TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE MANUAL

TRUCK, UTILITY: 1/4 TON, 4 X 4

M151 (2320-542-4783), M151A1 (2320-763-1092)

M151A2 (2320-177-9258)

TRUCK UTILITY: 1/4 TON, 4 X 4

M151A1C (2320-763-1091), M825 (2320-177-9257),

106MM RECOILLESS RIFLE

TRUCK, AMBULANCE, FRONTLINE:

1/4 TON, 4 X 4,

M718 (2310-782-6056), M718A1 (2310-177-9256)

This reprint includes all changes in effect at the time of publication - Change 3.

HEADQUARTERS, DEPARTMENT OF THE ARMY

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CHANGE

NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 25 July 1978

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL
TRUCK, UTILITY: 1/4 TON, 4 X 4
M151 (2320-00-542-4783), M151A1 (2320-00-763-1092), M151A2 (2320-00-177-9258);
TRUCK, UTILITY: 1/4 TON, 4 X 4
M151A1C (2320-00-763-1091), M825 (2320-00-177-9257); 106 MM RECOILLESS RIFLE
TRUCK, AMBULANCE, FRONTLINE: 1/4 TON 4 X 4, M718 (2310-00-782-6056), M718A1 (2310-00-177-9256)

TM 9-2320-218-34, 31 January 1972, is changed as follows:

Page 1-4. Paragraph 1-8*e* is added as follows:

e. Late model M151A2, M718A1 and M825 series vehicles are emission control equipped which includes nonvented fuel tank, charcoal activated canister, new carburetor and interconnecting lines. These vehicles are identified by a certification label located on the engine rocker arm cover.

Page 2-2. Figure 2-1 is superseded as follows:

*This change supersedes change 2, 29 November 1974.

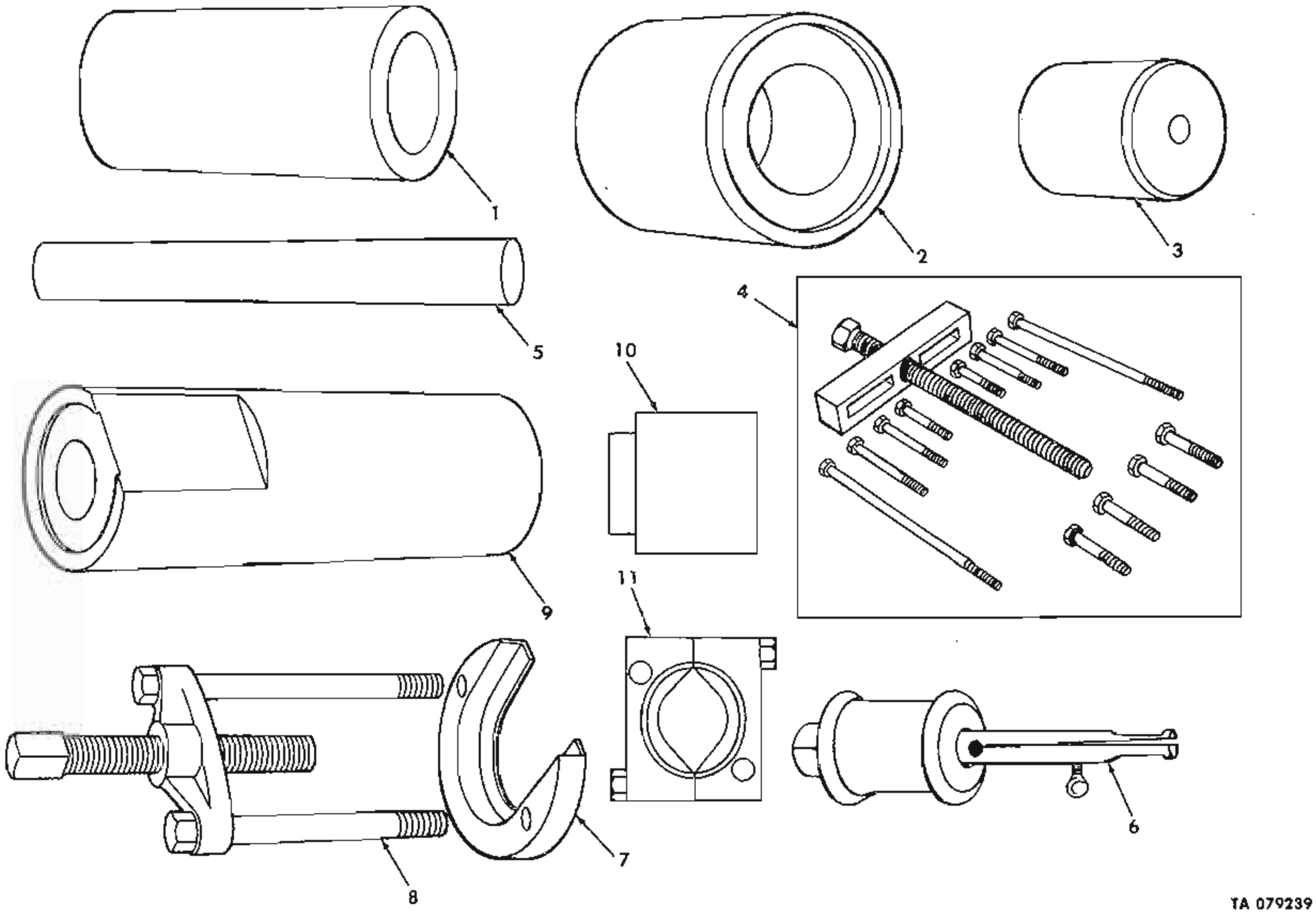


Figure 2-1. Special Tools and Equipment.

Page 2-3. Figure 2-2 is superseded as follows:

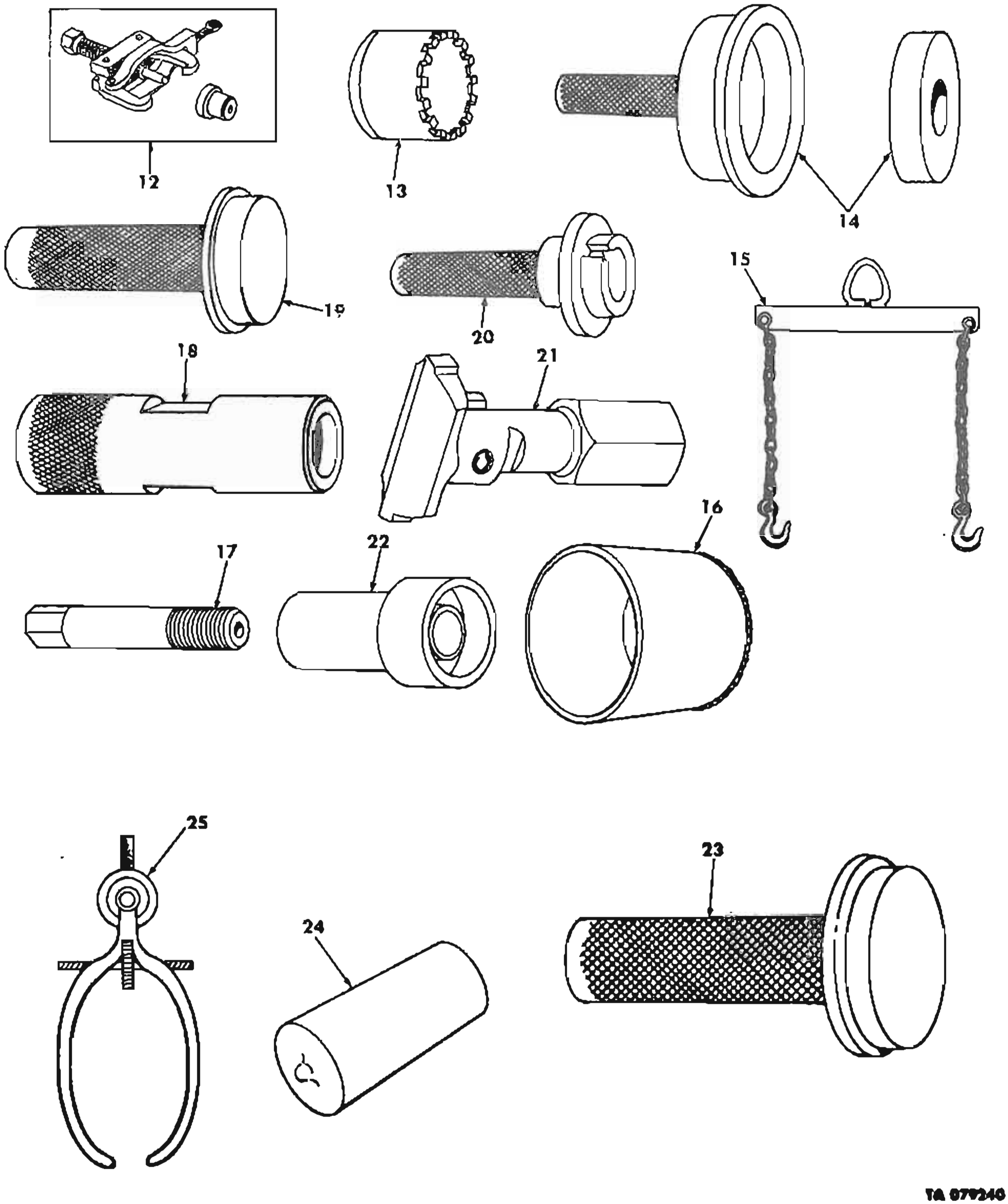


Figure 2-2. Special Tools and Equipment.

Page 2-11. Table 2-1 is superseded as follows:

Table 2-1. Special Tools and Equipment

(1) Reference Code	(2) Maintenance Level	(3) Nomenclature	(4) National/NATO Stock Number	(5) Tool Number
1 (1, fig. 8-16)	H	Driver output shaft bearing	5120-00-627-7168	7345231
2 (1, fig. 8-20) (2, fig. 12-37)	H	Driver, outut shaft seal and bearing	5120-00-627-7173	7345257
3 (fig. 8-35)	H	Protector, output shaft bearing	5120-00-627-7162	7345227
4 (fig. 4-106)	H	Puller, crankshaft and camshaft gear	5120-00-707-6223	7076223
5 (fig. 8-33)	H	Shaft, remove and replace transmission cluster gear	5120-00-627-7096	7345226
6 (fig. 4-109)	H	Puller, clutch pilot bearing	5120-00-474-9180	7077742
7 (1, fig. 8-35) (1, fig. 8-40)	H	Jaw, remove transmission input and output shaft bearing (used with puller 5120-00-627-7161)		7345235
8 (2, fig. 8-35) (2, fig. 8-40)	H	Puller, transmission output shaft bearings. (Use JAW 735235) for removing wheel spindle bearing use wedge assy, 5120-00-567-2492	5120-00-627-7161	7345234
9 (fig. 8-65)	H	Replacer, transfer, shifter rear oil seal	5120-00-627-7165	7345225
10 (1, fig. 10-45)	O	Protector. Remove outer wheel bearing (used with puller 5120-00-627-7161 and wedge assy 5120-00-567-2492)		11681729
11 (2, fig. 10-45)	O	Wedge assembly. Remove outerwheel (bearing used with puller 5120-00-627-7161)	5120-00-567-2492	7078129
12 (fig. 12-35)	H	Puller, differential carrier side bearings.	5120-00-473-7316	7078129
13 (fig. 12-67)	H	Socket differential side bearing adjusting nuts.	5420-00-627-7184	7345228
14 (fig. 4-234)	H	Replacer, crankshaft rear oil seal. (Composed of 7345203 and 7345199).	5120-00-627-7182	7345273

Table 2-1. Special Tools and Equipment (Continued)

(1) Reference Code	(2) Maintenance Level	(3) Nomenclature	(4) National/NATO Stock Number	(5) Tool Number
15 (fig. 4-40)	H	Sling, engine lift	3940-00-692-9112	7345279
16 (fig. 10-61)	O	Replacer, wheel bearing seals and differential seals.	5120-00-795-0152	7950152
17 (fig. 12-27)	H	Pin, alignment, differential gear	5120-00-627-7154	7345224
18 (fig. 12-20)	H	Adapter, differential pinion bearing removal	5120-00-627-7073	7345223
19 (fig. 4-157)	H	Replacer, expansion plug	5120-00-627-7179	7345197
20 (fig. 4-196)		Replacer, timing cover seal	5120-00-627-7180	7345198
21 (fig. 12-23)	H	Adapter, pinion shaft rear bearing and seal, removal	5120-00-627-7019	7345281
22 (fig. 10-63.1) (fig. 10-63.2)	O	Driver, install front suspension arm bushings	5120-00-627-7181	7345244
23 (fig. 4-174)	H	Remover and replacer-camshaft bearing	5120-00-627-7163	7345274
24 (fig. 8-26)	H	Tool alining-transfer case output shaft snapring	5120-00-777-1391	10885554
25 (fig. 10-21)	O	Caliper, outside-ball joint wear tolerance	5120-00-254-2342	GGG-C-95

Page 2-13. In table 2-4, item 4*e* and 5*a* is changed to read as follows:

Malfunction	*Probable Cause*	*Corrective Action*
4. Engine runs but misses.	e. Excessive exhaust back pressure.	e. Repair or replace vehicle exhaust system or exhaust manifold as necessary.
5. Rough engine idle.	a. Malfunction of fuel system.	a. Refer to items 28 through 31 for correction of fuel system malfunctions.

Page 2-14. Item 6*d* is changed as follows:

6. Poor acceleration.	d. Clutch slippage.	d. Adjust or replace clutch.

Page 2-15. Item 7*j* is changed as follows:

7. Engine does not develop full power or has poor high speed performance.	j. Restricted exhaust system.	j. Repair or replace vehicle exhaust system or exhaust manifold as necessary.

Page 2-16. Item 15*f* is changed as follows:

Malfunction	Probable Cause	Corrective Action
15. Engine overheats.	f. Restricted exhaust system.	f. Repair or replace vehicle exhaust system or exhaust manifold as necessary.

Page 2-16. Item 16 is changed as follows:

Malfunction	Probable Cause	Corrective Action
16. Temperature indicator fails to reach normal operating temperature.	*a.* Faulty sending unit or gage . .	*a.* Replace sending unit or gage. Refer to TM 9-2320-218-20.
	b. Faulty engine thermostat or incorrect heat range.	*b.* Refer to items 41 through 43 to correct cooling system malfunctions.

Page 2-17. Item 20*d* is changed as follows:

Malfunction	Probable Cause	Corrective Action
20. Engine cranks normally but will not start.	d. Fouled or improperly adjusted spark plugs.	d. Clean or replace spark plugs or adjust spark plug gap

Item 21*b* is changed as follows:

Malfunction	Probable Cause	Corrective Action
21. Engine starts but fails to keep running.	b. Fouled spark plugs.	b. Clean or replace spark plugs or adjust spark plug gap.

Item 22*a*, *b*, and *c* are changed as follows:

Malfunction	Probable Cause	Corrective Action
22. Engine runs but misfires steadily	a. Defective or crossed spark plug cables.	a. Replace defective spark plug cables.
at all speeds.	b. Fouled spark plug.	b. Replace spark plugs.
	c. Defective distributor cap.	c. Replace defective cap.

Item 23*a* is changed as follows:

Malfunction	Probable Cause	Corrective Action
23. Engine runs but misfires intermittently.	a. Fouled spark plug. Improperly adjusted or defective breaker points.	a. Replace spark plugs. b. Adjust or replace breaker points (para 6-8).

Items 24*c* and *d* are changed as follows:

Malfunction	Probable Cause	Corrective Action
24. Engine runs but misfires (at idle only).	c. Defective spark plug cables.	c. Replace defective spark plug cables.
	d. Excessive play in distributor or worn distributor cam.	d. Replace defective distributor.

Items 25*a* and *b* are changed as follows:

Malfunction	Probable Cause	Corrective Action
25. Poor acceleration or excessive fuel consumption.	a. Distributor not properly timed.	a. Time distributor.
	b. Fouled or improperly adjusted spark plugs.	b. Clean or replace spark plugs or adjust spark plug gap.

Items 26*a*, *b*, and *c* are changed as follows:

Malfunction	Probable Cause	Corrective Action
26. Engine does not develop full power or has poor high speed performance.	a. Distributor not properly timed.	a. Time distributor.
	b. Fouled or improperly adjusted spark plugs.	b. Clean or replace spark plugs or adjust spark plug gap.
	c. Excessive play in distributor or worn distributor cam.	c. Replace distributor.

Item 28a is changed as follows:

Malfunction	Probable Cause	Corrective Action
28. Engine cranks normally but will not start.	a. Incorrect starting procedure.	a. Refer to TM 9-2320-218-10 for proper starting procedures.

Malfunction	Probable Cause	Corrective Action
Page 2-18. Items 29*c*, *d*, and *g* are changed as follows:		
29. Engine starts but fails to keep running, runs rough or misfires at idle.	c. Incorrect idle fuel mixture	c. Adjust idle fuel mixture.
	d. Idle speed set too low.	d. Adjust carburetor idle speed stop screw to increase engine speed.
	g. Dirt or water in fuel lines or carburetor.	g. Remove drain plug from carburetor float chamber: clean carburetor and fuel lines. Drain dirt and water from fuel tank. Refer to TM 9-2320-218-20.
Page 2-19. Items 31*a* and *c* are changed as follows:		
31. Engine emits smoke and runs rough.	a. Incorrect idle fuel mixture.	a. Adjust idle fuel mixture.
	c. Improper use of choke or sticking choke.	c. Correct sticking choke.
Item 35*a* is changed as follows:		
35. Rough engine idle (too much air)	a. Incorrect idle fuel mixture.	a. Adjust idle fuel mixture.
Page 2-22. Item 45*i* is changed as follows:		
45. Engine wil not start or is hard to start when hot.	i. Fuel vapor lock.	i. Let engine cool, then locate cause of overheating.
Item 46*n* is changed as follows:		
46. Engine starts but does not continue to operate properly.	n. Fuel vapor lock.	n. Let engine cool then locate cause of overheating.
Page 2-23. Item 50*a* is changed as follows:		
50. Engine runs rough.	a. Incorrect idle fuel mixture.	a. Adjust idle fuel mixture.
Item 51*d* is changed as follows:		
51. Engine idles rough.	d. Idle speed to low.	d. Adjust idle speed.
Page 2-24. Item 52*b* is changed as follows:		
52. No voltage or weak voltage (on vehicle test).	b. Defective coil and/or ballast resistor.	b. Replace coil.
Page 2-26. Item 76 is added as follows:		
76. Radio Interference.	a. Faulty spark plugs.	a. Replace spark plugs.
	b. Faulty spark plug cables.	b. Replace spark plug cables.
	c. Ground strap loose.	c. Tighten ground strap.
	d. Faulty generator and/or generator regulator.	d. Temporarily disengage fan and generator drive belts from regulator pulley and start engine. If interference is eliminated when generator is not operating replace generator and or generator regulator.
	e. Faulty filter capacitor (primary lead).	c. Replace ignition capacitor para 2-70(s) (TM 9-2320-218-20).
	f. Faulty ignition distributor rotor or cap.	f. Replace ignition distributor rotor cap if contacts show evidence of burning.
	g. Faulty windshield wiper circuit.	g. Check external ground and electrical circuit. Replace windshield wiper motor.
	h. Faulty turn signals.	h. Replace turn signal flasher unit.

Page 2-37. Paragraph 2-10.1 is superseded as follows:

2-10.1. Carburetor Adjustment (Emission Vehicles).

a. The new emission control system carburetors are preset by the manufacturer and mixture adjusting screw is sealed. Do not attempt to adjust the carburetor during installation unless engine does not idle or perform properly.

NOTE

Upon receipt of new vehicles or during service of vehicles, if the idle operation of engine is erratic or otherwise not functioning properly, adjust carburetor as instructed in *b* below.

b. Lean Drop Method Adjustment. This procedure requires the use of a tester dwell tachometer (NSN 4910-00-788-8549), a screwdriver, and a 5 64-inch Allen Wrench.

(1) Connect tester dwell tachometer to engine.

NOTE

Insure that the tachometer is in proper calibration prior to making the adjustment.

(2) Check to see that the engine timing and dwell are properly adjusted.

(3) Warm up the engine to normal operating temperature.

(4) Turn the idle adjustment screw until the engine reaches 700 rpm.

(5) Remove seal plug (fig. 2-19.1) and turn mixture adjustment screw using Allen Wrench counterclockwise until the maximum rpm is reached.

(6) Turn idle adjusting screw until engine reaches 700 rpm.

(7) Turn mixture adjustment screw clockwise until engine reaches 640-650 rpm.

(8) Disconnect the tester dwell tachometer from engine.

(9) Install a new seal plug in the carburetor idle mixture adjustment screw hole.

Figure 2-19.1 is added as follows:

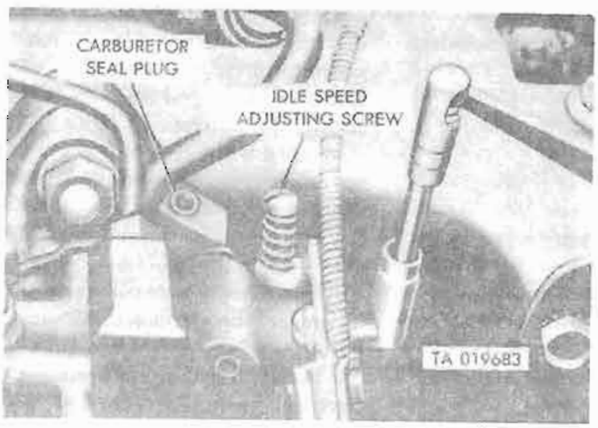


Figure 2-19.1. Idle Speed Adjusting Screw.

Paragraph 2-10.2 is superseded as follows:

2-10.2 Ignition Adjustment.

a. General. Ignition timing is accomplished by four separate and consecutive procedures: breaker point gap adjustment and alinement spring tension adjustment, timing by distributor positioning and precise timing by using an adapter, timing light and tachometer.

b. Breaker Point Gap Adjustment.

(1) Crank the engine until the rubbing block on moveable breaker point rests on the peak of a cam lobe.

(2) Loosen stationary breaker point mounting screw and lockwasher.

(3) Adjust point gap with adjuster screw until gap is 0.017 to 0.022 inch. Tighten contact mounting screw and lockwasher 5-20 lb in.

NOTE

If this procedure is not followed, the screw may loosen after several thousand miles, causing erratic engine operation.

(4) Check breaker point alinement.

c. Adjusting Spring Tension.

(1) Attach spring gage to end of movable contact and pull on gage at right angles to movable contact.

(2) Adjust spring tension by positioning spring slot until desired tension is obtained and tighten terminal screw. Points should start to open with a pull of 17 to 20 ounces.

d. Approximate Timing by Distributor Positioning. Set distributor to approximate timing as shown below:

(1) Mark the position of the no. 1 spark plug cable on distributor base. Adjust breaker point assembly (step b-1 through 3 above) but do not install cap and cover assembly.

(2) Rotate crankshaft until rotor is positioned toward no. 1 spark plug cable mark and pointer on timing gear cover and notch on crankshaft pulley are alined. Slowly rotate distributor counterclockwise until breaker points just start to open.

(3) Tighten distributor to adapter mounting screw to a snug fit.

(4) Install cap and cover assembly. This procedure alone is not adequate for good engine performance. Perform precise timing procedure below.

e. Precise Timing. Operations below show procedures required for ignition timing, when distributor shaft has not been removed from engine during previous maintenance.

(1) Remove no. 1 spark plug cable from spark plug, place light adapter on spark plug, and attach spark plug cable to timing light adapter.

(2) Connect timing light leads to timing light adapter, ground, and battery.

(3) Attach tachometer to primary connector and ground. Adjust engine idle to 500 to 550 rpm.

(4) With engine idling, direct timing light at timing pointer on timing gear cover.

(5) Slow rotate distributor until timing pointer and crankshaft pulley notches are alined. When timing marks are alined firing will take place at 6° before top dead

center of piston travel. When this alinement is accomplished tighten distributor to distributor mounting screw.

(6) After tightening mounting screw, recheck timing to determine that tightening has not disturbed alignment. Increase engine speed while directing timing light to notch and pointer. Notch should move away from pointer if distributor centrifugal advance is functioning. Readjust engine idle speed to 625-675 rpm. Disconnect all timing devices and install spark plug cable.

Table 2-5. Under "Engine condition", first sentence is changed to read as follows:

Normal (at 650 rpm). Loss of power in all cylinders caused possibly by late ignition or valve timing, or loss of compression due to leakage around piston rings.

Paragraph 2-10.3 Rescinded.

Page 4-9. Table 4-1. Line 12 and 13 are changed to read as follows:

Idle .... 625-675 rpm
Warmup .... 1000-1200 rpm

Page 4-10. Table 4-1. column 1. Line 13 is changed to read as follows:

Spark plug gap .... 0.032-0.036 inch

Table 4-1. column 1. Line 15 is changed to read as follows:

Fuel .... 91 RON minimum (Research Octane Number)

Table 4-1. column 1. Line 17 is changed to read as follows:

Carburetor .... Type– single barrel
Make—Zenith or Holley (non-emission)
Zenith (emission all models)

Choke– Manual and fast-idle linkage to throttle and vented bowl.

Table 4-1. column 1. Delete Line 26.

Table 4-1. column 2. Line 1 is changed to read as follows:

Lubrication:
Oil Specification —
32° to 120°F .... OEA HDO 30 (MIL-L-2104C)
-10° to 40°F .... OEA HDO 10 (MIL-L-2104C)
-65° to 0°F .... OEA (MIL-L-46167)

Page 4-11. After heading: Section II. POWER PLANT ASSEMBLY, REMOVAL AND INSTALLATION. Add note as follows:

NOTE

The M151A2 service engine (PN 11660530) will be installed on M151 or M151A1 series vehicles. Conversion instructions are contained in drawing 12275117 included with the service engine.

Page 4-11. Table 4-2 is superseded as follows:

Table 4-2. Accessory Data

Accessory	Model or ORD No.
Generator	7355736
Generator	10950808
Generator	10929868
Starter	7017647
Distributor	11660529
Spark plugs	MS35909-2
Vacuum pump	11599015 (M151, M151A1, M151A1C and M718 only)
Fuel pump	7017601 (M151, M151A1, M151A1C and M718 only)
Fuel pump	11640994 (M151A2, M825 and M718A1 only)
Fuel filter	477088 (M151, M151A1, M151A1C and M718 only)
Fuel filter	11640944 (M151A2, M825 and M718A1 only)
Oil filter	11630417
Breather valve	11630591
Air cleaner	7044861
Air cleaner	11681675 Emission control equipped vehicles
Canister, fuel vapor storage	11681677 Emission control equipped vehicles
Low pressure oil switch	10874979
Oil pressure sending unit	MS24538-1
Water temp. sending unit	MS24537-1
Carburetor	11681709
Thermostat	7998568
Radiator cap	MS35840-1

Page 4-16. Paragraph 4-7*a* (22) is changed to read as follows:

(22) Loosen clamp and remove fuel pump safety switch (M151 and M151A1 only) (oil pressure safety switch) and vent hose from air cleaner. Loosen two hose clamps (canister to air cleaner) on emission control equipped vehicles and remove hoses from air cleaner to bracket. Remove air cleaner (fig 4-30).

Page 4-22. Paragraph 4-12. The paragraph heading and first sentence are changed to read as follows:

4-12. Preparation of Engine for Repair or Replacement.

Power plants removed from the vehicles must be thoroughly cleaned, drained, and the following components removed prior to repair or replacement of engine:

Starter Motor Assembly
Transmission-Transfer Assembly
Flywheel Housing and Cover Assembly
Clutch Pressure Plate and Disc Assembly
Bell Crank and Bracket Assembly, Accelerator
Bell Crank Spring and Retainer Bracket
Generator or Alternator Assembly and Mounting Bracket
Radiator and Shroud Assembly
Radiator Upper and Lower Mounting Insulators
Radiator Lower Support Brackets
Fan Blade Assembly
Water Pump Pulley
Crankshaft Pulley
Drive Belt Set
Generator Adjusting Arm Assembly
Upper and Lower Radiator Hoses

Page 4-22. Paragraph 4-16 is superseded as follows:

4-16. Carburetor and Accelerator Bellcrank and Spring (Fig 4-53).

Disconnect the accelerator return spring rod, fuel supply line and distributor and crankcase ventilation lines from carburetor fittings. Remove carburetor and gasket from intake manifold. Discard gasket. Remove the accelerator bellcrank from the intake manifold.

Page 4-26. Paragraph 4-20 is superseded as follows:

4-20. Distributor, Ignition Harness and Spark Plugs.

Disconnect distributor ventilation inlet-outlet hose and ignition leads at spark plug. Remove screw plate and lock retaining distributor to adapter. Remove distributor harness and "O" ring seal, (as a unit) from the distributor adapter. Remove spark plugs from cylinder head.

Page 4-49. Table 4-3 is superseded as follows:

Table 4-3. Repair Standards — Cylinder Head, Valves, and Related Parts.

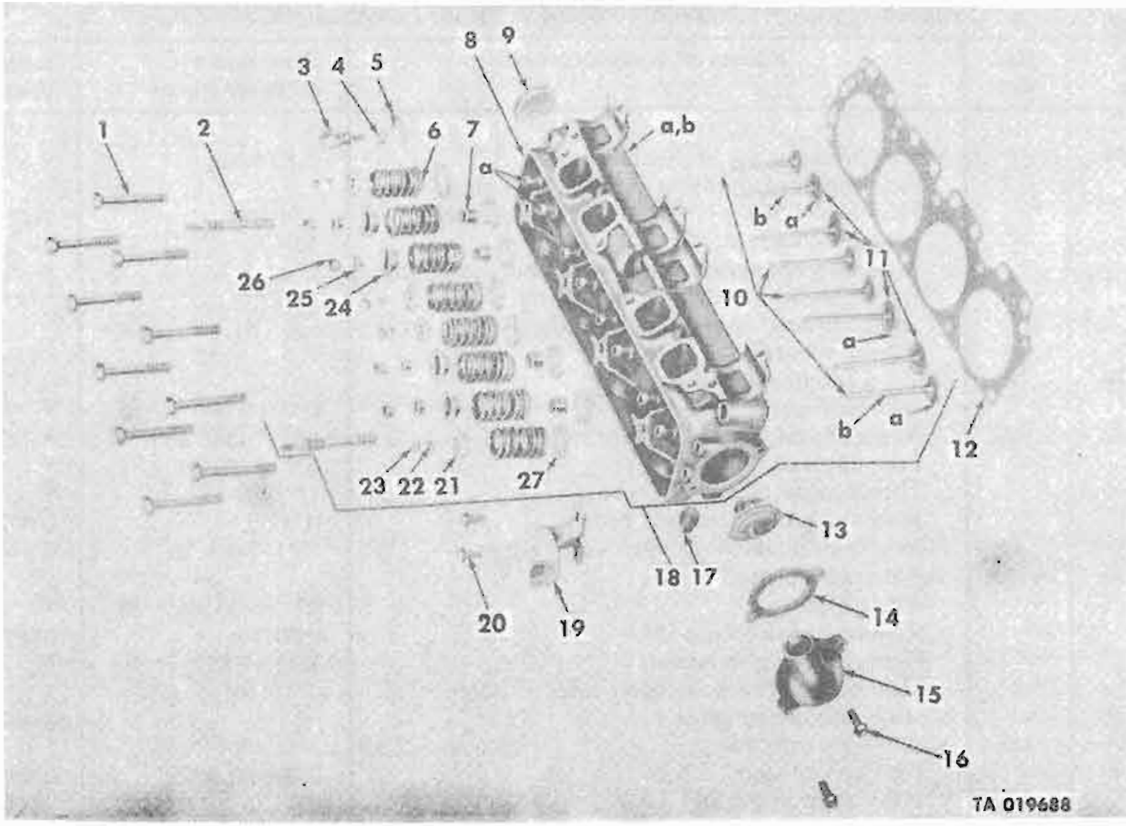
Fig. No.	Ref. Let.	Points of Measurement	Size and Fit of New Parts	Acceptable Wear Limits
4-134	6	Valve spring, intake and exhaust:	2.12 max.	*
		Free length of spring load in lbs at compressed:		
		Length of 1.505	124-140	110*
		Length of 1.821	54-62	48
		Squareness of spring with axis within maximum	2°	*
		spring assembled height from surface of cylinder head spring pad to underside of spring retainer.	1.812	**1.842
4-134	8	Valve seats, intake and exhaust:		
		Width of seat	0.070-0.080	*
		Angle of seat	45° 44° 45′	*
		Face angle of relief of seat	65° ± 0° 30′	*
		Throat angle of relief of seat	15° ± 0° 30′	*
		Maximum allowable seat runout	0.0020	0.0025
4-134	8a	Diameter of intake & exhaust valve guide	0.3115-0.3125	0.3145
4-134	10a	Valve head, exhaust:		
		Angle of face	45° 15′-45 30′	*
		Runout of valve face	0.0015	0.0020
		Diameter of valve head	1.327-1.337	*
		Minimum thickness of valve head at outer edge of tapered surface		0.0625
4-134	10b	Valve stem, exhaust:		
		Diameter of stem	0.3090-0.3095	0.3070
		Fit of stem in guide	0.0020L-0.0035L	0.0087L
		Clearance of stem to rotator cap	0.002-0.004	*
		Clearance of valve to rocker arm	0.015 ± 0.001	*
4-134	11a	Valve head, intake:		
		Angle of face	45° 15′-45° 30′	*
		Runout of valve face	0.0015	0.0020
		Diameter of valve head	1.728-1.738	*
		Minimum thickness of valve head at outer edge of tapered surface		0.625
4-134	11b	Valve stem, intake:		
		Diameter of stem	0.3100-0.3105	0.3080
		Fit of stem in guide	0.0010L-0.0025L	0.0077L
		Clearance of valve to rocker arm	0.015 ± 0.001	*
4-131		Cylinder head flatness:		
and	8a	Permissible out-of-flat overall	0.004	0.005
4-134	8b	Permissible out-of-flat in any 6 in.	0.002	0.004

*Refer to paragraph 4-45*a*(2)
**Refer to paragraph 4-52*g*.

Page 4-50. Paragraph 4-52*g* is superseded as follows:

g. Check Valve Spring Assembled Height. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with a scale or suitable instrument (fig 4-143). If the assembled height is greater than 1 13/16 inch, install 0.030 inch-thick spacers, as required, between the cylinder head spring pad and valve spring (fig. 4-134) to bring the recommended dimension of 1 13/16 + 0.03. Do not install spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve spring and cause excessive load loss and spring breakage.

Page 4-52. Figure 4-134 is superseded as follows:



1	Bolt 7/16-14x2.91 cylinder head (10)	15	Connection, water outlet
2	Stud, rocker arm shaft support and cover (2).	16	Screw and washer assembly 5/16-18x⅞
3	Eye, engine rear lifting	17	⅛ pipe plug
4	Nut, ⅜-16 hex-head	18	Head assembly, cylinder W/valves
5	Clip, vacuum line	19	Lifting eye front engine
6	Springs, exhaust and intake valve (8)	20	Screw & washer assembly, 5/16-18x¼ (2)
7	Seal, intake valve stem (4)	21	Retainer, exhaust valve spring (4)
8	Head, cylinder	22	Key, exhaust valve spring retainer (8)
9	Plug, expansion	23	Cap, exhaust valve stem (4)
10	Valve, exhaust (4)	24	Retainer, intake valve spring (4)
11	Valve, intake (4)	25	Sleeve, intake valve (4)
12	Gasket, cylinder head	26	Key, intake valve spring retainer (8)
13	Thermostat	27**	Spacer 0.030 inch thick
14	Gasket, water outlet connection		

**Used as required to obtain maximum spring assembled height (para 4-51g).

Figure 4-134. Cylinder Head, Valves and Related Parts — Exploded View.

Page 4-59. Paragraph 4-57*b* is superseded as follows:

b. Cylinder Block. Check all machined gasket surfaces for burs, nicks, scratches and scores. Remove minor imperfections with an oil stone. Check the flatness of the cylinder block gasket surface following the procedure and specifications recommended for the cylinder head (para 4-47). Inspect the cylinder walls for scoring, roughness, or other signs of wear. Check the cylinder bore for out-of-round and taper. Measure the bore with an accurate gage as follows: measure the diameter of each cylinder bore at the top, middle, and bottom with the gage placed at right angles and parallel to the centerline of the engine (fig. 4-149). If the cylinder bore wear does not exceed the limits and the cylinder block is in serviceable condition, remove the high polish on the cylinder wall, before installing new rings, to aid ring seating. This is done by passing a hone or glaze-removing tool through the cylinder bore a few times. Do not hone more than enough to rough up the polish. Make sure that oiled rags are placed in the bore to catch the hone grit and that the cylinders are thoroughly cleaned before installing the piston. If any cylinder bore exceeds the standard wear limits established in table 4-5, resize all cylinders to .020 inch oversize and fit with corresponding size piston and ring assemblies. If the cylinder walls have minor surface imperfections, but the out-of-round and taper are within limits, it may be possible to remove the imperfections by honing the cylinder wall and installing new service piston rings, provided the piston clearance is within limits. Use the finest grade of honing stone for this operation.

Page 4-70. Paragraph 4-65*f* is superseded as follows:

f. Camshaft Bearing Running Clearance. Check camshaft journals to bearing clearances by measuring diameter of journals and inside diameters of bearings. If clearance exceeds wear limit, camshaft should be replaced. If camshaft bearings are damaged or exceeds wear limits replace bearings using camshaft bearing remover and replacer number 5120-00-627-7163.

Page 4-61. Table 4-5 is superseded as follows:

Table 4-5. Repair Standards – Cylinder Block and Related Parts

Fig. No.	Ref. Let	Points of Measurement	Size and Fit of New Parts	Acceptable Wear Limits
4-156	8a	Cylinder bore diameter (standard)	3.8753-3.8777	**3.8797
		Cylinder bore diameter (.020 oversize)	3.8953-3.8977	
		Out-of-round (maximum)	0.0005 TIR	0.003 TIR
		Diametral taper of bore, largest at bottom	0.001	0.004
4-156	8b	Face of block:	0.001	0.004
		Maximum allowable warpage in any 6 inches	0.002	0.00025
4-156		Maximum allowable warpage overall	0.004	0.005
4-156	8c	Valve tappet bore diameter	0.500-0.501	0.503
4-156	8d	Diameter of camshaft bearing bore, with inserts	2.0110-2.0115	2.0125
4-156	8e	Diameter of main bearing bores, less inserts, at proper torque tighteness	2.4012-2.4020	*
4-183	5a 6a	Diameter of standard main bearing inserts when installed at proper torque tighteness (vertical)	2.2494-2.2512	*
4-183	19a,5a	Clearance between crankshaft and bearings	0.0005-0.003	0.004

*Refer to paragraph 4-45*a*(2)
**Refer to paragraph 4-57*b*

Page 4-68. Table 4-7, reference 4-170, key 3a is changed as follows:

Fig. No.	Ref. Let.	Points of Measurement	Size and Fit of New Parts	Acceptable Wear Limits
4-170	3a	Diameter of piston at bottom of skirt (standard)	3.8736-3.8756	*
		Diameter of piston at bottom of skirt (.020 oversize)	3.8936-3.8956	*

Page 4-88. Paragraph 4-81*b*(1) is superseded as follows:

b. Exhaust Manifold (Fig. 4-204).

(1) Inspect the exhaust manifold for cracks, warpage or other conditions that would make it unfit for further service. Check manifold ports for flatness, using a straightedge. If manifold ports are concave, refer to para 4-81*b*(3). Check outlet flange for flatness. Examine threads on the two bolts welded to manifold outlet flange. Repair of manifold should not be attempted except for correcting ports for flatness or defective threads on bolts

welded to manifold. Examine exhaust manifold-retaining bolts for bent or stripped condition, and replace as necessary. Replace tab lockwasher if one locking tab is broken. Replace exhaust manifold retaining clamps if warped or cracked.

Page 4-88, add paragraph 4-81 *b*(3) as follows:

(3) Exhaust manifold leaks may be corrected by performing the following operations.

(a) Apply penetrating oil to threads of exhaust manifold retaining bolts.

(b) Remove intake manifold (see para 2-39 of TM 9-2320-218-20, Sep 71).

(c) Remove two brass nuts securing exhaust pipe to exhaust manifold.

(d) Remove bolt and lockwasher securing exhaust manifold flange to block.

(e) Remove four bolts, four locking tabs, and two exhaust manifold retaining clamps.

(f) Lift off exhaust manifold and discard exhaust pipe gasket.

(g) Clean carbon deposit from ports and exhaust manifold ports using wire brush and scraper.

(h) Straighten exhaust manifold ports, if necessary, with the use of a special form-die welded to the jaws of a vice grip plier which may be field fabricated in accordance with figure 4-202.1. First obtain permission of the Commanding Officier. Check both sides of ports for flatness with a straight edged instrument.

(i) Apply graphite grease around exhaust ports of cylinder head. Use sealant NSN 9150-00-935-4018.

(j) Position exhaust manifold on cylinder head and secure, using four bolts, four lock tabs, and one lockwasher and two clamps.

NOTE

Do not rotate exhaust manifold on cylinder head during installation. Rotation may disturb distribution of the graphite grease.

(k) Tighten exhaust manifold retaining bolts to 12 to 16 lb-ft torque. Tighten exhaust manifold flange to block bolt to 23-28 lb-ft.

(l) Install intake manifold on cylinder head using two new gaskets, four screws, four lockwashers, four flatwashers.

(m) Tighten screws to 23-28 lb-ft torque.

(n) Install two bolts and one lock tab (dual type) in center lower manifold bolt holes.

(o) Tighten bolts to 12-16 lb-ft torque.

(p) Attach exhaust manifold to exhaust pipe using a new gasket and the two brass nuts removed in step *c* above.

Page 4-88, add figure 4-202.1 as follows:

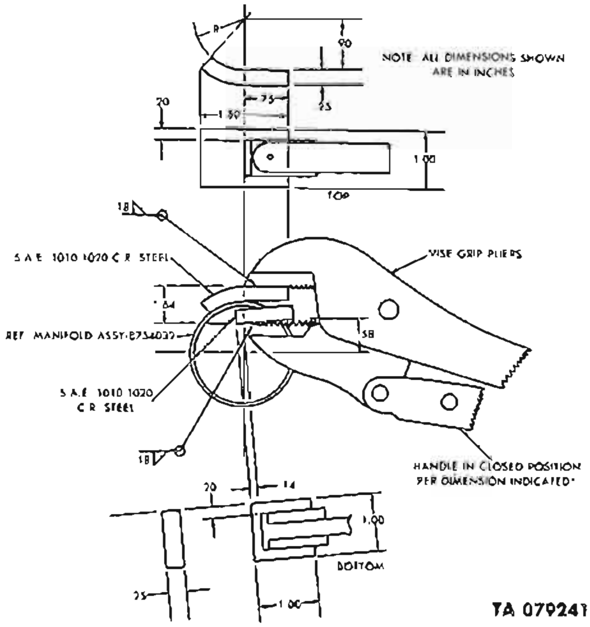


Figure 4-202.1. Exhaust manifold tool fabrication.

Page 4-100. Paragraph 4-86*a* is superseded as follows:

a. Distributor. Refer to paragraph 4-20 for removal and chapter 6 of this manual for repair and test of the engine distributor.

b is superseded as follows:

b. Spark Plug and Cable Assemblies. Examine all cable assemblies 12, 13, 14, for cracked or oil-soaked insulation. Check cable connector at ends of cable assembly for corrosion. Clean if necessary. Replace any spark plug cable if damaged. Clean spark plugs using suitable spark plug cleaner and tester equipment. Measure the gap between the two electrodes with a spark plug gage. Increase or decrease the gap as required by bending the outer electrode until the gap is 0.032-0.036 inch.

Page 4-106. Figure 4-220. Deleted.

Page 4-108. Paragraph 4-93*c* is changed as follows:

c. Before assembly, coat all bearings, shafts, and contact surfaces with engine oil (OEA/HDO 10).

Page 4-109. Paragraph 4-95*e*. The first sentence is changed to read as follows:

Dip rear bearing cap side seals in engine oil (OEA/HDO 10) and immediately press them firmly in the rear main bearing cap front grooves (with bevel end out toward cap).

Page 4-110. Paragraph 4-96*b*. The second sentence is changed to read as follows:

Apply a light coat of engine oil (OEA/HDO 10) to camshaft journals, lobes and bearings.

Page 4-117. Paragraph 4-100*b* is changed to read as follows:

b. Install Timing Gear Cover Assembly. Position timing gear cover assembly and gasket over two dowel pins and against cover mounting surface on cylinder block. Install eight ¼-20x¾-in panhead screws with ¼-inch flatwashers and ¼-inch lockwashers, tighten screws evenly to 36-48 lb-in torque. If crankshaft front oil seal has not been installed in timing gear cover, follow procedures in paragraph 4-73*b* (fig. 4-256).

Paragraph 4-100*c*(2) is changed to read as follows:

(2) Install one 9/16-18 x 1⅛ hex-head bolt with crankshaft pulley retaining washer and tighten to 80-90 lb-ft torque. It may be necessary to hold crankshaft to keep it from turning (fig. 4-257).

Paragraph 4-101*a*(2) is changed to read as follows:

(2) Position oil pan on guide studs, holding gaskets and install eight ¼-20 x ⅝ panhead screws with ¼ inch lockwashers and retainers, and four 5/16-18 x ⅝ hex-head screw and washer assemblies with 5/16 inch flatwashers. Remove four guide studs and install remaining four ¼-20 x ⅝ panhead screws with ¼ inch lockwashers and retainers. Tighten ¼-20 screws evenly from center of pan outward in each direction to 36-48 lb-in torque and tighten 5/16-18 hex-head screws to 9-12 lb-ft torque, in two steps. Check to make sure oil pan magnetic drain plug in bottom of oil pan is installed and is tight (fig. 4-259).

Paragraph 4-102*a*(1) is changed to read as follows:

(1)Make sure gasket surfaces of cylinder head and block are clean and free from burs. Apply sealer (NSN 8030-00-543-4384) to gasket and bolts. Position cylinder head gasket over the two cylinder head locating dowels on cylinder block (refer to fig. 4-260).

Paragraph 4-102*b*. The first sentence is changed to read as follows:

Lubricate each end of push rod with engine oil OEA/HDO-10

Page 4-122. Paragraph 4-103*a*. The note is changed to read as follows:

NOTE

A gasket between manifold and cylinder is not required. Coat surface with graphite grease (NSN 9150-00-223-4004).

Page 4-122. Paragraph 4-103*b*(2) is revised as follows:

(2) Install a (dual type) lock tab washer with two ⅜-16 x 1½ hex-head bolts in the center lower manifold bolt holes and tighten bolts to 12-16 lb-ft torque. Bend tabs on each end of lock tab washer against bolt heads to secure (fig. 4-268).

Paragraph 4-107*a* is changed to read as follows:

a. Coat one side of tappet cover gasket with oil resistant cement and lay cemented side of gasket in place in cover. Place cover on cylinder block, making sure gasket seals evenly all around tappet chamber. Install two ¼-20 x 1¼ panhead screws with rubber seal assemblies into two end cover openings to hold cover and gakset firmly in place, install two inboard screws with clips. Tighten all four screws to 3-4 lb-ft torque.

NOTE

One clip on M151 and M151A1 series vehicles is for retaining the vacuum fuel pump line. Two clips on the M151A2 series vehicles are for retaining the distributor vent line.

Page 4-123. Paragraph 4-109*a*, *b*, and *c* are deleted.

Paragraph 4-109*d*. The last sentence is changed to read as follows:

Refer to paragraph 2-10.2 for final ignition timing procedures.

Page 4-131. Table 4-13 is superseded as follows:

Table 4-13. Engine Run-In Schedule

Run	Duration Minutes	Engine Speed (RPM)	Intake Manifold Vacuum (IN HG)
1	As required	625-675 (initial idle adj)	N/A
2	10	2000	16
3	10	3000	10
4	As required	625-675 (valve lash and final adj)	N/A
5	10	3500	7
6	10	4000	5
7	5	625-675 (final idle speed and vacuum adj)	N/A

During each period of the break-in run the following data shall be recorded:

a. Oil sump temperature (at drain plug)
b. Gallery oil pressure
c. Engine speed
d. Period duration
e. Intake manifold vacuum
f. All adjustments shall be made during the break-in run. The valve lash shall be readjusted on a hot engine during run #4 immediately following run #3.

Coolant temperature requirements:

a. Immediately before coolant pump
b. Immediately after coolant outlet connection
c. Minimum coolant temperature shall be 140°F during the break-in run

Page 4-132. Paragraph 4-125*h*(4) is changed to read as follows:

(4) Secure the carburetor choke plate in the open position to insure against erratic fuel flow, and check carburetor idle fuel setting at 625-675 rpm (para 2-10.1).

Paragraph 4-126 is supersed as follows:

4-126. Engine Adjustments and Settings.

a. Carburetor. Adjust idle fuel mixture as instructed in paragraph 2-10.1.

b. Distributor. (Final ignition timing). For distributor final timing refer to paragraph 2-10.2.

c. Valve Clearance. Refer to paragraph 4-102*d* for final valve clearance adjustment.

Page 4-133. Table 4-15 Torque Wrench Specification. Line 13 is changed to read as follows:

Rocker arm cover attaching nuts — 5/16-24 — 18-24 lb-in.

Paragraph 4-130. The note is changed to read as follows:

NOTE

All bolts to be pulled up to torque gradually. All bolts to be tightened to an intermediate setting before any individual bolt is tightened to final setting.

Page 4-134. Table 4-16 is superseded as follows:

Table 4-16. Sealer and Lubricants to Assemble Engine

National Stock Number	Amount	Use
OEA/HDO-10 engine oil: NSN 9150-00-265-9424	As required	For miscellaneous assembling—cylinder bores, pistons, piston rings, bearings, tappets, camshafts, intake and exhaust valve stems.
Sealing compound: water and oil resistant NSN 8030-00-543-4384	As required	1. Cylinder head bolts 2. Water pump bolts 3. Drain cock 4. Flywheel bolts 5. Oil filter adapter bolts 6. Distributor adapter bolts 7. Oil level indicator tube 8. Vacuum pump bolts 9. Fitting (ventilation) 10. Camshaft gear bolts 11. Pressure and temperature sending units 12. Valve tappet cover gasket 13. Cylinder head gasket 14. Exhaust manifold
Grease Graphite 5 lb can 9150-00-223-4004		1. Exhaust manifold ports
Lubricant GAA NSN 9150-00-190-0904 and NSN 9150-00-248-3476	As required	1. Crankshaft front and rear oil seal assembly 2. Main bearing cap bolts and connecting rod nuts — lubricant to be applied to threads and under bolt head to nut before installation. 3. Distributor mounting adapter bore 4. Oil level indicator and seal cap

Table 4-17 is superseded as follows:

Table 4-17. Oversize Service Parts Available

Part Name	(In Inches) Oversize (O.S.)	Ordnance Part No.
Piston rings	0.020 O.S.	10950789 or 10950792
Piston assembly	0.020 O.S.	7345268

Page 5-1. Section I. The title is changed to read as follows:

Section I. HOLLEY CARBURETOR MODELS 7017440 AND 7017440-1 (DO NOT USE ON VEHICLES WITH EMISSION CONTROL EQUIPMENT)

Paragraph 5-1 is superseded as follows:

5-1. Tabulated Data.

Choke .... Manual
Choke flange .... Std. SAE 1¼ in.
Float setting (dry) ... 1-5 16 in. from machined edge of bowl cover to uppermost surface of molded float (cover inverted).
Fuel pressure .... 4.5 psi
High speed bleed .... One No. 71 drill dive hole
Idle adjustment .... ¾ turn from full closed position
Idle air bleed .... One No. 61 drill-size hole
Idle needle .... 15 R-34 (15°)
Idle tube .... Stamped No. 54 .020-.022 in.
Main metering jet .... Stamped No. 64
Manufacturer .... Holley
Army Part Number .... 7017440 and 7017440-1
Power valve .... Stamped No. 38: One No. 62 drill size hole
Pump capacity .... 12-16 cc at setting
Type .... Side draft
Venturi .... Single 1-1 32 diameter

Page 5-6. Paragraph 5-3. The last line is changed to read as follows:
For removal of unit from vehicle. refer to paragraph 4-16.

Page 5-17. Section title is changed to read as follows:

Section II. ZENITH CARBURETOR MODELS 10939511 AND 11641105 (DO NOT USE ON VEHICLES WITH EMISSION CONTROL EQUIPMENT)

Paragraph 5-9. The third sentence is changed to read as follows:
For removal of unit from vehicle, refer to paragraph 4-16.

Page 5-19. Figure 5-28 caption is changed to read as follows:

Figure 5-28. Carburetor (Zenith Models 10939511 and 11641105 exploded view). (Do not use on vehicles with Emission Control Equipment.)

Page 5-20. Section III is added as follows:

Section III. EMISSION CARBURETOR 11681709

5-11. Overhaul Instructions.

a. The following information is for the guidance of personnel performing major repair work on the Zenith Carburetor Model 11681709. It provides procedures for overhaul of the carburetor. For removal of the unit from the vehicle, refer to paragraph 4-16.

b. Disassembly and Cleaning (key numbers of parentheses refer to fig. 5-28.1).

NOTE

All valves and jets, needles, needle seats and tubes must be inspected for cleanliness, damage, and ease of operation. All damaged or worn parts must be replaced. Gasket surfaces must be clean and new gaskets used.

Identify and tag all carburetor parts and retain as matched items to assure proper reassembly.

(1) Remove the four screws and lockwashers holding the pump cover to the fuel bowl. Remove the spring (21) and diaphragm (20).

(2) Remove plug and washer (8) located on top of the fuel inlet boss of the throttle body.

(3) Remove six screws and washers retaining the fuel bowl body. Carefully remove the fuel bowl, taking care to withdraw it in a straight line directly away from the throttle body to avoid damaging the float or brass tube.

(4) Remove the idle tube (17), washer (19) and check valve assembly (18) from the fuel bowl.

(5) Drive out the float axle with a small punch. Note that one end of the axle is knurled: drive axle from smooth end. Remove the float, fuel valve needle (5) and bowl gasket (16).

(6) Using a screwdriver, carefully remove the fuel valve seat (6) and washer (7).

(7) Remove the seal plug (9) with a small punch and remove idle mixture adjusting screw (10).

(8) Using a screwdriver, remove the main metering jet (4) and washer (3) from bowl.

(9) Using a screwdriver, remove the power jet valve (22) from pump cavity.

(10) Remove the accelerating jet (1) and seal (2) from bottom of the bowl.

(11) Clean all metal parts by placing in a solvent bath. Agitate and brush parts in the cleaning solution to assure penetration of cleaning agents.

WARNING

Do not allow any sparks, open flame or smoking near cleaning area.

(12) Remove parts from cleaning solvent and remove any gasket material sticking to surfaces. Remove all carbon deposits from valve plate or throttle bore.

NOTE

Never use a wire or drill to clean air or fuel passages.

(13) Wipe all parts with a clean lint-free cloth. Be sure all dirt, gum, and other matter are removed.

(14) After all parts are clean, dry with compressed air. Thoroughly blow out all air and fuel passages.

(15) Visually inspect idle tube and main well tube housing for foreign particles. Make sure all dirt has been removed.

c. Assembly (key numbers in parentheses refer to figure 5-28.1).

NOTE

Required carburetor gaskets are currently available as individual line items. Refer to TM 9-2320-218-20P and changes thereto.

(1) Install fuel valve seat (6) with new washer (7) in throttle body.

(2) Position new bowl-to-body gasket (16) on throttle body and install fuel valve needle (5), float and float axle. Check to insure that valve needle is free and does not stick.

(3) Invert the throttle body so that the float is uppermost. Using a short ruler or scale, measure the distance between the gasket and the tips of the float farthest from the axle. This distance should be 3/32 inch + 1/32 inch.

NOTE

Be careful to place the end of the scale on the part of the gasket which is backed by metal to avoid false reading. Holding the carburetor body in its normal installed position, measure the float drop. This should be ⅛ inch minimum, measured from tip to gasket. Adjustment of the float is made by bending the tab of the float assembly.

(4) Install the main metering jet (4) with new washer (3) in fuel bowl.

(5) Install the power and accelerating jet (1) using new seal (2) in the fuel bowl.

(6) Install the power jet valve (22) in the fuel bowl pump cavity.

(7) Insert idle tube (17) with new washer (19) in the smaller of the two holes in the central boss in top of the fuel bowl.

(8) Install a new check valve assembly (18) in fuel bowl.

(9) Carefully lower the throttle body onto the fuel bowl and install the six retaining screws and washers.

(10) Position new pump diaphragm (20), with spring seat facing out, on the fuel bowl and install pump spring (21) and cover with four retaining screws and lockwashers.

(11) Install plug with new washer (8) in the throttle body.

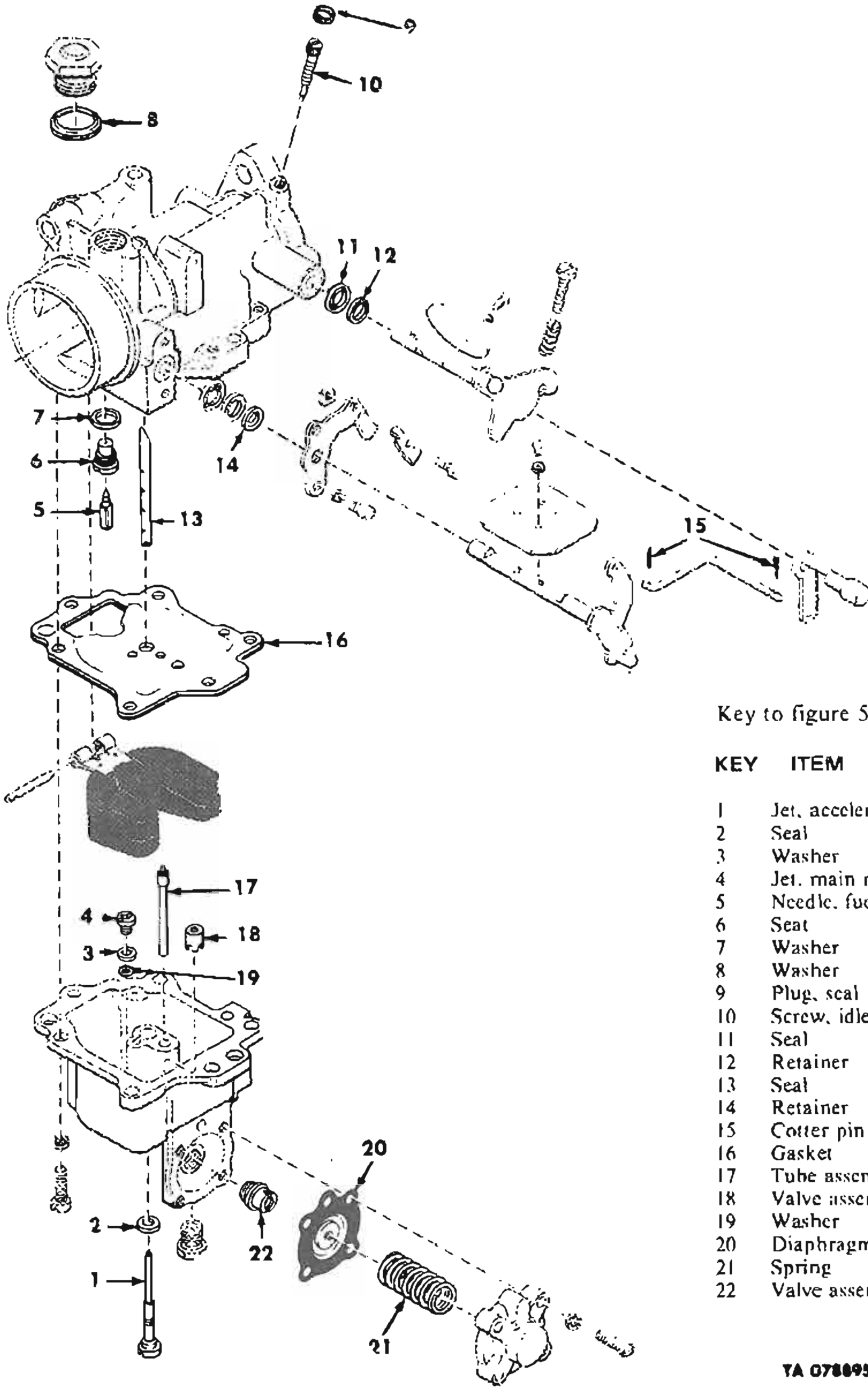
(12) Install the idle mixture screw (10) in the throttle body. Turn the idle mixture screw in slowly (approximately 4 turns).

NOTE

Final adjustment of the idle mixture screw must be accomplished after installation on the vehicle and using the lead drop method described in paragraph 2-10.1.

(13) Install seal plug (9) in the throttle body after final adjustment of carburetor described in paragraph 2-10.1.

Page 5-20. Figure 5-28.1 is added as follows:



Key to figure 5-28.1:

KEY	ITEM
1	Jet, accelerating
2	Seal
3	Washer
4	Jet, main metering
5	Needle, fuel valve
6	Seat
7	Washer
8	Washer
9	Plug, seal
10	Screw, idle mixture
11	Seal
12	Retainer
13	Seal
14	Retainer
15	Cotter pin
16	Gasket
17	Tube assembly
18	Valve assembly
19	Washer
20	Diaphragm
21	Spring
22	Valve assembly

Figure 5-28.1 (Zenith Model 10939511 and 11641105) — Exploded View.

Page 6-1. Paragraph 6-1 is superseded as follows:

6-1. General.

This section contains information for the guidance of personnel performing disassembly work on the distributor assembly 11660529. Refer to figure 6-1. Refer to paragraph 4-20 for removal and installation and to paragraph 2-10.2 for ignition timing instructions.

Page 6-1. after paragraph 6-1 add note as follows:

NOTE

Refer to TM 9-2320-218-20 for maintenance instructions on solid state ignition.

Page 6-2. Paragraph 6-2 is superseded as follows:

6-2. Cap, Coil, and Breaker Plate Disassembly.

(1) Remove four spark plug cables from cap and cover assembly.

(2) Remove six screws and and remove cap and cover assembly.

(3) Remove three screws and lockwashers which attach cap to cover. Remove cap from cover. Remove four seals from cap terminal.

(4) Lift rotor off cam. Remove two terminal wire nuts and lockwashers from coil terminal. Remove two coil mounting screws and lockwashers from distributor base.

(5) Remove four screws and lockwashers and remove filter capacitor assembly with attached resistor lead.

(6) Remove coil.

(7) Remove two breaker plate retaining screws, lockwashers, and clip and remove breaker plate assembly.

(8) Remove terminal screw, flatwasher, and lockwasher and remove coil cable and capacitor cable.

(9) Remove screw and lockwasher and remove capacitor.

Page 6-3. Paragraph 6-7*a*(1). Line 8 is changed to read: "Clean contacts with appropriate cleaning solvent."

Subparagraph *b*, line 5. "with carbon tetrachloride." is changed to read: "with appropriate cleaning solvent."

Subparagraph *c*. Add note to read as follows:

NOTE

In later model distributors, a new coil kit has been released containing a steel jacketed coil, filter, lead clamps and retaining screws for improved coil life. When replacing any of these items, the new replacement parts should be used.

Subparagraph *d*(2), line 2. "with carbon tetrachloride." is changed to read: "with appropriate cleaning solvent."

Paragraph 6-7*d* (8) is superseded as follows:

(8) Place one drop of oil (PL-S) on breaker point pivot. Operate lever once or twice and wipe excess oil from top end of pivot.

Paragraph 6-7*h*(3) is superseded as follows:

(3) Remove plug (fig. 6-8) and inspect felt wick in base. Lubricate wick with oil (PL-S). Install wick and plug.

Page 6-6. Paragraph 6-11*a* line 4 is revised as follows:

If side play is more than .005 inch measure shaft diameter.

Page 6-8. Paragraph 6-15 is superseded as follows:

6-15. Distributor Timing.

The primary terminal is accessible for connecting the timing light when the cover plug (fig. 6-1) is removed. For timing distributor on vehicle, refer to paragraph 2-10.2.

Page 8-1. Paragraph 8-3 is superseded as follows:

8-3. Scope.

The recommended procedures for removal of the transmission and transfer assembly will be found in paragraph 4-9. The procedures in section III of this chapter describes the complete disassembly of the transmission and transfer into subassemblies and also describes disassembly and repair of the subassemblies. Section IV describes the assembly of the transmission and transfer. Cleaning recommendations (para 8-4), and inspection and repair recommendations (para 8-5), cover all general conditions. Special precautions or inspections are noted in the text or illustrations adjacent to the part or parts involved. Torque recommendations are given in the paragraphs describing operations involved. Wear limits information is included in each section. When it is necessary to replace the transmission and transfer assembly the following components must be removed from the defective assembly and reinstalled on the new transmission-transfer assembly.

a. Knob, gear shift, transmission
b. Boot, transmission shift lever at tunnel cover
c. Boot, transmission shift lever at housing
d. Clamp, shift lever boot
e. Cap, gear shift lever
f. Seat, gear shift lever
g. Spring, gear shift lever
h. Gasket, gear shift housing cap
i. Lever assembly, gear shift
j. Knob, transfer gear shift
k. Shield, dust, transfer lever
l. Lever assembly, transfer shift lever
m. Pin, cotter, transfer shift lever
n. Washer, transfer shift lever (2)
o. Lever assembly, parking brake
p. Linkage, parking brake
q. Band and lining assembly, parking brake

Page 8-1. After paragraph heading 8-5 add note as follows:

NOTE

Transmission and transfer cases are machine matched and must remain in pairs.

Page 8-1. Paragraph 8-5*d*(1) is superseded as follows:

(1) Replace all seals, gaskets, and wear sleeves.

Page 8-1. Add paragraph 8-5*d*(5) as follows:

(5) Replace wear sleeves (later model transmission) whenever seals are replaced, as follows:

(a) Removal.

1 Place part in vice being careful not to damage machined surfaces.

2 Using a sharp chisel and hammer, split wear sleeve and remove from shaft. Or, using a small ballpeen hammer peen sleeve from shaft.

3 Check shaft for scores or roughness. If necessary, remove roughness with a file or crocus cloth.

(b) Installation.

1 Position a new wear sleeve on shaft.

2 Using a block of wood and a hammer, install sleeve onto shaft.

3 Position another wear sleeve on installed sleeve and tap until sleeve is bottomed on shaft.

Page 8-5. Paragraph 8-8*a* is superseded as follows:

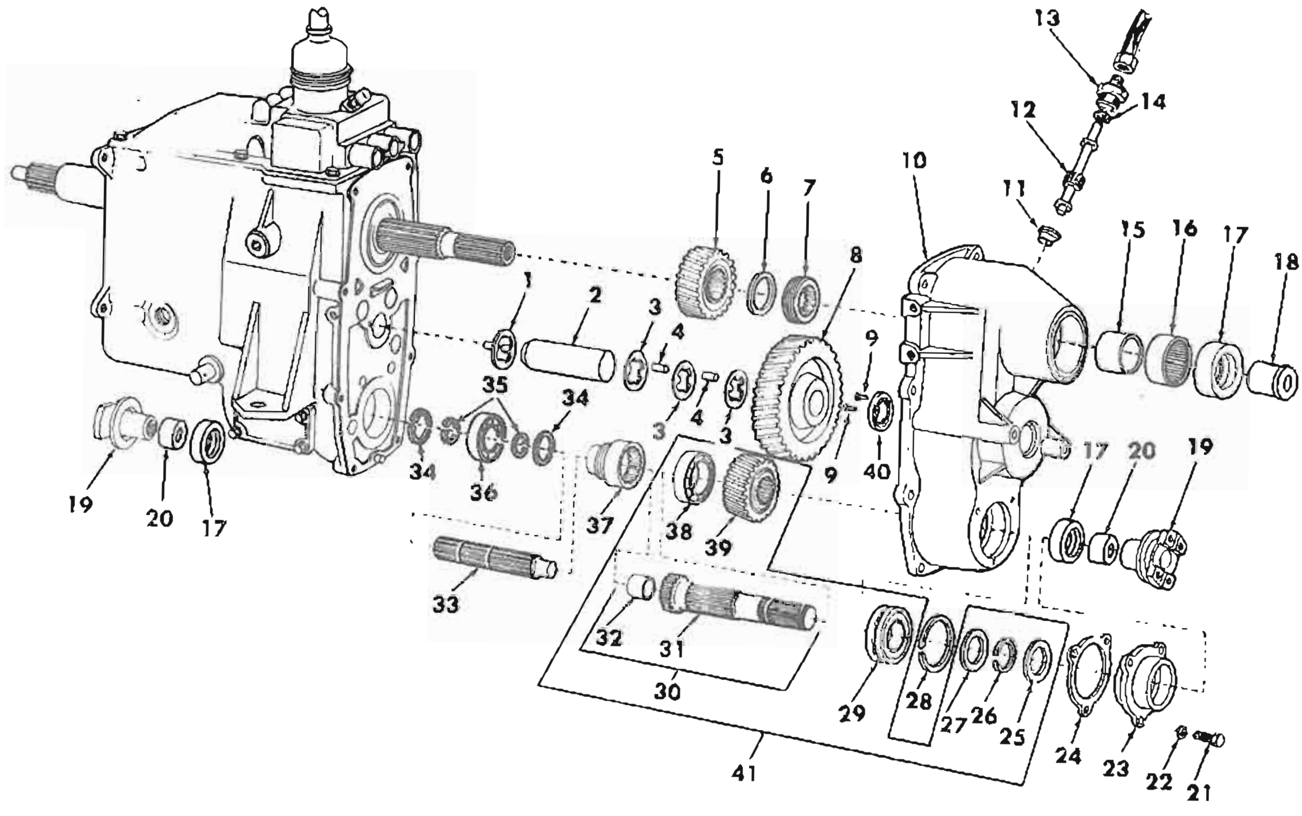
a. Clean transfer case with dry cleaning solvent, mineral spirits or paint thinner and inspect case for cracks. Inspect bore for size. Inspect intermediate gear thrust washer (fig. 8-17). If thrust washer is scored or worn, remove sealer from rivet holes and drive or drill out old rivets (fig. 8-18) and discard washer. Apply sealer NSN 8030-00-252-3391 to new rivets and install new thrust washer in transfer case by supporting head of rivets from inside of case and peening over end of rivets. Apply sealer NSN 8030-00-252-3391 to outside of case to cover rivets and fill rivet holes.

Page 8-5. after paragraph 8-8*a* add note as follows:

NOTE

Oil leakage from thrust washer rivet holes in transfer case can be corrected without removing assembly from vehicle by removing the floorboards and hand brake shoes and installing one seal NSN 5340-00-598-3446 into each of the two rivet holes from outside of case using a hammer.

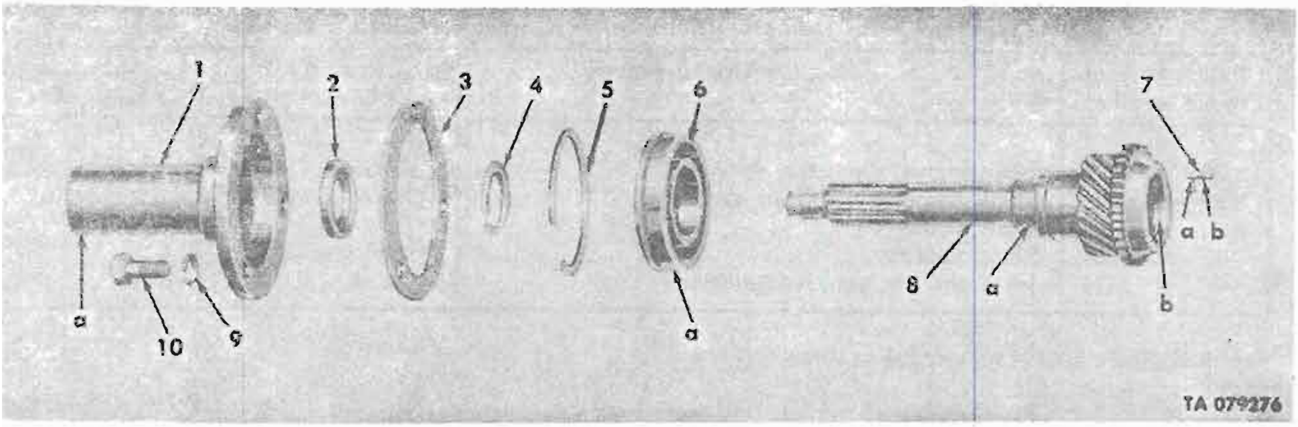
Page 8-8 figure 8-21 is superseded as follows:



1	Washer	21	Capscrew
2	Shaft assy	22	Lockwasher
3	Spacer	23	Output shaft retainer
4	Bearing, roller	24	Gasket
5	Gear	25	Retainer
6	Spacer	26	Retainer ring
7	Worm gear	27	Spacer
8	Gear	28	Retaining ring
9	Rivet	29	Bearing
10	Case assy	30	Shaft assy (rear output)
11	Bushing	31	Shaft (rear output)
12	Gear	32	Sleeve
13	Bearing	33	Shaft (front output)
14	Seal	34	Retaining ring
15	Inner bearing race	35	Retaining ring
16	Bearing	36	Bearing
17	Seal	37	Clutch
18	Wear sleeve	38	Bearing
19	Flange	39	Gear
20	Wear sleeve	40	Thrust washer
		41	Gear and shaft assy

Figure 8-21. Transfer Assembly — Exploded View.

Page 8-14 figure 8-41 is superseded as follows:



1 Retainer
2 Seal
3 Gasket
4 Snapring
5 Snapring
6 Bearing
7 Roller bearings, needle (14)
8 Shaft
9 Washer (3)
10 Screw (3)

Figure 8-41. Input shaft assembly — exploded view.

Table 8-3 is superseded as follows:

Table 8-3. Wear Limits — Input Shaft Assembly

Fig. No.	Ref. Let.	Points of Measurement	Size and Fit of New Parts	Acceptable Wear Limits
8-41	1a	Outside diameter at clutch release	1.181	1.176
8-41	7a	Outside diameter of roller	0.2186-0.12188	*
8-41	7b	Length of roller	0.605-0.625	0.600
8-41	8a	Seal contact area	0.998-1.002	0.996
8-41	8b	Inside diameter of bearing bore	1.2042-1.2048	1.2050
8-41	6a	Outside diameter of bearing	2.8346-2.8341	

*Refer to paragraph 8-6a(2).

Page 8-20 table 8-5 is superseded as follows:

Table 8-5. Wear Limits — Transmission Housing and Related Parts.

Fig. No.	Ref. Let	Points of Measurement	Size and Fit of New Parts	Acceptable Wear Limits
8-63	3a	Gear internal diameter	0.7505-0.7515	0.7530
8-63	4a	Shaft diameter at bearing surface	0.8925-0.8929	0.8920
8-63	5a	Shaft diameter	0.7490-0.7495	0.7470
8-63	9a	Shaft diameter	0.6260-0.6265	*
8-63	12a	Input shaft bearing bore diameter	2.8344-2.8354	

Page 8-21 figure 8-63 is superseded as follows:

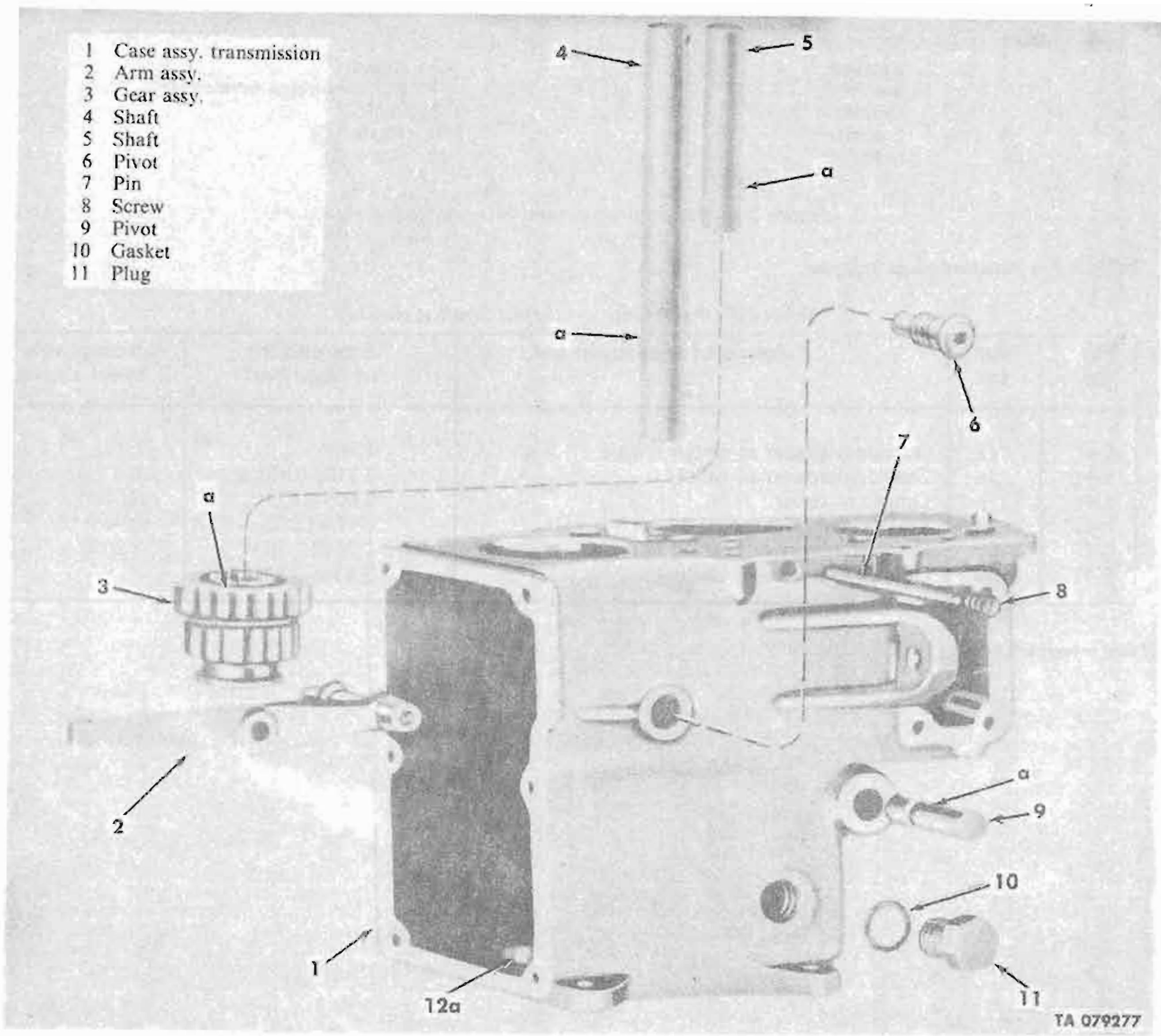


Figure 8-63. Transmission housing and related parts — exploded view.

Page 8-33. Figure 8-99 is superseded as follows:

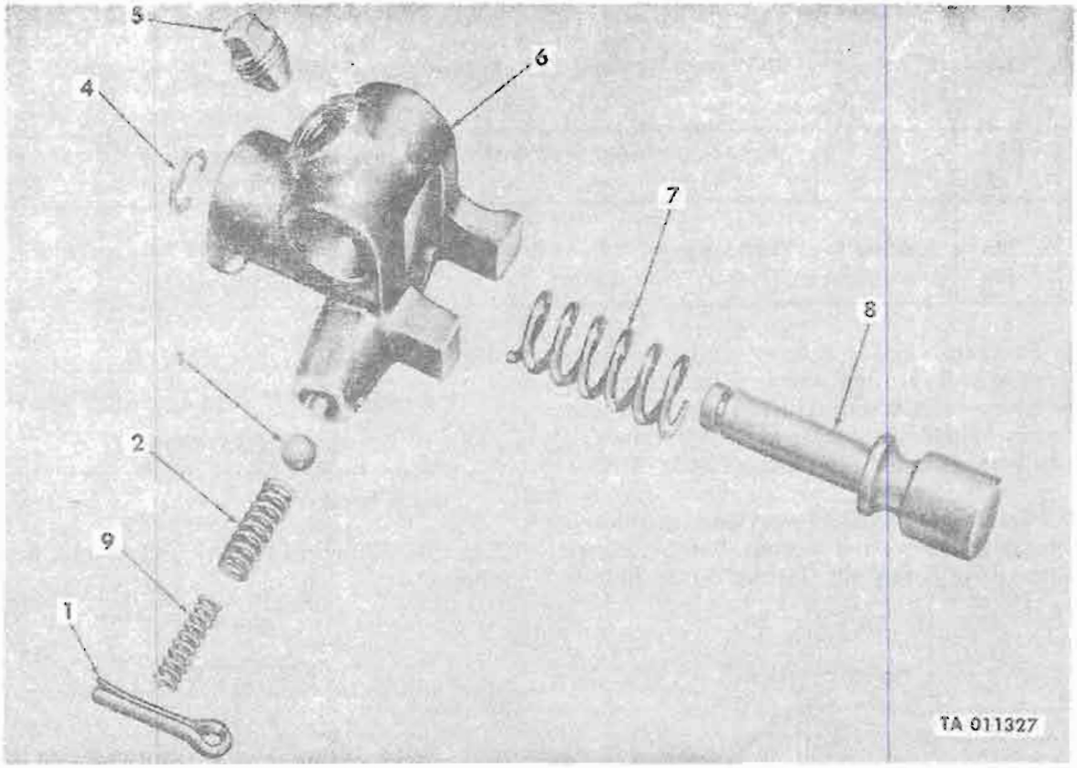


Figure 8-99. Reverse shift gate — exploded view.

Page 9-1. Paragraph 9-3*h*(1) and (2) are superseded as follows:

(1) Straighten bent tubes and fins. Repair radiator or shroud as necessary by soldering or welding in accordance with TM 9-237.

(2) Test for leaks. Refer to FM 43-2 for testing and repair procedures. Radiator cores with not more than two tubes blocked are acceptable if fins are properly replaced after blocking.

Page 10-1. Paragraph 10-5*d*(1) is superseded as follows:

(1) Replace all seals, gaskets, and wear sleeves.

Page 10-1. Paragraph 10-5*d*(3) is deleted.

Add note after paragraph 10-5*d*(4).

NOTE

Later model vehicle spindle and hub assemblies are equipped with wear sleeves for replacement information see TM 9-2320-218-20.

Page 10-9. Paragraph 10-12.1 is added as follows:

10-12.1 Removal of Upper and Lower Suspension Arm Bushings.

a. Remove cotter pins, nuts, and retainers from shaft ends.

b. If necessary, grind or cut four tack welds holding each arm bushing sleeve to arms.

c. Push out shaft with arm bushing sleeves.

d. Remove arm bushing sleeves and worn bushings from shaft. If applicable, remove left over weld material and clean-up weld area.

Page 10-14. Paragraph 10-13*q* is superseded as follows:

q. Remove outer bearing cone from spindle using puller (5120-00-627-7161) with wedge assembly (5120-00-567-2492) and protector block (11681729) (fig. 10-45).

Page 10-15. Figure 10-45 is superseded as follows:

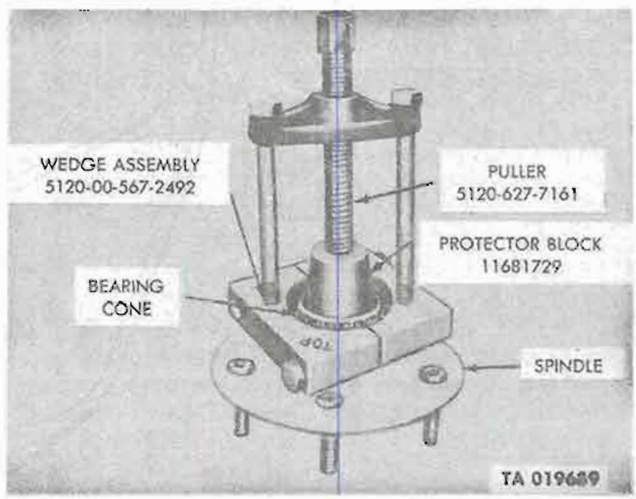


Figure 10-45. Removing outer wheel bearing.

Page 10-18. Paragraph 10-15*b* is superseded as follows:

b. Replace upper suspension arm assembly if arm (2) is bent or cracked, or if shaft is bent. Replace upper suspension arm rubber bushings if worn out or collapsed.

Page 10-18. Table 10-1. Reference 10-55, keys 24*a* and 24*b* are changed as follows:

Fig. No.	Ref. Let.	Points of Measurement	Size and Fit of New Parts	Acceptable Wear Limits
10-55	24a	Bearing Seat (Inside)	1.624-1.625	*
10-55	24b	Bearing Seat (Outside)	1.6255-1.6265	*

Page 10-20. Paragraph 10-17*b* is superseded as follows:

b. Lubricate spindle bearing cone in accordance with instructions given in paragraph 10-16*h*. Position and press bearing on spindle with improvised tool (thin wall tubing 3 inch long x 1¾ inch I.D.) (fig. 10-62).

Page 10-20. Paragraph 10-17*f*(2) is superseded as follows:

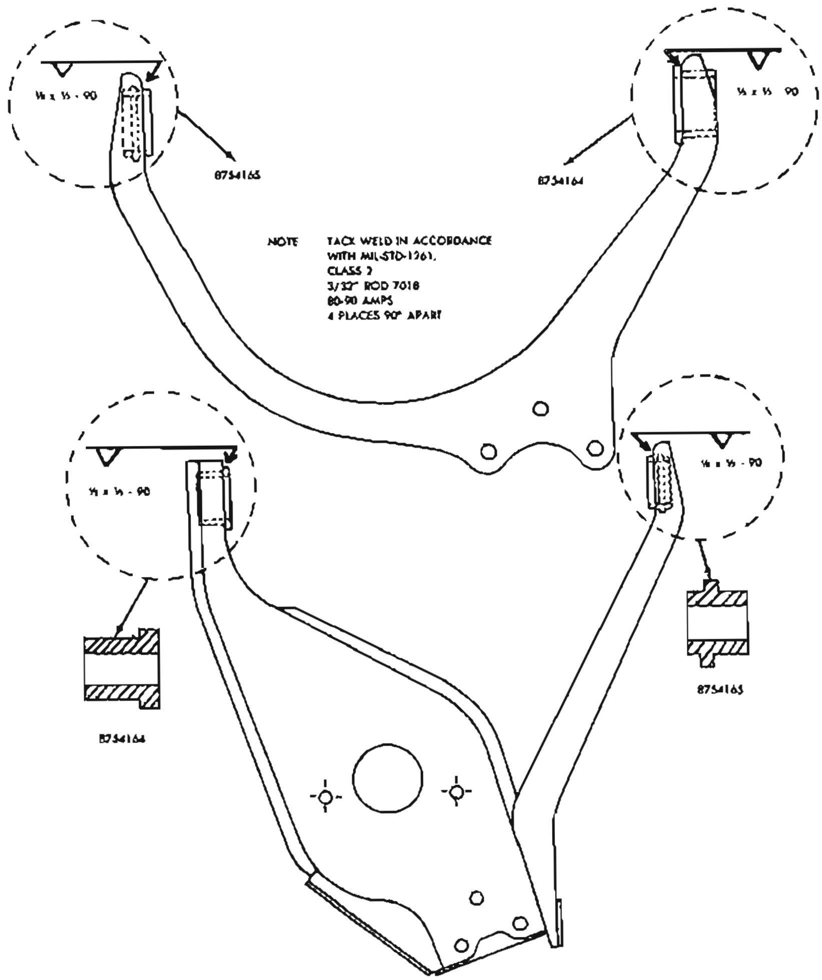
(2) Remove lifting eye and locknut. Remove cotter pin from wheel drive flange nut. Tighten nut to 30 lb-ft torque.

Paragraph 10-17*f*. Add note after step (6):

CAUTION

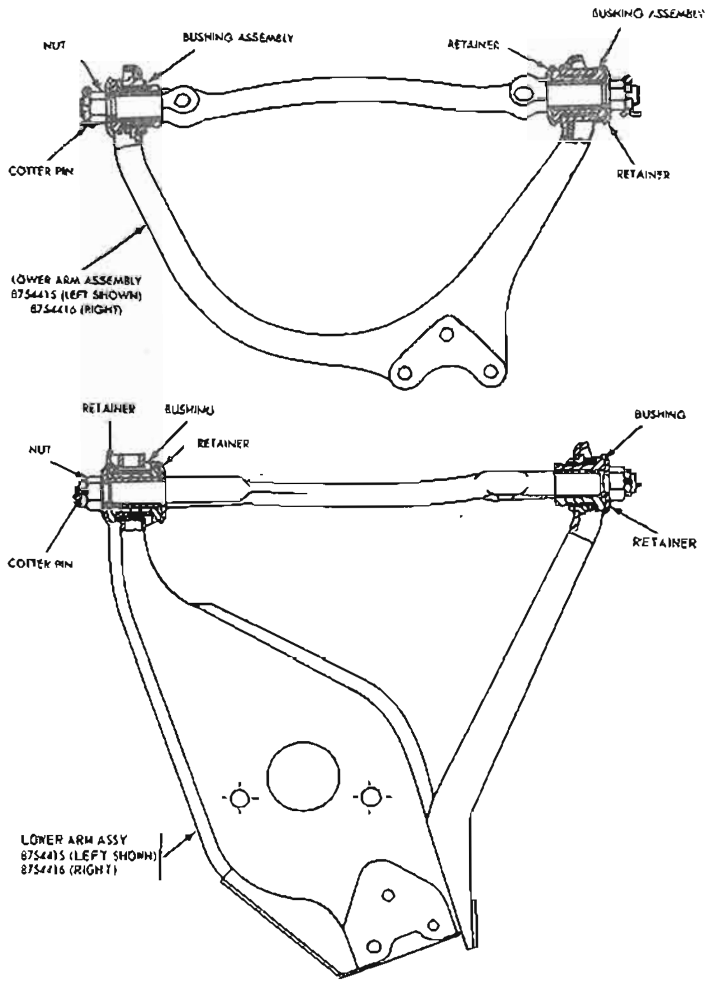
Do not rotate wheel or spindle when adjusting nut is backed off.

Page 10-22. Figures 10-63.1 and 10-63.2 are added as follows:



TA 079242

Figure 10-63.1 Front Suspension Arm Tack Weld Locations.



TA 079243

Figure 10-63.2 Front Suspension Arm Bushing Installed.

Page 10-23. Paragraph 10-18.1 is added as follows:

10-18.1 Installation of Upper and Lower Suspension Arm Bushings.

a. Reinstall arm bushing sleeves in suspension arm, and tack weld in 4 places. Refer to figures 10-63.1 and 10-63.2.

b. Install new bushing, using bushing driver, NSN 5120-00-627-7181, P/N 7345244, in arm bushing sleeve P/N 8754164.

c. Slide shaft through arm bushing sleeve, P/N 8754165, install retainer, and slide shaft through bushing sleeve.

d. Install new bushing, using bushing driver, NSN 5120-00-627-7181, P/N 7345244, in arm bushing P/N 8754165.

e. Install retainers, nuts, and cotter pins.

NOTE

Do not torque tighten nuts.

Page 10-23. Paragraph 10-19*a* is superseded as follows:

a. Install upper control arm to crossmember, using two bolts, lockwashers, and nuts. Refer to figure 10-29. Torque nuts to 70-90 lb-ft.

Figure 10-64 is superseded as follows:

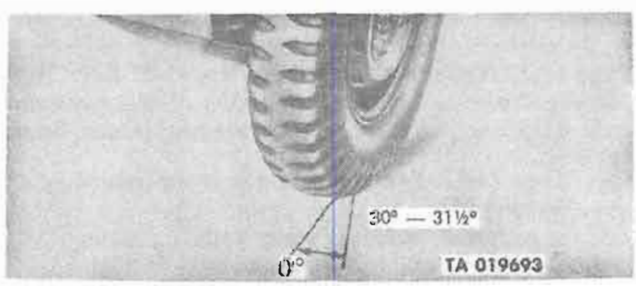


Figure 10-64. Front wheel swing arc.

Page 10-24. Paragraph 10-25*a*(3) is superseded as follows:

(3) *Check front wheel swing arc.* Swing front wheels through arc shown in figure 10-64. Loosen jam nut and adjust left side steering stop bolt (fig. 10-65) to allow specified turning angle (30°-31½°) as shown in figure 10-64. Adjust right side steering stop bolt using same procedure. After adjustments, the vehicle should have a maximum turning radius of 18.5 feet, measured from the centerline of the outside front wheel, when completing full turns right and left.

NOTE

Torque-tighten jam nut 35-40 lb-ft after adjustment. Do not tack weld steering stop bolt after adjustment.

Page 10-24 after paragraph 10-25*a*(3) add note as follows:

NOTE

M151A2 vehicles beginning with contract number DAAE07-76-D-0002 have wheel swing arc jam nuts spot welded, for contract number 0103 vehicles do not spot weld turn stop bolts as continued adjustment may be required.

Paragraph 10-25*a*(5) is superseded as follows:

(5) *Check Wheel Bearings.* Raise front wheels off floor. Grasp each front tire at the front and rear, then push the wheel inward and outward. If any excessive free play is noticed, adjust wheel bearings (para 10-17*f*). Replace bearings if they are worn or damaged.

Page 10-25. Figure 10-66:

View A, Front. Below the word "Front" between the arrows, add "D".

"C—D=1/32 TO 5/32" is changed to read "C—D=1/32" TO 5/32"."

Delete "+½° TO +1¾°".

View B, below CAMBER SPECIFICATION, ADD THE FOLLOWING, "+½° *TO* +*1¾°*".

Page 11-2. Paragraph 11-6*d*(1) is superseded as follows:

(1) Replace all seals, gaskets, and wear sleeves.

Page 11-2. Paragraph 11-6*d*(3) is deleted.

Add note after paragraph 11-6*d*(4).

NOTE

Later model vehicle spindle and hub assemblies are equipped with wear sleeves for replacement information see TM 9-2320-218-20.

Page 11-4. Paragraph 11-12. Add subparagraph *i* as follows:

i. Rear Suspension Arm.

(1) Rear suspension arms must be removed from vehicles to replace the suspension arm bushings.

(2) Removal of rear suspension arm. Refer to TM 9-2320-218-20 paragraph 2-158 and remove suspension arm from vehicle.

(3) Press bushing from suspension arm figures 11-26 and 11-27.

NOTE

When removing bushings exercise care not to damage the bushing bore.

Page 11-8. Figure 11-27.1 is added as follows:

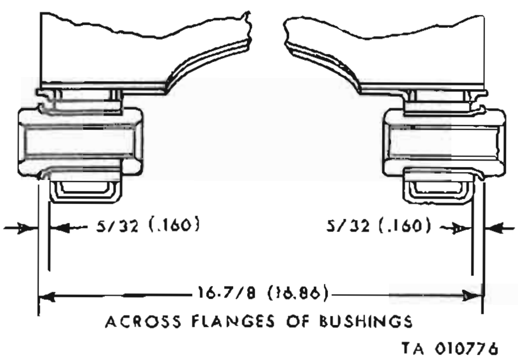


Figure 11-27.1. Installation of suspension arm bushings.

Page 11-8. Paragraph 11-14.1 is added as follows:

11-14.1 Installation of Suspension Arm Bushing.

a. Apply a thin film of GAA grease to outer case of bushing and start bushing into bore of suspension arm.

b. Press bushing into suspension arm bore to dimension shown on figure 11-27.1.

NOTE

When replacing bushing, always replace both bushings in suspension arm.

Page 11-12. Table 11-2. Reference No. 11-32 Key 13b is changed as follows:

Fig. No.	*Key*	*Point of Measurement*	*Size of New Part*	*Wear Limit*
11-32	13b	Bearing Seat (Outer Bearing)	1.6255-1.6265	*

Page 11-12. Paragraph 11-15*g* is superseded as follows:

g. Install backing plate with six bolts. Refer to figure 11-21 torque bolts to 65-70 lb-ft on M151A1 vehicles and 30-40 lb-ft on M151A2 vehicles.

Page 11-14. Add note after paragraph 11-17*c* as follows:

NOTE

Wheel bearing adjustment should be performed each time adjustment has been disturbed or to compensate for bearing wear.

Page 11-14. Paragraph 11-17*d* is superseded as follows:

d. Install nut on drive flange. Tighten drive flange nut to 30 lb-ft torque. Rotate spindle three complete rotations.

Page 11-14. After paragraph 11-17*d*, add the following subparagraphs:

e. Recheck torque. If not at 30 lb-ft tighten and repeat paragraph *d* until torque can be maintained.

f. Back nut off one complete rotation to relax the preload, without rotating spindle tighten nut fingertight.

g. Insert cotter pin and secure. The spindle has two through holes for the cotter pin. If the slots in the nut do not aline with either one of the holes, loosen the nut the least amount required to aline a slot with a hole and insert cotter pin.

h. Install lifting eye and locknut.

i. Install wheel and tire assembly.

Page 12-2. Paragraph 12-5*d*(4) is superseded as follows:

(4) Later model differential assemblies are equipped with wear sleeves for replacement information see TM 9-2320-218-20.

Page 12-2. Paragraph 12-7*a* is superseded as follows:

a. Prior to differential disassembly, externally check and record ring and pinion gear backlash. This backlash must be reset if used drive gears are reassembled into the original differential.

(1) Fasten a bolt securely in one of the open bolt holes of the differential pinion flange (fig. 12-1.1).

(2) Attach dial indicator gage to differential case as shown in figure 12-1.1.

(3) Rotate pinion flange clockwise to eliminate all free movement between the pinion and ring gear. Position dial indicator gage stem on bolt surface and set dial gage on "O".

(4) Slowly rotate pinion flange counterclockwise, but do not turn ring gear. Observe amount of free movement or backlash of the pinion flange on the dial indicator gage.

(5) The dial indicator gage should register 0.009 to 0.016 backlash or free movement. This setting is the correct and required amount of backlash between ring and pinion gears (fig. 12-1.1).

Page 12-2. Paragraph 12-8*a* is superseded as follows:

12-8. Disassembly of Differential Housing.

a. Position differential housing assembly in holding fixture and stand (fig. 12-1). Rotate assembly and remove magnetic drain plug to drain lubricant from housing. Clean magnetic drain plug before reinstalling.

b. Remove side gear drive flange retaining bolt and lockwasher (fig. 12-2) use a standard flange holding tool on opposite flange to prevent rotation.

c. Remove right and left drive flanges.

d. Pry off side gear bearing seals from differential case (fig. 12-3).

e. Remove bearing adjusting nut locks (fig. 12-4).

f. Using face spanner wrench 7345228 (fig. 12-5) loosen case bearing adjusting nuts. Do not remove adjusting nuts.

g. Remove ten housing cover plate bolts and lockwashers retaining cover to housing (fig. 12-6).

h. Using common tool remove cover plate from housing (fig. 12-7).

i. Remove differential case assembly from housing (fig. 12-8).

j. Remove differential bearing adjusting nut (fig. 12-9).

k. Remove side bearing cup from housing cover (fig. 12-10).

l. Remove nut locking tab, retaining nut, and washer from both ends of pinion shaft (fig. 12-11). Use standard flange holding tool to hold flange while loosening nut (fig. 12-12).

m. Remove pinion shaft drive flanges from pinion shaft (fig. 12-13).

n. Using soft steel drift drive pinion shaft front seal from housing (fig. 12-14).

o. Remove pinion bearing adjusting nut lock from housing (fig. 12-15).

p. Using face spanner wrench, remove front pinion bearing adjusting nut from housing (fig. 12-16).

q. Using soft hammer or hardwood block, drive pinion shaft inward to release outer front bearing (fig. 12-17).

r. Remove pinion outer front bearing from pinion shaft (fig. 12-18).

s. Remove pinion shaft bearing preload spacer from pinion shaft (fig. 12-19).

t. Using adapter 7345223 as a driver, set up assembly in arbor press as shown in figure 12-20. If no arbor press is available, attach slide hammer to opposite end of shaft and pull shaft out.

u. Press or pull pinion shaft and bearing from housing (fig. 12-21).

v. Attach adapter 7345228 to opposite end of pinion shaft and press inner bearing from shaft (fig. 12-22).

w. Using adapter 7345281 and standard slide hammer, remove pinion shaft rear bearing spacer and seal (fig. 12-23).

Figure 12-1.1 is added as follows:

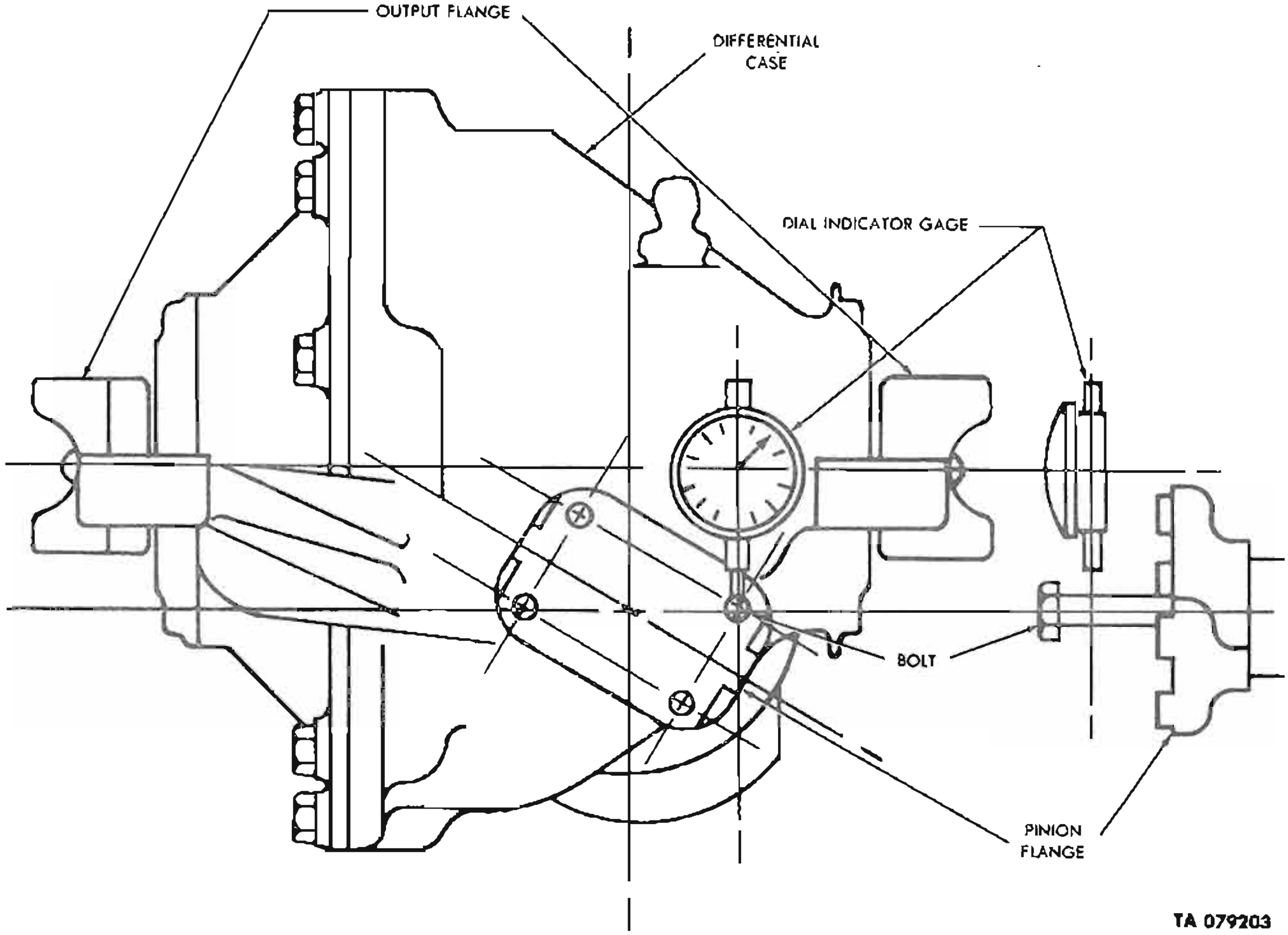


Figure 12-1.1 Externally Checking Ring and Pinion Gear Backlash at Pinion Flange.

Page 12-3. Figure 12-3 is superseded as follows:

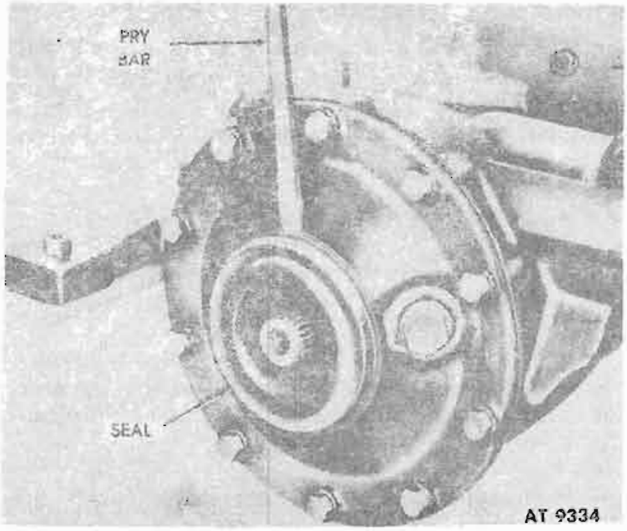


Figure 12-3. Removing Differential Case Side Gear Bearing Seal.

Figure 12-4 is superseded as follows:

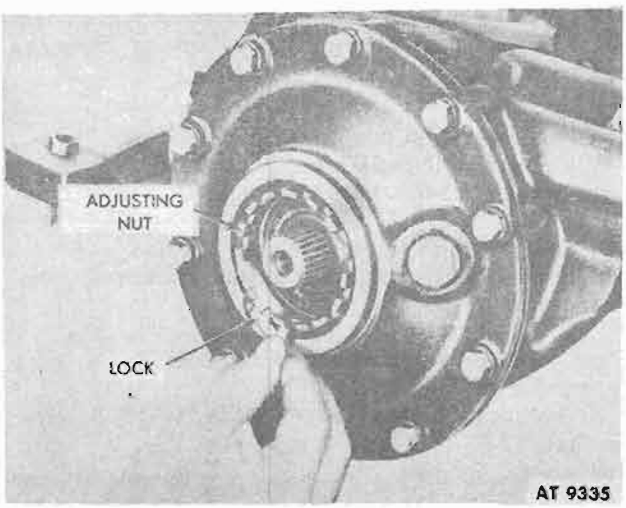


Figure 12-4. Differential Case Side Bearing Nut Lock.

Figure 12-5 is superseded as follows:

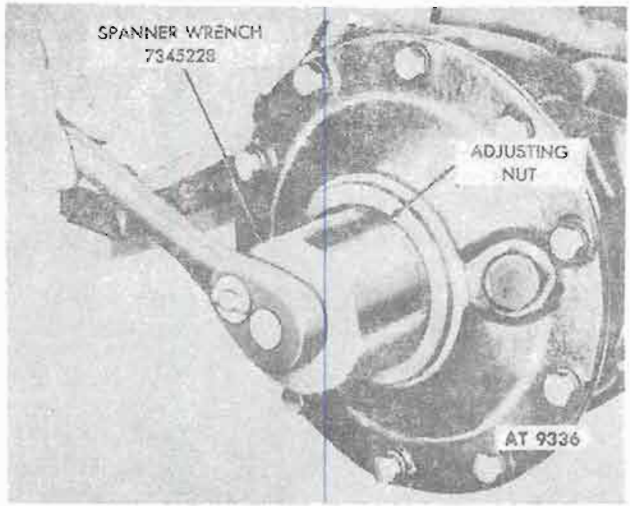


Figure 12-5. Using Spanner Wrench (7345228) to Loosen or Tighten Differential Bearing Adjusting Nuts.

Page 12-4. Figure 12-6 is superseded as follows:

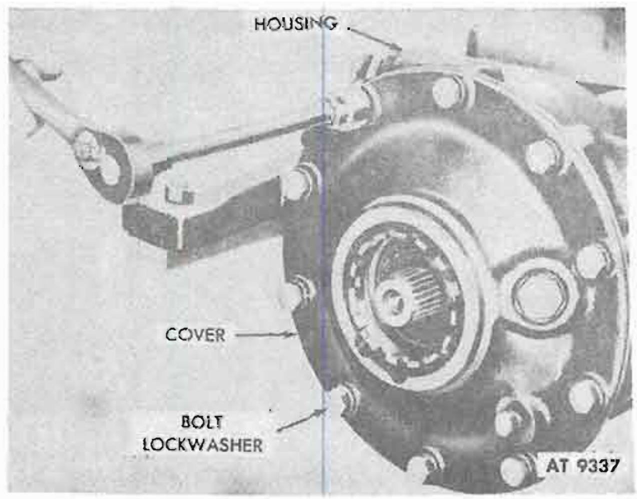


Figure 12-6. Housing Cover Plate Retaining Bolts and Lockwashers.

Figure 12-7 is superseded as follows:

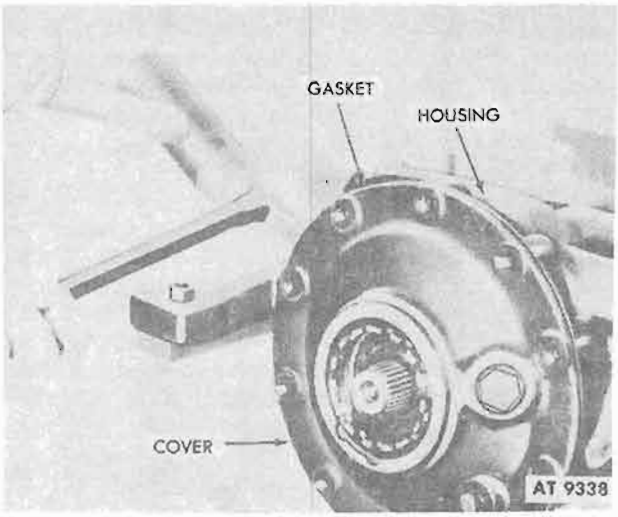


Figure 12-7. Removing Cover Plate from Housing.

Figure 12-8 is superseded as follows:

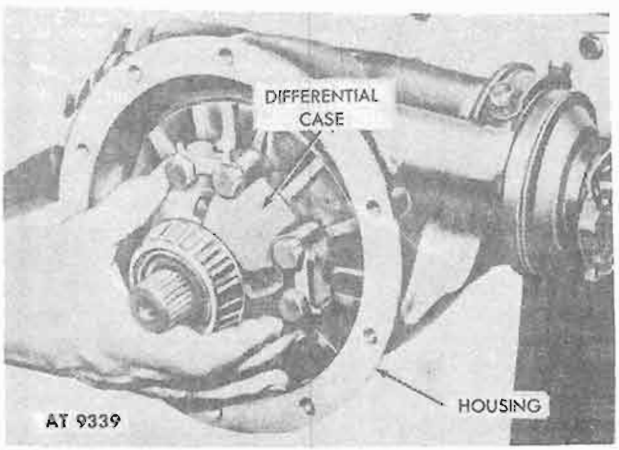


Figure 12-8. Removing Differential Case from Housing.

Page 12-11. Paragraph 12-12. Subparagraphs *c*, *d*, and *e*. are superseded as follows:

c. Lubricate backface of long side gear and both sides of washer. and install long section, using OE/HDO as a lubricant (fig. 12-38).

d. Lubricate four spider journals, spider pinion gears, bores, and both sides of four thrust washers; and install in case long section, using OE/HDO as a lubricant (fig. 12-39).

e. Lubricate backface of short side gear and both sides of washer; and install in case, using OE/HDO as a lubricant (fig. 12-40).

Subparagrah *h* is superseded as follows:

h. Lubricate bolts to prevent seizure using OE/HDO as a lubricant.

Subparagraph *k* is superseded as follows:

k. Position case in vise using installed bolts as clamping areas. Lubricate, using OE HDO as a lubricant, and install remaining four bolts and two lock plates (fig. 12-44).

Add note after paragraph 12-12*l*.

NOTE

Differential gears must rotate freely after assembly.

Page 12-16. Paragraph 12-14*a* is superseded as follows:

a. Insert pinion shaft rear bearing in housing bore. Lubricate bearing rollers, using OE HDO as lubricant (fig. 12-46).

Paragraph 12-15, subparagraphs *a* and *b*, are superseded as follows:

a. Position differential in housing. Refer to figure 12-8.

b. Install cover and bearing cups. Refer to figure 12-6.

Subparagraph *f* is superseded as follows:

f. Using wrench (7345228), tighten nut. Refer to figure 12-5. Tighten nut one notch for used bearings or two notches for new bearings, using housing mark as reference point (fig. 12-52).

Subparagraph *i* is superseded as follows:

i. Remove differential cover, do not disturb mark, refer to figure 12-6.

Subparagraph *j* is superseded as follows:

j. Remove differential case assembly from housing. Refer to figure 12-8.

Page 12-27. Paragraph 12-17, Subparagraph *d* is superseded as follows:

d. Torque differential cover bolts to 25-30 lb-ft. Refer to figure 12-6.

Subparagraph *k* is superseded as follows:

k. Remove housing cover bolts. Refer to figure 12-6.

Paragraph 12-19. Subparagraph *b* is superseded as follows:

b. Install ten housing cover retaining bolts. Refer to figure 12-6.

Subparagraph *d* is superseded as follows:

d. Install one bearing adjustment lock to each bearing adjustment nut. Refer to figure 12-4.

Subparagraph *g* is superseded as follows:

g. Using flange holding tool, torque side flange retaining bolts to 40-45 lb-ft (fig. 12-78).

Subparagraph *m* is superseded as follows:

m. Install tab on pinion shaft nuts. Bend tab ends down to secure locking tab. Refer to figure 12-11.

NOTE

Install tab by alining tab with nut and flange slots. Tighten nut if required.

Figure 12-73 is superseded as follows:

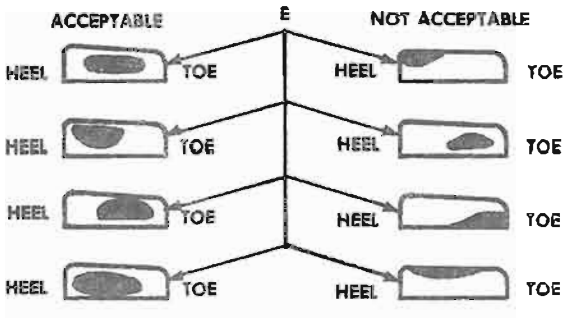


Figure 12-73. Sample Ring Gear Patterns Under No-Load Conditions.

Page 12-31. Figure 12-78 is superseded as shown:

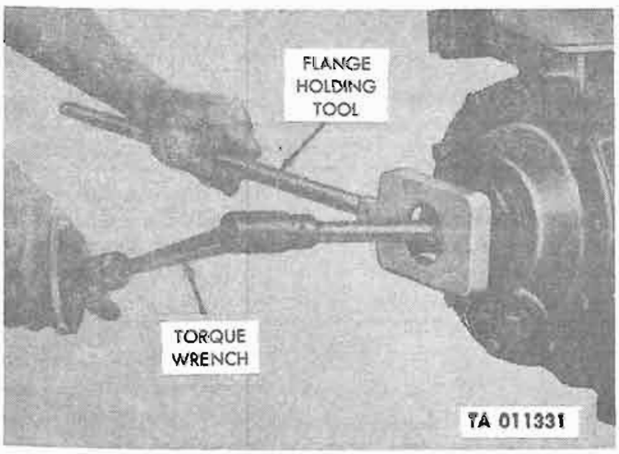


Figure 12-78. Torquing Side Flange Bolts.

Page 14-1. Paragraph 14-4 is rescinded.

Page 14-2. Delete figure 14-1.

Paragraph 14-5 is superseded as follows:

14-5. Cleaning.

Clean all metal parts of brake mechanism in dry cleaning solvent, mineral spirits or paint thinner. Clean brake lining with a wire brush.

CAUTION

If brake lining is contaminated with brake fluid or cleaning solution, replace shoes.

Paragraph 14-6*c* is superseded as follows:

c. Wheel cylinders. If wheel cylinder shows sings of leakage or damage replace the complete wheel cylinder.

Paragraph 14-6. Delete the note and *d* and *f*.

Page 14-3. Paragraph 14-7. Delete subparagraph *c*.

Paragraph 14-8 is rescinded.

Page 14-3 after paragraph 14-9 add note as follows:

NOTE

When relining the vehicle brake system with bonded linings, insure that the screw assembly, wheel brake adjusting P/N 12275100 and spring P/N 12275101 are utilized. These items are color coded blue for identification purposes.

Page 16-2. Figure 16-3 caption is changed to read as follows:

Steering column mounting bracket and attaching hardware.

Page 17-4. Paragraph 17-4*a*. Line four is changed to read as follows:

"instructions in FM 43-2 referring to sheet metal"

Page 17-4. Paragraph 17-4*b*. Line three is changed to read as follows:

"methods outlined in FM 43-2. Follow welding."

Page 17-16. Paragraph 17-32*b* is superseded as follows:

b. Plastic Windows. Plastic windows may be cleaned of fog, and light scratches removed by using soft cloth and waterless G.I. soap NSN 8520-00-262-7177.

Paragraph 17-32.1 is added as follows:

17-32.1 Soft Top Repair.

a. The following repair procedures and components, table 17-1, are used for patching the soft top.

b. Repair Procedure.

(1) Cut a patch from the vinyl coated nylon cloth to approximately the shape of the tear allowing at least one inch of overlap around the puncture or tear.

(2) Cut a filler from the cotton duck material to identical size and form as the vinyl patch.

(3) Place the filler first, then the patch on the interior surface of the fabric to be repaired, i.e., the filler would be sandwiched between the soft top material and the vinyl coated nylon patch.

(4) Line up the patch and the filler and mechanically sew in place, using seven (plus or minus one) stitches per inch in accordance with Federal Standard 751, applying a zigzag pattern on the tear form and a straight line pattern on the patch filler outer edges as shown in figure 17-26.1.

Figure 17-26.1 is added as follows:

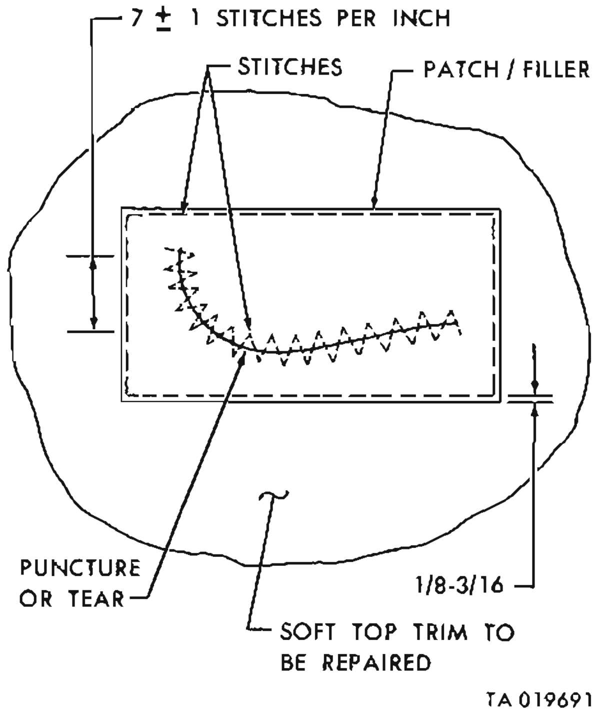


Figure 17-26.1 Soft Top Repair.

Table 17-1. Components Used for Patching Soft Top

Item No.	Part Name	Part No.
1	Cloth roll-vinyl coated nylon	MIL-C-20696 NSN 8305-00-616-0022
2	Cloth roll-duct cotton	CCC-C-428 NSN 8305-00-170-3903
3	Thread-polyester	VT-285 NSN 8310-00-988-1301

Section VIII title is changed to read as follows:

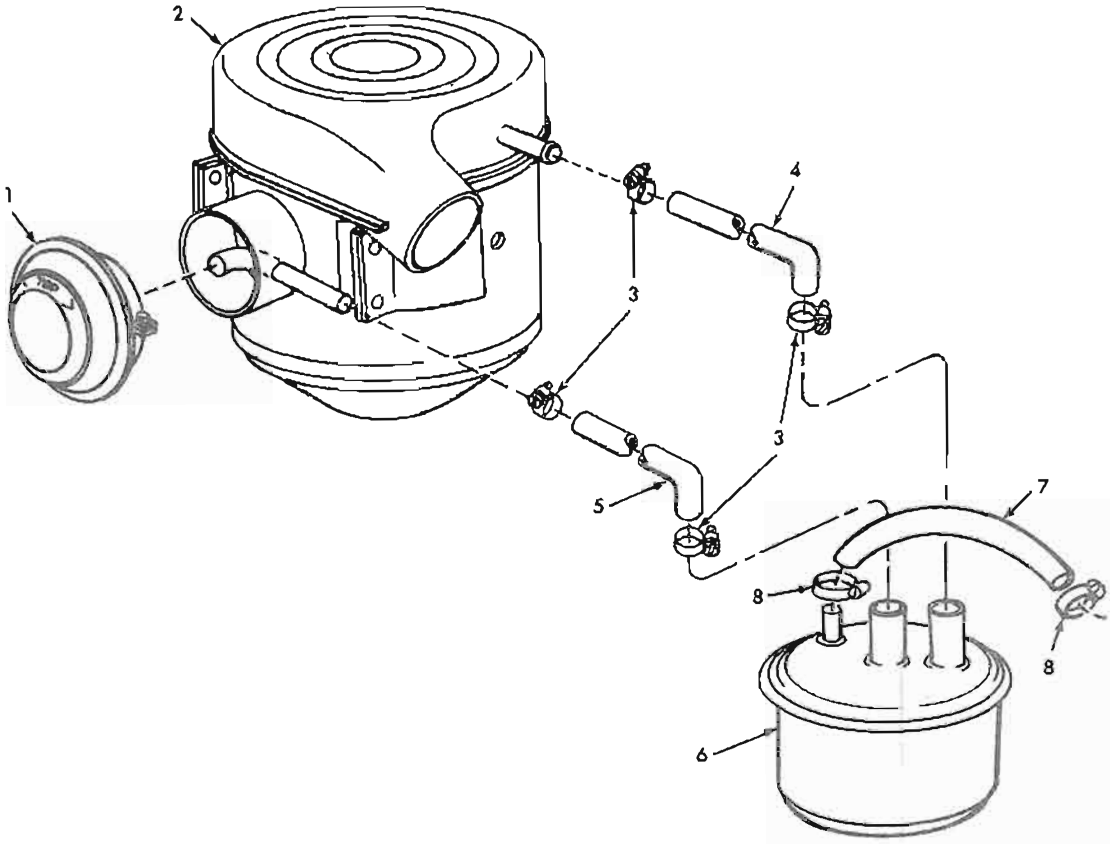
Section VIII. AIR CLEANER AND EVAPORATIVE CANISTER

Paragraph 17-34. The first two sentences are changed to read as follows:
Refer to TM 9-2320-218-20 for removing air cleaner and evaporative canister from vehicle. For disassembly of air cleaner refer to figure 17-28 and perform the following:

Page 17-17. Paragraph 17-36*f* is added to read as follows:
f. Canister Assembly. Check canister (fig. 17-28.1) for exterior damage or leaks. Check hoses and clamps at canister for cracks or exterior damage. Replace if damaged.

Paragraph 17-37*a* is superseded as follows:
a. Place oil cup in bottom of housing and fill with oil (2½ pints).

Page 17-18. Figure 17-28.1 is superseded as follows:



1	Cap air cleaner assembly
2	Air cleaner assembly
3	Clamps (4)
4	Hose
5	Hose
6	Canister assembly
7	Hose
8	Clamps (2)

Figure 17-28.1 Canister and Hose Assembly. Fuel Vapor Storage (Emission Control).

Page 17-18. Paragraph 17-40*b* is superseded as follows:

b. Repair. Repair and weld tank in accordance with FM 43-2 and TM 9-237.

Page 18-12. Paragraph 18-8*d* is deleted.

Page 18-14. Figure 18-12 is superseded as follows:

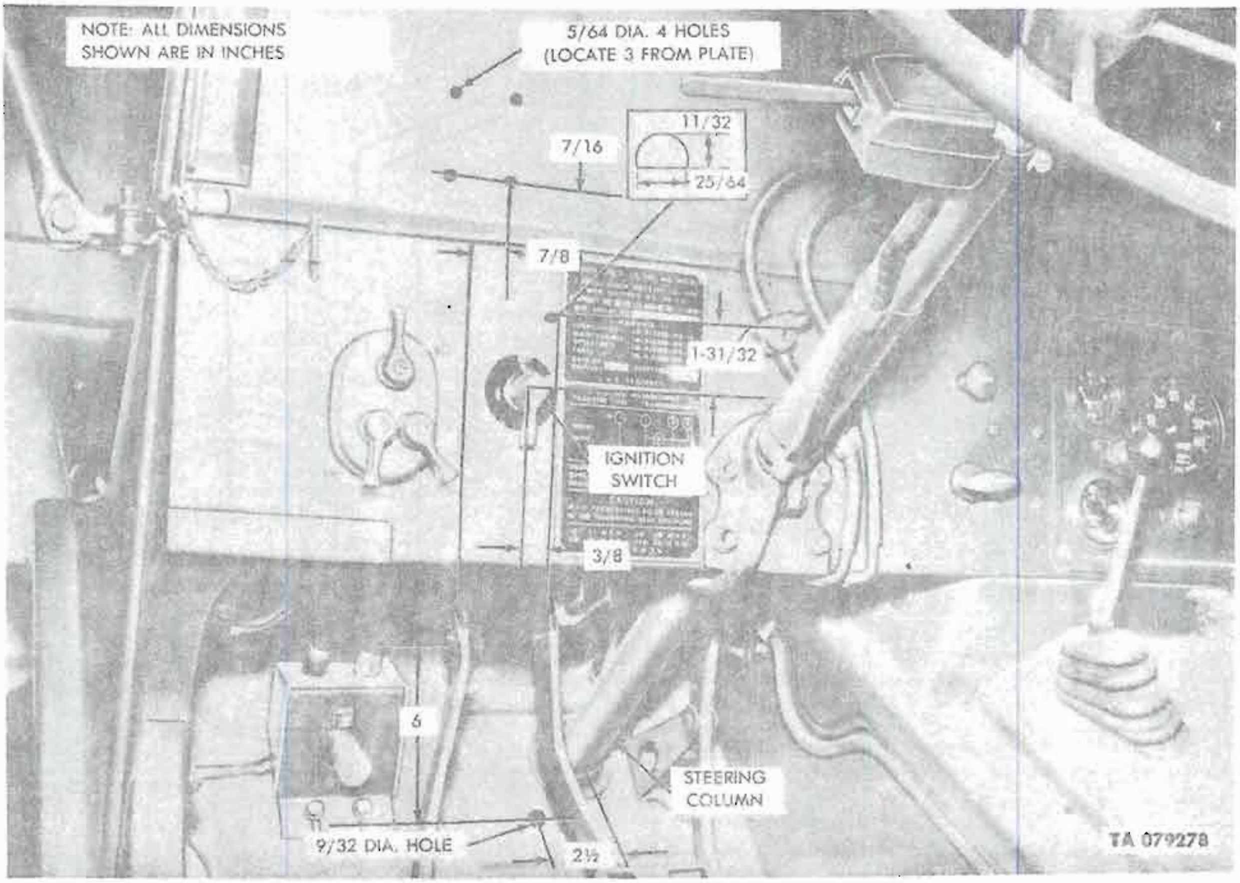


Figure 18-12. Drilling Instructions for Dash Panel — Left Side.

Page 18-15. Paragraph 18-9. Delete *a* (1) (2) (3) and (4).

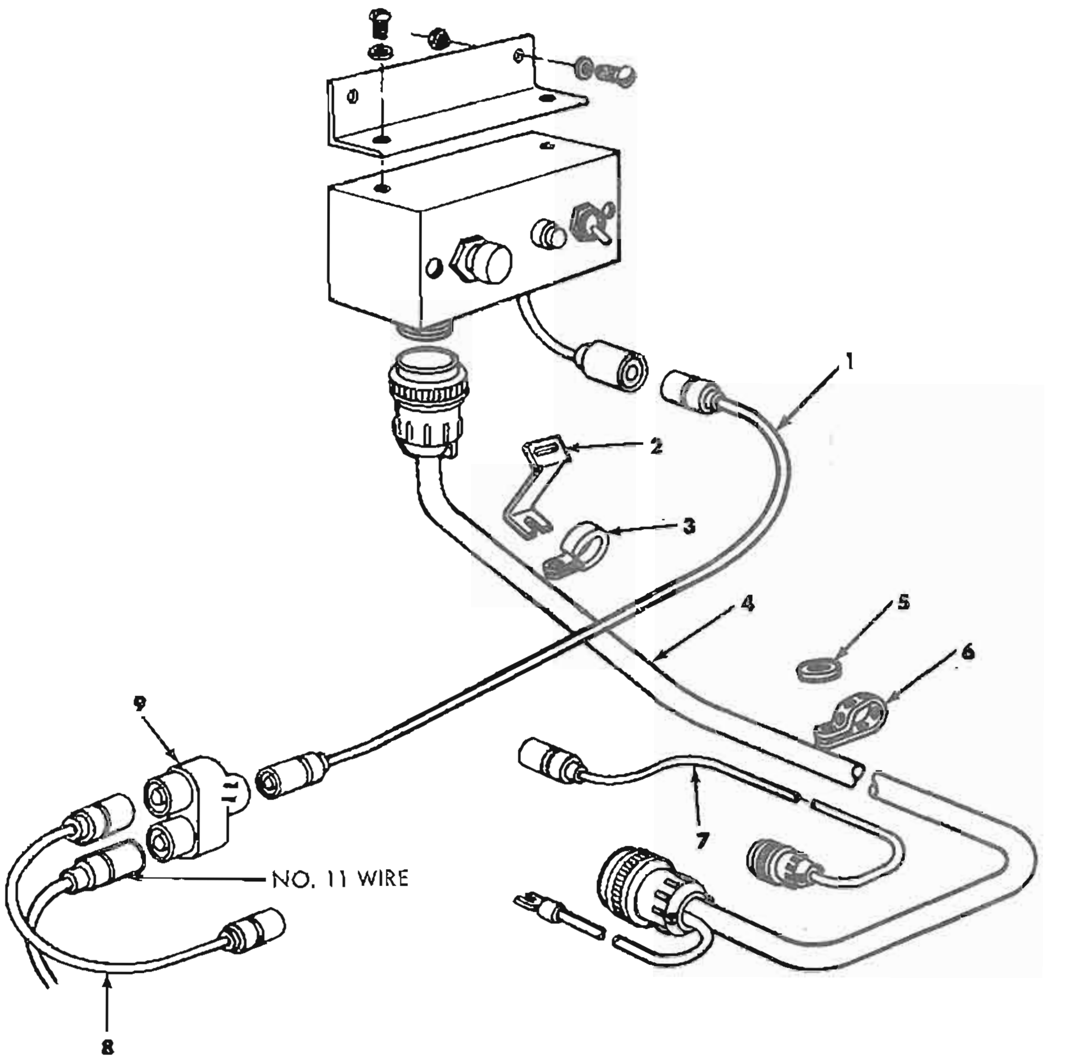
Page 18-16. Delete figure 18-18.

Page 18-25. Paragraph 18-9*k*(4) is deleted.

Page 18-25. Paragraph 18-9*k*(5) is superseded as follows:

(5) Connect long cable assembly (1) to terminal of Y connector (9).

Page 18-27. Figure 18-37 is superseded as follows:



KEY	ITEM	QUANTITY
1	Cable assembly (connector to control box)	1
2	Bracket	1
3	Clamp	2
4	Cable assembly (heater to control box)	1
5	Flat washer	1
6	Strap	2
7	Cable assembly (heater-to-fuel pump)	1
8	Cable assembly (ignition switch to connector)	1
9	Connector	1

Figure 18-37. Electrical Cables.

Page 18-75. Paragraph 18-56. Delete line a.

Page 18-75. Paragraph 18-56. Note is superseded as follows:

NOTE

When assembling panels, select a clean, level area. Care should be taken so that mating edges of panels do not come in contact with floor, and become soiled or damaged. The assistance of a second automotive repairman will be necessary for locating and positioning panels. Hardtop kit components must be installed on vehicle separately to insure proper fit and alinement to vehicle body.

(1) Align windshield post side curtain retainer channel with the body side curtain retainer channel on both sides of the vehicle so that they are in a straight line. Some slotting of the eight windshield hinge, body mounting holes may be necessary.

(2) Align and mount the pillar-door assemblies to the vehicle.

(3) Attach side panels along their bottom to the vehicle body, while adjusting position for proper door seal, and using rear panel for adjusting the rear of the side panel width and panel overhang.

(4) Attach rear panel along its bottom to vehicle body. Install so that the top of the side panels and rear panel are flush and mate evenly.

(5) Bolt the rear panel to the side panels. It may be necessary to align holes by leverage or by filing to overcome minor misalignment problems. (See pictures 3a, b).

(6) Position roof panel on the vehicle and bolt into place. Again, it may be necessary to align holes by leverage or by filing to overcome minor misalignment problems (pic. 4a, b).

Page 18-88. Key number 18 plug cover assembly flyer is deleted. Part is no longer supplied with kit.

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

OFFICIAL:
J.C. PENNINGTON
Brigadier General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-38, Direct and General Support maintenance requirements for ¼ Ton Truck, Utility, M151, 151A1, 151A2; w/106MM Recoilless Rifle, M151A1C, M825, Truck Ambulance, M718, 718A1.

TECHNICAL MANUAL
No. 9-2320-218-34

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *31 January 1972*

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE MANUAL

TRUCK, UTILITY: 1/4 TON, 4X4, M151 (2320-542-4783) M151A1 (2320-763-1092) M151A2 (2320-177-9258) TRUCK, UTILITY: 1/4 TON, 4X4, M151A1C (2320-763-1091), M825 (2320-177-9257), WITH 106MM RECOILLESS RIFLE TRUCK, AMBULANCE, FRONTLINE: 1/4 TON, 4X4, M718 (2310-782-6056), M718A1 (2310-177-9256)

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* This manual supersedes TM 9-2320-218-34, 31 July 1968; including all changes.

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This manual contains instructions for direct support and general support maintenance of ¼ ton, 4 x 4, utility trucks M151, M151A1, M151A2, M151A1C, M825, and M718 and M718A1 truck ambulance vehicles, and all current special purpose kits available for installation on these vehicles. It contains descriptions of, and procedures for, removal, disassembly, inspection, repair, assembly, and installation for the power train, steering gear, suspension, body, chassis components, and special purpose equipment for the ¼ ton, 4 x 4, utility trucks, M151 series vehicle (figs. 1-1 through 1-3). It also contains procedures for initial installation of special purpose kits to the vehicle.

b. Repair parts, special tools, test and support equipment are listed in TM 9-2320-218-34P.

1-2. Maintenance Allocation

The prescribed maintenance responsibilities as allocated in the Maintenance Allocation Chart of TM 9-2320-218-20 are reflected in this manual.

1-3. Forms and Reports

Maintenance forms and reports which are to be used by maintenance personnel of all maintenance levels are listed in and prescribed by TM 38-750.

1-4. Equipment Serviceability Criteria

Equipment serviceability criteria for the vehicles are found in TM 9-2320-218-ESC.

1-5. Reporting of Errors

Reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA form 2028 (Recommended Changes to Publications) and forwarded direct to Commanding General, US Army Tank Automotive Command, ATTN: AMSTA-MAPT, Warren, MI., 48090.

Figure 1-1. Utility truck, 4 x 4, ¼ ton—right front view with top removed.

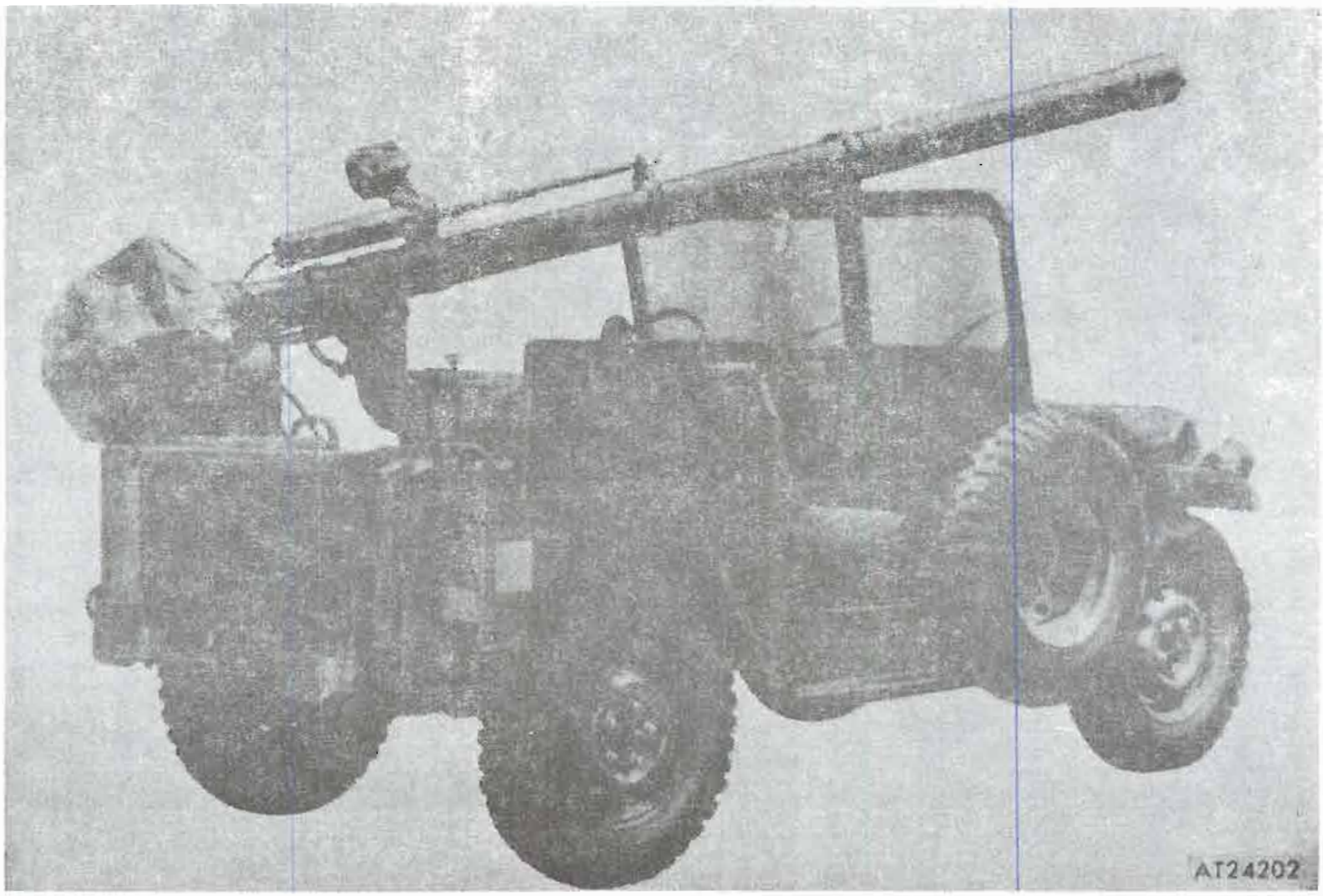


Figure 1-2. Utility truck, 4 x 4, ¼ ton, with 106-MM recoilless rifle; right rear view.

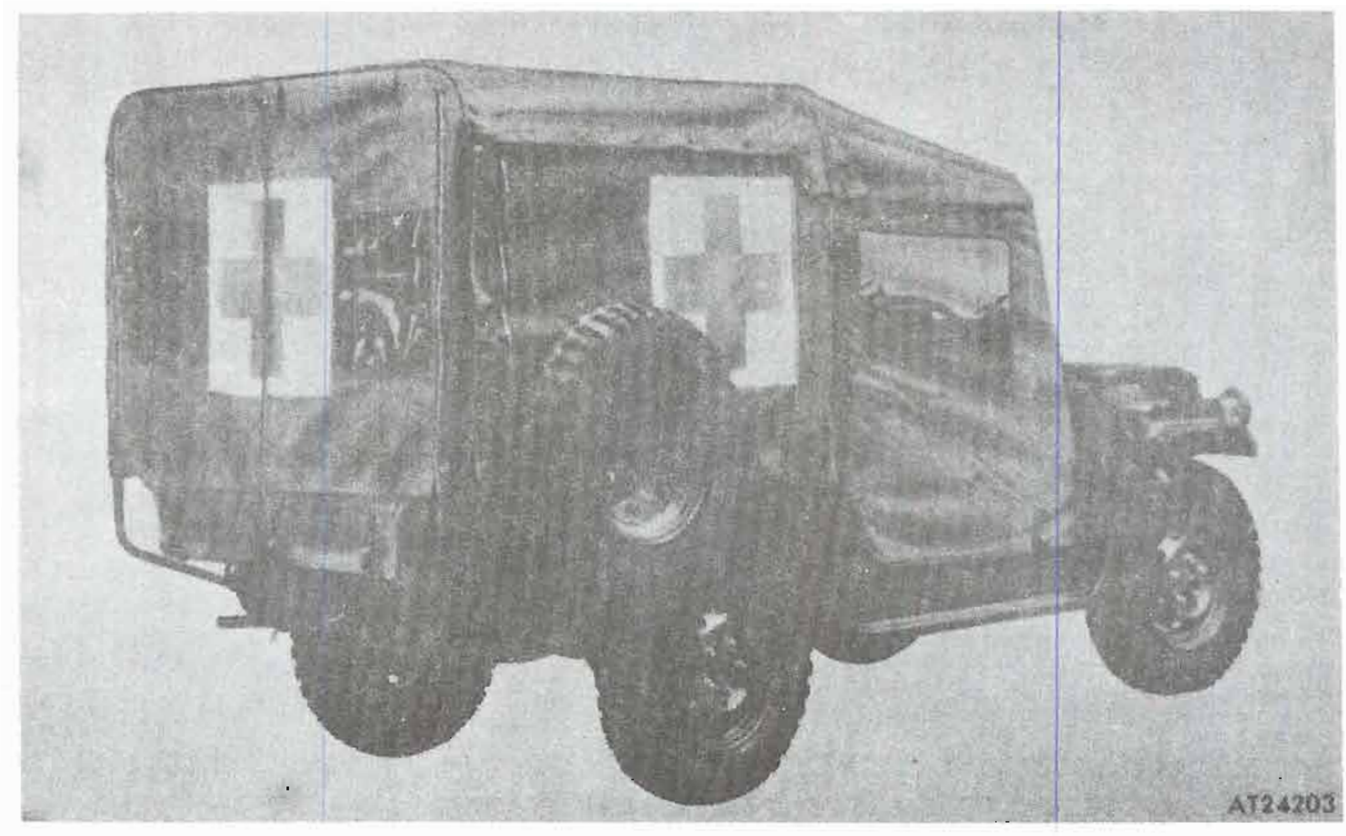


Figure 1-3. Frontline ambulance, 4 x 4 ¼ ton right rear view.

Section II. DESCRIPTION AND DATA

1-6. Description

Description for the assemblies and components covered in this manual are located in the pertinent chapter of this manual. For description of all M151 series vehicles, refer to TM 9-2320-218-20.

1-7. Data

Refer to the appropriate chapter and section in this manual for vehicle assembly, component part repair and special purpose equipment kit tabulated data.

1-8. Differences Between Models

a. The M151A1, ¼ ton, 4 x 4, utility truck (fig 1-1) is a general purpose personnel or cargo carrier similar to the M151. Early model (M151) vehicles do not have directional turn indicators and later models (M151A1) do not have rear side reflectors. The main functional difference between the M151 vehicle and later model M151A1, M151A1C and M718 vehicles is that the rear suspension system is substantially stronger.

b. The M151A1C vehicle (fig 1-2) mounts a 106-mm recoilless rifle, on an M79 rifle mount. Provisions are provided for carrying six rounds of ammuntion and weapon tools to create a mobile weapon system.

c. The M718, 4 x 4 ¼ ton, frontline ambulance truck (fig 1-3) is designed to carry ambulatory and litter cases. The cargo area of the M718 vehicle is 18 inches longer than the M151 and M151A1 vehicles and 5 inches higher to accommodate litters.

d. The M151A2 and M825 utility trucks and the M718A1 ambulance are updated and improved versions of the M151A1 and M151A1C utility trucks and the M718 ambulance.

CHAPTER 2

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

2-1. General

Tools and equipment and maintenance parts over and above those available to the using organization are supplied to maintenance units for maintaining, repairing and / or rebuilding the materiel.

2-2. Common Tools and Equipment

Standard and commonly used tools and equipment having general application to this vehicle are authorized for issue by tables of allowances and table of organization and equipment.

2-3. Special Tools and Equipment

Special tools and equipment tabulated in table 2-1 and illustrated in figures 2-1 through 2-3 are listed in TM 9-2320-218-34P. This tabulation contains only those special tools and equipment necessary to perform the operations described in this manual. It is included for information only and is not to be used as a basis for requisitions.

2-4. Improvised Tools

The improvised tools listed in table 2-2 and the dimensioned detail shown in figures 2-3 through 2-9 apply only to direct support and general support shops. This enables the maintenance organizations to fabricate the tools locally, if desired. These tools are of chief value to maintenance organizations engaged in rebuilding a large number of identical components; however, they are not essential for rebuild and are unavailable for issue.

2-5. Maintenance Repair Parts

Parts allocated to direct and general support maintenance are listed in TM 9-2320-218-34P, the authority for requisitioning replacements. Refer to the Appendix A for component manuals applicable to the ¼-ton, 4x4, utility truck, M151 series vehicles.

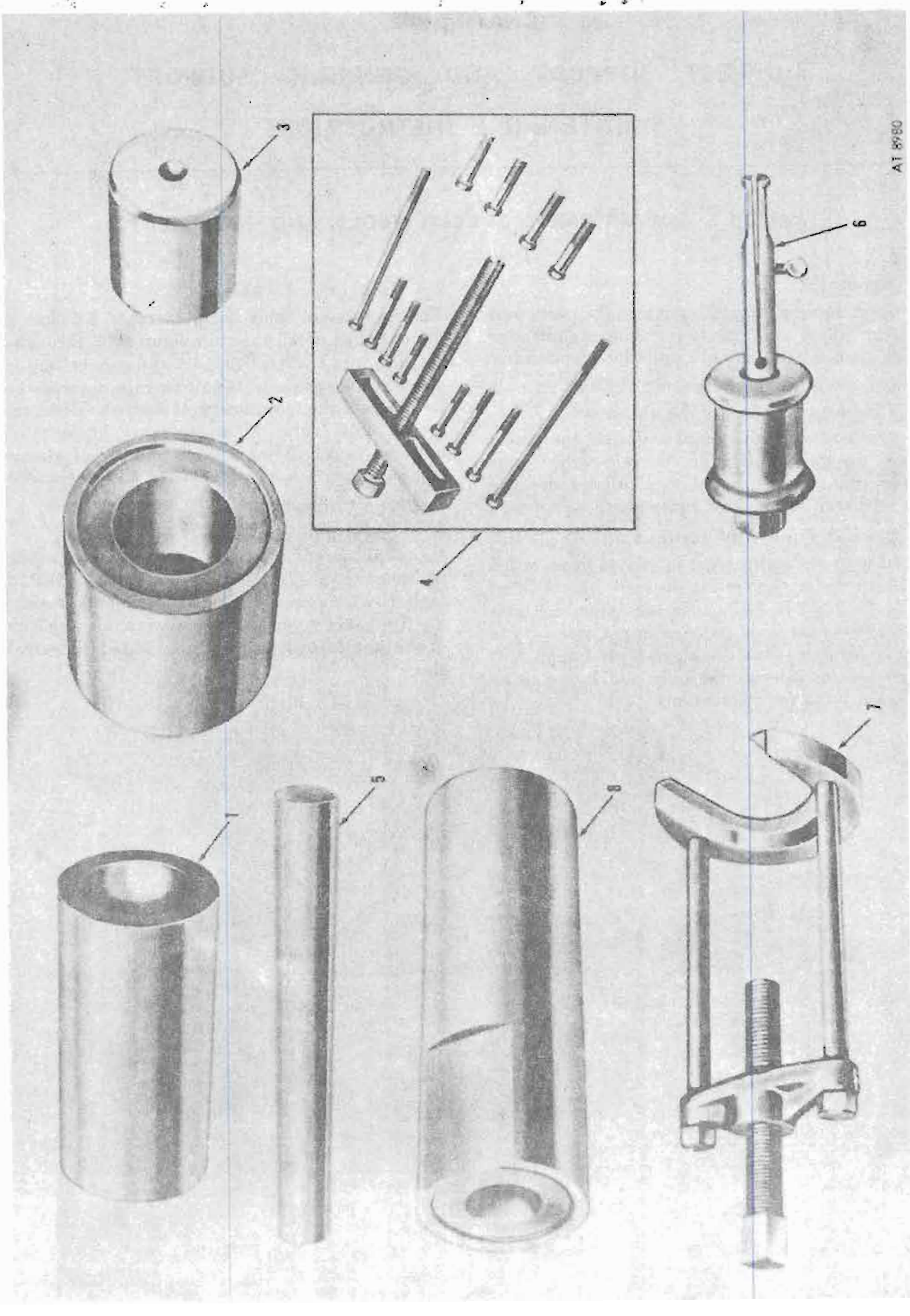


Figure 2-1. Special tools and equipment. (1 of 2).

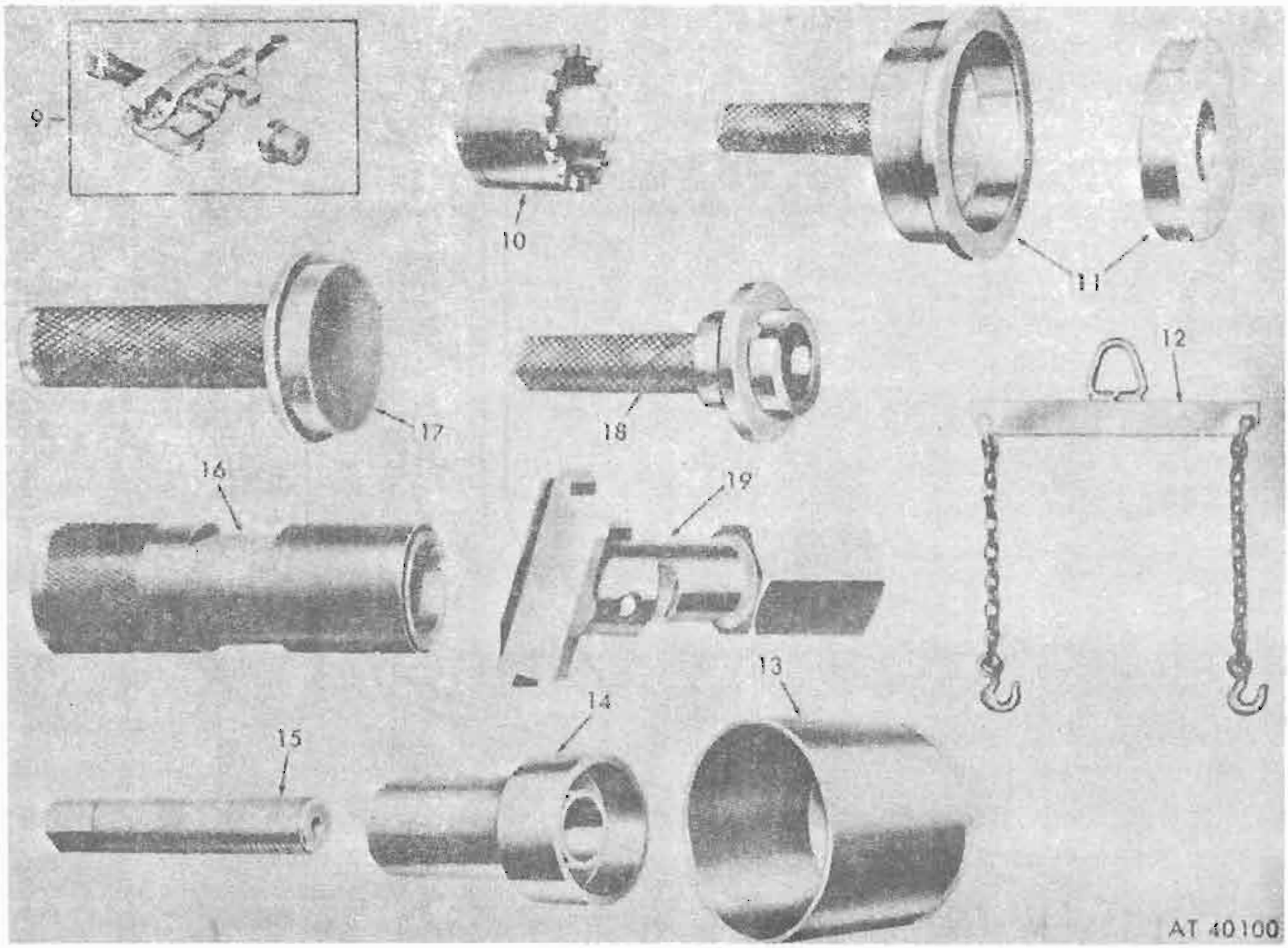


Figure 2-2. Special tools and equipment. (2 of 2).

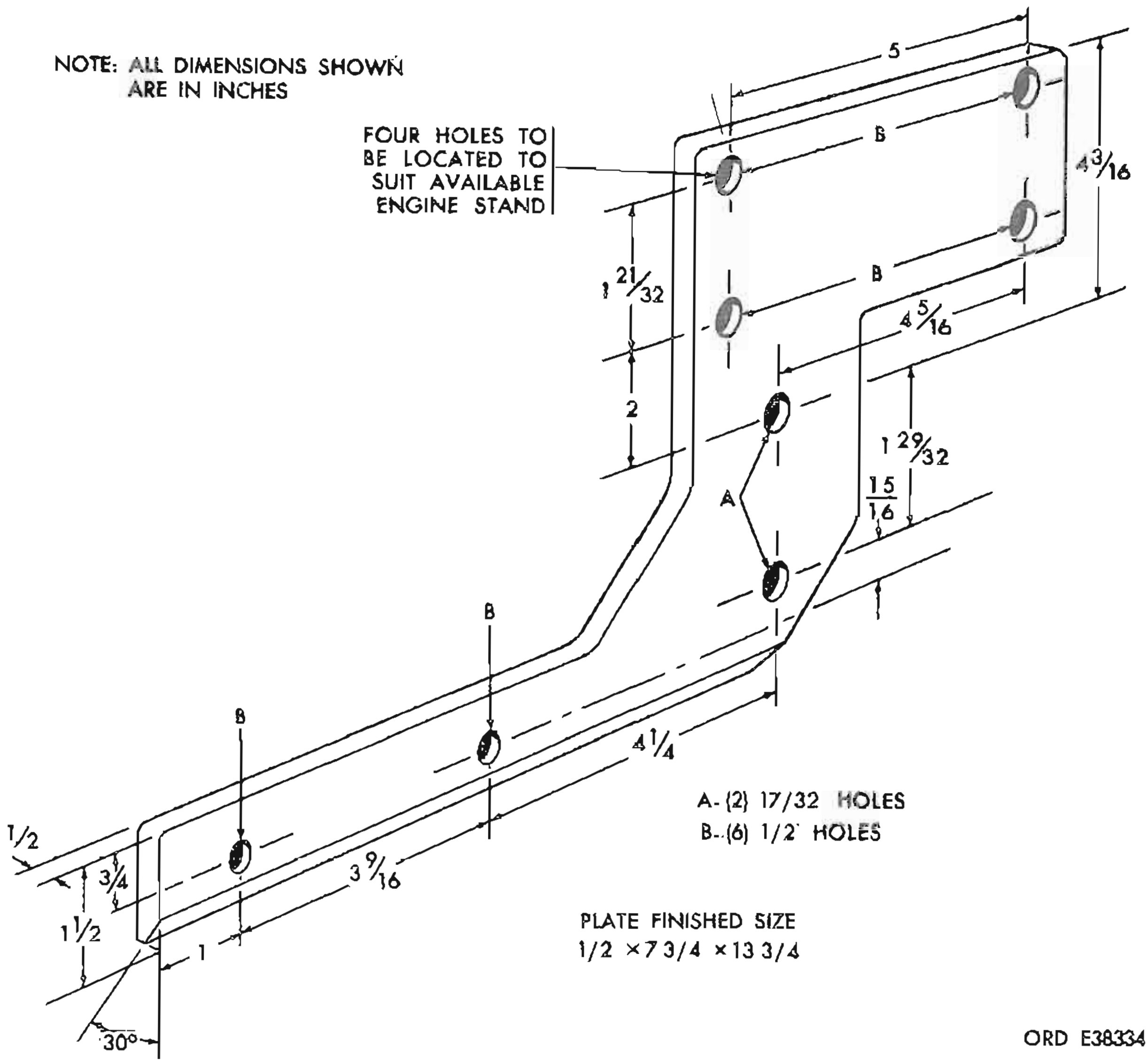


Figure 2-3. Improvised engine support bracket.

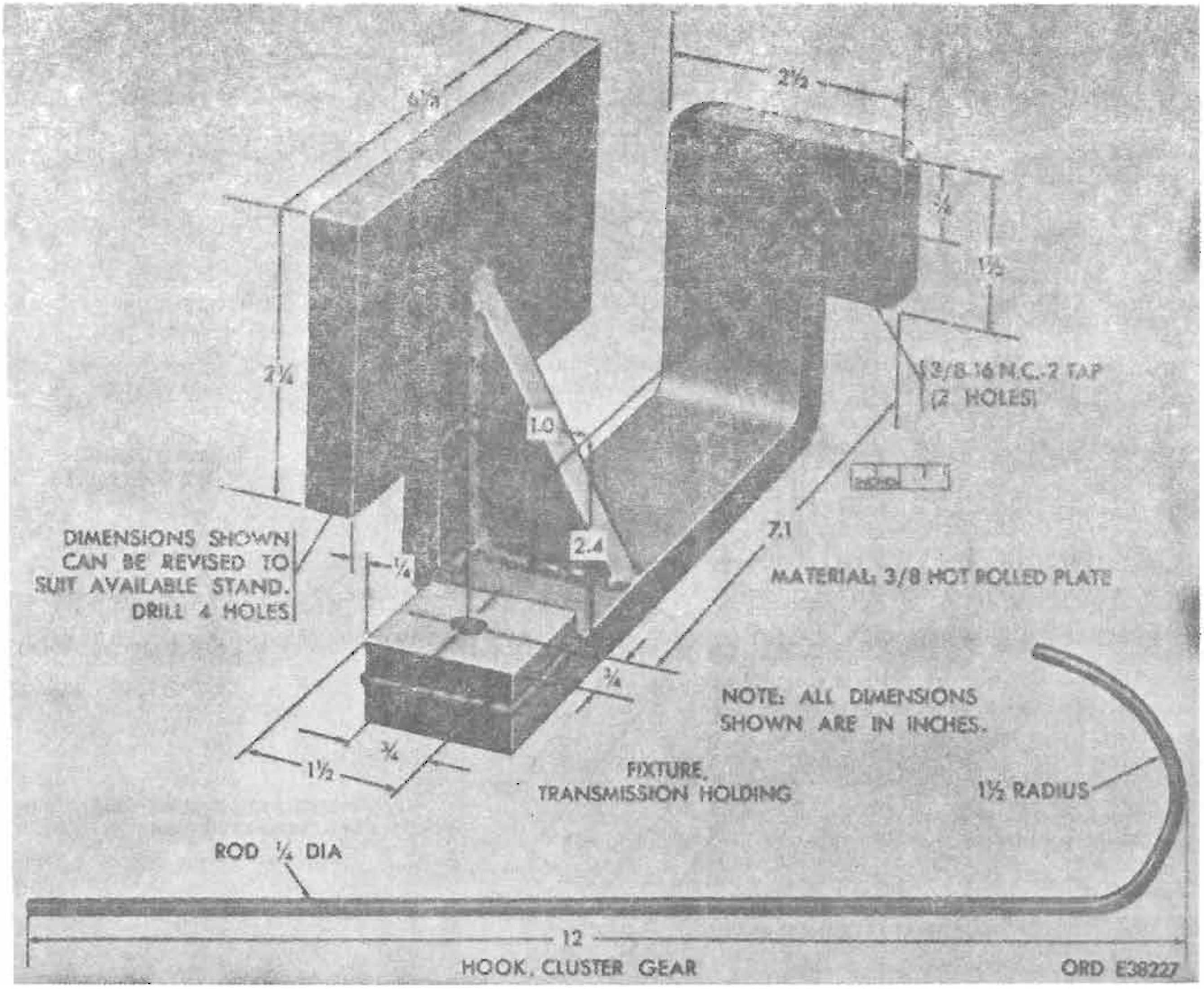


Figure 2-1. Improvised transmission holding fixture and cluster gear hook.

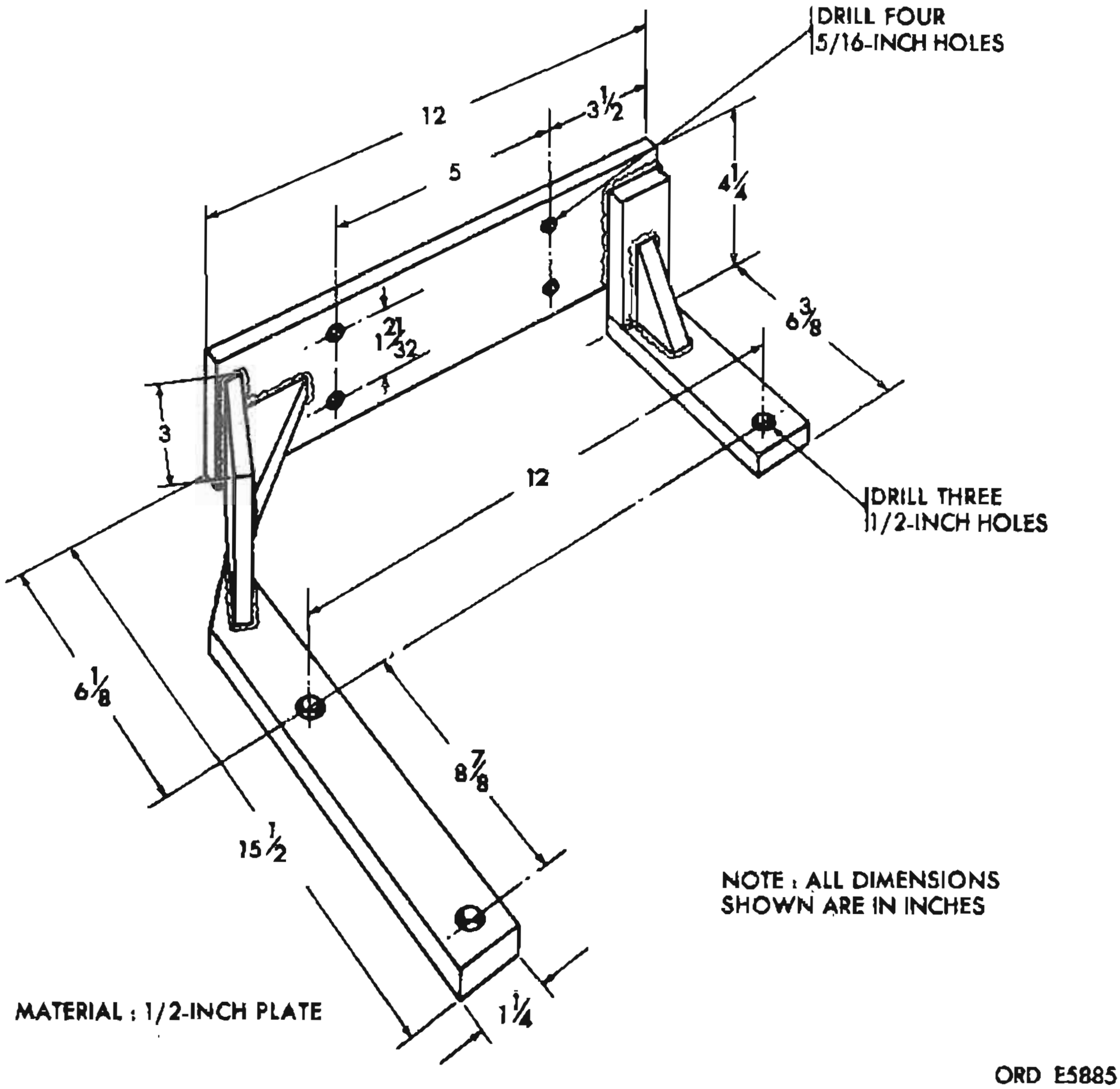


Figure 2-5. Improvised differential holding fixture—diagram view.

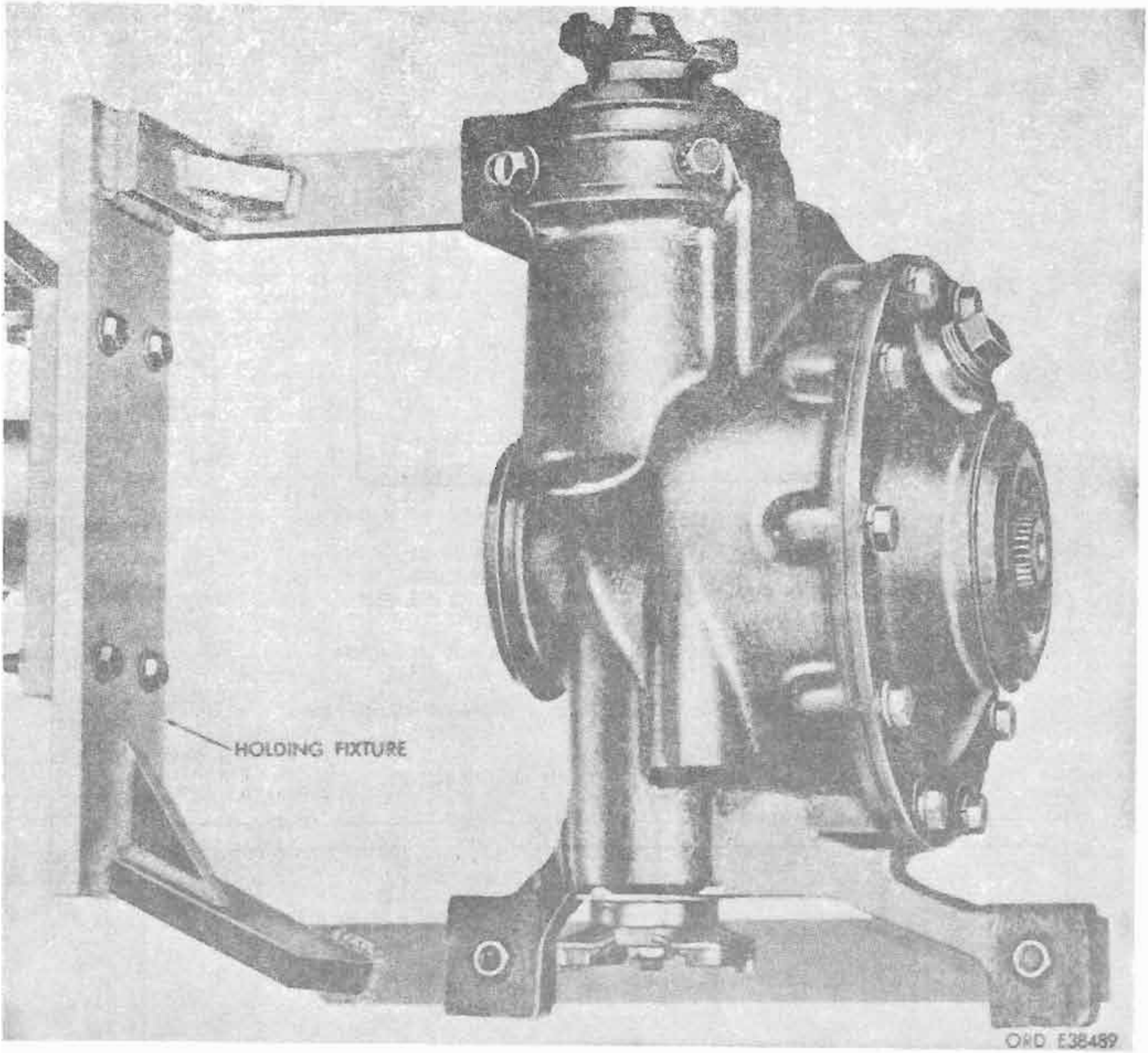


Figure 2-6. Improvised differential holding fixture—assembled view.

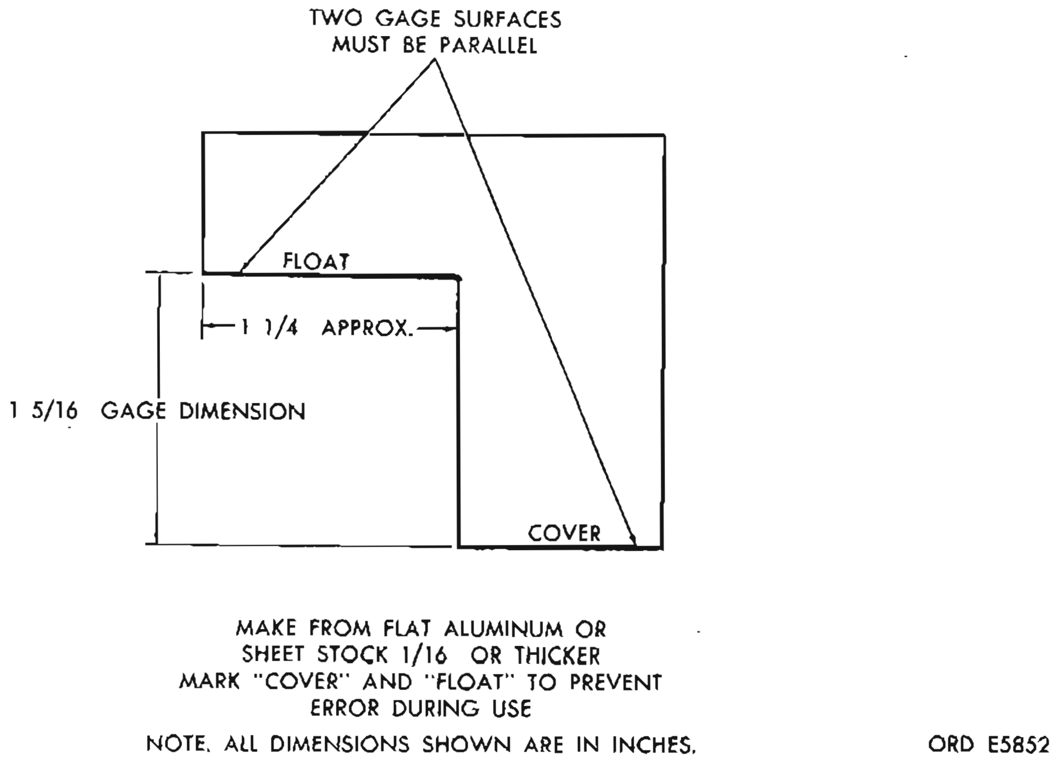


Figure 2-7. Improvised carburetor float-level adjusting gage.

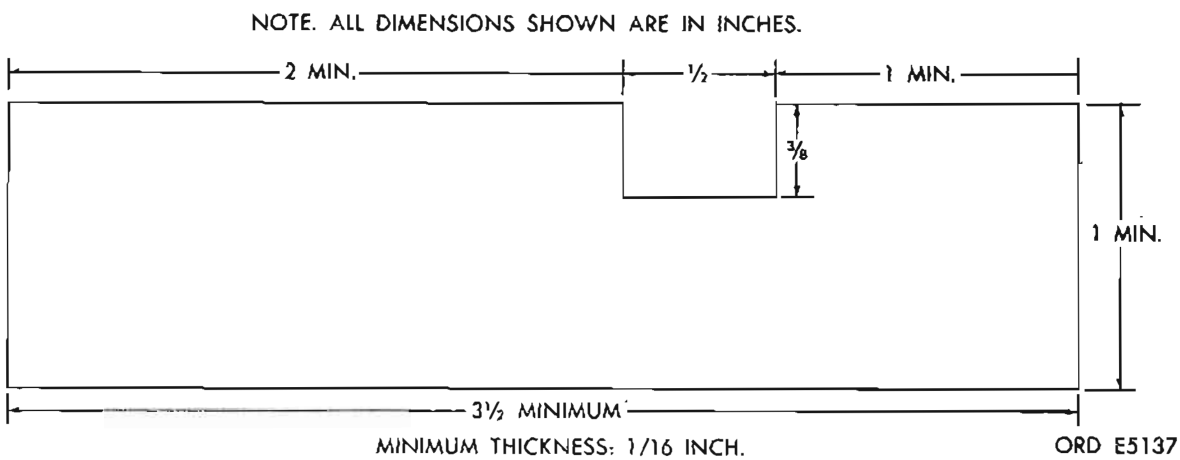
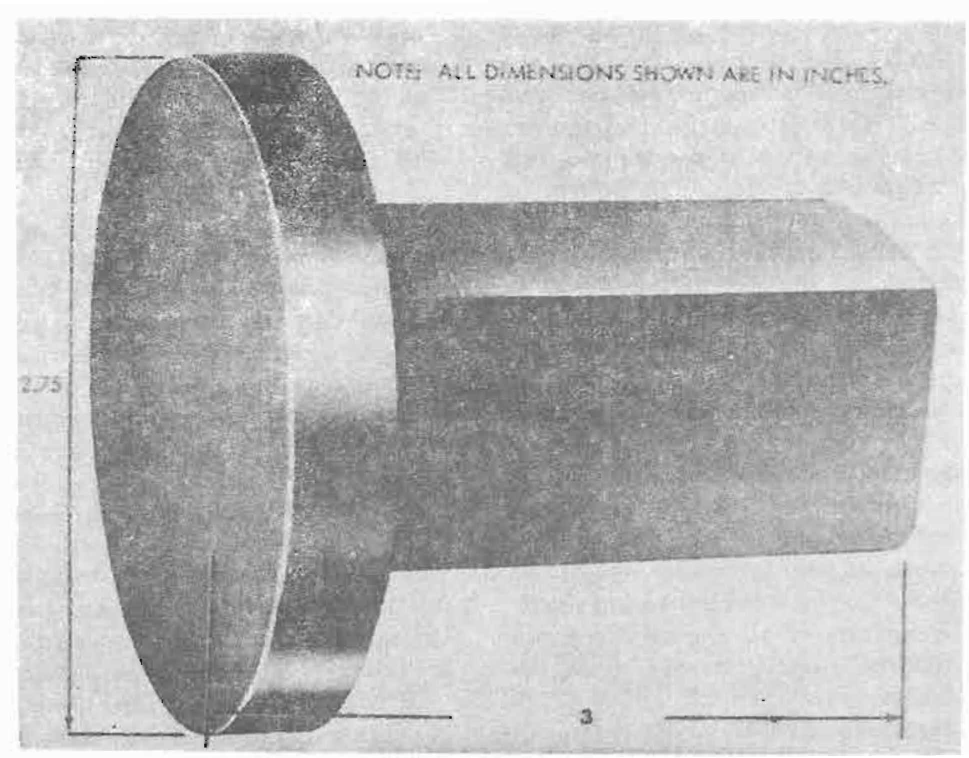


Figure 2-8. Improvised distributor-coupling alining tool.



AT 8985

Figure 2-9. Improvised wheel-bearing inner cup driver.

2-6. Special Purpose Kits

The special purpose equipment kits tabulated in table 2-3 are listed in TM 9-2320-218-34P. This tabulation lists the kits used to modify the vehicle for unusual operating conditions. It is included for information only and is not to be used as a basis for requisitions. Special purpose equipment kits are not furnished with the vehicle. They must be requisitioned separately. Requisitions must be authorized by the using organization commander. Requirements should be anticipated sufficiently in advance to allow delivery and installation to be completed before entering the area where use of a kit becomes imperative. Procedures for installation and field maintenance of these kits are contained in chaper 17.

Section II. TROUBLESHOOTING

2-7. Purpose

a. Information in paragraphs 2-7 through 2-9 is designed for use of support maintenance personnel in conjunction with, and as a supplement to, the troubleshooting section in TM 9-2320-218-20. It provides continuation of instructions where a remedy in the organizational maintenance manual refers to supporting maintenance personnel for corrective action.

b. Operation of a deadlined vehicle without a preliminary examination can cause further damage to a disabled component and possible injury to personnel. By careful inspection and troubleshooting, such damage and injury can be avoided and, in addition, the causes of faulty operation of a vehicle or component can often be determined without extensive disassembly.

2-8. General Instructions and Procedures

Paragraphs 2-7 through 2-9 contains inspection and troubleshooting procedures to be performed while a disabled component is still mounted in the vehicle and also after it has been removed.

a. The inspections made while the component is mounted in the vehicle are for the most part visual, and are to be performed before attempting to operate the vehicle. The object of these inspections is to determine the condition of the component and if found serviceable, to take precautions to prevent any further damage.

b. The troubleshooting performed while the component is mounted in the vehicle is ofter beyond the normal scope of the using organization. Check the troubleshooting section of the TM 9-2320-218-

20 organizational maintenance manual, then proceed as outlined in this section.

c. Inspection after the component is removed from the vehicle is performed to verify the diagnosis made when the component was in the vehicle, and to uncover further malfunctions; or to determine malfunctions if an individual component is received by the direct or general support organization. This inspection is particularly important because it is often the only means of determining the malfunction without complete disassembly.

d. Poor engine performance can be caused by parts being out of adjustment, by gradual wear of moving parts, or by a sudden parts failure. A good trouble diagnosis will indicate the need for a complete engine tune-up, individual adjustments, parts replacement, or major repair. Engine performance complaints usually fall under one of the basic headings listed in the troubleshooting chart.

e. The troubleshooting of all engine accesories while mounted on the engine, is covered in the organizational maintenance manual, TM 9-2320-218-20. For more extensive coverage of accessories refer to pertinent sections of this manual.

f. For coverage of the Delco Remy (25-amp) generator refer to TM 9-2920-214-35; for the Prestolite (25-amp) generator refer to TM 9-2920-247-34; and for the Leece-Neville (60-amp) generator (alternator) refer to TM 9-2920-225-35.

g. The distributor assembly may be bench-tested after removal from the engine. Rotate distributor shaft by hand to check for binding and freedom of rotation prior to bench-test.

CAUTION

Perform this check before bench-testing the distributor. Failure to run this check may damage the unit.

h. After starter has been removed from the vehicle, or has been received already removed, further inspection is necessary before operation on the test stand. The major troubleshooting procedures performed on a starter after removal from a vehicle are made on a test stand. However, the starter should be inspected before tests are performed to eliminate possiblity of further damage. Inspect exterior for damage: Look for cracks, broken parts, and loose parts. Check drive assembly for free operation of pinion on threads and for tightness of assembly on the starter shaft. Rotate the starter shaft by hand to make sure it turns freely, and to insure that bearings are not worn so badly that testing procedures will cause further damage. If starter is not suitable for testing, the damage must be remedied before proceeding with test. If no damage is evident, and if starter shaft turns freely, proceed with troubleshooting procedures. Use suitable test equipment and follow the manufacturer's instructions. Bench-testing the starter consists of a "load" and "no-load" test. In the "no-load" test, the armature is free to spin; in the "load" test the armature is locked.

i. The transmission tunnel cover must be removed to inspect the top portions of the transmission and transfer assembly. Do not remove transmission from the vehicle unless all other recommended procedures fail to disclose cause of malfunction. Most transmission lubricant leaks will be self-evident, showing lubricant around the leaking seal, plug, bolt, or vent. However, leaks around the input shaft retainer gasket, seal, or shaft will show up as lubricant seepage around the clutch housing lower pan, or in "grabbing" action of the clutch due to lubricant on the clutch disk facings.

j. To make a thorough test of the transmission while it is mounted in the vehicle, be sure transmission oil level has been properly checked. Operate the vehicle in all speed ranges and drives, including reverse. Note any abnormal symptoms.

k. Many noises generated by the vehicle running gear are transmitted to the transmission. Therefore, when troubleshooting transmission noise, examine attached parts which may be "telegraphing" sound through the drive lines. To determine if the transmission is actually causing the noise, raise the vehicle so the tires clear the ground. Start and operate the vehicle in all its speed ranges. Listen for characteristic transmission noises. Attempt to determine their origin within the transmission by visualizing the power flow through the various gears and bearings. To further isolate transmission noise, disconnect drive shafts so no other gearing operates while the transmission is tested.

l. As the transfer operates continuously with the transmission, the noise will be consistent in all gearshift positions. The following drive line noises may sound like transmission troubles.

(1) Propeller shafts out of balance or worn universal joints.

(2) Wheels out of balance or tires mismatched.

(3) Springs, differential, or suspension components loose or shifted.

(4) Drive pinion and drive gear teeth damaged or out of adjustment.

(5) Engine parts (crankshaft, flywheel, generator, or fan) out of balance.

2-9. Troubleshooting Table

The troubleshooting procedures are presented in table 2-4. Refer to the item which details the troubleshooting procedure for the faulty assembly or component, and proceed to isolate the cause of the malfunction.

Table 2-1. Special Tools and Equipment

Item	FSN or reference No.	Reference Fig.	Reference Para	Use	Fig.
1. DRIVER, BEARING AND BUSHING.	5120-627-7168 (7345231)	8-16	8-7	Removing and replacing transfer-output shaft bearing.	2-1
2. DRIVER, PLUG, BEARING AND BUSHING.	5120-627-7173 (7345257)	8-20	8-7	Installing transfer-output shaft seal.	2-1
3. PROTECTOR BLOCK, PULLER.	5120-627-7162 (7345227)	8-35	8-10	Removing transmission-output shaft bearing.	2-1
4. PULLER, TIMING GEAR.	5120-707-6223 (7076223)	4-106	4-36	Removing crankshaft gear or camshaft gear.	2-1
5. REMOVER AND REPLACER, SHAFT.	5120-627-7096 (7345226)	8-33	8-10	Removing and replacing transmission cluster shaft.	2-1
6. PULLER, SLIDE HAMMER.	5120-474-9180 (7077742)	4-109	4-37	Removing clutch pilot bearing from flywheel.	2-1
7. PULLER, MECHANICAL.	5120-627-7161 (7345234)	8-61	8-18	Removing transmission-output-shaft rear bearing.	2-1
8. REPLACER, OIL SEAL.	5120-627-7165 (7345225)	8-65	8-17	Installing transfer-shifter rear oil seal.	2-1
9. PULLER, MECHANICAL.	5120-473-7316 (7078129)	12-35	12-10	Removing differential carrier side bearings.	2-2
10. SOCKET, WRENCH.	5120-627-7184 (7345228)	12-67	12-18	Adjusting differential side bearing adjusting nuts.	2-2
11. REPLACER, OIL SEAL.	5120-627-7182 (7345273)	4-234	4-95	Installing crankshaft rear oil seal.	2-2
12. SLING, ENGINE LIFT.	4910-627-7180	4-40	4-7	Lifting engine assembly.	2-2
13. REPLACER, OIL SEAL	5120-795-0152 (7950152)	10-61	10-16	Installing wheel bearing seals and differential seals.	2-2
14. DRIVER, BEARING AND BUSHING.	5120-627-7181 (7345244)	TM 9-2320-218-20		Installing suspension arm bushings.	2-2
15. PIN, ALINEMENT.	5120-627-7154 (7345224)	12-27	12-12	Installing differential ring gear.	2-2
16. ADAPTER, MECHANICAL PULLER.	5120-627-7073 (7345223)	12-20	12-8	Removing differential pinion bearing.	2-2
17. REPLACER, CUP.	5120-627-7179 (7345197)	4-157	4-59	Installing expansion plugs.	2-2
18. REPLACER, SEAL.	5120-627-7180 (7345198)	4-196	4-73	Installing timing cover seal.	2-2
19. ADAPTER, MECHANICAL PULLER.	5120-627-7091 (7345281)	12-23	12-8	Removing pinion-shaft rear bearing and seal.	2-2

Table 2-2. Fabricated Tools

Item	Reference Fig.	Reference Para.	Use	Fig.
1. SUPPORT BRACKET, ENGINE HOLDING.	4-55	4-18	Installing engine on repair stand.	2-3
2. FIXTURE, TRANSMISSION HOLDING.	8-1	8-7	Installing transmission on standard holding stand.	2-4
3. FIXTURE, DIFFERENTIAL HOLDING.	12-1	12-7	Installing differential on standard holding stand.	2-5 & 2-6
4. TOOL, ADJUSTING, CARBURETOR FLOAT LEVEL.	5-25	5-10	Adjusting carburetor float level.	2-7
5. ALINER, DISTRIBUTOR COUPLING.	6-11	6-8	Alining distributor coupling on shaft.	2-8
6. HOOK, CLUSTER GEAR.	8-116	8-30	To support cluster gear during assembly of transmission.	2-4
7. DRIVER, INNER BEARING CUP.	11-34	11-15	Seating wheel bearing inner cup.	2-9

Table 2-3. Special Purpose Kits

Kit name	Part number
Winterization kit (—65°F.)	8712420
Hardtop kit	7535927
Hot water heater kit (—25°F.)	10950750
Deep water fording kit	7536098
100-ampere generator (alternator) kit	10885596
Machinegun mount kit	10885124
M14/M16 rifle mount kit	8712407
Door and side curtain kit	10950781

Table 2-4. Troubleshooting

Malfunction	Probable Cause	Corrective Action
	ENGINE	
1. Engine will not crank.	a. Improper starting procedure being used.	a. Refer to TM 9-2320-218-10 for proper starting procedures.
	b. Failed starter	b. Refer to item 17 for correction of starter system malfunctions.
	c. Hydrostatic lock	c. Remove spark plugs, then attempt to crank engine with starter. If engine cranks, it indicates that coolant or fuel is leaking into cylinders. Determine if hydrostatic lock was due to coolant or fuel. If coolant, remove cylinder head, inspect cylinder head gasket & cylinder head and block for cracks. If fuel, refer to item 28 for correction of fuel system malfunctions. If engine cannot be turned over freely, disassemble engine to repair damage of internal parts.
	d. Seized piston	d. If a piston is seized, disassemble engine and repair damage.
	e. Seized bearings	e. If a crankshaft main bearing or connecting rod bearing is seized, disassemble engine and repair.
2. Engine cranks normally, but will not start.	a. Malfunction of fuel system	a. Refer to item 28 for correction of fuel system malfunctions.
	b. Malfunction of ignition system.	b. Refer to items 20 through 27 for correction of ignition system malfunctions.
	c. Defective oil pressure switch or faulty connection.	c. Replace defective oil pressure switch, or refer to TM 9-2320-218-20 for troubleshooting vehicle electrical system.
	d. Low compression	d. Make compression test (para 2-11 if pressure is below 85 psig, or the pressure differential between the lowest reading cylinder and the highest is not within 25 psig, take appropriate action as indicated below. (1) Worn piston rings: disassemble engine and repair as necessary. (2) Leaking valves: Remove cylinder head, reface valves, and grind seats.
	e. Insufficient air reaching cylinders.	e. Refer to items 34 and 35 for correction of air intake system malfunctions.

Table 2-4. Troubleshooting—Continued

Malfunction	Probable Cause	Corrective Action
	ENGINE—Continued	
3. Engine starts but fails to keep running.	a. Defective oil pressure switch or faulty connection.	a. Replace defective oil pressure switch and refer to TM 9-2320-218-20 for trouble-shooting vehicle electrical system.
	b. Malfunction of fuel system	b. Refer to items 28 through 31 for correction of fuel system malfunctions.
	c. Malfunction of ignition system.	c. Refer to items 20 through 27 for correction of ignition system malfunctions.
4. Engine runs but misses.	a. Malfunction of ignition system.	a. Refer to items 20 through 27 for correction of ignition system malfunctions.
	b. Malfunction of fuel system	b. Refer to item 28 for correction of fuel system malfunctions.
	c. Improper valve clearance	c. Adjust valve clearance. Refer to paragraph 2-12.
	d. Low compression-leaking valves or worn piston rings.	d. Make compression test (para 2-11) if pressure is below 85 psig, or the pressure differential between the lowest reading and the highest is not within 25 psig, take appropriate action as indicated below. (1) Worn piston rings: Disassemble engine and repair as necessary. (2) Leaking valves: Remove cylinder head, reface valves, and grind seats.
	e. Excessive exhaust back pressure.	e. Repair or replace vehicle exhaust system or exhaust manifold as necessary. Refer to TM 9-2320-218-20 for instructions on vehicle exhaust system.
	f. Engine fails to reach proper operating temperature.	f. Refer to items 41 thru 43 for correction of cooling system malfunctions.
	g. Blown head gasket	g. Remove cylinder head and replace head gasket.
	h. Engine overheating	h. Refer to items 41 through 43 for correction of cooling system malfunctions.
	i. Leak in intake manifold	i. Refer to items 34 and 35 for correction of air intake system malfunctions.
5. Rough engine idle.	a. Malfunction of ignition system.	a. Refer to items 28 through 31 for correction of fuel system malfunctions.
	b. Malfunction of ignition system.	b. Refer to items 20 through 27 for correction of ignition system malfunctions.
	c. Improper valve clearance	c. Adjust valve clearance. Refer to paragraph 2-12.
	d. Leak in intake manifold	d. Refer to items 34 and 35 for correction of air intake system
	e. Worn piston rings or sticking or poorly seated valves.	e. Make compression test (para 2-11); if pressure is below 85 psig, or the pressure differential between the lowest reading cylinder and the highest is not within 25 psig, take appropriate action as indicated below.

Table 2-4. Troubleshooting—Continued

Malfunction	Probable Cause	Corrective Action
5. Rough engine idle—Continued	ENGINE—Continued	(1) Worn piston rings: Disassemble engine and repair as necessary. (2) Leaking valves: Remove cylinder head, reface valves & grind seats.
	f. Loose engine mounts	f. Tighten or replace engine mounts. Refer to TM 9-2320-218-20 for procedures.
	g. Improper cylinder head bolt torque.	g. Torque cylinder head bolts and adjust valves.
6. Poor acceleration.	a. Malfunction of fuel system.......	a. Refer to item 28 for correction of fuel system malfunctions.
	b. Malfunction of ignition system.	b. Refer to items 20 through 27 for correction of ignition system malfunctions.
	c. Improper valve clearance......	c. Adjust valve clearance, (para 2-12).
	d. Clutch slippage	d. Adjust or replace clutch. Refer to TM 9-2320-218-20 for procedures.
	e. Brakes dragging	e. Adjust or replace brake shoes. Refer to TM 9-2320-218-20 for proper procedures.
	f. Cold engine	f. Refer to items 41 through 43 for correction of cooling system malfunctions.
7. Engine does not develop full power or has poor high speed performance.	a. Malfunction of fuel system ..	a. Refer to item 28 for correction of fuel system malfunctions.
	b. Malfunction of ignition system.	b. Refer to items 20 through 27 for correction of ignition system malfunctions.
	c. Engine cold	c. Refer to items 41 through 43 for correction of cooling system malfunctions.
	d. Throttle not fully open......	d. Refer to items 34 and 35 for correction of air intake system malfunctions.
	e. Restriction in air intake system.	e. Refer to items 34 and 35 for correction of air intake system.
	f. Engine overheating	f. Refer to items 41 through 43 for correction of cooling system malfunctions.
	g. Low compression	g. Make compression test (para 2-11); if pressure is below 85 psig, or the pressure differential between the lowest reading cylinder and the highest is not within 25 psig, take appropriate action as indicated below. (1) Worn piston rings: Disassemble engine and repair as necessary. (2) Leaking valves: Remove cylinder head. Reface valves & grind seats.
	h. Improper valve clearance...... ..	h. Adjust valve clearance; refer to paragraph 2-12.
	i. Improper valve clearance........	i. Check camshaft lobe lift (para 2-13) and replace worn camshaft and/or valve tappets.

Table 2-4. Troubleshooting—Continued

Malfunction	Probable Cause	Corrective Action
	ENGINE—Continued	
7. Engine does not develop full power or has poor high speed performance—Continued	j. Restricted exhaust system.	j. Repair or replace vehicle exhaust system or exhaust manifold as necessary. Refer to TM 9-2320-218-20 for instructions on vehicle exhaust system.
	k. Brakes dragging	k. Adjust or replace brake shoes. Refer to TM 9-2320-218-20.
	l. Tire pressure low	l. Check air pressure on all tires. Refer to TM 9-2320-218-10.
	m. Malfunction of valve train	m. Refer to item 11 below.
8. Engine emits black smoke (gasoline).	a. Rich fuel mixture	a. Refer to item 28 for correction of fuel system malfunctions.
	b. Carburetor diaphragm ruptured.	b. Refer to item 31
	c. Restricted air cleaner	c. Refer to item 34 for correction of air intake system malfunctions.
9. Engine emits blue gray smoke (oil).	a. High oil level in air cleaner	a. Service air cleaner. Refer to TM 9-2320-218-20.
	b. High oil consumption	b. Refer to items 36 through 40 for correction of lubrication system malfunctions.
	c. Worn piston rings or broken piston.	c. Disassemble engine and replace worn piston rings or broken piston.
10. Knocking noise	a. Worn main or connecting rod bearings.	a. Disassemble engine and repair.
	b. Excessive crankshaft end play.	b. Check crankshaft end play (para 4-95). If end play is beyond limits specified, disassemble engine and replace bearings as necessary.
	c. Worn or broken piston	c. Disassemble engine and repair.
11. Tapping noise	a. Improper valve clearance	a. Adjust valve clearance. (para 2-12).
	b. Sticking valves	b. Remove cylinder head and replace defective parts.
	c. Defective or sticking valve rocker arms.	c. Remove valve rocker, replace if necessary.
	d. Weak or broken valve spring.	d. Remove cylinder head and replace defective parts.
	e. Broken valve rocker arm adjusting screw.	e. Replace broken valve rocker arm adjusting screw.
	f. Cracked or burned valves	f. Remove cylinder head and replace defective parts.
	g. Broken valve tappet	g. Disassemble engine to repair.
12. Grinding noise	a. Failed bearing or gear	a. Rotate crankshaft. If engine is tight and grinding noise persists, disassemble engine and repair damage.
13. Squealing noise	a. Fan drive belts loose or worn ..	a. Tighten or replace fan drive belts as necessary.
	b. Clutch slipping	b. Adjust or replace clutch.
14. Pinging noise (detonation or preignition).	a. Distributor not properly timed.	a. Refer to items 20 through 27 for correction of ignition system malfunctions.
	b. Improper distributor advance.	b. Refer to items 20 through 27 for correction of ignition system malfunctions.
	c. Improper grade fuel	c. Use proper-grade fuel (MIL-G-3056; 91 res. min. octane).
	d. Improper spark plug heat range.	d. Install proper heat range plug. Refer to TM 9-8638.

Table 2-4. Troubleshooting—Continued

Malfunction	Probable Cause	Corrective Action
	ENGINE—Continued	
14. Pinging noise (detonation or preignition)—Continued	e. Excessive combustion chamber deposits.	e. Make compression test (para 1-11); if pressure is above 160 psig, remove cylinder head, and remove deposits from piston and combustion chamber.
	f. Oil in air intake system caused by faulty crankcase ventilator valve, failed vacuum pump or fuel pump diaphragm or seal.	f. Replace crankcase ventilator valve or repair or replace pump as necessary.
15. Engine overheats	a. Faulty sending unit or gage	a. Replace sending unit or gage. Refer to TM 9-2320-218-20.
	b. Improper tightening of cylinder head bolts.	b. Torque cylinder head bolts and lash valves.
	c. Malfunctioning of cooling system.	c. Refer to items 41 through 43 to correct cooling system malfunctions.
	d. Ignition timing incorrect........	d. Refer to items 20 through 27 to correct ignition system malfunction.
	e. Cracked or burned valves	e. Remove cylinder head, disassemble and replace defective parts.
	f. Restricted exhaust system.	f. Repair or replace vehicle exhaust system or exhaust manifold as necessary. Refer to TM 9-2320-218-20.
16. Engine fails to reach normal operating temperature.	a. Faulty sending unit or gage ..	a. Replace sending unit or gage. Refer to TM 9-2320-218-20.
	b. Faulty engine thermostat or incorrect heat range.	b. Refer to items 41 through 43 to correct cooling system malfunctions.
	STARTING SYSTEM	
17. Starter will not crank engine	a. Improper starting procedure used.	a. Refer to TM 9-2320-218-10 for proper starting procedures.
	b. Low battery voltage	b. Test and charge battery.
	c. No electrical current to starter motor.	c. Refer to TM 9-2320-218-20 for troubleshooting procedures for vehicle electrical system.
	d. Locked starter drive	d. Remove starter and replace locked starter drive.
	e. Failed starter	e. Replace starter. Refer to TM 9-2320-218-20.
18. Starter runs but will not crank.	a. Worn, dirty, or failed starter drive.	a. Remove starter and replace starter drive.
19. Starter cranks engine slowly.	a. Low battery voltage. Improper grade engine oil.	a. Test and charge battery. Drain crankcase and refill with proper grade oil. Refer to LO 9-2320-218-12.
	b. Defective starter	b. Repair defective starter.
	c. Tight engine	c. If engine cannot be turned freely, the engine bearings or other internal working parts are tight and engine must be disassembled to investigate and repair the damage.
	IGNITION SYSTEM	
20. Engine cranks normally but will not start.	a. Improper starting procedure used.	a. Refer to TM 9-2320-218-10 for proper starting procedures.
	b. No electrical current to distributor coil.	b. Refer to TM 9-2320-218-20 for troubleshooting the vehicle electrical system.
	c. Improperly adjusted or defective breaker points.	c. Adjust or replace breaker points (para 6-8).

Malfunction	Probable Cause	Corrective Action
	IGNITION SYSTEM—Continued	
20. Engine cranks normally but will not start—Continued	d. Fouled or improperly adjusted spark plugs.	d. Clean or replace spark plug or adjust spark gap. Refer to TM 9-2320-218-20 for procedure.
	e. Failed coil	e. Replace failed coil. Refer to para. 6-8.
21. Engine starts but fails to keep running.	a. Improperly adjusted or defective breaker points.	a. Adjust or replace breaker points (para 6-8).
	b. Fouled spark plug..............	b. Clean or replace spark plug or adjust spark gap. Refer to TM 9-2320-218-20.
22. Engine runs but misfires steadily at all speeds.	a. Defective or crossed spark plug cables.	a. Replace defective spark plug cable. Refer to TM 9-2320-218-20.
	b. Fouled spark plug	b. Replace spark plug. Refer to TM9-2320-218-20.
	c. Defective distributor cap	c. Replace defective distributor cap.
23. Engine runs but misfires intermittently at all speeds.	a. Fouled spark plug. Improperly adjusted or defective breaker points.	a. Replace spark plug. Refer to TM 9-2320-218-20. Adjust or replace breaker points (6-8).
	b. Defective coil, capacitor, rotor, or cap.	b. Replace defective coil condenser, rotor, or cap. Refer to paragraph 6-2.
24. Engine runs but misfires (at idle only).	a. Improperly adjusted or defective breaker points.	a. Adjust (para. 6-10) or replace breaker points (6-2).
	b. Defective coil, condenser, rotor, or cap.	b. Replace defective coil, condenser, rotor, or cap. Refer to paragraph 6-2.
	c. Defective spark plug cable	c. Replace defective spark plug cable. Refer to TM 9-2320-218-20.
	d. Excessive play in distributor or worn distributor cam.	d. Replace defective distributor. Refer to TM 9-2320-218-20 for timing instructions.
25. Poor acceleration or excessive fuel consumption.	a. Distributor not properly timed.	a. Refer to TM 9-2320-218-20 for proper timing procedures.
	b. Fouled or improperly adjusted spark plug.	b. Clean or replace spark plug or adjust spark gap. Refer to TM 9-2320-218-20.
	c. Improper distributor internal advance.	c. Remove distributor and adjust spark advance. Refer to paragraph 6-15.
	d. Improperly adjusted or defective breaker points.	d. Adjust (para 6-10) or replace breaker points (para 6-2).
26. Engine does not develop full power or has poor high speed performance.	a. Distributor not properly timed.	a. Refer to TM 9-2320-218-20 for proper distributor timing procedures.
	b. Fouled or improperly adjusted spark plug.	b. Clean or replace spark plug or adjust spark gap. Refer to TM 9-2320-218-20.
	c. Improper distributor internal advance.	c. Remove distributor and adjust spark advance.
	d. Improperly adjusted or defective breaker points.	d. Adjust (para 6-10) or replace breaker points (para 6-2).
	e. Excessive play in distributor or worn distributor cam.	e. Replace distributor. Refer to TM 9-2320-218-20.
	f. Defective coil, condenser, rotor, or cap.	f. Replace coil, condenser, rotor, or cap. Refer to paragraph 6-2.
27. Engine overheating.	a. Distributor not properly timed.	a. Refer to paragraph 6-15 for proper distributor timing procedures.
	b. Improper distributor advance....	b. Remove distributor and adjust spark advance, paragraph 6-8.
	FUEL SYSTEM	
28. Engine cranks normally but will not start.	a. Incorrect starting procedure....	a. Refer to TM 9-2320-218-20 for proper starting procedure.
	b. Incorrect choke linkage adjustment.	b. Check adjustment of choke linkage and adjust if necessary. Refer TM 9-2320-218-20.

Table 2-4. Troubleshooting—Continued

Malfunction	Probable Cause	Corrective Action
	FUEL SYSTEM—Continued	
28. Engine cranks normally but will not start—Continued	c. No fuel to carburetor	c. Troubleshoot vehicle fuel system. Refer to TM 9-2320-218-20.
	d. Fuel filter or supply lines clogged with dirt, water, or ice.	d. Clean or replace as necessary.
	e. Defective fuel pump or faulty connection.	e. Repair or replace as necessary.
	f. Over choked (flooded)	f. Observe procedure for starting flooded engine.
	g. Dirt in carburetor idle system.	g. Disassemble carburetor, and clean, and repair.
	h. Carburetor fuel setting too high.	h. Check fuel pump pressure (TM 9-2320-218-20). Adjust float tab to proper level. Refer to paragraph 5-7 for Holley and paragraph 5-10 for Zenith.
	i. Carburetor flooding	i. Check fuel pump pressure. Service fuel inlet system, inlet needle and seat, and float assembly. Refer to paragraph 5-7 for Holley and paragraph 5-10 for Zenith.
	j. Carburetor vapor-locked	j. Cool off engine and locate cause for overheating. Refer to items 41 through 43 for correction of cooling system malfunctions.
29. Engine starts but fails to keep running, runs rough or misfires at idle.	a. Incorrect starting procedure.	a. Refer to TM 9-2320-218-10.
	b. Incorrect choke	b. Check adjustment of choke linkage and adjust if necessary. Refer to TM 9-2320-218-20.
	c. Incorrect idle fuel mixture	c. Adjust idle fuel mixture. Refer to TM 9-2320-218-20.
	d. Idle speed set too low	d. Adjust carburetor idle speed stop screw to increase engine speed. Refer TM 9-2320-218-20 for procedures.
	e. Carburetor fuel setting too high.	e. Check fuel pump pressure (TM 9-2320-218-20). Adjust float tab to secure proper level. Refer to paragraph 5-7 for Holley & paragraph 5-10 for Zenith.
	f. Carburetor flooding	f. Check fuel pump pressure (TM 9-2320-218-20). Service fuel inlet system, inlet needle and seat, and float assembly. Refer to paragraph 5-7 for Holley and paragraph 5-10 for Zenith.
	g. Dirt or water in fuel lines or carburetor.	g. Remove the drain plug from carburetor float chamber; clean carburetor and fuel lines, and drain dirt and water from fuel tanks. Refer to TM 9-2320-218-20.
	h. Clogged fuel filter	h. Clean or replace as necessary.
	i. Defective fuel supply system.	i. Troubleshoot vehicle fuel system. Refer to TM 9-2320-218-20.
	j. Defective fuel pump	j. Repair or replace as necessary. Refer to TM 9-2320-218-20 for instructions.
	k. Carburetor icing	k. Check thermostat and replace if necessary.
	l. Carburetor vapor-locked	l. Cool off engine and locate cause for overheating. Refer to items 41 through 43 for correction of cooling system malfunctions.
	m. Air leaks in air intake system.	m. Refer to items 34 and 35 for correction of air intake system malfunctions.

Table 2-4. Troubleshooting—Continued

Malfunction	Probable Cause	Corrective Action
	FUEL SYSTEM—Continued	
30. Engine runs hot, or runs rough & misfires, or has poor high speed performance (lean mixture).	a. Defective fuel supply system (low fuel pressure).	a. Troubleshoot vehicle fuel system. Refer to item 28 for procedures.
	b. Defective fuel pump (low fuel pressure).	b. Repair or replace as necessary. Refer to TM 9-2320-218-20.
	c. Clogged fuel filter	c. Clean or replace as necessary.
	d. Dirt or water in fuel lines or carburetor.	d. Remove the drain plug from carburetor float chamber; clean carburetor and fuel lines, and drain dirt and water from fuel tanks. Refer to TM 9-2320-218-20.
	e. Inoperative or defective accelerating pump.	e. Repair or replace as necessary.
	f. Restricted air cleaner	f. Refer to items 34 and 35.
	g. Carburetor float setting too low.	g. Check fuel pump pressure (TM 9-2320-218-20). Adjust float tab to proper level. Refer to paragraph 5-7 for Holley and paragraph 5-10 for Zenith.
	h. Power valve clogged; clogged or undersize main jet.	h. Repair or replace as necessary.
31. Engine emits smoke and runs rough (rich mixture).	a. Incorrect idle fuel mixture	a. Adjust idle fuel mixture needle. Refer to TM 9-2320-218-20.
	b. Defective fuel pump (high fuel pressure).	b. Repair or replace as necessary.
	c. Improper use of choke or sticking choke.	c. Correct sticking choke and refer to TM 9-2320-218-20.
	d. Float setting too high	d. Check fuel pump pressure (TM 9-2320-218-20). Adjust float tab to proper level. Refer to paragraph 5-7 for Holley and paragraph 5-10 for Zenith.
	e. Defective carburetor main jet worn or leaking, worn power valve piston or power valve air bleed obstructed, or fuel siphoning from acceleration pump discharge nozzle.	e. Replace or repair carburetor.
	f. Acceleration pump diaphragm ruptured.	f. Replace or repair carburetor.
	GENERATOR SYSTEM	
32. Generator turns will not charge.	a. Defective generator regulator	a. Refer to TM 9-2320-218-20 for troubleshooting generator regulator.
	b. Cables not properly connected.	b. Refer to TM 9-2320-218-20 for procedures.
	c. Failed generator	c. Replace generator. Refer to TM 9-2320-218-20.
33. Generator does not turn.	a. Failed generator	a. Refer to TM 9-2320-218-20.
	b. Drive belts worn or loose	b. Replace worn belts or tighten loose belts. (para 4-121).
	AIR INTAKE SYSTEM	
34. Engine does not develop full power or has poor high speed performance (restricted intake air).	a. Restricted air cleaner. Collapsed air induction hose.	a. Service air cleaner. Refer to TM 9-2320-218-20.
	b. Throttle plate not fully open.	b. Adjust throttle linkage. Refer to TM 9-2320-218-20 for procedures.
	c. Worn throttle linkage	c. Replace worn throttle linkage. Refer to TM 9-2320-218-20.
35. Rough engine idel (too much air).	a. Incorrect idle fuel mixture	a. Adjust idle fuel mixture needle. Refer to TM 9-2320-218-20 for procedures.
	b. Worn throttle linkage	b. Replace worn throttle linkage.

Table 2-4. Troubleshooting—Continued

Malfunction	Probable Cause	Corrective Action
	AIR INTAKE SYSTEM—Continued	
35. Rough engine idle (too much air)—Continued	c. Defective crankcase ventilator valve.	c. Repair or replace defective ventilator valve.
	d. Windshield wiper hose not connected to vacuum pump.	d. Connect windshield wiper hose to vacuum pump.
	e. Leak in crankcase ventilation system or vacuum pump tubes to intake manifold.	e. Repair leaks in crankcase ventilation system or vacuum pump tubes.
	f. Leak in intake manifold	f. Inspect intake manifold for leaks, and repair or replace as necessary.
	LUBRICATION SYSTEM	
36. Low pressure (oil).	a. Improper grade engine oil	a. Drain crankcase and refill with proper grade oil; refer to LO 9-2320-218-12.
	b. High oil temperature. Clogged oil.	b. Refer to item 39. Replace oil filter. Refer to TM 9-2320-218-20.
	c. Defective or stuck oil pressure relief valve.	c. Repair and replace oil pressure relief valve.
	d. Damaged oil pan, restricting oil pick up tube inlet.	d. Remove and repair oil pan.
	e. Diluted engine oil	e. Drain crankcase and refill with proper grade oil for prevailing temperature. Refer to LO 9-2320-218-12. Troubleshoot engine for cause of oil dilution; refer to items 28 through 31.
	f. Defective or clogged oil pick up tube & screen assembly. Loose or defective oil plug in camshaft assembly.	f. Remove oil pick up tube & screen assembly, and clean and repair. Disassemble engine and replace loose or defective oil plug in camshaft assembly.
37. High oil pressure.	a. Improper grade engine oil	a. Drain crankcase and refill with proper grade oil. Refer to LO 9-2320-218-12.
	b. Defective or stuck oil pressure relief valve.	b. Repair or replace oil pressure relief valve.
38. Fluctuating oil pressure.	a. Low crankcase oil level	a. Add oil to bring to proper level.
	b. Clogged oil filter	b. Replace oil filter. Refer to LO 9-2320-218-12.
	c. Defective or clogged oil pick up tube & screen assembly.	c. Remove oil pick up tube and screen assembly and clean and repair.
	d. Damaged oil pan, restricting oil pick up tube inlet.	d. Remove and repair oil pan.
	e. Defective oil pressure relief valve.	e. Repair or replace oil pressure relief valve.
	f. Defective oil pump	f. Replace defective oil pump.
39. High oil temperature.	a. Improper grade engine low or low oil level.	a. Drain crankcase and refill with proper grade oil. Refer to LO 9-2320-218-12.
	b. High coolant temperature......	b. Refer to items 41 through 43 for correction of cooling system malfunctions.
	c. Lean fuel mixture	c. Refer to items 28 through 31 for correction of fuel system malfunctions.
	d. Improper ignition timing	d. Refer to items 20 through 27 for correction of ignition system malfunctions.
	e. Tight engine bearing	e. If the engine cannot be turned freely, the engine bearing or other internal working parts are tight and the engine must be

Malfunction	Probable Cause	Corrective Action
39. High oil temperature—Continued	LUBRICATION SYSTEM—Continued	disassembled to investigate and repair the damage.
40. High oil consumption.	a. Improper grade engine oil	a. Drain crankcase and refill with proper grade oil. Refer to LO 9-2320-218-12.
	b. High oil temperature	b. Refer to item 39.
	c. Engine oil leaks	c. Repair engine oil leaks.
	d. Failure of vacuum pump	d. Repair or replace vacuum pump as necessary.
	e. Defective crankcase metering valve.	e. Replace defective crankcase metering valve. Refer to TM 9-2320-218-20.
	f. Worn piston rings or cylinders.	f. Disassemble engine and repair as necessary.
	g. Worn valve stems or valve guides or defective valve seal.	g. Remove cylinder head and replace worn valves or defective intake valve seals.
	COOLING SYSTEM	
41. Engine overheats.	a. Insufficient coolant. Coolant system leaks. Incorrect belt tension. Obstructed radiator fins. Defective thermostat.	a. Add coolant to bring to proper level. Repair coolant system leak. Adjust belt tension (para 4-121) Clean radiator to remove obstructions Replace defective thermostat. Refer to TM 9-2320-218-20.
	b. Cooling system passages blocked.	b. Clean cooling system to remove rust, scale, or other foreign matter.
	c. Defective fan blade	c. Repair or replace defective fan blade.
42. Engine fails to reach normal operating temperature.	a. Defective thermostat or incorrect heat range. Defective temperature sending unit. Defective temperature gage. Leaking radiator.	a. Replace defective thermostat. Refer to TM 9-2320-218-20. Replace defective temperature sending unit. Replace defective temperature gage. Refer to TM 9-2320-218-20. Repair or replace leaking radiator.
	b. Loose or damaged hose connection. Water pump leaking.	b. Repair or replace hose connection (s). Repair or replace water pump.
	c. Defective cylinder head gasket. Improper tightening of cylinder head bolts. Cylinder block and head expansion plugs leaking.	c. Replace cylinder head gasket. Properly torque cylinder head bolts. Remove expansion plugs and install new expansion plugs.
	d. Defective radiator cap. Cracked or warped cylinder head or block.	d. Replace defective radiator cap. Repair or replace cracked cylinder head or block as necessary.
	CARBURETOR	
43. Throttle plate will not travel from full-open to closed position.	a. Rust, carbon deposits, or gummy deposits on throttle plate or throttle shaft.	a. Clean parts thoroughly
	b. Bent or distorted throttle shaft.	b. Replace throttle shaft.
	c. Bent or warped throttle plate.	c. Replace throttle plate.
	d. Idle speed regulating screw improperly set.	d. Adjust screw (para 5-10).
	e. Friction or binding in accelerating pump or linkage.	e. Inspect pump & linkage. Replace pump & linkage if necessary.
	f. Improperly adjusted throttle linkage.	f. Adjust throttle linkage. Refer to TM 9-2320-218-20.

Malfunction	Probable Cause	Corrective Action
	CARBURETOR—Continued	
44. Choke plate will not travel from full open to closed position.	a. Rust, carbon deposits, or gummy deposits on choke plate or choke shaft.	a. Clean parts thoroughly
	b. Bent or distorted choke shaft.	b. Replace choke shaft
	c. Bent or distorted choke plate.	c. Replace choke plate
	d. Improperly adjusted choke operating cable.	d. Adjust choke control linkage. Refer to TM 9-2320-218-20.
45. Engine will not start or is hard to start.	a. Flooded carburetor	a. Open throttle & crank engine for a few revolutions to exhaust excessive fuel from intake manifold & combustion chambers. If necessary, adjust float setting (para 5-10).
	b. Carburetor improperly adjusted..	b. Adjust carburetor. (para 5-10).
	c. Choke linkage or choke plate binding (choke plate not closing or opening properly).	c. Adjust linkage. Refer to TM 9-2320-218-20.
	d. Defective choke plate or choke shaft.	d. Replace choke plate or choke shaft, as necessary.
	e. Improper starting procedure causing a flooded engine.	e. Open throttle and crank engine for a few revolutions to exhaust fuel. If necessary, adjust float setting.
	f. Improper carburetor fuel level ..	f. Adjust float setting
	g. No fuel to carburetor	g. Troubleshoot vehicle fuel system. Refer to item 28.
	h. Dirt in carburetor idle system. ..	h. Clean and repair carburetor.
	i. Carburetor vapor locked	i. Let engine cool, then locate cause of overheating. Refer to TM 9-2320-218-20.
46. Engine starts but does not continue to operate properly.	a. Float inoperative or binding. Carburetor improperly adjusted. Obstruction in internal fuel passages.	a. Inspect float and float shaft for binding. Adjust float setting. Adjust carburetor. Clean fuel passages thoroughly.
	b. Improper idle adjustment. Idle adjusting needle grooved, worn, or otherwise damaged.	b. Adjust idle needle. Replace needle.
	c. Idle air or fuel passages clogged.	c. Clean thoroughly
	d. Choke not operating properly.	d. See item 44
	e. Accelerating pump not operating properly.	e. Inspect pump and linkage. Replace pump or linkage as necessary.
	f. Air leak between carburetor and manifold.	f. Install new carburetor mounting gasket. Tighten mounting bolts.
	g. Insufficient fuel supply to carburetor.	g. Check fuel delivery system. Refer to TM 9-2320-218-20.
	h. Incorrect choke linkage adjustment.	h. Check adjustment of choke linkage and adjust. Refer to TM 9-2320-218-20.
	i. Incorrect idle fuel mixture	i. Adjust idle fuel mixture needle.
	j. Idle speed set too low	j. Adjust carburetor idle-speed stop screw to increase engine speed.
	k. High fuel level	k. Adjust float tab to proper level.
	l. Carburetor flooding	l. Check fuel inlet system inlet needle & seat and float assy. Adjust as necessary (para 5-7).
	m. Water in carburetor	m. Remove drain plug from carburetor float chamber. Clean carburetor.
	n. Carburetor vapor locked	n. Let engine cool and then locate cause of overheating. Refer to TM 9-2320-218-20.

Table 2-4. Troubleshooting—Continued

Malfunction	Probable Cause	Corrective Action
	CARBURETOR—Continued	
47. Poor acceleration (stalls, hesitates, or is sluggish).	a. Accelerating pump ruptured.	a. Install new diaphragm assembly.
	b. Accelerating pump linkage binding or defective.	b. Inspect pump & linkage. Replace pump or linkage as necessary.
	c. Float setting incorrect	c. Inspect float and float shaft for binding. Adjust float setting (para 5-7 or 5-10).
	d. Foreign matter in accelerating system.	d. Clean system with compressed air and suitable solvent.
	e. Air leak between carburetor and manifold.	e. Install new carburetor mounting gasket.
	f. Air leak at throttle shaft caused by worn shaft.	f. Replace throttle shaft
	g. Incorrect pump stroke caused by damaged linkage.	g. Inspect pump stroke linkage for damage. Replace linkage if necessary.
	h. Fuel inlet needle worn or not seating.	h. Replace needle and seat.
	i. Pump discharge check-ball inoperative.	i. Check pump discharge check-ball. Replace ball if necessary.
	j. Leaking throttle body gasket	j. Install new gasket
48. Flooding or leaking carburetor.	a. Cracked main body or float chamber.	a. Replace carburetor
	b. Defective gaskets	b. Install new gaskets
	c. High float setting	c. Adjust float setting. (para 5-7 or 5-10).
	d. Fuel inlet needle worn or not seating properly.	d. Replace needle
	e. Ruptured accelerating pump diaphragm.	e. Install new diaphragm assembly
49. Engine has poor high speed performance.	a. Dirt or water in carburetor	a. Remove drain plug from carburetor float chamber. Clean carburetor.
	b. Inoperative or defective accelerating pump.	b. Replace pump
	c. Low float setting	c. Adjust float setting (para 5-7 or 5-10).
	d. Power valve clogged; clogged or undersize jet.	d. Clean carburetor or replace, as necessary.
	e. Throttle plate not opening fully.	e. Inspect throttle linkage for damage. Replace if necessary. Inspect throttle plate shaft for damaged or sticking parts. Repair or replace as necesary.
	f. Worn throttle linkage	f. Replace worn throttle linkage.
50. Engine runs rough	a. Incorrect idle fuel mixture	a. Adjust idle fuel mixture needle. Refer to TM 9-2320-218-20.
	b. Improper use of choke or sticking choke.	b. Refer to TM 9-2320-218-10 for proper use of choke.
	c. High float setting	c. Inspect and adjust float setting (par. 5-7 or 5-10).
	d. Main jet worn & leaking; worn power valve piston or power valve; air bleed obstruction; fuel siphoning from accelerating pump discharge nozzle.	d. Replace or repair carburetor as necessary.
51. Engine idle rough (too much air).	a. Throttle plate not being fully closed.	a. Inspect throttle linkage and throttle plate for damage or sticking. Repair as necessary.
	b. Worn throttle linkage	b. Replace worn linkage
	c. Clogged air bleeds or idle passages.	c. Clean carburetor and blow out passages with compressed air.
	d. Idle speed too low	d. Adjust idle speed. Refer to TM 9-2320-218-20.

Table 2-4. Troubleshooting—Continued

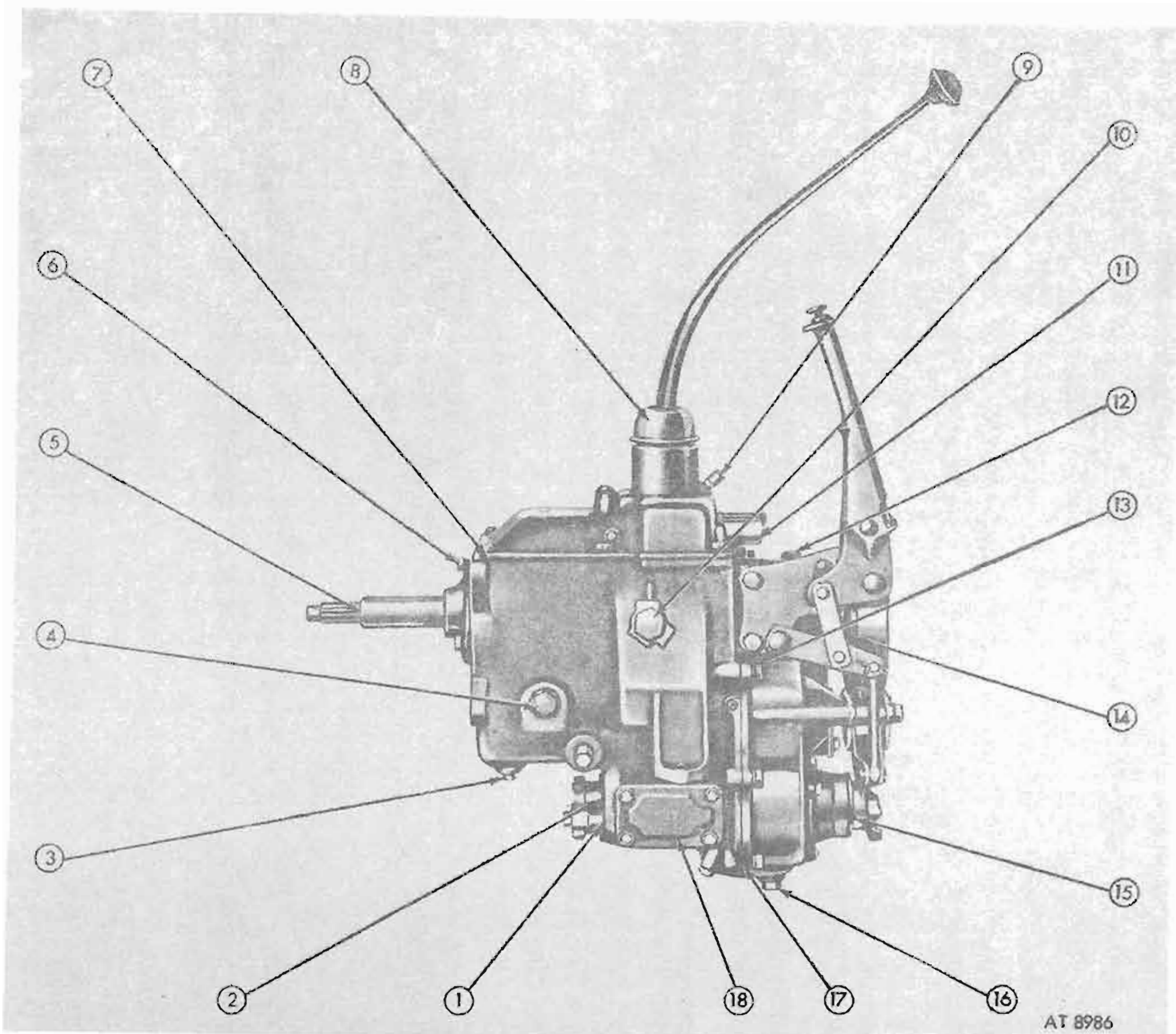
Malfunction	Probable Cause	Corrective Action
	IGNITION SYSTEM	
52. No voltage or weak voltage (on vehicle test).	a. Defective coil	a. Remove coil and check with suitable testing equipment. If defective, install new coil.
	b. Defective ballast resistor	b. Check continuity, if defective, replace.
	c. Defective capacitor in primary connector.	c. Remove capacitor and check with suitable testing equipment. If defective, install new capacitor.
	d. Burned or improperly adjusted breaker point contacts.	d. Inspect contacts. Adjust or replace as necessary (para 6-7).
	e. Grounded wire or terminal in primary circuit.	e. Check wire & clean terminal.
	f. Poor connection at primary connector.	f. Check connection and tighten.
53. Weak spark or no spark (on vehicle test).	a. Defective breaker point condenser.	a. Remove condenser and check with suitable testing equipment. If defective install new condenser.
	b. Ignition coil inoperative	b. Remove coil and check with suitable testing equipment. If defective, install new coil.
	c. Defective ballast resistor	c. Check continuity, if defective replace.
	d. Breaker points improperly adjusted or damaged.	d. Inspect contacts for burning or pitting. Install new breaker points if necessary. (para 6-2).
	e. Distributor cap damaged	e. Remove cap & cover assy. Inspect cap for damage. Install new cap if necessary.
	f. Rotor damaged or improperly installed.	f. Remove cap and cover assembly. Inspect rotor for damage (para 6-7). Install new rotor if necessary.
	g. Loose connections	g. Check all connections and tighten if necessary.
	h. Broken high voltage terminal in cap.	h. Remove cap and cover. Install new cap.
	i. Insufficient breaker point spring tension.	i. Check tension and adjust as necessary (para 6-9). Replace breaker points if proper spring tension cannot be obtained.
	j. Bent shaft	j. Check shaft and cam for wobble (para 6-7). Replace distributor if shaft is bent or damaged.
	k. Worn bushings	k. Inspect bushings for excessive wear. Install distributor if necessary.
	l. Poor connection between rotor and carbon contact.	l. See e above
	m. Cap inserts worn or corroded.	m. See e above
	n. Poor connections at high voltage outlet terminals.	n. Inspect cap outlet terminals (para 6-7). Clean or replace cap if necessary.
	o. Poor ground between breaker plate & base.	o. Check for loose or corroded plate holders and screws. Install new clips & screws if necessary.
54. Distributor noisy when running (bench test).	a. Loose governor weights	a. Check adjustment (para 6-13). Inspect governor weight holes & pivots. Replace distributor and/or governor weights as necessary.
	b. Excessive breaker point clearance.	b. Inspect contacts for burning or pitting. Install new breaker points if necessary, and adjust (para 6-2).
	c. Dry rubbing block on movable breaker point arm.	c. Lubricate cam w/thin layer of grease (GAA).

Table 2-4. Troubleshooting—Continued

Malfunction	Probable Cause	Corrective Action
	IGNITION SYSTEM—Continued	
54. Distributor noisy when running (bench test)—Continued	d. Weak governor weight springs.	d. Replace springs
	e. Broken antirattle spring......	e. Check antirattle spring. Replace spring if necessary.
	f. Broken snapring	f. Check snapring. Replace snapring if necessary.
	g. Breaker plate holder missing or not locked in.	g. Check breaker plate for security. Replace holder or lock as necessary.
55. Excessive end play in shaft (bench test).	a. Worn coupling assy	a. Inspect coupling. Replace coupling if necessary.
	b. Worn thrust washer governor weight drive plate.	b. Inspect washer. Replace washer if necessary.
	c. Broken roll pin	c. Check roll pin. Install new pin if necessary.
56. Irregular spacing of firing flashes (bench test). Excessive dwell variation (on vehicle and bench test).	a. Bent shaft	a. Replace distributor
	b. Worn shaft bushing	b. Replace distributor
	c. Worn cam	c. Replace cam
	d. Bent shaft	d. Replace distributor
	e. Worn shaft bushing	e. Replace distributor
	f. Weak breaker point spring	f. Install new breaker points (para 6-2).
	STARTER	
57. Low speed & high current (no-load test).	a. Faulty armature	a. Test armature for shorts and opens (para 7-15). Repair on replace as required.
	b. Excessive drag	b. Check armature shaft end play (para 7-17). Check for tight or worn bearings, loose field pieces, and bent armature shaft (para 7-9). Repair or replace as required.
	c. Grounded field coils	c. Test field coils for ground (para 7-9). Replace frame & field assembly if coils are grounded.
58. Low speed & low current (no-load test).	a. High resistance connections.	a. Look for improperly crimped & poorly soldered brush & field connections. Inspect for loose or poorly grounded brush plate. Repair as necessary.
	b. Poor brush contact	b. Look for worn or dirty commutator, worn or faulty brushes, and broken or frayed brush leads. Also check brush spring tension (para 7-9).
	c. High mica	c. Turn commutator and undercut mica.
59. Low torque & low current (stall test).	a. High resistance connections.	a. See para 7-15.
	b. Poor brush contact	b. See para 7-9.
60. Low torque and high current (stall test).	a. Faulty armature	a. See para 7-15.
	b. Excessive drag, shorted or grounded field coils.	b. See para 7-9.
	TRANSMISSION & TRANSFER (Fig. 2-10 through 2-19)	
61. Intermittent howl	a. Gears out-of-round, centerline of mating shaft.	a. Disassemble transmission. Repair or replace faulty parts.
62. Intermittent knocking or thudding.	a. Worn, broken, or burred gear teeth.	a. Disassemble transmission. Replace all faulty gears.
63. High pitched howl or whine.	a. Poor gear tooth contact	a. Disassemble transmission. Replace all faulty gears.
64. High pitched squeal thudding or knocking.	a. Faulty or damaged bearings	a. Disassemble transmission and examine bearings. Replace all faulty parts.
65. Grinding noise in neutral.	a. Faulty input shaft bearing	a. Depress clutch. If noise disappears, disassemble transmission & replace bearing.

Table 2-4. Troubleshooting—Continued

Malfunction	Probable Cause	Corrective Action
	TRANSMISSION & TRANSFER —Continued	
66. Noisy transmission gears or bearing whine.	a. Low on lubricant	a. Determine cause of leak, if possible. Make sure attaching bolts & plugs are tight. Replace defective gaskets & seals.
	b. Water in unit	b. Open drains & check for water in lubricant If water is found, drain, flush, and refill. Refer to LO 9-2320-218-12.
67. Loose gearshift lever.	a. Loose or worn parts	a. Tighten loose parts, replace damaged or worn parts. Refer to figs. 2-10 and 2-11.
68. Hard shifting	a. Low on lubricant	a. Check lubricant level. Refill as necessary. Refer to LO 9-2320-218-12.
	b. Wrong type lubricant too heavy.	b. Refer to LO 9-2320-218-12 for lubricant type. Refill with proper type lubricant.
	c. Bent or damaged shafts or forks.	c. If jammed, remove & check gearshift assy. If shifter is operating correctly, remove, disassemble and inspect transmission. Refer to fig. 2-12.
69. Gearshift lever stuck in reverse.	a. Bent or damaged gearshift	a. Remove and check gear shift housing assy. (fig. 2-13). Insure that the reverse shift lever has not fallen into transmission.
	b. Broken or, damaged gears	b. If shifter is operating, remove and disassemble transmission and inspect low and reverse gears. Refer to figure 2-13.
70. Gearshift lever stuck in second gear.	a. Bent or damaged gearshift shaft or fork.	a. Remove & check gearshift housing assy. Refer to figure 2-14.
	b. Damaged or broken second speed synchronizer.	b. Remove & disassemble transmission. Check second-speed synchronizer. Refer to figure 2-14.
71. Gearshift lever stuck in third or fourth gear.	a. Bent or damaged gearshift shaft or fork.	a. Remove & check gearshift housing assy. Refer to figure 2-15.
	b. Damaged or broken synchronizer.	b. Remove and disassemble transmission. Check third- and fourth-speed synchronizer. Refer to figure 2-15.
72. Gearshift slips out of first or reverse.	a. Bent or damaged gearshift shaft or fork.	a. Remove & check gearshift housing assy. Refer to figure 2-16.
	b. Worn or damaged transmission gears or shafts.	b. Disassemble transmission and check all gears & shaft. Refer to fig. 2-16. Replace worn & damaged parts.
73. Gearshift slips out of second gear.	a. Bent or damaged gearshift shaft or fork.	a. Remove & check gearshift housing assy. Refer to figure 2-17.
	b. Damaged or worn transmission second speed.	b. Remove and disassemble transmission. Check for worn or damaged parts. Refer to figure 2-17. Replace all worn or damaged parts.
74. Gearshift slips out of third or fourth gear.	a. Bent or damaged gearshift shaft or fork.	a. Remove & check gearshift housing assy. Refer to figure 2-18.
	b. Damaged or worn input shaft or third & fourth speed synchronizer.	b. Remove & disassemble, Check for worn or damaged parts. Refer to figure 2-18. Replace worn or damaged parts.
75. Transfer slips out of front drive.	a. Shift lever worn or damaged.	a. Inspect shift lever assy. Replace worn or damaged parts.
	b. Worn or damaged transfer shafts, bearings or clutch.	b. Remove and disassemble unit. Check all parts. Replace damaged or worn parts. Refer to figure 2-19.



1 Tranfer-shifter shaft seal
2 Transfer-front-output shaft seal
3 Transmission drain plug
4 Transmission fill plug
5 Input-shaft retainer seal
6 Input-shaft retainer gasket
7 Gearshift housing gasket
8 Gearshift lever retainer
9 Vent valve
10 Low-and reverse-shifter arm pivot
11 Shifter shaft seal
12 Speedometer bearing sealer
13 Transfer case retaining bolts
14 Transfer-input shaft seal
15 Transfer-rear-output shaft sel
16 Transfer darin plug
17 Transfer case gasket
18 Transfer-shift cover plate

Figure 2-10. Inspection of transmission transfer unit.

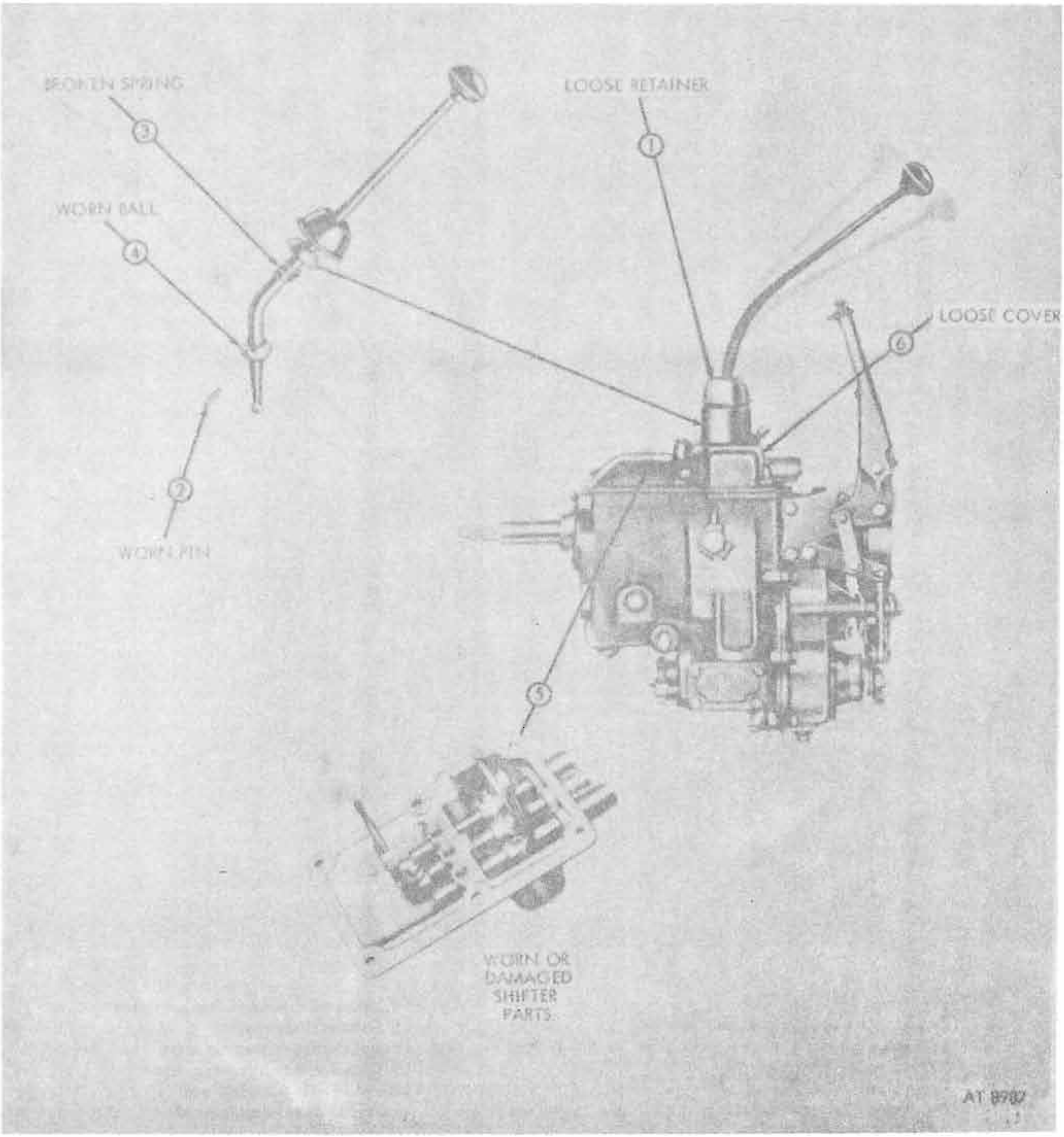


Figure 2-11. Loose gearshift lever.

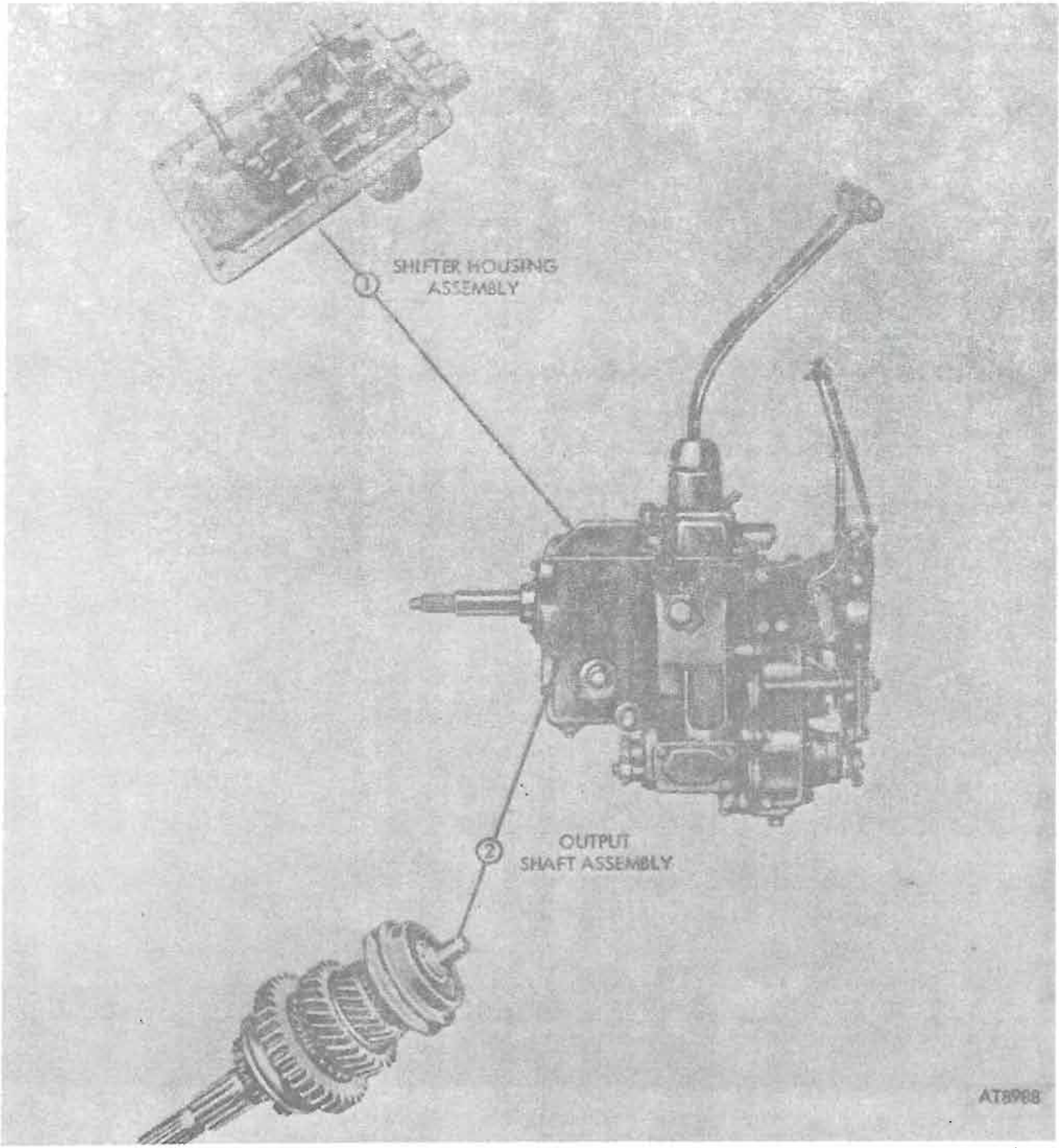


Figure 2-12. Hard shifting of transmission gears.

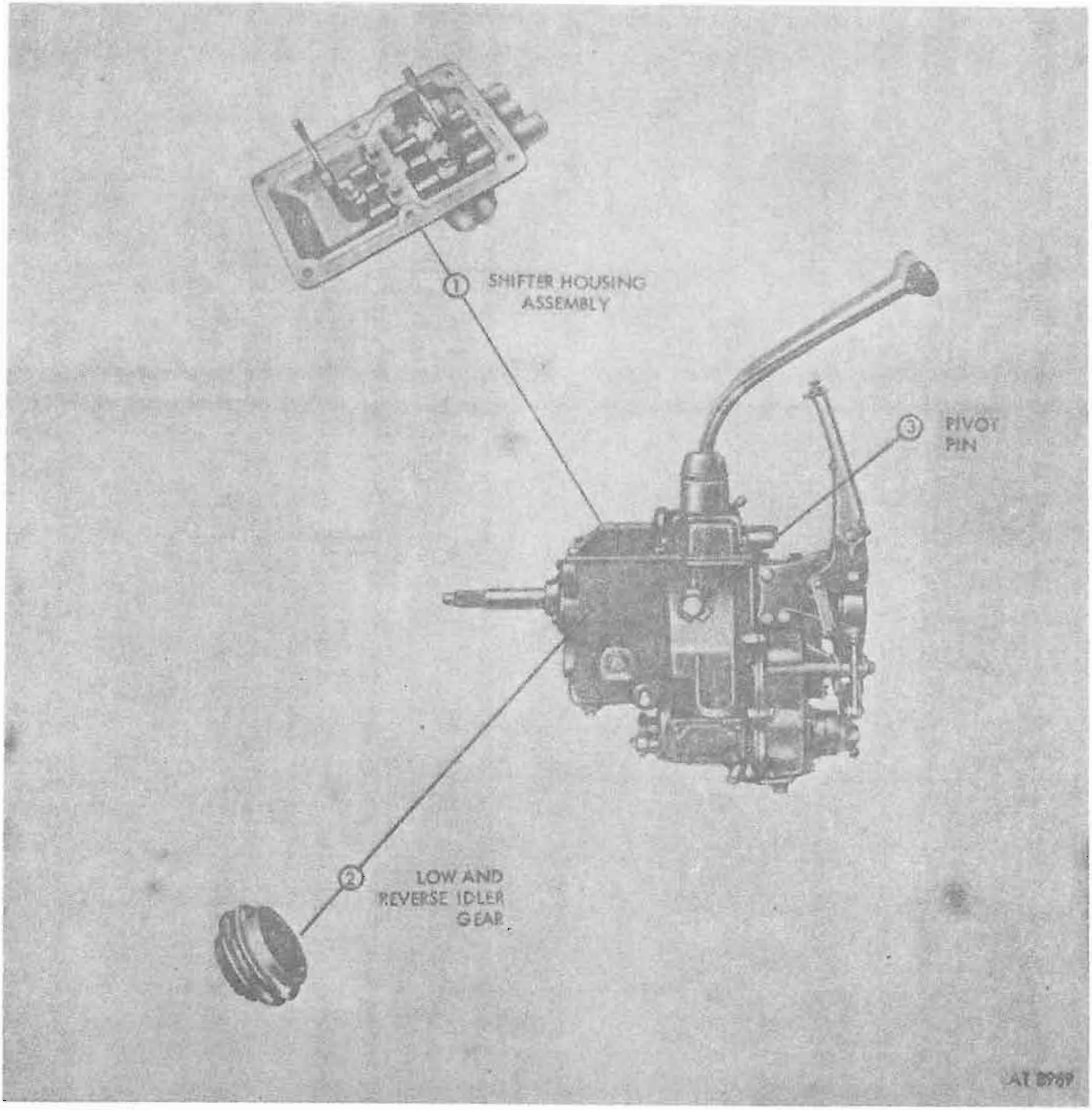


Figure 2-13. Gearshift lever stuck in reverse or first gear.

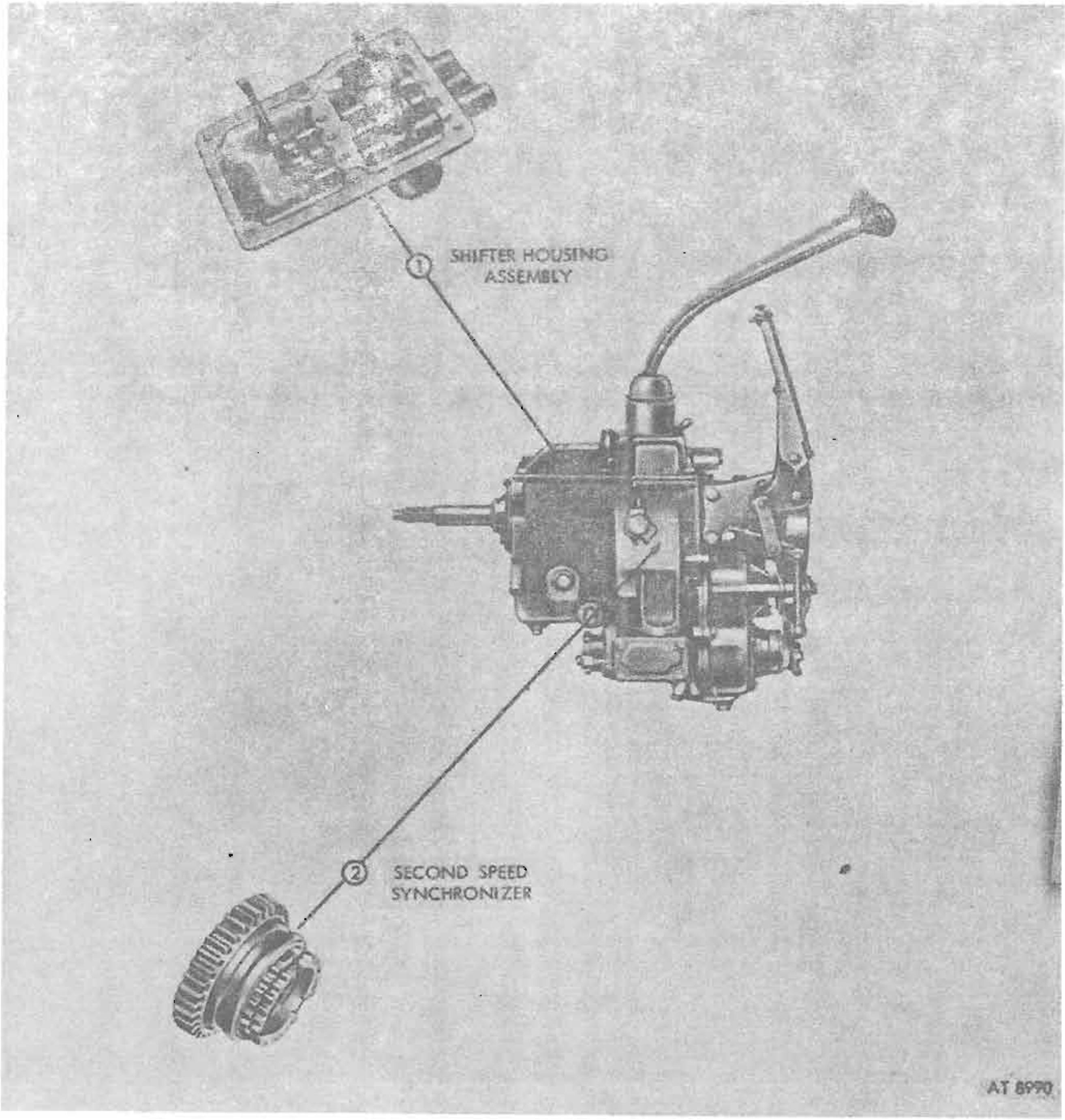


Figure 2-14. Gearshift lever stuck in second gear.

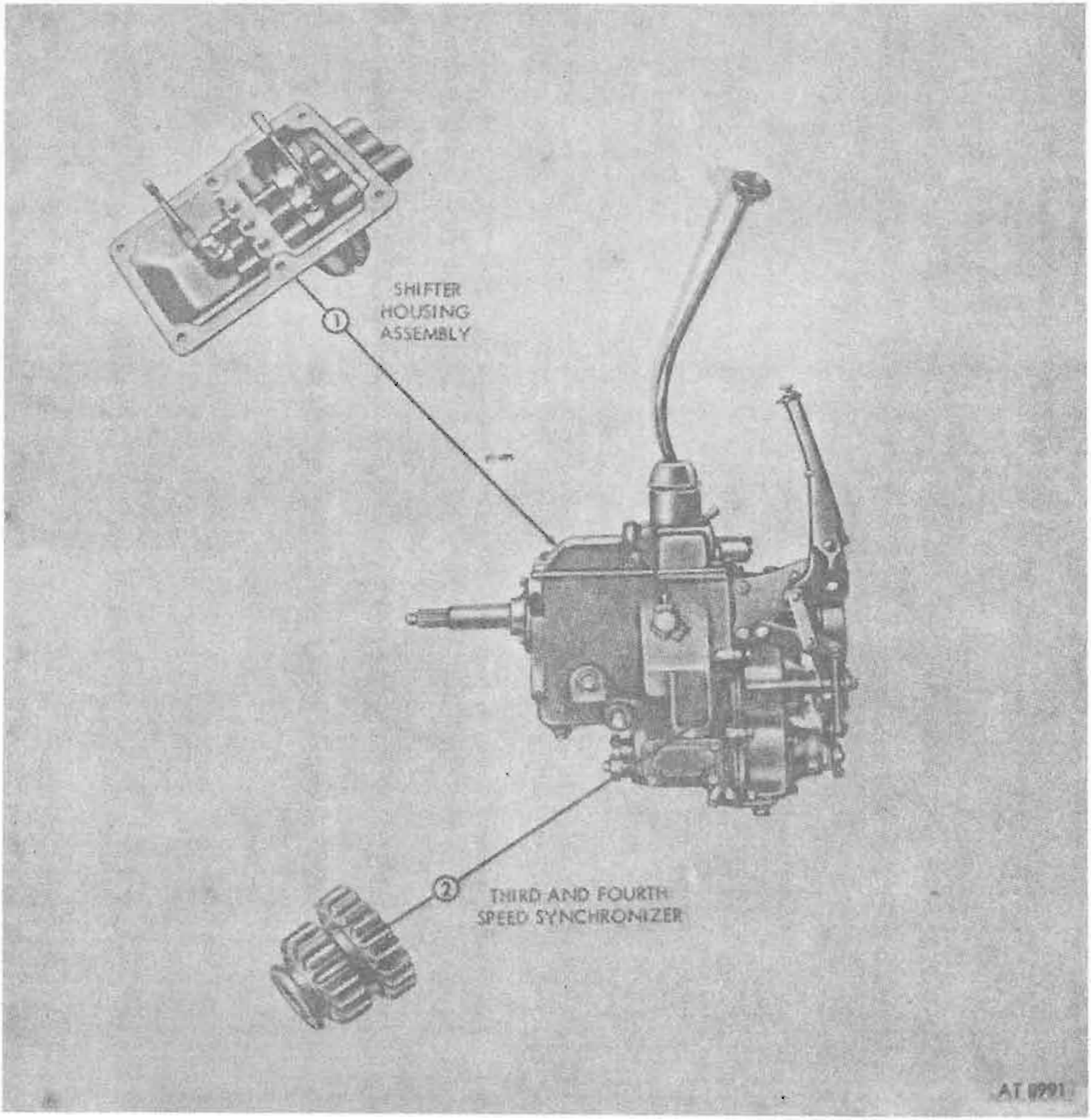


Figure 2-15. Gearshift lever stuck in third or fourth gear.

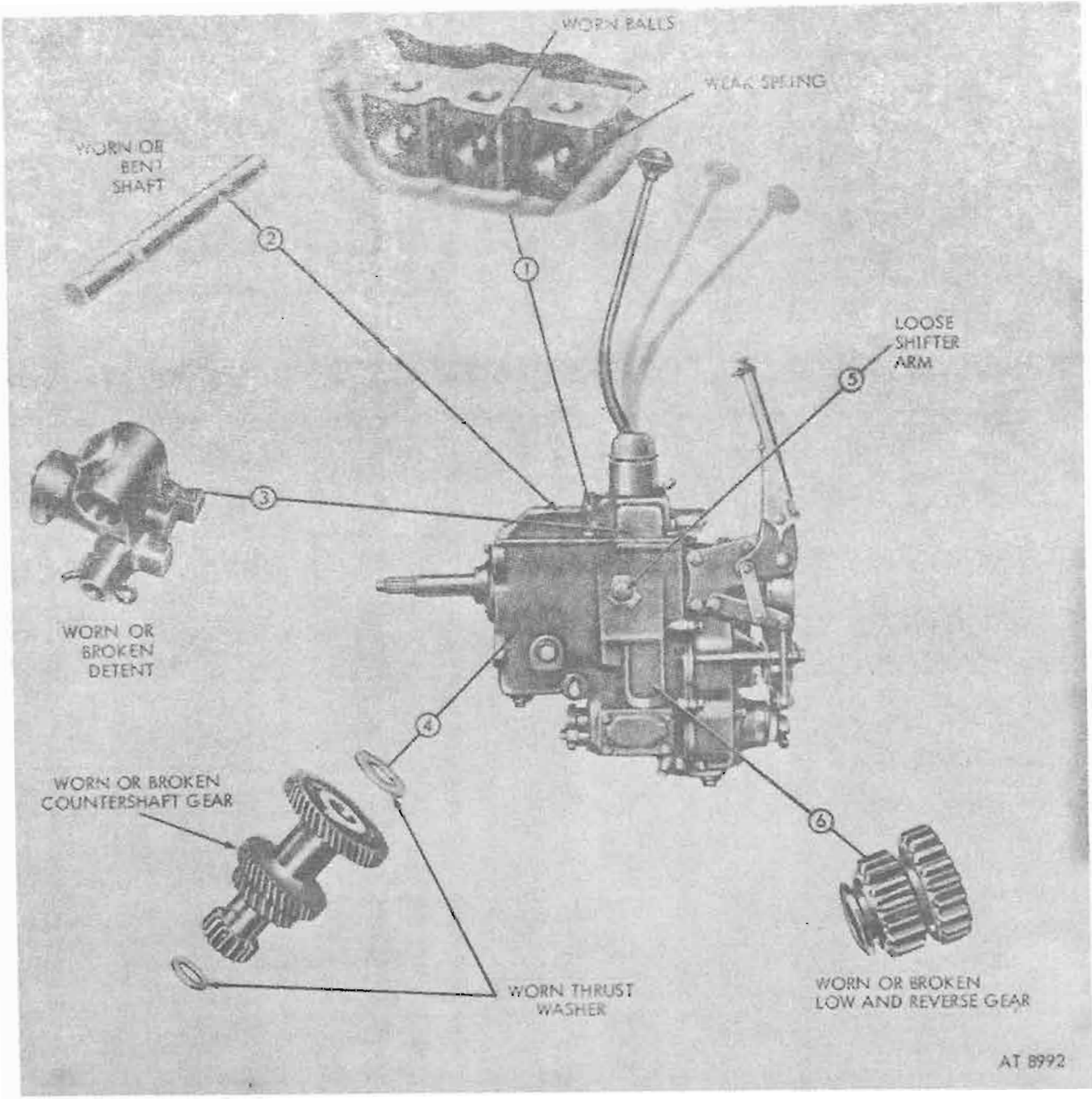


Figure 2-16. Gearshift lever slips out of first or reverse gear.

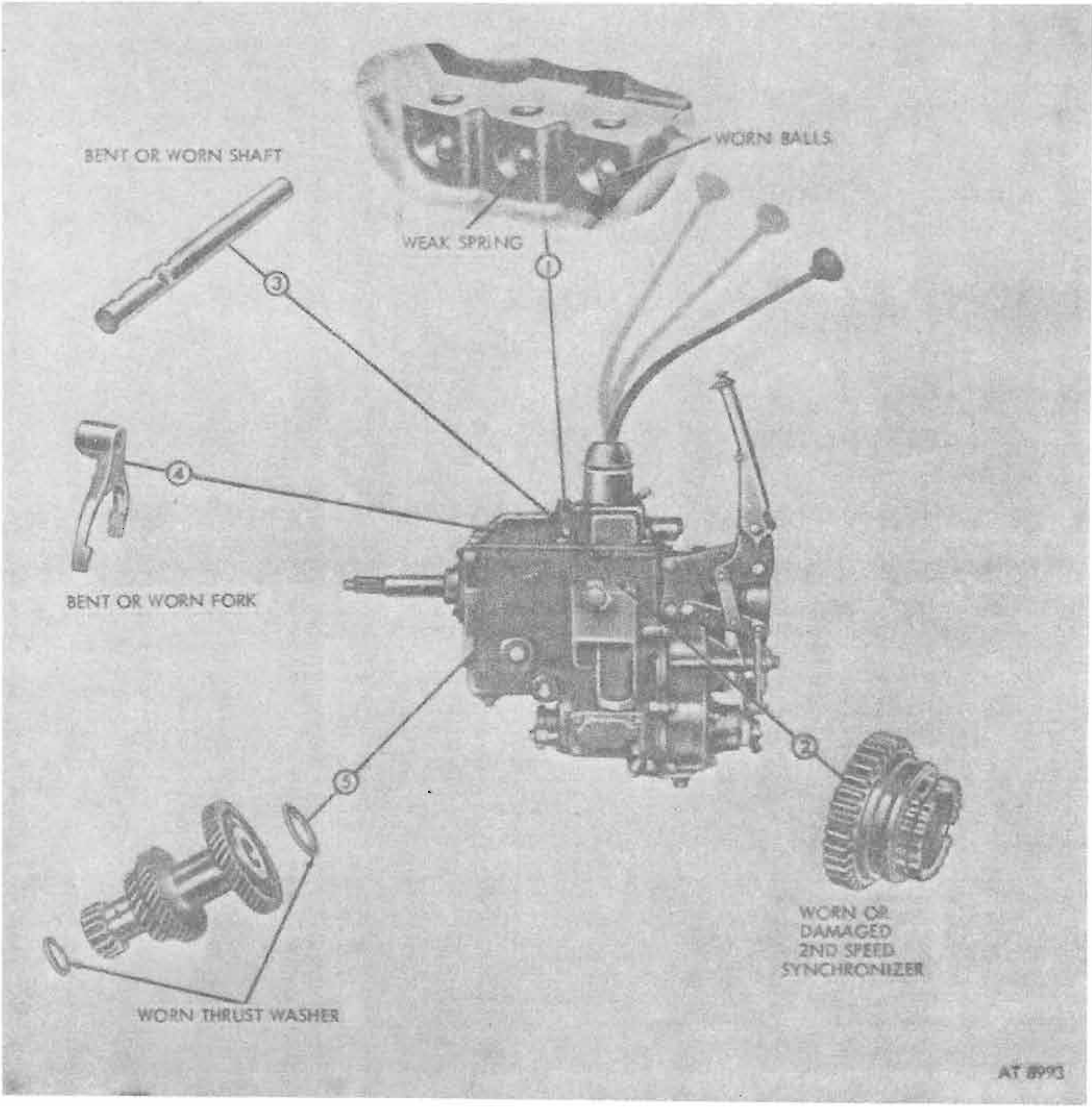


Figure 2-17. Gearshift slips out of second gear.

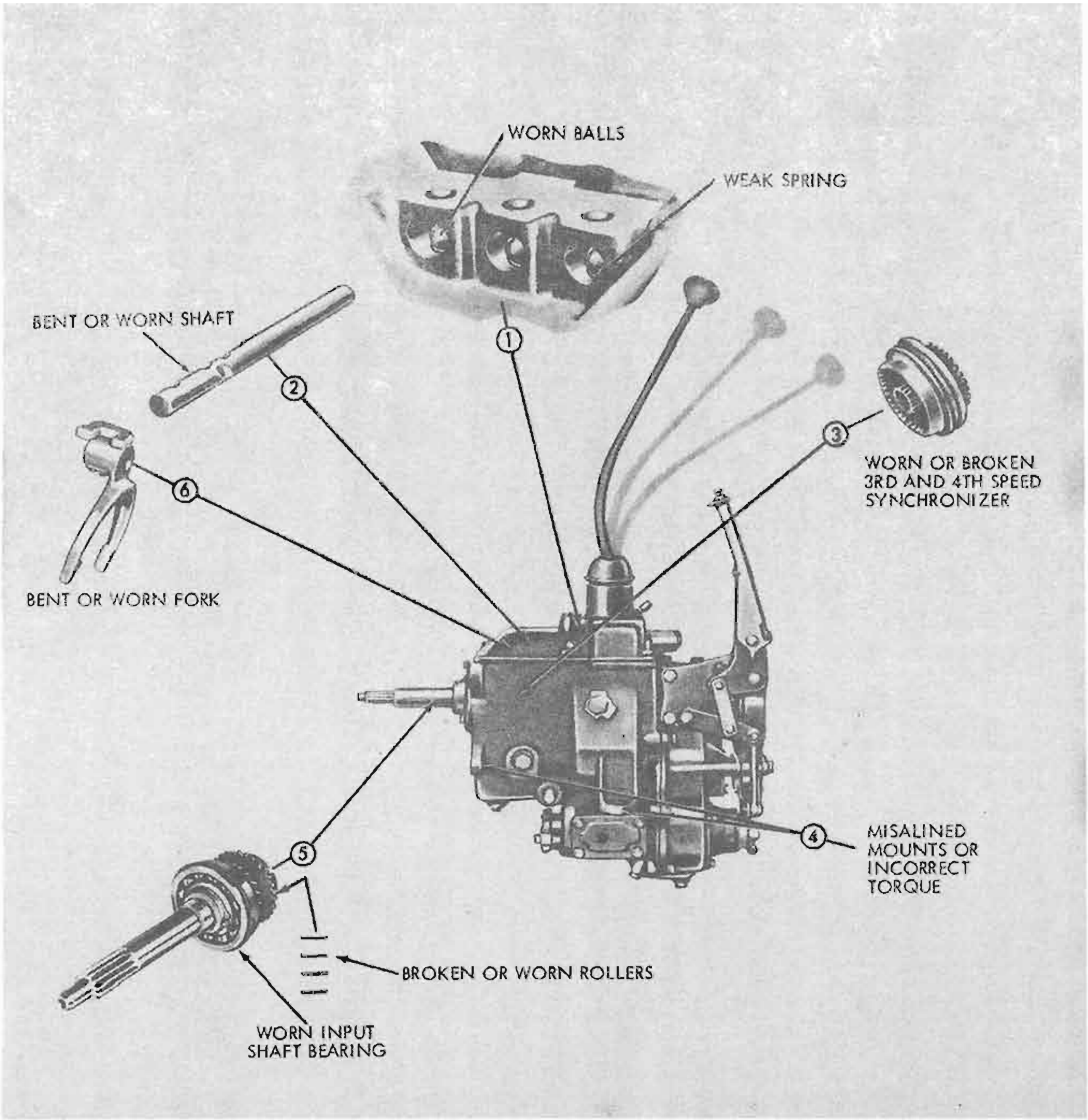


Figure 2-18. Gearshift slips out of third or fourth gear.

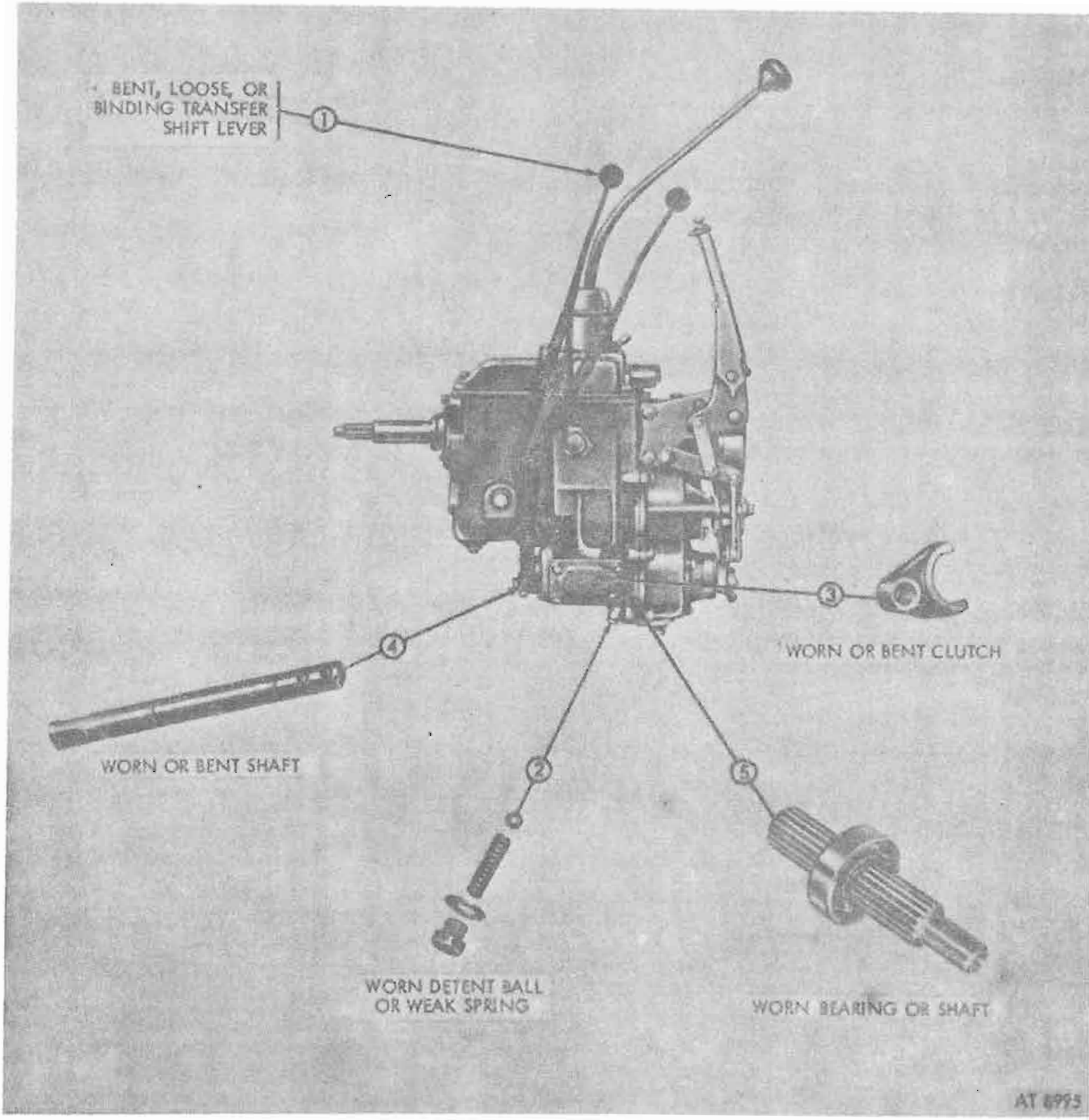


Figure 2-19. Transfer shift lever slips out of front drive.

2-10. Manifold Vacuum Test

a. *General.* A manifold vacuum test aids in determining the condition of an engine and in locating the cause of poor engine performance. To test manifold vacuum:

(1) Operate the engine for a minimum of ½ hour at 1200 rpm.

(2) Install an accurate, sensitive vacuum gage on the manifold vacuum line or on the fitting in the intake manifold.

(3) Idle engine at 550 rpm.

(4) Check the vacuum reading on the gage.

b. *Test Conclusions.* Manifold vacuum is affected by carburetor adjustment, valve timing, condition of valves, cylinder compression, and leakage of intake manifold, carburetor, or cylinder head gaskets. Because abnormal gage readings may indicate that more than one of the above factors is at fault, exercise caution in analyzing an abnormal reading. For example, if the vacuum is low, the correction of one item may increase the vacuum enough to indicate that the trouble has been corrected. It is important, therefore, that each cause of an abnormal reading be investigated and further tests conducted where necessary in order to arrive at the correct diagnosis of the trouble. Table 2-5 lists various types of readings and their possible causes. Allowance should be made for the effect of altitude on the gage reading. The engine vacuum will decrease with an increase in altitude.

Table 2-5. Manifold Vacuum Gage Readings

Gage reading	Engine condition
Low and steady, 18-19 psig.	Normal (at 550 rpm). Loss of power in all cylinders caused possibly by late ignition or valve timing, or loss of compression due to leakage around the piston rings.
Very low	Manifold, carburetor, or cylinder head gasket leak.
Needle fluctuates steadily as speed increases.	A partial or complete loss of power in one or more cylinders caused by a leaking valve; cylinder head, or intake manifold gasket leak; defect in the ignition system; or weak valve spring.
Gradual drop in reading at engine idle.	Excessive back pressure in the exhaust system.
Intermittent fluctuation	An occasional loss of power, possibly caused by a defect in the ignition system or a sticking valve.
Slow fluctuation or drifting of needle.	Improper idle mixture adjustment, carburetor or intake manifold gasket leak, or possibly late valve timing.

2-11. Engine Compression and Oil Pressure Test

a. *Procedure.*

(1) Be sure the battery is fully charged. Operate the engine for a minimum of ½ hour at 1200 rpm. Turn the ignition switch off, then remove all the spark plugs.

(2) Set the throttle plate and choke plate in the wide open position.

(3) Install a compression gage in No. 1 cylinder.

(4) Crank the engine several times and record the highest reading recorded. Note the number of compression strokes required to obtain the highest reading.

(5) Repeat the test on each cylinder, cranking the engine the same number of times for each cylinder as was required to obtain the highest reading on No. 1 cylinder.

b. *Compression Test Conclusions.*

(1) The compression pressure differential between any two cylinders must not be greater than 25 percent.

(2) A reading less than 85 psig indicates leakage at the cylinder head gasket, piston rings, or valves.

(3) A reading greater than 160 psig indicates excessive deposits in the cylinder.

(4) A low even compression in two adjacent cylinders indicates a cylinder head gasket leak. This should be checked before condemning the rings or valves.

(5) To determine whether the rings or the valves are at fault, squirt the equivalent of a tablespoon of engine oil (OE-30) into the combustion chamber. Crank engine to distribute oil and repeat compression test. Oil will temporarily seal leakage past the rings. If approximately the same reading is obtained, rings are satisfactory, but valves are leaking. If compression has increased 10 pounds or more over original reading, there is leakage past the rings.

(6) During a compression test, if the pressure fails to climb steadily and remains the same during the first two successive strokes, but climbs higher on the succeeding strokes, or fails to climb during the entire test, a sticking valve is indicated.

(7) Before condemning the rings and valves, perform all tune-up operations and check valve clearance. Repeat compression test.

c. *Oil Pressure Test.* The engine oil pressure gage indicates the pressure of the oil flow to the bearings, but does not show the amount of oil in the oil pan. Oil in the oil pan can become dangerously low and pressure will still show on the gage. Low oil pressure on a comparatively new engine may be caused by a damaged oil pump, defective oil pressure relief valve, or gage. The oil pressure reaching the bearings can be checked by removing the oil pressure sending unit at the oil filter adapter and installing a master gage in its place. After the engine has reached normal operating temperature, the oil pressure gage should read approximately 35 to 45 psi at 1400 rpm and not less than 10 psi at engine idle speed (550 rpm). Oil is thick when cold; therefore, oil pressure will be higher than normal when engine is cold. As the engine speed increases, the oil pressure will increase until the relief valve opens, and decrease when the engine speed is decreased. Extremely low oil pressure at engine idle speed (550 rpm) is generally caused by excessively worn bearings or oil pump gears.

2-12. Checking Valve Clearance

It is very important that the valve clearance be held to correct specifications. If clearance is set too close, valve will open too early and close too late, resulting in rough engine idle. Burning and warping of valves will occur because valves cannot make firm contact with seats long enough to cool properly. If clearance is excessive it will cause the valve to open too late and close too early, causing valve bounce. In addition, damage to the camshaft lobe is likely because the tappet foot will not follow the pattern of camshaft lobe, causing a shock contact between these two parts. Before checking or adjusting valve clearance, operate engine for a minimum of 30 minutes at 1200 rpm to stablize engine temperatures. Be sure engine is at normal operating temperature before attempting to set valve clearance. Check or adjust valve clearance with engine idling, using a 0.015 feeler gage between valve stem and rocker arm pad. If valve rocker arm shaft assembly had been removed and installed, it will be necessary to adjust valve clearance to 0.017 cold before starting engine to perform a final hot valve clearance adjustment.

2-13. Checking Valve Timing and Camshaft Lobe Lift

a. *General.* The valve timing should be checked when poor performance is noted and all other checks, such as carburetor, ignition, timing; etc., fail to locate the cause of the trouble. Before valve timing is checked, check for a bent timing pointer. If the valve timing is not within specification (table 2-6); remove timing-gear cover to check timing-gear alinement and timing gears. If camshaft lobe lift is not within specifications, check camshaft.

b. *Check Valve Timing.* Slide rocker arm to one side and secure in position. Make sure push rod is in tappet socket. Place dial indicator in such a manner as to have actuating tip of indicator in push rod socket and in the same plane as the rod movement (fig. 2-20). Turn crankshaft pulley slowly in direction of rotation until tappet is on base circle of camshaft lobe. At this point, push rod will be in its lowest position. Zero the dial indicator and continue turning crankshaft slowly in the direction of rotation until dial indicator registers specified camshaft lobe lift (table 2-6). Compare crankshaft degrees indicated on dial with specifications (table 2-6). After valve opening is checked, continue to rotate crankshaft to check intake valve closing.

Table 2-6. Valve Timing Specifications

Valve and position	Crankshaft position	Camshaft lobe lift (in inches)
Intake: opens	13° BTC	.0127
closes	68° ABC	.0127
Exhaust: opens	55° BBC	.0126
closes	22° ATC	.0126

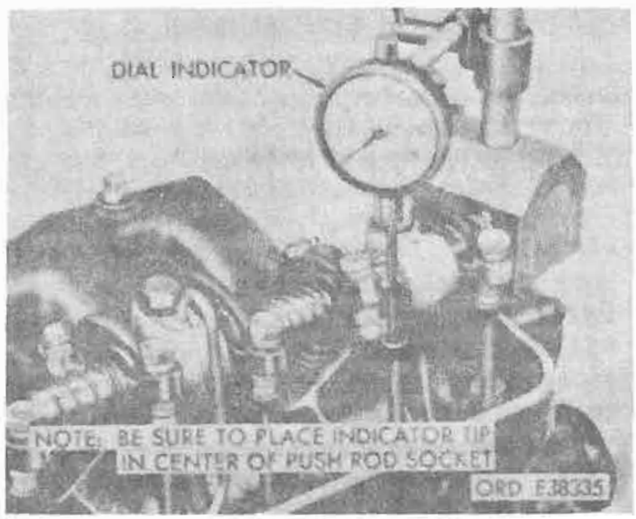


Figure 2-20. Camshaft lobe lift measuring, typical.

c. *Check Camshaft Lobe Lift.* This procedure is similar to procedure for checking valve timing. Place dial indicator in push rod socket (fig. 2-20). Turn crankshaft pulley slowly in direction of rotation until tappet is on base circle of camshaft lobe. At this point, push rod will be in its lowest position. Set dial indicator on zero. Continue to rotate crankshaft slowly until push rod is in fully raised position. Compare total lift recorded on indicator with specification (table 2-6). Continue to rotate crankshaft until indicator reads zero. This last step is a check on the accuracy of the original indicator reading.

CHAPTER 3

REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

Section I. DISASSEMBLY OF VEHICLE INTO MAJOR COMPONENTS

3-1. General

This section contains information for the guidance of personnel performing major rebuild work on the ¼-ton, 4x4, utility trucks, M151, M151A1, M151A2, M151A1C, M825, and M718 and M718A1 ambulance vehicles. It provides an assembly line procedure for the disassembly of the vehicle into its major components. It designates what constitutes a major component, illustrates the points of connections between major components, and states briefly what must be done.

3-2. Remove Power Plant

Refer to paragraph 4-7.

3-3. Disassembly of Power Plant

Refer to paragraph 4-8.

3-4. Removing Steering Gear

Refer to paragraph 16-3.

3-5. Remove Front and Rear Suspension

Refer to TM 9-2320-218-20.

3-6. Remove Front and Rear Differential

Refer to TM 9-2320-218-20.

3-7. Disassemble Front and Rear Suspension

Refer to paragraph 10-8 through 10-13 for front and paragraphs 11-8 through 11-12 for rear.

3-8. Remove Body Components

a. Batteries and cables (TM 9-2320-218-20).

b. Seats (TM 9-2320-218-20).

c. Fuel Tank (TM 9-2320-218-20).

d. Windshield (TM 9-2320-218-20).

e. Brake and clutch pedal assembly (Refer to paragraph 15-1).

f. Front electrical harness (Refer to TM 9-2320-218-20).

g. Rear electrical harness (Refer to TM 9-2320-218-20).

h. Generator regulator (TM 9-2320-218-20).

Section II. ASSEMBLY OF VEHICLE FROM MAJOR COMPONENTS

3-9. General

The following operations establish the recommended sequence of assembly of the vehicles from components.

3-10. Install Body Components

a. Rear electrical harness (Refer to TM 9-2320-218-20).

b. Front electrical harness and instruments (Refer to TM 9-2320-218-20).

c. Generator regulator (TM 9-2320-218-20).

d. Brake and clutch pedal assembly (Refer to para 15-6).

e. Fuel tank (TM 9-2320-218-20).

f. Windshield (TM 9-2320-218-20).

g. Batteries and cables (TM 9-2320-218-20).

h. Seats (TM 9-2320-218-20).

3-11. Assemble Front and Rear Suspension

Refer to paragraphs 10-16 through 10-25 for front and paragraphs 11-15 through 11-18 for rear.

3-12. Install Front and Rear Differential

Refer to TM 9-2320-218-20.

3-13. Install Front and Rear Suspension

Refer to TM 9-2320-218-20.

3-14. Install Steering Gear

Refer to paragraph 16-12.

3-15. Assembly Power Plant

Refer to paragraph 4-8.

3-16. Final Adjustments and Procedures

a. Lubricate vehicle completely, including filling engine, transmission and transfer, front and rear differentials, and steering gear with proper lubricants (refer to LO 9-2320-218-12).

b. Fill master cylinder, and bleed and adjust brakes (refer to TM 9-2320-218-20).

c. Adjust front wheel toe-in and alinement (Refer to paragraph 10-25 of this manual).

d. Inflate tires to proper pressure (refer to vehicle data plate).

e. Adjust clutch pedal clearance (refer to TM 9-2320-218-20).

f. Fill fuel tank, and inspect lines for leakage.

g. Fill radiator, and inspect connections for leakage.

h. Clean and wash vehicle, and touch up paint as required.

3-17. Technical Inspection

After completing final adjustments (para 3-16), perform the quarterly preventive-maintenance service (refer to TM 9-2320-218-20 for items not included in para 3-16).

NOTE

Special purpose M151 series vehicles may be found with 180-ampere alternators installed. For repairs to these special components, refer to TM 9-2320-225-35. For removal and installation data of 180-ampere alternators, 60-ampere alternators and 25-ampere generators, refer to TM 9-2320-218-20.

Section I. DESCRIPTION AND DATA

4-1. Location Terms

a. The fan end of the engine is referred to as the "front" and the flywheelend as the "rear."

b. The terms "left" and "right" are used when viewing the engine from the flywheel end or "rear."

c. Cylinders are numbered from the front starting with the first cylinder.

d. Viewing the engine from the front, the crankshaft rotates in a clockwise direction.

4-2. Description

a. General. The M151 series vehicle engine (figs. 4-1 through 4-3) is a four-cylinder, inline, four-stroke cycle, liquid-cooled, internal combustion, gasoline-type unit. Intake and exhaust manifold, carburetor and generator are mounted on the left side. The oil filter, oil level indicator and distributor are located on the right side. On earlier models, a vacuum pump is located on the right side. On the M151A2, M825, and M718A1 models, a mechanical fuel pump is located on the right side. The water pump is mounted on the front of the cylinder block and a cooling fan is mounted on the pump pulley. The engine front supports are located on each side of the cylinder block and rear supports are located on each side of the transmission. The engine data plate is attached to the cylinder block above the engine left support bracket. The first four symbols (M151) represent the engine model number, and the digits following indicate the serial number.

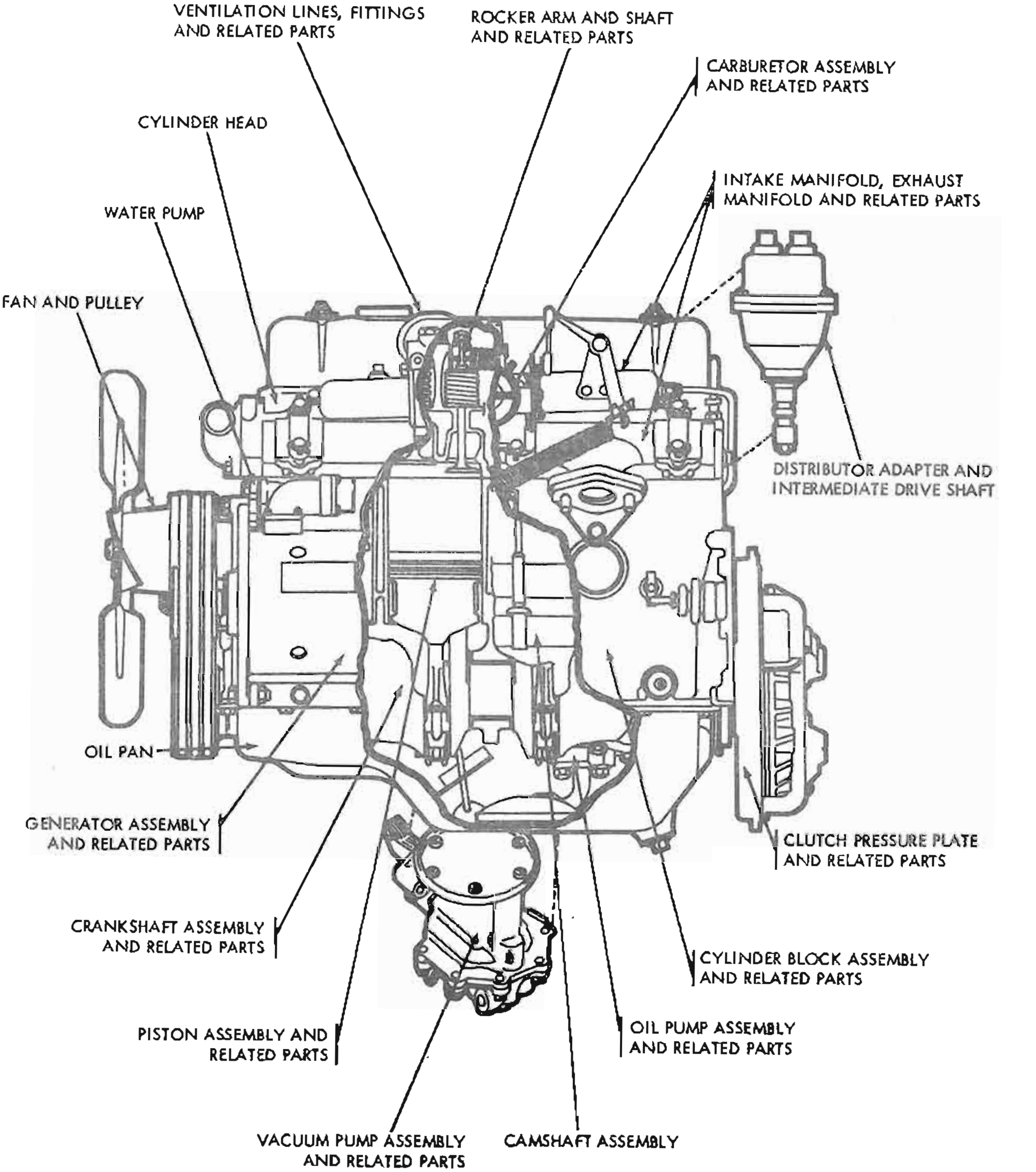


Figure 4-1. M151 series vehicle engine, functional illustration of major components—cutaway view.

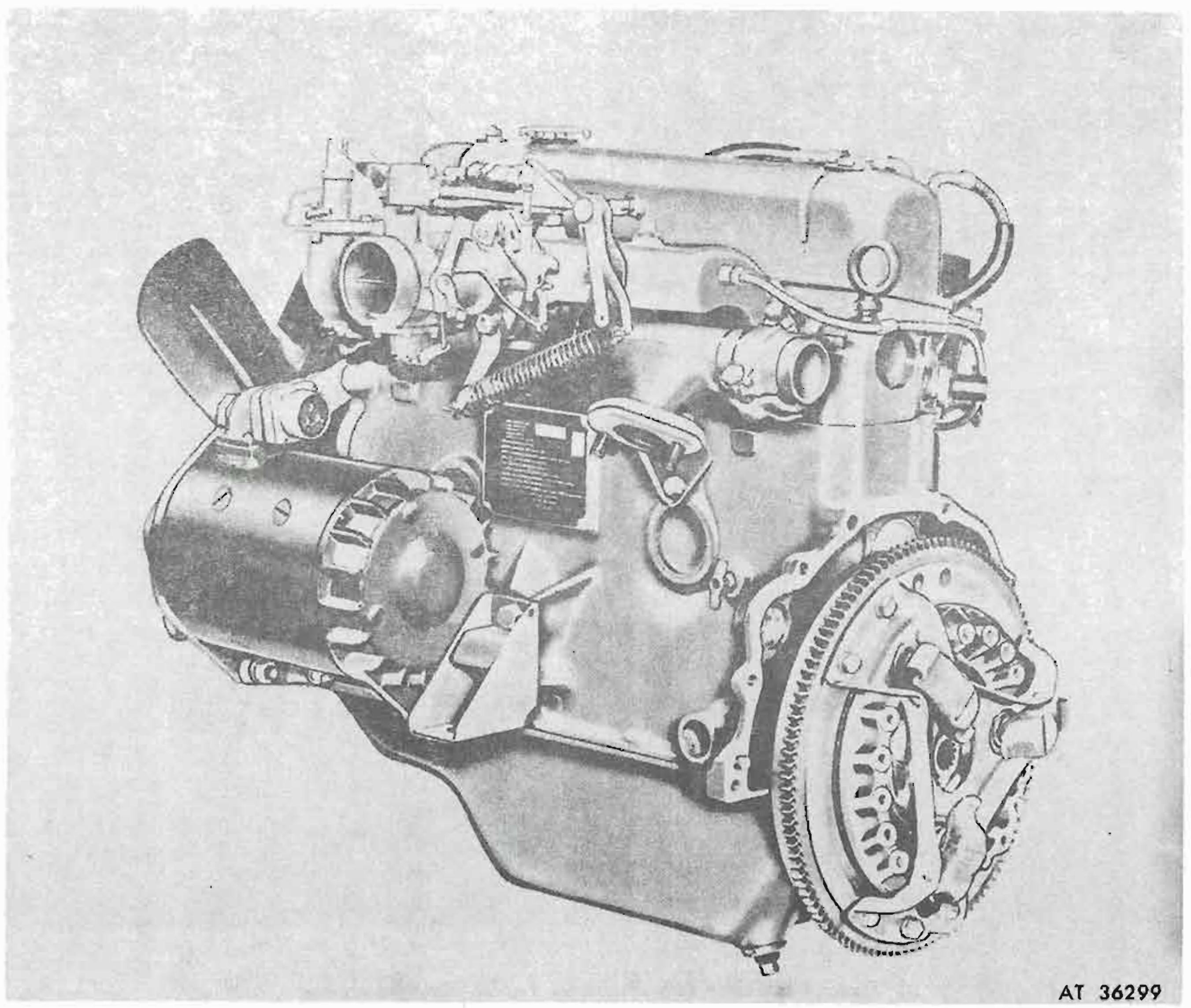


Figure 4-2. Engine with accessories, typical—left rear view.

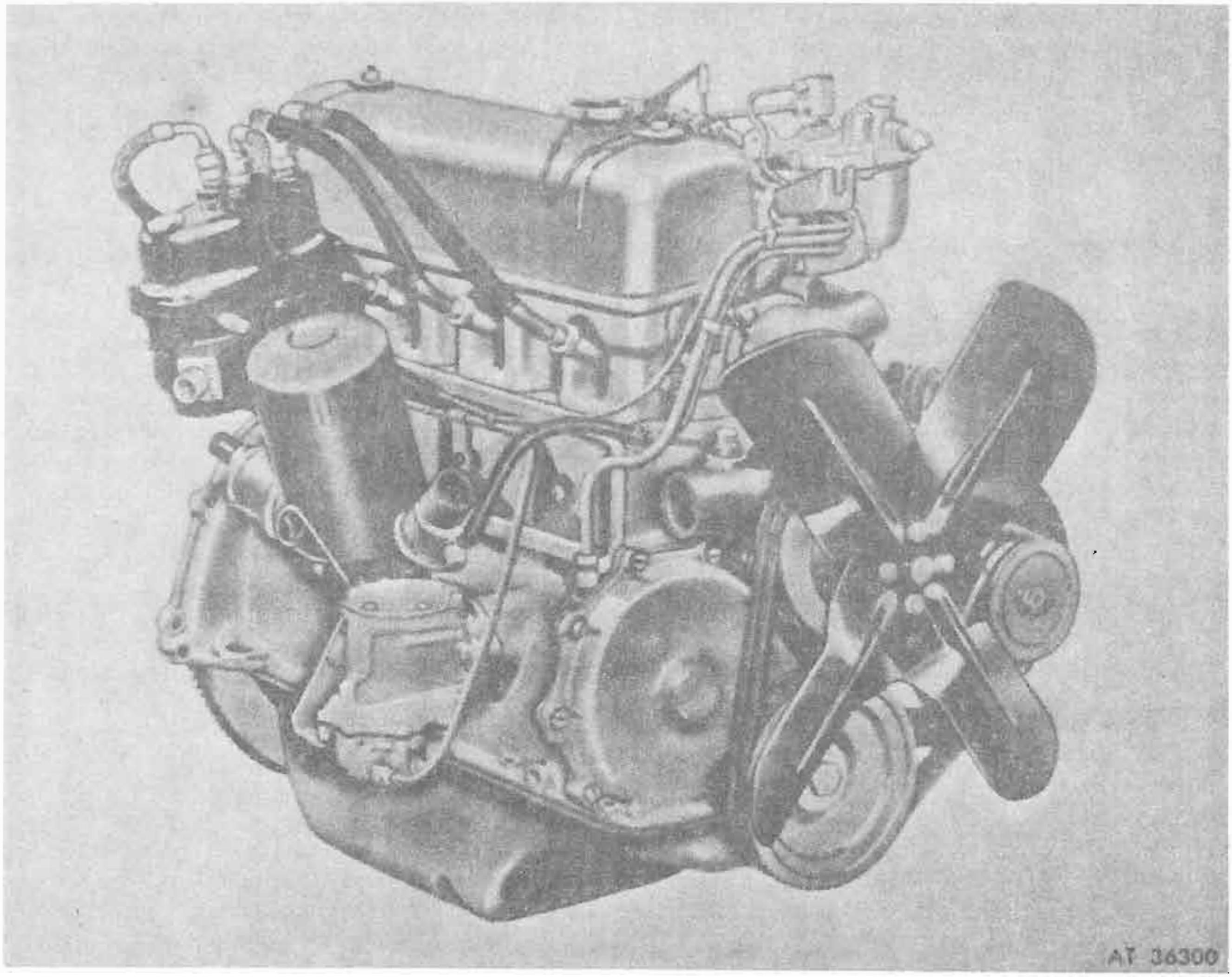


Figure 4-3. Engine with accessories, typical—right front view.

b. Cylinder Block. The cylinders are numbered from 1-4 starting at the front of the engine. Main bearings are supported by main bearing caps and three transverse webs integral with the cylinder block. Oil passages are drilled from the camshaft bearing bore through each transverse web, to the main bearing bores. Tappet guides are integral and are machined directly in the cylinder block. A stamped steel oil pan encloses the bottom of the cylinder block. A baffle is incorporated in the oil pan to prevent surging of the oil on sudden stops or fast acceleration. The magnetic drain plug is located at the rear of the pan. A die cast aluminum cover encloses the timing gears at the front of the cylinder block. A timing pointer is attached to the cover and extends to the timing mark on the front edge of the crankshaft pulley. A stamped steel push rod cover encloses the valve tappet chamber on the right side of the cylinder block.

c. Pistons and Connecting Rods. The pistons are cam ground and tapered, to provide accurate fit in the cylinder at all operating temperatures. The pistons have two compression rings and one oil ring. The top compression ring is chromium plated and the lower compression ring phosphate coated. The oil control ring assembly consists of a serrated spring expander and two chromium plated steel rails. Piston pins are tubular and full floating and are retained in the piston by snap rings. The connecting rods and caps are assembled with two bearing cap bolts and self-locking nuts. Bushings are pressed into the small end of each connecting rod for the piston pin. An oil hole is drilled in the rod just above the bearing cap bolt for cylinder wall lubrication. The connecting rod bearings are precision made, replaceable, and are interchangeable. A small tang on each half engages recesses in both rod and cap to prevent turning in the connecting rod bore.

d. Crankshaft and Main Bearings. The

crankshaft has three main bearing journals and integral counterweights. Holes drilled diagonally through each main journal and extending through the crank cheeks and crankpins provide direct passages for pressure lubrication to the connecting rods. An integral flange is provided for flywheel mounting. An oil slinger on the front and an integral slinger on the rear of the crankshaft control leakage by directing the oil away from the front and rear crankshaft. A crankshaft pulley is keyed to the front of the crankshaft and retained by a washer and bolt. The flywheel, bolted to the crankshaft, carries a starter ring gear on the outside diameter. Mounting holes are provided for the clutch assembly, which drives the transmission input shaft. The main bearings are precision made and are replaceable. A small tang on each half engages recesses in both the block and the main bearing cap to prevent turning in main bearing bores. Holes through the bearings aline with the oil passages drilled in the cylinder block. The center main bearing is a double flange type and controls crankshaft end thrust.

e. Cylinder Head. The cylinder head carries the valves, valve rocker arm and shaft assembly, intake and exhaust manifold, and the water outlet and thermostat. Valve guides are integral with the head and the valve seats are machined directly in the cylinder head. The valves are arranged from front to rear as follows: E(exhaust)-I(intake)-I-E-E-I-I-E. The valve rocker arm cover is attached to the top of the head to enclose the valve train.

f. Valve Train. Individual rocker arms, mounted on a hollow rocker shaft and operated by push rods and tappets contacting the camshaft, actuate the intake and exhaust valves. The intake and exhaust valve assemblies are free rotating type Intake valve stems are equipped with neoprene umbrella type shields to provide adequate valve stem and guide lubrication with positive oil control. The tappets are solid mushroom type, housed in bores in the cylinder block tappet chamber and operate directly on the camshaft lobes. The push rods are either solid forged or tubular with oil cushioned sockets. Valve clearance is maintained by self-locking adjusting screws on the rocker arms. The hollow camshaft, forming the main oil gallery, is supported by three bearings pressed into the right side of the block and is driven through a helical gear in mesh with a gear on the crankshaft. Camshaft thrust is controlled by a thrust plate located between the camshaft gear and the front journal of the camshaft. The camshaft gear is keyed to the front of the camshaft and retained by a bolt and lock tab washer. An eccentric on the camshaft operates the vacuum pump or fuel pump, and an integral helical gear at the rear drives the oil pump and distributor.

g. Sending Units. An oil pressure sending unit is located to the rear of the oil filter adapter on the right side of the engine. An electric type sending unit is located at the rear of the cylinder head and indicates coolant temperature. On the M151, M151A1, M151A1C, and M718 vehicles, an oil pressure actuated switch is located to the front of the oil filter adapter on the right side of the engine. This switch disconnects the electric fuel pump by opening the fuel pump circuit when oil pressure drops below 2½ to 5½ psi. Its purpose is to prevent flooding the carburetor and possible hydrostatic lock or a fire hazard should the engine stall when unattended.

h. Manifolds. The exhaust manifold is a tubular steel with four rectangular exhaust port openings. It is mounted on the left side of engine and is attached to machines exhaust saddle mounts in the cylinder head. The manifold is retained by clamping at each end and at the two center exhaust ports. Manifold alinement is maintained by bolting the exhaust outlet flange bracket to the cylinder block. The intake manifold is a casting with four rectangular ports in cylinder head mounting surface. It is bolted to the left side of the cylinder head. The carburetor is mounted to the side of the intake manifold. Intake manifold heat is obtained by clamping the intake manifold around the exhaust manifold at the two center exhaust ports. Transfer of heat from the exhaust gases assists in vaporizing the incoming fuel mixture. A tapped hole in the top center of the intake manifold is provided for crankcase ventilation valve.

4-3. Engine Systems

a. Ignition System. The distributor is mounted on the right side of the engine and is driven through a tang and slot-type intermediate shaft by the oil pump driven shaft (figs. 4-4 and 4-5). The distributor is a compact unit containing the ignition coil, spark advance mechanism, cam, and breaker plate assembly. The distributor is waterproof, and is shielded to eliminate radio interference. High tension current is delivered to the spark plug in each cylinder by individual radio-shielded cables. The distributor is ventilated.

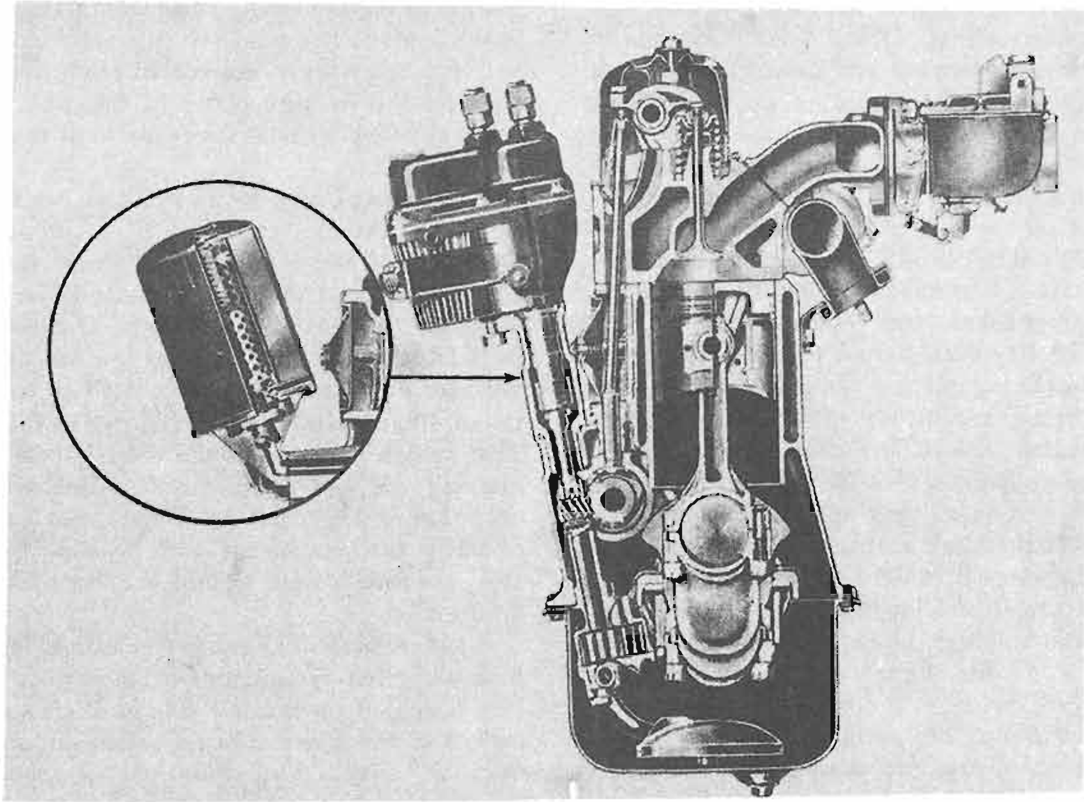


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Figure 4-4. Engine—cross sectional view.

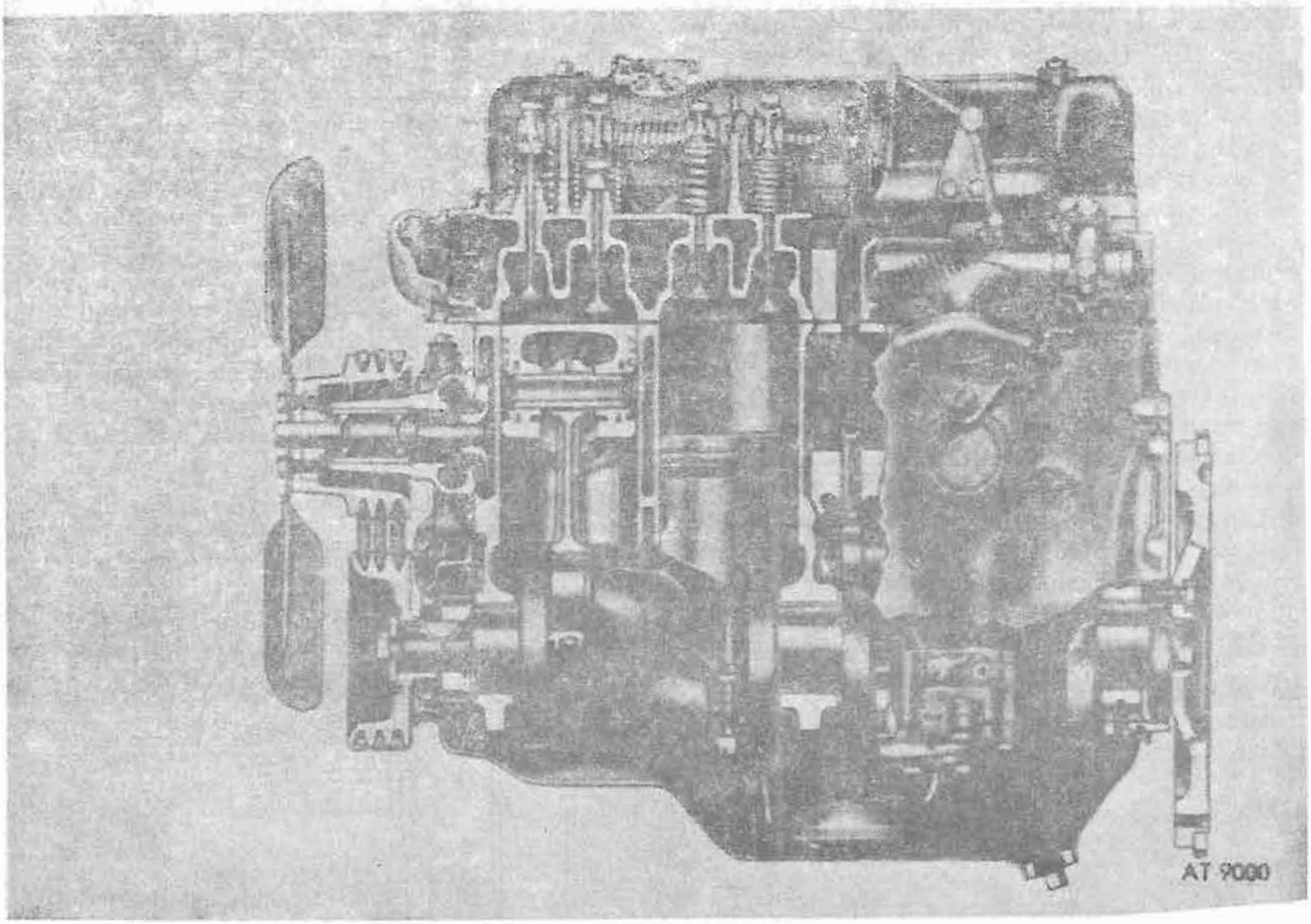


Figure 4-5. Engine—longitudinal view.

b. Fuel System.

(1) *M151, M151A1, M151A1C, and M718.* A tank mounted electric type fuel pump supplies fuel to a single venturi side draft-type carburetor, mounted on the intake manifold on left side of the engine. In the Holley carburetor only, the float chamber is vented to the air cleaner to preclude entry of a contaminant or water. The carburetor is mechanically controlled with an accelerator (throttle) pedal or a hand-operated throttle control. It is equipped with a manual choke which is connected to the throttle linkage to allow fast idle when the choke is in use.

(2) *M151A2, M825 and M718A1.* A mechanical type fuel pump is mounted on the right side of the engine and actuated by a camshaft eccentric. Fuel enters the pump from the tank through a filter at the end of the pickup tube. Fuel is delivered to the carburetor from the pump through an in-line fuel filter, enters the carburetor at the vapor diverter chamber and passes directly into a gallery above the fuel needle. Any vapors present pass through a return line at the top of the diverter chamber and return to the fuel tank. The carburetor is mechanically controlled with an accelerator (throttle) pedal or a hand-operated throttle control. It is equipped with a manual choke which is connected to the throttle linkage to allow fast idle when the choke is in use.

c. Lubrication System. Positive full-pressure lubrication (fig. 4-6) is provided by a gear type oil pump driven off the camshaft. A spring-loaded relief valve in the pump controls pressure in the system. Oil relieved by the valve is directed back to the intake side of the pump. The oil is picked up from the oil pan sump through a screened inlet and is pumped through a short drilled passage in the cylinder block to the full-flow-type filter. The filter has an integral relief valve. The filter relief valve permits oil to bypass the filter element if it becomes clogged, thereby maintaining an adequate emergency supply of oil to the engine at all times. An antidrain-back diaphragm prevents a reverse flow of oil when the engine is stopped. From the filter, the oil flows to the crankshaft center main bearing and through the center cam bearing into the hollow camshaft which forms the main oil gallery. The front and rear main and camshaft bearings are lubricated directly from this gallery. Connecting rod bearings are pressure lubricated from the main bearings through drilled passages in the crankshaft. The supply hole in the connecting rod journal of the crankshaft alines with a drilled hole in each connecting rod once each revolution, providing intermittent lubrication for the cylinder walls, pistons and piston pins. The camshaft thrust plate and timing gears are lubricated by run-off from the front camshaft bearing. An oil slinger directs excessive oil away from the crankshaft front and rear oil seals. Oil under reduced pressure flows to the rocker arm shaft from two intermittently indexing flats on the camshaft rear journal. A drilled passage from the camshaft rear bearing connects through an oil tube to the top side of the rocker arm shaft rear support to provide oil to the hollow rocker shaft. Oil from the rocker shaft is directed through drilled holes to lubricate rocker arms, valve stems, and push-rod sockets. Excess oil spirals down the rotating push rods and assists in lubricating the tappets and push rod sockets. A tube connected at the second rocker arm shaft support carries overflow oil to the camshaft and oil pump drive gear. Oil from each rocker arm drains into the tappet chamber through the push-rod-holes in the cylinder head and block. Excessive oil in the tappet chamber drains into the oil pan through an opening in the rear of the block and a drilled hole in the front of the block. Neoprene-type shields are fitted to the intake valve stems to control the amount of oil reaching the valve guides. The umbrellas move up and down with the valve, permitting an oil mist to enter the guide when the valve is closed, but covering the entrance when the valve is open.

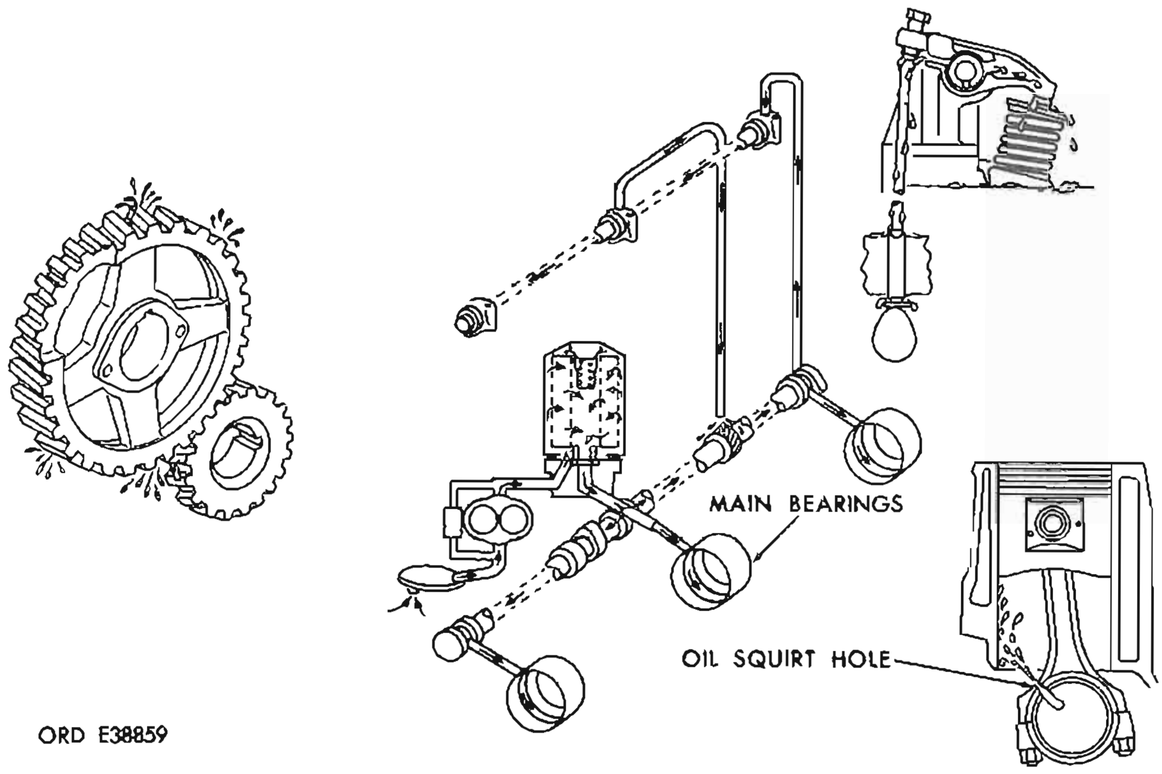


Figure 4-6. Engine lubricating system—oil flow diagram.

d. Cooling System. The coolant circulation follows a series flow pattern. The coolant is drawn from the bottom of the radiator by a centrifugal type water pump mounted on the front of the block, and circulates the coolant to the cylinder block (fig. 4-7). The pump, belt-driven from the crankshaft pulley, contains a sealed and permanently lubricated double-row ball bearing unit, with integral water pump shaft. The water pump housing contains a bleed hole for drainage of coolant that may leak past the seal. As coolant enters the block, it travels through passages cooling the entire length of each cylinder wall. Upon reaching the rear of the cylinder block, the coolant is directed upward into the cylinder head, where it cools the areas around the combustion chambers, spark plugs, valves, and valve seats on its return to the front of the engine. At this point, the coolant flows into the water outlet connection on the front of the cylinder head, through the water thermostat, and into the top of the radiator. If the thermostat is closed, a small portion of the coolant is returned to the water pump for recirculation. A drilled passage, connecting the cylinder head with the inlet side of the pump, allows constant recirculation of coolant within the block and head when the thermostat is closed, to prevent local hotspots. The thermostat is retained in the cylinder head by the water outlet connection. This restricts the flow of coolant to the radiator until a temperature of 180° F is reached. It opens fully at 202° F. The entire system is pressurized to 7 psi by the use of a pressure radiator cap. Air drawn through the shrouded radiator by the fan, mounted on the water pump pulley, and the forward motion of the vehicle cools the coolant in the radiator. The thermostat should always be installed with the valve facing out.

e. Ventilation System. Positive and separate ventilation for the engine and distributor pressure shutoff switch is provided by using tubing, rubber hose, metering control valve, and various tube fittings. The system utilizes vacuum from the intake manifold to remove fuel and water vapors from the engine and to ventilate the distributor assembly. The engine is designed to operate or remain submerged under a two-foot head of water with no leakage into engine. Clean filtered air from the carburetor air cleaner is taken at the carburetor air horn and piped through a fitting in the center of the intake manifold to the lower right front of the cylinder block. This air circulates upward through a large opening at the rear of the tappet chamber and to the cylinder head rocker arm chamber. Ventilating air and crankcase fumes are exhausted from the rocker arm chamber, through an automatic metering contol valve, into the intake manifold. Manifold vacuum thus maintains a continuous circulation of air through the crankcase. Ventilation of the distributor is completely separate from the engine ventilating system. This eliminates the possibility of crankcase fumes entering the distributor. Clean filtered air is taken from the carburetor air horn and piped to the front of the distributor. This air exhausts from the rear of the distributor, through a metered hole in the line fitting, into the intake manifold. Manifold vacuum thus maintains a continuous circulation of air through the distributor.

4-4. Engine Data

The following tabulated data (table 4-1) is limited to the basic engine assembly. Refer to table 4-2 for accessory make and model numbers.

Table 4-1. Engine Data

Make	Army.
Type	gasoline, liquid-cooled, 4-cylinder, in-line.
Models	M151, M151A1, M151A1C, M718, M151A2, M825, M718A1.
Dimensions (over-all):	
Length	26.87 in.
Width	21.43 in.
Height	23.01 in.
Weights:	
Dry, less accessories	259 lb.
Dry, less accessories	328 lb.
Speed:	
Idle	500-550 rpm
Warmup	100-1200 rpm
Horsepower gross	71@ 4000 rpm
Torque gross	128 lb.-ft. @ 1800 rpm
Cylinder:	
Number	4
Arrangement	in-line
Firing order	1-3-4-2
Dimensions	bore 3.875 in., stroke 3.00 in.
Displacement	141.5 cu. in.
Compression @ cranking speed	135 to 145 psi
Compression ratio	7.50-to-1.
Cooling:	
Type	forced circulation, pressure-type w/radiator, thermostat, engine belt drive water pump, and fan.
Engine operating temp (normal)	170 to 190°F.
Control	thermostat, spring and cartridge-type.
Opening range	180° F.
Fully open	202° F.
Capacity engine (coolant)	4 qt.
Total coolant capacity with radiator	8 qt.
Pump	centrifugal type.
Drive	2 "vee" wedge belts (25-amp system), 3 "Vee" wedge belts (60-amp system).
Capacity (pump	28 gpm @ 4000 rpm.

Radiator cap	7 psi, controlled pressure type.
Fan	4-blade.
Drive from crankshaft	clutch drive from face of flywheel.
Crankshaft rotation	clockwise viewed from the front.
Camshaft rotation	counterclockwise viewed from the front.
Valve overlap	35 deg.
Ignition:	
Timing	6° before top center initial (or at 400-500 rpm). 36° before top center full advance at 4000 rpm.
Spark advance	centrifugal—automatic.
Distributor drive	oil pump through a tang and slot type intermediate shaft.
Rotation (rotor end)	clockwise
Contact gap	0.017-0.022
Spark plug gap	0.029 to 0.032 in.
Fuel system:	
Fuel	regular grade gasoline—95 minimum-research octane.
Induction	naturally aspirated.
Carburetor	single venturi side draft with manual choke and fast-idle linkage to throttle and vented bowl.
Air cleaner:	
Type	oil bath top acess.
Oil Capacity	2.5 pt.
Fuel Pump:	
M151, M151A1, M151A1C, M718 type	electric-plunger, tank-mounted.
Pressure	4-to-5 psi.
Filter	impregnated paper (part of fuel pump).
Fuel grade	MIL-G-3056, 95 minimum-research octane.
Fuel Pump:	
M151A2, M825, M718A1 type	Mechanical (camshaft actuated)
Pressure	5-to-6 psi
Filter	inline monel screen
Valve timing:	
Exhaust opens	55 deg B.B.D.C. (before bottom dead center).
Exhaust closes	22 deg A.T.D.C. (after top dead center).
Intake opens	13 deg B.T.D.C. (before top dead center).
Intake closes	68 deg A.B.D.C. (after bottom dead center).
Valve clearance:	
Intake (hot setting)	0.015 in.
Exhaust (hot setting)	0.015 in.
Lubrication:	
Oil Specifications:	
32° to 120° F	OE 30 (MIL-L-2104)
—10° to 40° F	OE 10 (MIL-L-2104)
—65° to 0° F	OES (MIL-L-10295)
Normal oil pressure at idle	15-30 psi
Normal oil pressure at operating speed	35-45 psi
System type	full-pressure lubrication
Oil pump:	
Type	gear with integral pressure relief valve.
Capacity	6.3 gpm @ 4000 rpm.
Drive	camshaft helical gear
Oil filter	fuel flow-disposable canister type.
Oil required for oil change	4 qt.
Oil required for dry engine	5 qt.
Ventilation system:	
Crankcase ventilation	closed-circuit, including ventilation control valve at intake manifold.
Distributor ventilation	independent, positive closed type, w/fixed metering orifice to intake manifold.
Vacuum pump	diaphragm type, cam driven, (10.5 in. mercury min. @ 1800 rpm) (M151, M151A1, M151A1C, M718).
Drive ratios:	
Accessory drive ratios (accessory to crankshaft) and rotation viewed from accessory mounting face.:	
Cooling fan and water pump	1.2:1 clockwise.
Distributor	0.5:1 clockwise
Generator	1.8:1 clockwise.
Starter	12.7:1 clockwise.
Vacuum Pump	0.5:1 actuated by camshaft.

4-5. Accessory Data

a. Refer to field maintenance manual TM 9-2920-214-35 for information, data and repair of the Delco Remy (25-amp) generator.

b. Refer to field maintenance manual TM 9-2920-247-34 for information, data and repair of the Prestolite (25-amp) generator.

c. Refer to field maintenance manual TM 9-2920-225-35 for information, data and repair of the Leece-Neville (60-amp) generator-alternator.

Table 4-2. Accessory Data

Accessory	*Manufacturer*	*Model or Ord No.*
Generator	Delco Remy	1117495
Generator	Autolite	GHA-4802-UT
Generator	Leece-Neville	No. 3002 AA
Starter	Autolite	MC24005 UT
Distributor	Autolite	IAU 4020 UT
Spark plugs	Champion, Autolite AC or Blue Crown.	MS-35909-2
Vacuum pump	AC	11599015 (M151, M151A1, M151A1C and M718 only).
Fuel pump	Bendix	7017601 (M151, M151A1, M151A1C and M718 only).
Fuel pump	AC, Airtex	11640994 (M151A2, M825, M718A1 only).
Fuel Filter	Skinner	477088 (M151, M151A1,
Fuel Filter		M151A1C, M718 only).
Oil Filter	Purolator	11640944 (M151A2, M825,
Breather valve		M718A1 only).
Air CleanerAir Cleaner	Walker (opt) Wix	11630417
Low oil pressure switch	AC	11630591
Oil pressure sending unit	United Specialties Co.	7044861
Water temp sending unit	Carter	A 2770S
Carburetor (M151, M151A1,	AC	1508092
M151A1C and M718).	AC	1512779
Carburetor (M151A2, M825 and	Zenith, (opt) Holley.	10939511
M718A1).		7017440.
Thermostat	Zenith, (opt) Holley.	11641105
Radiator Cap		7017440-1.
	Dole Valve Co.	7998568
	Ordnance	MS-35840-1

Section II. POWER PLANT ASSEMBLY, REMOVAL AND INSTALLATION

4-6. General

The power plant assembly (fig. 4-8) consists of the engine, clutch, transmission and transfer, parking brake, radiator and all the various engine accessories, less the air cleaner and transmission and transfer shift levers. The power plant assembly can be removed as a unit without draining the cooling system, engine oil, or transmission oil. The radiator and all of the engine accessories can be replaced without removal of the power plant assembly. To replace the engine, transmission, or transfer, the power plant assembly must be removed from the vehicle. For description of the engine refer to paragraph 4-2. Coordinate engine replacement with support maintenance personnel. Engine replacement must be recorded in DA Form 2408-1 in accordance with TM 38-750.

4-7. Power Plant

a. Removal. M151, M151A1, M151A1C, and M718 vehicles. Remove power plant assembly by following the operations given in steps (1) through (34) below and shown in figures 4-9 through 4-54.

(1) Remove the front seat retaining pins located at the bottom of the two front seats (fig. 4-9).

(2) Pull out the locking pin (fig. 4-10) from the bottom rear of each front seat and remove seats.

(3) Open front and rear hold down snap clips on battery cover and remove cover (fig. 4-11). Lift cover up while removing.

(4) Loosen nut and remove ground cable from battery terminal post (fig. 4-12).

(5) Remove gearshift knobs. Remove six screws and lockwashers securing boot retainer to transmission cover plate and remove boots and boot retainer. Remove twelve screws and lockwashers securing transmission cover plate to floor panel (fig. 4-13). Remove transmission plate.

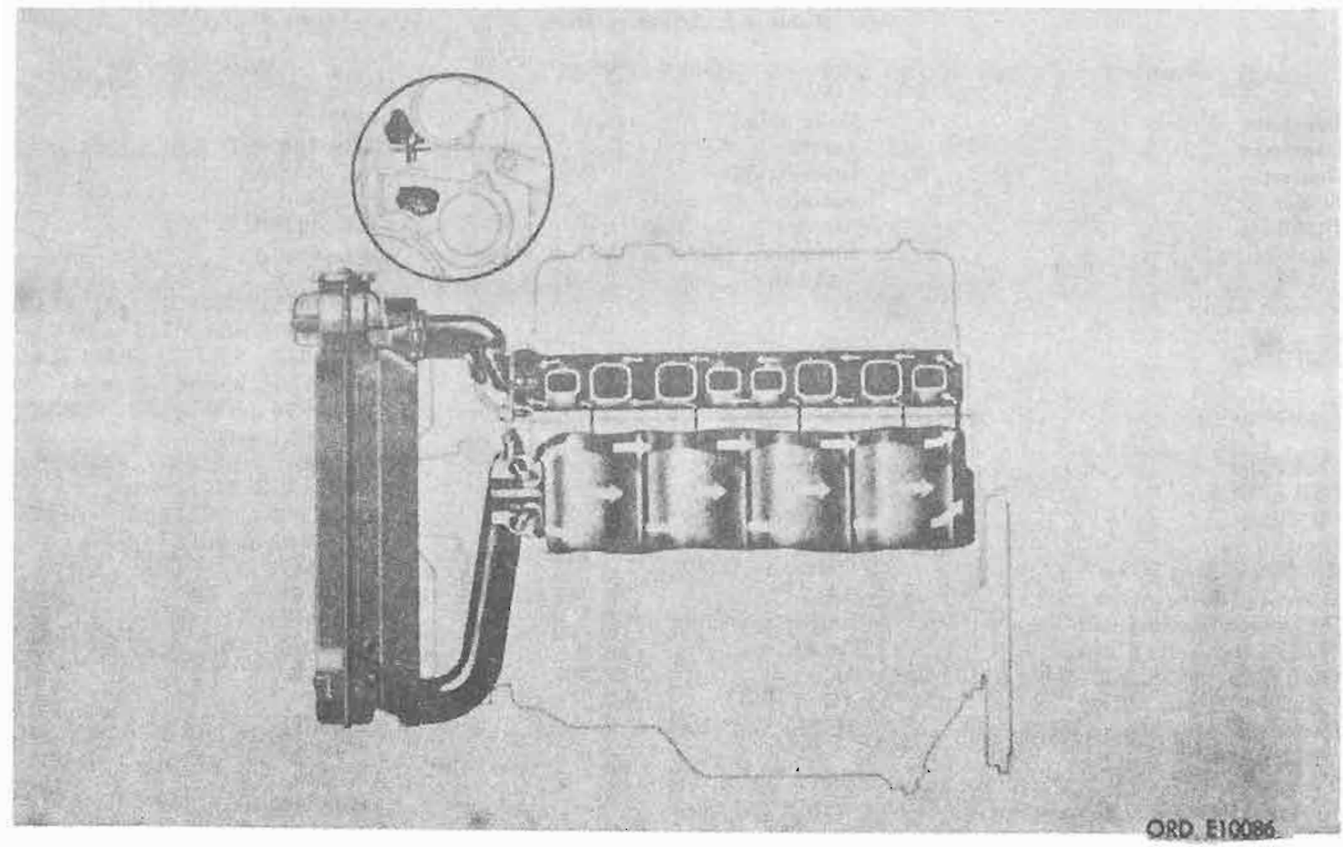


Figure 4-7. Engine cooling sytem—coolant flow diagram.

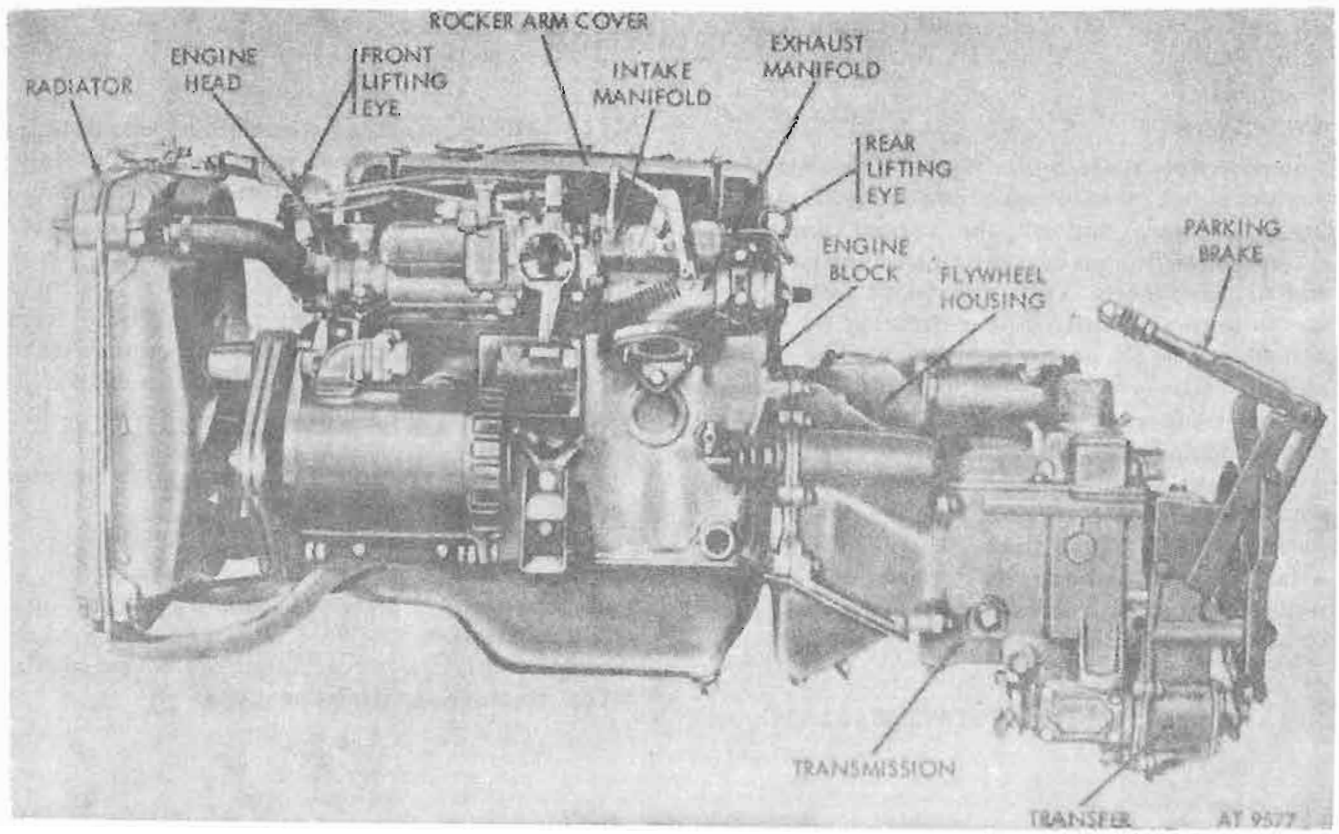


Figure 4-8. Side view of complete power plant assembly.

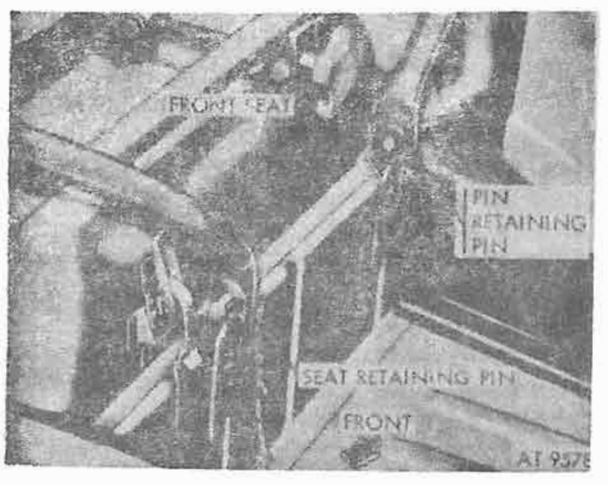


Figure 4-9. Front seat retaining pins.

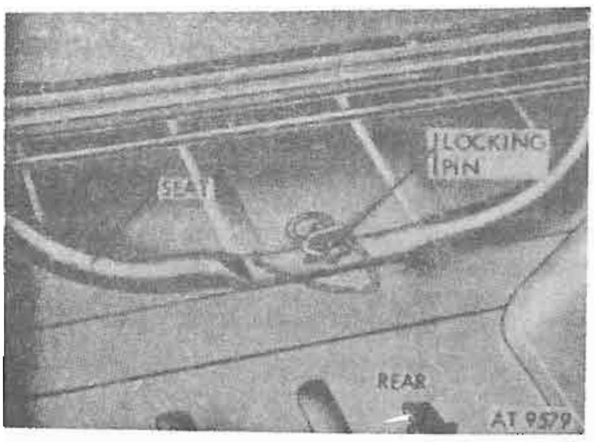


Figure 4-10. Front seat locking pin.

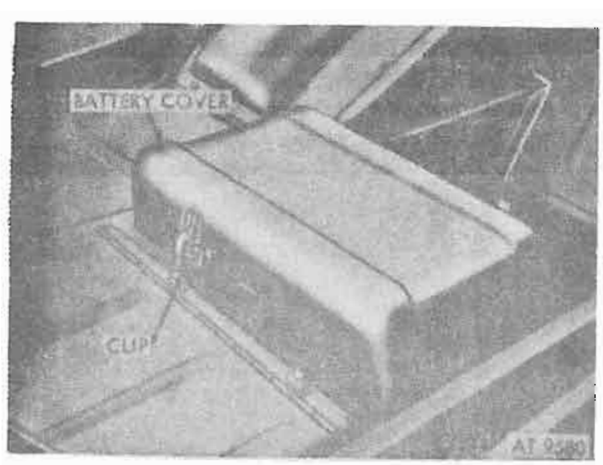


Figure 4-11. Remove battery cover.

(6) Loosen screw and nut on clamp and remove gearshift boot (fig. 4-14). Unscrew cap and remove gearshift lever, retainer, and spring. Tape clean rag over gearshift opening.

(7) Disconnect speedometer cable from drive adapter (fig. 4-15). Remove speedometer cable from clip beneath starter. Remove nut and flat washer securing electrical cables to starter terminal.

(8) Remove two bolts and lockwashers securing parking brake lever to transfer case (fig. 4-16).

(9) Drop lever forward and remove two rear support mounting bolts and washers (fig. 4-17).

(10) Remove four bolts (both ends) securing front propeller shaft to transfer and differential (fig. 4-18).

(11) Remove four bolts securing rear propeller shaft to transfer output shaft flange (fig. 4-19).

(12) Remove cotter pin and flat washer and spring washer (fig. 4-20). Remove transfer shift lever from shaft.

(13) Remove two locknuts and bolts at clamp securing muffler inlet pipe and exhaust pipe (fig. 4-21).

(14) Remove cotter pin and flat washer and disengage clutch (fig. 4-22). Remove two bolts and locknuts securing clutch release lever housing to housing bracket.

(15) Remove clutch release lever and housing (fig. 4-23).

NOTE

Be careful not to lose two washers, split brass bushings (4 ea.) and spring.

(16) Disconnect eight connectors from headlights and blackout marker lights (fig. 4-24).

(17) Remove six screws and lockwasher assemblies (and six washers) securing brush guard to fenders. Remove brush guard (fig. 4-25).

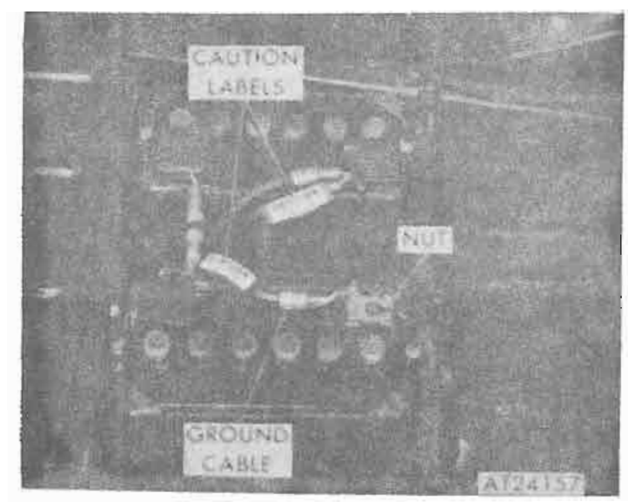


Figure 4-12. Disconnect battery cable.

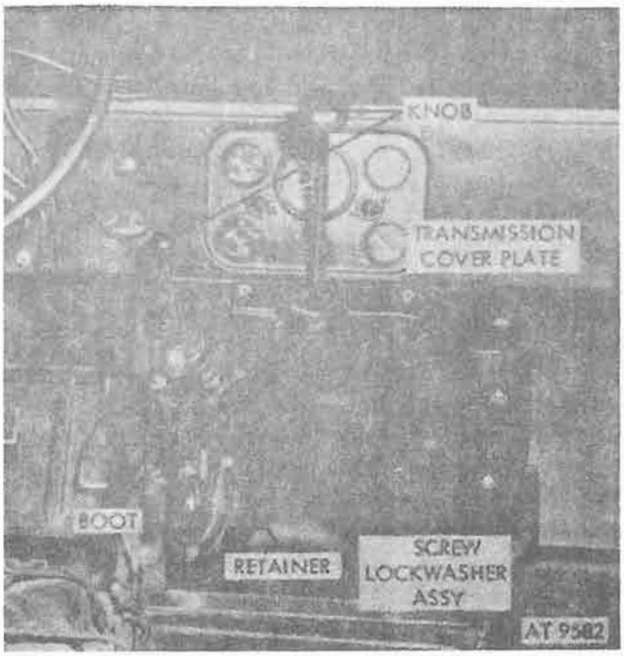


Figure 4-13. Transmission cover plate.

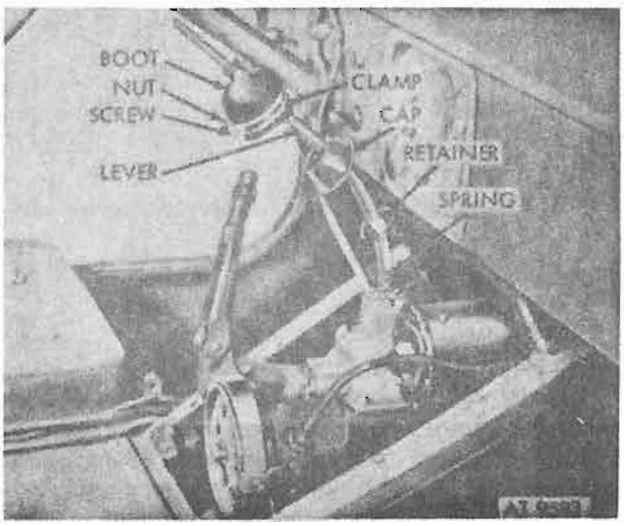


Figure 4-14. Gear shift lever.

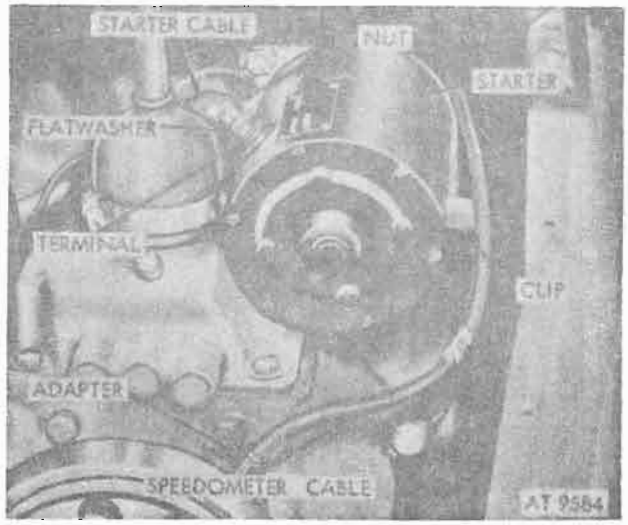


Figure 4-15. Speedometer cable.

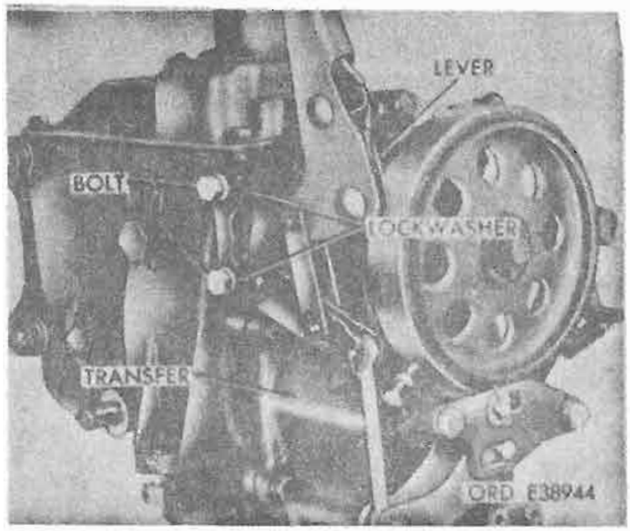


Figure 4-16. Parking brake lever.

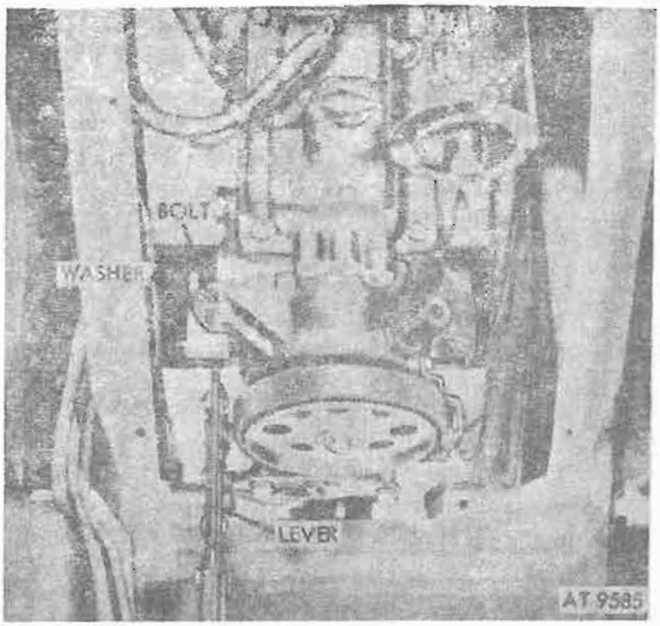


Figure 4-17. Rear support mounting bolts and washers.

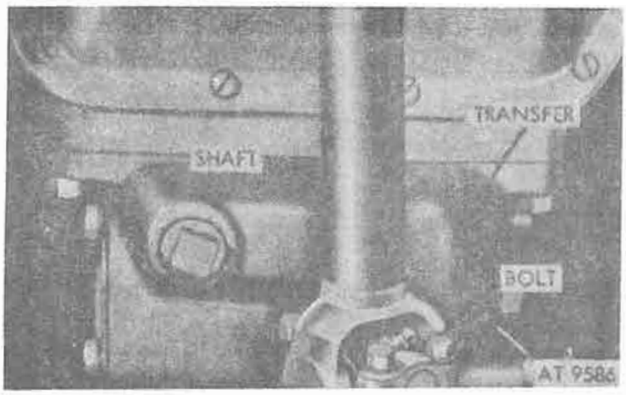


Figure 4-18. Front propeller shafts.

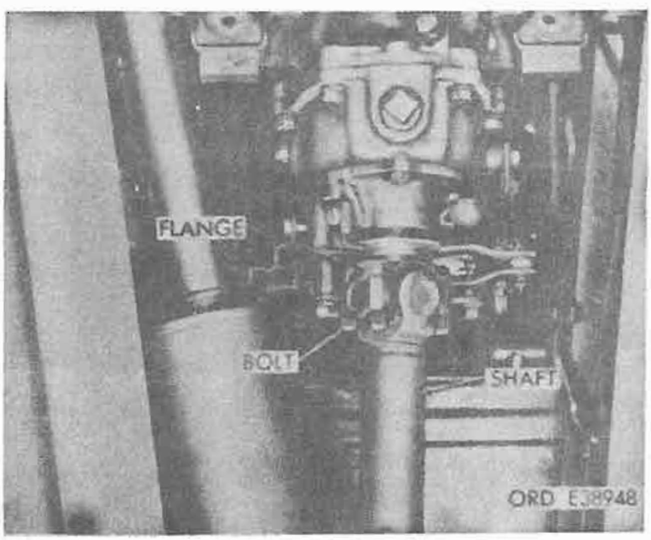


Figure 4-19. Rear propeller shaft.

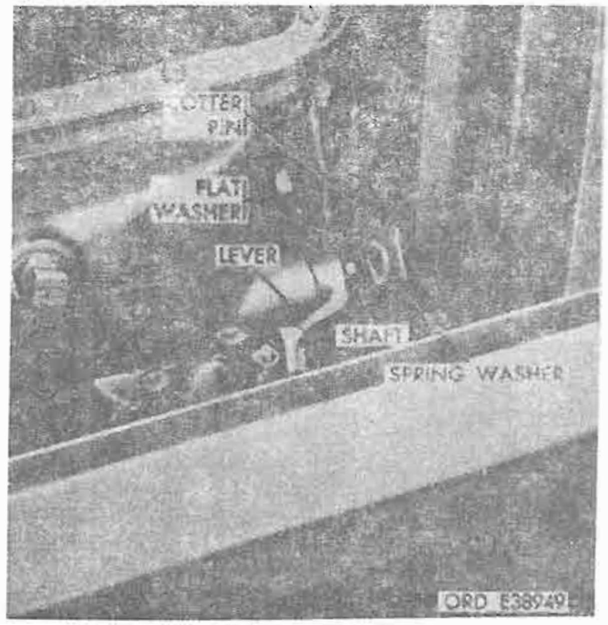


Figure 4-20. Transfer shift lever and shaft.

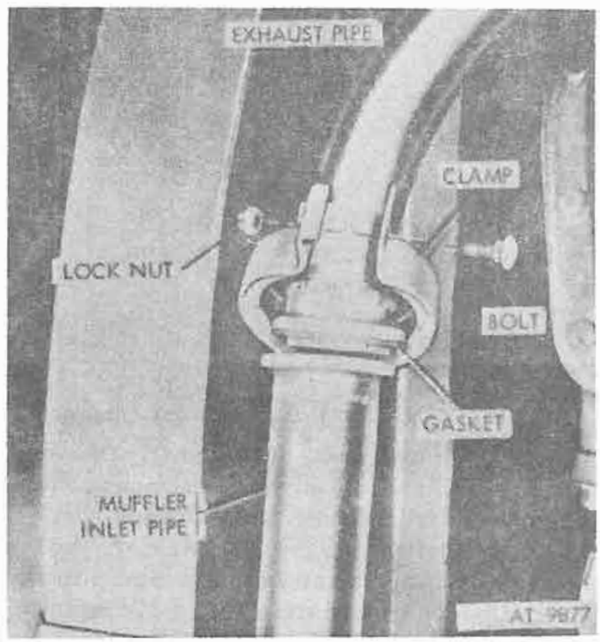


Figure 4-21. Exhaust pipe and clamp.

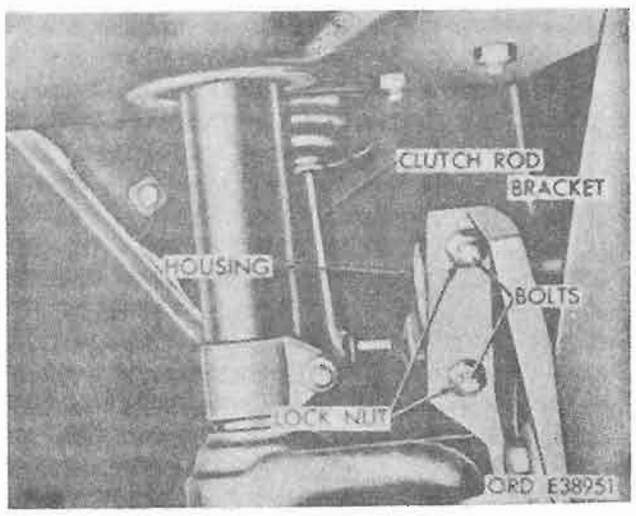


Figure 4-22. Disengage clutch rod.

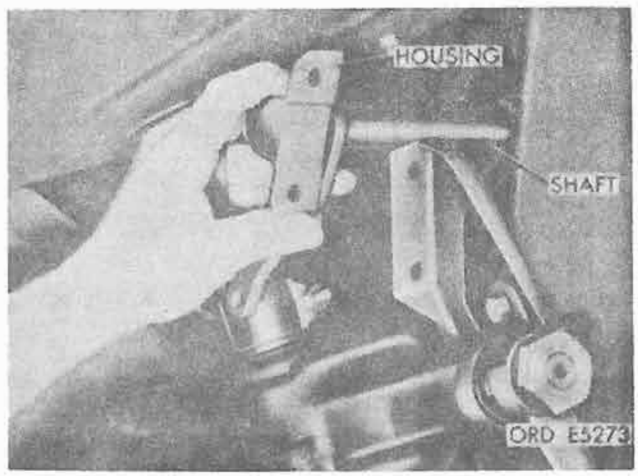


Figure 4-23. Clutch cross shaft and housing.

(18) Remove bolt, lockwasher, and washer securing vacuum hose clip to horn mount. Remove vacuum hose from fitting at the firewall (fig. 4-26).

(19) Remove screw, lockwasher, and flat washer securing strap and vacuum pump to engine block. Remove ground strap (fig. 4-27) and replace screw and washers.

(20) Loosen connector and remove fuel inlet hose. Loosen clamps and remove carburetor intake hose (fig. 4-28).

(21) Loosen clamp and remove float chamber vent hose from air cleaner. Loosen connector and remove fuel vent line, Holley carburetor only (fig. 4-29).

(22) Loosen clamp and remove fuel pump safety switch (oil pressure safety switch) vent hose from air cleaner. Remove four screw and washer assemblies securing air cleaner to bracket. Remove air cleaner (fig. 4-30).

(23) Using a spanner wrench, unscrew generator to regulator cable at generator (fig. 4-31).

(24) Remove clip and loosen two screws securing choke control cable (fig. 4-32).

(25) Remove clip securing accelerator rod to bell crank (fig. 4-32).

(26) Remove two brass nuts securing muffler inlet pipe to exhaust manifold. Remove pipe from manifold (fig. 4-33).

NOTE

Pipe will drop free when disconnected.

(27) Remove left front bracket mounting bolt flat washer and lockwasher (fig. 4-34).

NOTE

A clip was used prior to vehicle 2P4999, replaced by a flat washer.

(28) Unscrew ignition distributor electrical connector from distributor. Disconnect oil pressure sending unit electrical connector (fig. 4-35).

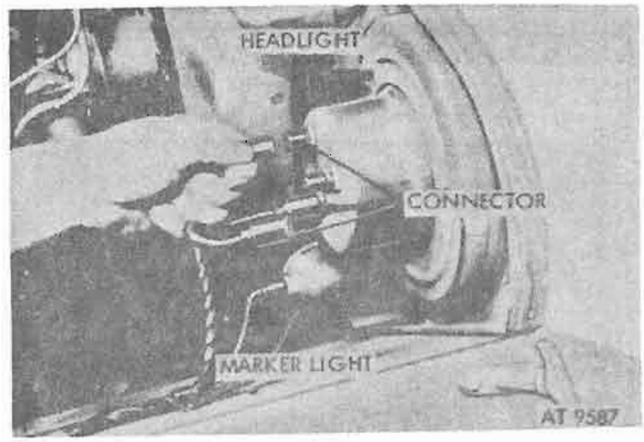


Figure 4-24. Headlight and marker light connectors.

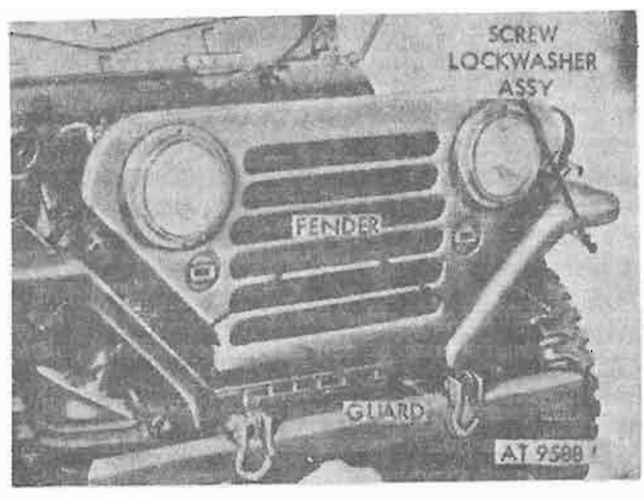


Figure 4-25. Remove brush guard.

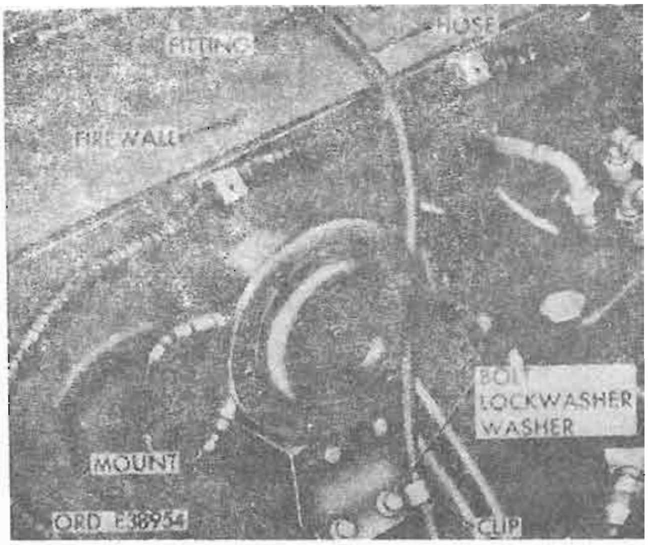


Figure 4-26. Remove vacuum hose from fitting at firewall.

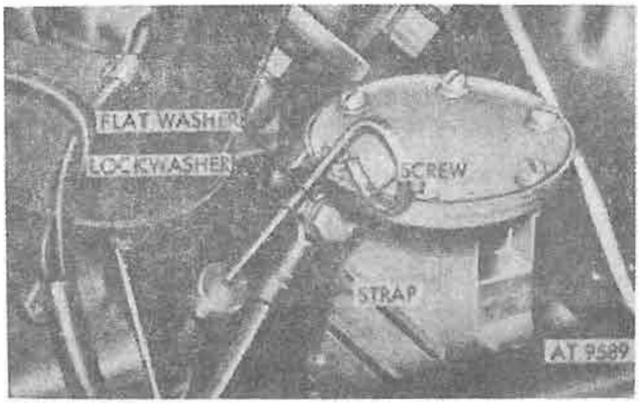


Figure 4-27. Engine ground strap.

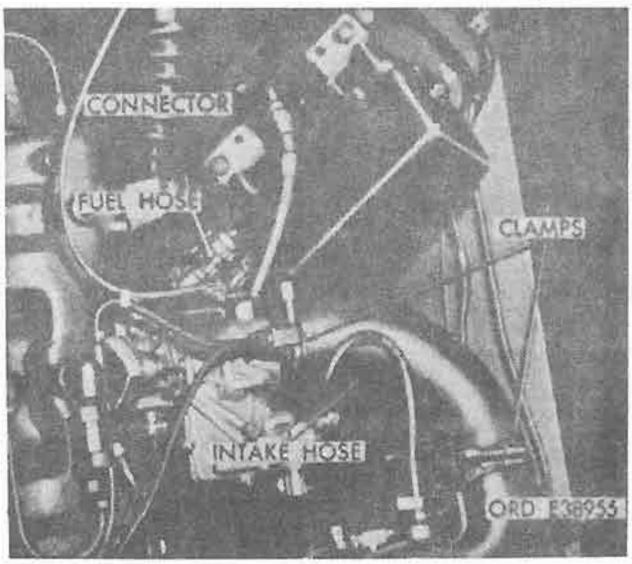


Figure 4-28. Fuel inlet and carburetor intake hoses.

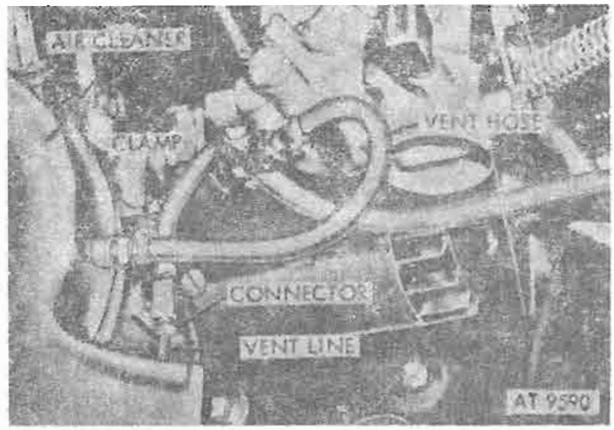


Figure 4-29. Float chamber vent hose and fuel vent line.

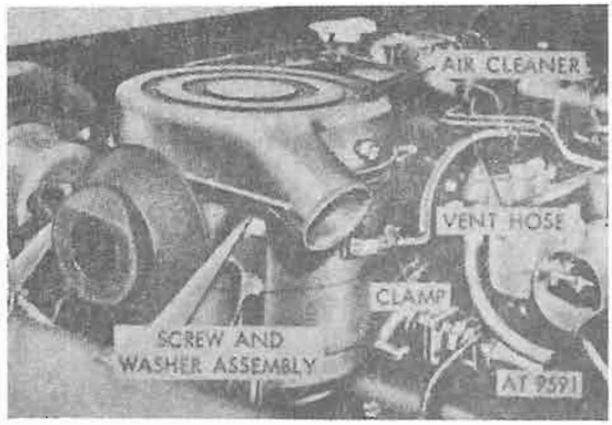


Figure 4-30. Remove air cleaner.

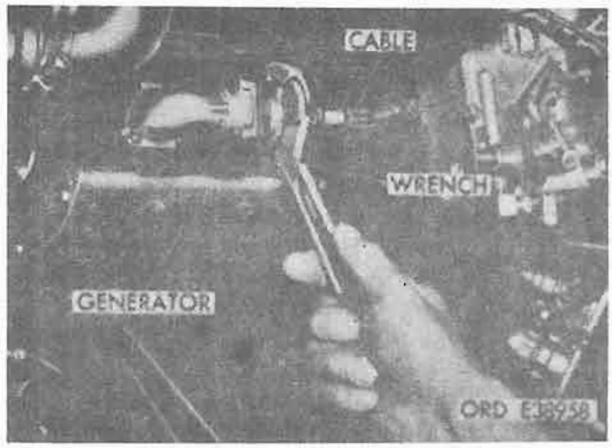


Figure 4-31. Generator to regulator cable at generator.

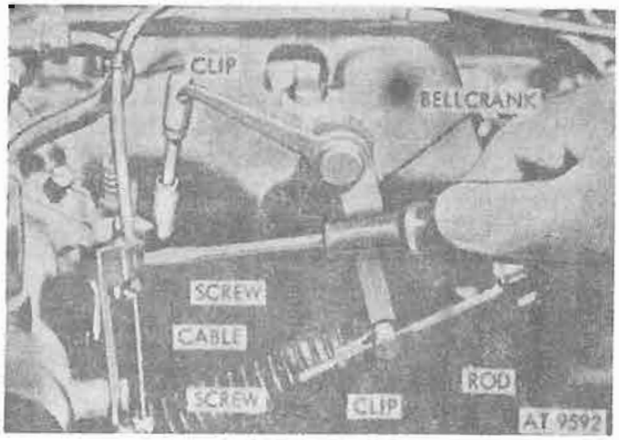


Figure 4-32. Choke control cable and accelerator rod.

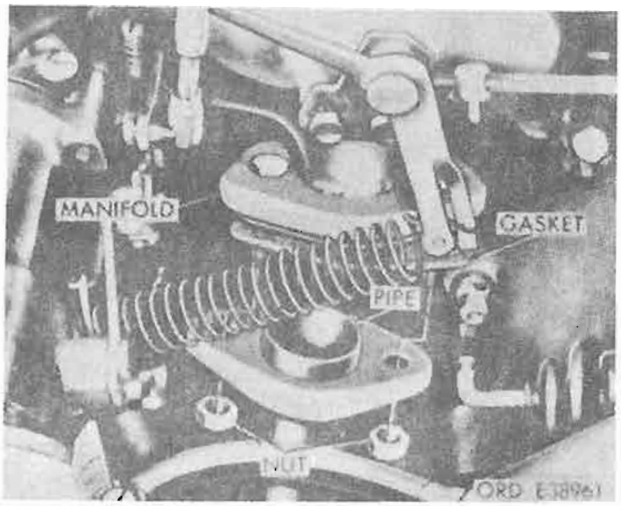


Figure 4-33. Pipe from manifold.

(29) Pull electrical connector (fig. 4-36) from fuel pump safety switch (oil pressure safety switch).

(30) Pull electrical connector from temperature indicator sending unit (fig. 4-37).

(31) Remove right front bracket mounting bolt and flat washer lockwasher (fig. 4-38).

NOTE

A clip was used prior to vehicle 2P4999, replaced by a flat washer.

(32) Hook sling into lifting eyes (fig. 4-39). Lift power plant assembly, counterbalancing front portion so as to prevent damage to adjacent parts.

(33) Continue lifting power plant assembly and push vehicle rearward (fig. 4-40).

(34) Place power plant assembly on supports for disassembly of transmission and flywheel housing.

b. Removal (M151A2, M825 and M718A1 vehicles).

(1) Remove two front seats by unhooking pin that secures retaining pin. Drive retaining pin out of its mounting position (fig. 4-9).

(2) Pull locking pin (fig. 4-10) from floor mounting position at rear of front seat, and lift front seat assembly away from vehicle. Remove other front seat in same manner.

(3) Release battery cover holddown clips and remove cover as shown in figure 4-11.

(4) Loosen nut at battery terminal ground cable post and disconnect ground cable (fig. 4-12).

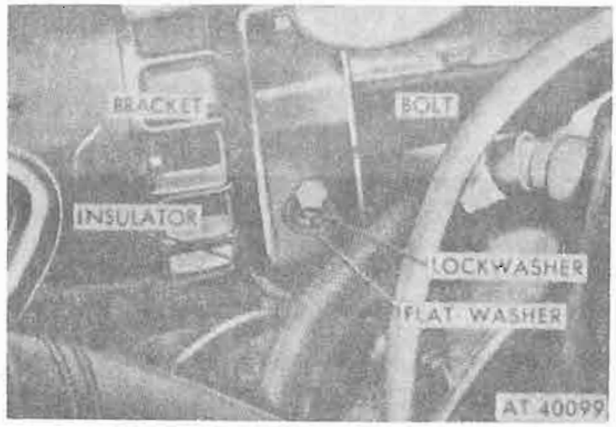


Figure 4-34. Left front bracket.

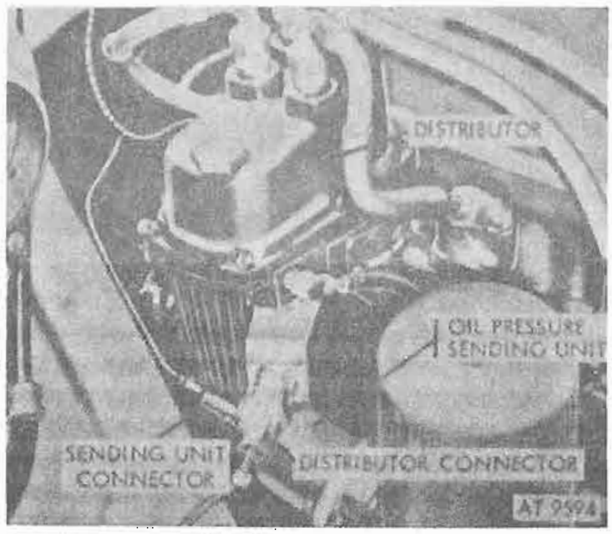


Figure 4-35. Oil pressure sending unit.

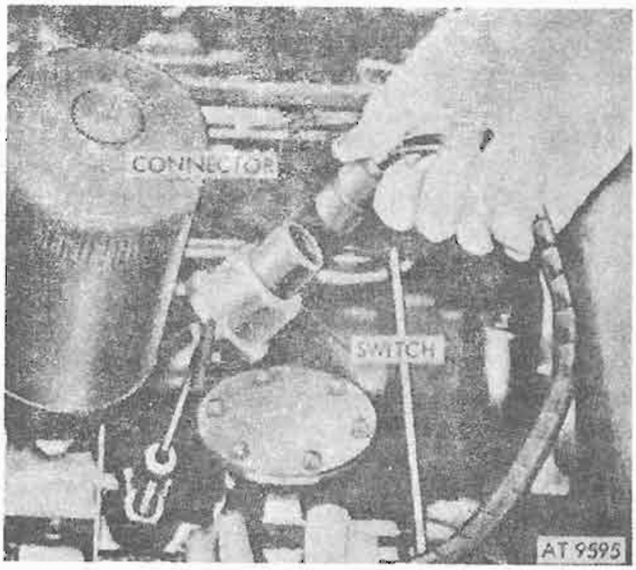


Figure 4-36. Fuel pump safety switch (M151, M151A1, M151A1C and M718 vehicles).

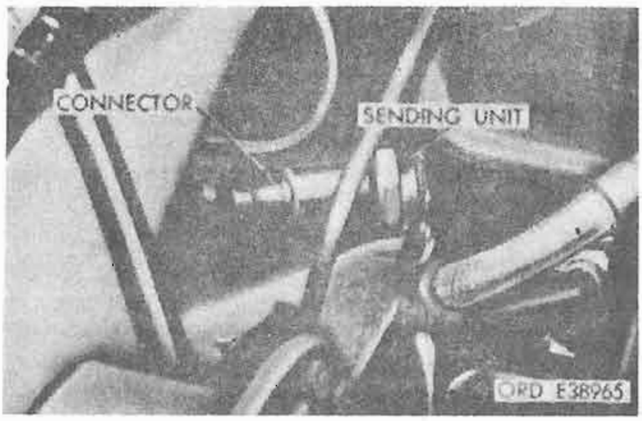


Figure 4-37. Temperature indicator sending unit.

Figure 4-38. Right front bracket mounting bolt and washer.

(5) Remove gearshift knobs. Remove six screws and lockwashers securing boot retainer to transmission cover plate and remove boots and boot retainer. Remove twelve screws and lockwashers securing transmission cover plate to floor panel (fig. 4-13). Remove transmission plate.

(6) Loosen screw and nut on clamp and remove gearshift boot (fig. 4-14). Unscrew cap and remove gearshift lever, retainer, and spring. Tape clean rag over gearshift opening.

(7) Disconnect speedometer cable from drive adapter (fig. 4-15). Remove speedometer cable from clip beneath starter. Remove nut and flat washer securing electrical cables to starter terminal.

(8) Remove two bolts and lockwashers securing parking brake lever to transfer case (fig. 4-16).

(9) Drop lever forward and remove two rear support mounting bolts and washers (fig. 4-17).

(10) Remove four bolts (both ends) securing front propeller shaft to transfer and differential (fig. 4-18).

(11) Remove four bolts securing rear propeller shaft to transfer output shaft flange (fig. 4-19).

(12) Remove cotter pin and flat washer and spring washer (fig. 4-20). Remove transfer shift lever from shaft.

(13) Remove two locknuts and bolts at clamp securing muffler inlet pipe and exhaust pipe (fig. 4-21).

(14) Remove cotter pin and flat washer and disengage clutch (fig. 4-22). Remove two bolts and locknuts securing clutch release lever housing to housing bracket.

(15) Remove clutch release lever and housing (fig. 4-23).

(16) Disconnect six electrical connections at both headlamp assemblies (fig. 4-41).

(17) Remove six screw and lockwasher assemblies (and six washers) securing brush guard and lift brush guard away from vehicle (fig. 4-25).

(18) Remove screw, lockwasher and flat washer securing ground cable to horn mounting bracket (fig. 4-42).

(19) Disconnect inlet hose at fuel pump (fig. 4-42).

NOTE

If heater assembly is installed to vehicle, loosen two clamps and disconnect two heater hoses at shut off cocks (cocks are near water pump at front right side of engine head) (fig. 4-42).

(20) Disconnect fuel line and intake hose at carburetor (fig. 4-43).

(21) Disconnect vent lines at air cleaner assembly. Remove air cleaner from bracket (fig. 4-44).

(22) Disconnect connector at generator. Remove screw, lockwasher, and flat washer securing ground cable at generator (fig. 4-45). Disconnect ground.

(23) Remove four screws and washers securing cap and plate retainer to generator. Disconnect electrical lead at terminal (fig. 4-45).

NOTE

Refer to *a* above and perform steps (24) through (28). Disregard step (29) as M151A1, M825, and M718A1 vehicles have a mechanical fuel pump and do not require the fuel pump safety switch (oil pressure safety switch) found on other M151 series vehicles. Perform steps (30) through (34).

c. Installation. Prior to installation, insure that all parts are installed on the power plant assembly that were on it when it was removed from the vehicle.

(1) *M151, M151A1, M151A1C, and M718 vehicle.* Begin at step (34) and work back through step (1) in *a* above. Adjust clutch linkage, throttle, and choke (TM 9-2320-218-20).

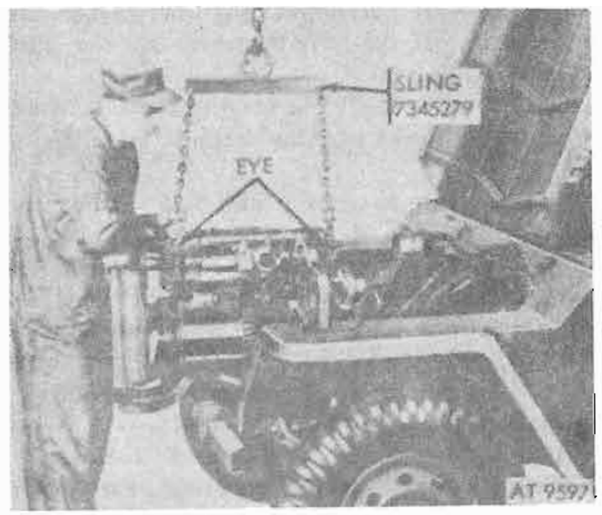


Figure 4-39. Power plant assembly lifting eyes.

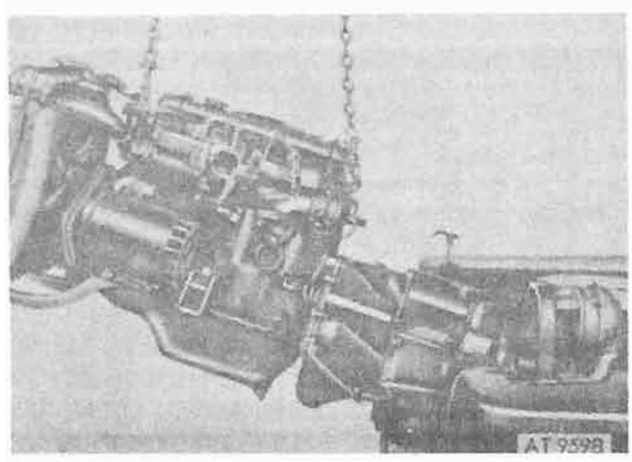


Figure 4-40. Removal of power plant assembly.

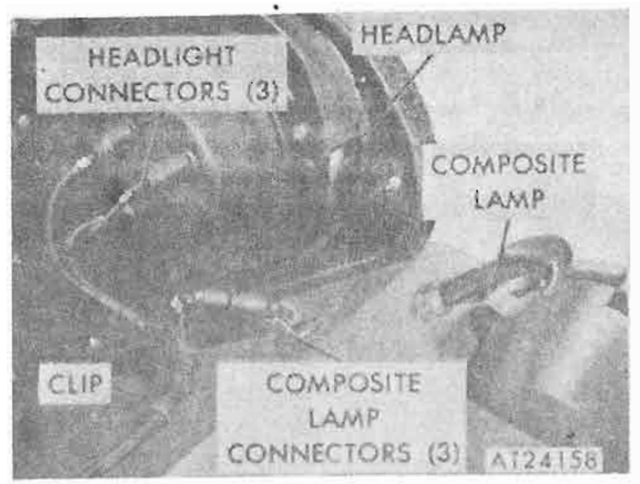


Figure 4-41. Disconnecting or connecting front lighting connectors on M151A2, M825 and M718A1 vehicles.

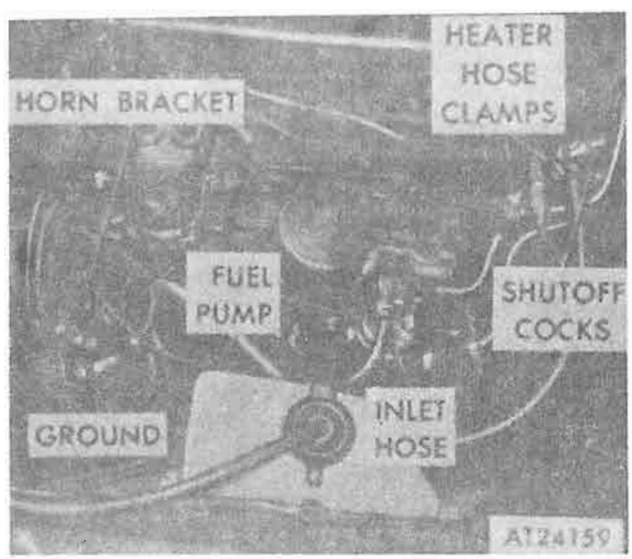


Figure 4-42. Disconnecting or connecting ground cable at horn, fuel pump line and heater hoses on M151A2, M825 and M718A1 vehicles.

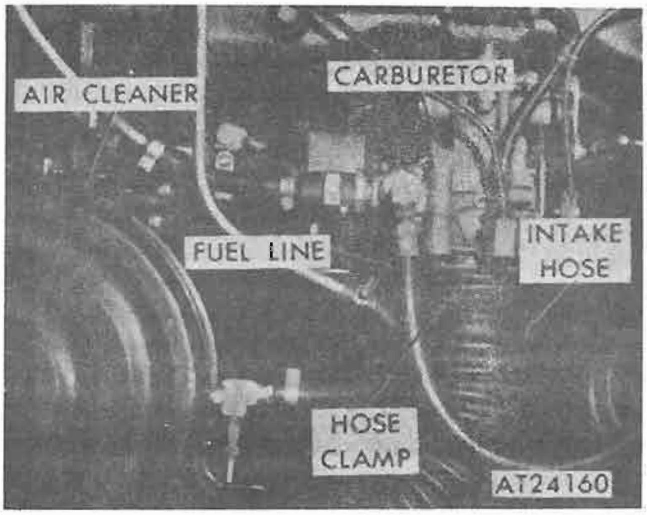


Figure 4-43. Disconnecting or connecting carburetor intake hose and fuel line.

(2) *M151A2, M825, and M718A1 vehicles.* Begin at step (34) and work back through step (30) in a above. Disregard step (29). Perform steps (28) through (24). Perform step (23) back through step (1). Adjust clutch linkage, throttle and choke (TM 9-2320-218-20).

NOTE

On vehicles prior to serial No. 2C2600 during operation (7), tighten hexhead nut finger tight, then tighten additional one-half turn.

NOTE

On vehicles with serial No. 2C2600 and later, during operation (7), tighten knurled nut finger tight, then tighten additional turn. The following attaching parts are to be torqued to the values shown:

Engine front support bolt (7 / 16-20) .... 30-40 lb.-ft.
Engine rear support bolt (7 / 16-20) .... 30-40 lb.-ft.
Muffler inlet pipe flange nut (3 / 8-24) .... 15-20 lb.-ft.
Brush guard to fender bolt (1 / 4-28) .... 3-4 lb.-ft.
Parking brake handle to transfer bolt .... 12-15 lb.-ft.
Exhaust inlet pipe clamp nut (5 / 16-18) .... 8-12 lb.-ft.
Propeller shaft universal joint bolt (5 / 16-24) .... 15-20 lb.-ft.

4-8. Engine Assembly

a. *General.* To remove the engine from the power plant assembly it is necessary to remove the transmission transfer assembly (para 4-9) and the radiator (TM 9-2320-218-20).

b. *Removal.* Remove power plant assembly from vehicle (para 4-7).

c. *Installation.* Install transmission transfer assembly (para 4-9), and radiator (TM 9-2320-218-20). Install power plant assembly (para 4-7).

4-9. Transmission Transfer Assembly

a. *Removal.* Remove transmission transfer assembly by following instructions given in procedures (1) through (3) below and shown in figures 4-46 and 4-47).

(1) Drain transmission and transfer (fig. 4-46).

(2) Remove four mounting bolts and lock-washers (fig. 4-46).

(3) Remove transmission. Remove and discard gasket (fig. 4-47).

b. *Installation.* Refer to figure 4-47 and 4-46. Torque the transmission attaching bolts (7 / 16-14) to 37-42 lb.-ft. Adjust parking brake (TM 9-2320-218-20). Refer to lubrication order for type and quantity of lubricant.

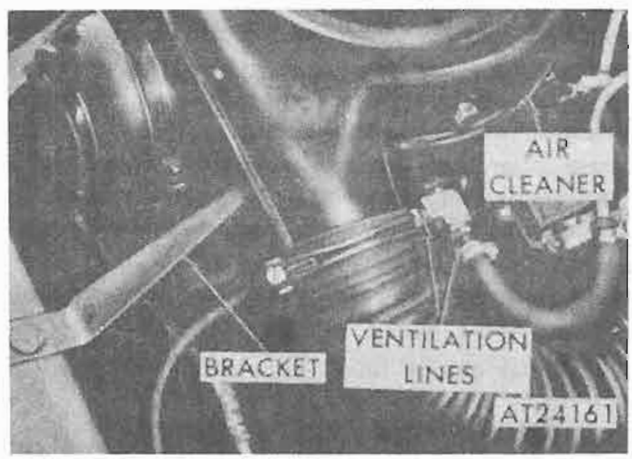


Figure 4-44. Removing or installing air cleaner on M151A2, M825 and M718A1 vehicles.

Section III. DISASSEMBLY OF ENGINE

4-10. Scope of Procedures

The procedures outlined in this section cover the removal of accessories and miscellaneous external parts mounted on the engine assembly.

4-11. Replacement of Major Components Before Engine Removal

a. Accessories and External Parts. Some accessories and external parts of the engine assembly can be replaced with the engine installed in the vehicle. Refer to TM 9-2320-218-20.

b. Engine Components. Some components of the basic engine assembly can be removed and repaired with the engine installed in the vehicle. Authorized procedures covering removal and installation of such components are included in TM 9-2320-218-20.

4-12. Preparation of Engine for Repair

Engines removed from vehicles must be thoroughly cleaned, drained, and stripped of accessories before disassembly is started.

a. Lifting Engine. Engine assembly may be handled with a hoist, using sling (7345279) as illustrated by figure 4-48.

b. Cleaning and Draining (figs. 4-49 and 4-50).

(1) *Cleaning.* Cover all openings on engine and thoroughly clean all external parts and outer surfaces. Make certain no foreign matter enters working parts of engine or accessories. Wash engine, using water under pressure to remove mud and dirt. Remove grease and dirt, using stiff brush and cleaning solvent.

(2) *Draining.* Use separate containers when draining oil and water from engine. Remove oil pan drain plug and drain thoroughly. When oil is completely drained from pan, replace drain plug. Open cylinder block drain cock to remove excess water and drain into container.

4-13. Preliminary Inspection During Disassembly

a. After engine has been cleaned externally, a visual inspection should be made to determine if any external parts are broken, cracked, rusted, or missing. The cylinder block should be examined for evidence of cracks.

b. As parts are removed, clearances, fits, and damage should be noted and recorded to serve as a guide in the repair or replacement of such parts. Check backlash and runout of timing gears, backlash of distributor drive gear, crankshaft and camshaft end play, and connecting rod side play. Paragraphs 4-10 through 4-41 include the preliminary inspection of parts during the disassembly sequence, where practical. Paragraphs 4-42 through 4-69 include repair procedures for basic engine components. Paragraphs 4-70 through 4-92 include complete inspection and repair procedures for subassemblies and miscellaneous external parts. Repair standards for all basic engine parts are referenced in paragraphs 4-128 through 4-130.

4-14. Equipment and General Procedures

a. Cleanliness of personnel, tools, and surroundings is a fundamental requirement where engines are to be repaired. All instructions contained in this manual are given on the assumption that these conditions prevail in the working area. Engine repairs, except those of an emergency nature, should never be attempted under any other condition.

b. Parts trays and cleaning receptacles should be available while the engine is being disassembled. All parts or trays should be tagged with the engine serial number so that parts which do not require replacement will be assembled to the engine from which they were removed. Make sure all parts are marked so they can be installed in their original position. Mark with a grease pencil if other marks are not evident. All parts removed should be lightly coated with preservative lubricating oil if they are to be exposed for any length of time.

Section IV. REMOVAL OF ACCESSORIES AND MISCELLANEOUS EXTERNAL PARTS

4-15. Drive Belts, Generator, Adjusting Arm, and Mounting Brackets

Loosen generator mounting bolts and adjusting arm bolts. Move generator toward engine to remove belts from generator pulley, and lift over fan (figs. 4-51 and 4-52). Remove generator, adjusting arm, and radiator support brackets. Refer to TM 9-2320-218-20 for detailed procedures.

4-16. Carburetor and Accelerator Bellcrank and Spring (fig. 4-53)

Disconnect the accelerator return spring rod, and distributor and crankcase ventilation lines from carburetor fitting. Remove carburetor and gasket from intake manifold. Discard gasket. Remove the accelerator bellcrank from the intake manifold.

Refer to TM 9-2320-218-20 for detailed procedures.

4-17. Engine Support Brackets

(fig. 4-54)

Remove two hex-head bolts and lockwasher securing engine right and left support brackets to the cylinder block and remove support brackets.

4-18. Installing Engine on Repair Stand

Install improvised engine support bracket to mounting pad on left side of cylinder block (fig. 4-55).

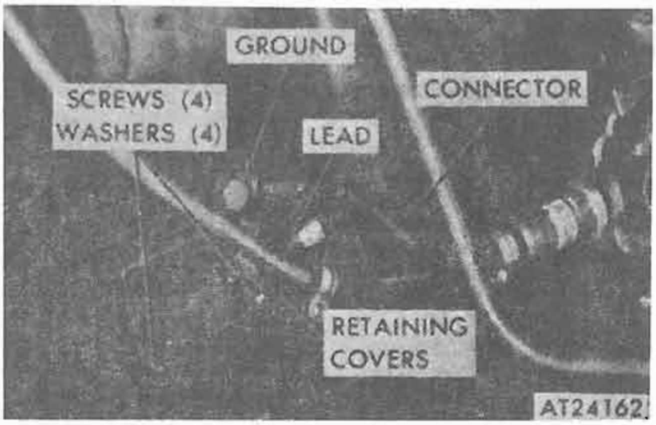


Figure 4-45. Disconnecting or connecting electrical connections at 60-ampere generator.

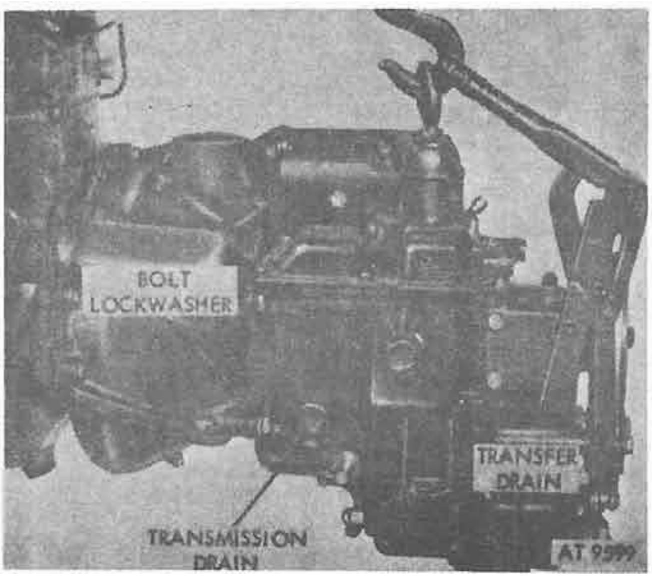


Figure 4-46. Transmission and transfer.

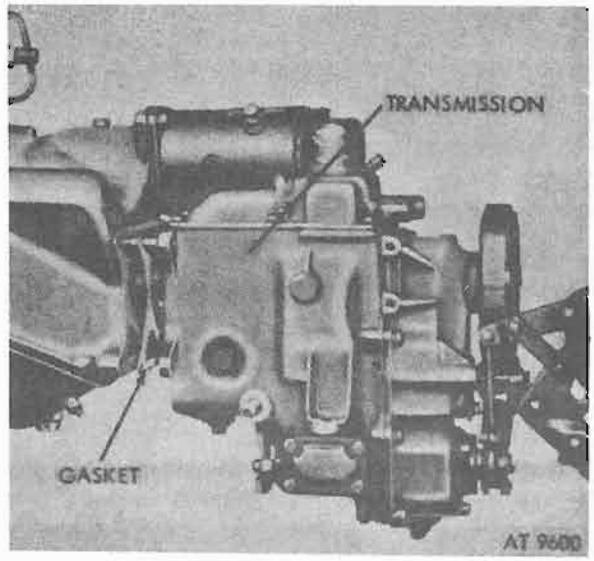


Figure 4-47. Transmission and gasket.

Figure 4-48. Lifting engine.

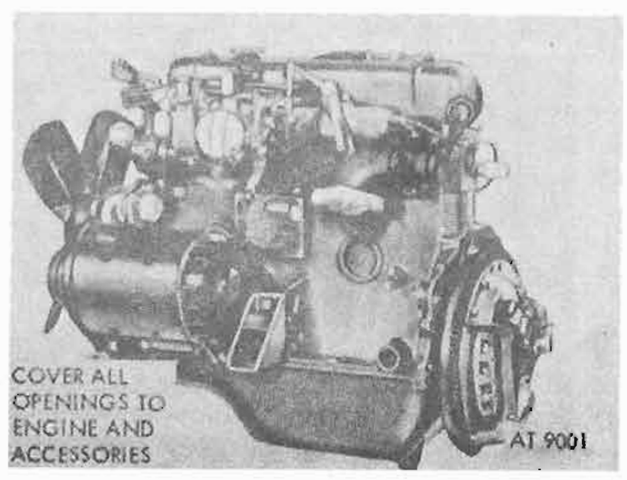


Figure 4-49. Preparing engine for cleaning.

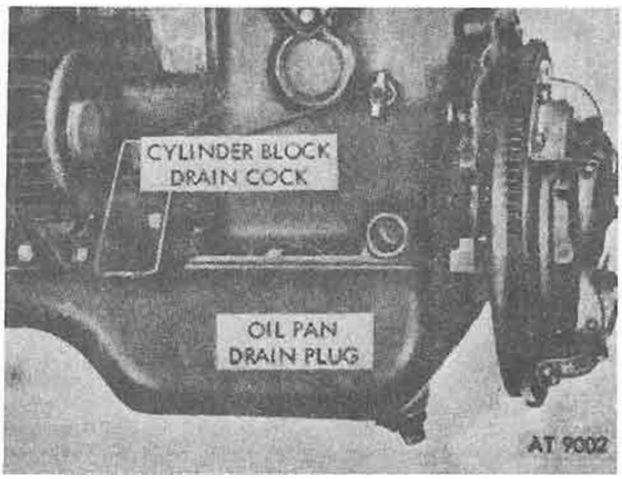


Figure 4-50. Draining engine.

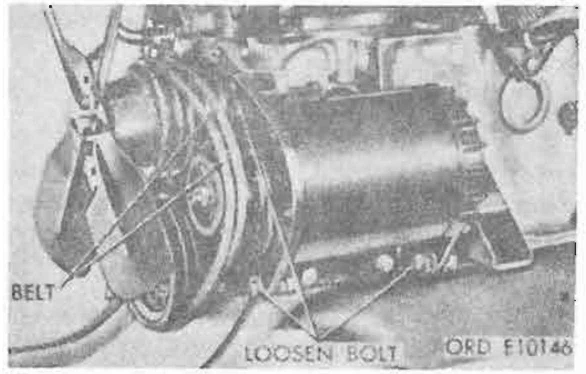


Figure 4-51. Drive belts.

Legend to figure 4-52:

1 Bolt, adjusting arm
2 Arm, generator adjusting
3 Washer, serrated
4 Screw ⅜-16x1½
5 Nut, self locking 7/16-20
6 Washer, flat
7 Bracket, generator mtg.
8 Locking plate
9 Screw ½-13x1⅜
10 Screw 7/16-20x1¾
11 Support, engine radiator
12 Nut ⅜-16
13 Nut, self locking ½-20
14 Washer, flat ⅝
15 Pulley, 60-amp
16 Key, Woodruff
17 Generator, 60-amp
18 Cotton pin
19 Nut, castellated ½-20
20 Washer, flat
21 Pulley, 25-amp
22 Generator, 25-amp
Delco-Remy
(opt) Prestolite

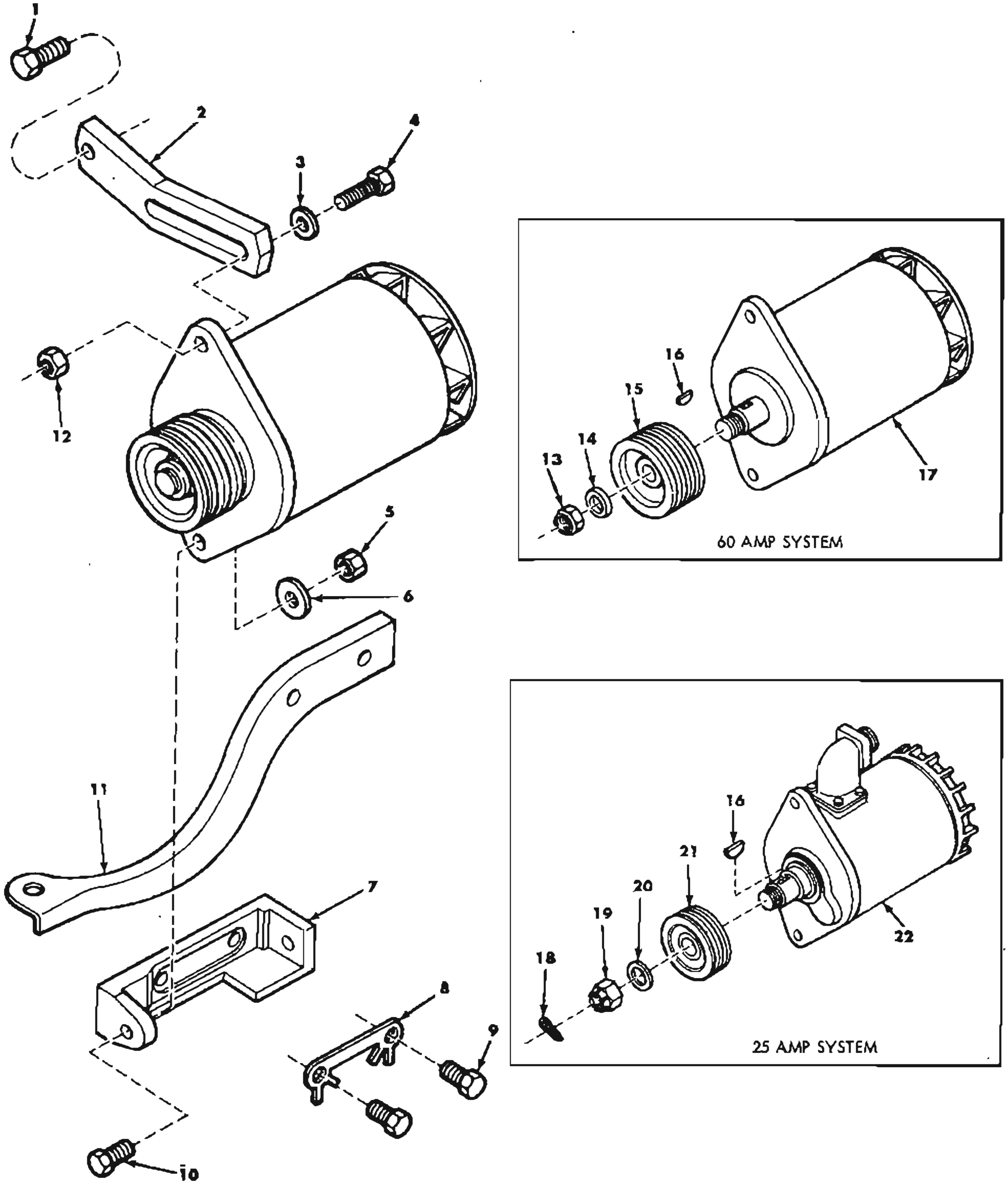


Figure 4-52. Generator assembly and related parts.

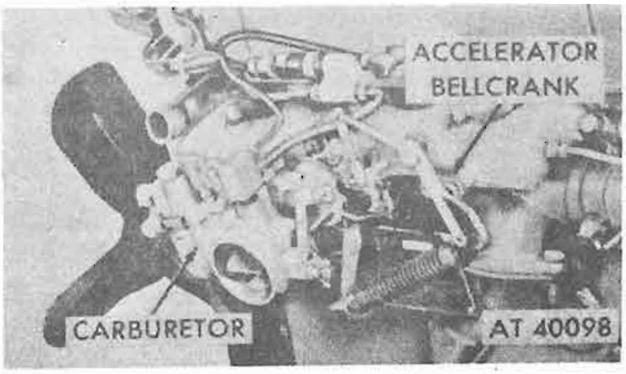


Figure 4-53. Carburetor and related parts.

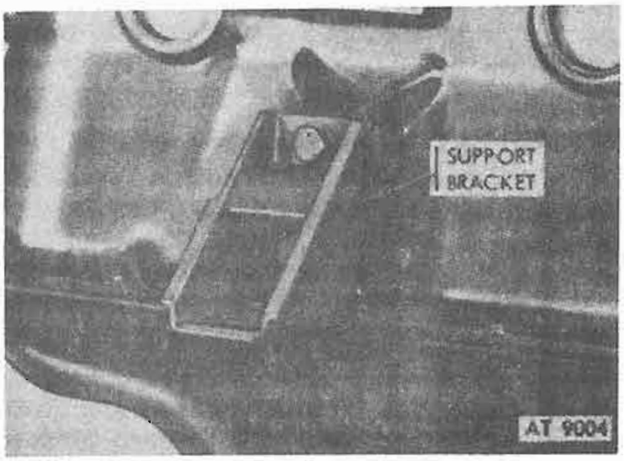


Figure 4-54. Engine support bracket.

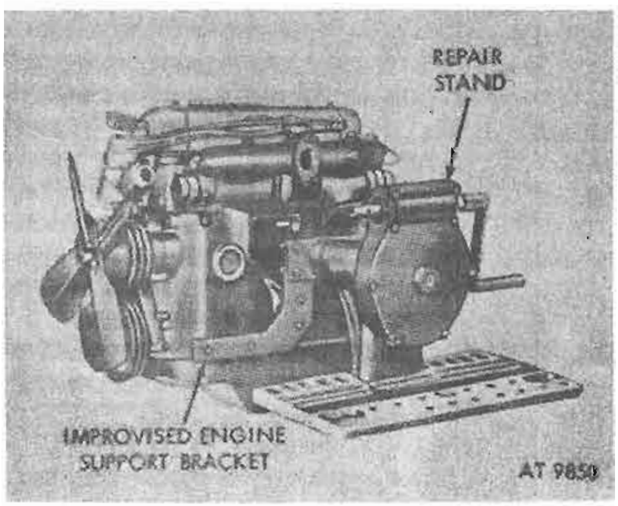


Figure 4-55. Engine installation on repair stand.

NOTE

If an engine repair stand is not available, exercise care to perform the following operations in a manner designed to protect personnel against injury and engine and parts against damage.

4-19. Oil Filter
(fig. 4-56)

Turn oil filter assembly counterclockwise and remove oil filter adapter. Discard oil filter.

4-20. Distributor Ignition Harness and Spark Plugs
(fig. 4-57).

Disconnect distributor ventilation inlet-outlet hose and ignition leads at spark plugs. Remove distributor, harness, and O-ring seal (as a unit) from distributor adapter. Remove spark plugs from cylinder head. Refer to TM 9-2320-218-20.

4-21. Sending Units
(fig. 4-58)

Disconnect vent hose at fuel pump safety switch (oil pressure safety switch) and remove oil pressure switch. Remove oil pressure sending unit from oil filter adapter. Remove water temperature sending unit from cylinder head. Refer to TM 9-2320-218-20.

4-22. Vacuum Pump or Fuel Pump Ventilation and Vacuum Lines or Fuel Pump Lines and Crankcase Metering Valve

a. *Vacuum Pump—M151, M151A1, M151A1C, and M718 Vehicles* (fig. 4-59). Disconnect vacuum line at vacuum pump. Remove pump and gasket from cylinder block. Discard gasket. Refer to TM 9-2320-218-20.

b. *Fuel Pump—M151A2, M825 and M718A1 Vehicles* (fig. 4-60). Disconnect fuel inlet line and tape end. Remove outlet and vent lines. Remove pump and gasket from cylinder block. Discard gasket. Refer to TM 9-2320-218-20.

c. *Ventilation Line (Distributor).* Remove two retaining clips from distributor ventilation line-to-crankcase line and one retaining clip from ventilation line-to-vacuum pump line. Remove distributor inlet line, hose, and clamps. Also remove distributor outlet hose and clamp from "tee" fitting at vacuum pump line. Refer to figure 4-61.

d. *Ventilation Line (Fuel Pump Safety Switch).* Remove two retaining clips from fuel pump safety switch (oil pressure safety switch) ventilation line to crankcase ventilation line.

Remove safety switch, ventilation line, hose, and clamps. (Applicable to M151, M151A1, M151A1C, and M718 vehicles only.) Refer to figure 4-62.

e. Crankcase Ventilation Lines—M151, M151A1, M151A1C and M718. Disconnect and remove crankcase ventilation tube assembly from elbow at rocker arm cover and from nut at metering valve assembly. Disconnect and remove crankcase ventilation lines from fitting at intake manifold and crankcase ventilation line from connector at cylinder block. Refer to figure 4-63.

f. Crankcase Ventilation Lines—M151A2, M825 and M718A1. Disconnect and remove crankcase ventilation tube assembly from elbow at rocker arm cover and from nut at metering valve assembly. Disconnect and remove crankcase ventilation lines from fitting at carburetor and crankcase and connector at cylinder block. Refer to figure 4-64.

g. Crankcase Metering Valve and Fitting. Remove crankcase metering valve from fitting at intake manifold and remove fitting (fig. 4-65).

h. Vacuum Pump Line. Remove two panhead screws securing vacuum pump line to push rod cover. Disconnect line from connector at intake manifold, and retaining clip at rear engine lifting eye. Remove vacuum pump line with the two retaining clips and tappet cover seal assemblies. Discard seal assemblies. (Applicable to M151, M151A1, M151A1C, and M718 vehicles only.) Refer to figure 4-66.

i. Fuel Pump Line. Disconnect fuel inlet, fuel outlet, and vent line at fuel pump. Refer to figure 4-67. Disconnect fuel line at filter on carburetor inlet. Free fuel line from clips at front of engine and remove.

4-23. Clutch Assembly

(fig. 4-68)

Loosen six hex-head bolts securing pressure plate assembly to flywheel evenly to release pressure plate spring tension. Remove pressure plate and clutch disk from flywheel.

4-24. Engine with Accessories Removed

Refer to figures 4-69 and 4-70.

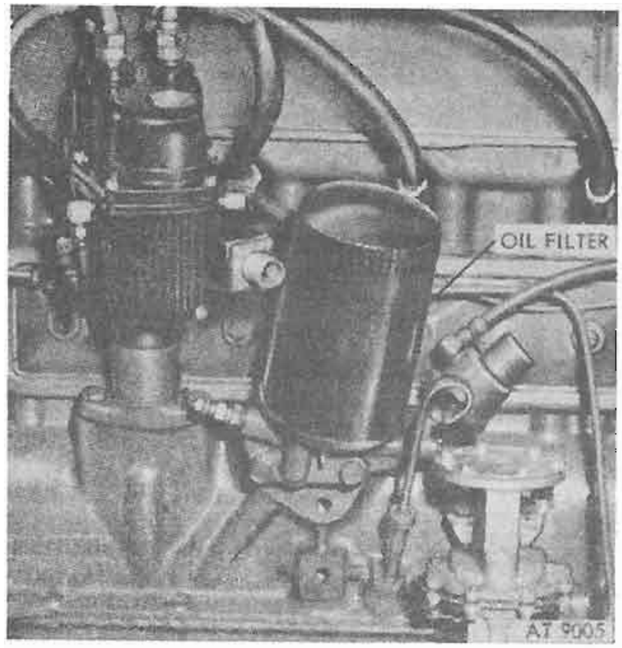


Figure 4-56. Oil filter.

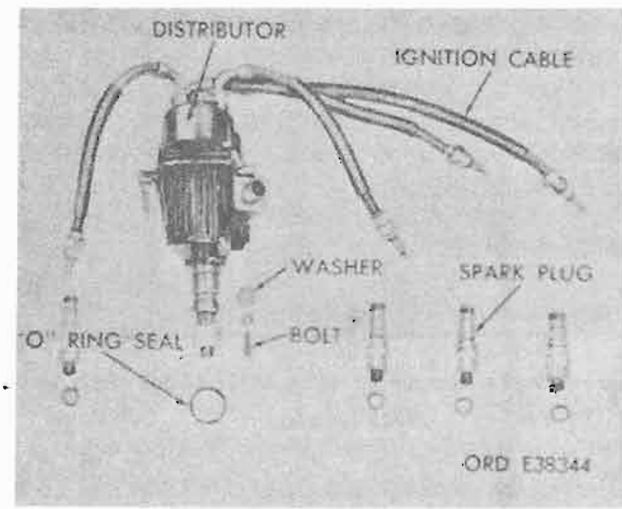


Figure 4-57. Distributor and related parts.

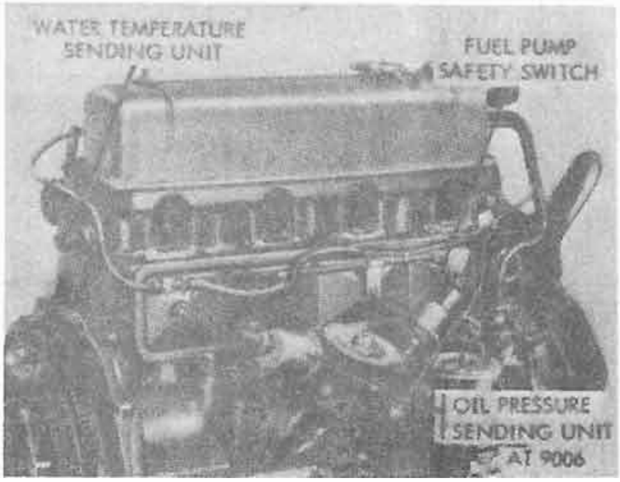


Figure 4-58. Sending units.

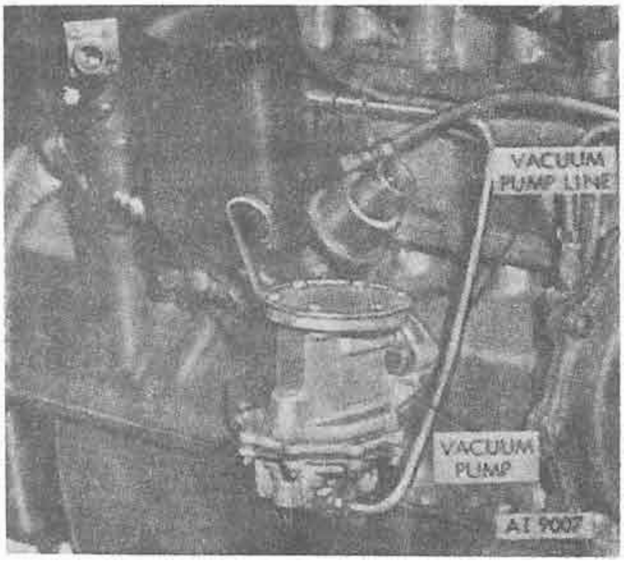


Figure 4-59. Vacuum pump (M151. M151A1. M151A1C and M718 vehicles).

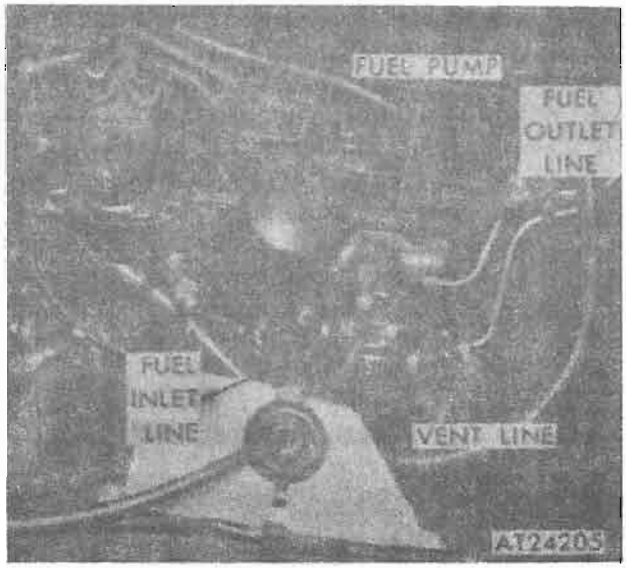


Figure 4-60. Fuel pump.

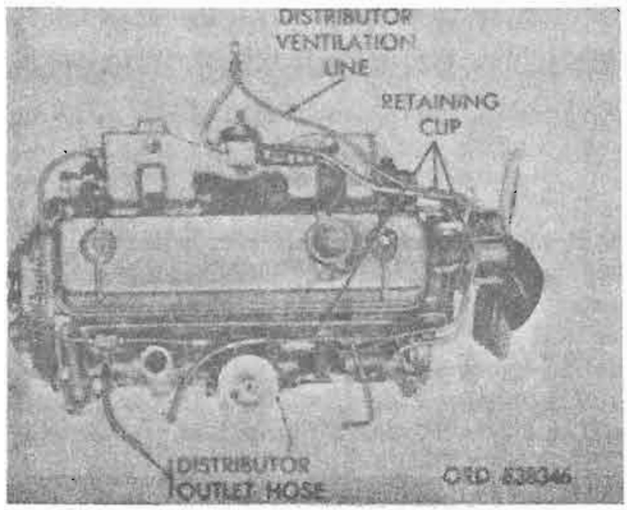


Figure 4-61. Distributor ventilation line and hose.

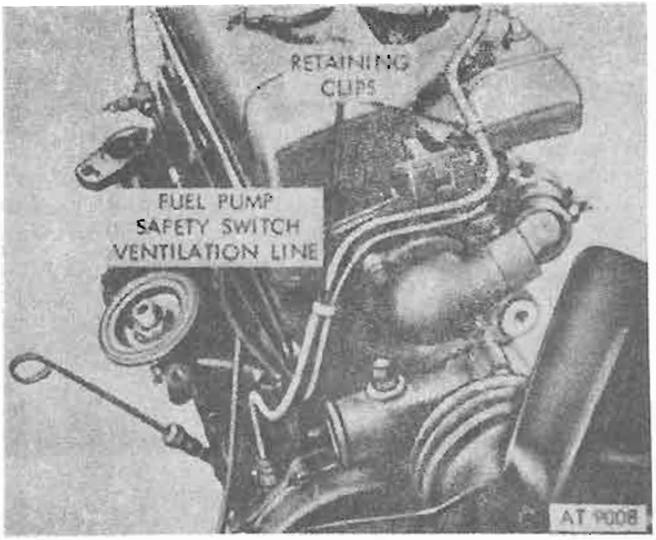


Figure 4-62. Fuel pump safety switch ventilation line (M151, M151A1, M151A1C and M718 vehicles).

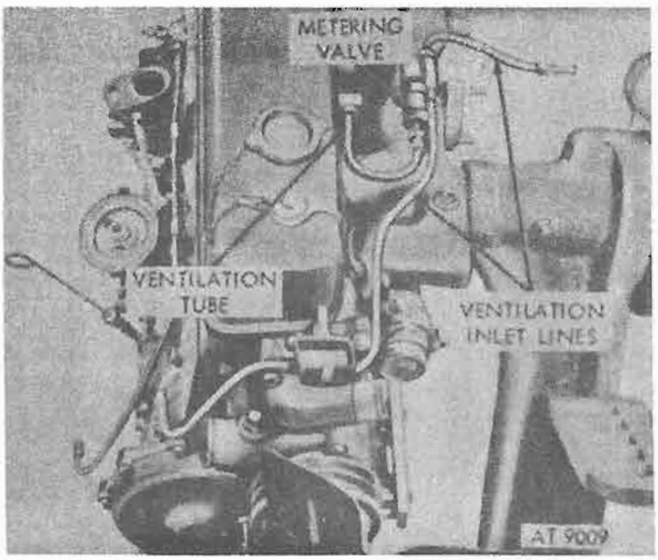


Figure 4-63. Crankcase ventilation lines (M151, M151A1, M151A1C and M718 vehicles).

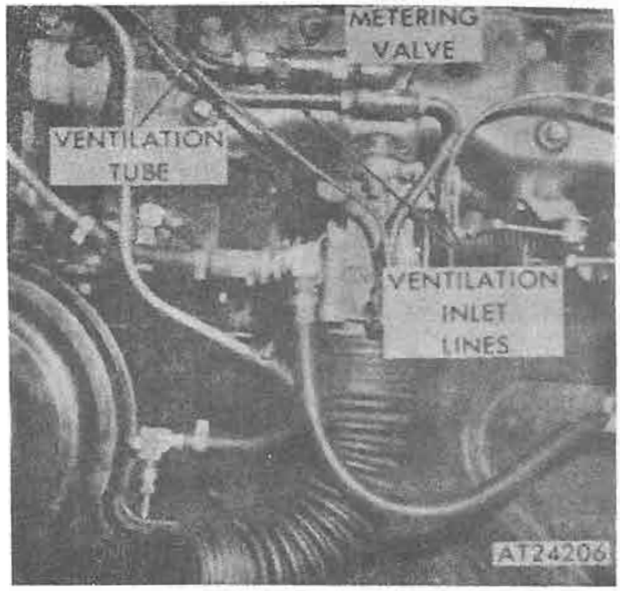


Figure 4-64. Crankcase ventilation lines (M151A2, M825 and M718A1 vehicles).

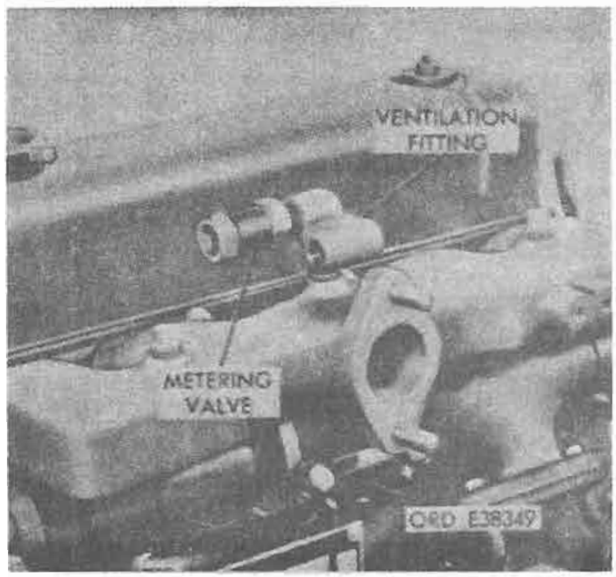


Figure 4-65. Crankcase metering valve and fittings.

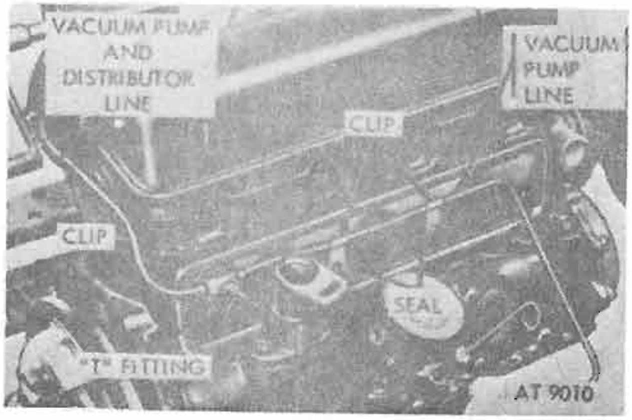


Figure 4-66. Vacuum pump line (applicable to M151, M151A1, M151A1C and M718 vehicles only).

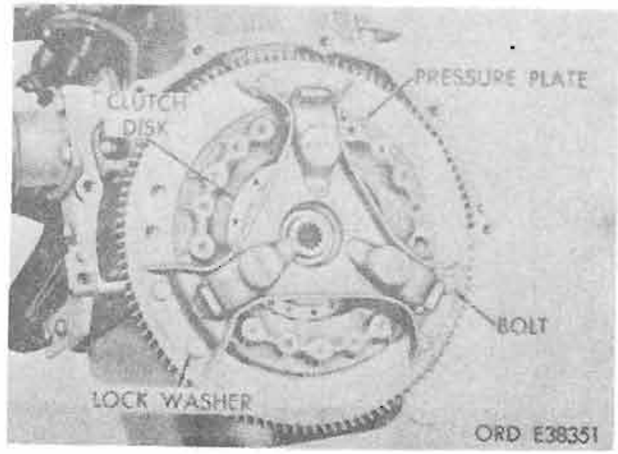


Figure 4-68. Clutch assembly.

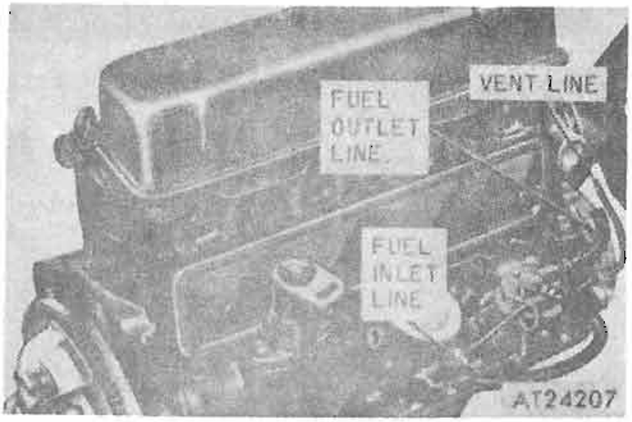


Figure 4-67. Fuel pump lines.

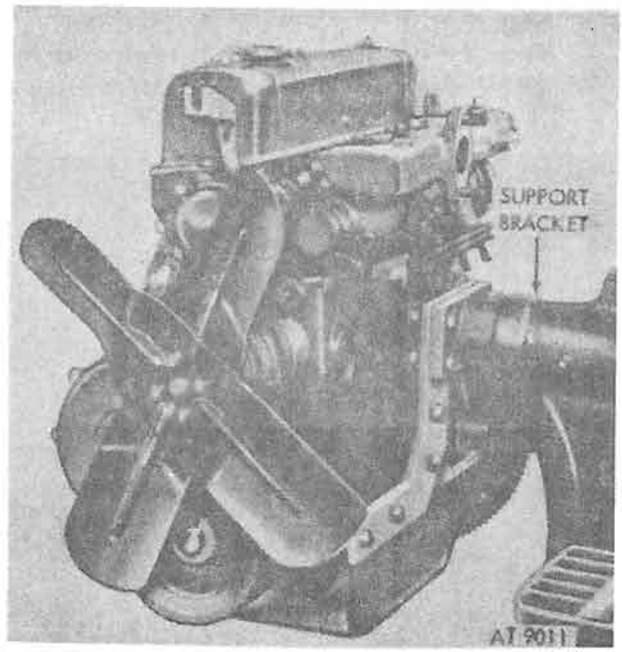


Figure 4-69. Engine with accessories removed—left front view.

Section V. DISASSEMBLY OF ENGINE INTO SUBASSEMBLIES

4-25. Remove Fan
(fig. 4-71)

a. Remove four hex-head screw and washer assemblies securing fan and pulley to water pump hub, and remove fan from water pump shaft.

b. Remove pulley from water pump shaft (fig. 4-72).

4-26. Remove Water Pump Assembly
(fig. 4-73).

a. *Water Pump Attaching Bolts.* Remove three hex-head bolts securing water pump to cylinder block.

b. Water Pump Assembly. Pull water pump assembly off cylinder block. Remove and discard gasket.

4-27. Remove Manifolds

a. *Lock Tab Washer.* Straighten tangs of dual-type lock tab washer under two hex-head bolts securing bottom center of intake manifold to cylinder head. Remove the two hex-head bolts and lock tab washer (fig. 4-74).

b. Intake manifold. Remove four hex-head screws and washers securing upper flanges of intake manifold to cylinder head. Lift intake manifold assembly from cylinder head (fig. 4-75). Discard gaskets.

c. *Exhaust Manifold Alining Bolt.* Remove hex-head bolt and lockwasher securing exhaust manifold to cylinder block (fig. 4-76).

d. *Exhaust Manifold and Attaching Parts.* Straighten tangs of four lock tab washers under hex-head bolts securing front and rear of exhaust manifold to cylinder head. Remove four hex-head bolts, lock tab washers, and two exhaust manifold retaining clamps. Remove exhaust manifold from cylinder head (fig. 4-77).

4-28. Remove Rocker Arm Cover (fig. 4-78)

a. *Rocker Arm Cover.* Remove two nuts, retainers, and seals securing rocker arm cover to cylinder head, and lift rocker arm cover off retaining studs. Discard seals.

b. *Rocker Arm Cover Gasket.* Remove and discard rocker arm cover gasket.

Figure 4-71. Fan.

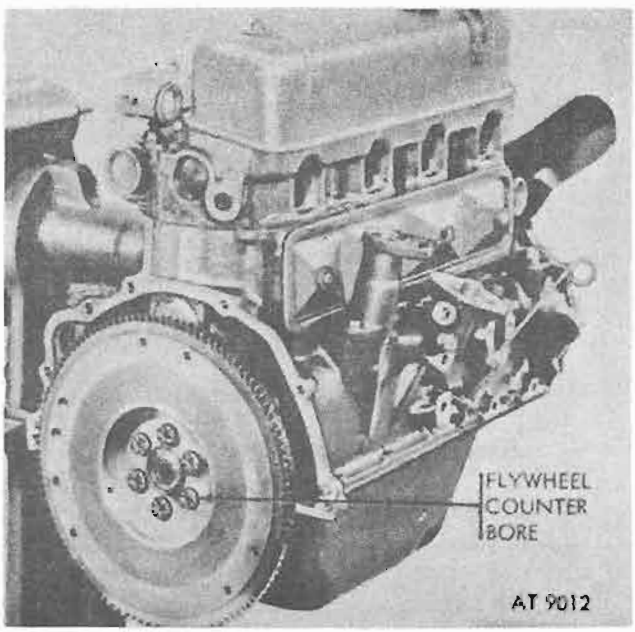


Figure 4-70. Engine with accessories removed—right front view.

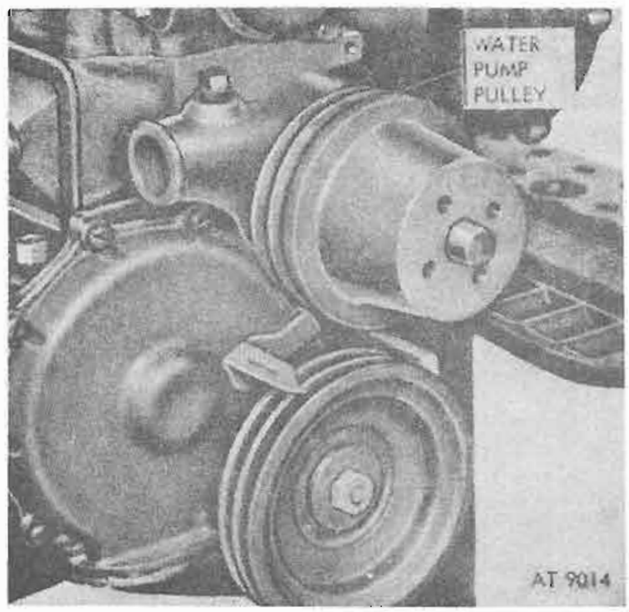


Figure 4-72. Water pump pulley.

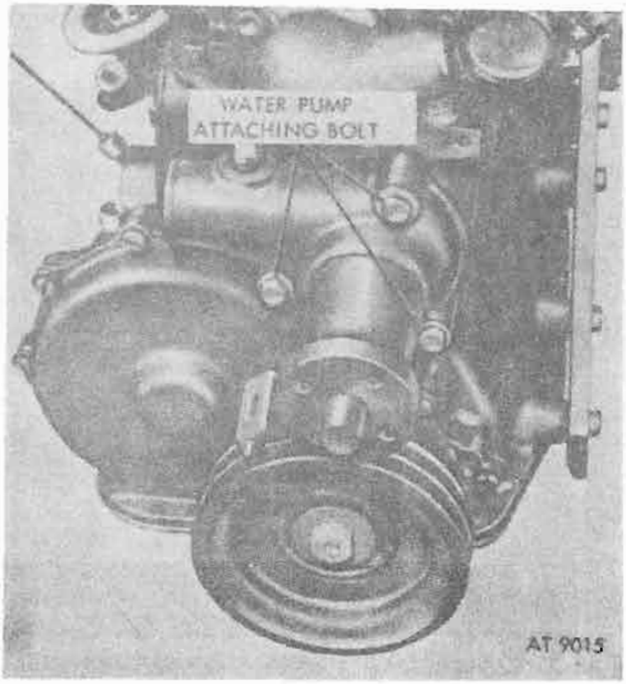


Figure 4-73. Water pump attaching bolts.

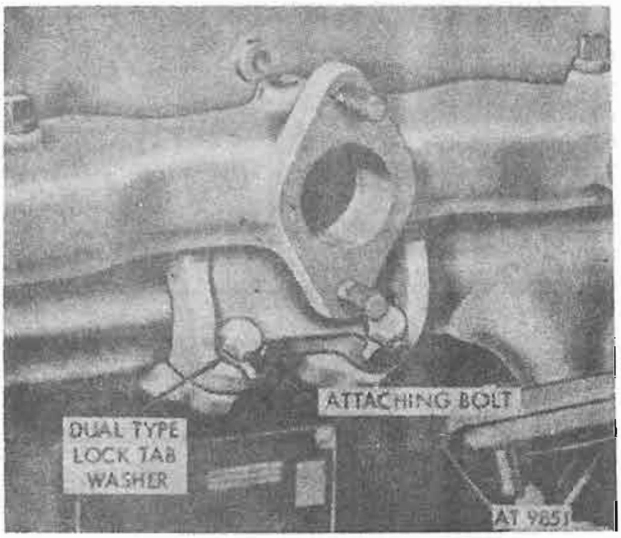


Figure 4-74. Lock tab washer.

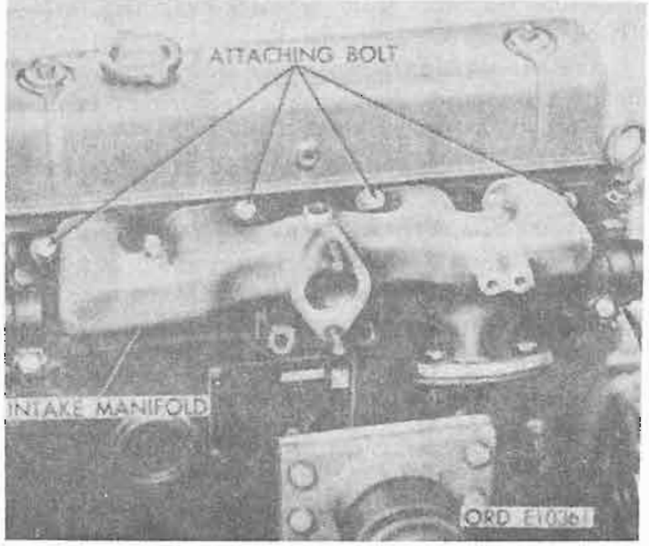


Figure 4-75. Intake manifold.

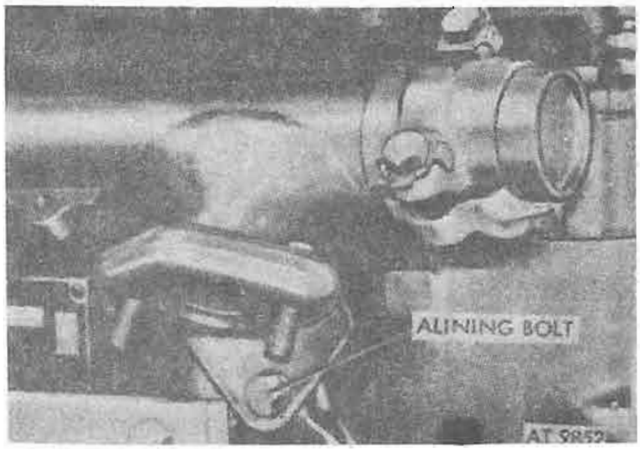


Figure 4-76. Exhaust manifold alining bolt.

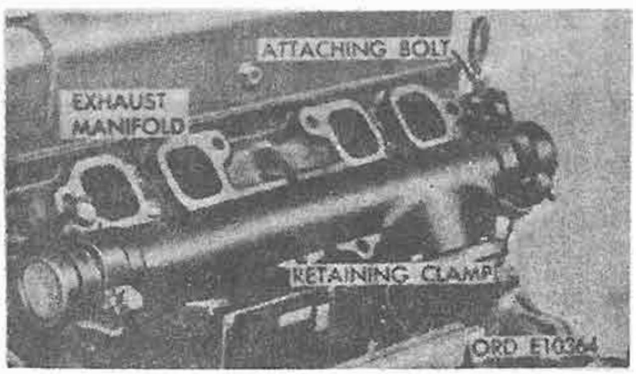


Figure 4-77. Exhaust manifold attaching parts.

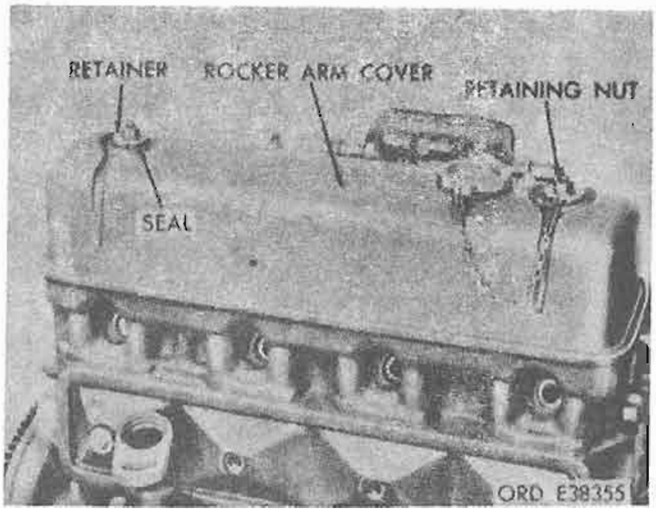


Figure 4-78. Rocker arm cover.

4-29. Remove Cylinder Head Assembly

a. Valve Adjusting Screws. Back off eight hex-head self-locking valve adjusting screws one turn to reduce load on rocker arms (fig. 4-79).

b. Rocker Arm Shaft Assembly Attaching Bolts. Remove hex-head bolts securing rocker arm shaft assembly to cylinder head (fig. 4-80).

c. Rocker Arm Shaft Assembly Attaching Parts. Remove hex-head nut, lockwasher, and flat washer from rocker arm shaft front support stud. Remove hex-head nut, lockwasher, and oil inlet tube bracket from rocker arm rear support stud. Remove inlet and outlet oil tubes (fig. 4-80).

d. Valve Rocker Arm and Shaft Assembly. Lift valve rocker arm assembly from rocker arm shaft support studs (fig. 4-81).

e. Oil Inlet Tube Seal. Remove O-ring seal from oil inlet tube and discard seal. Refer to figure 4-82.

f. Push Rods. Remove eight valve push rods and four exhaust valve caps in sequence and identify them so they can be installed in their original position (fig. 4-81).

g. Cylinder Head and Attaching Bolts. Remove 10 hex-head bolts securing cylinder head to cylinder block. Lift cylinder head assembly from two locating dowels in cylinder block (fig. 4-83).

NOTE

Do not pry between head and block as gasket surfaces may become damaged.

h. Cylinder Head Gasket. Remove and discard cylinder head gasket.

4-30. Remove Distributor Adapter and Intermediate Drive Shaft

a. Distributor Adapter. Remove two hex-head bolts and lockwashers securing distributor adapter to cylinder block. Pull out distributor adapter (fig. 4-84).

Seal. Remove distributor adapter O-ring seal from recess in cylinder block and lift out distributor intermediate drive shaft from oil pump (fig. 4-85).

4-31. Remove Oil Pan

a. Oil Level Indicator. Pull out oil level indicator from oil level indicator tube in cylinder block (fig. 4-86).

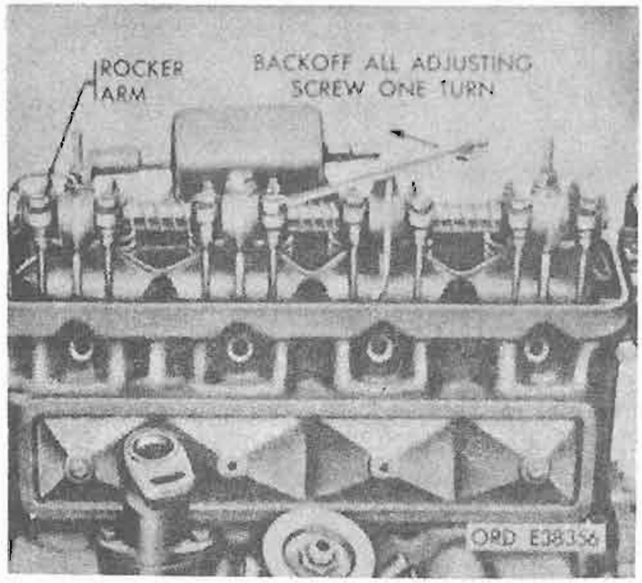


Figure 4-79. Valve adjusting screw.

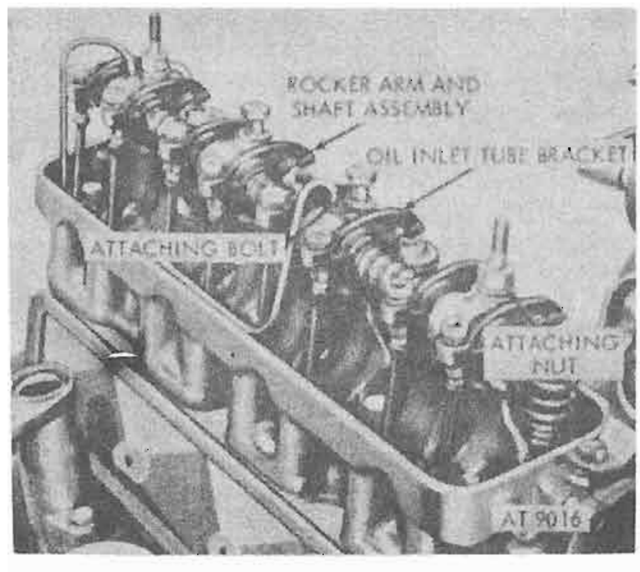


Figure 4-80. Rocker arm and shaft attaching bolts.

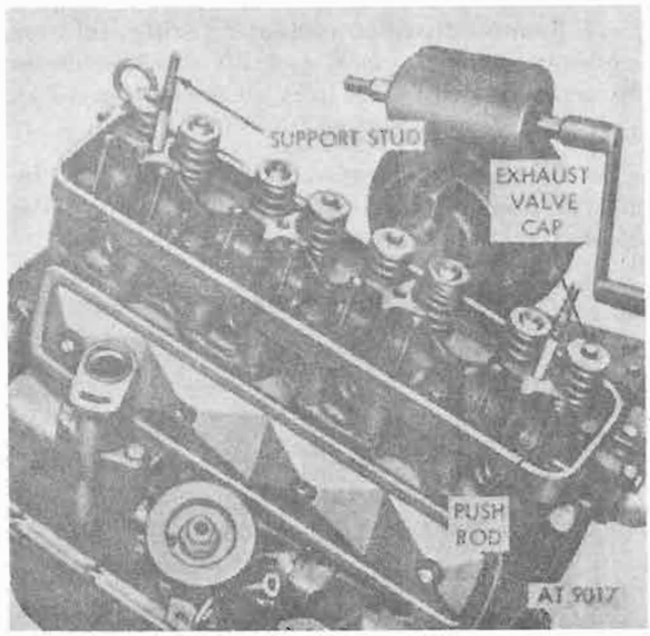


Figure 4-81. Valve rocker arm and shaft assembly removed.

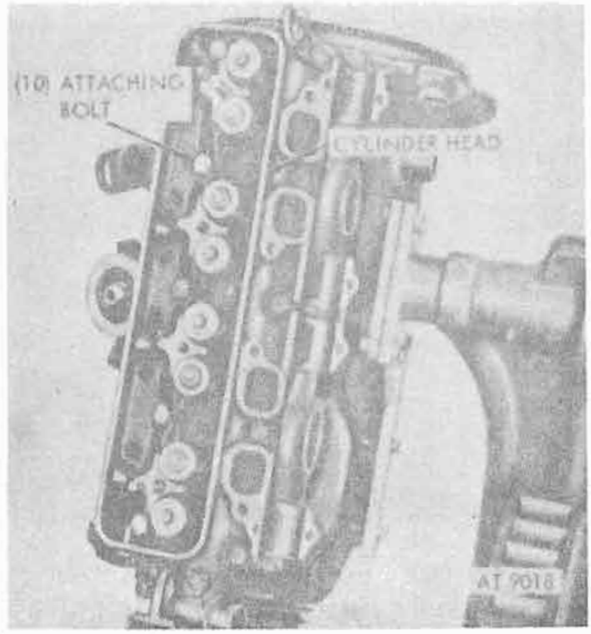


Figure 4-83. Cylinder head attaching bolts.

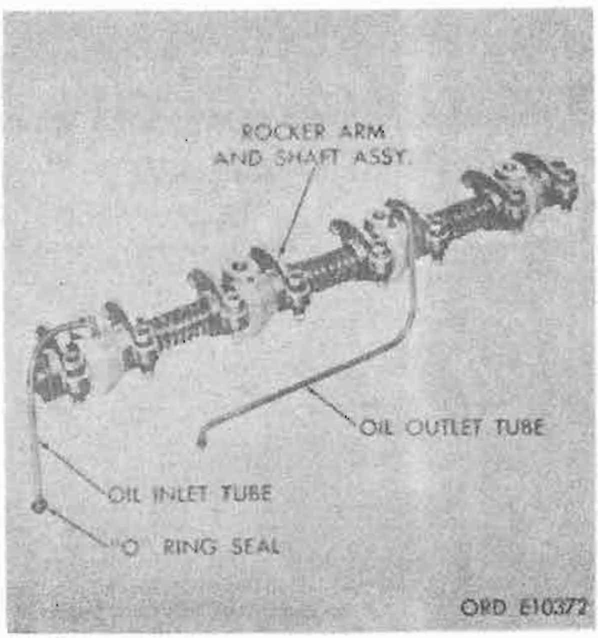


Figure 4-82. Valve rocker arm and shaft assembly with oil outlet and outlet tubes.

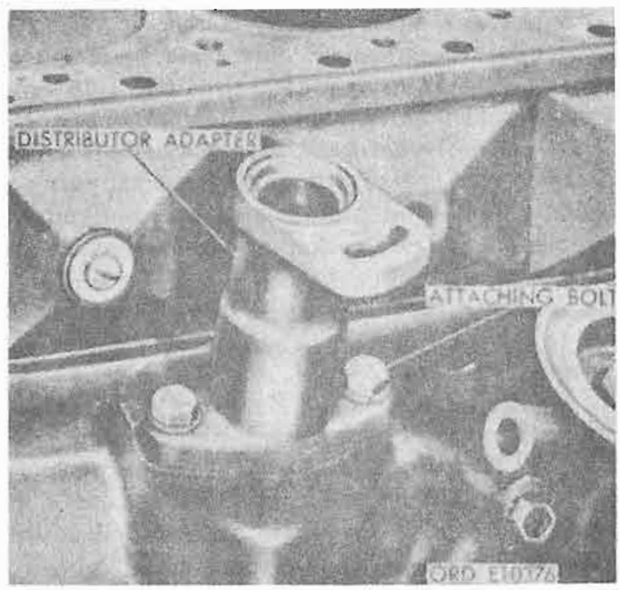


Figure 4-84. Distributor adapter.

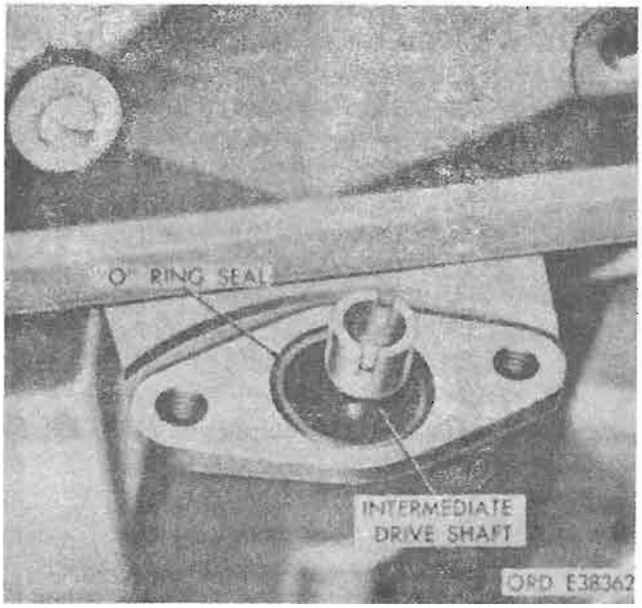


Figure 4-85. Distributor intermediate, drive shaft and O-ring seal.

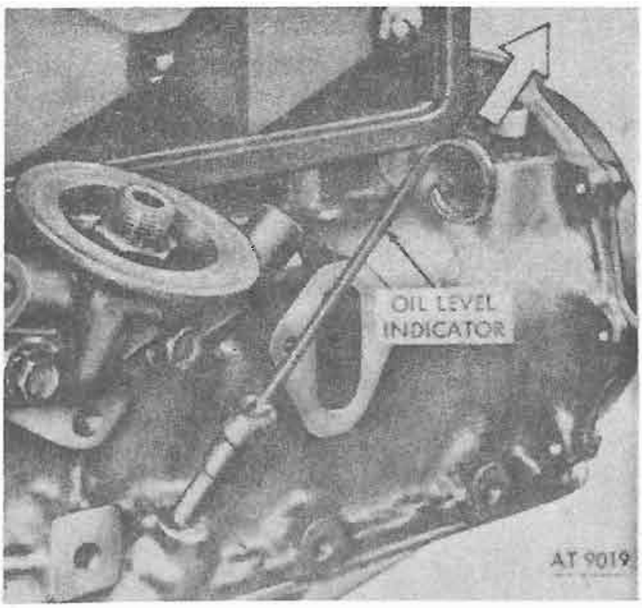


Figure 4-86. Oil level indicator.

b. Oil Pan. Remove four hex-head screws and washer assemblies with flat washer; also remove 12 slotted capscrews, lockwashers, and spring retainers securing oil pan to cylinder block and front cover. Remove oil pan from cylinder block (fig. 4-87).

c. Oil Pan Gaskets and Seals. Remove and discard oil pan front and rear seal. Discard left and right gasket (fig. 4-88).

4-32. Remove Oil Pump and Pickup Tube

a. Gear Backlash. Check and record backlash between oil pump drive gear and integral drive gear on camshaft by placing a dial indicator with the plunger bearing on one tooth of the pump drive gear (fig. 4-89).

b. Oil Pump Retaining Bolts. Remove two outer hex-head bolts, lockwashers, and flat washers retaining oil pump to cylinder block (fig. 4-90).

c. Oil Pump Assembly. Remove oil pump assembly with pickup tube and screen assembly in place (fig. 4-91).

d. Oil Pump Gasket. Remove and discard oil pump gasket.

4-33. Remove Pistons and Connecting Rods

a. Connecting Rod Side Play. With a feeler gage or suitable indicator, check side play of connecting rods on crankshaft and record (fig. 4-92). Refer to repair standards (table 4-7).

b. Carbon Deposits and Ridges. Remove any deposits and ridges from upper end of cylinder bores (fig. 4-93).

NOTE

Never cut into ring travel area when removing ridges with a ridge cutter. To avoid damage to piston and cylinder wall, use cloth to catch cuttings and carbon.

c. Connecting Rod Retaining Nuts. Turn crankshaft until piston of connecting rod being removed is at bottom of cylinder bore. Remove selflocking hex nuts from connecting rod bolts (fig. 4-94).

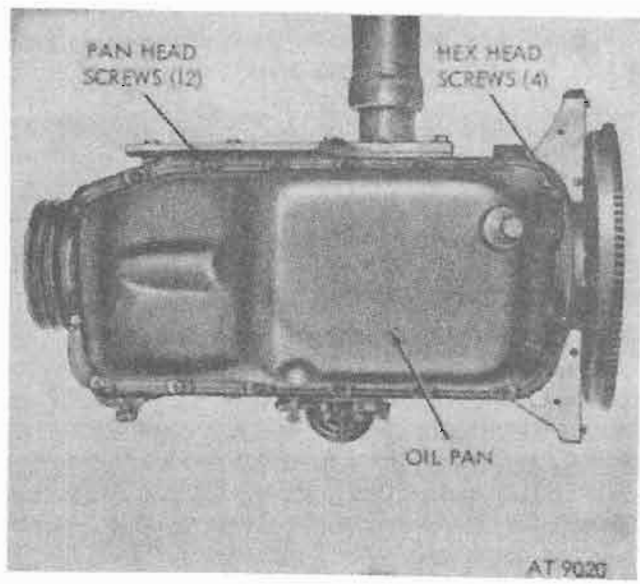


Figure 4-87. Oil pan.

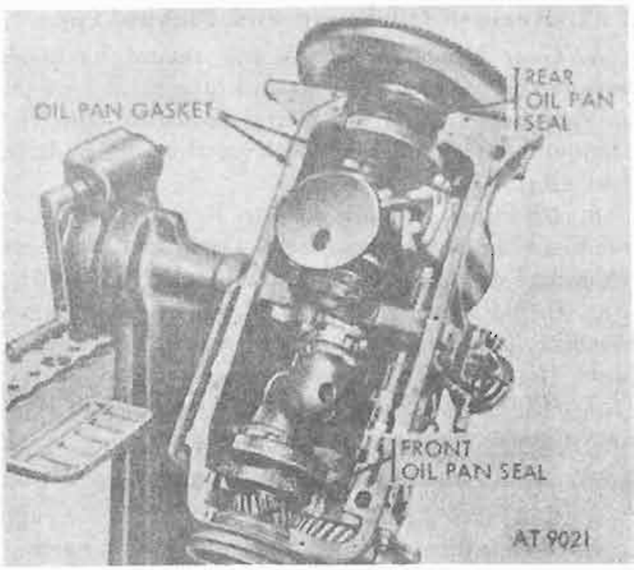


Figure 4-88. Oil pan gasket and seals.

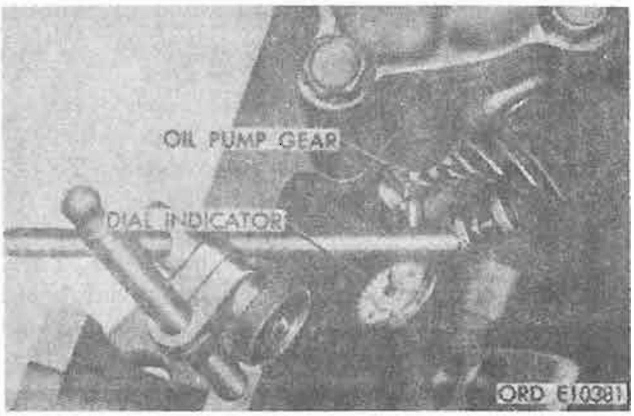


Figure 4-89. Measuring distributor and oil pump gear backlash.

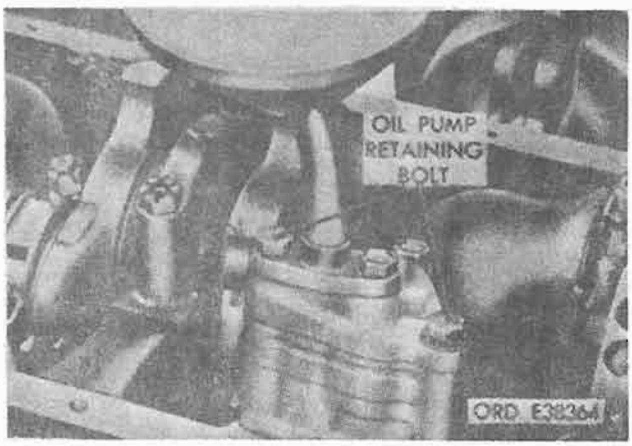


Figure 4-90. Oil pump retaining bolts.

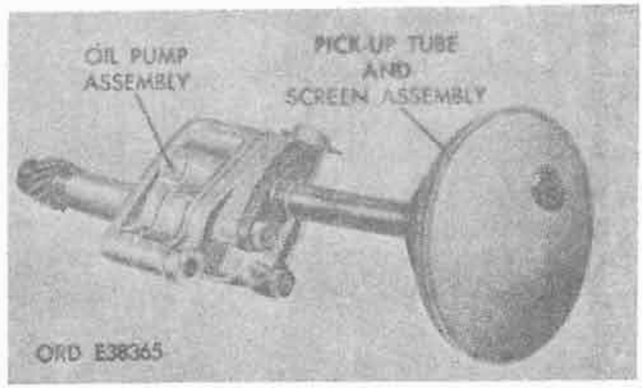


Figure 4-91. Oil pump assembly with pickup tube and screen assembly.

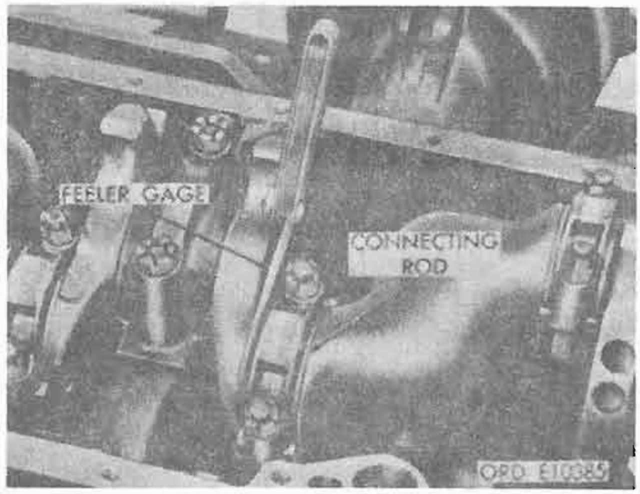


Figure 4-92. Measuring connecting rod side play.

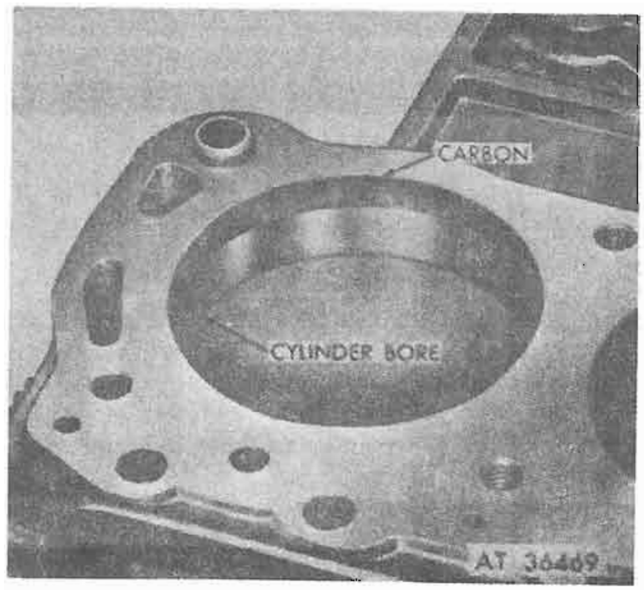


Figure 4-93. Carbon deposits and cylinder ridges.

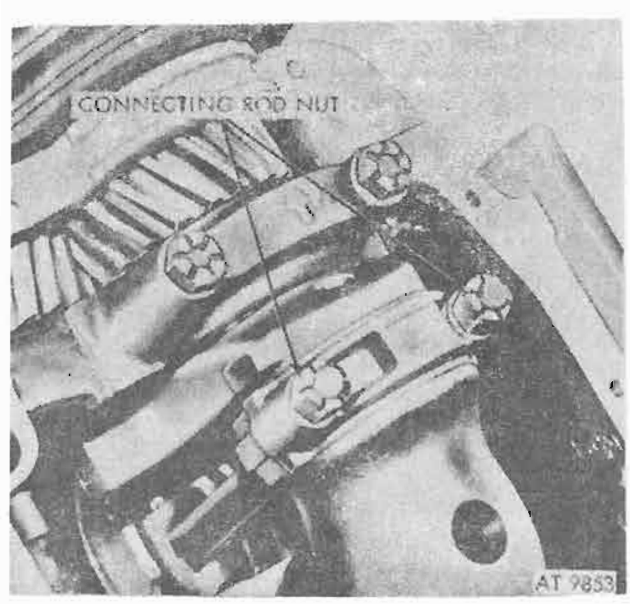


Figure 4-94. Connecting rod retaining nuts.

NOTE

Make sure all connecting rod bearings, cap, and pistons are marked so they can be installed in their original positions.

d. Connecting Rod Caps and Bearings. Remove connecting rod caps and bearings halves (fig. 4-95). Keep bearings with caps.

e. Connecting Rod and Piston Assembly.

(1) Push connecting rod and piston assembly out from top of cylinder with handle end of hammer (fig. 4-96).

NOTE

Avoid damage to crankpin or cylinder wall when removing piston and rod.

(2) Turn crankshaft as required and remove three additional pistons and connecting rod assemblies in the same manner.

f. Mark Connecting Rod and Piston Assemblies. Keep original assemblies together (fig. 4-97).

NOTE

Be sure bearings are marked showing their original position. Mark with grease pencil if no other marks are evident.

4-34. Remove Crankshaft Pulley

Remove hex-head bolt and washer securing crankshaft pulley to crankshaft. It may be necessary to hold crankshaft to keep it from turning. Remove crankshaft pulley from crankshaft (fig. 4-98).

4-35. Remove Timing Gear Cover and Crankshaft Oil Slinger

a. Timing Gear Cover. Remove eight panhead screws, lockwashers, and flat washers securing cover. Pull cover from two dowels in cylinder block (fig. 4-99).

b. Crankshaft Oil Slinger. Remove the timing gear cover gasket (cover-to-cylinder block) and oil slinger from crankshaft. Discard gasket (fig. 4-100).

4-36. Remove Timing Gears

a. General. Condition of gears and camshaft end play may allow engine to be put into serviceable condition without removing crankshaft or camshaft timing gears.

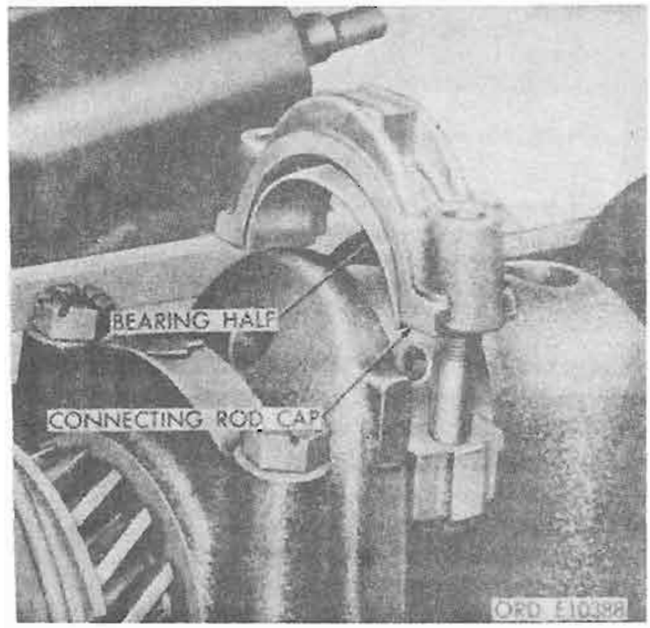


Figure 4-95. Connecting rod cap and bearing.

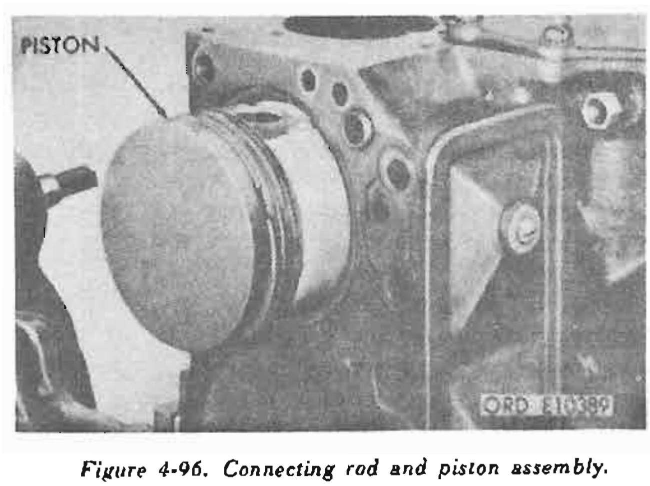


Figure 4-96. Connecting rod and piston assembly.

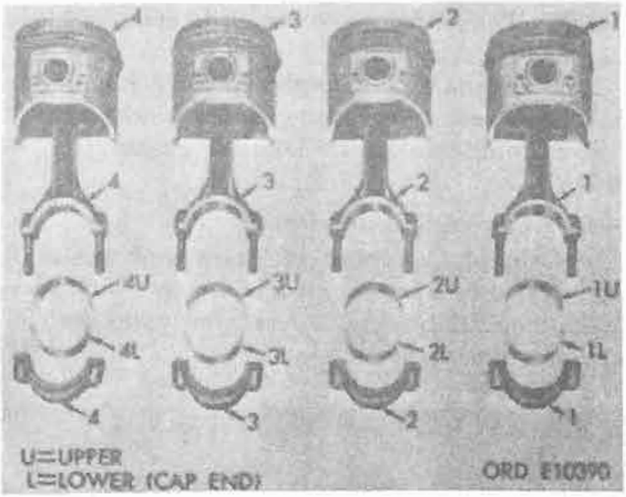


Figure 4-97. Marking connecting rod and piston assemblies.

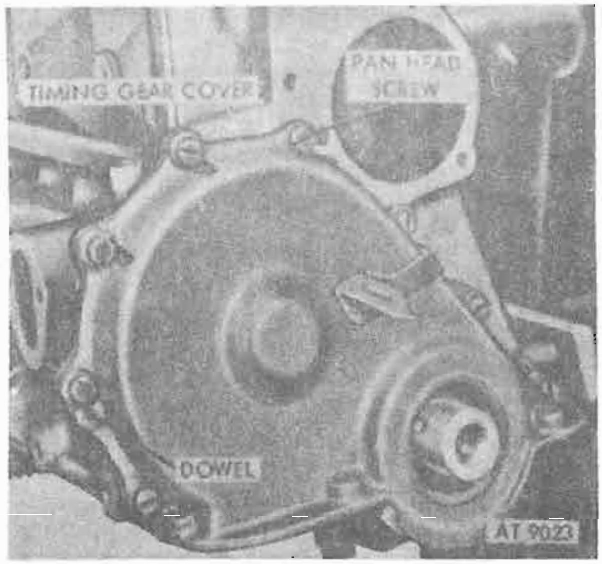


Figure 4-99. Timing gear cover.

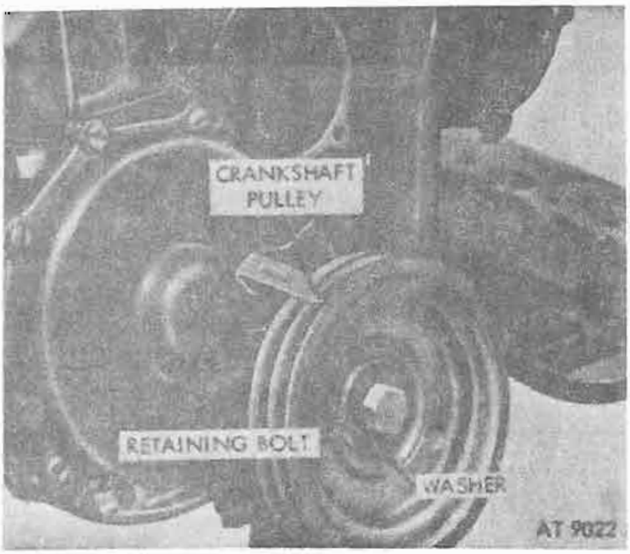


Figure 4-98. Crankshaft pulley.

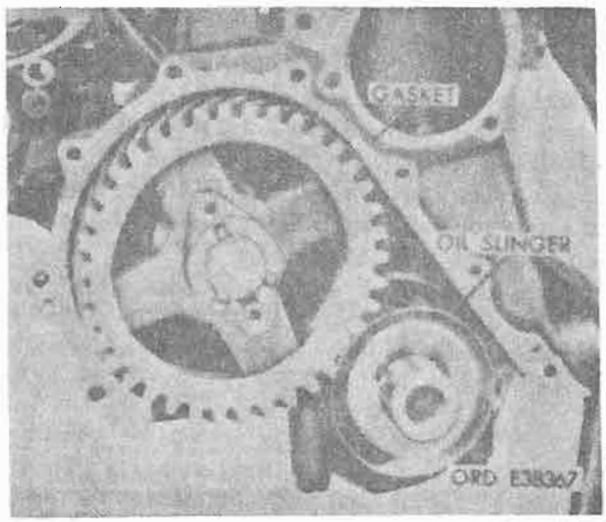


Figure 4-100. Crankshaft oil slinger.

b. Timing Gear Backlash (fig. 4-101). Place dial indicator on cylinder block with indicator tip against one of the camshaft gear teeth at right angle to helical gear tooth. Move gear from left to right to the limits of its play and record. Be sure to hold gear firmly toward block so that end play will not be indicated as backlash. Refer to repair standards (table 4-8).

c. Timing Gear Runout (fig. 4-102). Place dial indicator on cylinder block with the indicator tip against camshaft gear. Hold gear firmly toward block and rotate one full turn and note runout on indicator dial. Refer to repair standards (table 4-8).

d. Camshaft End Play (fig. 4-103). Place dial indicator on cylinder block with indicator tip against end of camshaft retaining bolt. With suitable lever, pry camshaft to limit of play and record. Refer to repair standards (table 4-8).

e. Camshaft Gear Retaining Bolt. Straighten tangs of lock tab washer securing camshaft gear retaining bolt and remove bolt, lock tab, and retainer washers. It may be necessary to hold crankshaft to keep it from turning (fig. 4-104).

f. Crankshaft Pulley Retaining Bolt. Install crankshaft pulley retaining bolt in front end of crankshaft to prevent damaging threads when removing gear with puller (fig. 4-105).

g. Crankshaft Timing Gear. Install gear puller 7076223 and remove crankshaft timing gear from crankshaft (fig. 4-106).

CAUTION

When removing timing gears, pull crankshaft gear first to prevent damage to camshaft gear. Remove Woodruff key and bolt from crankshaft.

h. Camshaft Gear Retaining Bolt. Install camshaft gear retaining bolt in front end of camshaft to prevent damaging threads when removing with puller (fig. 4-107).

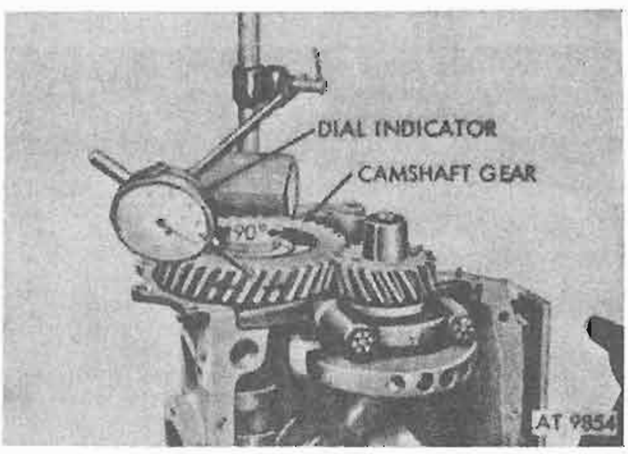


Figure 4-101. Measuring timing gear backlash.

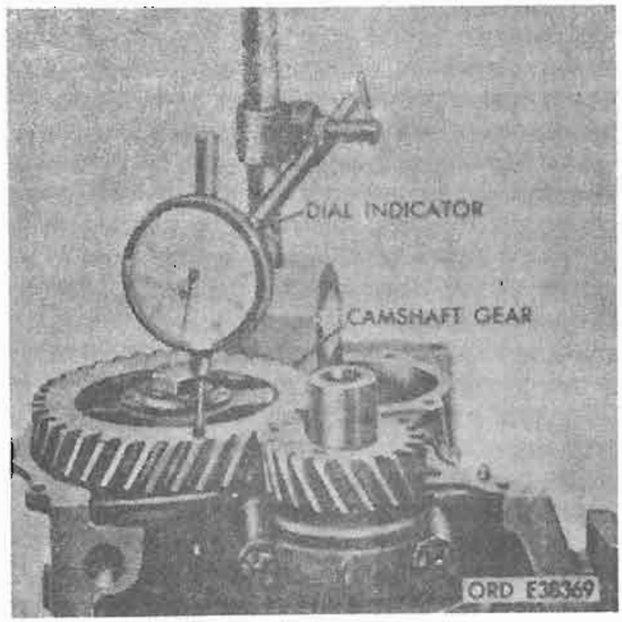


Figure 4-102. Measuring timing gear runout.

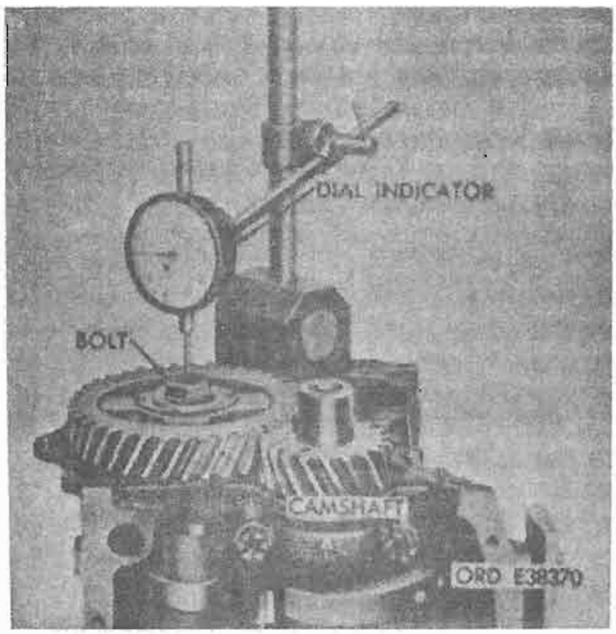


Figure 4-103. Measuring camshaft end play.

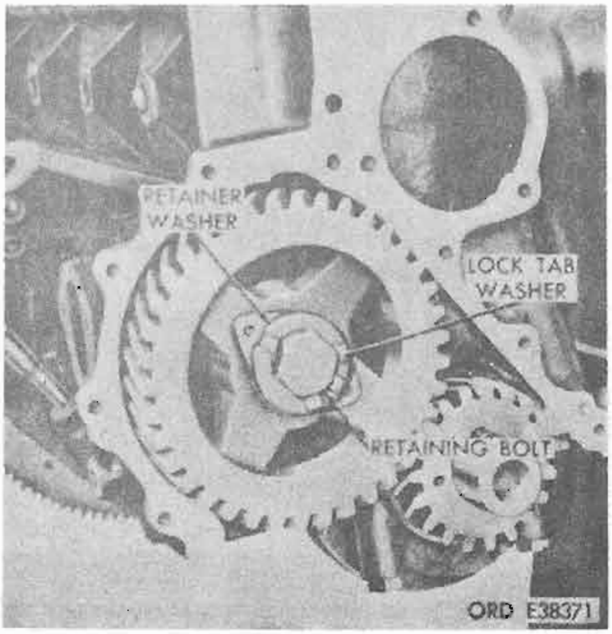


Figure 4-104. Camshaft gear retaining bolt.

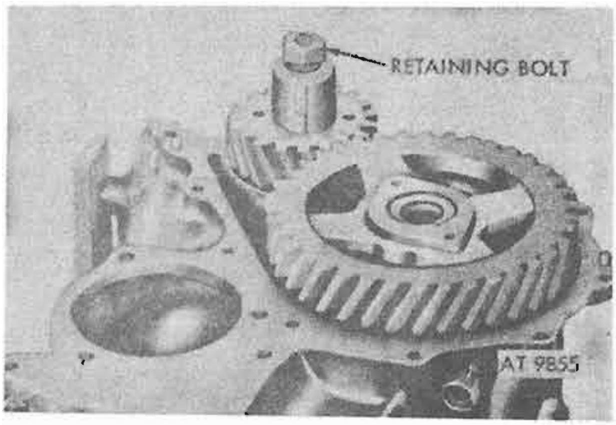


Figure 4-105. Install crankshaft pulley retaining bolt.

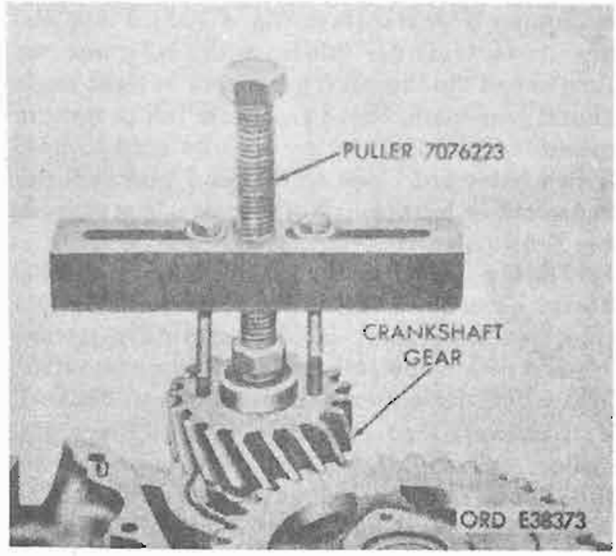


Figure 4-106. Crankshaft timing gear removal.

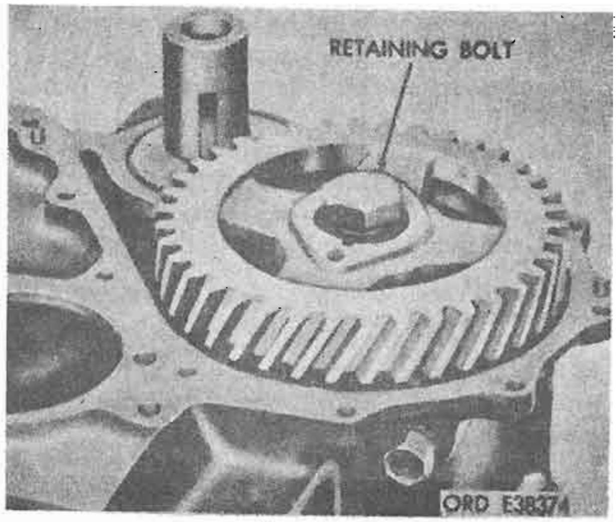


Figure 4-107. Install camshaft gear retaining bolt.

i. Camshaft Timing Gear. Install gear puller 7076223 and remove camshaft timing gear (fig. 4-108). Hold camshaft timing gear from turning with a punch or suitable tool.

CAUTION

Do not remove this gear until crankshaft gear is removed.

4-37. Remove Clutch Pilot Bearing

If the flywheel is removed from the crankshaft, a punch and hammer can be used to drive out bearing. To remove bearing when flywheel is assembled on crankshaft, insert puller 7077742 into clutch pilot bearing and spread tool with thumbscrew. Knock out the bearing with the slide hammer on puller (fig. 4-109).

4-38. Remove Flywheel

Remove six self-locking hex-head bolts securing flywheel to crankshaft and remove flywheel (fig. 4-110).

NOTE

Use care when removing flywheel so that it does not drop off pilot on crankshaft.

4-39. Remove Crankshaft

a. Crankshaft End Play (fig. 4-111). Place dial indicator on cylinder block with indicator tip against end of crankshaft. With suitable lever, pry crankshaft to limits of its play and record. Refer to repair standards (table 4-9).

b. Main Bearing Cap Bolts. Loosen six self-locking bolts securing three main bearing caps to cylinder block (fig. 4-112).

c. Main Bearing Caps and Bearing Halves. Remove three main bearing caps with bolts in place (fig. 4-113). Keep bearings with caps.

NOTE

Use care when removing bearing caps so bearing halves are not dropped. Main bearing caps are line-bored with block and are not interchangeable with other blocks.

d. Rear Main Bearing Cap Seal. Remove and discard four side seals on rear main bearing cap (fig. 4-114).

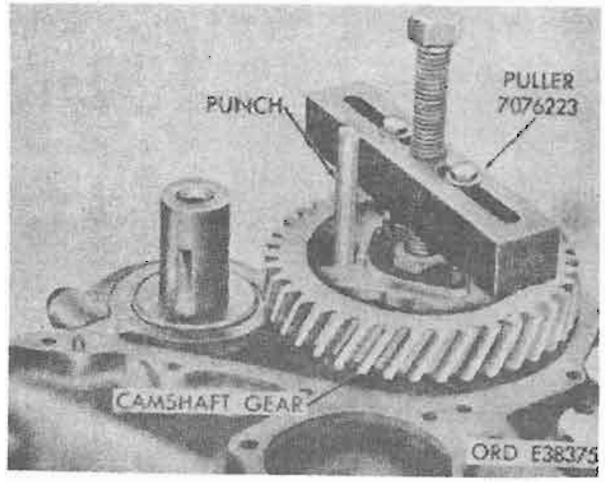


Figure 4-108. Camshaft timing gear removal.

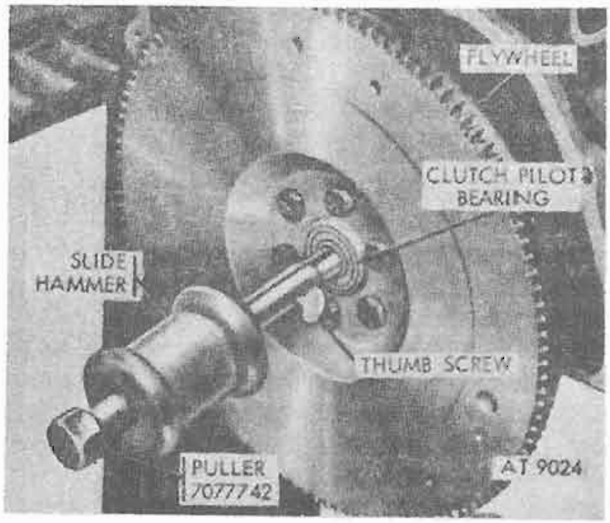


Figure 4-109. Installation of clutch pilot bearing puller.

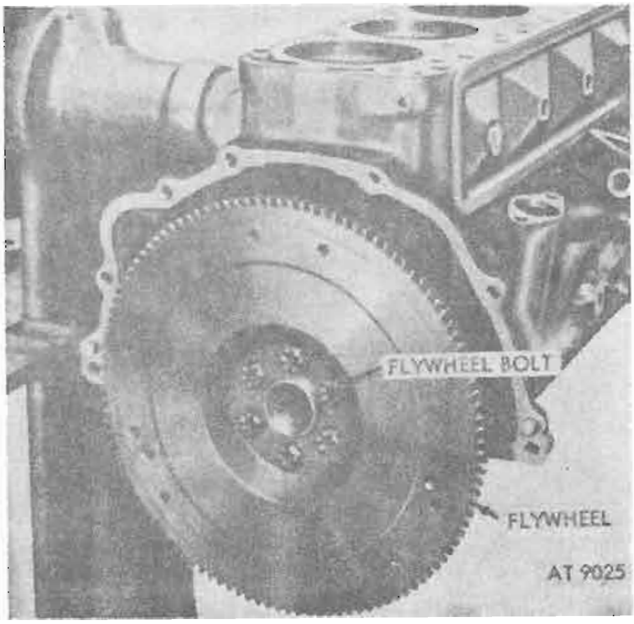


Figure 4-110. Flywheel removal.

Figure 4-111. Measuring crankshaft end play.

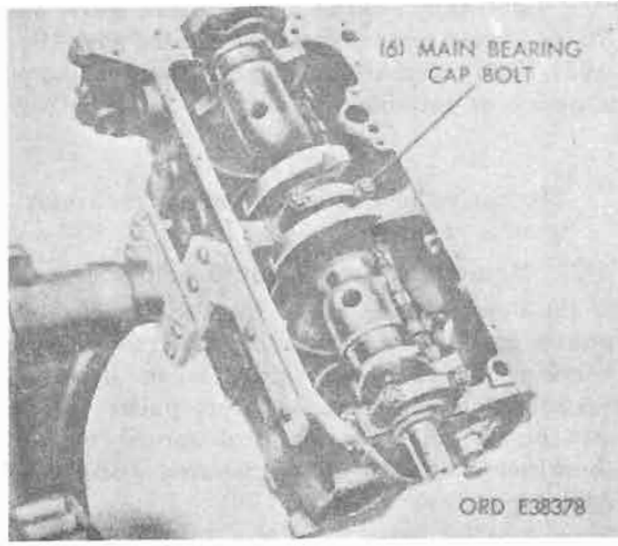


Figure 4-112. Main bearing cap bolts.

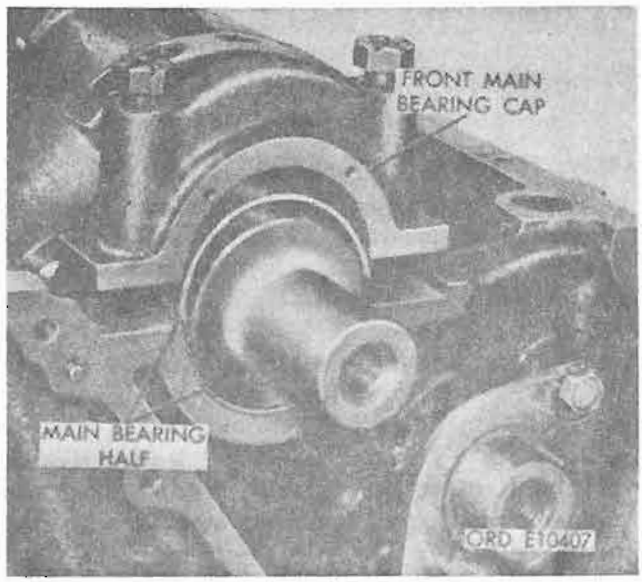


Figure 4-113. Main bearing cap and bearing halves.

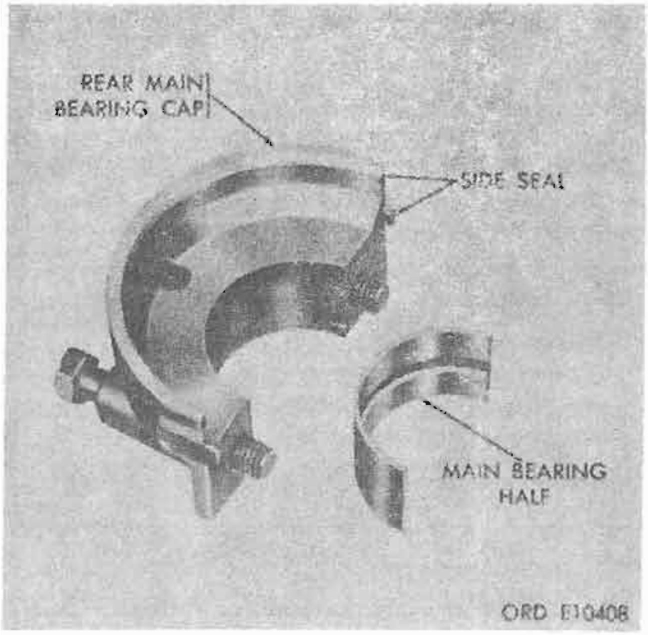


Figure 4-114. Rear main bearing cap seals.

e. Crankshaft. Lift crankshaft carefully out of cylinder block so thrust bearing surfaces are not damaged (fig. 4-115).

NOTE

Handle crankshaft with care to avoid possible fracture or damage to finished surface. Remove and discard rear oil seal.

f. Main Bearings. Remove the bearing halves in cylinder block main bearing bores. Be sure main bearings are marked showing their original position. Mark with grease pencil if no other marks are evident (fig. 4-116).

CAUTION

Do not scratch with hard tool.

4-40. Remove Camshaft and Tappets

a. Tappet Cover and Gasket. Remove remaining two panhead screws and seal assemblies holding push rod cover to cylinder block. Remove tappet cover and gasket (fig. 4-117). Discard gasket and seal assemblies.

b. Camshaft Thrust Plate. Remove two hex-head capscrews and washer assemblies securing camshaft thrust plate to cylinder block (fig. 4-118).

c. Camshaft. Turn cylinder block over on engine stand to prevent tappets from dropping out when camshaft is being removed. Carefully remove camshaft by pulling it toward front of engine (fig. 4-119).

NOTE

To remove camshaft with gear attached, aline holes in camshaft gear with hex-head capscrews on thrust plate and remove capscrews.

CAUTION

Exercise care to avoid damaging camshaft bearings, journals, and lobes.

d. Tappets. Remove eight tappets, keeping in order so they can be installed in their original positions (fig. 4-119).

4-41. Remove Oil Filter Adapter (fig. 4-120)

Remove two hex-head screw and lockwasher assemblies, and flat washers securing oil filter adapter to cylinder block. Remove oil filter adapter and gasket from block. Discard gasket.

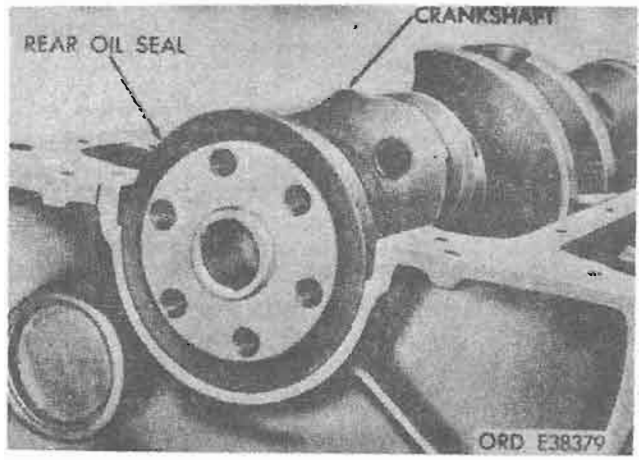


Figure 4-115. Crankshaft and rear oil seal.

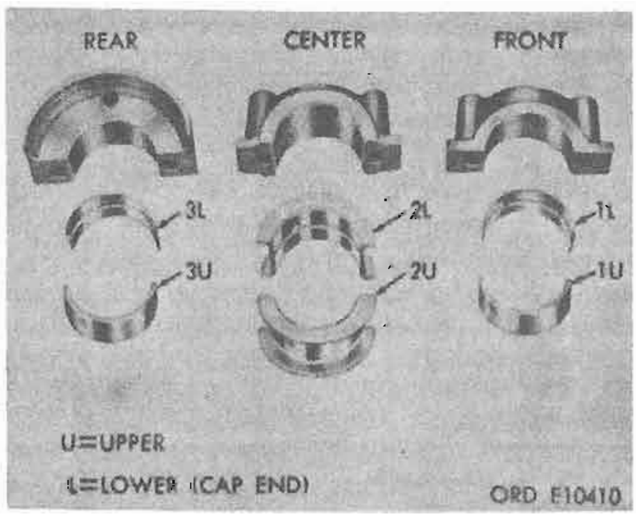


Figure 4-116. Main bearings.

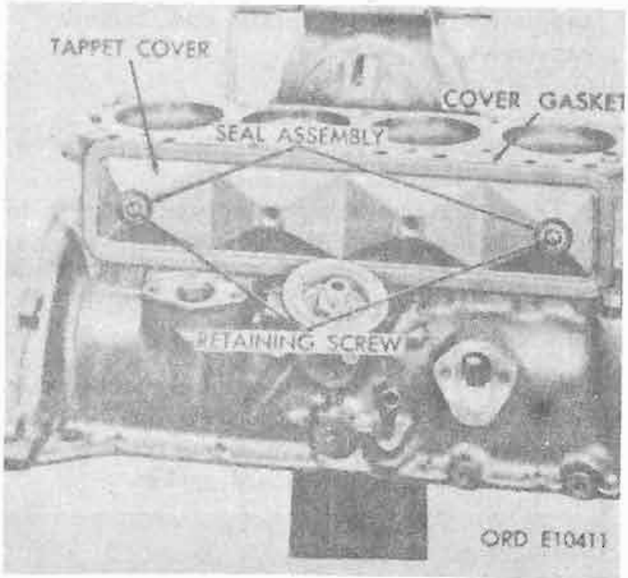


Figure 4-117. Tappet cover and gasket.

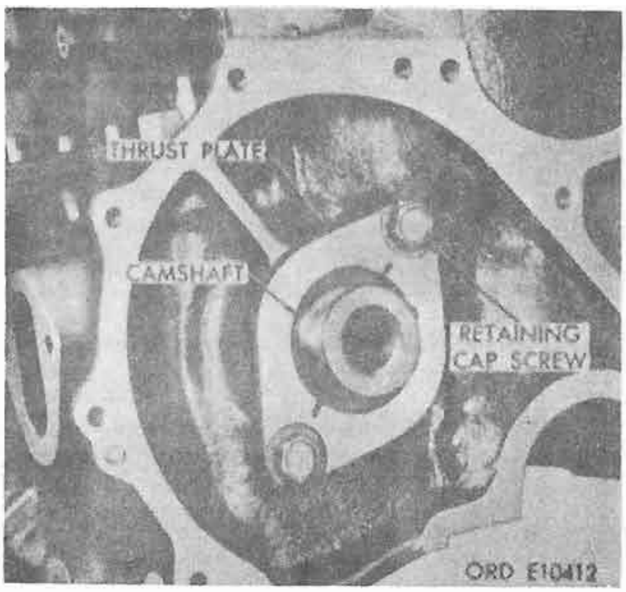


Figure 4-118. Camshaft thrust plate.

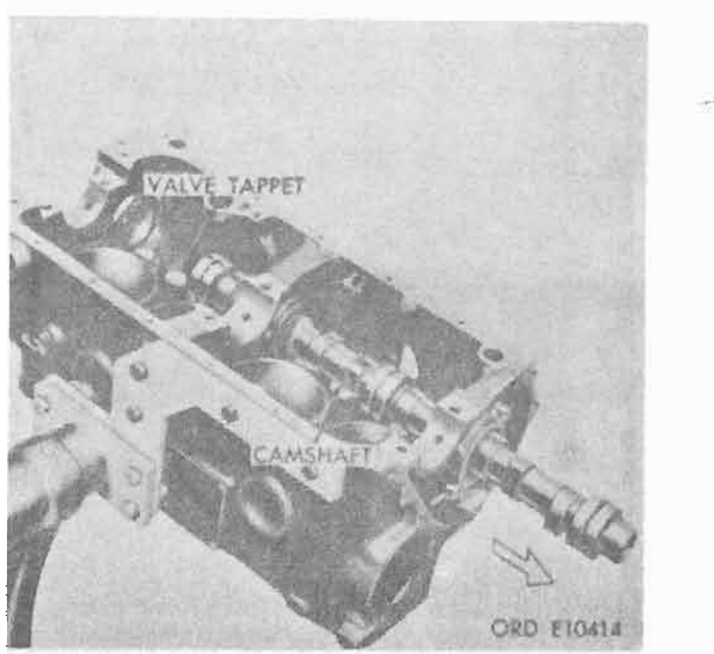


Figure 4-119. Camshaft removal.

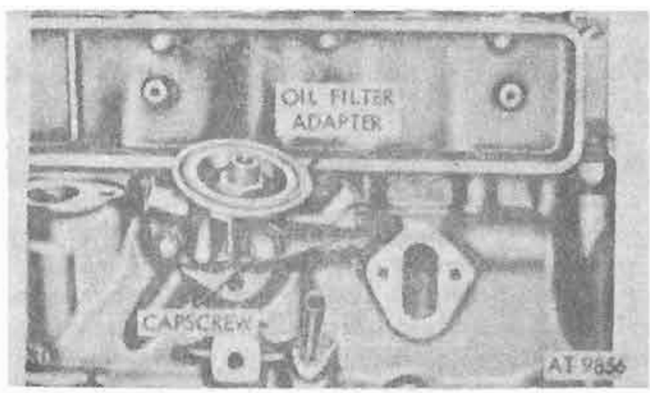


Figure 4-120. Oil filter adapter.

4-42. Repair

a. *General.* The principal purpose of repairs is to salvage parts which would otherwise be scrapped. Repair should not be attempted if parts to be repaired cannot be returned to a like-new condition. If parts are unavailable, or in short supply, every effort should be made to salvage as many parts as possible.

b. *Castings and Metal Parts.* Replace any casting or forging showing cracks. Minor nicks, scratches or burrs may be smoothed or removed with a fine stone or crocus cloth. Replace parts if damage cannot be corrected.

c. *Tapped holes, Studs, Screws, and Nuts.* Minor damage to internal threads may be corrected with a used tap; major damage requires replacement of the part. Minor thread damage on studs may be corrected with a thread die. Replace screws, bolts, studs, or nuts that have thread damage. Bolts, screws and studs that are bent or show evidence of stretch must be replaced.

4-43. Cleaning

a. *General.* The importance of cleaning must be thoroughly understood by all US Army maintenance personnel. The presence of dirt or foreign substances is a constant threat to satisfactory engine repair. All parts must be cleaned before inspection, after repair, and before assembly. Protect all parts from accumulation of dust and grit after cleaning.

b. *Castings and Metal Parts.* The inner and outer surfaces of all castings and metal parts subject to oil lubrication must be cleaned with a cleaning solvent. Make sure all gasket material is removed from mounting surfaces. Give particular attention to oil passages in both castings and machined parts. Remove plugs, where necessary, and use wires or probes to break up all sludge or gum deposits to admit cleaning solvent. Passages must be blown out with compressed air to free them of all foreign particles.

c. *Tapped Holes.* Clean out tapped holes, using old tap to prevent cutting oversize. Blow out bolt holes with compressed air, making certain threads are clean. Dirt in threads may cause binding, resulting in false torque readings.

d. *Lines and Fittings.* Soak lines and fittings in cleaning solvent. Use wires or probes to remove stubborn deposits of foreign matter. Blow out with compressed air, making certain all passages are clear. Avoid getting petroleum products such as cleaning solvent, mineral spirits paint thinner, engine fuel, or lubricants, or rubber parts, as they will deteriorate rubber.

4-44. Inspection

a. *General.* All parts, regardless of their application or use, must be carefully examined and inspected to determine whether they are to be used or scrapped. The wear or damage of some parts will be evident to the eye, whereas in others it will be necessary to use accurate precision equipment to determine fit and tolerances. Pertinent repair standards, together with points of measurement, are included with the exploded views in the repair sections of this chapter. After parts are inspected, whether new or used, they must be lightly coated with preservative oil to insure against rust.

b. *Castings and Metal Parts.* Inspect castings or forgings for cracks, nicks, burrs, and discoloration, indicating possible fluid leaks or high temperature. Pay particular attention to machined mounting surfaces and areas around bolt holes, tapped holes, bearing bores, and dowel pins. Test all questionable mounting surfaces with a straight edge or surface plate for evidence of warpage. Whenever available, magnetic inspection process may be applied to all ferrous metal parts, especially on ground or highly finished surfaces. This process is not recommended for ball or roller bearings. The Zyglo inspection method may be employed for inspecting aluminum parts. Whenever any cast iron part is to be inspected for cracks, the following method can be used to determine presence and location of cracks.

(1) Clean part thoroughly in cleaning solvent; then dry thoroughly.

(2) Immerse part in or apply a coat of mineral spirits paint thinner mixed with light oil. Dry part thoroughly with a clean cloth.

(3) Coat part immediately with a thin coat of zinc oxide powder mixed with wood alcohol. Wherever cracks are present, a brown discoloration will appear in the coating.

c. *Tapped Holes, Studs, Screws, Nuts, and Dowel Pins.* Inspect all tapped holes, studs, screws, and nuts for damaged threads. Examine dowel pins for evidence of damage and looseness.

d. *Lines and Fittings.* Inspect all lines and fittings for defects such as leaks, cracks, dents, and stripped threads. Minor dents or bends in metal lines may be straightened. Major dents, bends, or damage to lines or fitting require replacement of the damaged part.

4-45. Repair Clearances, Wear Limits, and Torque Specifications

a. *Clearances and Wear Limits.*

(1) Data covering size of new parts and wear limit information is included with the exploded

views in the applicable repair sections. These measurements (which will be found opposite the exploded view legends) list the minimum and maximum clearance of new or repaired parts.

(2) The wear limits indicate the dimension to which a part may wear before it must be replaced. Normally, any part not worn beyond its wear limits will be satisfactory for service, provided it is not damaged by corrosion or similar causes. An asterisk (*) in the wear limit column indicates that the part should be replaced when worn beyond the limits stated in the size of new parts column.

(3) The letters "L" or "T" affixed to a dimension, indicates a loose fit (clearance) or a tight fit (interference), respectively. The numbers following nomenclature are Army Part numbers.

b. Maintenance Policy. Refer to paragraph 1-1.

c. Torque Specifications. Refer to paragraph 4-130 for torque specifications. Special torque specifications are given in the repair sections (paras 4-42 through 4-92 and in the assembly section (paras 4-93 through 4-127).

Section VII. REPAIR OF CYLINDER HEAD, VALVES, AND RELATED PARTS

4-46. General.

The disassembly procedure in this section covers a complete removal of all components. The condition of the cylinder head may be such that it can be put into a serviceable condition without complete disassembly. Make a preliminary inspection to determine defective parts and apply the following steps to those parts which are defective.

4-47. Cleaning, Inspection, and Repair

a. General. Refer to general cleaning, inspection, and repair procedures (paras 4-42 through 4-44) and to repair standards (table 4-3 and fig. 4-134).

b. Cylinder Head. With the valves installed to protect the valve seats, remove carbon deposits from the valve heads and cylinder head surface with scraper and a wire brush. Be careful not to scratch the cylinder head gasket surface. After the valves are removed, clean the valve guide bores. Use cleaning solvent to remove dirt and grease. Check head for cracks and gasket surface for burrs and nicks. Replace head if cracks are found. Remove all burrs or scratches with an oil stone.

4-48. Disassembly

a. Remove Exhaust Valves (fig. 4-121).

(1) *Exhaust valve spring retainer keys and valve stem cap.* Compress each valve spring with a suitable valve spring compressing tool and remove two valve spring retainer keys and one valve stem cap.

NOTE

Identify keys and cap so they can be installed with the same valve.

(2) *Exhaust valve spring retainer and spring.* Remove valve spring compressing tool and lift exhaust valve spring retainer and spring from valve stem.

NOTE

Identify spring retainer so it can be installed with same valve.

(3) *Exhaust valve.* Withdraw exhaust valve from valve guide and identify with grease pencil so it can be installed in same guide from which it was removed. Repeat the above procedure on all four valves (fig. 4-122).

b. Remove Intake Valves.

(1) *Intake valve spring retainer keys.* Compress valve spring with a suitable valve spring compressing tool, and remove two valve spring retainer keys and valve spring sleeve (fig. 4-123).

(2) *Intake valve spring retainers, springs, and seals.* Remove valve spring compressing tool and lift valve spring retainer and spring from valve stem. Remove intake valve stem seals from intake valves. Discard valve stem seals.

(3) *Intake valve.* Withdraw intake valve from valve guide and identify with grease pencil so it can be installed in guide from which it was removed (fig. 4-124). Repeat the same procedure on all four valves.

c. Remove Studs. Check the two valve rocker arm shaft support studs (fig. 4-125) for cracks and for damaged threads. Remove if necessary with a suitable tool.

d. Remove Water Outlet Connection, Thermostat, and Heater Plug.

(1) *Water outlet connection.* Remove two hex-head capscrews and washer assemblies securing outlet connection to cylinder head. Remove outlet connection (fig. 4-126) and gasket from cylinder head. Discard gasket.

(2) *Thermostat.* Remove thermostat from recess in cylinder head (fig. 4-127). For testing thermostat, refer to TM 9-2320-218-20.

(3) *Heater outlet plug.* Check heater plug (fig. 4-128) for signs of leakage. Remove if necessary with a suitable wrench.

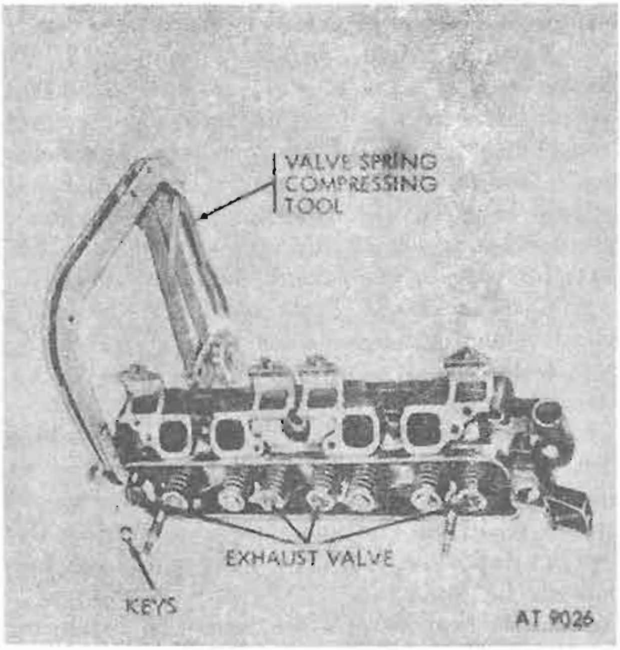


Figure 4-121. Exhaust valve spring retainer keys and valve stem cap—removal and installation.

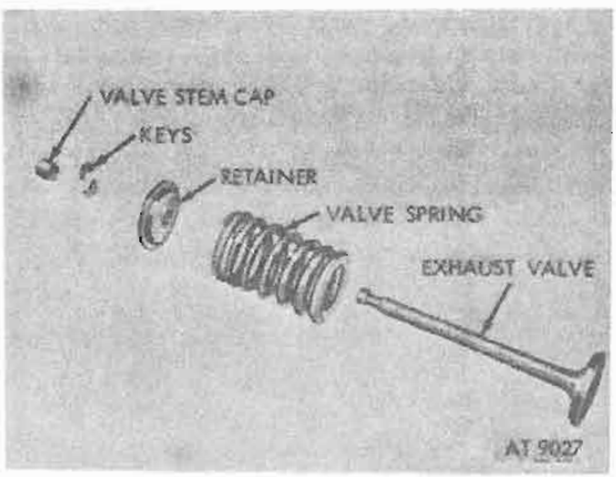


Figure 4-122. Exhaust valve assembly.

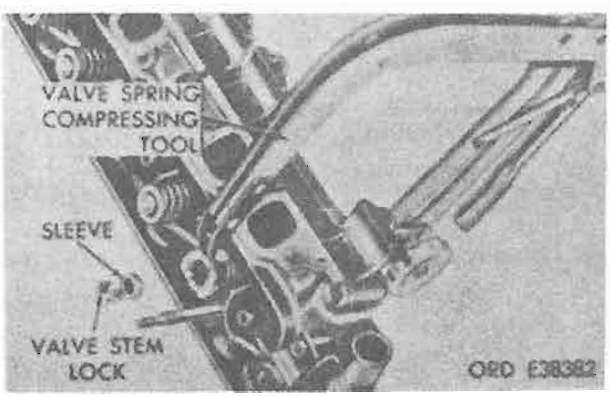


Figure 4-123. Intake valve spring retainer lock—removal and installation.

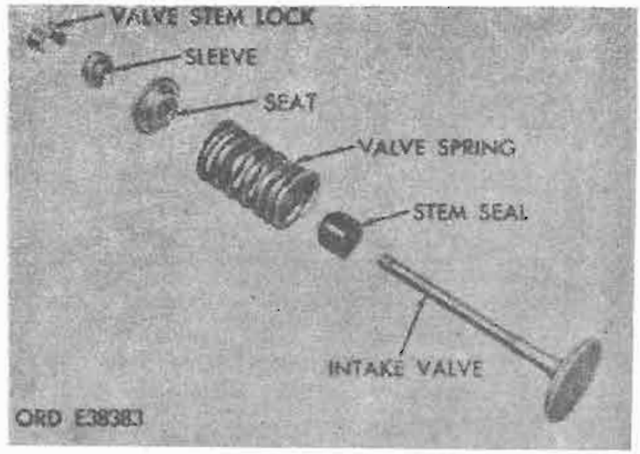


Figure 4-124. Intake valve assembly.

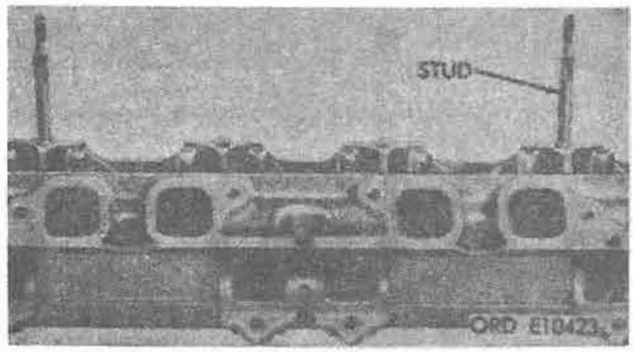


Figure 4-125. Valve rocker arm shaft support studs.

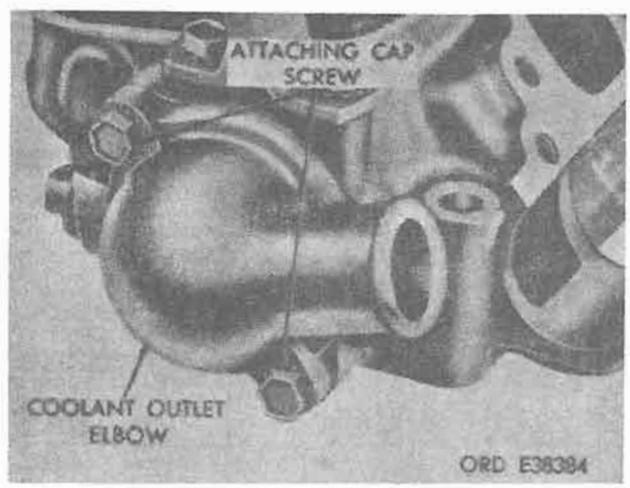


Figure 4-126. Water outlet connection.

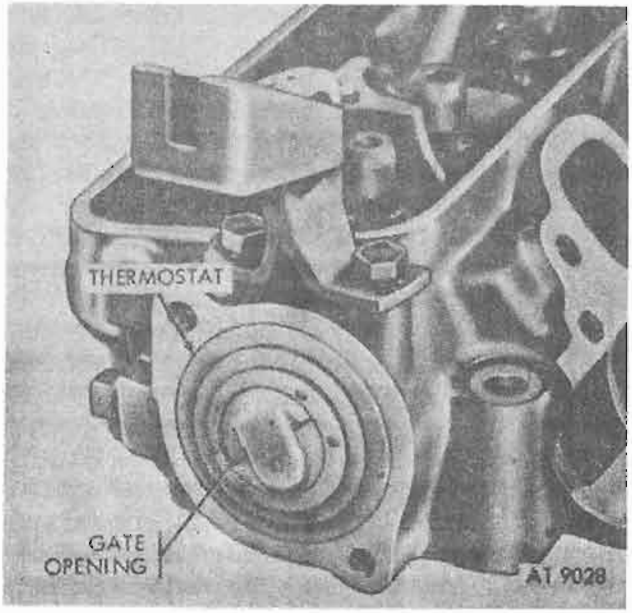


Figure 4-127. Thermostat.

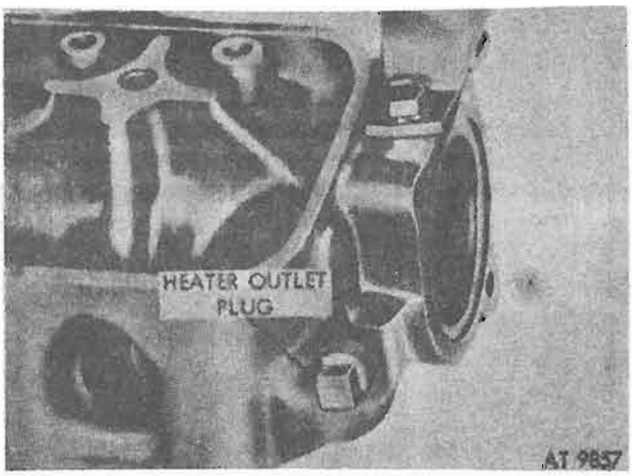


Figure 4-128. Heater outlet plug.

e. Expansion Plug. Check for leakage around expansion plug (fig. 4-129) by applying a pressure of 45 psi minimum to water jacket cavity. Replace if signs of leakage appear.

f. Remove Engine Lifting Eyes (fig. 4-130). Remove two hex-head capscrew and washer assemblies securing front lifting eye to cylinder head. Loosen hex-head jam nut securing vacuum line retaining clip and engine rear lifting eye to cylinder head. Screw engine rear lifting eye out of cylinder head. Check lifting eyes and attaching parts for cracks, bends, and damaged threads.

g. Cylinder Head Flatness. Check flatness of cylinder head gasket surface with a straightedge and feeler gage. Replace if warped beyond tolerance (table 4-3 and fig. 4-131).

h. Valve Seat Runout. Check valve seat runout with an accurate gage (fig. 4-132). Follow the instructions of the gage manufacturer. When going from a standard size valve to an oversize valve, always grind valve seat after valve guide has been reamed (fig. 4-133).

i. Valve Seat Width. Measure the valve seat width with a scale or suitable instrument (para 4-50 and fig. 4-135).

4-49. Reaming Valve Guides

Valve guide walls may be reamed to accommodate the use of oversize parts by using a proper size piloted reamer. See repair standards (table 4-3) for wear limits and new part size.

Table 4-3. Repair Standards—Cylinder Head, Valves, and Related Parts

Fig. No.	Key	Point of measurement	Size of new part	Wear limit
4-134	6	Valve spring, intake and exhaust:	2.12 max.	*
		Free length of spring Load in lbs. at compressed:		
		Length of 1.505.	124-140	110
		Length of 1.821.	54-62	48
		Squareness of spring with axis within Maximum	2°	*
		spring assembled height from surface of cylinder head spring pad to underside of spring retainer.	1.821	*
4-134	8	Valve seats, intake and exhaust:		
		Width of seat	0.070-0.080	*
		Angle of seat	45° -44° 45'	*
		Face angle of relief of seat	65° ±0 30'	*
		Throat angle of relief of seat	15° ± 0° 30'	*
		Maximum allowable seat runout	0.0020	0.0025
4-134	8a	Diameter of intake & exhaust valve guide.	0.3115-0.3125	0.3145
4-134	10a	Valve head, exhaust:		
		Angle of face	45° -15'-45° 30'	*
		Runout of valve face	0.0015	0.0020
		Diameter of valve head	1.327-1.337	*
		Minimum thickness of valve head at outer edge of tapered surface.		0.0625
4-134	10b	Valve stem, exhaust:		
		Diameter of stem (standard)	0.3090-0.3095	0.3070
		Diameter of stem (0.005 oversize)	0.3140-0.3145	0.3120
		Fit of stem in guide	0.0020L-0.0035L	0-0087L
		Clearance of stem to rotator cap	0.002-0.004	
		Clearance of valve to rocker arm	0.015±0.001	*
4-134	11a	Valve head, intake:		
		Angle of face	45° 15'-45° 30'	*
		Runout of valve face	0.0015	0.0020
		Diameter of valve head	1.728-1.738	*
		Minimum thickness of valve head at outer edge of tapered surface.		0.0625
4-134	11b	Valve stem, intake:		
		Diameter of stem (standard)	0.3100-0.3105	0.3080
		Diameter of stem (0.005 oversize)	0.3150-0.3155	0.3130
		Fit of stem in guide	0.0010L-0.0025L	0.0077L
		Clearance of valve to rocker arm	0.015±0.001	*
4-131 and 4-134		Cylinder head flatness:		
	8a	Permissible out-of-flat overall	0.004	0.005
	8b	Permissible out-of-flat in any 6 inches.	0.002	0.004

* Refer to paragraph 4-48a (2).

4-50. Refacing Valve Seats

a. Refacing of valve seats should be closely coordinated with refacing of valve face so the finished seat will match the valve face and be centered. This is important to insure that valve and seat will have a good compression and vacuum-tight fit.

b. Grind valve seat to a 45° -44° 45° angle. Remove only enough stock to clean up pits, grooves, or to correct valve seat runout. After seat has been refaced, measure seat width. Narrow the seat, if necessary, to bring it within limits (fig. 4-135).

NOTE

New exhaust valves have an aluminized face to aid break-in and should not be lapped in seat.

c. If valve seat width exceeds maximum limit, remove enough stock from top edge or bottom edge of seat to reduce width to specifications. Use a 30° angle grinding wheel to remove stock from bottom of seat (raising the seat). Use a 130° angle wheel to remove stock from top of seat (lowering the seat) (fig. 4-135).

d. The finished valve seat should contact the approximate center of the valve face. To determine where the valve seat contacts the face, coat seat with Prussian blue, and set valve in place. Rotate valve with light pressure. If blue is transferred to center of valve face, contact is satisfactory. If blue is transferred to top edge of valve face, lower valve seat. If blue is transferred to bottom edge of valve face, raise valve seat.

4-51. Valves and Springs

a. Cleaning and Inspection.

(1) Remove all carbon and varnish from valve with a fine wire brush or buffing wheel. Critical inspection points and tolerances of the valve are illustrated in figure 4-136.

(2) Inspect valve face and edge of valve head for pits, grooves, scores, or other defects. Inspect stem (fig. 4-137) for a bent condition and end of stem for grooves or scores. Check valve head for signs of burning or erosion, warpage, and cracking. Defects such as minor pits, grooves; etc., may be removed, Discard valves that are severely damaged, or have a head margin less than 1 / 32-inch after refacing.

(3) Inspect valve springs, valve spring retainers, locks, and sleeves for defects. Discard any defective parts.

b. Valve Face Runout. Check valve runout with accurate precision equipment (fig. 4-138), it should not exceed wear limits (fig. 4-136).

c. Valve Stem Clearance. Check valve stem-to-valve guide clearance of each valve in its respective valve guide. Valve guide wear may be measured with a small telescope hole gage and micrometer or suitable precision equipment. Worn valve guides set up a thrust action which imposes a severe stress on the valve which may result in early valve failure.

d. Valve Spring Pressure. Check valve spring for proper pressure (fig. 4-139). Weak valve springs cause poor performance. If pressure of any spring is less than specified in table 4-3, replace spring.

e. Valve Spring Squareness. Check each spring for squareness, using a steel square and a surface plate. Stand spring and square on end of surface plate. Slide spring up to square. Revolve spring slowly and observe space between top coil of spring and square. If out-of-square more than 1 / 16 inch, replace spring. Refer to figure 4-140.

f. Select Fitting Valves. If valve stem-to-valve guide clearance exceeds wear limit, it is recommended that valve guide be reamed for an oversized valve stem. Valves with oversize stem diameters of 0.005 inch are available for service.

4-52. Assembly

a. Install Engine Lifting Eyes. Assemble engine front lifting eye to cylinder head with two 5 / 16-18x¾ hex-head capscrew and washer assemblies. Tighten screws 10-15 lb-ft torque. Assemble hex-head nut and vacuum line retaining clip to engine rear lifting eye, and screw lifting eye into cylinder head until it bottoms. Position lifting eye and vacuum line retaining clip and tighten hex-head nut firmly. Refer to figure 4-130.

b. Install thermostat Coolant Outlet Connection and Heater Plug.

(1) *Heater outlet plug.* Apply water and oil-resistant sealer to heater plug thread and tighten firmly in cylinder head. Refer to figure 4-128.

(2) *Thermostat.* Check thermostat (para 4-76 e). Install thermostat in recess of cylinder head with gate opening facing outward. Refer to figure 4-127.

(3) *Coolant outlet connection.* Position new gasket on coolant outlet connection and assemble to cylinder head with two 5 / 16-18x7 / 8 hex-head capscrew and washer assemblies. Tighten screws to 10-15 lb.-ft. torque. Refer to figure 4-126.

c. Install Studs. Install two valve rocker arm shaft support studs with suitable tool. Tighten each stud firmly until threads shoulder on cylinder head surface. Refer to figure 4-125.

d. Install Expansion Plug. Refer to paragraph 5-60 a for installation procedure. Refer to figure 4-127.

e. Install Intake Valves.

(1) *Intake valve and seals.* Install each valve in guide from which it was removed or to which it was fitted. Install valve stem over end of intake valve as shown in figure 4-124.

(2) *Intake valve springs, seats, sleeves, and locks.* Install valve spring over valve stem with close-wound end of coil toward cylinder head. Install seat and sleeve. Use valve spring compressor to compress spring, being careful not to damage valve stem seal, and install locks. Remove tool. Refer to figure 4-123.

f. Install Exhaust Valves.

(1) *General.* Special equipment is required to accurately measure exhaust valve stem cap clearance. This clearance must be checked whenever an exhaust valve or any of its retaining parts are replaced. Gage kit ORD 7950601 or suitable accurate precision equipment can be used to measure clearance between end of valve stem and valve stem cap. Exhaust valve locks and valve stem cap, once fitting with valve, should be kept as a group with the valve. At installation, be sure that locks are assembled with wear on same side to avoid cocking spring seat. Valve stem locks can be inverted to use the unworn side of the locks. If this is done, valve cap clearance must be checked again (fig. 4-141).

(2) *Exhaust valve stem end-to-cap clearance.* Measure clearance between end of exhaust valve stem and inside of cap (fig. 4-142). Correct clearance is 0.0002-0.004 inch. Proper clearance is necessary so cap can carry valve spring pressure, permitting the valve to float and rotate. If clearance is greater than 0.004 inch, reduce clearance by lapping open end of cap on a flat smooth surface. If clearance is less than 0.0002 inch, increase clearance by grinding necessary amount from end of exhaust valve stem in a valve refacing machine.

(3) ***Exhaust valve installation.*** Install each valve in guide from which it was removed or to which it was fitted. Refer to figure 4-122.

(4) ***Exhaust valve springs, spring seats, locks and caps.*** Install valve spring over valve stem with close-wound end of coil toward cylinder block. Install spring retainer. Use valve spring compressor to compress spring and install keys on the valve from which it was removed, (1) above, then remove tool. Install valve stem caps on the valve from which they were removed and tape in place on valve to insure correct location and prevent loss when handling cylinder head prior to installation. Refer to figure 4-121.

g. Check Valve Spring Assembled Height. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with a scale or suitable instrument (fig. 4-143). If the assembled height is greater than 1 13/16 inches, install the necesary 0.030-inch-thick spacer(s) between the cylinder head spring pad and valve spring to bring the assembled height to the recommended dimension of $1\ 13/16 \pm {}^{.03}_{.00}$ inches. Do not install spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve spring and cause excessive load loss and spring breakage.

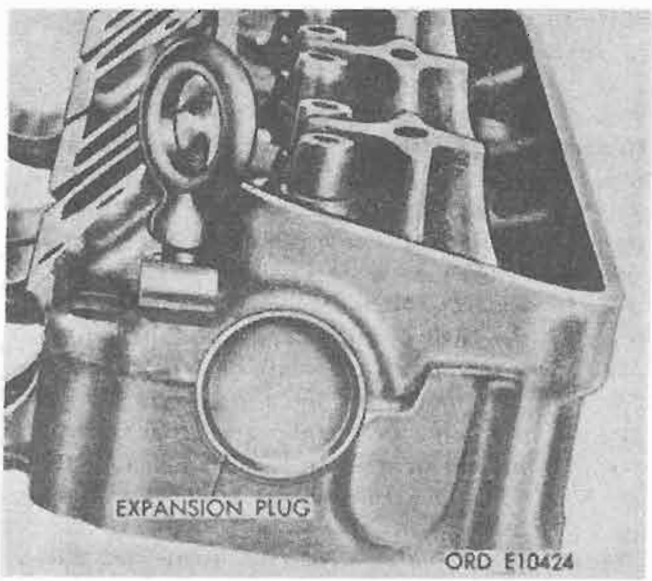


Figure 4-129. Expansion plug.

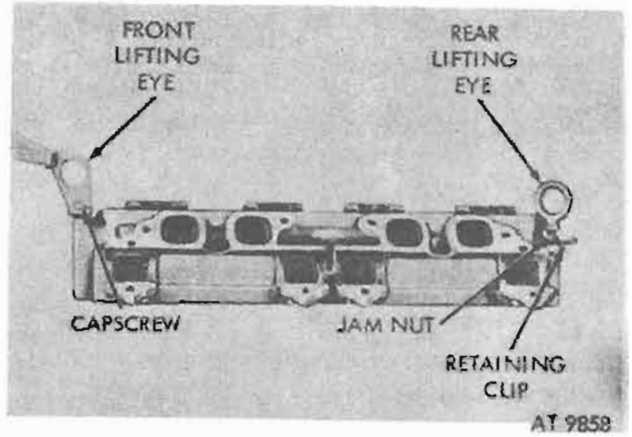


Figure 4-130. Front and rear engine lifting eyes.

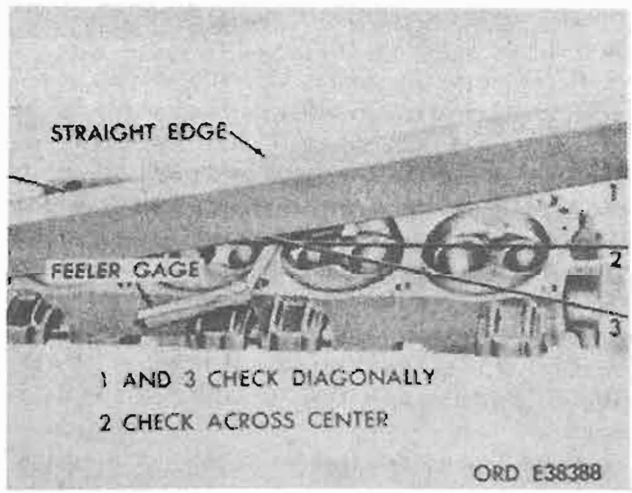


Figure 4-131. Cylinder head flatness—typical.

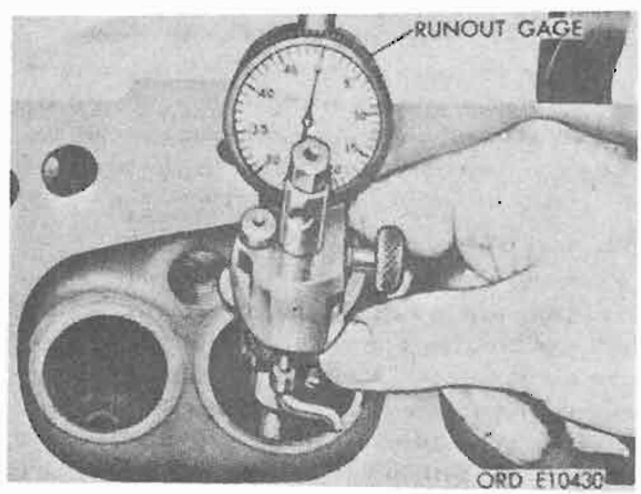


Figure 4-132. Valve seat runout—typical.

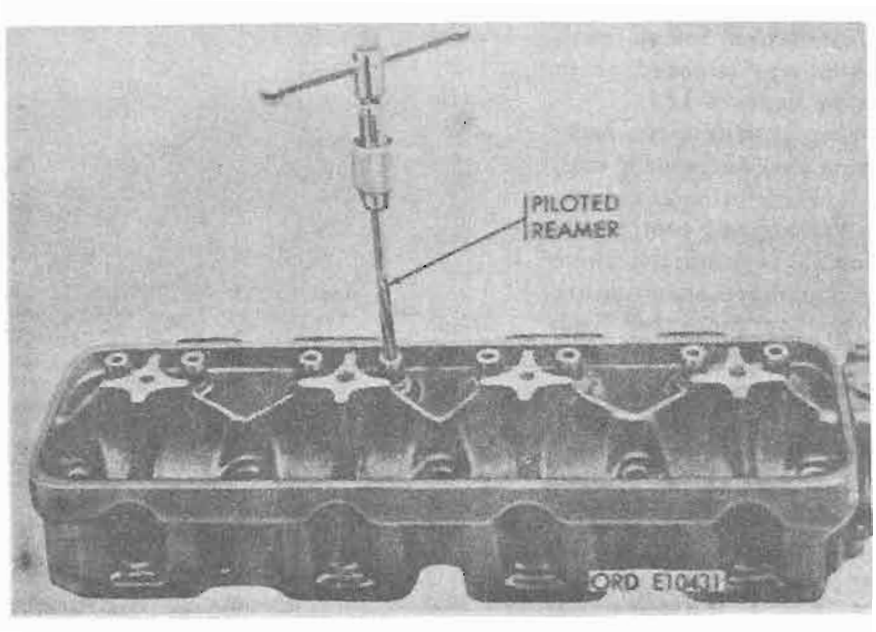


Figure 4-133. Reaming valve guides—typical.

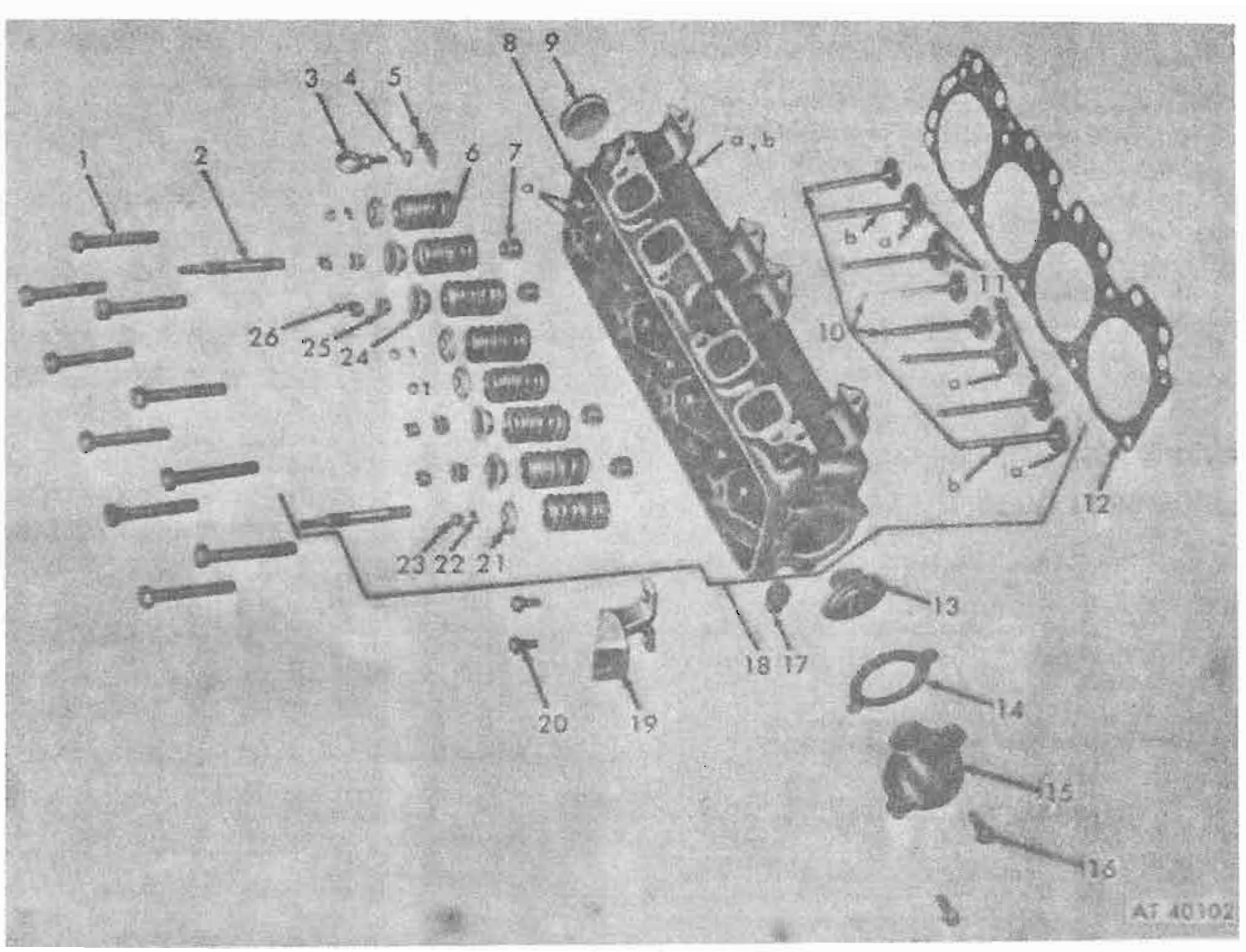


Figure 4-134. Cylinder head, valves and related parts—exploded view.

Legend to figure 4-134:

1 Bolt 7 / 16-14x2.91 cylinder head (10).
2 Stud, rocker arm shaft support and cover (2).
3 Eye, engine rear lifting
4 Nut, ⅜-16 hex-head
5 Clip, vacuum line
6 Springs, exhaust and intake valve (8).
7 Seal, intake valve stem (4)
8 Head, cylinder
9 Plug, expansion
10* Valve, exhaust (4)
11* Valve, intake (4)
12 Gasket, cylinder head
13 Thermostat
14 Gasket, water outlet connection
15 Connection, water outlet
16 Screw & Washer Assembly 5 / 16-18-x7 / 8.
17 ⅛ pipe plug
18 Head assembly, cylinder w / valves
19 Lifting eye front engine
20 Screw & washer assembly, 5 / 16-18x¾ (2)
21 Retainer, exhaust valve spring (4)
22 Key, exhaust valve spring retainer (8).
23 Cap, exhaust valve stem (4)
24 Retainer, intake valve spring (4)
25 Sleeve, intake valve (4)
26 Key, intake valve spring retainer (8).

* Indicates oversize service parts are available (table 4-3)

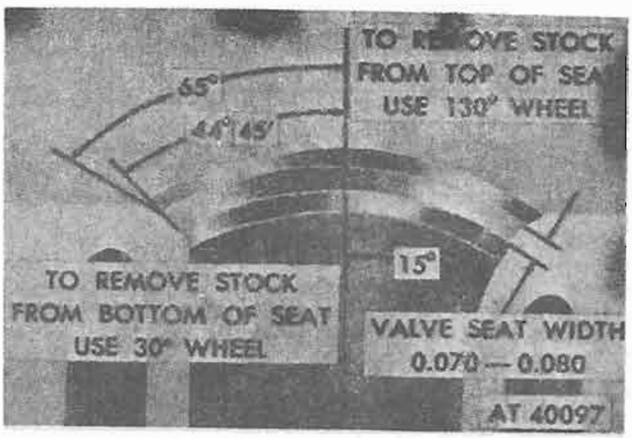


Figure 4-135. Valve seat replacing—typical.

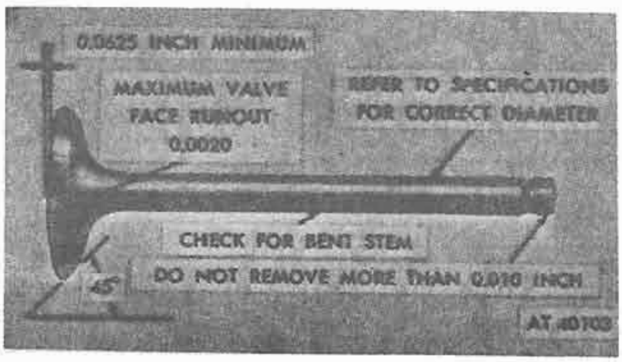


Figure 4-136. Critical tolerances—typical.

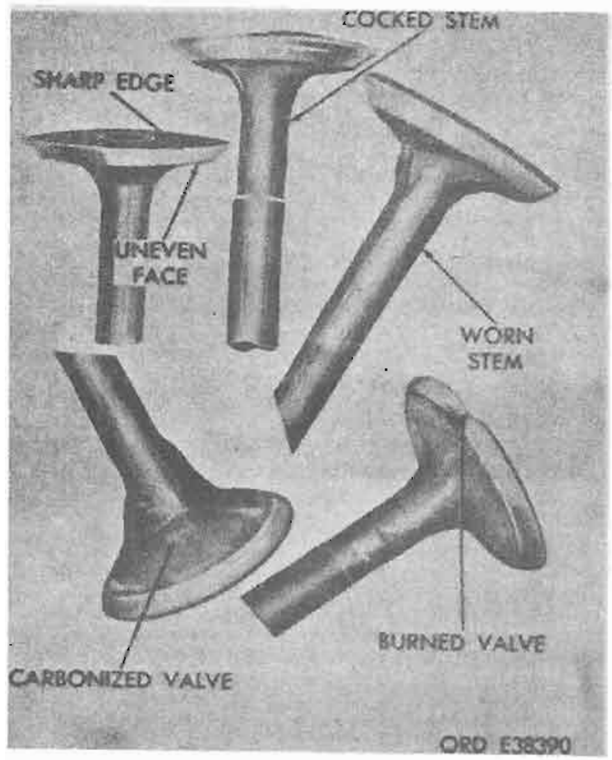


Figure 4-137. Unserviceable valves.

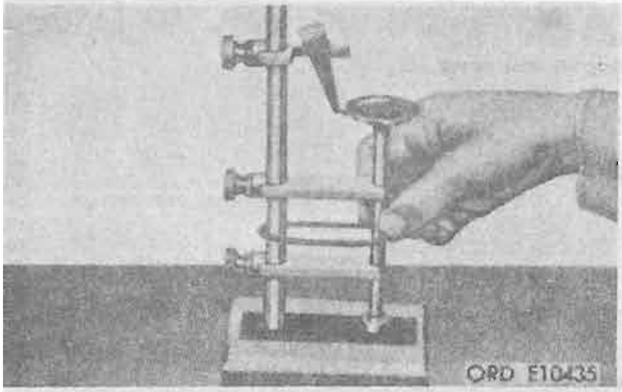


Figure 4-138. Valve race runout—typical.

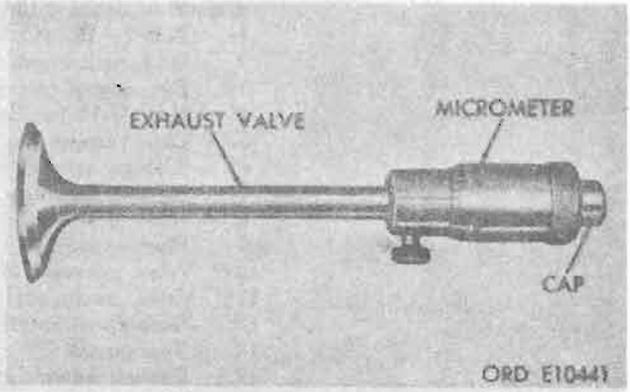


Figure 4-141. Typical gage for checking valve stem-to-cap clearance.

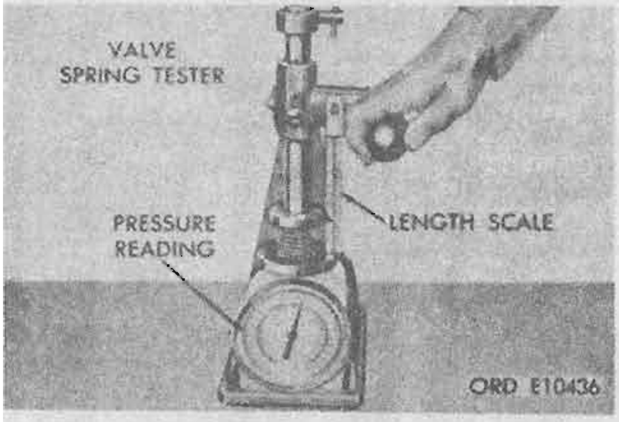


Figure 4-139. Valve spring pressure.

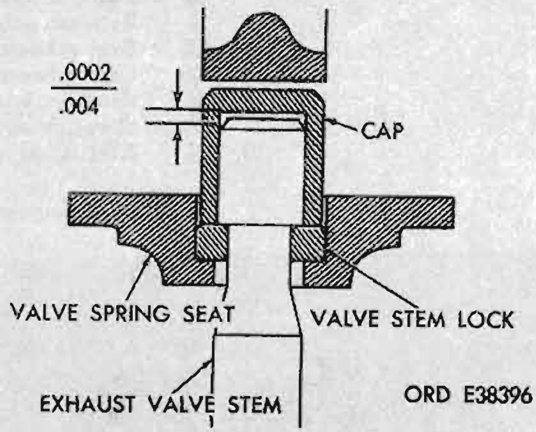


Figure 4-142. Exhaust valve stem-cap clearance.

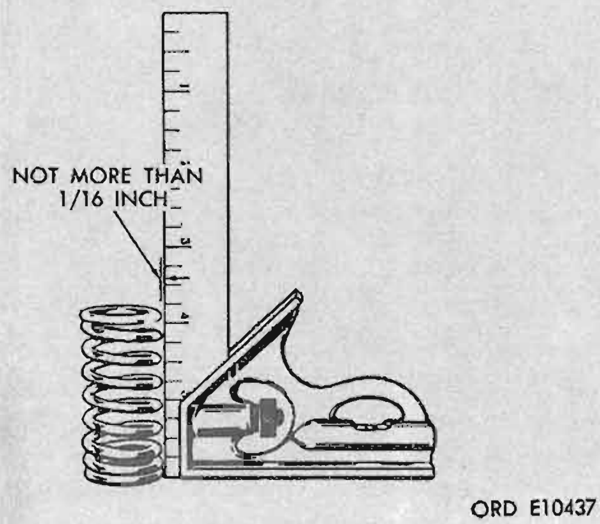


Figure 4-140. Valve spring squareness.

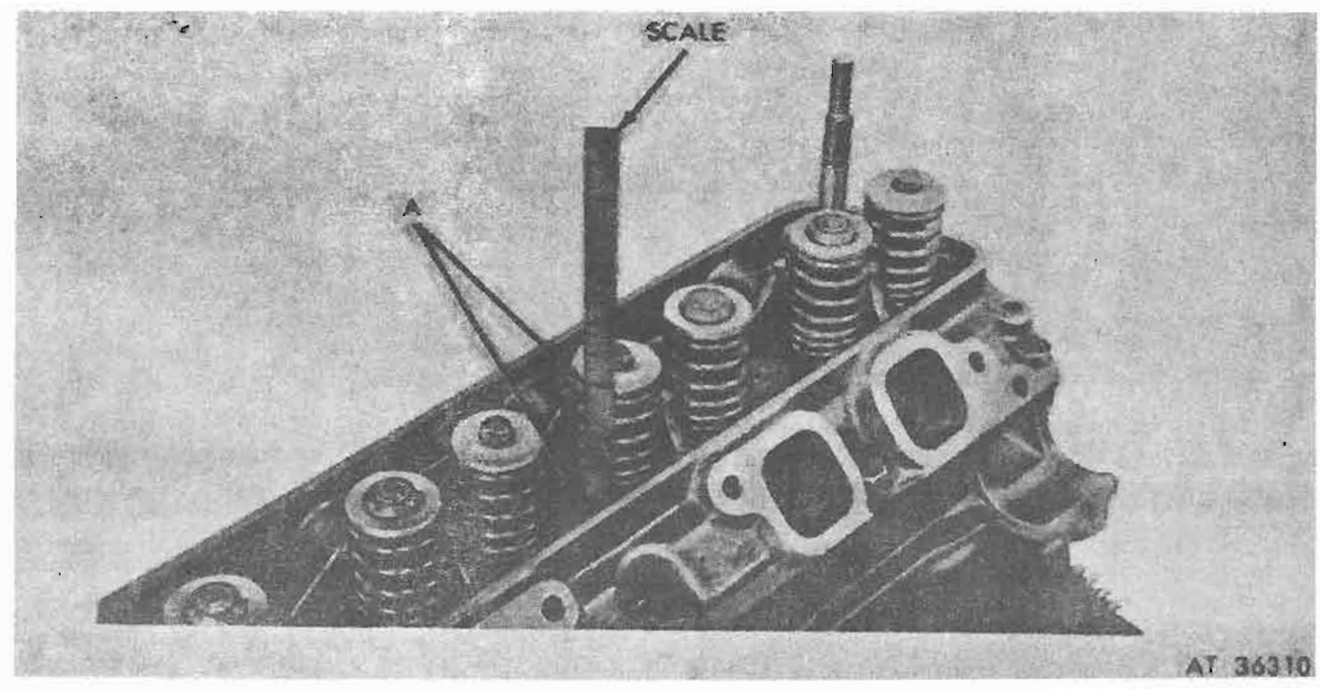


Figure 4-143. Valve spring assembled height.

Section VIII. REPAIR OF ROCKER ARMS AND SHAFT ASSEMBLY, AND RELATED PARTS

4-53. Disassembly

a. Remove Rocker Shaft Oil Inlet and Outlet Tube. Remove oil inlet tube from rear valve rocker arm shaft support (fig. 4-144). Remove oil outlet tube from second valve rocker arm shaft support. Discard O-ring seal.

b. Remove Valve Rocker Arms. Identify rocker arms with grease pencil so they can be installed in their original location. Remove cotter pin, two washers, and a spring washer from each end of rocker arm shaft and slide the rocker arms, rocker arm shaft supports, and rocker arm shaft locating springs off the rocker arm shaft (fig. 4-145).

c. Remove Valve Adjusting Screws. Remove hex-head self-locking, valve adjusting screws from rocker arms only if they are damaged or worn, or if the torque required to turn the screw is less than 5 lb.-ft. (fig. 4-146).

d. Remove Rocker Arm Shaft Plugs. If it is necessary to remove the plugs from the rocker arm shaft, drill a hole in plug on one end, and use a steel rod to knock out the plug on the opposite end. Working from the open end, knock out the remaining plug (figs. 4-147 and 4-148).

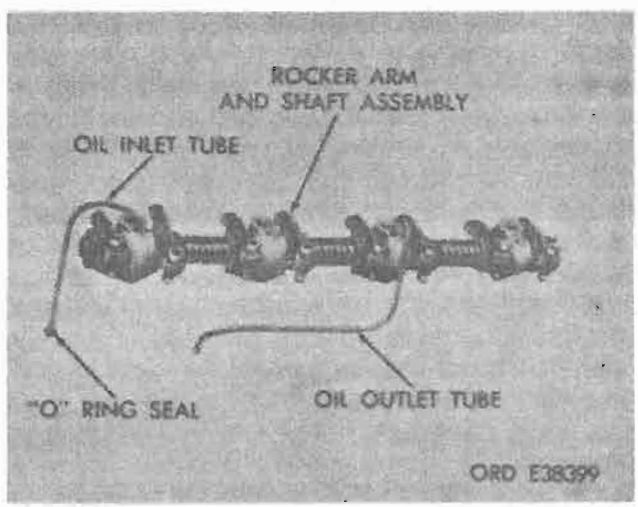


Figure 4-144. Rocker arm oil inlet and outlet tube.

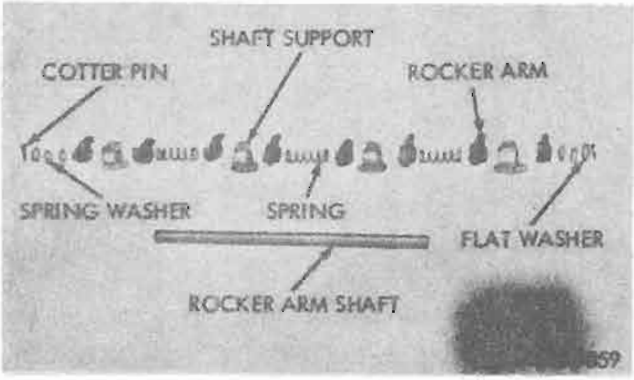


Figure 4-145. Rocker arm and shaft assembly.

Figure 4-146. Valve adjusting screw.

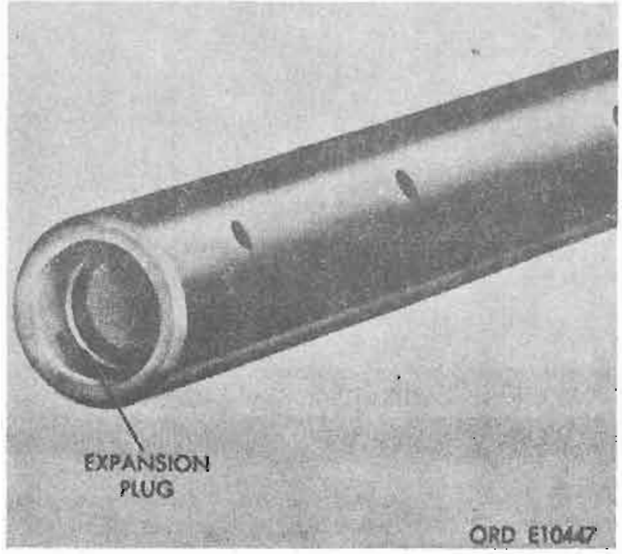
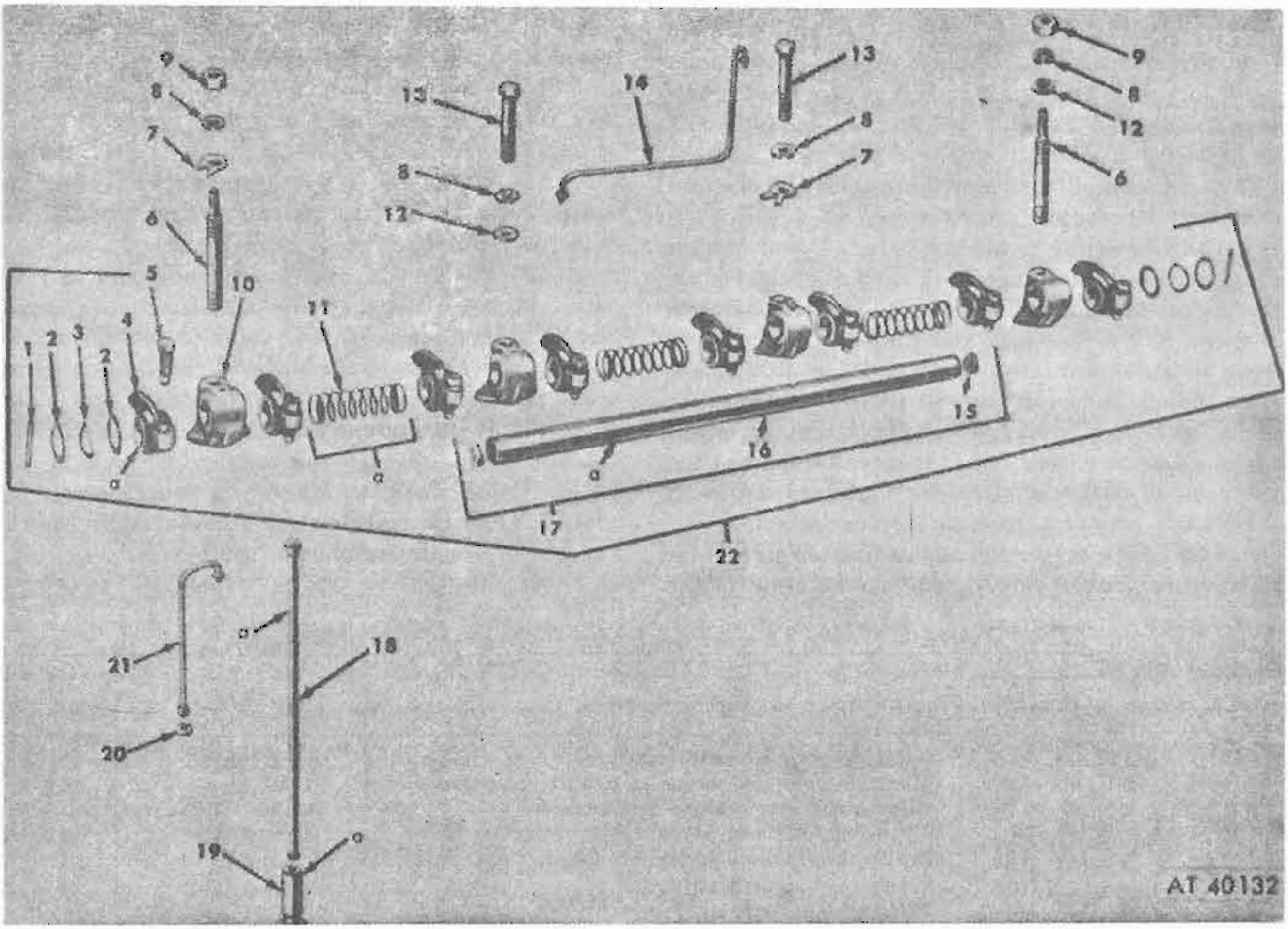


Figure 4-147. Rocker arm shaft assembly.



1 Pin, ⅛x1 Cotter (2)
2 Washer, 13/16 (12)
3 Washer, spring (2)
4 Rocker Arm (8)
5 Adjusting screw, rocker arm valve (8).
6 Stud, rocker arm shaft support and cover.
7 Bracket, rocker arm oil tube
8 Washer, 7/16 lock (2)
9 Nut, 7/16 (2)
10 Support, rocker arm shaft (4)
11 Spring, rocker arm locating (3)
12 Washer, 7/16 flat (2)
13 Bolt 7/16-13x2½ (2)
14 Tube, rocker arm oil outlet (1)
15 Plug, expansion (2)
16 Shaft, rocker arm
17 Shaft assembly, rocker arm
18 Rod, valve push (8)
Rod, valve push (8)
19 Valve tappet (8)
20 Seal, rocker arm oil inlet tube
21 Tube, rocker arm oil inlet (1)
22 Arm and shaft assembly valve rocker

Figure 4-148. Rocker arm and shaft assembly and related parts—exploded view.

4-54. Cleaning, Inspection, and Repair

a. Reference. Refer to paragraphs 4-42 through 4-44 for general cleaning, inspection and repair procedures and to table 4-4 for repair standards.

b. Valve Rocker Arm Shaft Assembly.

(1) Clean all the parts thoroughly. Make sure that all oil passages are open.

(2) Check the clearance between each rocker arm and the shaft by checking the i.d. of the rocker arm bore and o.d. of the shaft. If the clearance between any rocker arm and the shaft exceeds the wear limit, replace the shaft and / or the rocker arm. Inspect the shaft and the rocker arm bore for nicks, scratches, scores, or scuffs. Dress up minor surface defects with a hone. Inspect the pad at the valve end of the rocker arms for a grooved radius. If the pad is grooved, replace the rocker arm.

(3) Check the rocker arm adjusting screws for stripped or broken threads and the ball end of the adjusting screw for nicks, scratches, or excessive wear.

(4) Check for broken locating springs. Inspect the oil tubes for cracks or sharp bends.

c. Push Rods.

(1) Check the ball end and socket end of the push rods for nicks, grooves, roughness, or excessive wear.

(2) Push rods can be visually checked for straightness while they are installed in the engine by rotating them with the valve closed. They also can be checked between ball and cup centers with a dial indicator.

(3) If the runout exceeds the maximum limit at any point, discard the rod.

d. Valve Tappets. No repair is recommended for the valve tappet. Replace if damaged or worn in excess of repair standards (table 4-4).

Table 4-4. Repair Standards—Rocker Arm and Shaft and Related Parts

Reference		Point of measurement	Size of new part	Wear limit
Fig. No.	Key			
4-148	4a	Inside diameter of rocker arm bore	0.7820-0.7836	*
4-148	4, 5	Minimum allowable torque to tighten valve adjusting screw after screw thread interference.		5 lb.-ft.
4-148	4,16	Fit of rocker arm on shaft	0.0010L-0.0036L	0.006L
4-148	11a	Rocker arm locating spring free length.	3.0	
4-148	16a	Diameter of rocker arm shaft	0.780-0.0781	*
4-148	18a	Valve push rod runout		0.20
4-148	19a	Diameter of valve tappet	0.4989-0.4995	0.4969
		Diameter of tappet bore in cylinder blocks.	0.500-0.501	0.503
		Fit of tappet in bore	0.0005L-0.0021L	0.0055L

* Refer to paragraph 4-44b (2)

4-55. Assembly

a. Install Rocker Arm Shaft Expansion Plugs. If the plugs were removed from ends of the shaft, use a blunt tool or large diameter pin punch and install a new plug, cup-side out, in each end of valve rocker arm shaft.

b. Install Valve Adjusting Screws. Turn all the valve adjusting screws until thread interference is noted, then check torque required to turn screw further. If torque required is less than 5 lb.-ft., replace rocker arm and adjusting screw.

c. Assemble Valve Rocker Arms on Shaft Assembly. Position rocker arm shaft with eight rocker arm lubrication holes on the bottom and oil inlet hole (closest to end of shaft) facing upward and toward rear of engine. Install a flat washer, spring washer, another flat washer, and a cotter pin on one end of shaft. Install rocker arms, support brackets, and springs in order shown. Complete assembly by installing remaining two flat washers with spring washer between. Install and spread cotter pin. Refer to figure 4-144.

d. Install Rocker Shaft Oil Inlet and Outlet Tube. Install oil inlet tube on rear valve rocker arm shaft support and install new O-ring seal on lower end of oil inlet tube. Install oil outlet tube on second valve rocker arm shaft support. Make sure end of oil inlet and outlet tube enters rocker arm shaft supports and extends into rocker shaft to maintain shaft location, and lubricate rocker arms (fig. 4-144).

Section IX. REPAIR OF CYLINDER BLOCK ASSEMBLY AND RELATED PARTS

4-56. General

Disassembly procedures cover complete removal of all components. Determine if cylinder block can be put into a serviceable condition without complete disassembly. Do not replace any parts unless found defective. Apply the following steps only to those parts which are defective. During disassembly of cylinder block, inspect the wear pattern on all parts to help diagnose the cause of wear.

4-57. Cleaning, Inspection and Repair

a. References. Refer to paragraphs 4-42 through 4-44 for general cleaning, inspection, and repair procedures. Refer to table 4-5 for repair standards.

b. Cylinder Block. Check all machined gasket surfaces for burrs, nicks, scratches and scores. Remove minor imperfections with an oil stone. Check the flatness of the cylinder block gasket surface following the procedure and specifications recommended for the cylinder head. (para 4-47). Inspect the cylinder walls for scoring, roughness, or other signs of wear. Check the cylinder bore for out-of-round and taper. Measure the bore with an accurate gage as follows: Measure the diameter of each cylinder bore at the top, middle, and bottom with the gage placed at right angles and parallel to the centerline of the engine. (fig. 4-149). If the cylinder bore wear does not exceed the limits and the cylinder block is in serviceable condition, remove the high polish on the cylinder wall, before installing new rings, to aid ring seating. This is done by passing a hone or glaze-removing tool through the cylinder bore a few times. Do not hone more than enough to rough up the polish. Make sure that oiled rags are placed in the bore to catch the hone grit and that the cylinders are thoroughly cleaned before installing the piston. Replace cylinder blocks having cylinders that are deeply scored, out-of-round, or when taper exceeds wear limits. If the cylinder walls have minor surface imperfections, but the out-of-round and taper are within limits, it may be possible to remove the imperfections by honing the cylinder wall and installing new service piston rings, provided the piston clearance is within limits. Use the finest grade of honing stone for this operation.

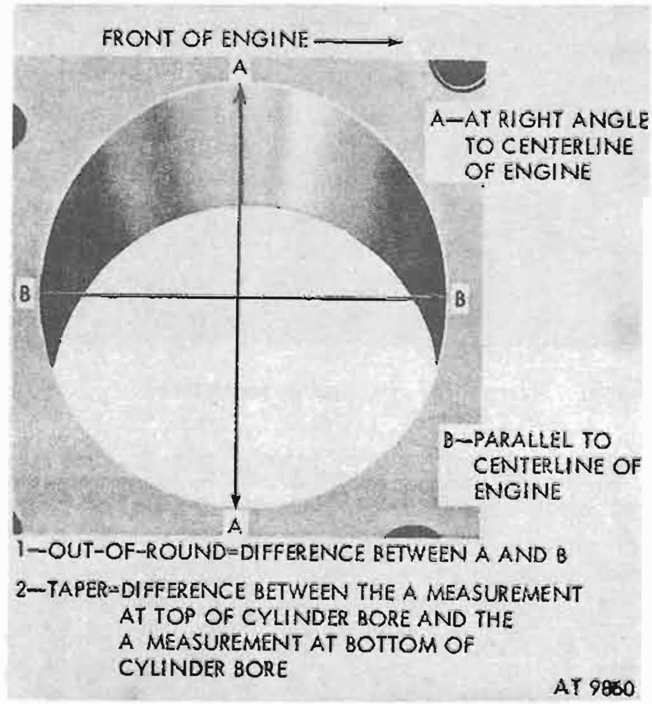


Figure 4-149. Cylinder bore and out of round taper—typical.

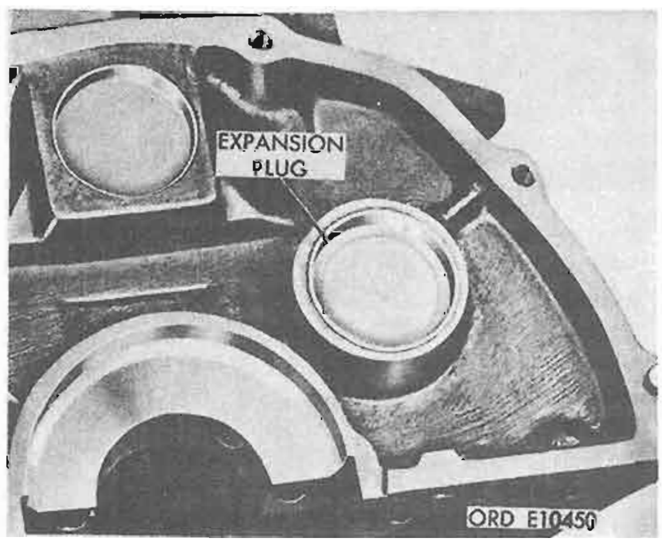


Figure 4-150. Camshaft bearing plug.

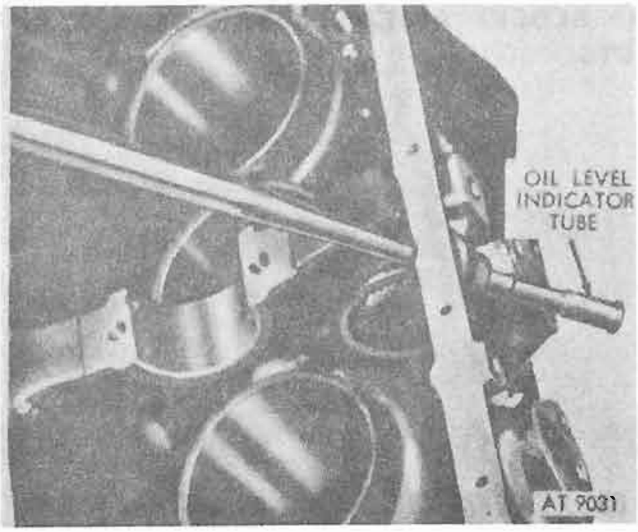


Figure 4-151. Oil level indicator tube.

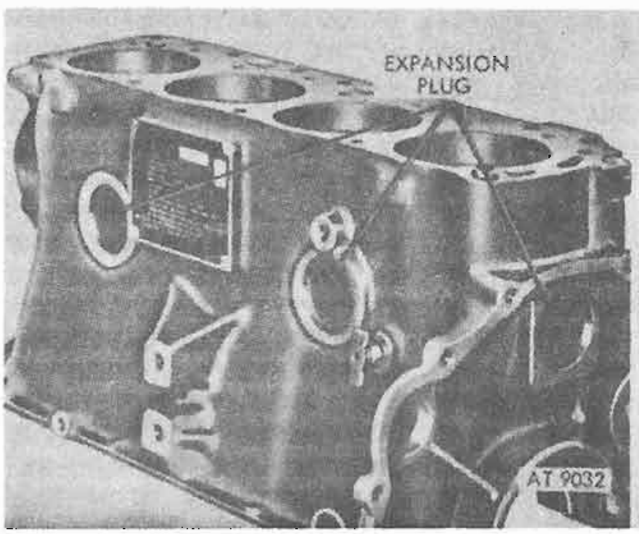


Figure 4-152. Expansion plugs.

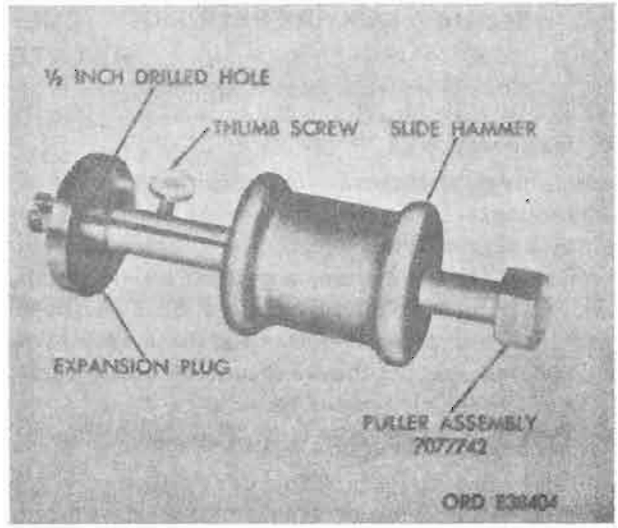


Figure 4-153. Removal of expansion plugs.

c. Main Bearing Caps. Main bearing caps are part of the cylinder block assembly and are not interchangeable with other cylinder blocks. The caps are line-bored with each block to maintain proper bearing bore alinement and bearing crush. Refer to paragraph 4-68 for measuring bearing bore and fitting bearings.

d. Dowel Pins. Examine flywheel housing, front cover, cylinder head, and gasket locating dowel pins for looseness or damage. Loose or damaged pins must be replaced. Drive ⅜x11 / 16 inch flywheel housing locating pins into cylinder blocks to a height of 9 / 32 inch from front face of cylinder block. Drive 41 / 64 x 7 / 16 inch cylinder head and cylinder head gasket hollow locating dowel pins until they strike the shoulder in the cylinder block.

4-58. Disassembly

NOTE

Camshaft bearings are nonreplaceable parts.

a. Remove Camshaft Bearing Plug. Insert a wooden dowel or suitable bar stock into camshaft bore and drive the protective cap from rear of cylinder block (fig. 4-150).

b. Remove Oil Level Indicator Tube. Examine oil level indicator tube for looseness or damage. If defective, drive tube from cylinder block with pin punch or suitable tool (fig. 4-151).

c. Remove Expansion Plugs. Examine the three expansion plugs in cylinder block for looseness or evidence of leakage (fig. 4-152). Defective or loose plugs must be replaced. If expansion plugs in cylinder block are defective and show evidence of leakage at 45 psi (minimum) pressure, drill a ½-inch hole in approximate center of plugs, and insert puller 7077742 (fig. 4-153). Spread tool with thumbscrew, and remove plug from cylinder block with slide hammer on puller.

d. Remove Drain Cock. Remove coolant drain cock from side of cylinder block (fig. 4-154).

e. Remove Clutch Release Rod Seal Retainer (fig. 4-154). If retainer is defective, remove with a suitable tool.

f. Remove Connector Fitting—Crankcase Ventilation Connector. Remove crankcase ventilation line connector fitting from front of cylinder block (fig. 4-155).

Table 4-5. Repair Standards—Cylinder Block and Related Parts

Reference		Point of measurement	Size of new part	Wear limit
Fig. No.	Key			
4-156	8a	Cylinder bore diameter	3.8753-3.8777	
		Out-of-round (maximum)	0.0005 TIR	0.003 TIR
		Diametral taper of bore, largest at bottom.	0.001	0.004
4-156	8b	Face of block:		
		Maximum allowable warpage in any 6 inches.	0.002	0.00025
4-156		Maximum allowable warpage overall.	0.004	0.005
4-156	8c	Valve tappet bore diameter	0.500-0.501	0.503
4-156	8d	Diameter of camshaft bearing bore, with inserts.	2.0110-2.0115	2.0125
4-156	8e	Diameter of main bearing bores, less inserts, at proper torque tightness.	2.4012-2.4020	*
4-183	5a 6a	Diameter of standard main bearing inserts when installed at proper torque tightness (vertical).	2.2494-2.2512	*
4-183	19a, 5a	Clearance between crankshaft and bearings.	0.0005-0.003	0.004

* Refer to paragraph 4-45a (2).

4-59. Assembly

a. Install Expansion Plugs.

(1) Preparation for installing expansion plugs. Thoroughly clean the plug recess in the cylinder block.

(2) Position plug on replacer. Coat outside surface of new expansion plug flange with water and oil-resistant sealer and slip over end of replacer 7345197 with the cup side up (fig. 4-157).

(3) Drive the expansion plug in camshaft rear bearing bore until flange of replace tool 7345197 is flush with casting surface (fig. 4-158). Replace all other defective expansion plugs in the same manner. If a water test stand is available, test for leakage around expansion plugs after inspection and repair are completed.

b. Clutch Release Rod Seal Retainer. Coat pilot diameter of clutch release rod seal retainer with water and oil-resistant sealer, and drive into cylinder block with a suitable tool until bead is flush with cast surface (fig. 4-154).

c. Oil Level Indicator Tube. Coat the pilot diameter of the oil level indicator tube with water and oil-resistant sealer (fig. 4-159). With a suitable tool, drive the tube until bead is flush with cast surface.

d. Drain Cock and Crankcase Ventilation Fitting. Apply water and oil-resistant sealer to threads on drain cock and crankcase ventilation fitting. It is a good practice never to use sealer on first two starting threads on any fitting. Install drain cock and crankcase ventilation fitting on cylinder block and tighten firmly. (figs. 4-154 and 4-155).

e. Distributor Gear Oiling Tube. Replace tube if loose, cracked or damaged. Drive tube in cylinder block flush with top of cylinder head gasket surface, using a suitable tool (fig. 4-160).

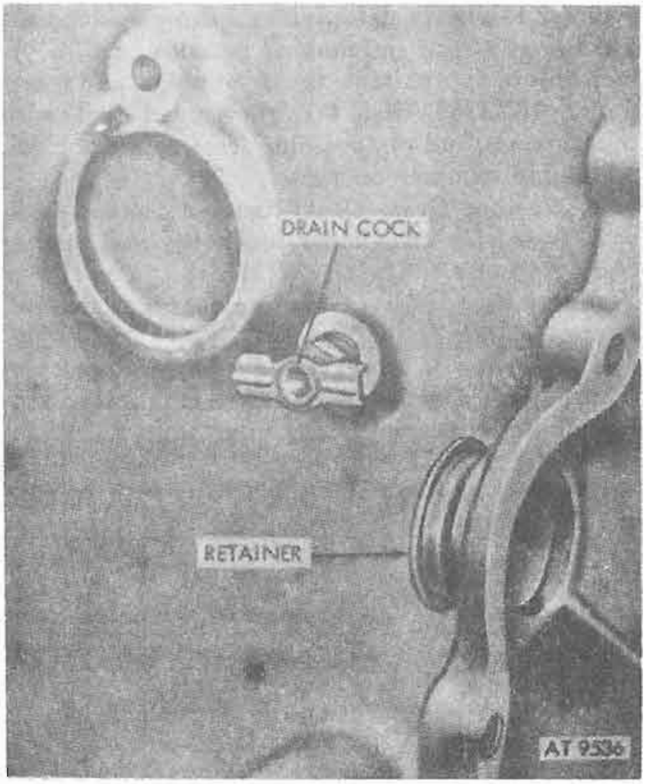


Figure 4-154. Drain cock and clutch release rod seal retainer.

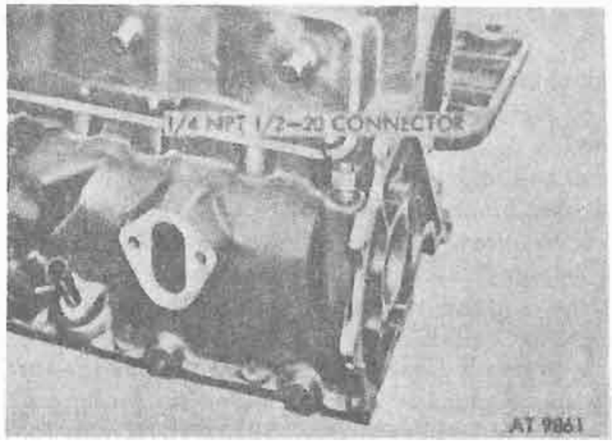
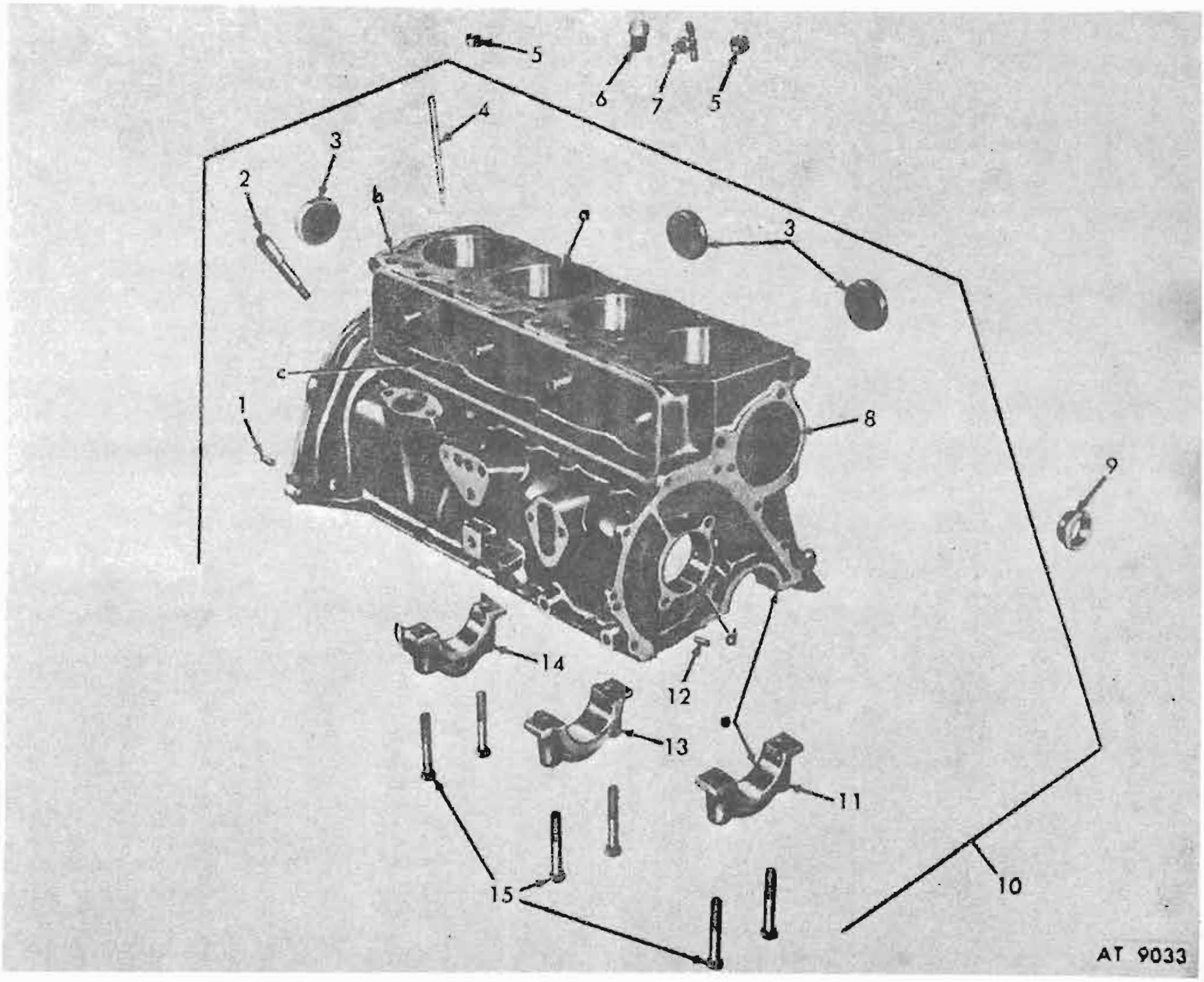


Figure 4-155. Crankcase ventilation connector fitting.



1 Dowel, ⅜x11 / 16 flywheel housing.
2 Tube, oil level indicator
3 Plug, expansion (3)
4 Tube, distributor gear oil
5 Dowel, 41 / 64 x 7 / 16 hollow (2)
6 Connector, ¼ NPT ½-20
7 Drain cock, MS-35782-5
8 Block, cylinder
9 Retainer, clutch release rod seal.
10 Cylinder block assembly
11 Cap, front main bearing
12 Dowel, 3 / 16x½ front cover
13 Cap, center main bearing
14 Cap, rear main bearing
15 Bolt, 7 / 16-14x2-¾ main bearing cap (6).

Figure 4-156. Cylinder block and related parts.

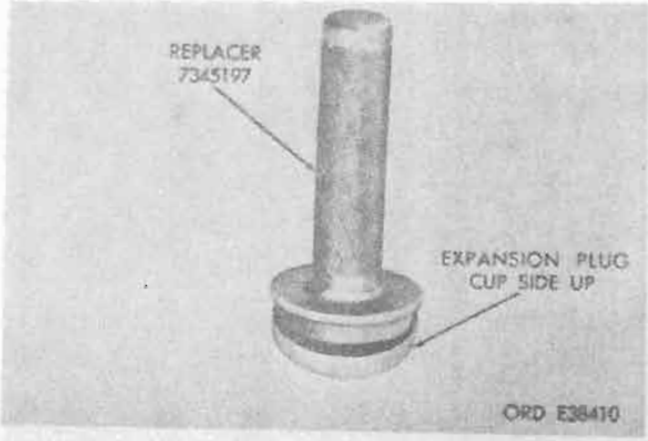


Figure 4-157. Installation of expansion plug on replacer tool.

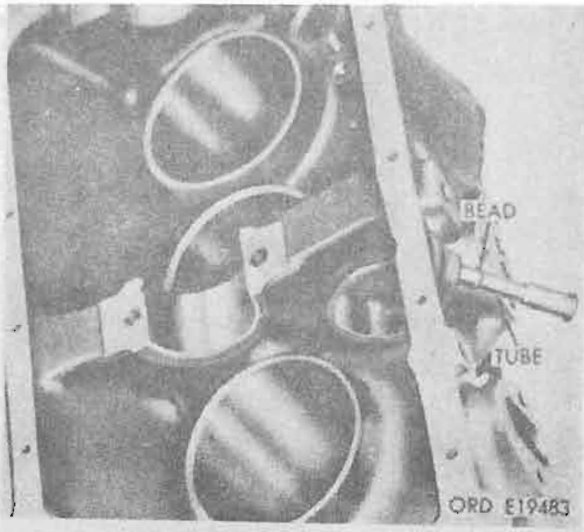


Figure 4-159. Oil level indicator tube.

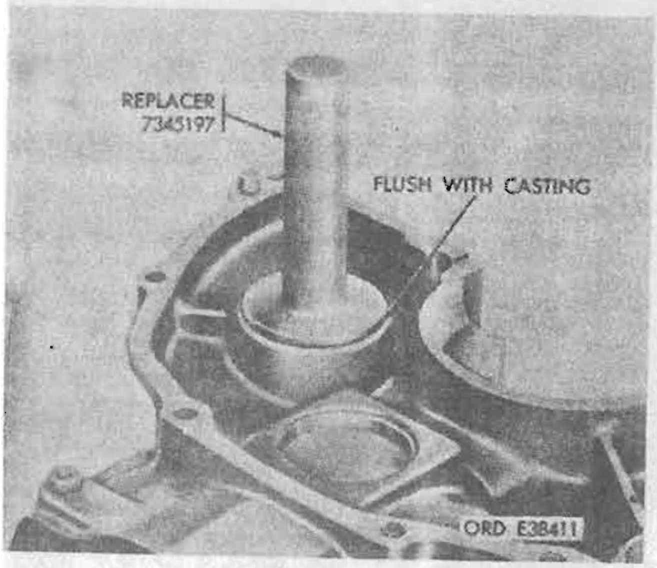


Figure 4-158. Expansion plug installed.

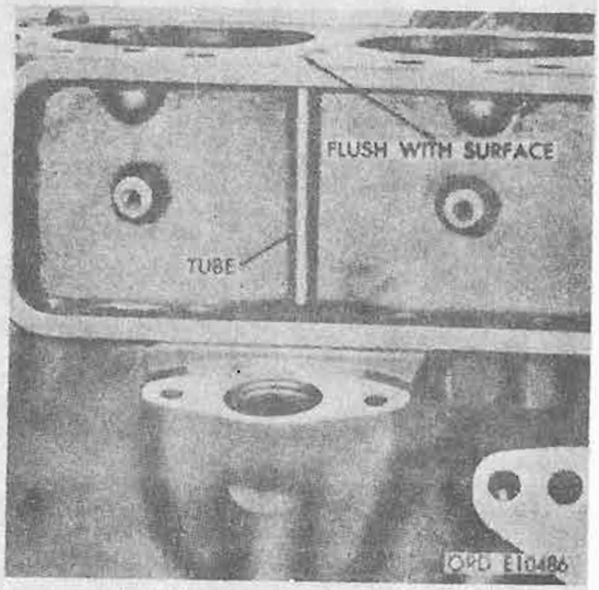


Figure 4-160. Distributor gear oiling tube.

Section X. REPAIR OF CONNECTING ROD AND PISTON ASSEMBLIES

4-60. Disassembly

a. Remove Piston Rings. Secure connecting rod in vise equipped with soft jaws and remove compression ring from top (No. 1) ring groove and compression ring from center (No. 2) ring groove in piston. Use 3-7/8-inch ring expander or equivalent tool. Remove oil control ring assembly upper and lower segments (steel side rails) by grasping one end of ring firmly with fingers or suitable tool and gently applying pressure. Remove both ring segments individually from bottom ring groove. Use care to prevent scratching piston when lifting the end of rings across the face of piston. Remove oil control ring assembly from bottom ring groove with fingers. Refer to figure 4-161.

b. Remove Piston Pin and Retainers. Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinder from which they were removed. Remove two piston pin retainers (fig. 4-162), one at each end of piston pin, with suitable pliers; then, push the pin out of the piston and rod. Place piston pins in pistons from which they were removed. Piston pin fit is a thumb press fit at normal temperature (70° F). Use a suitable tool to drive out a tight pin.

c. Remove Connecting Rod Bolts. Separate cap and connecting rod. Tap the connecting rod bolts out of the connecting rod with a soft hammer or suitable tool.

d. Connecting Rod Bushing. Replace connecting rod when inspection indicates that connecting rod piston pin bushing is worn excessively.

4-61. Cleaning, Inspection, and Repair

a. General. Refer to paragraphs 4-42 through 4-44 for general cleaning, inspection and repair procedures. Refer to table 4-7 for repair standards. The connecting rods and related parts should be carefully inspected and checked for conformance to specifications. Various forms of engine wear caused by these parts can be readily identified. A shiny surface on the pin boss side of the piston usually indicates that a connecting rod is bent or the piston pin hole is not in proper relation to the piston skirt and ring grooves. Abnormal connecting rod bearing wear can be caused by either a bent connecting rod an improperly machined journal, or a tapered connecting rod bore. Twisted connecting rods will not create an easily identifiable wear pattern, but badly twisted rods will disturb the action of the entire piston, rings, and connecting rod assembly and may be the cause of excessive oil consumption.

b. Connecting Rods.

(1) Clean the connecting rod in solvent. Probe oil passage and oil squirt hole. Do not use a caustic cleaning solution. Blow out all passages with compressed air.

(2) Inspect each bearing cap at clamping surface for scuffed condition and for burrs. Remove any slight imperfections with fine stone.

(3) Inspect rods for signs of fractures and bearing bores for out-of-round and taper. If bore exceeds maximum limit or if rod is fractured, it should be replaced.

(4) Check piston pin to connecting rod bushing clearance.

(5) Replace defective connecting rod nuts and bolts.

(6) After connecting rods are assembled to piston, check rods for bend or twist on a suitable alinement fixture. If bend or twist is in excess of repair standards in table 4-7, rod should be straightened or replaced.

(7) If rod side play was found excessive (para 4-33) replace connecting rod or crankshaft as necessary.

c. Connecting Rod Bearings. Clean bearing halves. Inspect each bearing carefully. Bearings that have a scored, chipped, or worn surface should be replaced. Do not file or lap bearing caps or use shims to obtain bearing clearance. Do not get dirt or other foreign matter under insert. In time dirt may distort bearing and cause bearing failure.

d. Piston, Pins and Rings

(1) Remove carbon deposits from the piston surfaces and from the underside of the piston head. Clean gum or varnish from the piston skirt, piston pins, and rings with solvent. Do not use a caustic cleaning solution or a wire brush to clean pistons. Clean the ring grooves with a suitable ring groove cleaner (fig. 4-163). Make sure the oil ring slots (or holes) are clean.

(2) Carefully inspect the pistons for fractures at the ring lands, skirt, pin bosses, and for scuffed, rough, or scored skirts.

(3) A shiny surface on the thrust surface of the piston, offset from the centerline between the piston pin holes, can be caused by a bent connecting rod. Replace pistons that show signs of excessive wear, wavy ring lands, fractures and damage from detonation or pre-ignition.

(4) Check the piston-to-cylinder bore clearance with a tension scale and gage and the ring side clearance following the recommended procedures.

(5) Replace piston pins showing signs of fracture or etching and / or wear. Check the piston pin fit in the piston and rod bushing.

(6) Replace all rings. Check the end gap and side clearance. It is good practice to always install new rings when overhauling the engine. Rings should not be transferred from one piston to another regardless of mileage.

4-62. Parts Identification

a. Piston. Observe top of each piston. The cylinder number should be stamped on each piston. If cylinder number is not found on top of piston, use numbering stamp and number pistons consecutively, beginning with number one at front of engine.

b. Connecting Rod. Inspect lower end of each connecting rod and cap for identification marks. Each rod and cap should bear the number of its respective cylinder. Rod caps are not interchangeable and should only be assembled to their respective rod with the identification marks together on the same side.

c. Connecting Rod Bearing Halves. Observe tang of each bearing half for identification marks. Each bearing should bear number of respective cylinder and position installed. Outside surface of bearing tang should be lightly marked for location and position, using respective cylinder number followed by letter "u" for upper or rod end and letter "l" for lower or cap end (fig. 4-96).

4-63. Assembly

a. Fitting Connecting Rod Bearings (fig. 4-164).

(1) Install bearings and caps. After inspecting connecting rod bolts, tap them into connecting rod with a soft hammer or suitable tool. Install the bearing insert in connecting rod and cap. Position cap on rod with the bearing lock slots together on the same side. If installing used bearings, make sure they are positioned in their original location in bearing bore. Apply lubricant (GAA) on connecting rod bolt threads and under 3/8-24 self-locking rod nuts and tighten to 40-45 lb.-ft. torque.

(2) Measuring connecting rod bearing running clearance. Measure inside of each connecting rod bearing in the same manner as shown in figure 5-180. If bearing clearance is not over 0.0028 inch or less than 0.0004 inch, bearing halves are satisfactory. If clearance is excessive, try new bearings to bring clearance within 0.0004-0.0028-inch limit.

b. Fitting Pistons (fig. 4-165).

(1) The piston and cylinder block should be at room temperature (70° F.) when the piston fit is checked. After any refinishing operation, allow the cylinder bore to cool before the piston fit is checked.

(2) Make sure the piston and cylinder bore are clean and dry. Attach a tension scale to the end of a feeler gage that is free of dents of burrs. The gage should be ½-inch wide and of the recommended thickness listed in table 4-6.

(3) Position gage in bore so it extends entire length of piston, 90° from piston pin location. Invert piston and install 1½ inches below top of cylinder block, and piston pin parallel to crankshaft axis.

(4) Hold piston and slowly pull scale in a straight line with gage, noting pull required to remove gage.

(5) In table 4-6, diagonal lines represent gages of various thicknesses. Horizontal lines represent pounds-pull, and vertical lines represent clearance. To determine clearance, locate line representing pounds-pull required to remove gages from cylinder bore. Follow horizontal line to right until it intersects diagonal line representing gage. Read down the vertical line for clearance.

Example 1. If a 0.0015-inch gage is used and it takes approximately 4¼ pounds-pull to remove the gage, the clearance is approximately 0.0008 inch. This is determined by locating pounds-pull (4¼) in table 14 and following line to right until it intersects with diagonal line representing 0.0015-inch gage. Read down vertical line for clearance (approximately 0.0008 inch.)

Example 2. If a 0.003-inch gage is used and it takes approximately 4 pounds-pull to remove gage, resultant clearance is approximately 0.0026-inch.

(6) If clearance is greater than the maximum limit, check calculations to be sure proper size piston has been selected. Check for a damaged piston. If beyond standard size piston limits, replace cylinder block. If the clearance is less than the minimum limit, check calculations before trying another piston. If none can be fitted, replace cylinder block.

(7) When a piston has been fitted, mark it for assembly in cylinder to which it was fitted.

c. Piston Rings (fig. 4-166).

(1) If the taper and out-of-round condition of the cylinder bore are within limits, new piston rings will give satisfactory service, provided the piston clearance in the cylinder bore is within limits. If the new rings are to be installed in a used cylinder, remove the cylinder wall glaze (para 4-57*b*).

(2) The rings must be checked for proper gap in the cylinder bore and for the proper side clearance in the piston grooves. First, check each ring for proper gap as follows: Measure gap between ends of ring with a feeler gage.

(3) Position ring in cylinder bore to be used. Push ring down into bore area where minimum ring gap is encountered. Use head of a piston to position ring in bore so ring is square with cylinder wall.

NOTE

Exercise care to avoid damage to the ring or cylinder bore.

(4) If ring gap is less than recommended lower limit, try another ring set.

d. Install Piston Pin and Retainer (fig. 4-167). Apply a light coat of engine oil (OE-10) to all parts. Assemble piston to connecting rod with indentation on top of piston facing forward (toward front of engine) and oil squirt hole in connecting rod facing camshaft (toward right side of engine). Position piston pin on one end of piston and with light thumb pressure push pin into piston and rod. Be sure piston and pins are properly assembled with the same rod from which they were removed, or to which they were fitted. Install piston pin retainer at each end of pin to hold it in place. Make sure they are properly seated in grooves provided in piston pin bore.

e. Install Piston Rings (fig. 4-168). Refer to *c* above for procedures to select proper ring set before proceeding with piston ring installation. Secure connecting rod in vise equipped with soft jaws, and install oil control ring assembly expander-type spacer in bottom (No. 3) ring groove with ends opposite indentation mark on top of piston. Install oil ring segments (steel side rails) above and below oil ring spacer in bottom (No. 3) ring groove of piston as follows. Firmly grasp both ends of ring individually between forefinger and thumb of each hand; twist one end down and insert into ring groove; then, gently apply pressure to free end to pull and lower ring into ring groove. Use care to prevent scratching piston when lowering end of rings across face of piston. Make sure inner portion of oil ring spacer is behind both oil ring segments. The oil ring assembly should fit snugly in oil groove. Stagger the oil ring segment gaps (steel side rails) 1½ inches to each side of oil ring spacer ends. Install phosphate coated compression ring in center (No. 2) ring groove with step side down, and chrome faced compression ring in top (No. 1) ring groove (fig. 4-161). Use 3-7/8 inch ring expander or equivalent tool to prevent breaking or over-stressing compression rings. Stagger compression ring gaps 150° to each side of oil ring spacer ends. Check side clearance on both compression rings against limits specified in table 4-7 (fig. 4-169). Replace piston if excessive clearance is indicated.

f. Connecting Rod Bearings Halves and Bolts. Refer to *a* above for fitting and checking connecting rod bearing halves and install connecting rod bolts and nuts.

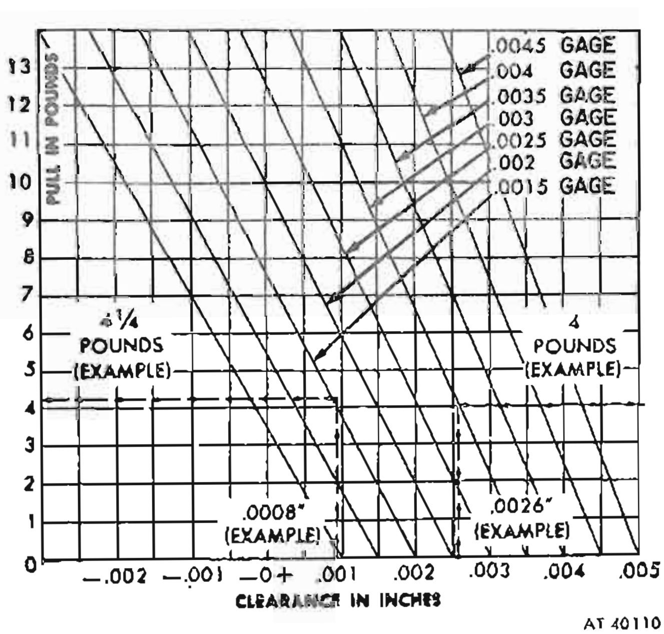


Table 4-6. Piston Clearance Chart.

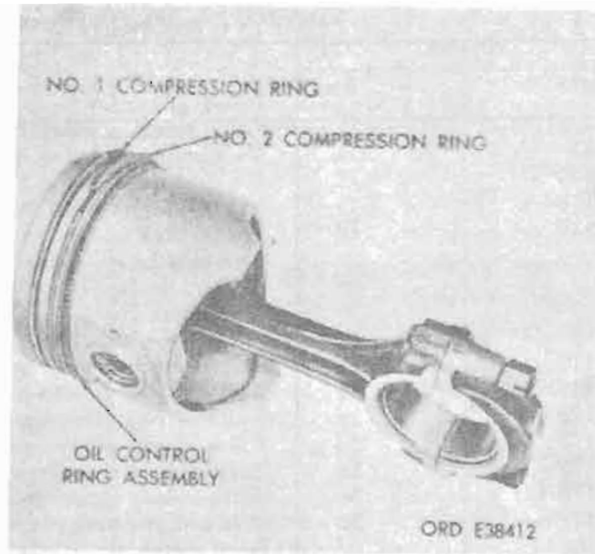


Figure 4-161. Piston rings.

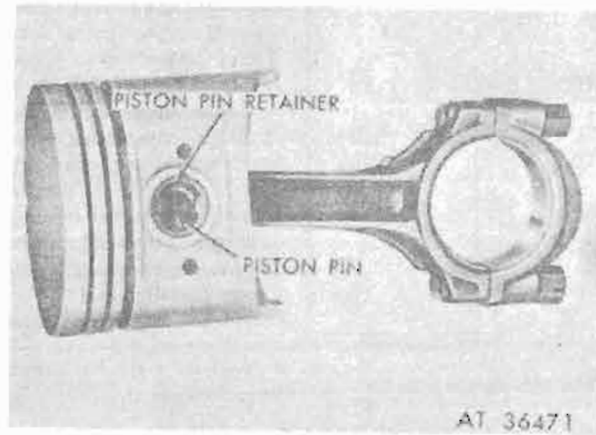


Figure 4-162. Piston pin and retainer.

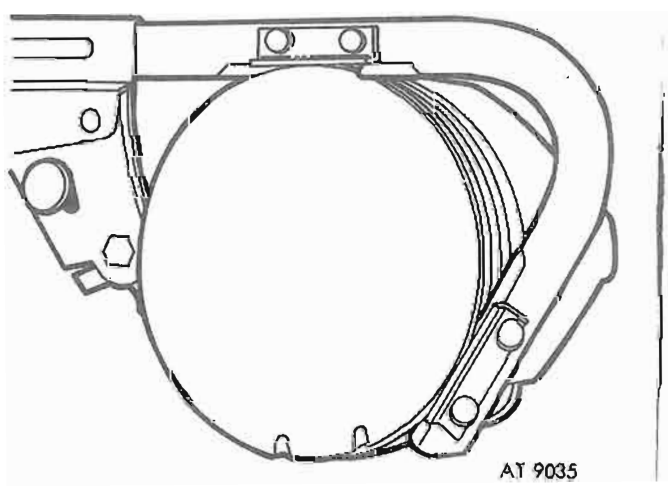


Figure 4-163. Cleaning piston ring grooves.

Table 4-7. Repair Standards—Connecting Rod, Bearing, Piston, Pin & Rings

Reference		Point of measurement	Size of new part	Wear limit
Fig. No.	Key			
		Piston ring gap installed in cylinder:		
4-170	1a	Compression ring No. 1 top	0.013-0.023	
4-170	1b	Compression ring No. 2 center	0.012-0.022	
4-170	1c	Oil ring segment No. 3 bottom	0.015-0.055	
4-170	1d	Oil ring spacer No. 3 bottom	0.0000	*
		Clearance between ring & piston groove:		
		Groove No. 1	0.002-0.0035	*
		Groove No. 2	0.0015-0.0035	*
		Groove No. 3	Snug	*
4-170	3a	Diameter of piston at bottom of skirt-standard.	3.8736-3.8756	*
4-170	3b	Width of ring grooves-groove No. 1 top.	0.0955-0.0965	0.0985
4-170	3c	Width of ring grooves-groove No. 2 center.	0.0955-0.0965	0.0985
4-170	3d	Width of ring grooves-groove No. 3 bottom.	0.188-0.189	*
4-170	3e	Piston-to-bore clearance-top of skirt.	0.0015-0.0030	0.0053
4-170	3e	Piston-to-bore clearance-bottom of skirt.	0.0010-0.0018	0.0038
4-170	3f	Diameter of piston pin bore	0.9123-0.9125	0.9130
		Fit of piston pin in piston	0.0001L-0.0003L	0.0006L
4-170	4a	Finished diameter of piston pin bushing installed.	0.9123-0.9125	*
		Axis of piston pin and bearing bores must be parallel within.	0.0005 in / in	
		Pin bushing and crankshaft bearing bore must be in the same vertical plane within.	0.0015 in / in	
		Fit of piston pin in bushing	0.0001T-0.0005L	0.0008L
4-170	5a	Inside diameter of large end, less inserts with cap at proper torque tightness.	2.1242-2.1250	
4-170	5b	Width of connecting rod & cap	0.994-0.996	0.991
4-170	10a	Inside diameter of bearing inserts when installed (vertical dia.) with cap at proper torque tightness.	1.9992-2.001	*
		Clearance between bearing & crankshaft (vertical).	0.0002-0.0028	0.0038
		Side play between connecting rod and crankshaft.	0.003-0.009	0.012
		Connecting rod length (center-to-center).	5.438-5.442	*
4-170	11a	Piston pin diameter	0.9120-0.9122	*
		Piston pin round and straight within.	0.00015	*

* Refer to paragraph 4-45a (2).

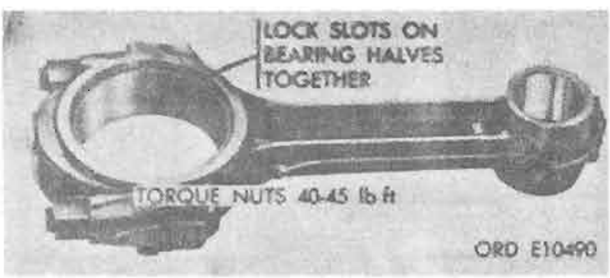


Figure 4-164. Connecting rod assembly.

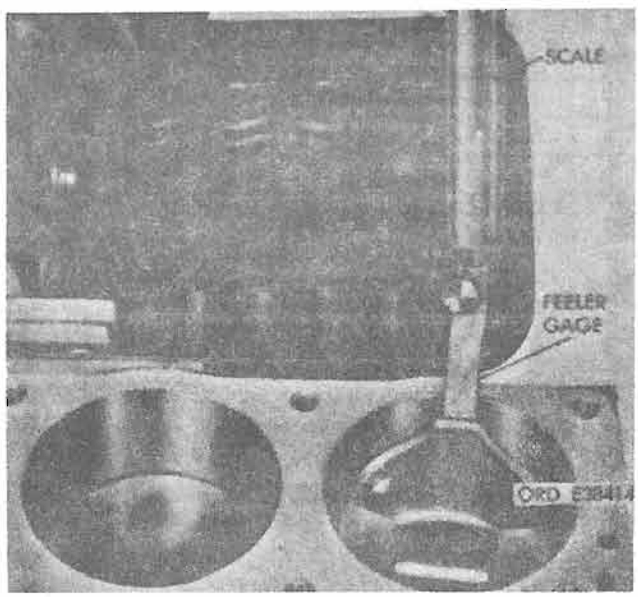


Figure 4-165. Checking piston fit—typical.

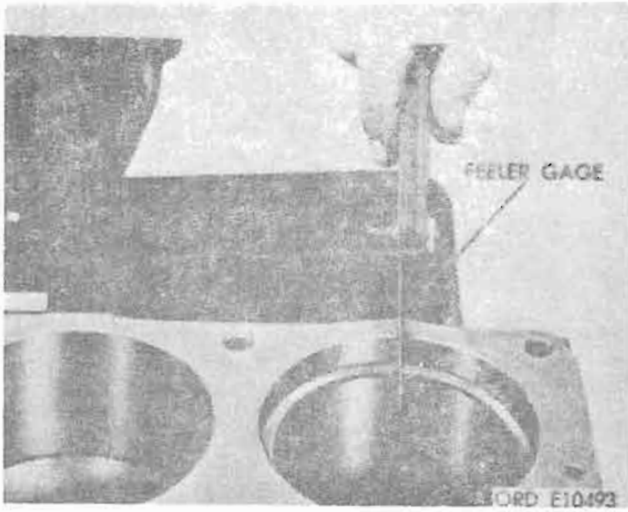


Figure 4-166. Piston ring cap—typical.

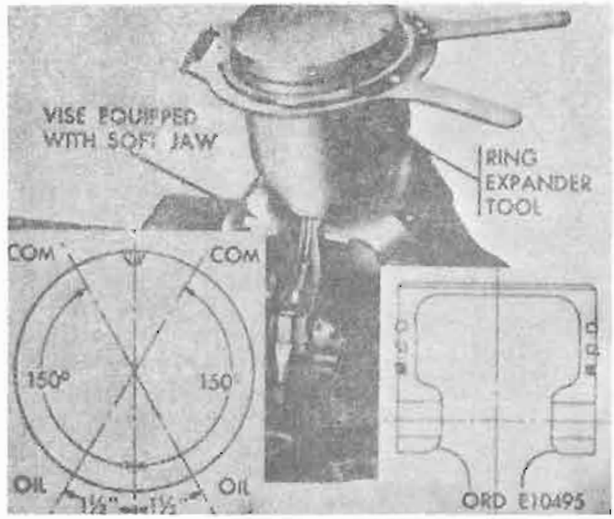


Figure 4-168. Piston ring installation.

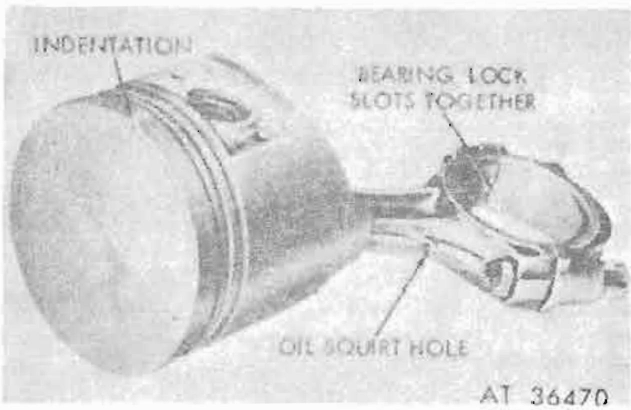


Figure 4-167. Piston and connecting rod assembly.

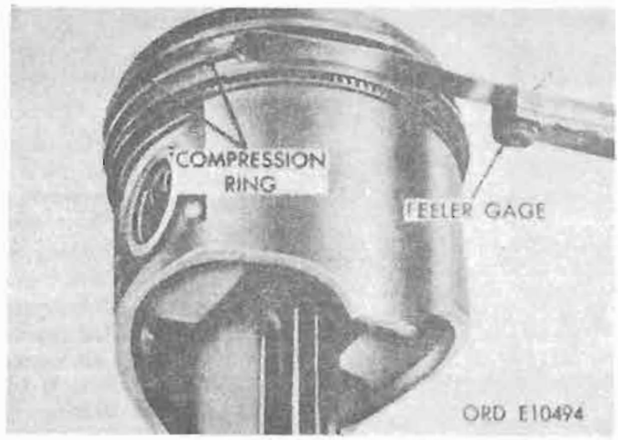
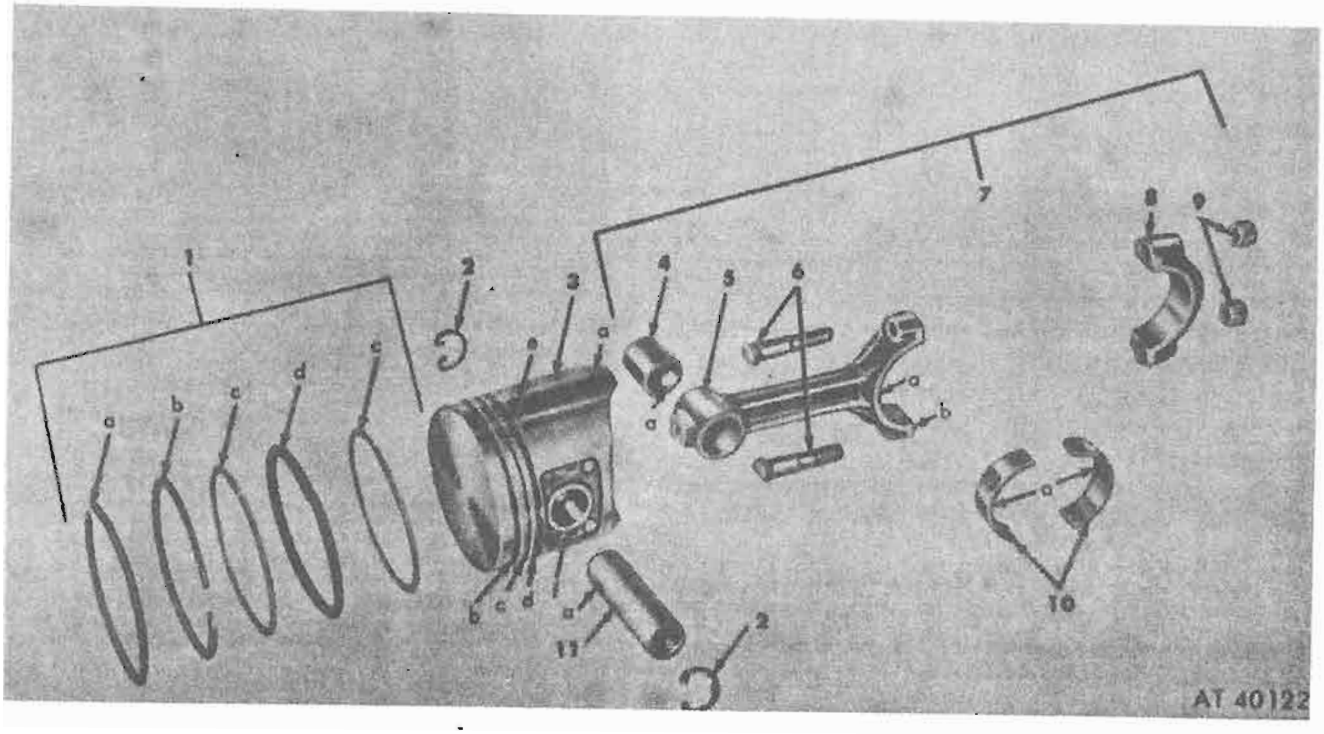


Figure 4-169. Piston compression ring side clearance—typical.



1 Set, piston ring (std.)
1 Set, piston ring (std.) opt.
2 Retainer, piston pin (2)
3 Piston assembly
4 Bushing, connecting rod
5 Rod, connecting
6 Bolt, connecting rod (2)
7 Rod assembly, connecting
8 Cap, connecting rod
9 Nut, ⅜-24 connecting rod (2)
10 Bearing, connecting rod
11 Pin, piston

Figure 4-170. Connecting rod and piston assembly—exploded view.

Section XI. REPAIR OF CAMSHAFT AND RELATED PARTS

4-64. Disassembly

a. *Remove Camshaft Plug.* If it is necessary to remove plug from end of camshaft, insert steel rod into open end and knock out plug (fig. 4-171).

b. *Remove Woodruff Key.* Remove key from slot on front end of camshaft by tapping end of key away from camshaft with a soft rod or suitable tool. (fig. 4-172).

4-65. Cleaning, Inspection, and Repair

a. *References.* Refer to paragraphs 4-42 through 4-44 for general cleaning inspection and repair procedures. Refer to table 4-8 for repair standards.

b. *Camshaft.* Handle camshaft with care to avoid possible fracture or damage to finished surfaces. Clean camshaft thoroughly with cleaning solvent, then blow out all passages with compressed air. Make sure main gallery passage, drilled lengthwise through camshaft, is clean. If camshaft together with camshaft gear and thrust plate was removed from engine as an assembly, remove camshaft gear retaining bolt so main gallery passage can be cleaned and inspected. Check distributor drive gear for broken, chipped, or worn teeth. Replace camshaft if distributor drive gear is worn and gear backlash (para 4-32) was found to be excessive. Check for loose or defective oil plug in rear end of camshaft. Remove light scuffs, scars, or nicks, from camshaft machined surfaces with a smooth oil stone. Inspect camshaft lobes for pitting, scoring, and signs of abnormal wear. Lobe wear characteristics may result in pitting in general area of nose portion of lobe. Pitting is not detrimental to operation of camshaft; therefore, camshaft should not be replaced until camshaft lobe life loss has exceeded 0.005 inch.

c. Pressure Check of Main Oil Gallery in Camshaft (fig. 4-173). Cut three 1-inch wide sections from a 2-inch inside diameter rubber hose and install one on each camshaft journal. Secure firmly in place with hose clamps. Immerse rear end of camshaft in water or equivalent and apply air pressure to front end of shaft and check for leakage of oil plug. Assembly must withstand 60 psi air pressure without leaking. When camshaft successfully passes pressure check, remove hose clamps and rubber hose from journals and blow out all oil passages with compressed air. Apply engine oil (OE-10) to inner and outer surfaces of camshaft to prevent rust.

d. Camshaft Lobe Lift (fig. 4-174). To accurately measure lift of suspected worn camshaft lobe(s), place camshaft on V-blocks or insert in cylinder block and install a dial indicator so tip bears against camshaft base circle. Zero dial indicator at lowest point on base circle and turn camshaft slowly until dial indicator registers highest point of nose portion of lobe. Compare the total lift recorded on indicator with specifications (tabe 4-8). Replace camshaft if lobe lift loss exceeds 0.005 inch. Lobes are arranged from front to rear E(exhaust)-I(Intake)-I-E-E-I-I-E.

e. Camshaft Alinement. Place camshaft on V-blocks and check alinement at center journal, using accurate indicator. Replace camshaft if runout is in excess of allowable limits (table 4-8).

f. Camshaft Bearing Running Clearance. Check camshaft journals to bearing clearances by measuring diameter of journals and inside diameters of bearings. If clearance exceeds wear limit, camshaft should be replaced. If one or more bearings are damaged or clearance exceeds wear limit, engine is considered to be beyond economical repair limts.

g. Woodruff Key. Inspect key for nicks and for snug fit in key slot. Nicks in key may be smoothed with a fine stone. A loose key must be replaced.

h. Camshaft Thrust Plate. Inspect face of camshaft thrust plate for evidence of wear. If plate is grooved or excessively worn, replace. If camshaft end play was found excessive (para 4-36) replace thrust plate.

i. Camshaft Gear. Inspect gear teeth for cracks and for any undue wear, pitting, or galling of tooth bearing surface. If teeth are scored or contact pattern on teeth is uneven, replace gear. Inspect keyway in hub; if damaged or worn, replace gear. Refer to paragraph 4-32 for removal of camshaft timing gear.

Table 4-8. Repair Standards, Camshaft and Related Parts

Reference				
Fig. No.	Key	Point of measurement	Size of new part	Wear limit
4-175	5a	Camshaft gear total backlash with crankshaft gear.	0.0025-0.0057	0.007
4-175	5b	Runout of camshaft timing gear when mounted on camshaft.	0.006 TIR	*
4-175	6a	Thrust plate thickness	0.188-0.190	0.185
4-175	8a,b,c	Diameter of bearing journals	2.009-2.010	2.007
4-175	8a,b,c	Clearance of bearing to journal	0.0010-0.0025	0.005
4-175	8b	Allowable runout of center journal when end journals are supported.		
4-175	8e	Intake lobe lift	0.005	
4-175	8d	Exhaust lobe lift	0.2419	0.2369
4-175	9e	Maximum allowable lobe lift loss	0.2380	0.2330
4-175	9d			
4-243		End play of camshaft (installed)	0.003-0.006	0.010

* Refer to paragraph 4-45a (2).

4-66. Assembly

a. Install Camshaft Oil Plug. If plug was removed from rear end of camshaft, use a press with suitable adapter or a large diameter punch and install new plug (cup side out) until it contacts shoulder firmly (fig. 4-171).

b. Install Key and Camshaft Thrust Plate. Drive a 5/32x⅝ inch woodruff key in key slot on front end of camshaft. Install camshaft thrust plate on front of camshaft with the bolt head relief in plate facing out (away from camshaft). Refer to figure 4-176.

c. Install Camshaft Gear. Position camshaft gear on front end of camshaft with timing mark facing out (away from camshaft). Aline keyway in gear, with key installed in camshaft. Center camshaft thrust plate to prevent interference with gear hub when installing gear. Apply pressure to gear inner hub with a suitable adapter, and press gear firmly against camshaft shoulder (fig. 4-177).

d. Install Camshaft Retaining Bolt. Refer to paragraph 4-96*b* for installing retainer, lock-tab washer, and retaining bolt. This operation can be more easily performed with camshaft installed in cylinder block.

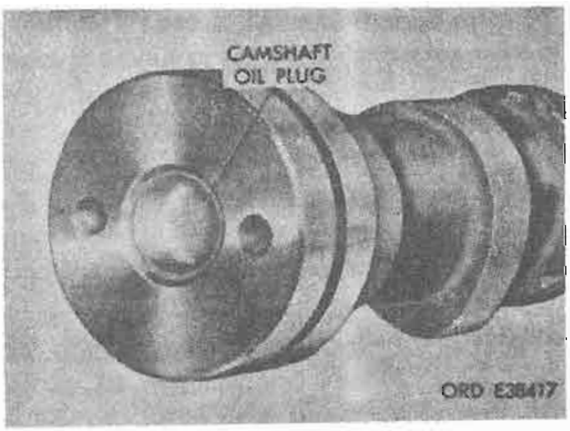


Figure 4-171. Camshaft oil plug.

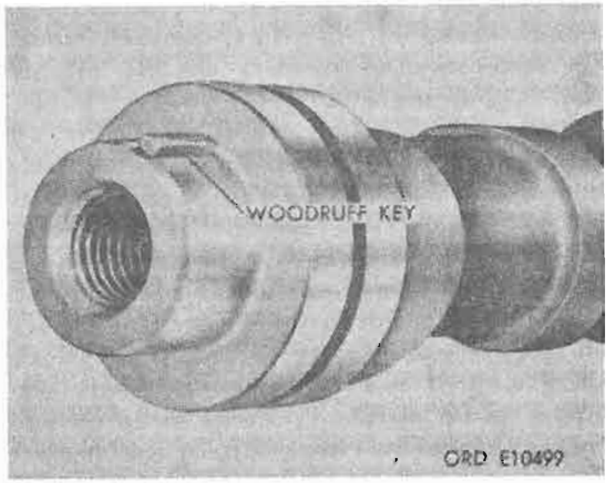


Figure 4-172. Woodruff key.

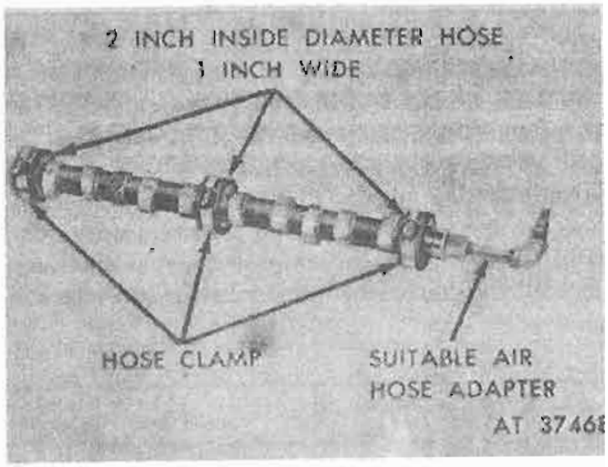


Figure 4-173. Camshaft pressure check.

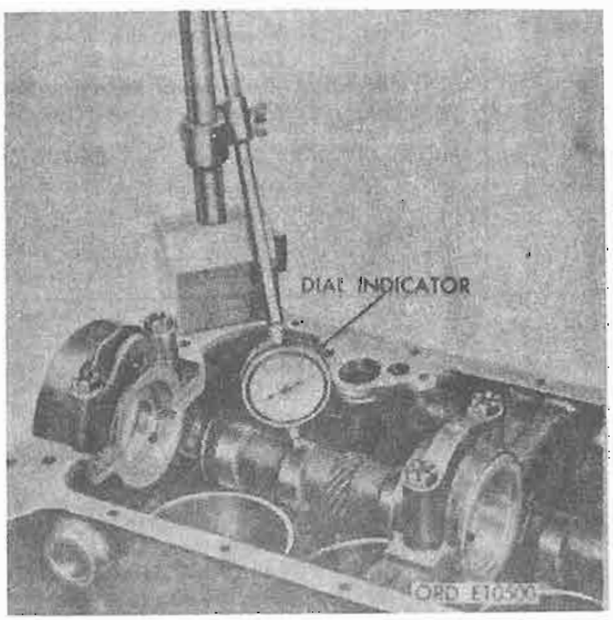
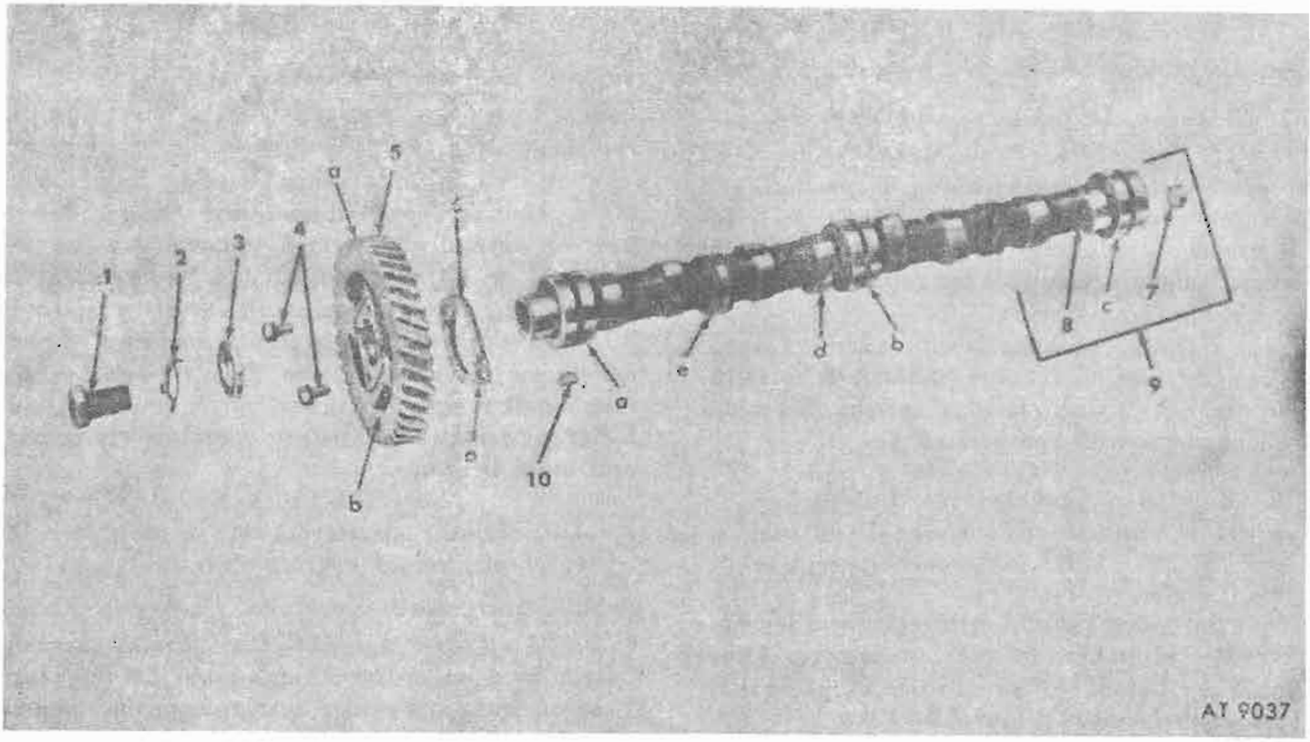


Figure 4-174. Camshaft lobe lift measurement—typical.



1 Bolt, ¾-10x1¼ camshaft gear
2 Washer, lock tab
3 Retainer, camshaft gear
4 Screw & washer assembly, 5 / 16-18x⅝ (2)
5 Gear, camshaft
6 Plate, camshaft thrust
7 Plug
8 Camshaft
9 Camshaft assembly
10 Key, 5 / 32x⅝ Woodruff

Figure 4-175. Camshaft and related parts—exploded view.

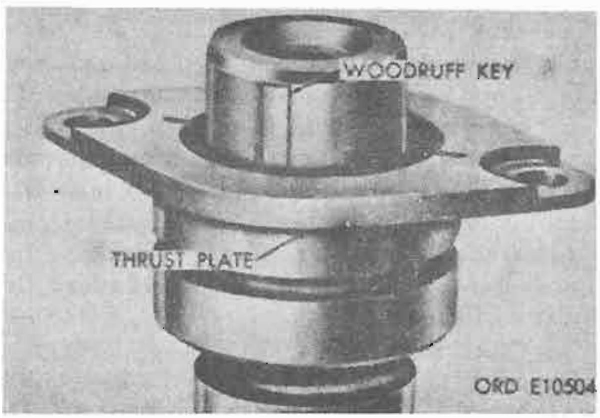


Figure 4-176. Installation of camshaft key and thrust plate.

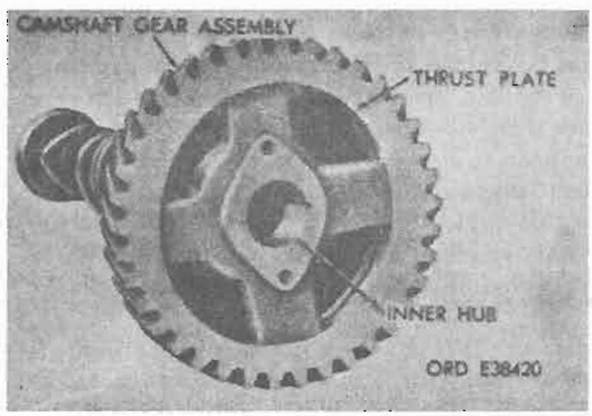


Figure 4-177. Camshaft gear installation.

4-67. Cleaning, Inspection, and Repair

a. References. Refer to paragraphs 4-42 through 4-44 for general cleaning, inspection, and repair procedures. Refer to paragraph 4-78 for instructions on repairing flywheel and clutch pilot bearing. Refer to table 4-9 for repair standards.

b. Crankshaft.

(1) Handle crankshaft with care to avoid possible fractures or damage to finished surfaces. Clean crankshaft with cleaning solvent. Blow out all oil passages with compressed air.

NOTE

Condidition of crankshaft rear hub surface which is contacted by oil seal. If oil seal surface on hub is grooved, replace crankshaft.

(2) Inspect main and connecting rod journals for cracks, scratches, grooves, or scores. Dress minor imperfections with an oilstone. Replace shaft having severely marred journals.

(3) Measure diameter of each journal in at least four places to determine out-of-round, taper, or undersize condition (fig. 4-178).

(4) If journals exceed wear limits (table 4-9) shaft should be replaced.

c. Crankshaft Alinement. Place crankshaft in V blocks or in lathe, and check runout at center main bearing journal and at flywheel mounting flange with accurate dial indicator. If runout is in excess of allowable limits (table 4-9), replace crankshaft.

d. Crankshaft Gear. Inspect gear teeth for cracks and for any undue wear, pitting or galling of teeth-bearing surface. If teeth are scored or contact pattern on teeth is uneven, replace gear. It is good practice to replace both crankshaft and camshaft gears if either gear needs replacing. If gear backlash was found excessive (para 4-36) and gear teeth appear to be satisfactory, try a new gear on camshaft assembly, and check backlash during engine assembly (para 5-96*d*). If still unsatisfactory, replace crankshaft timing gear. Refer to paragraph 4-36 for removal of crankshaft timing gear.

e. Crankshaft Pulley. Examine crankshaft pulley for cracks, broken edges, bent sheaves, or other damage. Inspect sides of belt grooves for corrosion and roughness. Use hone or abrasive cloth to smooth up rough areas in belt grooves. Inspect keyway in hub and note condition of hub surface contacted by oil seal. If keyway shows evidence of damage or wear, or if oil seal surface on hub is grooved, replace pulley.

f. Woodruff Key. Inspect key for nicks and snug fit in key slot. Nicks in key may be smoothed with a fine stone. Key loose in key slot must be replaced.

g. Main Bearings. Clean bearing halves and main bearing caps thoroughly. Inspect each bearing carefully. Bearings that have a scored, chipped, or worn surface should be replaced. If crankshaft end play was found excessive (para 4-39) and sides of flanged center bearing appear satisfactory, place a new bearing on center crankshaft main journal and check end play with feeler gage. If still unsatisfactory replace crankshaft and main bearings.

CAUTION

Do not file or lap bearing caps or use shims to obtain proper bearing clearance.

4-68. Fitting Main Bearings

a. Install Bearings and Caps. Install bearing halves in cylinder block and main bearing cap. Position front and center bearing caps on block so arrow (cast in top of cap) points towards front of engine. If replacing used bearings, make sure they are installed in their original location in bearing bore. Main bearing caps are not interchangeable and are line-bored with cylinder block as an assembly. The center main flanged bearing halves are not interchangeable with the front and rear bearing halves. Apply grease (GAA) or equivalent on threads and under the head of size 7/16-14x2¾ hex-head self-locking main bearing cap bolts, and tighten to 55-60 lb.-ft. torque (fig. 4-179).

b. Measuring Main Bearings Running Clearance. Measure the inside diameter of each main bearing ¼ inch in from each end and at right angles to split line, and 45° on both sides of the right angle measurement with telescope gage and precision micrometer or other suitable equipment. If bearing clearance is not over 0.004 inch or less than 0.0005 inch, the bearings are satisfactory. If the clearance is excessive, try new bearings to bring the clearance within the 0.0005-0.004-inch limit. Refer to figure 4-180.

c. Checking Clearance by Plastigage Method. Plastigage is placed on the lower half of the bearing (fig. 4-181), and the cap is installed and tightened to the specific torque. This flattens the Plastigage to whatever the bearing clearance is. The cap and bearing are removed.

The greater the width of the strip the less the bearing clearance and vice versa. The paper scale measures the clearance in thousandths of an inch. Actually, the scale can be read to ½ thousandth or less.

Plastigage is intended to be used for checking worn bearings and also for checking newly installed bearings to make sure that the clearance is within the required limits.

The Plastigage comes in a sealed envelope. It is made for three ranges of bearing clearances with a different color of wax, as follows: Green, 0.001" to 0.003"; red, 0.002" to 0.006"; blue 0.004" to 0.009". The blue is intended for very small crankshaft journal diameters. The red range is usually used for checking worn bearings. But if new bearings are installed, it may be necessary to use the green range to determine whether or not the new bearing is too tight. Bearing in mind that the green range measures as little as 0.001" clearance while the minimum for the red range is 0.002".

Before using Plastigage, clean the journals and the bearings so that all oil is removed. The Plastigage is soluble in oil, and therefore oil will affect the accuracy of the reading.

NOTE

Do not rotate the crankshaft when using Plastigage.

When checking main bearings with Plastigage, all caps should be tight.

If the bearings are badly worn, a paper shim should be installed in each main bearing except the one being checked. Otherwise, the weight of the crankshaft will press down on the Plastigage, making the reading smaller than it actually is.

4-69. Install Crankshaft Gear

Drive ¼x1-inch woodruff key slot on front end of crankshaft. Position crankshaft drive gear on front end of crankshaft with timing mark facing out (away from crankshaft). Aline keyway in gear, with key installed in shaft; and drive or press gear firmly against crankshaft shoulder. Refer to figure 4-182.

Table 4-9. Repair Standards—Crankshaft and Related Parts

Reference		Point of measurement	Size of new part	Wear limit
Fig. No.	Key			
4-183	3a	Runout of flywheel face when mounted on crankshaft.	0.006TIR	*
4-183	5a	Inside diameter of standard main bearing inserts	2.2502-2.2504	
	6a	When installed at proper torque tightness (vertical).		
4-183	6b	Width of center bearing insert	1.814-1.817	*
4-183	7	Crankshaft gear total backlash with camshaft gear.	0.0025-0.0057	0.007
4-183	14a 15a 16a	Diameter of main bearing bores, less inserts, at proper torque tightness.	2.4012-2.4020	
4-183	19	Clearance between crankshaft & bearings	.0012-.0022	0.004
4-230		End play of cranksahft (installed)	0.004-0.008	0.012
4-183	19a,e,j	Main bearing journal diameters	2.2482-2.2490	
		Allowable out-of-round	0.00025	0.0005
		Allowable taper	0.0005	0.001
4-183	19b	Main bearing journals fillet radius	0.10-0.12	*
4-183	19c,d,g,h	Connecting rod journal diameters	1.9982-1.9990	*
		Allowable out-of-round	0.00025	0.0005
		Allowable taper	0.0005	0.001
		Connecting rod journals fillet radius	0.10-0.12	*
4-183	19e	Allowable runout at center bearing journal when supported at each end.	0.001	0.002
4-183	19f	Thrust bearing journal length	1.821-1.823	*
		Allowable face runout	0.001	*
4-183	19k	Runout of flywheel mounting face	0.001	0.002

* Refer to paragraph 4-45a (2).

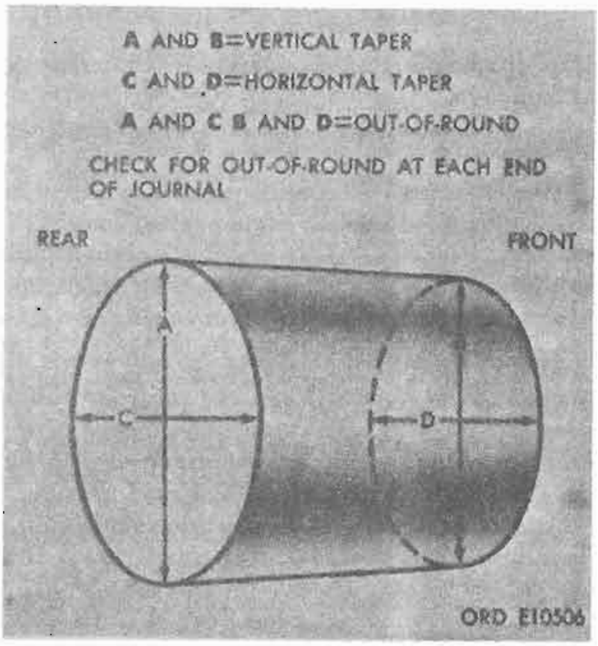


Figure 4-178. Crankshaft journal measurement.

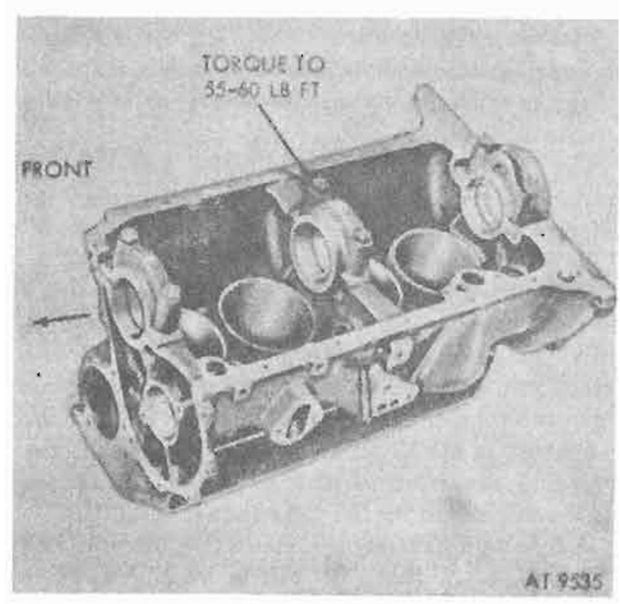


Figure 4-179. Main bearings and caps.

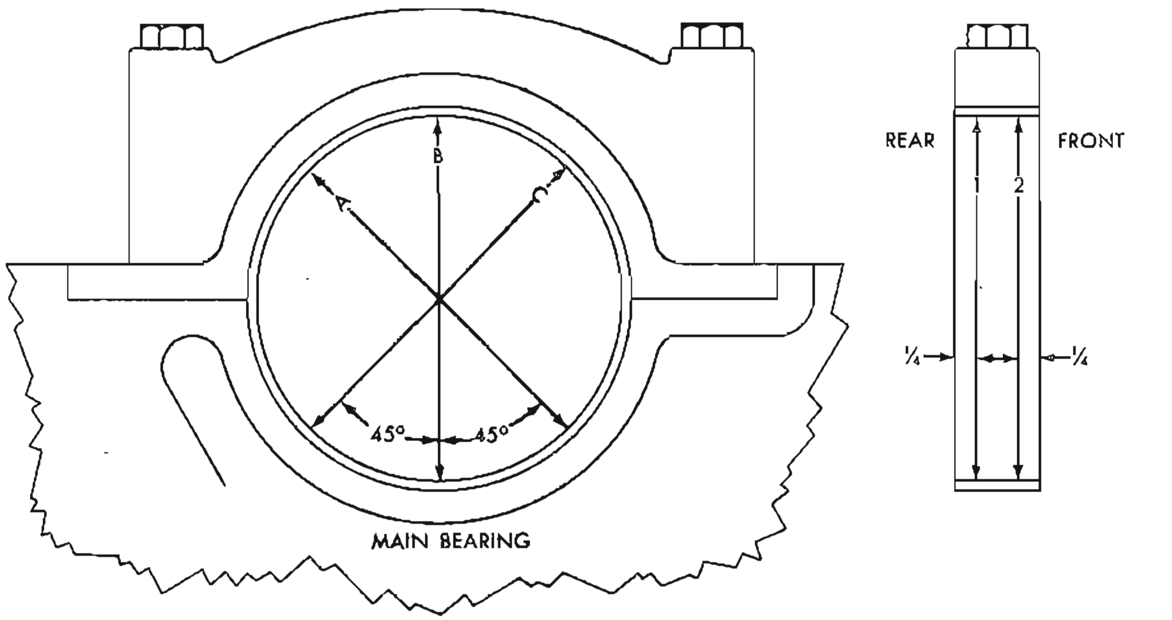


Figure 4-180. Main bearing measurement.

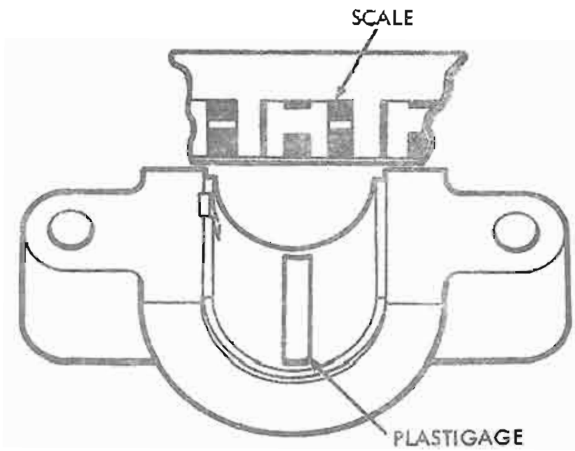


Figure 4-181. Measuring width of plasti-gage.

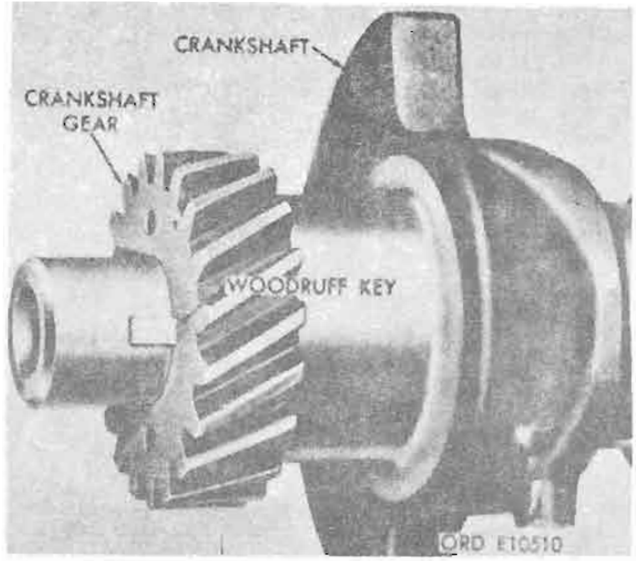
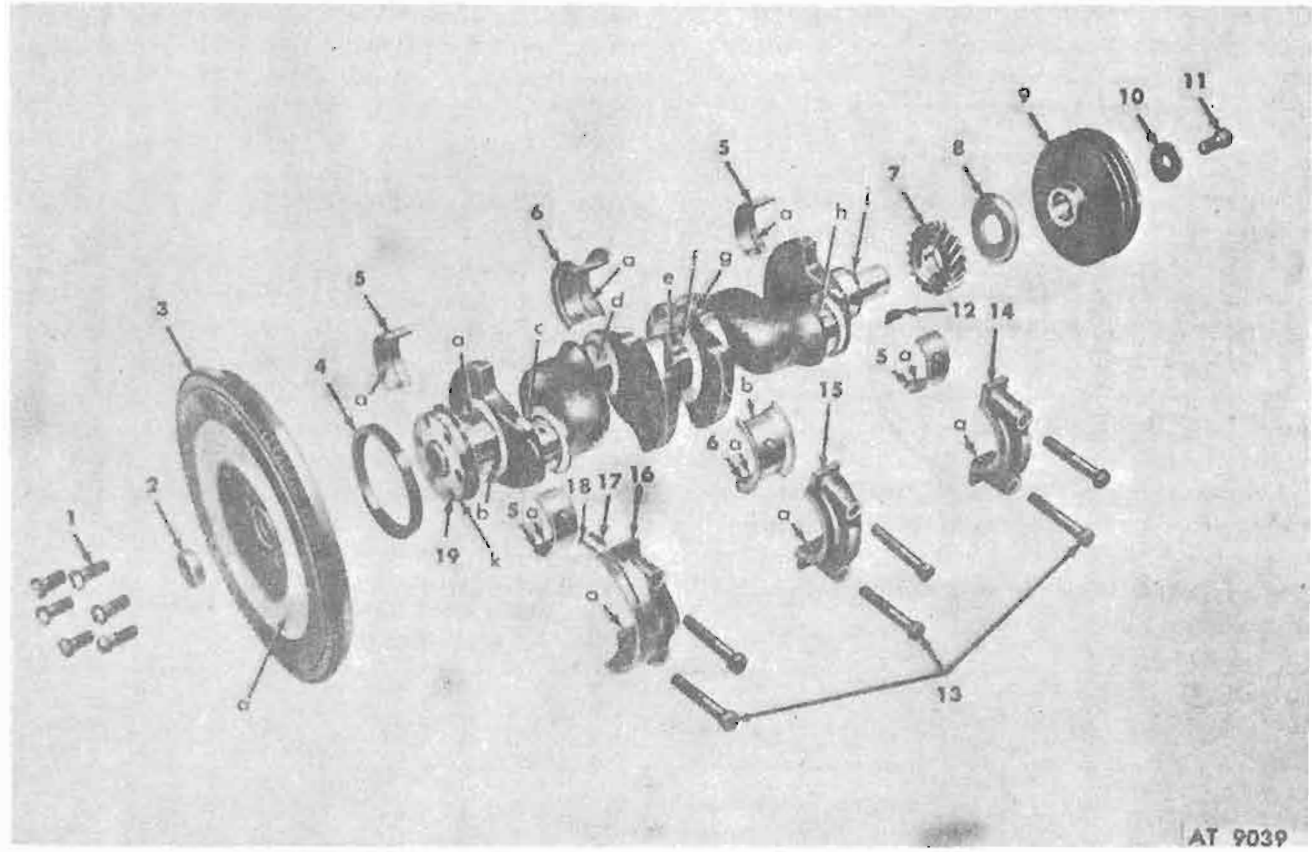


Figure 4-182. Crankshaft gear installation.



1 Bolt, 7/16-20x1⅛, flywheel (6).
2 Bearing, clutch pilot
3 Flywheel assembly
4 Seal, crankshaft rear
5 Insert, crankshaft bearing (4)
6 Insert, crankshaft center bearing (2).
7 Gear, crankshaft
8 Slinger, crankshaft oil
9 Pulley, crankshaft (60-amp)
Pulley, crankshaft (25-amp)
10 Retainer, pulley
11 Bolt, 9/16-18x1⅛ pulley
12 Key ¼x1/0
13 Bolt, 7/16-14x2¾ main bearing (6).
14 Cap, front main bearing
15 Cap, center main bearing
16 Cap, rear main bearing
17 Seal, rear cap
18 Seal, rear cap
19 Crankshaft

Figure 4-183. Crankshaft and related parts—exploded view.

Section XIII. REPAIR AND REPLACEMENT OF OIL PUMP AND PICKUP TUBE ASSEMBLIES

4-70. Disassembly

a. Remove Pickup Tube and Screen Assembly. Remove hex-head capscrew and washer assembly holding pickup tube to oil pump cover, and remove pickup tube and gasket. Discard gasket (fig. 4-184).

b. Remove Pump Cover Assembly. Remove hex-head capscrew and washer assembly holding oil pump cover assembly to oil pump body and lift off cover assembly (fig. 4-185).

c. Remove Pressure Relief Valve. Remove cotter pin from cover assembly and remove retainer, spring, and plunger (fig. 4-185).

d. Preliminary Inspection. Check oil pump gear radial and end running clearance to determine if further disassembly is necessary. Remove and replace parts only if wear exceeds specified clearance. Refer to table 4-10 for repair standards.

(1) *Radial clearance.* Check pump body to gear tooth clearance with feeler gage. Clearance should not exceed 0.005 inch (table 4-10 and fig. 4-186).

(2) *End clearance.* Place straightedge on pump body over pump gears and check clearance between gears and straightedge with a feeler gage. If clearance is more than 0.006 inch, replace pump (table 4-10 and fig. 4-187).

(3) *Running clearance.* Check the clearance between inside diameter of idler gear and outside diameter of idler gear shaft with micrometer. Clearance should not exceed 0.003 inch (fig. 4-188).

e. Remove Pump Shaft and Gear Assembly. Lift out oil pump idler gear from pump body (fig. 4-188). Press shaft and gear assembly out of oil pump drive gear with arbor press and suitable adapter. Lift oil pump drive gear from oil pump body (fig. 4-189).

f. Remove Idler Gear Shaft. Press oil pump idler gear shaft out of oil pump body with arbor press and suitable adapter. Refer to figure 4-190.

4-71. Cleaning and Inspection

a. References. Refer to paragraphs 4-42 through 4-44 for general cleaning, inspection, and repair procedures. Refer to table 4-10 for repair standards.

b. Cleaning. Wash all parts in cleaning solvent and dry thoroughly. Use a brush to clean the inside of pump housing and pressure relief valve chamber in pump cover. Be sure all dirt and chips are removed. Soak oil pump pickup tube and screen assembly in solvent. Direct high pressure steam into flange end of tube. Blow out with compressed air and shake any loose dirt and foreign particles from opening in bottom of screen and cover assembly.

c. Inspection. Inspect pump body, drive tang on shaft assembly, and gear teeth for damage or wear. Check dimensions of all parts against limits specified in repair standards (table 4-10). If any part fails to satisfy requirements, replace pump.

Table 4-10. Repair Standards—Oil Pump Assembly and Related Parts

Reference		Point of measurement	Size of new part	Wear limit
Fig. No.	Key			
4-191	4	Pressure relief valve spring free length.	2.18	*
		Pounds pressure when compressed to 1.40.	7.5-8.0	*
4-191	6	Outside diameter of pressure relief valve plunger.	0.4975-0.4985	*
4-191	6, 7b	Fit of plunger in cover	0.0015L-0.0035L	*
4-191	7a	Pump cover flatness.	0.001	0.001
4-191	7b	Inside diameter of plunger bore in cover.	0.500-0.501	*
4-191	10	Oil pump gears total backlash	0.006-0.008	0.010
4-191	10a	Oil pump gears (drive & idler) height	0.898-0.900	*
		Oil pump gear end clearance in pump body.	0.002-0.005	0.006
4-191	10b	Inside diameter of oil pump gears (drive and idler).	0.4915-0.4920	*
4-191	10b, 11	Fit of oil pump gear (idler) on shaft	0.001L-0.002L	0.003L
4-191	10b 14a	Fit of oil pump gear (drive) on shaft	0.0011T-0.002T	*
4-191	11	Outside diameter of idler gear shaft	0.4900-0.4905	*
		Fit of idler gear shaft in oil pump body.	0.001T-0.0025T	*
4-191	12a	Inside diameter of drive shaft bore in body.	0.4951-0.4955	*
4-191	12a	Fit of drive shaft in body	0.0016L-0.0024L	*
4-191	12b	Drive gear to body radial clearance	0.0025-0.0035	0.005
4-191	14a	Diameter of drive shaft	0.4931-0.4935	*
4-191	14b	Distributor and oil pump drive gear to camshaft gear backlash.	0.003-0.005	0.008
4-191	12c	Inside diameter of idler shaft bore in body.	0.488-0.489	

NOTE

Bench test of oil pump assembly: Pump to produce .5 gallons-per-minute at 20 psi minimum dead end pressure at 195-to-205 rpm pump shaft speed. Relief valve to open at 37-42 psi using 62-68 SSU oil.

* Refer to paragraph 4-45a (2).

4-72. Assembly

a. *Install Idler Gear Shaft.* Coat end of oil pump idler gear shaft with thin coat of white lead and oil and press into pump body (0.002-to-0.010 inch below pump cover face), using an arbor press and suitable adapter (fig. 4-192).

b. *Install Pump Gear and Shaft Assembly and Drive Gear.* Coat end of oil pump shaft and gear assembly with thin coat of white lead and oil. Lubricate shaft assembly and shaft bearing in pump body. Press gear and shaft assembly (with arbor press and suitable adapter) flush to within 0.010 inch of drive gear face (fig. 4-193).

c. *Install Pump Idler Gear.* Lubricate idler gear and gear shaft in pump body and install idler gear on shaft. Check gears for freedom of rotation. Check gear backlash, end clearance, and radial clearance. Refer to preliminary inspection (para 4-66 *d*) for procedures to check end clearance and radial clearance (fig. 4-143).

d. *Install Oil Pressure Relief Valve.* Lubricate relief valve plunger and valve chamber on side of pump cover and install plunger, relief valve spring, and spring retainer. Secure with 3/32x1 cotter pin. Spread cotter pin and check valve for freedom of movement (fig. 4-142).

e. *Install Oil Pump Cover Assembly.* Install oil pump cover on oil pump body with 5/16-inch flat washer and 5/16-18x7/8 hex-head capscrew and washer assembly. Check oil pump for freedom of rotation. To install oil pump refer to figure 4-89.

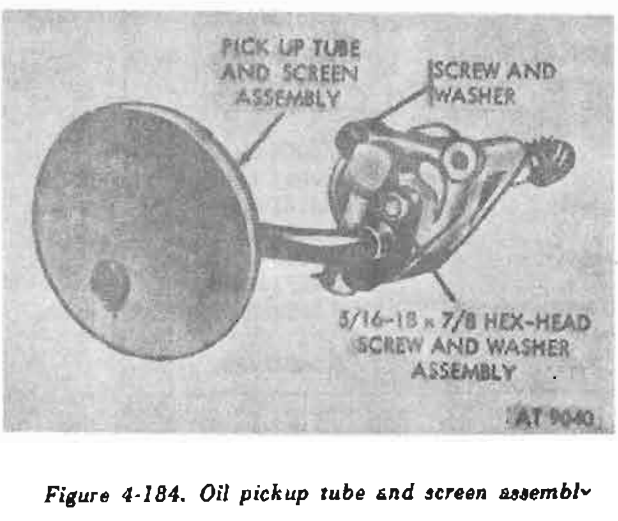


Figure 4-184. Oil pickup tube and screen assembly

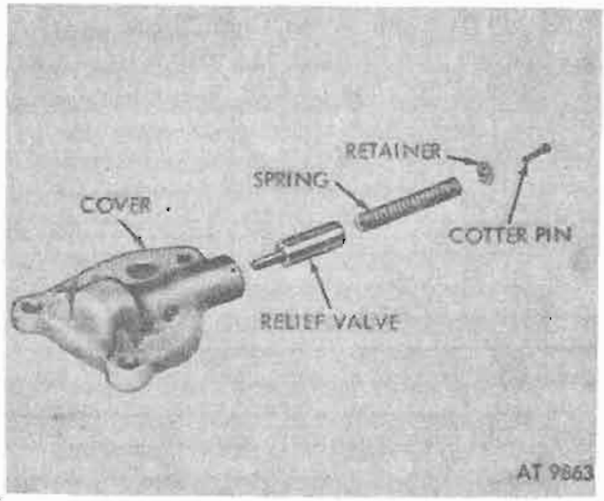


Figure 4-185. Oil pump pressure relief valve.

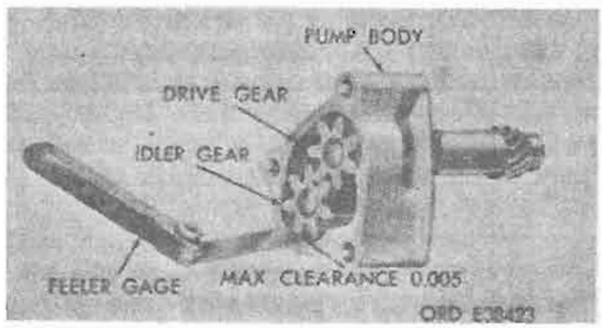


Figure 4-186. Oil gear radial clearance.

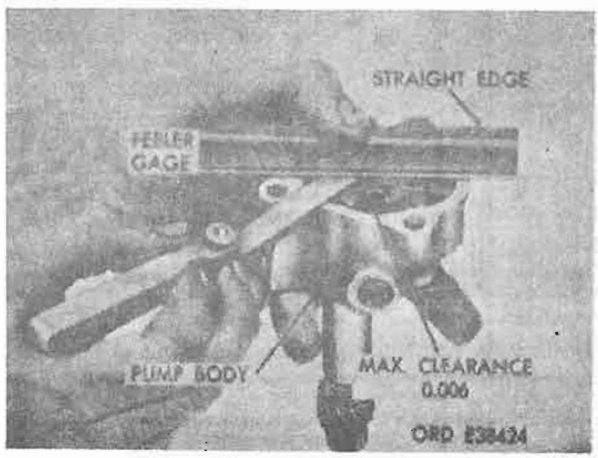


Figure 4-187. Oil pump gear and clearance.

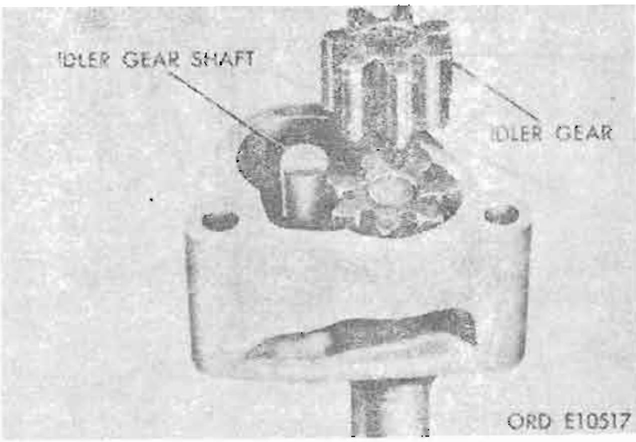


Figure 4-188. Oil pump gear to shaft—running clearance.

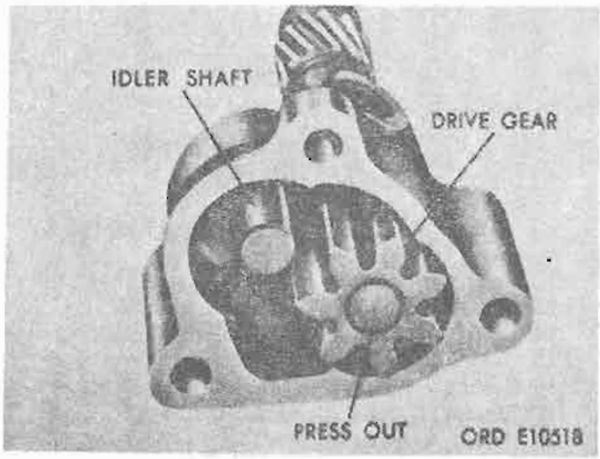


Figure 4-189. Oil pump—gear and shaft assembly.

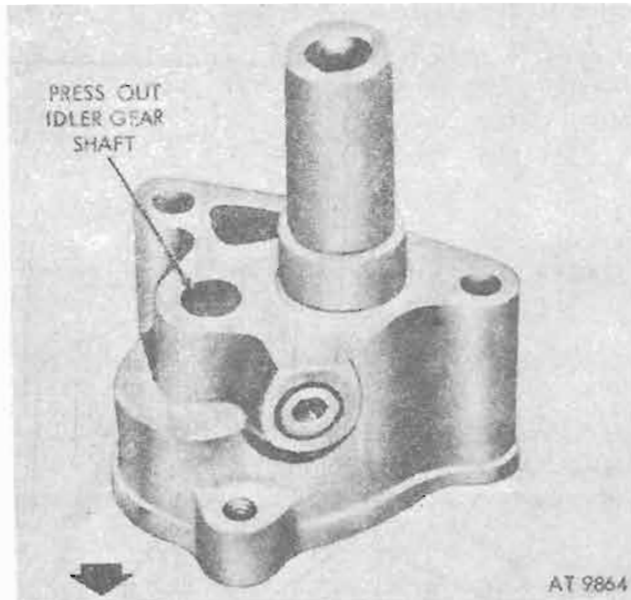
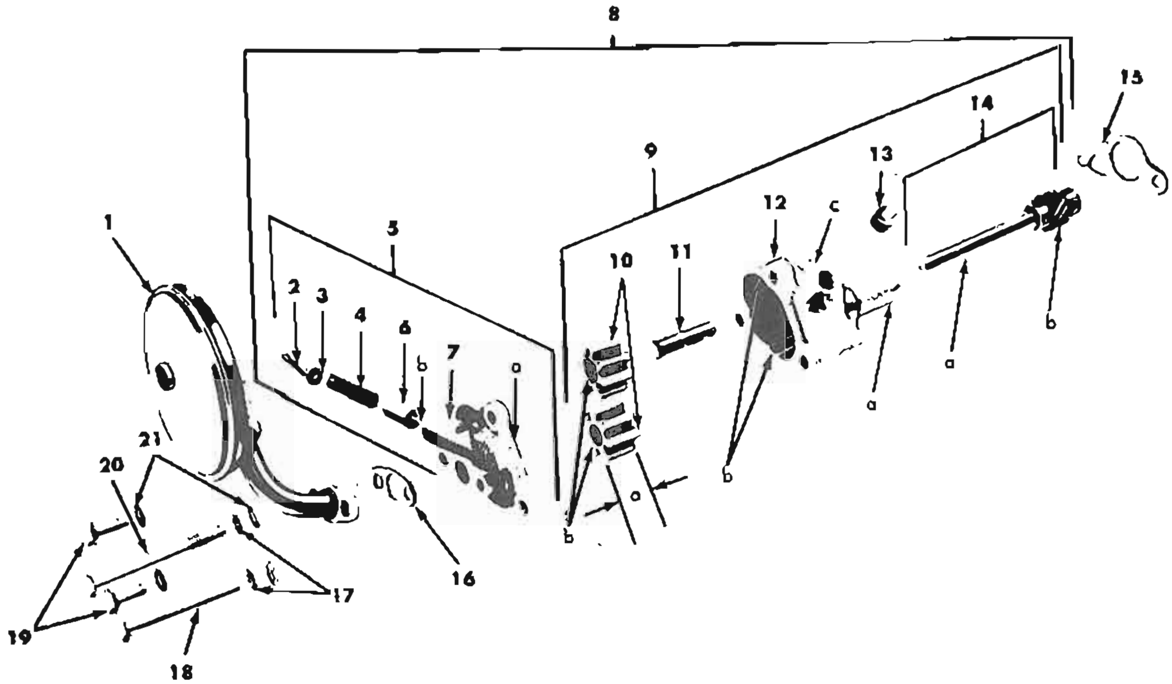


Figure 4-190. Oil pump idler gear shaft.



1 Strainer Assy, oil
2 Pin, 3 / 32x1 cotter
3 Retainer, relief valve spring.
4 Spring, relief valve
5 Cover assembly, oil pump
6 Plunger, relief valve
7 Cover, oil pump
8 Pump assembly, oil
9 Body assy, oil pump
10 Gear, oil pump drive & idler
11 Shaft, oil pump idler gear
12 Body, oil pump
13 Plug ¼-18 pipe
14 Shaft assy dist. & oil pump drive gear.
15 Gasket, oil pump
16 Gasket, oil pickup tube
17 Washer, 5 / 16 lock (ext.) (tooth)
18 Bolt, 5 / 16-18x3½
19 Screw & washer assy, 5 / 16-18x7 / 8.
20 Bolt, 5 / 16-18x2¾
21 Washer, 5 / 16 flat

Figure 4-191. Oil pump assembly and related parts—exploded view.

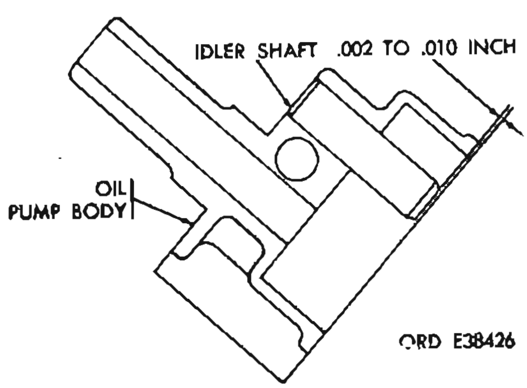


Figure 4-192. Oil pump, installation of idler gear shaft.

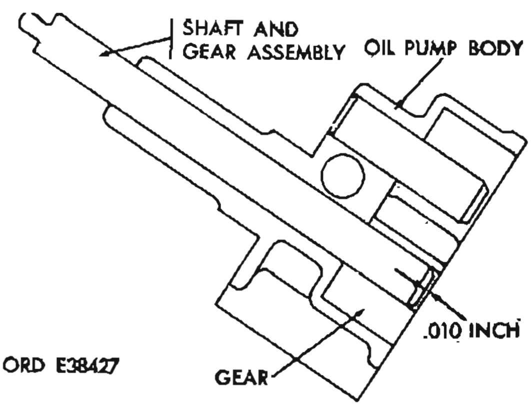


Figure 4-193. Oil pump, installation of drive gear, and gear and shaft assembly.

Section XIV. REPAIR AND REPLACEMENT OF GEAR COVER, TAPPET COVER, AND RELATED PARTS

4-73. Timing Gear Cover Assembly (fig. 4-194).

a. *Cleaning and Inspection.* Soak timing gear cover assembly in cleaning solvent and remove all accumulated deposits and oil gasket material. Check for cracks, damage, and distortion of gasket surface; mounting surface must be flat and smooth. Be sure oil seal assembly is in good condition. If oil leakage was noted or if seal lip is worn, deteriorated, hard, or otherwise damaged, replace seal assembly. Examine timing pointer in cover for loose, bent, or damaged condition. Repair or replace timing pointer as necessary or replace front cover assembly. Refer to tables 4-11 and 4-12 for repair standards.

b. *Repair.*

(1) *Remove oil seal assembly.* Drive oil seal out of timing gear cover from either side with punch or suitable tool.

(2) *Remove timing pointer.* Press or drive timing pointer out of timing gear cover with pin punch.

(3) *Install timing pointer.*

(a) Coat outer diameter of timing pointer with oil and water-resistant sealer and press timing pointer into cover flush with inside surface of casting. Remove any excess sealer from cover after pointer is installed. Make sure pointer is not loose. (For 25-ampere generator installation only.)

(b) Revise pointer hole in 8754360 cover to 0.189-0.193 diameter. Apply MIL-S-7916 sealer to hole. Attach 11599016 (stamped) pointer to cover with 11599017 drive screw. (For 60- and 100-ampere alternator applications only.)

(c) Install Oil Seal Assembly. Clean recess in cover, then coat outer diameter of seal assembly with oil and water-resistant sealer and install on replacer tool 7345198 with step side of seal away from replacer tool flange, as shown in figure 4-195. Drive oil seal assembly into front cover until flange of replacer tool is flush with front of casting (fig. 4-196). Remove any excess sealer from seal after the seal is installed. Make sure seal lip is pointing inward.

Table 4-11. Repair Standards Cover, Cylinder Front (25-Ampere Generator, 60-and / or 100-Ampere Alternator)

Fig. No.	Key	Point of measurement	Size of new part	Wear limit
4-197	1b	Outside diameter of drive screw	0.212-0.206	*
4-197	3b	Inside diameter of drive screw hole in cover.	0.189-0.193	*
4-197	1,3b	Fit of screw in cover	0.023-0.013	*
4-197	3a	Inside diameter of oil seal bore in cover.	2.373-2.375	*
4-197	6	Outside diameter of oil seal assy	2.380-2.376	*
4-197	6,3a	Fit of oil seal assembly in cover	0.001T-0.007T	*

* Refer to paragraph 4-45a (2).

4-74. Valve Push Rod Cover (fig. 4-198).

a. *Cleaning and Inspection.* Soak push rod cover in solvent and remove all accumulated deposits and old gasket material. Check for cracks, dents or warped gasket surface.

b. *Repair.* Repair any damage or replace cover if repair cannot be made.

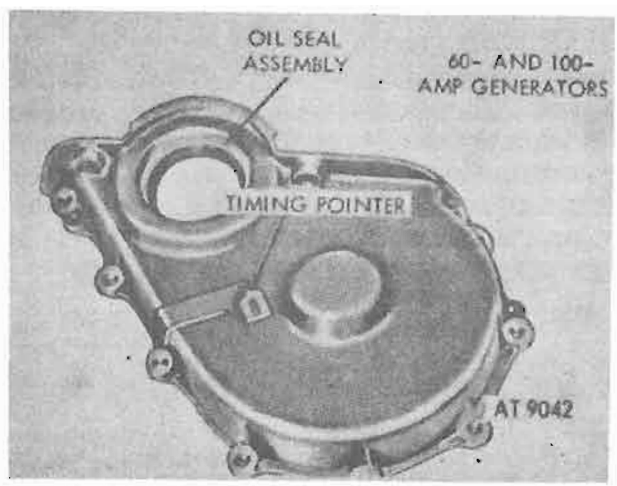


Figure 4-194. Timing gear cover assembly.

Figure 4-195. Oil seal assembly installation on replacer tool, 7345198.

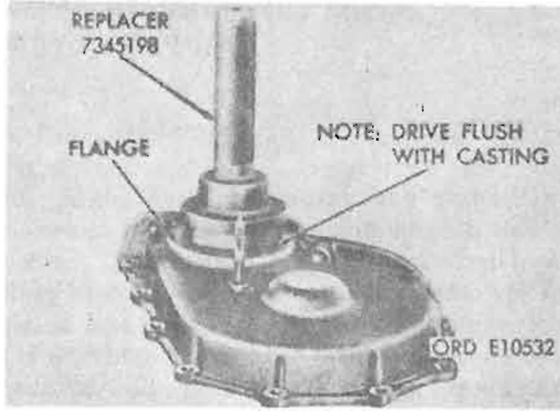


Figure 4-196. Installing oil seal in timing gear cover.

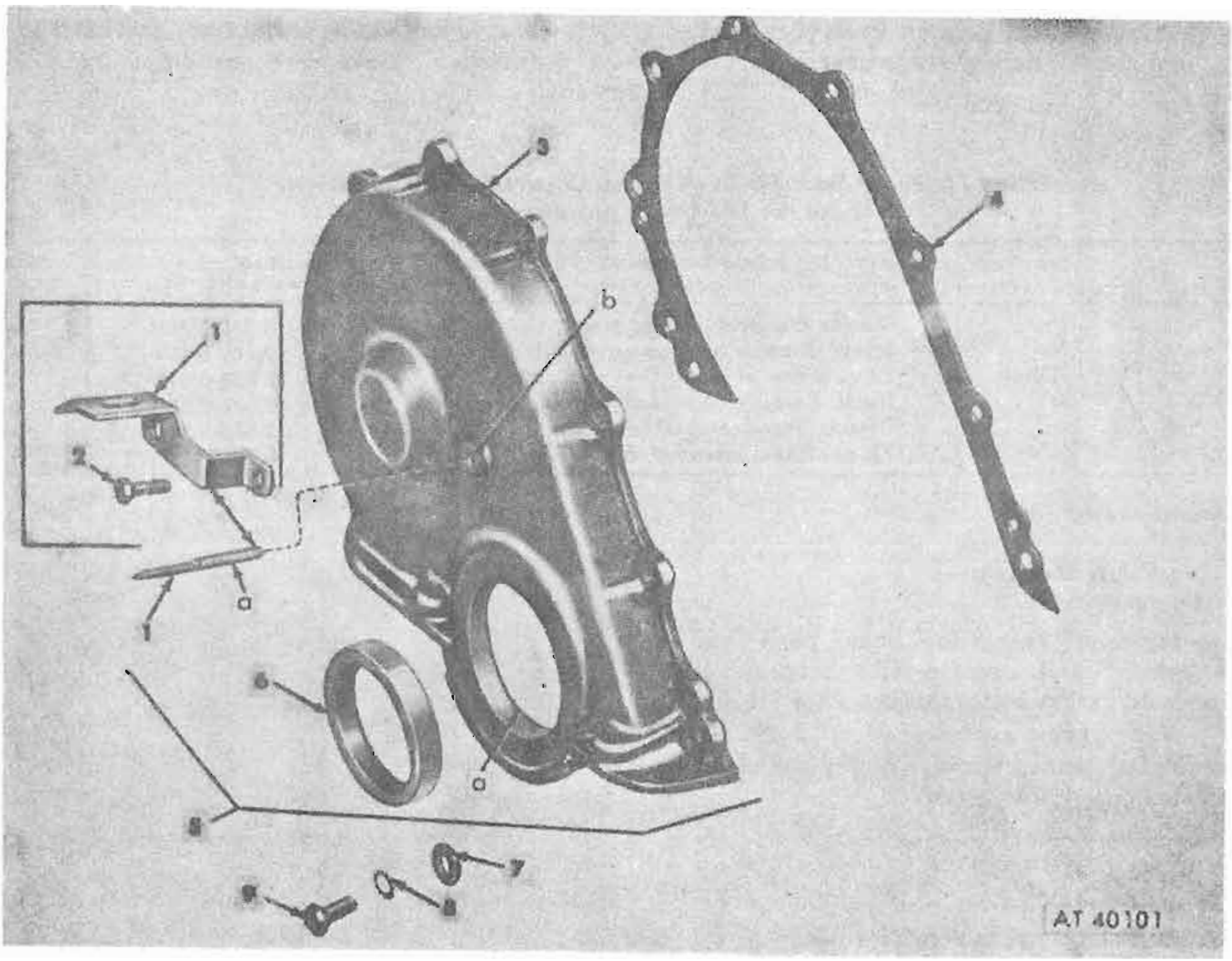
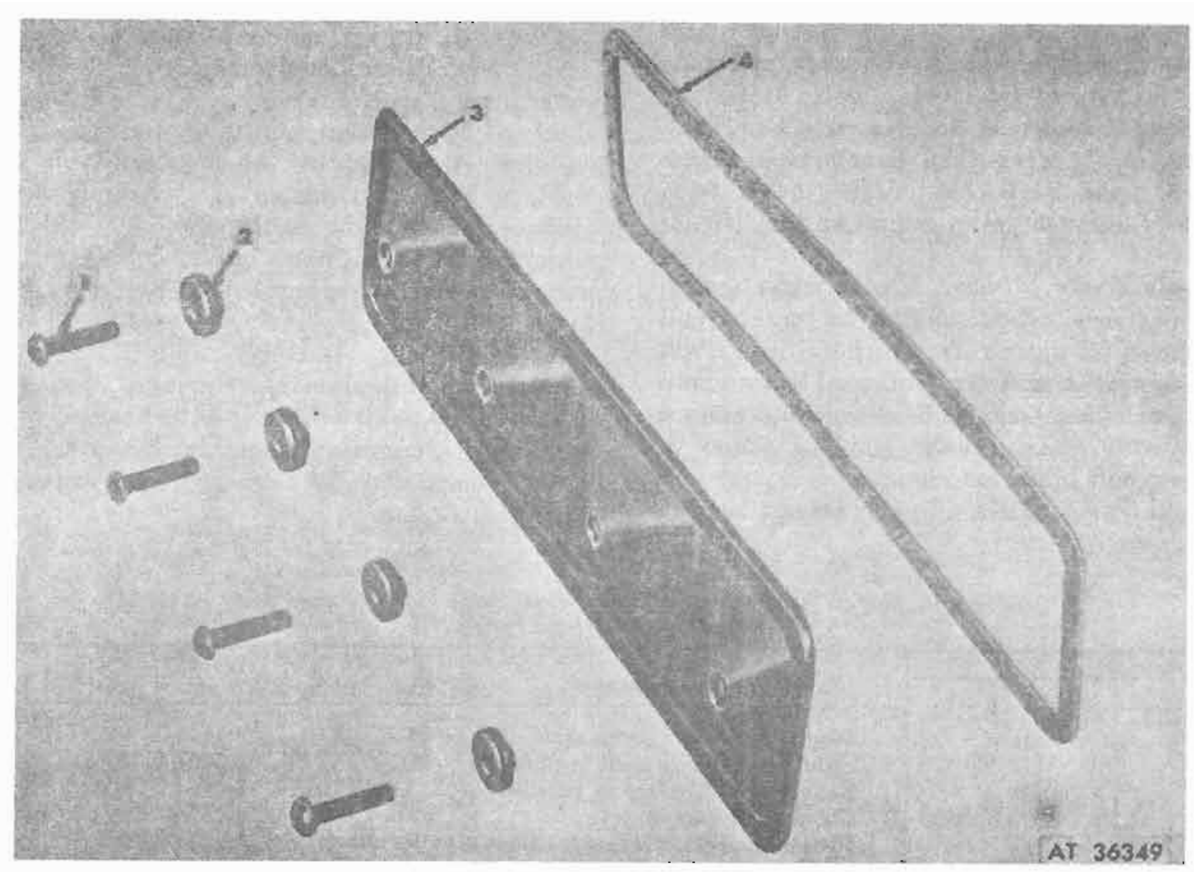


Figure 4-197. Timing gear cover and related parts—exploded view.

Legend to figure 4-197:
1 Pointer, timing (60- and 100-amp alternators) (Modify for 25-amp generator).
2 Screw, timing pointer (60- and 100-amp alternators).
3 Cover, timing gear
4 Gasket, timing gear cover
5 Cover assembly, timing gear (25-amp generator) (60- and 100-amp alternators)
6 Seal assembly, crankshaft front oil
7 Washer, ¼ flat (8)
8 Washer, ¼ lock (8)
9 Screw, ¼-20x¾ panhead (8)



1 Screw, ¼-20x1¼ panhead (4)
2 Seal assembly, push rod cover (4)
3 Cover, valve push rod
4 Gasket, valve push rod cover

Figure 4-198. Valve push rod cover and related parts—exploded view.

Section XV. REPLACEMENT OF FAN BLADE, PULLEY, WATER PUMP, THERMOSTAT AND RELATED PARTS

4-75. References

Refer to figure 4-201 for views of fan blade, drive belts, and water pump pulley, thermostat, and related parts. Refer to table 4-12 for pertinent repair standards. Test thermostat in accordance with TM 9-2320-218-20.

4-76. Cleaning and Inspection

a. *Fan Blade Assembly.* Clean fan assembly in solvent and scrape off dirt accumulation. Examine all rivets and bolt holes. Check blades and center section for cracks or bends. Replace fan blade assembly if rivets are loose, bolt holes are elongated, or if center section is cracked or bent. Each individual blade, when installed on engine assembly, should be 0.781-to-0.791 inches from front face of blade to pulley mounting face (fig. 4-199).

b. *Water Pump Pulley.* Clean water pump pulley in solvent. Check pulley for cracks and pulley grooves for nicks and corrosion. Inspect bolt holes for elongation and fit of pulley on water pump shaft. Repair minor nicks with oilstone and remove corrosion with crocus cloth. Replace pulley if cracked, or bolt holes are elongated.

c. *Water Pump.* Wash all parts except bearing and slinger assembly in cleaning solvent and dry thoroughly. Make sure drain hole in pump body is open. Remove all particles of gasket from body flange. Make sure all traces of oil sealer are removed from pump body. Examine impeller for erosion, corrosion, cracks, or broken blades. Examine pulley hub for damaged threads and fit of hub on shaft. Replace hub if threads are damaged beyond repair or if loose on shaft. Replace water pump if cracked, worn or damaged. Refer to TM 9-2320-218-20 for replacement of the water pump.

d. *Drive Belts.* Visually inspect generator and water pump drive belts for frayed, glazed, cracked, checked, or stretched condition. Belts should be replaced if any of the above conditions exist. Replace belts in matched sets. Examine pulley grooves for nicks or corrosion which will cause more than normal wear on drive belts. Repair pulley grooves and replace belts as necessary (fig. 4-200).

e. *Thermostat Assembly and Water Outlet Connection.* If thermostat is damaged by corrosion or does not operate within specified range, replace with new thermostat assembly. Examine water outlet connection for cracks or warpage; if damaged, replace.

Table 4-12. Repair Standards—Fan Blade, Water Pump Pulley, Water Pump, Thermostat and Related Parts

Reference		Point of measurement	Size of new part	Wear limit
Fig. No.	Key			
4-201	1a	Diameter of water pump shaft	0.7460-0.7465	*
4-201	1a, 2b	Fit of water pump shaft in pulley	0.002L-0.0005L	*
4-201	2a	Runout of pulley face as installed	0.010	*
4-201	2b	Diameter of bore in pulley	0.747-0.7485	*
4-199	2b	Distance from front face of fan blade to pulley hub.	0.781-0.791	*
		Misalinement of pulley grooves total	0.010	
4-201		Thermostat range:		
		Start to open	180° F.	
		Fully Open	202° F.	

* Refer to paragraph 4-78.

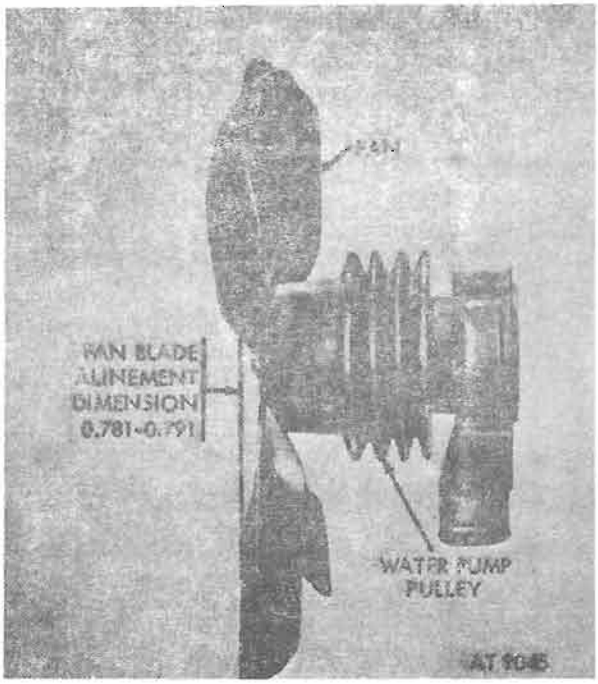


Figure 4-199. Fan blade—alinement dimension.

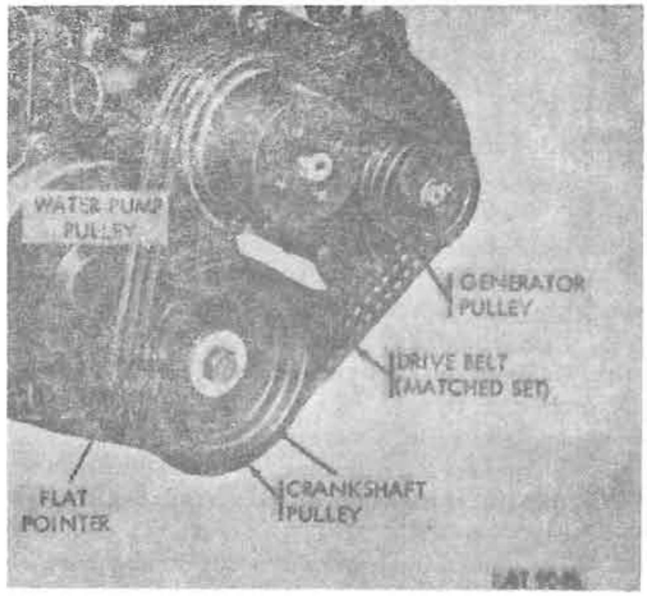
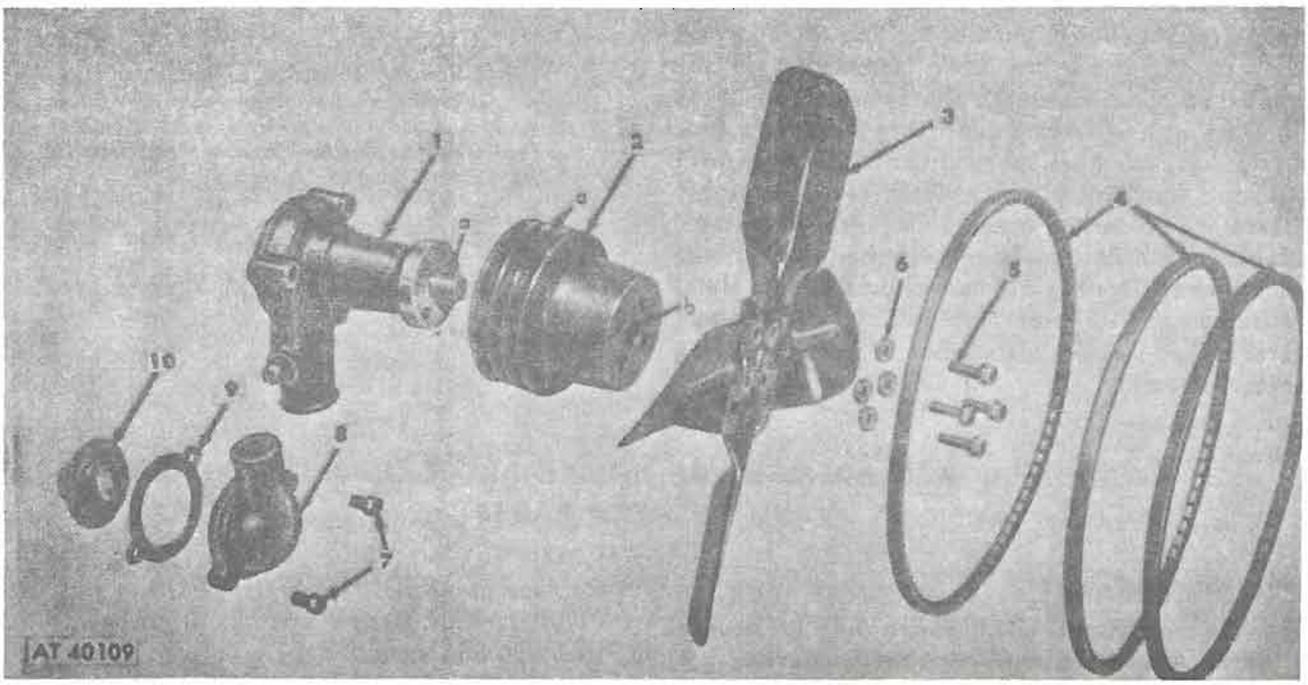


Figure 4-200. Drive belts.



1 Pump Assembly, water
2 Pulley, water pump
3 Blade assembly, fan
4 Set, drive belt (3) 60-amp
  Set, drive belt (3) 60-amp
  Set, drive bolt (2) 25-amp
5 Screw 5 / 16-18x7 / 8 hex-head (4)
6 Washer, Lock
7 Screw and washer assembly, 5 / 16-18x7 / 8 hex head (2)
8 Water outlet connection
9 Water outlet connection gasket
10 Thermostat assembly

Figure 4-201. Fan blade, water pump pulley, water pump, thermostat, and related parts—exploded view.

Section XVI. REPLACEMENT OF FLYWHEEL ASSEMBLY AND CLUTCH PILOT BEARING

4-77. Cleaning and Inspection

a. References. Refer to paragraphs 4-42 through 4-44 for general cleaning, inspection, and repair procedures for the flywheel assembly. Refer to paragraph 4-91 for replacement of the clutch assembly.

b. Inspection (fig. 4-202).

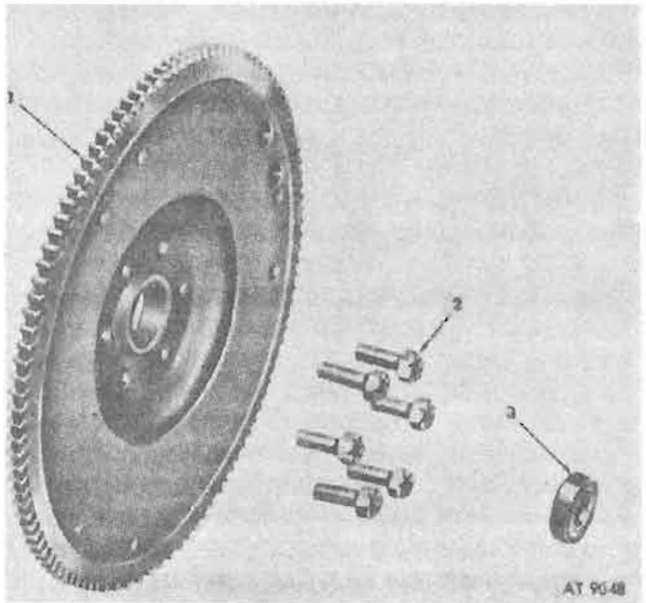
(1) Inspect the flywheel for cracks. Inspect the surface of flywheel for scoring or heat checks. Replace flywheel if necessary.

(2) Inspect the ring gear for worn, chipped, or cracked teeth. If the teeth are damaged, replace the flywheel.

(3) Check clutch pilot bearing in the bore of the flywheel. The bearing is pressed into the flywheel and should not be loose. Inspect the inner surface of the bearing bore in the flywheel and the bearing for wear. Inspect ball bearing for looseness or roughness. Replace pilot bearing if damaged.

4-78. Clutch Pilot Bearing Replacement

To obtain proper bearing position against crankshaft shoulder, install bearing in flywheel after the flywheel has been assembled to the crankshaft. Coat the clutch pilot bearing bore in the flywheel with a small quantity of grease (GAA). Avoid using too much lubricant as it may be thrown onto the clutch disk when clutch revolves. Apply pressure to bearing outer race with a suitable adapter and install the bearing in the flywheel bore until it shoulders against end of crankshaft. Refer to paragraph 4-37 for removal of bearing, and paragraph 4-97 c for installation of bearing during engine assembly.



1 Flywheel assembly
2 Bolt, 7/16-20x1⅛ selflocking (6).
3 Clutch pilot bearing

Figure 4-202. Flywheel assembly and related parts—exploded view.

Section XVII. REPLACEMENT OF INTAKE AND EXHAUST MANIFOLD AND RELATED PARTS

4-79. References

Refer to paragraphs 4-42 through 4-44 for general cleaning, inspection, and repair procedures.

4-80. Cleaning

Clean the manifold(s) in a suitable solvent to loosen and remove accumulated deposits, then dry with compressed air. Scrape all old gasket material from gasket surface.

4-81. Repair

a. Intake Manifold (fig. 4-203).

(1) Inspect the intake manifold for cracks, or leaks that would make it unfit for further service. Check manifold flanges for misalinement, using a straightedge or flat surface plate and feeler gage. Replace manifold if each flange is not flat within 0.002 inch or flanges are not in the same plane within 0.005 inch.

(2) Check intake manifold lower center mounting flange for warpage. Only this surface can be filed flat to assure clearance between intake manifold and cylinder head. Do not remove any more material than necessary. Remove studs that are stripped or otherwise damaged, using conventional stud remover. When installing new studs, drive until threads bottom on carburetor mounting flange of intake manifold. Check all the tapped holes for damaged threads. Repair of intake manifold should not be attempted except for

replacement of studs or repair of damaged threads in tapped holes.

(3) Remove all fillings and foreign matter that may have entered the manifold as a result of repairs.

(4) Torque intake manifold bolts to 23-28 lb.-ft.

b. *Exhaust Manifold* (fig. 4-204).

(1) Inspect the exhaust manifold for cracks, warpage, or other conditions that would make it unfit for further service. Check manifold for misalinement, using a straightedge or flat surface plate and feeler gage. Replace manifold if variation exceeds 0.020 inch over a distance of eight inches. Check outlet flange for flatness. Examine threads on the two bolts welded to manifold outlet flange. Repair of manifold should not be attempted except for correcting defective threads on bolts welded to manifold. Examine exhaust manifold-retaining bolts for bent or stripped condition and replace as necessary. Replace tab lockwasher if one locking tab is broken. Replace exhaust manifold-retaining clamps if warped or cracked.

(2) Remove all filings and foreign matter that may have entered the manifold as a result of repairs.

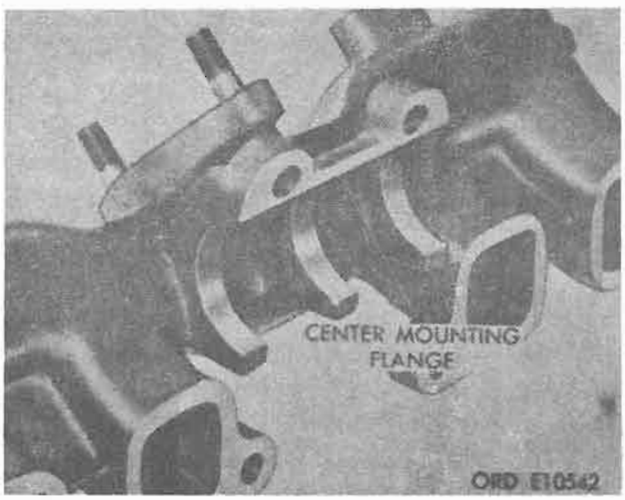


Figure 4-203. Intake manifold.

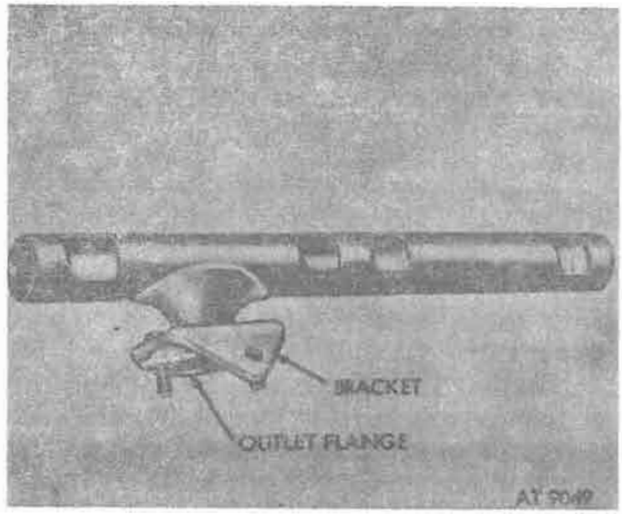
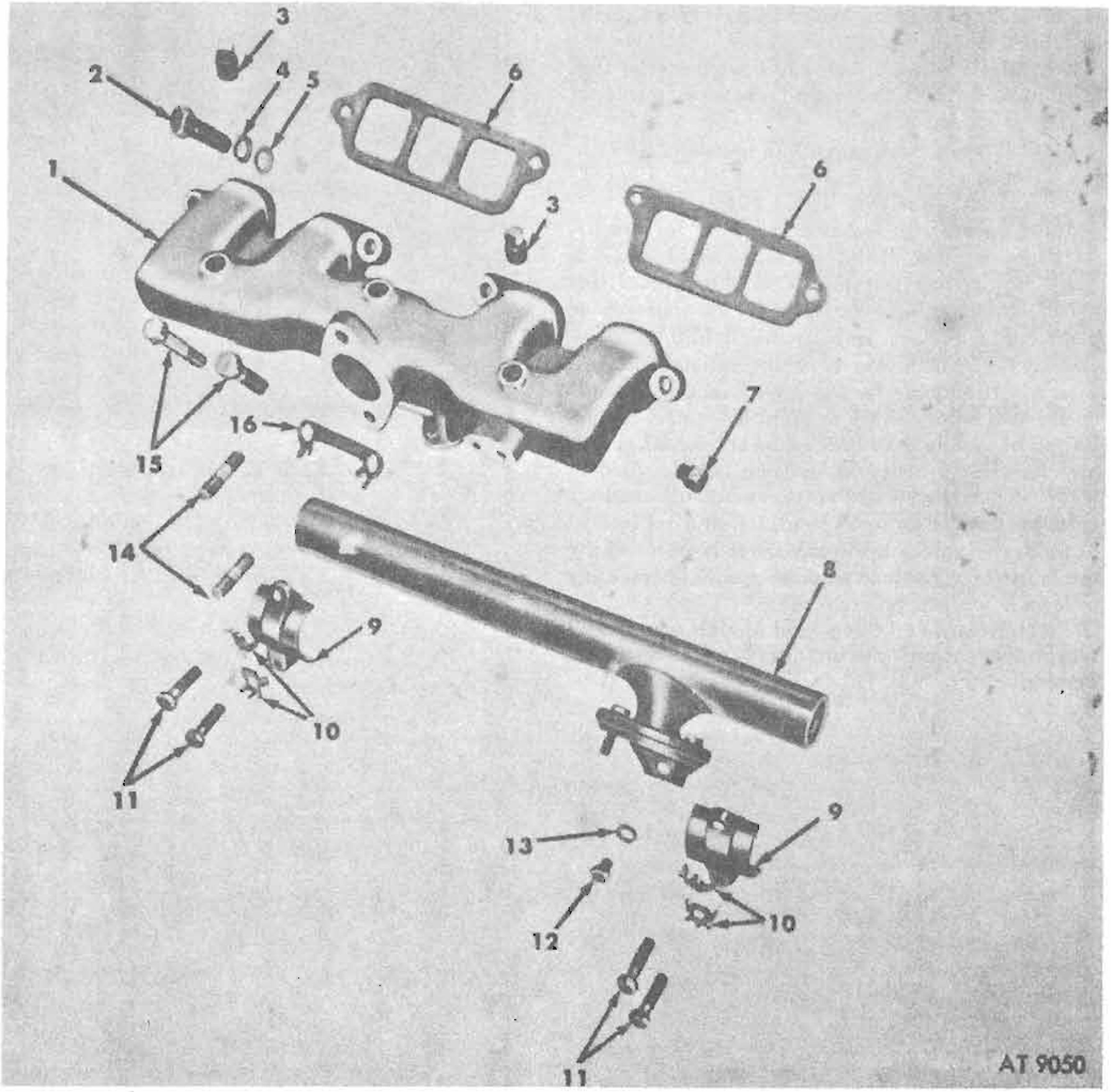


Figure 4-204. Exhaust manifold.



1 Manifold, intake
2 Bolt, 3/8-16x1 1/4 (4)
3 Plug, 1/4 pipe (2)
4 Washer, 3/8 lock (4)
5 Washer, 3/8 flat (4)
6 Gasket, intake manifold
7 Connector, 1/8 NPTx7/16-24 (M151, M151A1, M151A1C, and M718).
7 Connector (M151A2, M825 and M718A1)
8 Manifold assembly, exhaust
9 Clamp, exhaust manifold
10 Washer, 3/8 lock tabl (4)
11 Bolt, 3/8-16x1 1/2 (4)
12 Bolt, 3/8-16x5/8 (1)
13 Washer, 3/8 lock
14 Stud, 3/8-16-24x19/16 carburetor mounting (2)
15 Bolt, 3/8-16x1 1/2 (2)
16 Washer, lock tab (dual type)

Figure 4-205. Intake exhaust manifolds and related parts—exploded view.

4-82. Cleaning, Inspection, and Repair

a. Oil Filler Cap Assembly. Clean oil filter cap in cleaning solvent and dry thoroughly. Examine for bent or broken retaining lugs or loose center retaining rivet. Inspect cap gasket for deterioration or damage. Make sure diaphragm spring is not broken and will hold firmly against seat in top of rocker arm cover. If any damage is evident, replace cap. Make sure cap is secured to rocker arm cover seal retainer with filler cap chain and filler cap chain hooks.

b. Rocker Arm Cover. Soak rocker arm cover in cleaning solvent and remove all sludge deposits. Scrape gasket material from channel surface in cover. Check for cracks, dents, holes, or warped gasket surface. Repair any damage or replace the rocker arm cover if repairs cannot be made. Refer to figure 4-206.

c. Oil Level Indicator Assembly. Inspect oil level indicator for bent or damaged condition. Check cap seal. Seal must be in good condition to prevent dust and water from entering engine. Replace indicator assembly if there is the slightest evidence of damage or hardness of the seal. Check oil level indicator in oil level indicator tube, located on engine cylinder block, to make sure indicator seal retains the assembly firmly in place. Repair any evident damage or replace oil level indicator if repairs cannot be made.

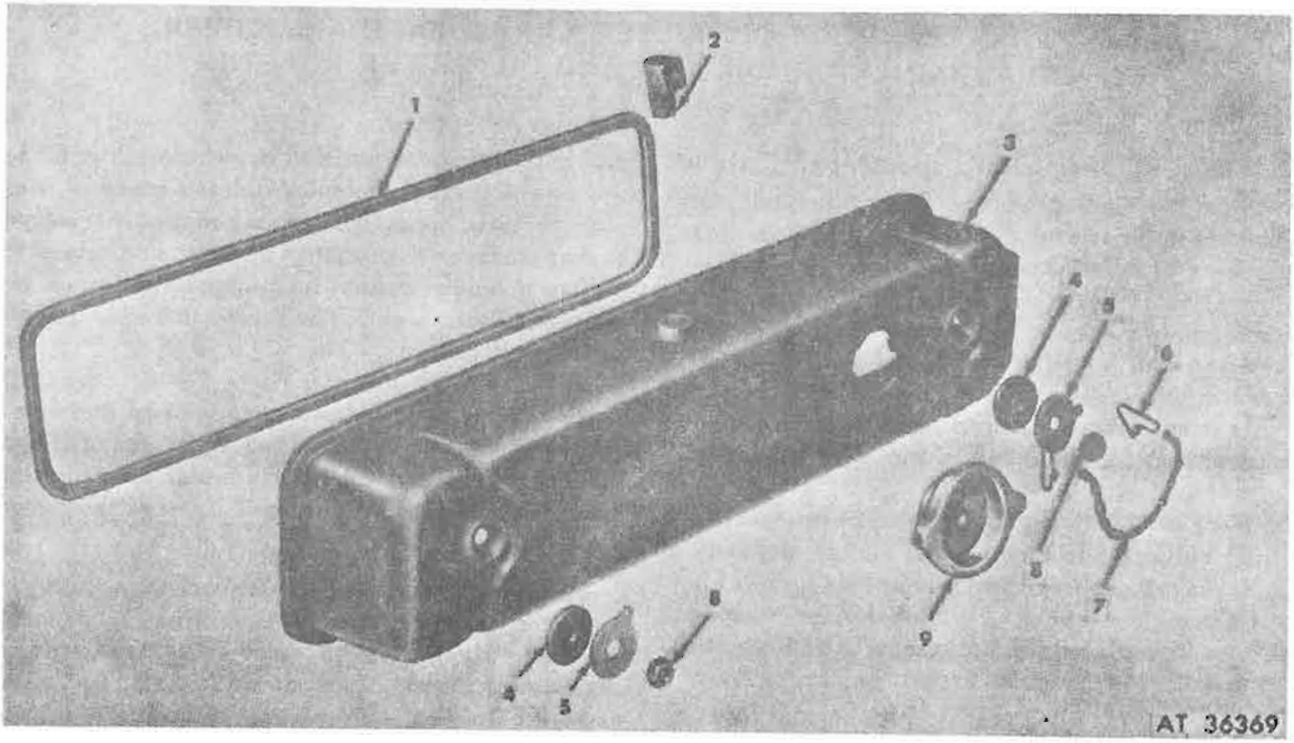
d. Oil Pan Assembly and Related Parts. Scrape any dirt or metal particles from inside of oil pan. Scrape gasket material from gasket surface. Wash pan in cleaning solvent and dry thoroughly. Check the pan for cracks, dents, holes, damaged drain plug threads, loose baffle, and nicked or warped gasket surface. Repair any damage or replace the oil pan if repairs cannot be made. Examine oil pan magnetic drain plug for damaged threads. Refer to figure 4-207.

e. Oil Filter Adapter (fig. 4-208). Examine casting for cracks, and for warpage and damage to gasket surface. Check tapped holes for damaged threads. Make sure oil filter adapter insert is tight in oil filter adapter. Replace if damage is evident.

4-83. Oil Filter Assembly

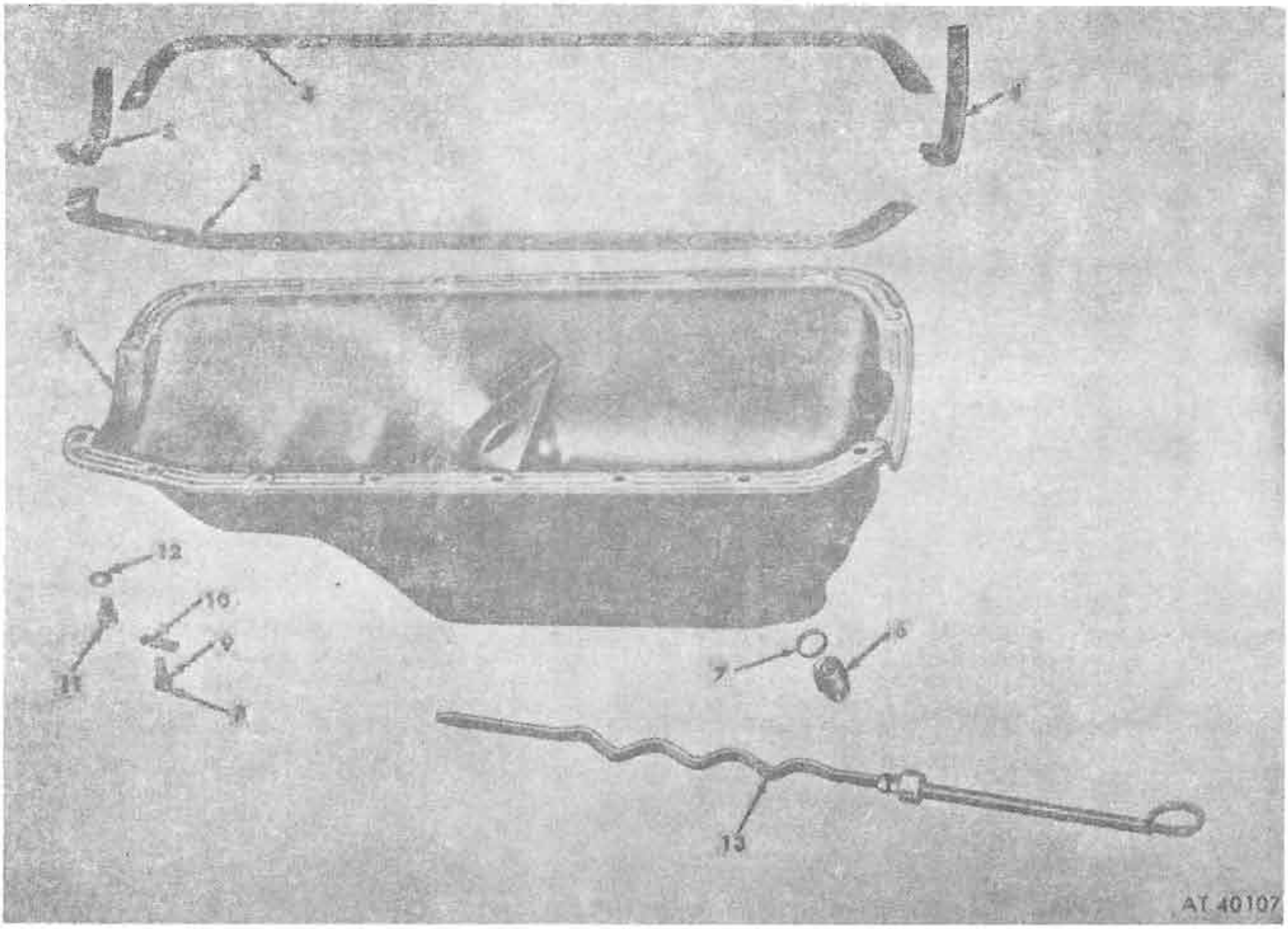
a. General. Disposable canister-type full-flow oil filter assembly cannot be cleaned or reconditioned. Replace with new filter assembly in accordance with TM 9-2320-218-20. Filter assembly contains an integral mounting seal and does not require a gasket (fig. 4-209).

b. Operation. If, due to a clogged filter, dirty oil is allowed to circulate through the lubricating system, premature wear of moving parts may occur. The total engine oil passes through the full-flow-type oil filter before entering the engine main oil gallery. Under this condition, the pressure at both sides of the filter bypass valve is equal and the valve is closed. When the filter becomes clogged, pressure in the tube at the bottom of the valve becomes lower than at the top of the valve. When the pressure differential equals 7 psi, the valve opens permitting the unfiltered oil to flow through the bypass valve and into the main oil gallery.



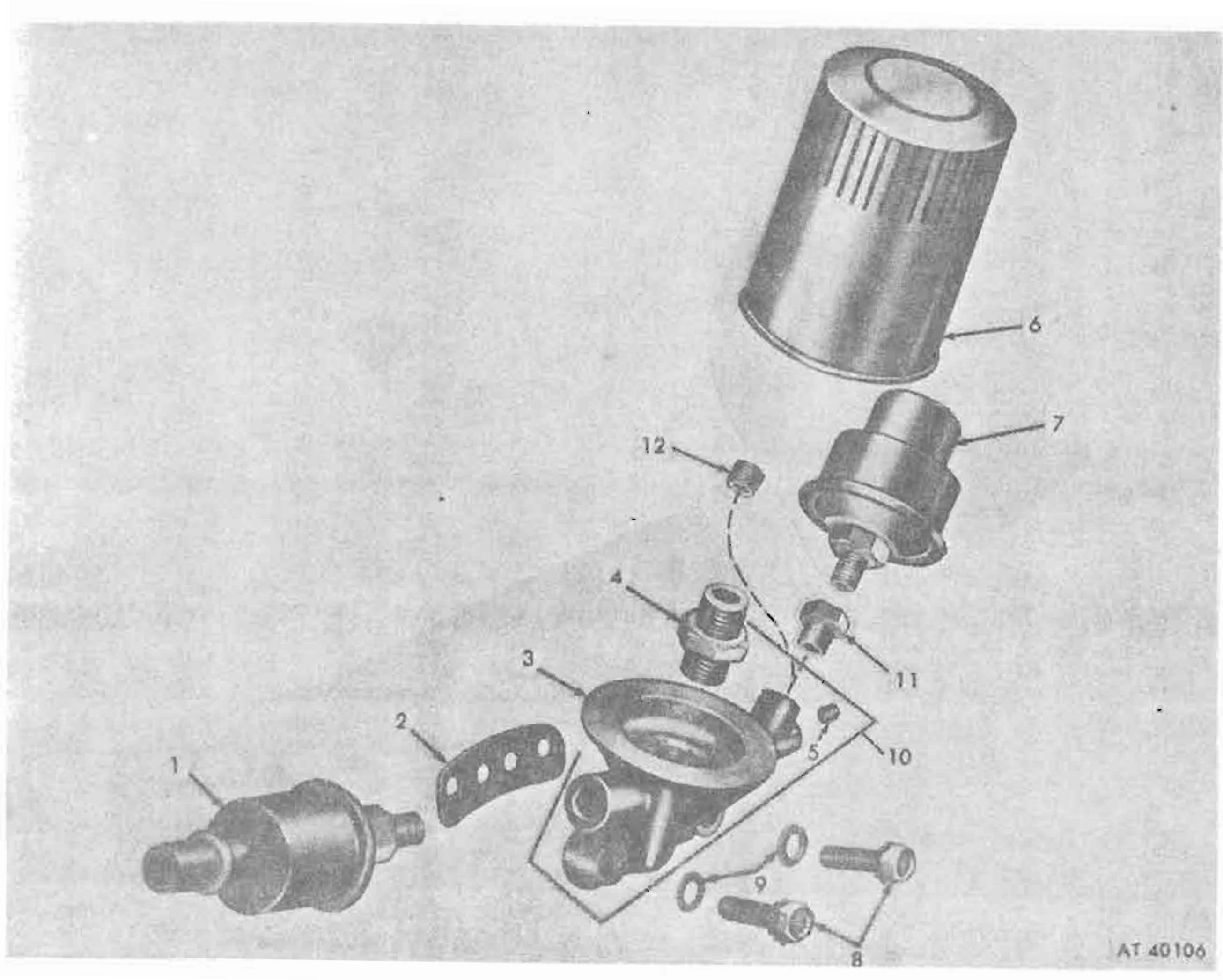
1 Gasket, valve rocker arm cover
2 Elbow, ¼ NPT ½-20 90°
3 Cover assembly, valve rocker arm
4 Seal, rocker arm cover (2)
5 Seal retainer, rocker arm cover (2).
6 Hook, oil fillter cap safety chain (2).
7 Chain, oil filler cap (15 links)
8 Nut, 5 / 16-24 (2)
9 Cap assembly, oil filler

Figure 4-206. Rocker arm cover assembly and related parts.



1 Oil pan assembly
2 Gasket, oil pan (left side)
3 Seal, oil pan (front end)
4 Gasket, oil pan (right side)
5 Seal, oil pan (rear end)
6 Plug 7 / 8-14 UNF magnetic, drain hex-head.
7 Gasket
8 Screw, ¼-20x⅝ panhead (12).
9 Washer, ¼ lock (12).
10 Spring, washer (12)
11 Screw and washer assembly 5 / 16-18x⅝.
12 Washer, 5 / 16 flat
13 Oil level indicator assembly

Figure 4-207. Oil pan assembly and related parts—exploded view.



1 Sending unit, oil pressure
2 Gasket, oil filter adapter
3 Adapter, oil filter
4 Insert, oil filter adapter
5 Plug, ⅛-27 pipe
6 Oil filter assembly (disposable canister type).
7 Switch assembly, fuel pump safety (oil pressure safety switch assembly) (M151, M151A1, M151A1C and, M718 vehicles only).
8 Bolt and lockwasher assembly, ⅜-16x1½ hex-head (2)
9 Washer, flat ⅜ (2)
10 Adapter assembly, oil filter
11 Reducer, pipe (M151, M151A1, M151A1C, and M718).
12 Plug, pipe (M151A2, M825, and M718A1).

Figure 4-208. Oil filter adapter and related parts—exploded view.

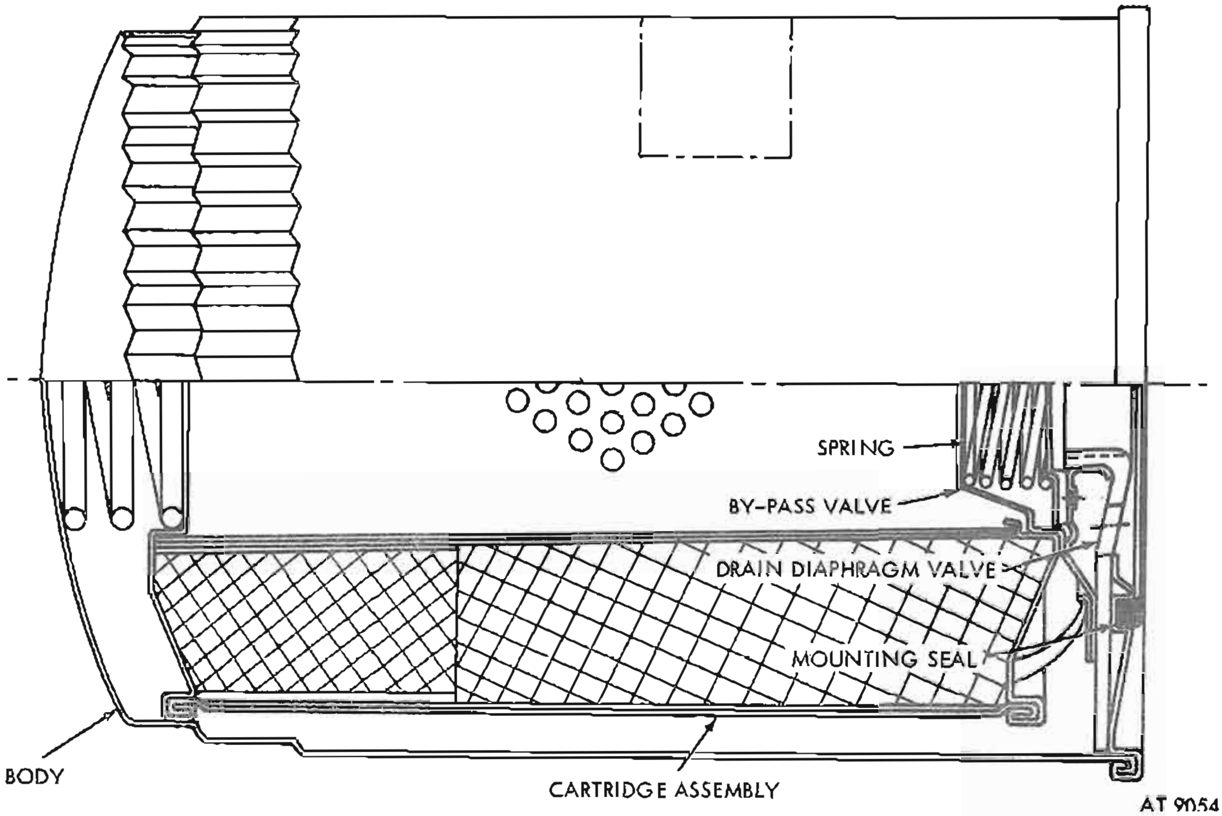


Figure 4-209. Oil filter assembly, full-flow disposable canister type—cutaway view.

Section XIX. REPAIR OF CRANKCASE VENTILATOR VALVE, LINES, AND RELATED PARTS

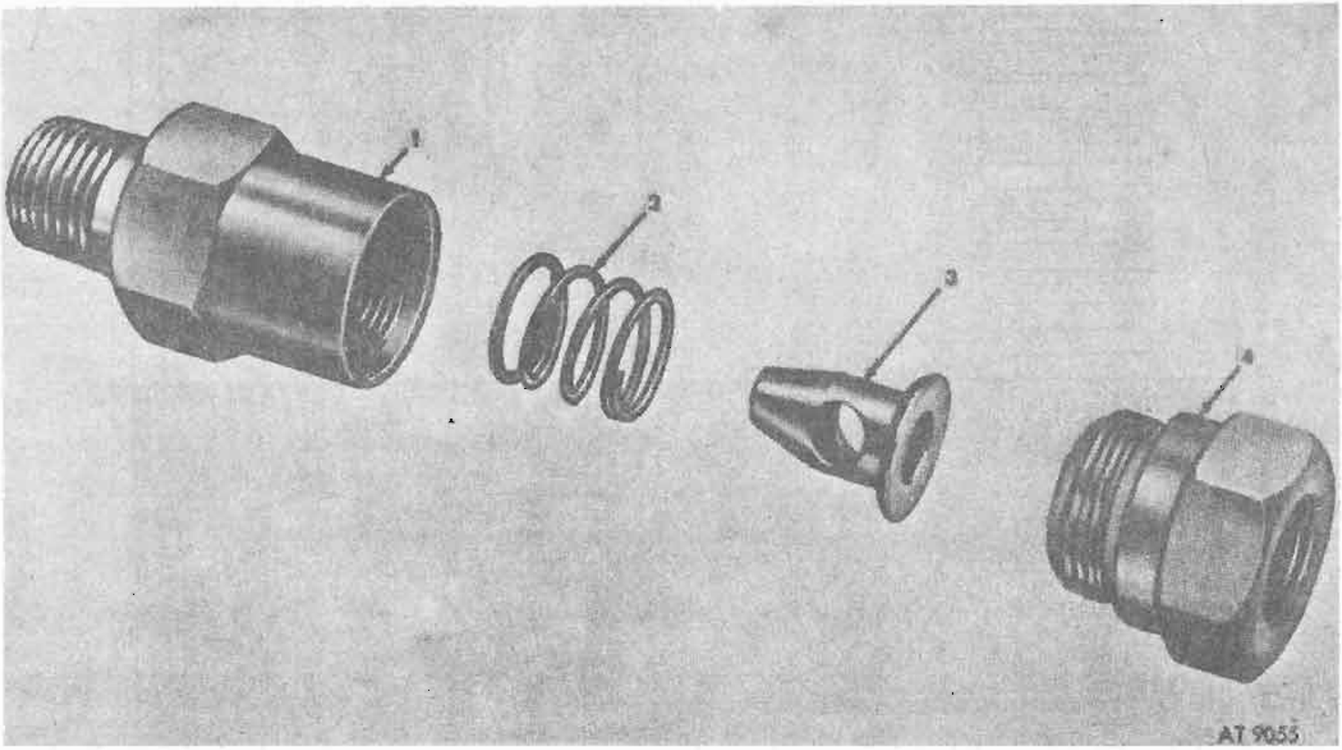
4-84. References

Refer to figures 4-210 through 4-214 for exploded views of each engine ventilating system. The systems shown on figure 4-210 and 4-211 are common to all engines. Refer to figure 4-212 and 4-214 for systems used only on M151, M151A1, M151A1C, and M718 vehicles. Refer to figure 4-213 for the system used only on M151A2, M825, M718A1 vehicles.

4-85. Cleaning and Inspection

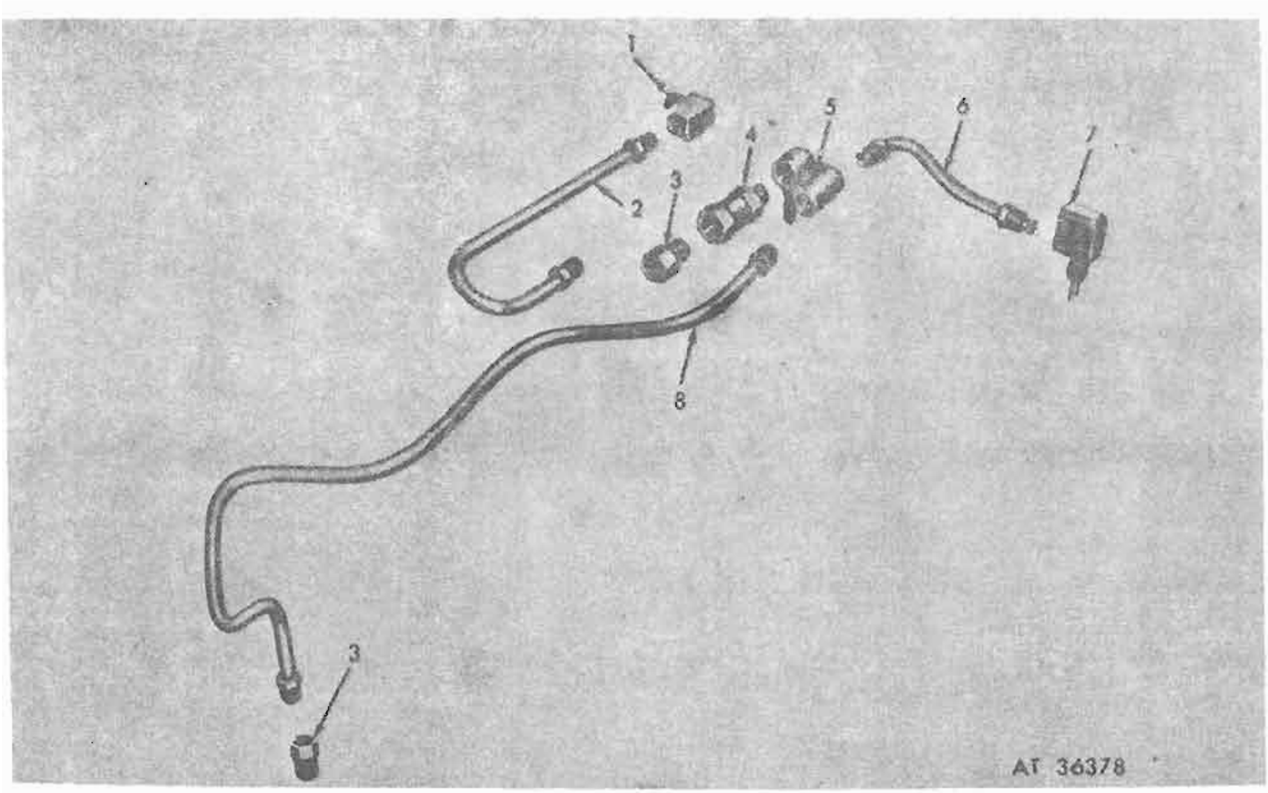
a. *Crankcase Metering Valve* (fig. 4-210). Unscrew nut (4) from valve body (1). Clean crankcase metering valve parts in cleaning solvent and dry thoroughly. Examine valve body (1) and nut (4) for damaged threads. Inspect valve seat in body for rough or rounded edges. Examine tapered end of plunger (3) for worn groove, where it contacts the seal in body. Check the valve spring (2) for free length and compression. Replace valve if worn or damaged.

b. *Ventilation and Vacuum Lines.* Clean lines with cleaning solvent and blow compressed air through all lines from both ends to remove foreign matter. Examine threaded fittings at end of ventilation lines for damaged threads. Examine all rubber lines for evidence of deterioration. Any line which is kinked, flattened, or damaged in any way should be discarded and new parts made up or obtained for assembly.



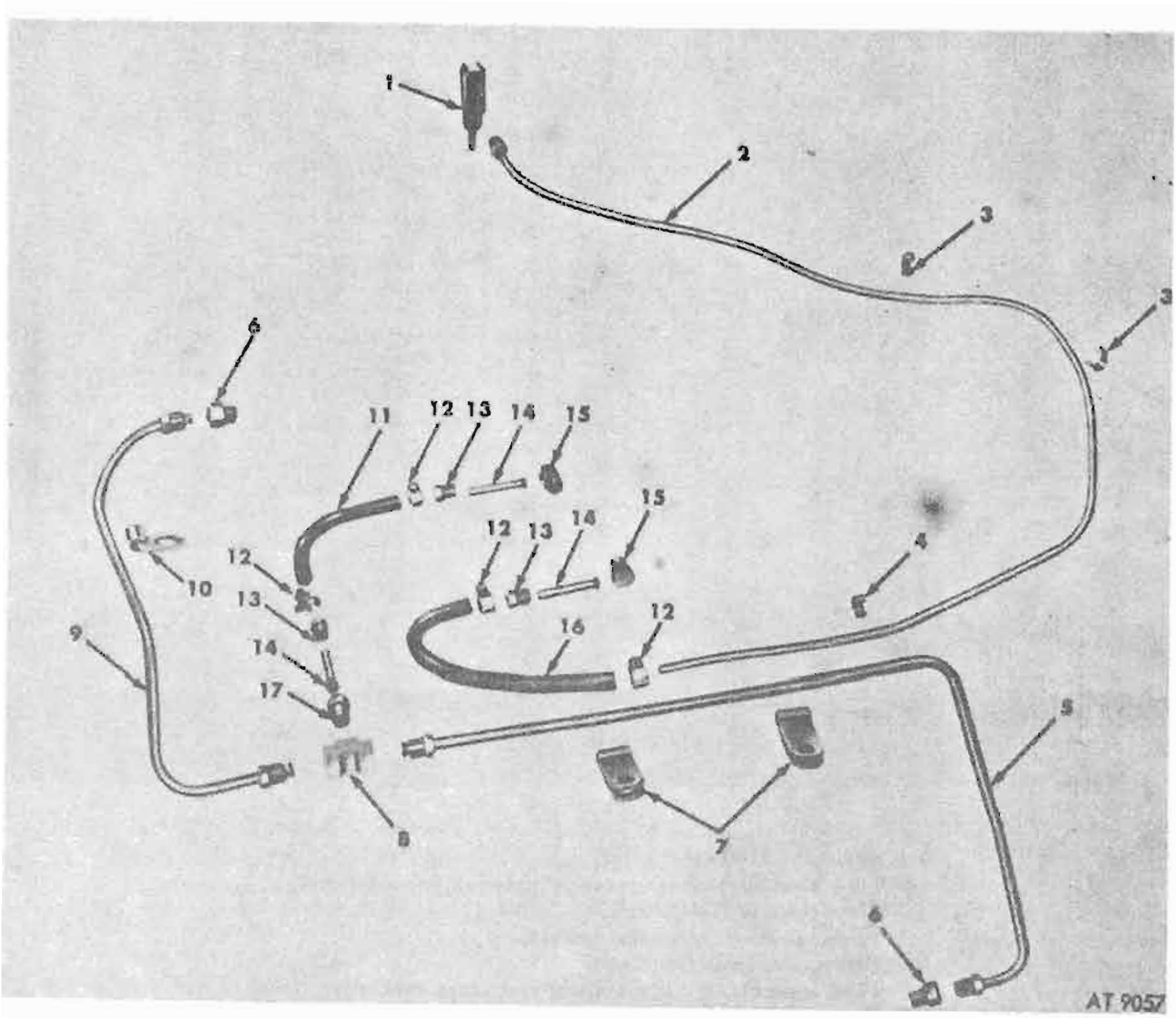
1 Body
2 Spring
3 Plunger
4 Nut

Figure 4-210. Crankcase metering valve—exploded view.



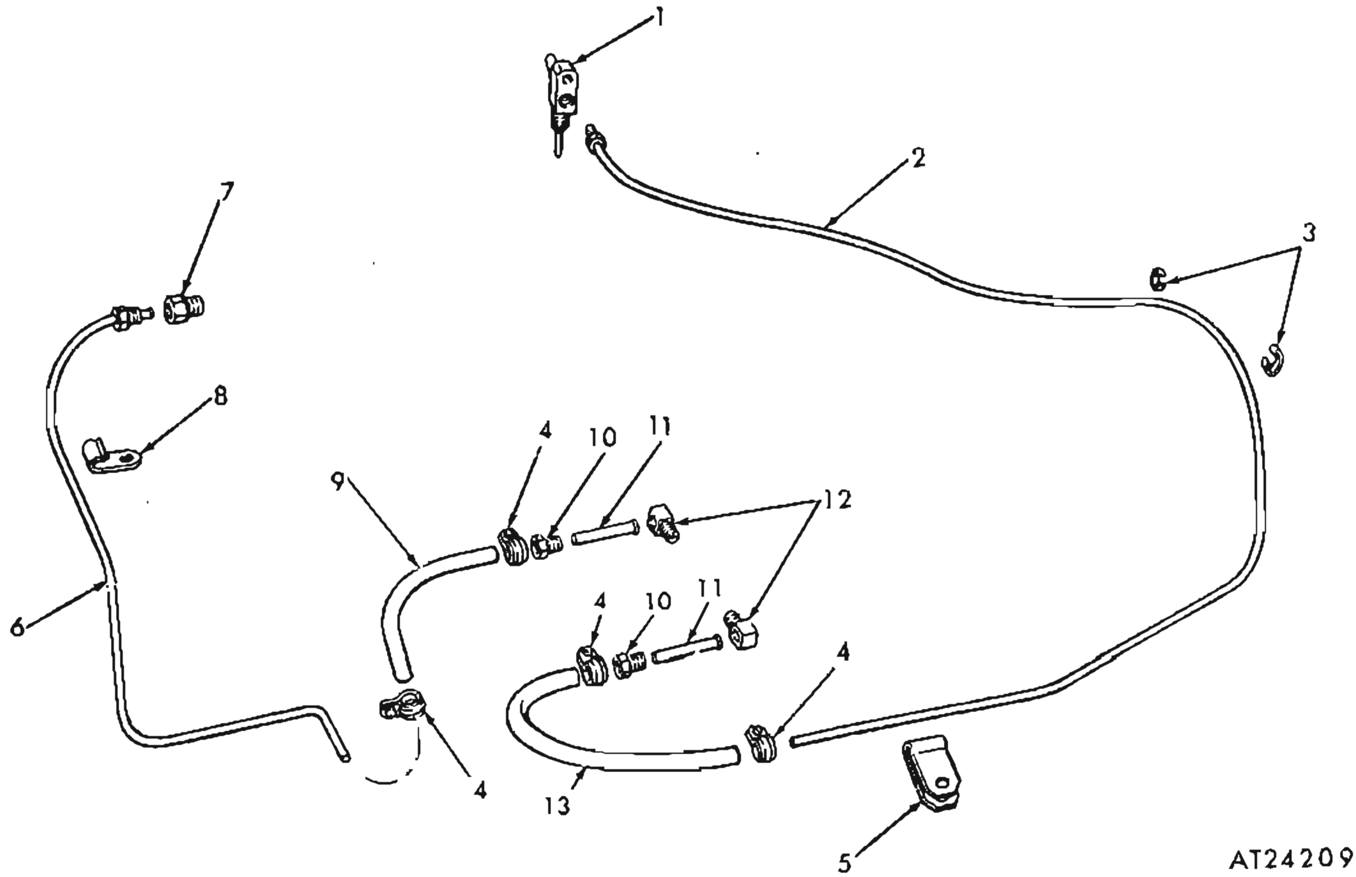
1 Elbow, 1/4 NPTx1/2-20 90°
2 Tube assembly, rocker cover to metering valve assembly.
3 Connector, 1/4 NPT x1/2-20
4 Valve assembly, crankcase ventilation.
5 Fitting, crankcase ventilation
6 Tube assembly, 5 / 16 diameter crankcase ventilation.
7 Fitting assembly, ventilation
8 Tube assembly, 5 / 16 diameter crankcase ventilation.

Figure 4-211. Crankcase ventilation system and related parts—exploded view.



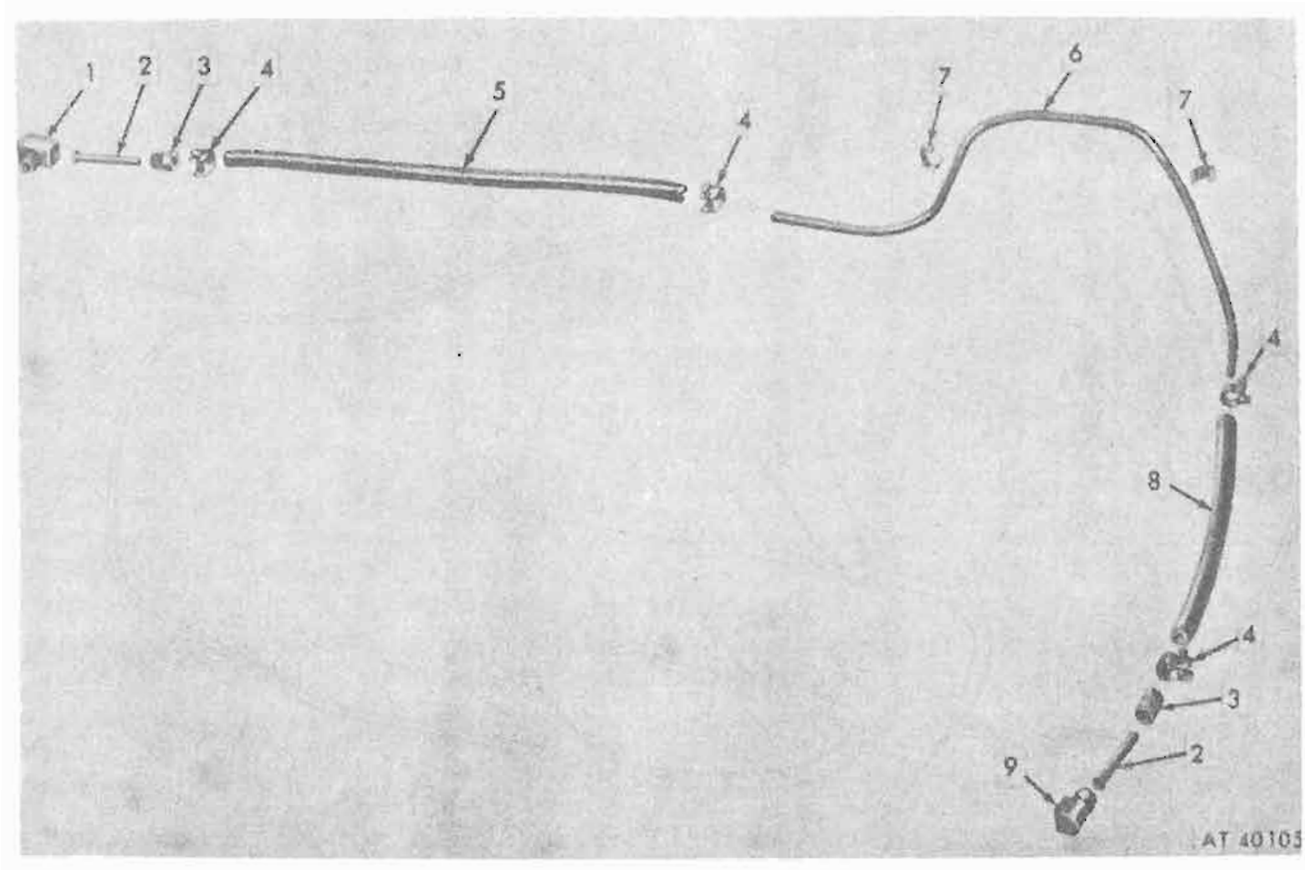
1 Fitting assembly, ventilation
2 Tube assembly, 3 / 16 diameter distributor ventilation inlet.
3 Clip, 3 / 16-5-16 diameter distributor tube (2).
4 Clip, 3 / 16-¼ diameter distributor tube.
5 Tube assembly, ¼ diameter vacuum pump.
6 Connector, ⅛ NPT x7 / 16-24 (2)
7 Clip, ¼ diameter vacuum pump tube (2).
8 Connection, ¼ flare tube "T"
9 Tube assembly, ¼ diameter distributor and vacuum pump.
10 Tube clip, ¼ diameter distributor and vacuum pump.
11 Hose, 11 / 32 outside dimensions x4 11 / 16 distributor ventilation outlet.
12 Clamp, 11 / 32 outside dimensions hose (4)
13 Nut, 3 / 16 flare tube (3).
14 Connector, 3 / 16 flare tube hose (3).
15 Elbow, ⅛ NPT 3 / 16 flared tube 90° (2).
16 Hose, 11 / 32 outside dimensions x 7¾ distributor ventilation inlet.
17 Fitting, ¼ NPT restricted (0.039) distributor vent.

Figure 4-212. Distributor ventilation system, vacuum pump tube, and related parts—exploded view (M151, M151A1, M151A1C, and M718 vehicles).



1 Fitting
2 Tube assembly, 3 / 16 diameter distributor ventilation inlet.
3 Clip, (2)
4 Clamp, distributor exhaust hose (2)
distributor intake hose (2).
5 Clip
6 Tube assembly, distributor to intake manifold.
7 Connector, manifold to distributor ventilating tube.
8 Clip
9 Hose
10 Nut, 3 / 16 flare tube (2)
11 Tube (2)
12 Elbow, ⅛ NPT 3 / 16 flared tube 90° (2).
13 Hose

Figure 4-213. Distributor ventilation system and related parts—exploded view (M151A2, M825, and M718A1 vehicles).



1 T-connection, ⅛ NPT 3/16 flared tube.
2 Tube, 3/16 flared hose connector (2).
3 Nut, 3/16 flared tube (2)
4 Clamp, 11/32 O.D. hose (4)
5 Vent hose, 11/32 O.D.x9-27/32 oil pressure switch upper.
6 Tube, 3/16 diameter oil pressure switch vent.
7 Clip, 3/16-5/16 oil pressure switch tube (2).
8 Vent hose, 11/32 O.D.x7 1/32 oil pressure switch lower.
9 Elbow, ⅛ NPT 3/16 flared tube 90°.

Figure 4-214. Oil pressure switch vent tubes and related parts—exploded view (M151, M151A1, M151A1C, and M718 vehicles).

Section XX. ELECTRICAL COMPONENTS AND ACCESSORIES

4-86. General

a. Distributor. Refer to TM 9-2320-218-20 for removal, and to chapter 6 of this manual for repair and tests of the engine distributor.

b. Generator. For coverage of the Delco Remy (25-amp) generator refer to TM 9-2920-214-35, for the Prestolite (25-amp) generator refer to TM 9-2920-247-34, and for the Leece-Neville (60-amp) generator (alternator) refer to TM 9-2920-225-35.

c. Starter. Refer to TM 9-2320-218-20 for removal, and to chapter 7 of this manual for repair and tests of the engine starter (fig. 4-216).

4-87. Inspection

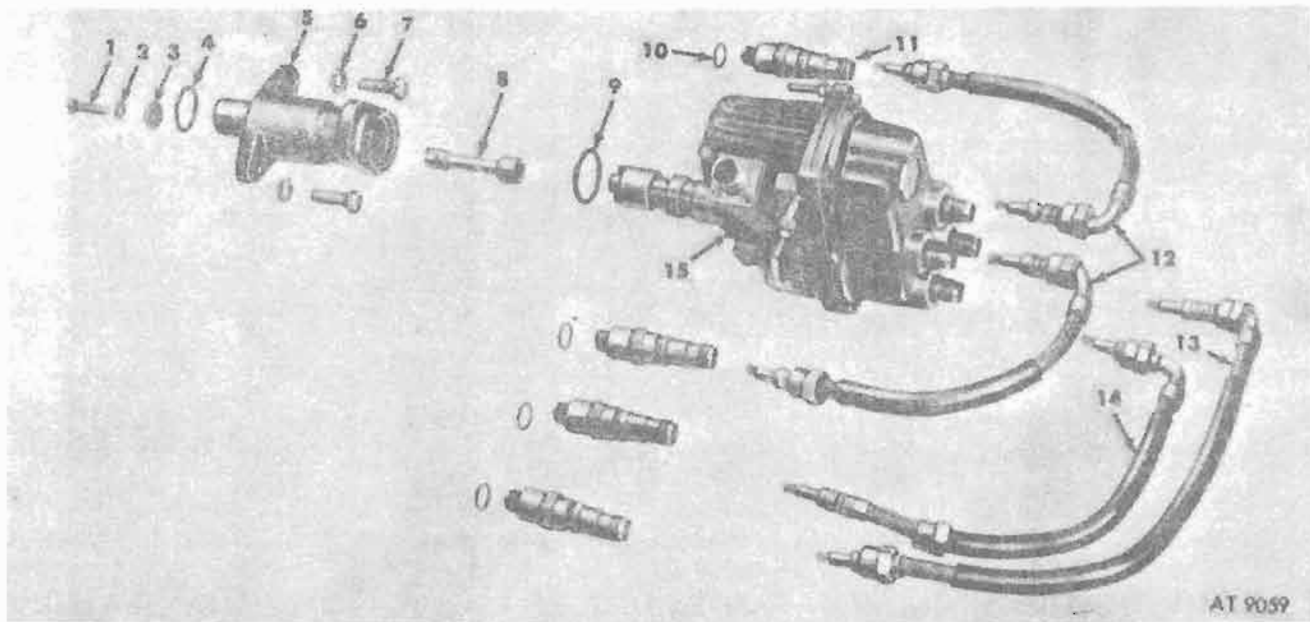
The key numbers shown in parentheses refer to figure 4-215.

a. Distributor Assembly and Related Parts. Clean distributor adapter 5 and intermediate distributor drive shaft 8 in solvent. Inspect adapter for cracks and corrosion. Replace adapter if damaged. Examine drive shaft tang and slot end for wear. Replace if excessive wear is evident. Check O-ring seals 4 and 9. Seals must be in good condition to prevent dust and water entering engine. Replace O-ring seals if there is evidence of damage, deterioration, or hardness.

b. Spark Plug Cable Assemblies. Examine all cable assemblies 12, 13, 14, for cracked or oil-soaked insulation. Check connector at ends of each cable assembly for corrosion; clean, if necessary. Replace any spark plug cables if damaged.

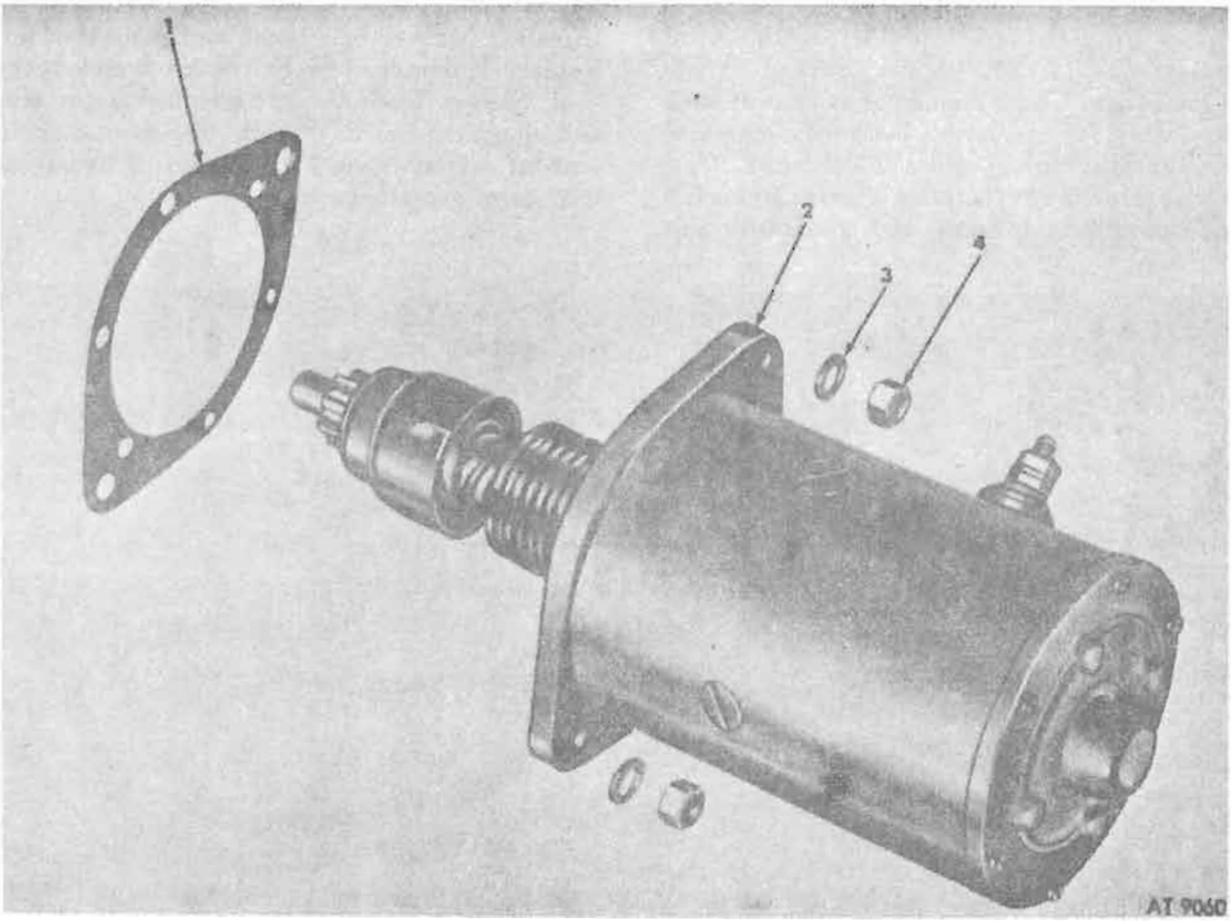
c. Generator and Related Parts. Examine generator mounting bracket and generator belt adjusting bracket for cracks and elongated holes. Replace if damaged or bolt holes are elongated.

d. Starter. Examine starter housing for cracks and elongated holes. Visually inspect starter drive unit for defects (para 7-9). Replace if damaged or bolt holes are elongated.



1 Bolt, ¼-20x1.0 distributor
2 Washer, ¼ lock
3 Washer, ¼ flat
4 Seal, O-ring distributor adapter.
5 Adapter, distributor
6 Washer, ⅜ lock (2)
7 Bolt, ⅜-16x⅛ distributor adapter (2).
8 Shaft, intermediate distributor drive.
9 Seal O-ring distributor
10 Gasket, spark plug
11 Spark plug assembly, 14 mm. (4)
12 Cable assembly, spark plug cylinder Nos. 3 and 4 (2).
13 Cable assembly, spark plug cylinder No. 1.
14 Cable assembly, spark plug cylinder No. 2.
15 Distributor assembly (ignition)

Figure 4-215. Distributor and related parts—exploded parts.



1 Gasket, starter motor
2 Starter motor assembly
3 Washer, ⅜ lock (2)
4 Nut, ⅜-24 (2)

Figure 4-216. Starter and related parts—exploded view.

Section XXI. ENGINE FRONT SUPPORTS, VACUUM PUMP, MECHANICAL FUEL PUMP, CARBURETOR ASSEMBLY AND RELATED PARTS

4-88. General

For repair procedures for carburetor assembly, refer to chapter 5 of this manual. For repair of the vacuum pump and mechanical fuel pump assembly and related attaching parts, refer to figure 4-217 and the following paragraph.

4-89. Inspection and Repair

a. Vacuum Pump / (M151, M151A1, M151A1C and M718 Vehicles). Examine actuating arm for excessive wear. If engine oil consumption is excessive (emitting blue smoke from exhaust), disassemble pump and check for damaged seal, valves, or diaphragm. Replace pump if necessary.

b. Fuel Pump, Mechanical (M151A2, M825, and M718A1 Vehicles). Examine actuating arm for excessive wear. If engine oil consumption is excessive (emitting blue smoke from exhaust), disassemble pump and check for damaged diaphragm. Replace pump if necessary. Refer to figure 4-218.

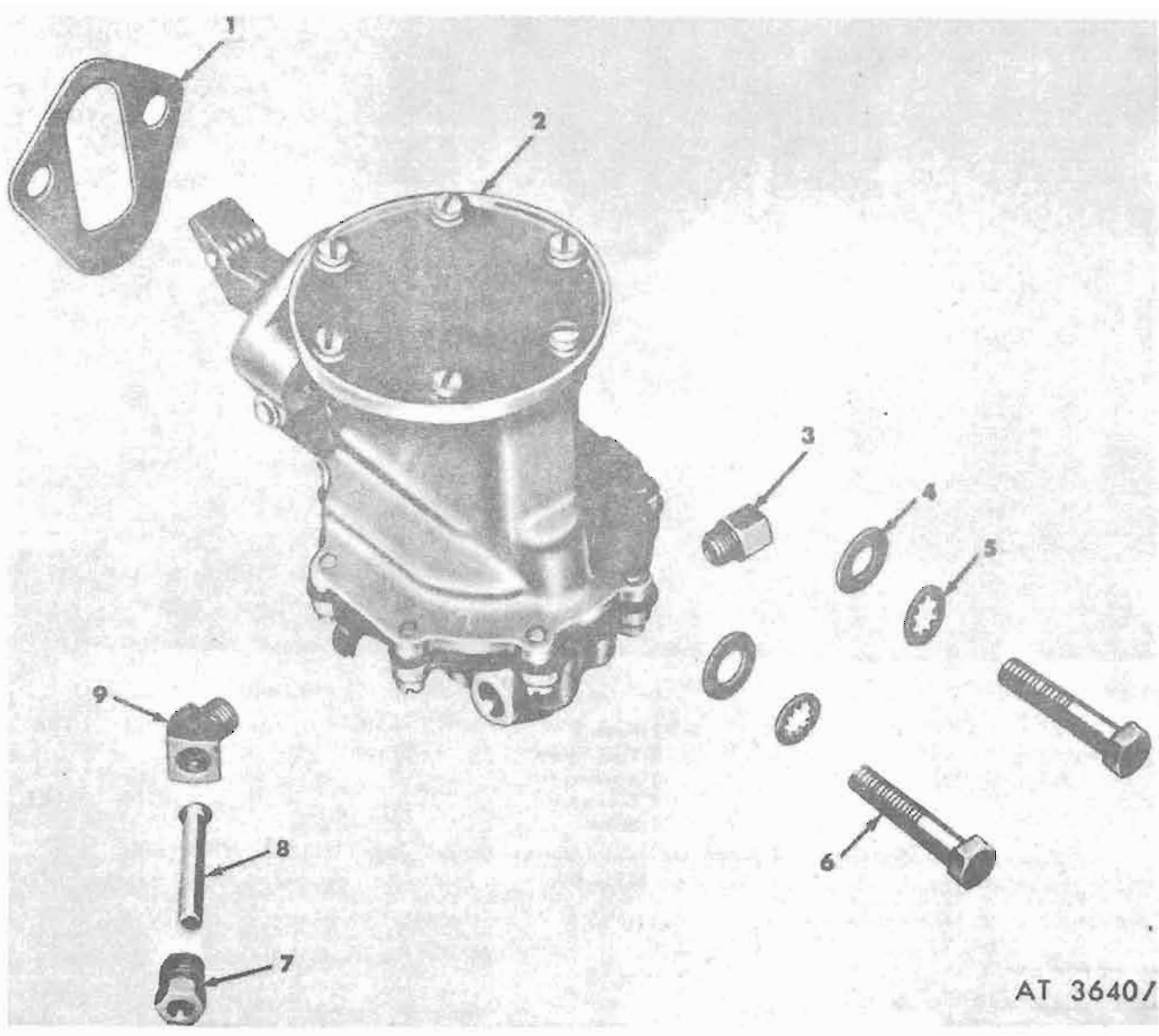
c. Engine Support Bracket. Inspect right and left engine support brackets for cracks or damage. Replace brackets if broken, bent, or cracked (fig. 4-219).

d. Carburetor Assembly and Related Parts.

NOTE

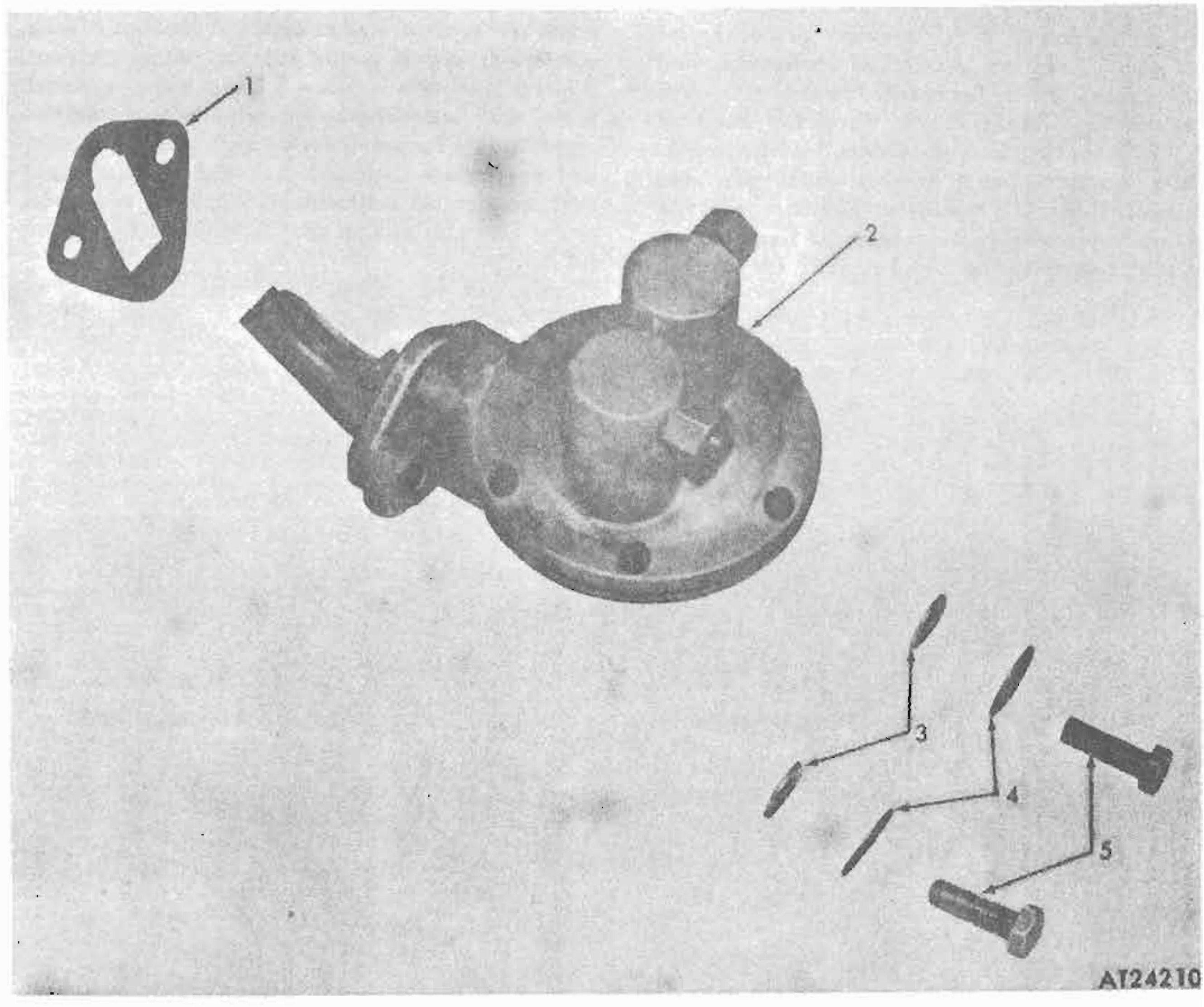
The key numbers shown in parentheses refer to figure 4-220.

Refer to chapter 5 of this manual for carburetor inspection. Examine accelerator bellcrank and bracket assembly (5) for cracked, worn, or broken parts and for visible distortion. Check for elongated holes in mounting bracket and end of bellcrank. Bellcrank must be free in bracket without excessive looseness. Repair or replace accelerator bellcrank and bracket assembly as necessary. Examine accelerator return spring bracket (12) for cracks; repair or replace if damaged or broken. Check accelerator return spring (8) for proper tension. Replace if tension is below 3.0 lbs. when extended to 6-7/32 inch length. Examine accelerator rod assembly (7) for looseness on carburetor ball stud and accelerator bellcrank ball end. Replace ball stud, accelerator bellcrank and bracket assembly, or rod assembly as necessary to maintain a positive fit.



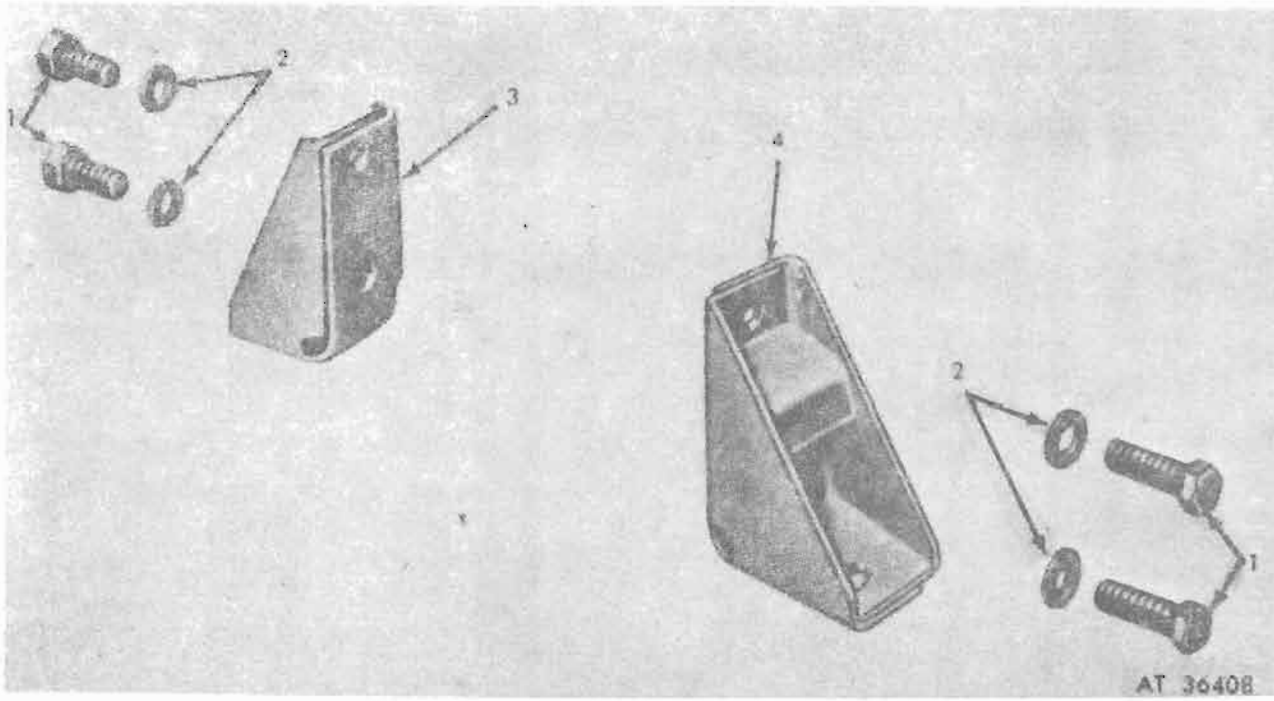
1 Gasket, vacuum pump
2 Pump assembly, vacuum
3 Connector, 1/8 NPTx7/16-24
4 Washer, 5-16 flat (2)
5 Washer, 5/16 lock (2)
6 Bolt, 5/16-18x1½ (2)
7 Nut, 1/4 flared tube
8 Tube, 1/4 flared hose connector
9 Elbow, 1/8 NPTx7/16-24 45°

Figure 4-217. Vacuum pump and related parts—exploded view (M151, M151A1, M151A1C and M718).



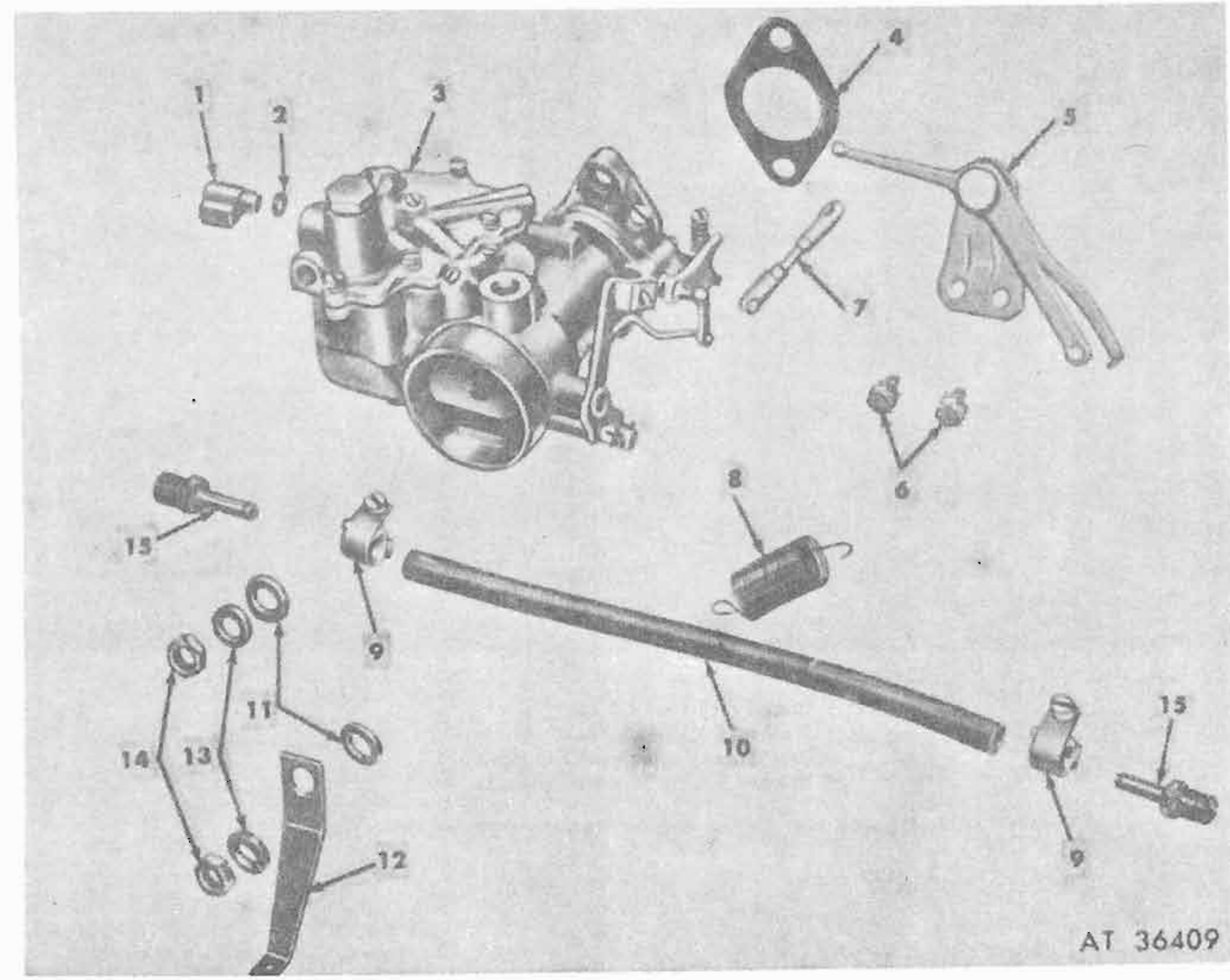
1 Gasket
2 Fuel Pump
3 Washer, flat
4 Lockwasher
5 Screw

Figure 4-218. Mechanical full pump and related parts—exploded view (M151A2, M825, and M718A1).



1 Bolt, 7 / 16-14x7 / 8 (4)
2 Washer, 7 / 16 lock (4)
3 Bracket, engine support left side.
4 Bracket, engine support right side.

Figure 4-219. Engine support bracket—exploded view.



1 Elbow, ⅛ NPSF 7/16-24 90°
2 Nut, ⅛ NPSF sealing
3 Carburetor assembly (Zenith)
Carburetor assembly (Holley) optional.
4 Gasket, carburetor
5 Bellcrank and bracket assembly accelerator
6 Screw and washer assembly accelerator.
7 Rod assembly, accelerator
8 Spring, accelerator return
9 Clamp, 5/16 O.D. hose (2) *
Clamp (opt (2)
10 Hose, 13/32 O.D. Carburetor vent*.
11 Washer, ⅜ flat (2)
12 Bracket, accelerator return spring.
13 Washer, ⅜ lock (2)
14 Nut, ⅜-24 (2)
15 Adapter

*Used on carburetor 7017440 only.

Figure 4-220. Carburetor assembly and related parts—exploded view.

4-90. Description and Operation

The clutch (fig. 4-221) is a single-plate, dry-disk type consisting of a driven disk assembly and a pressure plate assembly. The disk assembly is mounted to the transmission input shaft. The disk assembly includes a splined hub, coil springs, and two friction-type facings which are riveted to both sides of the disk assembly. The pressure plate assembly is bolted to the engine flywheel. The pressure plate assembly includes the pressure plate, coil springs, and levers. The coil springs maintain a constant pressure against the pressure plate, which holds the driven disk assembly against the engine flywheel. When the vehicle clutch pedal is depressed, the clutch release bearing is forced against the pressure plate levers. The levers cause the pressure plate to move away from the clutch disk assembly. This releases the pressure holding the disk assembly against the engine flywheel, thereby disengaging the clutch. Refer to TM 9-2320-218-20 for troubleshooting operations.

4-91. Removal and Installation of Clutch Pressure Plate Assembly and Disk

a. Removal. Remove six bolts and lockwashers securing pressure plate to flywheel, and remove pressure plate and driven disk at same time. Refer to figure 4-222.

b. Installation. Aline clutch disk with pilot bearing. Install clutch pressure plate. Secure clutch pressure plate to flywheel assembly with six bolts and washers. Torque bolts to 20-25 lb.-ft.

4-92. Cleaning and Inspection

a. Cleaning. Clean pressure plate assembly thoroughly, using cleaning solvent. Blow dry with compressed air. Clean the cover and hub of the disk assembly with compressed air or a clean dry cloth.

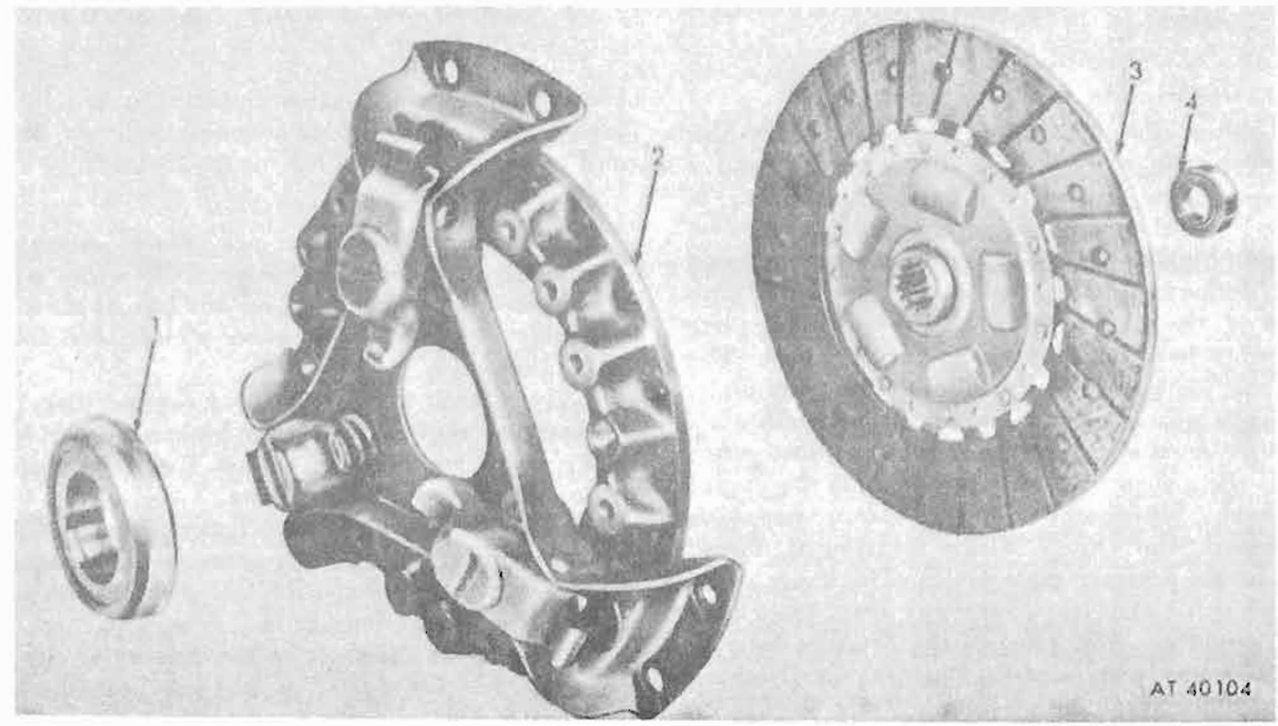
b. Inspection.

(1) *Clutch disk assembly.* Examine disk for broken disk segments, loose or broken cover rivets and rusty, burred, or worn splines. Replace the disk if any of these conditions exist.

(2) *Clutch disk facings.* Examine facings for wear, warpage, cracks, oil or grease contamination, or loose mounting rivets. Replace disk assembly if any of these conditions exist.

(3) *Clutch pressure plate.* Examine clutch pressure plate for ridges, scoring and heat checks. Replace pressure plate if these conditions are found.

(4) *Clutch pressure plate bracket assembly.* Examine bracket assembly for distortion or warpage. If either of these conditions exists, replace pressure plate assembly. Examine each of the three clutch plate levers for looseness or binding. If the above conditions exist, replace pressure plate assembly.



1 Clutch release bearing
2 Pressure plate assembly
3 Disk assembly
4 Bearing, clutch pilot

Figure 4-221. Clutch pressure plate assembly and disk.

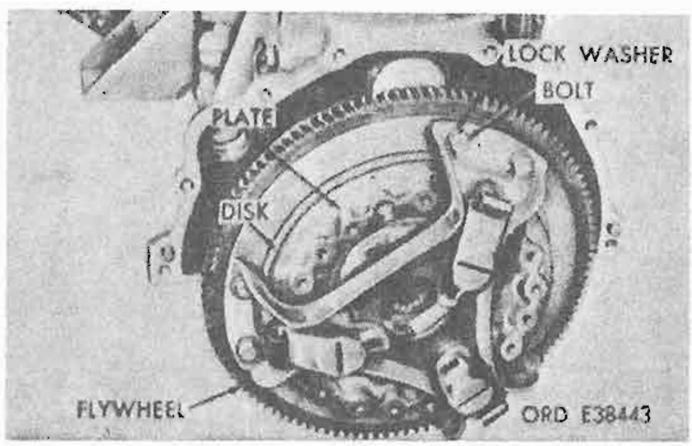


Figure 4-222. Clutch pressure plate and disk—removal and installation.

Section XXIII. ASSEMBLY OF ENGINE FROM SUBASSEMBLIES

4-93. General

a. The engine is a precision product; consequently, repair standards of its component parts have been fixed at close limits. Extreme care must be exercised in all phases of assembly operations to insure satisfactory engine performance.

b. Cleanliness is essential in all assembly operations. Dirt and dust, even in minute quantities, are abrasive. Be sure parts have been cleaned as specified, and be sure they are kept clean.

c. Before assembly, coat all bearings, shafts and contact surfaces with engine oil (OE-10). This is to insure lubrication of moving parts when first put into operation.

d. Always use new gaskets seals and O-rings.

e. During assembly of engine, numerous references are made to torque specifications. Torque wrenches with indicating scales must be used for tightening nuts and bolts to specified limits. Threads must be undamaged and clean and they must be lubricated where specified to reduce friction. When using a torque wrench, final reading must be taken while nut or bolt is turning. To start a partially tightened nut or bolt will require a greater torque than is required to keep it turning. Do not exceed torque specified. Excess torque may overstress the assembly.

NOTE

When lubricating bolts, apply grease sparingly.

f. Assembly procedures are arranged in logical sequence. All subassemblies and accessories should be repaired before beginning operations described herein.

4-94. Cylinder Block Installation on Repair Stand

Install improvised engine support bracket (fig. 4-55) to mounting pad on left side cylinder block (fig. 4-223). Tighten mounting bolts firmly. If engine repair stand is unavailable, take care to perform the following operations in a manner designed to protect personnel against harm, and engine and its parts against damage.

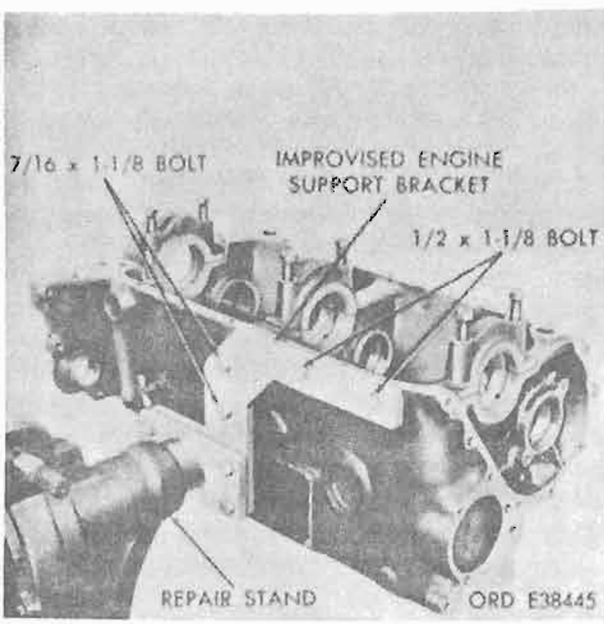


Figure 4-223. Cylinder block installation on repair stand—left side view.

4-95. Installation of Crankshaft/Main Bearings and Seals

a. General. After the main bearing clearances have been checked and found satisfactory with the crankshaft to be used (para 4-68), bearings should be removed one at a time and outside surface of tangs lightly marked for position and location so they can be permanently identified for installation in their original positions. Be sure the bearing bores and main bearing halves are clean, and place the tangs in notches provided in edge of bores in cylinder blocks and caps. Refer to figure 4-224.

b. Install Rear Main Bearing Cap Side Seals. Install the two rear main bearing cap side seals in rear main bearing cap rear grooves with mall side of seal facing inward. Do not cut seal-projecting ends. Use care when installing seals so be ring half is not dropped. Refer to figure 4-225.

c. Install Crankshaft Assembly. Be sure bearings and crankshaft journals are clean and apply a light coat of engine oil (OE-10) on them. Carefully lower crankshaft in place with the Woodruff key and crankshaft gear installed. Refer to paragraph 4-65 for procedure to install Woodruff key and crankshaft gear on crankshaft. Be careful not to damage bearing surface. Refer to figure 4-226.

d. Install Main Bearing Caps (figs. 4-227, 4-228, and 4-229).

(1) *Front and rear main bearing caps.* Install front and rear bearing caps with the arrows on the cap pointed toward front of engine. Apply lubricant (GAA) on threads and under head of four 7/16 x 2¾ self-locking main bearing cap bolts. Tighten front and rear cap bolts to 55-60 lb.-ft. torque. Be sure side seals are installed on rear main bearing cap (b above).

(2) *Install Center (thrust) bearing cap.*

(a) Install thrust bearing cap with the bolts finger tight. Pry the crankshaft forward against thrust surface of upper half of the bearing.

(b) Hold crankshaft forward and pry thrust bearing cap to rear. This procedure alines thrust surfaces of both halves of bearings.

(c) Hold forward pressure on crankshaft and tighten the cap bolts to 55-60 lb.-ft. torque. Turn crankshaft and check for freedom of rotation. Crankshaft must turn freely in bearings. Refer to figure 4-230.

(d) Check crankshaft end play. Place dial indicator so contact tip rests on end of crankshaft. Pry crankshaft to limits of its end play and note reading on indicator dial. If end play exceeds wear limit (refer to table 4-9), replace thrust bearing. If end play is less than minimum limit inspect thrust bearing face for scratches, burrs, nicks or foreign

matter. If thrust faces are not defective, they probably were misalined. Install center main bearing and aline the faces following the above procedures. Check end play (fig. 4-231).

e. Install Rear Main Bearing Side Seals. Dip rear bearing cap side seals in engine oil (OE-10) and immediately press them firmly in the rear main bearing cap front grooves (with bevel end out toward cap). Do not use sealer on side seals. The seals are designed to expand when dipped in oil. Using sealer may retard expansion. It may be necessary to tap seals lightly into place for portion of travel. Do not cut seal-projecting ends (fig 4-232).

f. Trim Rear Main Bearing Cap Side Seals. Make sure rear main bearing cap has been properly torqued and trim ends of rear bearing cap side seals flush with inside diameter of crankshaft rear seal bore, using a sharp knife or suitable tool. Do not cut seal end projecting away from main bearing cap towards oil pan. Seal ends are designed to seal against oil pan gasket, flywheel housing cover and oil pan seal. Refer to figure 4-233.

g. Install Crankshaft Rear Seal.

(1) Coat outside surface and lip of new seal with lubricant (GAA), and install on replacer tool washer ORD 7345199 with seal lip pointing away from chamfered side of washer (fig. 4-234).

(2) Install replacer tool washer with seal over flywheel pilot end of crankshaft (fig. 4-235).

(3). Apply pressure evenly to top of seal with fingers and slide seal onto crankshaft until it contacts cylinder block (fig. 4-236).

(4) Install replacer ORD 7345203 over replacer tool washer ORD 7345199, and drive seal evenly into seal bore in cylinder block until replacer flange contacts the casting (fig. 4-237).

(5) Check if crankshaft rear seal is flush with cylinder block and rear main bearing cap. If rear main bearing cap is removed for any reason, replace crankshaft rear seal to insure against leakage. Refer to figure 4-238.

4-96. Installation of Valve Tappets and Camshaft

a. Install Valve Tappets. After valve tappet bore clearance has been checked and found satisfactory install eight tappets in the bores from which they were removed (fig. 4-239).

b. Install Camshaft.

(1) *Camshaft.* Be sure bearings and camshaft journals are clean. Apply a light coat of engine oil (OE-10) to camshaft journals, lobes, and bearings. Carefully install camshaft with thrust plate, woodruff key, and camshaft gear, through bearings from front of engine. Refer to paragraph 4-66 for installation of thrust plate, Woodruff key, and camshaft gear on camshaft. Use caution to avoid damaging camshaft bearings, journals, and lobes (fig. 4-240).

(2) *Aline timing gears.* Turn crankshaft until No. 1 rod journal is in the up position, on center of No. 1 cylinder bore. Aline timing mark "O" on face of camshaft gear with timing mark "O" on crankshaft timing gear and push camshaft towards rear of engine. (fig. 4-241).

(3) *Camshaft thrust plate.* Aline bolt holes in thrust plate with two tapped holes in cylinder block, behind camshaft gear, and insert two hex-head 5/16-18x⅝ thrust plate retaining screw and washer assemblies. Tighten retaining bolts to 10-15 lb.-ft. torque (fig. 4-242).

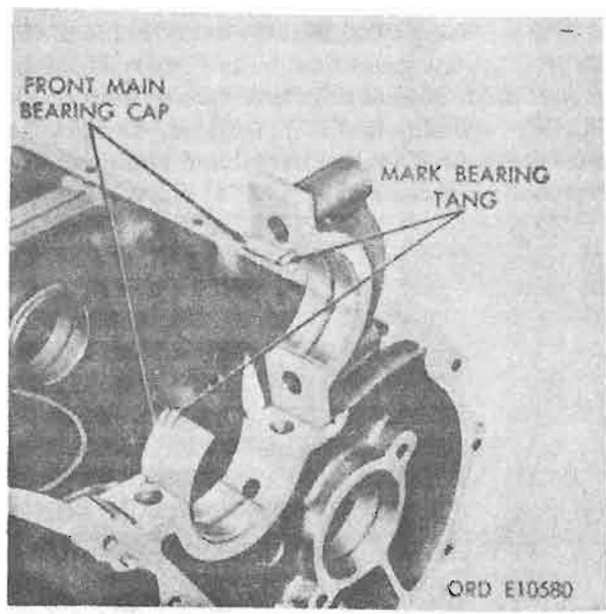


Figure 4-224. Main bearing installation.

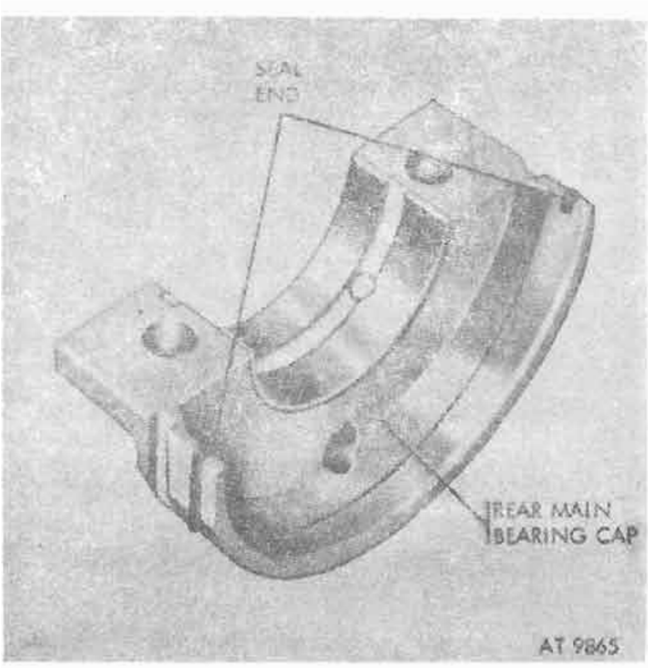


Figure 4-225. Rear main bearing cap side seals installation.

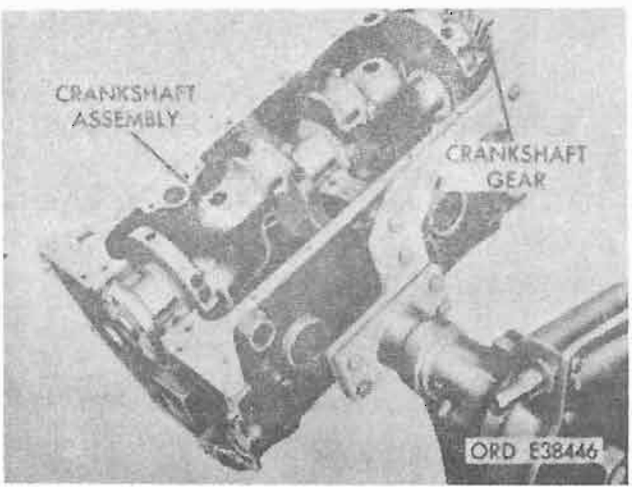


Figure 4-226. Crankshaft assembly.

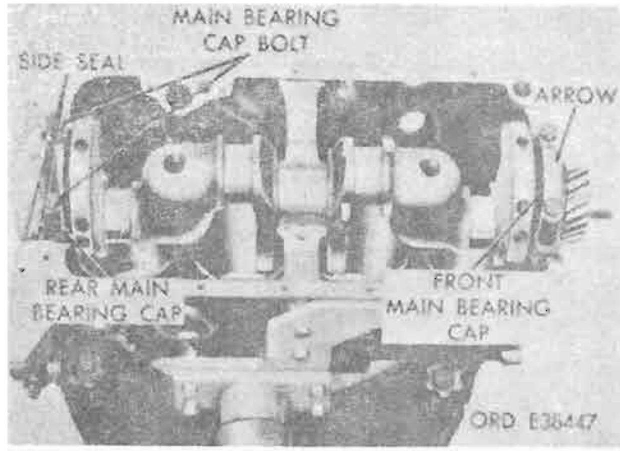


Figure 4-227. Front and rear main bearing caps installed.

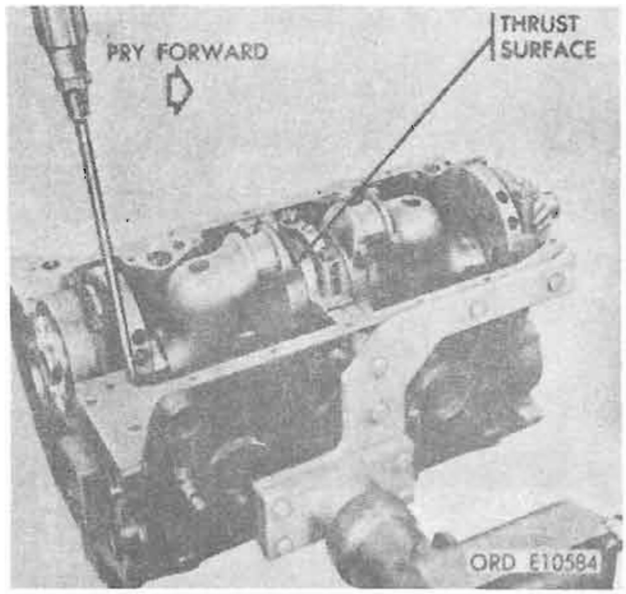


Figure 4-228. Center main bearing cap positioned.

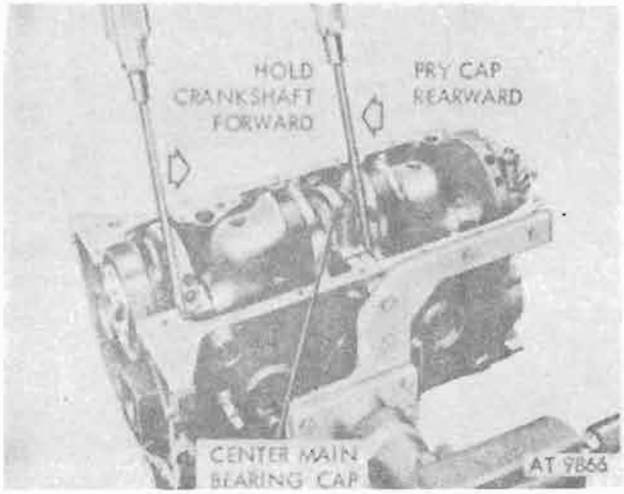


Figure 4-229. Center main bearing alined.

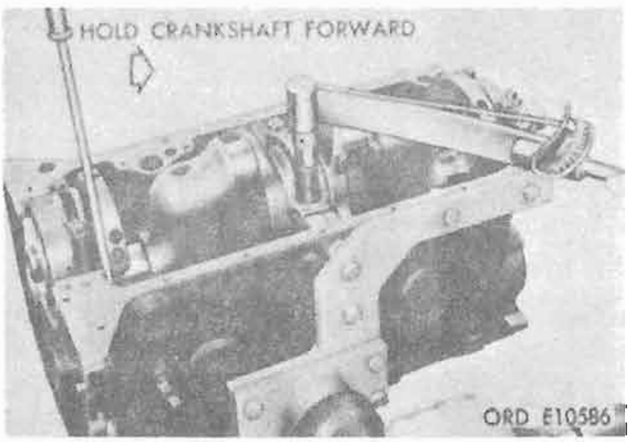


Figure 4-230. Center main bearing cap installed.

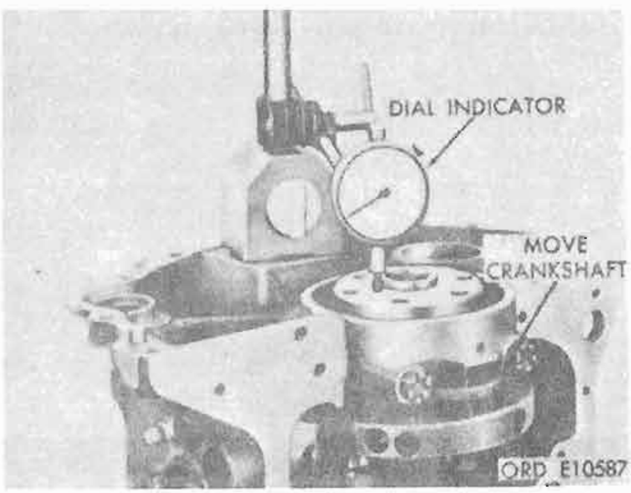


Figure 4-231. Measuring crankshaft end play.

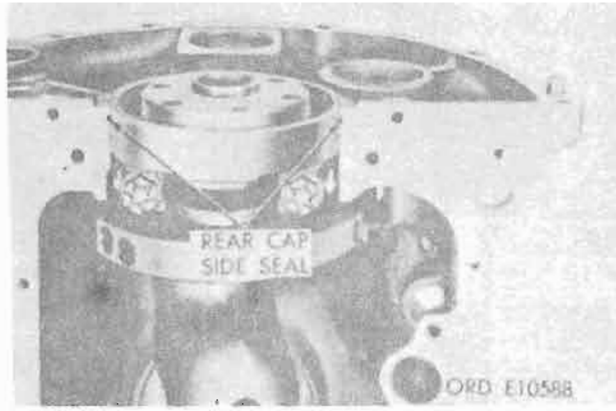


Figure 4-232. Rear main bearing cap side seals.

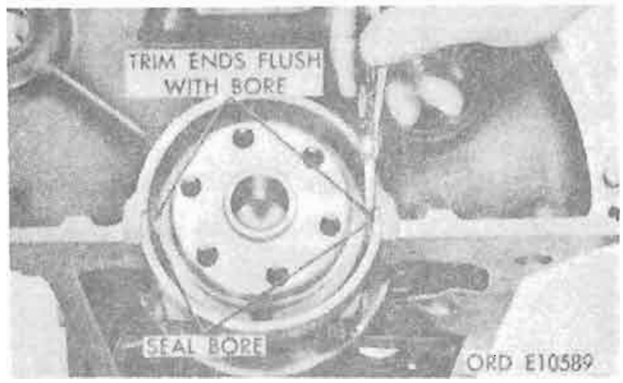


Figure 4-233. Trimming of rear main bearing side seals.

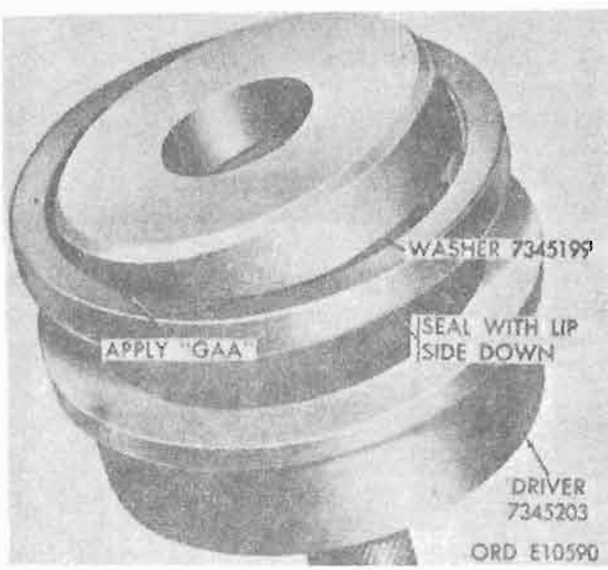


Figure 4-234. Crankcase rear seal on replacer tool.

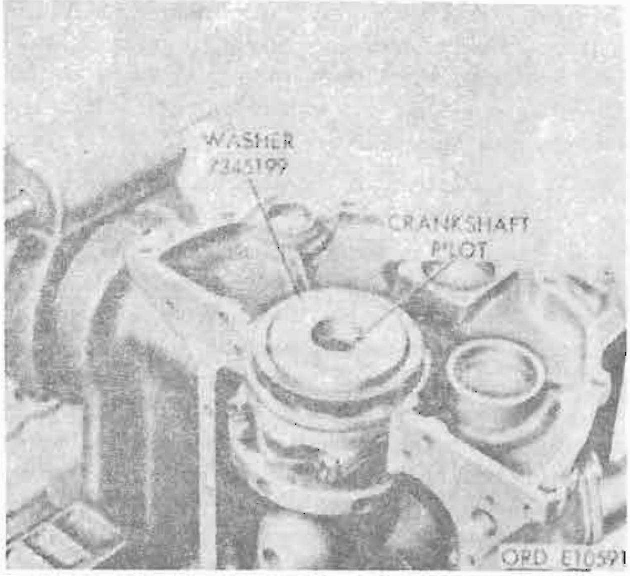


Figure 4-235. Installation of replacer tool washer and rear seal on crankshaft.

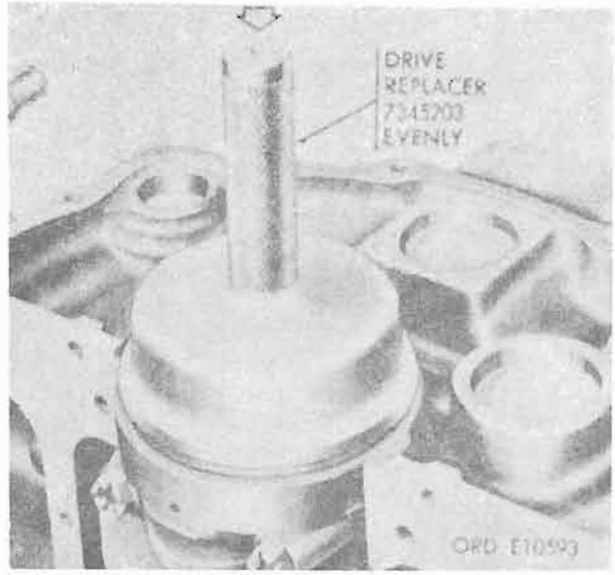


Figure 4-237. Driving crankshaft rear seal into cylinder block.

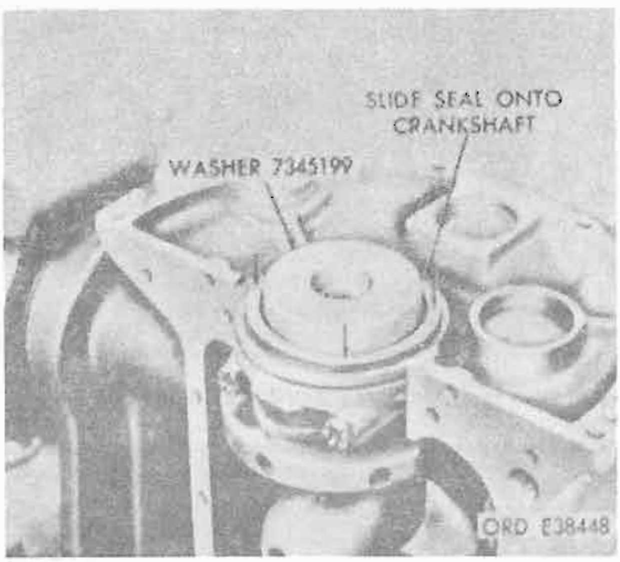


Figure 4-236. Sliding crankshaft rear seal drum over crankshaft.

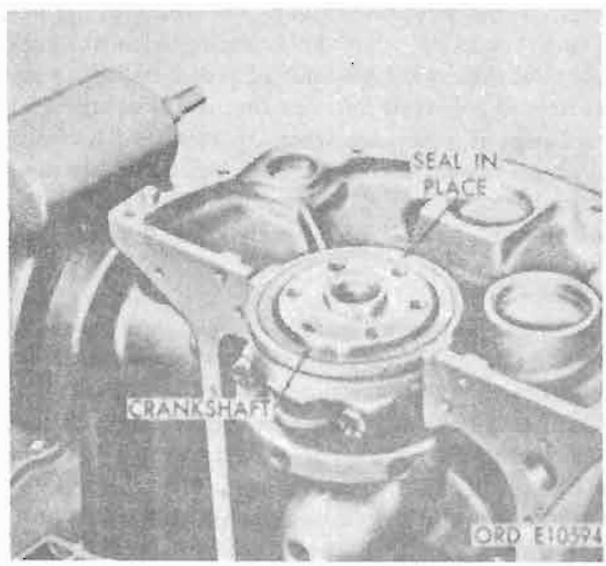


Figure 4-238. Crankshaft rear seal installed.

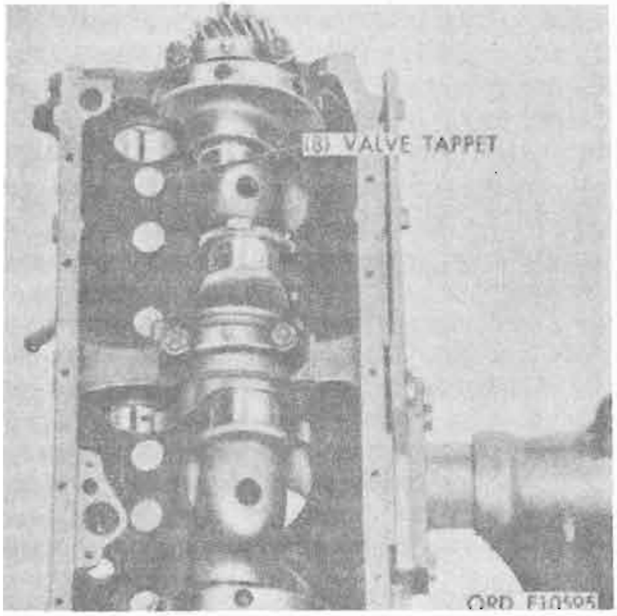


Figure 4-239. Valve tappets installed.

c. Check Camshaft End Play. Place dial indicator on cylinder block so contact tip resets against end of camshaft and indicator axis is parallel to crankshaft axis. Move camshaft to limits of its end play and note reading on indicator dial. If end play is excessive (refer to table 4-9), check to make sure camshaft gear was pressed firmly against camshaft shoulder. Replace thrust plate if necessary (para 4-65). Recheck end play (fig. 4-243).

d. Check Timing Gear Backlash. Check backlash between camshaft gear and crankshaft gear with a dial indicator. Place indicator so contact tip rests against one of the camshaft gear teeth and indicator axis is at right angle to helical gear tooth. Move gear from left to right to limits of its play and not reading on indicator dial. Turn crankshaft and check backlash at several points on each gear. Specified backlash must exist at each point. If backlash in insufficient or exceeds limits, remove crankshaft gear (para 4-36) and try a new gear on crankshaft assembly. If still unsatisfactory, replace camshaft gear. Check backlash. Be sure timing marks on gears are alined (fig. 4-244).

e. Install Camshaft Gear Retainer Bolt. After camshaft end play and timing gear backlash have been checked and found satisfactory, insert ⅜-10x¼ camshaft gear retainer and lock tab washer. Apply sealer, oil-and-water-resistant, on bolt threads and install in front end of camshaft. Hold crankshaft to keep it from turning and tighten bolt to 50-55 lb.-ft. torque. To prevent sealer from entering hollow camshaft (main oil gallery), do not use sealer on first two starting threads on bolt. Bend tab on lock tab washer against bolt head to secure bolt (fig. 4-245).

4-97. Installation of Flywheel and Clutch Pilot Bearing

a. Install Flywheel. Position flywheel assembly in place and crankshaft flange with bolt holes alined. Flywheel-to-crankshaft bolt holes are equally spaced, hence flywheel can be installed in any position. Apply sealer, water-and-oil-resistant, on threads of six self-locking 7/16-20x1⅛ flywheel retaining bolts and install. To prevent sealer from entering tapped-through holes in crankshaft, do not use sealer on first two starting threads on bolts. Tighten bolts in sequence across from each other to 75-85 lb.-ft. torque. Refer to figure 4-246.

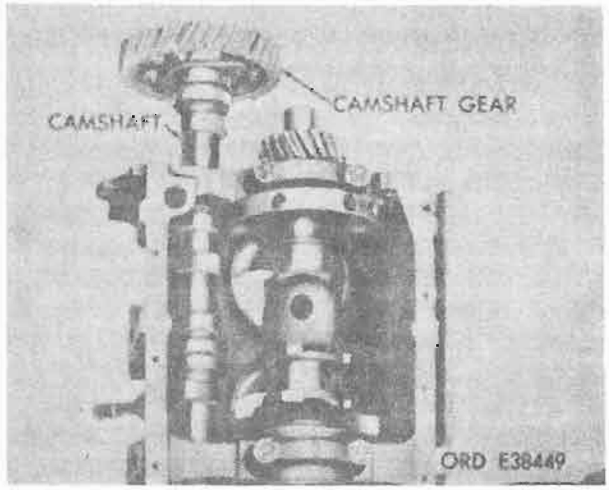


Figure 4-240. Camshaft.

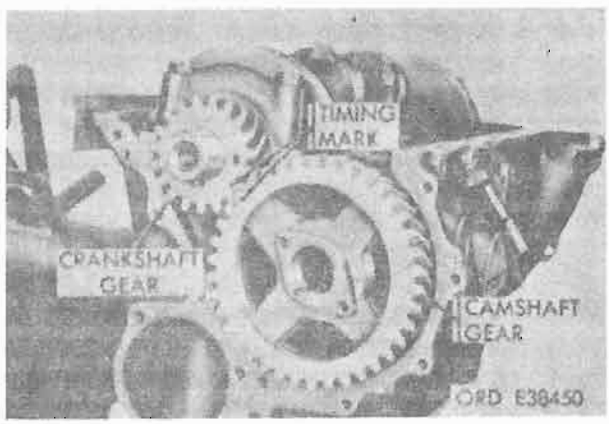


Figure 4-241. Timing gears marks.

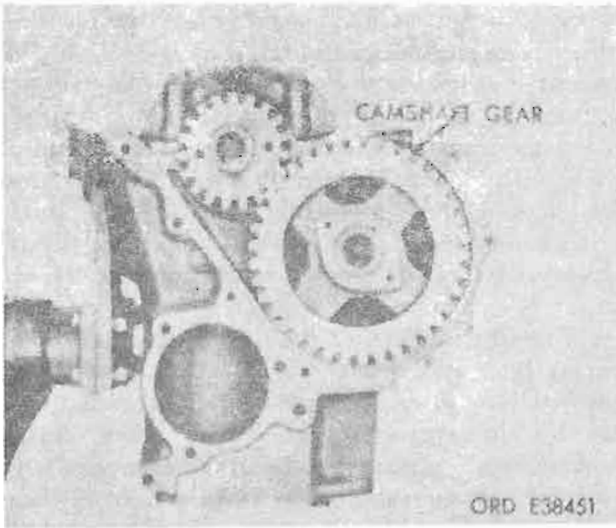


Figure 4-242. Camshaft thrust plate.

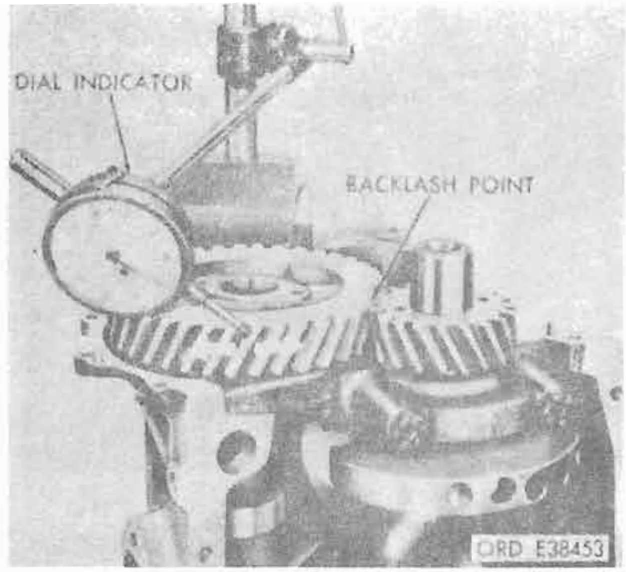


Figure 4-244. Measuring timing gear backlash.

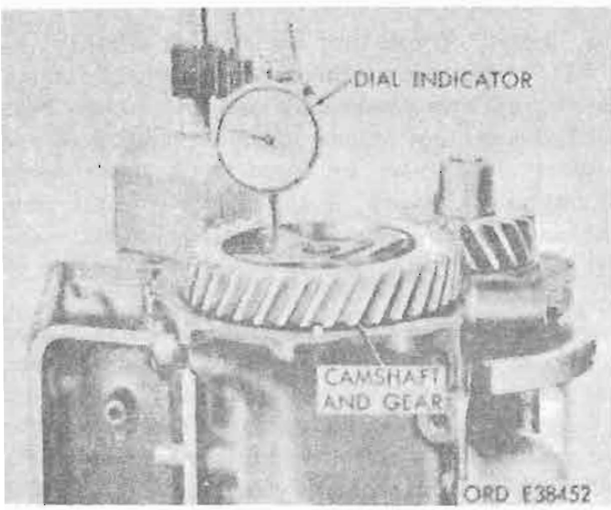


Figure 4-243. Measuring camshaft end play.

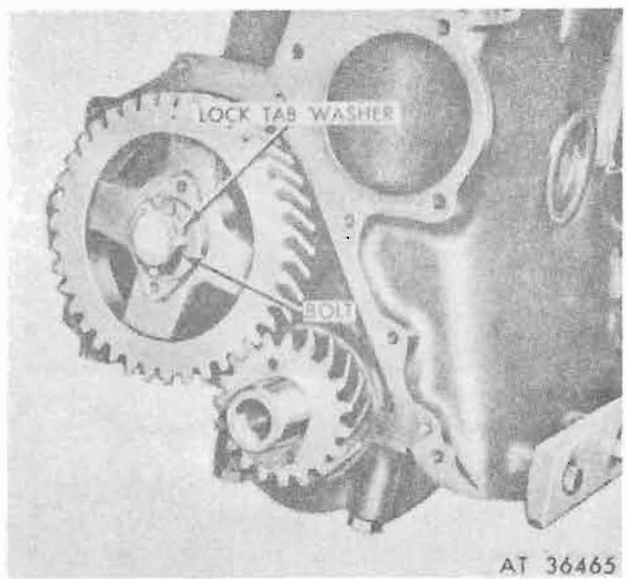


Figure 4-245. Camshaft gear retaining bolt.

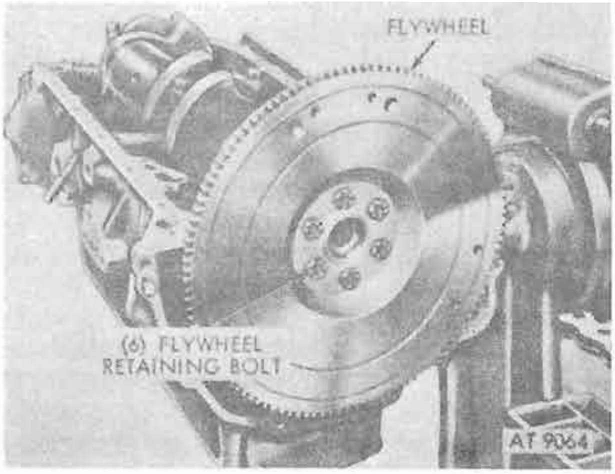


Figure 4-246. Flywheel.

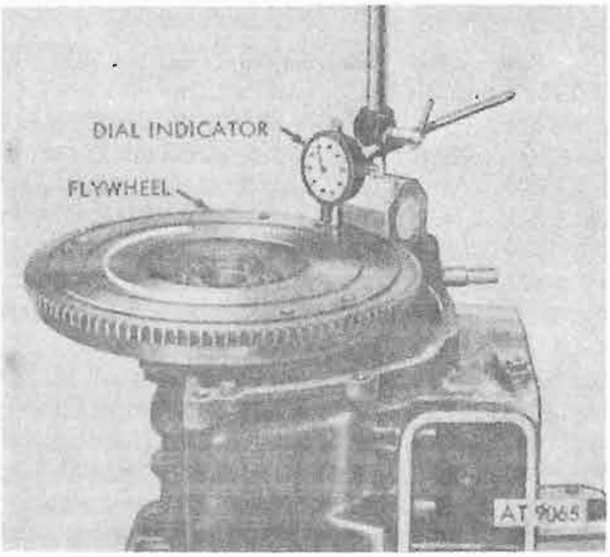


Figure 4-247. Flywheel face runout.

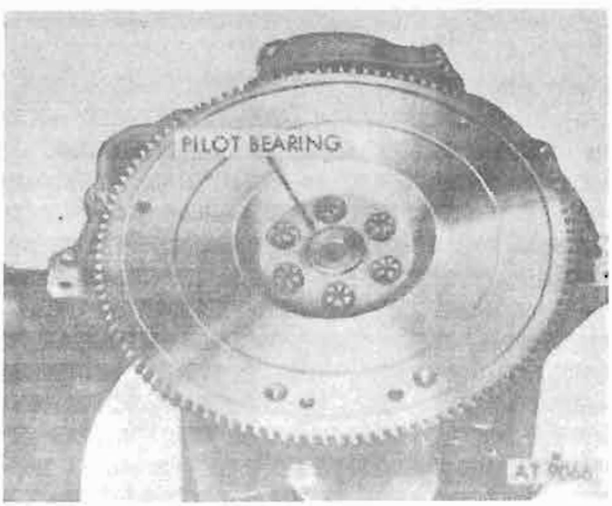


Figure 4-248. Clutch pilot bearing installation.

b. Check Flywheel Face Runout. Place dial indicator so tip bears against flywheel clutch face. Turn flywheel, making sure crankshaft is full forward or rearward so crankshaft end play will not be indicated as flywheel runout. If runout exceeds maximum limit (refer to table 4-9), remove flywheel and check for burrs between flywheel and face of crankshaft mounting flange. If no burrs exist, check runout of crankshaft mounting flange. Replace flywheel or crankshaft if mounting flange runout is excessive (fig. 4-247).

c. Install Clutch Pilot Bearing. Coat clutch pilot bearing bore in flywheel with a small quantity of grease (GAA). Avoid using too much lubricant as it may be thrown onto clutch disk when clutch revolves. Apply pressure to bearing outer race with a suitable adapter and drive bearing into flywheel bore until it shoulders against end of crankshaft (fig. 4-248).

4-98. Installation of Pistons and Connecting Rods

a. Install Pistons and Connecting Rods.

(1) After connecting rod bearings, pistons, piston pins, and piston ring clearances have been checked and found satisfactory with crankshaft and cylinder block to be used and have been subassembled (para 4-63) remove caps and lubricate piston rings, pistons, cylinder walls, crankshaft journals, and bearings with engine oil (OE-10).

(2) Make sure ring gaps are properly spaced around circumference of piston (para 4-63), and that piston is assembled to connecting rod as shown in figure 4-167. Install ring compressor on piston and push piston with rod and upper bearing half in cylinder bore from which it was removed. Tap with a hammer handle until piston is slightly below top of cylinder. Be sure to guide connecting rods to avoid damaging crankshaft journals. Position piston with notch in head toward front of engine (fig. 4-249).

(3) Turn crankshaft to bottom of its stroke, then push piston all the way down until connecting rod bearing seats on crankshaft journal. Install connecting rod cap and bearing half on rod from which it was removed, with numbers on connecting rod and bearing cap on the same side. Check to be sure oil squirt hole in connecting rod is facing the camshaft. Apply lubricant (GAA) on connecting rod bolt threads and under head of each self-locking ⅜-24 rod cap nut and tighten nuts to 40-45 lb.-ft. torque. Turn crankshaft and install other three pistons in the same manner (fig. 4-250).

b. Check Connecting Rod Side Play. After piston and connecting rod assemblies have been installed, check side play between connecting rods on each crankshaft journal with a feeler gage or suitable indicator. Check connecting rod for bind. Connecting rod assembly should move endwise when pressure is exerted by hand. Side play must be within specified limits. Refer to table 4-7 and figure 4-251.

4-99. Installation of Oil Pump and Oil Pickup Tube and Screen Assemblies

a. Install Oil Pump Assembly.

(1) After oil pump assembly has been checked and found satisfactory (paras 4-70 through 4-72) lubricate with engine oil (OE-10) and install oil pump gasket on pump body. Turn crankshaft so timing mark on crankshaft gear is alined with corresponding mark on camshaft gear (para 4-96) and install oil pump into oil pump pilot bore in cylinder block so notch in oil pump gear is facing front of engine parallel to crankshaft. If notch on gear does not move into the proper position, remove pump and turn gear one tooth and try again. Make sure notch on gear is facing front of engine, as it will affect distributor position and timing (fig. 4-252).

(2) After oil pump has been assembled on cylinder block with pump gear notch installed toward front of engine, shift oil pump assembly as necessary to line up tapped holes in cylinder block. Install one 5/16-18x2¾ hex-head oil pump retaining bolt with 5/16-inch flat washer and 5/16-inch lockwasher in rear oil pump bolt hole (finger. tight) (fig. 4-253).

b. Install Oil Pump Pickup Tube and Screen Assembly. Place oil inlet tube flange gasket and oil pump pickup tube and screen assembly on oil pump assembly. Install one 5/16-18x3½ hex-head bolt with 5/16-inch lockwasher in front oil pickup tube flange and oil pump bolt hole, and 5/16-18x7/8 hex-head screw and washer assembly in rear oil pickup tube flange bolt hole. Tighten four 5/16-18 bolts to 10-15 lb.-ft. torque (fig. 4-253).

c. Check Oil Pump Drive Gear Backlash. Check backlash between integral drive gear on camshaft and oil pump drive gear on oil pump with a dial indicator mounted on cylinder block oil pan rail. Install indicator so contact tip rests against one of the oil pump gear teeth, and indicator axis is at right angle to helical gear tooth. Hold gear firmly, so end play will not be indicated as backlash, and move from left to right to limits of its play and note reading on indicator dial. Backlash must be within limits specified (table 4-10), (fig. 4-254).

4-100. Installation of Crankshaft Oil Slinger, Timing Gear Cover, and Crankshaft Pulley

a. Install Crankshaft Front Oil Slinger. Install crankshaft oil slinger over front end of crankshaft and onto Woodruff key with dished end facing front of engine (fig. 4-255).

b. Install Timing Gear Cover Assembly. Position timing gear cover assembly and gasket over two dowel pins and against cover mounting surface on cylinder block. Install eight ¼-20x¾ panhead screws with ¼ inch flat washers and ¼ inch lockwashers, and tighten screws evenly to 6-9 lb.-ft. torque. If crankshaft front oil seal has not been installed in timing gear cover, follow procedures in paragraph 4-73 *b* (fig. 4-256).

c. Install Crankshaft Pulley.

(1) Make sure lip of crankshaft front oil seal in timing gear cover is lubricated (para 4-73 *b*) and slip crankshaft pulley over front end of crankshaft and onto Woodruff key.

(2) Install one 9/16-18x1⅛ hex-head bolt with crankshaft pulley retaining washer and tighten to 50-55 lb.-ft. torque. It may be necessary to hold the crankshaft to keep it from turning (fig. 4-257).

4-101. Installation of Oil Pan Assembly and Oil Level Indicator

a. Install Oil Pan Assembly.

(1) Make sure gasket and seal surface of cylinder block and oil pan are clean and free from burrs. Obtain four ¼-20 studs or cut heads from four ¼-20x1½ bolts, and screw into outer ends of cylinder block pan rail to position and guide oil pan and gasket. Place oil pan right and left gasket over guide studs and against oil pan mounting surface on cylinder block. Fit oil pan front seal into groove in timing gear cover, and rear seal button into drilled hole in rear main bearing cap with seal ends on top of oil pan gaskets (fig. 4-258).

(2) Position oil pan on guide studs, holding gaskets, and install eight ¼-20x⅝ pan head screws with ¼-inch lockwashers and retainers, and four 5/16-18x⅝ hex-head screw and washer assemblies with 5/16-inch flat washers. Remove four guide studs and install remaining four ¼-20x⅝ panhead screws with ¼ inch lockwashers and retainers. Tighten ¼-20 screws evenly from center of pan outward in each direction to 3-5 lb.-ft. torque, and tighten 5/16-18 hex-head screws to 9-12 lb.-ft. torque in two steps. Check to make sure oil pan magnetic drain plug in bottom of oil pan is installed and is tight (fig. 4-259).

b. Install Oil Level Indicator Assembly. Install a new O-ring seal on oil level indicator, and insert oil level indicator assembly in oil level indicator tube on cylinder block.

4-102. Installation of Cylinder Head, Push Rods, Valve Rocker Arms, and Shaft and Cover Assembly

a. Install Cylinder Head Assembly.

(1) Make sure gasket surfaces of cylinder head

and block are clean and free from burrs. Position new cylinder head gasket (dry) over the two cylinder head locating dowels on cylinder block. Refer to figure 4-260.

(2) After cylinder head has been checked, valve stem-to-guide clearance found satisfactory and cylinder head subassembled (paras 4-44 through 4-48); install head assembly on the two hollow dowel pins on cylinder block. Apply sealer, oil-and water-resistant, on threads of ten 7/16-14x3.0 hex-head cylinder head bolts with 7/16-inch flat washers and install finger tight (fig. 4-261).

(3) The cylinder head bolt tightening procedure is performed in three steps, following the sequence shown in figure 4-262. Tighten bolts to 10 lb.-ft. torque, then tighten bolts to 55-60 lb.-ft. torque; then to 60-65 lb.-ft. Finally recheck bolts to 60-65 lb.-ft. torque. After cylinder head bolts have been tightened to specifications, the bolts should not be disturbed.

NOTE

Torque sequence of bolts.

Tighten cylinder head bolts in three steps in sequence of numbers shown by figure 4-262. Torque all bolts to:

1. 10 lb.-ft.
2. 45-55 lb.-ft.
3. 60-65 lb.-ft.

b. Install Push Rods. Lubricate each end of push rod with engine oil (OE-10). Install push rods in original bores, positioning lower end of rods into tappet sockets (fig. 4-263).

c. Install Valve Rocker Arm Shaft Assembly (fig. 4-264).

(1) After valve rocker arms and shaft have been checked, clearances found satisfactory, and subassembled (paras 4-54 and 4-55); lubricate rocker arm pads. Position the valve rocker arm shaft assembly on cylinder head with oil inlet and outlet tubes and retaining brackets installed on Nos. 2 and 4 rocker arm shaft supports. Make sure oil lines enter rocker arm shaft locating holes and O - ring seal is installed on lower end of oil inlet tube. An exhaust valve stem cap is installed on each of the four exhaust valve stems.

(2) Lower rocker arm shaft assembly on two studs in cylinder head assembly. Make sure lower end of oil inlet tube O -ring seal is in supply hole, and lower end of oil outlet tube is in oil drain hole provided in cylinder head. Position upper end of push rods onto valve adjusting screw ball ends. Install an oil tube retaining bracket over each oil tube on Nos. 2 and 4 rocker arm shaft supports, and install a 7/16 inch flat washer on Nos. 1 and 3 supports. Install two 7/16-14 hex-head nuts with 7/16-inch lockwashers on the studs, and two 7/16-14x2½ hex-head bolts with 7/16 inch lockwashers in supports Nos. 2 and 3. Tighten nuts and bolts evenly to 35-40 lb.-ft. torque.

d. Adjust Valve Clearance (preliminary) (fig. 4-265).

(1) Rotate crankshaft until No. 1 piston is near top dead center (T.D.C.) at end of compression strock (both valves are closed and timing mark on crankshaft pulley is in line with timing pointer).

(2) Using a 0.017 feeler gage between rocker arm pad and valve stem, turn the self-locking valve adjusting screws and adjust the intake and exhaust valve clearance for No. 1 cylinder. Repeat this procedure for remaining set of valves, turning crankshaft ½ turn at a time, while adjusting the valves in the firing order sequence of 1-3-4-2. If torque required to turn an adjusting screw is less than 5 lb.-ft., try a new adjusting screw. If this is still unsatisfactory, replace rocker arm and adjusting screw. Refer to paragraph 4-126 for final valve clearance adjustment.

e. Install Rocker Arm Cover. Coat one side of valve rocker arm cover gasket with oil resistant cement and lay cemented side of gasket in cover. Install cover, making sure gasket seats evenly all around head. Install two rubber seals, seal retainers, and 5/16-24 hex-head nuts on the studs and tighten to 3-4 lb.-ft. torque. Install oil filler cap on cover and attach to front seal retainer with chain and chain hooks (fig. 4-266).

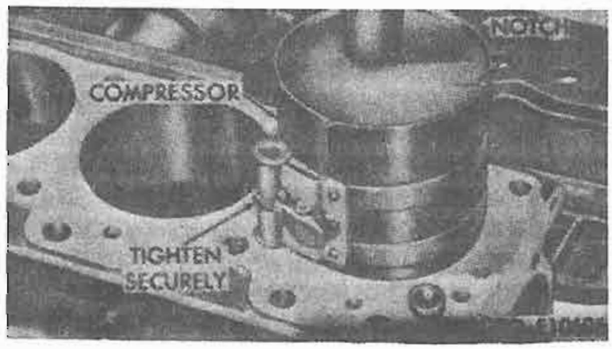


Figure 4-249. Piston installation.

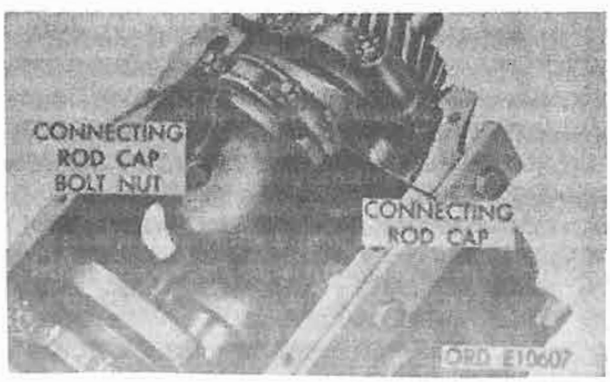


Figure 4-250, Connecting rod cap installation.

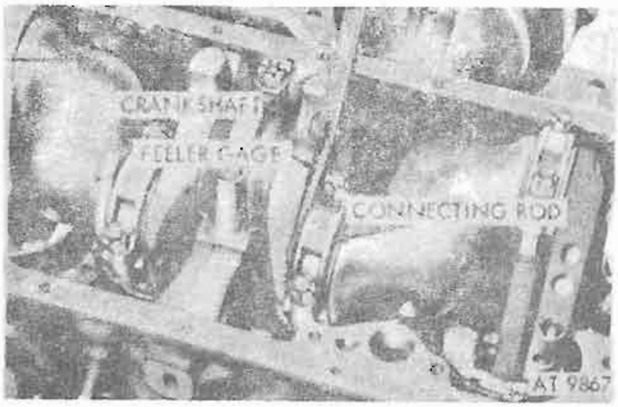


Figure 4-251. Connecting rod side play.

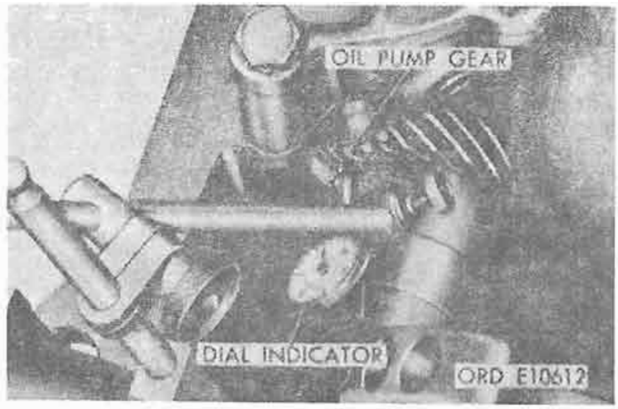


Figure 4-254. Measuring oil pump gear backlash.

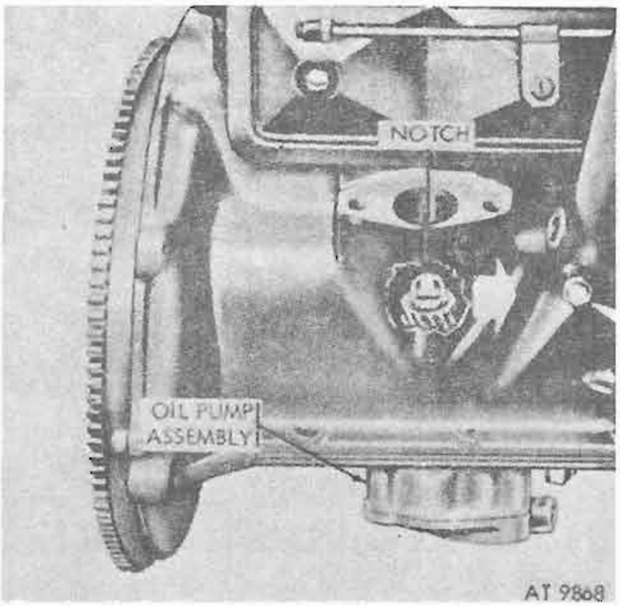


Figure 4-252. Oil pump gear installation.

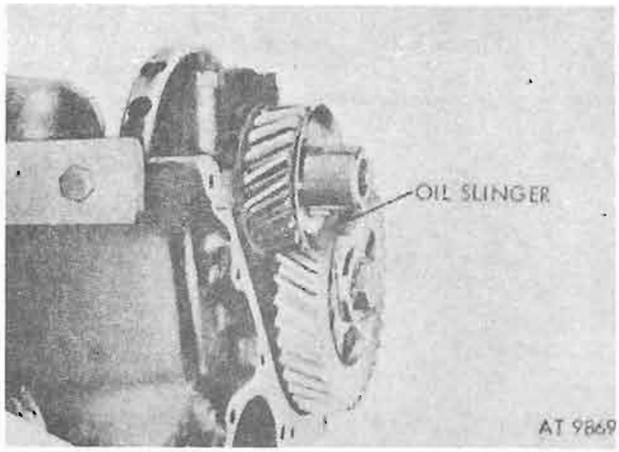


Figure 4-255. Crankshaft front oil slinger.

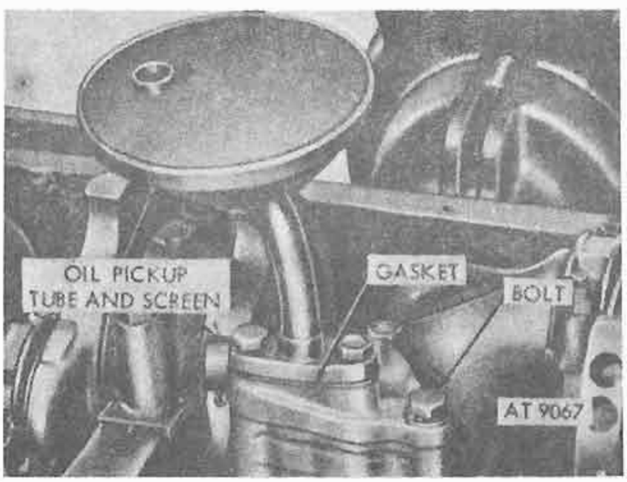


Figure 4-253. Oil pump, pickup tube, and screen assembly installation.

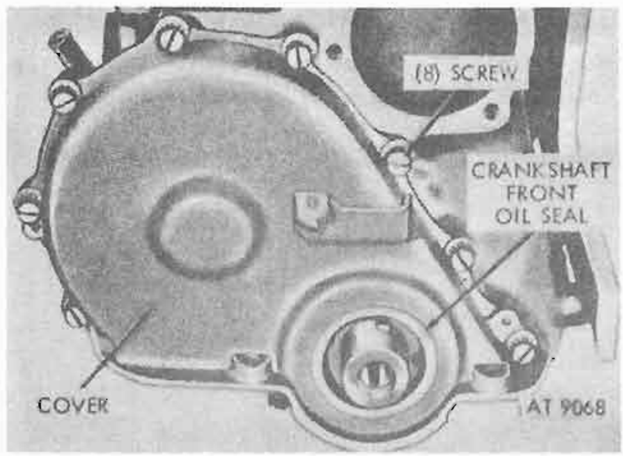


Figure 4-256. Timing gear cover installation.

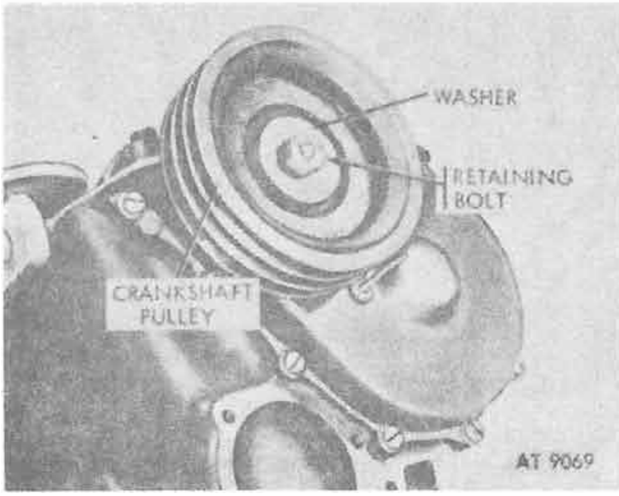


Figure 4-257. Crankshaft pulley.

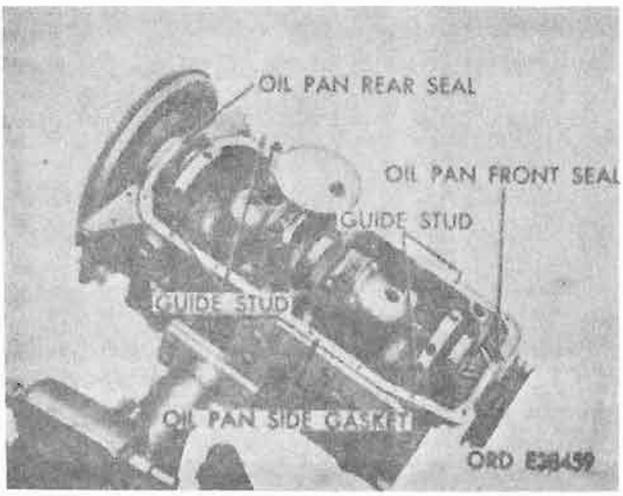


Figure 4-258. Oilpan gasket and seals installation.

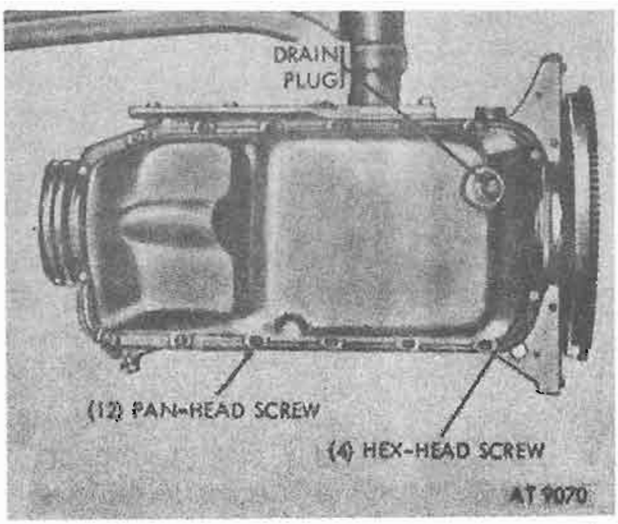


Figure 4-259. Oil pan assembly installation.

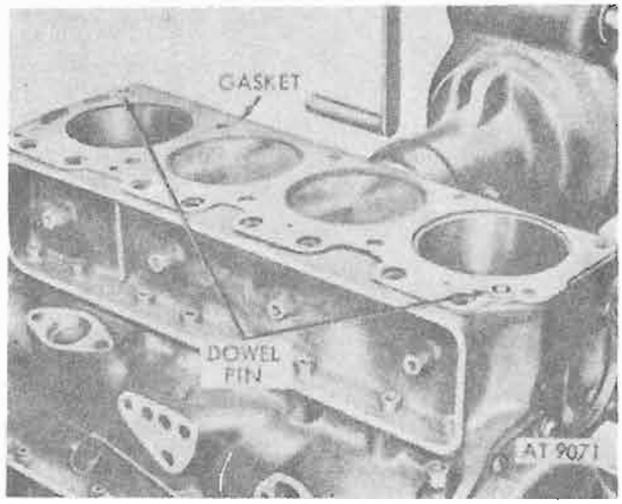


Figure 4-260. Cylinder head gasket.

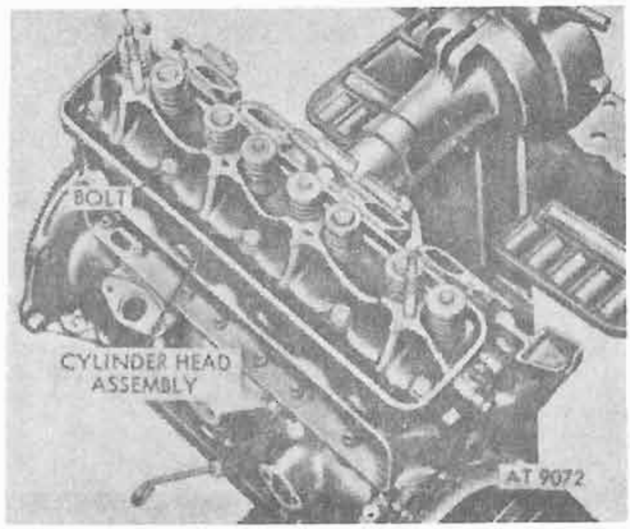


Figure 4-261. Cylinder head assembly.

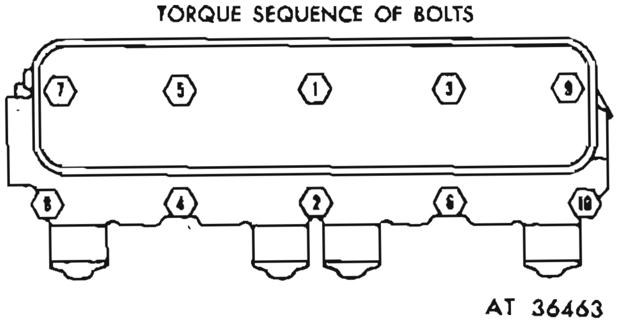


Figure 4-262. Cylinder head bolt tightening sequence.

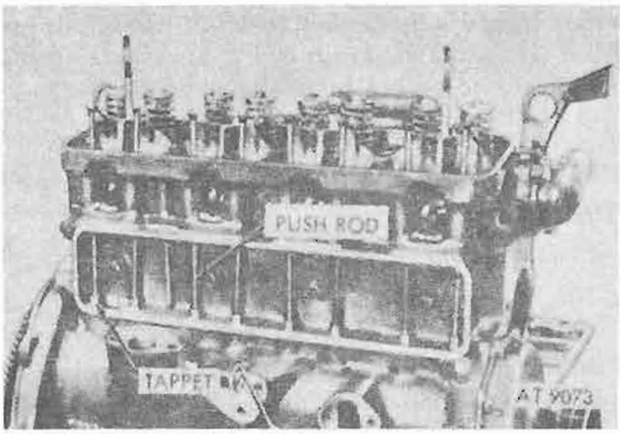


Figure 4-263. Push rod installation.

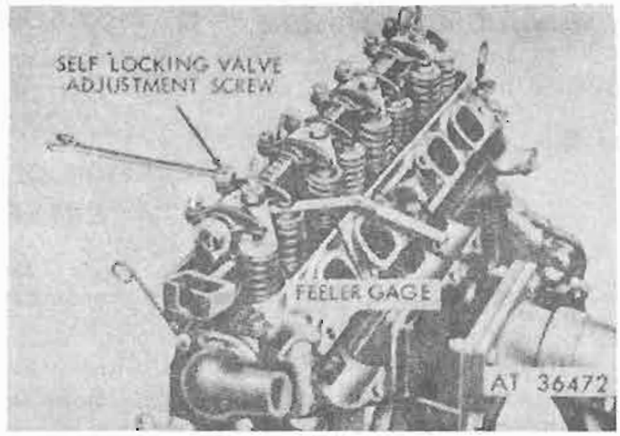


Figure 4-265. Preliminary valve clearance adjustment.

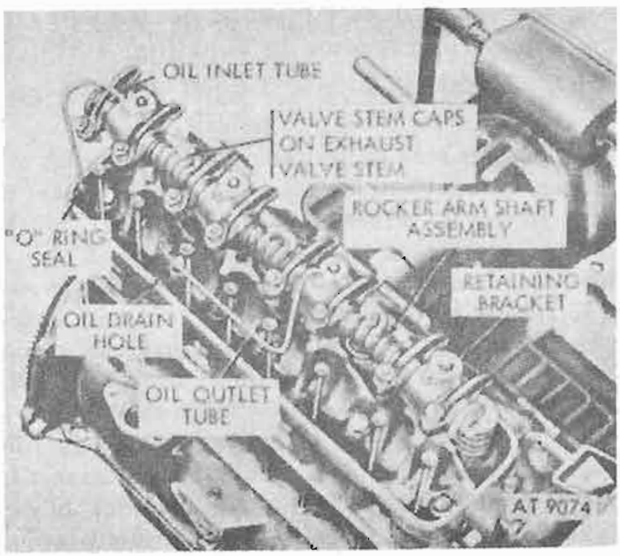


Figure 4-264. Valve rocker and shaft and shaft with inlet and outlet tube installed.

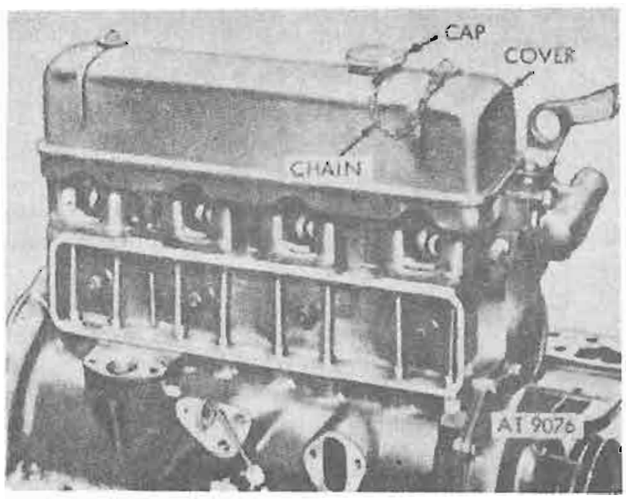


Figure 4-266. Rocker arm cover and oil filler cap installation.

4-103. Installation of Exhaust and Intake Manifolds

a. Install Exhaust Manifold. Place exhaust manifold on mounting saddles and aline bolt hole on outlet flange bracket with tapped hole in cylinder block.

NOTE

A gasket between manifold and cylinder is not required. Coat surface with graphite grease FSN 9150-223-4004.

Install a ⅜-16x⅝ hex-head exhaust outlet flange alining bolt with ⅜ inch lockwasher finger tight to position manifold (fig. 4-267).

b. Install Intake Manifold.

(1) Install intake manifold and gaskets on cylinder head mounting surface with four ⅜-16x1¼ hex-head screw and washer assemblies and four ⅜ inch flat washers in the upper flange bolt holes. Tighten to 23-28 lb.-ft. torque (fig. 4-268).

(2) Install a (dual type) lock tab washer with two ⅜-16x1½ hex-head bolts in the center lower manifold bolt holes and tighten bolts to 10-12 lb.-ft. torque. Bend tabs on each end of lock tab washer against bolt heads to secure (fig. 4-268).

c. Install Exhaust Manifold Clamps. Install two exhaust manifold retaining clamps, one on each end of manifold. Install two ⅜-16x1½ hex-head bolts with ⅜ inch lock tab washers on each clamp and tighten to 12-16 lb.-ft. torque. Tighten exhaust outlet flange alining bolt to 23-28 lb.-ft. torque. Bend tabs on each of four lock tab washers against bolt heads to secure bolts (fig. 4-269).

Section XXIV. INSTALLATION OF ACCESSORIES AND MISCELLANEOUS EXTERNAL PARTS

4-104. Installation of Water Pump Assembly, Fan, and Pulley

a. Install Water Pump Assembly. Position water pump assembly and gasket against mounting surface on front of cylinder block. Apply oil and water-resistant sealer on threads on three 5/16-18x1¾ hex-head bolts, then shift pump as necessary to line up bolt holes with tapped holes in cylinder block and install. Tighten bolts to 10-15 lb.-ft. torque (fig. 4-270).

NOTE

No washers are used under water pump retaining bolts.

b. Install Fan and Water Pump Pulley.

(1) Install pulley against hub on water pump shaft. Turn pulley. Aline holes with tapped holes in water pump hub (fig. 4-271).

(2) Install fan against pulley on water pump shaft. Turn fan to line up bolt holes in fan and pulley with tapped holes in water pump hub. Install four 5/16-24x1 hex-head screw and washer assemblies and tighten to 15-17 lb.-ft. torque (fig. 4-272).

4-105. Installation of Vacuum Pump Assembly (M151, M151A1, M151A1C, and M718 vehicles)

Position vacuum pump and gasket against vacuum pump mounting pad, on right side of cylinder block, with actuating arm over top of eccentric on camshaft. Apply oil and water-resistant sealer on threads of two 5/16-18x1½ hex-head bolts with 5/16 inch flat washer and 5/16 inch lockwasher. Tighten to 10-15 lb.-ft. torque. Do not use sealer on first two starting threads on bolts (fig. 4-273).

4-106. Installation of Fuel Pump (M151A2, M825 and M718A1 vehicles)

Position fuel pump and gasket against fuel pump mounting pad, on right side of cylinder block, with actuating arm over top of eccentric on camshaft. Apply oil-and-water-resistant sealer on threads of two 5/16-18x1½ hex-headed bolts with 5/16 inch flat washer and 5/16 inch lockwasher. Tighten to 10-15 lb.-ft. torque. Do not use sealer on first two starting threads on bolts (fig. 4-274).

4-107. Installation of Tappet Cover and Vacuum Pump Line (fig. 4-275)

a. Coat one side of tapped cover gasket with oil-resistant cement and lay cemented side of gasket in place in cover. Place cover on cylinder block, making sure gasket seals evenly all around tappet chamber. Install two ¼-20x1¼ panhead screws with rubber-seal assemblies into two end cover openings to hold cover and gasket firmly in place, but do not tighten to specified torque (M151, M151A1, M151A1C, and M718 vehicles only).

b. Coat one side of tappet cover gasket with oil-resistant cement and lay cemented side of gasket in place in cover. Place cover on cylinder block, making sure gasket seals evenly all around tappet chamber. Install four ¼-20x1¼ panhead screws and rubber seal assemblies into two end cover openings to hold cover and gasket firmly in place. Tighten all four screws to 3-4 lb.-ft. torque (M151A2, M825, and M718A1 vehicles only).

c. Install vacuum pump line on tappet cover with two retaining clips, and two ¼-20x1¼ panhead screws and rubber seal assemblies. Insert screws into two center cover openings and tighten all four screws to 3-4 lb.-ft. torque. Connect tube nut on lower end of vacuum pump line to connector in vacuum pump assembly. Tighten nut firmly to provide leak-proof connection.

4-108. Installation of Oil Filter Adapter and Filter Assembly

a. Install Oil Filter Adapter. Position oil filter adapter and gasket against adapter mounting surface on right side of cylinder block. Apply oil and water-resistant sealer on threads of two ⅜-16x1½ hex-head screw and lockwasher assemblies and install with ⅜ inch flat washer. Tighten to 23-28 lb.-ft. torque. Make sure ⅛-27 pipe plug is installed in drilled oil passage in front of oil filter adapter. Do not use sealer on first two starting threads on bolts (fig. 4-276).

b. Install Oil Filter Assembly. Coat seal on filter with engine lubricating oil (OE-10) and place filter in position on the adapter fitting. Hand tighten filter until seal contacts adapter face, then advance ½ turn minimum (fig. 4-277).

4-109. Installation of Distributor Intermediate Drive Shaft, Adapter, and Distributor Assembly

a. Install Distributor Intermediate Drive Shaft. Install distributor intermediate drive shaft with offset slot in large end toward front of engine, and small slot end engaged on oil pump drive shaft tang. Make sure offset slot in intermediate drive shaft is toward the front of engine, as it will determine distributor rotor position (fig. 4-278).

Figure 4-267. Exhaust manifold.

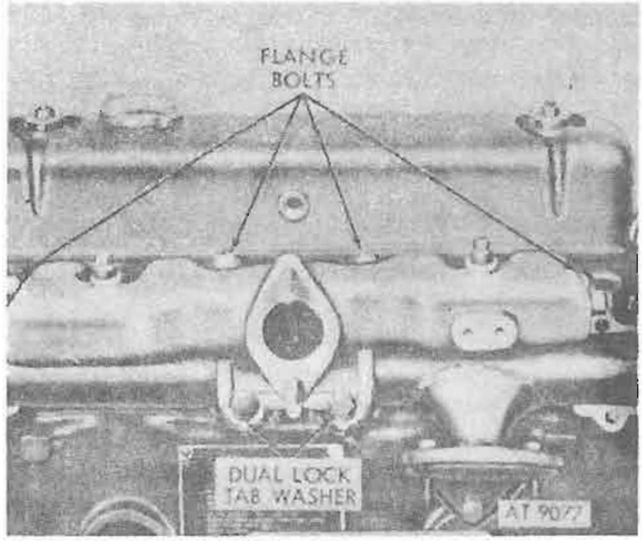


Figure 4-268. Intake manifold flange bolts.

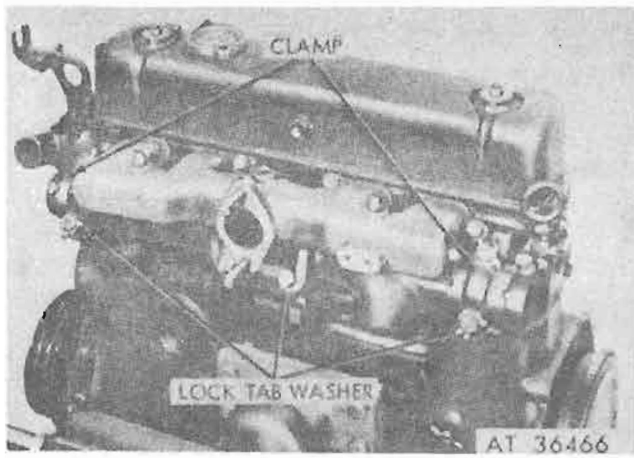


Figure 4-269. Exhaust manifold clamps.

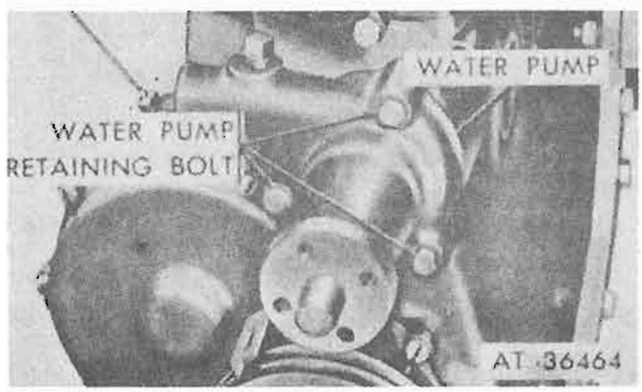


Figure 4-270. Water pump installation.

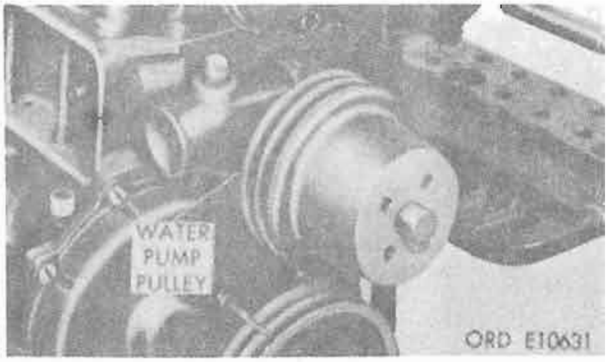


Figure 4-271. Water pump pulley.

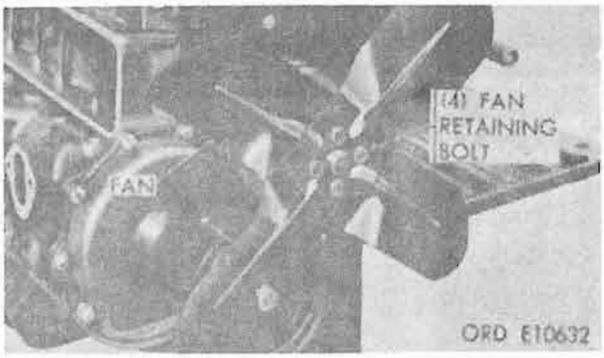


Figure 4-272. Fan and pulley installation.

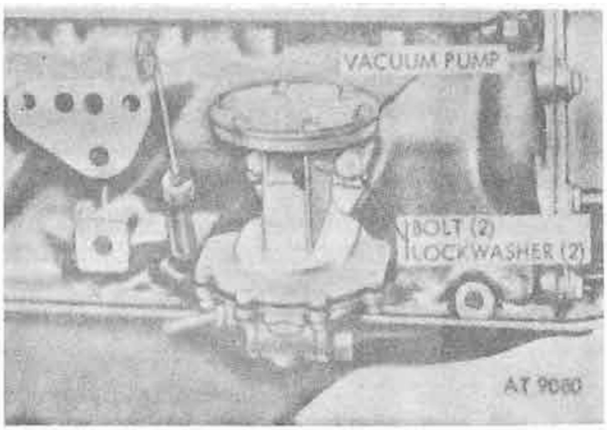


Figure 4-273. Vacuum pump (M151, M151A1, M151A1C and M718 vehicles only).

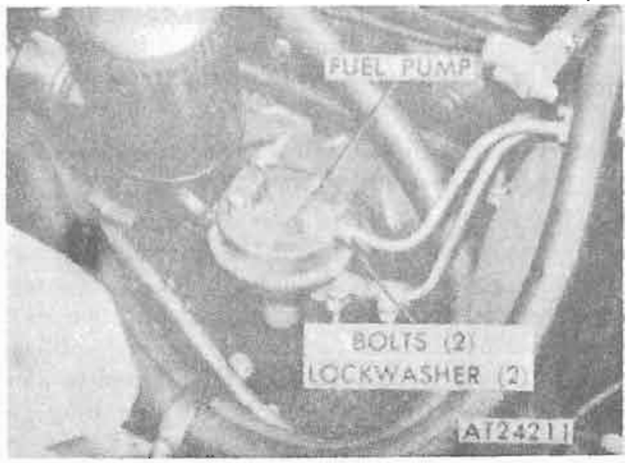


Figure 4-274. Fuel pump (M151A2, M825 and M718A1 vehicles).

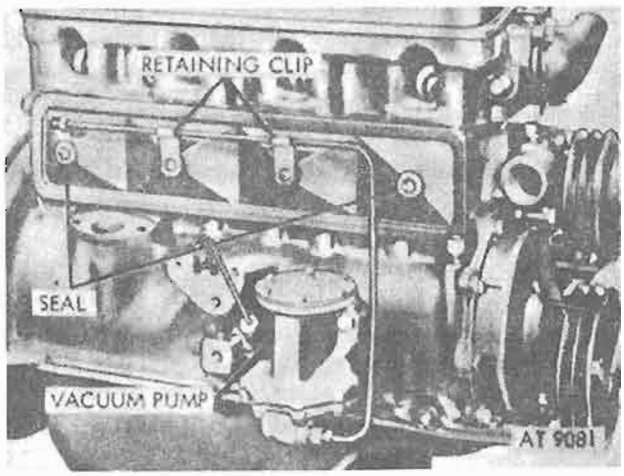


Figure 4-275. Tappet cover and vacuum pump line.

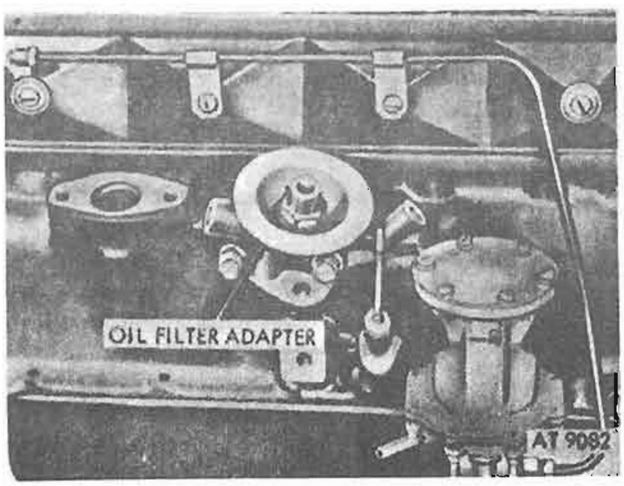


Figure 4-276. Oil filter adapter.

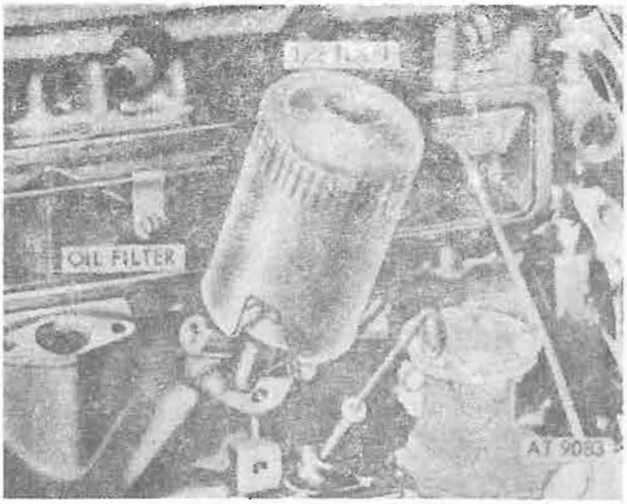


Figure 4-277. Oil filter assembly.

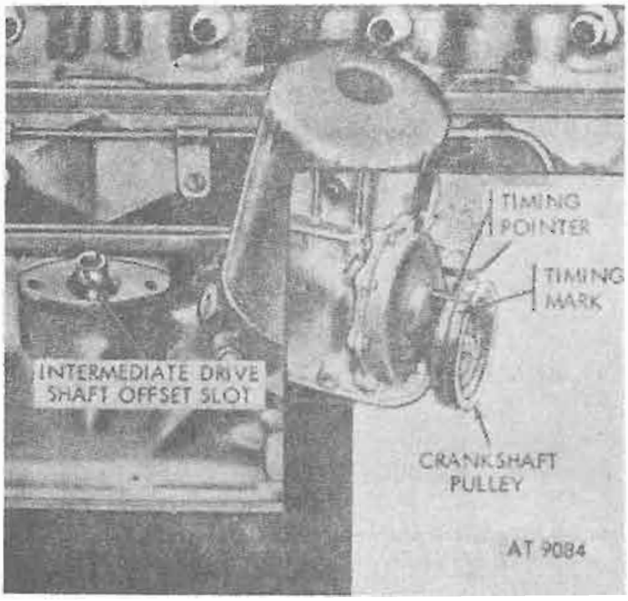


Figure 4-278. Distributor intermediate drive shaft timing position.

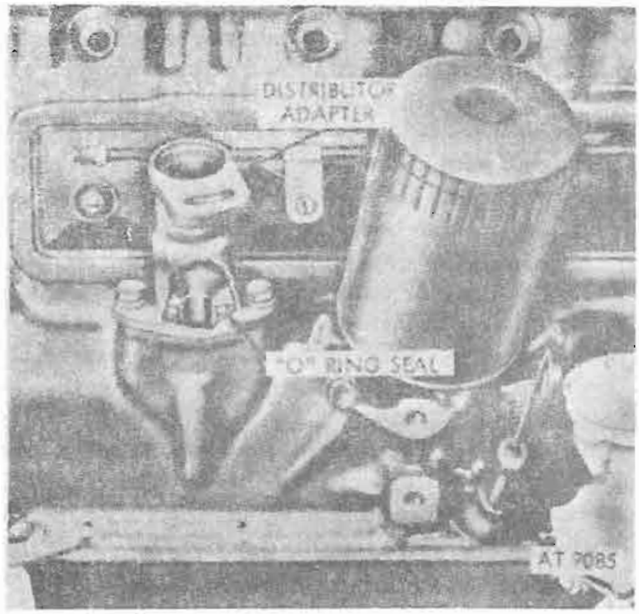


Figure 4-279. Distributor adapter.

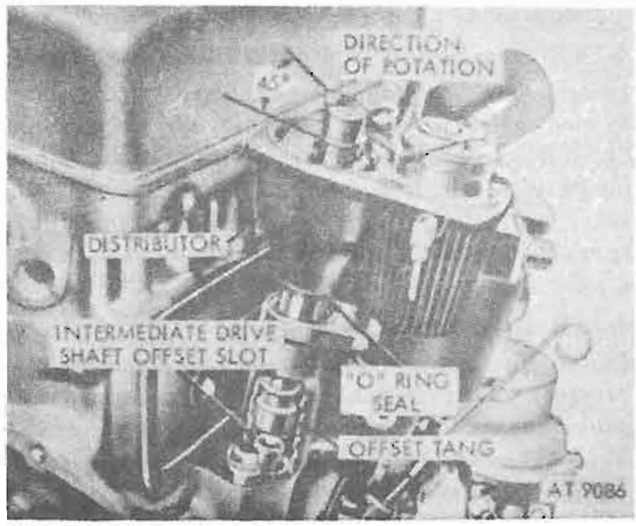


Figure 4-280. Distributor installation.

b. Install Distributor Adapter. Install O -ring seal against flange on distributor adapter outer pilot diameter. Install adapter into opening on right side of cylinder block. Apply water and oil-resistant sealer on threads of two 3/8-16x1 1/8 hex-head bolts and install with 3/8 inch lockwasher. Tighten 23-28 lb.-ft. torque. Apply thin coat of lubricant (GAA) to inside of adapter bore (fig. 4-279).

c. Install Distributor Assembly. Install O -ring seal on distributor outer pilot and turn distributor shaft to aline offset tang with offset slot in intermediate drive shaft. Insert distributor assembly into opening in adapter on cylinder block (fig. 4-280).

d. Time Distributor (preliminary). Slowly turn distributor housing on distributor adapter until breaker points just start to open. Install 1/4-20x1.0 hex-head distributor retaining bolt with 1/4 inch flat washer and 1/4 inch lockwasher through slot in adapter into tapped hole in distributor (fig. 4-281). Tighten bolt 3-5 lb.-ft. torque and install distributor cover assembly. Tighten screws firmly. Refer to paragraph 4-126 for final ignition timing procedures.

4-110. Installation of Spark Plugs and Cables

Install four spark plugs with new gaskets into tapped holes provided on right side of cylinder head. With a suitable spark plug wrench, tighten plugs to 18-20 lb.-ft. torque. Connect spark plug cable nuts finger tight on distributor cover and spark plugs, then tighten an additional 1/4 turn with a suitable wrench (figs. 4-282 and 4-283).

4-111. Installation of Sending Units

Install fuel pump safety switch assembly (oil pressure safety switch assembly) in tapped hole provided in front of oil filter adapter (M151, M151A1, M151A1C, and M718 vehicles only). Install oil pressure sending unit in tapped hole provided in rear of oil filter adapter. Install water temperature sending unit in tapped hole provided in rear of cylinder head. Apply water and oil-resistant sealer on threads and tighten firmly to provide leak-proof assembly. Do not use sealer on first two starting threads (figs. 4-282 and 4-283).

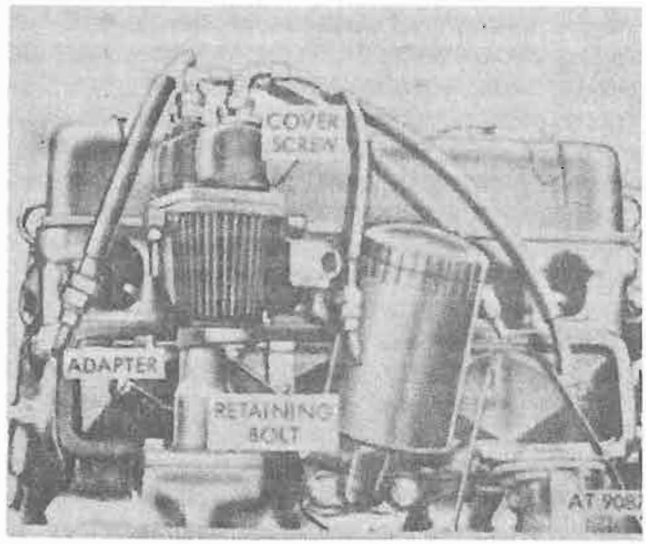


Figure 4-281. Preliminary ignition timing.

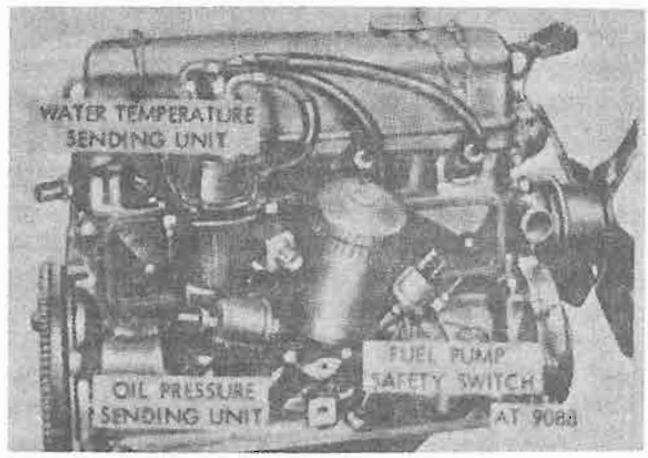


Figure 4-282. Spark plugs and cables, and sending units installed (M151. M151A1. M151A1C and M718 vehicles).

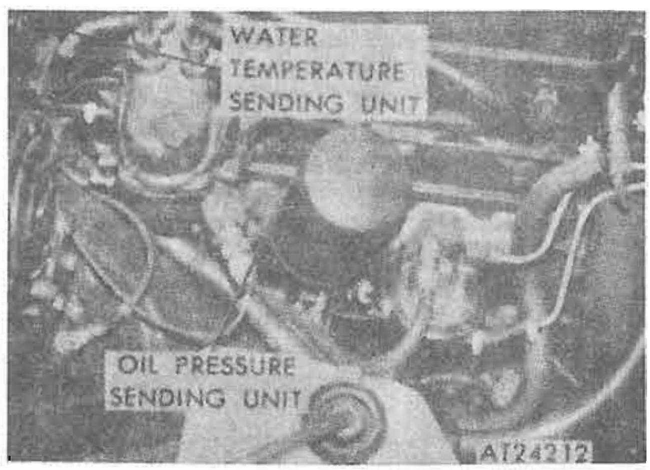


Figure 4-283. Spark plugs and cables and sending units installed (M151A2. M825, and M718A1 vehicles).

4-112. Installation of Crankcase Ventilation System Components

a. Install Crankcase Ventilation Valve and Fitting. Install fitting in center tapped hole provided in top of intake manifold and crankcase ventilating valve in tapped hole provided in fitting. Ventilation fitting should be tightened so that tapped hole for crankcase metering valve is toward front of engine. Use oil-and-water-resistant sealer on all connections (figs. 4-284 and 4-285).

b. Install Ventilation Inlet Line.

NOTE

The key numbers shown in parentheses refer to figures 4-284 and 4-285.

Connect one end of ventilation line assembly (1) to ventilation fitting in intake manifold and the other end to connector in right front of cylinder block. Tighten tube nuts firmly. Connect one end of ventilation line assembly (2) to ventilation fitting in intake manifold, hand tight.

c. Install Ventilation Outlet Tube Assembly and Attaching Parts.

NOTE

The key numbers shown in parentheses refer to figure 4-211.

Connect one 1/4 NPTx1/2-20, 90° elbow (1) to rocker arm cover; tighten and position elbow. Connect one 1/5NPTx1/2x20nut (3) to crankcase metering valve. Install tube assembly (2) and tighten tube nuts firmly (fig. 4-286).

4-113. Installation of Fuel Pump Safety Switch (Oil Pressure Safety Switch Ventilation Line) (M151, M151A1, M151A1C, and M718 Vehicles)

Install vent line with upper and lower hose and hose clamps to switch hose connector tube. Tighten hose clamps firmly. Attach two clips to secure switch vent line to crankcase ventilation inlet line (fig. 4-287).

4-114. Installation of Fuel Pump Ventilation Line

Install vent line with upper and lower hose and hose clamps to switch hose connector tube. Tighten hose clamps firmly. Attach two clips to secure vent line to crankcase ventilation inlet line (fig. 4-288).

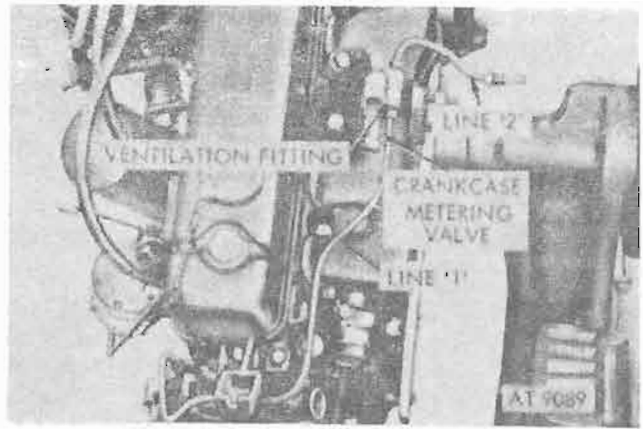


Figure 4-284. Crankcase metering valve and ventilation lines and fitting (M151, M151A1, M151A1C, and M718A1 vehicles).

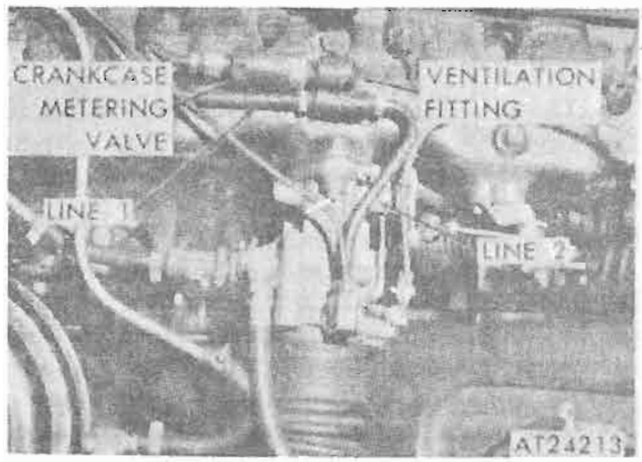


Figure 4-285. Crankcase metering valve and ventilation lines and fitting (M151A2, M825, and M718A1 vehicles).

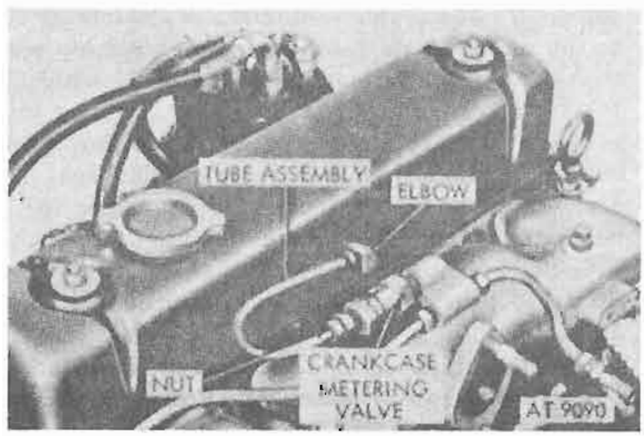


Figure 4-286. Crankcase ventilation outlet tube assembly and attaching parts.

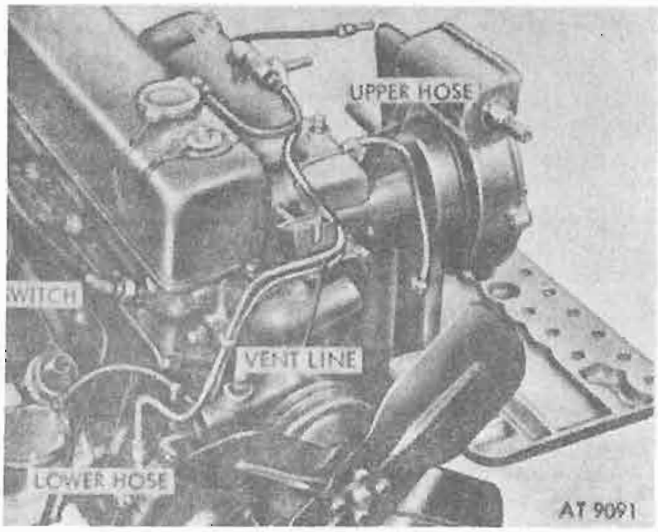


Figure 4-287. Fuel pump safety switch (oil pressure safety switch) ventilation line and attaching parts (M151, M151A1, M151A1C and M718 vehicles).

4-115. Installation of Distributor Ventilation Lines and Attaching Parts (M151, M151A1, M151A1C, and M718 Vehicles)

NOTE

The key numbers shown in parentheses refer to figure 4-212.

Attach and tighten restricted connector (17) firmly in center tapped holehole in "tee" fitting (8) and connect one end of "tee" fitting to tube nut on vacuum pump line (5). Connect and position two ⅛ NPT 90° elbows (15) in tapped holes provided on distributor assembly. Connect two 3 / 16-inch O.D. hose connector tubes with 3 / 16-inch tube nuts (13) in each 90° elbow in distributor. Position and secure distributor ventilation line assembly (2) on top of crankcase ventilation line assembly with clip (3), and on vacuum pump line (5) with clip (4). Install distributor vent hose (11) and hose (16) with four hose clamps. Slip ventilation line (9) in clip (10) attached to rear engine lifting eye, and connect one end to ⅛ inch NPT connector (6) in rear intake manifold, and other end to "tee" fitting (8). Tighten hose clamps, fittings and tube nuts firmly to provide waterproof connections (fig. 4-289).

4-116. Installation of Distributor Ventilation Lines and Attaching Parts (M151A2, M825, and M718A1 Vehicles)

The key numbers shown in parentheses refer to figure 4-213. Connect and position two ⅛ NPT 90° elbows (12) in tapped holes provided on distributor assembly. Connect two 3 / 16-inch tube nuts (10) in each 90° elbow in distributor. Position and secure distributor ventilation line assembly (2) on top of crankcase ventilation line assembly with two clips (3). Install distributor vent hose (11) and hose (16) with four hose clamps (4). Slip ventilation line (6) in clip (8), attached to rear engine lifting eye, and connect one end to ⅛ inch NPT connector (7) in rear intake manifold and other end to hose (9). Tighten hose clamps and tube nut firmly to provide waterproof connections (fig. 4-290).

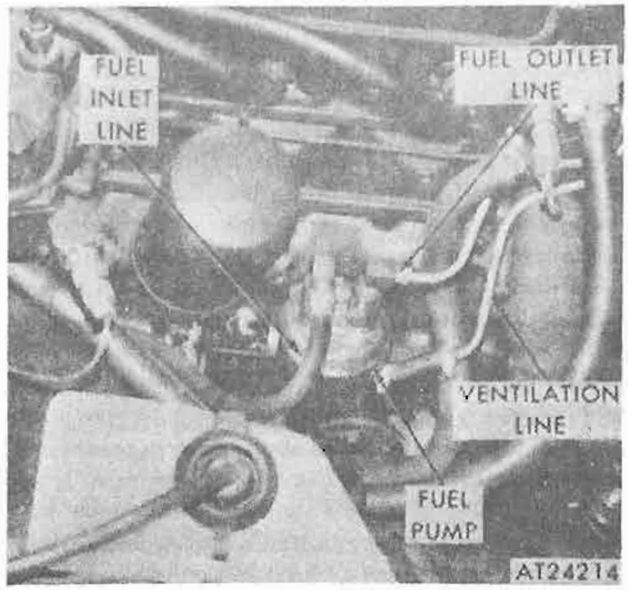


*Figure 4-288. **Fuel pump ventilation** line (M151A2, M825 and M718A1).*

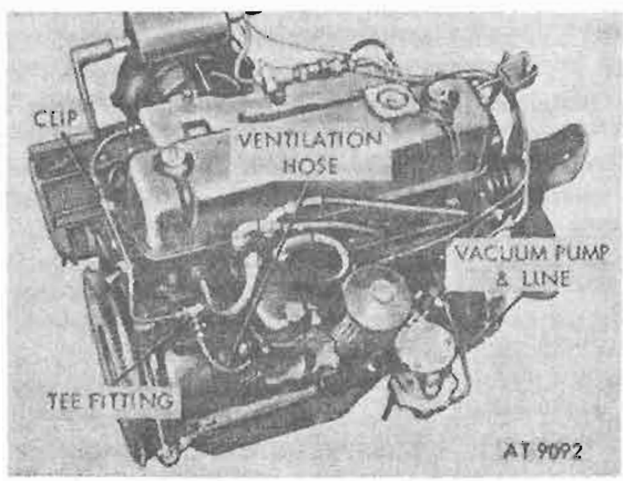


*Figure 4-289. **Distributor ventilation** line and attaching parts (M151, M151A1, M151A1C and M718 vehicles).*

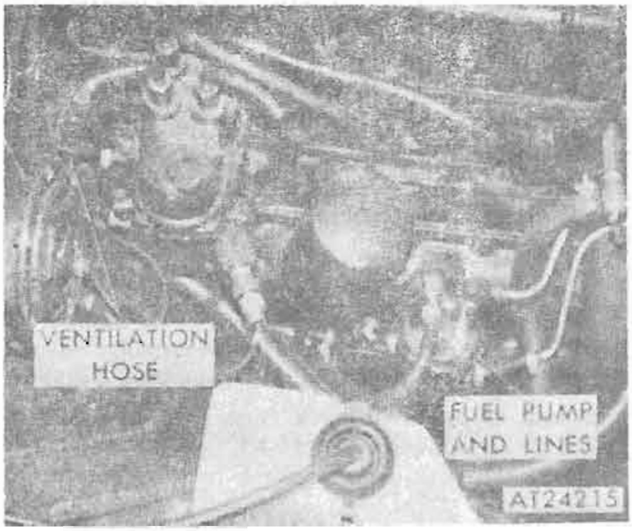


Figure 4-290. Distributor ventilation line and attaching parts (M151A2, M825, and M718A1 vehicles).

4-117. Installation of Clutch Assembly

Place clutch disk and pressure plate assembly in position on flywheel. Start six 5 / 16-18x1.0 hex-head clutch retaining bolts with 5 / 16-inch lock-washers to hold pieces in place, but do not tighten them. Insert a suitable pilot tool to aline the clutch disk and tighten bolts evenly to 20-25 lb.-ft. Remove pilot tool (fig. 4-291).

4-118. Removal of Engine from Repair Stand

Remove engine from repair stand before proceeding with remainder of engine assembly. Engine assembly may be handled with a hoist, using sling ORD 7345279 (fig. 4-47). Remove four bolts holding engine assembly to improvised engine support bracket on repair stand, and set engine in a suitable wooden pallet supported by oil pan mounting flange.

CAUTION

If a suitable wooden pallet is not available, exercise care to perform the following operations in a manner designed to protect personnel against injury and engine parts against damage.

4-119. Installation of Carburetor Assembly, Accelerator Bellcrank and Attaching Parts

a. Install Carburetor Assembly and Attaching Parts. Install carburetor assembly and gasket on two studs in center of intake manifold. Position ends of crankcase ventilation line and distributor ventilation line into ventilation fitting in top of carburetor air horn. Install accelerator return spring bracket against carburetor mounting flange on lower stud. Install carburetor with two ⅜-24 hex-head nuts, two ⅜ inch flat washers and two ⅜ inch lockwashers. Tighten nuts to 30-35 lb.-ft. torque. Tighten tube nuts firmly to provide leak proof connection (fig. 4-292).

b. Install Accelerator Bellcrank, Bracket Assembly and Attaching Parts. Position accelerator bracket assembly on mounting pad provided on rear of intake manifold. Install two ¼-20x½ hex-head screws and washer assemblies and tighten to 3-5 lb.-ft. torque. Install one end of accelerator rod assembly over ball stud on carburetor throttle lever, and other end over ball end of bellcrank. Attach one end of accelerator return spring in hole provided in retaining bracket, and other end in slot provided in bellcrank arm (fig. 4-293).

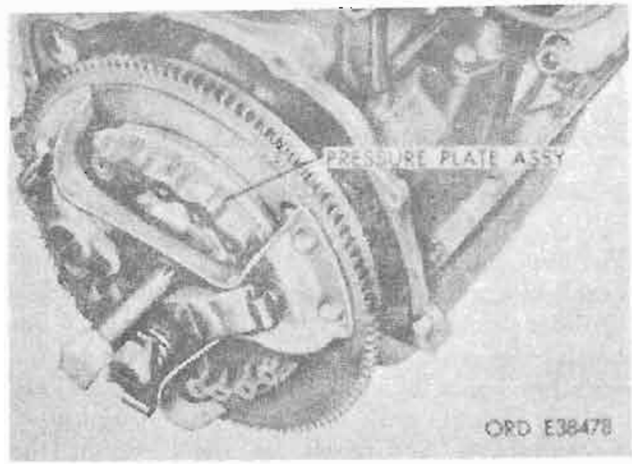


Figure 4-291. Clutch assembly.

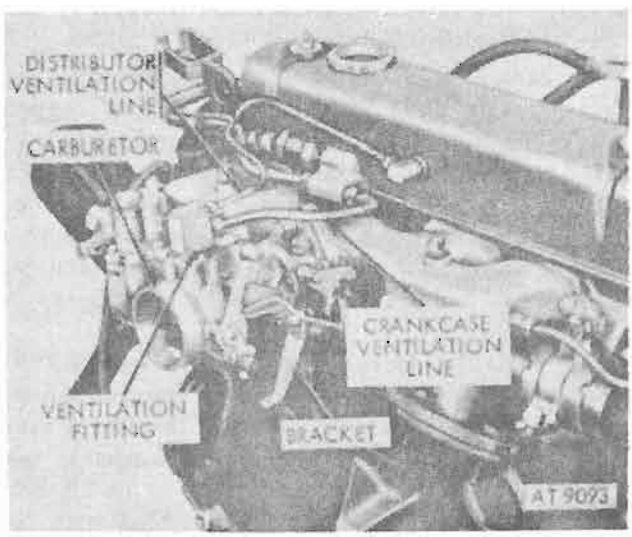


Figure 4-292. Carburetor installation—typical.

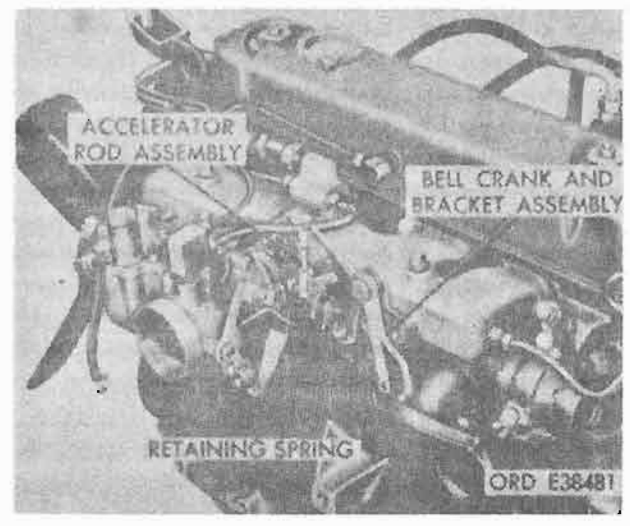


Figure 4-293. Installation or accelerator bellcrank.

4-120. Installation of Engine Front Support Brackets

Position engine right and left front support brackets against their respective mounting pads on cylinder block. Install two 7/16-14x7/8 hex-head bolts with 7/16-inch lockwashers to hold each bracket to block, and tighten to 35-40 lb.-ft. torque. Right and left brackets are not interchangeable and must be installed on their respective mounting pads. Install the larger of the two brackets on the left side of the block (fig. 4-294).

4-121. Installation of Generator Assembly and Attaching Parts

a. *Install Radiator Lower Support Brackets.* Position left and right radiator lower support brackets against their respective mounting pads on side of cylinder block. Install two ½-13x1⅜ hex-head bolts, with a dual type lock-tab washer, through the bolt holes in each bracket, and tighten bolts to 58-65 lb.-ft. torque. Bend tabs on each end of lock-tab washer firmly against bolt head to secure (fig. 4-295).

b. *Install Generator Assembly* (fig. 4-296). Position generator, with pulley, on mounting bracket and attach with two 7/16-20x1½ hex-head bolts, four 7/16-inch flat washers, two 7/16-inch lockwashers, and two 7/16-20 hex-head nuts. Be sure bolts are assembled with flat washers against each outer end of aluminum generator end plates. Tighten nuts finger tight. Position generator belt adjusting arm bracket with bolt hole alined with tapped hole provided in front of cylinder block and install a self-locking ⅜-16x1 hex-head bolt finger tight. Install a ⅜-16x1⅛ hex-head bolt with heavy ⅜ inch flat washer and ⅜ inch lockwasher through slotted end of bracket into tapped hole provided in generator front end plate finger tight. Do not tighten bolts until drive belts are installed.

c. *Install Drive Belts.* Place a matched set of drive belts over pulley. Adjust belt tension by moving top end of generator away from cylinder block, as necessary, to obtain correct tension. Tension is correct when light thumb pressure is applied midway between generator and water pump pulley causes ⅛ inch deflection for new belt, and ¼ inch deflection for used belt. After adjusting belt tension, tighten generator mounting bolts to 47-56 lb.-ft. torque. Tighten self-locking adjusting arm bolt in cylinder block to 47-56 lb.-ft. torque, and bolt on opposite end of adjusting arm bracket to 23-28 lb.-ft. torque. Recheck belt deflection (fig. 4-297).

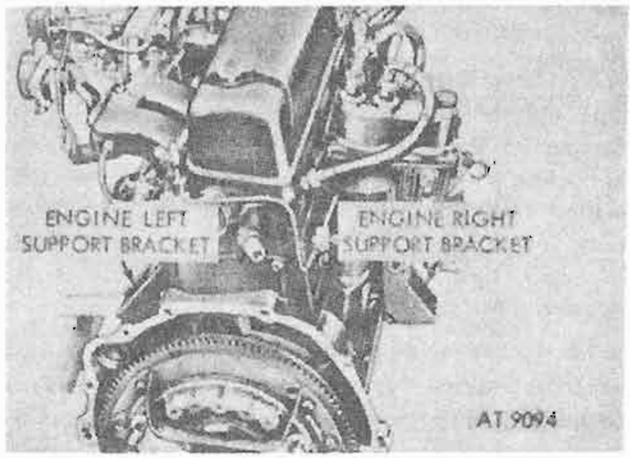


Figure 4-294. Engine front support brackets.

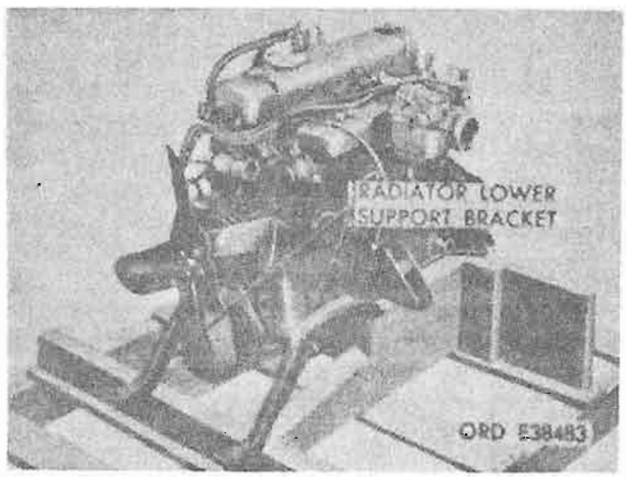


Figure 4-295. Radiator lower support brackets.

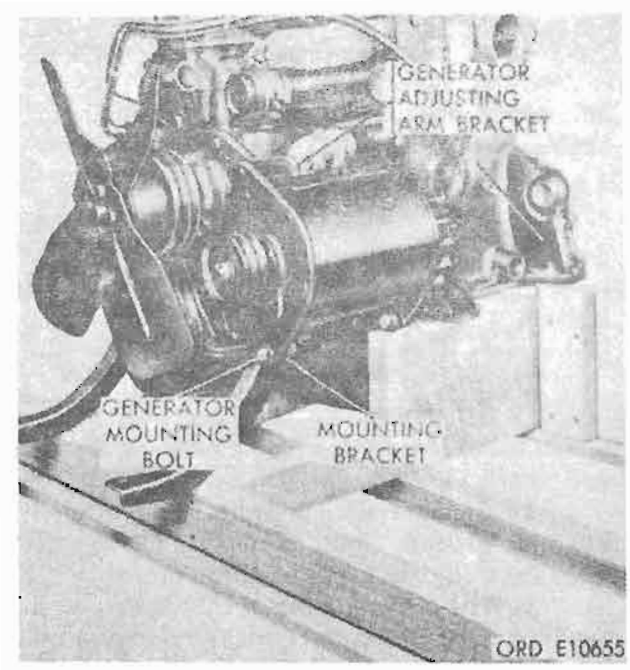


Figure 4-296. Generator assembly.

4-122. Engine Painting

Cover all openings into engine and accessories and clean exterior surface of engine and accessories with cleaning solvent, and wipe dry. Touch up or spray engine with air dry enamel (Federal Specification TT-E-485). If engine is to be sprayed, mask off clutch and flywheel, engine carburetor, and accelerator bellcrank assembly. Remove drive belts and mask off all pulley grooves and cooling fan. Engines not disassembled for complete overhaul need not be entirely repainted. Care should be taken, however, to see that the engine is clean and coated protectively where necessary.

Table 4-13. Engine Run-In Schedule

Period	Duration minutes	Engine speed RPM	Intake manifold depression in. hg
1	Run until normal temp has been reached.	1200	
2	10	2000	16
3	10	3000	10
4	5	500	Adjust tappets, check ignition timing.
5	As required	500	7
6	10	3500	7
7	10	4000	5
8	As required	600-650	Set idle and vacuum

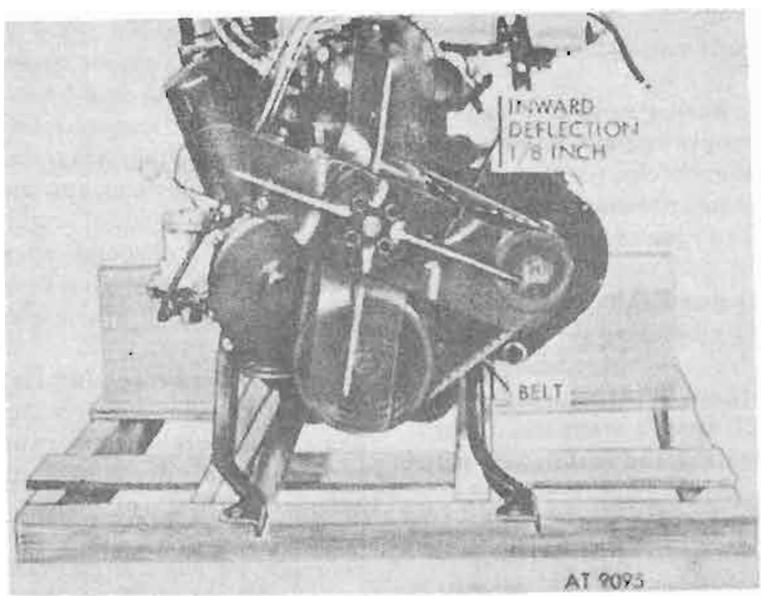


Figure 4-297. Drive belt deflection.

4-124. Preparation for Run-In and Test

The procedures set forth in this section will be performed after the engine has been repaired and before the engine is released for installation in vehicles, or for forwarding to supply channels. Refer to TB ORD 392 for procedures to insure proper lubrication of engine before starting. The purpose of an engine run-in test is to break in new parts, to detect deficiencies such as leaks or faulty assembly, to make final adjustments, and to determine that the engine will operate satisfactorily. A test stand can be used for run-in final check and adjustments. Test stand can also be used to check previously run in engines or to check operation of a disabled unit.

4-125. Run-In Procedures

a. Install engine on suitable test stand and install radiator, along with sufficient electrical and fuel connections; etc., to operate.

b. Start and run engine at 1200 rpm. Check for water and oil leaks. After the engine has reached normal operating temperatures, make the following checks.

(1) Check oil pressure at 500-550 rpm idle speed.

(2) Adjust valve clearances (para 4-119*c*).

(3) Check ignition timing (para 4-119*b*).

(4) Secure the carburetor choke plate in the open position to insure against erratic fuel flow, and check carburetor idle fuel setting at 500-550 rpm (para 4-119*a*).

(5) Check for oil and water leaks. Listen for unusual noises.

c. Run-in engine in accordance with instructions provided in table 4-13.

d. After the engine has been run-in and found satisfactory, shut off fuel supply and run engine out of fuel. Make the following checks.

(1) Check the cylinder compression pressure at cranking speed (para 2-11) to make sure engine is satisfactory.

(2) Retorque the intake and exhaust manifold bolts and secure the bolts by bending the tangs on the lock-tab washers.

(3) Remove oil filter (para 4-14) and drain oil from engine (para 4-7*b*(2). Install magnetic drain plug after draining is completed and install new oil filter (para 4-103).

(4) Flush engine water passages with a mixture of 60 percent noncorrosive antifreeze compound (ethylene glycol-type) and 40 percent water. Add 5 percent soluble corrosion-preventive oil. Allow mixture to circulate throughout the engine water passage.

4-126. Engine Adjustments and Settings

a. Carburetor. Plug the vacuum pump inlet and adjust the idle fuel mixture to obtain the highest intake manifold depression at 500-550 idle speed. Refer to TM 9-2320-218-20 for procedure to adjust carburetor.

b. Distributor (Final Ignition Timing).

(1) Disconnect No. 1 spark plug cable and install suitable timing adapter between distributor and spark plug.

(2) Connect timing light leads properly to adapter ground and battery. Follow the instructions of timing light manufacturer.

(3) With engine idling at 500-550 rpm, direct beam of timing light toward end of timing pointer on timing gear cover. Adjust timing by loosening distributor retaining bolt, then slowly turn distributor assembly, as necessary, to aline pointer and notch in crankshaft pulley. View the 6° timing mark on crankshaft pulley with the timing pointer in line with center of pulley to eliminate parallax, and obtain accurate timing. Refer to paragraph 4-109*d* for preliminary timing procedure.

c. Valve Clearance. Before a final valve clearance adjustment is made, operate engine for 25 minutes minimum to stabilize engine temperatures. Idle engine and, using a GO NO-GO gage, adjust valve clearance to GO -0.014, NO-GO 0.017. Refer to paragraph 4-102*d* for procedure to adjust valve clearance.

4-127. Preparation for Storage or Shipment.

a. General. If engine assembly is to be stored or shipped, engine should be processed in accordance with applicable instructions.

b. Internal Processing. Remove all spark plugs. With an air-atomizing gun and dry air, spray or fog approximately 2 oz. of engine preservation oil into each cylinder through spark plug holes. Turn crankshaft at least five revolutions during spray operation at each spark plug hole. Install spark plugs.

c. External Processing. Remove grease, dirt, and oil from exterior surfaces and seal all openings in engine with adhesive tape (non-hygroscopic). Paint engine with air dry enamel and allow to dry. Spray exterior surfaces of engine and accessories with ignition insulating compound. Drive belts should be removed from engine and packed in a waterproof package and attached to the engine.

Section XXVI. REPAIR STANDARDS

4-128. General

The repair and rebuild standards are included with the exploded view in the rebuild sections. Refer to paragraph 4-45 for description of the standards.

4-129. Repair Standards and Torque Specifications

Table 4-14 below contains a cross reference to the engine and accessories repair standards. Standard torque wrench specifications are shown in table 4-15.

4-130. Sealers and Lubricants

Sealers and lubricants required to assemble the engine are shown in table 4-16.

Table 4-14. Cross Reference to Repair Standards

Part or function	Table	Para
Manifold vacuum gage readings	2-5	2-10
Valve-timing specifications	2-6	2-13
Cylinder head, valves, and related parts.	4-3	4-57
Rocker arm and shaft assembly, and related parts.	4-4	4-54
Cylinder block and related parts	4-5	4-57
Piston clearance chart	4-6	4-63
Connecting rod, bearing, piston, pins, and rings.	4-7	4-61
Camshaft and related parts	4-8	4-65
Crankshaft and related parts	4-9	4-67
Oil pump assembly and related parts	4-10	4-71
Timing gear cover	4-11	4-73
Fan blade, water pump pulley, thermostat, and related parts.	4-13	4-76

Table 4-15. Torque Wrench Specifications

Function or location	Thread size	Torque (pound feet)
Generator belt adjusting arm bracket to block attaching bolt.	7/16-14	47-56
	3/8-16	30-35
Generator mounting bracket attaching bolt.	1/2-13	58-65
Main bearing cap attaching bolt	7/16-14	55-60
Connecting rod cap attaching nut	3/8-24	40-45
Camshaft thrust plate attaching bolt	5/16-18	10-15
Cylinder head attaching bolt	7/16-14	60-65
Flywheel attaching bolt	7/16-20	75-85
Clutch pressure plate cover attaching bolt.	5/16-18	15-20
Spark plug	14 mm	18-20
Tappet cover attaching screw	1/4-20	3/4
Crankshaft pulley attaching bolt	9/16-18	50-55
Rocker arm shaft support attaching nut and bolt.	7/16-14	35-40
Rocker arm cover attaching nut	5/16-24	3-4
Intake manifold upper flange attaching bolt.	3/8-16	23-28
Intake manifold lower flange attaching bolt.	3/8-16	10-12
Exhaust manifold clamp attaching bolt	3/8-16	12-16
Oil pan attaching screw	1/4-20	3-5
Oil pan attaching bolt	5/16-18	9-12
Oil pump attaching bolt	5/16-18	9-12
Oil pump tube and screen attaching bolt	5/16-18	10-15
Water pump attaching bolt	5/16-18	10-15
Water outlet connection attaching bolt	5/16-18	10-15
Camshaft gear attaching bolt.	3/4-10	50-55
General torque specifications for bolts and nuts not listed.	1/4-20	3-5
	5/16-18	10-15
	5/16-24	15-20
	3/8-16	23-28
	3/8-24	30-35
	7/16-14	45-50
	7/16-20	50-60

NOTE

All bolts to be pulled up to torque gradually. All bolts to be tightened to an intermediate setting before any individual bolt is tightened to final setting.

Table 4-16. Sealer and Lubricants to Assemble Engine

Federal stock number	Amount	Use
OE-10 engine oil: 9150-265-9424	As required 5 quart (4-1) in crankcase with filter	For miscellaneous assembling—cylinder bores, pistons, piston rings, bearings, tappets, camshaft, intake and exhaust valve stems.
Sealing compound, water and oil-resistant: 8030-543-4384	As required	1. Cylinder head bolts. 2. Water pump bolts. 3. Drain cock 4. Flywheel bolts 5. Oil filter adapter bolts. 6. Distributor adapter bolts. 7. Oil level indicator tube. 8. Vacuum pump bolts. 9. Fitting (ventilation). 10. Camshaft gear bolts. 11. Pressure and temperature sending units.
Type 2 adhesive cement; (FSN 8040-262-9034) 1 quart	As required	Valve tappet cover gasket.
Lubricant (GAA) (FSN 9150-190-0904 and 2 or 9150-248-3476, and 1, 1 (b, as applicable)	As required	1. Crankshaft front & rear oil seal assy. 2. Main bearing cap bolts and connecting rod nuts—lubricant to be applied to threads and under bolt head to nut before installation. 3. Distributor mounting adapter bore. 4. Oil level indicator and seal cap.

Table 4-17. Oversize Service Parts Available

Part name	Oversize (o.s.) in inches	Ordnance part no.
Exhaust valve	0.005 O.S. on O.D.	7345218
Intake valve	0.005 O.S. on O.D.	7345259

CHAPTER 5

CARBURETOR

Section I. HOLLEY CARBURETOR MODELS 7017440 and 7017440-1

5-1. Tabulated Data

Choke	Manual
Choke flange	Std. SAE 1¼ in.
Float setting (dry)	1 5/16 in. from machined edge of bowl cover to uppermost surface of molded float (cover inverted).
Fuel pressure	4.5 psi
High speed bleed	One No. 71 drill drive hole
Holley part number	R-1345-1A
Idle adjustment	¾ turn from full closed position
Idle air bleed	One No. 61-drill-size hole
Idle needle	15 R-34 (15°)
Idle tube	Stamped No. 54 .020-.022 in.
Main metering jet	Stamped No. 64
Manufacturer	Holley
Model number	2160
Army part number	7017440
Power valve	Stamped No. 38; one No. 62 drill size hole.
Pump capacity	12-16cc at setting
Type	Side draft
Venturi	Single 1 1/32 in. diameter

5-2. Operation

a. Float System (fig. 5-1). Purpose of the float system is to maintain fuel at a predetermined level in the flat chamber. A regulated flow of fuel under pressure from the fuel pump enters the carburetor through a fine mesh screen, passes the fuel inlet needle and seat and flows into the float chamber. The fuel flow is determined by the level of fuel in the float chamber. As the level goes down, the carburetor float goes down, thereby allowing the needle to unseat and fuel to enter. As the fuel level rises, the float rises, raising the needle valve which reduces the fuel flow into the float chamber. When the float reaches a predetermined height, the needle valve seats, cutting off the flow of fuel. A tab on the float lever prevents the float from dropping low enough to touch the bottom of the float chamber. Float level is extremely important. Too high a float level will likely result in an overrich mixture and loss of operating economy. Too low a float level will result in an overlean mixture and loss of power and economy. Only when the float is at its specified level will the other systems meter properly.

b. Main Metering System (fig. 5-2). Purpose of the main metering system is to inject sufficient fuel into the air stream to provide correct fuel-air ratio for normal engine operating conditions. Fuel from the float chamber flows through the main metering jet, which limits the amount of fuel passing through to the main well. Gravity forces fuel to fill the main well to the level allowed by the float; vacuum then pulls the fuel from main well to main well tube. Vacuum also determines the amount of fuel pulled from the main well tube through a passage to the discharge nozzle. A high speed bleed vents the main tube and is designed to introduce air to the main metering system, thus preventing too-rich mixtures. Introducting air to the fuel at this point also serves to provide a mixture of fuel and air which vaporized more readily. A restriction in the high-speed bleed passage limits the amount of air passing through, preventing an overlean mixture. Position of the throttle plate controls the fuel-air mixture passing through the venturi, thus regulating speed and power output of the engine in direct relation to accelerator pedal or hand throttle movement.

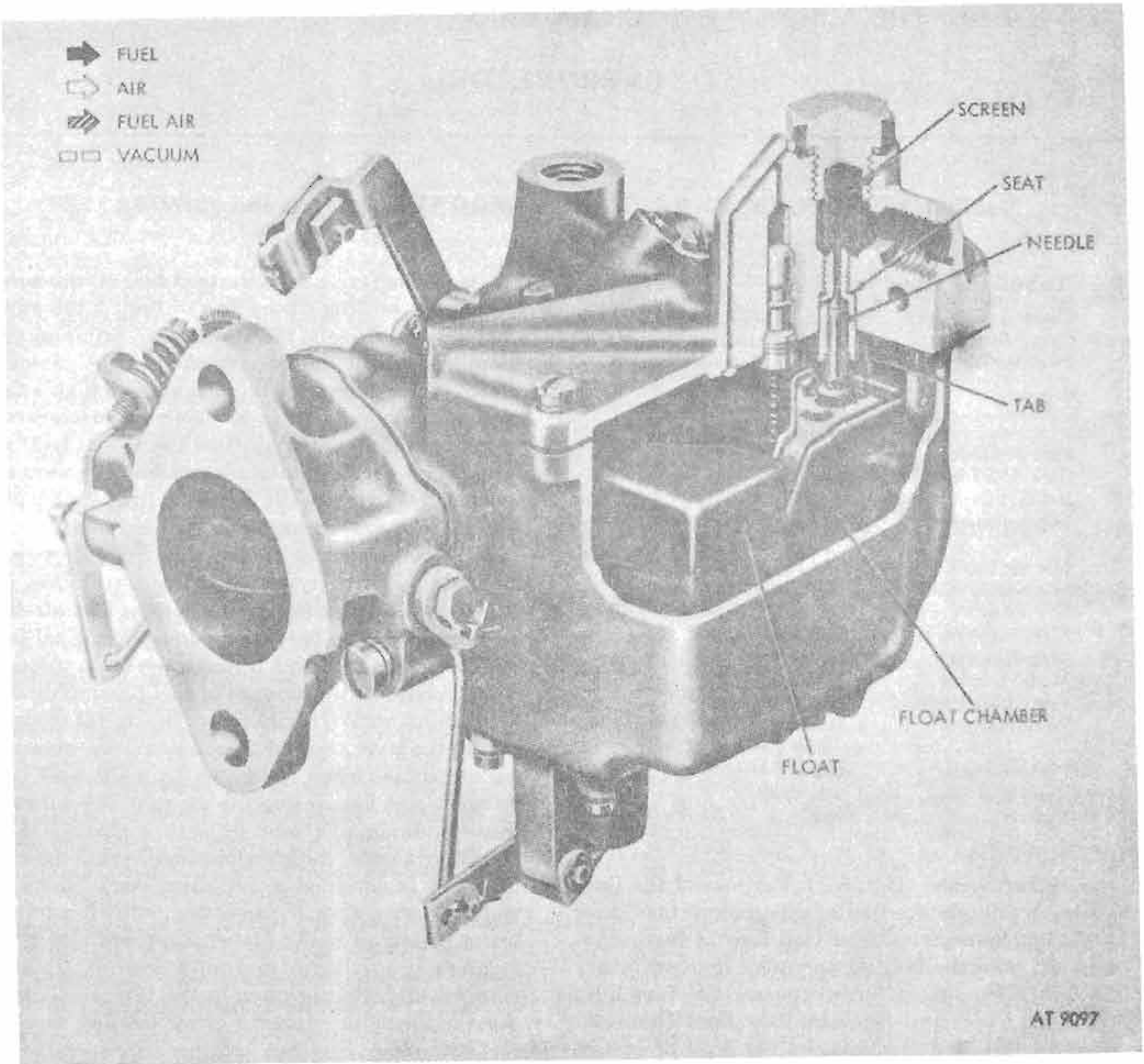


Figure 5-1. Float system.

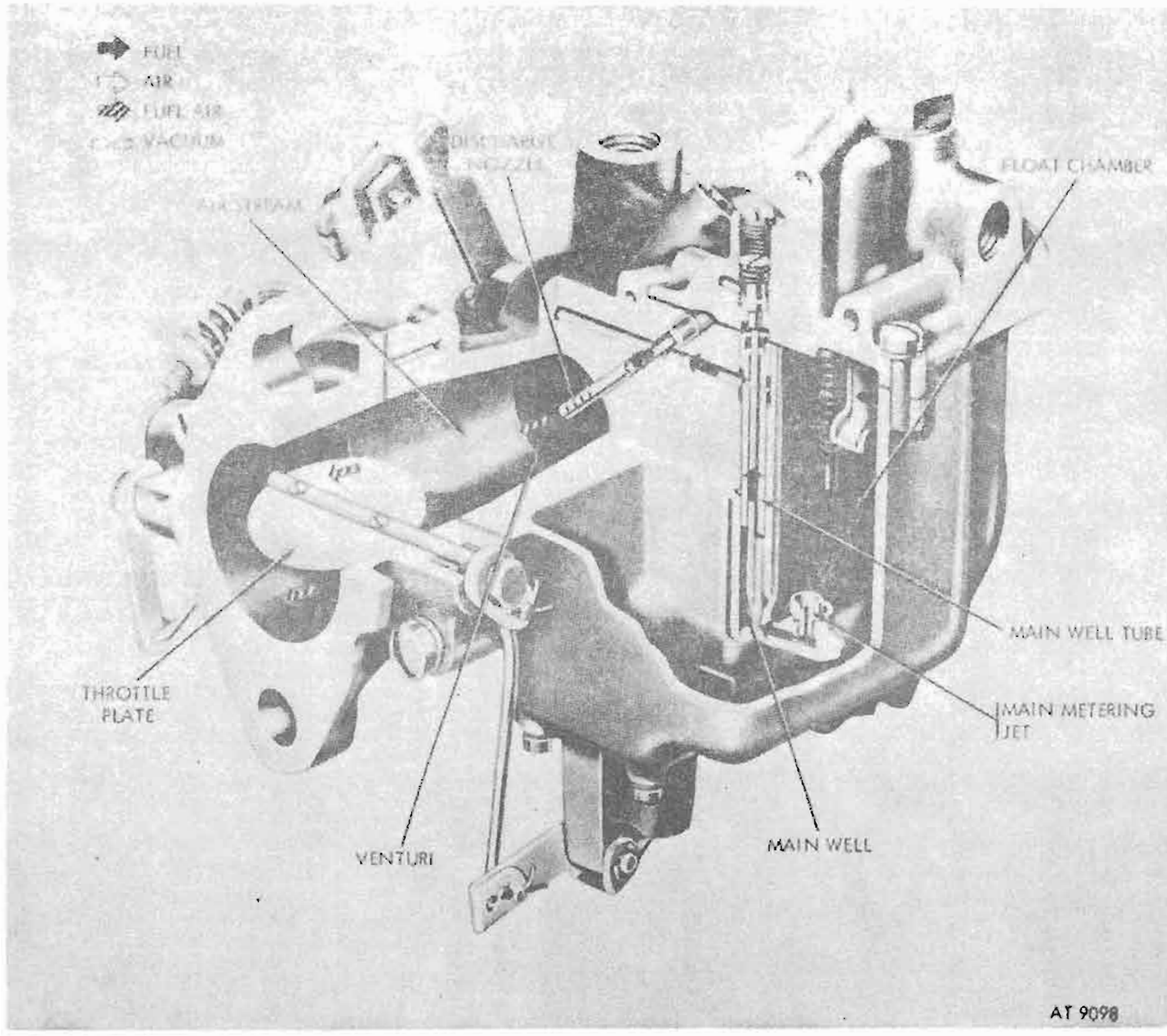


Figure 5-2. Main metering system.

c. *Idle Fuel System* (fig. 5-3). Purpose of the idle system is to provide proper air-fuel mixture at idle and extremely low speeds. At idle and low speeds, air flow through the carburetor is slow and vacuum created in the venturi is not sufficient to operate the main metering system. Intake manifold vacuum is high because the nearly closed throttle plate has greatly restricted air flow. This high manifold vacuum provides the pressure differential which operates the idle system. The idle system functions independently of any other system from idle to part-throttle. From part-throttle to full-throttle the main metering system gradually takes over, and the idle system ceases to function. Fuel enters the idle tube located in the main well tube. The idle tube has a restriction at the bottom end to control the amount of fuel entering. The idle bleed passage introduces air to the fuel at the top of the idle tube. A restriction in this idle bleed passage controls the amount of air introduced. From the idle tube the fuel passes through a passage in the cover into the main body, then to the throttle body. A restriction in the throttle body limits the amount of fuel passing through the idle system. From the throttle body the fuel travels to the idle adjusting needle orifice and is discharged at the idle discharge hole. The idle adjusting needle controls the mixture discharged at idle only. Two fuel transfer holes are drilled into the idle passage ahead of the needle. With the throttle plate closed, the two transfer holes serve as air-bleed passages, mixing additional air with the idle fuel. As the throttle plate opens, it passes one of the holes. This hole allows fuel to pass through, providing proper fuel-air mixture. The other hole still serves as an air bleed at this point. As the throttle plate opens further, it passes the second fuel transfer hole, allowing additional fuel to flow through. The flow from the idle system tapers off as the main metering system begins to operate with increased throttle openings. This provides smooth transition from idle to cruising speeds.

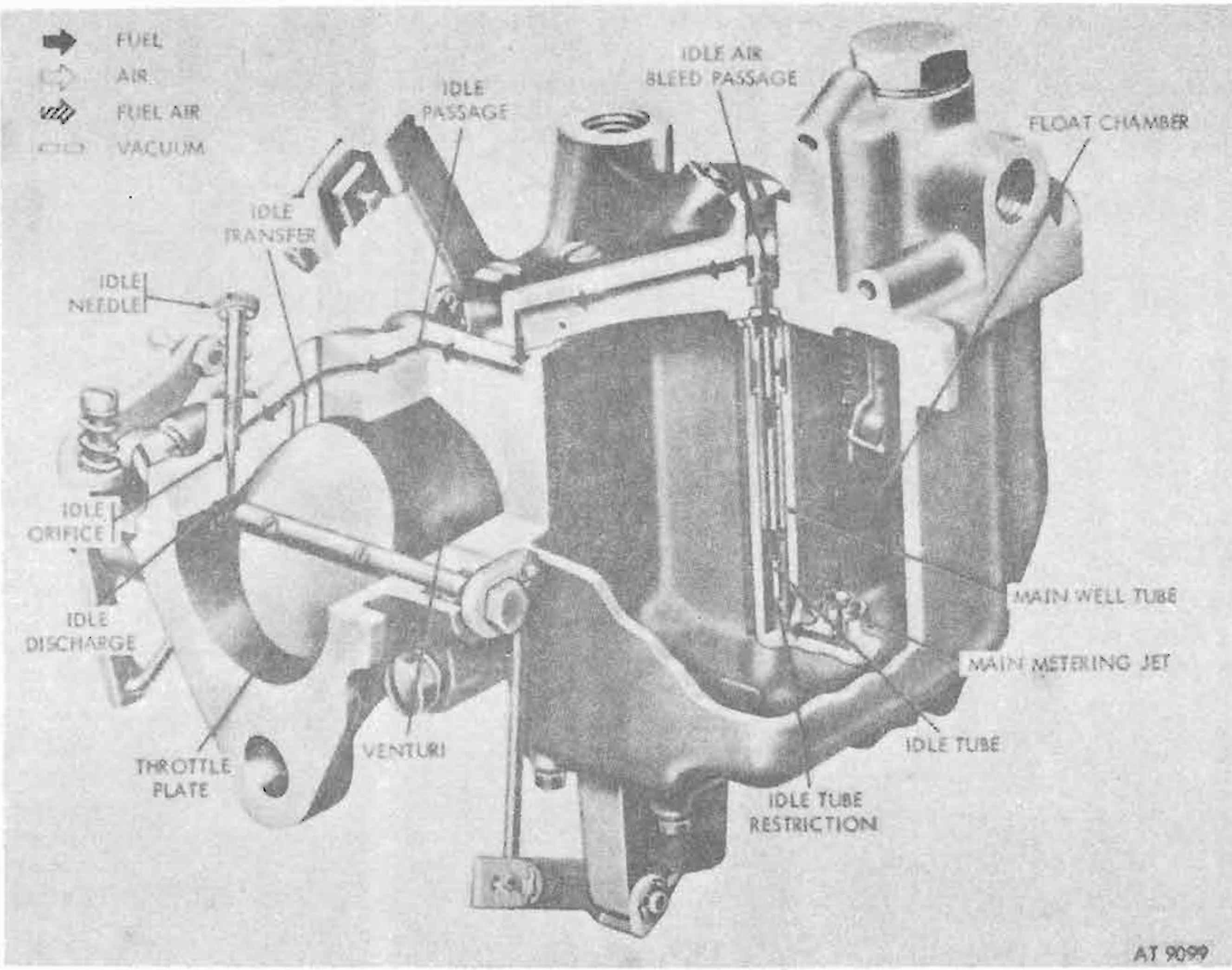


Figure 5-3. Idle fuel system.

d. Power System (fig. 5-4). Purpose of the power system (sometimes called economizer system) is to supply added fuel for a proper mixture to enable the engine to develop maximum power. The main metering system by itself cannot deliver maximum power. The main metering system by itself cannot deliver sufficient fuel to supply engine needs at high speed and full power. At idle and cruising speeds, manifold vacuum is strong enough to hold the power valve actuating piston up against the compressed load of the spring. When a high engine load is applied (when the throttle opens suddenly on acceleration) manifold vacuum drops. The drop in vacuum allows the spring to expand, forcing piston and stem assembly down, moving the power valve to the open position. Depressing the valve opens it and allows fuel to pass through. Amount of vacuum loss determine how far the valve is pushed down, which in turn determines the amount of fuel passing through the valve. Fuel passing through the valve goes into the main well, where it joins the fuel flow of the main metering system to obtain proper mixture for full power. In effect, the power system augments the main metering jet allowing additional fuel to pass through the carburetor.

e. Accelerating Pump System (fig. 5-5). Purpose of the accelerating pump system is to supply extra fuel necessary to maintain proper fuel-air mixture when the engine is accelerated. Air flow responds immediately to a suddenly opened throttle, but gasoline, being heavier than air, is slower to move. The accelerating pump system operates during this time lag to supply extra fuel until other systems can again provide proper mixture. When the throttle is opened, mechanical linkage actuates the accelerating pump arm. The arm pushes against the accelerating pump diaphragm forcing fuel from the accelerating pump chamber into a passage in the main body past a needle check valve. The fuel then flows through another passage through the pump discharge nozzle, and into the carburetor venturi. The pump discharge nozzle contains a metering hole which controls the rate at which fuel passes into the air stream. An air passage takes in air ahead of the choke plate to prevent siphoning action. The same air passage serves as an air bleed to mix air with fuel before it is discharged through the pump discharge nozzle. The pump discharge chamber is kept filled by means of a ball check valve which opens by suction caused when the pump diaphragm returns to normal position. The check valve also prevents fuel being pushed back into the float chamber during accelerating pump strokes. The needle check valve prevents air from being drawn into the pump discharge chamber when the diaphragm returns to normal position. The needle valve also aids in preventing siphoning.

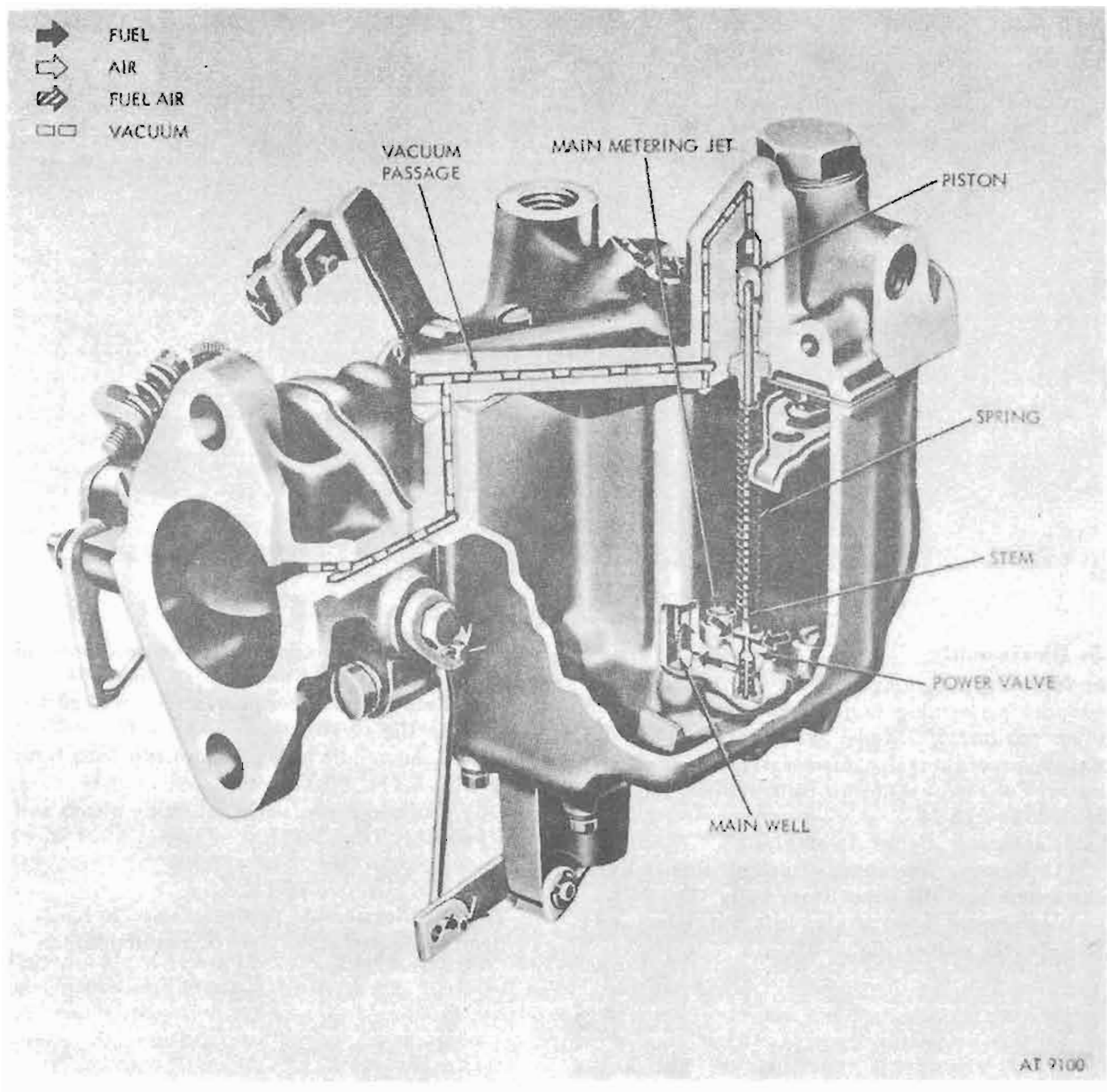


Figure 5-4. Power system.

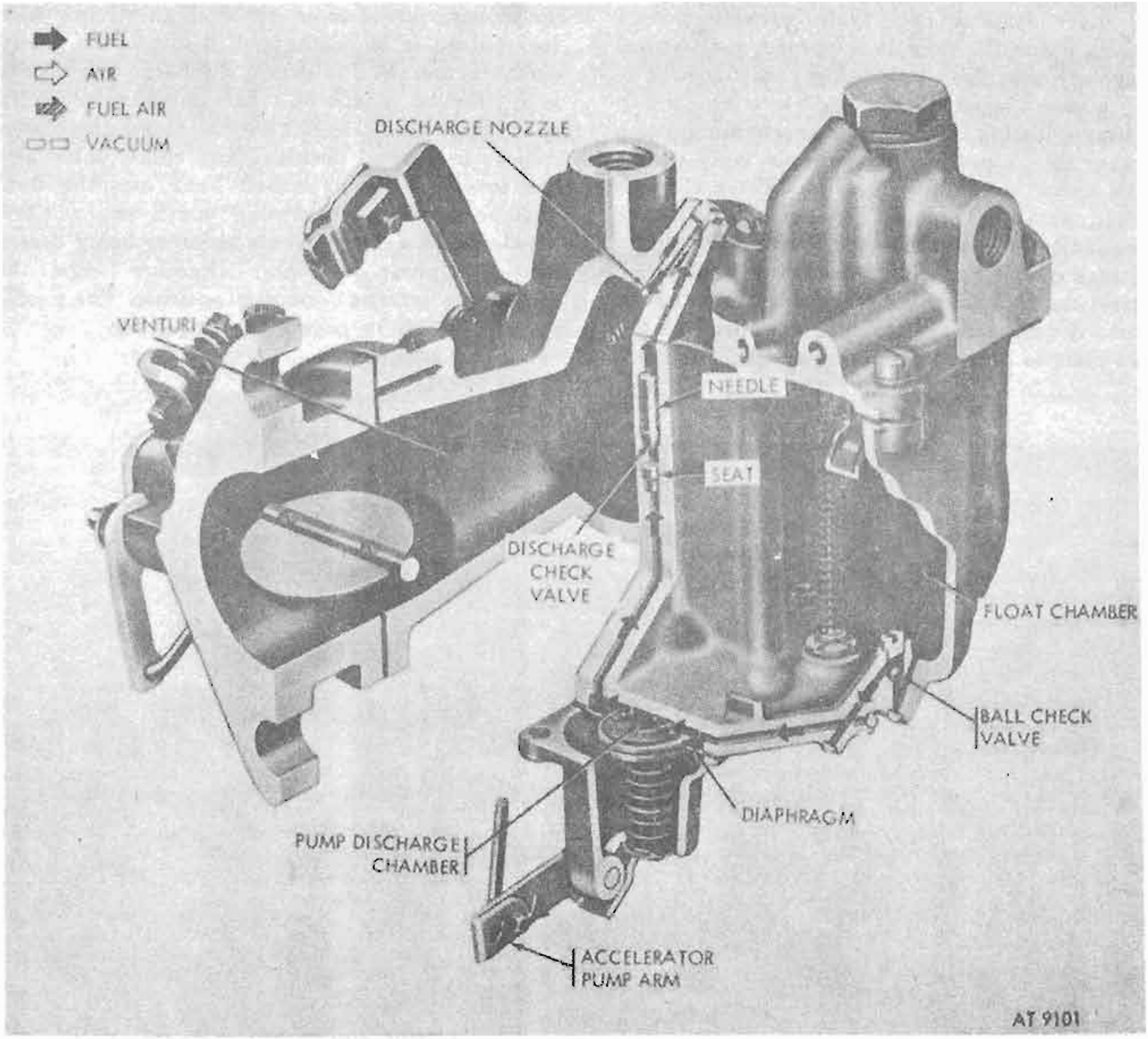


Figure 5-5. Accelerating pump system.

5-3. Disassembly

The following information is for the guidance of personnel performing major repair work on the Holley carburetor Model 2160 (fig. 5-6). It provides procedures for disassembly of the carburetor. For removal of unit from vehicle, refer to TM 9-2320-218-20.

a. *Carburetor Cover Assembly.*

(1) Remove five cover attaching screws and lockwashers and lift cover from body (fig. 5-7).

(2) Remove float shaft. Lift out float and remove cover gasket (fig. 5-8).

(3) Tilt cover to allow fuel inlet needle to fall out. Remove fuel inlet needle seat (fig. 5-9).

(4) Remove fuel filter plug, screen, and gasket from cover (fig. 5-10).

(5) Remove idle tube plug and idle tube from cover (fig. 5-11).

(6) Remove power valve actuating piston and stem assembly (fig. 5-12).

NOTE

Do not disassemble this assembly. It has been calibrated at the time of manufacture.

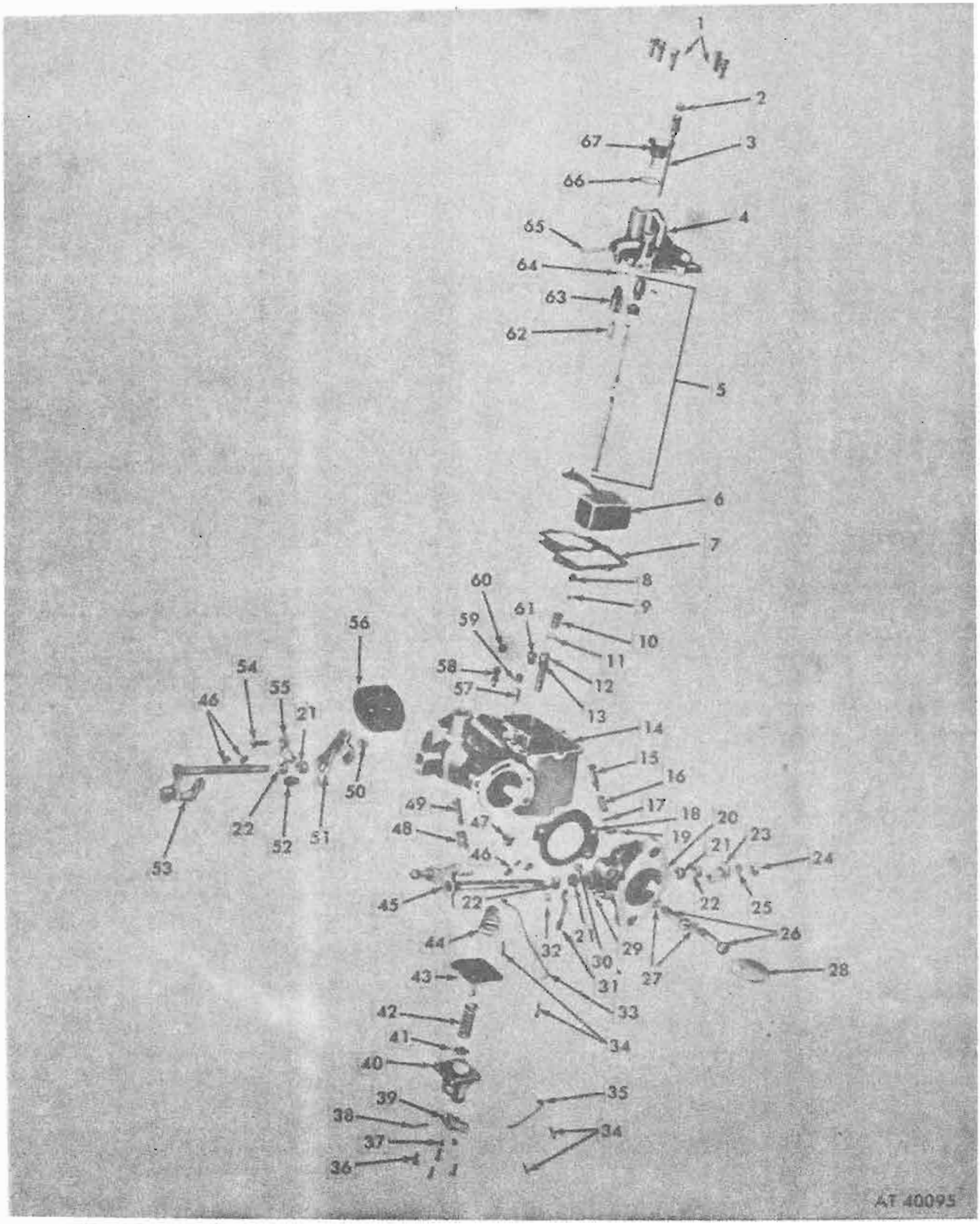


Figure 5-6. Holley carburetor model 2160—exploded view.

Key to figure 5-6:
1 Screw and washer assembly
2 Plug, idle tube
3 Tube assembly, idle
4 Cover
5 Piston and stem assembly
6 Float
7 Gasket
8 Plug
9 Ball, check valve
10 Valve assembly
11 Gasket
12 Tube
13 Gasket
14 Main body
15 Needle
16 Spring
17 Washer
18 Gasket
19 Gasket
20 Body
21 Packing
22 Retainer
23 Lever
24 Nut
25. Washer
26 Screw
27 Washer
28 Plate
29 Pin
30 Plug
31 Cam
32 Ring
33 Rod
34 Pin
35 Link
36 Screw and washer
37 Ring
38 Pin
39 Lever
40 Cover
41 Retainer
42 Spring
43 Diaphragm
44 Spring
45 Throttle lever
46 Screw
47 Plug
48 Spring
49 Screw
50 Nut
51 Bracket
52 Screw
53 Shaft and lever assembly
54 Screw
55 Clamp
56 Plate
57 Needle
58 Nozzle
59 Plug
60 Plug
61 Jet
62 Needle
63 Seat
64 Gasket
65 Pin
66 Gasket
67 Strainer assembly

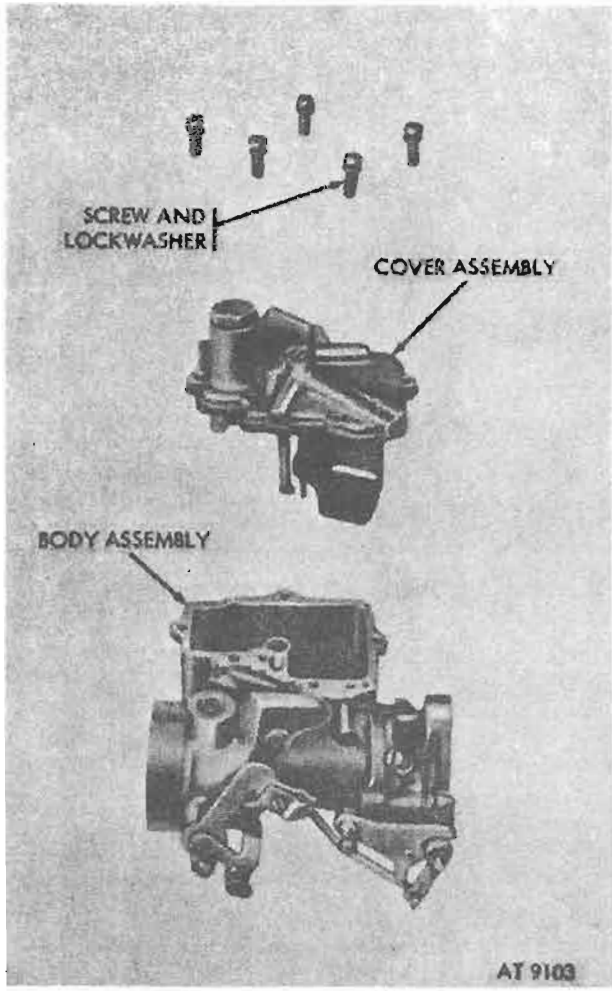


Figure 5-7. Carburetor cover and attaching screws.

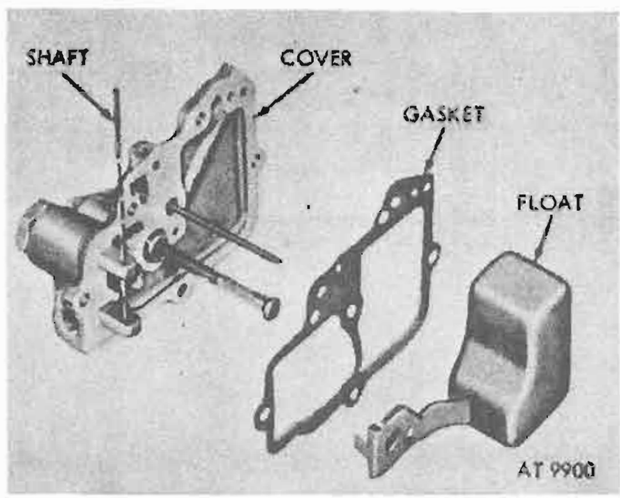


Figure 5-8. Carburetor float and float shaft.

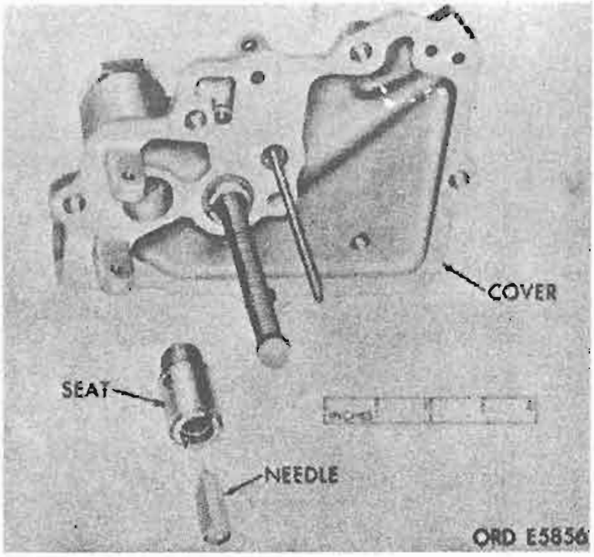


Figure 5-9. Inlet needle seat and needle.

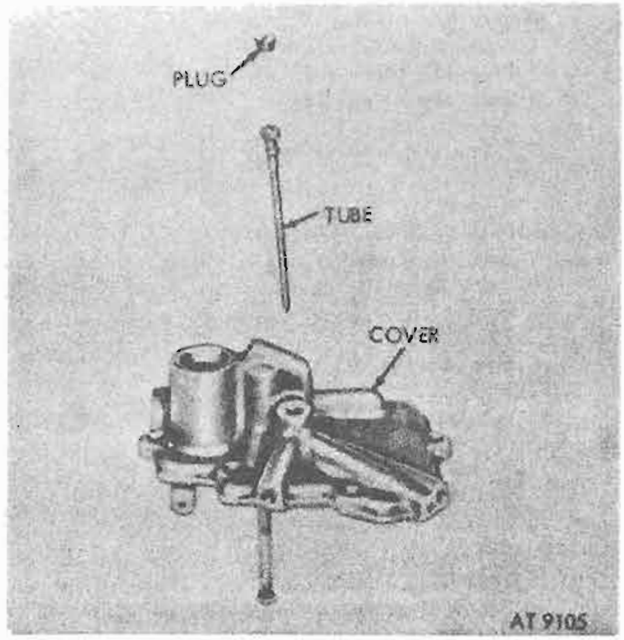


Figure 5-11. Idle tube and plug.

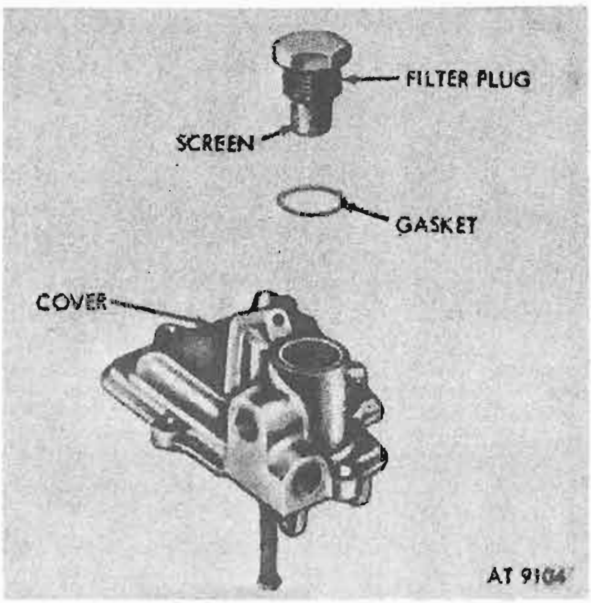


Figure 5-10. Fuel filter screen assembly and gasket.

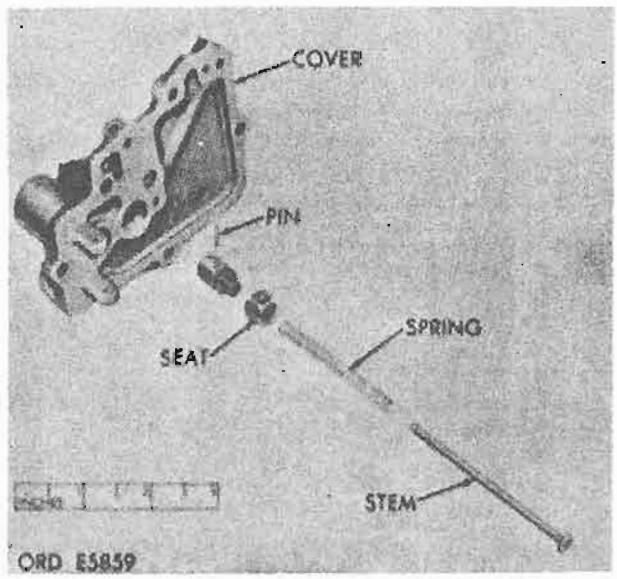


Figure 5-12. Power valve actuating piston assembly.

b. Carburetor Throttle Body Assembly.

(1) Remove idle-speed regulating screw and spring. Remove idle adjusting needle, seal, seal retainer, and spring (fig. 5-13).

(2) Remove cotter pin from arm on throttle shaft (fig. 5-14).

(3) Remove cotter pin from accelerating pump arm. Remove actuating rod (fig. 5-14).

(4) Remove two mounting screws. Take off throttle body and gasket. Discard gasket (fig. 5-15).

(5) Remove nut and lockwasher and take off actuating arm (fig. 5-16).

(6) File the two throttle plate screws to remove staking and remove screws. Remove throttle plate. Remove throttle shaft and lever from body. Remove seals and seal retainers (fig. 5-17).

NOTE

Before removing throttle shaft, scribe a line on the plate along the throttle shaft so that the plate may be positioned correctly at assembly.

(7) Remove cotter pin from fast-idle cam lever (fig. 5-18).

(8) Remove snap ring and lift off cam lever (fig. 5-18).

c. Accelerating Pump Assembly.

(1) Remove four mounting screws from pump diaphragm cover assembly.

(2) Remove accelerating pump cover diaphragm assembly and pump return spring from carburetor (fig. 5-19).

(3) Remove two snap rings from accelerating pump arm shaft (fig. 5-20).

(4) Compress pump to remove arm from actuating spring and diaphragm. Remove shaft (fig. 5-20).

d. Choke Plate.

NOTE

Before removing choke plate, scribe a line along edge of choke plate to help position plate at assembly.

(1) Remove attaching screw from choke control bracket (fig. 5-21).

(2) Remove cotter pin from choke-idle speed rod and disconnect rod from choke arm (fig. 5-22).

(3) File choke plate screws to remove staking and remove screws from choke plate. Remove the choke plate and pull out shaft. Remove seal, seal retainer, and choke control bracket (fig. 5-23).

e. Miscellaneous Parts. Remove main well tube (5), power valve (8), and gasket (11), main metering jet (7), pump inlet valve plug (9), pump discharge needle (2) and seal (1), pump discharge nozzle plug (6), and pump discharge nozzle (4), (fig. 5-24).

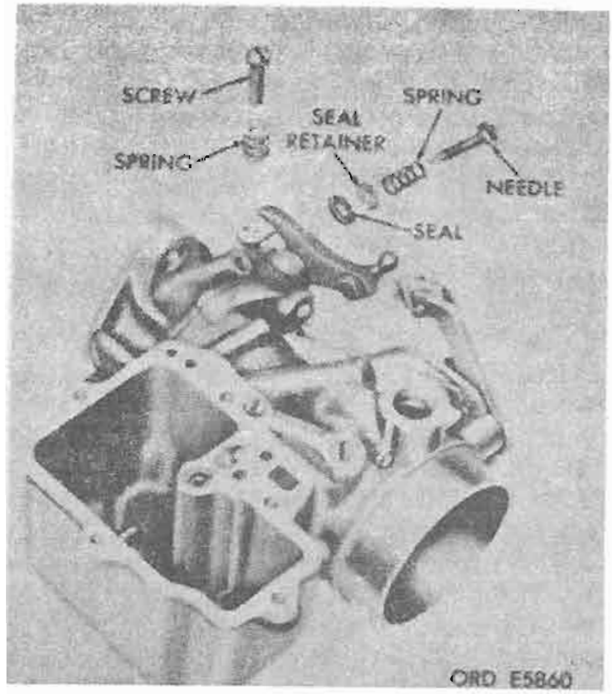


Figure 5-13. Idle speed regulating screw and related parts.

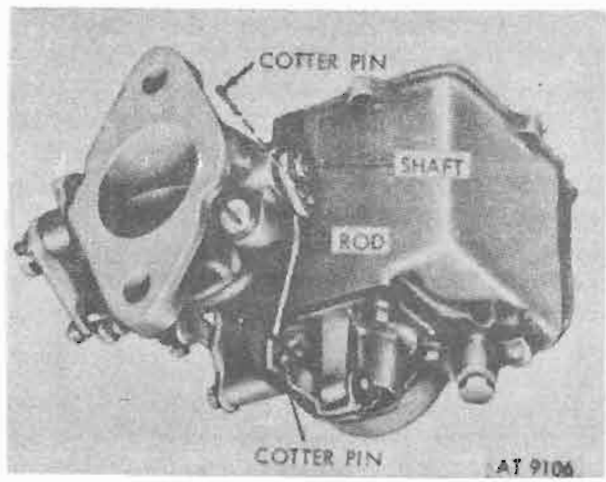


Figure 5-14. Throttle shaft and arm.

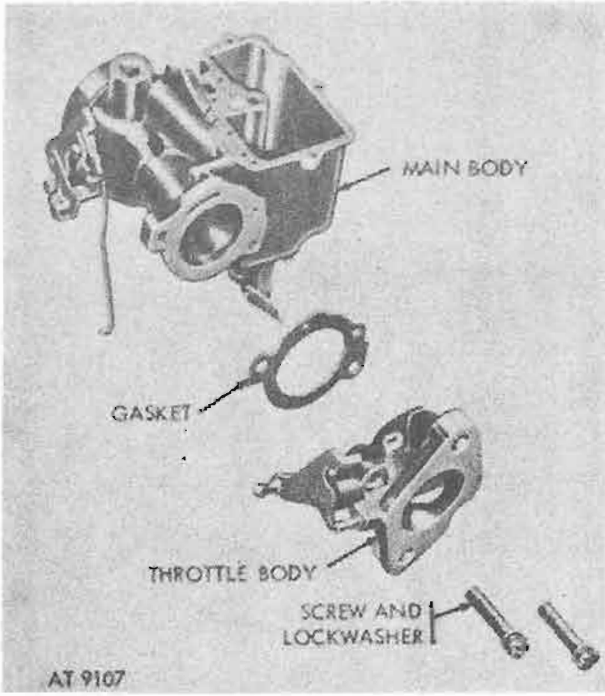


Figure 5-15. Throttle body and gasket.

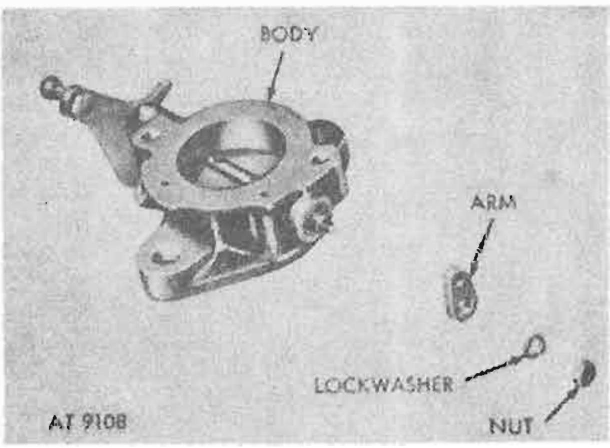


Figure 5-16. Accelerating pump actuating arm and attaching hardware.

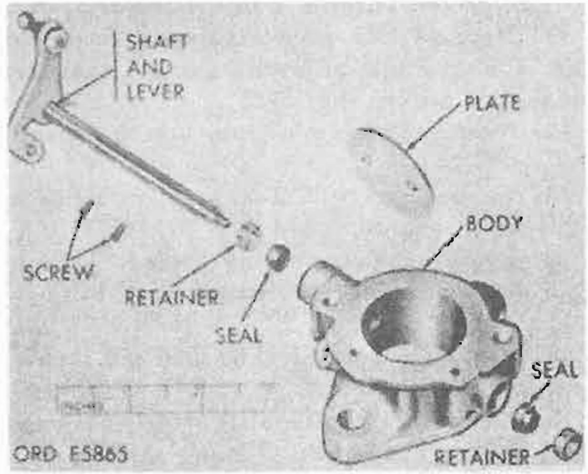


Figure 5-17. Throttle shaft and related parts.

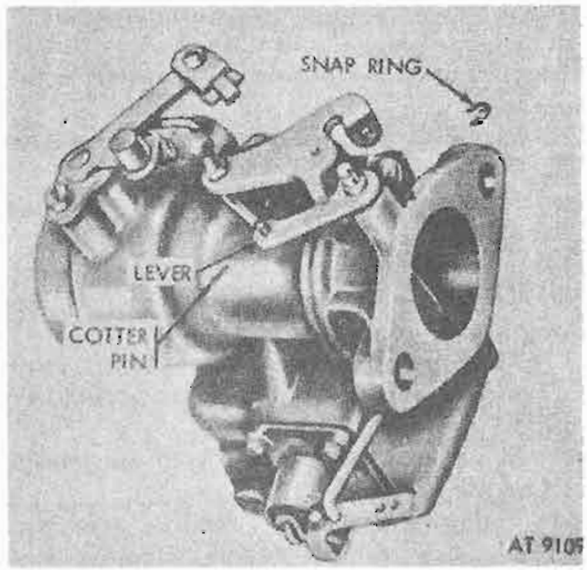


Figure 5-18. Idle lever.

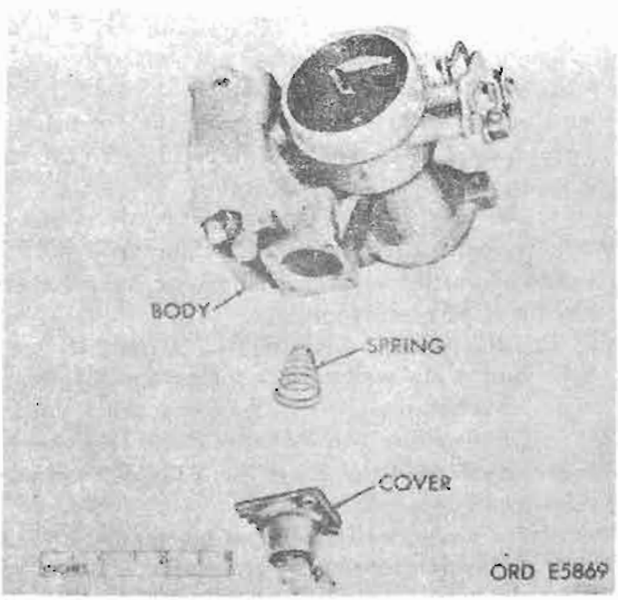


Figure 5-19. Pump diaphragm cover and return spring.

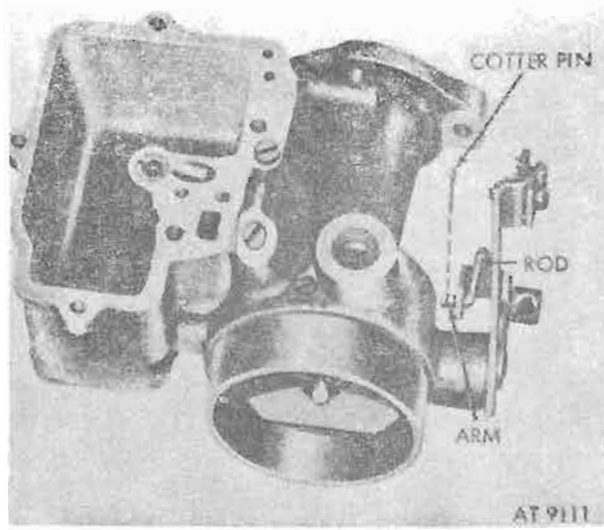


Figure 5-22. Choke arm and idle speed rod.

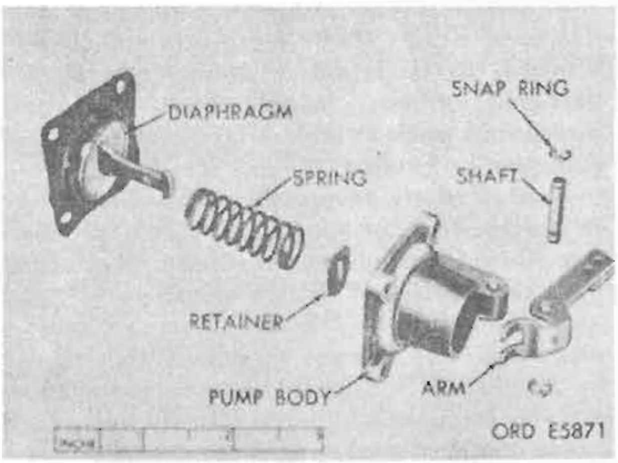


Figure 5-20. Accelerating pump assembly.

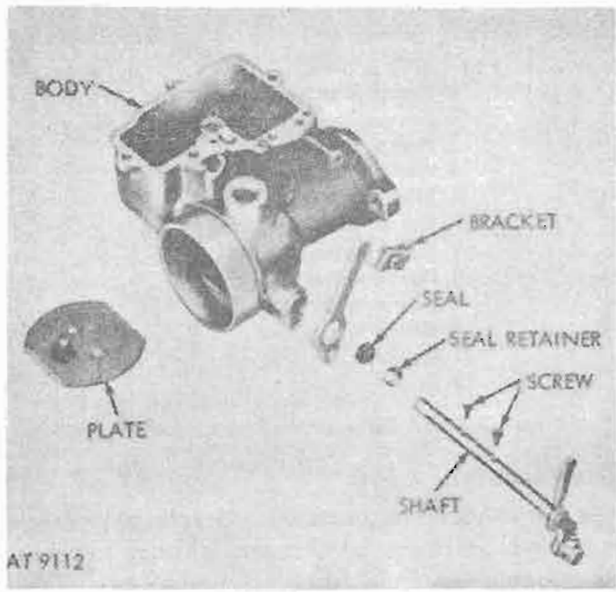


Figure 5-23. Choke shaft and related parts.

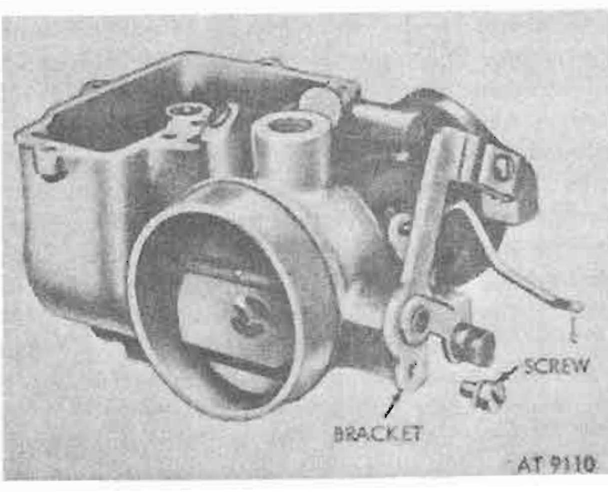
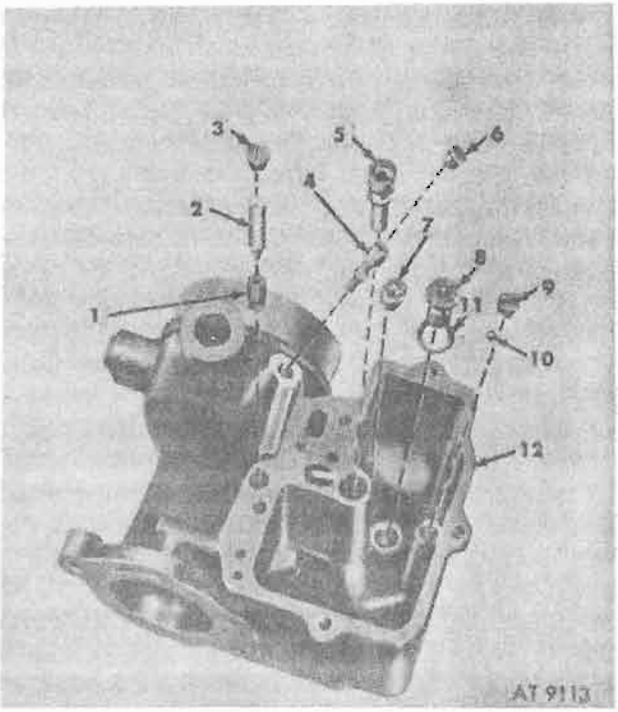


Figure 5-21. Choke control bracket.



1 Pump discharge needle seat
2 Pump discharge needle
3 Pump discharge plug
4 Pump discharge nozzle
5 Main well tube
6 Pump discharge nozzle plug
7 Main metering jet
8 Power valve
9 Pump inlet valve plug
10 Pump inlet valve
11 Gasket
12 Body

Figure 5-24. Carburetor miscellaneous parts.

5-4. Cleaning

a. Clean all metal parts with drycleaning solvent or mineral spirits paint thinner. Be sure to remove all grease, oil, and dirt. Remove any gasket material sticking to surfaces. Remove all carbon deposits from valve plate or throttle bore.

NOTE

Never use a wire, drill, or similar object to clean air or fuel passages.

b. Wipe all parts that cannot be immersed in solvent with clean, soft, dry cloth. Be sure all dirt, gum, and other foreign matter are removed from all parts.

c. After all parts are clean, dry with compressed air. Blow out thoroughly and dry all passages.

5-5. Inspection and Repair

a. Float. Inspect float for cracks, pin holes, loose float lever, or other damage. Inspect lever arm for distortion. Inspect float shaft for damage or wear. Discard any damaged part. Check float for leaks by holding under water heated to just below boiling point. Bubbles will appear if there is a leak. Discard a float that leaks.

b. Inlet Needle Valve. Inspect inlet needle valve and valve seat for signs of wear or corrosion. Inspect point of valve for ridges or other damage. Discard valve if any are found.

c. Idle Adjusting Needle. Inspect idle adjusting needle for signs of wear and damage. Make sure point of needle is free of ridges or burrs. Discard needle if any are found.

d. Idle Tube and Main Well Tube. Inspect idle tube and main well tube housing for foreign particles. Make sure all dirt has been removed.

e. Choke Plate and Throttle Plate. Inspect choke plate and throttle plate for bends, burrs, or damaged edges. Make sure plates are free of carbon deposits. Very small burrs can be cleaned up with a file; if they cannot be, discard plates. Check poppet valve for ease of operation.

f. Choke Shaft and Throttle Shaft. Inspect shafts of choke shaft and lever assembly and of throttle shaft and lever assembly for signs of wear and damage. Inspect shafts for bends and scratches. Discard any shaft that is not straight or that is damaged. Check throttle shaft for correct dimensions (refer to table 5-1). Check for excessive looseness or binding.

g. Main Body. Inspect float chamber and body for cracks, dents, or other signs of damage. Discard if any of these conditions are found. Make sure all passages are free of foreign particles.

h. Miscellaneous. Discard all screws, nuts, and plugs that have stripped threads. Check all valves for freedom of movement. Inspect gasket mating surfaces for nicks and burrs. Discard any part that has a damaged gasket surface.

5-6. Assembly

For assembly of the carburetor follow the procedures in the order given. At each assembly operation, reference is made to a disassembly illustration which should be followed in reverse order. Also refer to figures 5-6 and 5-24 for exploded views of the carburetor.

a. Miscellaneous Parts. Install pump discharge nozzle and plug; install pump discharge seat, needle and plug; install main well tube; install power valve and gasket, main metering jet, and pump inlet valve and plug in main body (fig. 5-24).

NOTE

Refer to paragraph 5-7 (adjustment) if new accelerating pump valve is installed.

b. Choke Plate. Slip choke plate on shaft and lever, taking care to position plate in alinement with scribe mark made during disassembly (fig. 5-23). Install screws but do not tighten. Hold choke in fully closed position to note amount of light clearance around circumference of plate. Adjust until minimum light appears around plate. Tighten screws while holding choke in closed position and stake. Connect idle-speed rod (fig. 5-22) and secure with cotter pin. Fasten shaft lever with mounting screw and lockwasher (fig. 5-21).

c. Accelerating Pump. Compress pump to install arm on spring and diaphragm assembly (fig. 5-20). Place snap rings on arm shaft (fig. 5-20). Position spring against carburetor body and secure pump cover with four mounting screws.

d. Carburetor Throttle Body. Slip throttle plate into throttle shaft and lever in throttle body. Position throttle plate in throttle shaft, using scribe mark as a guide (fig. 5-17). Install screws but do not tighten. Close throttle and aline throttle plate in bore so equal amount of light shows all around plate. Then tighten screws while plate is held in closed position. Stake screws. Install accelerating pump arm and retaining nut and washer (fig. 5-16). Mount throttle body and gasket to carburetor body with two mounting screws (fig. 5-15). Connect linkage between accelerator pump arm and shaft and secure with cotter pins (fig. 5-14). Install idle adjusting needle, seal, washer, and spring and idle-speed regulating screw and spring (fig. 5-13).

NOTE

Screw idle adjusting needle down gently until it is seated, then back it off three-quarters of a turn. Do not force needle against its seat.

e. Cover Assembly. Install power valve actuating piston and stem assembly (fig. 5-12).

CAUTION

The number of nylon spacers at the base of the stem will vary from zero to four; therefore, the piston, stem, spring, and any spacers must be serviced as an assembly.

Install idle tube and idle tube plug (fig. 5-11). Install fuel filter screen, plug and gasket (fig. 5-10). Install fuel inlet needle seat and fuel inlet needle (fig. 5-9). Install float with new gasket; secure float with float shaft (fig. 5-8).

NOTE

See paragraph 5-7 (adjustment) if new fuel inlet needle is installed. Before attaching cover assembly to main body, adjust float level (fig. 5-25).

5-7. Adjustment

a. Before attaching cover assembly to main body, adjust float level, refer to figures 5-25 and 5-26.

(1) With gasket off carburetor and with cover inverted, use improvised tool to measure 1 5/16 in. from machined surface of cover to uppermost surface of float (fig. 5-25).

(2) Adjust float by bending tab on float arm (fig. 5-26).

b. If new accelerator pump needle (fig. 5-24) or new fuel inlet needle (fig. 5-9) is installed, be sure needles seat properly. To seat new fuel inlet needle, tap lightly with small hammer. To seat new pump needle, use small hammer and suitable size drift.

5-8. Repair Standards
(fig. 5-27)

The repair standards included herein give the minimum, maximum, and key clearances of new and used parts. They also give wear limits which indicate that point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the wear limits column or damaged from corrosion will be approved for service. An asterisk (*) in the wear limits column indicates that the part or parts should be replaced when worn beyond the limits given in the size and fit of new parts column. In the size and fit of new parts column, the letter "L" indicates a loose fit (clearance). Refer to table 5-1.

Table 5-1. Repair Standards

Fig. No.	Reference No.	Point of measurement	Size of fit of new parts	Wear limit
		Throttle body assembly:		
5-27	1	Diameter of Shaft	0.249 to 0.250	0.238
5-27	2	Diameter of shaft bore in body.	0.252 to 0.254	0.255
5-27	1,2	Fit of shaft in bore	0.002L to 0.005L	0.008
		Accelerator pump assembly:		
5-27	3	Free length of accelerator pump return spring.	0.97 to 1.03	*
5-27	4	Free length of accelerator pump operating spring	1.33 to 1.39	*
		Main body assembly:		
5-27	5	Diameter of choke shaft	0.249 to 0.250	0.247
5-27	6	Diameter of shaft bore in body.	0.252 to 0.254	0.255
5-27	5,6	Fit of bore	0.002L to 0.005L	0.008

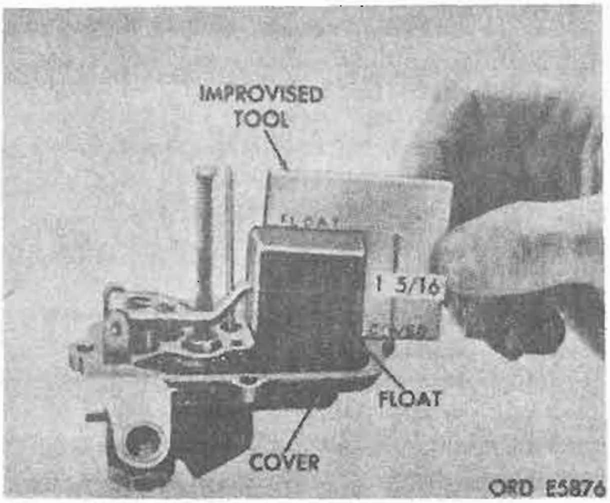


Figure 5-25. Adjusting float level.

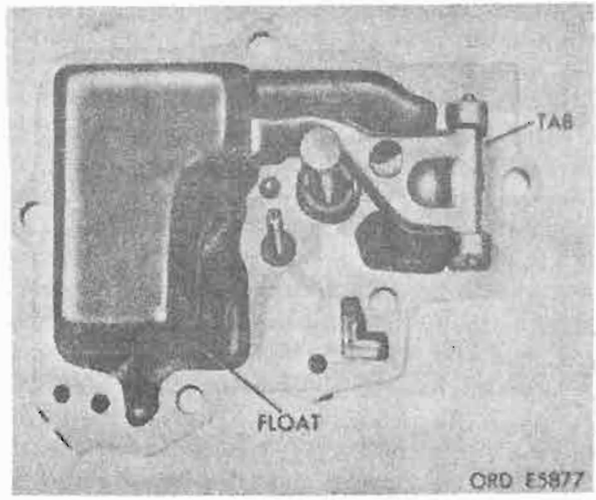


Figure 5-26. Float arm tab.

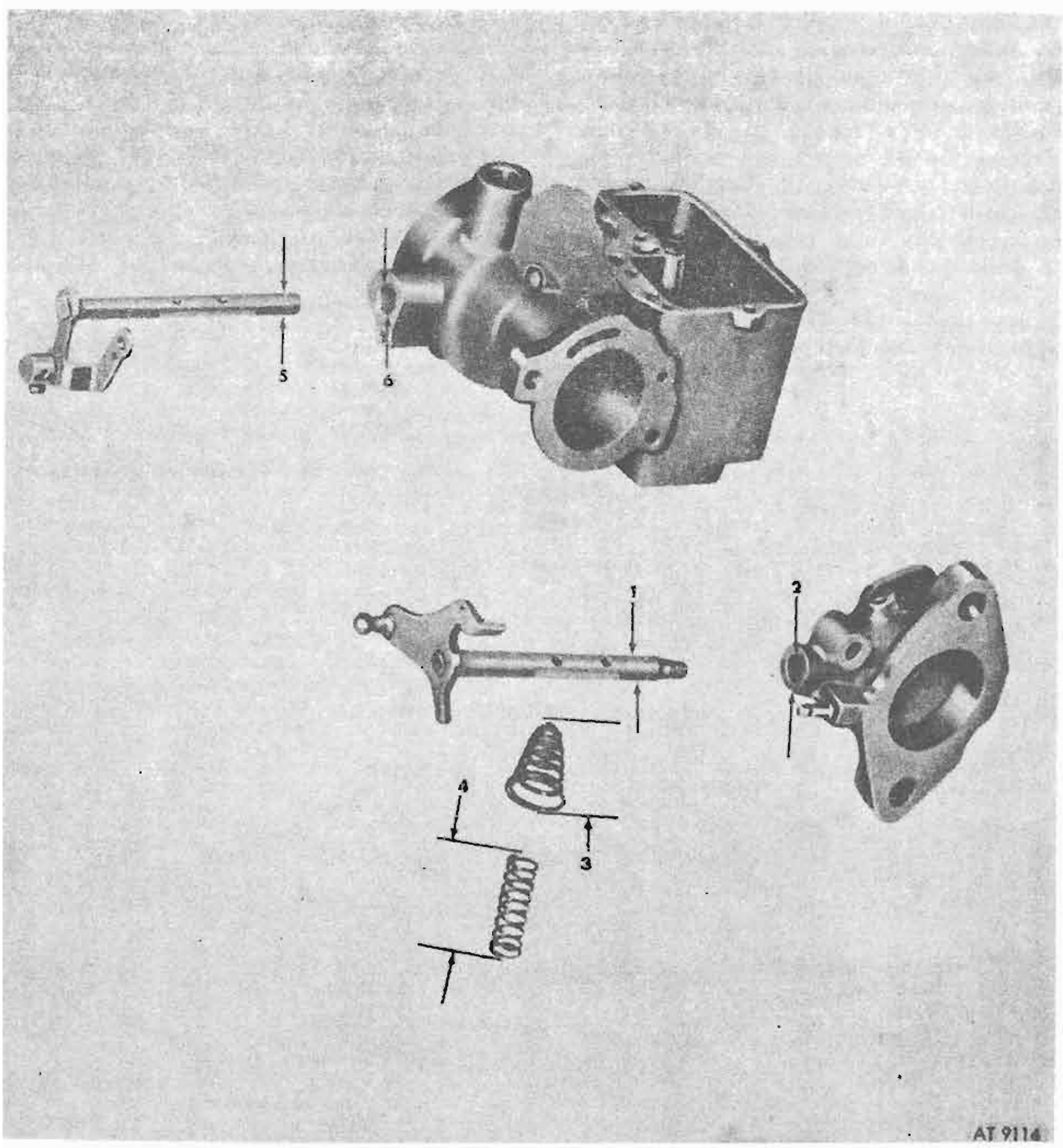


Figure 5-27. Repair standards, reference points.

Section II. ZENITH CARBURETOR MODELS 10939511 and 11641105

5-9. Overhaul Instructions

The following information is for the guidance of personnel performing major repair work on the Zenith carburetor model 10939511. It provides procedures for overhaul of the carburetor. For removal of the unit from the vehicle, refer to TM 9-2320-218-20. For identification of the parts being removed refer to figure 5-28.

NOTE

All valves and jets, needle and needle seats, tubes and diaphragms must be inspected for cleanliness, damage and ease of operation. All damaged or worn parts must be replaced. Gasket surfaces must be clean and new gasket used.

a. Remove the four screws and lockwashers (42) holding the pump cover (41) to the fuel bowl (39). Remove and set aside the spring (43) and diaphragm (40).

b. Remove the fuel filter head (1) located on top of the fuel inlet boss of the throttle body (11), and remove the fuel filter element (3) and clean with solvent and compressed air. Use care not to damage filter element. If damaged or broken replace element.

c. Remove the six screws and washers (48) retaining the fuel bowl body (39). Carefully remove the fuel bowl, taking care to withdraw it in a straight line directly away from the throttle body (11) to avoid damaging the float or any of the various brass tubes.

d. Remove the idle tube (37), and place the fuel bowl (39) to one side for now.

e. Drive out the float axle (51) with a small punch. Note that one end of the axle is knurled; drive axle from smooth end. Remove the float (36), fuel valve needle (52), and bowl gasket (35).

f. Using small screwdriver, carefully remove the fuel valve seat (53) and washer (54). Remove the idle mixture adjusting screw (7), spring (8), washer (9), and rubber seal (10).

g. Wash the throttle body (11) in a solvent, being careful not to damage the brass tube (34) or bowl gasket surface.

Legend to figure 5-28:

1 Head, filter
2 Washer
3 Element
4 Tube
5 Retainer
6 Screw
7 Screw
8 Spring
9 Washer
10 Seal
11 Throttle body
12 Seal
13 Retainer
14 Plate
15 Screw and washer
16 Screw
17 Spring
18 Shaft and lever assembly
19 Lever
20 Pin
21 Advance rod
22 Cotter pin
23 Shaft and lever assembly
24 Plate
25 Screw and washer
26 Screw
27 Clip
28 Bracket
29 Nut
30 Seal
31 Retainer
32 Washer
33 Screw and washer
34 Tube
35 Gasket
36 Float assembly
37 Tube assembly
38 Valve assembly
39 Bowl
40 Diaphragm
41 Cover
42 Screw and lockwasher
43 Spring
44 Valve assembly
45 Plug
46 Jet assembly
47 Washer
48 Screw and washer
49 Washer
50 Jet
51 Float axle
52 Valve assembly
53 Seat
54 Washer

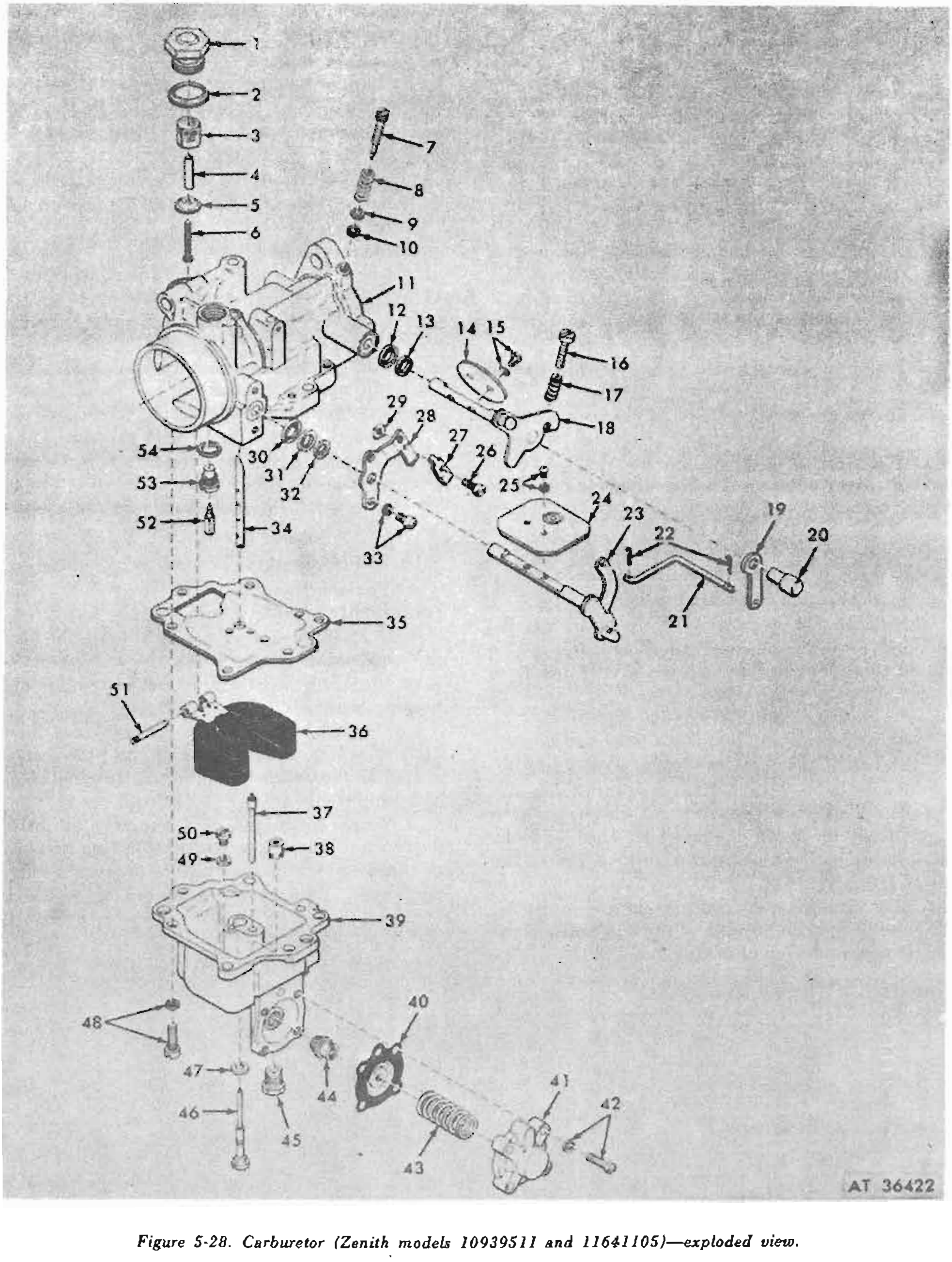


Figure 5-28. Carburetor (Zenith models 10939511 and 11641105)—exploded view.

CAUTION

Do not use carburetor cleaner as this will damage the shaft seals.

h. Using small screwdriver, remove the main metering jet (50) and washer (49) from bowl.

i. Using small screwdriver, remove the power jet valve (44) from the pump cavity.

j. Remove the accelerating jet (46) and seal (47) from the bottom of the bowl, and place the bowl (39) in the solvent bath.

k. Blow out all channels of the throttle body (11) with compressed air, and install the fuel valve seat (38) using a new washer.

l. Install a new bowl-to-body gasket (35). Install fuel valve seat (53) using a new washer.

m. Install fuel valve needle (52), float (36), and a new float axle (51).

n. Invert the throttle body so that the float is uppermost. Using a short ruler or scale, measure the distance between the gasket and the tips of the float farthest from the axle. This distance should be 3 / 32 inch ± 1 / 32 inch.

NOTE

Be careful to place the end of the scale on the part of the gasket which is backed by metal to avoid false reading.

o. Holding the carburetor body in its normal installed position, measure the float drop. This should be ⅜ inch minimum, measured from tip to gasket.

NOTE

Adjustment of the float is made by bending the tab of the float assembly.

p. Remove bowl (39) from solvent bath; dry with compressed air, blowing out all channels.

q. Install the main metering jet (50) and the accelerating jet (46), using new gaskets. Install the power jet valve (44).

r. After cleaning with compressed air, insert the idle tube (37) in the smaller of the two holes in the central boss in the top of the fuel bowl (39).

s. Carefully lower the throttle body (11) onto the fuel bowl (39), and install the six retaining screws and washers (48).

t. Position the pump diaphragm (40) on the fuel bowl (39), and install pump spring (43) and cover (41) with four retaining screws and washers (42).

NOTE

When available use four alining studs to insure proper fitting of the pump diaphragm.

u. Install the fuel filter assembly (1 through 6).

v. Install the idle mixture adjusting screw (7), spring (8), washer (9) and rubber seal (10).

NOTE

Fuel level may be measured by means of a U-shaped sight tube, connected at ⅛ pipe plug hole in bottom of fuel bowl. Fuel level should be 12-14mm. from top of fuel bowl @ 4.5 psi fuel pressure. This carburetor with vacuum pump will release one shot of fuel from pump when ignition is shut-off; this however, will not cause a flooding condition of the engine.

5-10. Adjustment

a. For adjustment of the float level refer to paragraphs 5-9 *n* and *o*.

b. If a new fuel valve needle is installed be sure the needle seats properly. If a new valve seat is not used the valve needle may be seated by lightly tapping with a small hammer.

c. Throttle and choke plates must not bind in their housings, rough edges of the plates may be stoned or filed with fine tooth file to remove burrs and rough edges.

d. When adjusting the carburetor air mixture never screw the idle mixture adjusting screw into the housing tightly since this will cause a ridge in the screw; a ridged screw should be replaced.

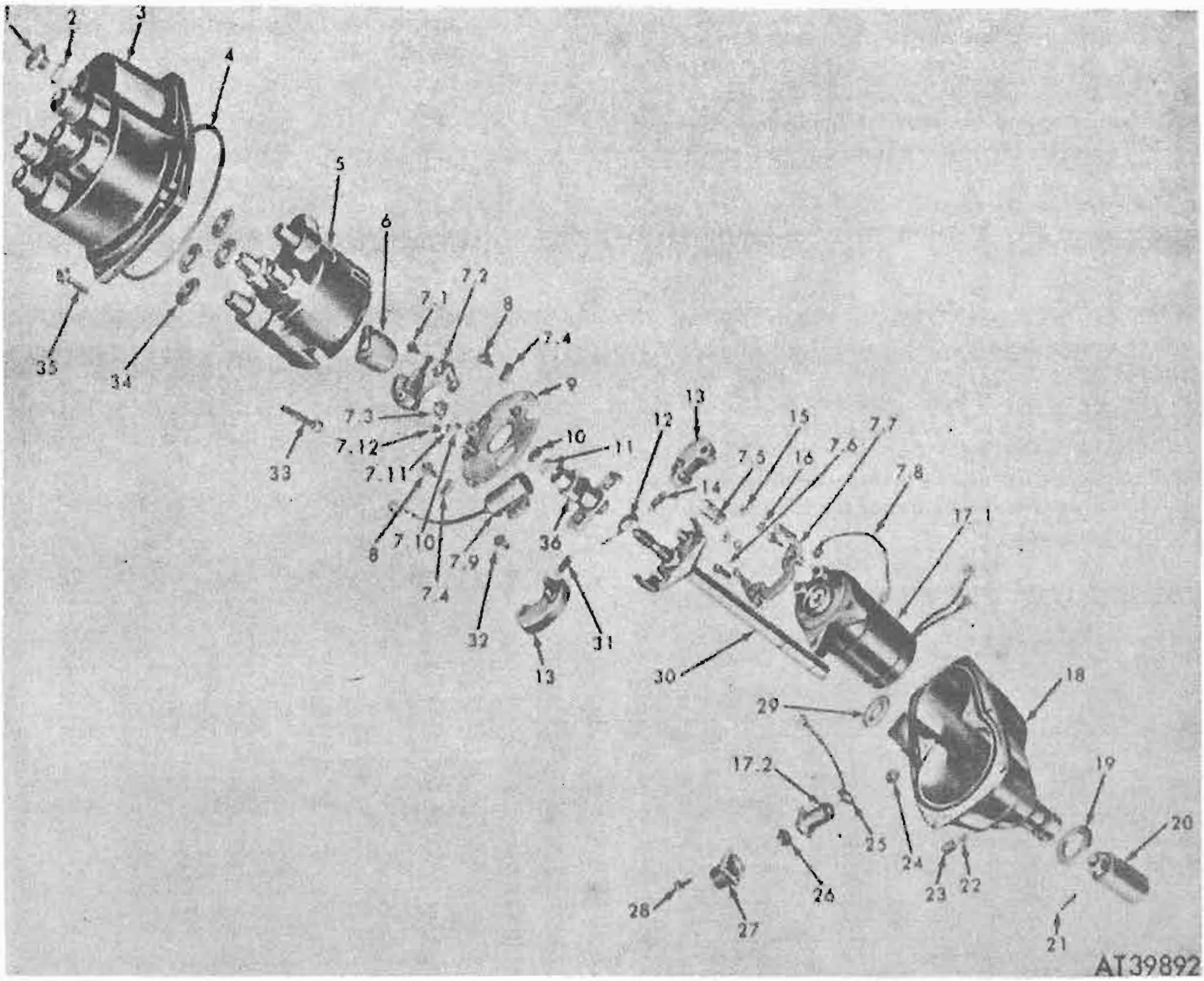
CHAPTER 6

DISTRIBUTOR ASSEMBLY

Section I. DISASSEMBLY

6-1. General

This section contains information for the guidance of personnel performing disassembly work on the distributor assembly 11660529. Refer to figure 6-1. Refer to TM 9-2320-218-20 for removal, installation, and ignition timing instructions.



1	Plug	7.7	Clamp	14	Spring	25	Packing
2	Packing	7.8	Lead	15	Nut	26	Grommet
3	Cover	7.9	Capacitor	16	Washer	27	Receptacle
4	Packing	7.10	Washer	17.1	Coil	28	Screw
5	Cap Assy.	7.11	Washer	17.2	Capacitor	29	Washer
6	Rotor	7.12	Screw	18	Base	30	Shaft
7.1	Screw and Washer	8	Screw	19	Washer	31	Spring
7.2	Point Set	9	Plate	20	Coupling	32	Screw
7.3	Clip	10	Wick	21	Pin	33	Screw
7.4	Holder	11	Ring	22	Wick	34	Washer
7.5	Spring	12	Spring	23	Plug	35	Screw
7.6	Screw	13	Weight	24	Plug	36	Cam

Figure 6-1. Exploded view of ignition distributor.

6-2. Cap, Coil, and Breaker Plate Assembly

For removal of cap, cover, and breaker plate assembly, refer to TM 9-2320-218-20 manual.

6-3. Cam

a. Remove felt wick using long-nosed pliers or sharp pointed instrument. Remove snapring (spring) securing cam to shaft (fig. 6-2).

b. Lift off cam and anti-rattle spring.

6-4. Distributor Shaft and Governor

a. Remove roll pin with drift and hammer (fig. 6-3).

CAUTION

Place coupling on support before removing pin. Refer to paragraph 6-8*d* after assembly of coupling shaft.

b. Slide coupling off shaft. If coupling does not come off easily, tap with hammer. Pull shaft and governor assembly out of housing. Remove thrust washers (fig. 6-4).

c. Slip governor springs off lugs with long-nosed pliers. Mark weak spring lug to be sure weak spring is assembled to correct lug when assembling (fig. 6-5).

d. Lift governor weights off pivots and remove springs from governor weights (fig 6-5). Refer to paragraph 7-14*a* before assembling shaft.

6-5. Primary Connector

a. Remove four primary connector attaching screws and pull off terminal housing (fig. 6-6). Remove filter capacitor assembly with attached resistor lead. Cut lead to remove capacitor and discard. Retain capacitor mounting hardware and packings (fig. 6-6).

Section II. CLEANING, INSPECTION AND REPAIR

NOTE

Key numbers in parenthesis refer to figure 6-1.

6-6. Cleaning

It is important that each part be cleaned with the proper cleaning agent. To avoid possible damage, check the proper cleaning agent for each individual part in paragraph 6-7.

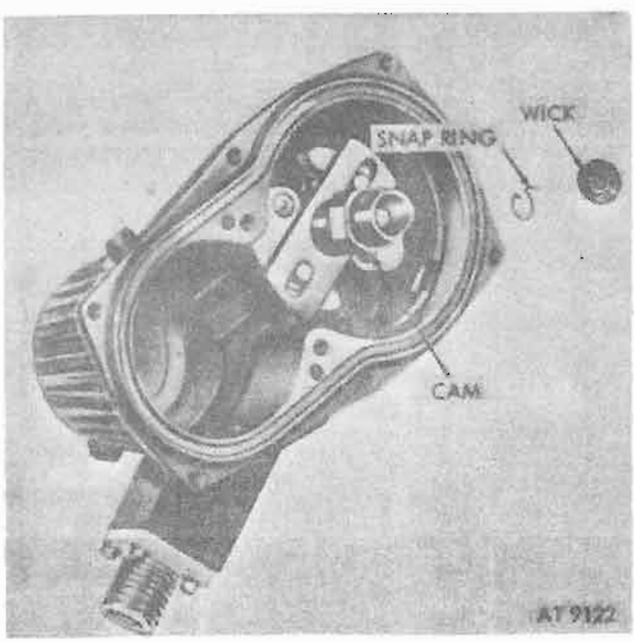


Figure 6-2. Cam assembly.

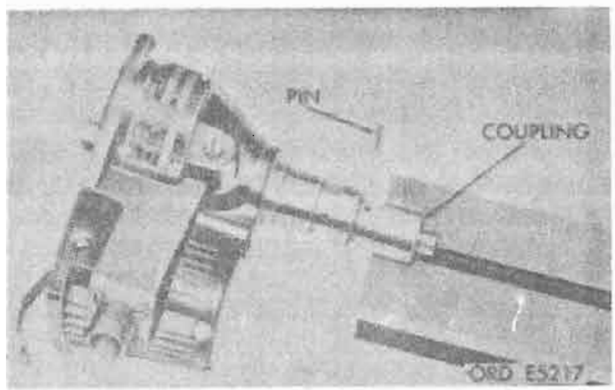


Figure 6-3. Shaft coupling removal.

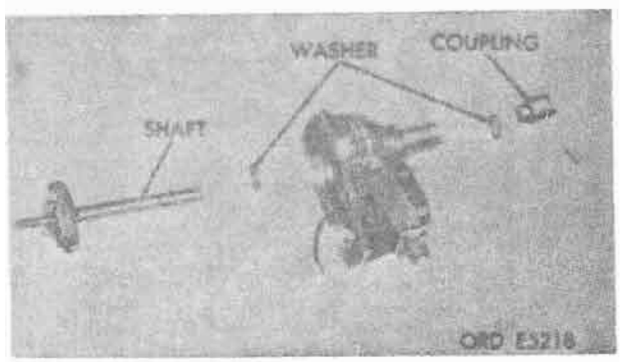


Figure 6-4. Distributor shaft removal.

6-7. Inspection and Repair

a. Cap and Cover Assembly (fig. 6-7).

(1) Discard cap if it is cracked or if carbon runners have formed either on inside or outside surfaces. Inspect inserts on inside of cap. If they show uneven or excessive burning, discard cap (slightly burned inserts are normal). If there are burned spots on the horizontal face of inserts it means the rotor is too short and must be replaced. Clean contacts with carbon tetrachloride. Do not file. Do not clean carbon contact with solvent. Wipe dry and inspect for cracks and an oil-soaked condition. Discard cap if carbon contact is not in good condition. Discard O-ring if damaged or excessively dirty.

(2) Discard rubber terminal sealing washers if they are rough or if they do not fit properly.

(3) Clean cover in mineral spirits paint thinner or drycleaning solvent. Inspect for cracks or other damage. Place cover on base to make sure it touches base on all sides.

b. Rotor (6, fig. 6-1). Discard rotor if it is cracked, has a loose contact strip or if strip shows burning. If burning is excessive on end of contact, discard rotor; if the burning is only slight, clean with carbon tetrachloride. Do not file. Discard rotor if contact spring does not instantly spring back when contact button is pressed against rotor.

NOTE

Apply pressure to button to avoid setting spring. Clean button so that it will make a good contact with the carbon contact in the center of the cap. Check height of spring to be sure it touches carbon contact when cap is on.

c. Ignition Coil (17.1, fig 6-1). Inspect for dents and cracks. Test coil. Discard coil if cracked or if terminals are badly corroded, pitted, or loose. Clean entire coil in mineral spirits paint thinner or drycleaning solvent.

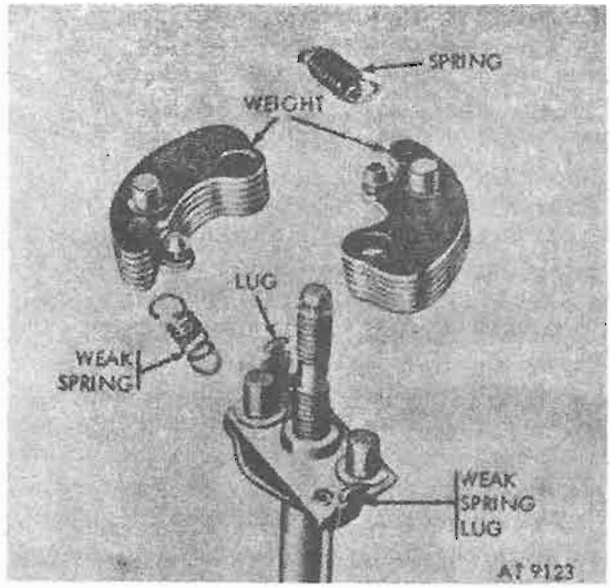


Figure 6-5. Governor assembly.

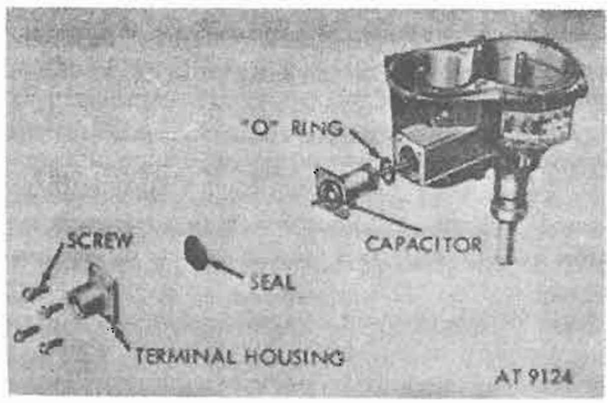


Figure 6-6. Terminal housing removal.

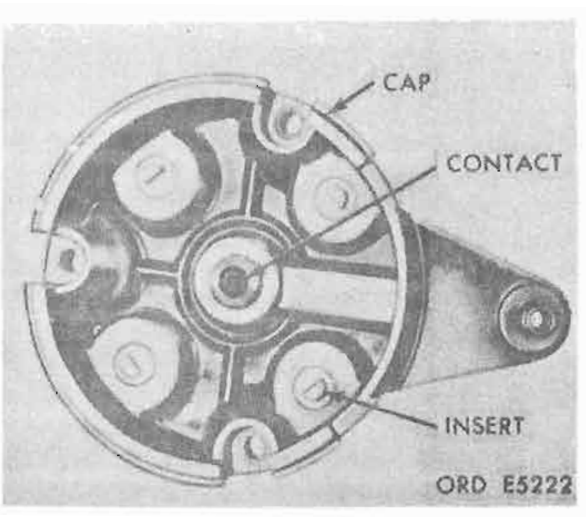


Figure 6-7. Distributor cap.

d. Breaker Plate, Points, and Condenser Assembly.

(1) Clean all parts of plate except condenser, leads, and contacts in mineral spirits paint thinner or drycleaning solvent.

(2) Rub contacts with linen tape, dampened with carbon tetrachloride. Dry with clean tape to remove any residue.

(3) Test condenser for capacity and grounding on condenser tester. (Use reliable test equipment and follow the manufacturer's instructions.) Discard condenser if grounded, leaky, or if it is not within limits. Discard if lead is chafed, broken, or damaged.

(4) Check primary terminal on breaker plate for grounding using test probes. Discard plate if terminal is grounded. Inspect for stripped threads and damaged or worn lever pivot. Discard plate if these conditions are found.

(5) Inspect contacts. Discard if contacts are rough, pitted or burned. (A grayish color is normal after use.)

(6) Install breaker points on plate (6.2) and check fit of movable breaker point on pivot. It must turn easily, without binding or excessive looseness. Discard plate if pivot is worn or loose or if not perpendicular to plate.

(7) Install condenser on breaker plate and connect cable to primary terminal. Breaker point spring must be installed on the inner side of the terminal.

(8) Place one drop of oil (PL) on breaker point pivot. Operate lever once or twice and wipe excess oil from top end of pivot.

e. Primary Connector (fig. 6-6).

(1) Clean all parts of unit with cloth dampened in mineral spirits paint thinner or drycleaning solvent.

(2) Inspect capacitor for damaged or corroded connector pin, lead, and terminal. Check for groundings using test probes, by testing between terminal pin and connector body. Discard capacitor if grounded.

CAUTION

Do not use an alternating current (ac) test light.

(3) Inspect gasket and gasket seats. Discard if rough or corroded.

f. Cam (fig. 6-2). Clean cam in mineral spirits paint thinner or drycleaning solvent. Inspect cam lobes and weight slots for wear. Discard cam if lobes are grooved or if sides of weight slots are rough.

g. Governor (fig. 6-5). Clean governor weights, governor springs and snapring, in drycleaning solvent or mineral spirits paint thinner and dry thoroughly. Discard weights if pivot holes are worn or if they are a loose fit on pivots. Discard springs if bent or distorted.

h. Base and Shaft (fig. 6-4).

(1) Wipe shaft and inside of base with cloth dampened in mineral spirits paint thinner or drycleaning solvent. Do not soak. Dry immediately with clean dry compressed air.

(2) Inspect base for cracks or other damage. Make sure groove for cap O-ring gasket is smooth and clean.

(3) Remove plug (fig. 6-8) and inspect felt wick in base. Lubricate wick with oil (PL). Install wick and plug.

(4) Check rivets for looseness, cracks in tabs, and excessive wear in notches of spring tabs. Wear is indicated by shiny or unsymmetrical appearance. Discard shaft if any of these conditions exists.

(5) Support shaft on V-blocks and check runout at bearing surface. Runout must not exceed 0.0015 inch. Check wear. Shaft must not be worn to less than 0.497 inch.

Section III. ASSEMBLY

NOTE

Key numbers in parenthesis refer to figure 6-1.

6-8. Assembly

a. Before assembling governor, place a small amount of grease (GAA) on weight pivots, weight holes, cam yoke slots, and weight spring lugs and pins.

b. Replace governor weights on pivots and place springs on governor weights (fig. 6-5). Insure that weak spring is in proper positioning for positioning on the weak spring lug as outlined in paragraph 6-4 c. Slip governor springs over lugs with long-nose pliers (fig. 6-5).

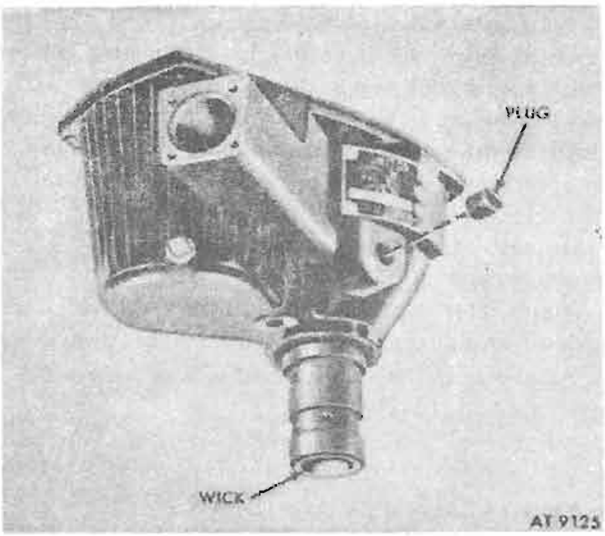


Figure 6-8. Lubrication wick.

c. If existing shaft and coupling are to be reinstalled, proceed as follows. If either shaft or coupling are discarded, proceed as indicated in *d* (1) through (7) below.

(1) Install one thrust washer on shaft, install shaft in housing, and slide second thrust washer into place on shaft.

(2) Slide coupling into distributor shaft and install roll pin with drift and hammer (fig. 6-3).

d. If either shaft or coupling is discarded and replaced, the new shaft or coupling must be alined since the drive tongue is off center. It is important that these alinement procedures be followed any time a shaft or coupling is descarded. Refer to figure 6-11.

(1) Install one washer on shaft and install shaft in housing (fig. 6-4).

(2) Install one cover-attaching screw in lower left hand corner of housing (fig. 6-9).

(3) Place piece of 1-inch stock so that one side is flush with flat side of cam and other side against cover-attaching screw. Clamp stock securely in this position (fig. 6-9).

(4) Invert housing and install suitable-size bolt in distributor mounting bolt hole (fig. 6-10).

(5) Install one washer on shaft and slide coupling on shaft (fig. 6-10).

(6) Place improvised tool against bolt and tangs of coupling as shown in figure 6-11, with smaller portion of coupling in opening of the tool. Scribe alining mark on coupling and base of housing. With base of housing and coupling in V-blocks, drill hole through coupling and shaft to accommodate roll pin.

NOTE

If used shaft is being installed, cross drill; do not install a shaft that has already been cross drilled.

(7) Install roll pin (fig. 6-1).

e. Insert new filter capacitor assembly into base. Existing packing should be placed on capacitor prior to insertion. Use existing hardware to retain capacitor (fig. 6-6).

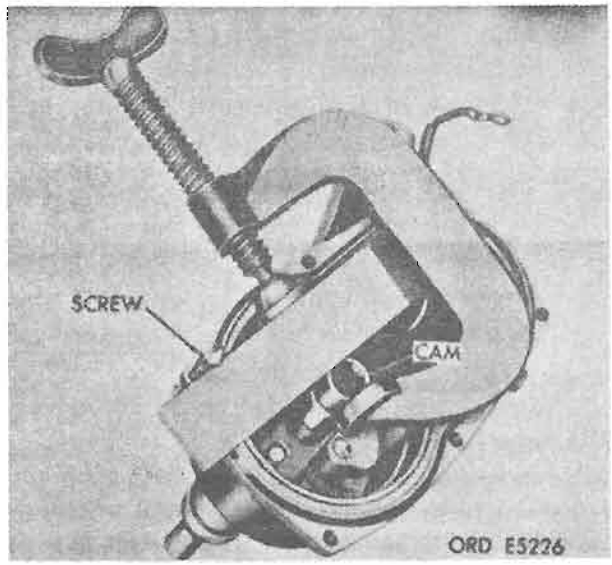


Figure 6-9. Clamping distributor shaft.

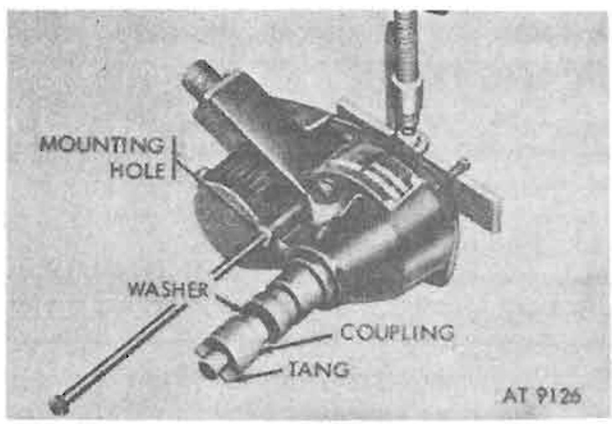


Figure 6-10. Install coupling on distributor shaft.

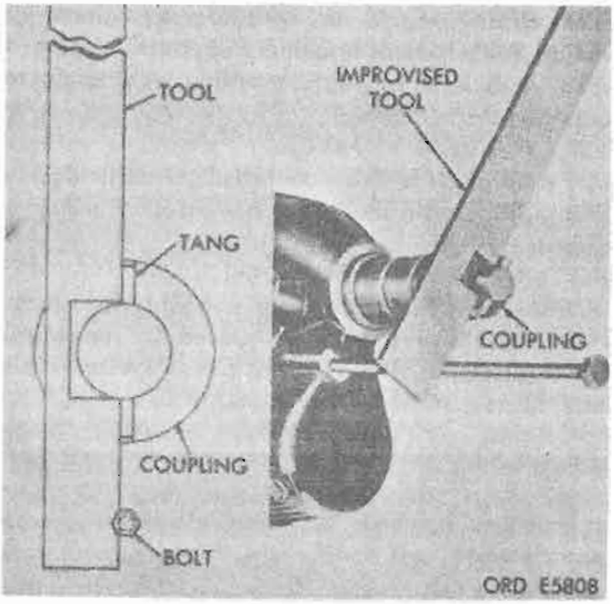


Figure 6-11. Aligning coupling on distributor shaft.

f. Install capacitor on breaker plate and secure with screw and lockwasher (32).

g. Install breaker point assembly on breaker plate and secure with screw and lockwasher (7.1).

h. Install capacitor and coil cables on terminal block. Secure with screw (7.12), lockwasher (7.11) and flatwasher (7.10).

i. Install breaker plate assembly in distributor base and secure with two screws, (8) lockwashers and clips (7.3).

NOTE

Clips must be installed with the bent end in the up position.

j. Install new coil assembly in distributor base and secure with lock tab and two screws. Route the filter capacitor and coil wires through the clamping ears and into the opening provided in the lock tab. Torque retaining screws to 40-50 lb.-in. Position head of screw within the torque range so that one of lock tabs can be bent up parallel against one of the hex-head flats.

k. Attach filter capacitor wire to the positive post of the coil and the capacitor wire to the negative post. Secure with two lockwashers and two nuts. Torque nuts to 15-20 lb.-in.

Section IV. TESTS AND ADJUSTMENTS

6-9. Contact Spring Tension

a. Hook spring scale on movable contact arm and pull on line with points. Take reading as points separate. Tension should be 17-20 ounces (fig. 6-12).

b. Adjust tension by loosening movable contact arm terminal screw and sliding spring in or out as necessary. Tighten screw and check tension again (fig. 6-13).

6-10. Contact Gap

a. Turn shaft until contacts close. Bend stationary contact bracket to aline points for full-face contact.

b. Turn shaft until movable contact arm rubbing block is on high point of cam.

c. Loosen stationary contact lock screw slightly. Adjust gap to 0.017-0.022 inch by turning contact point adjusting screw. If new points are installed, use wire gage to check contact gap.

6-11. End Play and Side Play

a. Clamp dial indicator on base with plunger resting against side of shaft (fig. 6-14). With tension gage, apply a 5-pound pull in line with plunger. If side play is more than 0.0005 inch, measure shaft diameter. If shaft is between 0.497 and 0.499 inch, discard base.

b. Clamp dial indicator on base with plunger against end of shaft. Move shaft to its two extreme positions and read total end play. End play can also be measured with flat feeler gage inserted between shaft collar and lower thrust washer. If end play is less than 0.003 inch, tap lower end of shaft to loosen. If end play is more than 0.010 inch, remove collar and install additional thrust washers.

6-12. Distributor Dwell

a. Mount distributor on test fixture and connect test leads. Set fixture for correct rotation.

b. Start fixture and set speed at 400 rpm. Advance indicator should read 1.7 to 3.2 degrees. If advance is too high, increase tension on weak weight spring by bending governor outer spring lug (fig. 6-5). If advance is too low, decrease tension on weak spring.

c. If distributor dwell is not within limits, the cam, camshaft, movable breaker point arm, or rubbing block is worn, misalined, or the shaft is bent.

6-13. Governor

a. Start test fixture and increase speed slowly until spark just begins to advance. Reduce speed 75 to 150 rpm, and set indicator to zero.

b. Increase speed to 400 rpm. Advance indicator should read 1¾—3¼ degrees. If advance is too high, increase tension on weak weight spring by bending governor outer spring lug (fig. 6-5). If advance is too low, decrease tension on weak spring.

c. Check 250 rpm setting then check and adjust on 400 rpm point (*a* and *b* above).

d. Increase speed to 1600 rpm. Advance indicator should read 11¾—13 degrees. If advance is too high, increase tension on strong weight spring by bending governor outer spring lug (fig. 6-5). If advance is too low, decrease tension on strong spring.

e. Check advance at all points in specifications, and make whatever adjustments are necessary to bring all points within the tolerance in specifications (para 6-16).

f. Check advance while increasing and decreasing rpm. If there is more than one-half degree difference in any one point, there is friction in the governor.

6-14. Checking Distributor for Leaks

a. Connect an air hose to one of the ventilating holes in distributor base and install plugs in other holes (fig. 6-15).

b. Apply six pounds air pressure and put unit under water. If bubbles occur at any point except around drive shaft the leak must be eliminated.

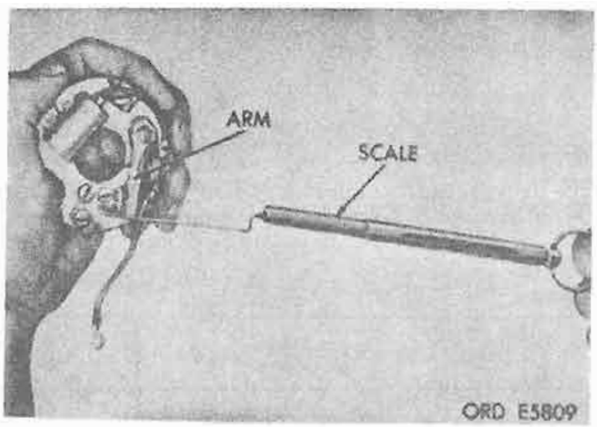


Figure 6-12. Checking distributor point tension.

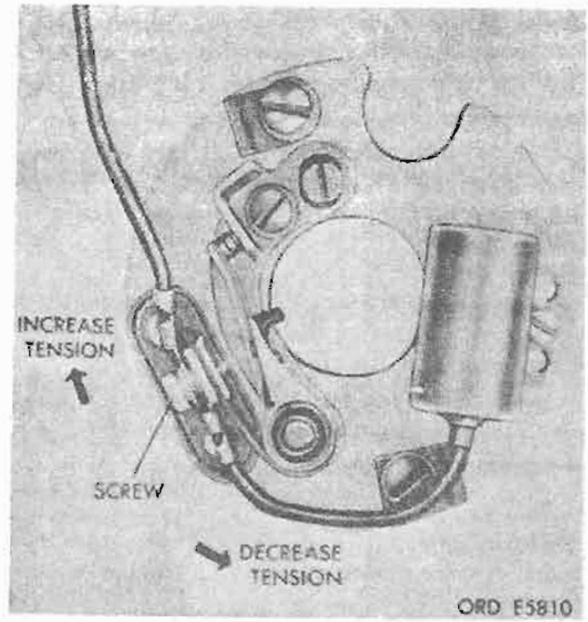


Figure 6-13. Adjusting distributor point tension.

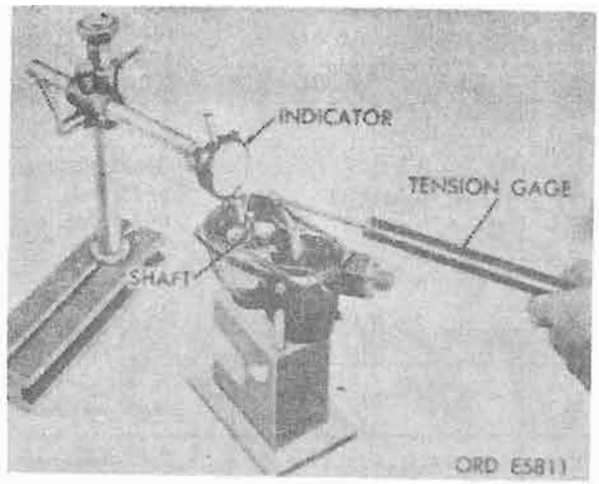


Figure 6-14. Measuring side play of shafts.

6-15. Distributor Timing

The primary terminal is accessible for connecting the timing light when the cover plug (fig. 6-1) is removed. For timing distributor on vehicle, refer to TM 9-2320-218-20.

Section V. REPAIR STANDARDS

6-16. Specifications and Adjustments

Table 6-1 lists specifications and adjustments necessary for repair of the Prestolite model IDA-4401-UT ignition distributor.

Table 6-1. Specifications and Adjustments

Breaker point:	
Gap	0.17—0.22 inch
Spring tension	17-20 ounces
Dwell	39° —46°
Capacitor, primary connector	18-21 microfarads
Condenser, breaker plate	18-21 microfarads
Governor advance:	
Speed of distributor	Degree of advance
200	0
400	1¾-3¼
900	7¾-9
1600	11¾-13
2200 and over	14-15½
At speeds above 2200, advance should not increase beyond 15.5°.	
Shaft:	
End play	0.010-0.003 inch
Run-out, top to bearing	0.0015 inch
Side play	0.001-0.005 inch

6-17. Wear Limits

Table 6-2 lists wear limits necessary for repair of the Prestolite model IDA-4401-UT ignition distributor. Refer to figure 6-16.

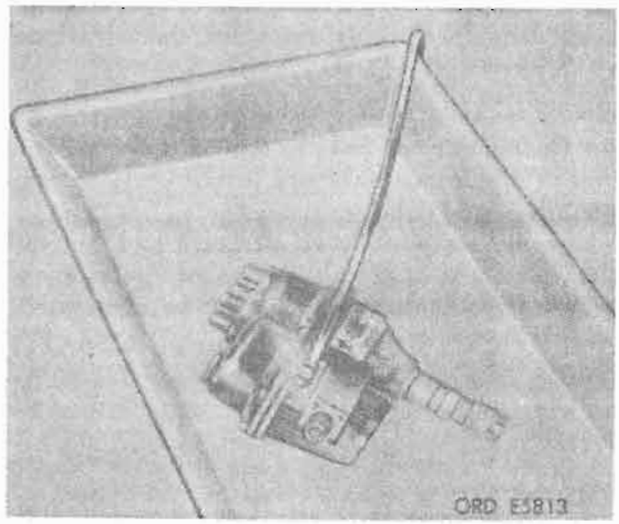


Figure 6-15. Checking distributor for leaks.

Table 6-2. Wear Limits

Fig. No.	Reference letter	Point of measurement	Size and fits of new parts	Wear limits
6-16	a	Shaft diameter Bearing diameter	0.498-0.499 in. 0.4995-0.500 in.	0.001 in. 0.005 in.

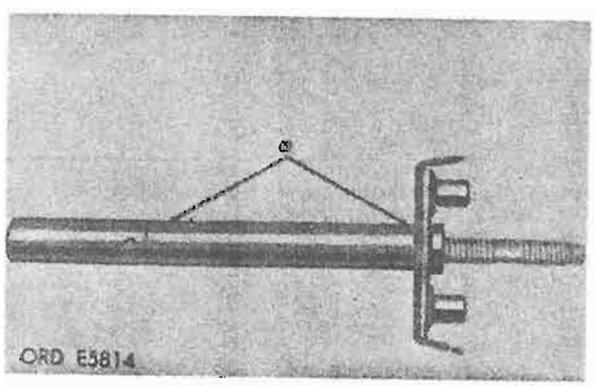


Figure 6-16. Wear limits points of measurement.

CHAPTER 7

STARTER ASSEMBLY

Section I. DISASSEMBLY

7-1. General

The repair procedure explained in this chapter is based on complete disassembly. Field repair units will use the procedure to the extent authorized in the maintenance allocation chart of TM 9-2320-218-20. For procedures on removal and installation of starting motor (to vehicle), refer to TM 9-2320-218-20.

7-2. Drive Assembly Removal

a. Compress drive spring and turn out lock screw until it clears recess on armature shaft (fig. 7-2).

b. Slide drive assembly off armature shaft. Remove Woodruff key. Be sure to remove all burs from shaft, to avoid damage to bearing when shaft is pulled through drive end head at later step (fig. 7-3).

CAUTION

Under any circumstance do not disassembly drive assembly. Refer to paragraph 7-9 *e*

7-3. Commutetor End Head Removal

a. Note that position of locating tab is 90° clockwise from terminal stud, (fig. 7-4).

b. Remove six commutator end head attaching screws and washers (fig. 7-4).

c. Tap drive end of armature shaft with soft hammer to free commutator end head from frame. (Refer to fig. 7-5).

CAUTION

Tap only enough to allow room to reach in and pull brushes from brush holders, then pull head free of frame.

7-4. Armature Removal.

Be sure armature shaft is free of burs, then pull armature out of frame assembly. Remove all thrust washers (fig. 7-6).

7-5. Drive End Head Removal

a. Note that shaft hole, end-head attaching screw, starting mounting bolt hole, and terminal stud are all in line. Drive end head must be assembled to frame in this position (fig. 7-7).

b. Remove six drive-end-head attaching screws and washers, and tap end head with soft hammer until it is clear of frame (fig. 7-7).

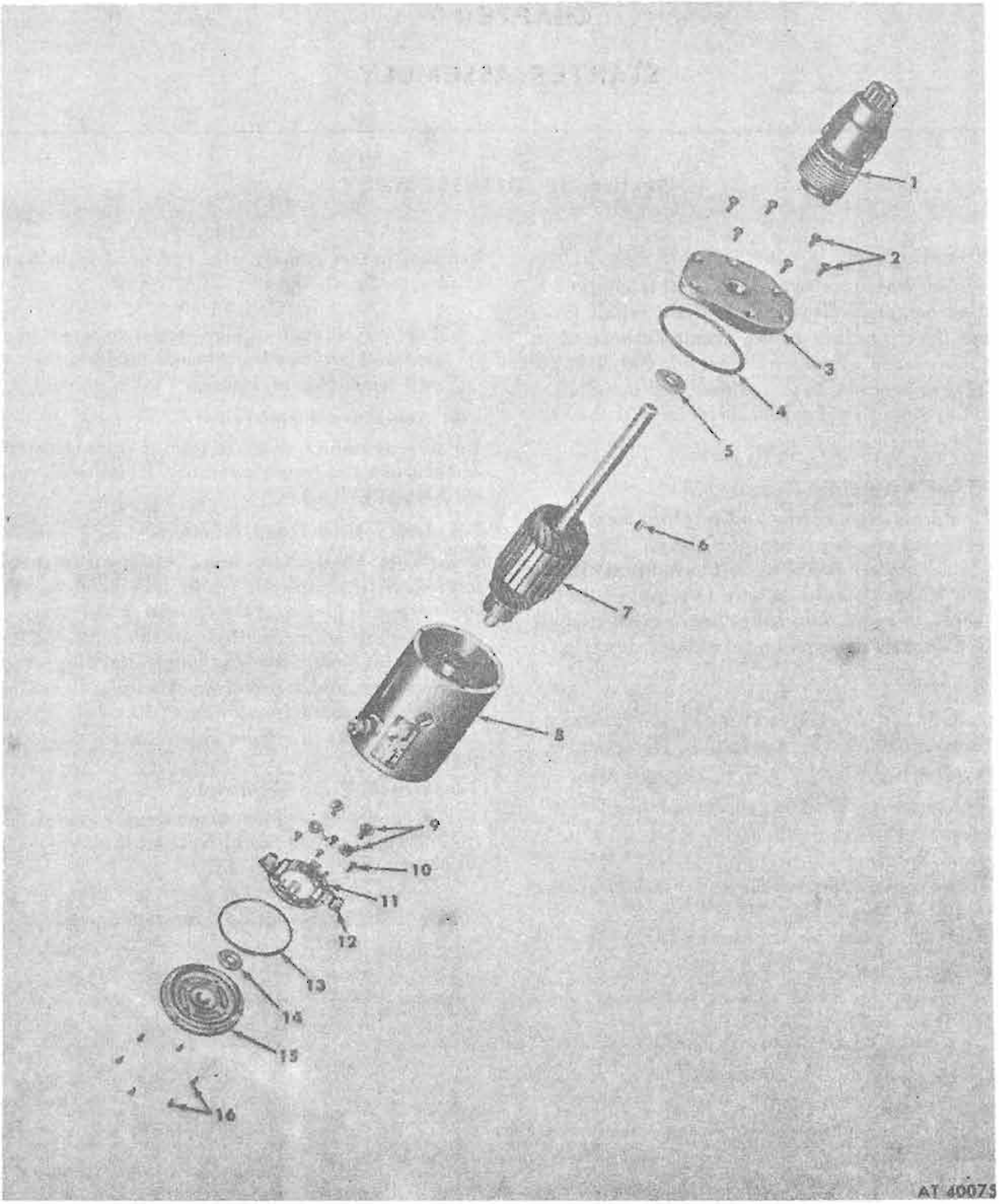
c. Remove O-ring from groove in end head (fig. 7-8).

7-6. Brush Plate Removal

a. Remove O-ring from commutator end head (fig. 7-9). Remove varnish from brush retainer plate with suitable solvent.

NOTE

Do not get solvent on lubrication wick in bearing bore.



1. Bendix drive assembly
2. Drive-end-head screw and lockwasher
3. Drive end head assembly
4. Drive end head O ring (preformed packing).
5. Thrust washer
6. Woodruff key
7. Armature
8. Frame and field, assembly
9. Brush spring
10. Brush retainer plate attaching screw
11. Brush retainer plate
12. Brush set
13. Commutator-end-head O ring
14. Thrust washer
15. Commutator end head assembly
16. Commutator end head attaching screw and lockwasher.

Figure 7-1. Starter motor and drive—exploded view.

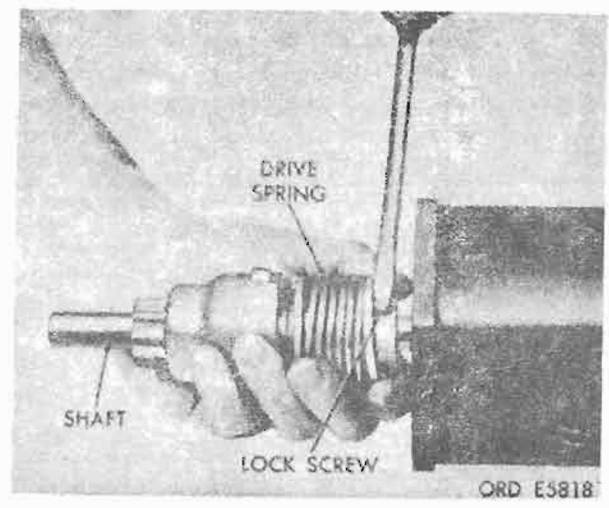


Figure 7-2. Drive assembly lock screw.

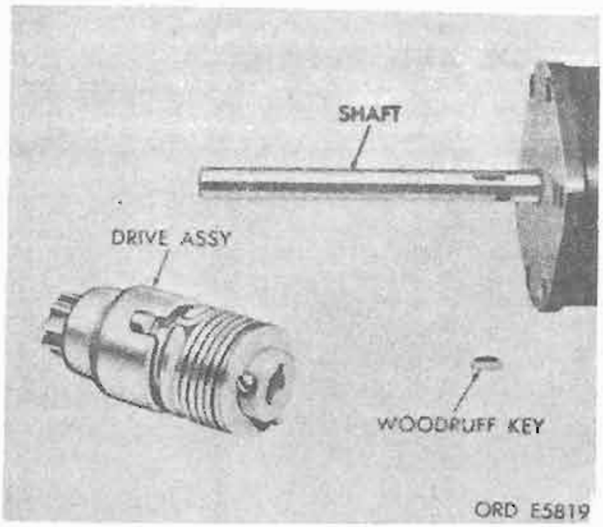


Figure 7-3. Removal of drive assembly.

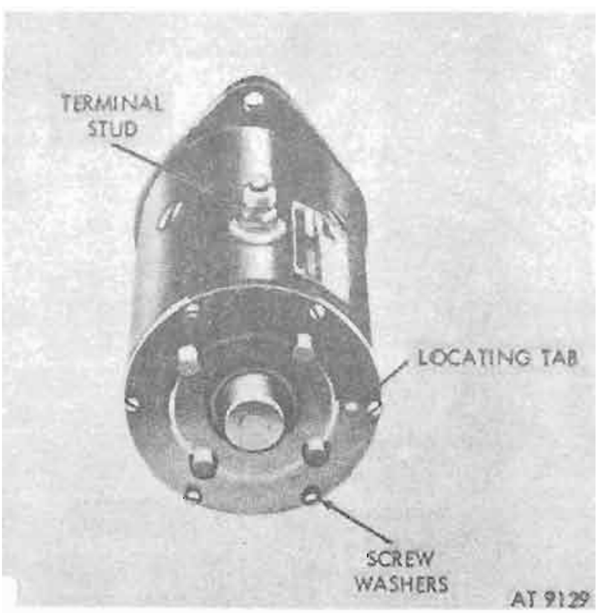


Figure 7-4. Commutator end head.

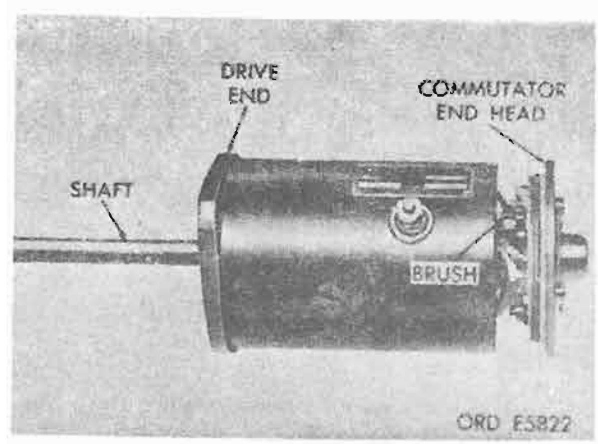


Figure 7-5. Removing commutator end head.

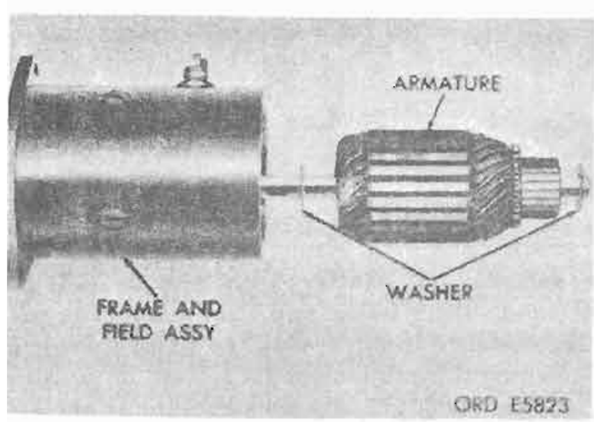


Figure 7-6. Removing armature from frame assembly.

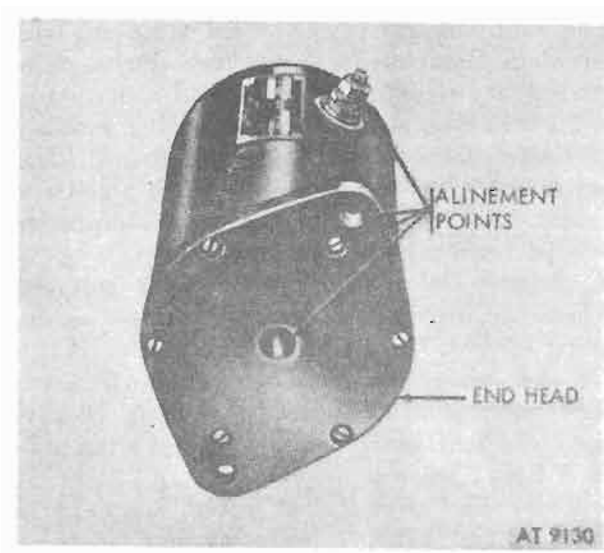


Figure 7-7. Remove drive end head.

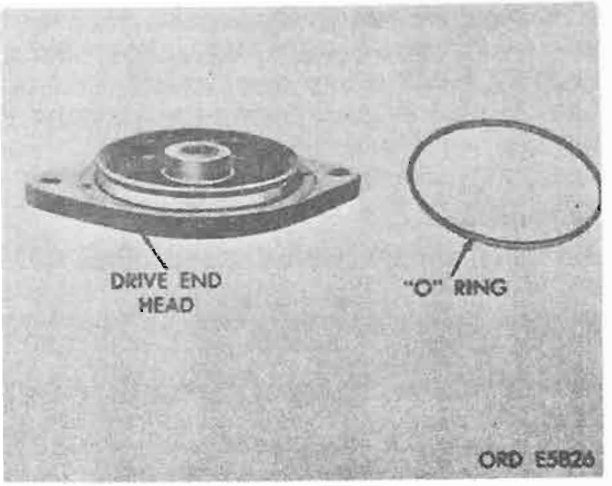


Figure 7-8. Drive end head O-ring.

b. Note position of grounded brush in relation to locating tab on outside of commutator end head. Whether a new plate is installed on assembly or old plate replaced, one of the grounded brushes must be in position shown (fig. 7-10).

c. Remove four brush plate retaining screws. Lift plate from head (fig. 7-9).

7-7. Brush Spring Removal

Use needle-nosed pliers to remove brush springs from brush retainer plate. Refer to figure 7-11.

Section II. CLEANING, INSPECTION, AND REPAIR

7-8. Cleaning

a. Frame and Field Assembly. Blow off all loose dirt and foreign matter with compressed air. Thoroughly clean frame and field assemblies with cloth dampened in mineral spirits paint thinner or dry cleaning solvent. Do not get solvent on brushes. Be careful not to damage insulation or wire connections. Blow dry with compressed air. Wipe brushes with a clean dry rag.

b. Armature. Blow off all loose dirt and foreign matter with compressed air. Wipe armature with clean cloth dampened in mineral spirits paint thinner or dry cleaning solvent. Sand commutator with 2 / 0 flint paper. Do not touch after sanding.

c. Commutator End Head and Brush Plate. Clean commutator end head and brush plate with dry cloth. Blow bearing bore clean with compressed air. Wipe brushes with clean dry rag.

d. Starter Drive. Clean drive with soft rag dampened in mineral spirits paint thinner or dry cleaning solvent. Do not soak Bendix drive as it is sealed and cannot be packed with grease. It needs no lubrication prior to assembly on shaft. If drive pinion locks in extended position, do not attempt to force it back; leave it as is.

e. Drive End Head. Soak drive end head in mineral spirits paint thinner or dry cleaning solvent. Clean thoroughly and dry.

f. Miscellaneous Parts. Clean all miscellaneous parts except O-rings in mineral spirits paint thinner or dry cleaning solvent.

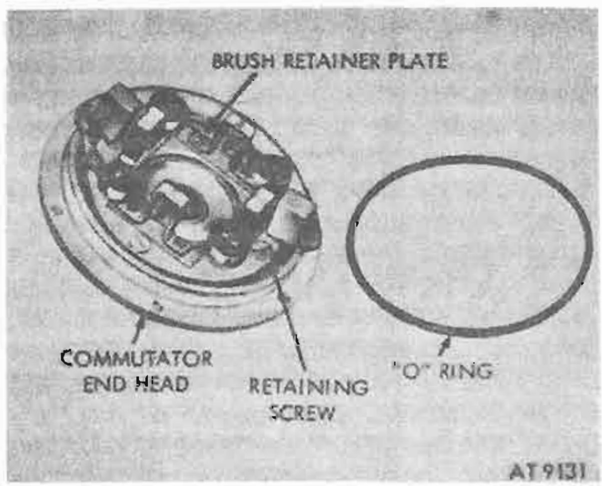


Figure 7-9. Commutator-end-head O-ring.

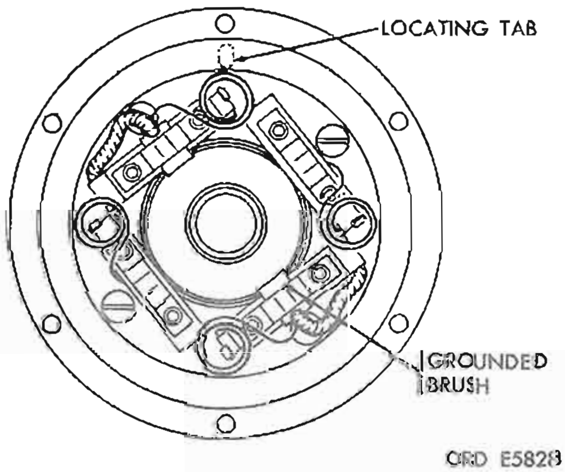


Figure 7-10. Grounded brush location.

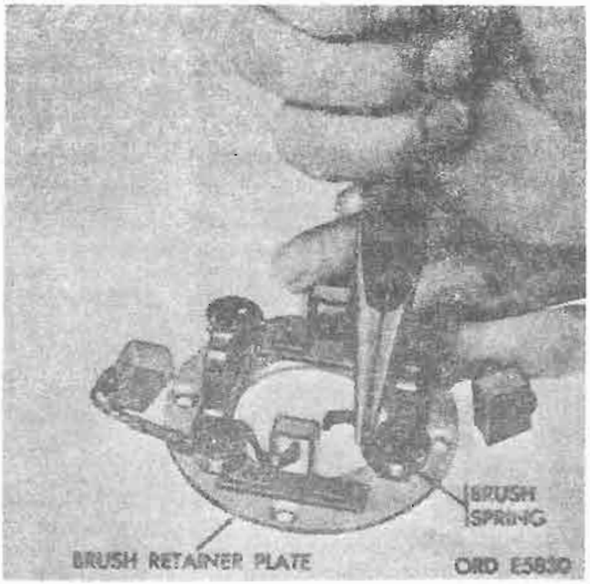


Figure 7-11. Remove brush spring.

7-9. Inspection and Repair

a. Frame and Field Coil Assembly.

(1) Inspect for worn, cracked, or frayed insulation, corroded or burned terminal, and for loose or corroded connections. All connections must be clinched and soldered to assure good electrical contact. Repair defective parts or replace with new.

(2) Inspect field brushes and leads for oil-soaked condition. Inspect leads for breaks or fraying and for poor condition of insulation. Measure length of brushes. If length is less than 5 / 16 inch or if any of above conditions are found, install new brushes and leads. Use rosin-core solder.

(3) Test frame and field assembly for grounds as shown in figure 7-12. Make sure brushes are insulated from frame and field assembly, then touch one probe of continuity tester to terminal stud and other probe to ground on frame. If test shows a ground, discard frame and field assembly.

(4) Test frame and field assembly for opens as shown in figure 7-13. Touch one probe of continuity tester to terminal stud and other probe to either brush. If open circuit is indicated, discard frame and field assembly.

(5) Brush paint inside of frame and field assembly and pole pieces with air-drying, fungus-resistant varnish. Do not paint pilot area, brush leads, or brushes.

b. Armature.

(1) Inspect armature to make sure all coils are pressed into core slots and staked and soldered securely to commutator risers. Restake and solder as necessary. Inspect armature core for excessive scoring and loose windings. Discard armature if either condition is found.

(2) Check diameter of shaft at the three bearing points and discard if worn beyond the limits shown in table 7-2.

(3) Test armature for grounds with continuity tester as shown in figure 7-14. Touch probe to any commutator riser segment. Do not touch bearing surface or commutator surface where brushes ride as arcing will mar the smooth finish. Discard armature if grounded.

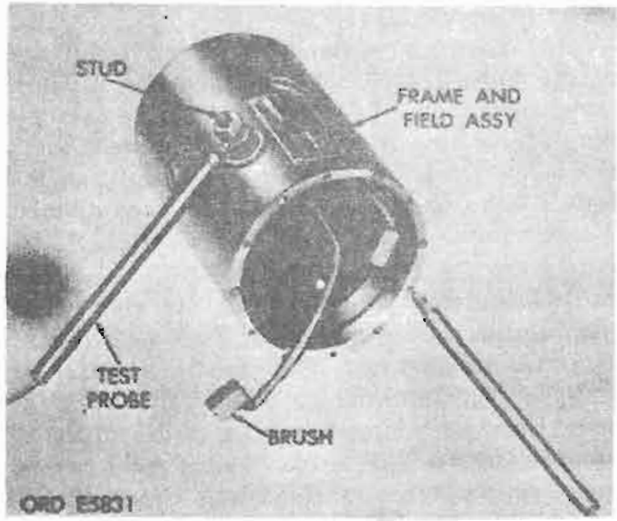


Figure 7-12. Testing frame and field assembly for ground.

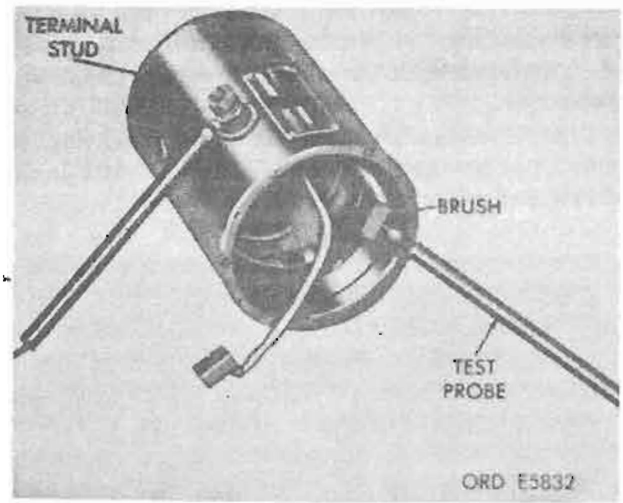


Figure 7-13. Testing frame and field assembly for opens.

(4) Test armature for shorts as shown in figure 7-15. Place amature on growler, following instructions of manufacturer of test equipment. Hold think steel strip on core and rotate armature slowly through one complete revolution. Short will be indicated by steel strip becoming magnetized and vibrating. Discard armature if shorted.

(5) Test armature for opens, following instructions of the manufacturer of the test equip-

ment. When opens occur, they are usually found at connections of coils to commutator risers. Such opens can be repaired by staking and soldering. Check run-out of shaft before repairing open as a bent shaft will require armature to be discarded.

(6) Check run-out of shaft as shown in figure 7-16. If runout exceeds 0.002 inch at drive end bearing location, discard armature.

(7) Check commutator for burned areas or excessive roughness. Check for out-of-round as shown in figure 7-17.

(8) Turn commutator down on a lathe to remove burned areas of roughness, or if out-of-round more than 0.003 inch. Take light cuts with rounded tip tool mounted approximately 1 / 32 inch below centerline of shaft. Chuck both ends of shaft in lathe. See figure 7-18. If finished diameter of commutator is less than 1.450 inches, discard armature.

(9) Undercut mica, after turning down commutator, as shown in figure 7-19. Cut to depth of 1 / 32 to 3 / 64 inch. Cuts must be square and clean. Sand commutator 2 / 0 flint paper to remove burrs. Examples of good and bad undercutting are shown in figure 7-20.

c. Commutator End Head and Brush Plate.

(1) Inspect commutator end head and brush plate for cracks or distortion. Discard head or brush plate if defective. Check brush tension springs for corrosion or distortion, and discard defective springs. If brushes are worn to less than 5 / 16 inch in length install new brushes. Use rosin-core solder.

(2) Check inside diameter of shaft bearing. If diameter is not between 0.6375 and 0.6403 inch, discard end plate.

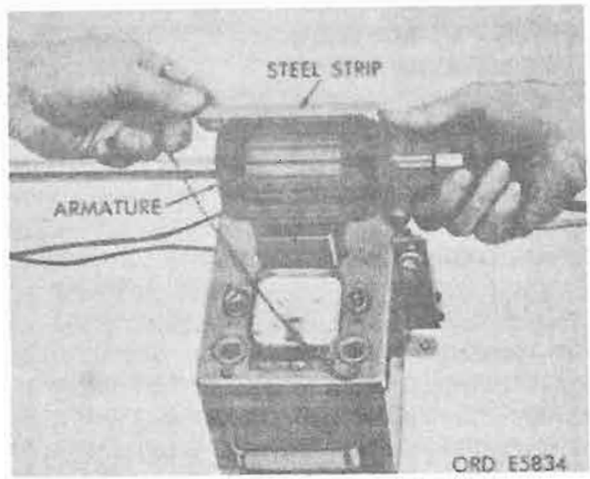


Figure 7-15. Testing armature for shorts.

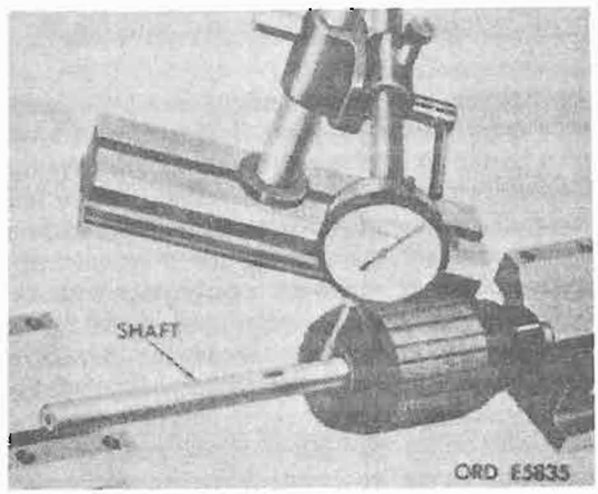


Figure 7-16. Checking run-out of armature shaft.

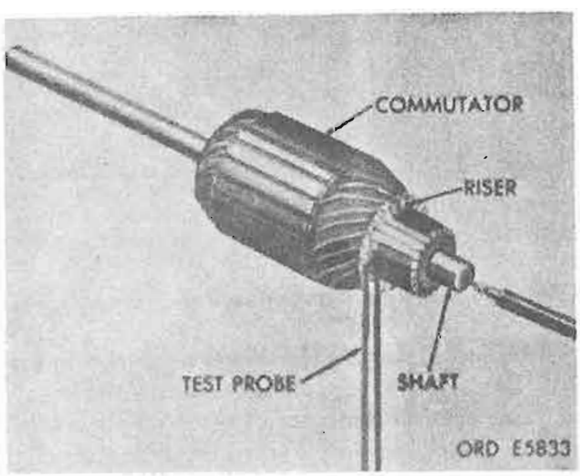


Figure 7-14. Testing armature for grounds.

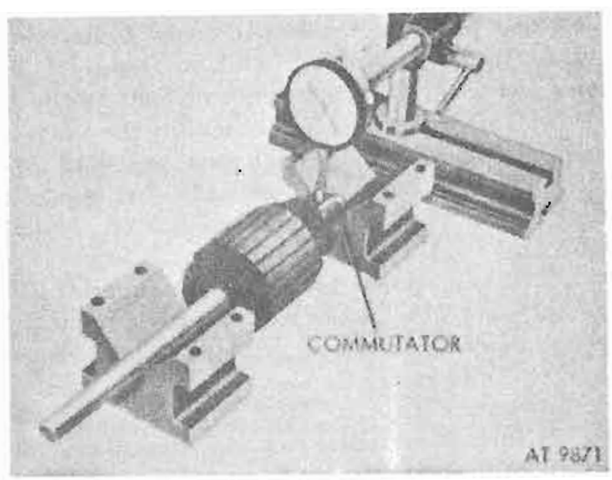


Figure 7-17. Checking run-out of commutator.

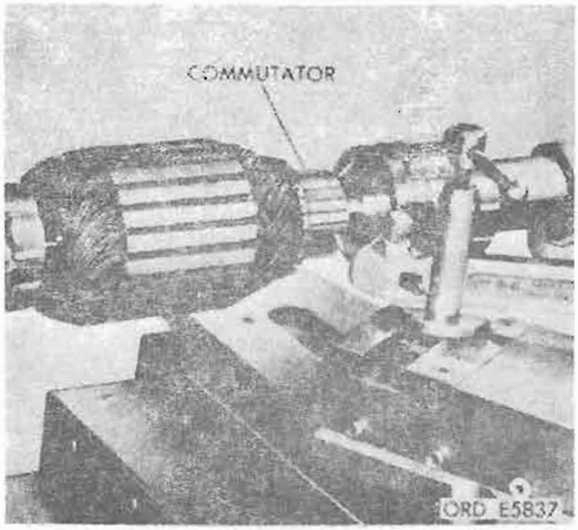
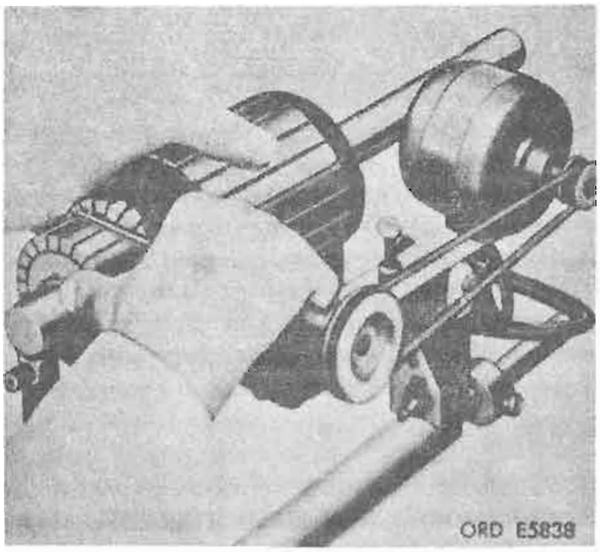


Figure 7-18. Turning down commutator.



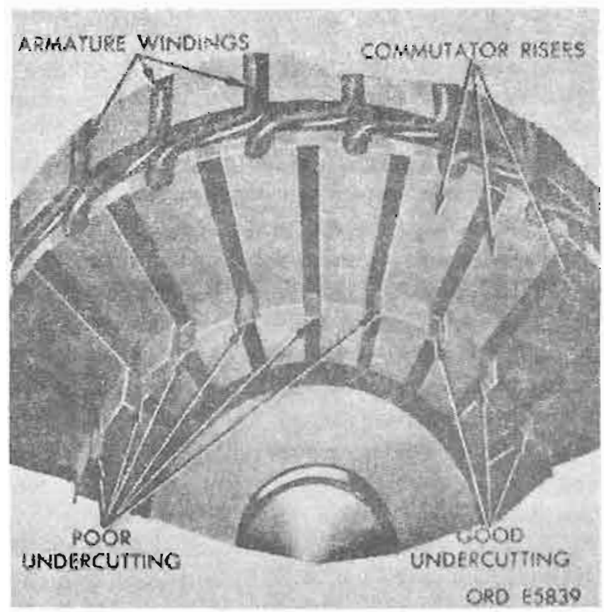


Figure 7-20. Examples of good and bad undercutting on armature commutator.

(3) Check insulated brush holders with continuity tester for grounds and discard plate assembly if grounds are present. Install brush retainer plate on head; refer to figure 7-10 for correct position. Apply red glyptol (RX 1820) to insulation, soldered connections, and exposed metal surfaces on inner face of assembly, except brush leads, brush contact surfaces, and 1⅜-inch minimum diameter area at thrust washer surface. When dry, cover red glyptol with RX 3335 varnish. Allow to dry before assembly.

(4) Install brush springs and check tension with spring scale as shown in figure 7-21. Pull scale on a line perpendicular to spring; take reading

ounces by bending spring at point where spring is seated in spring holder.

(5) Saturate bearing bore with internal combustion engine lubrication oil (OE-30) (MIL-G-2104 or equal), then turn upside down and allow excess oil to drain off.

(6) Clamp armature in padded vise and install thrust washers and head on commutator end of shaft. Install brushes in brush holders and put springs in place. Discard brush plate if brushes are not in perfect alinement with commutator segments or if brushes do not slide easily in brush holders.

d. Drive End Head.

(1) Inspect drive end head for cracks, and discard if defective. Inspect O-ring seats: discard end head if seats are not perfectly smooth.

(2) Check inside diameter of bearing; if diameter is not between 0.626 and 0.632 inch, discard end head.

e. Starter Drive.

(1) Starter drive unit is serviced as an assembly. If visual inspection shows an operational defect in any component of the drive unit discard the entire assembly.

(2) Inspect pinion for cracked, broken, or worn out teeth. Check condition of internal spirals. Barrel must turn easily on the spirals.

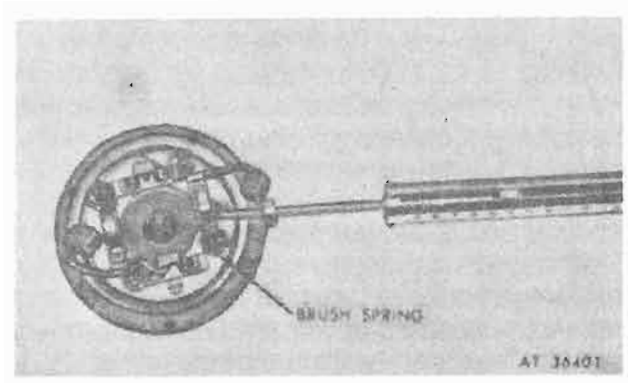


Figure 7-21. Checking spring tension.

CAUTION

If the pinion and barrel assembly is accidentally rotated manually to a fully extended locked position on the screw shaft, do not attempt to force it in the reverse direction. The unit can be installed on the vehicle with pinion and barrel locked in extended position. It will release as soon as the engine operates at a speed high enough to demesh the detent pin in the pinion.

(3) Check drive spring for cracks, breaks, or excessive corrosion. Inspect dentil clutch teeth for proper mesh in drive position.

f. Miscellaneous Parts. Inspect all miscellaneous parts—screws, nuts, washers, and O-rings. If not in perfect condition discard and replace with new.

Section III. ASSEMBLY

7-10. Drive End Head Assembly

a. Install O-ring on drive end head after wiping ring seat and frame contact faces clean. Coat O-ring with waterproof grease. Wipe off excess grease.

b. Install drive end head on frame. Position head with frame as shown in figure 7-7, and secure head to frame with retaining screws.

c. Install one 1/32-inch-thick thrust washer on long end of armature shaft, and insert long end of shaft through drive end bearing.

d. Install fiber thrust washer on stub end of armature shaft.

7-11. Commutator End Head Assembly

a. Install O-ring on commutator end head after wiping ring seat and frame contact faces clean. Coat O-ring with waterproof grease. Wipe off excess grease.

b. Install side-loading ground brushes with brush springs (fig. 7-22).

c. Insert field brushes in field-brush holders and side-load in same manner as ground brushes (fig. 7-23).

d. Position armature so commutator extends out of frame one to two inches, and position commutator end head on commutator and armature shaft.

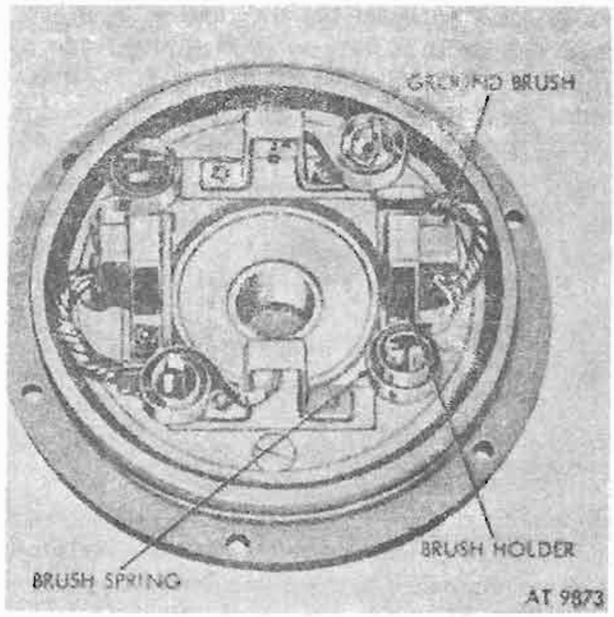


Figure 7-22. Side-loading ground brushes.

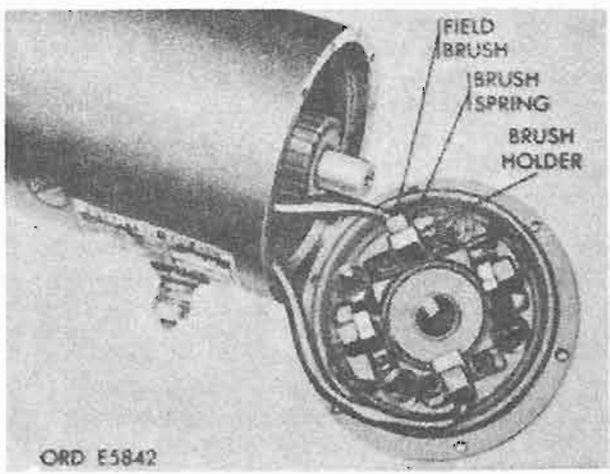


Figure 7-23. Installing and side-loading field brushes.

e. Rotate commutator end head to position shown in figure 7-5, then release brushes. Arrange brush leads so they will not touch armature, and push commutator end plate into contact with frame and field assembly.

f. Secure head to frame with two or three retaining screws. Turn armature to see that it turns freely. Install remainder of head screws.

g. Check end play of shaft with dial indicator (fig. 7-24), moving shaft to extreme positions. End play must be between 0.005 and 0.030 inch. If end play is more than 0.030, install additional thrust washers on commutator end of shaft as required. If less than 0.005 replace thrust washer on commutator end of shaft with thinner one.

7-12. Bendix Drive Assembly

a. Install Woodruff key in keyway on shaft (fig. 7-3).

b. Slip Bendix drive assembly on armature shaft and over Woodruff key.

c. Secure drive assembly to armature shaft with lock screw (fig. 7-2). Be sure screw enters recess in shaft.

Section IV. TEST AND ADJUSTMENT

7-13. General

The tests described in this section are made after the starter is completely assemblied. If the testing procedure indicates defective operation of the starter, it must be disassembled as far as necessary to replace the faulty part or parts. The starter must then be completely assembled and installed on the test stand for further testing. Refer to table 7-1 for performance and test data.

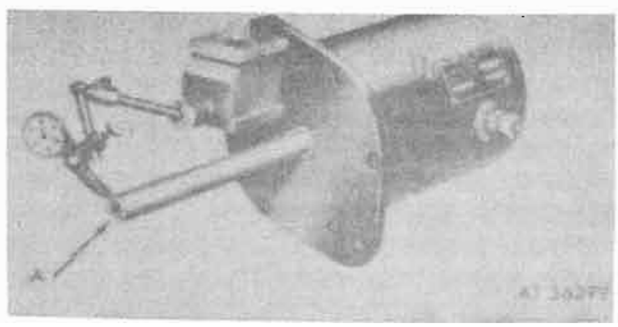


Figure 7-24. Checking end play of armature shaft.

Table 7-1. Performance and Test Data

Rotation	Counterclockwise
Rated volts	24 d.c.
No-load test:	
Volts	22
Max. amperes	12
Min. rpm	3600
Stall test:	
Volts	16
Max. amperes	145
Min. torque (lb.-ft.)	13

7-14. No-Load Current and Speed Test

Perform no-load current and speed test. Follow instructions of manufacturer of test equipment. No-load current should not exceed 12 amperes at 22 volts. No-load speed should read no less than 3600 rpm at 22 volts. Failure to meet no-load current and speed specifications generally indicates mechanical trouble within the starter.

7-15. Stall Torque and Current Test

Perform stall torque and current test. Follow instructions of manufacturer of test equipment. Stall torque should read at least 13 lb.-ft. at 16 volts. Stall current should not exceed 145 amperes at 16 volts. Failure to meet stall torque and current specifications generally indicates electrical defects within the starter.

Section V. REPAIR STANDARDS

7-16. General

The repair standards included herein give minimum, maximum, and key tolerances of new or rebuilt parts. They also give wear limits which indicate that point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the wear limits column or damaged by corrosion, will be approved for service. All measurement are given in inches unless otherwise indicated.

7-17. Standards

Table 7-2 lists the point of measurement, sizes and fits of new parts, and wear limits used in repair of the starting motor. Refer to figure 7-25.

Table 7-2. Repair Standards

Fig. No.	Key	Point of measurement	Sizes of new parts	Wear limits
7-25	7	Brush length	15 / 32	5 / 16
		Armature shaft diameter		
7-25	3	At drive end bearing	0.6243 to 0.6250	0.6230
7-25	2	At flywheel pilot bearing.	0.6243 to 0.6250	0.6230
7-25	5	At commutator end bearing.	0.6345 to 0.6375	0.6340
		Armature shaft runout commutator:		
7-25	4	Out-of-round.		0.003
7-25	9	Diameter.	1.562	1.450
7-25	9	Mica under cut.	1 / 32 to 3 / 64	1 / 32 to 3 / 64
7-25	8	End bearing inside diameter.	0.6375 to 0.6385	0.6430
7-25	6	Brush spring tension	42 to 53 oz.	42 to 53 oz.
7-25	1	Drive end head bearing inside diameter.	0.626 to 0.627	0.632
7-25	10	Armature shaft end play	0.005 to 0.030	0.005 to 0.030

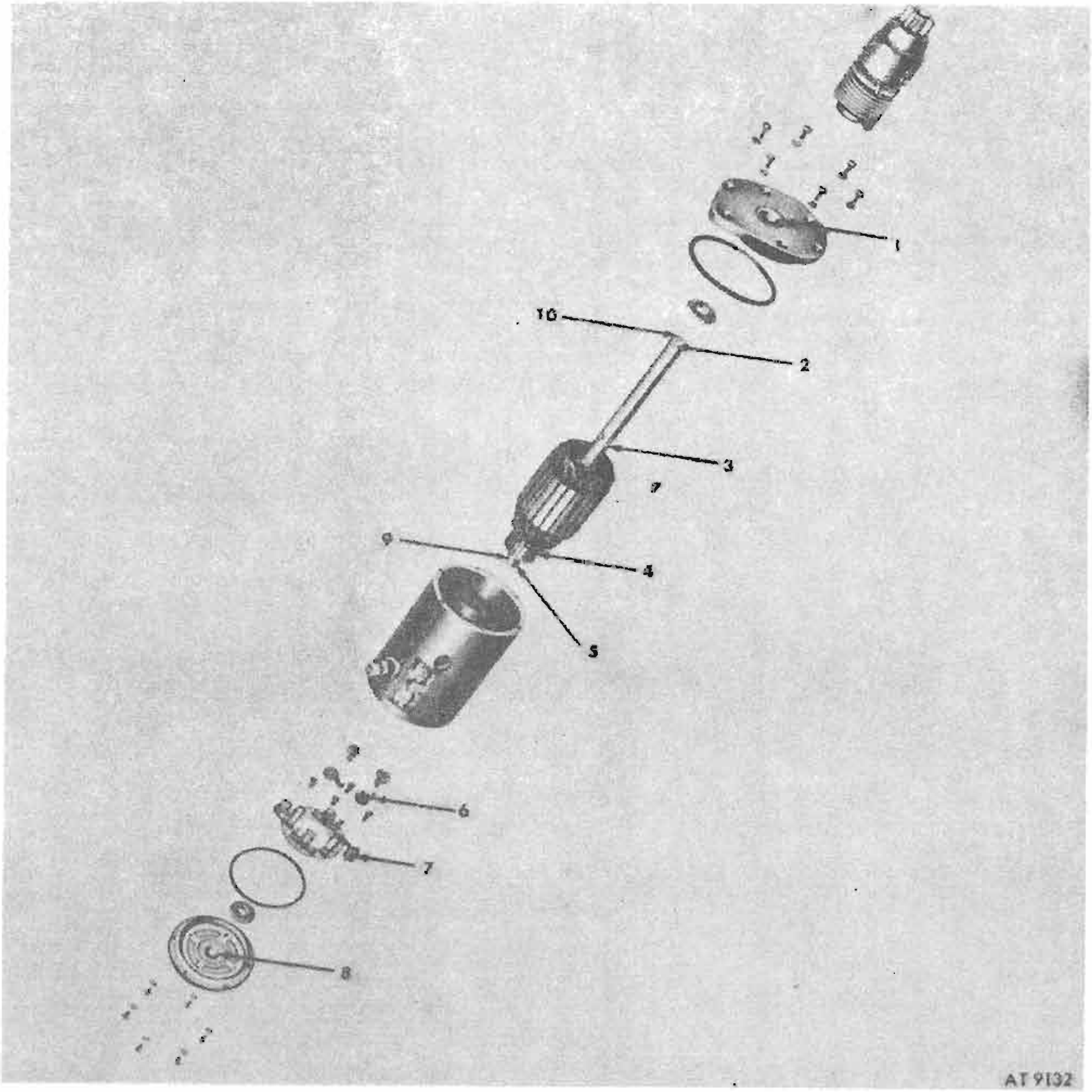


Figure 7-25. Repair standards reference points.

CHAPTER 8

REPAIR OF TRANSMISSION AND TRANSFER ASSEMBLY

Section I. DESCRIPTION AND TABULATED DATA

8-1. Description

For description of the transmission and transfer assembly refer to TM 9-2320-218-20 manual.

8-2. Tabulated Data

a. General.

Make	Ordnance
Type	Selective synchromesh
Speeds	4 forward, 1 reverse
Synchronized	2nd, 3rd, 4th
Lubricant capacity transmission and transfer	5.5 pt.

b. Gear Ratios.

Reverse	7.497 to 1.000
First	5.712 to 1.000
Second	3.179 to 1.000
Third	1.674 to 1.000
Fourth	1 to 1
Transfer	1 to 1

c. Bearing Types—Transmission.

Output shaft—rear	Ball and roller bearing
Output shaft—pilot	Needle roller
Cluster gear	Needle roller
Reverse gear	Bushing

d. Bearing Types—Transfer.

Intermediate gear	Needle roller
Front output shaft:	
Front bearing	Ball
Rear bearing	Bushing
Rear output shaft:	
Front bearing	Roller
Rear bearing	Ball

Section II. CLEANING AND INSPECTION

8-3. Scope

The recommended procedures for removal of the transmission and transfer assembly will be found in TM 9-2320-218-20. The procedures in section III describe the complete disassembly of the transmission and transfer into sub-assemblies and also describe disassembly and repair of the subassemblies. Section IV describes the assembly of the transmission and transfer. Cleaning recommendations (para 8-4), and inspection and repair recommendation (para 8-5), cover all general conditions. Special precautions or inspections are noted in the text or illustrations adjacent to the part or parts involved. Torque recommendations are given in the figures describing operations involved. Wear limits information is included in each section.

8-4. Cleaning Recommendations

a. General. Whenever an assembly is contaminated with dirt or other abrasive matter, unnecessary wear will result. Inspect all parts for possible abrasive material any time a unit is disassembled. Metallic contamination of oil is evidence of failure of some part in the assembly. If metal particles are found, the entire assembly containing the contaminated lubricant must be thoroughly cleaned.

b. Cleaning Parts.

(1) All metallic parts of the transmission and transfer assembly except bearings and seals should be cleaned thoroughly with dry cleaning solvent, volatile mineral spirits paint thinner, or steam. Do not use caustic soda for steam cleaning.

(2) Parts should be dried with compressed air. Steam-cleaned parts should be oiled immediately after drying.

(3) After cleaning, examine parts—especially oil passages—to make certain they are entirely clean.

c. Cleaning Bearings. Refer to TM 9-214 for care and maintenance of bearings.

8-5. Inspection and Repair Recommendations

a. Inspecting Cast Parts and Machined Surfaces.

(1) Inspect bores for cracks, wear, grooves, scratches, and dirt. Remove scratches and burrs with crocus cloth. Remove foreign matter. Replace parts that are cracked, deeply grooved or scratched.

(2) Inspect all oil passages for obstructions. Remove obstruction with compressed air or by

working a wire back and forth through the passage and flushing with cleaning solvent.

(3) Inspect mounting faces for nicks, burrs, scratches, and foreign matter. Remove such defects with crocus cloth or soft stone. If scratches are deep, replace part.

(4) Inspect tapped holes for damaged threads. Chase damaged threads with correct size tap.

(5) Discard cases or other cast parts that are broken.

(6) Inspect all machined surfaces for damage that could cause oil leakage or other malfunctions. Repair or replace the defective parts.

b. Inspecting Bearings.

(1) Inspect bearings for roughness of rotation. Replace a bearing if its rotation is still rough after cleaning and oiling.

(2) Inspect bearings for scored, pitted, scratched, cracked or chipped races, and for indication of excessive wear of rollers or balls. If damage is found, replace the bearing.

(3) Inspect a damaged bearing bore and shaft for grooved, burred, or galled conditions that would indicate the bearing has been turning in its bore or on its shaft. If the damage cannot be repaired with crocus cloth, replace the defective parts. Refer to TM 9-214.

(4) If a bearing must be removed or installed without a pressing sleeve, be careful to press only on the race which is adjacent to the mounting surface. If an arbor press is not available, seat the bearing with a brass drift and a hammer, driving against the supported race.

c. Inspecting Bushing-Type Bearings and Thrust Washers.

(1) Inspect bushings for roundness, scores, burrs, sharp edges, and evidence of overheating. Remove scores with crocus cloth. Remove burrs and sharp edges with a scraper or knife blade. If the bushing is out-of-round, deeply scored, or excessively worn, replace it using the proper replacer.

NOTE

Sometimes it is necessary to cut out a damaged bushing. Be careful not to damage the bore into which the bushing fits.

(2) Inspect thrust washers for distortion, scores, burrs, and wear. Replace thrust washers if defective or worn.

d. Inspecting Seals and Gaskets.

(1) Inspect seals for scoring, cuts, and hardness. Replace damaged or unserviceable seals.

(2) When replacing lip-type seals, place spring-loaded side toward oil to be sealed in (toward inside of unit). Use hardening sealer (5330-252-3391) on outside of seal to prevent leaks. Pack inside lips of seal with light grease (GAA), or lubricant specified in LO 9-2320-218-12.

(3) Replace all gaskets.

(4) Inspect surfaces of parts on which seals bear. If grooving is excessive, replace the part and seal (grooves deeper than 0.003).

e. Inspecting Gears.

(1) Inspect gears for scuffed, nicked, burred or broken teeth. If defect cannot be removed with a soft stone, replace gear.

(2) Inspect gear teeth for wear. If original tooth shape is destroyed, replace gear.

(3) Inspect thrust faces of gears for scores, scratches and burrs. Remove defects with soft stone. If scratches and scores cannot be removed, replace gear.

f. Inspecting Splined Parts. Inspect parts for stripped, twisted, chipped, or burred splines. Remove burrs with a soft stone. If other damages are found, replace the part. Wear on splines such as used on wheel drive shafts is not considered critical, since such splines are made with long contact surfaces designed to slide back and forth under all conditions. However, wear on short splines such as drive flanges must be minimum since a spline is used in this kind of installation because it is stronger than a keyway. This strength is lost if fit is loose.

g. Inspecting Threaded Parts. Inspect parts for damaged threads. Remove burrs with a soft stone or fine file. Replace damaged parts.

h. Inspecting snaprings. If parts are available, snaprings should generally be replaced, since they are difficult to remove without distorting. Snaprings controlling shaft end play should always be replaced. If a snapring must be used again, remove any nicks or distortion before installing.

i. Inspecting Springs. Inspect all springs for signs of overheating, permanent set, or wear due to rubbing adjacent parts. Inspect for broken or distorted coils. Check for loss of compression or stretching. Replace spring for any one of the defects. (See appropriate wear limit tables.)

8-6. Wear Limits and Torque Specifications

a. Wear Limits.

(1) Data covering the size and fit of new parts, and wear limits information are included in the exploded views in the repair section and tables 8-1 through 8-8. These measurements list the maximum and minimum clearances for new parts.

(2) The wear limits indicate the dimensions to which a part may wear before it must be replaced. Normally, any part not worn beyond its wear limit may be approved for service, provided it is not damaged by corrosion or similar causes. An asterisk (*) in the wear limits column indicates that the part should be replaced when worn beyond the limits stated in the size and fit of new parts column.

b. Torque Specifications. Torque specifications are called out in the text relating to the individual part in paragraphs 8-7 through 8-31.

Section III. DISASSEMBLY AND REPAIR OF TRANSMISSION AND TRANSFER BY SUBASSEMBLIES

8-7. Disassembly of Transfer

a. Secure improvised transmission holding fixture to available stand (fig. 8-1).

b. Mount transmission on holding fixture and secure stand in bench vise. Drain lubricant from transmission (fig. 8-2).

c. Remove six bolts and lockwashers securing gearshift housing to transmission case. Remove gearshift housing and gasket from transmission case (fig. 8-3).

d. Remove speedometer-driven gear bearing from transfer case (fig. 8-4) and withdraw speedometer-driven gear from transfer case.

e. Open tab of tab washer and remove parking brakedrum-retaining bolt and washer and then remove parking brakedrum from transmission output shaft (fig. 8-5).

f. Remove three retaining screw-and-washer assemblies and remove output shaft retainer and gasket (fig. 8-6).

g. Remove eight transfer case retaining bolts and lockwashers (fig. 8-7) and then remove transfer case and gasket from transmission case.

NOTE

Tilt transmission slightly to avoid dropping transfer idler gear bearing rollers.

h. Remove 44 roller bearings and three spacers from transfer intermediate gear and shaft (fig. 8-8).

i. Remove snapring retainer.

j. Using snapring pliers, remove output shaft retaining snapring from output shaft (fig. 8-9) and remove selective-fit spacer.

k. Using arbor press and protective block (7345227) press output shaft and gear from rear bearing (fig. 8-10). Remove output gear and shaft assembly from transfer case.

l. Using arbor press and protective block (7345227) press output shaft from front bearing (fig. 8-11).

m. Press transfer intermediate gear shaft from case (fig. 8-12) and remove transfer intermediate shaft and gear from case (fig. 8-13).

CAUTION

Be sure that intermediate gear is clear of locating pin of intermediate shaft.

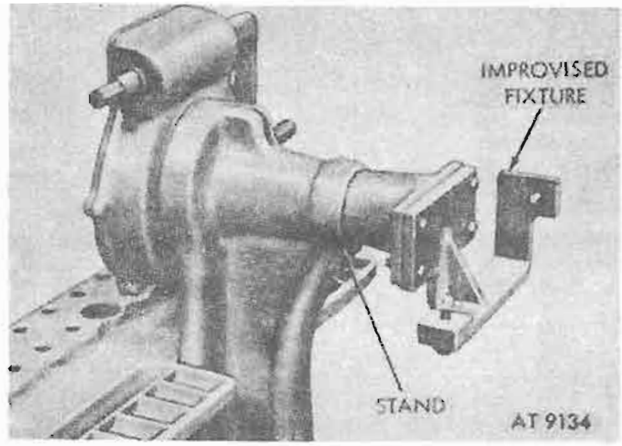


Figure 8-1. Transmission holding fixture.

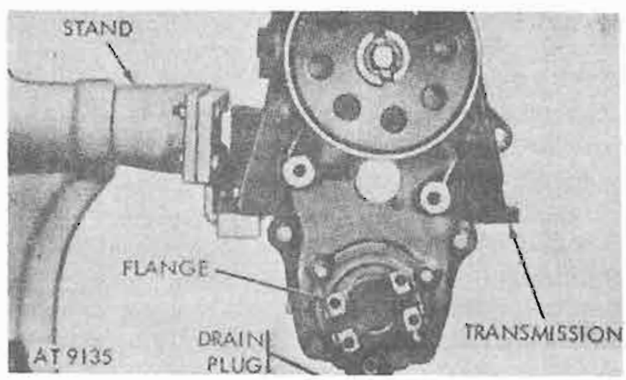


Figure 8-2. Transmission mounted on fixture stand.

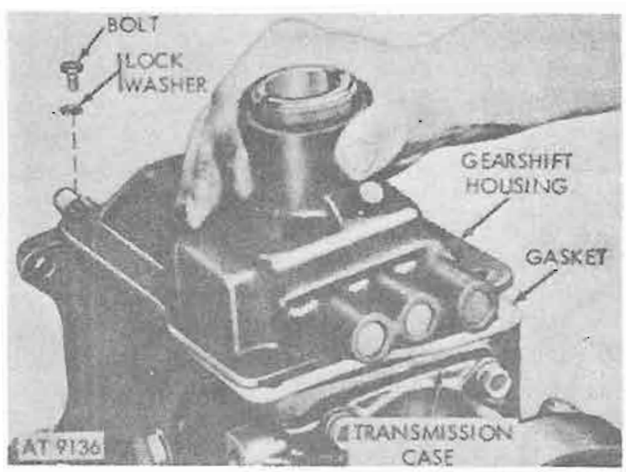


Figure 8-3. Gearshift housing and gasket.

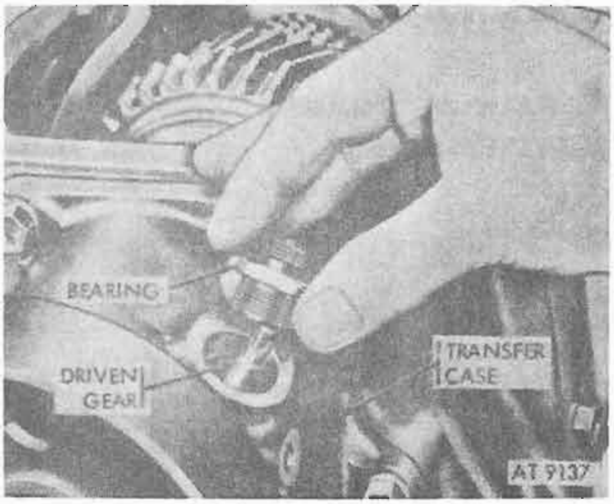


Figure 8-4. Speedometer driven gear and bearing.

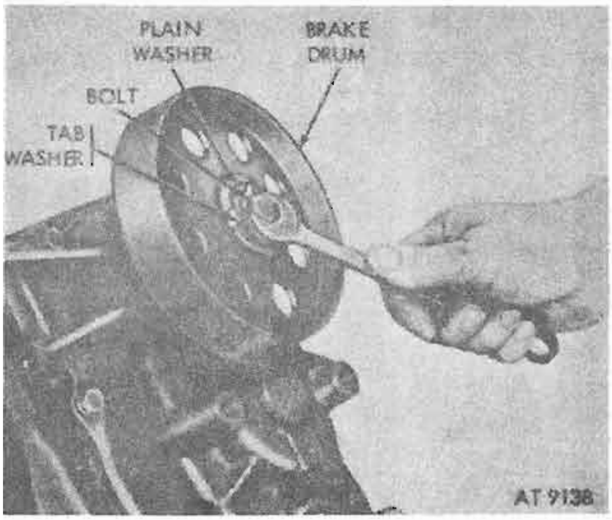


Figure 8-5. Parking brakedrum.

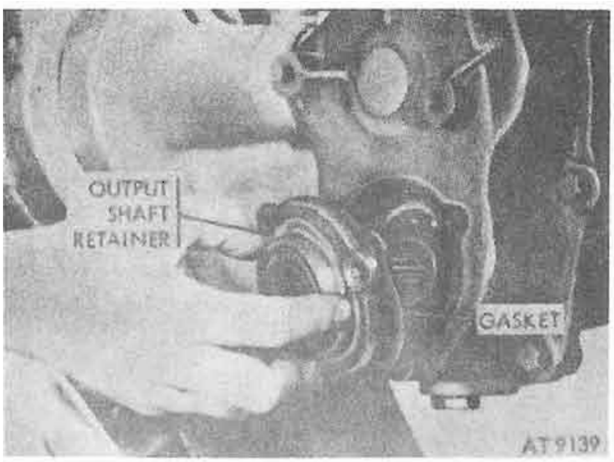


Figure 8-6. Transfer rear output shaft retainer and gasket.

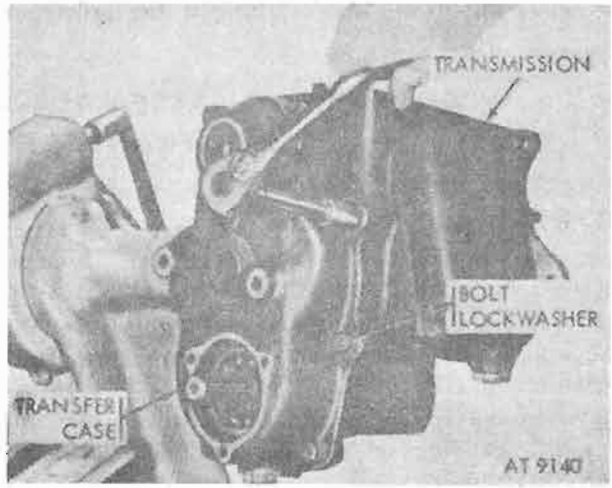


Figure 8-7. Transfer case and gasket.

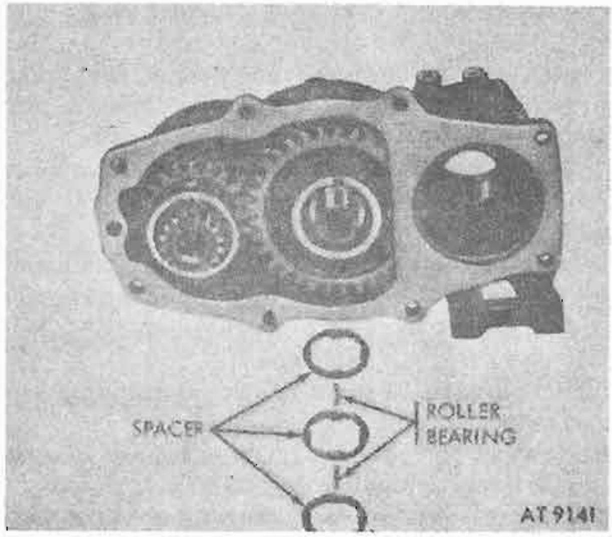


Figure 8-8. Intermediate gear and shaft bearings.

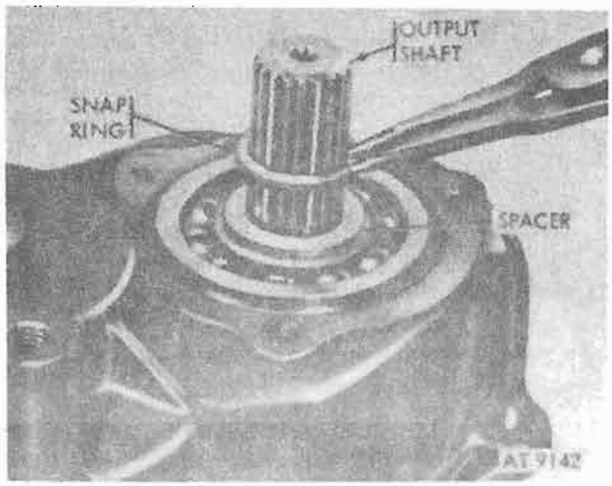


Figure 8-9. Transfer output shaft snapring and spacer.

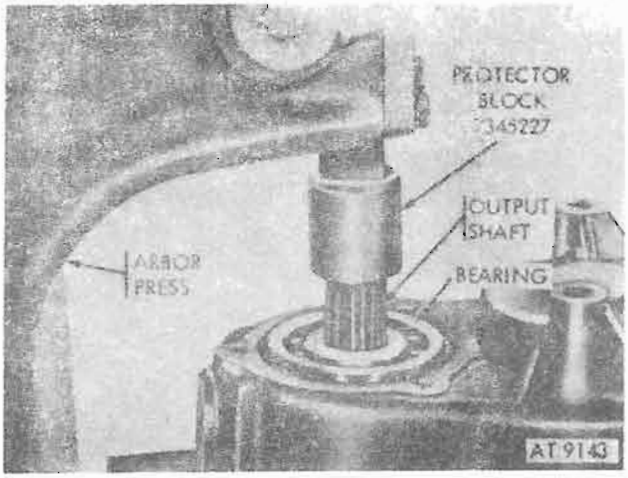


Figure 8-10. Pressing output shaft and gear from rear bearing.

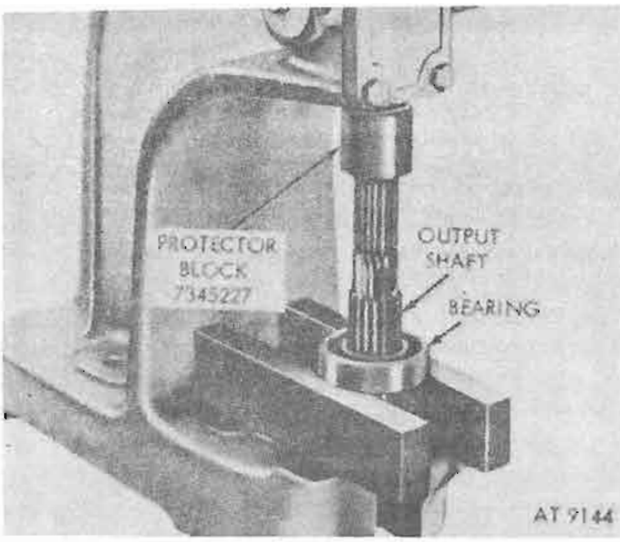


Figure 8-11. Pressing output shaft from front bearing.

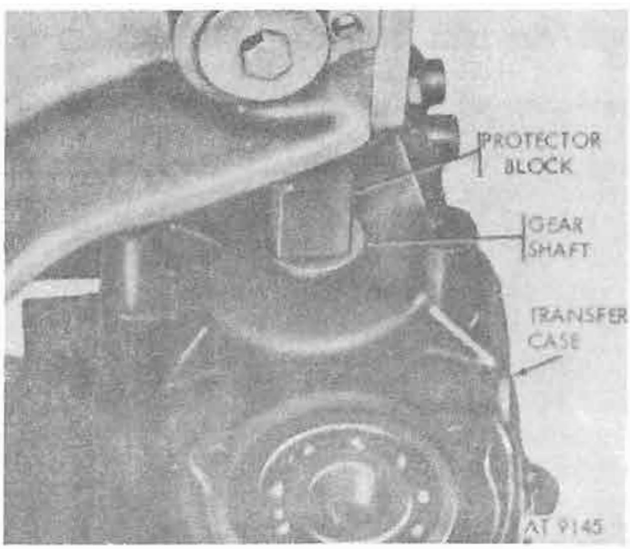


Figure 8-12. Pressing intermediate gear shaft from transfer case.

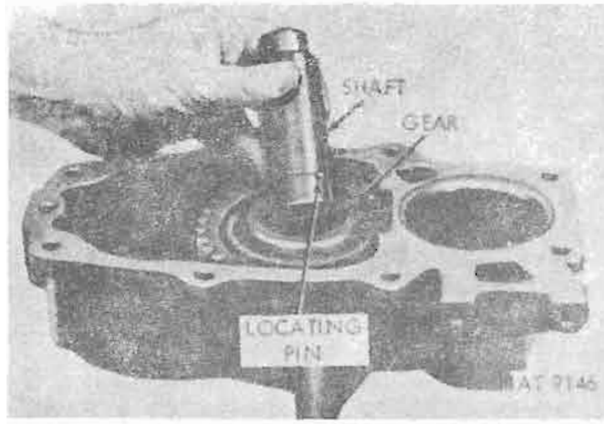


Figure 8-13. Intermediate shaft and gear.

n. Press output shaft rear bearing from transfer case, using a standard press block (fig. 8-14).

o. Using puller from puller kit (5120-313-9496) remove parking brake-drum seal from transfer case (fig. 8-15).

p. Use driver (7345231) with arbor press or hammer to remove output shaft roller bearing from transfer case (fig.8-16).

8-8. Cleaning, Inspection and Repair

Refer to paragraph 8-4 for cleaning and to figure 8-21 and table 8-2 for wear limits and allowable tolerances.

a. Clean transfer case with drycleaning solvent, mineral spirits, or paint thinner, and inspect case for cracks. Inspect bores for size. Inspect intermediate gear thrust washer for wear (8-17). If thrust washer is scored or worn, drill out rivets (fig. 8-18) and replace washer.

b. Clean bearings (fig. 8-19) as prescribed in TM 9-214 and inspect. Inspect gear teeth and splines. Inspect shaft bore bushing and machined bearing surfaces. Inspect snapring grooves and remove abrasions with stone or fine tooth file.

c. Using driver plug (7345257) or equivalent remove output shaft seal from output shaft retainer (fig. 8-20).

d. Refer to figure 8-21 and table 8-2 for wear limits and size of new parts for the transfer assembly.

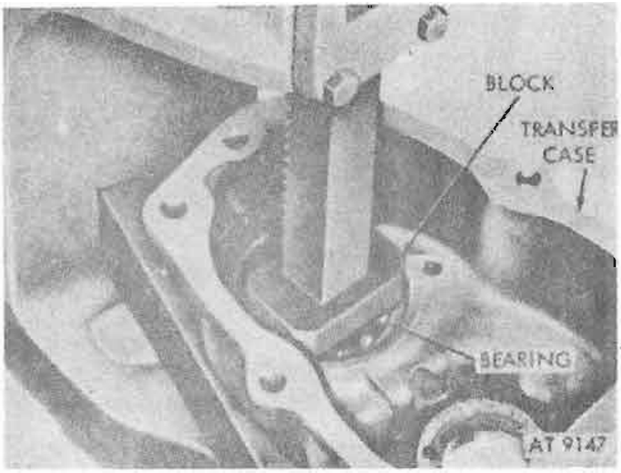


Figure 8-14. Pressing output shaft rear bearing from transfer case.

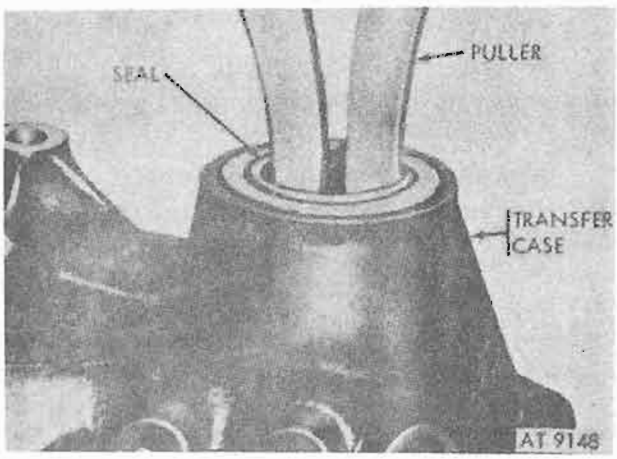


Figure 8-15. Removing parking brakedrum seal.

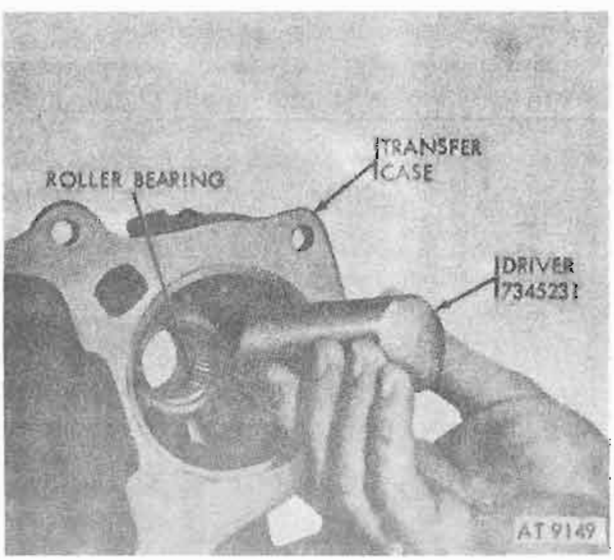


Figure 8-16. Output shaft roller bearing and driver 7345231.

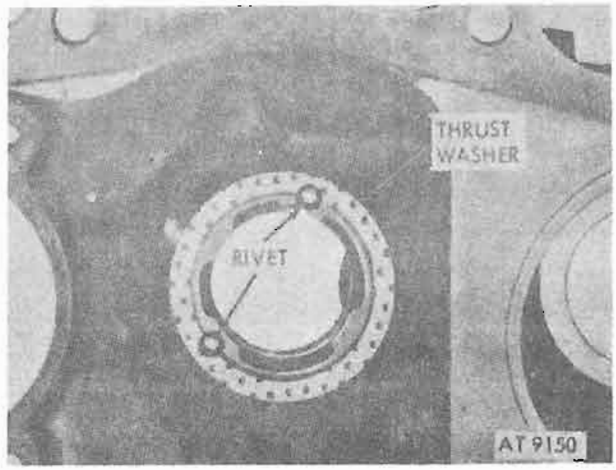


Figure 8-17. Intermediate Gear Thrust Washer.

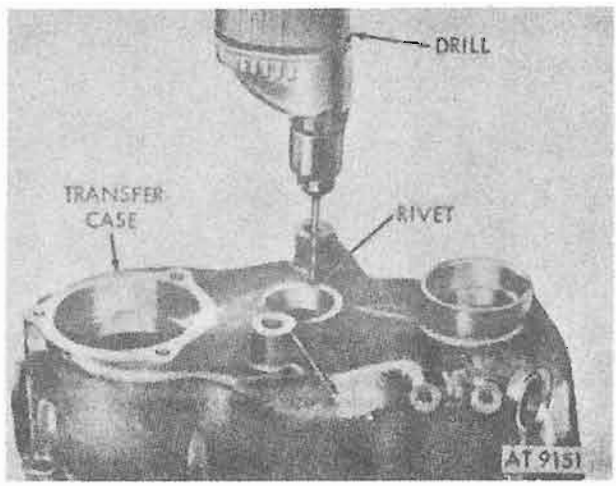
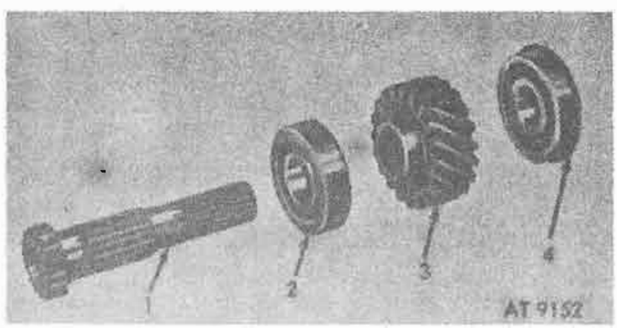


Figure 8-18. Drilling out thrust washer securing rivets.



1 Output shaft
2 Front bearing
3 Gear
4 Rear bearing

Figure 8-19. Transfer output shaft assembly.

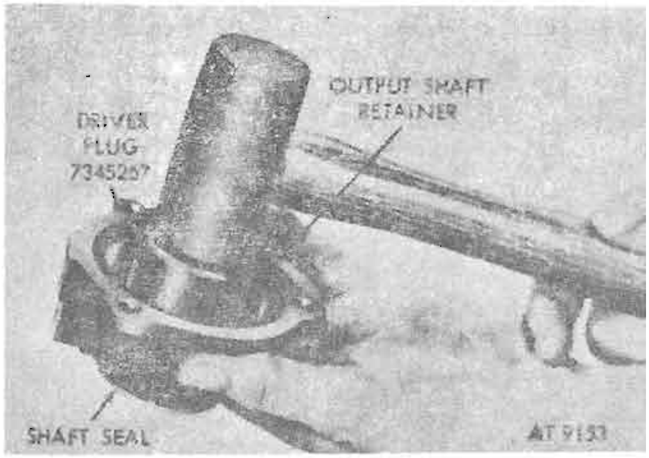
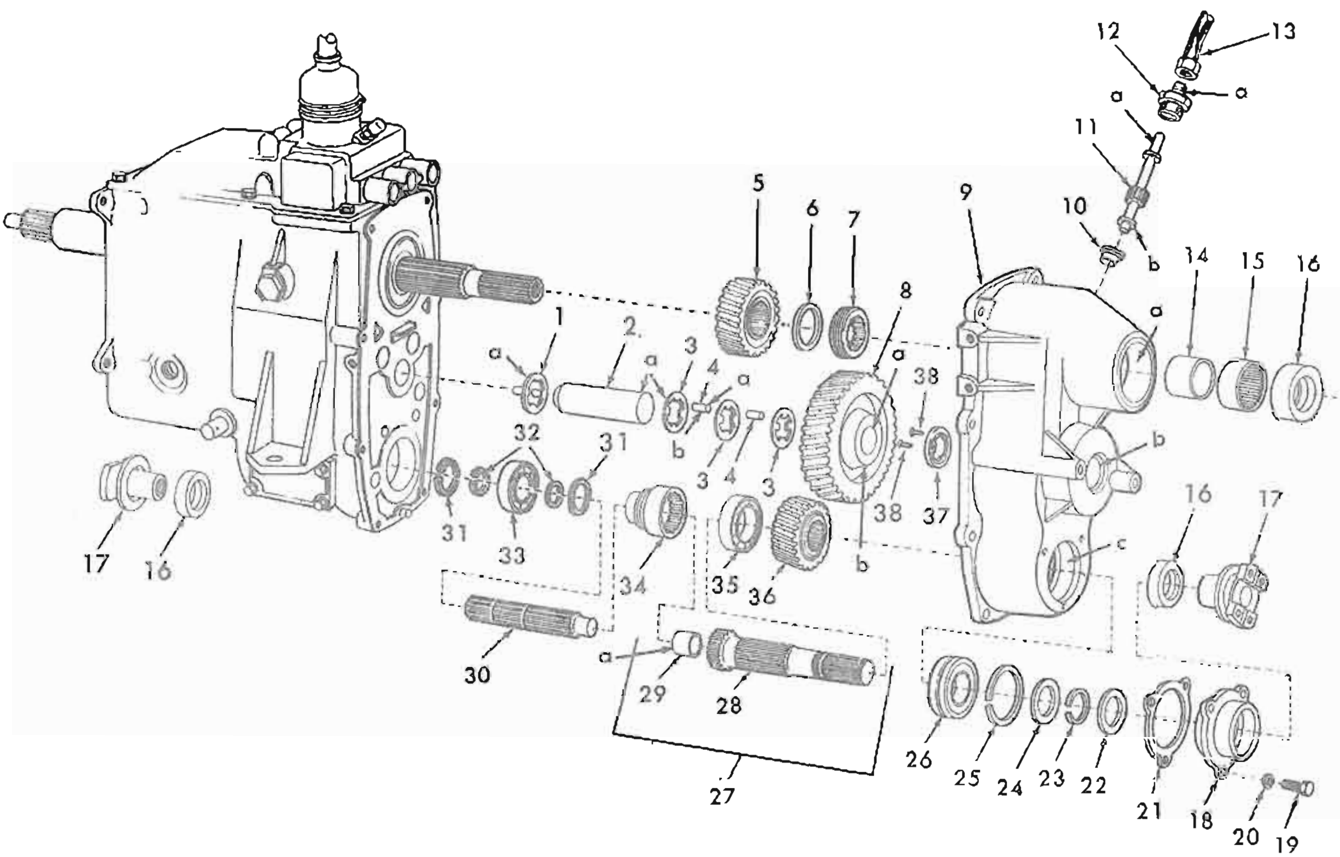


Figure 8-20. Removing output shaft seal.



AT 40072

1 Washer
2 Shaft assy.
3 Spacer
4 Bearing
5 Gear
6 Spacer
7 Gear
8 Gear
9 Case assy.
10 Bushing
11 Gear assy.
12 Bearing
13 Shaft assy.
14 Race
15 Bearing
16 Seal
17 Flange
18 Retainer
19 Screw
20 Washer
21 Gasket
22 Retainer
23 Ring
24 Spacer
25 Ring
26 Bearing assy.
27 Shaft assy.
28 Shaft
29 Bearing
30 Shaft
31 Ring
32 Ring
33 Bearing assy.
34 Clutch
35 Bearing
36 Gear
37 Washer
38 Rivet

Figure 8-21. Transfer assembly—exploded view.

Table 8-1. Wear Limits—Transfer

Reference		Point of measurement	Size of new parts	Wear limits field maintenance
Fig. No.	Key			
8-21	2a	Outside diameter of bearing surface.	1.5060-1.5072	1.5060
8-21	1a	Thickness of washer	0.146-0.142	0.140
8-21	3a	Thickness of spacer	0.090-0.092	0.085
8-21	4a	Length of each roller bearing.	1.10-1.12	1.09
8-21	4b	Diameter of each roller	0.2498-0.2500	*
8-21	8a	Inside diameter of gear bore.	2.0098-2.0106	2.0111
8-21	8b	Length of gear	2.470-21474	2.465
8-21	12a	Shaft bore	0.311-0.313	0.309
8-21	11a	Shaft diameter at upper bearing.	0.307-0.309	0.305
8-21	11b	Shaft diameter at lower bearing.	0.246-0.248	0.244
8-21	9a	Inside diameter of bearing bore.	1.4995-0.5005	*
8-21	9b	Inside diameter of shaft bore.	1.4465-1.4475	*
8-21	9c	Inside diameter of bearing bore.	2.8344-2.8354	*
8-21	29a	Internal bushing diameter.	0.6275-0.6290	0.6310

* Refer to paragraph 8-6a (2).

8-9. Assembly of Transfer

a. Coat outside surface of output shaft seal with sealer and press seal into bearing retainer using arbor press and protector block (7345227) (fig. 8-22).

b. Position intermediate gear in transfer case and then position shaft in case so that locating pin is alined with case slot. (Refer to fig. 8-13). Use protector block to press shaft into position (fig. 8-23).

c. Press front output bearing on output shaft using protector block (7345227)(fig. 8-24).

d. Position output gear in case and press output shaft and bearing assembly into rear bearing using driver plug (7345231) (fig. 8-25).

e. Install selective-fit spacer on output shaft using alining tool (108855544) and driver (7345231). Secure with snapring and snapring retainer (fig. 8-26). Check clearance after installation (fig. 8-27).

NOTE

Determine clearance prior to installation of spacer and snapring. Vary washer thickness to obtain 0.002 inch maximum clearance. Refer to table 8-2 for spacer thickness.

Table 8-2. Output Shaft Thrust Washer Thickness

Washers (spacers) are available in 7 thicknesses.

Part number	*Thickness (in.)*
8754385	0.127-0.129
8754384	0.124-0.126
8754383	0.121-0.123
8754382	0.118-0.120
8754381	0.115-0.117
8754380	0.112-0.114
8754379	0.109-0.111

f. Install bottom spacer and 22 roller bearings around intermediate gear hub. Refer to figure 8-8. Install center spacer and 22 roller bearings and top spacer (fig. 8-28).

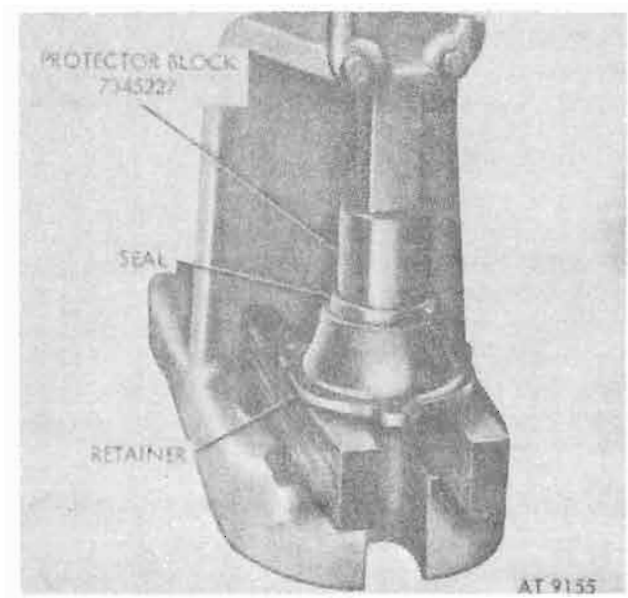


Figure 8-22. Install output shaft seal.

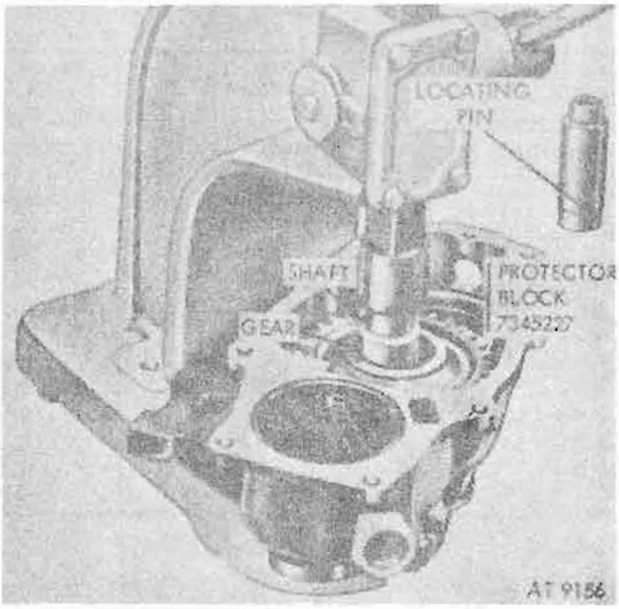


Figure 8-23. Pressing intermediate gear shaft in position.

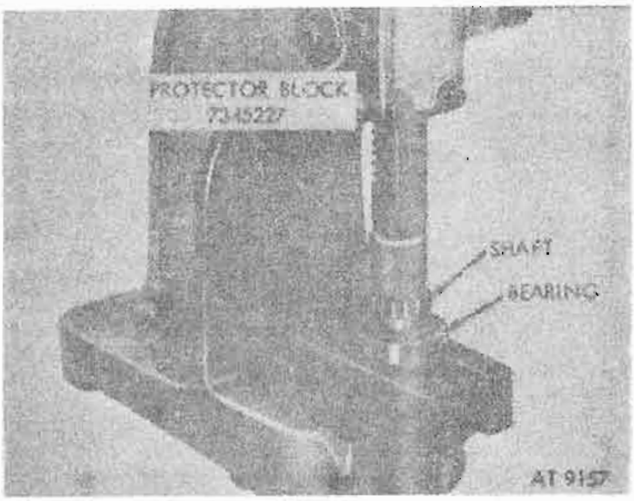


Figure 8-24. Installing front output bearing on output shaft.

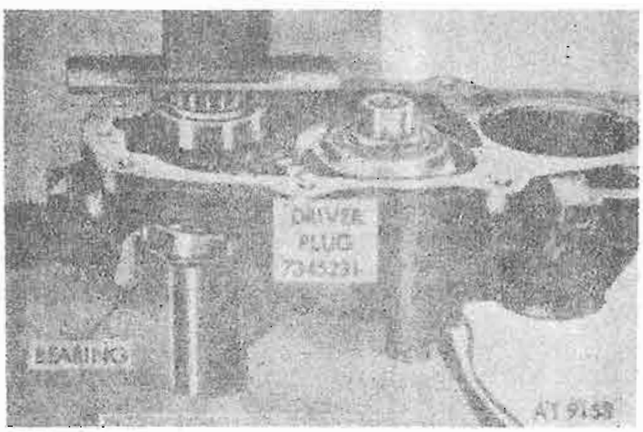


Figure 8-25. Installing output shaft and bearing assembly.

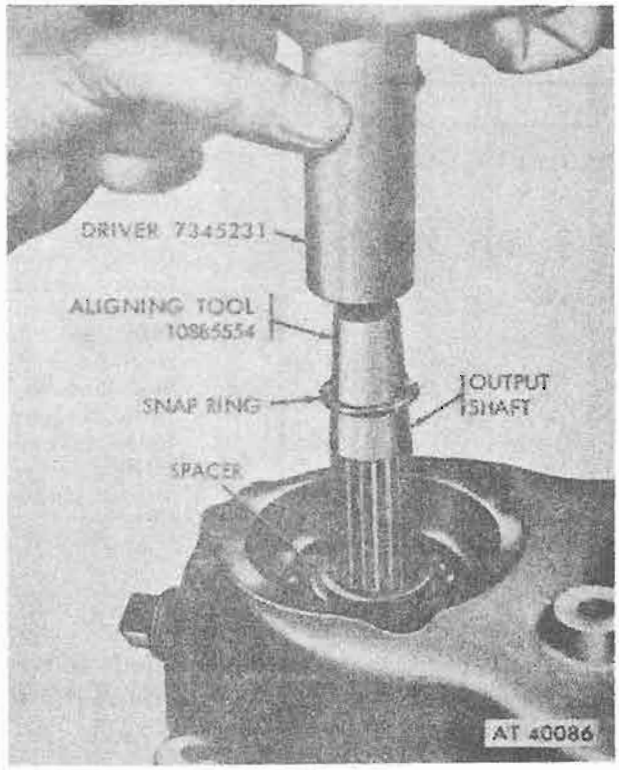


Figure 8-26. Installing spacer and snapring.

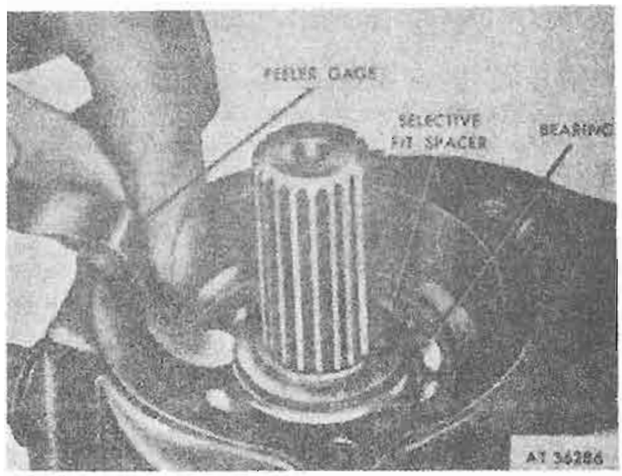


Figure 8-27. Check clearance between spacer and bearing.

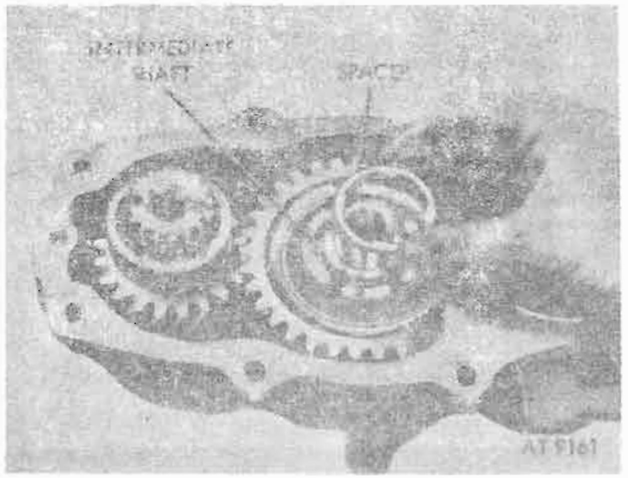


Figure 8-28. Installing top spacer on output shaft.

8-10. Disassembly of Transmission into Subassemblies

a. For early models, straighten tab on tab washer securing pivot. Remove and discard tab washer and pivot. Lift shift arm from case (fig. 8-29).

b. For late models remove pivot and lift shifter arm from case (fig. 8-29).

c. Remove three input shaft bearing retainer screws and washers and then remove input shaft retainer and gasket from transmission case (fig. 8-30).

d. Remove two countershaft lockpin screws (fig. 8-31).

NOTE

A lock pin screw is installed on each end of the countershaft pin to secure the pin in the case.

e. Using small diameter long shank drift, drive out lock pin securing countershaft in transmission case (fig. 8-32).

f. Using insert remover-replacer (7345226), force countershaft from transmission case, leaving remover-replacer in countershaft gear cluster to hold bearings in position (fig. 8-33).

NOTE

Countershaft must be removed to permit countershaft gear cluster to drop down; permitting removal of input shaft.

g. Tap input shaft gently with soft hammer and carefully remove input shaft assembly and 14 needle bearings from transmission housing (fig. 8-34).

CAUTION

Tip transmission forward slightly to prevent input shaft needle bearings from falling into transmission case.

h. Remove speedometer drive gear, spacer and transfer input gear from output shaft. Install puller (7345234) and protector block (7345227) as shown in figure 8-35, and remove rear bearing from shaft.

i. Slide output shaft assembly rearward and lift from transmission case (fig. 8-36).

j. Remove countershaft gear cluster by lifting straight up. Note position of the two thrust washer tangs (fig. 8-37) for reference during assembly.

CAUTION

Needle bearings may fall out of cluster gear bore.

k. Slide out low and reverse idler shaft and remove idler gear from housing (fig. 8-38).

8-11. Input Shaft Disassembly

a. Clean input shaft assembly thoroughly and inspect before disassembly. Refer to paragraph 8-4 for cleaning and paragraph 8-51 for inspection of the bearings.

NOTE

Do not disassembly the input shaft assembly unless necessary, as bearing may be damaged in removal.

b. For inspection and repair, refer to figure 8-41 and table 8-3 for wear limits and allowable tolerances.

c. Using snapring pliers remove snapring securing bearing on input shaft (fig. 8-39).

d. Install puller (7345234) with protector block (7345227) as shown in figure 8-40, and pull bearing from input shaft.

e. Inspect bore and bearing of shaft (8) for scores, ridges and wear (refer to fig. 8-41). Inspect bearing (6) for noise, galling, scoring and wear. Discard snapring (5).

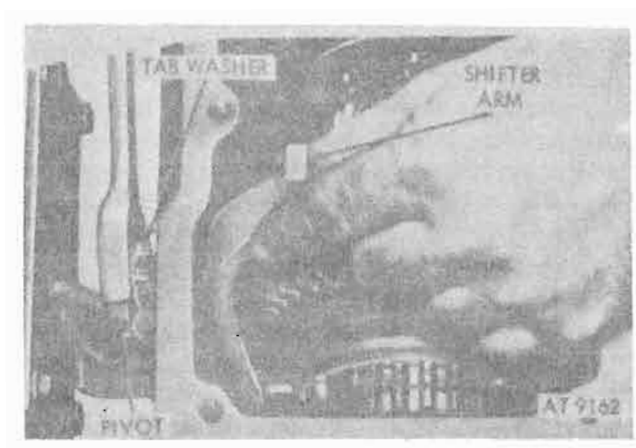


Figure 8-29. Shifter arm and pivot.

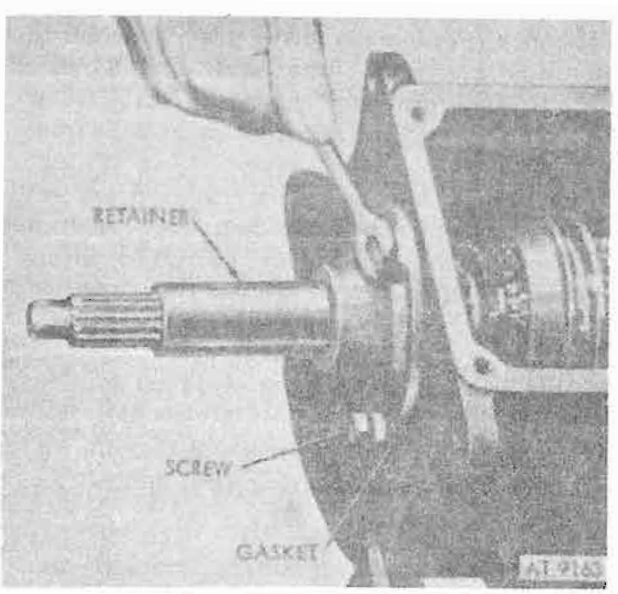


Figure 8-30. Input shaft retainer.

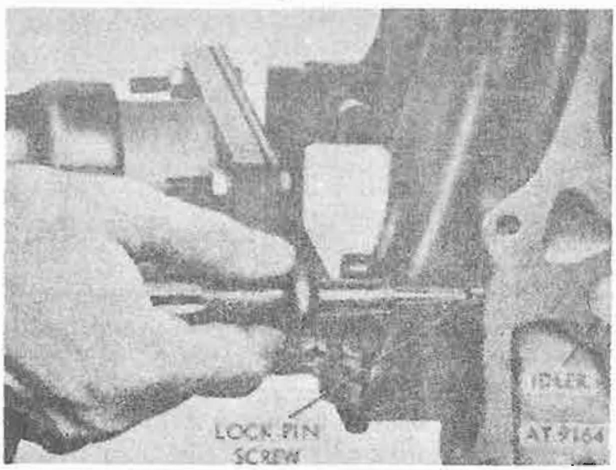


Figure 8-31. Countershaft and idler shaft lock-pin screw.

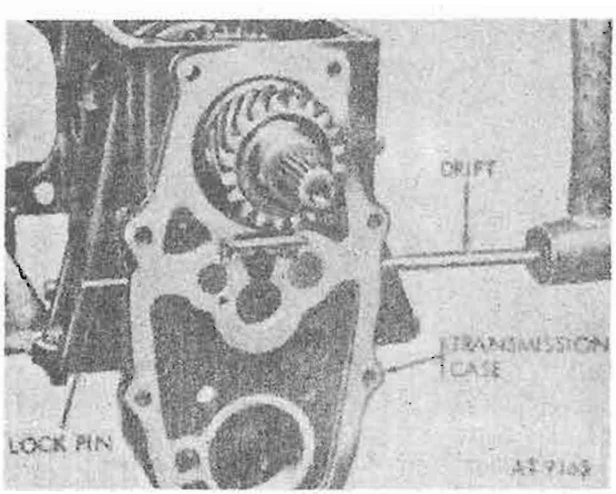


Figure 8-32. Countershaft lock pin.

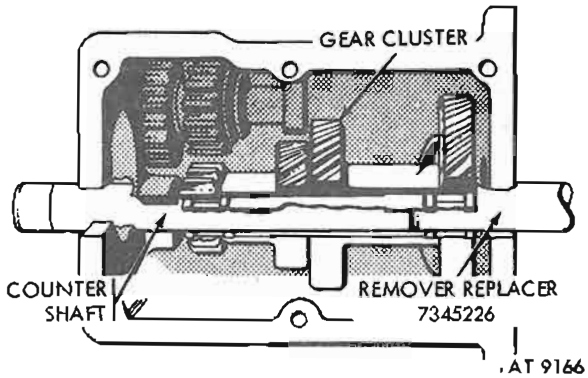


Figure 8-33. Countershaft gear cluster and countershaft.

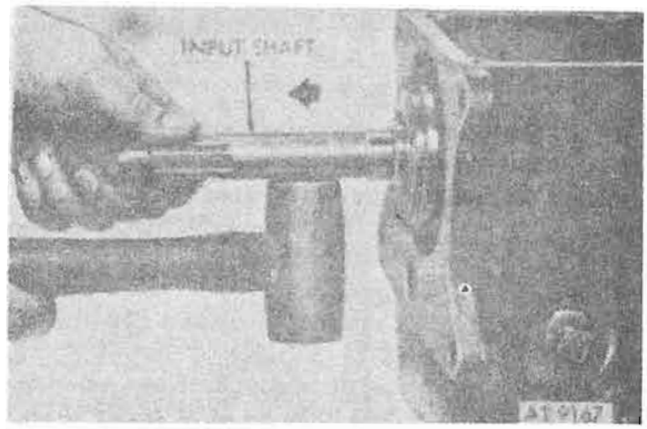


Figure 8-34. Removing input shaft from transmission.

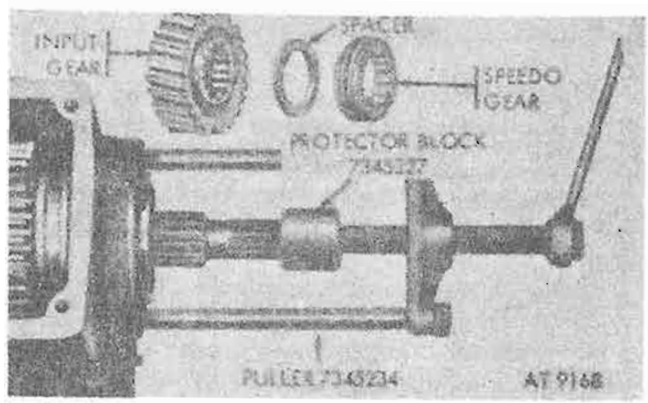


Figure 8-35. Removing transmission output shaft rear bearing.

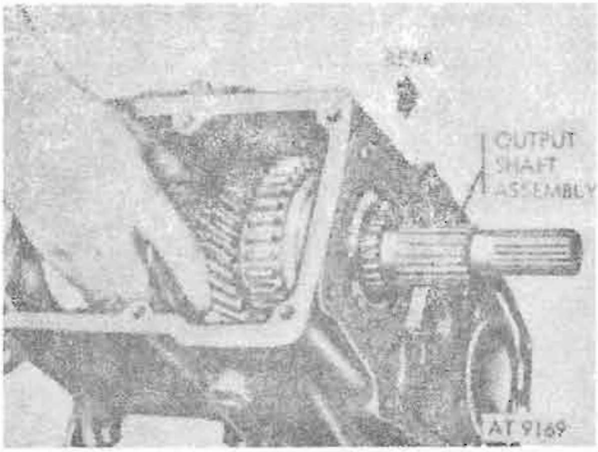


Figure 8-36. Removing output shaft assembly.

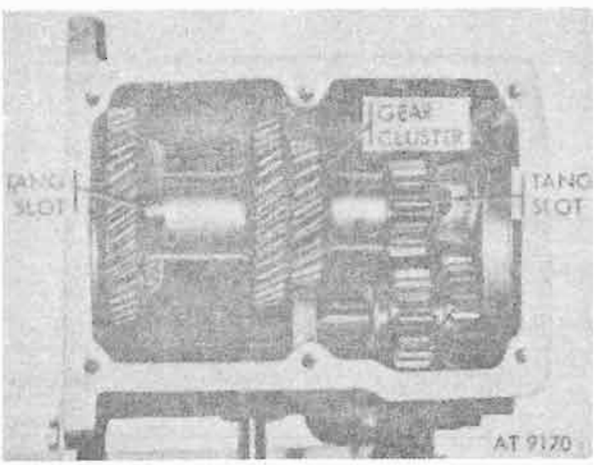


Figure 8-37. Countershaft gear cluster.

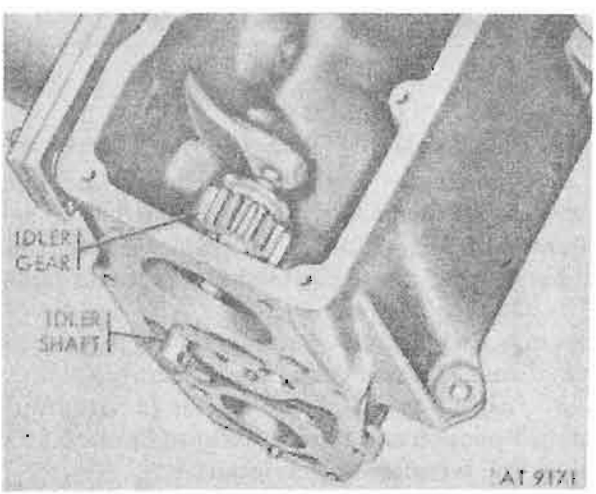


Figure 8-38. Idler gear and shaft.

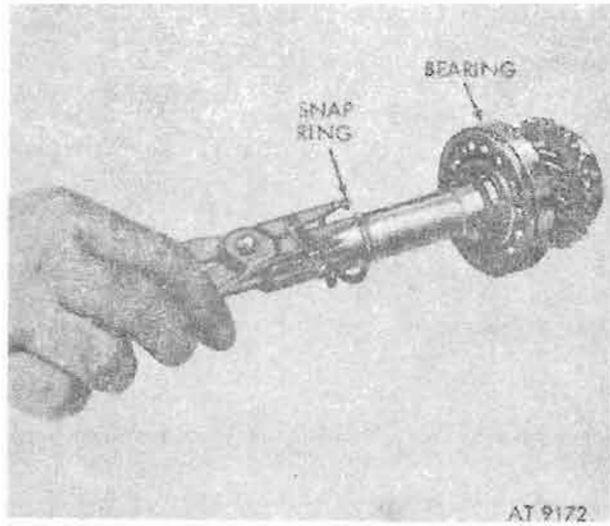


Figure 8-39. Input shaft bearing retaining snapring.

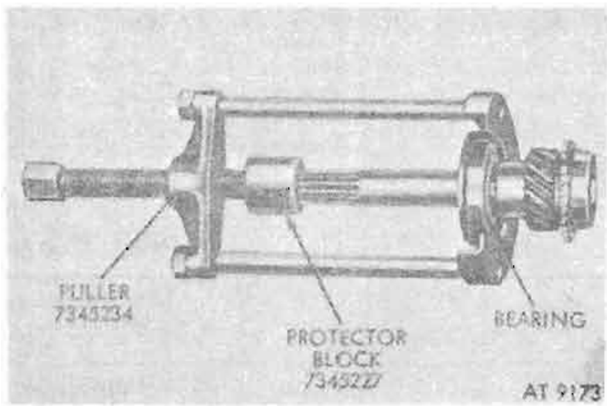
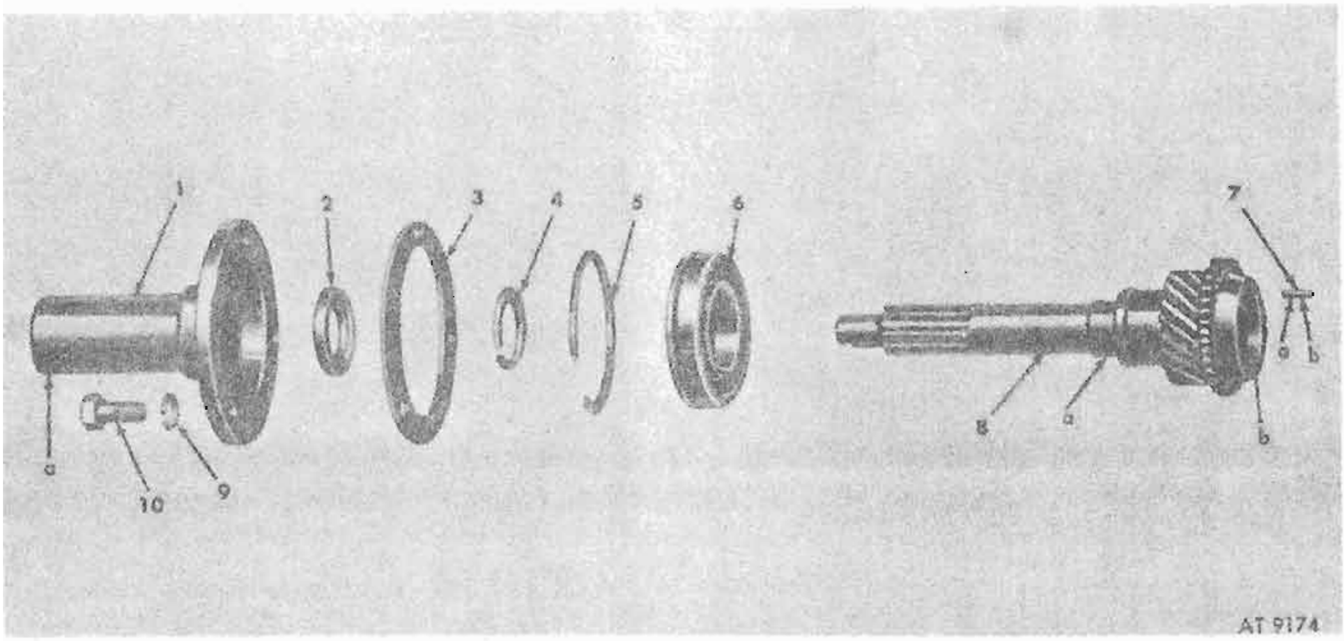


Figure 8-40. Removing bearing from input shaft.



1 Retainer
2 Seal
3 Gasket
4 Snapring
5 Snapring
6 Bearing
7 Roller bearings, needle (14)
8 Shaft
9 Washer (3)
10 Screw (3)

Figure 8-41. Input shaft assembly—exploded view.

Table 8-3. Wear Limits—Input Shaft Assembly

Fig. No.	Key	Point of measurement	Size of new parts	Wear limits field maintenance
8-41	1a	Outside diameter at clutch release.	1.181	1.176
8-41	7a	Outside diameter of roller	0.2186-0.12188	*
8-41	7b	Length of roller	0.605-0.625	0.600
8-41	8a	Seal contact area	0.998-1.002	0.996
8-41	8b	Inside diameter of bearing bore.	1.2042-1.2048	1.2050

* Refer to paragraph 8-6a (2).

8-12. Input Shaft Assembly

a. Using arbor press, position bearing on input shaft and press into position (fig. 8-42).

b. Install new snapring to secure bearing on shaft (fig. 8-39).

c. Apply GAA grease to inside of bore to retain needle roller bearings in position.

d. Install 14 input shaft needle roller bearings in shaft bore (fig. 8-43).

e. Remove input shaft retainer seal (fig. 8-44).

f. Coat outside of new seal with sealer (5330-252-3391) and press into position using protector block (7345227) (fig. 8-45). Pack lips of seal with GAA grease.

8-13. Countershaft Gear Cluster Disassembly

a. *Procedure.* The gear cluster assembly, consisting of the parts shown in figure 8-46 is hand-disassembled by tilting the cluster gear assembly and allowing the countershaft remover-replacer (7345226) to slide out, release the 36 needle roller bearings, two narrow spacers, one long spacer, and two thrust washers from the assembly.

b. Inspection and Repair. Refer to paragraph 8-5 for inspection and repair. Refer to figure 8-46 and table 8-4 for allowable tolerances.

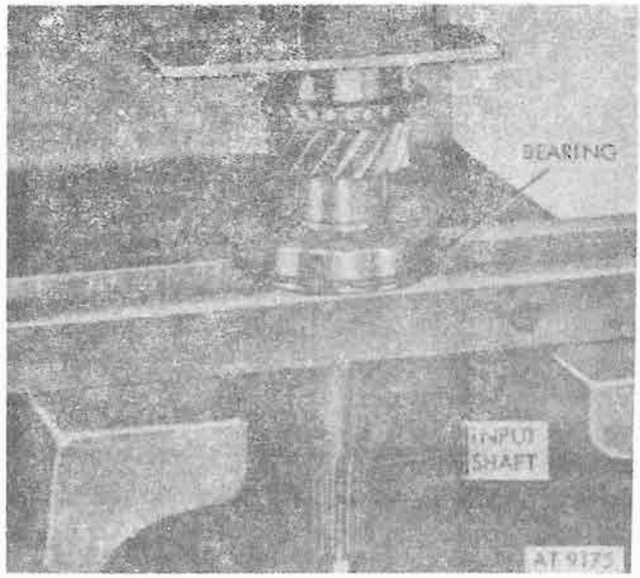


Figure 8-42. Installing bearing on input shaft.

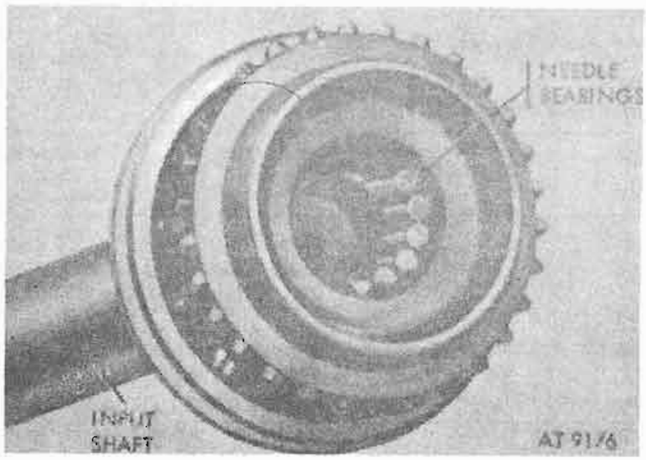


Figure 8-43. Installing needle bearings in input shaft bore.

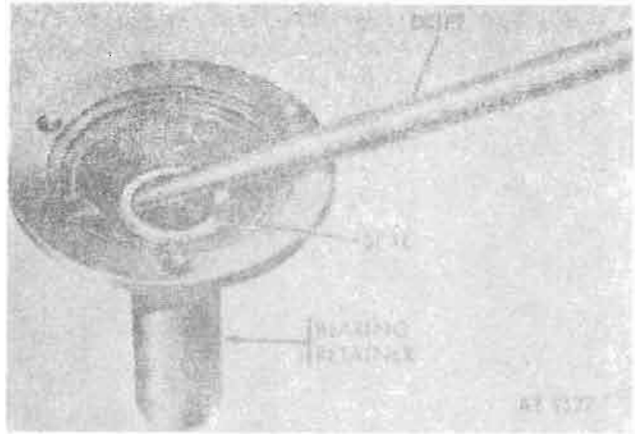


Figure 8-44. Removing retaining seal.

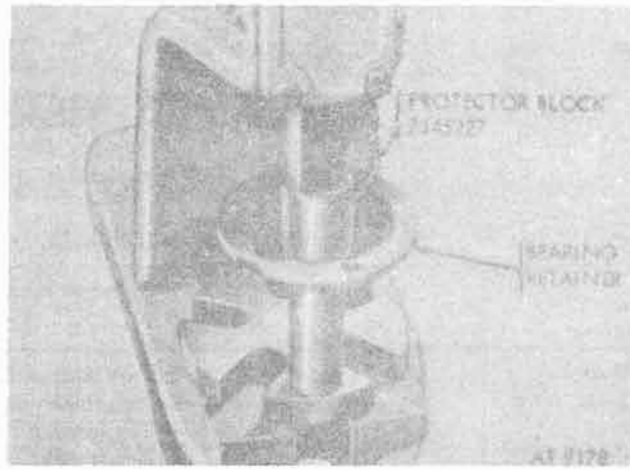
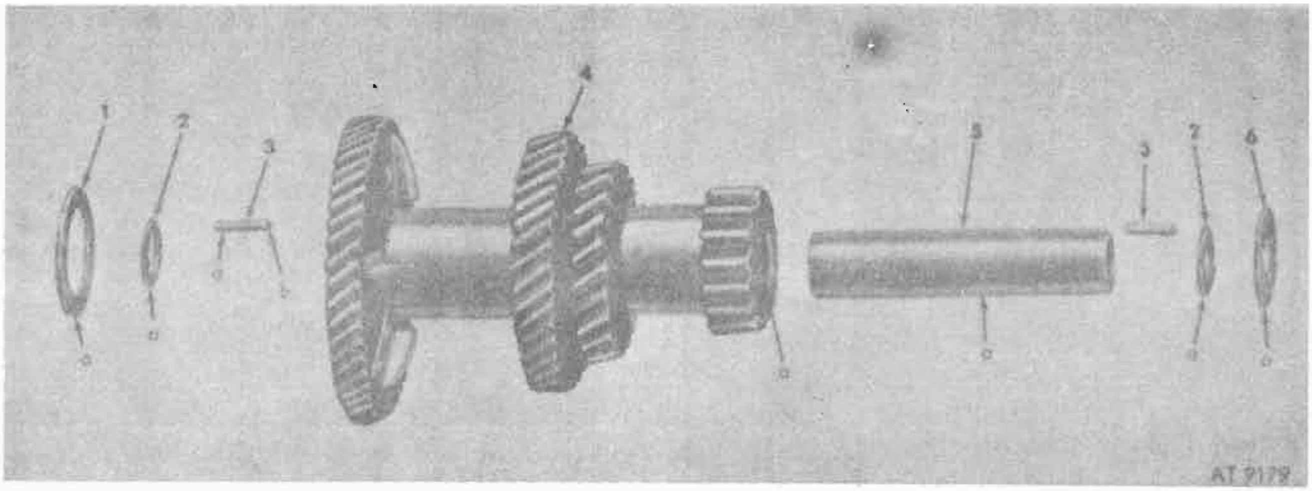


Figure 8-45. Press retainer seal in position.



1 Thrust washer
2 Spacer (2)
3 Roller needle (36)
4 Gear cluster assembly
5 Spacer
6 Thrust washer

Figure 8-46. Countershaft gear cluster assembly—exploded view.

Table 8-4. Wear Limits—Countershaft Gear Cluster Assembly

Fig. No.	Key	Point of measurement	Size of new parts	Wear limits field maintenance
8-46	1a	Thrust washer thickness	0.0615-0.0635	0.060
8-46	2a	Spacer thickness	0.085-0.095	0.080
8-46	3a	Roller bearing length	0.860-0.880	0.850
8-46	3b	Roller bearing diameter	0.1875-0.1873	*
8-46	4a	Internal diameter at bearing surfaces.	1.2695-1.2705	*
8-46	5a	Spacer length	5.250-5.270	5.230
8-46	6a	Thrust washer thickness	0.0615-0.0635	0.0600

Refer to paragraph 8-6a (2).

8-14. Countershaft Gear Cluster Assembly

a. Lubricate remover-replacer (7345226), and long spacer and install in countershaft gear bore (fig. 8-47).

b. Coat bearing bore with GAA grease to retain bearings in place and install 18 roller bearings in each end of shaft bore (fig. 8-48).

c. Coat bearing spacers with GAA grease and install in both ends of shaft bore (fig. 8-49).

d. Coat the two thrust washers with GAA grease. Install one washer on each end of shaft and gear at bearing face (fig. 8-49). Refer to figures 8-37 and 8-50 for correct placement of thrust washers.

8-15. Transfer Clutch Disassembly

a. Remove four screws and washers from transmission case and then remove clutch cover and gasket (fig. 8-51).

b. Remove detent plug, gasket, spring and ball from transmission bore (fig. 8-52).

c. Move shifter shaft forward and remove rear snapring (fig. 8-53).

d. Push shifter shaft toward rear and remove front snapring (fig. 8-54).

e. Remove shifter shaft, washer, and spring (fig. 8-55).

f. Remove shifter fork and clutch (fig. 8-56).

g. Using snapring pliers, remove rear bearing-retaining snapring from transmission housing bore (fig. 8-57).

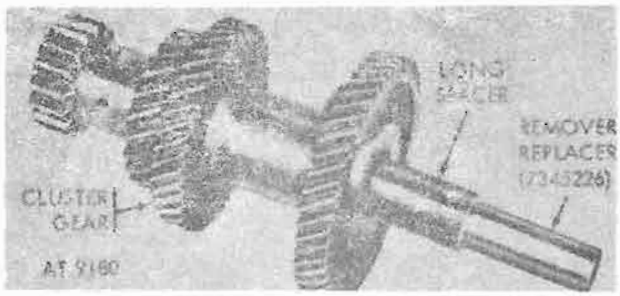


Figure 8-47. Installing remover—replacer (7345226) and long spacer in countershaft.

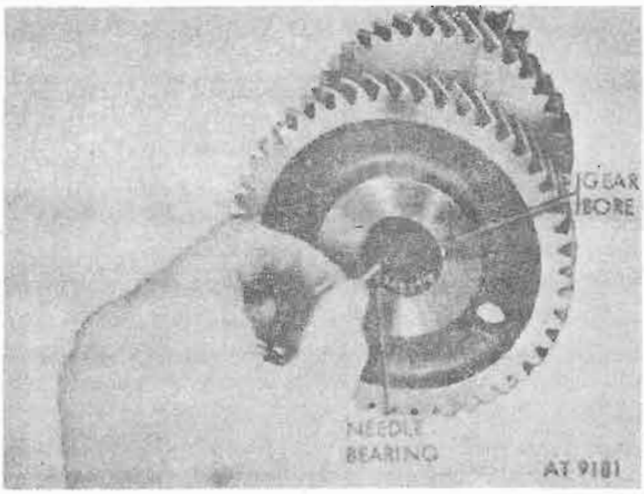


Figure 8-48. Installing needle bearings in cluster gear bore.

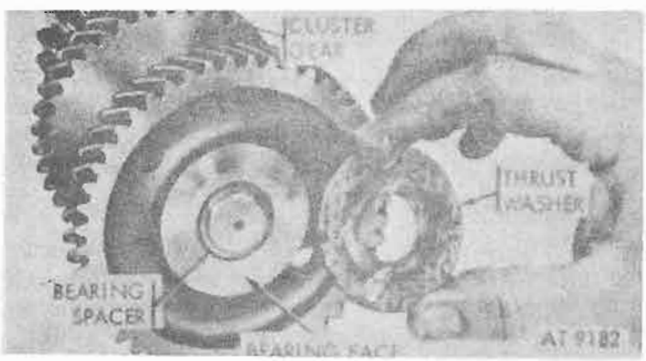


Figure 8-49. Installing bearing spacers and thrust washer.

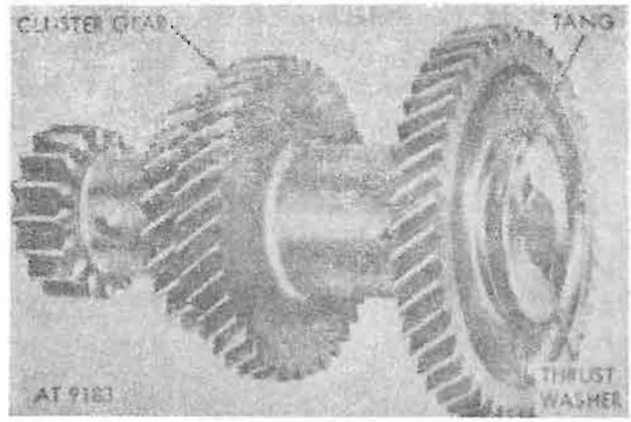


Figure 8-50. Cluster gear assembly—location of thrust washer tang.

h. Using bronze or plastic drift, drive bearing and shaft assembly from transmission housing bore (fig. 8-58).

i. Remove shifter shaft seal from transmission case bore (fig. 8-59).

j. Using drift or punch, remove front output shaft seal from transmission case bore (fig. 8-60).

k. Using snapring pliers, remove bearing-retaining snapring from output shaft (fig. 8-61).

l. Press bearing from output shaft, using protector block (7345227) with arbor press (fig. 8-62).

8-16. Inspection and Repair of Transmission Case and Related Parts

a. Transmission Case. Refer to figure 8-63 and table 8-5 for allowable tolerances.

b. Transfer Clutch, Transfer Front Output Shaft, and Related Parts. Refer to figure 8-64 and table 8-7 for allowable tolerances.

8-17. Assembly of Transfer Clutch

a. Coat outside surface of seal with compound sealer (5330-252-3391). Pack in inner lips of seal with grease (GAA). Using replacer (7345225) and mallet, carefully drive shifter shaft seal in bore (fig. 8-65).

b. Using driver plug (7345257) and mallet, carefully drive front output shaft seal in bore (fig. 8-66).

NOTE

See sealing instructions in *a* above.

c. Using snapring pliers install a new snapring on transfer front output shaft (fig. 8-67)

d. Using driver plug (7345231), press g on output shaft (fig. 8-67).

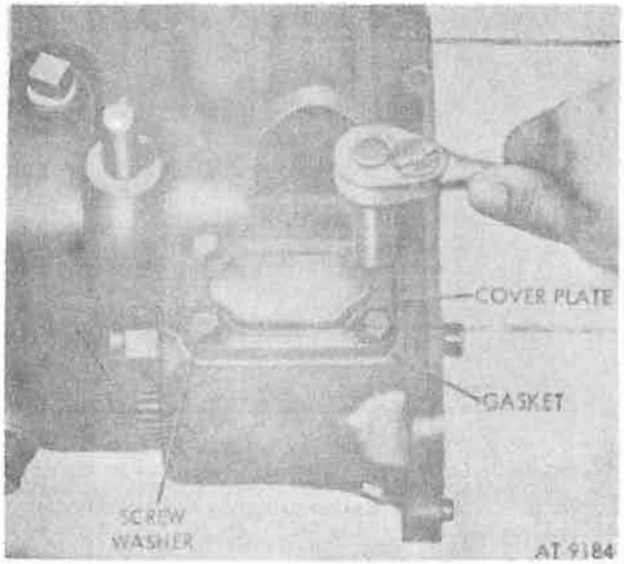


Figure 8-51. Clutch cover plate and gasket.

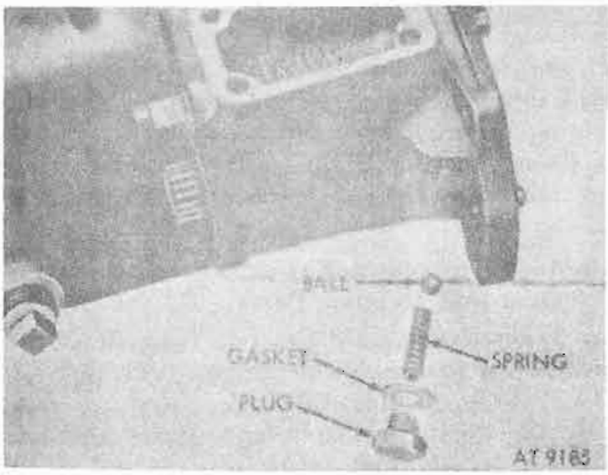


Figure 8-52. Clutch shifter fork detent assembly.

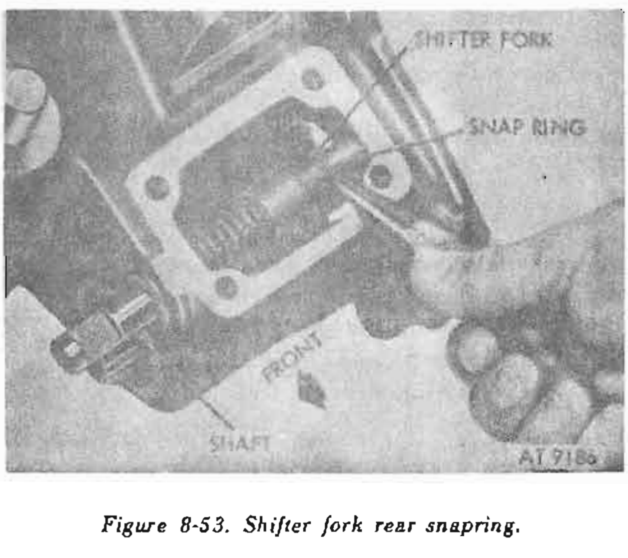


Figure 8-53. Shifter fork rear snapring.

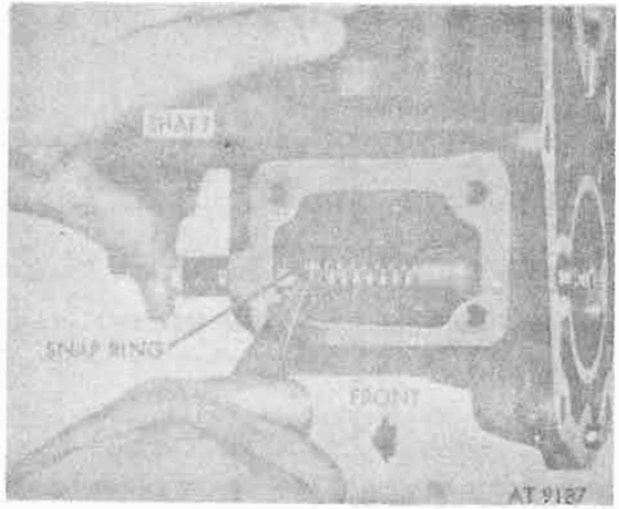


Figure 8-54. Shifter fork front snapring.

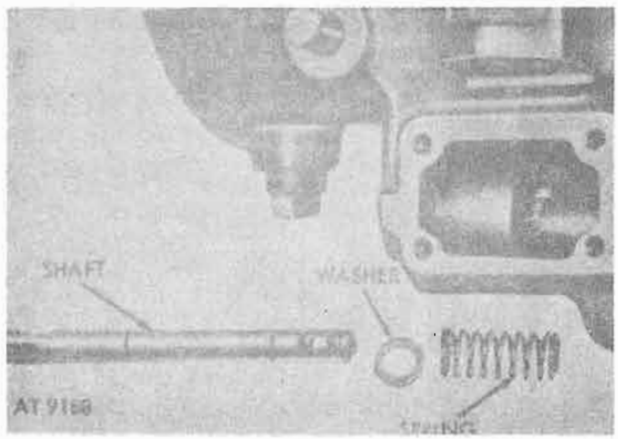


Figure 8-55. Shifter fork shaft assembly.

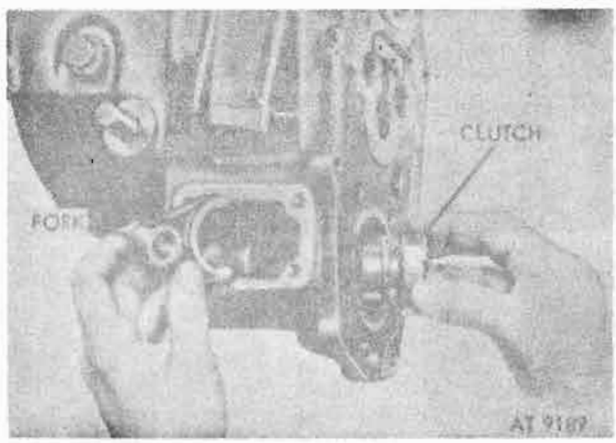


Figure 8-56. Shifter fork and clutch.

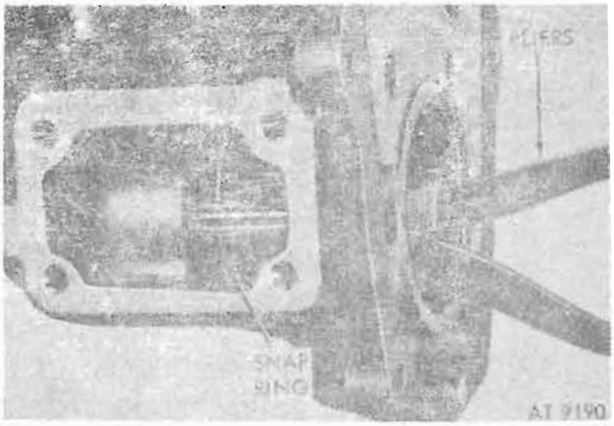


Figure 8-57. Output shaft bearing rear retaining ring.

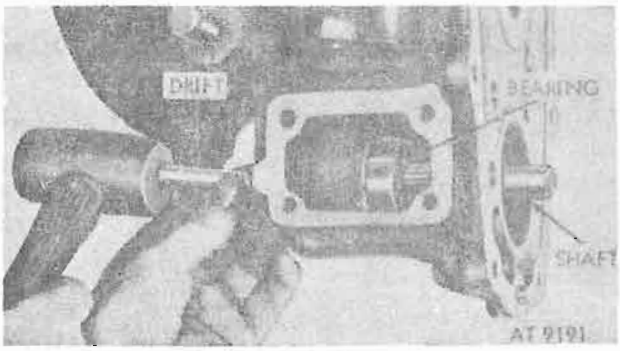


Figure 8-58. Removing bearing and output shaft assembly.

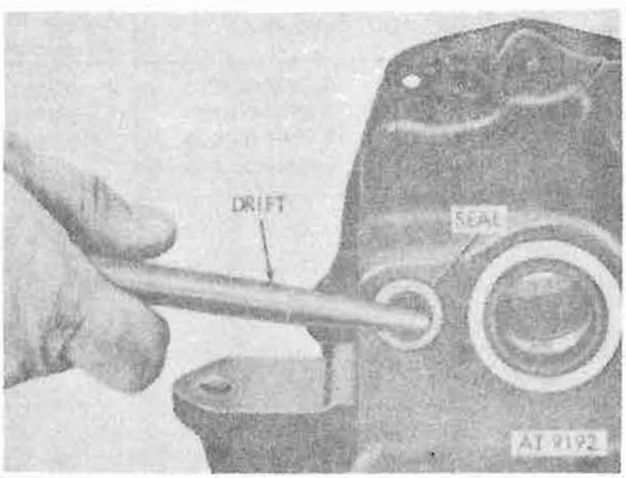


Figure 8-59. Removing shifter shaft seal.

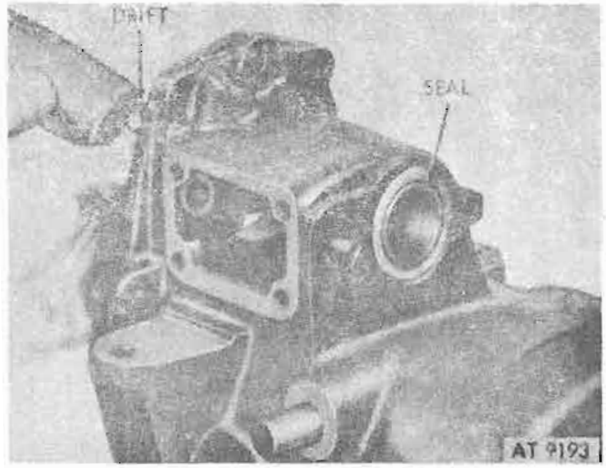


Figure 8-60. Removing front output shaft seal.

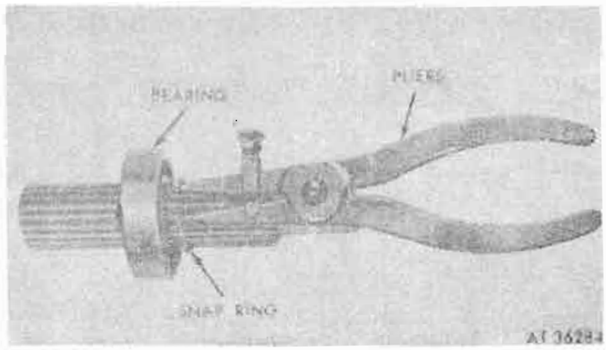


Figure 8-61. Removing bearing from output shaft.

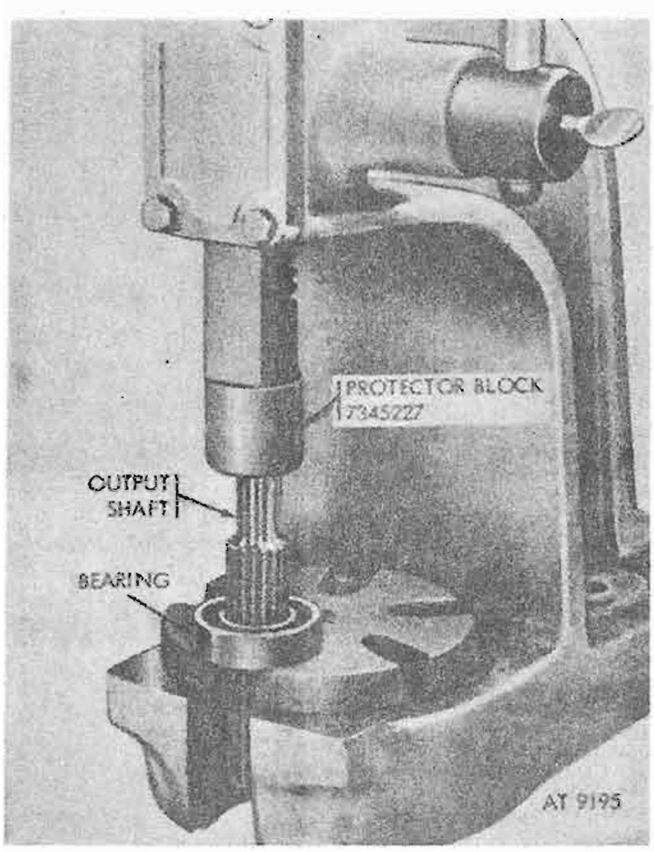
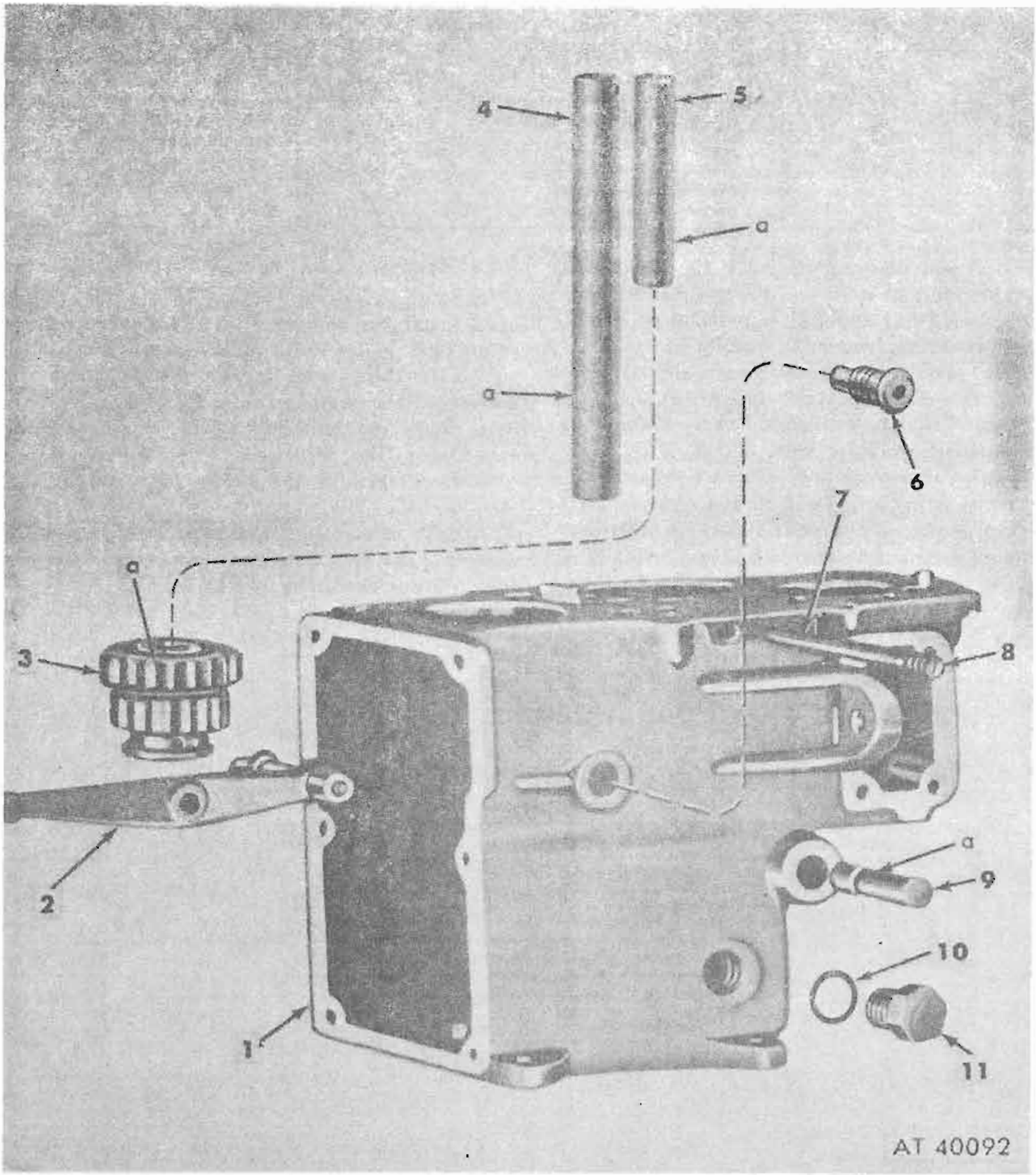


Figure 8-62. Pressing bearing off output shaft.

Table 8-5. Wear Limits—Transmission Housing and Related Parts

Reference		Point of measurement	Size of new parts	Wear limits field maintenance
Fig. No.	Key			
8-63	3a	Gear internal diameter	0.7505-0.7515	0.7530
8-63	4a	Shaft diameter at bearing surface.	0.8925-0.8929	0.8920
8-63	5a	Shaft diameter	0.7490-0.7495	0.7470
8-63	9a	Shaft diameter	0.6260-0.6265	*

* Refer to paragraph 8-6a (2).



1 Case assy. transmission
2 Arm assy.
3 Gear assy.
4 Shaft
5 Shaft
6 Pivot
7 Pin
8 Screw
9 Pivot
10 Gasket
11 Plug

Figure 8-63. Transmission housing and related parts—exploded view.

Table 8-6. Wear Limits—Transfer Clutch and Transfer Front Output Shaft

Reference		Point of measurement	Size of new parts	Wear limits field maintenance
Fig. No.	Key			
8-64	7a	Outside diameter of shaft	0.5605-0.5610	0.560
8-64	7b	Detent ball seat radius	0.1820R-0.1920R	0.1940R
8-64	11a	Shift collar contact width	0.210-0.213	0.205
8-64	4a	Machined bearing seat	0.6245-0.6250	0.623
8-64	6a	Shifter contact groove	0.218-0.224	0.229

e. Install rear snapring on shaft (fig. 8-67) and then position output shaft and bearing assembly in case bore (fig. 8-68) and seat in position with drift (reverse procedures shown in fig. 8-58).

f. Install clutch on shaft and then position shifter form in groove of clutch. Refer to figure 8-53.

g. Install shifter fork on shifter shaft, along with spring, washer, and rear lock.

h. Position detent parts in detent bore in order shown (refer to fig. 8-52) and torque screws 15-20 lb-ft. Apply sealer to threads before installation.

i. Install gasket and cover on housing, using four screws and washers. Torque screws to 10-14 lb-ft. Refer to figure 8-51.

8-18. Transmission Output Shaft Disassembly

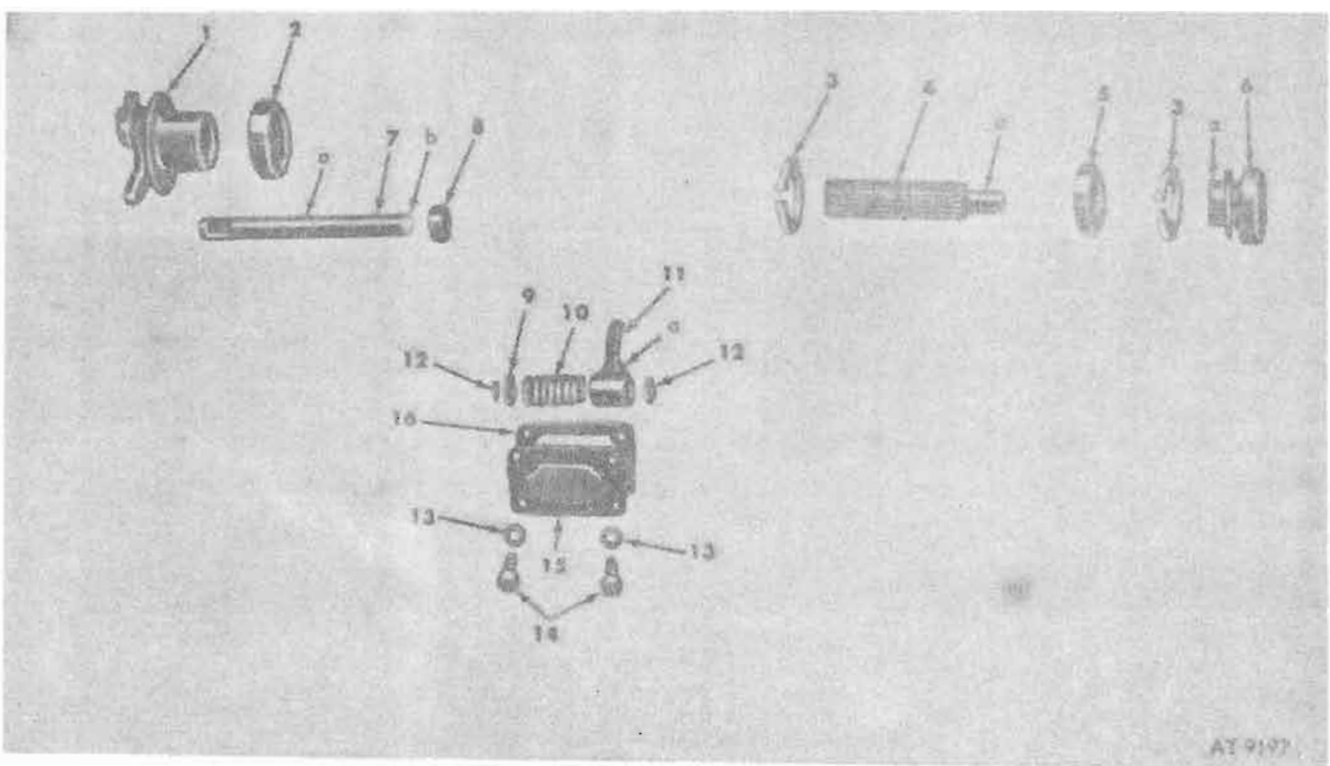
a. Stand output shaft assembly in a vise, parking brakedrum, or holding fixture and remove front snapring (fig. 8-69).

b. Lift third and fourth gear synchronizer assembly from output shaft (fig. 8-69).

c. Lift synchronizer blocking ring from third speed gear (fig. 8-70).

d. Remove third speed gear from output shaft (fig. 8-70).

e. Reverse shaft in fixture and remove first and second speed gear synchronizer assembly snapring from output shaft (fig. 8-71).



1 Flange
2 Seal assembly
3 Snapring (2)
4 Shaft
5 Bearing
6 Clutch
7 Shaft
8 Seal assembly
9 Washer
10 Spring
11 Fork
12 Snapring (2)
13 Washer (4)
14 Screw (4)
15 Cover
16 Gasket

Figure 8-64. Transfer clutch and front output shaft—exploded view.

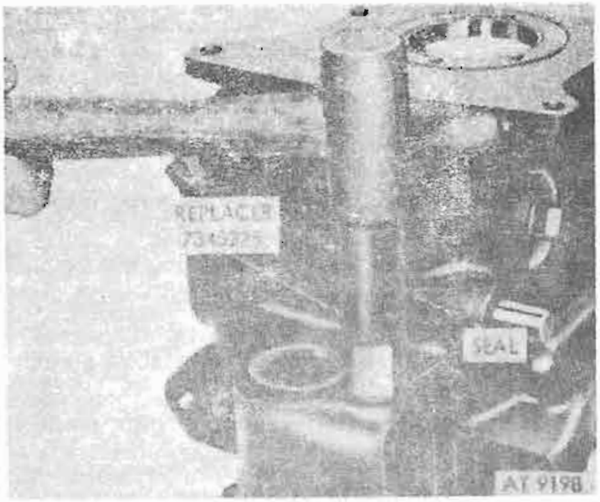


Figure 8-65. Installing shifter shaft seal.

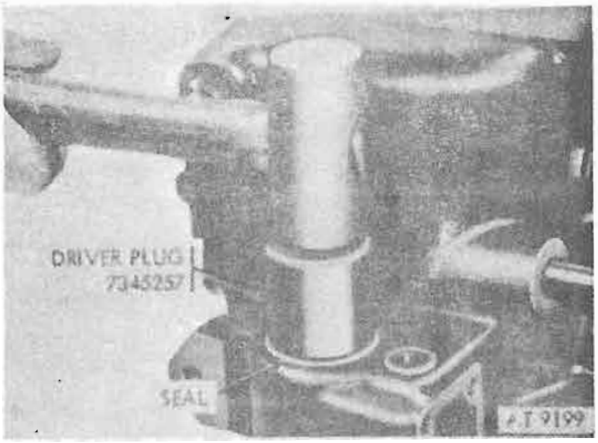


Figure 8-66. Installing front output shaft seal.

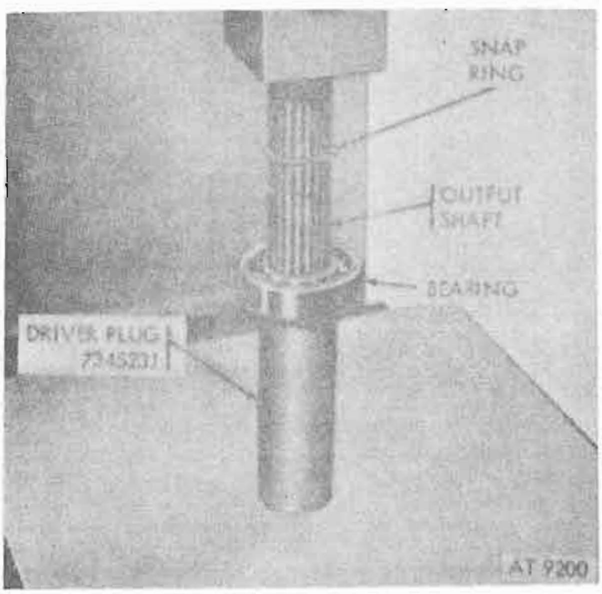


Figure 8-67. Pressing bearing on output shaft.

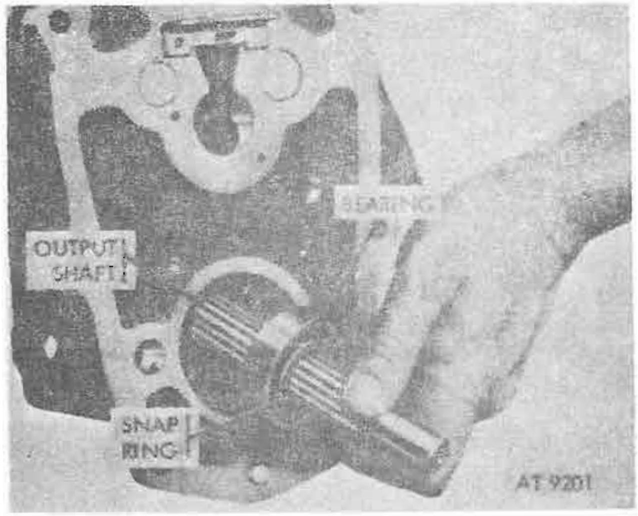


Figure 8-68. Positioning output shaft and bearing assembly in case.

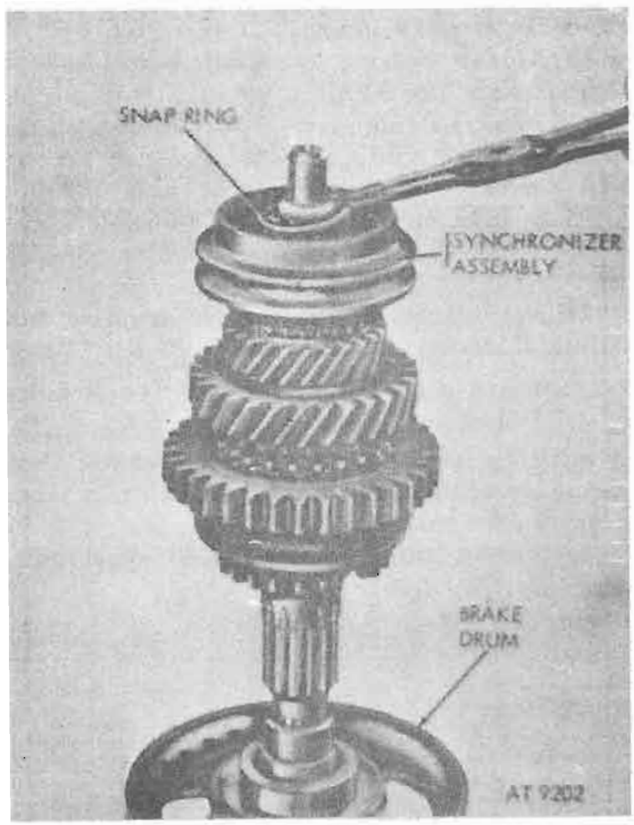


Figure 8-69. Third and fourth gear synchronizer assembly.

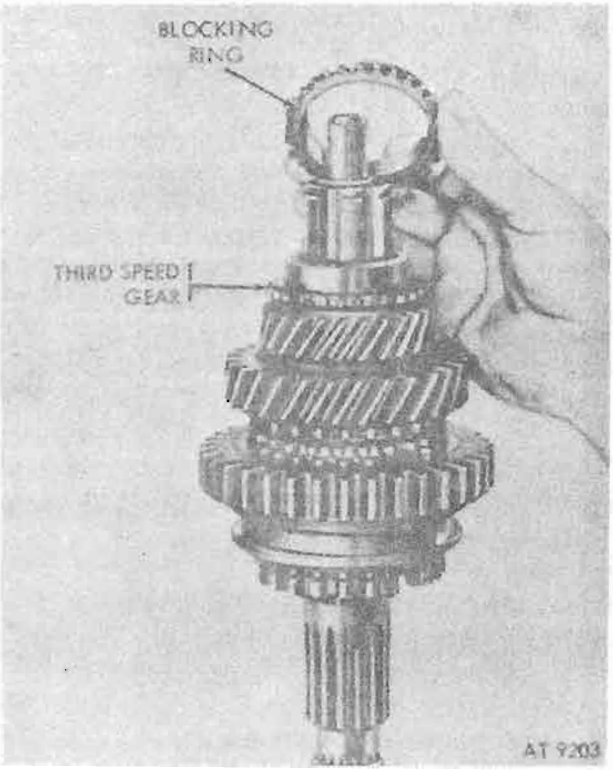


Figure 8-70. Third speed gear and blocking ring.

f. Remove first and second speed gear synchronizer assembly from shaft gear (fig. 8-72).

h. Remove bearing retaining snapring from output shaft (fig. 8-73).

i. Remove bearing spacer from output shaft (fig. 8-74).

j. Remove second speed gear and 37 roller bearings from output shaft (fig. 8-75).

k. Remove bearing retainer from output shaft (fig. 8-76).

l. Using snapring pliers remove snapring from output shaft (fig. 8-77).

8-19. Third and Fourth Speed Synchronizer Disassembly

a. Using needle nosed pliers remove large springs securing inserts from front and rear side of synchronizer hub (fig. 8-78).

b. Remove three inserts from synchronizer assembly (fig. 8-79).

c. Remove sleeve from synchronizer hub (fig. 8-80).

8-20. First and Second Speed Synchronizer Disassembly.

WARNING

Balls are spring-loaded and can injure personnel.

a. Carefully slide first speed sliding gear off hub, holding three springs and three balls with fingers and thumb (fig. 8-81).

b. Remove balls and first speed sliding gear from hub.

c. Remove three plates and springs from hub (fig. 8-82).

8-21. Inspection and Repair of Transmission Output Shaft and Related Parts.

a. Refer to paragraph 8-5 for inspection and repair.

b. Refer to figure 8-83 and table 8-7 for allowable tolerances.

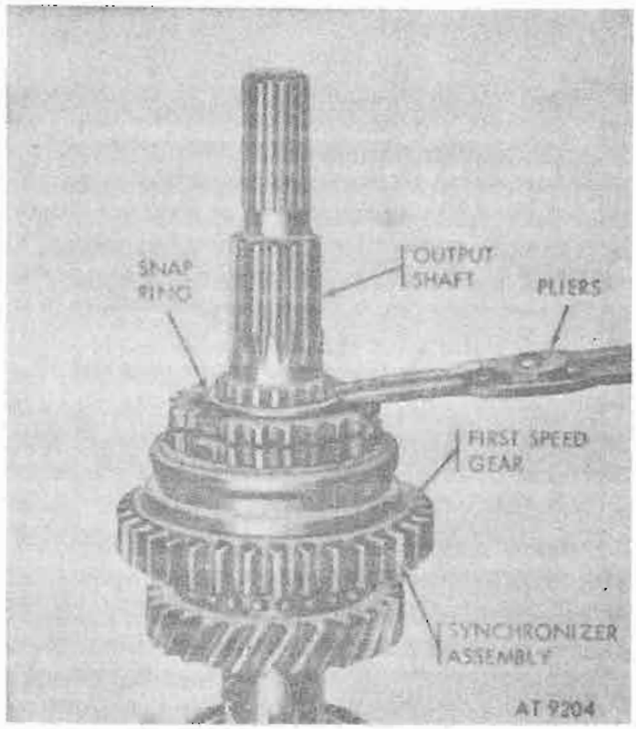


Figure 8-71. First and second speed gear synchronizer.

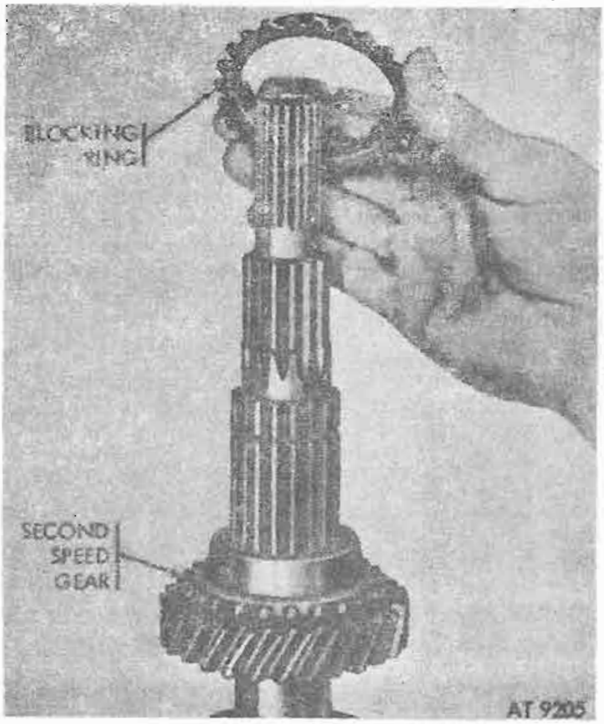


Figure 8-72. Second speed gear synchronizer blocking ring.

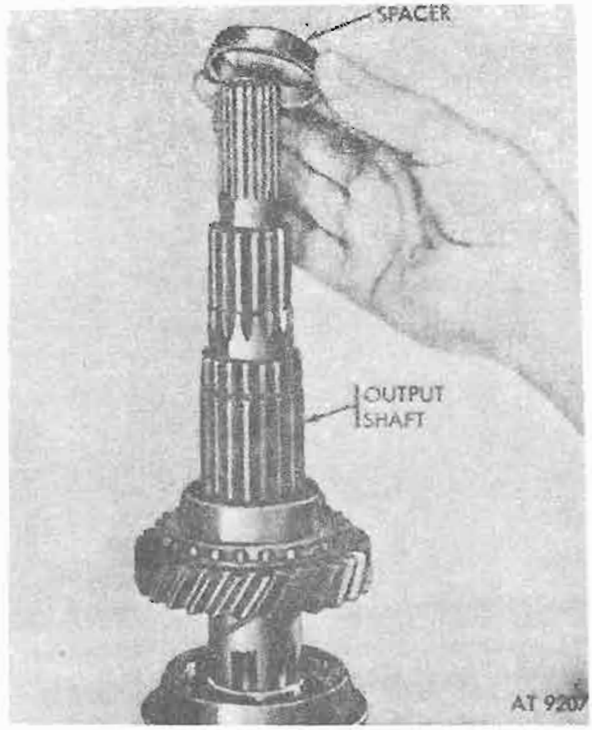


Figure 8-74. Output shaft bearing spacer.

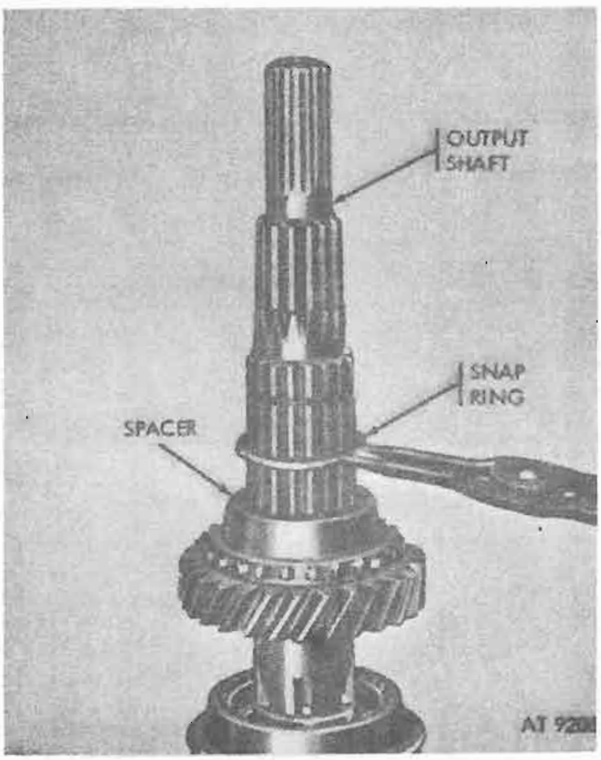


Figure 8-73. Bearing retaining snapring.

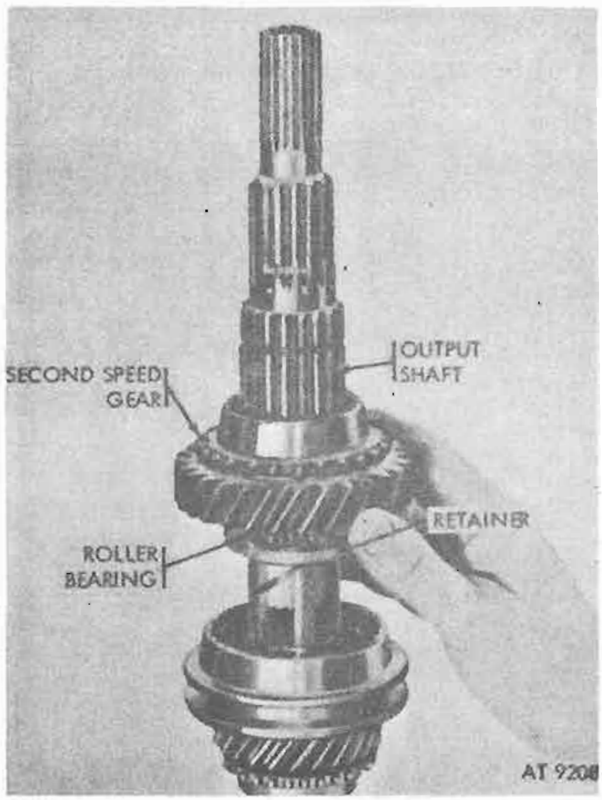


Figure 8-75. Second speed gear and roller bearings.

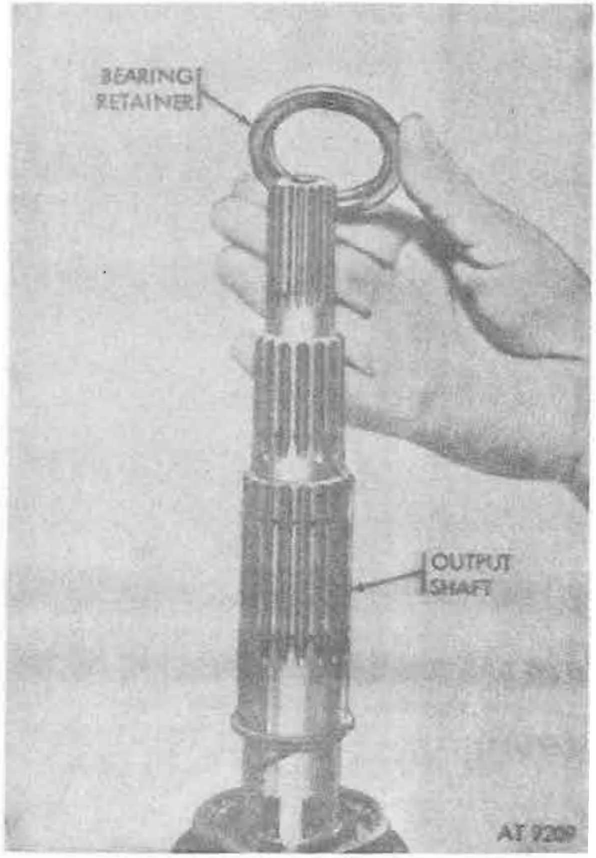


Figure 8-76. Output shaft bearing retainer.

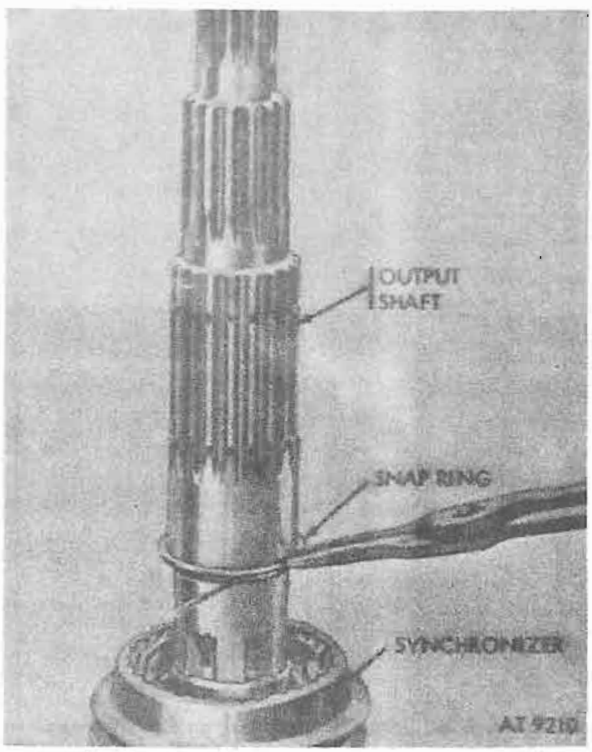


***Figure** 8-77. Third and fourth speed gear synchronizer snapring.*

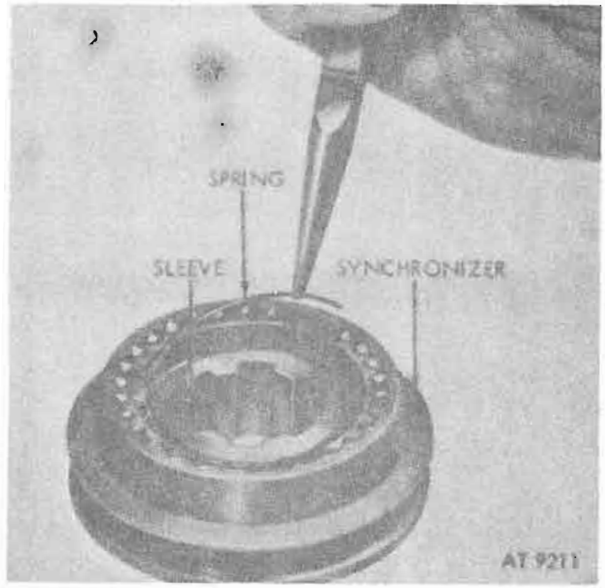


***Figure 8-78.** Synchronizer sleeve retaining springs.*

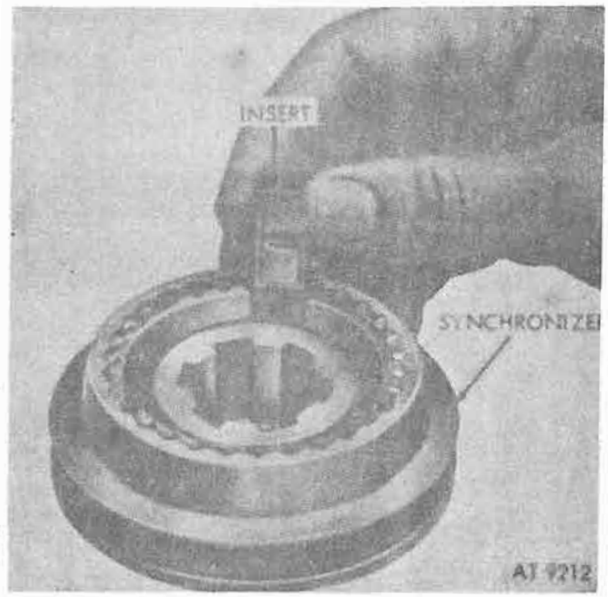


Figure 8-79. Synchronizer inserts.

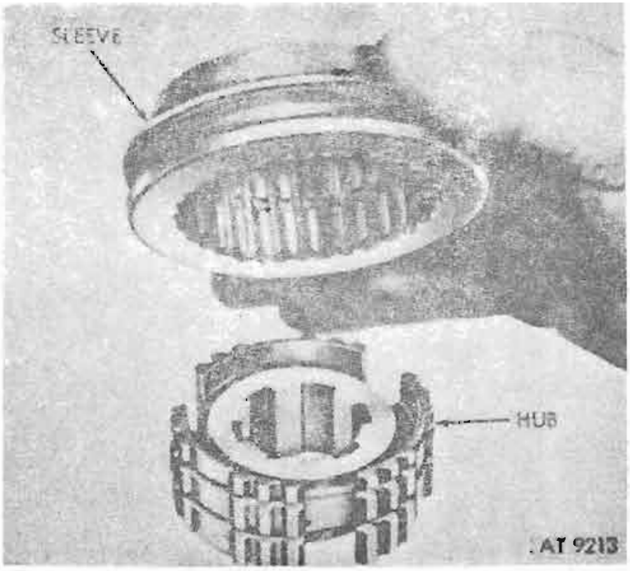


Figure 8-80. Synchronizer sleeve and hub.

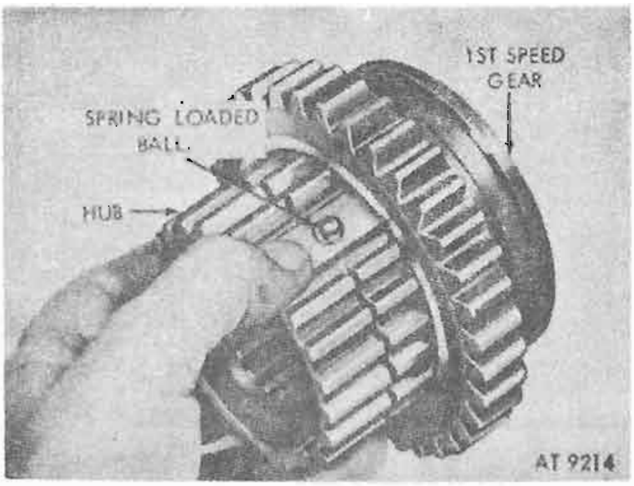


Figure 8-81. First speed gear hub and spring-loaded balls.

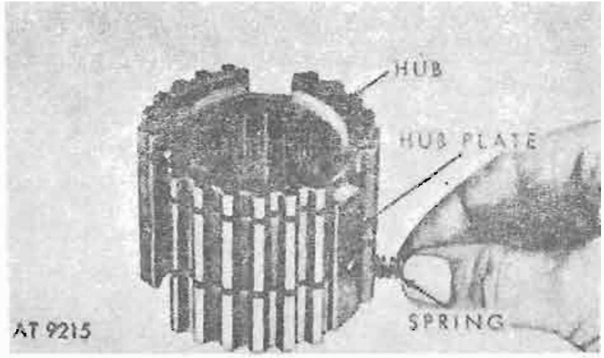
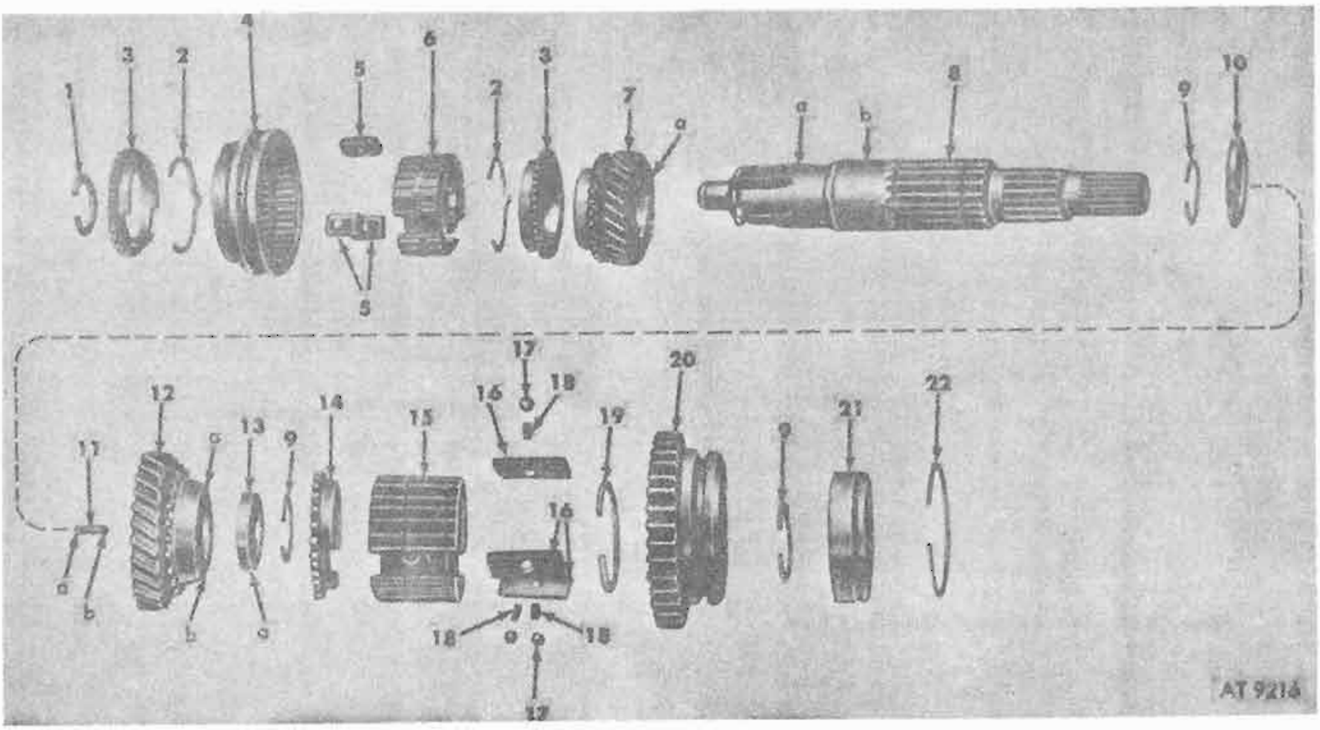


Figure 8-82. Hub plates and springs.



1 Snapring
2 Ring (2)
3 Spring (2)
4 Sleeve
5 Insert (3)
6 Hub
7 Gear
8 Output shaft
9 Snapring (3)
10 Retainer
11 Bearings (37)
12 Gear
13 Spacer
14 Ring
15 Hub
16 Plate (3)
17 Ball (3)
18 Spring (3)
19 Snapring
20 Gear
21 Bearing
22 Snapring

Figure 8-83. Output shaft assembly—exploded view.

Table 8-7. Wear Limits—Transmission Output Shaft and Related Parts

Reference		Point of measurement	Size of new parts	Wear limits field maintenance
Fig. No.	Key			
8-83	7a	Inside diameter of gear bearing.	1.5015-1.5020	1.5040
8-83	8a	Outside diameter at 3rd speed gear synchronizer seat.	1.4995-1.5000	*
8-83	8b	Outside diameter at 2nd speed gear bearing surface.	1.6858-1.6863	1.6853
8-83	11a	Diameter of each roller bearing.	0.1562-0.1560	*
8-83	11b	Length of roller bearing	1.000-1.020	0.960
8-83	12a	Inside diameter of bearing bore.	1.9992-1.9998	*
8-83	12b	Length of gear	1.635-1.645	*
8-83	13a	Thickness of spacer	0.390-0.400	0.380

* Refer to paragraph 8-6a (2).

8-22. Assembly of First and Second Speed Synchronizer

a. Position parts to be sure of correct assembly. Synchronizer blocking ring will seat only in deeply recessed end of synchronizer hub; note position of first speed gear. Refer to figures 8-82, 8-84, and 8-85.

b. Remove first speed gear and proceed with assembly.

c. Install plates and springs to synchronizer hub. Refer to figure 8-82.

d. Holding plates and springs as shown in figure 8-86, position hub to first speed gear and partially install on splines.

e. Position balls in detent bores on top of springs, and then assemble by pushing first speed gear over detent balls (fig. 8-87).

8-23. Assembly of Third and Fourth Speed Synchronizer

a. Position hub on clean surface and install sleeve on hub. Refer to figure 8-80.

b. Install the three inserts in the hub and sleeve assembly. Refer to figure 8-81.

c. Using needle-nosed pliers install front and rear springs. Refer to figure 8-80.

NOTE

Springs must be in line so that humps in springs are retaining same insert.

8-24. Assembly of Output Shaft and Gear Train

a. Install snapring on output shaft. Refer to figure 8-77.

b. Install bearing retainer on output shaft. Refer to figure 8-76.

NOTE

Recessed side down.

c. Coat shaft with GAA grease to hold bearings to shaft.

d. Install 37 roller bearings to output shaft (fig. 8-88), and install second-speed gear by sliding down over bearings and against the retainer. Refer to figure 8-75.

e. Install bearing spacer and snapring on the output shaft. Refer to figures 8-73 and 8-74.

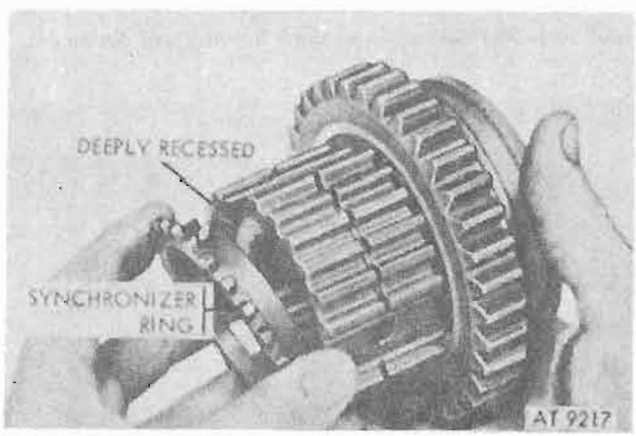


Figure 8-84. Installing synchronizer ring.

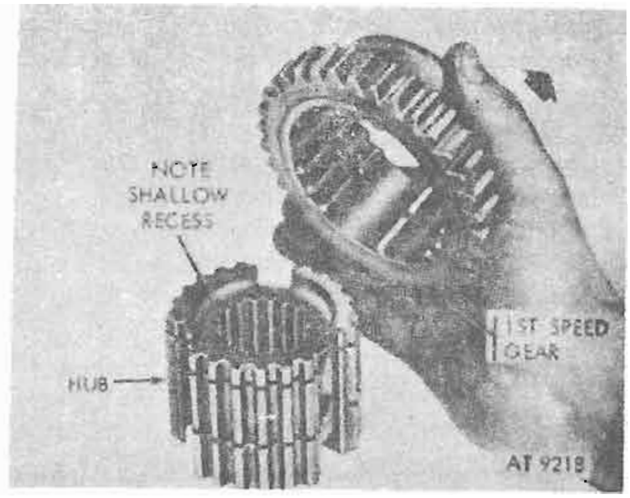


Figure 8-85. First speed gear hub recess.

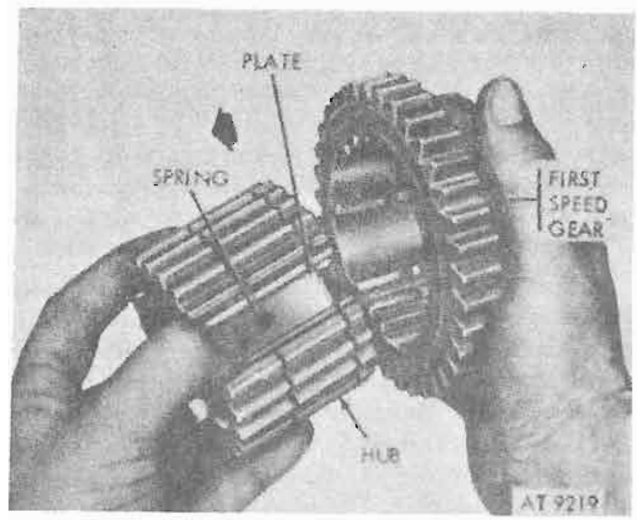


Figure 8-86. Position first speed gear on hub.

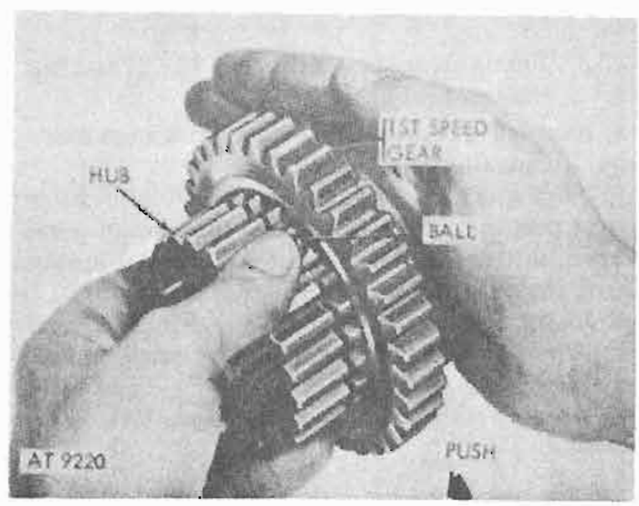


Figure 8-87. Installing first speed gear on hub assembly.

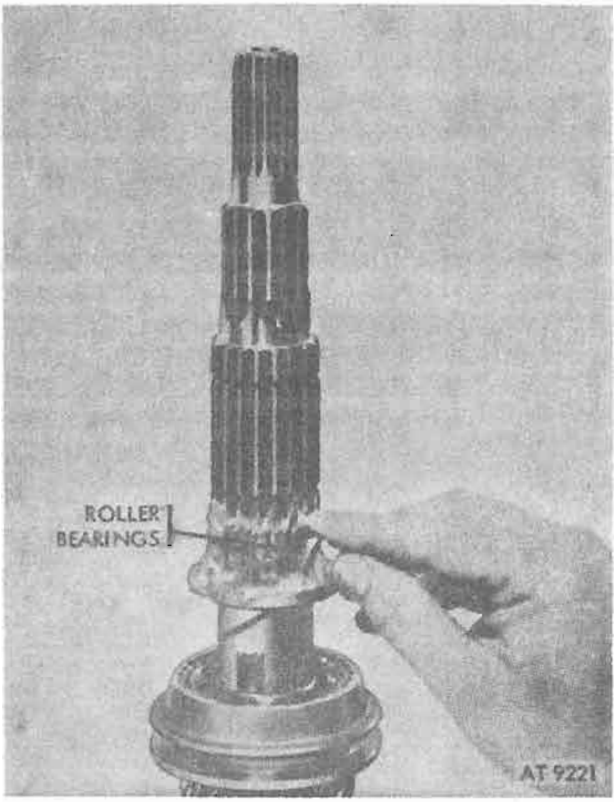


Figure 8-88. Positioning roller bearing to output shaft.

f. Position second-speed synchronizer blocking ring on second-speed gear. Refer to figure 8-72.

g. Install second-speed synchronizer assembly to output shaft and secure by positioning snapring in groove of shaft. Refer to figure 8-71.

h. Carefully reverse the output shaft and install third-speed gear and synchronizer blocking ring to the third speed gear. Refer to figure 8-70.

i. Install third and fourth-speed gear synchronizer to output shaft and secure by installing front snapring in groove of output shaft. Refer to figure 8-69.

8-25. Transmission Gearshift Housing Disassembly

a. Remove breather from top of transmission gearshift housing (fig. 8-89).

b. Turn housing over and place shifter shafts in neutral position. Cut and remove four safety wires securing shifter fork and gate lock screws. Remove screws (fig. 8-90).

c. Using a brass drift carefully drive third- and fourth-speed shifter shaft rearward until shifter fork is free (fig. 8-91).

d. Remove third- and fourth-speed fork from housing.

e. Drive third- and fourth-gear shaft further rearward and remove housing shaft bore expansion plug (fig. 8-92).

f. Remove interlock pin from shifter shaft (fig. 8-93).

CAUTION

Do not drive shaft out before pin is removed.

g. Drive shifter shaft from housing and remove gate (fig. 8-93).

CAUTION

Detent balls are spring-loaded.

h. Using drift remove first- and second-speed gear-shifter shaft and fork from housing (fig. 8-94).

i. Remove reverse-shifter shaft and shifter gate from housing (fig. 8-95).

j. Remove three detent balls, three springs and two interlocking plungers (fig. 8-96).

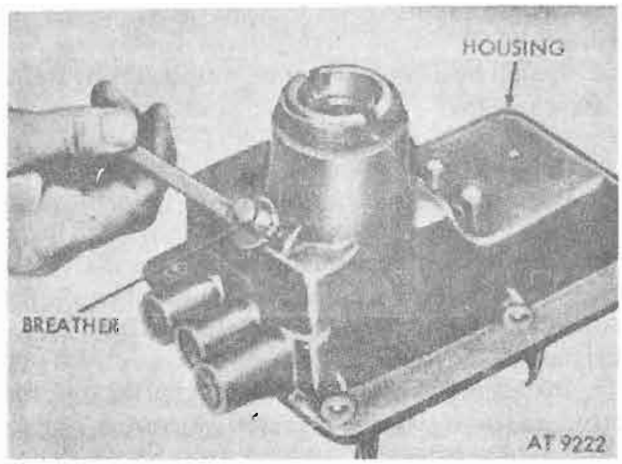


Figure 8-89. Transmission gearshaft housing and breather.

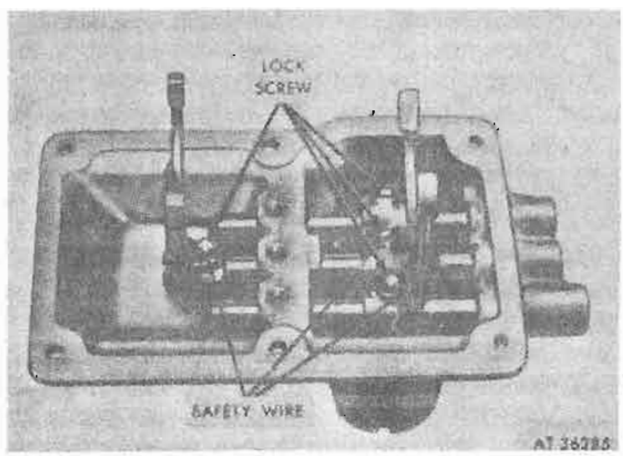


Figure 8-90. Shifter fork and gate lock screws and safety wires.

NOTE

Refer to figure 8-101 for interlocking plungers.

8-26. Reverse-Shifter Gate — Disassembly and Assembly

a. Remove or install clip and reverse-shifter gate plunger by compressing spring as shown in figure 8-97.

b. Depress detent spring and remove cotter pin retaining detent spring and ball (fig. 8-98). Remove spring and ball from gate (fig. 8-99).

8-27. Inspection and Repair of Transmission Gearshift Housing Assembly

a. Refer to paragraph 8-5 for inspection and repair.

b. Refer to figure 8-100 and table 8-9 for wear limits and allowable tolerances.

8-28. Assembly of Gearshift Housing

a. Position two interlock plungers in bore, and rotate with finger tips into position as shown in figure 8-101.

b. Position three shifter detent balls and three springs in housing bores (fig. 8-102). Refer to figure 8-96 for procedure.

c. Position reverse-shifter shaft in bore with slot facing outward (fig. 8-103).

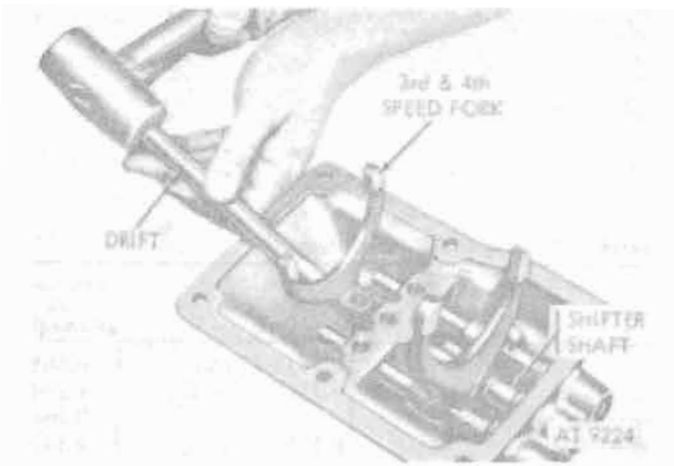


Figure 8-91. Driving third and fourth speed shifter shaft rearward.

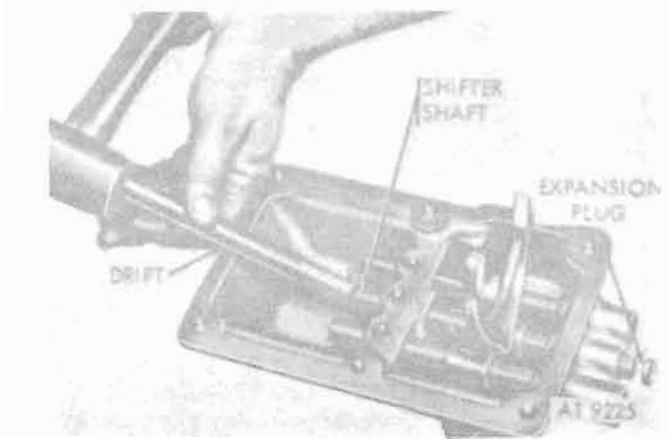


Figure 8-92. Housing shaft bore expansion plug.

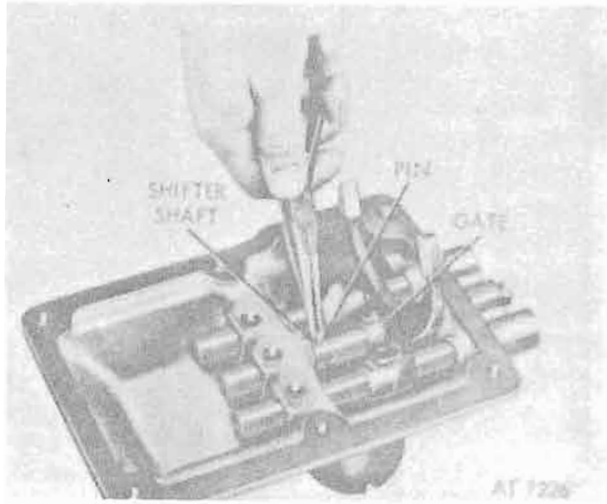


Figure 8-93. Shifter shaft interlock pin.

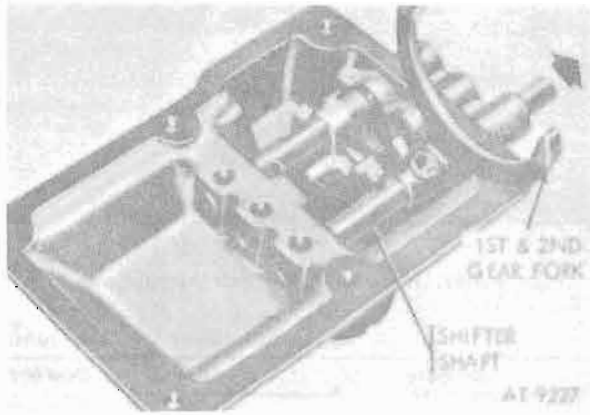


Figure 8-94. First and second speed shifter shaft and fork.

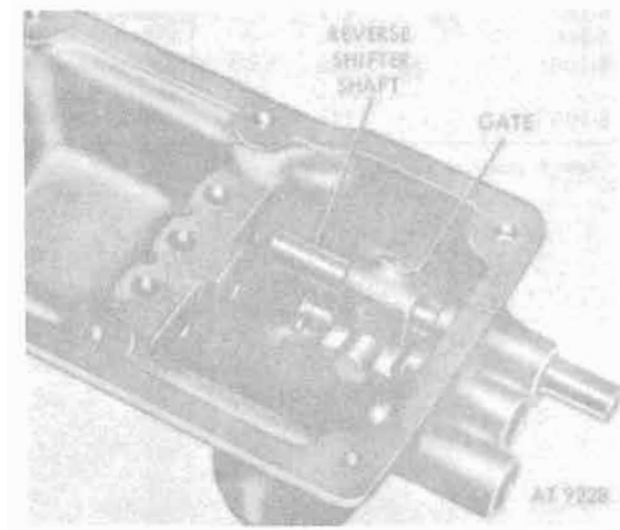


Figure 8-95. Reverse shifter shaft and shifter gate.

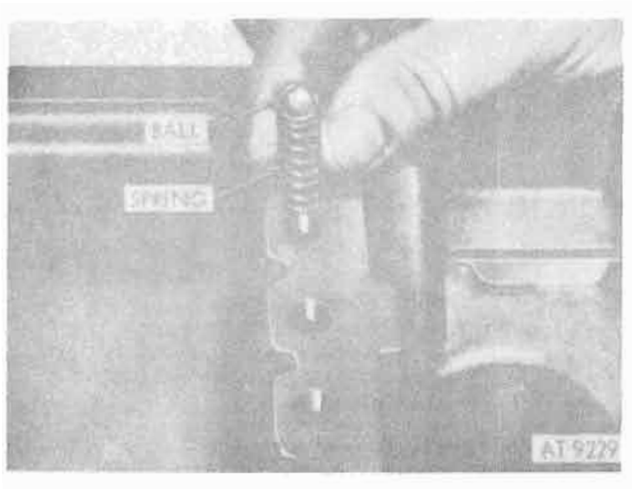


Figure 8-96. Detent balls and springs.

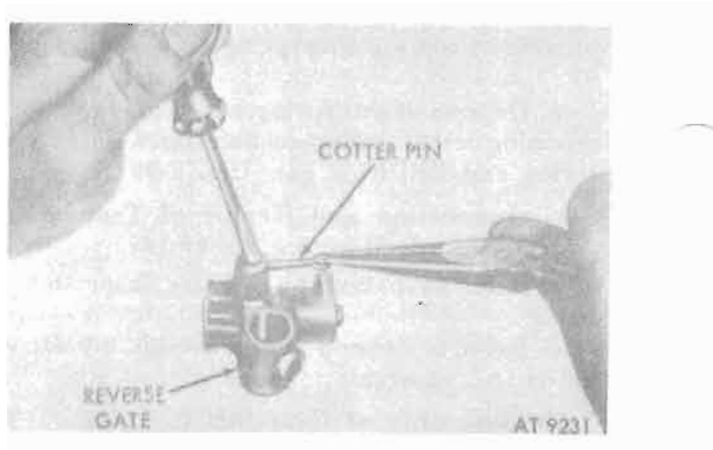


Figure 8-98. Reverse gate detent spring and ball retaining pin.

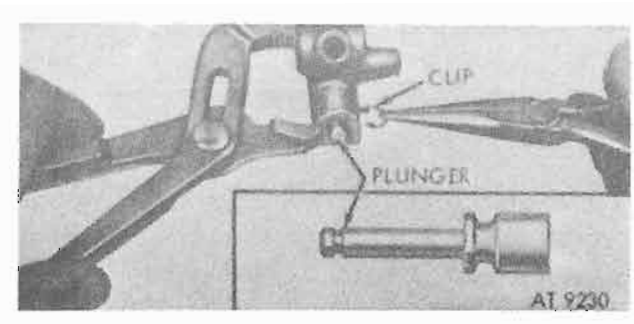
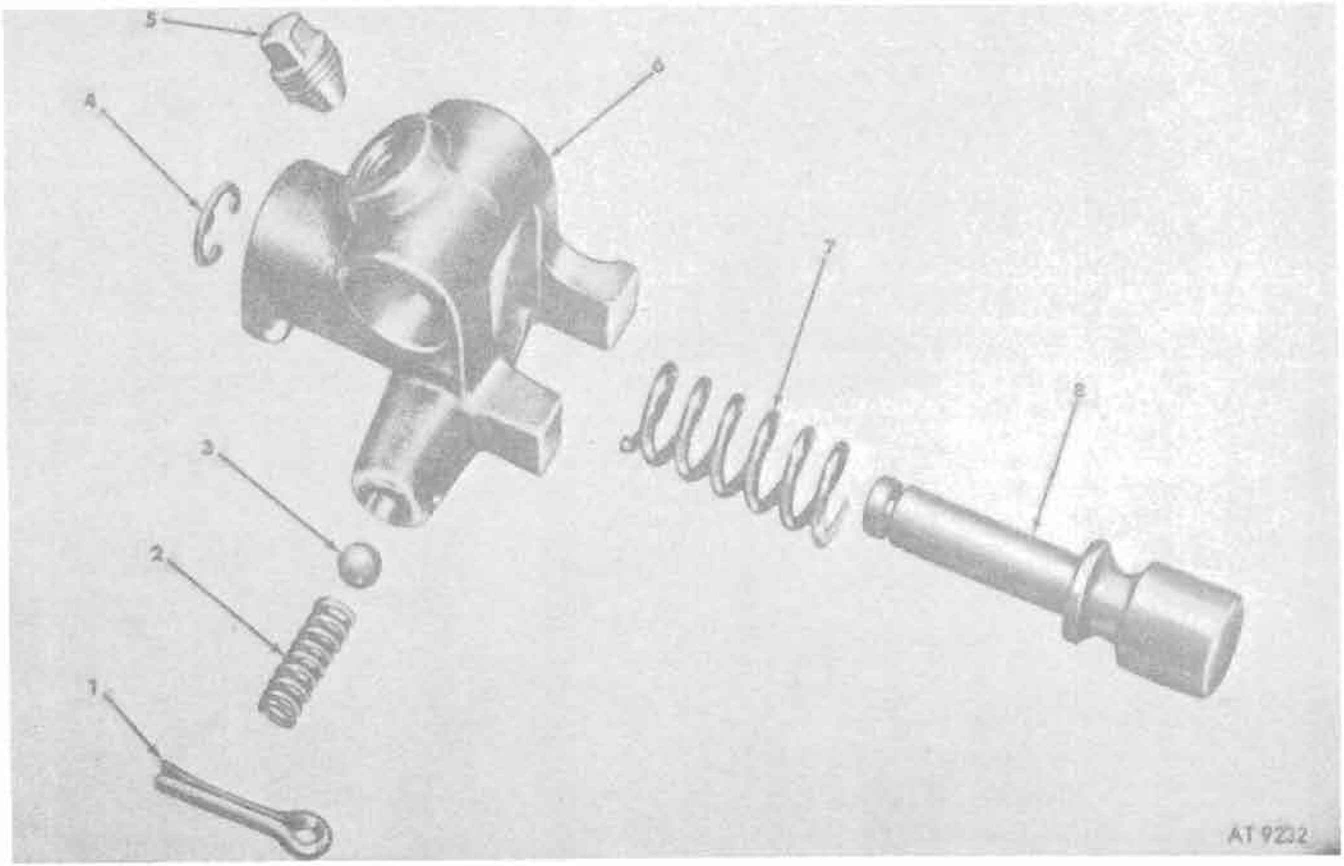


Figure 8-97. Reverse shifter gate plunger and clip.

Table 8-8. Wear Limits—Transmission Gearshift Housing and Related Parts

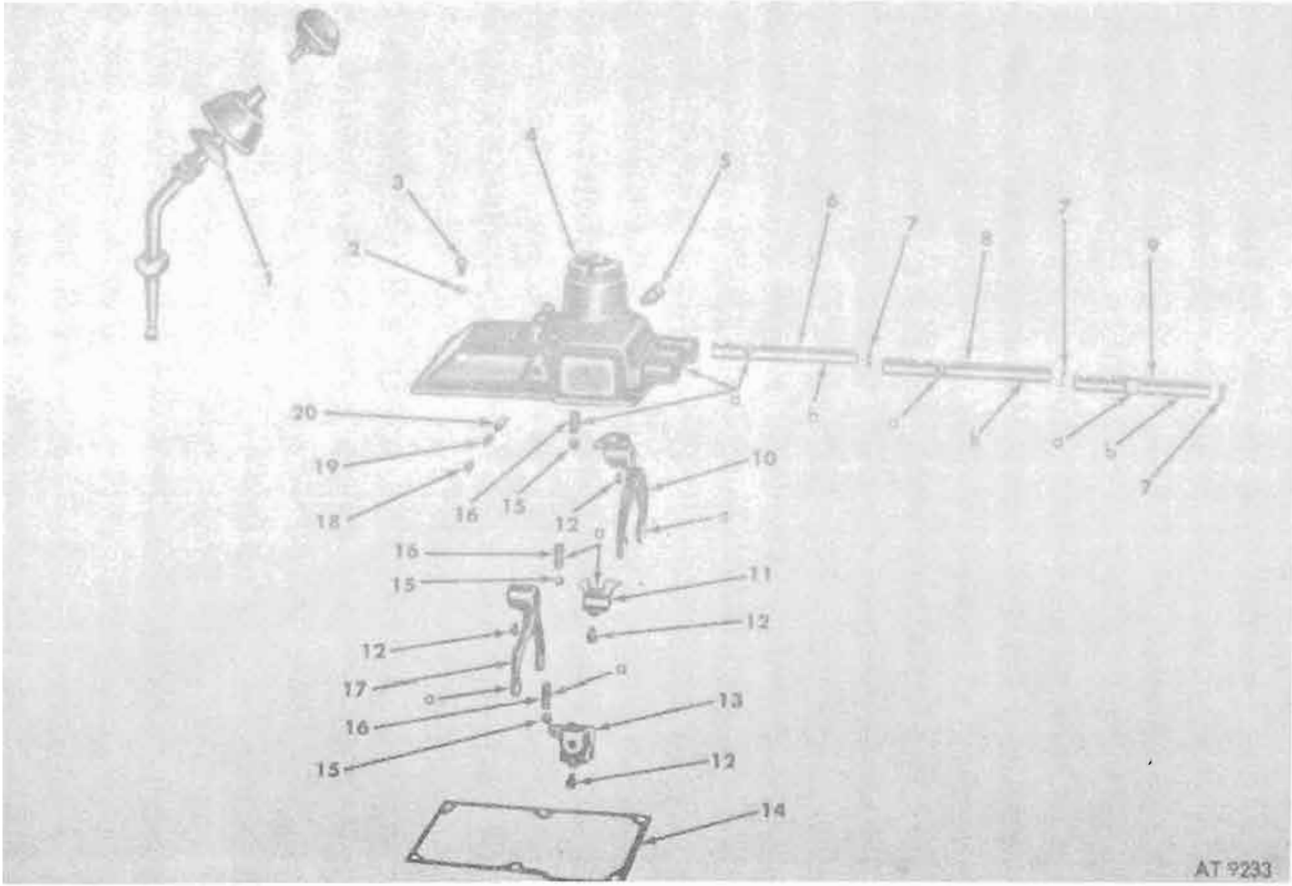
Reference		Point of measurement	Size of new parts	Wear limits field maintenance
Fig. No.	Key			
8-100	4a	Shifter shaft bores (3)	0.5615-1.5625	0.5630
8-100	6a,8a,9a	Detent ball seat radius	0.182R-0.192R	0.194R
8-100	6b,8b,9b	Runout at center, total indicator reading.		0.004
8-100	10a	Shift collar contact width	0.352-0.362	0.342
8-100	11a	Width of shifter gate slot	0.560-0.564	0.574
8-100	16a	Compression length of spring	.64 1.01 underload of 40- 46 lbs.	
8-100	17a	Shift collar contact width	0.352-0.362	0.342

* Refer to paragraph 8-6a (2).



1 Pin
2 Spring
3 Ball
4 Clip
5 Screw
6 Gate
7 Spring
8 Plunger

Figure 8-99. Reverse-shifter gate—exploded view.



1 Lever	11 Gate
2 Washer (6)	12 Screw (4)
3 Screw (6)	13 Gate
4 Housing	14 Gasket
5 Breather	15 Ball (3)
6 Shaft	16 Spring (3)
7 Plug (3)	17 Fork
8 Shaft	18 Plug
9 Shaft	19 Pin
10 Fork	20 Plunger

Figure 8-100. Gearshift housing assembly—exploded view.

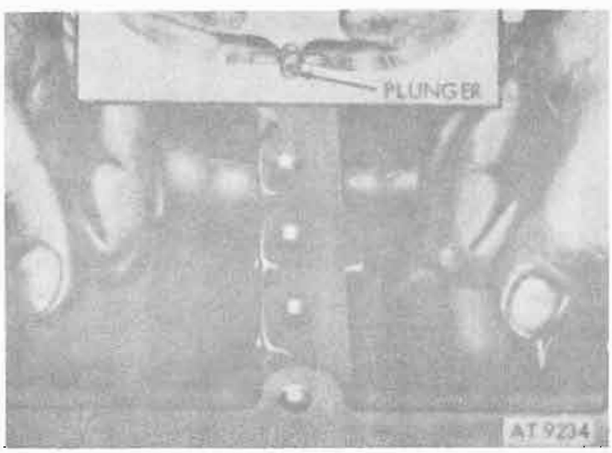


Figure 8-101. Interlocking plungers.

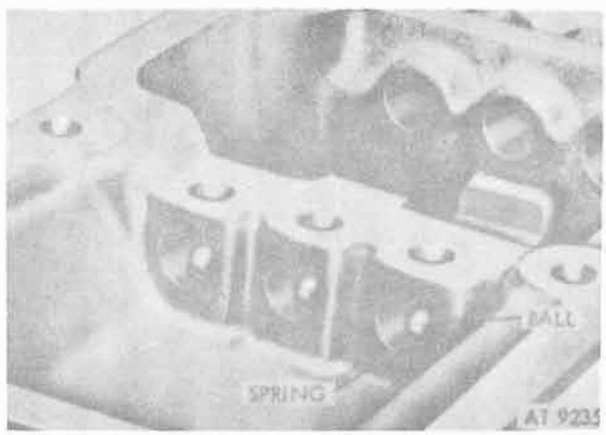


Figure 8-102. Detent balls and springs—installed view

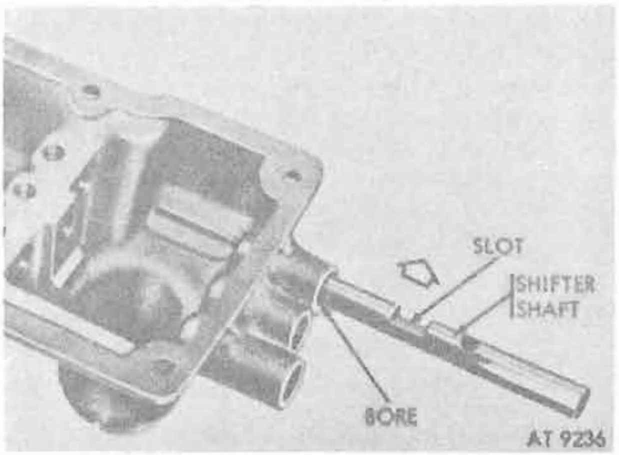


Figure 8-103. Reverse shifter shaft.

d. Install reverse-shifter gate assembly on reverse-shifter shaft. Refer to figure 8-95.

e. Using a piece of 1/4 inch tube, depress detent ball and slide shaft into position (fig. 8-104).

f. Position reverse-shifter gate on shaft over slot as shown and install lock screw (fig. 8-105). Refer to figure 8-103 for position of slot.

g. Install first- and second-speed gear-shifter shaft and fork (fig. 8-94) by depressing detent ball. Refer to *e* above.

h. Position fork on first- and second-speed shifter shaft and install lock screw (fig. 8-106).

i. Install third- and fourth-speed shifter gate on shaft. Assembly gate down as shown in figure 8-107.

j. Position reverse-shifter shaft and first- and second-speed shifter shaft in neutral (fig. 8-108).

k. Depress detent spring and ball as described in *e* above. Slide third- and fourth-speed shifter shaft rearward and install interlock pin. Refer to figure 8-93.

l. Install third- and fourth-speed shifter fork on shifter shaft. Refer to figure 8-96.

m. Install four lock screws securing shifter forks and gates to shifter shafts; tighten screws to 12-15 lb.-ft., and safety wire screws in position. Refer to figure 8-90.

n. Coat new expansion plugs with sealer (5330-252-3391), and install with flat-face punch (fig. 8-109).

o. Install breather in housing. Refer to figure 8-89.

Section IV. ASSEMBLY OF TRANSMISSION AND TRANSFER ASSEMBLY

8-29. Assembly Instructions

a. General. The transmission-transfer is assembled basically by reversing the disassembly procedure. A few new operations are involved, along with general precautions to insure proper operation after assembly. Assembly of the transmission is similar to other conventional transmissions in the Ordnance System in the use of "Dummy-Shaft" installation tool (remover-replacer B7345226), needle bearings, standard synchronizers; etc. The transfer is unique in being intergral with the transmission, but represents no departure from conventional practice in construction or assembly.

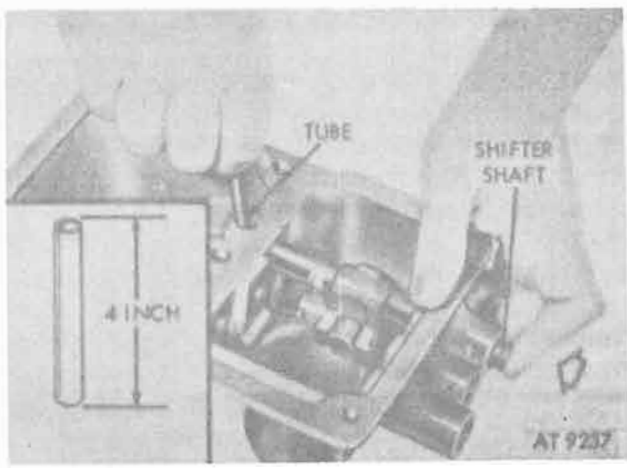


Figure 8-104. Depressing detent balls.

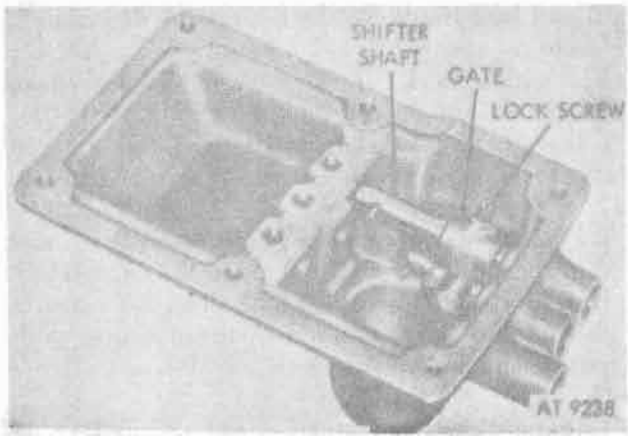


Figure 8-105. Shifter gate lock screw.

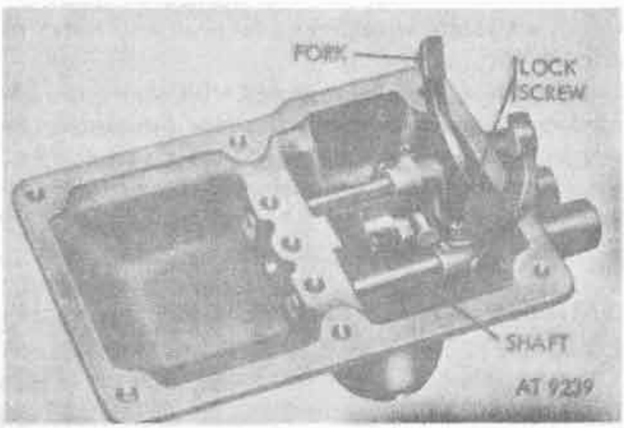


Figure 8-106. First and second speed fork lock screw.

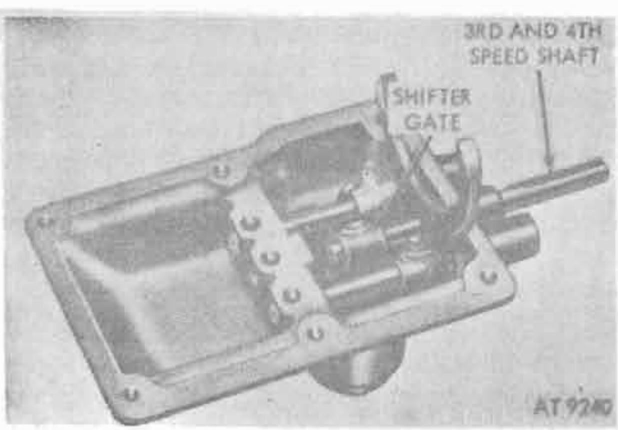


Figure 8-107. Third and fourth speed shifter gate—installed view.

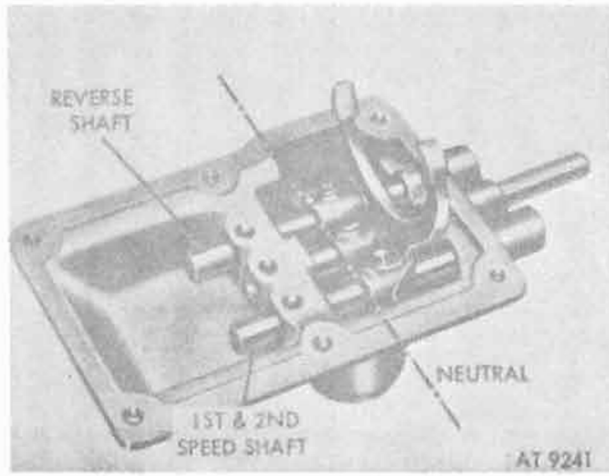


Figure 8-108. Neutral position of reverse, and first and second speed shifter shafts.

b. Lubrication During Assembly. To insure immediate lubrication when the transmission is operated and also to protect the parts involved, apply the specified transmission lubricant to parts when assembling. Use GAA grease in positioning needle bearings.

c. Sealing. All threaded retaining screws, plugs, and seal outer surfaces should be coated with a non-hardening sealer, such as 5330-252-3391, to prevent seepage of lubricant when the transmission-transfer is at operating temperature. Gaskets, unless specifically indicated in the assembly steps, are normally installed without sealer. A light grease such as GAA is used for this purpose.

d. Tools. Use the special tools provided whenever possible. When the specified tools are not available, use procedures which will not subject the parts to stresses for which they were not designed. For instance, avoid striking hardened surfaces with hardfaced hammers or tools. Before using excessive force in assembling, check the previous assembly procedure to determine if assembly has been correct up to the point where excessive force is apparently required.

8-30. Assembly of Transmission from Sub-assemblies

a. Position low and reverse idler gear and shaft in transmission case (fig. 8-110).

NOTE

Pencil a centerline (a) on both shafts before assembly to assist in lining up retaining holes.

b. Position countershaft gear cluster assembly in transmission case with remover-replacer (dummy-shaft) installed as shown in figure 8-111. Thrust washer tangs should line up with slots in case. Refer to *c* below.

c. Slide countershaft gear cluster assembly to bottom of case. Note slot in which thrust washer tangs must seat (at both ends of shaft). Refer to figure 8-37.

d. Install output shaft assembly in housing by first entering output shaft in rear bearing bore, and then lowering shaft assembly into case. Refer to figure 8-36.

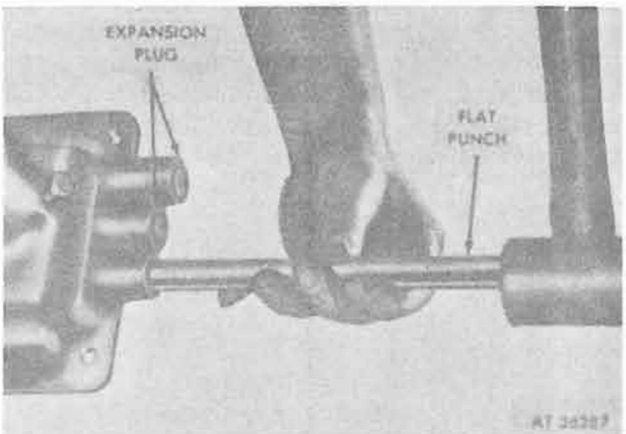


Figure 8-109. Installing housing expansion plugs.

e. Install front synchronizer blocking ring to output shaft front (third- and fourth-speed) synchronizer. Then install input shaft assembly to output shaft assembly (fig. 8-112).

CAUTION

Do not allow bearing to fall into transmission.

f. Install input bearing retainer gasket, using sealer (5330-252-3391), and position input shaft bearing retainer to transmission case. Install and tighten retaining screw and washer assemblies (fig. 8-113). Apply sealer to threads before installation.

g. Torque bearing retaining screw assemblies to 10-14 lb.-ft. (fig. 8-113).

h. Position output shaft rear bearing on output shaft, and install snapring to bearing (fig. 8-114).

i. Position transfer input gear spacer, speedometer gear, and bearing race on output shaft and press parts on shaft, using brakedrum and bolt (fig. 8-115).

NOTE

After assembled parts have been pressed in position, remove brakedrum.

j. Using improvised gear hook, raise the cluster gear to a position where the gear bore alines with the case bores. Push countershaft into position which in turn will force shaft (7345226) from case (fig. 8-116).

k. Tap cluster gear countershaft into place with soft hammer while alining shaft lock-pin bore with case bore. Install lock pin. Refer to figure 8-32.

NOTE

Lock pin must retain both the countershaft and the idler gear shaft in the transmission case.

l. Install the two slotted headless screws, using sealer (5330-252-3391) on threads, to secure lock pin in case. Refer to figure 8-31.

m. Install reverse-shifter arm and tighten pivot (8754455) to secure arm and tighten pivot 11639772 to secure arm in position. Use sealer (5330-252-3391) on threads of bolt. Torque bolt to 40.50 lb.-ft. Refer to figure 8-29.

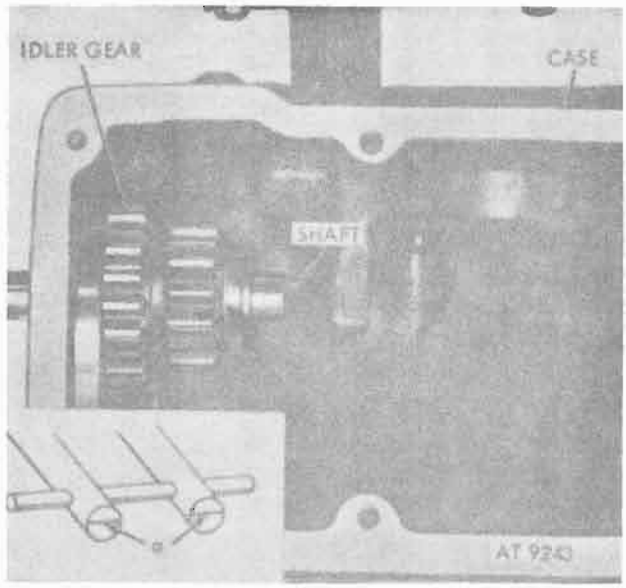


Figure 8-110. Low and reverse idler gear—installed view.

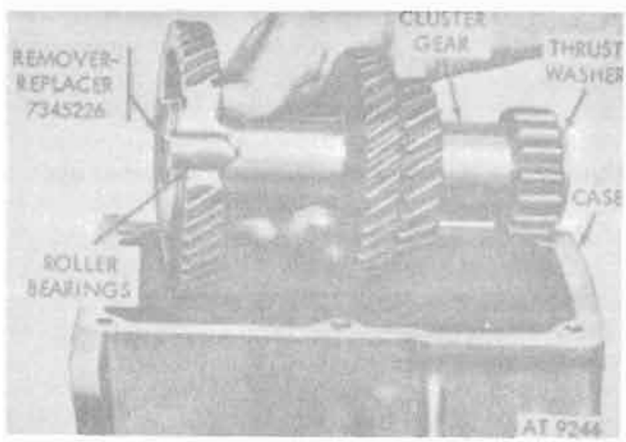


Figure 8-111. Installing countershaft gear cluster.

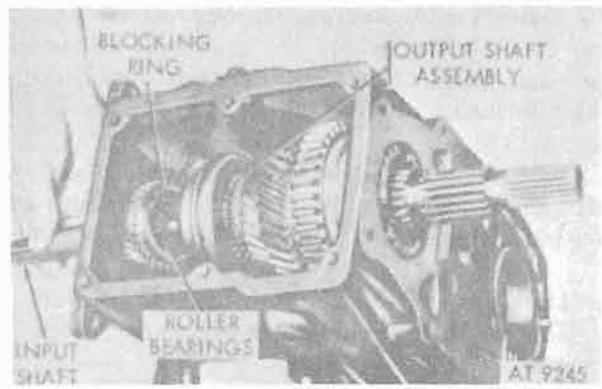


Figure 8-112. Installing front synchronizer blocking ring and input shaft assembly.

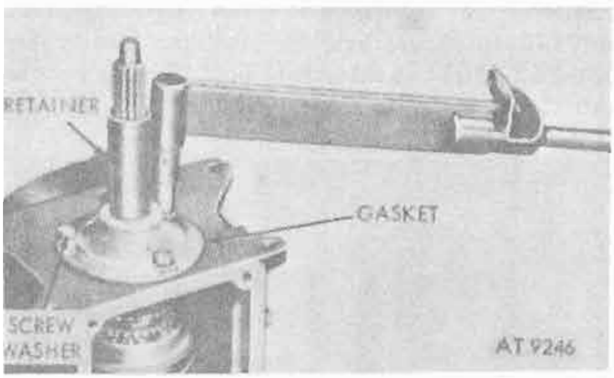


Figure 8-113. Installing input shaft bearing retainer.

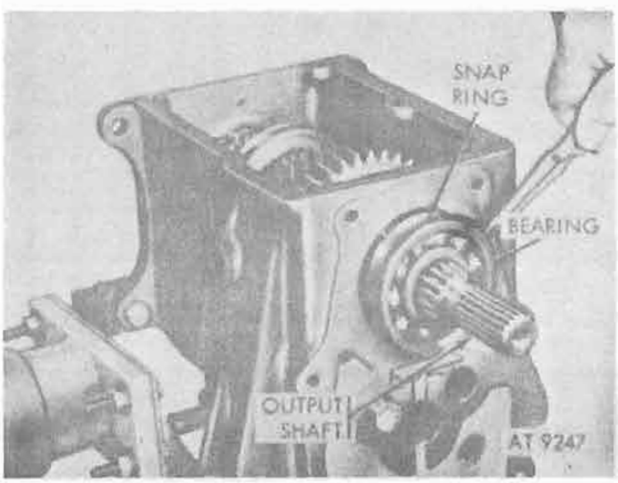


Figure 8-114. Installing output shaft rear bearing and snapring.

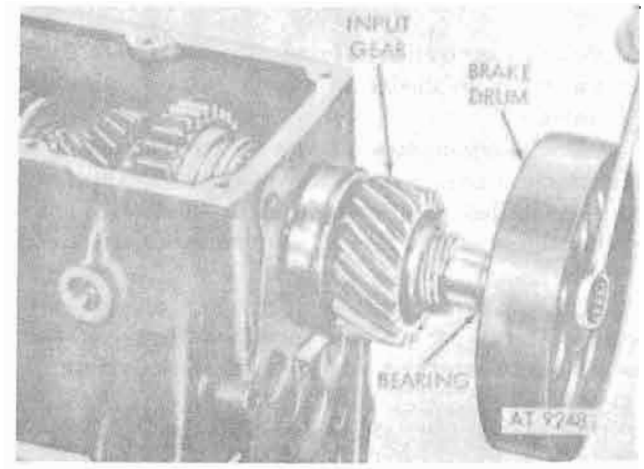


Figure 8-115. Pressing input gear, speedometer gear and bearing race on input shaft.

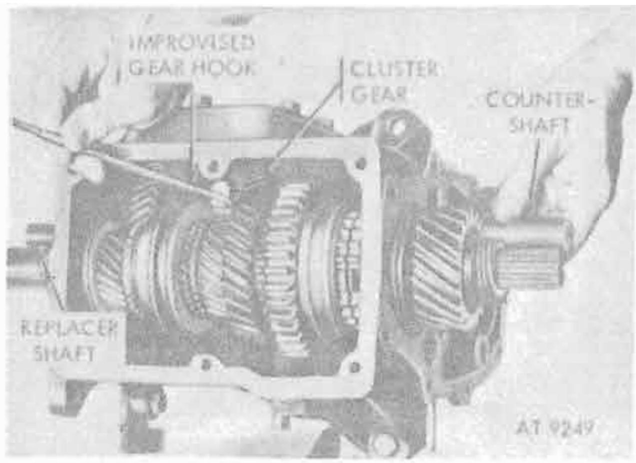


Figure 8-116. Raising cluster gear and installing countershaft.

8-31. Installation of Transfer Assembly

a. Install thrust washer to transmission case, seating legs of washer in case as shown in figure 8-117.

b. Position transfer gasket to transmission case, using light grease (GAA), and install transfer assembly to transmission case. Refer to figure 8-7.

CAUTION

Do not allow rollers to drop out of intermediate gear.

c. Install eight case retaining bolts and lockwashers. Torque bolts to 20-25 lb.-ft. Refer to figure 8-7.

d. Install transfer input shaft bearing and seal, and parking brakedrum. Refer to figure 8-5. Coat outside of seal with sealer (5330-252-3391) and press into position. Pack lips of seal with GAA grease.

e. Install washer, bolt lock, and retaining bolt; securing brakedrum. Torque retaining bolt 60-65 lb.-ft. and bend tab on lock to hold bolt in position. Refer to figure 8-5.

f. Apply sealer to threads and install speedometer drive gear and bearing. Torque bearing to 12-15 lb.-ft. Refer to figure 8-4.

g. Install transfer output shaft bearing retainer to transfer case. Torque bolts to 10-14 lb.-ft. Refer to figure 8-6.

h. Install gearshift housing and gasket on the transmission case. Torque the six retaining screws and washers to 10-14 lb.-ft. Refer to figure 8-3.

i. Install flange to transfer rear output shaft and remove transmission-transfer unit from fixture stand. Refer to figure 8-2.

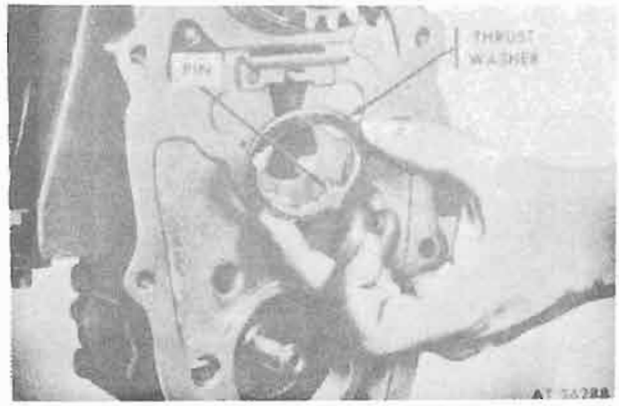


Figure 8-117. Seating legs of thrust washer on transmission case.

CHAPTER 9

RADIATOR AND RADIATOR SHROUD

9-1. Removal

For removal of radiator and shroud, refer to TM 9-2320-218-20.

NOTE

If brush guard is not removed from vehicle, shroud must be disconnected from radiator before radiator or shroud can be removed (fig. 9-1).

9-2. Cleaning

Clean outside of radiator with water and stiff (medium) brush. Remove accumulations of oil or grease with drycleaning solvent or mineral spirits paint thinner. To clean inside of radiator, refer to TM 10-450 for procedure.

9-3. Inspection and Repair

a. Inspection.

(1) Check to see that all radiator fins are parallel, and that tubes are not bent.

(2) Check all soldered seams for obvious external damage such as cracking.

(3) If radiator shroud accompanies radiator, inspect shroud for damage such as dents and tears.

b. Repair.

(1) Straighten bent tubes and fins.

(2) Test for leaks. Refer to TM 10-450 for testing and repair procedures. Radiator cores with not more than two tubes blocked are acceptable if fins are properly replaced after blocking.

(3) Remove dents and bends from radiator shroud.

(4) Weld tears in radiator shroud.

(5) Paint all areas where paint has been removed.

9-4. Installation

For installation of radiator and shroud refer to TM 9-2320-218-20.

NOTE

If radiator and shroud are to be installed on vehicle without removing brush guard from vehicle, do not subassemble radiator and shroud

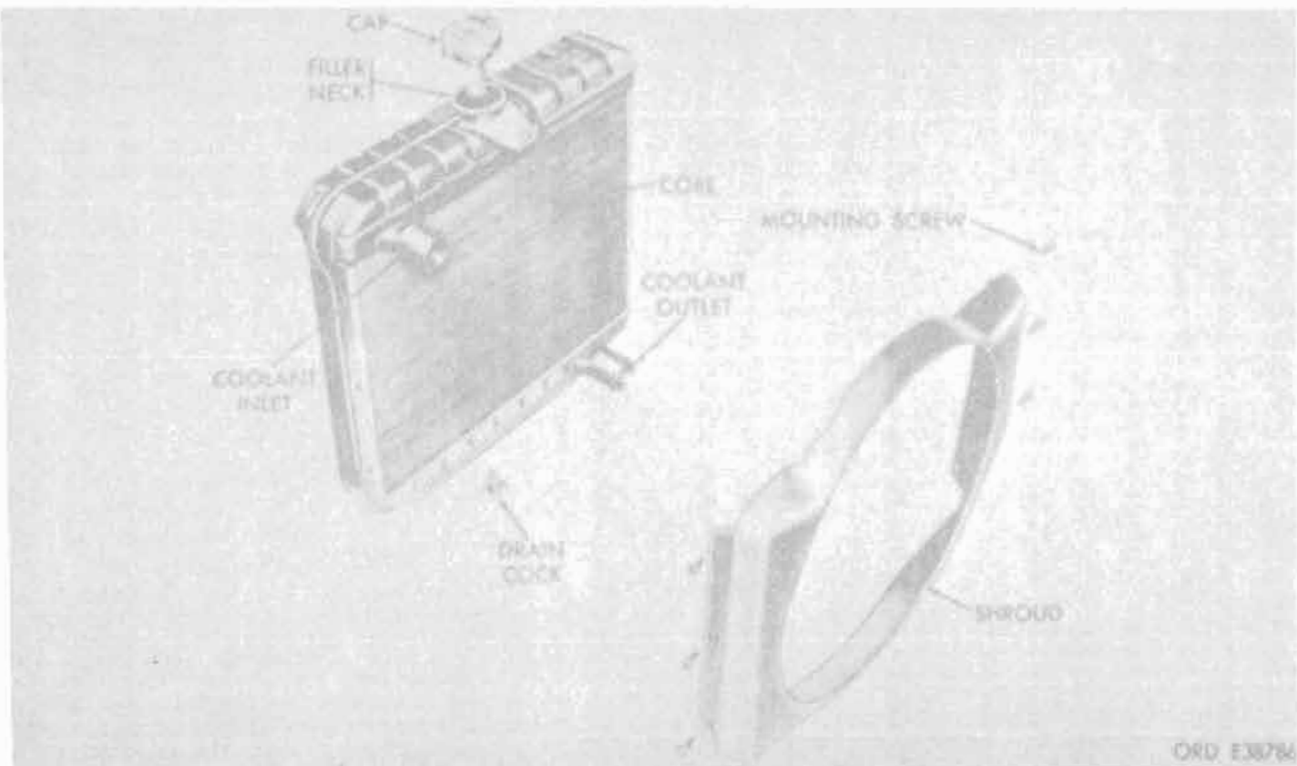


Figure 9-1. Radiator and shroud.

CHAPTER 10

FRONT SUSPENSION

Section I. DESCRIPTION AND DATA

10-1. Description

For description of front suspension refer to TM 9-2320-218-20.

10-2. Data

a. Front Suspension.

Make	Ordnance design
Type	2-arm independent
Arm type	Stamped A frame
Shock absorber	Hydraulic telescopic
Shock absorber characteristics.	Jounce and rebound hydraulic stop.
Action	2-way direct
Shock absorber bore size.	1.18 in.
Kingpin type	Ball joint
Kingpin inclination	6.5 degree
Wheel camber at curb weight.	Plus ½ to plus 1¾ degree maximum variation between wheels, not to exceed ½ degree.
Wheel caster at curb weight.	Plus ½ degree to minus ½ degree.
Wheel toe-in at curb weight.	1/32 to 5/32 in.

b. Front Drive.

Type	Frame-mounted differential with wheel drive shafts.
Make	Ordnance design
Universal joints	2 per shaft
Type of joint	Gardan (needle bearing)
Type of wheel drive shaft.	2-piece splined sliding
Spindle	One per wheel
Spindle bearings	tapered roller

Section II. INSTRUCTIONS FOR FRONT SUSPENSION REPAIR

10-3. Scope

Procedures for removal of the suspension and drive units from the vehicle will be found in TM 9-2320-218-20. Complete disassembly procedures for the front suspension and drive units are given in paragraphs 10-7 through 10-13. Inspection and repair standards are enumerated in paragraphs 10-14 and 10-15. Assembly of the units is described in paragraphs 10-16 through 10-23. Cleaning, inspection, and repair recommendations (paras 10-4 and 10-5) cover all general conditions. Torque recommendations are given in the figures describing the operations involved. Wear limits information is included in the inspection and repair section, paragraphs 10-6, 10-14, and 10-15.

10-4. Cleaning

a. General. Whenever an assembly is contaminated with dirt or other abrasive matter, unnecessary wear will result. Inspect all parts for possible abrasive material any time a unit is disassembled. Metallic contamination of lubricant is evidence of failure of some part in the assembly. If metal particles are found, the entire assembly containing the contaminated lubricant must be thoroughly cleaned.

b. Cleaning Parts.

(1) All metallic parts of the suspension and drive assemblies except bearings should be cleaned thoroughly with drycleaning solvent or mineral spirits paint thinner. Do not use caustic soda for steam cleaning.

(2) Parts should be dried with compressed air. Steam-cleaned parts should be oiled immediately after drying.

(3) After cleaning, examine parts to make certain they are entirely clean; clean them again if necessary.

c. Cleaning Bearings. Refer to TM 9-214 for care and maintenance of bearings.

10-5. Inspection and Repair Recommendations

a. Cast Parts and Machined Surfaces.

(1) Inspect bores for wear, grooves, scratches and dirt. Remove scratches and burrs with crocus cloth. Remove foreign matter. Replace parts that are deeply grooved or scratched.

(2) Inspect all lubrication passages for obstructions. If an obstruction is found, remove it with compressed air or by working a wire back and forth through the passage and flushing it with cleaning solvent. (Not applicable to M151A2, M825, and M718A1.)

(3) Inspect mounting faces for nicks, burrs, scratches, and foreign matter. Remove such defects with crocus cloth or a soft stone. If scratches are deep, replace the defective parts.

(4) Inspect thread openings for damaged threads. Chase damaged threads with correct tap.

(5) Discard housings or other cast parts that are broken.

(6) inspect all machined surfaces for damage that could cause oil leakage or some other malfunction of the part. Rework or replace the defective parts.

b. Bearings.

(1) Inspect bearings for roughness of rotation. Replace a bearing if its rotation is still rough after cleaning and oiling.

(2) Inspect bearings for scored, pitted, scratched, cracked, or chipped races, and indication of excessive wear of rollers. If one of these defects is found, replace the bearing.

(3) Inspect bearing housing bore and shaft for grooved, burred, or galled conditions that would indicate the bearing has been turning in its housing or on its shaft. If the damage cannot be repaired, with crocus cloth, replace the defective parts. Refer to TM 9-214.

(4) If a bearing must be removed or installed without a pressing sleeve, be careful to press only on the race which is adjacent to the mounting surface. If an arbor press is not available, seat the bearing with a soft steel drift and a hammer, driving against the supported race.

c. Thrust Washers. Inspect thrust washers for distortion, scores, burrs, and wear. Replace thrust washers if worn beyond wear limits.

d. Seals and Gaskets.

(1) Inspect seals for scoring, cuts, and hardness. Replace defective seals.

(2) When replacing lip-type seals, place spring loaded side toward oil to be sealed in (toward inside of unit). Use nonhardening compound sealer (FSN 8030-656-1426) on outside of seal to prevent leaks. Pack inside lips of seal with light grease (GAA), or specified lubricant.

(3) Replace all gaskets.

(4) Inspect surfaces of parts on which seals bear. If grooving exceeds wear limits, replace the part and seal.

e. Splined Parts. Inspect parts for stripped, twisted, chipped, or burred splines. Remove burrs with a soft stone. If other defects are found, replace the part. Wear on splines such as used on wheel drive shafts is not considered critical, since such splines are made with long contact surfaces designed to slide back and forth under all conditions. However, wear on short splines such as drive flanges must be minimum since a spline is used in this kind of installation because it is stronger than a key way. This strength is lost if fit is loose.

f. Threaded Parts. Inspect parts for damaged threads. Remove burrs with a soft stone or fine file. Replace damaged parts.

g. Snaprings. If parts are available, snaprings should generally be replaced since they are difficult to remove with distorting. If a snapring must be used again, remove any nicks or distortion before installing.

h. Springs. Inspect all springs for weak, broken, or distorted coils. Replace the spring if any of these defects are found.

10-6. Wear Limits and Torque Specifications

a. Wear Limits.

(1) Data covering the size of new parts, and wear limits information is included in table 10-1, and paragraphs 10-14, 10-15, and (2) below. These measurements list the minimum and maximum clearances for new or used parts.

(2) The wear limits indicate the dimensions to which a part may wear before it must be replaced. Normally, any part not worn beyond its wear limit may be approved for service, provided it is not damaged by corrosion or similar causes. An asterisk (*) in the wear limits column indicates that the part should be replaced when worn beyond the limits stated in the size of new parts column.

b. Torque Specifications. Torque specifications are called out in the text or on the illustration relating to the individual part in the repair sections.

Section III. DISASSEMBLY OF FRONT SUSPENSION

10-7. Removal of Differential Assembly and Steering Components

Refer to figures 10-1 and 10-2 and *a* through *f* below.

NOTE

Front suspension is mounted on bench upside down to provide stability and access for disassembly.

a. Remove right and left spindle connecting rod (tie rod) from steering arm by removing cotter pin and tie rod retaining nut (fig. 10-3).

b. Strike both right and left steering arms a sharp blow, while pulling upward on rod ends (fig. 10-4). Remove rod ends. Refer to TM 9-2320-218-20 for repair of steering linkage.

c. Disconnect universal joint U-bolts on both sides of differential (four nuts and washers on each side) (fig. 10-5).

d. Separate universal joint from flange on both sides of differential (fig. 10-6).

e. Remove three differential mounting bolts and nuts (fig. 10-7).

f. Remove differential assembly from crossmember.

10-8. Removal of Brake Tubes and Hoses

a. Remove brake hose clips from welded tang on right and left hose support brackets at each end of the hoses (fig. 10-8).

b. Disconnect brake hose from brake tubes at each end (fig. 10-9).

c. Remove brake cylinder tubes by removing nuts at right and left brake backing plates (fig. 10-10).

d. Remove brake tube assembly by removing "tee" fitting clip from crossmember (fig. 10-11).

10-9. Removal of Wheel Drive Shaft Assemblies

a. Disconnect universal joints at spindle flanges. (Four nuts and washers on each spindle flange, fig. 10-12).

b. Remove wheel drive shaft from right and left spindle flange.

10-10. Removal of Shock Absorbers

a. Remove right and left front shock absorber lower retaining nuts from stems (fig. 10-13).

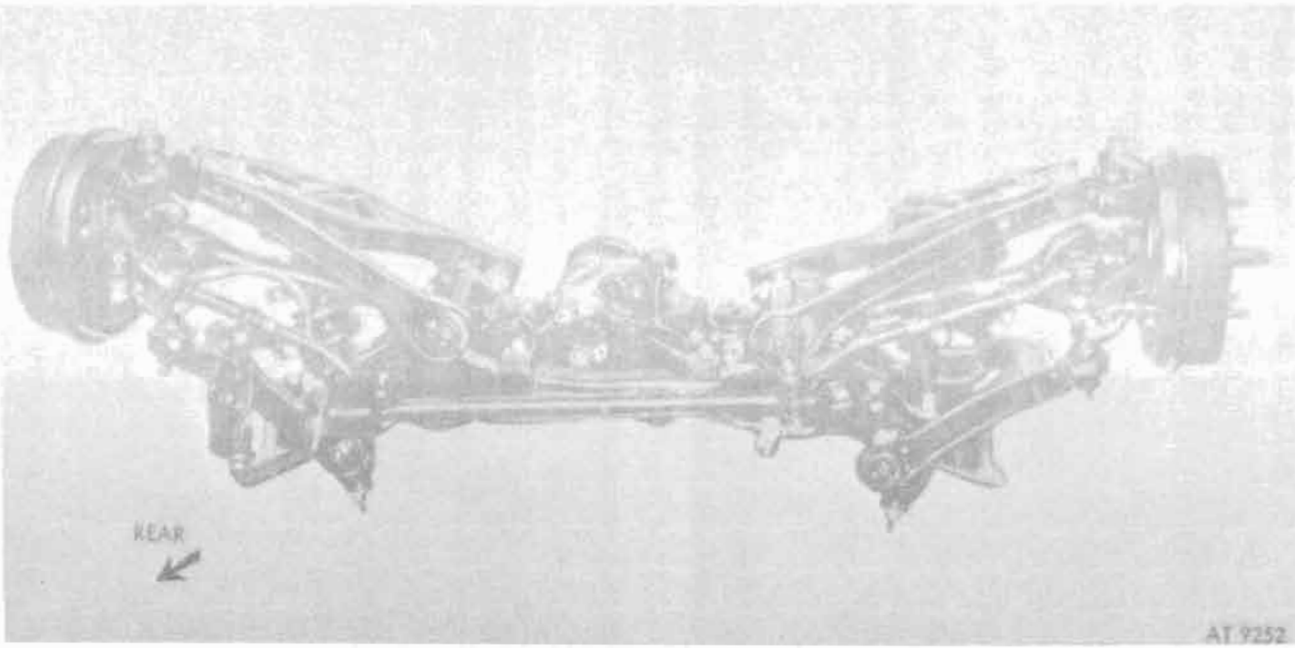


Figure 10-1. Front suspension mounted on bench—rear view.

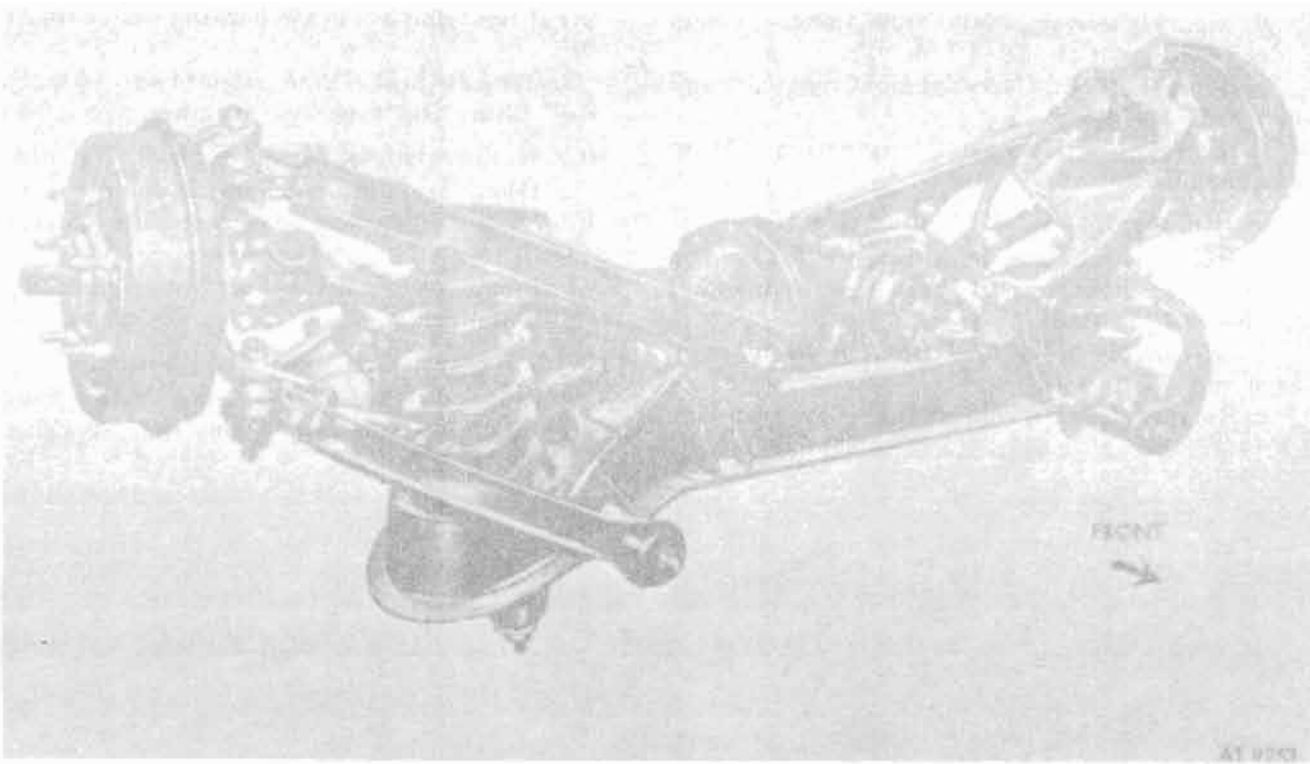


Figure 10-2. Front suspension mounted on bench—front view.

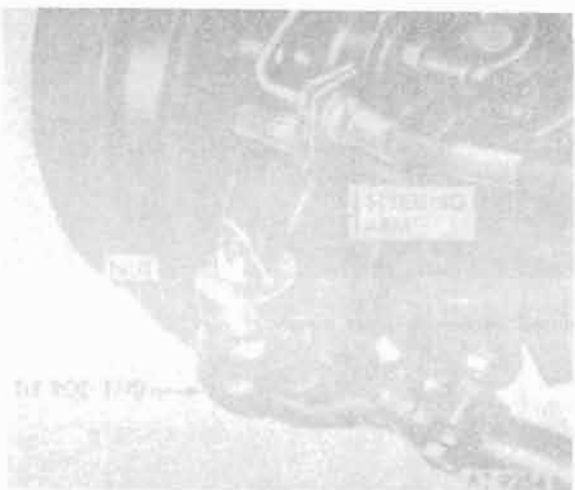


Figure 10-3. Tie rod end and steering arm—right side.

Figure 10-4. Removing tie rod end—right side.

Figure 10-5. Universal joint and differential flange—right side.

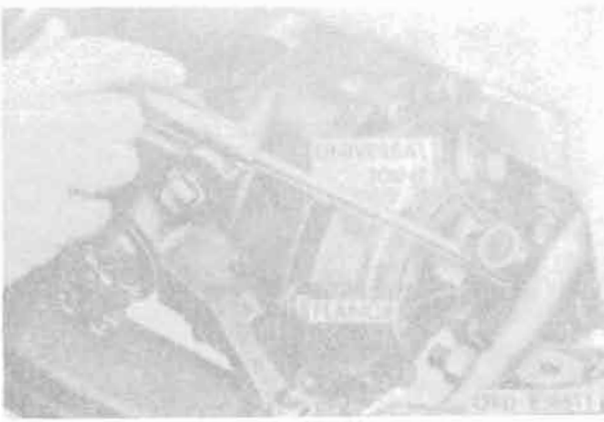


Figure 10-6. Separating universal joint from differential drive flange—right side.

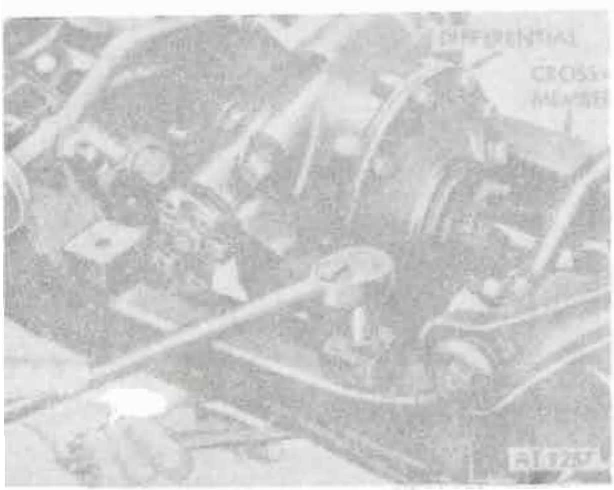


Figure 10-7. Differential mounting bolts.

Figure 10-8. Brake hose support bracket and clip—right side.

Figure 10-9. Brake hose and brake tube disconnect—right side.

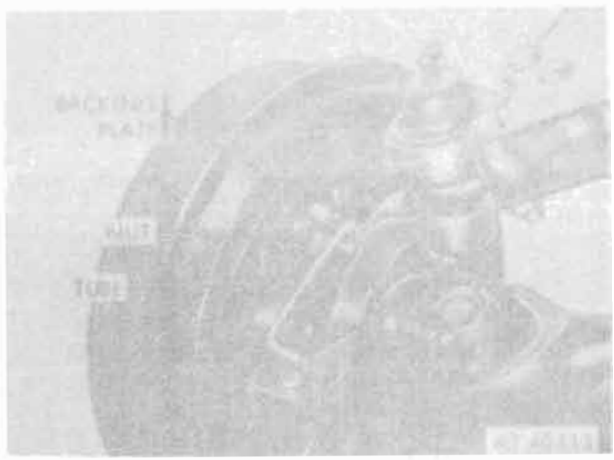


Figure 10-10. Brake cylinder tube—right side.

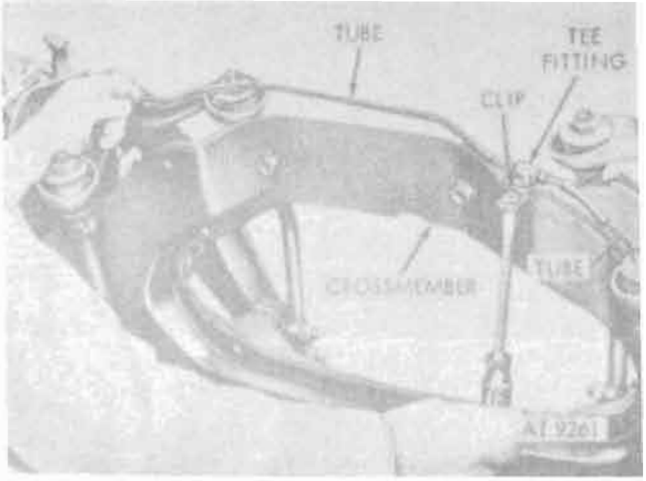


Figure 10-11. Front brake tube assembly, "tee" fitting clip

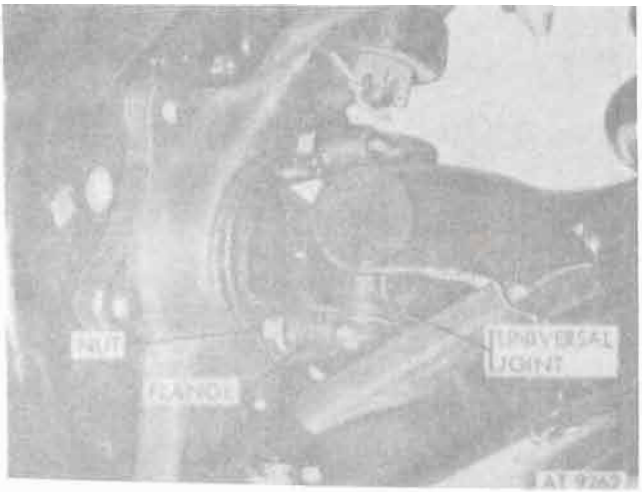


Figure 10-12. Universal joint and right spindle flange.

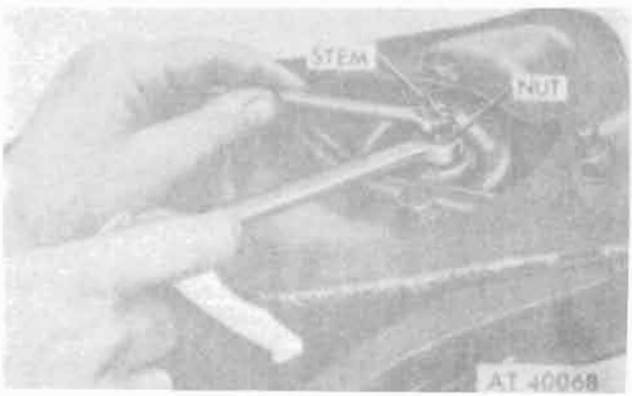


Figure 10-13. Right front shock absorber lower retaining nut.

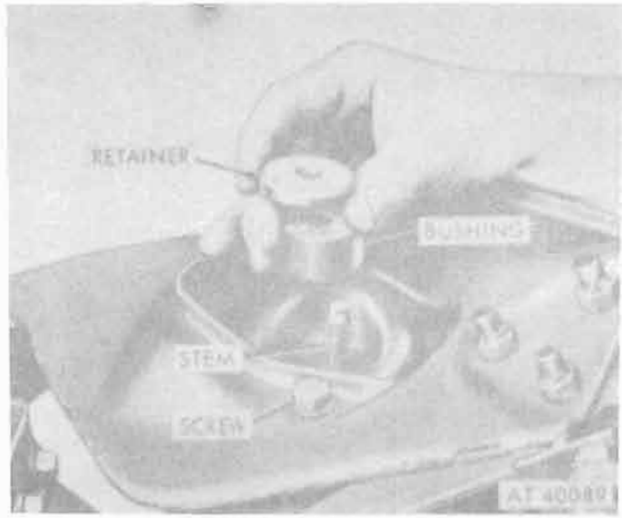


Figure 10-14. Right shock absorber, lower bushing and retainer.

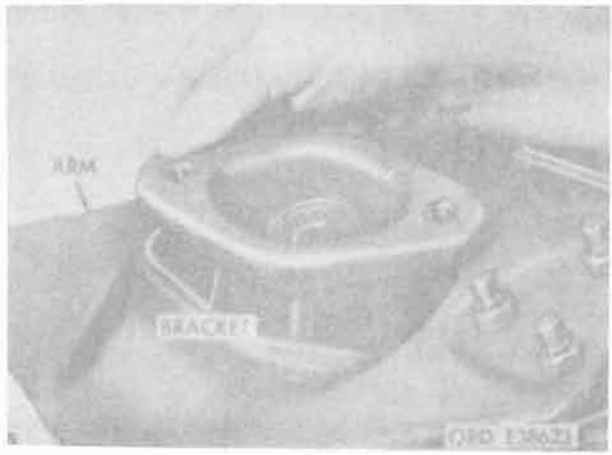


Figure 10-15. Right shock absorber lower bracket.

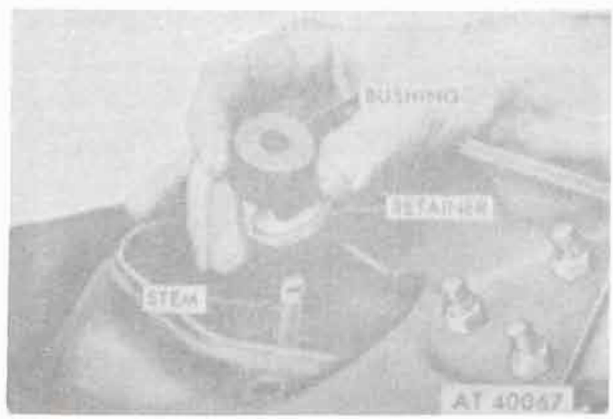


Figure 10-16. Right shock absorber lower bushing and retainer.

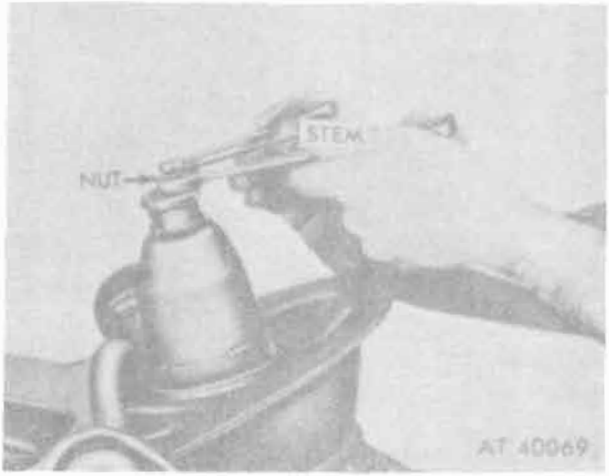


Figure 10-17. Right shock absorber upper retaining nut.

Figure 10-18. Right shock absorber upper outer bushing and retainer.

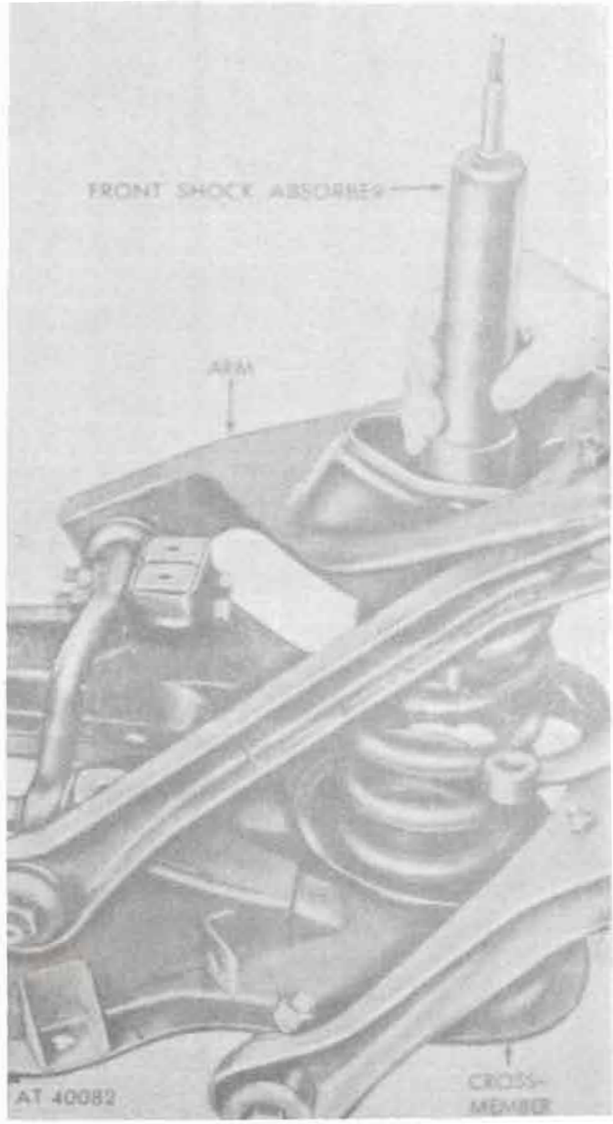


Figure 10-19. Shock absorber and right front suspension crossmember and arm.

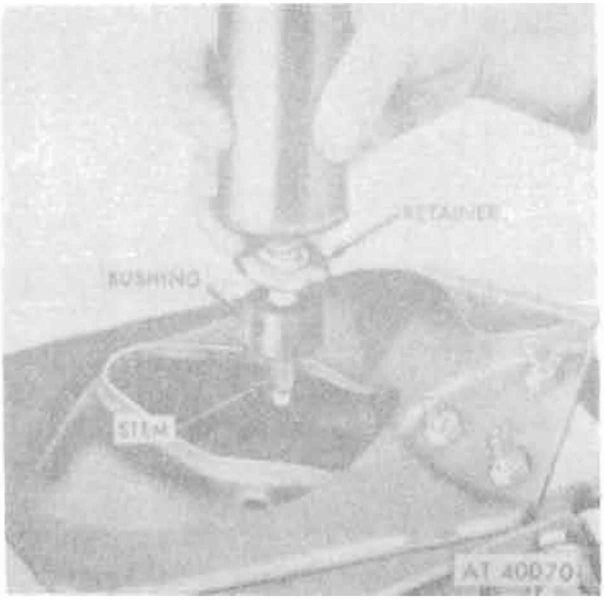


Figure 10-20. Shock absorber upper inner bushing and retainer.

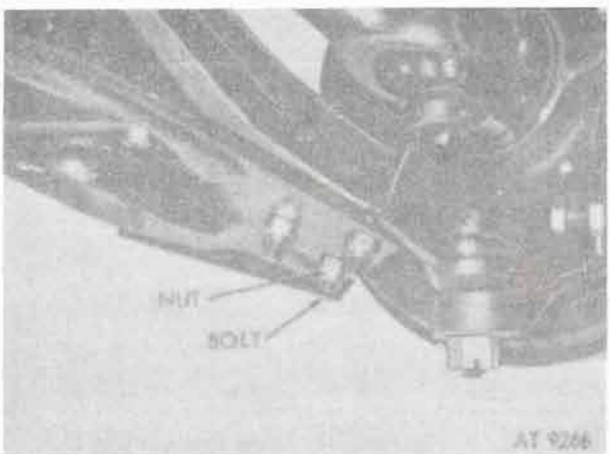


Figure 10-21. Right spindle support lower ball joint and attaching hardware.

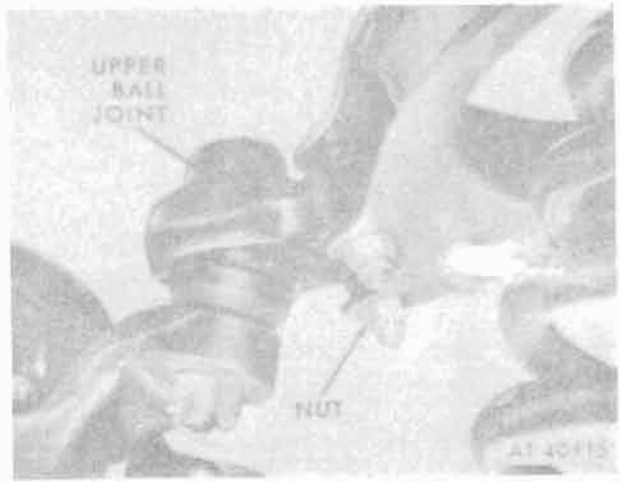


Figure 10-22. Right spindle support upper ball joint and attaching hardware.

NOTE

Shaft must be held in order to loosen retaining nut.

b. Remove right- and left-front shock absorber lower bushings and retainers from shock absorber lower stems (fig. 10-14).

c. Remove two shock absorber lower bracket retaining screws from left- and right-shock absorber brackets (fig. 10-14).

d. Remove right- and left-front-shock absorber lower brackets from lower control arms by rotating bracket one-quarter turn and lifting upward (fig. 10-15).

e. Remove inner lower bushings and retainers, from right- and left-front-shock absorber stems (fig. 10-16).

f. Remove right- and left-front-shock absorber upper retaining nuts from shock absorber stems (fig. 10-17).

NOTE

Stem must be held in order to loosen retaining nut.

g. Remove upper outer bushings and retainers from right- and left-front-shock absorber upper stems (fig. 10-18).

h. Remove right- and left-front-shock absorbers from suspension crossmember and lower arms (fig. 10-19).

i. Remove upper inner bushings and retainers from right- and left-front-shock absorber stems (fig. 10-20).

10-11. Removal of Spindle Support and Brake as an Assembly

a. Remove three nuts and bolts securing the right and left lower ball joints to the lower arms (fig. 10-21).

b. Remove three nuts and bolts securing the right and left upper ball joints to the upper arms (fig. 10-22).

c. Remove right and left spindle support, ball joints, and brake unit from control arms as an assembly (fig. 10-23).

10-12. Removal of Coil Spring and Suspension Arms

a. Remove right and left coil spring from crossmember (fig. 10-24).

NOTE

When the spindle support is removed from the crossmember raise lower control arm and lift spring from crossmember.

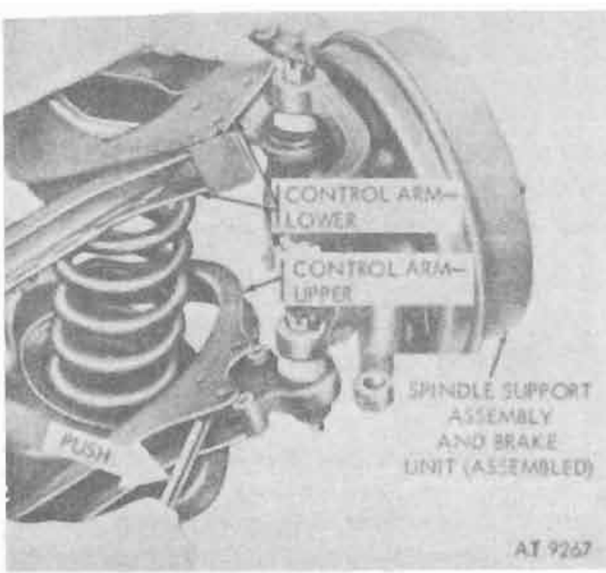


Figure 10-23. Removal of right spindle support assembly and brake unit.

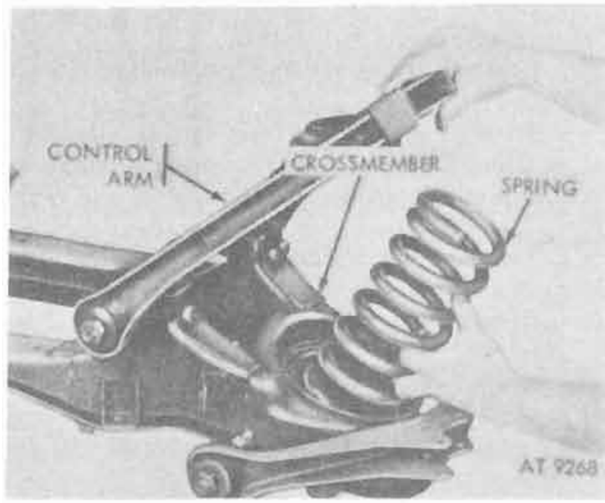


Figure 10-24. Right coil spring, lower control arm and crossmember.

b. Remove right- and left-coil spring insulator from crossmember (older models) (fig. 10-25).

c. Remove three nuts from the bolts securing right and left lower control arms to the crossmember (fig. 10-26).

d. Remove three bolts and alinement shims from right and left lower control arms (fig. 10-27).

NOTE

When removing alinement shims, note sequence and number of shims removed from each arm bolt to assist in assembling and adjusting.

e. Remove right and left lower control arm from crossmember (fig. 10-28).

f. Remove two nuts, lockwashers, and bolts securing right and left upper arms to crossmember (fig. 10-29).

g. Remove right and left upper control arms from crossmember (fig. 10-30).

10-13. Removal of Ball Joints, Brakes, and Bearings from Spindle Support

a. Clamp spindle support and brake unit in soft-jawed vise as shown in figure 10-31.

b. Remove cotter pin and loosen ball joint retaining nut (fig. 10-32).

c. Tap support as shown in figure 10-33 with hard-face hammer to loosen ball stud taper. Drive ball joint loose with soft hammer (fig. 11-33).

d. Remove ball-joint retaining nut and remove ball joint and seal from support (fig. 11-34).

e. Repeat procedures *a*, *b*, *c*, and *d* above and remove remaining ball joints.

f. Remove lifting eye and nut from spindle (fig. 10-35).

g. Remove brakedrum from spindle (fig. 10-36).

h. Unhook brakeshoe retracting springs from anchor pin using brake spring remover and replacer tool (fig. 10-37).

i. Remove two retracting springs (fig. 10-37) from brakeshoes. Note order springs are removed for assembly purposes.

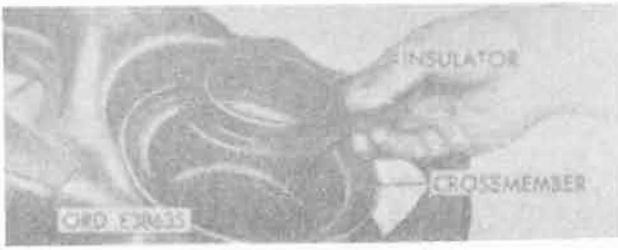


Figure 10-25. Right coil spring insulator (older models).

Figure 10-26. Right lower control arm retaining bolts and nuts.

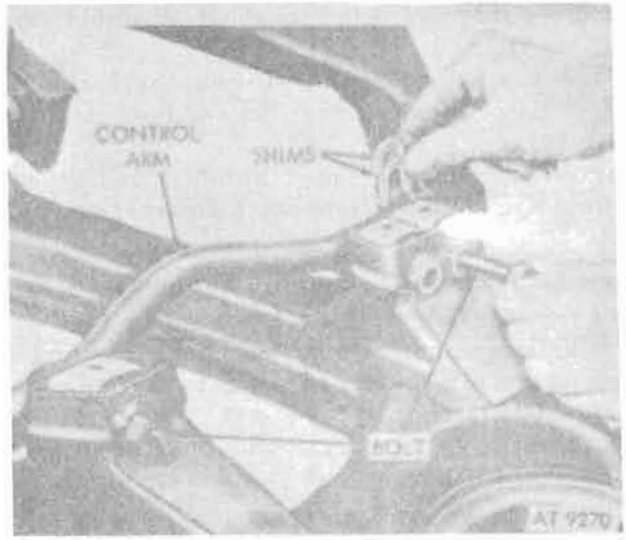


Figure 10-27. Right lower control arm alinement shims.

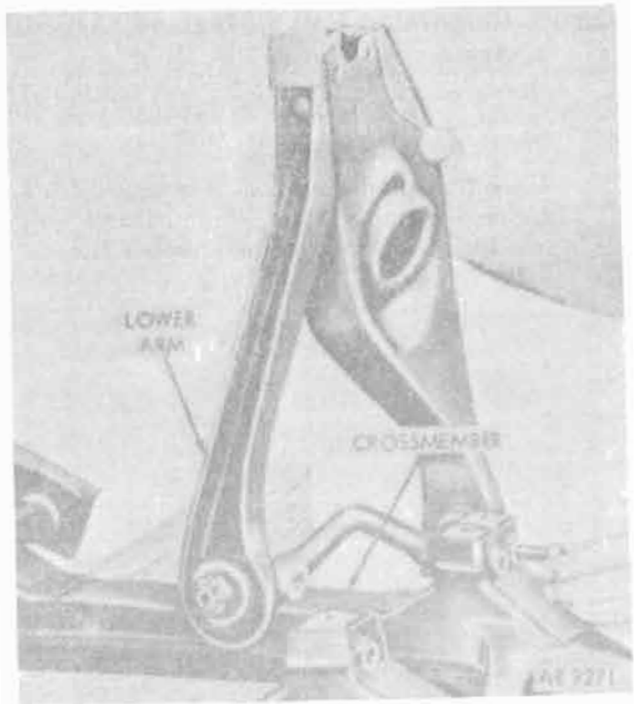


Figure 10-28. Right lower control arm and crossmember.

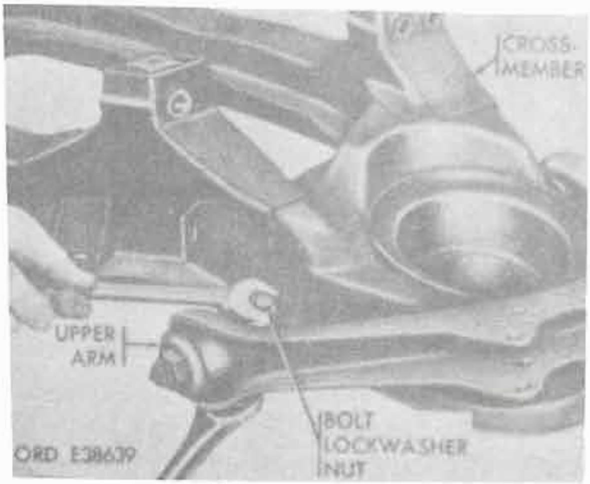


Figure 10-29. Right upper control arm and attaching hardware.

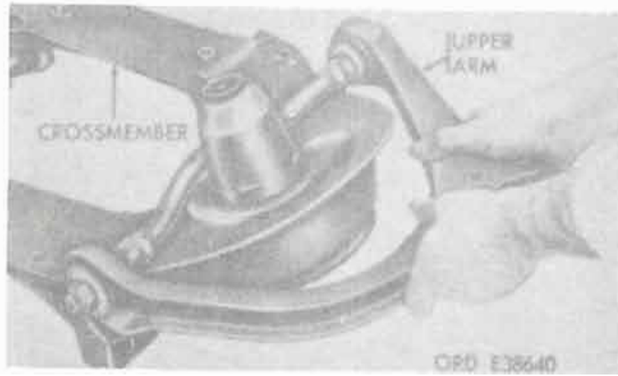


Figure 10-30. Right upper control arm and crossmember.

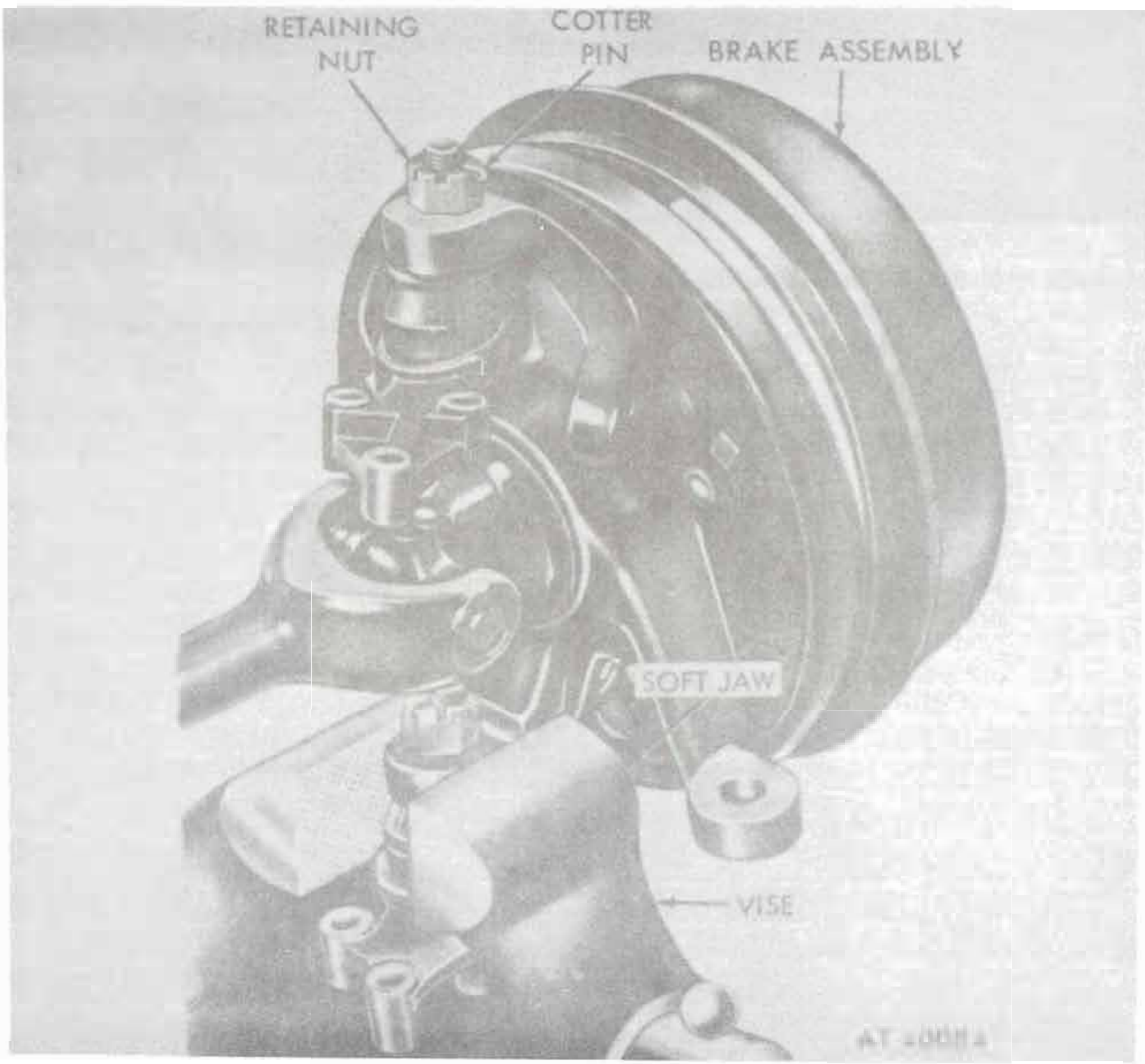


Figure 10-31. Support assembly and brake assembly clamped in vise.

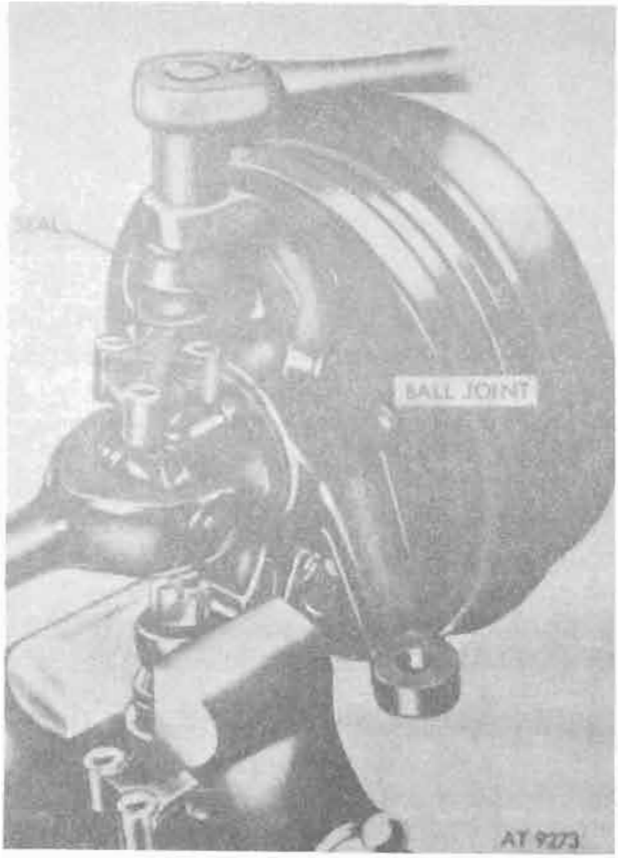


Figure 10-32. Ball joint seal and retaining nut.

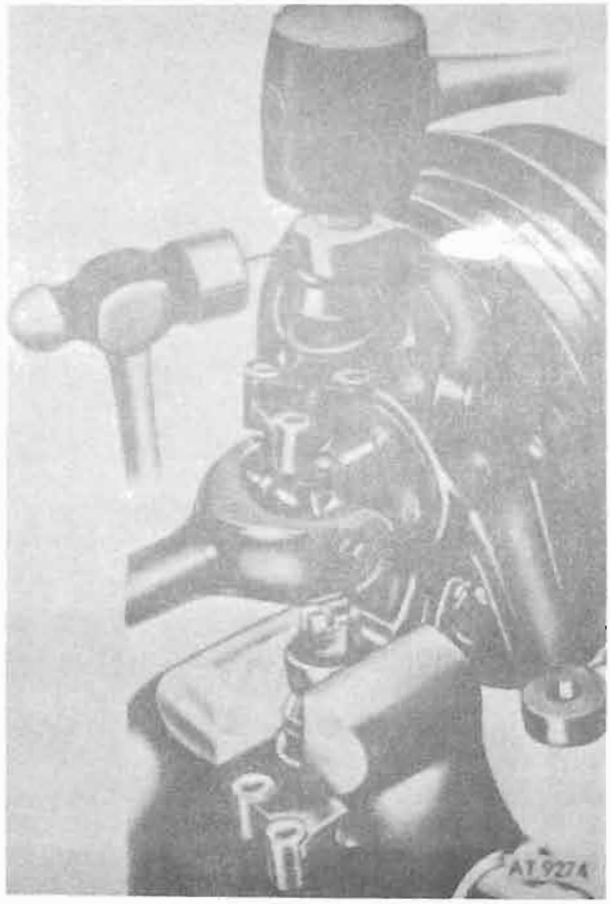


Figure 10-33. Loosening ball joint stud.

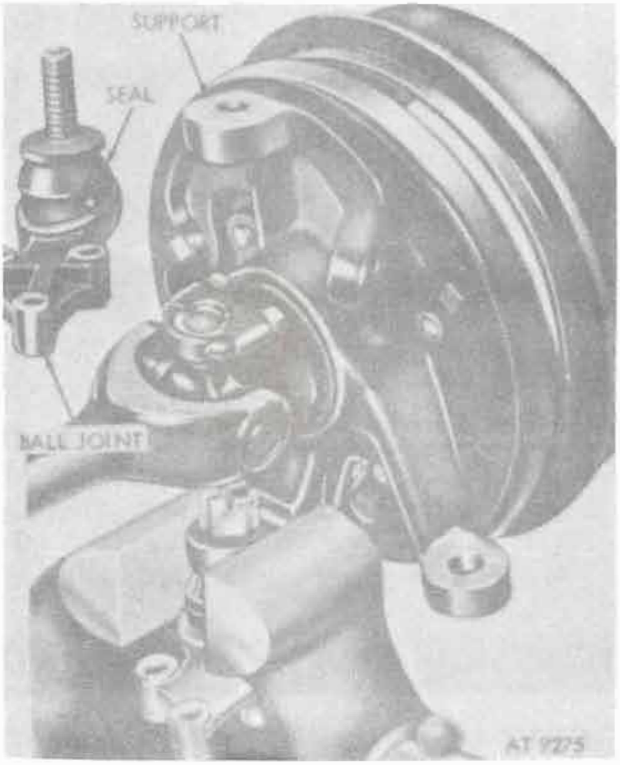


Figure 10-34. Ball joint seal, and support.

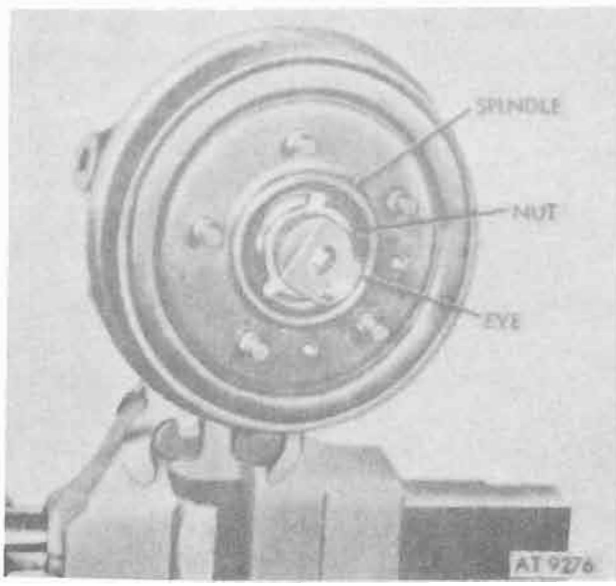


Figure 10-35. Lifting eye and nut.

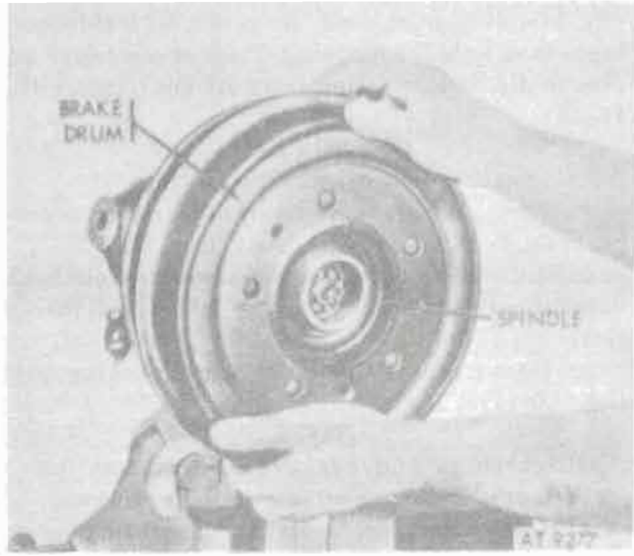


Figure 10-36. Brakedrum and spindle.

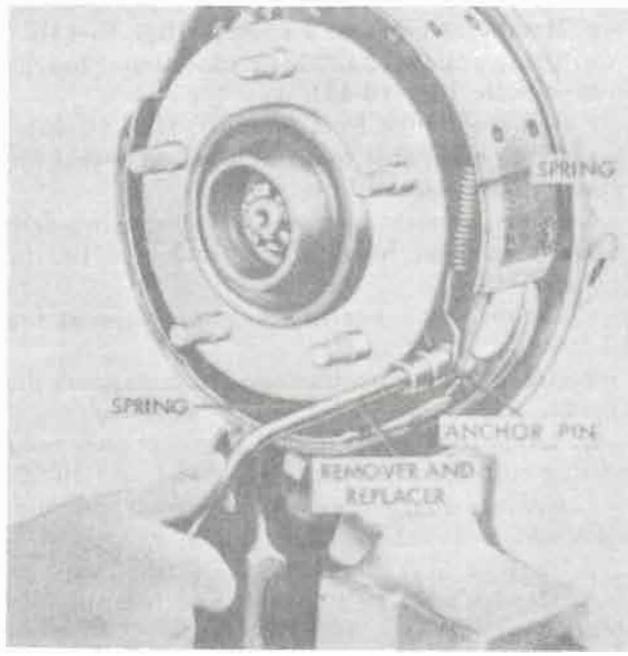


Figure 10-37. Brakeshoe retracting springs and anchor pin.

j. Install slotted-head screwdriver inside each brakeshoe holddown spring. Push screwdriver and turn to disconnect spring from spring retainer (fig. 10-38).

NOTE

Use care not to distort the spring.

k. Open brakeshoe assembly and remove brakeshoes from backing plate (fig. 10-39).

l. Remove two bolts and lockwashers from brake backing plate securing brake wheel cylinder to plate (fig. 10-40).

m. Remove brake cylinder from backing plate (fig. 10-41).

NOTE

Brakeshoes and brake cylinders may be removed before or after spindle is removed.

n. Hold wheel drive flange from turning by placing bar or common tool through support eyes as shown in figure 10-42.

o. Remove cotter pin and nut retaining spindle to flange (fig. 10-43).

p. Remove washer and spindle (fig. 10-44).

q. Using puller (7345234) remove outer bearing from spindle (fig. 10-45).

r. Remove flange from support. (fig. 10-46).

s. Using a suitable tool, remove outer seal and retainer from support (fig. 10-47).

t. Using wooden block—and due care—drive outward on inner bearing cone to loosen bearing seal (fig. 10-48).

u. Remove inner bearing seal from support (fig. 10-49).

v. Remove inner bearing cone from support (fig. 10-50).

w. Using soft steel remove outer and inner bearing cups from support (fig. 10-51 and 10-52).

x. Remove four brake backing plate retaining bolts and lockwashers (fig. 10-53).

y. Remove brake backing plate from support.

z. Remove steering stop bolt and locknut from spindle support (fig. 10-54).

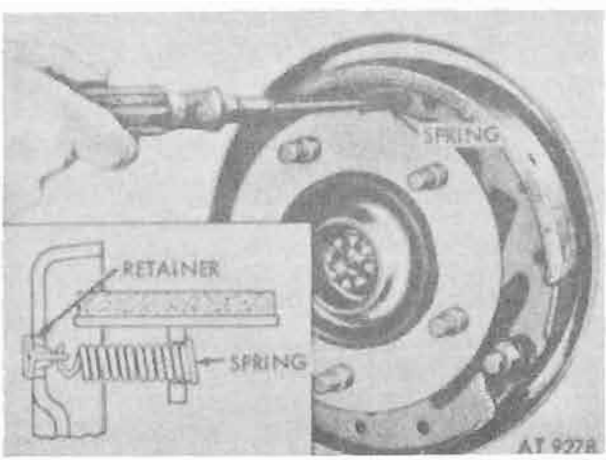


Figure 10-38. Brakeshoe holddown spring.

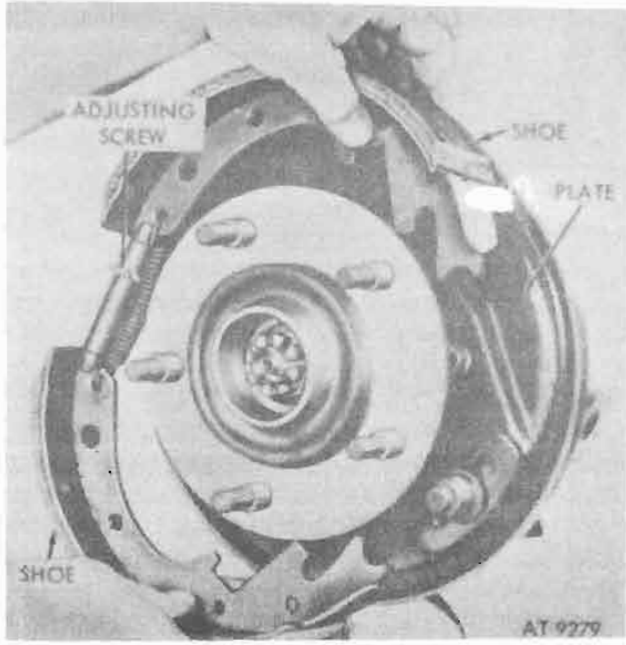


Figure 10-39. Brakeshoe and adjusting screw and spring assembly.

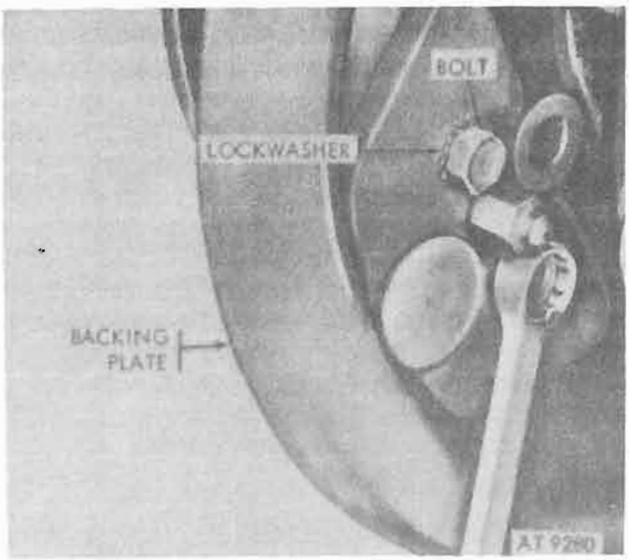


Figure 10-40. Brake wheel cylinder retaining bolts and lockwashers.

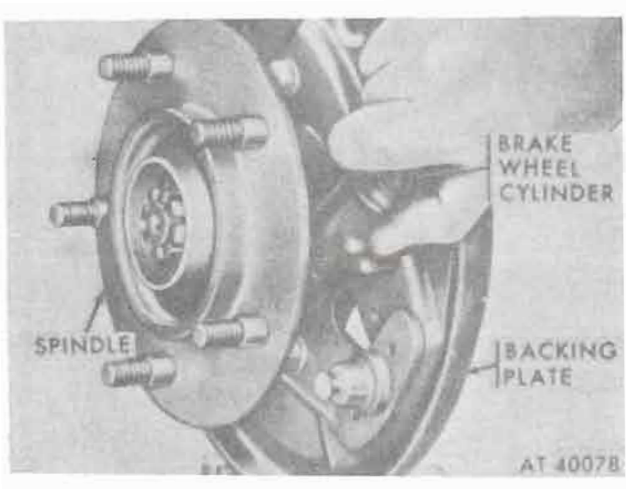


Figure 10-41. Brake wheel cylinder and backing plate.

Figure 10-42. Securing drive flange from turning.

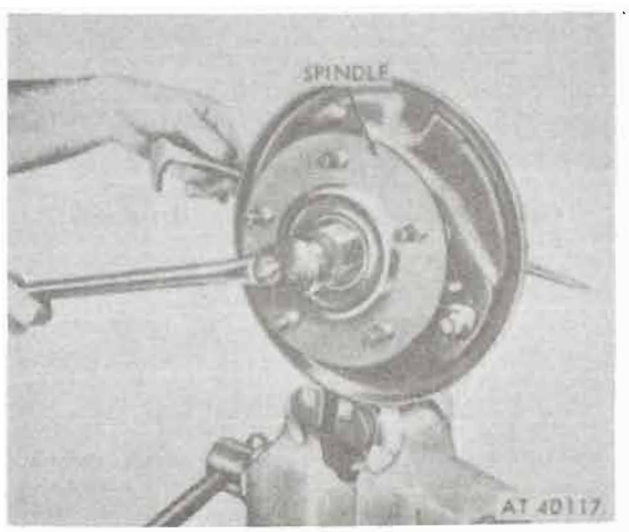


Figure 10-43. Spindle and retaining nut.

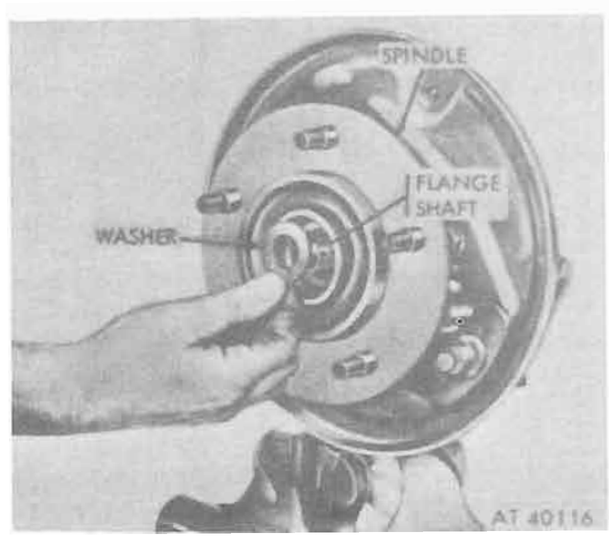


Figure 10-44. Spindle, flange shaft and washer.

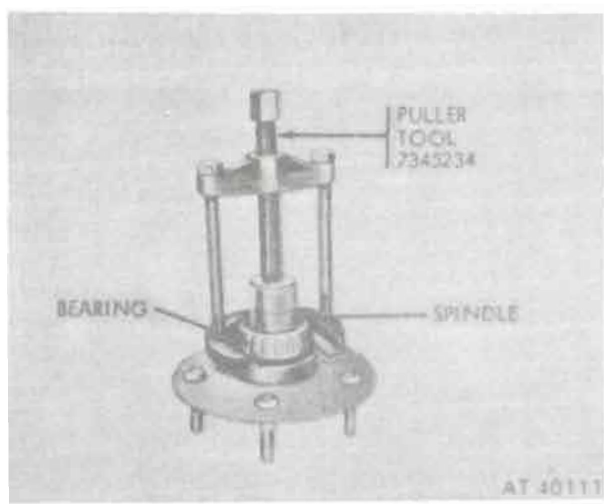


Figure 10-45. Using puller 7345234 to remove bearing from spindle.

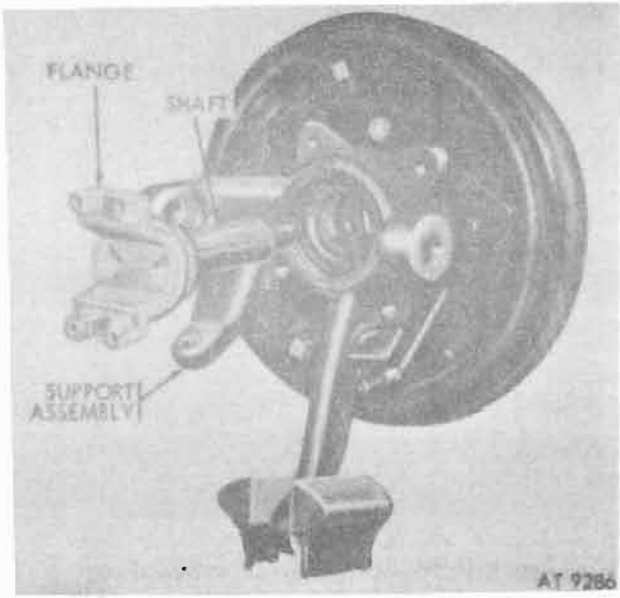


Figure 10-46. Front wheel flange and support assembly.

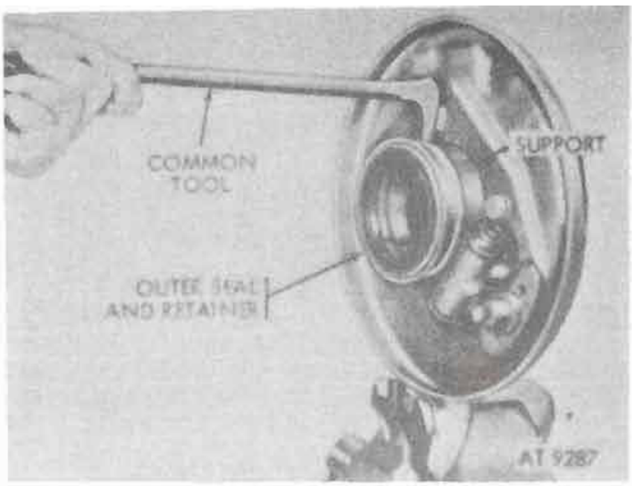


Figure 10-47. Removing outer seal and retainer from support.

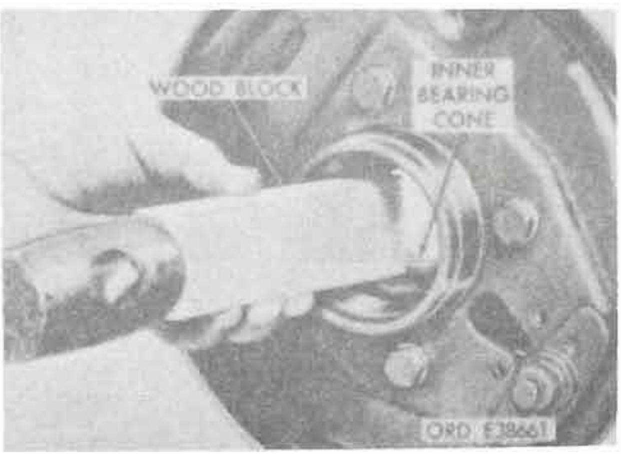


Figure 10-48. Driving inner bearing cone to loosen bearing seal.

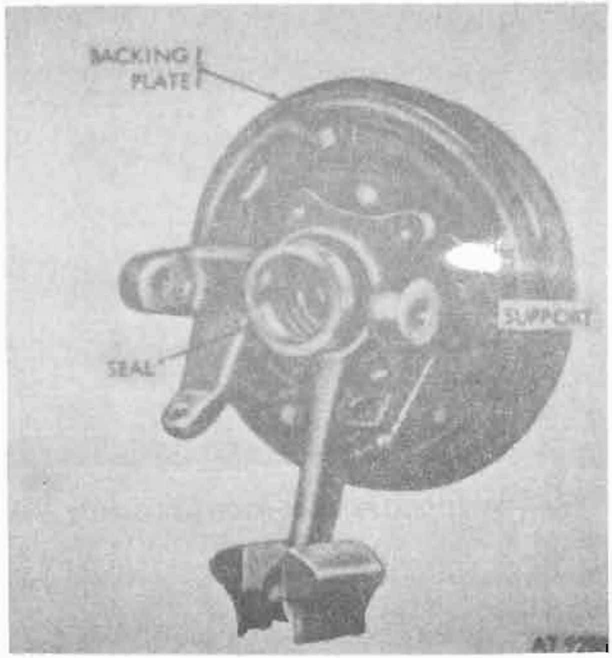


Figure 10-49. Support and inner bearing seal.

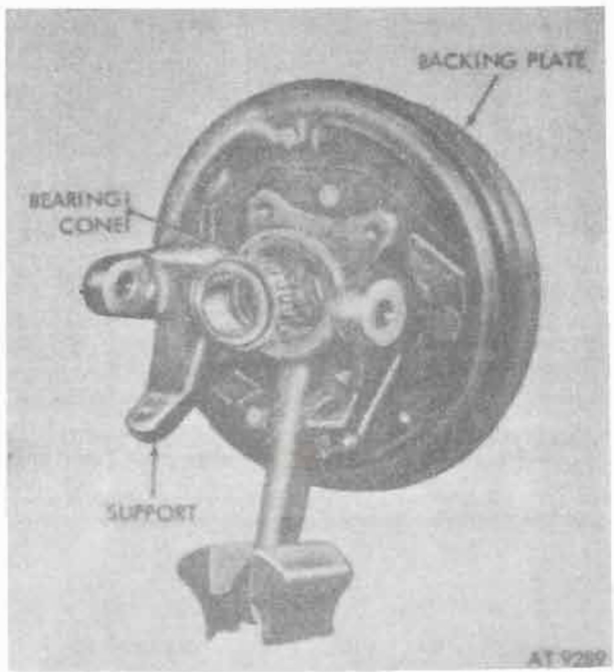


Figure 10-50. Support and inner bearing cone.

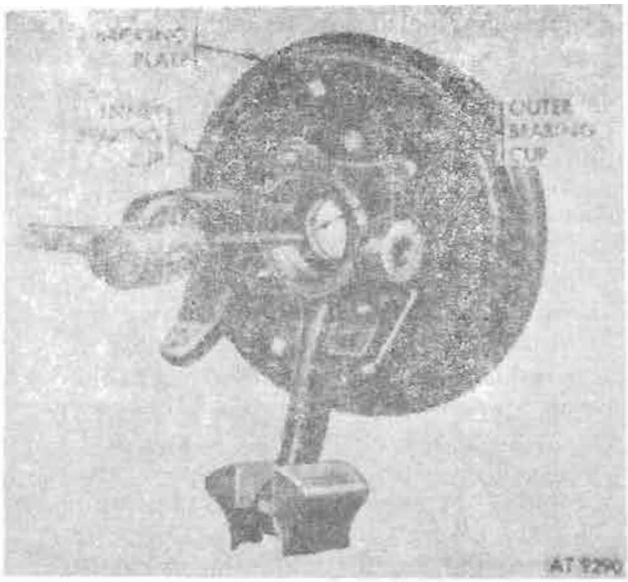


Figure 10-51. Using soft steel to loosen outer bearing cup.

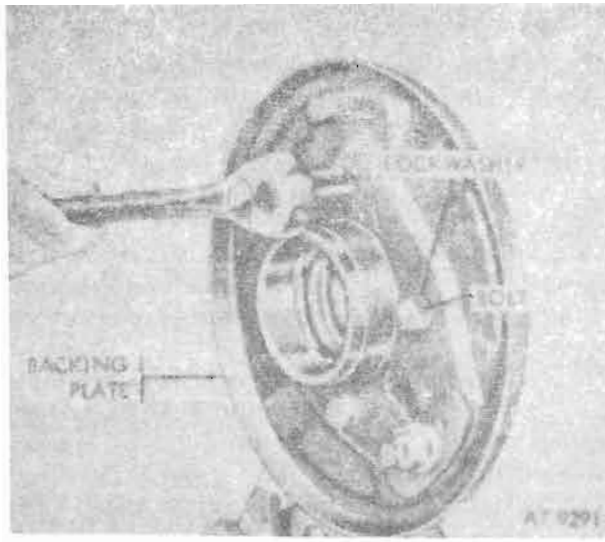


Figure 10-53. Brake backing plate retaining bolts and lockwashers.

Figure 10-52. Outer bearing cup.

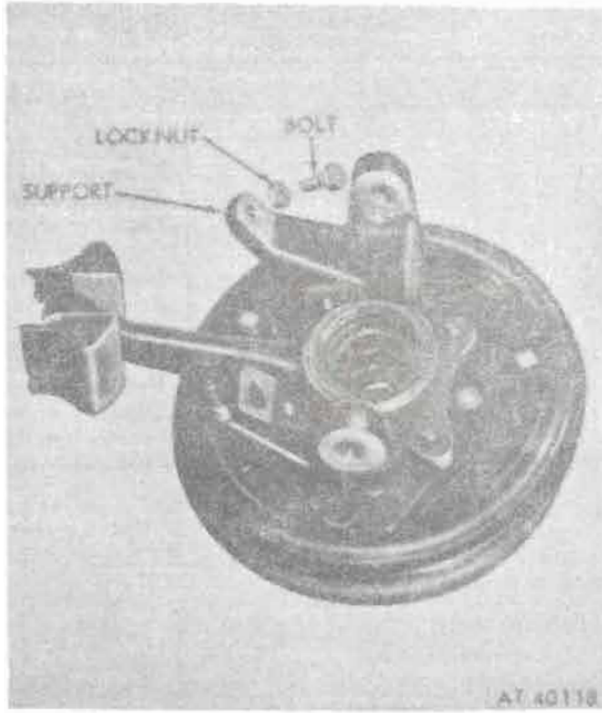


Figure 10-54. Steering stop bolt and locknut.

Section IV. INSPECTION AND REPAIR OF FRONT SUSPENSION COMPONENTS

10-14. General

The front suspension assembly contains many stamped and forged parts which require supplementary inspections and repairs beyond those covered in paragraph 10-5. In general, stamped and welded parts may be straightened and welded as necessary, provided the strength of the part is maintained. Forged parts should not be straightened. Additional specific instructions are covered in paragraph 10-15 below.

10-15. Inspection and Repair

Refer to table 10-1 and figure 10-55. Proceed with inspection and repair as outlined below.

NOTE

The key numbers in parentheses refer to Figure 10-55.

a. Inspect crossmember (40) for cracks or loose parts. Weld as necessary in accordance with instructions in TM 9-237. Straighten if bent, provided proper alinement of front suspension can be obtained.

b. Replace upper suspension arm assembly if arm (2) is bent or cracked, or if shaft is bent. Replace assembly if rubber bushings of arm are worn out or collapsed.

c. Replace lower arm assembly (31) under conditions in *b* above.

d. Inspect spring (13) for height. Replace weak, broken, or shortened spring.

e. Replace shock absorber (36) if inoperative or leaking.

f. Replace any bushing (12) when shock absorber is replaced, or if collapsed, excessively weathered or worn.

g. Replace lower ball joint if worn, sloppy, or broken.

NOTE

This ball joint (25) carries the weight of the vehicle which keeps the ball firmly seated and the joint constantly loaded during the operation. When the vehicle is raised in such a manner as to relieve the ball joint of the vehicle weight, the ball joint will be noticeably loose. This looseness will probably be due to normal operating clearance. Check the ball joint for wear. Refer to TM 9-2320-218-20 for inspection and measurement requirement.

Table 10-1. Wear Limits—Front Suspension Components

Reference		Point of measurement	Size of new part	Wear limit
Fig. No.	Key			
10-55	14a	Diameter of bearing bore	2.8895-2.8905	*
10-55	14b	Diameter of outer seal seat	3.2585-3.2630	*
10-55	14	Diameter of inner seal seat	2.9930-2.9975	*
10-55	15a	Outside diameter of bearing cup.	2.8910-2.8920	*
10-55	16a	Inside diameter of bearing cone.	1.6250-1.6255	*
10-55	24a	Bearing set, inside	1.624-1.625	*
10-55	24b	Bearing seat, outside	1.655-1.6265	*
10-55	24c	Outside diameter of seal seat.	2.7475-2.7525	*
10-55	39a	Bearing seat	1.3190-1.3195	*
10-55	39b	Diameter of seal seat	2.2475-2.2525	*
10-55	13	Spring, free length	11.0	*

* Refer to paragraph 10-6a (2).

Legend to figure 10-55:

1 Bolt (½ inch)
2 Arm assembly, upper
3 ⅜-24x2 cap screw
4 Upper ball joint socket
5 Pin, cotter
6 9/16-inch slotted nut
7 ⅜-inch nut, lock
8 Nut
9 ½-inch lockwasher
10 ⅜-inch hexagon nut
11 Retainer
12 Bushing
13 Spring
14 Support, LH
14 Support, RH
15 Roller bearing cup
16 Roller bearing
17 Seal retainer
18 Seal
19 3/32X3 cotter pin
20 Spindle washer
21 Spindle nut
22 Lifting eye
23 Nut, lifting eye
24 Wheel spindle (M151A2, M825 and M718A1).
24 Wheel spindle (M151, M151A1, M151A1C and M718).
25 Lower ball joint (socket)
26 Hexagon nut
27 ⅜X7/8 bolt
28 Shock absorber bracket
29 7/16-20x4 cap screw
30 Spacer
31 Arm assembly, lower
32 7/16-inch flat washer
33 7/16-inch self locking nut
34 ½-20x4 cap screw
35 Shim
36 Shock absorber
37 Retainer
38 Seal
39 Wheel drive flange
40 Front crossmember

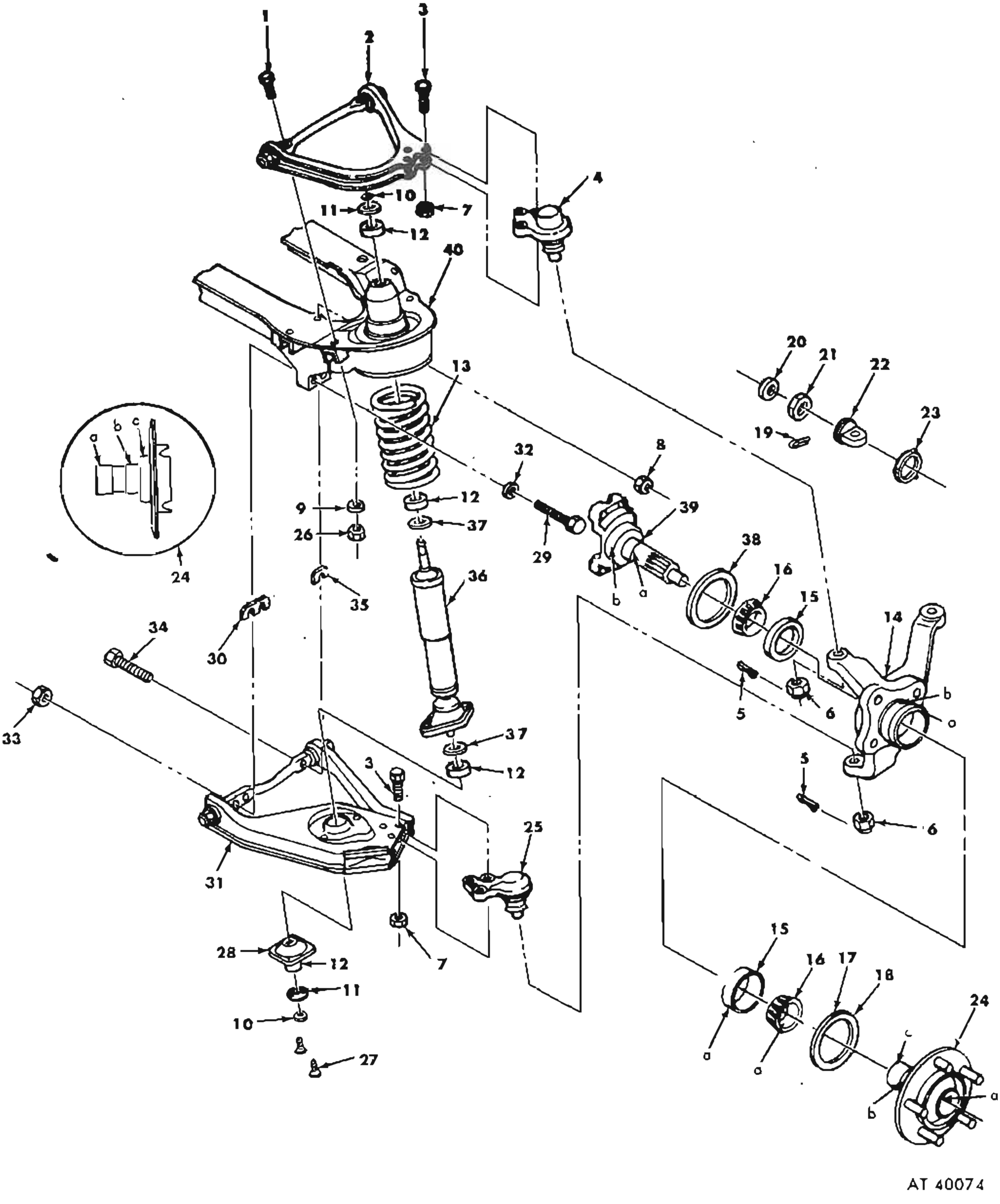


Figure 10-55. Front suspension and drive—points of measurement.

10-16. Installation of Bearing Cups, Seals, and Brake Backing Plate to Spindle Support

a. Position inner bearing cup in spindle support (fig. 10-56).

b. Seat bearing cup in support using improvised driver (fig. 10-57).

c. Install steering stop bolt and nut assembly in support. Refer to figure 10-54.

d. Install backing plate to spindle support, using four bolts and lockwashers. Refer to figure 10-53. Torque bolts to 55-65 lb.-ft.

e. Hand-pack inner bearing cone with grease (GAA) and position bearing cone in bearing cup. Refer to figure 10-50 for installation of bearing cone and to *h* below for lubrication.

f. Coat outside seating area of bearing oil seal with compound sealer FSN 8030-656-1426 and inner lips with grease (GAA). Position spring side of seal to face bearing cone. Install inner bearing seal in support, using improvised driver. Refer to figures 10-49 and 10-57.

NOTE

Spring side of seal must face toward the wheel bearing when installing optional seal assembly without flange. When flange type seal assembly and retainer are properly seated, a gap of approximately 0.063 inch should exist between them.

g. Position outer bearing cup to support and seat in bore as shown in figure 10-58.

h. Coat entire inside of support bearing bore with a one-sixteenth layer of grease (GAA) to prevent rust (fig. 10-59). Pack bearing cones and rollers full of grease by hand.

NOTE

The above procedure must be strictly followed in lubricating wheel bearing with grease (GAA).

i. Position outer bearing seal assembly to support. Coat seating surface of seal with compound sealer FSN 8030-656-1426 and lips of seal with grease (GAA) (fig. 10-60).

NOTE

Spring side of seal must face towards wheel bearing. When flange type seal assembly and retainer are properly seated, a gap of approximately 0.075 inch (max.) should exist between the seal assembly and retainer as shown in view A, figure 10-61. Seals seated at the flange level can result in early seal and bearing failure.

Using a soft wood block and replacer (7950152), seat seal on support as shown in figure 10-61, view A.

10-17. Installation and Adjustment of Wheel Flange, Spindle, and Bearings

a. Position flange in support. Refer to figure 10-46.

b. Lubricate spindle bearing cone in accordance with instructions given in paragraph 10-16 *h*. Position and press bearing on spindle with improvised tool (fig. 10-62).

c. Position spindle assembly on support and flange (fig. 10-63).

d. Position washer and nut on flange shaft. Refer to figure 10-44.

e. Install support in vise and install common tool or bar to prevent flange from turning. Refer to figure (10-42.

f. Adjust wheel bearings as follows:

(1) Remove wheel and tire.

(2) Remove cotter pin from wheel drive flange nut. Tighten nut to 30 lb.-ft. torque.

(3) Rotate wheel spindle three complete rotations.

(4) Recheck torque. If not 30 lb.-ft., tighten and repeat step 3.

(5) Repeat steps 3 and 4 until torque can be maintained after rotating spindle, then rotate spindle three complete rotations.

(6) Back nut off one complete rotation to relax all preload without rotating spindle. Then tighten nut with fingers.

(7) Insert cotter pin and secure. The spindle has two through-holes for the cotter pin. If the slots in the nut do not aline with either one of the holes, loosen the nut the least amount required to aline a slot with a hole and insert and secure the cotter pin.

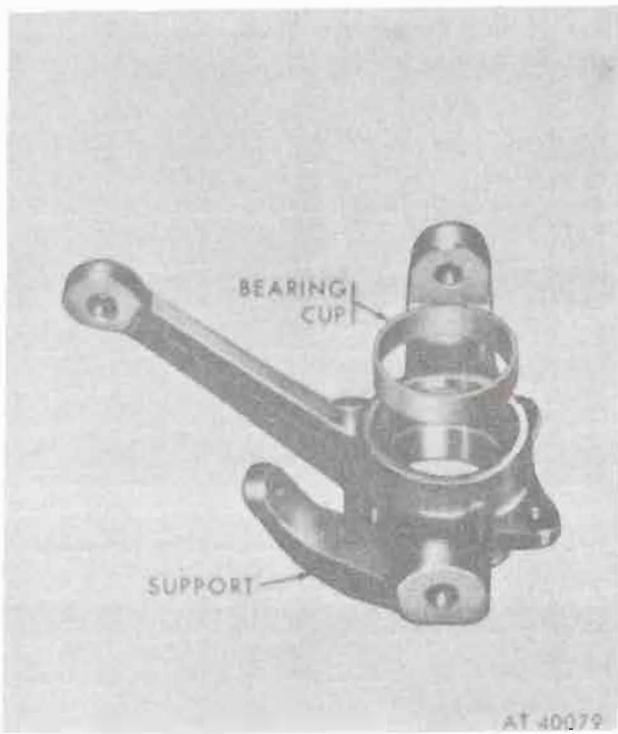


Figure 10-56. Spindle support, inner bearing cup.

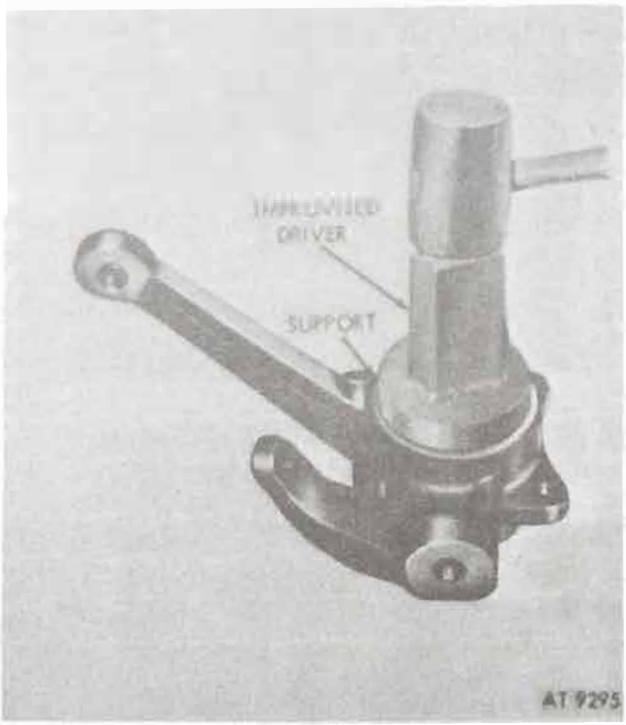


Figure 10-57. Seating inner bearing cup in spindle suppo

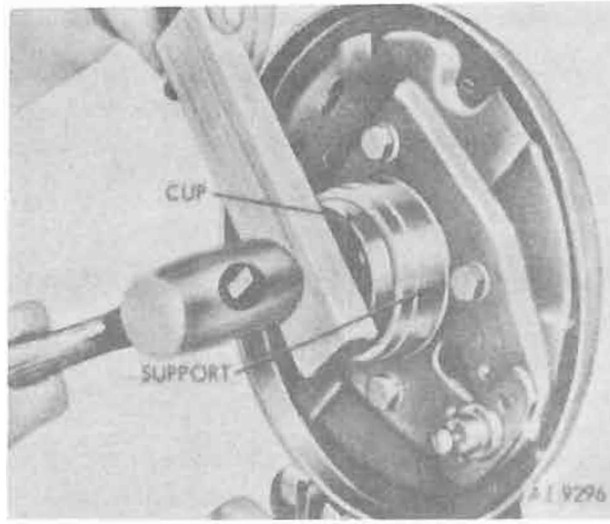


Figure 10-58. Seating spindle support outer bearing cup.

Figure 10-59. Coating bearing cups in with grease (GAA).

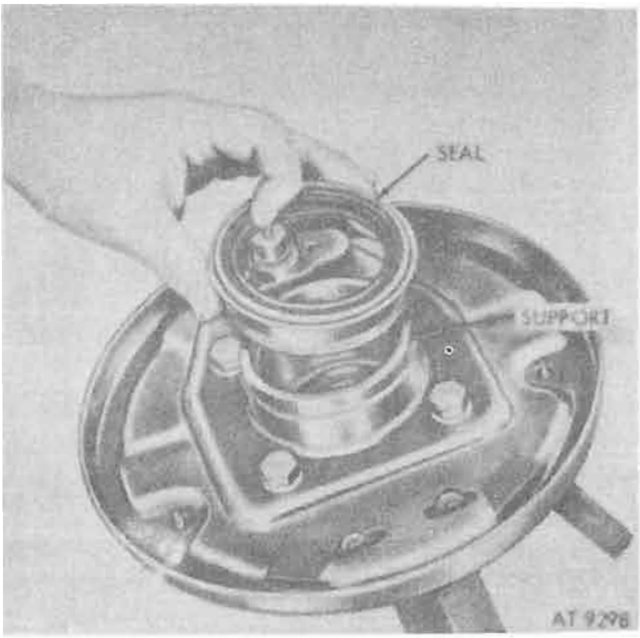


Figure 10-60. Positioning outer bearing seal on spindle support.

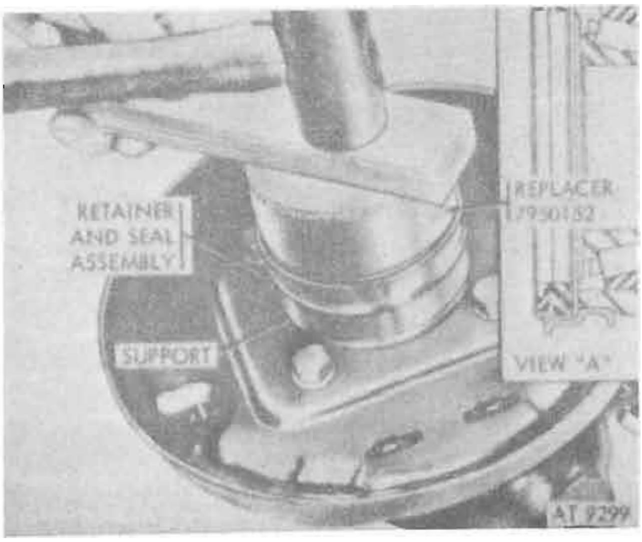


Figure 10-61. Installing spindle support outer bearing seal.

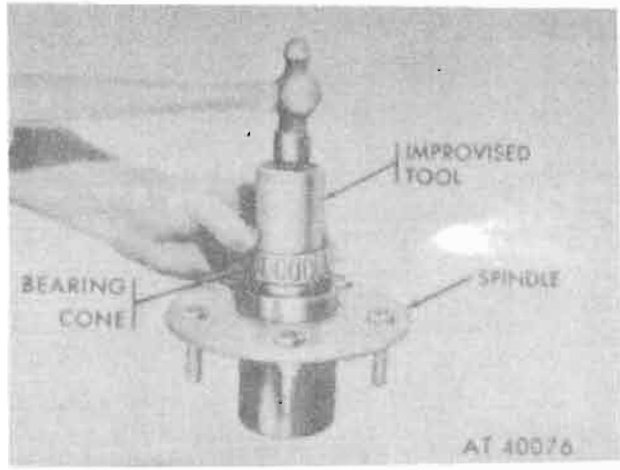


Figure 10-62. Installing inner bearing on spindle.

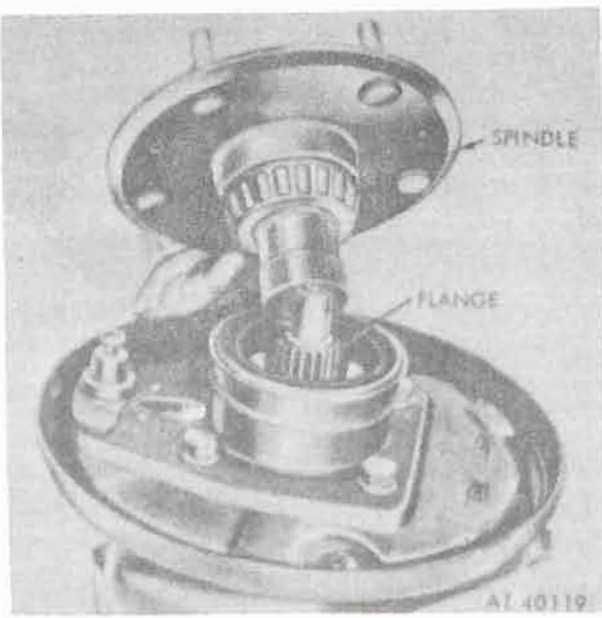


Figure 10-63. Positioning spindle assembly on support and flange.

10-18. Installation of Ball Joints and Brake Components to Spindle Support

a. Position brake wheel cylinder to backing plate. Refer to figure 10-41.

NOTE

If one front wheel cylinder is replaced on an older vehicle both front wheel cylinders should be changed to the later model (1 inch) wheel cylinders.

b. Install two brake cylinder retaining bolts and lockwashers. Refer to figure 10-41. Torque bolts to 8-10 lb.-ft.

c. Position the two brakeshoes and adjusting screw assembly to brake backing plate. Refer to figure 10-39.

d. Install the two brakeshoe holddown springs to spring retainers. Refer to figure 10-38.

e. Position the two brake retracting springs to brakeshoes. Refer to figure 10-37.

f. Secure retracting springs to brake anchor pin in the same order they were removed. Refer to figure 10-37.

g. Position brakedrum on spindle. Refer to figure 10-36.

h. Install upper ball joint and lower ball joint to spindle support. Refer to figure 10-34.

i. Install ball joint retaining nuts and cotter pins. Torque nuts to 50-60 lb.-ft. Refer to figure 10-32.

10-19. Installation of Suspension Arms and Spring

a. Install upper control arm to crossmember, using two bolts, lockwashers, and nuts. Refer to figure 10-29. Torque nuts to 75-85 lb.-ft.

b. Position lower control arm and alinement shims (as removed) to crossmember. Install three bolts, flat washers, and lock nuts. Refer to paragraph 10-12*d* and figures 10-28, 10-27, and 10-26. Torque the two 7/16-inch nuts to 40-55 lb.-ft. and the single 1/2-inch nut to 45-65 lb.-ft.

c. Place coil spring insulator in crossmember (older models only). Refer to figure 10-25.

d. Position coil spring to front crossmember. Refer to figure 10-24.

NOTE

End of spring coil must fit in shaped recess in lower arm. This procedure applies to both the right and left suspension arms and springs as applicable.

10-20. Installation of Support and Brake Assembly

a. Install upper ball joint to upper control arm with three bolts and nuts. Refer to figure 10-22.

b. Force lower arm downward and slide lower ball joint bracket into control arm and install three retaining bolts and nuts. Refer to figure 10-21.

c. Tighten and torque the six retaining bolt nuts to 35-40 lb.-ft. Refer to figures 10-22 and 10-21.

10-21. Installation of Shock Absorbers

a. Place retainer and bushing on shock absorber. Refer to figure 10-20.

b. Position shock absorber in crossmember and lower control arm. Refer to figure 10-19.

NOTE

Cup-end of shock absorber must face downward when suspension is installed under vehicle.

c. Position inner lower retainer and bushing on shock absorber lower shaft. Refer to figure 10-16.

d. Position shock absorber lower bracket to lower control arm. Refer to figure 10-15.

e. Secure lower bracket to lower control arm using two screws and lockwashers. Refer to paragraph 10-10*d* and figure 10-14.

f. Position lower outer shock absorber bushing and retainer to shock absorber stem. Refer to figure 10-14.

g. Install nut to shock absorber lower stem. Torque nut to 15-20 lb.-ft. Refer to figure 10-13.

h. Install upper outer bushing and retainer on upper shock absorber stem. Refer to figure 10-18.

i. Install nut to shock absorber upper stem. Torque nut to 15-20 lb.-ft. Refer to figure 10-17.

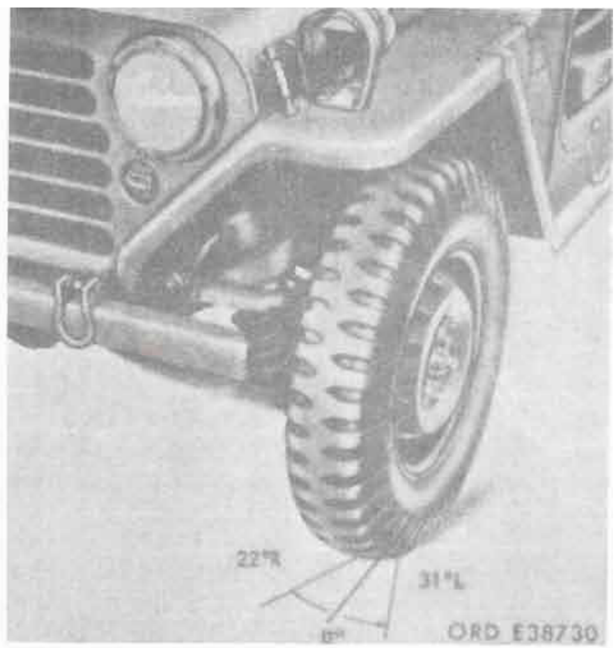


Figure 10-64. Front wheel swing arc.

10-22. Installation of Brake Tubes and Hoses

a. Position brake tube to wheel cylinder and tighten nut. Refer to figure 10-10.

b. Place brake hose in brake spindle support bracket and connect brake hose to brake tube. Refer to figure 10-9.

c. Install brake hose clip to lock brake hose in position. Refer to figure 10-8.

d. Install brake tubes and "tee" assembly to crossmember and fasten to brake hoses. Refer to figure 10-11.

10-23. Installation of Wheel Drive Shafts

a. Position wheel drive shaft assembly to spindle flange. Refer to figure 10-12.

b. Secure wheel drive shaft to flange with U Bolts, four lockwashers and nuts. Refer to figure 10-12.

10-24. Installation of Differential and Steering Linkage

a. Position differential assembly to crossmember.

b. Install differential with one long bolt (in front), two short bolts (in rear), three nuts, and six washers. Refer to figure 10-7. Torque nuts to 30-40 lb.-ft.

c. Install wheel drive shaft universal-to-differential drive flange with two U Bolts and four lockwashers and nuts. Refer to figure 10-5. Torque nuts to 10-15 lb.-ft.

d. Install steering connecting rod ends to spindle arms. Secure ball sockets of rod ends to spindle arms with nuts and cotter keys. Refer to figure 10-3. Torque nuts to 35-45 lb.-ft.

10-25. Adjustment of Front Suspension Geometry and Alinement

a. *Preliminary Operations*. Perform the following preliminary operations:

(1) *Level surface*. The alinement check and adjustment can be accomplished on a reasonably level surface without removal of a fixed payload, such as radio sets and the other auxiliary equipment normally carried on the truck, provided it is not in excess of 250 pounds.

NOTE

Prior to alinement operations, the 106 mm rifle (M40A1) and the ammunition load must be removed.

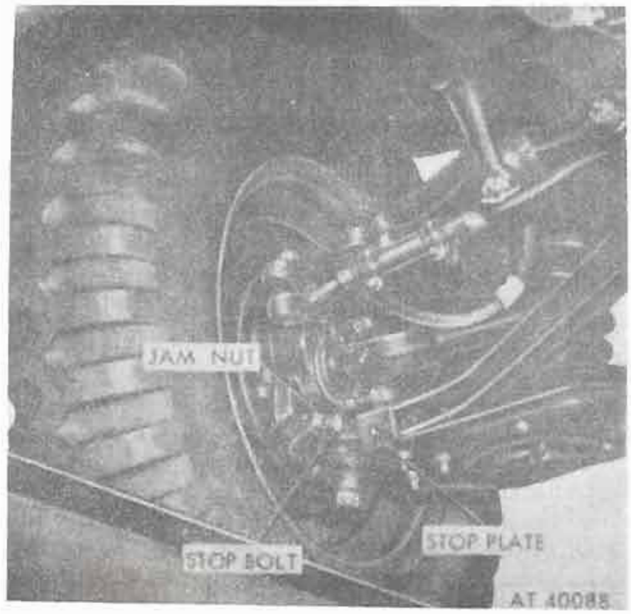


Figure 10-65. Front wheel swing arc adjustment.

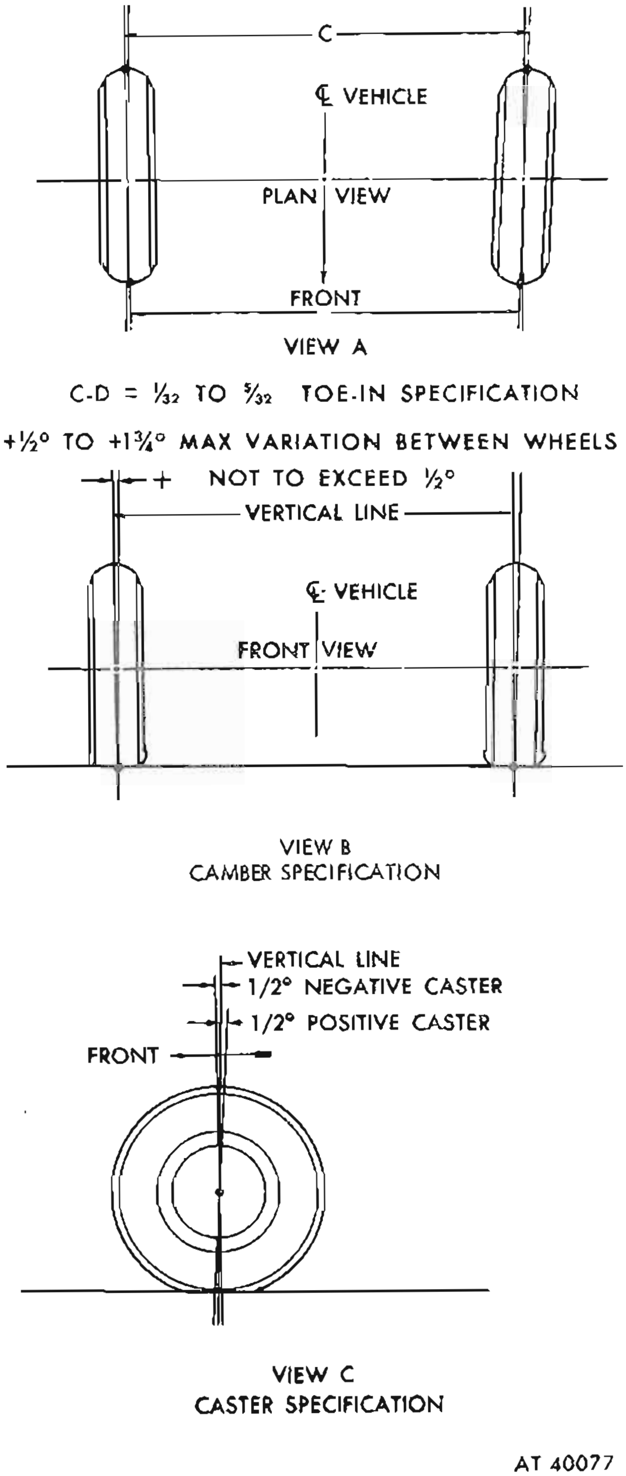


Figure 10-66. Steering geometry specifications.

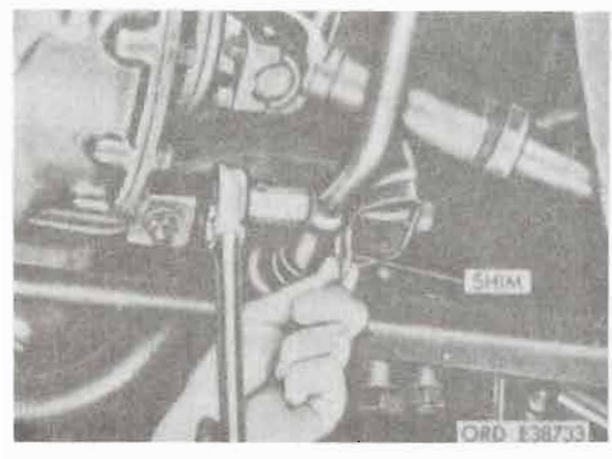


Figure 10-67. Installing rear shims.

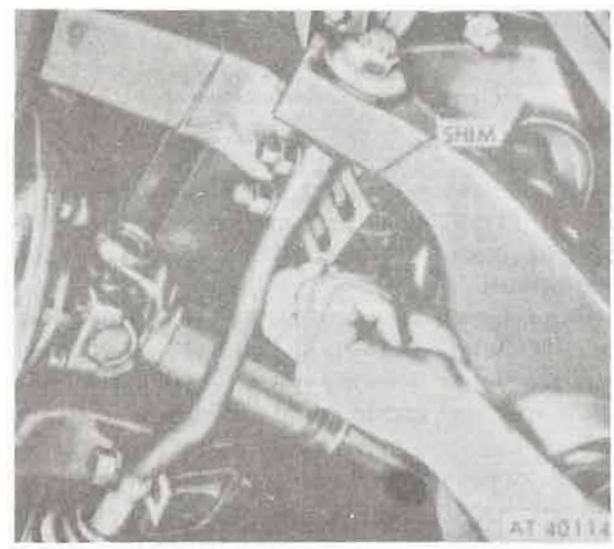


Figure 10-68. Installing front shims.

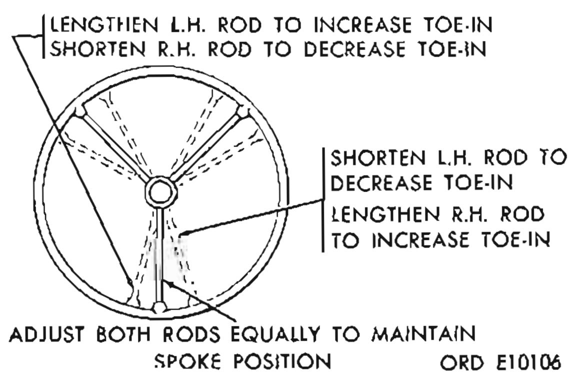


Figure 10-69. Toe-in adjustment and steering wheel spoke alinement diagram.

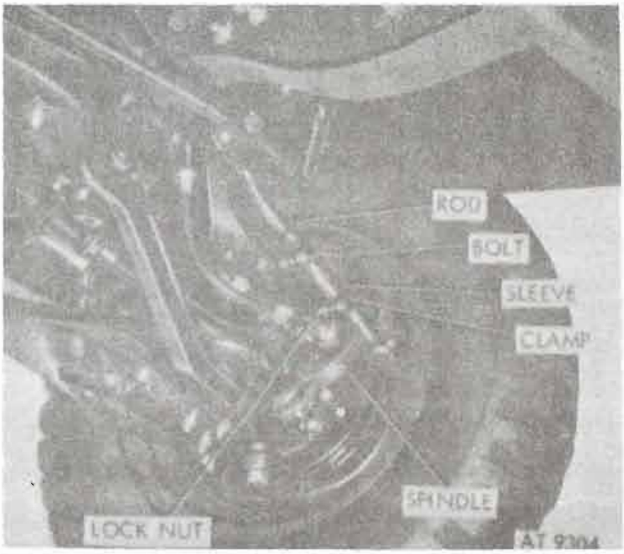


Figure 10-70. Toe-in adjustment and steering wheel spoke adjustment procedures.

(2) *Check tire pressure.* Check air pressure in all tires. Make sure pressure agrees with the specified pressure. Both front tires must be at the same pressure.

(3) *Check front wheel swing arc.* Swing front wheels through arc shown in figure 10-64. Loosen jamnut and adjust steering stop bolt (figure 10-65) to allow specified turning angle as shown in figure 10-64.

(4) *Straight-ahead position.* Drive vehicle in a straight line far enough to establish straight-ahead position of the steering wheel, bottom spoke should be vertical. Stop vehicle and place corresponding chalk marks on steering wheel hub and on steering column. To place the front wheels in a straight-ahead position at any time during the checking procedures, aline mark on steering wheel hub with mark on steering column.

(5) *Check wheel bearings.* Raise front wheels off floor. Grasp each front tire at the front and rear, then push the wheel inward and outward. If any excessive free play is noticed, adjust wheel bearings (para 10-7 *e*). Replace bearings if they are worn or damaged.

(6) *Check ball joints and mountings.* Check ball joints for wear. Refer to TM 9-2320-218-20.

(7) *Check steering linkage.* With front wheels off floor, grasp front of both front wheels, push them away from each other, then pull them toward each other. Watch spindle connecting rod (tie rod) ends for looseness. Replace worn parts.

(8) *Check mounting bolts.* Check steering gear mounting bolts and tighten as required. Check idler bracket mounting bolts and tighten as required.

(9) *Check caster.* Position vehicle in wheel alinement stall with front wheels in center of level spots on floor. Install gage (4910-221-2472) on front wheels, and check the caster angle. The correct caster angle (fig. 10-66) should be positive 1 / 2° to negative 1 / 2°.

(10) *Check camber.* Adjust the gage on wheels, and check camber angle. Correct camber angle should be positive ½° to 1¾°. The maximum difference between wheels should not exceed ½° (fig. 10-66).

(11) *Check toe-in.* Place a suitable toe-in gage at front wheels. Push the vehicle backwards approximately six feet, then pull vehicle forward about three feet. Scale pointer will register toe-in. Toe-in should be between 1 / 32 inch and 5 / 32 inch (fig. 10-66).

(12) *Check king pin inclination.* Check for damaged suspension parts. Angle of king pin inclination is a "built-in" factor and will be correct unless the related parts are bent.

b. Adjustment Procedures. Refer to figures 10-67 through 10-69.

(1) *General.* The corrective procedures for caster, camber, and toe-in are given below. Correction of alinement factors by bending any of the suspension members is not authorized.

(2) *Caster adjustments.* The caster adjustments are made between the lower suspension arm inner shaft and the front crossmember. Loosen three bolts securing lower arm shaft to crossmember. Insert or remove shims between the shaft and the crossmember as shown in figures 10-67 and 10-68 to obtain desired caster angle. When the desired caster angle (fig. 10-66) has been obtained, tighten rear bolt to 55-65 lb-ft. torque. Tighten front (2) bolts to 50-55 lb.-ft. torque.

NOTE

Each 0.060 shim added at the rear bolt only will add a negative caster of approximately ¼°. Each 0.060 shim added at the front bolts only will add a positive caster of approximately ¼°.

NOTE

Each 0.060 shim added or removed at rear bolt changes negative caster by approximately ¼°. The maximum difference between shim stack thicknesses at the two bolt locations should not exceed ⅛ inch.

(3) *Camber adjustments.* The camber adjustments are also made between the lower arm shaft and the front crossmember. Loosen three bolts securing the lower shaft to the crossmember. Insert or remove the necessary shims to obtain the correct camber angle. When the desired camber angle has been obtained (fig. 10-66), tighten the front bolts to 50-55 lb.-ft. torque. Tighten rear bolt to 55-65 lb.-ft. torque.

NOTE

A 0.060 shim added or removed from each of the three bolts will change camber approximately ¼°.

NOTE

Both caster and camber adjustments can be made at the same time after wheel alinement checks have been completed.

(4) *Toe-in adjustment.* If toe-in is incorrect, note position of steering wheel spokes when front wheels are in the straight-ahead position. If lower spoke is not in vertical position, lengthen or shorten the spindle connecting rods equally to obtain correct toe-in. Refer to (5) below.

(5) *Steering wheel adjustment.* If the steering wheel lower spoke is rotated clockwise from the vertical position, make adjustments as shown at top of figure 10-69. If lower spoke is rotated counterclockwise, adjust toe-in as shown at side of figure 10-69. Refer to (6) below for adjustment procedures.

(6) *Adjustment procedures.* Loosen locknut on two clamps at both spindle arm tie rod adjusting sleeves. Lengthen or shorten both connecting rods equally; the right- and left-connecting rod sleeves must be turned an equal number of turns, but each in an opposite direction. Refer to figure 10-70.

CHAPTER 11

REAR SUSPENSION

Section I. DESCRIPTION AND DATA

11-1. Description

For description of rear suspension refer to TM 9-2320-218-20.

11-2. Data (M151, M151A1, M151A1C, M718)

a. Rear Suspension.

Make	US Army design
Type	Stamped and forged A frame assembly
Type of action	Single-pivot swing arm
Spring type	Coil
Shock absorber type	Hydraulic telescopic
Characteristics	Rebound hydraulic stop
Action	2-way direct
Shock absorber bore size	1.18 in.

b. Rear Drive. Same characteristics as front drive; refer to chapter 10 for data. Although some of the parts are not interchangeable, the characteristics are the same.

11-3. Data (M151A2, M825 and M718A1)

a. Rear Suspension.

Make	US Army design
Type	Stamped and welded design
Type of action	Trailing
Spring type	Coil
Shock absorber type	Hydraulic telescope
Characteristics	Rebound solid stop
Action	2-way direct
Shock absorber bore size	1.37 in.

b. Rear Drive. Same characteristics as front drive; refer to chapter 10 for data.

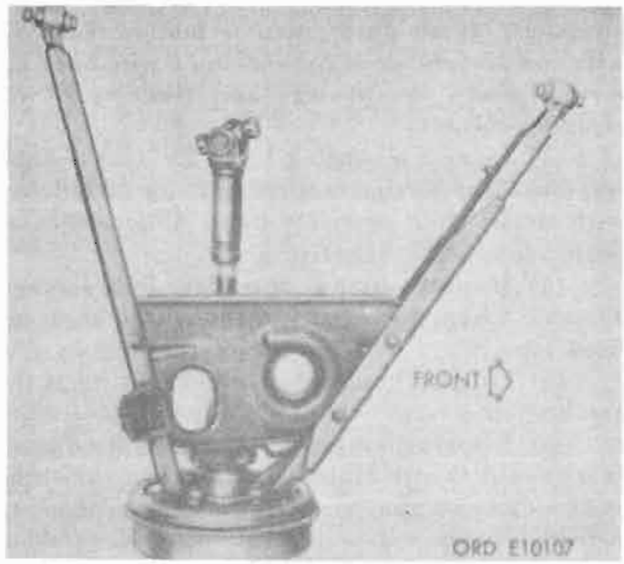


Figure 11-1. Rear Suspension Arm Assembly—Bottom View (M151, M151A1, M151A1C and M718 Vehicles).

Section II. INSTRUCTIONS FOR REAR SUSPENSION REPAIR

11-4. Scope

Procedures for removal of the suspension and drive units from the vehicle are in TM 9-2320-218-20. Complete disassembly procedures for the rear suspension and drive units are given in paragraphs 11-7 through 11-11, and inspection and repair standards are enumerated in paragraphs 11-12 and 11-13. Assembly of the units is described in paragraphs 11-14 through 11-18. Cleaning, inspection and repair recommendations (para 11-5 and 11-6) cover all general conditions. Torque recommendations are given in the figures describing the operations involved. Wear limits information is included in the inspection and repair section (tables 11-1 and 11-2), and paragraphs 11-7 and 11-13.

11-5. Cleaning Recommendations

a. General. Whenever an assembly is contaminated with dirt or other abrasive matter, unnecessary wear will result. Inspect all parts for possible abrasive material any time a unit is disassembled. Metallic contamination of lubricant is evidence of failure of some part in the assembly. If metal particles are found, the entire assembly containing the contaminated lubricant must be thoroughly cleaned.

b. Cleaning Parts.

(1) All metallic parts of the suspension and drive assemblies except bearings should be cleaned thoroughly with drycleaning solvent or mineral spirits paint thinner. Do not use caustic soda for steam cleaning.

(2) Parts should be dried with compressed air. Steam-cleaned parts should be oiled immediately after drying.

(3) After cleaning, examine parts to make certain they are entirely clean; clean them again if necessary.

c. Cleaning Bearings. Refer to TM 9-214 for care and maintenance of bearings.

11-6. Inspection and Repair Recommendations

a. Cast Parts and Machined Surfaces.

(1) Inspect bores for wear, grooves, scratches, and dirt. Remove scratches and burrs with crocus cloth. Remove foreign matter. Replace parts that are deeply grooved or scratched.

(2) Inspect all lubricant passages for obstructions. If an obstruction is found, remove it with compressed air or by working a wire back and forth through the passage and flushing it with cleaning solvent.

(3) Inspect mounting faces for nicks, burrs, scratches, and foreign matter. Remove such defects with crocus cloth or a soft stone. If scratches are deep, replace the defective parts.

(4) Inspect thread openings for damaged threads. Chase damaged threads with correct size used tap.

(5) Discard housings or other cast parts that are broken.

(6) Inspect all machined surfaces for damage that could cause lubricant leakage or other malfunction of the part. Rework or replace the defective parts.

b. Bearings.

(1) Inspect bearings for roughness of rotation. Replace a bearing if its rotation is still rough after cleaning and oiling.

(2) Inspect bearings for scored, pitted, scratched, cracked, or chipped races, and for indication of excessive wear of rollers. If one of these defects is found, replace the bearings.

(3) Inspect a defective bearing's housing bore and shaft for grooved, burred, or galled conditions that would indicate the bearing has been turning in its housing or on its shaft. If the damage cannot be repaired with crocus cloth, replace the defective parts. Refer to TM 9-214.

(4) If a bearing must be removed or installed without a pressing sleeve, be careful to press only on the race which is adjacent to the mounting surface. If an arbor press is not available, seat the bearing with a drift and a hammer, driving against the supported race.

c. Thrust Washers. Inspect thrust washers for distortion, scores, burrs, and wear. Replace thrust washers if defective or worn beyond wear limits.

d. Seals and Gaskets.

(1) Inspect seals for scoring, cuts and hardness. Replace defective seals.

(2) When replacing lip-type seals, place spring-loaded side toward oil to be sealed in (toward inside of unit). Use non-hardening compound sealer (FSN 8030-656-1426) on outside of seal to prevent leaks. Pack inside lips of seal with light grease (GAA), or specified lubricant.

(3) Replace all gaskets.

(4) Inspect surfaces of parts on which seals bear. If grooving exceeds wear limits, replace the part and seal.

e. Splined Parts. Inspect parts for stripped, twisted, chipped, or burred splines. Remove burrs with a soft stone. If other defects are found, replace the part. Wear on splines such as used on wheel drive shafts is not considered critical, since such splines are made with long contact surfaces designed to slide back and forth under all conditions. However, wear on short splines such as drive flanges must be minimum since a spline is used in this installation because it is stronger than a keyway. This strength is lost if fit is loose.

f. Threaded Parts. Inspect parts for damaged threads. Remove burrs with a soft stone or fine file. Replace damaged parts.

g. Snaprings. Snaprings should generally be replaced, since they are difficult to remove without distorting. If a snapring must be used again, remove any nicks or distortion before installing.

h. Springs. Inspect all springs for weak, broken, or distorted coils. Replace the spring if any of these defects are found.

11-7. Wear Limits and Torque Specifications

a. Wear Limits.

(1) Data covering the size of new parts, and wear limits information are included in the views in the appropriate repair section. These measurements list the minimum and maximum clearances for new or used parts.

(2) The wear limits indicate the dimensions to which a part may wear before it must be replaced. Normally, any part not worn beyond its wear limit may be approved for service, provided it is not damaged by corrosion or similar causes. An asterisk (*) in the wear limits column indicates that the part should be replaced when worn beyond the limits stated in the size and fit of new parts column.

b. Torque Specifications. Torque specifications are called out in the text or on the illustration relating to the individual part in the repair sections.

11-8. Removal of Rear Suspension

Refer to TM 9-2320-218-20 for removal of rear suspension from the vehicle.

11-9. Removal of Wheel Drive Shafts

a. Remove four nuts and lockwashers securing wheel drive shaft universal joint to rear wheel flange (fig. 11-5, 11-6).

b. Remove rear wheel drive shaft from flange.

11-10. Removal of Rear Brake Tubes and Brakedrum

a. Remove brake tube clamp and remove tube from support arm (figs. 11-7, 11-8).

b. Disconnect brake tube at cylinder and remove tube (fig. 11-9).

c. Remove brake cylinder bleeder valve (fig. 11-9).

d. Remove lifting eye and nut from spindle hub, using bar or wrench (fig. 11-10).

e. Remove brakedrum from spindle (fig. 11-11).

11-11. Disassembly of Rear Spindle, Flange and Brakes

a. Remove cotter pin and nut retaining spindle to flange shaft (fig. 11-12).

b. Remove washer from flange shaft (fig. 11-13).

c. Remove spindle assembly from flange (fig. 11-14).

d. Remove flange from support (fig. 11-15).

e. Disconnect brake retracting springs from anchor, using brake spring remover and replacer (fig. 11-16).

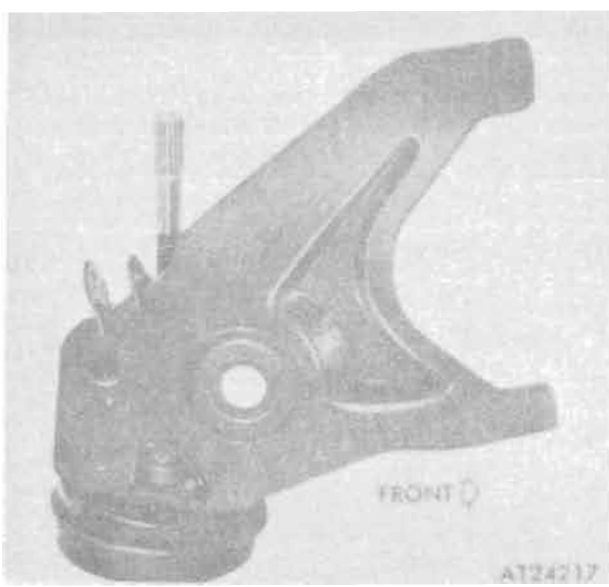


Figure 11-2. Rear Suspension Arm Assembly—Bottom View (M151A2, M825, and M718A1 Vehicles).

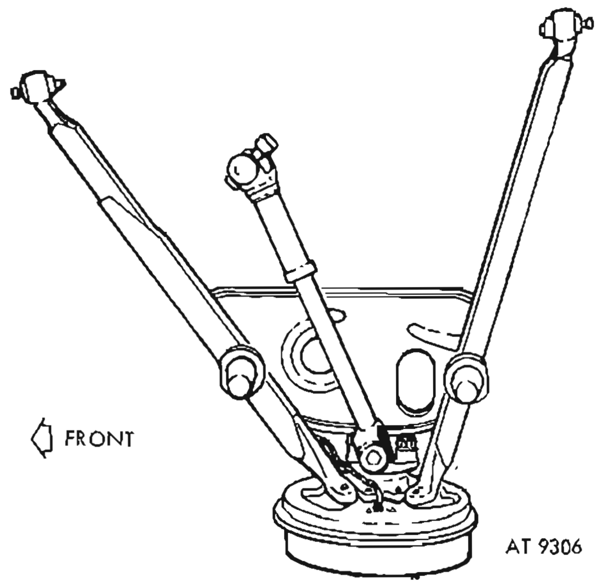


Figure 11-3. Rear Suspension Arm Assembly—Top View (M151, M151A1, M151A1C and M718 Vehicles).

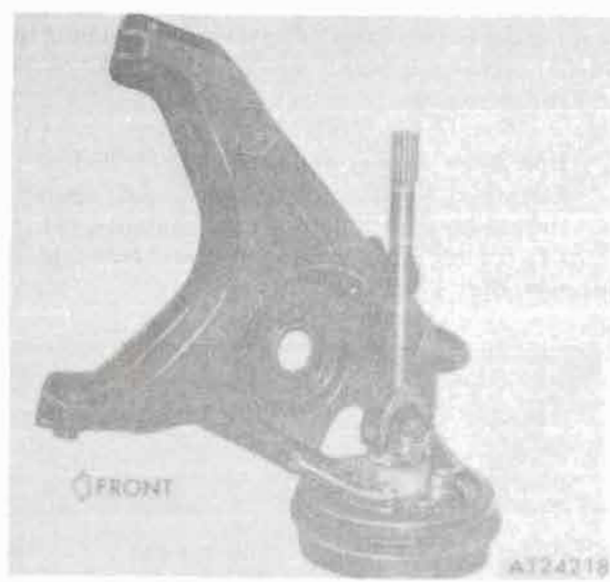


Figure 11-4. Rear Suspension Arm Assembly—Top View (M151A2, M825 and M718A1 Vehicles)

NOTE

Mark and retain springs with front and rear shoe assemblies.

f. Remove two brake retracting springs from brakeshoes (fig. 11-16).

g. Remove two brakeshoe holddown springs from spring retainer, using slotted screwdriver. Exercise care not to distort the spring (fig. 11-17).

h. Remove brakeshoes and adjusting screw and spring assembly from backing plate (fig. 11-18).

i. Remove two screws and washers securing wheel cylinder to backing plate. Remove wheel cylinder from backing plate (fig. 11-19).

NOTE

Cylinder may be removed before or after spindle removal.

11-12. Disassembly of Rear Brake Backing Plate, Support, Bearings, and Seals

a. Using common tool, remove outer seal and retainer from spindle support (fig. 11-20).

b. Remove six bolts and lockwashers securing brake backing plate to spindle support (fig. 11-21).

c. Remove backing plate from support (fig. 11-22 and 11-23).

d. Remove rear support from suspension arm (fig. 11-22 and 11-23).

e. Remove bumper assemblies from suspension arm assembly by turning bumper out of threaded pad on suspension arm (fig. 11-24) on M151, M151A1, M151A1C and M718 vehicles. On M151A2, M825 and M718A1 vehicles, remove bumper assembly from suspension arm assembly by turning the nut under the bumper (fig. 11-25).

f. Remove bushings from suspension arm (fig. 11-26 and 11-27).

g. Remove four bolts and nuts securing spring seat to suspension arms as necessary for repair (fig. 11-28). (Not applicable to M151A2, M825 and M718A1 vehicles.)

NOTE

Bolt holes in seat and arms are drilled at assembly (in fixture). Arms and seats should be kept together as a matched set.

h. Drive out inner bearing and seal from spindle support (fig. 11-29).

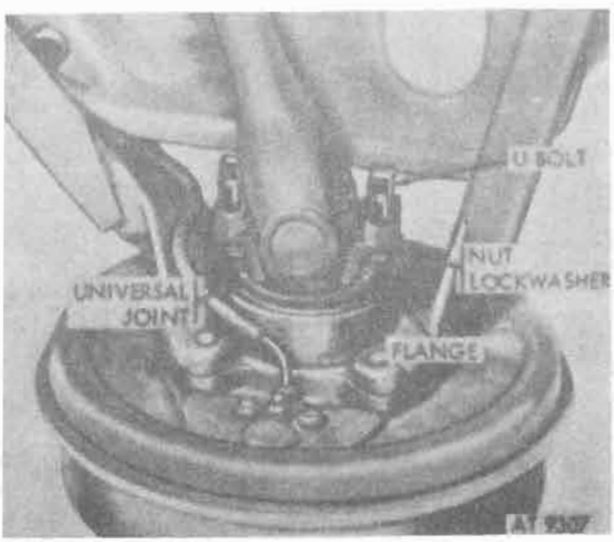


Figure 11-5. Rear wheel flange and drive shaft universal joint (M151, M151A1, M151A1C and M718 vehicles).

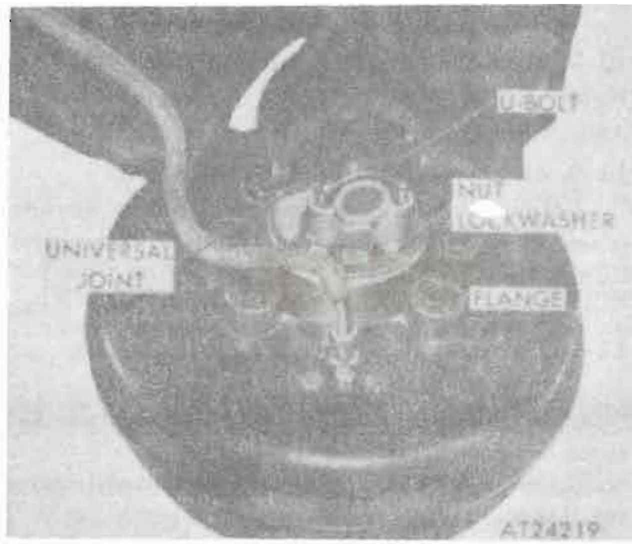


Figure 11-6. Rear wheel flange and drive shaft universal joint (M151A2, M825 and M718A1 vehicles).

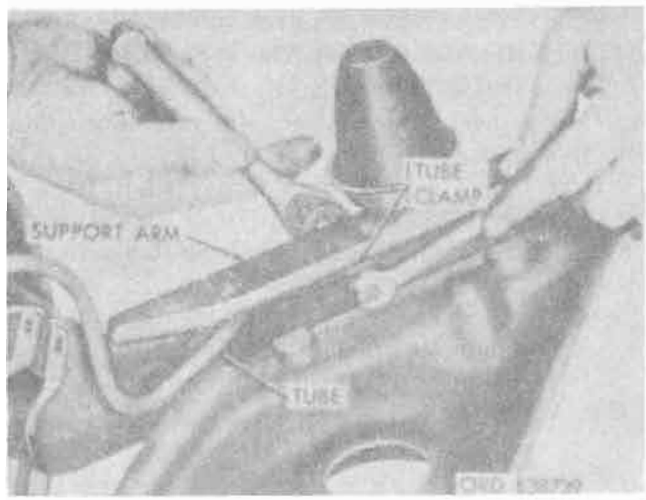


Figure 11-7. Rear brake tube and clamp (M151, M151A1, M151A1C and M718 vehicles).

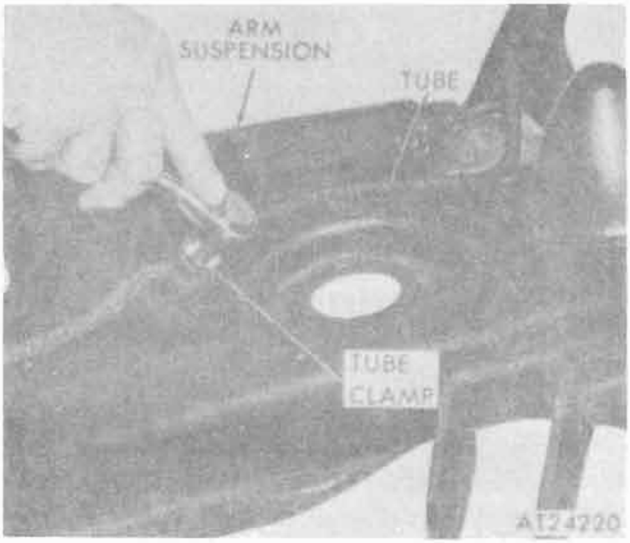


Figure 11-8. Rear brake tube and clamp (M151A2, M825 and M718A1 vehicles.)

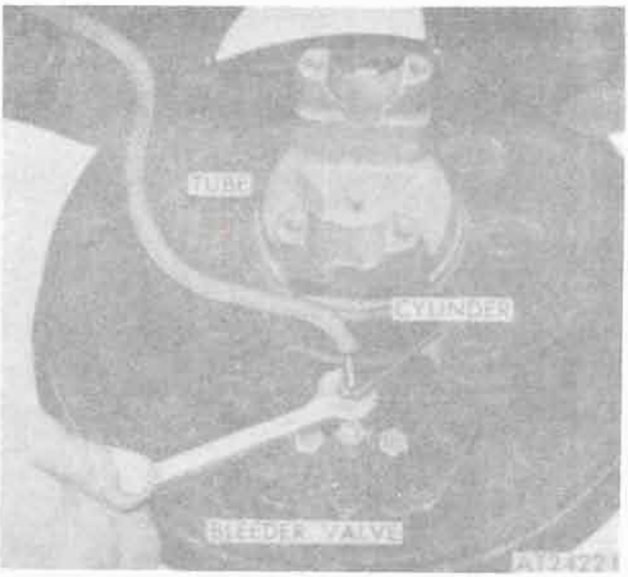


Figure 11-9. Rear wheel brake cylinder tube.

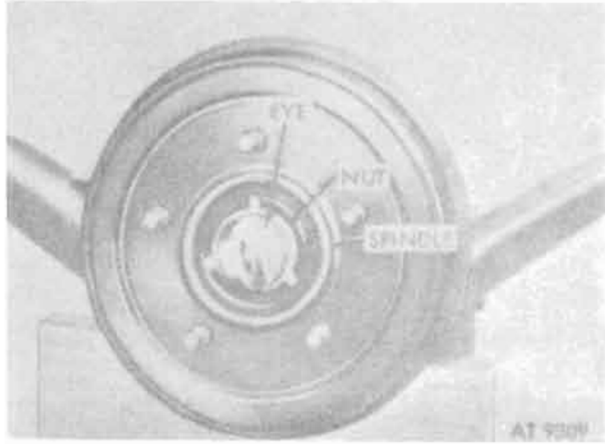


Figure 11-10. Lifting eye and nut.

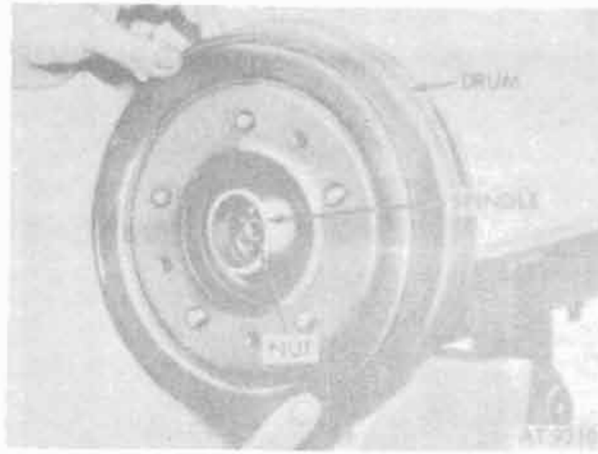


Figure 11-11. Rear wheel brakedrum.

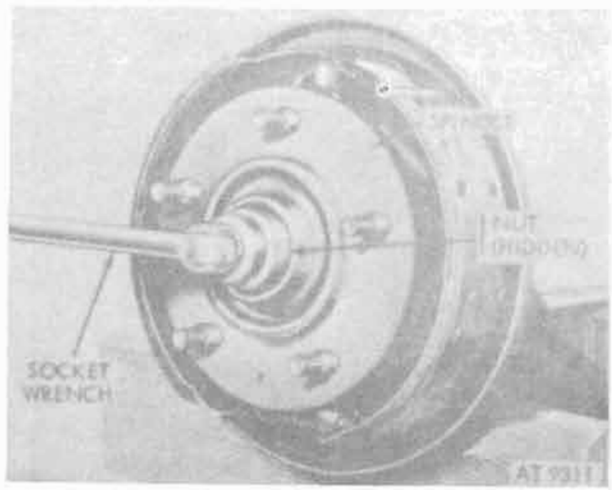


Figure 11-12. Rear wheel spindle and retaining nut.

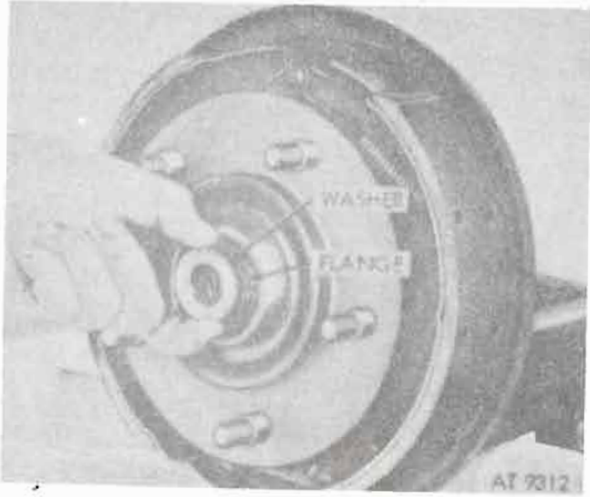


Figure 11-13. Spindle retaining washer.

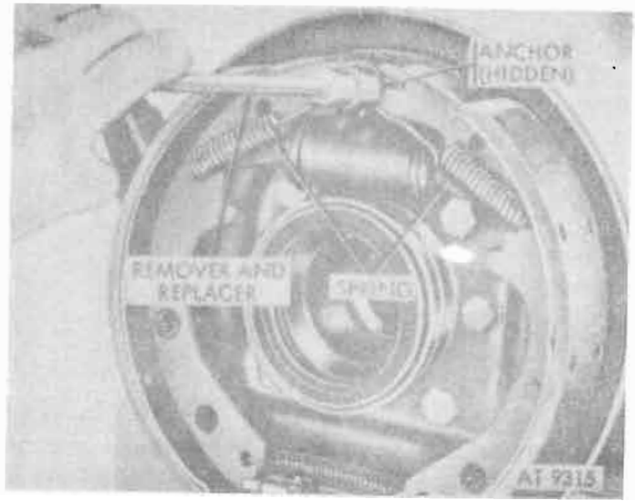


Figure 11-16. Brake retracting springs and anchor pin.

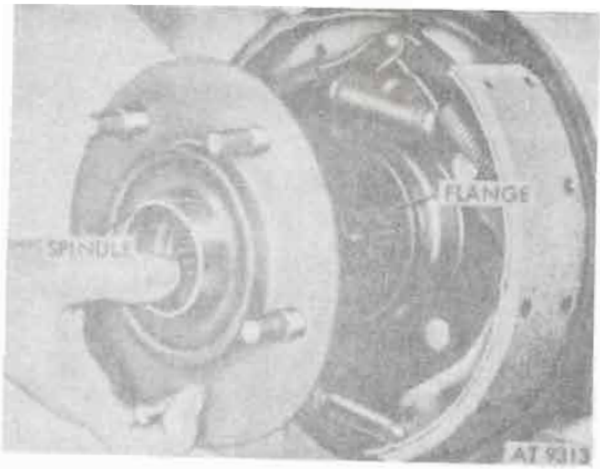


Figure 11-14. Rear wheel spindle.

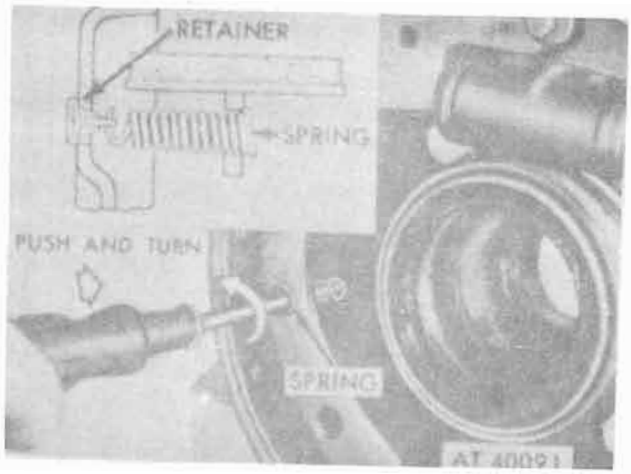


Figure 11-17. Brakeshoe holddown spring.

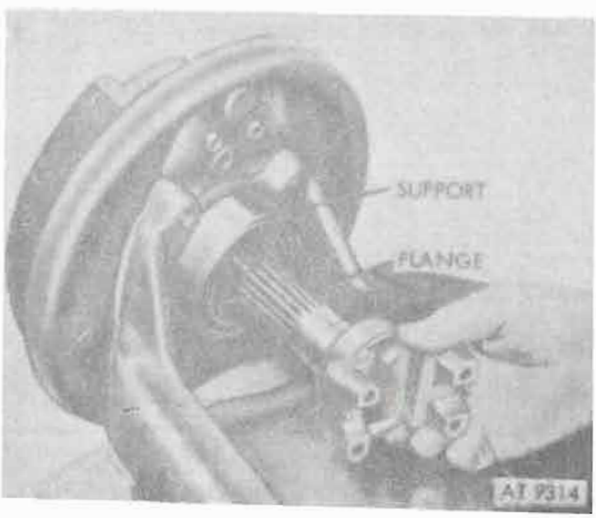


Figure 11-15. Rear wheel support and flange.

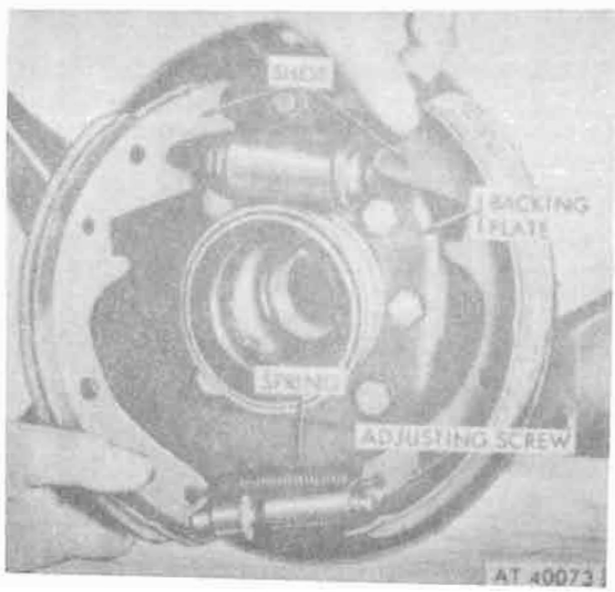


Figure 11-18. Brakeshoes and adjusting screw and spring assembly.

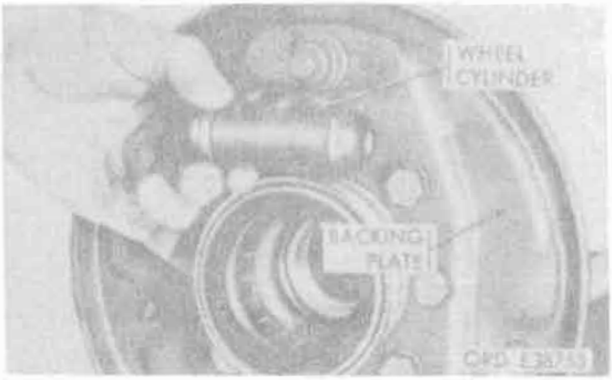


Figure 11-19. Rear wheel brake cylinder.

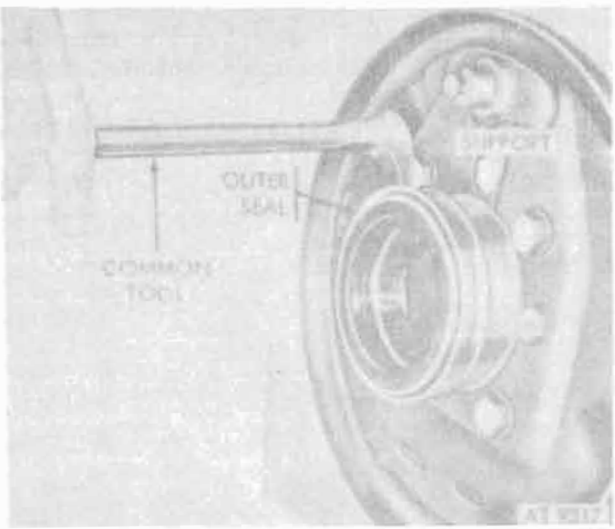


Figure 11-20. Removing outer seal and retainer from spindle support.

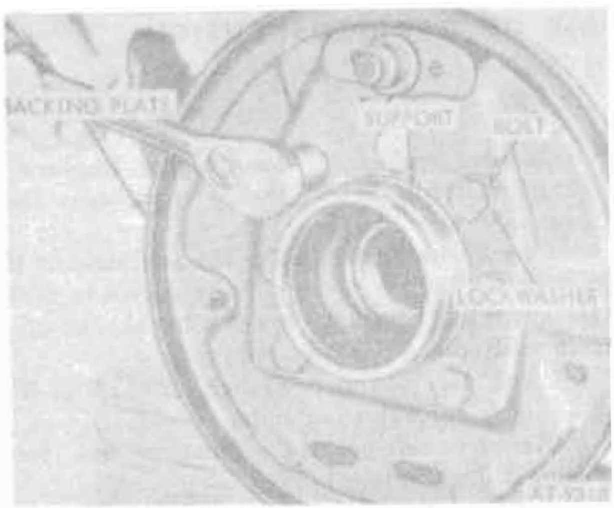


Figure 11-21. Brake backing plate and attaching hardware.

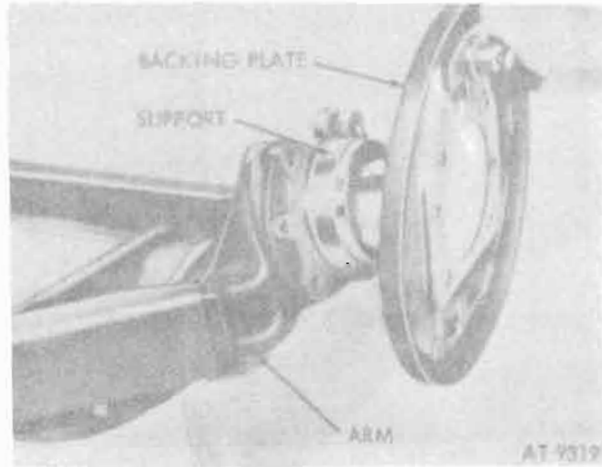


Figure 11-22. Brake backing plate and support (M151 M151A1, M151A1C and M718 vehicles).

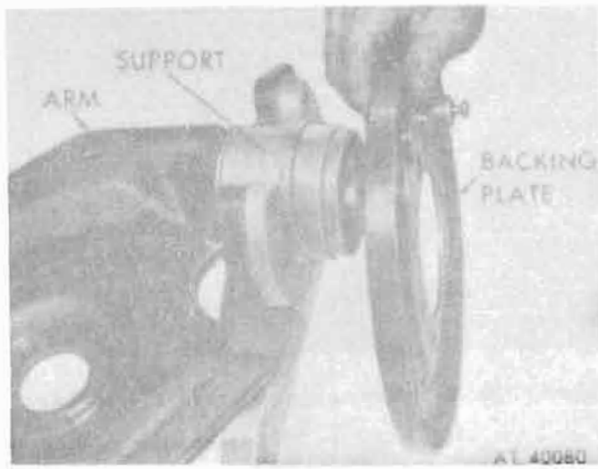


Figure 11-23. Brake backing plate and support (M151A2, M825, and M718A1 vehicles).

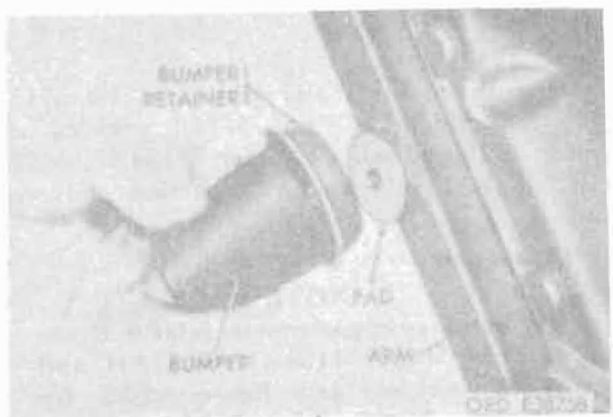


Figure 11-24. Suspension arm bumper and pad (M151, M151A1, M151A1C and M718 vehicles).

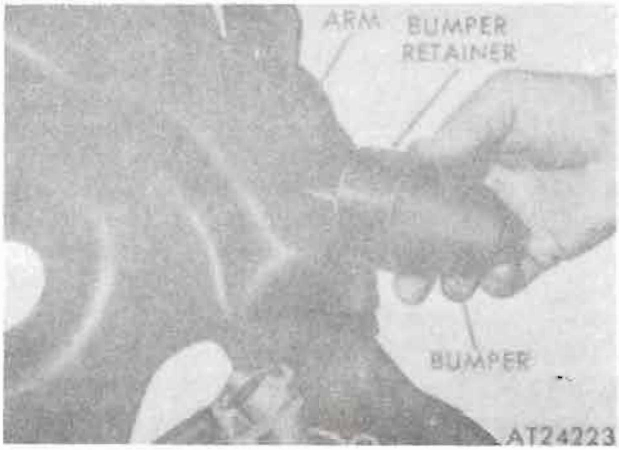


Figure 11-25. Suspension arm bumper and pad (M151A2, M825 and M718A1 vehicles).

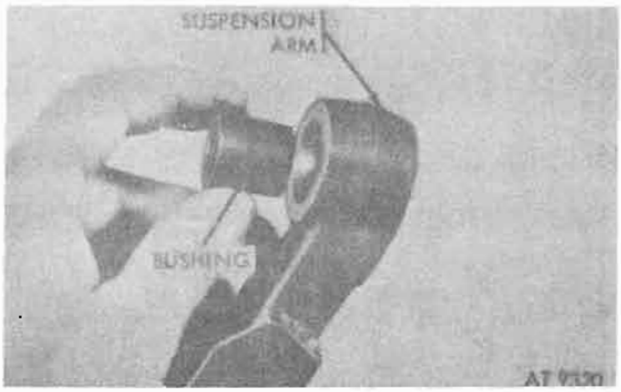


Figure 11-26. Suspension arm bushings (M151, M151A1 M151A1C and M718 vehicles).

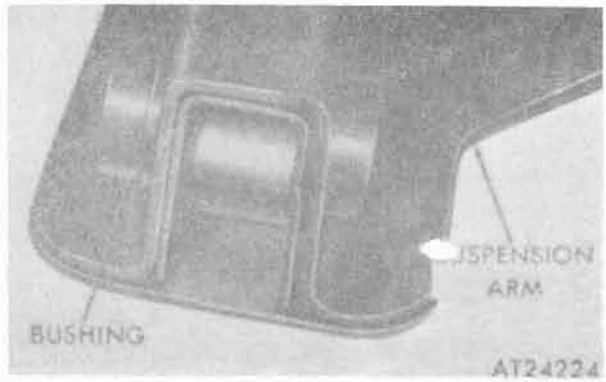


Figure 11-27. Suspension arm bushings (M151A2, M825 and M718A1 vehicles).

i. Drive inner and outer bearing cups from spindle support, using suitable tool (fig. 11-30).

Section IV. INSPECTION AND REPAIR OF REAR SUSPENSION COMPONENTS

11-13. Inspection

Refer to figure 11-31 and table 11-1 for M151, M151A1, M151A1C and M718 vehicles and figure 11-32 and table 11-2 for M151A2, M825, and M718A1 vehicles for inspection and wear limits.

11-14. Repair

NOTE

Key numbers in parenthesis refer to figure 11-31 for M151, M151A1, M151A1C and M718 vehicles. and figure 11-32 for M151A2, M825 and M718A1 vehicles.

a. Inspect arm assembly (1) for cracks or loose parts. Straightening and welding of components is permissible, provided alinement or strength of parts is not disturbed.

b. Inspect spring (4) for height. Replace if broken or if free height is less than wear limit shown in tables 11-1 or 11-2.

c. Check wheel drive flange (5) and support (9) for wear beyond serviceable limits shown in tables 11-1 and 11-2. Check for cracks, breaks, or other damage. Replace parts as required.

j. Using face spanner wrench (7345228) (fig. 12-8) back out adjusting nuts.

k. Remove side-bearing adjusting nut from housing (fig. 12-9).

l. Remove side-bearing cups from housing (fig. 12-10).

NOTE

The seals and adjusting nuts may be removed before removing cover.

m. Remove nut locking tab, retaining nut, and use standard flange holding tool to hold flanges while loosening nuts (fig. 12-12).

n. Remove pinion-shaft drive flanges from pinion shaft (fig. 12-13).

o. Using soft steel drift, drive pinion-shaft front seal from housing (fig. 12-14).

p. Remove pinion-bearing adjusting nut lock from housing (fig. 12-15).

q. Using face spanner wrench, remove front pinion-bearing adjusting nut from housing (fig. 12-16).

r. Using soft hammer or hardwood block, drive pinion shaft inward to release outer front bearing (fig. 12-17).

s. Remove pinion outer front bearing from pinion shaft (fig. 12-18).

t. Remove pinion-shaft-bearing preload spacer from pinion shaft (fig. 12-19).

u. Using adapter (7345223) as a driver, set up assembly in arbor press as shown in figure 12-20. If no arbor press is available, attach slide-hammer to opposite end of shaft and pull shaft out.

v. Press or pull pinion shaft and bearing from housing (fig. 12-21).

NOTE

Because of a slip fit of the pinion bearing in the housing on later model vehicles, the bearing may now be removed by hand.

w. Attach adapter (7345223) to opposite end of pinion shaft and press inner bearing from shaft (fig. 12-22).

x. Using adapter (7345281) and standard slide hammer, remove pinion-shaft-rear bearing spacer and seal (fig. 12-23).

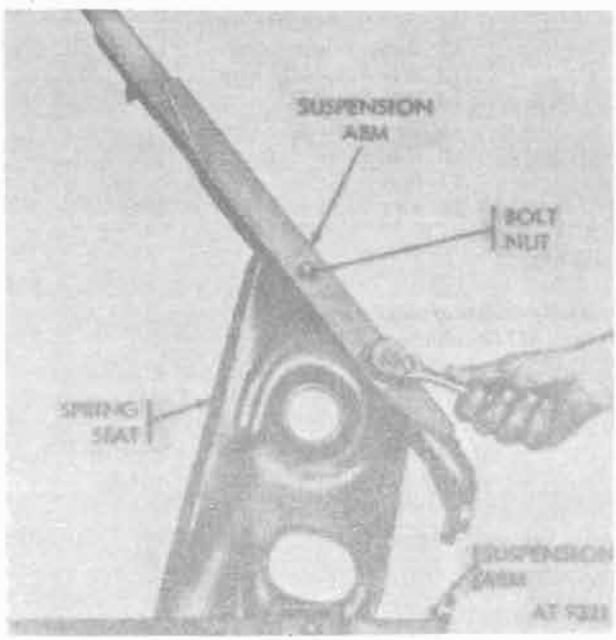


Figure 11-28. Suspension arm and spring seat assembly (M151, M151A1, M151A1C and M718 vehicles only).

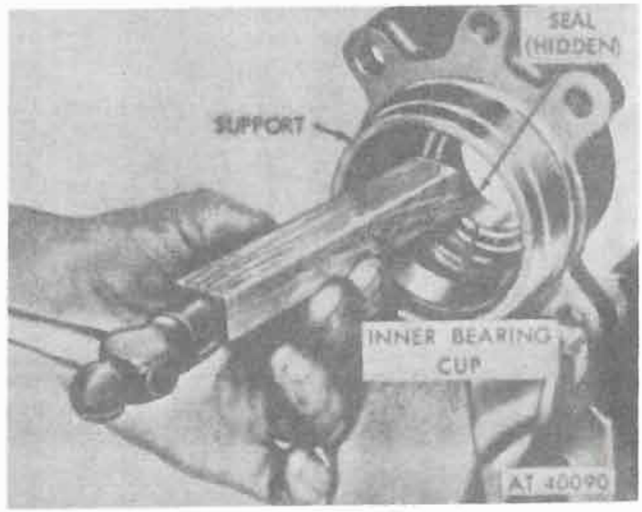
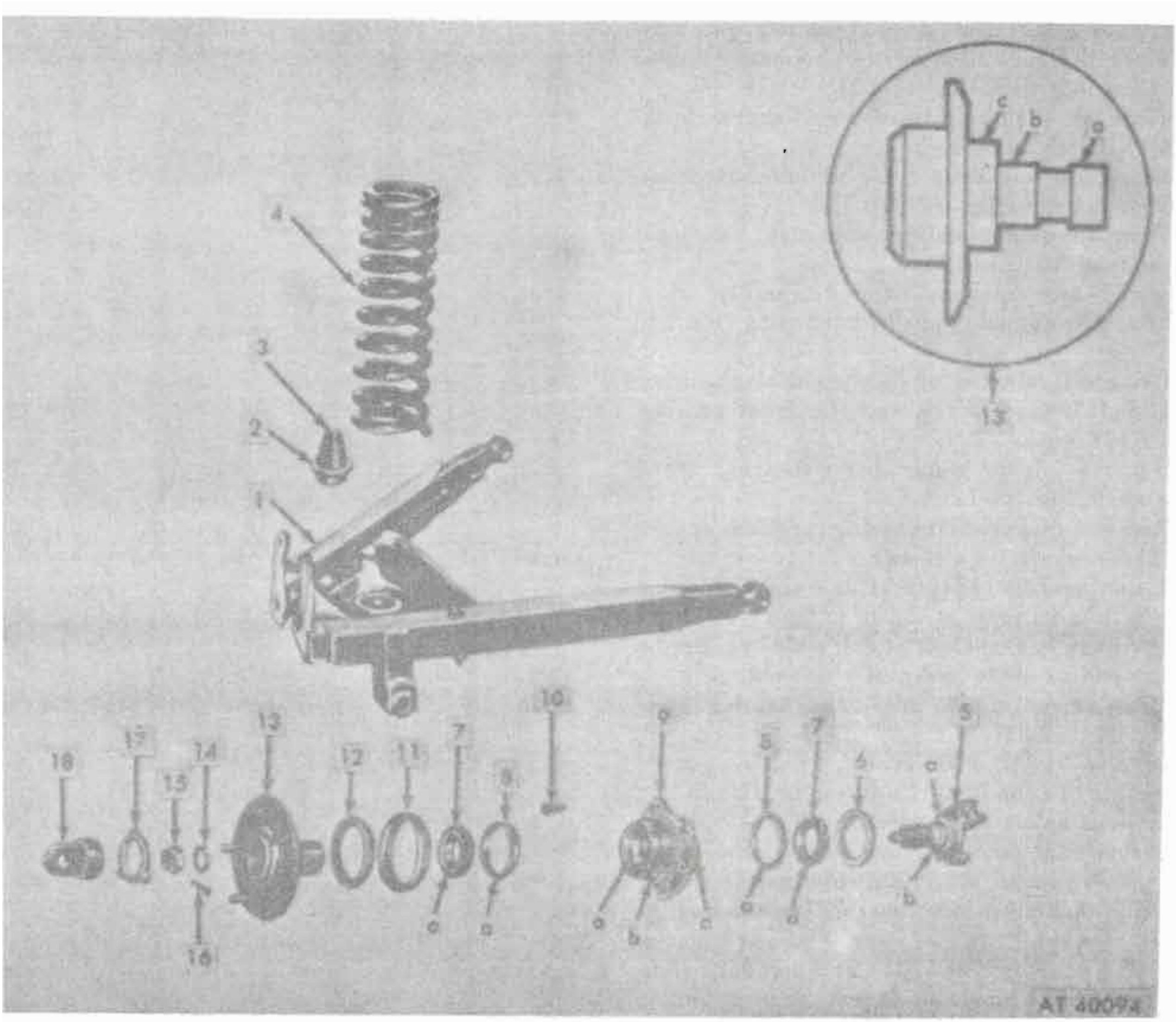


Figure 11-29. Spindle support inner bearing cup and seal.

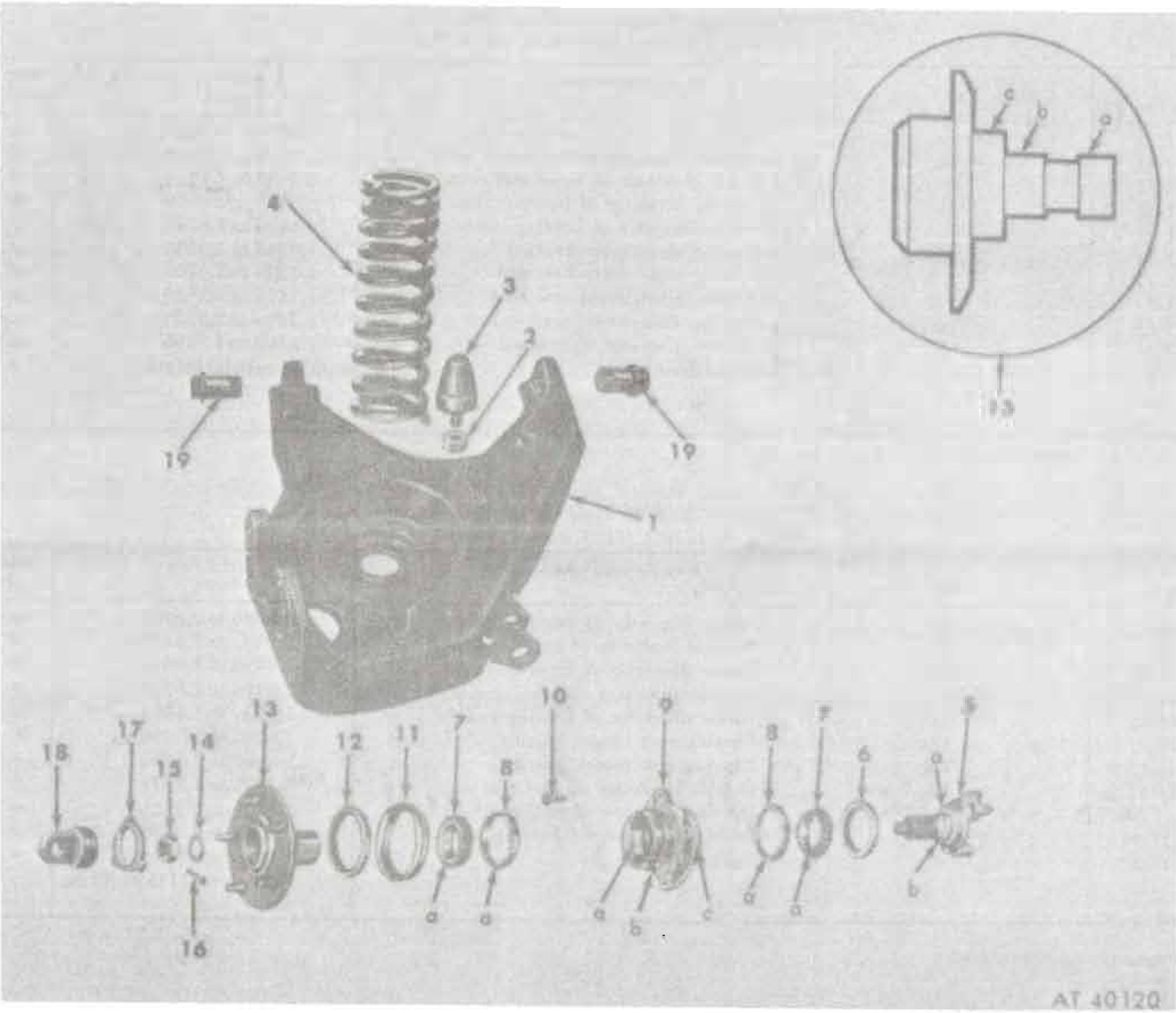
Figure 11-30. Spindle support inner and outer bearing cups.



1 * Suspension arm and seat assy.
2 Bumper Retainer
3 Bumper assy.
4 Spring
5 Wheel drive flange
6 Inner bearing seal
7 Wheel bearing cone
8 Wheel bearing cup
9 Support
10 Bolt
11 Oil seal retainer assy.
12 Outer bearing seal
13 Wheel Spindle assy.
14 Washer
15 Nut
16 Cotter pin
17 Nut
18 Eye

* Vehicles incorporating 4-bolt type suspension arms use part number 8754453 L.H. and 8754795 R. H.

Figure 11-31. Rear suspension components—points of measurements (M151. M151A1. M151A1C and M718 vehicles).



1 Suspension arm assy.
2 Nut
3 Bumper assy.
4 Spring
5 Wheel drive flange
6 Inner bearing seal
7 Wheel bearing cone
8 Wheel bearing cup
9 Support
10 Bolt
11 Oil seal retainer
12 Outer seal
13 Wheel spindle assy.
14 Washer
15 Nut
16 Cotter pin
17 Nut
18 Eye
19 Bushing assy.

Brake assembly 8744053 and 8744054 and drive assembly 7025887 (not shown) same as front suspension components

Figure 11-32. Rear suspension components—points of measurements (M151A2, M825, and M718A1 vehicles).

Table 11-1. Wear Limits, Rear Suspension (M151, M151A1, M151A1C, and M718)

Fig. No.	Key	Point of measurement	Size of new part	Wear limit
11-31	9a	Inside diameter of bearing bore.	2.8895 to 2.9805	*
11-31	9b	Outside diameter of outer-seal seat.	3.2585 to 3.2630	*
11-31	9c	Inside diameter of inner-seal seat.	2.9930 to 2.9975	*
11-31	8a	Outside diameter of bearing cup.	2.8910 to 2.8920	*
11-31	7a	Inside diameter of bearing cone.	1.6250 to 1.6255	*
11-31	13a	Bearing seat (inner bearing)	1.6245 to 1.6250	*
11-31	13b	Bearing seat (outer bearing)	1.6255 to 1.6265	*
11-31	13c	Outside diameter of seal seat.	1.7475 to 2.7525	*
11-31	5a	Outside diameter of seal seat.	2.2475 to 2.2525	*
11-31	5b	Outside diameter of bearing	1.3200 to 1.3195	*
11-31	4	Spring free height	Compressed length 9.70±.01 at 1115±35 lb. load.	*

* Refer to paragraph 11-7a (2).

Table 11-2. Wear Limits, Rear Suspension (M151A2, M825, and M718A1)

Fig. No.	Key	Point of measurement	Size of new part	Wear limit
11-32	9a	Inside diameter of bearing bore.	2.8895 to 2.8905	*
11-32	9b	Outside diameter of outer-seal seat.	3.2585 to 3.2630	*
11-32	9c	Inside diameter of inner-seal seat.	2.9930 to 2.9975	*
11-32	8a	Outside diameter of bearing cup.	2.8910 to 2.8920	*
11-32	7a	Inside diameter of bearing cone.	1.6250 to 1.6255	*
11-32	13a	Bearing seat (inner bearing)	1.6245 to 1.6250	*
11-32	13b	Bearing seat (outer bearing)	1.6260 to 1.6265	*
11-32	13c	Outside diameter of seal seat	2.7475 to 2.7525	*
11-32	5a	Outside diameter of seal seat	2.2475 to 2.2525	*
11-32	5b	Outside diameter of bearing seat.	1.3200 to 1.3195	*
11-32	4	Spring free height	Compressed length 9.70 ± at 1115 ± 35 lb. load.	*

* Refer to paragraph 11-7a (2).

Section V. ASSEMBLY OF REAR SUSPENSION

11-15. Assembly of Rear Brake Backing Plate, Spindle Support, Bearings, and Seals

a. Position outer rear bearing cup and inner bearing cup to support (fig. 11-33).

NOTE

Bearing cups are identical.

b. Seat bearing cups in support using improvised driver (fig. 11-34).

NOTE

Both bearing cups are installed in the same manner.

c. Coat entire inside of spindle support bearing bore with a 1/16-inch layer of grease (GAA). Pack bearing cone and rollers full of grease by hand. Position inner bearing cone in cup (fig. 11-35). Coat outside seating surface of seal with compound sealer (FSN 8030-656-1426). Coat lips of seal with grease (GAA).

d. Seat seal in support, using a block of soft wood (fig. 11-36).

Figure 11-33. Outer-bearing cup and support.

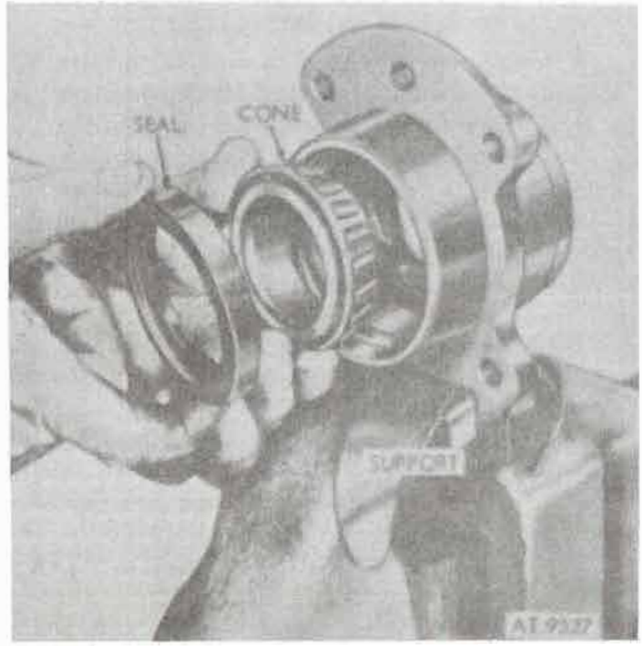


Figure 11-35. Inner-bearing cone and seal assembly.

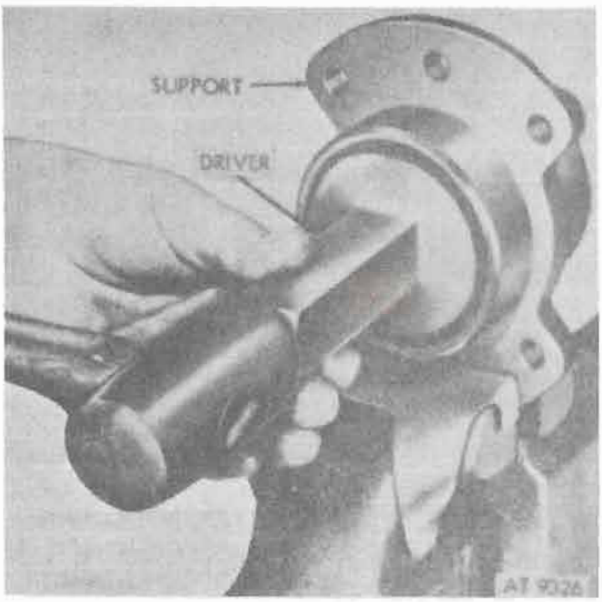


Figure 11-34. Installing inner-bearing cup.

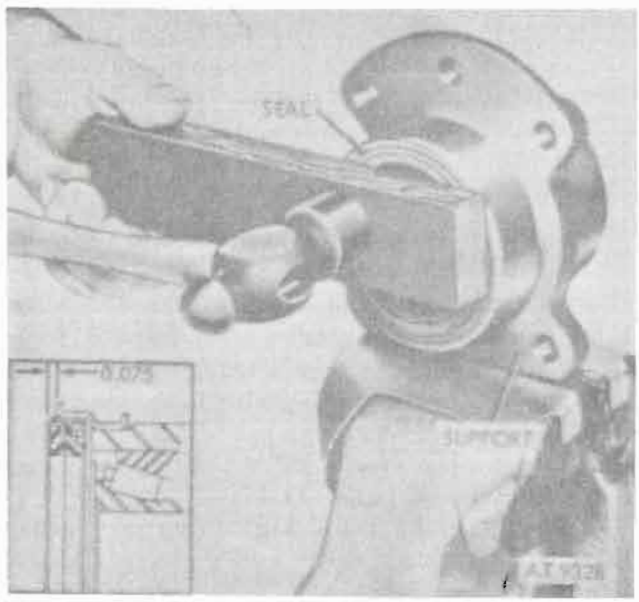


Figure 11-36. Installing inner-bearing seal.

NOTE

When flange type seal and retainer are properly seated a gap of approximately 0.075 inch (max.) should exist between the seal assembly and retainer as shown in view A, figure 11-36. Seals seated at the flange can result in early seal and bearing failures.

e. Assemble support to left or right-hand arm assembly. Refer to figures 11-22 and 11-23.

NOTE

TOP mark on support must face upward.

f. Position backing plate to support. Refer to figures 11-21 and 11-22.

g. Install backing plate with six bolts. Refer to figure 11-21. Torque bolts to 65-70 lb.-ft.

h. Coat seating surface of outer bearing seal assembly with compound sealer (FSN 8030-656-1426). Coat lips of seal with grease (GAA). Position to support (fig. 11-37).

i. Start assembly on support, using soft wood block (fig. 11-38). Seat seal assembly on support, using driver (7950152).

NOTE

Spring-side of seal must face towards the wheel bearing when installing optional seal assembly without flange. When flange type seal assembly and retainer are properly seated, a gap of approximately 0.063 inch should exist between them. Refer to view a, figure 11-38.

11-16. Installation of Brakeshoes and Cylinder to Backing Plate

a. Install wheel cylinder to brake backing plate, using two screws and washer assemblies. Refer to figure 11-19. Torque screws to 8-10 lb.-ft.

b. Position brakeshoe assembly to backing plate. Refer to figure 11-18.

c. Install brakeshoe holddown springs to spring retainer. Refer to figure 11-17.

d. Install brake retracting spring to anchor, using brake-spring remover and replacer. Refer to figure 11-16.

11-17. Installation and Adjustment of Wheel Spindle, Flange and Bearings

Figure 11-37. Outer-bearing seal assembly.

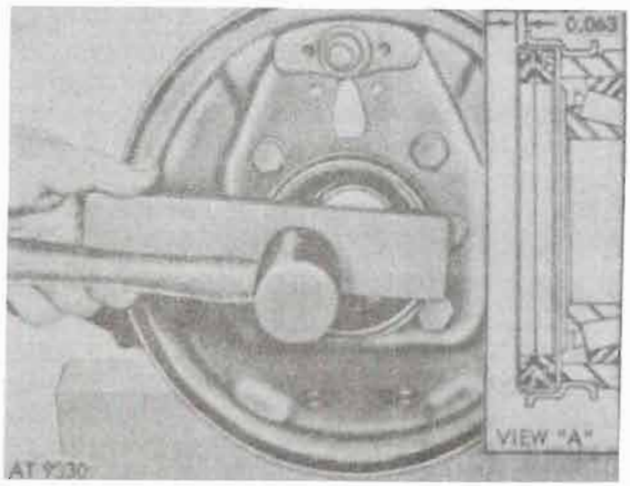


Figure 11-38. Installing outer-bearing seal.

a. Insert flange into spindle support. Refer to figure 11-15.

b. Position wheel spindle on flange. Refer to figure 11-14.

c. Position washer on flange. Refer to figure 11-13.

d. Install nut to flange. Adjust wheel bearing as shown in figure 11-12, and install lifting eye and nut as shown in figure 11-10.

11-18. Installation of Brakedrum and Brake Tubes

a. Position brakedrum on spindle. Refer to figure 11-11.

b. Install bumper stud into threaded pad on suspension arm. Refer to figure 11-24.

c. Install brake tube to cylinder. Refer to figure 11-9.

d. Attach brake tube clip to arm. Refer to figure 11-7.

e. Install wheel drive shaft U-joint with two U-bolts, four lockwashers, and nuts. Refer to figure 11-5. Torque nuts to 28-33 lb.-ft.

CHAPTER 12

REPAIR OF DIFFERENTIAL ASSEMBLY

Section I. DESCRIPTION AND TABULATED DATA

12-1. Description

For description of the differential assembly refer to TM 9-2320-218-20.

12-2. Tabulated Data, Differential (Front or Rear)

Make	Ordnance design
Type	Drive-thru
Mounting method	3-point
Lubricant capacity	2-pt.
Gear type	Hypoid
Drive gear ratio	4.86:1
Hypoid ring gear diameter	7.00 in.
Hypoid pinion offset	1.625 in.
Differential type	4-pinion

Section II. INSTRUCTIONS FOR DIFFERENTIAL REPAIR

12-3. Scope

Recommended procedures for removal of the suspension and drive units from the vehicle are found in TM 9-2320-218-20. Complete disassembly procedures for the suspension and drive units are given, and inspection and repair standards are enumerated in paragraphs 11-7 through 11-13. Assembly and adjustment of the suspension units are described in paragraphs 11-14 through 11-17. Cleaning, inspection, and repair recommendations cover all general conditions. Additional specific information on cleaning or repair of certain parts is given in the appropriate section describing that part. Torque recommendations are given in the figures describing operations involved. Wear limits information is included in this inspection and repair section.

12-4. Cleaning Recommendations

a. General. Whenever an assembly is contaminated with dirt or other abrasive matter, unnecessary wear will result. Inspect all parts for possible abrasive material any time a unit is disassembled. Metallic contamination of oil is evidence of failure or wear of some part in the assembly. If metal particles are found, the entire assembly containing the contaminated lubricant must be thoroughly cleaned.

b. Cleaning Parts.

(1) All metallic parts of the differential assembly except bearings should be cleaned thoroughly with drycleaning solvent or mineral spirits paint thinner. Do not use caustic soda for steam cleaning.

(2) Parts should be dried with compressed air. Steam-cleaned parts should be oiled immediately after drying.

(3) After cleaning, examine parts—especially oil passages—make certain they are entirely clean; clean them again if necessary.

c. Cleaning Bearings.
Refer to TM 9-214 for care and maintenance of bearings.

12-5. Inspection and Repair Recommendations

a. Cast Parts and Machined Surfaces.

(1) Inspect bores for wear, grooves, scratches, and dirt. Remove scratches and burrs with crocus cloth. Remove foreign matter. Replace parts that are deeply grooved or scratched.

(2) Inspect all oil passages for obstructions. If an obstruction is found, remove it with compressed air or by working a wire back and forth through the passage and flushing it with cleaning solvent.

(3) Inspect mounting faces for nicks, burrs, scratches, and foreign matter. Remove such defects with crocus cloth or a soft stone. If scratches are deep, replace the defective parts.

(4) Inspect thread openings for damaged threads. Chase damaged threads with correct size used tap.

(5) Discard housings or other case parts that are broken.

(6) Inspect all machined surfaces for damage that could cause oil leakage or malfunction of the part. Rework or replace the defective parts.

b. Bearings.

(1) Inspect bearings for roughness of rotation. Replace a bearing if its rotation is still rough after cleaning and oiling.

(2) Inspect bearings for scored, pitted, scratched, cracked, or chipped races, and for indication of excessive wear of rollers. If one of these defects is found, replace bearing.

(3) Inspect a defective bearing's housing bore

and shaft for grooved, burred, or galled conditions that would indicate the bearing has been turning in its housing or on its shaft. If the damage cannot be repaired with crocus cloth, replace the defective parts. Refer to TM 9-214.

NOTE

Differential bearings, cups and pinion bearings are assembled with a slip fit to permit adjustment. Indication of turning will therefore be noted, but no wear should be evident.

(4) If a bearing must be removed or installed without a pressing sleeve, be careful to press only on the race which is adjacent to the mounting surface. If an arbor press is not available, seat the bearing with a soft steel drift and a hammer by driving against the supported race.

c. Thrust Washers. Inspect thrust washers for distortion, scores, burrs, and wear. Replace thrust washers if defective or worn beyond wear limits.

d. Seals and Gaskets.

(1) Replace all seals.

(2) When replacing lip type seals, place spring-loaded side toward oil to be sealed in (toward inside of unit). Use nonhardening compound (8030-656-1426) on outside of seal to prevent leaks. Pack inside lips of seal with light grease (GAA).

(3) Replace all gaskets.

(4) Inspect surfaces of parts on which seals bear. If grooving exceeds wear limits, replace the part and seal.

e. Gears.

(1) Inspect gears for scuffed, nicked, burred, or broken teeth. If defect cannot be removed with a soft stone, replace gear.

(2) Inspect gear teeth for wear. If original tooth shape is destroyed, replace gear.

(3) Inspect thrust faces of gears for scores, scratches, and burrs. Remove defects with a soft stone. If scratches, burrs, and scores cannot be removed, replace gear.

f. Splined Parts. Inspect parts for stripped, twisted, chipped, or burred splines. Remove burrs with a soft stone. If other defects are found, replace the part. Wear on splines, such as those used on wheel drive shafts, is not considered critical since such splines are made with long contact surfaces designed to slide back and forth under all conditions. However, wear on short splines, such as drive flanges, must be minimum since a spline is used in this installation because it is stronger than a keyway. This strength is lost if fit is loose.

g. Threaded Parts. Inspect parts for damaged threads. Remove burrs with a soft stone or fine file. Replace damaged parts.

12-6. Wear Limits and Torque Specifications

a. Wear Limits.

(1) Data covering the size and fit of new parts, and wear limits information are included in the views in the appropriate repair section and tables 12-1 through 12-3. These measurements list the minimum and maximum clearances for new or used parts.

(2) The wear limits indicate the dimensions to which a part may wear before it must be replaced. Normally, any part not worn beyond its wear limit may be approved for service, provided it is not damaged by corrosion or similar causes. An asterisk (*) in the wear limits column indicates that the part should be replaced when worn beyond the limits stated in the size of new parts column.

b. Torque Specifications. Torque specifications are called out in the text or on the illustration relating to the individual part in the repair sections.

Section III. DISASSEMBLY, INSPECTION, AND REPAIR OF DIFFERENTIAL ASSEMBLY

12-7. Preliminary Steps

a. Prior to disassembly, check and record backlash. This backlash must be reset if the used drive gears are reassembled into the original differential.

b. Ring gear and pinion shaft assemblies and shim must be kept together as matched parts. Pinion bearings, with outer race and spacer should be wired together, in proper relation, as matched parts.

c. Housing assembly, ring gear and pinion shaft sets, shims, and pinion bearing packs from the same differential must be tagged and kept together to insure proper reassembly.

d. Before removing pinion and shaft assembly, measure pinion bearing end play. If end play exceeds .001 inch, replace bearing rather than adjust.

12-8. Disassembly of Differential Housing

a. Position differential housing assembly in holding fixture and stand (fig. 12-1). Rotate assembly and remove drain plug to drain lubricant from housing.

b. Remove right and left output flange retaining bolt and lockwasher (fig. 12-2). Use a standard flange-holding tool on flange to prevent rotation.

c. Remove right and left output flanges.

d. Remove ten housing cover plate bolts and lockwashers retaining cover to housing (fig. 12-3).

e. Using common tool, remove cover plate from housing (fig. 12-4).

f. Remove differential case assembly from housing (fig. 12-5).

g. Pry off output seals from differential housing (fig. 12-6).

h. Remove bearing adjusting nut locks (fig. 12-7).

i. Mark position of adjusting nut for future reference.

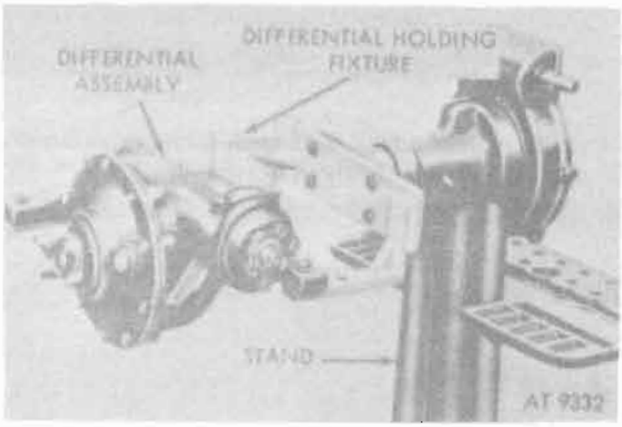


Figure 12-1. Differential housing assembly mounted in holding fixture.

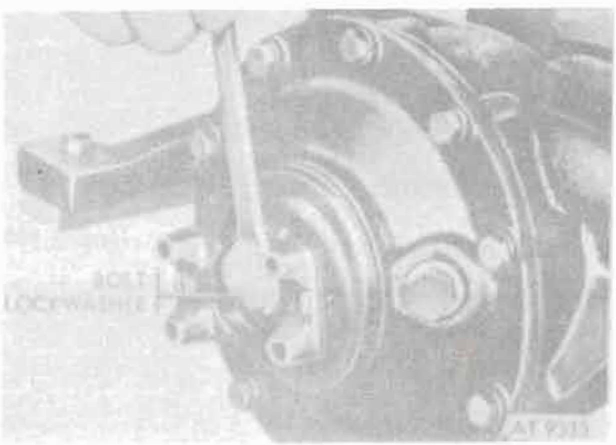


Figure 12-2. Side gear drive flange retaining bolt and lockwasher.

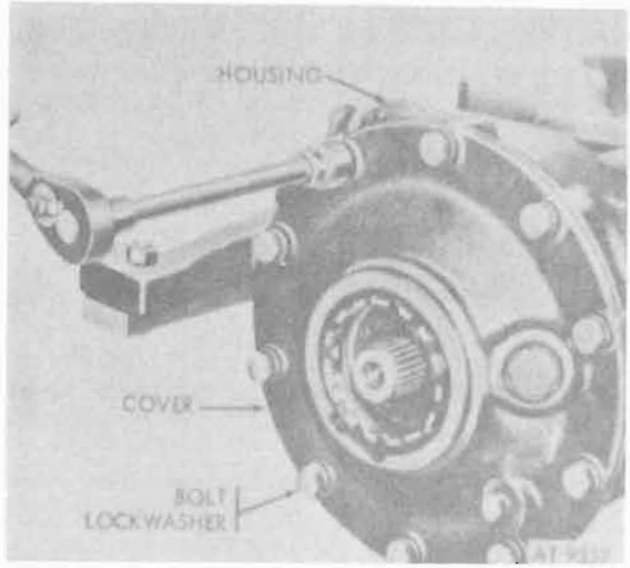


Figure 12-3. Housing cover plate retaining bolts and lockwashers.

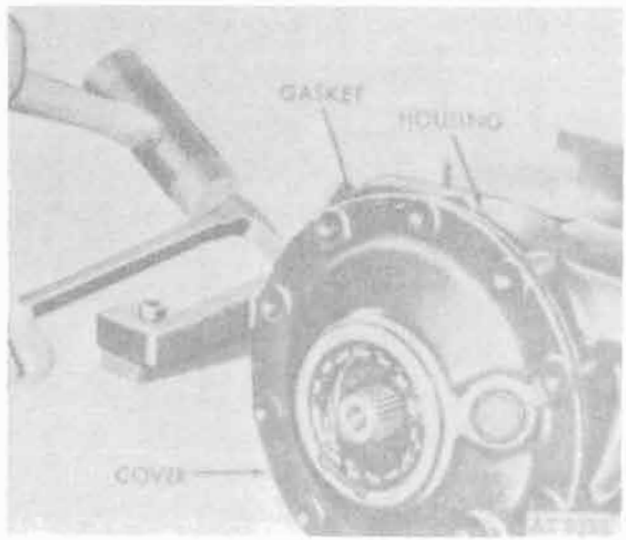


Figure 12-4. Removing cover plate from housing.

Figure 12-5. Removing differential case from housing.

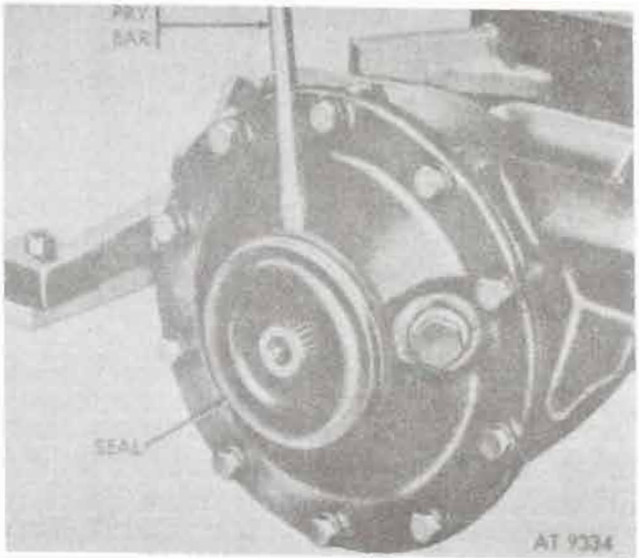


Figure 12-6. Removing differential case side gear bearing seal.

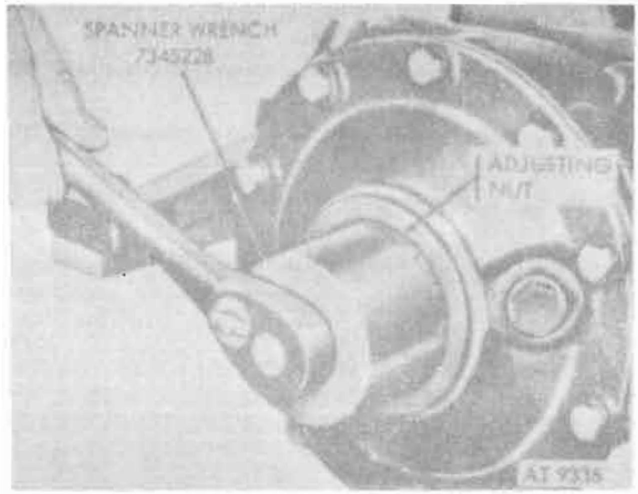


Figure 12-8. Using spanner wrench (7345228) to loosen or tighten differential case bearing adjusting nuts.

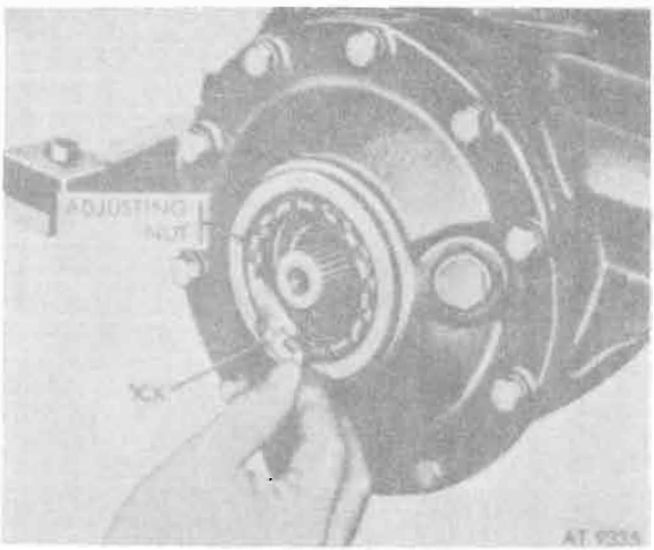


Figure 12-7. Differential case side bearing nut lock.

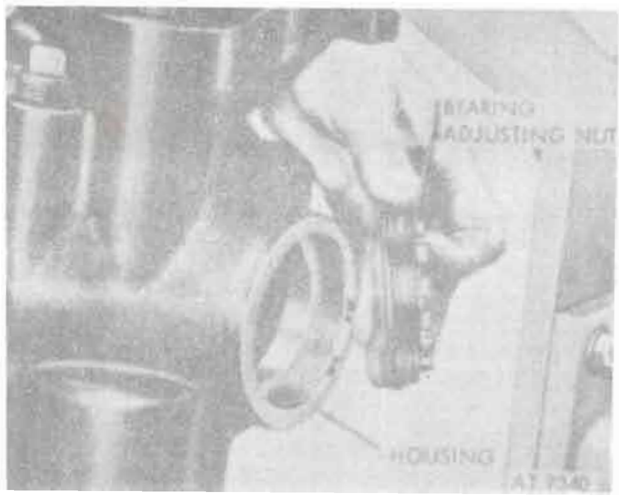


Figure 12-9. Differential case bearing adjusting nut.

Figure 12-10. Differential case bearing cup.

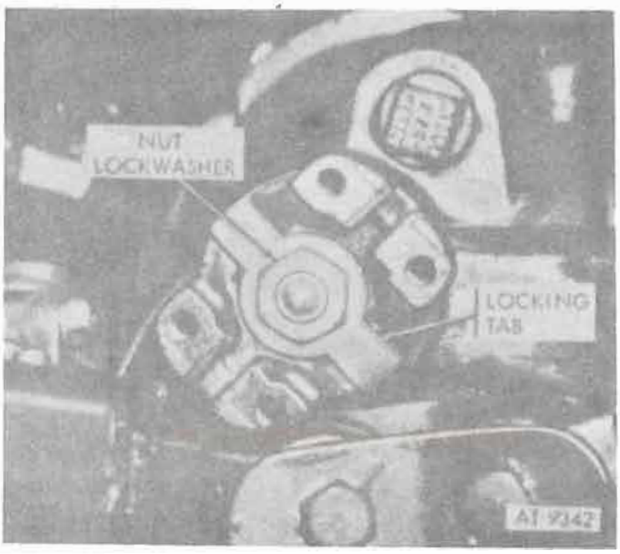


Figure 12-11. Pinion shaft flange nut, locking tab, and lockwasher.

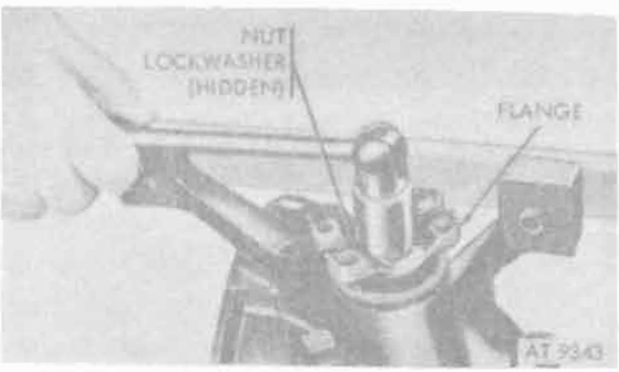


Figure 12-12. Pinion shaft rear flange nut and lockwasher.

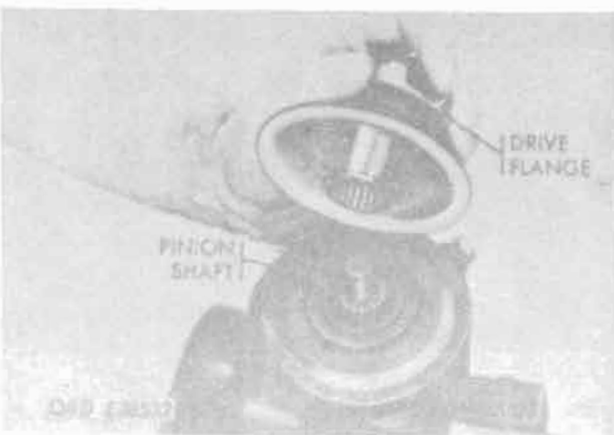


Figure 12-13. Pinion shaft front drive flange.

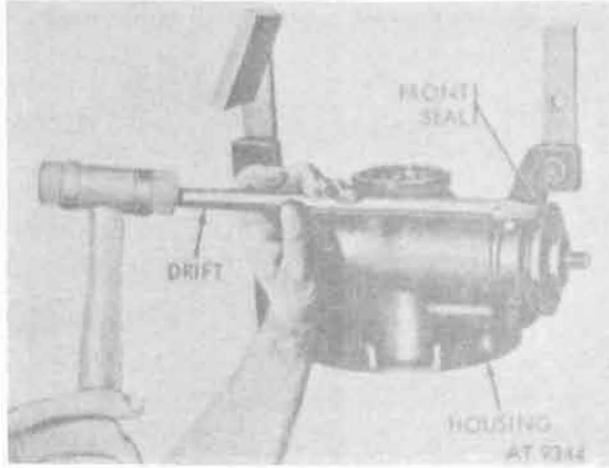


Figure 12-14. Removing pinion shaft front seal.

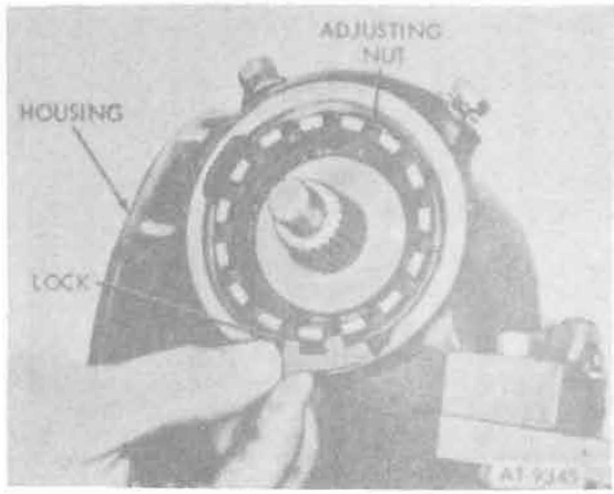


Figure 12-15. Pinion bearing adjusting nut lock.

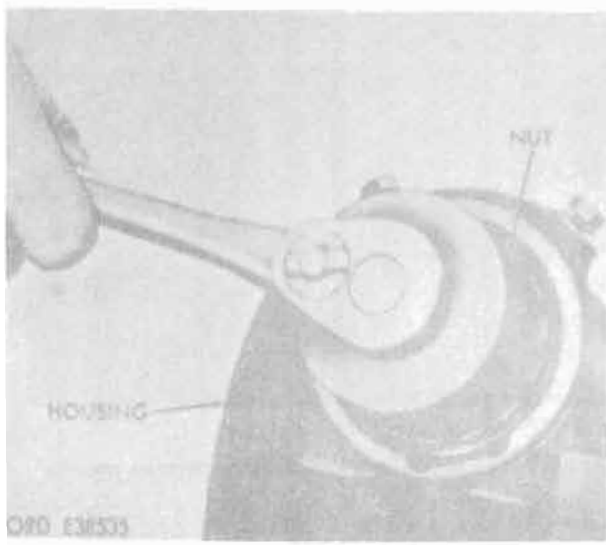


Figure 12-16. Front pinion bearing adjusting nut.

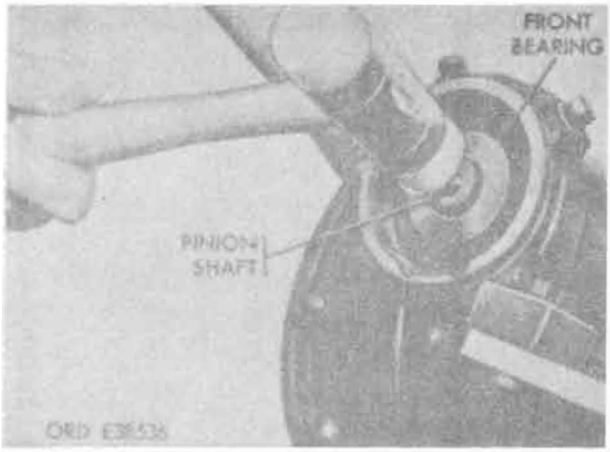


Figure 12-17. Driving pinion shaft inward.

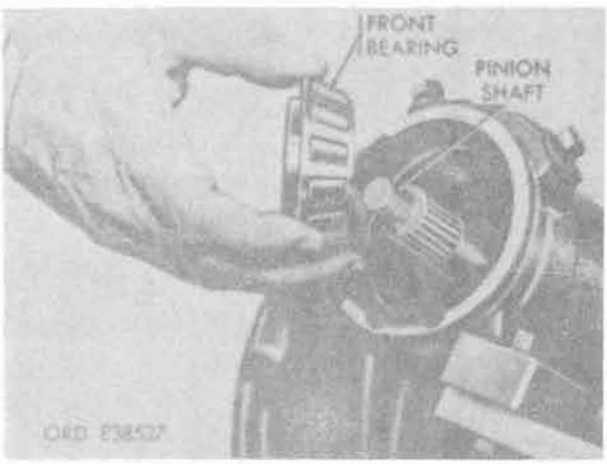


Figure 12-18. Pinion shaft outer front bearing.

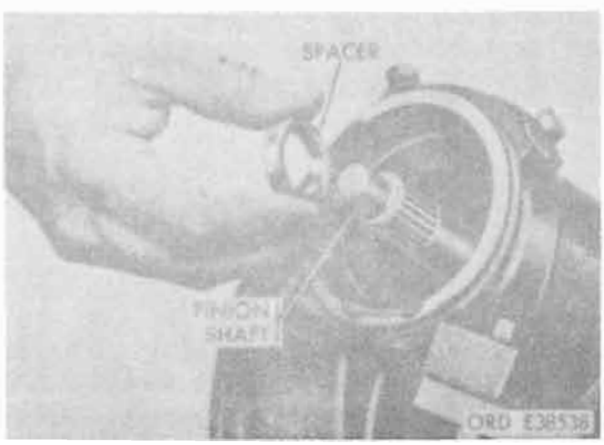


Figure 12-19. Pinion shaft bearing preload spacer.

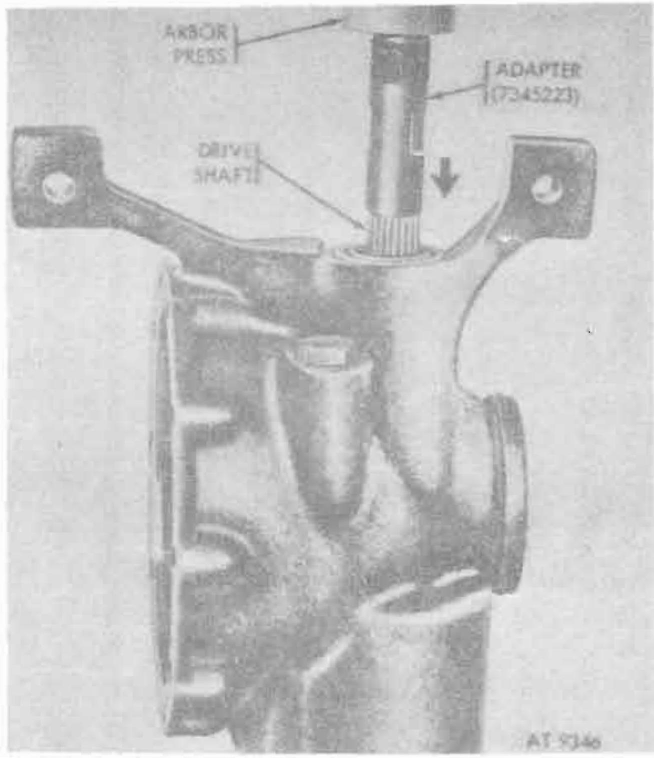


Figure 12-20. Positioning adapter (7345223) on pinion shaft

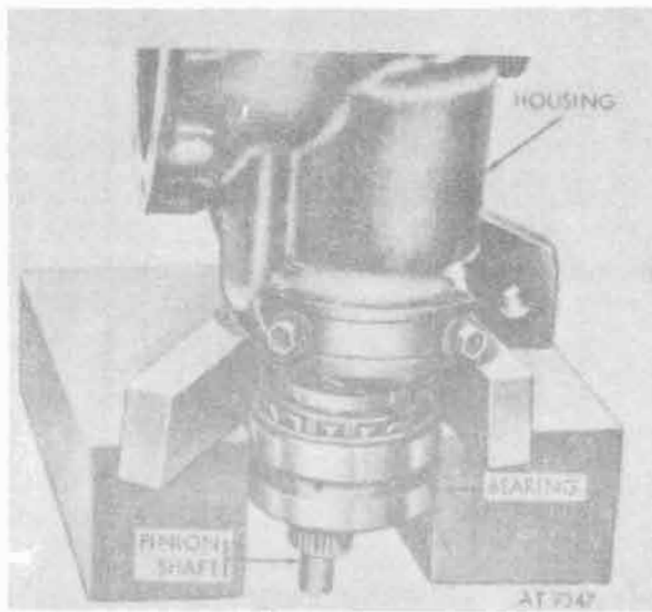


Figure 12-21. Removing pinion shaft and bearing from housing.

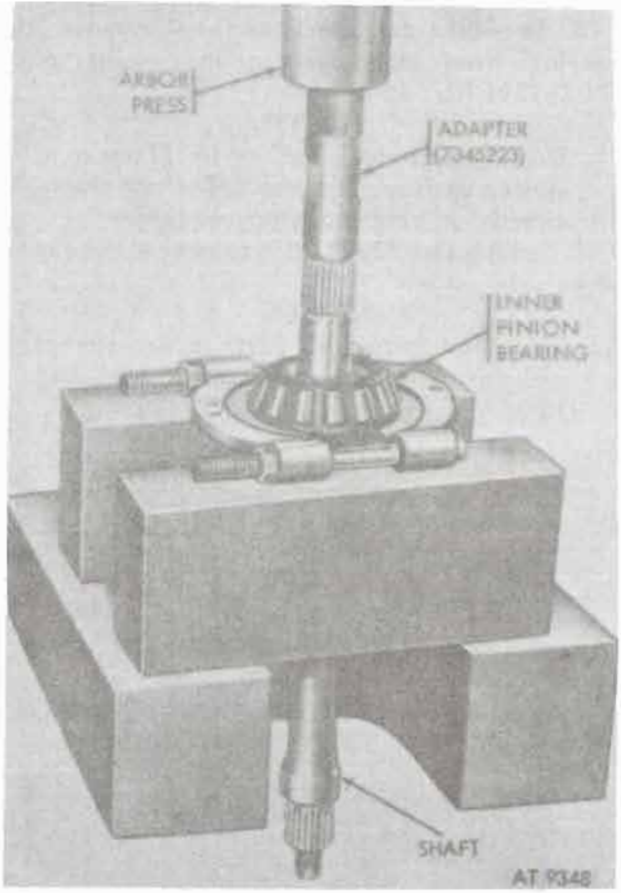


Figure 12-22. Removing inner front pinion bearing from pinion shaft.

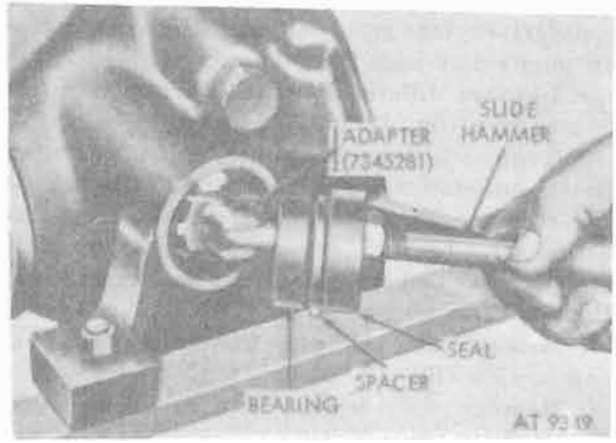


Figure 12-23. Removing pinion shaft rear bearing and seal.

12-9. Inspection and Repair of the Differential Housing

a. Inspection. For inspection of the differential housing, refer to table 12-1 and figure 12-24.

b. Repair. For repair of the differential housing, refer to the general instructions in paragraph 12-5.

Table 12-1. WEAR LIMITS DIFFERENTIAL HOUSING

Fig. No.	Key	Point of measurement	Size of new part	Wear limit
12-24	4a	Inside diameter, side bearing bore	3.001-3.002	*
12-24	4b	Inside diameter, pinion front bearing bore.	3.1870-3.1895	*
12-24	4c	Inside diameter, pinion rear bearing bore.	1.8500-1.8509	*
12-24	7a	Inside diameter, side bearing bore	3.001-3.002	*

* See paragraph 12-6a (2).

NOTE

The differential housing and cover are a matched assembly, and should not be replaced separately.

NOTE

The fit of the differential bearing cup (8a, table 12-2) in the cover (7a, table 12-1) and carrier housing (4a, table 12-1) is from 0.000- to 0.002-inch loose. A small amount of cup rotation or creeping is possible but is not detrimental. It is not advisable to tamper with 0.000- to 0.002-inch fit of these cups, as it may become difficult to obtain the proper reload condition when the unit is assembled.

12-10. Disassembly of Differential Case Assembly

a. Mount differential case assembly is soft-jawed vise and open tangs on locks. If no index mark is provided on case, prick-punch the two parts of case before disassembly (fig. 12-25).

b. Remove eight retaining bolts and four locks (fig. 12-26).

c. Install two alinement pins (7345224) in ring gear. Wrench (7345228) may be used as a holding tool during disassembly, as shown (fig. 12-27).

d. Drive ring gear off case by tapping on alinement pins with soft hammer (fig. 12-28).

e. Remove differential case short section from long section (fig. 12-29).

f. Remove differential spider, spider gears, and thrust washers from long case section (fig. 12-30).

g. Remove short side gear from case short section (fig. 12-31).

h. Remove thrust washer from case short section (fig. 12-32).

i. Remove long side gear from differential case long section (fig. 12-33).

j. Remove thrust washer from case long section (fig. 12-34).

k. Assemble case sections and remove side bearing from long case section, using puller (7078129) (fig. 12-35).

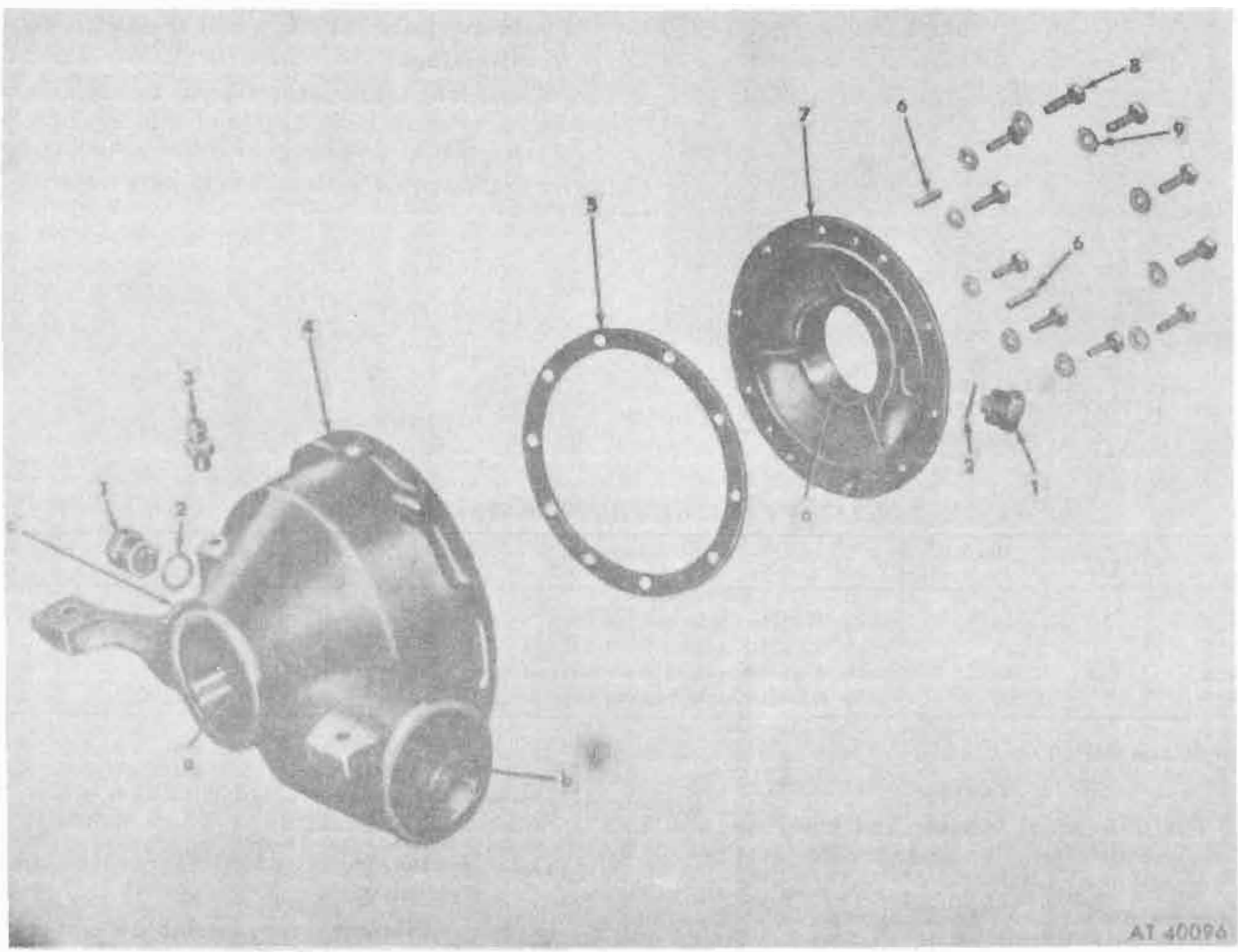
NOTE

Do not clamp single half in vise. Damage to mating surface may result. Do not clamp directly on ring mounting surface.

l. Using puller (7078129), remove side bearing; short side.

NOTE

Clean and inspect all parts in accordance with instructions in paragraphs 12-4 and 12-5.



1 Plug (drain and fill)
2 Gasket (drain and fill)
3 Vent assembly
4 Carrier
5 Gasket
6 Pin, locating
7 Cover
8 Bolt
9 Washer

Figure 12-24. Differential housing—points of measurement.

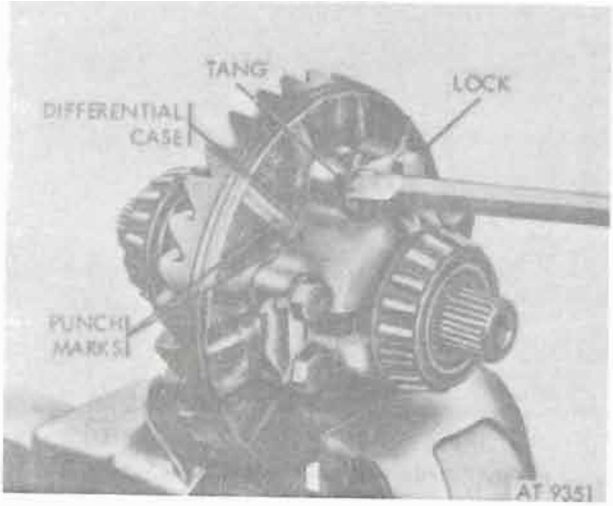


Figure 12-25. Lock tangs and case markings.

Figure 12-26. Differential case retaining bolts and locks.

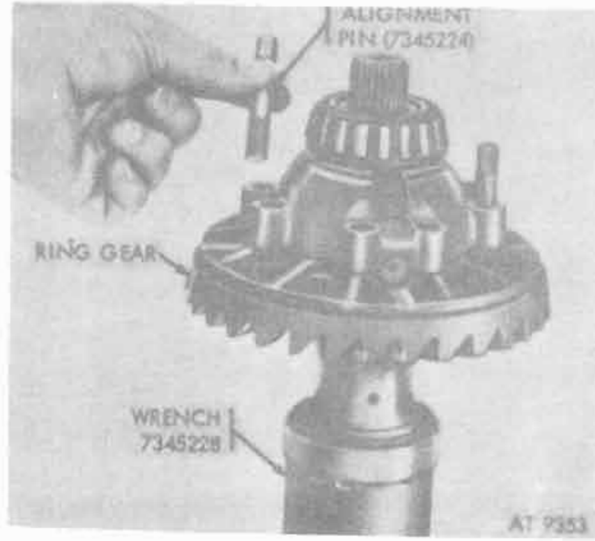


Figure 12-27. Placement of ring gear alinement pins (7345224).

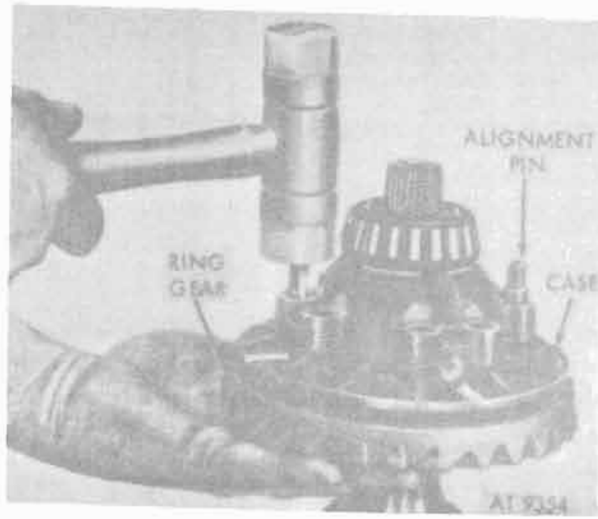


Figure 12-28. Removing ring gear.

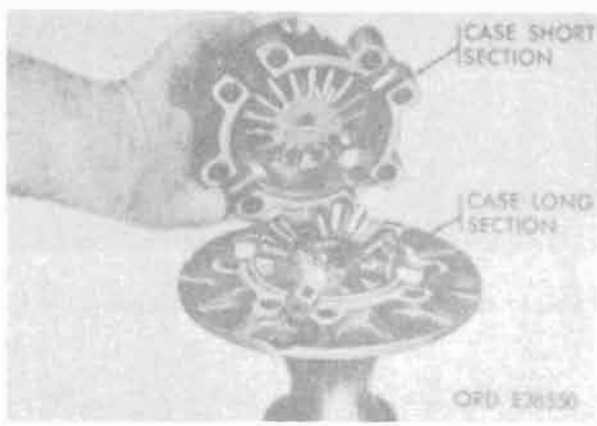


Figure 12-29. Differential case, short and long sections.

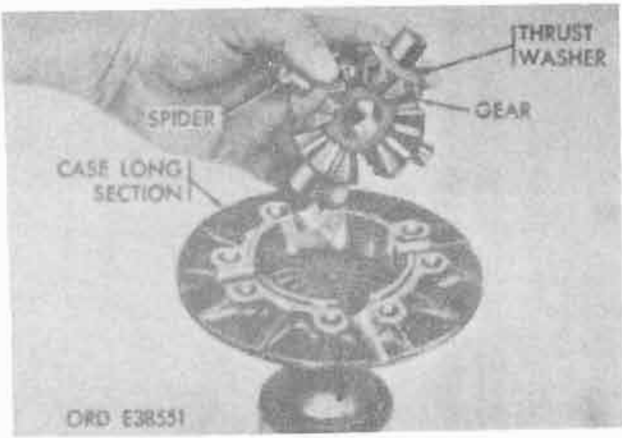


Figure 12-30. Differential spider, spider gears, and thrust washers.

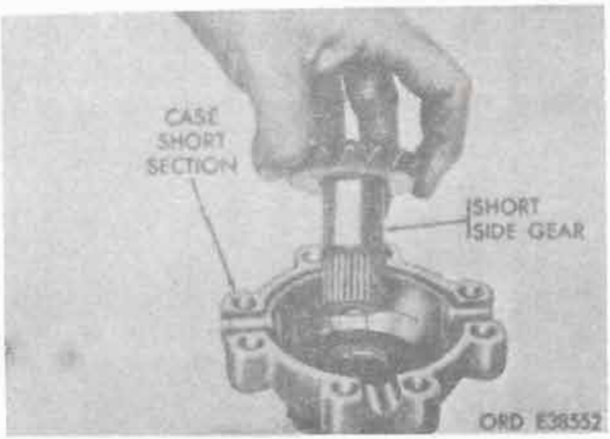


Figure 12-31. Differential case, short side gear.

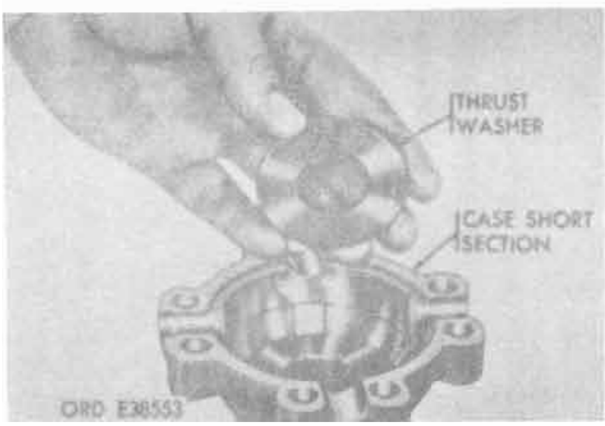


Figure 12-32. Differential case, short section side gear thrust washer.

Figure 12-33. Differential case, long side gear.

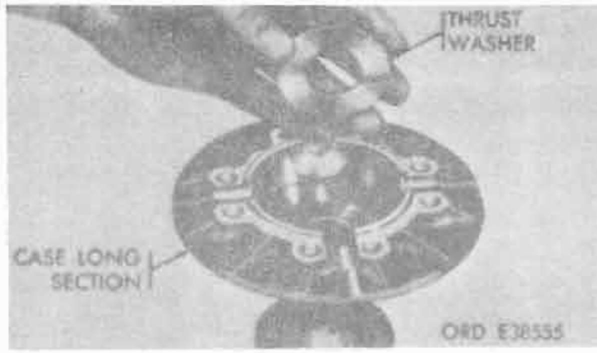


Figure 12-34. Differential case, long section side gear thrust washer.

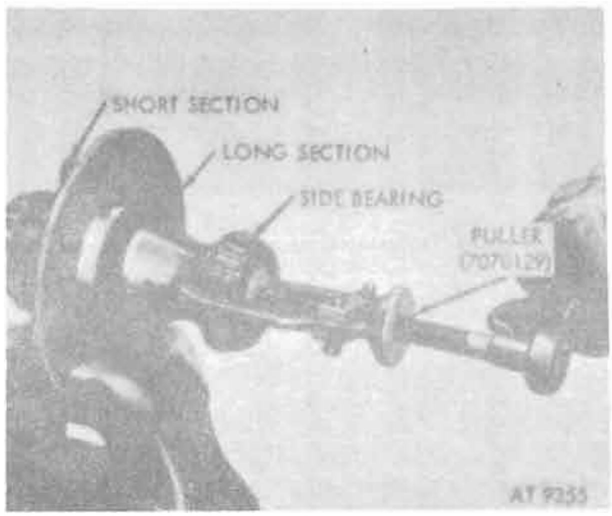


Figure 12-35. Using puller (7078129) to remove side bearing from case section.

12-11. Inspection and Repair of the Differential Case Assembly

a. Inspection. For inspection of the differential case assembly refer to table 12-2 and figure 12-36.

b. Repair. For repair of the differential case assembly refer to general instructions in paragraph 12-5.

Table 12-2. WEAR LIMITS, DIFFERENTIAL CASE ASSEMBLY

Fig. No.	Key	Point of measurement	Size of new part	Wear limit
12-36	1a	Inside diameter of gear	3.500-3.501	*
12-36	2a	Inside diameter of bore	1.126-1.127	1.129
12-36	2b	Outside diameter at side bearing seat.	1.6265-1.6275	*
12-36	2c	Outside diameter at ring gear shoulder.	3.499-3.500	*
12-36	2d	Inside diameter of eight drive-gear mounting holes.	0.447-0.450	*
12-36	3a	Outside diameter of side gear shaft (long).	1.124-1.125	1.123
12-36	4a	Outside diameter of spider shafts.	0.6245-0.6252	0.6240
12-36	5a	Inside diameter of pinion gear bore.	0.627-0.629	0.630
12-36	6a	Outside diameter of side gear shaft (short).	1.124-1.125	1.123
12-36	7a	Inside diameter of side gear shaft bore.	1.126-1.127	1.129
12-36	7b	Inside diameter of spider shaft bore (with 2 mated TØ7).	0.6241-0.6276	*
12-36	7c	Outside diameter at bearing seat.	1.626-1.627	*
12-36	8a	Outside diameter of bearing cup.	2.999-3.0008	*
12-36	8b	Inside diameter of bearing cone.	1.6250-1.6255	*
12-36	11a	**Outside diameter of drive flange at oil seal contact area.	1.560-1.565 *	*
12-36	16a	Outside diameter of bolt	0.437-0.438	*
12-36	18a	Thickness of thrust	0.046-0.048	0.044
12-36	19a	Thickness of thrust washer	0.030-0.032	0.029

** Replace drive flange 11 if seal grooves are deeper than 0.003 inch.

* See paragraph 12-6a (2).

NOTE

The fit of the differential cup (8a, table 12.2) in the cover (7a, table 12-1) and carrier housing (4a, table 12-1) is from 0.000- to 0.002-inch loose. A small amount of cup rotation or creeping is possible, but is not detrimental. It is not advisable to tamper with the 0.000- to 0.002-inch fit of these cups, as it may become difficult to obtain the proper preload condition when the unit is assembled.

12-12. Assembly of Differential Case

a. Using driver (7345257) and arbor press, press side bearing on case short section (fig. 12-37).

b. Using driver (7345257) and arbor press, press side bearing on long case half (fig. 12-37).

c. Lubricate backface of long side gear and both sides of washer, and install long section, using OE as a lubricant (fig. 12-38).

d. Lubricate four spider journals, spider pinion gears, bores, and both sides of four thrust washers; and install in case long section, using OE as a lubricant (fig. 12-39).

e. Lubricate backface of short side gear and both sides of washer; and install in case, using OE as a lubricant (fig. 12-40).

f. Assemble case sections. Index mating marks must be matched. Refer to paragraph 12-9 and figure 12-41.

g. Assemble drive (ring) gear to case using alinement pins (7345224) (fig. 12-42).

h. Lubricate bolts to prevent seizure using OE as a lubricant.

i. With alinement pins (7345224) in place, position lock plates and start bolts into ring (fig. 12-42).

j. Tighten for opposite bolts and remove alinement pins (7345224) (fig. 12-43).

k. Position case in vise using installed bolts as clamping areas. Lubricate, using OE as a lubricant, and install remaining four bolts and two lock plates (fig. 12-44).

l. Torque all bolts to 65-85 lb.-ft. Close lock plate tangs against bolt heads.

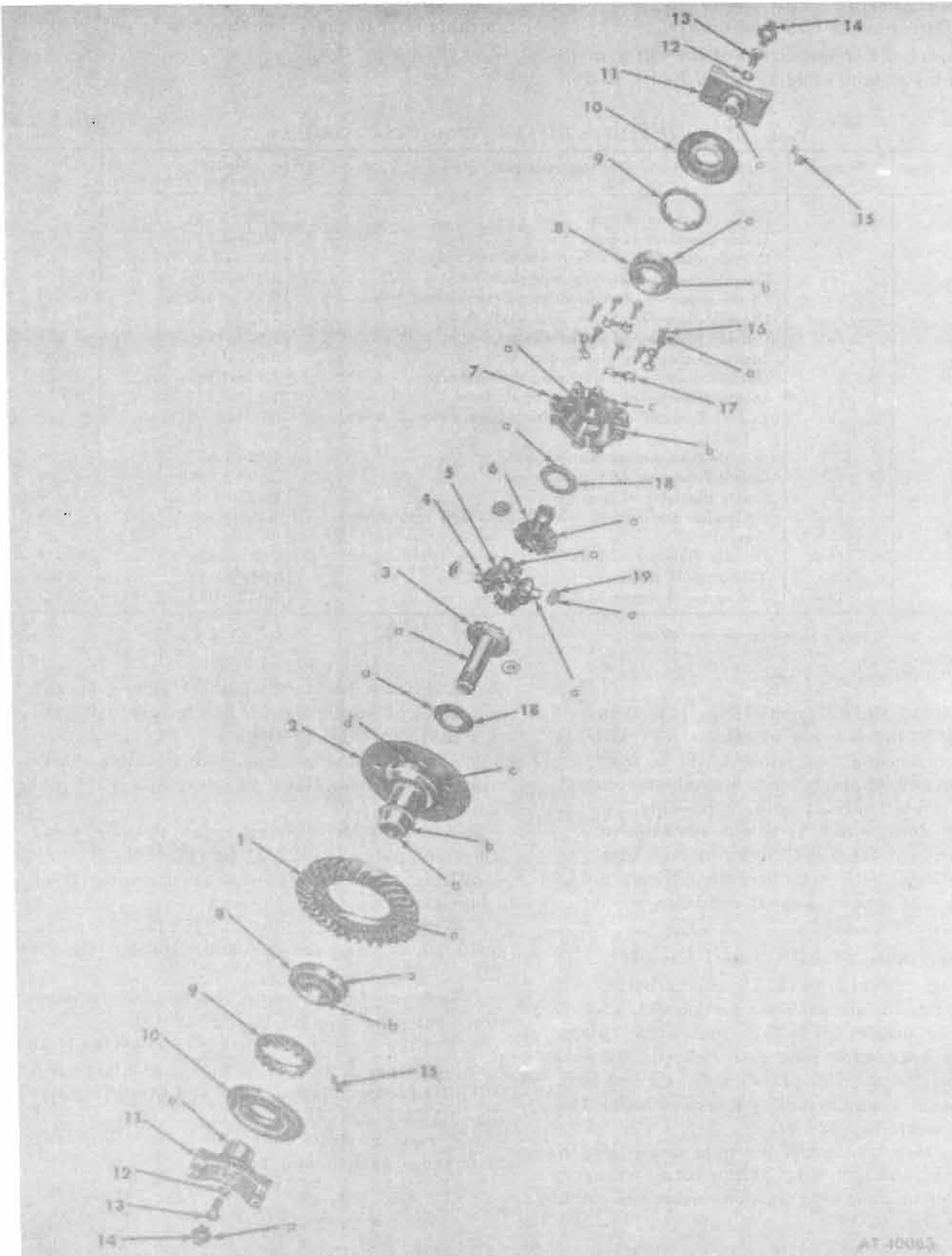


Figure 12-36. Differential case assembly—points of measurement.

Legend to figure 12-36:

1* Ring gear
2 Case (long)
3 Side gear (long)
4 Spider
5 Pinion gears
6 Side gear (short)
7 Case (short)
8 Bearing and cup
9 Adjusting nut
10 Oil seal assembly
11 Flange assembly
12 Washer
13 Bolt
14 Tab lock (older vehicles only)
15 Lock
16 Bolt
17 Lock plate
18 Thrust washer
19 Thrust washer

* Ring gear and pinion shaft assemblies are marked and supplied in matched set.

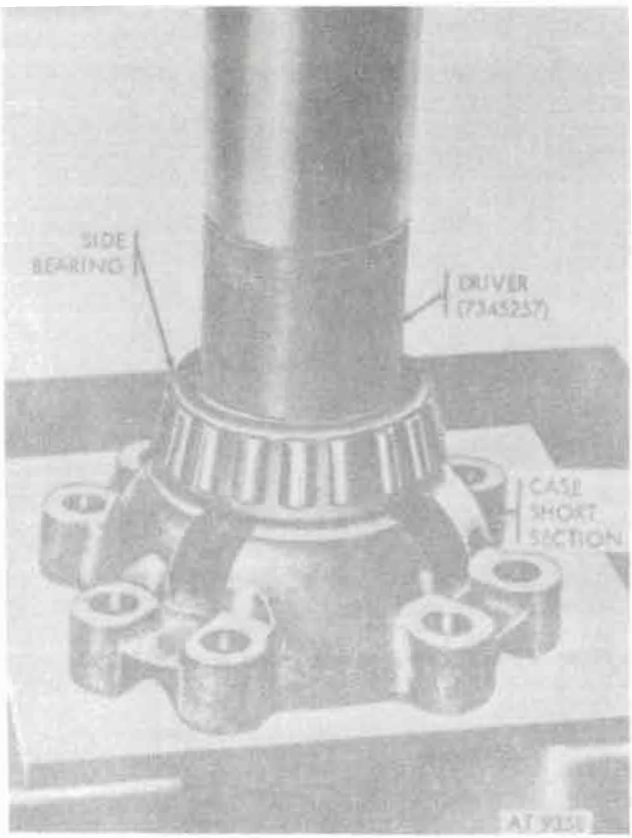


Figure 12-37. Installing side bearing on differential case.

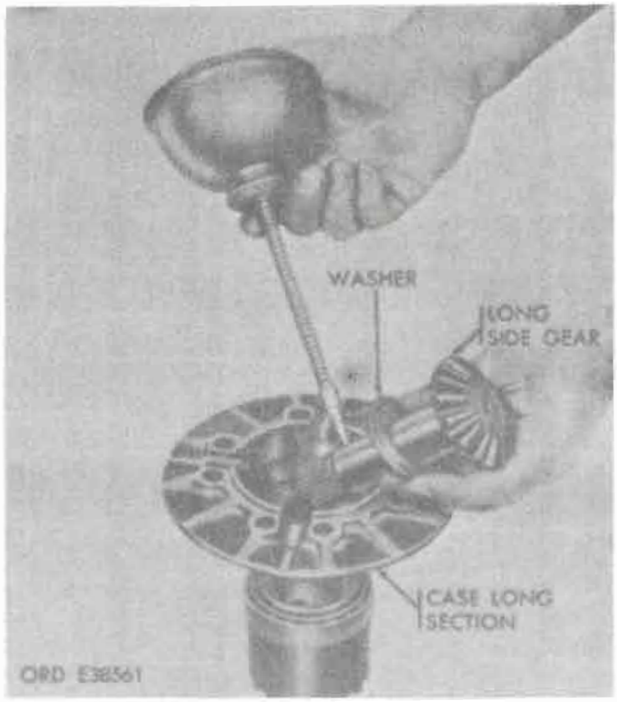


Figure 12-38. Lubricating and installing long side gear and thrust washer.

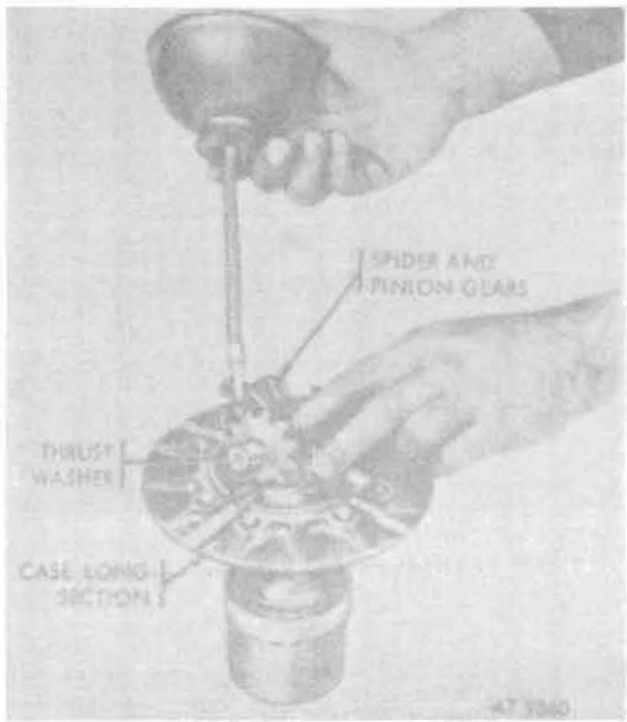


Figure 12-39. Lubricating and installing spider, spider pinion gears, and thrust washers.

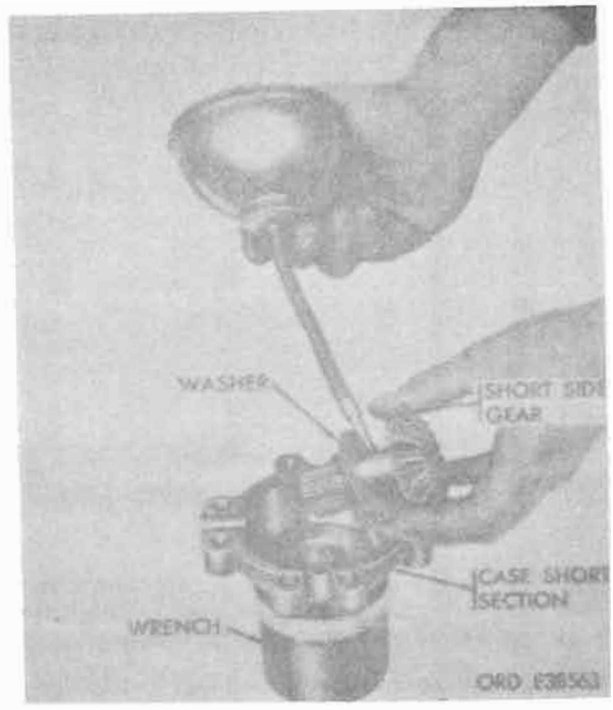


Figure 12-40. Lubricating and installing short side gear and thrust washer.

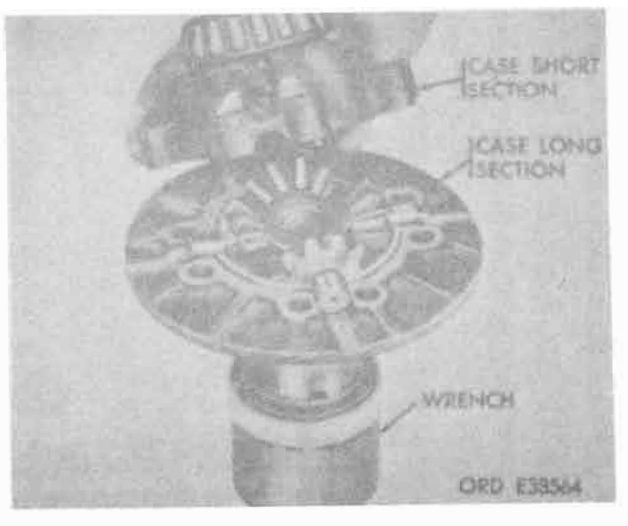


Figure 12-41. Assembling differential case sections.

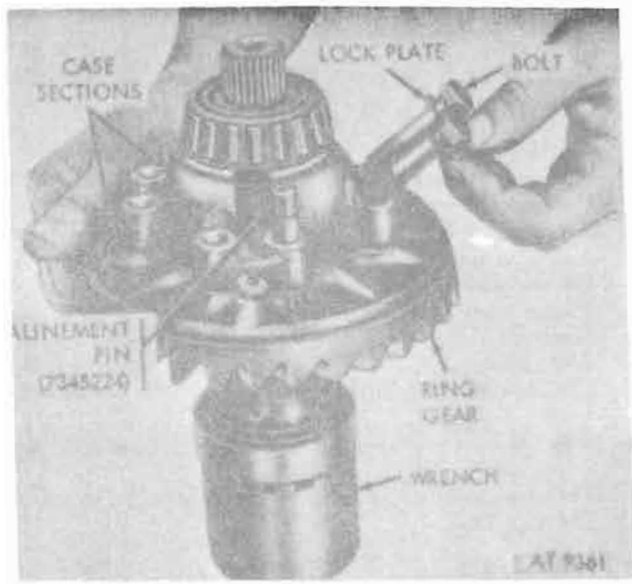


Figure 12-42. Using alinement pins (7345224) to assemble drive gear to differential case.

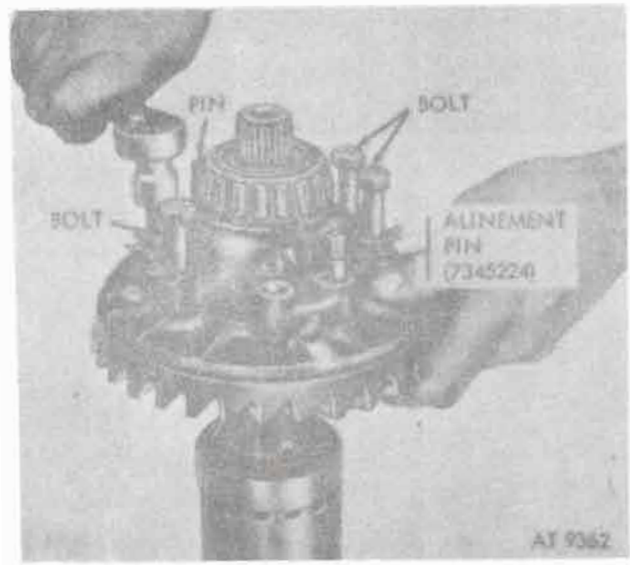


Figure 12-43. Removing alinement pins (7345224).

12-13. Inspection and Repair of the Pinion Shaft

a. Inspection. For inspection of the pinion shaft refer to table 12-3 and figure 12-45.

b. Repair. For repair of the pinion shaft refer to general instructions in paragraph 12-5.

Table 12-3. Wear Limits—Pinion Shaft and Associated Parts

Reference Fig. No.	Key	Point of measurement	Size of new part	Wear limit
12-45	8a	Pinion shaft, large-end bearing front cone.	0.0600-0.9605	*
12-45	8b	Pinion shaft, small-end bearing seat.	1.1088-1.1084	*
12-45	8c	Pinion shaft, large-end bearing.	0.9610-0.9615	*
12-45	10a	Bearing cup assy., outside diameter.	3.1875-3.1885	*
12-45	10b	Bearing mounting diameter	0.9600-0.9605	*
12-45	15	**Outside diameter at oil seal contact area.	1.312-1.315	*
12-45	7a	Bearing outside diameter	1.8504-1.8499	*
12-45	4a	**Outside diameter at oil seal contact area.	1.312-1.315	*

** Replace drive flange (4 or 15) if seal grooves are deeper than 0.003 in.

* See paragraph 12-6a(2)

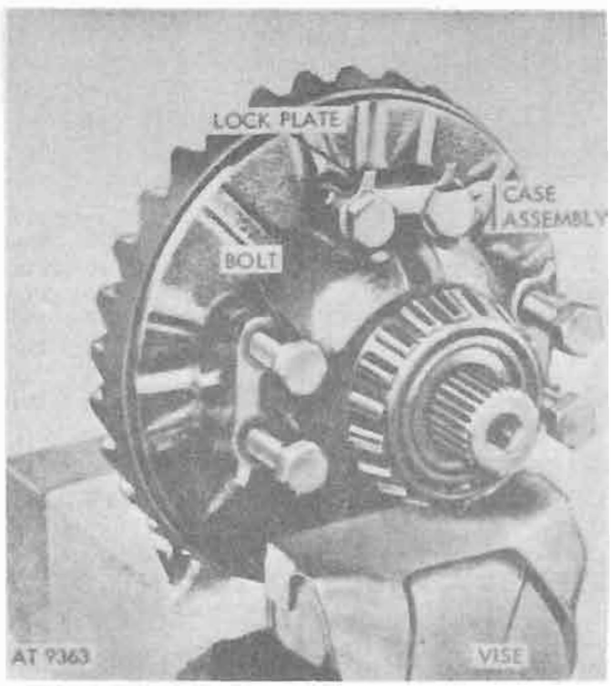
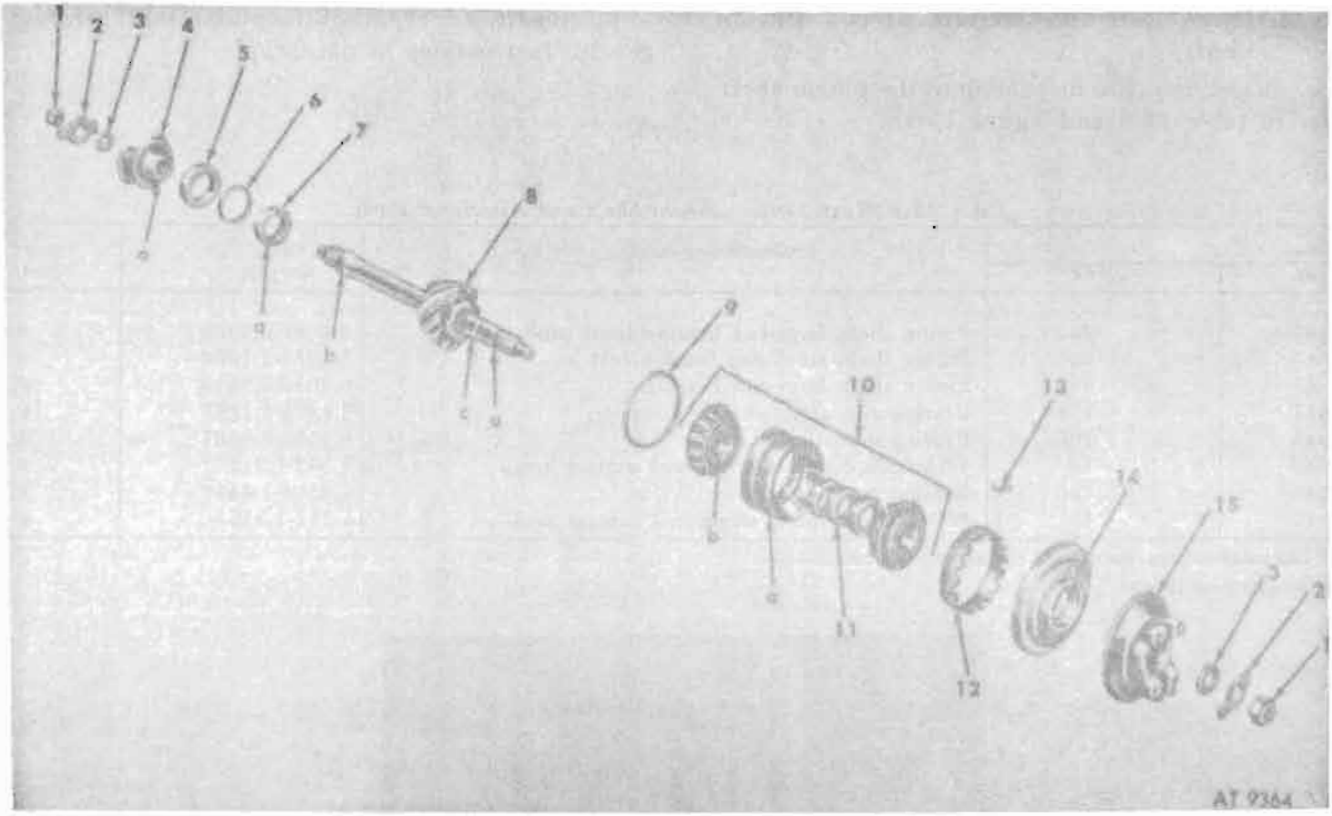


Figure 12-44. Position differential case in vise.



1	Nut	9	Shim
2	Tab	10	Pinion bearing assy.
3	Washer	11	Pinion bearing spacers
4	Drive flange	12	Adjusting nut
5	Seal	13	Lock
6	Spacer	14	Seal
7	Pinion Bearing	15	Drive flange
8*	Pinion assembly		

* Ring gear and pinion shaft assembly are marked and supplied as matched sets.

Figure 12-45. Pinion shaft and associated parts—points of measurement.

Section IV. ASSEMBLY AND ADJUSTMENT OF DIFFERENTIAL

12-14. Installation of Pinion Shaft Rear Bearings, Spacer, and Seal

a. Insert pinion shaft rear bearing in housing bore. Lubricate bearing rollers, using OE as lubricant (fig. 12-46).

b. Insert pinion shaft rear bearing spacer in housing bore. (fig. 12-47.)

c. Position seal in housing bore (spring toward inside). Lubricate lips of seal with grease (GAA), and coat outside of seal with compound sealer (FSN 8030-656-1426) (fig. 12-48).

d. Install bearing, spacer, and seal into housing, using driver (7345257) (fig. 12-49).

12-15. Adjustment of Differential Side Bearing Pre-Load

In order to hold the rollers of a tapered roller bearing in the exact designed relationship to the bearing cone and cup, a certain amount of preload is required. This acts to continously squeeze the bearing rollers into the conical surfaces. New roller bearings have a small amount of irregularities due to manufacturing tolerances, and preloading must be adjusted so that a normal preload remains after the bearings have run-in to a perfect fit. Used bearings are preloaded to a lesser degree since the running-in process has already taken place. Preloading of differential bearings must be very carefully done since the preload also controls gear position when under load. When adjusting the gearing of this differential, be sure that bearing preload is maintained along with the gear settings.

NOTE

It is recommended that a pin or short drift be inserted through one of the four oil windows in the short differential case half to jam the differential (spider) gears while the bearing check is being made. The pin must be removed when the differential case is removed from the housing (after the adjustment is determined and the adjusting nuts and housing have been marked).

Figure 12-46. Pinion shaft rear bearing.

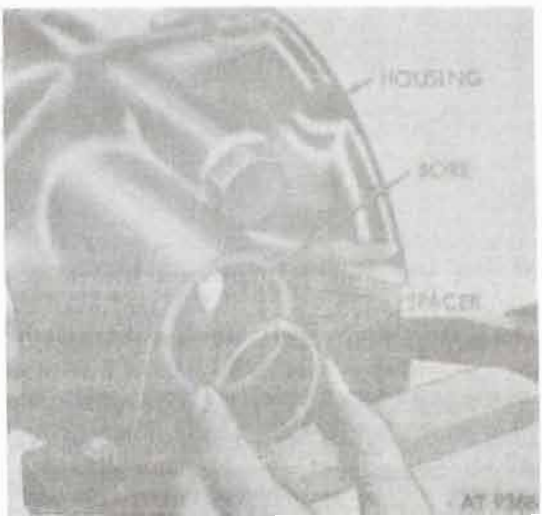


Figure 12-47. Pinion shaft rear bearing spacer.

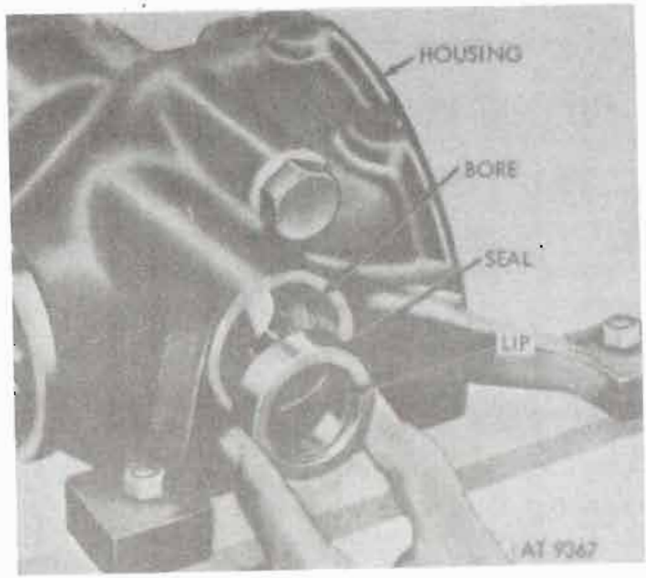


Figure 12-48. Pinion shaft rear bearing seal.

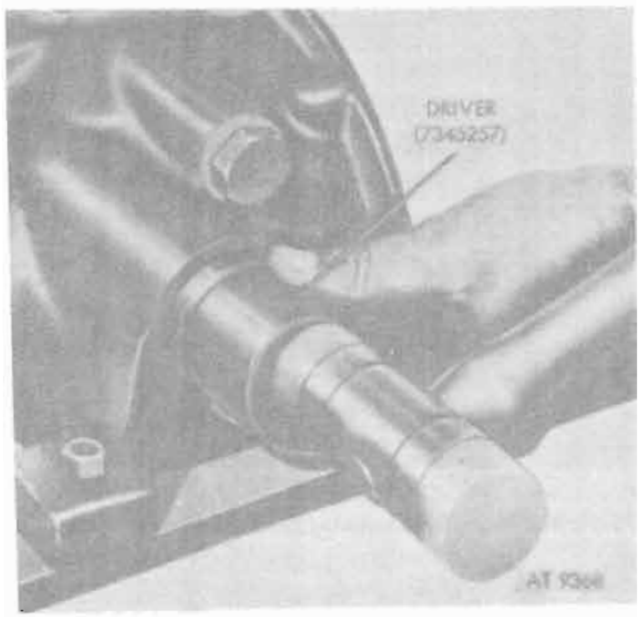


Figure 12-49. Using driver (7345257) to install pinion shaft rear bearing seal, spacer, and bearing.

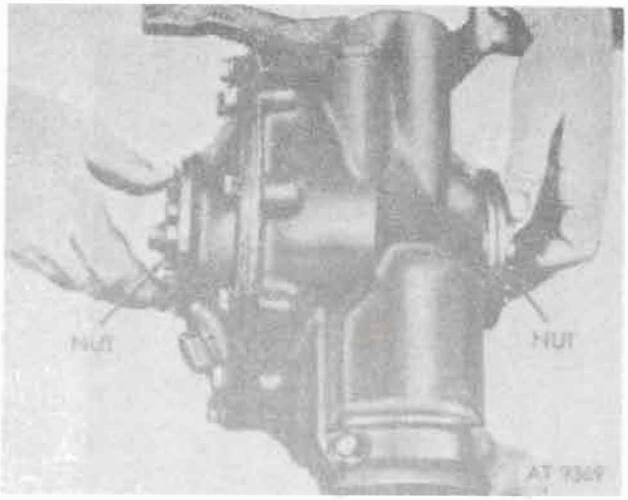


Figure 12-50. Differential case bearing cups adjusting nut.

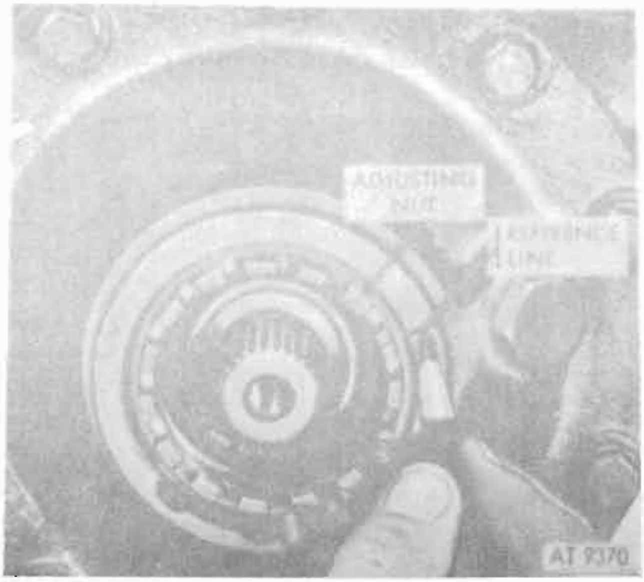


Figure 12-51. Marking reference line of bearing adjusting nut.

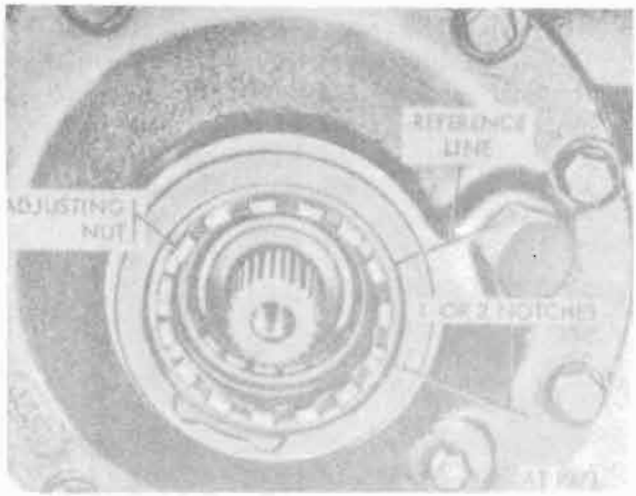


Figure 12-52. Position of tightened bearing cup adjusting nut

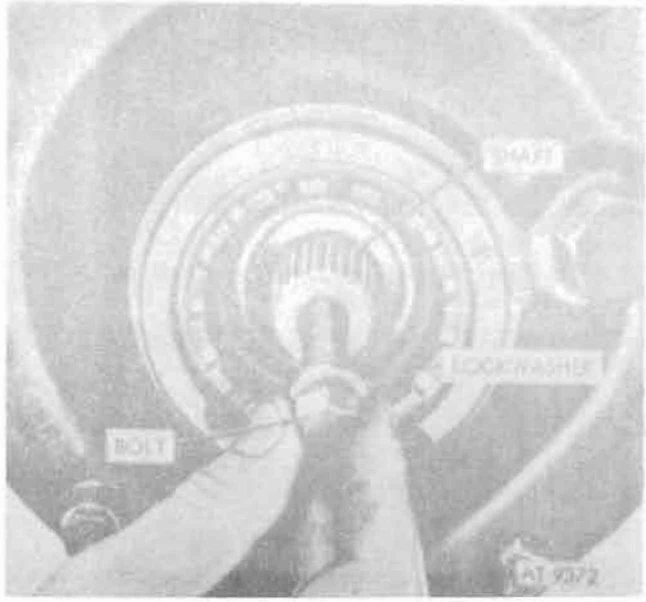


Figure 12-53. Drive flange retaining bolt and lockwasher.

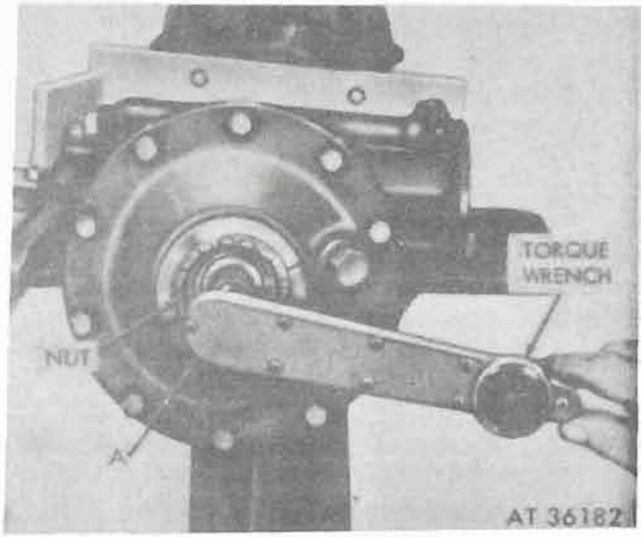


Figure 12-54. Adjusting and checking preload of differential case bearings.

a. Position differential in housing. Refer to figure 12-5.

b. Install cover and bearing cups. Refer to figure 12-3.

NOTE

Use no gasket at this point (temporary installation).

c. Install adjusting nuts approximately the same number of turns on each side (fig. 12-50).

d. Tighten adjusting nuts clockwise finger tight.

e. Mark a reference line on adjusting nut and housing (fig. 12-51).

f. Using wrench (7345228), tighten nut clockwise. Refer to figure 12-8. Tighten nut one notch clockwise for used bearings or two notches for new bearings, using housing mark as reference point (fig. 12-52).

g. Temporarily install flange retaining bolt in shaft (fig. 12-53).

h. Measure preload, using torque wrench, and rotate side bearing adjusting nuts as required to obtain correct preload (fig. 12-54). Record number of notches required to obtain preload for reference when assembling. Effort required to turn shaft should be 15-25 lb.-in. for new bearings or 2-6 lb.-in. for used bearings.

i. Remove differential cover; do not disturb mark. Refer to figure 12-3.

j. Remove differential case assembly from housing. Refer to figure 12-5.

12-16. Assembly, Installation, and Adjustment of Pinion Gear and Bearings

a. Install inner front bearings on pinion shaft (fig. 12-55).

b. Position spacer, bearing cup, and outer bearing on pinion shaft (fig. 12-56).

c. Using suitable holding tool, install front drive flange, washer and nut on pinion shaft. Torque nut to 60-70 lb-ft. (fig. 12-57).

NOTE

Rotate bearings while torquing nut to properly seat them. This prevents damage to cup and cone and roller.

d. Check bearing preload by holding bearing outer race and turning shaft using a pound-inch torque wrench. Effort to turn shaft in either direction should be 10-20 lb.-in. for new bearing installation only (fig. 12-58).

NOTE

Vary spacer size as necessary to secure correct preload. To increase preload, use thinner spacer. To decrease preload, use thicker spacer. For used bearings, cones, cups and spacer must be kept together in proper relation as a bearing pack from previous assembly. When used bearings are reinstalled, preload must approach zero.

e. Remove nut and flange from pinion shaft.

f. Install pinion assembly and pinion shim in housing (figs. 12-59 and 12-60).

NOTE

Pinion shim size will be etched on pinion shaft. If shim dimension is the same as that on the replacement gear, use the same thickness shim. If the shim dimension is greater than the original, use a thinner shim. Shims are provided in eight thicknesses to accurately adjust the depth of the pinion into the drive (ring) gear. Refer to figure 12-73 for gear pattern. If shim dimension is not marked on new gear set use shim removed from old gear set for initial adjustment.

g. Install bearing outer race, spacer, and outer pinion bearing on pinion shaft (figs. 12-18 and 12-19).

NOTE

On earlier carriers the outer race is a press fit into the bore. Press the outer race in housing before assembling spacer and bearing (fig. 12-61).

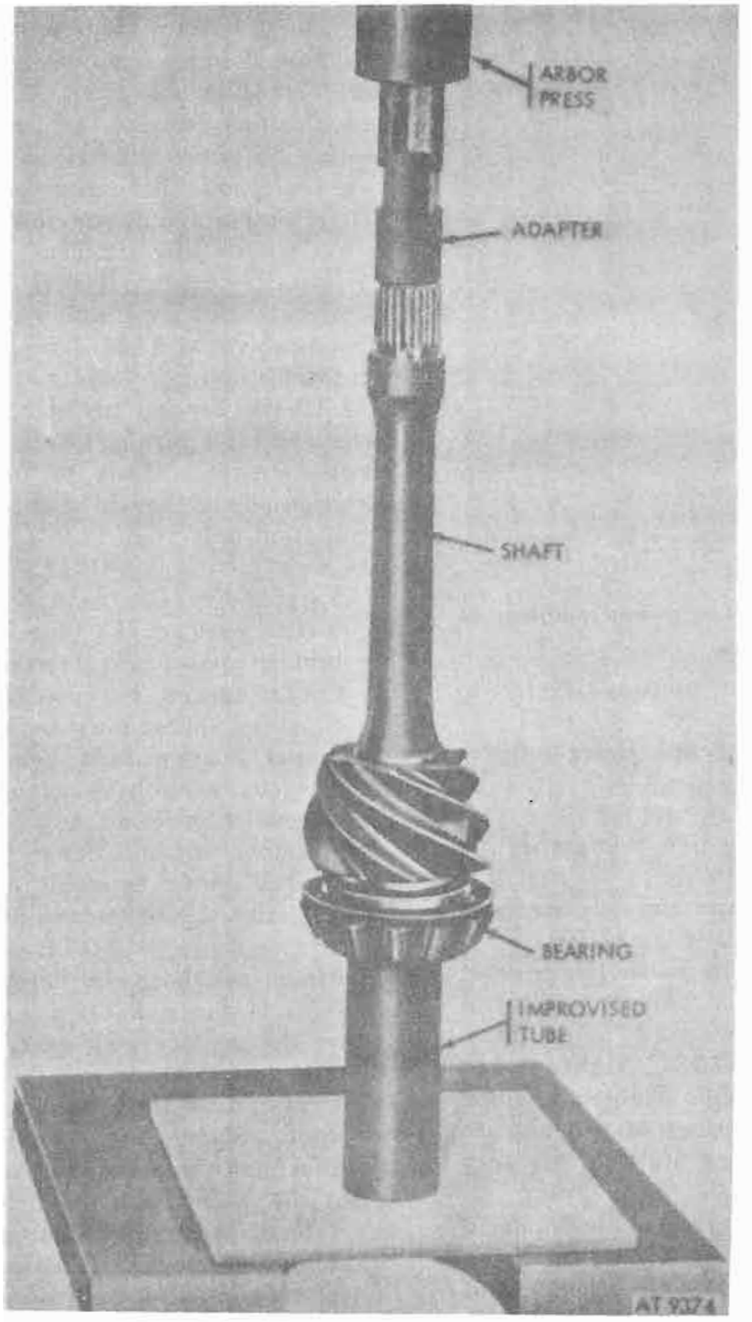


Figure 12-55. Installing inner front bearing on pinion shaft.

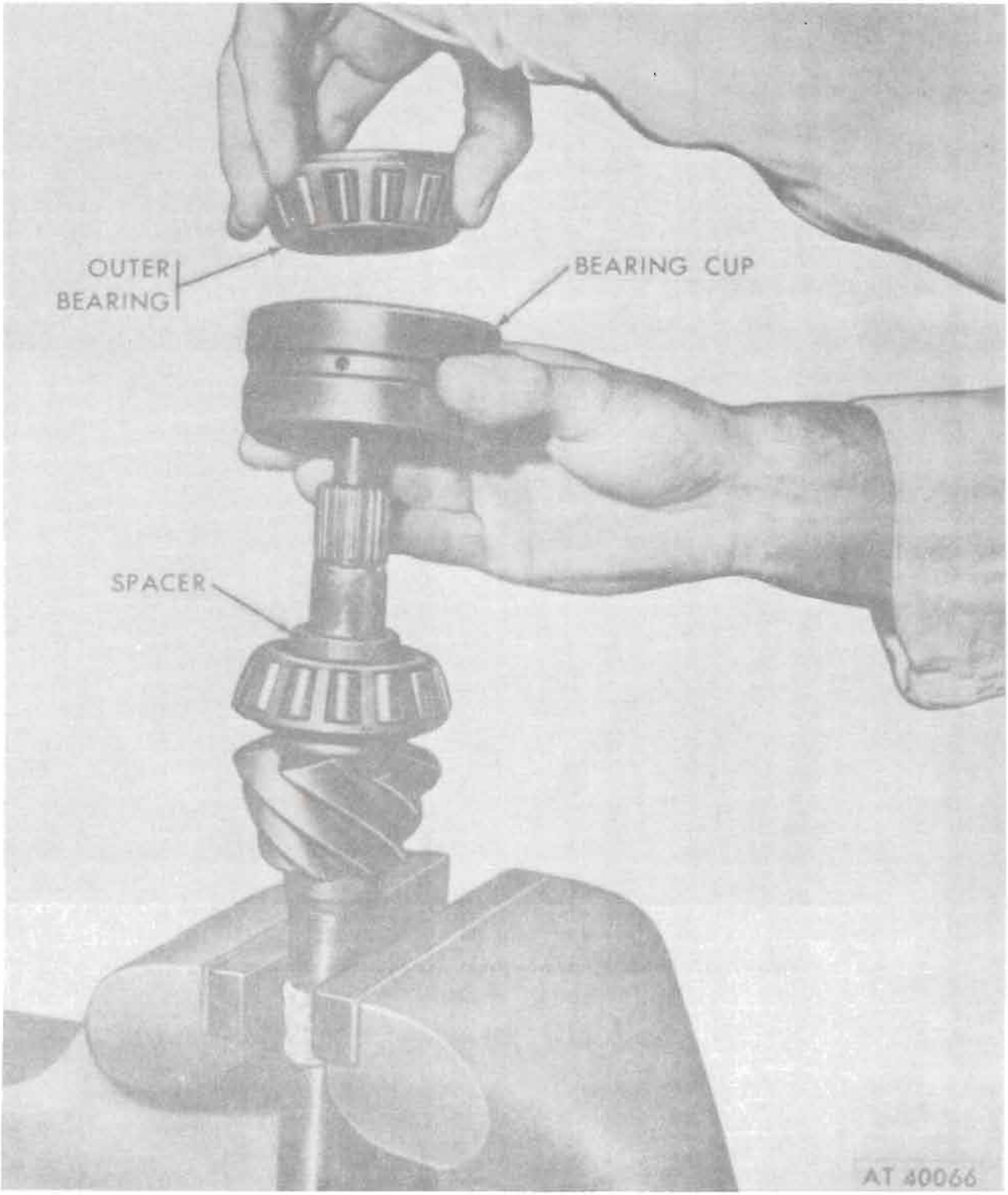


Figure 12-56. Position of spacer, bearing cup, and outer bearing on shaft.

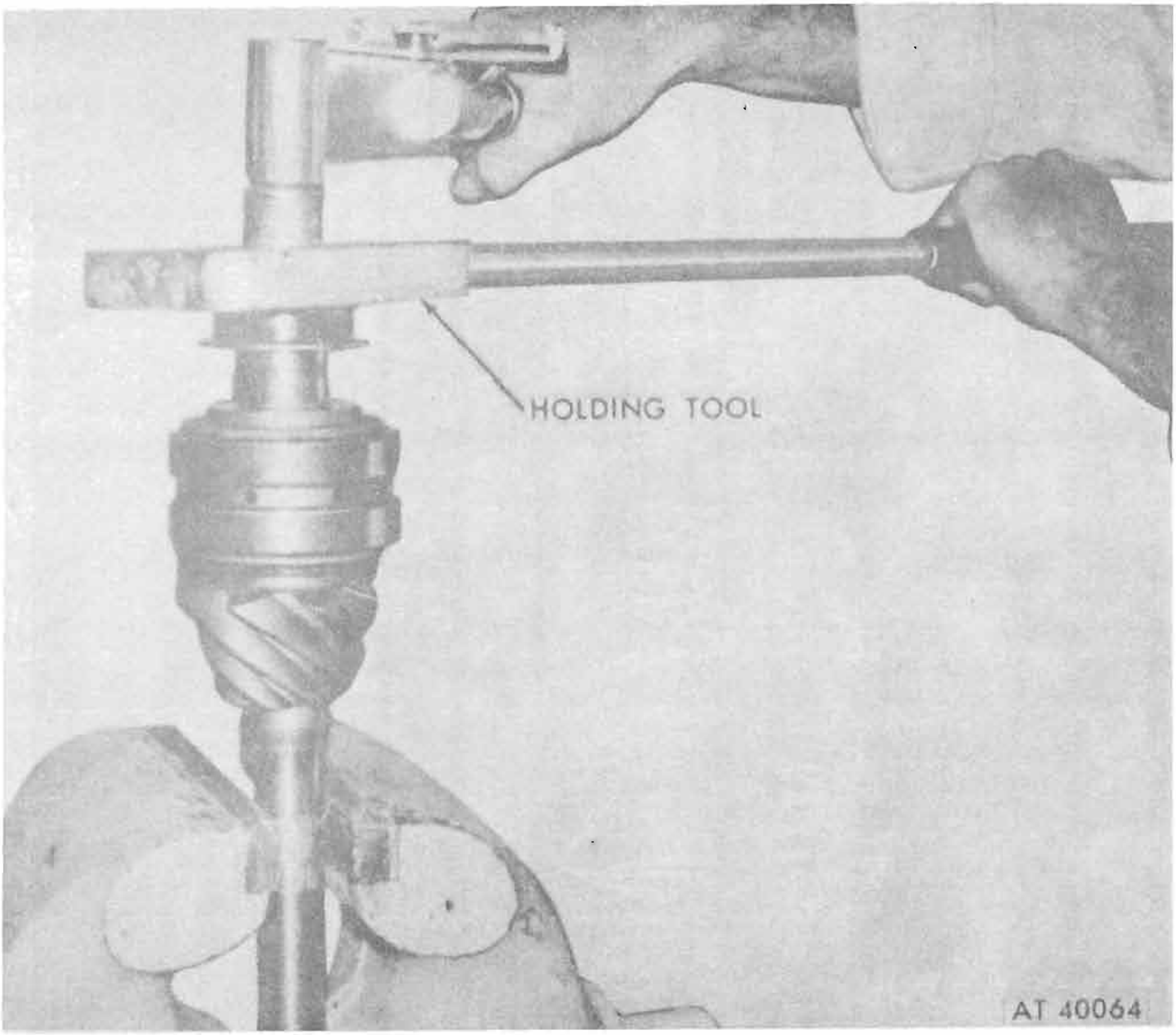


Figure 12-57. Installing front drive flange, washer, and nut on pinion shaft.

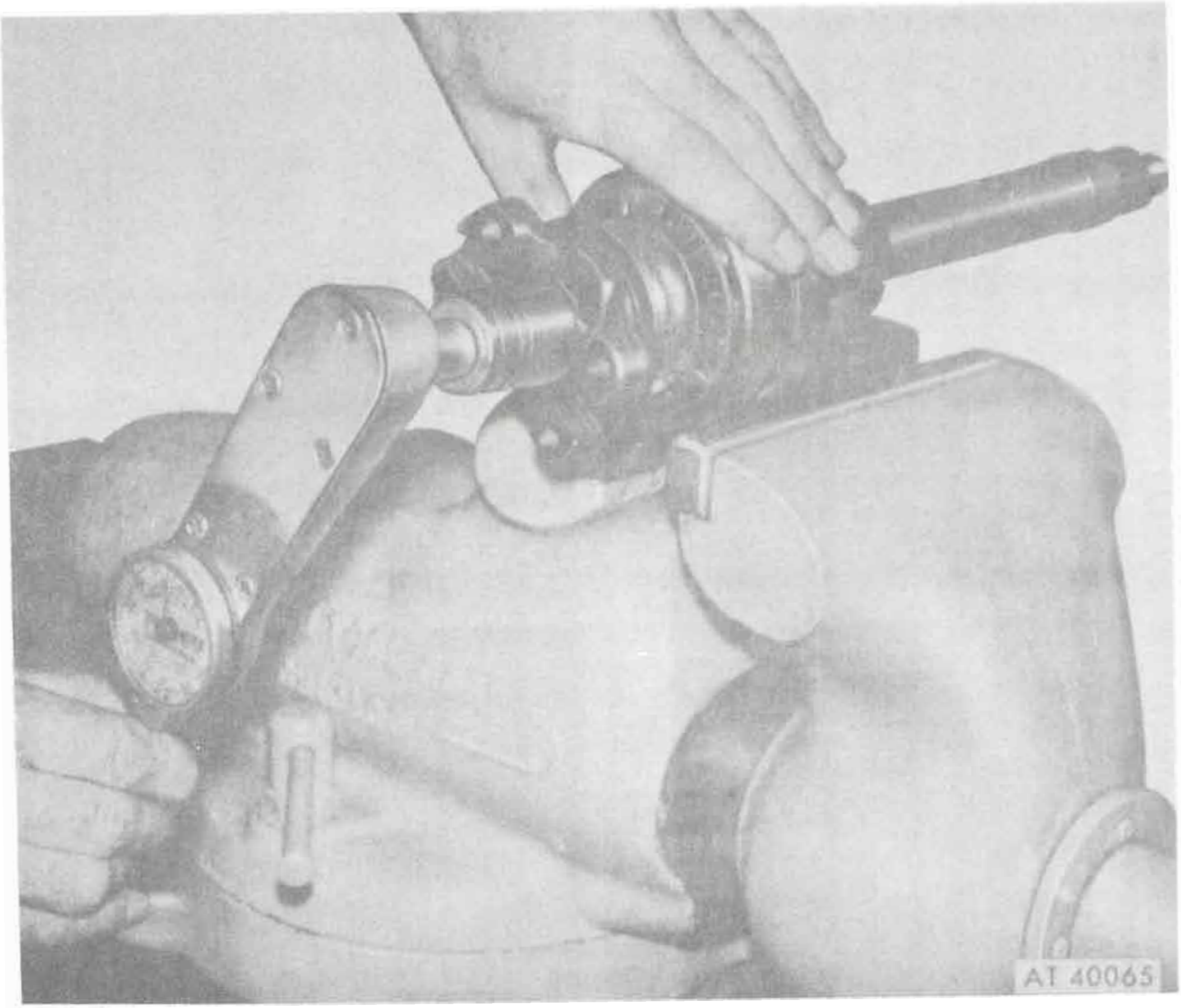


Figure 12-58. Checking differential pinion bearing preload.

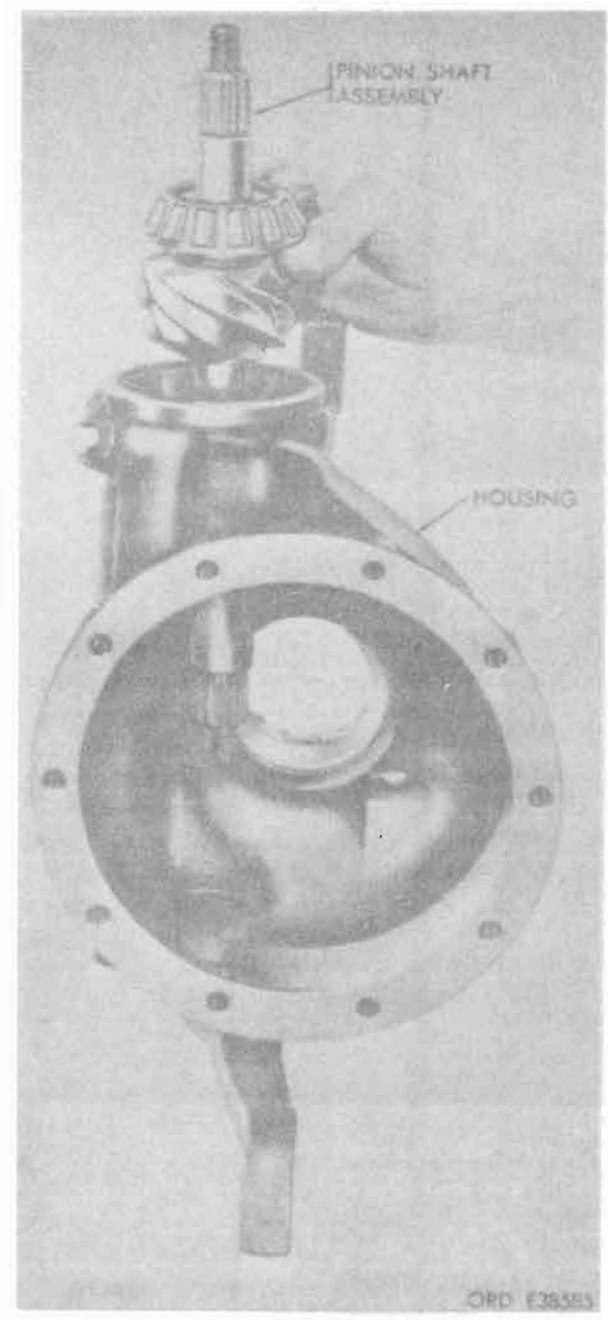


Figure 12-59. Installing pinion shaft in housing.

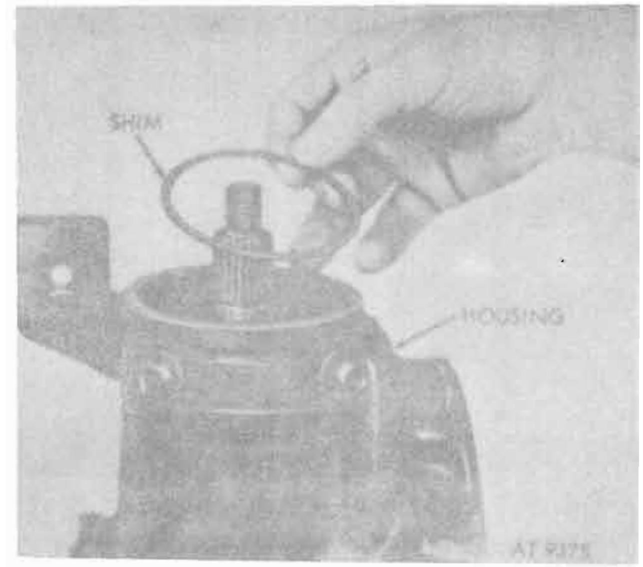


Figure 12-60. Positioning pinion gear shim(s) in housing bore.

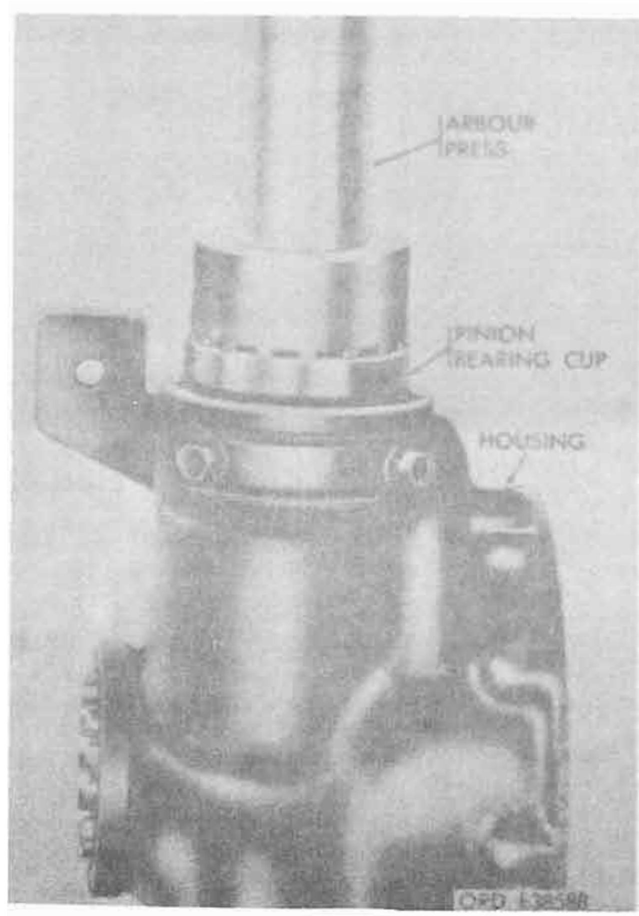


Figure 12-61. Pressing pinion bearing cup in housing.

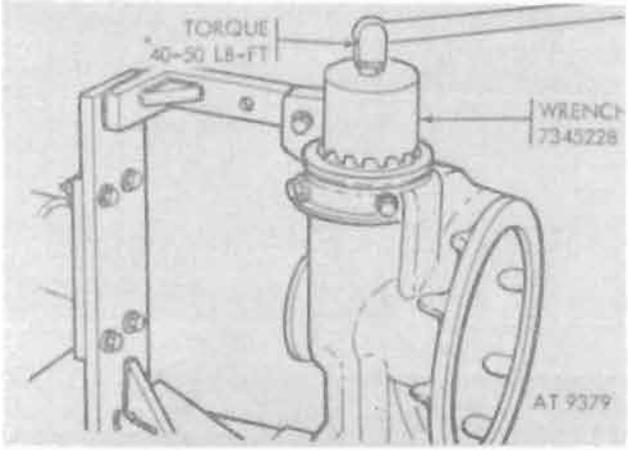


Figure 12-62. Torquing pinion bearing adjusting nut.

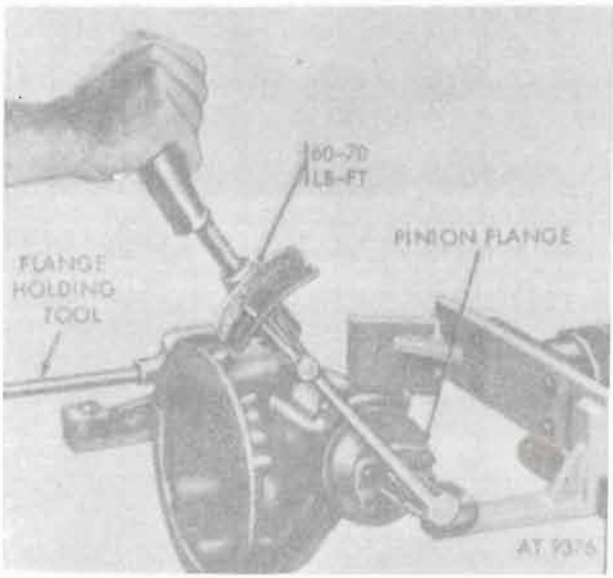


Figure 12-63. Torquing pinion flange nut.

Figure 12-64. Coating ring gear teeth with red lead and oil.

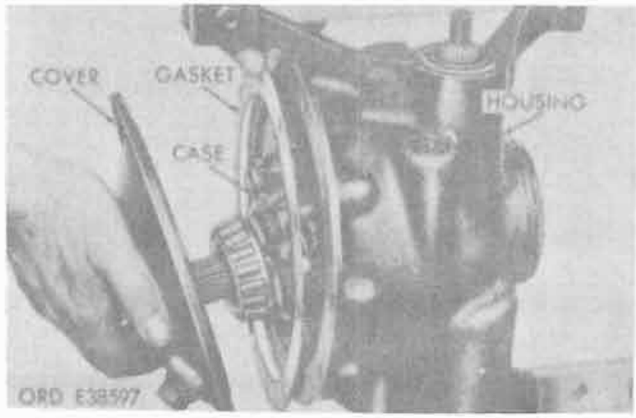


Figure 12-65. Assembling differential case in housing.

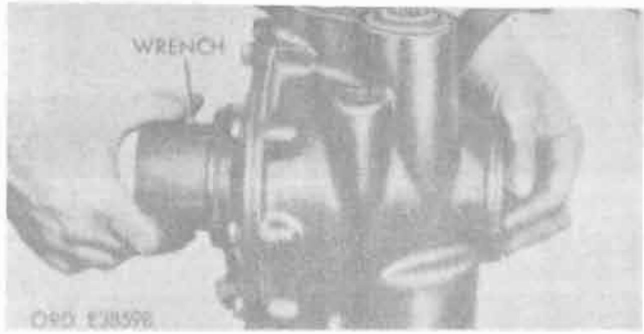


Figure 12-66. Loosening left side bearing adjusting nut.

Figure 12-67. Resetting side bearing preload.

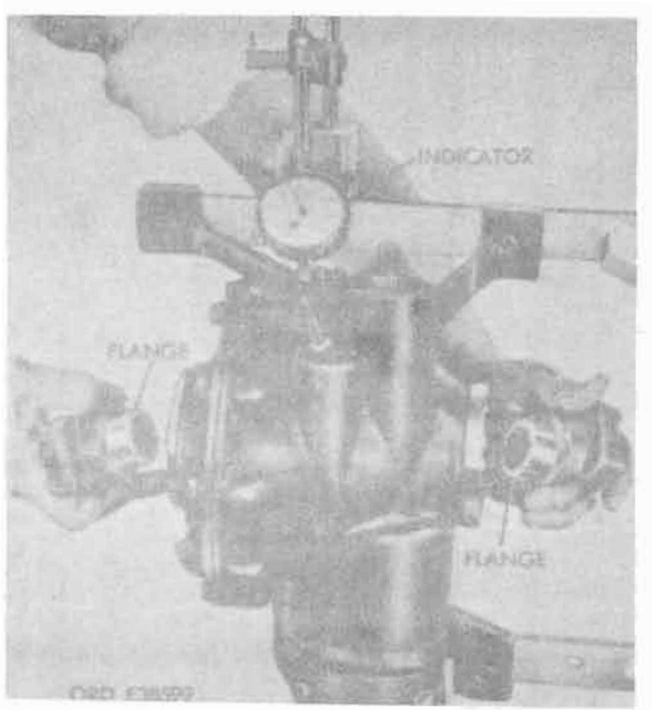


Figure 12-68. Installing dial indicator to check backlash of gears.

Figure 12-69. Setting of dial indicator.

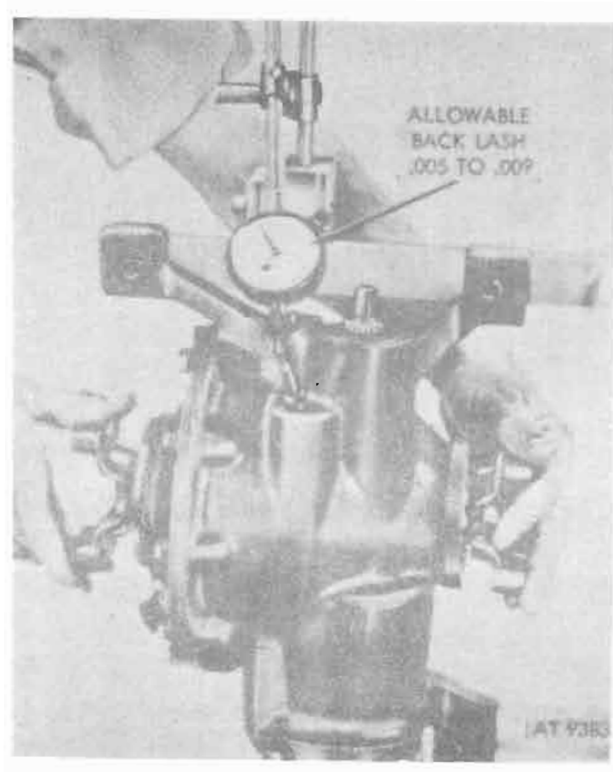


Figure 12-70. Rocking gears to check backlash.

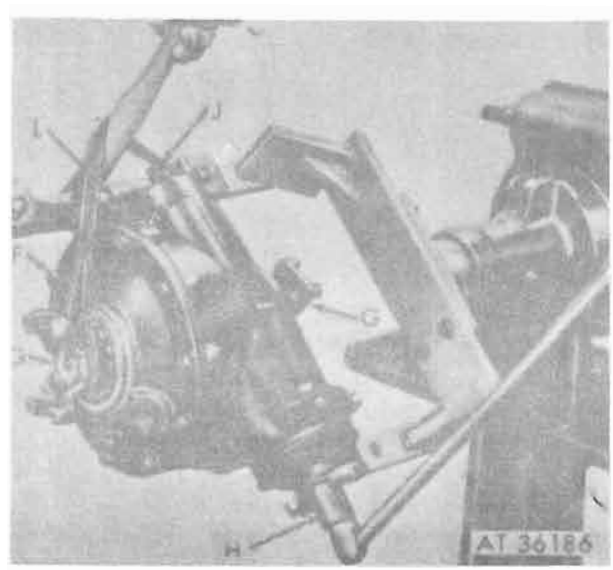


Figure 12-71. Applying resistance (rope brake) to side flanges.

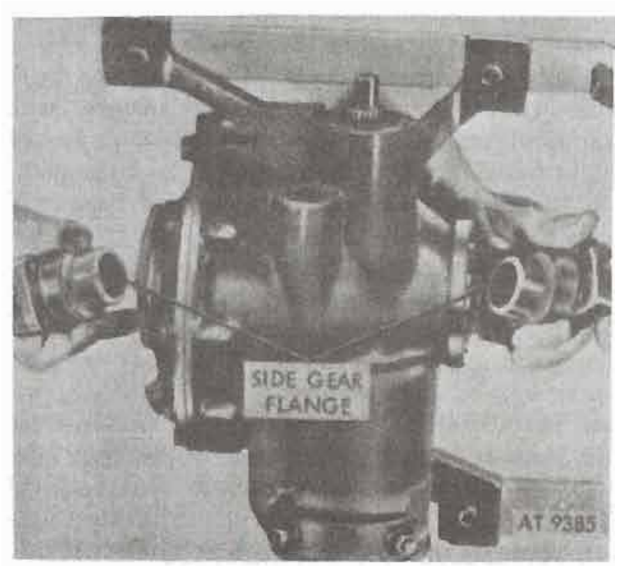


Figure 12-72. Side gear flanges.

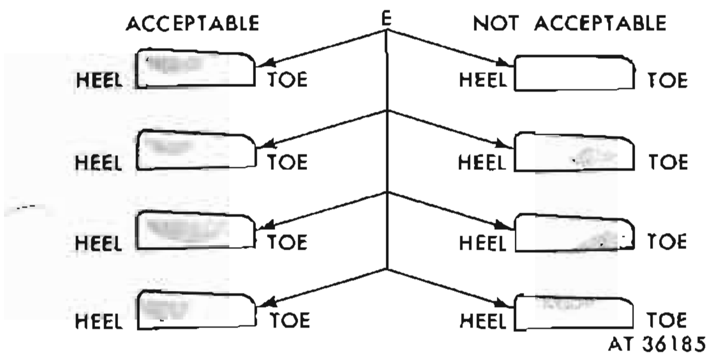


Figure 12-73. Sample ring gear patterns under no-load conditions.

h. Install pinion bearing adjusting nut and torque nut to 40-50 lb.-ft., using wrench (7345228) (fig. 12-62).

i. Install pinion flange and nut and torque nut to 60-70 lb.-ft. (fig. 12-63).

12-17. Adjustment of Ring Gear Backlash

a. Apply a thin coat of red lead in oil to ring gear teeth, (fig. 12-64).

b. Position differential case, cover, and gasket to differential housing (fig. 12-65).

c. Loosen left side bearing adjusting nut several turns (fig. 12-66).

d. Torque differential cover bolts to 25-30 lb.-ft. Refer to figure 12-3.

e. Tighten adjusting nut finger tight, mark reference line, tighten nut the amount determined in paragraph 12-15*h* (figs. 12-51, 12-52, 12-54, and 12-67).

f. Position side flanges and install dial indicator (fig. 12-68).

NOTE

The above and following illustrations show a typical setup for checking backlash. A magnetic type indicator is used; however, a clamptype is adequate for performing the operations.

g. Set up dial indicator through drain hole to check backlash (fig. 12-69).

h. Rock ring gears back and forth and rotate gears to read backlash in several positions (fig. 12-70). Set backlash by adjusting side bearings.

NOTE

When adjusting gear backlash, always maintain correct preload by moving one adjusting nut opposite to the other and the same amount. Backlash must be 0.009-0.016 with a maximum total variation of 0.004 for new gear set installation. Set backlash same as recorded during disassembly for used gear sets. Set .009 backlash for initial adjustment on gear sets that do not have shim dimension marking.

i. Remove dial indicator. Apply resistance (rope brake) to side flanges and rotate pinion shaft with speed wrench (fig. 12-71).

j. Remove rope brake and side flanges (fig. 12-72).

k. Remove housing cover bolts. Refer to figure 12-3.

l. Remove housing cover, gasket, and differential case (fig. 12-65). Inspect ring gear pattern according to following instructions. Adjust as indicated to obtain pattern shown in figure 12-73 for new gear sets. Used gear sets must be adjusted to meet patterns recorded during disassembly.

12-18. Checking and Adjusting Ring and Pinion Gear Mesh

Refer to figures 12-73, 12-74, and 12-75 for sample patterns and adjusting procedure. Adjust reused drive gears to original pattern as recorded during disassembly.

NOTE

Used gear sets must be reassembled with the original carrier, shim, and backlash to insure proper tooth contact pattern. Normally this will return the gear set to its original position, and it will be unnecessary to take pattern check. After obtaining the correct gear pattern, backlash, and bearing preload, remove the differential cover, and clean red lead from the gears. Use caution not to disturb the side carrier bearing adjustment.

12-19. Assembly of Differential

a. Install differential case, housing cover, and gasket. Refer to figure 12-65.

b. Install ten housing cover retaining bolts. Refer to figure 12-3.

c. Torque housing cover bolts to 25 lb.-ft. (fig. 12-76.)

d. Install one bearing adjustment lock to each bearing adjusting nut. Refer to figure 12-7.

CAUTION

Do not disturb bearing adjustment.

e. Install side carrier seals using replacer (7950152) (fig. 12-77).

NOTE

Apply compound sealer (FSN 8030-656-1426) to outer case of seal before installing in case.

f. Install each output flange and secure each with one retaining bolt. Refer to figure 12-12.

g. Using flange holding tool, torque side flange retaining bolts to 40-50 lb.-ft (fig. 12-78).

h. Remove pinion drive flange, nut, and washer.

i. Install pinion adjusting locknut. Refer to figure 12-15.

j. Lubricate pinion shaft front seal lips with grease (GAA), and coat seating surface with compound sealer (FSN 8030-656-1426). Install seal to housing (fig. 12-79).

k. Install front and rear pinion drive flanges to shaft. Refer to figure 12-12.

l. Install pinion shaft flange retaining washers and nuts. Torque nuts to 60-70 lb.-ft. at pinion bearing end. Rotate bearing to keep from binding. Torque nut at opposite end to 35-45 lb.-ft. (fig. 12-80).

m. Install tab on pinion shaft nuts. Bend tab ends down to secure locking tab. Refer to Figure 12-11.

n. Fill carrier assembly to level of fill plug with approximately two pints of lubricating oil, MIL-L-2105, GO 90 for temperatures above +32° F., GO 75 for temperatures +40° F. to —10° F., and GOS for temperatures 0° F. to—65° F.

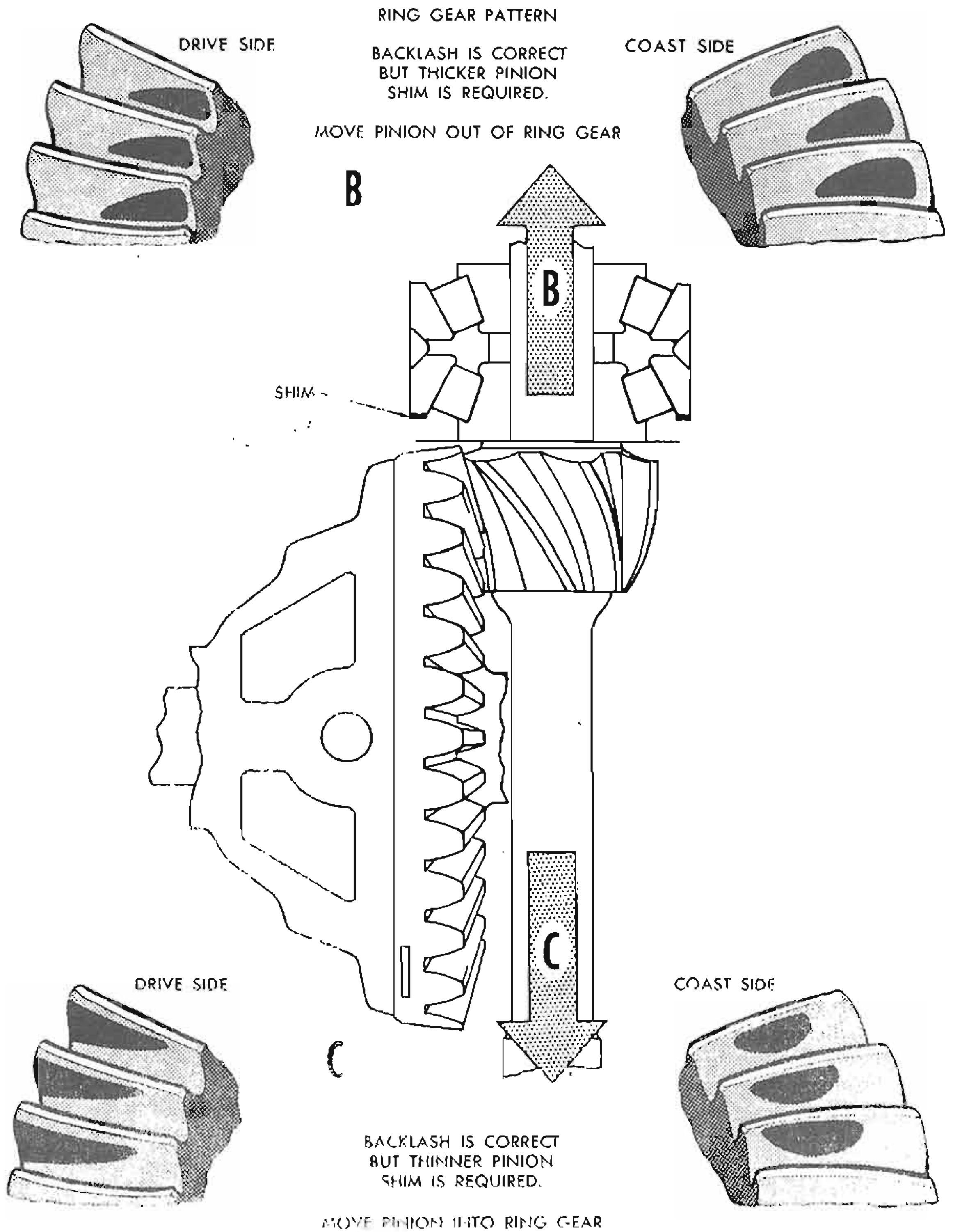


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Figure 12-71. Adjusting pinion depth.

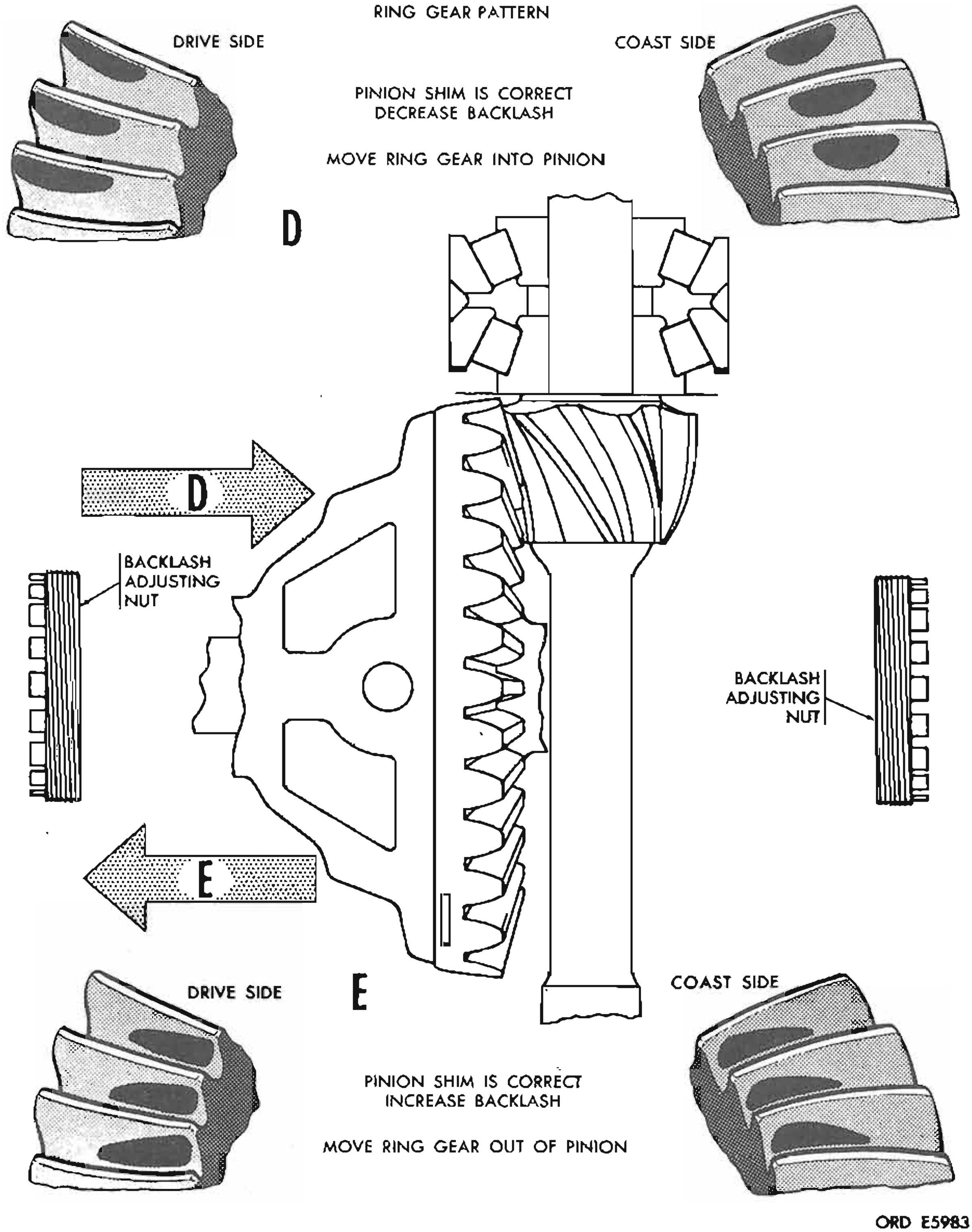


Figure 12-75. Adjusting ring gear backlash.

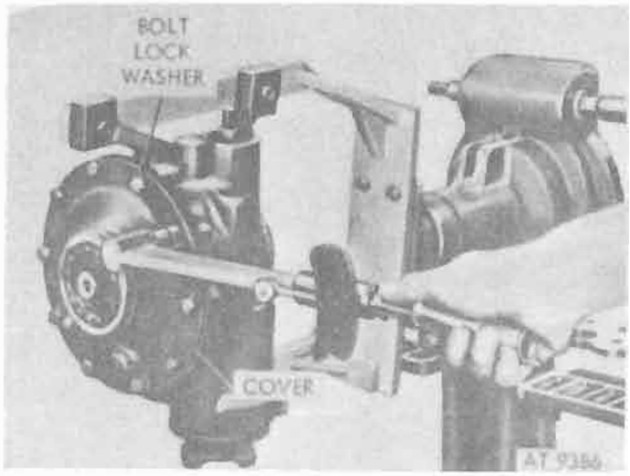


Figure 12-76. Torquing housing cover bolts.

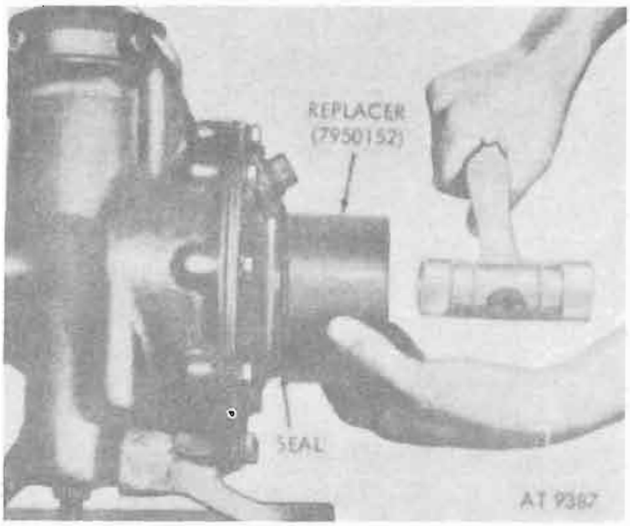


Figure 12-77. Using replacer to install side carrier seal.

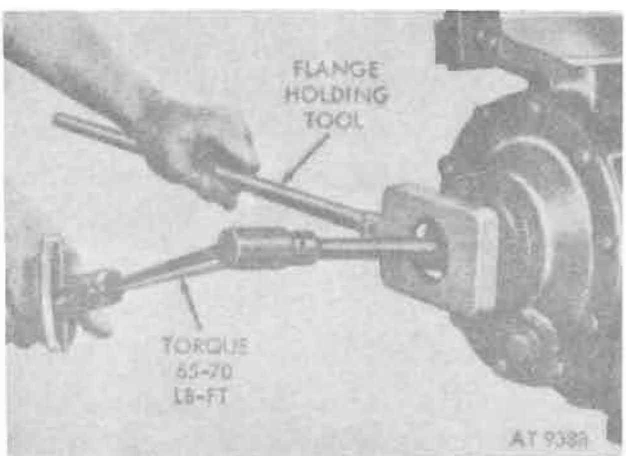


Figure 12-78. Torquing side flange retaining bolt.

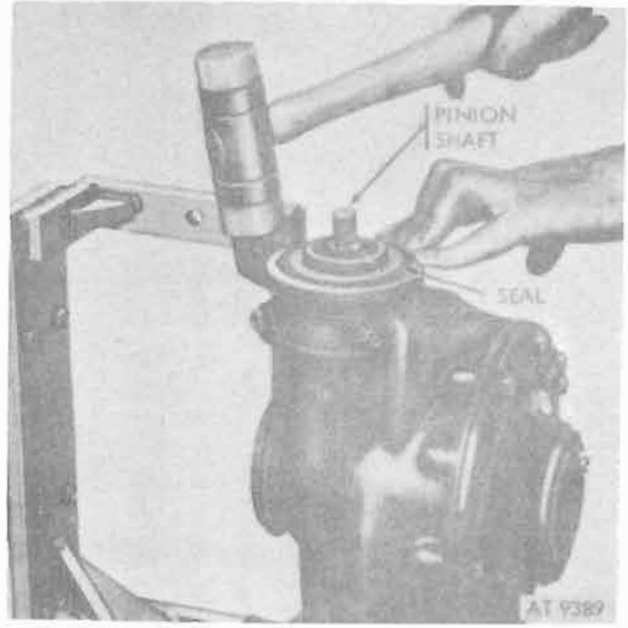


Figure 12-79. Installing pinion bearing seal.

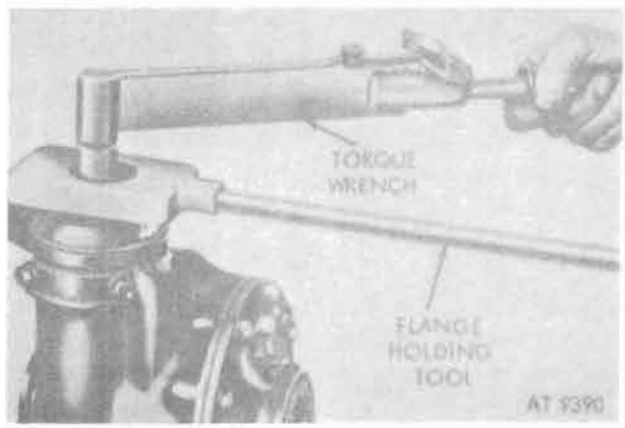


Figure 12-80. Torquing pinion flange nut.

CHAPTER 13

PARKING BRAKE

Section I. DESCRIPTION AND DATA

13-1. Description

For description of parking brake refer to TM 9-2320-218-20.

13-2. Tabulated Data

Type	transmission-drum
Actuated	mechanically
Diameter	6.00 in.
Width	1.00 in.
Location	rear of transmission-transfer output shaft

Section II. REMOVAL AND DISASSEMBLY

13-3. Removal

Refer to TM 9-2320-218-20 to remove the parking brake components from the vehicle.

13-4. Disassembly

a. Remove two cotter pins, two clevis pins, and one washer—mounting links to handle (early models only) (view B, fig. 13-1).

b. Remove two cotter pins and two clevis pins, mounting link to handle and actuating levers (later models only) (view A, fig. 13-1).

c. Remove cotter pin and clevis pin from rod and remove rod (older models only) (fig. 13-2).

NOTE

If actuating rod has been disconnected at support end, remove cotter pin and clevis pin to disconnect rod from handle assembly.

d. Remove cotter pin and washer from clevis pin in support assembly (fig. 13-3).

e. Remove rear support from support assembly (fig. 13-4).

f. Remove rear lever from support assembly (fig. 13-5).

g. Remove clevis pin from band and support assembly (fig. 13-6).

h. Lift remaining support assembly from lever and band assembly (fig. 13-7).

i. Lift front lever from trunnion and band assembly.

j. Unscrew and remove brake-band adjusting nut (fig. 13-8).

k. Slide trunnion off band assembly.

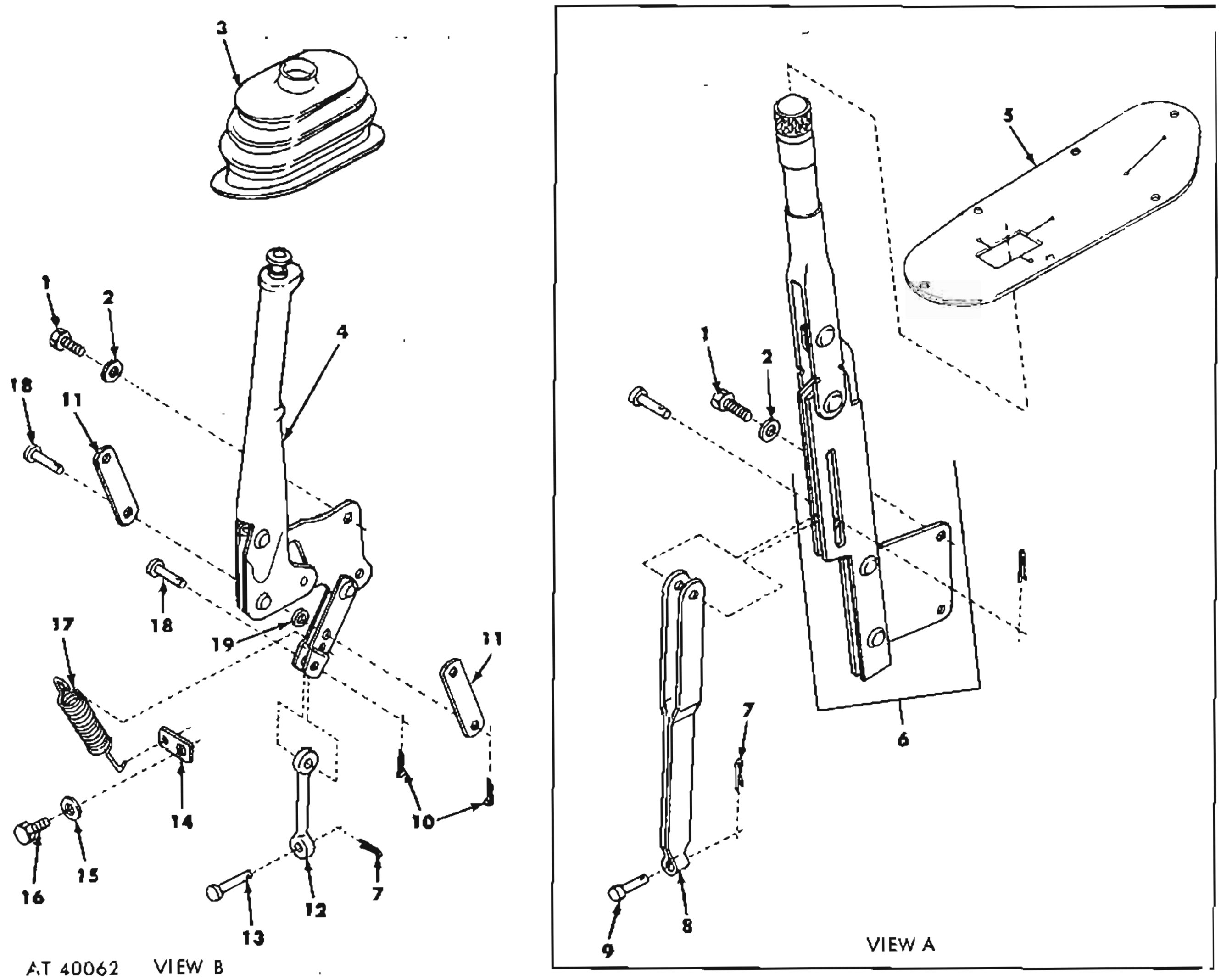
Section III. CLEANING, INSPECTION AND REPAIR

13-5. Cleaning

Clean all parts in mineral spirits paint thinner or drycleaning solvent. Remove all gum deposits. Dry with compressed air or cloth.

13-6. Inspection and Repair

a. *General*. Check all threads. Discard bent bolts and nuts having stripped threads.



1 Capscrew
2 Lockwasher
3 Boot
4 Handle assembly
5 Dust shield
6 Lever assembly
7 Cotter pin
8 Link
9 Clevis pin
10 Cotter pin
11 Link
12 Brake rod
13 Clevis
14 Plate
15 Lockwasher
16 Screw
17 Spring
18 Clevis pin
19 Spacer

Figure 13-1. Handbrake handles (levers)—exploded view.

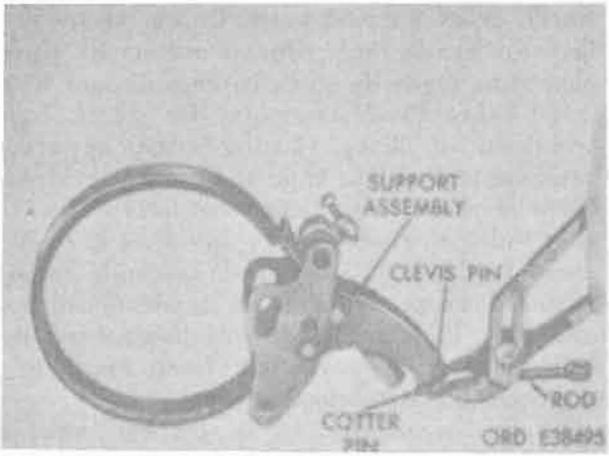


Figure 13-2. Brake rod clevis pin and attaching hardware.

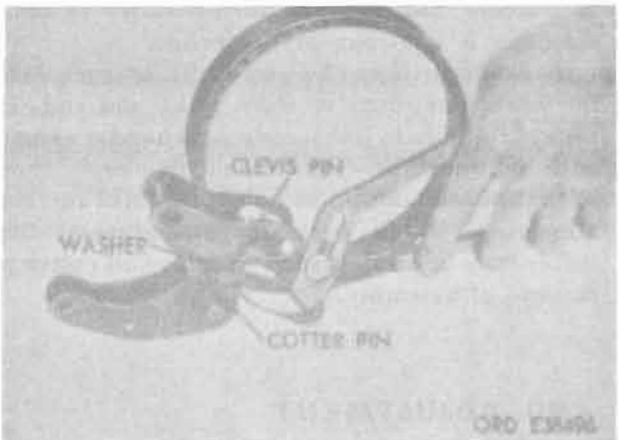


Figure 13-3. Support assembly clevis pin, washer, and cotter pin.

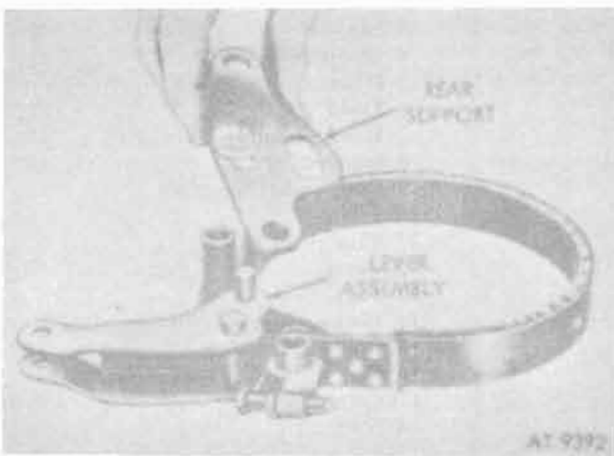


Figure 13-4. Rear support and lever assembly.

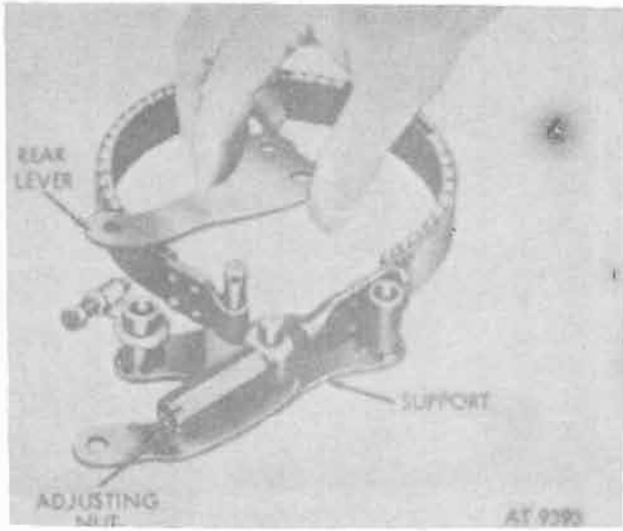


Figure 13-5. Rear support lever.

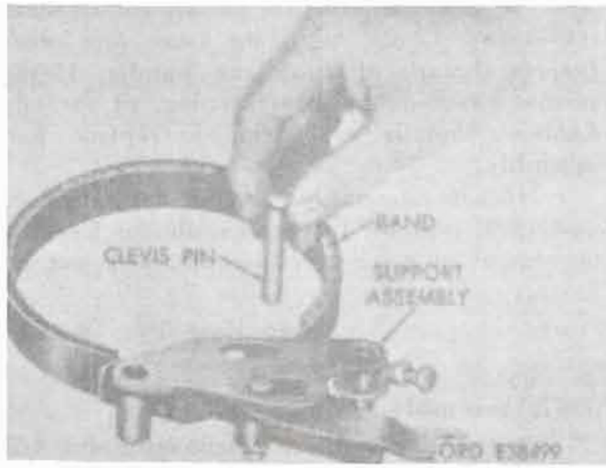


Figure 13-6. Band and support assembly.

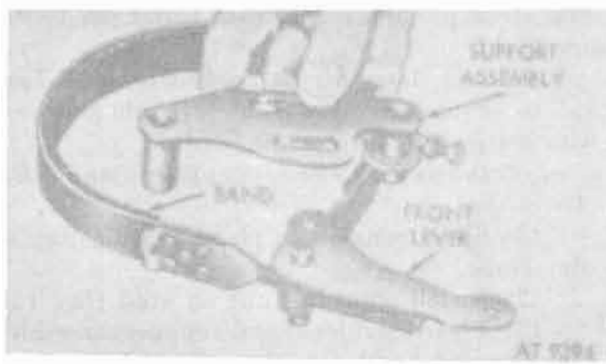


Figure 13-7. Support assembly.

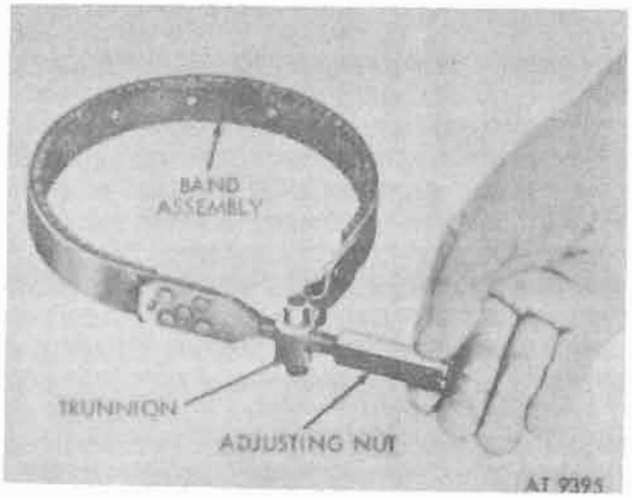


Figure 13-8. Brake band adjusting nut and trunnion.

b. Handle Assembly. Orsheln type (figs. 13-1 and 13-9, view a). Inspect handle for freedom of movement. Check adjusting knob for freedom. Inspect threads of knob and handle. If repair cannot be made by straightening, or threads of knob or handle are stripped, replace handle assembly.

c. Handle Assembly, ratchet type (figs. 13-1 and 13-9, view b). Inspect handle for freedom of movement of ratchet. If handle does not move freely, check for bent parts. Check release button on top of handle for freedom of movement. If repair cannot be made by straightening, discard handle.

d. Brake Band Assembly (fig. 13-9). Inspect condition of lining. Lining must be securely attached to the brake band and show no evidence of oil or grease. Check thickness of lining. If worn so that lining thickness above any rivet head is less than 1/32 inch, the band assembly must be replaced. Inspect threads on band adjusting stud and nut; if damaged, discard band assembly or nut. Inspect support and level assembly for damage; discard defective parts.

e. Brakedrum (fig. 13-9). Inspect brakedrum for cracks or other evidence of damage. Discard if defective. Inspect braking surface for scoring; badly scored drum may be reclaimed by machining. In no case may drum be turned down so outside diameter is less than 5.940 inches.

f. Linkage (figs. 13-1 and 13-9). Inspect linkage for worn pins, bent or worn links and rod. Pins should fit holes in links, rods, and handle assembly with light-push fit. Parts should fit closely enough so that pins do not tip in holes and links remain in alinement. Check parts for straightness. Slight bends may be straightened. Replace all cotter pins at time of assembly.

Section IV. ASSEMBLY AND ADJUSTMENT

13-7. Assembly

a. Handle Assembly (early models only). Install two links to handle assembly with two clevis pins and one washer (view b, fig. 13-1). Secure with two cotter pins (fig. 13-1, view b). Install actuating rod with clevis pin and secure with cotter pin (view b, fig. 13-1).

b. Handle Assembly (later models only). Install link to handle assembly with clevis pin and secure with cotter pin (view a, fig. 13-1).

c. Actuating Lever Support and Band Assemblies.

(1) Slide trunnion in place on adjusting stud (fig. 13-8).

(2) Install adjusting nut on stud (fig. 13-8).

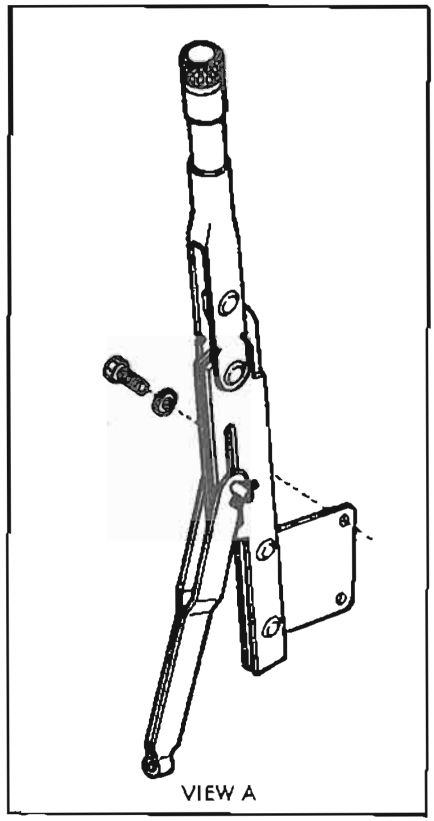
(3) Place front lever and support assembly on trunnion and band assembly (fig. 13-7).

(4) Install clevis through support and lever (fig. 13-6).

(5) Install rear lever (fig. 13-5) and support (fig. 13-4).

Legend to 13-9:

1 Capscrew
2 Nut
3 Support
4 Clevis pin
5 Drum
6 Lever
7 Band assembly
8 Support
9 Bolt washer assembly
10 Spring
11 Trunnion
12 Lever
13 Support
14 Lockwasher
15 Bolt
16 Flat washer
17 Cotter pin
18 Nut



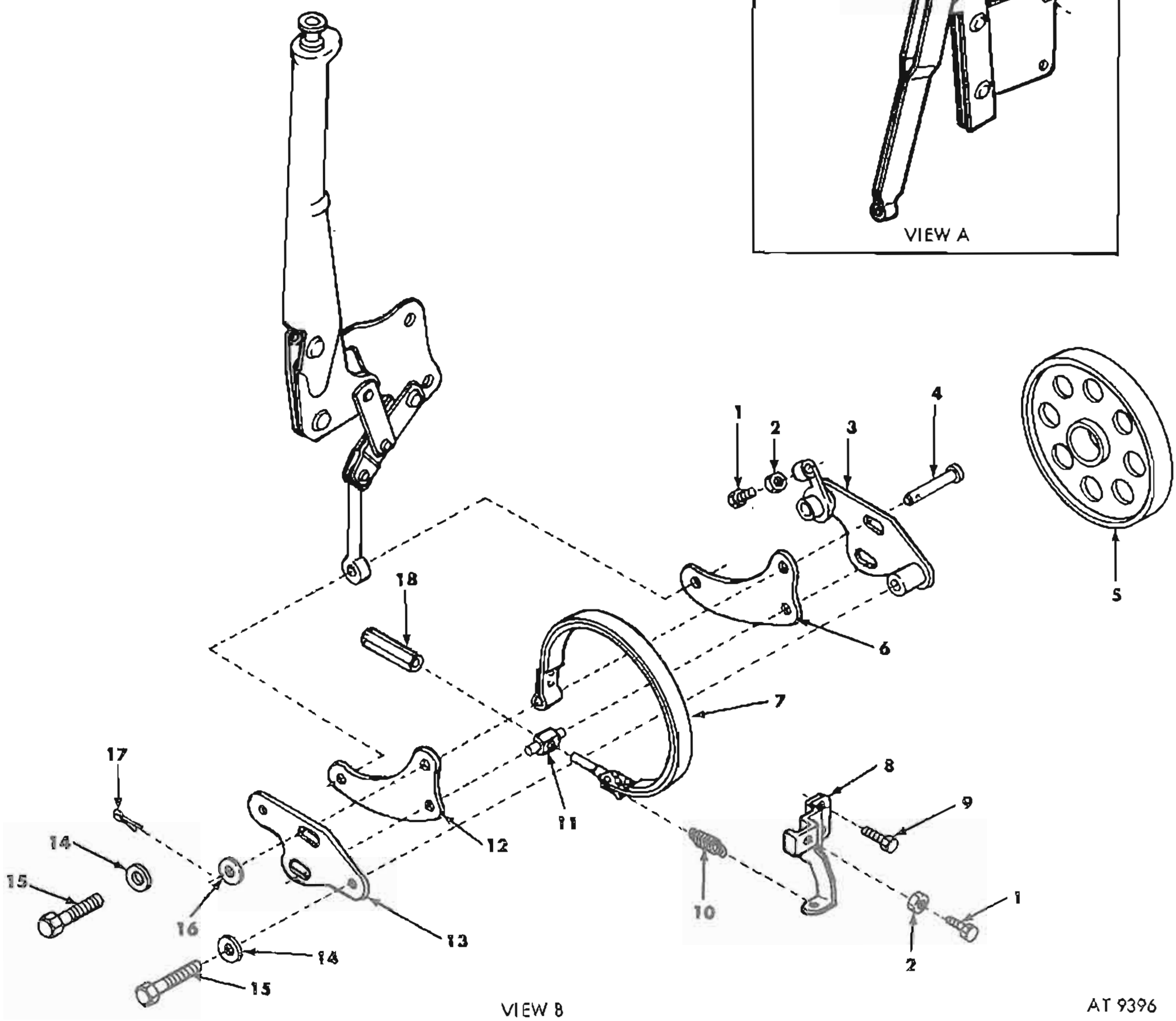


Figure 13-9. Handbrake assy—exploded view.

(6) Secure clevis pin with washer and cotter pin (fig. 13-3).

(7) Attach support and band assembly to rod (older models) or link (later models) with clevis pin and secure with cotter pin (fig. 13-1).

13-8. Adjustment

Refer to TM 9-2320-218-20 for adjustment of parking brake after installation on vehicle.

CHAPTER 14

SERVICE BRAKES

Section I. DESCRIPTION AND DATA

14-1. Description

For description of service brakes refer to TM 9-2320-218-20.

14-2. Tabulated Data

Service brake:

Type	Hydraulic
Anchor	Fixed
Diameter	9.120-9.130 in.
Width	2.00 in.
Lining area per brake	35.5 in.
Fluid capacity (system)	8.00 fluid oz.

Wheel cylinder:

Type	Straight bore
Diameter	0.75 in. front and rear (M151, M151A1, M151A1C, and M718)
	1.00 in. front, 0.75 in. rear (M151A2, M718A1, and M825)

Master Cylinder:

Location	Cowl
Type	Reservoir and cylinder
Bore size	1.00 in.
Material	Aluminum alloy

Section II. REPAIR OF SERVICE BRAKE SYSTEM

14-3. Removal of Components

For removal of brakeshoes, wheel cylinders, brakedrums, and master cylinder, refer to TM 9-2320-218-20.

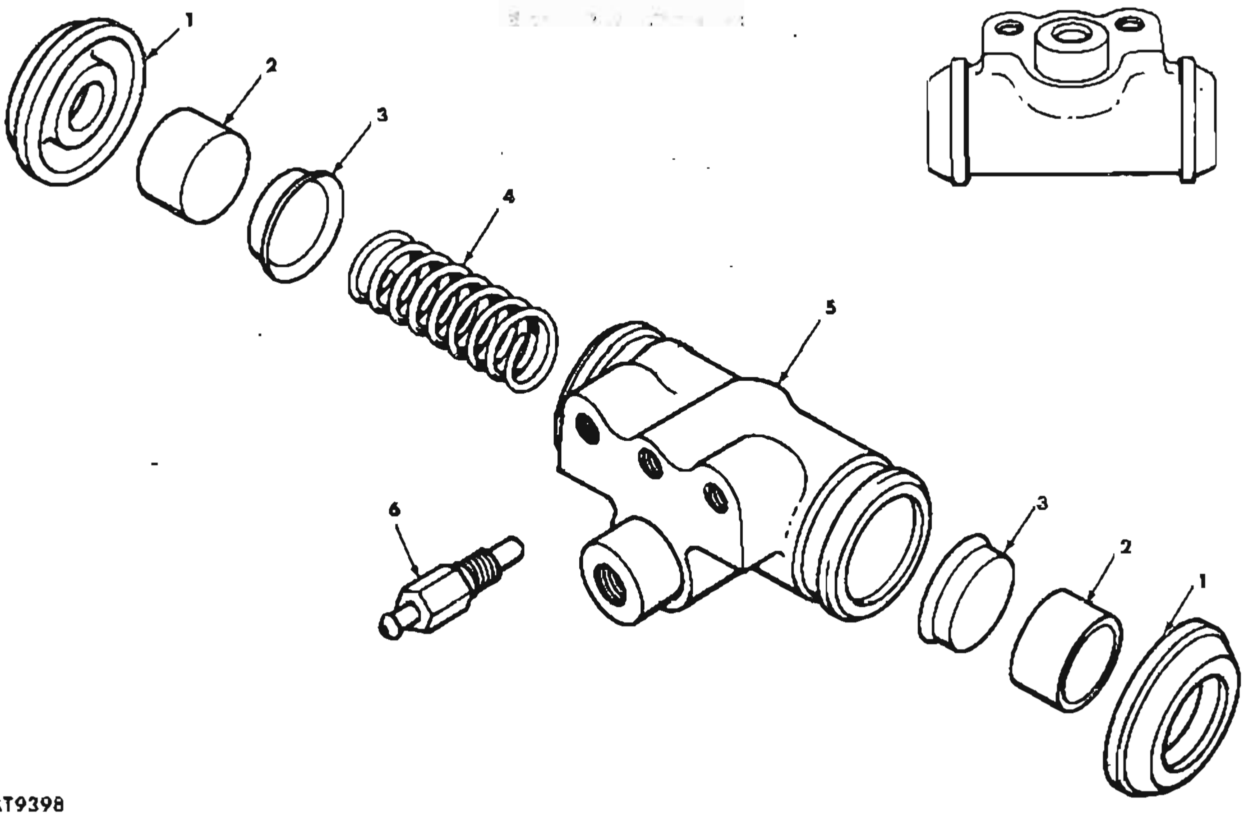
14-4. Disassembly of Wheel Cylinder

Refer to figure 14-1.

a. Remove bleeder screw (6) from cylinder (5).

b. Remove both end boots (1) and pistons from cylinder (5).

c. Using thumb, push one cup (3) inward, forcing the opposite cup (3) and spring (4) from cylinder (5).



1 Boot
2 Piston
3 Cup
4 Spring
5 Cylinder
6 Bleeder, screw

Figure 14-1. Wheel cylinder—exploded view.

d. Remove remaining cup from opposite end of cylinder.

e. Remove boots (1) from piston (2).

14-5. Cleaning

Clean all metal parts of brake mechanism in drycleaning solvent or mineral spirits paint thinner, except brake lining and wheel cylinder cups and boots. Clean brake linings with a wire brush.

CAUTION

If brake lining is contaminated with brake fluid or cleaning solutions, replace lining.

Clean cylinder cups and boots in brake fluid. Refer to TM 9-1827C for cleaning procedures.

14-6. Inspection

a. Brakedrums (fig. 14-2). Inspect brakedrums for warpage, cracks, or scored braking surface. Place drum in lathe and check runout of braking surface. Runout is not to exceed 0.006-inch total indicator reading. Refinish drum surface if scored or if runout exceeds 0.006 inch. Drum may be refinished to 9.19-inch diameter maximum (0.030 oversize), for use with standard thickness brake lining.

b. Brake Backing Plate. Inspect backing plate for cracks, dents, or unpainted surface. Check if anchor is securely attached to backing plate.

c. Wheel Cylinders (fig. 14-1). Hold cylinder body toward strong light and sight through cylinder bore. A pitted or deeply scratched cylinder bore requires honing. Light scratches may be removed by using fine emery cloth.

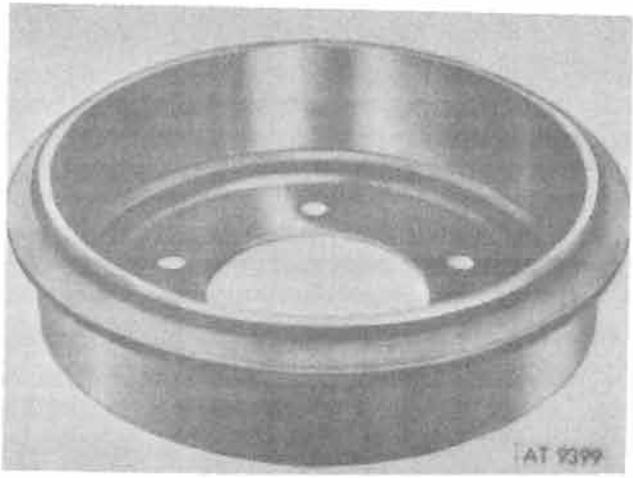


Figure 14-2. Brakedrum.

NOTE

Always clean cylinders thoroughly after reworking.

d. Brake Cylinder Cups. Deeply pitted, scratched, worn, soft, or stiff cylinder cups must be replaced.

e. Brake Linkage and Adjusters. Check for bent, worn, or corroded linkage. Check if adjusters operate freely, are free of rust, and have no damaged threads.

f. Boots. Replace boots which have holes, cuts; etc.

14-7. Repair

a. Brakedrums. Refer to paragraph 14-6.

b. Brake Backing Plate. Straighten backing plate if practical. Touchup paint if required.

c. Wheel Cylinders. Hone cylinders if required. Refer to TM 9-1827C.

d. Brake Linkage and Adjusters. Straighten and clean linkage and remove corrosion if possible. Hand-chase threads on adjusters with knife file.

14-8. Assembly of Wheel Cylinder

Refer to figure 14-1 and reverse procedures given in paragraph 14-4.

NOTE

Cups (3) and pistons (2) should be dipped in clean brake fluid before assembling. Cup lips must face inward toward spring (4).

CAUTION

Exercise extreme care to keep parts clean during assembly.

14-9. Installation of Components

For installation of brakeshoes, wheel cylinder, and brakedrum, refer to TM 9-2320-218-20.

14-10. Adjustment

Refer to TM 9-2320-218-20.

CHAPTER 15

BRAKE AND CLUTCH PEDALS AND FLYWHEEL HOUSING ASSEMBLY

Section I. BRAKE AND CLUTCH PEDAL ASSEMBLY

15-1. Removal

To remove the clutch and brake pedal assembly refer to TM9-2320-218-20.

15-2. Disassembly

NOTE

Key numbers shown in parentheses refer to figure 15-1.

a. Remove screw (1) and washer (2) securing clutch link (3) to clutch pedal shaft (20). Remove lever (3), pedal shaft (20), and two bushings (4).

b. Remove nut (27), washer (26), eccentric bolt (24), and two nylon bushings (25) attaching brake pedal (10) to master cylinder rod.

c. Remove two screws (7) and nuts (6) securing bumper bracket (8) to pedal support brackets (5 and 19).

d. Remove nut (34) securing rod (33) to brake pedal (10) (M151A2, M825, and M718A1 only).

e. Remove two bolts (17) and lockwashers (18) securing master brake cylinder (11) in support brackets (5 and 19). Remove master brake cylinder (11).

NOTE

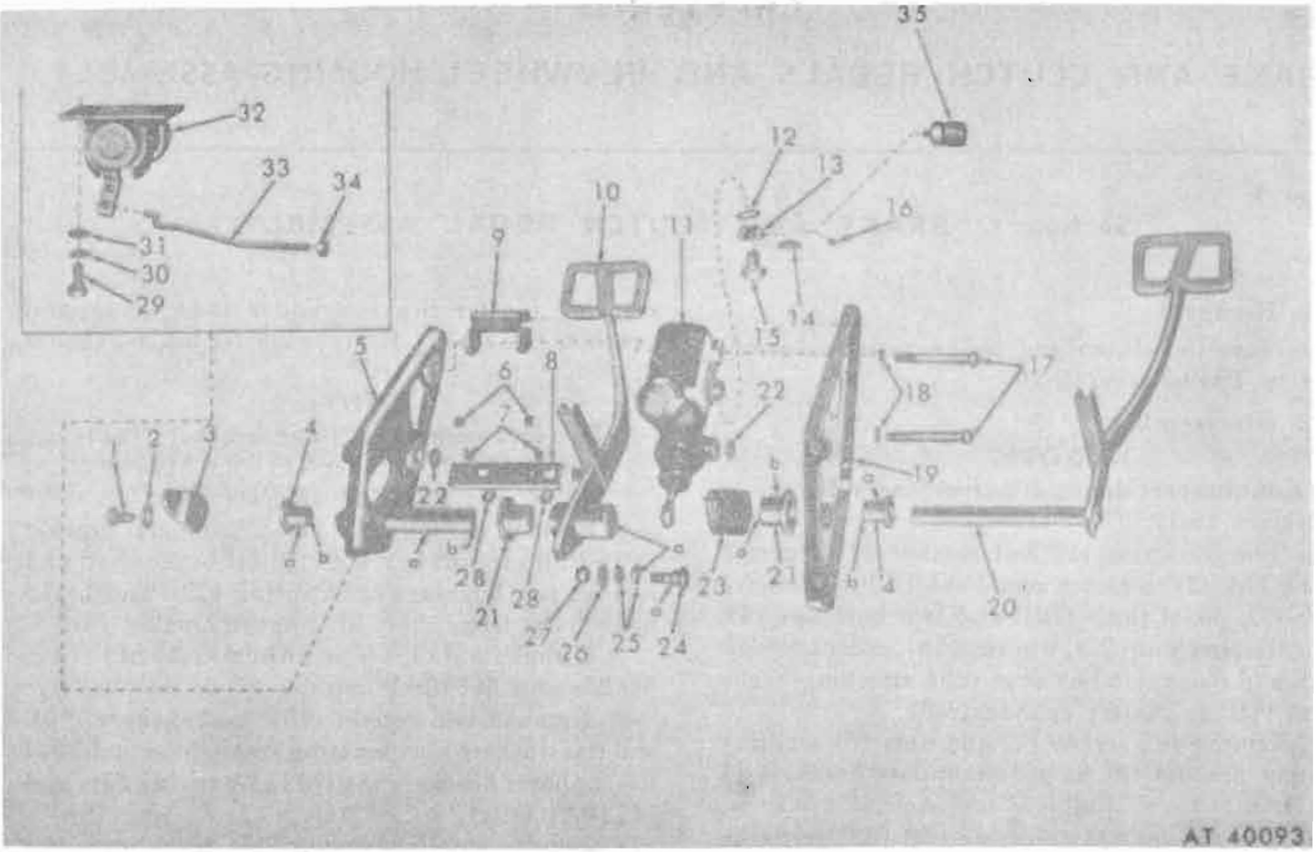
Two lockwashers (22) and bracket (9) are removed with cylinder (11) on M151A2, M825, and M718A1 vehicles only.

f. Unhook spring (23) from support bracket (19). Pull support bracket (19) off brake shaft and remove two bushings (21), spring (23), and brake pedal (10) from shaft of support bracket (5).

g. Unhook rod (33) from switch (32) (M151A2, M825, and M718A1 only).

h. Remove two screws (20), lockwashers (30), and flat washers (31) securing stoplight switch (32) to support bracket (5) (M151A2, M825, and M718A1 only).

i. Remove stoplight switch (35) from connector (13) on master brake cylinder (11) (M151, M151A1, M151A1C, and M718 only).



1 Screw
2 Washer, flat
3 Lever
4 Bushing
5 Support assembly, RH (M151A2, M825, and M718A1 only).
5 Support assembly, RH (M151, M151A1, M151A1C, and M718 only).
6 Nut
7 Screw and washer
8 Bracket
9 Bracket (M151A2, M825 and M718A1 only).
10 Pedal assembly (M151A2, M825, and M718A1 only).
10 Pedal assembly (M151, M151A1, M151A1C, and M718 only).
11 Master cylinder assembly
12 Gasket
13 Connector (fitting)
14 Gasket
15 Bolt
16 Plug (M151A2, M825, and M718A1 only).
17 Screw (M151A2, M825 and M718A1 only).
17 Screw (M151, M151A1, M151A1C, and M718 only).
18 Washer, lock (M151A2, M825, and M718A1 only).
18 Washer, lock (M151, M151A1, M151A1C, and M718 only).
19 Support assembly, LH (M151A2, M825, and M718A1 only).
19 Support assembly, LH (M151, M151A1, M151A1C and M718 only).
20 Pedal, clutch
21 Bushing
22 Washer, lock (M151A2, M825, and M718A1 only).
23 Spring
24 Bolt
25 Bushing
26 Washer, flat
27 Nut
28 Bumper
29 Screw (M151A2, M825, and M718A1 only).
30 Washer, lock (M151A2, M825, and M718A1 only).
31 Washer, flat (M151A2, M825, and M718A1 only).
32 Switch (M151A2, M825, and M718A1 only).
33 Rod (M151A2, M825, and M718A1 only).
34 Nut (M151A2, M825, and M718A1 only).
35 Switch (M151, M151A1, M151A1C, and M718 only).

Figure 15-1. Brake and clutch pedal assembly.

15-3. Inspection and Repair

a. Bracket Assembly. Inspect both pieces of bracket assembly for cracks and distortion. Repair by straightening or welding, as necessary. Inspect weld nuts for security and condition of threads; rethread or replace as necessary. Check outside and inside diameter of pedal pivot shaft. If worn beyond limits shown in paragraph 15-4 (table 15-1), discard pedal assembly.

b. Pedal Assemblies. Inspect for damage and security of welds. Repair by straightening or welding, as necessary. Check outside diameter of clutch pedal shaft; if worn beyond limits shown in paragraph 15-4 discard clutch pedal assembly. Check inside diameter of brake pedal hub; if worn beyond limits shown in paragraph 15-4 discard pedal assembly. Inspect internal threads in end of shaft; rethread or discard as necessary. Inspect square shoulder on end of shaft; if corners are rounded: discard pedal assembly.

c. Clutch Pedal Shaft Bushings. Inspect bushings; if badly scored, discard. Check inside and outside diameters. If worn beyond limits shown in paragraph 15-4 (table 15-1), discard.

d. Brake Pedal Bushings. Inspect bushings; if badly scored, either inside or outside, discard. Check inside and outside diameter. If worn beyond limits shown in paragraph 15-4 (table 15-1), discard.

e. Master Cylinder Push Rod Bushings and Eccentric Adjusting Bolt. Inspect nylon bushings for evidence of failure; discard if defective. Check bushing inside diameter. If worn beyond limits shown in paragraph 15-4 (table 15-1), discard.

f. Brake Pedal Spring. Inspect spring for cracks or distortion; discard if any evidence of failure is found.

g. Pedal Bumpers. Inspect condition of rubber bumpers. Discard if badly worn or deteriorated.

15-4. Repair Standards

The repair standards included herein give the minimum, maximum and key clearance of new or usable parts. They also give wear limits which indicate that point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the wear limits column or damaged from corrosion will be approved for service. Refer to figure 15-1 and table 15-1 for repair standards.

Table 15-1. Repair Standards—Brake and Clutch Pedal Assembly

Fig. No.	Key	Point of measurement	Size of new part	Wear limit
15-1	5a	Outside diameter of brake pedal pivot shaft.	0.874-0.875	0.870
15-1	5b	Inside diameter of brake pedal pivot shaft.	0.740-0.745	0.746
15-1	20a	Outside diameter of clutch pedal shaft.	0.610-0.613	0.606
15-1	10a	Inside diameter of brake pedal	1.056-1.058	1.062
15-1	4a	Outside diameter of clutch pedal shaft bushings.	0.740-0.739	0.737
15-1	4b	Inside diameter of clutch pedal shaft bushings.	0.614-0.615	0.623
15-1	21b	Outside diameter of brake pedal bushings.	1.054-1.055	1.047
15-1	21a	Inside diameter of brake pedal bushings.	0.876-0.877	0.885
15-1	25a	Inside diameter of master cylinder rod bushings.	0.561-0.562	0.567
15-1	24a	Diameter of eccentric adjusting bolt.	0.558-0.560	0.567

15-5. Assembly

Refer to paragraph 15-2 and reverse disassembly operations with the following instructions—

a. Coat all bushings with lubricant (GAA) prior to installation.

b. Tighten attaching hardware as follows:

Master cylinder mounting bolts .... 17-19 lb.-ft.
Cylinder-to-brake pedal
eccentric bolt .... 20-25 lb.-ft.
Link lever-to-shaft screw .... 24-26 lb.-ft.
Fitting to master cylinder bolt .... 45-50 lb.-ft.

15-6. Installation

To install the clutch and brake pedal assembly refer to TM 9-2320-218-20.

15-7. Adjustment

Adjust master cylinder rod to brake pedal eccentric bolt as follows:

a. Allow brake pedal to rest against stop and note distance of free travel before master cylinder rod contacts piston.

b. Adjust eccentric bolt to give approximately ¼ inch free travel. Tighten nut.

c. Adjust mechanical stoplight switch used on M151A2, M718A1, and M825 vehicles as directed in TM9-2320-218-20.

15-8. Removal

a. Remove power plant. Remove transmission transfer and starting motor from power plant.

b. Slip boot off release rod (fig. 15-2).

c. Remove ten slotted head screws and lockwashers, and two hexagon screws and lockwashers securing flywheel housing cover (fig. 15-3). Remove cover. Discard gasket.

d. Slip clutch release bearing out of clutch release lever (fig. 15-4).

e. Remove seven screws and lockwashers securing flywheel housing to engine. Remove housing (fig. 15-5). Discard gasket.

15-9. Disassembly

a. Removal of clutch release lever. Press clutch release lever toward center of flywheel housing (fig. 15-6) to deflect yoke spring, and thus release lever from trunnion ball.

b. Removal of clutch release rod. Unscrew clutch release rod from adjusting nut (fig. 15-7) and pry adjusting nut from yoke spring.

c. Removal of starting motor shaft bushing. Press or drive bushing out of forward mounting flange of flywheel housing (fig. 15-8).

15-10. Inspection and Repair

a. Clutch release lever. (Refer to fig. 15-7.)

(1) Inspect lever assembly. If lever is bent or cracked, discard assembly.

(2) Inspect fingers at yoke end of lever. If badly worn, discard assembly.

(3) Inspect two yoke springs riveted to lever. If springs are bent or broken, discard assembly.

b. Clutch release rod and adjusting nut.

(1) Inspect release rod. If bent, straighten. If flange at end is broken, discard. If threads are defective, thread with 5 / 16-24 thread chaser or discard as required.

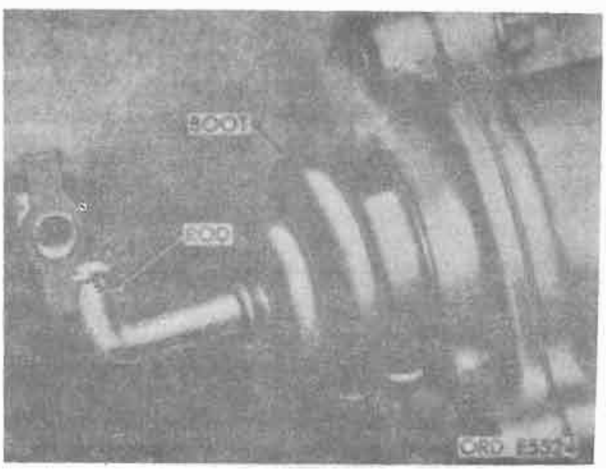


Figure 15-2. Clutch rod boot.

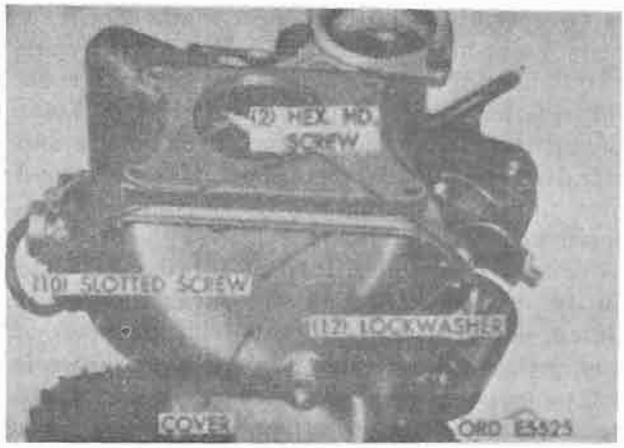


Figure 15-3. Flywheel housing cover and retaining screws.

(2) Inspect adjusting nut. If ball face is scored or threads are defective, discard.

c. Clutch Release Hub and Bearing Assembly. Hold the hub and rotate the outer race while applying pressure to it. If the bearing rotation is rough or noisy, replace the bearing (fig. 15-9).

d. Flywheel Housing.

(1) Inspect housing for cracks or breaks, and discard if defective.

(2) Inspect trunnion (fig. 15-6). If cracked or broken, or if ball is scored badly, discard housing.

(3) Inspect alinement holes (fig. 15-6). If inside diameter exceeds 0.3727 inch, discard housing.

(4) Inspect threaded holes for transmission mounting bolts. If threads are damaged, rethread with 7 / 16-14 tap or discard housing, as required.

(5) Inspect threaded holes for bottom cover plate bolts. If threads are damaged, rethread with ¼-20 tap or drill and tap to 5 / 16-18 as required.

(6) Inspect threaded hole for ground cable bolt. If threads are damaged, rethread with 5 / 16-18 tap or drill and tap to 3 / 8-24, as required.

(7) Inspect starter mounting studs (fig. 15-8). If defective in any way, replace stud.

e. Starting Motor Shaft Bushing. Inspect bushing for excessive wear. If worn beyond serviceability, drive or press out bushing and press in replacement bushing. Inside diameter of new bushing is 0.629-0.630 inch (figs. 15-6 and 15-8).

15-11. Assembly

Obtain replacements for all discarded parts and assemble in the reverse order of disassembly. Refer to paragraph 15-9.

15-12. Installation

Install flywheel housing by reversing removal procedures. Refer to paragraph 15-8. Use a new flywheel housing cover gasket and a new flywheel housing-to-engine gasket when installing flywheel housing cover and flywheel housing. Clean gasket mating surfaces. The following attaching parts should be torqued to the values shown.

Transmission case-to-flywheel housing bolt (7 / 16-14) 37-42 lb.-ft.
Flywheel housing-to-cylinder block bolt (3 / 8-16) . . . . 20-25 lb.-ft.
Flywheel housing cover-to-flywheel housing (5 / 16-18) 8-10 lb.-ft.

Figure 15-4. Clutch release lever and bearing assembly.

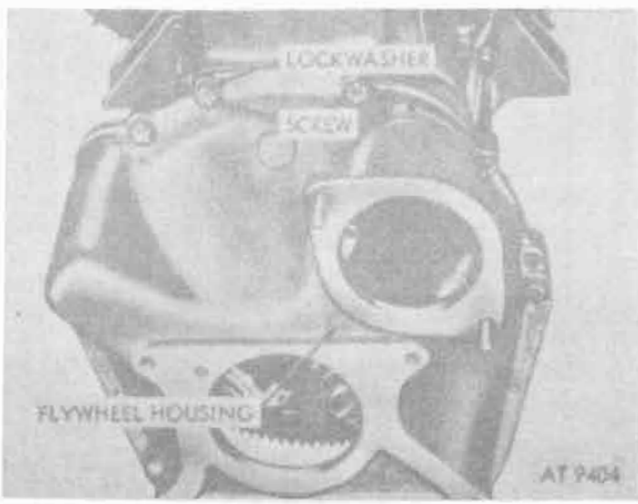


Figure 15-5. Flywheel housing and retaining screws.

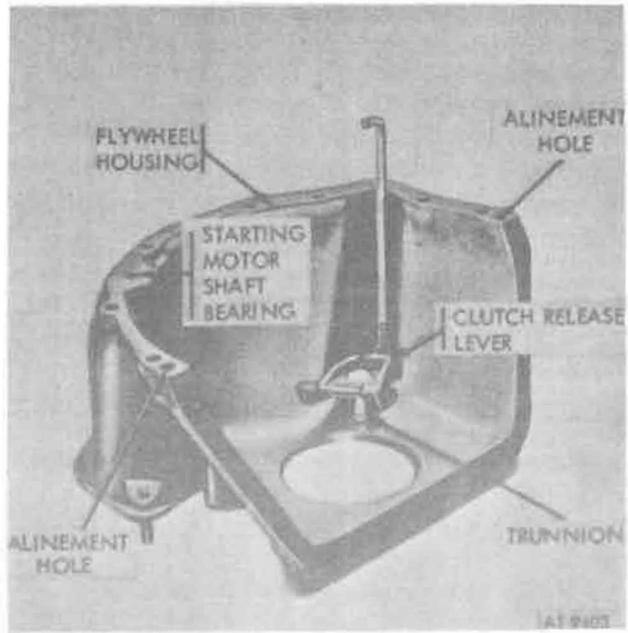


Figure 15-6. Flywheel housing assembly—inside view.

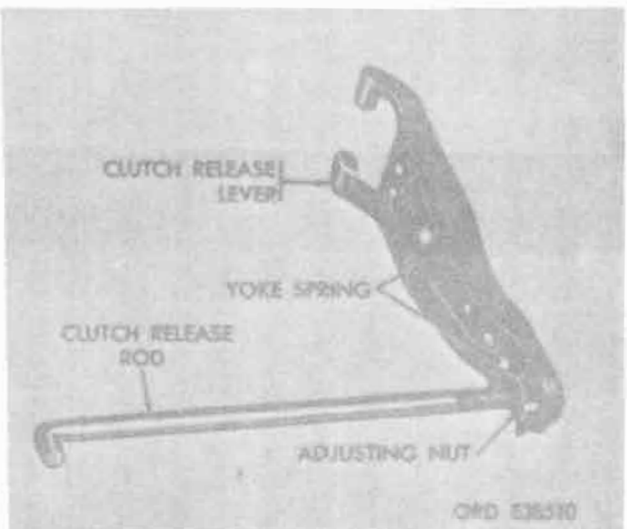


Figure 15-7. Clutch release rod and clutch release lever.

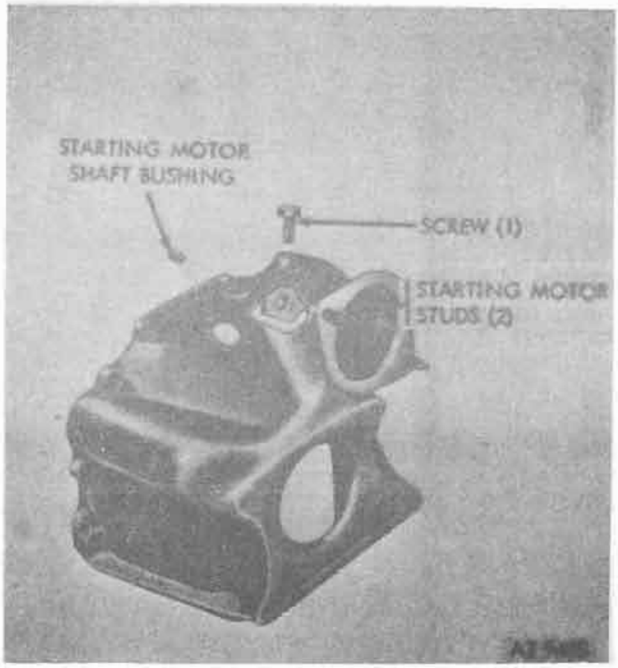


Figure 15-8. Flywheel housing assembly—outside view.

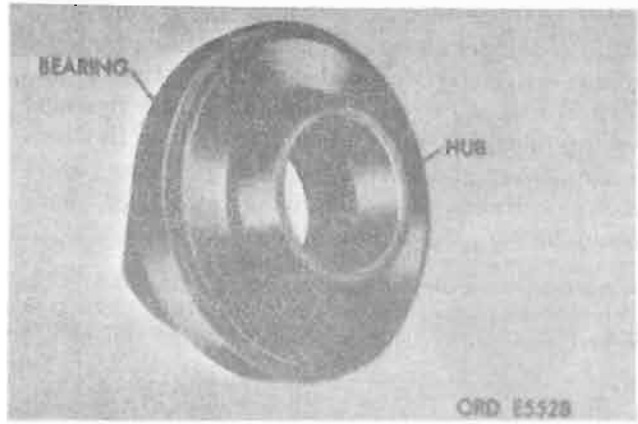


Figure 15-9. Clutch throwout bearing and hub assembly.

CHAPTER 16

STEERING GEAR

Section I. REMOVAL AND DISASSEMBLY OF STEERING GEAR AND COLUMN ASSEMBLY

16-1. Preliminary Operations

Perform the following operations to remove the steering gear and column assembly.

a. Remove left front wheel.

b. Remove steering pitman arm. (Refer to TM 9-2320-218-20.)

c. Remove steering wheel, and horn wire. (Refer to TM 9-2320-218-20.)

16-2. Steering Gear Removal Operations for M151A2, M825, and M718A1 Vehicles

a. Remove one bolt from upper portion of flange and insulator assembly (fig. 16-1).

b. Remove three bolts, nuts, and lockwashers securing steering gear to frame side rail (fig. 16-1), and remove steering gear for further disassembly.

16-3. Steering Gear and Column Removal Operations for M151, M151A1, M151A1C, and M718 Vehicles

a. Remove three bolts, nuts, and lockwashers securing steering gear to frame side rail (fig. 16-2).

b. Remove rubber grommet from toe panel and slide it down column (fig. 16-2).

c. Loosen steering gear column clamping bolt on instrument panel bracket (fig. 16-3).

d. Remove four bolts securing column bracket to instrument panel and remove bracket (fig. 16-3).

e. Remove two harness clips under edge of instrument panel. Remove ignition switch. Refer to TM 9-2320-218-20.

f. Reach up under instrument panel and disconnect front wiring harness at light switch and stoplight switch. Refer to TM 9-2320-218-20.

g. Hold column against top of slot in instrument panel and work harness out of lower flange of instrument panel (fig. 16-4).

h. Using jack, raise front end of vehicle to allow front suspension to swing down to lowest point.

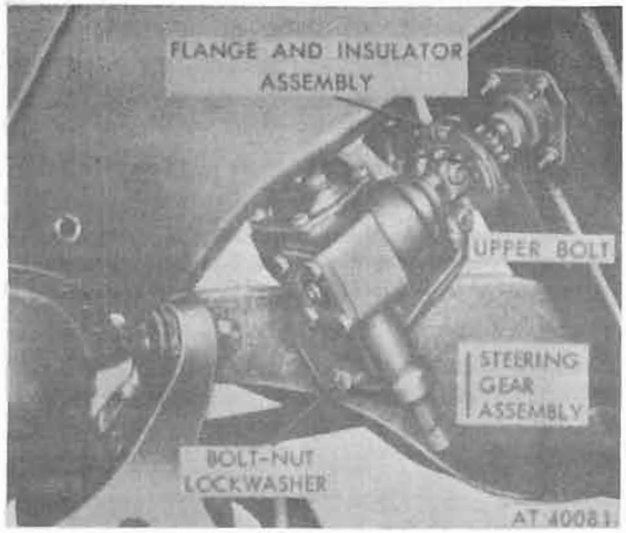


Figure 16-1. Steering gear and attaching hardware (M151A2, M718A1, and M825 vehicles).

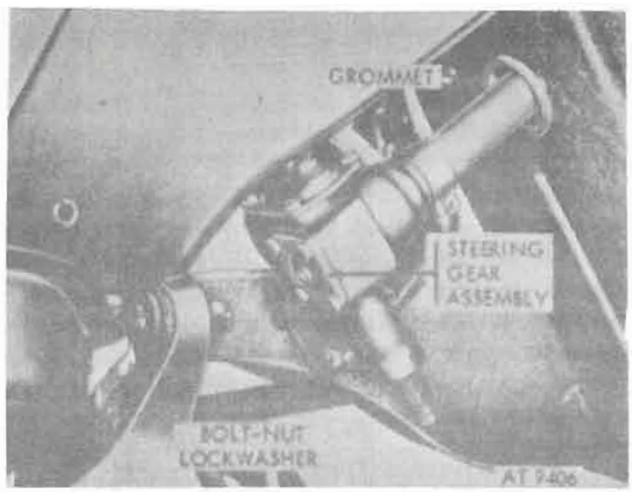


Figure 16-2. Steering gear and attaching hardware (M151, M151A1, M151A1C, and M718 vehicles).

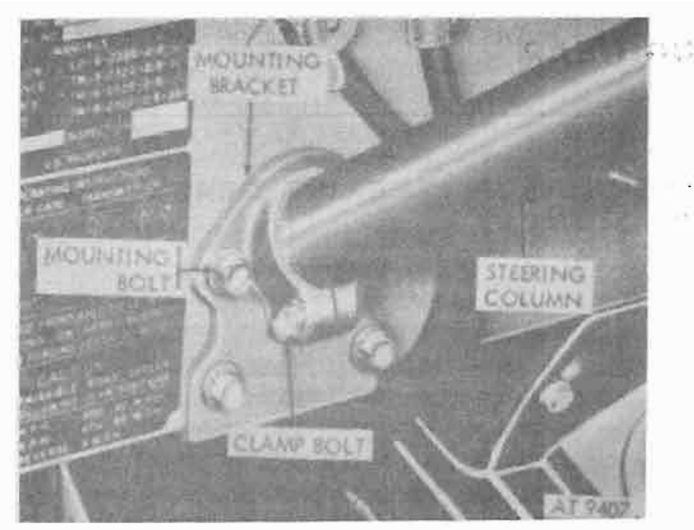


Figure 16-3. Steering column mounting bracket and attaching hardware (M151, M151A1, M151A1C, and M718 vehicles).

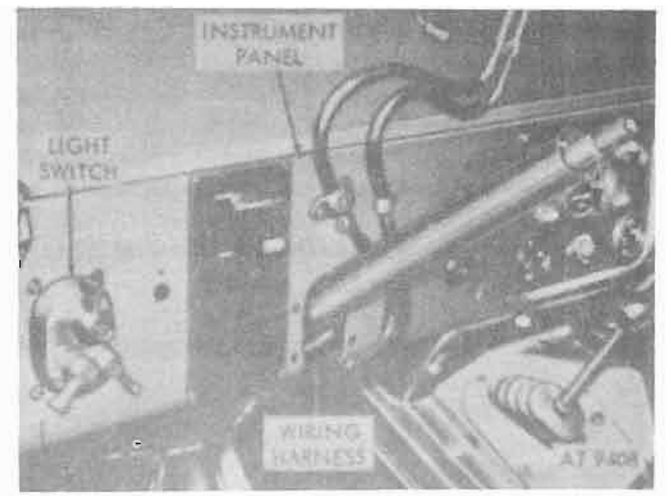


Figure 16-4. Instrument panel, light switch and wiring harness (M151, M151A1, M151A1C, and M718 vehicles).

i. Pull steering column through hole in dash panel while passing the steering gear over the front suspension upper arm (fig. 16-5).

16-4. Steering Column Removal for M151A2, M718A1, and M825 Vehicles

a. Remove three screws, washers, and nuts securing steering column toe panel brackets. Slide lower bracket and rubber grommet down column.

b. Remove four screw and lockwasher assemblies and four nuts securing column bracket to instrument panel, and remove bracket.

c. Pull steering column through hole in dash panel.

16-5. Steering Column Disassembly for M151A2, M718A1, and M825 Vehicles

a. Remove steering column tube cap from steering column.

b. Remove steering shaft from steering column tube.

c. Press nylon bushing out of lower end of steering column tube.

d. Remove two snap rings from steering shaft using snap ring pliers.

e. Press roller bearing from steering shaft.

16-6. Steering Gear Disassembly

a. Loosen bolt securing flange and insulator assembly to steering gear box worm shaft. Remove flange and insulator assembly (M151A2, M718A1, and M825 vehicles).

b. Loosen clamp at base of steering column and slide column off housing and steering wormshaft (M151, M151A1, M151A1C, and M718 vehicles).

c. Remove jam nut from adjusting screw on housing cover (fig. 16-6).

d. Remove four screws securing cover to housing (fig. 16-6).

e. Turn adjusting screw down (clockwise) to raise cover assembly off housing (fig. 16-7).

f. Lift off cover assembly and gasket (fig. 16-8). Remove plug from cover (fig. 16-7).

g. Slide adjusting screw and plate assembly out of trunnion of sector shaft (fig. 16-8).

h. Lift sector shaft assembly out of gear housing (fig. 16-9).

NOTE

Tap bottom of sector shaft lightly with hammer to loosen if necessary.

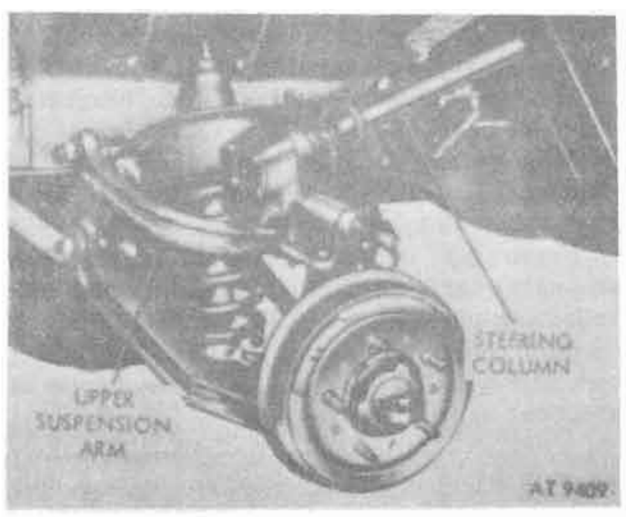


Figure 16-5. Left front suspension and steering gear assembly (M151, M151A1, M151A1C, and M718 vehicles).

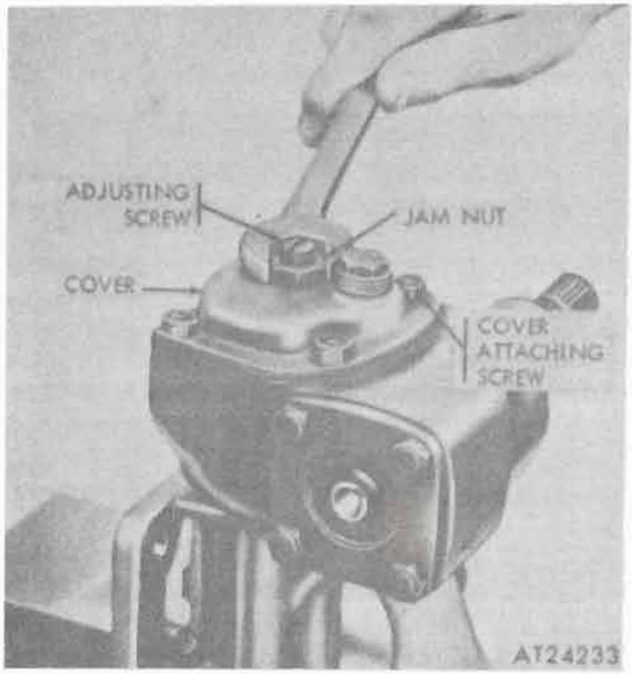


Figure 16-6. Steering gear adjusting screw and jam nut.

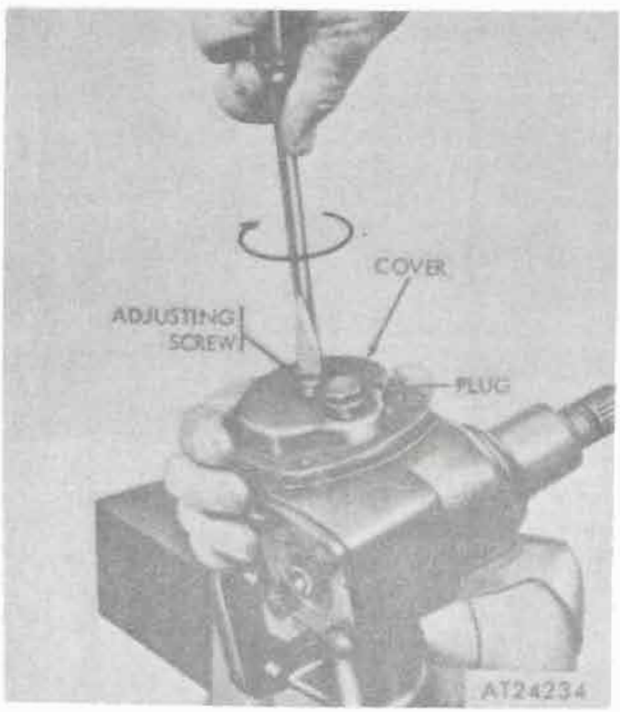


Figure 16-7. Removing cover assembly.

i. Remove four cap attaching screws (fig. 16-9).

j. Remove cap assembly gasket and shim or shims from housing (fig. 16-10).

k. Remove bearing cup and roller bearing assembly from housing.

l. Pull steering wormshaft and roller bearing through gear housing (fig. 16-12). Remove bearing from shaft.

m. Remove steering wormshaft seal from housing (fig. 16-13).

n. Remove sector shaft seal from housing (fig. 16-14).

o. Remove steering wormshaft bearing cup and sector shaft bushings, using suitable tools (fig. 16-15).

16-7. Cleaning

Clean all metal parts in mineral spirits paint thinner or drycleaning solvent. Make sure all parts are free from oil, grease, or any gummy substance. Dry with compressed air or with a clean cloth. All seals, splines, and threads must be free from paint. Clean all gasket mating surfaces thoroughly.

16-8. Inspection and Repair

a. Steering Shaft Column. Inspect column for bent or dented condition and discard column if either of these conditions exists.

b. Steering Shaft and Worm. Inspect worm threads for wear, cracking, chipping, or pitting. Check serrations on steering wheel and shaft for wear. Discard shaft and replace if necessary.

c. Housing and Covers. Inspect housing, housing cover, and housing end cap for cracks or other damage.

d. Pitman Arm. Check pitman arm for damage; inspect serrations. Discard arm if serrations are worn to the point where arm will not lock properly to sector shaft. Discard if arm is bent.

e. Sector Shaft. Inspect serrations for wear or other damage. Check adjusting screw for freedom of movement. Inspect double-tooth roller for wear and freedom of movement. Discard shaft if roller action is rough, roller is indented or chipped, or shaft is bent or has damaged serrations.

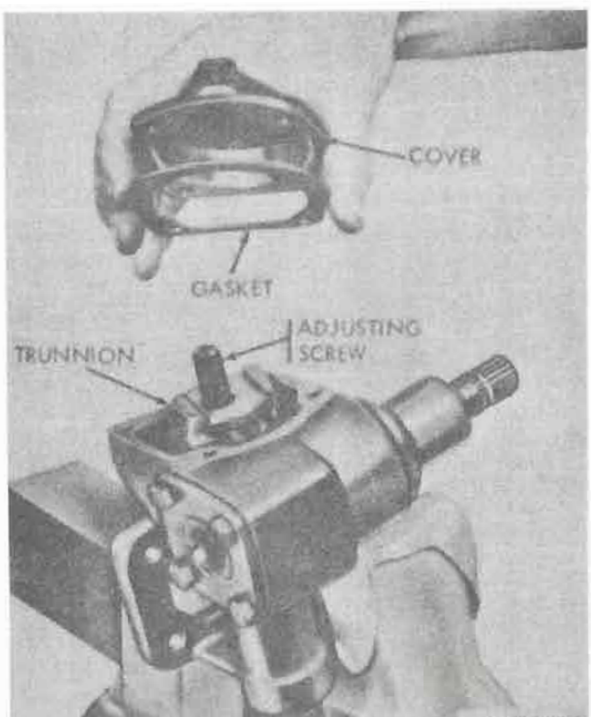


Figure 16-8. Cover assembly and gasket.

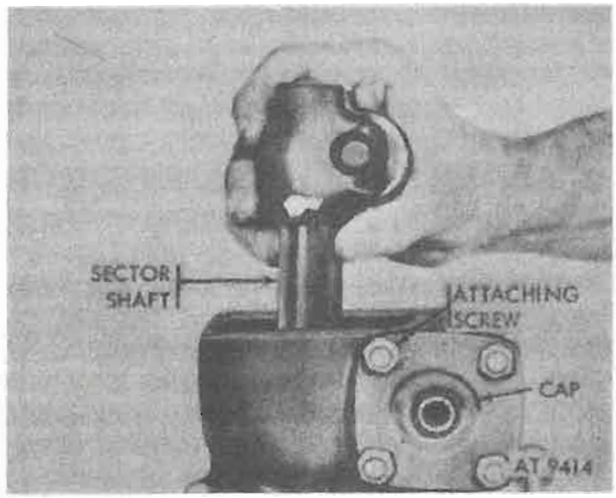


Figure 16-9. Steering gear sector shaft.

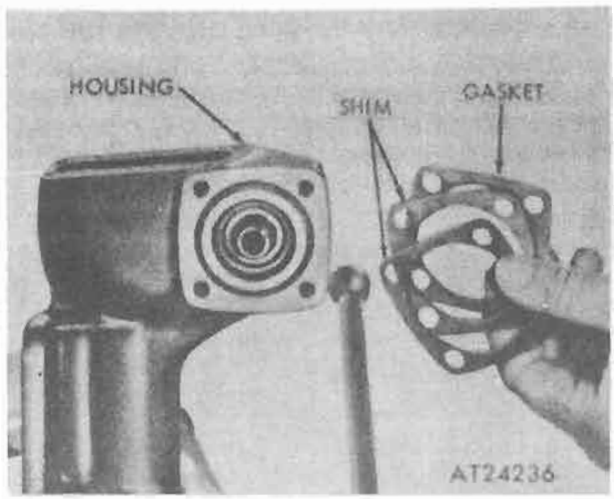


Figure 16-10. Housing end cap shims and gasket.

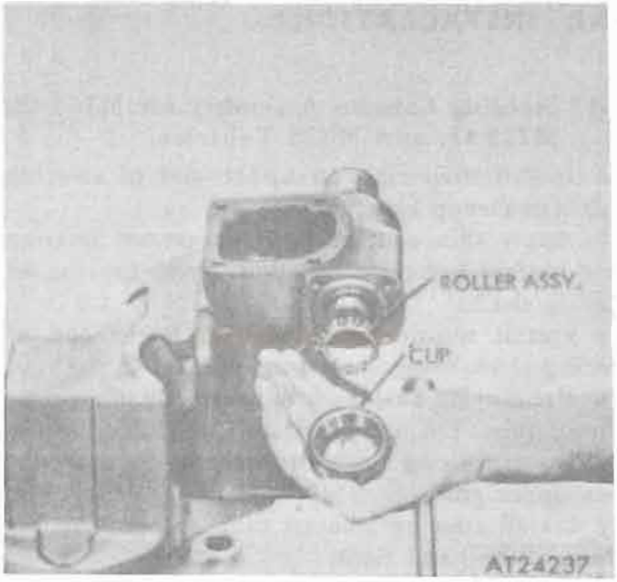


Figure 16-11. Wormshaft lower bearing and cup.

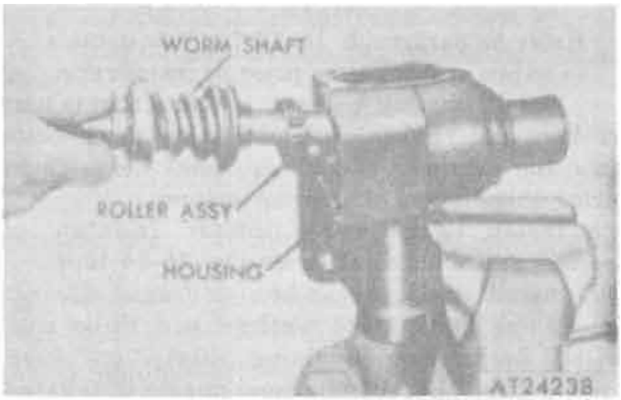


Figure 16-12. Wormshaft and upper bearing assembly.

Figure 16-13. Removing wormshaft seal.

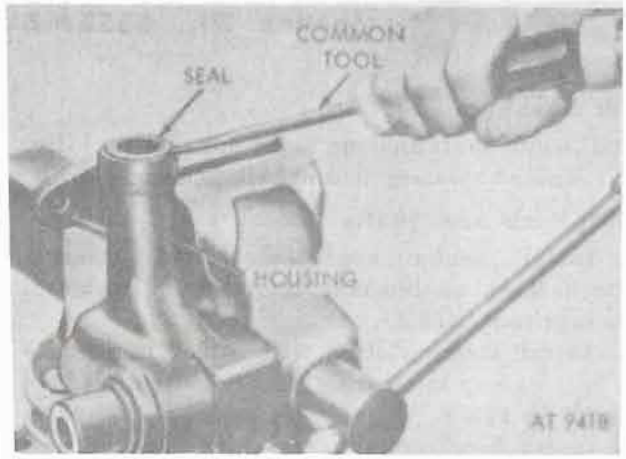


Figure 16-14. Removing sector shaft seal.

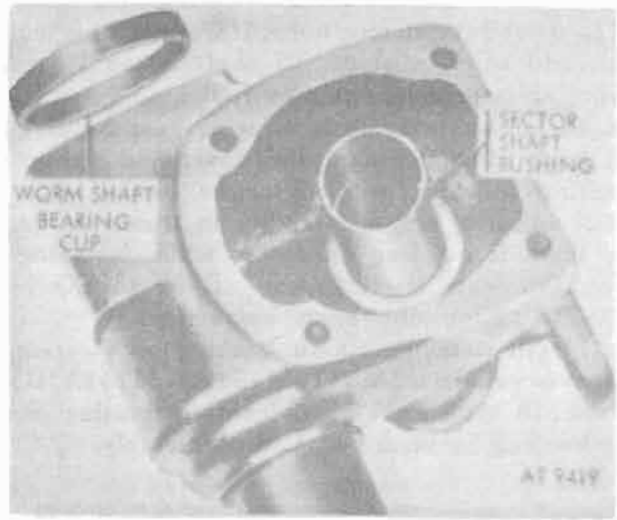


Figure 16-15. Wormshaft bearing cup and sector shaft bushing.

f. Miscellaneous. Check seals, bushings, bearings, roller assemblies, and other parts for wear or damage. Check threads of all bolts and nuts, and discard if stripped. Replace all gaskets, and discard damaged or worn parts. Check flange and insulator assembly on M151A2, M718A1, and M825 vehicles for damage; replace assembly if insulator material is deteriorated or if flanges are cracked or have damaged serrations.

16-9. Bushings and Cup

Install sector shaft bushing using suitable tool (fig. 16-5). Install steering wormshaft bearing cup.

16-10. Seals and Shafts

a. Install sector shaft seal and steering wormshaft seal as shown in figure 16-16. Pack seal with lubricant (GAA).

b. Install steering shaft with roller assemblies and bearing cup in steering gear housing (figs. 16-12 and 16-11).

c. Install necessary shim or shims, gasket, and end cap on gear housing (see bearing preload adjustment, para. 16-16 or 16-17). Tighten cap attaching screws (fig. 16-9), to specified torque (table 16-1, para 16-18). Turn steering shaft back and forth while tightening bolts. If wormshaft is too tight, add shim or shims. If shaft is too loose, remove shim or shims as required.

d. Install sector shaft in steering gear housing (fig. 16-9). Install gasket and cover and tighten attaching bolts to specified torque (table 16-1). Install adjusting screw assembly in trunnion. Be sure there is no drag on sector while installing cover. Lubricate steering gear. (Refer to LO 9-2320-218-12 for lubrication instructions.)

e. Install steering column housing on steering shaft (wormshaft) on M151, M151A1, M151A1C, and M718 vehicles. Tighten column housing on gear housing by means of clamp assembly.

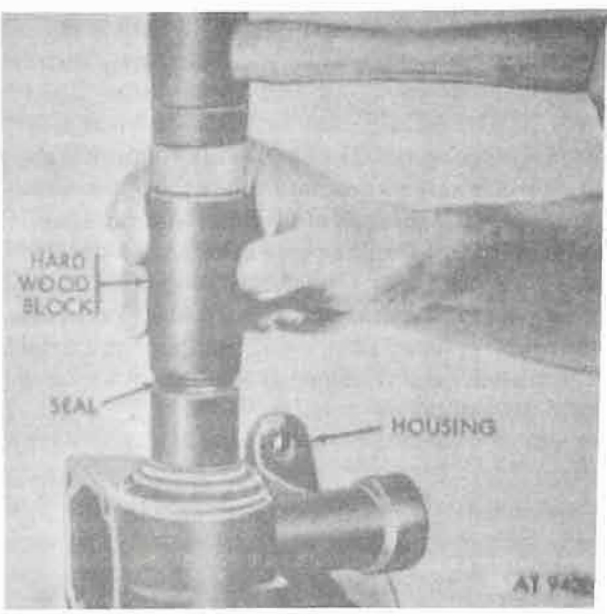


Figure 16-16. Installing steering wormshaft seal.

16-11 Steering Column Assembly for M151A2, M718A1, and M825 Vehicles

a. Install snap ring on upper end of steering shaft using snap ring pliers.

b. Apply thin coat of light grease on bearing inner surface before installation. Press bearing on steering shaft.

c. Install second snap ring on lower end of steering shaft using snap ring pliers.

d. Press nylon bushing into lower end of steering column tube. Do not lubricate.

e. Insert steering shaft into steering column tube from upper end.

f. Install steering column tube cap on steering column tube hand tight.

16-12. Installation of Steering Gear and Column on M151A2, M718A1 and M825 Vehicles

NOTE

Refer to paragraph 16-17 for instructions to adjust steering gear prior to installation.

a. Install steering column toe board retaining brackets and rubber grommet using three bolts, three flat washers and three nuts. Leave loose during installation of steering column.

b. Install flange and insulator assembly on steering gear box shaft torque to 26-34 lb.-ft.

c. Install steering gear box to frame side rail using three bolts, three washers and three nuts. Install brake line retaining clamp on lower attaching bolt. Leave bolts loose during installation of steering column.

d. Install steering column cowl brackets using four screw and lockwasher assemblies and four nuts. Leave loose during installation of steering column.

e. Lower steering column down through cowl bracket and toe board brackets. Aline steering column shaft with flange and insulator assembly opening, and engage.

f. Tighten steering column cowl attaching brackets.

g. Tighten bolts securing steering gear box to frame side rail. Torque to 24-36 lb.-ft.

h. Tighten flange and insulator assembly to steering column bolt. Torque to 24-36 lb.-ft.

i. Tighten bolts securing toe board brackets.

j. Rotate steering shaft to check for binding condition.

k. If binding exists, loosen brackets at toe board and adjust until binding condition is relieved.

l. Install steering wheel and horn wire; refer to TM 9-2320-218-20.

m. Install steering pitman arm.

16-31. Installation of Steering Gear and Column on M151, M151A1, M151-A1C and M718 Vehicles

To install steering gear and column, reverse the operations in paragraph 16-3 and 16-1. Refer to paragraph 16-14 and 16-16 for instructions on centering steering wheel and adjusting steering gear to the vehicle suspension and steering linkage.

Section IV. ADJUSTMENT PROCEDURES

16-14. Steering Column Alinement on M151, M151A1, M151A1C, and M718 Vehicles

Test and adjustment of a repaired steering gear assembly are usually made before the steering gear is installed on the vehicle. After installation and before proceeding with on-vehicle adjustments, eliminate any misalinement of the steering column as follows:

a. Remove Pitman arm. Loosen three bolts securing steering gear on frame side rail (fig. 16-2). Loosen four bolts attaching steering column to instrument panel (fig. 16-3) to relieve any possible horizontal strain.

b. Tighten four bolts attaching steering column to instrument panel (fig. 16-3). Tighten three bolts securing steering gear to frame side rail (fig. 16-2).

c. Before installing steering wheel, attach pull scale to the steering shaft in the undercut below the splines, and measure force required to center the shaft within 0.060 inch. If the effort required to center the shaft in steering column is more than 20 pounds, exchange the steering gear and shaft assembly.

NOTE

Steering gear and shaft assemblies that fail to center properly may be used in another vehicle where they may be able to pass the centering force requirements specified above.

16-15. Steering Column Alinement on M151A2, M718A1, and M825 Vehicles

a. Install steering gear, leaving bolts securing steering gear to frame side rail loose.

b. Install steering column, cowl brackets, and toe board brackets. Insure that steering column is not too low at cowl bracket.

c. Tighten steering column cowl attaching bolts.

d. Tighten bolts securing steering gear to frame side rail. Make sure that steering column floats at toe board to prevent binding (loose brackets).

e. Tighten bolt securing steering column to flange and insulator assembly.

f. Tighten bolts securing toe board brackets.

g. Rotate to insure against binding.

h. If binding exists, loosen brackets at toe board and adjust until binding condition is relieved.

16-16. Steering Gear Adjustment on M151, M151A1, M151A1C and M718 Vehicles

The following adjustment procedure may be made with the steering gear off the vehicle, or with it installed on the vehicle but not connected to the pitman arm.

a. Install steering wheel on shaft and turn wheel two complete turns. Hook spring scale to steering wheel at point where spoke joins rim. Rotate wheel at least one turn in opposite direction with aid of scale and note pull required to keep wheel moving. Scale reading is worm bearing preload, and should be between 5.0 and 15.4 ounces. A reading that is too high indicates excessive preload, and a gasket or gaskets must be added. A reading that is too low indicates insufficient preload, and a gasket or gaskets must be removed. Removed or add one gasket at a time. Check worm bearing preload after each variation in gasket pack. Steering gear housing cap must be assembled on steering gear housing each time preload is checked.

b. Worm and roller mesh adjustment is controlled by adjustment screw mounted in sector shaft cover (fig. 16-7). With steering wheel on shaft, turn wheel from lock-to-lock (extreme right to extreme left). Return wheel one-half distance of extreme right to extreme left. This is a high spot or straight-ahead position. Turn adjusting screw clockwise until there is drag on the wheel. Install jam nut on adjusting screw and turn down finger tight. Hook spring scale to steering wheel at point where spoke joins rim, and rotate wheel through high spot with aid of scale. Scale reading should be between 1.6 and 2.2 pounds. If reading is too high, turn adjusting screw counterclockwise and check tension again. If reading is too low, turn adjusting screw clockwise and check tension again. When correct tension is obtained, lock jam nut by holding adjusting screw in place with screwdriver while tightening nut with wrench.

16-17. Steering Gear Adjustment on M151A2, M718A1 and M825 Vehicles

On M151A2, M825 and M718A1 vehicles the

following adjustment procedure should be made with the steering gear removed from the vehicle and mounted in a bench vise (fig. 16-17). Equipment required for this adjustment procedure is shown in figure 16-18, and consists of the steering gear with flange and insulator assembly secured to fit, one ⅝-inch bolt with unthreaded shoulder, and a pound-inch torque wrench.

a. The following sequence should be followed in performing the steering gear preload procedure.

(1) With steering gear secured in bench vise, secure flange and insulator assembly to steering gear shaft.

(2) Cut threaded portion from ⅝-inch bolt and discard.

(3) Secure bolt in other end of flange and insulator assembly. (A piece of emery cloth or similar material may be used to obtain a tight slip-free fit.)

(4) Using pound-inch torque wrench and an appropriate socket, rotate the torque wrench. A reading of 2.2 to 11 pound-inches should be obtained.

(5) If reading is too high, add shim or shims. If reading is too low, remove shim or shims.

b. The following sequence should be followed in performing the w[illegible]m and roller mech adjustment.

(1) With steering gear secured in bench vise, secure flange and insulator assembly to steering gear shaft.

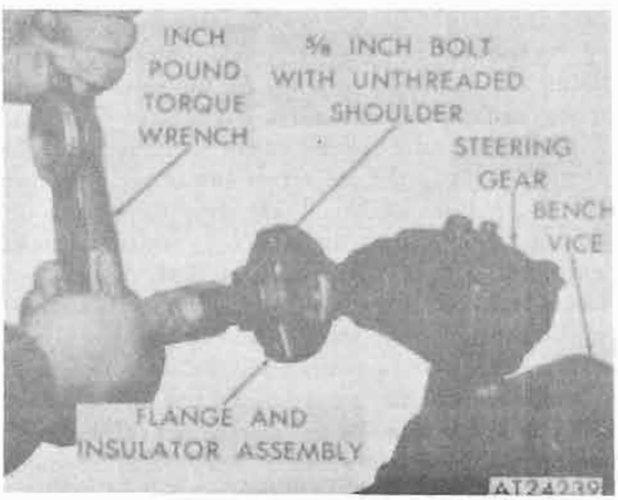


Figure 16-17. Steering gear adjustment (M151A2, M718A1, and M825 vehicles).

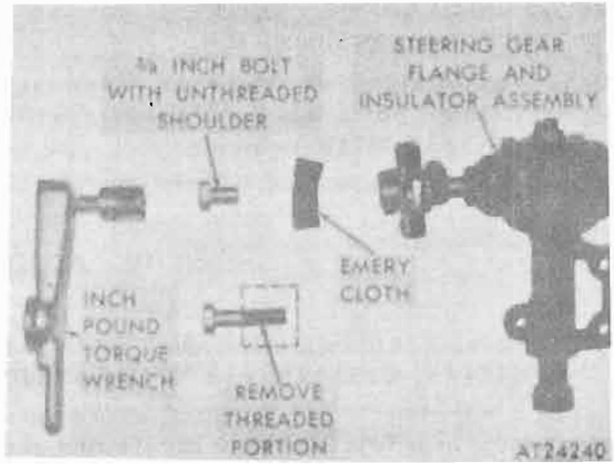


Figure 16-18. Steering gear adjustment equipment (M151A2 M718A1, and M825 vehicles).

(2) Cut threaded portion from ⅝-inch bolt and discard.

(3) Secure bolt in other end of flange and insulator assembly. (A piece of emery cloth or similar material may be used to obtain a tight, slip-free fit.)

(4) Rotate flange and insulator assembly from lock-to-lock (extreme right to extreme left). This is a high spot, or straight-ahead position. Turn adjusting screw clockwise until there is a drag on the flange and insulator assembly. Install jam nut on adjusting screw and turn down finger tight.

(5) Using a pound-inch torque wrench, rotate the flange and insulator assembly through the high spot. Reading at the high spot should be 11-15 lb.-in. If reading is too high, turn adjusting screw counterclockwise and check tension again. If reading is too low, turn adjusting screw clockwise and check tension again. When correct tension is obtained, lock jam nut by holding adjusting screw in place with screwdriver while tightening nut with wrench.

16-18. Repair Data

Refer to table 16-1 for repair data for the steering gear, including torque values, adjustments, and lubrication specifications.

Table 16-1. Repair Data—Steering Gear

Application	*Thread size*	*Torque (lb.-ft.)*
Steering gear housing cover-to-housing bolt.	5/16-18	10-15
Steering gear housing cap-to-housing bolt.	5/16-18	10-15
Steering gear-to-frame mounting bolt.	3/8-24	25-30
Steering wheel to shaft nut	5/8-18	25-35
Steering column to instrument panel bracket bolt.	5/16-24	12-15
Steering pitman arm to sector shaft nut.	3/4-16	100-110

Point of adjustment	*Scale reading*
Steering shaft worm bearing preload.	5.0 to 15.4 oz. at 7.00 in. radius
Steering shaft worm and roller mesh	1.6 to 2.2 lb. at 7.00 in. radius (M151, M151A1, M151A1C, and M718 vehicles). 11-15 lb.-in. as described in paragraph 16-17*b*. (M151A2, M718A1, and M825 vehicles).
Lash between worm and roller.	0 to within 30° each side of center

Application	*Lubricant*
Steering shaft and sector shaft seals.	GAA
Steering gear housing	GO (refer to lubrication instructions in LO 9-2320-218-12).

CHAPTER 17

REPAIR OF BODY, SEATS, WINDSHIELD, HOOD, FUEL TANK, FUEL PUMP, AIR CLEANER, AND MISCELLANEOUS COMPONENTS

Section I. BODY AND HOOD

17-1. Tabulated Data

Weight	400 lb.
Body Framing	0.060 steel (SAE 1017)
Body Sheet Metal	0.036-0.042 steel (SAE 1009-1020).

17-2. Disassembly

a. *Body.* As the body is a welded unit, it cannot be disassembled other than to remove the attached parts.

b. *Hood.* The hood is removed or installed by removing or installing the six screws, washers, and nuts, retaining the hood hinges to the body cowl panel.

17-3. Inspection

a. *General.* This body is a unit structure, wherein each part bears a portion of the entire structural load or stress. The interrelation of all parts should be kept in mind when inspecting the body, as one damaged area may affect another apparently sound unit.

b. *Under Structure* (Fig. 17-1). Inspect all underbody structural parts, especially inner and outer frame rails, crossmembers, coil spring seats, and suspension support brackets for damage. Look for elongated or torn holes for mounting bolts. Inspect entire structure for cracks. Check all weld points.

c. *Upper Structure* (Figs. 17-2 and 17-3). Check all seat brackets and attaching parts for security of attachment and damaged parts. Inspect all welds and joints for cracks. Inspect panels for cracks.

d. *Hood.* Inspect hood for dents and cracks. Inspect spring catch on top center of hood, and repair or replace as necessary. Inspect brackets for holddown catches on front sides of hood, and replace if defective. Inspect cover panel on left side of hood, and repair if necessary or replace if missing.

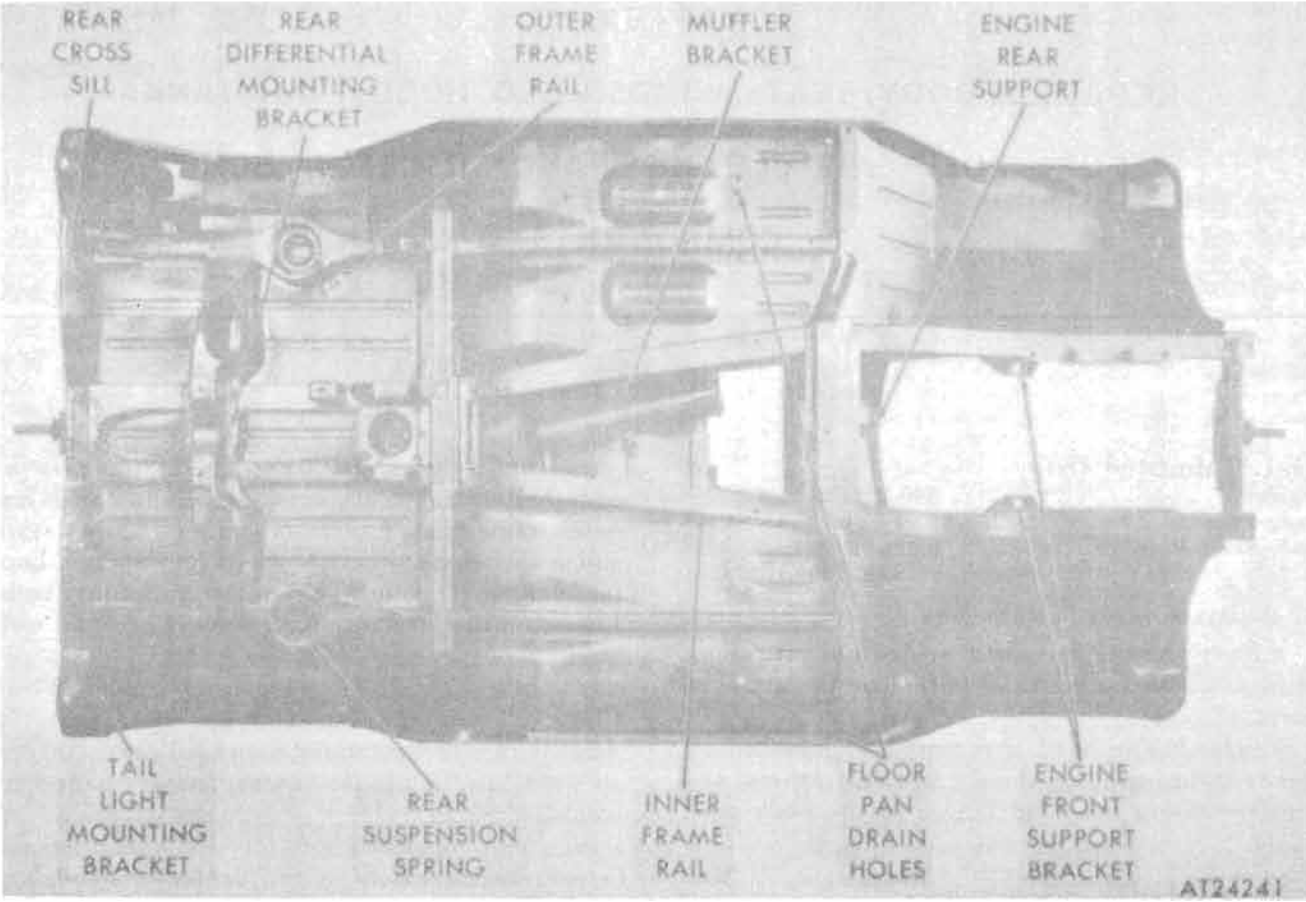


Figure 17-1. Body and frame—bottom view.

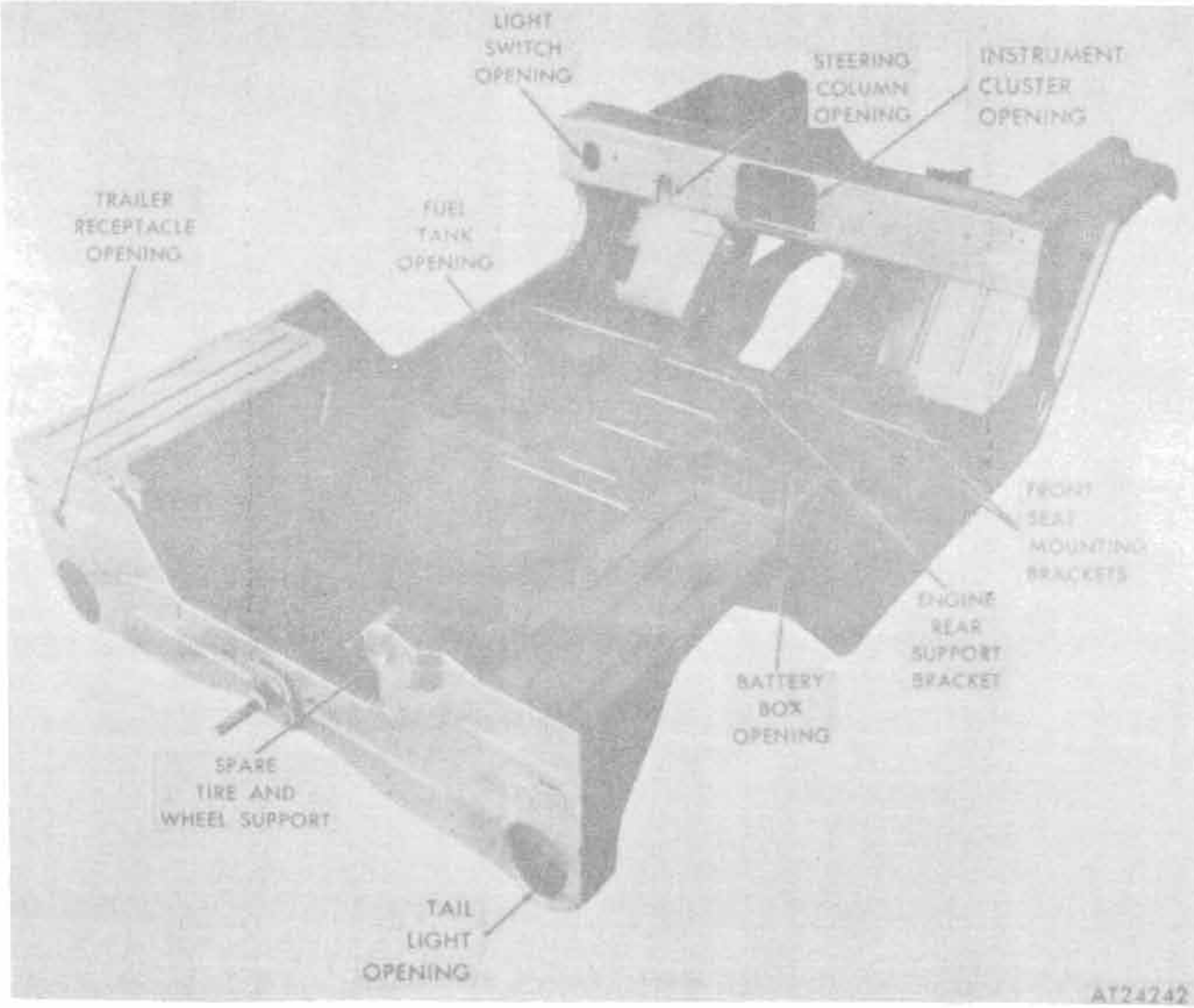


Figure 17-2. Body and frame—¾ right rear view.

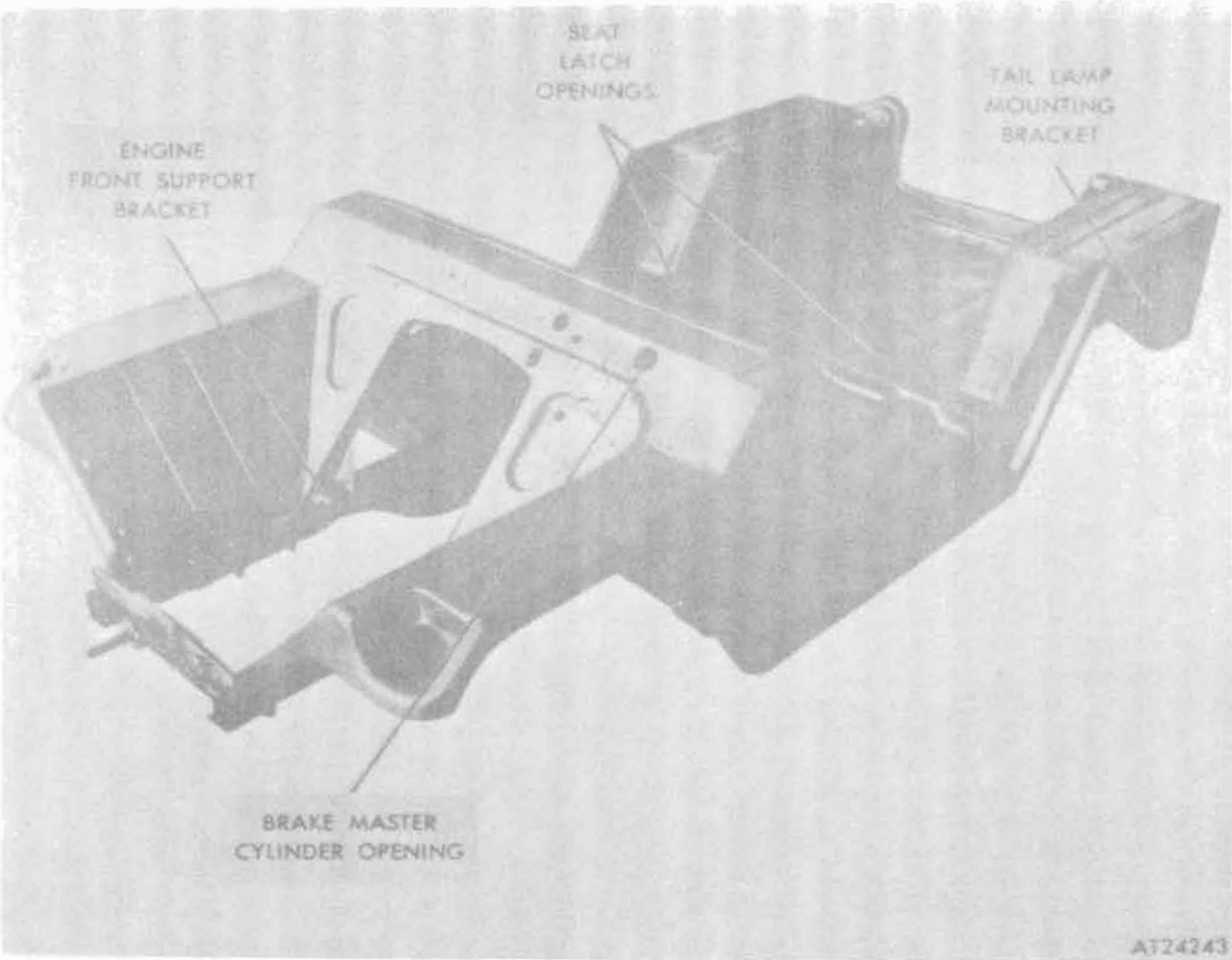


Figure 17-3. Body and frame—¾ front left view.

17-4. Repair

a. *General.* Repairs to the unitized body and frame are basically the same as repairs to separate body and frame type vehicles. The general instructions in TM 10-450 referring to sheet metal repair and straightening and squaring operations all apply, including the use of hydraulic body jacks and associated repair equipment. When using a body jack or other equipment, avoid concentrating stresses in one spot by the use of blocks or plates of wood or metal to distribute the force. Avoid use of flame welding in repair if possible, and do not apply excessive heat to the main frame members as annealing and loss of strength may result. Most collision damage may be repaired by use of jacks and bumping blocks or irons to shape the damaged panel back to its original form. Usually it is uneconomical to repair a body which has sustained damage to the main structural members severe enough to collapse the box section members.

b. *Body Sheet Metal.* Fenders, hood, and body side panels may be repaired using standard methods outlined in TM 10-450. Follow welding instructions in TM 9-237. When welding operations are necessary, use heliarc or equivalent type equipment to avoid overheating or changing the metal characteristics.

c. *Spare Wheel Mounting Bolt.* The spare wheel mounting bolt is held permanently in the support bracket by a weld at the head of the bolt. To replace a broken or damaged bolt, grind off the head and the weld, then drive bolt out. Insert new bolt, with head forward, and securely tack-weld in place.

d. *Body Drain Openings.* Two eyebrow type openings located in the outer sides of the seat bulkhead floor panels are provided to drain the water from the floor of the crew compartment. The holes must be kept open and the eyebrow concaves must be kept clean.

e. *Engine Rear Support Crossmember.*

(1) Inspection.

(a) Check for elongated or torn holes in mounting bracket.

(b) Check for cracks and separated welds around mounting brackets and crossmember.

(c) Check crossmember for ¼-inch deflection at any point (see fig. 17-4).

(d) Check for section height of less than 11 / 16 inches. Repair is mandatory if any of the above conditions exists.

(2) *Repair procedures.*

(a) *Cleaning.* Surfaces to be welded must be free of dirt to prevent contamination of weld. Use a wire brush or grinding wheel to remove rust, paint, and undercoating.

(b) *Welding.* All repair welding will be done by the electric arc process if possible (refer to TM 9-237). It is suggested that low hydrogen electrode 3 / 32-inch diameter be used.

(c) *Method of repairing cracks or tears.* Dependent, upon individual conditions, spotwelds may be repaired by drilling out and "plug" "puddle"-skip weld or continuous weld, or an arc bead or fillet may be laid along the panel at that point. Refer to figure 17-5 for welding tears and cracks in crossmember.

NOTE

When an arc weld is not adequate, use oxyacetylene method for welding, being careful not to warp the metal panels from prolonged or excessive heat.

(d) *Capping of crossmember.* Capping is required when section height is less than 11 / 16 inches, and shall be accomplished as shown in figure 17-6. Engine removal is not necessary for this repair.

1. Straighten distorted area of crossmember to original shape if possible, using porta-power equipment, automotive jack, and chain. Heat should not be applied to aid the straightening process.

NOTE

Care should be taken, if a chain or cable is used, not to bend the flanges downward.

2. Shape cap from SAE 1010 or 1017, 0.09-inch thick, steel material to fit mating surface for best weld conditions (refer to figure 17-6).

(e) *Straightening of deflected crossmember.* If ¼-inch crown dimensions are exceeded, crossmember must be straightened.

1. Removal of engine is necessary (TM 9-2320-218-20).

2. Straightening can be accomplished with the use of C clamps, porta-power, automotive jack, and chain. Heat should not be applied to aid straightening process.

NOTE

Care should be taken, if a chain or cable is used, not to bend the flanges downward. Size and material of beams and supporting blocks are optional, provided they are of sufficient strength for the straightening process (fig. 17-7).

(f) *Inspection after repair.*

1. Inspect for any weld failures resulting from straightening process. Refer to repair procedures if welding is required.

2. Check 9.00-inch dimension between engine mounting holes, prior to engine installation (fig. 17-7).

3. Clean all welded and capped areas in accordance with TM 9-237.

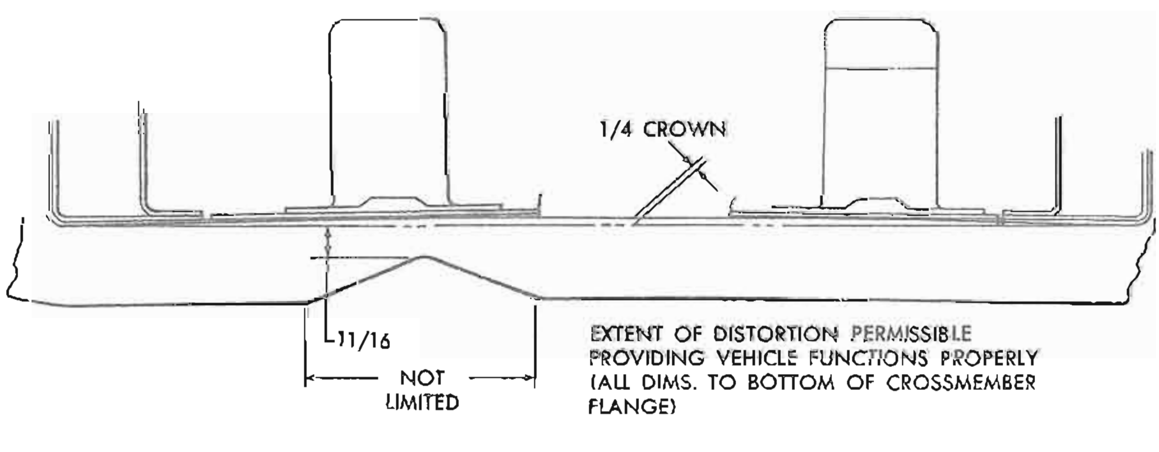


Figure 17-4. Engine rear support crossmember deflection.

Figure 17-5. Welding procedures for tears and cracks.

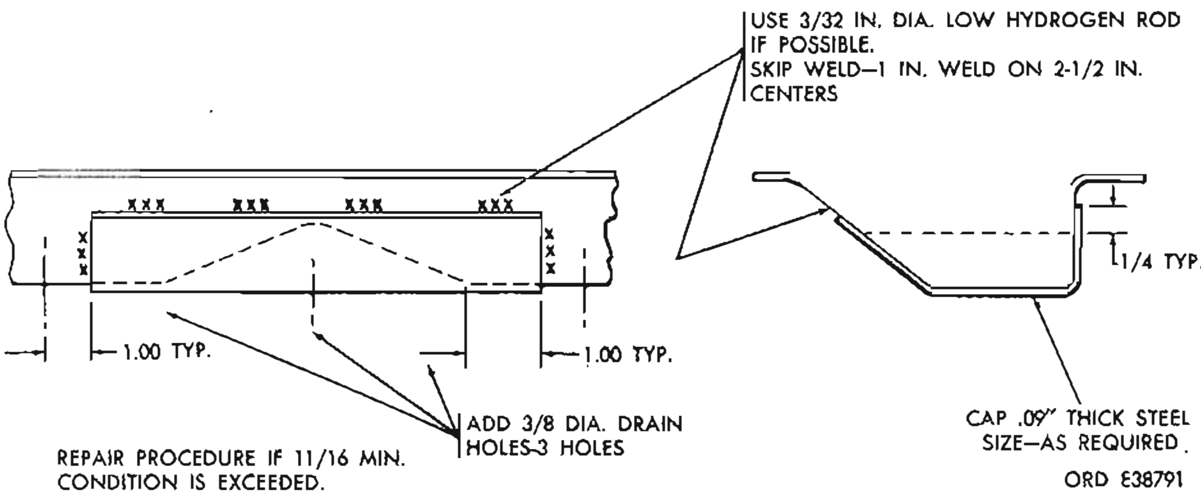


Figure 17-6. Capping of crossmembers.

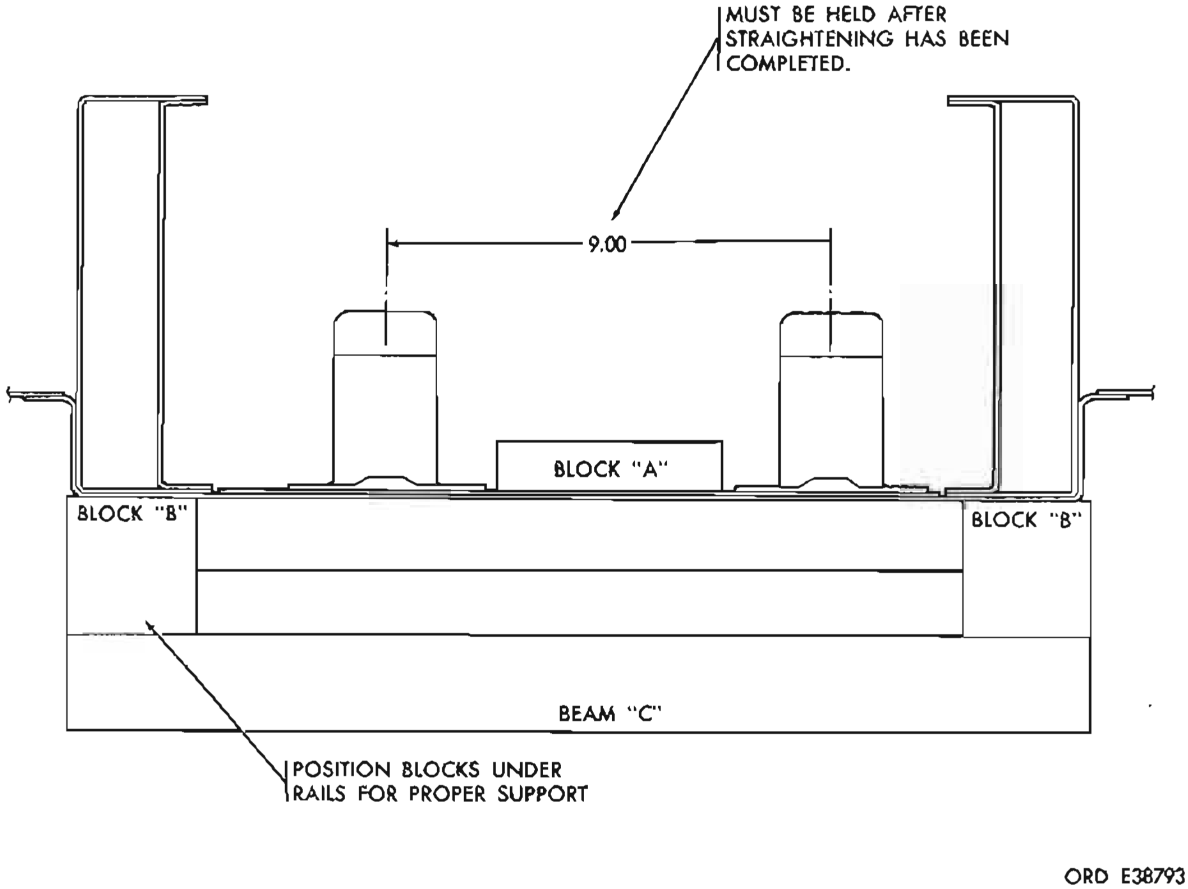


Figure 17-7. Location of supporting blocks and beams for crossmember repair. and dimensions between engine mounting holes.

Section II. M79 RIFLE MOUNT, GUNNER'S SEATS, AND AMMUNITION RACKS, M151A1C and M825 VEHICLES

17-5. Ammunition Racks

Racks may be straightened and repaired by using general body repair practices. Refer to paragraph 17-4.

17-6. Seat Cushion

Canvas seat cushion may be repaired by sewing all tears and open seams of the canvas or by replacing the cover. Replace defective buttons and strap fasteners.

17-7. Gun Mount

For repair of the M79 rifle mount, refer to TM 9-1000-205-12.

17-8. Spare Wheel.Mounting and Guard

The spare wheel mounting is a support assembly that is bolted and reinforced with backing plates to the right front of the body. The support assembly has three nuts welded over holes in the support to secure the mounting bolts. When nut threads become damaged or badly worn. the nut(s) may be removed and a new nut tackwelded in position. The guard assembly can be removed from the body for straightening by removing the attaching screws, washers, nuts, and backing plates (fig. 17-8).

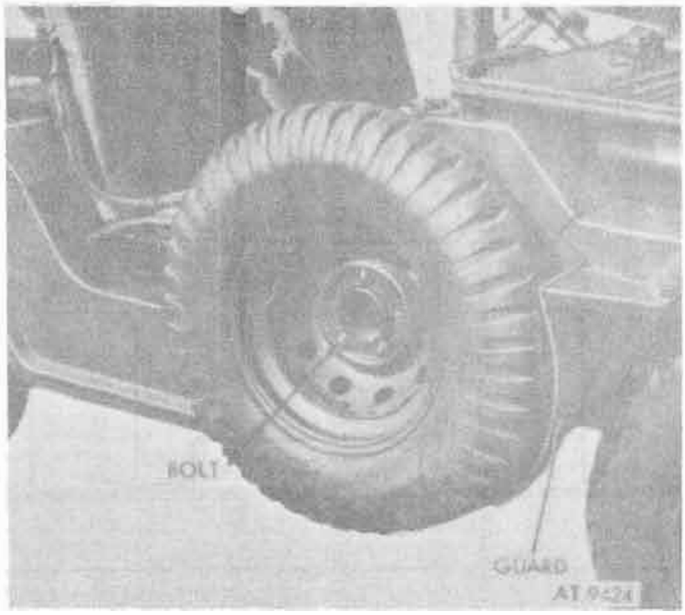


Figure 17-8. M151A1C and M825 spare wheel support and guard.

Section III. BODY EXTENSION ASSEMBLY M718 and M718A1 AMBULANCE VEHICLE

17-9. Description

The M718 and M718A1 ambulance vehicle body is a modified M151 vehicle design, the main differences being an 18-inch body extension (fig. 17-9). The extension is bolted to the rear of the M151 body (fig. 17-10), and the spare wheel and tire assembly is mounted on the right rear side of the body instead of the rear.

17-10. Disassembly

The extension can be removed from the main body and disassembled for straightening by removing the bolts, washers and nuts securing it to the unitized body (figs 17-10 and 17-11).

17-11. Repair

a. Body Extension. Refer to paragraphs 17-4 for general and sheet metal repair procedures.

b. Spare Wheel and Tire Mounting. The spare wheel and tire mounting is a reinforced bracket assembly that is bolted to the right rear of the body and body extension (fig. 17-12). The mounting plate has three nuts welded over drilled holes in the plate to secure the mounting bolts. When nut threads become damaged or badly worn, the nut(s) may be removed and a new nut tack-welded in position.

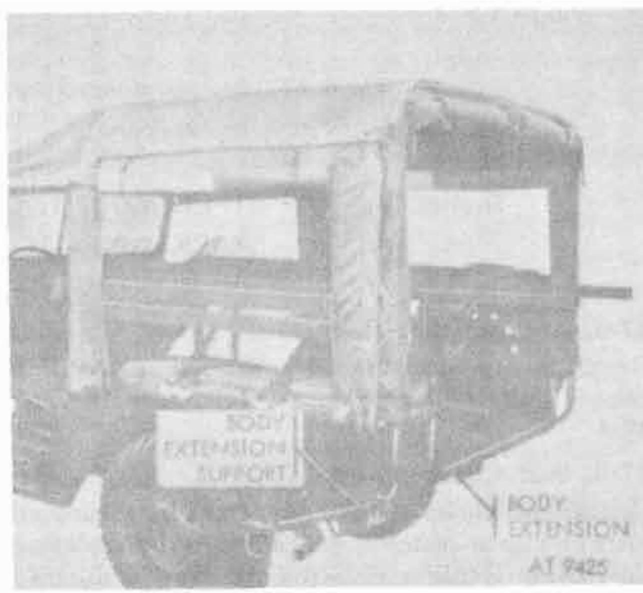


Figure 17-9. M718 and M718A1 ambulance body extension

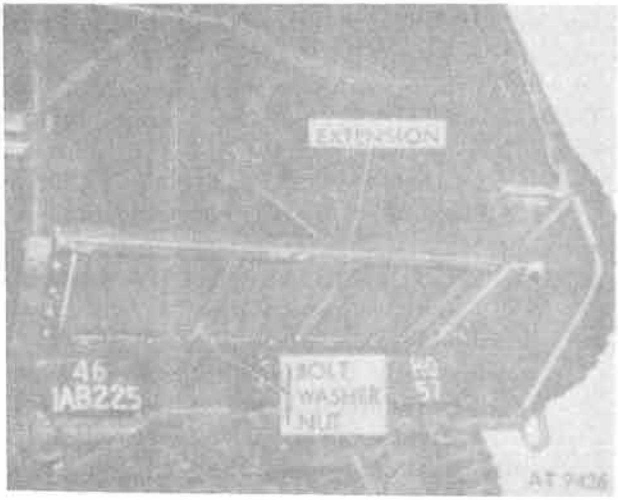


Figure 17-10. Body extension attaching hardware.

Figure 17-11. Body extension support.

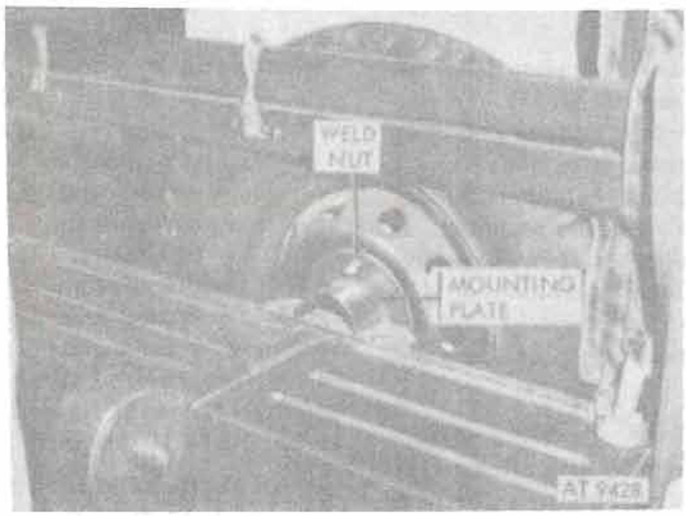


Figure 17-12. M718 and M718A1 ambulance spare wheel mounting bracket and wheel assembly.

Section IV. WINDSHIELD ASSEMBLY

17-12. Description

The windshield assembly is of the folding, quick-removable type. It is attached to the body with slotted hinges. The glass is of high strength safety type and mounted in the frame in a molded rubber weatherstrip. Two windshield wipers are mounted on the assembly. A molded rubber seal attached to the bottom of the windshield frame provides a tight fit at the cowl panel. The M151, M151A1, M151A1C, and M718 vehicles have a two-piece glass in the assembly, divided in the center by a metal strip. The wiper motors for these early model vehicles are of the vacuum type, powered by a vacuum pump located on the engine. The M151A2, M718A1, and M825 vehicles have a one-piece windshield glass and an electric windshield wiper system. A windshield washer and an inside rear view mirror are also provided on these later model vehicles.

17-13. Removal

For instructions on removal of the windshield assembly from the vehicle, refer to TM 9-2320-218-20.

17-14. Disassembly

a. Refer to TM 9-2320-218-20 for removal of windshield wiper arms, wiper motor assemblies and rear view mirror if installed.

b. For M151, M151A1, M151A1C and M718 vehicles, remove three nuts securing center divider strips, and remove divider strips leaving bolts in outside strip (fig. 17-13).

c. Depress flange of rubber weatherstrip at inside corner and push on glass to force it and weatherstrip forward out of frame (fig. 17-14).

d. Apply force gradually, working each way from corner, until glass and weatherstrip are free of frame (fig. 17-15).

17-15. Inspection

a. *Glass.* Inspect windshield glass for scratches, cracks, and milky, foggy, or stained condition. Minor defects that do not restrict the driver's visibility are acceptable.

b. *Frame.* Inspect frame assembly for distortion, dents, and cracks or breaks. Inspect condition of all brackets. Inspect rubber gasket on bottom of frame where it mates with body; check for deterioration, hardening, or damage, and for alinement of openings with defroster openings in frame. Inspect hinge halves for damage or excessive wear; check security of attaching bolts.

c. *Weatherstrip.* Inspect weatherstrip around glass for deterioration, hardening, or damage. Discard if defective.

17-16. Repair

Repair of the windshield assembly is limited to the replacement of defective parts and to tightening loose bolts and screws, except for the removal of dents and the repair of cracks in the frame assembly. Refer to TM 10-450 for sheet metal repairs. If repairs cannot be made, replace windshield assembly. If hinge halves are replaced on windshield assembly or body panel, apply sealer (FSN 8040-877-9872) between hinge half and windshield or body panel.

a. *Glass.* Install windshield glass as follows:

(1) Position weatherstrip on windshield glass.

NOTE

On M151, M151A1, M151A1C and M718 vehicles, which have a two piece windshield glass, place a strip of wood approximately 5/16-inch thick between two glasses to maintain proper clearance for center divider strip (fig. 17-16). Apply adhesive (FSN 8040-262-9028) on both sides of glasses at center divider strip area (fig. 17-16).

(2) Place cord in channel of weatherstrip as shown in figure 17-16. Apply liquid soap to external surface of weatherstrip.

(3) Starting at bottom, apply gradual force on glass and pull on cord to seat glass and weatherstrip in place (fig. 17-17). Continue applying pressure, just ahead of cord and continue pulling cord until weatherstip is completely seated.

CAUTION

High-strength glass is to be positioned and installed so that the trademark can be readable from outside of the vehicle.

(4) On M151, M151A1, M151A1C and M718 vehicles, remove wood strip from between glass pieces and install center divider strips and retain with three nuts and screws.

b. *Wiper Arms and Motor Assemblies and Center Mounted Rearview Mirror.* Refer to TM 9-2320-218-20 for installation.

17-18. Installation

Refer to TM 9-2320-218-20 for instructions on installation of windshield assembly to the vehicle.

Section V. WINDSHIELD WIPER MOTOR

17-19. Data

Vacuum type (M151, M151A1, M151A1C, and M718 vehicles):

Manufacturer .... Trico
Part No. 7017830

Electrical type (M151A2, M718A1, and M825 vehicles):

Manufacturer .... Bosch or Prestolight
Part No. 11644874

17-20. Removal and Installation

Refer to TM 9-2320-218-20.

17-21. Disassembly

a. *Vacuum Motor.*

NOTE

Key numbers in parentheses refer to figure 17-18. Remove two valve cover screws (4), and remove valve cover (3) and gasket (2). Remove six screws (8) from top cover (7). Remove cover (7) and two gaskets (5) from housing (1).

b. *Electrical Motor and Linkage* (fig. 17-19). Disassembly of the motor from the linkage and windshield wiper arm was accomplished during removal of components from the windshield assembly. Further disassembly of the motor is not recommended as it is replaced as a unit.

17-22. Cleaning, Inspection and Repair

a. *Cleaning.* Remove dirt, grease and gummy coating from vacuum motor parts, wiper arms, and linkage components. Wipe clean the electrical motor and gear drive unit.

b. *Inspection and Repair.*

(1) *Vacuum pump* (fig. 17-18). Check paddle assembly (6) for hardening and deterioration. Inspect housing (1) for cracks and deep grooves on inner surface. Check cover and valve assembly for cracks and damage. Replace parts as required.

(2) *Electrical (motor and linkage)* (fig. 17-19). Check motor for damaged electrical connector and smoothness of operation. Replace as required. Inspect linkage and pivot parts for bent or cracked condition; replace as required.

17-23. Assembly

a. *Vacuum Motor* (fig. 17-18). Coat paddle assembly with grease (GAA) and position in housing (1). Position top cover gaskets (5) and top cover (7) on housing (1) and retain with six screws (8). Install valve cover (3) and gasket (2) using two screws (4).

b. *Electrical Motor and Linkage* (fig. 17-19). Assembly of these parts will be accomplished during installation on the windshield assembly.

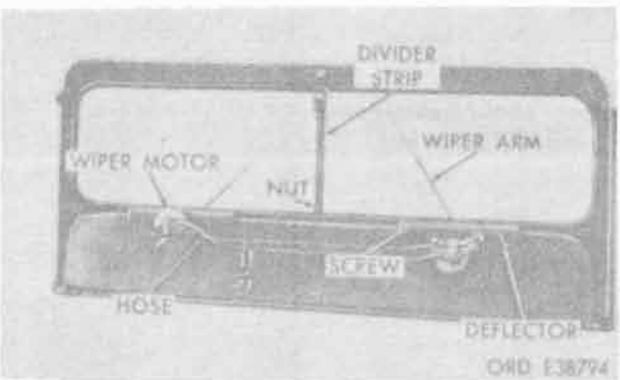


Figure 17-13. Windshield divider strip and wiper motors (M151, M151A1, M151A1C and M718 vehicles).

Figure 17-14. Depressing windshield weatherstrip flange.

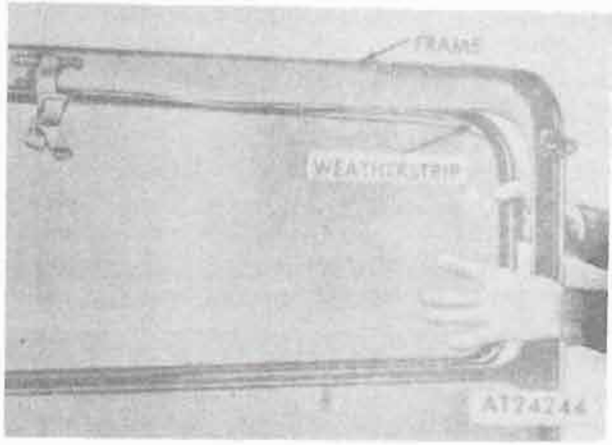


Figure 17-15. Freeing glass and weatherstrip from windshield frame.

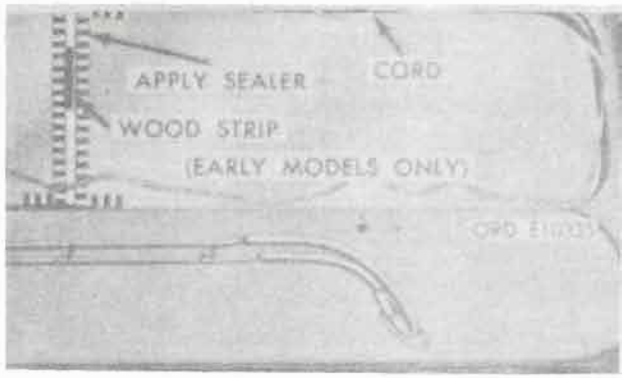


Figure 17-16. Placing cord in weatherstrip.

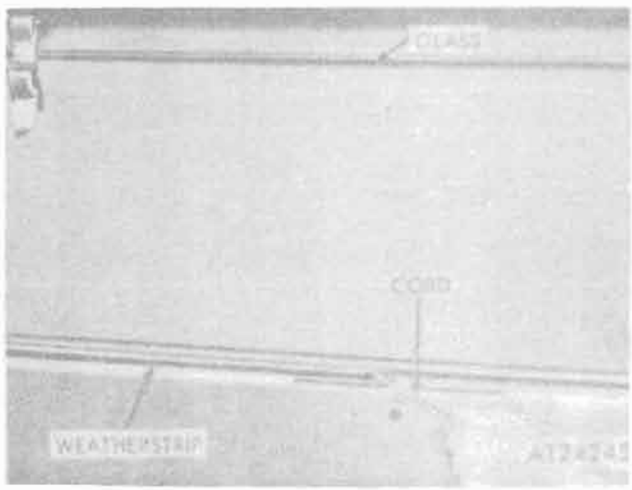
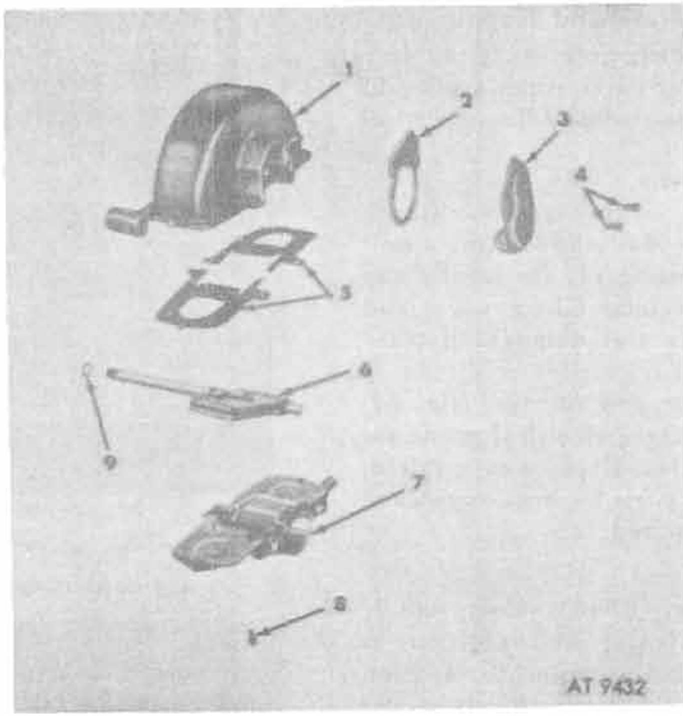
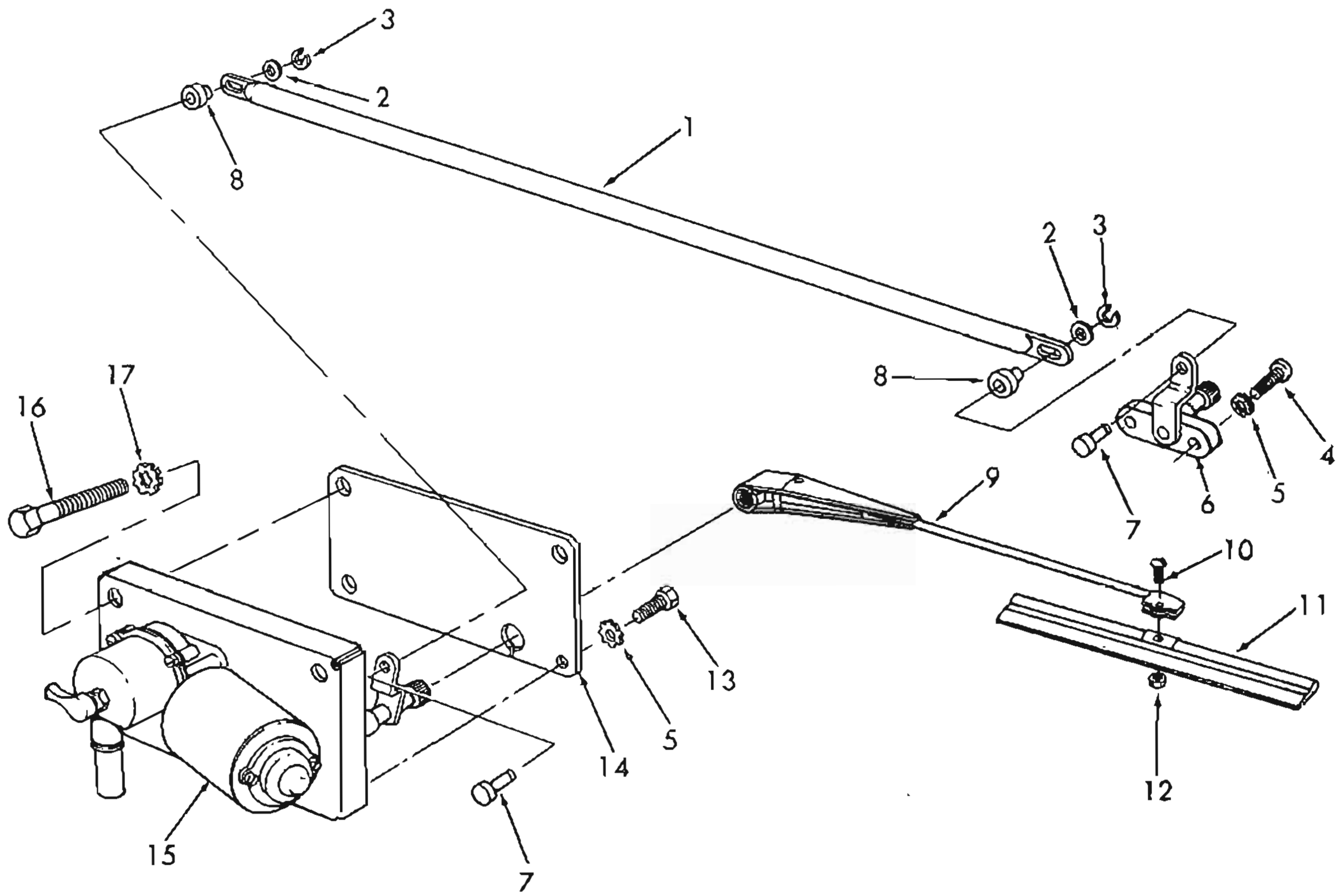


Figure 17-17. Installing windshield glass.



1 Housing
2 Gasket
3 Cover
4 Screw
5 Gasket
6 Paddle assembly
7 Cover
8 Screw
9 Lock

Figure 17-18. Windshield wiper motor—partial exploded view. (M151, M151A1, M151A1C and M718 vehicles)



1 Link
2 Washer
3 Retaining ring
4 Screw
5 Lockwasher
6 Arm and pivot shaft
7 Pin
8 Bushing
9 Arm assembly
10 Screw
11 Blade assembly
12 Nut
13 Screw
14 Gasket
15 Motor and bracket assembly
16 Screw
17 Lockwasher

Figure 17-19. Windshield wiper motor and linkage assembly—partial exploded view (M151A2, M718A1, and M825 vehicles).

Section VI. SEATS

17-24. Removal and Installation

For removal or installation of the vehicle seats, refer to TM 9-2320-218-20.

17-25. Disassembly

a. Front Seat Cushions. To remove the back cushion from the front seat frame, grasp cushion at top and pull upward until free of frame (fig. 17-20). To remove seat bottom cushion, tip the seat forward, and from the underside unfasten the snaps and remove the cushion (fig. 17-21).

b. Rear Seat Cushion. To remove the rear seat cushion on the M151, M151A1, and M151A2, unfasten the seat snap fasteners and remove the cushion from the tube frame (fig. 17-22). To remove cushions on M151A1C and M825, remove two screws holding cushion to frame. The M718 and M718A1 cushion is removed by unlocking the turn-button fasteners.

c. Front Seat Frame. The front seat frames are identical and constructed of tube welded steel. Remove three retaining pins to remove frame from floor (fig. 17-23).

d. Rear Seat Frame. To separate the seat back frame from the bottom frame on the M151, M151A1 and M151A2, drill out one rivet on each side at the hinge point (fig. 17-24). On the M151A1C and M825 the frames are separated by drilling out the rivet at the hinge point and check link on each side of the seat.

e. Springs. To remove an individual spring, unhook links attaching adjacent springs together, then unhook ends of spring from clips on frame (fig. 17-25).

17-26. Inspection

a. Cushions. Inspect condition of seat cushion and back cushion assemblies; look for tears, open seams, and wear. Check operation of turn-button fasteners on map stowage pockets. Check condition of seat pins and rear fastener and attaching chain, at rear bottom frame member. Check springs for breaks and bent condition.

b. Check Condition of All Welds. Inspect and check operation of seat adjusting mechanism; operation should be free and smooth through entire travel of adjustment. Check condition of seat pins and rear fastener and attaching chain, at rear bottom frame member. Check springs for breaks, distortion, and security in frame clips.

c. Rear Seat Frame Assembly. Inspect frame for cracks, breaks, and bent condition. Check all welds. Check springs for breaks, distortion, and security in frame clips. Check condition of seat straps and strap fasteners.

17-27. Seat Repair

Repair of the seat assemblies is limited to straightening the tubular sections and welding. Sew all tears and open seams of the canvas or replace cover of cushion assemblies as necessary. Replace defective button and snap fasteners. When straightening bend in frames and welding cracks or breaks, refer to TM 9-237.

17-28. Seat Assembly

Secure replacements for all discarded defective parts, and assemble. Assemble frames, assemble springs to frames, and then assemble cushions to springs and frames.

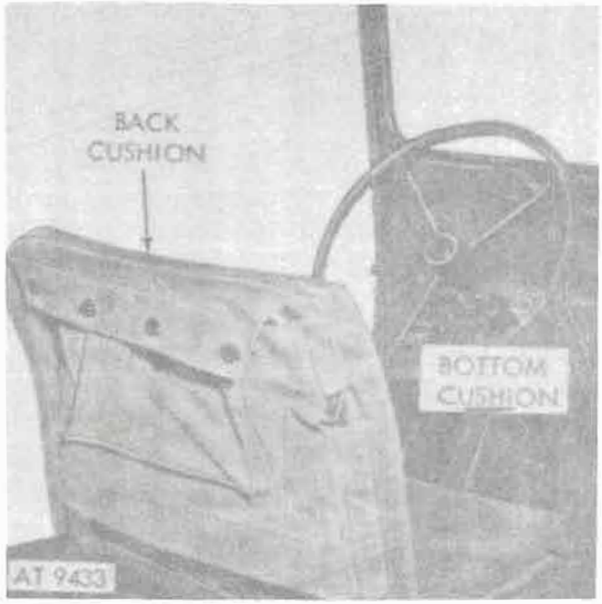


Figure 17-20. Front seat back.

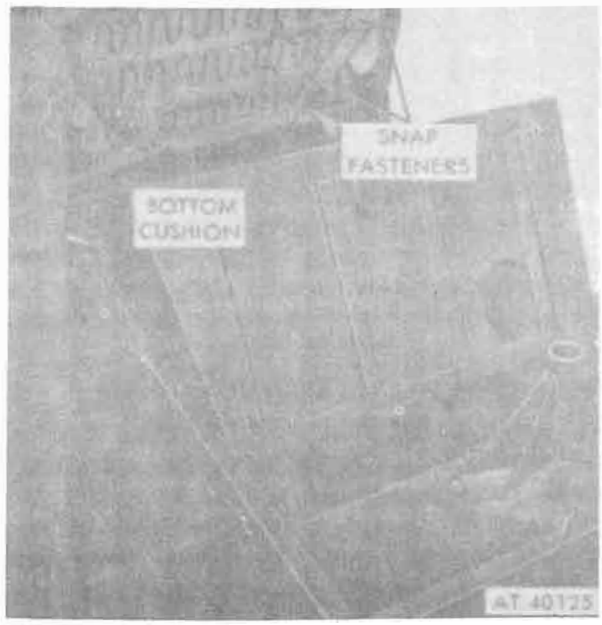


Figure 17-21. Front seat cushion snap fasteners.

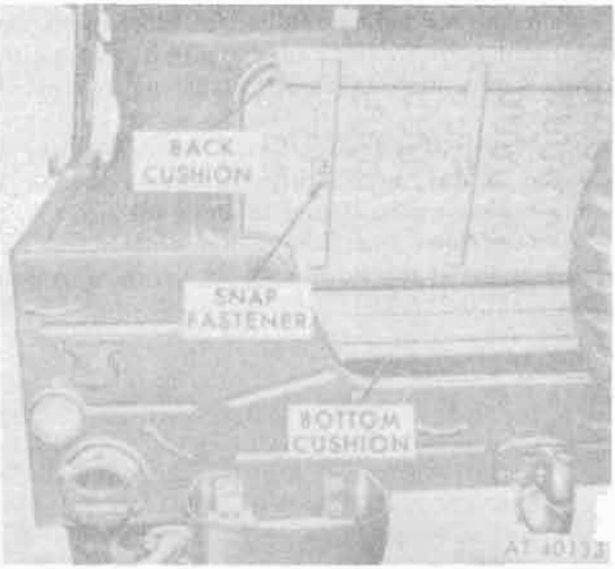


Figure 17-22. Rear seat.

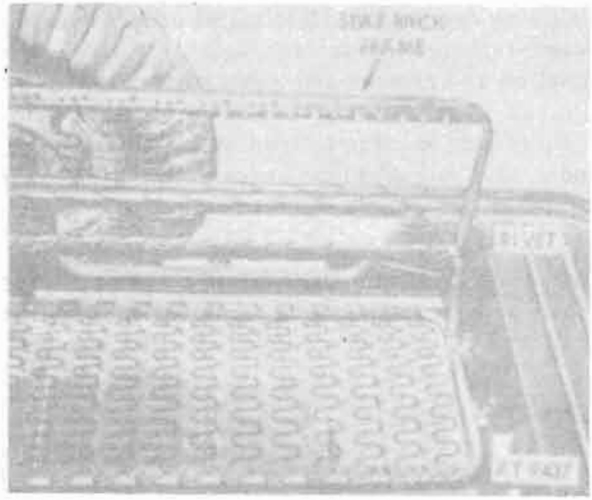


Figure 17-24. Rear seat frame assembly.

Figure 17-23. Front seat removal.

Figure 17-25. Front seat springs.

Section VII. CANVAS TOP, SIDE CURTAINS, AND DOORS

17-29. Description

The M151, M151A1, and M151A2 utility trucks (fig. 17-26) are equipped with canvas tops and rear curtains. Canvas doors and side curtains are obtained in a special purpose kit. For M718 and M718A1 vehicles, a special canvas enclosure is provided. Doors and side curtains are included.

17-30. Removal

For removal of either the top side curtains or canvas doors, refer to TM 9-2320-218-10.

17-31. Inspection

a. *Canvas.* Inspect all canvas side curtains, doors, and top for tears, seam rips, and cuts.

Examine canvas for mildew and other signs of dry deterioration. Check all fasteners for proper function and remove any signs of rust that may be present.

b. Plastic Windows. Inspect plastic windows on doors, and side and rear curtains for breaks, deep scratches, and other signs of damage.

17-32. Repair

a. Canvas Items. Use yellow GI soap and stiff brush with warm water to wash all canvas items; dry thoroughly before folding for storage. If rips, cuts, and tears in the canvas cannot be repaired, replace the item. Damaged fasteners must be replaced.

b. Plastic Windows. Plastic windows may be cleaned of fog, and light scratches removed by using crocus cloth dipped in light oil.

c. Top Bows and Door Frames. For repair or replacement of top bows and door frames, refer to TM 9-2320-218-20.

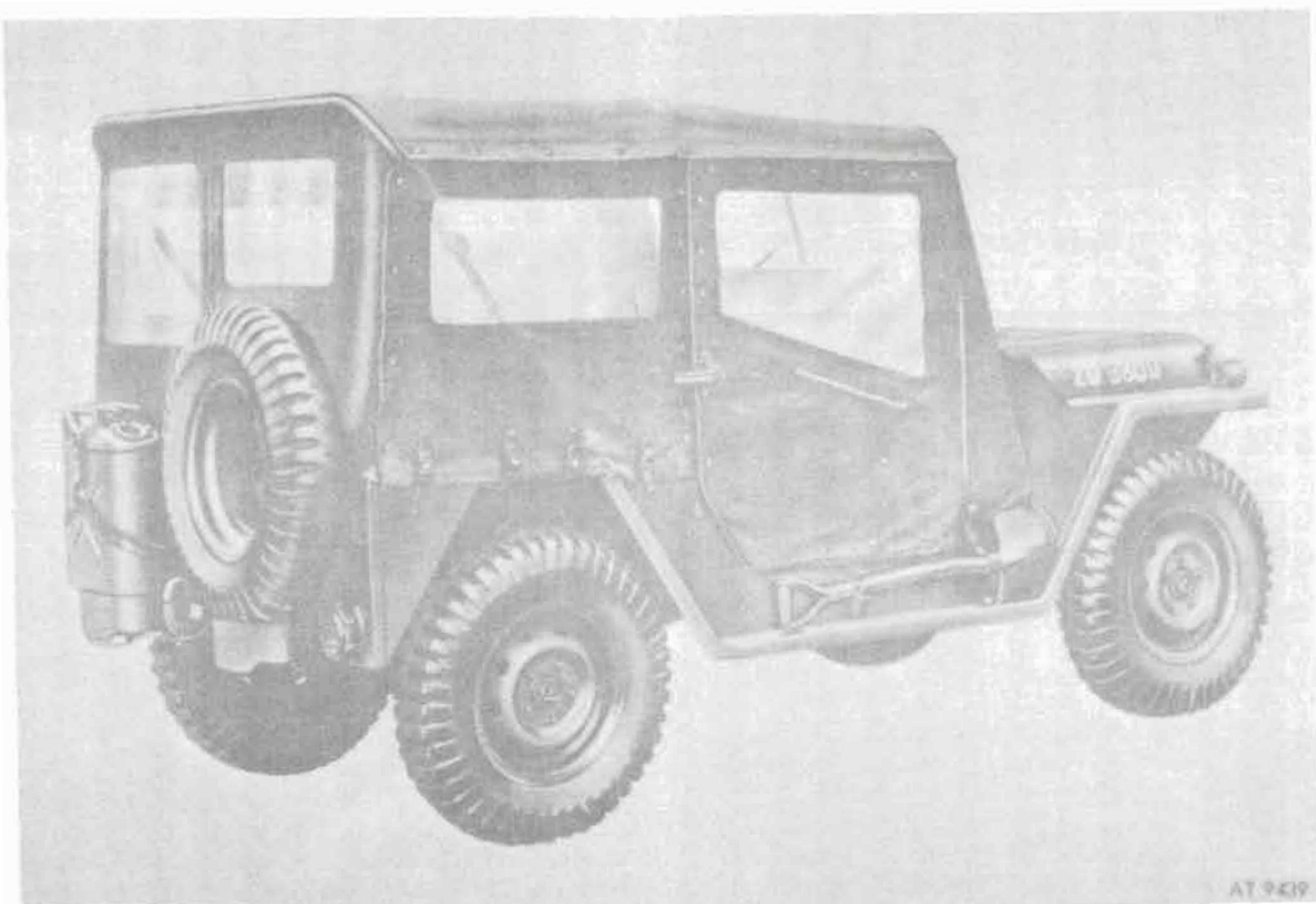


Figure 17-26. Utility truck, vehicle canvas enclosure.

Section VIII. AIR CLEANER

17-33. Troubleshooting
(fig. 17-27.)

If a defective air cleaner is mounted on a vehicle, the engine will not develop full power. Or, if the vehicle is operated in a mildly dusty area it will develop a clogged air cleaner which will cause premature engine failure. Failure to develop full power can be caused by a restricted air cleaner or a restriction in the air cleaner-to-carburetor air hose.

NOTE

If air cleaner is "over full" with oil, it will cause the engine to emit blue smoke.

17-34. Removal and Disassembly

Refer to TM 9-2320-218-20 for removing air cleaner from vehicle. For disassembly, refer to figure 17-28, and perform the following:

a. Loosen screw on ring securing perforated cap, and remove cap.

b. Loosen wing bolt on clamp securing upper half assembly to lower half assembly, and lift off upper half assembly.

c. Lift removable filter assembly out of cleaner lower half assembly.

d. Lift oil cup out of lower half assembly.

17-35. Cleaning

Clean all metal parts in mineral spirits paint thinner or drycleaning solvent. Dry with cloth. Flush upper filter and removable filter with mineral spirits paint thinner or drycleaning solvent several times. Dry filters with air hose, or allow filters to stand until dry.

17-36. Inspection and Repair (fig. 17-28.)

a. *Cover Assembly*. Inspect threads on brass fittings to vent lines, and threads on wing bolt. Discard if any threads are stripped. Be sure filter is clean and in good condition. Inspect cover assembly connection for flexible rubber hose to be sure hose fits tightly on upper half air outlet.

b. *Filter*. Check filters for damage or dents. Inspect filter fiber for damage such as tearing or matting. Discard removable filter if damaged. Replace upper half assembly if its filter is damaged.

c. *Oil Cup*. Inspect oil cup and baffle assembly for leaks. Discard if there are any leaks or if cup is excessively dented.

d. *Lower Half Assembly*. Inspect assembly for excessive dents. Check threads of outlets to brass fittings. Be sure mounting brackets are solidly in place; discard assembly if brackets are loose or broken.

e. *Perforated Cap*. Check bolt and nut on edge of perforated cap; discard perforated cap if excessively damaged. Straighten any distortion found in cap assembly.

17-37. Assembly and Installation (fig. 17-28.)

a. Place oil cup in bottom of housing, and fill with oil.

b. Place removable filter in housing above oil cup.

c. Install upper half assembly on housing, and tighten wing bolt securely.

d. Install perforated cap, and tighten attaching bolt and nut.

e. Install air cleaner to vehicle (TM 9-2320-218-20).

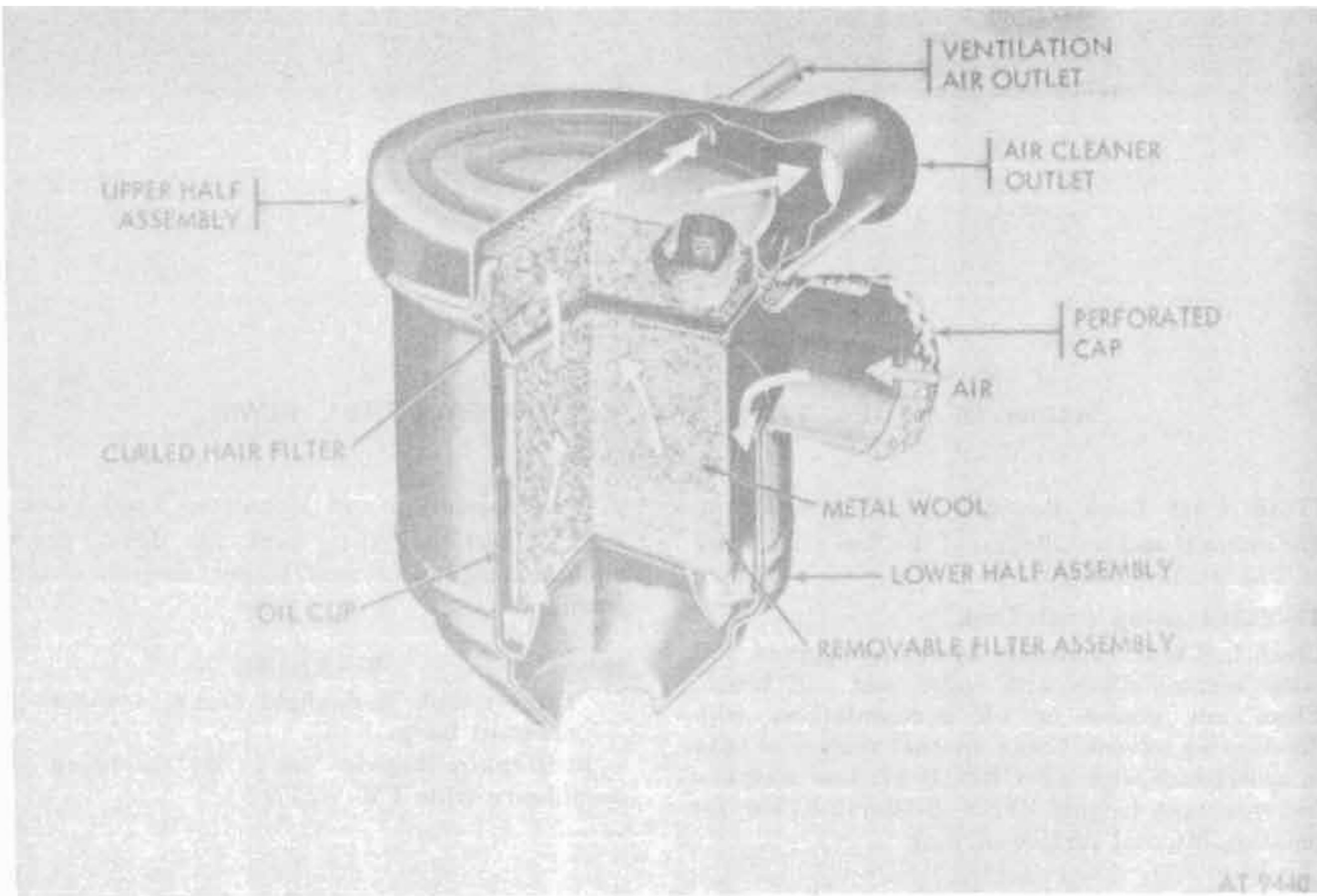
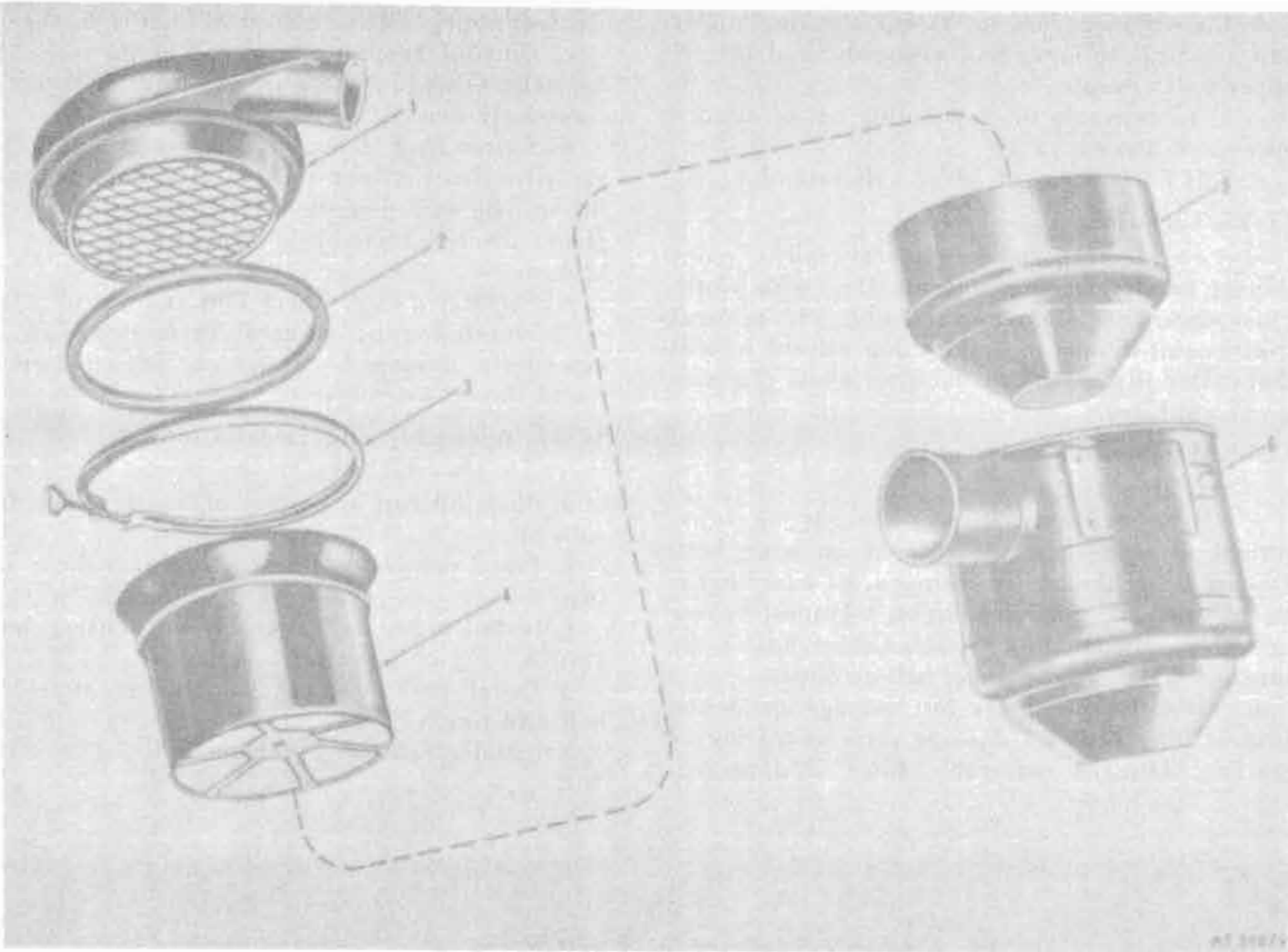


Figure 17-27. Air cleaner—section view.



1 Upper half assembly
2 Seal
3 Clamp assembly
4 Removable assembly
5 Oil cup and baffle assembly
6 Lower half assembly

Figure 17-28. Air cleaner assembly.

Section IX. FUEL TANK AND ELECTRICAL FUEL PUMP

17-38. Fuel Tank Removal and Installation.

For removal and installation of the fuel tank, refer to TM 9-2320-218-20.

17-39. Cleaning Fuel Tank

Clean fuel tank externally by removing mud and other accumulations with water and stiff brush. Clean any grease or oil accumulations with drycleaning solvent. Clean internal surface of tank in accordance with TB ORD 1047. Use aromatic fuel resistant lacquer (FSN 8-10-598-5156) for painting internal surface of tank.

17-40. Inspection and Repair of Fuel Tank

a. Inspection. Inspect tank for dents, cracks along seams, and for rust. Inspect interior of tank corrosion.

WARNING

Inspect tank in daylight or use a vapor-resistant lamp.

b. Repair. Repair tank by welding in accordance with TM 9-237.

WARNING

Prepare tank before welding to remove any explosion hazard. Refer to TM 9-237.

17-41. Fuel Pump, Electrical (M151, M151A1, M151A1C, and M718 vehicles)

a. Removal. Refer to TM 9-2320-218-20 for removal of pump from fuel tank.

b. Repair.

NOTE

Key numbers in parentheses refer to figure 17-29.

(1) Remove screws (12) retaining plate (11) and gasket (9) securing fuel filter element (10) to fuel pump motor assembly (8).

(2) Clean and inspect filter element; if element cannot be thoroughly cleaned or is damaged, replace filter element.

(3) Disconnect electrical fittings from top of fuel pump mounting plate (1), using special wrench provided with repair kit (FSN 2910-921-5618).

(4) Cut electrical wire to motor at mounting plate. Discard rubber grommet (7).

(5) Loosen two line fitting nuts (13), and remove fuel pump motor assembly (8) from mounting plate (1).

(6) Discard electric motor assembly (8).

(7) Install new electric motor assembly in reverse order of removal, using new rubber grommet (7) and element gaskets (9) contained in repair kit.

NOTE

The electric motor feed wire should be secured in the mounting plate, and a continuity (for grounding) test performed before pump is installed in fuel tank.

17-42. Fuel Pump, Mechanical (M151A2, M718A1, and M825)

a. Refer to paragraph 4-89 for repair of the mechanical fuel pump which is mounted on the engine assembly.

b. Inspect filter screen assembly which is located on the fuel pickup line. Replace filter if screen is torn or damaged, or if cleaning will not free clogged material.

Section X. GENERATOR REGULATOR (25 AMP SYSTEM)

17-43. Removal and Installation

For removal and installation of the 25-ampere generator regulator, refer to TM 9-2320-218-20.

17-44. Adjustment and Repair

No adjustment or repair of the 25-ampere generator regulator will be performed.

Section XI. REPAIR OF BATTERIES, BATTERY CABLES, AND LAMPS

17-45. Batteries

For removal and installation, refer to TM 9-2320-218-20. For cleaning and repair, refer to TM 9-6140-200-15.

17-46. Cables

For removal, installation, and repair, refer to TM 9-2320-218-20.

17-47. Lamps

For replacement of headlight seal beam units, and other vehicle light lamps, refer to TM 9-2320-218-20.

Section XII. REPAIR OF WHEELS, TIRES, AND TUBES

17-48. Tabulated Data

a. Tires.

Type	Lightweight, nylon cord
Thread	Nondirectional cross-country
Size	7.00x16
Plies	4 (6-ply rating)

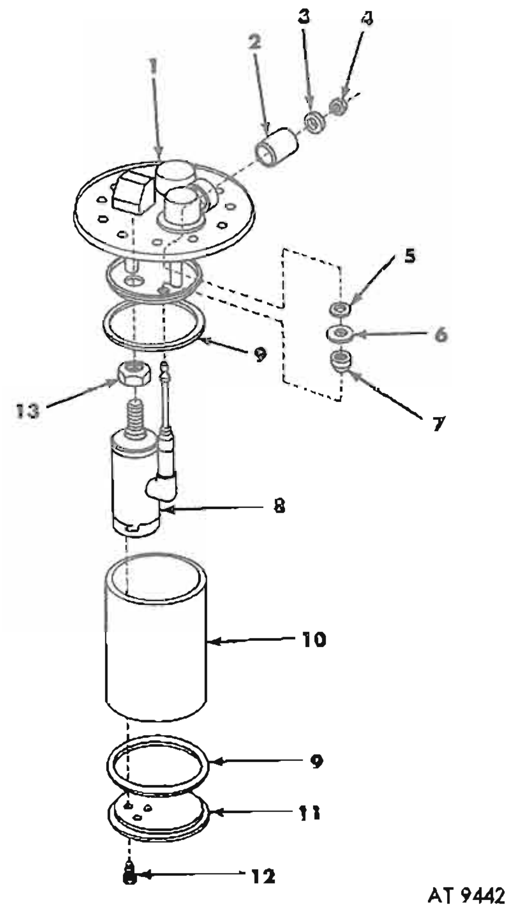
b. Wheels.

Number of mounting studs	5
Material	Steel stamping
Type	Drop-center safety rim
Weight	20.5 lb. each
Rim Width	4-½ in.
Wheel nut torque	65-70 lb.-ft.

17-49. Repair
(fig. 17-30.)

a. *Wheels.* Inspect wheels for concentricity and elongated mounting stud holes. Minor bends can be straightened, but cracks require wheel replacement.

b. *Tires and Tubes.* Refer to TM 9-2610-200-20 and TM 2610-200-34.



1 Mounting Plate
2 Shell
3 Cup
4 Nut (hex)
5 Washer
6 Sleeve
7 Grommet
8 Motor (pump)
9 Gasket (filter)
10 Filter
11 Plate
12 Screw assembled washer.
13 Nut

Figure 17-29. Fuel pump, electrical (M151, M151A1, M151A1C, and M718 vehicles).

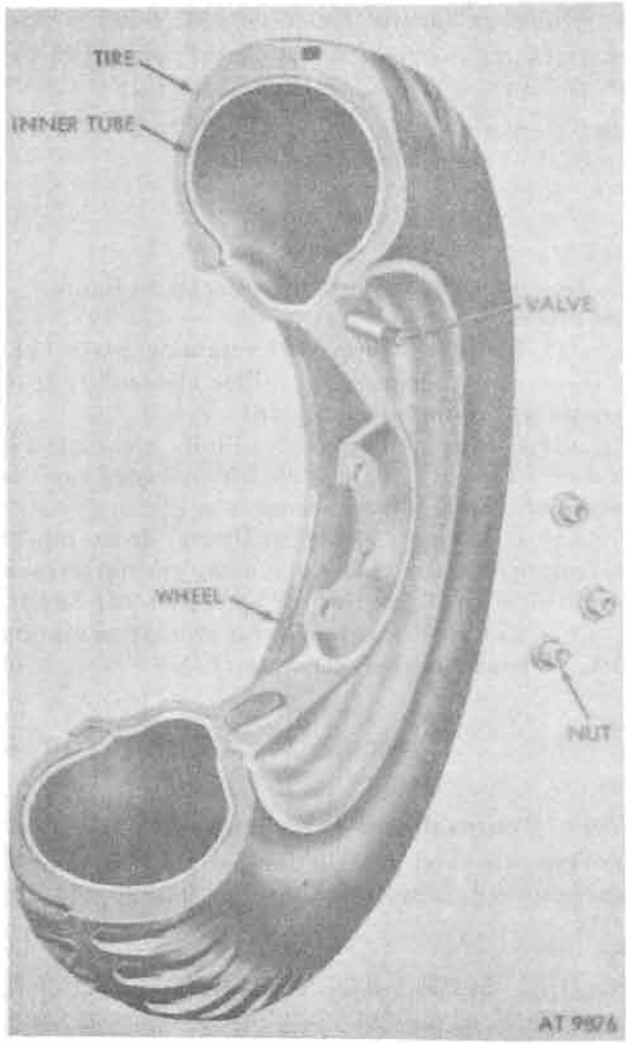


Figure 17-30. Wheel and tire.

CHAPTER 18

MAINTENANCE OF MATERIEL USED IN CONJUNCTION WITH MAJOR ITEMS

SPECIAL PURPOSE EQUIPMENT (KITS)

Section I. INTRODUCTION—SPECIAL PURPOSE KITS

18-1. Scope

This chapter contains installation instructions for special purpose kits designed for use on the ¼-ton, 4x4, utility truck, M151, M151A1, M151A1C, M151A2, M825, and M718 and M718A1 ambulance vehicles. This chapter also contains a description of the major units of each kit and their function in relation to other components of the vehicle. Further, the components of each kit are listed herein. These listings are not to be used for requisitioning of kits, or repair parts in support of kit-equipped vehicles.

18-2. Kit Requisitioning

Special purpose kits must be requisitioned independently of the vehicle. Supply lead time must be considered when placing requisition(s) for special purpose kit(s).

18-3. Authorization

a. Installation of kits is authorized under criteria defined in SB9-16 for winterization kits, SB 9-155 for the deepwater fording kit, and SB 11-131 for the 100-ampere generator (alternator) kit when certain radios are authorized by instructions contained therein.

b. Records of unit replacement of components of this equipment should be kept separate from those pertaining to the basic vehicle, and turned in with the equipment when removed for inspection, repair, or returned to stock.

18-4. Service Upon Receipt of Materiel

a. Inspection and Cleaning. When a new or reconditioned kit is received, determine if it has been properly prepared for service and that all necessary parts are present. Inspect all assemblies, subassemblies, and parts for proper assembly and condition. If any exterior surfaces are coated with rust preventive compound, remove with drycleaning solvent or mineral spirits paint thinner.

b. Correction of Deficiencies.

(1) Ordinary deficiencies disclosed during preliminary inspection, servicing, or installation will be corrected by maintenance personnel who will perform or are performing the installation.

(2) Serious deficiencies detected in the equipment which occur under the circumstances indicated in DOD 4140.34-M should be immediately reported in accordance with instructions in these regulations.

Section II. VEHICLE WINTERIZATION KIT (—65° F.)

18-5. Description and Data

a. Description. For description of the vehicle winterization kit (—65° F), refer to TM 9-2320-218-20.

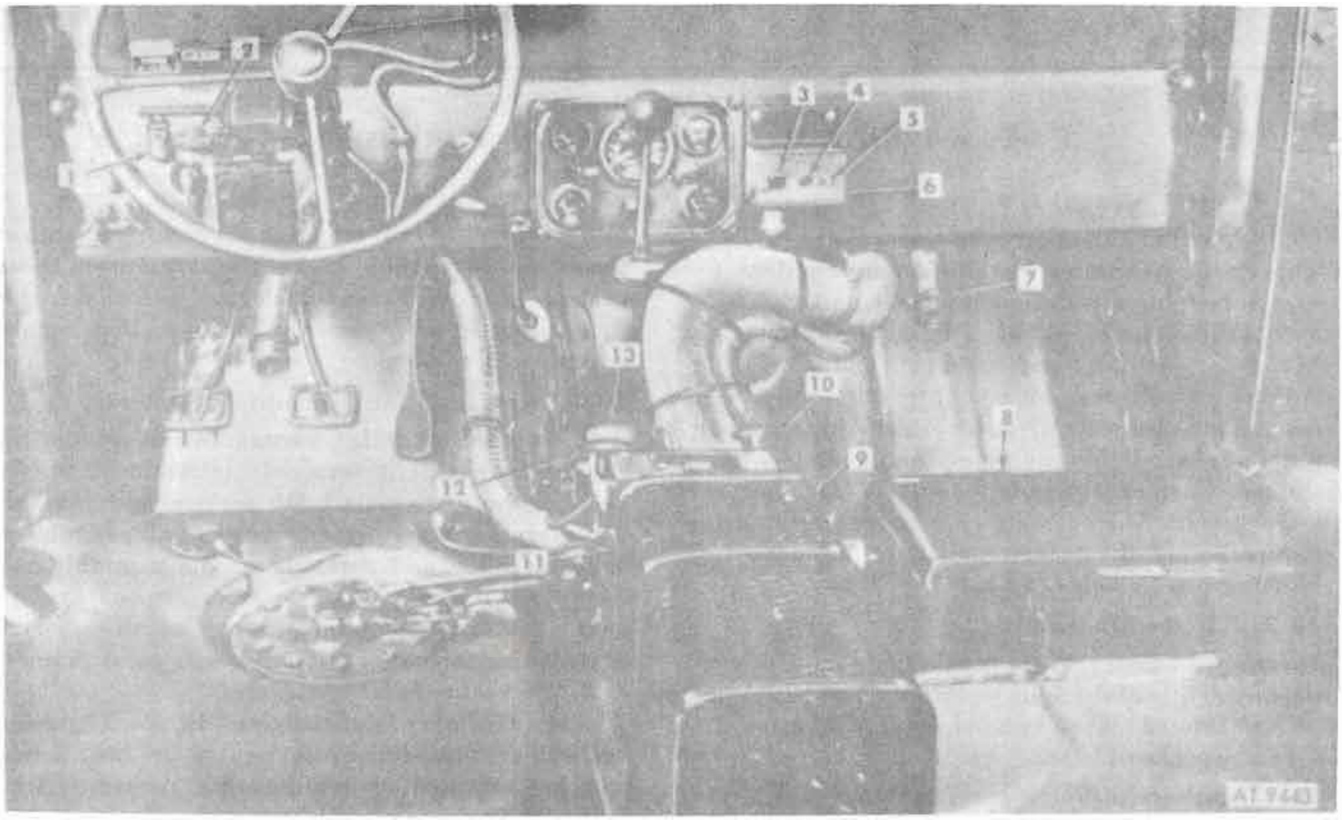
b. Tabulated Data.

Perfection Heater	Ord. No. 10920608
Stewart-Warner	Ord. No. 8720193
Manufacturer Model	Perfection E500 A
Manufacturer Model	Southwind 1030-D24
Weight	21 lb.
Dimensions:	
Width	6⅜ in.
Length	19 in.
Height	10½ in.
Electrical requirements:	
Operating voltage	24 volts
Current consumption:	
Starting	15 amp.
High Heat (running)	6 amp.
Low Heat (running)	6 amp.
Fuel pressure required	1 to 5 psi
Fuel Consumption:	
High heat	0.45 gph
Low heat	0.27 gph
Heat output (fresh air):	
High heat	30,000 Btu./hr.
Low heat	18,000 Btu./hr.
Exhaust gas for engine oil pan pre heating high heat	20,000 Btu./hr.
Total heat output (max.)	50,000 Btu./hr.
Free air delivery (high heat):	
No restriction	130 cfm.
One inch of water back pressure	94 cfm.

Air temperature rise (high heat position and no air restriction). . . . . 230°F

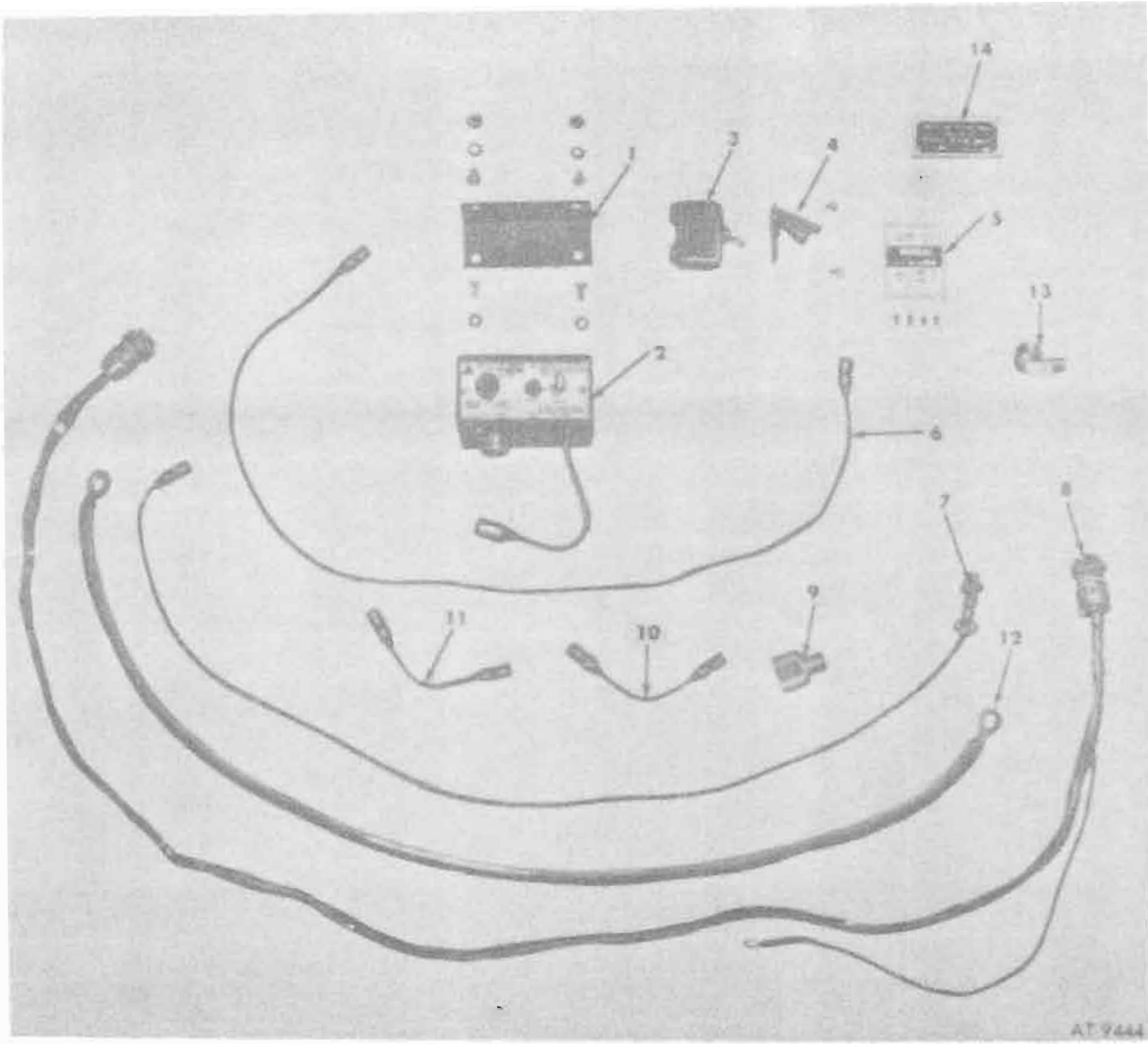
18-6. General Installation Instructions

The complete winterization kit (—65° F.) installation consists of four subassembly installations: Slave receptacle, brush guard and hood cover, insulation, installation, and the heater system. Before these assemblies can be installed, the vehicle must be prepared as outlined in paragraph 18-7. Refer to figures 18-1 through 18-8 for kit contents.



1 Emergency switch
2 Defroster diverter control handle
3 Indicator test lamp
4 Circuit breaker reset button
5 Heater control switch
6 Control box
7 Defroster diverter hose
8 Battery box
9 Heater guard
10 Heater diverter control handle
11 Heater diverter box
12 Exhaust diverter control handle
13 Fuel pump

Figure 18-1. Winterization kit (—65° F.)—installed view.



Key	Item	Quantity
1	Heater control box bracket.	1
	Screw (¼-20x½)	4
	Lockwasher	4
	Nut (¼-20)	2
2	Heater control box assembly.	1
3	Toggle switch (emergency).	1
4	Emergency switch guard.	1
	Screw	2
	Lockwasher	2
5	Instruction plate.	1
	Screw	4
6	Control box-to-emergency switch cable.	1
7	Cable assembly, heater-to-fuel pump.	1
8	Cable assy, heater-to-control box.	1
9	Y adapter	1
10	Ignition switch-to-adapter cable assembly.	1
11	Emergency switch-to-adapter cable assembly.	1
12	Battery-to-thermal switch cable assy.	1
13	Clamp	2
14	Plate	1

Figure 18-2. Heater control components. —65°F. winterization kit.

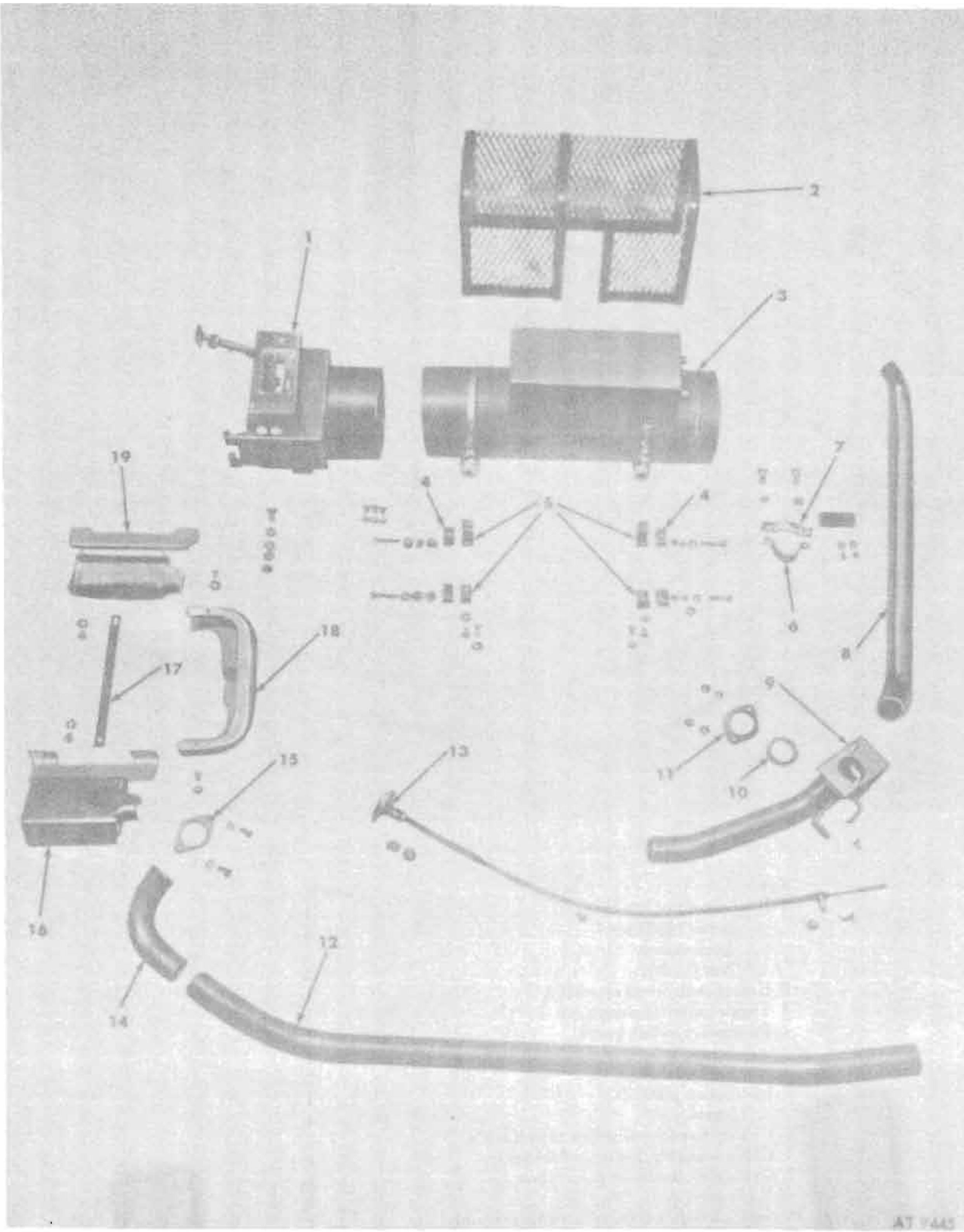
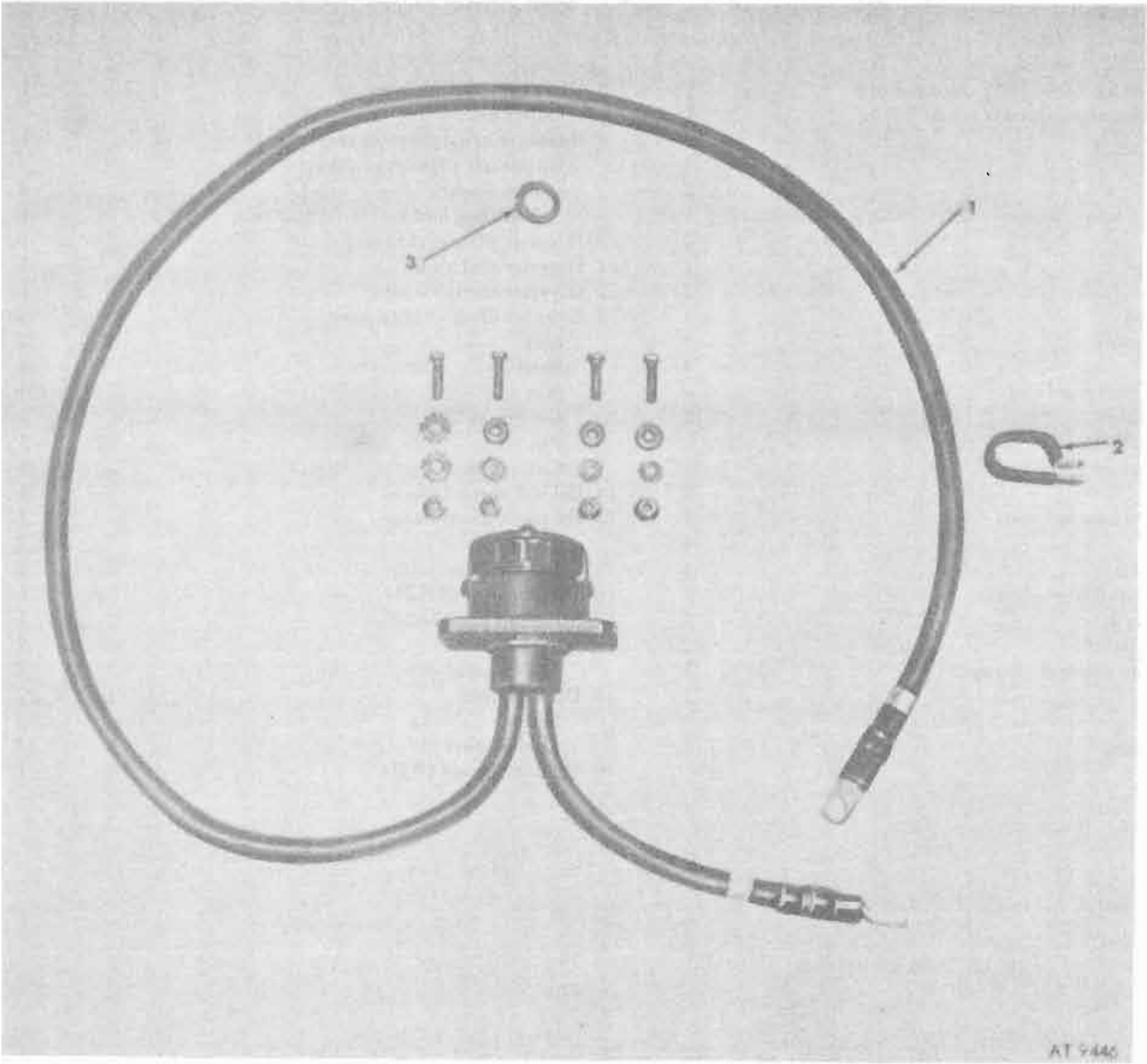


Figure 18-3. Heater components, —65° F. winterization kit.

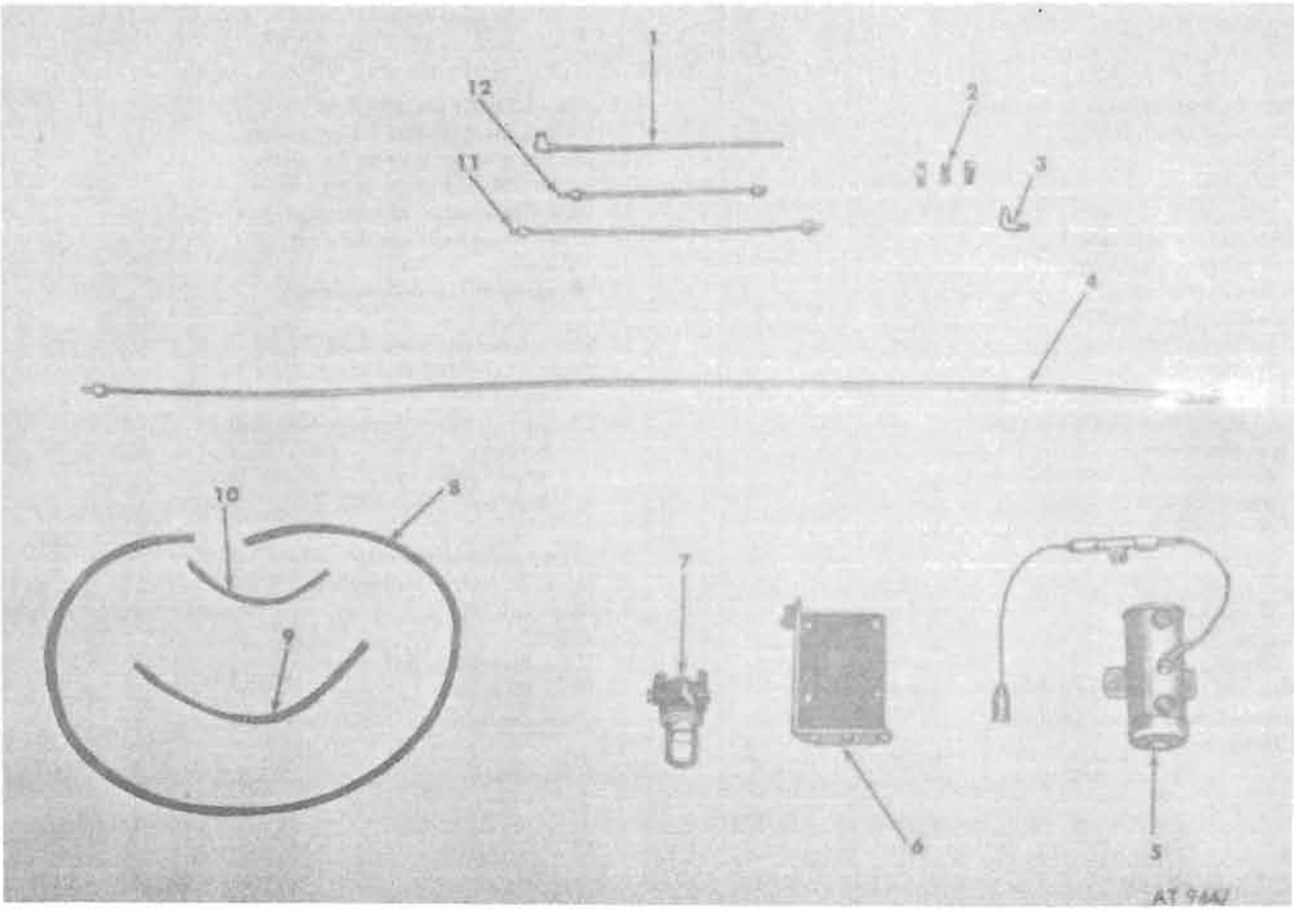
Key to figure 18-3.

Key	Item	Quantity
	Winterization kit (—65° F) composed of:	1
1	Diverter and actuating assy.	1
	Screw	3
	Screw	1
	Washer	3
	Washer	1
	Washer	1
	Nut	1
	Nut	3
2	Heater guard	1
3	Heater assembly	1
4	Spacer	4
	Screw, hexagon-head	4
	Flat washer	4
	Lockwasher	
	Lockwasher	1
	Nut	4
5	Heater guard bracket assy.	4
	Screw	4
	Lockwasher	4
6	Diverter exhaust pipe clamp	1
	Carriage bolt	2
	Nut (hug lock)	2
7	Exhaust pipe support clamp	1
	Bracket	1
	Screw	2
	Lockwasher	2
8	Diverter exhaust pipe	1
	Cotter pin	1
9	Heater exhaust diverter assy	1
	(to attach plate and diverter).	
	Flat washer	2
	Nut (hug lock)	2
10	Diverter plate seal O ring	1
11	Diverter seal plate	1
12	Diverter-to-elbow pipe	1
13	Exhaust diverter cntrl assy.	1
	Nut	2
	Screw	1
	Nut	1
	Grommet	1
	Pin	1
	Cotter Pin	1
14	Oil pan shroud elbow	1
15	Oil pan shroud flange	1
	Screw	2
	Lockwasher	2
16	Oil pan shroud (LH)	1
17	Strap, oil pan shroud	1
	Screw	2
	Lockwasher	2
18	Oil Pan duct	1
	Screw	2
	Lockwasher	2
19	Oil pan shroud (RH)	1



Key	Item	Quantity
1	Slave receptacle, electrical lead assy.	1
	Screw	4
	Flat washer	3
	Lockwasher (external)	3
	Lockwasher (internal-external)	2
	Nut	4
2	Slave receptacle cable clamp	1
3	Slave receptacle cable grommet.	1

Figure 18-4. Slave receptacle components, —65°F. winterization kit.



Key	Item	Quantity
1	Fuel tank tube and elbow	1
2	Connector assembly	4
3	Pump-to-filter tube elbow	1
4	Filter-to-heater tube	1
5	Fuel pump assy.	1
	Screw	2
	Flat washer	2
	Lockwasher	2
	Nut	2
6	Pump and filter bracket	1
	Screw	3
	Lockwasher	3
	Flat washer	3
	Nut	3
7	Filter assy.	1
	Screw and lockwasher assy.	2
8	Filter-to-heater tube conduit	1
9	Fuel pump-to-fuel tank tube conduit.	1
10	Pump-to-filter tube conduit	1
11	Fuel pump-to-fuel tank tube	1
12	Filter-to-pump tube	1

Figure 18-5. Major components, fuel pump and lines (—65° F. winterization).

Key to figure 18-6.

Key	Item	Quantity
1	Battery heating cover & box assy.	1
2	Duct assy., air intake	1
	Bolt	4
	Washer	8
	Nut	4
3	Control assy (defroster)	1
	Washer control assy.	1
	Nut control assy.	1
4	Hood assy (air intake)	1
	Bolt	7
	Washer	14
	Nut	7
5	Gasket, hardtop and hood assy.	1
6	Defroster deflector	1
	Lockwasher	8
	Screw	8
7	Box diverter	1
	Screw	2
	Washer	2
	Washer	2
	Nut	2
	Screw	1
8	Bracket, diverter hose defroster-to-tunnel cover.	1
9	Bracket, heater hose defroster.	1
10	Clamp, heater hose	2
11	Clamp, heater diverter hose	2
12	Clamp, diverter hose RH to nozzle.	2
13	Clamp, diverter hose-to-defroster.	4
14	Adapter, heater-to-air intake pipe.	1
15	Pipe, heater adapter-to-air duct screw.	1
16	Elbow, hose defroster ducting	1
	Screw	3
17	Defroster nozzle & flange assy.	2
	Screw	4
18	Strap, hose-attaching, long	5
19	Strap, hose-attaching, short	4
	Strap	1
20	Clamp, cab heater hoses-to-toeboard.	4
	Screw	2
	Washer	2
	Washer	2
	Nut	2
21	Clamp, defroster control cable.	2
22	Hose, diverter to battery box.	1
23	Hose, cab heater	2
24	Tube	2
25	Hose, diverter to RH nozzle	1
26	Hose, diverter to LH nozzle	1
27	Hose, heater diverter to defroster diverter.	1

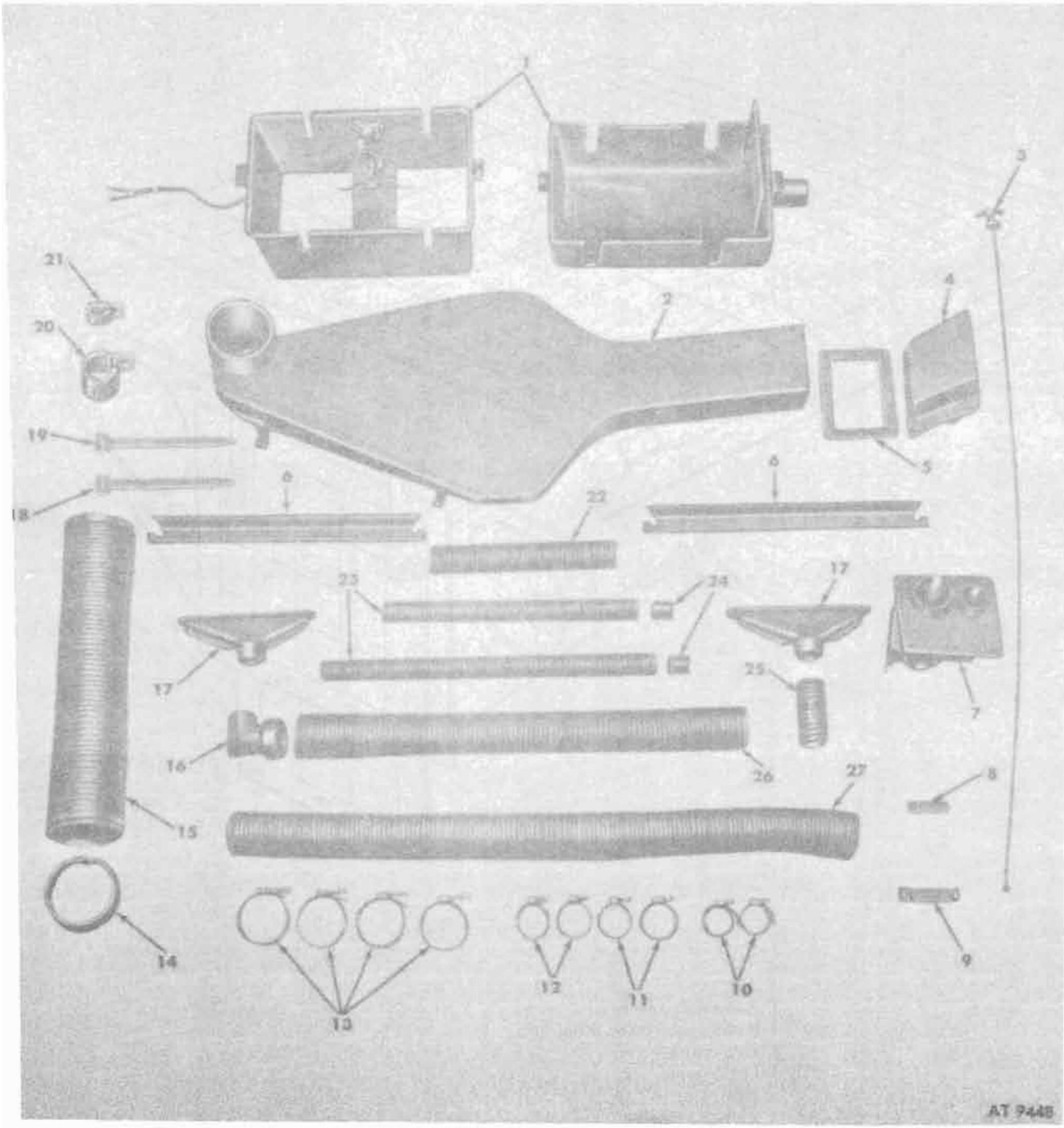
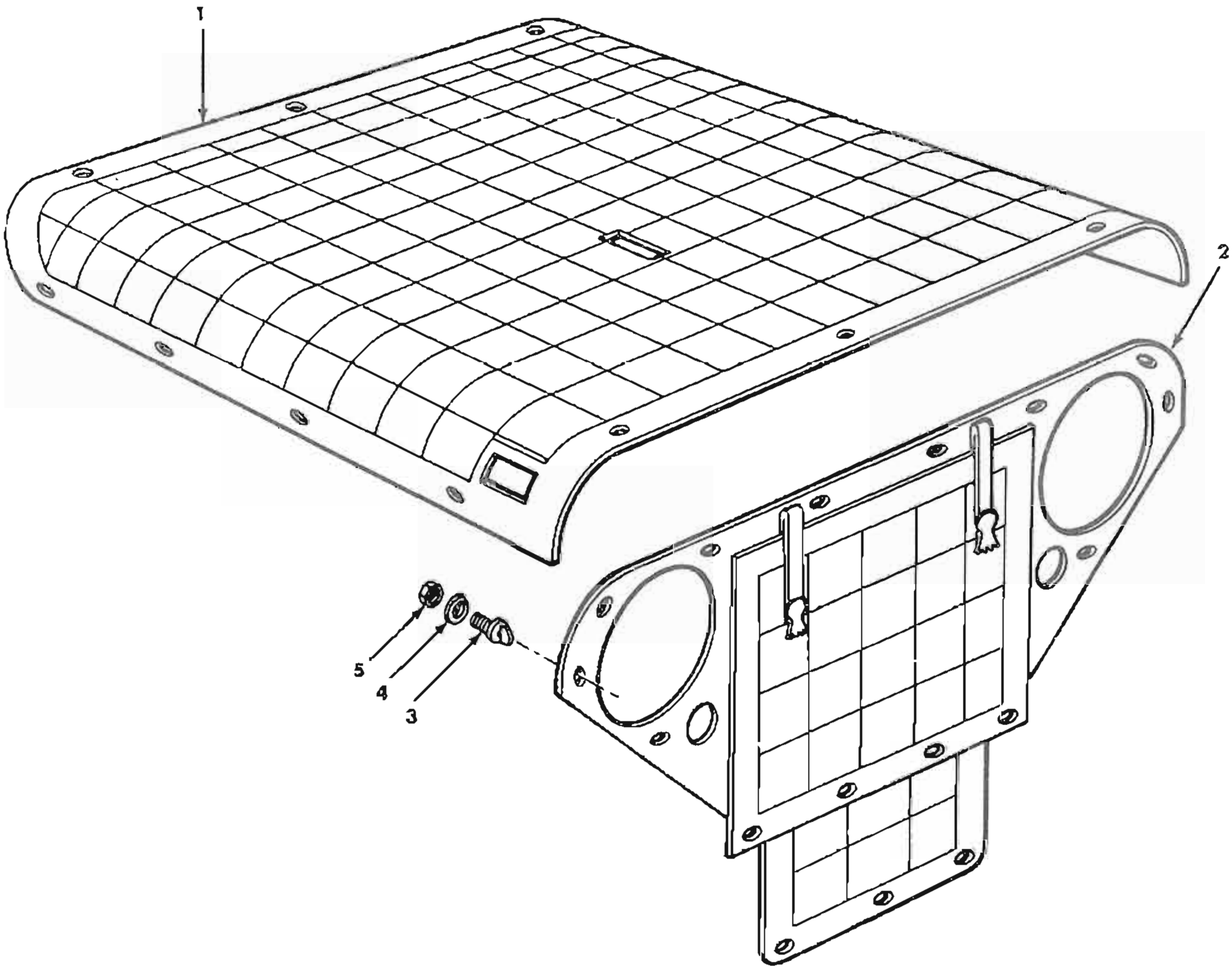
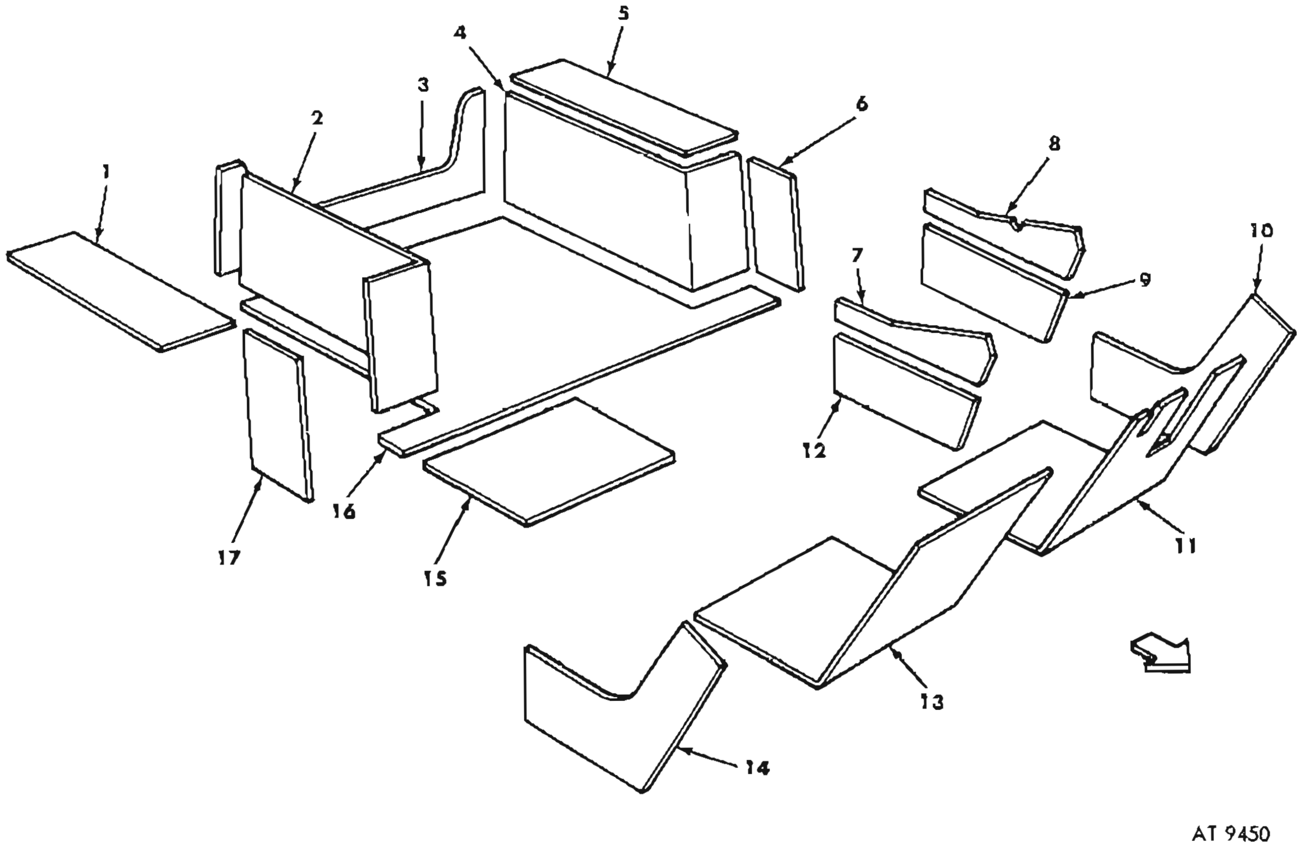


Figure 18-6. Major components, air intake, defroster and hoses, —65° F. winterization kit.



Key	Item	Quantity
1	Hood top panel cover	1
2	Brush guard cover & flap assy.	1
3	Single stud	26
4	Lockwasher	26
5	Nut	26

Figure 18-7. Hood and brush guard cover (—65°F. winterization kit).



Key	*Item*	*Quantity*
1	Top wheel house insulation RH	1
2	Side wheel house insulation	1
3	Rear panel insulation	1
4	Side wheel house insulation LH	1
5	Top wheel house insulation LH	1
6	Side panel insulation LH	1
7	Tunnel side insulation	1
8	Tunnel side insulation	1
9	Tunnel side insulation	1
10	Side panel insulation LH	1
11	Driver floor insulation	1
12	Tunnel side insulation	1
13	Passenger floor insulation	1
14	Side panel insulation RH	1
15	Tool box insulation	1
16	Rear floor insulation	1
17	Side panel insulation RH	1

Figure 18-8. Vehicle insulation (—65°F. winterization kit).

18-7. Preliminary Operations

a. Remove muffler inlet pipe and front outlet pipe (TM 9-2320-218-20) and stow.

b. Disconnect front axle propeller shaft at front axle flange. Move shaft to right to gain access to engine oil pan (TM 9-2320-218-20) and stow.

c. Remove four oil pan attaching nuts and washers from four oil pan studs (fig. 18-9); stow nuts and discard washers.

d. Remove both front seats (TM 9-2320-218-20) and stow.

e. Remove battery compartment cover and stow.

f. Disconnect cables and remove both batteries, and stow. Clean battery compartment.

g. Remove pipe plug from top of fuel tank (fig. 18-10) and discard.

h. Remove four instrument panel retaining screws, and stow. Disconnect speedometer cable housing from speedometer and move panel assembly to side with gage wires connected.

i. Remove three transmission tunnel cover screws (fig. 18-10) and stow.

j. Remove tape from defroster openings on dash panel.

18-8. Drilling Instructions

a. Locate centers of all holes to be drilled in floor panel. (Use dimensions shown in figure 18-11.)

b. Drill ten 9 / 32-inch diameter holes and one 25 / 32-inch diameter holes in floor. Cut 1⅝-inch diameter hole in panel (fig. 18-11).

c. Locate centers for holes to be drilled in dash panel. (Use dimensions shown in figure 18-12 and 18-13.)

d. Drill one 11 / 16-inch and two 3 / 16-inch diameter holes in face of upper left body side dash panel (fig. 18-12). Drill one 11 / 32-inch diameter holes, and file to dimension shown in face of upper left-body-side dash panel (fig. 18-12).

e. Drill four holes 5 / 64 -inch diameter in face of windshield (fig. 18-12).

f. Drill two 9 / 32-inch diameter holes in face of upper right-side-body dash panel (fig. 18-13).

g. Drill two 9 / 32-inch diameter holes in right side body dash panel lip, and one 7 / 64-inch hole in right side of transmission tunnel (fig. 18-13).

h. Drill two 9 / 32-inch diameter holes in right and left toeboards (figs. 18-12 and 18-13).

i. Using dimpled marks in rear of hardtop roof, as corner points, scribe lines forming a rectangle (fig. 18-14).

j. Cut out rectangular opening for heater air intake hood assembly (fig. 18-14).

k. Position heater air intake hood assembly in rectangular opening and use the center of each hole to locate and drill seven 9 / 32-inch diameter holes in hardtop enclosure roof (fig. 18-15).

l. Position heater air intake duct assembly under roof cutout, and on the center of hardtop enclosure rear panel, locate and drill four 9 / 32-inch holes. (Allow ⅜ inch between bottom of duct and floor panel for insulation.)

m. Locate and drill two 5 / 32-inch diameter holes in body rear cross-member (fig. 18-16).

n. Drill thirteen 5 / 32-inch holes in brush guard using cover and flap assembly to locate holes. In locating holes, allow for fabric shrinkage.

p. Locate and drill four 9 / 32-inch holes for slave receptacle as indicated in paragraph 18-12.

q. Locate and cut out slot on inboard end of battery box cover (fig. 18-17).

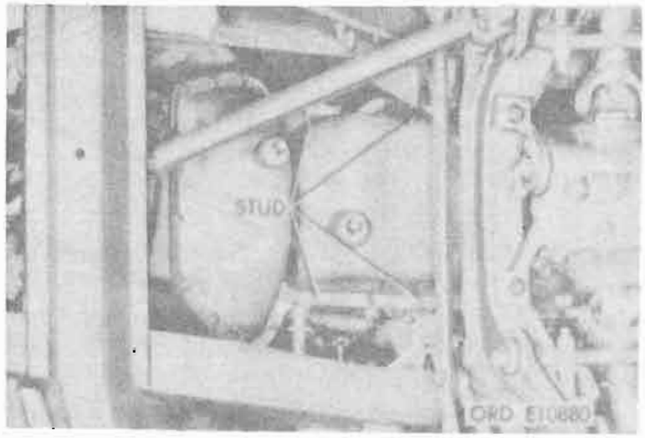


Figure 18-9. Oil pan nuts with drive shaft disconnected and exhaust pipe removed.

Figure 18-10. Tunnel cover screws and fuel tank plug.

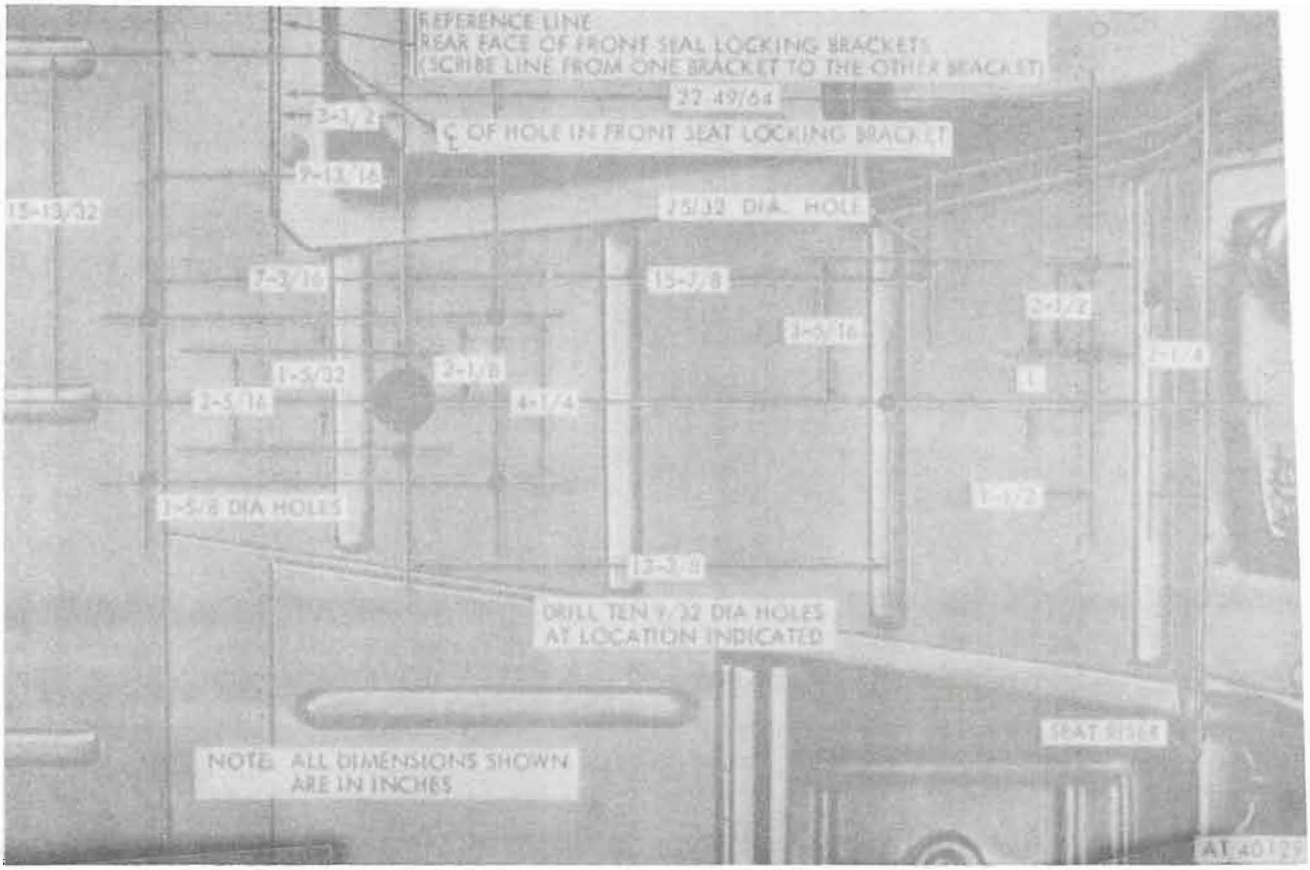


Figure 18-11. Floor panel.

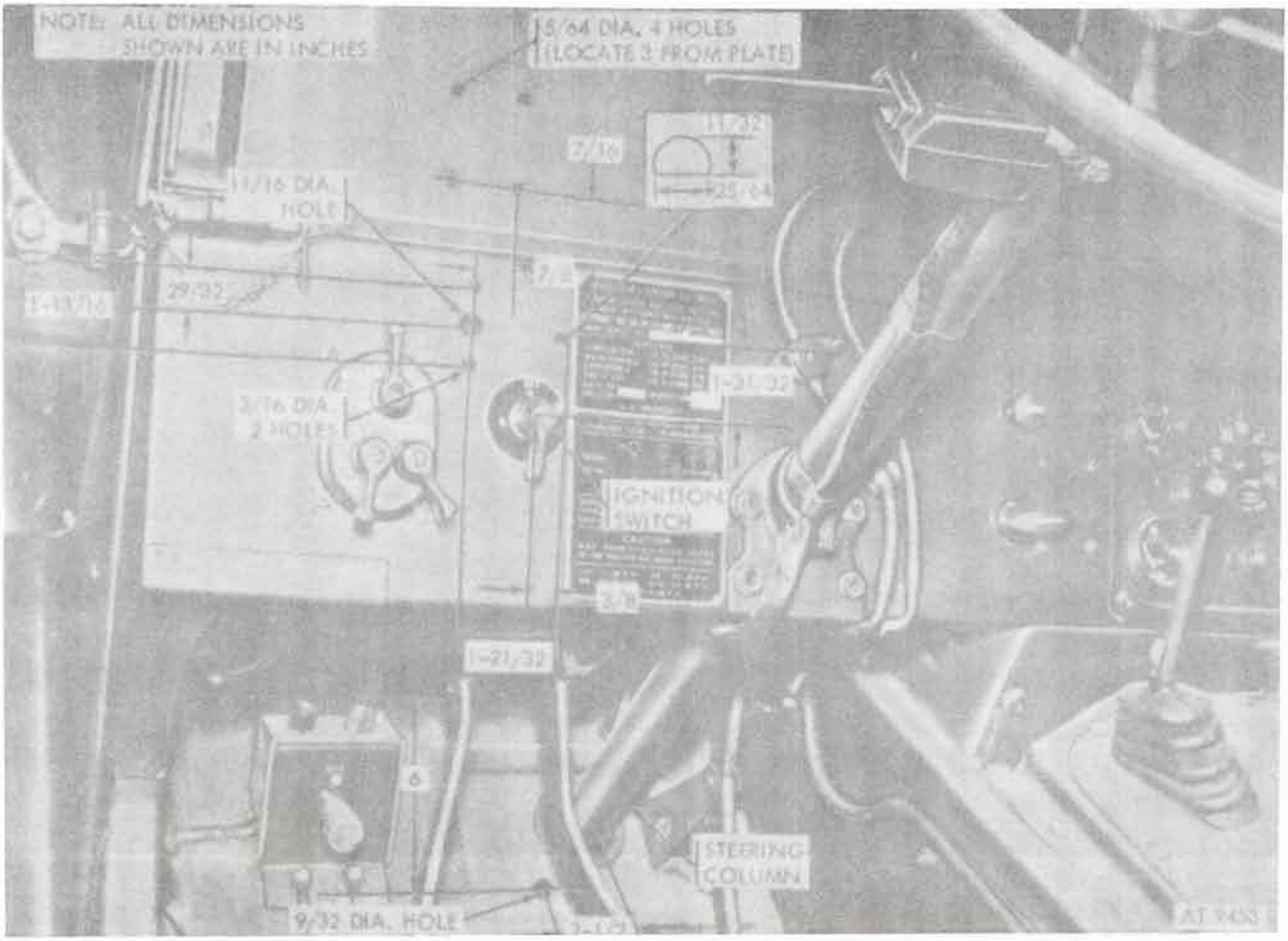


Figure 18-12. Drilling instruction for dash panel—left side.

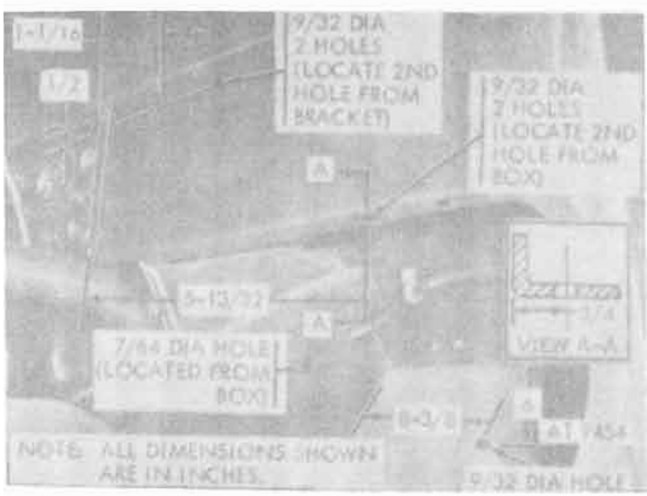


Figure 18-13. Drilling instruction for dash panel—right side.

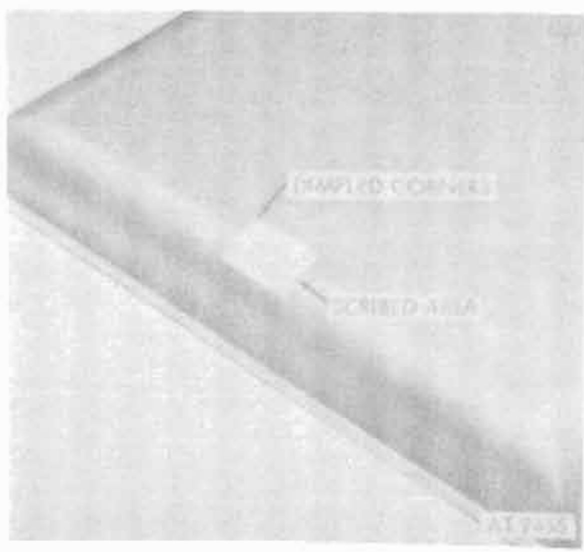


Figure 18-14. Hardtop roof cutout.

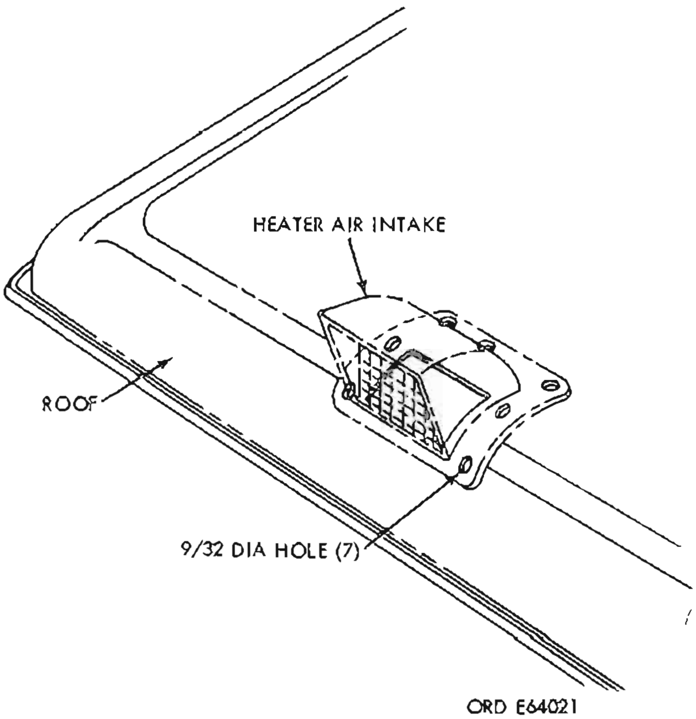


Figure 18-15. Drilling instruction for hardtop roof.

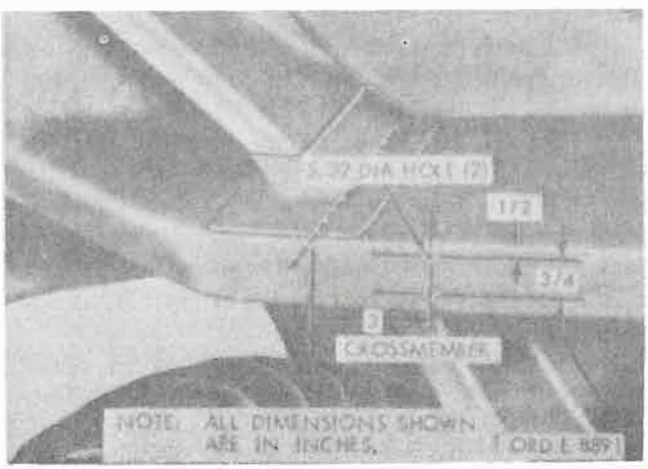


Figure 18-16. Drilling instruction for body rear crossmember.

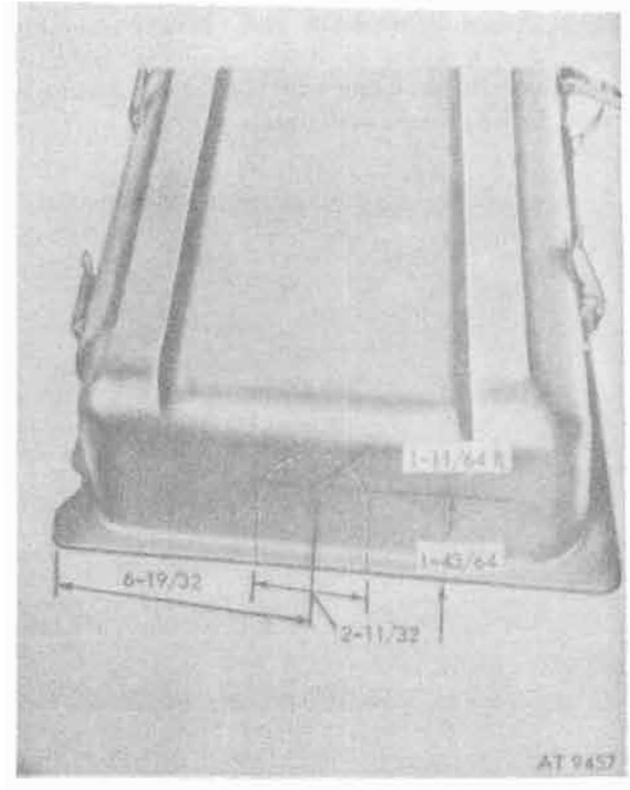


Figure 18-17. Battery box cutout.

18-9. Installation of Subassemblies

a. Installation of Emergency Switch. Instruction Plate, and Caution Plate (fig. 18-18).

(1) Locate switch at 11 / 16-inch hole, to left of the ignition switch, from the engine side of the dash panel.

(2) Locate guard assembly over switch toggle and on face of dash panel. Attach guard assembly with two screws and lockwashers.

(3) Locate instruction plate at 5 / 64-inch holes in windshield assembly and attach with four screws.

(4) Locate caution plate (fig. 18-18) at right of instruction plate and install. See figure 18-18.

b. Installation of Control Box (fig. 18-19).

(1) Attach bracket to control box assembly using two ¼-20-x½ roundhead screws and lockwashers.

(2) Attach control box and bracket assembly to 9/32-inch holes in dash panel to right of instrument cluster, using two ¼-20x½ roundhead screws, lockwashers, and nuts.

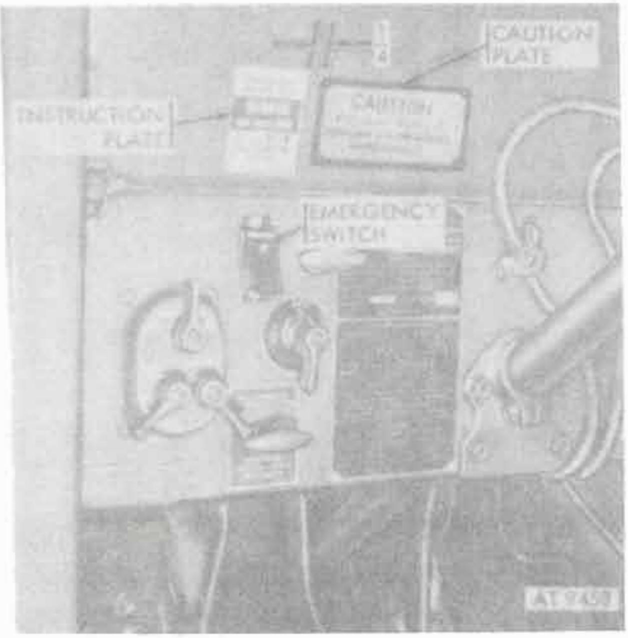


Figure 18-18. Emergency switch installation.

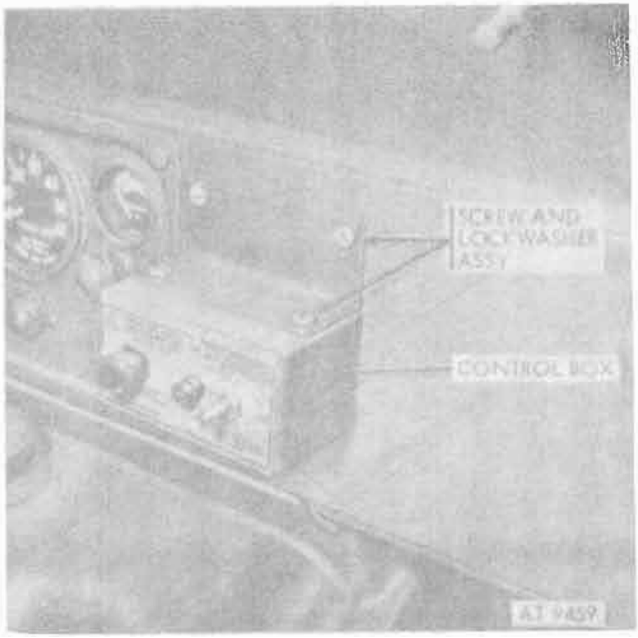


Figure 18-19. Control box installation.

c. *Installation of Windshield Defroster* (fig. 18-20).

(1) Attach elbow (19) to defroster nozzle (6) using three screws (18).

(2) Attach nozzle and elbow assembly to defroster opening on left side of dash panel, using two screws (5) (see fig. 18-21).

(3) Attach the other nozzle to right side of dash panel in the same manner used on left side.

(4) Route hose (3) behind dash panel, using instrument cluster opening for accessiblity, and attach to elbow with clamp (4).

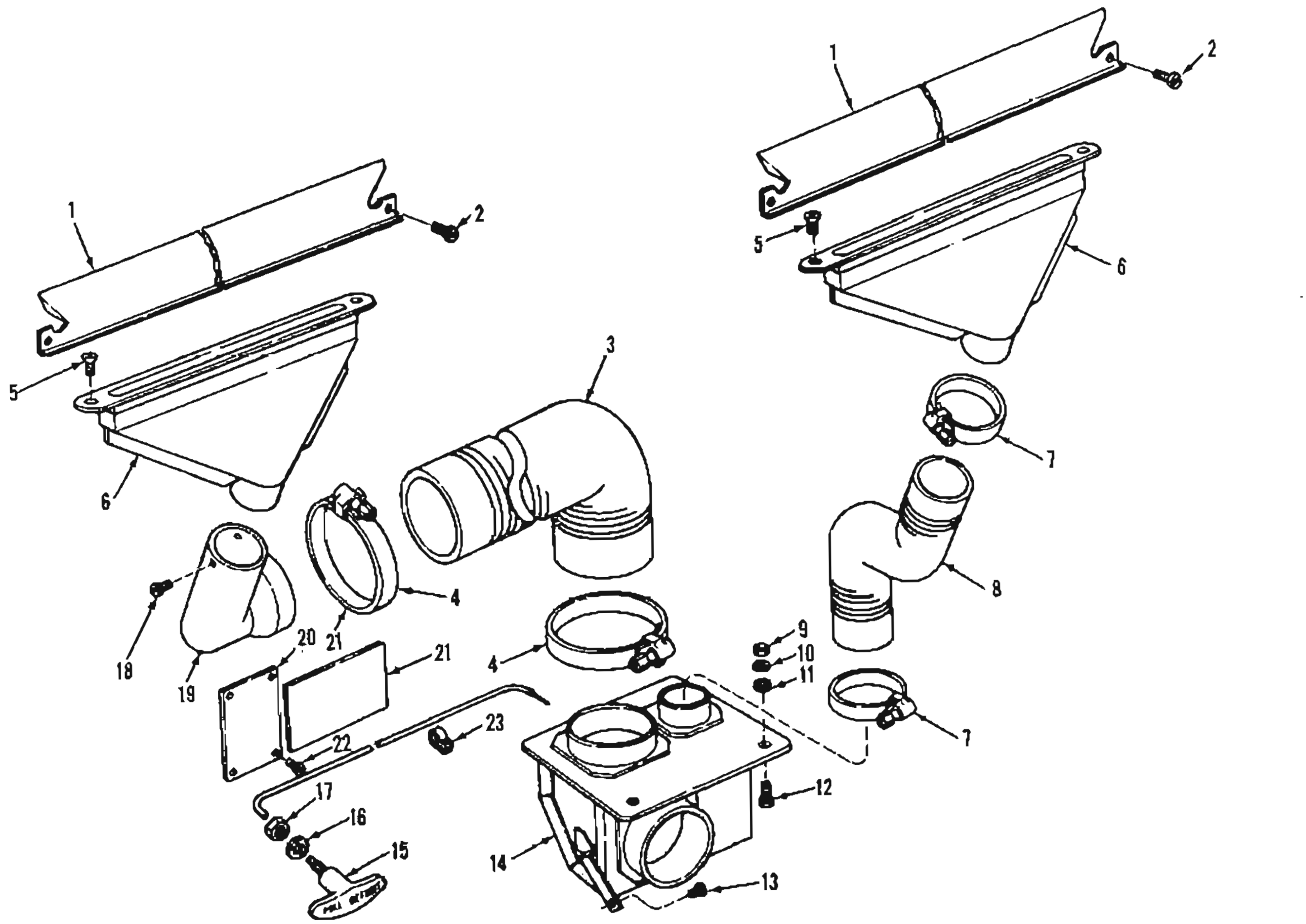
(5) Connect hose (8) to right nozzle using clamp (7).

(6) Attach defroster diverter (14) to dash panel lip on right side, using two screws (12), flat washers (11), lockwashers (10), and nuts (9) (see fig. 18-22).

(7) Attach diverter box bracket to tunnel using one screw (13) (see fig. 18-22).

(8) Connect left defroster hose to right outlet of diverter box using clamp (7).

(9) Connect right defroster hose to right outlet of diverter box using clamp (7).



AT 39939

Key	Item	Quantity
1	Deflector	1
2	Screw	4
3	Hose	1
4	Clamp	2
5	Screw	4
6	Nozzle and flange assy.	2
7	Clamp	2
8	Hose	1
9	Nut	2
10	Lockwasher	2
11	Flat Washer	2
12	Screw	2
13	Screw	1
14	Diverter box	1
15	Control assembly defroster	1
16	Lockwasher	1
17	Nut	1
18	Screw	1
19	Elbow	1
20	Plate	1
21	Plate	1
22	Screw	4
23	Clamp	2

Figure 18-20. Defroster control, diverter and hoses.

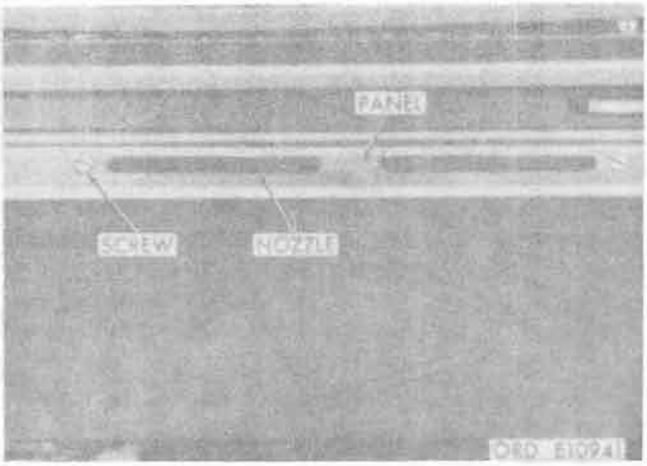


Figure 18-21. Installation of defroster nozzle.

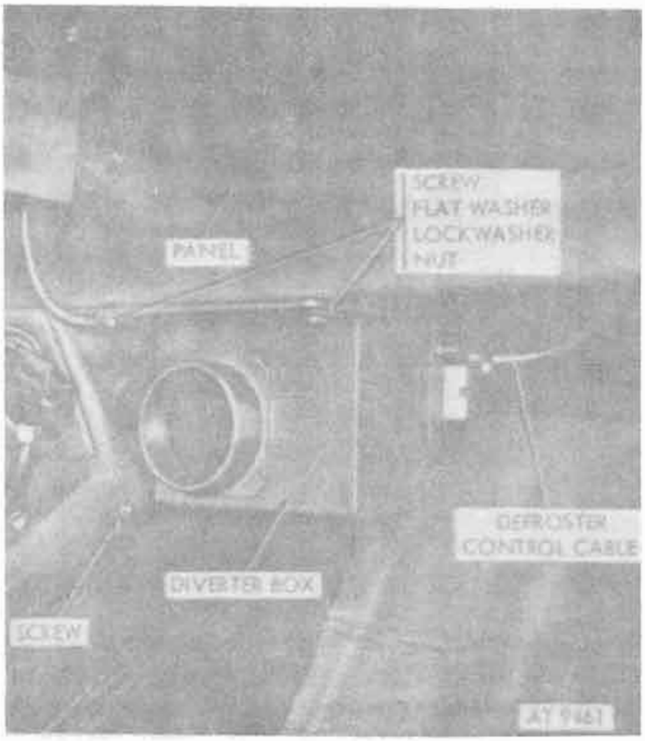


Figure 18-22. Installation of defroster diverter box.

(10) Locate defroster control assembly (15) in filed hole to right of ignition switch, and attach with lockwasher (16) and nut (17) from back side of instrument panel.

(11) Attach two clamps (23) to control cable and secure to firewall using the existing parts, which secure the clamps holding the starter switch to battery cable and vacuum pump to wiper motor hose.

(12) Secure control cable end to clamp on diverter box control lever (fig. 18-22).

(13) Attach two defroster deflectors (1) to windshield at lower edge of glass using eight screws (2).

(14) Connect speedometer cable and attach instrument panel removed in paragraph 18-7.

d. Installation of Exhaust Diverter.

(1) Attach control assembly to bracket of diverter assembly, using ¼-20x½ hex head screw and locknut (fig. 18-23).

(2) Connect control cable to arm of diverter with clevis pin. Insert cotter pin into hole in clevis pin. Bend ends of cotter pin around clevis pin.

(3) Position diverter to underside of floor panel as shown in figure 18-24. Aline studs to mounting holes and block or tape diverter in position.

(4) Install diverter mounting parts to diverter studs protruding through floor panel in the following order: Flat washers; ring (with locating indentations toward flat washers); plate; ¼-20 locknuts. Do not tighten nuts at this time.

(5) Remove T-handle and nut from diverter control cable. Slide grommet over threaded parts of control assembly and onto cable.

(6) Feed control cable through hole in floor panel and install grommet in hole.

e. Installation of Exhaust Diverter Pipes and Oil Pan Shrouds (fig. 18-25).

(1) Attach clamps (12) and (17), and bracket (14) to heater exhaust pipe (11), using screw (13) and nut (18). Do not tighten.

(2) Slide pipe over short diverter outlet, beneath the floor, and slide bracket and clamp assembly along pipe until positioned under the two 5/32-inch holes in the crossmember.

(3) Attach bracket to crossmember with two screws (16) and lockwashers (15).

(4) Position pipe on diverter outlet until the edge of pipe is 2¼ inch from face of diverter (fig. 18-26), and tighten clamps.

(5) Locate and drill one 5/32-inch hole through pipe and diverter outlet (fig. 18-26).

(6) Insert cotter pin (10) through hole, and bend ends of pin over.

(7) Attach duct (9) to shrouds (5) and (6), using two screws (7) and lockwashers (8).

(8) Position shroud assembly on oil pan with duct wrapping around the rear of oil pan; using the oil pan nuts removed in paragraph 18-7c, attach to oil pan.

(9) Attach strap (20) to bottom of shrouds, using two screws (7) and lockwashers (8).

(10) Slide flange (4) over elbow (1) so that recess in flange mates with lip on elbow.

(11) Slide oil pan heater pipe (19) over elbow: locate and drill one 5/32-inch hole through pipe and elbow as indicated on figure 18-27.

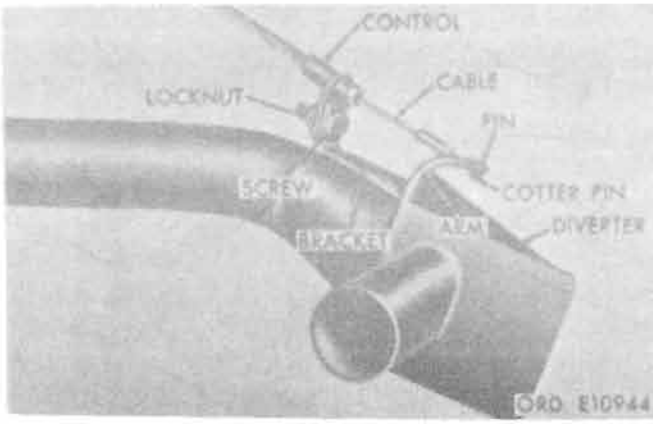
(12) Insert cotter pin (10) through hole, and bend ends of pin over.

(13) Slide open end of pipe over the remaining

diverter outlet, beneath the floor, and locate elbow flange at opening of left shroud.

(14) Attach flange to shroud using two screws(2) and lockwasher (3).

(15) Reinstall muffler pipes and propeller shaft removed in paragraphs 18-7a and 18-7b.



Key	*Item*	*Quantity*
1	Elbow	1
2	Screw	2
3	Lockwasher	2
4	Flange	1
5	Shroud	1
6	Shroud	1
7	Screw	2
8	Lockwasher	2
9	Duct	1
10	Cotter Pin	2
11	Pipe	1
12	Clamp	1
13	Carriage Bolt	2
14	Bracket	1
15	Lockwasher	2
16	Screw	2
17	Clamp	1
18	Nut	2
19	Pipe	1
20	Strap	1

Figure 18-23. Exhaust control cable connected to diverter.

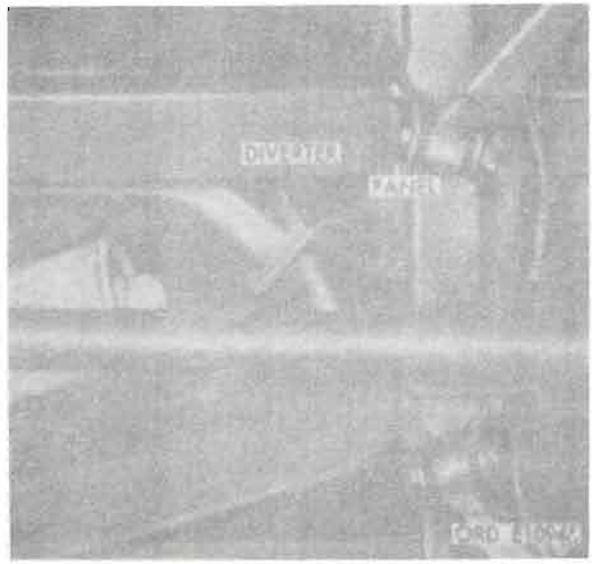


Figure 18-24. Positioning exhaust diverter.

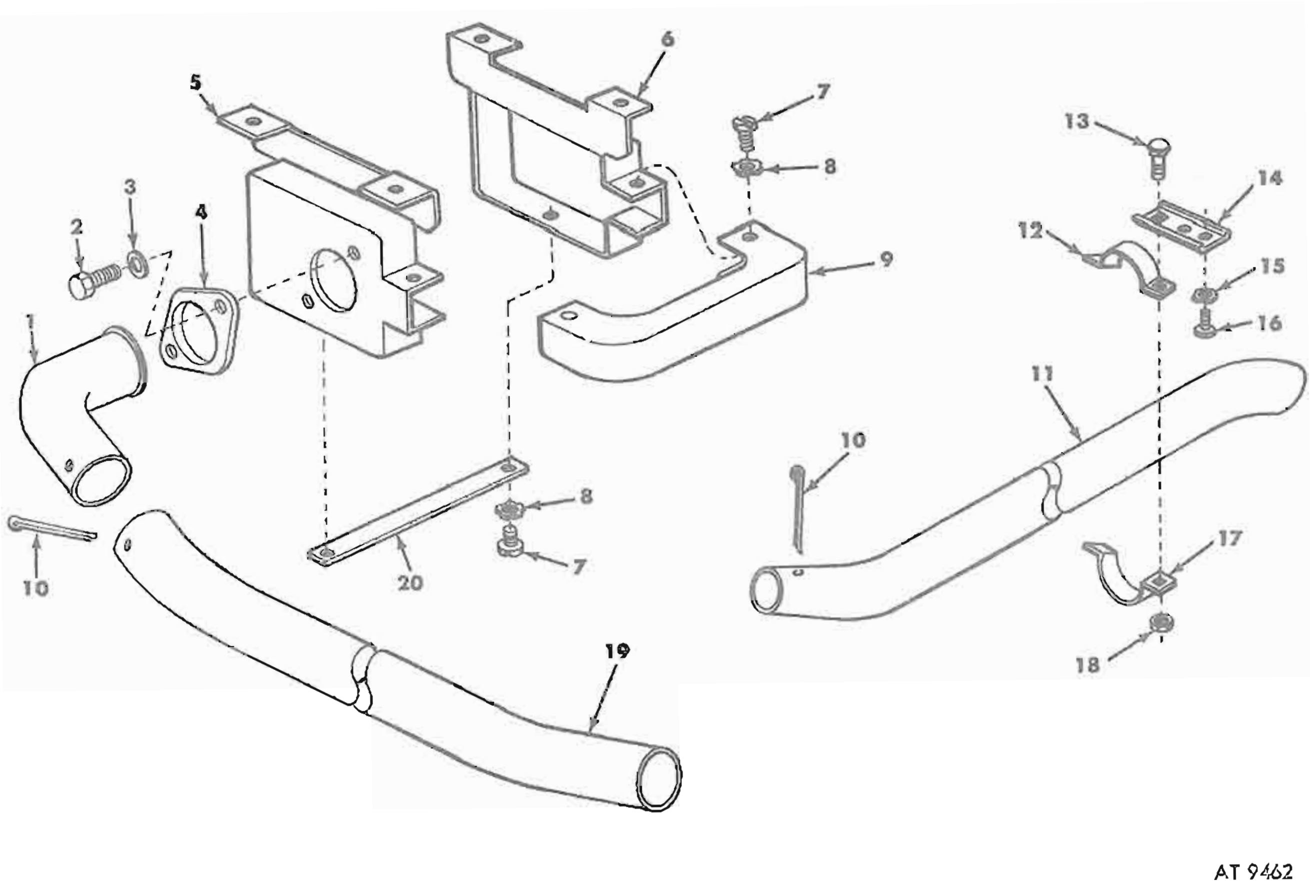


Figure 18-25. Exhaust diverter pipes and oil pan shrouds.

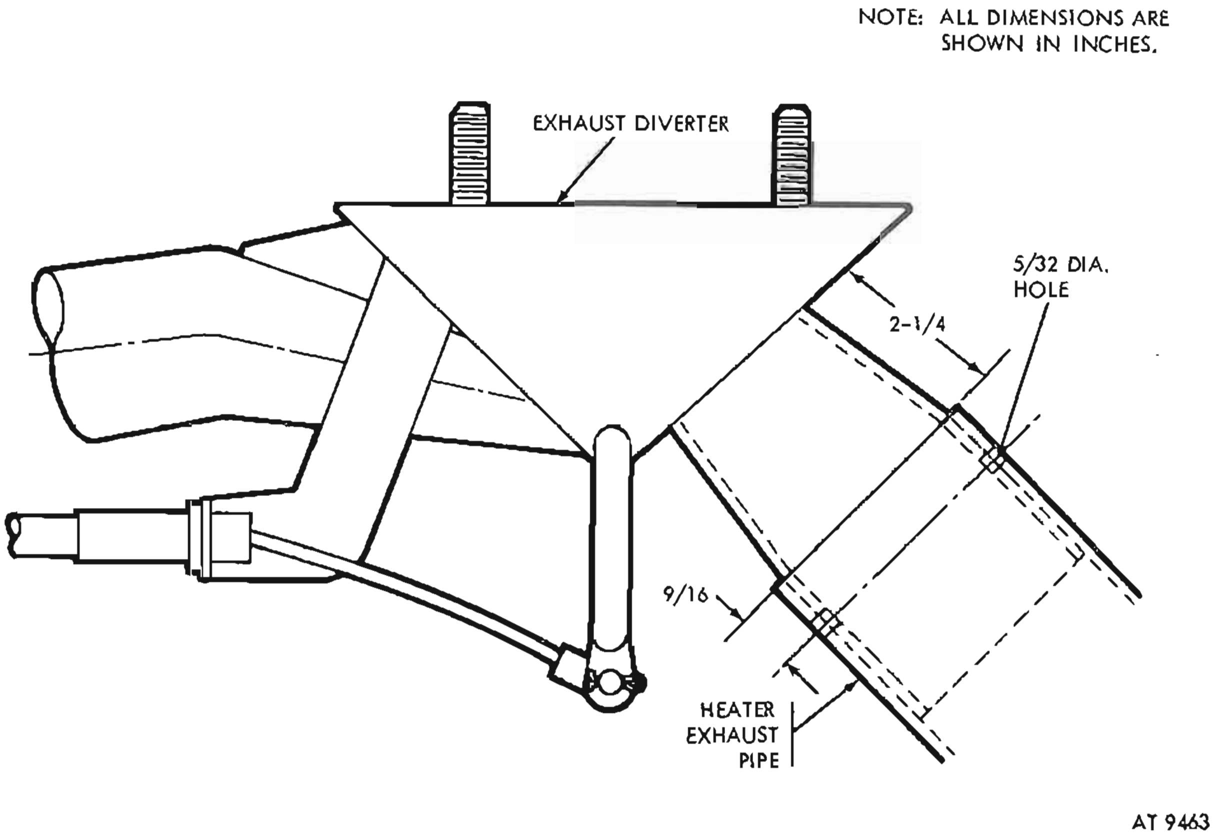


Figure 18-26. Positioning heater exhaust pipe.

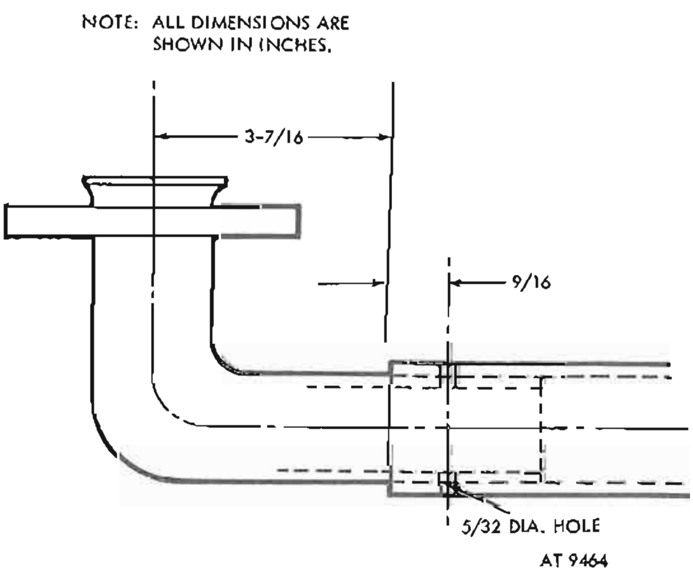


Figure 18-27. Positioning oil pan heater pipe on elbow.

f. Installation of Diverter and Actuator Assembly to Heater.

(1) Installation of diverter to heater 10920608 is accomplished by sliding the diverter over the heater and attaching with three screws (fig. 18-28). The relation of diverter and heater tops must be maintained during assembly.

(2) When installing heater (8720193), a chalk line is drawn across heater and adapter at top center.

(3) Remove four screws retaining outlet adapter to heater, and remove adapter (fig. 18-29).

(4) Slide diverter assembly onto outlet adapter with top of diverter in line with chalk mark on adapter.

(5) Connect diverter to adapter, using three 8-32x5 / 16 round head screws, lockwashers, and three hex nuts (fig. 18-30).

(6) Install adapter and diverter assembly to heater (8720193) with four screws (fig. 18-30).

g. Installation of Heater and Diverter Assembly.

(1) Loosen heater mounting straps.

(2) Position heater assembly to floor panel with heater mounting holes in line with floor panel mounting holes and exhaust pipe inserted into diverter assembly. Install spacer under each of four heater mounting points with offset portion square with ends of mounting bracket (fig. 18-31).

(3) Remove undercoating from bottom of floor panel ½ inch around right front mounting hole.

(4) Position four guard mounting brackets with flat surface parallel to side of heater, and with long end on heater mounting bracket (fig. 18-31).

(5) Install four ¼-20x7 / 8 screws through brackets, spacers, and floor panel (fig. 18-31).

(6) Install one flat washer (MS45904-68) on right front mounting screw, and secure with hex nut. Do not tighten.

(7) Install three flat washers, lockwashers, and nuts on the remaining mounting screws (fig. 18-31). Do not tighten right rear screw.

(8) Tighten heater mounting straps and exhaust diverter mounting nuts.

(9) Attach diverter mounting bracket to floor panel using one screw, flat washers, lockwasher, and nut.

h. Installation of Exhaust Diverter Control (fig. 18-32).

(1) Insert threaded sleeve through lower hole of bracket. Run locknut down threaded portion of sleeve. Insert sleeve through upper hole of bracket and install nut.

(2) Install locknut and T-handle.

i. Installation of Fuel Pumper, Filter, Lines and Fittings (fig. 18-33).

(1) Install fuel pump bracket (6) to floor panel, using three screws(7), flat washers (5), lockwashers (4), and nuts (3).

(2) Install fuel pump to heater side of bracket, using two screws (7), flat washers (5), lockwashers (4), and nuts (3). Attach electrical filter, which is on the pump cable, to the right mounting screw.

(3) Install fuel filter (2) to left side of bracket, using two screw and lockwasher assemblies (14).

(4) Install tube and elbow assembly (13) in fuel tank. Position elbow toward rear of vehicle.

(5) Install connector (9) and 13-inch tube (10) in upper fitting of fuel pump. Other end of tube is connected to tube and elbow assembly.

(6) Install elbow (1) in forward fitting of fuel filter. Position elbow toward floor.

(7) Install connector (9) and 43-inch tube (11) to heater inlet fitting. Other end of tube is connected to elbow on fuel filter.

(8) Install connectors (9) in fuel pump lower fitting and fuel filter rear fitting.

(9) Install 8-inch tube (12) from fuel filter to pump.

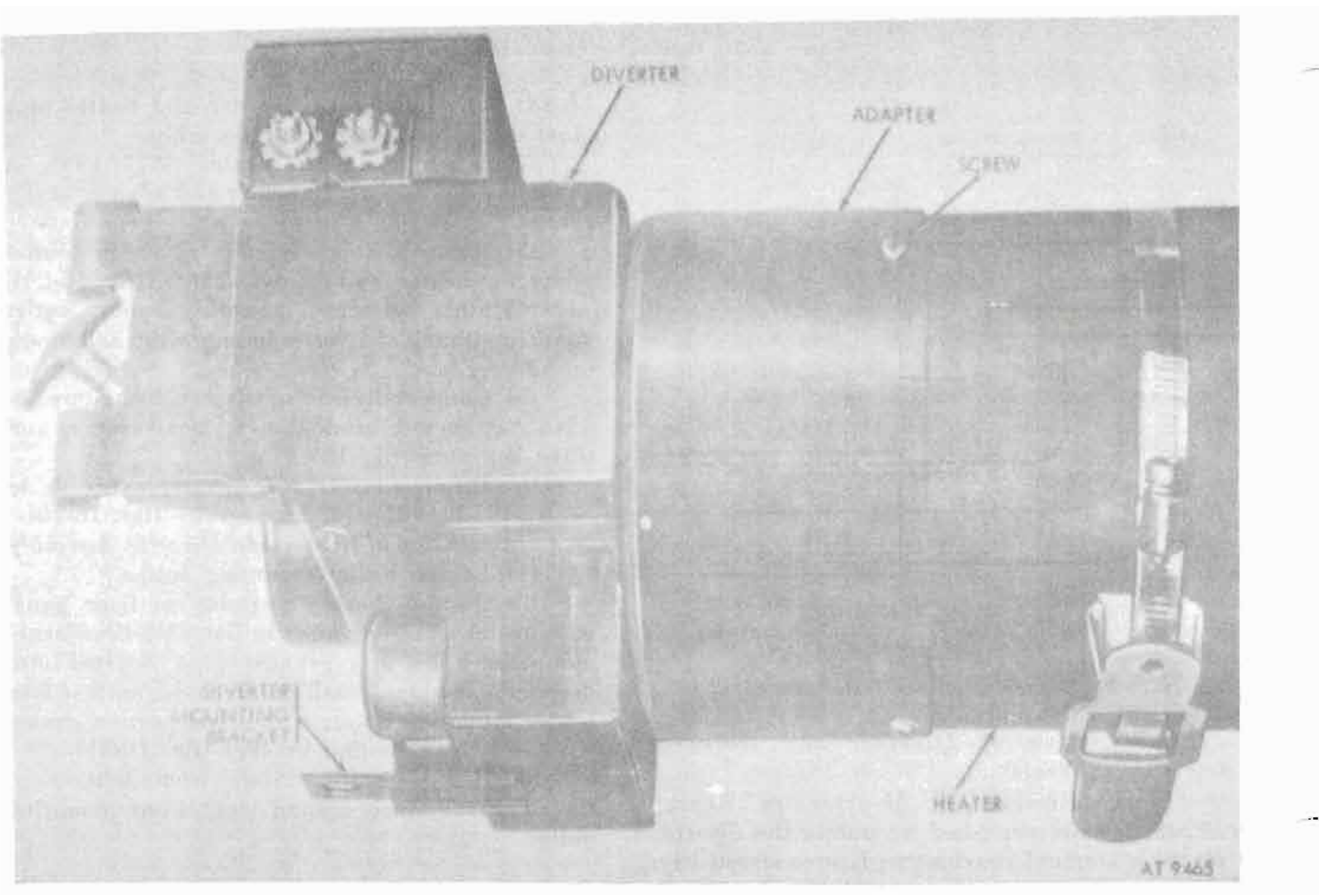


Figure 18-28. Diverter installed on heater (10920608).

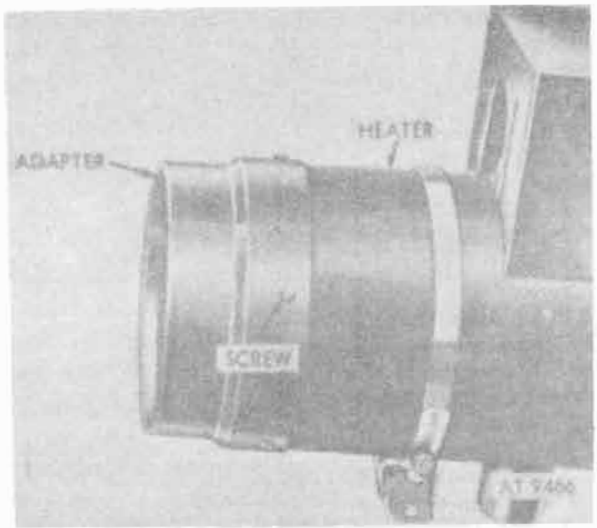


Figure 18-29. Heater (8720193) outlet adapter.

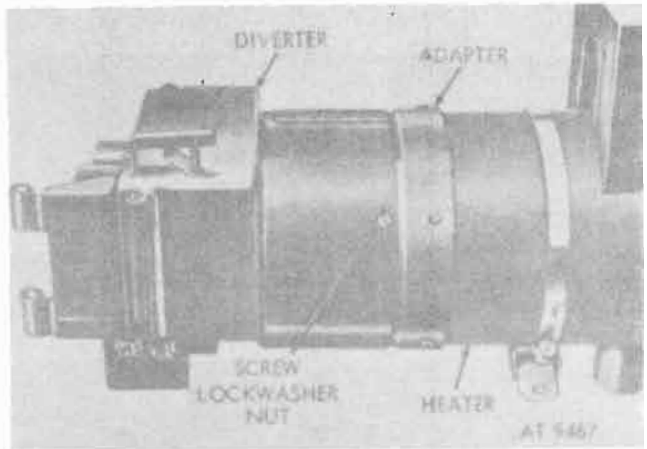


Figure 18-30. Diverter installation on heater (8720193).

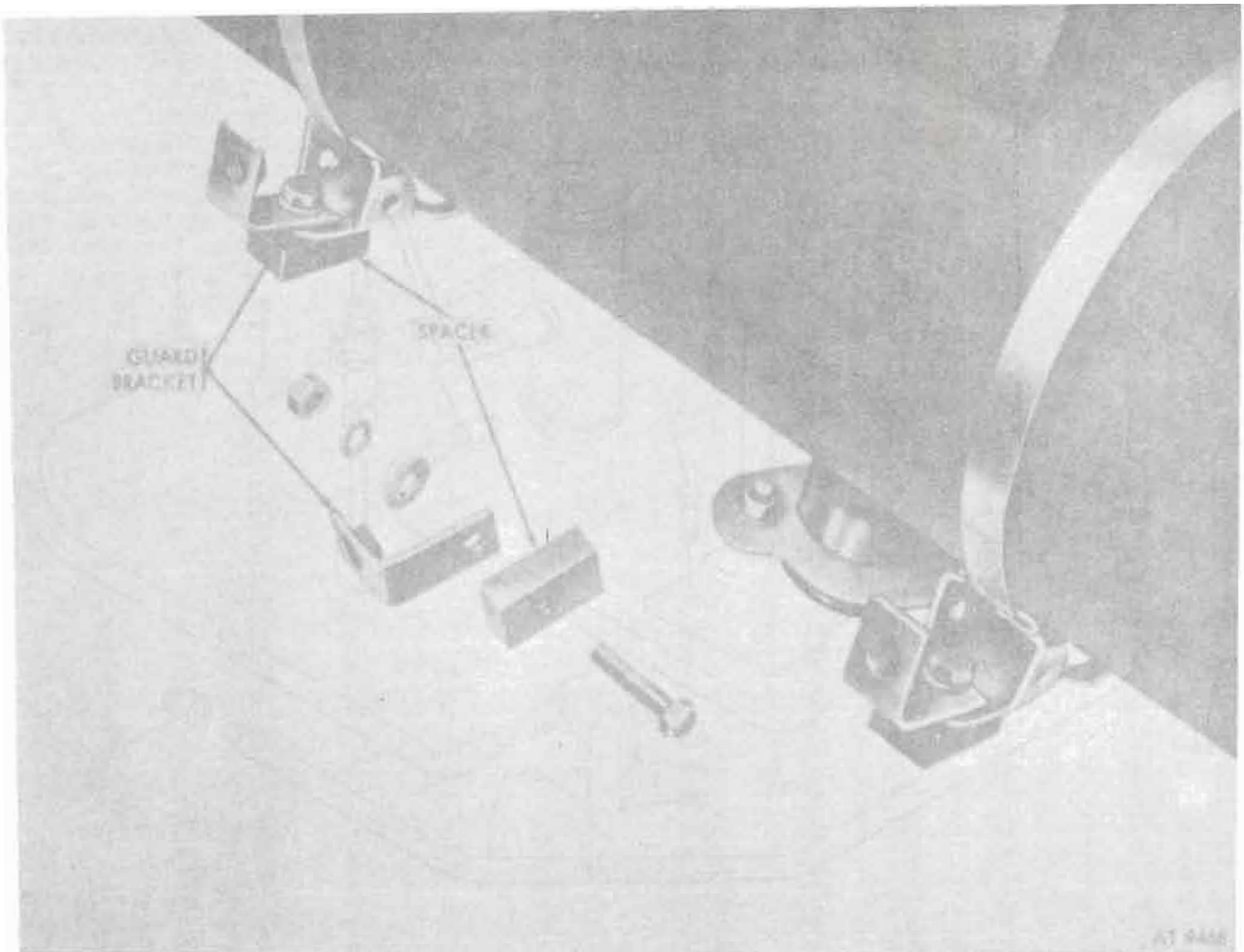


Figure 18-31. Heater mounting.

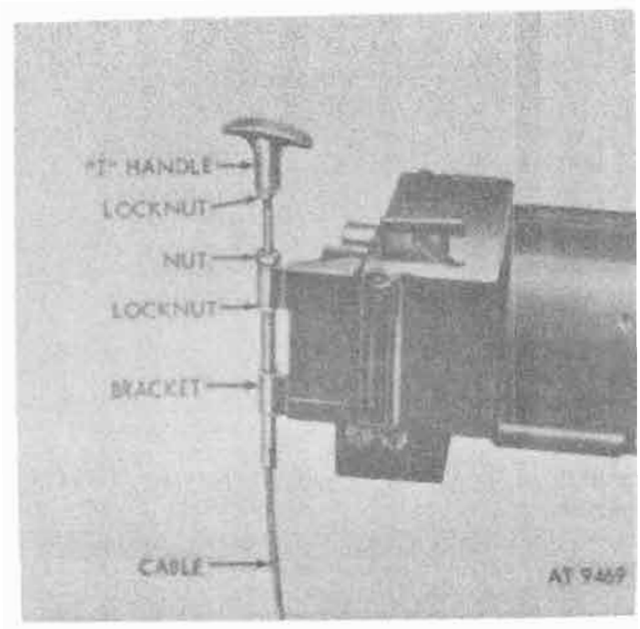


Figure 18-32. Exhaust diverter control cable installation.

Key to figure 18-33.

Key	*Item*	*Quantity*
1	Elbow Assembly	1
2	Filter Assembly	1
3	Nut	5
4	Lockwasher	5
5	Flat Washer	5
6	Bracket	1
7	Screw	5
8	Pump Assembly	1
9	Connector	3
10	Tube assembly (13-inch) Fuel Pump to Tank	1
11	Tube Assembly (43-inch) Fuel Filter to Heater	1
12	Tube Assembly (8-inch) Fuel Pump to Filter	1
13	Tube and Elbow Assembly	1
14	Screw and Washer Assembly	2

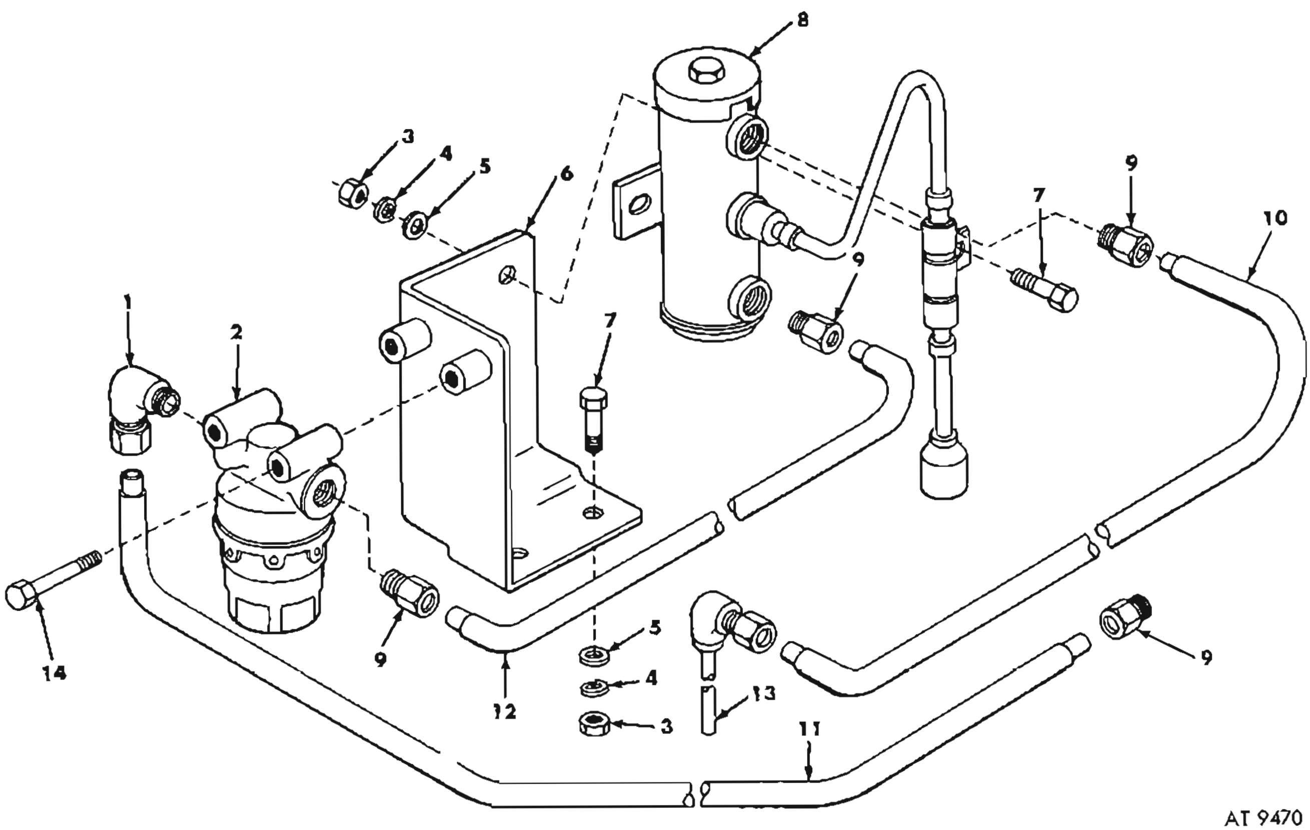


Figure 18-33. Fuel pump, filter, lines, and fittings.

j. Installation of Battery Box.

(1) Position four battery holddown bolts in upward position.

(2) Insert ground cable through hole opposite thermostat of box assembly (fig. 18-34).

(3) Insert battery positive and slave cables (refer to paragraphs 18-10 through 18-13) through hole below thermostatic switch.

(4) Pull the two long thermostat leads out through hole below thermostat. Route leads around side of battery case toward inner end.

(5) Move box down into battery compartment by pulling cables as box is lowered. The four battery holddown bolts must be retained in upward position during this operation.

(6) Install batteries and clamps on battery post. Connect cables to battery post clamps (TM 9-2320-219-20). Connect short wire from circuit breaker to positive clamp (fig. 18-35).

(7) Connect thermostat lead wires to actuator terminal strip (fig. 18-36). To establish correct polarity of these two wires, observe position of diverter damper door. The damper door should be open (parallel to side of diverter box) when temperature of battery box is below 100°F.) Momentarily touch each wire to terminals to establish polarity.

(8) Install new battery box cover and then old cover (with slot) over battery box, and secure using winged screw and clip.

k. Installation of Main Wiring (fig. 18-37).

(1) Remove the No. 11 wire from the ignition switch, and attach to connector (9).

(2) Connect short cable assembly (8) to ignition switch at the connector left open after removal of the No. 11 wire.

(3) Connect free end of short cable assembly to adapter (9).

(4) Connect cable assembly (10) to single end of Y-connector, and to upper terminal of emergency switch.

(5) Connect long cable assembly (1) to lower terminal of emergency switch.

(6) Route long cable assembly along lower lip of dash panel.

(7) Connect free end to connector lead on control box.

(8) Connect large cable assembly (4) to heater, using end with ground lead (fig. 18-38).

(9) Connect fuel pump cable (7) to heater (fig. 18-38).

(10) Route both cable assemblies and ground lead to heater mounting screws on right side.

(1) Position two straps (6) around the cables at the heater mounting screws. The ground lead should not be attached in the forward strap.

(12) Attach the straps using the heater mounting screws. A flat washer (5) should be installed between the screwhead and strap. Connect heater ground lead to forward mounting screw. Right side mounting screws can now be tightened.

(13) Connect free end of fuel pump cable (7) to fuel pump connector.

(14) Route large cable assembly (4) along right side of transmission tunnel cover, and connect to receptacle on control box (fig. 18-39).

(15) Install two clamps (3) attaching cable to tunnel cover, using the tunnel cover screws removed in paragraph 18-7 *i*. The upper defroster hose bracket (2) should be installed with the upper clamp. The slotted face of the bracket should be parallel with the dash panel and leaning rearward (fig. 18-39).

(16) Slide heater guard over heater with slotted side on left to provide clearance to fuel tube. Aline guard and bracket mounting holes and install four screws and lockwashers.

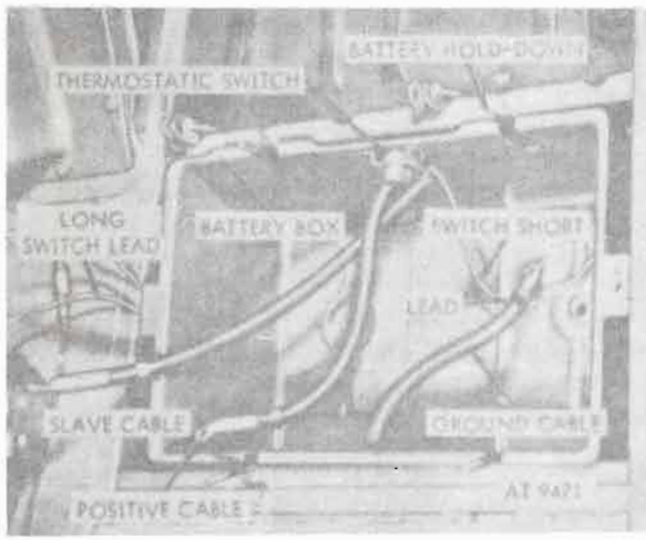


Figure 18-34. Battery box installed.

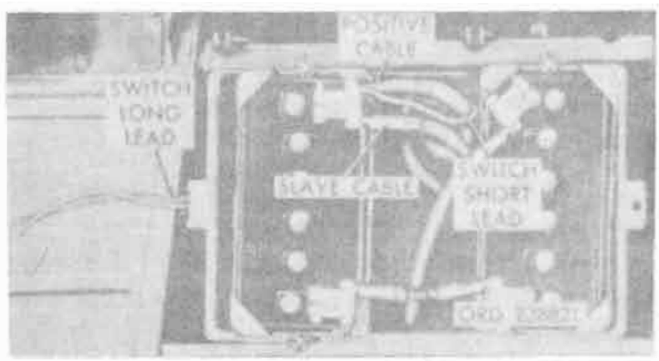


Figure 18-35. Batteries and cables installed.

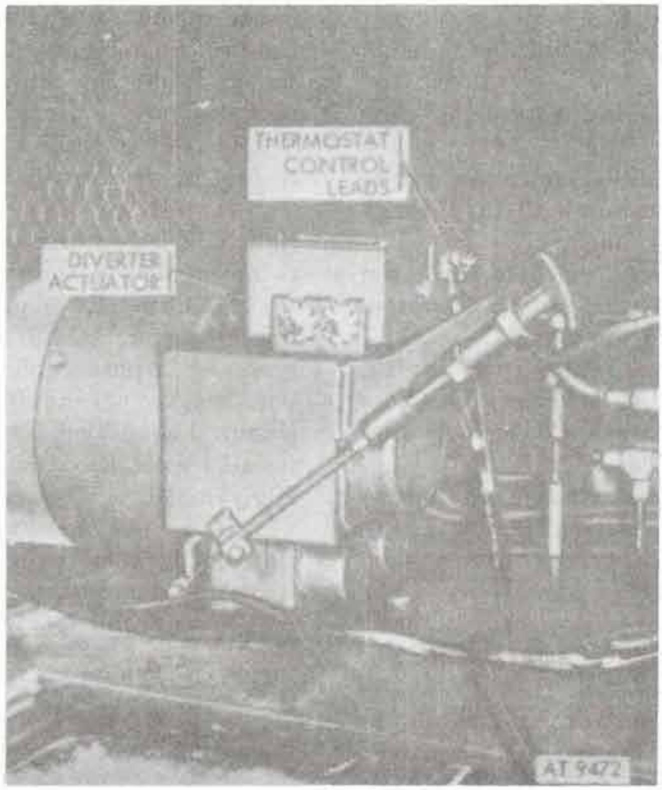
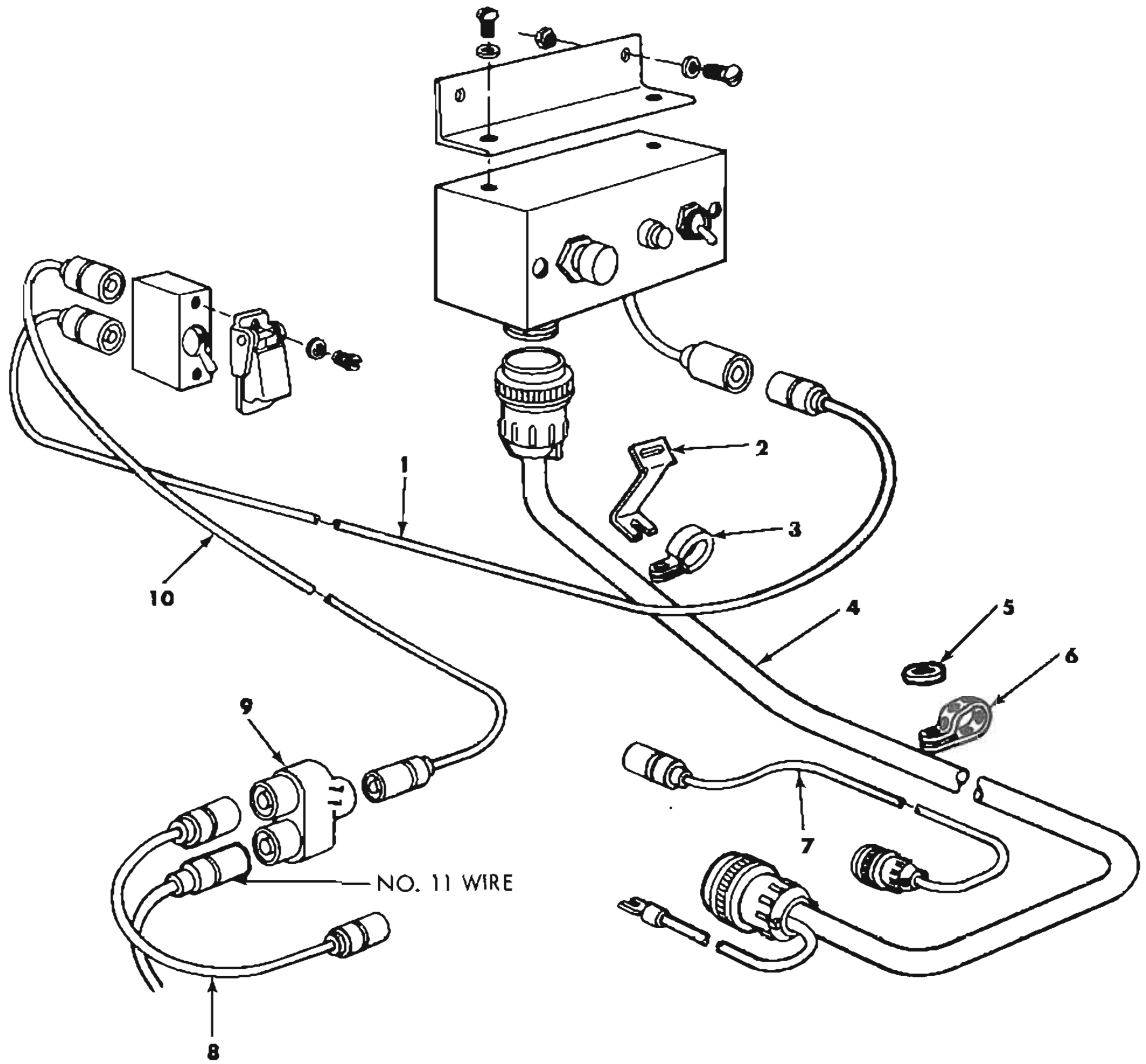


Figure 18-36. Thermostat control leads installed.



Key	Item	Quantity
1	Cable assy. (switch-to-control box).	1
2	Bracket	1
3	Clamp	2
4	Cable assy. (heater-to-control box).	1
5	Flat Washer	1
6	Strap	2
7	Cable assy. (heater-to-fuel pump).	1
8	Cable assy. (ignition switch-to-connector)	1
	Connector	1
10	Cable assy. (Connector-to-switch)	1

Figure 18-37. Electrical cables.

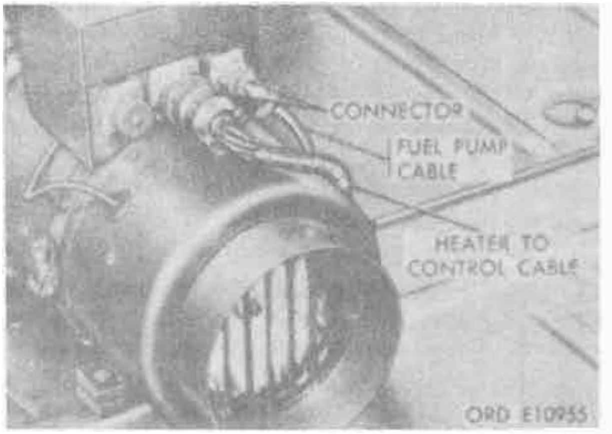


Figure 18-38. Electrical cables installed on heater.

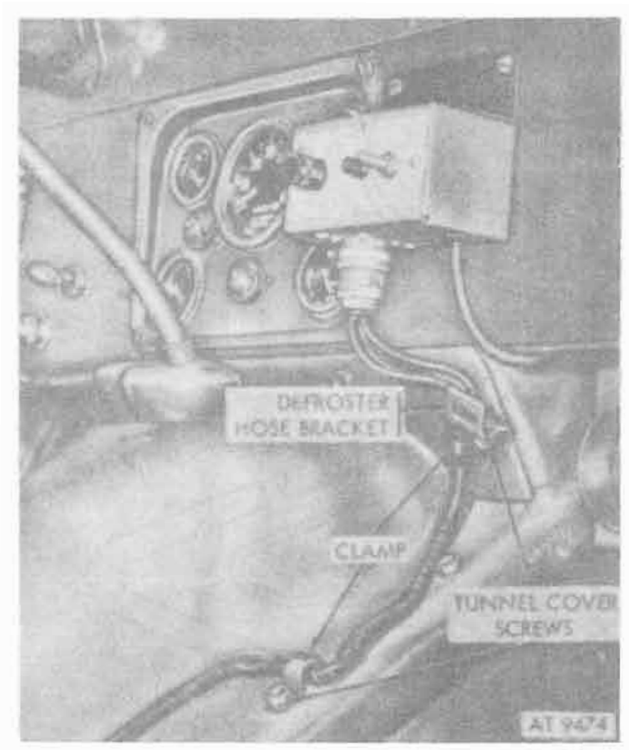


Figure 18-39. Control box cable installed.

l. Installation of Vehicle Insulation (fig. 18-8).

(1) Before applying adhesive, place toeboard insulation in place and locate the two holes drilled in toeboard (para 18-8 *h*).

(2) Apply adhesive (FSN 8040-262-9032) liberally to both insulation panel and vehicle panel (leather grain side of insulation is the side that should be visible after installation). Let adhesive dry until tacky before joining to vehicle. Perform the installation in a heated area.

m. Installation of Heater Hoses (fig. 18-40).

(1) Connect 14-inch hose (14) between battery box cover and upper left outlet of heater diverter box, using two 2½-inch clamps (13).

(2) Connect two 52-inch cab heater hoses (3) to smaller outlets on lower face of diverter heater, using two 2¼-inch clamps (15). Route hoses over battery box heater hose.

(3) Connect the large diameter, 36-inch defroster hose (6) between the remaining heater diverter outlet and the defroster diverter, using two 3½-inch clamps (5).

(4) Slide clamp (8) over free end of left cab heater hose to a position near parking brake lever, and secure with tunnel cover screw.

(5) Insert a small tube (7) into the free end of each cab heater hose. Let tube project out of hose ¼ inch.

(6) Attach the free end (opening facing down and to rear of vehicle) of the cab heater hoses with two clamps (8), screws (9), flat washers (10), lockwashers (11), and nuts (12). In both cases the clamps should be positioned so that the hoses are on the outboard side of screws.

(7) Secure left heater hose to steering column using strap (1), and to brake line using strap (2).

(8) Install bracket (4) using tunnel cover screw.

(9) Unscrew two 3½-inch clamps (5), locate around defroster hose, and insert through slot in brackets on tunnel cover and tighten.

(10) Secure right cab heater hose to defroster hose in four places using four straps (1).

(11) Secure right cab heater hose to vehicle battery cable, under dash panel, using one strap (2).

(12) Install both front seats (TM 9-2320-218-20).

n. Installation of Air Intake Duct.

NOTE

Prior to installation of air intake duct, the hardtop enclosure must first be installed. Refer to paragraphs 18-54 through 18-58 for procedures.

(1) Position duct assembly (fig. 18-41) on the vehicle floor and against the center of the hardtop enclosure rear panel.

(2) Position gasket (fig. 18-42) over rectangular opening on outside of hardtop enclosure roof.

(3) Position hood assembly (fig. 18-42) through and over rectangular opening of hood assembly to face the rear of vehicle. Insert the bottom of hood assembly into the top of the duct assembly, on the inside of the hardtop enclosure. Line up holes.

(4) Install seven ¼-28x¾ hex-head capscrews, fourteen flat washers and seven self-locking nuts (fig. 18-42).

(5) Install air intake duct assembly using four ¼-28x¾ hex-head capscrews, eight flat washers and four self-locking nuts (fig. 18-41).

(6) Remove three screws securing louver to heater and stow (nuts on heater 10920608) and install adapter (7536014) using stowed three screws (fig. 18-43).

(7) Position pipe (10939577) over duct assembly opening and the heater adapter so that the existing holes for the attaching screws in the pipe are in a horizontal position (fig. 18-41).

(8) Using existing holes in the pipe as a template, locate and drill two ⅛-inch diameter holes through the duct assembly, and two ⅛-inch diameter holes through the heater adapter.

(9) Install four 8-18x½ panhead tapping thread screws (fig. 18-41).

o. Installation of Hood and Brush Guard Cover.

(1) Install twenty-six turnbutton studs, lockwashers, and nuts on brush guard and hood. Turnbutton portion of stud must be on exterior of vehicle.

(2) Position covers to that eyelets in covers mate with turnbutton studs and secure.

(3) Do not stretch covers tightly, allow for shrinkage.

18-10. Slave Receptacle

An electrical slave receptacle is mounted on the right cowl and provides a means of connecting the vehicle batteries with an outside source of electrical power which, when properly connected with another vehicle or a slave booster kit, may be used to start the vehicle engine or to charge the vehicle batteries.

18-11. Preliminary Operations

NOTE

If slave receptacle is being installed individually, apply steps *a* through *e* below.

a. Remove right front seat (TM 9-2320-218-20).

b. Remove battery compartment cover.

c. Disconnect and remove right battery.

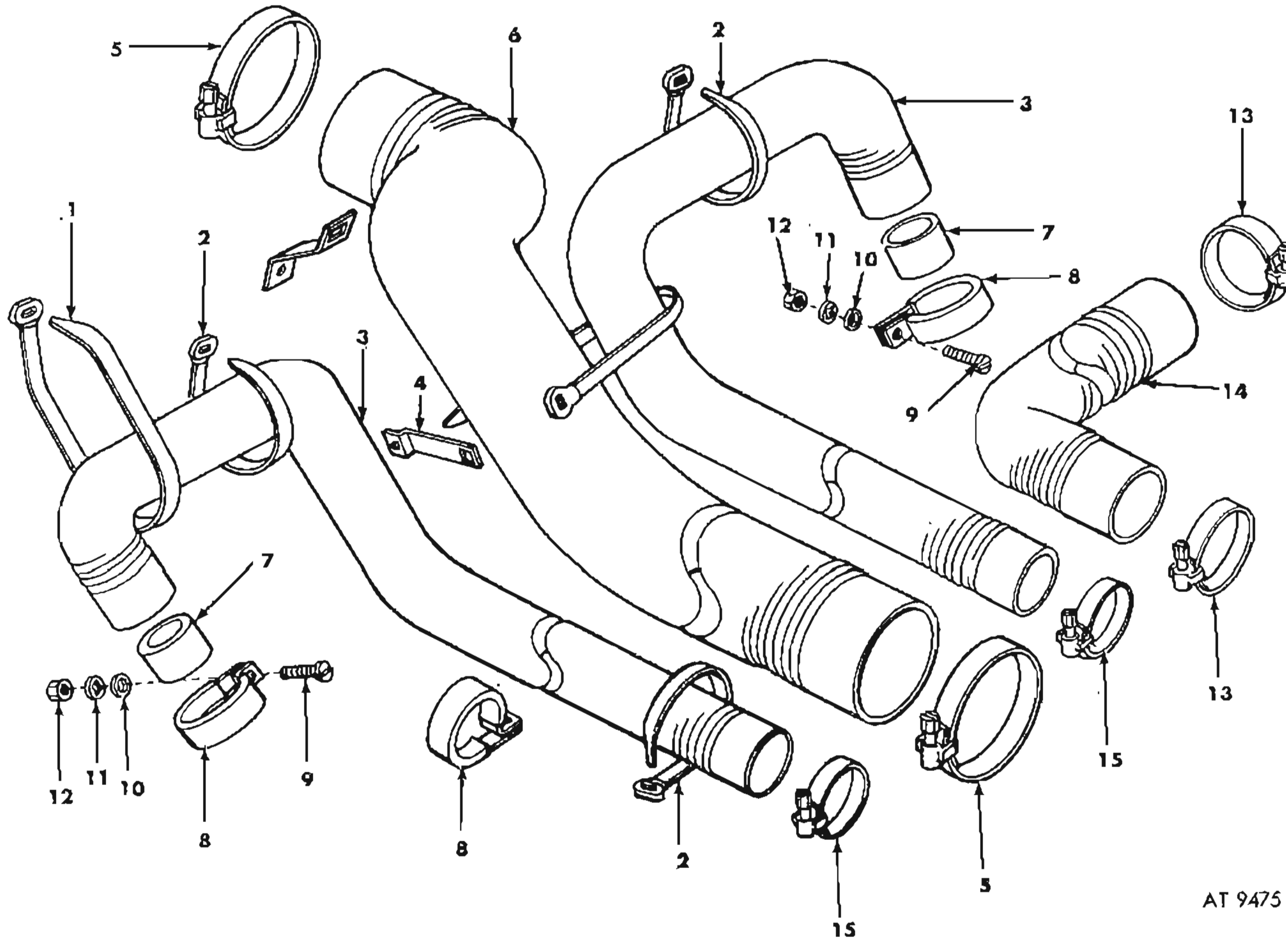
d. Remove and discard battery cable retaining clamp from right body side panel.

e. If vehicle is not equipped with alternator, remove two cable clips (7331197) from battery cable on right cowl side channel. Remove left battery positive terminal cable retaining nut.

18-12. Drilling Instructions

a. Locate and drill a 2-inch diameter hole and four 9 / 32 inch diameter holes in the inclined surface of cowl panel (fig. 18-44).

b. Locate and drill a 7 / 8-inch diameter hole in front seat riser (fig. 18-45).



Key	Item	Quantity
1	Strap	5
2	Strap	3
3	Hose, 52-inch (cab heater).	2
4	Bracket	1
5	Clamp 3½ in.	2
6	Hose 36-inch (defroster).	1
7	Tube	2
8	Clamp	2
9	Screw	2
10	Flat washer	2
11	Lockwasher	2
12	Nut	2
13	Clamp 2½in.	2
14	Hose, 14-inch (battery box).	1
15	Clamp 2¼ in.	2

Figure 18-40. Cab heater hoses.

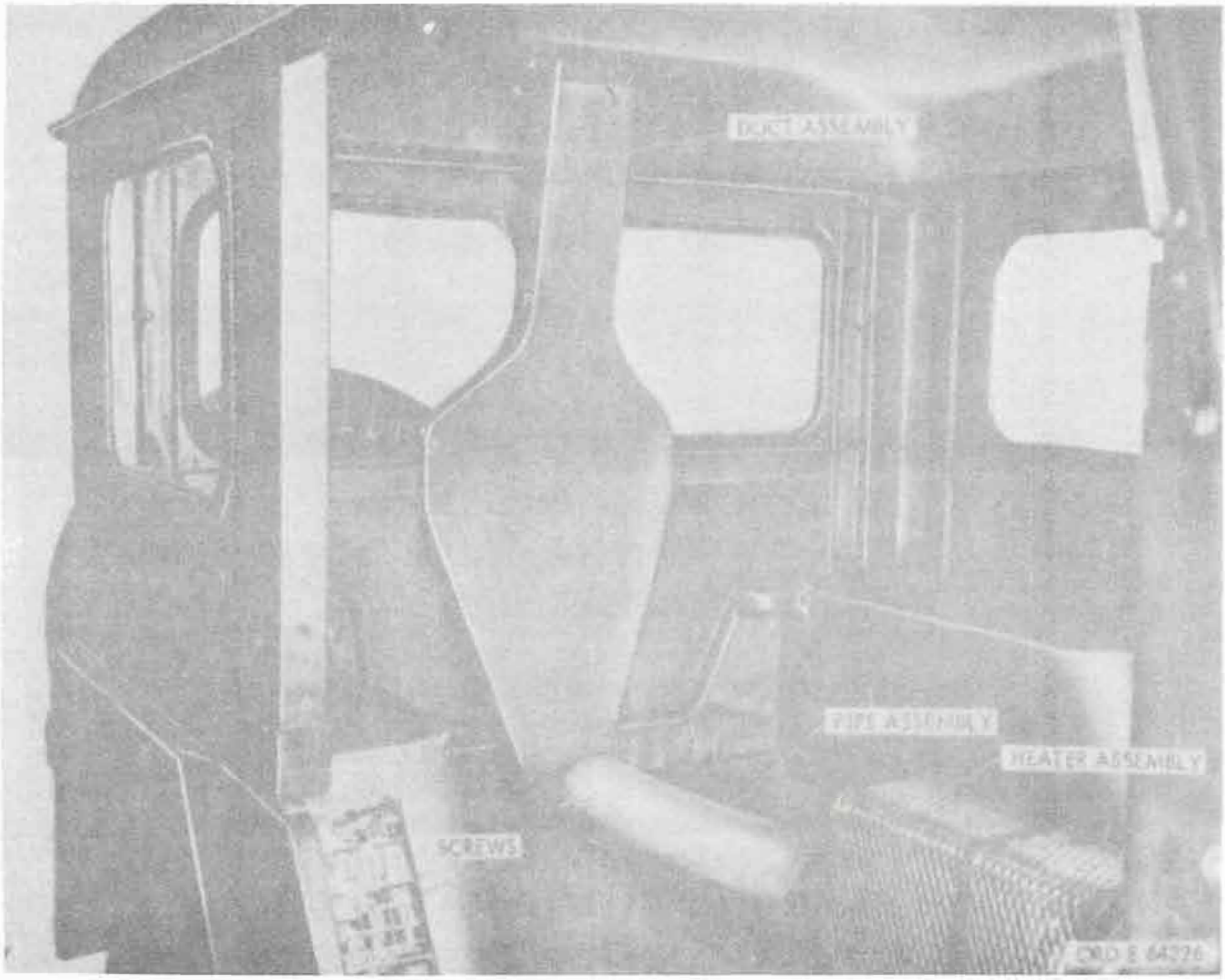


Figure 18-41. Air intake duct installation.

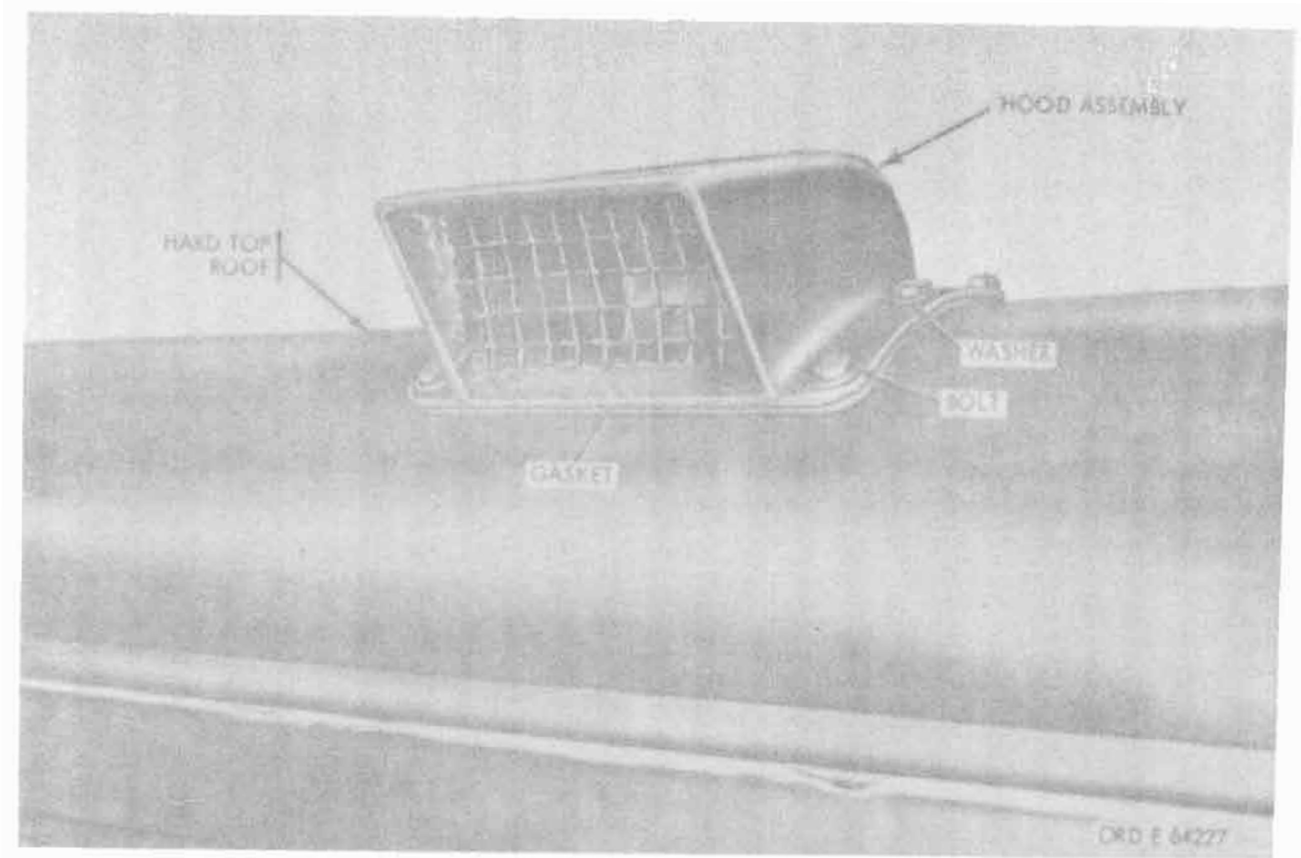


Figure 18-42. Air intake hood installation.

Figure 18-43. Heater louver mounting screws.

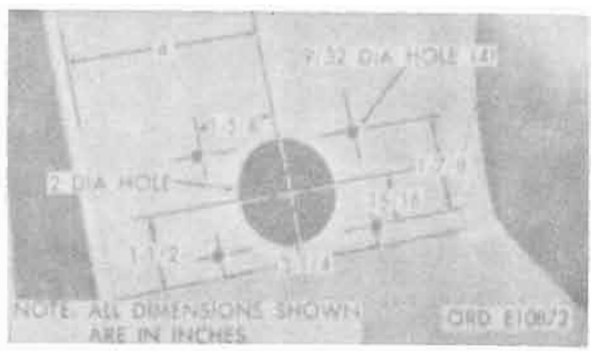


Figure 18-44. Hole location for slave receptacle.

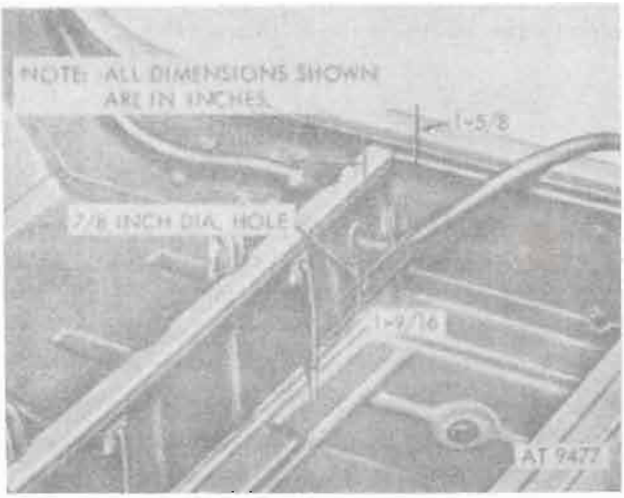


Figure 18-45. Seat riser drilling.

18-13. Installation of Slave Receptacle

a. Position receptacle assembly on right cowl panel.

b. Insert four ¼-20x1 screws and secure (except lower left screw) with three flat washers, lockwashers, and nuts.

c. Attach ground (short) cable to lower left mounting screw; install lockwashers on each side of cable lug, and secure in place with a ¼-20 nut.

d. Route receptacle cable along existing battery cable and through grommet hole in seat riser.

e. Install grommet in 7/8-in. diameter hole in right seat riser (fig. 18-46).

f. Attach two original cable clips to edge of right cowl channel. Position clips over battery and slave receptacle cables.

g. Secure receptacle and battery cables to right body side with supplied clamp and original screw, washers, and nut (fig. 18-46).

h. Route receptacle cable along seat riser to positive terminal of inner battery.

i. Position cable end terminal retaining bolt, and install existing terminal retaining nut (fig. 18-35).

18-14. Operating Test of Heater (—65°F.)

After the —65°F. heater kit has been installed on the vehicle, perform the following test:

a. Snap emergency switch to ON position.

b. Press reset button on control box.

c. Use Press-to-test feature of indicator light. The lamp should light.

d. Snap control switch to ON-HI position. Fuel pump should start immediately and indicator light should come on within two minutes after control switch is snapped on.

e. Heater blower should transfer from low-speed to high-speed operation when indicator light comes on.

f. Check operation of battery compartment damper actuator. With a temperature of approximately 100°F., in the battery compartment, the actuator should close the damper. When the temperature in the battery box drops to approximately 70°F., the actuator should open the damper, permitting heated air to again flow to the batteries. Perform test by removing battery compartment and battery box covers after the damper door has closed. This will allow the thermostat to cool more rapidly, causing the actuator to open the damper. If the damper opens when it should close, reverse the thermostat lead wire connections at the terminal strip of the actuator (fig. 18-46). Repeat test.

g. Pull exhaust diverter T-handle up. Check for heat at the engine oil pan shroud.

h. Push exhaust diverter T-handle down. Check for exhaust gas from heater exhaust pipe and for exhaust smoke. Heavy smoking indicates a malfunctioning heater.

i. Position diverter box damper control handle toward the exhaust diverter T handle. This positions the damper for maximum air to defroster diverter.

j. Position defroster diverter control handle to ON. Check for hot air output from both defroster nozzles.

k. Snap control switch to ON-LO position. Check for cooler air leaving the heater. Blower speed should remain constant for both the ON-HI and on the ON-LO positions of the control switch, since switch controls heat output, not blower speed.

l. Snap control switch to OFF position. Indicator light and blower must remain on for several minutes until heater has cooled.

m. Check operation of emergency switch. Remove five-pin connector plug from control box.

n. Check mechanical operation of circuit breaker.

(1) Remove five-pin connector plug from control box.

(2) Press indicator light. Maintain finger pressure on light. Pull circuit breaker reset button out to "open" position, using fingernail pressure under the lip of button. Indicator light should go out. Push reset button. Indicator light should come on. Release indicator light.

o. Replace any unit which fails to pass any test, or shows signs of failure such as intermittent operation.

(1) Press indicator light. Maintain finger pressure on light, and snap emergency switch to OFF position. Indicator light should go out. Snap emergency switch to "ON" position. Indicator light should come on. Release indicator light.

(2) Install five-pin connector plug to control box.

18-15. Troubleshooting Heater (—65° F.)

a. *Troubleshooting Table.* Table 18-1 is a list of possible trouble causes and remedies which may occur during heater operation. To repair the heater, refer to the instructions in this section.

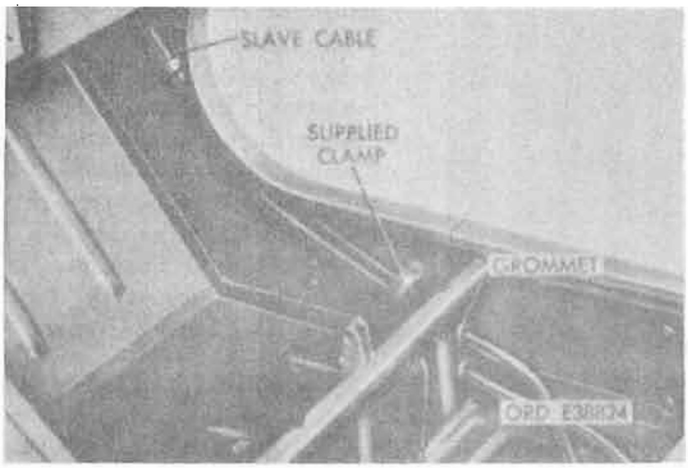


Figure 18-46. Slave receptacle cable installed.

Table 18-1. Troubleshooting Heater (—65° F.)

Malfunction	Probable Cause	Corrective Action
1. Excessive time for ignition.	a. Weak battery	a. Check battery voltage during ignition. Replace battery or use external power not exceeding the voltage rating of the heater.
	b. Low fuel rate	b. Check fuel supply line for ice or dirt. Check the fuel pump. Check fuel metering tee assembly. Check regulator valve.
2. Failure to ignite	a. Electrical system	a. Place control switch in ON-HI or ON-LO position. If the blower motor does not start, check the power supply to the heater.
	b. Overload	b. Short circuit in system. Check out circuits.
	c. Circuit breaker open	c. Press in circuit breaker button. Press in press-to-test indicator lamp. Lamp will light if the circuit is completed. Failure of lamp to light indicates a faulty circuit. Before checking circuit, test indicator bulb to make certain that the bulb is not burned out.
	d. Limit switch contacts open or switch inoperative.	d. Correct reason for overheating. Reset manually. Replace an inoperative switch.
	e. Igniter or resistor burned out (motor operates, unit does not ignite).	e. Replace igniter or resistor
	f. Lack of fuel	f. Check fuel supply
	g. Thermal relay open or defective.	g. Wait approximately five minutes for contacts to close with control switch at OFF. Restart heater; if heater still does not operate, check fuel pump. If fuel pump operates from a separate source of power, replace termal relay.

Table 18-1. Troubleshooting Heater (—65° F.)— Continued

Malfunction	Probable Cause	Corrective Action
	h. Fuel pump failure	h. Disconnect fuel line at outlet of pump and check for fuel flow. If fuel pump does not operate, wait approximately five minutes with control switch at OFF as the thermal relay may be open. Recheck, replace with new fuel pump and check. If new fuel pump does not operate, replace the thermal relay and recheck fuel pump.
	i. Obstruction in fuel line	i. Clean fuel line if fuel does not pass through line.
	j. Regulator valve failure	j. Unscrew cap of fuel tee and check for fuel flow. Replace regulator valve if there is no fuel flow.
	k. Dirty line filter	k. Remove pipe plug & inner nozzle from tee assembly and check for fuel flow. Replace line filter if there is no fuel flow.
	l. Nozzle assy. dirty	l. Disconnect fuel line between the assembly and burner inlet. Check for proper fuel flow (25 plus or minus 3cc. / min on high-fire; 17 plus or minus 2.5cc. / min on low-fire) Clean inner nozzle if flow rate is low. Recheck rate; if still low, replace inner nozzle.
	m. Flame switch failure	m. If motor and limit switch are normal, but motor does not operate, replace flame switch.
	n. Excessive carbon deposits in burner.	n. Overhaul heater & clean burner bowl.
	o. Burner wick excessively burned or disintegrated.	o. Overhaul heater and replace burner wick.
3. Failure to keep	a. Flame switch failure (motor stops after heater ignition).	a. Replace flame switch
	b. Broken quartz rod	b. Replace quartz rod
	c. Combustion chamber overheated. Limit switch stops operation.	c. Correct cause of overheating. Provide ample control to cycle heater and prevent overheating. Reset limit switch button and restart heater.
	d. Air in fuel system	d. Bleed at drain cock.
	e. Blower motor failure or slow down.	e. Check motor. If motor does not operate, replace.
	f. Poor electrical connections.	f. Check circuit continuity
	g. Plugged exhaust line.	g. Disconnect exhaust line, inspect and clean.
	h. Plugged fuel lines	h. Inspect and clean
	i. Burner clogged	i. Clean burner
	j. No fuel	j. Check fuel supply. Check regulator valve. Check fuel pump. Check fuel supply line for restrictions.
4. Failure to shut off	a. Flame switch failure	a. Adjust or replace
	b. Fault in electrcal circuit	b. Check the electrical circuits
	c. Faulty regulator valve	c. Check for shut-off and replace valve if faulty.
5. Surging combustion	a. Fuel pump operating erratically	a. Replace fuel pump.
	b. Regulator valve operating erratically.	b. Check fuel flow rate and replace regulator valve if necessary.

Table 18-1. Troubleshooting Heater (—65 ° F.)—Continued

Malfunction	Probable Cause	Corrective Action
6. Smoke from heater	a. Low fan speed or defective motor.	a. Check motor. If motor does not operate satisfactorily, overhaul heater, or replace motor.
	b. Faulty inner nozzle	b. Replace inner nozzle
	c. Improperly located fan assembly	c. Check position of fan assy.
	d. Faulty regulator valve (excessive fuel pressure).	d. Replace regulator valve
	e. Air in fuel system	e. Bleed at fuel tee
	f. Vapor lock in fuel system	f. Protect fuel system from overheating to prevent vapor locks.
7. Motor operates with control switch in "OFF" position.	a. Quartz rod broken	a. Replace quartz rod
	b. Faulty flame switch adjustment	b. Check flame switch for proper adjustment.

b. Heater Operation (8720193 Heater).

(1) *Combustion air system.* The combustion air blower forces air into the primary and secondary combustion air openings in the end of the heat exchanger (figs. 18-47 and 18-48). With the flame detector switch in its cold position, blower motor current passes through one half of the preheat resistor. This causes the blower to operate at slow speed to aid starting and provide a quick warmup. The primary combustion air (black arrows in figs. 18-47 and 18-48) flows around a circular channel within the combustion chamber to impart a swirling movement to the flame. Secondary combustion air is admitted through a separate hole in the end of the heat exchanger and is distributed through a series of holes in a cone-shaped mixer inside the combustion chamber (white arrows in figs. 18-47 and 18-48). Combustion air is divided into two parts to provide a very rich mixture within the combustion chamber to insure ignition and a continuous flame while providing sufficient secondary air for complete and efficient combustion after the fuel has been ignited. This combustion system minimizes explosive starts which are caused by a lean mixture. After ignition, the hot gasses pass through the passages of the heat exchanger and out through the exhaust tube on the bottom of the heater (figs. 18-47 and 18-48), through the exhaust diverter to outside air or to the engine oil pan to heat the engine oil for easier starting.

(2) *Ignition system.* The ignition system of the heater serves two functions. First, it preheats fuel as it drips down the standpipe. Second, it ignites preheated fuel by means of a glow-plug type igniter. Since combustion is self-sustaining once started, fuel preheating and ignition are no longer required. The flame detector switch opens the igniter and preheating resistor circuit when the flame in the chamber becomes continuous (fig. 18-49).

(3) *Fuel system.* Fuel under pressure of 4 to 4.5 psi is delivered to the fuel control valve by the electric fuel pump. The fuel is regulated by the diaphragm and needle valve (pressure regulator portion) of the fuel control valve. From the pressure regulator the fuel flows to the shutoff solenoid. When the shutoff solenoid is closed, no fuel can enter the standpipe, and the heater is completely shut off. When the shutoff solenoid is energized, fuel flows through both the low-heat orifice and the restriction orifice, producing high-heat operation. When the restriction solenoid is energized, fuel flows through the low-heat orifice only (for low heat operation), (fig. 18-50).

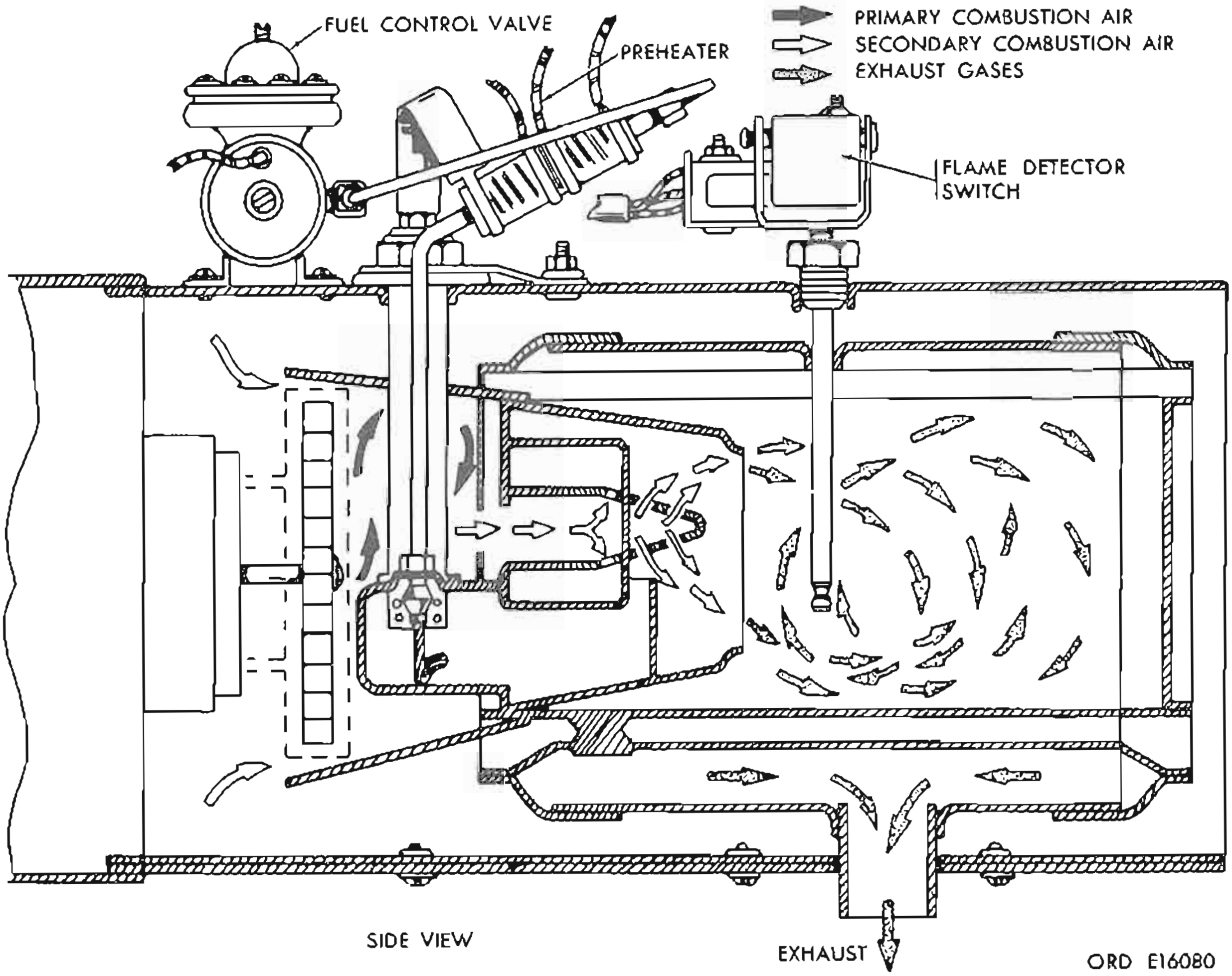


Figure 18-47. Flow system—side view (8720193 heater).

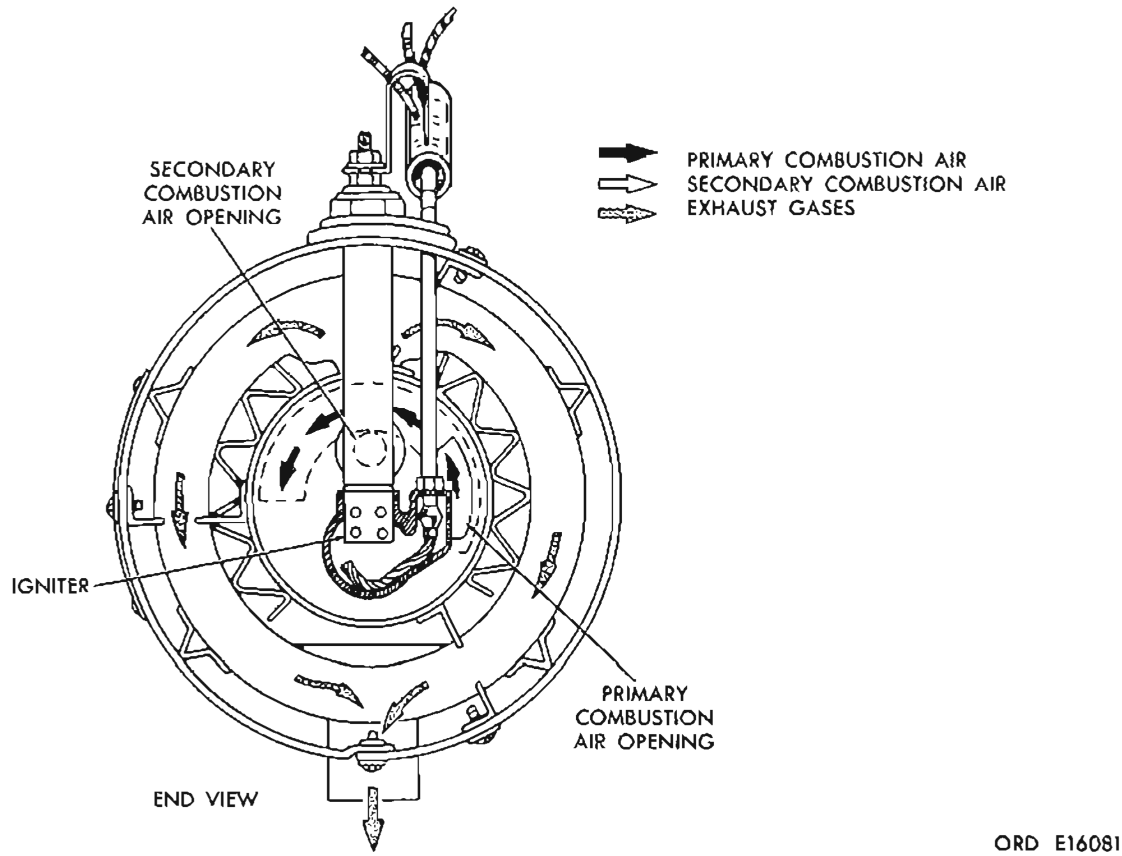


Figure 18-48. Flow system—end view (8720193 heater).

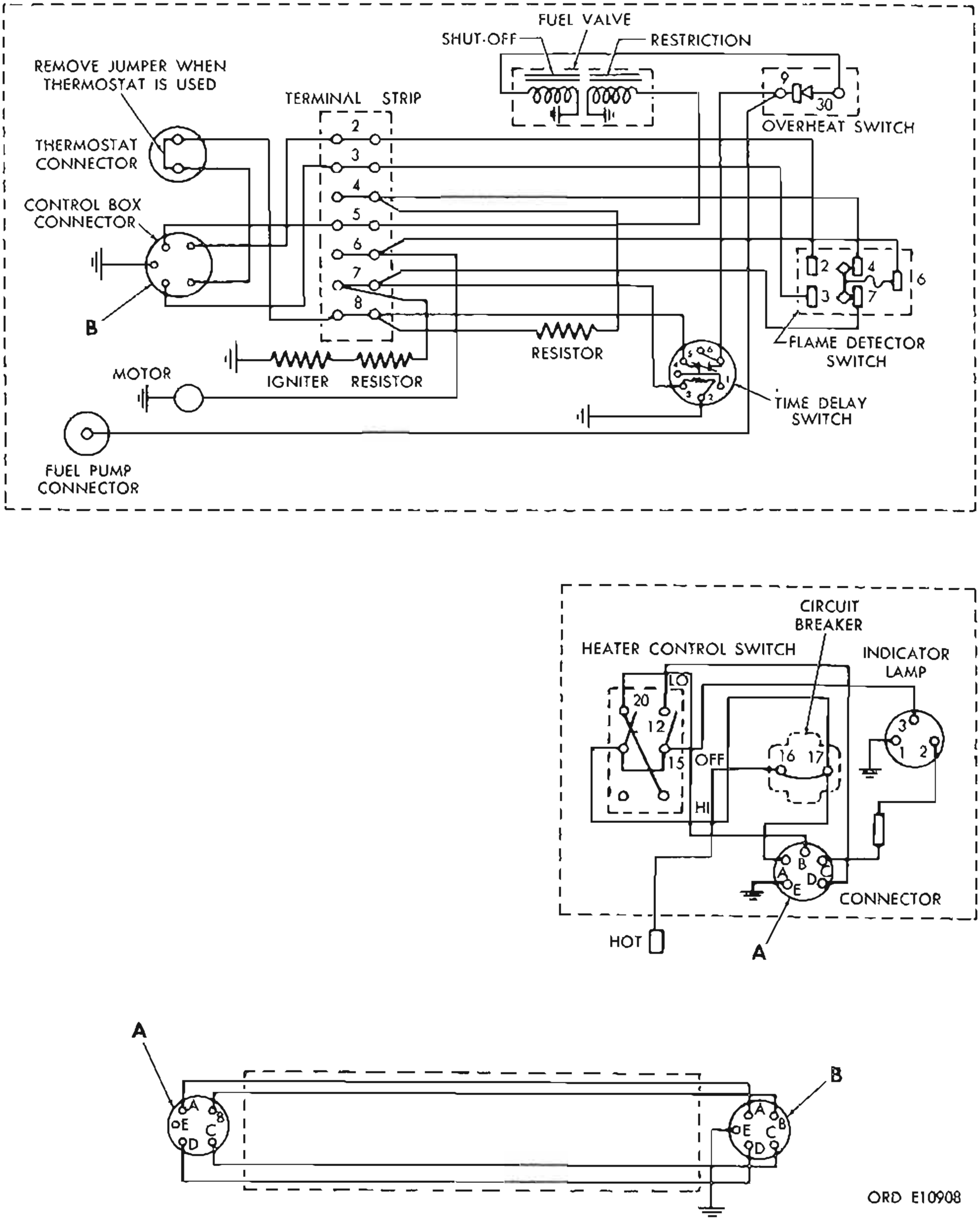


Figure 18-49. Heater, control box and connector wiring (8720193 heater).

(4) *Ventilating air system.* The ventilating air blower wheel is attached to the shaft on one end of the motor and the combustion air blower to the opposite end. Air is received from the fresh air intake assembly through a flexible duct. Part of this air is pushed through the combustion areas of the heat exchanger by the combustion air blower. The greater part of the air is forced through the slots of the heat exchanger and around the side where it absorbs the heat transmitted through the walls of the heat exchanger.

(5) *Cycle of operation.* When the heater control switch is turned on, the following actions occur simultaneously: The fuel pump starts; the shut-off solenoid is energized and fuel drips down into the standpipe; the blower motor starts and runs at a reduced speed; the igniter is energized through the flame detector switch; and the resistor assembly heats the fuel in the standpipe. The heater fuel drips down the standpipe where it saturates the stainless steel wick. At the same time, primary combustion air carries some of the vaporized fuel up to the red-hot igniter wire, and a flame is established. The rich burning mixture of gases then passes through the end of the mixer cone, where additional combustion air is added for complete combustion. There hot gases (shaded arrows in figs. 18-47 and 18-48) swirl around inside the heat exchanger and pass through a long slot at the top. Here they turn and are forced to complete a second path through the outside wrap of the heat exchanger before being discharged through the exhaust outlet. The burning gases heat the tube of the flame detector switch and cause it to expand and lengthen. This tube contains a quartz rod which has a low rate of expansion. The lengthening steel tube causes the pressure exerted by the quartz rod on the microswitch linkage to be relieved. The spring-loaded microswitch transfers and opens the igniter circuit. Simultaneously the blower motor is switched to its normal operating speed, and the preheat resistors are inactivated. When the heater switch is turned to the OFF, fuel flow to the heater is shut off instantly and burning soon stops. However, the blower motor continues to run until the heat tube of the flame detector switch cools, causing the microswitch to open and stop the motor.

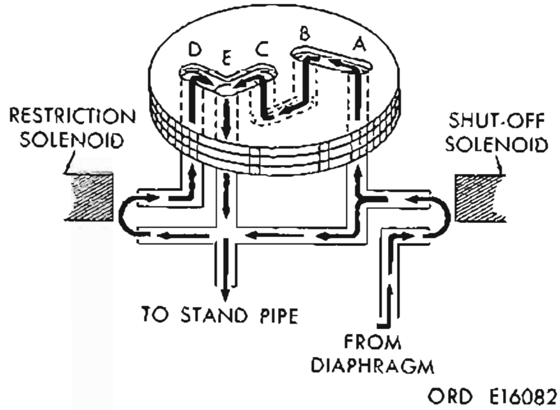


Figure 18-50. Fuel control valve (8720193 heater).

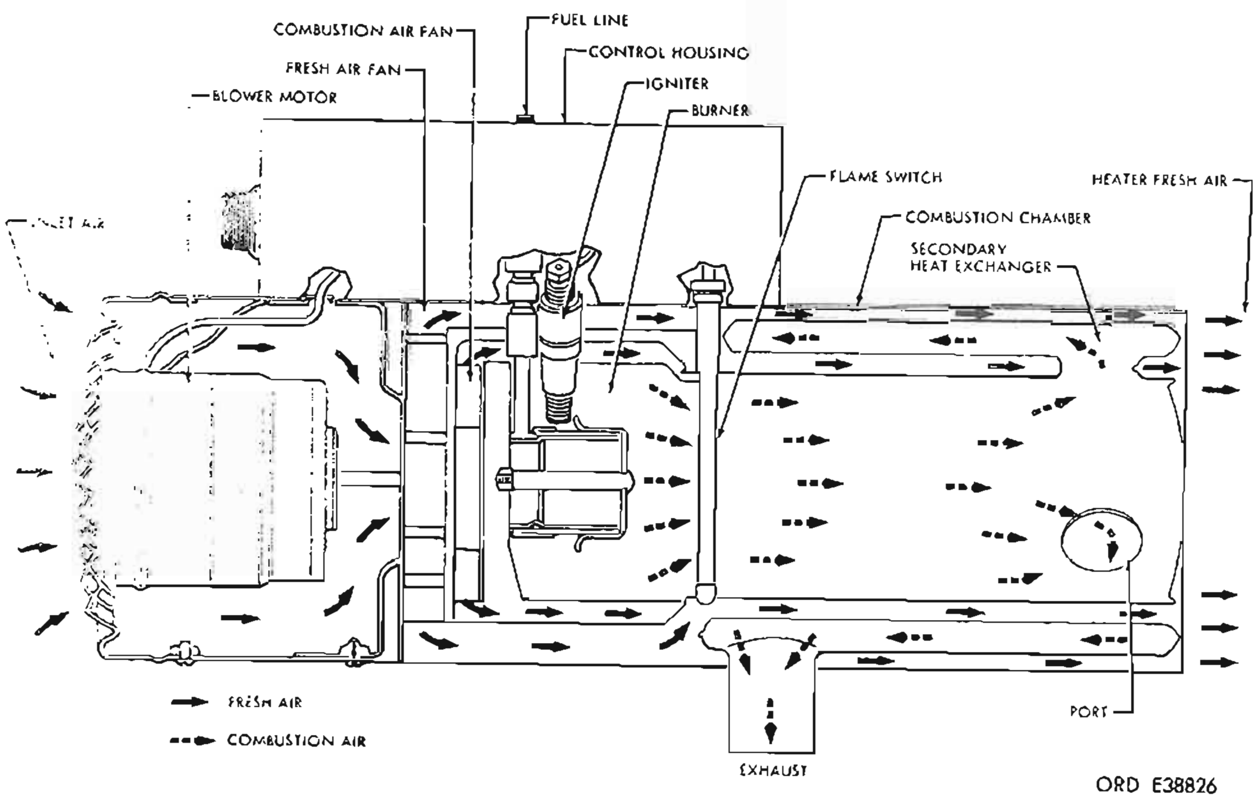


Figure 18-51. Flow system—side view (1092608 heater).

(6) *Overheat switch.* The overheat switch is connected in series with the fuel shutoff solenoid. Therefore, if for any reason the heater becomes overheated, fuel flow is automatically stopped.

(7) *Thermal relay.* A thermal relay (time-delay switch) is connected in series with the overheat switch, fuel shutoff solenoid, and the fuel pump. This switch is actuated by a bimetal blade and a heating element. The heating element is energized through the flame detector switch and is in parallel with the igniter switch. If the heater fails to ignite, the flame detector switch will not transfer and the continued flow of current through the heating element will cause the switch contacts to open. This will deenergize the fuel shutoff solenoid and the fuel pump. The control switch must be snapped off to allow the heating element to cool before fuel pressure can be restored.

c. Heater Operation (1092608 Heater).

(1) *Combustion and ventilating air system.* The air system consists of the blower motor, fan, and air passages through and around the combustion chamber. The blower motor supplies both combustion air and fresh air for the heater. The motor has a single shaft and operates a dual, backward-tip fan. Air is drawn into the screened end of the heater (fig. 18-51), passes over the blower motor (for cooling), and enters the splittype backward-tip fan. The fan, consisting of a larger fresh air impeller and smaller combustion air fan, distributes the intake air to the two heater air systems as follows: Fresh air, from the larger fan, passes around the burner unit and through the passageway between the combustion chamber and the inner wall of its secondary heat exchanger. The air also passes between the heater outer casing and the outer wall of the heat exchanger. The blower action forces the fresh air through the heater with sufficient pressure to deliver heated fresh air to the various components of the installation. As the air is forced through the heater, it absorbs, approximately 30,000 Btu / hr. at the high-fire rate, and 18,000 Btu / hr. at the low-fire rate for distribution as fresh, heated air, dependent on system resistance. The second air system is for combustion air. This is supplied to the burner by the smaller, backward-tip fan. The burner shell separates the combustion air from the fresh air. The combustion air enters the burner through the primary and secondary air holes of the burner port and the thin aperture between the burner throat and the inside wall of the combustion chamber. The air mixes with the fuel vapor in the burner and combustion takes place in the burner bowl and the combustion chamber. The combustion (contaminated) air is passed through the three ports at the far end of the combustion chamber, and into the secondary heat exchanger where it reverses its flow and leaves the heater through the centrally located exhaust opening. These products of combustion are ducted off and used to heat the engine oil pan.

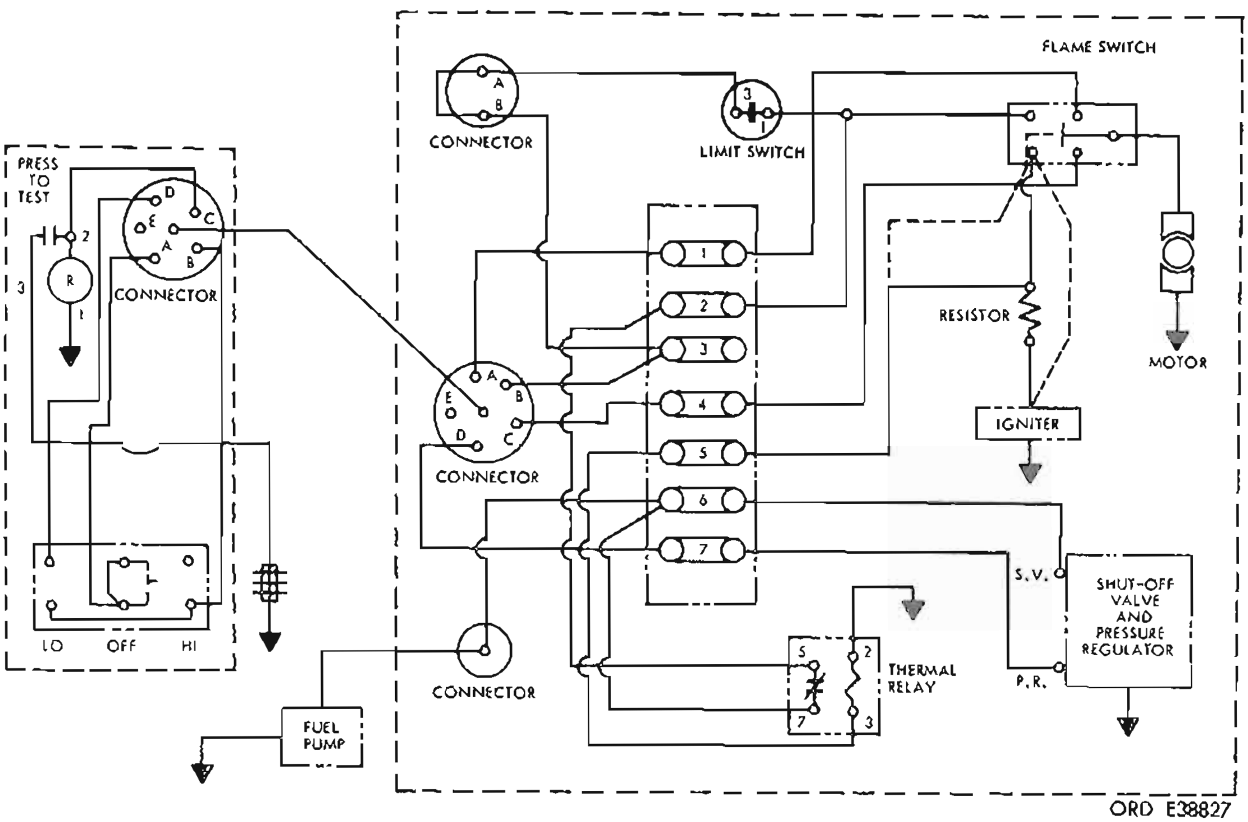


Figure 18-52. Wiring diagram (1092608 heater).

(2) *Electrical system (fig. 18-52).* The heater electrical system is designed for fail-safe operation. Therefore, the heater will cease to operate in case of a failure of any circuit, mechanical part, or in the event that the heater casing overheats. The electrical system includes a remotely mounted control box assembly (directly connected to the heater controls support assembly by the cable assembly), the terminal block, flame switch, resistor, igniter assembly, thermal relay, connectors, blower, and limit switch (fig. 18-53). The three connectors of the terminal block, mounted on the controls support, are the junction for connections of the thermal relay, regulator valve, flame switch, and resistor on 24-volt units. The flame switch controls the electrical supply to the igniter, blower motor, thermal relay, and control box assembly indicator lamp. The switch is mounted in the upper part of the frame. The lower part contains a long, heat resisting metal tube which encases a quartz rod and a heat resisting metal rod. The open end of the frame is attached by a screw, which permits the adjustment of pressure exerted by the quartz and metal rods on the switch. The heat resisting metal tube extends into the combustion chamber of the heater, where it is subjected to the heat resulting from combustion. The heat causes the tube to expand and allows the quartz rod, which does not expand as much as move and release the pressure from the switch button. This changes the contact positions of the switch and removes the igniter and resistor from the circuit. When the heater is turned off, the metal tube cools and contracts, forcing the quartz rod back into position against the metal rod and the switch button. This resets the switch to its original (cold) position. The igniter assembly consists of a coil of resistance wire, partially encased in a protective metal cartridge. When the proper voltage is applied to the igniter assembly, it becomes hot enough to vaporize and ignite the fuel which has entered the burner through the fuel inlet connection and saturated the burner wick. The igniter is designed for not more than a 12-volt system. The system on this vehicle (24v) must have a resistor wired into the circuit to reduce the voltage at the igniter. The thermal relay is a safety device incorporated into the heater's electrical system. It consists of a heating element, warp lever, and a set of contacts. The thermal relay completes the circuits to the fuel pump, regulator valve solenoid shutoff coil, flame switch, and resistor. When the control switch is placed in an operating position, ignition should take place within two minutes. If ignition does not take place as specified, the thermal relay warp lever will heat up and, after 120 seconds of operation, will separate the contacts to break the circuit to the fuel pump and stop the flow of fuel. The control switch must be snapped off to allow the heating element to cool before fuel pressure can be restored. If the system voltage is below nominal, the delay period will be somewhat longer. Higher than nominal voltage shortens the delay period. The purpose of the overheat limit switch is to shut the heater off if the temperature of the combustion chamber rises beyond a safe limit. The switch incorporates a manual reset button which must be pressed before the heater is restarted.

(3) *Fuel system.* Fuel is brought to the heater assembly by a fuel pump. From the fuel pump it flows to the regulator valve assembly which controls the amount of fuel as called for by the control switch setting. From the regulator valve, the fuel passes through a thin-plate orifice fuel metering tee assembly which meters the correct amount of fuel entering the burner for combustion. The fuel pump is installed in the fuel system and is electrically connected to the heater's operating circuits. The fuel pump supplies fuel at low pressure to the regulator valve. The pump is designed with a solenoid which, when energized, activates a hollow plunger. The stroke of the plunger is controlled by a set of interrupter points in the electrical circuit and a calibrated plunger spring. The pump is self-priming, requiring no bleeding or adjustments on first start. The regulator valve (fig. 18-53) is mounted on the heater's controls support. It is made up of two parts: The upper is a solenoid shut off valve, and the lower is a high-low pressure regulator. The pressure regulator controls the pressure of the fuel being supplied to the tee assembly for the burner. The regulator valve is electrically operated with the solenoid shutoff part connected to the heater circuit which supplies power to the fuel pump. The high-low pressure regulator is directly connected to the control switch on the control box assembly. When the solenoid shutoff valve coil is energized, it raises a valve from its seal, and allows fuel to flow into the pressure regulator section of the assembly. This pressure regulator consists of a diaphragm which is balanced by calibrated springs and actuates a needle valve by means of fuel pressure against the diaphragm. At the "high-fire" setting, there are two springs separated by an armature working with this diaphragm. These springs exert an upward force against the diaphragm. When fuel pressure against the diaphragm has reached the preset spring pressure, the needle valve shuts off the flow of fuel until the pressure has decreased. In this manner, fuel under constant pressure is provided the tee assembly for metering to the burner. At the "low-fire" setting, when the pressure regulator coil is energized by the setting of the control switch, the armature separating the two springs is held down

against a shoulder to override the pressure of one of the springs. This reduces the total spring pressure against the diaphragm and allows it to close the needle valve and regulate the fuel to half the pressure of the high-fire setting. Thus, with a lower regulated pressure against the thin-plate orifice of the tee assembly, a reduction of fuel flow is accomplished. The tee assembly consists of an inner nozzle housed in an adapter. The nozzle acts in the manner of a thin-plate orifice through which the fuel is metered to the burner for combustion. In conjunction with the regulator valve, the operation of this orifice assures a constant, smooth, metered flow of fuel, regardless of fuel viscosity. The burner is of the modified vaporizing-pot type with a burner wick mounted in its base. Fuel enters the burner through the fuel inlet connection. Combustion takes place in the burner throat and combustion chamber.

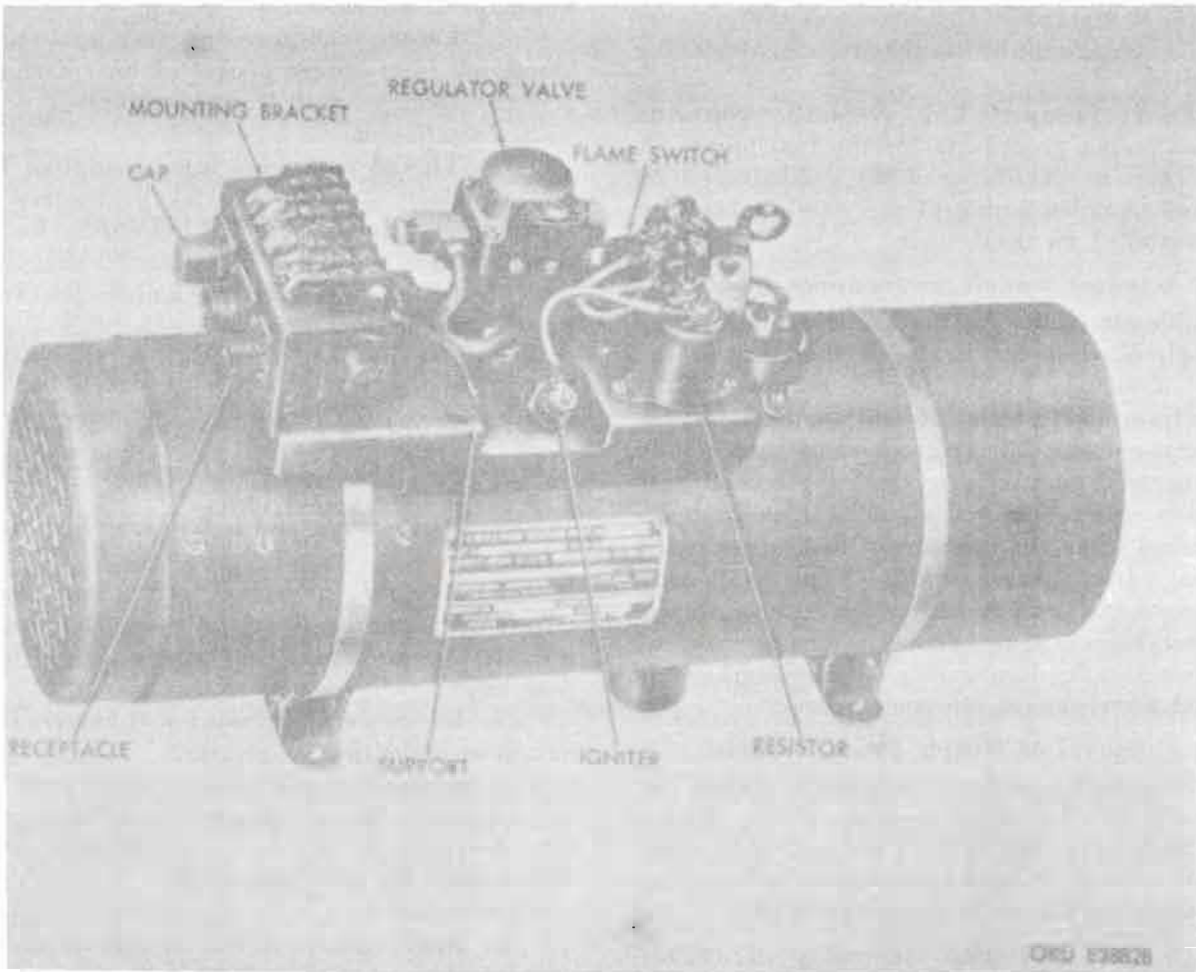


Figure 18-53. Electrical system components (1092608 heater).

(4) *Operation cycle.* Before placing the heater in operation, it is possible to ascertain whether power is being supplied. When the "press-to-test" lamp is pressed in, the lamp will light if power is available at the heater circuit breaker. When the control switch is placed in the ON-HI position, the motor igniter and resistor, and the thermal relay heating element are energized through the cold position of the flame switch. The solenoid shutoff coil of the regulator valve and the fuel pump are energized through the normally closed contacts of the thermal relay to supply fuel to the burner. When the igniter coil heats up and fuel reaches the burner, ignition will take place (usually in 30 to 45 seconds). If ignition does not take place in 120 seconds, the thermal relay contact points will open. This will deenergize the fuel pump and regulator valve, and will shut off the flow of fuel to prevent flooding. After ignition has taken place, the combustion heat causes the flame switch tube to expand and release the switch plunger. The flame switch then shifts to the "run (hot)" position and breaks the circuits to the igniter and resistor and the heating element of the thermal relay. The motor

and the "press-to-test" lamp are now energized through the "run (hot)" position contacts of the flame switch. Since the thermal relay heating element is out of the circuit after ignition takes place, the thermal relay contacts will remain closed. This serves to keep the fuel pump and solenoid shutoff coil of the regulator valve energized to supply fuel to the burner. When the control switch is placed in the ON-LO position, the operation cycle of the heater is the same as for the ON-HI position except that the coil of the regulator valve pressure regulator is energized. This decreases the pressure of the fuel being supplied to the metering device for the burner.

d. Fuel Pump. TM 9-8662 contains troubleshooting procedures for the fuel pump.

e. Damper Actuator. TM 9-2320-218-20 describes troubleshooting of the damper actuator when installed on the vehicle.

18-16. General Repair Procedures (—65° F.)

Accessible components of the heater assembly may be repaired while the heater is installed in the vehicle. Extensive repairs require removal of the heater from the vehicle. It will be necessary to remove the heater for replacement of heater body components. Repair of the remaining components of the winterization kit (—65° F.) is best accomplished when the component to be repaired is removed from the vehicle. The following paragraphs include procedures for removal of the subassemblies, removal of components of subassemblies, or disassembly of subassemblies as required for repair of the components.

18-17. Removal of Heater From Vehicle

To remove the heater from the vehicle, reverse the procedures shown in paragraph 18-9*g*. Where disassembly of the heater body is required, remove the diverter assembly and inlet adapter by reversing the procedures shown in paragraph 18-9*g*.

18-18. Repair of Heater Assembly (8720193)

The following paragraphs 18-19 through 18-29 refer to the repair of heater assembly (8720193).

18-19. Resistor Assembly
(fig. 18-54)

a. Removal.

(1) Disconnect fuel line from standpipe, and from fuel valve.

(2) Disconnect resistor assembly lead wires from terminal strip.

(3) Loosen igniter terminal nut, and remove connector strip.

(4) Slide resistor off standpipe.

b. Cleaning. Wipe all loose dust from resistor, connector strip, and wire leads.

c. Installation.

(1) Slide resistor assembly onto fuel standpipe with connector strip end first.

(2) Install connector strip to igniter terminal. Position connector strip under lockwasher.

(3) Connect lead wires to terminal strip with numbers on wires matching terminal strip numbers.

(4) Connect fuel line to fuel valve, and to standpipe.

18-20. Fuel Tube Wick

a. Removal.

(1) Use procedure in paragraph 18-19 to remove resistor assembly.

(2) Loosen compression nut, and remove standpipe from igniter pocket of heat exchanger.

(3) Remove wick from standpipe.

b. Installation.

(1) Thread new wick into standpipe. Leave approximately 3/4 inch of wick protruding from standpipe. (Refer to TM 9-8662 for test procedure.)

(2) Install standpipe in igniter pocket and tighten compression nut.

(3) Use procedure in paragraph 18-19 to install resistor.

18-21. Igniter Assembly
(fig. 18-55)

a. Removal.

(1) Remove nut and lockwasher from igniter terminal.

(2) Remove connector strip from igniter terminal. Rotate resistor on fuel standpipe to provide clearance past connector strip for igniter removal.

(3) Remove igniter from top of heater. Utilize hex head of igniter for rotating.

b. Cleaning. Scrape carbon deposits from inner surface, exercising care to prevent damage to flow wire. Scrape outer surface and clean holes (refer to TM 9-8662 for test procedure).

c. Installation.

(1) Insert igniter into hole at top of heater and into igniter pocket. Install igniter.

(2) Rotate resistor on fuel standpipe, and position connector strip to igniter terminal. Install nut and lockwasher.

18-22. Termanl Relay
(fig. 18-56)

a. Removal. Use finger pressure to disengage relay connector pins from socket while sliding relay through grommet.

b. Installation. Slide relay through grommet. Install relay to socket. Utilize wide pin spacing as a locator.

18-23. Overheat Switch
(figs. 18-49 and 18-54)

a. Removal.

(1) Remove nut, lockwasher, and both No. 9

cables from No. 9 terminal. Terminal identification is stamped on the mounting plate.

(2) Remove nut, lockwasher, and No. 30 cable from No. 30 terminal furtherest from fuel control valve).

(3) Remove both mounting screws.

b. Cleaning, Inspection, and Repair. Clean contacts by sliding a clean piece of paper between them. Do not attempt to bend blade or contact arm. Discard switch if defective.

c. Installation.

(1) Position switch to heater with terminal No. 9 nearest fuel control valve. Terminal identification is stamped on the mounting plate. Install both mounting screws.

(2) Connect both No. 9 cables to No. 9 terminal. Install lockwasher and nut.

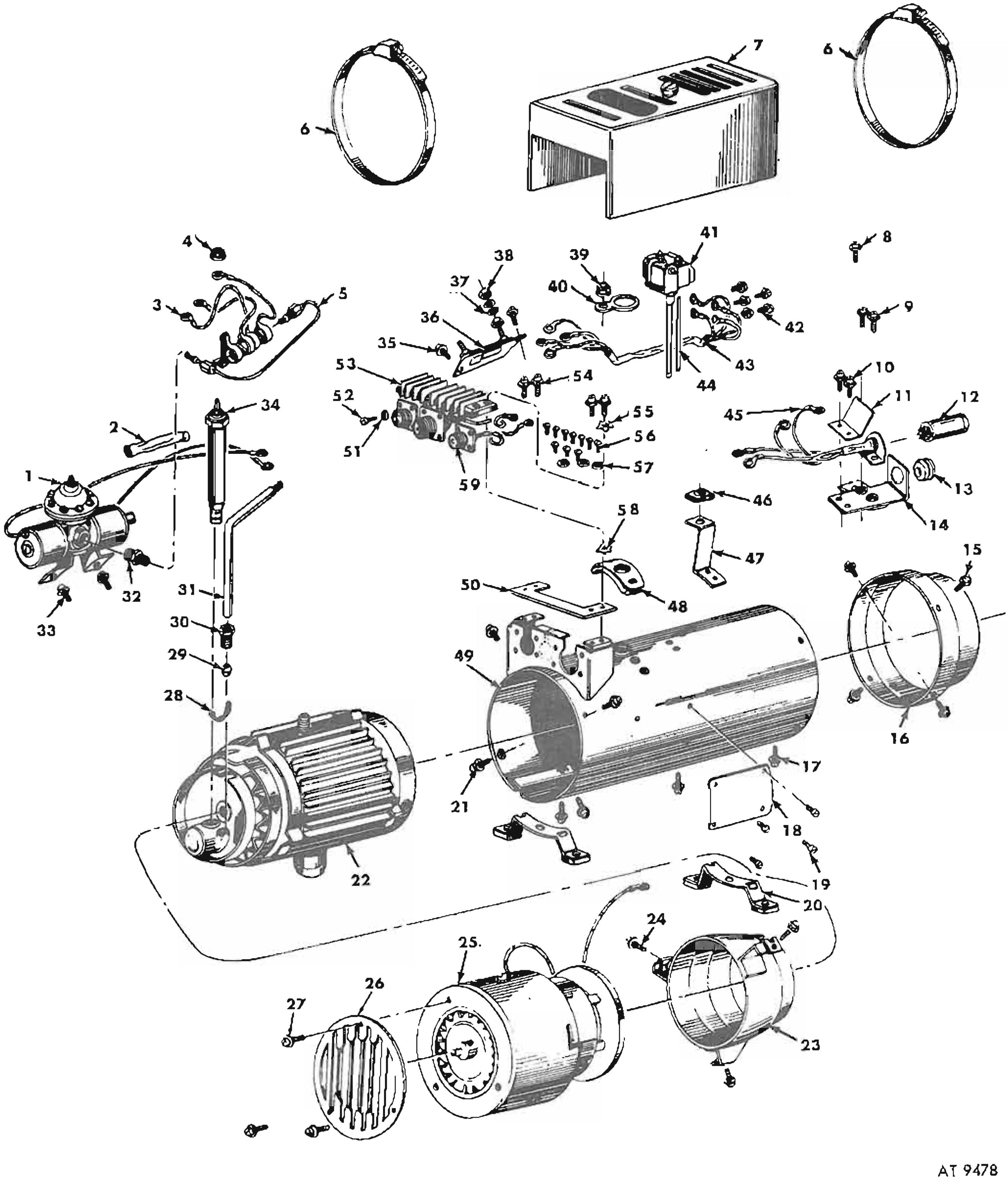


Figure 18-54. Heater (8720193).

Key to figure 18-54.

Key	Item	Quantity
1	Fuel control valve	1
2	Sleeve	1
3	Resistor	1
4	Nut	1
5	Fuel line	1
6	Clamp	2
7	Guard	1
8	Screw	1
9	Screw	2
10	Screw	2
11	Shield	1
12	Thermal relay	1
13	Grommet	1
14	Bracket	1
15	Screw	4
16	Adapter	1
17	Screw	3
18	Nameplate	1
19	Rivet	4
20	Bracket	2
21	Screw	4
22	Heat exchanger	1
23	Mounting ring	1
24	Screw	3
25	Blower housing	1
26	Louver plate	1
27	Screw	3
28	Wick	1
29	Ferrule	1
30	Nut	1
31	Standpipe	1
32	Connector	1
33	Screw	2
34	Igniter	1
35	Screw	2
36	Overheat switch	1
37	Washer	2
38	Nut	2
39	Nut	1
40	Terminal strip	1
41	Flame detector switch	1
42	Screw	5
43	Harness	1
44	Quartz rod	1
45	Socket assy.	1
46	Nut	1
47	Bracket	1
48	Cover	1
49	Housing	1
50	Marker strip	1
51	Washer	12
52	Screw	12
53	Terminal strip	1
54	Screw	4
55	Washer	3
56	Screw	10
57	Washer	3
58	Lockwasher	3
59	Receptacle assy.	1

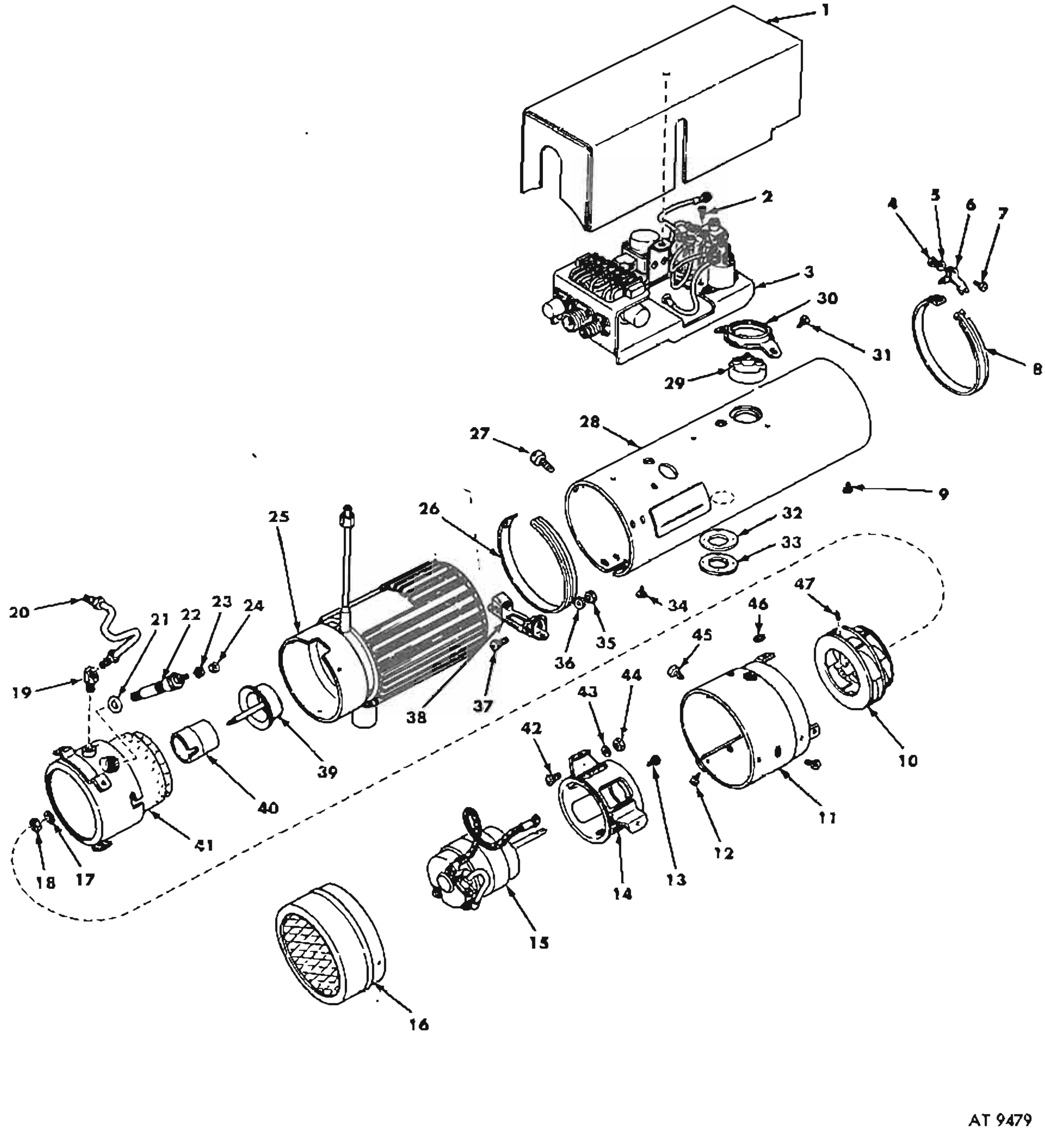


Figure 18-55. Heater (10920608)—exploded view.

Key to figure 18-55.

Key	*Item*	*Quantity*
1	Controls cover assy.	1
2	Fastener (8-32x⅜)	2
3	Controls support assy	1
4	Nut (¼-20)	1
5	Lockwasher (¾-inch size).	1
6	Mounting clamp	1
7	Capscrew (¼-20x1½)	1
8	Mounting ring—front	1
9	Fastener 8-32x¼)	1
10	Fan assy.	1
11	Motor casing housing assy.	1
12	Fastener (8-32x⅜)	3
13	Fastener (8-32x⅜)	4
14	Motor support assy	1
15	Blower motor assy.	1
16	Intake cover assy.	1
17	Lockwasher (10)	1
18	Nut (No. 10-24)	1
19	Elbow	1
20	Fuel line tube assy	1
21	Igniter gasket	1
22	Igniter assy.	1
23	Lockwasher (10)	1
24	Nut (Gripco lock steel) (No. 10-24).	1
25	Combustion chamber assy.	1
26	Heater mounting ring—rear	1
27	Fastener (10-32x⅜)	3
28	Casing assy.	1
29	Limit switch	1
30	Switch retainer	1
31	Fastener—rd hd. thread cutting type 1 (No. 8-32x¼).	2
32	Exhaust tube gasket	1
33	Exhaust tube seal	1
34	Fastener (8-32x⅜)	4
35	Hex nut (¼-20)	4
36	Lockwasher (¼-inch size).	4
37	¼-20x1½ capscrew.	4
38	Mounting base	2
39	Wick retainer shell assy.	1
40	Burner wick	1
41	Burner assy.	1
42	Screw (10-32x⅜)	1
43	Lockwasher (10)	1
44	Nut (10-32)	1
45	Fastener (10-32x⅜)	3
46	Grommet	1
47	Special screw	1

(3) Connect No. 30 Cable to No. 30 terminal. Install lockwasher and nut.

18-24. Fuel Control Valve (fig. 18-49 and 18-54)

a. *Removal.*

(1) Remove No. 30 lead wire from No. 30 terminal of overheat switch.

(2) Remove No. 5 lead wire from No. 5 terminal of terminal strip.

(3) Remove both mounting screws.

b. *Disassembly.* Refer to TM 9-8662.

c. *Cleaning, Inspection, and Repair.* Refer to TM 9-8662.

d. *Assembly.* Refer to TM 9-8662.

e. *Installation.*

(1) Position valve to heater with fuel line connection facing toward side. Install both mounting screws.

(2) Connect No. 5 cable to No. 5 terminal of terminal strip.

NOTE

Terminal identification is stamped on the mounting plate of the overheat switch.

(3) Connect No. 30 cable to No. 30 terminal of overheat switch.

18-25. Flame Detector Switch (figs. 18-49 and 18-54)

a. *Removal.*

(1) Remove fuel cables from microswitch.

(2) Loosen compression nut located between microswitch and heater case.

(3) Lift assembly straight out of heat exchanger to prevent damage to expansion tube.

b. *Disassembly*

(1) Remove locking cement and adjusting screw.

(2) Invert assembly to permit quartz rod to slide out through adjusting screw hole.

(3) Remove microswitch mounting screws, nut and lockwasher assemblies, steel plate, and insulating paper.

(4) Remove coil spring from microswitch.

c. *Cleaning. Inspection and Repair.* Refer to TM 9-8662.

d. *Assembly.*

(1) Position coil spring to microswitch.

(2) Position microswitch to bracket. Position steel plate and insulating paper to switch. Install mounting screws and nuts.

(3) Insert quartz rod into expansion tube, utilizing adjustment screw hole for accessibility.

(4) Install adjustment screw. Position quartz rod in center of depression in end of adjustment screw.

(5) Adjust switch by turning adjusting screw clockwise one-half turn past point where switch just clicks.

(6) Cement adjusting screw to lever arm with a small quantity of insulation cement (FSN 8030-098-9280).

e. *Installation.*

(1) Insert expansion tube straight into fitting on heat exchanger.

(2) Position assembly with terminals of microswitch toward the heater outlet. Tighten compression nut.

(3) Connect five cables to microswitch. Each of the numbered cables must be connected to its respective terminal.

18-26. Quartz Rod

a. *Removal.* Refer to paragraphs 18-25 *a* and *b*.

b. *Inspection.* Refer to TM 9-8662.

c. *Assembly.* Refer to paragraphs 18-25 *d* and *e*.

18-27. Blower Assembly (figs. 18-49 and 18-54)

a. *Removal.*

(1) Disconnect motor lead wire from terminal No. 6 of terminal board.

(2) Loosen four screws at bayonet connection of blower assembly to heater case.

(3) Turn blower assembly slightly, and remove from heater case.

b. *Disassembly* (fig. 18-57)

(1) Loosen combustion air blower wheel setscrew and slide wheel off motor shaft.

(2) Remove four screws retaining heater to blower motor and remove heater.

(3) Remove three motor mounting bracket to blower housing retaining screws.

(4) Remove motor mounting bracket and ventilating air blower wheel as an assembly.

(5) Loosen blower wheel setscrew, and slide wheel off motor shaft.

(6) Mark position of motor within mounting bracket. Loosen mounting bracket clamping screw.

(7) Remove motor from bracket.

(8) Remove grommet from blower housing and lead wire from grommet.

c. *Cleaning.* Wash blower wheels, mounting bracket, exterior surfaces of motor, and blower housing in drycleaning solvent or mineral spirits paint thinner.

d. *Inspection.* Refer to TM 9-8662.

e. *Assembly.*

(1) Insert motor lead wire through hole in blower housing. Install grommet to blower housing.

(2) Install motor to mounting bracket. Use the mark made during disassembly to locate motor in mounting bracket. Tighten clamping screw.

(3) Install large blower wheel to motor shaft (at lead wire end of motor). Setscrew must contact flat portion of shaft squarely.

(4) Position motor and wheel assembly in blower housing, and aline mounting holes. Install three retaining screws.

(5) Position header to blower motor, and install four mounting screws.

(6) Install combustion air blower wheel to motor shaft. Setscrew must contact flat portion of shaft squarely.

(7) Position bayonet mounting slots to four mounting screws on heater assembly. Aline recessed portion of lip to area of connector sockets. Turn blower assembly slightly to lock. Tighten mounting screws.

(8) Connect lead wire to terminal No. 6 of terminal strip.

18-28. Heat Exchanger (fig. 18-54)

a. Removal.

(1) Remove three screws from housing seam.

(2) Spread housing enough for exchanger to be slid out of end of housing.

b. Cleaning, Inspection and Repair.

(1) Inspect for damage or leaks. If the exchanger is burned through or shows cracks, it must be discarded.

(2) Scrape carbon out of ignition pocket as soon as possible, using sharp tool, and blow out with compressed air.

(3) Remove combustion residue from heat exchanger by soaking it in a 20 percent (by weight) solution of ammonium acetate at a temperature of 180°F. for a period of 5 to 10 hours. This is the best method of cleaning heat exchanger, and will produce a noticeable increase in efficiency if the heater has been used for a long period of time. An alternate method is to pour a quantity of small shot into the exhaust outlet, and shake the exchanger vigorously while tapping lightly with a rawhide mallet. This will loosen most of the residue so it may be blown out with compressed air.

CAUTION

Remove all shot after this operation.

18-29. Repair of Heater Assembly (10920608)

Paragraphs, 18-30 through 18-40 refer to heater assembly (10920608).

NOTE

Refer to figures 18-55 and 18-56 for all repair operations.

18-30. Controls-Support Assembly

NOTE

The key numbers shown in parentheses below refer to figure 18-55 unless otherwise indicated.

a. Removal.

(1) Loosen the captive screw in the top of the controls cover (1). Lift off the controls cover.

(2) Disconnect the fuel line tube (20) at the tee of the controls support assembly (12, fig. 18-56). Remove the fuel line and inverted elbow (19).

(3) Disconnect the lead from the blower motor (15) from the terminal (centered at the rear of the switch at the top of the flame detector switch assembly) (41, fig. 18-54).

(4) Disconnect the lead at terminal No. 1 of the limit switch (29). Replace terminal screw.

(5) Disconnect the lead at the igniter (22) by removing the nut (24) and lockwasher (23). Replace nut and washer.

(6) Loosen the flame switch tube hex nut located under the controls support.

(7) Remove the two fasteners (2) attaching the controls support assembly (3) to the burner. Lift off the controls support assembly.

CAUTION

When removing the controls support assembly, lift straight off to prevent damaging the flame switch tube which extends into the combustion chamber (25).

b. Disassembly.

NOTE

The key numbers shown in parentheses below refer to figure 18-56.

(1) Remove the nuts from the resistor assembly (42) terminals, and disconnect the wire assemblies (14, 16, 17) from the resistor. Replace the nuts on the terminals. Remove 2 fasteners (15); remove resistor assembly.

(2) Disconnect the wire assembly (14) at the flame switch (22) and remove wire assembly. Disconnect wire assemblies (18, 19, 20, 21) at the flame switch. Pull switch tube carefully through grommet.

(3) Disconnect the regulator valve assembly (13) from the terminal block (5). Remove the two fasteners (25) attaching the regulator valve to the bracket of the controls support (27).

(4) Remove the tee assembly from the fuel filter outlet port by unscrewing the adapter tee (12). To disassemble the tee assembly, remove the pipe plug (10), and unscrew the nozzle assembly (11).

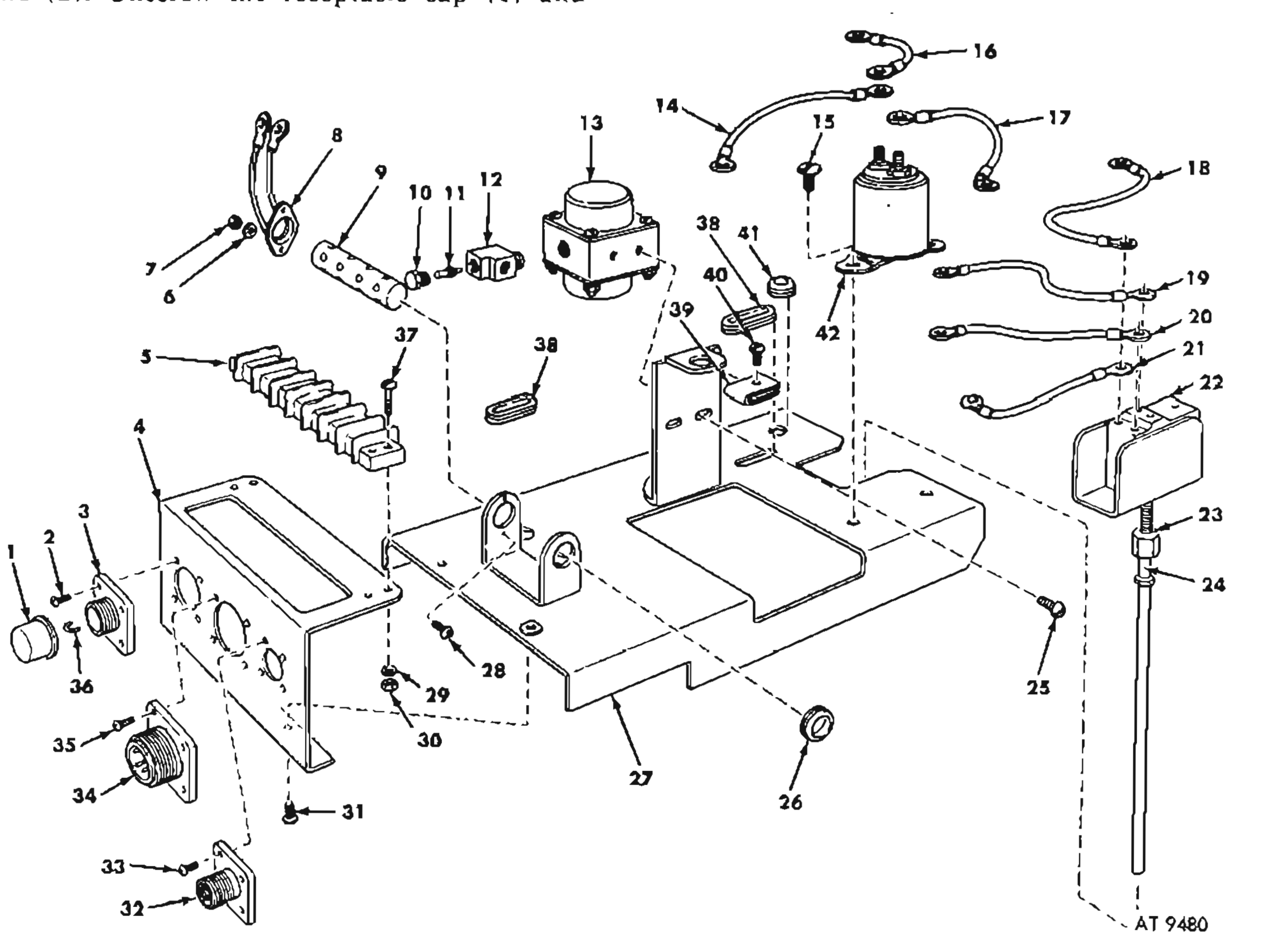
(5) Pull the thermal relay (9) from the socket (8). Disconnect the socket leads from the terminal block (5). Remove the socket by taking out the two screws (28), lockwasher (6), and nuts (7).

(6) Disconnect the remaining leads from the terminal block. Remove the terminal block by

taking out the four screws (37), lockwashers (29), and nuts (30).

(7) When disassembling the receptacle assemblies (3, 32, 34), first remove the control mounting bracket (4) from the controls support (27) by taking out the two fasteners (31) at the underside of the controls support. Remove the thermostat receptacle (3) by taking out the four screws (2). Unscrew the receptacle cap (1) and remove the wire jumper (36). To remove the cable assembly receptacle (34) take out the four screws (35). Remove the fuel pump receptacle (32) by taking out the four screws (33).

(8) Remove the two grommets (38) from the controls support (27). Remove the grommet (26) from the thermal relay bracket. Remove the grommet (41) from the controls support (27).



Key	Item	Quantity
1	Receptacle cap	1
2	Screw	1
3	Receptacle (thermostat)	1
4	Control mounting bracket	1
5	Terminal block	1
6	Lockwasher	4
7	Nut	2
8	Socket assembly	1
9	Thermal relay	1
10	Pipe plug	1
11	Inner nozzle	1
12	Adapter tee	1
13	Regulator valve	1
14	Wire assembly	1
15	Fastener	2
16	Wire assembly	1
17	Wire assembly	1
18	Wire assembly	1
19	Wire assembly	1
20	Wire assembly	1
21	Wire assembly	1
22	Flame detector switch	1
23	Nut	1
24	Sleeve	1
25	Fastener	2
26	Grommet	1
27	Controls support	1
28	Screw	2
29	Lockwasher	4
30	Nut	4
31	Fastener	2
32	Receptacle (fuel pump)	1
33	Screw	4
34	Receptacle	1
35	Screw	4
36	Wire jumper	1
37	Screw	4
38	Grommet	2
39	Fastener	1
40	Fastener	1
41	Grommet	1
42	Resistor assembly	1

Figure 18-56. Controls support assembly—exploded view.

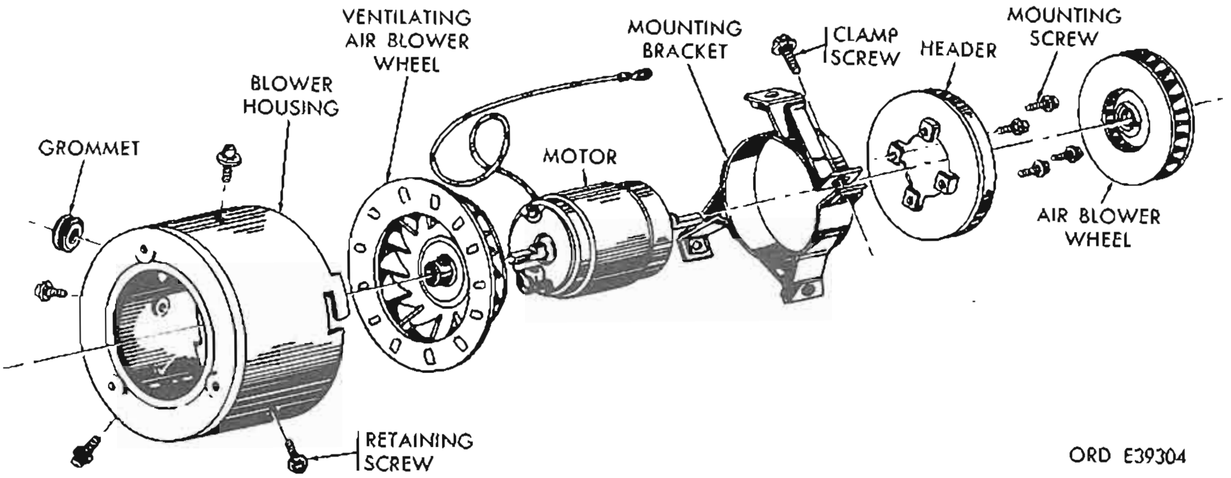


Figure 18-57. Blower assembly (8720193 heater).

c. *Assembly.*

(1) Install the thermostat receptacle (3) in the control mounting bracket (4) and attach with four screws (2). If the heater is used without a thermostat, install the wire jumper (36) in the receptacle, and screw on the receptacle cap (1).

(2) Position the cable assembly receptacle (34) in the bracket, and attach with four screws (35).

(3) Position the fuel pump receptacle (32) in the bracket and attach with the four screws (33).

(4) Attach the terminal block (5) to the bracket with four screws (37), lockwashers (29), and nuts (30).

(5) Make the electrical connections between the receptacles and the terminal block in accordance with the wiring diagram (fig. 18-52).

(6) Position the control mounting bracket (4) on the controls support (27) and attach from the underside with two fasteners (31).

(7) Install the two grommets (38) in the slotted openings of the controls support. Install the grommet (41) in the flame switch position at the corner of the support, and the grommet (26) in the bracket for the thermal relay (9).

(8) Attach the socket assembly (8) to the thermal relay bracket with two screws (28), lockwashers (6), and nuts (7). Make the electrical connections between the socket assembly and terminal block in accordance with the wiring diagram (fig. 18-52).

(9) Plug the thermal relay (9) into the socket assembly (45, fig. 18-54), being careful not to damage any of the thermal relay pins.

NOTE

The regulator valve (13) and tee assembly were previously assembled when the fuel control system was tested under Operation Test, (para 18-33c).

(10) Position the fuel control system on the controls support. Attach the regulator valve to the support bracket with two fasteners (25). Connect the regulator valve leads to the terminal block.

(11) Install the flame switch in the controls support (27) so that it lies in a line parallel to the bracket for the regulator valve (13), and the single, centered terminal is toward the inside of the support.

(12) Attach the resistor assembly (42) to the controls support with two fasteners (15).

(13) Connect the lead from the regulator valve solenoid shutoff side to the terminal block No. 6 terminal.

NOTE

When making the following wiring connections, refer to the wiring diagram (fig. 18-52). All wiring between the terminal block side of the controls support and the other side of the unit must pass through the two oblong-shaped grommets (38), and along the underside of the controls support.

(14) Connect wire assembly (21) between terminal block terminal No. 1 and the switch.

(15) Connect wire assembly (20) between terminal No. 4 and the switch.

(16) Connect wire assembly (19) between terminal No. 2 and the switch.

(17) Connect wire assembly (14) to one terminal of the resistor assembly (42) with the lead assembly (16) connected to the switch.

NOTE

The wire assembly (17) connects the other resistor terminal to the igniter assembly.

d. Installation.

NOTE

The key numbers shown in parentheses below refer to figure 18-55.

(1) Position the controls support assembly (3) on the heater with the terminal block end toward the air intake side of the unit with the flame detector switch tube entering compression nut. Push support assembly straight down to avoid bending the switch tube. Attach with the two fasteners (2). Tighten flame switch tube nut.

(2) Connect the wire assembly from the resistor to the igniter assembly (22) with the nut (24) and lockwasher (23).

(3) Connect the fuel line tube (20) to the open port of the metering tee assembly.

(4) Connect the blower motor power lead to the flame switch. This lead passes between the controls support and heater casing and through the grommet in the corner of the controls support cover.

(5) Install the controls cover assembly (1), and turn the screw at its top one-quarter turn to engage the fitting and lock the cover in position.

18-31. Resistor Assembly (fig. 18-56)

a. Removal. Refer to paragraph 18-19.

b. Disassembly and Assembly. Resistor assembly should not be disassembled and is replaced as a unit.

c. Inspection and Repair.

(1) Continuity through the coil of the resistor should be checked with an ohmmeter or other suitable instrument when the resistor is cold.

(2) Inspection of the resistor should be made with 12 volts dc power only. Connect the resistor in series with an ammeter of at least 15 ampere capacity. When 12 volts dc are applied to the resistor, the current draw should be 12 to 14 amperes after 10 seconds.

(3) At the same time the continuity is checked, it should be determined whether a short circuit exists between the resistor terminals and the case. Connect an ohmmeter between one of the terminals and the case. An open circuit must be indicated at all times during this check, otherwise a short exists in the resistor. Replace defective resistor.

d. Installation. Refer to paragraph 18-30c (12).

18-32. Flame Detector Switch (fig. 18-56)

a. Removal. Refer to paragraph 18-25.

b. Disassembly.

(1) Completely remove the adjusting screw at top of switch.

(2) Turn switch over and let metal and quartz rods slide out of frame assembly tube. Use care not to damage quartz rod.

c. Cleaning, Inspection, and Repair.

(1) Clean and inspect the quartz rod. The rod must not be chipped or cracked. Replace unserviceable rod.

(2) Clean the tube of the switch with a wire brush and inspect for straightness and corrosion. Replace entire switch if tube is bent or corroded.

d. Assembly. Install the quartz rod and metal rod in the frame assembly, being especially careful not to damage the quartz rod. Fold in the operating levers and the switch in the frame assembly and attach with two screws and lockwasher nuts. Install the adjusting screw.

18-33. Regulator Valve

a. Removal. Refer to paragraph 18-30b (3).

b. Disassembly and Assembly. Do not disassemble regulator valve.

c. Operation Test. In order to test the fuel control system, the following equipment is necessary: DC power supply with the same voltage rating as the heater (24 volts); a fuel pump which will supply a steady flow of fuel under a constant pressure of 3 to 4 psi (6 to 8 inches of mercury) against the regulator valve inlet; and a pressure gage or mercury manometer. Test the fuel control system in accordance with the following: Connect the fuel pump to the regulator valve inlet port. Remove the tee assembly and install a street tee with the pressure reading instrument. Connect the metering tee assembly to this tee. Connect the fuel pump and the regulator valve solenoid shutoff coil to the power supply.

NOTE

The solenoid shutoff coil is located at the top of the pressure regulator assembly. The pressure regulator coil is located at the bottom of the pressure regulator assembly.

As soon as the fuel pump and regulator valve solenoid shutoff coil are energized, bleed the system by loosening the cap at top of the adapter tee until the fuel flows freely, then tighten the air vent securely in position. After the system has been bled, the pressure reading instrument should indicate an outlet pressure of 2 psi or 4.1 inches of mercury, plus or minus 10 percent. At this reading, fuel flow should be 25 cubic centimeters (cc.) per minute, plus or minus 3 cc. per minute. Deenergize the regulator valve; fuel flow must stop immediately. Connect the pressure regulator coil power lead to the power supply, and energize both sides of the regulator valve. The outlet pressure should now read 1 psi or 2 inches of mercury, plus or minus 15 percent, and fuel flow should be 17 cc. per minute, plus or minus 2.5 cc. per minute. Deenergize the solenoid side of the regulator valve; fuel flow must stop immediately. If the outlet pressures do not conform to the values given, or the fuel flow does not stop when the solenoid shutoff side of the regulator valve is deenergized, the regulator valve is unserviceable and should be replaced. If the pressures do conform but the fuel flow rate is lower than specified, it indicates that the tee assembly inner nozzle or line fuel filter is clogged. Disconnect the fuel filter and the regulator valve and disassemble in accordance with the following instructions (see fig. 18-56). Remove the pipe plug (10) from the adapter tee (12), and unscrew the nozzle assembly (11). Remove the adapter tee. Inspect all parts for wear or damage, paying special attention to the nozzle assembly (11) and adapter tee (12). Replace the complete tee assembly if one of these parts is damaged.

NOTE

The tee assembly outlet port must point toward the regulator valve and be parallel to the bottom of the control support. If the fuel flow pressure does conform to the specified reading but the fuel flow rate is higher than required, it indicates that the tee assembly and/or the inner nozzle is defective and should be replaced.

d. Installation. Refer to paragraph 18-30 *c*(10).

NOTE

The heater must be bled at the next start-up. To bleed the heater, see TM 9-2320-218-20.

18-34. Thermal Relay
(fig. 18-55)

a. Removal. Refer to paragraph 18-30 *b* (5).

b. Disassembly and Assembly. Do not disassemble the thermal relay.

c. Inspection and Test. Inspect for visible signs of burning, broken wires, and damaged insulation. Test as outlined in TM 9-2320-218-20. Scrap unserviceable relay.

d. Installation. Refer to paragraph 18-30 *c* (9).

18-35. Limit Switch
(fig. 18-55)

a. Removal. Disconnect wires and remove screws. Remove switch.

b. Inspection and Test. Inspect the switch for outward signs of damage and check current continuity through the limit switch with an ohmmeter. Refer to TM 9-2320-218-20.

c. Installation. Locate limit switch and secure with screws. Connect wiring.

18-36. Igniter
(fig. 18-55)

a. Removal. Disconnect wire assembly. Unscrew igniter assembly from heater body.

b. Cleaning, Inspection and Test. Brush off excess carbon accumulation. Inspect for damage. Test as outlined in TM 9-2320-218-20. Replace unserviceable igniter.

c. Installation. Locate copper gasket or igniter tube and start igniter into body of heater by hand. Use wrench to tighten only sufficiently to start compression of copper gasket.

18-37. Heater Body
(fig. 18-55)

a. Disassembly.

(1) Removal of blower assembly (fig. 18-55). Disconnect blower motor power lead from rear center terminal of flame detector switch (22, fig. 18-56). Remove three screws securing the rear blower assembly mounting ring (26). Pull blower housing assembly off heater housing.

(2) Removal of combustion chamber with burner assembly (fig. 18-55). Slide the rear mounting ring (26) off the casing assembly (28). Loosen the capscrew (7) and slide the front mounting ring (8) off the casing assembly. Remove the four fasteners (34) attaching the burner assembly (25) to the casing assembly. Remove the three fasteners (9) along the seam of the casing assembly. Remove the gasket (32) and the seal (33). Slip combustion chamber out of end of casing assembly.

b. Assembly.

NOTE

The key numbers shown in parentheses refer to figure 18-55.

(1) Installation of combustion chamber with burner assembly. Position the casing assembly (28) around the combustion chamber and burner so that the exhaust opening fits in the hole of the casing. Install the three fasteners (9) to close the casing at the seam. Two fasteners secure the gasket (32) and seal (33) at the exhaust connection. The third fits at the combustion chamber end of the assembly. Install the four fasteners (34) to attach the burner assembly (41) to the casing. Position the limit switch (29) with switch retainer (30), and attach with two fasteners (31). Slide the mounting rings on the assembly. The rear mounting ring (26) fits on the burner end, and the front mounting ring (8) on the air outlet end. Do not attach the rear mounting ring at this time. Position the front mounting approximately two inches from the end of the assembly with the clamps in a line with the

openings in the casing assembly. Tighten the capscrew (7).

(2) Installation of blower assembly (fig. 18-55). Position the blower assembly in the casing assembly (28). The motor power lead must be toward the top or in a line with the threaded opening in the burner for the fuel line connection. Aline the screw holes in the rear mounting ring (26) with the holes in the casing assembly (28) and motor casing housing (11), and install the three fasteners (27). Connect blower motor power lead to the flame detector switch rear center terminal.

18-38. Blower Assembly
(fig. 18-55)

a. Disassembly.

(1) Loosen the setscrew (47) and remove the fan assembly (10).

CAUTION

Do not disassemble fan.

(2) Remove the intake cover assembly (16) by taking out the three fasteners (12).

(3) Remove the three fasteners (45) at the outside of the motor casing housing (11), and pull out the motor support assembly (14) with blower motor (15). Remove the grommet (46) from the casing.

(4) To separate the blower motor (15) from the motor support assembly (14), remove the four fasteners (13) and the ground strap by removing screw (42), lockwasher (43), and nut (44).

CAUTION

Do not disassemble the blower motor any further as critical clearances are maintained which cannot be duplicated without special tools.

b. Inspection and Repair.

(1) Install the fan assembly (10) on the blower motor shaft, and tighten the setscrew (47).

(2) Connect the motor to a power source of the correct dc voltage with an ammeter in series, and check the motor rpm. The 24-volt motor should have a minimum of 7600 rpm with a maximum current drain of 6.8 amperes. If the motor does not meet these requirements, loosen the setscrew and remove the fan assembly from the motor shaft, and replace the motor.

c. Assembly (fig. 18-55).

(1) Install the blower motor (15) in the motor support assembly (14), and attach with four fasteners (13).

(2) Connect the ground lead from the motor to the motor support assembly by means of a screw (42), lockwasher (43), and nut (44).

(3) Install the grommet (46) in the motor casing housing (11). Position the blower motor in the motor casing housing so that the motor lead is in a line with the position of the grommet. Pull the lead through the grommet. Attach the motor support to the casing, using three fasteners (45), from outside the casing.

(4) Install the fan assembly (10) on the motor shaft, and tighten the setscrew (47).

(5) Assemble the intake cover (16) to the casing with three fasteners (12).

18-39. Combustion Chamber with Burner Assembly
(fig. 18-55)

a. Disassembly.

(1) Disengage the burner assembly (41) from the combustion chamber assembly (25) by twisting the burner counterclockwise to free its slots from the studs at the end of the combustion chamber.

(2) To remove the burner wick (40), take off the nut (18) and lockwasher (17) at the outside of the burner, and lift out the wick retainer shell (39) and burner wick (40).

NOTE

Discard the burner wick. Always use a new wick for assembly.

b. Inspection and Repair.

(1) Thoroughly clean the parts of the burner of all carbon. Make certain all air holes are open. Use a pipe cleaner or piece of wire to clean the air filter.

(2) Inspect the burner for breaks, dents, or burn-through. Make certain there are no signs of leakage around the igniter housing or fuel inlet connection. Replace a damaged burner.

(3) Clean all carbon from the chamber assembly, and blow out with compressed air. (Refer to paragraph 18-28*b*(3). Inspect the combustion chamber for breaks, dents, or burn-throughs, and make sure that there are no visual signs of distortion of the materials. Check that all connections are in good condition. Do not attempt to repair a damaged combustion chamber. Replace a damaged assembly to prevent exhaust gas leakage during operation.

c. Assembly (fig. 18-55).

(1) Install a new burner wick (40) in the burner assembly (41). The notch in burner wick must line up with the fuel inlet tube, and the wick should seat fully in the bottom of the burner.

(2) Install the wick retainer shell (39), and attach at the outside of the burner assembly with the lockwasher (17) and nut (18).

(3) Assemble the burner assembly (41) to the combustion chamber assembly (25) so that the slots in the burner assembly engage the studs at the opening of the combustion chamber.

NOTE

When the burner is assembled to the

combustion chamber, the opening for the fuel inlet connection at the burner must be at a position 180° from the combustion chamber exhaust opening, or in a line with the position of the flame switch tube.

18-40. Damper Actuator Assembly

NOTE

The key numbers shown in parentheses below refer to figure 18-58.

a. *Removal.*

(1) Mark one thermostat lead wire and its respective terminal (for reference) when installing actuator. Remove both termostat lead wires from terminal strip (23).

(2) Slide actuator downward to disengage connector link. Remove actuator from diverter assembly.

b. *Disassembly.*

(1) Remove two screws, retaining front panel. Remove panel (2).

(2) Remove two screw and lockwasher assemblies from bearing plate bracket. Remove bracket (13).

(3) Remove safety wire (11) from lock plate pin, and shaft screw.

(4) Slide toggle spring (10) off lock plate pin (5). Remove spring.

(5) Slide flat washer (6) and connecting rod (7) off lock plate pin.

(6) Remove 1-inch long screw, lockwasher assembly (21), and spacer (28) supporting solenoid assembly.

(7) Remove two screw and lockwasher assemblies (24) which retain solenoid assembly and solenoid end assemblies (19).

(8) Unsolder lead wires, and remove solenoid assembly.

(9) Remove as an assembly: Connecting rod (7), plunger (15), and solenoid end assembly (19) from solenoid shell (1). Remove spring pin (14) from plunger.

(10) Remove solenoid end assembly, plunger tube (18), and solenoid coil (16) from solenoid shell (1).

(11 Remove shaft screw (12), contact plate assembly (9), lock plate pin assembly (5), and hub (4) from actuator housing in case.

(12) Remove two screws, nuts, flat washers, and lockwashers retaining terminal block assembly (32). Remove terminal block and contact plate assembly.

(13) Drill two rivets (20) retaining terminal strip. Remove terminal strip (23).

c. *Cleaning.*

(1) Wash mechanical parts in drycleaning solvent or mineral spirits paint thinner.

(2) Clean terminal block assembly and contact plate assembly with trichlorethane.

WARNING

Trichlorethane has toxic properties.

d. *Inspection and Repair.*

(1) Replace either or both solenoid coils if they are burned, shorted, or have an open circuit. If coils are burned, check "toggle" action of contact plate for binding, bent parts, or improper lubrication. Contact plate must "snap" to alternate contact each time hub is rotated.

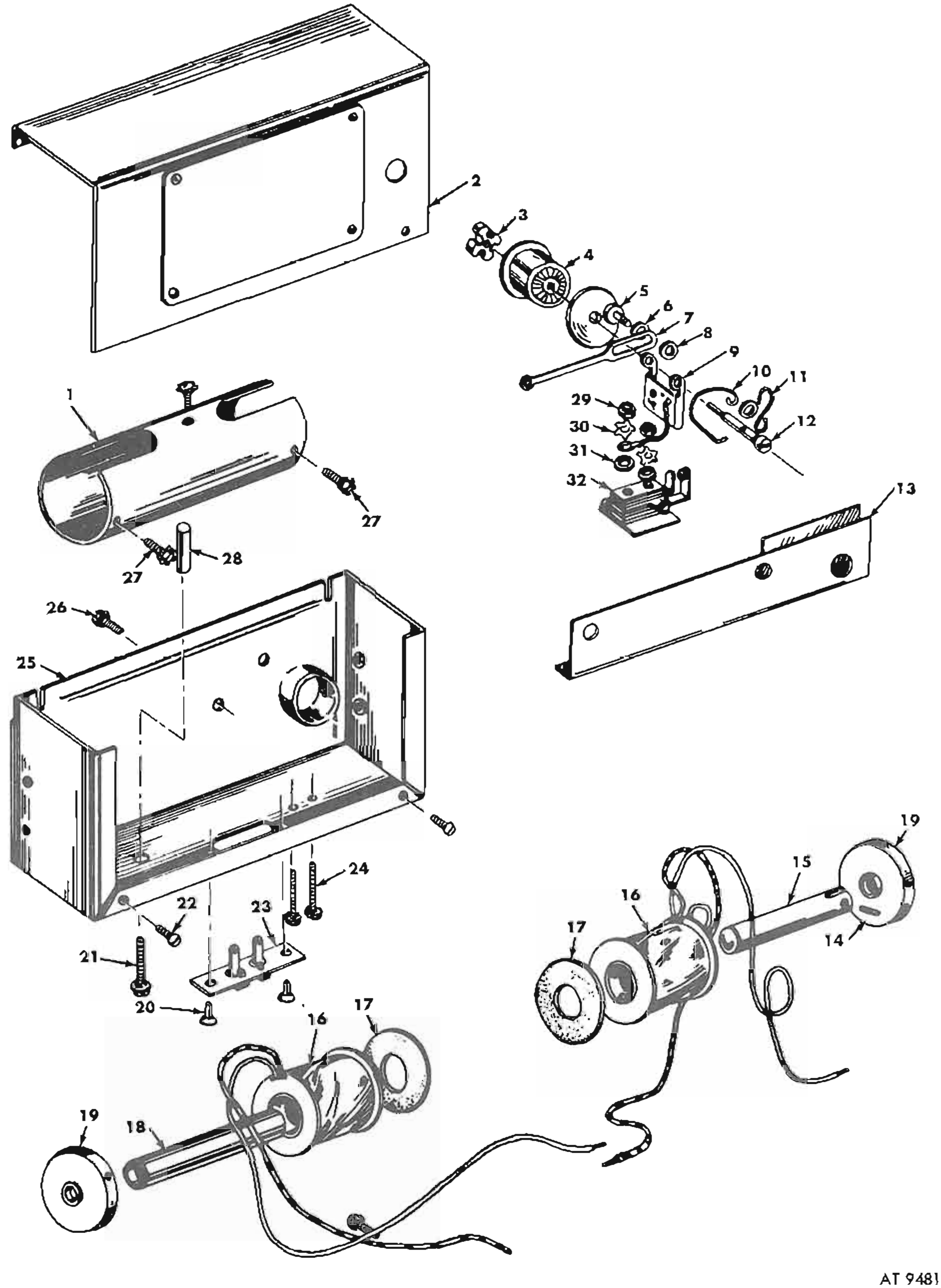


Figure 18-58. Damper actuator assembly—exploded view.

Key to figure 18-58.

Key	Item	Quantity
1	Solenoid shell	1
2	Front panel assembly	1
3	Coupling	1
4	Hub	1
5	Lock plate pin assembly	1
6	Flat washer	1
7	Connecting rod	1
8	Flat washer	1
9	Contact plate assembly	1
10	Spring	1
11	Wire	1
12	Shoulder screw	1
13	Bearing plate bracket	1
14	Spring pin	1
15	Plunger	1
16	Solenoid coil	2
17	Gasket	2
18	Plunger tube	1
19	Solenoid end assembly	2
20	Rivet (1/8x3 / 16)	2
21	Screw (No. 8-32x1)	1
22	Screw (No. 4-40x3 / 16)	2
23	Terminal strip	1
24	Screw (No. 5-40x1)	2
25	Back wrap assembly	1
26	Screw (No. 6-32x5 / 16)	2
27	Screw (No. 8-32x5 / 16)	3
28	Spacer	1
29	Nut (No. 5-40)	2
30	Lockwasher (No. 5)	2
31	Flat washer (No. 5)	2
32	Terminal block assy.	1

(2) Lubricate hub bearing surface with grease (FSN 9150-223-4014).

e. Assembly.

(1) Install terminal strip (23). Use new rivets 1/8x3 / 16 tubular oval head, or use two new No. 8x1/4 sheet metal screws. Enlarge terminal strip mounting holes using a 3 / 16-inch diameter drill when screws are used.

(2) Mount terminal block (32). Use two screws (24), nuts (29), lockwashers (30), and flat washers (31). Install contact plate ground wire terminal to mounting screw nearest terminal strip.

(3) Place hub (4) in actuator housing. Position lock plate pin assembly (5), and contact plate (9) to shaft screw (12). Install shaft screw to hub. Position contact plate with ground wire attachment toward solenoid.

(4) Install solenoid coils (16) to solenoid shell.

(5) Connect one outboard solenoid lead wire (solenoid furthest from hub) to terminal block lug nearest terminal strip. Connect remaing lead wire to terminal strip lug furtherest fron terminal block. Solder both lead wires.

(6) Connect one inboard solenoid lead wire (solenoid closest to hub) to terminal block lug furtherest from terminal strip. Connect remaining lead wire to terminal strip lug closest to terminal block. Solder both lead wires.

(7) Install plunger tube (18), and outboard solenoid end assembly (19) to solenoid shell. Use a screw and lockwasher assembly (26) to retain end assembly and shell to actuator housing.

(8) Install as an assembly, plunger, connecting rod, and solenoid end assembly. Connect connecting rod to lock plate pin. Use screw and lockwasher assembly (26) to retain end assembly and shell to actuator housing.

(9) Install flat washer (6) on lock plate pin (5).

(10) Hook toggle spring (10) to contact plate (9) hole. Install looped end of spring to lock plate pin (5).

(11) Install 1-inch long screw (21) and spacer (28) to solenoid assembly.

(12) Position bearing plate bracket (13) to shaft screw head (12) and solenoid shell. Aline mounting holes. Install two screw and lockwasher assemblies (24). Tighten all six screws retaining solenoid assembly.

f. Installation.

(1) Install actuator assembly to diverter assembly. Engage pins of damper door coupling with rubber coupling (3) in hub (4) of actuator. Install four retaining screw and lockwasher assemblies.

(2) Adjust hub for equal travel in both directions. Position and hold damper door in the center of its travel. Loosen shaft screw, and slip lock plate until pin is in line with shaft screw when viewed toward contact points. Operate damper door by hand and adjust as required to obtain equal travel in each direction.

(3) Install safety wire (11) to shaft screw at holes provided. Twist wire and attach to groove in lock plate pin.

(4) Check operation of damper door for freedom of travel. If necessary, loosen four mounting screws and shift actuator slightly to obtain better alinement to coupling.

(5) Connect thermostat lead wires to terminals of terminal strip. Connect marked wire to marked terminal.

18-41. Repair Standards

Refer to TM 9-8662 for repair standards for —65° F. heaters and their components.

Section III. HOT WATER HEATER KIT (—25° F.)

18-42. Description and Data

a. Description. For description of the vehicle hot water heater kit (—25° F.) refer to TM 9-2320-218-20.

b. Tabulated Data.

Heater model number	MS51326-1
Blower motor electrical requirements:	
Maximum volts	28
Minimum volts	18
Amperes at 24 volts	4.5 amperes
Blower motor resistor	.5 ohm
Switch type	S.P.D.T. (center off)
Water capacity	1 quart
Weight of kit	105 lb.
Free air delivery	200 c.f.m.
Air temperature, rise	100° F
Core size	5-13/16x6½x8 7/16
Hot water hose:	
Inside diameter	⅝ in.
Length	55 in.
Defroster and drive heat air hose lengths:	
Diverter to left defroster	39 in.
Diverter to right defroster	7.5 in.
Diverter to driver heat discharge	36 in.

c. Major Components. An exploded view of the major components of the hot water heater kit (—25° F.) is shown in figure 18-60.

d. Electrical System. A relative location view of the heater (—25° F.) electrical system is shown in figure 18-61.

18-43. General Installation Instructions

a. The hot water heater kit (—25° F.) installation consists of three subassembly installations; slave receptacle, brush guard cover, and heater and diverter. Before these assemblies can be installed the vehicle must be prepared as directed in paragraphs 18-46 and 18-47.

b. Contents of the heater kit (—25° F.) are illustrated and identified in figure 18-59.

Key to figure 18-59.

Key	*Item*	*Quantity*
1	Heater assembly	1
2	Cover flap assembly	1
3	Intake duct	1
4	Hose, hot water heater	1
5	Hose, defroster	1
6	Cable assembly, slave receptacle.	1
7	Clamp, defroster nozzle	4
8	Clamp, hot water heater hose.	1
9	Clamp, ducting hose	2
10	Bracket, heater assembly	1
11	Cable assembly, switch	1
12	Deflector, defroster	2
13	Diverter box assembly	1
14	Nozzle, flange assembly	2
15	Hose, hot water heater	1
16	Hose, defroster ducting	1
17	Clamp, hot water heater hose.	4
18	Clamp, hot water heater hose.	2
19	Stud, turnbutton fastener.	13
20	Stud, turnbutton fastener.	4
21	Cable assembly, ignition switch.	1
22	Bracket, intake duct	1
23	Clamp, slave receptacle	1
24	Connector adapter, cable assemblies.	1
25	Resistor assembly, heater cable.	1
26	Cover assembly, ventilator.	1
27	Diverter, weldment	1
28	Bracket, defroster hose.	1
29	Elbow hose, defroster ducting.	1
30	Switch, ignition	1
31	Elbow, hot water heater cock.	1
32	Cable assembly, connector.	1
33	Cable assembly, connector.	1
34	Clamp, hot water heater hose.	1
35	Adapter, hot water heater cock.	2
36	Cock, heater hose shutoff.	2
37	Nameplate, heater switch.	1
38	Grommet	1
39	Grommet, heater hose	2
40	Circuit breaker	1
41	Nameplate identification	1

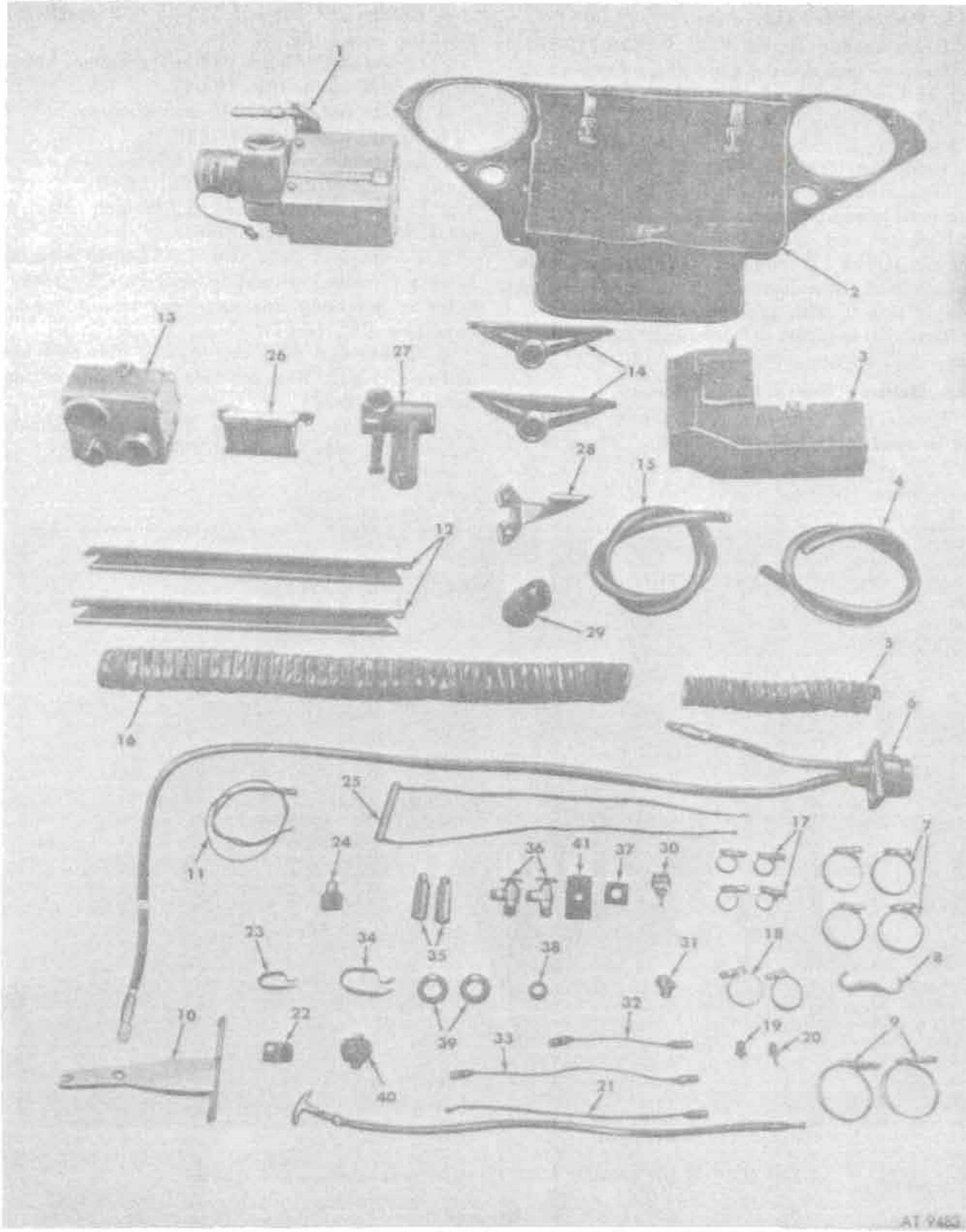


Figure 18-59. Hot water heater kit (—25° F.) parts and components.

18-44. Preliminary Operations

a. Drain cooling system (TM 9-2320-218-10).

b. Remove and discard pipe plugs from water pump and cylinder head (fig. 18-62).

c. Remove both front seats (TM 9-2320-218-20) and stow.

d. Remove battery compartment cover and stow.

e. Disconnect cables and remove both batteries. Clean battery compartment (TM 9-2320-218-20).

f. Remove and stow four instrument panel retaining screws. Disconnect speedometer cable housing from speedometer, and move panel assembly to side with gage wires connected.

g. Remove tape from defroster openings on dash panel.

18-45. Drilling Instructions.

a. Locate and drill four 9 / 32-inch diameter holes in cowl top panel (fig. 18-63).

b. Locate and cut out 5x3-25 / 32 opening in cowl top panel (fig. 18-63).

c. Locate and drill a 9 / 32-inch diameter hole in right fender apron (fig. 18-64).

d. Locate and cut two 1⅜-inch diameter holes in right tunnel panel (fig. 18-65).

e. Locate and drill a 9 / 32-inch diameter hole as shown in lip of dash panel (fig. 18-65).

f. Locate and drill two 5 / 16-inch diameter holes in toeboard (fig. 18-66).

g. Locate and drill two 5 / 32-inch diameter holes for resistor mounting, and two 3 / 16-inch holes in left body side panel for circuit breaker mounting (fig. 18-67).

h. Locate and drill one ½-inch diameter hole and one ⅛-inch diameter hole in left side of dash panel (fig. 18-68).

i. Locate and drill four 3 / 32-inch diameter holes in left side of windshield (fig. 18-68).

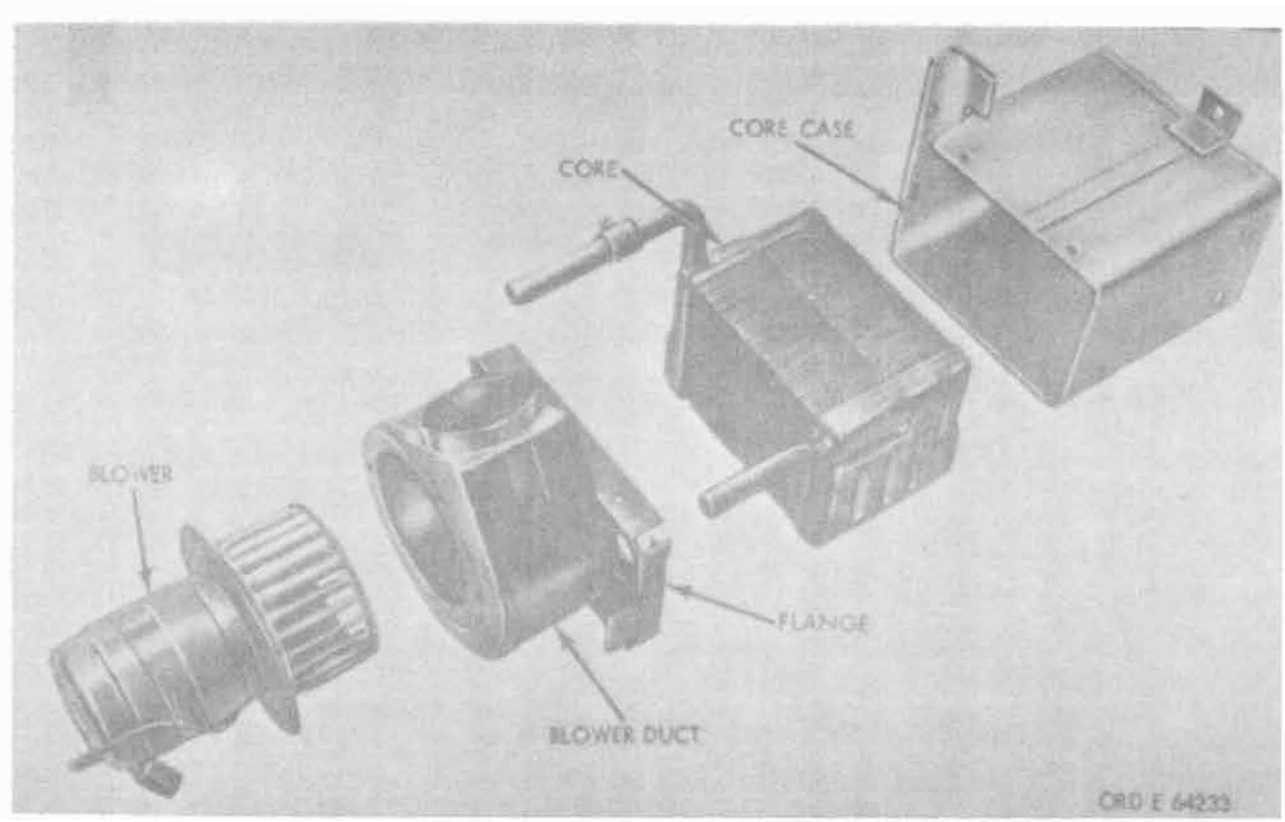


Figure 18-60. Heater assembly (—25°F.) major components—exploded view.

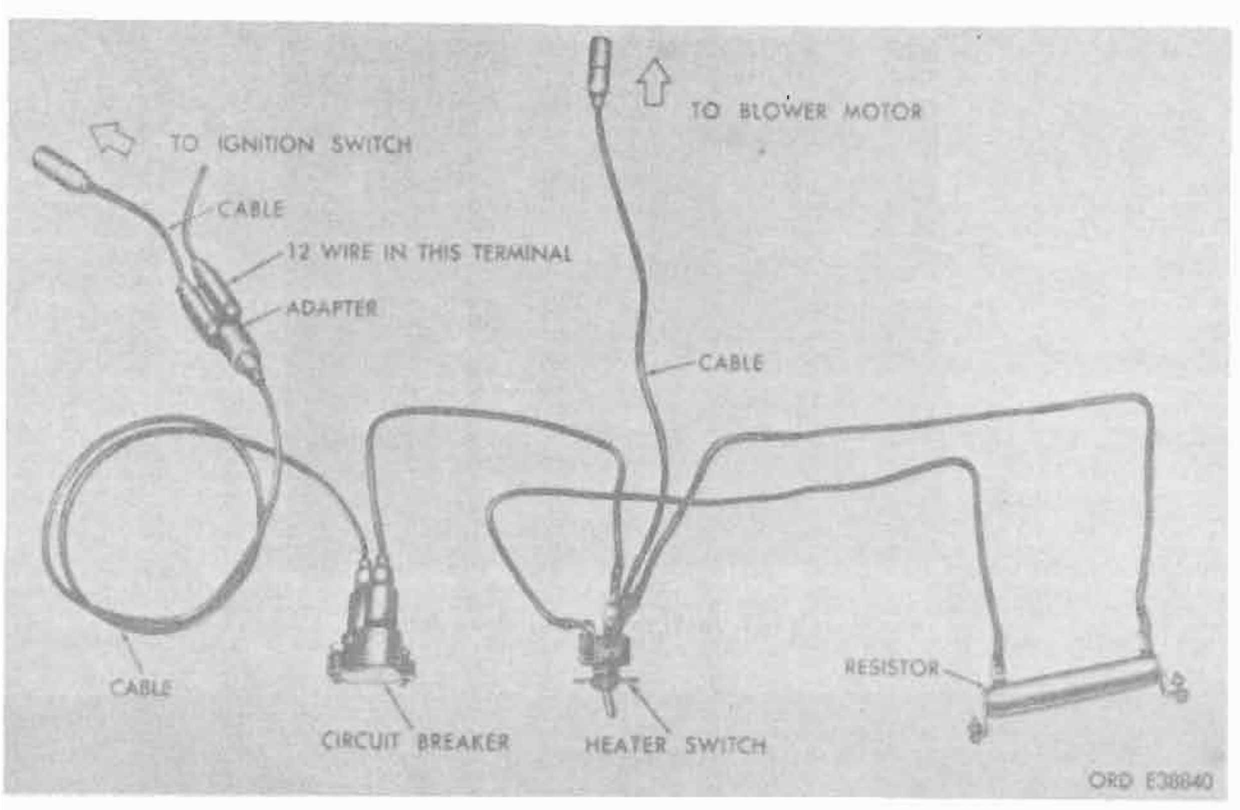


Figure 18-61. Circuit breaker, heater switch, resistor, and cables relative location.

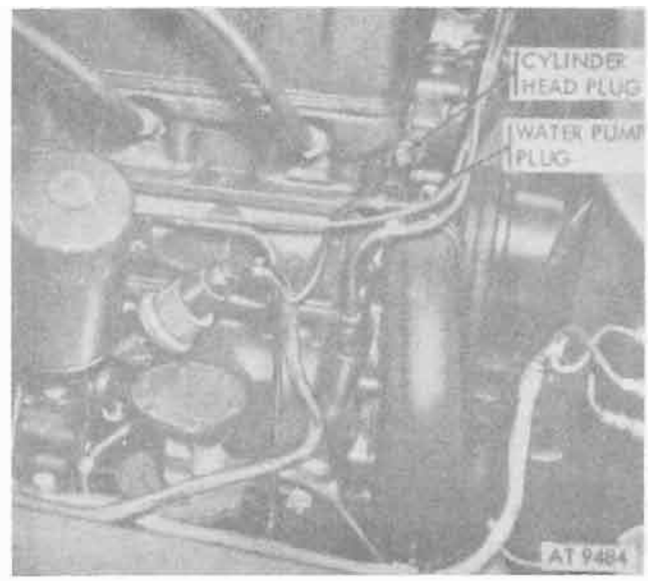


Figure 18-62. Water pump and cylinder head plugs.

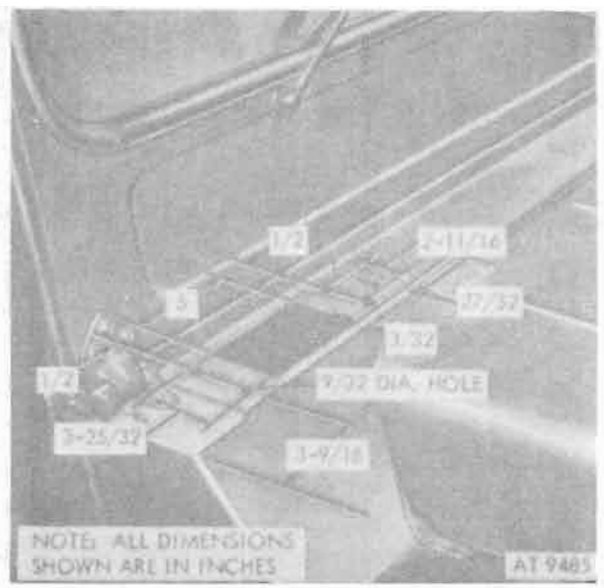


Figure 18-63. Cowl top panel drilling.

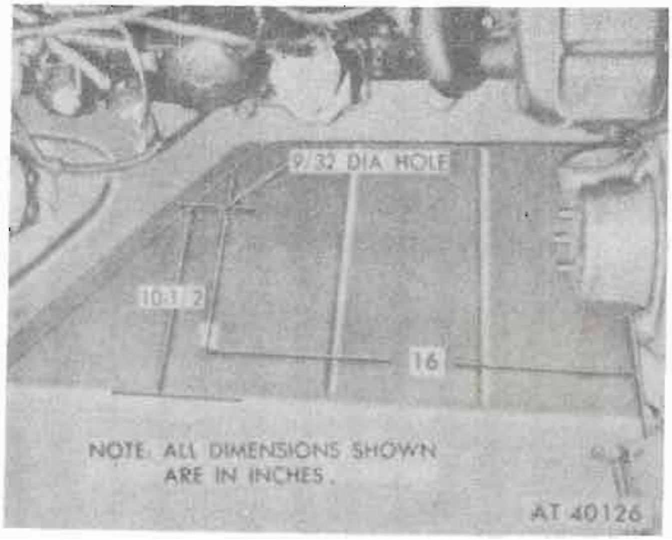


Figure 18-64. Right front fender apron drilling.

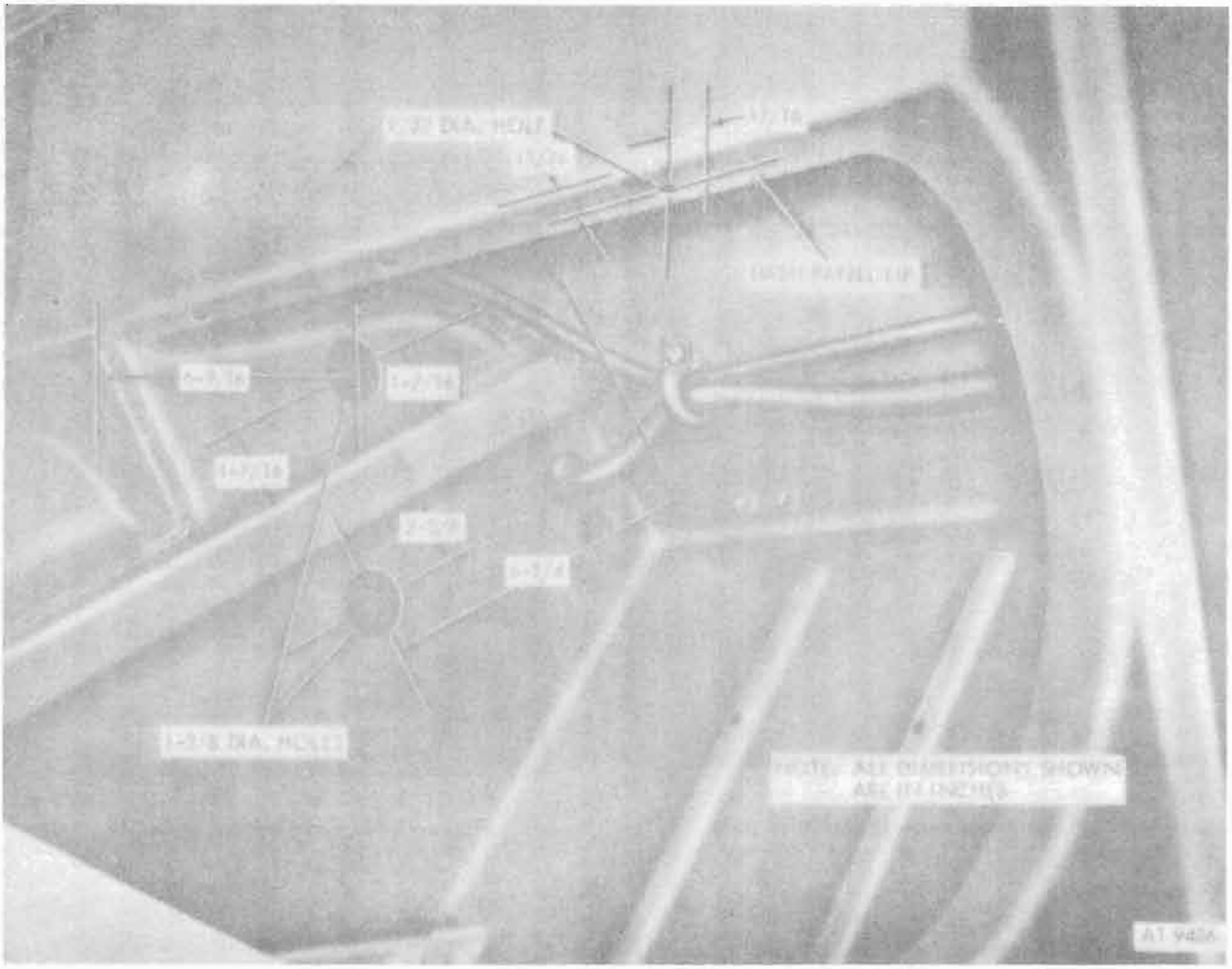


Figure 18-65. Right tunnel panel and dash panel drilling.

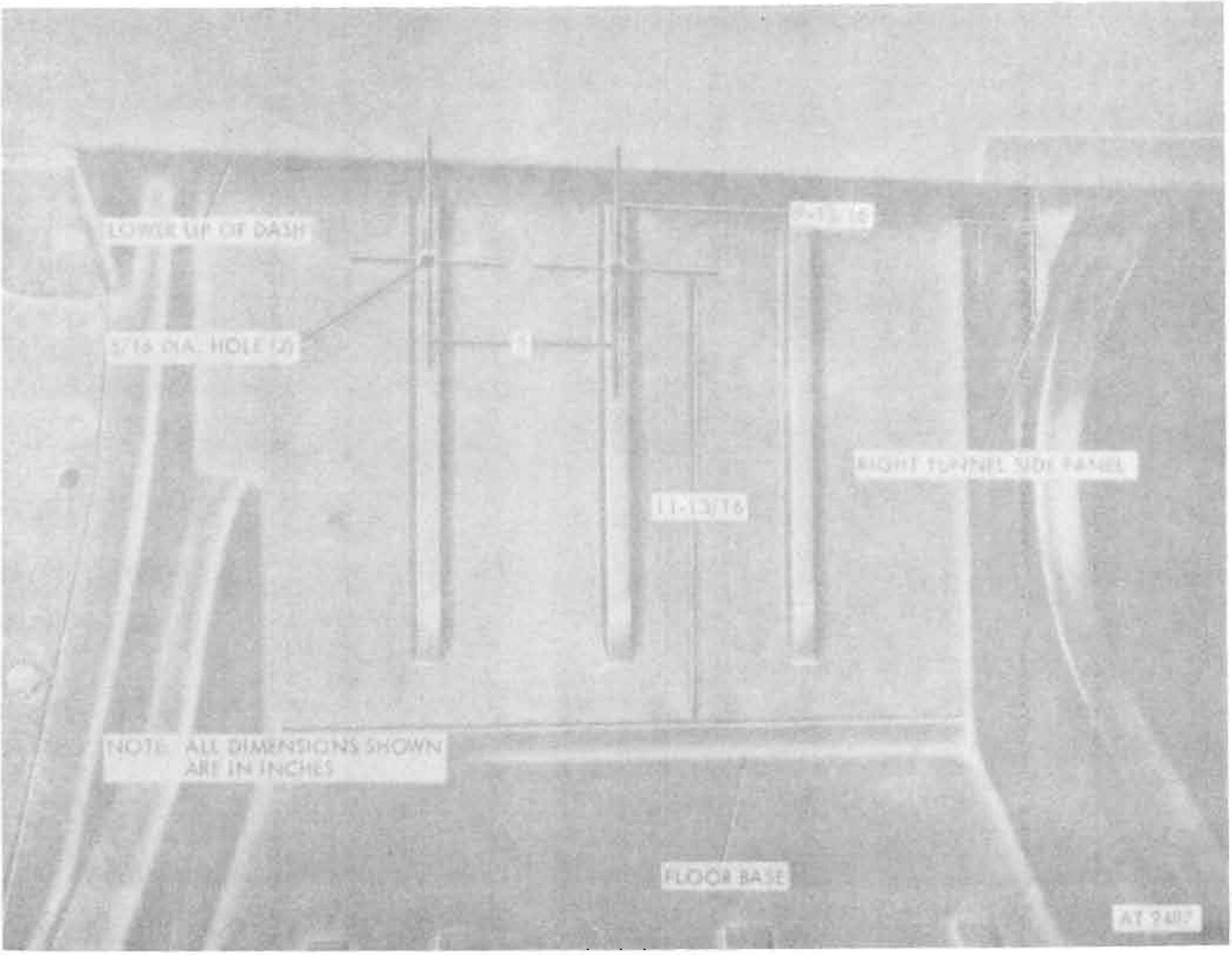


Figure 18-66. Right toeboard drilling.

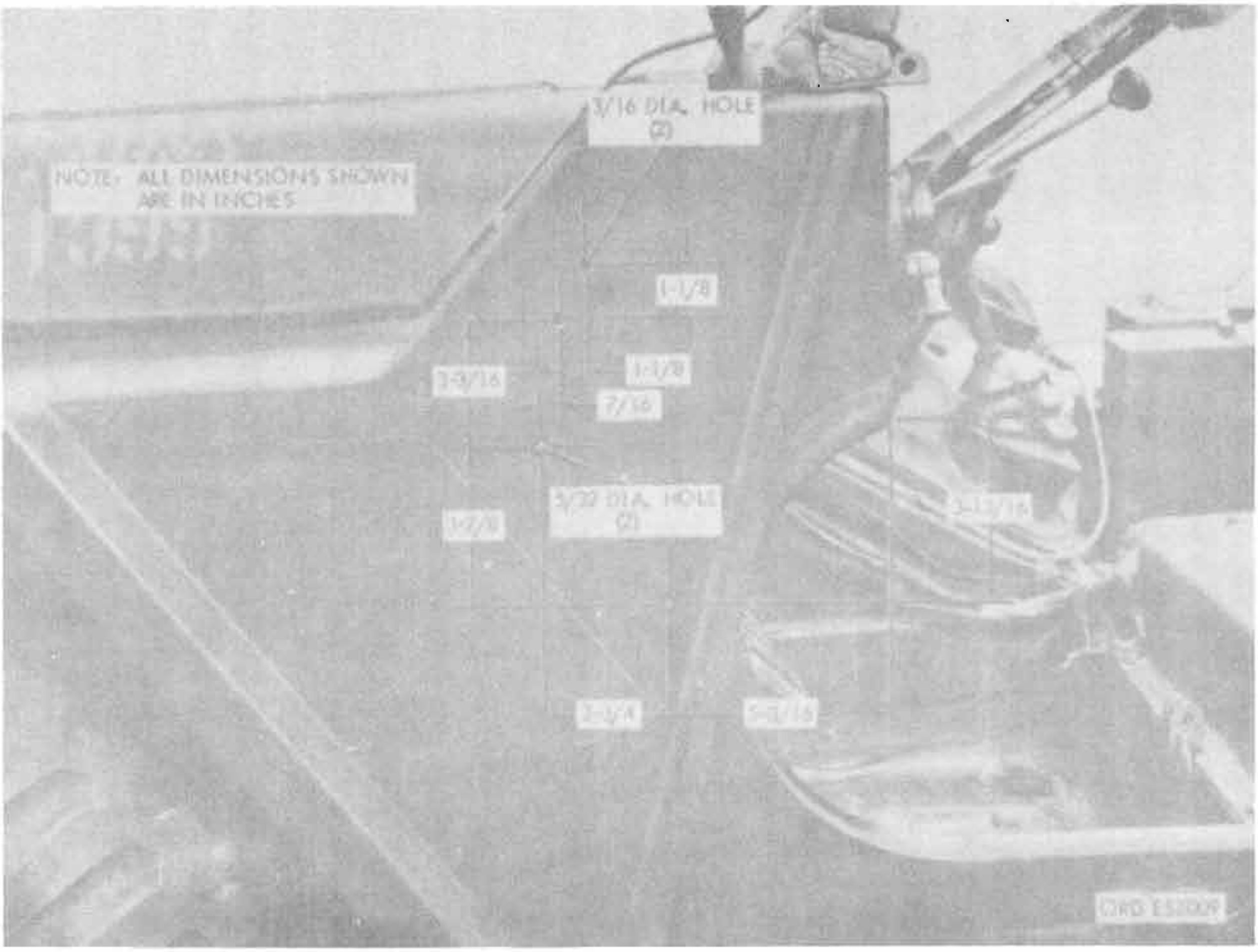


Figure 18-67. Left body side panel drilling.

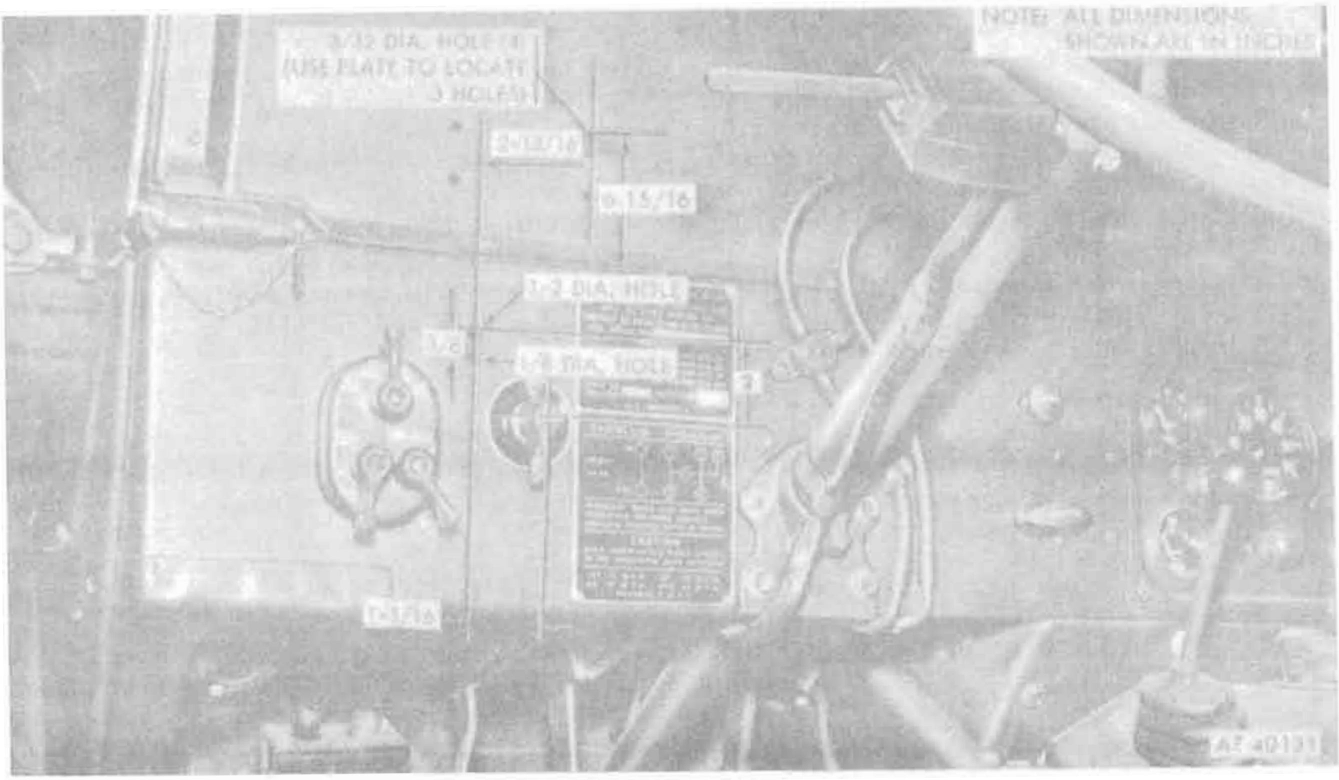


Figure 18-68. Left dash panel and windshield drilling.

j. Locate and drill holes for slave receptacle as indicated in paragraphs 18-12 and 18-13.

18-46. Installation of Subassemblies

a. Installation of Electrical Wiring (fig. 18-69).

(1) Install circuit breaker (16) to left side panel, using two screws (17), lockwashers (15), and nuts (14).

(2) Install resistor (12) to left side panel, using two screws, (11), lockwashers (10), and nuts (9).

(3) Connect one resistor lead to upper terminal of heater switch (2), and the other lead to lower terminal.

(4) Remove No. 12 cable from ignition switch, and install in double end of connector (7).

(5) Connect cable (8) from vacated ignition switch outlet to double end of connector (7).

(6) Connect cable (13) from circuit breaker to single end of connector.

(7) Connect cable (1) from circuit breaker to center terminal on heater switch (2).

(8) Connect long cable (5) to bottom terminal of heater switch and route cable along lower lip of dash panel to right side.

(9) Remove locknut from heater switch and insert through ½-inch hole from back side of dash panel. Locate plate (6) over toggle and replace locknut.

(10) Install plate (3), using four screws (4), to windshield.

(11) Install slave receptacle (paras 19-12 and 19-13).

(12) Install batteries and battery box cover. Refer to TM 9-2320-218-20.

b. Installation of Defroster Nozzles and Hoses (fig. 18-70).

(1) Connect one elbow (13) to defroster nozzle (5), using one 2½-inch wire clamp (7).

(2) Install nozzle and elbow assembly under dash panel defroster opening (fig. 18-71), using two screws (4).

(3) Connect one short hose (8) to remaining nozzle (5), using one 2½-inch wire clamp (7).

(4) Install nozzle and hose assembly under dash panel defroster opening (fig. 18-71), using two screws (4)

(5) Route hose (6) behind dash panel.

(6) Position legs of diverter (12) on steering column behind dash panel, and lightly secure with two 2½-inch metal band clamps (11). The shorter leg should be toward the rear of the vehicle so that cab heater door is to right of steering column and facing downward. In this position, the larger diverter box outlet should be facing right, and the smaller facing to the rear of the vehicle.

(7) Connect long hose (6) to right diverter outlet, using one 2¾-inch wire clamp (9).

(8) Connect defroster nozzle hose to remaining diverter outlet, using one 2½-inch wire clamp (7).

(9) Tighten diverter clamps (11).

(10) Install bracket (10) to speedometer mounting nuts. Connect speedometer cable, and install instrument panel, insuring that bracket (10) is positioned under hose (6) and supporting it.

(11) Install two defroster deflectors (1) to windshield (fig. 18-71) at bottom edge of glass, using eight screws (3) and lockwashers (2).

c. *Installation of Water Hoses* (fig. 18-72).

(1) Install elbow (4) to water pump.

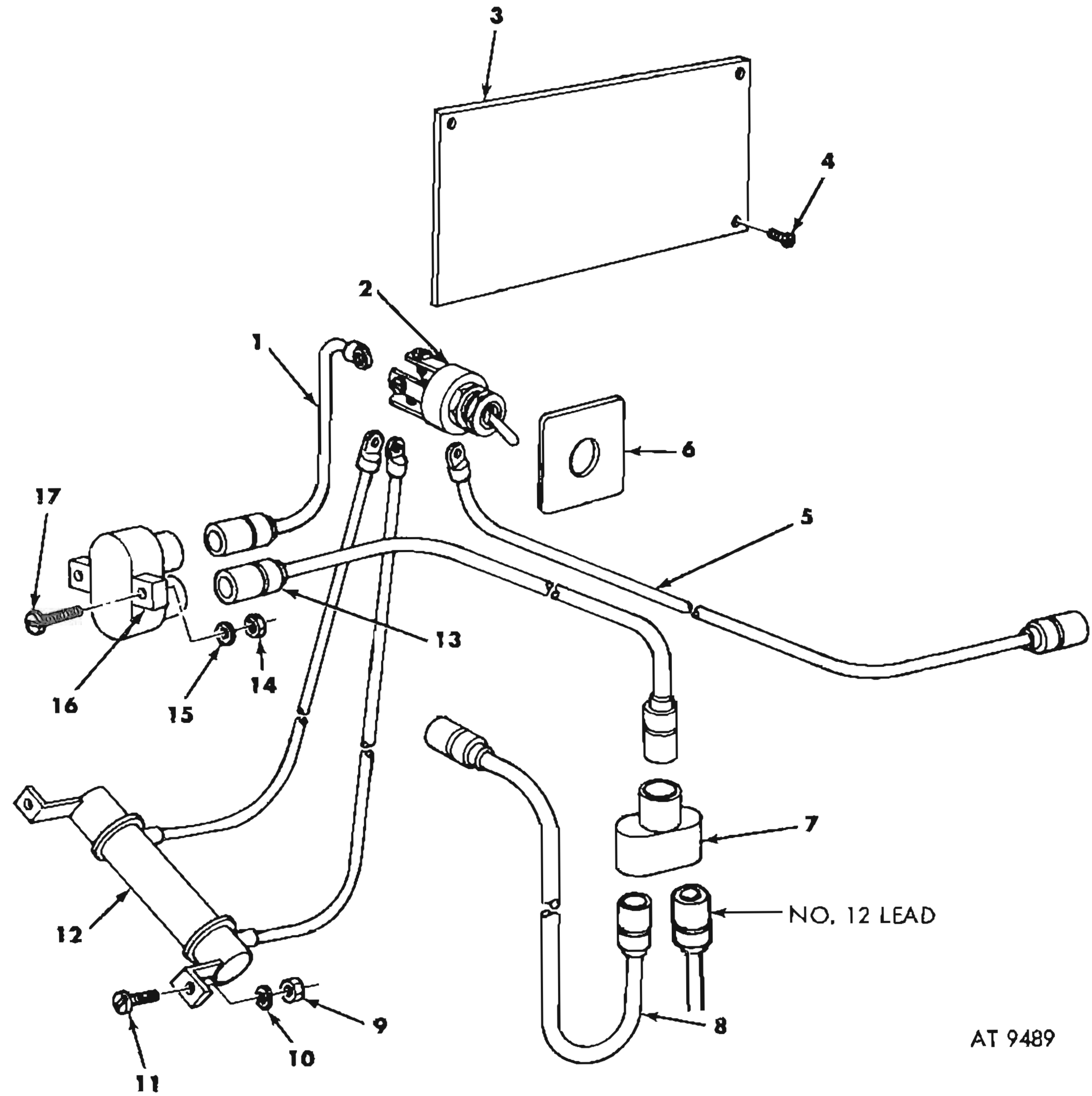
(2) Install adapter (3) to water pump elbow and cylinder head.

(3) Install shutoff cock (2) to both adapters. Hose outlet of cock should be pointed downward.

(4) Attach 42-inch hose (5) to cylinder head cock.

(5) Attach 48-inch hose (7) to water pump cock.

(6) Route hoses along right fender apron, with long hose (7) on top, and attach hoses to apron, at 9/32-inch hole, using one clamp (10), screw (9), lockwasher (11), and nut (12).



1 Cable assembly (circuit breaker-to-heater switch).
2 Heater switch
3 Plate
4 Screw
5 Cable assembly (heater switch-to-heater).
6 Plate
7 Connector
8 Cable assembly (connector-to-ignition switch).
9 Nut
10 Lockwasher
11 Screw
12 Resistor assembly
13 Cable assembly (connector-to-circuit breaker).
14 Nut
15 Lockwasher
16 Circuit breaker
17 Screw

Figure 18-69. Heater switch and electrical components.

(7) Secure hoses on right firewall using clamp (8).

(8) Feed hoses through grommets (6), and install grommets in right tunnel side with 48-inch hose (7) in the upper hole.

d. Assembly of Heater to Diverter and Intake Duct. (fig. 18-73).

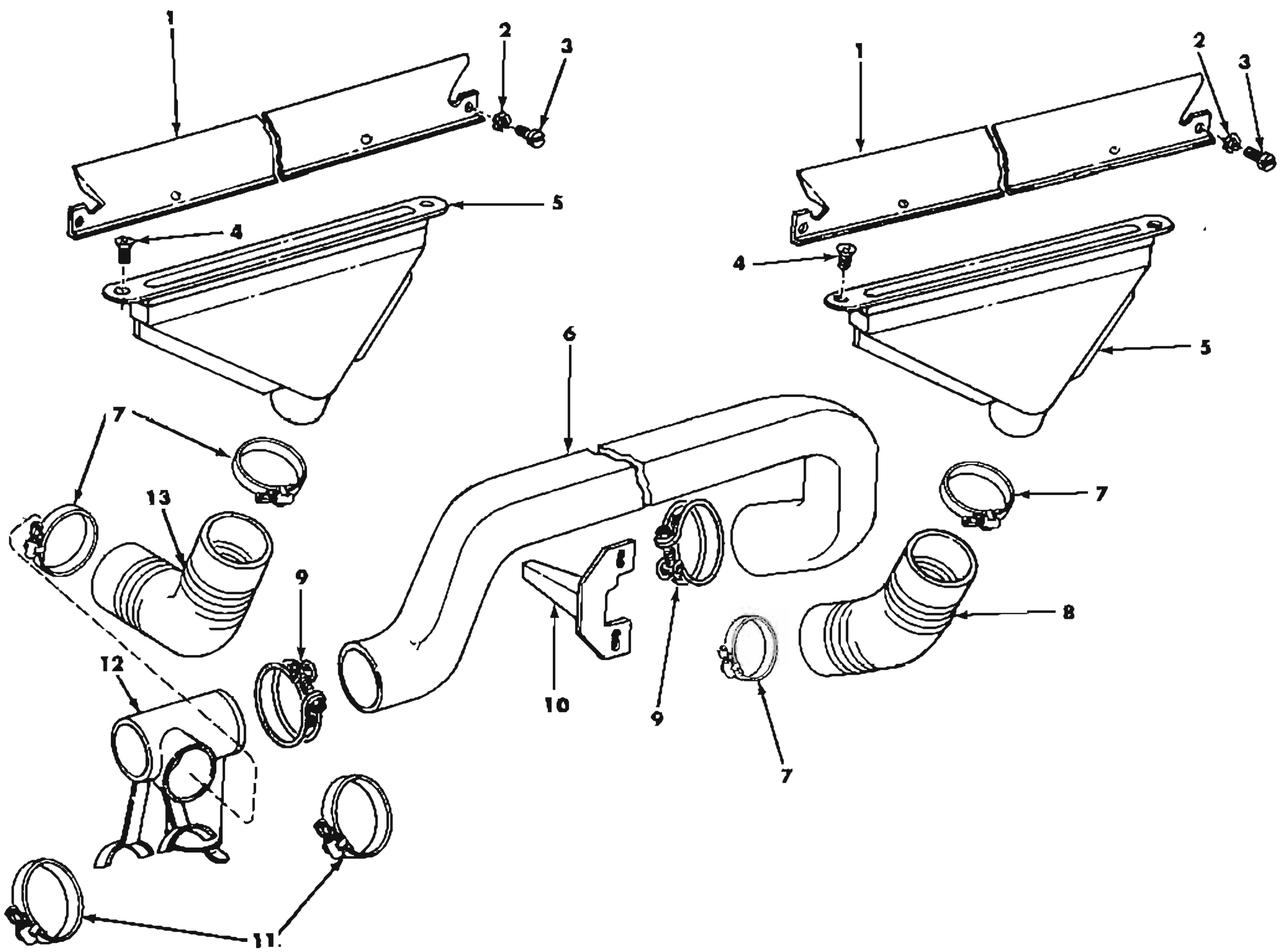
(1) Position bracket (13) on bottom of heater (18) with angle portion of bracket on same side as impeller housing outlet and pointed away. The hole in the bracket nearest the angle should be alined with hole in heater core case bracket at impeller housing.

(2) Secure bracket, using two screws (12), lockwashers (10), and one nut (14).

(3) Position intake duct (5) over heater at opposite end of impeller housing.

(4) Secure upper bracket, using existing core case screw, one lockwasher (10) and nut (14).

(5) Attach bracket (2) at heater bracket on opposite side of impeller housing outlet, using one screw (12), lockwasher (10), and nut (11). The opposite side of heater is secured to intake duct in same manner without bracket (2).



Key	Item	Quantity	Key	Item	Quantity
1	Deflector	2	8	Hose	1
2	Lockwasher	4	9	Clamp	2
3	Screw	8	10	Bracket	1
4	Screw	8	11	Clamp	2
5	Nozzle and flange assembly	2	12	Diverter	1
6	Hose	1	13	Elbow	1
7	Clamp	4			

Figure 18-70. Defroster, nozzles, and hoses.

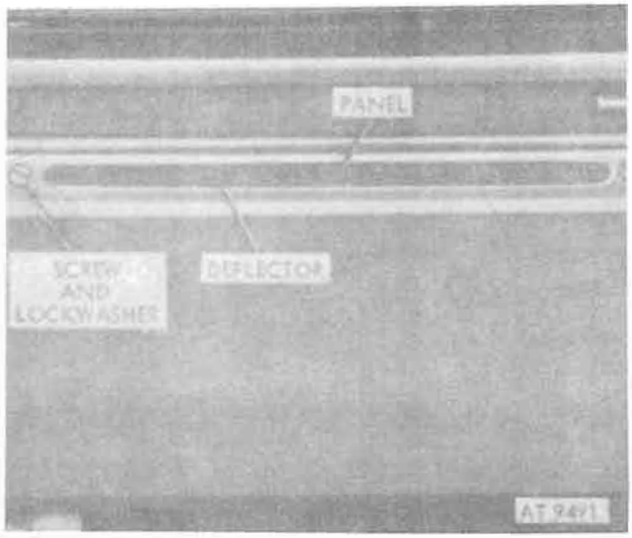
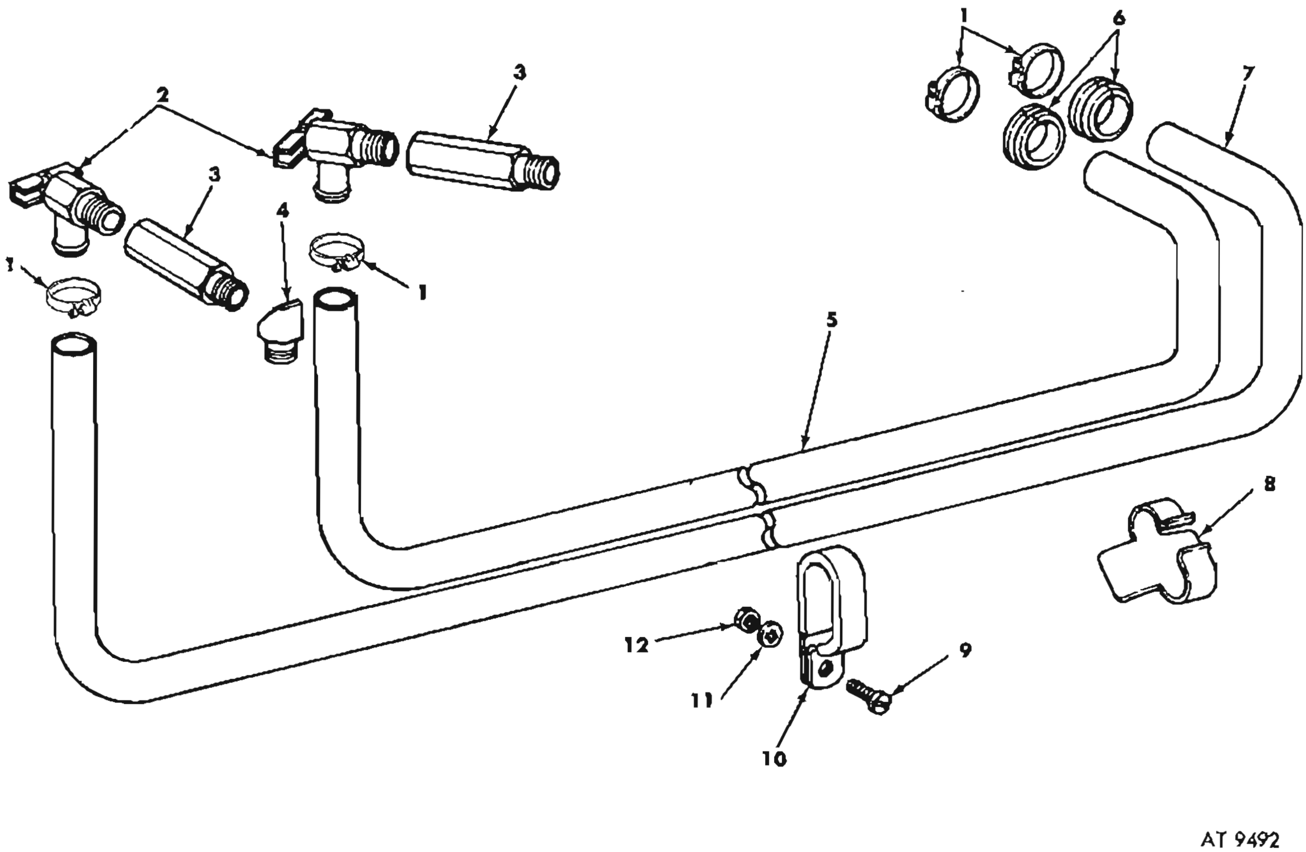


Figure 18-71. Defroster deflectors installed.



Key	Item	Quantity
1	Clamp	4
2	Cock	2
3	Adapter	2
4	Elbow	1
5	Hose	1
6	Grommet	2
7	Hose	7
8	Clamp	1
9	Screw	1
10	Clamp	1
11	Lockwasher	1
12	Nut	1

Figure 18-72. Water hoses and attaching parts.

(6) Attach diverter (16) to heater and duct assembly, using one screw (17), two screws (15), and three lockwashers (3). When attached, the two remaining diverter outlets should be above the impeller housing outlet.

e. Installation of Heater Assembly. (fig. 18-73).

(1) Position heater assembly at right toeboard with intake duct behind dash panel and alined with cutout in right cowl panel. Prop heater assembly off floor.

(2) Attach upper water hose to upper core outlet, and lower water hose to lower core outlet, using two clamps (1, fig. 18-72).

(3) Attach long hose on left to left diverter outlet, using one 2¾-inch wire clamp (9, fig. 18-70).

(4) Attach right defroster hose to right diverter outlet using one 2½-inch wire clamp (7, fig. 18-70).

(5) Apply sealer (MIL-S-11030) between intake duct and cowl.

(6) Raise heater assembly into mounting

position so that intake duct opening matches cutout in cowl, and lower mounting bracket matches holes in toeboard.

(7) Position cover assembly (6) in cowl cutout with hinge at windshield side.

(8) Attach cover assembly and intake duct to cowl, using four screws (8), lockwashers (9), and flat washers (7).

(9) Attach heater lower bracket (13) to toeboard, using two screws, lockwashers, and flat washers.

(10) Attach bracket (2) to lower lip of dash panel, using one screw (1), lockwasher (3), and nut (4).

(11) Connect heater electrical lead to heater switch cable (5, fig. 18-69).

(12) Install front seats.

(13) Fill cooling system (TM 9-2320-218-10).

(14) Start engine and open both shutoff cocks (turn counterclockwise). Disconnect heater water hose at water pump cock and bleed air from heater system. Connect hose when a steady flow of coolant is achieved.

18-47. Operating Test

a. *Operation of Heater.* For operation of heater controls, refer to TM 9-2320-218-10.

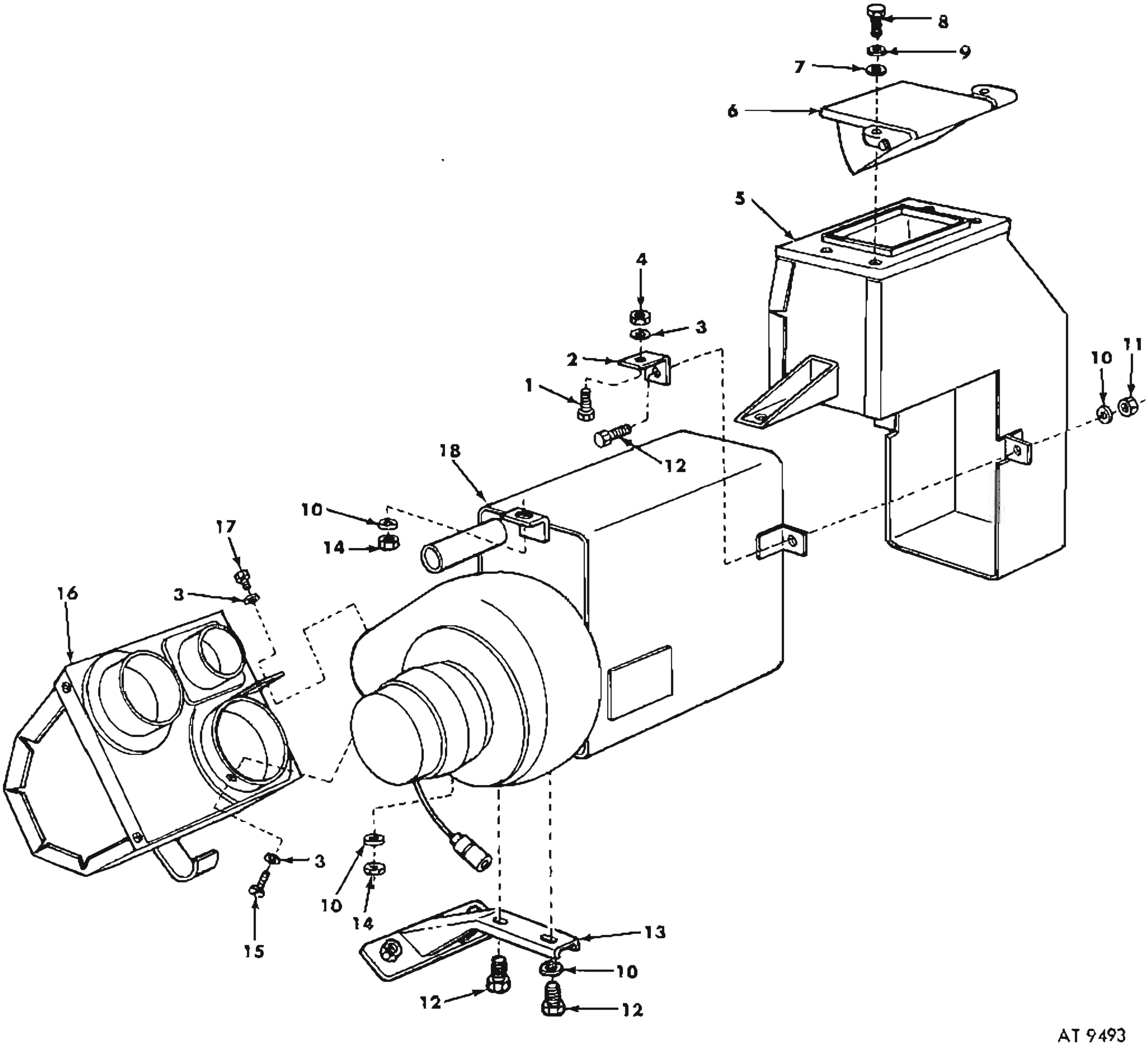
b. *Operation of Blower Motor.* Open cowl ventilator. Check operation of blower motor at high and low speeds for flow of air at defrosters and heat outlets.

18-48. Troubleshooting

For troubleshooting of the heater system, refer to TM 9-2320-218-10 and TM 9-2320-218-20. Troubleshooting of the individual units when removed from the vehicle consists of a careful inspection and check of parts for damage, operation, and fit.

18-49. General Repair Procedures

If a required new part is not available, reconditioning of the old part is permissible. Such parts should be examined carefully after reconditioning to determine their suitability. When disassembling a unit, remove the major subassemblies whenever possible. Subassemblies may then be disassembled as necessary for repair. Unserviceable and unrepairable assemblies will be broken down into items of issue, and serviceable parts will be returned to stock.



Key	Item	Quantity	Key	Item	Quantity
1	Screw	1	10	Lockwasher	3
2	Bracket	1	11	Nut	1
3	Lockwasher	3	12	Screw	2
4	Nut	4	13	Bracket	1
5	Intake duct	1	14	Nut	2
6	Cover assembly	1	15	Screw	1
7	Flat washer	1	16	Diverter assembly	1
8	Screw	1	17	Screw	1
9	Lockwasher	1	18	Heater assembly	1

Figure 18-73. Heater, diverter, and intake duct.

18-50. Repair of Blower Motor and Wheel Assembly (fig. 18-60)

a. Removal.

(1) Disconnect blower motor to circuit breaker leads.

(2) Remove four screws and lockwashers attaching the blower motor and wheel to scroll housing.

b. Disassembly.

(1) Loosen socket head setscrew securing the blower wheel to motor armature shaft. Remove wheel.

(2) Remove two nuts and lockwashers securing the motor to mounting adapter. Remove adapter.

c. Cleaning. Blowing wheel and adapter may be washed in drycleaning solvent or mineral spirits paint thinner.

d. Inspection and Repair.

(1) *Blower Wheel.* Inspect blades and hub for possible damage. Straighten or replace blower wheel.

(2) *Mounting adapter.* Inspect for distortion and damage. Straighten or replace as required.

(3) *Motor body.* Inspect motor body for cracks. Replace motor if body is faulty.

e. Assembly of Blower Motor and Wheel.

(1) Position motor mounting adapter to motor assembly and install two lockwashers and nuts.

(2) Position blower wheel over shaft of armature with setscrew on same side as flat on shaft. Tighten setscrew.

f. Installation.

(1) Position assembled blower motor, wheel, and adapter to blower motor scroll housing, and install four lockwashers and screws

(2) Connect blower motor cable to circuit breaker cable.

18-51. Repair of Heater Core (fig. 18-60).

a. Removal.

(1) Remove two core tube seals and bleeder valve.

(2) Remove the four screws and lockwashers attaching cover to case.

(3) Remove core and baffle from case.

NOTE

Core may be firmly seated in case requiring forceful pressure to remove.

b. Inspection and Repair. Inspect core for leaks, restriction of air flow between fins, plugged tubes, and damaged tanks. Repair or replace core as required. refer to TM 10-450 for repair procedure.

c. Installation.

(1) If sealing felt has been removed from core during repairs, apply cement (FSN 8040-262-0031) to felt and position to tube side of core. Position felt so entering air can pass between the fins.

(2) Position core in case with the core lower tank seated in support.

(3) Insert core air baffle between core and case side.

(4) Position cover to case, and install four screws and lockwashers.

(5) Install core bleeder valve and core tube seals.

18-52. Repair Standards

There are no repair standards applicable since the blower motor is not a repair item.

Section IV. HARDTOP KIT

18-53. Description and Data

For description and data of the vehicle hardtop kit, refer to TM 9-2320-218-20.

18-54. General Installation Instructions

a. The hardtop kit consists of eight major subassemblies: Two doors, two hinges, pillars, two side panels, back panel, and roof panel.

b. Refer to figure 18-74 for contents of the hardtop kit.

18-55. Preliminary Operations

a. Remove soft top, doors, and curtains (TM 9-2320-218-10).

b. Remove three screws, washers retaining roof bows, and bracket assembly on both sides of vehicle (fig. 18-75). Remove bows with bracket assembly.

c. Remove two screws and lockwasher assemblies, retaining windshield horizontal top rod bracket to windshield panel on both sides, and remove brackets (fig. 18-76).

d. Remove two screws retaining footman loop to body on rear of vehicle (fig. 18-77).

e. Remove safety strap eyebolt, washer, and nut, (fig. 18-78).

f. Remove and discard battery cable retaining clamp from right side of vehicle panel (fig. 18-79).

18-56. Assembly of Kit Components and Drilling Instructions

a. Assembly of Roof, Rear, and Side Panels.

NOTE

When assembling panels, select a clean,

level area. Care should be taken so that mating edges of panels do not come in contact with floor, and become soiled or damaged. The assistance of a second automotive repairman will be necessary for locating and positioning panels.

(1) Assemble side panels to rear panel using eight screws, sixteen flat washers, eight lockwashers, and nuts (fig. 18-80). Apply calking compound (MIL-C-18969) to contacting surfaces. Flat washers are to be placed so as to prevent contact between screw head or nut, and aluminum panel.

(2) Assemble roof panel to rear and side panels using sixteen screws, thirty-two flat washers, sixteen lockwashers, and nuts (fig. 18-81). Apply calking compound (MIL-C-18969) to contacting surfaces.

(3) Position roof and side panels assembly on vehicle, and clamp in place.

b. Assembly of Door and Pillar.

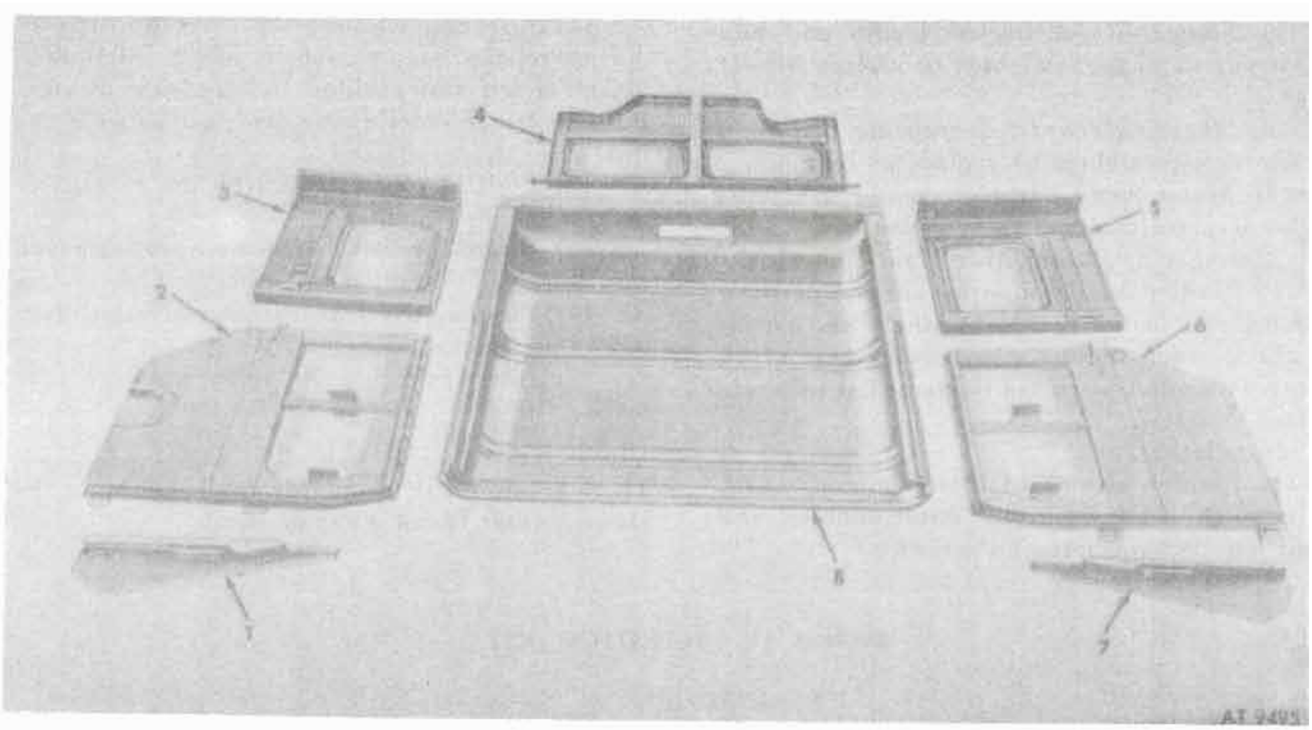
(1) Position door hinges on pillar mounting holes (fig. 18-82).

(2) Attach, using two screws, flat washers, lockwashers, and nuts.

(3) Attach anchor to pillar; position anchor on door hinge, using two screws, flat washers, and nuts. When mounted, the slotted portion of anchor should be on the door side of its mounting screws, angling away from pillar.

(4) Feed strap assembly through both anchors and temporarily tighten strap to simulate a closed door.

(5) Repeat the above for other door.



Key	*Item*	*Quantity*
	Hardtop kit Composed of:	
1	Pillar assembly LH)	1
2	Door assembly (LH)	1
3	Side panel assembly (LH)	1
4	Rear panel assembly	1
5	Side panel assembly (RH)	1
6	Door assembly (RH)	1
7	Pillar assembly (RH)	1
8	Roof assembly	1

Figure 18-74. Major components, hardtop kit.

Figure 18-75. Removal of soft top bows and brackets.

Figure 18-77. Footman loop.

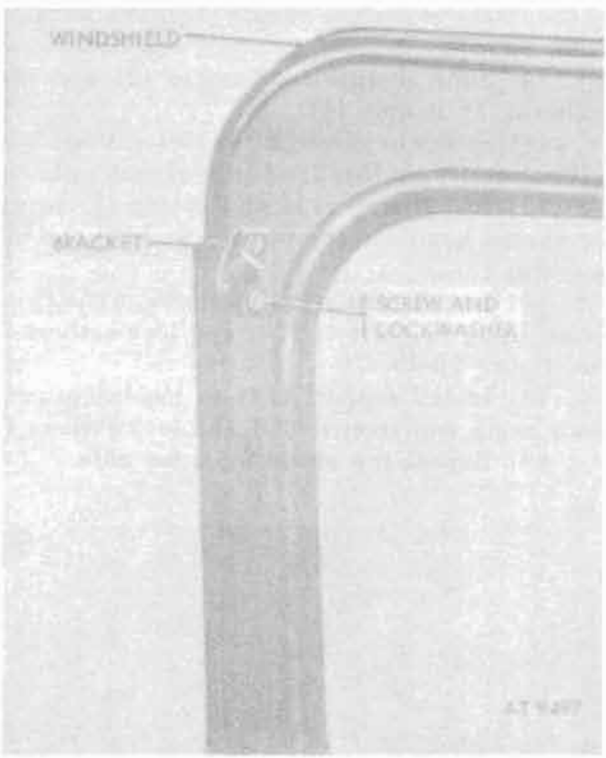


Figure 18-76. Windshield horizontal top rod bracket.

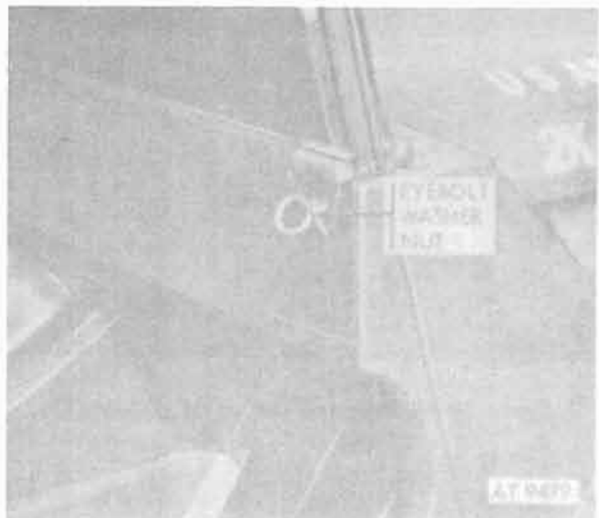


Figure 18-78. Safety strap eyebolt.

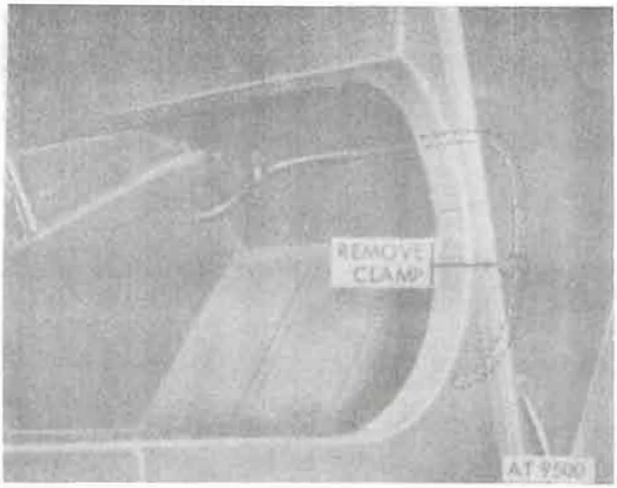


Figure 18-79. Battery cable retaining clamp.

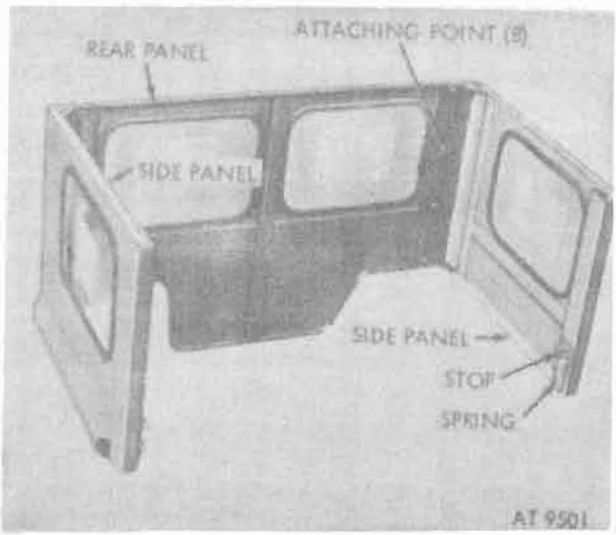


Figure 18-80. Rear and side panel assembly.

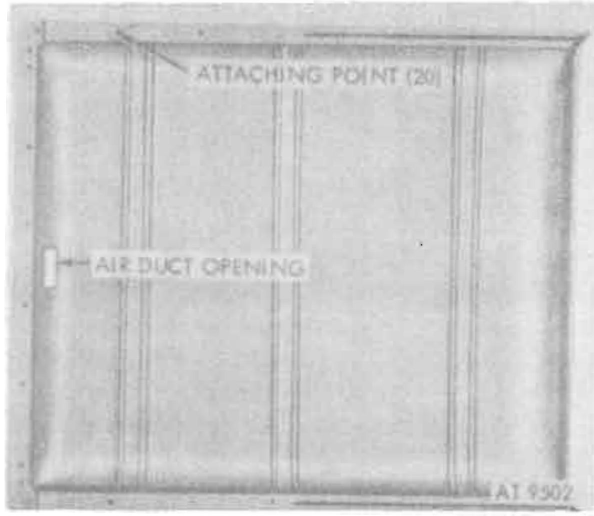


Figure 18-81. Roof assembly.

c. *Assembly of Door Handle, Latch, and Related Parts* (fig. 18-83).

(1) Insert two bushings (3) into handle hole in door.

(2) Slide flat washer (2) over handle hole in door.

(3) Insert shaft of handle (1) into hole in door from outside.

(4) Slide another flat washer (2) over shaft followed by handle (4).

(5) Secure handle with one lockwasher (5) nut (7) and cotter pin (6). Bend ends of cotter pin over.

(6) Install stop (11) and spring (8) to door just below handle, using two screws (10) and lockwashers (9).

(7) Install spring (15) and stop (16) to side panel using two screws (10) and lockwashers (9). See figure 18-83.

(8) Install support (12) to inside bottom of door using two screws (10) and lockwashers (9).

(9) Repeat the above for other side.

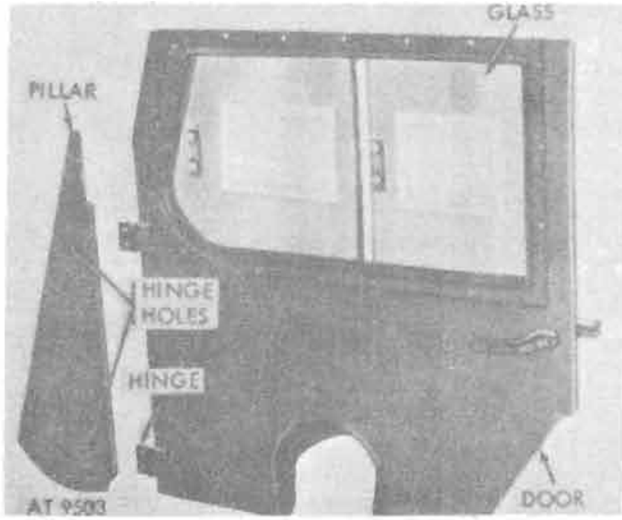
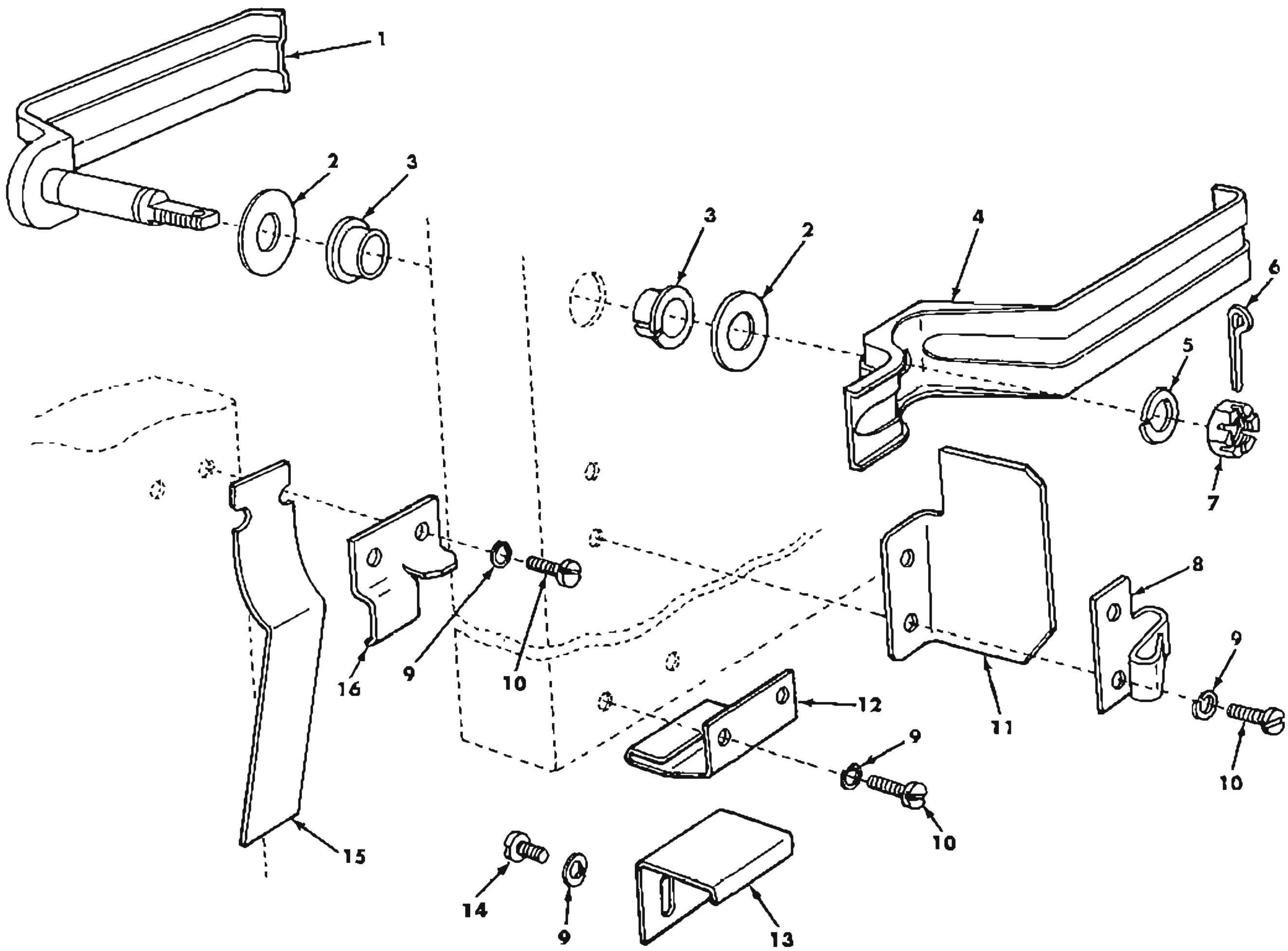


Figure 18-82. Door and pillar.



Key	Item	Quantity	Key	Item	Quantity
1	Handle assembly	2	9	Lockwasher	6
2	Flat washer	4	10	Screw	6
3	Bushing	4	11	Stop LH	2
4	Handle	2		RH.	2
5	Lockwasher	2	12	Support	2
6	Cotter pin	2	13	Pad	2
7	Nut	2	14	Screw	2
8	Spring	2	15	Spring	2
			16	Stop	2

Figure 18-83. Left and right door handle, latch and related parts—left side shown.

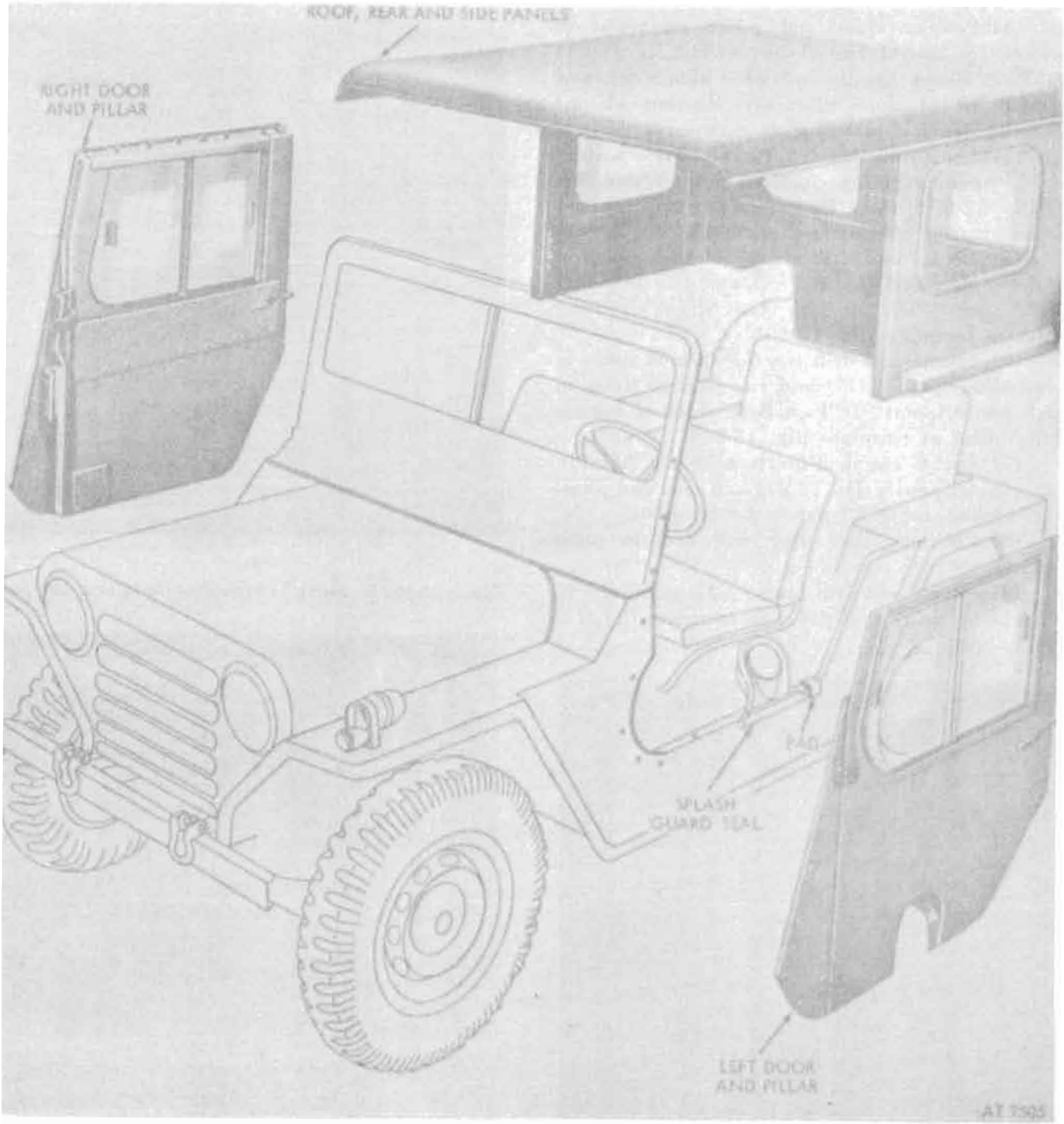


Figure 18-84. Positioning panels.

d. Drilling Instruction.

CAUTION

Exercise extreme care in positioning enclosure assembly to body. Very little adjustment is possible after holes are drilled and installation is completed. Critical areas at this point in the installation are door fit and door latching. Inspect enclosure to body fit at all contact points, paying particular attention to door latch and door fit.

(1) Locate and drill one ¼-inch hole in bottom of door opening for door check link (fig. 18-85).

(2) Apply adhesive (MIL-A-5092, type II) to seal (10950839) and install on vehicle left side panel, centered at fuel tank splash guard (fig. 18-84).

(3) Position door and pillar assembly on vehicle (fig. 18-84). Install support (12, fig. 18-83) on door. Check handle and latch alinement, and general fit of door assembly. Loosen clamps securing panels and adjust as necessary.

(4) Locate one pad (13, fig. 18-83) on bottom of door opening, in line with door support, and drill two 7/32 inch holes. Pad mounting holes should be on exterior of vehicle (fig. 18-84).

(5) Locate and drill six 9/32-inch holes in vehicle side panel (point "A") and two in windshield (point "B") on both sides of vehicle using pillar as template (fig. 18-85).

(6) Locate and drill two 7/32-inch holes in windshield (point "C") and two ⅜-inch holes in dash panel (point "D") on both sides of vehicle using pillar as template (fig. 18-86).

(7) Locate and drill fourteen ⅜-inch holes in side quarter panels (fig. 18-87) and rear end panel (fig. 18-88), using kit panels for template.

(8) Position other door and drill in same manner.

(9) Locate and drill four 9/32-inch holes in windshield, using roof panel as template (fig. 18-89).

Figure 18-85. Mounting holes in windshield and side panel.

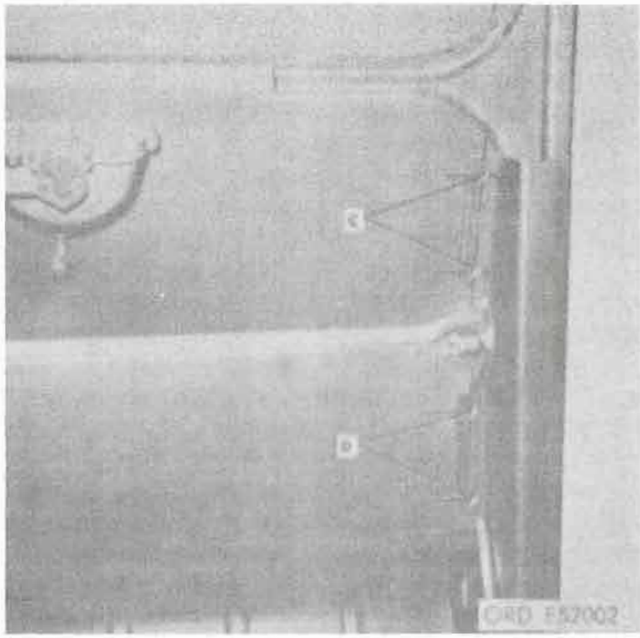


Figure 18-86. Mounting holes in windshield and dash panel.

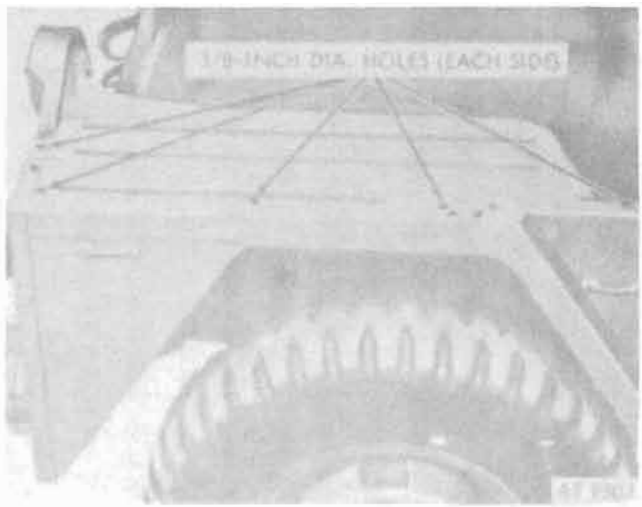


Figure 18-87. Mounting holes in side quarter panel.

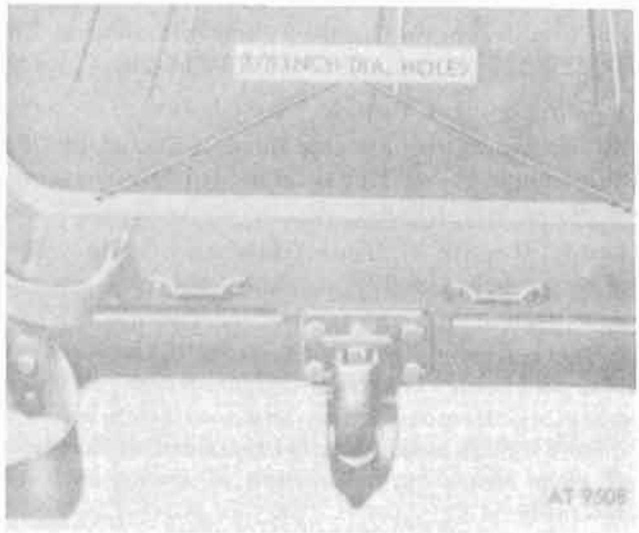


Figure 18-88. Mounting holes in rear end panel.

Figure 18-89. Mounting holes in windshield.

e. Installation of Panels.

(1) Install pad to side panel on each side of vehicle, using two screws and lockwashers (9 and 14, fig. 18-83).

(2) Apply calking compound (MIL-C-16969) to contacting surfaces of roof panel, side panel, rear panel, windshield, rear quarter panels, and rear end panel.

(3) Attach side panels to rear quarter panels using ten screws, flat washers, lockwashers, and nuts.

NOTE

Flat washers are to be placed so as to prevent contact between screw head and aluminum panel.

(5) Attach roof panel to windshield using four screws, flat washers, lockwashers, and nuts.

(6) Attach pillar to body side panel and side of windshield on each side of vehicle using eight screws, lockwashers, and flat washers. After attaching one pillar and door assembly, loosen retaining strap and adjust to be tight when other door is in maximum open position. When other door is installed, adjust strap in same manner.

(7) Attach door check link on bottom of door to side panel using one screw, flat washers, and nut. Back nut off 1/4 to 1/2 turn after tightening (fig. 18-90).

(8) Attach pillar to dash panel on each side of vehicle, using two screws, flat washers, lockwashers, and nuts.

(9) Attach pillar to windshield on each side of vehicle, using two screws, lockwashers, and flat washers.

(10) Apply adhesive (MIL-A-5092, type II) to weatherstrips and to side of windshield at door openings. Install weatherstrips (fig. 18-91).

(11) Remove hood catch on windshield and discard screws.

(12) Install hood catch on windshield with two spacers between catch and windshield, using two screws and lockwasher assemblies, and nuts.

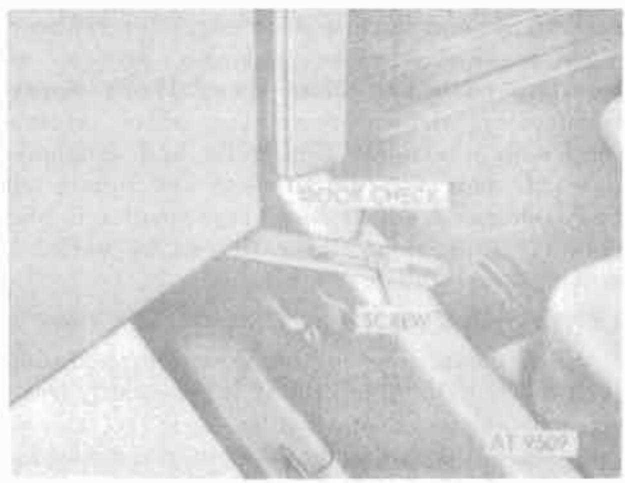


Figure 18-90. Door check link.

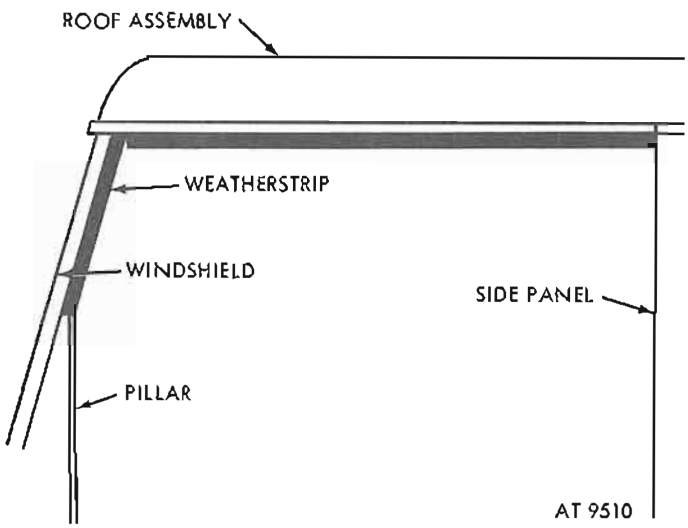


Figure 18-91. Door weatherstrip installation.

f. Adjustment of Doors. Carefully close doors and check fit by having a second mechanic inside the vehicle to determine if door is centered in the opening. When the loosely fitted door is centered in the opening, hold in position, and mark lines (pencil) around outside door edges for reference. Tighten outside pillar retaining screws, and carefully open and close door. If fit appears satisfactory, tighten remaining pillar retaining screws on windshield side pillar and instrument panel. If door does not fit flush and square with body side panel, adjust door hinge position to bring door into alinement. Door fit can be varied by moving hinge pillar and hinges.

18-57. Operating Test

a. On completion of the assembly, perform a road test to determine if body is reasonably free of air leaks, squeaks, and rattles.

b. Check door fit, and operation of the door lock and door check link.

c. Check operation of sliding glass.

d. Examine installed enclosure for nicks or misalined parts. Correct any misalinement, and touchup paint to prevent corrosion.

18-58. Troubleshooting

For troubleshooting hardtop enclosure, refer to TM 9-2320-218-10 and TM 9-2320-218-20.

18-59. General Repair Procedures

Repair procedures are contained in paragraphs 18-60 through 18-69. Repair standards are contained in paragraph 18-70.

18-60. Repair of Door Glass and Seals (fig. 18-92)

a. Removal.

(1) Remove seven screws (10), lockwashers (4), and nuts (5) from upper frame and seal assembly. Remove frame and seal assembly.

(2) Slide outer glass (1) rearward so that front of glass clears curved section of frame and seal assembly.

(3) Lift upward to remove glass from lower frame and seal assembly.

(4) Lift inner glass (2) upward to remove from lower frame and seal assembly.

(5) Remove front and lower seal assembly (8) from frame by pulling out of channel.

(6) Remove rear seal (7) from door channel and top seal (6) from upper frame (3).

b. Cleaning and Inspection. Clean all seal retaining channels to remove rust and other foreign material. If cement has been used to retain seals in place, it may be softened and removed by applying mineral spirits paint thinner. Inspect channels for damage and collapsed areas; repair as necessary.

c. Installation.

(1) Position front and bottom seal (8) in door channel, and press firmly into groove. Position and install rear seal (7) in door channel.

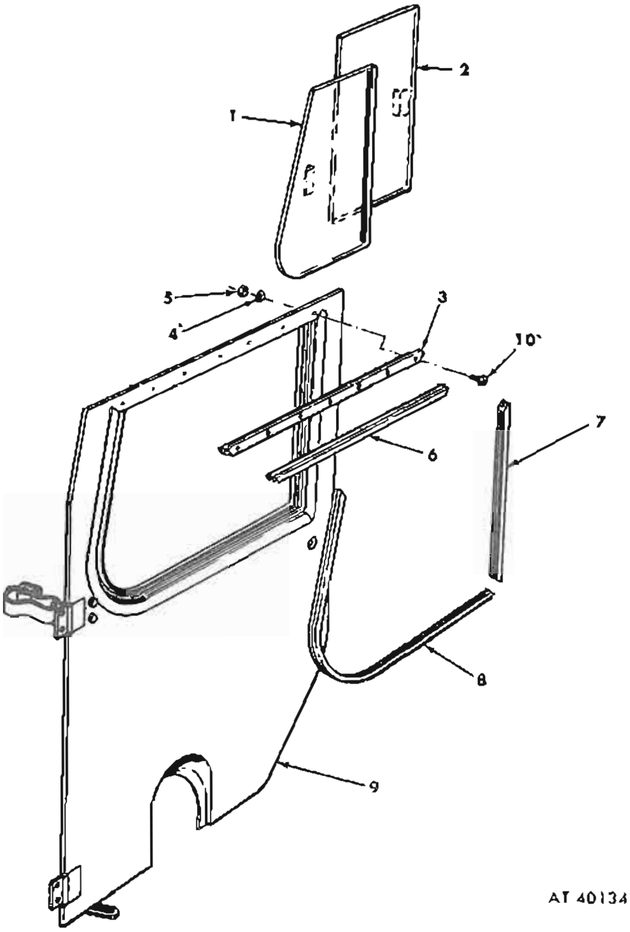
(2) Position rear glass (2) in inner track of lower seal, and slide toward rear.

(3) Locate front glass (1) in outer track of lower seal, and slide fully forward into curved section of door and front seal.

(4) Position top seal (6) on upper frame channel (3), and press firmly into groove.

(5) Locate upper frame and seal assembly on front and rear glass panels, and aline with door frame.

(6) Install seven screws (10), lockwashers, (4) and nuts (5), securing upper frame to door assembly.



Key	Item	Quantity
1	Glass assembly, front	1
2	Glass assembly, rear	1
3	Frame, upper channel	1
4	Washer, lock	7
5	Nut	7
6	Seal, upper	1
7	Seal, rear	1
8	Seal assembly, front and lower	1
9	Door assembly (left side shown)	1
10	Screw	7

Figure 18-92. Door assembly—exploded view.

18-61. Repair of Door Handle, Door Latch, and Associated Parts (Fig. 18-83).

a. Removal. Remove cotter pin (6) from door handle nut (7). Remove nut and door handles. Remove bushings (3) and washers (2).

b. Installation. Install two bushings (3). Position washers on outer door handle assembly with shaft through bushings. Install inner handle on shaft, and secure with nut and cotter pin.

18-62. Repair of Door Weatherstrips

a. Removal.

(1) Remove screw, nut, and washers retaining door check link to body (fig. 18-90), and allow door to swing fully open so all weather strips will be accessible.

(2) Carefully remove weatherstrips using a putty knife to separate weatherstrip from door edges. Avoid using solvents.

(3) Wire-brush area to receive new weatherstrip and clean with mineral spirits paint thinner if necessary to remove grease.

b. Installation.

(1) Cut suitable lengths of material from bulk weatherstrip stock.

(2) Apply a light but thorough coat of adhesive (FSN 8040-262-9031) to weatherstrip contact area of door.

(3) Apply a light coat of the same adhesive to weatherstrip mating surface.

(4) Allow adhesive to become tacky, and then mate weatherstrip to door, working from one end and taking care not to stretch rubber material.

(5) Install door check link (fig. 18-90).

18-63. Repair of Door Handle Stop and Spring

a. Removal. Remove two retaining screws and remove stop and spring.

b. Installation (fig. 18-83). Position stop and spring to inside of door panel and install two retaining screws and two lockwashers.

18-64. Repair of Side Panel Door Latch Stop and Spring (fig. 18-83)

a. Removal. Remove two retaining screws and lockwashers. Remove stop and spring.

b. Installation. Position stop and spring. Install two screws and lockwashers.

18-65. Repair of Door Support. (fig. 18-83)

a. Removal. Remove two screws (10) and lock-washers (9), and remove supports (12).

b. Installation. Position support at two holes near rear bottom inner edge of door. Secure with two screws and lockwashers.

18-66. Repair of Door Support Pad (fig. 18-83)

a. Removal. Remove two screws (14) and lock-washers (9), and remove pad (13).

b. Installation. Locate pad at two holes previously drilled in lower rear outer surface of side panel door opening. Secure with two screws and lockwashers.

18-67. Repair of Body Side Panel Weatherstrip

a. Removal.

(1) Remove top-retaining screw, washers, and nuts securing top to windshield and side panel.

(2) Remove side panel to vehicle body, retaining screws, nuts, and washers.

(3) Remove side panel to rear panel retaining screws, nut, and washers.

(4) Remove side panel to roof panel retaining screws, nut, and washers, and slide panel out of assembly.

(5) Separate weatherstrip from side panel mating surface with a putty knife.

(6) Clean weatherstrip mounting surface with mineral spirits paint thinner.

b. Installation.

(1) Fabricate weatherstrip from bulk material (FSN 9320-810-0999) using standard punch set to cutscrew holes.

(2) Follow procedure outlined in paragraph 18-62b(2), (3), and (4) for applying adhesive (FSN 8040-262-9031).

(3) Install weatherstrip to panel.

(4) Raise top panel by hand pressure and carefully slide side panel into position.

(5) Carefully lower top panel and install top, side, and lower panel retaining screws, nuts, and washers finger tight.

(6) Tighten side and rear panel and top to windshield retaining bolts with opposite door closed to keep body square.

(7) Aline panel to stop, bottom sides, and door opening, and tighten retaining screws and nuts securely.

18-68. Repair of Body Rear Panel Weatherstrips

a. Removal.

(1) Loosen and remove body joint retaining screws.

(2) When enclosure is loosened, slide rear panel out of assembly.

(3) Remove weatherstrip from panel using putty knife if necessary.

(4) Clean weatherstrip mounting surface with mineral spirits paint thinner.

b. Installation.

(1) Fabricate weatherstrip from bulk material (FSN 9320-810-0999), using standard punch set to cut screw holes.

(2) Apply adhesive (FSN 8040-262-9031) to rear panel as outlined in paragraph 18-62b(2), (3), and (4).

(3) Install weatherstrip to panel.

(4) With assistance from a second mechanic, hold top and side panels clear of mating edges until rear panel is in-position.

(5) Lower panel and install all retaining screws and nuts finger tight.

(6) Close both doors, check enclosure for alinement, and tighten retaining screws and nuts securely.

18-69. Repair of Body Side or Rear Glass

NOTE

The procedure for removing and installing glass in the enclosure is basically similar to windshield removal and installation outlined in paragraphs 17-19 through 17-23. Perform glass replacement in a heated area if possible to insure total flexibility of the mounting rubber.

a. Removal.

(1) Working from the inside of enclosure and using fingers, peel top of rubber channel downward, away from metal, and at the same time forcing outward on the glass. Gradually work along top and sides of rubber channel until channel is free on three sides.

(2) Working from outside vehicle, carefully pull glass and channel outward until removed from enclosure.

(3) Remove rubber channel from glass.

b. Installation.

(1) Before installing glass, inspect glass rubber channel for deterioration, weathering, cracking, or tearing, and for glass chips; etc. Clean glass channel of any hardened adhesive.

(2) Inspect glass for scratches, cracks, milky or fogged appearance, or stains; replace defective glass panels.

(3) Carefully insert glass in rubber channel.

(4) Coat mounting groove of rubber channel with liquid soap.

(5) Use a length of braided or woven cord sufficient to encircle the glass and to allow 1 foot on each end for holding. Install cord in rubber channel mounting groove, crossing in center top position.

(6) Insert glass and channel assembly into window opening in enclosure, top edge first.

(7) Push inward and upward on glass assembly at the same time pulling steadily on one end of cord to force mounting lip of channel to engage inside of opening.

(8) Continue pulling on cord and working glass assembly into opening until mounting lip is entirely inside opening.

(9) Wipe off all excess liquid soap and use a thin spouted pressure oiler to seal glass to channel and channel to body with adhesive (FSN 8040-262-9031).

18-70. Repair Standards

As the hardtop enclosure is constructed primarily of aluminum, all the standard precautions in working with this metal apply. Avoid excessive cold working and be sure protective coating (primer) TT-P-636 is restored after repairs. Welding or riveting is permissible when necessary.

18-71. Description and Data

a. Description. For description of the deepwater fording kit refer to TM 9-2320-218-20.

b. Data.

Shipping weight of kit	71.5 lb.
Fording depth w/kit installed	5 ft.
Vehicle height w/kit installed	80 in.
Shipping cubage	7.67 cu. ft.

18-72. General Installation Instructions

a. Preliminary Instructions. The deepwater fording kit consists of intake and exhaust extensions to allow the engine to run when completely submerged, and also contains parts necessary to couple all normal atmospheric ventilation lines to the carburetor air intake tube to avoid entrance of water. Lines are furnished to connect the brake master cylinder and fuel tank ventilation systems to the extension intake tube by means of a four-way fitting and a fording valve and control.

b. Kit Contents. Refer to figure 18-93.

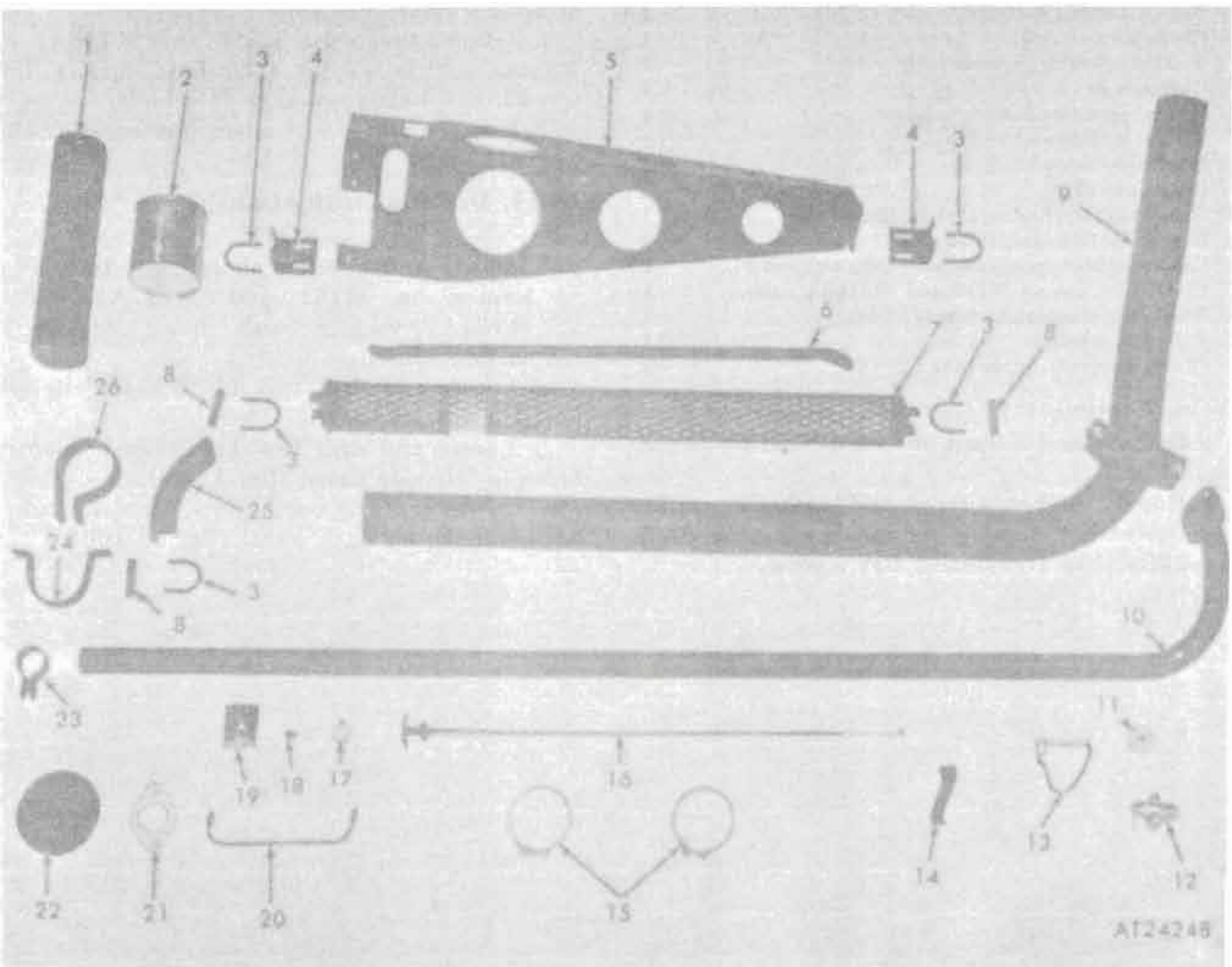


Figure 18-93. Deep water fording kit, major parts.

Key to figure 18-93.

Key	Item	Quantity
	Deepwater fording kit (2540-780-0844). Composed of:	1
1	Hose air intake tube to air cleaner.	1
2	Sealer (1 qt. container) MIL-S-12158, type II.	
3	U bolt	2
4	Clamp vertical exhaust pipe (not for use on M718 or M718A1).	2
5	Support assembly, exhaust mounting (not for use on M718 or M718A1).	1
6	Support, air intake tube	1
7	Guard assembly	1
8	Clamp	3
9	Tube assembly, fording air intake.	1
10	Tail pipe assembly, fording exhaust.	1
11	Plug, master cylinder vent, fording master cylinder.	1
12	Valve assembly, fording.	1
13	Clevis pin assembly.	1
14	Bracket assembly, bowden cable.	1
15	Clamp, hose	1
16	Control assembly, fording valve.	1
17	Fitting, fording vent line.	1
18	Plug, cover assembly, flyer	1
19	Instruction plate	1
20	Tube assembly, fording brake cylinder vent.	1
21	Gasket, fording exhaust tail pipe.	1
22	Cap assembly (use cap assembly from air cleaner).	1
23	Clamp (for use on M718 and M718A1 only).	1
24	Bracket, fording intake tube to fender.	1
25	Tail pipe, exhaust	1
26	Clamp assembly, intake tube.	1

18-73. Preliminary Operations

a. Remove and discard left windshield hinge pin (fig. 18-94).

b. Remove and stow screw and washer assembly from lower left steering column bracket on dash panel (fig. 18-94). Discard flat washer.

c. Remove and discard tailpipe extension and attaching parts (fig. 18-95).

d. Remove and discard plug from master cylinder (fig. 18-96). Stow gasket.

e. Disconnect lines at tee assembly. Remove and discard tee (fig. 18-96).

f. Disconnect lines at fitting on manifold. Remove and discard fitting (fig. 18-97).

g. Remove and stow intake manifold mounting screw and lockwasher to rear of fitting (fig. 18-97). Discard flat washer.

h. Remove and discard air cleaner cap assembly (fig. 18-97).

i. Remove and discard hood panel assembly and attaching parts (fig. 18-98). M151 vehicles only.

j. Remove and stow M718 and M718A1 ambulance vehicle tailpipe extension, support, three screws, and nuts from rear of vehicle.

k. Remove and stow battery box cover (TM 9-2320-218-20).

18-74. Drilling Instructions

NOTE

Steps d and e below should not be performed on M151 and M151A1 and M151A2 vehicles with door and side curtain kit.

a. Locate and drill two 11/32-inch diameter holes in left fender (fig. 18-99).

b. Locate and drill two 11/32-inch diameter holes in left side panel (fig. 18-99).

c. Locate and drill one ⅜ inch diameter hole to left of choke on dash panel (fig. 18-100).

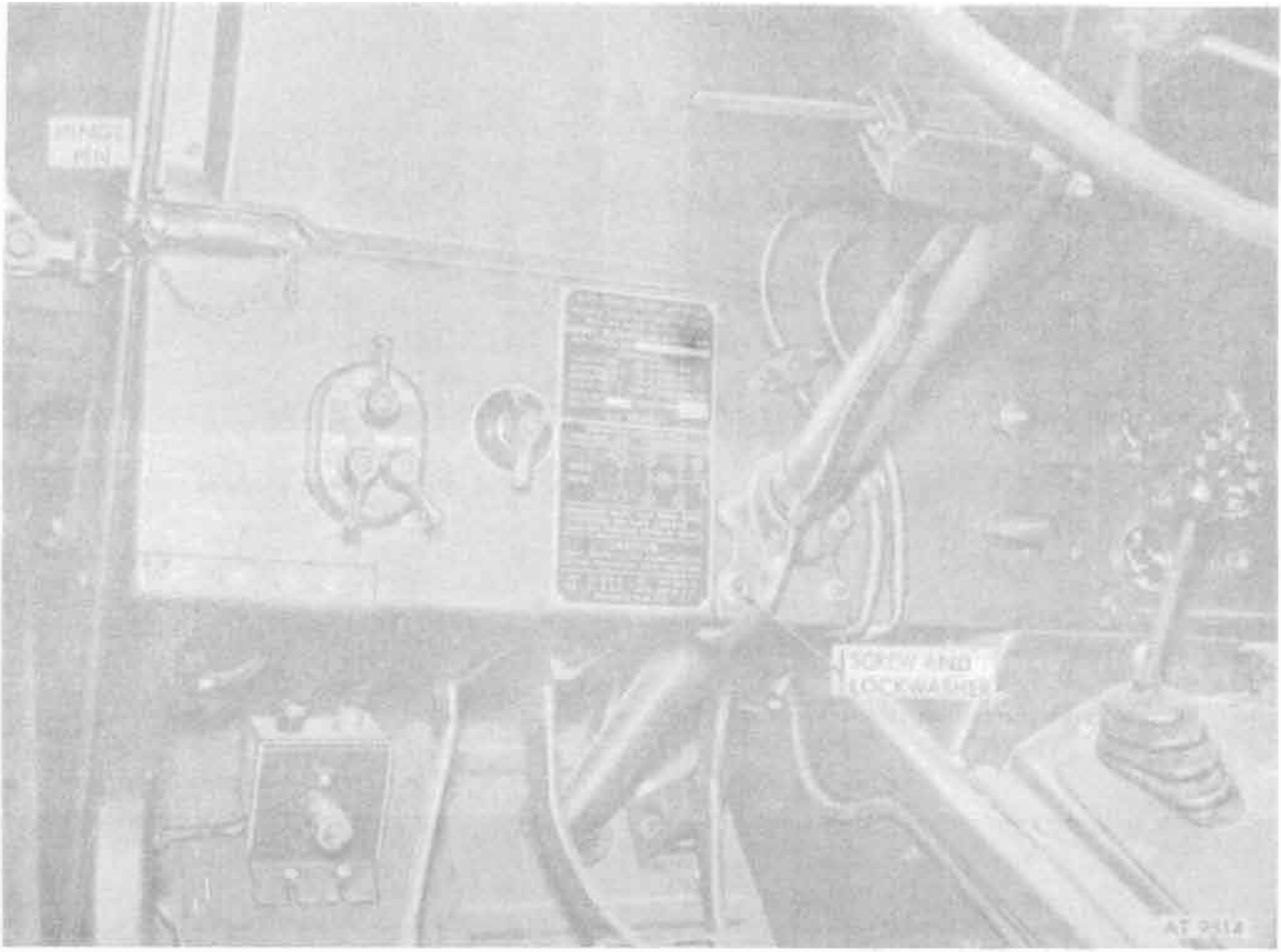


Figure 18-94. Steering column mounting bracket and hinge pin.

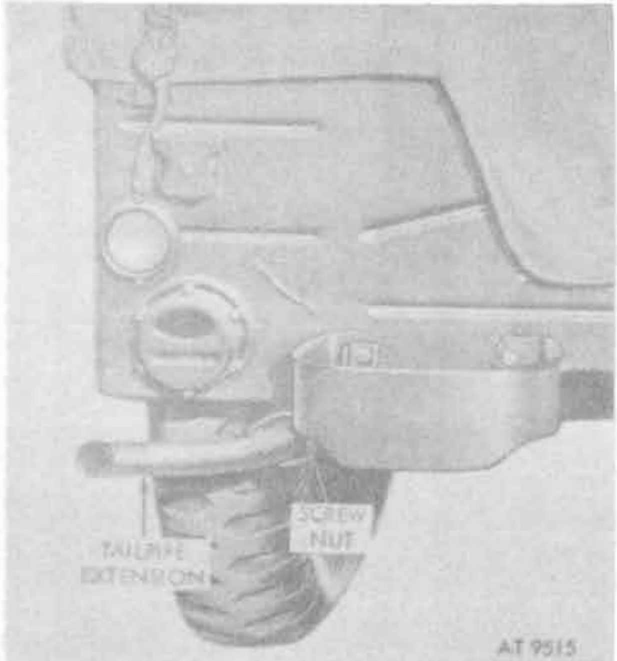


Figure 18-95. Tailpipe extension.

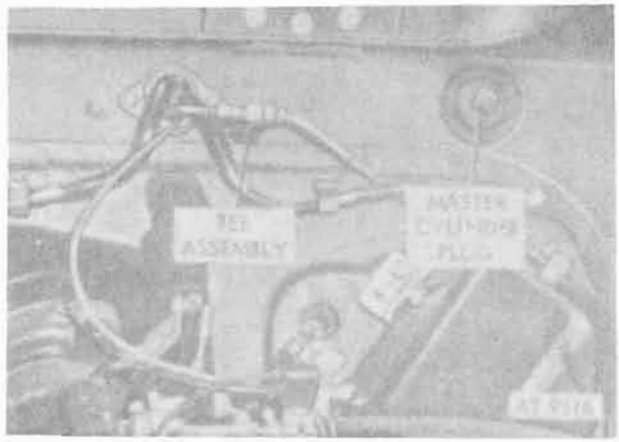


Figure 18-96. Master cylinder plug and ventilation tee.

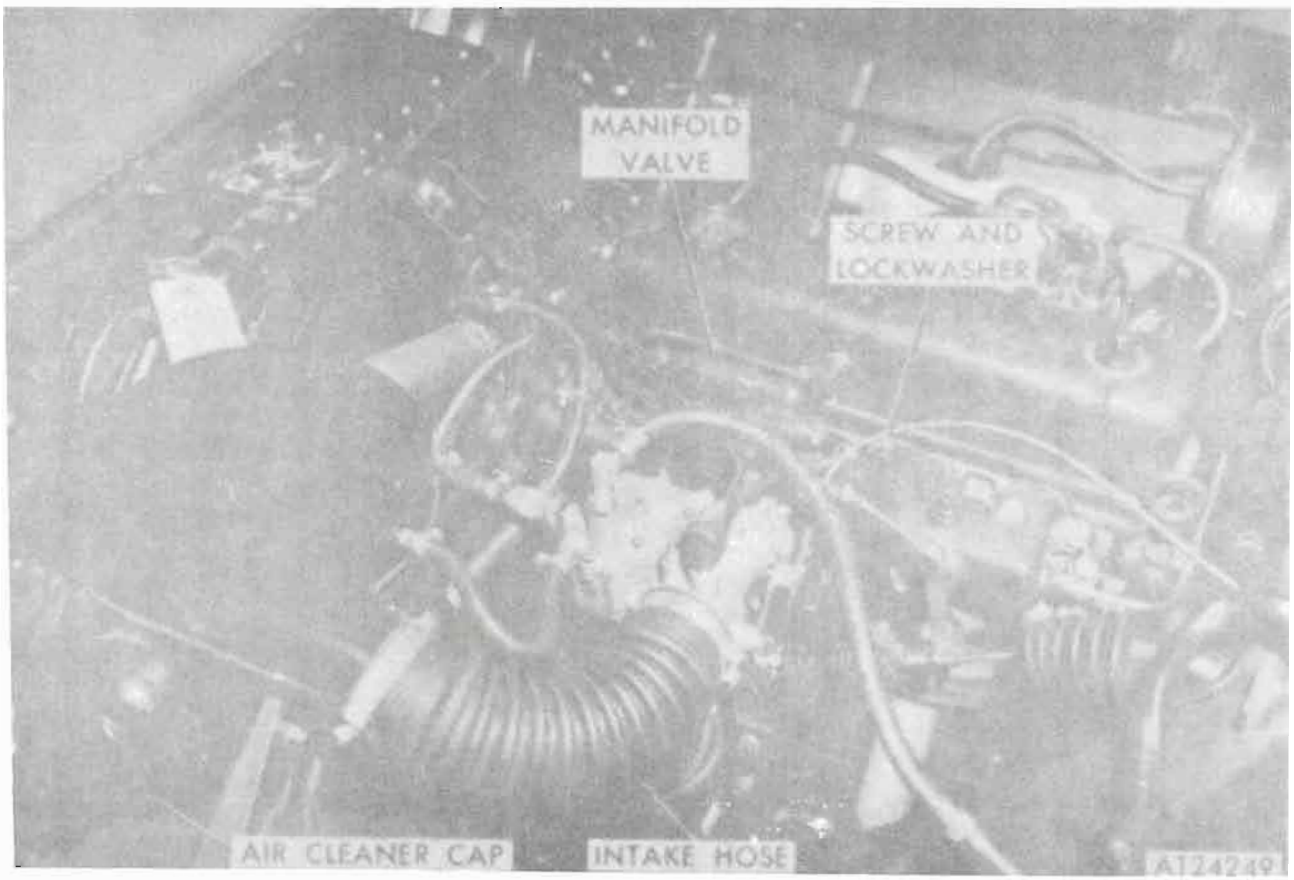


Figure 18-97. Engine compartment.

Figure 18-98. Hood panel assembly (M151 vehicles only).

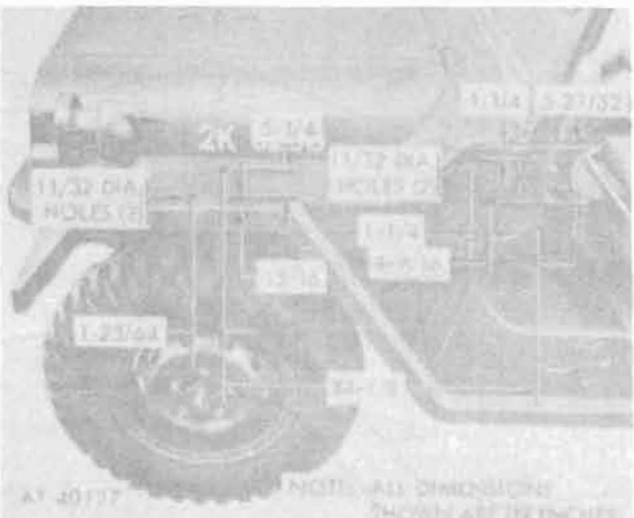


Figure 18-99. Left fender and side panel drilling.

Figure 18-100. Dash panel drilling.

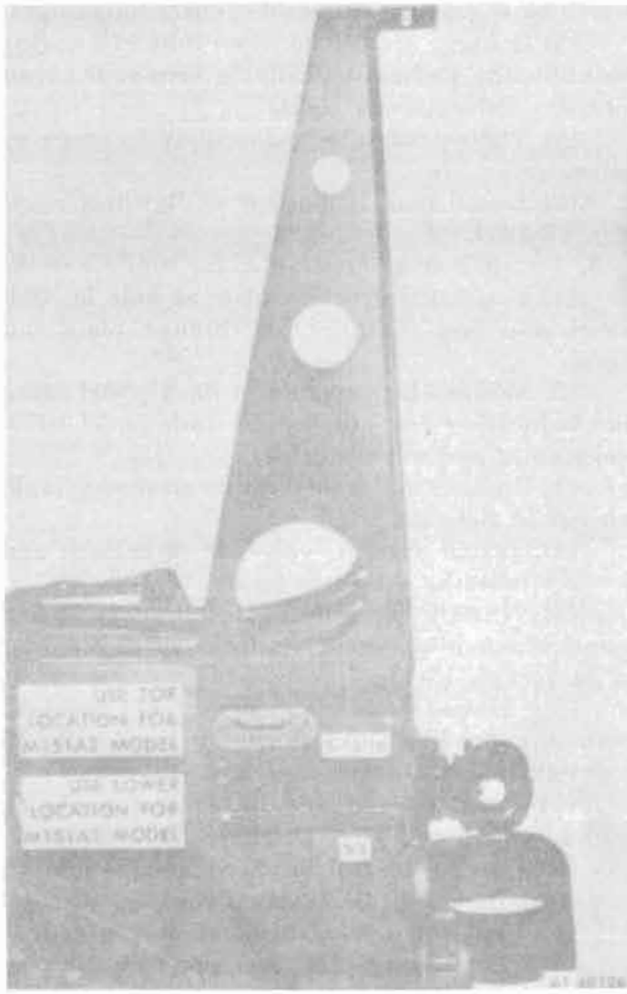


Figure 18-101. Left rear quarter panel drilling.

d. Locate and drill (M151, M151A1 and M151A2 only) 11/32-inch diameter hole in left rear quarter panel (fig. 18-101).

e. Position support assembly and locate and drill (M151, M151A1 and M151A2 only) seven 11/32-inch diameter holes in left rear end panel.

f. Locate and drill (M718 and M718A1 only) lower tailpipe support holes by installing tailpipe extension (para 18-73j) to vehicle tailpipe and position support as template to locate two 25/64-inch diameter holes in body extension (fig. 18-102).

18-75. Installation of Subassemblies

a. Installation of Brake Master Cylinder Vent Tube (fig. 18-103).

(1) Install master cylinder cap (5) to master cylinder, using gasket removed in paragraph 18-73d and tighten securely.

(2) Install vent tube (4) into master cylinder cap.

(3) Position four-way valve (2) on fuel tank vent tube at grommet (6), and connect finger tight.

(4) Connect windshield wiper tube (1), engine vent tube (3), and master cylinder vent tube (4) to four-way valve; finger tight.

(5) Tighten all tube connections to four-way valve.

(6) Install plug in bottom of flywheel cover (fig. 18-104).

b. Installation of Fording Valve and Control.

(1) Position instruction plate at hole in dash panel, and feed control cable through plate and panel.

(2) Secure control cable to dash panel using one lockwasher and nut behind dash panel (slide lockwasher and nut up cable).

(3) Feed control cable through grommet (main wiring) in firewall.

(4) Install fording valve in manifold and connect tubes as shown in figure 18-105.

(5) Install control cable bracket using manifold mounting screw and lockwasher removed in paragraph 18-73g.

(6) Loosen retaining screw of bracket; position control cable as shown in figure 18-105 and tighten.

(7) Position eyed end of control cable on fording valve lever (fig. 18-105).

(8) Operate control to check installation.

c. Installation of Air Intake Tube (fig. 18-106).

(1) Install new windshield hinge pin (10).

(2) Slide clamp (7) over long portion of L-shape on tube (5). Position approximately 20 inches from end of tube.

(3) Attach (do not tighten) support (11) to clamp using one screw (8) and nut (9). On vehicles with door and side curtain kit, it will be necessary to delay attachment of support to tube as a final operation since the support will be on the inside of the vehicle and a hole will have to be located and cut in canvas for the attaching screw.

(4) Slide clamp (2) over same end of tube.

(5) Position rain deflector (6) over end of tube and secure by sliding clamp (2) back up tube and over lip of deflector and tighten.

(6) Position tube (5) on left side of vehicle so that bracket on tube mates with holes in vehicle side panel.

(7) Attach (do not tighten) tube (5) at bracket using two screws (4), flat washers (12) and nuts (9).

(8) Attach (do not tighten) support (11) to steering column bracket using attaching parts removed in paragraph 18-73 *b*.

(9) Connect hose (1) from air cleaner to intake tube using two clamps (2).

(10). Attach (do not tighten) tube (5) to fender using one bracket (3), two screws (4), and nuts (9).

(11) Tighten tube bracket nuts on vehicle side; then tighten fender bracket.

(12) Check alinement of support (11) and clamp (7), and tighten clamp and support.

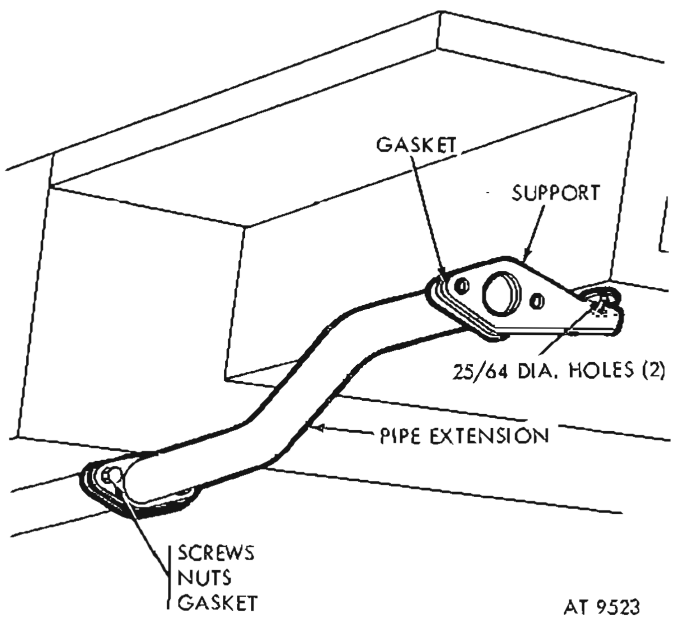
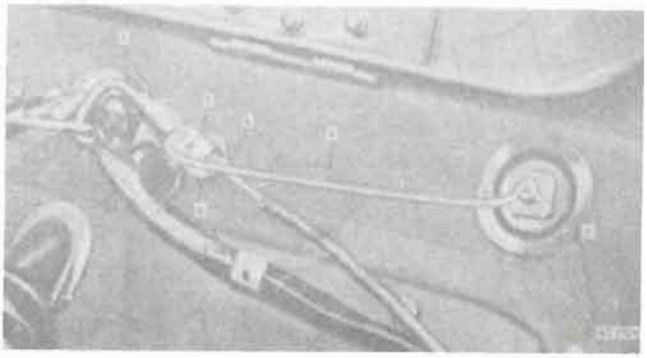


Figure 18-102. M718 and M718A1 ambulance body extension drilling.



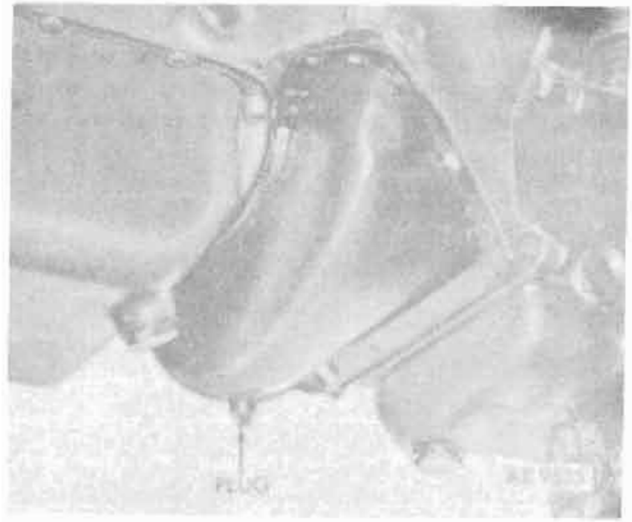


Figure 18-104. Flywheel cover plug.

1 W / S wiper tube
2 Four-way fitting
3 Engine vent tube
4 Master cylinder vent tube
5 Master cylinder cap
6 Grommet

Figure 18-103. Ventilation tubes.

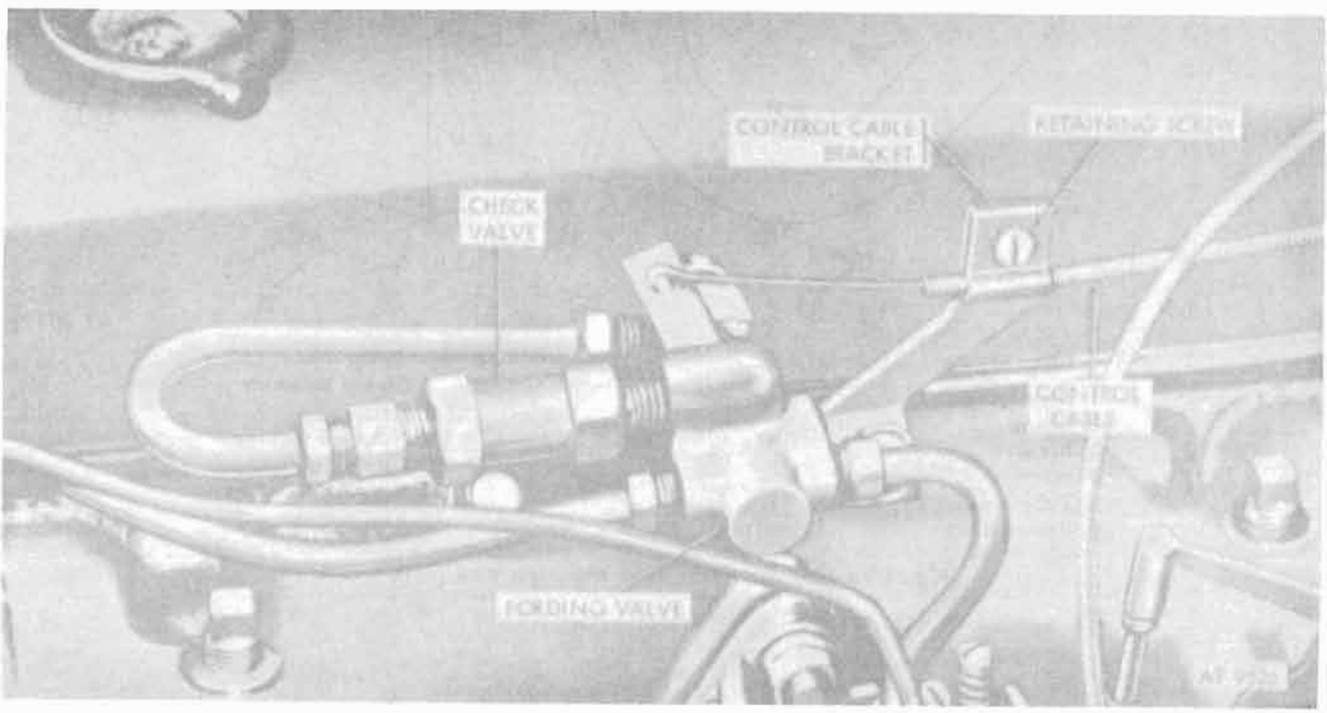


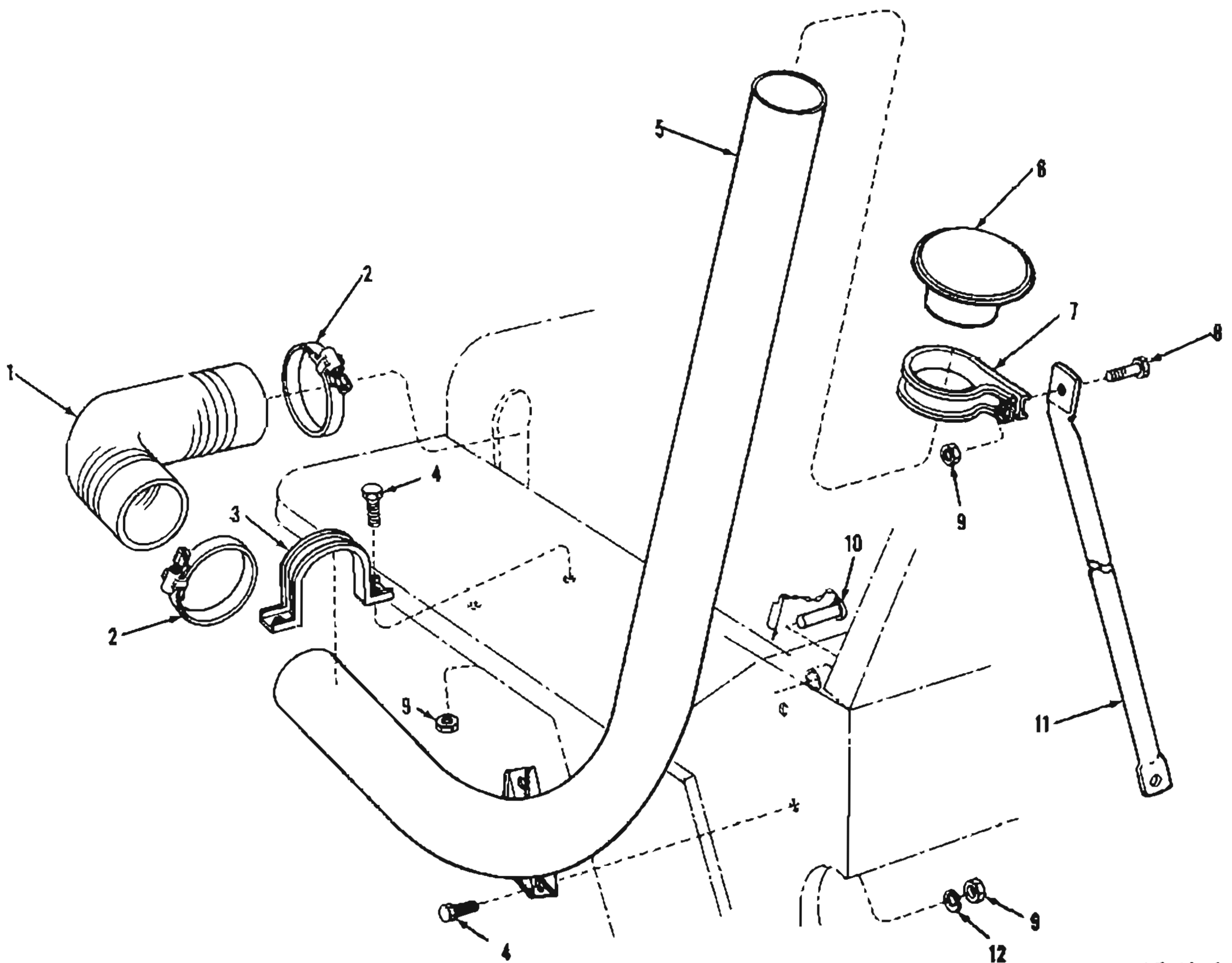
Figure 18-105. Fording valve installed.

d. Installation of Exhaust Pipe Extension, M151, M151A1, and M151A2 vehicles (fig. 18-107).

(1) Slide guard (11) over long end of pipe (10), and position approximately 5 inches from bend. Opening in guard should face same way as short portion of pipe.

(2) Loosely secure guard to pipe using two U bolts (9) two clamps (12), four lockwashers (7), and four nuts (6).

(3) Install tail pipe extension (8) on end of tube (10) and secure, using U-bolt (9) clamp (12), two lockwashers (7), and two nuts (6).



1 Hose
2 Clamp
3 Bracket
4 Screw
5 Tube assembly
6 Rain deflector
7 Clamp assembly
8 Screw
9 Nut, self locking
10 Clevis pin
11 Support
12 Flat washer

Figure 18-106. Air intake tube and associated parts.

(4) Loosely attach clamps (2) to tube (10) at lower and upper end of guard (11), using two U-bolts (9), four lockwashers (7) and four nuts (6).

(5) Attach support (1) to vehicle left rear corner panel, using eight screws (5) and eight nuts (3).

(6) Position pipe on vehicle and aline two clamps (2) with brackets on support (1), and attach using four screws (5), four washers (4), and four nuts (3).

(7) Insert gasket (14) between flanges of pipe (10) and exhaust pipe on vehicle, and secure with two screws (13) and nuts (15).

(8) Adjust position of guard (11) and clamps (2) with support (1), and tighten all clamps and retaining screws.

NOTE

Guard must be positioned to clear top of tail light assembly.

e. Installation of Exhaust Pipe Extension, M718 and M718A1 (fig. 18-107).

(1) Slide guard (11) over long end of pipe (10), and position approximately five inches from bend. Opening in guard should face same way as short portion of pipe.

(2) Loosely secure guard to pipe, using two U-bolts (9), two clamps (12), four lockwashers (7), and four nuts (6).

(3) Slide clamp (19) over end of tube (10).

(4) Install extension pipe (8) on end of tube and secure, using U-bolt (9), clamp (12), two lockwashers (7), and two nuts (6).

(5) Loosen clamp and link assembly located at vehicle upper left rear canvas bow. Slit canvas top at clamp location and extend link through slit.

(6) Position exhaust pipe assembly at rear of vehicle, and aline clamp with link on roof bow.

(7) Attach pipe to exhaust pipe (18) and support (17), using gaskets (14), two screws (13), and two nuts (15).

(8) Attach support (17) to body extension, using two screws (16) and two nuts (15).

(9) Attach clamp (19) to link or canvas bow, using one screw (5) and nut (3).

(10) Adjust guard (11) on pipe (10) so that guard clears top of tail light, and tighten all hardware.

f. Sealing System.

(1) Apply sealer (MIL-S-12158 type II) to battery terminals, starter terminals, and starter switch terminals.

CAUTION

Remove battery terminal ground cable prior to applying sealer to starter and starter switch terminals to prevent accidental shorting.

(2) Replace battery box cover

(3) Remove fuel tank filler cap and turn valve on underside to closed position; reinstall cap.

18-76. Operation Test

NOTE

Before fording make certain that drain plug is installed in flywheel housing cover (fig. 18-104).

a. Refer to TM 9-2320-218-10 for description of vehicle fording characteristics and operation when equipped with this kit. The operating tests should insure adequate performance.

b. Perform the following tests:

(1) Start engine, remove intake tube cap, and attempt to stall engine by holding palm of hand over intake pipe opening. Engine should start to stall and no suction leak should be detected at flexible intake hose connection.

(2) Attempt to stall engine by blocking extension exhaust pipe. Engine should start to stall. At the same time, inspect exhaust gasket connecting tailpipes for leaks.

(3) Remove fuel tank filler cap and set vent for fording. Pull out fording control on instrument panel and continue running engine to determine if venting system is operating.

(4) Push fording control in. Remove fuel tank filler cap, and set fuel tank filler cap vent.

18-77. Troubleshooting

For troubleshooting of the deepwater fording kit, refer to TM 9-2320-218-10 and TM 9-2320-218-20.

18-78. General Repair Procedures

Repair procedures are contained in paragraphs 18-79 through 18-83. Repair standards are contained in paragraph 18-84.

18-79. Air Intake Tube, Hose, and Associated Parts

Refer to figure 18-106 for disconnect points.

a. Removal.

(1) Loosen clamps (2) retaining intake hose to air cleaner and air intake tube.

(2) Remove two screws, lockwashers, nuts, and bracket (3) retaining intake tube to fender.

(3) Remove screw and washer, retaining air intake support (11) to steering column bracket; and remove screw, washer, and nut retaining air intake tube clamp (7) to support.

(4) Remove two screws (4), lockwashers (12), and nuts (9), retaining intake tube integral bracket to left cowl side panel, and remove intake tube and intake tube hose.

b. Installation. Refer to paragraph 18-75 *c.*

18-80. Extension Exhaust Tailpipe, Brackets, and Associated Parts

NOTE

Refer to figure 18-107 for disconnect points.

a. *Removal.*

(1) Remove one screw, washer, and nut retaining upper tailpipe clamp (2) to the upper support bracket.

(2) Remove U-bolt (9) and two nuts and washers retaining the lower tailpipe bracket (2) to the tailpipe.

(3) Remove two screws (13) and two nuts connecting the extension tailpipe (10) to the vehicle tailpipe; discard gasket (14).

(4) Remove upper pipe (8) on top of pipe (10), and slide upper clamps upward and off pipe.

(5) Remove eight screws, nuts, and washers, retaining the tailpipe support to the vehicle body, and remove support.

(6) Remove two clamps (9), retaining guard (11) to pipe (10); slide guard upward and off pipe.

b. *Installation.* Refer to paragraph 18-75 *d* and *e*.

18-81. Fording Valve (fig. 18-105)

a. *Removal.*

(1) Disconnect control cable at valve operating lever by loosening retaining screw in support bracket and pulling the eyed end of the control cable off valve operating lever.

(2) Remove valve cover ventilation tube from ventilator check valve.

(3) Unscrew ventilator check valve from fording valve body.

(4) Remove carburetor vent line.

(5) Remove ignition ventilation line.

(6) Unscrew fording valve from intake manifold.

b. *Installation.* Refer to paragraph 18-75 *b*.

18-82. Four Way Ventilation Fitting (fig. 18-103)

a. *Removal.* Disconnect brake master cylinder, fuel tank vent, and windshield wiper fittings from four way fitting on face of firewall. Remove fitting.

b. *Installation.* Refer to paragraph 18-75 *a*.

18-83. Fording Valve Control (fig. 18-105)

a. *Removal.*

(1) Remove control cable from control valve.

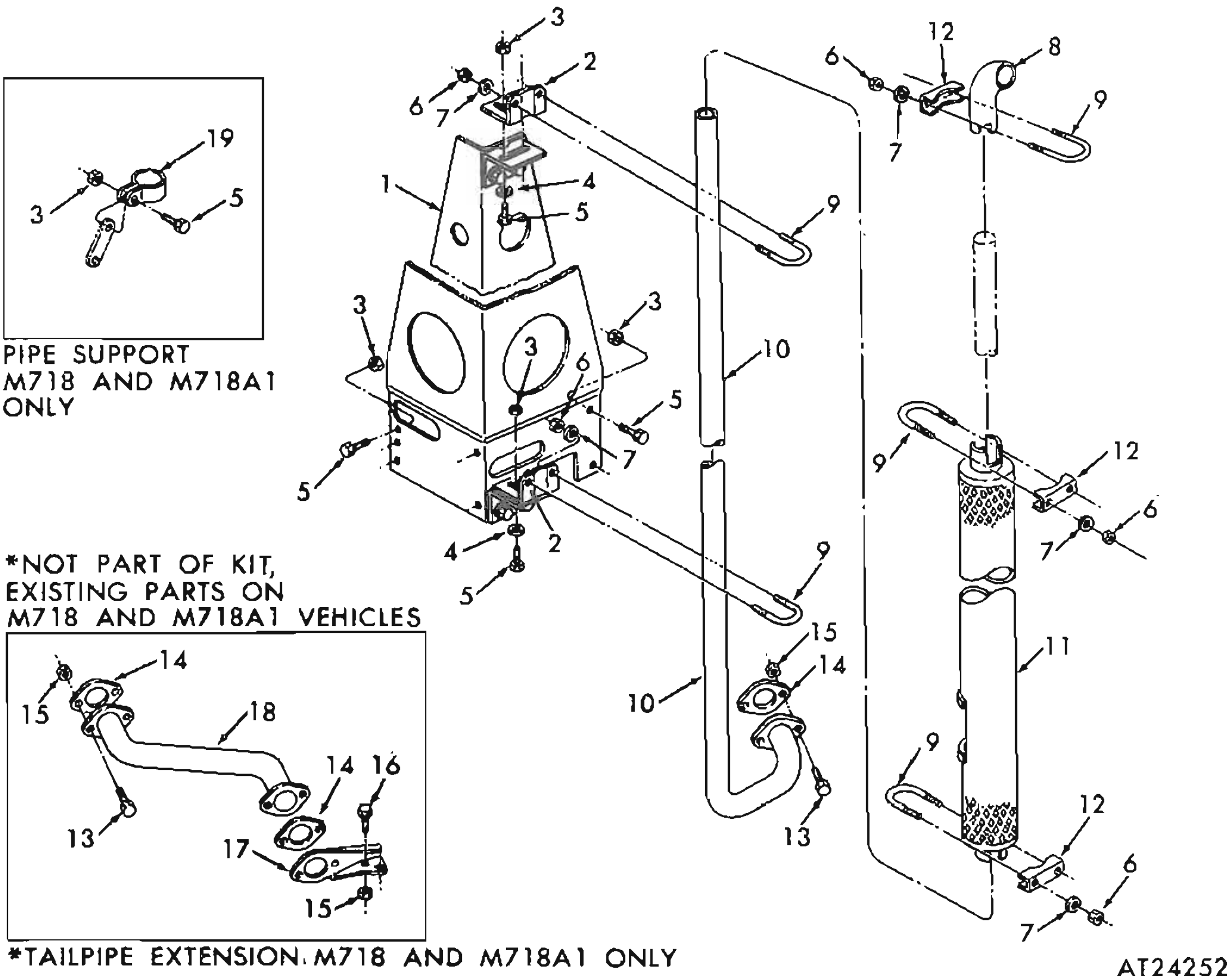
(2) Remove nut retaining control assembly to instrument panel and carefully pull control and cable from instrument panel and firewall along with instruction plate.

(3) Remove one intake manifold screw retaining control bracket, and remove bracket.

b. *Installation.* For installation instructions, refer to paragraph 18-75 *b*.

18-84. Repair Standards

Inspect the fording kit components for damage and determine repairs required. If a part is bent so that watertight alinement is lost, it must be discarded. Weathered air hoses should be discarded. Tubes may be welded, provided the watertight properties are retained and the tube is not weakened or restricted to impede flow of air or exhaust gases. Aluminum parts should be protected from corrosion. Brackets and supports that are cracked, excessively bent, or collapsed should be discarded.



Key	Item	Quantity
1	Support (not for use on M718 and M718A1).	1
2	Clamp (not for use on M718 and M718A1).	2
3	Nut (Not for use on M718 or M718A1).	12
4	Washer	4
5	Screw	12
6	Nut	10
7	Lockwasher	10
8	Tail pipe, exhaust	1
9	U bolt	5
10	Pipe assembly	1
11	Guard assembly	1
12	Clamp	3
13	Screw	2
14	Gasket	1
15	Nut	2
16	Screw (M718 and M718A1 only).	2
17	Support	1
18	Pipe, exhaust (part of M718 and M718A1).	1
19	Clamp (M718 and M718A1)	1

Figure 18-107. Exhaust pipe extension and associated parts.

18-85. Description and Data

For description and data of 100-ampere generator (alternator) kit, refer to TM 9-2320-218-20.

18-86. Preliminary Operations

a. Remove right front seat, battery cover; disconnect and remove both batteries, remove air cleaner, carburetor intake hose from vehicle, radiator, and fan shroud.

b. Before starting this operation, check that batteries have been disconnected as indicated in *a* above. Disconnect main wiring harness lead from 60-ampere generator or 25-ampere generator; remove cable retaining clips on fender panel, and horn mounting screw.

c. On 25-ampere systems, push contact out of cable receptacle, and tape to prevent the possibility of grounding.

d. On 60-ampere systems, tape terminals.

e. Remove and discard generator regulator and attaching parts.

f. Remove generator and stow attaching parts.

g. Remove generator adjusting arm.

h. Remove radiator support from engine; discard support and stow attaching parts.

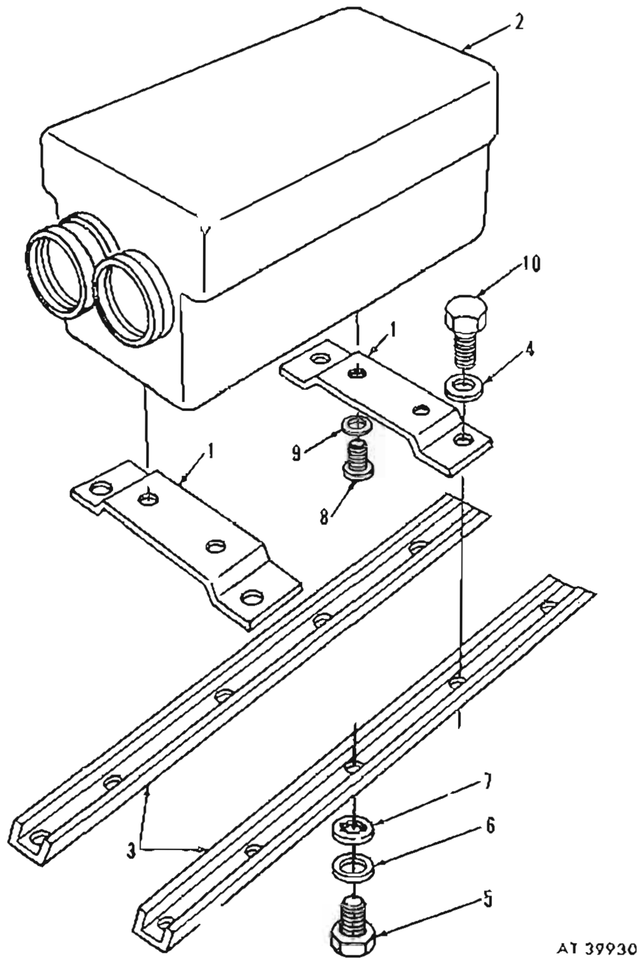
i. Remove four screw and washer assemblies securing fan and water pump pulley to water pump. Lift off fan and pulley from water pump.

j. Remove hex-head capscrew and washer securing crankshaft pulley to crankshaft. Discard crankshaft pulley, but save capscrew and washer.

NOTE

If necessary to hold crankshaft, place transmission in gear and apply parking brake.

k. Remove and discard cable clip located on inside of vehicle at the right side of the transmission tunnel cover on the dash panel. Retain bolt, nut, and washers.



Key	*Item*	*Quantity*
1	Bracket	2
2	Regulator (100 ampere)	1
3	Bracket	2
4	Washer (lock)	5
5	Screw (5/16-18)	6
6	Washer (lock)	6
7	Washer (flat)	5
8	Screw (10-32)	4
9	Washer (lock)	4
10	Screw (5/16-18)	4

Figure 18-108. Regulator and attaching hardware.

NOTE

If vehicle under preparation is equipped with —65° F. winterization kit, remove and discard the two clips (7331197) securing the cables at the body side cowl (right side—inside vehicle).

18-87. Drilling
(fig. 18-108)

a. Assemble two brackets (1) to regulator assembly (2), using four screws (8) and four washers (9). Assemble two brackets (3) to regulator brackets using four screws (10) and four washers (4).

b. Using regulator and bracket assembly as a template, locate on right fender apron and scribe six hole locations (fig. 18-109). Drill six 11/32-inch holes.

c. Locate and drill two 9/32-inch holes in upper cowl panel and one 9/32-inch hole in dash support panel (fig. 18-110).

d. Locate and drill one 1-inch diameter hole in right side of transmission tunnel (fig. 18-111).

e. Locate and drill one 13/16-inch hole in right seat riser (fig. 18-112).

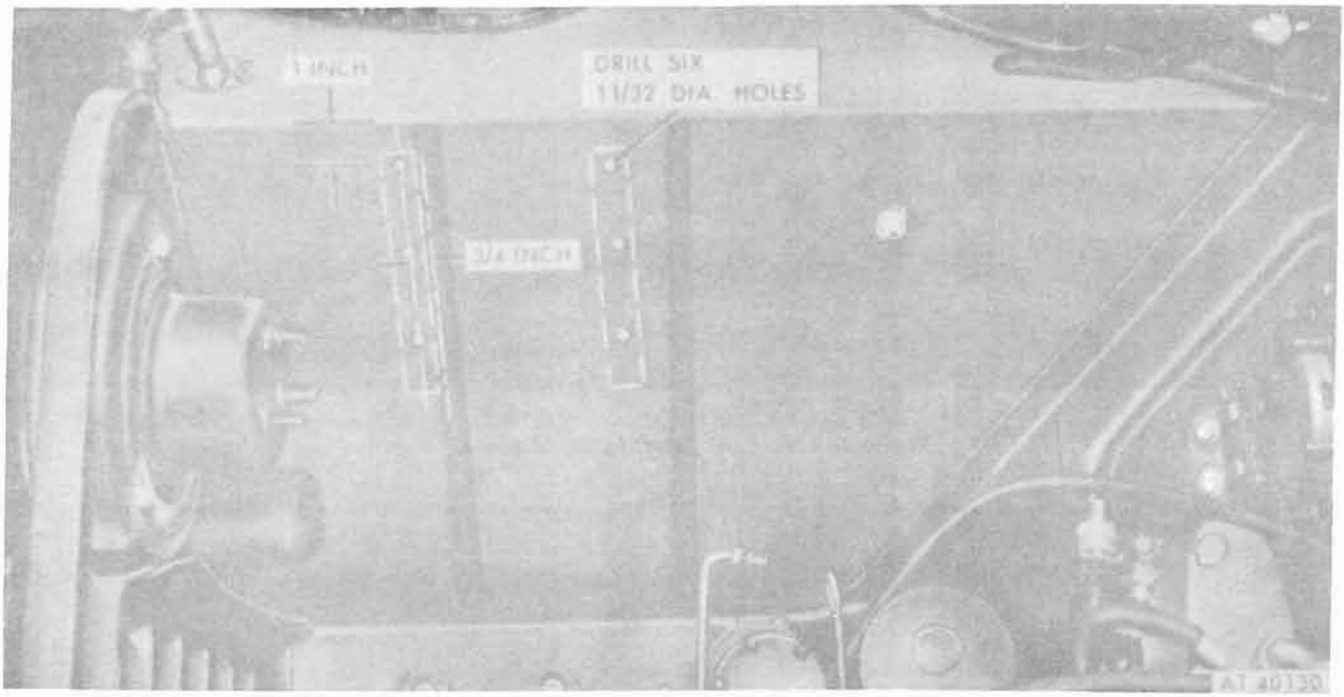


Figure 18-109. Right fender apron drilling diagram.

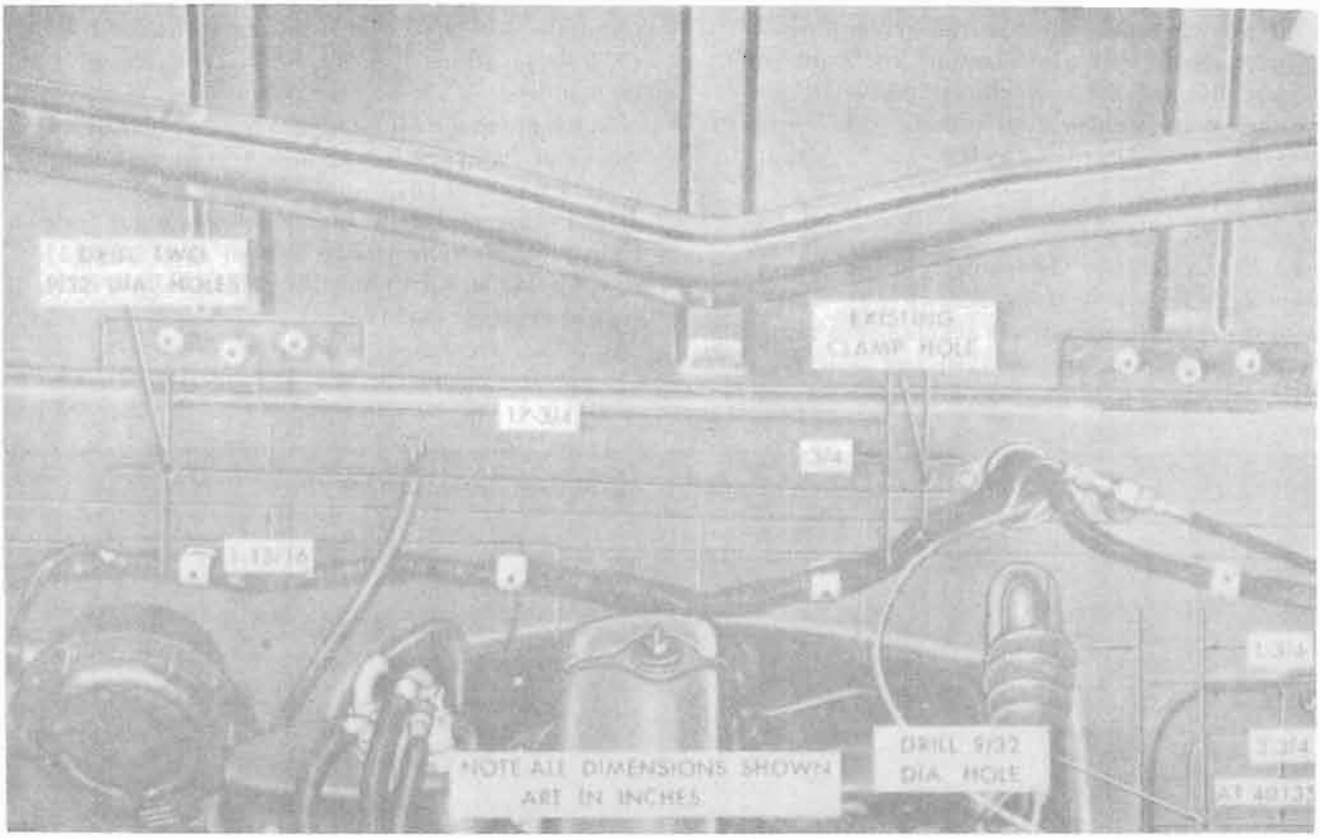


Figure 18-110. Cowl panel drilling diagram.

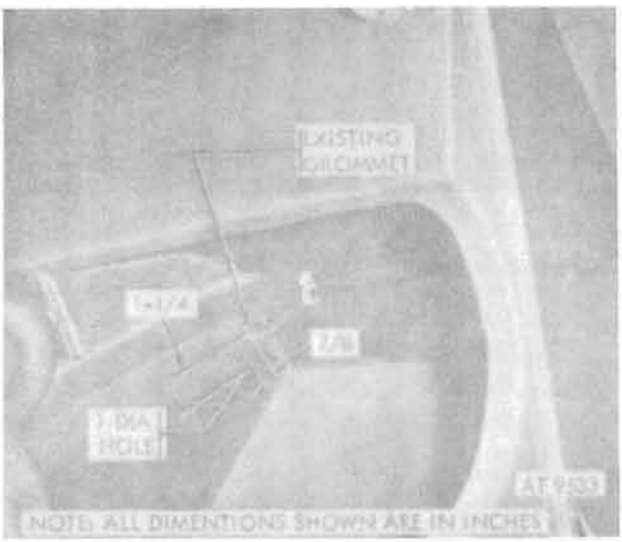


Figure 18-111. Right transmission tunnel drilling diagram

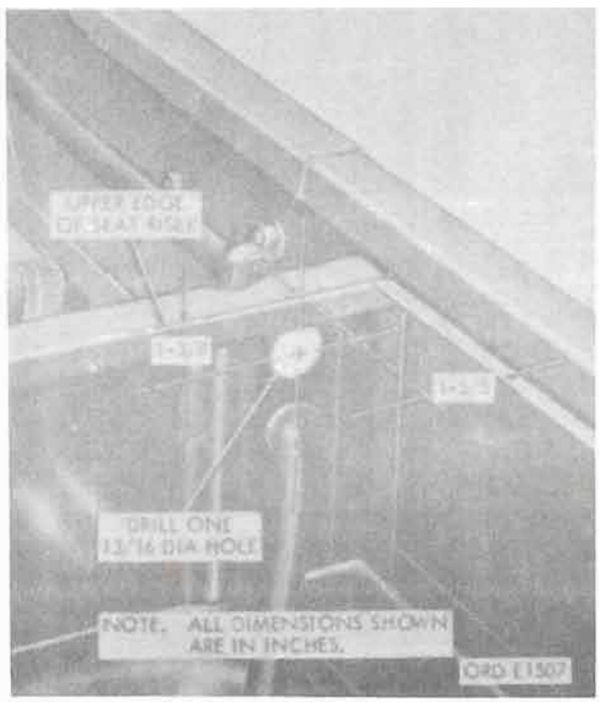


Figure 18-112. Right seat riser drilling diagram.

18-88. Installation of Subassemblies

a. Installation of Regulator Assembly. Position regulator and bracket assembly on fender panel, and secure with five lockwashers (6), five washers (7), one internal-external tooth lockwasher (4), and six screws (5)(fig. 18-108). Tighten screws to 14-16 lb.-ft. torque.

NOTE

Install screws from the wheel side of the fender panel. Position internal-external tooth washer at screw head of one retaining screw.

b. Installation of Alternator.

NOTE

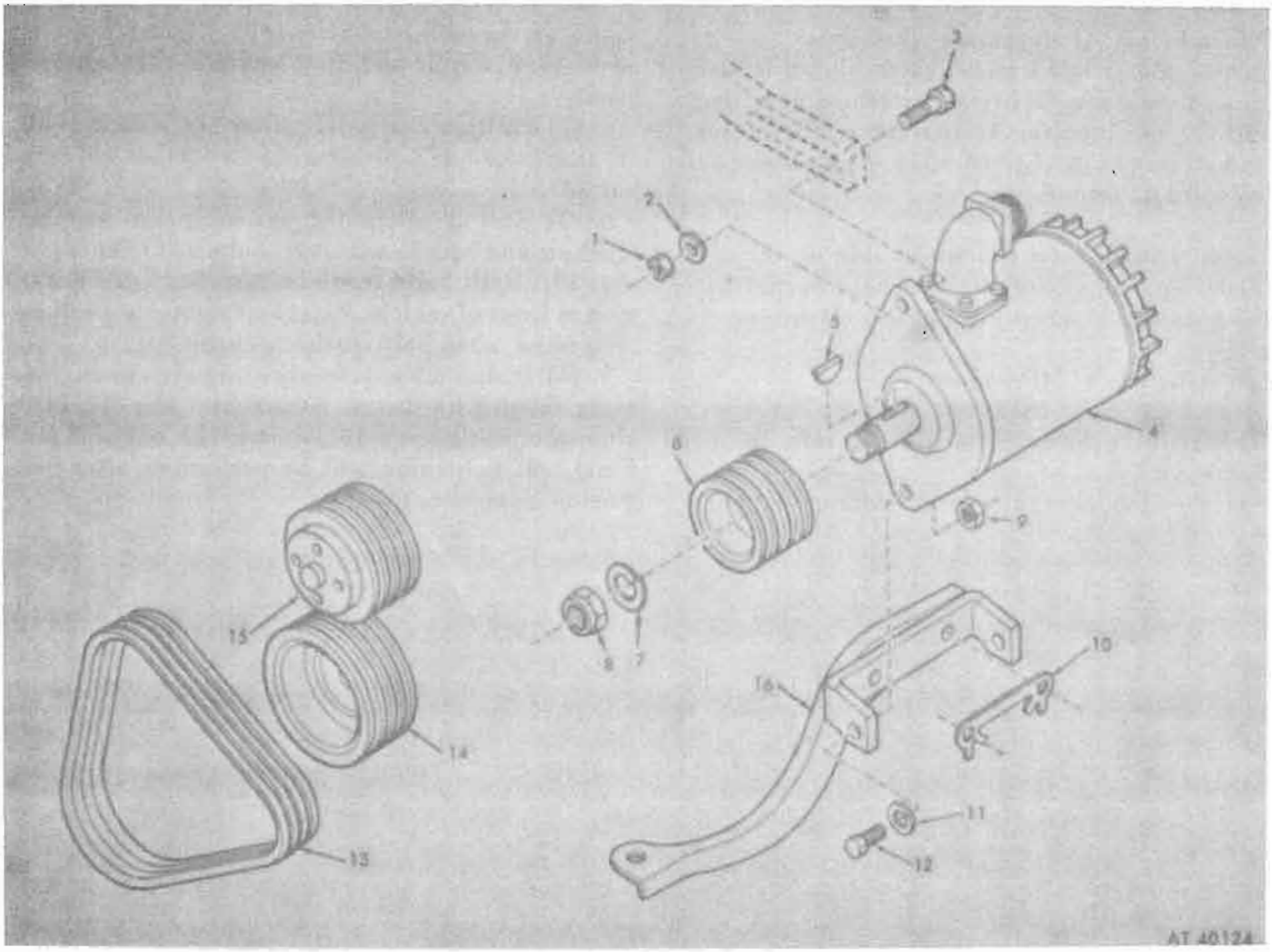
Key numbers shown in parentheses refer to figure 18-113.

(1) Position alternator and radiator support bracket (16) on engine, and secure using existing support bolts with lock plate (10). Tighten bolts to 58-65 lb.-ft. torque and bend lock plate against bolt heads.

(2) Position alternator pulley (6) with key (5) on alternator (4) and secure with washer (7) and nut (8).

(3) Install alternator assembly on support bracket, and secure with two bolts (12), and two nuts (9). Both bolts are to be installed with heads toward front of vehicle. Final bolt tightening will be performed after belt tension adjustment.

(4) Install alternator adjusting arm to engine, using existing hardware. Attach arm (fig. 18-114) alternator using screw (3), washer (2), and nut (1). Final bolt tightening will be performed after belt tension adjustment.



Key	Item	Quantity
1	Nut (3/8-16 UNC)	1
2	Washer (knurled 3/8)	1
3	Screw (3/8-16 UNC)	1
4	Alternator (W / O Pulley)	1
5	Key	1
6	Pulley (alternator)	1
7	Washer (flat)	1
8	Nut (self-locking)	1
9	Nut (self-locking)	2
10	Plate (lock)	1
11	Washer (flat)	2
12	Screw (7 / 16-20) UNF)	2
13	Belt set	1
14	Pulley (crankshaft)	1
15	Pulley (water pump)	1
16	Bracket	1

Figure 18-113. 100-ampere alternator and attaching hardware.

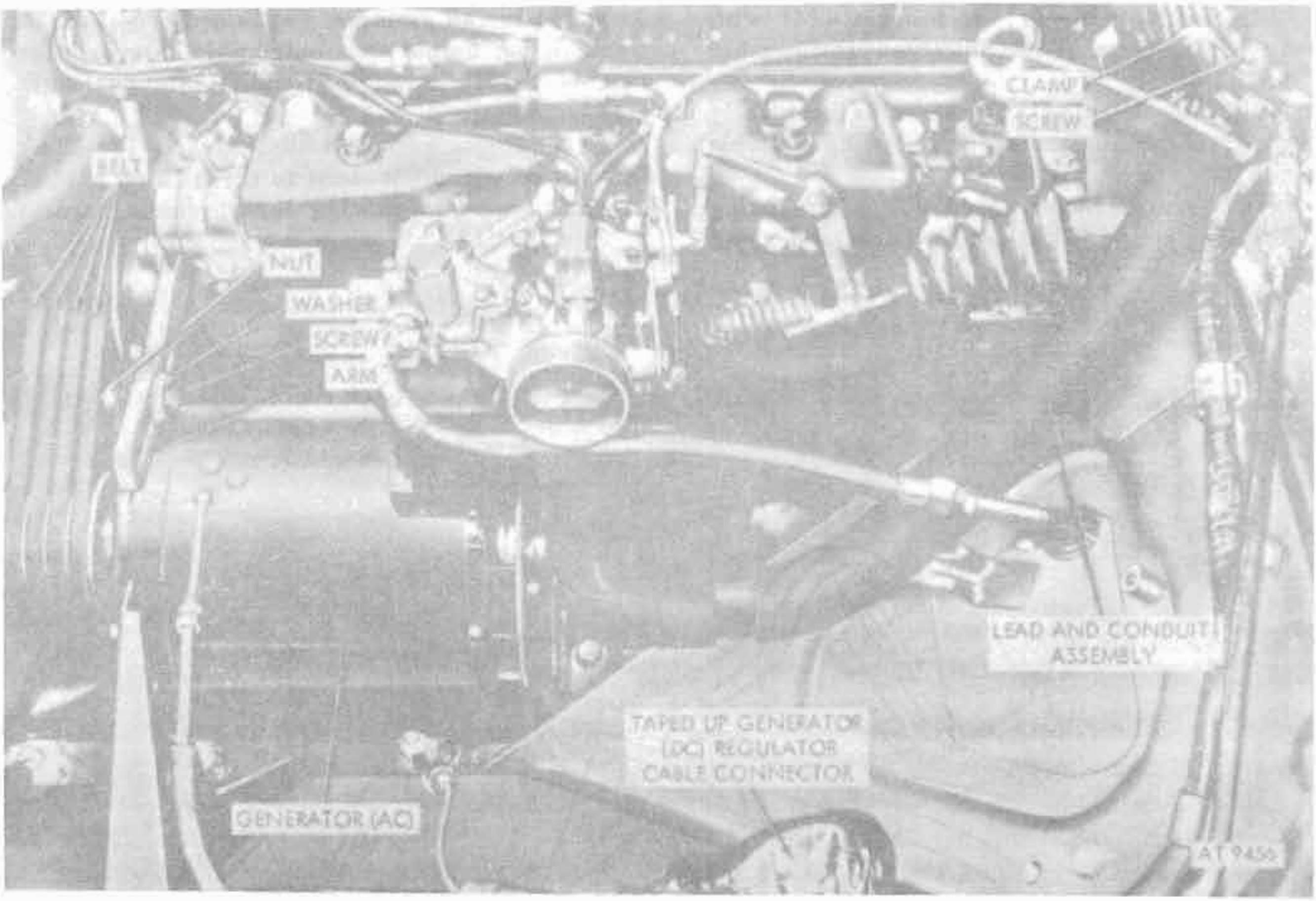


Figure 18-114. Generator (alternator) installed.

c. Installation of Pulleys and Belts (fig. 18-113).

(1) Install crankshaft pulley (14) and secure with existing hardware. Tighten capscrew to 50-55 lb.-ft. torque.

(2) Install water pump pulley (15) and existing fan on water pump, using existing hardware. Tighten screws to 15-18 lb.-ft. torque.

(3) Install belt set (13) over pulleys. Pull alternator outward and tighten adjusting arm bolt. Check belt tension by placing a straight edge over belts between water pump pulley and alternator pulley. Maintain a deflection of approximately ⅛ inch when 18-22 pounds pressure is applied. Adjust as required, and tighten adjustment arm bolt to alternator 35-40 lb.-ft. torque, adjustment arm to engine bolt 47-56 lb. ft. torque, and alternator to support bolts 60-70 lb.-ft. torque.

(4) Install radiator and fan shroud.

d. Installation of Wiring Harness and Cables.

NOTE

Key numbers shown in parentheses refer to figure 18-115.

(1) Reposition existing front wiring harness into harness clips on fender panel, and secure ground wire to fender panel, using existing clamp, screw, washer, and nut.

(2) Connect wiring harness (13) to regulator forward receptacle; aline slot with guide to assure proper installation. Tighten connector securely, using suitable wrench.

(3) Route harness along fender panel, and fasten ground lead terminal (4) to horn bracket, using screw (MS90725-6), one washer (MS45904-68), and two washers (MS35335-33).

NOTE

Install one external-internal tooth washer between ground terminal and horn bracket, and one external tooth washer on each side of existing clamp.

(4) Connect cable (1) to regulator receptacle; aline slot with guide to assure proper installation. Tighten connector securely using suitable wrench.

(5) Route cable rearward to cowl panel; remove the clamp from rear of the right fender panel and replace with clamp (3) to secure cable (1).

(6) Route cable along cowl panel and secure with two clamps (3) at the two drilled holes using two screws MS90725-5 and nuts MS51967-2.

(7) Install bracket (14) at dash support drilled hole using screw MS90725-3, washer MS35333-40, and nut MS51967-2.

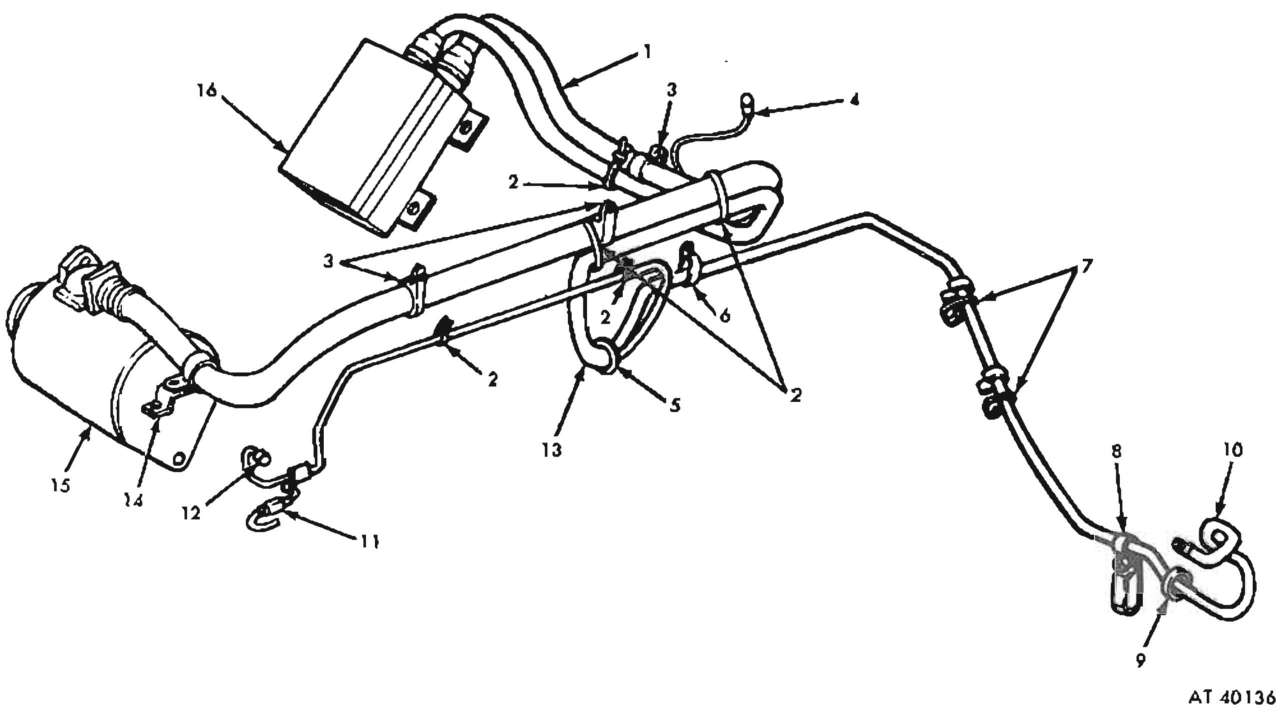
(8) Secure cable (1) at bracket (14) with clamp (3) using screw MS90725-5 and washer MS35333-40.

(9) Connect cable (1) at alternator receptacle; tighten cable connector securely, using suitable wrench.

(10) Secure cables (1 and 13) with existing cables using straps (3) at fender panel and along cowl.

(11) Install grommet (5) into drilled hole in transmission tunnel and route cable harness leads (10, 11, 12) through grommet into passenger compartment.

(12) Route harness leads (11 and 12) along front of crew compartment to the ignition switch. Secure harness to existing main vehicle harness using straps (2).



Key	*Item*	*Quantity*	*Key*	*Item*	*Quantity*
1	Cable (alternator to regulator).	1	9	Grommet	1
2	Strap	5	10	Harness positive (at battery terminal).	1
3	Clamp	4	11	Harness connector (to ignition switch).	1
4	Harness ground (at horn mount).	1	12	Harness connector (to existing harness lead No. 27).	1
5	Grommet	1	13	Cable (regulator to battery).	1
6	Clamp	1	14	Bracket (clamp retainer).	1
7	Strap	2	15	Alternator and pulley assembly.	1
8	Clamp	1	16	Regulator	1

Figure 18-115. 100-ampere alternator system components.

(13) Disconnect existing lead No. 27 from the ignition switch and insert into lead (12) and connect lead (11) on ignition switch.

(14) Install grommet (9) in right seat riser and route cable lead (10) into battery compartment.

(15) Secure cable lead (10) to existing battery cable using straps (7) and secure cables to vehicle using clamps (6 and 8) with existing hardware (fig. 18-116).

(16) Install batteries and reconnect cables; connect lead (10) to positive terminal connector.

(17) Install battery compartment cover and right front seat.

(18) Fill radiator with coolant and check for leaks.

18-89. Operating Test

a. Start engine and increase speed to approximately 1,500 rpm.

b. Observe generator-battery indicator; indicator should be in green band.

c. Turn on electrical equipment to create a 70- to 80-ampere load. The indicator should still be in the green band.

d. Continue this operation for several minutes to allow fan belts to seat.

e. Turn off all equipment except the headlights and run engine at 1,000 rpm for 15 to 20 minutes.

f. Stop engine and adjust belt tension (para 18-88).

g. Check all attaching bolts, nuts, and cable connectors.

18-90. Troubleshooting

a. For troubleshooting the 100-ampere generator system, as installed on the vehicle, refer to TM 9-2320-218-20. For pertinent organizational maintenance test procedures, refer to TB 9-2300-206-15.

b. For troubleshooting component defects, refer to TB 9-2300-206-15.

18-91. Repair Procedures

a. For instructions on installation of components, refer to paragraph 18-88. For removal of components, reverse the installation as applicable.

b. For disassembly, repair, and assembly of the major components; generator (alternator) and regulator, refer to TB 9-2300-206-15.

18-92. Repair Standards

For repair standards, refer to TB 9-2300-206-15 and TM 9-2920-225-34.

Section VII. M16/14' RIFLE MOUNT KIT

18-93. Installation

For description and installation of the M16/14 rifle mount kit refer to TM 9-2320-218-20.

18-94. Inspection and Repair

a. Inspection. Inspect dash panel, panel reinforcement, floor bracket, and mount for cracks, straightness, and/or other damage.

b. Repair. Straightening and repair may be made using general maintenance practices and procedures when necessary.

Section VIII. DOORS AND SIDE CURTAINS

18-95. Installation

For description and installation of the door and side curtain kit (10950781), refer to TM 9-2320-218-20.

18-96. Inspection and Repair

a. Inspection. Inspect canvas doors and side curtains for fit, broken fasteners, rips and tears in the canvas and cracked or broken plastic windows.

b. Repair. Refer to paragraph 17-33 for repair of canvas body items.

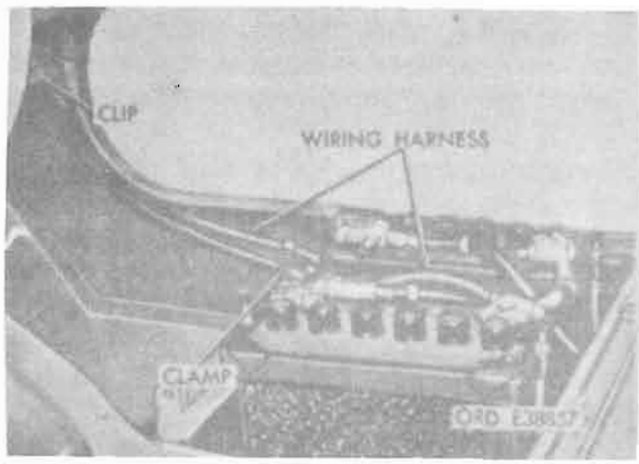


Figure 18-116. Crew compartment wiring and clips.

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By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

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Major General, United States Army,
The Adjutant General.

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