TM 9-2320-244-34

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

TRUCK CARGO 1 1/4-TON 4x4, M715
WO/WINCH (FSN 2320-921-6365)
W/WINCH (FSN 2320-921-6366)

TRUCK, AMBULANCE 1 1/4-TON, 4x4, M725 WO/WINCH
(FSN 2310-921-6369)

TRUCK, MAINTENANCE, 1 1/4-TON 4x4, M726
W/O WINCH (FSN 2320-921-6370)
W/WINCH (FSN 2320-921-6833)

HEADQUARTERS, DEPARTMENT OF THE ARMY Washington, D. C., 2 October 1971

*This manual supersedes TM 9-2320-244-34, 30 September 1968, including all changes.

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CHAPTER 1
INTRODUCTION

Section I.
GENERAL

1-1. Scope.
a. This technical manual contains instructions for direct support and general support maintenance of Cargo Truck M715, Ambulance Truck M725 and Maintenance Truck M726. Contained herein are removal, disassembly, inspection, repair, overhaul, assembly and installation procedures normally beyond the

scope of tools, equipment or supplies available to the using organization.
b. Those references required by and available to direct support and general support maintenance personnel are contained in Appendix A.
c. Repair parts, special tools, test and support equipment are listed in TM 9-2320-244-34P.

1-2. Maintenance Allocation.
The prescribed maintenance responsibilities, as allocated in the Maintenance Allocation Chart of TM 9-2320-244-20, are reflected in this manual.

1-3. Maintenance forms, records and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

1-4. Equipment Serviceability Requirement.
Equipment Serviceability Criteria for the Cargo Truck and Ambulance are contained in TM 9-2320-244-ESC.

1-5. Reporting of Errors.
Report of errors, omissions, and recommendations for improving this publication by the user is encouraged. Reports should be submitted on DA Form 2028, Recommended Changes to Publications, and forwarded direct to: Commanding General, U. S. Army Tank Automotive Command, Attn: AMSTA-MAPT, Warren, Michigan 48090.

1-6. Description.
a. The Cargo Truck (fig 1-1) is designed as a cargo and personnel carrier for use over all types of roads, highways, crosscountry terrain and all types of climatic conditions. The Cargo Truck is designed to ford hard bottom fresh or salt water crossings up to a depth of 30-inches and to a depth of 60-inches when equipped with special fording kit.

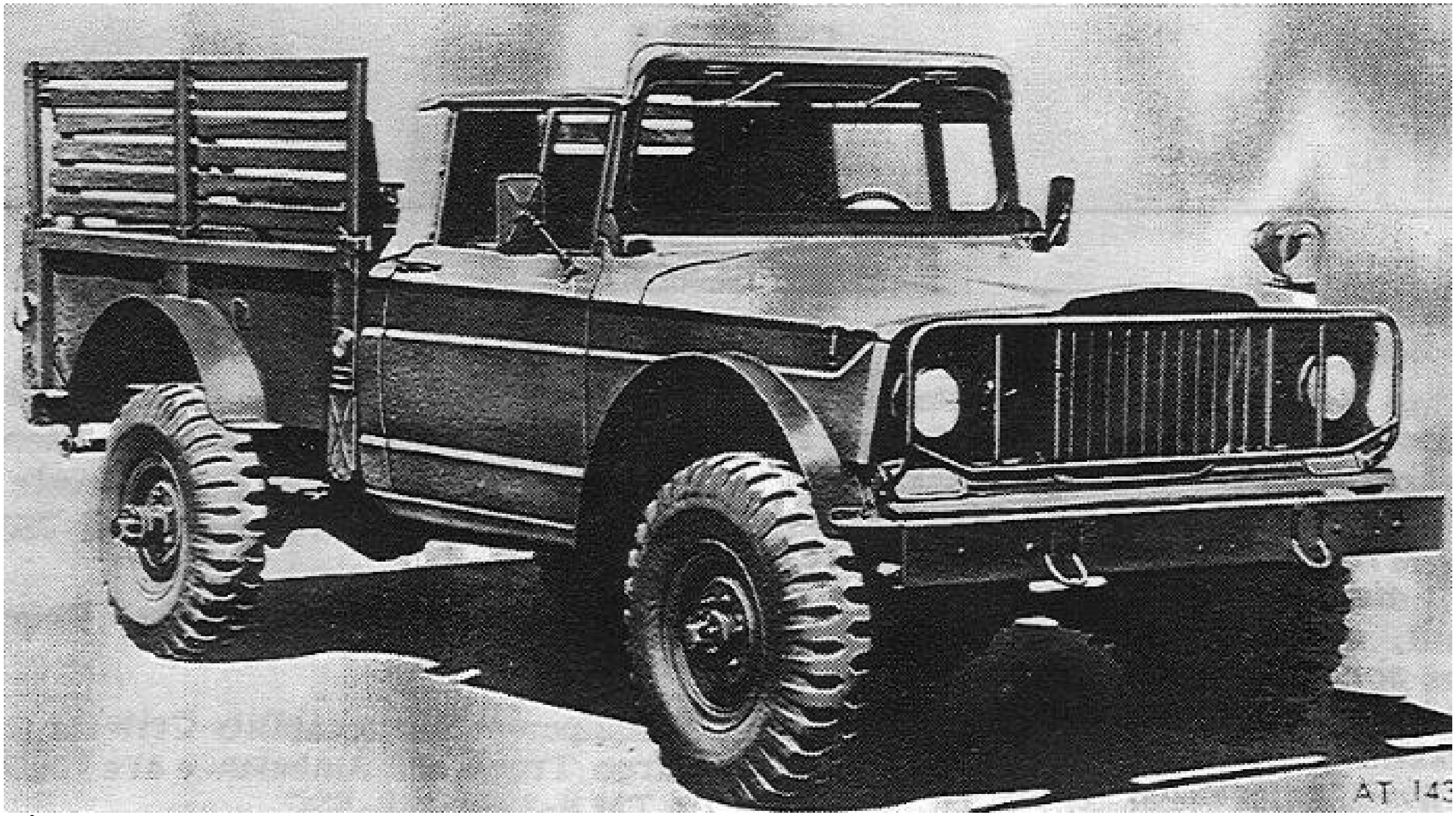


Figure 1-1

b. The Ambulance Truck (fig 1-2) is designed to carry eight patients and one attendant, or it will accommodate five litter patients. The body consists of a cab and patients compartment which is separated by a bulkhead with a sliding door. The body is constructed of rust resistant steel and is completely insulated; the floor pan is undercoated. A set of double doors at the rear of the vehicle provides access to the patient compartment. The Ambulance has the same capabilities and operational characteristics as the Cargo Truck.

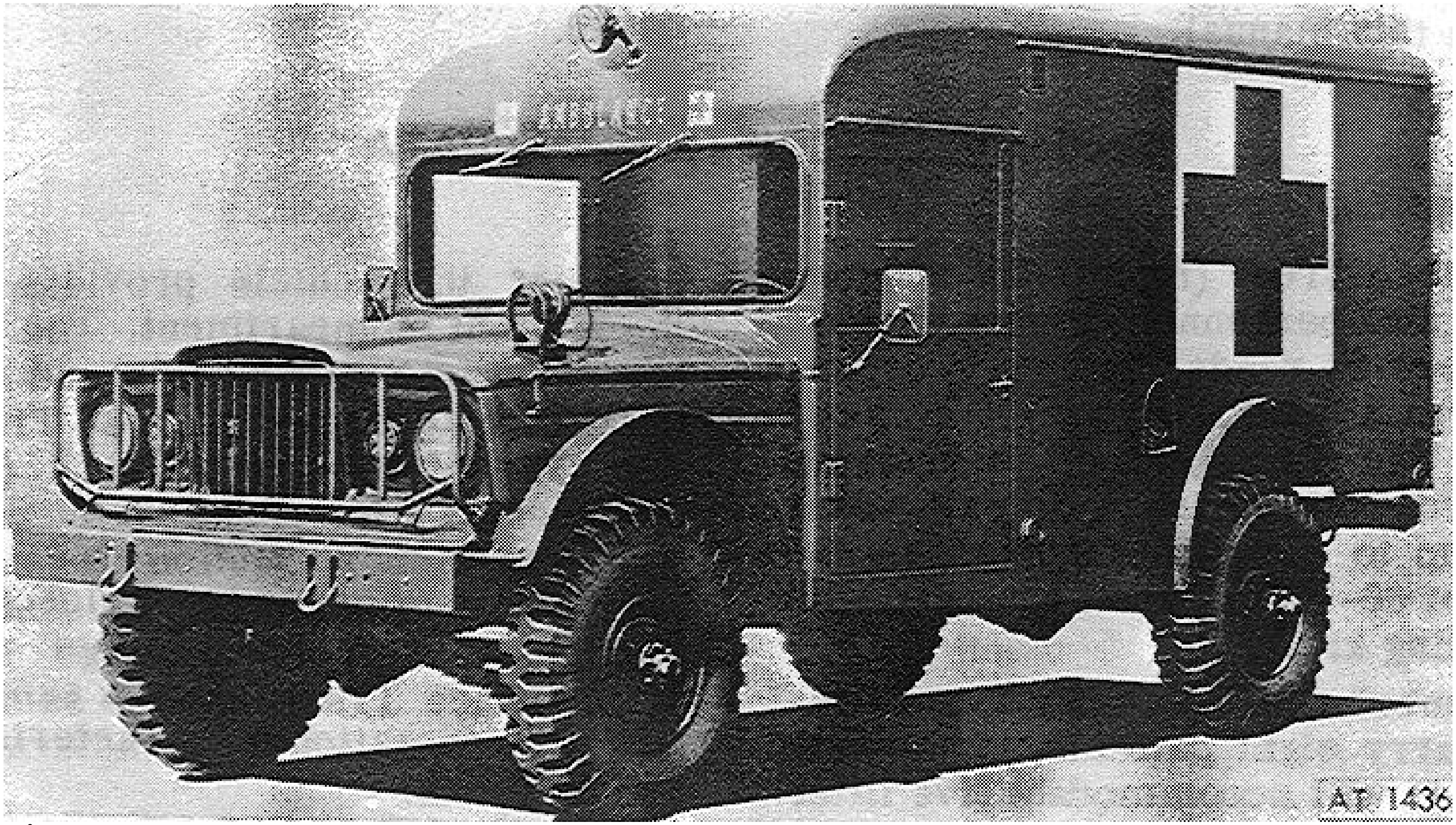


Figure 1-2

c. The Maintenance Truck (fig 1-3) is designed as a telephone maintenance truck. The rear body section consists of two side banks of drawer and closet type compartments with open cargo space. The Maintenance Truck has the same capabilities and operational characteristics as the Cargo Truck.
d. Information pertaining to the identification plates are contained in TM 9-2320-244-20. A more detailed description of specific components and assemblies is contained in the applicable section(s) of this manual.

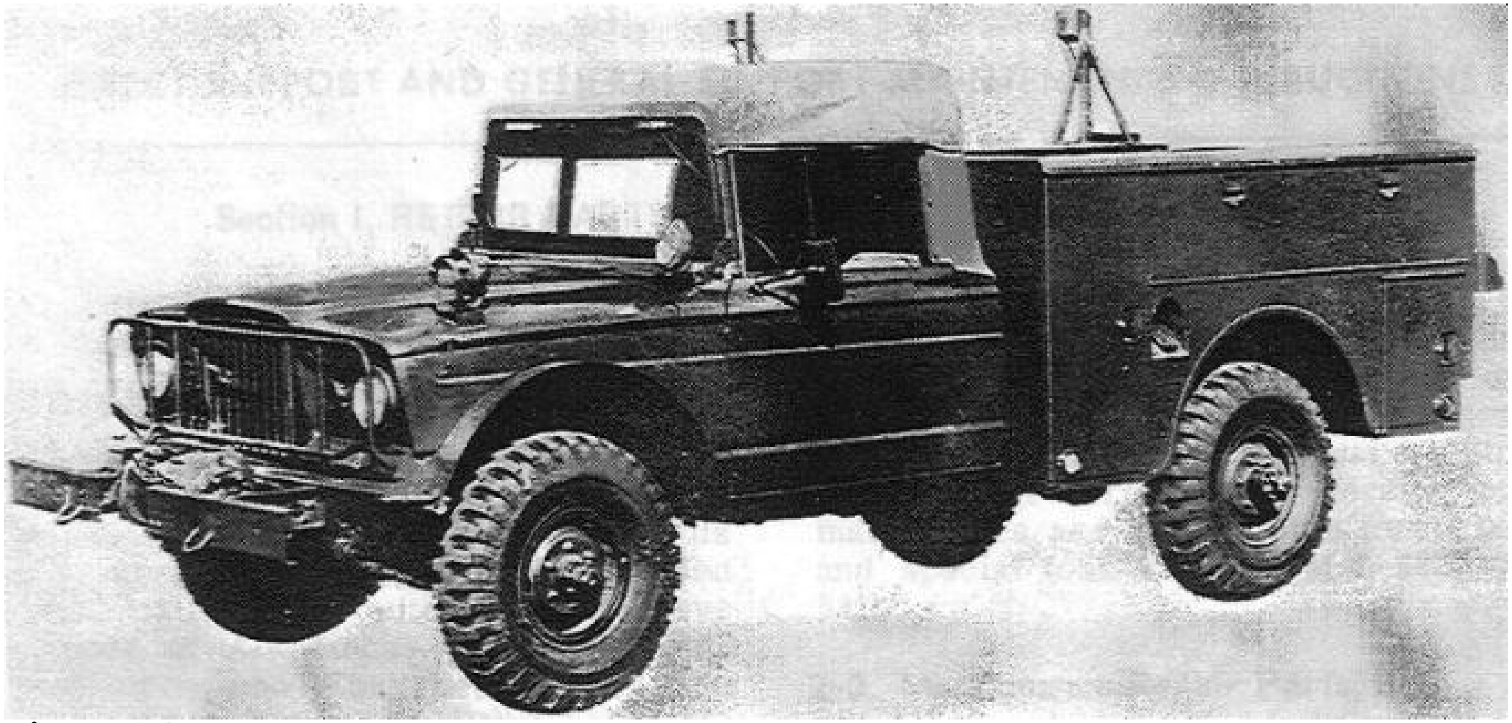


Figure 1-3

1-7. Differences Between Models.
A winch assembly is mounted by brackets attached to the frame side rails and front bumpers when the vehicle is so equipped. Vehicles equipped with a front winch have a transmission power take-off and a drive shaft to drive the winch.

1-8. Tabulated Data.
Refer to TM 9-2320-244-10 and TM 9-2320-244-20 for tabulated data pertaining to general characteristics and performance; and to repair chapters in this manual for technical data pertaining to major components.

CHAPTER 2
DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I.
REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

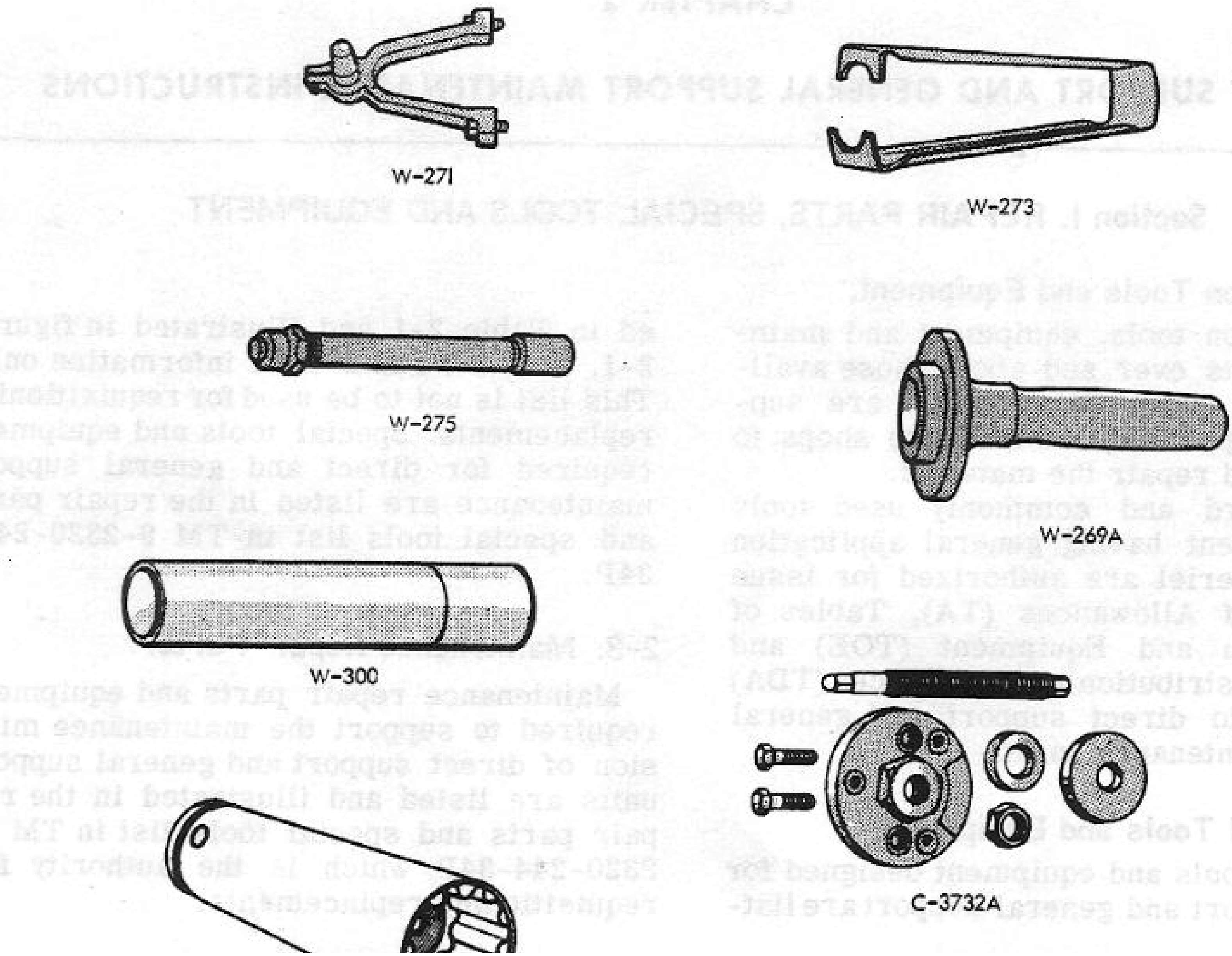
2-1. Common Tools and Equipment.
a. Common tools, equipment and maintenance parts over and above those available to the using organization are supplied to supporting maintenance shops to maintain and repair the materiel.
b. Standard and commonly used tools and equipment having general application to this materiel are authorized for issue by Table of Allowances (TA), Tables of Organization and Equipment (TOE) and Tables of Distribution and Allowances (TDA) applicable to direct support and general support maintenance units.

2-2. Special Tools and Equipment.

Special tools and equipment designed for direct support and general support are listed in Table 2-1 and illustrated in figures 2-1, 2-2, 2-3 and 2-4 for information only. This list is not to be used for requisitioning replacements. Special tools and equipment required for direct and general support maintenance are listed in the repair parts and special tools list in TM 9-2320-244-34.

2-3. Maintenance Repair Parts.

Maintenance repair parts and equipment required to support the maintenance mission of direct support and general support units are listed and illustrated in the repair parts and special tools list in TM 9-2320-244-34P which is the authority for requisitioning replacements



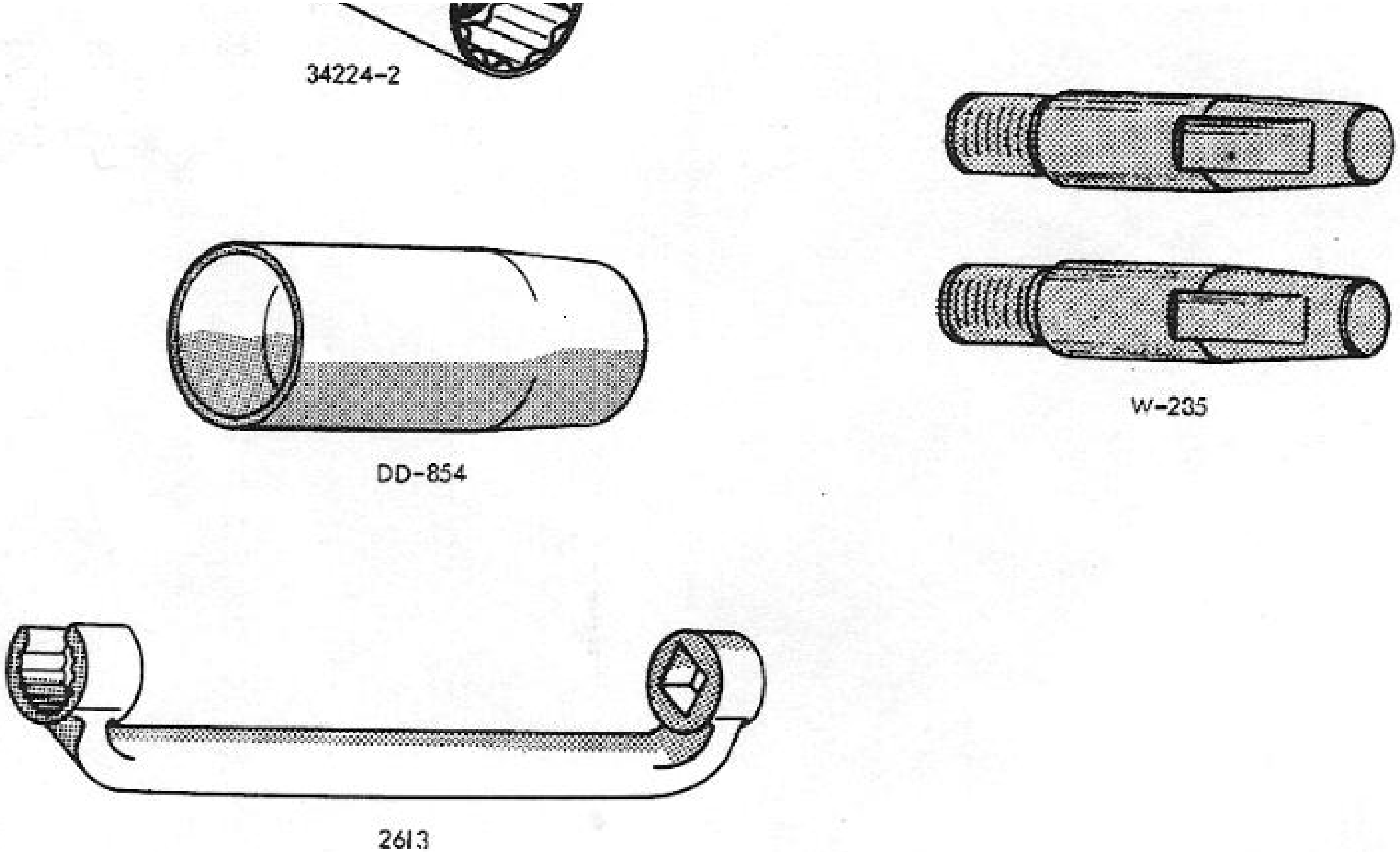
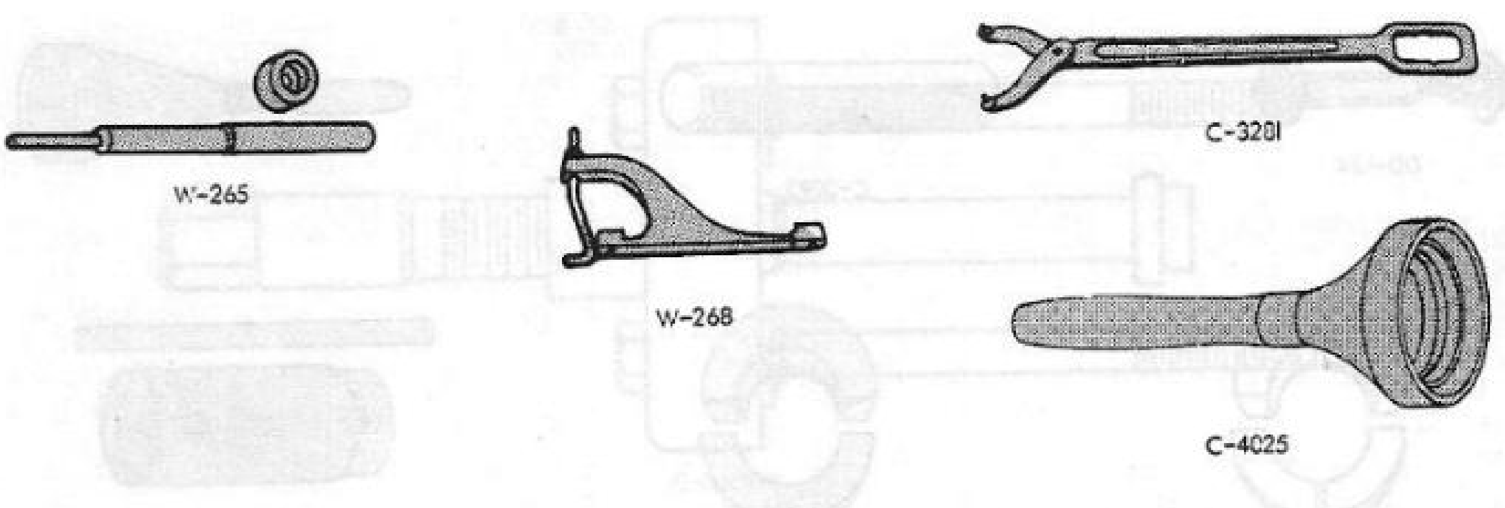


Figure 2-1. Special Tools



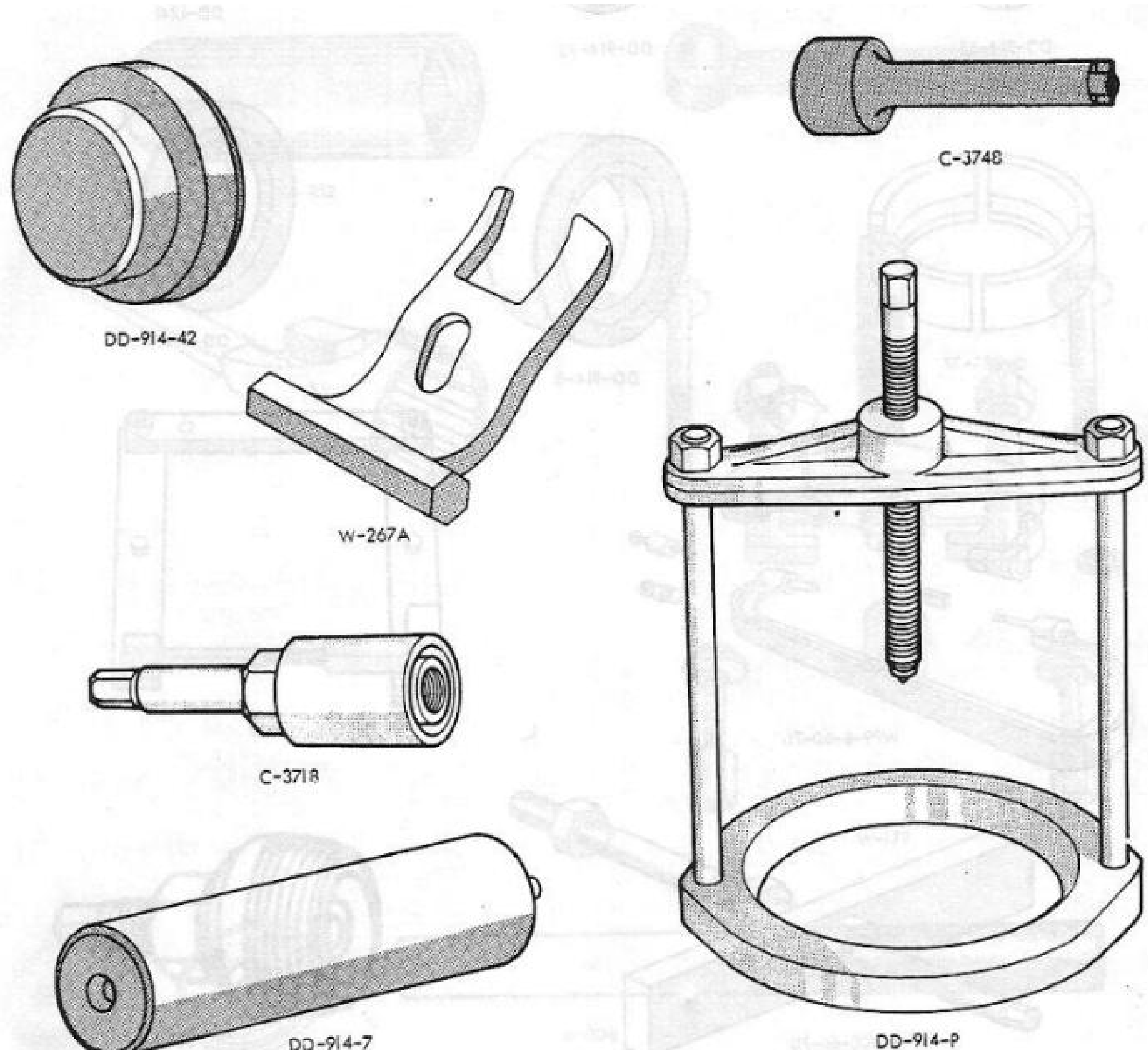
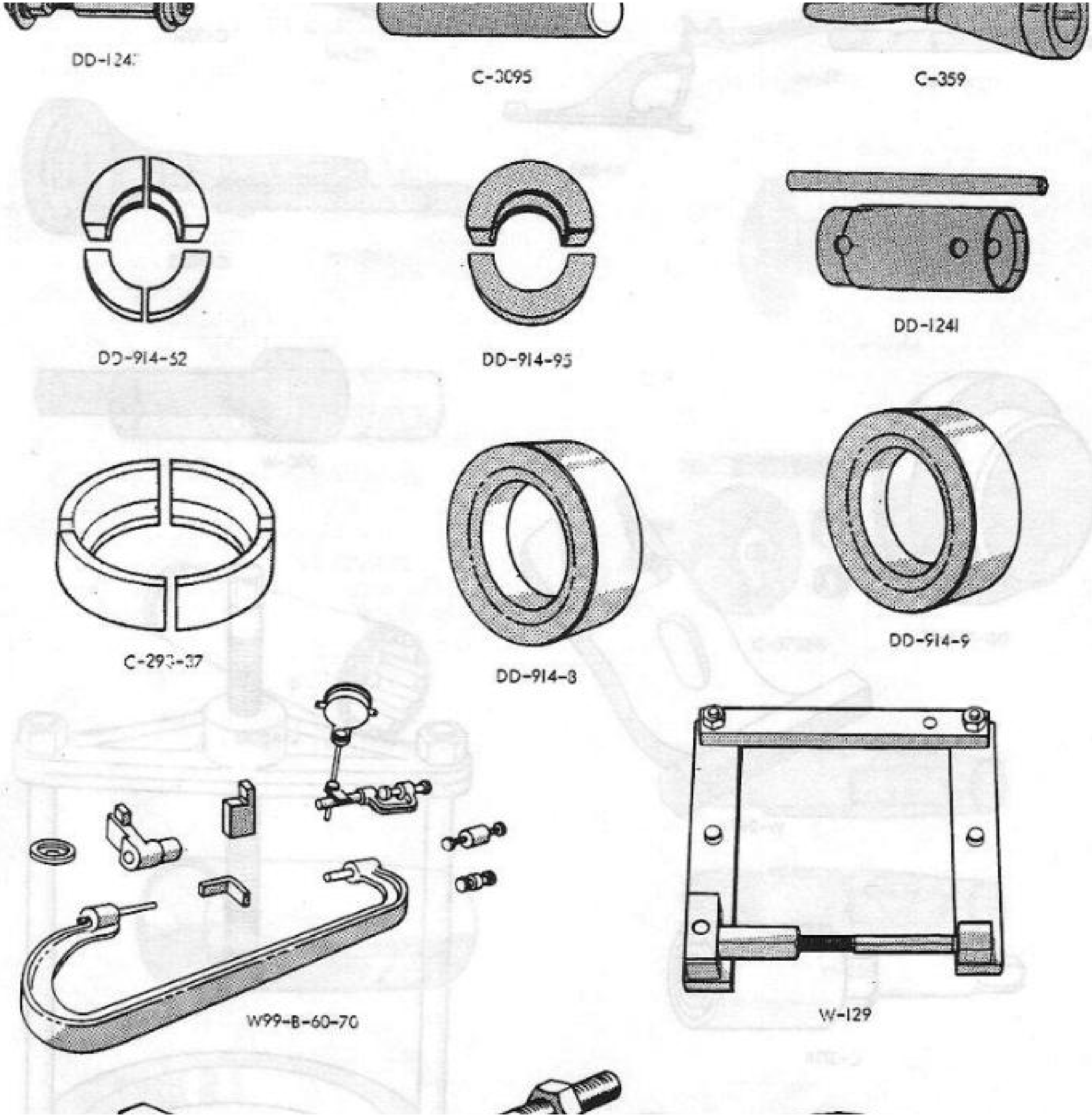


Figure 2-2. Special Tools


DD-124
C-3095
C-359
DD-914-52
DD-914-95
DD-1241
C-293-37
DD-914-8
DD-914-9
W99-B-60-70
W-129

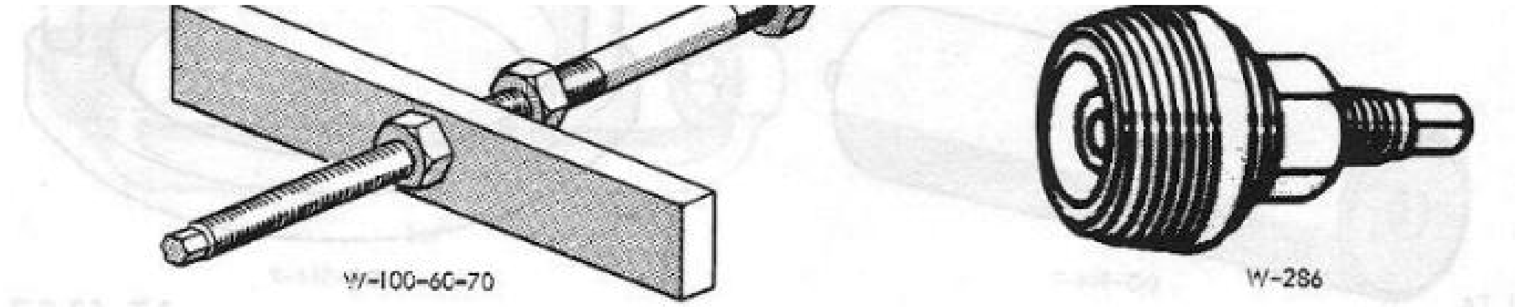
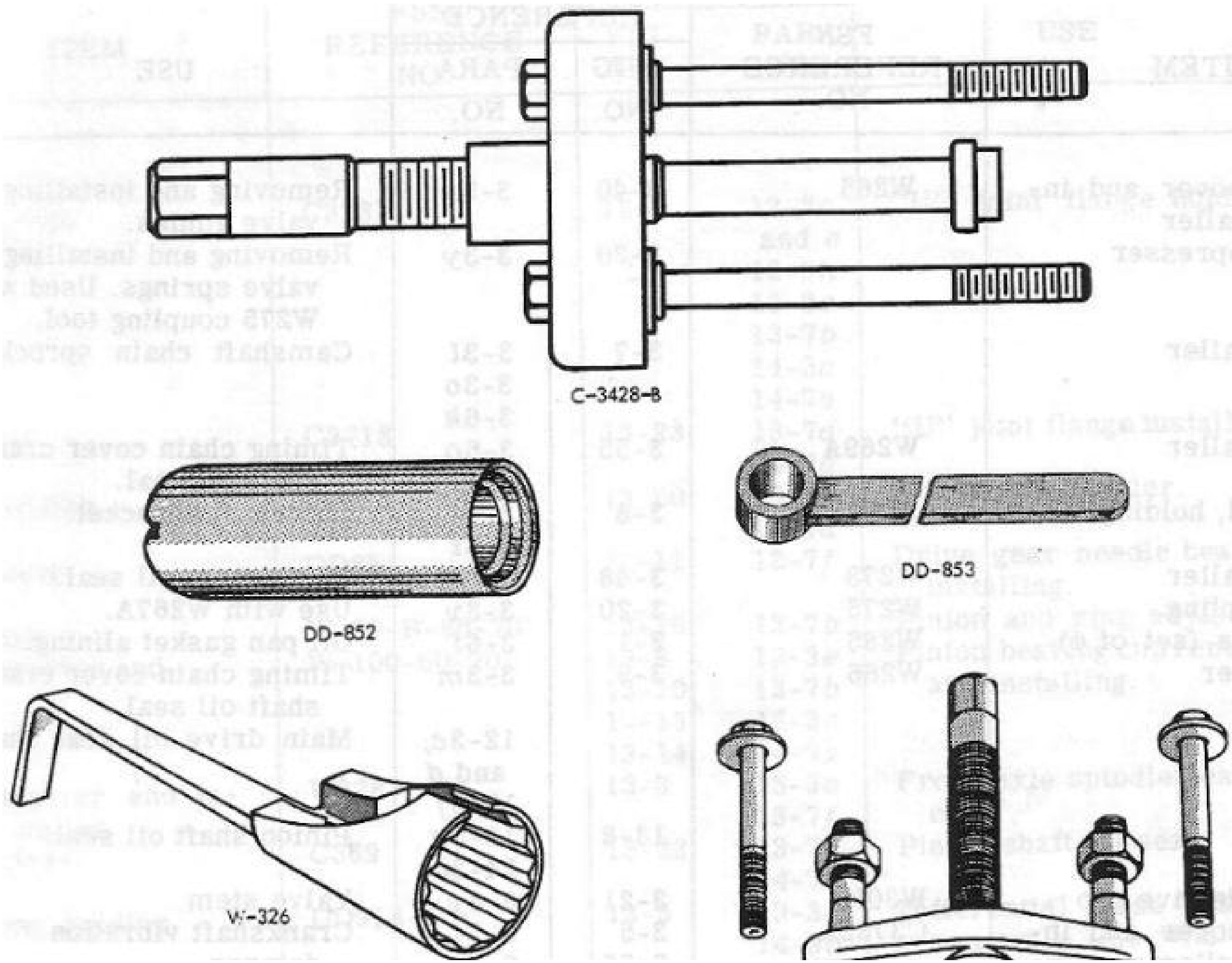


Figure 2-3. Special Tools



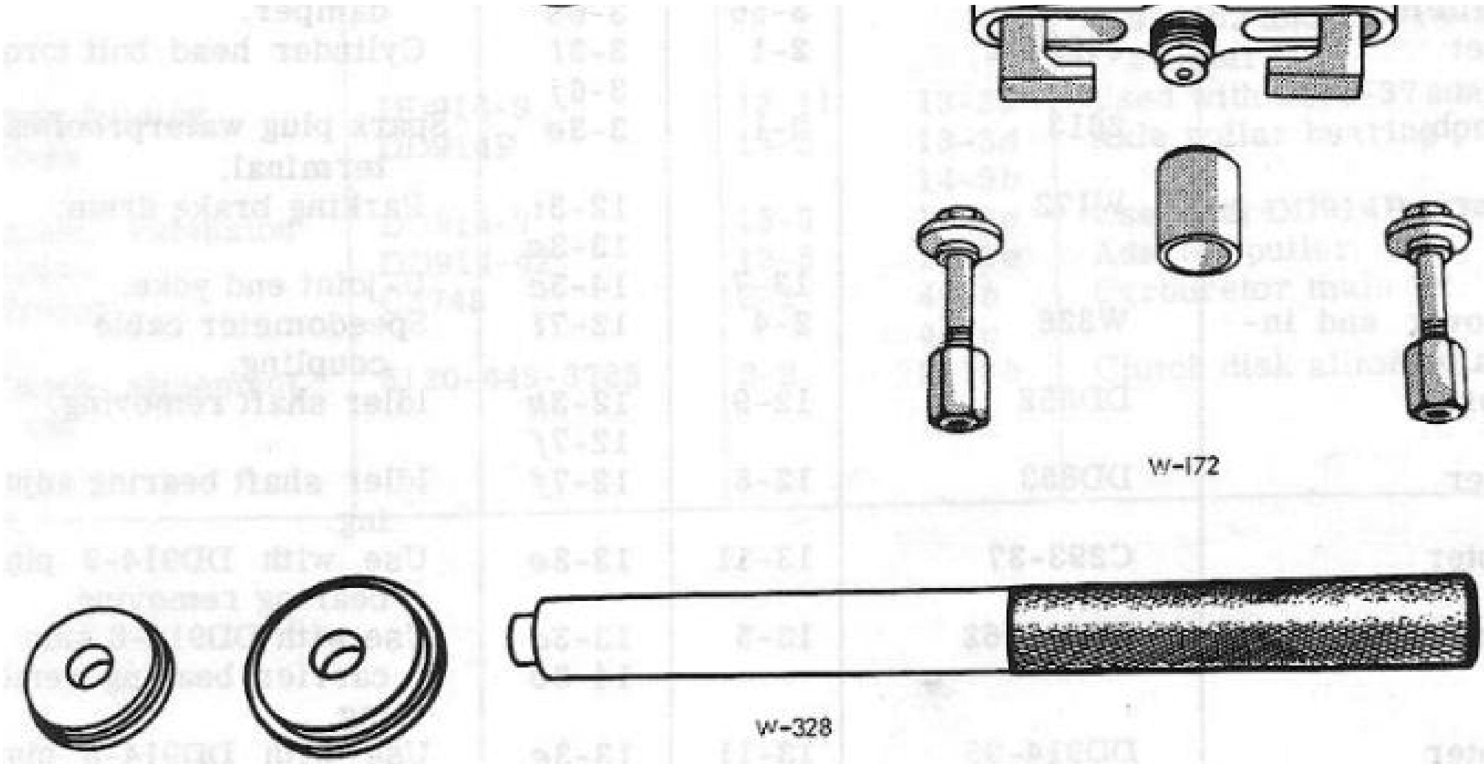


Figure 2-4. Special Tools

TABLE 2-1. Special Tools, Test, and Support Equipment.

ITEM	FSN REFERENCE NUMBER	REFERENCE FIGURE	REFERENCE PARAGRAPH	USE
Remover and installer	W265	3-40	3-5v	Removing and installing valve guides.
Compresser		3-20	3-3y	Removing and installing valve springs. Used with W275 coupling tool.
Installer		3-7	3-3l,3-3o,3-6k	Camshaft chain sprocket.
Installer	W269A	3-55	3-6o	Timing chain cover crank shaft oil seal.
Tool, holding	W27l	3-8	3-3l,3-3t	Camshaft sprocket.
Installer	W273	3-48	3-6b	Valve stem oil seal.
Coupling	W275	3-20	3-3y	Use with W267A.
Studs (set of 4)	W285	2-1	3-6i	Oil pan gasket alining.
Puller	W286	3-9	3-3m	Timing chain cover crankshaft oil seal.
			12-3c and d, 12-3j	Main drive oil seal shaft.
		13-8	13-3e,14-3a	Pinion shaft oil seal.

Protective cap	W300	3-21	3-3y	Valve stem.
Remover and installer	C3732A	3-5	3-3j	Crankshaft vibration damper.
		3-56	3-6s	Crankshaft vibration damper.
Socket	34224-2	2-1	3-31,3-6j	Cylinder head bolt torque.
Wrench	2613	2-1	3-3e	Spark plug waterproof cable terminal.
Puller	W172	12-31	13-3e	Parking brake drum.
		13-7	14-3a	U-joint end yoke.
Remover and installer	W326	2-4	12-7i	Speedometer cable coupling.
Arbor	DD852	12-9	12-3k,12-7f	Idler shaft removing.
Spacer	DD853	12-8	12-7f	Idler shaft bearing adjusting.
Adapter	C293-37	13-11	13-3e	Use with DD914-9 pinion bearing removing.
Adapter	DD914-62	13-5	13-3d,14-3b	Use with DD914-8 side carrier bearing removing.
Adapter	DD914-95	13-11	13-3e,14-3b	Use with DD914-8 pinion inner bearing.
Installer	DD1243	13-12	l3-6b	Side carrier oil seal.
Sleeve	C3095	13-15	13-7b,14-7b	Pinion bearing installing.
Wrench	C3281	13-6	12-3c and e,12-3k 13-3e, 13-7b 14-3a,14-7a	“U" joint flange holding.
Tool	C3718	13-23	l3-7d,14-7d	“U” joint flange installing.
Installer	C4025	13-20	13-7d,14-7d	Side carrier roller.
Sleeve	DD854	12-11	12-7f	Drive gear needle bearing installing.
Gage	W-99-B-60-70	13-16	13-7b	Pinion and ring adjusting.
Remover and installer	W-100-60-70	13-9,13-10, 13-13,13-14, 13-15	l3-3e,13-7b, 14-3c,14-7a	Pinion bearing cup removal and installing.
Remover and installer	W328	13-3	13-3c,13-7f	Front axle spindle bearing cup.
Driver	C359	13-22	13-7d,14-7d	Pinion shaft oil seal.
Ring, holding	DD914-8	13-5	13-3d,14-3b	Differential case bearing removal. Use with DD 914-62 and DD914-95 adapters.
Ring, holding	DD914-9	13-11	13-3e	Used with C293-37 adapter.
Press	DD914P	13-5	13-3d,14-3b	Axle roller bearing puller.
Screw, extension	D1D914-7	13-5	13-3e	Use with DD914P press.
Button	DD914-42	13-5	13-3e	Adapter puller.
Wrench	C3748	2-2	4-3b,4-7c	Carburetor main jet.
Clutch alinement set	5120-449-3785	2-2	2-l9b	Clutch disk alining.

Section II. TROUBLESHOOTING

2-4. Scope.

a. This section contains Table 2-2, which lists the malfunctions probable causes, and corrective actions required with reference to applicable maintenance paragraphs.

b. Information in this section is designed for use of support maintenance personnel in conjunction with and as a supplement to the troubleshooting sections in TM 9-2320244-10 and TM 9-2320-244-20. It provides continuation of instructions when a remedy in the Operator's or Organizational Maintenance Manual refers to support maintenance for corrective action.

Table 2-2 Troubleshooting

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
	ENGINE	
1. Engine will not crank.	a. Improper starting procedure.	a. Refer to TM 9-2320-244-10 for proper starting procedure.
	b. Defective starter.	b. Refer to starting system malfunctions (items 18 through 20).
	CAUTION: Do not tow vehicle when mechanical seizure or hydrostatic lock is suspected until condition is corrected or drive shafts have been disconnected (TM 9-2320-244-20).	
	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 and cylinder head and block for cracks. If fuel, refer to fuel system malfunctions (item 29 through 32). If engine cannot be turned over freely, disassemble engine to repair damage of internal parts. (Refer to para 3-3).
	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 (para 3-3).

2. Engine cranks normally, but will not start.	a. Malfunction of fuel system.	a. Refer to fuel system malfunctions (items 29 through 32).
	b. Malfunction of ignition system.	b. Refer to ignition system malfunctions (items 21 through 28).
	c. Low compression.	c. Make compression test. Refer to TM 92320-244-20 for procedures. If reading is irregular, seal the piston with a few drops of engine oil squirted into the spark plug hole, and take a second reading; if pressure increases, this indicates that worn rings, worn cylinders, or a leaky head gasket is at fault. For worn piston rings and leaky cylinder head gasket refer to paragraph 3-5e. If pressure does not increase this will indicate that poor seating of valves is at fault. For leaking valves, remove cylinder head (para 3-3). Reface valve and grind seats.
3. Engine starts but fails to keep running.	a. Defective vehicle electrical connection.	a. Refer to TM 9-2320-244-20 for troubleshooting the vehicle electrical system.
	b. Malfunction of fuel system.	b. Refer to fuel system malfunctions (items 29 through 32).
	c. Malfunction of ignition system.	c. Refer to ignition system malfunctions (items 21 through 28).
	d. Leaking cylinder head gasket.	d. Pour a small quantity of oil onto edges of cylinder head gasket. Start engine and check for a blowing out or sucking in of oil. Tighten cylinder head bolts in proper sequence and proper torque. If leak still persists, repair or replace cylinder head or gasket (para 3-6j).
	e. Improper functioning intake and exhaust valves.	e. Remove rocker arm cover (para 3-3l) and check for broken or weak valve springs. Check for sticky valves and apply penetrating oil if necessary. Check valve clearance (para 3-10h). Adjust if necessary.

	f. Low compression.	f. Make compression test. Refer to TM 9-2320-244-20 for procedures. Refer to item 2c for corrective action.
4. Engine runs but misses.	a. Malfunction of ignition system.	a. Refer to ignition system malfunctions (items 21 through 28).
	b. Malfunction of fuel system.	b. Refer to fuel system malfunctions (items 29 through 32).
	c. Improper valve clearance.	c. Adjust valve clearance. (para 3-10h).
	d. Low compression-leaking valves or worn piston rings.	d. Make compression test. Refer to TM 9-2320-244-20 for procedures. Refer to item 2c for corrective action.
	e. Excessive exhaust back pressure.	e. Replace vehicle exhaust system. Refer to TM 9-2320-244-20 for procedures.
	f. Engine fails to reach proper operating temperature.	f. Refer to cooling system malfunctions (items 40 through 42).
	g. Blown head gasket.	g. Remove cylinder head and replace head gasket. Refer to (para 3-5e).
	h. Engine overheating.	h. Refer to cooling system malfunctions (items 40 through 42).
	i. Cracked cylinder head.	i. Replace cylinder head. Refer to (para 3-5 e).
5. Rough engine idle.	a. Malfunction of fuel system.	a. Refer to fuel system malfunctions (items 29 through 32).
	b. Malfunction of ignition system.	b. Refer to ignition system malfunctions (items 21 through 28).
	c. Improper valve clearance.	c. Adjust valve clearance (para 3-10h).
	d. Cracked cylinder head.	d. Replace cylinder head.
	e. Dirty or defective positive crankcase ventilation valve.	e. Clean or replace defective positive crankcase ventilation valve. Refer to TM 9-2320-244-20.
	f. Sticking, worn piston ring or poorly seated valves.	f. Make compression test. Refer to TM 9-2320-244-20 for procedures. Refer to item 2c for corrective action.
	g. Improper cylinder head bolt torque.	g. Adjust valves and torque cylinder head bolts (para 3-10k).
6. Poor acceleration.	a. Malfunction of fuel system.	a. Refer to fuel system malfunctions (items 29 through 32).

	b. Malfunction of ignition system.	b. Refer to ignition system malfunctions (items 21 through 28).
	c. Improper valve clearance.	c. Adjust valve clearance (para 3-10k).
	d. Grease or oil on clutch driven disk facing.	d. Repair or replace clutch facing (para 11-6) or replace defective crankshaft rear seal (para 3-5x).
	e. Worn clutch driven disk facing.	e. Replace defective facing.
	f. Weak or broken clutch pressure plate springs.	f. Replace defective springs or replace clutch (para 11-6).
	g. Cold engine.	g. Refer to cooling system malfunctions (items 40 through 42).
7. Engine does not develop full power or has poor high speed performance.	a. Malfunction of fuel system.	a. Refer to fuel system malfunctions (items 29 through 32).
	b. Malfunction of ignition system.	b. Refer to ignition system malfunctions (items 21 through 28).
	c. Engine cold.	c. Refer to cooling system malfunctions (items 40 through 42).
	d. Engine overheating.	d. Refer to cooling system malfunctions (items 40 through 42).
	e. Low compression.	e. Make compression test. Refer to TM 9-2320-244-20 for procedures. Refer to item 2c for corrective action.
	f. Dirty or defective positive crankcase ventilation valve.	f. Clean or replace defective positive crankcase ventilation valve, Refer to TM 9-2320-244-20.
	g. Improper valve clearance.	g. Adjust valve clearance (para 3-10k).
	h. Worn camshaft or valve rocker arm.	h. Check camshaft for wear and replace worn camshaft and/or valve rocker arm (para 3-5r, s).
	i. Malfunction of valve train.	i. Refer to item 11 below.
8. Engine emits black smoke (gasoline).	a. Rich fuel mixture.	a. Refer to fuel system malfunctions (items 29 through 32).
	b. Defective carburetor.	b. Refer to fuel system malfunctions (items 29 through 32).
9. Engine emits blue gray smoke (oil).	a. High oil consumption.	a. Refer to lubrication system malfunctions (items 35 through 39).

	b. Worn piston rings or broken piston.	b. Disassemble engine and replace worn piston rings or broken piston (para 3-3).
10. Knocking noise.	a. Worn main or connecting rod bearings.	a. Disassemble engine and replace worn bearings (paras 3-3 and 3-5).
	b. Excessive crankshaft end play.	b. Check crankshaft end play. If end play is beyond limits specified, disassemble engine and replace thrust washers (para 3-5o).
	c. Worn or broken piston.	c. Disassemble engine and replace defective piston (para 3-3).
11. Tapping noise.	a. Improper valve clearance.	a. Adjust valve clearance (para 3-10k).
	b. Sticking valves.	b. Remove cylinder head and replace defective parts (paras 3-3 and 3-6j).
	c. Defective or sticking valve rocker arms.	c. Remove valve rocker arms and replace if necessary.
	d. Weak or broken valve spring.	d. Remove cylinder head and replace defective parts.
	e. Broken or worn valve rocker arm.	e. Replace broken or worn valve rocker arm.
	f. Cracked or burned valves.	f. Remove cylinder head and replace defective parts (paras 3-3 and 3-6j).
12. Grinding noise.	Defective bearing gear.	Rotate crankshaft. If engine is tight and grinding noise persists, disassemble engine. Refer to (para 3-5) for rebuild procedures.
13. Squealing noise.	a. Grease or oil on clutch driven disk facing.	a. Repair or replace clutch disk facing (para 11-6) or replace defective crankshaft rear seal (para 3-5x).
	b. Worn clutch driven disk facing.	b. Replace defective facing (para 11-6).
	c. Weak or broken clutch pressure springs.	c. Replace defective springs or replace clutch (para 11-6).
	d. Clutch slipping.	d. Adjust clutch. Refer to TM 9-2320-24420 for procedures.
14. Pinging noise (detonation or preignition).	a. Distributor not properly timed.	a. Refer to ignition system malfunctions (items 21 through 28).
	b. Improper distributor advance.	b. Refer to ignition system malfunctions (items 21 through 28).
	c. Improper grade fuel.	c. Use proper grade fuel. Refer to TM 9-2320-244-10.

	d. Improper spark plug heat range.	d. Install proper heat range plug.
	e. Excessive combustion chamber deposits noticeable when engine is accelerated while hot.	e. Remove cylinder head, and remove deposits from pistons and cylinder head (paras 3-3 and 3-6j).
15. Engine overheating indication.	a. Faulty sending unit or indicator.	a. Replace sending unit or indicator. Refer to TM 9-2320-244-20.
	b. Improper tightening of cylinder head bolts.	b. Torque cylinder head bolts (para 3-6j).
	c. Malfunctioning of cooling system.	c. Refer to cooling system malfunctions (items 40 through 42).
	d. Faulty Thermostat.	d. Replace thermostat (para 3-6r).
	e. Ignition timing incorrect.	e. Refer to ignition system malfunctions (items 21 through 28).
	f. Cracked or burned valves.	f. Remove cylinder head and replace defective parts (paras 3-3 and 3-6j).
	g. Restricted exhaust system.	g. Repair or replace vehicle exhaust system. Refer to TM 9-2320-244-20. Repair exhaust manifold.
16. Engine fails to reach normal operating temperature.	a. Faulty sending unit or indicator.	a. Replace sending unit or indicator. Refer to TM 9-2320-244-20.
	b. Faulty engine thermostat or incorrect heat range.	b. Replace thermostat. Refer to cooling system malfunctions (items 40 through 42).
	CRANKCASE VENTILATION SYSTEM	
17. Erratic idling.	a. Defective metering valve.	a. Clean positive crankcase ventilation valve. Refer to TM 9-2320-244-20.
	b. Leak or hole in line or fitting.	b. Replace defective line or fitting.
	STARTING SYSTEM	
18. Starter will not crank engine.	a. Improper starting procedure used.	a. Refer to TM 9-2320-244-10 for proper starting procedures.
	b. Low battery voltage.	b. Refer to TM 9-2320-244-20 for troubleshooting the vehicle electrical system.
	c. No electrical current to starter motor.	c. Refer to TM 9-2320-244-20.
	d. Locked starter drive.	d. Refer to TM 9-2320-244-20.
	e. Defective starter.	e. Refer to TM 9-2320-244-20.

19. Starter runs but will not crank engine.	a. Worn, dirty, or defective starter drive.	a. Refer to TM 9-2320-244-20.
	b. No electrical current to starter motor.	b. Refer to TM 9-2320-244-20.
20. Starter cranks engine slowly.	a. Low battery voltage.	a. Refer to TM 9-2320-244-20.
	b. Improper grade engine oil.	b. Drain crankcase and refill with proper grade oil. Refer to lubrication order LO 9-2320-244-12.
	c. Defective starter.	c. Replace starter. For rebuilding of starter refer to paragraph 7-6.
	d. Tight engine.	d. 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. Refer to paragraph 3-3 for rebuild procedures.
	IGNITION SYSTEM	
21. Engine cranks normally but will not start.	a. Improper starting procedure used.	a. Refer to TM 9-2320-244-10.
	b. No electrical current to distributor coil.	b. Refer to TM 9-2320-244-20.
	c. Improperly adjusted or defective breaker points.	c. Refer to TM 9-2320-244-20 for troubleshooting procedures for vehicle electrical system.
	d. Fouled or improperly adjusted spark plugs.	d. Remove starter and repair or replace starter drive (para 7-6).
	e. Defective coil.	e. Replace starter. For rebuilding of starter refer to paragraph 7-6.
22. Engine starts but fails to keep running.	a. Improperly adjusted or defective breaker points.	a. Remove starter and repair or replace starter drive (para 7-6).
	b. Fouled spark plug.	b. Refer to TM 9-2320-244-20 for troubleshooting procedures for vehicle electrical system.
23. Engine runs but misfires steadily at all speeds.	a. Defective or crossed spark plug cables.	a. Refer to TM 9-2320-244-20.
	b. Fouled spark plug.	b. Refer to TM 9-2320-244-20.
	c. Defective distributor cap.	c. Refer to TM 9-2320-244-20.
24. Engine runs but misfires (intermittently at all speeds).	a. Fouled spark plug.	a. Refer to TM 9-2320-244-20.
	b. Improperly adjusted or defective breaker points.	b. Adjust or replace breaker points. Refer to TM 9-2320-244-20.

	c. Defective coil, condenser, rotor, or cap.	c. Replace defective coil, condenser, rotor, or cap. Refer to TM 9-2320-244-20.
25. Engine runs but misfires (at idle only).	a. Improperly adjusted or defective breaker points.	a. Adjust or replace breaker points. Refer to TM 9-2320-244-20.
	b. Defective coil, condenser, rotor or cap.	b. Replace defective coil, condenser, rotor, or cap. Refer to TM 9-2320-244-20.
	c. Defective spark plug cable.	c. Replace defective spark plug cable. Refer to TM 9-2320-244-20.
	d. Excessive play in distributor or worn distributor cam.	d. Replace defective distributor. Refer to TM 9-2320-244-20.
26. Poor acceleration or excessive fuel consumption.	a. Distributor not properly timed.	a. Adjust engine timing. Refer to TM 9-2320-244-20.
	b. Fouled or improperly adjusted spark plug.	b. Clean or replace spark plug or adjust spark gap. Refer to TM 9-2320-244-20.
	c. Improperly adjusted or defective breaker points.	c. Adjust or replace breaker points. Refer to TM 9-2320-244-20.
27. Engine does not develop full power or has poor high speed performance.	a. Distributor not properly timed.	a. Adjust engine timing. Refer to TM 9-2320-244-20.
	b. Fouled or improperly adjusted spark plug.	b. Clean or replace spark plug or adjust spark gap. Refer to TM 9-2320-244-20.
	c. Improper distributor internal advance.	c. Remove distributor and adjust spark advance. Refer to TM 9-2320-244-20.
	d. Improperly adjusted or defective breaker points.	d. Adjust or replace breaker points. Refer to TM 9-2320-244-20.
	e. Excessive play in distributor or worn distributor cam.	e. Replace or rebuild distributor. Refer to TM 9-2320-244-20.
	f. Defective coil, condenser, rotor, or cap.	f. Replace coil, condenser, rotor, or cap. Refer to TM 9-2320-244-20.
	g. Dirty or defective positive crankcase ventilation valve.	g. Clean or replace defective positive crankcase ventilation valve. Refer to TM 9-2320-244-20.
28. Engine overheating.	a. Late ignition timing.	a. Adjust ignition timing. Refer to TM 9-2320-244-20.

	b. Improper distributor advance.	b. Remove distributor and spark advance. Refer to TM 9-2320-244-20.
	FUEL SYSTEM	
29. Engine cranks normally but will not start.	a. Incorrect starting procedure.	a. Refer to TM 9-2320-244-10 for proper starting procedure.
	b. Incorrect choke linkage adjustment.	b. Check adjustment of linkage and adjust if necessary. Refer to TM 9-2320-244-20.
	c. No fuel to carburetor caused by lines clogged with dirt, water, or ice.	c. Clean or replace supply lines as necessary.
	d. Defective fuel pump.	d. Refer to TM 9-2320-244-20 for test and repair procedures. Replace fuel pump.
	e. Overchoked (flooded).,	e. Refer to TM 9-2320-244-20 for starting procedure.
	f. Dirt in carburetor idle system.	f. Disassemble carburetor and clean or repair (para 4-6).
	g. Carburetor fuel setting too high.	g. Check fuel pump pressure. Adjust float tab to secure proper level (para 4-6).
	h. Carburetor flooding.	h. Check fuel pump pressure. Service, fuel inlet system, inlet needle and seat, and float assembly (para 4-6).
30. Engine starts but fails to keep running, runs rough, or misfires at idle.	a. Incorrect starting procedure.	a. Refer to TM 9-2320-244-10 for proper starting procedure.
	b. Incorrect choke linkage.	b. Check adjustment of choke linkage and adjust if necessary. Refer to TM 9-2320-244-20.
	c. Incorrect idle fuel mixture.	c. Adjust idle fuel mixture needle. Refer to TM 9-2320-244-20.
	d. Idle speed set too low	d.Adjust carburetor idle speed stop screw to increase engine speed.
	e. Carburetor fuel setting too high.	e. Check fuel pump pressure. Adjust float tab to secure proper level (para 4-6).

	f. Carburetor flooding.	f. Check fuel pump pressure. Service fuel inlet system, inlet needle and seat, and float assembly (para 4-6).
	g. Dirt or water in lines or carburetor.	g. Remove the fuel bowl from carburetor float chamber; clean carburetor, fuel lines and drain dirt or water from fuel tanks. Refer to TM 9-2320-244-20.
	h. Clogged fuel filter.	h. Clean or replace as necessary. Refer to TM 9-2320-244-20.
	i. Defective fuel supply system.	i. Troubleshoot vehicle fuel system. Refer to TM 9-2320-244-20.
	j. Defective fuel pump.	j. Replace fuel pump. For repair procedures refer to paragraph 4-6.
31. Engine runs hot or runs rough and misfires, or has poor high speed performance (lean mixture).	a. Defective fuel supply system.	a. Troubleshoot vehicle fuel system. Refer to TM 9-2320-244-20.
	b. Defective fuel pump (low fuel pressure).	b. Repair or replace fuel pump. For repair procedures refer to paragraph 4-6.
	c. Clogged fuel filter.	c. Clean or replace as necessary. Refer to TM 9-2320-244-20.
	d. Dirt or water in fuel lines or carburetor.	d. Remove the fuel bowl from carburetor float chamber; clean carburetor, fuel lines, and drain dirt and water from fuel tanks. Refer to TM 9-2320-244-20.
	e. Inoperative or defective carburetor accelerating pump.	e. Repair or replace as necessary. Refer to paragraph 4-6.
	f. Carburetor float setting too low.	f. Check fuel pump pressure. Adjust float tab to secure proper level (para 4-6).
32. Engine emits black smoke and runs rough (rich mixture).	a. Incorrect idle fuel mixture.	a. Adjust idle fuel mixture needle. Refer to TM 9-2320-244-20.
	b. Defective fuel pump (high fuel pressure).	b. Repair or replace fuel pump. For repair procedures refer to paragraph 4-6.
	c. Improper use of choke or sticking choke.	c. Correct sticking choke. Refer to TM 9- 2320-244-20.

	d. Float setting too high.	d. Check fuel pump pressure. Refer to TM 9-2320-244-20. Adjust float tab to secure proper level. Refer to paragraph 4-6.
	e. Defective carburetor.	e. Replace or repair carburetor. Refer to paragraph 4-6.
	f. Dirty or defective positive crankcase ventilation valve.	f. Clean or replace defective positive crankcase ventilation valve.
	GENERATOR SYSTEM	
33. Generator turns. Will not charge.	a. Defective generator regulator.	a. Refer to TM 9-2320-244-20 for troubleshooting generator regulator.
	b. Cables not properly connected.	b. Refer to TM 9-2320-244-20.
	c. Defective generator.	c. Replace generator. Refer to TM 9-2320-244-20.
34. Generator does not turn.	a. Defective generator.	a. Replace generator. Refer to TM 9-2320-244-20.
	b. Drive belts worn or loose.	b. Replace worn belts or tighten loose belts. Refer to TM 9-2320-244-20.
	LUBRICATION SYSTEM	
35. Low oil pressure.	a. Improper grade engine oil.	a. Drain crankcase and refill with proper grade oil. Refer to LO 9-2320-244-12.
	b. High oil temperature.	b. Refer to troubleshooting lubrication system, item 38.
	c. Clogged oil filter.	c. Replace oil filter element.
	d. Damaged oil pan, restricting oil pick-up tube inlet.	d. Remove and repair oil pan (para 3-3).
	e. Diluted engine oil.	e. Drain crankcase and refill with proper grade oil for prevailing temperature. Refer to LO 9-2320-244-12. Troubleshoot engine for cause of oil dilution. Refer to troubleshooting fuel system for correction of rich fuel mixture.
	f. Defective or clogged oil tube and screen assembly.	f. Remove oil tube and screen assembly, and clean and repair.

	g. Worn rod or main bearings and/or camshaft bearing.	g. Disassemble engine and replace worn rod or main bearings (paras 3-3 and 3-5).
36. High oil pressure.	a. Improper grade engine oil.	a. Drain crankcase and refill with proper grade oil. Refer to LO 9-2320-244-12.
	b. Defective or stuck oil pressure relief valve.	b. Repair or replace oil pressure relief valve (para 3-5aa).
37. Fluctuating oil pressure.	a. Low crankcase oil level.	a. Add oil to bring to proper level.
	b. Clogged oil filter.	b. Replace oil filter element.
	c. Defective or clogged oil pick-up tube and 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 replace oil pan (paras 3-3 and 3-5).
	e. Defective oil pressure relief valve.	e. Repair or replace oil pressure relief valve.
	f. Defective oil pump.	f. Replace defective oil pump (paras 3-3e and 3-6t).
	g. Worn bearings.	g. Disassemble engine and replace worn bearings (paras 3-3u and 3-5k, l, m).
38. High oil temperature.	a. Improper grade engine oil or low oil level.	a. Drain crankcase and refill with proper grade oil. Refer to LO 9-2320-244-12.
	b. High coolant temperature.	b. Refer to cooling system malfunctions (items 40 through 42).
	c. Lean fuel mixture.	c. Refer to fuel system malfunctions (items 29 through 32).
	d. Improper ignition timing.	d. Refer to ignition system malfunctions (items 21 through 28).
	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 disassembled to investigate and repair the damage. Refer to (para 3-3) for rebuild procedures.

39. High oil consumption.	a. Improper grade engine oil.	a. Drain crankcase and refill with proper grade oil. Refer to LO 9-2320-244-12.
	b. High oil temperature.	b. Refer to item 38.
	c. Engine oil leaks.	c. Repair engine oil leaks.
	d. Worn piston rings or cylinders.	d. Disassemble engine and replace defective or worn piston rings or recondition cylinder bores (para 3-3 and 3-5).
	e. Worn valve stems, valve guides, or defective valve seals.	e. Replace worn valves, valve guides, or defective valve seals (para 3-5t).
	COOLING SYSTEM	
40. Engine overheats.	a. Insufficient coolant.	a. Add coolant to bring to proper level.
	b. Coolant system leaks.	b. Repair coolant system leak.
	c. Incorrect belt tension.	c. Adjust belt tension. Refer to TM 9-2320-244-20.
	d. Defective thermostat.	d. Replace defective thermostat. Refer to TM 9-2320-244-20.
	e. Cooling system passages blocked.	e. Clean cooling system to remove rust, scale, or other foreign matter.
	f. Defective fan blade.	f. Replace defective fan assembly. Refer to TM 9-2320-244-20.
41. Engine fails to reach normal operating temperature.	a. Defective thermostat or incorrect heat range.	a. Replace defective thermostat. Refer to TM 9-2320-244-20.
	b. Defective temperature sending unit.	b. Replace defective temperature sending unit. Refer to TM 9-2320-244-20.
42. Loss of coolant.	a. Loose or damaged hose connection.	a. Repair or replace hose connection(s). Refer to TM 9-2320-244-20.
	b. Water pump leaking.	b. Replace water pump. Refer to TM 9-2320-244-20.
	c. Defective cylinder head gasket.	c. Replace cylinder head gasket (para 3-6j).
	d. Improper torque of cylinder head bolts.	d. Properly torque cylinder head bolts (para 3-6f).
	e. Cylinder block and head expansion plugs leaking.	e. Remove expansion plugs. Install new expansion plugs (para 3-5af).

	f. Cracked or warped cylinder head or block.	f. Replace cracked cylinder head or block as necessary (para 3-5).
	EXHAUST SYSTEM	
43. Unusual noise.	a. Break or crack in exhaust muffler.	Inspect muffler for breaks or cracks. If muffler is unserviceable, replace. Refer to TM 9-2320-244-20.
	b. Loose or damaged connections.	b. Inspect exhaust system for broken brackets or leaking gaskets. Replace damaged parts as required. Refer to TM 9-2320-244-20.
44. Exhaust system restricted.	Muffler outlet pipe or pipes damaged.	Repair or replace pipe. Refer to TM 9-2320-244-20.
	CLUTCH	
45. Clutch chatter.	a. Grease on clutch driven disk, flywheel, or pressure plate.	a. Clean flywheel and pressure plate. Repair or replace clutch (para 11-6) or replace defective crankshaft rear seal (para 3-5x).
	b. Binding of clutch release linkage.	b. Clean and free linkage.
	c. Disk facings loose on disk.	c. Replace defective facing. Refer to paragraph 11-6.
	d. Broken pressure plate.	d. Replace pressure plate. Refer to paragraph 11-6.
	e. Loose or worn engine mounts.	e. Tighten or replace.
46. Clutch grabbing.	a. Grease on disk, flywheel or pressure plate.	a. Clean flywheel and pressure plate. Repair or replace clutch (para 11-6) or replace defective crankshaft rear seal (para 3-5x).
	b. Clutch disk or pressure plate broken.	b. Replace defective parts.
	c. Hub of disk not sliding freely on splined shaft.	c. Inspect splines, replace defective parts.
	d. Release linkage binding.	d. Clean and free linkage.
47. Clutch slipping.	a. Lack of pedal free play.	a. Adjust pedal free play. Refer to TM 9-2320-244-20.
	b. Release linkage binding.	b. Clean and free linkage.
	c. Pressure plate spring weak or broken.	c. Replace defective springs or replace clutch (para 11-6).
	d. Disk facing worn.	d. Replace defective facing or clutch disk assembly (para 11-6).

	e. Pressure plate warped.	e. Replace pressure plate (para 11-6).
	f. Oil on disk facing.	f. Repair or replace clutch disk (para 11-6) or replace defective crankshaft rear seal (para 3-5x).
48. Clutch dragging	a. Excessive pedal free play.	a. Adjust pedal free play. Refer to TM 9-2320-244-20.
	b. Clutch disk bent	b. Replace clutch disk (para 11-6).
	c. Clutch disk facings loose or broken.	c. Replace clutch disk (para 11-6).
	d. Friction in flywheel pilot bearing.	d. Replace pilot bearing (para 2-18(3)).
49. Gear clash.	NOTE Gear clash caused by the clutch disk spinning, is frequently confused with clutch dragging. A clutch disk which releases perfectly will naturally spin under its own weight and momentum immediately after being released, if transmission gears are in neutral position. When shifting from neutral to first speed, or to reverse, wait for clutch to stop turning to avoid gear clash. If symptom is definitely gear clash, troubleshoot transmission.	
50. Hard gear shifting.	a. Too much clutch pedal free play.	a. Adjust pedal free play. Refer to TM 9-2320-244-20.
	b. Clutch disk or other clutch parts damaged.	b. Replace clutch assembly (para 11-6).
51. Slips out of gear.	Transmission parts worn or damaged.	Repair transmission assembly (para 10-6).
52. Engagement of two speeds.	Transmission cover parts worn or damaged.	Replace defective parts (para 10-6).
53. Lubricant leakage.	a. Lubricant level too high in transmission.	a. Drain to proper level. Refer to LO 9-2320-244-12.
	b. Leak at main drive gear bearing retainer capscrew.	b. Remove screw, dip it in white lead or paint, and install.
	c. Drain plug loose or damaged.	c. Tighten or replace drain plug.
	d. Transmission input shaft seal leaking.	d. Replace seal (para 10-6).
	e. Transmission expansion plugs loose.	e. Replace defective parts (para 10-6).
	f. Transmission cover gasket leaking.	f. Tighten cover mounting bolts or replace cover gasket.
54. Transmission noisy.	a. Loose mounting bolts.	a. Tighten loose bolts.
	b. Flywheel housing.	b. Aline housing (para 3-5ae).
	c. Insufficient lubricant.	c. Fill to proper lubricant level. Refer to LO 9-2320-244-12.

	d. Worn or damaged parts.	d. Replace transmission and/or defective parts (para 10-6).
	TRANSFER CASE	
55. Transfer not shift will into gear.	a. Incorrect lubricant.	a. Refer to LO 9-2320-244-12.
	b. Transfer worn or damaged.	b. Replace transfer case. For repair procedure, refer to paragraph 12-6.
56. Transfer slips out of gear.	Damaged or worn parts.	Replace worn parts.
57. Transfer noisey in operation.	a. Insufficient lubrication.	a. Check the transfer case and fill to required lubricant level.. Refer to LO 9-2320-244-12.
	b. Incorrect lubricant.	b. Refer to LO 9-2320-244-12.
	c. Transfer parts worn or damaged.	c. Repair or replace transfer case (para 12-6).
58. Transfer leaks lubricant.	a. Drain plug loose or damaged.	a. Tighten or replace drain plug.
	b. Damaged transfer input, output, or shifter shaft oil seal.	b. Replace defective seals (para 12-6).
	c. Case cracked.	c. Repair or replace defective parts.
59. Hard shifting out of front axle drive.	Torsional windup between front and rear propeller shafts.	Drive a short distance in a straight line, preferably on dirt or gravel.
	PROPELLER SHAFTS	
60. Backlash or noise in joint.	Damaged or worn bearings.	Repair universal joint. Refer to TM 9-2320-244-20.
61. Vibration in propeller shaft.	a. Worn or damaged universal joint or propeller shaft sprung.	a. Repair universal joint and/or replace propeller shaft. Refer to TM 9-2320-244-20.
	b. Loose attaching bolts or nuts.	b. Check attaching bolt torque.
	AXLES	
62. Front axle assembly, unusual noise.	a. Insufficient lubricant	a. Lubricate in accordance with LO 9-2320-244-12.
	b. Front wheel bearings worn or incorrectly adjusted.	b. Adjust or replace bearings. Refer to TM 9-2320-244-20.
	c. Wheel drive shaft universal joint worn, loose or damaged.	c. Replace defective parts. Refer to TM 9-2320-244-20.
	d. Worn or damaged differential.	d. Replace differential assembly (para 13-3).

63. Rear axle assembly, unusual noise.	Same as front axle, item 62 above.	Same as front axle, item 62 above.
64. Axle leaks lubricant.	a. Pinion oil seal damaged.	a. Replace pinion seal (para 13-6).
	b. Differential housing or cover gasket leaking.	b. Replace cover gasket (para 13-6).
65. Excessive backlash (play).	a. Worn or damaged differential.	a. Replace differential assembly (13-6).
	b. Differential bearings out of adjustment.	b. Replace bearings and adjust.
	c. Loose universal flanges.	c. Tighten or replace flanges.
	SERVICE BRAKES	
66. One brake drags.	a. Distorted or improperly adjusted brake shoes.	a. Inspect brakeshoe and adjust or replace as necessary. Refer to TM 9-2320-244-20.
	b. Faulty retracting spring.	b. Replace retracting spring. Refer to TM 9-2320-244-20.
	c. Brakedrum out-of-round.	c. Repair or replace brakedrum. Refer to TM 9-2320-244-20.
	d. Faulty wheel cylinder.	d. Repair wheel cylinder (para 16-6).
	e. Improperly adjusted or damaged wheel bearing.	e. Adjust or replace wheel bearings. Refer to TM 9-2320-244-20.
	f. Brakeline restricted.	f. Replace or clean affected brakeline.
67. All brakes drag.	a. Pedal improperly adjusted.	a. Adjust brake pedal. Refer to TM 9-2320-244-20.
	b. Distorted or improperly adjusted brake-shoe.	b. See item 66a above.
	c. Brakeline restricted.	c. See item 66f above.
	d. Faulty master cylinder	d. Repair master cylinder (para 16-6).
68. Hard pedal.	a. Pedal linkage to master cylinder binding.	a. Free binding or repair or replace damaged portion of linkage.
	b. Glazed or worn brake linings.	b. Replace brakeshoe assemblies. Refer to TM 9-2320-244-20.
	c. Brakeline restricted.	c. See item 66f above.
	d. Distorted or improperly adjusted brake-shoes.	d. See item 66a above.
69. Spongy pedal.	a. Brakeline restricted.	a. See item 66f above.
	b. Air in system.	b. Bleed brake system. Refer to TM 9-2320-244-20.
	c. Insufficient hydraulic fluid.	c. Fill master cylinder to proper fluid level. LO 9-2320-244-12.
70. Vehicle pulls to one side when brakes are applied.	a. Improper tire pressure.	a. Refer to vehicle data plate for proper tire pressure.

	b. Distorted or improperly adjusted brake-shoes.	b. See item 66a above.
	c. Glazed or worn brake-linings.	c. See item 68b above.
	d. Brakedrum out-of-round.	d. See item 66c above.
	e. Oil grease, or brake fluid on linings.	e. Inspect brake linings. Refer to TM 9-2320-244-20 and replace if necessary.
	f. Faulty retracting spring.	f. See item 66b above.
	g. Faulty wheel cylinder.	g. See item 66d above.
	h. Worn wheel bearings.	h. Adjust or replace wheel bearings. Refer to TM 9-2320-244-20.
	i. Improperly adjusted wheel bearings.	i. Adjust wheel bearings. Refer to TM 9-2320-244-20.
	j. Brakeljne restricted.	j. See item 66f above.
	k. Loose suspension.	k. Check suspension parts. Tighten as required.
71. One wheel locks.	a. Distorted or improperly adjusted brake-shoe.	a. See item 66a above.
	b. Oil, grease, or brake fluid on lining.	b. See item 70e above.
	c. Front wheel locks on turn.	c. Inspect brake linings. Replace brakeshoe assemblies. Refer to TM 9-2320-244-20.
72. Brake chatter.	a. Brakedrum out-of-round.	a. See item 66c above.
	b. Glazed or worn brake linings.	b. See item 68b above.
	c. Oil, grease or brake fluid on brake linings.	c. See item 70e above.
	d. Loose brake linings.	d. Inspect brake linings. Replace brake-shoe assemblies. Refer to TM 9-2320-244-20.
73. Excessive pedal travel.	a. Brakes out of adjustment.	a. Adjust brakes. Refer to TM 9-2320-244-20.
	b. Insufficient hydraulic fluid.	b. See item 69c above.
	c. Leaks in hydraulic system.	c. Bleed brake system. Refer to TM 9-2320-244-20.
	d. Glazed or worn brakelinings.	d. See item 68b above.
74. Pedal gradually goes to floor.	a. Insufficient hydraulic fluid.	a. See item 69c above.
	b. Leaks in hydraulic system.	b. See item 73b above.
	c. Faulty master cylinder.	c. See item 67d above.
75. Brakes uneven.	a. Scored brakedrum.	a. Replace or service brakedrum. Refer to TM 9-2320-244-20.
	b. Incorrect adjustment.	b. Adjust brakes. Refer to TM 9-2320-244-20.
76. Brakes grab.	a. Distorted or improperly adjusted brake-shoe.	a. See item 66a above.
	b. Glazed or worn brake-lining.	b. See item 68b above.
	c. Oil, grease or brake fluid on brakelining.	c. See item 70e above.

	d. Scored brakedrum.	d. See item 75a above.
	e. Dirt on drum or lining surface.	e. Inspect and clean brakedrum and shoe assemblies.
	f. Faulty wheel cylinder.	f. See item 66d above.
77. Brakes fail completely.	a. Insufficient hydraulic fluid.	a. See item 69c above.
	b. Leaks in hydraulic system.	b. See item 73b above.
	c. Air in hydraulic system.	c. See item 69b above.
	d. Faulty master cylinder.	d. See item 67d above.
	e. Linkage from pedal to master cylinder disconnected or broken.	e. Free binding or repair or replace damaged portion of linkage. Refer to TM9-2320-244-20.
	f. Damage to hydraulic components.	f. Incorrect type of fluid. Drain, flush, and replace with non-petroleum base fluid LO 9-2320-244-12.
	PARKING BRAKE	
78. Parking brake does not hold.	a. Brakeshoes improperly adjusted.	a. Adjust. Refer to TM 9-2320-244-20.
	b. Brake lining worn or damaged.	b. Replace band and lining. Refer to TM 9-2320-244-20. Also inspect drum. Replace drum if necessary. Refer to TM 9-2320-244-20.
	c. Components coated with dirt or other contaminant.	c. Clean components if possible, replace parts as necessary.
	d. Brake linkage damaged.	d. Replace damaged linkage.
79. Parking brake drags and overheats	a. Brake partially applied.	a. Release lever fully.
	b. Shoes improperly adjusted.	b. Adjust. Refer to TM 9-2320-244-20.
	c. Lining loose and damaged	c. Replace band and lining. Refer to TM 9-2320-244-20.
	WHEELS AND TIRES	
80. Abnormal tire wear.	a. Continual use of four-wheel drive on hard surface roads and at speeds in excess of 25 mph.	a. Use four-wheel drive only when maximum traction is needed.
	b. Tire pressure incorrect.	b. Correct tire pressure. (Refer to vehicle data plate).
	c. Improper toe-in.	c. If wear is in front tires, adjust toe-in. Refer to TM 9-2320-244-20. If wear is in rear tires check rear suspension for damage.
	d. Wheels, tires, or brakedrums out-of-balance.	d. Balance or replace as necessary.
81. Wheel wobbles.	a. Bent wheel.	a. Replace wheel.

	b. Wheel bearings out of adjustment or damaged.	b. Adjust or replace bearings. Refer to TM 9-2320-244-20.
	STEERING	
82. Backlash in steering.	a. Pitman arm loose.	a. Tighten pitman arm nut. Refer to TM 9-2320-244-20.
	b. Worn or damaged parts in steering gear.	b. Repair steering gear assemble. Refer to paragraph 15-6 for rebuild procedures.
83. Erratic steering.	a. Incorrect front wheel alinement.	a. Adjust toe-in. Refer to TM 9-2320-244-20. If conditions persists, remove and replace defective parts. Refer to TM 9-2320-244-20.
	b. Incorrect steering gear adjustment.	b. Adjust steering gear (para 15-6).
	c. Loose steering linkage.	c. Tighten all loose connections
	d. Incorrect front wheel bearing adjustment.	d. Adjust wheel bearings. Refer to TM 9-2320-244-20.
84. Hard steering.	a. Incorrect tire pressure.	a. Inflate tires to proper pressure. (Refer to vehicle data plate).
	b. Tires not of uniform	b. Install tires of uniform size.
	c. Lack of lubrication.	c. Lubricate in accordance with LO 9-2320-244-12.
	d. Incorrect steering gear adjustment.	d. Adjust steering gear (para 15-6).
85. Shimmy	a. Incorrect tire pressure.	a. Inflate tires to proper pressure. (Refer to vehicle data plate).
	b. Incorrect front wheel alinement.	b. Check toe-in. Refer to TM 9-2320-244-20.
	c. Incorrect steering gear adjustment.	c. Adjust steering gear (para 15-6).
	d. Tires not of uniform size.	d. See item 84b.
	e. Loose steering linkage.	e. Tighten steering linkage.
	f. Incorrect front wheel bearing adjustment.	f. Adjust wheel bearings. Refer to TM 9-2320-244-20.
	g. Weak front shock absorber.	g. Replace front shock absorber. Refer to TM 9-2320-244-20.
	h. Loose or worn spindle support.	h. Tighten.
	i. Loose suspension arm mounting bolts.	i. Tighten loose suspension arm mounting bolts.
	j. Loose crossmember mounting bolts.	j. Tighten loose crossmember mounting bolts.
	k. Bent wheel.	k. Replace wheel.
86. Pull to one side.	a. Incorrect tire pressure.	a. Inflate tires to proper pressure. (Refer to vehicle data plate).
	b. Incorrect front wheel alinement.	b. Adjust toe-in. Refer to TM 9-2320-244-20.
	c. Tires not of uniform size.	c. See item 84b.

	d. Unequal brake adjustment.	d. Adjust service brakes. Refer to TM 9-2320-244-20.
	e. Incorrect front wheel bearing adjustment.	e. Adjust wheel bearing. Refer to TM 9-2320-244-20.
	f. Bent spindle arm.	f. Replace spindle arm. (para 13-6).
	g. Sagging or broken suspension, front spring.	g. Replace suspension front spring. Refer to TM 9-2320-244-20.
87. Wander; body sway.	a. Incorrect tire pressure.	a. Inflate tires to proper pressure. (Refer to vehicle data plate).
	b. Tires not of uniform size.	b. Refer to item 84b.
	c. Loose steering linkage.	c. Tighten steering linkage.
	d. Incorrect steering gear adjustment.	d. Adjust steering gear (para 15-7b).
	e. Loose steering gear mounting bolts.	e. Tighten loose steering gear mounting bolts.
	f. Incorrect front wheel alinement.	f. Adjust toe-in. Refer to TM 9-2320-244-20.
	g. Defective shock absorbers.	g. Replace shock absorbers. Refer to TM 9-2320-244-20.
88. Tires squeal on turns.	a. Incorrect tire pressure.	a. Inflate tires to proper pressure. (Refer to vehicle data plate).
	b. Incorrect front wheel alinement.	b. Adjust toe-in. Refer to TM 9-2320-244-20.
	c. Bent spindle arm.	c. Replace spindle arm (para 13-6).
	SPRING AND SHOCK ABSORBERS	
89. Spring breakage.	a. Extremely rough handling of vehicle over rough terrain.	a. Reduce vehicle speed over rough terrain when possible.
	b. Lack of shock absorber control.	b. Replace shock absorbers. Refer to TM 9-2320-244-20.
90. Poor recovery or slow action of shock absorbers.	a. Shock absorber bushing binding or damaged.	a. Replace shock absorbers. Refer to TM 9-2320-244-20.
	b. Lack of shock absorber control.	b. Replace shock absorbers.Refer to TM 9-2320-244-20.
	c. Loose mountings.	c. Check insulators. If serviceable, tighten shock absorber mounting nuts.
91. Lack of spring control.	a. No fluid in shock absorbers.	a. Replace shock absorber. Refer to TM 9-2320-244-20.
	b. Shock absorbers inoperable.	b. Replace shock absorbers. Refer to TM 9-2320-244-20.

2-5. Diagnostic Test Points.

The vehicle design includes provisions for the connection of electrical, pressure actuated, and mechanical test equipment. These provisions areas follows:

Item	Purpose	Test Point Location
1	Determine intake manifold pressure.	1/4 NPT opening provided on intake manifold, requires bushing for 1/8 NPT.
2	Sense reflected wave form in coil primary.	Distributor top has 3/8-inch tap to accept adapter (FSN 4910-356-7492).
3	Determine engine torque.	Replace original propeller shaft with torque meter attached propeller shaft.
4	Measure carburetor air flow.	Carburetor provides an interface for attachment of an adapter when air cleaner is removed.
5	Measure oil pressure.	1/8 NPT opening provided in cylinder case assembly.
6	Measure exhaust blowby.	Flex hose from crankcase vent tube can be replaced with appropriate transducers.
7	Measure engine oil.	An oil pan dipstick with markings for positive measurement is located on left hand side of engine.
8	Measure engine oil temperature.	Oil level gage tube.
9	Determine cylinder pressure.	Insert compression pressure gage into spark plug hole and crank engine until maximum compression pressure is obtained.
10	Determine engine inlet coolant temperature.	1/2 NPT opening provided on water pump.
11	Determine engine outlet coolant temperature.	3/4 NPT opening provided on bypass housing.
12	Measure fuel rate.	Flexible fuel line from engine to frame provides for insertion of measuring equipment.
13	Determine battery voltage and charging current.	Diagnostic test connector provided in glove compartment.

Section III. GENERAL MAINTENANCE

2-6. General.
This section contains general repair instructions or references thereto which are the responsibility of direct and general support maintenance for Cargo Truck M715, Ambulance Truck M725 and Maintenance Truck M726, and which would otherwise have to be repeated several times.
2-7. Cleaning.
a. General. The importance of cleaning must be thoroughly understood by maintenance personnel. The presence of dirt or foreign substances is a constant threat to satisfactory component or assembly 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. Precautions in Cleaning.
(1) Drycleaning solvent or mineral spirits base paint thinner are flammable and should not be used near an open flame. Fire extinguishers should be provided when these materials are used.

WARNING:
Use drycleaning solvent or mineral spirits base paint thinner only in a well-ventilated area.

(2) These cleaners evaporate quickly and have a drying effect on the human skin. If used without gloves, they may cause cracks in the skin, and in some cases irritation and inflammation.
(3) Avoid getting petroleum products such as drycleaning solvent, mineral spirits base paint thinner, engine fuels, or lubricants on rubber coverings or rubber parts as they will deteriorate rubber.
(4) The use of gasoline, benzene (benzol) or diesel fuel oil for cleaning is prohibited.
c. Castings and Metal Parts. The inner and outer surfaces of all castings and metal parts, subject to oil lubrication, must be cleaned with dry-cleaning solvent. Insure that 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.
d. Tapped Holes. Clean out tapped holes using old tap to prevent cutting oversize. Blow out bolt holes with compressed air; insure that threads are clean. Dirt in threads may cause binding and result in false torque readings.
e. Tubes and Fittings. Soak tubes and fittings in cleaning solvent, Use wires or probes to remove stubborn deposits of foreign matter. Blow out with compressed air; insure that all passages are clear.
f. Electrical Cables and Flexible Hoses. Clean cables and flexible hoses with soap and water.
g. Oil Seals and Air Seals. Clean oil seals and air seals with soap and water.

CAUTION
Do not allow drycleaning solvent or mineral spirits base paint thinner to be in prolonged contact with electrical cables, flexible hoses, or seals. These cleaners cause leather, rubber, and synthetic materials to dry, rot and lose pliability, making them unserviceable.

2-8. Inspection.
a. General. The latest inspection equipment (when available), methods, and procedures should be used to inspect various components. The appearance of a component or assembly will indicate its general condition and will reflect the type of treatment it has received.
b. 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 obstructions with compressed air or by working a wire back and forth through passages 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 parts.
(4) Inspect tapped holes for damaged threads. Chase damaged threads with a tap of the same size as the damaged threads.
(5) Discard cases or other cast parts that are broken.
(6) Inspect all machined surfaces for damage that could cause oil leakage or other malfunction. Repair or replace the defective parts.
c. 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 bearing.
(3) Inspect a damaged bearing bore and shaft for grooved, burred, or galled conditions that would indicate bearing has been turning in its bore or on its shaft. If damage cannot be repaired with crocus cloth, replace 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 race which is adjacent to mounting surface. If an arbor press

is not available, seat bearing with a brass drift and a hammer, driving against supported arc.

d. 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 bushing is out-of-round, deeply scored, or excessively worn, replace it using proper replacer.

NOTE

Sometimes it is necessary to cut out a damaged bushing. Be careful not to damage bore into which bushing fits.

(2) Inspect thrust washers for distortion, scores, burrs, and wear. Replace thrust washers if defective or worn.

e. 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 (FSN 5330-252-3391) on outside of seal to prevent leaks. Pack inside lips of seal with light grease (GAA), or lubricant specified in LO 9-2320-244-12.

(3) Replace all gaskets.

(4) Inspect surfaces of parts on which seals bear. If grooving is excessive, replace part and seal (grooves deeper than 0.003).

f. 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

(3) Inspect thrust faces of gears for scores, scratches and burrs. Remove defects with soft stone. If scratches and scores cannot be removed, replace gears.

g. Splined Parts. Inspect splined parts for stripped, twisted, chipped, or burred splines. Remove burrs with a soft stone. If other damages are found, replace 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 kind of installation because it is stronger than a keyway. This strength is lost if fit is loose.

h. Threaded Parts. Inspect parts for damaged threads. Remove burrs with a soft stone or fine file. Replace damaged parts.

i. Snap Rings. If parts are available, snap rings should generally be replaced, since they are difficult to remove without distorting. Snap rings controlling shaft end play should always be replaced. If a snap ring must be used again, remove any nicks or distortion before installing.

j. 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 defect.

2-9. Maintenance Time Guide.

TM 9-2320-244-20 contains time estimates for performing maintenance operations on vehicle assemblies and components. The man-hours shown include removal, cleaning, overhaul (when applicable) adjusting, testing, and installation where applicable. This data will serve as a guide for maintenance officers to accomplish two tasks:

(1) Planning the shop workload and improving efficiency by better utilization of labor and equipment by comparing actual performance time with estimated maintenance times in the table.

(2) The table will provide information which can be used for determining the allocation of maintenance workloads between direct support and general support units within elements of the army.

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND AUXILIARIES

2-10. Power Pack Assembly.
Refer to TM 9-2320-244-20.

2-11. Fuel System.
Refer to TM 9-2320-244-20.

2-12. Exhaust System.
Refer to TM 9-2320-244-20.

2-13. Cooling System.
Refer to TM 9-2320-244-20.

2-14. Electrical System.
Refer to TM 9-2320-244-20.

2-15. Instrument Cluster, Instruments and Switches.
Refer to TM 9-2320-244-20.

2-16. Ventilating Equipment (Ambulance).
Refer to TM 9-2320-244-20.

2-17. Propeller Shafts.
Refer to TM 9-2320-244-20.

2-18. Clutch Assembly.
a. Removal.
(1) Clutch pressure plate and disk. (Fig 2-5)
(a) Refer to paragraph 10-2 for transmission removal.
(b) Remove bolts securing flywheel housing pan to housing.
(c) Remove flywheel housing pan and discard gasket.
(d) Loosen clutch to flywheel attaching bolts (11 fig 2-5) one turn at a time on each bolt, until spring load is released from clutch.
(e) Mark clutch pressure plate cover (1) and flywheel so that similar marks on new clutch can be alined properly with flywheel for proper balancing of engine.
(f) Remove bolts and clutch assembly.

(2) Release bearing and sleeve assembly.
(a) Disconnect yoke spring (4 fig 2-6) from each side of sleeve (1).
(b) Cut lock wire and remove lock screw (3) securing yoke (6) to shaft (5).
(c) Tilt bearing yoke rearward on shaft and remove sleeve (1) and release bearing (2) as an assembly.

(3) Pilot bushing.
(a) Thread tapered end of a pilot bushing removal tool into bushing until a solid grip is obtained.
(b) Insert puller screw into tool and rotate until bushing is forced out of crankshaft end.
b. Installation.
(1) Pilot bushing.
(a) Slide new bushing onto end of the installing and burnishing tool and insert bushing into crankshaft end. A soft hammer can be used against tool to aide in driving bushing in place.
(b) Apply small amount of lubricant to bushing bore.

(2) Release bearing and sleeve assembly. (Fig 2-6)

(a) Position release bearing (2) and sleeve (1) against the release bearing yoke (6).

(b) Install the yoke shaft lock screw (3) and tighten. Install lock wire and secure lock screw.

(c) Connect and seat yoke spring (4) at each side of sleeve as shown.

(3) Clutch pressure plate and disk. (Fig 2-5).

(a) Install clutch disk (4) (with short end of hub toward flywheel) and pressure plate (5) in position against flywheel.

(b) Using a clutch disk aiming tool FSN 5120-449-3785 or a spare transmission shaft, aline the clutch disk splines.

(c) With tool in position, install and tighten the pressure plate bolts (11) even ly.

(d) Apply sealant to new flywheel housing pan gasket and position gasket on pan.

(e) Install bolts which secure flywheel housing pan and tighten.

(f) Refer to TM 9-2320-244-20 for clutch adjustment.

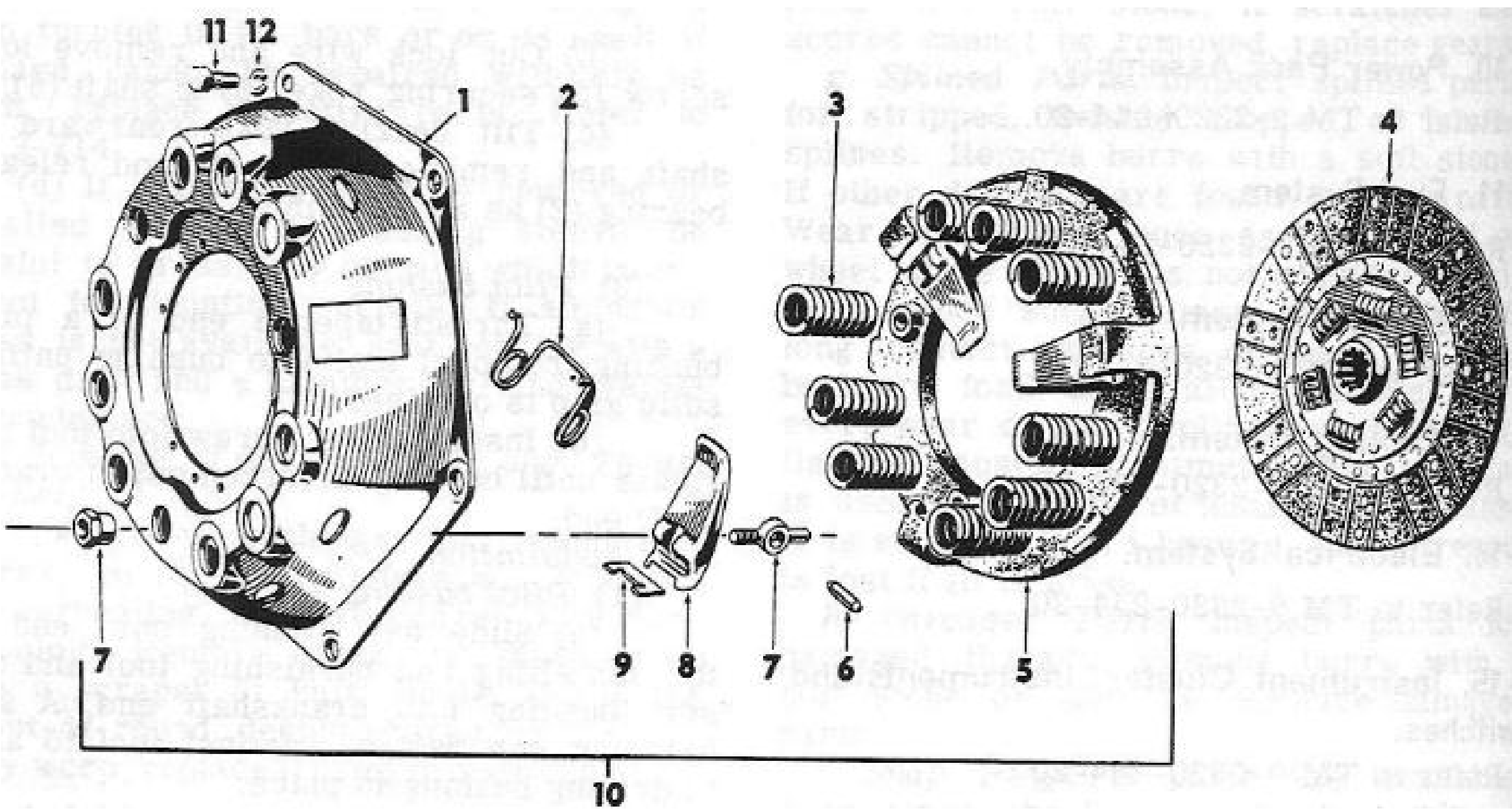


Figure 2-5. Clutch assembly components.

1 Pressure plate cover	5 Pressure plate	9 Pressure plate strut
2 Anti-rattle spring	6 Release lever pin	10 Clutch assembly (less driven plate)

3 Pressure spring	7 Bolt and nut	11 Bolt; hex hd., 3/8-inch 16 x 7/8 inch
4 Clutch disk and hub	8 Pressure plate lever	12 Lock washer, 3/8-inch

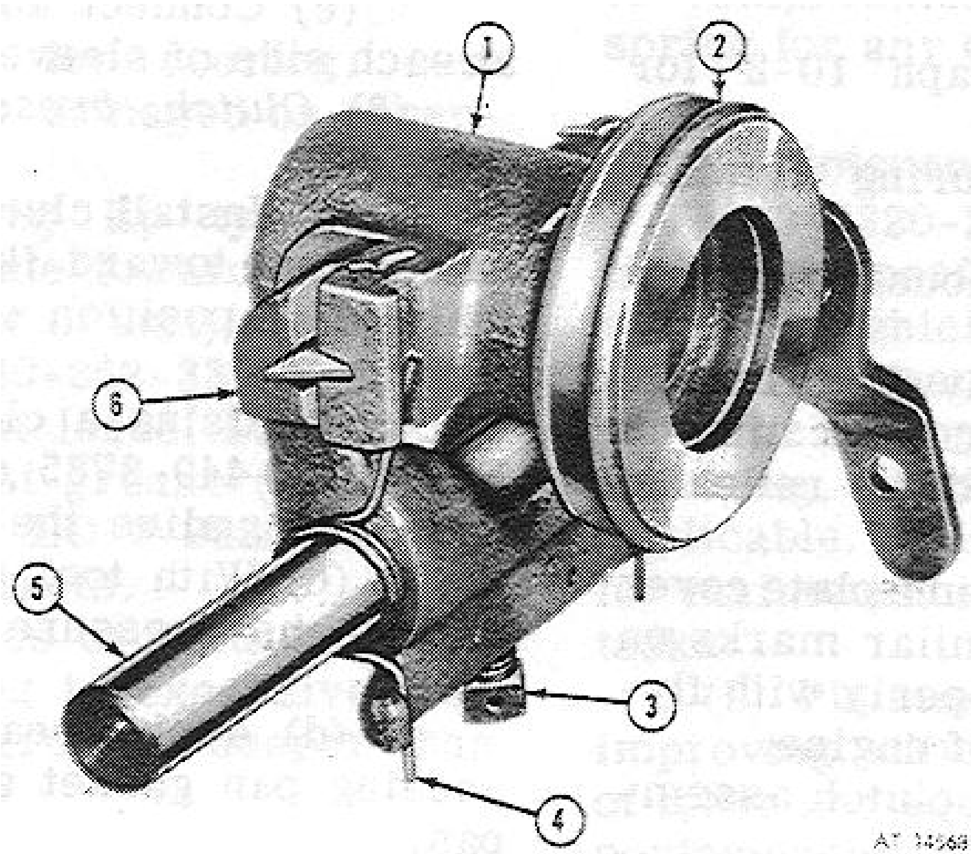


Figure 2-6. Clutch release bearing, yoke and shaft.

1 Sleeve
2 Clutch release bearing
3 Lock screw
4 Yoke spring
5 Release bearing shaft
6 Release bearing yoke

(4) Clutch housing alinement. (Fig 2-7)

NOTE
Misalined clutch housing can cause improper clutch release, driven plate failure, front transmission bearing failure, uneven wear in crankshaft pilot bushings, clutch “crackle” noise, vibration and, in extreme cases of misalinement, “jumping out of gear” on deceleration. Should any of these malfunctions occur, the rear face of the flywheel housing should be checked for alinement and concentricity of transmission pilot bore with center line of crankshaft, as follows:

(a) Install a clutch shaft aiming bar in the crankshaft pilot bushing and mount dial indicator on the end of the bar. The clutch shaft aiming bar may be altered to insure a secure fit in the pilot bushing in the crankshaft. Saw a slot down approximately one inch in the end of the bar that enters the pilot bushing. Spread the end of the bar with a thin chisel so that the bar fits securely in the pilot bushing when tapped into place.

(b) Attach dial indicator to the bar and locate the indicator so it contacts the rear face of clutch housing approximately 1/8-inch from the edge of the rear open-

NOTE

The dial indicator clutch shaft aiming bar must be held firmly in the crankshaft pilot bushing when taking either reading.

(c) Check squareness of face of housing by turning the crankshaft. Total indicator reading should not exceed 0.005-inches. Crankshaft end play must be held to zero when checking face alinément.

(d) To correct indicated misalinement of the clutch housing, install shims between the clutch housing and the engine. to bring the indicator reading on the face of the housing within the specified limits. To install the shims, loosen the clutch housing assembly and locate shims where necessary by loosening the bolts and inserting the shims in place. Tighten the bolts and recheck the face alinement. Total indicator reading on the face of the flywheel housing should not exceed 0.005-
inches. Relocate shims, if necessary, to bring reading within limits.

(e) To check bore alinement, locate the dial indicator on the inside diameter of the rear opening of the clutch housing. Rotate the engine and note the indicator reading at four equally spaced points. Total indicator reading must not exceed 0.005 -inches.

(f) Any change in face alinement will change bore alinement. Therefore, it may be possible to correct bore alinement by changing the face alinement. Where it is impossible to correct the bore alinement to a maximum of 0.005-inches run-out with change of face alinement (not to exceed 0.005-inches) replace the housing.

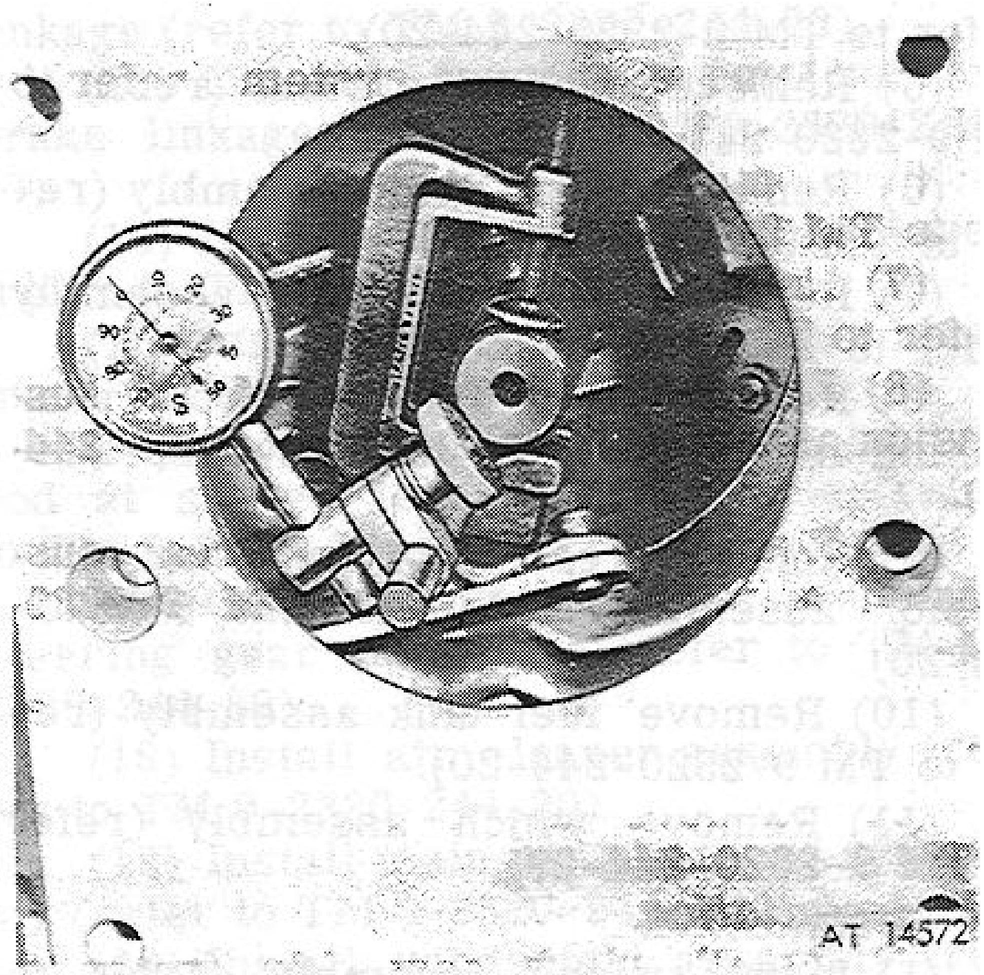


Figure 2-7. Clutch housing alinement.

(Note: The following section has been added from the -24 Kaiser Maintenance manual as it contains information not found in other manuals which may be of help to those performing maintenance. brute4c)

02-9. Clutch Lever Adjustment

Important: Always inspect release lever height adjustment when installing a new clutch drive plate.

The clutch pressure plate adjustment must be checked before installing a new clutch. The proper spacer thickness and gauge length for the clutch is listed in par. 02-10. The gauge and spacers can be fabricated as described in par. 02-11. Proceed as follows:
a. Place the .305” spacers between the pressure plate face and the clutch adjusting fixture. Locate the spacers under the pressure plate fingers and at the center of the pressure plate face.
b. With the spacers properly installed, bolt the pressure plate to the adjusting fixture. Draw the bolts down evenly, a little at a time, until they are tight.
c. Using the 1 15/16 gage length, check the lever adjustment.
d. Turn the lever adjusting nut until the top of the fingers touch the 1 1 15/16 step on the fabricated gauge. Before staking the adjusting nuts to lock them in place, work the levers up and down and recheck the adjustment again. Stake the nut with a dull punch.

02-10. Clutch Adjusting Fixture Data
DISC DIAMETER 10½”
SPACER THICKNESS .305”
GAUGE LENGTH 1 15/16"

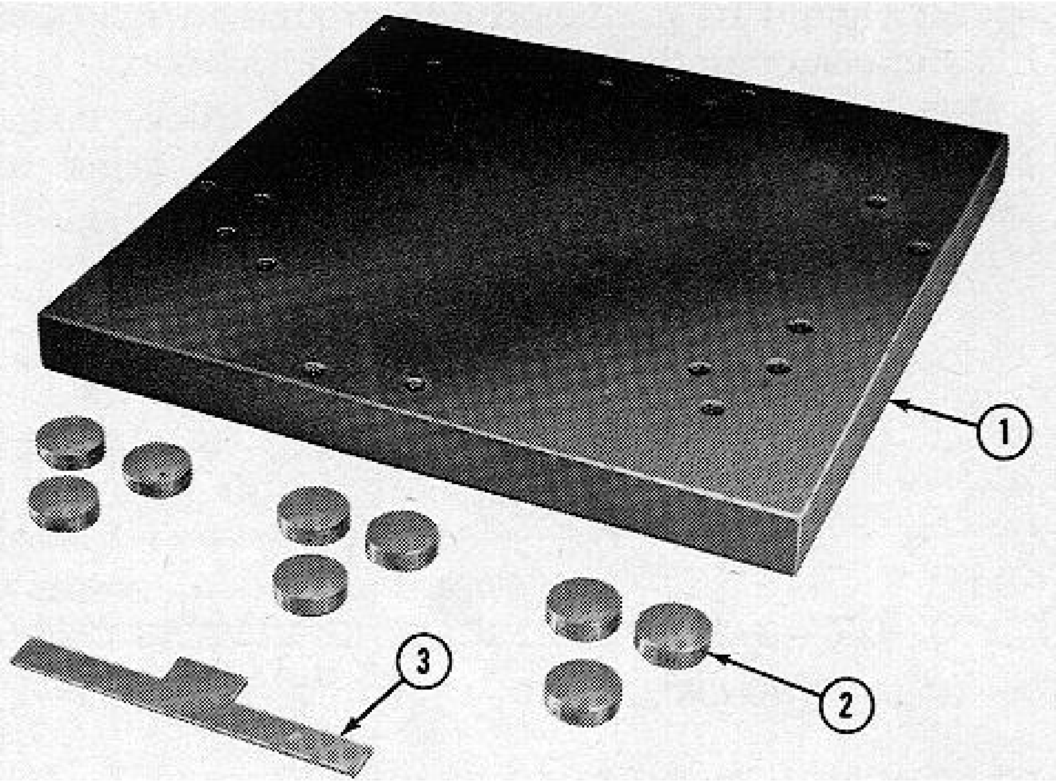


FIG. 02-4—CLUTCH ADJUSTING FIXTURE
1 Mounting Fixture
2 Spacers
3 Gauge

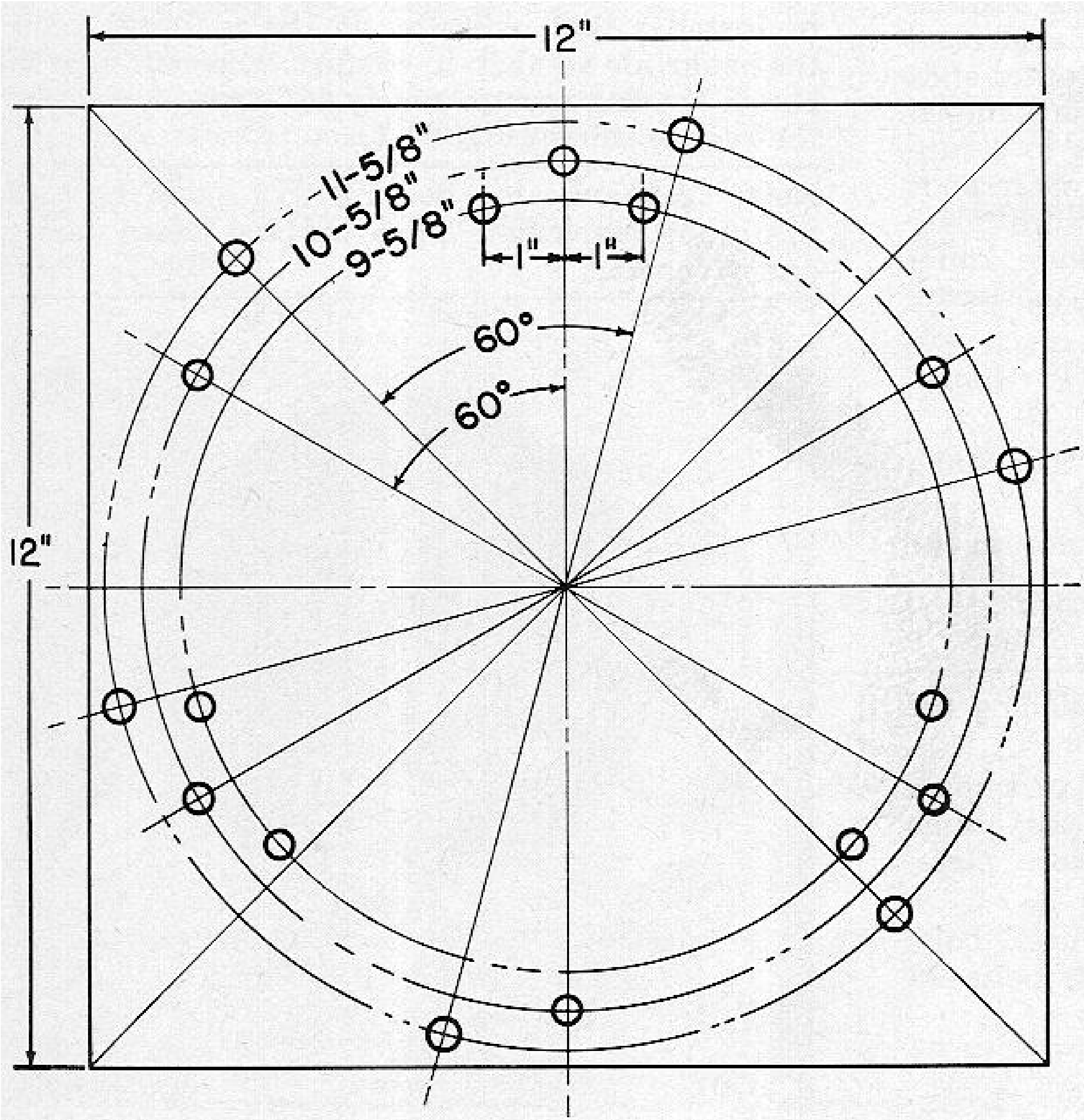


FIG. 02-5--MOUNTING FIXTURE HOLE DIMENSIONS

02-11. Fabricating the Clutch Fixture

a. For the mounting fixture, as shown in Figs. 02-4 and 02-5, select a flat steel plate 1” x 12” x 12”.
Drill and tap six equally spaced holes 3/8 x 16 thread on a 15 5/8" diameter bolt circle.
b. From steel bar stock any size from ½” to 1 1/2”, make three spacers .305” of an inch thick. Each spacer should be hardened and ground to size and the dimensional thickness stamped thereon.
c. From flat bar stock at least 1/8” thick, make a gauge as shown in Fig. 02-6. Harden, grind to size, and stamp sizes on the gauge.

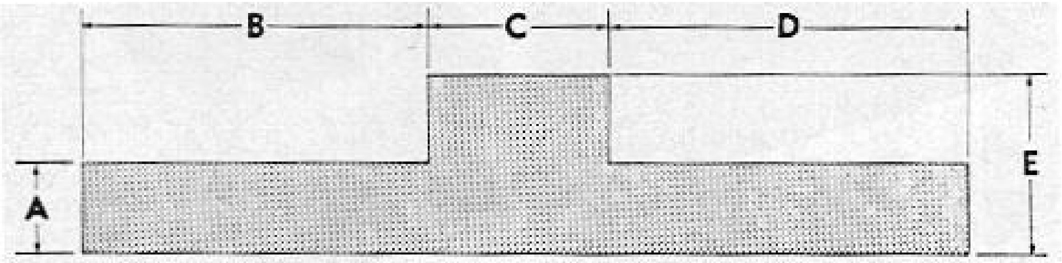


FIG. 02-6—GAUGE FABRICATING DIMENSIONS
A—1/2”
B—1 15/16”
C—1”
D—2”
E—1”

02-12. Clutch Lever Positions
When the clutch pedal is depressed, the release bearing is moved toward the flywheel and contacts the inner ends of the release levers. Each lever is pivoted on a floating pin which remains stationary in the lever and rolls across a short flat portion of the enlarged hole in the eyebolt. The outer ends of the eyebolts extend through holes in the stamped cover and are fitted with adjusting nuts to secure the levers in the correct position. The outer ends of the release levers engage the pressure plate lugs by means of fulcrums, which provide knifeedge contact between the outer ends of the levers and the lugs.

(NOTE: This is the end of the added section from the -24 Kaiser Maintenance manual. brute4c)

2-19. Power Transfer.
Refer to TM 9-2320-244-20.

2-20. Front Axle, Suspension and Steering Linkage.
Refer to TM 9-2320-244-20.

2-21. Rear Axle and Suspension.
Refer to TM 9-2320-244-20.

2-22. Brakes.
Refer to TM 9-2320-244-20.

2-23. Tires, Wheels, Bearings, Hubs and Drums.
Refer to TM 9-2320-244-20.

2-24. Steering Gear, Wheel and Column.
Refer to TM 9-2320-244-20.

2-25. Frame.

a. Removal. This paragraph contains removal procedures necessary to completely separate the vehicle from the frame.

(1) Remove cargo body (para 2-27a).
(2) Remove front end sheet metal (refer to TM 9-2320-244-20).
(3) Remove cab assembly (para 2-26a).
(4) Remove propeller shaft assemblies (refer to TM 9-2320-244-20).
(5) Remove exhaust system (refer to TM 9-2320-244-20).
(6) Remove power plant assembly (refer to TM 9-2320-244-20).
(7) Remove transfer case assembly (refer to TM 9-2320-244-20).
(8) Remove front axle and front suspension assembly (refer to TM 9-2320-244-20).
(9) Remove rear axle and rear suspension assembly (refer to TM 9-2320-244-20).
(10) Remove fuel tank assembly (refer to TM 9-2320-244-20).
(11) Remove winch assembly (refer to TM 9-2320-244-20).

b. Installation.

(1) Install winch assembly (refer to TM 9-2320-244-20).
(2) Install fuel tank assembly (refer to TM 9-2320-244-20).
(3) Install rear axle and rear suspension assembly (refer to TM 9-2320-244-20).
(4) Install front axle and front suspension assembly (refer to TM 9-2320-244-20).
(5) Install transfer case assembly (refer to TM 9-2320-244-20).
(6) Install power plant assembly (refer to TM 9-2320-244-20).
(7) Install exhaust system (refer to TM 9-2320-244-20).
(8) Install propeller shaft assemblies (refer to TM 9-2320-244-20).
(9) Install cab assembly (para 2-26b).
(10) Install hood and front end sheet metal (refer to TM 9-2320-244-20).
(11) Install cargo body (para 2-27b).

2-26. Cab and Sheet Metal.

a. Removal.

(1) Remove batteries (refer to TM 9-2320-244-20).
(2) Remove front end sheet metal (refer to TM 9-2320-244-20).
(3) Remove cab soft top (refer to TM 9-2320-244-20).
(4) Remove windshield assembly (refer to TM 9-2320-244-20).
(5) Remove cab main wiring harness (refer to TM 9-2320-244-20).
(6) Remove air cleaner assembly (refer to TM 9-2320-244-20).
(7) Disconnect steering gear column at steering gear assembly (refer to TM 9-2320-244-20).
(8) Disconnect power take-off control rod at shifter lever if applicable (refer to TM 9-2320-244-20).
(9) Remove transfer case shift lever (refer to TM 9-2320-244-20).
(10) Remove transmission shift lever (refer to TM 9-2320-244-20).
(11) Disconnect handbrake and service brake linkage (refer to TM 9-2320-244-20).
(12) Disconnect accelerator and choke linkage (refer to TM 9-2320-244-20).

(13) Disconnect clutch linkage (refer to TM 9-2320-244-20).
(14) Remove driver and passenger seats (refer to TM 9-2320-244-20).
(15) Disconnect heater hose if equipped with a heater (refer to appropriate sections of Chapter 21).
(16) Remove two front mounting bolt access plugs from floor panel with a screwdriver.
(17) Remove two front cab to frame mounting bolts, two cab mounting lower cushions, washers and nuts.

NOTE
When removing cab mounting bolts, hold head of bolt to keep it from turning and remove the nut from underside of cab.

(18) Remove two rear cab to frame mounting bolts, lower cushions, washers and nuts.
(19) Install four eyebolts into cab mounting bolt holes at each corner of the cab.
(20) Attach lifting cables or chains to eyebolts and carefully lift cab from chassis.

CAUTION
Guide cab while lifting to prevent steering shaft from hitting engine. Do not allow cab to swing forward and strike engine ignitor.

(21) Remove one cab mounting upper cushion, spacer and washer from each frame body mounting bracket.
b. Installation.
(1) Install one cab mounting upper cushion, spacer and washer at each frame body mounting bracket.
(2) Install four eyelets, one at each corner of the cab.
(3) Insert and hold two pry bars (FSN 5120-244-1389), one in each of the front mounting brackets. Install pry bars from the bottom side of frame brackets, being careful not to knock. mounting cushions off brackets,
(4) Attach lifting cables or chains to eyebolts; carefully lift cab and set on chassis using the pry bars as guide pins.

CAUTION
Guide cab while setting on chassis to prevent steering shaft from hitting engine. Do not allow cab to swing forward and strike engine ignitor.

(5) Remove lifting cables or chains and four eyebolts from cab.
(6) Remove two pry bars.
(7) Install two new front cab to frame mounting bolts, lower cushions washers and nuts. The front mounting bolts are shorter than rear mounting bolts.

NOTE
When replacing mounting nuts and bolts, they shall be replaced with one of the same part number. Do not use a replacement part of lesser quality or substitute design. Torque value shall be used as Specified during installation to assure proper retention of these parts.

(8) Install two rear cab to frame mounting bolts, lower cushions, washers and nuts. Tighten mounting bolts 20 to 30 lbs-ft.

NOTE
While head of bolt is being held from inside cab, tighten nut from under cab.

(9) Install two front mounting bolt access plugs by pushing them into the floor panel.
(10) Install driver and passenger seats (refer to TM 9-2320-244-20).
(11) Connect clutch pedal to clutch linkage (refer to TM 9-2320-244-20).
(12) Connect accelerator and choke linkage (refer to TM 9-2320-244-20).
(13) Connect handbrake and service brake linkage (refer to TM 9-2320-244-20).
(14) Install transmission shift lever (refer to TM 9-2320-244-20).
(15) Install transfer case shift lever (refer to TM 9-2320-244-20).

(16) Connect power take-off control rod at shifter lever if applicable (refer to TM 9-2320-244-20).
(17) Connect steering gear column at steering gear assembly (refer to TM 9-2320-244-20).
(18) Install air cleaner assembly (refer to TM 9-2320-244-20).
(19) Install main body harness assembly (refer to TM 9-2320-244-20).
(20) Install windshield assembly (refer to TM 9-2320-244-20).
(21) Install cab soft top (refer to TM 9-2320-244-20).
(22) Install front end sheet metal assembly (refer to TM 9-2320-244-20).
(23) Install batteries (refer to TM 9-2320-244- 20).

2-27. Body.
a. Removal.
(1) Remove the eight attaching bolts (four each side) which secure cargo box to frame.
(2) Attach lifting chains to eight cargo tiedowns inside cargo box.
(3) Attach lifting chains to overhead lifting device and remove cargo body from frame. Remove mounts and cushions.
b. Installation.
(1) Attach lifting chains to eight cargo tiedowns inside cargo box.
(2) Attach lifting chains to overhead lifting device or fork lift truck, and position cargo box on frame assembly.
(3) Install the eight rubber mounts (four each side) and mounting bolts which secure the cargo box. Tighten bolts to 20-30 lbs-ft.
(4) Remove lifting chains.

2-28. Winch and Power Take-Off.
a. Refer to TM 9-2320-244-20 for installation and removal of winch assembly.
b. Installation and removal of power take-off refer to paragraph 20-12.

CHAPTER 3
REPAIR OF ENGINE

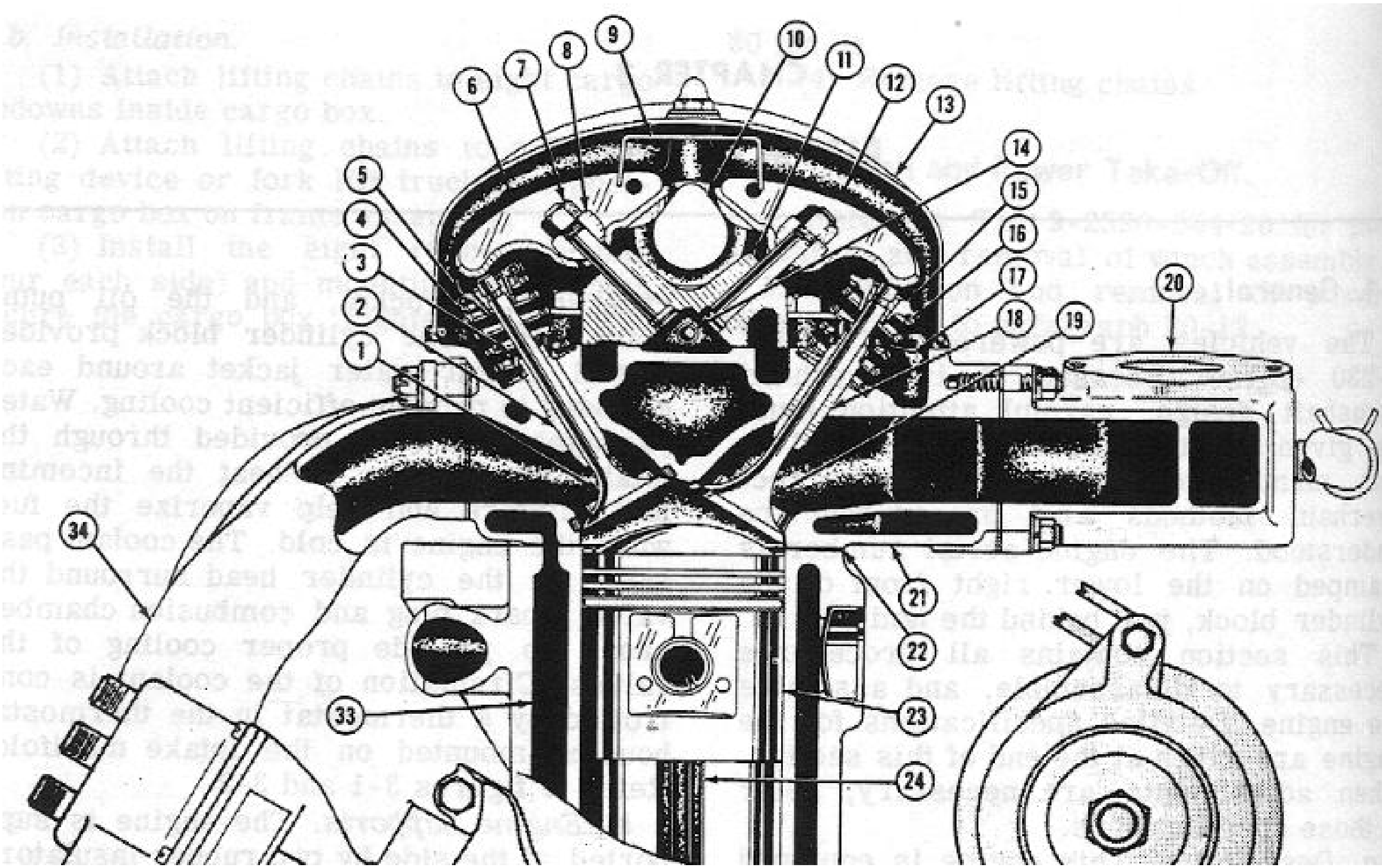
3-1. General.
The vehicles are powered by a OHC 6-230 engine. Because of its overhead camshaft design, careful attention must be given to the procedures outlined in this manual to make sure the correct overhaul methods and procedures are understood. The engine serial number is stamped on the lower right front of the cylinder block, just behind the ignitor.
This section contains all procedures necessary to disassemble, and assemble the engine. Detailed specifications for the engine are given at the end of this section. When adjustments are necessary, refer to those specifications.
a. Description. This engine is equipped with an overhead camshaft and the valves and valve parts are all mounted entirely on the cylinder head. The camshaft, valves, valve springs, rocker arms, and cylinder head can be removed as an assembly for easy repair or overhaul. The camshaft has only six cams, with the same cam operating the intake and exhaust valve rocker arm for each cylinder. The cylinders and crankcases are cast integrally, forming a rigid reinforced unit. The large main bearing caps assure rigid support of main bearings and crankshaft. A fully counter balanced crankshaft is supported by four main bearings. Crankshaft end play is controlled by thrust flanges provided on the rear main bearings. The engine is pressure lubricated. An oil pump, driven from the crankshafts, forces lubricant through the drilled passages to efficiently lubricate the main bearings and connecting rod bearings. A lubrication tube conducts the oil, under pressure, from the cylinder block to the cylinder head to provide lubrication to the cam lobes through the drilled passage in the camshaft. An oil passage is cast into the cam-bearing support deck from which the camshaft bearings are lubricated. An oil fitting is provided on the front of the cylinder block

to spurt oil on the timing chain,
crankshaft sprocket, and the oil pump drive gear. The cylinder block provides a full length water jacket around each cylinder to provide efficient cooling. Water passages are also provided through the intake manifold to preheat the incoming fuel mixture and help vaporize the fuel when the engine is cold. The coolant passages in the cylinder head surround the valve, spark plug and combustion chamber areas to provide proper cooling of the valves. Circulation of the coolant is controlled by a thermostat in the thermostat housing mounted on the intake manifold. Refer to figures 3-1 and 3-2.

b. Engine Supports. The engine is supported at the side by two rubber insulators attached to the frame side rail brackets. It is supported at the rear of the transmission by a rubber insulator attached to the engine rear support crossmember. A torque reaction support arm is attached at the rear of the transmission and bolted to the frame crossmember. The torque reaction arm relieves extreme torque loads from the rear transmission insulator when the vehicle is operating. An engine rear support crossmember is bolted to the frame side rail to enable it to be dropped when removing the transmission. Check the rubber insulators for separation and wear by jacking the power plant away from the frame near the supports, while observing the action of the insulators. Vibration cannot be effectively controlled by separated or worn insulators and they should be replaced if faulty. Refer to figure 3-3.

3-2. Removal.

Refer to TM 9-2320-244-20 for power pack removal.



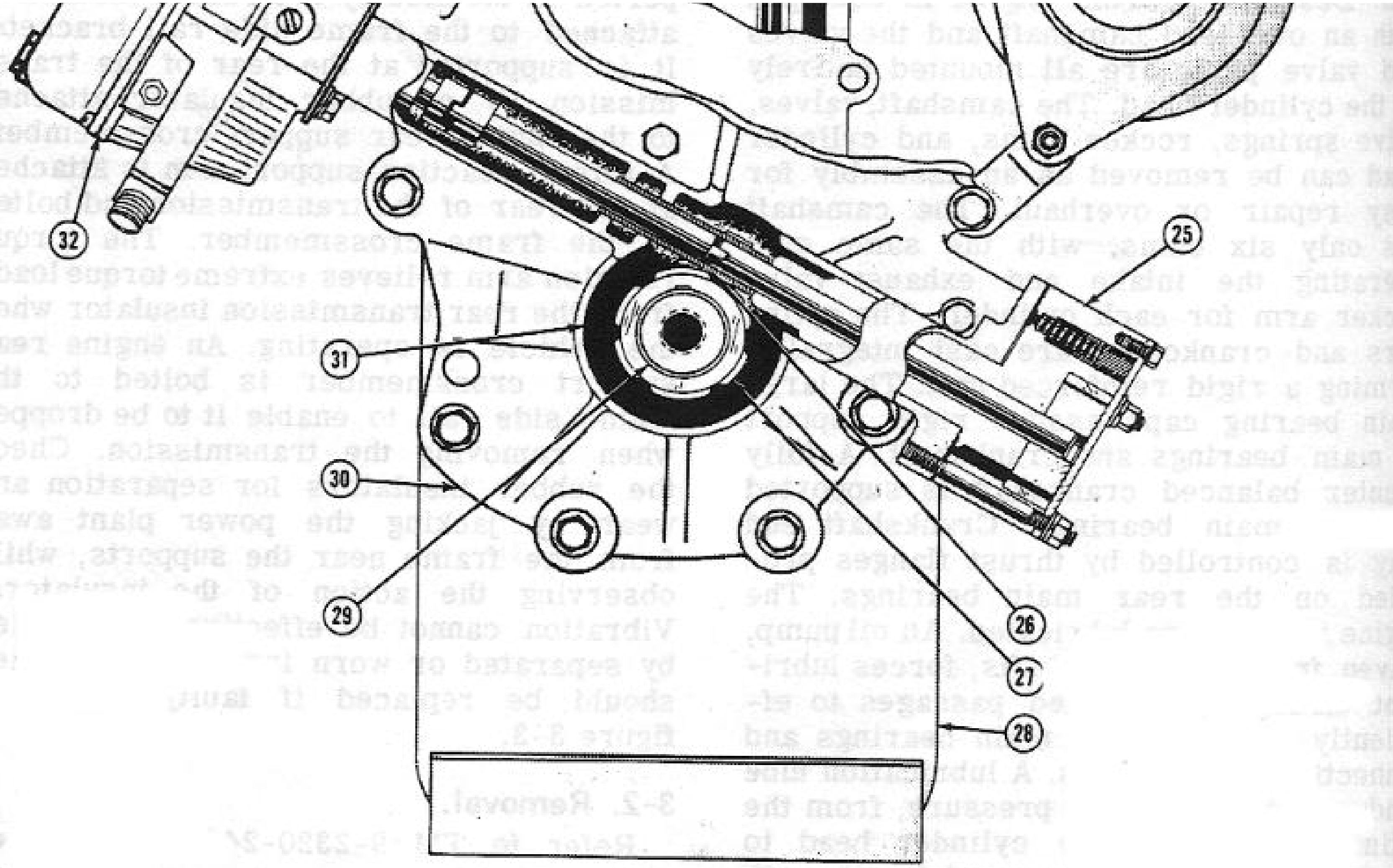


Figure 3-1. Engine front section view.

1 Exhaust valve	10 Camshaft	19 Intake valve	28 Oil pan
2 Exhaust valve guide	11 Cam bearing support deck	20 Intake manifold	29 Crankshaft
3 Valve guide seal	12 Intake rocker arm	21 Cylinder head	30 Timing chain cover
4 Valve spring	13 Rocker arm cover	22 Cylinder head gasket	31 Timing chain cover oil seal
5 Exhaust valve rotator	14 Lubrication pipe	23 Piston	32 Ignitor
6 Exhaust rocker arm	15 Intake valve spring retainer	24 Connecting rod	33 Cylinder block
7 Rocker arm stud	16 Valve spring	25 Oil pump	34 Exhaust manifold
8 Rocker arm ball	17 Valve guide seal	26 Oil pump driven gear	

9 Rocker arm guide	18 Intake valve guide	27 Oil pump drive gear

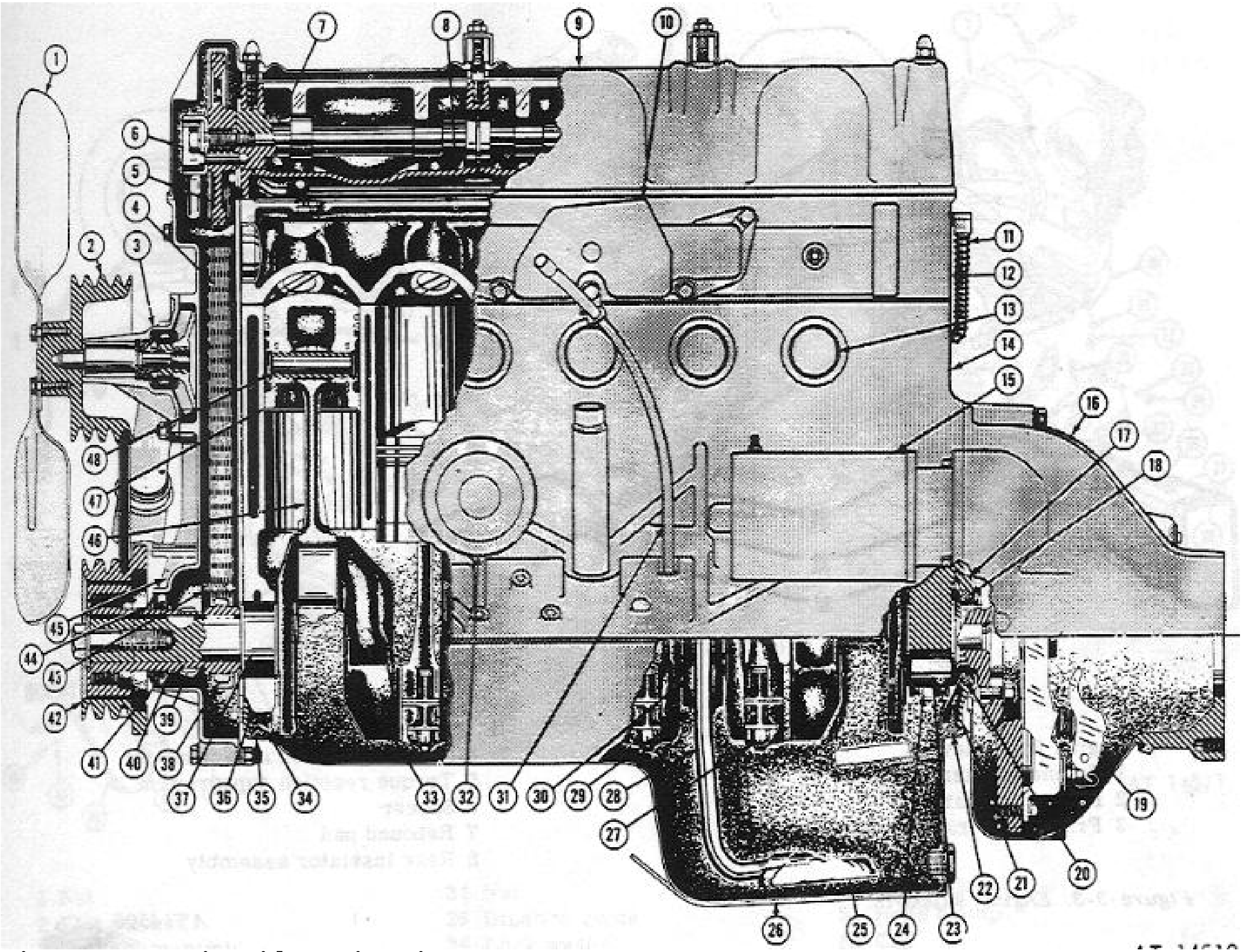


Figure 3-2. Engine side section view.

1 Cooling fan	13 Core plug	25 Oil intake screen	37 Front main bearing

2 Fan drive pulley	14 Cylinder block	26 Oil pan	38 Crankshaft sprocket
3 Water pump	15 Starting motor	27 Connecting rod bearing cap	39 Oil pump drive gear
4 Timing chain	16 Flywheel housing	28 Oil intake pipe	40 Oil Slinger
5 Camshaft sprocket	17 Filler block guard	29 Intermediate main bearing cap screw	41 Timing chain cover oil seal
6 Fuel pump eccentric	18 Upper rear oil seal	30 Intermediate main bearing cap	42 Vibration damper
7 Camshaft	19 Clutch	31 Dipstick guide	43 Oil fitting
8 Cam bearing support deck	20 Lower rear oil seal	32 Oil filter	44 Seal excluder
9 Rocker arm cover	21 Rear filler block	33 Crankshaft	45 Timing chain cover
10 Intake manifold	22 Oil pan seal	34 Front filler block	46 Connecting rod
11 Lubrication tube	23 Rear main bearing	35 Oil pan seal	47 Piston
12 Cylinder head	24 Rear main bearing cap	36 Front main bearing cap	48 Piston pin

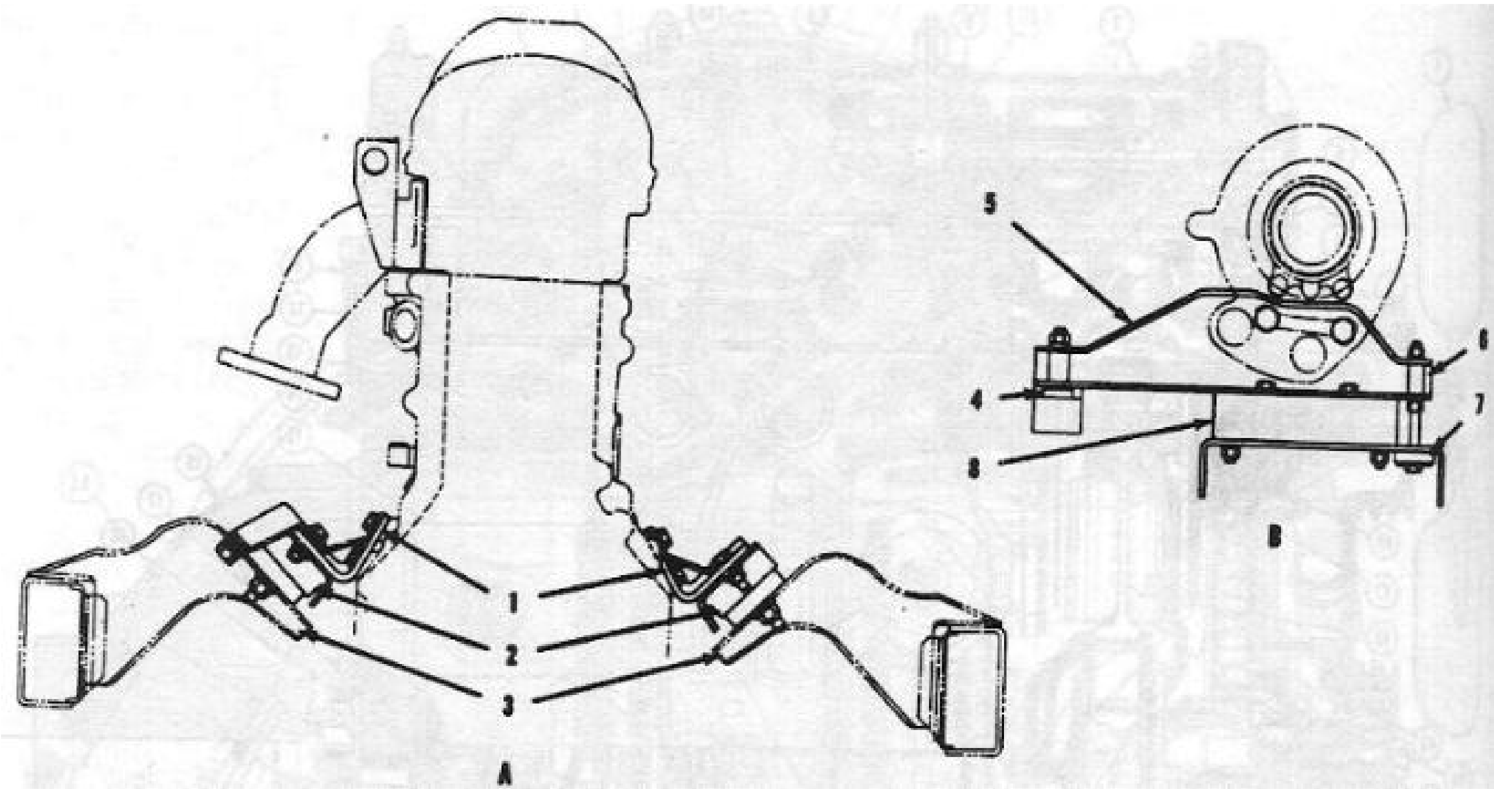


Figure 3-3. Engine supports.

A Engine front view	B Transmission rear view
1 Engine adapter bracket	4 Torque reaction arm insulator
2 Rubber insulator	5 Torque reaction support arm

3 Frame side rail brackets	6 Spacer
	7 Rebound pad
	8 Rear insulator assembly

3-3. Disassembly.

a. General. Engine disassembly is presented in the sequence to be followed when the engine is to be completely overhauled on an engine stand after removal from the vehicle. Most of the operations also apply separately with the engine in the vehicle, provided that wherever necessary, that part of the engine is first made accessible by removal of accessories and other engine parts.

When disassembly operations are performed with the engine out of the vehicle, it is assumed in this procedure that the oil and water have been drained.

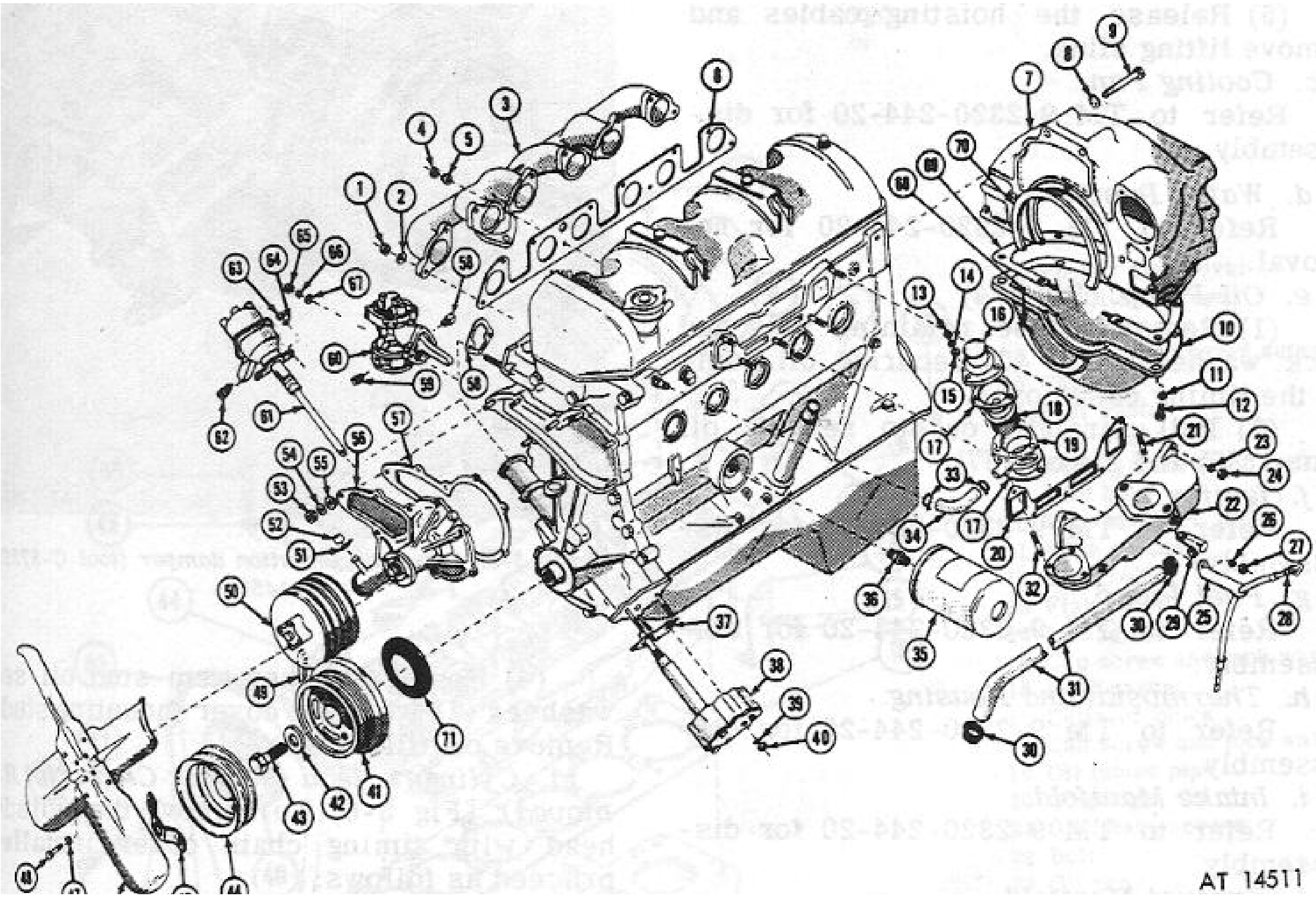


Figure 3-4. External engine part - exploded view.

1 Nut	19 Thermostat housing	37 Oil pump gasket	55 Flat washer
2 Flat washer	20 Intake manifold gasket	38 Oil pump	56 Water pump
3 Exhaust manifold	21 Stud	39 Lock washer	57 Water pump gasket
4 Nut	22 Intake manifold	40 Nut	58 Fuel pump gasket
5 Retainer	23 Lock washer	41 Vibration damper	59 Elbow
6 Exhaust manifold gasket	24 Nut	42 Pilot washer	60 Fuel pump
7 Flywheel housing	25 Dipstick guide	43 Bolt	61 Ignitor
8 Lock washer	26 Lock washer	44 Crankshaft pulley	62 Elbow
9 Bolt	27 Nut	45 Vibration damper lock	63 Nut
10 Flywheel housing pan	28 Dipstick	46 Cooling fan	64 Lock washer
11 Lock washer	29 Elbow	47 Lock washer	65 Nut
12 Cap screw	30 Hose	48 Bolt	66 Lock washer
13 Nut	31 Water by-pass hose	49 Fan belt	67 Flat washer
14 Lock washer	32 Stud	50 Fan pulley	68 Flywheel housing pan-to-oil pan gasket
15 Flat washer	33 Hose clamp	51 Hose clamp	69 Flywheel housing pan gasket
16 Water outlet elbow	34 Hose	52 Cap	70 Flywheel housing-to-block gasket
17 Thermostat housing gasket	35 Oil filter	53 Nut	71 Seal-excluder
18 Thermostat	36 Adapter	54 Lock washer	

NOTE:
If the engine has been missing or if it has been impossible to satisfactorily time the engine and the cause is unknown, check for slippage of the oil pump driven gear before disassembling the engine. First rotate the crankshaft until number one piston is on the compression stroke. Continue to rotate the crankshaft until the pointer on the timing chain cover is alined with the zero timing mark on the vibration damper. Then remove the ignitor and check the position of the slot in the end of the oil pump shaft. The slot should be at 3 and 9 o’clock position with the narrow side of the shaft on top. If the slot is in any other position, it is an indication of gear slippage. Refer to paragraph 3-5t.

b. Mounting Engine on Engine Stand.

(1) Hoist the engine using sling attached to lifting eyes, and position engine on engine stand.

(2) Secure flywheel housing to engine stand mounting plate.

(3) Slightly release tension on hoisting cables.

(4) Check to make sure engine is mounted securely on stand. Make sure position lock on the engine stand is tight to prevent the engine from accidentally inverting.

(5) Release the hoisting cables and remove lifting sling.

c. Cooling Fan.

Refer to TM 9-2320-244-20 for disassembly.

d. Water Pump.

Refer to TM 9-2320-244-20 for removal.

e. Oil Pump. (Fig 3-4)
(1) Remove three retaining nuts and lock washers (39, 40) securing oil pump to the timing case cover.
(2) Pull straight out to remove oil pump (38) and gasket (37).
f. Ignitor.
Refer to TM 9-2320-244-20 for disassembly.
g. Fuel Pump.
Refer to TM 9-2320-244-20 for disassembly.
h. Thermostat and Housing.
Refer to TM 9-2320-244-20 for disassembly.
i. Intake Manifold.
Refer to TM 9-2320-244-20 for disassembly.
j. Exhaust Manifold.
Refer to TM 9-2320-244-20 for disassembly.
k. Vibration Damper. Before removing vibration damper, check for looseness. If there is any indication of looseness, a new vibration damper should be installed (fig
3-4).
(1) Remove bolt (43) and pilot lock washer (42) securing vibration damper to the crankshaft.
(2) Install vibration damper puller C3732A (fig 3-5) using attaching bolts provided. Turn center screw clockwise to remove vibration damper from the crankshaft.

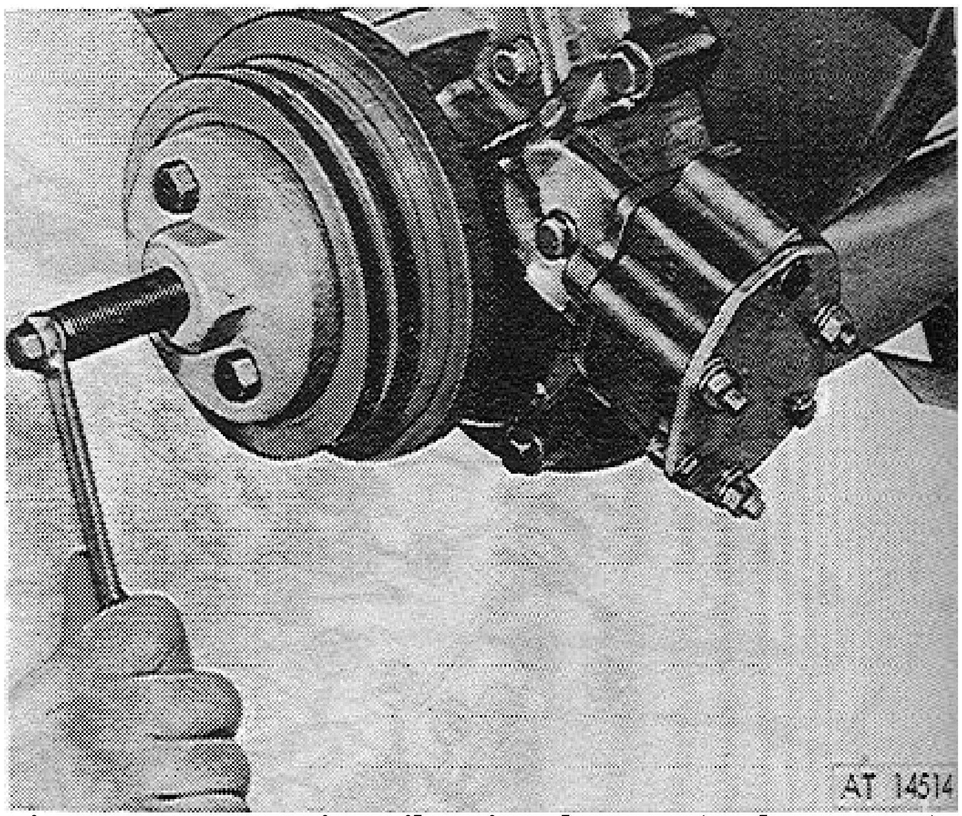


Figure 3-5. Removing vibration damper (tool C-3732A)

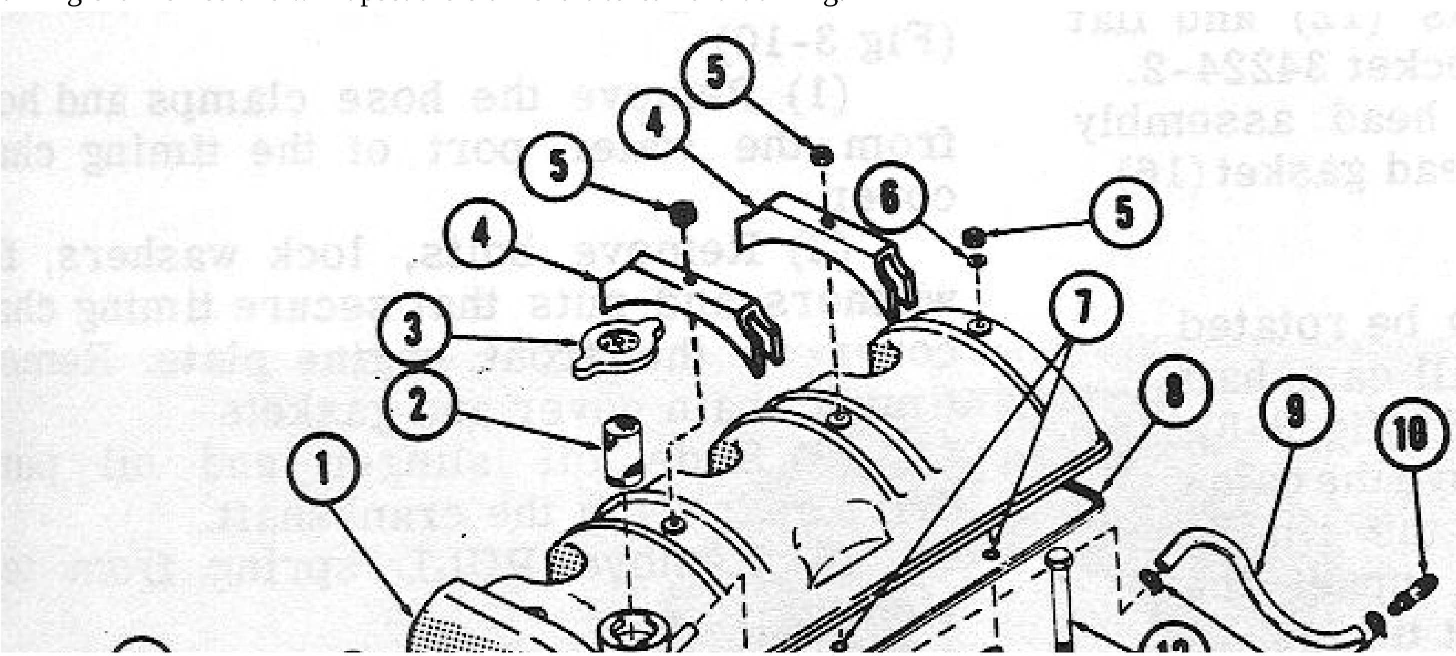
l. Rocker Arm Cover. (Fig 3-6)
(1) Disconnect crankcase ventilation hose (9) from oil filler tube.
(2) Remove the four cap nuts (5) and two cover supports (4).

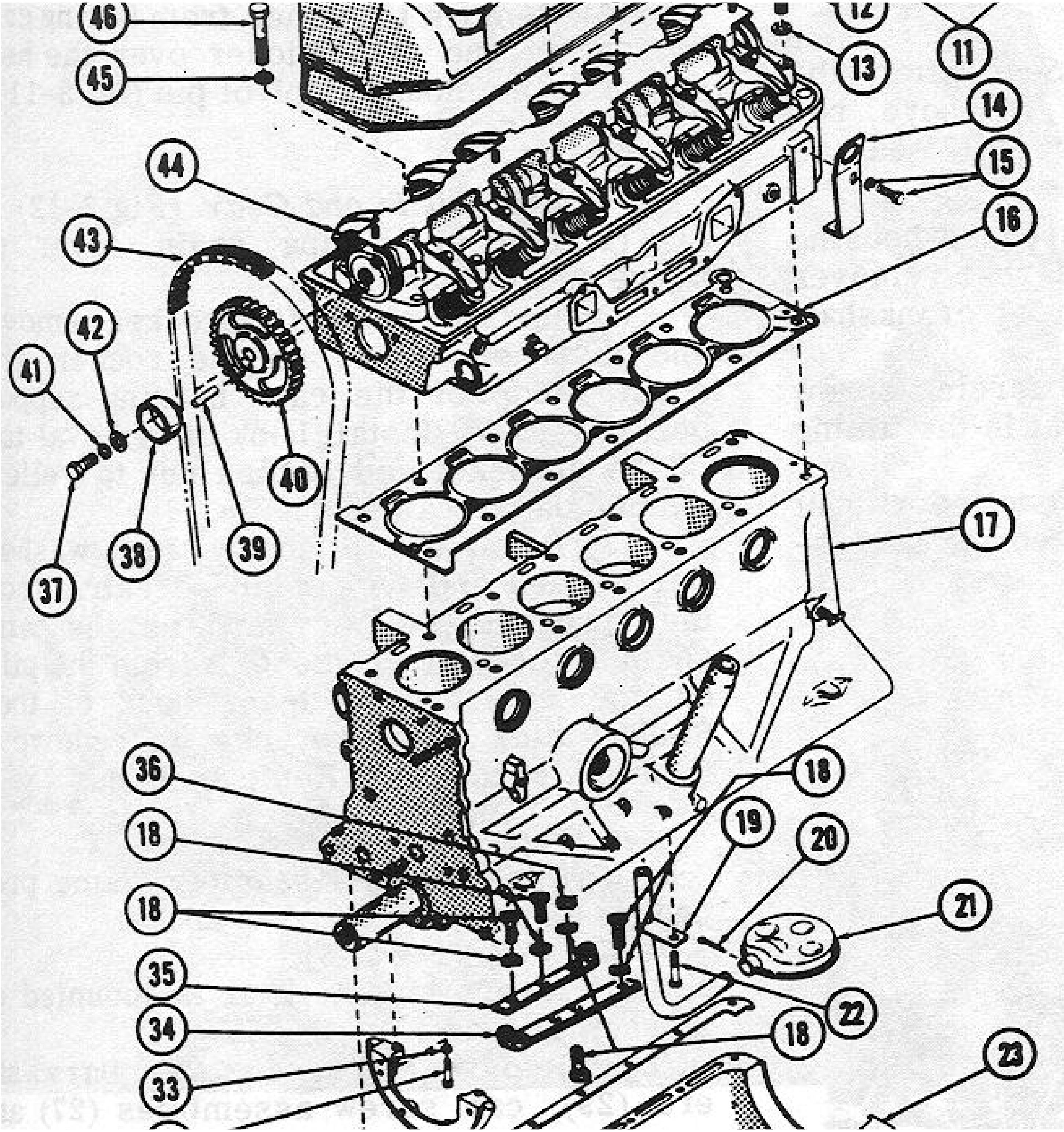
(3) Remove rocker arm cover (1) and gasket (8) with care. The gasket can be damaged by contact with any sharp metallic object. Handle the cover with care since any improper handling can result in distortion or damage. Examine rocker arm cover gasket for nicks or cuts — replace if damaged.
(4) Remove rocker arm stud oil seal washers (7) from the cover mounting studs. Remove oil filler cap (3).
m. Cylinder Head (Timing Chain Not Removed). (Fig 3-6) To remove the cylinder head with timing chain cover installed, proceed as follows:
(1) Remove rocker arm cover (l) above.
(2) Install camshaft sprocket remover and installer W-268 (fig 3-7) on the rocker arm cover studs. Secure with rocker arm cover nuts (5). Install the hook of the removal tool in the sprocket and tighten the nut to relieve tension on the camshaft.
(3) Remove cap screw, lock washer, flat washer and fuel pump eccentric from camshaft sprocket.
(4) Pull forward on the camshaft sprocket to remove it from the pilot on the camshaft. With the sprocket still engaged in the timing chain, release tension on the sprocket removal tool by loosening the nut. Gently allow the sprocket to rest on the bosses in the timing chain cover.

CAUTION
Do not rotate the crankshaft when the camshaft sprocket is removed from the camshaft and is resting on the bosses in the timing chain cover.

(5) Disconnect cylinder head to block flexible oil line located at block connection.
(6) Remove the two timing chain cover-to-head bolts.
(7) Remove the three short (46) and the eleven long head bolts (12) and flat washers, using thin wall socket 34224-2.
(8) Lift off cylinder head assembly (44) and remove cylinder head gasket (16).

NOTE
If the crankshaft is to be rotated at this time, first install camshaft sprocket holder W-271 (fig 3-8). Do not attempt to remove the camshaft sprocket from the timing chain since this will upset the crankshaft-to-camshaft timing.

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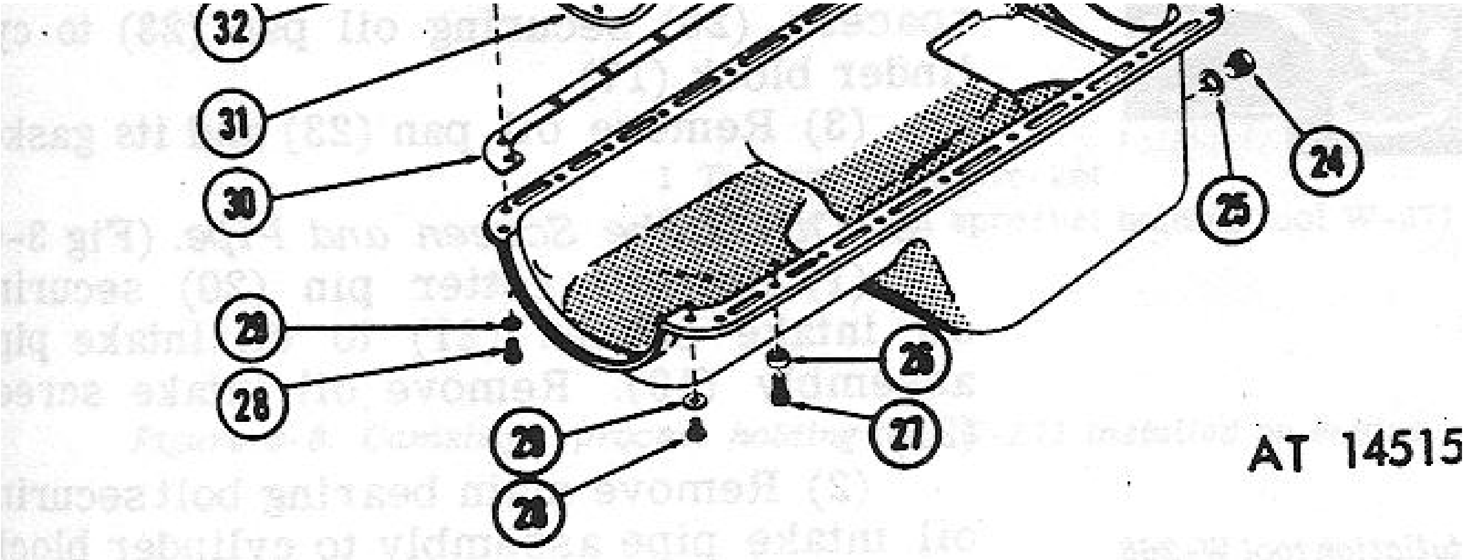

Figure 3-6. Cylinder head and oil pan, exploded view.

1 Rocker arm cover	13 Flat washer	25 Gasket	37 Cap screw
2 Oil filler screen	14 Lifting eye	26 Spacer	38 Fuel pump eccentric
3 Oil filler cap	15 Cap screw and lock washer	27 Cap screw	39 Driving dowel
4 Rocker arm cover support	16 Head gasket	28 Cap screw	40 Camshaft sprocket
5 Cap nut	17 Cylinder block	29 Flat washer	41 Lock washer
6 Flat washer	18 Cap screw and lock washer	30 Pan gasket	42 Flat washer
7 Seal washer	19 Oil intake pipe	31 Front filler block	43 Timing chain
8 Rocker arm cover gasket	20 Cotter pin	32 Bolt	44 Cylinder head
9 Vent hose	21 Oil intake screen	33 Washer	45 Flat washer
10 Vent valve	22 Bolt	34 Lower alternator bracket	46 Head bolt
11 Hose clamps	23 Oil pan	35 Upper alternator bracket	
12 Head bolt	24 Plug	36 Nut	

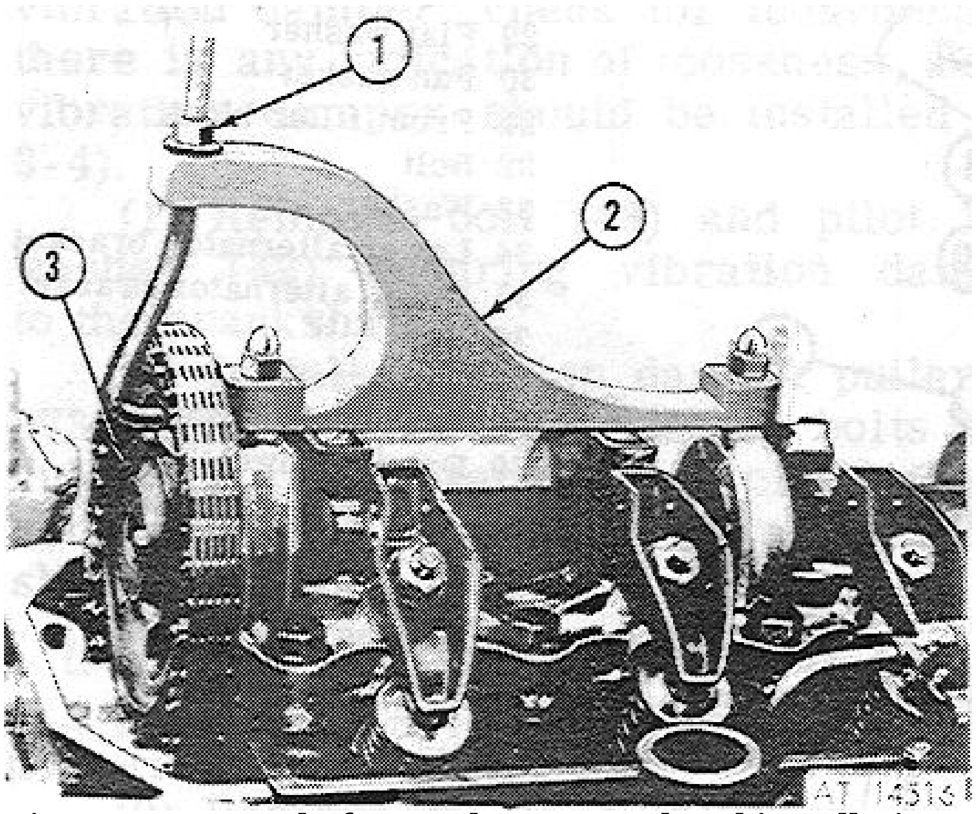

Figure 3-7. Camshaft sprocket removal and installation tool W-268

1 Nut
2 Tool W-268
3 Camshaft sprocket

n. Front Crankshaft Oil Seal, After vibration damper is removed (k) above, remove the front crankshaft oil seal as follows:
(1) Turn the coarse threaded housing of the crankshaft front oil seal remover W-286 (fig 3-9) into the front crankshaft oil seal.
(2) Turn clockwise on forcing screw to remove seal from its seat in the timing chain cover.
(3) A new seal can be installed without removing the timing chain cover as described in (o) below.
o. Timing Chain Cover and Tensioner. (Fig 3-10)
(1) Remove the hose clamps and hose from the water port of the timing chain cover.
(2) Remove bolts, lock washers, flat washers and nuts that secure timing chain cover to the front engine plate. Remove timing chain cover and gaskets.
(3) Slide oil slinger and oil pump drive gear from the crankshaft.
(4) Remove PULL spring from tension.
(5) Remove tensioner from timing case by forcing end of tensioner over the head of tensioner mounting pivot pin (fig 3-11).
p. Timing Chain and Gear. (Fig 3-12)
(1) Remove timing chain cover (o) above and tensioner.
(2) Install camshaft sprocket remover and installer W-268 on the rocker arm cover studs of the cam bearing support deck (fig 3-7). Install hook of removal tool

in the sprocket and tighten nut to relieve tension on the camshaft.

(3) Remove cap screw, lock washer, flat washer and fuel pump eccentric from the sprocket. Pull forward on the camshaft sprocket to remove it from the pilot on the camshaft. Release hook of tool. Slide timing chain sprocket to remove it from the crankshaft. Remove chain.

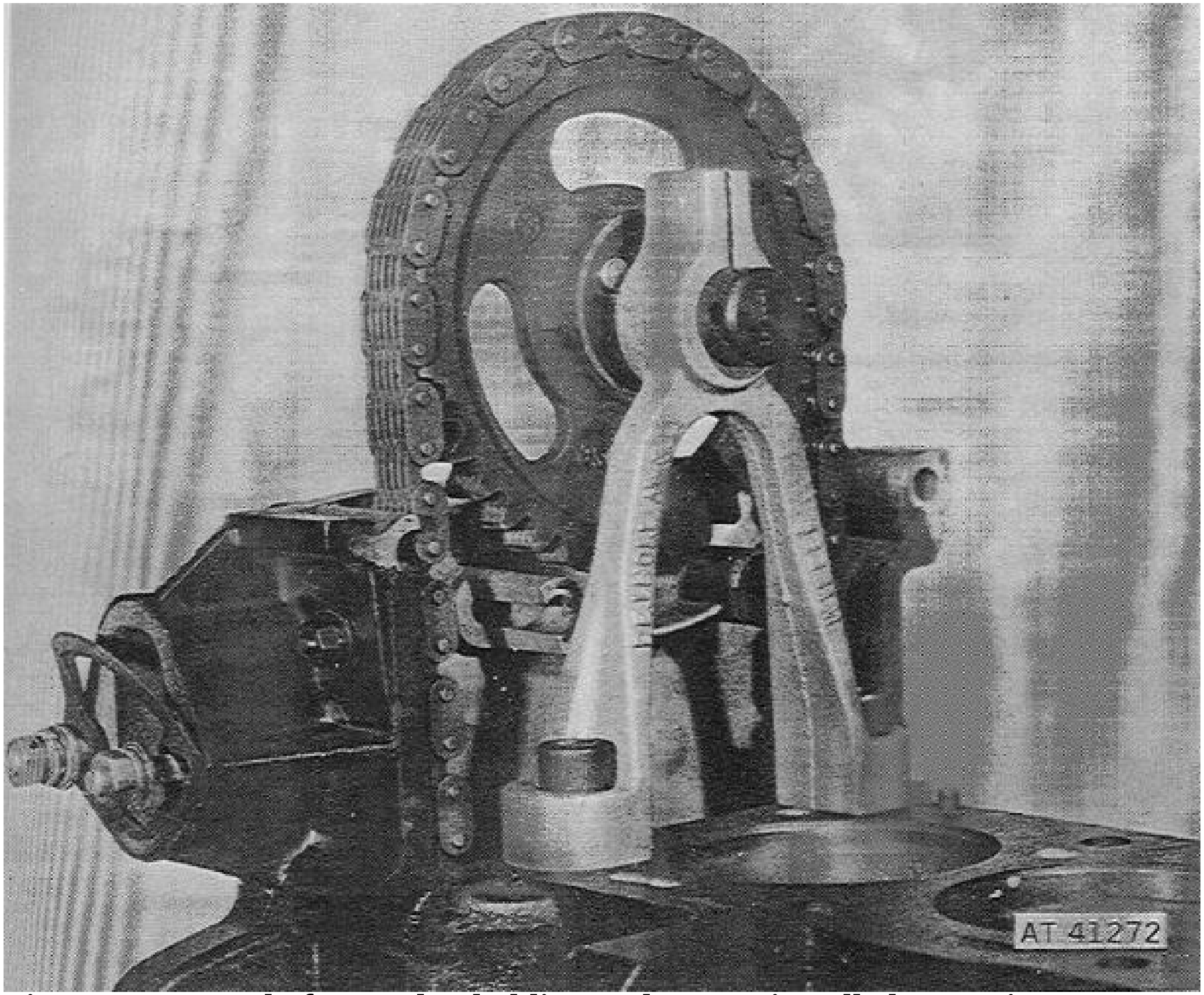

Figure 3-8. Camshaft sprocket holding tool W-271 installed on engine.

1 Timing chain sprocket
2 Timing chain sprocket holding tool W-271

q. Cylinder Head Assembly. Same procedure as described in (m) above.

r. Oil Pan. (Fig 3-6)

(1) Invert engine if it is mounted on, an engine stand.

(2) Remove cap screws (28), flat washers (29), cap screw assemblies (27) and spacers (26) securing oil pan (23) to cylinder block (17).

(3) Remove oil pan (23) and its gasket (30).

s. Oil Intake Screen and Pipe. (Fig 3-6)

(1) Remove cotter pin (20) securing oil intake screen (21) to oil intake pipe assembly (19). Remove oil intake screen (21).

(2) Remove main bearing bolt securing oil intake pipe assembly to cylinder block. Pull straight out to remove oil intake pipe (19).

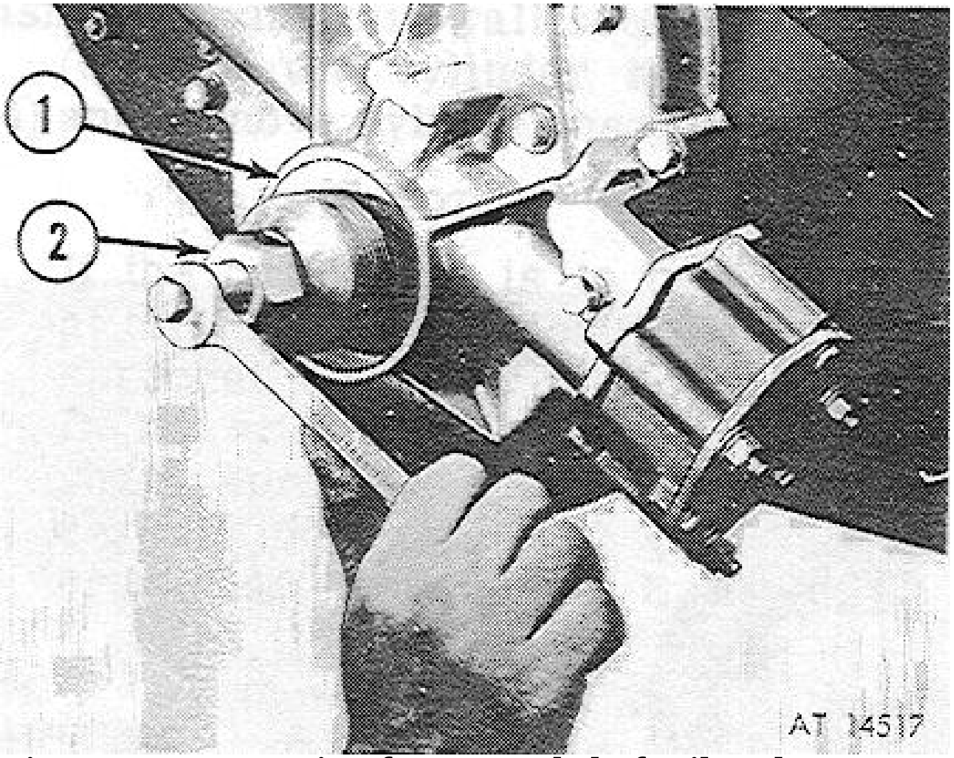

Figure 3-9. Removing front crankshaft oil seal.

1 Oil seal
2 Puller W-286

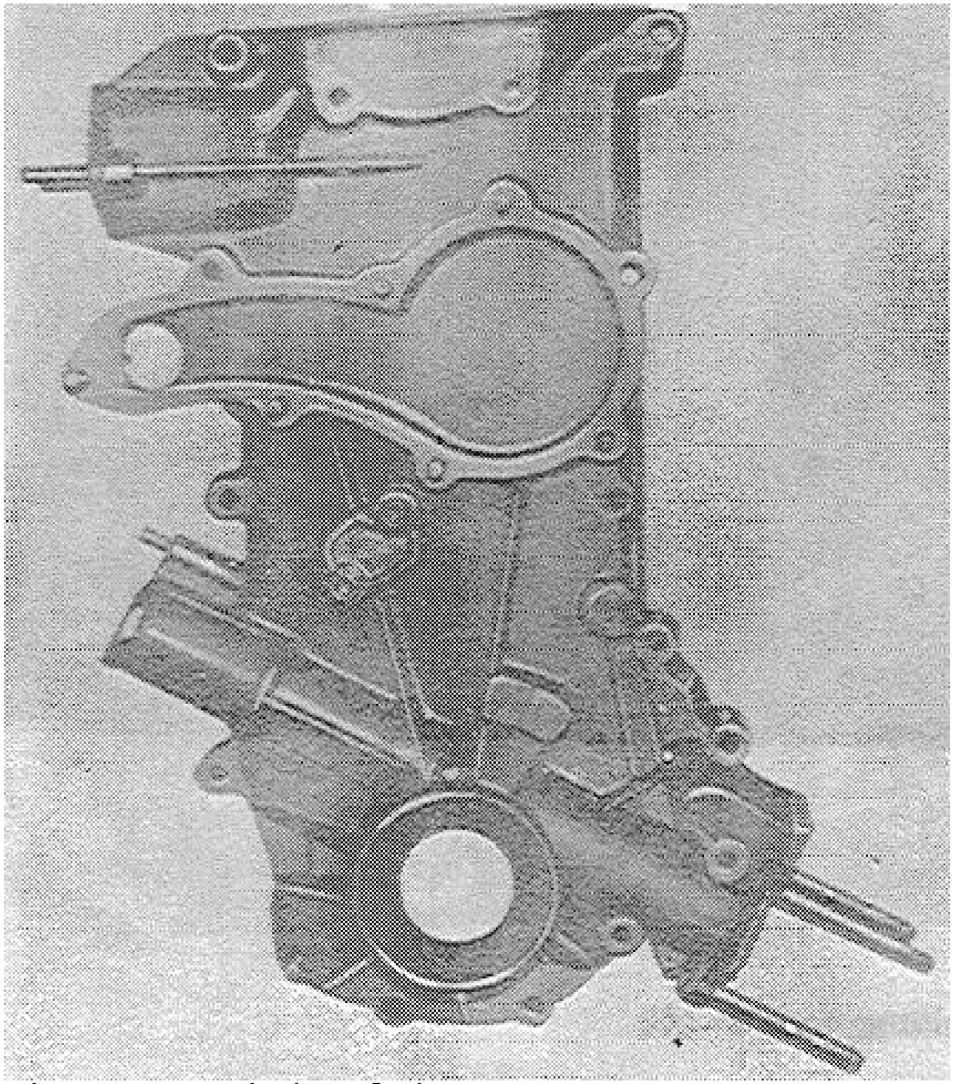

Figure 3-10. Timing chain cover.

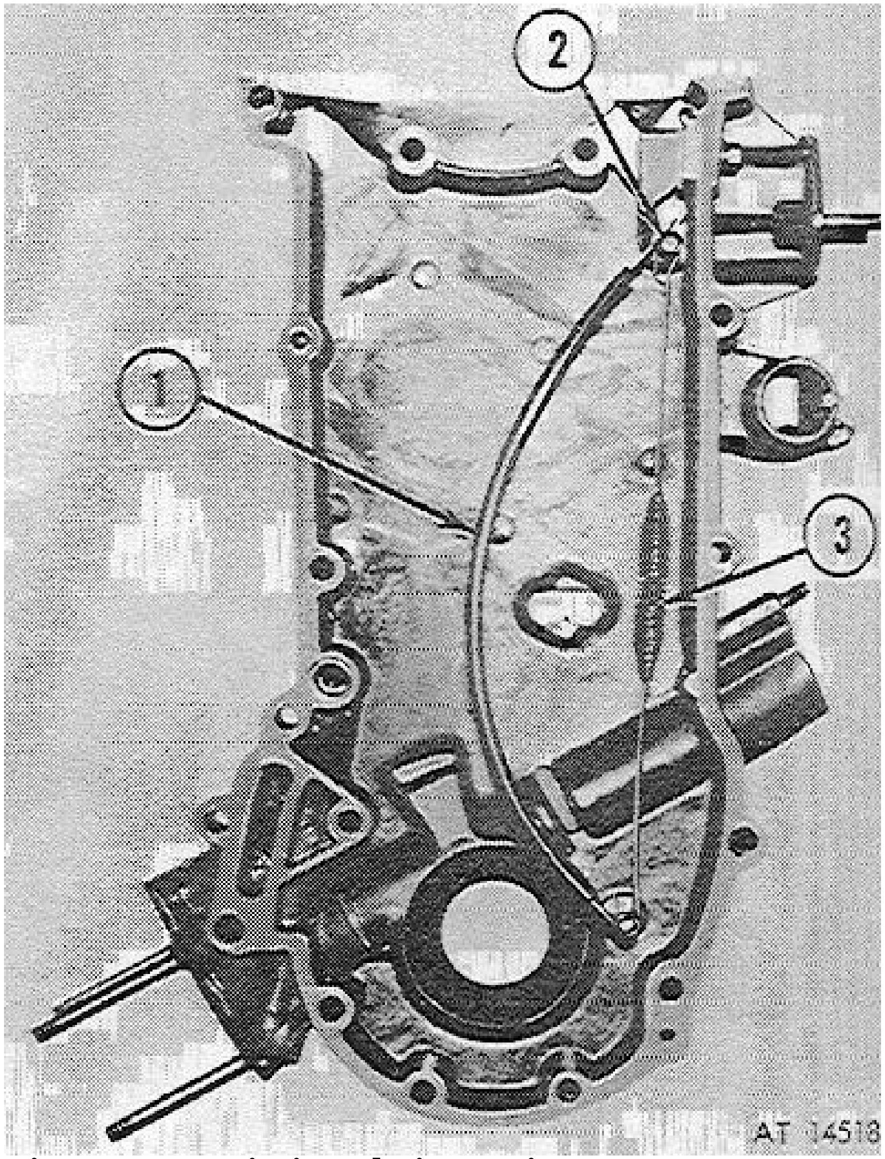

Figure 3-11. Timing chain tensioner.

1 Tensioner blade assembly
2 Tensioner pin
3 Chain tensioner spring

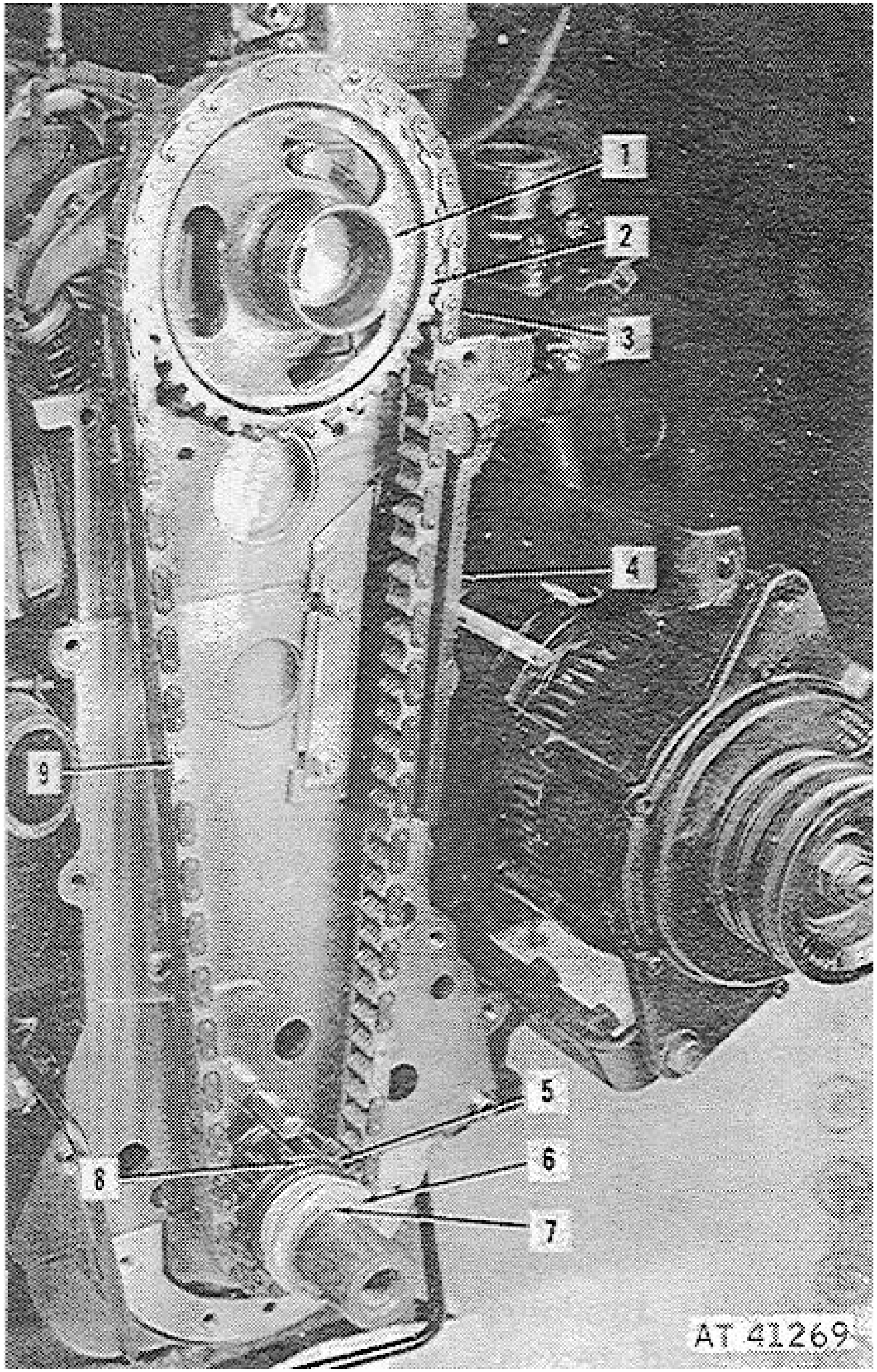
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Figure 3-12. Timing chain and gears.

1 Fuel pump eccentric
2 Camshaft gear
3 Timing chain
4 Timing chain guide and bracket
5 Crankshaft gear
6 Oil pump drive gear
7 Key
8 Timing marks
9 Copper links

t. Clutch. (Fig 3-13)
(1) Remove cap screws and lock washers attaching flywheel housing cover to flywheel housing. Remove flywheel housing cover.
(2) Loosen the six bolts and lock washers securing clutch assembly to flywheel.
(3) Be sure opposing bolts are loosened alternately until clutch spring pressure is relieved.
(4) Support clutch assembly with one hand while removing bolts. Remove the clutch assembly.

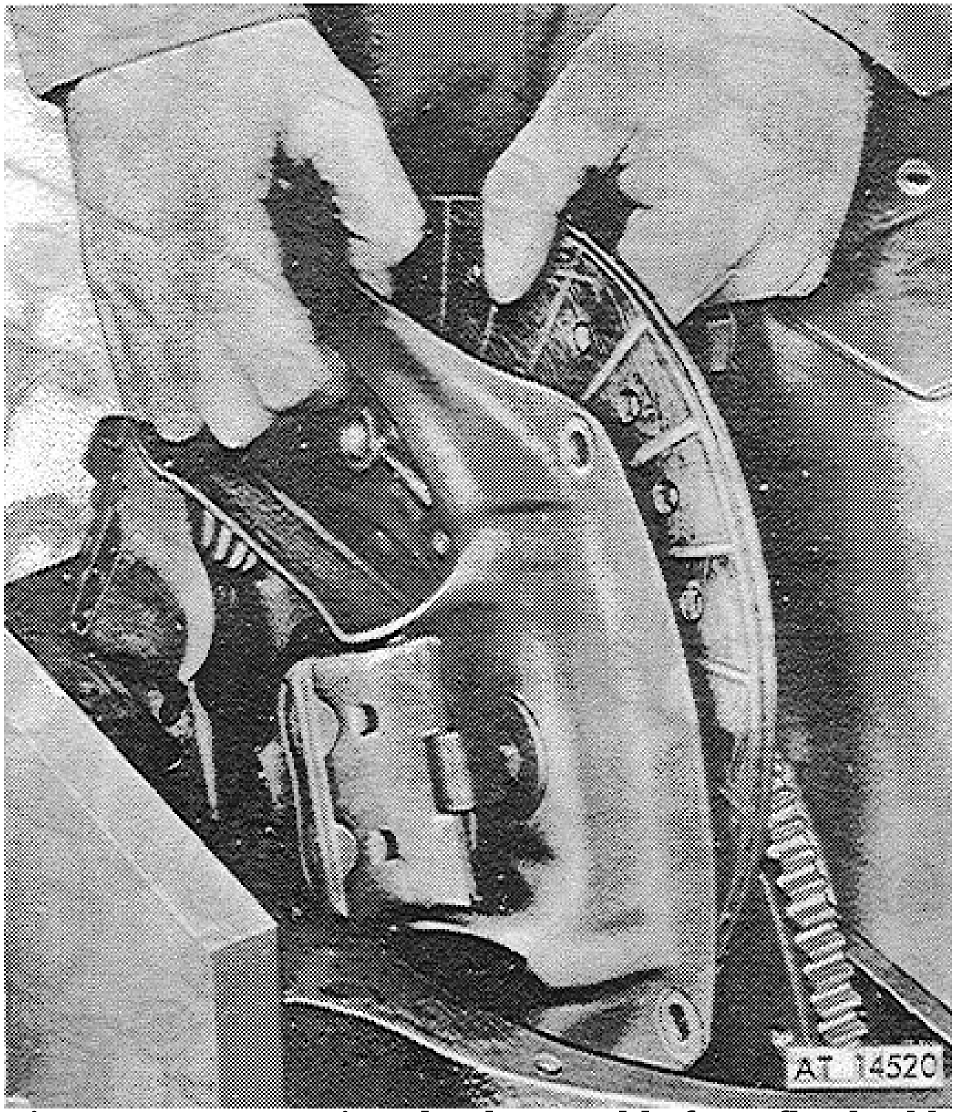
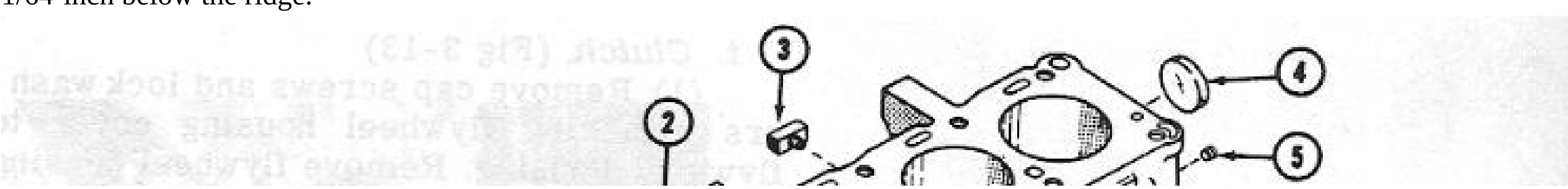
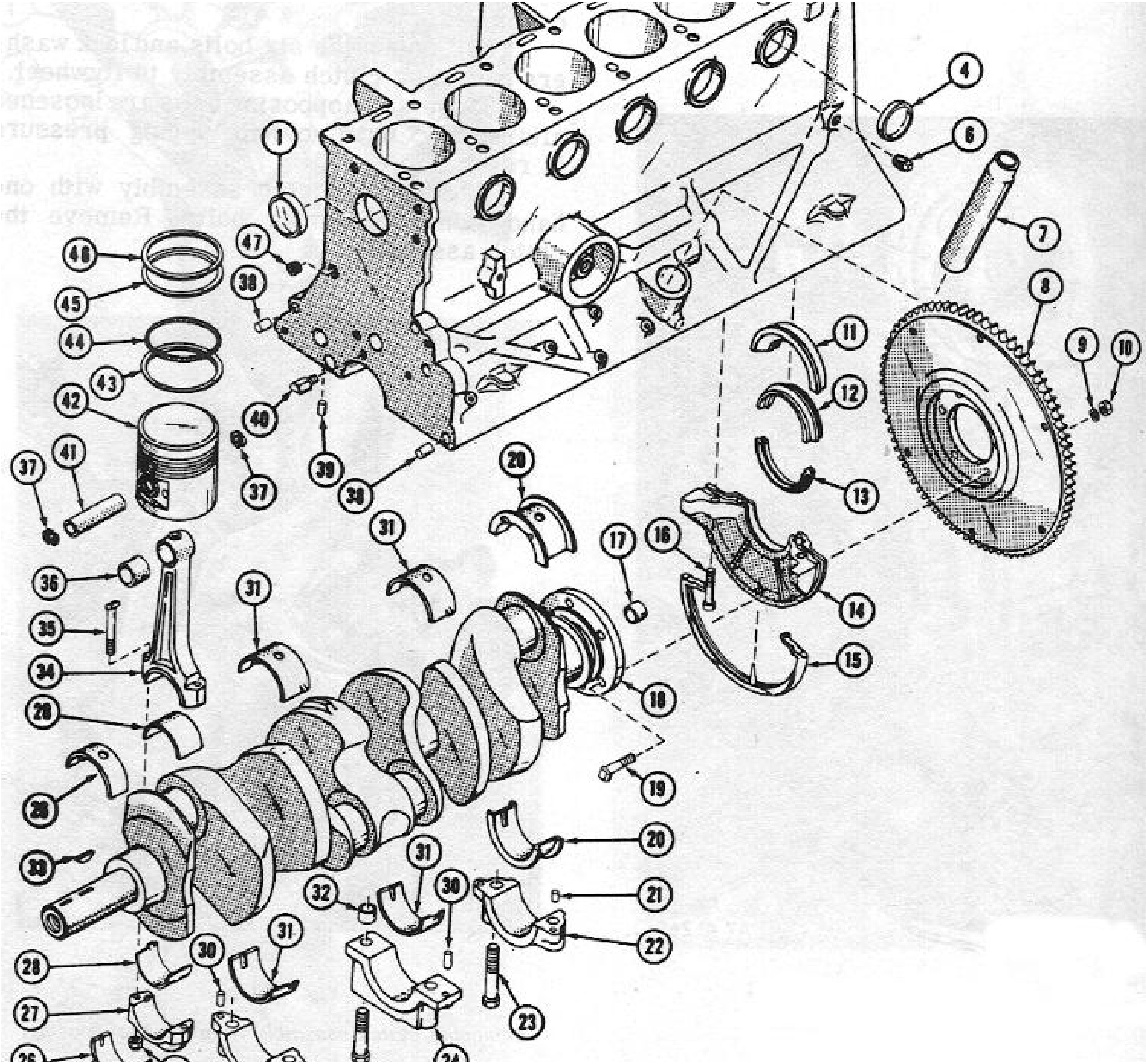


Figure 3-13. Removing clutch assembly from flywheel housing.

u. Piston and Connecting Rod Assemblies. (Fig 3-14)
(1) To prevent breaking the piston lands, the ridge at the top of each cylinder bore must be removed before attempting to remove the pistons. To remove ridge, use a cylinder ridge reamer. (Fig 3-15).
(2) For proper use of ridge reamer, follow instructions furnished by the manufacturer. The portion of metal removed from the bore should not extend more than 1/64-inch below the ridge.

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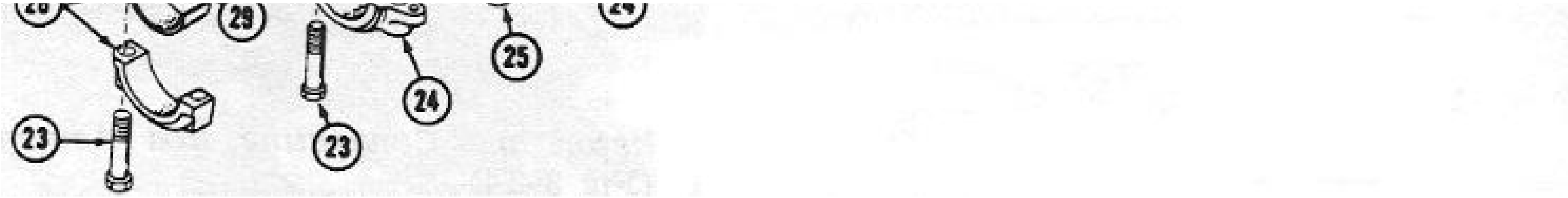


Figure 3-14. Engine crankshaft and components - exploded view.

1 Expansion plug	13 Gasket inserts	25 Special main bearing bolt	37 Retaining ring
2 Cylinder block	14 Lower filler block	26 Lower front main bearing and cap	38 Dowel
3 Tee	15 Oil pan seal	27 Connecting rod bearing cap	39 Dowel
4 Expansion plug	16 socket head machine screw	28 Crank pin bearing	40 Oiler
5 Plug	17 Pilot bushing	29 Self locking nut	41 Piston pin
6 Drain plug	18 Crankshaft	30 Dowel	42 Piston
7 Breather tube	19 Flywheel bolt	31 Lower intermediate main bearing	43 Oil ring
8 Flywheel	20 Upper and lower rear main bearing	32 Sleeve	44 Ring expander
9 Lock washer	21 Dowel	33 Key	45 Lower compression ring
10 Nut	22 Rear main bearing cap	34 connecting rod	46 Upper compression ring
11 Filler block guard	23 Main bearing cap bolt	35 Cap bolt	47 Plug
12 Upper rear seal	24 Rear intermediate main bearing cap	36 Piston pin bushing	

(3) Remove self-locking nuts (29) securing connecting rod bearing cap (27) to connecting rod (34). Remove bearing cap.
(4) Push connecting rod and piston assembly out of the cylinder block (using handle end of a hammer) until piston rings are free from the cylinder bore (fig 3-16). Remove piston and connecting rod assembly from top of cylinder block. Reassemble connecting rod bearing cap, with bearings in place, to the rod from which it was removed.
(5) Rotate crankshaft and follow same procedure until all pistons and connecting rod assemblies are removed.

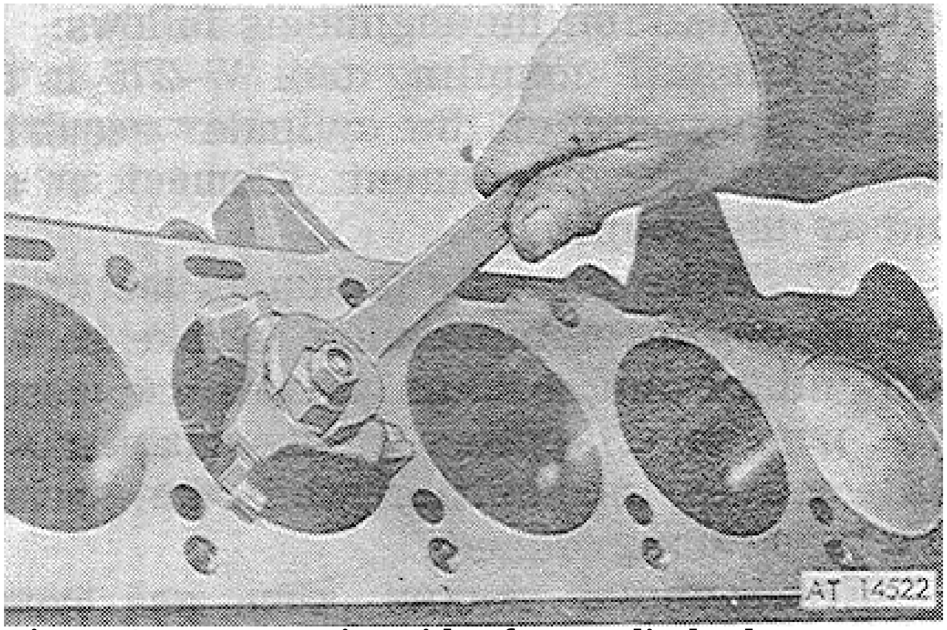


Figure 3-15. Removing ridge from cylinder bore.

v. Crankshaft and Flywheel. (Fig 3-14)
(1) Remove two socket head machine screws (16) securing rear lower filler block (14) to the cylinder block (2). Remove oil pan seal filler block (14), gasket inserts (13) and lower rear seal (15). Remove bolts securing front filler block to cylinder block.
(2) Remove main bearing cap bolts (23) securing main bearing caps (24) to cylinder block.
(3) Using a bar inserted under recessed ends of bearing caps, pry bearing caps from cylinder block (fig 3-17). Be careful not to exert enough pressure to cause damage to the bearing caps or dowels. Pry alternately, a little at a time, at each end of bearing caps until each one is free from the dowels. Lift assembled crankshaft and flywheel from the cylinder block.

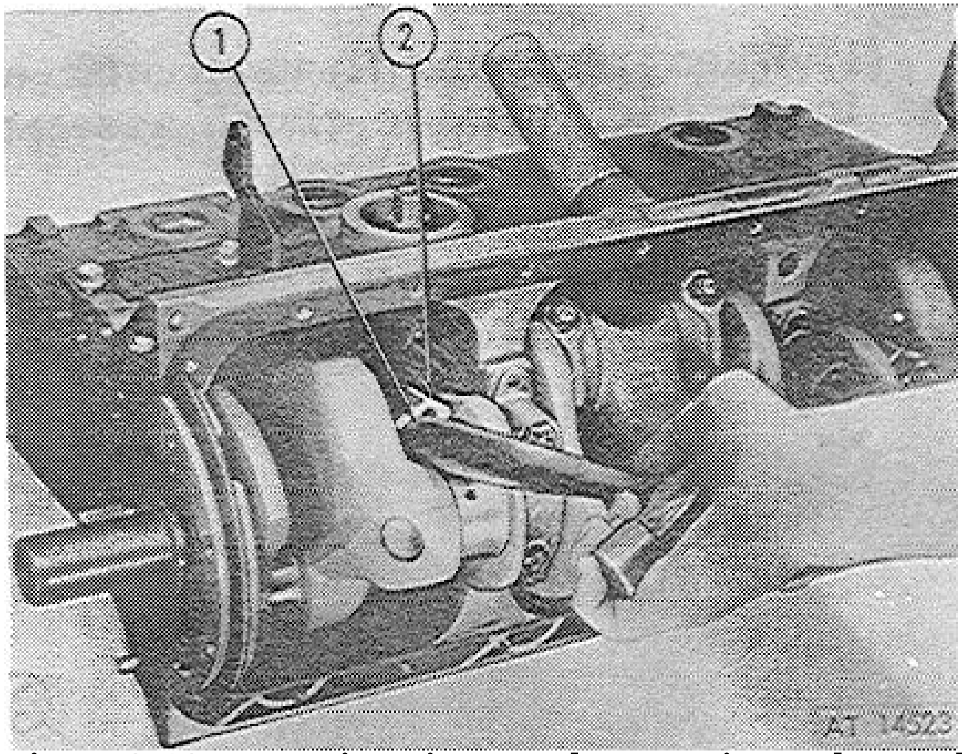


Figure 3-16. Removing piston and connecting rod assembly.

1 Hammer handle
2 Connecting rod

(4) Install main bearing caps (24) and bearings (20, 31) onto cylinder block in their original position.

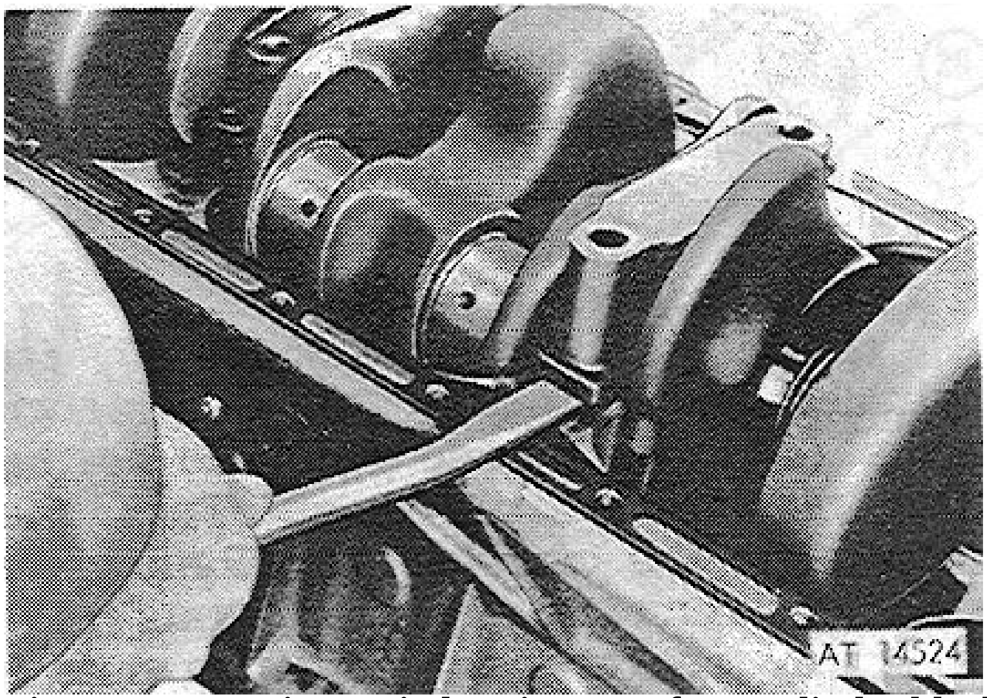


Figure 3-17. Prying main bearing caps from cylinder block.

(5) Remove nuts (10), lock washers (9) and bolts (19), securing flywheel to crankshaft. Remove flywheel assembly (18).
w. Flywheel (Engine in Vehicle). (Fig 3-18)
(1) When removing flywheel with engine in vehicle, remove clutch assembly to gain access to flywheel bolts.
(2) Remove flywheel nuts.
(3) Tap flywheel bolts forward to provide clearance for flywheel removal.

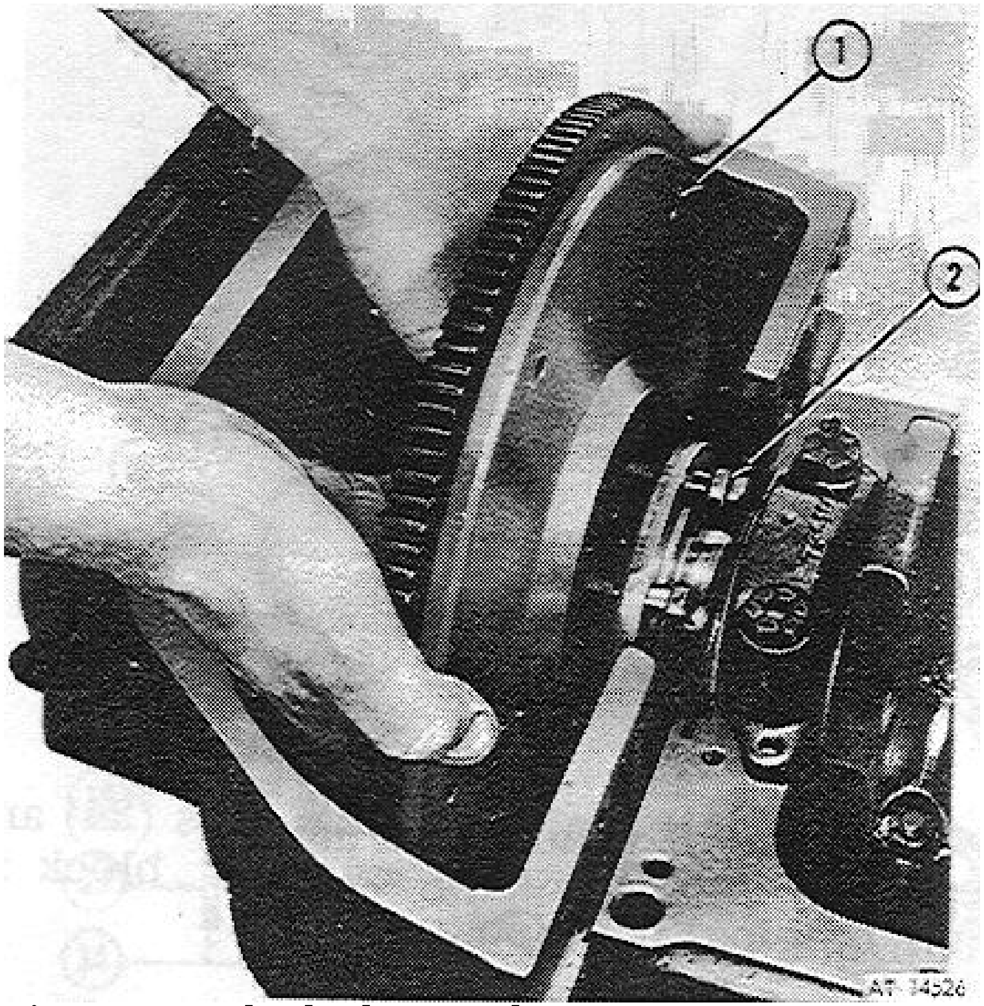


Figure 3-18. Flywheel removal.

1 Flywheel
2 Flywheel bolts

x. Camshaft. (Fig 3-19)
(1) Lift rocker arm guide (7) from cylinder head assembly (20). Check rocker arms (4) to determine which do not have cam tension against them. Turn these parallel to the camshaft (8). Remove tension on remaining rocker arms (4) by loosening rocker arm adjusting nuts (6). Turn these parallel to the camshaft also. Continue to do this until all rocker arms are out of engagement with the camshaft.
(2) Remove two nuts (1) and lock washers (2) securing camshaft retainer (3).
(3) Pull forward on camshaft (8) to remove it from the cam bearing support deck (14).
(4) Remove three nuts (11), lock washers (12) and flat washers (13) securing cam bearing support deck (14) to cylinder head (20. Remove cam bearing support deck (14).
y. Rocker Arms.

(1) Remove nuts securing rocker arms to rocker arm studs.
(2) Remove rocker• arms and rocker arm balls.

NOTE

Whenever rocker arms are being removed from engine, the individual arms and rocker arm balls must be marked to identify their original location on the engine. The rocker arms can be removed either before or after removal of camshaft.

z. Valve Spring. (Fig 3-20) Valve springs may be removed and replaced with the cylinder head on the engine as follows:
(1) Install coupling tool W-275 in the spark plug port of the cylinder requiring valve spring replacement. Connect an air line to the coupling.
(2) Make sure the piston of that cylinder is on the compression stroke so that both intake and exhaust valves are closed. Air pressure applied to the adapter will hold valves in position while the springs are being compressed.
(3) Remove rocker arm and install valve spring compressor W-267-A onto rocker arm stud. Install rocker arm nut on the stud.
(4) Pry on the tool to compress valve spring far enough to remove valve locks, valve retainer, and valve spring. Refer to figure 3-20.

NOTE

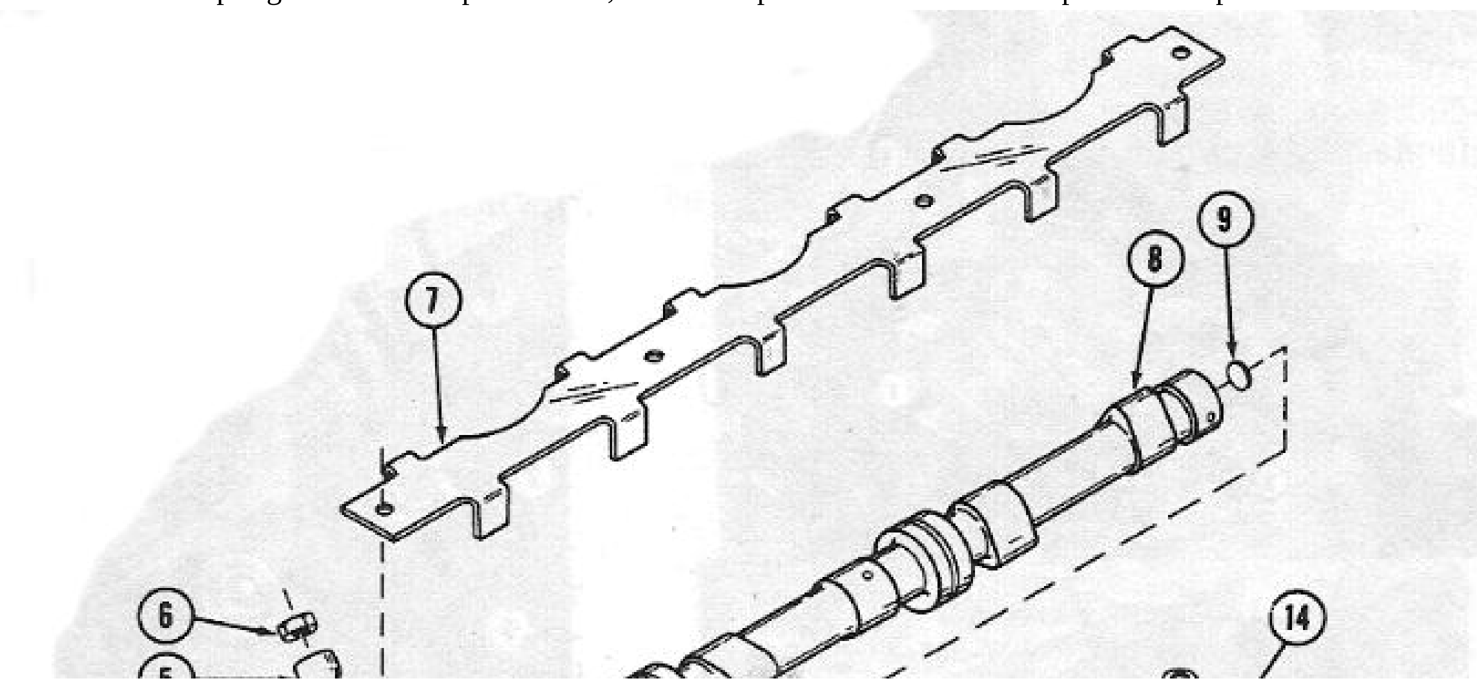
All exhaust valves are equipped with rotator type spring retainers.

(5) Always replace valve guide seals.

NOTE

To prevent valve stem damage, place metal protective cap tool W-300 over valve stem before installing and compressing valve retainer and spring.

(6) Position new valve spring on the cylinder head, making sure it is properly seated. Place metal protective cap W-300 over valve stem (fig 3-21). Position valve spring retainer on the valve spring and compress valve spring with compressor tool. Remove metal protective cap from valve stem. Install valve locks to retain valve and spring. Remove compressor tool, release air pressure and remove air pressure adapter tool.



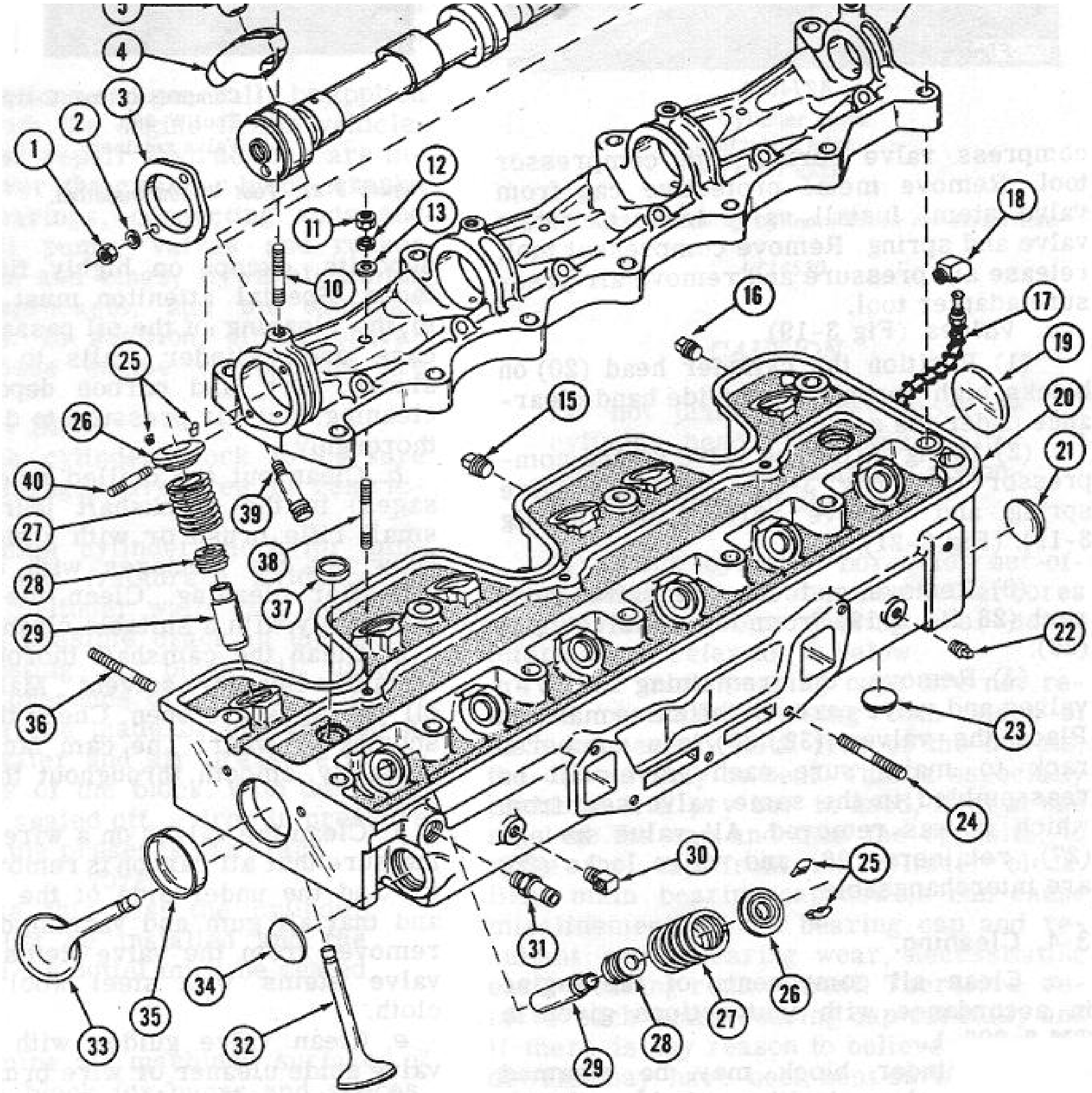

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Figure 3-19. Cylinder Head and Valve Component--Exploded View

1 Nut	9 Plug	17 Flexible oil line	25 Valve locks	33 Intake valve
2 Lock washer	10 Stud	18 Elbow	26 Exhaust valve rotator	34 Expansion plug
3 Camshaft retainer	11 Nut	19 Expansion plug	27 Valve spring	35 Expansion plug
4 Rocker arm	12 Lock washer	20 Cylinder head	28 Valve guide seal	36 Stud
5 Rocker arm ball	13 Flat washer	21 Expansion plug	29 Valve guide	37 Plug
6 Rocker arm nut	14 Cam bearing support deck	22 Plug	30 Elbow	38 Stud
7 Rocker arm guide	15 Plug	23 Expansion plug	31 Hose adapter	39 Rocker arm stud
8 Camshaft	16 Plug	24 Stud	32 Exhaust valve	40 Stud

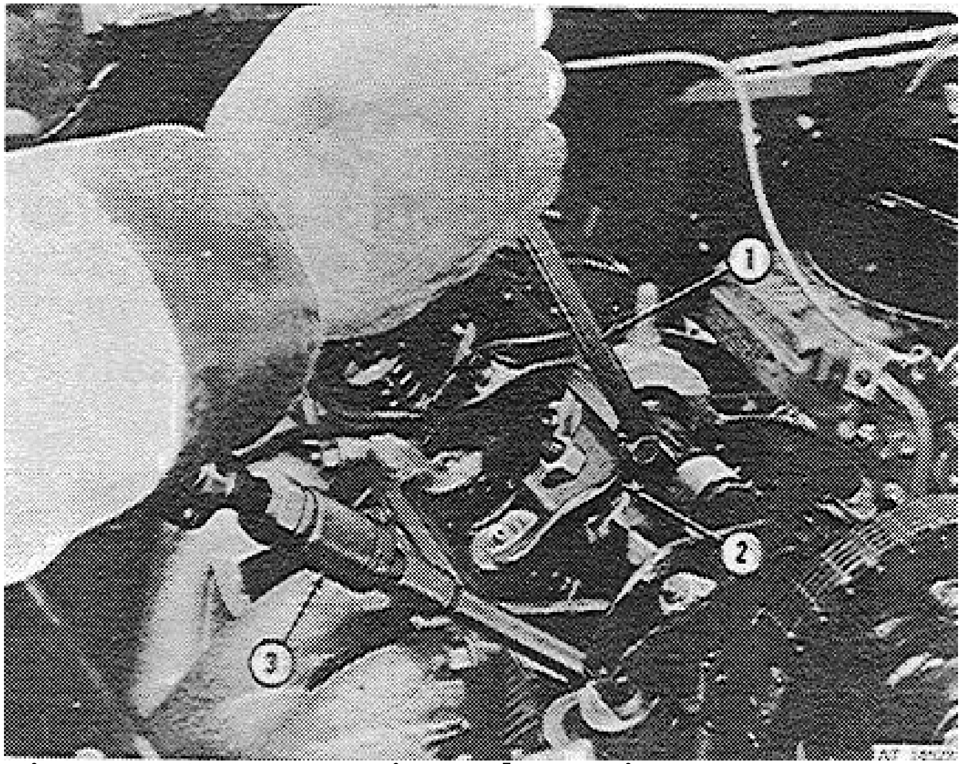


Figure 3-20. Compressing Valve Spring

1 1/2 -inch box wrench
2 Compressor tool W-267-A
3 Coupling tool W-275

a. Valves. (Fig 3-19)

(1) Position the cylinder head (20) on blocks high enough to provide hand clearance under the assembly.

(2) Using a (C-type valve spring compressor tool) (fig 3-21), compress valve spring and remove valve locks (25 fig 3—19). (Fig 3—21).

(3) Remove and discard valve guide seal (28 fig 3-19) from top of valve guide (29).

(4) Remove the remaining eleven valves and valve parts in the same manner. Place the valves (32, 33) in a numbered rack to make sure each valve will be reassembled in the same valve seat from which it was removed. All valve springs (27), retainers (26) and valve locks (25) are interchangeable.

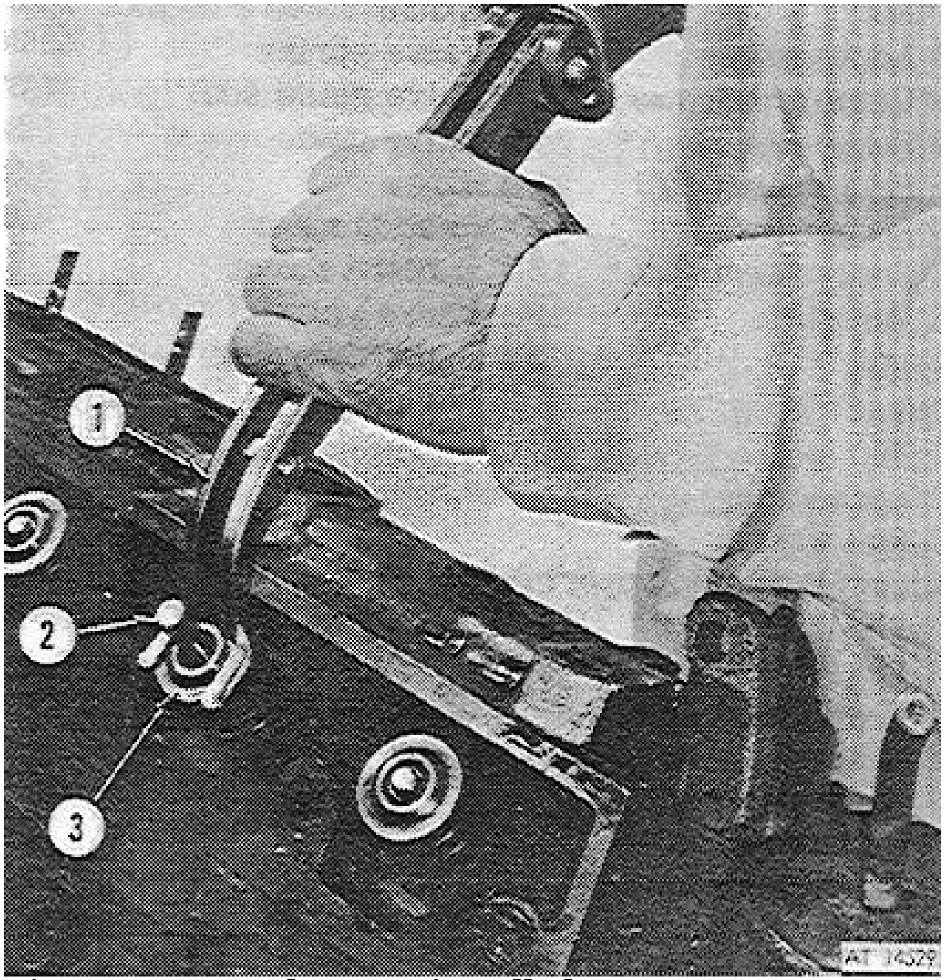


Figure 3-21. Tool W-300 installed.

1 Compressor tool C-type.
2 Tool W-300
3 Valve retainer

3-4. Cleaning.

a. Clean all components of the engine in accordance with instructions given in TM 9-208-1.

The cylinder block may be steamed cleaned or cleaned with a suitable solvent. A scraper is recommended to remove hard deposits, except on highly finished surfaces. Special attention must be directed to the cleaning of the oil passages, crankcase and cylinder walls to remove all sludge, dirt, and carbon deposits. After cleaning, use air pressure to dry the block thoroughly.
b. Clean out the drilled holes (oil passages) in the crankshaft journals with a small rifle brush or with a piece of wire. Blow out the passages with compressed air after cleaning. Clean the crankshaft thoroughly with a suitable cleaning solvent.
c. Clean the camshaft thoroughly with a suitable cleaning solvent. Make sure all oil passages are open. Check the cams for scoring or wear. The cam faces must be perfectly smooth throughout their contact areas.
d. Clean the valves on a wire wheel making sure that all carbon is removed from the top and the under side of the valve heads and that all gum and varnish deposits are removed from the valve stems. Polish the valve stems with steel wool or crocus cloth.
e. Clean valve guides with a standard valve guide cleaner or wire brush.
f. Remove all gaskets or parts of gaskets from mating surfaces, using a putty knife or suitable scraper. Be careful to avoid scratching or gouging the surface metal when removing gaskets.
g. Clean all inner and outer surfaces of castings and all areas subject to oil and grease with dry-cleaning solvent or mineral spirits paint thinner.
h. Parts susceptible to rust, whether new or used, are to be lightly coated with preservative oil immediately after cleaning, inspection or repair and prior to their assembly.

3-5. Inspection, Repair and Replacement.
a. General. The inspection and repair procedures detailed herein are recommended when a complete engine overhaul is to be made with the engine out of the vehicle, These instructions can generally be applied separately with the engine in the vehicle. Inspection and repair instructions are included to cover the cylinder block, crankshaft and bearings. connecting rods and bearings, oil pump, valves and rocker arms, pistons and rings, flywheel, timing chain and sprockets, and the camshaft and bearings. In addition, fitting operations for these engine components are included.
b. Cylinder Block.
(1) Check cylinder block to be sure all water passages are free of restrictions.
(2) Examine cylinder block for minute cracks and fractures. Evidence of rust on the cylinder walls is a good indication of a possible crack in the block. Pressure testing the block will usually indicate the presence of a crack. A pressure test may be made by applying 30 to 60 pounds water and air pressure to the water jackets of the block. With the water jacket ports sealed off, a drop in pressure will indicate the presence of a crack.

NOTE

To make this test the cylinder head must be installed and the inlet and the outlet must be sealed tight.

(3) Examine all machined surfaces of the cylinder block for burrs and scores. Check cylinder block distortion by placing a straight edge along the length of the Cylinder head surface of the block (fig 3-22). With a feeler gage check for clearance between the straight edge and the block, particularly between adjacent cylinders. Maximum allowable tolerance is 0.005-inch, If clearance exceeds this, block should be replaced.

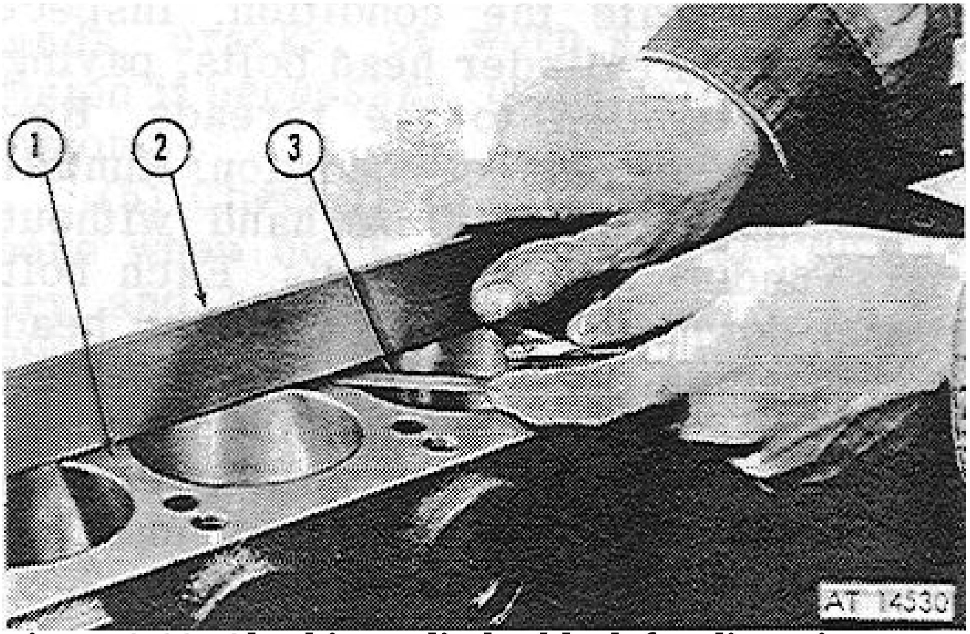


Figure 3-22. Checking cylinder block for distortion.

1 Cylinder block
2 Straight edge
3 Feeler gage

CAUTION

Do not plane cylinder block or cylinder head. This would alter the timing chain centers, piston-to-cylinder-head clearance.

(4) Check cylinder bores for out-of-round and taper to determine whether bores require honing or reboring. For detail information, refer to (d) below.
(5) If main bearing caps are not removed carefully, raising both sides of each cap evenly until free of the dowels, the dowels may be bent. This is especially probable if a pry bar is used, first at one side of the cap and then the opposite, to raise the cap from the cylinder block. Bent main bearing cap dowels can cause misalinement of the bearing cap and resultant rapid bearing wear, necessitating early bearing replacement. Therefore, remove each main bearing cap carefully and if there is any reason to believe any of the dowels may have been bent during bearing cap removal, remove those dowels and install new ones as detailed in (c) below.
(6) Using a chain fall, lower the cylinder head down on top of the block without the gasket in place. Examine cylinder head and block for uneven surface condition. Uneven surface conditions in localized areas of the head and block must not exceed 0.015-inch at any point. If such condition exists, parts must be replaced as necessary to eliminate the condition. Inspect condition of all cylinder head bolts, paying particular attention to the threads. Replace any not in perfect condition. Run all cylinder head bolts in by hand without washers under the bolt heads. Each bolt must run down tight on the cylinder head or cam bearing deck. If the bolt does not turn down freely in a certain hole or holes, check to be sure all head bolts are of the proper length. Cylinder head bolts installed in holes 2, 8 and 10, shown in figure 3-51 are 2-1/4-inch long, and those in holes 12 and 14 are 5-41/64. All other head bolts are 5-1/2-inch long. Next, lift the head off the block and check to make sure there is no restriction in the bolt hole, and the bolt is of the proper length. Drill and retap the hole deep enough so the bolt can be run down tight on the head or deck. Holes should be drilled to a depth of 1.25-inch and tapped to a depth of 1.09-inch.
c. Cylinder Block Dowel.

(1) Since hardened dowels must fit tightly to ensure correct cap alinement, gripping them with a tool for removal is sometimes difficult. To simplify the operation, file a notch on each side of the dowel to accommodate a pair of diagonal cutters.

(2) Using a piece of bar stock under the diagonals for leverage, work the dowel out of the cylinder block.

(3) Before installing a new dowel in the cylinder block, make sure the dowel hole is clean.

(4) Start the dowel straight in the hole. Then tap the dowel lightly with a hammer until it bottoms.

d. Cylinder Bores.

(1) The cylinder bores may be reconditioned by honing or reboring. Use oil-soaked rags to protect crankshaft journals and other engine parts from abrasive dust during all reconditioning operations. Both honing and reboring of the cylinders must be closely coordinated with fitting the pistons to maintain specified tolerances.

(2) Reboring the cylinders may be
accomplished only when the engine is removed from the vehicle and mounted in a suitable level holding fixture.

(3) The amount of material to be removed is determined from the original diameter of the cylinder bores (3.3430-inches to 3.3455-inches diameter) and the amount of oversize in diameter of the oversized pistons to be fitted.

(4) The largest cylinder bore will determine the oversize to which all cylinders must be reboréd since the size and weight of all pistons must be uniform to maintain proper engine balance. The maximum rebore should not exceed 0.020-inch from standard.

(5) Measure the cylinder diameters by making measurements both parallel to, and at right angles to, crankshaft over entire piston travel and at bottom of cylinder by using a cylinder bore checking gage (fig 3-23).

(6) If bores are scored: if out-of-rounds exceed 0.005-inch; if diameters differ more than 0.005-inch; or if taper exceeds 0.005-inch on diameter, it is generally recommended that cylinders be reconditioned by boring and honing to the next oversize, using new pistons of the proper size. If reboring is performed, all cylinders must be rebored to the same oversize, allowing 0.0015-inch for final honing. All cylinder bore diameters must be within 0.002-inch after reconditioning.

(7) If bore measurements are within the above limits, but indicate hollows or waviness, cylinders should be honed with
250 grit stones. Pump hone up and down in cylinder while it is rotating to produce a satin-finish, diamond cross-hatched pattern approximately 30° from horizontal. Hone only enough to correct waviness. Refer to figure 3-24.

(8) If cylinder bore correction is unnecessary, break the glaze on cylinder walls with a hone with 250 grit stones or with a suitable deglazing tool. Operate the hone or deglazer to obtain diamond cross- hatched pattern approximately 30° from horizontal.

(9) After correction of cylinder walls, clean out the bores thoroughly and apply a light coat of clean engine oil. If cylinders have been rebored or honed heavily, measure cylinder diameter again to ensure proper selection of piston size.

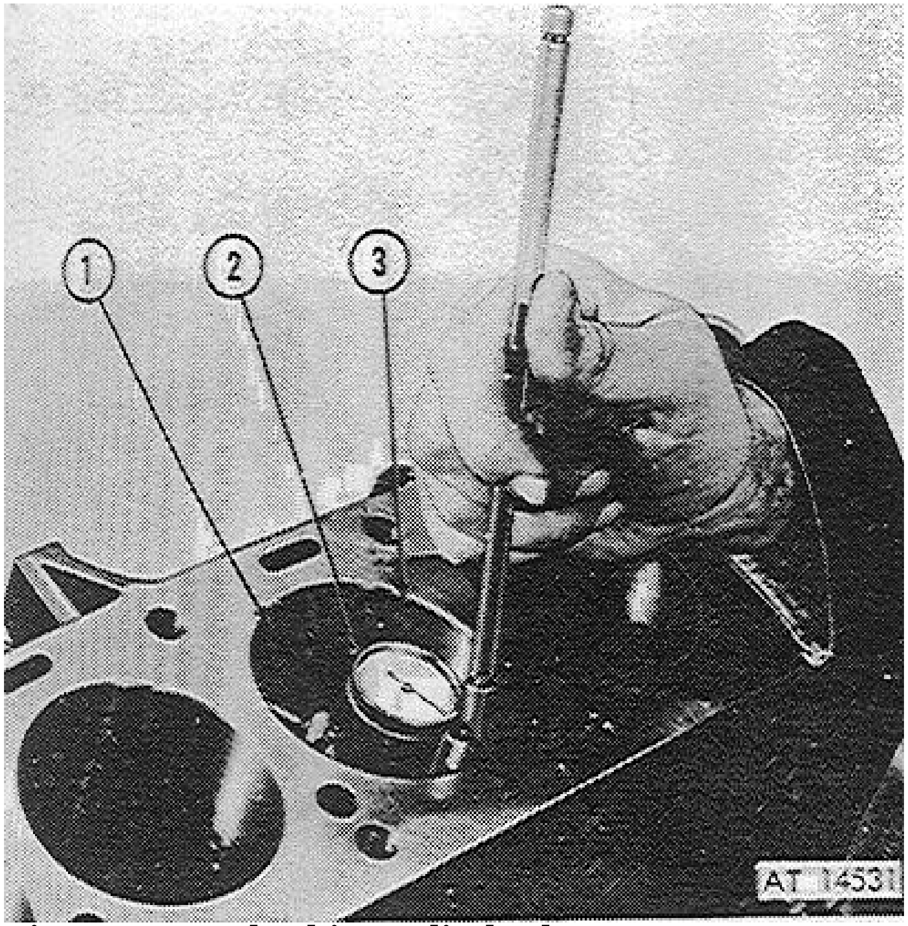


Figure 3-23. Checking cylinder bore.

1 Cylinder bore
2 Cylinder bore checking gage
3 Lock screw

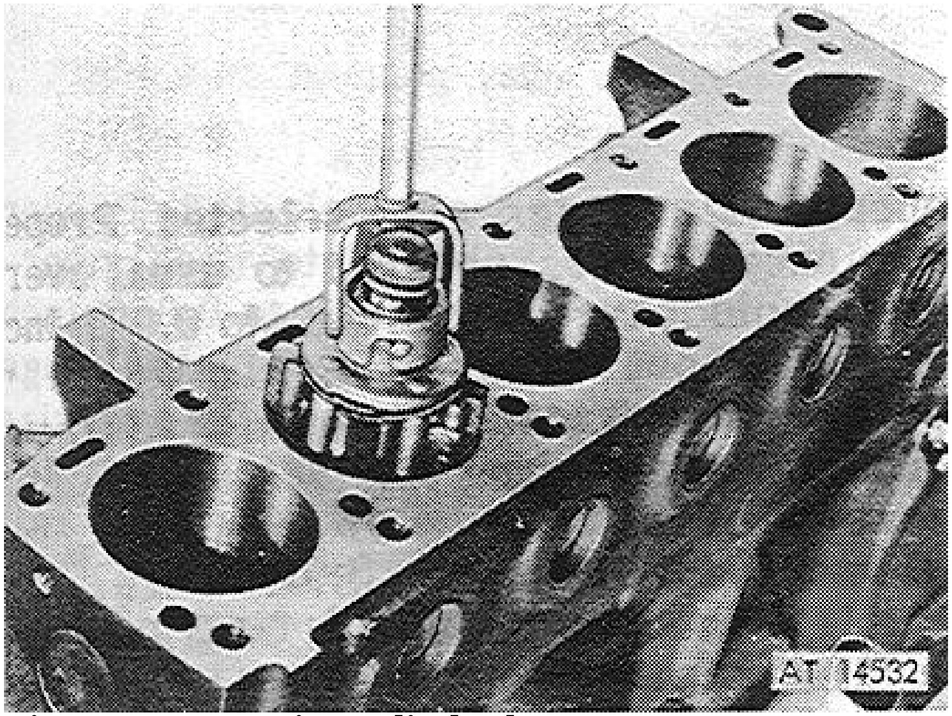


Figure 3-24. Honing cylinder bore.

e. Pistons, Rings, and Connecting Rods.

(1) The pistons and connecting rods are removed from the engine as assemblies. If cylinders are rebored, new oversized pistons and rings will have to be installed as determined at the time cylinders are rebored.

(2) Disassemble pistons and rods by removing piston pin retaining rings and pressing out pin.

(3) Keep the parts of each assembly identified so they may be installed in the same cylinder from which they were removed. Remove rings from piston. Clean carbon from piston head and clean ring grooves and drain holes.

(4) Use care not to scrape metal from side of grooves nor to make burrs on ring groove surfaces. Check pistons for broken lands, cracks, or worn grooves. Replace piston if necessary, using same size as old piston.

(5) Check fit of each piston to cylinder bore when block and pistons are clean and dry and at approximately 70° F by using piston fitting gage and scale (fig 3-25). Use a 0.004-inch thickness gage 1/2-inch wide if worn pistons are to be reused. When fitting new pistons, use 0.0015-inch gage. The piston is fitted upside down in the block to facilitate the operation, and the gage must extend the full length of piston on the thrust side. Scale should register 5 to 10 pounds pull to remove thickness gage from between cylinder wall and piston. Excessive pull indicates need for additional honing of cylinder. Insufficient pull indicates need for a larger piston.

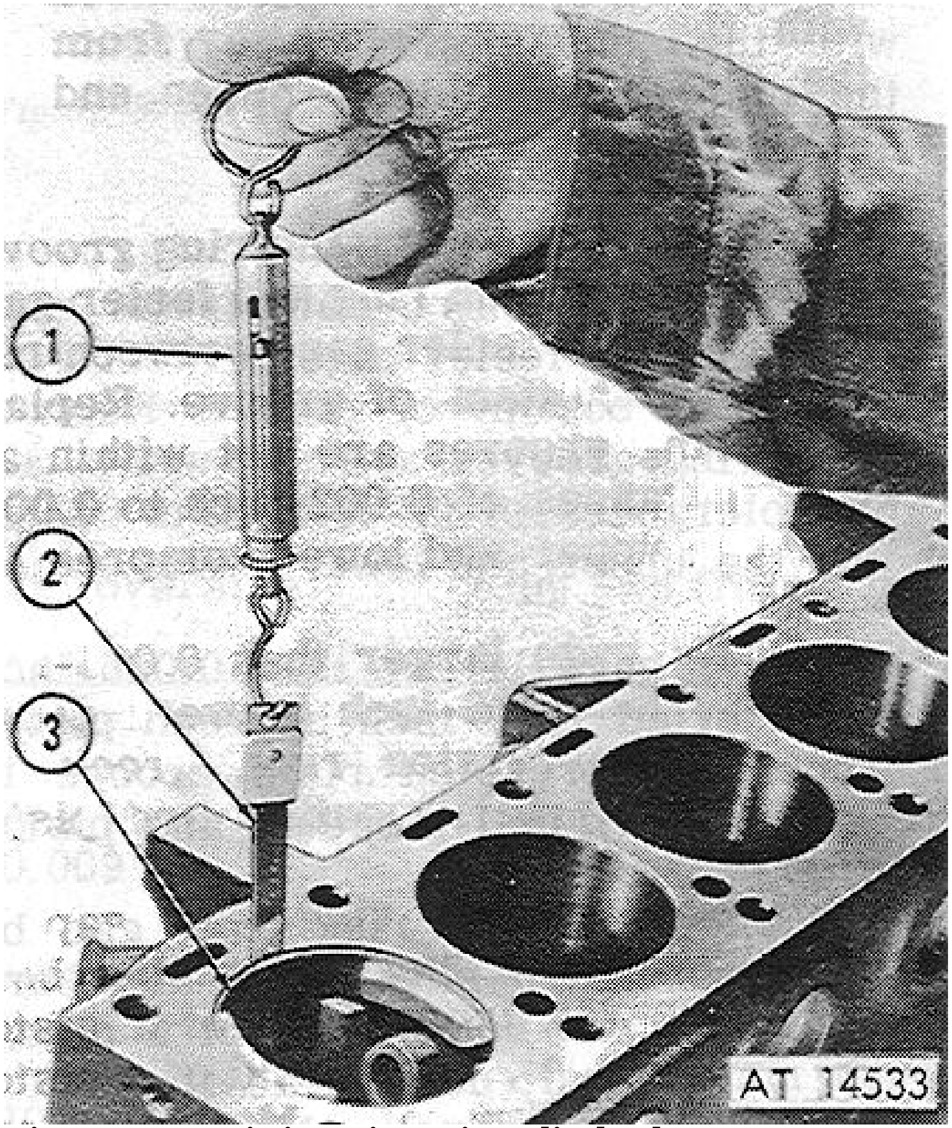


Figure 3-25. Fitting piston in cylinder bore.

1 Piston fitting gage and scale
2 Feeler gage
3 Piston

(6) Check piston pin fit. The piston pin should be palm-push fit at room temperature. If the pin is loose, a new pin must be used. It may be necessary to use a 0.003-inch or a 0.005-inch oversize pin and ream the piston with a piston pin reamer to obtain a push fit.
(7) After checking the piston pin fit in the piston, check its fit in the connecting rod bushing. The pin should just slip through the bushing under its own weight. If the pin is too tight, ream the inside diameter of the bushing with piston pin reamer 0.8597-inch to 0.8599-inch for a standard pin or, if an oversize pin is used, ream the bushing 0.003-inch to 0.005-inch oversize. If the pin is too loose, install a new bushing of proper size. The new bushing must be installed with the oil

hole aimed with the oil hole in the connecting rod.
(8) Assemble piston and rod. Install the piston pin by pushing it in by hand. Install the pin retaining rings.

NOTE

The latest type piston pin retaining ring should be installed whenever replacement is required. When installing the new type retaining ring, it should be positioned with the convex side away from the piston pin, and the open end down.

(9) Check width of piston ring grooves by using a new piston ring and feeler gage (fig 3-26). Insert feeler gage between ring and piston to bottom of groove. Replace piston if ring grooves are not within allowable tolerances of 0.002-inch to 0.004-inch for the upper and lower compression ring.
If a feeler gage larger than 0.006-inch can be inserted 1/16-inch between piston and upper compression ring, groove is worn excessively bell-mouthed and piston should be replaced.
(10) Check piston ring end gap by placing compression ring in cylinder bore below ring travel, using head of a piston to push ring travel, using head of a piston to push ring in squarely. Minimum end gap must be 0.010-inch for compression rings. If less, place ring in a vise and file ends to obtain minimum gap. Excessive filing or ring gap over 0.045-inch indicates
improper size rings were selected. Proper rings in cylinders rebored to usual oversizes should have 0.010-inch to 0.020-inch end gap without filing. Select piston rings of proper size for installation in the oversize cylinder bores using the piston ring application chart in (f) below. Oil ring rail gap must be 0.013-inch to 0.023-inch.
(11) When installing oil ring, position the ring expander spring in the ring groove (fig 3-27). Slide the outer oil ring over the piston with the flatside of ring "up". Position oil ring, in ring groove, making sure the expander ring is centered in the oil ring inner groove. Use a piston ring tool to install rings on pistons.

NOTE

Do not expand rings more than necessary to install. Also be careful not to burr the piston with the ends of rings. Make sure both compression rings are installed in groove with correct side up (marked with "top" or pip mark). Position rings so gaps are staggered. (Fig 3-28)

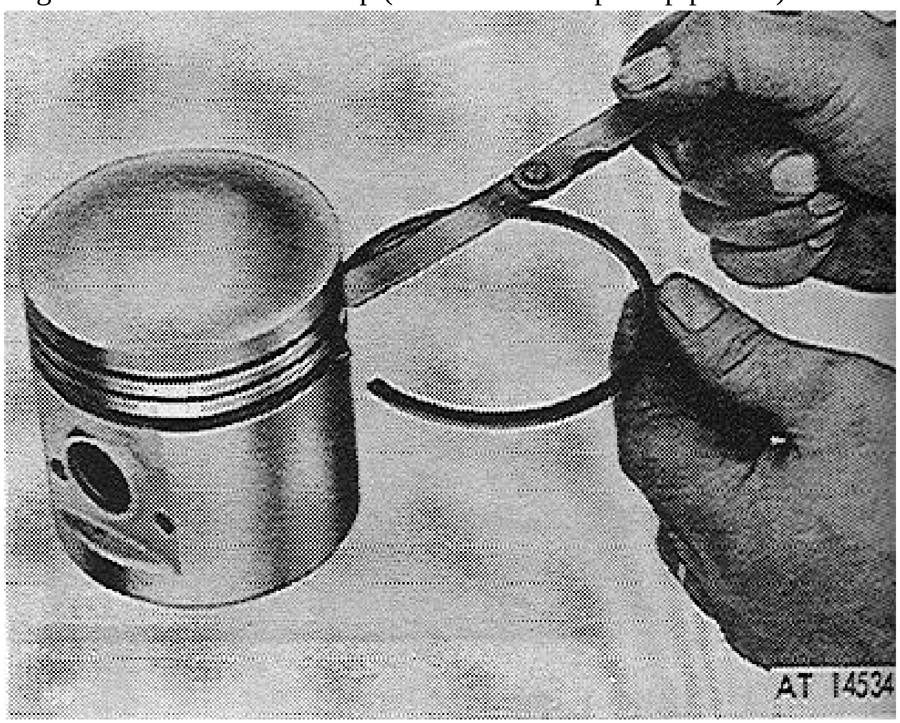


Figure 3-26. Checking piston ring side clearance.

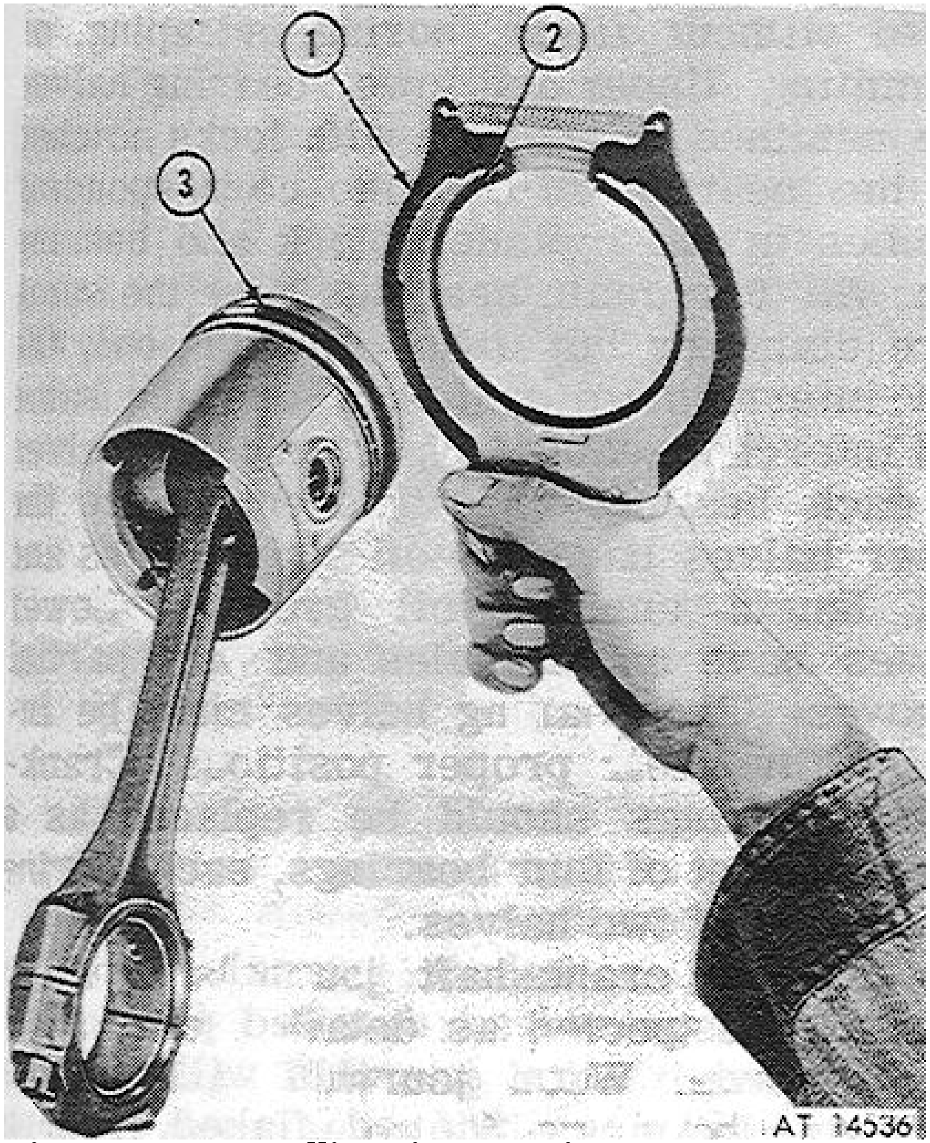


Figure 3-27. Installing rings on piston.

1 Piston ring installing tool
2 Piston ring
3 Piston rings installed

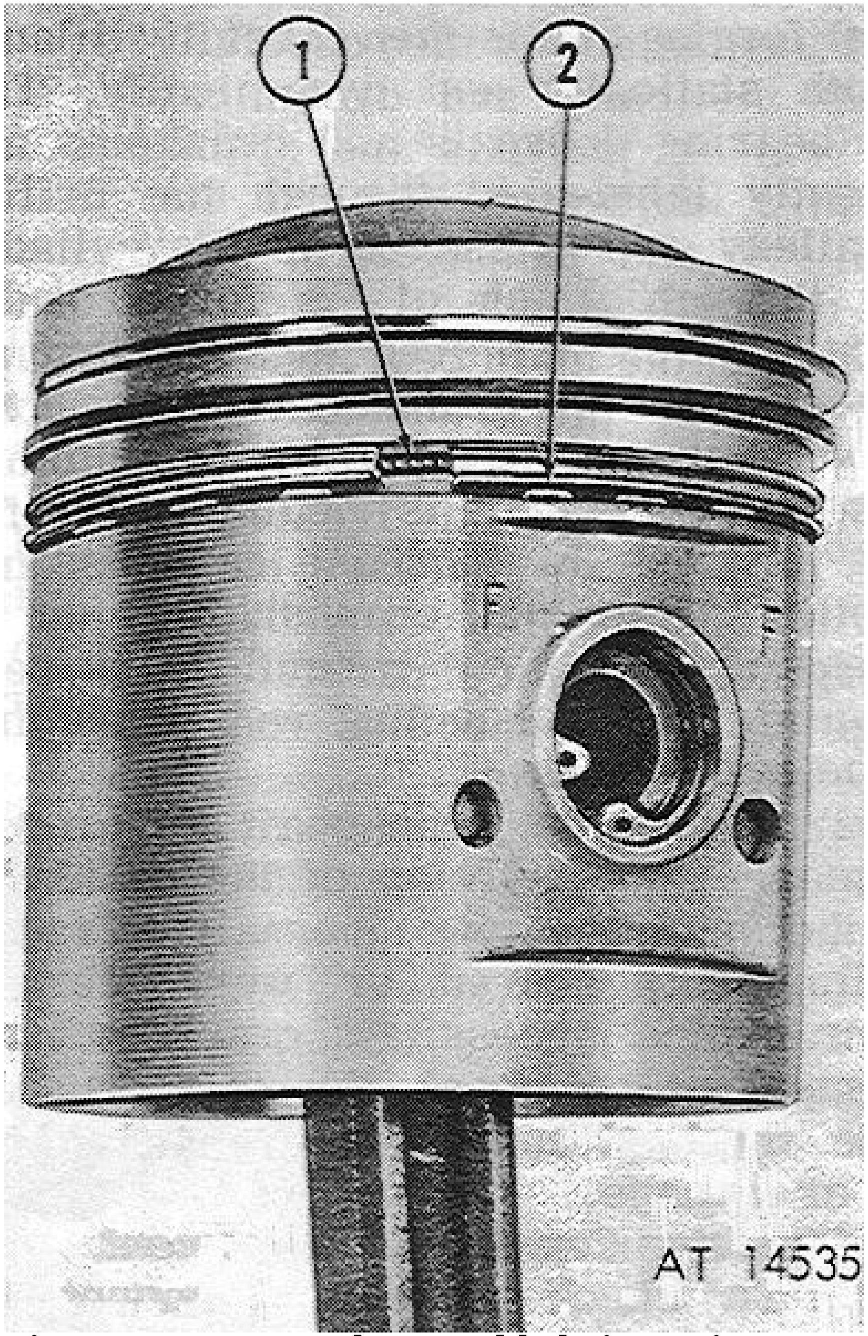


Figure 3-28. Correctly assembled piston rings.

1 Ring expander
2 Oil control ring

f. Piston Ring Application Chart.

Actual Ring Size	Ring oversize range	For best fit use in cylinder bore oversize	Ring gap fitting
Standard	Standard to 0.009"	Standard to 0.009"	No fitting necessary
0.020"	0.010" to 0.029"	0.010" to 0.019"	0.077" gap
0.020"	0.010" to 0.029"	0.020" to 0.024"	No fitting necessary

g. Crankshaft.
(1) The crankshaft is machined from a steel forging and is then carefully balanced both statically and dynamically. The main bearing journals and crankpins are efficiently lubricated through the drilled oil gallery and passages in the cylinder block through which oil is forced under pressure to the main bearings and through the cheeks of the crankshaft to the connecting rod bearings. After machining, the entire crankshaft is treated with Tuftriding process to increase hardness and durability. While the crankshaft is out of the engine, be very careful to prevent damage to the connecting rod crankpins and the main journals.
(2) Inspect the crankshaft for cracks, alinement, and condition of the crankpins and the main bearing journals. Cracks, misalinement, scored or worn journals and crankpins necessitate crankshaft replacement. Also check the pilot bushing in the flywheel end of the crankshaft for wear or damage.
h. Checking Crankshaft Alinement.
(1) To check alinement, mount the crankshaft in the cylinder block with the front and rear bearings in place but with the two intermediate bearings removed.
(2) With a dial indicator mounted on the crankcase and the indicator button resting on one intermediate bearing journal at a time, slowly rotate the crankshaft and note the reading on the indicator dial. Install the two intermediate bearings and remove the front and rear bearings.
(3) Repeat the operation with the dial indicator, checking at the front and rear bearing journals - The maximum allowable run-out is 0.002-inch.
i. Checking Main Bearing Journals.
Check the crankshaft main bearing journals with a 3-inch micrometer. The standard journal diameter is 2.3747-inch to 2.3755inch for all main bearings. Allowable taper or out-of-round of the journals is 0.001-inch.
j. Checking Connecting Rod Crankpins.
Check the crankpin diameters with a micrometer to assure they are not out-of-round or tapered more than 0.001-inch. The standard crankpin diameter is 2.0627-inch to 2.0619-inch.
k. Crankshaft Main Bearing.
(1) The steel-backed crankshaft main
bearings are replaceable and are to be fitted without filing, boring, scraping, or shimming. Upper and lower bearing halves are retained in position with locks notched on the bearing to fit into corresponding notches in the cylinder block and bearing cap. All four main bearings have the same bore diameter but differ in width; only the two intermediate bearings are the same and interchangeable. Upper and lower halves of each bearing are different, since the upper halves have the oil supply holes and full length annular oil grooves. Lower halves have no oil holes and only partial grooves. The bearing halves must be installed in their proper positions. Crankshaft bearings should be replaced as a complete set of four bearings, each bearing consisting of two halves.
(2) The crankshaft journals must be carefully inspected as detailed previously in (z) above. Worn journals will require undersize bearings. Scored, flaked, or worn bearings must be replaced. Bearing wear can be checked by measuring the thickness which should be 0.0923-inch to 0.0926-inch for standard bearings.
(3) Measure main bearing bores using a telescope gage and micrometer. (Fig 3-29) Measure bores both at right angles to the split line and also at 45° to the split line.
(4) The standard bore diameter is 2.5622-inch to 2.5615-inch. The bores should not exceed 0.001-inch out-of-round or 0.001-inch in taper from end to end. Also, the bores should not be more than 0.00 1-inch oversize considering the average diameter of the bore.

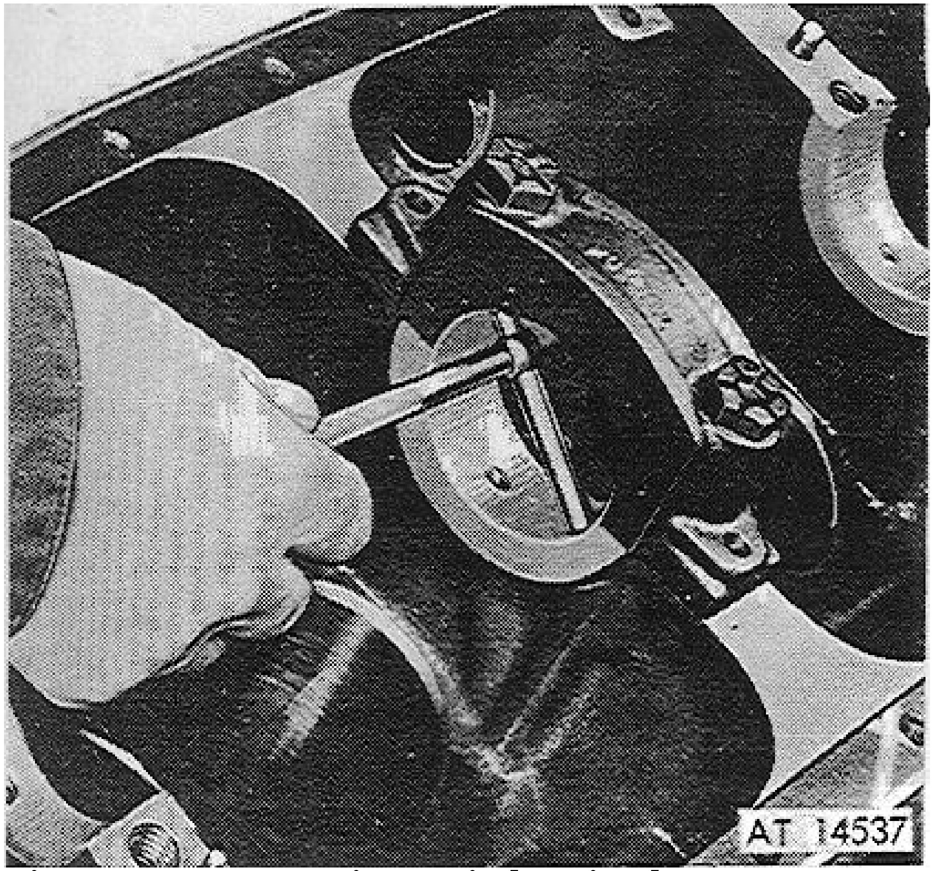


Figure 3-29. Measuring main bearing bores.

1. Fitting Crankshaft Main Bearings Using Plastigage.

(1) After wiping and carefully inspecting the bearing bore, install the proper bearing. Make certain oil hole in the bearing upper half alines properly with oil hole in block, and that the bearing lock fits properly in notch of block. Lubricate bearings with clean engine oil and install the crankshaft.

(2) The desired running fit for a main bearing is 0.002-inch with limits of 0.0008-inch to 0.0029-inch.

(3) Install bearing lower half. Install bearing cap and draw cap bolts down equally and only slightly tight. Rotate crankshaft by hand to be sure it turns freely without drag. Pull cap bolts tighter, first one then the other a little at a time, intermittently rotating the crankshaft by hand until the recommended torque of 85 to 95 lbs-ft is reached. If bearings were of correct size and lightly lubricated before installation, the crankshaft should turn freely in the bearings. If crankshaft cannot be turned, a larger bearing is required. If there is no binding or tightness, it is still necessary to check clearance to guard against too loose a fit.

CAUTION

Never file bearing cap or bearing to compensate for too much clearance. Do not use shims under a bearing cap or behind a bearing shell. Do not run a new bearing half with a worn bearing half.

(4) The use of “Plastigage” of the proper size to measure 0.002-inch clearance is recommended for checking crankshaft main bearing clearance. The method of checking clearance is as follows:

(a) Remove bearing cap and carefully wipe all oil from bearing and the journal.

(b) Place a piece of “Plastigage” 1/S-inch shorter than the width of the bearing across the journal (lengthwise of the crankshaft).

(c) Install bearing and cap and tighten first one bolt, then the other, a little at a time, until a torque of 85 to 95 lbs-ft
is reached. As the bearing tightens down around the journal, the “Plastigage” flattens to a width indicating the bearing clearance.

(d) Remove cap and measure width of flattened “Plastigage”, using the scale printed on edge of the envelope. (Fig 3-30) The proper size “Plastigage” will accurately measure clearance down to 0.002-inch.

(e) If the flattened “Plastigage” tapers toward the middle, or toward the end, or both ends, there is a difference in clearance, indicating a taper, a low spot, or other irregularity of the bearing or journal.

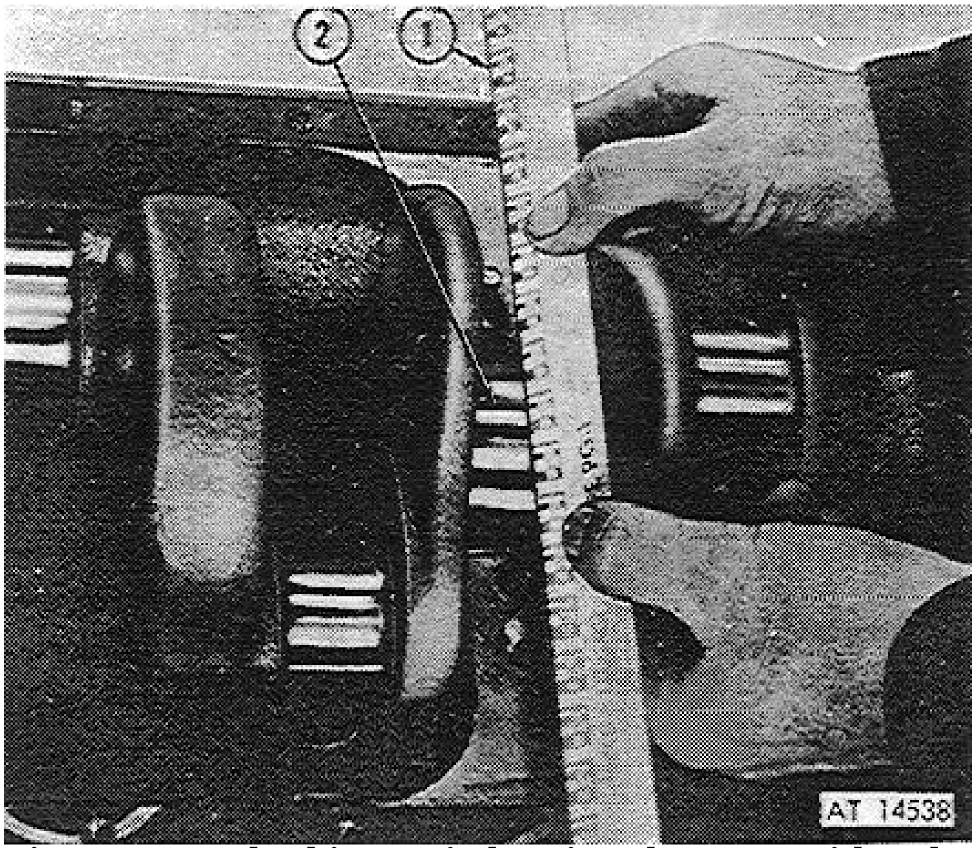


Figure 3-30. Checking main bearing clearance with “Plastigage’

1 Plastigage scale
2 Platigage

m. Fitting Crankshaft Main Bearings Using Shim Stock.

(1) Thin feeler or shim stock may be used instead of “Plastigage” to check bearing clearances. The method is simple, but care must be taken to protect the bearing metal surface from injury by too much pressure against the feeler stock.

(2) Cut a piece of 0.001-inch thick by 1/2-inch wide feeler stock 1/8-inch shorter than the width of the bearing. Coat this feeler stock with light engine oil and lay it on the bearing in the cap (fig 3-31). With the shim in this position, install the bearing and cap on the crankshaft.

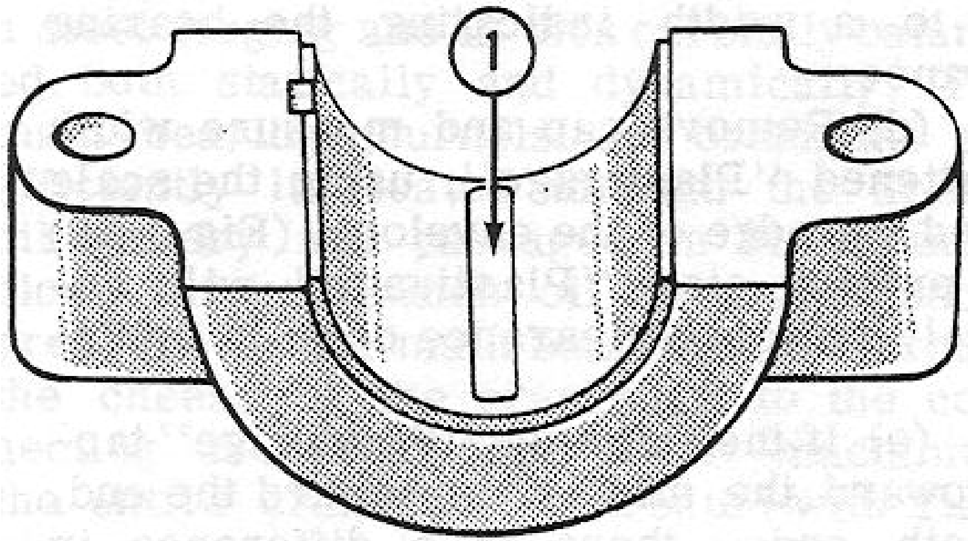


Figure 3-31. Shim stock in postion on main bearing cap.

1. 0.001-inch feeler stock, 1/2 inch wide

(3) Tighten bearing cap bolts, first one and then the other, a little at a time, until 85 to 95 lbs-ft torque is reached.

(4) Turn crankshaft. by hand not more than one inch in either direction.

CAUTION

Turning crankshaft more than one inch may imbed the shim stock in the bearing, giving a false indication of fit and damaging the bearing. If bearing clearance is correct, the piece of 0.001-inch feeler stock should produce a drag. If there is little or no drag, the bearing fit is too loose; if the crankshaft will not turn or turns with difficulty, there is not enough clearance. In either case another bearing must be selected to provide the proper fit.

(5) After the bearing has been correctly fitted, remove shim stock, wipe bearing and journal carefully, and apply clean engine oil to surfaces. Replace cap and tighten bolts first one, then the other, a little at a time, until the prescribed torque of 85 to 95 lbs-ft. is reached. Figure 3-32 shows rear main bearing installed. Recheck crankshaft rotation making certain it turns freely without drag.

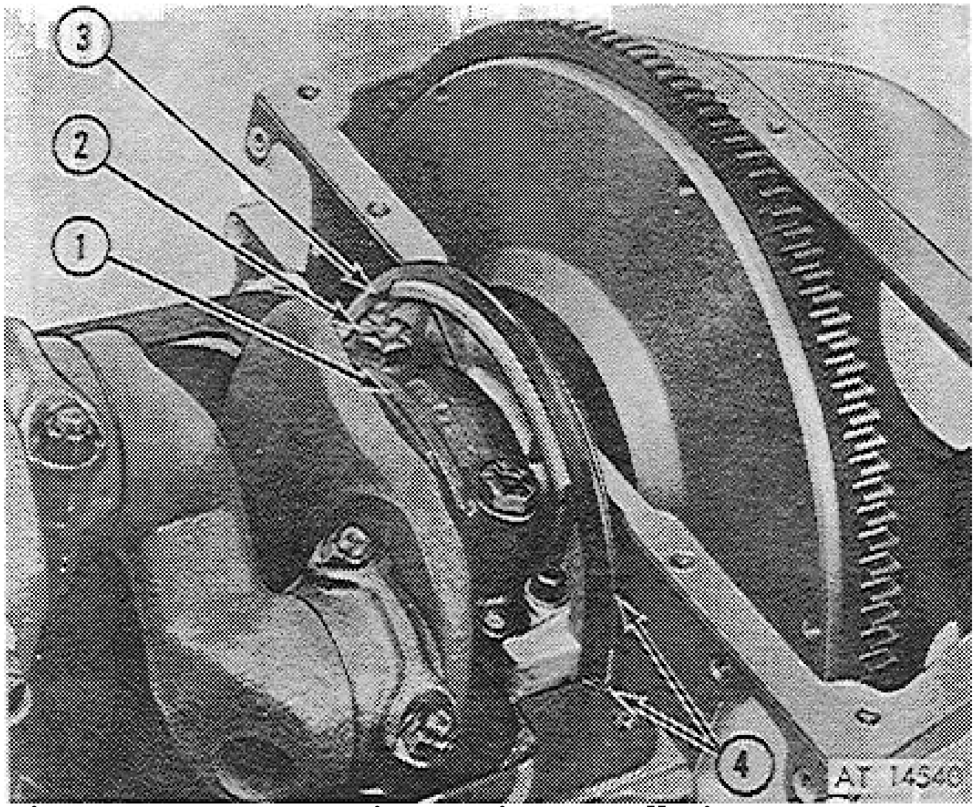


Figure 3-32. Rear Main Bearing Installation

1 Rear main bearing cap
2 Bearing cap bolt
3 Filler block
4 Oil pan seals

n. Connecting Rod Bearings.
(1) The connecting rod bearings, like the crankshaft main bearings, are the replaceable type. When correctly installed, the bearings provide proper clearance without filing, boring, scraping or shimming. Upper and lower bearing halves are retained in position with locks notched in the bearing to fit into corresponding notches in the cap and connecting rod.
The position of the bearing lock and oil hole in the bearings for number 1, 3 and 5 connecting rods is the opposite of those for number 2, 4 and 6 and, therefore, they are not interchangeable. Connecting rod bearings should be replaced as a complete set of six bearings, each bearing consisting of two halves.
(2) The bearings are replaced by removing the bearing cap and the upper and lower bearing halves. The new bearings must be installed so that the locks aline with those in the connecting rod and the locks must fit into the corresponding notches in the rod and cap and seat evenly. Each bearing cap must be installed on the connecting rod from which it was removed, and in the same position.
(3) The crankpins must be carefully inspected as detailed previously in (j) above, Worn crankpins will require undersize bearings. Scored, flaked, or worn bearings must be replaced.
(4) The bearing fit may be roughly checked by shaking the connecting rod by hand, prior to removal of the bearing cap, to determine if it is loose on the crankshaft. The bearing clearances may be measured with “Plastigage” or shim stock as follows:

(a) After wiping and carefully inspecting the bearing bore, install the proper bearing. Make certain oil hole in the bearing upper half alines properly with the oil hole in the connecting rod and the lock fits properly in the notch in the rod. Lubricate the bearing with clean engine oil.

CAUTION

Never file bearing cap or bearing to compensate for too much clearance. Do not shim under a bearing cap or behind a bearing shell. Do not run a new bearing half with a worn half.

(b) The desired running fit for a connecting rod bearing is 0.0015-inch with limits of 0.0006-inch to 0.0025-inch.
(c) Install the bearing lower half. Install connecting rod cap and draw the cap bolt nuts down equally and only slightly tight. Move connecting rod endwise, one way or the other, on the crankshaft to be sure bearing is not tight. Pull nuts tighter, first one then the other, a little at a time, and keep trying the fit of the rod on the crankshaft by hand until recommended torque of 40 to 50 lbs-ft is reached. If bearings are of correct size, and lightly lubricated before installation, the connecting r o d should be easy to slide back and forth parallel to the crankpin. If connecting rod is tight on the crankshaft, a larger bearing is required. If there is no binding or tightness, it is necessary to check clearance to guard against too loose a fit.
(d) The use of "Plastigage" or shim stock of the proper size to measure 0.0015-. inch clearance is recommended for checking connecting rod bearing clearances. This is the same materiel recommended for checking crankshaft main bearings and the method of checking is similar. Refer to (l and m) above. Connecting rod bearings are fitted to the same clearance as the main bearings but the torque specification for connecting rod cap bolt nuts is only 40 to 50 lbs—ft.
o. Crankshaft End-Play.
(1) The end-play of the crankshaft is controller by flanges on the rear main bearing and the machined surface on the number 8 cheek and on the inner side of the oil seal flange of the crankshaft.
(2) Allowable end-play is 0.003-inch to 0.007-inch. If the crankshaft end-play is greater than 0.007-inch, the bearing flange is probably worn, which will necessitate bearing replacement.
(3) Install vibration damper bolt and washer. Mount a dial indicator on the front end of the engine with the indicator button against the front end of the vibration damper bolt. Move crankshaft endwise, rearward, as far as possible and set the indicator dial at zero. Then move the crankshaft forward, prying with a screwdriver. The indicator reading is the total amount of end-play. Refer to figure 3-33.

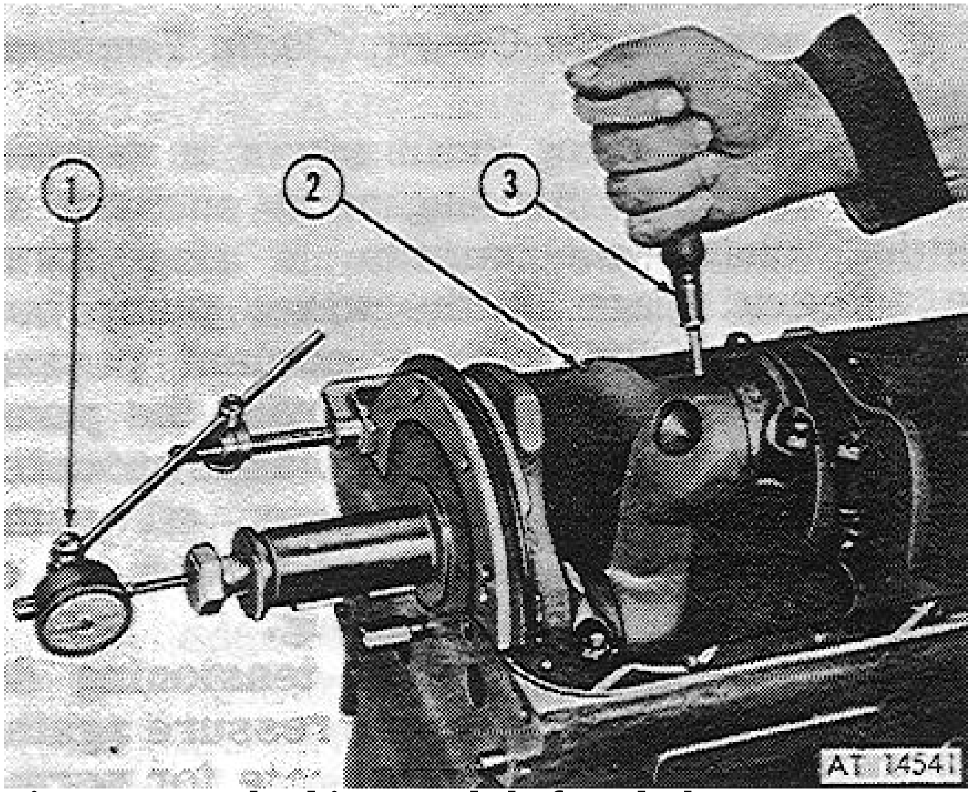


Figure 3-33. Checking crankshaft end-play.

1 Dial indicator
2 Crankshaft
3 Screwdriver

p. Timing Chain and Sprocket.
(1) Timing chain sprockets are mounted at the front of both crankshaft and camshaft. These sprockets are connected by a timing chain which transfers rotation from the crankshaft to the camshaft. The lower sprocket is keyed to the crankshaft. The upper sprocket is provided with a dowel that mates with a hole in the flange of the camshaft, Lubrication is provided by a steady stream of oil from the engine pressure lubrication system. This stream is directed at the chain and lower sprocket. The chain carries the oil up to lubricate the upper sprocket. Normally the chain and sprockets will last for the life of the engine. If one of the sprockets of the chain requires replacement for any reason, however, it is necessary to replace the chain and both sprockets to make sure the proper tolerances are maintained.
(2) Check the general condition of both sprockets and chain and inspect for evidence of excessive wear. Replace excessively worn or damaged sprockets or chain.
(3) Check the chain for excessive wear or stretch. When the chain is installed measure the distance between the chain sides at the narrowest point. This distance should not be less than 3.38-inch. If the distance is less than required, the chain has stretched or is worn excessively and the chain and sprockets must be replaced. Refer to figure 3-12.
q. Timing Chain Cover, Chain Tensioner and Oil Seat.
(1) The timing chain cover is mounted on the front of the engine to enclose the timing chain mechanism. It also forms an integral part of the water pump body and is provided with a coolant passage to discharge the coolant from the pump. The timing chain cover provides mounting surfaces for the distributor, oil

pump, and fuel pump. It is provided with an oil seal in the crankshaft opening.

(2) The timing chain tensioning device maintains a constant pressure against the timing chain to compensate for normal stretch and wear of the chain. Check the rubber on the contact face of the tensioner blade. Replace if badly worn. Check the tensioner spring to make sure it is not distorted.

(3) Check the timing chain cover for cracks, distortion, and damaged component mounting studs. Replace loose or damaged studs. Check the fit of the fuel pump push rod in the push rod bore. Clearance should not exceed 0.0045-inch.

(4) It is recommended that the front crankshaft oil seal be replaced each time the timing chain cover is removed. Instructions for removing the oil seal are given in paragraph (n). Install the front crankshaft oil seal after the timing chain cover is installed.

(5) The replacement timing cover for engines does not have distributor, water pump, oil pump, and fuel pump mounting studs. These studs must be removed from the old cover and installed by the mechanic.

(6) The studs involved are self-tapping. Special care must be taken when installing these studs to be sure they are not cocked.

(7) Special attention must be given in installation to assure that the proper length of each stud protrudes from the cover. Proper length of studs from cover should be as follows:

(a) Water pump mounting studs: 0.88-inch

(b) Distributor mounting studs: 0.59-inch

(c) Oil pump mounting studs: 2.62-inch

(d) Fuel pump mounting studs: 1.15-inch to 1.21-inch

r. Camshaft and Bearings.

(1) The overhead camshaft is supported by four bearings in the cam bearing support deck. The camshaft is chain driven from the timing chain sprocket on the front of the camshaft. The camshaft sprocket mounts on a pilot at the front of the camshaft and drives the camshaft through a dowel.

(2) The fuel pump is actuated by an eccentric that mounts on the front of the camshaft sprocket. The push rod is spring-loaded to hold it in place when the fuel pump is removed. The cam bearing support deck is cast with an inverted V in the bottom center. When mounted on the cylinder head, this V forms a passage with the top of the cylinder head. A 1/4-inch steel tube is inserted in this passage to conduct the lubricating oil to the front of the support deck and to prevent oil drain-back when the engine is shut down. Oil passages are provided in the support deck to lubricate the cam bearings. The oil passage to the rear cam bearing also provides oil under pressure to fill the oil passages in the camshaft to keep the cams lubricated.

(3) Before the cam bearing deck is installed, check for interference between the deck oil control tube and the deck-to-cylinder head bolt hole bosses on the cylinder head. The points of possible interference are locations 15, 16 and 17 in figure 3-51. Interference between the tubes and the bosses will prevent the cam bearing deck from seating firmly on the cylinder head.

(4) To eliminate an y interference, move the oil control tube to the left (away from the deck-to-head bolt holes) as far as possible. Make sure the tube retaining clip remains in position. This procedure should eliminate interference in most cases.

(5) If interference still exists after the above procedure has been followed,. grind a 3/32-inch flat on the bosses on the cylinder head at the points of interference. Grind only deep enough to provide the necessary clearance.

(6) Check the cams for scoring or wear. The cam faces must be perfectly smooth throughout their contact area, Camshaft run out, measured with a dial indicator at the intermediate bearing journals, must not exceed .0005-inch.

(7) Check the diameter of the camshaft journals with a micrometer. The specified journal diameters are listed in specifications.

(8) Check the cam bearing support deck for cracks or distortion. Check the bearing surfaces of the cam bearing deck for visible wear or scoring.

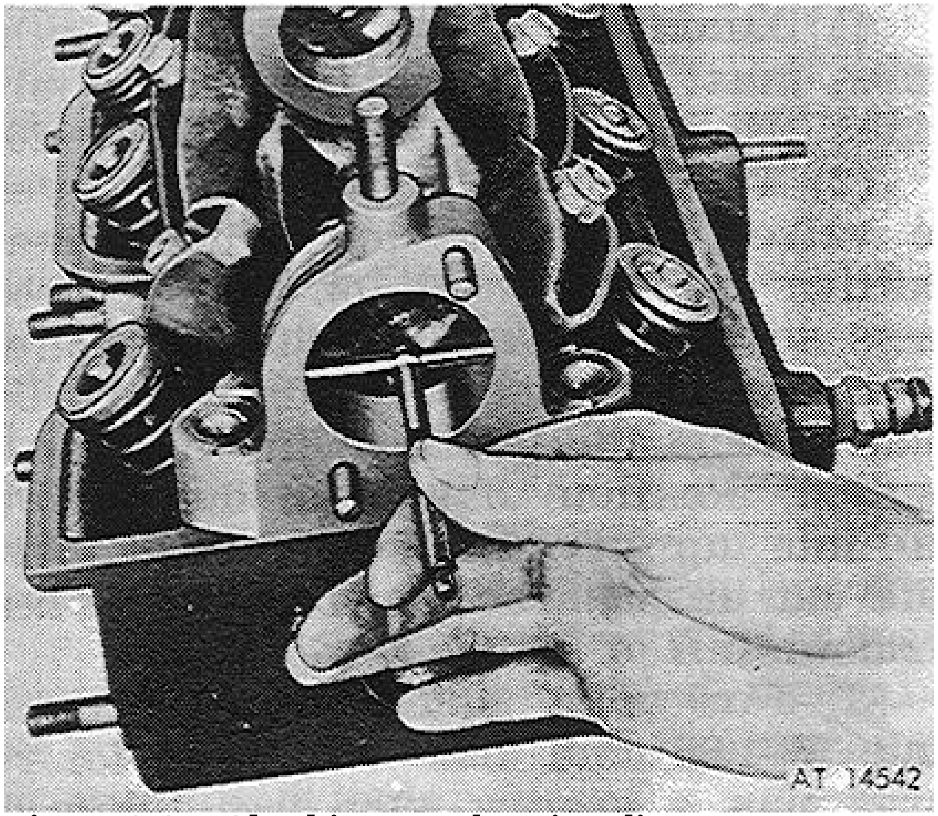


Figure 3-34. Checking cam bearing diameter.

(9) Using a telescope gage and a micrometer, check the internal diameters of the cam bearing deck bearings. (Fig 3-34)
(10) The specified internal diameters are listed in specifications. Compare each journal diameter with the corresponding bearing diameter. If the bearings are defective or permit more than 0.004-inch running clearance, either the cam bearing deck, or the camshaft, or both must be replaced.
(11) Make a visual inspection of the three lower intake manifold attaching studs to determine if a stud leak exists. If so, remove the stud involved, liberally apply thread sealer to the stud threads and re
install the stud. -
(12) It is recommended that thread sealer be applied to the threads of all the lower intake manifold attaching studs any time the removal and replacement of these studs is required during the course of engine repair.
(13) If any of the rocker arm studs are loose, worn, distorted, or have damaged threads, replace with a new cam bearing deck assembly with studs installed.
s. Rocker Arm Cover and Gasket.
(1) Examine the rocker arm cover stud oil seal washer for cuts or other damage. If damaged, they should be replaced. Check the thickness of these washers, They should be 0.222-inch to 0.238-inch thick. Replace all washers not within these dimensions with new washers.
(2) Inspect rocker arm cover for distortion. With the gasket removed, place bottom edge of cover on a flat surface. Apply pressure to the cover, holding it against the flat surface. Check bottom edge of cover with a feeler gage. Distortion should not exceed 0.020-inch at any point. If distortion exceeds this limit, replace cover.
(3) Inspect gasket surface on the cover for burrs or jagged pieces of metal. Smooth the surface where necessary. Inspect rocker arm cover gasket for damage. If damaged, replace it.

t. Valves, Springs, and Guides.

(1) The valves, springs and guides are installed on the cylinder head with the valve stems extending up through the head so that the valves, seat on the underside of the cylinder head. (Fig 3-35) The valve spring and associated parts are assembled on top of the cylinder head and are locked to the end of the valve stem. The valve retaining lock is a split lock which fits into a recess in the valve stem and into a taper in the valve spring retainer.

(2) An exhaust valve rotator used as a valve spring retainer is installed on the upper end of the exhaust valve. This valve rotator is a coil spring type rotating device. On each lift, or opening stroke of a valve, the rotator gives the valve a slight positive clockwise rotation,

(3) To repair or replace the valves, it is necessary to remove the cylinder head from the engine.

(4) Visually inspect all valves for war-page, cracks, or excessive burning. Discard if any of these conditions exist. Replace any worn, pitted, or corroded valves that cannot be cleaned, with wire brush or a valve refacing machine.

(5) Replace valves with marks or scoring, or abrasion visible on the stem. Replace any valves with bent stems. This condition will be immediately apparent when the valve starts to rotate in a valve refacing machine.

(6) With a micrometer, check diameter of the valve stem at two or three different places along length of the stem. The stem diameter of the intake valve is 0.3400-inch to 0.3410-inch. The stem diameter of the exhaust valve is 0.3385-inch to 0.3395-inch, Replace valves if stems are worn.

(7) Visually examine springs and replace any that are deformed or obviously damaged. Examine for corrosion from moisture or for acid etching which might develop into surface cracks and cause failure.

(8) Measure over all free length of the springs and replace any that are not the standard 1.55-inch for both intake and exhaust valve springs.

Using a standard spring checking fixture (fig 3-36) test each spring when compressed to the two different spring lengths given below. These values represent the valve closed and valve open spring lengths. If any spring fails to register spring tension equal to or greater than the minimum load limit in pounds specified for that spring length, replace the spring.

Valve Spring Tension Values

Length	Minimum Load
1. 26-inch	59 lb
0.085-inch	142 lb.

NOTE

When using a spring checking fixture, it is necessary to convert the torque wrench reading, which is in pounds-feet, to the static pound pressure specified above, according to the instructions furnished with the wrench. For example, if the torque wrench reading is 50 lbs-ft, and the wrench is 2 feet long, the static pressure of the spring is 50 x 2 or 100 pounds.

(9) Replace valve guides that are damaged or worn enough to cause excessive valve stem-to-valve guide clearance. Standard intake clearance is 0.001-inch to 0.003-inch. Standard exhaust valve clearance is 0.0025-inch to 0.0045-inch. Check clearance with a plug gage. If this indicates excessive clearance, replace the valve guide.

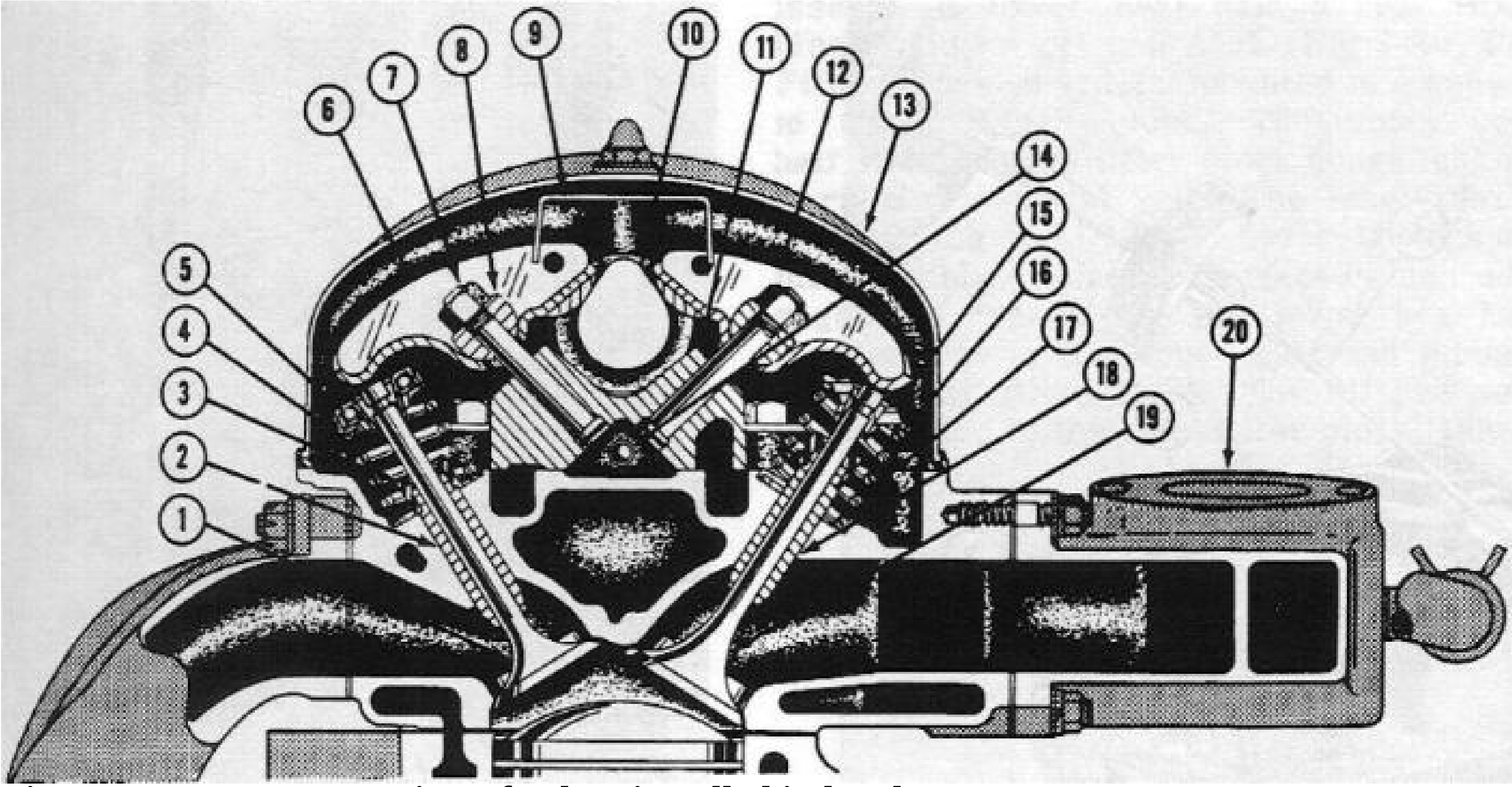


Figure 3-35. Cut-a-way view of valves installed in head.

1 Exhaust valve	6 Rocker arm	11 Cam bearing support deck	16 Valve spring
2 Valve guide	7 Rocker arm stud	12 Rocker arm	17 Valve guide seal
3 Valve guide seal	8 Rocker arm ball	13 Rocker arm cover	18 Valve guide
4 Valve spring	9 Rocker arm guide	14 Oil tube	19 Intake valve
5 Exhaust valve rotator	10 Camshaft	15 Intake valve spring retainer	20 Intake manifold

u. Cylinder Head,
(1) Inspect cylinder head for cracks or leaks, damaged or distorted gasket surfaces, damaged threads, loose or damaged studs, damaged valve seats, or loose or worn valve guides.
(2) Check area around core hole expansion plugs for sign of leaking. Replace any leaking plugs.
(3) Check cylinder head to be sure all water passages are free of restrictions.
v. Valve Guide Replacement. (Fig 3-37)
(1) Damaged, loose, or worn valve guides must be replaced. To remove valve guides, use valve guide remover tool W-265.
(2) This tool is a mandrel to press the valve guide from the cylinder head. Position cylinder head on bed of arbor press so that the valve guide is squarely in line with the arbor of the press. Use metal blocks to block cylinder head in position. Position driver of the remover tool into top of valve guide. Press valve guide out through bottom of cylinder head as shown in A of figure 3-37.
(3) For valve guide installation, use same W-265 tool that was used for removal plus a spacing stop that limits the distance that the valve guide can be pressed

into place. The valve guide is installed from top of cylinder head. Intake and exhaust valve guides are the same and are installed in exactly the same way.
(4) To install guide; make sure valve guide bore in cylinder head is free from burrs, dirt, and carbon, and area around top of bore is also clean. Position valve guide on cylinder head and slip the spacing stop of the valve guide installer tool over the valve guide as shown in B of figure 3-37. Insert pilot of the W-265 driver tool into hole in top of valve guide. Aline driver squarely with arbor press and press valve guide into place until shoulder on driver strikes the spacing stop. This will provide positioning of the guide in the cylinder head. Properly positioned, the top of the valve guide will be 0.45-inch above the machined surface of the cylinder head.
(5) After installing valve guide, ream guide 0.342-inch to 0.343-inch.
w. Valve Seat Inspection and Refacing.
(1) Inspect valve seats for cracks,
burns, pitting, ridges, or improper angle. During any general engine overhaul, it is advisable to reface valve seats regardless of their condition.
(2) If valve guides are to be replaced, this must be done before refacing valve seats. Hardened exhaust valve seat inserts were installed in production and will seldom require replacement. To avoid damaging the block, remove an insert with a tool designed for this purpose. When installing a new insert, make certain the counterbore is clean and smooth. Use a driver that will keep the insert in true alinement with the bore. Cool the insert and the installing tool with dry ice for 30 minutes.
(3) The insert should be sufficiently cooled to permit installation with light taps; excessive driving of the insert may cock it in the counterbore or crack the insert.

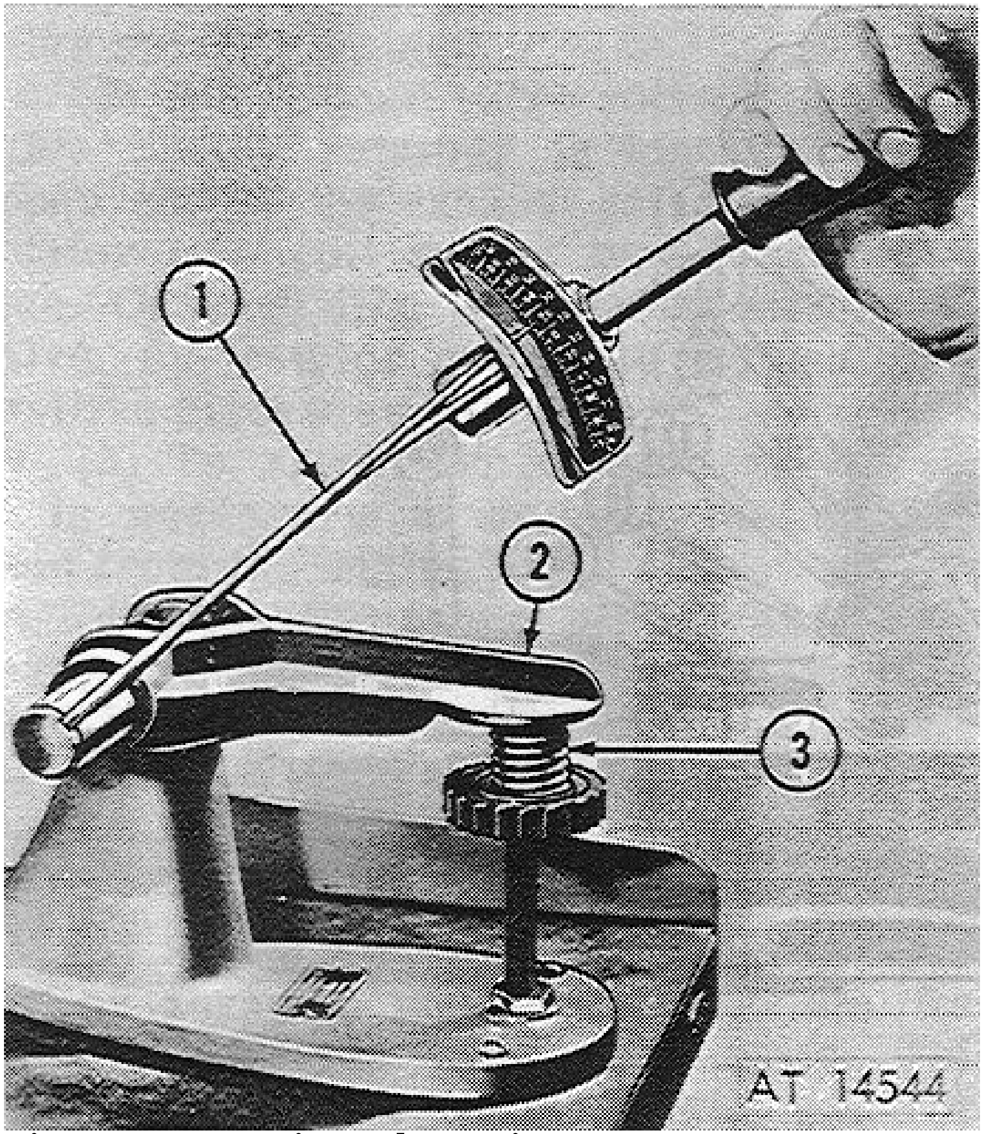


Figure 3-36. Testing valve spring.

1 Torque wrench
2 Spring checking fixture
3 Spring

(4) Make certain valve seat is facing out. Use tool and carefully drive valve seat insert until it bottoms in the counter-bore. After installation, grind valve seat at an angle of 45° and then check with a dial indicator.
(5) Refacing valve seats may be accomplished with a 45° valve seat grinder.
(6) Use grinder in accordance with the manufacturer’s instructions. The valve seat width after refacing should measure no less than 5/64-inch and no more than

3/32-inch. (Fig 3-38)

(7) Valve seats that are too wide tend to trap carbon particles that cause seat burning. Seats that are too narrow will not transfer heat from the valve to the coolant as rapidly as is necessary to keep valve in proper operating condition. Check the valve seat as shown in figure 3-39.

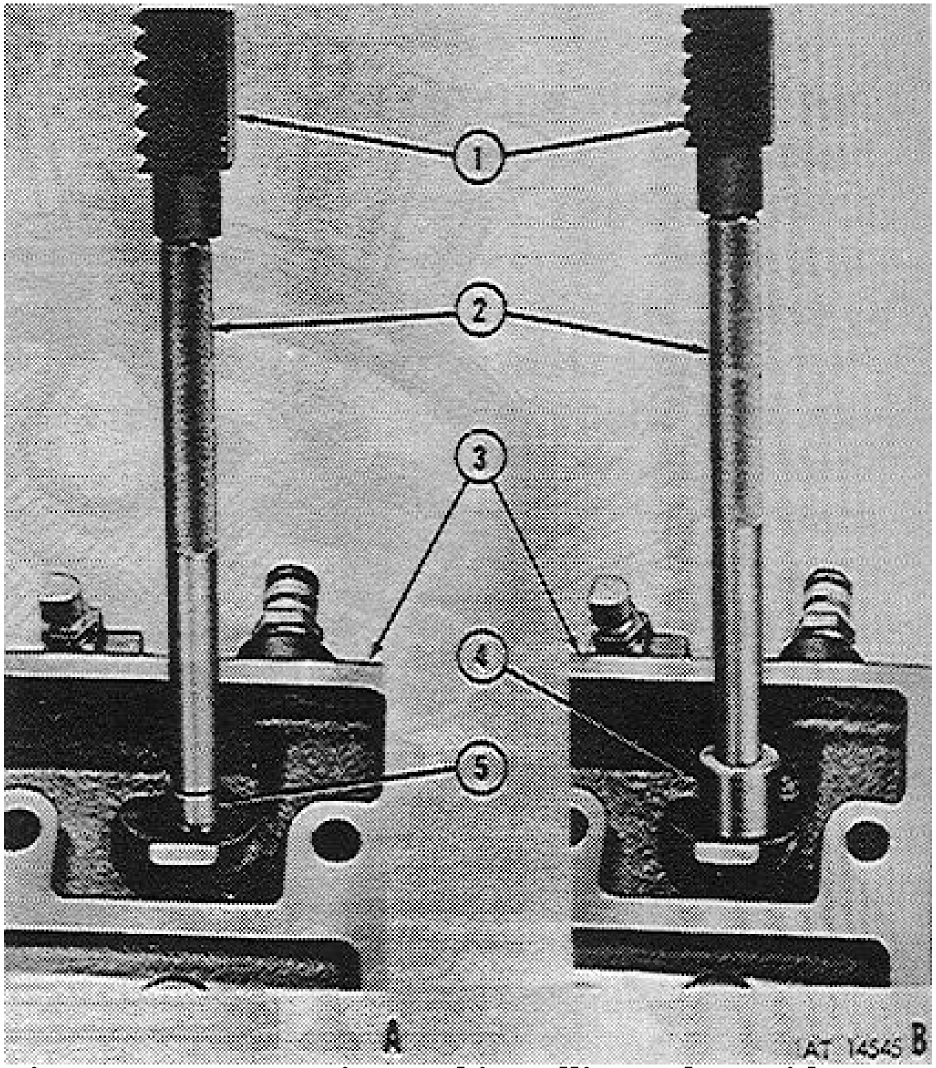


Figure 3-37. Removing and installing valve guide.

1 Arbor press
2 Driver tool W-265
3 Cylinder head
4 Stop
5 Valve guide

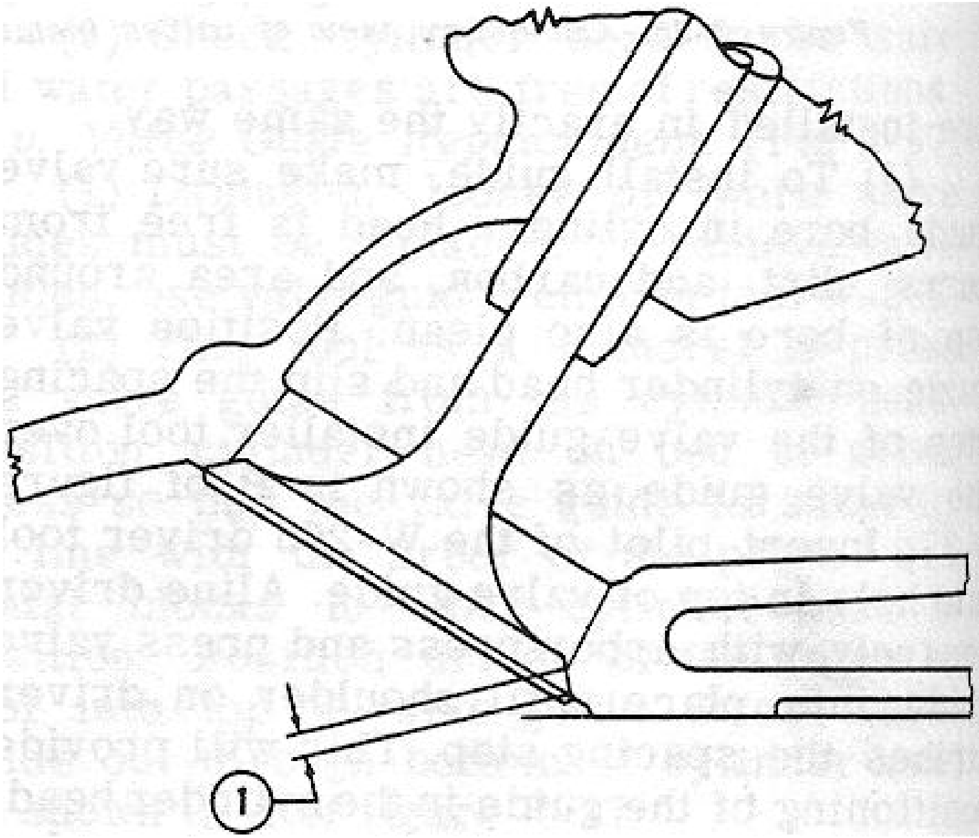


Figure 3-38. Valve seat face dimension.

1. 5/64-inch to 3/32-inch

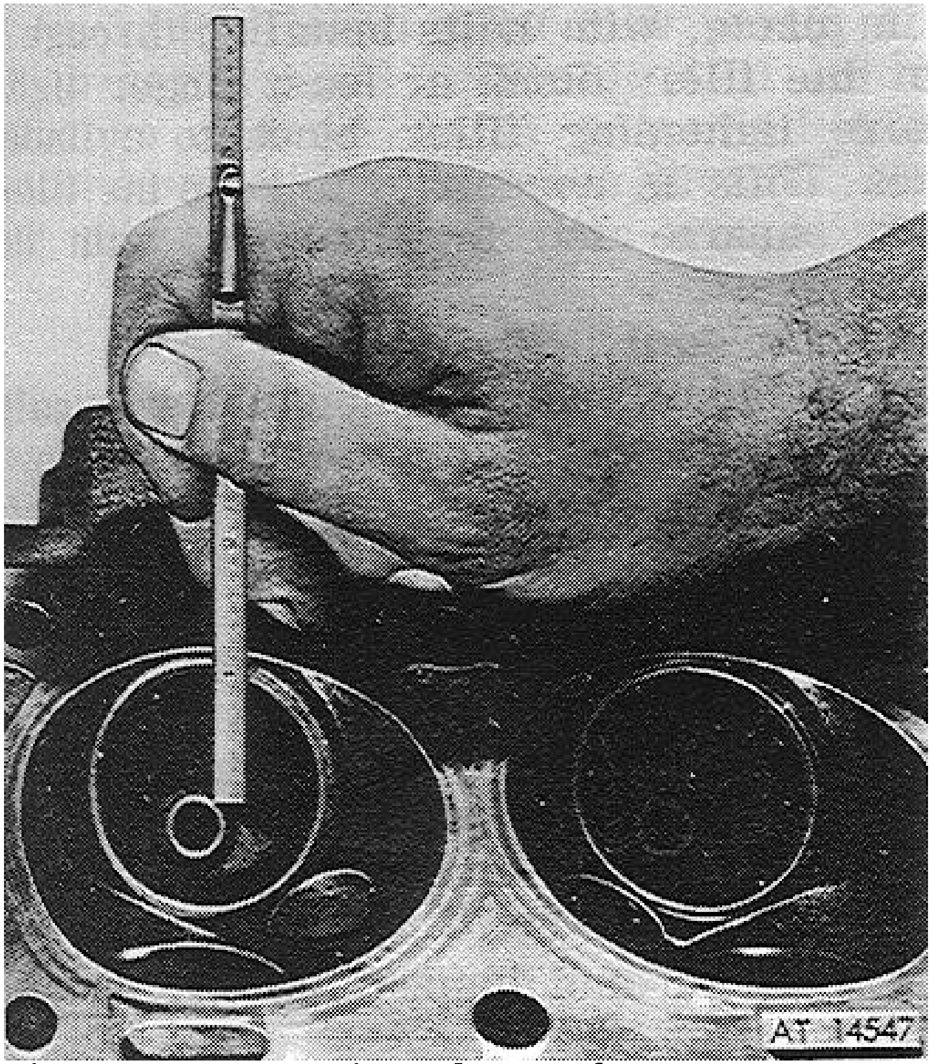
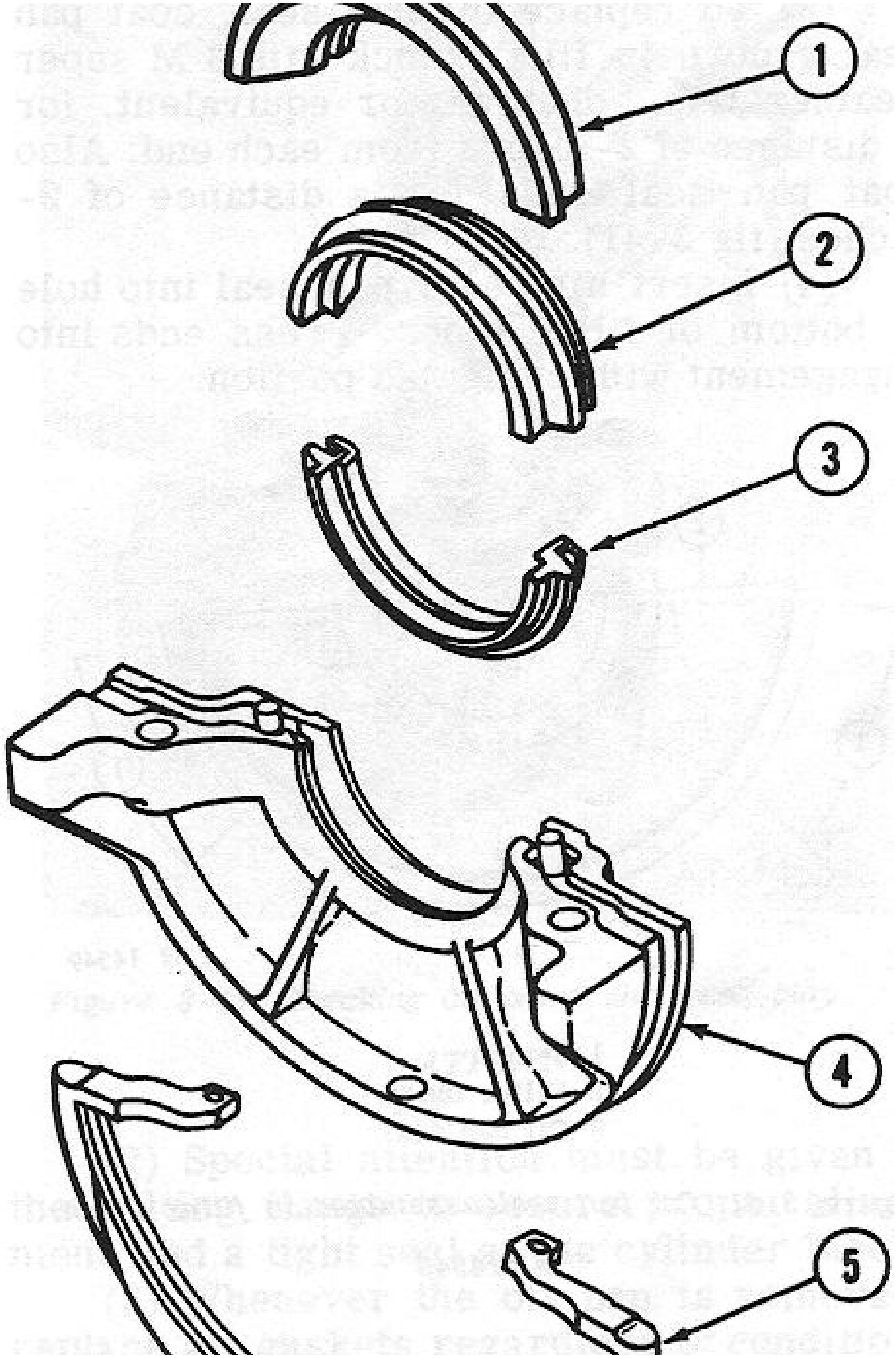


Figure 3-39. Measuring valve seat face.

CAUTION

When using valve seat cutting tools, remove only the minimum amount of metal necessary to satisfactorily accomplish that phase of the operation being performed. Excessive removal o f materiel may damage the head beyond repair by factory approved methods or nullify the reconditioning work that has been accomplished on the valve seat up to that point.

(8) A simple check can be made to prove the fit of the valve in the valve seat by spreading a thin film of prussian blue on the valve face and then inserting valve into the valve seat. With hand pressure, rotate valve a quarter of a turn. Then remove valve and observe transfer of prussian blue to the valve seat. An uneven transfer of prussian blue will indicate an inaccurate valve and valve seat refacing operation.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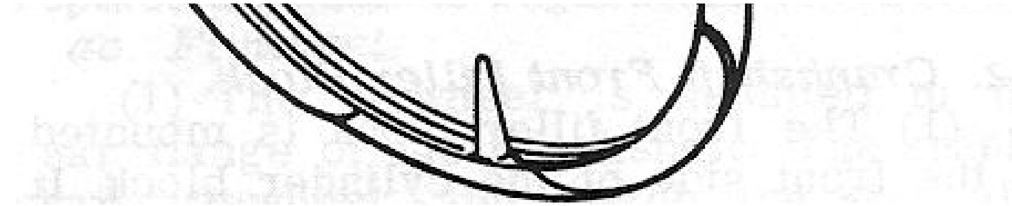


Figure 3-40. Crankshaft rear Oil seal - exploded view.

1 Filler block guard
2 Upper seal half
3 Lower seal half
4 Rear filler block
5 Oil pan seal

x. Crankshaft Rear Oil Seal, The rear end of the crankcase is sealed against oil leaks by a seal consisting of the filler block guard, upper seal half, two gasket inserts, a lower seal half, a rear filler block, and an oil pan seal. (Fig 3-40) The Filler block guard is mounted in a recess in the cylinder block. The upper seal half fits into the filler block guard making a rubber-to-metal seal. The inner diameter of the seal has a fabric-faced synthetic rubber sealing surface which engages the crankshaft. The lower seal half is identical to the upper half and mounts in the rear filler block. The oil pan seal is cemented to the rear filler block. Dowel pins in the rear filler block aline the parts properly during assembly. When the rear filler block is bolted to the crankcase, the gasket inserts are compressed to form a tight seal between the parts of the seal. Gasket inserts, two seal halves, and oil pan gasket, should be replaced each time engine is disassembled.
y. Crankshaft Rear Filler Block.
(1) Clean rear filler thoroughly. Remove oil pan seal and cement used to secure it.
(2) Check dowel pins to make sure they are straight and tight. Replace dowel pins if necessary.
(3) To replace oil pan seal, coat pan seal groove in filler block with 3 M super weatherstrip adhesive, or equivalent, for a distance of 2-inches from each end. Also coat pan seal ends for a distance of 2 inches (fig 3-41).
(4) Insert nipple of pan seal into hole in bottom of filler block. Press ends into engagement with cemented portion.

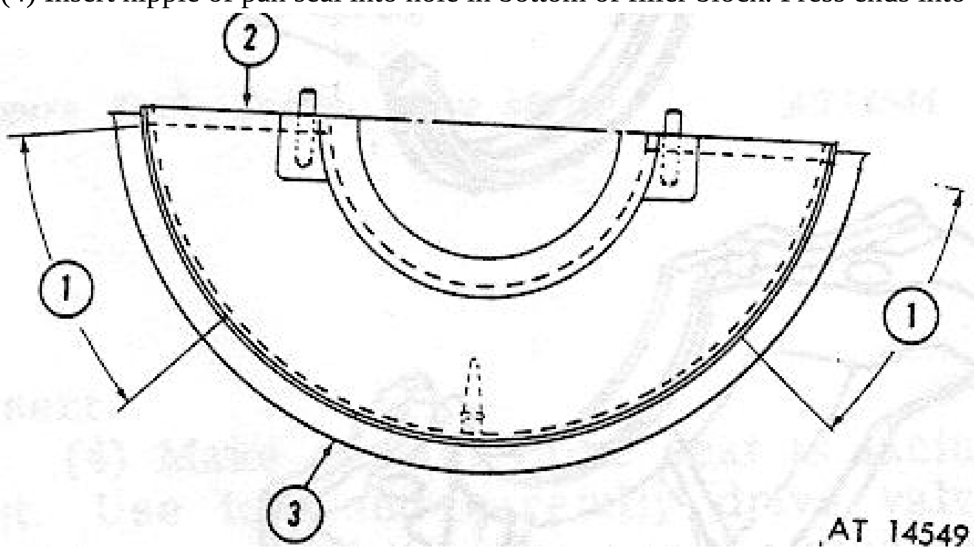
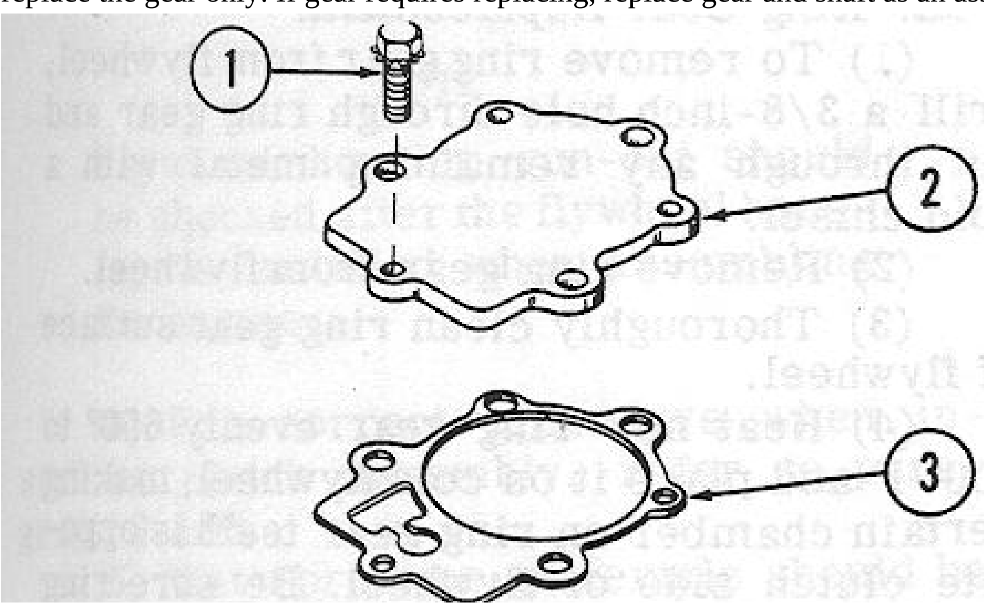
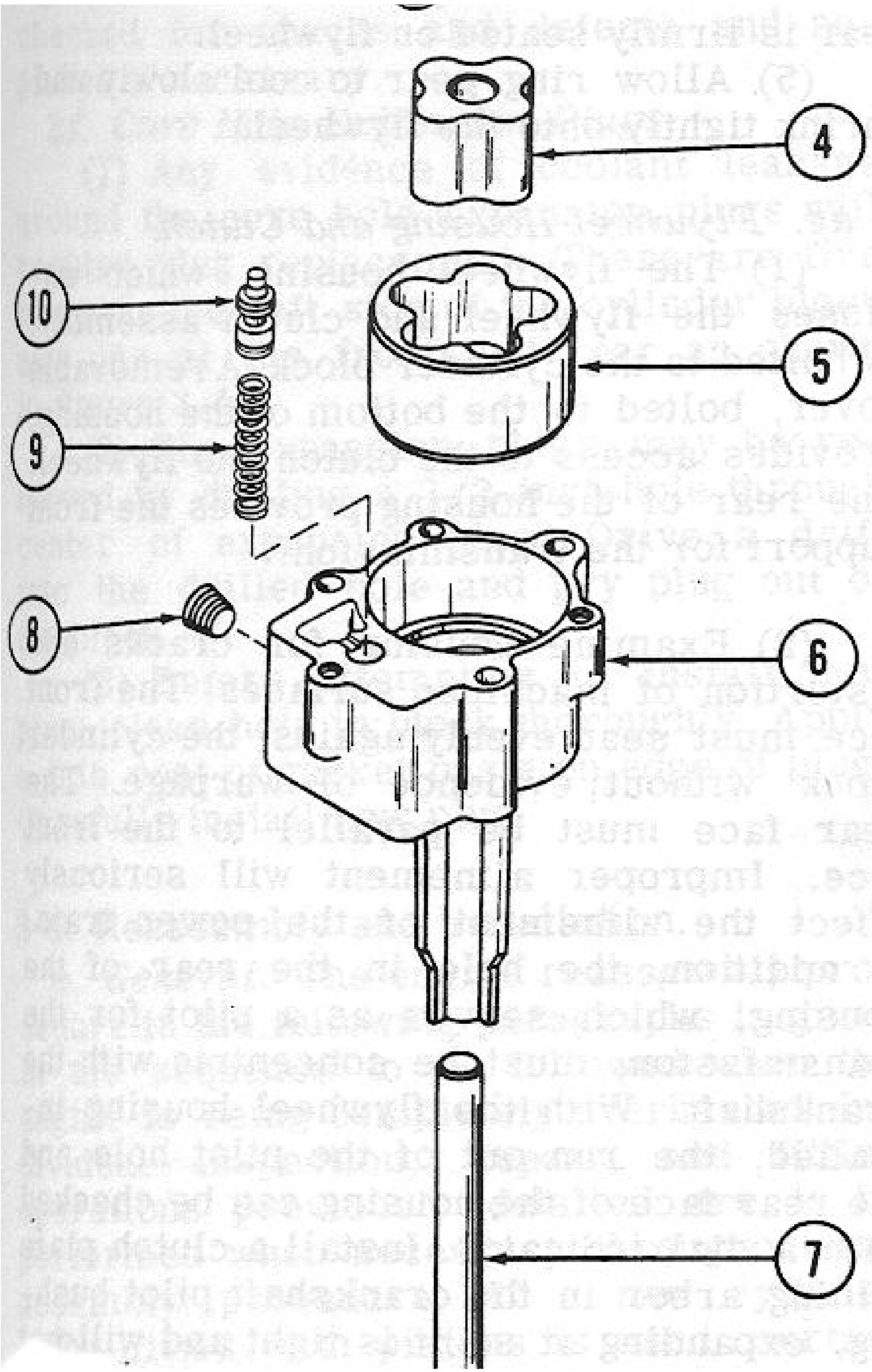


Figure 3-41. Oil pan seal assembled to filler block

1 2-inch
2 Filler block
3 Oil pan seal

z. Crankshaft Front Filler Block.
(1) The front filler block is mounted on the front side of the cylinder block. It is fitted with an oil pan seal to seal area at front of oil pan.
(2) Clean front filler block thoroughly, removing the old oil pan seal and cement.
(3) Install new oil pan seal following same procedure described for rear filler block in (y) above.
(4) It is important that the chain cover be in place, with bolts installed through it into the filler block at least finger tight, before tightening filler block to cylinder block. This is necessary to keep the filler block square and in alinement with the chain cover.
aa. Oil Pump. (Fig 3-42)
(1) The oil pump is mounted externally on the timing chain cover. It is driven by a helical gear on the front of the crankshaft. The pump consists of an inner and outer rotor (4, 5) within a pump body (6). It also includes a pressure relief valve (10) which opens a port from the discharge side of the pump to the inlet side when excessive pressure builds up within the lubrication system. If inspection shows the pump to be worn or defective, it should be replaced.
(2) Clean and inspect the oil pump as follows:
(a) Wash exterior of pump with cloth dampened with cleaning solvent.
(b) Check entire pump for cracks or leaks.
(c) Check drive gear for cracked, chipped, or worn gear teeth. Replace gear if damaged.
(d) Mount a dial indicator on oil pump to check for end-play. (Fig 3-43) Move pump shaft to its extremes and check for total end-play. If end-play exceeds 0.005-inch, replace pump. Inspect oil pump driven gear on oil pump drive shaft. Correct positioning of the gear on the drive shaft is important. The outside end of gear hub should be 7-1/32-inch from mounting face of the oil pump. In this position, the centerline of the face of the gear teeth will coincide with bottom of ignitor shaft slot in end of the oil pump shaft. Check position of the gear with respect to slot in end of shaft. Correctly positioned, the centerline of the spaces between gear teeth should be perpendicular to centerline of the slot. If gear is in any other position, slippage of the gear on the shaft has occurred. Do not replace the gear only. If gear requires replacing, replace gear and shaft as an assembly.

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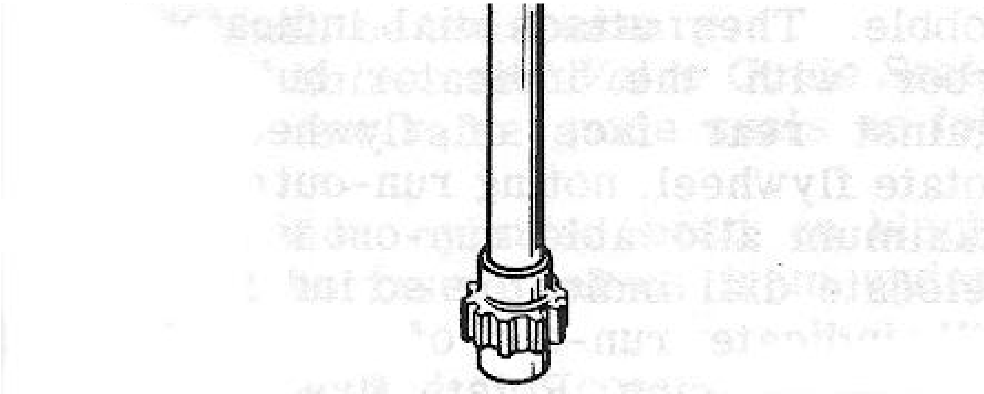
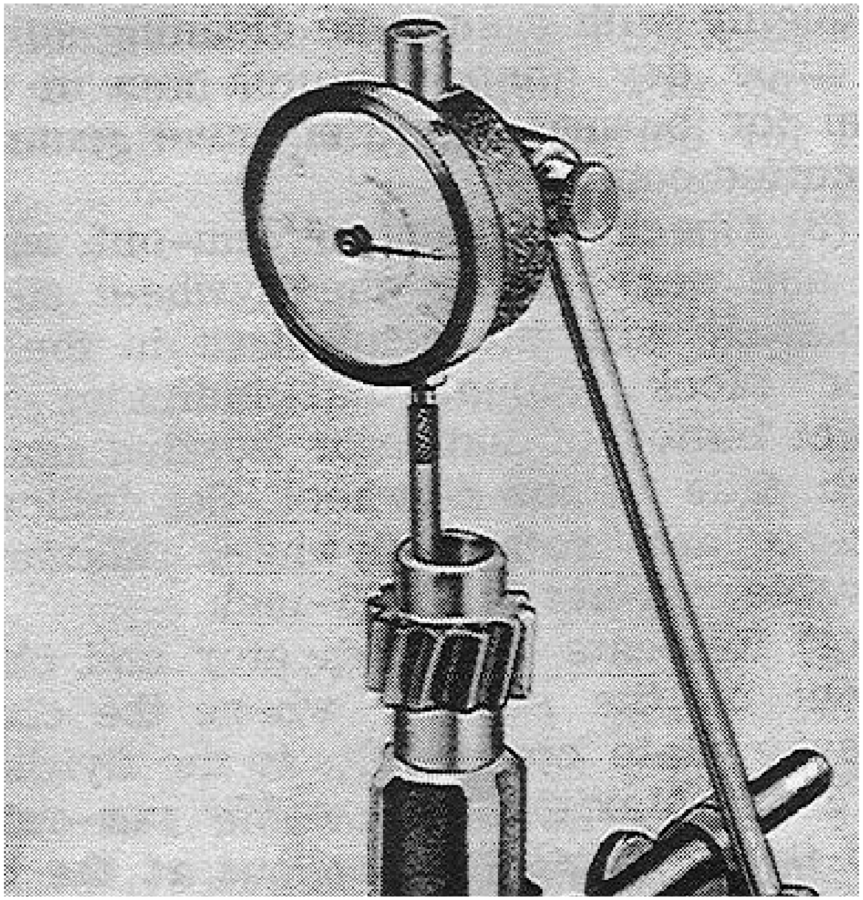


Figure 3-42. Oil pump-exploded view

1 Screw	3 Cover gasket	5 Outer rotor	7 Drive shaft	9 Relief valve spring
2 Cover	4 Inner rotor	6 Pump body	8 Plug	10 Relief valve



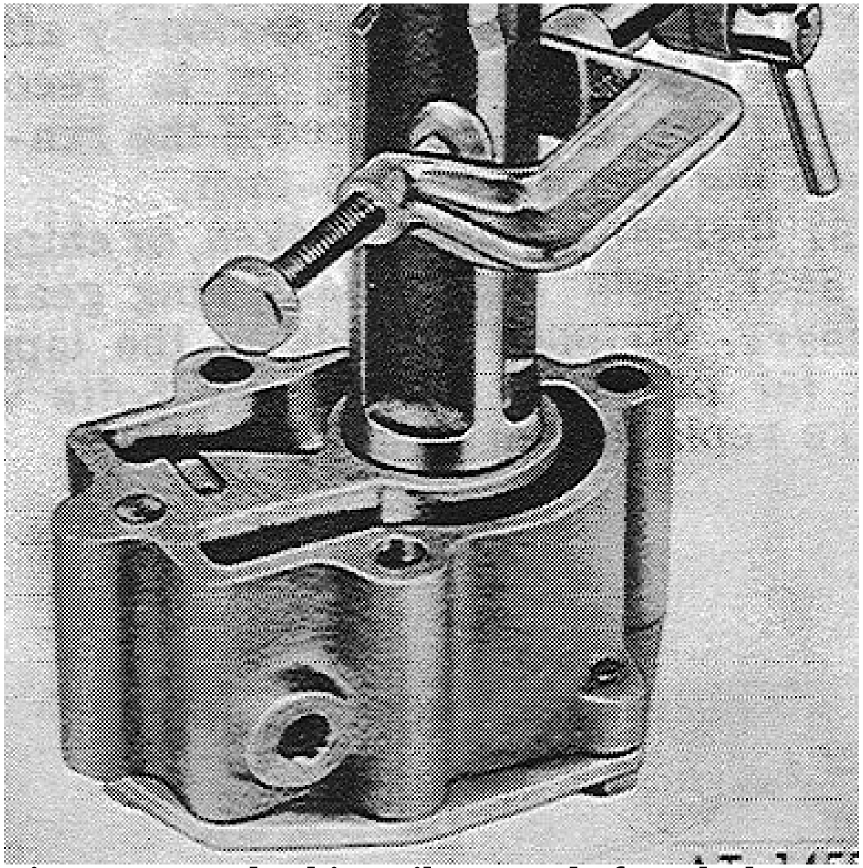


Figure 3-43. Checking oil pump shaft end-play.

ab. Oil Pan.

(1) Examine oil pan carefully for evidence of corrosion, dents, or other damage. Replace with a new pan if necessary.

(2) Special attention must be given the bolting flange to assure proper alinement and a tight seal at the cylinder block.

(3) Whenever the oil pan is removed, replace all gaskets regardless of condition.

ac. Flywheel

(1) The flywheel is mounted to the rear flange of the crankshaft. The flywheel, crankshaft and clutch are statcially and dynamically balanced seperately and as a unit. Therefore, the components should be assembled in their original relative positions to maintain balance if possible.

(2) Inspection should be done only when assembling the flywheel to the crankshaft when assembling the engine. Clean flywheel thoroughly with a suitable cleaning solvent and wipe dry. Inspect clutch face to flywheel for burned condition, rivet grooves, or scuffed condition.

(3) Check flywheel for run-out, warping, and wear. Mount the flywheel on the crankshaft with the crankshaft in the cylinder block. Mount dial indicator with contact button of indicator resting against clutch face of the flywheel. Set indicator at zero and rotate flywheel. Maximum allowable run-out is 0.005-inch.

(4) Relocate dial indicator and check run-out on the surface where the clutch pressure plate cover bolts to the flywheel. (Fig 3-44) Maximum allowable run-out is 0.005-inch. Excessive run-out at the bolt circle or clutch face will seriously affect clutch action. Therefore, it is recommended flywheel be replaced if the run-out exceeds the specified 0.005-inch.

(5) Inspect for worn, broken, or chipped ring gear teeth and replace ring gear if necessary. Stripped threads in the tapped holes for pressure plate cover bolts will require replacement of the flywheel.

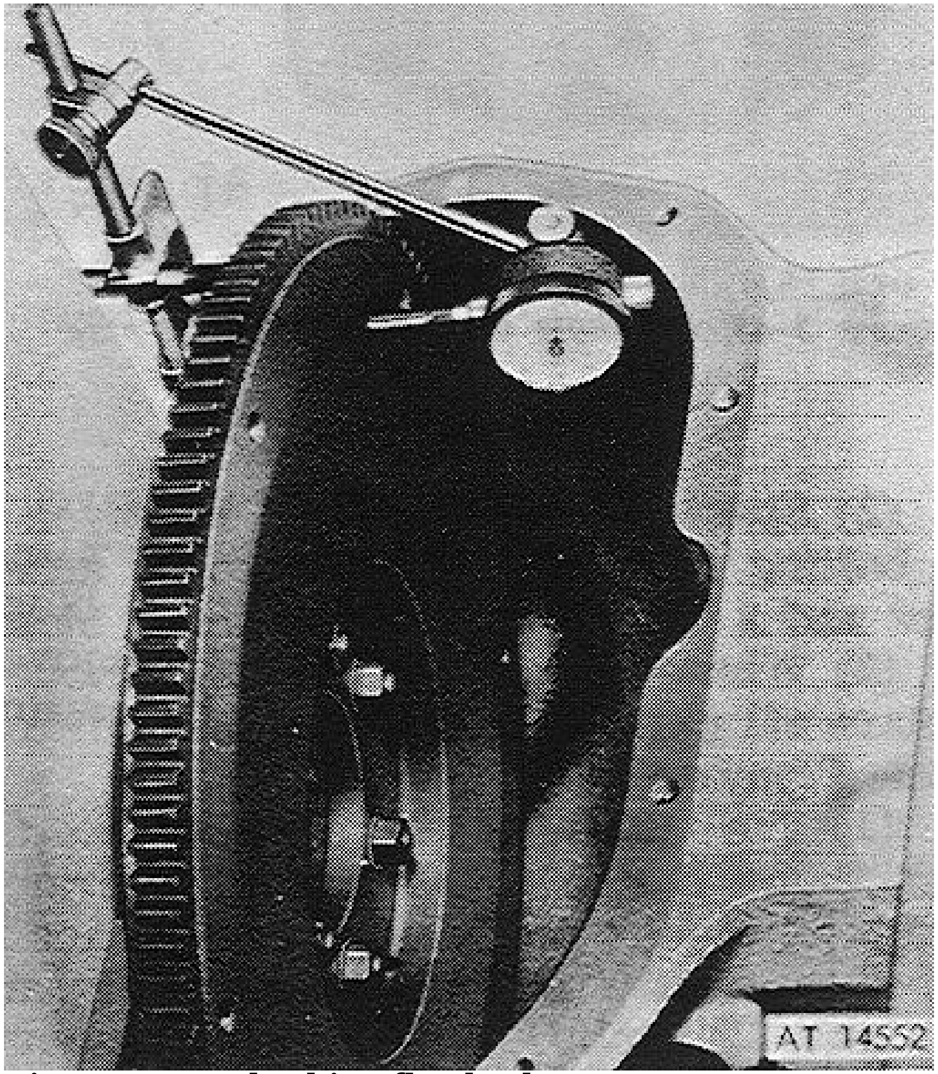


Figure 3-44. Checking flywheel run-out.

ad. Ring Gear Replacement.
(1) To remove ring gear from flywheel, drill a 3/8-inch hole through ring gear and cut through any remaining metal with a cold chisel.
(2) Remove ring gear from flywheel.
(3) Thoroughly clean ring gear surface of flywheel.
(4) Heat new ring gear evenly 650° to 700° F and place it on cold flywheel, making certain chamber on ring gear teeth is opposite clutch side of flywheel. Be sure ring gear is firmly seated on flywheel.
(5) Allow ring gear to cool slowly and shrink tightly onto the flywheel.
ae. Flywheel Housing and Clutch.
(1) The flywheel housing, which encloses the flywheel and clutch assembly, is bolted to the cylinder block. A removable cover, bolted to the bottom of the housing, provides access to the clutch and flywheel. The rear of the housing provides the front support for the transmission.

(2) Examine housing for cracks and distortion of machined surfaces. The front face must seat evenly against the cylinder block without evidence of warpage. The rear face must be parallel to the front face. Improper alinement will seriously affect the alinement of the power train. In addition, the hole in the rear of the housing, which serves as a pilot for the transmission, must be concentric with the crankshaft. With the flywheel housing installed, the run-out of the pilot hole and the rear face of the housing can be checked with a dial indicator. Install a clutch plate alining arbor in the crankshaft pilot bushing, expanding it so it is tight and will not wobble. Then attach dial indicator to the arbor with the indicator button resting against rear face of flywheel housing. Rotate flywheel, noting run-out of indicator. Maximum allowable run-out is 0.005-inch. Relocate dial indicator so indicator button will indicate run-out of pilot hole in the flywheel housing. Rotate flywheel and note run-out which should not exceed 0.006-inch.

(3) If desired, a suitable fixture can be made to attach flywheel with one of the flywheel bolts and provided clutch is not installed on flywheel permitting dial indicator to be mounted on flywheel to check housing run-out.

NOTE

Flywheel housing run-out should be checked after the flywheel housing is installed when assembling the engine.

(4) For correct procedure when installing clutch assembly, refer to paragraph 2-l9b.

(5) Waterproofing materials should be checked for cracks and defects and replaced if necessary.

a. Core Hole Expansion Plugs.

(1) Any evidence of coolant leakage around the core hole expansion plugs will require plug replacement. There are five plugs in the left side of the cylinder block and one at the front and rear as shown in figure 3-14.

(2) The expansion plugs may be removed by drilling a 1/2-inch hole through center of expansion plug. Drive a drift into the drilled hole and pry plug out of the block.

(3) Before attempting to install new plug, clean hole in block thoroughly. Apply a thin coat of gasket paste on edge of plug. Carefully install new plug.

3-6. Reassembly and Installation.

a. General. The engine reassembly procedure in the following paragraphs is given in the sequence to be followed when the engine is being completely overhauled. Individual inspection, repair, and fitting operations previously detailed are to be performed when necessary throughout the assembly procedure. If a new cylinder block fitted with pistons is used, certain operations will be unnecessary.

b. Install Valves and Valve Guide Seals. Always use new valve guide seals as follows:

(1) Position cylinder head on blocks high enough to insert valves from underside of head.

(2) Apply a light coat of lubriplate no. 4 on valve stem before assembly. Insert valve into valve guide from which it was removed.

(3) Place plastic cap, included in each valve guide seal kit, on top of the valve stem, to protect valve guide seal lip. (Fig 3-45) Cut off excess length of cap. It should extend 1/16-inch below groove on the valve stem. Lightly lubricate the cap.

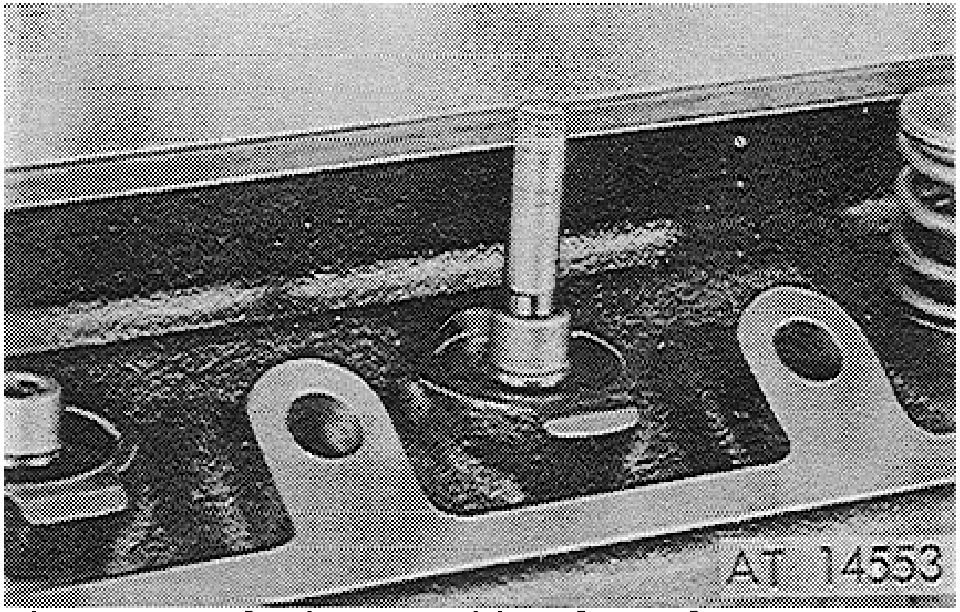


Figure 3-45. Plastic cap positioned on valve stem.

(4) Position valve guide seal squarely on end of valve stem. Push it down with the thumb until thumb strikes top of plastic cap. (Fig 3-46)

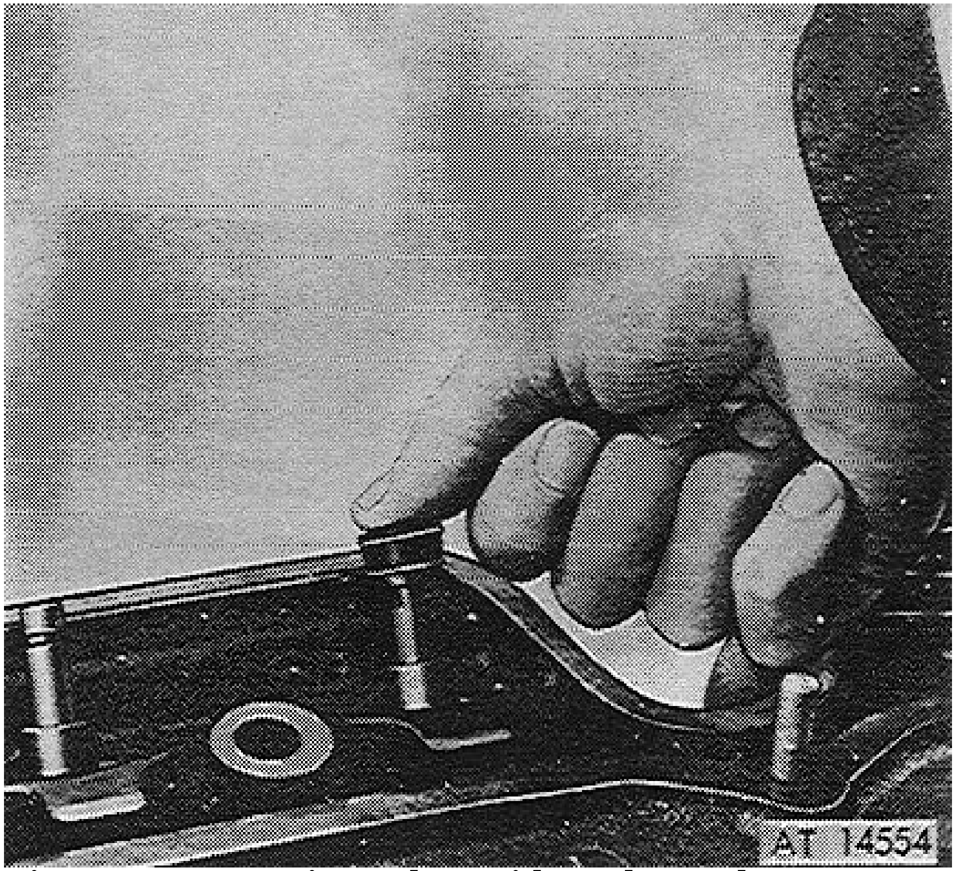


Figure 3-46. Starting valve guide seal on valve stem.

(5) Use two thumbs to hold insert in place until seal touches top of the valve guide (fig 3-47). Remove plastic cap.
(6) Use valve guide seal installer W273 to push down on valve guide seal until it is fully seated on the valve guide. (Fig 3-48)

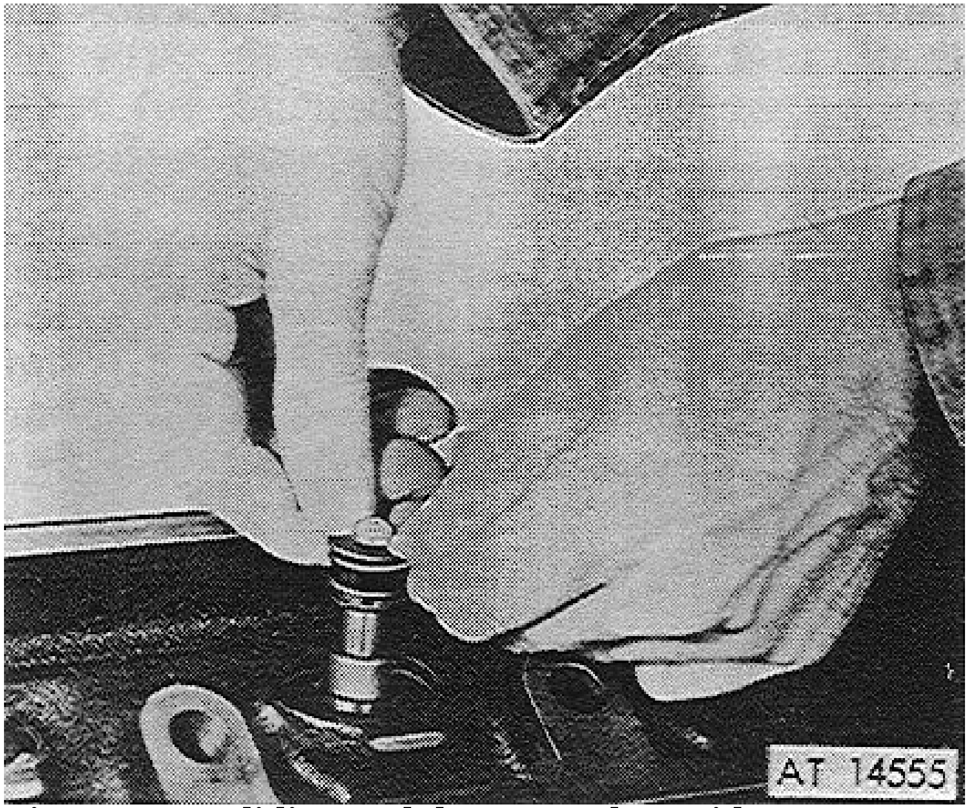


Figure 3-47. Sliding seal down to valve guide.

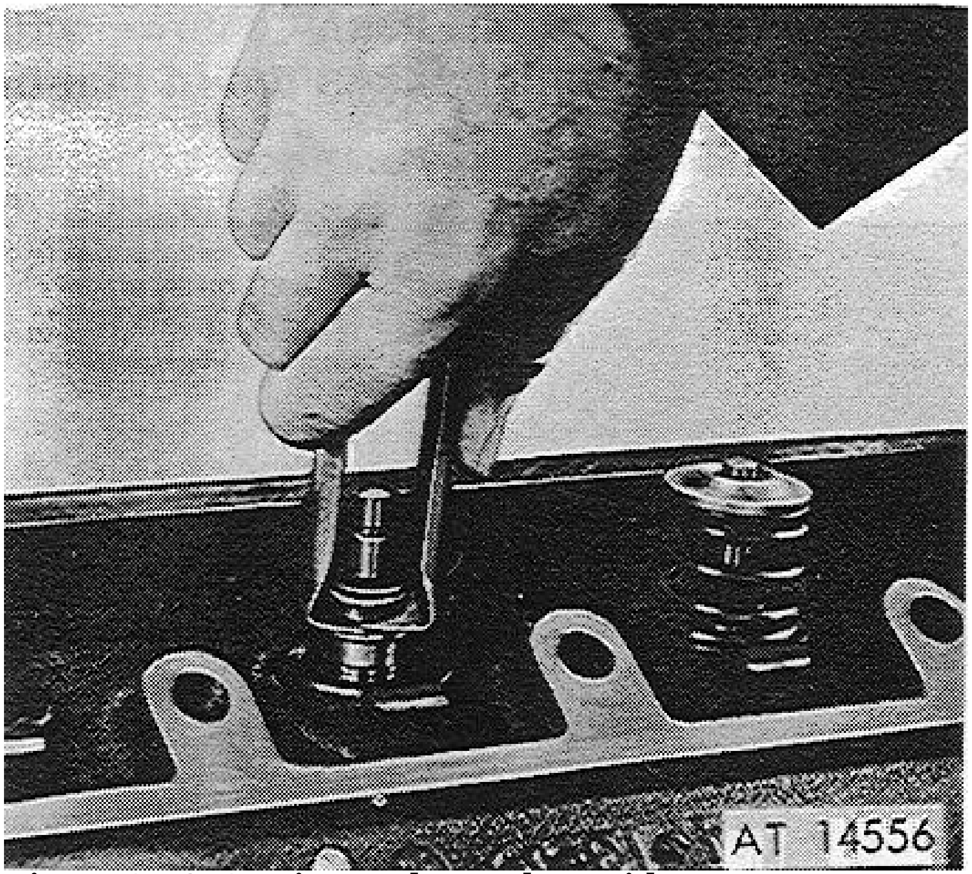


Figure 3-48. Seating seal on valve guide.

NOTE

To prevent valve stem damage, place metal protective cap tool W-300 over valve stem before installing and compressing valve retainer and spring as shown in figure 3-21.

(7) Position valve spring on cylinder head, making sure it is fully seated in its recess on the head. Place metal protective cap W-300 over valve stem. Position valve
spring retainer or rotocap on top of spring. Install C-type valve spring compressor. Compress valve spring and remove metal protective cap W-300 from valve stem. Install valve locks to hold retainer to valve stem. Release pressure on valve spring. Check and be sure valve locks seat properly in groove of valve stem.

CAUTION

Take care not to compress valve springs so far as to damage the valve guide seals during reassembly.

(8) Install remaining eleven valves in same manner, being sure to install a new valve guide seal on each valve guide.
c. Install Camshaft.
(1) Position cam bearing support deck on cylinder head. Secure with three nuts, lock washers and flat washers.
(2) Lubricate bearing journals and camshaft lobes with lubriplate and carefully slide camshaft into support deck bearing bore from the front, being careful not

to damage the bearing bores in support deck or journals on the camshaft.
(3) When camshaft is fully seated into bearing bores, position retainer on front support deck and secure with two nuts and lock washers.
d. Install Rocker Arms.

NOTE

When rocker arms are reinstalled make certain that companion rocker arms and rocker arm balls are kept together and installed in their original location.

(1) Position rocker arm and rocker arm ball on the rocker arm stud-lubricate.
(2) Install and turn down rocker arm nut several turns, but do not tighten nut.
(3) Install remaining eleven rocker arms in the same manner. Straighten each rocker arm on its stud. Install the rocker arm guide to hold each in place.
(4) Adjust valve clearance after cylinder head is installed on engine.
e. Install Crankshaft and Flywheel.
(1) With cylinder block inverted, apply a coat of Permatex Aviation Form-A-Gasket No. 3, or equal, to outer edge and shoulder of the filler block guard. Install guard firmly in the seat in the cylinder block before cement hardens. Position upper rear seal in filler block guard.
(2) Install upper main bearings in their seats in the cylinder block. Make sure oil hole is properly aimed and small projection is alined with its notch. Lubricate bearings liberally with light engine oil.
(3) Install flywheel on the crankshaft with six flywheel bolts, internal-tooth lock washers and nuts. Position and lay assembled flywheel and crankshaft into the cylinder block journal bores. Lubricate the crankshaft main bearing journals.
(4) Position lower main bearings and bearing caps. Tighten bolts on each cap evenly to pull the cap into place without bending the dowels or distorting the bearing caps. Torque the bolts 95 lbs-ft. with torque wrench.
(5) Do not install filler blocks until after oil pan gaskets are installed on cylinder block. Rotate the crankshaft. It should spin freely, without binding. If crankshaft binds, determine and correct cause of binding. Refer to (l and m) . below for proper clearance instructions.
f. Install Pistons and Connecting Rods.
(1) Before installing each piston and connecting rod assembly in cylinder block, generously lubricate entire assembly with clean engine oil.
(2) Install piston and connecting rod assembly in the cylinder to which it was previously fitted. When installing each assembly, rotate crankshaft so the crankpin is in the down position. Insert connecting rod in cylinder with oil spurt hole toward exhaust side of cylinder block.
(3) Fit piston ring compressor tightly around piston.
(4) Using a hammer handle, gently tap piston into the cylinder bore. (Fig 3-49)
(5) Install upper crankpin bearing in connecting rod and lower crankpin bearing in the connecting rod bearing cap.
(6) Lubricate connecting rod bearing surfaces generously with clean engine oil. Install bearing cap.
(7) Use new self-locking nuts and torque 40 to 50 lbs-ft. Refer to paragraphs (3-5d and 3-5e) for detailed information in fitting pistons and rings in the cylinder bores.
(8) Check connecting rod side play with a feeler gage. Side clearance should be 0.004-inch to 0.010-inch.

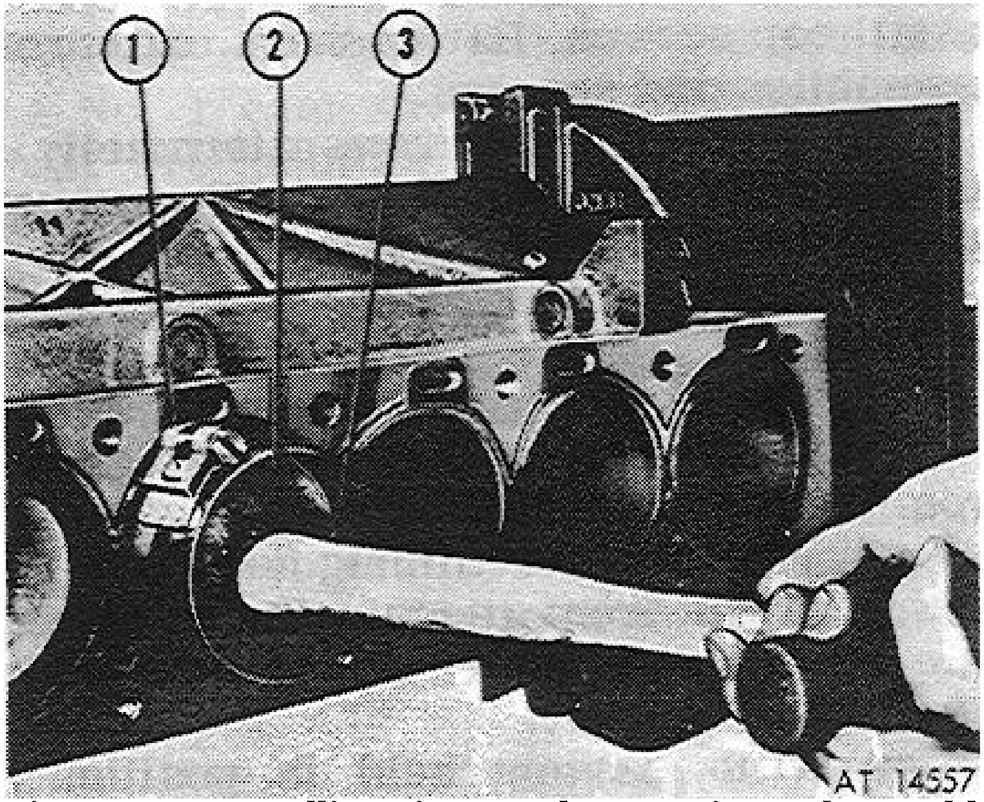


Figure 3-49. Installing piston and connecting rod assembly.

1 Piston ring compressor
2 Piston
3 Hammer handle

g. Install Oil Intake Parts.
(1) If old oil intake pipe is to be reinstalled, the end that inserts into the port in the cylinder block must be retinned to insure a tight seal.
(2) Press end of pipe into port until bracket alines with main bearing cap bolt.
(3) Use this bolt to secure pipe to the cylinder block.
(4) Position oil intake screen on oil intake pipe. Secure with cotter pin.
h. Install Oil Pan.
(1) Apply a thin coat of non-hardening Permatex, or equal, over engine surfaces of the oil pan gaskets. Install gaskets on cylinder block.
(2) Make sure new oil pan seals are installed on front and rear filler blocks. Install lower rear seal in rear filler block. Position gasket inserts in recesses of filler block.
(3) Position assembled filler block on the cylinder block, making sure the dowels in the filler block squarely engage holes in the filler block guard. Secure filler block to the cylinder block with two screws. Torque screws 15 to 20 lbs-ft.
(4) Position front filler block on the crankcase. Secure with two bolts. Torque screws 8 to 15 lbs-ft.
(5) Apply a liberal coating of nondrying Permatex, or equal, to front and rear filler block seal grooves in the oil pan. Position oil pan on cylinder block. Install cap screws, flat washers, cap screw assemblies and spacers.

(6) Tighten cap screws alternately to prevent movement of oil pan. Torque cap screws 10 to 17 lbs-ft.

1. Oil Pan Gasket Replacement - Engine in Vehicle.

(1) Remove oil pan from engine.

(2) Pull ends of oil pan seal gasket from front and rear filler blocks.

(3) Insert gasket alining dowels W-285 in the oil pan front attaching holes on each side of cylinder block. Place new gasket on top of old gasket.

(4) With gaskets held in position by the dowels, make a cut through both gaskets, 3/32-inch from edge of front filler block or 5/16-inch from edge of the nearest hole. The cut must be so the triangular end of the oil pan seal will cover the splice.

(5) Remove both old and new gaskets. Discard old gasket.

(6) Clean the surface of the cylinder block. Apply thin coat of non-hardening Permatex, or equal, on the new oil pan gaskets and the splice near the front filler block. With dowels in the holes, position gaskets on the cylinder block. Replace ends of the oil pan seal at both front and rear filler blocks.

(7) Clean and inspect oil pan gasket grooves and bolt flanges.

(8) Lubricate filler block oil pan seals with engine oil.

(9) Loosely install oil pan. Hand tighten screws, being careful not to change position of oil pan in respect to the filler blocks.

(10) Working from the center screws outward and alternating from side to side, torque screws 10 to 17 lbs-ft.

j. Install Cylinder Head.

(1) A new cylinder head gasket should always be used whenever cylinder head has been removed for any reason. The new gasket is to be installed with sealing compound. Install cylinder head as follows:

NOTE

A gasket kit is available and must be installed whenever cylinder head is being reinstalled without removing the timing chain cover. The proper installation of gasket and seals are shown in figure 3-50.

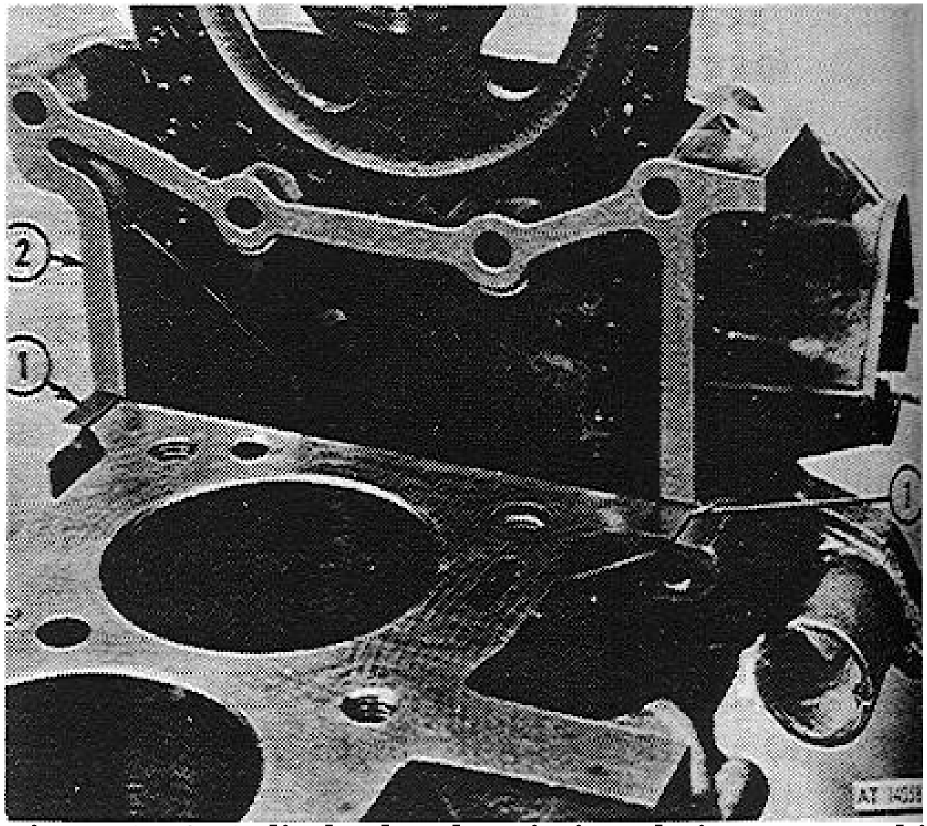


Figure 3-50. Cylinder head to timing chain cover seal installation.

1 Cylinder head to block seal
2 Timing chain cover gasket to cylinder head

(2) Make certain entire top of cylinder block assembly and lower mating surface of cylinder head are clean. Blow all dirt and carbon from blind tapped bolt holes in cylinder block before cylinder head and gasket are installed.
(3) Cover both sides of new cylinder head gasket evenly with a thin coat of sealing compound. Position gasket on cylinder block, Make certain cylinder head bolt holes in the gasket line up with holes in cylinder block.
(4) Lower cylinder head with chain fall until it is suspended about 1/4-inch above the cylinder head gasket.
(5) Cut hexagon head from two extra bolts equivalent to the 5-1/2-inch long cylinder head bolts and file a screwdriver slot in the cut end. Install the two modified bolts as guide pins in cylinder head bolt holes 12 and 14 (fig 3-51) and screw them into the block. This is to be done with cylinder head still suspended 1/4-inch above the block.

CAUTION

If engine is in the vehicle, it is particularly important that the guide pins hot be installed before cylinder head is positioned 1/4-inch above the block because of the limited firewall clearance.

NOTE

The location and smaller size of the number 12 and 14 holes make these the only locations that can be used effectively for guide pins. Two special cylinder head bolts are installed in number 12 and 14 cylinder head holes (fig 3-51). These are zinc plated and the head is marked with red paint. When removing and replacing cylinder head bolts, always install the two zinc plated bolts in holes 12 and 14.

(6) Carefully lower the cylinder head on top of the gasket.

NOTE

When installing the cylinder head (with timing chain cover installed), start the four timing chain cover-to-cylinder head bolts into the head before torquing the head bolts.

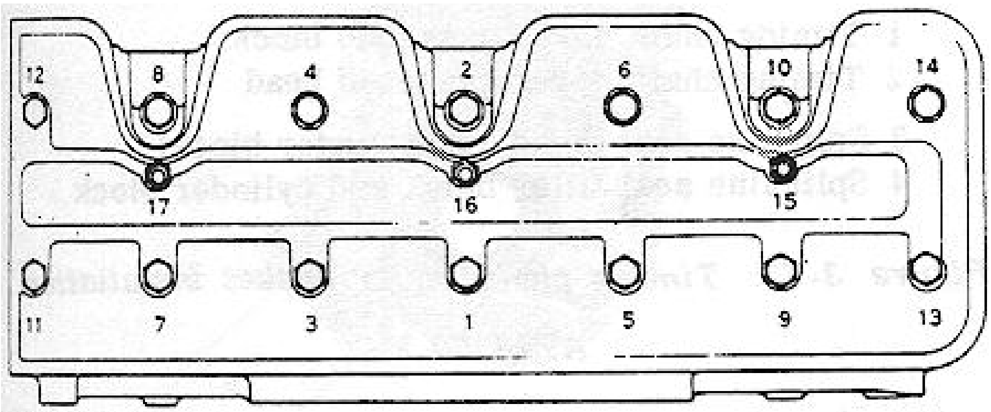


Figure 3-51. Cylinder head bolt location and tightening sequence.

(7) Install the cylinder head bolts in all but the guide pin locations with proper washers and tighten them down snugly in the sequence indicated in figure 3-51. Remove the two guide pins and install two zinc plated cylinder head bolts and washers in their place. In the sequence given, torque all head bolts 80 to 95 lbs-ft, using thin wall socket 34244-2.
k. Install Timing Chain and Sprockets.
(1) With spark plugs removed, crank engine with starter until air starts to blow from the No. 1 spark plug port to indicate that the No. 1 piston is on the compression stroke. Continue to crank engine until keyways in crankshaft are at 12 o’clock position thus indicating No. 1 piston is at top center.
(2) Temporarily install camshaft sprocket and turn camshaft until nose of the No. 1 cam and the dowel hole on camshaft are pointing downward to the 6 o'clock position. In this position, both valves are closed. This occurs when associated piston is in top center position of compression stroke. Remove camshaft sprocket.
(3) Install woodruff key into crankshaft keyway nearest the cylinder block. Install Timing Chain Sprocket Remover and Installer W-268 on rocker arm cover studs. (Fig 3-7).
(4) Position crankshaft timing chain sprocket and camshaft timing chain sprocket in opposite ends of timing chain so keyway of timing chain sprocket is up and the dowel of the camshaft sprocket is down. Position parts so copper links of the chain are aimed with timing marks on the sprockets. The copper segments are 32 links apart. Refer to figure 3-12.
(5) Lift up assembled chain and sprockets and slide timing chain sprocket on crankshaft until sprocket is fully seated.
(6) Engage hook of tool W-268 in camshaft sprocket. Tighten nut to tension the chain and pull mounting hole of sprocket into alinement with pilot on end of camshaft. Push sprocket onto pilot of camshaft until dowel engages hole in flange of camshaft. This may require slight rotation of crankshaft to secure perfect alinement.
(7) Position fuel pump eccentric on the camshaft sprocket. Install cap screw, lock washer and flat washer.
(8) Release tension of tool W-268. Remove tool from rocker arm cover studs.

(9) Install timing chain guide bracket on front of block and adjust to contact the chain.

NOTE

The timing chain bracket guide should be positioned so tight side of chain is deflected 0.060-inch to 0.120-inch from its free position after cam bearing deck has been properly torqued to cylinder head and block.

l. Valve Clearance Adjustment. Valve clearance adjustment is made after installation of engine in vehicle. Follow the procedure given in paragraph 3-10. Intake and exhaust cycles are shown in figure 3-52.

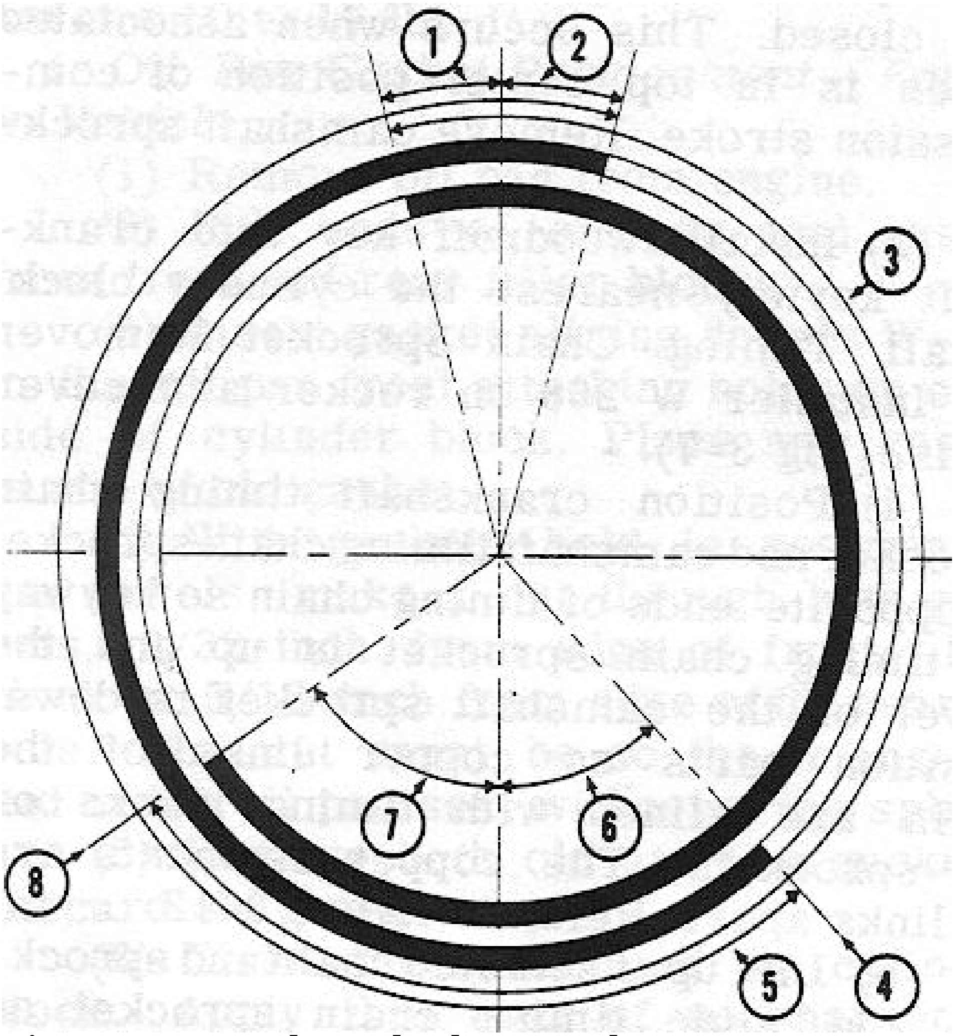


Figure 3-52. Intake and exhaust cycles.

1 Intake opens 15°
2 Exhaust closes 15°
3 Intake cycle 250°
4 Exhaust opens

5 Exhaust cycle 230°
6 43°
7 55°
8 Intake closes

m. Install Timing Chain Tensioner.
(1) Position and install tensioner blade assembly over timing case cover pivot pin.
(2) Install tension blade assembly tension spring.
n. Install Timing Chain Cover.

NOTE

Timing chain cover gaskets to the block and head (fig 3-53), must be replaced whenever timing chain cover is removed. When supplied, these gaskets are attached and must be separated at serrations.

(1) Cement a new timing chain cover gasket onto the cover with Permatex Form-A-Gasket No. 2, or equal.
(2) Make sure woodruff key, oil pump drive gear and oil slinger are all installed on the crankshaft.
(3) Assemble and install the sleeve and 0-rings in the oil port of the cylinder head.

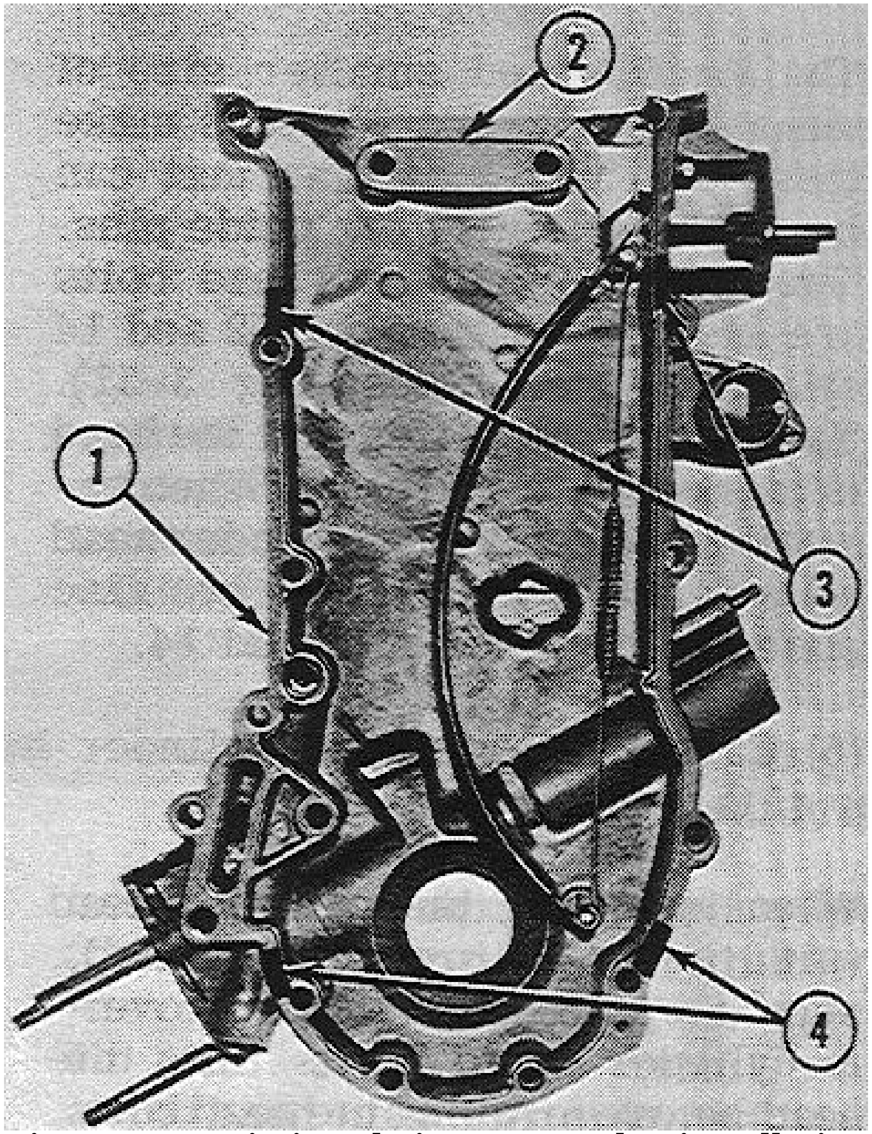


Figure 3-53. Timing chain cover gasket installation.

1 Timing chain cover gasket to block
2 Timing chain cover gasket to head
3 Split line seal (head and cylinder block)
4 Split line seal filler block and cylinder block

(4) Install new seal washers on high pressure oil passage sleeve before installing sleeve.
(5) Lubricate fuel pump push rod and spring. Install rod and spring in timing chain cover.
(6) Position fabricated tool (fig 3-54), through hole in timing case cover and “preset” timing chain tensioner in position to enable timing chain cover and tensioner to be installed without difficulty.

NOTE

Install four (4) 3/8-inch x 1-inch adhesive seals to the timing cover gasket.

(7) Seals must be installed to cover the cylinder head and cylinder block split line, also the filler block and cylinder block split line (fig 3-50).
(8) Carefully position timing chain cover and timing chain tensioner on front of engine block.
(9) Secure cover with bolts and associated lock washers and flat washers as required.
(10) Torque 5/16-inch bolts 12 to 20 lbs-ft and the 3/8-inch bolts to 15 to 20 lbs-ft.

NOTE

During process of pre-setting timing chain tensioner in timing case cover, make sure top of timing chain tensioner is centered in the upper recess section of cover.

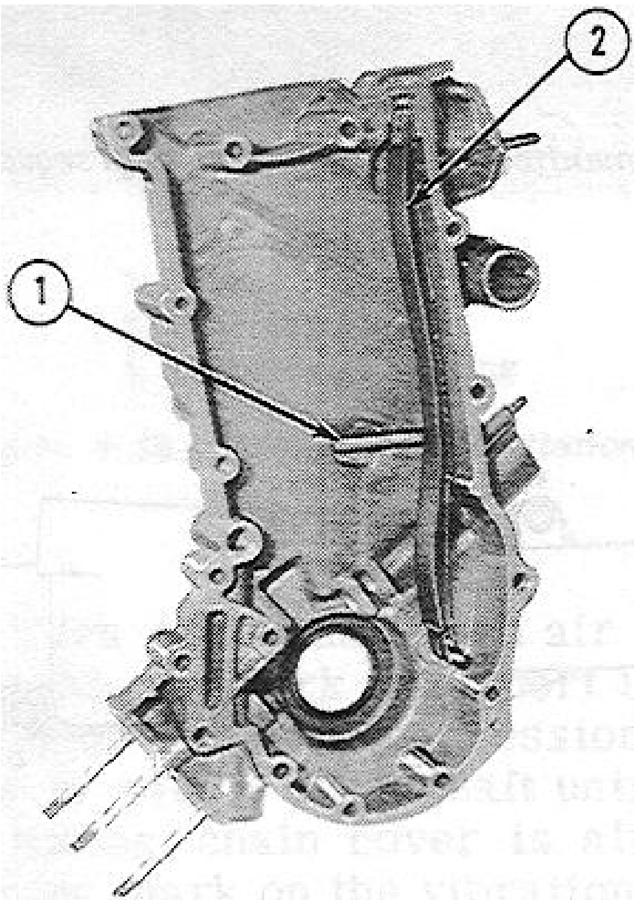


Figure 3-54. Tensioner tool in Position.

1 Tensioner tool
2 Tensioner blade assembly

o. Install Front Crankshaft Oil Seal.

(1) After timing chain cover is installed, install front crankshaft oil seal in the timing chain cover.

(2) Check crankshaft to make sure it is free of burrs on sharp projections.

(3) Apply a thin coating of sealing compound on outer edge of the seal.

(4) Position seal in the seal bore with seal lip toward inside of cover.

(5) Use crankshaft front oil seal instiller W-269A to drive seal in place. (Fig 3-55)

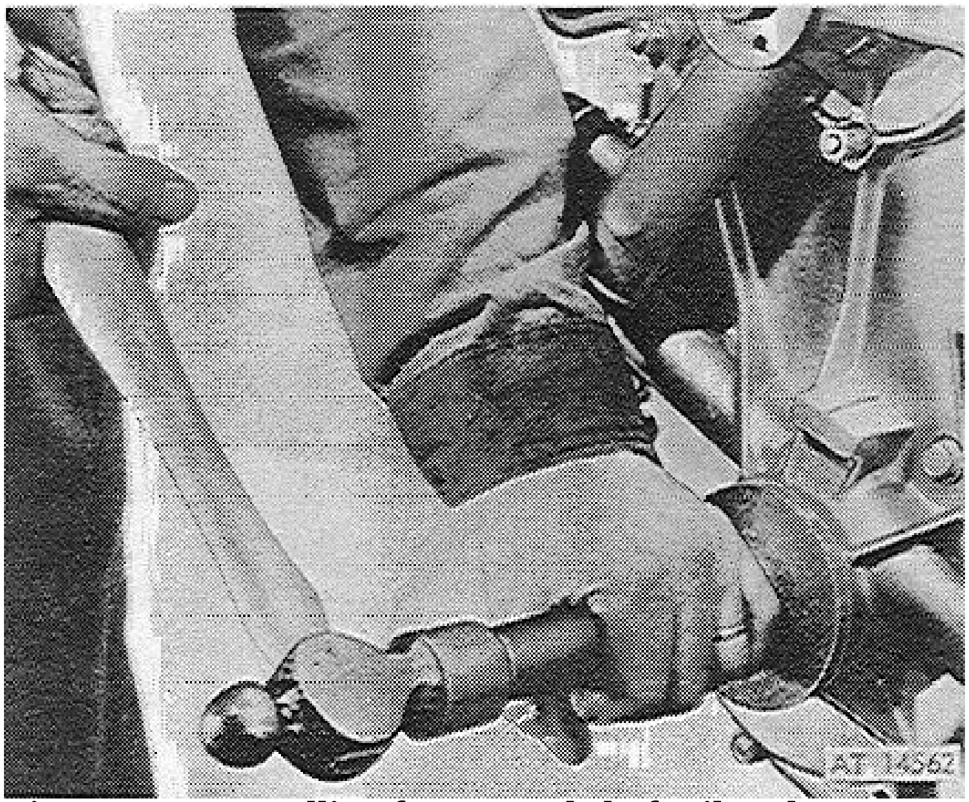


Figure 3-55. Installing front crankshaft oil seal.

p. Install Vibration Damper.

(1) Install woodruff key in keyway of crankshaft. Make sure vibration damper hub. crankshaft, key and keyway are free of burrs. Install seal-excluder Onto vibration damper hub. Aline keyway of vibration damper onto end of crankshaft as far as possible.

(2) Turn center post of vibration damper remover and installer tool C-3732-A into threaded bore of the crankshaft. Position plate, thrust washer and nut on center post. (Fig 3-56)

(3) Holding center post with a wrench, turn nut into center post until vibration damper is fully seated.

(4) Back off nut. Turn center post out from end of crankshaft.

(5) Install bolt and pilot washer to retain vibration damper. Secure vibration damper lock. Torque bolt 100 to 130 lbs-ft. Torque lock-to-damper bolts 40 to - 50 lbs.-ft.

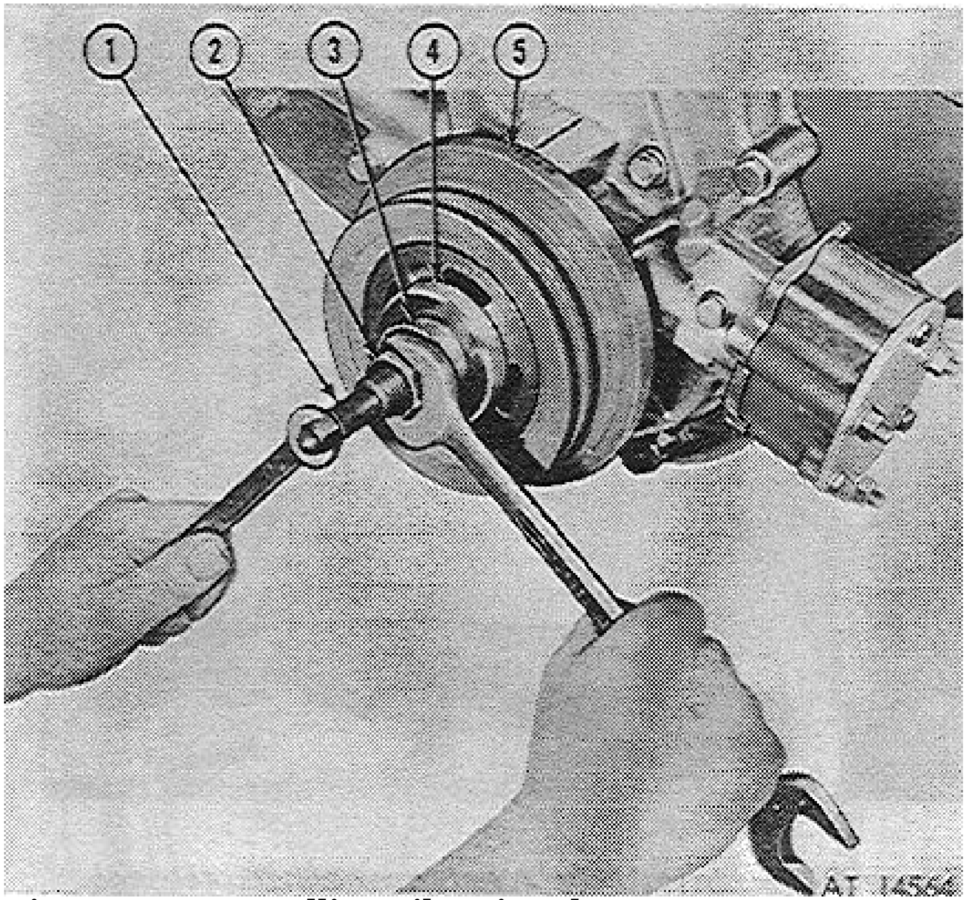


Figure 3-56. Installing vibration damper.

1 Center post
2 Nut
3 Thrust washer
4 Plate
5 Damper

q. Install Exhaust Manifold.
(1) Make sure mounting surfaces of cylinder head and exhaust manifold are clean.
(2) Position exhaust manifold gasket and exhaust manifold on cylinder head.
(3) Secure with two retainers, nuts, eight lock washers and nuts. Torque nuts 25 to 30 lbs-ft. in sequence shown in figure 3-57.

When installing manifolds, there should be no bind between manifold studs and stud holes. Where such a condition is experienced, enlarge stud holes only enough to relieve binding.

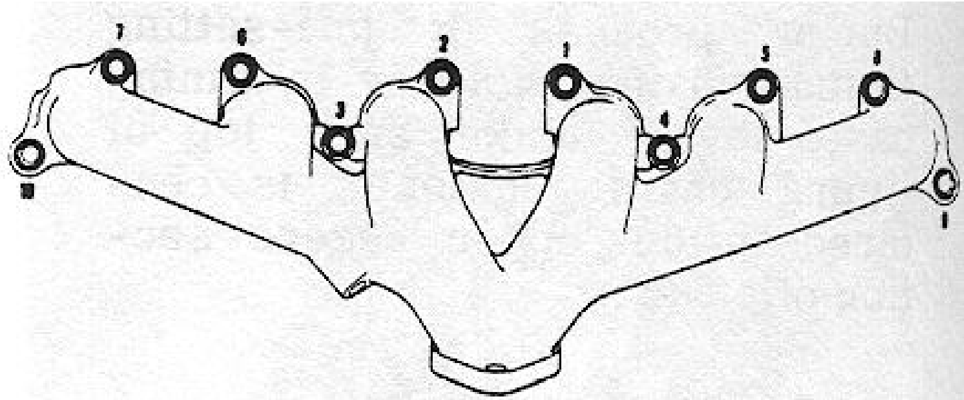


Figure 3-57. Exhaust manifold stud nut tightening sequence.

r. Install Intake Manifold.
(1) Make sure mounting surfaces of intake manifold and cylinder head are clean.
(2) Position intake manifold gasket and intake manifold on the studs at intake side of cylinder head.
(3) Attach with four nuts and lock washers, leaving lower center nut and washer off.
(4) Install dipstick guide in the dipstick port.
(5) Position bracket of guide on the lower center stud. Attach with remaining nut and lock washer. Torque nuts 15 to 20 lbs-ft. in sequence shown in figure 3-58.
s. Install Thermostat Housing and Thermostat.
(1) Position water outlet elbow gasket and thermostat housing on studs at front of intake manifold. Install thermostat and
gasket. (Fig 3-59)
(2) The thermostat. must be installed before the gasket. Position water outlet elbow on thermostat housing and secure with three nuts, lock washers and flat washers.

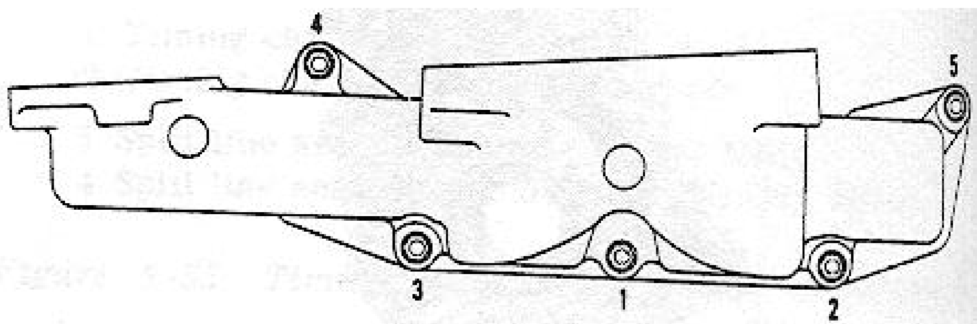


Figure 3-58. Intake manifold stud nut tightening sequence.

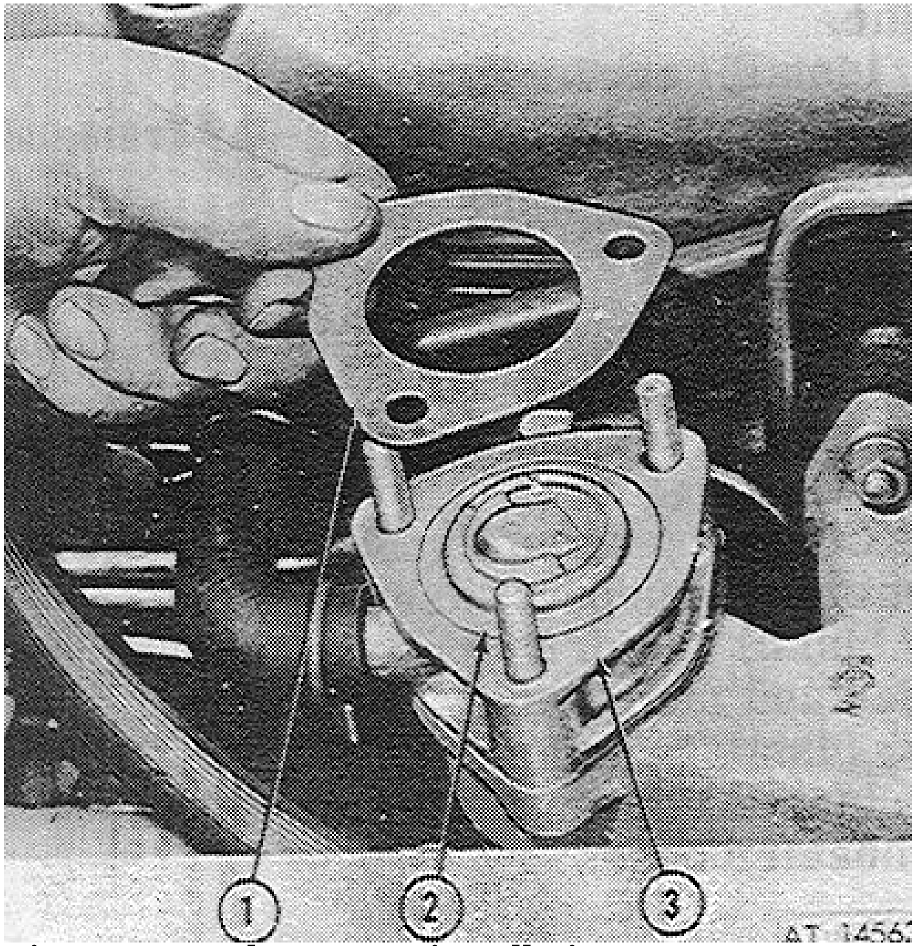


Figure 3-59. Thermostat installation.

1 Gasket
2 Thermostat
3 Thermostat housing

(3) Connect hose from outlet port on housing to adapter on cylinder head with two hose clamps.
t. Install Oil Pump.
(1) The oil pump is driven by means of a helical gear mounted on front of crankshaft. The ignitor in turn, is driven by the oil pump by means of a tongue on end of ignitor shaft which engages a slot in end of the oil pump shaft. Because the tongue and the slot are both machined off center, the two shafts can be meshed in only one position. Since the position of ignitor shaft determines the timing of the engine and is controlled by the oil pump shaft, the position of the oil pump shaft must be correct with respect to the crankshaft.
(2) Turn crankshaft until air is forced from the No. 1 spark plug port indicating No. 1 piston is on compression stroke. Continue to rotate crankshaft until pointer on the timing chain cover is aimed with “0” timing mark on the vibration damper. Install oil pump mounting gasket on oil pump.

NOTE

Always prime oil pump with engine oil before installation to assure instant oil pick-up and circulation.

(3) Position oil pump on mounting studs on the timing chain cover. Do not install the pump far enough to engage the drive gear with the worm.
(4) Insert a long screwdriver into ignitor shaft opening in the opposite side of chain cover and engage slot in oil pump shaft.
(5) Turn shaft so the slot is positioned at 4 and 10 o’clock position with narrow side of shaft up.
(6) Remove screwdriver and, look down ignitor shaft hole with a flashlight, observe position of slot in end of oil pump shaft to make certain it is properly positioned.
(7) Insert screwdriver into shaft slot and, while turning shaft counterclockwise guide oil pump shaft gear into engagement with the crankshaft gear, press against oil pump to force it into position.
(8) Remove screwdriver and again observe position of slot. If installation was properly made, slot will be at 3 and 9 o’clock position with narrow side of shaft still on top. If slot is improperly positioned, remove oil pump and repeat the operation.
(9) Secure oil pump with three nuts and lock washers. Torque nuts 12 to 20 lbs - ft.
u. Install Ignitor.
(1) Make sure oil pump shaft has been positioned as described in (t) above.
(2) Rotate ignitor shaft until tongue, at end of shaft, engages groove in end of oil pump shaft.
(3) Install nut and lock washer. Torque nut 12 to 15 lbs-ft.
v. Install Fuel Pump.
(1) Rotate crankshaft until fuel pump eccentric allows maximum travel of the fuel pump push rod.
(2) Make sure spring is over push rod to hold it against the eccentric. Then position fuel pump gasket on the timing chain cover studs.
(3) Slip fuel pump into position on the studs. The pump housing should fit snugly against the cover with only enough pressure to overcome resistance of the fuel pump spring. Additional resistance will indicate interference between fuel pump arm and push rod.

CAUTION

Never force fuel pump into place by tightening the mounting nuts.

(4) If interference exists, remove fuel pump and reposition it so fuel pump arm is under end of push rod.
(5) The attaching nuts, lock washers and flat washers should be turned down evenly and alternately to prevent cocking of fuel pump. Torque nuts 12 to 15 lbs-ft.
w. Install Rocker Arm Cover.
(1) Install gasket on rocker arm cover without sealer of any kind. If desired, motor oil may be used to ease installation.
(2) Install new rocker arm cover stud oil seal washers on four cam bearing studs. Check position of rocker arm guide and rocker arms to be sure tabs on guide are inside the rocker arms.
(3) Place rocker arm cover in position, being careful not to damage the gasket.
(4) Install two rocker arm support brackets over the two center rocker arm cover studs.
(5) If necessary for proper fit of rocker arm cover gasket, trim top edges of the timing chain cover gasket.
(6) Install four crown nuts on cover studs. Torque these nuts alternately and evenly 5 to 8 lbs-ft. Correct torque is important. Insufficient torque can cause an oil leak at stud opening in cover. Excessive torque can distort cover to cause oil leakage between cylinder head and cover, usually in area of the spark plugs.
x. Install Water Pump and Cooling Fan.

NOTE

If engine is to be installed in a vehicle immediately after assembly, the fan drive pulley, fan hub and cooling fan should be installed when engine has been reinstalled in the engine compartment.

(1) Make certain water pump mounting surfaces are clean on both timing chain cover and water pump.
(2) Coat both sides of water pump gasket with gasket paste. Position gasket on studs of timing chain cover.
(3) Position water pump on timing chain cover and secure with seven nuts, lock washers and flat washers. Torque nuts 12 to 15 lbs-ft.
(4) Position fan drive pulley, fan hub and cooling fan on hub of water pump.
(5) Secure with four bolts and lock washers. Torque bolts 12 to 15 lbs-ft.

3-7. Engine Installation.
a. With engine on mounting stand, attach a lifting sling to the two lifting eyes on the engine. Attach lifting sling to a chain fall or floor crane. Eliminate slack and remove bolts securing engine to the stand.
b. Lower engine slowly into engine compartment. Position engine to transmission and aline clutch to transmission main drive gear at the same time.
c. Aline engine to engine side supports and install engine side support bolts.
d. Secure transmission to bellhousing.
e. Disconnect and remove sling from engine.
f. Install carburetor.
g. Connect clutch linkage at frame and engine.
h. Connect throttle linkage and choke-control cable.
i. Secure exhaust pipe to exhaust manifold with two bolts.
j. Connect exhaust pipe bracket to flywheel housing.
k. Connect engine ground strap at right front engine support assembly.
1. Install fan drive pulley, fan hub, cooling fan and fan belts.
m. Install radiator.
n. Install upper and lower radiator hoses and heater hoses.

NOTE

Check and make sure radiator drain cock is shut off before filling cooling system.

o. Fill cooling system.
p. Install new engine oil filter. Improper seating of the oil filter can result in oil leaks or blown oil filter gaskets.
q. Connect fuel line at flexible hose between frame and engine.
r. Connect wires at:
(1) Temperature gage sending unit.
(2) Oil pressure gage sending unit.
(3) Starter.
(4) Alternator.
(5) ignitor wire.
s. Install air cleaner and crankcase ventilation hose.
t. Secure hood to hood hinges.

3-8. Oil. Pressure Check (In Vehicle).
a. The oil pressure may be tested by installing a pressure gage at the oil passage fitting at right rear of cylinder block. This fitting connects block-to-head oil

pipe, to cylinder block.
b. Check oil pressure with engine at operating temperature (160°). Minimum pressure should be 10 psi at 600 engine rpm; 25 psi at 2,000 engine rpm.

NOTE

Misalined clutch housings can cause improper clutch release,
driven plate failure, front transmission bearing failure, uneven wear in crankshaft pilot bushings, clutch “cackle” noise, vibration and, in extreme cases of misalinement, “jumping out of gear” on deceleration. Should any of these malfunctions occur, the rear face of the flywheel housing should be checked for alinement and concentricity of transmission pilot bore with center line of crankshaft.

a. Install clutch shaft alining bar in crankshaft pilot bushing and mount dial indicator on end of bar. The clutch shaft alining bar may be altered to insure- a secure fit in the pilot bushing in the crankshaft. Saw a slot down approximately one inch in end of bar that enters pilot bushing. spread end of bar with a thin chisel so bar fits securely in pilot bushing when tapped into place.
b. Attach dial indicator to bar and locate indicator so that it contacts rear face of clutch housing approximately 1/8-inch from edge of the rear opening (fig 2-7).

NOTE

The dial indicator clutch shaft aiming bar must be held firmly in crankshaft pilot bushing when taking either reading.

c. Check squareness of face of housing by turning crankshaft. Total indicator reading should not exceed 0.005-inch. Crankshaft end-play must be held at zero when checking face alinement.
d. To correct indicated misalinement of clutch housing, install shims between clutch housing and engine to clutch housing spacer to bring indicator reading on face of housing within the 0.005-inch limits.
To install the shims, loosen clutch housing assembly and locate shims where necessary by loosening bolts and inserting shims in place. Tighten bolts and recheck face alinement. Total indicator reading on face of flywheel housing should not exceed 0.005-inch. Relocate shims, if necessary, to bring reading within limits.
e. To check bore alinement, locate dial indicator on inside diameter of rear opening of clutch housing. Rotate engine and note indicator reading at four equally spaced points. Total indicator reading must not exceed 0.005-inch.
f. Any change in face alinement will change bore alinement. Therefore, it may be possible to correct bore alinement by changing the face alinement. Where it is impossible to correct the bore alinement to a maximum of 0.005-inch run-out with change of face alinement (not to exceed 0.005-inch), replace the housing.

3-10. Final In-Vehicle Adjustments.
a. When engine has been reinstalled in vehicle, perform the following checks and adjustments.
b. Clean and check battery.
c. Check ignition wires and connections.
d. Service air cleaner.
e. Service positive crankcase ventilating valve.
f. Check fuel lines.
g. Gap and install new spark plugs.
h. Adjust valve clearance (fig 3-60) as follows:

NOTE

Always shut down engine before removing rocker arm cover.

(1) Remove rocker arm cover and discard gasket.
(2) Rocker arm clearance adjustment must be made with engine thoroughly warmed up and idling at 600-650 rpm.

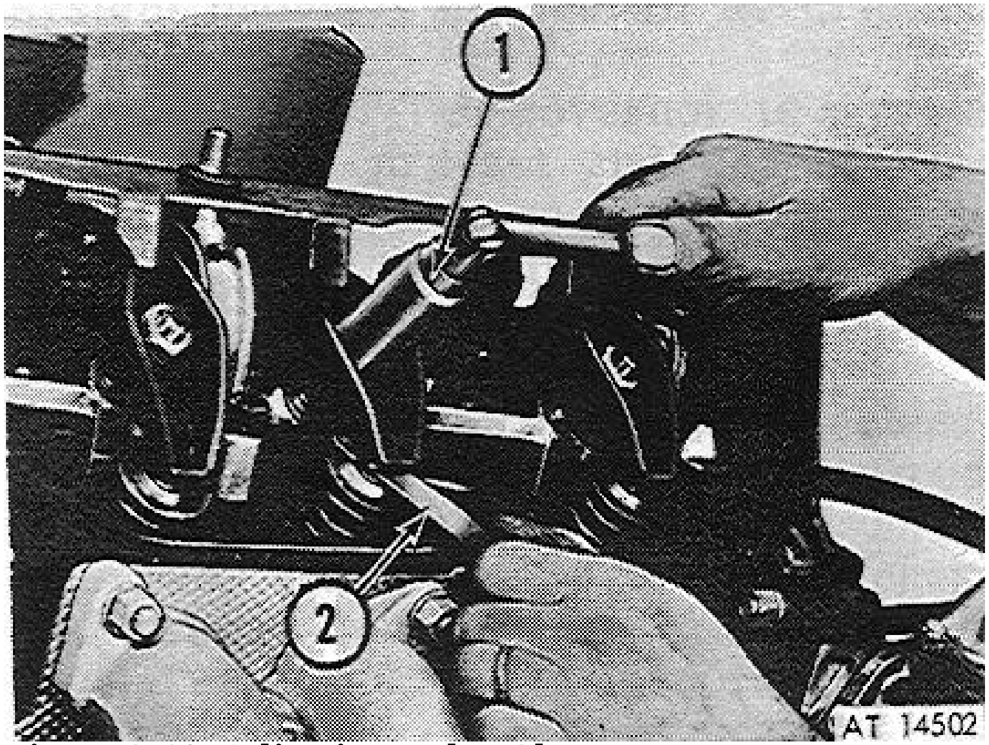


Figure 3-60. Adjusting Valve Clearance

1 Socket wrench
2 Feeler gage

A suitable shield should be installed over the camshaft sprocket to prevent excessive oil splash and to protect the mechanic from being injured by opening the timing chain.

(3) Four 3/8-24 nuts and four 3/8 washers should be installed on four cam bearing deck studs to hold rocker arm guide in position while adjusting the valve clearance.
(4) Insert gap gage between valve stem and rocker arm pad and adjust to 0.008-inch clearance. Adjust intake and exhaust valve rocker arms for all six cylinders in this manner.
(5) Install rocker arm cover gasket and cover.
i. Check ignitor.
j. Adjust carburetor.
k. Set ignition timing. Refer to TM 9-2320-244-20.
1. With engine warm re-torque cylinder head and manifolds. Check cylinder head gasket and all head bolts for leaks.

NOTE

It is advisable to check tightness of head bolts again after 500 miles of normal operation and again at 1,000 miles.

m. Adjust fan belt tension. Refer to TM 9-2320-244-20.
n. Check thoroughly for oil and/or coolant leaks. Refer to TM 9-2320-244-20.

CHAPTER 4
Repair of Fuel System

4-1.General.
REPAIR OF FUEL SYSTEM

This chapter contains descriptions and instructions for removal, disassembly, cleaning, inspection, repair or replacement, reassembly and installation of the fuel tank, sending unit, fuel pump, fuel lines, filter, air cleaner, crankcase ventilator valve, carburetor assembly and governor.
a. Fuel Tank. A metal, 28 gallon capacity, fuel tank is mounted on the left side toward rear of frame side rail forward of the rear axle. The fuel tank is vented to the air cleaner by a vapor line connecting the fuel tank filler neck to the air cleaner. A non-vented type fuel tank cap, chain and filler neck is utilized.
A float unit is mounted into top of tank and consists of a housing inclosing a
rheostat that is actuated by the float arm which moves with the fuel level in the tank. The fuel outlet pipe has a mesh filter on the bottom end. A drain plug is located on the bottom of the tank.
b. Fuel Pump Lines and Filter.
1. Description: The combination fuel and vacuum pump is mounted on the upper right side of the engine timing chain cover. The pump rocker arm is actuated by an eccentric mounted on the front side of the camshaft sprocket. The fuel section is located below the vacuum section of the pump assembly. It has a built-in air dome with a diaphragm to damper out pulsations in the fuel stream. The fuel and vacuum sections form two separate, independently operated diaphragm and piston type pumps, which are combined in one compact unit. The single rocker arm actuates both the fuel and the vacuum sections through separate mechanism which permit each section to function independently. The fuel pump moves the fuel through a replaceable filter (located between fuel pump and carburetor) and a combination of rubber and metal fuel lines.
2. Operation of fuel section of pump.
The fuel section of the pump draws gasoline from the tank and supplies it to the carburetor in sufficient quantity to meet engine requirements under all operating conditions.
The rocker arm spring and the operating rod holds the rocker arm in constant contact with the push rod contacting the eccentric on the engine camshaft sprocket so that the rocker arm swings up and down as the camshaft rotates. As the arm swings upward it bears against a shoulder on the fuel link which is pivoted on the rocker arm upward bushing. The fuel link swings upward, thereby pulling the fuel diaphragm upward by means of the connecting pull rod. Upward movement of the fuel diaphragm compresses the diaphragm spring and also creates a vacuum in the fuel chamber below the diaphragm. The vacuum causes the outlet valve to close and causes fuel from the gasoline tank to enter the fuel chamber through the inlet valve.
As the rotating eccentric permits the rocker arm to swing upward, the arm releases the fuel link; it cannot move the link downward. The compressed diaphragm spring then exerts pressure on the diaphragm and the fuel in the chamber below diaphragm. This pressure closes the inlet valve and forces fuel out through the outlet valve to the carburetor.
Since the fuel diaphragm is moved downward only by the diaphragm spring, the pump delivers fuel to the carburetor only when the pressure in the outlet line is less than the pressure maintained by the diaphragm spring. This condition arises when the carburetor float needle valve is not seated and the fuel passage from the pump into the carburetor float chamber is open. When the needle valve is closed and held in place by the pressure of the fuel on the float, the pump builds

up pressure in fuel chamber until it overcomes the pressure of the diaphragm spring. This pressure results in almost complete stoppage of diaphragm movement until more fuel is needed

The air dome with diaphragm in the bottom of fuel pump provides a pocket in which fuel under pressure can compress a certain volume of air. When the pressure is relieved (pump on suction stroke) the pocket of compressed air pushes the fuel on to its destination. The air dome minimizes flow variations experienced with double-acting pump stroke and increases the pump output.

3. Operation of vacuum section of pump.

The vacuum section of the pump acts as a booster when engine manifold vacuum is insufficient to operate the windshield wipers at proper speed. This section is a double acting pump since it is effective on both the upward and downward movement of the piston.

The rocker arm swings up and down as the engine camshaft rotates. As the arm swings upward it contacts the vacuum piston rod and pushes the vacuum piston upward. Upward movement of the piston compresses the piston spring which then pushes the piston downward as the rotating operat
ing eccentric permits the rocker arm to swing downward. Upward and downward movement of the piston produces a pumping action in the air chamber on both sides of the piston.

When the windshield wiper control valve is opened and the piston is moved upward by the rocker arm, air is drawn through the windshield wiper motor into the lower air chamber through the inlet valve in the pump body.

At the same time air is exhausted from the upper air chamber into the engine manifold through the outlet valve in the vacuum cover. As the spring moves the piston downward, air is drawn into the upper air chamber through the inlet valve in the cover, while air is exhausted from the lower chamber through the outlet valve which opens into the pump body from which it exhausts in the crankcase. When the windshield wiper control valve is closed, or when the engine manifold vacuum is sufficient to operate the wiper motor, vacuum holds the piston in the upward position so that the rocker arm cannot operate the piston rod. The vacuum pump remains inactive until low manifold vacuum permits the piston spring to push the diaphragm downward.

c. Air Cleaner. Two types of air cleaners (early and late) are utilized on the vehicles, depending upon vehicle serial number. The air cleaner assemblies are a dry single element type air cleaner, mounted under the vehicle hood or on the carburetor air horn. Air is drawn into the air cleaner head, filters through the air cleaner element, and is drawn out through a hose connecting the air cleaners to the carburetor air horn.

d. Crankcase Ventilation Valve. The fuel system incorporates a positive crankcase ventilating system designed to reduce the engine's air contaminating hydrocarbon emissions into the air by burning these fumes. The crankcase is ventilated by clean air drawn into the air cleaner and passed through a breather hose connected to the breather tube that is located on the side of the crankcase. As the air passes through the crankcase, the vapors are forced through the vent valve, and into the intake manifold. The crankcase vapor and contaminants are then burned in the combustion chambers.

The critical point of the system is the positive crankcase ventilating valve which is located in the intake manifold riser below the carburetor flange. The valve controls the flow of fumes entering the engine for burning by opening against spring pressure. The ventilator valve should be serviced periodically as the hydrocarbon deposits accumulate on the valve causing it to stick so fumes cannot flow, forcing the vapors to remain in the engine crankcase, developing sludge, varnish, and acids. When these corrosive agents develop, they cause premature wear on engine parts or result in other serious engine difficulties. Carburetion problems will also occur when the fumes are not properly expelled or the valve does not seat properly due to carbon formation. These malfunctions create poor idling conditions and engine stalling.

The system should be checked for air leaks at the tube connections and oil filler cap gasket.

e. Carburetor. The carburetor is a concentric down-draft type equipped with a manual choke. The carburetor controls and vaporizes the fuel through six separate operating systems: fuel inlet system, idle system, accelerating -pump system, main metering system, power enrichment system, and the choke system. A description of the functions and operations of each system provides an overall description of the carburetor.

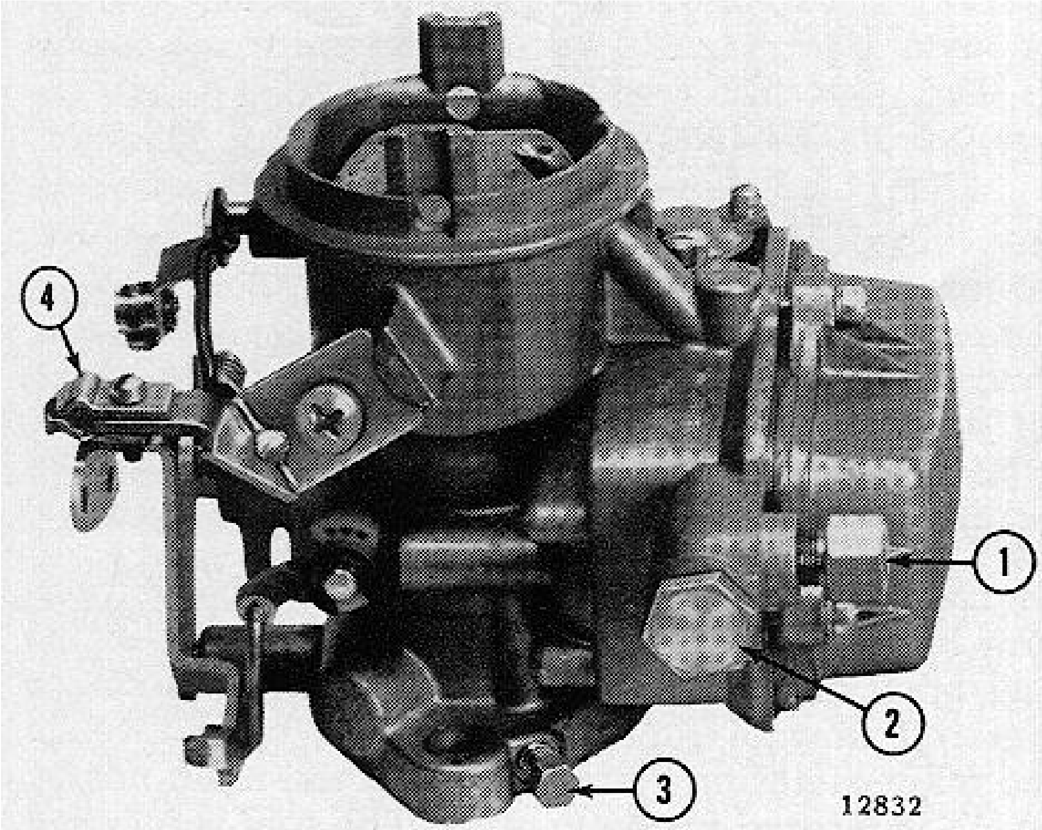


FIG. 03-7—CARBURETOR — PUMP SIDE

1 Fuel Inlet Fitting
2 Needle and Seat
3 Idle Mixture Adjusting Needle
4 Choke Cable Clamp

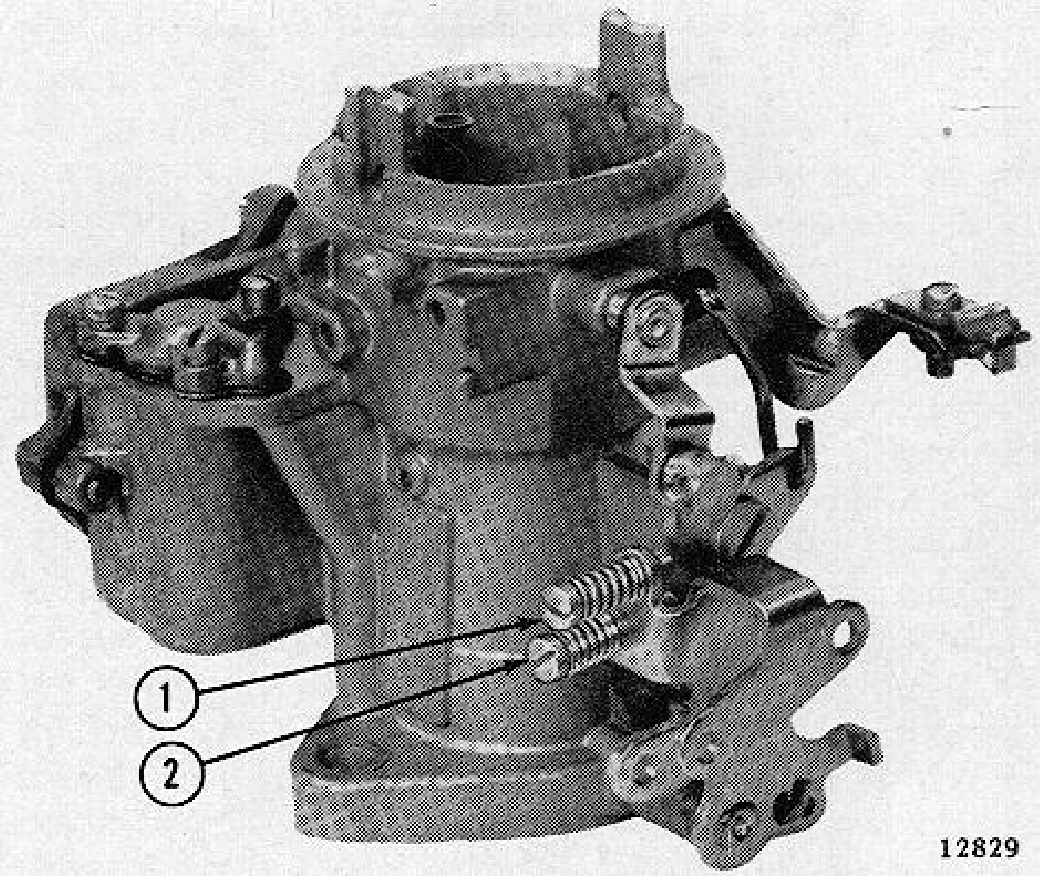


FIG. 03-8—CARBURETOR — ADJUSTMENT SIDE
1—Fast Idle Screw
2—Curb Idle Screw

1 Fuel Inlet and Float System

All fuel used by the four basic fuel metering systems enter the carburetor through the fuel inlet needle valve and seat assembly. The fuel, under pressure from the engine's fuel pump, flows past the needle valve and into the float chamber, The float rises and falls with the fuel level in the float chamber, moving the fuel inlet needle valve correspondingly to control the amount of fuel admitted to the carburetor, as shown in Fig. 03-9. The fuel inlet system must constantly maintain this specified level of fuel because the basic fuel metering systems are calibrated to deliver the proper mixture only when the fuel is at the proper level.

The fuel bowl is vented internally by a vent passage which connects the fuel bowl with the air horn. A float stabilizing spring assists in maintaining the proper fuel level during rough road or off-highway operation.

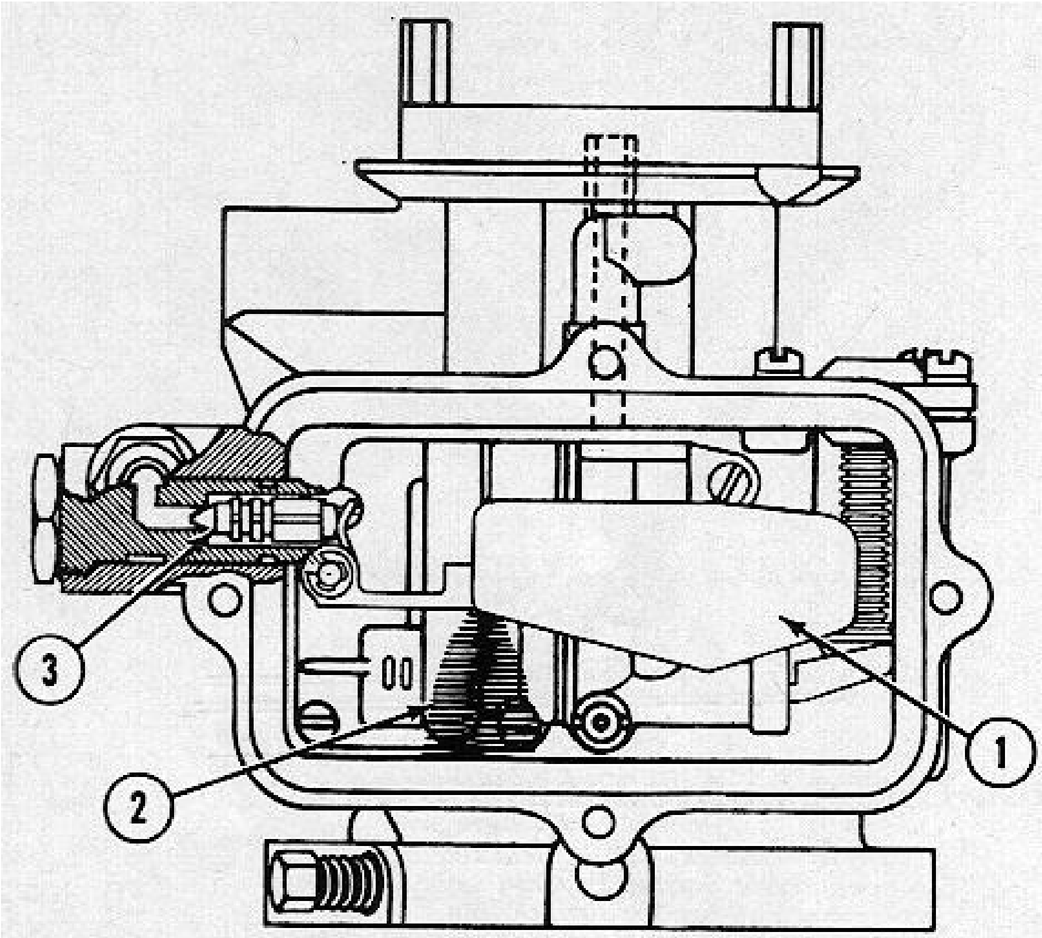


FIG. 03-9—FUEL INLET SYSTEM
1 Float
2 Float Stabilizing Spring
3 Fuel Inlet Needle and Seat

Note: Fuel passages of the four basic fuel metering systems originate in the main well and economizer body assembly in the carburetor fuel bowl, as shown in Fig. 03-10. A study of the passages in this assembly will result in a clearer understanding of the explanations of the four fuel metering systems.

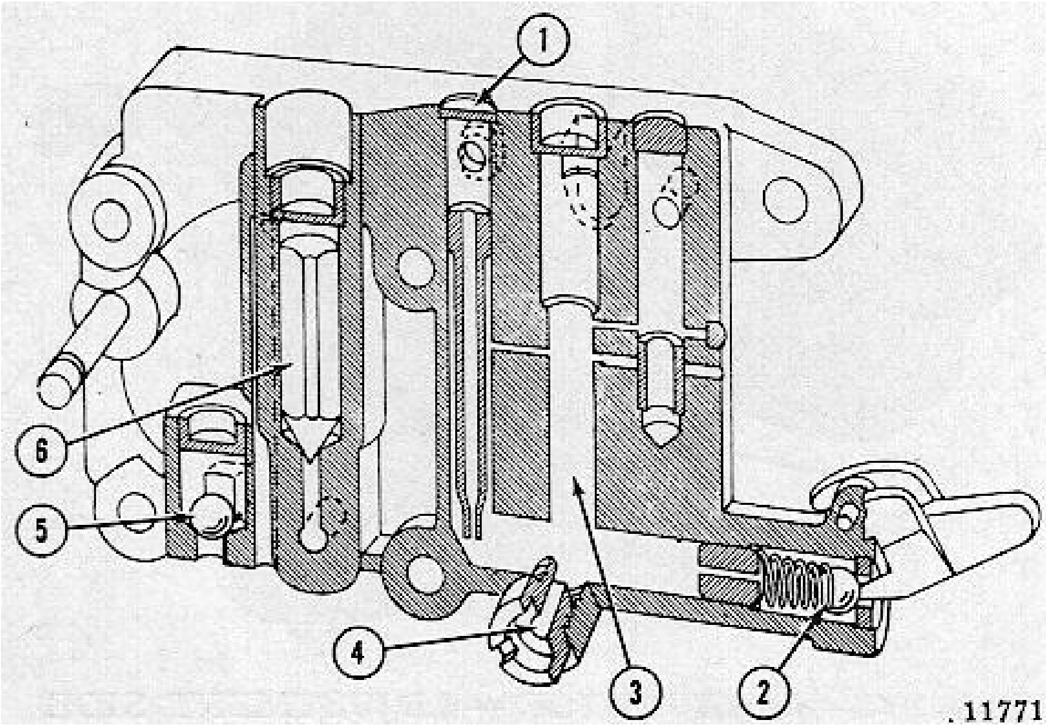


FIG. 03-10—MAIN METERING BODY (CUTAWAY)
I—Idle well
2—Power Valve
3—Main Well
4—Main Jet
5—Pump Inlet Valve
6—Pump Discharge Valve

2 The Idle System
At idle, fuel flows through the main jet into the main well then through a horizontal passage into the idle well. A restriction in the idle well is calibrated to flow the proper amount of fuel. The fuel
passes out of the top of the idle well and into the idle system passages in the main body. The top of the vertical idle system passage in the main body contains the idle air bleed which admits a metered flow of air to the fuel. The fuel is discharged from the idle discharge hole into the carburetor throttle body below the throttle plate. The pointed tip of the idle adjusting needle is set a short distance off its seat at the idle discharge hole. The setting of the idle adjusting needle controls the fuel-air mixture discharge at idle, as shown in Fig. 03-11, During off-idle operation, the throttle plate is moved slightly past the transfer slot, which begins discharging fuel as it is exposed to manifold vacuum. As the throttle plate is opened still wider and engine speed increases, the air flow through the carburetor is also increased. This creates a vacuum in the venturi strong enough to bring the main metering system into operation. The flow from the idle system tapers off as the main nozzle begins discharging. This allows a smooth transition from idle to cruising speeds.

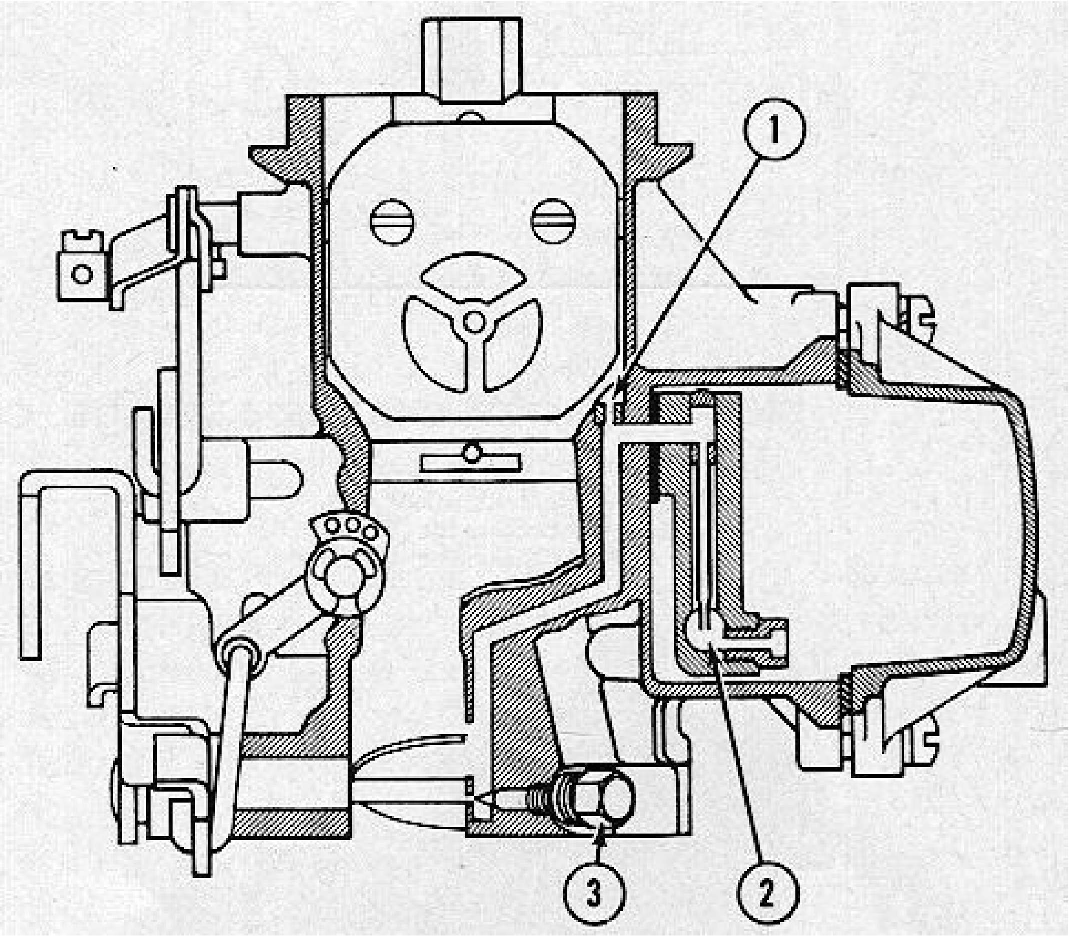


FIG. 03-11—IDLE SYSTEM
1 Idle Air Bleed
2 Idle Restriction
3 Idle Adjustment Needle

3 Main Metering System
At normal cruising speeds, the difference in pressure between near atmospheric air pressure in the fuel bowl and the vacuum in the venturi forces a metered flow of fuel from the fuel bowl through the main metering system and out the main nozzle, which is located in the venturi. The fuel is metered by the main jet as it flows into the main well. The fuel moves up the main well past narrow air bleed passages. Filtered air from the carburetor air inlet passes through the high speed bleed into the air bleed well, and mixes with the fuel in the main well through short horizontal air bleed passages. This mixture of fuel and air, being lighter than solid fuel, responds faster to any change in venturi vacuum. It also vaporizes more readily than solid fuel when it is discharged.
Fuel continues to flow up the main well into the nozzle bar of the carburetor. The distribution passages are located in projections on each side of the nozzle bar. The throttle plate controls the amount of fuel-air mixture admitted to the intake manifold, regulating the speed and power output of the engine in accordance with accelerator pedal movement. See Fig. 03-12.

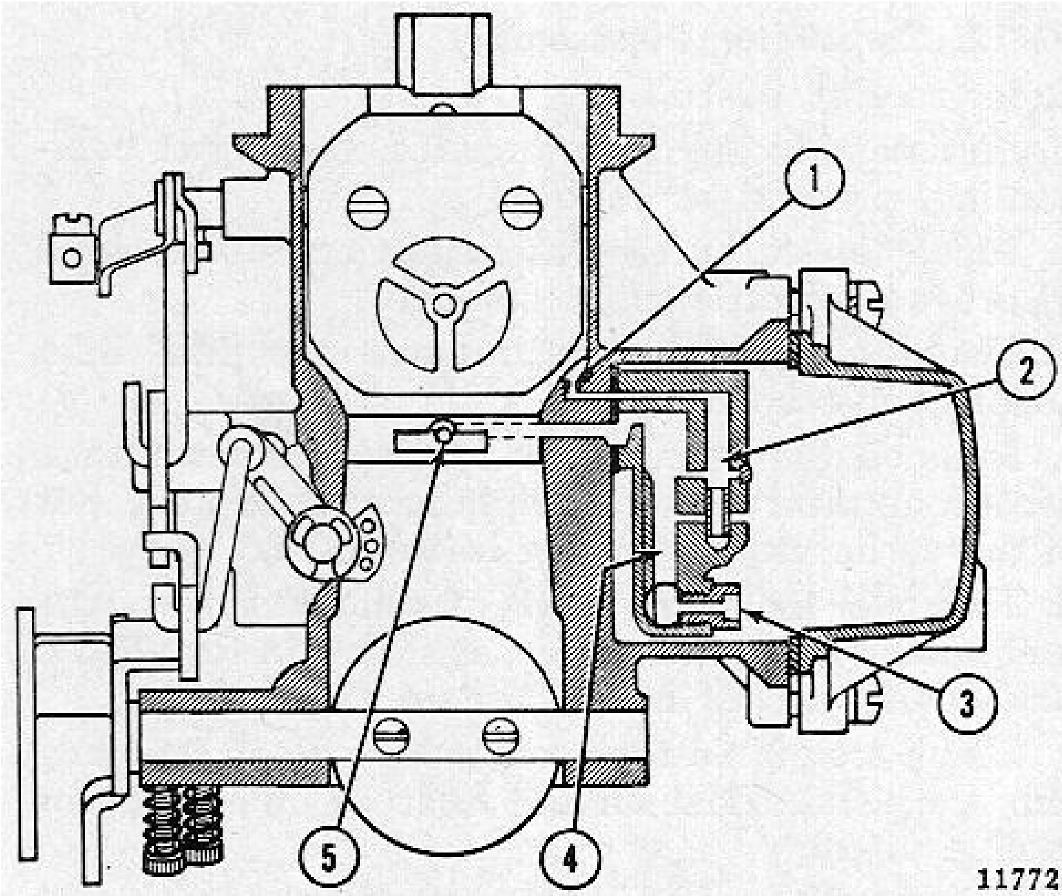


FIG. 03-12—MAIN METERING SYSTEM
1 High Speed Air Bleed
2 Air Bleed Well
3 Main Jet
4 Main Well
5 Main Discharge Nozzle

4 Power Enrichment System
During periods of increased road loads or high speed operation, the ratio of fuel to air must increase for added power. The additional fuel required during this period is supplied by the power enrichment system.
The power system is controlled by manifold vacuum, which gives an accurate indication of the power demands on the engine. Manifold vacuum is transmitted from an opening in the throttle body below the throttle plate through a passage in the throttle body and main body to the vacuum chamber above the diaphragm. At idle and normal speed, the manifold vacuum is great enough to hold the diaphragm up against the tension of the diaphragm spring. This raises the diaphragm stem clear of the power valve lever. The power valve is held closed by the tension of its spring, as shown in Fig. 03-13.
When the demand for engine power is increased, manifold vacuum is reduced. When the vacuum drops below a predetermined level, the diaphragm can no longer overcome the tension of the diaphragm spring and the diaphragm stem is forced down on the power valve lever. This depresses the ball in the end of the valve passage, opening the valve. Fuel from the fuel bowl flows into the power valve. From the valve, the fuel passes through a restriction and then into a horizontal passage which leads to the main well. Here, the fuel is added to the fuel from the main metering system.

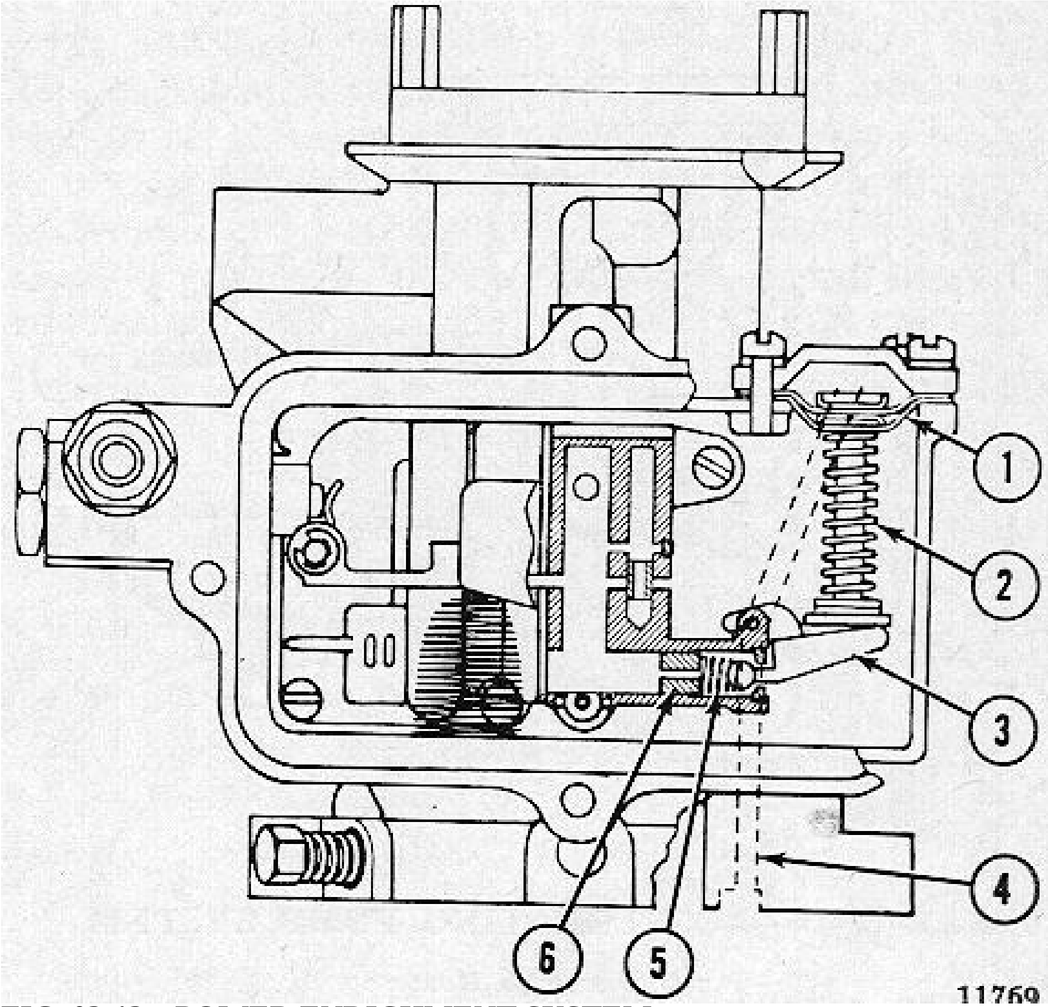


FIG. 03-13—POWER ENRICHMENT SYSTEM
1 Vacuum Diaphragm
2 Diaphragm Spring
3 Power Valve Lever
4 Vacuum Passage
5 Power Valve Ball and Spring
6 Power Valve Restriction

5 Accelerating Pump System

Upon acceleration, the air flow through the carburetor responds almost immediately to the increased throttle opening. There is, however, a brief interval before the fuel, which is heavier than air, can gain speed and maintain the desired balance of fuel and air. The accelerating pump system operates during this interval to supply fuel until the other systems can provide the proper mixture.

When the throttle is suddenly opened, the diaphragm which is connected by linkage to the throttle, forces fuel from the accelerating pump chamber into the discharge passage. The fuel, which is under pressure, forces the discharge needle-check up. The pump operating Spring is compressed and maintains a pressure on the fuel in the pump cavity. The fuel then passes out of the discharge nozzle where it is sprayed into the air stream of the venturi, as shown in Fig. 03-14.

When the throttle is closed, the pump return spring forces the diaphragm toward the back of the chamber, drawing fuel into the chamber through the inlet. A ball check in the inlet opens to admit fuel from the fuel bowl and closes when the accelerating pump is operated to prevent a reverse flow of fuel. The discharge needle check prevents air from entering when the diaphragm draws fuel into the chamber.

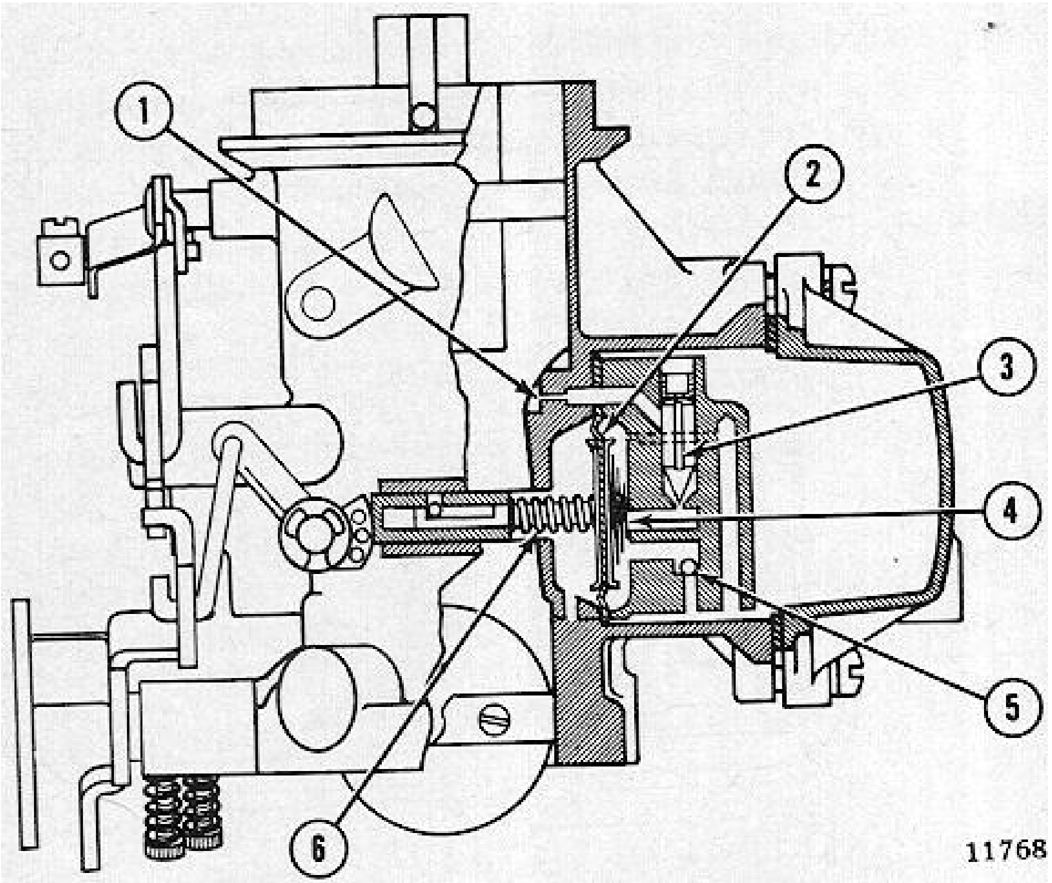


FIG. 03-14—ACCELERATING PUMP SYSTEM

1 Pump Discharge Nozzle
2 Pump Diaphragm
3 Pump Discharge Needle Check
4 Return Spring
5 Pump Inlet Ball Check
6 Pump Operating Spring

6 Choke Circuit

The choke control is manually operated by a control knob on the instrument panel. The choke system provides a richer fuel-air mixture which is required for starting and operating a cold engine. Most of the vaporized fuel condenses to a liquid on contact with the cold surfaces of the intake manifold. In this liquid form, it burns slowly and incompletely in the cylinders and will cause stalling and loss of power. The choke plate, located in the air horn above the venturi, when closed, provides a high Vacuum above as well as below the throttle plates. With vacuum above the throttle plate, fuel will flow from the main fuel system as well as from the idle fuel system thus bringing about an extremely rich mixture which is necessary for cold engine operation. The manual choke plate is attached to the carburetor choke shaft that in turn is linked to the manual control cable.

If, during the engine warm up period, the engine should reach the stall point because of a lean mixture, the choke must be moved toward the closed position providing a richer mixture to help prevent engine stalling.
f. Governor. The governor is a velocity type that is pre-set and sealed by the manufacturer. The engine speed is controlled by the velocity of gasoline and air mixture passing through the governor from the carburetor.
g. Accelerator Linkage. The accelerator linkage consists of an accelerator pedal, adjustable linkage rod, bellcrank, and accelerator control cable which attaches to the throttle lever at the carburetor. The accelerator linkage is in correct adjustment when the carburetor throttle lever obtains full throttle position properly and also returns to the idle position when the accelerator pedal is released. Adjustments are made by varying the length of the linkage rod at its threaded end.
g. Choke
The choke circuit consists of a manually operated choke valve, a fast idle connecting rod and a fast idle arm. The choke is operated by a cable and is secured at the instrument panel and carburetor.

4-2. Removal
a. Carburetor and Governor Assembly. Refer to TM 9-2320-244-20 for removal of carburetor and governor assembly.
b. Fuel Tank, Sending Unit, Lines, Accelerator Linkage, Air Cleaner, Filter and Positive Crankcase Valve. Refer to TM 9-2320-244-20 for removal of the fuel tank, sending unit, lines, accelerator linkage, air cleaner, filter and positive crankcase valve.
c. Fuel Pump. Refer to TM 9-2320-244-20 for removal of fuel pump.

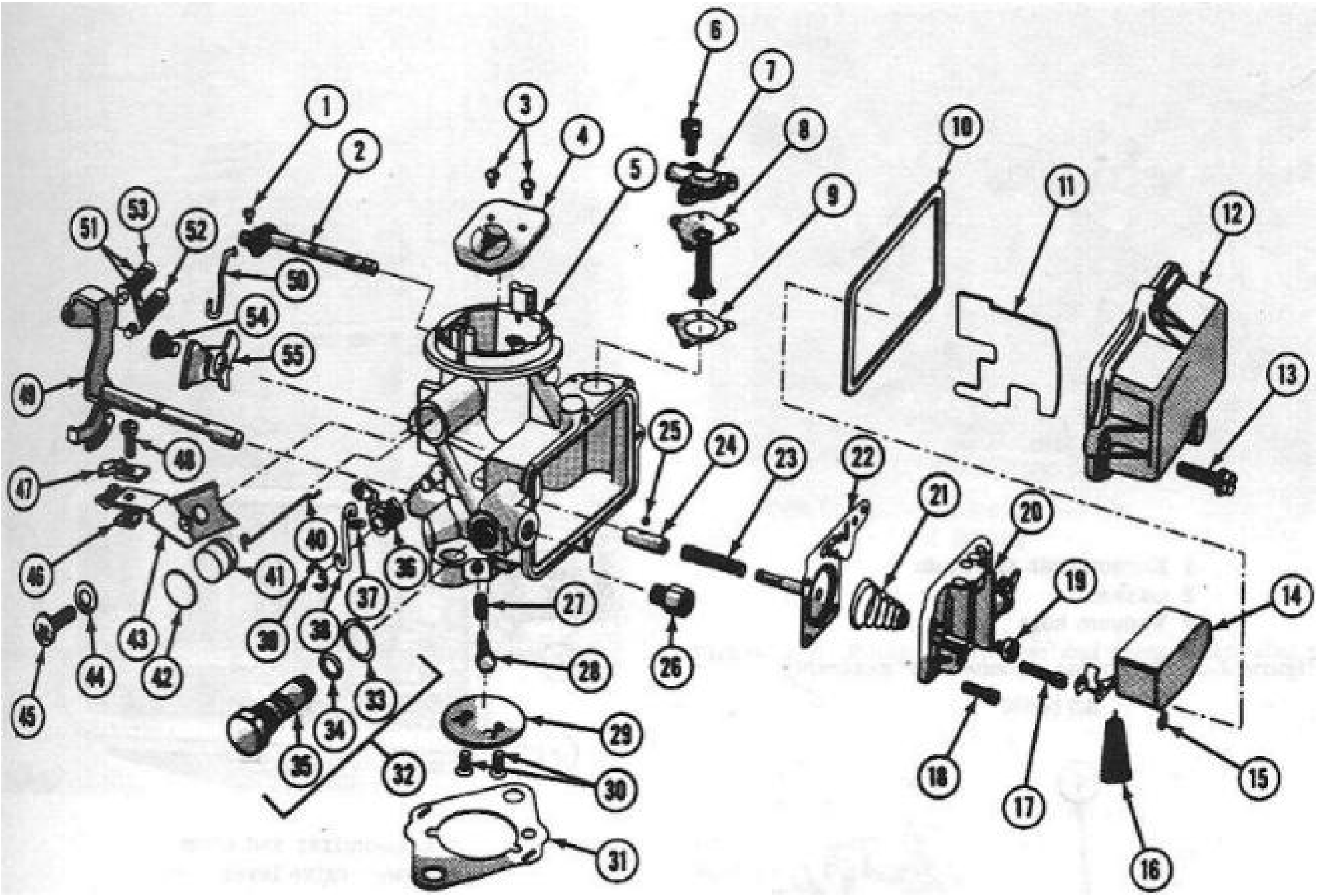


Figure 4-1. Carburetor-exploded view

1 Screw	15 Float retainer	29 Throttle plate	43 Choke cable bracket
2 Choke shaft and lever	16 Float spring	30 Screw	44 Washer
3 Screw and lock washer	17 Economizer body screw and lock washer (long)	31 Gasket	45 Screw
4 Choke plate	18 Economizer body screw and lock washer (short)	32 Fuel inlet needle and seat assembly	46 Nut
5 Carburetor body	19 Main jet	33 Washer	47 Clamp
6 Screw and lock washer	20 Main well and economizer body	34 0-Ring	48 Screw
7 Economizer body cover	21 Pump return spring	35 Needle and seat	49 Throttle lever and shaft assembly

8 Economizer and stem	22 Pump diaphragm and rod	36 Pump operating lever	50 Fast idle rod
9 Gasket	23 Pump operating spring	37 Washer	51 Springs
10 Gasket	24 Sleeve	38 Pump operating link	52 Curb idle screw
11 Fuel inlet baffle	25 Ball	39 Pump operating lever retainer	53 Fast idle cam screw
12 Fuel bowl	26 Inlet fitting	40 Choke piston link	54 Screw
13 Screw and lock washer	27 Spring	41 Choke piston	55 Fast idle cam
14 Float and lever assembly	28 Idle mixture needle	42 Choke piston plug	

4-3. Disassembly.
a. Fuel Tank. Fuel tank is disassembled when fuel sending unit, filler neck and cap are removed. Fuel tank sending unit disassembly is not authorized. Refer to TM
9-2320-244-20.
b. Carburetor. (Fig 4-1)
(1) Place carburetor assembly on repair stand to prevent throttle plate (29 fig 4-1) damage.
(2) Using a 11/16-inch wrench, remove fuel inlet needle valve and seat (32 fig 4-1).
(3) Remove economizer retaining screws, then lift economizer cover, economizer and stem out of carburetor (fig 4-2).
(4) Remove fuel bowl attaching screws, fuel bowl, baffle, and gasket. Slide baffle out of bowl (fig 4-3). Discard the gasket.
(5) Using a suitable tool, remove float retaining clip, then slide float off the fulcrum pin. (Fig 4-4)
(6) Remove screws attaching the main-well and economizer body assembly (fig 4-5) and remove economizer body (fig 4-6).
(7) Slide pump diaphragm spring and spacer assembly out of fuel bowl. (Fig 4-7)
(8) To disassemble pump diaphragm, compress pump push rod sleeve and spring slightly toward diaphragm until ball drops out. Slide sleeve and spring off the diaphragm stem. (Fig 4-8)
(9) Using tool C-3748, remove main jet (19 fig 4-1) from economizer body (20).
(10) Remove fast idle cam retaining screw (54), then remove cam (55), and at the same time, disengage the fast idle
rod (50).
(11) Remove idle air mixture adjusting screw (28) and spring (27) from carburetor body mounting flange (5).
(12) Remove fast idle and curb idle speed screws (52, 53) and springs (51) from throttle lever (49).
(13) Remove choke cable bracket (43). Remove choke plate screws (3) and choke plate (4). Remove choke shaft and lever assembly (2 fig 4-1).
(14) At this point, the carburetor assembly has been disassembled as far as necessary for cleaning and inspection. It is usually not advisable to remove the throttle shaft (49) and plate (29) from the throttle flanges, unless wear or damage necessitates the installation of new parts.
c. Governor Assembly. Refer to TM 9-2320-244-20 for disassembly of governor assembly..
d. Fuel and Vacuum Pump Assembly. (Fig 4-9)
(1) Fuel pump. (Fig 4-10)

NOTE

Thoroughly clean outside of pump assembly with mineral spirits paint thinner and dry with compressed air.

(a) Mark main pump body (12 fit 4-10) and pump valve body (21) with a file or hacksaw for reassembly in the same position.
(b) Remove cam lever return spring (22), cam lever pin plug (24), cam lever retainer pin (25) and remove the cam lever (23).
(c) Remove screws (1) securing pump valve body (21) to main pump body (12). Separate pump bodies. Remove diaphragm assembly (13) from main pump body.
(d) Remove two screws (19) and washers attaching the pump valve body (21) to the cover (18). Separate pump valve body assembly from pump valve cover. Remove gasket (17), valve seat (14), spring (15), valve (16), and filter screen (20) from valve housing.
(2) Vacuum Pump.
(a) Mark castings at vacuum cover (28) and main pump body (12) with a file or hacksaw.

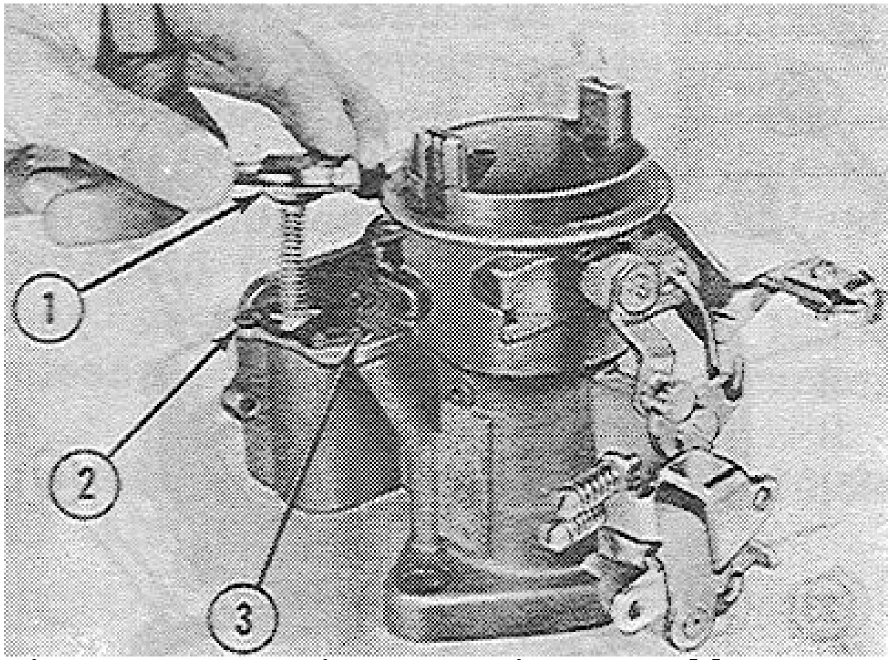


Figure 4-2. Removing economizer assembly.

1 Economizer and stem
2 Gasket
3 Vacuum hole

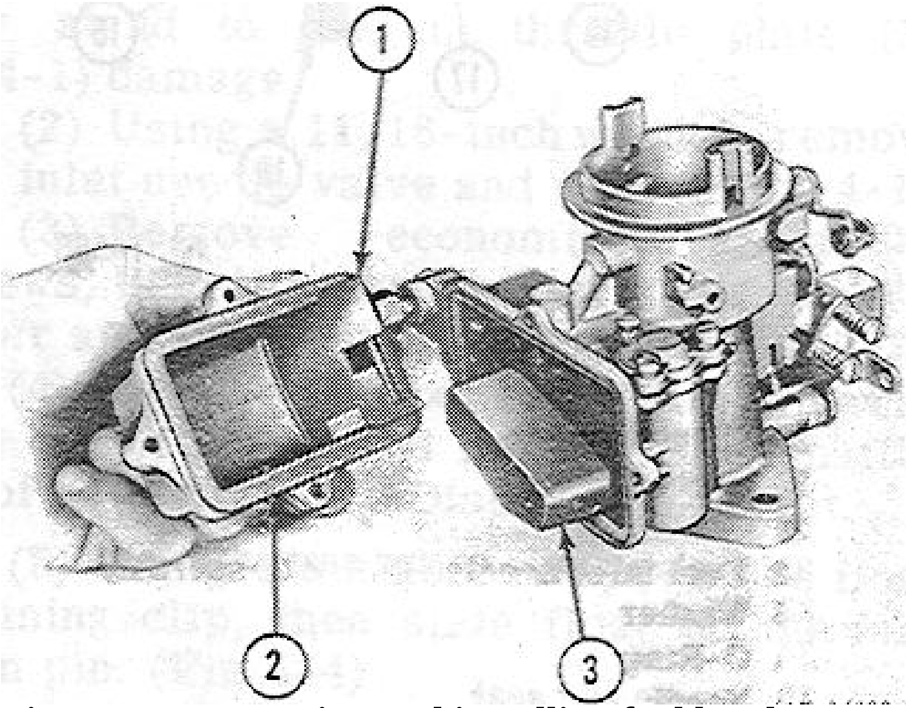


Figure 4-3. Removing and installing fuel bowl.

1 Baffle
2 Gasket
3 Fuel bowl

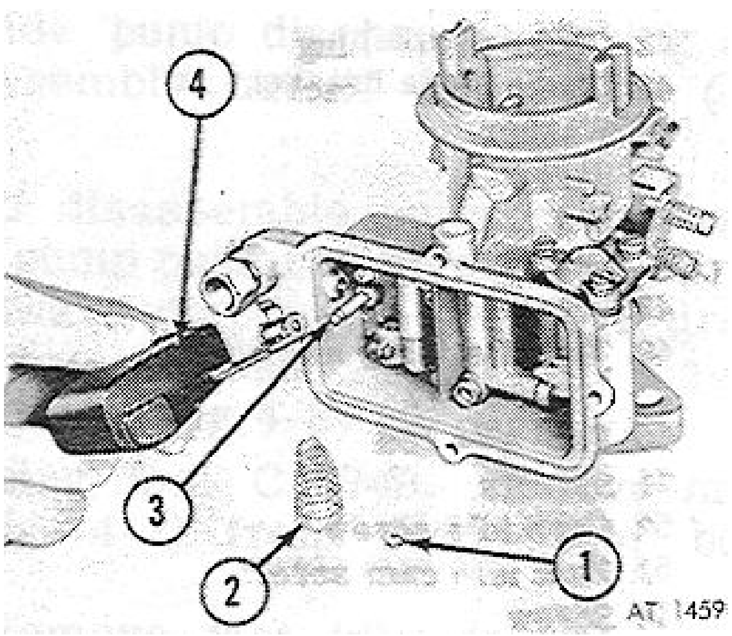


Figure 4-4. Removing and installing float.

1 Retainer clip
2 Spring
3 Float pivot pin
4 Float

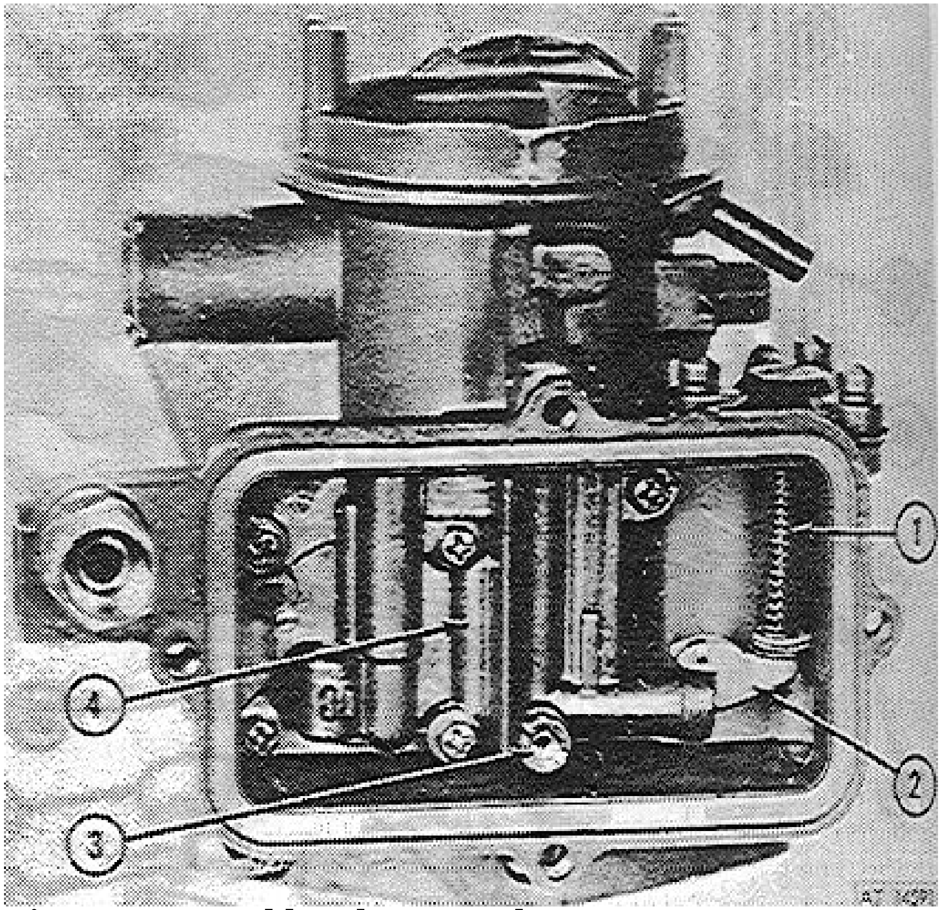


Figure 4-5. Fuel bowl removed

1 Economizer and stem
2 Power valve lever
3 Main jet
4 Economizer body baffle

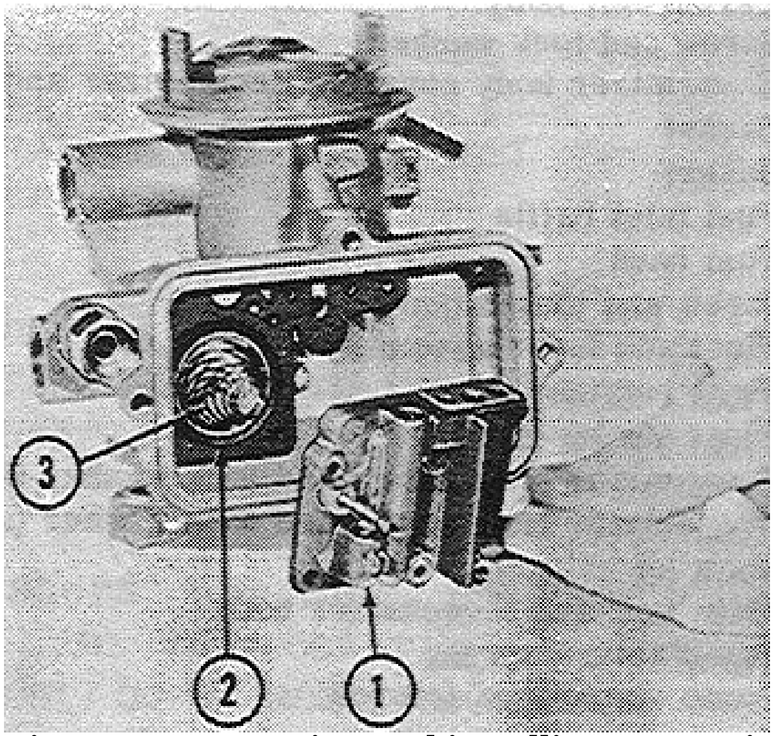


Figure 4-6 Removing and installing economizer body.

1 Economizer body
2 Pump diaphragm
3 Spring

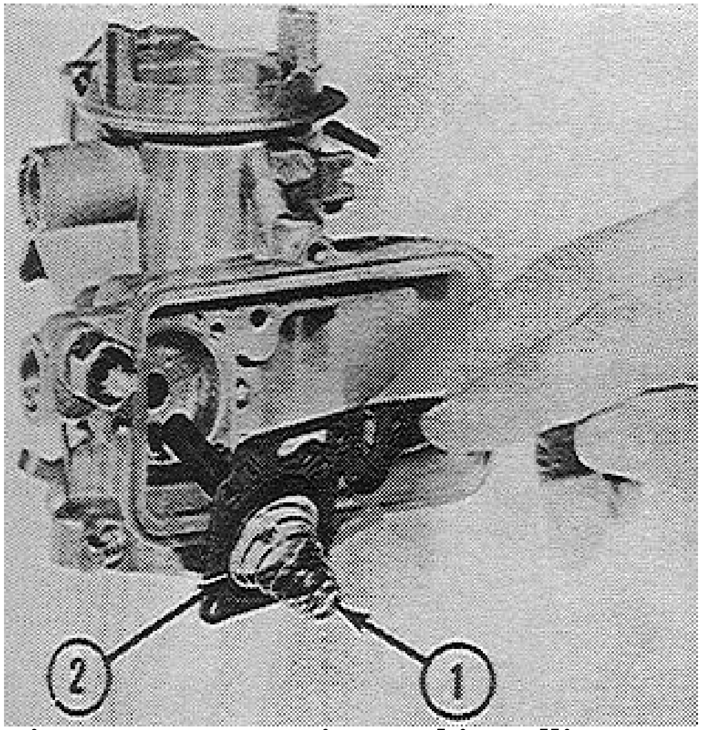


Figure 4-7. Removing and installing pump diaphragm assembly.

1 Spring
2 Pump diaphragm

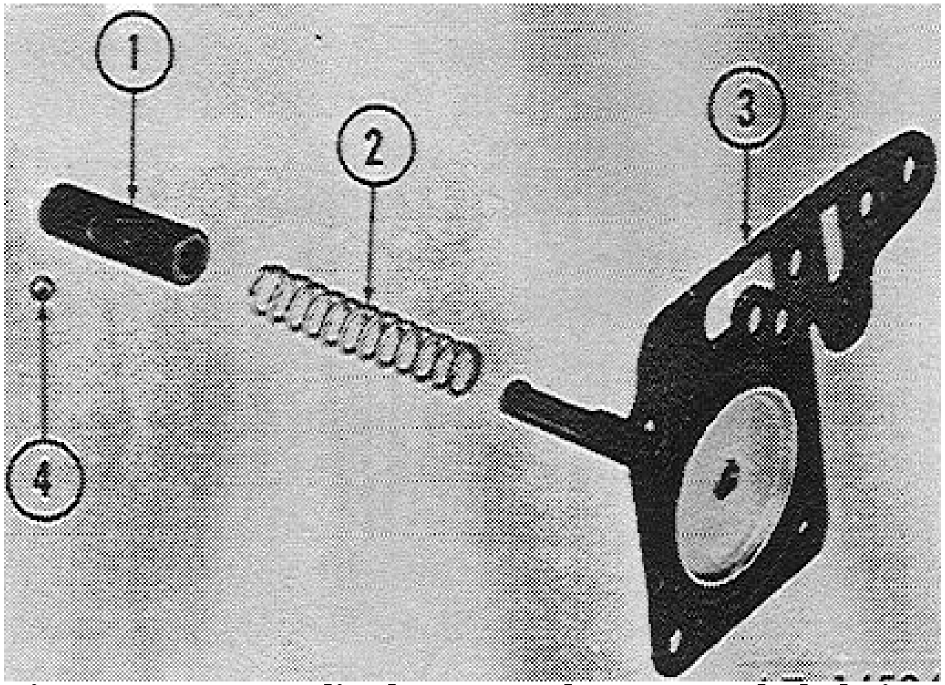


Figure 4-8. Pump diaphragm and stem - exploded view.

1 Sleeve
2 Spring
3 Pump diaphragm
4 Ball

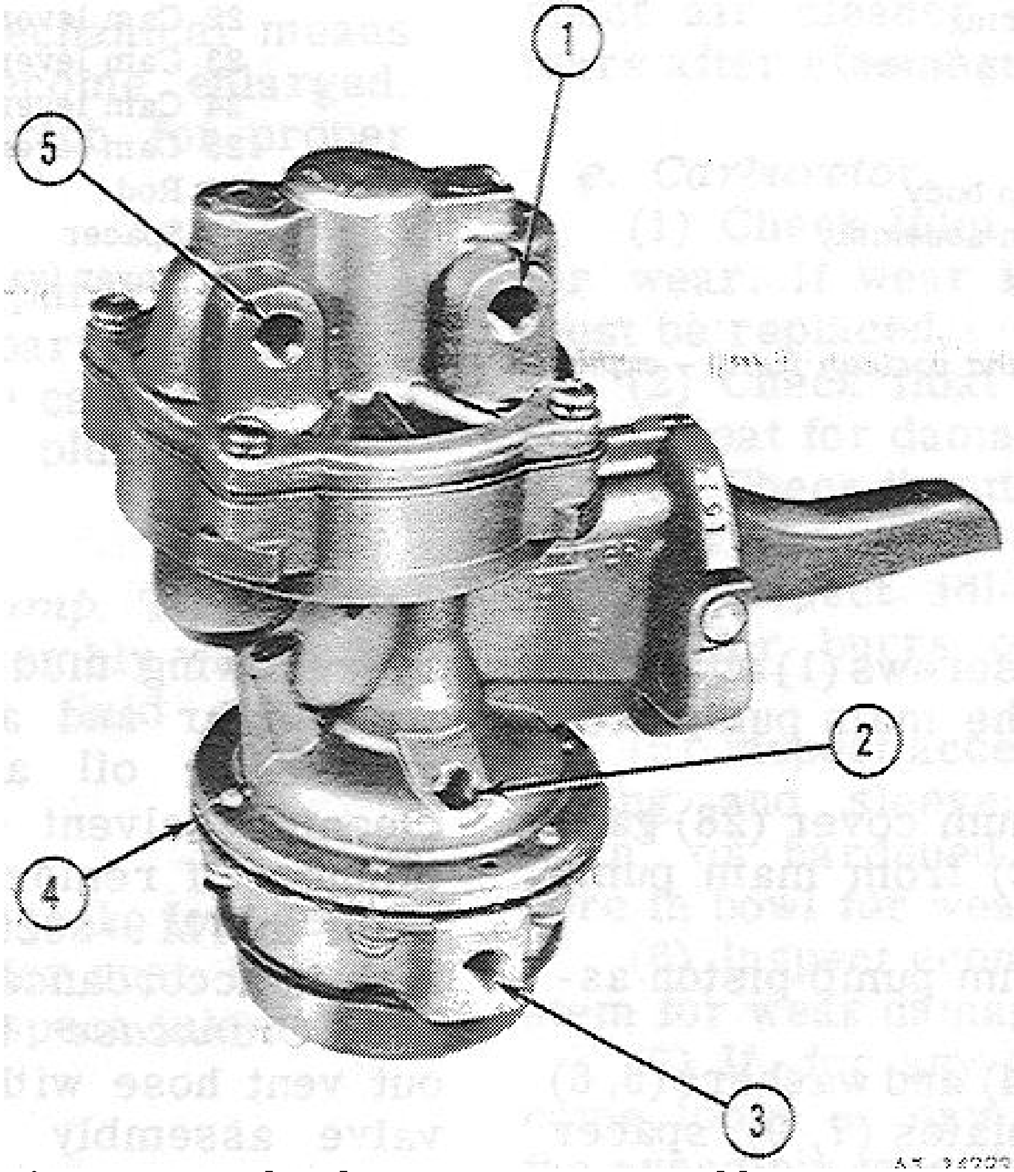


Figure 4-9. Fuel and vacuum pump assembly.

1 Vacuum outlet
2 Vent plug connection
3 Fuel outlet
4 Fuel inlet
5 Vacuum inlet

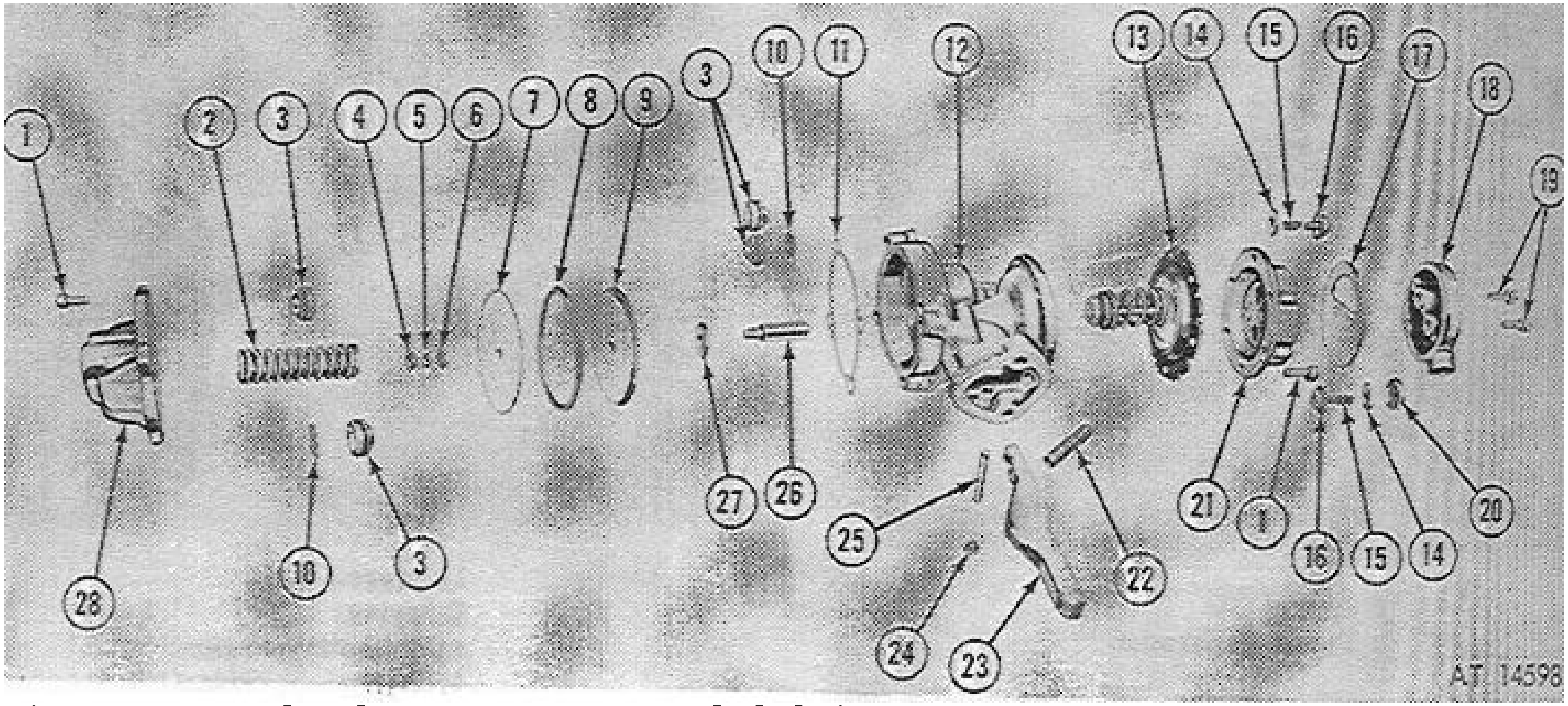


Figure 4-10. Fuel and vacuum pump - exploded view.

1 Screw	8 Piston 0-ring	15 Spring	22 Cam lever return spring
2 Spring (vacuum)	9 Piston plate (lower)	16 Valve	23 Cam lever
3 Valve	10 Screen	17 Gasket	24 Cam lever retainer pin plug
4 Nut	11 Gasket	18 Cover (fuel)	25 Cam lever retainer pin
5 Lock washer	12 Main pump body	19 Screw	26 Rod
6 Flat washer	13 Diaphragm assembly	20 Filter screen	27 Spacer
7 Piston plate (upper)	14 Valve seat	21 Pump valve body	28 Cover (vacuum)

(b) Remove four screws (1) attaching vacuum cover (28) to the main pump body (12).
(c) Separate vacuum cover (28) gasket (11) and spring (2) from main pump body (12).
(d) Remove vacuum pump piston assembly from pump body.
(e) Remove nut (4) and washers (5, 6) securing pump piston plates (7, 9), spacer (27) and piston 0-ring (8) to the pump piston rod (26). Discard piston 0-ring (8).
e. Accelerator Linkage. Refer to TM 9-2320-244-20 for disassembly of accelerator linkage.

4-4. Cleaning.
a. Fuel Tank. Clean fuel tank externally by removing mud and other accumulations with water and a stiff brush. Clean any grease or oil accumulations with dry-cleaning solvent or mineral spirits paint thinner. If removal of tank is necessary, refer to TM 9-2320-244-20. Internally clean tank in accordance with

TB-ORD-1047.
b. Crankcase Ventilation Valve. Blow out vent hose with compressed air. Clean valve assembly by soaking in mineral spirits or drycleaning solvent.
c. Air Cleaner. Clean all metal parts in mineral spirits base paint thinner or drycleaning solvent. Dry with cloth. Clean filter element with mild soap and warm water. Rinse with clean water. Dry filter with air hose, or allow filter to stand until dry.

NOTE

Do not use high pressure air stream directly on wet element. Keep air nozzle at least 6-8 inches from paper element. Do not install element in vehicle air cleaner until it is thoroughly dry. To minimize down time, created by waiting for the element to dry, it is suggested that the newly cleaned filter be replaced by a similar standby unit.

d. Carburetor. The recommended solvent for gum deposits is denatured alcohol. However, there are many other Commercial carburetor cleaners which may be used with satisfactory results. If the Commercial cleaner recommends the use of water as a rinse, it should be hot. After rinsing, all trace of water must be blown from the passages with air pressure. It is further advisable to rinse all parts in clean solvent to be certain no trace of moisture remains. Never clean jets with a wire, drill, or other mechanical means because orifices may become enlarged, making the mixture too rich for proper performance.

CAUTION

Accelerator pump diaphragm and any fiber or rubber parts should never be immersed in carburetor cleaner. Wash pump plunger in cleaning solvent.

e. Fuel and Vacuum Pump. Thoroughly clean outside of pump assembly with mineral spirits, drycleaning fluid and dry with compressed air.

4-5. Inspection.
a. Fuel Tank. Inspect tank for dents, cracks along seams, and for rust. Remove fuel sending unit and inspect interior of tank for corrosion

WARNING

Inspect tank in daylight or use a vapor-resistant light.

b. Fuel Sending Unit. Inspect gage for proper operation
c. Fuel Pump. (Fig 4-10)
(1) Clean and rinse all metal parts in solvent. Blow out all passages with air hose.
(2) Inspect main pump body (12), fuel cover (18) and vacuum cover (28) for cracks, breakage and distorted flanges. Examine all screw holes for stripped or crossed threads. Replacement of pump assembly is advisable if one of the three main castings is not serviceable.
(3) Inspect cam lever (23) for wear
or scores at point of contact with push rod.
(4) Discard diaphragm (13) and piston O-ring (18).
(5) Discard valves (3, 16), and assemblies as these parts cannot be visually checked for wear.
(6) Discard cam lever (23), pistons (7, 9) and diaphragm springs (2, 13), as removed because old springs may be distorted, weak or corroded.
d. Air Cleaner Inspect air cleaner cover and case for cracks and distortion Inspect air cleaner cover seal and wing nut seal for cracks, cuts, deterioration, or loss of resiliency. Inspect dust unloader (rubber boot) for tears and general condition. Inspect air cleaner element for holes and tears after cleaning.
e. Carburetor.
(1) Check inlet Valve needle and seat for wear. If wear is noted, the assembly must be replaced.
(2) Check float hinge pin for wear and check float for damage.
(3) Check throttle and choke shaft bores for wear and out-of-round
(4) Inspect idle mixture adjustment needle for burrs or grooves; replace if damaged.
(5) Inspect accelerator pump operating spring and sleeve; replace if damaged, worn, or hardened. Inspect pump sleeve bore in bowl for wear or scoring.

(6) Inspect economizer body cover and stem for wear damage.
(7) If, for any reason, parts have become loose or damaged in the main body, the assembly must be replaced.

f. Crankcase Ventilation Valve. Inspect inner chamber of valve assembly and make certain valve plunger operates freely. Insert a stiff brush in valve body and observe if valve plunger can be easily moved. Replace valve if plunger does not operate freely after cleaning.

4-6. Repair or Replacement
a. Fuel Tank. Repair tank by welding in accordance with TM 9-237.

WARNING

Prepare tank, before welding, to remove explosion hazard. Refer to TM 9-237.

b. Fuel Pump. Repair of the fuel pump is accomplished by replacing defective parts which are supplied in repair kits.
c. Fuel Sending Unit. Repair is not authorized. Replace inoperative sending units with new units.
d. Air Cleaner. Replace worn, damaged or torn dust unloader (rubber boot). Repair cracked or dented case using general shop practices..
e. Crankcase Ventilation Valve. Replace inoperative ventilation valve with new unit.
f. Carburetor. Repair of the carburetor assembly is accomplished by replacing defective parts which are supplied in repair kit.
g. Governor. Repair is not authorized. Replace inoperative governor with new unit. Refer to TM 9-2320-244-20.

4-7. Reassembly.

a. Fuel Tank. Fuel tank is reassembled when sending unit, filler neck and cap assembly are installed. Refer to TM 9- 2320-244-20.
b. Fuel and Vacuum Pump.
(1) Fuel Pump. (Fig 4-10)
(a) Install filter screen and valve assembly (14, 15, 16) into pump valve body assembly (20). Install gasket (17) and cover (18) and secure with the two housing cover screws and lock washers (19). Refer to figure 4-10.
(b) Install diaphragm assembly (13) in main pump body (12).
(c) Install pump valve body assembly (21) on main pump body with marks alined. Start screws (1) but do not tighten.
(d) Install cam lever (23), cam lever retaining pin (25) and cam lever pin plug (24).
(e) Flex diaphragm assembly (13) to the full up position. Hold in place, and secure valve housing retaining screws (1). Install cam lever return spring (22).
(2) Vacuum pump.
(a) Assemble vacuum pump piston lever spacer (27), lower piston plate (9), 0-ring (8), upper piston plate (7), upper washer (6), to the pump piston rod (26) and secure with nut (4) and lock washer (5).
(b) Install vacuum pump piston in the main pump body bore (12).

NOTE

Coat O-ring (8) with lubricant or vaseline for ease of assembly and to eliminate piston sticking in main pump body bore (12).

(c) Install vacuum valve piston spring (2), gasket (11) and vacuum cover (28) in the main pump body (12).
(d) Secure vacuum cover (28) to main pump body with four retaining screws (1).

NOTE

Tighten retaining screws evenly to avoid vacuum leaks.

c. Carburetor. (Fig 4-1)

NOTE

Always refer to the carburetor part number stamped on the upper flat surface of the fuel bowl to determine the correct repair kit. Install new parts supplied in kit, also other parts that are questionable. Refer to figure 4-1 for carburetor reassembly.

(1) Carburetor throttle body. Check throttle shaft (49) for excessive wear in carburetor body. If wear is extreme, it is recommended the carburetor assembly be replaced rather than installing a new shaft in the old body (5). During manufacture, the location of the idle transfer port and the spark advance control ports to the throttle valve is carefully established for one particular assembly.
If a new shaft should be installed in an old, worn throttle body, it would be very unlikely that the original relationship of the ports to the valve would be obtained. Changing the relationship of the valve to the ports would adversely affect normal vehicle operation between speeds of 15 and 30 mph. However, if it has been determined that a new shaft or throttle plate is to be installed, adhere to the following instructions:

(a) Remove screws (30) holding throttle plate to the shaft (49), then slide throttle plate out of the bore.
(b) Slide throttle shaft (49) out of the carburetor body (5).
(c) Install new throttle shaft and lever assembly (49), also new throttle plate (29).
(d) Install new screws (30) but do not tighten. Hold plate in place with finger pressing on high side of plate. Tap plate lightly with screwdriver to seat in the throttle bore. Tighten screws securely. Operate throttle lever to assure proper positioning and freedom of throttle plate.
(e) Install idle mixture screw (28) and spring (27) in carburetor body (5). The tapered portion of the mixture screw must be straight and smooth. If tapered portion is grooved or ridged, a new idle mixture screw (28) should be installed to assure correct idle mixture control. Using the fingers, turn screw lightly against its seat. Back off one full turn for approximate adjustment.
(2) Carburetor main body. (Fig 4-1)
(a) Install choke shaft (2), plate (4) and choke plate screws (3). Check for binding and tighten screws.
(b) Install fast idle (53) and curb idle (52) speed screws and springs (51) in the throttle lever (49).
(c) Slide pump diaphragm operating spring (23) over pump diaphragm and rod (22), followed by the sleeve (24). Compress spring (23) and sleeve (24) far enough to install the ball (25) and release tension.
(d) Install main jet (19) in economizer body, using tool C-3748.
(e) Install pump diaphragm and stem into position, then install pump return spring with large end of spring seating in diaphragm lip, as shown in figures 4-6 and 4-7. Be sure pump spring is correctly centered.
(f) Position main well and economizer body in. carburetor (figs 4-5 and 4-6). Install screws and tighten securely.
(g) Install washer on cam end of pump link. Engage pump cam link with cam and throttle lever, then in stall cam and secure with clip. When installing pump link, be sure link is positioned in the center hole.
(h) Engage choke link with the choke
lever and fast idle cam. Place cam in position, then install retaining screw, Tight-en screw securely.
(1) Slide float over fulcrum pin and secure with retainer clips as shown in figure 4-4.
(j) Install fuel inlet needle and seat new O-ring and gasket. Tighten seat securely. Check dry float setting as outlined in paragraph (3) below.

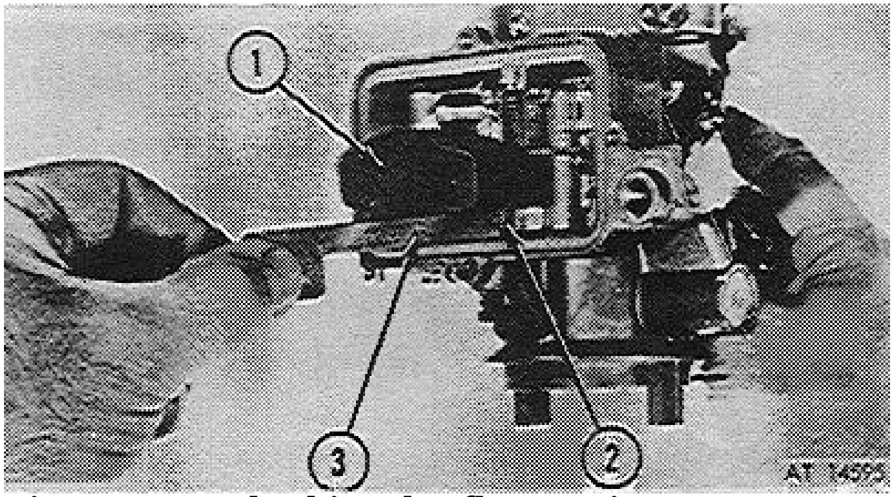


Figure 4-11. Checking dry float setting.

1 Float
2 Fabricated 21/64-inch float gage
3 Economizer body baffle

(3) Checking dry float setting.
(a) With carburetor inverted, slide a 21/64-inch drill rod, or a fabricated gage, into position at the economizer body baffle and check dry float setting. ‘The float should just touch the gage. (Fig 4-11)
(b) If an adjustment is necessary, bend float tab (which touches the head of the fuel inlet needle) using needle nosed pliers. Do not allow float tab to contact the float needle head during this operation as the synthetic rubber tip of the needle can be compressed, giving a false setting.
(c) Recheck float setting as described above after adjustment.
(d) Slide economizer diaphragm and stem assembly into position, making sure vacuum holes are aimed and the stem is on the power valve. Install cover and retaining screws. Tighten screws securely (fig 4-2).
(e) Slide baffle into position in the fuel bowl. Now, place fuel bowl gasket on the cover. Place fuel bowl in position, install screws and washers and tighten alternately. (Be sure gasket is sealed in the recess section of the main body.) Tighten screw gently to compress only the lock washer. Screws drawn down too tightly could distort fuel bowl and cause a leak.
(4) Carburetor adjustments. Refer to TM 9-2320-244-20.
(5) Checking wet fuel level.
(a) With engine running and vehicle on a level floor, fuel level can be checked or measured through the economizer diaphragm opening.
(b) Using a 6-inch scale with a depth gage, measure the distance from the machined surface. (Fig 4-12) The measurement should be 3/4-inch. If not correct, readjust float setting by removing fuel bowl and adjusting float tab using needle nose pliers.
(6) Accelerator Linkage. Refer to TM 9-2320-244-20.

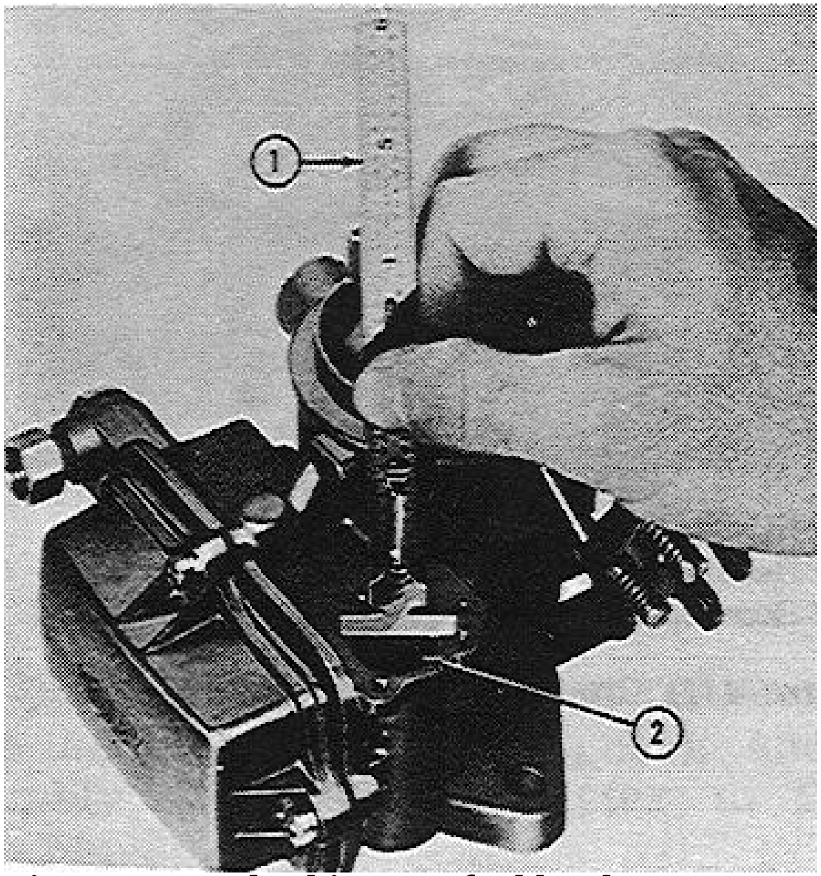


Figure 4-12. Checking wet fuel level.

1 Scale
2 Economizer well

4-8. Installation.
a. Carburetor and Governor Assembly. Refer to TM 9-2320-244-20 for installation of carburetor and governor assembly.
b. Fuel Tank, Sending Unit, Fuel Pump, L in e s, Accelerator Linkage, Positive Crankcase Valve and Air Cleaner. Refer to TM 9-2320-244-20 for installation.
c. Fuel and Vacuum Pump Test.
(1) Volume check.
(a) To measure fuel pump capacity (amount of fuel delivered in a given time), disconnect the pump-to-carburetor fuel line at carburetor end.
(b) Place open end of fuel line in suitable container. Start engine and operate at normal idle speed. Delivery should be one quart within one minute.
(2) Pressure check.
(a) To measure fuel pump pressure (force of fuel delivery), disconnect the pump-to-carburetor fuel line at carburetor end.
(b) Plug a pressure gage and T-fitting into open end of this line and into carburetor.
(c) Start engine and operate at normal idle speed. Pressure should be 3-1/2 to 5-1/2 psi at 600 rpm at 16-inch above fuel pump outlet.
(3) Fuel Pump vacuum check.
(a) To measure fuel pump vacuum (pull of the pump at inlet side) disconnect the pump-to-fuel-tank line at fuel pump.
(b) Attach vacuum gage to fuel pump inlet. Refer to figure 4-9.

(c) Start engine and accelerate to specified speed. Retain engine speed while observing gage reading. Permissible gage reading is 8-inch of mercury (Hg) at 1,200 rpm and 10-1/2-inches of mercury at 1,800 rpm.

(4) Vacuum booster check.

(a) To test condition of vacuum booster pump, disconnect both inlet and outlet lines at the pump. (Fig 4-9)

(b) Attach vacuum gage to windshield wiper connection at pump.

(c) Start engine, accelerate to 2,000 rpm, and retain this engine speed while observing gage reading. Permissible gage reading is 10-inches to 14-inches of mercury (hg).

SERVICE DIAGNOSIS

SYMPTOMS	**PROBABLE REMEDY**
Hard Starting	
Incorrect Idle Adjustments	Adjust
Binding Linkage, Choke Plate	Clean and Adjust
Improper Fuel Level	Adjust
Dirty, Worn or Faulty Needle Valve & Seat.	Replace
Float Sticking	Clean and Adjust
Rough Idle and Stalling	Adjust
Improper Idle Adjustments	Adjust
Damaged Tip on Idle Mixture Screw	Replace
Clogged Air Bleed or Idle Passages	Clean
Leaking Intake Manifold & Carburetor Gaskets	Replace
Throttle Plate Not Closing	Adjust
Improper Throttle Stop Adjustment	Adjust
Improper Fuel Level	Adjust
Improper Fast Idle Cam Adjustment	Adjust
Dirty Air Cleaner	Clean or Replace
Improper Choke Setting	Adjust
Choke Binding	Adjust
Poor Low-Speed Operation	
Clogged Idle Transfer Slots	Remove and clean
Restricted Idle Air Bleeds & Passages	Remove and clean
Dirty or Restricted Air Cleaner	Replace
Improper Fuel Level	Adjust
Faulty Acceleration	
Improper Pump Stroke	Adjust

Inoperative Pump Discharge Check Ball or Needle	Replace
Worn or Damaged Pump Diaphragm	Replace
Leaking Main Body Cover Gasket	Replace
Engine Cold & Choke Too Lean	Adjust
Improper Metering Rod Adjustment	Adjust
Surging (Cruising Speeds to Top Speeds)	
Clogged Main Jet	Clean
Undersize Main Jet	Replace
Low Fuel Level	Adjust
Low Fuel Pump Pressure or Volume	Replace
Blocked Air Bleeds	Clean
Clogged Fuel Filter Screen	Clean or Replace
Dirty or Restricted Air Cleaner	Clean or Replace
Reduced Top Speed	
Low Fuel Pump Volume	Replace
Clogged Vacuum Passage	Clean
Improper Size or Obstructed Main Jet	Replace
Faulty Choke Operation	Clean and Adjust
Clogged Secondary Metering Passages	Clean
Dirty or Restricted Air Cleaner	Clean or Replace
Secondary Linkage, Throttle Plates or Shaft Binding	Adjust
Throttle Linkage Not Properly Adjusted, Restricting Full Travel	Adjust
Partially Restricted Exhaust Pipe. Muffler or Tail Pipe	Replace
Poor Gas Mileage	
Restricted Air Bleed	Clean
Improper Fuel Level	Adjust
Dirt Under Fuel Inlet Needle Causing Flooding	Clean
Dirty or Restricted Air Cleaner	Clean or Replace
Improper Jet	Replace
Accelerator Pump Discharge Ball or Needle Not Seating	Replace
Improper Speedometer Driven Gear	Replace
Brakes Dragging	Adjust
Spark Retarded	Adjust
Burnt, Worn Spark Plug Electrodes	Replace
Thermostat (Engine Operating Temperatures Below Normal)	Replace

Leaks at Fuel Line Connection	Tighten or Repair
Underinflation of Tires	Inflate
Improper Toe-In Adjustment	Adjust
Heavier Than Recommended Lubricants in Engine, Transmission or Differential	Replace
Excessive Fuel Consumption	
Tires Improperly Inflated	Inflate
Brakes Drag	Adjust
Engine Operates Too Cold	Check Thermostat
Leak in Fuel Line	Check All Connections
Carburetor Float Level High	Adjust
Accelerator Pump Not Properly Adjusted	Adjust
Leaky Fuel Pump Diaphragm	Replace
Loose Engine Mounting Causing High Carburetor Fuel Level	Tighten
Ignition Timing Slow or Spark Advance Stuck	See “Ignitor” Section
Low Compression	Check Valve Tappet Clearance
Air Cleaner Dirty	Remove and Clean
Engine Hesitates on Acceleration	
Accelerator Pump Does Not Function Properly	Adjust or Replace Piston and Rod
Carburetor Float Level	Adjust
Spark Plugs	Replace or Clean and Adjust
Low Compression	Check Valves
Ignitor Points Dirty or Pitted	Replace
Weak Condenser or Coil	Replace
Carburetor Jet Restricted	Remove and Clean
Excessive Engine Heat	See “Engine” Section
Engine Stalls — Won’t Idle	
Improper Condition of Carburetor	See “Carburetor” Section
Low Speed Jet Restricted	Remove and Clean
Air Cleaner Dirty	Remove and Clean or Replace Filter
Leaky Manifold or Gasket	Tighten or Replace
Fuel Pump Diaphragm Porous	Replace
Loose Carburetor	Tighten or Replace
Water in Fuel	Drain and Clean System
Improper Ignition	See “Distributor” Section
Spark Plugs	Clean and Adjust

Valve Sticking	Grind Valves
Dirty Ventilator Valve	Clean or Replace
Carburetor Floods or Leaks	
Cracked Body	Replace
Defective Body Gaskets	Replace
High Float or Fuel Level	Adjust
Worn Needle Valve and Seat	Replace
Damaged Float	Replace
Excessive Fuel Pump Pressure	Replace Pump

CHAPTER 5
REPAIR OF COOLING SYSTEM

5-1. General.
This chapter contains a description of and instructions for, removal, disassembly. cleaning, inspection and repair of the radiator, radiator shroud, fan pulleys and drive belts. The cooling system (fig 5-1), is composed of a coolant pump, radiator, fan, thermostat, thermostat bypass and associated plumbing. The cooling system also has provisions for connecting and supplying coolant to the personnel heater and engine arctic heater kits. This system provides controlled, safe engine operating temperatures by removing engine heat and exchanging it into the atmosphere. Coolant flows from the engine outlet through the radiator forced by a belt driven centrifugal water pump, which takes coolant from the radiator outlet and forces it through engine cooling passages. Coolant flows from the engine through the thermostat and is returned to the top of the radiator through a rubber hose. When the thermostat is closed, coolant is returned directly to the coolant pump through the bypass housing and hose. Ambient air is pulled rearward through the radiator by a fan, mounted on the water pump.

NOTE
The water pump is serviced only as a unit. If pump is defective, a new pump should be installed.

5-2. Removal.
a. Radiator. Refer to TM 9-2320-244-20 for removal of radiator.
b. Radiator Shroud. Refer to TM 9-2320-244-20 for removal of radiator shroud.
c. Water Pump, Thermostat and Thermostat Bypass. Refer to TM 9-2320-244-20 for removal of water pump, thermostat and thermostat bypass.
d. Fan, Fan Pulley and Drive Belts. Refer to TM 9-2320-244-20 for removal of fan, fan pulley and drive belts.
5-3. Disassembly.
Radiator is disassembled when steps a and b in paragraph 5-2 have been completed.
5-4. Cleaning.
Refer to TM 9-208-1 for general cleaning procedures. Refer to TM 9-2858 for internal cleaning procedures.
5-5. Inspection.
a. Inspect radiator for breaks, cracks, leaks or corrosion.
b. Inspect chafing strips for tears, deterioration and condition of bond.
c. Inspect for paint damage or deterioration.
d. Check condition of radiator cap, gasket and spring.

5-6. Repair or Replacement.

a. Replace parts if broken. Weld cracked or split parts. Refer to TM 9-23'7 for welding procedures.

b. Replace parts that are excessively worn.

c. Replace or rebond damaged or loose chafing strips. Refer to TM 9-247 for sealing data.

d. Replace cap if gasket or spring is worn or damaged.

5-7. Reassembly.

Radiator is reassembled when steps b and c in paragraph 5-8 have been completed. Refer to TM 9-2858 for leakage test procedure.

5-8. Installation.

a. Water Pump, Thermostat and Thermostat Bypass. Refer to TM 9-2320-244-20 for installation.

b. Radiator. Refer to TM 9-2320-244-20 for installation.

c. Fan, Fan Pulley and Drive Belts. Refer to TM 9-2320-244-20 for installation.

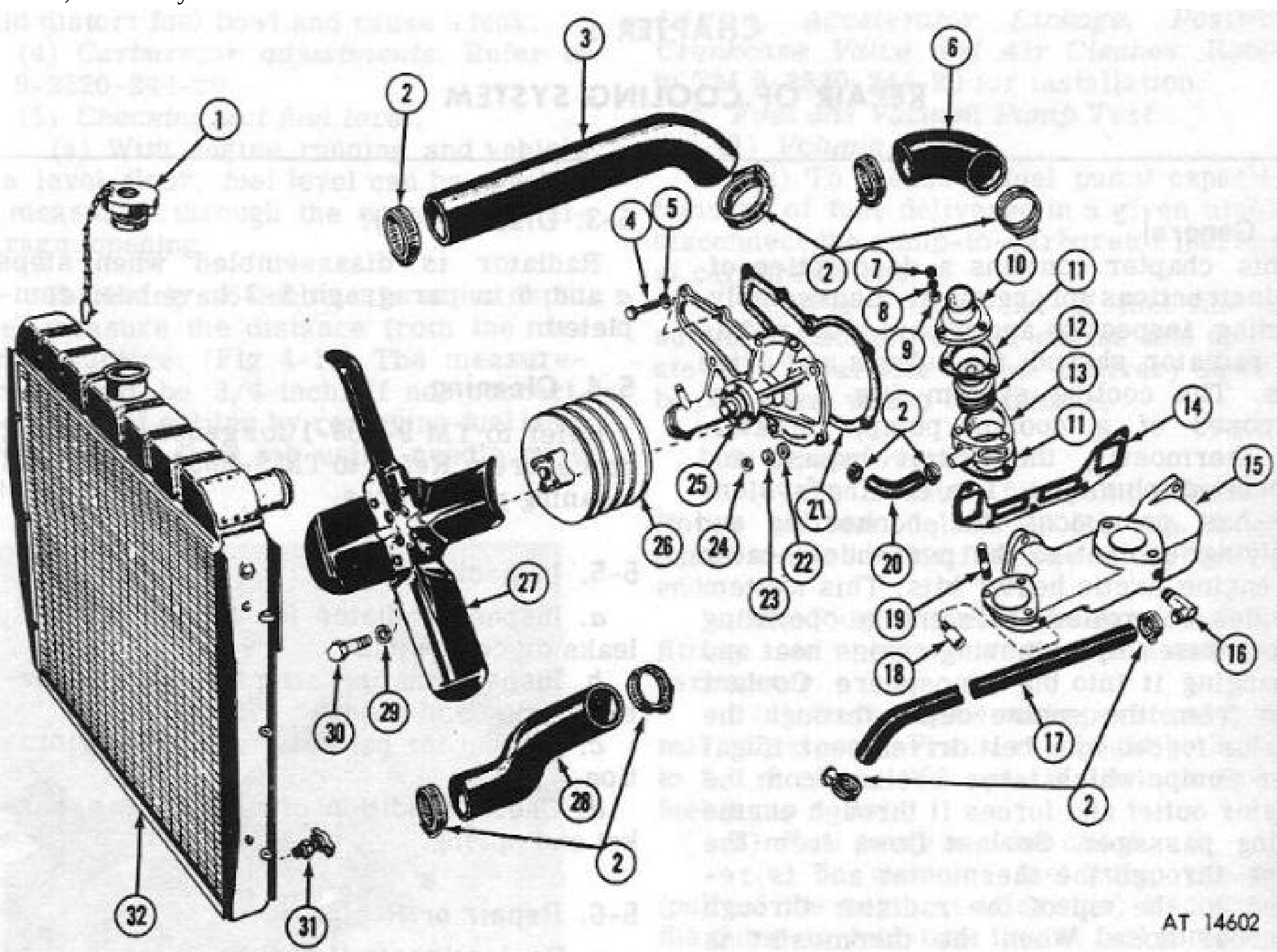


Figure 5-1. Engine Cooling System-exploded view

1 Radiator pressure cap and chain	9 Flat washer	17 Water hose	25 Water pump
2 Hose clamp	10 Water outlet elbow	18 Temperature sending unit	26 Fan drive pulley
3 Upper radiator hose	11 Thermostat gasket	19 Stud	27 Cooling fan
4 Cap screw	12 Thermostat	20 Bypass hose	28 Lower radiator hose
5 Lock washer	13 Thermostat housing	21 Water pump gasket	29 Lock washer
6 Water hose	14 Intake manifold gasket	22 Flat washer	30 Cap screw
7 Nut	15 Intake manifold	23 Lock washer	31 Drain cock
8 Lock washer	16 Elbow	24 Nut	32 Radiator

CHAPTER 6
REPAIR OF IGNITION SWITCH

6-1. General.
This chapter contains descriptions and instructions for removal, disassembly, cleaning, inspection, repair or replacement, reassembly, testing and installation of the batteries, ignitor, ignition switch, ignition coil, spark plugs and spark plug cables.
The ignition system furnishes the spark for the spark plugs. Spark at the plugs must occur in each cylinder at exactly the proper time to fire the cylinder. To accomplish this, the following units are required.
a. The Battery System. Supplies the electrical energy.
b. The Ignition Coil. Transforms the battery low tension current too high tension current that will jump the spark plug gap in the cylinder when under compression.
c. The Ignitor. Delivers the spark at the precise time to the proper cylinder spark plug and incorporates the mechanical breaker that opens and closes the primary circuit. The engine ignitor is mounted at the right front of the engine and is operated by a coupling on the oil pump shaft that is driven by a worm gear on the crankshaft. The firing order of the engine is 1-5-3-6-2-4.
d. Spark Plugs. Provides the gap in the engine cylinders that the spark must jump to fire the cylinder.
e. Wiring. Delivers the electrical energy to the various electrical units.
f. Ignition Switch. Controls the battery current when it is desired to start, run or stop the engine.

6-2. Removal.
a. Ignition Switch, Spark Plugs and Spark Plug Cables. Refer to TM 9-2320-244-20 for removal of ignition switch, spark plugs and spark plug cables.
b. Ignitor and Ignition Coil. Refer to
TM 9-2320-244-20 for removal of ignitor and ignition coil.
c. Batteries and Cables. Refer to TM 9-2320-244-20 for removal of batteries and cables.

6-3. Disassembly.
a. Batteries. None required.
b. Ignition Switch. Disassembly of ignition switch is not authorized.
c. Ignitor. Refer to TM 9-2320-244-20 for disassembly of ignitor.

6-4. Cleaning.
a. Batteries. Refer to TM 9-6140-200-15 for battery inspection procedure.
b. Ignitor, Coil, Ignition Switch, Spark Plugs and Cables. Refer to TM 9-2320-244-20 for cleaning procedures.

6-5. Inspection.
a. Batteries. Refer to TM 9-6140-200-15 for battery inspection procedures.
b. Ignitor, Coil, Ignition Switch, Spark Plugs and Cables. Refer to TM 9-2320-244-20 for inspection procedures.

6-6. Repair or Replacement.
a. Batteries. Refer to TM 9-6140-200-15 for battery replacement procedures.
b. Ignitor, Ignition Switch, Coil, Spark Plugs and Cables. Refer to TM 9-2320-244-20 for repair or replacement procedures.

6-7. Installation.
a. Ignition Switch, Spark Plugs and Stark Plug Cables. Refer to TM 9-2320-244-20 for installation procedures.
b. Ignitor and Ignition Coil. Refer to TM 9-2320-244-20 for installation procedures.
c. Batteries and Cables. Refer to TM 9-2320-244-20 for installation procedures.

CHAPTER 7
REPAIR OF STARTING SYSTEM

7-1. General.
This chapter contains procedures for disassembly, cleaning, inspection, repair and reassembly of the starting motor (fig 7-1). The operation of the starting motor is controlled by the starter switch. The starter consists of a frame, field coil, armature and brushes. The starting switch electrically closes the circuit between the battery and the starting motor. The starting switch is located on the hump of the floor board, to the right of the accelerator pedal and ahead of the gear shift level. No repairs or adjustments can be made to the starter switch. If trouble develops in the starter switch, it must be replaced.

7-2. Removal.
Refer to TM 9-2320-244-20 for removal of the starting system components.

7-3. Disassembly. (Fig 7-1)
a. Remove four screws (1) and lock washers (2) securing commutator end head (3) to starting motor frame (12), and remove the end head (3) and thrust washer (5).
b. Remove six cap screws and lock washers securing pinion housing (24) to the starting motor frame (12).
c. Remove armature (29), Bendix drive (27) and pinion housing (24) as an assembly from the motor frame.
d. Remove armature (29) and Bendix drive (27) as an assembly from the pinion housing (24).
e. Compress Bendix (27) until retaining pin (28) is visible through hole in gear housing. Using 3/16-inch drive pin punch, drive the starter drive retaining pin (28) from the armature shaft. Remove and discard retainer (26) and snap ring (25) from shaft. Remove starter drive (27) from the armature shaft (29).

f. Remove three screws (34) and lock washers (35) securing brush holder assembly (6) to motor frame.
g. Disconnect field connections at brush holder (6) and remove brush holder.
h. Remove four countersunk head screws (20), securing field coil and pole shoes (11).
i. Remove screw (7) and lock washer (8) and disconnect field wire from terminal stud (10).
j. Remove field coils (11), pole shoes and insulators (33) from the motor frame (12).
k. Remove bushing (32) and felt wick (4) from commutator end head. Remove bushing (21) from pinion housing nose (24).
l. Remove terminal stud nuts (15), lock washer (16), washer (14), insulated washer (13), insulated square spacer (18), square shank washer (9) and terminal stud (10) from motor frame (12).

7-4. Cleaning.
a. Clean starting motor parts with compressed air, using mineral spirits or suitable cleaning solvent to clean triple thread of drive.

NOTE

Do not clean field coils in solvent. Wipe clean with rag and use compressed air.

b. Air dry all parts.

7-5. Inspection.
a. Brushes. Inspect brushes for arcing, cracks, breaks and size.

NOTE

Do not disassemble beyond point of replacing defective part.

b. Brush Holder.
(1) Check brush holder for arcing shorts, breakage, cracks and missing parts.
(2) Check brush spring tension. Hook a brush spring scale under bend of the spring, near the brush.
(3) Pull on the scale in a direction opposite the force exerted by the spring.
(4) Read spring tension just as spring leaves the brush.

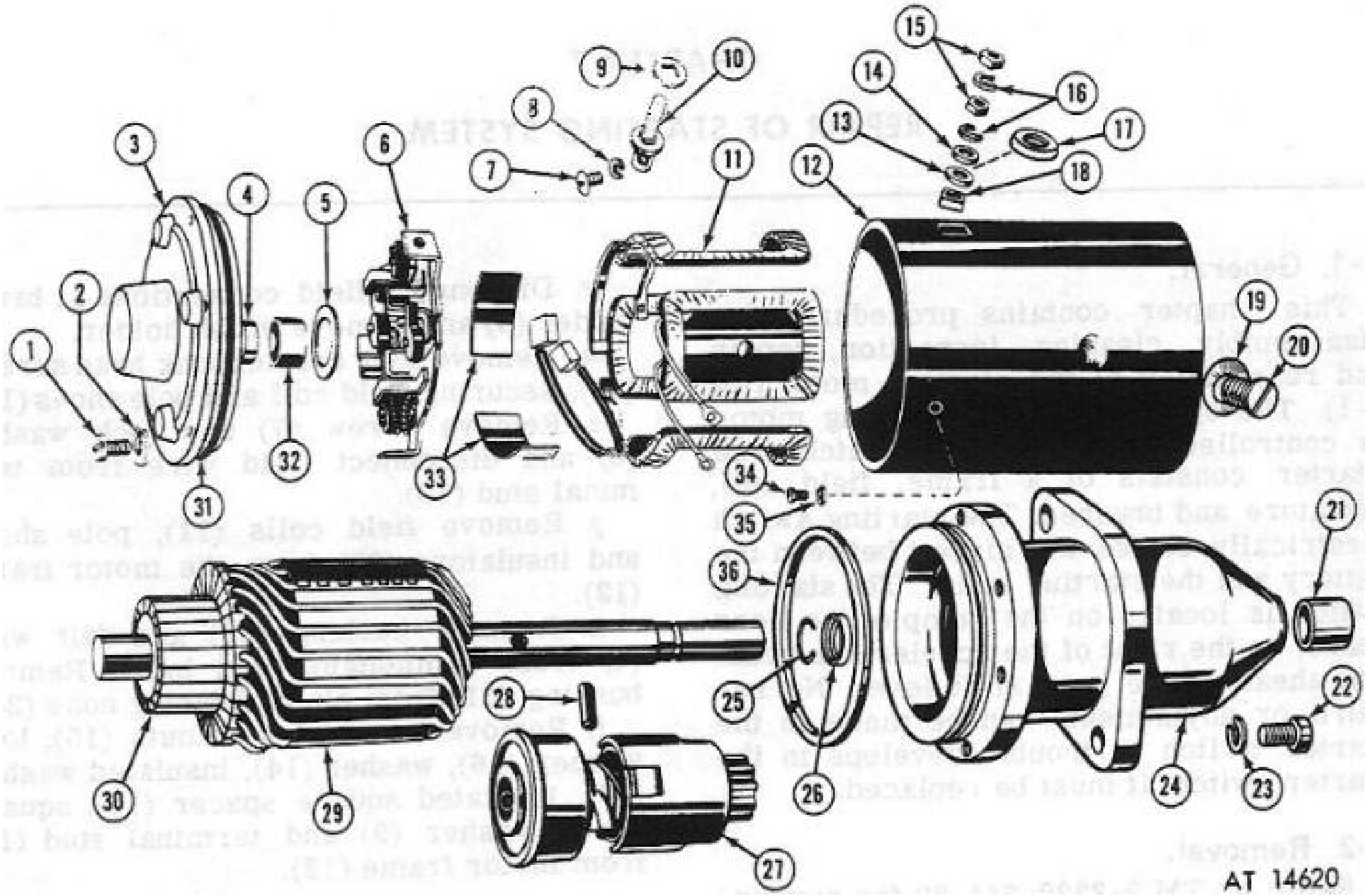


Figure 7-1. starting motor - exploded view.

1 Screw	10 Terminal stud	19 Pole screw gasket	28 Pin
2 Lock washer	11 Field coil assembly	20 Pole screw	29 Armature
3 Commutator end head	12 Motor frame	21 Bushing	30 Commutator
4 Felt wick	13 Insulated washer	22 Cap screw	31 0-ring
5 Thrust washer	14 Flat brass washer	23 Lock washer	32 Bushing
6 Brush holder assembly	15 Terminal end nuts	24 Pinion housing	33 Insulator
7 Screw	16 Lock washer	25 Snap ring	34 Screw
8 Lock washer	17 Retainer and gasket	26 Retainer	35 Lock washer
9 Insulated washer	18 Insulator spacer washer	27 Bendix drive	36 O-ring

(5) The tension should be between 32 and 40 oz. If tension is too low, there will be poor brush contact. Too great a spring tension will cause excessive brush wear. To change spring tension, twist spring at the holder with long nosed pliers.
c. Commutator.
(1) Check commutator for wear and discoloration.
(2) Commutator may be cleaned with 00 sandpaper using compressed air to remove all traces of sand after sanding.

NOTE

Do not use emery cloth to clean commutator since emery dust or metal burrs can short out the commutator, use an armature lathe or its equivalent. Remove as little materiel from commutator as possible to “true-Up” commutator.

d. Armature.
(1) Inspect shaft for rough bearing surfaces.
(2) Make visual inspection of armature for mechanical defects before check-tug for shorted or grounded coils.
(3) With test probes, first test armature for grounds by touching one probe to a commutator segment and the other probe to the core (shaft).

CAUTION

Do not touch test probes to either bearing surface or brush surface as the resulting arc will burn the finish.

If test lamp lights, the coil connected to the commutator segment is grounded and the armature must be replaced.
(4) To test for a shorted armature coil, place armature on a growler. (Fig 7-2)

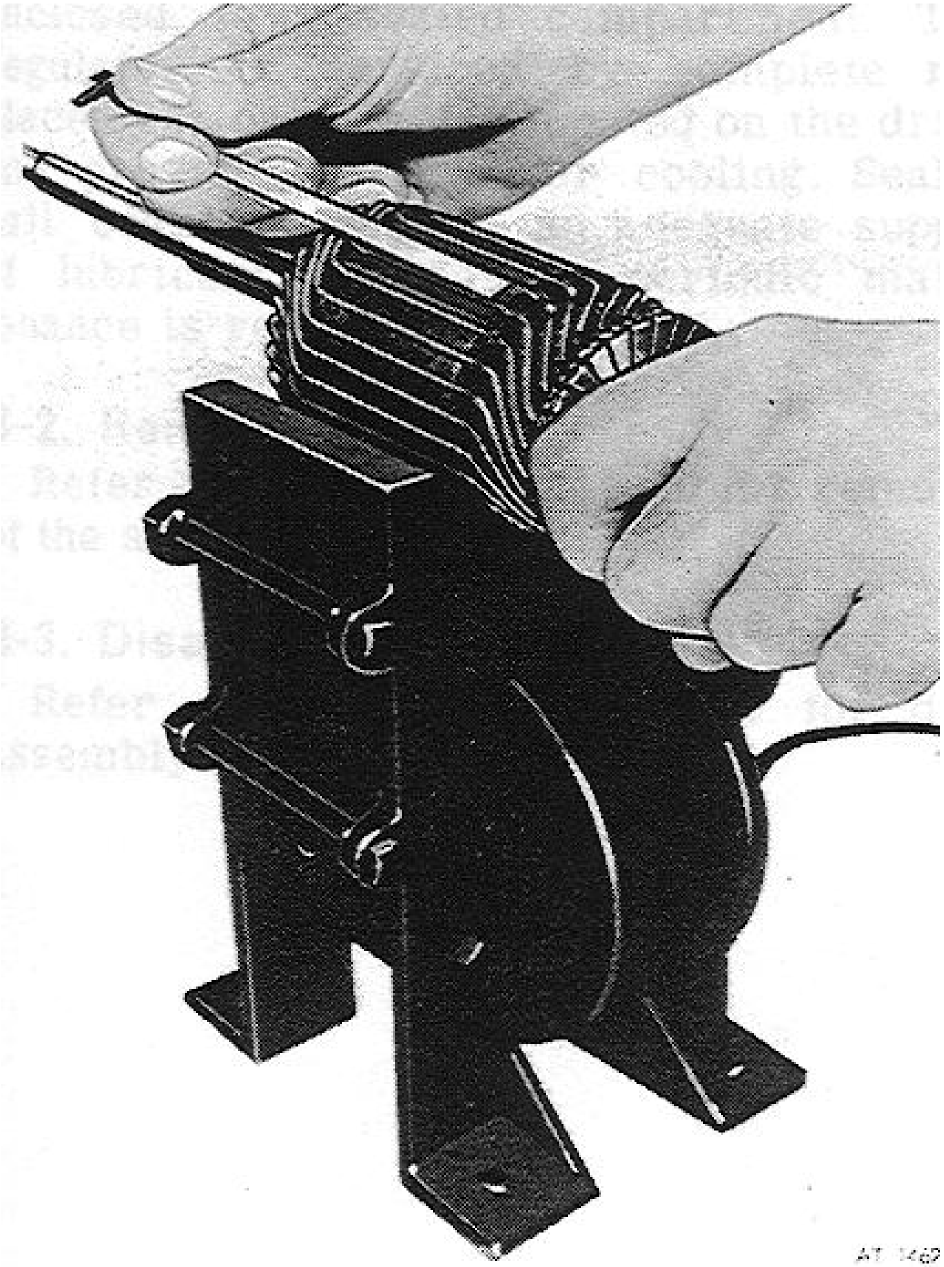


Figure 7-2. Testing armature on growler.

e. Field Coil.
(1) After field coils have been installed in motor frame, use test probes and check field coils for both ground and open circuits.
(2) To test for ground, touch one probe on motor frame or pole piece and touch the other probe to the field coil terminals. If test lamp lights, the field coil is ground and must be replaced.
f. Pinion Housing and Commutator End Head.

(1) Check casting for distortions, stripped threads, cracks, breaks and broken out sections.
(2) Inspect bearing bores for out-of-round and oversize (worn).
g. Starter Drive.
(1) Inspect starter drive for slippage, broken spring, cracked housing, looseness or binding on armature shaft.
(2) Inspect drive gear for broken, worn or chipped teeth. Replace drive if any of the above malfunctions are present.

7-6. Repair, Replacement and Reassembly. (Fig 7-1)
a. Install felt wick (4) and then press bushing (32) into commutator end head (3).
b. Press bushing (21) into pinion housing nose (24).
c. Apply three drops of #10 oil to the triple threads on Bendix (27) and to the shaft. Assemble starter drive (27) on armature shaft.
d. Install new snap ring (25) into groove in armature shaft and install retainer (26) onto shaft over the snap ring.
e. Secure starter drive (27) to armature shaft with holding pin (28).
f. Install new 0-ring (36) on pinion housing (24) and lubricate 0-ring with heavy grease.
g. Insert armature shaft (29) with starter drive (27) into the pinion housing (24) as an assembly.
h. Position four field coil and pole shoes (11) and insulators (33) in the motor frame (12) and secure in place with four countersunk head screws (20) and pole screw gaskets (19).
i. Install terminal stud (10) and square shank insulated washer (9) into motor frame (12). Assemble insulated square spacer insulator washer (18), insulated washer (13), flat brass washer (14) and secure with a lock washer (16) and nut (15).
j. Secure field wire to terminal stud with screw (7) and lock washer (8).
k. Insert brushes in brush holder (6).

NOTE

New brush length is 15/32-inch. Allowable wear is 1/4-inch. Replace brush at 11/32-inch.

1. Install motor frame (12) over armature assembly (29) and position brushes over commutator (30) and position motor frame (12) to pinion housing (24) and secure with six cap screws (22) and lock washers (23).
m. Install brush holder (6) in motor frame (12) and secure with three retaining screws (34) and lock washers (35).
n. Install new 0-ring (31) on commutator end head (3) and lubricate 0-ring with heavy grease. Position commutator end head on armature shaft (30) and secure to motor frame (12) with four screws (1) and lock washers (12).
o. Insert feeler gage between retainer (26) and drive end frame housing (24) to check armature end play. Add thrust washer (5) to the commutator end (30) to obtain 0.005-inch to 0.050-inch.

7-7. Testing.
a, Starting Motor Test. Check starting motor for free-running voltage and amperage draw. To test, connect starting motor to a 24-volt battery, ammeter and voltmeter. The amperage draw should not be over 30 amps at 24-volts. If amperage draw is higher, check bearing alinement and end play to make sure that there is no binding or interference. Both a free run and stall test is required to establish that a reliable repair has been made.
b. Waterproof Test. With pinion housing sealed, assemble air hose into 1/8-inch pipe plug in motor frame. Submerge in tap water, apply 6 psi internal air pressure and check for air leaks. Replace plug coating threads with sealant.

7-8. Installation.
Refer to installation in TM 9-2320-244-20.

CHAPTER 8
Repair Of Generating System

8-1. General
This chapter contains description and instructions for removal, disassembly, cleaning, inspection, testing, repair or replacement, reassembly and installation of the alternator assembly.
The 60 ampere 24-volt DC negative ground alternator is a self-rectifying unit with built-in voltage regulator. The only movable part in the assembly is the rotor, which is mounted on ball bearings at the drive end and at the rectifier end. All current- carrying conductors, field windings, stator windings, six rectifying diodes and the regulator circuit components are stationary. The regulator and diodes are enclosed in a sealed compartment. The regulator is serviced by complete replacement only. A fan located on the drive end provides airflow for cooling. Sealed ball bearings contain an adequate supply of lubricant so that no periodic maintenance is required.

8-2. Removal.
Refer to TM 9-2320-244-20 for removal of the alternator.

8-3. Disassembly (60 and 100 Amp).
Refer to TM 9-2920-255-35 for disassembly of the alternator.

8-4. Cleaning.
Clean exterior of alternator with a clean rag.

8-5. Inspection.
Examine alternator mounting lugs and belt adjusting lug for cracks and elongated bolt holes.

8-6. Repair or Replacement.
a. Refer to TM 9-2320-244-20 for replacement of alternator.
b. Refer to TM 9-2920-225-35 for repair of alternator.

8-7. Reassembly (60 and 100 Amp).
Refer to TM 9-2920-225-35 for reassembly of alternator.

8-8. Testing (60 and 100 Amp).
Refer to TM 9-2920-225-35 for testing of alternator.

8-9. Installation.
Refer to TM 9-2320-244-20 for installation of alternator.

NOTE: The following is from the Kaiser -24 maintenance manual and is not in any other manual, thus it's inclusion here.

06-4.ALTERNATOR CHARGING SYSTEM

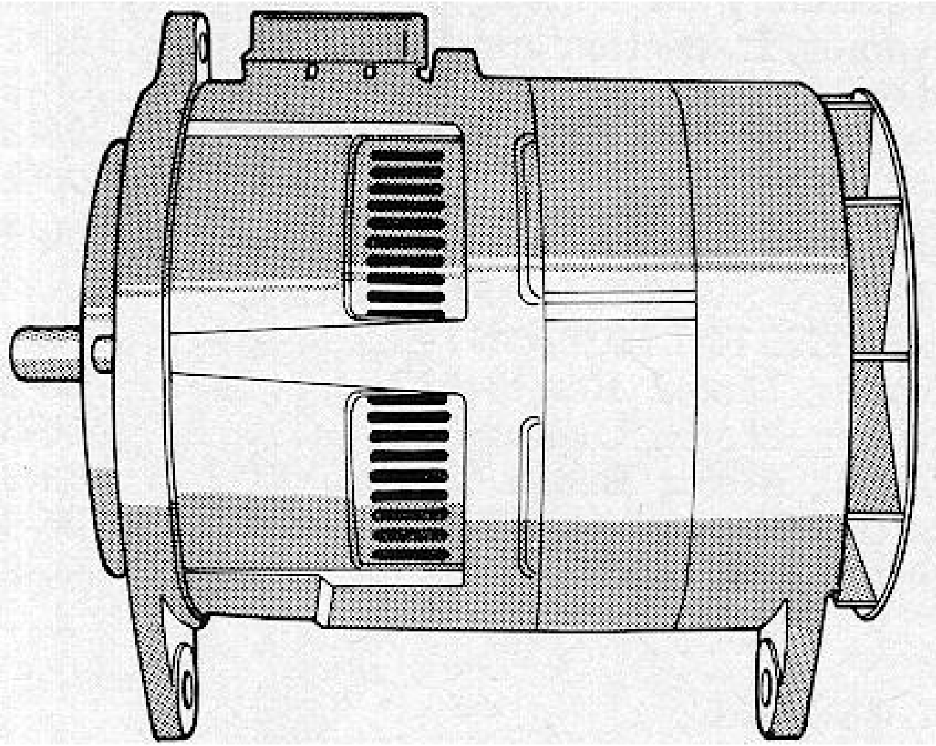


FIG. 06-2—ALTERNATOR

The vehicle has, as standard equipment, a 60 ampere 24-volt negative ground alternator (Fig. 06-2) with an internal voltage regulator. As optional equipment a 100 ampere alternator is available for heavy-duty operation. The alternator charging circuit consists of a battery, alternator with a built in regulator, ignition switch, and battery charge indicator.

Note: This manual covers service procedures for the 60 ampere alternator only.

a. Alternator operation: An alternator differs from a conventional DC shunt generator in that the armature is stationary, and is called the stator, while the field rotates, and is called the rotor. With this type of alternator construction, the higher current values involved in the stator may be conducted to the external circuit through fixed leads and connections, rather than through a rotating commutator and brushes, as in the DC generator.

b. Basic operation: Both the 60 and 100 ampere alternators are of the revolving field type. The rotor being the field, only two contact rings are needed. The contact rings and brushes carry only low amperage current for exciting the field. The alternator is excited by current received from an internally mounted regulator.
c. Rectifiers: The alternator is equipped with inteTnally mounted rectifiers that convert the alternating current to direct current. This is accomplished by means of six silicon diodes that permit the passage of electrical current in one direction only. The six diodes are arranged and wired as shown in Fig. 06-3. The positive pulses of the alternating current are passed through rectifier bank “A” to the positive direct current lead, and the negative pulses of the alternating current are passed through rectifier bank “B” to the negative current lead. Alternating current pulsations are thereby converted to a pulsating direct current.
d. Regulator: The internally-mounted regulator
controls the output of the alternator. The alternator, rectifier, and regulator are illustrated schema-
tically in Fig. 06-4.

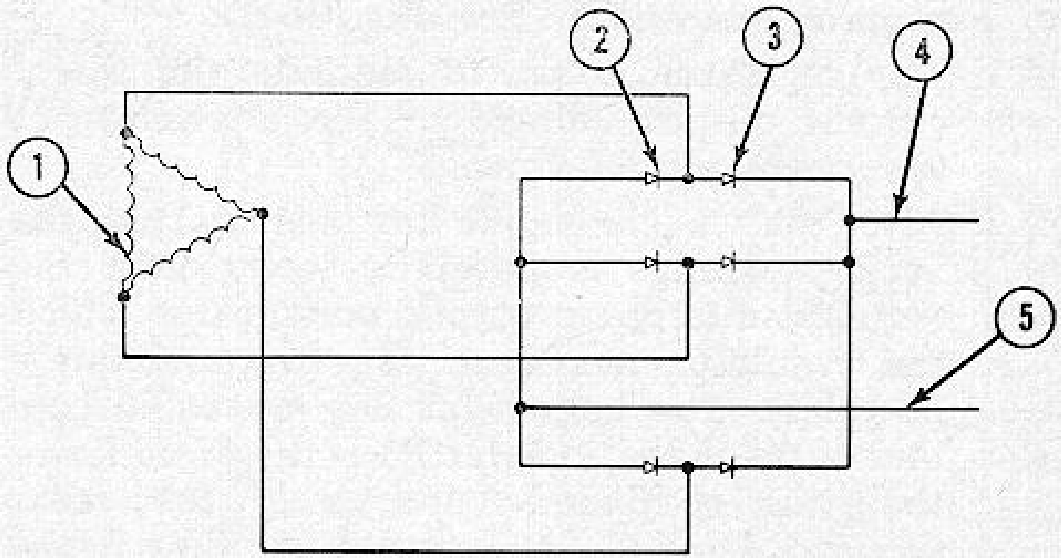


FIG. 06-3—ALTERNATOR RECTIFIER ASSEMBLY SCHEMATIC DIAGRAM

1 Alternator stator
2 Rectifier bank B
3 Rectifier bank A
4 Positive terminal
5 Negative terminal

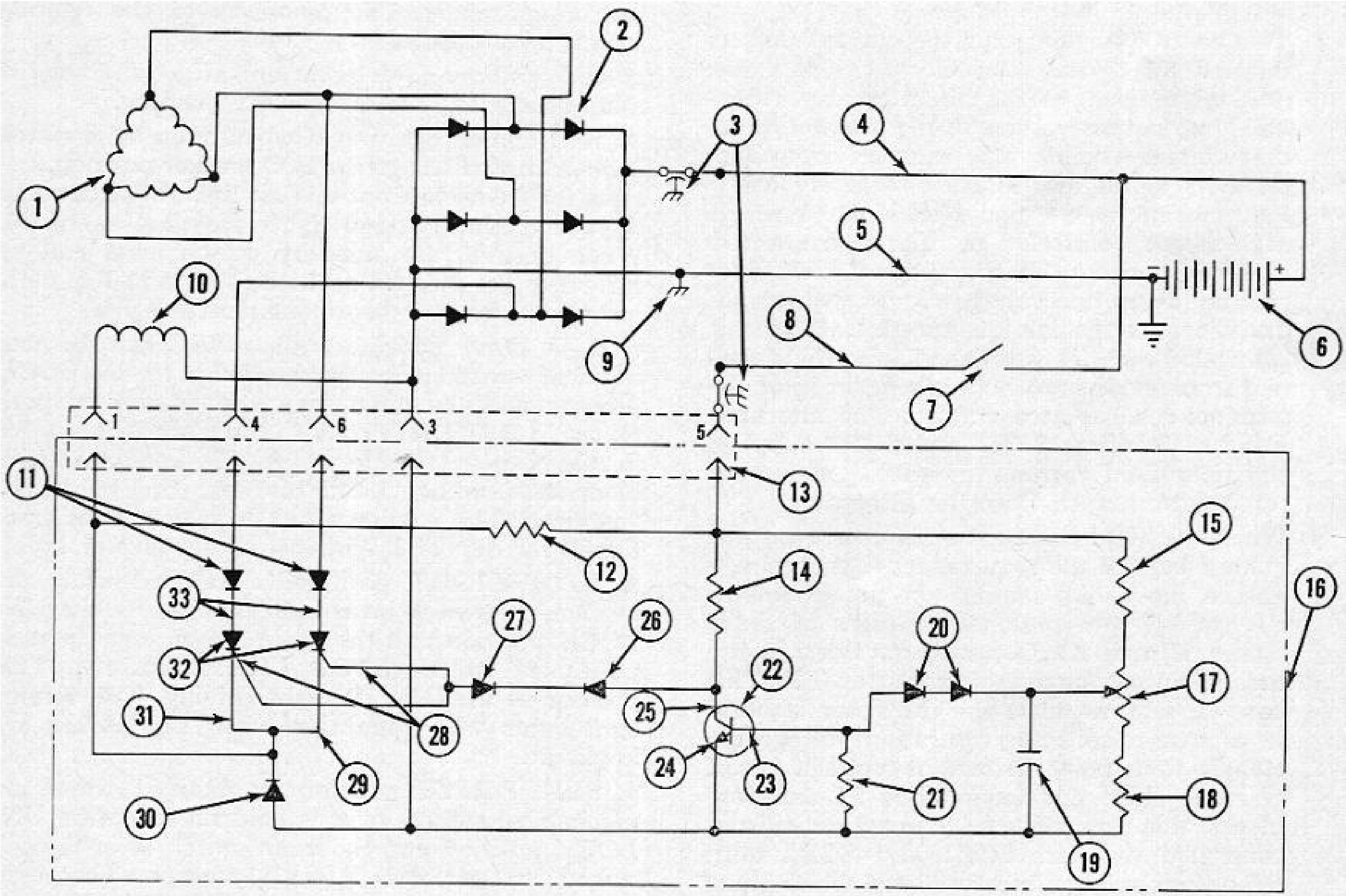


FIG. 06-4—-REGULATOR — SCHEMATIC DIAGRAM

1 Alternator stator	10 Alternator field (rotor)	19 Capacitor, ripple filter, 22 mf. (Cl)	28 SCR gate terminals
2 Rectifier bank	11 Diodes (D1, D2)	20 Zener diodes (Z2, Z3)	29 SCR2 cathode terminal

3 Radio interference suppression capacitors	12 Resistor, 370 ohms (R1)	21 Resistor, 270 ohms (R3)	30 Diode, field discharge (D3)
4 Positive output lead	13 Connector, regulator to alternator	22 Transistor, driver, silicon NPN (TR)	31 SCR1 cathode terminal
5 Negative output lead	14 Resistor, 370 ohms (R2)	23 Transistor base terminal	32 Silicon controlled rectifiers (SCR)
6 Vehicle battery	15 Resistor, 370 omhs (R4)	24 Transistor emitter terminal	33 SCR diode terminals
7 Ignition switch	16 Regulator Assembly	25 Transistor collector terminal	
8 Ignition lead	17 Potentiometer, 50 omhs (P1)	26 Diode (D4)	
9 Grounded to alternator frame	18 Resistor, 300 omhs (R5)	27 Zener diode (Zi)	

e. Regulator operation: (See Fig. 06-4).
1. The regulator is set to regulate the direct current output voltage of the alternator at approximately 28-volts.
2. After the vehicle engine has been started, the battery voltage is normally lower than the required alternator output voltage for which the regulator has been set (approximately 28-volts). The voltage at the moveable contact of the potentiometer P1 is therefore lower than the combined voltages of the zener diodes Z2 and Z3. No current can flow in the base circuit of transistor TR, and the transistor displays a high resistance from emitter to collector. The voltage across the transistor (emitter to collector) is greater than the voltage of zener diode Zi and the control current therefore flows in the gate to cathode circuit of silicon controlled rectifiers SCR1 and SCR2.
3. This control current, plus the current passed through R1 to the alternator field plus the residual magnetism in the alternator rotor, builds up output voltage of the alternator. As the voltage builds up, silicon controlled rectifiers SCR1 and SCR2 alternately carry field current, as the phase terminal to which each silicon controlled rectifier is connected becomes positive. This additional field current builds up line voltage almost instantaneously, even at engine idle speed. Each silicon controlled rectifier stops conducting field current from anode to cathode whenever its phase terminal reaches zero voltage. The alternate firing of rectifiers SCR1 and SCR2 supplies sufficient field current to provide maximum rated performance from the alternator.
4. When this field current builds up the output voltage beyond the required level, the voltage at the moveable contact on potentiometer P1 exceeds the combined voltages of zener diodes Z2 and Z3. Current now flows in the base-to-emitter circuit of transistor TR. This base current switches the transistor on, and its emitter-to-collector saturation voltage decreases to a point below the voltage cutoff of zener diode Z1. Zener diode Zi therefore blocks the flow of gate current in silicon-controlled rectifiers SCR1 and SCR2 until the output voltage falls to a level which shuts off the base current of transistor TR as previously explained. As the phase terminals of silicon controlled rectifiers SCR1 and SCR2 become negative, the rectifiers are switched off, and they remain switched off until gate current is again restored. The field current switching action is rapid enough to provide a level output voltage control under varying load conditions.

06-16. ALTERNATOR PRECAUTIONS
The following precautions must be observed to prevent damage to the alternator and regulator.
a. Never reverse battery connections. Always check the batteries polarity with a voltmeter before any connections are made to be sure that all connections correspond to the battery ground polarity of the vehicle.
b. Booster batteries for starting must be properly connected. Make sure that the negative cable of the booster batteries is connected to the negative terminal of the batteries in the vehicle and that the positive cable of the booster batteries is connected to the positive terminal of the batteries in the vehicle.
c. Disconnect the battery cables before connecting a fast charger to charge the batteries in the vehicle.
d. Never use a fast charger as a booster for starting the vehicle engine.
e. Never disconnect the voltage regulator sensing lead while the engine is running.
f. Do not ground the alternator output terminal.

g. Do not operate the alternator on an open circuit with the field energized.
h. Do not attempt to polarize an alternator.
These precautions are stated here as an aid to service personnel. They are also restated at appropriate places in the text of this section of the manual.

06-17. CHARGING SYSTEM SERVICE

06-18. Service Diagnosis

In diagnosing a suspected malfunction of the alternator charging system, consideration must be given to the complete electrical power system of the vehicle including the alternator, regulator, ignition switch, charge indicator, batteries and all associated wiring. If it is suspected that the alternator is not fully charging the batteries and fulfilling the electrical requirements of the electrical system, several checks should be made before checking the alternator itself.
a. Test the condition of the batteries and state of charge. If the batteries are not fully charged and in good condition, use replacement batteries for making alternator system tests.

Caution: Make certain that the negative battery post is connected to ground when making the replacement battery installation. Serious damage to the alternator can result if battery polarity is reversed.

b. Check fan belts for proper tension.

06-19. Alternator Tests (On-Vehicle)

Several alternator system tests can be completed with the alternator on the vehicle. Paragraphs a. and b. list the tests that can be made when the alternator is mounted on the vehicle.
a. Alternator system output test. This test is made to determine if the charging system is functioning properly and, if not, to obtain information on probable causes of the trouble. Refer to Par. 06-20 for test procedures.
b. Battery charging circuitry test. This test is made to isolate the condition to the battery charging circuit or the negative ground return circuit. Par. 06-20.
c. Further tests must be conducted with the alternator removed and disassembled. With this done, the condition of the rotor, the rectifying and isolation diodes, and the stator can be further tested.
d. When the trouble has been isolated and corrected, the alternator should be installed on the vehicle and checked with the alternator system test.

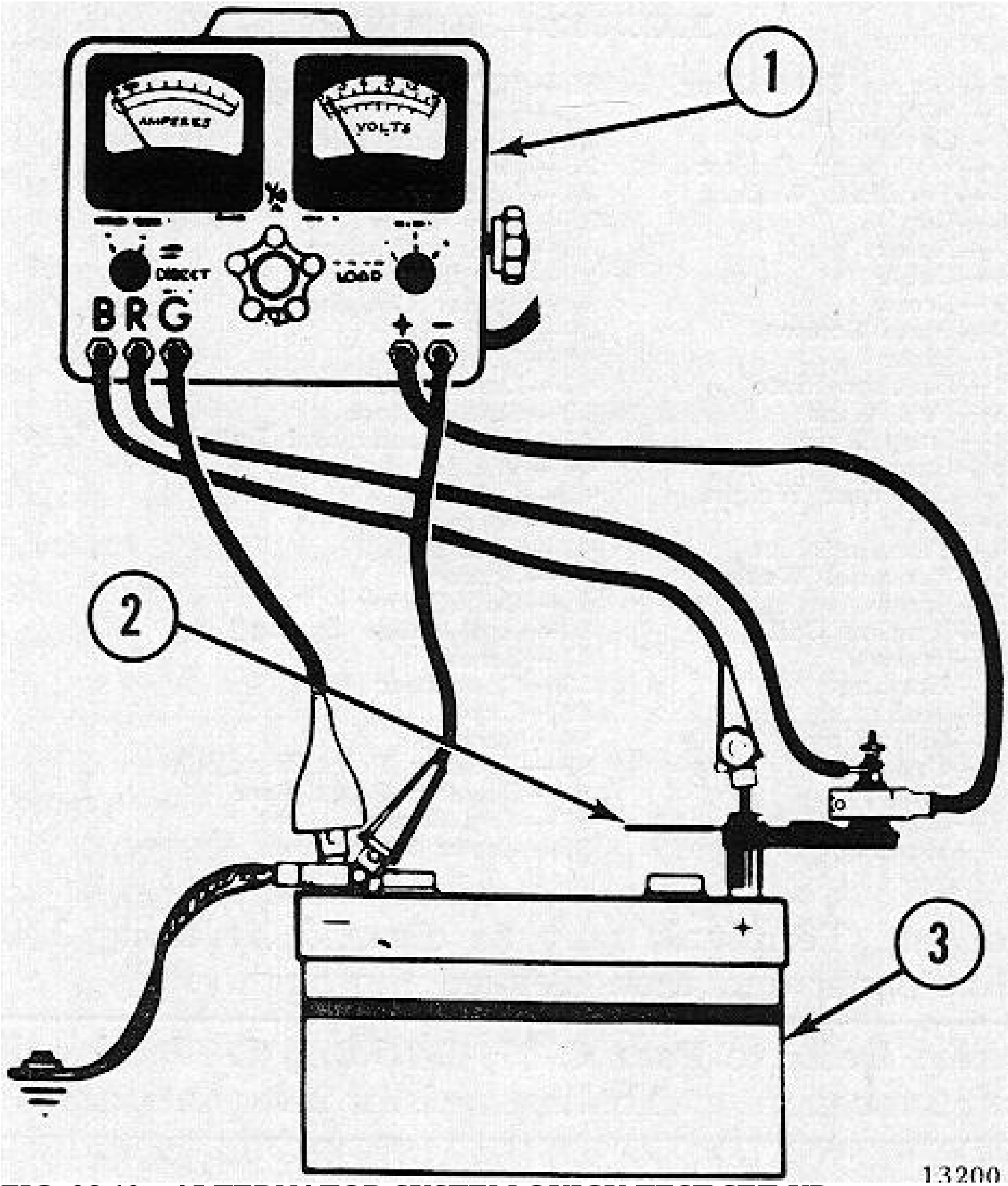


FIG. 06-10—ALTERNATOR SYSTEM QUICK TEST SET-UP
1—Volt-Ammeter
2—Adapter
3—Battery

06-20. ALTERNATOR SYSTEM QUICK TEST
Refer to Fig. 06-10.
This test checks the current and voltage output of the alternator system to determine if the system is functioning properly. Tests are based on the use of a volts ampere tester. This test is designed to make an overall check of the alternator to minimize the time spent in checking systems that are in good condition. If the

charging system fails to pass any of the following tests, service work is indicated and complete detailed testing of the system should be performed.

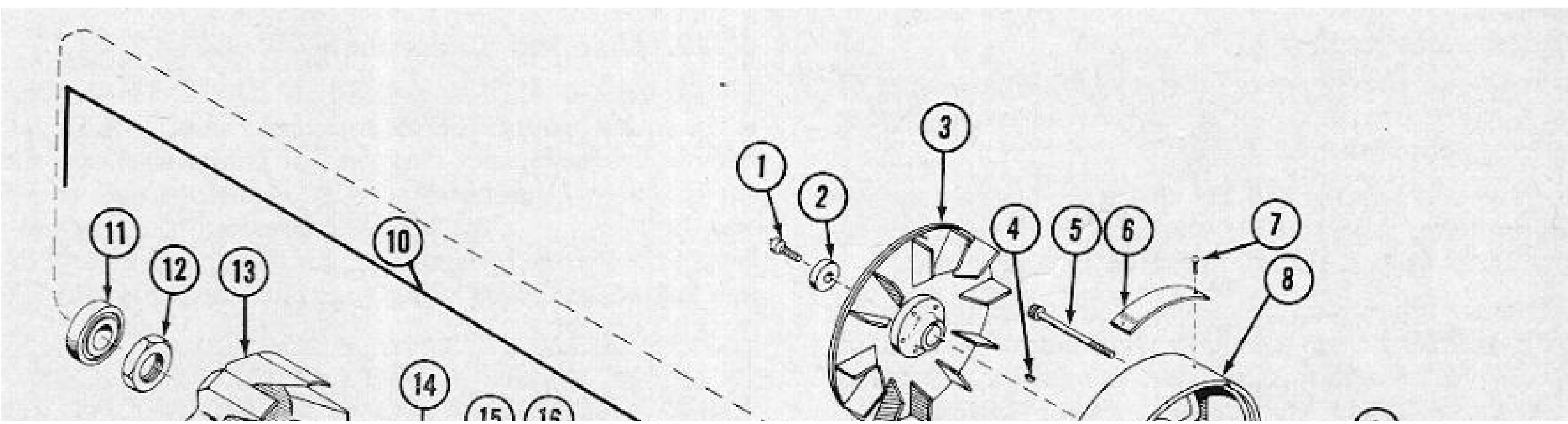
Preliminary Checks
a. Check Battery Condition.
b. Check Alternator Belt Tension and Condition.
c. Check Condition of Wires and Connections.

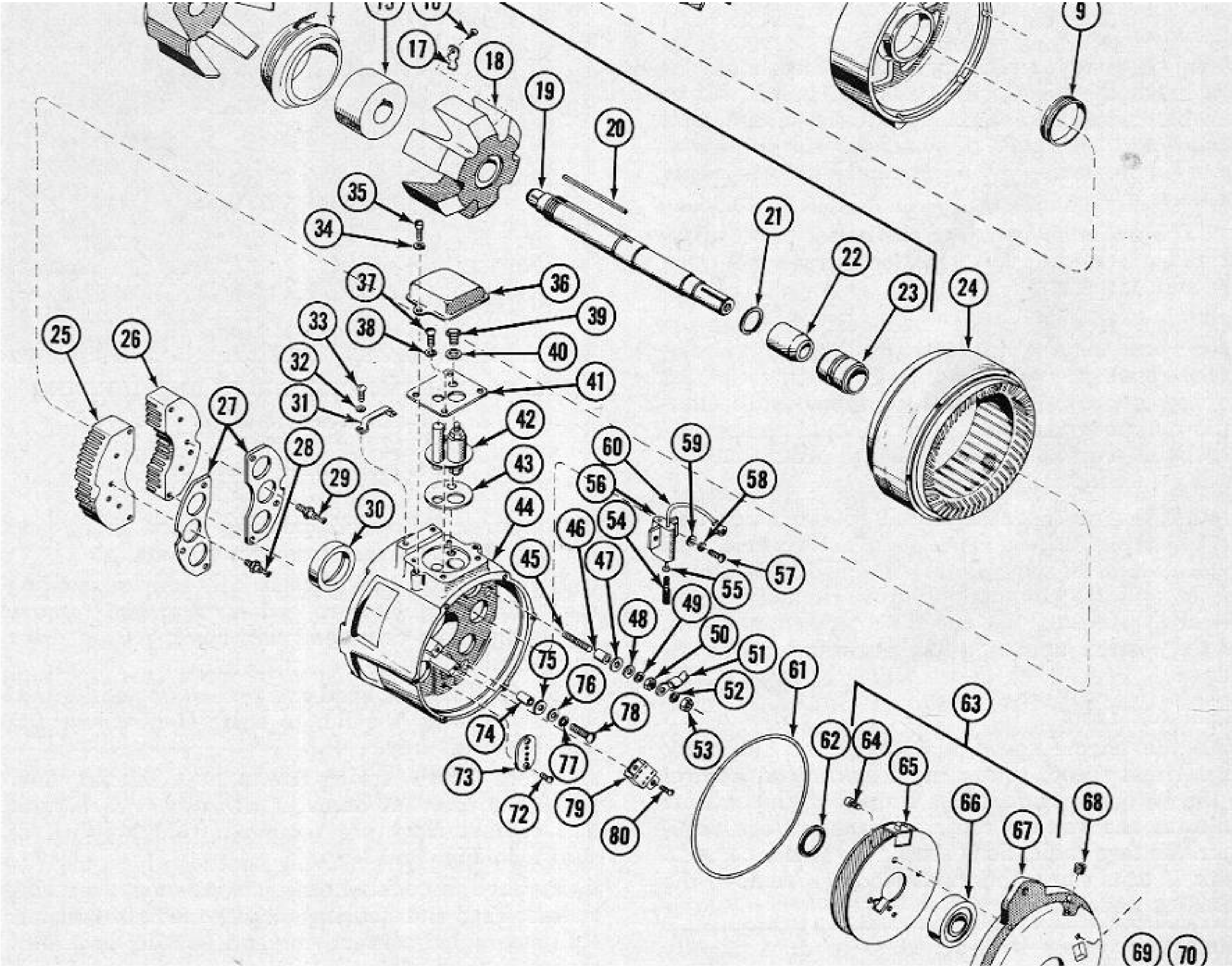
Test Connections
a. Remove the positive battery cable and install the battery post adapter between the battery post and the disconnected cable.
b. With load control in the direct position, connect the ammeter leads to the connectors on the battery post adapter and to the negative battery post.
c. Observing polarity, connect the voltmeter leads to the battery with the voltage selector switch in the 24-volt position, and set the tester's ground polarity switch to the negative ground position.

Alternator Tests
When observing alternator output, it should be noted that the tester's ammeter indication will be less than actual alternator output. To obtain total output, add the amperage used by the alternator field (approximately 2.5 amperes) to the tester ammeter indication.
a. Close the knife switch of the battery post adapter and start engine. After engine has started, open the knife switch.
b. With engine speed set to idle RPM, rotate the tester's load control clockwise until the highest ammeter reading is obtained. Add to this the 2.5 amperes not seen by the tester's ammeter for alternator output at idle speed which should be approximately 10 amperes or more. A low indication indicates a defective alternator.
c. With engine speed increased to alternator output test speed, adjust the tester's load control until highest ammeter indication is obtained. (Maximum output will be obtained at approximately 26 to 28-volts.) Add to this the 2.5 amperes not seen by the tester's ammeter for maximum alternator output.

Regulator Tests
With the engine speed maintained at alternator output test speed, rotate the tester's load control to the 1/4 ohm position. The tester's voltmeter now indicates the voltage setting of the voltage regulator. Voltage indications should be within .2 to .5 volts. If tests show abnormal readings, remove the units for bench tests.

Note: The system is designed to produce slightly more output at low operating temperatures and less at higher temperatures to accommodate the varying demands of electrical power normally consumed at these temperatures.

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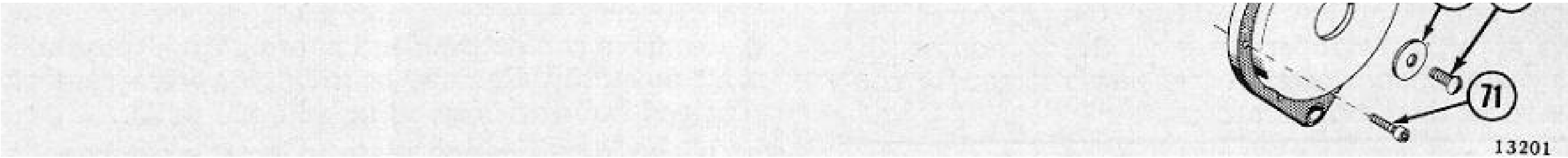


FIG. 06-11-ALTERNAT0R — EXPLODED VIEW

1 Screw	21 Retainer Ring	41 Capacitor Plate	61 Preformed Packing
2 Washer	22 Sleeve	42 Capacitor and Lead Assembly	62 Seal
3 Fan	23 Contact Ring	43 Gasket	63 End Housing and Regulator Assy
4 Woodruff Key	24 Stator	44 Housing	64 Cap Screw
5 Screw	25 Rectifier Mount	45 Stud	65 Voltage Regulator
6 Plate	26 Mount	46 Bushing	66 Ball Bearing
7 Drive Screw	27 Gasket	47 Insulator Washer	67 Drive End Housing
8 Housing	28 Rectifier	48 Guard Washer	68 Pipe Plug
9 Bearing Ring	29 Rectifier	49 Lock Washer	69 Flat Washer
10 Rotor Assembly	30 Seal	50 Hex Nut	70 Machine Screw
11 Ball Bearing	31 Wire Clamp	51 Terminal	71 Machine Screw
12 Hex Nut	32 Lock Washer	52 Lock Washer	72 Machine Screw
13 Rotor	33 Machine Screw	53 Hex Nut	73 Insulator
14 Coil	34 Lock washer	54 Contact Brush	74 Bushing
15 Hub	35 Machine Screw	55 Contact	75 Insulator Washer
16 Drive Screw	36 Capacitor Cover	56 Brush Holder	76 Guard Washer
17 Clip	37 Machine Screw	57 Machine Screw	77 Lock Washer
18 Rotor	38 Lock Washer	58 Lock Washer	78 Machine Screw
19 Shaft	39 Cap Screw	59 Guard Washer	79 Connector
20 Machine Key	40 Lock Washer	60 Terminal	80 Machine Screw

06-22. Alternator Disassembly Refer to Fig. 06-11

a. Remove round head machine screw and flat washer from contact ring end of shaft. Remove six socket head machine screws securing the drive end housing to intermediate housing; pull assembled end housing, drive end ball bearing, and voltage regulator from housing, as shown in Fig. 06-12.

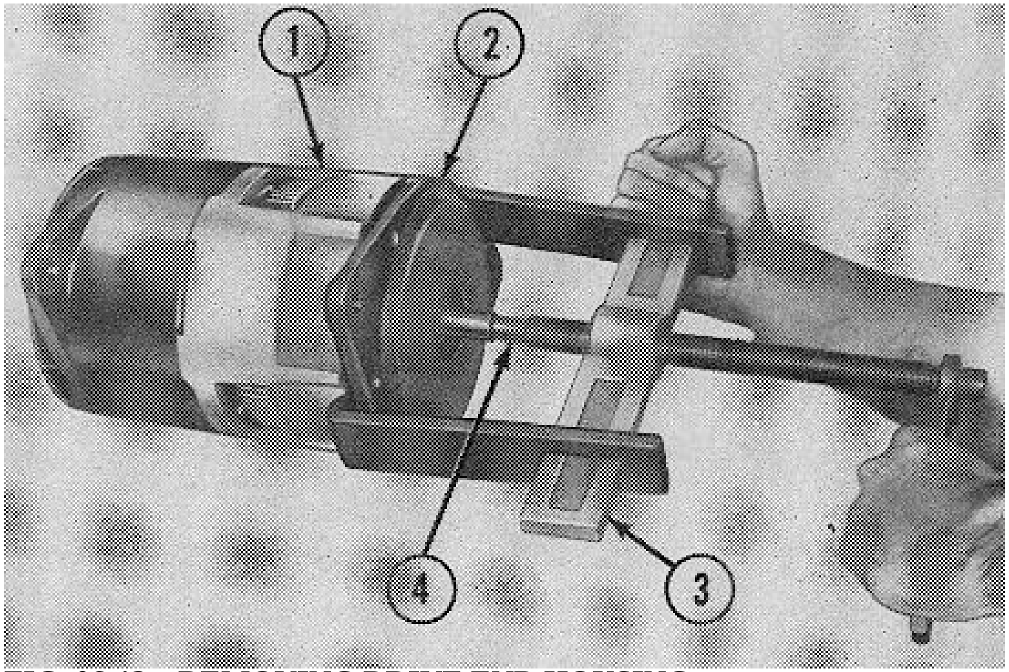


FIG. 06-12—REMOVING DRIVE END HOUSING
1 Intermediate Housing
2 Drive End Housing
3 Puller
4 Forcing Screw Adapter Tool

b. Remove preformed packing from drive end housing. Remove seal from rotor shaft.
c. Remove four socket-head cap screws securing the voltage regulator to end housing and remove regulator. Press drive end ball bearing from drive end housing.
d. Remove socket head machine screw and guard washer securing the fan to shaft and remove fan and woodruff key.
e. Insert brush spring compressor clamp over brushes to prevent damage to brushes when rotor and contact rings are removed from housing, as shown in Fig. 06-13.

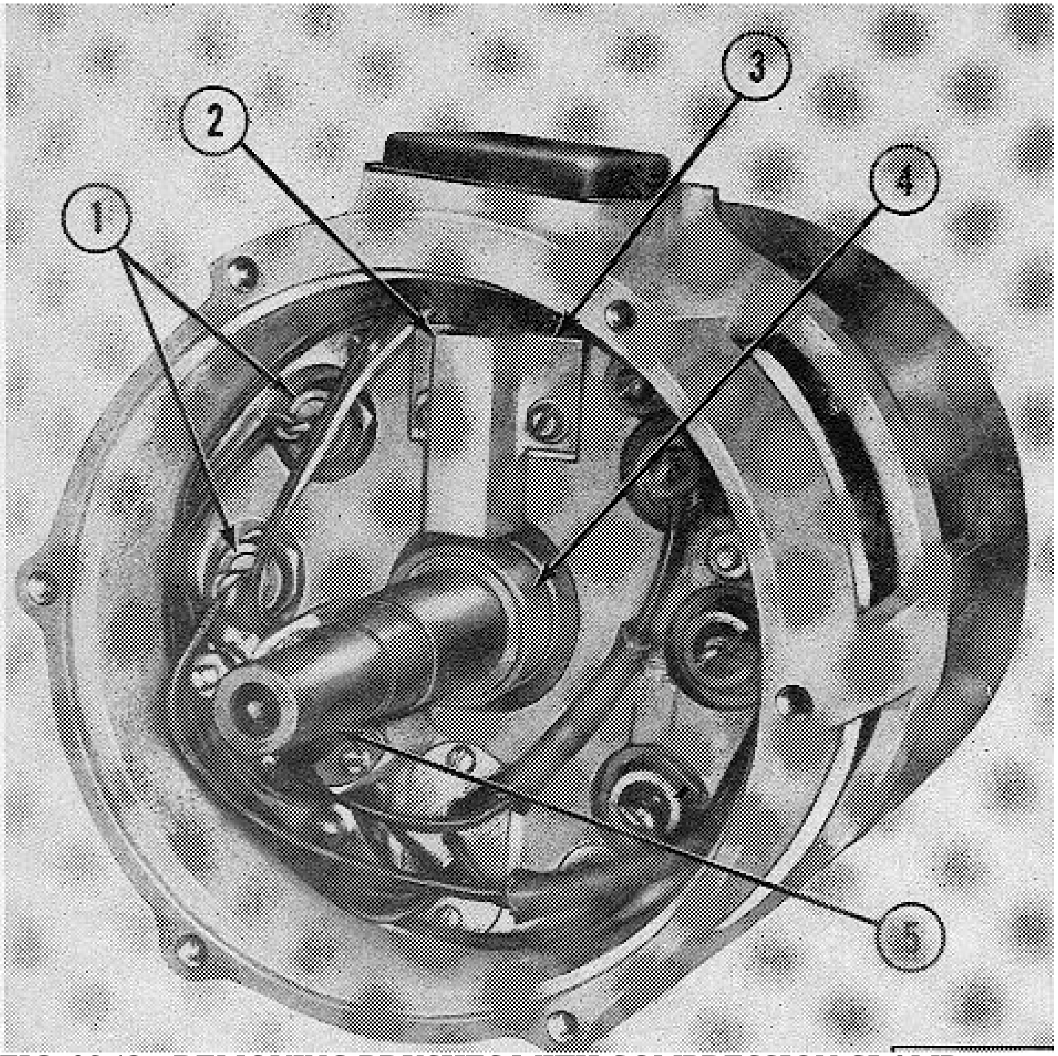
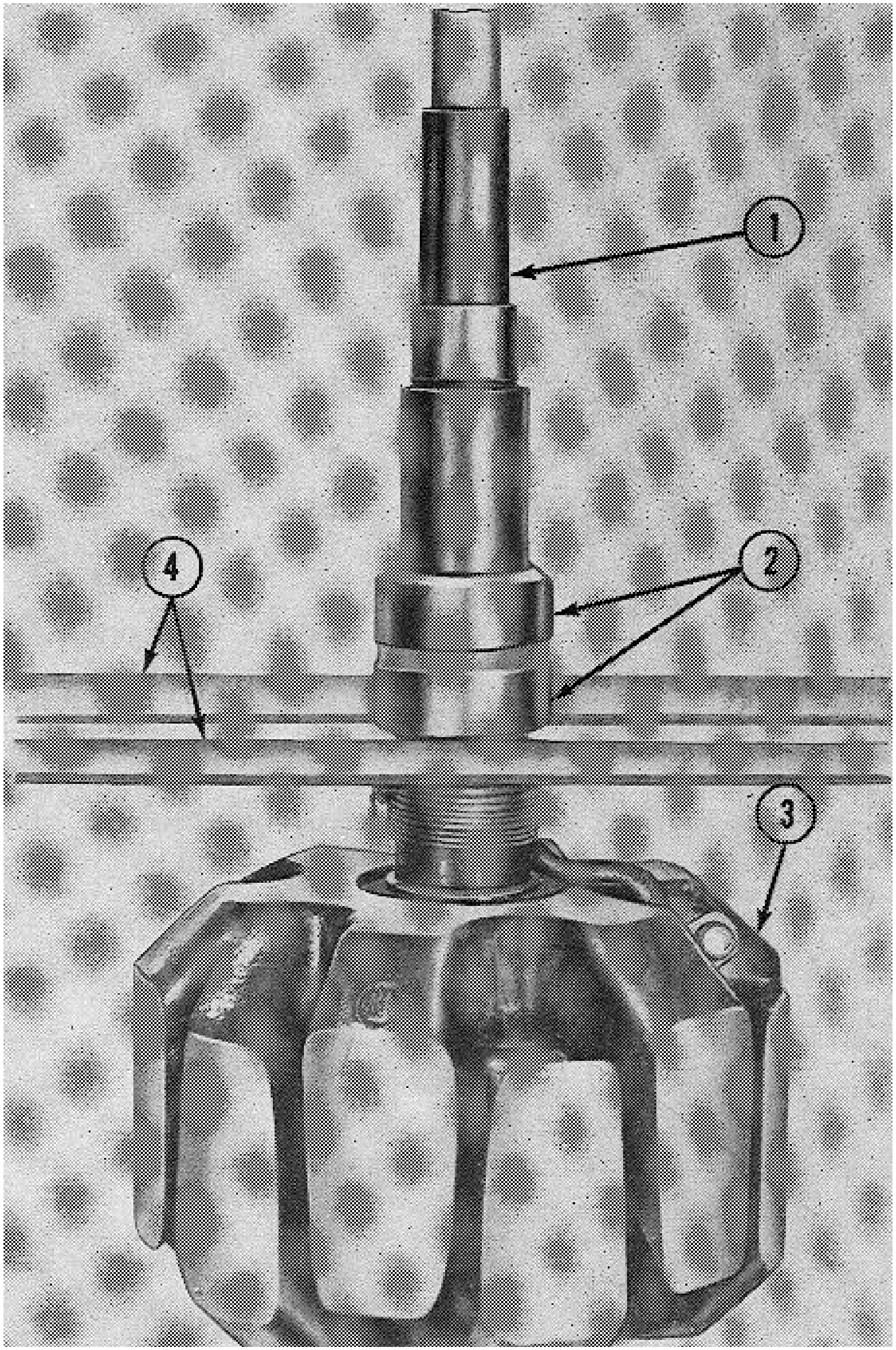


FIG. 06-13—REMOVING BRUSHES WITH COMPRESSION CLAMP
1 Rectifier
2 Compression Clamp
3 Brush Holder
4 Contact Ring
5 Rotor Shaft

f. Remove six socket-head machine screws securing contact ring end housing to intermediate housing. Pull assembled contact ring end housing and rotor assembly from stator.
g. Remove contact ring end housing from rotor and shaft assembly. Remove bearing ring from contact ring end housing bore, using suitable puller.
h. If the identification plate is loose, scratched, or damaged, remove the two drive screws securing the plate to the contact ring housing and remove plate.
i. Remove contact ring and ball bearing from shaft.
j. If inspection indicates that contact rings must be replaced, unsolder connections to contact rings and remove contact rings and sleeve from shaft, as shown in Fig. 06-14.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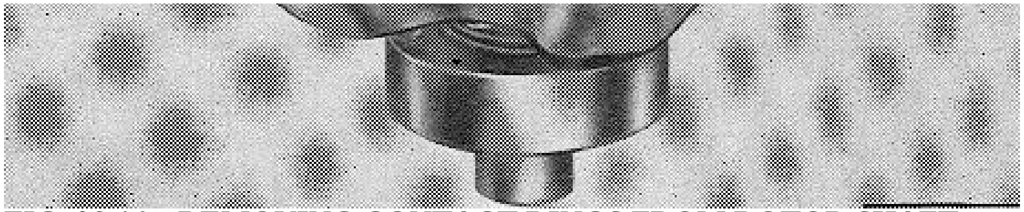


FIG. 06-14—REMOVING CONTACT RINGS FROM ROTOR SHAFT
1 Rotor Shaft
2 Contact Ring
3 Rotor
4 Steel Bar

k. If inspection indicates that rotor coil is defective, remove drive screw securing clip to rotor and remove clip. Remove hex nut securing rotor components on rotor shaft. Remove rotor, rotor coil, hub, rotor, and machine key from shaft.
l. Remove the two brushes from the two brush holders. Do not unsolder contact unless it is damaged.
m. Press seal from housing. Remove two round head machine screws and lock washers securing wire clamp to housing and remove clamp.

Note: Further disassembly of alternator is recommended only if inspection indicates that component parts are defective.

n. Remove two round head machine screws that secure connector to housing; unsolder connections at connector and remove connector from housing.
o. Remove two hex nuts and lock washers securing terminals to two studs and remove terminals from studs.
p. Remove two fillister-head machine screws and lock washers securing capacitor cover to housing, and remove cover.
q. Remove hex-head cap screw and lock washer from capacitor plate. Remove the two fillister-head machine screws and lock washers securing capacitor plate to housing. Remove plate, capacitor, and lead assembly, and gasket from housing. Remove plate, capacitor, and lead assembly, and gasket from housing.
r. Remove the two fillister-head machine screws, lock washers, and guard washers securing the brush holder to housing and remove brush holder.
s. Disconnect splices 1, 2, and 3, and six connections to six rectifiers (see Fig. 06-13). Remove the
two roundhead machine screws securing the insulator to the housing and remove insulator.
t. Remove stator from housing.
u. Remove the two hex nuts, lock washers, guard washers, insulation washers, and bushings from two studs. Remove two roundhead machine screws, lock washers, guard washers, insulation washers, and bushings securing the two rectifier mounts to the housing and remove the rectifier mounts.
v. Remove six rectifiers from mounts. Remove stud and gasket from each mount.
w. Disassembly of the regulator assembly is not recommended.

06-23. CLEANING, INSPECTION, AND REPAIR
a. Cleaning:
1. Inspect screws, bolts, nuts, and plugs for worn or damaged threads and mutilated screw slots or wrench damage. Inspect smaller hardware items such as flat washers, lock washers, etc., for breaks and other obviously damaged conditions. Replace all defective hardware items.
2. Minor thread damage can be repaired by chasing threads with a used tap or die of correct thread size.
3. Discard all preformed packings, gaskets, and oil seals, as these parts are to be replaced during assembly.
4. Clean stator assembly, rotor, and brush holder with a cloth dampened in volatile mineral spirits or dry cleaning solvent. Do not soak parts in solvent. Dry with clean, dry, compressed air; take care not to damage insulation, cables or windings.
5. Wipe bearings clean and inspect bearings for roughness or damage.

Note: Ball bearings are sealed and packed with lubricant, and will normally require cleaning only at overhaul or repair periods.

Note: Cooling ducts in stator and rotor assemblies should be kept free of dirt and grease. A thin rod can be used to loosen caked dirt.

6. If contact rings are rough or have minor pits, polish them with No. 000 or finer sandpaper. Clean rings and rotor with compressed air after polishing rings.

Caution: Do not use emery cloth to polish contact rings. Fragments from emery cloth may short-circuit rotor.

7. Brushes should always be replaced when alternator is rebuilt. If brushes are removed between normal rebuild periods for any reason, they should be wiped with a clean, dry cloth to remove foreign material.

Caution: Do not use carbon tetrachloride for cleaning brushes or contact rings as it will remove inherent lubricating value of brushes and produce excessive wear and scoring of contact ring surface.

8. Clean all other metallic parts with dry cleaning solvent; dry all parts thoroughly.

Caution: Many parts of the alternator are made of aluminum alloys. Do not use a solvent that will attack aluminum.

b. Inspection and Repair:
1. Fan. Inspect vanes for cracks or damage.
2. Hub. Inspect hub for worn keyway, distortion, cracks and breaks.
3. Bearing retainers. Inspect for cracks or damage.
4. End housings. Inspect for cracks and damage. Inspect bearing bore for proper size (Table B). Check that mating face is not warped.
5. Bearings. Inspect bearings as directed in bearing cleaning (Par. 06-23). Inspect for size (Table B).

Note: If there is any doubt as to serviceability of bearings, replace.

6. Brush holder. Inspect for cracks. Inspect terminal studs and screws for looseness and damaged threads.
7. Brushes. See brush cleaning (Par. 05-23).

Note: Minimum allowable brush wear is one-half the length of a new brush.

8. Brush levers. Inspect for distortion and damage.
9. Brush lever springs.
(a) Inspect for cracks and distortion.
(b) Use a spring pressure checker to check spring pressure exerted by brush springs. When loaded with 10 ounces, spring length must be 1 inch. Replace springs that fail to meet this requirement.
10. Stator assembly.
(a) Inspect for stripped threads.
(b) Inspect for loose or frayed insulation.
(c) Inspect terminal for damaged or stripped threads.
11. Rotor.
(a) Inspect shaft keys and key seats for damage.
(b) Inspect shaft for burred or stripped threads.
(c) Place ohmmeter probes on inner and outer rotor contact rings as shown in Fig. 06-15, and check for resistance. If rotor does not meet these specifications, replace rotor.

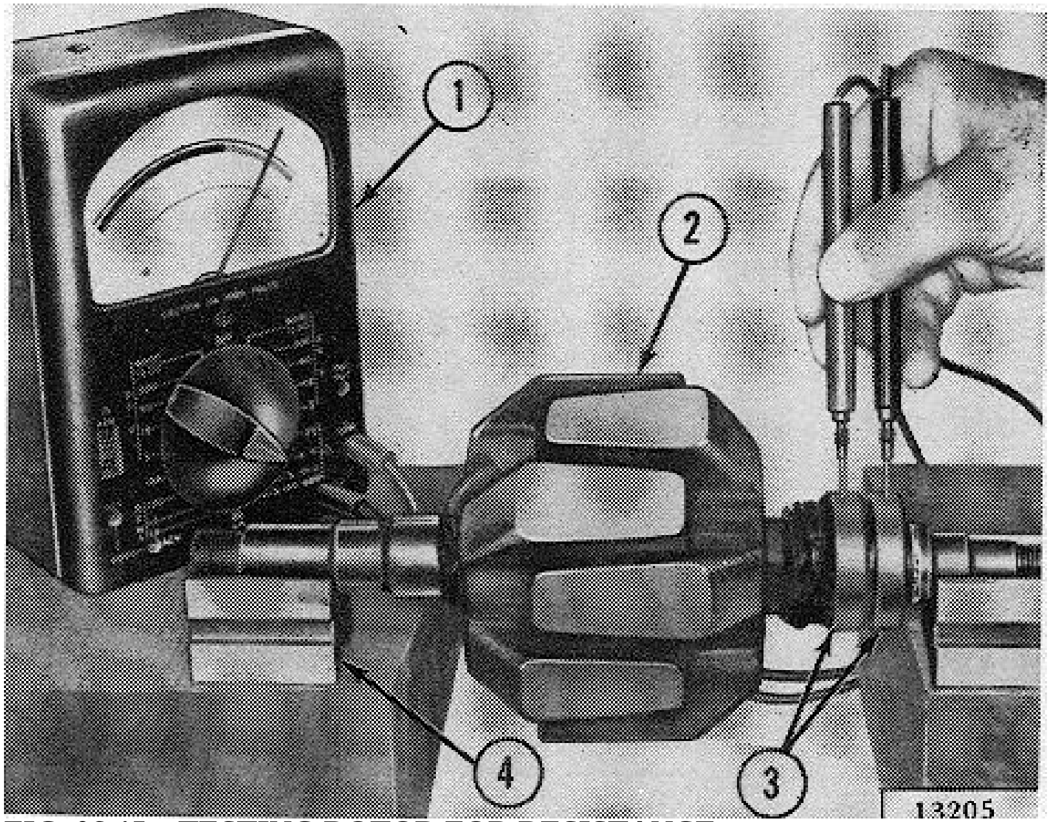


FIG. 06-15—TESTING ROTOR FOR RESISTANCE
1 Ohmmeter
2 Rotor
3 Contact Ring
4 V-Block

(d) Place rotor in V-blocks and check each contact ring with dial indicator as shown in Fig. 06-16. Maximum allowable distortion is 0.001”.

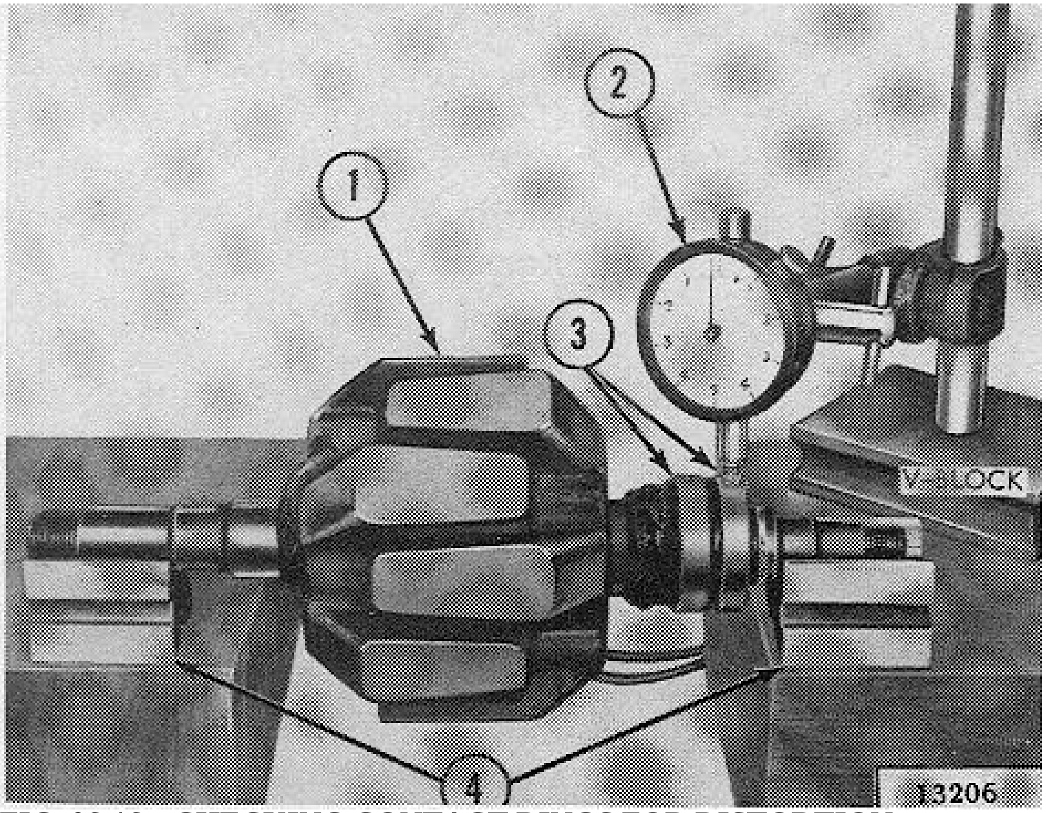


FIG. 06-16—CHECKING CONTACT RINGS FOR DISTORTION
1 Rotor
2 Dial Indicator
3 Slip Ring
4 V-Block

(e) Check for ground between rotor shaft and each contact ring as shown in Fig. 06-17. If ohmmeter reading is 10,000 ohms or less, replace rotor assembly.

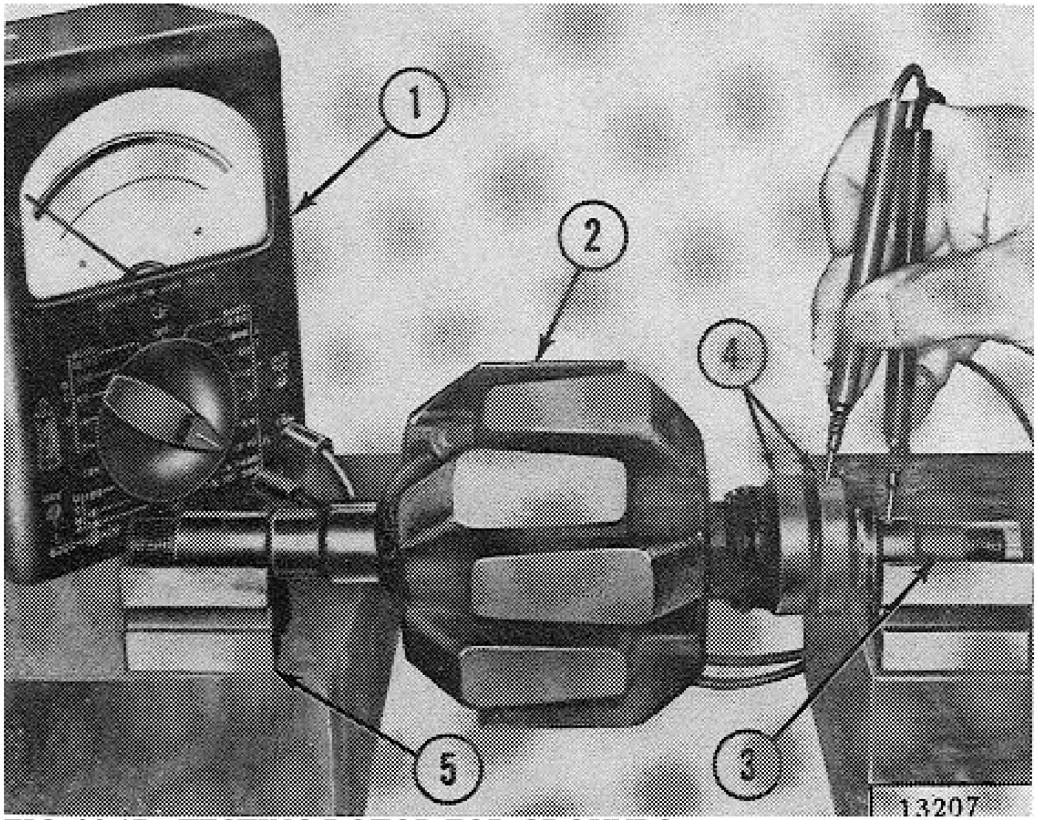


FIG. 06-17—TESTING ROTOR FOR GROUNDS
1 Ohmmeter
2 Rotor
3 Rotor Shaft
4 Contact Ring
5 V-Block

12. Rectifiers. Check rectifiers as follows:
(a) Connect negative lead of ohmmeter to checkpoint 2 shown in Fig. 06-18. Ohmmeter must show a low resistance when positive lead is touched to rectifier terminals 1, 2, and 3. When leads are reversed, ohmmeter must show infinite resistance or open circuit.

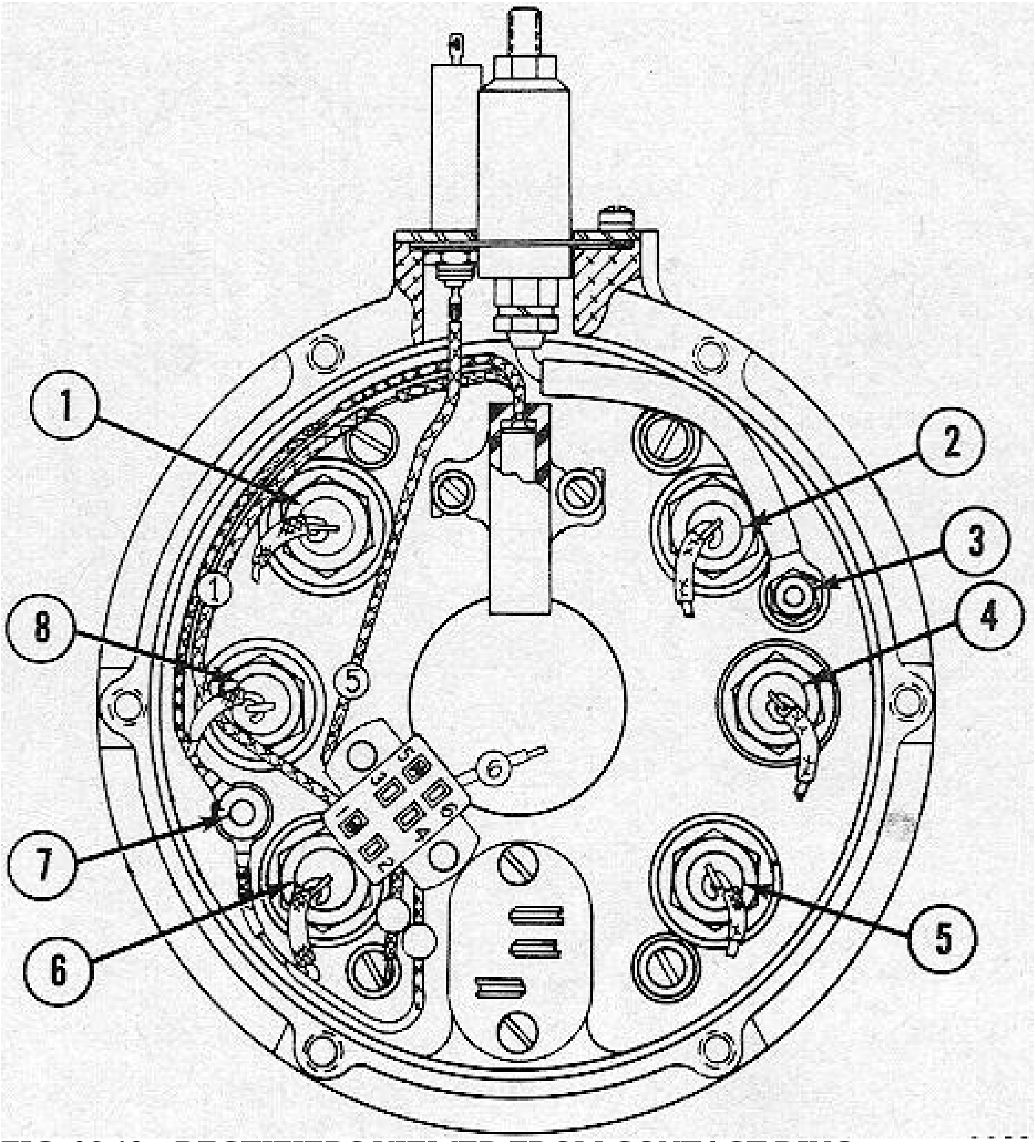


FIG. 06-18—RECTIFIERS VIEWED FROM CONTACT RING

1 Rectifier No. 6
2 Rectifier No. 1
3 Checkpoint No. 2
4 Rectifier No. 2
5 Rectifier No. 3
6 Rectifier No. 4
7 Checkpoint No. 1
8 Rectifier No. 5

(b) Connect positive lead of ohmmeter to checkpoint 1 shown in Fig. 06-18. Ohmmeter must show low resistance when negative lead is touched to rectifier

terminals 4, 5, and 6. When leads are reversed, ohmmeter must show infinite resistance or open circuit.
(c) If either of above tests indicates a short circuit, disconnect splices 1, 2, and 3 shown in Fig. 06-19 and repeat tests given in (a) and (b) above. This is necessary to determine which rectifier is defective.

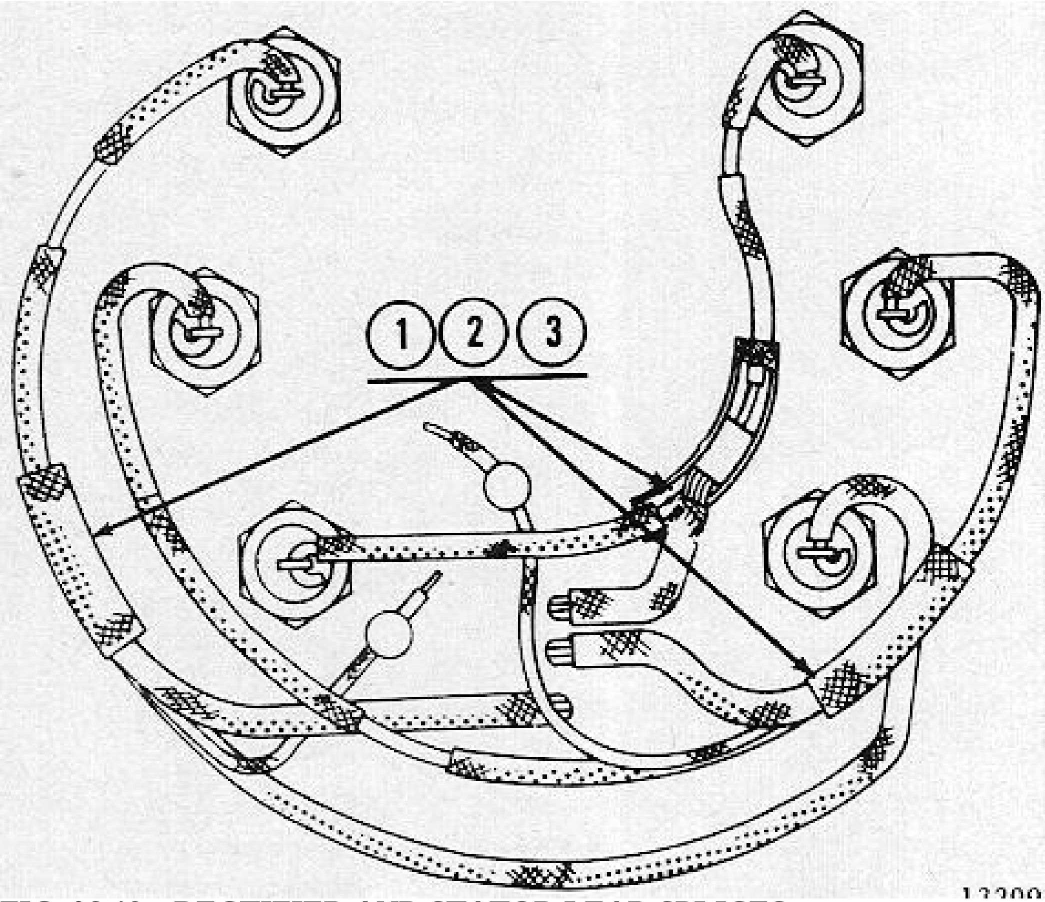


FIG. 06-19---RECTIFIER AND STATOR LEAD SPLICES

Note: On ohmmeters that are energized with a 1 ½-volt dry cell, “low resistance” readings will be approximately 20 to 30 ohms. On ohmmeters that are energized with a 3-volt dry cell, “low resistance” reading will be approximately 10 to 15 ohms.

Caution: Do not use a battery or test lamp to make a continuity test. Reverse battery connection will burn out diodes instantly.

(d) While splices are disconnected, check resistance or stator windings. Resistance must be between 0.14 and 0.16 ohm.

13. Regulator.
(a) Tests of regulator are made with regulator removed from alternator. Test points on regulator are located in Fig. 06-20.

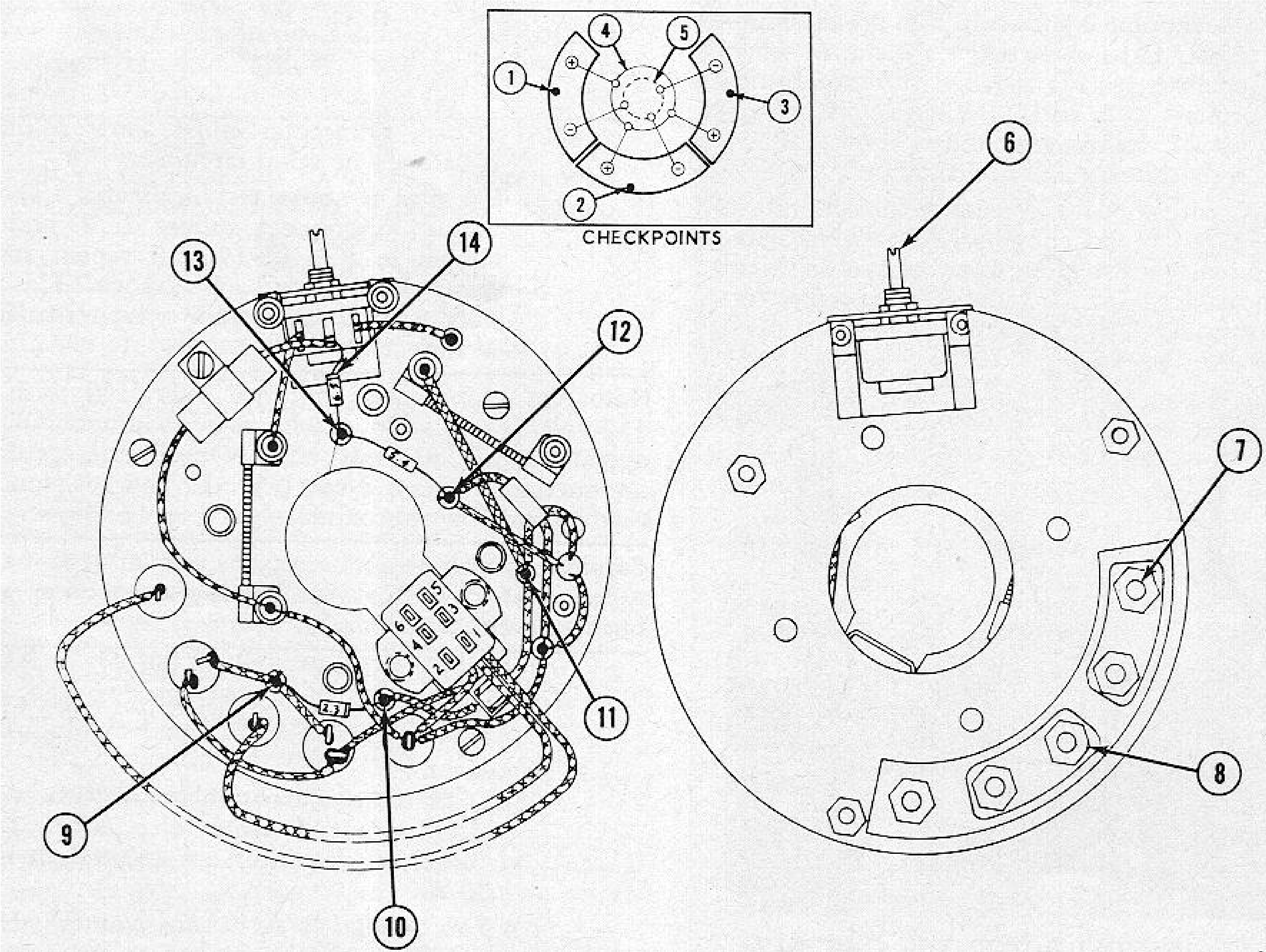


FIG. 06-20-LOCATION OF REGULATOR TEST POINTS

1 Checkpoint No. 1	6 Voltage output adjustment	11 Checkpoint No. 11
2 Checkpoint No. 2	7 Checkpoint No. 7	12 Checkpoint No. 12
3 Checkpoint No. 3	8 Checkpoint No. 8	13 Checkpoint No. 13
4 Plate A	9 Checkpoint No. 9	14 Checkpoint No. 14
5 Plate B	10 Checkpoint No. 10	

(b) Table A gives resistance values which should be obtained when a test is made across test points indicated. Values given in Table A were determined using a Weston model 301 ohmmeter powered with a 1.5 volt flashlight battery and also with a Simpson model 372 ohmmeter, with readings taken on the R x 10 scale. Because semiconductor junctions are non-linear devices, battery voltage and resistance of ohmmeters other than two used in these tests may give different readings. Values in Table A therefore are guides, not exact values. Use of a vacuum tube voltmeter is not recommended.
(c) Replace regulator if it fails to register rated resistances.

c. Repair.
1. General. The following subparagraphs cover only those parts wherein a repair operation will return damaged part to serviceable condition. Parts not detailed herein must be replaced when they fail to pass the required inspection and test.
2. Contact Rings. If contact rings are rough or out-of-round, machine in a lathe and polish with No. 000 or finer sandpaper. Minimum allowable diameter of contact rings is given in Table B. If either ring does not meet this specification, replace contact rings.
3. Rotor. Remove minor burrs and nicks from rotor shaft and shaft threads with a fine file.
4. Stator and connector assembly. Repair damaged or defective solder connections. Clean up minor thread damage with a tap of proper size and proper number of threads per inch.
5. End housings. Remove minor nicks and burrs from machined surfaces of end housings with a stone or file.

Table A. Regulator Resistance Test Values

	Ohmmeter polarity	Ohmmeter polarity	Ohmmeter readings (ohms)	Ohmmeter readings (ohms)
HIGH VOLTAGE TESTS	Positive terminal	Negative terminal	Good device	Faulty device
Device fault				
Shorted Zl	10	9	Infinite resistance	Zero resistance
Open Z2	12	13	40-50	Infinite resistance
Open Z3	13	14	40-50	Infinite resistance
Open R4	5	14	400-500	Infinite resistance
Open P1(1)	14	3	350-400	Infinite resistance
Open P1(2)	14	5	275-300	Infinite resistance
Open TR(1)	12	11	35-40	700+
Open TR(2)	12	3	40-45	700+
Shorted SC R1	7	1	Infinite resistance	Zero resistance
Shorted SC R2	8	1	Infinite resistance	Zero resistance
Shorted C1	14	3	350-400	Zero resistance
LOW VOLTAGE TESTS				
Open Dl rectifier	4	7	30-35	Infinite resistance

Open D2 rectifier	6	7	30-35	Infinite resistance
Shorted Z2	13	12	Infinite resistance	Zero resistance
Shorted Z3	14	13	Infinite resistance	Zero resistance
Open R2	5	11	250-300	Infinite resistance
Open Z1	9	10	40-45	Infinite resistance
Open D4	11	10	30-40	Infinite resistance
Open R5	14	3	350-400	Infinite resistance
Shorted TR	11	3	1000	Zero resistance
Shorted D3	1	3	1000	Zero resistance

Table B. Inspection Specifications and Tolerances

Inspection Point	**Size**	**Wear Limit**
Inside diameter of fan hub bore	0.6270 - 0.6280	
Inside diameter of contact ring end bearing ring.	1.8497 - 1.8501	
Outside diameter of contact ring end bearing.	1.8499 - 1.8504	
Inside diameter of contact ring end bearing	0.7870 - 0.7874	
Outside diameter of shaft	0.6250 - 0.6255	
Outside diameter of contact ring bearing seat on shaft	0.7874 - 0.7878	
Outside diameter of drive end bearing seat of shaft	0.7871 - 0.7874	
Outside diameter of drive end of shaft	0.6684 - 0.6690	
Outside diameter of sleeve	1.3480 - 1.3500	
Outside diameter of contact ring.	1.3120	1. 2820
Length of brush	0.5000	0. 2500
Inside diameter of drive end bearing.	0.7870 - 0.7874	
Outside diameter of drive end bearing.	2.0467 - 2.0472	
Inside diameter of drive end housing bore	2.0470 - 2.0475	
Inside diameter of contact ring	0.9360 - 0.9370	
Inside diameter of fan hub to shaft	0.0015 (L) -0.0030 (L)	
Contact ring end bearing to shaft seat	0.0008 (T) -0.0001 (L)	
Drive end bearing to shaft seat	0.0004 (T) -0.0003 (L)	
Drive end bearing to bore in drive end housing.	0.0002 (T) -0.0008 (L)	

06-24. Alternator Assembly
Refer to Fig. 06-11.
a. Install stud into each rectifier mount. Position rectifier mount and gasket in intermediate housing; secure with two roundhead machine screws, lock washers, and guard washers.
b. Install guard washer and lock washer on stud; and secure with a hex nut.

c. Position rectifier mount and gasket in housing; secure with two roundhead machine screws, lock washers, guard washers, insulation washers, and bushings.
d. Position bushing, insulation washer, guard washer, lock washer on stud; secure with hex nut.

Note: Positive rectifier mount is insulated from housing with bushings and insulation washers. Negative rectifier mount is intentionally grounded to housing and therefore has no insulation bushings or insulation washers.

e. Install six rectifiers in rectifier mounts. Tighten rectifiers to 20 to 25 inch-pounds torque. Rectifiers are identified by arrow markings on their sides. Install rectifiers designated “A” (arrow pointing toward screw) in Fig. 06-21 in “A” positions, Install “B” rectifiers (arrow pointing away from screw) in “B” positions.
f. Press seal into intermediate housing.

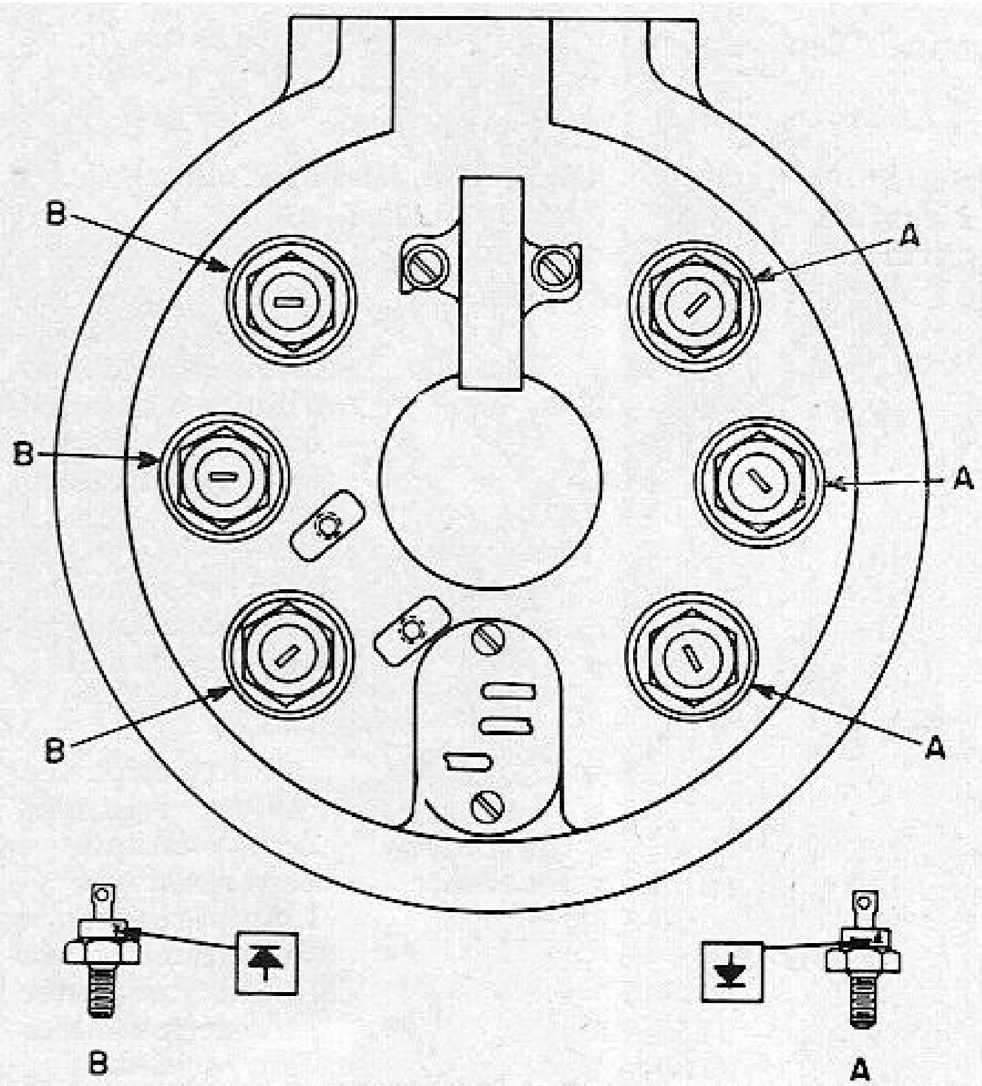


FIG. 06-21—RECTIFIER IDENTIFICATION AND LOCATION

g. Install gasket, capacitor and lead assembly, and capacitor plate on housing; secure with two fillisterhead machine screws and lock washers. Install hex-head

cap screw and lock washer on capacitor plate.
h. Position brush holder on housing; secure with two fillister-head machine screws, lock washers, and guard washers.
i. Position stator on housing. Run leads from stator into drive end of housing and through insulator. Secure insulator to housing with two roundhead machines screws. Seal hole behind insulator with Emerson-Cuming Stypast with catalyst No. 11 (or equivalent).
j. Solder lead to each rectifier and connect stator leads to rectifier leads.
k. Solder leads to connector. Position connector on housing and secure with two roundhead machine screws.
l. Position leads on two studs and secure with two lock washers and hex nuts.
m. Install two brushes in brush holder as shown in Fig. 06-22. Hold brushes in position with brush spring compressor clamp.

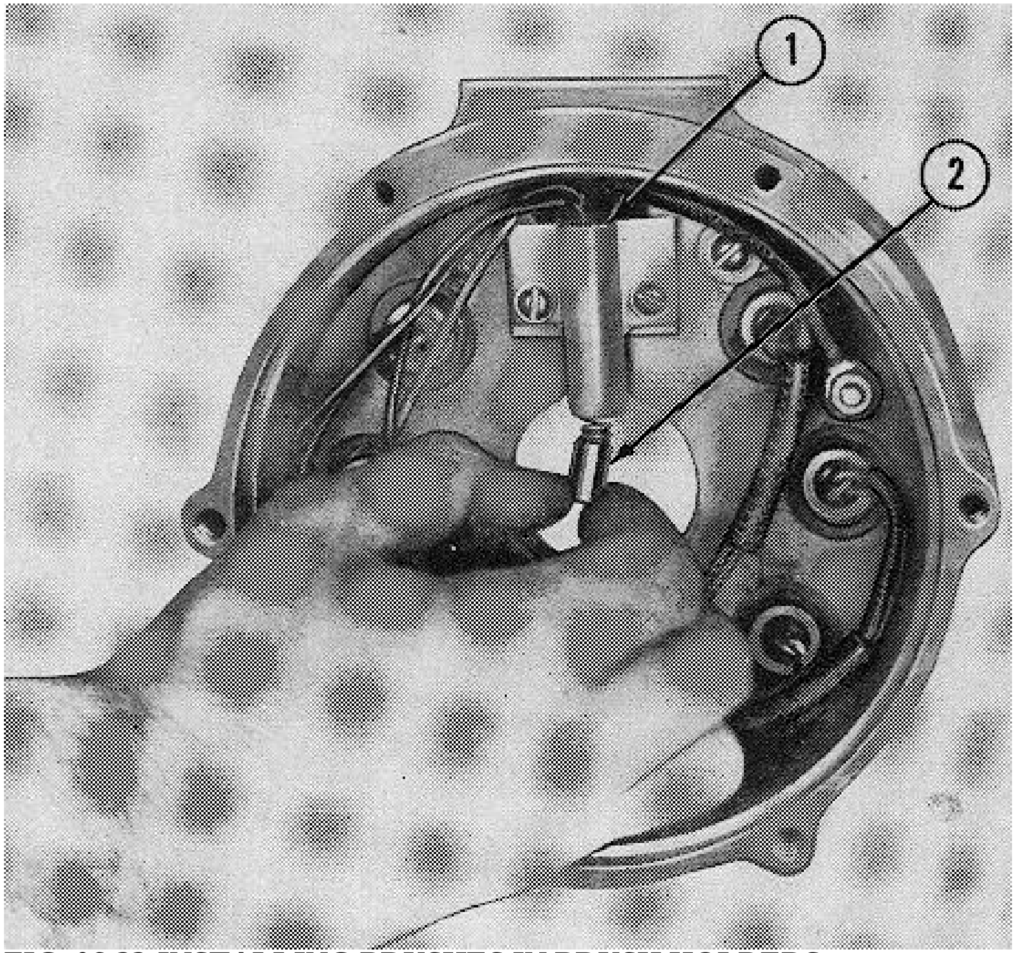


FIG. 06-22-INSTALLING BRUSHES IN BRUSH HOLDERS
1 Brush Holder
2 Brush

n. Push lead from coil into slot in shaft. Press sleeve and contact rings onto shaft. Solder coil leads to contact rings. Dynamically balance rotor and shaft assembly to 0.1 inch-ounces.
o. Press contact ring end bail bearing onto shaft.
p. If identification plate was removed, position identification plate, and secure with two drive screws.
q. Insert bearing ring in contact ring end housing bore; tap contact ring and housing onto contact ring end bearing.

r. Install assembled contact ring end housing and rotor in housing; secure with six socket-head machine screws. Remove brush spring compressor clamp.
s. Position woodruff key and fan on shaft and secure with socket-head machine screw and guard washer.
t. Press drive end ball bearing into drive end housing. Before installing regulator, press drive end housing onto intermediate housing; secure with six socket-head machine screws; perform test directed in Par. 06-25.
u. Remove drive end housing and bearing from housing; position regulator on drive end housing; secure with four socket-head cap screws.
v. Install preformed packing on drive end housing, and seal on shaft.
w. Press drive end housing onto intermediate housing; secure with six socket-head machine screws. Secure flat washer to end of shaft with a roundhead machine screw.

Note: Align connector on regulator with connector on intermediate housing before installing drive end housing onto intermediate housing. This is most easily accomplished by inserting several socket head machine screws through holes in drive end housing and into holes in intermediate housing.

x. Install pipe plug after regulator has been adjusted.
y. Position capacitor cover on housing and secure wth two fillister-head machine screws and lock washers.
z. Manually rotate alternator rotor to ensure that there is no binding or scraping.

06-25. Testing and Adjusting After Assembly
a. General. After the alternator has been assembled, test it for proper performance. If the alternator does not function properly during the tests described in d through f below, disassemble the alternator and retest for malfunctioning components.
b. Test Setup with Regulator Removed. To check alternator output without regulation, remove the regulator from the alternator as directed in Par. 06-22. Connect a jumper between terminals 1 and 5 of the connector as shown in Fig. 06-23. Install the drive end housing on the alternator. Connect the alternator as shown in Fig. 06-24. Operate the alternator at the speeds indicated in Table C and adjust the variable resistor until the alternator is producing the indicated voltage at the rated amperage.

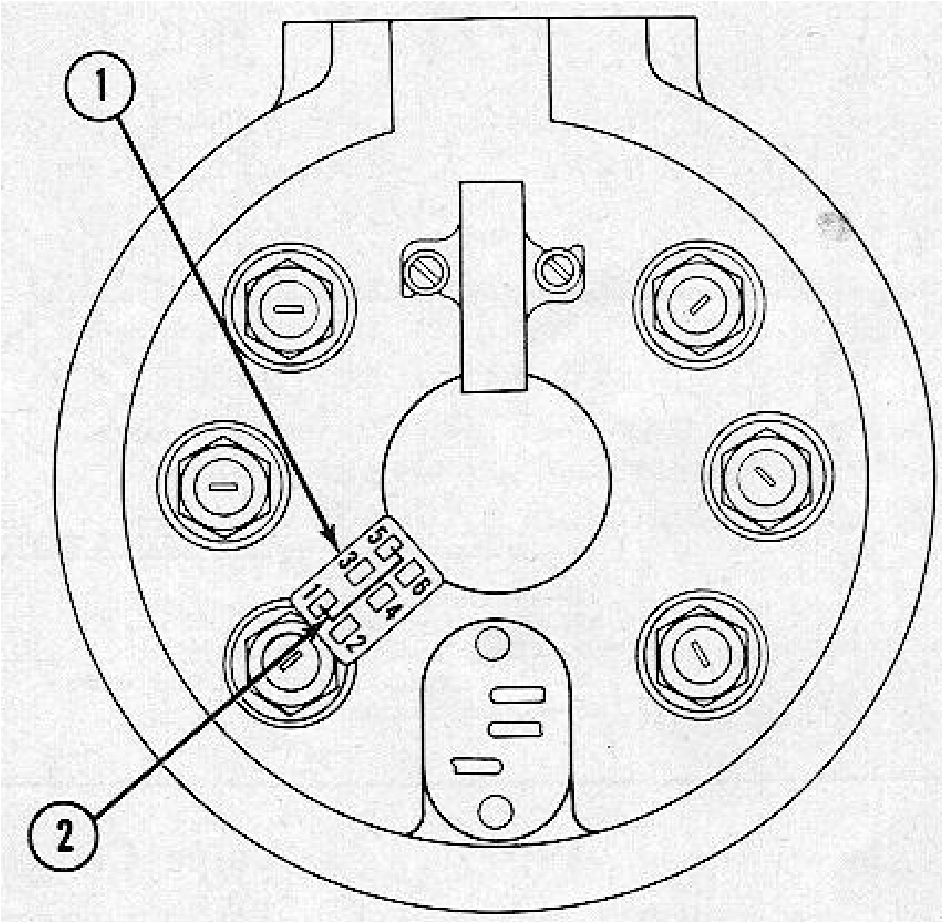


FIG. 06-23—JUMPER INSTALLED IN CONNECTOR
1 Connector
2 Wire jumper

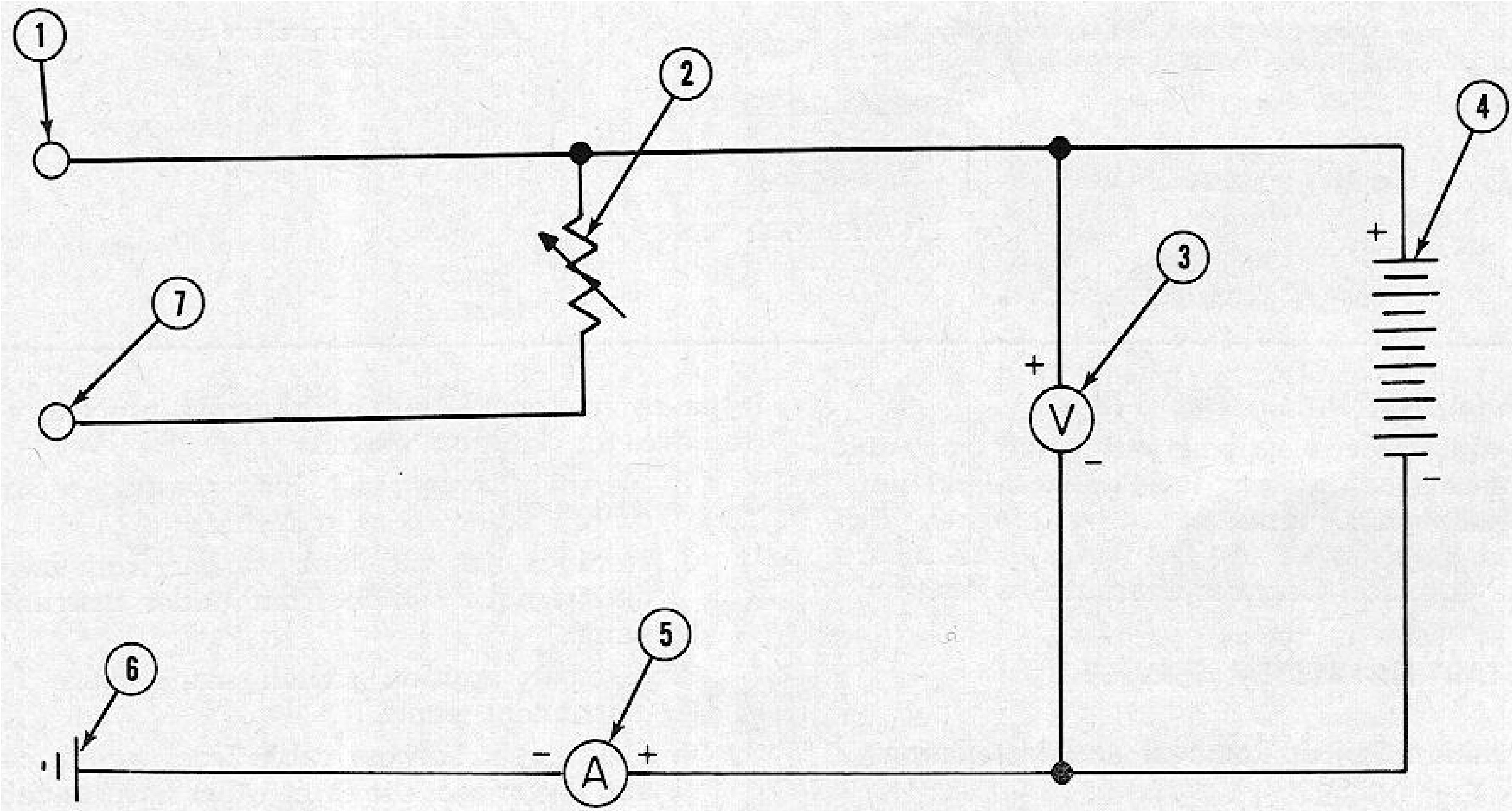


FIG. 06-24—ALTERNATOR REMOVED TEST CIRCUIT
1 Alternator positive terminal
2 Rheostat, 50 ohms, 50 watts
3 Voltmeter, 0-50 volts, dc
4 Test battery, 24-volts, fully charged
5 Ammeter, 0-100 amps, dc
6 Alternator housing ground terminal
7 Alternator ignition terminal

c. Test Setup with Regulator Installed. Install the regulator in the alternator as directed in Par. 06-24. Connect the alternator as shown in Fig. 06-25. The 0- to 20-ampere ammeter measures field current; the 0- to 100-ampere ammeter measures load current; and the 0- to 50-volt voltmeter measures alternator output voltage.

Note: The field current switch must be closed at all times during tests. This switch completes the field coil circuit.

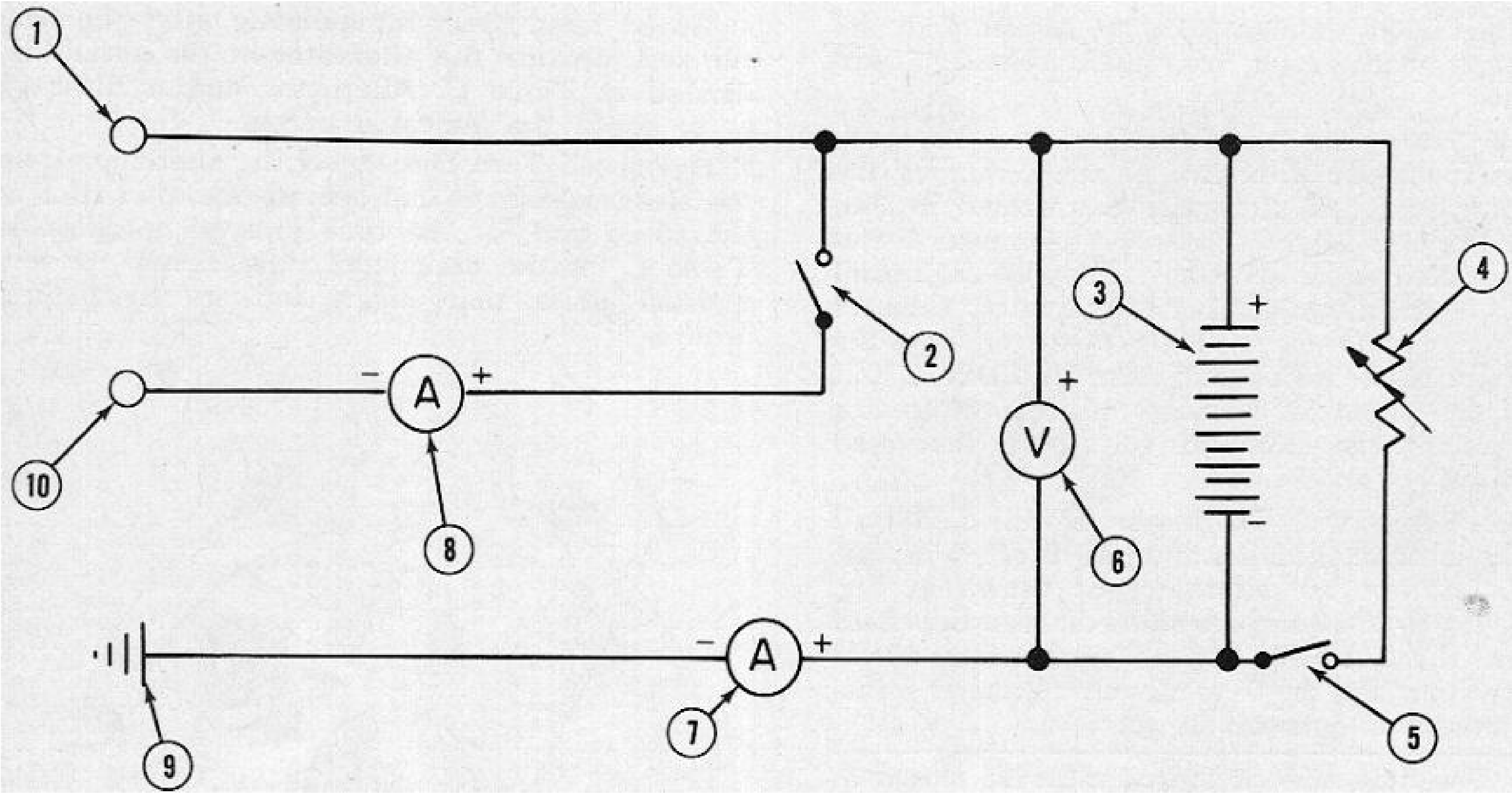


FIG. 06-25—ALTERNATOR REGULATED TEST CIRCUIT

1 Positive terminal	6 Voltmeter, 0-50 volt dc
2 Field current switch	7 Ammeter, 0-100 amps dc
3 Test battery — 24-volt	8 Ammeter, 0-20 amps dc
4 Rheostat, 75 ohms, 2000 watt	9 Alternator housing ground terminal
5 Load Switch	10 Ignition terminal

d. Heat Run Test. Operate the alternator under the conditions given in Table C. Adjust the alternator output voltage to 28 volts by removing the pipe plug, (Fig. 06-11) and rotating the potentiometer adjusting screw. Operate for 1 hour. Check frequently that temperature rise does not exceed 280° F.

Note: Perform this test at room temperature of 80° F.

e. Speed Load Test. Immediately after the heat run test, operate the alternator at the speeds indicated in Table C. Alternator output must be at or above the indicated output.

f. Overspeed Test. Disconnect the alternator from the electrical circuit and operate the alternator at the speed and for the time interval specified in Table C for the designated time. Listen for any unusual noise that might indicate mechanical failure.

Table C. Alternator Test Data

REGULATOR REMOVED TEST			
Speed (rpm)	Amperage	Voltage	
1500 - 1800	55 - 60	28 - 30	
HEAT RUN TEST			
Speed (rpm)	Amperage	Time	Allowable temperature rise
2000	58	1 hr	280°F
SPEED LOAD TEST			
Speed (rpm)	Amperage	Voltage	
2000	58	28	
OVERSPEED TEST			
Speed (rpm)	Time		
8000	10 Min.		

CHAPTER 9
Repair Of Instrument Cluster, Instruments, Switches And Indicator Lights

9-1. General.
This chapter contains procedures for disassembly, cleaning, inspection, repair and reassembly of the instrument cluster. Repair of the following items consists of replacing worn, defective or otherwise unserviceable components by the direct exchange method:
a. Ignition Switch.
b. Starter Switch.
c. Headlamp Selector Switch.
d. Directional Signal Switch.
e. Indicator Light Switch.
f. Ventilator Blower Switch (Ambulance only).
g. Horn Switch.

9-2. Removal, Disassembly, Cleaning, Inspection, Repair or Replacement, Reassembly and Installation.
Refer to TM 9-2320-244-20.

CHAPTER 10
REPAIR OF TRANSMISSION ASSEMBLY

10-1 General

a. This chapter contains description, instructions for removal, disassembly, cleaning, inspection, repair or replacement, reassembly and installation of the transmission assembly.
b. The transmission assembly (fig 10-1) is a manual shift, 4-speed, synchromesh type with all forward gears of helical design and synchromesh engagement in second, third and fourth gear.
c. The main drive gear is supported by a ball bearing at the front end of the transmission case and is piloted at its front end in an oil impregnated bushing mounted in the crankshaft.
d. The front end of the mainshaft is piloted in a row of roller bearings set into the hollow end of the main drive gear and the rear end is carried by a ball bearing mounted in the rear transmission case.
e. The counter gear is carried on a double row of rollers at both ends. The reverse idler gear is carried on a single row of rollers at both ends. Thrust is taken on thrust washers located between the ends of the counter and reverse idler gear and the thrust bosses in the case.
f. The forward gears, second, third and fourth, are fully synchronized. The synchronizer assembly consists of clutch hubs, clutch sleeves, clutch springs, and three synchronizer plates and are retained on the mainshaft by a select fit snap ring.
g. The shift is manual through a cane shift lever and interlock assembly to the rearward shift fork operating low and second gear and to the forward shift fork operating third and fourth gear.

10-2. Removal.

a. Gearshift Lever.
(1) Loosen rubber boot clamp and jam-nut on shift lever.
(2) Turn shift counter-clockwise and remove from transmission.
b. Transmission Top Cover.
(1) Remove gearshift lever as described in (a) above.
(2) Remove screws securing transfer case floor pan cover to cab floor panel.
(3) Remove bolts and washers which secure transmission floor pan cover to cab floor panel.
(4) Lift transmission floor pan cover and seal and disconnect from transmission and transfer case shift levers.
(5) Disconnect transmission ventilation pipe from transmission tower.
(6) Remove bolts and lock washers which secure transmission top cover to transmission case.
(7) Partially engage transmission into reverse gear while pulling up on shift lever and top cover. When cover dislodges from case, remove top cover assembly.
c. Transmission.
(1) Remove gearshift lever as described in (a) above.
(2) Remove the transfer lever cover and floor board inspection cover. Disconnect ventilation pipe to transmission cover.
(3) From underside of vehicle disconnect the transfer shift rods and parking brake control cable from the lever assembly mounted on the right side of the transmission housing.
(4) Remove the three bolts securing transfer lever and parking brake handle assembly to the transmission and remove lever and handle assembly.
(5) On winch equipped vehicles, disconnect power-take-off control rod from power-take-off mounted on the left side of the transmission.
(6) On winch equipped vehicles, disconnect winch drive propeller shaft from power-take-off.
(7) Disconnect and remove the intermediate propeller shaft mounted between the transmission and transfer case. To do this, loosen the transfer case mounting and move slightly back.
(8) Disconnect the front axle propeller shaft from the transfer case.

(9) Place jacks under the engine and transmission. Protect the engine oil pan with a block of wood placed between the pack and pan.
(10) Remove bolts securing torque arm and rear engine mount to frame cross-member.
(11) Remove bolts securing engine support frame crossmember to right and left frame side rail brackets and slide cross-member rearward to free member from brackets. Place crossmember on floor out of work area.
(12) Remove the four bolts securing the transmission to the flywheel housing.
(13) Lower engine and transmission slightly while sliding transmission rearward. When transmission main drive clears the flywheel housing, t il t transmission slightly forward and lower transmission to floor. Remove transmission from under the vehicle.

10-3. Disassembly. (Fig 10-1)
a. Subassemblies.
(1) Mount transmission in suitable holding fixture and remove cap screws attaching transmission top cover assembly (2) to transmission case. Remove top cover and gasket (1).
(2) Remove five bolts (34) securing power take-off housing to the transmission housing. Remove power take-off housing assembly and gasket (33).
(3) Remove propeller shaft yoke (51) and transmission main shaft rear bearing retainer assembly (47) from rear of transmission.
(4) Remove oil seal (48) from the bearing retainer housing (47).
(5) To make certain the two blocking rings (1, 14, fig 10-3), direct-and-third clutch hub (6 fig 10-3) and the direct-and-third clutch sleeve (2 fig 10-3) will be reassembled in their original order, mark them with a quick-drying lacquer. Also mark the blocking ring, low-and-second clutch hub (18 fig 10-3) and the low-and-second speed gear (20 fig 10-3).
(6) Slide low-and-second gear (20 fig 10-3) toward rear of the transmission case.
(7) Remove reverse shifting arm pivot pin (38 fig 10-1) from case.
(8) Remove reverse shifting arm pivot (9) and oil seal (10 fig 10-1).
(9) Remove reverse shifting arm (7 fig 10-1) from case.
(10) Slide low-and-second gear back into neutral position.
(11) Remove snap rings (1, 2, fig 10-2) from main drive gear shaft (5 fig 10-2) and outer race of the ball bearing (3 fig 10-2).

NOTE

If only the main drive gear bearing is to be replaced, it can be removed with a bearing puller.

(12) The oil slinger (4 fig 10-2) can be removed after removing the main drive gear bearing (3 fig 10-2).
(13) Remove snap ring (40 fig 10-1) from outer bearing race of the transmission main shaft rear ball bearing (39).
(14) Using a bearing puller, remove mainshaft ball bearing.
(15) Disengage mainshaft assembly (3 fig 10-1) from the main drive gear (28).
(16) Being careful not to lose the mainshaft pilot bearing rollers (29), lift mainshaft assembly out through top of transmission case (30).
(17) Pull main drive gear (28) out from rear of transmission case.
(18) Remove mainshaft pilot bearing rollers (29) from cavity of main drive gear (28).
(19) Remove lock plate bolt (46), lock washer (45) and lock plate (44).
(20) Use pry bar in lock plate slot of reverse idler gear shaft (43) to loosen shaft, Then slip shaft out of housing and gear (17).
(21) Lift reverse idler gear assembly (17) out through top of transmission case.
(22) With a heavy brass drift, drive countershaft (37) toward rear of transmission case. When countershaft end is even with inside of transmission case, use a dummy shaft to force it the remainder of the way.
(23) With dummy shaft in position, place transmission case on its side and carefully roll countershaft gears (19) out of case.
(24) Complete disassembly by removing dummy shaft, thrust washers (4, 5, 23), four sets of bearing rollers and spacers (20, 21, 22).

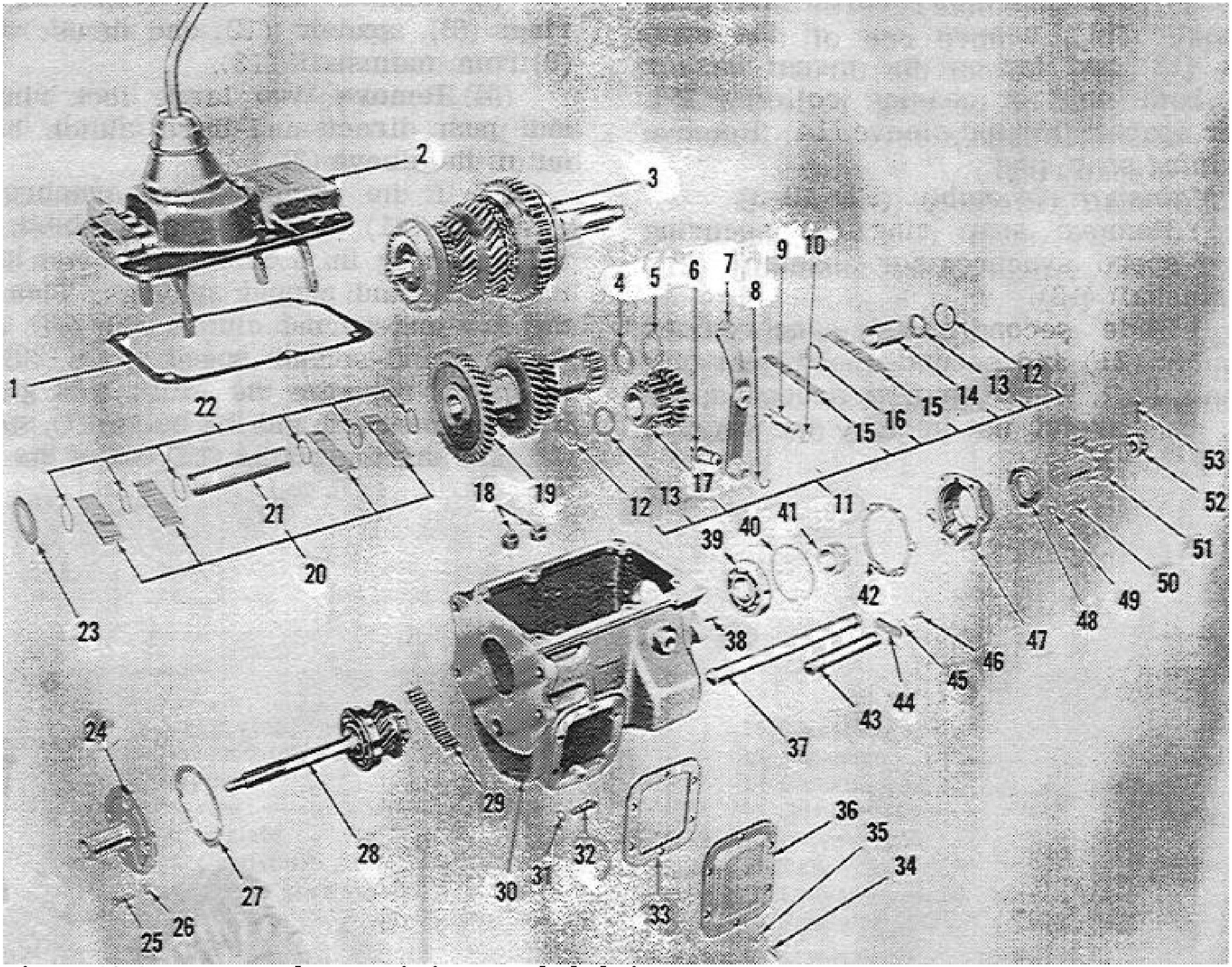


Figure 10-1. Four speed transmission - exploded view.

1 Gasket, top cover	19 Gears, transmission countershaft	37 Countershaft gear, transmission
2 Top cover assembly	20 Bearing, roller, countershaft gear	38 Pin, taper, no. 0 (shifting arm pivot)
3 Shaft, main assembly	21 Spacer, countershaft bearing	39 Bearing, transmission main shaft

4 Washer, countershaft thrust, rear	22 Washer, countershaft bearing	40 Snap ring, main shaft bearing
5 Washer, countershaft thrust, rear (steel)	23 Washer, countershaft thrust, front (bronze)	41 Collar
6 Shoe, transmission shifting, reverse	24 Retainer, main drive gear bearing	42 Gasket
7 Arm, transmission reverse shifting	25 Bolt, hex head, 5/16-inch -18 x 7/8-inch	43 Shaft, reverse idler gear
8 Washer, “C” transmission shifting shoe, reverse	26 Lock washer, 5/16-inch	44 Plate, lock, idler and countershaft
9 Pivot, transmission reverse shifting arm	27 Gasket, bearing retainer, main drive gear	45 Lock washer, 3/8-inch
10 Oil seal, transmission reverse shifting arm pivot	28 Gear, main drive (27 teeth)	46 Bolt, hex head, 3/8-inch -16 x 3/4-inch
11 Gear, reverse idler, assembly	29 Roller, transmission main shaft pilot bearing	47 Bearing retainer housing
12 Snap ring, reverse idler gear	30 Case, transmission	48 Seal
13 Washer, reverse idler gear thrust	31 Lock washer, 9/16-inch	49 Star washer
14 Sleeve, reverse idler shaft	32 Bolt, hex head, 9/16-inch -12 x 1-3/4-inch	50 Cap screw
15 Roller, reverse idler gear bearing	33 Gasket, transmission case side opening cover	51 End yoke
16 Spacer, reverse idler gear bearing roller	34 Bolt, hex head, 3/8-inch -16 x 5/8-inch	52 Lock nut
17 Gear, reverse idler	35 Lock washer, 3/8-inch	53 Cotter pin
18 Plug, pipe, 3/4-inch	36 Cover, transmission, case side opening	

(25) To disassemble reverse idler gear assembly (11), remove one of the snap rings (12) and tap out the thrust washer (13), both sets of bearing rollers (15), center spacer (16) and sleeve (14). Remove remaining snap ring.

b. Mainshaft Assembly. (Fig 10-3)

(1) Remove snap ring (8) securing second-speed synchronizer assembly (21) on mainshaft (13).

(2) Slide second-speed synchronizer assembly (21) and second-speed gear (11) off mainshaft. When removing second-speed gear, be careful not to lose the bearing rollers (10).

(3) Remove the two remaining snap rings (8), spacer (12) and thrust washer (9) from mainshaft (13).

(4) Remove two large lock rings (4) and push direct-and-third clutch hub (6) out of the sleeve (2).

(5) If the second-speed synchronizer assembly (21) is to be disassembled, wrap the assembly in a cloth to prevent loss of lock balls and poppet springs. Then push the low-and-second clutch hub (18) out of the low-and-second speed gear (20) in a direction opposite the shift fork groove. Remove the cloth and lift balls (17), springs (16) and shifting plates (15) out of the hub.

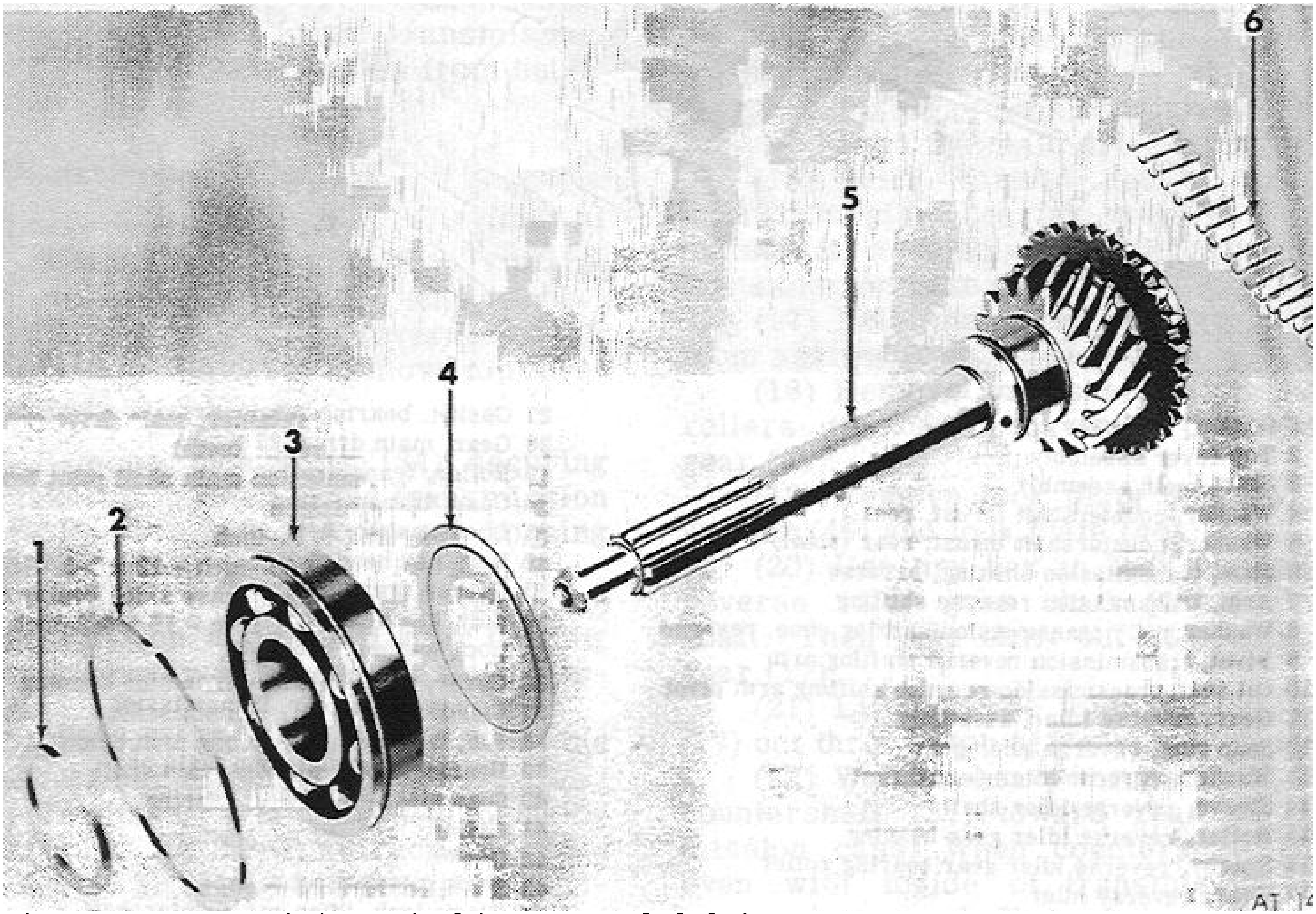


Figure 10-2. Transmission main drive gear-exploded view

1 Snap ring
2 Snap ring
3 Bearing
4 Oil slinger washer
5 Main drive gear
6 Bearing rollers

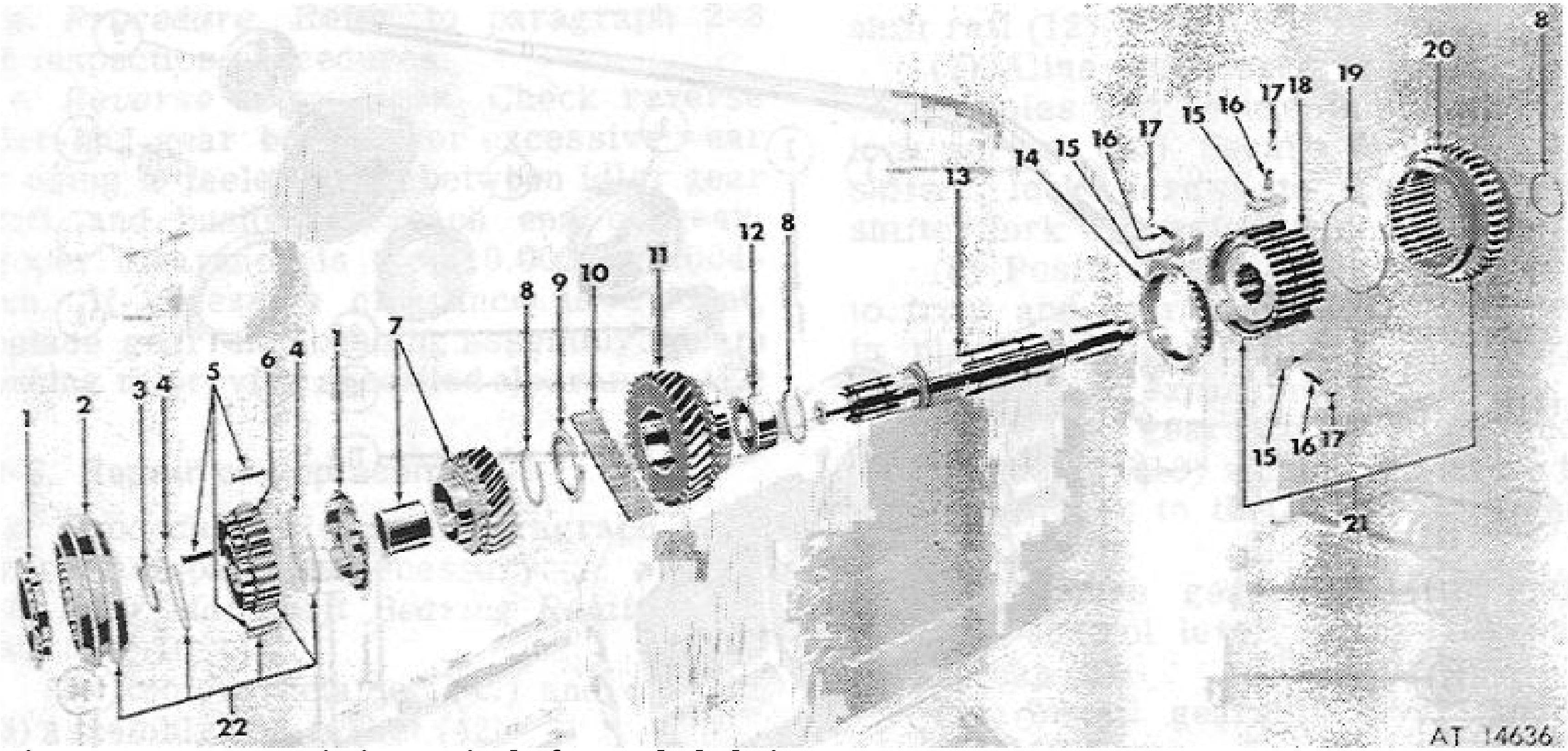


Figure 10-3. Transmission mainshaft - exploded view.

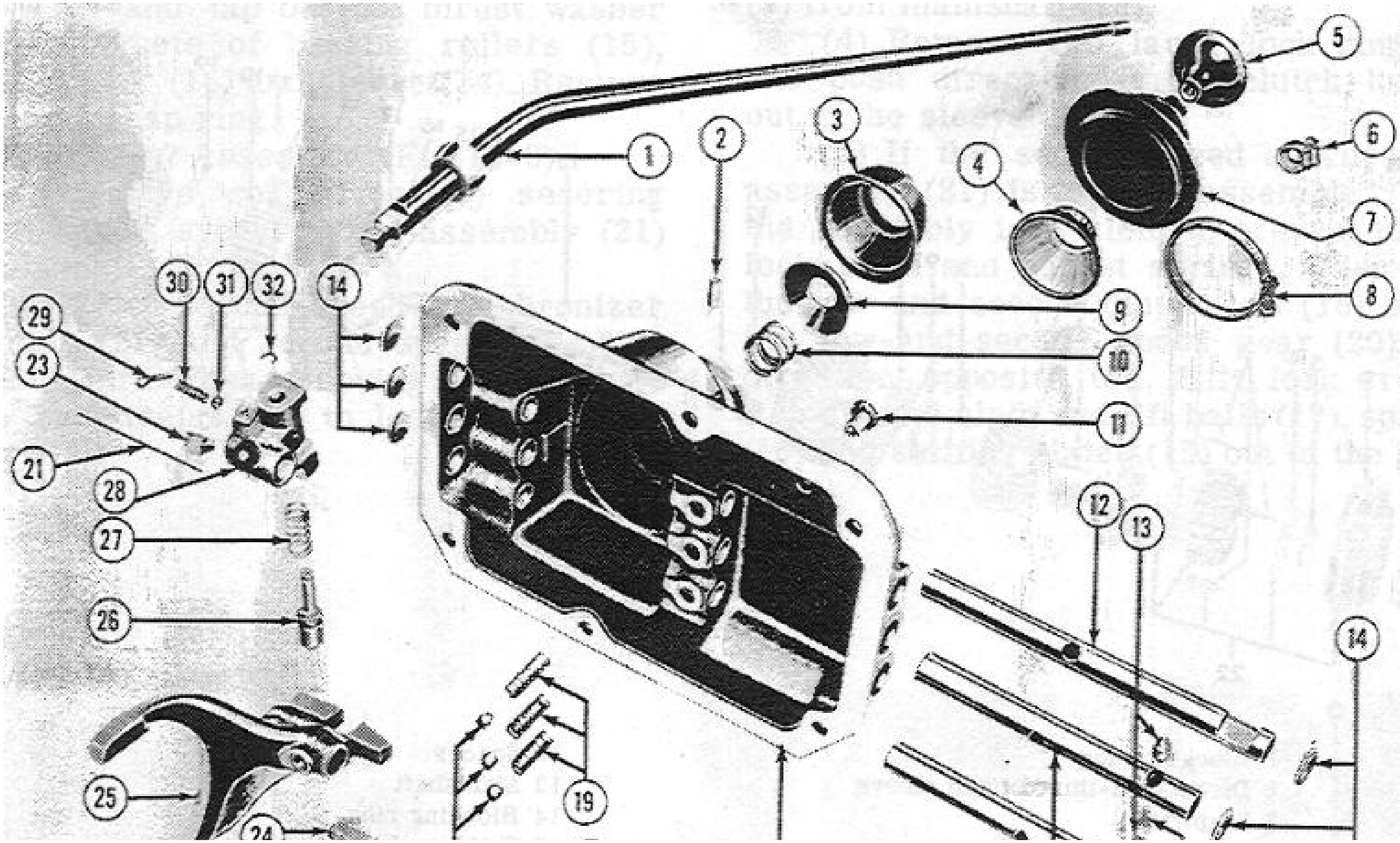
1 Blocking ring	7 Third-speed gear assembly	13 Mainshaft	19 Retaining ring
2 Direct-and-third clutch sleeve	8 Snap ring	14 Blocking ring	20 Low-and-second speed gear
3 Snap ring	9 Thrust washer	15 Shifting plate	21 Second-speed synchronizer assy.
4 Lock ring	10 Bearing rollers	16 Poppet spring	22 Direct-and-third synchronizer assy.
5 Shifting plate	11 Second-speed gear	17 Ball	
6 Direct-and-third clutch hub	12 Spacer	18 Low-and-second clutch hub	

c. Transmission Top Cover Assembly. (Fig 10-4)

NOTE

If hard shifting, simultaneous shifting into two gears, or jumping out of gear is experienced, the trouble m.ay be in the cover assembly.

(1) Remove three lock wires (21) and lock screws (23) from gearshift forks (22, 25) and gearshift rail ends (24, 28).
(2) Remove six expansion plugs (14) from front and rear of cover (18).
(3) Before removing shift rails, cover poppet ball hole to prevent loss of poppet balls and springs. Remove direct-and-third shift rail first (17). Drive direct-and-third shift rail rearward, out of cover assembly, remove shift rail interlock pin (16) from crossover hole in direct-and-third shift rail (17).
(4) Remove low-and-second speed shift rail (15) in the same manner.
(5) Remove shift rail poppet balls (20) and springs (19). Using a piece of wire, push the two shift rail interlock plungers (13) out of the pockets in the center section of the cover assembly (18).
d. Reverse Shift Rail End Assembly.
(Fig 10-4)
(1) Remove cotter pin (29) from reverse rail end (28) and, at same time, hold finger over hole to prevent loss of the reverse plunger poppet spring (30) and ball (31). Then shake out spring and ball.
(2) Compress spring (27) until C-washer groove just clears end of casting. Remove the C-washer (32). Remove reverse plunger (26).



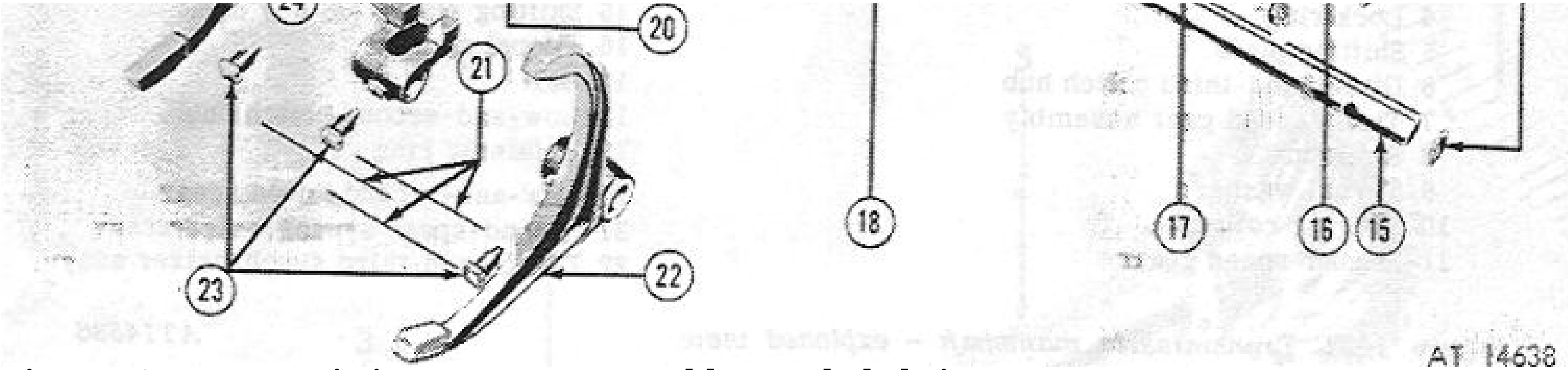


Figure 10-4. Transmission top cover assembly - exploded view.

1 Gearshift lever	9 Washer	17 Direct-and-third shift rail	25 Direct-and-third shift fork
2 Top cover pin	10 Control lever spring	18 Top cover	26 Reverse plunger
3 Top cover cap	11 Pipe plug	19 Shift rail poppet spring	27 Reverse plunger spring
4 Spherical cap	12 Reverse shift rail	20 Shift rail poppet ball	28 Reverse rail end
5 Shift lever knob	13 Shift rail interlock plunger	21 Lock wire	29 Cotter pin
6 Upper boot clamp	14 Expansion plug	22 Low-and-second Shift fork	30 Reverse plunger poppet spring
7 Gearshift lever boot	15 Low-and-second shift rail	23 Lock screw	31 Reverse plunger poppet ball
8 Lower boot clamp	16 Shift rail interlock pin	24 Shift rail end	32 C-washer

10-4 Cleaning
a. All metallic parts of transmission assembly, except bearings and seals, should be cleaned thoroughly with drycleaning solvent, volatile mineral spirits base paint thinner, or steam. Do not use caustic soda for steam cleaning.
b. Parts should be dried with compressed air. Steam-cleaned parts should be oiled immediately after drying.
c. After cleaning, examine parts, especially oil passages, to make certain they are entirely clean.
d. Refer to TM 9-214 for care and maintenance of bearings.

10-5 Inspection
a. Procedure. Refer to paragraph 2-8 for inspection procedures.
b. Reverse Idler Gear. Check reverse idler and gear bushing for excessive wear by using a feeler gage. between idler gear shaft and bushing at each end of gear. Proper clearance is from 0.002 to 0.004-inch. If excessive clearance is evident, replace gear and bushing assembly. Ream bushing to provide specified clearance.

10-6. Repair of Replacement.
a. Procedure. Refer to paragraph 10-5 and replace parts as necessary.
b. Rear Mainshaft Bearing Retainer Oil Seal. (Fig 10-1)
(1) Remove retainer (47) and oil seal (48) assembly and gasket (42).
(2) Pry oil seal out of retainer.
(3) Install new seal with lip of seal toward front of transmission.

10-7. Reassembly.

a. Reverse Shift Rail End Assembly. (Fig 10-4)

(1) Insert reverse plunger spring (27) and reverse plunger (26) into reverse rail end (12). Compress reverse plunger (26) until grooved end clears casting and secure in place with C-washer (32).

(2) Position reverse plunger poppet ball (31) and spring (30) into reverse rail end (12). Compress ball and spring and secure with cotter pin (29).

b. Transmission Top Cover Assembly. (Fig 10-4)

(1) Position the two shift rail interlock plungers (13) and interlock pin (16) into pocket of center section of top cover assembly (18).

(2) Install shift rail poppet balls (20) and springs (19) into their respective positions in the cover.

(3) Compress low and second speed shift rail poppet ball and spring and install low and second speed shift fork (22), shift rail end and shift rail (15).

(4) Neutralize low and second speed shift rail (15) so interlock will center in the shift rail detent pocket.

(5) Compress direct and third shift rail poppet ball and spring and install shift fork and shift rail (25).

(6) Compress reverse rail poppet ball and spring and position reverse rail end assembly to the cover. Install the reverse shift rail (12).

(7) Aline shift forks to shift rail lock screw holes and secure in place with four lock screws (23). Secure each of the four shifter lock screws to their respective shifter fork with safety wire (21).

(8) Position six expansion plugs (14) to front and rear of cover (18) and secure in place by tapping firmly on the raised portion of each expansion plug.

(9) Install gearshift lever (1) and pin (2) into cover (18) and, at the same time, aline the lever to the shifter fork neutral groove.

(10) Secure gearshift lever and pin with the control lever spring (10), washer (9) and cap (3).

(11) Install gearshift lever (knob) (5) on gearshift lever.

c. Mainshaft Assembly. (Fig 10-3)

(1) Position the three shifting plates (15), poppet springs (16) and balls (17) into the recesses in the low and second clutch hub (18).

(2) Slide low-and-second speed gear (20) on low and second clutch hub (18), at the same time guiding the second-speed gear over the three shifting plates, poppet springs and balls.

(3) Install retaining ring (19) at rear of second-speed synchronizer assembly (21).

(4) Install blocking ring (14) at front of second-speed synchronizer assembly (21).

(5) Install second-speed synchronizer on main shaft and secure in position with two snap rings (8).

(6) Lubricate and install bearing rollers (10) and spacer (12) into second-speed gear (11).

(7) Install second-speed gear (11) on mainshaft (13) and center with the blocking ring (14). Secure in place with snap ring (8).

(8) Position thrust washer (9) on mainshaft (13) and to second-speed gear.

(9) Assemble third-speed gear assembly (7) onto mainshaft (13).

(10) Position three shifting plates (5) to the direct and third clutch hub (6).

(11) Assemble direct and third clutch sleeve (2) on direct and third clutch hub (6) and over the three shift plates (5).

(12) Install two lock rings (4) onto the direct and third synchronizer assembly (22).

(13) Position both blocking rings (1) to the direct and third synchronizer assembly (22).

(14) Install direct and third synchronizer assembly (22) to mainshaft (13) and secure in place with a snap ring (3).

d. Main Drive Gear. (Fig 10-2)

(1) Lubricate and install rollers (6) to cavity of main drive gear (5).

(2) Assemble oil slinger washer (4) and roller bearing (3) to main drive gear and secure with snap ring (2).

NOTE

Outer snap ring (1 fig 10-2) will be installed after assembling main drive gear to transmission.

e. Transmission Subassemblies. (Fig 10-1)

(1) Lubricate and install rollers (15), spacer (16), sleeve (14) and thrust washer (13) into reverse idler gear (17) and secure in position with two snap rings (12).

(2) Position reverse idler gear (17) with groove facing toward front of transmission case and install reverse idler gear shaft (43) with groove for locking plate facing "in" toward the center.

NOTE

Use care installing the reverse idler shaft so as not to dislodge the needle roller bearings in the reverse idler gear.

(3) Install dummy shaft in counter shaft gear (37).
(4) Lubricate and install long spacer (21), spacer washers (22), bearing rollers (20) and thrust washers (23, 4, 5) to the countershaft gear (19), using dummy shaft as a guide.
(5) Install reverse shifting shoe (6) into reverse shifting arm (7) and secure in place with the retaining C-washer (8).
(6) Position reverse shifting arm to reverse idler groove and to the transmission case.
(7) Install new oil seal (10) on reverse shifting arm pivot (9).
(8) Install reverse shifter arm pivot
and oil seal (10) to transmission case (30) and reverse shifter arm (7).
(9) Secure reverse shifter arm pivot (9) to case with the shifting arm pivot taper pin (38).
(10) Tilt transmission on side and, with dummy shaft still in position, roll countershaft gear assembly (19) and thrust washers (23, 4, 5) into position in transmission case (30).
(11) Slide main drive gear assembly (28) into front bore of transmission case. Install outer snap ring.
(12) Tilt mainshaft assembly (3) into transmission case and carefully guide front of mainshaft into roller bearing cavity of main drive gear (28).
(13) Install rear mainshaft bearing (39) and snap ring (40).
(14) Aline lock plate slots in reverse idler shaft (43) and counter-shaft-to-trans mission case (30) and install lock plate (44). Secure lock plate with bolt (46) and lock washer (45).
(15) Aline countershaft gear assembly (19) and thrust washers (23, 4, 5) to counter-shaft bores in transmission case and install countershaft (37) with lock plate slot (44) facing "out".

NOTE

Make sure countershaft is kept in direct contact with dummy shaft at all times to prevent dropping bearing rollers or thrust washers.

(16) Install front bearing retainer gasket (.27) and bearing retainer (24) and secure with four screws (25) and lock washerS (26).
(17) Install mainshaft spacer collar (41), rear bearing retainer gasket (42) and rear bearing retainer housing (47) and secure in place with five retaining cap screws (50) and lock washers (49).
(18) Install rear bearing retainer oil seal (48).

NOTE

Install oil seal with lip of seal facing forward.

(19) Install propeller shaft yoke (51) and nut (52). Torque propeller shaft yoke nut to 125 lbs-ft. and secure with a cotter pin (53).
(20) Place transmission gears in neutral and install transmission top cover gasket (1) and cover assembly (2). Secure with six cap screws and lock washers. Refer to figure 10-1.

10-8. Installation.
a. Transmission Assembly.
(1) Install new seal between transmission and flywheel housing.
(2) Position the transmission and move it forward to engage the transmission shift in the clutch and crankshaft pilot bearing. Do not attempt to force the

transmission through the clutch disk by hammering or other extreme methods. Turn output shaft, if necessary, to aline input shaft splines with clutch hub splines. Transmission must be in gear for this step.
(3) Install the transmission attaching bolts and lock washers. Check alinement of transmission and tighten attaching bolts.
(4) Install engine support frame cross-member to right and left frame side rail brackets. Install bolts and tighten.
(5) Install torque arm and rear engine mount to rear crossmember bolts and tighten.
(6) Connect front axle propeller shaft to transfer case.
(7) Install power take-off control rod in power take-off shift lever. Install retaining clip in control rod.
(8) Position drive shaft to transmission output shaft yoke. Install attaching lock washers and nuts and tighten to 12-17 lbs-ft.
(9) Connect power take-off drive shaft to power take-off output shaft.
(10) Connect ventilation pipe to transmission tower.
(11) Check lubricant level.
b. Transmission Top Cover.
(1) Apply sealant to new gasket and position on transmission case.
(2) Position transmission top cover on transmission case and install six bolts and lock washers, Tighten securely.
(3) Connect ventilation pipe to transmission tower.
(4) Position transmission and transfer case floor pan cover over transfer case and transmission shift levers.
(5) Install bolts and lock washers which secure transmission floor pan cover to cab floor panel. Tighten securely. Install transfer case floor pan cover screws.
(6) Install transmission gearshift lever as described in (c) below.
(c) Gearshift Lever.
(1) Install gearshift lever and turn clockwise until tight.
(2) Tighten gearshift lever jamnut securely against gearshift lever. Install rubber boot and tighten clamp.

CHAPTER 11
Repair Of Clutch Assembly And Pilot Bearing

11-1. General.
This chapter contains description and instructions for removal, disassembly, cleaning, inspection, repair or replacement, reassembly and installation of the clutch (where applicable), clutch housing cover and clutch pilot bushing.
a. Clutch Assembly. The clutch assembly (fig. 2-5), consists of a clutch cover, pressure plate and a driven plate. When the clutch is engaged, the pressure plate forces the driven disk against the engine flywheel to transmit torque through the driven friction disk to the transmission main drive gear.
b. Clutch Housing Cover. The clutch housing cover supports a system of levers for engaging and disengaging the pressure plate. A cover plate, located in the bottom of the clutch housing, allows convenient access for inspection or removal of the clutch assembly.
c. Clutch Pilot Bushing. The clutch pilot bushing is pressed into the crankshaft and can be serviced only when the clutch is removed from the vehicle. The clutch pilot bushing is lubricated at time of assembly.

11-2. Removal.
a. Clutch Housing.
(1) Remove transmission assembly refer to paragraph 10-2.
(2) Remove clutch assembly refer to paragraph 2-19.
(3) Remove cable from starting motor.
(4) Remove bolts and lock washers which secure starting motor to clutch housing.

(5) Remove nuts and bolts securing flywheel assembly to crankshaft. Remove flywheel.
(6) Remove bolts securing clutch housing to engine block. Remove clutch housing.
b. Clutch Assembly. Refer to paragraph 2-19.
c. Clutch Pilot Bushing.
(1) Remove transmission assembly (para 10-2).
(2) Remove clutch housing assembly (a) above.
(3) Remove clutch assembly (para 2-1 9a).
(4) Place clutch pilot bushing tool in center of flywheel and remove bushing.

11-3. Disassembly.
a. Clutch Housing.
(1) Remove wire from yoke bolt and remove bolt. Remove yoke spring.
(2) Pull yoke shaft from clutch housing. Remove yoke from shaft.
(3) Remove yoke shaft housing plug and remove yoke shaft bushings by pressing out of housing.
(4) Remove housing access plate by removing attaching bolts.
b. Clutch Cover and Pressure Plate Assembly. Disassembly of clutch is not authorized.

11-4. Cleaning.
Clean pressure plate assembly thoroughly, using cleaning solvent. Blow dry with compressed air. Clean cover and hub of disk assembly with compressed air or a clean dry cloth.

NOTE
Throwout bearing is permanently packed with lubricant and should not be soaked in cleaning solvent as this may dissolve the lubricant.

11-5. Inspection.
a. Inspect clutch springs, fingers and cover for excessive wear or damage.
b. Inspect pressure plate and flywheel for scores on contact surface.
c. Check throwcut bearing for roughness and free fit on sleeve of transmission clutch gear bearing retainer.
d. Check runout of transmission pilot hole in clutch housing by installing an indicator. Runout should be within an indicator reading of 0.005 inch dial. Refer to paragraph 2-18b(4).
e. Inspect clutch disk for worn, loose or oil soaked facings.
f. Examine splines in hub and insure that they slide freely on splines of transmission clutch shaft.
g. Inspect clutch pilot bushing for excessive looseness, wear or roughness.

11-6. Repair or Replacement.
a. Refer to paragraph 11-5 and replace those components that are unserviceable.
b. Replace clutch cover and pressure plate as a unit. Repair is not authorized.

11-7. Reassembly.
a. Clutch Housing.
(1) Install yoke shaft bushings into clutch housing. Lubricate bushings.
(2) Install yoke shaft plug into housing.
(3) Connect yoke spring to each side of yoke sleeve. Install yoke onto shaft. Slide yoke shaft end into housing (use care not to dislodge plug in housing).
(4) Install yoke/shaft bolt and tighten to 15-25 lbs-ft.
(5) Install lock wire.

(6) Install housing cover access plate. Tighten bolts 14-25 lbs-ft.
b. Clutch Cover and Pressure Plate. If defective, replace complete assembly. Repair is not authorized.

11-8. Installation.
a. Clutch Pilot Bushing. Using installer tool, place pilot bushing on pilot of tool with radius in bore of bushing next to shoulder of tool and drive into crankshaft.
b. Clutch Assembly.
(1) Install new seal and secure housing cover to engine block. Tighten bolts to 40-50 lbs—ft.
(2) Install bolts and lock washers which secure starting motor to clutch housing. Tighten to 40-45 lbs-ft. Connect cable to starting motor.
(3) Install transmission assembly in accordance with paragraph 10-8.

Chapter 12

Repair Of Transfer Case Assembly

12-1. General.
a. This chapter contains description and instructions for removal, disassembly, cleaning, inspection, repair or replacement, reassembly and installation of the transfer case assembly.
b. The transfer case assembly (fig 12-1) is a two speed manual shift assembly mounted under the body on a frame cross-member. The transfer case input shaft is connected to the transmission by a propeller shaft. The transfer case assembly provides the vehicle with two wheel drive and four wheel drive by transmitting power to the front and rear axles using conventional propeller shafts. Shifting of the transfer case gears is controlled by two levers located in the cab, right of driver. (Fig 12-2)

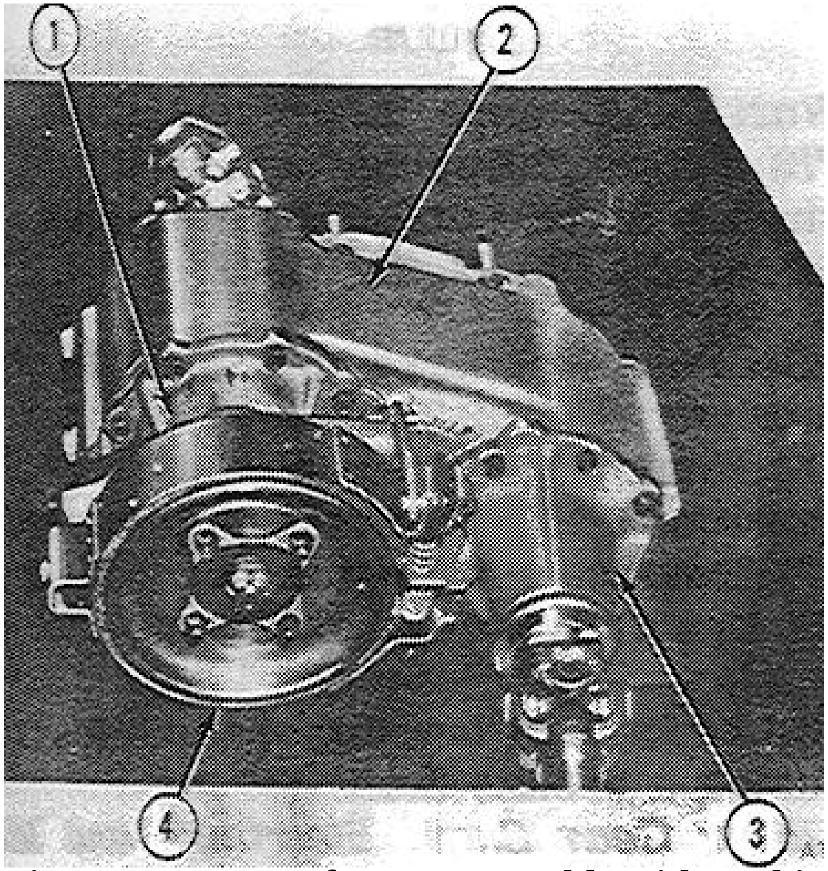


Figure 12-1. Transfer case assembly with parking brake installed.

1 Brake output shaft bearing retainer assembly
2 Transfer case assembly
3 Rear axle output shaft bearing assembly
4 Brake assembly

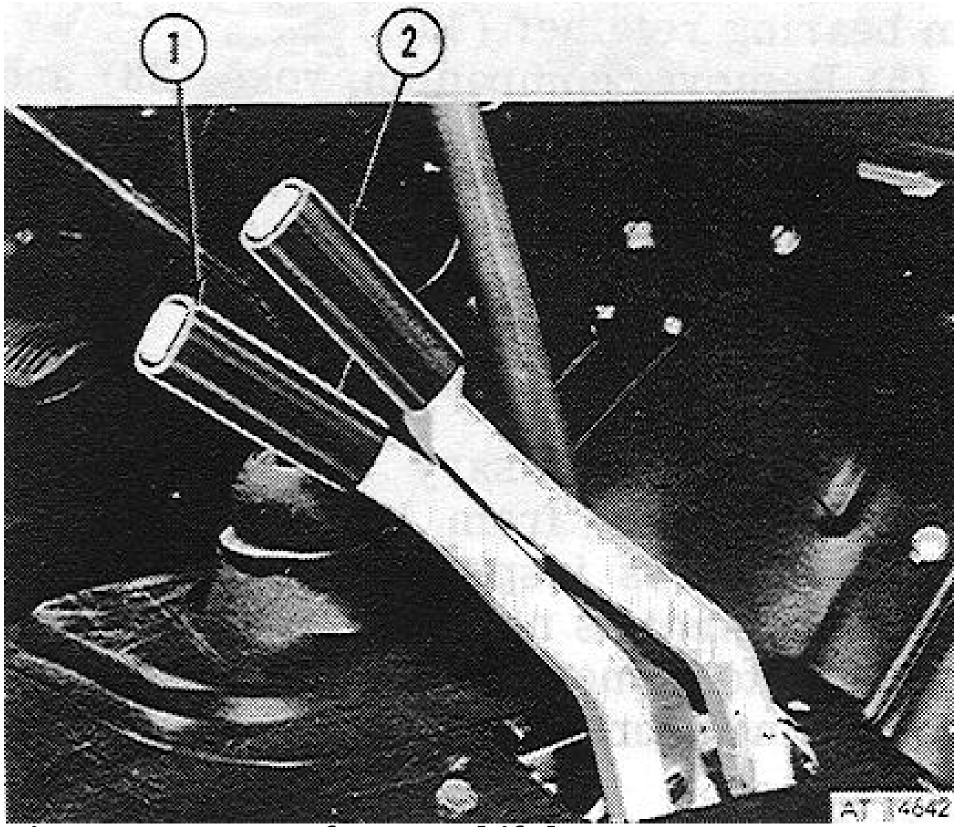


Figure 12-2. Transfer case shift levers

1 De-clutch lever
2 Shift lever

12-2. Removal.
Refer to TM 9-2320-244-20 for removal of the transfer assembly.

12-3. Disassembly.
To simplify the servicing of the transfer case assembly, the unit is divided into three subassemblies. These are the brake output shaft bearing retainer assembly (fig 12-3); the rear axle output shaft bearing retainer assembly (fig 12-4) and the transfer case assembly (fig 12-5), which consists of the idler gear, input shaft, front axle output shaft and the shifter parts.
a. Brake Output Shaft Bearing Retainer Assembly. (Fig 12-3)
(1) Remove pipe plug from bottom of case and drain lubricant. Clean exterior of case with cleaning solvent and dry with compressed air. Mount transfer case in suitable holding fixture.
(2) Remove brake output shaft bearing retainer assembly from transfer case by applying brake and removing cotter pin (28) and slotted nut (29) from brake output shaft (58).
(3) Remove cap screws (47), stud nuts (6) and washers (5) attaching bearing retainer to transfer case. Remove bearing retainer (49), gasket (43) and brake assembly as a unit.
(4) Remove speedometer drive retaining nut (2) and speedometer drive gear (3) from bearing retainer (49).

(5) Remove companion yoke (33) and brake drum (34).
(6) Remove brake support (42).
(7) Remove companion yoke oil seal (39) from brake support (42) using tool W-286.

NOTE

It is not necessary to remove bearing cups from bearing retainer unless inspection indicates replacement is necessary. If necessary to remove cups drive them out using a brass drift.

(8) To remove bearing retainer assembly (49), remove output shaft (58), rear bearing cone (44), bearing shims (50, 51, 52, 53), speedometer drive gear spacer (54) and speedometer drive gear (55), from bearing retainer (49).
(9) Remove vent fitting (4).
(10) Remove front bearing cone (57) from output shaft.
(11) Remove output shaft rollers (59) from counterbore of shaft (58).
b. Rear Axle Output Shaft Bearing Retainer Assembly. (Fig 12-4)
(1) Hold yoke with wrench C-3281, remove cotter pin (3) and remove yoke nut (4).
(2) Remove companion yoke oil seal (7) with tool W-286. Remove seal carefully to avoid damage to retainer (12).
(3) Remove output shaft (20), front and rear bearing cones (8, 19), spacer (17) and bearing shims (13) from bearing retainer (12).
(4) Remove front bearing cone (19) from output shaft (20).
(5) Remove output shaft rollers (21) from counterbore or output shaft (20).
c. Shifter Fork, 2-Speed Clutch Gear and Shifter Shaft. (Fig 12-5)
(1) Remove locking wire (31) and screw (30) from shifter fork (75).
(2) Remove poppet ball screw (41), gasket (61), spring (62) and poppet ball (63).
(3) Remove shifter shaft (48), fork (75) and 2-speed clutch gear (74).
d. Front Axle Clutch Gear, Shifter Fork and Shaft. (Fig 12-5)
(1) Remove locking wire (24) and screw (23). Remove poppet ball screw (13), gasket (14), spring (15) and poppet ball (16) from shifter fork (22).
(2) Remove shifter shaft (47), fork (22) and front axle clutch gear (25).
(3) Remove shifter shaft oil seals (46).
e. End Yoke and Front Axle Output Shaft. (Fig 12-5)
(1) Hold yoke (4) with wrench C-3281 and remove cotter pin (1) and yoke nut (2).
(2) Remove washer (3) and yoke (4).
(3) Remove front output shaft (21) and thrust washer (20) from case (64).
f. End Yoke, Input Shaft, Gear and Rollers. (Fig 12-5)
(1) Hold yoke (52) with wrench C-3281 and remove cotter pin (49) and yoke nut (50).
(2) Remove washer (51) and companion yoke (52) using puller W-172.

NOTE

Work with care to prevent shaft (73) from slipping out of input shaft gear (68) and to prevent loss of rollers (69, 71 fig 12-5).

g. Bearing Retainers and Ball Bearing Assemblies. (Fig 12-5)
(1) Remove bearing retainers (8, 56) and gaskets (9, 57) from transfer case (64).
(2) Remove companion yoke oil seals (5, 53) from transfer case using tool W-286.
(3) Drive ball bearing assemblies from case using a bronze drift.
h. Idler Gear Shaft, Bearings and Idler Gear. (Fig 12-5)

(1) Remove cotter pin (42), nut (44), cover (28) and gasket (29).
(2) Screw arbor, tool DD-852, on threaded idler shaft (77). Make certain that arbor is firmly seated against the shaft shoulder.
(3) Drive shaft from case using a plastic hammer.
(4) Remove arbor, DD-852, from shaft and leave arbor in idler gear (38).
(5) Remove idler gear (38) and bearing (76) from case.
(6) Remove arbor, DD-852, bearing cones (40, 76), shims (33 through 36) and spacer (37) from idler gear (38).

NOTE

It is not necessary to remove bearing cups from idler gear unless inspection indicates replacement is necessary. If necessary to remove cups, drive them out using a brass drift and hammer (fig 12-6).

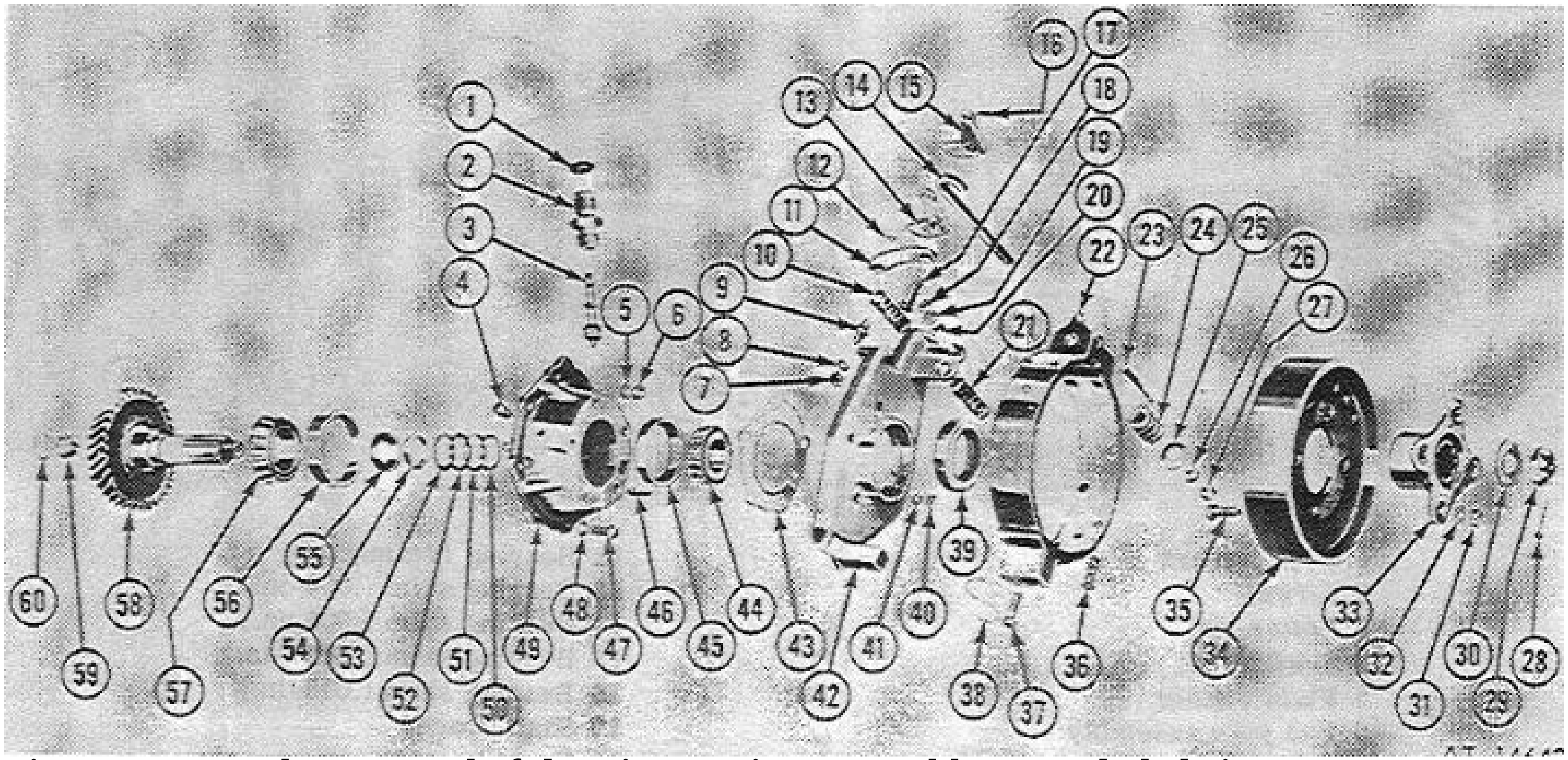


Figure 12-3. Brake output shaft bearing retainer assembly — exploded view.

1 Speedometer cable gasket and seal	21 Brake adjusting bolt compression spring	41 Lock washer
2 Speedometer drive gear retaining nut	22 Brake band assembly with lining	42 Brake support
3 Speedometer drive gear	23 Brake adjusting screw	43 Brake support gasket
4 Vent assembly	24 Brake operating compression spring	44 Rear bearing cone
5 Lock washer	25 Plain washer	45 Rear bearing cup
6 Nut	26 Nut	46 Stud

7 Nut	27 Nut	47 Screw
8 External teeth lock washer	28 Cotter pin	48 Lock washer
9 Brake spacer link stud	29 Slotted nut	49 Bearing retainer
10 Brake adjusting bolt compression spring	30 Plain washer	50 Bearing shim (0.004-in.)
11 Brake spacer link	31 Nut	51 Bearing shim (0.005-in.)
12 Cotter pin	32 Lock washer	52 Bearing shim (0.0125-in.)
13 Brake cam lever	33 Companion yoke	53 Bearing shim (0.015-in.)
14 Brake adjusting bolt	34 Brake drum	54 Speedometer drive gear spacer
15 Brake cam lever	35 Brake drum bolt	55 Speedometer drive gear
16 Cotter pin	36 Anchor clip compression spring	56 Front bearing cup
17 Brake cam lever clevis pin	37 Brake band anchor clip screw	57 Front bearing cone
18 Nut	38 Anchor clip screw locking wire	58 Output shaft with integral gear
19 Lock washer	39 Companion yoke oil seal	59 Output shaft rollers
20 Nut	40 Nut	60 Output shaft rollers snap ring

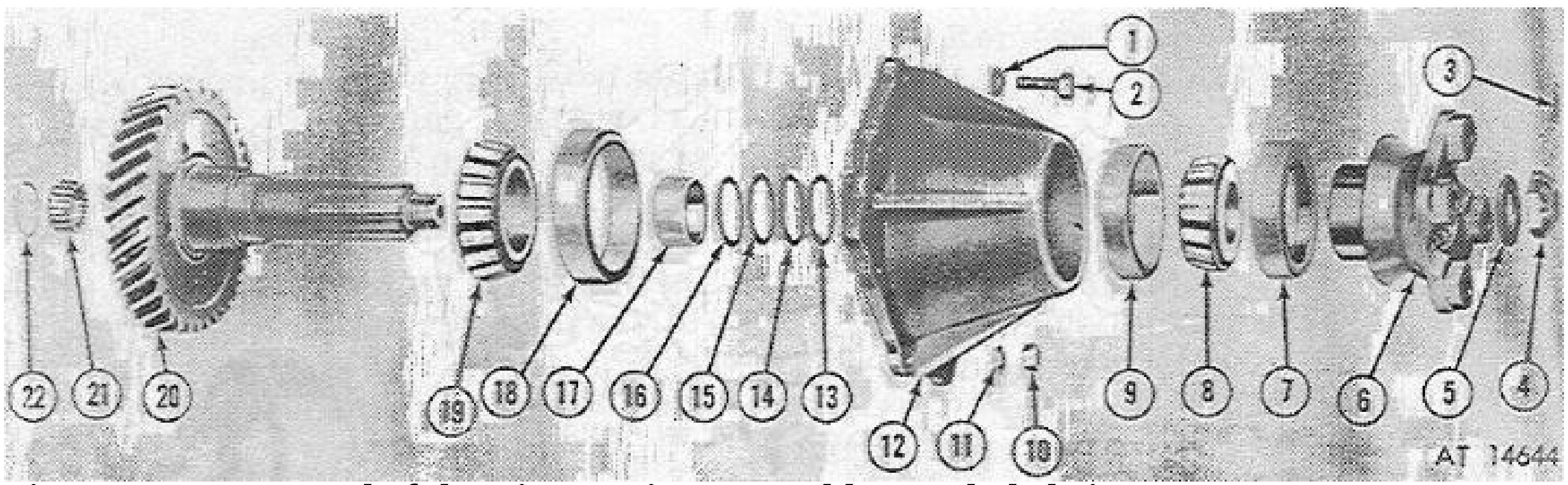


Figure 12-4. Output shaft bearing retainer assembly - exploded view.

1 Lock washer	9 Rear bearing cup	17 Shaft spacer
2 Screw	10 Nut	18 Front bearing cup
3 Cotter pin	11 Lock washer	19 Front bearing cone
4 Slotted nut	12 Bearing retainer	20 Output shaft with integral gear
5 Plain washer	13 Bearing shim (.004-in.)	21 Output shaft rollers
6 End yoke assembly	14 Bearing shim (.005-in.)	22 Output shaft rollers snap ring

7 Oil seal	15 Bearing shim (.0125-in.)
8 Rear bearing cone	16 Bearing shim (.015-in.)

12-4. Cleaning.

a. Bearings. Place all bearings and rollers in cleaning solution and allow to remain long enough to loosen all accumulated lubricant. Bearings shall be agitated, up and down, and turned slowly below surface of solution to remove lubricant. Remove bearings and blow out with compressed air, being careful to direct air across bearing so that bearings do not spin.

b. Shafts and Gears. Clean all shafts in cleaning solution to remove deposits. Dry with compressed air.

c. Case, Cover and Bearing Cups. Transfer case, cover and bearing cups shall be thoroughly cleaned in solution to remove deposits of lubricant and dirt. Remove all traces of gaskets from mating surfaces.

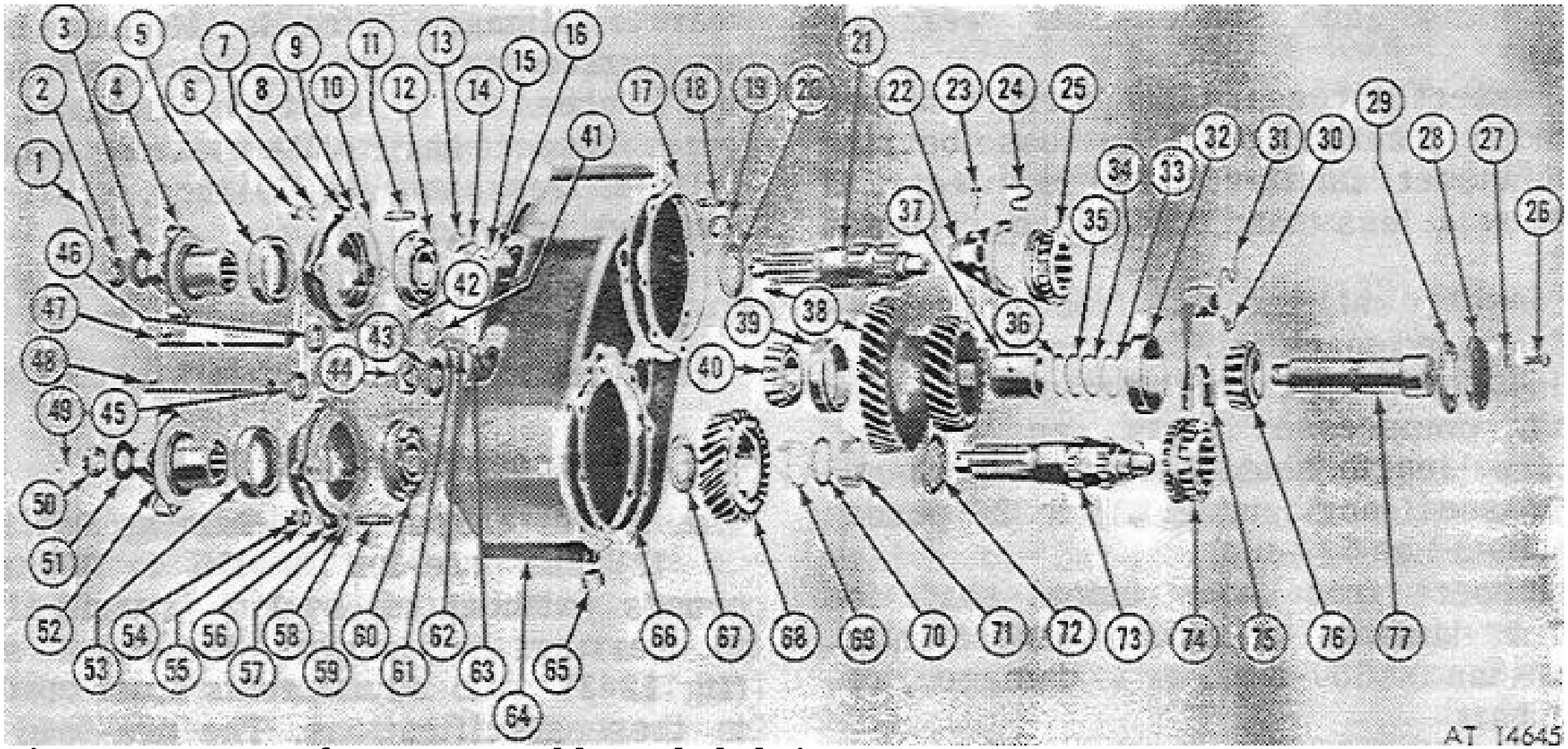


Figure 12-5. Transfer case assembly exploded view.

1 Cotter pin	21 Front axle output shaft	41 Poppet ball screw	61 Poppet ball screw gasket
2 Slotted nut	22 Shifter fork	42 Cotter pin	62 Poppet ball spring
3 Plain washer	23 Shifter fork screw	43 Plain washer	63 Poppet ball
4 End yoke	24 Locking wire	44 Slotted nut	64 Transfer case
5 Oil seal	25 Front axle clutch gear	45 Shifter shaft oil seal	65 Pipe plug
6 Nut	26 Screw	46 Shifter shaft oil seal	66 Bearing retainer gasket

7 Lock washer	27 Lock washer	47 Front axle clutch gear shifter shaft	67 Input shaft gear, outer thrust washer
8 Bearing retainer	28 Idler gear shaft cover	48 2-speed clutch gear shifter shaft	68 Input shaft gear
9 Bearing retainer gasket (.009-in.)	29 Idler gear shaft cover gasket	49 Cotter pin	69 Input shaft gear roller
10 Bearing retainer gasket (.013-in.)	30 Shifter fork screw	50 Slotted nut	70 Input shaft gear roller spacer
11 Bearing retainer stud	31 Locking wire	51 Plain washer	71 Input shaft gear roller
12 Ball bearing assembly	32 Idler gear	52 End yoke	72 Input shaft gear, inner thrust washer
13 Poppet ball screw	33 Bearing shim (.004-in.)	53 Oil seal	73 Input shaft
14 Poppet ball screw gasket	34 Bearing shim (.005-in.)	54 Nut	74 2-speed clutch gear
15 Poppet ball spring	35 Bearing shim (.0125-in.)	55 Lock washer	75 Shifter fork
16 Poppet ball	36 Bearing shim (.015-in.)	56 Bearing retainer	76 Idler gear bearing cone
17 Bearing retainer gasket	37 Idler gear bearing spacer	57 Bearing retainer gasket (.009-in.)	77 Idler gear shaft
18 Stud	38 Idler gear	58 Bearing retainer gasket (.013-in.)	
19 Pipe plug	39 Idler gear bearing cup	59 Bearing retainer stud	
20 Front axle output shaft thrust washer	40 Idler gear bearing cone	60 Ball bearing assembly	

12-5. Inspection.
a. Inspect all bearings, cones and cups for wear, corrosion, scores, chips or cracks and brinnelling. Inspect all bearing retainers for damaged machined surfaces, cracks, scores, or loose cups in bearing cup counterbores.
b. Inspect all shafts for worn, scored, cracked or damaged teeth, threads and splines.
c. Measure diameter of brake output shaft and bore of gear with a micrometer. If shaft measures less than 1.271-inches, replace the worn shaft and gear. Inspect output shaft rollers for wear, corrosion, or rough spots.
d. Measure diameter of rollers with a micrometer. If they are less than 0.218-inch, replace them.
e. Inspect all bolt holes, cap screws, nuts, shims and spacers for wear or damage.
f. Inspect all gears for worn, chipped scored or cracked teeth, or loose bearing cups. Inspect shifter shafts for wear. If diameter is less than 0.7445-inch, replace shafts.
g. Inspect shifter forks for misalinement, scored machined surfaces or cracks.
h. Inspect poppet ball springs for free length, compressed length and damage. The free length should be 13/16-inch and compressed length under 22 to 26 pounds load should be 5/8-inch.
i. Inspect front axle output shaft for wear or damage. If ground end of shaft is less than 0.830-inch, or is damaged, replace shaft.
j. Inspect input shaft gear for scores, chips or cracks. Measure bore with a micrometer. If more than 1.936-inches diameter in bore, or if damaged, replace gear.
k. Inspect input shaft rollers for wear, spots or corrosion and measure the diameter. If it is less than 0.158 to 0.1582-inch, replace rollers.
1. Inspect outer and inner input thrust washers and front axle output thrust washers for scores, cracks or and measure the thickness. If washer measures less

than 0.151-inches or is damaged, replace.
m. Inspect input shaft for chips, cracks, wear or damaged threads. Measure bearing surface for wear. If it is less than 1.6152-inches or if shaft is damaged, replace. Inspect shaft roller bearing surface. If it is less than 0.830-inch, or if it is damaged, replace.

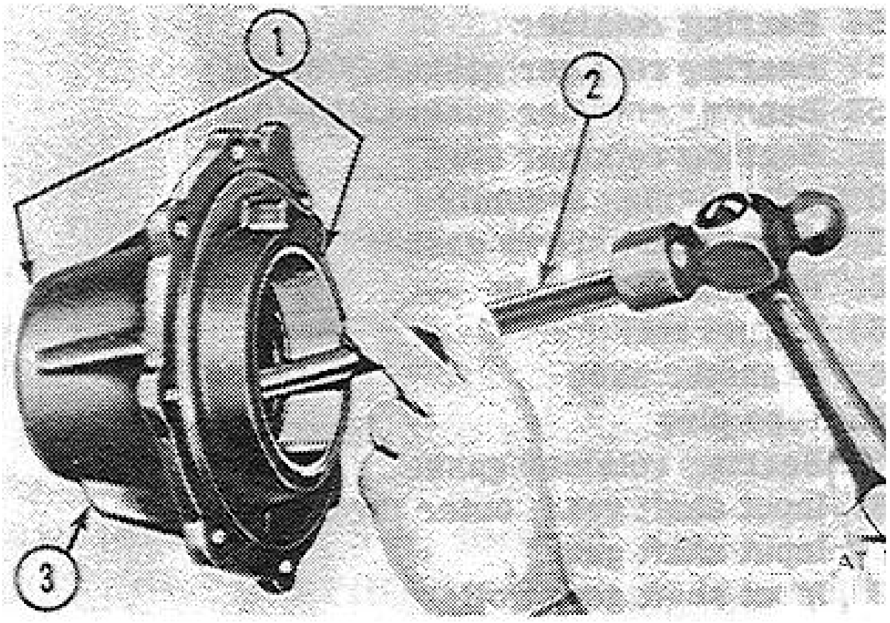


Figure 12-6. Removing bearing retainer caps.

1 Bearing retainer assembly
2 Drift punch
3 Retainer housing

12-6. Repair or Replacement.
Replace any worn or unserviceable parts

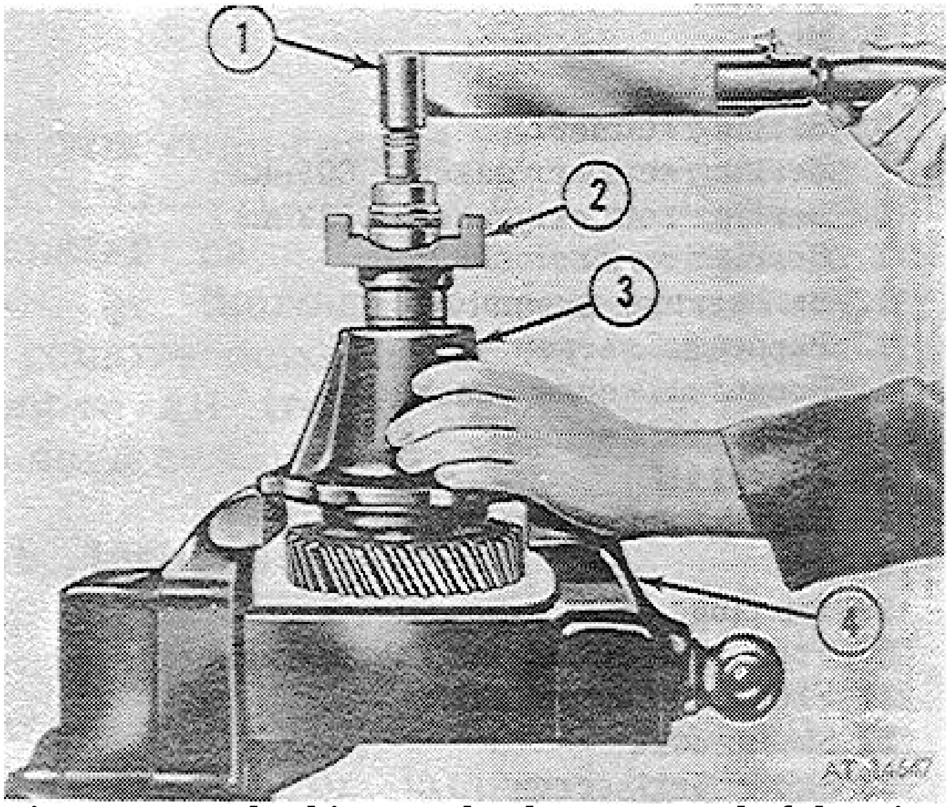


Figure 12-7. Checking pre-load on output shaft bearings.

1 Torque wrench
2 Companion yoke
3 Bearing retainer
4 Vise

12-7. Reassembly.

a. Brake Output Shaft Bearing Retainer.
(1) The pre-load of 15 to 30 inch-pounds (without oil seal) is specified for the bearings that support the output shaft (fig 12-3). All adjustments must conform to these specifications. The pre-load can be measured after all parts are properly assembled by rotating the output shaft with a torque wrench and socket on the companion yoke nut. (Fig 12-7)
(2) If they have been removed, install front and rear bearing cups in retainer.
(3) If replacement of bearing cups (fig 12-3), is necessary, clean the counterbores in the bearing retainer and remove all burrs. Using an arbor press, install bearing cups in the bearing retainer, being certain that they are firmly seated against the shoulders in the counterbores.
b. Brake Support on Bearing Retainer. (Fig 12-3)
(1) Tighten studs in bearing retainer (46).
(2) Place brake support gasket (43) and brake support (42) on bearing retainer (49) so that the cutout in gasket, and the oil drain openings in bearing retainer and brake support are alined.

(3) Install lock washers (5) and nuts (6).
(4) Tighten nuts securely.
c. Output Shaft Rollers. (Fig 12-3)
(1) Lubricate 15 rollers (59) with gear lubricant; position them in the output shaft counterbore (58) and install snap ring (60).
(2) Install front bearing cone (57) on output shaft (58).
(3) The front bearing cone should be installed on the output shaft with an arbor press and suitable tubular sleeve, pressing against inner cone of the bearing. Make certain bearing cone is firmly seated against the gear.
d. Output Shaft in Bearing Retainer. (Fig .12-3)
(1) Position speedometer drive gear (55), speedometer drive gear spacer (54) and bearing shims (50 through 53) on output shaft (58). If new shims are required, start with a 0.0365-inch shim pack consisting of (one each: 0.004-inch, 0.005-inch, 0.0125-inch and 0.015-inch shims.
(2) Check adjustment of bearings as outlined below.
(3) Lubricate bearings with gear lubricant and install output shaft in bearing retainer.
(4) Install rear bearing cone (44), companion yoke (33), washer (30), and slotted nut (29). Clamp companion yoke between copper jaws of a vise and tighten slotted nut with torque wrench and socket from 140 to 160 lbs-ft.
(5) Adjust pre-load on bearings (fig 12-7) as follows:
(6) Place bearing retainer on a suitable stand or in the open jaw of a vise, in a vertical position, so that the output shaft is free to rotate.
(7) Turn shaft with a torque wrench until bearings roll smoothly.
(8) Check pre-load on bearings with the wrench in motion. If the pre-load on bearings is not within 15 to 30 inch-pounds limit, (without oil seal) add or remove shims, as required, to obtain correct preload.

NOTE

Correct bearing pre-load is very important. It will assure quiet operation, prevent oil seal leakage and provide proper bearing life.

(9) Remove slotted nut (29), plain washer (30) and companion yoke (33). Refer to figure 12-3 and install oil seal (39), brake drum (34) and companion yoke (33) as follows.
(10) Prepare new companion yoke oil seal. It is necessary to soak the neoprene seal in oil but it should be lubricated before installation.

NOTE

Many oil seals are replaced because of lubricant seepage which has been incorrectly diagnosed as lubricant leakage. Seepage of lubricant is not always an indication of an ineffective oil seal. Some seepage is desired to preserve the seal lip and hub it contacts. If the lubricant seepage past the seal does not form a pool, and if the lubricant level in the unit does not change perceptibly after repeated checks, the seal is functioning properly and should not be replaced. Also, there is a marked difference between lubricant seepage and leakage from oil seals. Inspect to determine if the lubricant level in the unit is actually being lowered before replacement of the seal is made.

(11) Coat outer surface of oil seal with plastic type gasket cement. This will prevent lubrication leakage between the outer diameter of the seal and the inner diameter of the seal and the inner diameter of the seal recess.
(12) Position oil seal (39) in brake support (42) with lip of seal toward bearings.
(13) Install oil seal using end yoke and plastic hammer.
(14) Place companion yoke (33) in shallow side of brake drum (34) so that hub of companion yoke will protrude through brake drum.
(15) Insert drum bolts (35) from opposite side of drum, install lock washers (32) and nuts (31) and tighten nuts securely.
(16) Position speedometer drive gear (3) in bearing retainer (49), being certain that pilot at lower end of gear engages in hole of retainer boss.
(17) Place speedometer drive gear oil seal (1) in retaining nut (2) and install nut in bearing retainer assembly. Tighten nut.
(18) Install parking brake drum with end yoke on output shaft. Install plain washer (30) and slotted nut (29). Apply parking brake and tighten nut to 140-160

pounds feet torque.
(19) Install cotter pin (28).
(20) Install vent assembly (4) on top of bearing retainer assembly.
e. Rear Axle Output Shaft Bearing Retainer. (Fig 12-4)(1) A pre-load of 15 to 30 inch-pounds (without oil seal) is specified for the bearings that support the output shaft (fig 12-4).
(1) A pre-load of 15-30 inch-pounds (without oil seal) is specified for the bearings that support the output shaft (fig. 12-4). All adjustments must conform to these specifications. The pre-load can be measured, after all parts are assembled, by rotating the output shaft with a torque wrench and socket on the end yoke.
(2) Install front and rear bearing cups (9, 18) in retainer as follows:
(3) If inspections indicates that the front and rear bearing cups require replacement clean the counterbores in the bearing retainer and remove burrs that may be present.
(4) Install bearing cups (9, 18) in retainer with an arbor press, being certain cups are seated against the shoulders in the counterbore.
(5) Install output shaft rollers (21). Lubricate 14 rollers with gear lubricant; position them in the output shaft counter-bore (20) and install snap ring (22).
(6) Install front bearing cone on output shaft (19). The front bearing cone should be installed on the output shaft with an arbor press and suitable tubular sleeve, pressing against the inner cone of the bearing. Make certain bearing cone is firmly seated against the gear.
(7) Install output shaft in bearing retainer as follows:
(8) Position shaft spacer (17) and bearing shims (13 through 16) on output shaft (20). If shims are required, start with a 0.0365-inch shim pack, consisting of (one each): 0.004-inch, 0.005-inch, 0.0125-inch and 0.015-inch shims. Check adjustment bearings.
(9) Lubricate bearings with gear lubricant and install output shaft in bearing retainer.
(10) Install rear bearing cone (8), yoke (6), washer (5) and slotted nut(4).

NOTE

Be sure to use the correct end yoke.

(11) Clamp end yoke between copper jaws of a vise and tighten slotted nut with torque wrench and socket from 140 to 160 lbs-ft.
(12) Adjust pre-load on bearings (fig 12-7) as follows:
(13) Place bearing retainer on a suit able stand or on the open jaws of a vise in a vertical position, so that output shaft is free to rotate.
(14) Turn shaft with a torque wrench to assure bearings roll smoothly.
(15) Then check pre-load on bearings with the wrench in motion. If pre-load on bearings is not within 15 to 30 inch- pounds limit, add or remove shims to obtain correct pre-load.

NOTE

Correct bearing pre-load is very important. It will assure quiet operation, prevent oil seal leakage and provide proper bearing life.

(16) When correct pre-load is obtained, remove slotted nut (4), plain washer (5) and companion yoke (6).
(17) Install oil seal (7) and end yoke(6)

NOTE

Oil seal may be installed by starting seal and driving it into position with companion yoke.

(18) Prepare oil seal (fig 12-4) by coating outer surface of oil seal with a plastic type cement.
(19) Position seal (7) in bearing retainer (12) with lip of seal toward bearings and install seal with a plastic hammer.
(20) Install end yoke (6), plain washer (5) and slotted nut (4). Clamp end yoke between copper jaws of a vise and tighten slotted nut from 140 to 160 lbs-ft with a torque wrench and socket. Install cotter pin (3).
f. Idler Gear, Input Shaft, Front Axle Output Shaft and Shifter Parts.

(1) Tighten bearing retainer studs in transfer case (11 fig 12-5).
(2) Tighten the four studs in transfer case securing rear axle output shaft and brake output shaft bearing retainers.

CAUTION
These studs are installed adjacent to the idler gear (38 fig 12-5) to prevent interference. If long cap screws are used, gear may be damaged.

(3) If replacement of idler gear bearing cups (32, 39 fig 12-5) is necessary, install them in the idler gear using an arbor press, making certain that they are firmly seated against t h e counterbore shoulders.
(4) Adjust idler gear bushings (fig 12-8) as follows:
(5) Place large end of idler gear shaft (fig 12-8) vertically between copper jaws of a vise.
(6) Lubricate bearing cones with gear lubricant and place on bearing cone on idler gear shaft against shoulder. Then install spacer and bearing shims. If new shims are required, start with a 0.0365-inch shim pack, consisting of (one each): 0.004-inch, 0.005-inch, 0.0125-inch and 0.015inch thickness shims.
(7) Place idler gear on shaft, with the small gear end down, and install other bearing cone.
(8) Install bearing adjustment spacer tool DD-853, plain washer and nut hold spacer tool DD-853, and tighten nut to 140 to 160 lbs-ft with a torque wrench and socket. Rotate idler gear until bearings roll smoothly. The correct adjustment of idler gear bearing is free-rolling, but not end-play.
(9) To accomplish this correct adjustment, remove bearing shims until a slight drag is evident when gear is revolved. Then add a thin shim so that bearing will roll freely. Remove nut, washer and spacer tool DD-853, from idler gear shaft. Remove parts from vise.

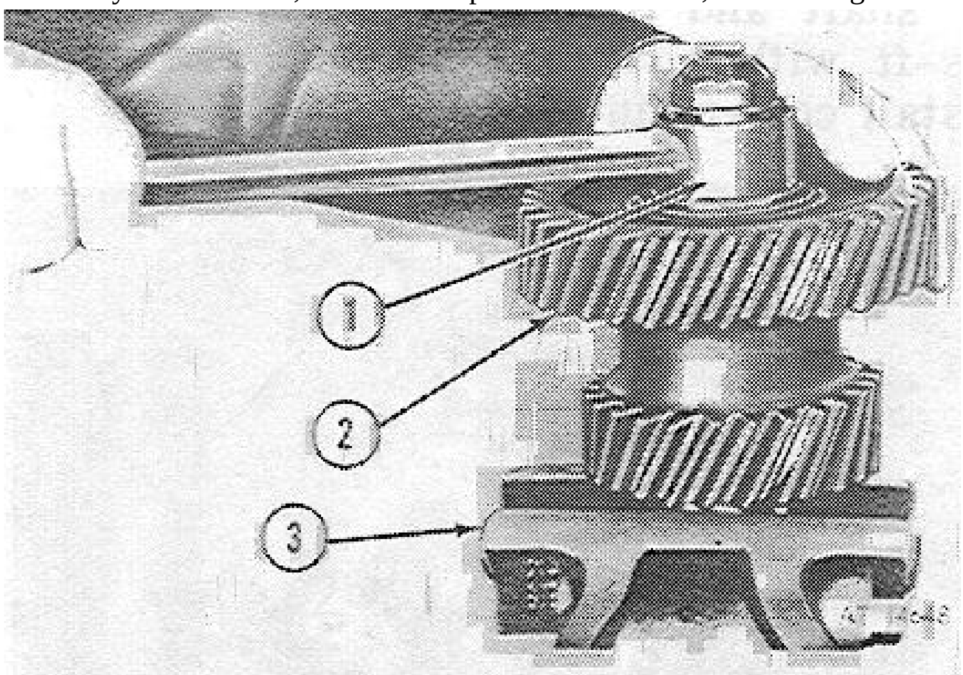


Figure 12-8. Checking idler gear bearing adjustment.

1 Spacer tool DD-853
2 Idler gear
3 Vise

(10) Install idler gear, shaft and bearings in case as follows:
(11) Place one of the idler gear bearing cones (40, 76 fig 12-5) in the large gear end of idler gear (38) and then position gear on bench with small gear end up.
(12) Install idler shaft arbor tool, DD852 (threaded end up), spacer (37), selected bearing shims (33 through 36) and other bearing cone and then place idler gear assembly in transfer case with small gear toward rear of case.

NOTE

The large openings in case are at the rear.

(13) Insert idler gear shaft through opening at rear of case and screw threaded end of shaft into arbor tool DD-852 (fig 12-9) previously installed in idler gear assembly. Make certain that the shaft is firmly seated in the arbor.

WARNING

Arbor tool, DD-852, must be used when idler gear shaft is installed to prevent damage to bearing shims.

(14) Drive idler gear shaft into case with a bronze drift and hammer, as far as it will go, and remove arbor. Install washer (43 fig 12-5) and slotted nut (44) on shaft and tighten nut from 140 to 160 lbs-ft with a torque wrench and socket. Install cotter pin (42).

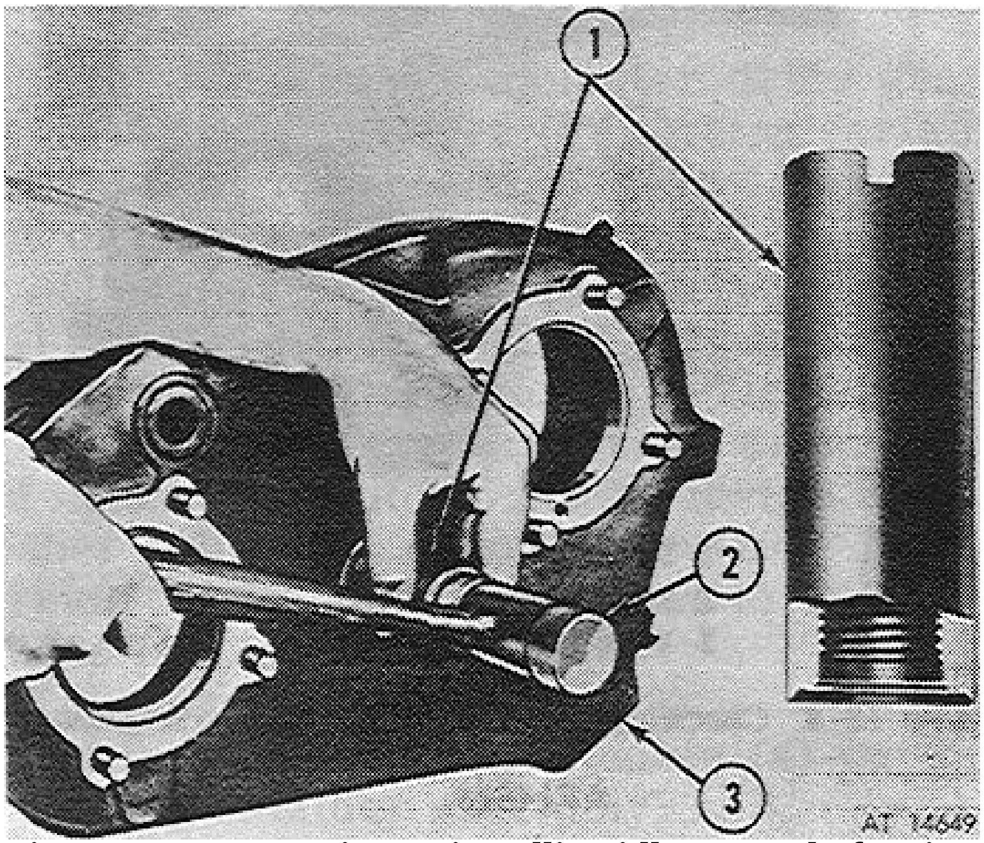


Figure 12-9. Removing or installing idler gear shaft using arbor tool.

1 Arbor tool DD-852
2 Mallet

3 Transfer case

NOTE

Never back off nut to aline cotter pin hole. Tighten, if necessary.

(15) Install gasket (29), cover (28), lock washers (27) and cap screws (26). Tighten screws. Install ball bearing assemblies (12, 60), bearing retainers (8, 56), gaskets (9, 57) and companion yoke oil seals (5, 53).
(16) Lubricate bearings with gear lubricant and install bearings in transfer case with a plastic hammer until bearing snap rings are firmly seated against case.
(17) Hold bearing retainers firmly against case with the hand and, without gaskets or nuts in place, measure clearance between machined surface of retainer and case with a thickness gage (fig 12-10).
(18) Select a combination of gaskets, that are 0.006-inch, more or less than the greatest clearance between retainer and case.

NOTE
Gaskets are available in 0.009-inch and 0.013-inch thickness.

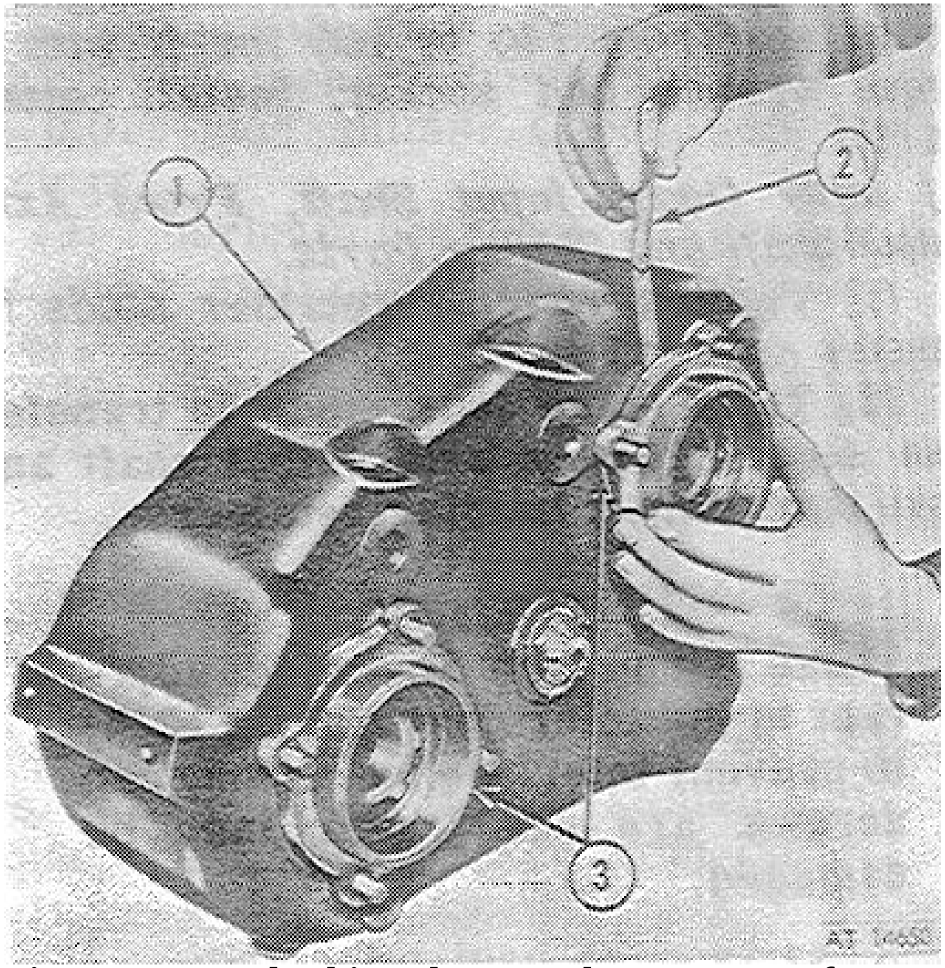


Figure 12-10. Checking clearance between transfer case and bearing retainer

1 Transfer case
2 Feeler gage
3 Bearing retainer

(19) Prepare companion yoke oil seals. Coat outer surface of oil seals with a plastic type gasket cement and position seals in bearing retainers with the lip of seal toward bearing.
(20) Install oil seals in retainers with plastic hammer.
(21) Install selected gaskets, bearing retainers, lock washers and nuts. Tighten nuts.
(22) Assemble input shaft rollers, gear and shaft (fig 12-li) as follows:
(23) Place input shaft gear (68 fig 12-5) on a clean surface with a plain side of gear up, and then position bearing installing sleeve tool, DD-854, (with tapered end up) in gear.
(24) Fill space between gear and sleeve tool, DD-854, with gear lubricant and install 35 rollers (69 fig 12-5), spacer (70) and the other 35 rollers (71).

NOTE

A total of 70 rollers is required.

(25) Position input shaft gear inner thrust washer (72 fig 12-5) on input shaft (73) and insert shaft in sleeve tool, DD854, as shown in figure 12-11. Keep rollers from coming out of gear and push input shaft into position. This will remove sleeve from rollers. Remove sleeve from shaft.

NOTE

Hold gear and shaft firmly to avoid disturbing the bearing rollers.

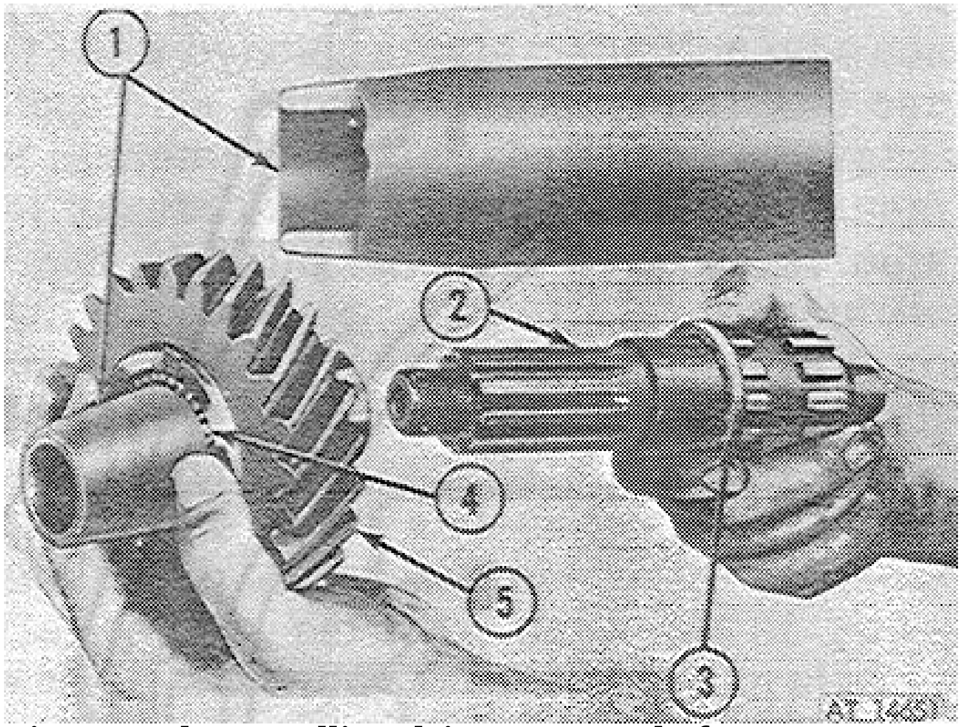


Figure 12-l1. Installing drive gear on shaft.

1 Sleeve tool DD-854
2 Drive shaft
3 Inner thrust washer
4 Rollers
5 Drive gear

(26) Place outer thrust washer (67 fig 12-5) over end of input shaft and position it against gear to prevent loss of rollers and then install input shaft assembly in transfer case. (Fig 12-12)
g. Brake Output Shaft Bearing Retainer Assembly.
(1) Place new bearing retainer gasket (fig 12-5) on bearing retainer.
(2) Position retainer onto transfer case so that pad on retainer flange covers the shifter shaft opening.
(3) Install lock washers on studs and cap screws.
(4) Install nuts and cap screws and tighten from 30 to 35 lbs-ft torque.
h. Rear Axle Output Shaft Bearing Retainer Assembly.
(1) Place new bearing retainer gasket (fig 12-4) on rear axle output shaft bearing retainer.
(2) Position retainer onto transfer case so that pad on retainer flange covers the shifter shaft opening.

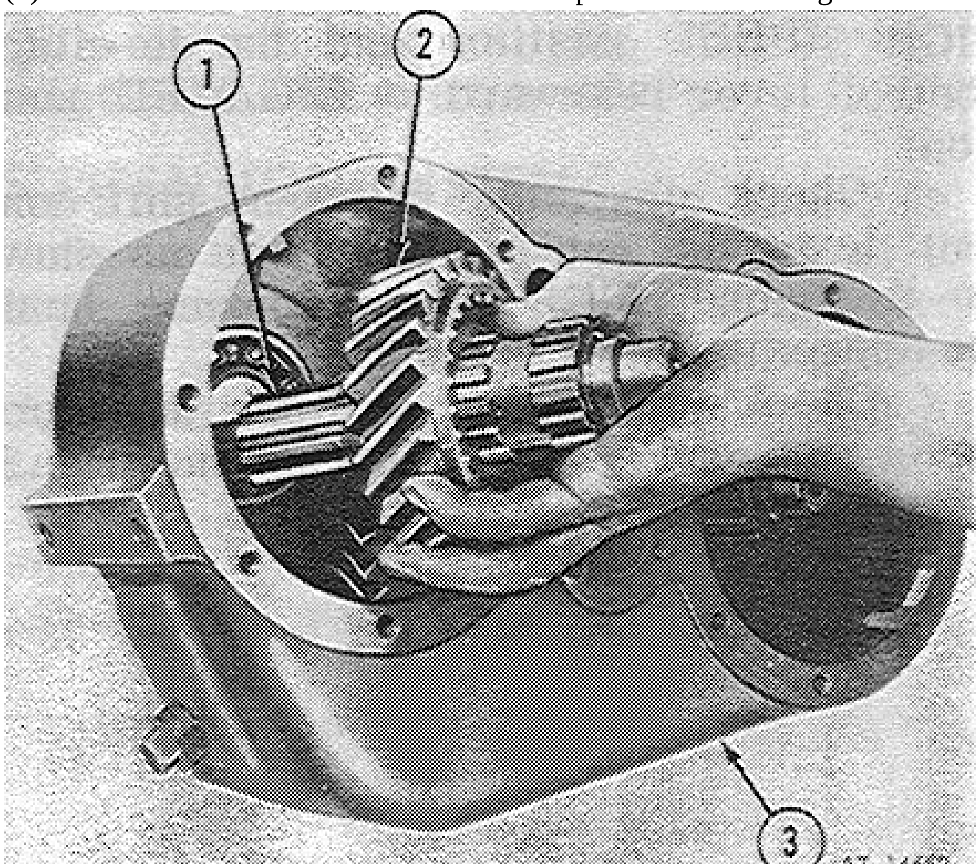


Figure 12-12. Removal and installation of drive gear and input shaft assembly.

1 Input shaft
2 Drive gear
3 Transfer case

(3) Install lock washers on studs and cap screws.
(4) Install nuts and cap screws and tighten from 30 to 35 lbs-ft torque.
(5) Install drain plug and tighten 25 to. 45 lbs-ft.

NOTE

With transfer case out of vehicle, fill assembly with five (5) pints of lubricant as specified: Install filler plug and tighten securely. Turn transfer case over, to allow lubricant to flow into the rear output bearing cavity.

12-8. Installation and Linkage Adjustments.
a. Install cross support and stabilizer bracket to transfer case.
b. Place transfer case on jack and roll under vehicle. Lift assembly into mounting position and secure cross supports and stabilizer bracket to frame side rails.
c. Install transfer case control rods, speedometer cable housing (using tool W326) and O-ring using tool W-326; brake cable and propeller shafts. Fill case with specified lubricant. Attach vent hose.
d. Shift speed control lever forward to HIGH SPEED position and the de-clutch control lever rearward to ENGAGED position.
e. Check clearance between shift control lever and end of floor slot as shown in A, figure 12-13. The clearance should be approximately 1/2-inch.
f. Check clearance between de-clutch lever and end of floor slot as shown in B, figure 12-13. The clearance should be approximately 5/8-inch.

NOTE

After adjusting levers, check and make shift rails fall into their respective “dedents” and the levers operate freely and have ‘‘full throw.’’

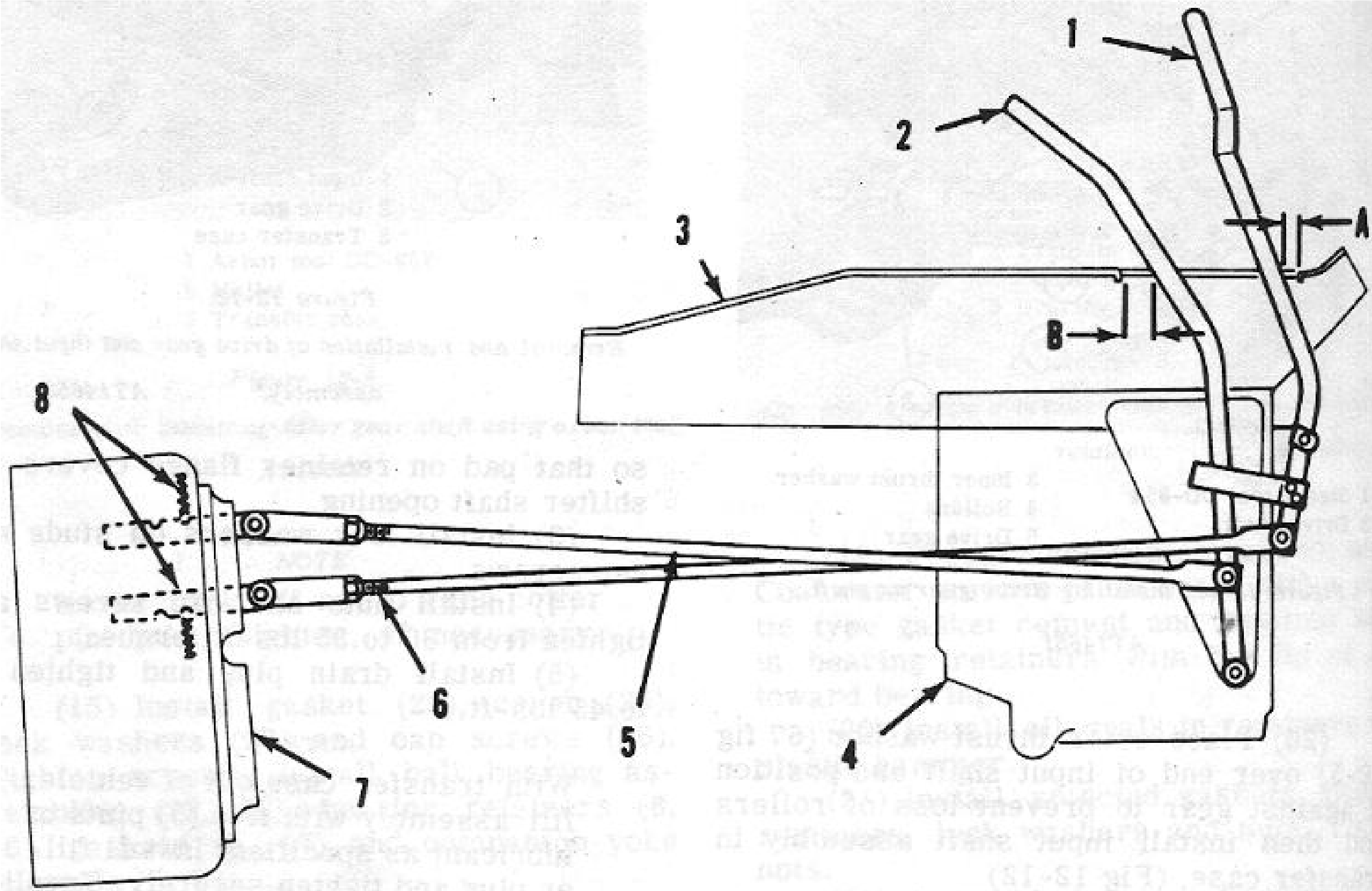


Figure 12-13. Transfer case shift rod assembly

1 De-clutch lever
2 Shift lever
3 Transmission floor cover
4 Transmission
5 Control shift rod
6 Control de-clutch rod
7 Transfer case
8 Poppet spring

CHAPTER 13
REPAIR OF FRONT AXLE AND SUSPENSION SYSTEM

Section I. FRONT AXLE ASSEMBLY

13-1. General.
The front driving axle assembly (fig 13-1) is a hypoid, single reduction type consisting of a housing, differential and carrier assembly, axle shaft and universal joint assemblies, steering tie rod assembly and steering knuckle support at outer ends of housing. Power is transmitted through drive pinion to drive gear and differential in same manner as rear axle. Power from differential is transmitted through axle shaft and universal joint assemblies to front wheels. Action of universal joints permits delivery of power to wheels when they are turned from straight ahead position.

13-2. Removal.
Refer to TM 9-2320-244-20 for removal of front axle.

13-3. Disassembly.
a. Front Axle Shaft Assembly. (Fig 13-1)
(1) Mount axle in suitable holding fixture.
(2) Drain lubricant from knuckle.
(3) Remove cap screws that attach brake backing plate and spindle to housing. Remove brake backing plate, then carefully remove spindle (9).
(4) Pull axle shaft assembly (23) from atle housing, working universal joint through bore of steering knuckle (12).
b. Universal Joints. (Fig 13-2)

CAUTION
To avoid damage to universal joint bearings, use a soft drift with a face about 1/32-inch smaller in diameter than hole in yoke arm to drive out bearing.

(1) Remove retainer snap rings (3) from bearing cup assemblies (2).
(2) Press on end of one bearing cup
assembly (2) until opposite bearing is pushed from yoke arm (1, 4). Turn yoke over and press first bearing back out of arm (press on exposed end of journal shaft).
(3) Repeat this process for the other two bearing cups. Bearing cross journal (7) can be removed by sliding it to one side.
c. Steering Knuckle. (Fig 13-1)
(1) Remove axle shaft and joint assembly (23), (a) above.
(2) Disconnect tie rod (52) from steering knuckle (12) by removing cotter pin and castle nut. Attach tool and press tie rod end from steering knuckle.
(3) Remove eight cap screws (26) and seal washers (25) securing oil seal retainer (24) to steering knuckle (12). Remove felt seal and seal ring (74) and let them hang on axle housing.
(4) Remove four steering arm stud nuts (15) and remove steering arm (14), king pin bearing cone (70) bearing cup (69), woodruff key and king pin upper adjuster shims (13).
(5) Remove four bolts (59) and lock washers (60) securing king pin bearing cap (61) to lower steering knuckle (12). Remove bearing cap (61) and adjuster shims (62 through 65).

NOTE

Tag upper and lower shim pack for installation and/or sizing of new shim pack to enable steering knuckle bushing to maintain same precision fit.

(6) Remove steering knuckle from housing and remove bearing cones from axle housing. Remove bearing cups if necessary using tool W-328 as shown in figure 13-3.

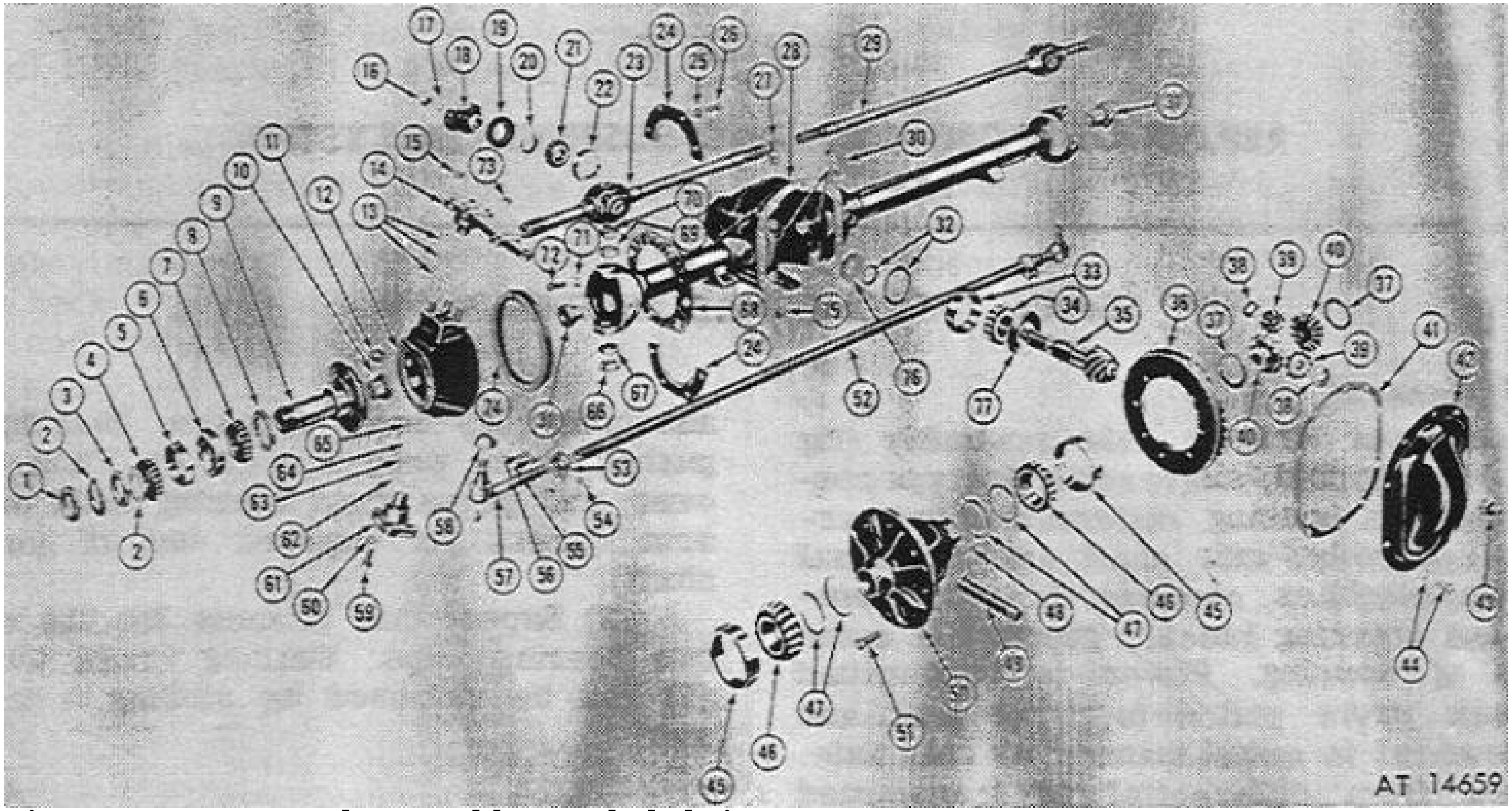


Figure 13-1. Front axle assembly - exploded view.

1 Nut	21 Cone and rollers - outer	41 Housing cover gasket	61 King pin bearing cap, lower
2 Lock washer	22 Bearing cup - outer	42 Housing cover	62 Shim
3 Inner wheel bearing adjusting nut and pin	23 Right axle shaft and universal joint	43 Fill plug	63 Shim
4 Wheel bearing cup - outer	24 Knuckle oil seal retainer	44 Screw and lock washer	64 Shim
5 Cone and roller - outer	25 Seal washer	45 Bearing cup	65 Shim
6 Cone and roller - inner	26 Cap screw	46 Cone and rollers	66 Cone and rollers

7 Wheel bearing cup - inner	27 Housing breather	47 Shims	67 Bearing cup
8 Oil seal	28 Front axle housing	48 Lock pin	68 Gasket
9 Spindle	29 Left axle shaft and universal joint	49 Pinion shaft - spider gears	69 Bearing cup
10 Spindle bushing	30 Oil seal	50 Differential case	70 Bearing cone
11 Filler plug	31 Axic shaft guide bushing	51 Bolt	71 Nut
12 Right steering knuckle	32 Shim pack	52 Steering tie rod	72 Stop bolt
13 Shims, upper	33 Bearing cup - inner	53 Lock washer	73 Nut
14 Right steering arm and pivot pin	34 Cone and rollers - inner	54 Tie rod clamp nut	74 Felt seal
15 Nut (4)	35 Pinion gear	55 Tie rod socket clamp	75 Drain plug
16 Nut	36 Ring gear	56 Cap screw	76 Guard
17 Washer	37 Thrust washer - side carrier gears	57 Tie rod socket	77 Pinion slinger
18 Pinion flange yoke	38 Thrust washer - spider gears	58 Dust cover	
19 Oil seal	39 Differential gears - spider	59 Cap screw	
20 Oil slinger	40 Differential gears - side carrier	60 Lock washer	

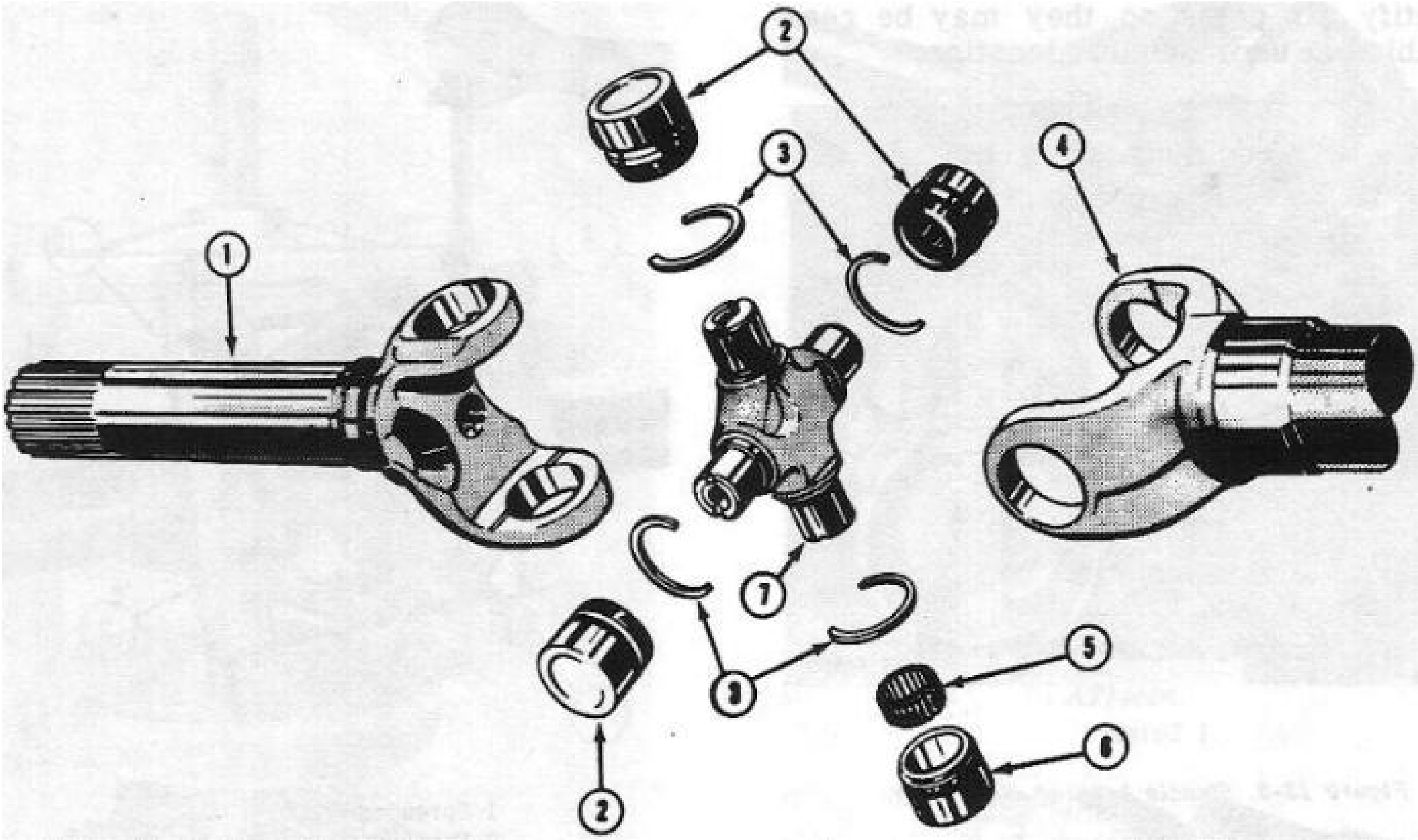


Figure 13-2. Cardan cross universal joint exploded view.

1 Axle shaft, yoke
2 Bearing cup
3 Snap ring
4 Axle shaft, yoke
5 Roller bearing
6 Bearing cup
7 Bearing cross journal

d. Pinion, Drive Gear and Differential.
(1) Clean axle housing with solvent or thinner.
(2) Drain lubricant.
(3) Remove axle shaft assemblies (23, 29 fig 13-1), (a) above.
(4) Remove differential housing cover attaching bolts (44 fig 13-1) and remove cover (42). Discard cover gasket (41).
(5) Remove four differential bearing cap attaching bolts and remove two caps. Caps are selective fit and must be used on same side as originally installed. Mark caps for proper identification during reinstallation.

(6) Install differential housing spreader tool W-129. Refer to figure 13-4.

CAUTION

Do not attempt to remove differential without using the spreader tool. Install dial indicator and expand carrier not more than 0.020-inch or carrier may take a permanent set.

(7) Remove dial indicator and, using a pry bar, lift out differential assembly. Remove and tag bearing cups so they may be reinstalled in their original positions. Relieve pressure on spreader too.
(8) Remove bearing cones from case, using puller DD-914P, holding ring DD914-8 and adapter DD-914-62 as shown in figure 13-5. Remove shims from case. Identify all parts so they may be reassembled in their original location.

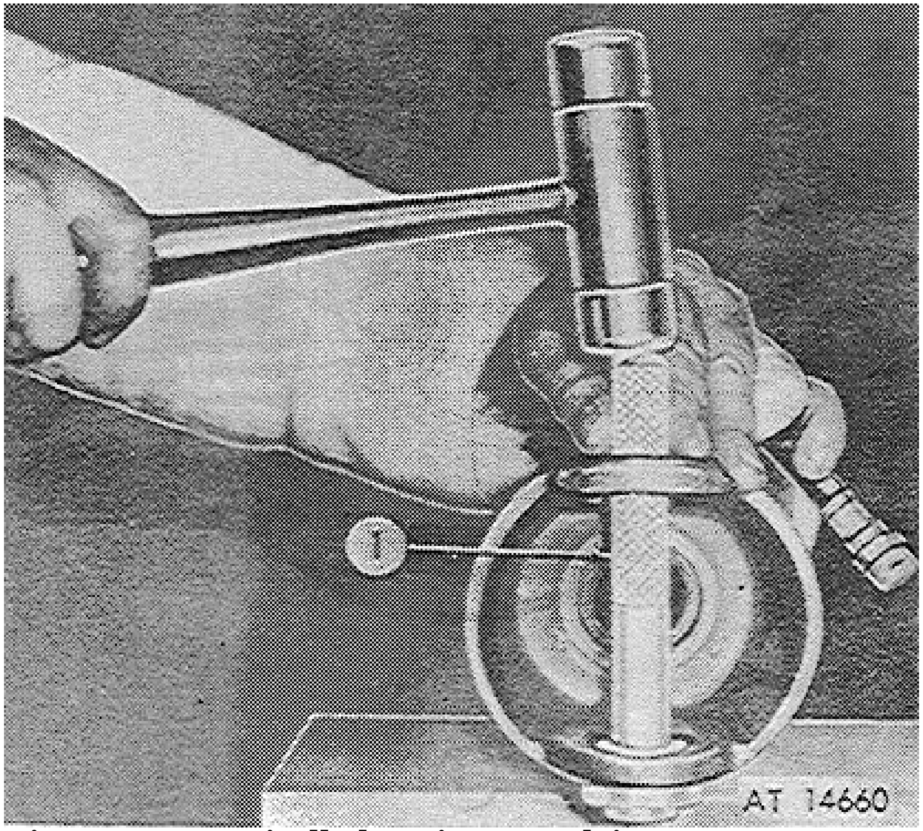


Figure 13-3. Spindle bearing cup driver.

1 Driver

(9) Remove ring gear bolts (51 fig 13-1) from case (50) and separate gear from case.
(10) Using small punch, drive differential shaft lock pin (48) from case assembly (50).
(11) Remove differential shaft (49), spider gears (39), side gears (40) and thrust washers (37, 38) from case (50).

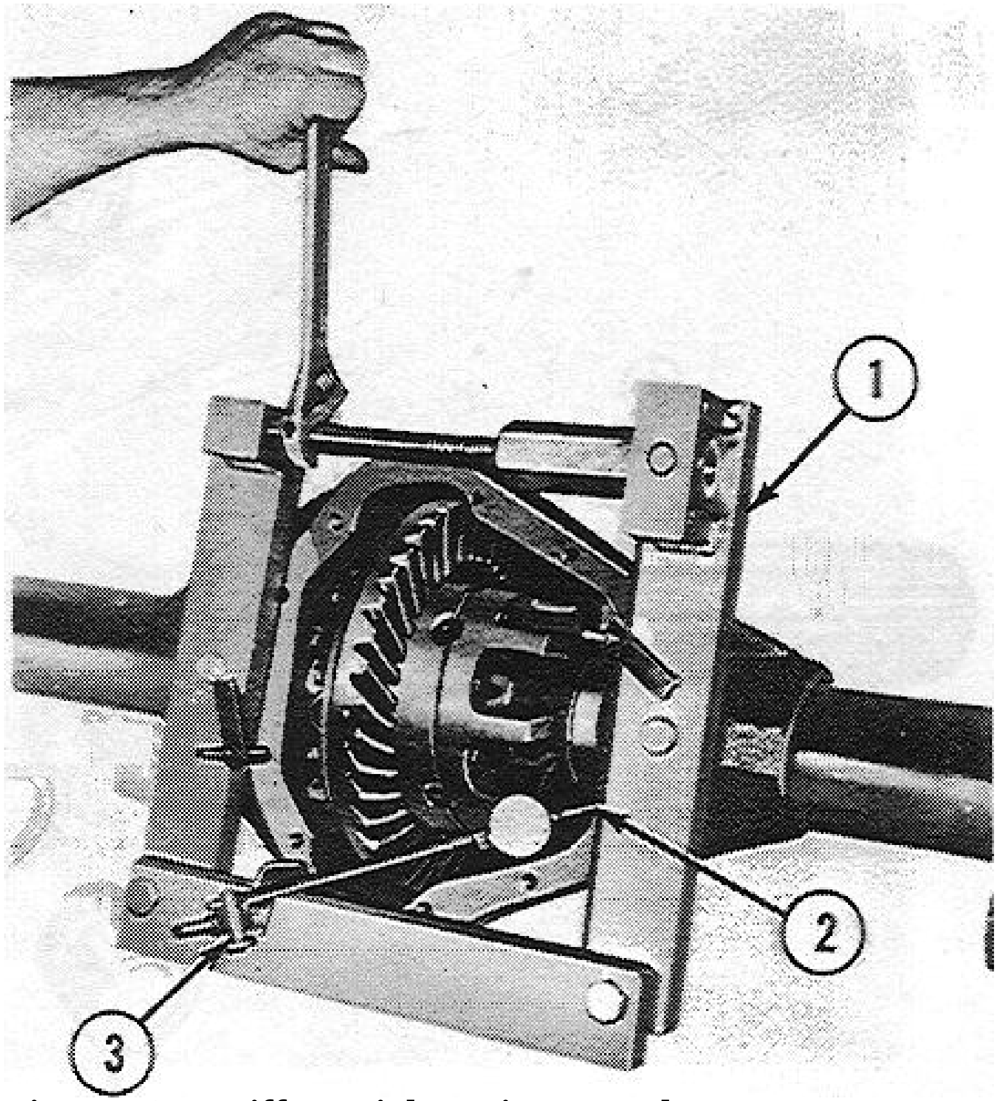


Figure 13-4. Differential carrier spreader.

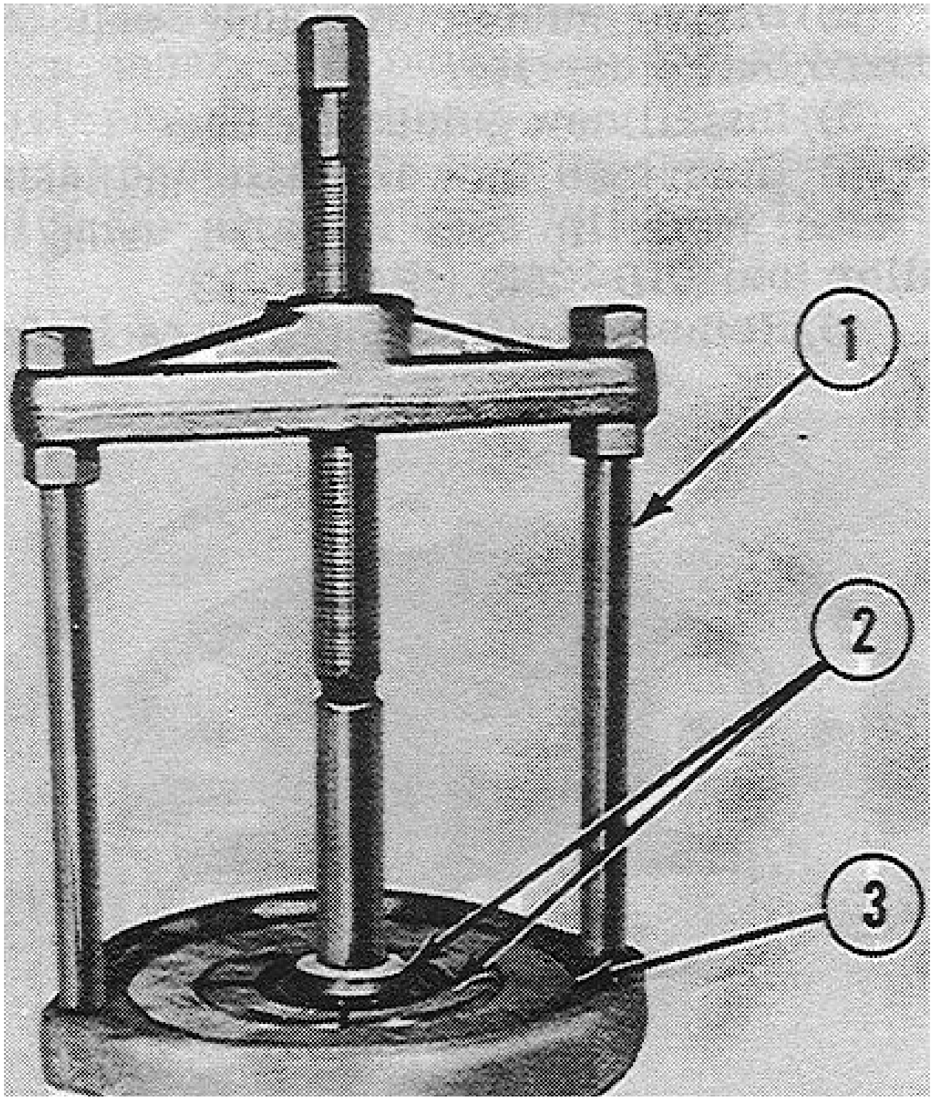
1 Spreader W-129
2 Dial indicator and pointer
3 Dial indicator clamp

e. Pinions and Bearings.
(1) Remove differential in accordance with (d) above.
(2) Remove pinion flange nut (16) and washer (17), using wrench C-3281, (fig 13-6). Remove pinion flange (‘18), using puller tool W-172, (fig 13-7) and oil seal (19) using tool W-286, (fig 13-8).
(3) Tap drive pinion gear (35) and inner bearing cone (34) out of carrier housing (28), using a soft hammer. Tag and save shim pack (32) on splined end of pinion (outer bearing shim) for reference during reassembly.

(4) Remove pinion outer bearing cone (21) from carrier.
(5) Remove inner bearing cup (33) from carrier, using tool W-100-60-70, (fig 13-9). Remove guard (‘76) and shims (32). Tag and save shim pack for use or for sizing of new pack during reassembly.
(6) Remove outer bearing cup (22) from carrier, using tool W-100-60-70 (fig 13-10).
(7) Press front and rear differential pinion bearing cone off pinion (fig 13-il). Front axle use tool DD-914-P with holding ring DD-914-9 and adapter C-293-37. When using an arbor press, DD-914-7 extension and DD-914-42 button are used for both front and rear bearing removal. Remove oil slinger (77 Fig 13-1) from pinion. To remove rear axle pinion bearing cone and rollers, use tool puller DD-914-P, adapter DD-914-95 and holding ring DD-914-8.

13-4. Cleaning.
Refer to paragraph 2-7 for general cleaning instructions.

13-5. Inspection.
Refer to paragraph 2-8 for inspection procedures.



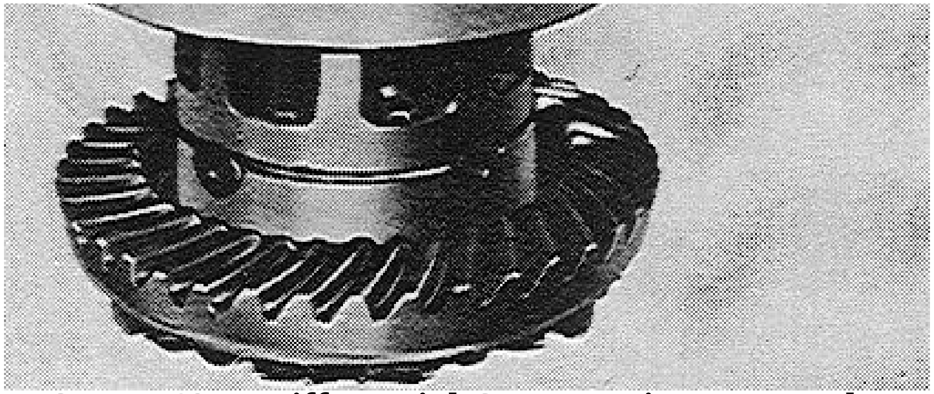


FIGURE 13-5. Differential Case Bearing Removal

1 Puller DD-914-P
2 Adapter DD-914-62
3 Holding Ring DD-914-8

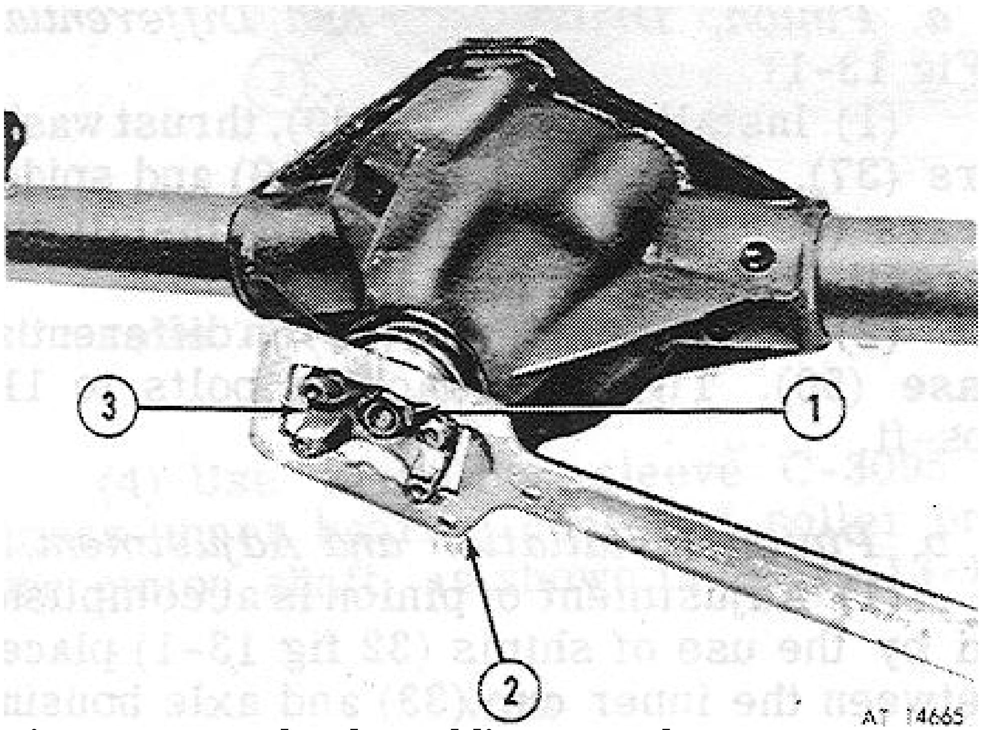


Figure 13-6. End Yoke Holding Wrench

1 Nut
2 Wrench C-3281
3 Yoke

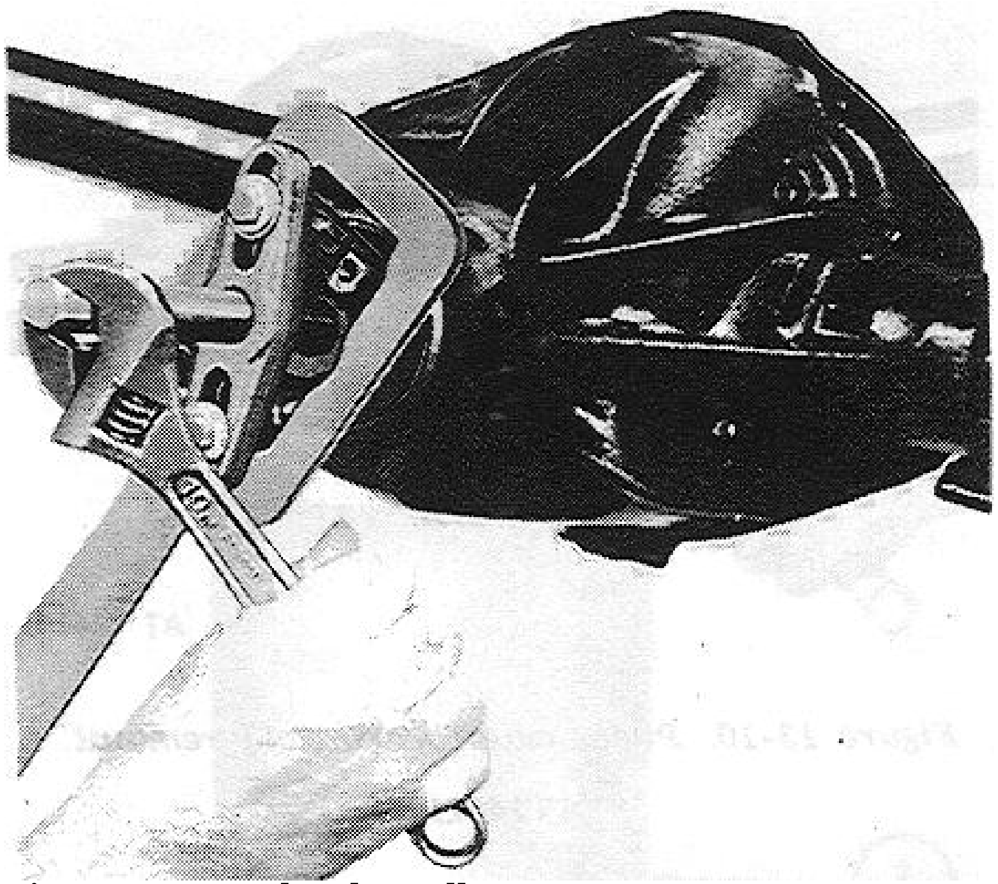


Figure 13-7. End Yoke Puller

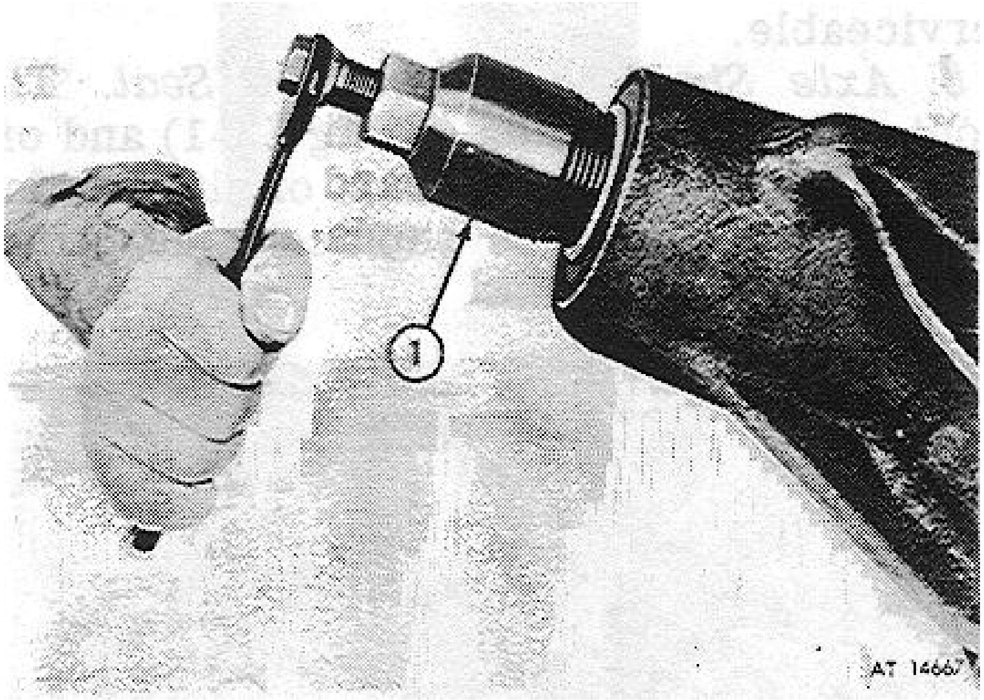


Figure 13-8. Pinion Oil Seal Puller.

1 Tool W-286

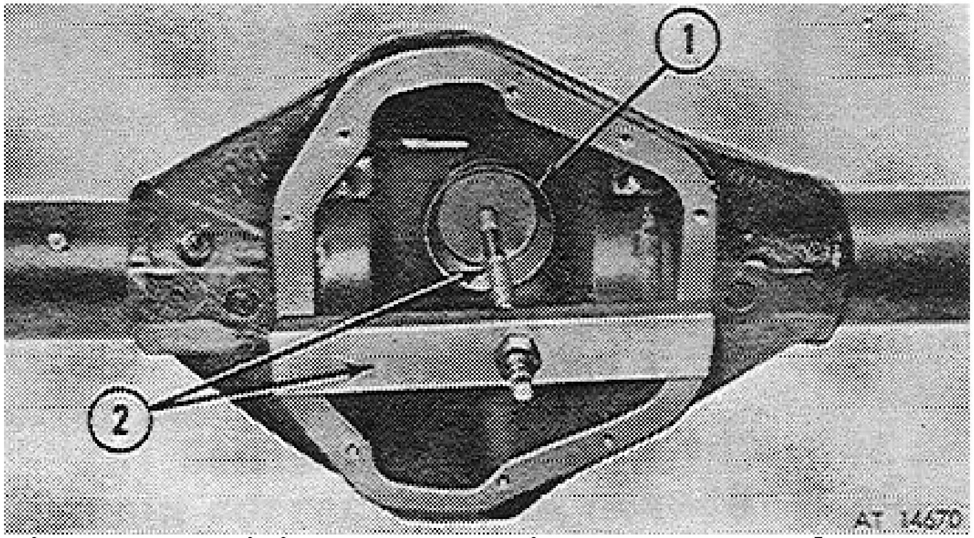


Figure 13-9. Pinion Inner Bearing Cup Removal

1 Bearing cup
2 Tool W-100-60-70

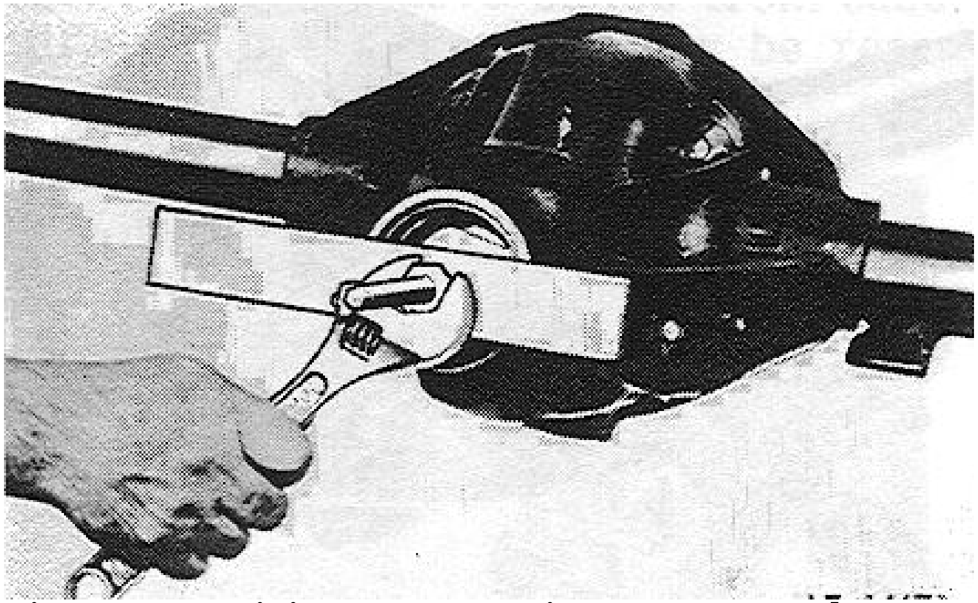


Figure 13-10 Pinion Outer Bearing Cup Removal

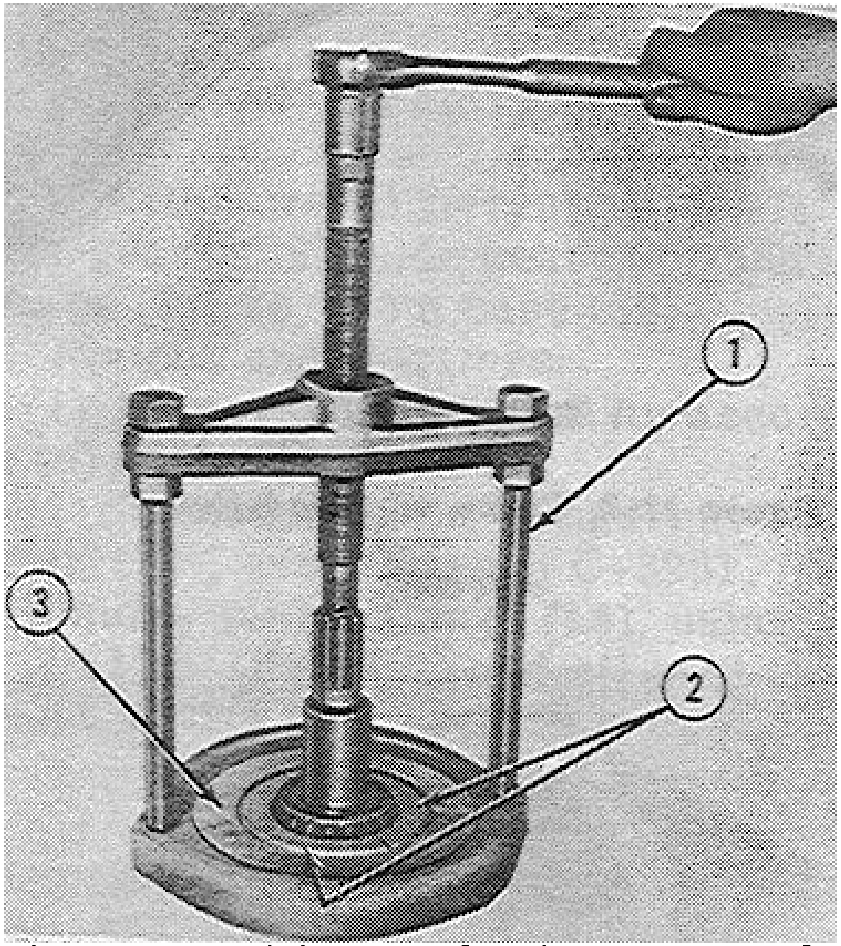


Figure 13-10. Pinion outer bearing cup removal.

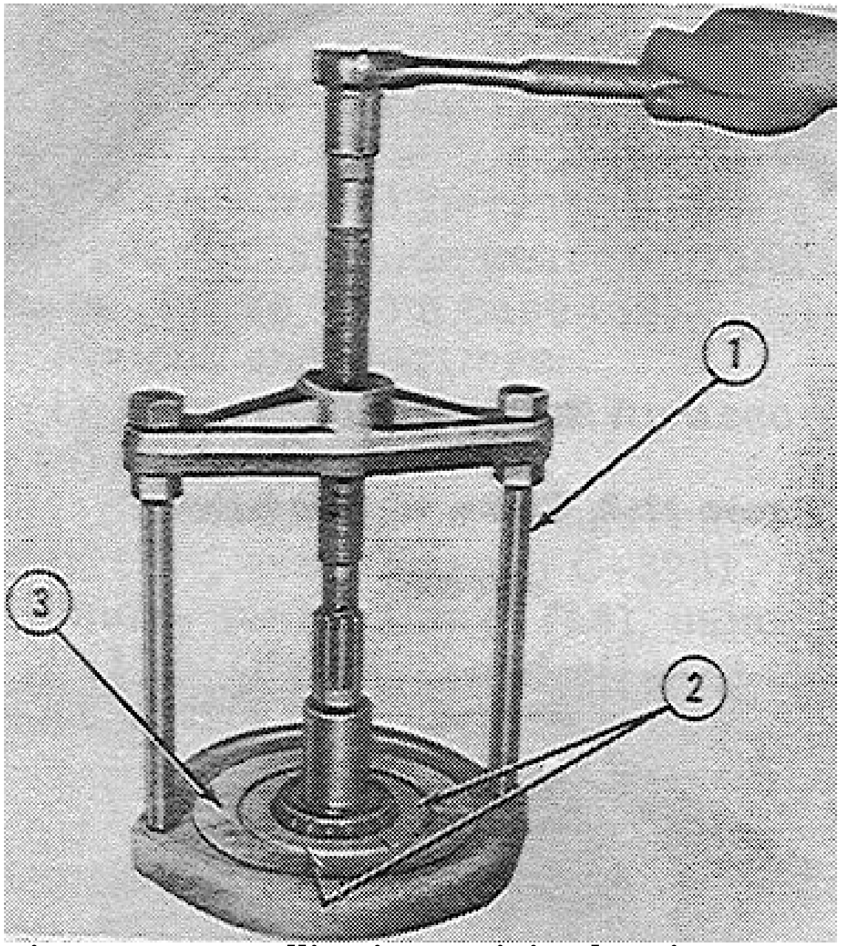


Figure 13-11. Pulling inner pinion bearing.

A - Front Axle	B - Rear Axle
1 Puller DD-914-P	1 Puller press DD-914-P
2 Adapter C-293-37	2 Adapter DD-914-95
3 Holding ring DD-914-9	3 Holding ring DD-914-8

13-6. Repair or Replacement.
a. Differential and Related Components. Refer to paragraph 2-8 and replace those parts and components that are worn or unserviceable.
b. Axle Shaft Guide and Oil Seal. The front axle shaft guides (31 fig 13-1) and oil seals (30), located outboard of differential bearings (46), can be replaced only after removal of differential.
(1) Remove differential (para 13-3d).
(2) Drive guides (31) and seals (30) inboard out of carrier.
(3) Install new guides in tube.
(4) Lubricate new oil seals and install in tube, with lip seal inboard, using installer tool DD-1243. (Fig 13-12)

(5) Reinstall differential (para 13-7a).

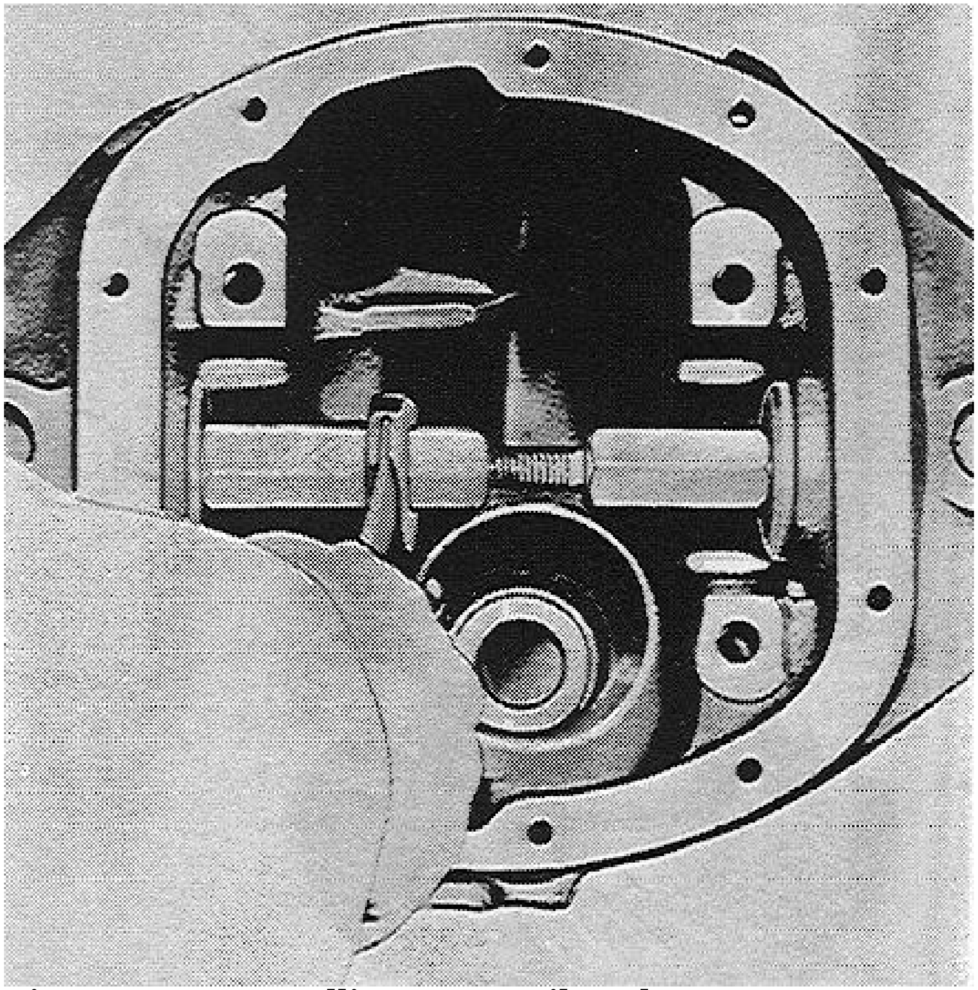


Figure 13-12. Installing Inner Oil Seals

13-7. Reassembly.
a. Pinion, Drive Gear and Differential.
(Fig 13—1)
(1) Install side gears (40), thrust washers (37), differential shaft (49) and spider gears (39) in differential case. Install differential shaft lock pin (48).
(2) Install ring gear (36) on differential case (50). Tighten attaching bolts to 110 lbs-ft.
b. Pinion Installation and Adjustment.
(1) Adjustment of pinion is accomplished by the use of shims (32 fig 13-1) placed between the inner cup (33) and axle housing (28) and between pinion shoulder (35) and outer bearing (21). The shims behind the inner bearing cup adjust position of pinion (35) in relation to the ring gear (36). The shims behind the outer bearing (21) adjust pinion inner and outer bearing pre-load. Install pinion as follows:
(2) Install outer bearing cup, using tool W-100-60-70, as shown in figure 13-13.

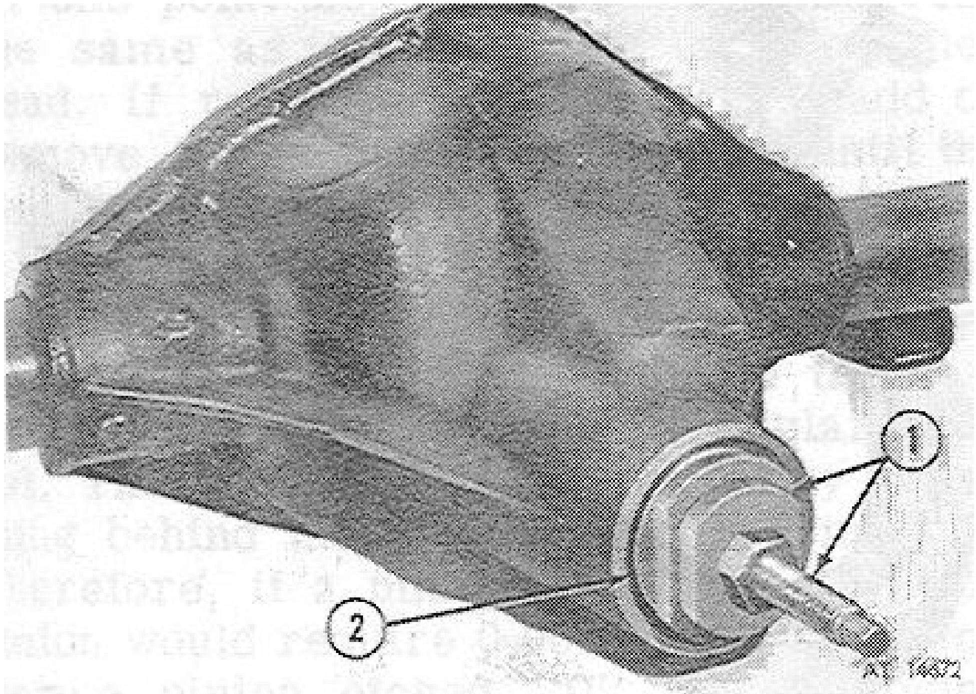


Figure 13-13. Installing outer bearing cup.

1 Tool W-100-60-70
2 Outer bearing cup

(3) Install inner bearing cup, using tool W-100-60-70 to pull the cup into the housing (fig 13-14).

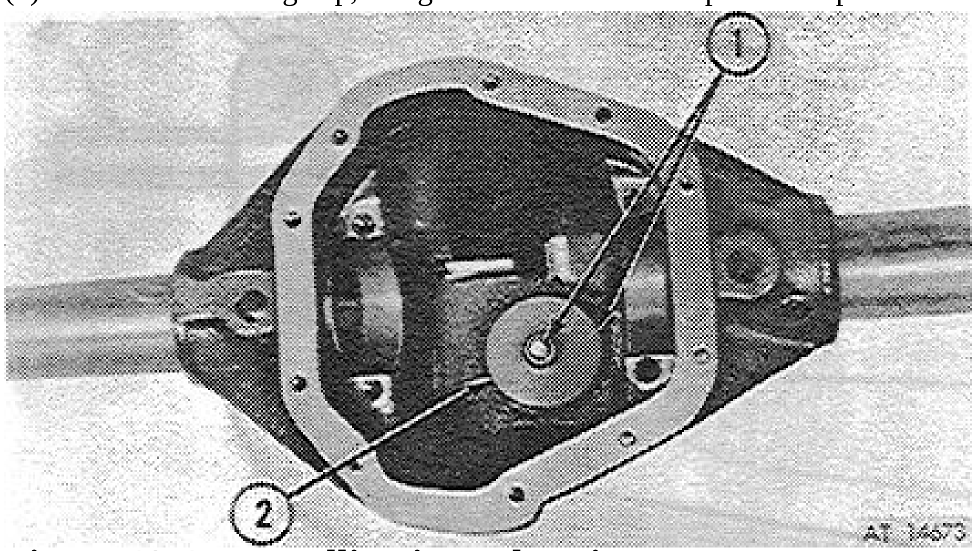


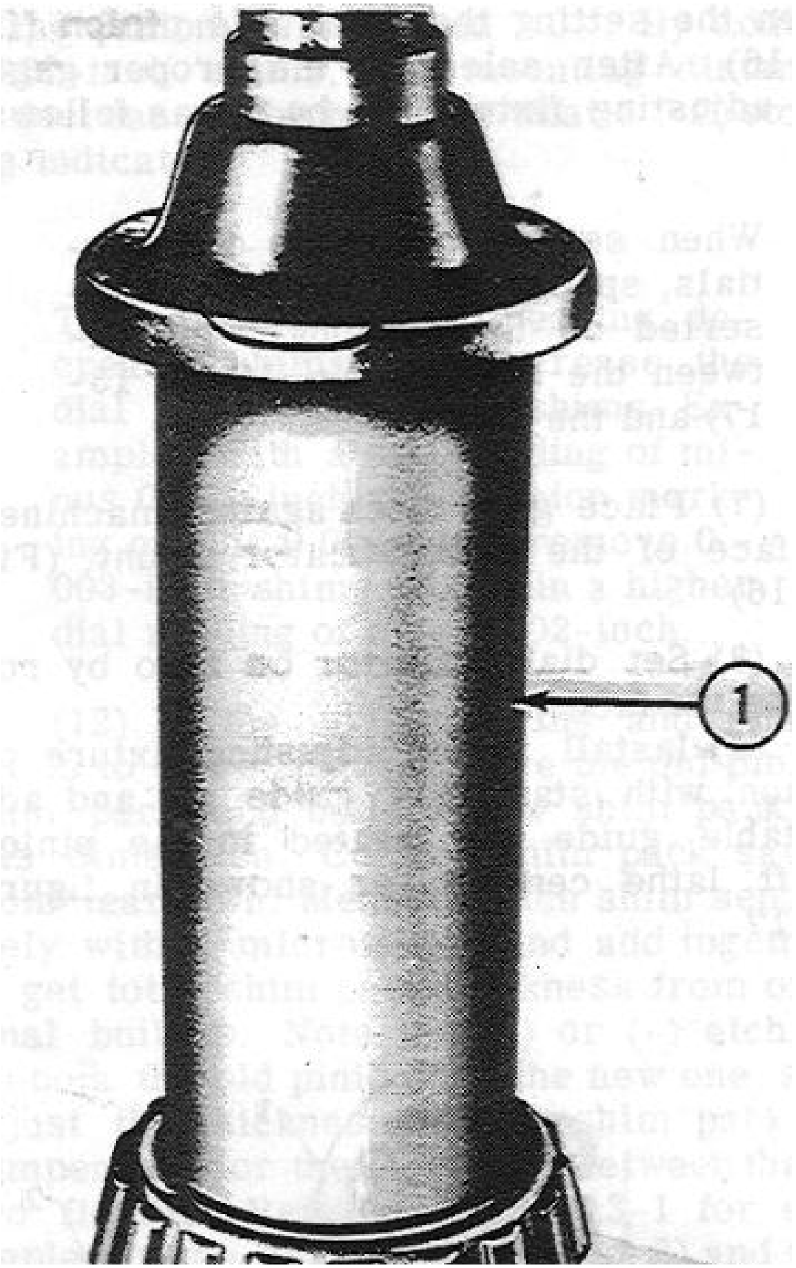
Figure 13-14. Installing inner bearing cup.

1 Tool W-100-60-70
2 Inner bearing cup

(4) Use installing sleeve C-3095 to press inner bearing cone and roller onto the pinion shaft, as shown in figure 13-15.

NOTE

Install inner pinion oil slinger onto the pinion shaft before pressing inner bearing onto the pinion shaft.



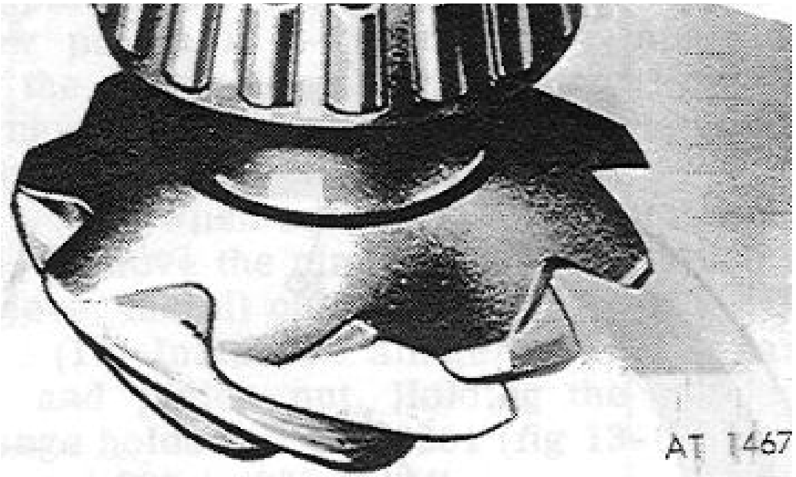


Figure 13-15. Pinion bearing installing sleeve.

1 Sleeve C-3095

(5) Place pinion in housing and install a 0.065-inch shim, inner cone and roller and pinion nut.
(6) Select proper pinion adjusting gage to obtain correct reading. The pinion adjusting fixture must first be set by a master gage which is included in the W-99-B-60-70 kit. The gage block supplied with the W-99-B-60-70 Master Gage Set is stamped with the letter J. Use the J step for setting the front axle pinion and the opposite side when the setting the rear axle pinion (fig 13-16). After selecting the proper gage, the adjusting fixture can be set as follows:

NOTE

When setting rear axle differentials, spacer W-99-19 must be inserted on the stationary pin between the housing (No. 10, fig 13-17) and the pinion head.

(7) Place gage block against machined surface of the dial indicator mount. (Fig 13-16)
(8) Set dial indicator on zero by rotating the face.
(9) Install pinion . adjusting fixture on pinion with stationary guide pin and adjustable guide pin seated in the pinion shaft lathe centers, as shown in figure 13-17.

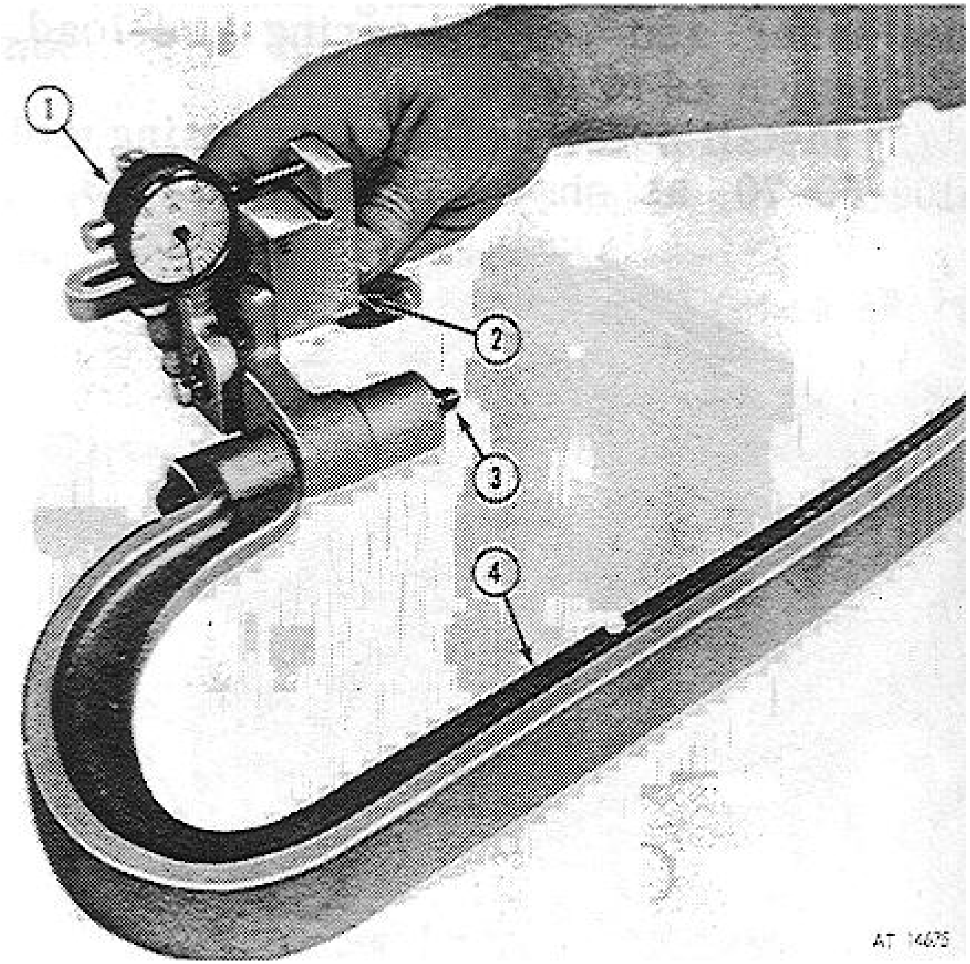


Figure 13-16. Setting dial indicator using gage block.

1 Dial indicator
2 Gage block
3 Stationary pin
4 C-clamp

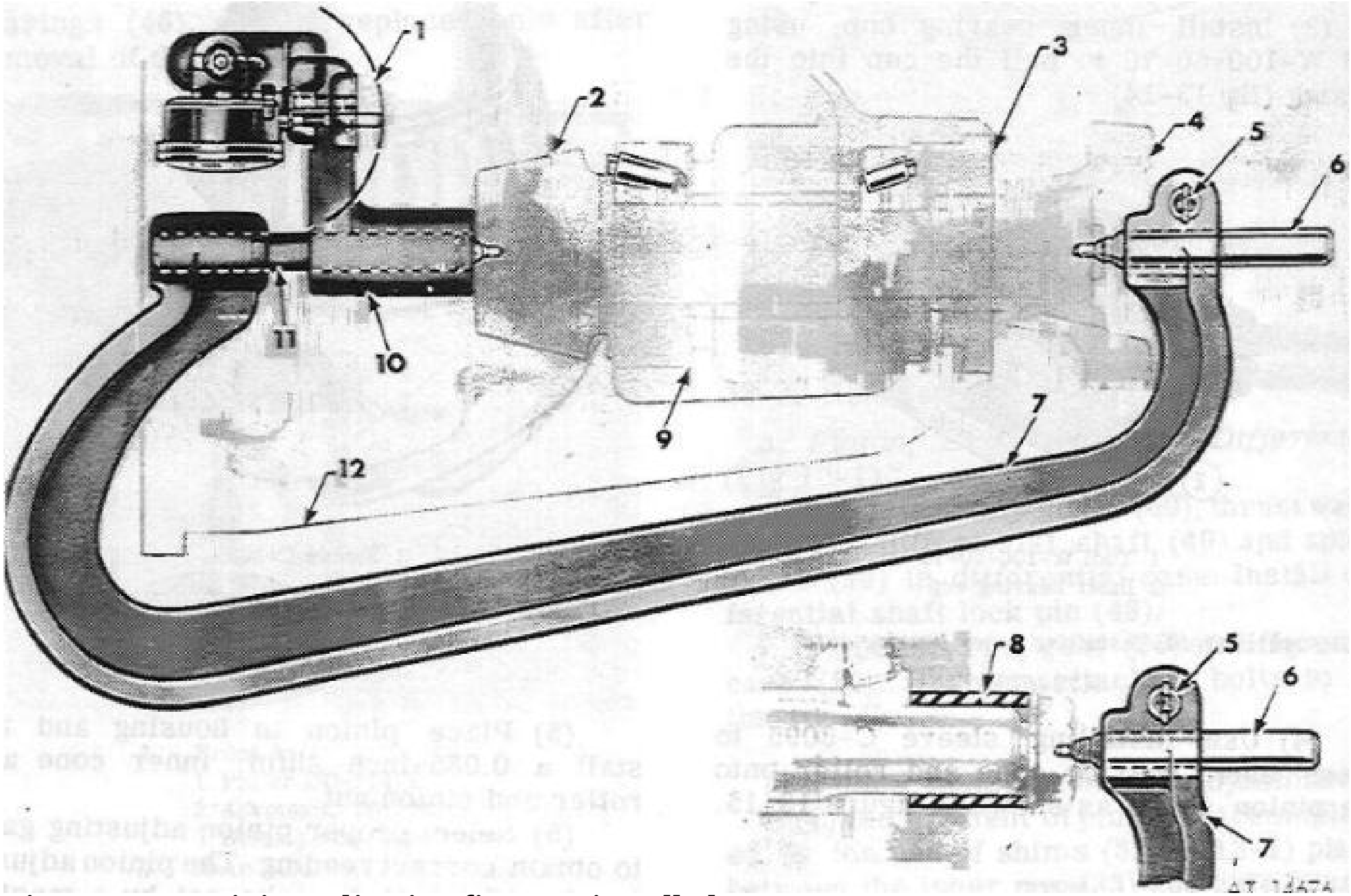


Figure 13-17. Pinion adjusting fixture - installed.

1 Dial gage swing arc	5 Thumb screw	9 Inner bearing
2 Pinion	6 Guide pin	10 Housing
3 Flange	7 C-clamp	11 Stationary guide pin
4 Yoke	8 Sleeve	12 Pinion housing

(10) Seat gage mount firmly on the pinion head and swing dial indicator through the differential bearing bore as shown in figure 13-18. The lowest reading indicates the center of differential bearing bore. At this point the dial indicator should read the same as mark etched on the pinion head. If reading does not agree, add or remove shims behind bearing cup until the readings agree.

(11) The end of each pinion is etched with a plus (+) number, a minus (-) number or zero (0) number to indicate the best running position for each particular gear set. This dimension is controlled by shimming behind the inner pinion bearing cup. Therefore, if a pinion is etched (÷2), this pinion would require

0.002-inch less shims than a pinion etched “0”. By removing shims, the mounting distance is increased which is just what a (+2) etching indicates. Or if a pinion is etched (-2), add 0.002- inch more shims than would be required if the pinion were etched “0”. By adding 0.002-inch shims, the mounting distance is decreased which is just what a (-.2) etching indicates.

NOTE

To increase the dial reading, decrease shims; to decrease the dial reading, increase shims. Example: With a dial reading of minus 0.001-inch and a pinion marking of plus 0.002-inch, remove 0.-003-inch shims to obtain a higher dial reading of plus 0.002-inch.

(12) If the original ring and pinion set is to be reused, measure the old pinion shim pack and build a new shim pack to this dimension. Collect shim pack saved from teardown. Measure each shim separately with a micrometer and add together to get total shim pack thickness from original buildup. Note the (+) or (-) etching on both the old pinion and the new one, and adjust the thickness of new shim pack to compensate for the difference between these two figures. Refer to Table 13-1 for example. If the old pinion reads (÷2) and the new pinion is (-2), add 0.004-inch shims to the original pack dimension. Now build a new shim pack to this resulting dimension.
(13) When correct adjustment is reached, remove the pinion adjusting fixture and sleeve. Install outer bearing.
(14) Install oil slinger, yoke, flat washer and pinion nut. Holding the yoke with flange holder tool C-3281 (fig 13-6), torque the nut 225 to 275 lbs-ft.
(15) Using inch-pound torque wrench on the nut, check rotating torque. The rotating torque should be 10-25 lbs-in.

TABLE 13-1

Old Pinion Marking	New Pinion Marking	New Pinion Marking	New Pinion Marking	New Pinion Marking	New Pinion Marking
	-4	-3	-2	-1	0
+4	+0.008	+0.007	+0.006	+0.005	+0.004
+3	+0.007	+0.006	+0.005	+0.004	+0.003
+2	+0.006	+0.005	+0.004	+0.003	+0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001
0	+0.004	+0.003	+0.002	+0.001	0
-1	+0.003	+0.002	+0.001	0	-0.001
-2	+0.002	+0.001	0	-0.001	-0.002
-3	+0.001	0	-0.001	-0.002	-0.003
-4	0	-0.001	-0.002	-0.003	-0.004

Old Pinion Marking	New Pinion Marking	New Pinion Marking	New Pinion Marking	New Pinion Marking
	+1	+2	+3	+4
+4	+0.003	+0.002	+0.001	0
+3	+0.002	+0.001	0	-0.001
+2	+0.001	0	-0.001	-0.002
+1	0	-0.001	-0.002	-0.003
0	-0.001	-0.002	-0.003	-0.004

-1	-0.002	-0.003	-0.004	-0.005
-2	-0.003	-0.004	-0.005	-0.006
-3	-0.004	-0.005	-0.006	-0.007
-4	-0.005	-0.006	-0.007	-0.008

NOTE

Disregard starting torque.

(16) Add or remove shims between pinion outer bearing and pinion shaft to obtain correct torque reading.
c. Adjustment of Differential Side Gear.
(1) Clearance between differential side gears and differential case should be 0.000-inch to 0.006-inch. Procedure for checking clearance is as follows:
(2) With differential case positioned as shown in figure 13-19, tap differential case lightly on a flat surface so differential gears settle into proper position.
(3) Measure clearance between side gears and case with leaf feeler gage as illustrated.
(4) If clearance exceeds 0.006-inch, add shims between side gears and case. If shims are required, at least one shim should be placed on each side and shim packs kept as even as possible. After adding shims, repeat clearance check.

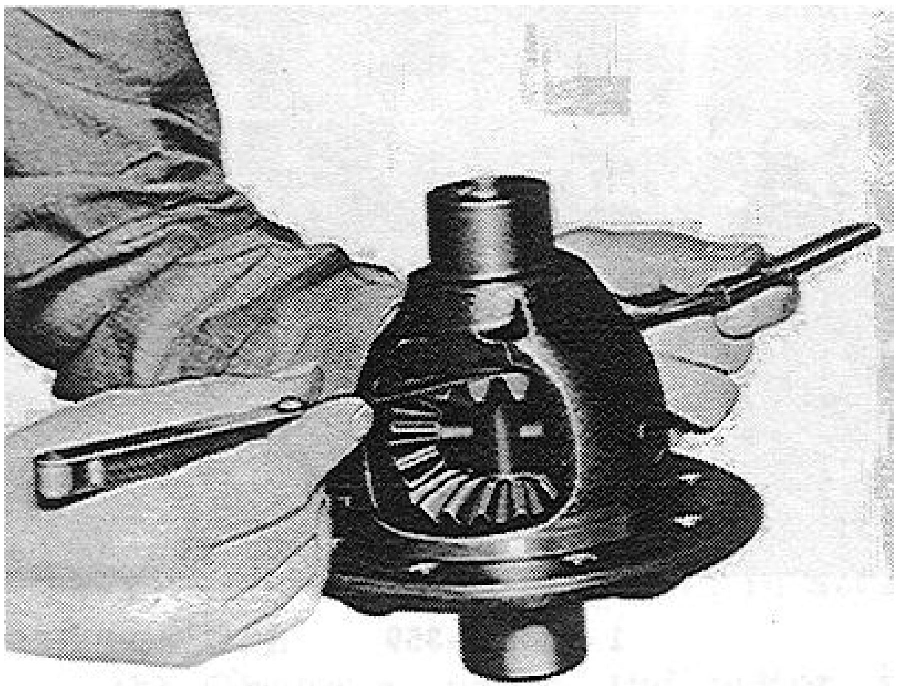


Figure 13-19. Checking side gear clearance.

d. Adjustment of Differential Bearing Pre-Load and Ring Gear Backlash.
(1) The adjustment of differential bearings is maintained by use of shims placed between differential case and differential bearings. Procedure for adjusting bearing pre-load is as follows:
(2) Install differential case and bearings in axle housing without shims and with bearing cups snug.
(3) Holding the ring gear in contact with the pinion and using a screwdriver blade to move the differential bearing cups toward the center, insert feeler gage on

each side between differential bearing cup and the axle housing.
(4) After shim pack requirement for each bearing has been established, remove differential assembly. Make up shim packs and keep them separated.
(5) Add an additional 0.015-inch shim thickness to shim pack on tooth side of ring gear.
(6) Place differential bearing shim packs on differential case under each bearing. Install bearings with driver tool C-4025. (Fig 13-20).

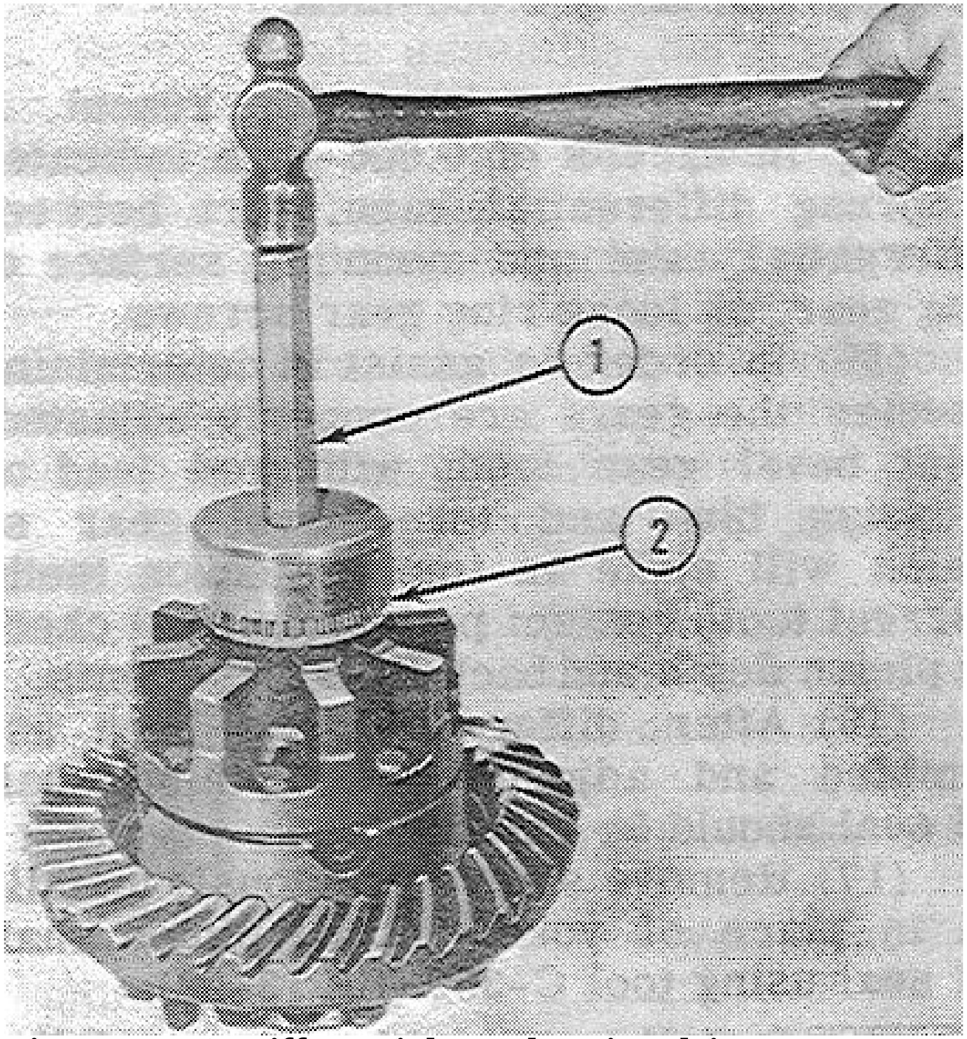


Figure 13-20. Differential case bearing driver.

(7) Attach the carrier spreader W129, install a dial indicator, (fig 13-4) and spread the carrier a maximum of 0.020-inch.
(8) Remove the dial indicator.
(9) Lubricate bearings and place differential case in carrier housing.
(10) Tap unit carefully into place with soft mallet, making sure ring gear teeth mesh with pinion teeth.
(11) Install bearing caps, matching their markings with those on the carrier housing.
(12) Apply sealing compound to the screw threads. Torque screws 70 to 90 lbs - ft.
(13) Install dial indicator to check ring gear backlash (fig 13-21). Check backlash at two points. Backlash must be held between 0.004-inch to 0.009-inch. If

backlash does not fall within specifications, shims should be interchanged between the two differential bearing shim packs until correct backlash is obtained.

NOTE

Changing position of a 0.005-inch shim from one side to the other will change amount of backlash approximately 0.003-inch.

(14) Check ring gear for runout. A reading in excess of 0.006-inch indicates a sprung differential case, dirt between differential case and mounting surface of ring gear, or loose ring gear screws.
(15) In order to assist in determining whether the gears are properly adjusted, paint bevel gear teeth with red lead or prussian blue and turn bevel gear so pinion will make an impression on teeth. Correct tooth contact pattern is final check on pinion depth and backlash adjustments.
(16) After differential has been assembled and adjusted, the pinion shaft oil seal should be installed.
(17) Remove sleeve previously installed in place of yoke. Install pinion shaft oil seal using tool C-359 (fig 13-22).
(18) Install yoke with yoke installer tool C-3718 (fig 13-23).
(19) Install washer (17 fig 13-1) and pinion nut (16).
(20) Apply sealant to a new cover gasket (41) and position on axle housing (28).
(21) Position axle housing cover (42) and install attaching bolts (44). Apply sealant to bolt threads and tighten to 20 lbs-ft.
e. Universal Joints.
(1) Pack bearing cones one third full of lubricant and install rollers.
(2) Insert bearing into end yoke arm and seat firmly against bearing shoulders.
(3) Hold bearings in a vertical position; reassemble joint in axle shaft yoke.

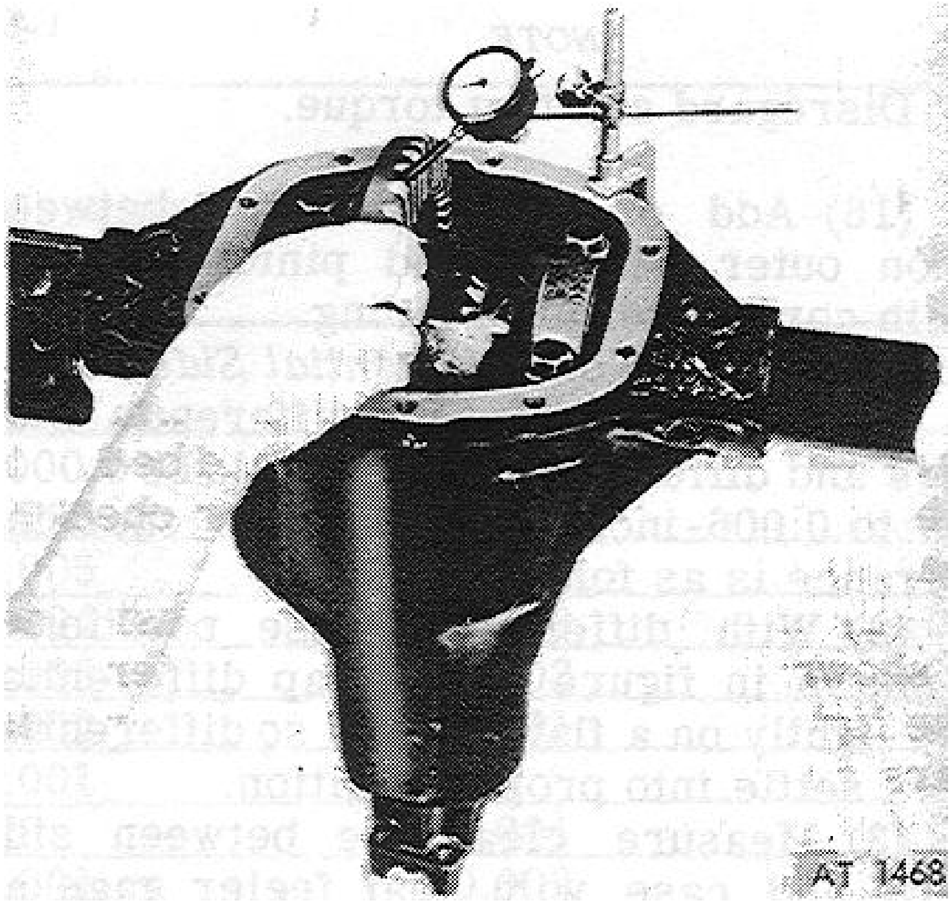


Figure 13-21. Checking ring gear backlash.

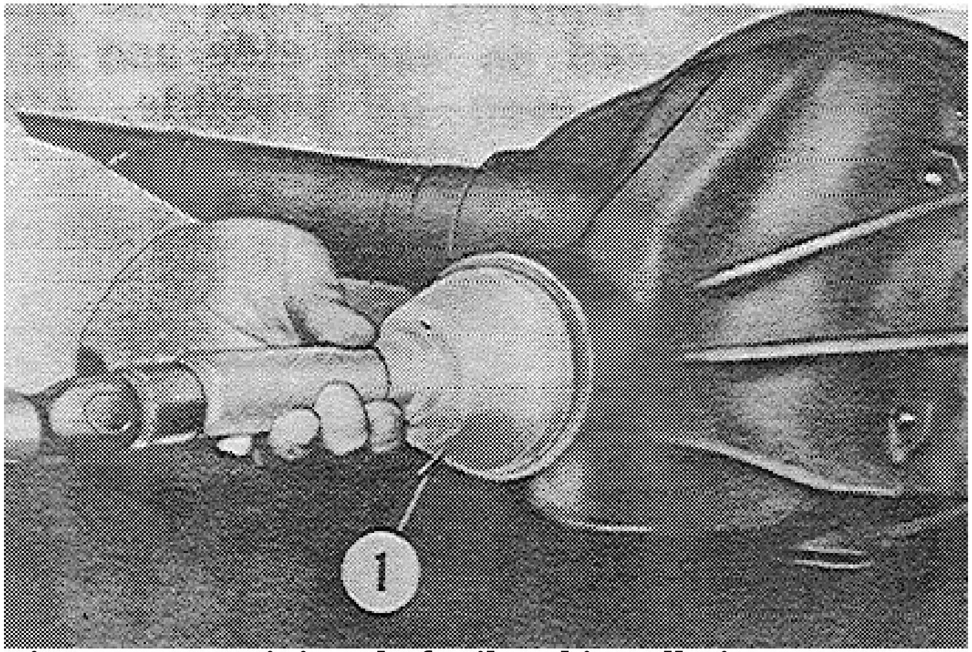


Figure 13-22. Pinion shaft oil seal installation.

1 Tool C-359

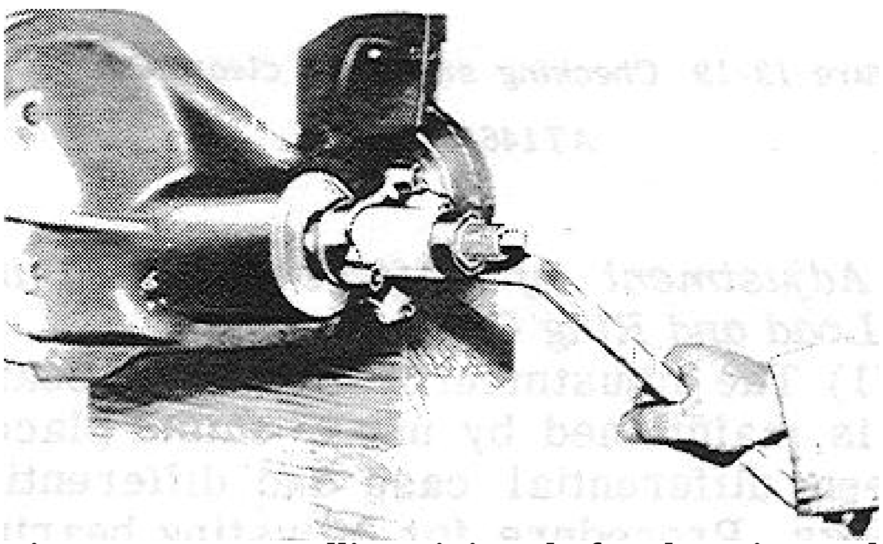


Figure 13-23. Installing pinion shaft yoke using tool C-3718.

(4) If joint binds after assembly, tap yoke lightly, relieving any pressure on bearings at end of journal. Refer to figure 13-2.

f. Steering Knuckles.

NOTE

Replace steering knuckle bearings and cups if worn or damaged (fig 13-3).

(1) Position steering knuckle (12 fig 13-1) on axle housing (28).
(2) Position lower shim pack (62 through 65) on steering knuckle and cone and rollers (66) and cup (67) into housing.
(3) Position lower king pin bearing cap on steering knuckle (12) and install four washers (60) and cap screws (59). Tighten 80 lbs-ft.
(4) Position upper shim pack (13), woodruff key, steering arm and upper pivot pin (14) on steering knuckle (12). Install four new self locking nuts (15). Tighten to 80 lbs-ft.
(5) Position seal ring, felt seal (74) and oil seal retainer (24) to steering knuckle (12).
(6) Clean threads of cap screws (26). Apply sealant to threads and install using new seal washers (25). Tighten to 20 lbs-ft. Refer to figure 13-1.
(7) Check pivot pin pre-load as follows:
(a) Hook a spring scale in tie rod socket hole in steering knuckle arm (14 fig 13-1) with steering knuckle in straight ahead position.
(b) Observe scale indication when knuckle has just started its sweep. Scale indication should be between 12 to 16 pounds.
g. Reassembly of front axle shaft assembly.
(1) Slide axle shaft assembly (23) into housing (28) (fig 13-1), engaging splines in differential side gear (40). Position oil seal (8) on spindle (9).
(2) Install bushing (10) and spindle assembly (9) on shaft.
(3) Install brake flange plate on spindle, aline mounting holes between flange plate, spindle and knuckle. Secure with bolts and washers. Tighten 70 to 90 lbs-ft.
(4) Fill steering knuckle with proper lubricant LO 9-2320-244-12. Coat plug (11) with sealant and install in steering knuckle housing.
(5) Fill axle assembly with proper lubricant LO 9-2320-244-12.

13-8. Installation.
a. Support axle assembly on a jack and slide into position under vehicle.
b. Swing the spring into position and reassemble spring shackles.
c. Replace spring clip plates and spring clips.
d. Connect brake hydraulic hoses at connections between front brake lines and flexible hoses. Connect breather hose.
e. Connect shock absorbers at axle mounting pads.
f. Connect propeller shaft.
g. Connect steering connecting rod at ball and socket connections on the steering knuckles.
h. Adjust and bleed hydraulic brake system.
i. Remove supports and lower front end of vehicle to floor.
j. Check front end wheel alinement. Refer to TM 9-2320-244-20.
k. Check turning angle.
l. Lubricate front axle universal joints.

Section II. FRONT SUSPENSION ASSEMBLY

13-9. General.
The front suspension assembly (fig 13-24) consists of springs, shock absorbers and rubber bumper stops. Repair is limited to disassembly of the spring assemblies and replacement of shocks and bumpers.
The front spring assemblies consist of leaf spring elements, mounting bushings at each end of one leaf, shackles at rear end of each spring, two U-bolts, and a plate for each spring element, which clamp the spring elements to the axle. Direct acting hydraulic shock absorbers, with dust shield and rubber bushings, are

located at the left and right outboard position on the front axle. Rubber bumper stops, mounted on the frame, restrict axle from bottoming on frame.

13-10. Removal.
Remove front spring and shock absorber assemblies in accordance with TM 9-2320-244-20.

13-11. Disassembly.
a. Clamp spring leaves firmly together using one C clamp on each side of center bolt or using an arbor press.
b. Remove nuts from two rebound clip bolts, then remove bolts, spacers and clips.
c. Remove nut from center bolt and remove bolt.
d. Release C clamp or arbor press slowly to avoid personal injury.
e. If clip(s) is damaged, remove rivet in bottom of two rebound clips by grinding off rivet head and knocking out the stud or by drilling out the rivet.

13-12. Cleaning
Clean all dirt and corrosion from spring leaves, using a wire brush if necessary, then wash with drycleaning solvent or mineral spirits.

13-13. Inspection.
Inspect spring assemblies for broken leaves, broken rebound clips, cracked spacer material and spring eye bushings or broken center bolts.

13-14. Repair or Replacement.
Replace any broken or unserviceable spring parts. Replace worn or unserviceable shock absorber assemblies in accordance with TM 9-2320-244-20.

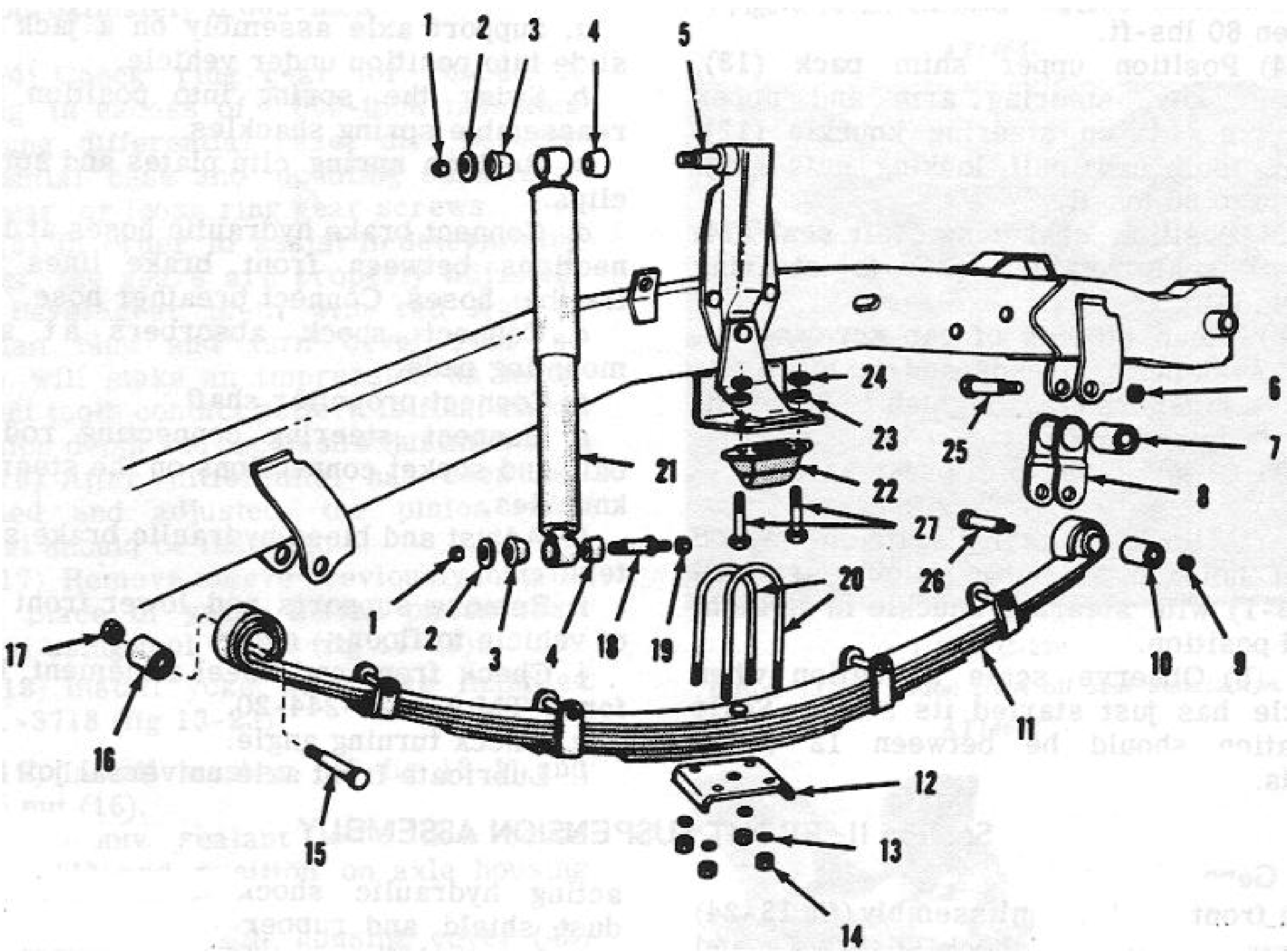


Figure 13-24. Front Suspension-exploded view

1 Locknut	8 Spring shackle	15 spring bolt	22 Bumper
2 Flat washer	9 Lock nut	16 Bushing	23 Lock washer
3 Mounting pin bushing	10 Spring bushing	17 Lock nut	24 Nut
4 Mounting pin bushing	11 Spring	18 Lower mounting pin	25 Spring shackle bolt

5 Upper mounting pin	12 Spring clip plate	19 Lock nut	26 Spring shackle bolt
6 Lock nut	13 Flat washer	20 Spring clip	27 Bolt
7 Spring shackle bushing	14 Lock nuts	21 Shock absorber	

13-15. Reassembly.
a. Rivet rebound clips to bottom leaf, if removed during disassembly.
b. Stack spring leaves in correct order with spacer material between them and with center bolt holes alined. Distance between inside of military wrap and outside of front eye should be 1/4 to 1/2-inch.
c. Compress spring leaves using C clamps or arbor press.
d. Install center bolt and nut with nut at top and tighten securely.
e. Install rebound clip bolts, spacers and nuts.
f. Remove C clamps or remove spring assembly from arbor press.

13-16. Installation.
Install the front spring and shock absorber assemblies in accordance with TM 9-2320-244-20.

CHAPTER 14
REPAIR OF REAR AXLE AND SUSPENSION

Section I. REAR AXLE ASSEMBLY

14-1. General.
The single speed rear axle assembly (fig 14-2) is a full floating hypoid type with differential and carrier mounted as an assembly in the housing. Power is transmitted from the transfer case to the rear axle differential by a propeller shaft. Venting of the axle housing is provided through a plastic tube to the engine compartment.
The axle model number is cast into the housing as illustrated in (fig 14-1). A metal tag under two of the differential housing cover screws is stamped to identify the number of teeth in the drive gear and pinion, (fig 14-1). To determine the axle ratio, divide the larger number (ring gear teeth) by the smaller number (pinion teeth). This section contains information for servicing the rear axles.

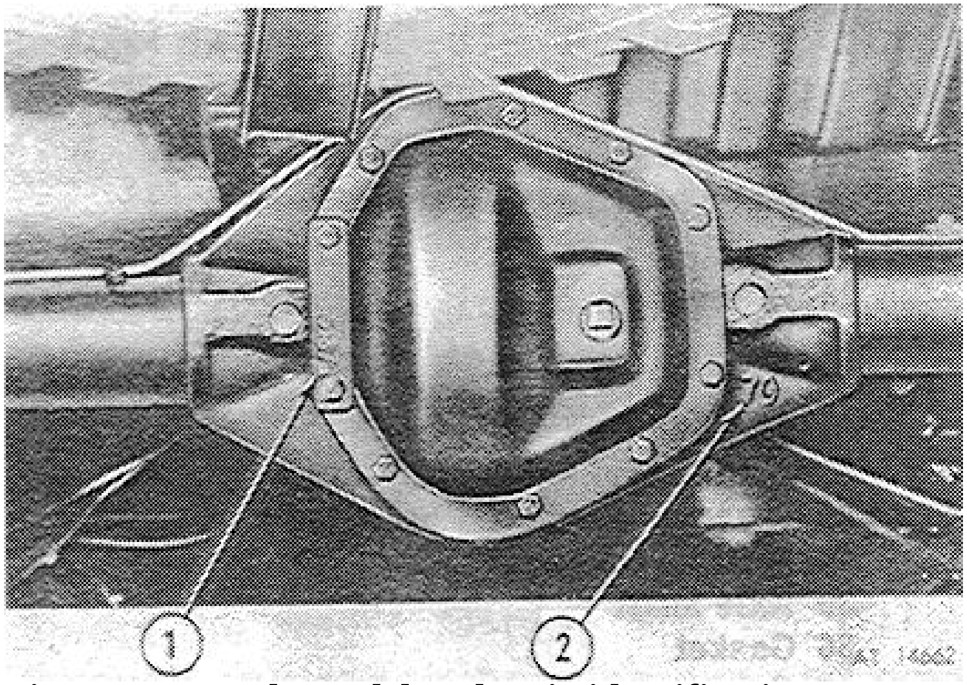


Figure 14-1. Axle model and ratio identification.

1 Ratio
2 Axle model

14-2. Removal.
a. Rear Axle Assembly. Refer to TM 9-2320-244-20.
b. Rear Axle Shafts. (Fig 14-2)
(1) Remove axle flange nuts (30), lock washers (31), lift hook bracket (32), spacer (33) and split washers (34) securing axle shaft flange (35).
(2) Pull axle shaft (35) free from housing (10).
(3) A broken axle shaft can be removed from a full floating axle by removing the opposite axle shaft and inserting a pipe which will drive the broken axle shaft out.
(4) Remove and discard gasket (36).

14-3. Disassembly.

NOTE

The rear axle differential assembly is similar to the front differential and is removed, inspected, disassembled and reassembled in the same manner as the front axle differential. Refer to Chapter 13 when servicing the rear axle differential.

a. Differential Carrier.

(1) Remove axle shafts (35).

(2) Remove housing cover (45), gasket (44) and four cap screws holding the two differential side bearing caps in position. Make sure they are matching letters, or. some type of identification marks, on the caps and housing so each cap can be reinstalled in the same position and location from which it is removed.

(3) Use spreader W-129, (fig 13-4) to spread the housing. Install hold-down clamps to keep the spreader in position. Position and clamp on a dial indicator. From the side, measure the carrier spread. Do not spread the carrier more than 0.020-inch.

(4) Remove the dial indicator.

(5) Carefully pry differential case (4) loose, using pry bars at heads of ring gear bolts and carrier casting.

(6) Remove spreader immediately to prevent possibility of carrier taking a set.

(7) Remove screws (48) holding ring gear (6) to differential case (4).

(8) Mark case halves for reassembly in their same relationship.

(9) Separate differential case halves (4) by removing attaching cap screws (43).

(10) Carefully, so as not to lose thrust washers, remove differential gear set (5).

(11) Using wrench C-3281 to hold the shaft (fig 13-6), remove the nut. Using puller W-172, remove yoke as shown in figure 13-7.

(12) Remove pinion oil seal using pinion oil seal puller W-286 (fig 13-8).

(13) Using a hammer and brass drift, drive on end of pinion shaft to force pinion into the differential housing so it may be removed.

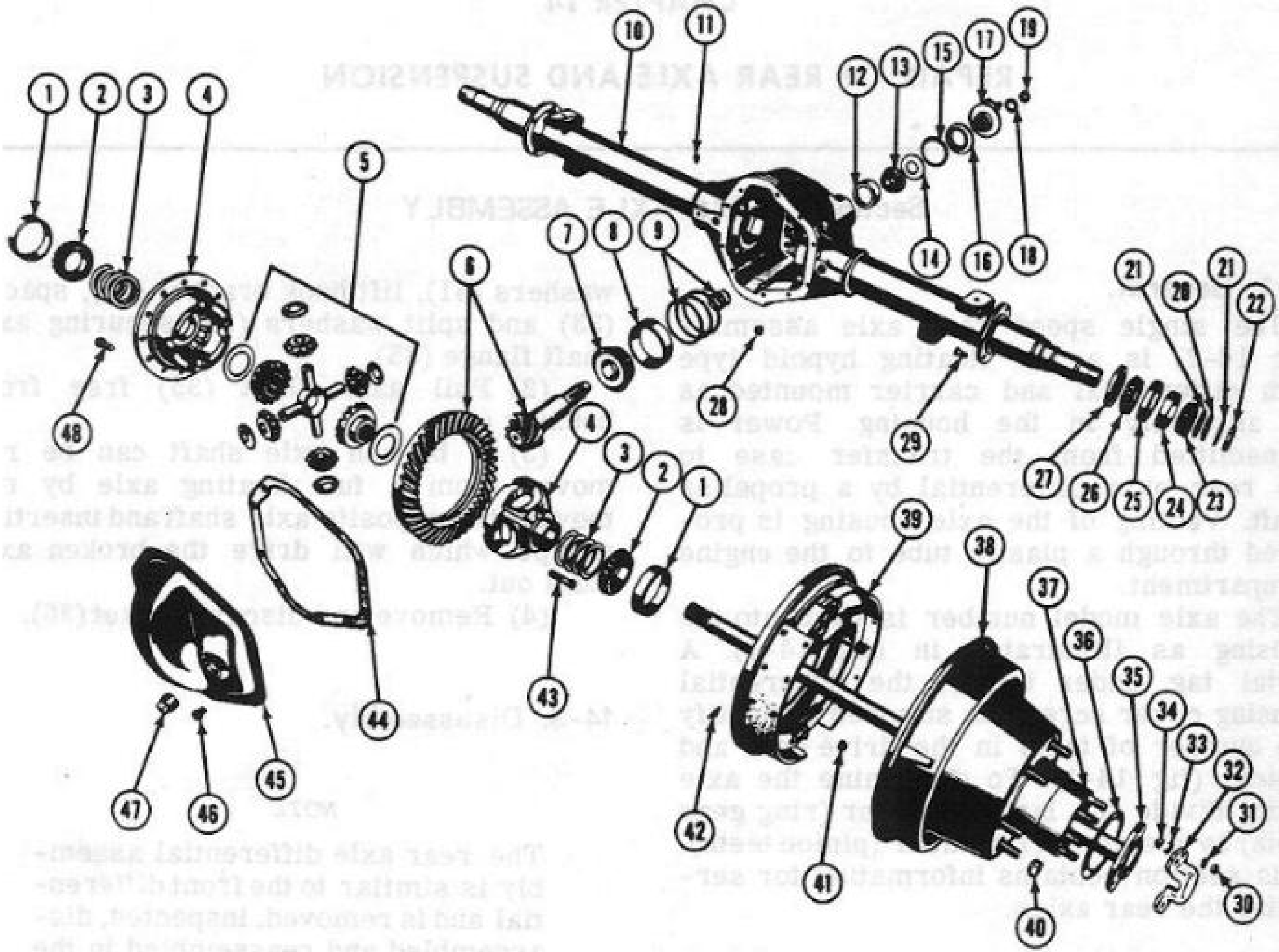


Figure 14-2. Full floating rear axle-exploded view.

1 Differential bearing cup	13 Pinion outer bearing cone and rollers	25 Inner bearing cup	37 Hub
2 Differential bearing cone and rollers	14 Oil slinger	26 Inner bearing cone and rollers	38 Brake drum
3 Shims	15 Yoke gasket	27 Seal	39 Brake assembly
4 Differential case	16 Pinion oil seal	28 Drain plug	40 Wheel lug nut

5 Differential gear set	17 Yoke	29 Bolt	41 Nut
6 Ring gear and pinion	18 Washer	30 Nut	42 Dust plug
7 Pinion inner bearing cone and rollers	19 Nut	31 Lock washer	43 Cap screw
8 Pinion inner bearing cup	20 Nut	32 Lifting bracket	44 Cover gasket
9 Pinion shims	21 Lock washer	33 Spacer	45 Housing cover
10 Axle housing	22 Nut	34 Split lock washer	46 Screw and lock washer
11 Vent plug	23 Outer bearing cone and rollers	35 Axle shaft	47 Filler plug
12 Pinion outer bearing cup	24 Outer bearing cup	36 Gasket	48 Cap screw

b. Pinion and Case Bearings. (Fig 14-2)
(1) Remove differential case bearings (2) using puller tool DO-914-P, holding ring DO-914-8 and adapter DO-914-62 (fig 13-5).
(2) Remove shims (3) from case (4). Identify all parts so they may be reassembled in their original location.
(3) Remove pinion inner bearing (7) using puller DO-914-P, holding ring DO-914-8 and adapter DO-914-95 (fig 13-11).
c. Pinion Bearing Cups.
(1) To remove pinion inner and outer bearing cups (8, 12 fig 14-2), use tool W 100-60-70, with its adapter plates. Remove the inner bearing cup first. Refer to figures 13-9 and 13-10.
(2) Remove hex nuts from each end of tool W-100-60-70.
(3) From housing cover end, carefully insert the round adapter with two flat sides through the inner bearing cup and position it behind the bearing cup shoulder.
(4) Insert the short-threaded end of the main puller screw through the hole in this adapter and secure adapter with a hex nut.
(5) Position the plate across open face of differential housing and secure with a hex nut.
(6) Make sure the adapter plate sets flat against the pinion rear bearing adjusting shims. Turn down the nut to remove the bearing cup.
(7) Remove tool W-100-60-70 from housing cover end.
(8) Attach tool W-l00-60-70 at yoke end of housing.
(9) Insert adapter behind shoulder of outer bearing cup.
(10) Make sure the adapter plate sets flat against the pinion outer bearing adjusting shims. Turn down the nut to remove the bearing cup.

14-4. Cleaning.
Refer to paragraph 2-7 for general cleaning instructions.

14-5. Inspection.
Refer to paragraph 2-8 for inspection procedures.

14-6. Repair or Replacement.
Refer to paragraph 2-8 and replace those parts and components that are worn or unserviceable.

14-7. Reassembly,.
a. Pinion and Adjustment. Refer to paragraph 13-7c.
b. Differential Side Gear Adjustment. Refer to paragraph 13-7c.
c. Axle Assembly.
(1) Assemble differential gear set.

(2) Install differential gear set in differential case. Aline marks made at disassembly and fasten differential case together with cap screws. Torque screws 35 to 55 lbs—ft.
(3) Check side gear clearance as described in paragraph 13-7c.
(4) Aline marks made at disassembly. Install ring gear on the differential case. (Fig 14-2)
(5) Install cap screws. Torque screws 100 to 120 lbs-ft.
d. Differential Bearing Pre-Load and Ring Gear Backlash. Refer to paragraph 13- 7d.

14-8. Installation.
Refer to TM 9-2320-244-20 for installation of rear axle assembly.

14-9. General.
The rear suspension assembly (fig 14-3) consists of springs, shock absorbers and rubber bumper stops. Repairs are confined to disassembly of the spring assemblies and replacement of shocks and bumpers. The rear springs contain leaf spring elements, spacer materiel and spring mounting bushings at each end of the leaf element. Compression-tYPe shackles are located at the rear end of each spring, connecting the bushings to appropriate frame brackets. Each spring assembly is clamped to the axle with an anchor plate, spacer and U-bolts. Direct actinghydraUliC shock absorbers, with dust shield and rubber bushings, are located at the left and right outboard position on the rear axle. Rubber bumper stops, mounted on the axle, restrict axle from bottoming on frame.

14-10. Removal.
Remove rear spring and shock absorber assemblies in accordance with TM 9-2320-244-20.

14-11. Disassembly.
a. Clamp spring leaves firmly together using one C clamp on each side of center bolt or using an arbor press.
b. Remove nuts from two rebound clip bolts, then remove bolts, spacers and clips.
c. Remove nut from center bolt and remove bolt.
d. Release C clamp or arbor press slowly to avoid personal injury.
e. If clip(s) is damaged, remove rivet in bottom of two rebound clips by grinding off rivet head and knocking out stud or by drilling out rivet.

14-12. Cleaning.
Clean all dirt and corrosion from spring leaves, using a wire brush if necessary, then wash in drycleaning solvent or volatile mineral spirits.

14-13. Inspection.
Inspect spring assemblies for broken leaves, broken rebound clips, cracked spacer materiel and spring eye bushings, or broken center bolts.

14-14. Repair or Replacement.
Replace any broken or unserviceable spring parts. Replace worn or unserviceable shock absorber assemblies in accordance with TM 9-2320-244-20.

14-15. Reassembly.
2z. Rivet rebound clips to bottom leaf, if removed during disassembly.
b. Stack spring leaves in correct order, with spacer materiel between them and with center bolt holes alined. Distance between inside of military wrap and outside of front eye should be 1/4 to 1/2-inch.
c. Compress spring leaves using C clamps or arbor press.
d. Install center bolt and nut with nut at top and tighten securely.
e. Install rebound clip bolts, spacers and nuts.
f. Remove C clamps or remove spring assembly from arbor press.

14-16. Installation.

Install rear spring and shock absorber assemblies in accordance with TM 9-2320-244-20.

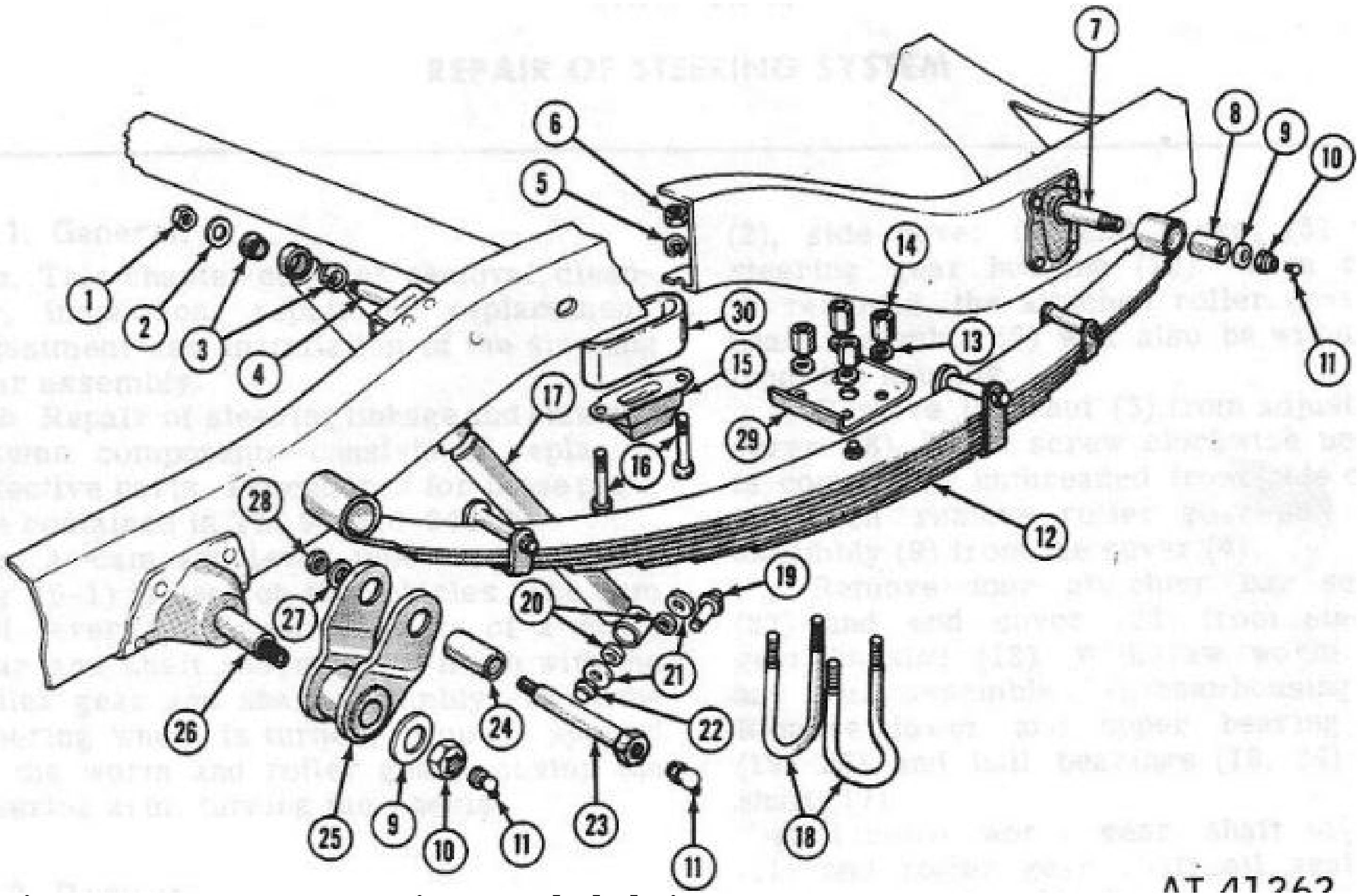


Figure 14-3. Rear suspension - exploded view.

1 Lock nut	7 Spring hanger	13 Flat washer	19 Lower mounting pin	25 Spring shackle
2 Flat washer	8 Spring bushing	14 Lock nut	20 Lower mounting pin bushing	26 Spring hanger
3 Mounting pin bushing	9 Flat washer	15 Bumper	21 Flat washer	27 Flat washer
4 Upper mounting pin	10 Lock nut	16 Bolt	22 Lock nut	28 Lock nut
5 Lock washer	11 Lube fitting	17 Shock absorber	23 Spring shackle bolt	29 Spring clip plate
6 Nut	12 Spring	18 Spring clip	24 Spring bushing	

CHAPTER 15
REPAIR OF STEERING SYSTEM

15-1. General.
a. This chapter contains removal, cleaning, inspection, repair or replacement, adjustment and installation of the steering gear assembly.
b. Repair of steering linkage and steering column components consists of replacing defective parts. Procedures for these parts are contained in TM 9-2320-244-20.
c. A cam and lever type steering gear (fig 15-1) is used on the vehicles. The cam and lever type gear Consists of a worm gear and shaft assembly in mesh with the roller gear and shaft assembly. When the steering wheel is turned, torque is applied to the worm and roller gear, moving the steering arm, turning the wheels.

15-2. Removal.
Refer to TM 9-2320-244-20 for removal of steering gear and linkage.

15-3. Disassembly. (Fig 15-1)
a. Clean exterior of steering gear. Remove filler plug (1) from steering gear housing and drain lubricant from gear.
b. Make index marks on the roller gear and shaft assembly (9) and on the steering arm (14), to assure correct alinement during reassembly. Remove nut (16) and lock washer (15) from shaft end (9). Remove steering arm (14) from shaft (9) using a steering arm puller or gear puller.

CAUTION
Do not use a hammer or wedge to remove steering arm from the roller gear and shaft assembly. This will damage the gear and shaft assembly.

c. Using a fine file or piece of emery cloth, remove any nicks or burrs from the exposed portions of the roller gear and shaft assembly (9) and from the worm gear and shaft assembly (17).
d. Remove four attaching cap screws
(2), side cover (4) and gasket (5) from steering gear housing (12). When cover is removed, the attached roller gear and shaft assembly (9) will also be withdrawn from the housing.
e. Remove lock nut (3) from adjustment screw (8). Turn screw clockwise until it is completely unthreaded from side cover (4); then remove roller gear and shaft assembly (9) from the cover (4).
f. Remove four attaching cap screws (23) and end cover (22) from steering gear housing (12). Withdraw worm gear and shaft assembly (17) from housing (12). Remove lower and upper bearing cups (19, 25) and ball bearings (18, 24) from shaft (17).
g. Remove worm gear shaft oil seal (11) and roller gear shaft oil seal (13) from the housing (12). Discard both seals.

15-4. Cleaning.
Clean all parts with suitable cleaning solvent and wipe dry. Clean all gasket mating surfaces thoroughly.

15-5. Inspection.
a. Inspect steering gear housing for cracks, breaks, leaks, or other damage. Replace if damaged.
b. Inspect roller gear and shaft assembly visually for wear, scoring, or pitting. If necessary, polish lightly with a fine abrasive cloth. Inspect roller gear to assure proper freedom of movement and lacks excessive lash or roughness. Replace gear and shaft assembly if visibly worn or damaged.
c. Check adjustment screw of roller gear and shaft assembly for excessive end-play. If end-play exceeds 0.015-inch, remove retaining ring, thrust washer and screw from gear and shaft assembly. Replace the retaining ring if unserviceable. Install new adjustment screw, thrust washer and retaining ring into gear and

shaft assembly.

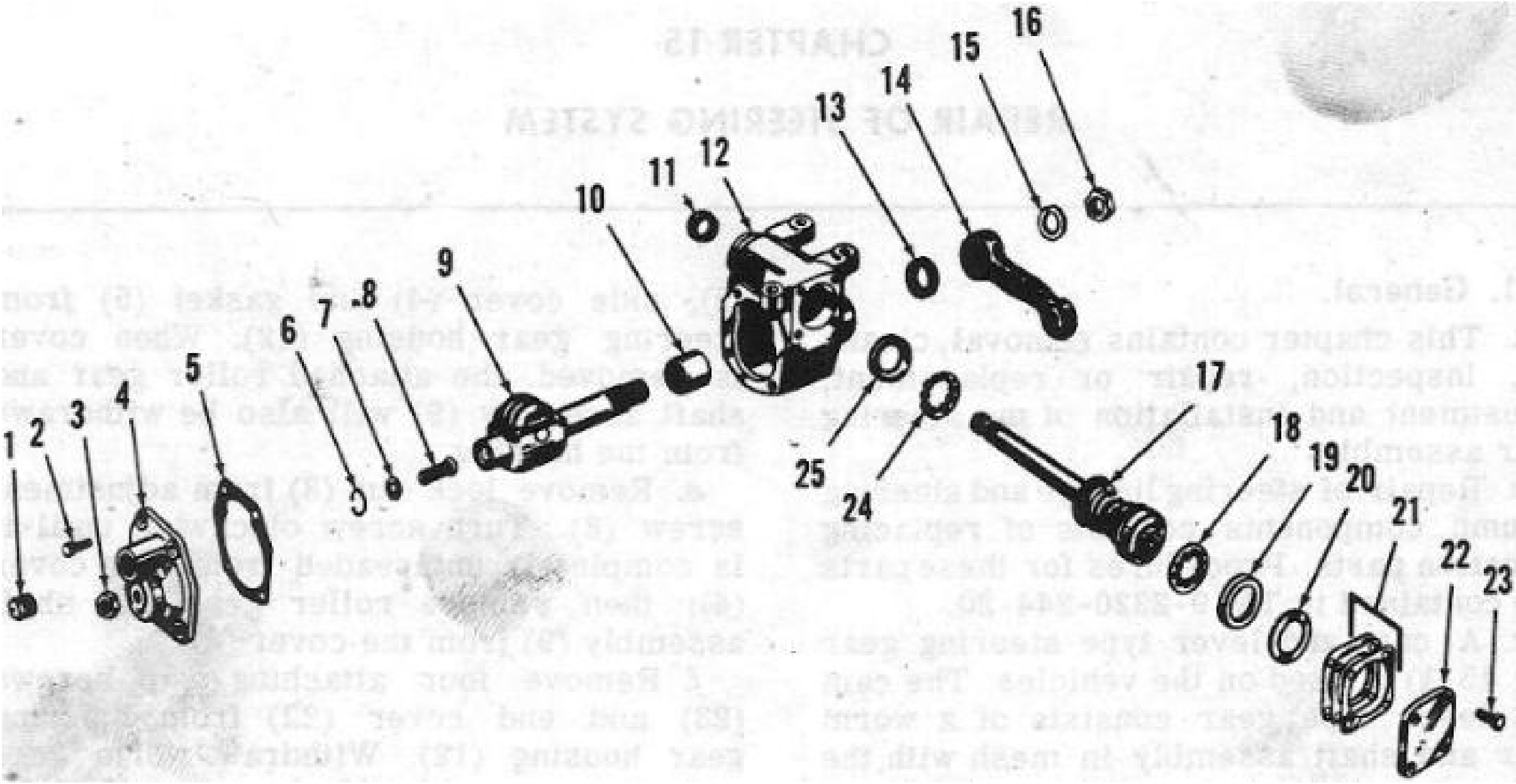


Figure 15-1. Steering gear - exploded view.

1 Filler plug	8 Adjustment screw	15 Lock washer	22 End cover
2 Cap screw	9 Roller gear and shaft assembly	16 Nut	23 Cap screw
3 Lock nut	10 Needle bearing	17 Worm gear and shaft assembly	24 Upper ball bearing race
4 Cover	11 Oil seal	18 Lower ball bearing race	25 Upper bearing cup
5 Gasket	12 Steering gear housing	19 Lower bearing cup	
6 Retaining snap ring	13 Oil seal	20 Thrust spacer	
7 Thrust washer	14 Steering arm	21 Shim	

d. Inspect bearing surface in side cover and replace if worn or damaged. Inspect worm gear and shaft assembly for wear, scoring, or pitting. If necessary, polish lightly using a fine abrasive cloth. Replace assembly if worn or damaged.

e. Inspect upper and lower ball bearings and cups of worm gear and shaft assembly for wear or damage. Replace if necessary.

NOTE

Bearing balls must be replaced as a set in each bearing.

15-6. Repair or Replacement.
Replace all worn, damaged, or unserviceable parts.

15-7. Reassembly. (Fig 15-1)
a. Steering Gear.
(1) Install new oil seals (11, 13) into worm and roller gear shaft oil seal bores of steering gear housing, with lip of each seal facing into housing. Press each seal into housing using a mandrel of suitable diameter.
(2) Lubricate worm gear and shaft assembly (17) and upper ball bearing and cup (24, 25) with specified gear oil. Install bearing and cup on the shaft. Install shaft assembly (17) into steering gear housing (12). Be certain splined end of shaft does not damage oil seal (11).
(3) Lubricate lower end of worm gear and shaft assembly and the lower ball bearing and cup (18, 19) with proper gear oil. Install bearing (18), cup (19) and spacer (20) onto shaft. Install shims (21) and end cover (22) onto steering gear housing (12); attach loosely with four cap screws (23). Adjust bearing pre—load as described in (b) below.
(4) Position tapped hole of side cover (4) onto adjustment screw (8) of the roller gear and shaft assembly (9). Thread screw (8) counter-clockwise into cover (4) until end of shaft touches inner face of the cover. Install lock nut (3) loosely on adjustment screw (8).
(5) Install new gasket (5) on side cover (4). Lubricate roller gear and shaft assembly (9) with specified gear oil. Insert gear and shaft assembly (9) into steering gear housing (12). Be certain end of shaft does not damage oil seal (13) in housing. Roller gear (9) and worm gear (17) must mesh, allowing side cover (4) to seat against the housing (12). Secure cover to housing using four cap screws (2). Torque cap screws 18 to 22 lbs-ft. Adjust gear clearance as described in (c) below.
(6) Clamp exposed section of roller gear and shaft assembly firmly in a soft-jaw vise. Observe index marks made during disassembly and position steering arm (14) to splined end of the shaft (9). Install lock washer (15) and nut (16) on shaft threads; tighten nut to draw arm into position on the spline.
(7) Fill steering gear housing to re4uired level using specified lubricant.
b. Steering Gear Bearing Pre-Load Adjustment. (Fig 15-1)
(1) This steering gear adjustment determines pre-load applied to upper and lower ball bearings (18, 19, 24, 25), which support the worm gear and shaft assembly (17). It is made by adding to or subtracting from the number of shims (21) between the steering gear housing (12) and end cover (22), with the roller shaft assembly (9) removed.
(2) If necessary, loosen four cap screws (23) which fasten the end cover (22) to the steering gear housing (12).
(3) Alternately tighten cap screws (23) evenly, but only slightly at a time, and rotate the worm gear shaft (17). Torque screws 18 to 22 lbs-ft.
(4) Check rolling torque required to rotate the worm gear shaft (17). When bearing pre-load is correct, rolling torque will be 6 to 12 lbs-in. •If necessary; remove cap screws (23) and end cover (22). Either add to, or subtract from, the existing number of shims (21), and repeat step (3) above; to obtain correct bearing preload.
c. Steering Gear Clearance Adjustment. (Fig 15-1)
(1) This steering gear adjustment sets proper backlash between the worm gear (17) and roller gear (9) of the steering gear assembly. It prevents gear wear and steering play which would result from excessive backlash. Gear backlash is adjusted by an adjustment screw (8), which determines the longitudinal position of the roller gear and shaft assembly (9).
(2) If necessary, loosen lock nut (3) and turn adjustment screw (8) at the side cover (4) counter-clockwise until worm gear shaft (9) turns freely throughout its entire range of travel (fig 15-1).
(3) Count number of turns necessary to rotate worm gear shaft through its entire range of travel. Turn shaft to center its travel. Rotate shaft back and forth through its center of travel, and tighten adjustment screw until shaft shows slight bind at center of its travel. Adjust screw to obtain a rolling torque requirement of 15 to 29 lbs-in, to rotate shaft through center of its travel. Hold adjustment screw in position and torque lock nut 16 to 20 lbs-ft.
(4) Recheck rolling torque necessary to rotate worm gear shaft through center of its travel. If necessary, repeat steps (2) and (3) above, until rolling torque is correct.

d. Steering Column and Wheel Service. Refer to TM 9-2320-244-20.

15-8. Installation.
Refer to TM 9-2320-244-20 for installation of steering gear and linkage.

CHAPTER 16
REPAIR OF BRAKE SYSTEM

16-1. General.
a. This chapter contains description, removal, disassembly, cleaning, inspection, repair or replacement, reassembly and installation of the brake master cylinder and wheel cylinders.
b. Refer to TM 9-2320-244-20 for removal and installation of service and parking brake assembly.
c. When pressure is applied to the brake pedal, the master cylinder forces pressure through the lines and into the wheel cylinders. This pressure forces the pistons in the wheel cylinders outward, expanding the brake shoes against the drums. As the pedal is further depressed, higher pressure in the hydraulic system causes the brake shoes to exert greater force against the brake drums.
d. The wheel cylinders, (fig 16-1) are double piston cylinders. The purpose of the two pistons is to distribute the pressure evenly to each of the two brake shoes.
e. Rubber cylinder cups on the pistons prevent the leakage of fluid. The rubber boots over the end of the cylinder prevent dust from entering the cylinder.

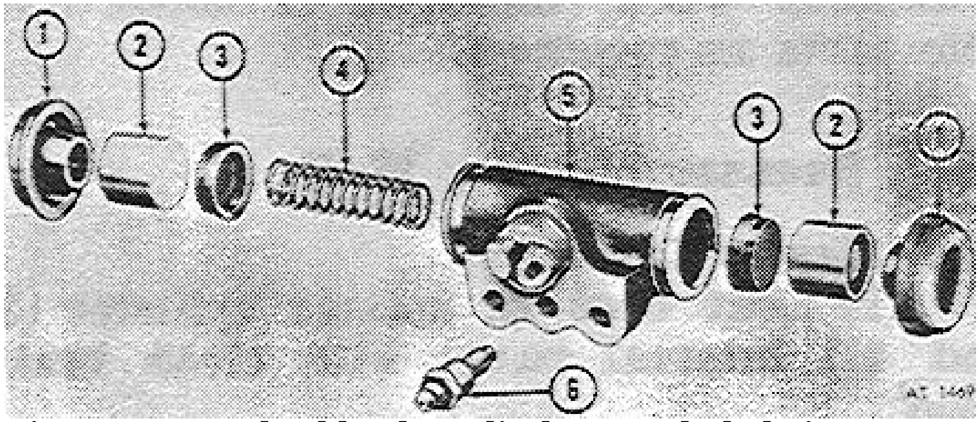


Figure 16-1. Wheel brake cylinder - exploded view.

1 Boot
2 Piston
3 Cylinder cup
4 Cup spring
5 Cylinder
6 Bleeder screw

16-2. Removal.
Refer to TM 9-2320-244-20 for removal of brake components.

16-3. Disassembly. (Fig 16-1)
a. Wheel Cylinders. Pull boots (1) off ends of cylinders (5) and remove push rods from boots. Push pistons (2), cups (3) and spring (4) out of cylinder (5). Remove bleed screw (6).
b. Master Cylinder. (Fig 16-2)
(1) Clamp master cylinder in a bench vise.
(2) Remove boot (9), piston stop snap ring (8), primary piston (7) and cup (6) assembly, valve return spring (5), and check valve and seat assembly (4).

16-4. Cleaning.

CAUTION

Never use mineral spirits base cleaning solvents such as gasoline, kerosene, carbon-tetrachloride, acetone, paint thinner or similar compounds as these solvents deteriorate rubber parts, causing them to become soft and swollen in an extremely short time. Before washing parts. hands must be clean. Do not wash in gasoline or oil before cleaning parts. Use soap and water only. Be careful to keep all parts of the master cylinder and wheel cylinder clean and free from mineral oil and grease.
Use denatured alcohol or brake fluid to clean all metal parts thoroughly. Immerse parts in cleaning fluid and brush to remove foreign matter. Blow out all passages, orifices and valve holes. Dry all parts thoroughly with compressed air and place them on clean paper or a lint-free clean cloth. Be sure to keep parts clean until reassembly. Re-wash parts, if there is any doubt as to cleanliness.

16-5. Inspection.
a. Wheel Cylinders. (Fig 16-1)
(1) Inspect cups and seals for leakage.

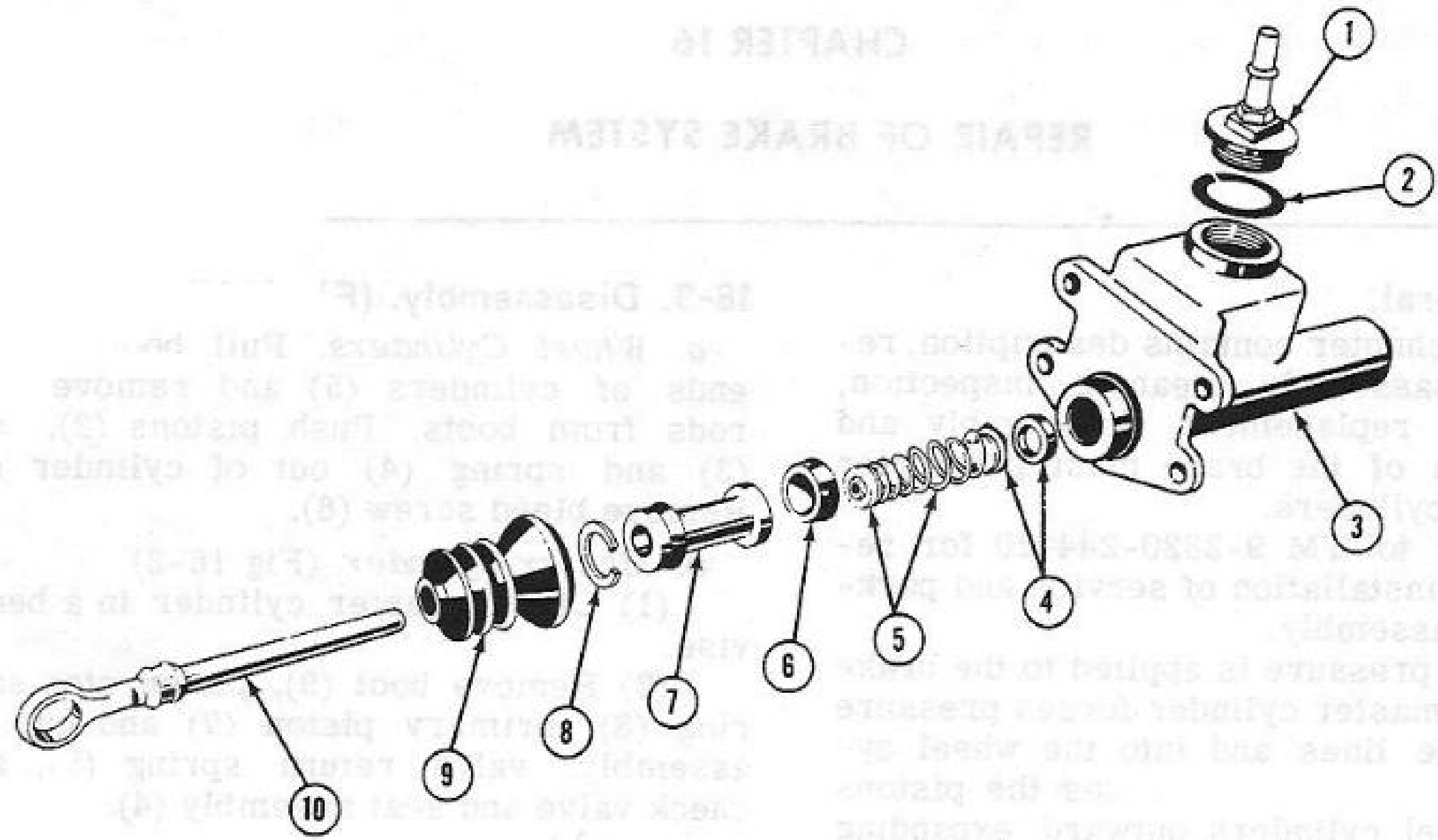


Figure 16-2. Brake master cylinder — exploded view.

1 Vented filler cap	6 Primary cup
2 Filler cap gasket	7 Piston
3 Supply tank	8 Piston stop ring
4 Valve and seat	9 Boot
5 Valve return spring	10 Piston rod

(2) Inspect cylinder bore for scores, scratches, or corrosion. Light scratches or slightly corroded spots may be polished out with crocus cloth. Never use emery cloth or sandpaper. If scratches or corrosion are too deep to be polished out, replace cylinder.

(3) Check fit of new pistons in cylinder bore, using a feeler gage. Clearance should be within 0.002 to 0.004-inch. Re place cylinder if clearance exceeds 0.004- inch.

b. Master Cylinder. (Fig 16-2)

(1) Inspect cylinder bore for corrosion, pits and foreign matter. Insure that outlet ports are clean and free of dirt. Replace cylinder if corroded.

NOTE

Do not confuse staining with corrosion. Corrosion will show up in the form of pits or excessive bore roughness. Polish any discoloredor stained area with crocus cloth supported by a finger. Do not use emery cloth or sandpaper. Do not slide cloth in a lengthwise manner under pressure. Clean the cylinder after polishing.

(2) Inspect fluid reservoirs for foreign matter. Check bypass and compensating ports in cylinder bore to insure they are not restricted. Do not use wire to check ports. (The wire could push a burr into the cylinder bore.)
(3) Inspect spring for distortion or weakness and rubber parts for wear or deterioration.
(4) Check pistons for scratches or other damage.

16-6. Repair or Replacement.Replace worn, damaged or unserviceable parts as required.

16-7. Reassembly. (Fig 16-2)
a. Master Cylinder.
(1) Coat bore of master cylinder (3) and all internal parts with clean brake fluid.
(2) Install valve seat (4) into end of cylinder bore, with flat surface toward valve assembly.
(3) Install valve assembly.
(4) Install return spring (5) and primary cup (6), with flat side of cup toward piston.
(5) Install piston (7) and piston stop snap ring (8).
(6) Install fitting connection.
(7) Fill reservoir half full of brake fluid and operate the piston (7) with the piston rod (10) until fluid is ejected at fitting. This completes master cylinder reassembly. Install filler cap (1) and gasket (2).
b. Wheel Cylinder Reassembly. (Fig 16-1).

NOTE

Dip each internal part of wheel cylinder in brake fluid before reassembly.
Insert pistons (2), cups (3) and spring (4) into cylinder (5). Install boot (1) on push rods and pull boots over ends of cylinder(5).

16-8. Installation.Refer to TM 9-2320-244-20 for installation of brake components.

CHAPTER 17
REPAIR OF FRAME ASSEMBLY

17-1. General.
This chapter contains description, removal, disassembly, cleaning, inspection, repair or replacement, reassembly and installation of the frame assembly. The frame provides support for the spring and unsprung masses, such as cab and cargo body units, power train, other chassis units and also maintains the proper relationship of these units. The frame is constructed of channel-type side rails, and channel or hat-type crossmembers appropriately spaced with necessary brackets for component attachments. Rivets or bolts are used to attach crossmembers and major component brackets to the frame side rails and crossmembers.

17-2. Removal.

a. Frame Assembly. This paragraph references removal procedures necessary to completely separate the vehicle from the frame.
(1) Remove body. Refer to TM 9-2320-244-20.
(2) Remove front end sheet metal. Refer to TM 9-2320-244-20.
(3) Remove cab assembly. Refer to TM 9-2320-244-20.
(4) Remove propeller shaft assemblies. Refer to TM 9-2320-244-20.
(5) Remove exhaust system. Refer to TM 9-2320-244-20.
(6) Remove power plant assembly. Refer to TM 9-2320-244-20.
(7) Remove transfer case assembly. Refer to TM 9-2320-244-20.
(8) Remove front axle and front suspension assembly (para 13-2).
(9) Remove rear axle and rear suspension assembly (para 14-2).
(10) Remove fuel tank assembly. Refer to TM 9-2320-244-20.
(11) Remove winch assembly. Refer to TM 9-2320-244-20.
b. Frame Components. This paragraph references procedures necessary to remove all other parts attached to frame assembly.
(1) Pintle. Refer to TM 9-2320-244-20.
(2) Towing shackles. Refer to TM 9-2320-244-20.
(3) Lifting brackets. Refer to TM 9-2320-244-20.
(4) Front bumpers. Refer to TM 9-2320-244-20.
(5) Rear bumperettes. Refer to TM 9-2320-244-20.

17-3. Disassembly.
The frame is disassembled when transmission and transfer case crossmembers and all other attaching parts are removed from frame assembly.

17-4. Cleaning.
Refer to paragraph 2-7 for general cleaning procedures.

17-5. Inspection.
Check frame assembly for cracks, broken wells, bent or twisted metal.

17-6. Repair or Replacement.
a. Frame Straightening. A bent or twisted frame may be straightened provided extent of misalinement is not excessive. To avoid weakening the frame, straightening should be performed without application of heat. It is recommended that severely damaged frame parts be replaced.
b. Checking Frame Alinement.
(1) The most efficient and satisfactory method of checking frame alinement is with a frame aiming fixture, equipped with bending tools for straightening frame parts. No attempt will be made in this manual to instruct in the use of available equipment as each manufacturer furnishes necessary instructions.
(2) In the absence of such a fixture, frame alinement may be determined by using the X, or diagonal method, of checking from given points on each side rail. Figure 17-1 illustrates this method of checking the frame alinement.
(3) The most convenient way to make this check, particularly when the body is on the chassis, is by marking on the floor all points from which measurements should be taken.
(4) Select a space on the floor that is level. If a cement floor is available, clean it so that chalk will mark underneath the frame to be checked.
(5) If a wooden floor, lay a sheet of paper underneath the vehicle and tack in place, dropping a plumb-bob from each point indicated in figure 17-1, marking the floor directly underneath the point. Satisfactory checking depends upon the accuracy of the marks in relation to the frame. To reach the points shown that have been marked, have vehicle carefully moved away from layout on the floor, and proceed as follows:
(6) Check frame width at front and rear end using corresponding marks on the floor. If widths correspond to specifications, draw center line full length of vehicle, half-way between marks indicating front and rear widths. If frame width is not correct and the center line cannot be laid out from checking points at

the end of frame, it can be drawn through intersections of any two pairs of equal diagonals.
(7) With center line properly laid out, measure distance from it to points opposite over entire length of chassis. If frame is in proper alinement, measurement should not vary.
(8) To locate point at which frame is sprung, measure the diagonals marked A-B, B-C, C-D. If the diagonals in each pair are within 1/8-inch, that part of the frame included between points of measurements may be considered as satisfactory alinement. These diagonals should also intersect at the center line. If measurements do not agree within the above limits, it means that correction will have to be made between those points that are not equal.
c. Frame Dimensions. Points for checking frame alinement are shown in figure 17-1. For a more detailed measurement when straightening a frame or positioning
a crossmember, refer to figure 17-2. The correct measurements are given in the callout listing.
d. Front Axle Atinement. When frame is properly alined, front axle alinement to frame should also be checked. The front axle is square with the frame when the distance between front and rear axles is the same on both sides. The distance from the spring upper bushings to the front axle on both sides should be equal.

17-7. Reassembly.
a. Frame Components. This paragraph references procedures necessary to reassemble all other parts directly attached to frame assembly.
b. Pintle. Refer to TM 9-2320-244-20.
c. Towing shackles. Refer to TM 9-2320-244-20.
d. Lifting brackets. Refer to TM 9-2320-244-20.
e. Front bumpers. Refer to TM 9-2320-244-20.
f. Rear bumperettes Refer to TM 9-2320- 244-20.

17-8. Installation.
a. Install winch assembly. Refer to TM 9-2320-244-20.
b. Install fuel tank assembly. Refer to TM 9-2320-244-20.
c. Install rear axle and rear suspension assembly. Refer to paragraph 14-8 and 14-16.
d. Install front axle and front suspension assembly. Refer to paragraph 13-8 and 13-16.
e. Install transfer case assembly. Refer to TM 9-2320-244-20.
f. Install power plant assembly. Refer to TM 9-2320-244-20.
g. Install exhaust system. Refer to TM 9-2320-244-20.
h. Install propeller shaft assemblies. Refer to TM 9-2320-244-20.
i. Install cab assembly. Refer to TM 9-2320-244-20.
j. Install hood and front end sheet metal. Refer to TM 9-2320-244-20.
k. Install cargo body. Refer to TM 9-2320-244-20.

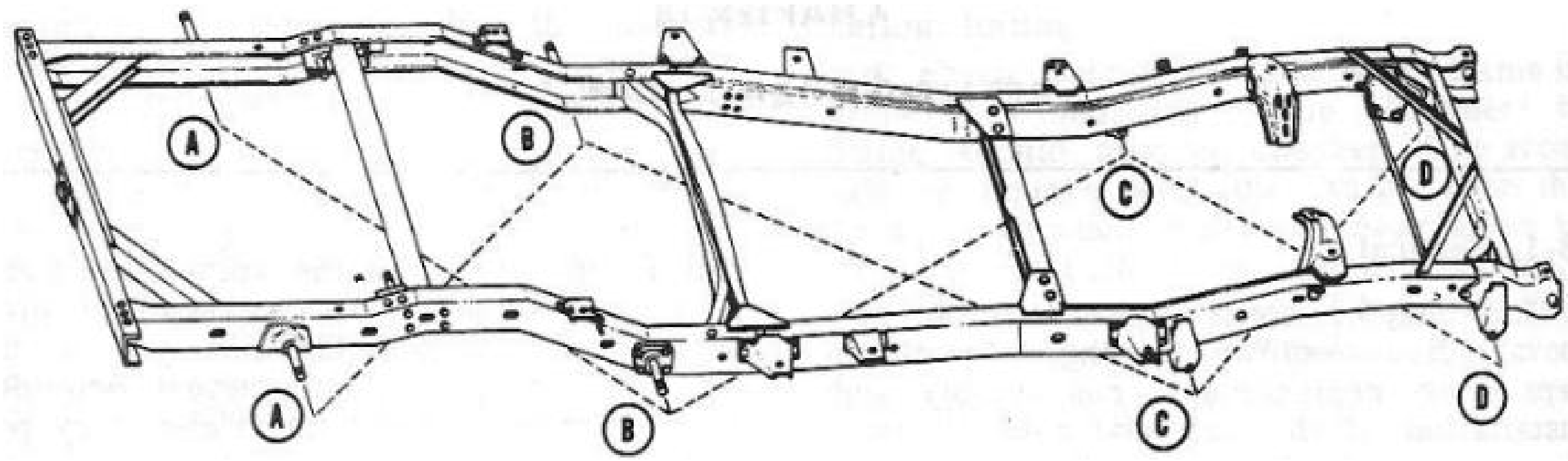


Figure 17-1. Frame points for measuring alinement.

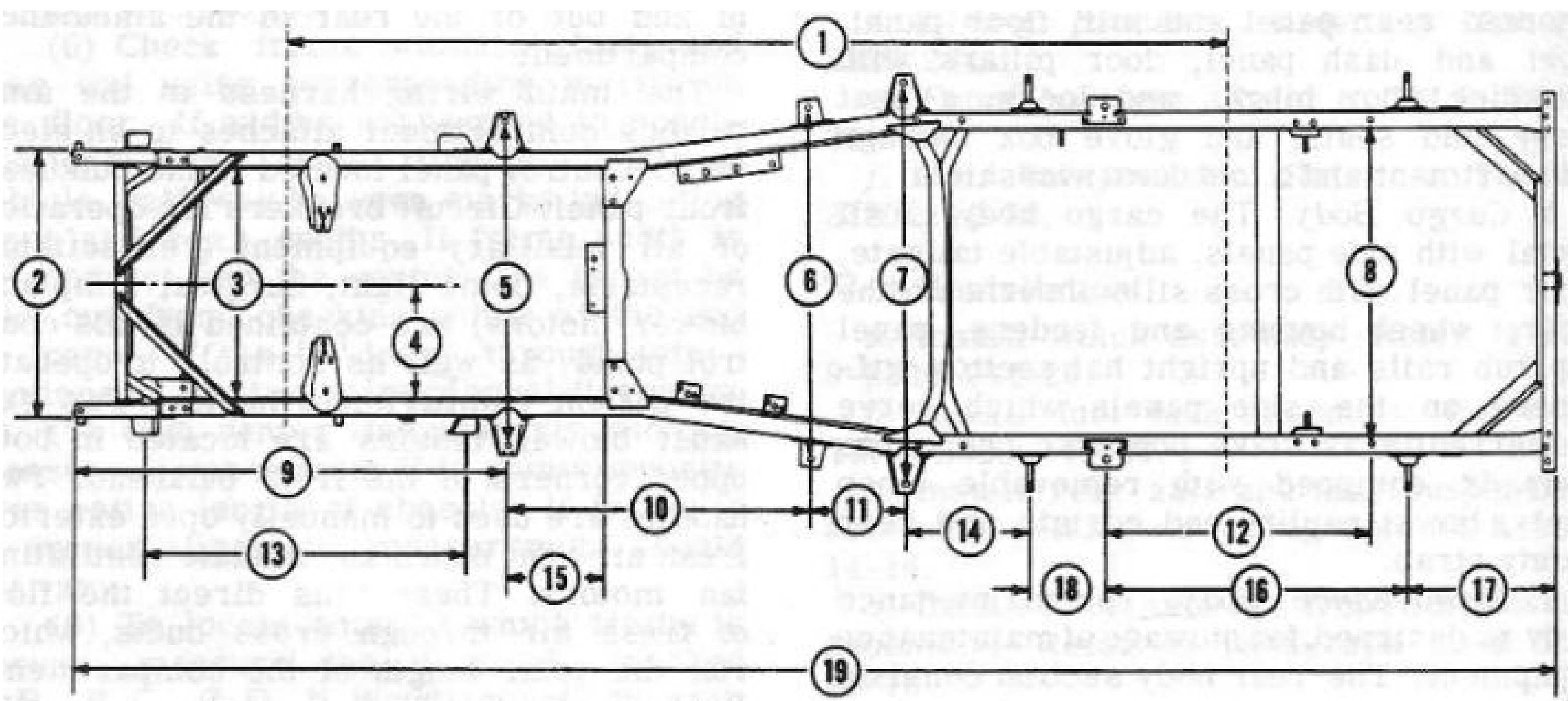


Figure 17-2. Frame Dimensions.

1 126” wheelbase	6 45.88”	11 12.66”	16 41”
2 34.36”	7 52.46”	12 36”	17 20.99”
3 30”	8 42.14”	13 41.88”	18 10.31”
4 15”	9 58.69”	14 17.03”	19 201.80”

5 42.50	10 41.12”	15 13.18”

CHAPTER 18
REPAIR OF CAB AND BODY

18-1. General.

This chapter contains description, removal, disassembly, cleaning, inspection, repair or replacement, reassembly and installation of the cab and related components, cargo body, maintenance body, ambulance body and components related to the patient compartment.
a. Cargo and Maintenance Cab. The cargo cab is of the open type, all metal construction incorporating a removable canvas soft top. Cab construction consists of reinforced rear panel and sill, floor panel, cowl and dash panel, door pillars with attaching door hinges and locks, a seat riser and seats, and glove box storage compartment and a fold down windshield.
b. Cargo Body. The cargo body is all metal with side panels, adjustable tailgate, floor panel with cross sills underneath the floor, wheel housing and fenders, panel top rub rails Sand upright hat section stiffeners on the side panels which serve concurrently as stake pockets. The cargo body is equipped with removable troop seats, bows, paulin, end curtain and rear safety strap.
c. Maintenance Body. The maintenance body is designed for stowage of maintenance equipment. The rear body section consists of two side banks of drawer and closet type compartments with open cargo space between. A rear tailgate with chains and recessed door locks on all compartments are furnished. Also furnished on the rear body are grab handles, ladder rack, utility hooks, furnace and solder pot holder, wire reel and three gallon water can.
d. Ambulance Cab. The ambulance cab is similar in design to the cargo cab, except the ambulance is equipped with cab hardtop and doors. In addition, the back panel is cut away at center of cab to allow passage of an attendant from cab to the ambulance body.
e. Ambulance Body. The ambulance body is constructed of sheet metal panels welded together and mounted on a chassis. The
cab is integral with the ambulance body. A sliding door in the bulkhead permits entrance to the ambulance body from the cab. The patient compartment provides accommodations for eight ambulatory patients, or four litter patients, or a combination of two litter and four ambulatory patients in addition to furnishing treatment and movement space for one medical attendant. A fifth litter patient can also be accommodated on the floor of the compartment. Two rear doors provide access in and out of the rear of the ambulance compartment.
The main wiring harness to the ambulance compartment attaches to an electrical control panel located in the bulkhead front panel. Circuit breakers for operation of all auxiliary equipment (resuscitator receptacle, dome light, surgical lamp and blower motors) are contained in this control panel, as well as controls to operate the patient compartment heater. Two exhaust blower motors are located in both upper corners of the front bulkhead. Two handles are used to manually open exterior fresh air vent doors and actuate ventilating fan motors. These fans direct the flow of fresh air through cross ducts, which run the total length of the compartment. Foul air is expelled through a manually controlled vent located in the right rear of the compartment.

18-2. Removal.
a. Cab. Refer to TM 9-2320-244-20 for removal of cab and related components.
b. Cargo Body. Refer to TM 9-2320-244-20 for removal of cargo body and related components.
c. Ambulance Body.
(1) Remove batteries. Refer to TM 9-2320-244-20.
(2) Disconnect cab to engine wiring harness. Refer to TM 9-2320-244-20.
(3) Remove hood and air cleaner assembly. Refer to TM 9-2320-244-20.

(4) Disconnect steering column at steering gear. Refer to TM 9-2320-244-20.
(5) Remove radiator assembly. Refer to TM 9-2320-244-20.
(6) Remove two spring loaded radiator guard hold downs. Refer to TM 9-2320-244-20.
(7) Disconnect power take-off control rod at shifter lever, if applicable. Refer to TM 9-2320-244-20.
(8) Remove transfer case shift lever. Refer to TM 9-2320-244-20.
(9) Remove transmission shift lever. Refer to TM 9-2320-244-20.
(10) Disconnect handbrake and service brake linkage. Refer to TM 9-2320-244-20.
(11) Disconnect accelerator and choke linkage, Refer to TM 9-2320-244-20.
(12) Disconnect clutch linkage. Refer to TM 9-2320-244-20.
(13) Remove driver and passenger seats. Refer to TM 9-2320-244-20.
(14) Disconnect heater hose, if equipped with heater. Refer to TM 9-2320-244-20.
(15) Remove body to frame hold down bolts. Refer to TM 9-2320-244-20.
(16) Disconnect ambulance compartment wiring harness at underbody.
(17) Disconnect ambulance body fuel line to heater at underbody.
(18) Disconnect fuel tank filler pipe. Refer to TM 9-2320-244-20.
(19) Use two fork lift trucks, positioned on either side of the body, to lift body from frame.
d. Patient Compartment Heater and Control Panel.
(1) Exhaust air ducts, fan and switches. Refer to TM 9-2320-244-20.
(2) Surgical and dome lamp. Refer to TM 9-2320-244-20.

18-3. Disassembly.
a. Patient Compartment Heater. Heater unit for cargo arctic kit and ambulance compartment are identical, refer to TM 92320-244-20 for disassembly and repair. Refer to TM 9-2320-244-20 for repair of electrical control panel.
b. Blower Motor Assembly. Refer to TM 9-2320-244-20.
c. Rear Step and Attendants Seat.
(1) Remove four bolts and lock washers at each of the two mounting hinges on floor of patient compartment. Remove step and seat assembly from compartment.
(2) Remove four bolts and lock washers (two each side) securing lower step to outer rails. Remove bottom step.
(3) Remove lock arm pivot snap ring and lock arm spring. Punch out pin to remove lever.
(4) Remove four screw and lock washer assemblies (two each side), and remove extension outer rails and stop plate.

18-4. Cleaning.
Refer to TM 9-208-1 for general cleaning procedures.

18-5. Inspection.
a. Inspect cab, cargo and ambulance bodies for general internal and external condition, such as rust, cracked, broken or loose parts.
b. Check operation of ventilating and heating equipment, receptacle unit, dome and surgical lamps, also patient litter racks, seat backs and attendants seat conversion to rear step assembly..

18-6. Repair or Replacement.
a. Cab, Cargo and Ambulance Bodies.
(1) General. The following instructions do not contain detailed step-by-step procedures on body repair. Since the nature and extent of damage to the body will vary, no definite repair procedure can be established.
(2) Straightening. Steel parts can be repaired by straightening, brazing, or welding; however, badly damaged parts shall be replaced. Heat shall not be used

when straightening parts of the body or cab. Heat weakens the structural characteristics of metal; therefore, all straightening shall be done with parts cold. Any part buckled or bent sufficiently to show strains or cracks after straightening shall be replaced or reinforced.
(3) Patching and welding.
(a) Preparation. Prepare hole or break for patching by trimming off all curled edges with a cutting torch.
(b) Equipment. Electric welding equipment should be used exclusively in the repair of the body and cab. Use shielded arc method; the heat of the weld is localized and burning of the material is minimized with this method. In the event electric welding equipment is not available, gas welding or brazing may be used.
(c) Welding materials. Welding rods of electrode classification number E-6012 A.W.S. (American Welding Society) should be used. When patching the cab or body, the patch should be of the same thickness as the panel to which the patch is being applied.

WARNING

Welding or cutting shall not be undertaken in areas where fire is forbidden, nor shall work of this nature be performed near inflammable materials unless proper precautions are taken to prevent fire. During operation in an inadequately ventilated place, the fumes, suffocating gases, and toxic gases generated in welding process, or the reduction of oxygen in the air, may overcome the operator. For this reason, welding shall not be attempted in such places unless adequate forced ventilation is provided. Refer to TM 9-237 prior to welding near or around fuel tank.

(d) Preparing patch. Cut a patch of the same material and thickness as the panel to which the patch is to be applied. The patch must be of sufficient size to overlap at least two inches all around the hole. Form patch to fit contour of mating part.
(e) Applying patch. Position patch over hole and tack weld patch to one side of panel or part at several evenly spaced points. On the other side of the panel or part, run a continuous fillet weld all around the edge of the hole. When welding body panels, patch can be applied to the inside or outside of the panel. The edges of the fracture inside the body or cab should be hammered smooth to fit against the patch and then weld solidly to patch. After welding, all slag must be chipped and the area primed and painted in accordance with TM 9-213.
b. Blower Motor Assembly. Repair of the exhaust blower motor assembly consists of replacing an inoperative or defective motor. Refer to TM 9-2320-244-20.
c. Heater Control Panel Component Re-
placement.
(1) Heater switch replacement. Refer to TM 9-2320-244-20.
(2) Circuit breaker replacement. Refer to TM 9-2320-244-20.
(3) Relay switch replacement.
(a) Identify wiring a n d remove screws from relay switch leads.
(b) Remove two screws and nuts securing relay switch to control panel. Remove switch.
(c) Position and secure a new relay switch to control panel with two screws and nuts.
(d) Place wiring on relay switch leads. Secure wiring in place with screws.
d. Bulkhead Door.
(1) Door replacement.
(a) Close door and remove four bolts (two each side) securing nylon roller and bracket to door. Lift out door.
(b) Position door in opening and secure nylon roller and bracket to door with four bolts (two each side). Tighten bolts securely.
(2) Glass replacement.
(a) Pull up on weatherstrip with hand, while exerting pressure at base of glass with other hand. This will force the glass and weatherseal out of cavity. Continue this procedure along entire bottom of glass until completely removed.
(b) Position new glass in weatherstrip and lubricate weatherstrip with soap or suitable lubricating substance.
(c) Place glass in window opening from the cab side. Place a piece of mason string around circumference of seal and through to ambulance compartment side.
(d) Hold glass with one hand while pulling string with other to force seal through window opening and seatglass.
(3) Bulkhead door window blackout cur-lain replacement.

(a) Remove screw securing length of sheet metal and curtain to door. Remove. curtain.
(b) Position new window curtain and length of sheet metal on door and secure with screws.
(4) Bulkhead door lock and handle repla cement.
(a) Remove four screws from door front panel and remove lock.
(b) Remove two screws securing handle to door and remove handle.
(c) Position new door lock into door.
(d) Position new door handle and secure with two screws. Install four screws that secure door lock to bulkhead door.
(e) Close door and check locking action of new assembly.
e. Rear Doors.
(1) Door replacement.
(a) Remove clip from rod limiting door travel and remove rod from door bracket.

NOTE

Scribe mark on body indicating location of hinges, for alinement purposes during reinstallation.

(b) Support door and remove six bolts and lock washers securing door hinge to body. Remove the other door following the same procedure.
(c) Position and support door on body and install six bolts and lock washers to secure door hinge to body. Aline door to scribed marks on body, made during removal. Tighten bolts to 70-95 lbs-in.
(d) Position limiting rod in door bracket and secure with clip.
(e) Perform the same procedure for the other door.

NOTE

If doors require adjustment, the body hinge bolts govern vertical door travel; door hinge bolts govern horizontal travel.

(2) Rear door glass replacement. Replace window glass following the same procedure outlined in (2d) above.
(3) Window blackout curtain replacement. Replace window blackout curtain following the same procedure outlined in (3b) above.
(4) Rear door seal replacement. Seal is attached to outer diameter of rear doors by nylon threaded T shaped pins. Remove pins from door using a screw driver or other suitable tool to pry out.
f. Repair of Rear Step and Attendant Seat. Repair consists of straightening of frame, installing new rubber bumpers,
removing burrs or bends in telescoping sides, repairing locking mechanism, or welding breaks in the metal when necessary.
g. Resuscitator Receptacle.
(1) Disconnect battery leads.
(2) Remove two screws securing receptacle to body.
(3) Pull receptacle from body and separate connectors.
(4) Attach connector leads and position receptacle into body opening.
(5) Secure assembly in place with two dcrews.
(6) Check receptacle for operation.
h. Litter Rack and Patient Seat Repair.
Use general shop practice to repair bent or cracked components. Replace racks if necessary.
(1) Upper litter rack replacement.
(a) Unlatch front and rear inboard locks.
(b) Unhook rear arm assembly and lower rear of tray on bottom litter.
(c) Pull forward end of tray out of bracket by pulling rack toward center and out of track and remove upper litter tray.

(d) Aline front pins of upper litter rack into track assembly and attach forward linkage onto upper litter rack by sliding into track.
(e) Replace connecting washers in forward assembly and lock into place.
(f) Raise rear of litter rack and lock into place.
(g) Check operation of litter rack in patient loading position and seat back position. Aline or refit as necessary.
(2) Rear litter retainer arm assembly replacement.
(a) Place rear of upper litter rack on bottom litter rack.
(b) Drill out four rivets in arm assembly with 3/16-inch drill.
(c) Remove arm assembly and pin.
(d) Position plate near ceiling markings and screw into position using 1/8 x 1/2-inch sheet metal screws.
(e) Raise litter rack and check for fit and security of the upper litter rack.
(3) Front or rear mounting bracket assembly replacement.
(a) Remove litter rack as outlined in (1) above.
(b) Drill out three attaching rivets with 5/16-inch drill and remove attaching bracket.
(c) Position new bracket assembly to wall and aline holes, Tighten down assembly with 3/8 x 1/2-inch sheet metal
(d) Replace litter rack assembly as outlined in (1) above and check for fit and alinement.
(4) Litter rack retaining linkage arm assembly repla cement.
(a) Remove litter rack as outlined in (1) above.
(b) Drill out attaching rivets with 5/16-inch drill and remove retaining linkage.
(c) Aline bracket with holes on ambulance body wall and attach with two 3/8 x 1/2-inch sheet metal screws.
(d) Aline and fit litter rack into arm and lock assembly.
i. Windshield Glass Replacement.
(1) Remove windshield assembly from vehicle. Refer to TM 9-2320-244-20.
(2) Place windshield on table or floor with exterior surface of frame facing down.
(3) Pull edge of weatherseal away from glass at either bottom corner.
(4) With a firm grip on weatherseal, pull toward top of windshield while exerting a downward pressure on base of weather-seal.
(5) Continue this procedure for entire circumference of weatherseal until glass and seal are removed.
(6) Place weatherseal around new glass and support glass on blocks.
(7) Lubricate weatherseal with soap or suitable lubricating substance and position front of windshield frame on top of glass.
(8) Using a curved rod or other suitable tool, pull weatherseal through frame and seat in place. Continue this procedure for entire circumference of windshield frame.
j. Seat Cushion Repair. Seat cushions are molded rubber; repair consists of replacing unserviceable cushions.
k. Top Bows and Cab Frame Bow Repair. Use standard shop practice to repair cracked or bent top and cab frame bows. Replace those items that are unserviceable.
l. Front Door Glass Removal - M715 and M726. (Fig 18-1)
(1) Lower sliding glass (6). Remove inner door handle (12), window regulator handle (13) and trim panel screws and clips (15, 17). Remove trim panel.
(2) Remove three screws (8, 10) attaching fixed glass frame to door, then
lift fixed glass (7) up and out of door (30).
(3) Reach through access holes in door and, using screwdriver, remove retaining clip attaching window regulator assembly (20) to the sliding window lifter guide (6). The retaining clip is removed by lifting the small projection on the retainer- off the concave portion ofthe window regulator pin and sliding retainer free of groove in the pin.
(4) Push pin out of window lifter guide (6) and raise glass up and out of door (30).

NOTE

Component subassemblies of doors such as window regulators, door locks, remote controls and windows can be replaced without removing the complete door assemblies from the vehicle. Doors can be removed; however, without prior removal of the subassemblies.

m. Front Door Window Regulator- Replacement - M715 and M726.
(1) Remove inside door hardware and trim panel.
(2) Lower door glass and disconnect regulator control arm from lifter channels as described in (1) above.
(3) Lift glass to top and secure with screwdriver through hole in door panel.
(4) Remove four screws securing regulator to door panel and lower assembly so it can be removed through large opening at bottom of door panel.
n. Front Door Lock and Remote Control Removal - M715 and M726.
(1) Remove inside door hardware and trim panel.
(2) Remove screws from inside door lock remote control. Push control in and lower to bottom of door.
(3) Remove screws securing door lock to rear edge of door. Push door lock in and remove lock through lower access hole in door panel. (Fig 18-1).
o. Outside Door Handle Replacement -M715 and M726.
(1) Remove inside door hardware and trim panel.
(2) Place window in up position, reach through access opening in door and remove two screws securing handle to door.

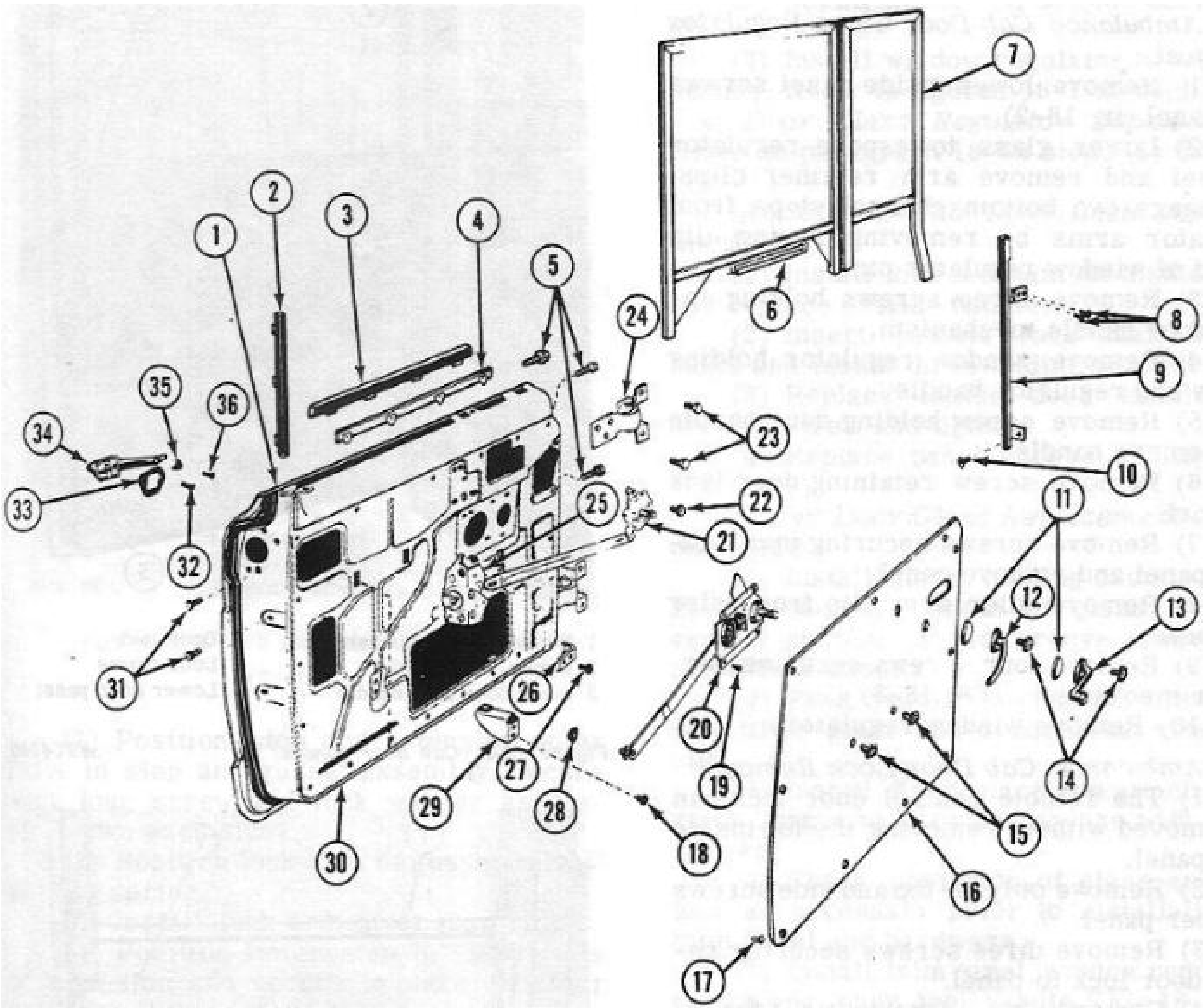


Figure 18-1. Front door components (M715 and M726) -exploded view.

1 Door weatherstrip	10 Screw	19 Screw	28 Retaining clip
2 Rear glass run	11 Plastic washers	20 Window regulator assembly	29 Glass stop
3 Outer belt weatherstrip	12 Inner door handle	21 Door lock remote control	30 Door

4 Inner belt weatherstrip	13 Window regulator handle	22 Screw	31 Screws
5 Bolt and washer assembly	14 Handle screws	23 Bolts	32 Screw
6 Door glass lifter guide	15 Trim panel screws	24 Upper hinge	33 Gasket
7 Fixed door glass	16 Trim panel clip holes	25 Door lock	34 Outer door handle
8 Screw	17 Trim panel retainer clip	26 Front glass run lower bracket	35 Gasket
9 Front glass run	18 Screw	27 Screw	36 Screw

(3) When reinstalling handle, be sure to use rubber gasket between handle and door to protect paint finish. (Fig 18-1)
p. Ambulance Cab Door Glass Regulator Removal.
(1) Remove lower inside panel screws and panel (fig 18-2).
(2) Lower glass to expose regulator channel and remove arm retainer clips. Disengage two bottom channel stops from regulator arms by removing spring clip at end of window regulator pins.
(3) Remove three screws holding inside door handle mechanism.
(4) Remove window regulator holding screw and regulator handle.
(5) Remove screw holding door handle and remove handle.
(6) Remove screw retaining door lock to panel.
(7) Remove screws securing upper inside panel and remove panel.
(8) Remove idler arm clip from idler channel.
(9) Remove four screws securing regulator mechanism. (Fig 18-3)
(10) Remove window regulator.
q. Ambulance Cab Door Lock Removal.
(1) The remote control door lock can be removed without removing the top inside door panel.
(2) Remove only the top and side screws of upper panel.
(3) Remove three screws securing remote door lock to panel.
(4) Remove two screws at edge of door holding lock in place.
(5) Remove outside and inside handles.
(6) Remove lock mechanism from behind panel. (Fig 18-3)
r. Ambulance Cab Door Glass Removal.
(1) Remove door glass regulator (p) above.
(2) Remove bolts, nuts and clamps securing bottom of glass channels.
(3) Tilt channels outward and carefully remove glass. (Fig 18-4)

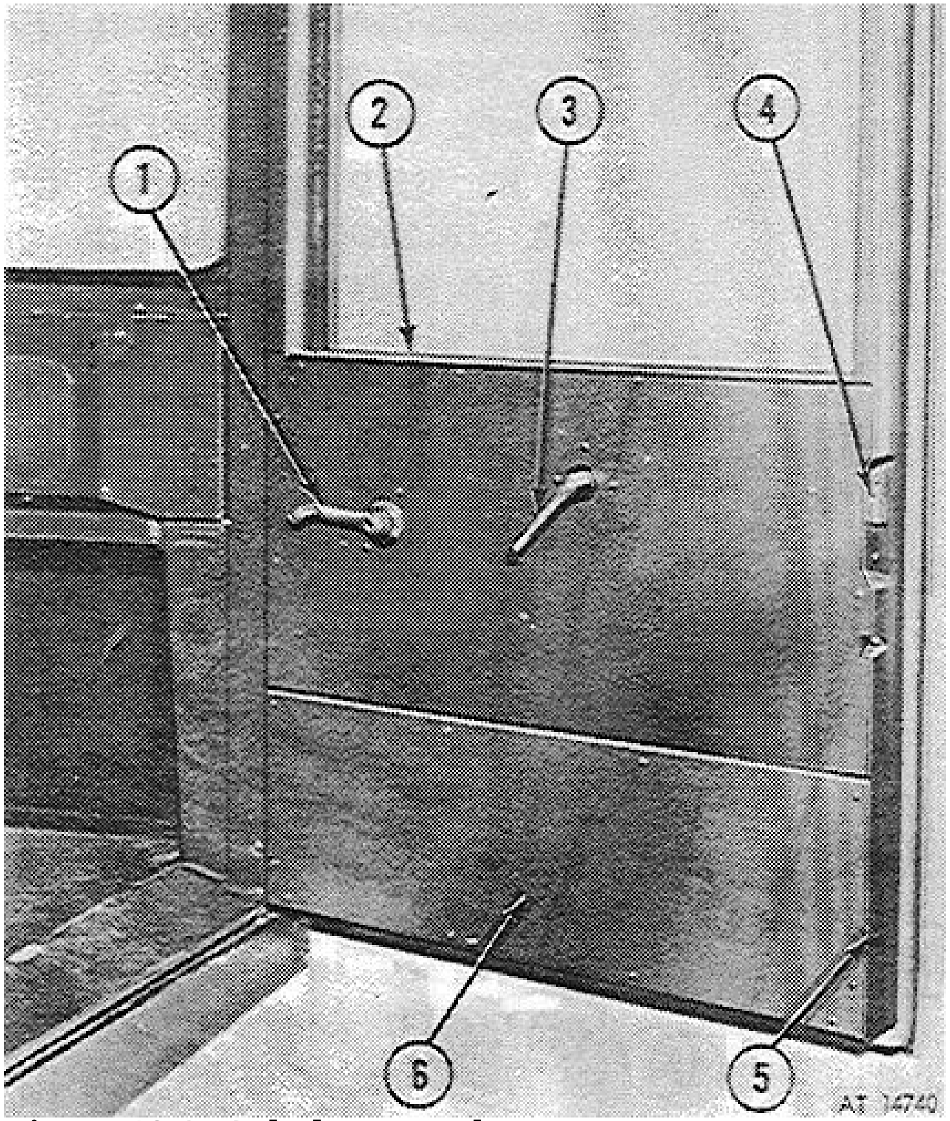


Figure 18-2. Cab door panels.

1 Window regulator handle
2 Upper door panel
3 Inner door lock handle
4 Door lock
5 Door frame
6 Lower door panel

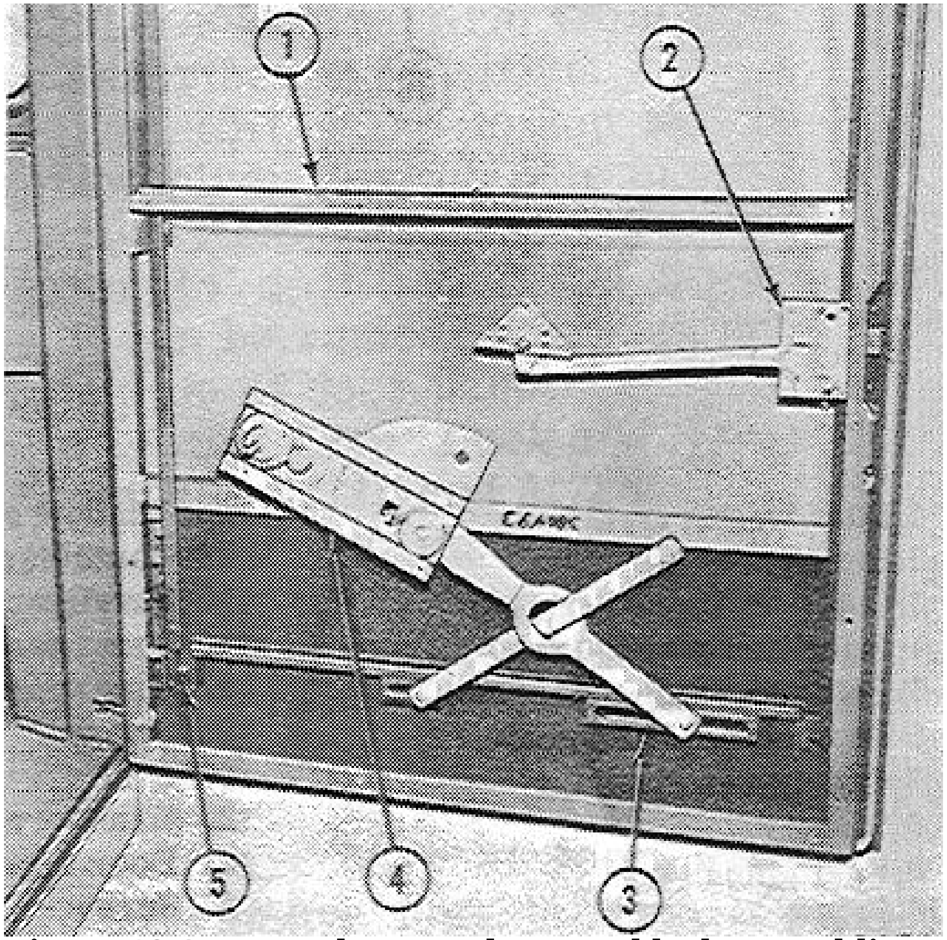


Figure 18-3. Door glass regulator and lock assemblies

1 Door glass
2 Lock assembly
3 Regulator channel
4 Regulator assembly
5 Window stop

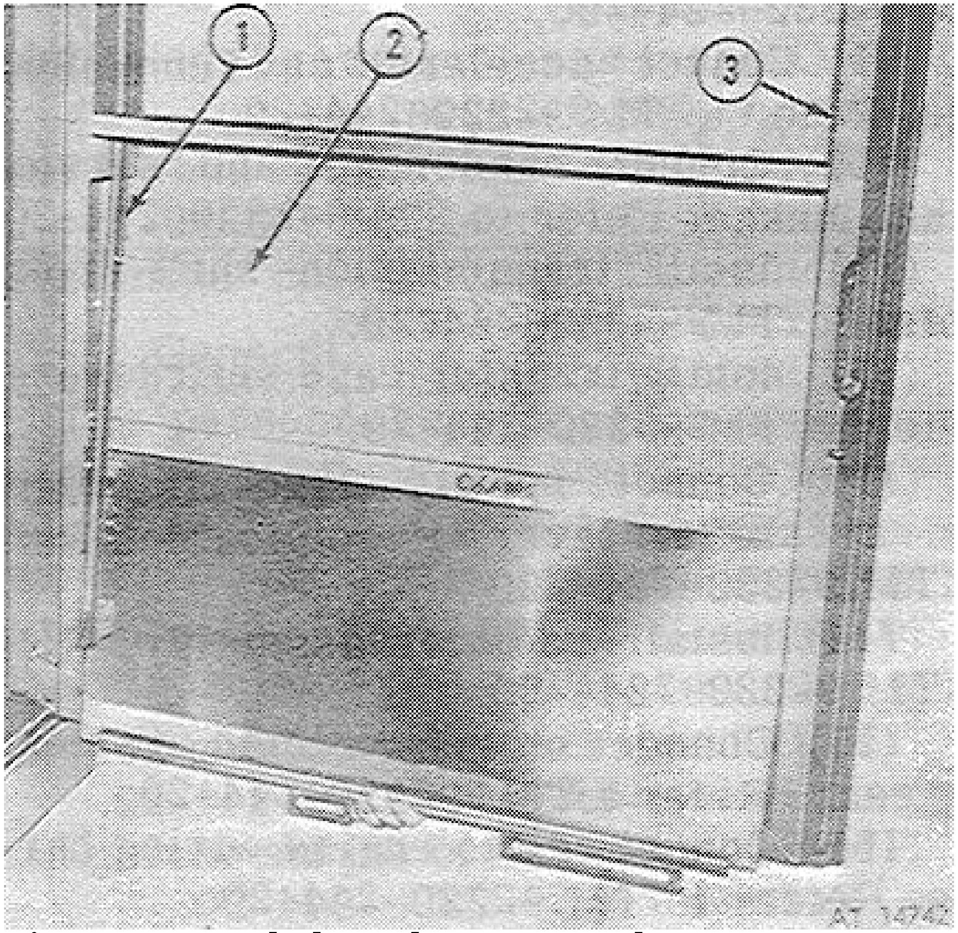


Figure 18-4. Cab door glass - removal.

1 Glass channel
2 Door glass
3 Door frame

18-7. Reassembly.
a. Patient Compartment Heater. Refer to TM 9-2320-244-20.
b. Blower Motor Assembly. Refer toTM 9-2320-244-20.
c. Reassembly of Rear Step and Attendants Seat.
(1) Position stop and extension outer rails in step and gusset assembly. Secure with four screw and lock washer assemblies (two each side).
(2) Position lock arm on gusset, install pin and spring.
(3) Install lock arm pivot snap ring.
(4) Position lower step to outer rails of extension and secure in place with four bolts and lock washers (two each side).
(5) Position attendant seat on floor of patient compartment and install four bolts and lock washers at each of the two mounting hinges. Tighten bolts 12-22 lbs-ft. Test movement of seat and clearance with rear doors closed. Adjust if necessary.

d. Ambulance Cab Door Glass Replacement.
(1) Work glass up the channels until bottom of channels can be tilted in and secured with two clamps, bolts andnuts.
(2) Place glass in up position and install window regulator; secure with four screws.
(3) Place regulator arm pins into window regulator channel and secure with clips.
(4) Install door lock assembly and secure.
(5) Install inside door panels and secure with screws.
(6) Install inside and outside door handle.
(7) Install window regulator handle and secure. Refer to figures 18-1 through 18-3.
e. Door Glass Regulator Replacement. Refer to paragraph 18-7d steps (1) through (7).
f. Ambulance Cab Door Lock Replacement.
(1) Install lock mechanism inside door and replace outside handle.
(2) Insert remote lock shaft in the panel and install three holding screws.
(3) Replace inside door handle and holding screw and tighten.
(4) Replace panel screws and tighten. (Fig 18-3)
g. Front Door Glass Replacement - M715 and M726.
(1) Install glass, making certain lifter guide attaching bottom of glass has recessed portion of the groove toward the inner door panel.
(2) Push regulator arm pin into window lifter guide and secure with retaining clip.
(3) Install fixed glass and attach fixed glass frame to door and secure with three screws.
(4) Check operation of glass and adjust as necessary prior to installation of trim panel and hardware.
(5) Install trim panel, window regulator handle and inner door handle. (Fig 18-1)
h. Front Door Fixed Glass Assembly Replacement - M715 and M726.
(1) Lower sliding glass.
(2) Insert fixed glass into door and attach with three screws.
i. Front Door Lock and Remote Control Replacement - M715 and M726.

NOTE

Before installing door lock and remote control assembly, check for positive engagement of spring loaded washer on door lock with remote control arm.

(1) Install door lock through lower access hole and position lock assembly into hole in rear edge of door and secure with screws.
(2) Position door lock remote control to inner metal door panel opening and secure with three screws.
(3) Install inner door trim panel, door handle and window regulator handle.

18-8. Installation.
a. Cab. Refer to TM 9-2320-244-20 for installation of cab and related components.
b. Cargo Body. Refer to TM 9-2320-244-20 for installation of cargo body components.
c. Ambulance Body.
(1) Use two fork lift trucks, positioned on either side of the body to lift ambulance body onto frame.
(2) Install ten body to frame holddown bolts and two spring loaded radiator hold-downs. Refer to TM 9-2320-244-20.
(3) Connect fuel tank filler pipe. Refer to TM 9-2320-244-20.
(4) Connect ambulance body fuel line to heater at underbody.
(5) Connect ambulance compartment wiring harness.
(6) Connect heater hose, if equipped with heater. Refer to TM 9-2320-244-20.
(7) Install driver and passenger seats. Refer to TM 9-2320-244-20.
(8) Connect clutch linkage. Refer to TM 9-2320-244-20.

(9) Connect accelerator and choke linkage. Refer to TM 9-2320-244-20.
(10) Connect handbrake and service brake linkage. Refer to TM 9-2320-244-20.
(11) Install transmission shift lever. Refer to TM 9-2320-244-20.
(12) Install transfer case shift levers. Refer to TM 9-2320-244-20.
(13) Connect power take-off control rod at shifter lever, if applicable. Refer to TM 9-2320-244-20.
(14) Install radiator assembly. Refer to TM 9-2320-244-20.
(15) Connect steering column at steering gear. Refer to TM 9-2320-244-20.
(16) Connect cab to engine wiring harness. Refer to TM 9-2320-244-20.
(17) Install hood and air cleaner assembly. Refer to TM 9-2320-244-20.
(18) Install batteries. Refer to TM 9-2320-244-20.
d. Patient Compartment Heater and Control Panel.
(1) Exhaust air ducts, fan and switch. Refer to TM 9-2320-244-20.
(2) Surgical and dome lamp. Refer to TM 9-2320-244-20.

CHAPTER 19
REPAIR OF FRESH AIR HEATER

19-1. General.
The personnel fresh air heater utilizes engine coolant as the source of heat which is circulated throughout the cab area by a blower. The system also includes defrosters capable of defogging and defrosting the windshield.

19-2. Removal, Cleaning, Inspection and Installation.
Refer to TM 9-2320-244-20.

19-3. Repair or Replacement.
Repair or replace worn or unserviceable components.

CHAPTER 20

REPAIR OF MATERIEL USED IN CONJUNCTION WITH VEHICLE
Section I. GENERAL

20-1. Scope.
This chapter describes repair procedures for accessories, components, attachments and special purpose kits which are used in conjunction with the vehicle and which are the responsibility of direct and general support maintenance personnel as allocated by the Maintenance Allocation Chart (MAC). Operating instructions are contained in TM 9-2320-244-10.

20-2. Service Upon Receipt.

a. Inspection arid Cleaning. When a new or reconditioned kit is received, determine if it has been properly prepared for service and that all necessary parts are pre
sent. 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 base paint thinner.

b. Correction of Deficiencies.

(1) Ordinary deficiencies disclosed during preliminary inspection, servicing, or during installation will be corrected by maintenance personnel performing the installation.

(2) Serious deficiencies detected in the equipment should be immediately reported in accordance with local instructions.

Section II. WINCH ASSEMBLY

20-3. General.

A geared winch assembly (fig 20-1) is underslung behind the front bumper of the vehicle, and is driven by a propeller shaft connected to a power take-off mounted on the transmission. The winch drum is provided with 150 feet of 7/16-inch cable terminated with a four foot chain and hook. The rated line pull capacity at the drum is 7,500 pounds. The winch assembly contains a replaceable shear pin for overload protection.

20-4. Removal.

Refer to TM 9-2320-244-20.

20-5. Disassembly. (Fig 20-1)

a. Remove drain plug (61) and drain lubricant into a suitable container. Install drain plug and tighten after draining lubricant.

b. Remove housing side cover retaining cap screws (75) and lock washers (76).

c. Remove side cover (1) and cover gasket (2).

d. Remove four mounting cap screws (73) and lock washers (72) securing adapter housing and bearing container (74) to worm housing (5).

e. Remove drive sleeve, drive key, adapter housing rear bearing container (74) and gasket (71). Remove adapter housing seal (70) and bearing cup (69).

f. Remove bearing cone (68) and worm spacer (67) from wormshaft (65).

g. Remove four cap screws (15) and lock washers (14) securing front bearing container (10) to worm housing (5).

h. Remove front bearing container (10) and gasket (9). Remove bearing cup (6) from bearing container (10).

i. Remove bearing cone (7) and bearing spacer (67) from wormshaft (65).

j. Remove wormshaft (65) from worm housing (5). Press shaft out of worm (66) and remove key (64) from shaft (65).

k. Remove eight cap screws (51, 60) and lock washers securing two base angle brackets (49) to the worm housing (5) and clutch housing (24). Remove brackets (49).

1. Remove cap nuts and remove drag brake screw (15).

m. Slide clutch housing (24) and clutch (21) from clutch drum shaft (46).

n. Remove two clutch keys (19, 47) and thrust ring (45) from clutch drum shaft (46).

o. Slide cable drum (16) from clutch drum shaft (46).

p. Remove clutch drum shaft (46) and worm gear (4) from worm housing (5).

q. Remove worm gear spacer from clutch drum shaft (46).

r. Press worm gear (4)fromclutchdrum shaft (46).

s. Remove two worm gear keys (55) from clutch drum shaft (46).

t. Remove setscrew (36) from shifter fork (37) and shifter shaft (40).

u. Remove shifter shaft (40) and shifter handle (32) from clutch housing (24). Remove shifter fork (37).

v. Remove shaft set screw (29) securing shifter handle (32) to shifter shaft (40).

w. Slide shifter handle (32) from shifter shaft (40).

20-6. Cleaning.

Refer to paragraph 2-7 for general cleaning instructions.

20-7. Inspection.

a. Inspect all castings for wear, breaks, stripped threads, uneven and irregular mating surfaces or out-of-round bores.
b. Inspect bearings for wear, galling or pitting. . Inspect bearing cups for wear, galling or pitting.
c. Inspect shafts for straightness, wear, galling and/or distorted keyways.
d. Inspect gears for wear, cracks, oversize and distorted keyway slots, distortion and scoring.
e. Inspect bushings for wear, galling, scoring and/or broken out sections.
f. Inspect cable assembly for broken or frayed strands. Inspect clamp chain and hook for damage.
g. Inspect thrust rings for wear, scoring or galling.
h. Inspect all other parts for wear, cracks, twists, distortion, and/or elongated holes.
i. Inspect drum friction brake for serviceability.

20-8. Repair or Replacement.

Refer to paragraph 20-7 above and replace any worn, defective or unserviceable parts.

20-9. Reassembly.

a. Slide shifter handle (32) on shifter shaft (40) and secure shifter handle to shifter shaft with shaft set screw (29).
b. Position shifter fork in clutch housing (24) and install shifter shaft assembly (40).
c. Aline holes in shifter fork (37) and shifter shaft (40) and install shaft key (33).
d. Install worm gear keys (55) on clutch drum shaft (46) and press worm gear (4) on the clutch drum shaft (46).
e. Slide thrust ring (45) onto drum shaft (46) and install clutch drum shaft (46) in worm housing (24).
f. Slide cable drum (16) on clutch drum shaft (46).
g. Install thrust ring (45) and ciutch keys (19, 47) on clutch drum shaft (46).
h. Install clutch (21) on clutch drum shaft (46) and engage clutch keys (19, 47) to clutch (21).
i. Guide shifter fork (37) on groove of clutch (21) and clutch housing (24) on clutch drum shaft (46).
j. Position drag brake screw (42) and fasten with cap nuts.
k. Position the two base angle brackets (49) on the worm housing (5) and the clutch housing (24) and secure with eight cap screws and lock washers.
1. Position worm key (64) to worm shaft (65) and press worm (66) in place on worm shaft (65).
m. Position bearing spacer (67) and bearing cone (68) on worm shaft (65) and slide, as in assembly, in the worm housing (5).
n. Press bearing cup (6) in front bearing container (10) and position new gaskets (9) and front bearing container (10) on worm housing (5) and secure with four mounting cap screws (73) and lock washers (72).
o. Position seal (8) and bearing cup (6) in rear bearing retainer (10).
p. Position new gasket (9), rear bearing container (10) and worm brake housing (12) to worm housing (5) and secure with four mounting cap screws and lock washers.
q. Adjust end-play of wormshaft to allow for 1/64 to 1/32-inch.
r. Position drive key on work shaft and install driver sleeve.

NOTE

Be sure drive key is alined to keyway in drive sleeve.

20-10. Installation.

Refer to TM 9-2320-244-20 for installation of winch assembly.

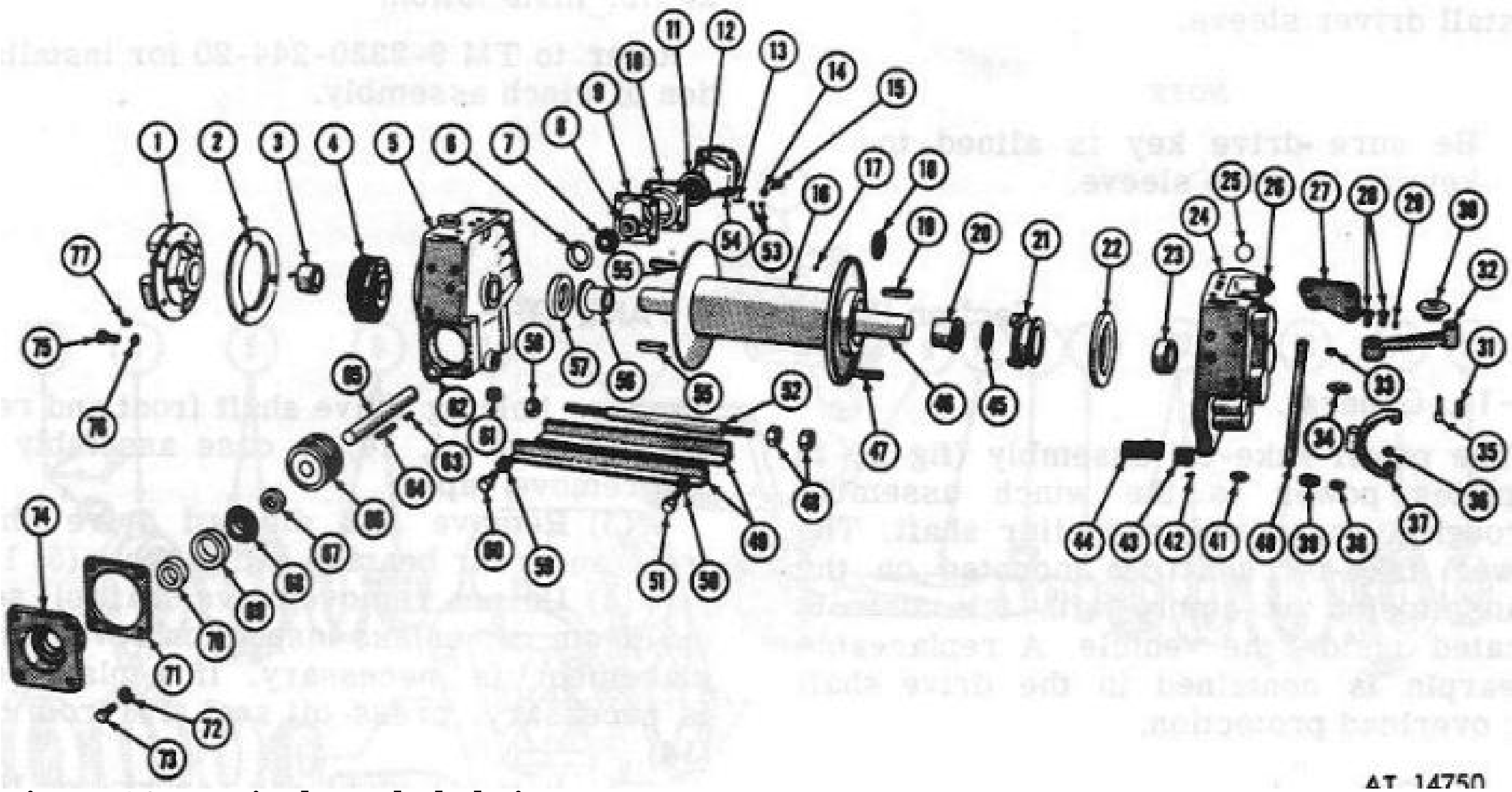


Figure 20-1. Winch-exploded view.

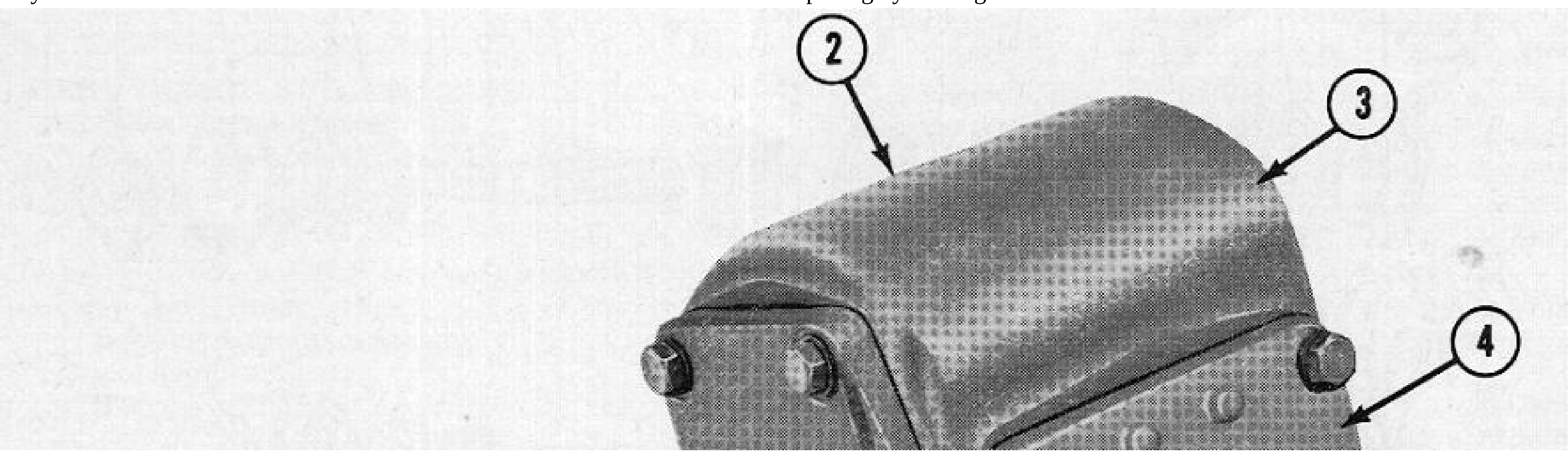
1 Housing Cover	21 Clutch	41 Shifter shaft spacer	61 Drain plug
2 Housing cover gasket	22 Clutch housing seal	42 Brake screw	62 Worm spacer
3 Cover bushing	23 Clutch housing bushing	43 Spacer	63 Brake drum key
4 Worm gear	24 Clutch housing	44 Drag brake assembly	64 Worm key
5 Worm housing assembly	25 Welsh plug	45 Thrust ring	65 Worm shaft
6 Bearing cup	26 Drain plug	46 Clutch drum shaft	66 Worm
7 Bearing cone	27 Clutch indexing plate	47 Clutch key	67 Worm spacer
8 Bearing container seal	28 Indexing plate screws	48 Nut	68 Bearing cone
9 Bearing container gasket	29 Handle setscrew	49 Bracket	69 Bearing cup
10 Bearing container	30 Shifter handle knob	50 Lock washer	70 Bearing container seal

11 Brake drum	31 Shifter spring	51 Cap screw	71 Bearing container gasket
12 Worm brake housing	32 Shifter handle	52 Spacer bar	72 Lock washer
13 Brake spring	33 Woodruff key	53 Hex nut	73 Cap screw
14 Lock washer	34 Washer	54 Brake band assembly	74 Bearing container
15 Cap screw	35 Shifter handle stem	55 Worm gear key	75 Cap screw
16 Cable drum	36 Shifter fork setscrew	56 Cable drum bushing	76 Lock washer
17 Setscrew	37 Shifter fork	57 Cable drum seal	77 Breather plug
18 Retaining ring	38 Snap ring	58 Nut	
19 Clutch key	39 Shifter handle seal	59 Lock washer	
20 Cable drum bushing	40 Shifter shaft	60 Cap screw	

Section III. POWER TAKE-OFF

(NOTE: This first section is from the -24 Kaiser Maintenance manual and contains info not found in other manuals which may be of use to those doing maintenance. brute4c)

The winch drive reversible power-take-off, Fig. 07-5, is mounted to left side of the transmission housing and is lubricated by the transmission lubricant oil. It is controlled by a three position shift lever located on the cab floor to the right of the drivers seat, adjustable rod connects the shift lever to the shift lever of the power-take-off. When installing the power-take-off a new gasket should always be used and mounting bolts should be torqued 18 to 30 lb-ft. Adjustment of the power-take-off may be made by loosening the jam nut and adjusting the shifter rod as necessary.
When reinstalling the Power Take Off on the transmission, the backlash between the Power Take Off Gear and the transmission gear should be approximately .006” to .012”. If too few gaskets are used, the unit will whine. If too many gaskets are used, the unit will clatter. When in doubt about the proper backlash, it may be advisable to remove the shifter cover and check backlash thru the cover opening by rocking the Idler Cluster Gear.



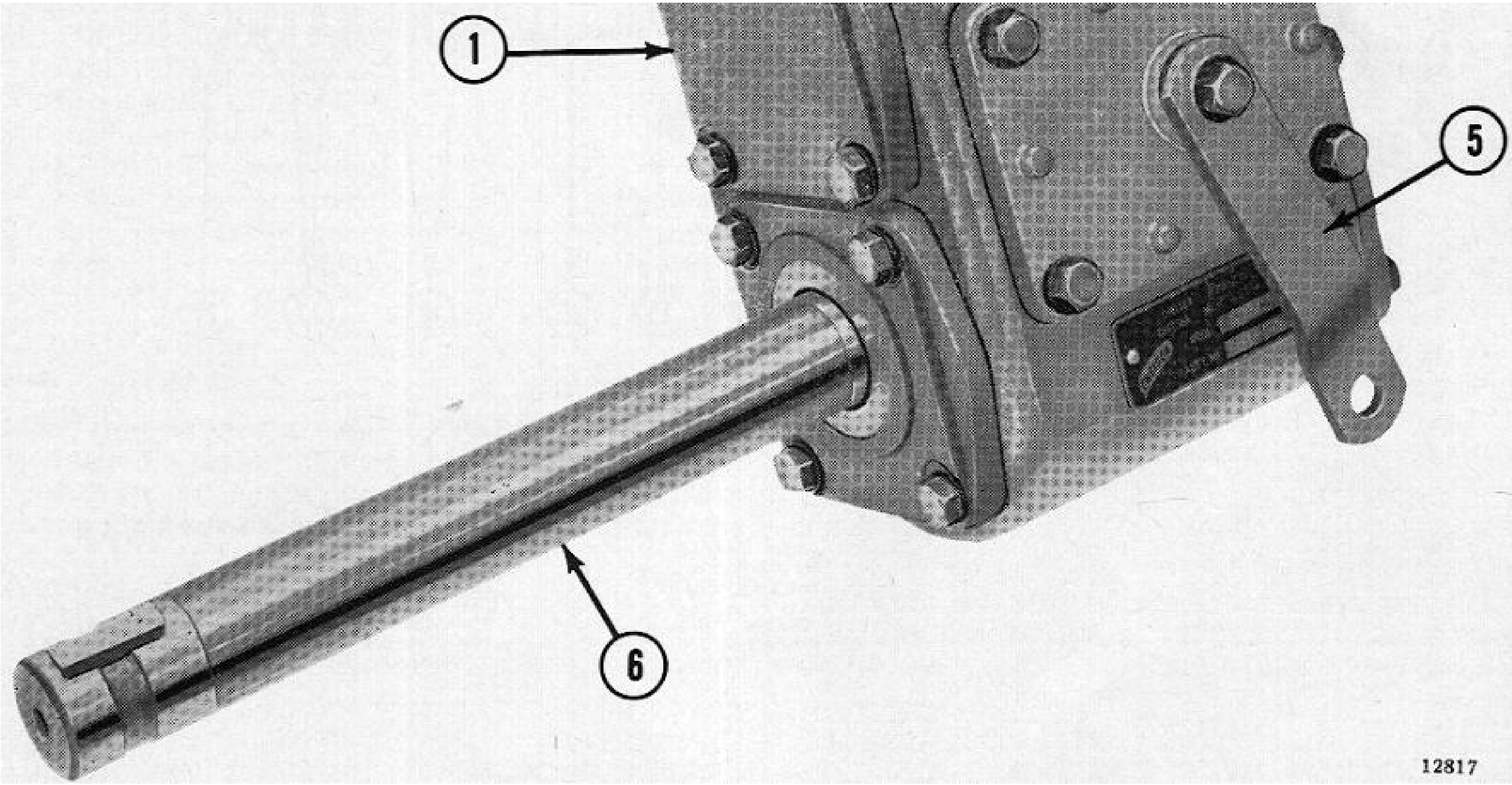


FIG. 07-5—TRANSMISSION POWER-TAKE-OFF
1 Bearing End Cap
2 Mounting Flange
3 Housing
4 Shifter Cover
5 Shifter Lever
6 Drive Shaft

(NOTE: This is the end of the section from the -24 Kaiser Maintenance manual. brute4c)

20-11. General.
The power take-off assembly (fig 20-2) supplies power to the winch assembly through a connecting propeller shaft. The power take-off unit is mounted on the transmission assembly with the controls located inside the vehicle. A replaceable shearpin is contained in the drive shaft for overload protection.

20-12. Removal.
a. Remove transmission drain plug and allow lubricant to drain completely.

b. Remove cotter pin which secures power take-off control rod to shift lever.
c. Disengage control rod from shift lever and push rod up through floor panel.
d. Loosen nut, washer and bolt on power take-off shaft and slide driveshaft yoke slip joint forward and disengage drive shaft from power take-off output shaft. Tie driveshaft up out of the working area.
e. Remove the six nuts which secure power take-off to transmission.
f. Remove power take-off gasket from transmission; discard gasket.

20-13. Disassembly.

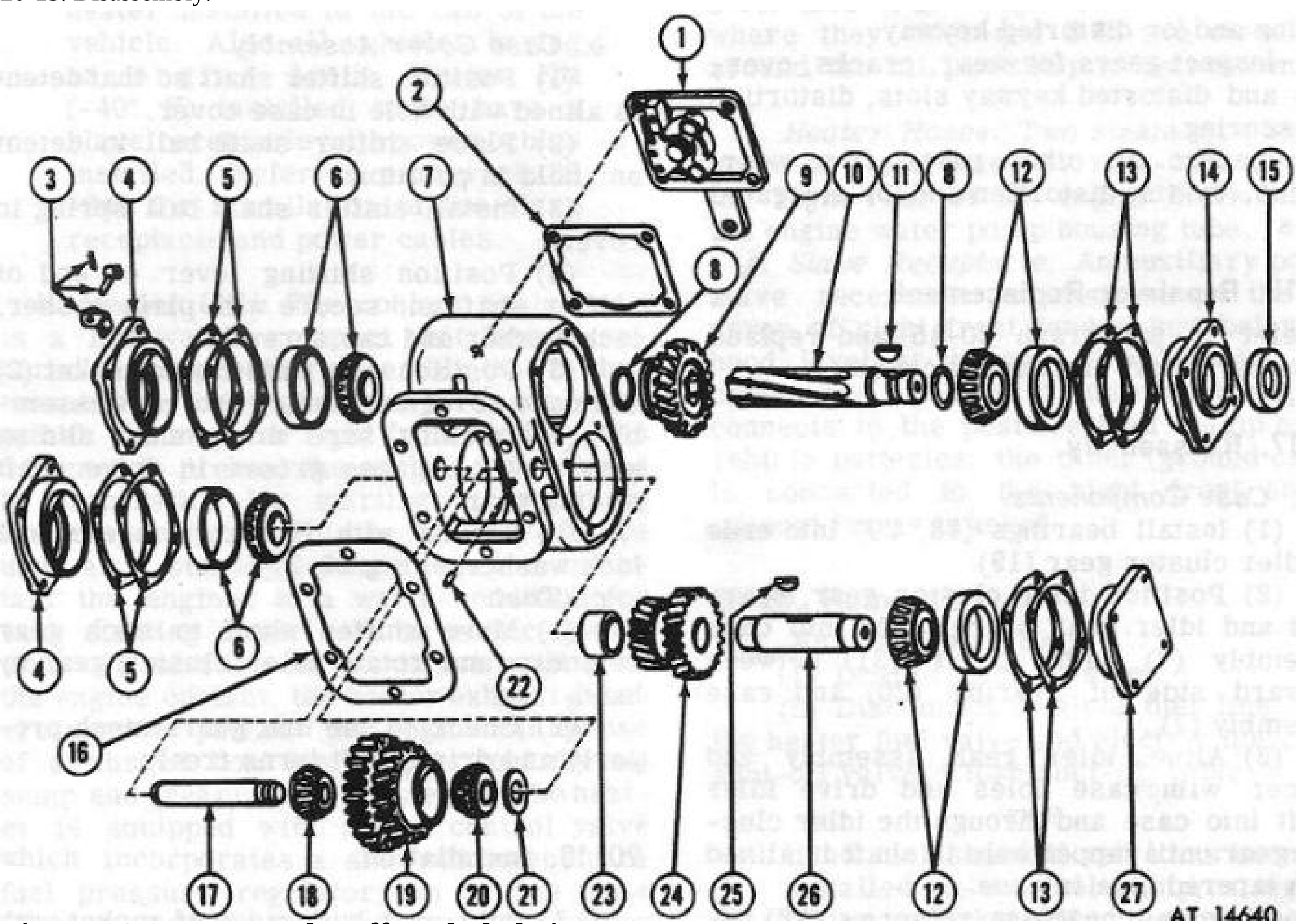


Figure 20-2. Power take-off exploded view.

1 Shifter cover and lever	10 Drive shaft	19 Idler cluster gear

2 Shifter cover gasket	11 Woodruff key	20 Tapered roller bearing
3 Assembly, wire control bracket swivel eye bolt and cotter pin	12 Tapered roller bearing	21 Idler gear spacer
4 Bearing end cap	13 Bearing gasket cap	22 Setscrew
5 Bearing cap gasket	14 Bearing end cap (open)	23 Reverse idler gear spacer
6 Tapered roller bearing	15 Oil seal	24 Reverse idler gear cluster
7 Housing	16 Mounting gasket	25 Woodruff key
8 Lock ring	17 Idler gear shaft	26 Reverse idler shaft
9 Sliding gear	18 Tapered roller bearing	27 Bearing end cap (closed)

a. Case Cover Assembly. (fig 20-2)
(1) Remove four cap screws and lock washers holding shifter cover and lever assembly (1) to case assembly (7) and remove cover assembly.
(2) Remove and discard case cover gaskets (2).
(3) Remove cap screw, lock washer and plain washer holding shifter lever on shifter shaft and remove lever.
(4) Remove shifter shaft ball and spring from case cover.
b. Front and Rear Bearing Cars.
(1) Remove woodruff key (11) from drive shaft (10).
(2) Remove eight cap screws and lock washers holding drive shaft front and rear bearing caps (4, 14) to case assembly (7) and remove caps.
(3) Remove and discard drive shaft front and rear bearing cap gaskets (5, 13).
(4) Do not remove drive shaft oil seal (15) from cap unless inspection revealsreplacement is necessary. If replacement is necessary, press oil seal (15) from cap (14).
(5) Remove eight cap screws and lock washers securing front and rear reverse idler shaft bearing caps (4, 27) to case assembly (7) and remove caps.
(6) Remove and discard reverse idler front and rear bearing cap gaskets (5, 13).
c. Case Components.
(1) Remove drive shaft (10), bearings and sliding gear (9) from case assembly (7).
(2) Press bearing from each end of drive shaft and remove sliding gear from shaft.
(3) Remove reverse idler shaft (26), cluster gear (24) and bearings (6, 12) from case assembly.
(4) Press bearing from each end of shaft and remove reverse idler cluster gear (24) and spacer (23) from shaft.
(5) Remove headless setscrew (22)se-curing idler gear shaft (17) to case (7).
(6) Using a suitable punch, drive idler gear shaft (17) from case.
(7) Remove idler cluster gear (19) idler gear spacer (21) and bearings (18, 21) from case assembly (7).

20-14. Cleaning.
Refer to paragraph 2-7 for general cleaning instructions.

20-15. Inspection.
a. Inspect casting for wear, breaks, stripped threads, uneven and irregular mating surfaces of out-of-round bores.
b. Inspect bearings for wear, galling or pitting. Inspect bearing cups for wear, galling or pitting.
c. Inspect shafts for straightness, wear, galling and/or distorted keyway.
d. Inspect gears for wear, cracks, oversize and distorted keyway slots, distortion and scoring.
e. Inspect all other parts for wear, cracks, twists, distortion and/or elongated holes.

20-16. Repair or Replacement.
Refer to paragraph 20-15 and replace those parts that are unserviceable.

20-17. Reassembly.
a. Case Components.
(1) Install bearings (18, 20) into ends of idler cluster gear (19).
(2) Position idler cluster gear, bearings and idler gear spacer (21) into case assembly (7) with spacer (21) between forward side of bearing (20) and case assembly (7).
(3) Aline idler gear assembly and spacer with case holes and drive idler shaft into case and through the idler cluster gear until tapped hole in shaft is alined with tapered hole in case.
(4) Install headless setscrew (22) securing idler shaft (17) to case (7).
(5) Install reverse idler cluster gear (24) and spacer (21) onto reverse idler shaft (26).
(6) Press bearing (6, 12) onto each end of reverse idler shaft (26).
(7) Position reverse idler shaft and bearing assembly into case bearing bores.
(8) Using new gaskets (5, 13), install front and rear reverse idler shaft bearing caps (4, 27) to case assembly (7) and secure with four cap screws and lock washers at each end.
(9) Install new drive shaft (10) front and rear bearing cap gaskets (5, 13) and install drive shaft bearing caps (4, 14) to case assembly (7) and secure with four cap screws and lock washers at each end.
b. Case Cover Assembly.
(1) Position shifter shaft so that detent is aimed with hole in case cover.
(2) Place shifter shaft ball in detent and hold in position.
(3) Install shifter shaft ball spring in cover.
(4) Position shifting lever on end of shifter shaft and secure with plain washer, lock washer and cap screw.
(5) Position new case cover gasket (2) and case cover assembly (1) to case assembly (7), making sure drive shaft sliding gear lever engages groove in drive shaft sliding gear.
(6) Secure with four cap screws and lock washers. (Fig 20-2)
c. Test.
(1) Move shifter shaft to each gear selection and rotate idler cluster gear by hand.
(2) Check to see that gears mesh properly and drive shaft turns freely.

20-18. Installation.
a. Lightly coat both sides of gasket with sealant and position on transmission case.
b. Position power take-off assembly on transmission case.
c. Install six bolts and tighten to 30-50 lbs-ft.
d. Connect driveshaft as described in (a) above.
e. Pull control rod down from floor panel and insert control rod end in power takeoff lever.
f. Install cotter pin through control rod.
g. Fill transmission with proper seasonal grade lubricant.

Section IV. ENGINE ARCTIC HEATER

20-19. General.
a. Engine Arctic HeaterKit. The (-40° F) engine Arctic Heater Kit consists of a gasoline burning coolant (water) heater equipped with a separate oil pan heating shroud, a control box, a flexible fuel line, electrical cable wiring assembly and a slave receptacle with attaching cables. All component parts and attaching hardware are furnished. (Fig 20-3)

NOTE

The engine arctic heater covered in this manual is installed in a vehicle already having an arctic heater installed in the cab of the vehicle. Also all vehicles having an engine Arctic Heater Kit (-40° F) installed must have a slave receptacle with power cables installed. Refer to paragraph 20-24b for installation of the slave receptacle and power cables.

b. Heater Unit. The coolant heater unit is a lightweight compact unit that is secured to a supporting assembly that is then mounted in the engine compartment of the splash apron of the right front fender. It is designed to preheat the áoolant of the engine in preparation for starting at extremely low temperatures. This heater may also be used as a standby coolant heater to maintain the engines in a warm condition for easy starting under cold or arctic conditions. In addition to the direct heating of the engine coolant, the heater exhaustgases are used to preheat the engine oil by use of a shroud box installed around the oil sump end (rear) of the engine pan. The heater is equipped with a fuel control valve which incorporates a shut-off solenoid, a fuel pressure regulator, an orifice plate which meters the fuel flow for high and low heat and a restricted solenoid which controls flow through the orifice plate. The heater has two fuel rates, consequently two levels of heat output. An overheat switch is provided to shut the fuel off if the cycling switch should fail to function properly.

c. Control Box. The heater control box houses the heater control switches, indicator lamp and circuit breaker. The control box is mounted on the lower center position of the instrument panel to the left of the crew compartment arctic heater control box. The 24-volt lead wire of the control box is connected to a multiple connector that connects with the auxiliary lead of the instrument panel wiring harness.

d. Fuel Pump and Fuel Line. The engine arctic heater uses the same fuel pump as the crew compartment arctic heater, The flexible fuel line for the engine heater con-fleet to the shut-off valve of the crew compartment arctic heater.

e. Oil Pan Shroud. An oil pan shroud is attached to the engine oil pan at the sump end of the pan. The engine heater exhaust gases are directed through a short flexible steel tube to the right side of the shroud where they enter and then are circulated around the oil pan sump to heat the engine oil.

f. Heater Hoses. Two steam type heater hoses are connected by shut-off valves to the right rear of the engine block and to the engine water pump housing tube.

g. Slave Receptacle. An auxiliary power slave receptacle is mounted on the top apron of right front fender just below the hood level at the cowl. Two battery type cables are attached to the receptacle, one connects to the positive lead clamp of the vehicle batteries; the other (ground cable) is connected to the right front engine support frame bracket.

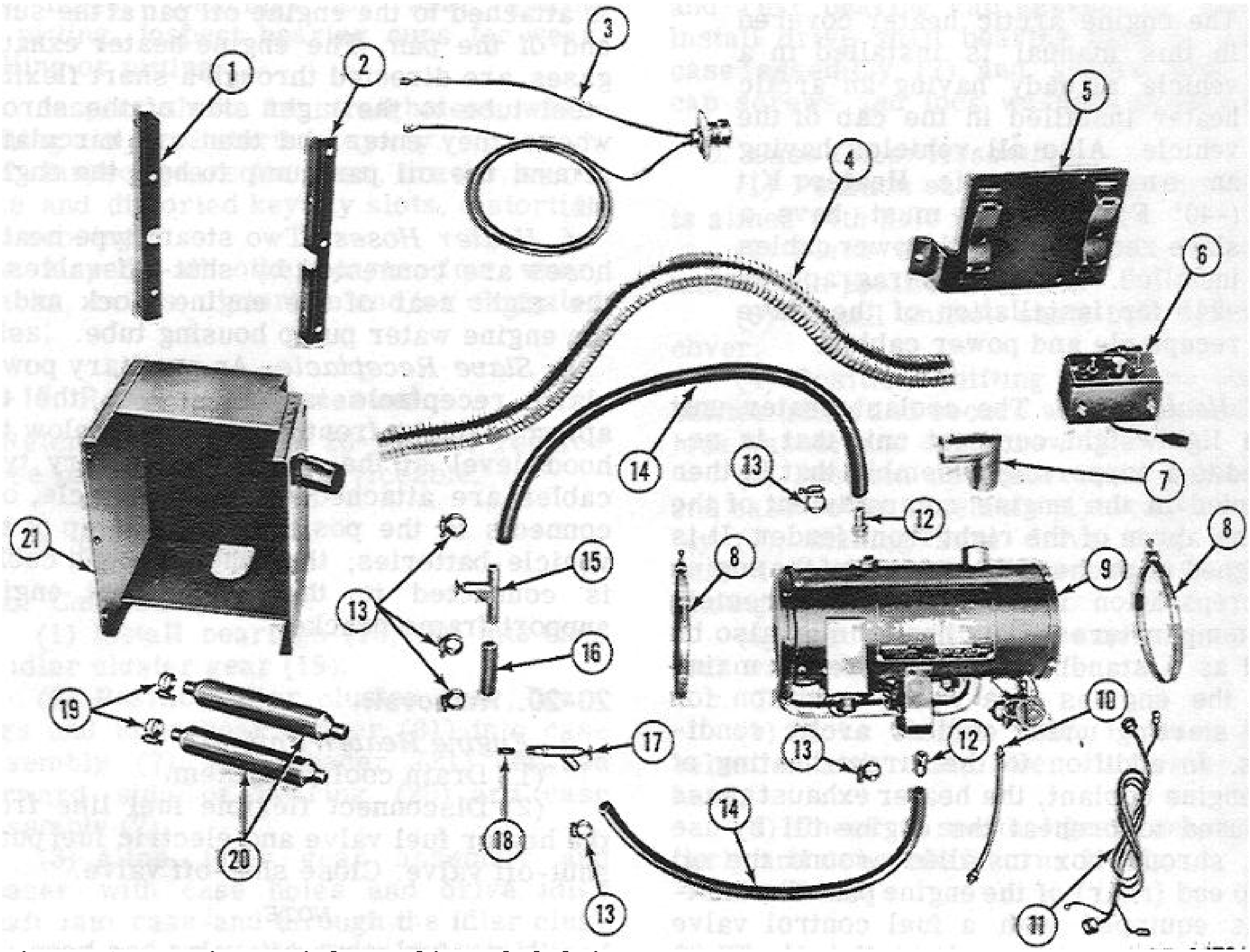


Figure 20-3. Engine arctic heater kit-exploded view.

1 Left shroud bracket	8 6-inch clamp	15 90° shut-off valve
2 Right shroud bracket	9 Heater unit	16 3-1/2-inch heater hose

3 Slave receptacle assembly	10 Flexible fuel line	17 45° shut-off valve
4 Flexible exhaust pipe	11 Wiring harness	18 Pipe nipple
5 Heater support assembly	12 Hose nipple	19 Screw clamps
6 Control box	13 Hose clamps	20 Shield sleeves
7 Exhaust pipe elbow	14 Long heater hose	21 Oil pan shroud

Note: The following items also are included in the kit.

(1) Spacer - support mountin	(1) Closed clip — splash apron	(1) Clip, nylon	(6) 5/16 lock washer
(8) 5/16-18 x 1-1/8 hex head bolt	(1) Decal	(1) Clip - slave cable	(4) Clip
(8) 5/16 hex nut	(4) 1/4-20 x 5/8 hex head bolt	(1) 3/8 pipe coupling - engine head	(3) 1/2 x 2-1/2 cotter pin
(8) 5/16 lock washer	(4) 1/4-20 hex nut & lock washer assy.	(1) Male connector - shut-off valve	(2) Cables
(8) 5/16 flat washer	(1) 3/8-24 x 1 hex head bolt	(1) Clamp - clamp insulators together	(4) No. 10-24 hex nut
(4) Spacer shroud	(1) 3/8-24 hex nut	(1) Connector	(4) Clip, nylon - slave cable
(6) 5/16-24 x 5/8 hex head bolt	(2) 3/8 lock washer	(1) Split grommet - dash panel	(1) Battery ground cable
(4) 5/16-18 x 1 bolt and 1/ washer assy.	(1) 3/8 plain washer	(4) No. 10-24 x 1/2 screw	(1) Battery-to-battery cable

20-20. Removal.
a. Engine Heater Unit.
(1) Drain cooling system.
(2) Disconnect flexible fuel line from the heater fuel valve and electric fuel pump shut-off valve. Close shut-off valve.

NOTE

If no fuel shut-off valve has been installed on the fuel pump, a tee fitting and shut-off valve must be installed in the position shown in figure 20-4.

(3) Remove cotter pins securing exhaust pipe to heater exhaust elbow and oil pan heater shroud collar. Remove exhaust pipe.
(4) Close water pump heater outlet coolant valve and the engine block inlet valve.
(5) Loosen four hose clamps and remove heater outlet and inlet coolant hoses with shield sleeves attached.
(6) Disconnect heater wiring harness from elbow of control box.
(7) Disconnect personnel and engine control box leads from waterproof connectors of three-way connector.
(8) Disconnect three-way connector from instrument panel wiring harness at waterproof connector and remove threeway connector.
(9) Disconnect personnel heater control box lead to instrument panel wiring harness lead at waterproof connector.
(10) Remove screws securing switch panel to control box and remove panel.
(11) Remove nuts and lock washers securing control box to instrument panel lower reinforcement flange.
(12) Remove control box and reinstall switch panel.

(13) Remove screws securing firewall lower side plate to panel and remove heater wiring harness from underside of cowl through access opening.
(14) Disconnect wiring harness from connector on engine heater and waterproof connector of fuel pump lead.
(15) Disconnect harness ground lead from fender apron and remove wiring harness from vehicle.
(16) Remove bolts, nuts and lock washers securing heater support to fender apron. Remove heater unit.
(17) Jack front of vehicle up off ground. Working from under the engine, remove six bolts and lock washers securing the oil pan shroud to the brackets mounted to the underside of the engine crankcase. Remove four bolts, lock washers and spacers securing the left and right shroud brackets to the crankcase. Remove brackets and lower vehicle to ground.
b. Slave Receptacle.
(1) Disconnect slave receptacle cable from battery positive post cable clamp.
(2) Remove bolt, nut and star washer securing slave receptacle ground (negative) cable to the right front engine support frame bracket.
(3) Remove four bolts, nuts and lock washers securing slave receptacle to right front fender. Remove slave receptacle and cables from vehicle.
c. Heater Unit Components.
(1) Remove blower assembly.
(a) Remove four shield screws securing shield bracket to heater housing and remove bracket.
(b) Remove tube screw securing air inlet tube on heater housing and remove air inlet tube and blower outlet tube.
(c) Disconnect lead on blower assembly from terminal 4 of terminal strip.
(d) Loosen four blower nuts securing blower assembly to heater housing, rotate blower assembly counter- clockwise to clear bayonet slots, and remove blower assembly.
(2) Remove flame detector switch.
(a) Disconnect five leads from five terminals on flame detector switch.
(b) Loosen compression nut under flame detector switch securing flame detector switch to head exchanger and remove switch.

NOTE

To prevent damage to quartz rod, do not bend tube during removal.

(3) Remove fuel control valve.
(a) Disconnect two leads of fuel control valve from overheat switch and one lead of fuel control valve from terminal 5 of terminal strip.
(b) Loosen compression nut on union and remove fuel control valve from stand-pipe.
(4 Remove overheat switch. Disconnect switch lead from overheat switch.
(b) Remove cover nut and lock washer securing switch cover to heat exchanger and remove cover.
(c) Remove overheat switch and preformed packing from heater exchanger. Discard packing.
(5) Remove ignitor.
(a) Loosen four end plate nuts securing end plate on heater housing, rotate end plate counter-clockwise to free bayonet slots, and remove end plate.
(b) Remove ground lead screw and lock washer securing ground lead and ground lead on igniter to burner assembly, and bend ground lead on igniter so it will fit inside a deep socket.
(c) Remove two igniter nuts securing preheat resistor on igniter and disconnect copper connecting strap of preheat resistor from igniter.
(d) Using a 13/16-inch deep socket, remove igniter and igniter gasket from burner assembly. Discard gasket.
(6) Remove stand pipe and preheat resistor.
(a) Remove two plate screws securing cover flange and cover plate to heater housing and remove cover plate from standpipe.
(b) Remove resistor screw and washer securing resistor lead on preheat resistor and remove lead.
(c) Unscrew standpipe from burner assembly and remove standpipe and preheat resistor.
(d) Remove preheat resistor and cover flange from standpipe.
(7) Remove burner assembly.

(a) Remove three burner screws and washers securing burner assembly on heat exchanger.
(b) Remove burner assembly and burner preformed packing from heat ex changer. Discard packing.
(8) Remove restriction switch.
(a) Disconnect switch leads (25 and 51) of restriction switch from terminals 4 and 5 of terminal strip.
(b) Remove two switch nuts and washers securing restriction switch to heat exchanger and remove switch and two spacers.
(c) Remove two grommets from heater housing. Discard grommets.
(9) Remove motor resistor.
(a) Disconnect two leads of motor resistor from terminals 4 and 6 of terminal strip.
(b) Remove motor resistor screw, nut and lock washer securing resistor to terminal and receptacle bracket, and remove resistor.
(10) Remove receptacle and cable assembly, terminal strip and bracket.
(a) Disconnect diode from terminals 5 and 6 of terminal strip.

NOTE
Mark position of diode for assembly.

(b) Remove four terminal screws securing terminal strip and marker strip to terminal and receptacle bracket and remove terminal strip and marker strip.
(c) Remove motor resistor screw, nut and washer securing ground lead of receptacle and cable assembly to bracket.
(d) Remove four receptacle screws, washers and nuts securing receptacle and cable assembly to bracket and remove receptacle and cable assembly.
(e) Remove four bracket screws securing bracket to heater housing and remove bracket.
(11) Remove heater housing.
(a) Remove three housing screws securing heat exchanger in heater housing.
(b) Spread heater housing to clear heat exchanger and remove housing.
20-21. Disassembly.
a. Blower.
(1) Remove engine coolant heater blower.
(2) Remove nine screws and speed nuts and separate blower cover from plate assembly.
(3) Loosen setscrew and slide blower wheel off shaft of motor.
(4) Remove three screws and remove motor and three spacers from plate assembly.
b. Fuel Control Valve.
(1) Remove engine coolant heater fuel control valve.
(2) Remove nut, remove electrical lead and heating element lead from stud, and remove stud from diaphragm cap.
(3) Remove five screws and lock washers and remove diaphragm cap, adjusting cap, spring, diaphragm assembly, two gaskets and heating element from valve body. Remove screw from cap. Discard gaskets.
(4) Disconnect heating element electrical lead from thermostat.
(5) Remove valve assembly, gasket, screen and gasket from valve body. Discard gaskets.
(6) Disconnect electrical lead from thermostat.
(7) Remove three screws and washers and remove clamp, thermostat, cover, gasket, orifice plate and gasket from valve body. Discard gaskets.

NOTE
The solenoids in both sides of valve body are removed in a similar manner.

(8) Remove screw, lock washer, coil assembly and washer from solenoid cup.
(9) Remove three screws and remove solenoid cup, sleeve and core, spring, plunger assembly and gasket from valve body. Discard gasket.

(10) Remove screen from inlet port of valve body.

20-22. Cleaning.
Refer to paragraph 2-7 for general cleaning procedures.

20-23. Inspection and Repair.

NOTE

For summer operation, in addition to removing the oil pan shroud and exhaust pipe, the coolant shutoff cocks must be closed, the coolant hoses removed, and the heater be completely drained after flushing it with clear water to remove the sediment.

a. Inspect coolant hoses for cracks and deterioration.
b. Inspect electrical wiring harness for frayed wires, broken terminals. Clean all terminals of rust and corrosion.
c. Inspect fuel lines for cracks and kinks. Check threads of attaching fittings for thread deformation.
d. Inspect the engine oil pan shroud; it must be free of dirt, ice and mud. Check tightness of the bracket mounting bolts and oil pan screws.
e. Inspect exhaust pipes and attaching parts for deterioration. Clean rust scale and corrosion from exterior surfaces.
f. Inspect radiator brush guard cover for evidence of tears and deterioration.
g. Clean and lightly oil threads of all attaching bolts and nuts.
h. Inspect threaded parts for burrs and stripped threads. Remove burrs. Replace parts that cannot be repaired.
i. Inspect heat exchanger for excessive burns and evidence of cracks. Replace heat exchanger that shows either of these defects.
j. Inspect flame detector switch' quartz rod for chipping and cracking. Replace rod that shows either of these defects.
k. Inspect all electrical leads for excessive wear and loose terminals. Re-solder loose terminals. Replace electrical leads that cannot be repaired.
1. Inspect blower wheel for cracks and vane distortion. Replace wheel that shows either of these defects.
m. Inspect blower cover and plate assembly for cracks and distortion. Replace part that shows either of these defects.
n. Inspect threaded parts for burrs and stripped threads. Remove burrs. Replace parts that cannot be repaired.
o. Inspect threaded parts for burrs and stripped threads. Remove burrs. Replace parts that cannot be repaired.
p. Inspect valve body for cracks and distortion. Replace valve body that shows either of these defects.
q. Inspect orifice plate with a magnifier and clean with compressed air.

CAUTION

Do not force any object through orifice openings because these calibrated holes, if distorted, may cause serious overheating. Refer to paragraph 20-23 and replace those parts that are unserviceable.

20-25. Reassembly.
a. Blower.
(1) Position three spacers and motor on plate assembly and secure with three screws.
(2) Position blower wheel on shaft of motor, making sure hub is flush with shaft, and secure wheel with setscrew. Spin fan and hold blower cover in position to make sure wheel does not scrape. When wheel is free, secure cover to plate assembly with nine screws and speed nuts.
(3) Install engine coolant heater blower.
b. Fuel Control Valve.
(1) Install screen in inlet port of valve body.
(2) Position new gasket, plunger assembly, spring, sleeve and core and solenoid cup in valve body, and secure with three screws.
(3) Position washer and coil assembly in solenoid cup and secure with lock washer and screw.
(4) Position new gasket, orifice plate, new gasket, cover and thermostat in valve body, and secure with clamp, three washers and screws.

(5) Connect electrical lead to thermostat.
(6) Install new gasket, screen, new gasket and valve assembly in valve body.
(7) Position heating element, two new gaskets, diaphragm assembly, spring and adjusting cap in valve body, and secure with diaphragm cap and five screws and lock washers. Install screw in cap.
(8) Connect heating element electrical lead to thermostat.
(9) Install stud in diaphragm cap. Position electrical lead and heating element lead on stud and secure with nut.
(10) Install engine coolant heater control valve.

20-26. Installation.
a. Heater Unit Components. Refer to figure 20-3.
(1) Install heater housing.
(a) Spread heater housing to clear cover plate and stand cover plate and cover housing with two plate heat exchanger and position housing on heat exchanger.
(b) Secure heater housing to heat exchanger with three housing screws.
(2) Install receptacle and cable assembly, terminal strip and bracket.
(a) Position bracket on heater housing and secure with four bracket screws.
(b) Position receptacle and cable assembly on bracket and secure with four receptacle screws, washers and nuts.
(c) Position, ground lead of receptacle and cable assembly on bracket and secure with motor resistor screw, washer and nut.
(d) Position marker strip and terminal strip on bracket and secure with four terminal screws.
(e) Connect diode to terminals 5 and 6 of terminal strip.
(3) Install motor resistor.
(a) Position motor resistor onbracket and secure with motor resistor lock washer, nut and screw.
(b) Connect two leads of resistor tb terminals 4 and 6 of terminal strip.
(4) Install restriction switch.
(a) Install two new grommets in heater housing.
(b) Position two spacers and restriction switch on heat exchanger and secure with two washers and nuts.
(c) Connect switch leads 25 and 51 of restriction switch to terminals 4 and 5 of terminal strip.
(5) Install burner assembly.
(a) Position new burner preformed packing and burner assembly on heat exchanger.
(b) Secure burner assembly to heat exchanger with three burner washers and screws.
(6) Install stand pipe and preheat resistor.
(a) Install preheat resistor and cover flange on standpipe.
(b) Install standpipe with preheat resistor in burner assembly.
(c) Position resistor lead on preheat resistor and secure with resistor washer and screw.
(d) Position pipe and secure flange to heater screws.
(7) Install ignitor
(a) Using a 13/16-inch deep socket, install new ignitor gasket and ignitor in burner assembly.
(b) Position copper connecting strap of preheat resistor on ignitor and secure with two ignitor nuts.
(c) Position ground lead on ignitor and ground lead on burner assembly and secure with ground lead lock washer and screw.
(d) Position end plate on heater housing, rotate end plate to engage bayonet slots and secure with four end plate nuts.
(8) Install overheat switch.
(a) Position new preformed packing and overheat switch on heat exchanger.
(b) Position switch cover on heat exchanger and secure with cover lock washer and nut.
(c) Connect switch lead to overheat switch.

(9) Install fuel control valve.
(a) Install union on fuel control valve.
(b) Position fuel control valve on standpipe and secure compression nut to union.
(c) Connect two leads of fuel control valve to overheat switch and one lead of fuel control valve to terminal 5 of terminal strip.
(10) Install flame detector switch.
(a) Position flame detector switch in heat exchanger and secure compression nut under flame detector switch.

NOTE

Do not bend flame detector switch tube.

(b) Connect five leads to five terminals on flame detector switch.
(11) Install blower assembly.
(a) Thread lead of blower assembly through new grommet and position blower assembly on heater housing.
(b) Rotate blower assembly clockwise to engage bayonet slots and secure with four nuts.
(c) Connect lead on blower assembly to terminal 4 of terminal strip.
(d) Position air inlet tube and blower outlet tube on heater housing and blower assembly and secure with tube screw.
(e) Position shield bracket on heater housing and secure with four shield screws.

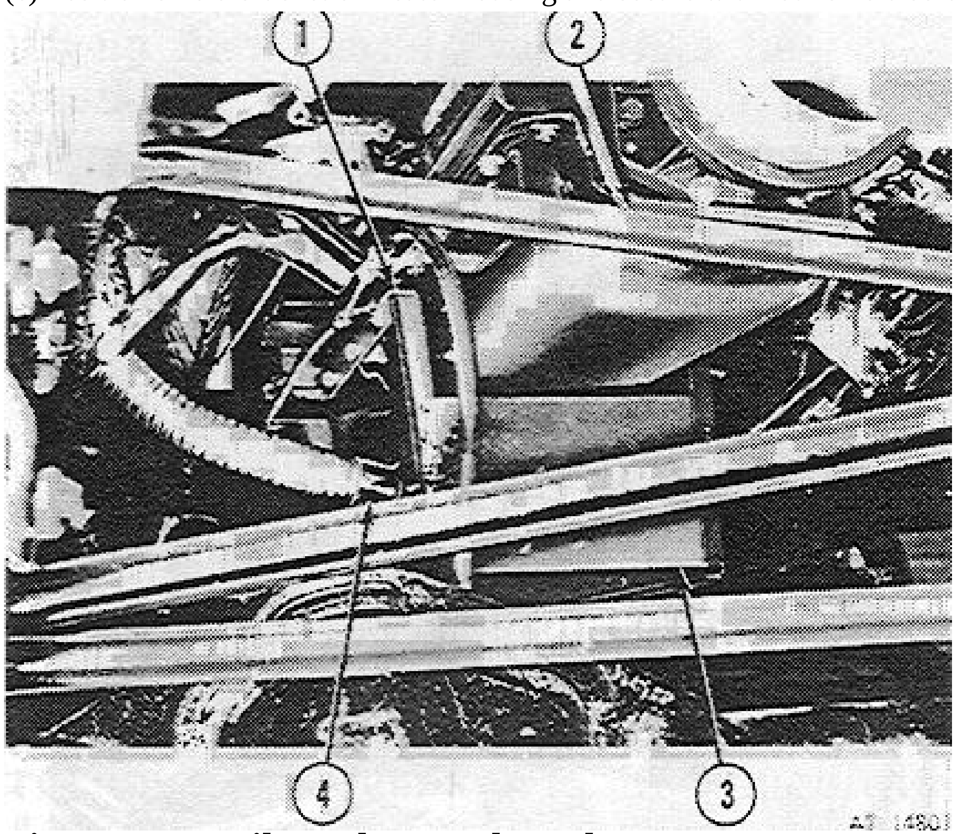


Figure 20-4. Oil pan heater shroud.

1 Shroud bracket

2 Engine oil pan
3 Engine oil pan shroud
4 Shroud exhaust collar

b. Engine Heater Unit.
(1) Jack up the front of the vehicle and working from underneath the engine, remove the first and fourth bolts, from the rear, on each side of the oil pan.
(2) Using four 5/16-18 x 1-inch bolts and lock washers and with a round metal spacer mounted on the upper side and over the bolts, position and secure the right and left shroud support brackets to the engine crankcase -
(3) Position the engine oil pan heating shroud on the brackets and secure each of the two outer sides of the shroud with three 5/16-24 x 5/8-inch bolts and lock washers as shown in figure 20-4.

NOTE
When installing the oil pan heater shroud, the exhaust collar of the shroud must face the right side of the vehicle.

(4) Position heater unit on heater support assembly. Secure heater unit to the support assembly with two six inch clamps, running the clamp through the mounting brackets of the support assembly.

NOTE
The air in hole end of the heater is placed on the end of the support assembly having the offset bracket.

Position heater unit on right fender apron, (fig 20-5) and secure with three 5/16-18 x 1-1/4-inch bolts, nuts and lock washers.
c. Heater Hose and Valve.
(1) Drain coolant from radiator and engine block into a suitable clean container.
(2) Remove clamp and rubber plug cap from the coolant tube of the water pump housing. Using a 3-1/2-inch long piece of heater hose and two hose clamps, secure the tee shutoff coolant valve to the water pump tube (fig 20-5).
(3) Remove the short heater hose pipe located between Nos. 4 and 5 engine exhaust ports. Using a 3/8 x 1-1/2-inch nipple and 3/8-inch connector, secure the 40° coolant shutoff valve to the engine block.

NOTE
Coolant shutoff valves must be positioned as shown in figure 20-5.

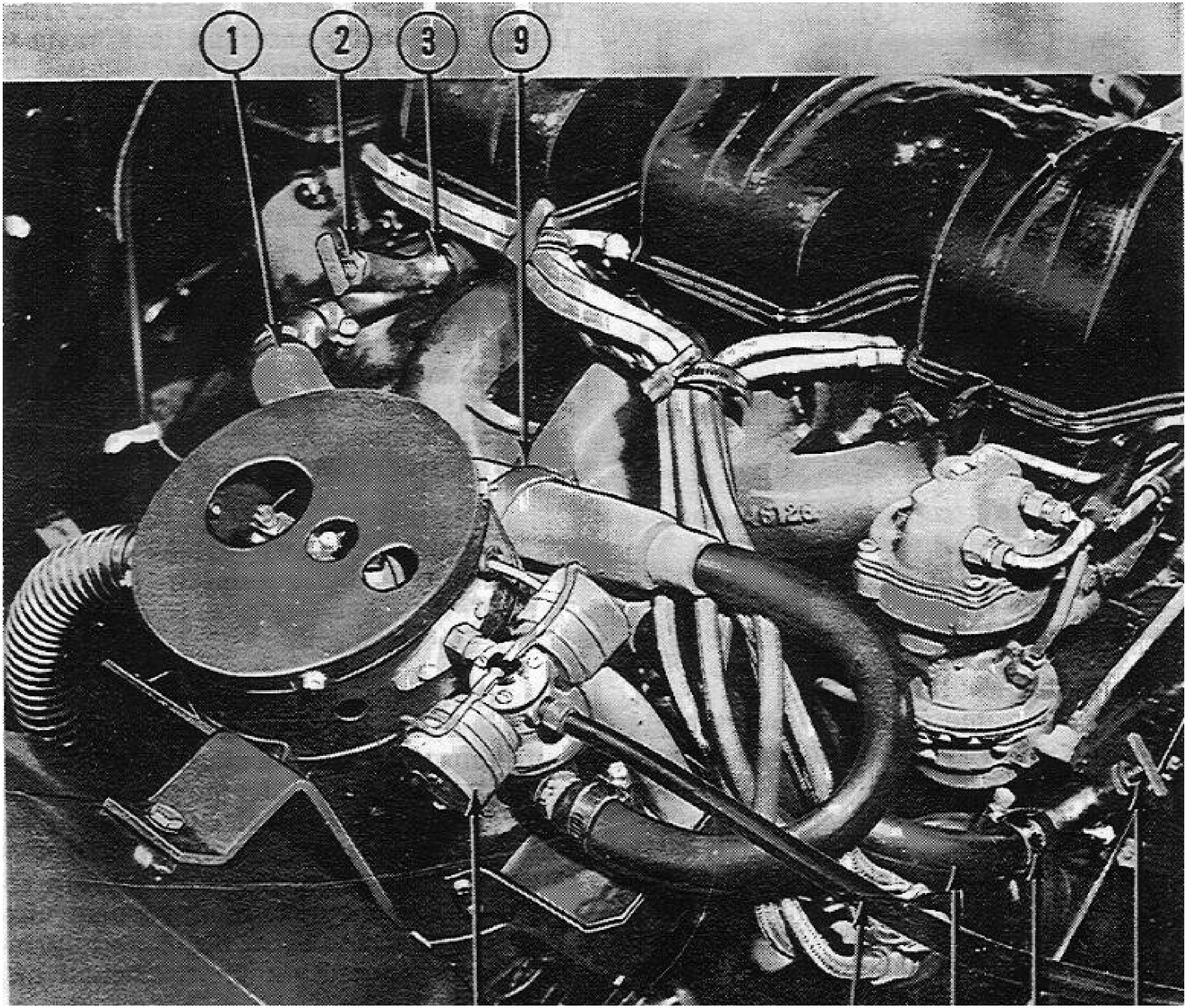
(4) Install the two hose nipples supplied in the kit to the coolant inlet and outlet opening of the heater unit.
(5) Place one of the 14-inch shield sleeves over the end of a long heater hose. Using a hose clamp, position and secure this hose between the water pump shutoff valve and the heater inlet coolant nipple. Position the shield on the hose to provide maximum protection from exhaust manifold heat.
(6) Place the second 14-inch shield sleeve over the remaining long heater hose and using a heater hose clamp, position and secure this hose between the engine block heater shut-off valve and the heater outlet nipple. Position the shield on the hose to provide maximum protection from exhaust manifold heat.
(7) Clamp the two hoses together with clamps furnished in kit as shown in figure 20-5. Refill radiator with coolant.

NOTE
After heater has been installed and engine has been run until warm, recheck coolant level and refill as necessary.

d. Fuel Line. Connect the flexible fuel line to the heater fuel valve and the arctic heater fuel pump shut-off valve (fig 20-5).

NOTE

If no fuel shutoff valve has been installed on the fuel pump, a tee fitting and shutoff valve must be installed in the position shown in figure 20-5.



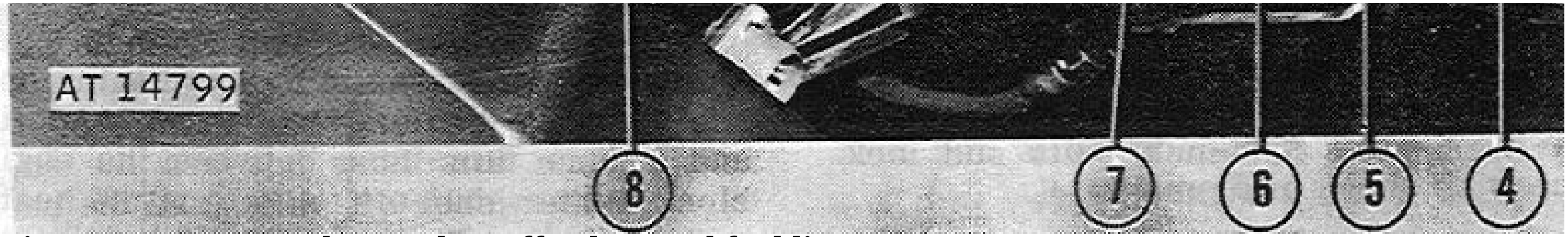


Figure 20-5. Heater, hoses, shut-off valves and fuel lines.

1 Long heater hose
2 45° shut-off valve
3 Pipe nipple
4 3-1/2-inch heater hose
5 90° shut-off valve
6 Long heater hose
7 Flexible fuel line
8 Heater fuel control valve
9 Clamp

e. Control Box.

(1) Remove the two screws securing the switch panel to the control box case. Carefully remove the switch panel from the case.

(2) Position the control box case on the instrument pan e 1 lower reinforcement flange at the left of the personnel heater control box and secure it to the flange with two 5/16-20 nuts and lock washer.

(3) Insert switch panel assembly in control box case and secure panel with two screws previously removed (fig 20-6).

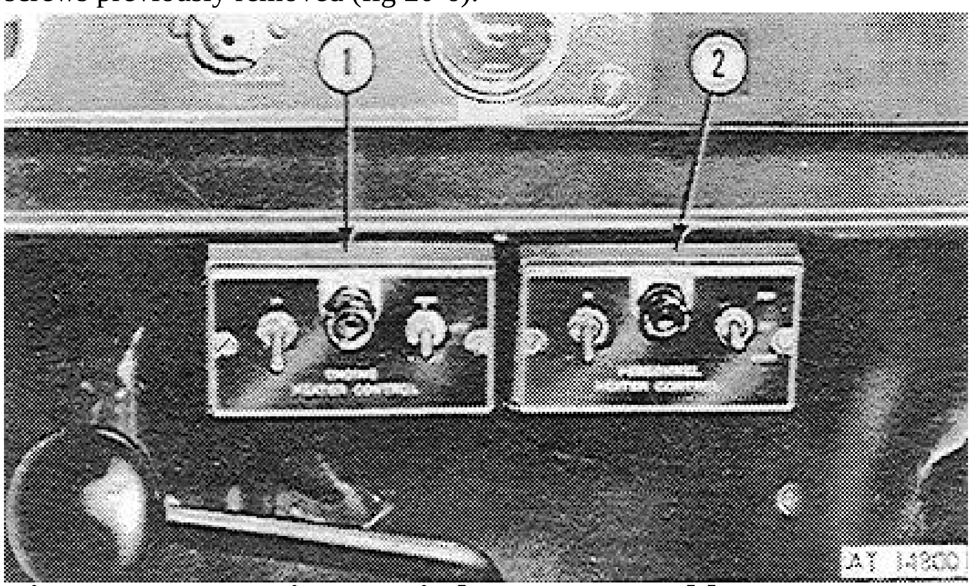


Figure 20-6. Engine arctic heater control box.

1 Engine heater control box
2 Personnel heater control box

f. Heater Exhaust Pipe.
(1) Position the flexible metal exhaust pipe on the heater exhaust elbow and drill a 5/32-inch diameter hole through both walls of the pipe and elbow then secure pipe to elbow with long cotter pin (fig 20-7).
(2) Position exhaust pipe elbow on heater exhaust collar and drill a 5/32- inch diameter hole through both walls of the collar and elbow. Secure elbow to heater tube with long cotter pin (fig 20-7).
(3) Position exhaust pipe on the oil pan heater shroud collar and drill a 5/32-inch diameter hole through both walls of the pipe and tube. Secure pipe to shroud tube with long cotter pin. (Fig 20-8).

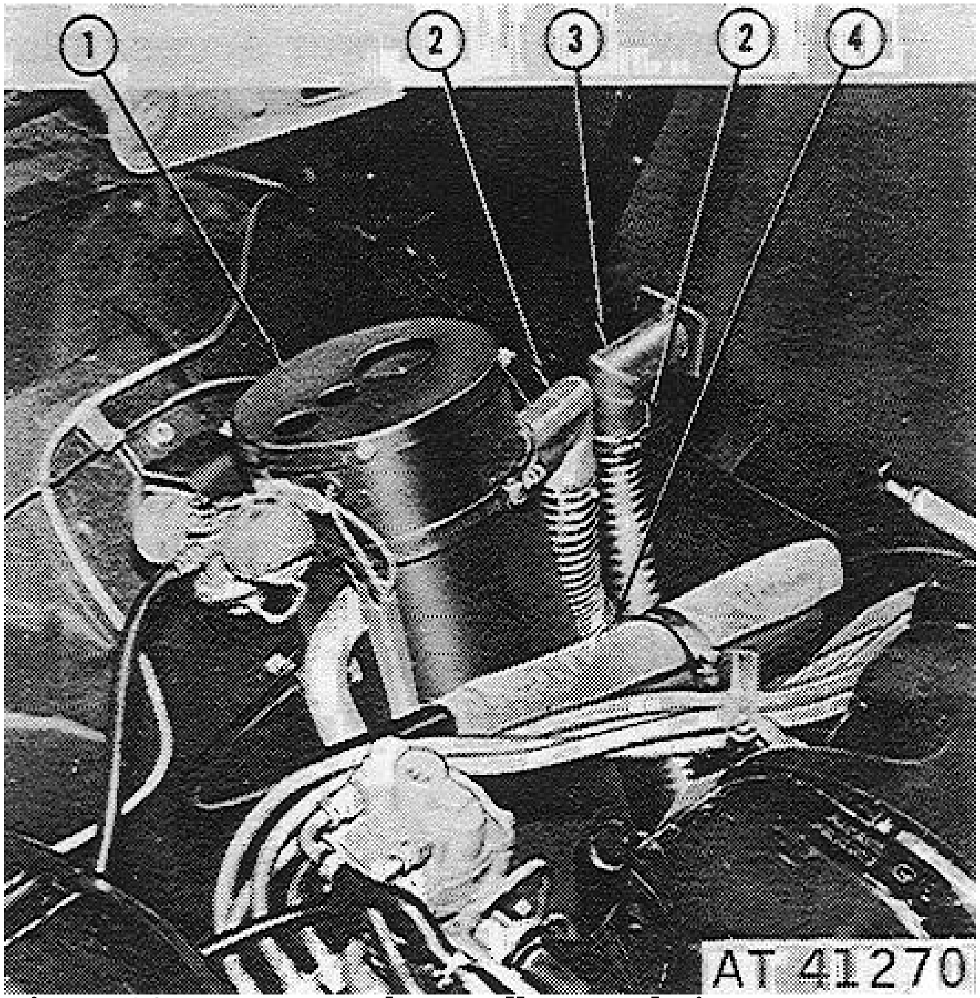


Figure 20-7. Heater exhaust elbow and pipe.

1 Heater unit
2 Cotter pin

3 Exhaust pipe elbow
4 Flexible exhaust pipe

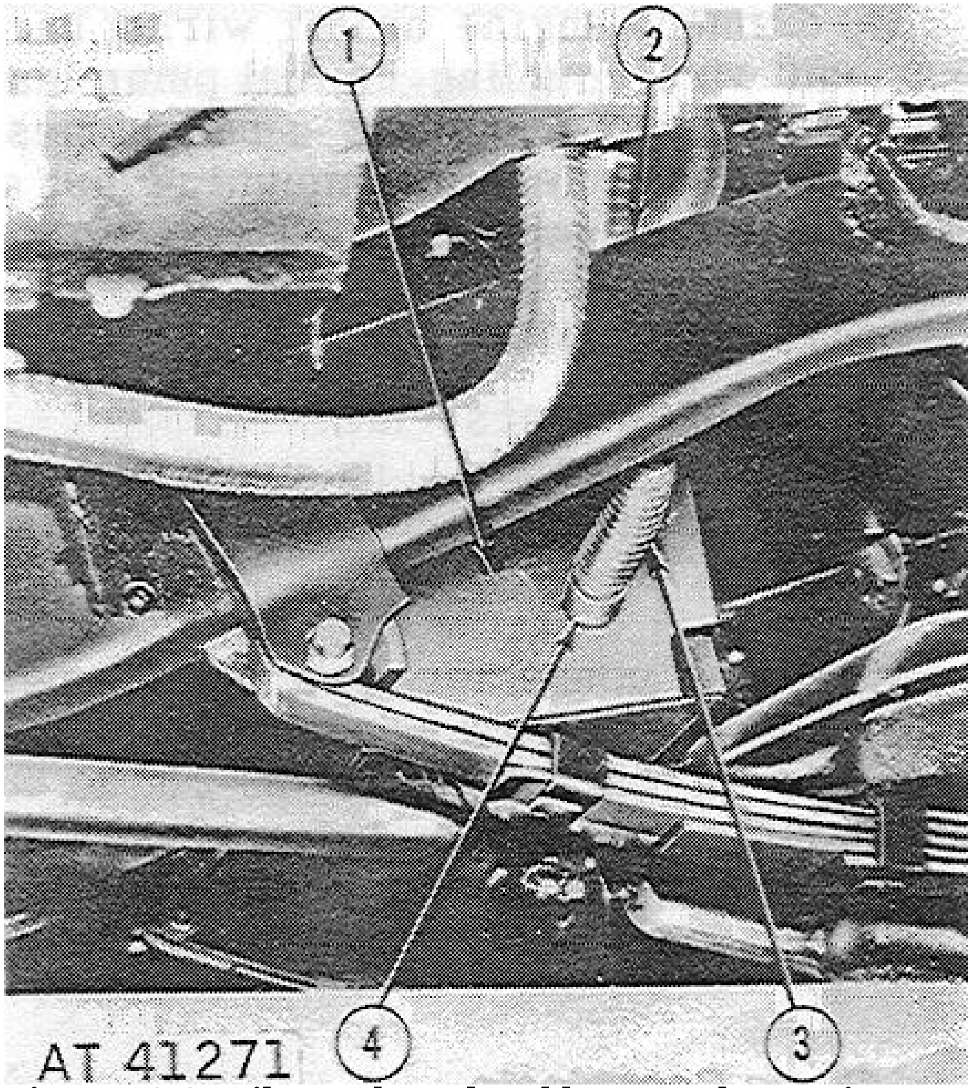


Figure 20-8. Oil pan shroud and heater exhaust pipe.

1 Oil pan shroud
2 Right frame side rail
3 Heater exhaust pipe
4 Cotter pin

g. Wiring Harness.

(1) Remove the left lower access plate from the outer side of the dash panel.
(2) Connect the engine arctic heater wiring harness elbow connector to the engine heater control box and opposite end of harness to the switch receptacle on the engine heater unit.

NOTE

When connecting the wiring harness to the engine heater, the harness is fed from under the cowl through the dash panel access plate opening to the engine compartment.

(3) Disconnect fuel pump lead wire from waterproof couplings on pump lead and personnel heater control box. Remove pump lead wire.
(4) Place rubber grommet around engine heater wiring harness and hole in dash access plate, Secure access plate to dash panel with four screws previously removed.
(5) Connect engine heater wiring harness lead wire coupling to fuel pump lead wire waterproof coupling an d harness ground lead wire terminal mounting bolt of engine heater support (fig 20-9).

NOTE

Make sure mount surface of ground lead wire terminal is clean and makes good metal-to-metal contact.

(6) Using connector, connect the personnel and engine heater control box lead wires, as shown in figure 20-10, to the instrument panel harness battery lead wire. Connect the engine heater control box lead to the personnel heater control box lead.

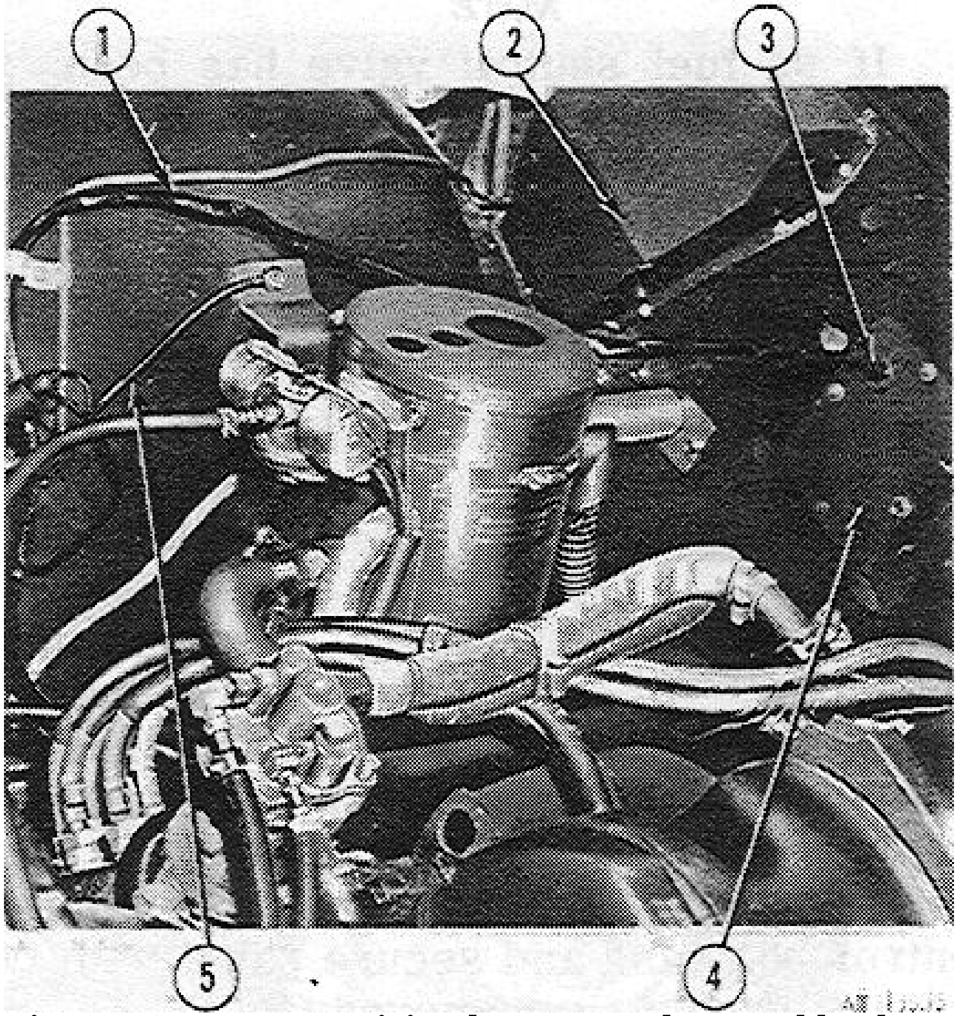


Figure 20-9. Heater wiring harness and ground lead.

1 wiring harness
2 Dash panel
3 Grommet
4 Left lower access plate
5 Ground lead

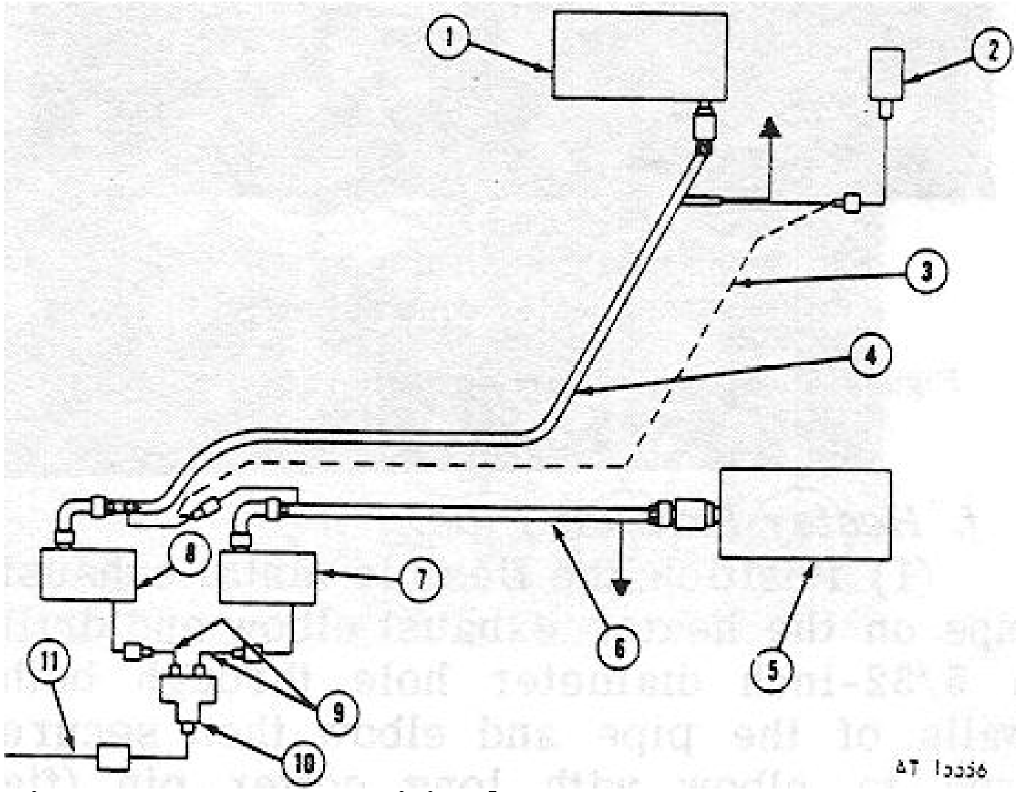


Figure 20-10. Heater wiring harness.

1 Engine heater	7 Personnel wiring heater (control box)
2 Heater electric fuel pump	8 Engine heater control box
3 Fuel pump feed wire (with personnel heater only)	9 Connecting cables
4 Engine heater wiring harness	10 Connector
5 Personnel heater	11 Instrument panel feed cable
6 Personnel wiring heater (wiring harness)	

h. Slave Receptacle.

NOTE

Refer to the slave receptacle location drawing (fig 20-11) to locate four 9/32-inch diameter and one 2-inch diameter holes to be drilled or cut in the right front fender to accommodate mounting the vehicle slave receptacle.

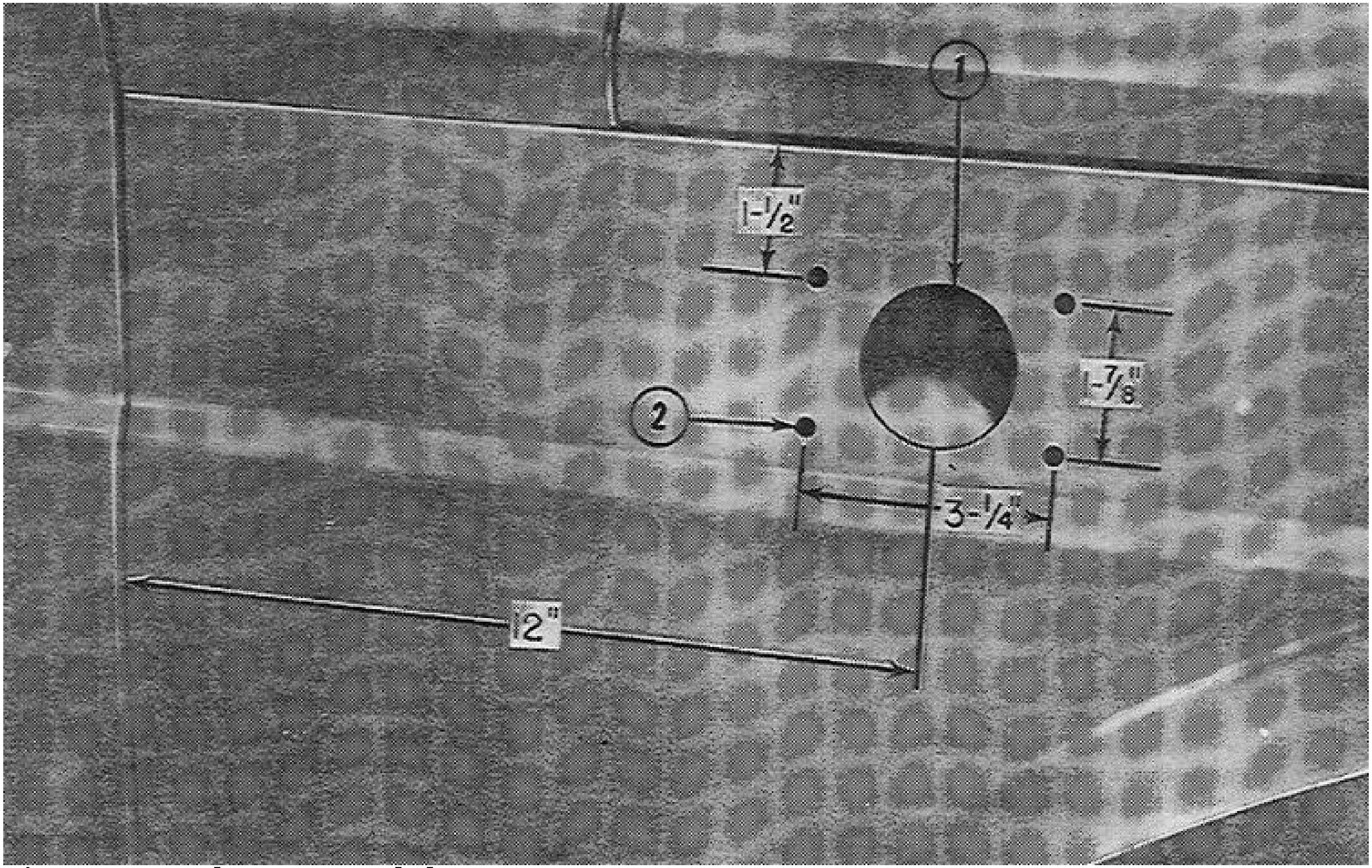


Figure 20-11. Slave receptacle locater.

1 2-inch diameter hole
2 9/32-inch diameter hole

(1) Position slave receptacle cables through large hole cut in right fender, guide cables under the hood hinge and close to the fender panel. Secure slave receptacle to fender with four 1/4-20 x 1-inch diameter bolts, nuts and lock washers (fig 20-12).
(2) Secure receptacle ground cable to engine right frame support bracket after cleaning mating surfaces to make bare metal contact with one 3/8-24 x 3/4-inch bolt, nut and two star washers. (Fig 20-13)
(3) Route slave receptacle battery lead cable through cable hole opening in cab floor. Secure cable terminal to battery clamp of positive battery post. (Fig 20-14)
i. Test and Adjustment

(1) Burn test.
(a) Mount heater in same position it normally occupies in carrier. Connect fuel, electrical and exhaust connections to coolant heater.
(b) Place heater control switch to ON position. Start timing the heater operation from the instant the switch is energized.
(c) Current draw should be approximately 11 amperes.

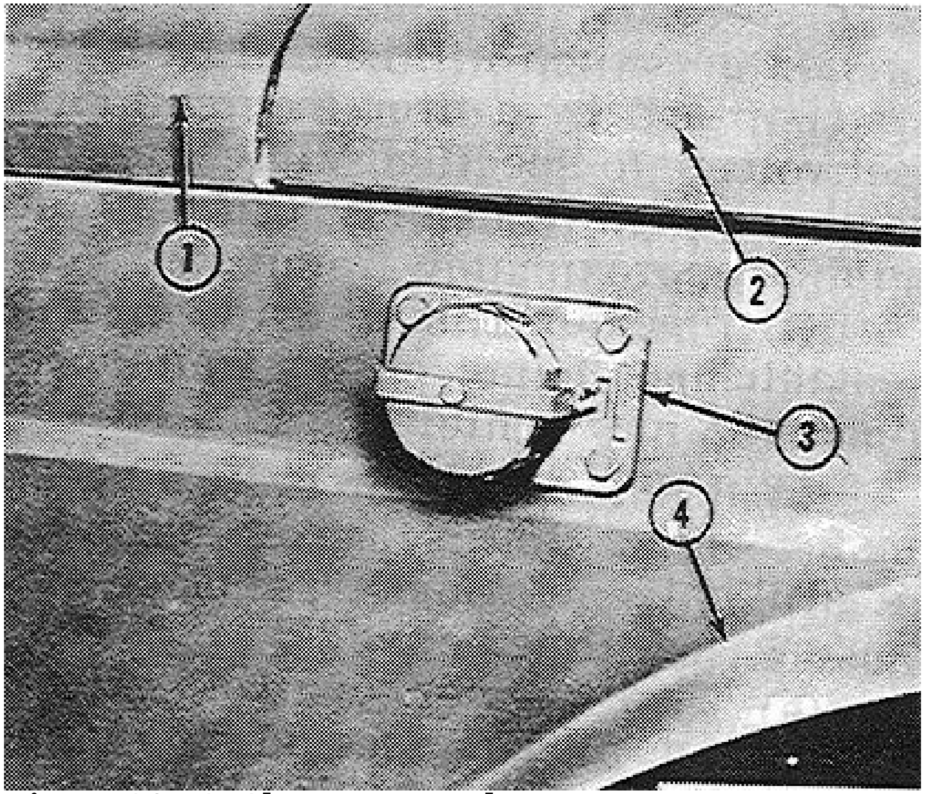


Figure 20-12. Slave receptacle.

1 Cowl
2 Hood
3 Slave receptacle
4 Right front fender

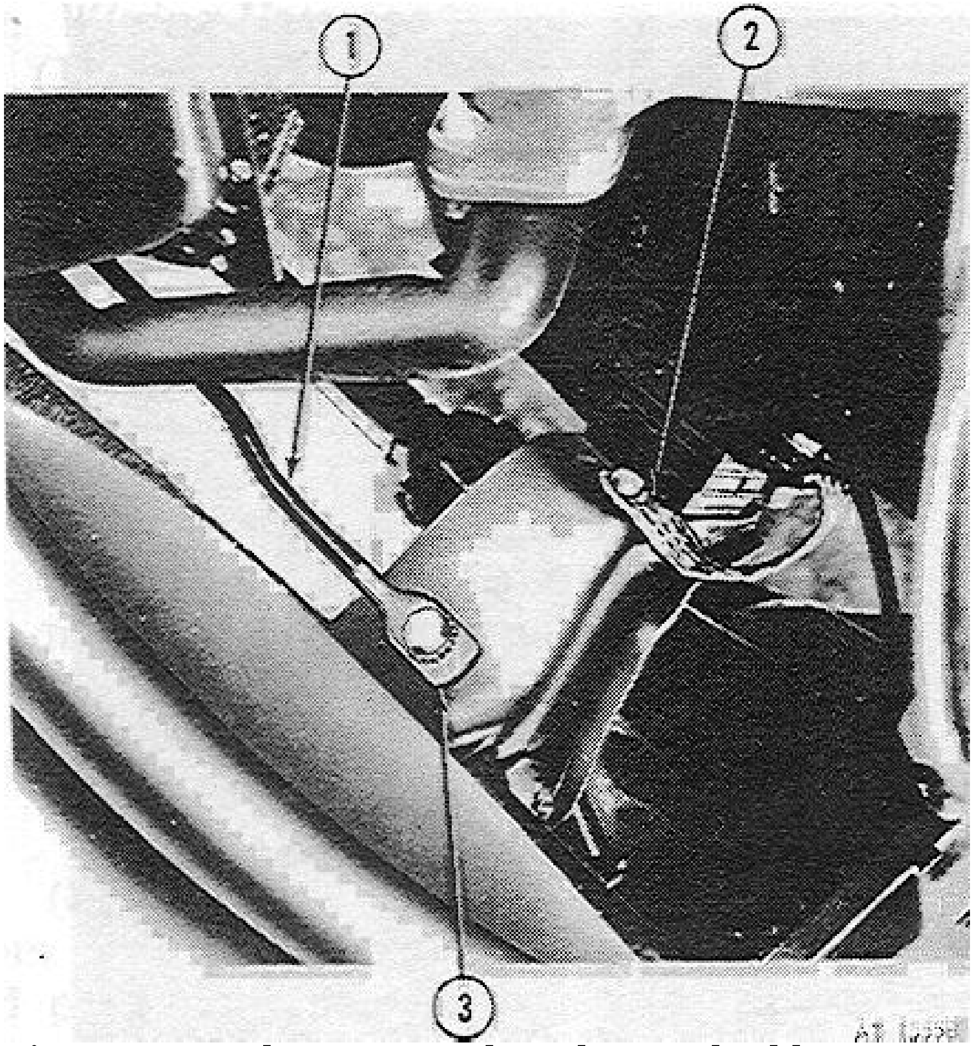


Figure 20-13. Slave receptacle and ground cable.

1 Slave receptacle ground cable
2 Engine ground strap
3 Right front engine mounting bracket

(d) Heater should ignite within 20 seconds from instant switch is energized.
(e) The flame detector switch must transfer in more than 8 seconds, but less than 25 seconds, from instant of ignition. Transfer of switch will be indicated by the pilot lamp and by a drop in current draw. Reset voltage to specified value after flame detector switch transfers. Current draw should be approximately 1 ampere.
(f) If heater fails to ignite or is slow in establishing flame, clean igniter cavity and install a new igniter.
(g) If flame detector switch does not transfer within limits, reset the switch. If it still fails to transfer, replace switch or quartz rod, if defective.
(h) Turn heater control switch to OFF position. Burning should stop immediately, and fuel flow should also stop. The blower should continue to run for more

than 1, but less than 2 minutes, then stop automatically. If blower operation is not within limits, reset flame detector switch and retest. If blower fails to stop, the quartz rod of the flame detector switch is broken and must be replaced.
(2) Overheat switch test.
(a) Turn heater on and allow it to run until coolant is heated.
(b) Short across terminals of the HILO switch so heater will remain on HI heat. Allow coolant to heat until overheat switch cuts out (burning will stop).
(c) Take temperature immediately when switch opens. The temperature must not be less than 230° F or more than 260° F. Replace overheat switch if not within these limits.

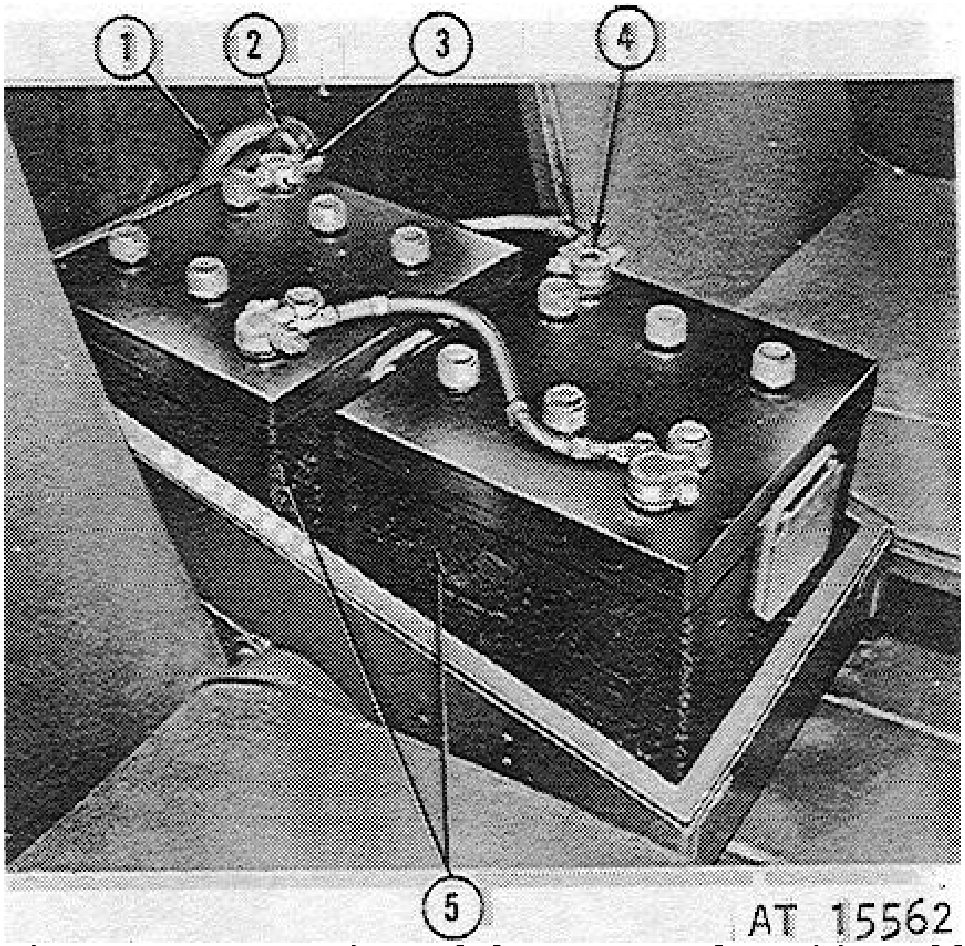


Figure 20-14. Batteries and slave receptacle positive cable.

1 Positive vehicle cable
2 Positive slave receptacle cable
3 Positive battery post
4 Negative battery post
5 Vehicle batteries

(3) Blower test.

(a) Install a short section of tubing with a pressure tap on the combustion air inlet of the exchanger, and attach a water manometer to the tap. Reconnect blower hose to the tap.
(b) Disconnect No. 6 blower lead from terminal strip and energize the blower. Check carefully for air leaks, then note static pressure indicated on the manometer. The pressure should be at least LB inH2O. If static pressure is less, replace blower motor.
j. Operation
(1) Place control box START-OFF-RUN switch in START position. This switch is spring loaded and must be held in position until pilot lamp glows.
(2) When pilot lamp glows, immediately snap switch to RUN without stopping in the OFF position.
(3) Set HI-LO switch to HI rate of heat. When set for HI, the heater should automatically go onto LO heat when temperature of the coolant reaches 220° F.

NOTE

The LO position is suitable for standby operation when the heater will burn over an extended period of time.

(4) When heater is turned on, the blower should operate and the heater should ignite automatically, and the pilot lamp should glow when the flame detector switch transfers.
(5) After heater has ignited, and flame detector switch has transferred, the heater should be in full operation and continue to run until shut off. After a few minutes of heater operation, the upper hose connected between the heater and water pump housing should be warm, and after fifteen minutes of operation the upper hose should be hot and the lower hose, between the engine block and lower heater nipple, should be warm. If this is true, it is known the heater is operating properly and warm water is being circulated through the engine.
If lower hose is cold, hot water is not circulating through the engine and a check of the hose(s) and valves should be made. Both coolant hose valves must be fully open and the hoses must be in good condition. A check should be made of all coolant lines, fittings and valves for leaks.

TROUBLESHOOTING

Malfunction	Probable Cause	Corrective Action
1. Heater fails to start when control switch is turned on	a. No fuel pressure	a. Check fuel level, fuel pump, lines and filter. Clean or replace part(s) as necessary.
	b. Defective electrical circuit	b. Check electrical circuit and wiring. Repair as necessary.
	c. Defective heater component(s)	c. Replace defective heater component(s) or replace heater.
2. No heat output, or low heat output	a. Low or no fuel pressure	a. Check fuel level, fuel pump, lines and filter. Clean and replace parts as necessary.
	b. Ice in fuel system	b. Clean fuel system if necessary. Remove ice from fuel filter bowl and pump.
	c. Hi-Lo switch in low position	c. Place switch in Hi position.
	d. Defective heater component(s)	d. Repair or replace defective component(s) or replace heater.
3. Indicator light inoperative	a. Defective lamp	a. Replace lamp.

	b. Defective electrical wiring	b. Check wiring circuit. Repair or replace broken or damaged wiring.
4. Heater operates several minutes, then stops	a. Restricted fuel line	a. Clean fuel line of restriction.
	b. Defective fuel control valve	b. Replace fuel control valve.
	c. Defective flame detector switch	c. Replace flame detector switch.
5. Blower will not stop when heater is turned off	a. Defective flame detector switch	a. Replace flame detector switch.
	b. Defective electrical wiring	b. Check wiring circuit. Repair or replace broken or damaged wiring.
6. Heater smokes excessively or “bangs” upon starting	a. Starting with Hi-Lo switch in high position	a. Place switch in Lo position.
	b. Defective fuel control valve	b.Replace fuel control valve.
7. Blower runs, but heater fails to ignite	a. Low or no fuel pressure	a. Check fuel filter and lines for restriction. Replace fuel filter element or pump as necessary.
	b. Restriction in fuel line	b. Inspect fuel lines for restriction. Clean or replace fuel lines as necessary.
	c. Defective electrical wiring	c. Repair or replace wiring as necessary.
	d. Defective preheat resistor	d. Replace preheat resistor.
	e. Defective ignitor	e. Clean or replace ignitor as necessary.
	f. Defective fuel control valve	f. Replace fuel control valve.
8. Inadequate heat output	a. Coolant shutoff valves partially or fully closed	a. Fully open all coolant shutoff valves.
	b. Extreme cold weather	b. Install or adjust brush guard cover.
	c. Defective heater component(s)	c. Repair or replace defective component(s) or replace heater.
	d. Broken or disconnected exhaust pipe to oil pan shroud	d. Inspect exhaust pipe. Connect pipe if disconnected. Replace damaged or broken pipe.
9. Heater overheats but continues to run	a. Defective overheat switch	a. Replace overheat switch.
	b. Defective fuel control valve	b. Replace fuel control valve.
10. Fuel odor	a. Fuel leak	a. Tighten fuel fittings. Replace damaged fuel line or fitting(s) as necessary.
	b. Defective component(s)	b. Repair or replace damaged component(s) or replace heater.

Section V. PERSONNEL ARCTIC HEATER

20-27. General.

a. Crew Compartment Arctic HeaterKit. The (-40° F) crew compartment arctic heater kit, (fig 20-15), consists of a gasoline burning heater of the fresh air type equipped with a windshield defroster unit, a separate control box and connecting cable wiring harness, an electric fuel pump, a fuel filter, variable component parts and attaching hardware.

b. Heater Unit. The heater unit is installed under the cowl and in front of the passenger seat of the cab compartment. It is designed to produce a maximum heat output of more than 20,000 B.T.U. per hour. The fuel combustion occurs within a sealed, all welded, stainless steel heat exchanger. Air for combustion is supplied by a motor driven blower contained in the heater. A separate blower motor is used to circulate the heated air into the cab of the vehicle and to the defrosters.

c. Fuel Pump and Fuel Filter. The fuel filter is attached to the electric fuel pump by a pipe nipple. The fuel pump assembly is mounted to the engine radiator right baffle plate in the engine compartment. A flexible fuel line connects the electric fuel pump to a tee fitting that is installed in the vehicle engine fuel line just before the fuel enters the engine fuel pump.

d. Control Box. The heater control box houses the heater control switches, indica
tor lamp and circuit breaker. The control box is mounted on the lower center position of the instrument panel by two bolts securing it to the reinforcement flange of the panel. The 24-volt battery lead wire of the control box is connected by a waterproof connector to the auxiliary lead of the instrument panel wiring harness.

e. Diverter Box and Defroster Nozzle. A diverter box is mounted under the center of the cowl panel to control the air to the defroster nozzles or the floor. The diverter box is connected to the heater by a flexible hose and an adapter that mounts to the heater unit.

f. Heater Exhaust Tube. The heater exhaust gases are expelled through a flexible metal tube connected to an elbow on the dash panel inside the engine compartment and running along the outer side of the vehicle right rail to the rear of the vehicle just forward of the right rear wheel.

20-28. Removal.

a. Fuel Pump and Fuel Filter. (Fig 20-16)

(1) Disconnect fuel line from fuel pump filter and engine main fuel line tee at the engine fuel pump.

(2) Disconnect main fuel line from tee fitting and remove fitting. Connect fuel line to fuel pump.

(3) Disconnect heater fuel line from shutoff valve of electric pump.

(4) Disconnect heater electric lead wire from fuel pump lead at Packard connector.

(5) Remove bolts, nuts and washers securing electric fuel pump and condenser housing to the radiator right baffle. Remove pump assembly.

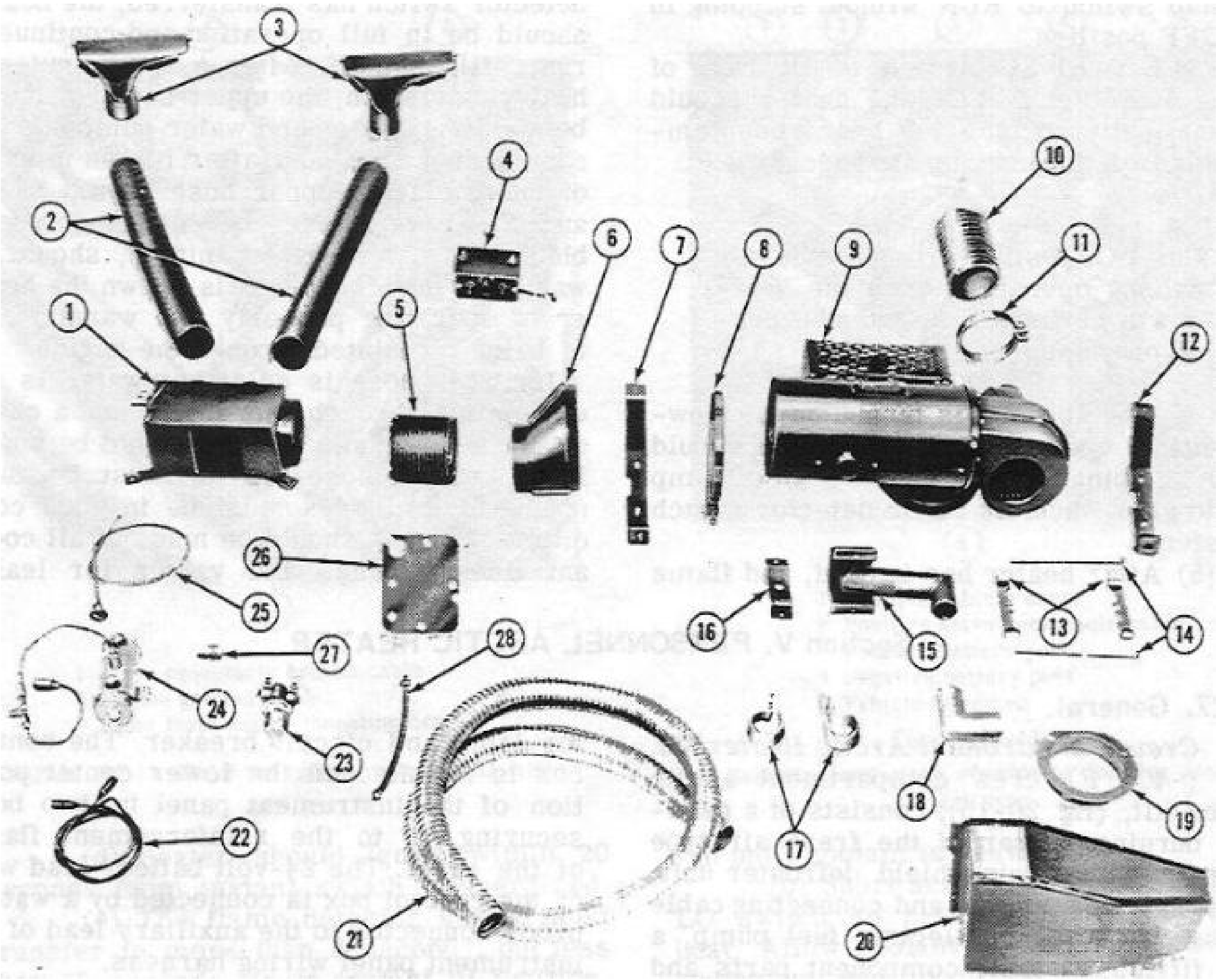


Figure 20-15. Arctic heater kit (-40°F) crew compartment.

1 Diverter box	8 Clamp	15 Exhaust bracket and pipe assembly	22 Lead wire
2 Defroster flexible tubes	9 Heater assembly	16 Exhaust mounting bracket	23 Fuel filter
3 Defroster nozzle	10 Flexible hose	17 Exhaust tube clamp	24 Fuel pump
4 Control box	11 Clamp	18 Exhaust elbow	25 Bowden cable
5 Flexible coupling hose	12 Mounting bracket	19 Intake adapter	26 Lower cover

6 Adapter	13 Clamps	20 Air vent chamber	27 Shutoff valve
7 Mount bracket	14 Bolts	21 Flexible exhaust tube	28 Flexible fuel line

Note: The following items are also in the kit.

(1) Instruction plate - heater operation	(2) 1/8 x 2-1/2 cotter pins	(2) 1/4 plain washer	(8)#8-15x1/2 pan head tapping screw
(4)#10-24x5/16 pan head mach. screw	(1) 3/8-24 x 5-3/4 hex bolt	(2) 1/4-20 x 11/16 hex bolt	(1) #8-32 hex nut
(1) 60-inch fuel line	(2) 3/8-24 lock nut	(9) 1/4-20 hex nut & 1/washer assy.	(1) Drain hose - dash panel
(2) Pipe nipple 1/8 x 1-3/4	(1) 3/8-24 x 3 hex bolt	(2) Spacer - mounting bracket	(7) 1/4-20 x 1/2 hex bolt
(1) Adapter tee	(1) Decal - personnel	(6) #12-24 hex nut & 1/washer assy.	(2) Exhaust washer
(1) Bulkhead union	(4) 5/16 plain washer	(6) #12-24x1/2 hex head mach. screw	(2) Preformed seal, heater & vent blower
(1) Female connector	(2) 5/16-24 hex nut	(8)#8-32x5/16 pan head screw & washer	(40) 1/2-inch sealer - permagum
(1) Cable - fuel pump feed	(2) 5/16-18 x 3/4 hex head bolt	(1) 3/8-24 hex nut & 1/washer assy.	(3) Closed clip
(1) Grommet	(4)5/16-18 hex nut & washer assy.	(8) #10-24 hex nut & 1/washer	

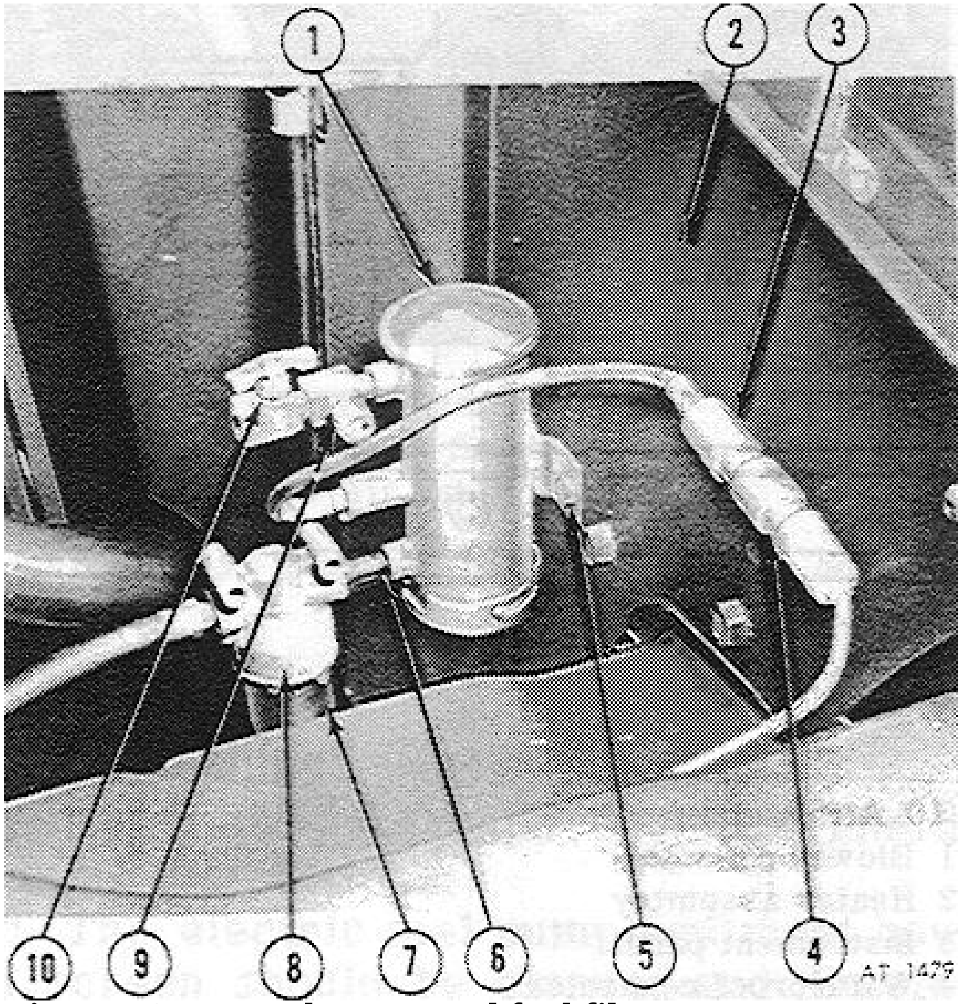


Figure 20-16. Fuel pump and fuel filter.

1 Fuel pump	6 Pipe nipple
2 Right radiator side baffle	7 Sump bowl
3 Condenser	8 Fuel filter
4 1/4-20 x 1/2-inch bolt	9 Adapter tee
5 1/4-20 x 1/2-inch bolt	10 Shutoff valve

b. Control Box. (Fig 20-17)
(1) Disconnect heater wiring harness elbow from control box.
(2) Disconnect control box lead wire from instrument panel wiring harness Packard connector.
(3) Remove screws securing switch panel to control box and remove panel.
(4) Remove nuts and lock washers securing control box to instrument panel lower reinforcement flange. Remove control box and reinstall switch panel.

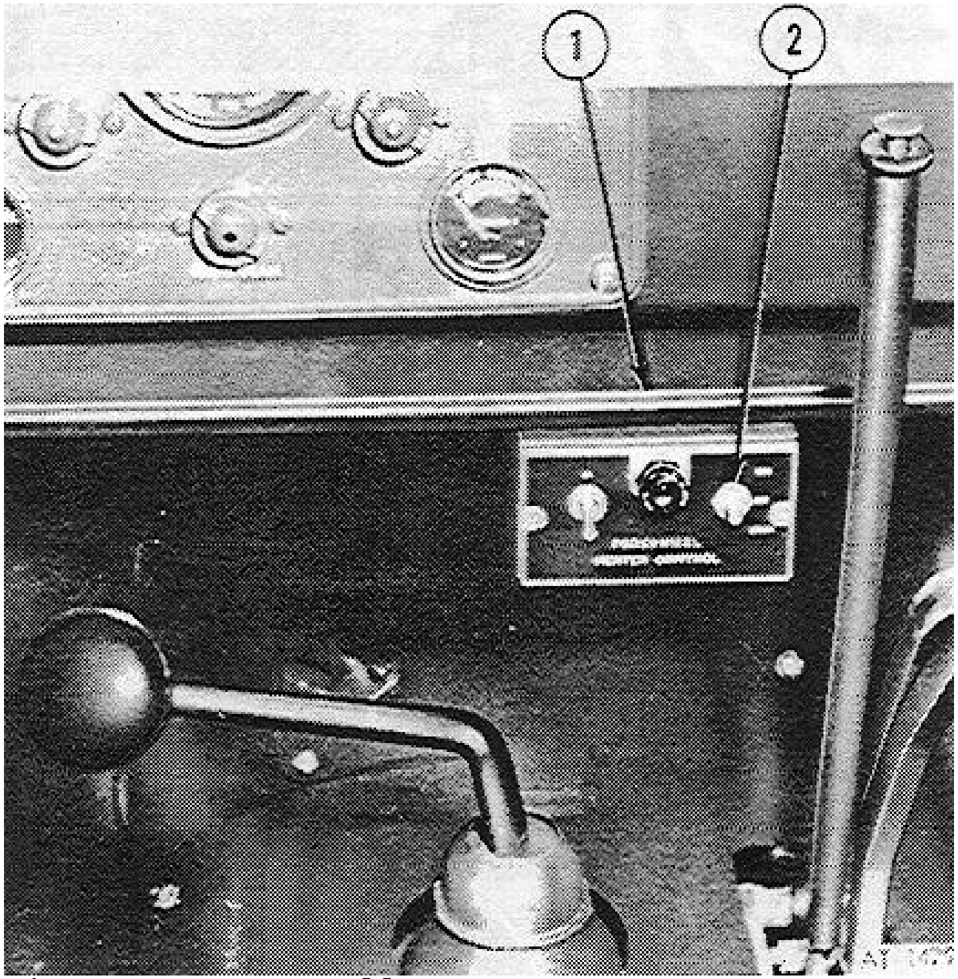


Figure 20-17. Control box

1 Instrument panel lower reinforcement flange
2 Control box

c. Heater Wiring Harness.
(1) Disconnect heater wiring harness from heater receptacle.
(2) Disconnect wiring harness ground lead from instrument panel and fuel pump lead wire from Packard connector. Remove heater wiring harness.
d. Heater Unit. (Fig 20-18)
(1) Disconnect fuel line from heater unit.
(2) Remove flexible hose from heater air-out adapter.

(3) Remove nuts and lock washers securing heater mounting brackets to outer dash panel.

(4) Remove bolts, nuts and lock washers securing heater mounting brackets to instrument panel lower flange reinforcement. Remove heater unit.

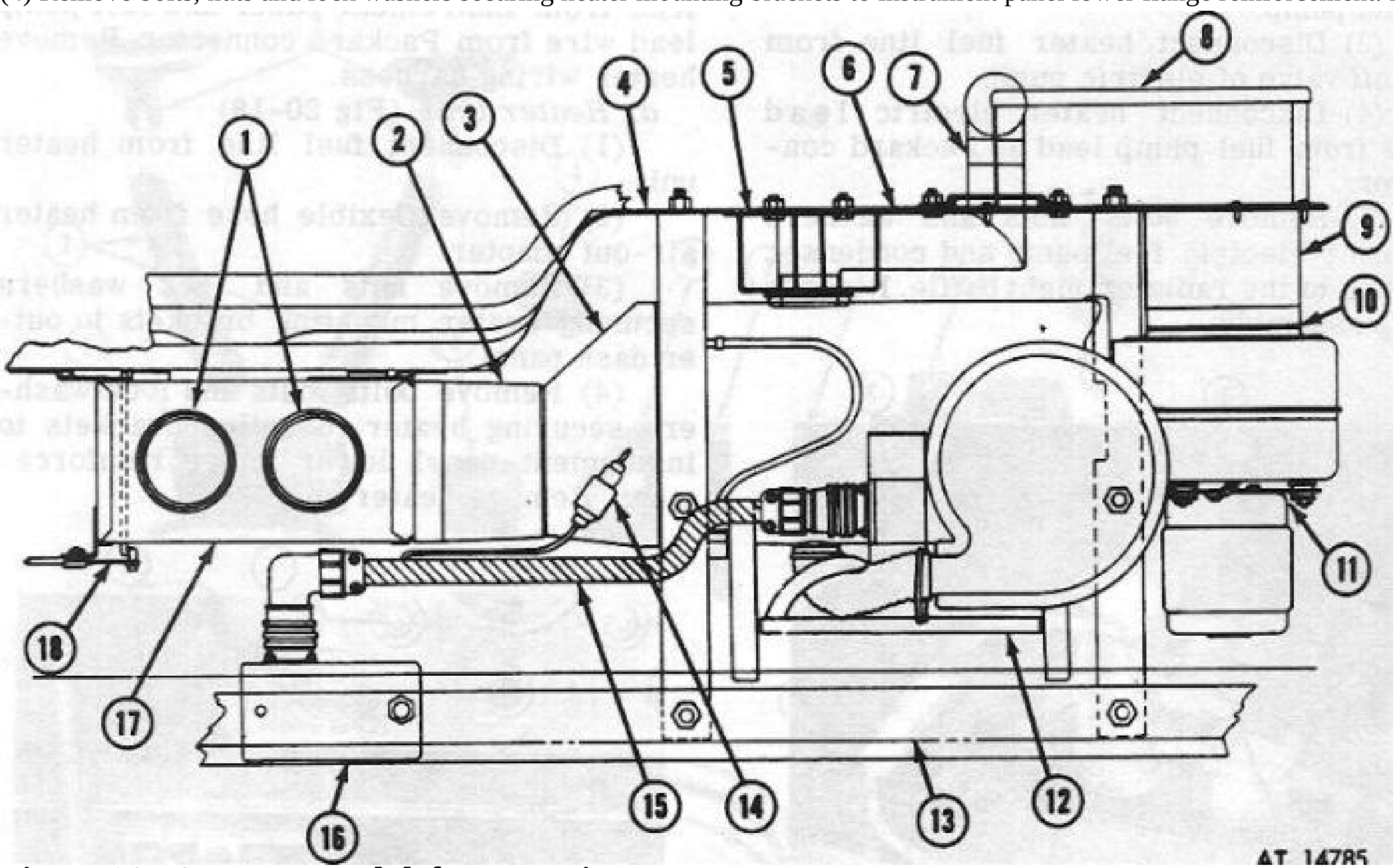


Figure 20-18. Heater and defroster unit.

1 Defroster hose collar	7 Exhaust tube elbow	13 Instrument panel
2 Flexible air outlet hose	8 Air vent chamber	14 Waterproof connector
3 Air outlet adapter	9 Flexible air inlet hose	15 Heater wiring harness
4 Dash panel	10 Air inlet adapter	16 Control box
5 Exhaust pipe mounting bracket	11 slower assembly	17 Diverter box
6 Short exhaust pipe	12 Heater assembly	18 Bowden control cable

e. Diverter Box. (Fig 20-19)

(1) Remove right and left flexible defroster nozzle hose.

(2) Disconnect Bowden cable housing and cable wire from diverter clamp and lever arm.

(3) Remove machine screws, nuts and lock washers securing diverter box to the cowl. Remove diverter box.

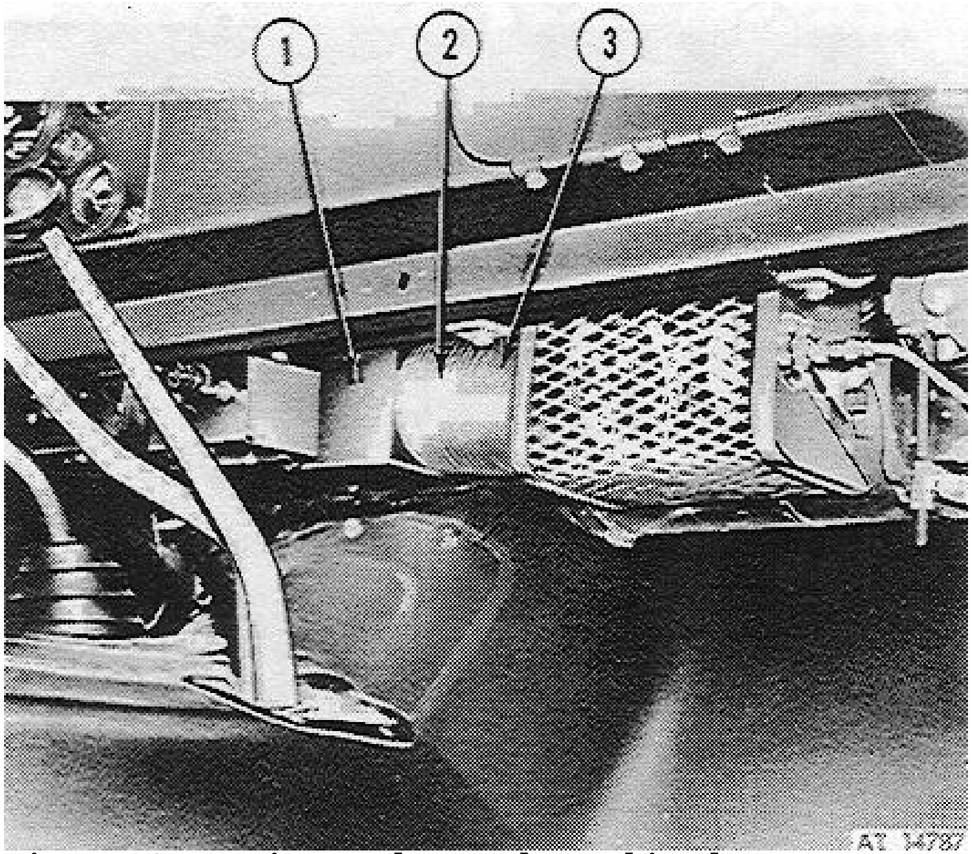


Figure 20-19. Diverter box and attaching hose.

1 Diverter box
2 Short flexible hose
3 Air outlet adapter

f. Air Vent Chamber. (Fig 20-20)

(1) Remove screws and lock washers securing air vent chamber to outer dash panel. Remove vent chamber.

(2) From storage, get upper dash panel heater cover plate and secure plate to dash with screws and lock washers.

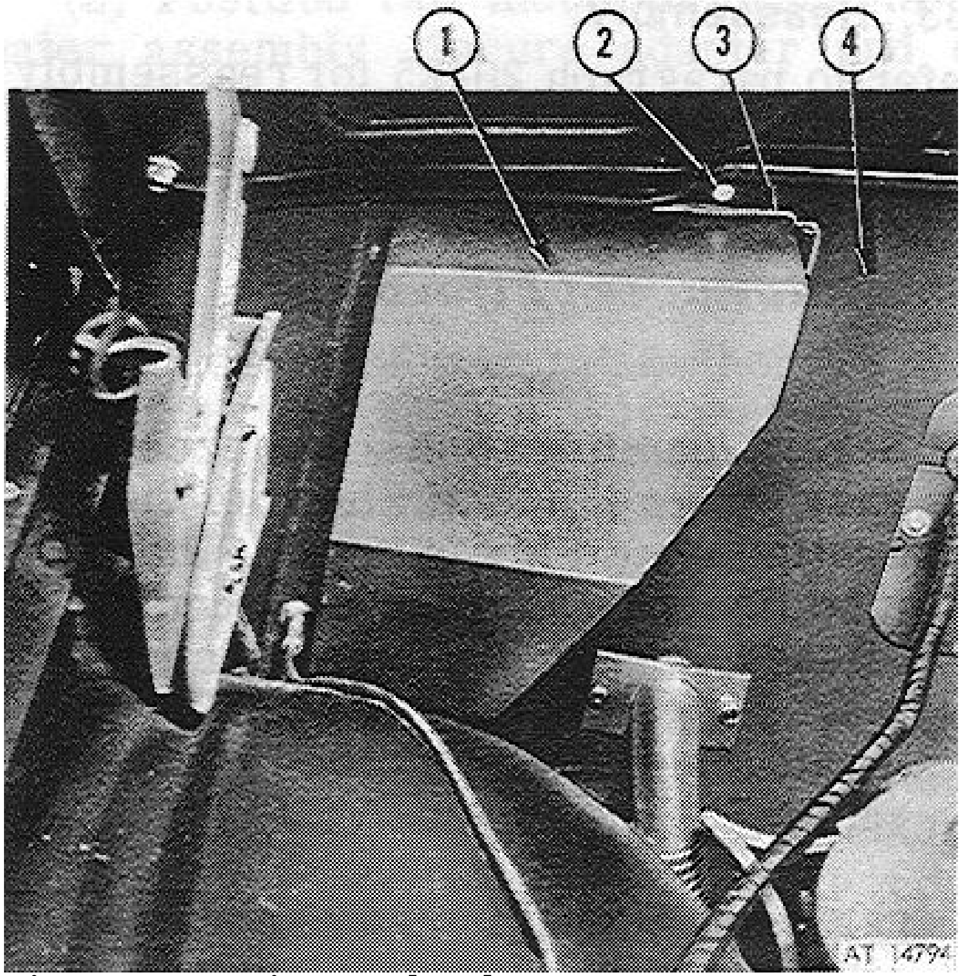


Figure 20-20. Air vent chamber.

1 Air vent chamber
2 8-15 x 1/2-inch screw
3 Permagum sealant
4 Firewall

g. Exhaust Pipe.
(1) Remove bolts, nuts and lock washers securing exhaust pipesupport bracket to outer side of dash panel. Remove cotter key securing exhaust pipe to bracket elbow. Remove support bracket and elbow (fig 20-21).
(2) Remove nuts and lock washers securing exhaust pipe clamps to body mounting bolts, Remove exhaust pipe and clamps (fig 20-22).

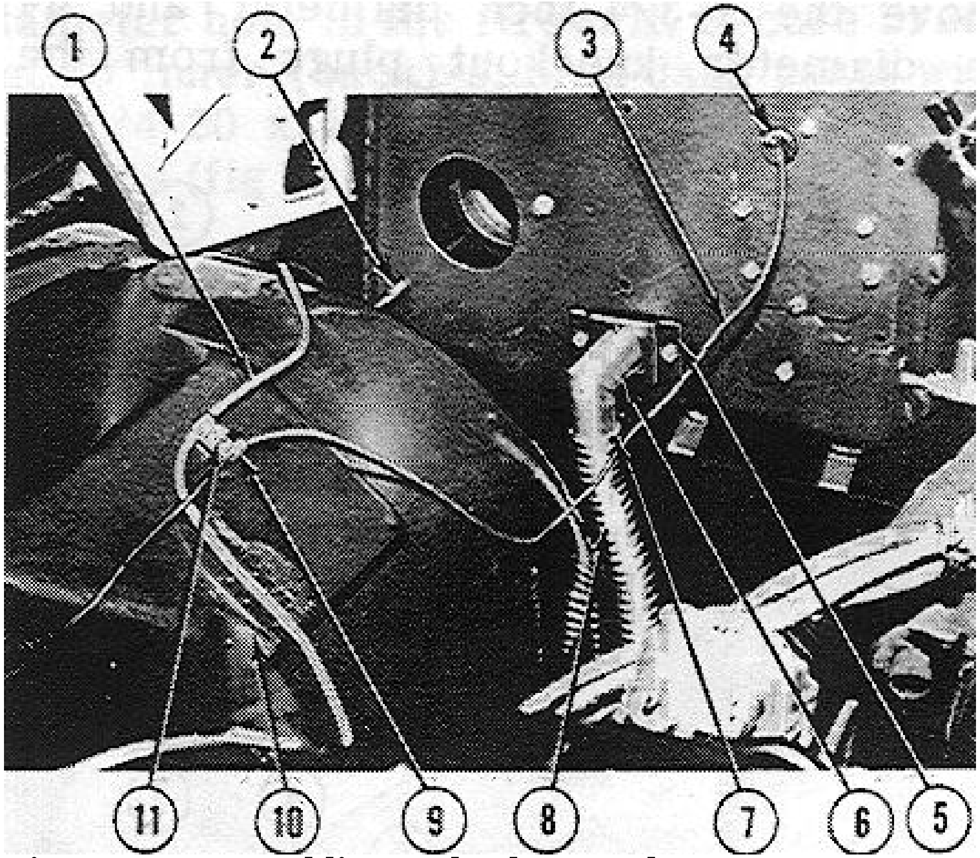


Figure 20-21. Fuel line and exhaust tube.

1 45-inch fuel line	7 Cotter pin
2 Bulkhead union	8 Exhaust tube
3 Electric lead wire	9 Closed clip
4 Grommet	10 Right fender splash panel
5 Exhaust tube mounting bracket	11 12 x 24 x 1/2-inch screw
6 Exhaust tube elbow	

h. Small Component Parts.
(1) Remove heat electric fuel pump lead wire from grommet, in lower side cover plate. Remove lead wire from vehicle.
(2) Remove nuts and lock washers securing defroster nozzles to cowl extension. Remove defroster nozzles.
(3) Remove bolts, nuts and lock washers securing heater exhaust bracket and pipe to inner dash panel. Remove exhaust bracket and pipe. Refer to figure 20-18.

NOTE

Using adhesive tape, cover the 1-3/4-inch and 4-inch diameter holes in dash panel. Other small holes in dash panel should be sealed with perrnagum.

i. Heater Unit Components. Refer to paragraph 20-20.

20-29. Disassembly.
Refer to paragraph 20-21 for disassembly of heater unit components.

20-30. Cleaning.
a. Refer to paragraph 2-7 for general cleaning instructions.
b. The electric fuel pump sediment bowl and screen should be cleaned and the element or screen be replaced, if damaged or defective.

20-31. Inspection.
Personnel who operate the heater should be alert for any signs of trouble during the starting and running of the heater, with particular attention given to difficult starting, unusual noises, fuel or exhaust orders, low heat output, or improper heat control. Unsatisfactory performance is not always caused by defects in the heater proper, but may be due to defects in associated equipment, therefore check for damage which may have occurred during operation of the vehicle, such as loose or deformed ducts and hoses, frayed wires, etc. To ensure efficient operation of the heater, it is necessary that the maintenance services listed below be performed at regular intervals.
a. The sediment bowl and screen of the electric fuel pump should be cleaned and the element or screen be replaced, if damaged or defective.
b. Inspect fuel lines, air hoses and ducts, exhaust pipes, fitting and tubes for leaks, breaks, restrictions, and faulty connections. Tighten, repair or replace loose or damaged part or component assembly.
c. Examine wiring for broken strands, frayed, cracked or damaged insulation, and loose or dirty connections. Repair or replace wires or cables as necessary.
d. Remove any accumulated dirt or heavy dust from around heater, check heater and duct mountings and tighten if loose.
e. Check exposed parts of heater for physical damage. Repair or replace damaged parts as necessary.

NOTE

The tendency of gasoline to form gum during long periods of storage makes it advisable to keep fuel lines empty during long storage or during months the heater is out of service.

20-32. Repair or Replacement.
Replace worn, damaged or unserviceable parts as required.

20-33. Reassembly.
Refer to paragraph 20-25 for reassembly of heater components.

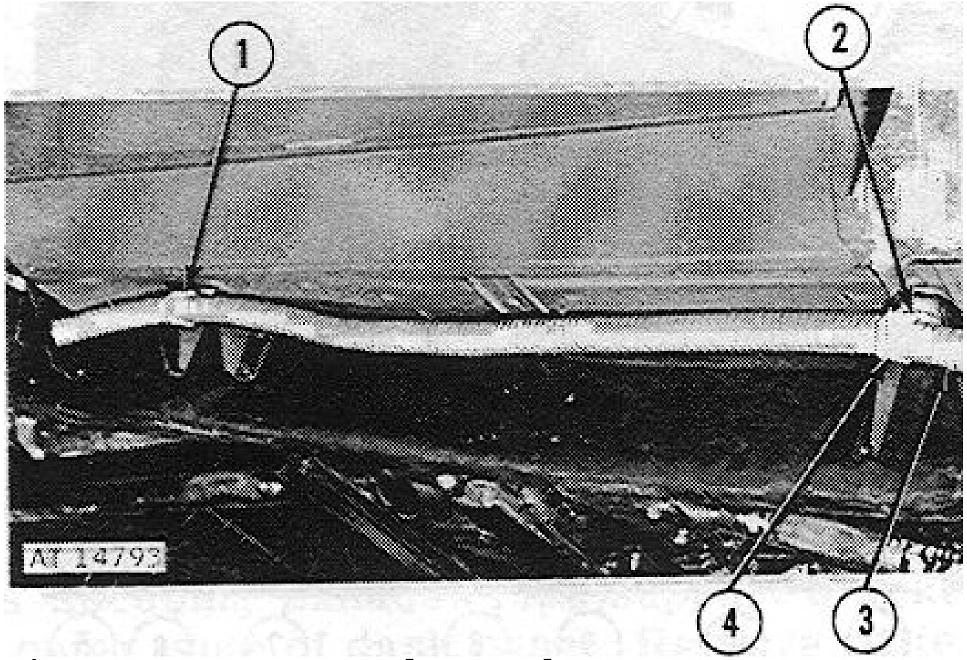


Figure 20-22. Heater exhaust tube.

1 Floor support bolt
2 Floor front side sill bolt
3 Flexible exhaust hose
4 Clamp

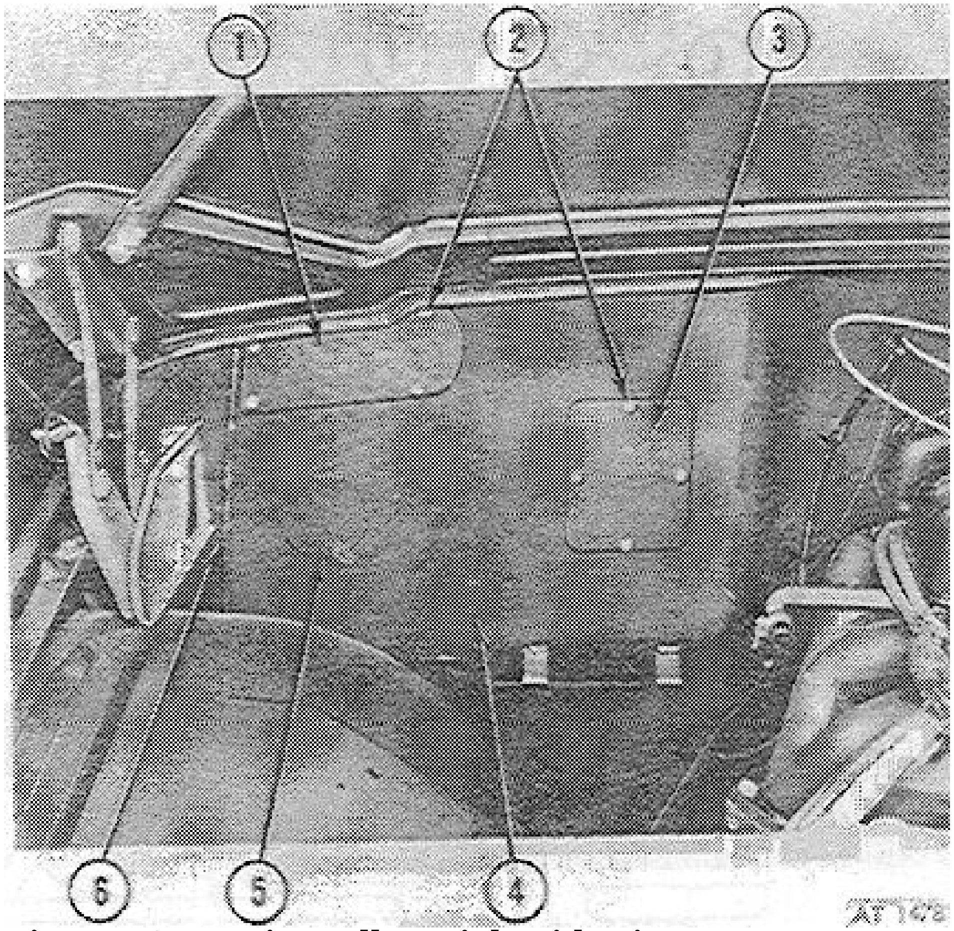


Figure 20-23. Firewall — right side view.

1 Upper cover plate
2 Screw
3 Lower cover plate
4 1-3/4-inch diameter knock out hole
5 4-inch diameter knock out hole
6 Firewall

20-34. Installation.
a. Modification of Firewall.

NOTE

Several modifications are necessary before installation of the arctic heater kit (-40° F). Other modifications must be accomplished during kit installation. A marking is furnished with kit to locate holes to be drilled in dash panel.
(1) Remove eight screws securing upper and lower side firewall cover plates (fig 20-23). Remove cover plates.

(2) Replace existing side heater plate using plate from kit.

(3) Using hammer and wood block, remove the 1-3/4-inch diameter and 4-inch diameter knockout plugs from the firewall.

(4) Place firewall marking template (fig 20-24) provided in kit on the front (outer) side of the firewall and aline circumference of the firewall knockout holes (4-inch and 1-3/4-inch) with two mating holes shown on template. Secure template with masking tape and mark centers of nine holes to be drilled. Drill two 3/16-inch holes using air vent chamber as a template.

(5) Remove template and drill all nine marked holes to size.

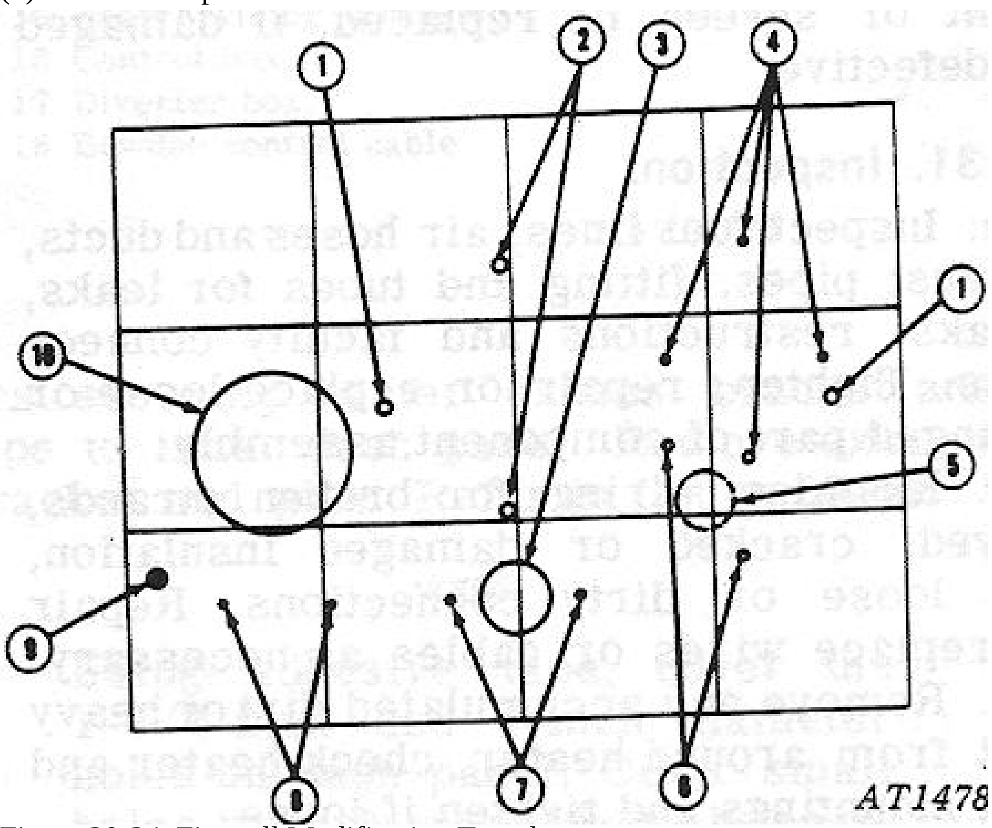


Figure 20-24. Firewall Modification Template

1 Drill two 3/8-inch diameter holes	6 Drill two 5/16-inch diameter holes
2 Existing two holes to be covered with perrnagum	7 Drill two 5/16-inch diameter holes
3 Removed 1-3/4-inch diameter knock-out plug hole	8 Drill two 2/16-inch diameter holes
4 Existing four .128-inch diameter holes cover plate	9 Drill one 15/32-inch diameter hole
5 Location of exhaust pipe support bracket (under dash)	10 Removed 4-inch diameter knock-out plug hole

b. Modification of Instrument Panel. Using metal saw, cut an angle segment from lower right flange support of instrument panel as shown in figure 20-25.

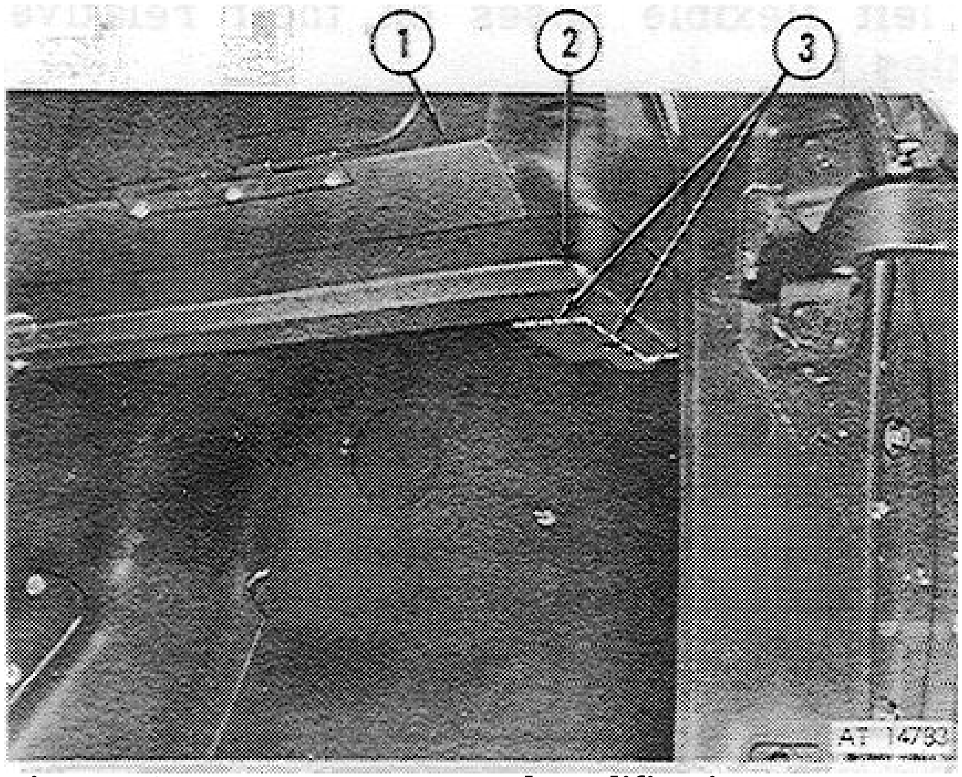


Figure 20-25. Instrument panel modification.

1 Instrument panel
2 Lower right flange support
3 Cutout area

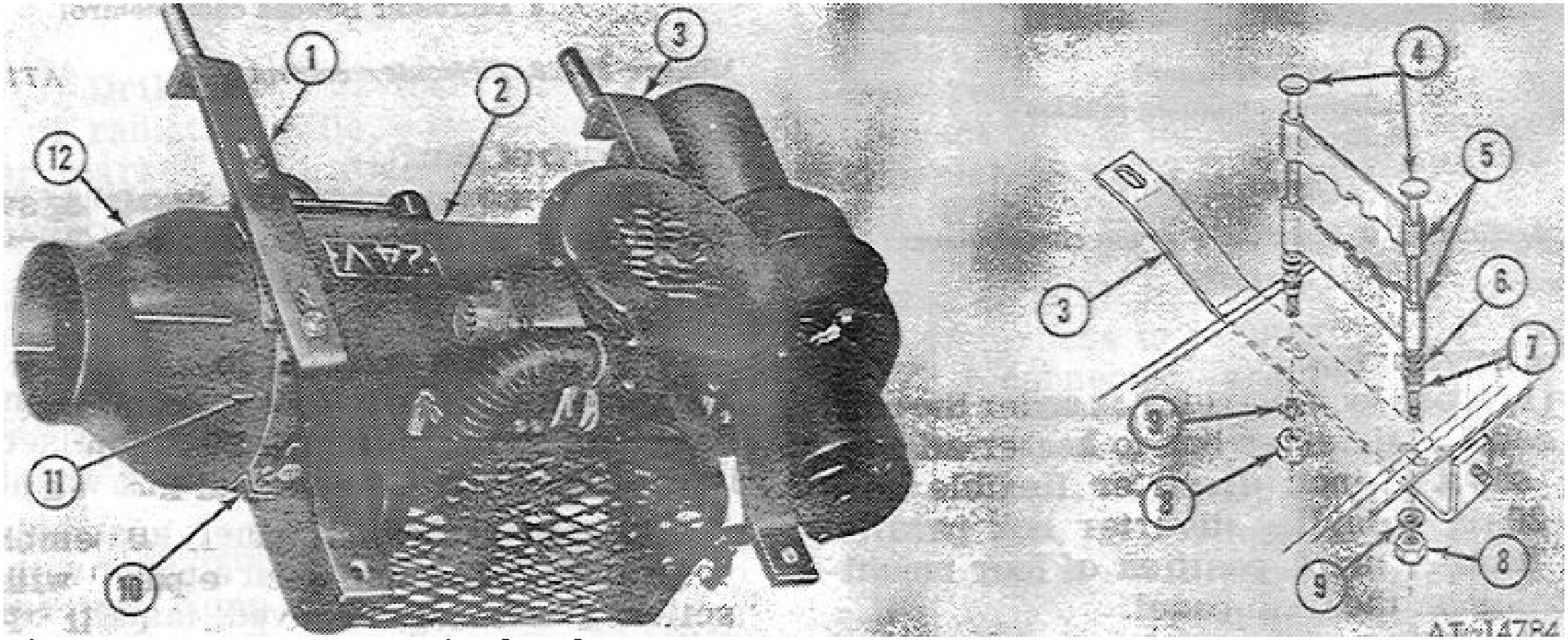


Figure 20-26. Heater mounting brackets.

1 Left mounting bracket	5 Clamp	9 Lock washer
2 Heater (-40 degrees F) crew compartment	6 Washer	10 Large clamp
3 Right mounting bracket	7 Spacer	11 Screw
4 Clamp bolt	8 Nut	12 Air-out adapter

c. Installation of Heater Unit Components.
(1) Position air-out tube adapter on heater assembly making sure offset is toward top side of heater (fig 20-26), Secure adapter to heater with four 8-32 x 5/16-inch screws.
(2) Position two mounting brackets on heater assembly. Secure adapter end of heater to bracket with large clamp from kit. Secure opposite end of heater to the second bracket with two bolts and two clamps (fig 20-26).
(3) Position air vent adapter (fig 20-26) onto heater blower intake housing and secure with two 8-32 x 5/16-inch screws.
(4) Position 4-inch diameter x 3.5-inch long flexible hose (fig 20-18) on the air vent adapter, attached to heater unit, and secure hose to adapter with large clamp.
(5) Position right and left windshield defroster nozzles on four mounting studs, protruding downward from the cowl extension directly below the windshield, and on each side of air slats cut in the cowl panel. Secure each nozzle to the cowl with two 10-24 hex nuts and lock washers.
(6) Working from underside of cowl, position heater exhaust bracket and pipe assembly on the firewall with the pipe elbow protruding through the 1-3/4-inch diameter hole in the firewall. Secure bracket to inner (back) side of dash panel with two 1/4-20 x 1/2-inch bolts, nuts and lock washers (fig 20-18).
d. Heater Unit Components. Refer to paragraph 20-26.

e. Heater Unit. The two mounting bracket studs must protrude through their relative mounting holes in the dash bracket mounting holes and, using a 3/8-inch drill bit and motor, drill two holes in lower flange. Secure the two heater mounting brackets to the lower flange with 5/16-18 x 3/4-inch bolts, nuts, lock washers and plain washers (fig 20-27). Secure the two bracket studs to the firewall with 5/16-24 hex nuts and lock washers.

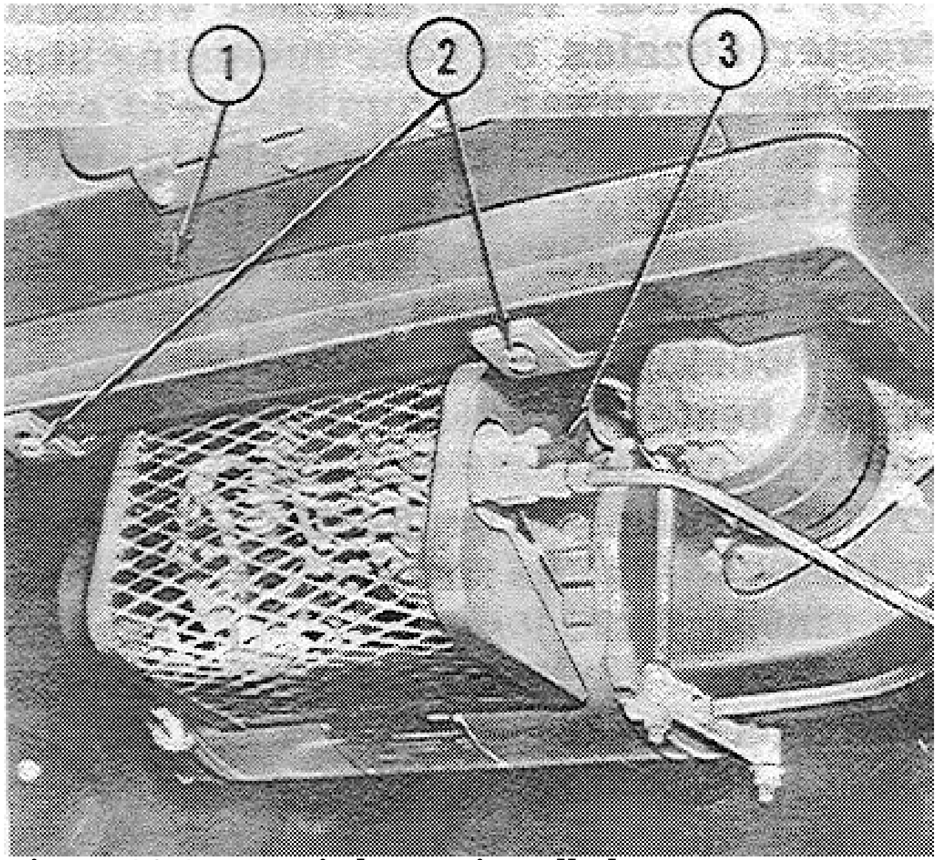


Figure 20-27. Arctic heater installed - crew comparment.

1 Instrument panel
2 Heater mounting brackets
3 Heater

f. Diverter Box.
(1) Position diverter box under the cowl and connect diverter box to heater adapter with short 4-inch diameter flexible hose (fig 20-19). Holding diverter box parallel with heater, mark position of four mounting holes on the dash panel.
(2) Remove diverter box and drill four 1/4-inch holes in dash panel.
(3) Replace diverter boxunder the cowl and secure to dash panel with four 12-24 x 1/2-inch machine screws, nuts and lock washers.
(4) Install flexible hose on diverter box and heater adapter.
(5) Install defroster nozzle hoses on diverter box tube flanges and position right nozzles.
(6) Insert Bowden control cable through hole in instrument panel as shown in figure 20-28. Secure cable to dash panel with hex nut and washer. Push cable knob completely in (closed position) and, after placing cable wire in defroster door controller pivot block, tighten cable clamp to hold cable housing in proper

position. Hold defroster door closed and tighten screw in pivot block to secure cable wire to door control lever.

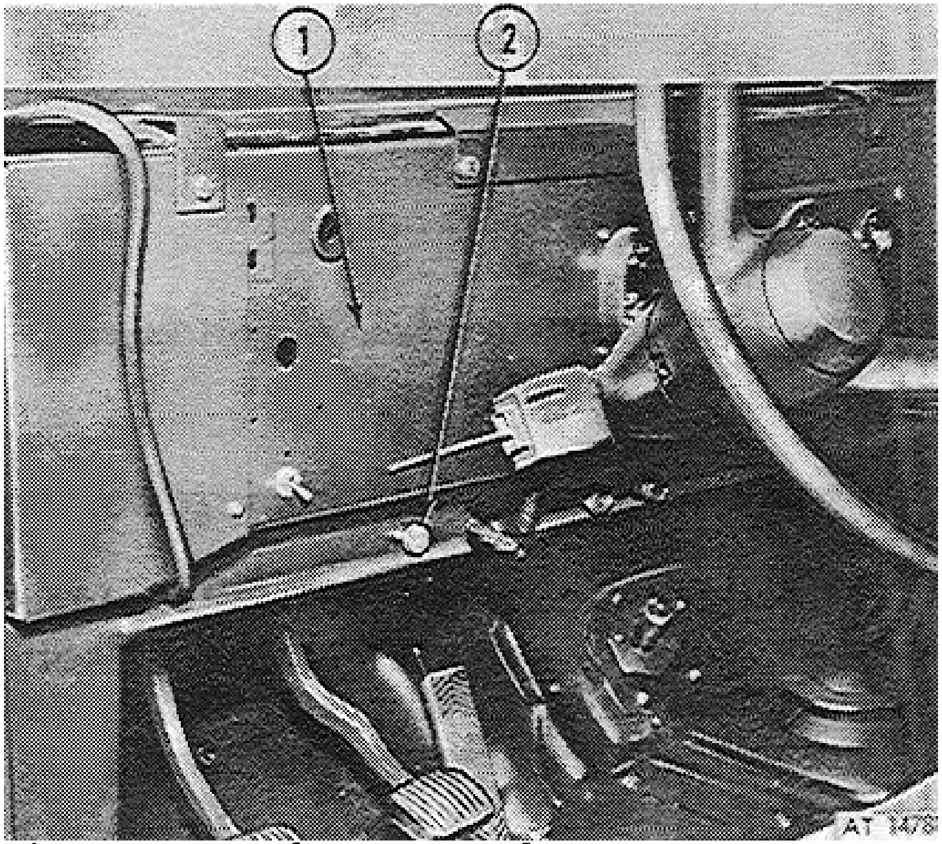


Figure 20-28. Defroster control.

1 Instrument panel
2 Defroster Bowden cable control

g. Control Box.
(1) Remove two screws securing switch panel to the control box case. Carefully remove switch panel from the case (fig 20-29).
(2) Position control box case on the instrument panel lower reinforcement flange as shown in figure 20-17 and secure it with two 5/16-24 nuts and lock washers.
(3) Insert switch panel assembly in control box case and secure panel with two screws previously removed. Install “PERSONNEL” decal above “heater control.”
h. Fuel Pump, Fuel Filter and Lines.
(1) Remove fuel filter sump bowl from fuel filter (right hand thread) and, using male pipe nipple, install fuel filter body to the fuel pump; then install sump bowl on fuel filter.
(2) Install adapter tee and drain shutoff valve on pump, as shown in figure 20-16.

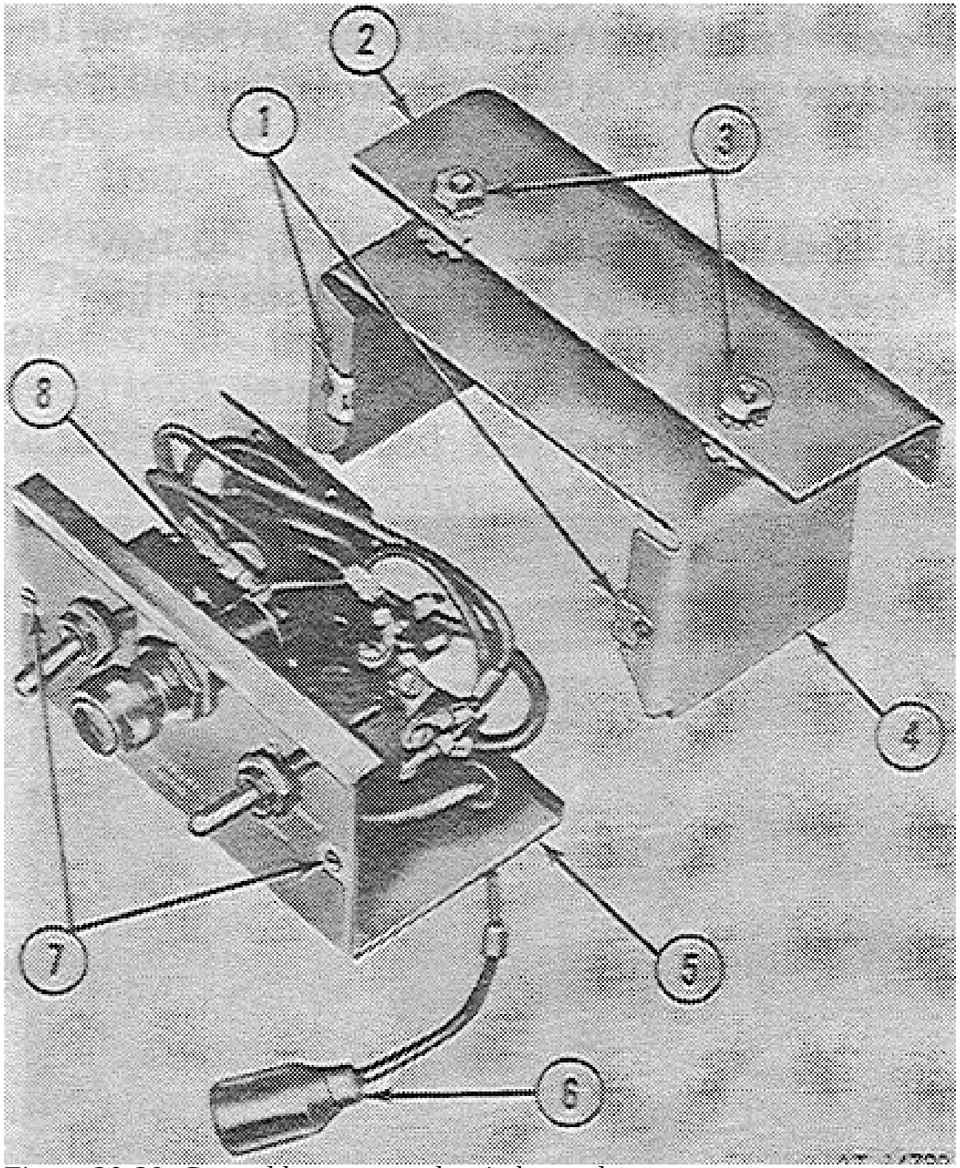


Figure 20-29. Control box case and switch panel

1 Sheet metal nuts
2 Mounting bracket
3 Mounting hardware
4 Case
5 Control box
6 Battery wire connector
7 Retaining screws
8 Electrical connector

(3) Drill two 9/32-inch holes in right side of radiator baffle, down from existing lower marker light attaching hole, and 2-1/2-inch apart. Position fuel pump and filter assembly on radiator side baffle and secure with two 1/4-20 x 1/2-inch bolts, nuts and external star tooth lock washers.
(4) Position fuel pump condenser on radiator baffle (fig 20-16), and secure with 1/4-20 x 1/2-inch bolt, nut and lock nut.
(5) Disconnect engine fuel line from engine fuel pump and install tee fitting to pump. Connect flexible fuel line to heater fuel pump filter and tee of engine fuel pump. Connect engine fuel line to tee of pump.
(6) Using a 45-inch length of fuel line fittings, connect heater fuel pump tee to bulkhead union (fig 20-21).
(7) Remove one nut from bulkhead union and insert union in drilled hole on right side of dash panel (fig 20-21). Working from underside of cowl, secure union to dash using nut previously removed.
(8) Using a 15-inch length of fuel line
and fittings, connect the union fitting with the fuel fitting on the heater unit (fig 20-18).
(9) Place rubber grommet over electric lead wire and connect Packard plug of electric line to fuel pump condenser lead. Place electric line through side plate hole in dash side plate and install grommet in hole opening (fig 20-21). Connect lead to heater lead wire.
(10) Place closed clips on fuel line and electriclead and secure clips to splash panel. of right fender with 12-24 x 1/2-inch screw, nut and lock washer (fig 20-22).
i. Exhaust Tube.
(1) Remove 3/8-24 x 2-inch bolt securing floor front side sill to body outrigger and replace with bolt from kit 3/8-24 x 3-inches long. Remove 3/8-24 x 5.25-inch bolt from floor support, shown in figure 20-22 and replace with new bolt 3/8-20 x 5.72-inches long.
(2) Position 60-inch length of flexible exhaust tube on the heater exhaust elbow and drill 5/32-inch diameter hole through both walls of pipe and elbow and secure with long cotter pin. Position elbow on the heater exhaust pipe at firewall and drill 5/32-inch diameter hole through elbow and tube and secure tube and elbow with long cotter pins, (fig 20-21). Run tube downward between fender apron and right frame rail, then rearward along outer side of rail. Connect tube to the two long outrigger bolts with clamps and 3/8-24 lock nuts.
j. Wiring Harness.
(1) Connect heater wiring harness elbow connector to control box and opposite end of harness to receptacle on heater unit. Tighten connectors securely.
(2) Connect harness battery lead to waterproof connector on vehicle instrument harness lead. Connect heater harness ground lead to suitable ground on rear side of instrument panel after cleaning mating surfaces.
k. Air Vent Chamber.
(1) Using permagurn between mating surfaces, position air vent chamber on front side of firewall and aline top existing hole of the panel and chamber. Install 8-15 x 1/2-inch tapping screw to hold chamber in position.
(2) Swing chamber clockwise up against cowl flange and mark six remaining mounting hole centers.
(3) Using a 0.128-inch diameter drill
bit and motor, drill the six marked holes and secure air chamber to the firewall with seven 8-15 x 1/2-inch tapping screws (fig 20-20).
l. Operating Instruction Plate.
(1) Place instruction plate in center of glove box door - mark centers of the four mounting holes and remove plate.
(2) Drill four 7/32-inch diameter holes in door.
(3) Position plate on outer side of glove box door and secure with four 10-24 x 5/16-inch pan head machine screws, nuts and lock washers (fig 20-30).
m. Testing.
(1) With heater HI-LO switch in HI position, hold heater switch in the start position. The fuel pump should start to pump fuel and the heater blower motor should operate.
(2) If blower motor operates and fuel pump does not, the probable causes are a defective fuel pump or a break in the wiring circuit.
(3) If blower motor and fuel pump both operate, the probable causes are a defective fuel valve or a burned or damaged fuel ignitor.
(4) In order to properly test and troubleshoot arctic heaters, a Circuit Analyzer (South Wind Part No. G-487890, Ord. No. 7951950) should be used. Using this analyzer, the arctic heater may be tested under actual driving conditions. When using analyzer follow instructions given on instruction plate attached to the

analyzer unit.

CAUTION

If fuel odors are detected, do not operate or attempt to start the arctic heater.

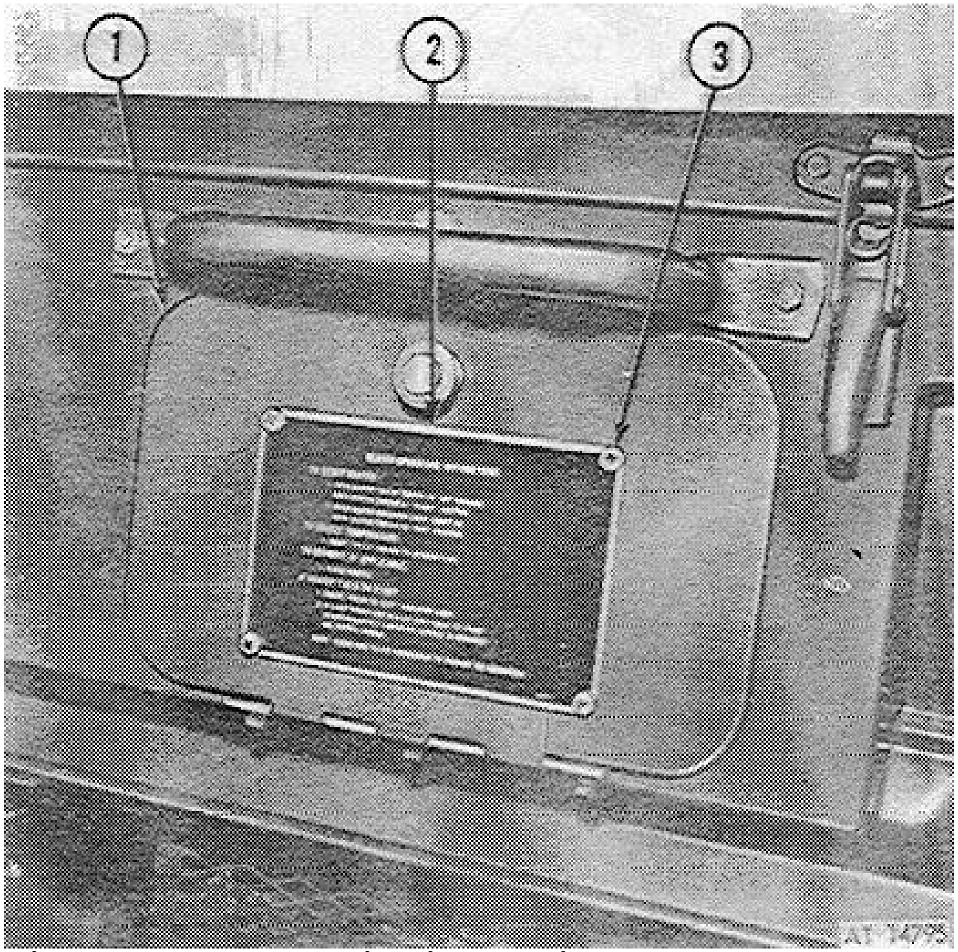


Figure 20-30. Operating instruction

1 Glove box door
2 Instruction plate
3 10-24 x 5/16-inch pan head machine screw

33-C29. TROUBLESHOOTING

Malfunction	Probable Cause	Corrective Action

1. Heater fails to start when control switch is turned on	a. Emergency switch off	a. Position switch in ON position.
	b. No fuel pressure	b. Check fuel level, fuel pump, lines and filter. Clean or replace part(s) as necessary.
	c. Defective electrical circuit	c. Check electrical circuit and wiring. Repair as necessary.
	d. Defective heater component(s)	d. Replace defective heater component(s) or replace heater.
2. No heat output, or low heat output	a. No fuel pressure	a. Check fuel level, fuel pump, lines and filter. Clean or replace part(s) as necessary.
	b. Ice in fuel system	b. Clean fuel system if necessary. Remove ice from fuel bowl and pump.
	c. Defective component(s)	c. Repair or replace defective component(s) or replace heater.
	d. Hi-Lo switch in low position	d. Place switch in Hi position.
3. Indicator light inoperative	a. Defective lamp	a. Replace lamp.
	b. Defective wiring or lamp holder	b. Repair or replace defective part(s).
4. Indicator light always on	a. Defective component(s)	a. Repair or replace defective component(s) or replace heater.
	b. Short in electrical wiring	b. Check electrical wiring and repair or replace wiring.
5. Heater operates several minutes then stops	a. Restriction in fuel line	a. Check fuel line and fuel filter for restriction. Clean fuel lines and fuel filter.
	b. Defective fuel control valve	b. Replace fuel control valve.
	c. Defective flame detector switch	c. Replace flame detector switch.
6. Blower does not stop when heater is turned off	a. Defective flame detector switch	a. Replace flame detector switch.
	b. Defective blower motor wiring	b. Repair or replace wiring as necessary.
7. Heater smokes excessively or “bangs” upon starting	a. Starting with Hi-Lo switch in Hi position	a. Place starting switch in Lo position.
	b. Defective fuel control valve	b.Replace fuel control valve.
8. Blower runs but heater fails to ignite	a. Low or no fuel pressure	a. Check fuel filter for restriction. Replace fuel filter element or pump as necessary.
	b. Restriction in fuel line	b. Inspect fuel lines for restriction. Clean or replace fuel line as necessary.
	c. Defective electrical wiring	c. Repair or replace wiring as necessary.
	d. Defective pre-heat resistor	d. Replace pre-heat resistor.
	e. Defective ignitor	e. Clean ignitor or replace as necessary.

	f. Defective fuel control valve	f. Replace fuel control valve.
9. Inadequate heat output	a. Fuel pump filter element restricted	a. Clean or replace filter element as necessary.
	b. Ice crystals in fuel line	b. Clean fuel filter and check fuel lines and fuel tank for condensation.
	c. Extreme cold weather	c. Install or adjust brush guard cover.
	d. Defective component(s)	d. Repair or replace defective component(s) or replace heater.
10. Inadequate windshield defrosting	a. Improperly adjusted heater control cable	a. Check cable operation. Adjust cable as necessary.
	b. Defroster hose(s) loose or damaged	b. Inspect hoses. Install or replace hose(s) as necessary.
11. Heater overheats but continues to run	a. Defective overheat switch	a. Replace heater switch.
	b. Defective fuel control valve	b. Replace fuel control valve.
12. Fuel odor	a. Fuel leak	a. Tighten fuel fittings. Replace damaged fuel line or fitting(s) as necessary.
	b. Defective component(s)	b. Repair or replace defective component(s) or replace heater.
13. Burned fuel odor	a. Restriction in exhaust	a. Check exhaust outlet pipes, fittings and tube. Repair or replace part(s) as necessary.
	b. Defective heat exchanger	b.Replace heat exchanger.

Section VI. DEEP WATER FORDING KIT

20-35. General.
The deep water fording kit consists of carburetor air intake and engine exhaust extension tubes (stacks), crankcase air inlet ventilation valve, ventilation shutoff valve, valve control cables and all necessary lines, hoses and fittings.
The air intake extension tube, extending through the left front fender, is attached to the fender by four bolts and secured to the cowl pillar post at the windshield hinge level by two bolts. The engine exhaust system is extneded from the tailpipe flange by a shielded exhaust extension tube that is secured by two bolts to the extreme right rear of the cargo body.
A control handle, mounted left of the steering column on the instruction panel, opens and closes the engine fording valves.
One ventilation fording valve is mounted in the crankcase air vent hose. This hose connects the crankcase and carburetor air cleaner. The other ventilation fording shutoff valve is attached to the hose inlet fitting of the engine intake manifold.
The engine bellhousing is pressurized by a line which connects into the engine crankcase lower ventilating hose.

NOTE

Remove envelope containing drain plug from the glove box and install drain plug into bellhousing drain hole. Reverse the above procedure.

Ventilation of front and rear axle housings, transmission, transfer case, master cylinder and fuel tank is accomplished by hoses, lines and fittings extending to the carburetor air cleaner. These lines must be checked before all fording operations. Make sure all connections are tight and lines and hoses are not damaged or broken.
The insulating compound furnished is applied at time of kit installation to the electrical lead connections on the starter, starter switch and batteries (with exception of ground connections). Additional insulation may be applied prior to fording, if deemed necessary.
With kit properly installed, the vehicle can ford hard bottom water crossings up to depth of 60-inches.

CAUTION

When fording water in depths over 42-inches, the engine fan belts must be loosened to allow slippage of the engine fan.

20-36. Removal, Disassembly, Cleaning, Inspection, Repair or Replacement, Reassembly and Installation.
Refer to TM 9-2320-244-20, deep water fording kit.

Section VII. 100 AMPERE ALTERNATOR KIT

20-37. General
a. Description. The 100 ampere alternator kit (24-volts) consists of a 100 ampere alternator, alternator drive pulley, fan belts, rectifier, rectifier support bracket assembly, regulator assembly, two shielded wiring harnesses, one cable assembly with connector and attaching hardware.
b. 100 Ampere Alternator: The 100 ampere alternator is an engine belt driven generator and is constructed in three main functional sections: a rotor, a stator, and the brushes. The rotor revolves in the stator, suspended by pre-lubricated neoprene sealed ball bearings mounted in the drive end housing and contact ring end. The alternator is mounted to existing brackets on the engine and is driven by four V-belts from the engine crankshaft pulley.
c. Rectifier. The rectifier is a selenium type and changes alternating current to direct current. The rectifier is secured in a bracket assembly that is mounted in front of the engine radiator and secured to the upper radiator support and baffle.
d. Regulator. The regulator controls the output of the alternator and is mounted in the engine compartment to the apron of the left front fender.
e. Wiring Harnesses. Two shielded wiring harnesses are used to connect the rectifier with the alternator and regulator.

20-38. Removal and Installation.

Refer to TM 9-2320-244-20, 100 ampere alternator kit.

20-39. Disassembly, Repair or Replacement, Reassembly and Testing.
Refer to TM 9-2920-255-35, 100 ampere alternator kit.

Section VIII. ARCTIC ENCLOSURE KIT

20-40. Description.
The Arctic Enclosure Kit is a metal and glass enclosure designed to protect the vehicle cab and crew from weather extremes and, at the same time, provide maximum comfort and vision. It’ consists of a roof panel and a back panel which attach to the body and each other with common bolts, nuts and screws. Both panels are fabricated with insulation installed. The back panel is equipped with a window glass, assembled to the panel with weatherstripping. Weatherseals are supplied loose with the kit for cab door openings. Sealant for all mating surfaces is furnished with kit.

20-41. Removal, Disassembly, Cleaning, Inspection, Repair or Replacement, Reassembly and Installation.
Refer to TM 9-2320-244-20, arctic enclosure kit.

APPENDIX A
REFERENCES

A-1. Publication Indexes and General References.
Indexes should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this publication.
a. Military Publication Indexes. Index of Army Films, Transparencies, GTA Charts, and Recordings DA Pam 108-1
Index of Administrative Publications DA Pam 310-1 Index of Blank Forms DAPam310-2
Index of Doctrinal, Training and Organizational Publications DA Pam 310-3
Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders DA Pam 310-4
Index of Graphic Training Aids and Devices DA Pam 310-5
b. General References.
Dictionary of United States Army Terms AR 320-5
Authorized Abbreviations and Brevity Codes AR 320-50
Military Training FM 21-5
Techniques of Military Instruction FM 21-6
Military Symbols FM 21-30

A-2. Forms.
The following forms pertain to this materiel. Refer to DA Pamphlet 310-2 for index of blank forms and to TM 38-750 for explanation on usage.
DA Form 2400, Equipment Utilization Record.
DA Form 2401, Organizational Control Record for Equipment.
DA Form 2402, Exchange Tag.
DA Form 2404, Equipment Inspection and Maintenance Worksheet.
DA Form 2405, Maintenance Request Register.
DA Form 2406, Materiel Readiness Report.
DA Form 2407, Maintenance Request. DA Form 2707-1, Maintenance Request Continuation Sheet.
DA Form 2408, Equipment Log Assembly (Records).
DA Form 2408-1, Equipment Daily or Monthly Log.
DA Form 2408-5, Equipment Modification Record.
DA Form 2408-7, Equipment Transfer Record or Equipment Usage Report.
DA Form 2408-8, Equipment Acceptance and Registration Record.
DA Form 2408-10, Equipment Component Register.
DA Form 2409, Equipment Maintenance Log (Consolidated).
DA Form 348, Equipment Operator’s Qualification Record.

DA Form 285, Accident Report (Supervisor's).
DD Form 314, Preventive Maintenance Schedule and Record.
DD Form 518, Accident-Identification Card.
Standard Form 46, U.S. Government Motor Vehicle Operator's
Identification Card.
Standard Form 91, Operator's Report of Motor Vehicle Accident (Card).

A-3. Other Publications.
The following Publications contain information pertinent to the major item materiel and associated equipment.
a. Vehicle.
Lubrication Order, Truck, Cargo, 1-1/4 Ton, 4 x 4, M715 Truck, Maintenance, 1-1/4 Ton, 4 x 4, M726 Truck, Ambulance, 1-1/4 Ton, 4 x 4, M725
LO 9-2320-244-12
Operator's Manual TM 9-2320-244-10
Organizational Maintenance TM 9-2320-244-20 Organizational Maintenance
Repair Parts and Special
Tools List TM 9-2320-244-202 Equipment Serviceability
Criteria TM 9-2320-244-ESC
Direct and General Support Repair Parts and Special Tools List TM 9-2320-244-34P
b. Camouflage.
Camouflage FM 5-20
c. Decontamination. Chemical, Biological, and Radiological (CBR) Decontamination TM 3-220
Chemical, Biological, Radiological, and Nuclear Defense . . . FM 21-40
d. General.
Accident Reporting and Records AR 385-40
Basic Cold Weather Manual FM 31-70
Cooling Systems: Vehicle and Powered Ground Equipment TM 9-2858
Manual for Wheeled Vehicle Driver TM21-305
Driver Selection and Training (Wheeled Vehicles) TM21-300
Deep-Water Fording of Ordnance Materiel TM9-238 Command Maintenance
Management Inspections AR750-8
Mountain Operations FM31-72
Northern Operations FM31-71
Operation and Maintenance of Army Materiel in Extreme Cold Weather (0° F to -65° F) TM9-207
Petroleum Handling Equipment and Operations TM10-1101
Principles of Automotive Vehicles TM98000
Prevention of Motor Vehicle Accidents AR38555
Organizational Maintenance Spark Plugs used on Ordnance Materiel TM9-8638,
e. Maintenance and Repair. DS and GS Maintenance of Pneumatic Tires and Tubes TM9-2610-200-34
Cleaning of Ordnance Materiel TM9-208-l
Combat Vehicles and Tactical Transport Vehicles: Procedure for Starting Engines with Slave Cable TB ORD 537
Description, Use, Bonding Techniques, and Properties of Adhesives TB ORD 1032 General Supply:
Winterization Kits for Army Tank-Automotive Material SB9-l6
Inspection, Care and Maintenance of Antifriction Bearings TM9-214

Tank-Automotive Gasoline Engines: Lubrication Before Use TB ORD 392
Lubrication of Ordnance Materiel TM9-273
Materials Used for Cleaning, Preserving, Abrading, and Cementing Ordnance Materiel and Related Materiels Including Chemicals TM9-247
Operation and Organizational, Field and Depot Maintenance: Storage Batteries, Lead- Acid Type TM9-6140-200-l5
Ordnance Tracked and Wheeled Vehicle Hull and Chassis Wiring; Repair of Cracked or Peeled Plastic, Natural Rubber, or Synthetic Rubber-Covered Conduit Cables TB ORD 650
Organization, Policies and and Responsibilities for Maintenace Operation AR 750-5
Painting Instructions for Field Use TM9-213
Use of Antifreeze Solutions and Cleaning Compounds in Engine Cooling Systems TB 750-651
Welding Theory and Application TM9-237
f. Shipment and Limited Storage. Color and Marking of Army Materiel AR 746-5
Preservation, Packaging, and Packing of Military Supplies and Equipment: Preservation and Packaging Volume I TM 38-230-1
Preservation, Packaging and Packing of Military Supplies and Equipment: Packing Volume II . . . TM 38-230-2
Preservation, Packaging and Packing Materials, Supplies, and Equipment Used by the Army SB38-100
The Army Maintenance Management Systems (TAMMS) TM 38-750

APPENDIX B SPECIFICATIONS

B-1. Axle.	
Front:	
Make	Dana
Model	60-2F
Description	Full-Floating Hypoid Gear
Universal Joints:	
Make	Spicer
Type	Cardan
King Pin:	
Bearing preload	l2 to 16 lb
Drive Pinion Offset	.500
Gear ratio	5.87:1
Ring gear:	
Outside diameter	9.750-inch
Pinion Adjustment	Shim
Pinion bearing adjustment	Shim

Rear:	
Make	Dana
Model	70
Description	Full-Floating Hypoid Gear
Driving pinion offset	1.12-inch
Number of differential pinons	4
Gear ratio	5.87:1
Ring gear outside diameter	10.5
Pinion adjustment	Shim
Pinion bearing adjustment	Shim
B-2. Brakes.	
Drum diameter:	
Front	13”
Rear	13”
Lining size:	
Front shoe:	
Front wheel	13” x 2-1/2” x 1/4”
Rear wheel	13” x 2-1/2” x 1/4”
Rear shoe:	
Front wheel	13” x 2-1/2” x 1/4”
Rear wheel	13” x 2-1/2” x 1/4”
Wheel cylinder bore:	
Front	1-1/16”
Rear	1-1/16”
Master cylinder bore	1”
Pedal free play	1/2”
Rear propeller shaft:	
Parking brake:	
Type	External
Drum diameter	7.84”
Lining size	7-31/32” x 2” x 1/4”
B-3. Clutch.	
Clutch size and type	10.50” Dry Plate
Rated Torque Capacity	290 lbs-ft
Disk:	
Outside diameter	10.5”

Inside diameter	6.5”
Area (sq. in.)	106.75”
Facing Thickness	0.125”
Pressure Plate	10.50”
Springs:	
Total pressure	1,640 lbs.
No. of Springs	9
B-4. Cooling.	
Cooling System Capacity:	
Without heater	11 qt.
With heater	l2qt.
Fan:	
Numbering of blades	4
Spacing	76 - 104 degrees
Diameter	17”
Ratio - fan to crankshaft	1.1:1
Pitch width	2.25”+ or - .06
Drive Belts:	
Angle of V	38°
Width	3/8”
Radiator Cap:	
Relief valve pressure	l5 psi
Vacuum valve pressure	1 psi
Thermostat:	
Starts to open	187° F
Fully open	190° F
Water Pump:	
Type	Centrifugal
Location	On Timing Chain Cover
Drive	V Belts
B-5. Electrical.	
Battery:	
Model	Two(2)-2HN
Hour rating	45 ampere-hour
Voltage	24 volts (two 12 volt in series)
Terminal ground	Negative

Specific gravity:	
Fully charged	1.280 + or - .005
Recharge at	1.235
Location	Compartment between the two front seats
Alternator:	
Make	Leece-Neville
Model	Ordnance 10929868
Ground polarity	Negative
Rated output	60 amp
Voltage adjustment range	26 to 30 volts
Rated output	800 rpm min. amp hot cut in 1000 rpm min.
Reduced output	2500 rpm min. amp hot 60 amp hot 23 10,000 rpm min. amp, hot 60
Regulator:	
Location	In alternator housing
Type	Solid state
Starting Motor:	
Make	Prestolite
Model	MHJ-4001 UT
Brush spring tension	32-40 ozs
Lock test:	
Temperature	70°
Amp. (max.)	210
Volt	8v
Stall torque (min)	8 lb-ft.
No load test:	
Temperature	70 degrees
Amp. (max.)	43
Volt	20 v
RPM (min)	6200
Drive:	
Type	Bendix Folo-Thru
Number of teeth - pinion	9
Coil:	

Make	Prestolite
Model	IDA-1
Amperes:	
Primary resistance @ 75 degrees	4.26 - 4.9 ohms
Secondary resistance @ 75 degrees	12090 - 13910 ohms
Location	In ignitor housing
Ignition coil ballast:	
Make	Prestolite
Model	IDA-2
Location	In ignitor housing
Ohms at:	
Resistance @ 75 degrees	1.68 to 1.88 ohms
Ignitor:	
Make	Prestolite
Model	IDA 4601UT
Rotation	Counterclockwise
Breaker point gap	.020” + or - .002”
Breaker arm tension	17 to 22 oz
Primary current draw @ 75 degrees	2 to 4 amps @ 24 to 25 volt
Governor advance (crankshaft)	0 @ 800 engine rpm 30° @ 2800 engine rpm
Governor tolerance	+ or - crankshaft - 100 engine rpm
Condenser capacity	18 to 23 mid
Timing:	
Crankshaft	5° BTC @ idle
Mark location	Vibration damper
Firing order	1-5-3-6-2-4
Spark plugs:	A/C AC WR 43 L
Type	
Thread	14mm
Thread reach	1/2”
Gap	.028” to .033”
Lamp bulb trade numbers:	
Headlight	4801
Front parking light	1683 (1), 1251 (2)
Stop, tail, and directional signal	1683 (1), 1251 (2)

Indicator Light:	
Headlight beam	1829
Directional signals	313
Indicator Light:	
Cluster	1829
Heater control	1829
Fuse data:	
Heater	9amp

B-6. Engine.	
Type	Overhead Camshaft
Number of cylinders	6
Bore	3-11/32”
Stroke	4-3/8”
Piston Displacement	230 Cu. in.
Bore Spacing (center-to-center)	3.876”
Firing Order	1-5-3-6-2-4
Compression Ratio	7.50:1
Compression Pressure	135 to 145 psi
Horsepower (SAE)	26.77
Horsepower (max. brake)	132.5 @ 4,000 rpm
Torque (max. at 2,000)	198 lbs-ft.
Idle speed	600 to 650 rpm
Pistons:	
Clearance Limits:	
Top land	0190” to .0255”
Skirt Top	0.0007” to 0.0017”
Skirt Bottom	Selective Feeler Kit
Ring Groove Depth:	
No. 1 and No. 2 Ring	0.176” to 0 183”
No. 3 Ring	0.1785” to 0.1855”
Cylinder Bore — Standard	0.005”
Maximum out of round	
Maximum taper	0.005”
Maximum rebore	0.040”
Piston Rings:	
Gap:	

No.1	0.009” to 0.019”
No.2	0.009” to 0.017”
Oil Ring	0.013” to 0.023”
Side Clearance, No. 1 and No.2	0.002” to 0.0031”
Piston Pins:	
Length	2.779”
Diameter	0.8592”
Clearance in Piston	0.0002”
Clearance in Rod	0.0004” to 0.0008”
Connecting Rods:	
Weight	29.6 oz.
Length (center to center)	7.000”
Bearing:	
Overall Length	1.000”
Clearance Limits	0.0006” to 0.0025”
Nut Torque	40 to 50 lb-ft.
Crankshaft:	
End play	0.003” to 0.007”
Main Bearings:	
Clearance	0.0008” to 0.0029”
Journal Diameter	2.3747” to 2.3755”
Allowable Taper	0.001”
Torque	80 to 95 lbs-ft.
Crankpin Journal Diameter	2.0619” to 2.0627”
Flywheel Runout	0.005”
Camshaft:	
Journal Diameters:	
Front	1.9975” to 1.9965”
Front Intermediate	1.8725” to 1.8715”
Rear Intermediate	1.7495” to 1.7505”
Rear	1.3745” to 1.3755”
Bearing Diameters:	
Front	1.9995” to 2.0005”
Front Intermediate	1.8745” to 1.8755’’
Rear Intermediate	1.7495” to 1.7505”
End play	0.077” to 0.18”

Valve Clearance:	
Normal Operative Temp. at idle	
Intake	0.008”
Exhaust	0.008”
Valves:	
Intake:	
Overall Length	4.675”
Head Diameter	1.895”
Stem Diameter	.3400” to .3410”
Stem-to-Guide Clearance	0.001” to 0.003”
Exhaust:	
Overall Length	4.485”
Head Diameter	1.618”
Stem Diameter	0.3385’’ to 0.3395”
Stem-to-Guide Clearance	0.0025” to 0.0045”
Springs (Intake and Exhaust):	
Free Length	1.55
Pressure @ Length:	
Valve Closed	1.26” at 59 lb.
Valve Open	0.885” at 142 lb.
Lubrication System:	
Type of Lubrication:	
Main Bearings	Pressure
Connecting Rods	Pressure
Piston Pins	Splash
Camshaft Bearings	Pressure
Rocker Arms	Splash
Timing Chain	Nozzle
Cylinder Walls	Splash
Oil Pump:	
Type	Internal Rotor
Drive	Crankshaft Gear
Relief Valve Opens	65 to 70 psi
Oil Pressure Sending Unit	Electric
Oil Intake	Stationary Screen
Oil Filter System	Full Flow

Operating Oil Pressure at Sending Unit (At Normal Operating Temp. 160 degrees)	10 lb. @ 600 rpm, 25 lb. @ 2,000 rpm
B-7. Exhaust	
Exhaust Pipe:	
Diameter	2”
Wall thickness	0.065”
Tail Pipe:	
Diameter	2”
Wall thickness	0.049”
B-8. Frame.	
Number of crossmembers	5
Overall length	201-13/16”
Front	34-23/64”
Rear	42-9/64”
B-9. Fuel	
Carburetor:	
Make	Holley
Model	1920
Manual Choke	R - 2647A
Fuel Level Setting (wet)	3/4”
Fuel Tank:	
Capacity	28 gals.
Location	Center
Fuel Pump:	
Make	Carter
Model	NP 4390S
Pressure at 600 rpm	3-1/2 to 5-1/2 psi

B-10. Propeller Shaft and U-Joints	
Front:	
Make	Spicer
Dimension	2.00 x 36.80 x 0.095
Intermediate:	
Make	Spicer
Dimension	3.00 x 6.86 x 0.065
Universal Joints:	

Make	Spicer
Type	Snap Ring
Bearing	Anti-Friction
Rear:	
Make	Spicer
Dimension	2.50 x 44.66 X 0.083
B-11. Shock Absorbers.	
Front:	
Type	Hydraulic
Action	Double
Length:	
Compressed	12-9/16”
Extended	20-9/16”
Rear:	
Type	Hydraulic
Action	Double
Length:	
Compressed	12-9/16”
Extended	20-9/16”
B-12. Springs.	
Front:	
Number of leaves	7
Length	44”
Width	2-1/2”
Rate	480/550 lb. per inch.
Rear:	
Number of leaves	7
Length	52”
Width	2-1/2”
Rate	665/765 lbs. per in.
B-13. Steering.	
Steering Gear:	
Make	TRW (Ross Gear)
Type	Worm and Roller
Ratio	24.2 to 1
Bearings:	

Cam-Upper	Ball
Cam-Lower	Needle
Lever Shaft	Needle
Steering Column Upper	Bushing
Cam bearing Preload	1 – 5 in.-lb.
Input Torque Over Center (Maximum):	
24:1 Ratio Gear	12 in-lb.
Wheel Diameter	16-17 in.
Steering Geometry:	
King-Pin Inclination	8 degrees
Toe-In	1/32” to 7/16”
Camber	1/2°
Caster	1°
Turning Radius	56’
Turning Angle	29 degrees
B-14. Transfer Case.	
Make	New Process Gear
Model	200 Series
Mounting	To Transmission by Propeller Shaft
Shift Lever	On Floor
Ratio	High 1.00:1 Low 1.96:1
B-15. Transmission.	
Make	Warner
Model	98AT
Speed Ratios:	
First	6.3 98:1
Second	3.092:1
Third	1.686:1
Fourth	1.000:1
Reverse	7.820:1
B-16. Tune-Up.	
Battery:	
Voltage	24 volts
Terminal Ground	Negative
Specific Gravity:	

Full Charged	1.280 + or -.005
Recharge at	1.235
Spark Plugs:	
Make and Model	AC WR 43L
Gap	.030 + or - .002
Tightening Torque	
Cylinder Head Bolts:	26 to 30 lbs-ft.
Torque	80 to 95 lbs-ft.
Intake Manifold Bolts:	
Torque	15 to 20 lbs-ft.
Exhaust Manifold Stud Nuts Torque	25 to 30 lbs-ft.
Compression Pressure	145 to 155 psi
Valve Clearance (Normal Operating Temp. at Idle):	
Intake	0.008”
Exhaust	0.008”

Ignitor:	
Breaker Point Gap	.020” + or - .002”
Breaker Arm Tension	17 to 20 ozs.
Ignition Timing	5° BTC
Engine Idle Speed:	
RPM	600 to 650

B-17. Wheels.	
Make	Motor Wheel Corp.
Type	Rim and disk w/side ring
Material	Steel
Rim Size	16 x 6.50 H

APPENDIX C
TOROUE SPECIFICATIONS

C-1. Body.

ITEM	Pounds-Feet

Front Door Hinges, to Door, to Pillar	25-35
Hood Hinge to Hood and to Cowl	15-20

C-2. Chassis.

ITEM	Pounds-Feet
Brake Backing Plate Bolts (front)	45-60
Brake Backing Plate Bolts (rear)	45-60
Clutch Pressure Plate to Flywheel	25-35
Spring Clip (front)	90-100
Spring Clip (rear)	45-65
Propeller Shaft U-Joint Flange	13-18
Rear Axle Shaft Flange Nut	32-50
Spring Pivot Bolts (rear)	35-40
Steering Column Shaft Clamp	13-18
Steering Gear to Bracket	40-50
Steering Arm Nut	110-140
Steering Knuckle Arm Nut	70-90
Tie Rod Stud Nut	70-90
Steering Wheel Nut	18-30
Steering Tie Rod Clamps Bolts	38-42
Torque Reaction Arm to Transmission	50-70
Transmission Main Shaft Nut	130-170
Wheel to Hub Nuts	250-300

C-3. Chassis and Body.

NOTE
Applies to all applications not listed.

Bolt Size	Pounds-Feet
1/4	4-8
5/16	8-15
3/8	18-30
7/16-14	27-45
7/16-20	32-46
1/2-13	40-60

1/2-20	48-62
9/16-12	48-80
5/8-11	75-140
5/8-18	87-152
3/4-16	150-184
3/4-10	126-192
7/8-9	215-290
7/8-14	255-290
1-8	300-430
1-14	300-390

C-4. Engine.

ITEM	Pounds-Feet
Alternator Brace to Adjusting Strap	12-15
Alternator Support Bracket to Block	25-30
Alternator to Support Bracket	25-30
Alternator Adjusting Strap to Alternator	15-20
Alternator Pulley Nuts	40-50
Cam Bearing Deck to Cylinder Head Studs	12-15
Camshaft Thrust Plate to Cam Bearing Deck Nut	12-15
Carburetor to Intake Manifold Nut	15-20
Chain Guide Bracket to Cylinder Block	12-15
Chain Guide and Pin Assy. To Chain Cover	5-8
Connecting Rod Bolt Cap Nut	40-50
Cylinder Block Stud to Chain Cover Nut	12-15
Cylinder Head and Bearing Deck to Cylinder Block Bolt	80-95
Cylinder Head to Cylinder Bolt	80-95
Exhaust Manifold to Cylinder Head	25-30
Fan to Pulley Bolt	12-15
Filler Block, Front, to Cylinder Block Screw	8-15
Filler Block, Rear, to Cylinder Block Screw	15-20
Flywheel Housing to Cylinder Block Screw	27-42
Flywheel to Crankshaft Nut	35-40
Fuel Line, Intake, and Spacer to Oil Pan Screw	12-15
Fuel Pump Eccentric and Sprocket to Camshaft Screw	40-15

Fuel Pump to Timing Chain Cover Nut	12-15
Ignitor to Timing Chain Cover Nut	12-15
Insulator Adapter Bracket to Block Bolt	15-20
Insulator to Front Frame Bracket	25-30
Insulator to Transmission Support	15-20
Intake Manifold to Cylinder Head	15-20
Lifting Eye to Cylinder Head Screw	15-20
Lock and Crank Pulley to Damper	25-30
Main Bearing Cap Bolt	80-95
Oil Filter to Cylinder Block	45-50
Oil Flex Line to Cylinder Head	30-35
Oil Pan Drain Plug	25-30
Oil Pan to Cylinder Block Screw	10-17
Oil Pump Cover to Oil Pump	5-8
Oil Pump to Timing Chain Cover Nut	12-20
Rocker Arm Cover Mounting Nut	5-8
Spark Plug to Cylinder Head	26-30
Starter Switch Assembly to Transmission Cover	5-8
Starting Motor to Flywheel Housing Bolt	40-45