# TM 9-1827A

WAR DEPARTMENT TECHNICAL MANUAL



*ORDNANCE MAINTENANCE*

# Power Brake Systems (Bendix-Westinghouse)


*WAR DEPARTMENT* • *21 DECEMBER 1943*

**FOR ORDNANCE PERSONNEL ONLY**

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(For explanation of symbols, see FM 21-6.)

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# CHAPTER 1

# INTRODUCTION



## 1. SCOPE.

**a.** The instructions contained in this manual are for the information and guidance of personnel charged with the maintenance and repair of Bendix-Westinghouse air brake equipment. These instructions are supplementary to field and technical manuals prepared for the using arm. This manual does not contain information which is intended primarily for the using arm, since such information is available to ordnance maintenance personnel in 100-series TM's or FM's.

**b.** This manual contains a description of, and procedure for disassembly, inspection, repair, assembly, and test, of Bendix-Westinghouse air brake devices after they have been removed from a vehicle.

**c.** Chapters 2 through 12 are devoted to the complete overhaul of the various types and sizes of air brake devices used on trucks, tractors, trailers, and gun mounts. Chapter 13 includes auxiliary air devices used in the air brake systems of such vehicles. Chapter 14 includes the special tools and test equipment mentioned in the previous chapters.

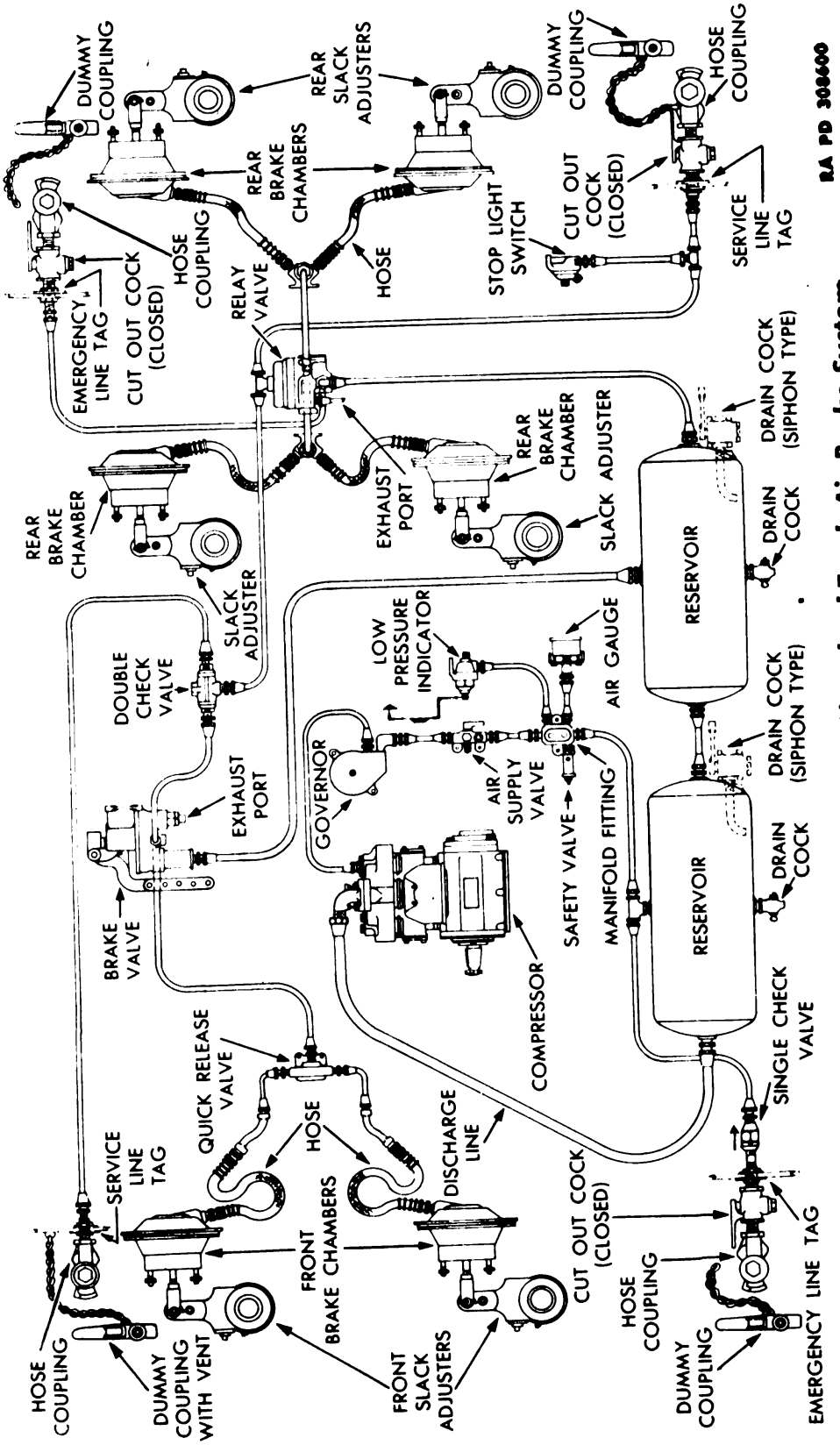


***Figure 1 — Piping Diagram of a Six-wheel Truck Air Brake System***

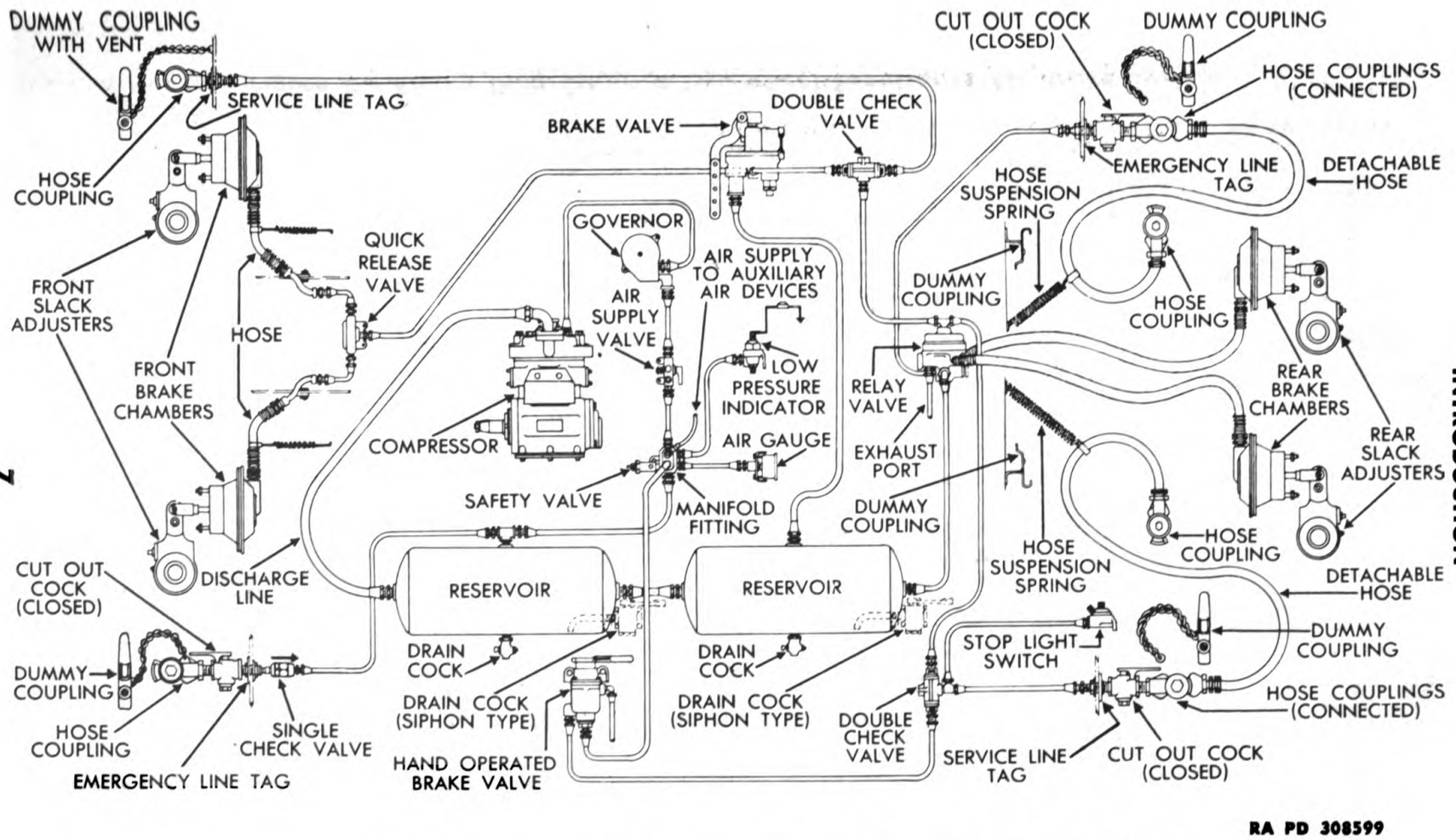


***Figure 2 — Piping Diagram of a Four-wheel Tractor Air Brake System***

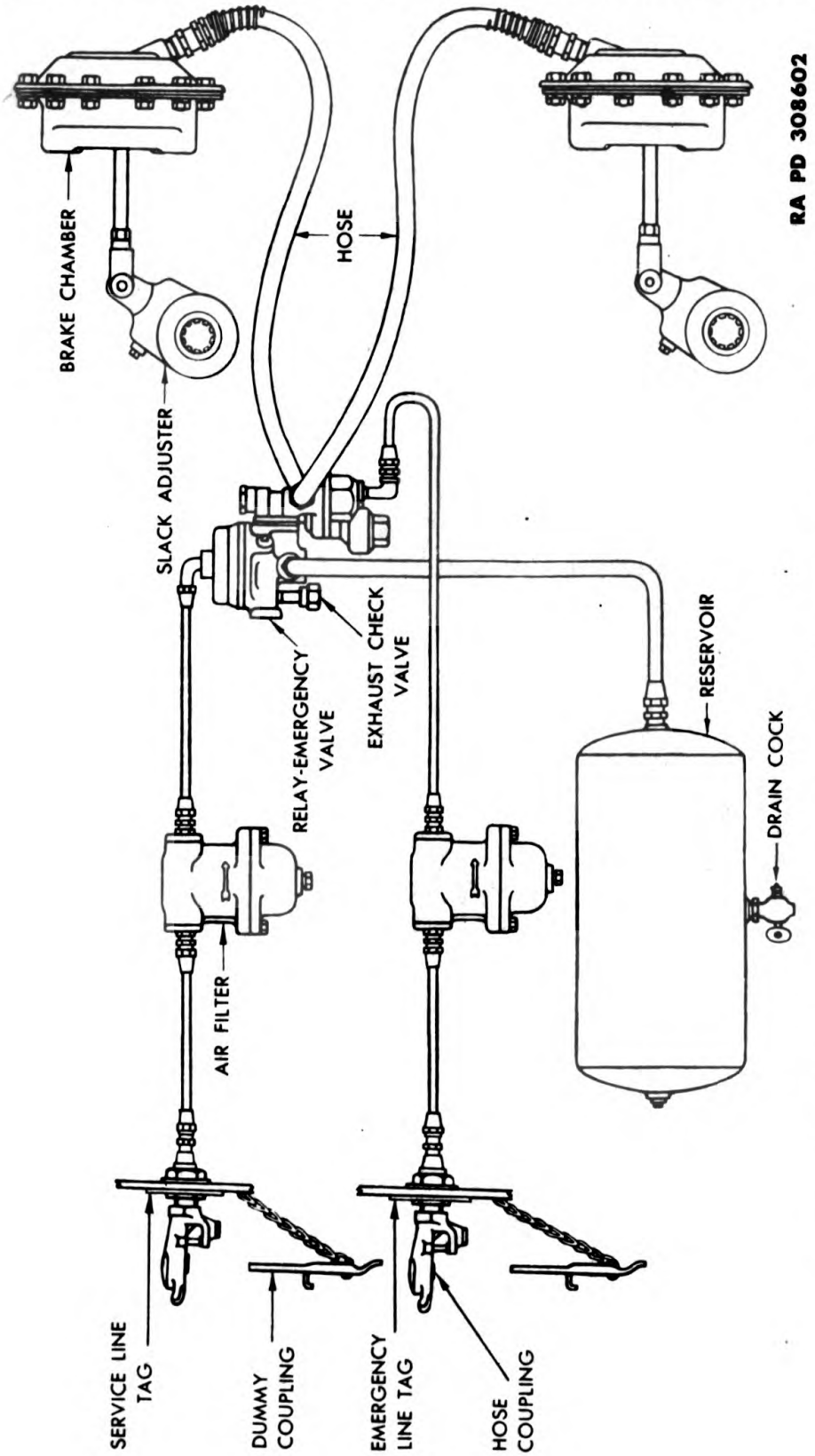


*Figure 3 — Piping Diagram of a Two-wheel Semitrailer Air Brake System*

## INTRODUCTION

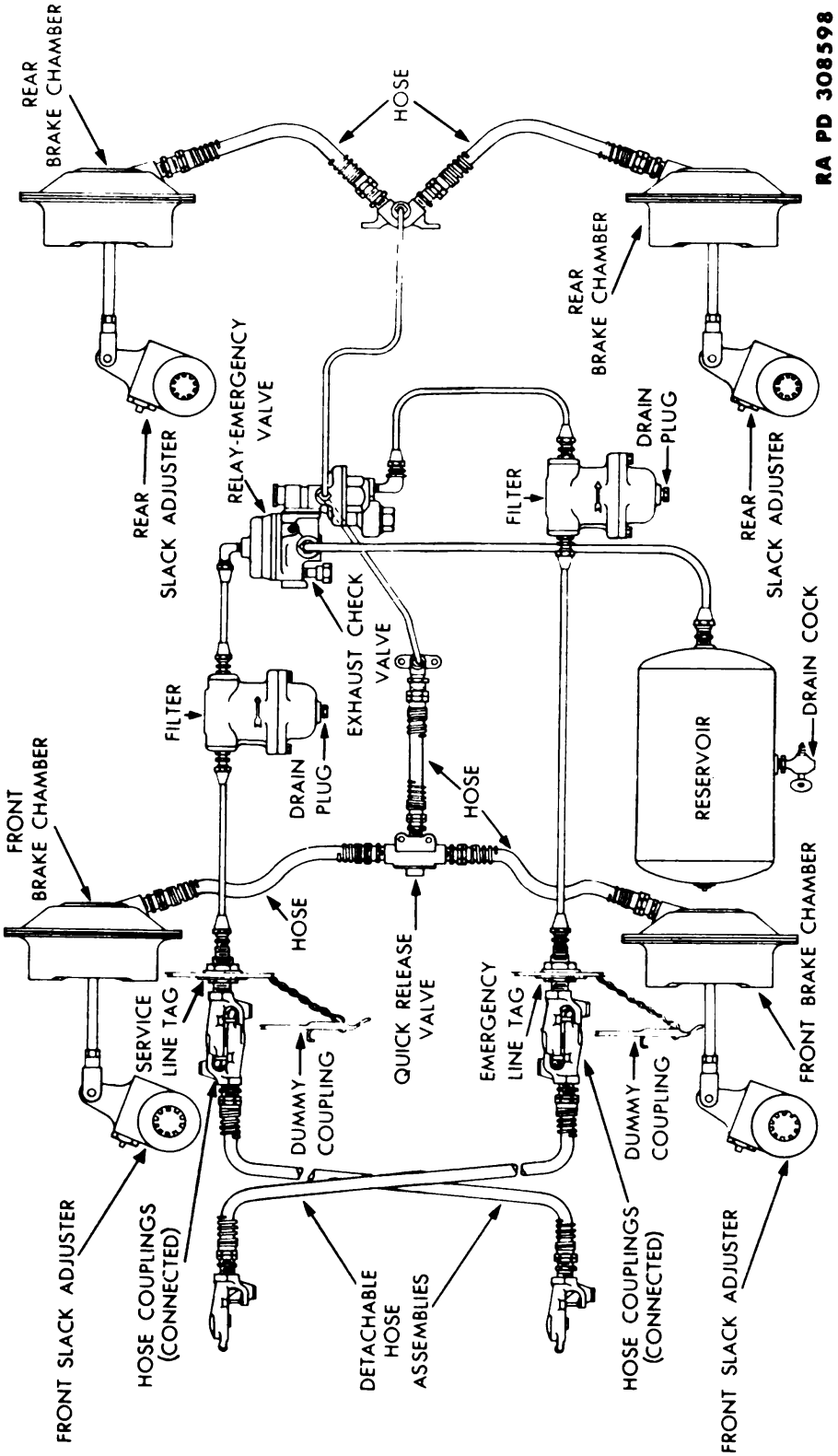


*Figure 4 — Piping Diagram of a Four-wheel Trailer Air Brake System*

# CHAPTER 2

# COMPRESSORS

## Section I

## DESCRIPTION AND OPERATION



**2. DESCRIPTION** (figs. 5, 6, and 7).

**a. General.** All Bendix-Westinghouse compressors are the single-

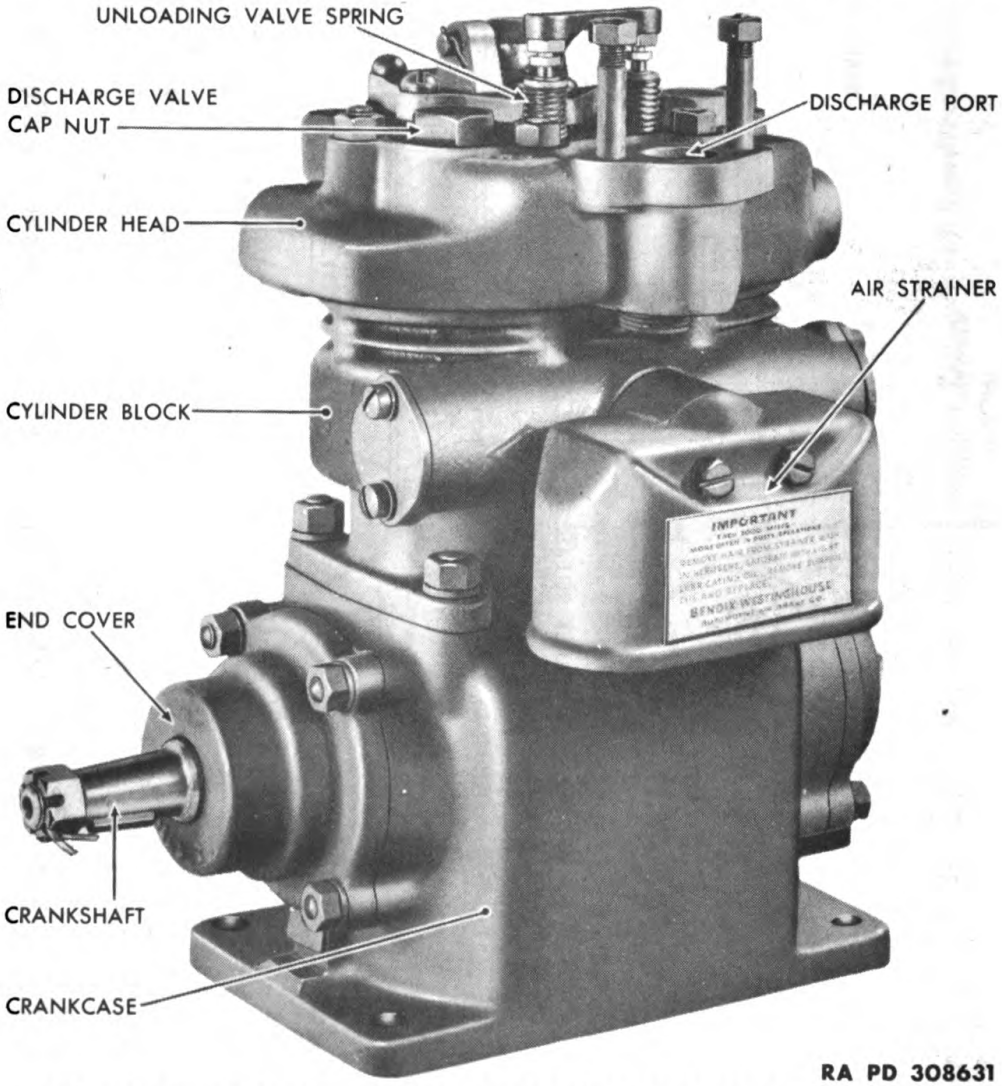


***Figure 5 — A Two-cylinder Engine-lubricated Compressor***

## COMPRESSORS

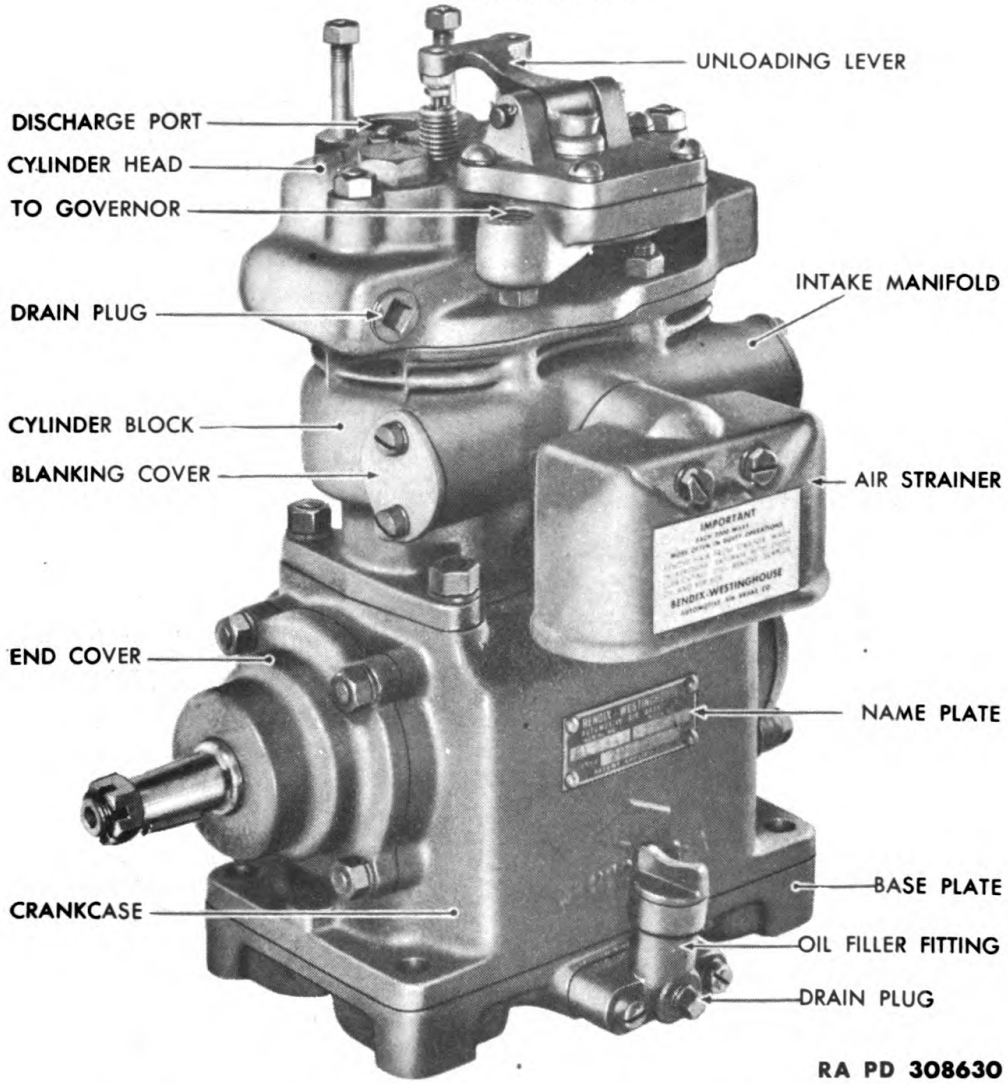


***Figure 6 — A Two-cylinder Self-lubricated Compressor***

acting reciprocating type and either have their own lubricating system or they are lubricated from the engine lubricating system. Most of them have water-cooled cylinder heads but a few have air-cooled cylinder heads. The two different sizes have piston displacements of 7¼ and 12 cubic feet per minute at 1,250 revolutions per minute. Compressors having a displacement of 7¼ cubic feet per minute have two cylinders, each with $2\frac{1}{16}$-inch bore, and 1½-inch stroke. Those compressors with a displacement of 12 cubic feet per minute have three cylinders, each with $2\frac{3}{16}$-inch bore, and 1½-inch stroke. The compressors will be found in a variety of designs to meet different installation requirements for vertical, horizontal or flange type mountings, and for belt, gear, or direct drives. All types operate continu-

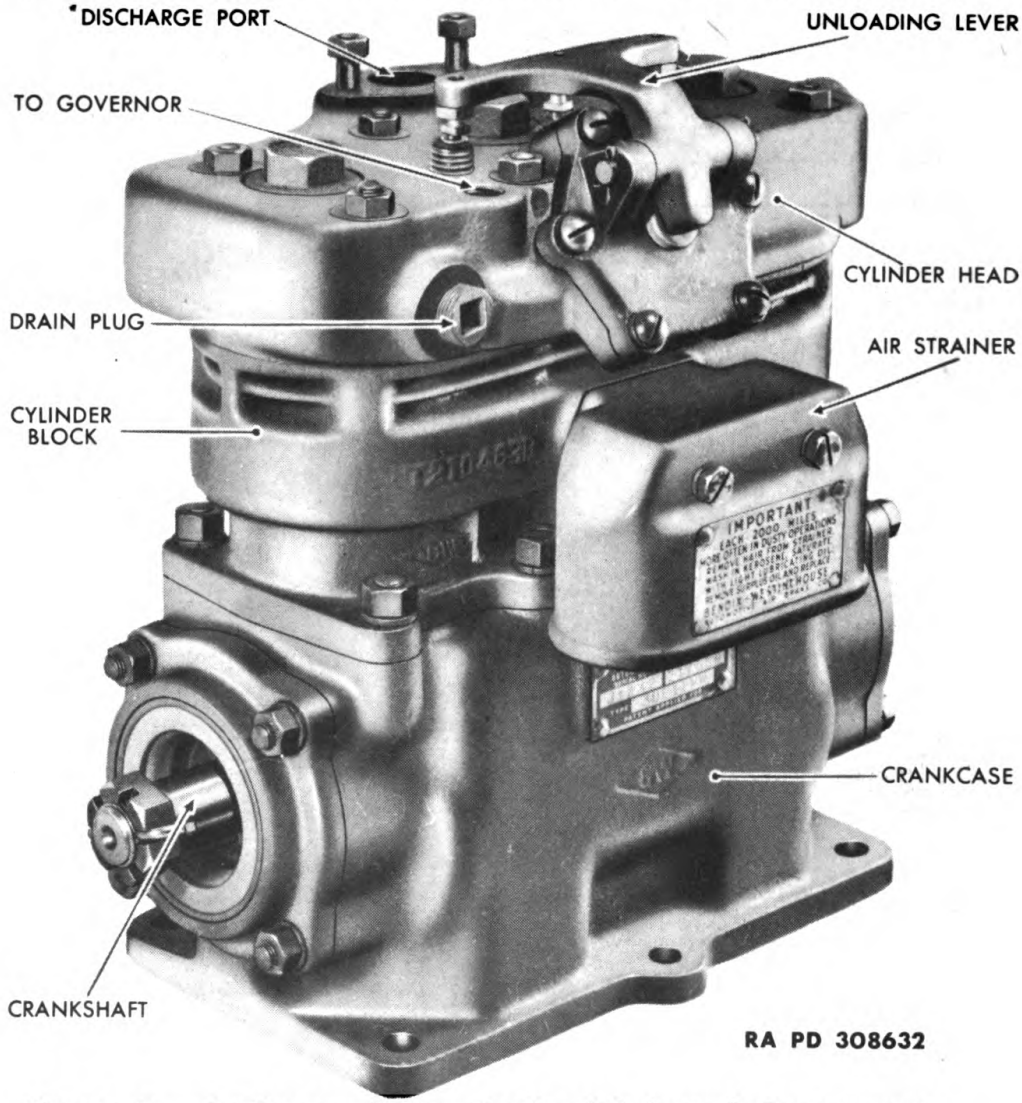


***Figure 7 — A Three-cylinder Engine-lubricated Compressor***

ously while the engine is running, but the actual compression of air is controlled by the governor. Acting in conjunction with the unloading mechanism in the compressor cylinder head, the governor starts or stops the compression of air by loading or unloading the compressor when the air pressure in the air brake system reaches the desired minimum or maximum.

**b. Identification.** All compressors are identified by the piece number stamped on the name plate riveted to the side of the crankcase. Name plates also show the serial number and type of the compressor, but compressors cannot be identified by the serial number or the type designation.

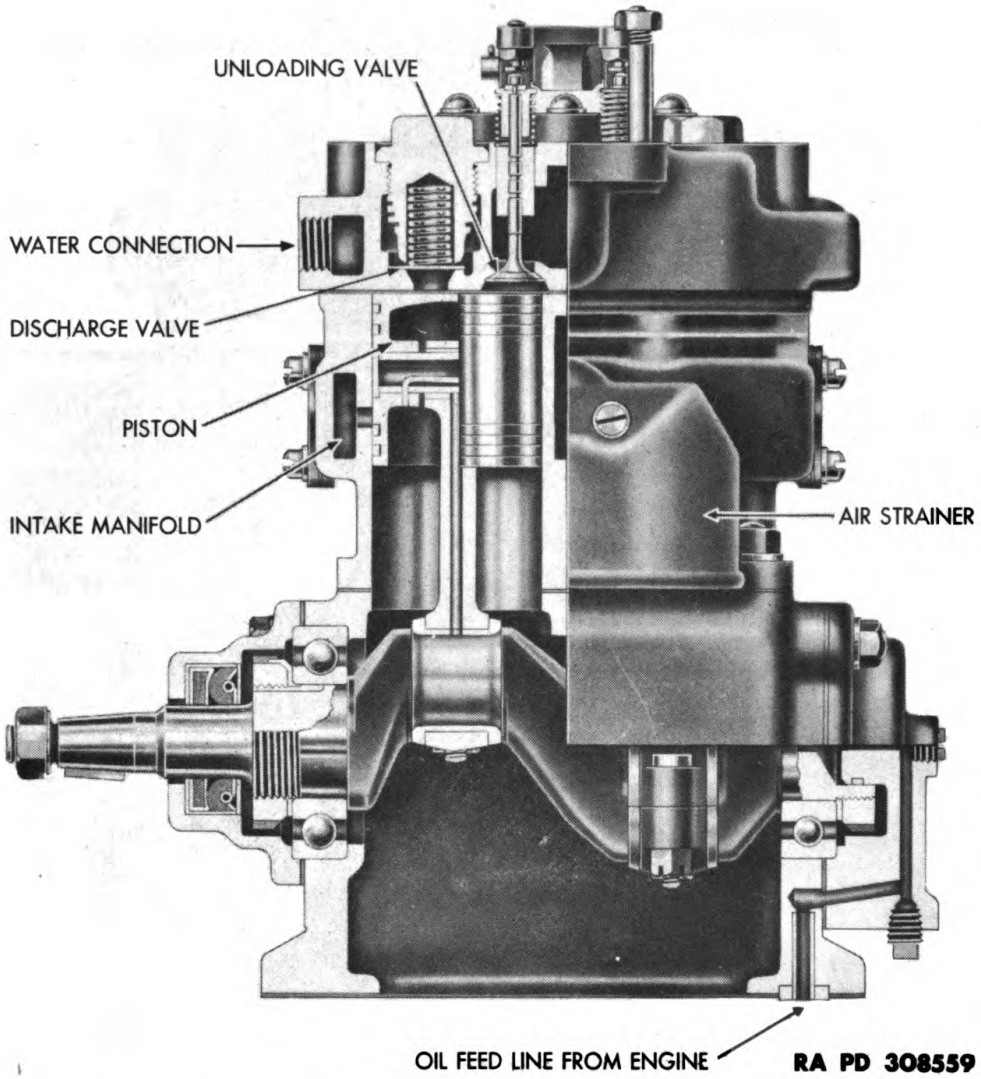


***Figure 8 — Sectional View of a Two-cylinder Engine-lubricated Compressor***

## 3. OPERATION.

**a. Compressing Air** (figs. 8, 9, and 10).

(1) During the downstroke of each piston, a partial vacuum is created above the piston and as the piston nears the bottom of its stroke, it uncovers intake ports in the cylinder wall. Air then enters the cylinder above the piston by passing through the intake strainer, the intake manifold, and the intake ports, in the cylinder wall.

(2) As each piston begins its upstroke, it covers the intake ports in the cylinder wall and the air which has entered the cylinder is trapped above the piston. As the piston continues its upstroke, the

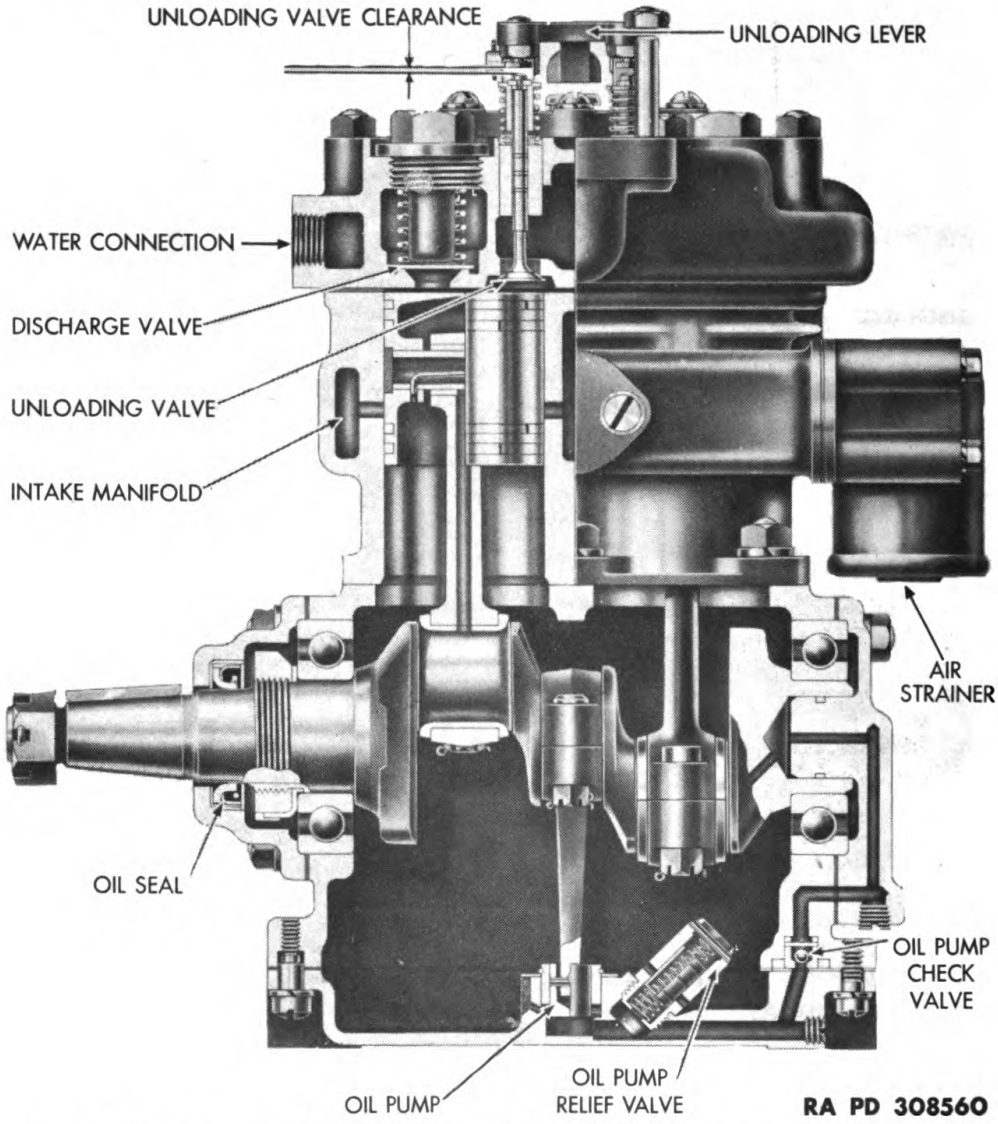


***Figure 9 — Sectional View of a Two-cylinder Self-lubricated Compressor***

air above the piston is compressed until the pressure developed lifts the discharge valve and the compressed air is discharged through the discharge line into the reservoir.

(3) As each piston starts its downstroke, each discharge valve returns to its seat preventing the compressed air from returning to the cylinder and the same cycle is repeated.

**b. Not Compressing Air (Unloaded)** (fig. 11). When the air pressure in the reservoir reaches the maximum setting of the governor, air pressure passes through the governor into the cavity below the

**COMPRESSORS**

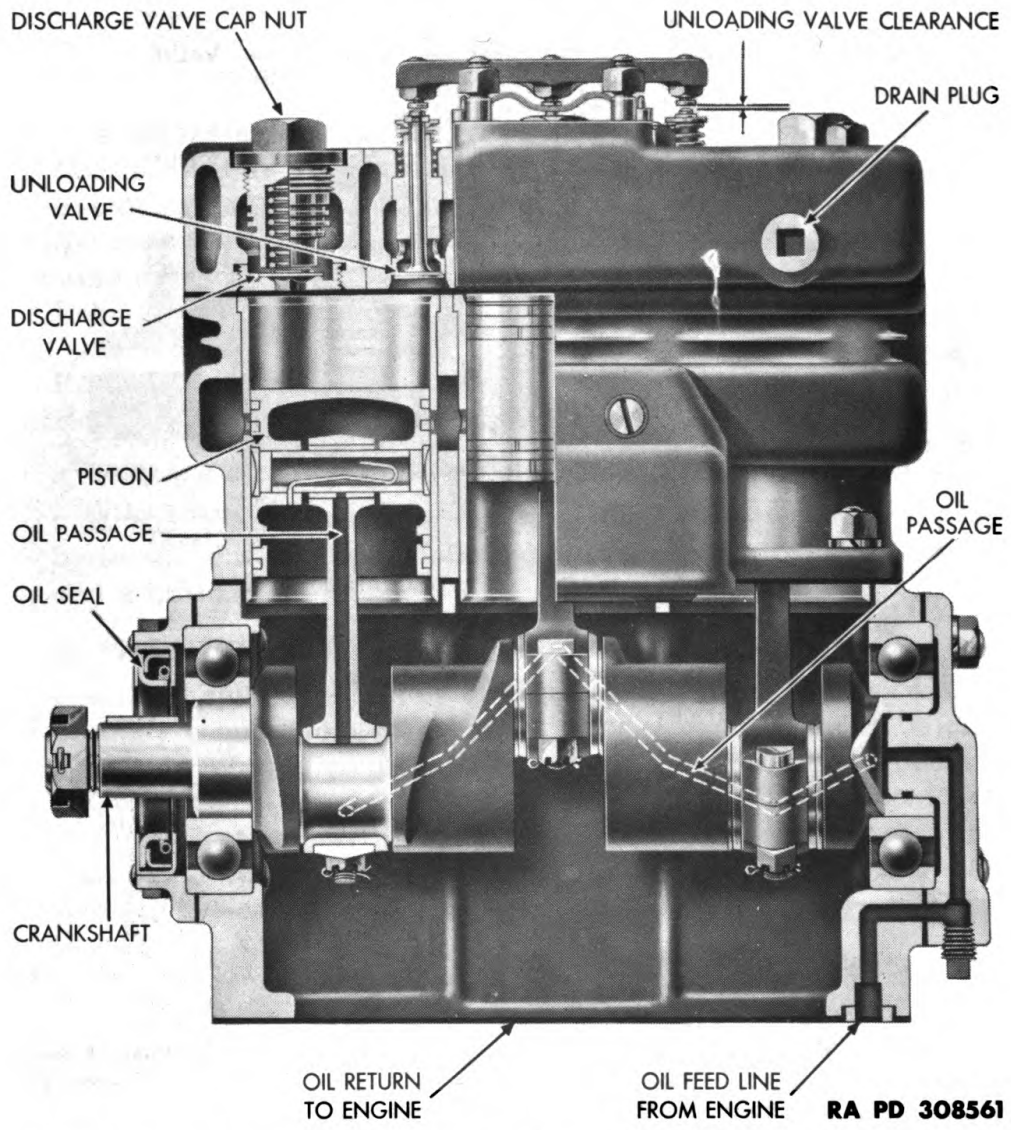


***Figure 10 — Sectional View of a Three-cylinder Engine-lubricated Compressor***

unloading diaphragm in the compressor cylinder head. This air pressure lifts the unloading diaphragm and one end of the unloading lever. The unloading lever then pivots on its pin and the other end pushes the unloading valves off their seats. With the unloading valves off their seats, the unloading cavity forms a passage between the cylinders above the pistons. Thus during the upstroke of each piston, air merely passes back and forth through this passage and compression is stopped. When the air pressure in the reservoir drops to the minimum setting of the governor, the governor releases the air

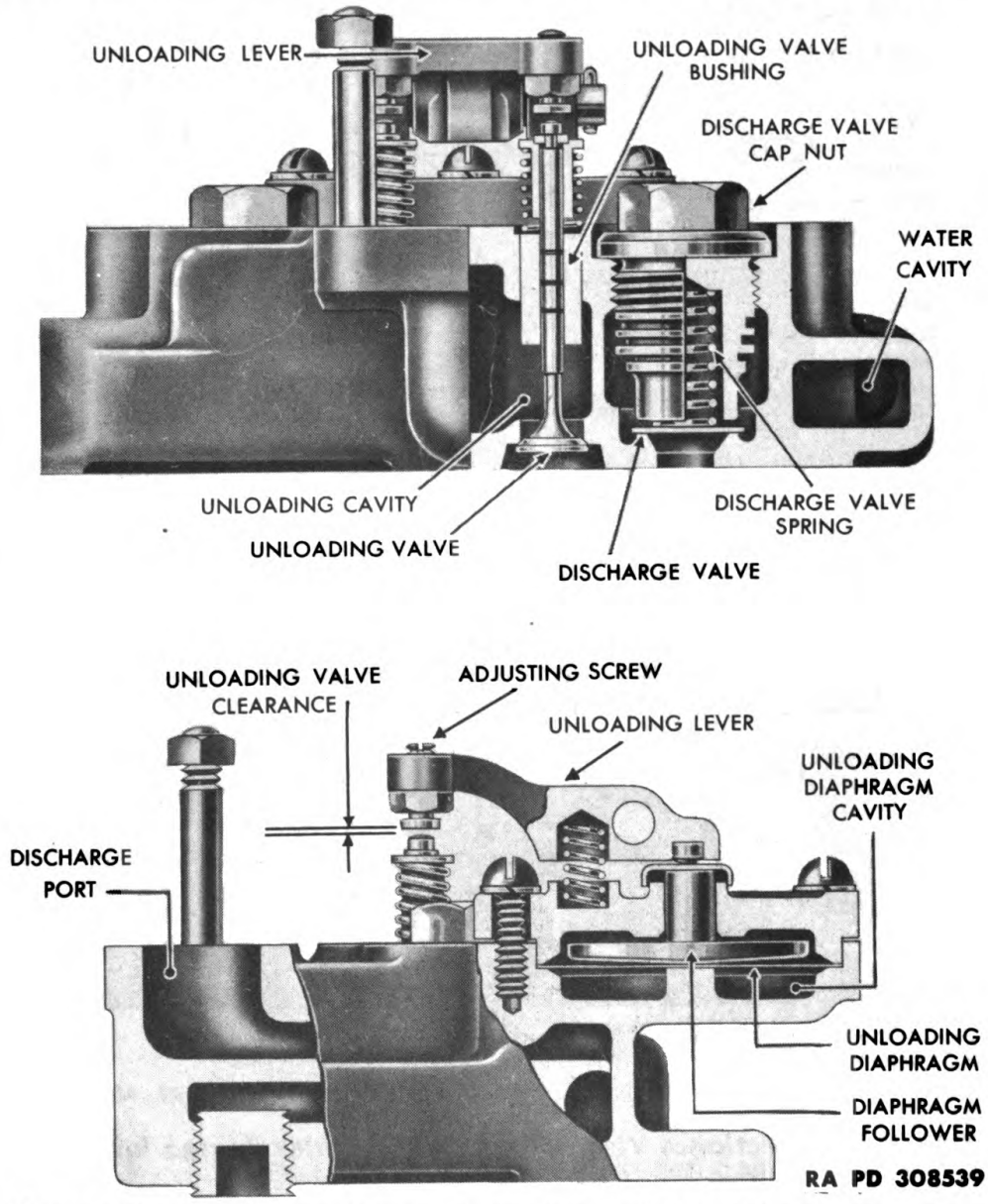


***Figure 11 — Sectional View of a Two-cylinder Water-cooled Compressor Cylinder Head***

pressure from beneath the unloading diaphragm. The unloading valve springs therefore returning the unloading valves to their seats and compression is resumed.

## Section II

# DISASSEMBLY



### 4. CLEANING BEFORE DISASSEMBLY.

**a.** Remove all grease or dirt from the exterior of the compressor by scraping, if necessary, followed by the use of dry-cleaning solvent and a brush.

### 5. MARKING BEFORE DISASSEMBLY.

**a.** The cylinder head, cylinder block, air strainer, and crankshaft of many compressors are designed so the compressor can be assembled in several different ways to meet installation requirements. In order to insure correct assembly, such parts must be marked before disassembly to show their correct position in relation to each other. This can best be done by making center punch marks in the related parts to act as guides during assembly. The following parts, in all cases, must be marked:

(1) Position of cylinder head in relation to cylinder block.

(2) Position of air strainer in relation to cylinder block.

(3) Position of cylinder block in relation to crankcase.

(4) Position of front end cover (drive end of crankshaft) in relation to the crankcase. (Make one punch mark on each.)

(5) Position of rear end cover in relation to the crankcase. (Make two punch marks on each.)

(6) Position of oil filler fitting in relation to base plate (self-lubricated compressors only).

**b.** All crankshafts are already marked with one punch mark on the throw nearest the drive end. Marking the crankcase with one punch mark at the drive end will permit the crankshaft to be properly positioned in the crankcase during assembly.

### 6. REMOVING AND DISASSEMBLING CYLINDER HEADS.

**a.** Remove nuts from all cylinder head studs, and lift off cylinder head (fig. 12). The cylinder head may have to be tapped lightly with a rawhide hammer to break the gasket joint.

**b.** Scrape cylinder head gasket off cylinder head and block.

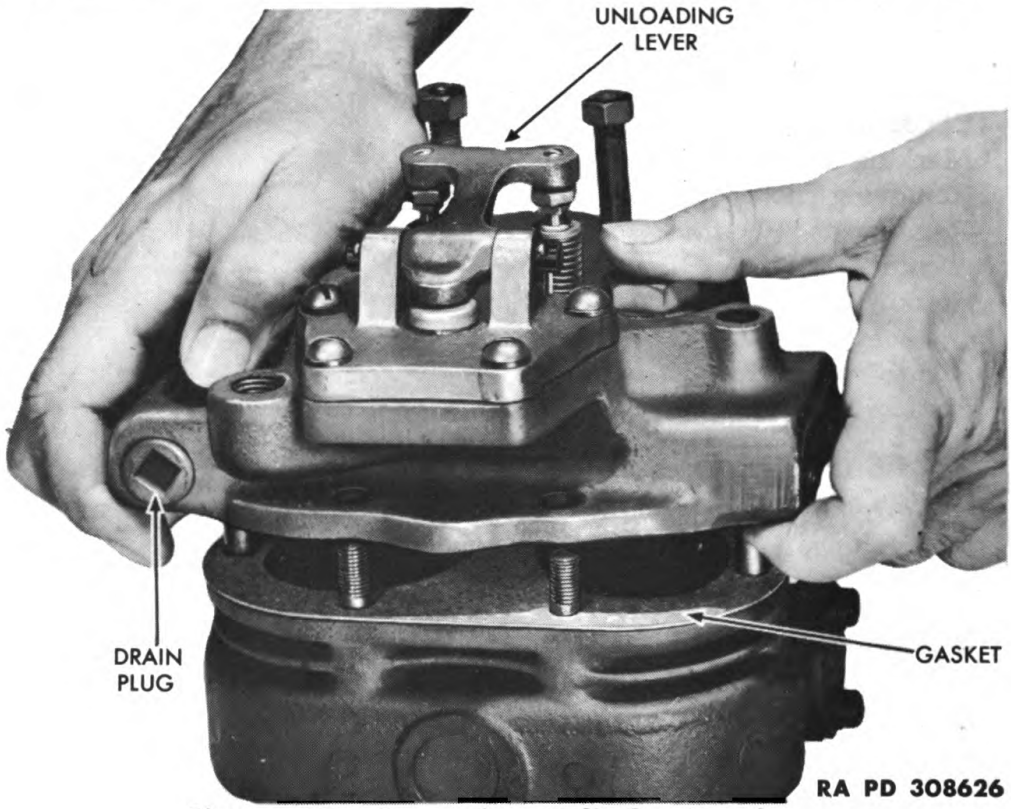


***Figure 12 — Removing Cylinder Head***

c. Remove cotter pins from unloading lever. Drive out unloading lever pin and remove unloading lever, spring, and dust guard. (If the compressor is fitted with a water-tight unloader cover, remove the unloader cover before removing the unloading lever. The headless screw, spring, and ball, must be removed from such water-tight unloader covers and inspected for corrosion or damage.)

d. Remove unloading valve adjusting screws and adjusting screw lock nuts from unloading lever.

e. Remove machine screws attaching unloading box cover to cylinder head. Lift off box cover and remove diaphragm follower and two diaphragms.

f. Remove discharge valve cap nuts and lift out discharge valve springs and discharge valves.

g. By hand, compress unloading valve springs (fig. 23) and remove spring retaining rings. Then remove unloading valve stops and unloading valve springs. Remove unloading valves by pushing them out the bottom of the cylinder head body.

h. Remove drain plug from side of cylinder head.

## 7. REMOVING AND DISASSEMBLING BASE PLATES (SELF-LUBRICATED COMPRESSORS ONLY).

a. If the compressor is the self-lubricated type, remove the ma-

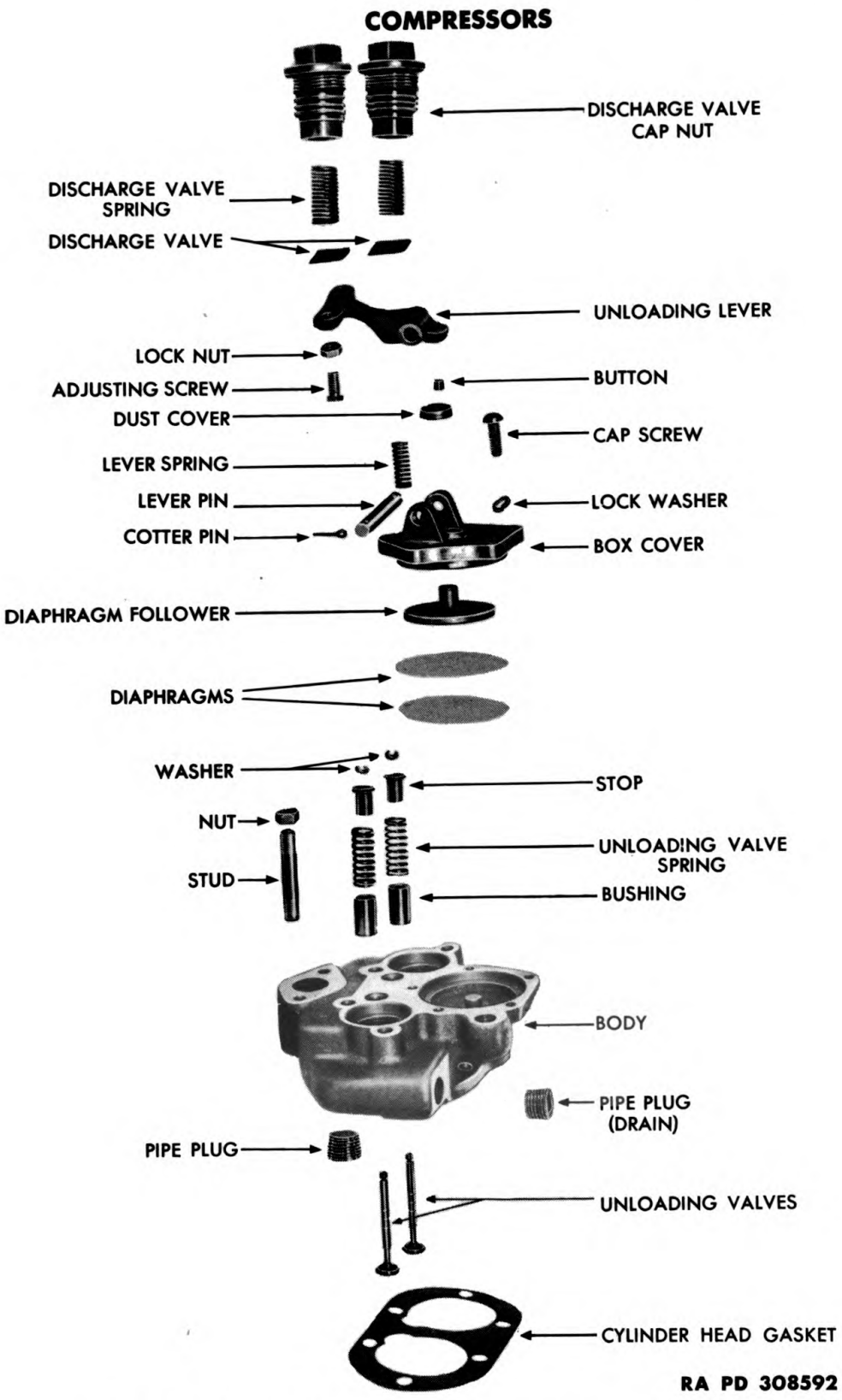


***Figure 13 — A Two-cylinder Compressor Cylinder Head Disassembled***

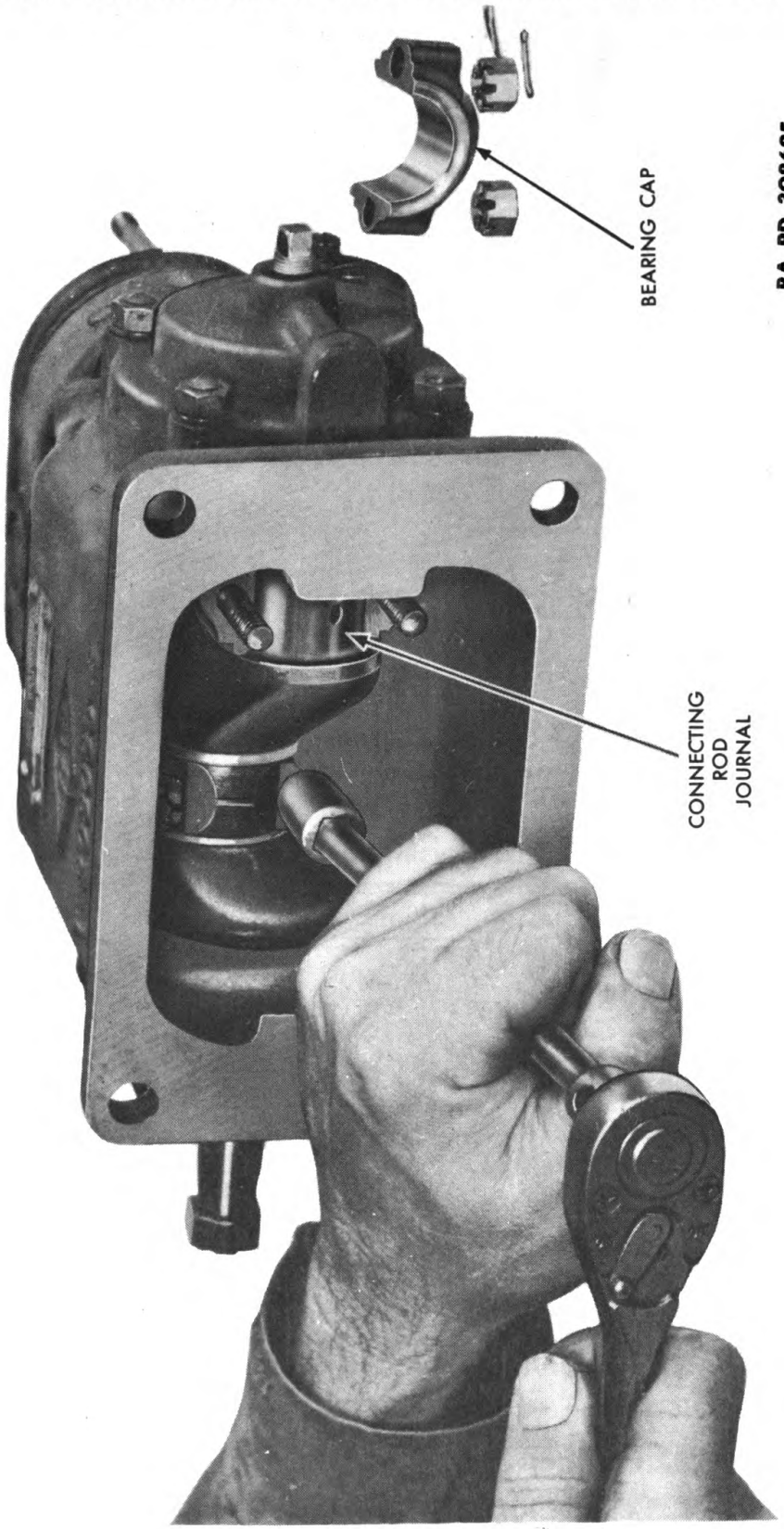


*Figure 14 — Removing Connecting Rod Bearing Caps*

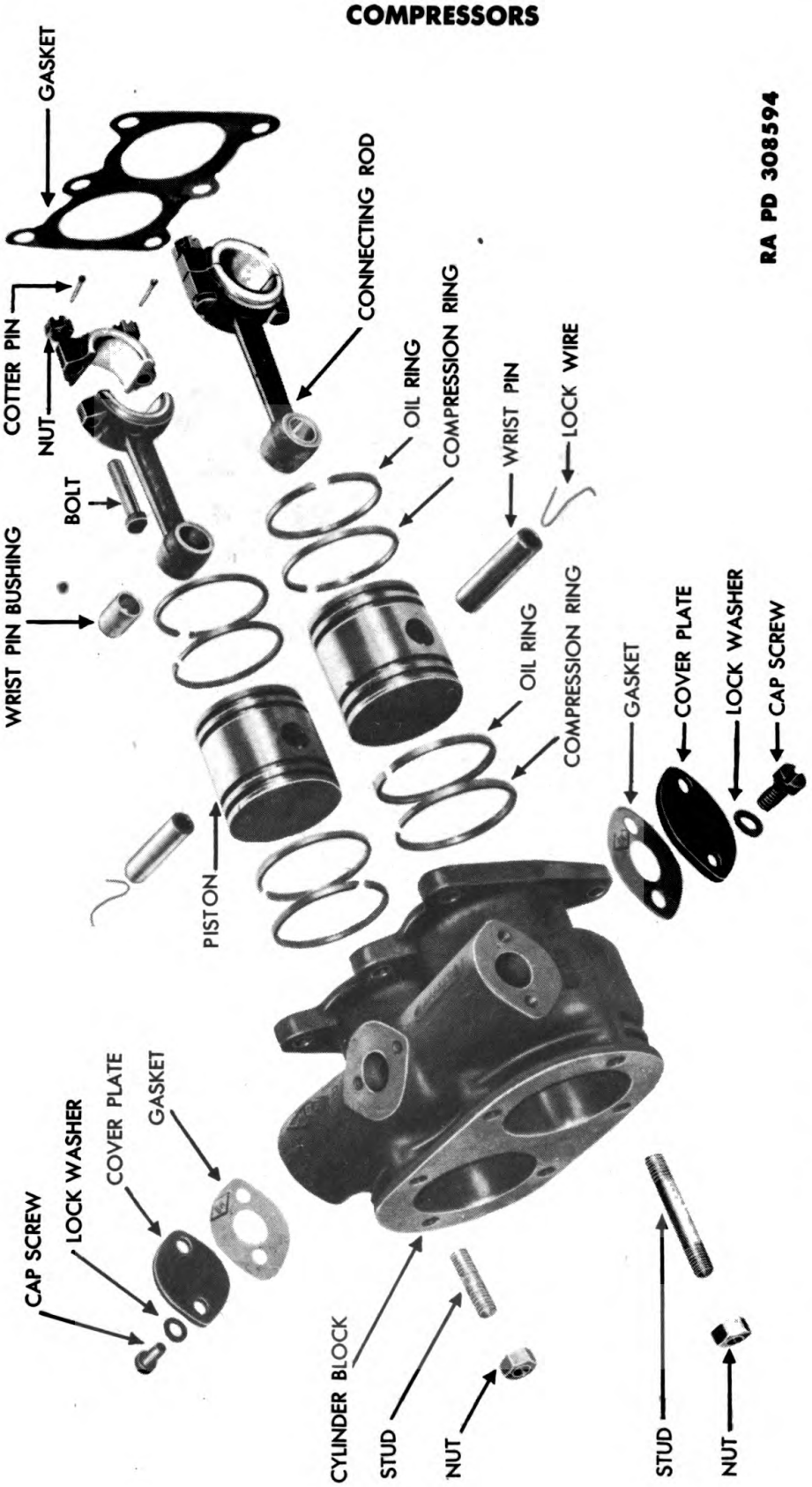


*Figure 15 — Cylinder Block Section of a Two-cylinder Compressor Disassembled*

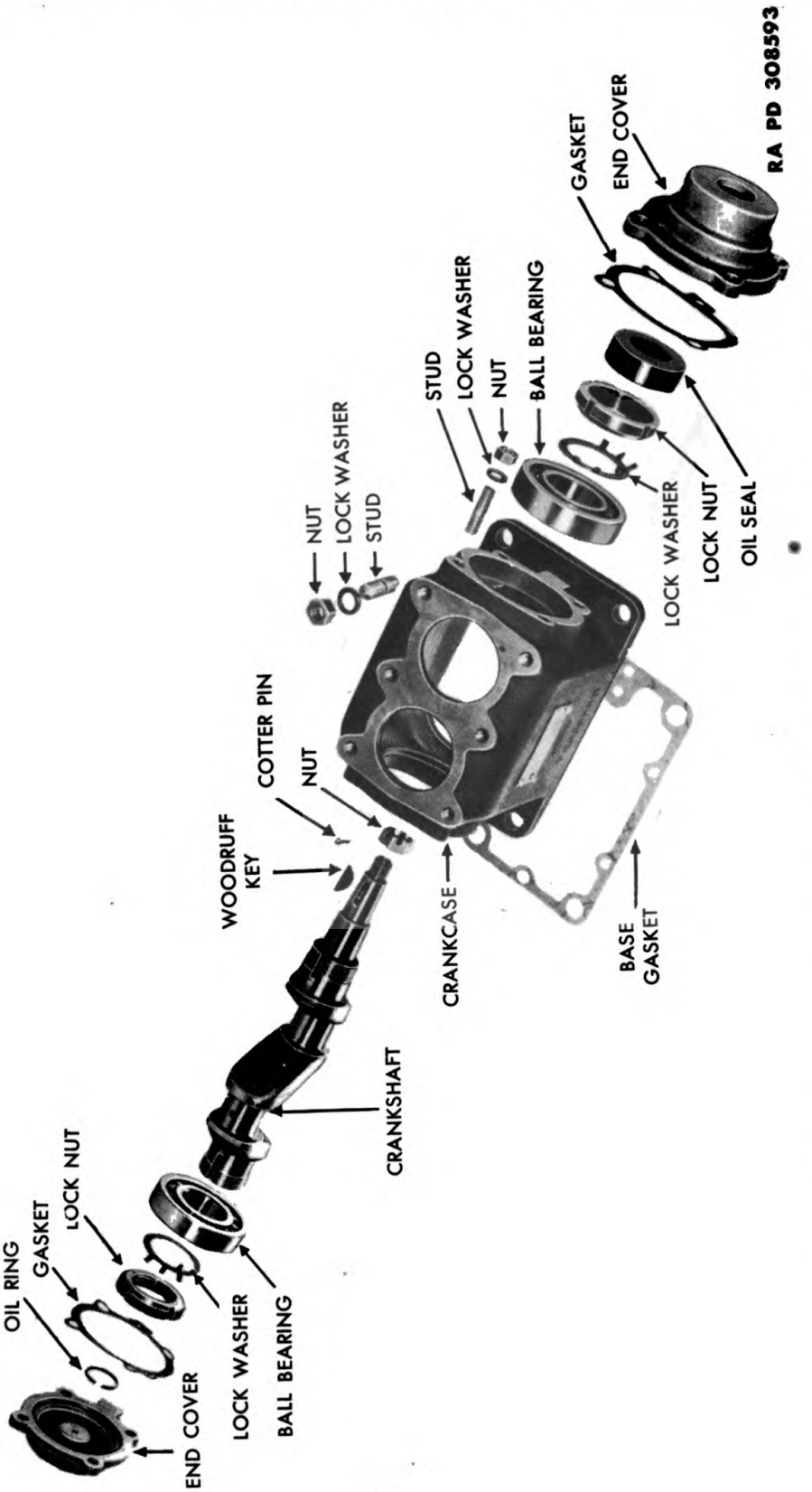


***Figure 16 — Crankcase Section of a Two-cylinder Compressor Disassembled***

chine screws securing the base plate in place, and lift off the base plate (fig. 33). (In some three cylinder self-lubricated compressors having a large oil sump attached to the crankcase, the oil pump is located in the rear end cover. In such cases, the rear end cover assembly must be removed before removing the crankcase base plate.)

**b.** Unscrew oil pump relief valve from base plate. Drive out spring retaining pin at the top of the oil pump relief valve and lift out upper piston spring, piston, and lower piston spring (fig. 9).

**c.** Remove spring retaining ring securing oil screen in place and lift out oil screen.

**d.** Do not remove oil pump piston bushing.

## 8. REMOVING AND DISASSEMBLING PISTON AND CONNECTING ROD ASSEMBLIES.

**a.** If compressor is the self-lubricated type, remove cotter pins from castellated nuts on bolts attaching oil pump piston rod bearing cap. Remove oil pump piston rod and bearing cap. Replace bearing cap on oil pump rod to protect oil pump rod bearing. Do not remove oil pump piston from rod unless it is to be replaced. Remove by driving out oil pump piston pin.

**b.** Remove cotter pins from castellated nuts on bolts attaching connecting rod bearing caps. Lift out the connecting rod bearing caps. Then push pistons, with connecting rods attached, out the top of the cylinder block. Replace cap on each connecting rod to avoid damage to bearings. Connecting rod caps and connecting rods are already marked with center punch marks to show proper position of caps.

**c.** Remove piston rings from each piston. If pistons are to be removed from connecting rods, remove wrist pin lock wires from each wrist pin and press wrist pins from pistons and connecting rods.

## 9. REMOVING CRANKSHAFTS.

**a.** Remove nuts and lock washers from studs securing front or drive end cover to crankcase. Remove end cover with oil seal and gasket. If oil seal needs replacing, remove it from end cover.

**b.** Remove nuts and lock washers from studs securing rear end cover to crankcase. Remove end cover and gasket. If rear end cover is fitted with an oil seal ring, remove oil seal ring.

**c.** If compressor is fitted with special lock nuts and lock washers at either or both ends of the crankshaft, bend up lugs on lock washers, and remove lock nuts and lock washers.

**d.** Some crankcases are fitted with a shoulder to position crankshaft in place. In such cases, the crankshaft may only be removed through one end of the crankcase. Press crankshafts and ball bearings out of crankcases, and press ball bearings off of crankshafts.

**ORDNANCE MAINTENANCE—POWER BRAKE SYSTEMS (BENDIX-WESTINGHOUSE)**

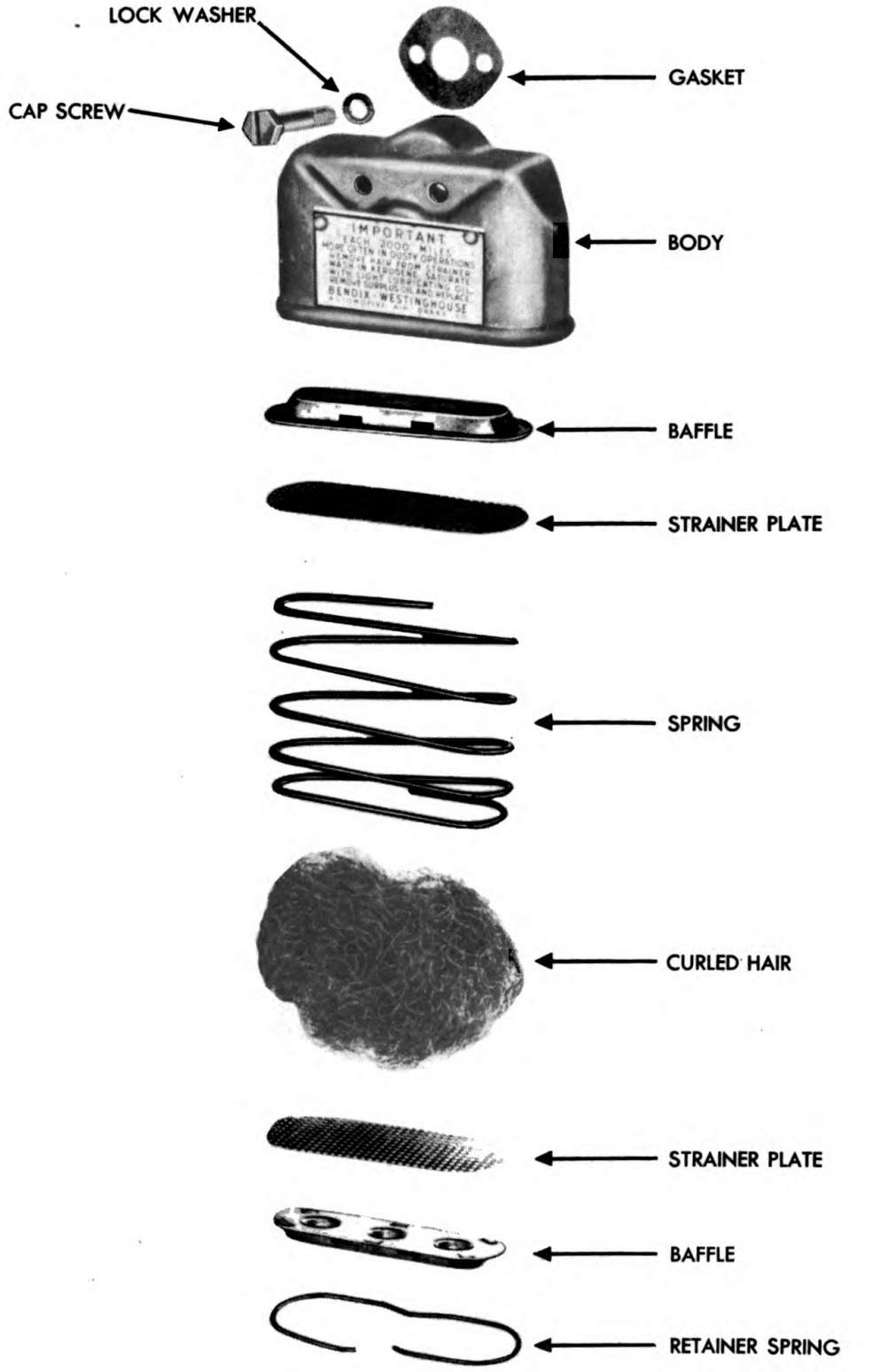


***Figure 17 — Compressor Air Strainer Disassembled***

## COMPRESSORS

### 10. REMOVING CYLINDER BLOCKS.

**a.** If compressor is fitted with an air strainer, remove screws and lock washers securing air strainer in place, and remove and disassemble air strainer (fig. 17). Remove intake manifold covers and gaskets.

**b.** Remove nuts and lock washers securing cylinder block to crankcase, and remove cylinder block and gasket.

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## Section III

## CLEANING AND INSPECTION OF PARTS



### 11. CLEANING.

**a. General.** Clean all parts using dry-cleaning solvent to remove all traces of dirt, oil, or grease, before inspection.

**b. Cylinder Head and Components.**

(1) Put cylinder head body through a dry-cleaning solvent to remove all carbon from discharge valve cavities and unloading valve cavity, and to remove all rust and scale from water cavity. If necessary, remove unloading valve bushings (par. 20 **a**) to facilitate removal of carbon from unloading valve cavity. Use air pressure to blow dirt out of all cavities. Scrape carbon, dirt, or particles of old gaskets, from all surfaces.

(2) Clean discharge valves, not worn excessively or damaged, by lapping them on a piece of crocus cloth on a flat surface (fig. 18).

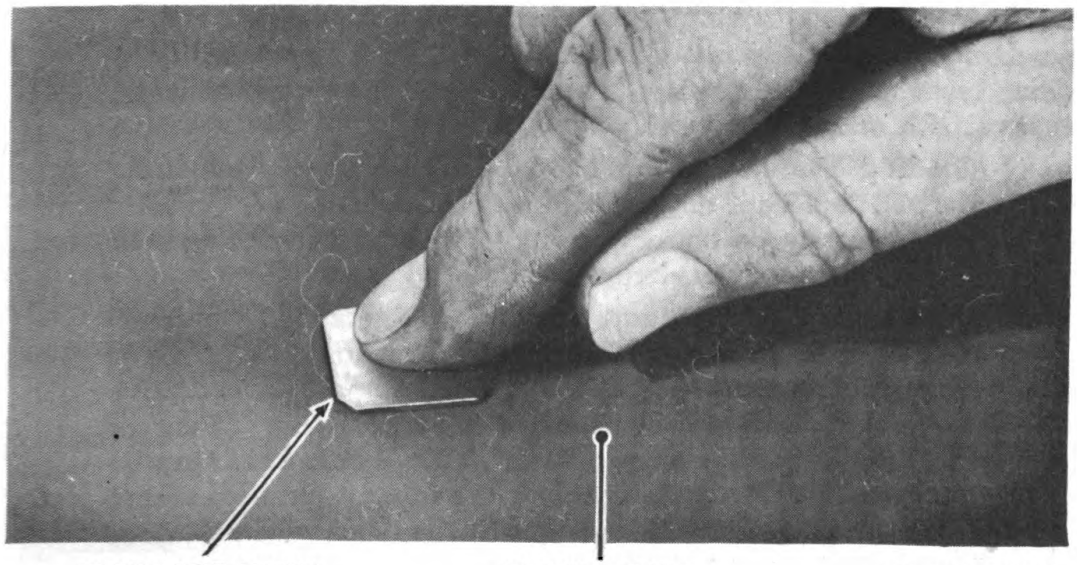



***Figure 18 — Cleaning Discharge Valves***

**c. Oil Passages.** Thoroughly clean all oil passages through crankshafts, connecting rods, crankcases, base plates, and end covers. If necessary, prod oil passages with a piece of wire and flush with dry-cleaning solvent.

**d. Cylinder Block.** Put cylinder block through a dry-cleaning solvent to remove all carbon or dirt from intake manifold and intake ports. If necessary, remove welsh plug in manifold to accomplish this.

**e. Air Strainer.** Wash curled hair in air strainer in dry-cleaning solvent. Then saturate it in clean engine oil and squeeze out excess oil before replacing it in the strainer.

**f. Crankcase Breather.** If the compressor is the self-lubricated type having a crankcase breather, be sure it is washed thoroughly clean.

**g. Ball Bearings.** All ball bearings must be washed thoroughly in dry-cleaning solvent.

**h. Crankcase.** If the compressor is the self-lubricated type having an oil pump check valve in the crankcase wall, be sure it is thoroughly cleaned.

## 12. INSPECTION OF PARTS.

**a. Cylinder Head Body.** Inspect cylinder head body for cracks or breaks. Replace if any are found. Check condition of unloading diaphragm seat in unloading diaphragm cavity in cylinder head. Replace cylinder head body if seat is pitted or damaged in any way.

**b. Water Jacket.** Test water jacket for leakage after cleaning, using air pressure. If any leakage is found, the cylinder head body must be replaced.

**c. Unloading Lever Pin.** Check fit of unloading lever pin in unloading lever for excessive play. If pin or lever show signs of wear, either or both must be replaced.

**d. Unloading Diaphragms and Box Cover.** Check unloading diaphragms and replace if any signs of wear or cracking are present. Check diaphragm seat on bottom of unloading box cover. Lap seat or replace cover if necessary.

**e. Unloading Valve Stems and Bushings.** Check fit of unloading valve stems in unloading valve bushings. Unloading valve stems must be a neat sliding fit in unloading valve bushings. If excessive clearance is found, check unloading valve stems for wear. Wear of the unloading valve stems must not exceed 0.002 inch. This may be checked by comparing the diameter of the unloading valve stem where it engages the bushing, with the diameter of the stem where it does not engage the bushing. If there is excessive clearance between the unloading valve stems and the unloading valve bushings, the unloading valves, unloading valve bushings, or both must be replaced. If

the unloading valve bushings are to be replaced, they are removed by pressing them out. Unloading valve bushings in two cylinder ccmpressors must be pressed out through the top of the cylinder head. Unloading valve bushings in three cylinder compressors must be pressed out through the bottom of the cylinder head.

**f. Discharge Valve Springs.** Discard all used discharge valve springs and replace with new springs.

**g. Discharge Valves and Seats.** Inspect condition of discharge valves and discharge valve seats. If discharge valves are grooved deeper than 0.003 inch where they contact the seats, they must be replaced. If the discharge valve seats are worn excessively so there is no longer sufficient metal left to reclaim the seat by reaming, the cylinder head body must be replaced.

**h. Oil Pump Piston and Bushing.** If compressor is the self-lubricated type, check fit of oil pump piston in base plate oil pump bushing. Oil pump piston must be a neat sliding fit in oil pump bushing. If excessive clearance is found, the oil pump piston, the base plate or both must be replaced. If the oil pump piston bushing is loose in the base plate or if it shows any signs of being scored or damaged in any way, the base plate assembly with bushing must be replaced.

**i. Oil Pump Relief Valve.** Check fit of oil pump relief valve piston in relief valve body. Piston must be a neat sliding fit without any evidence of binding. Discard piston springs in oil pump relief valve.

**j. Crankcases and End Covers.** Check crankcases and end covers for cracks and broken lugs. Replace if any are found.

**k. Oil Pump Check Valve.** If compressor is the self-lubricated type having an oil pump check valve in one end of the crankcase wall, check its condition by blowing air pressure back through the oil passage from the opening in the end of the crankcase. If the check valve is in good condition, no leakage will be noticeable through the check valve. If excessive leakage is found, a new check valve must be installed in the crankcase.

**l. End Covers.** If an oil seal ring is used in the end cover, check fit of ring in ring groove. Ring must be a neat fit in ring groove and have 0.008-inch to 0.015-inch clearance at the gap when placed in the end bore of the crankshaft. Check lip of oil seal for wear. If worn thin, the oil seal must be replaced.

**m. Crankcase Bearing Bores.** Check fit of ball bearings in crankcase. Bearings must be a light press fit. If the crankcase bearing bores are worn or damaged, the crankcase must be replaced.

**n. Oil Pump Screen.** If compressor is the self-lubricated type, inspect condition of oil pump screen. Replace if damaged in any way.

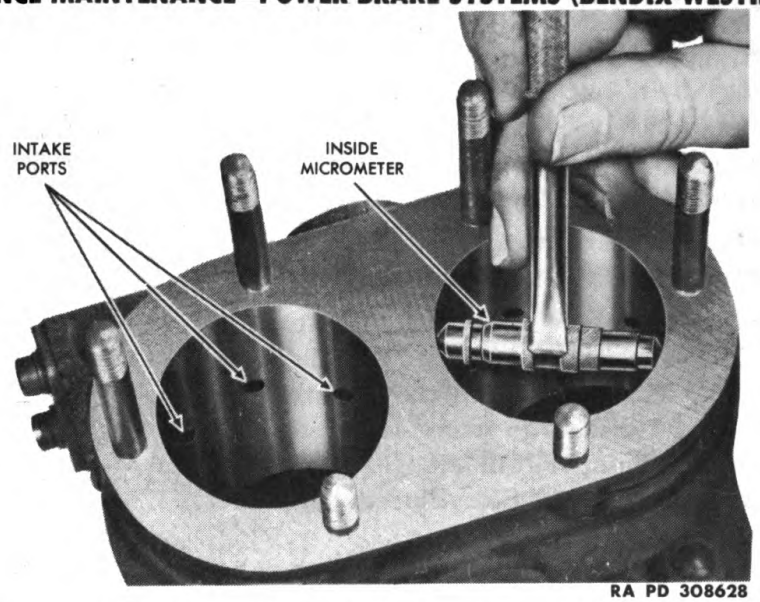



***Figure 19 — Measuring Cylinder Bore Diameters, Using Tool 41-C-304***

**o. Cylinder Blocks.** Cylinder blocks with broken lugs or with cracks of any kind must be replaced.

**p. Cylinder Bores** (fig. 19). Check cylinder bores for evidence of excessive wear, out-of-roundness, or scoring. Cylinder bores which are scored or out-of-round more than 0.003 inch or tapered more than 0.003 inch must be rebored, ground, or honed oversize. Oversize pistons are 0.010-inch, 0.020-inch, or 0.030-inch oversize. Cylinder bores must be smooth, straight, and round, and must be finished with a 500 (or finer) grit hone. Clearance between pistons and cylinder blocks must be 0.002-inch minimum and 0.004-inch maximum.

**q. Pistons.** Inspect pistons for scores, cracks, or damage of any kind. If scores or cracks are found, replace the piston. Check each picton with a micrometer in relation to the cylinder bore diameter to be sure the clearance is between 0.002 inch minimum and 0.004 inch maximum.

**r. Piston Rings.** Check fit of piston rings in the ring grooves. Clearance between the ring and the ring groove must not be less than 0.0015 inch nor more than 0.0025 inch. Piston rings which have a gap of more than 0.020 inch when positioned in the cylinder must be replaced. Clearance at the gap of new piston rings when installed in the cylinder must not be less than 0.010 inch nor more than 0.015 inch (fig. 20).

**s. Wrist Pins.** Check fit of wrist pin in piston and connecting rod. Wrist pins must be a light press fit in the piston. If wrist pin is a loose fit in the piston, the wrist pin, piston, or both must be replaced. Check fit of wrist pin in connecting rod bushing by rocking

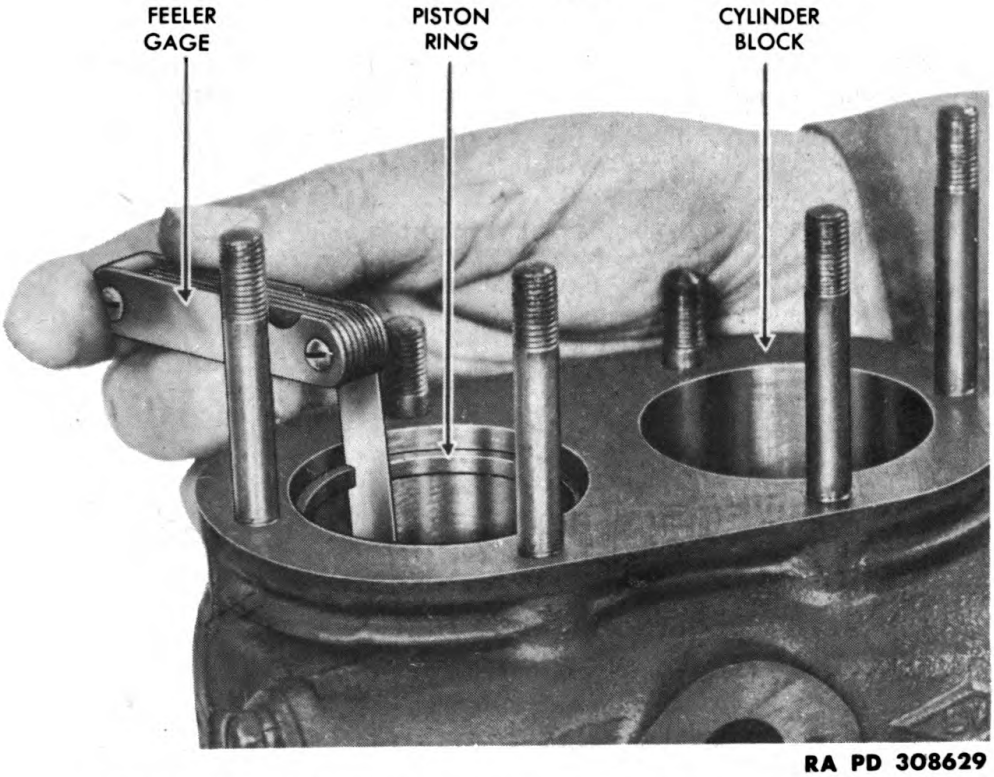



***Figure 20 — Checking Ring Gap Clearance in Cylinder, Using Tool 41-G-400***

the piston. If any clearance is apparent, replace wrist pin bushings in connecting rod. Discard all used wrist pin lock wires.

**t. Connecting Rod Bearings.** Inspect connecting rod bearings for proper fit on crankshaft journals. Also check babbitt bearing for wear. If worn, cracked, or broken, the connecting rods must be re-babbitted or replaced. Clearance between the side of the connecting rod bearing and the check of the crankshaft must not exceed 0.015 inch. Clearance between the connecting rod journal and the connecting rod bearing must not be less than 0.001 inch and not more than 0.002 inch.

**u. Crankshafts.** Crankshaft journals which are more than 0.001-inch out-of-round or bruised, must be reground. When regrinding, the fillets at the ends of the journals must be maintained. Connecting rods 0.010-inch, 0.020-inch, and 0.030-inch undersize are made for reground crankshafts. Screw threads, keyways, tapered ends, and all ground and machined surfaces of the crankshaft must not be mutilated or excessively worn. Main bearing journals must not be worn sufficiently to prevent the ball bearings being a light press fit. The width of the splines on crankshafts must not be less than 0.171 inch for those having 10 splines nor less than 0.246 inch for those having 6 splines. The oil seal ring groove in crankshafts fitted with

oil seal rings must not be worn to prevent a good fit of the oil seal ring. Clearance between side of the oil seal ring and ring groove must be between 0.0015-inch minimum and 0.0025-inch maximum.

v. **Ball Bearings.** Check for wear or flat spots and if found, the bearings must be replaced.

## Section IV
## REPAIRS



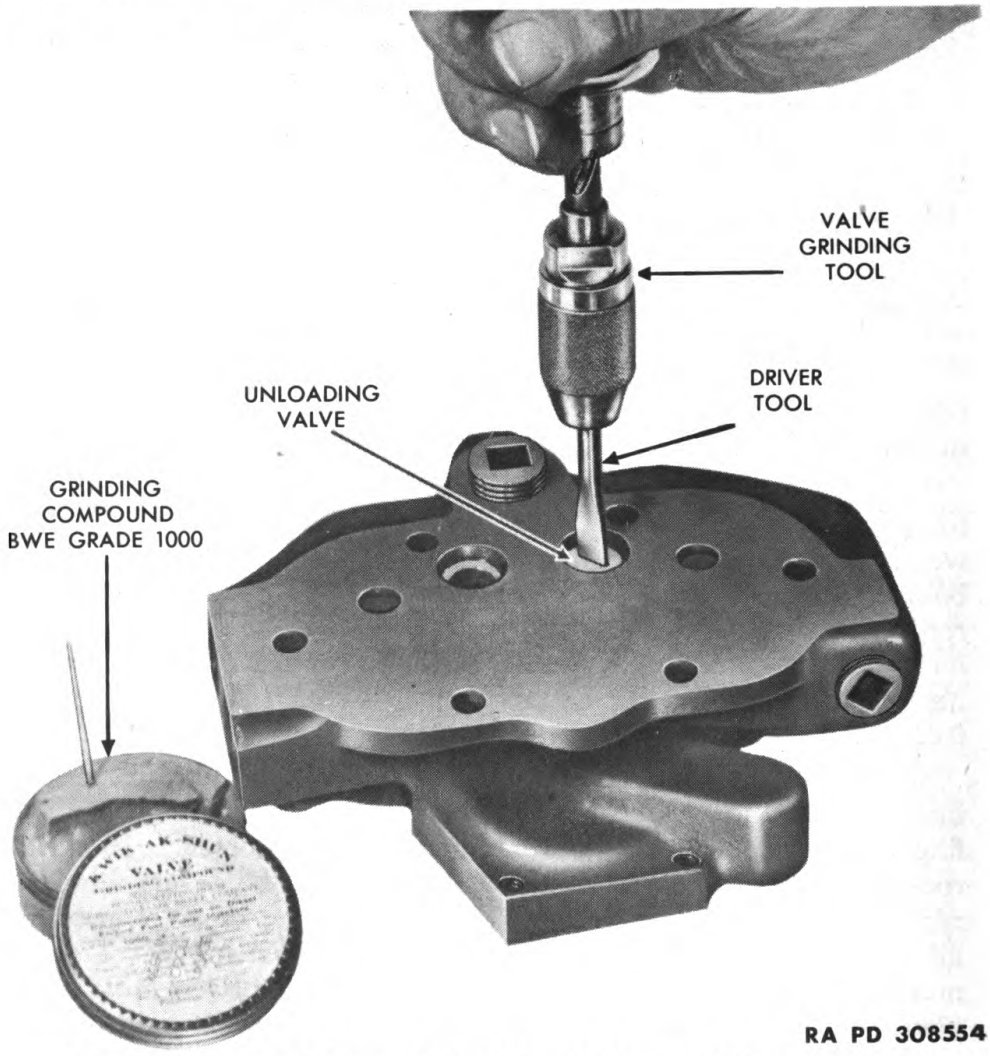



***Figure 21 — Grinding Unloading Valves, Using Tools 41-T-3381-15 and 41-B-660***

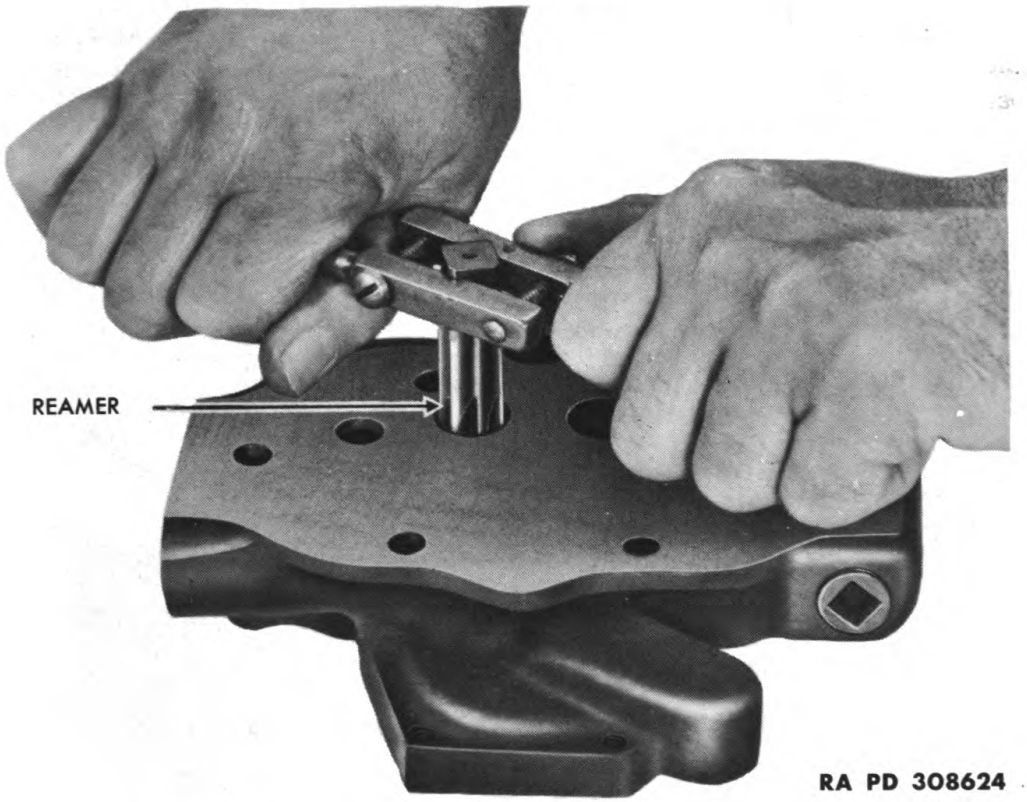



***Figure 22 — Reaming Unloading Valve Seats, Using Reamer 41-R-2309***

## 13. UNLOADING VALVES.

**a.** Grind unloading valves (fig. 21) which are not too badly worn or pitted, to their seats using (BWE grade 1000) grinding compound, reciprocating valve grinding tool (41-T-3381-15) and drive tool (41-B-660). If the valve seats are badly pitted or worn, they must be reamed using special reamers (fig. 22). Use reamer (41-R-2309) for 7¼ cubic foot, two-cylinder compressors. Use reamer (41-R-2309-25) for 12 cubic foot, three-cylinder compressors. Valves must be ground to their seats and cleaned after reaming. After grinding, install the unloading valves, unloading valve springs, spring seats and retaining washers in the cylinder head (fig. 23) and test the unloading valves for leakage (fig. 24).

**b.** Test the unloading valves for leakage by clamping the cylinder head in a special fixture (figs. 173, 174, or 175). Test with 75-pound air pressure using soap suds.

**c.** Each two cylinder 7¼ cubic foot compressor unloading valve must be tested by applying soap suds to the exhaust port of the fixture (fig. 24) while holding the other unloading valve down off its seat.

**d.** Each three cylinder 12 cubic foot compressor unloading valve,

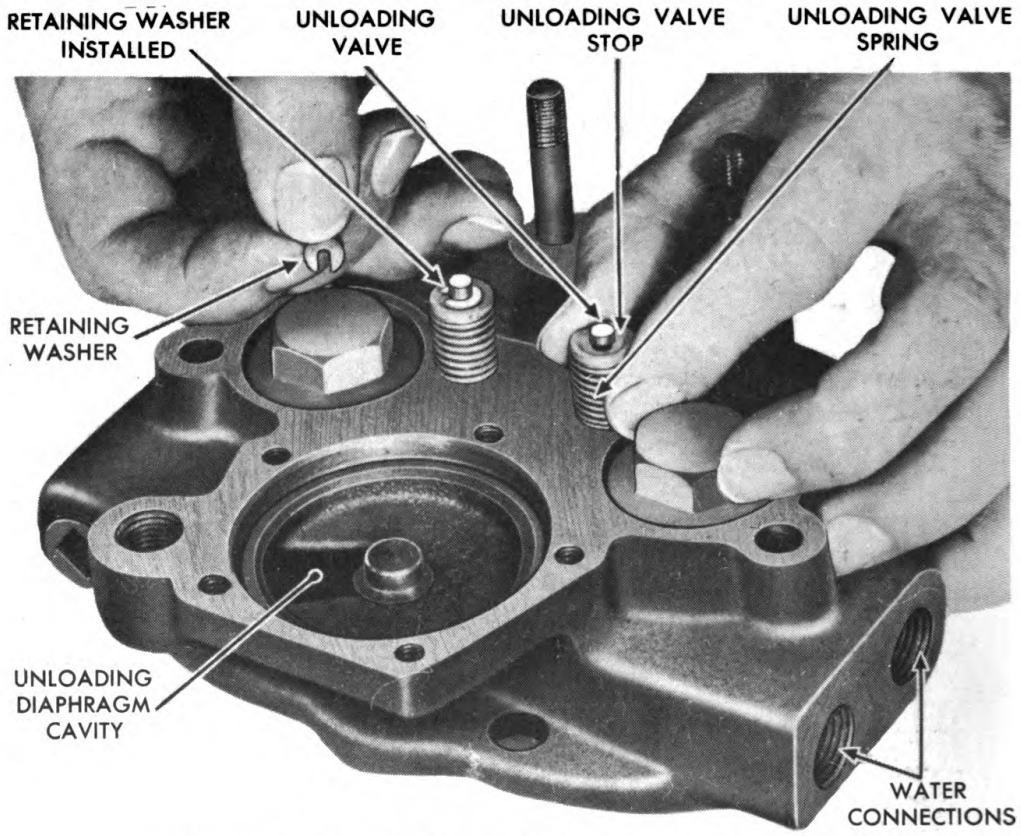



***Figure 23 — Installing Unloading Valves***

must be tested by applying soap suds to the exhaust port of the fixture while holding the other two unloading valves down off their seats.

e. Leakage in excess of a 1-inch soap bubble in 3 seconds for any one unloading valve is not permissible. If excessive leakage is found, grind the unloading valve to its seat.

## 14. DISCHARGE VALVES.

a. If the discharge valve seats merely show signs of slight scratches, they can usually be reclaimed by using grinding compound (BWE grade 1,000), lapping disk (41-D-1261-500), grinding tool (41-T-3381-15), and driver (41-B-660).

b. If the valve seats are pitted, use lapping stone (41-T-3224), driver (41-B-660) and grinding tool (41-T-3381-15) before using lapping disk (41-D-1261-500) and (BWE grade 1,000) grinding compound.

c. If the valve seats are badly pitted or scratched, use reamer (41-R-1396) (fig. 25) before using lapping stone (41-T-3224) or lapping disk (41-D-1261-500).

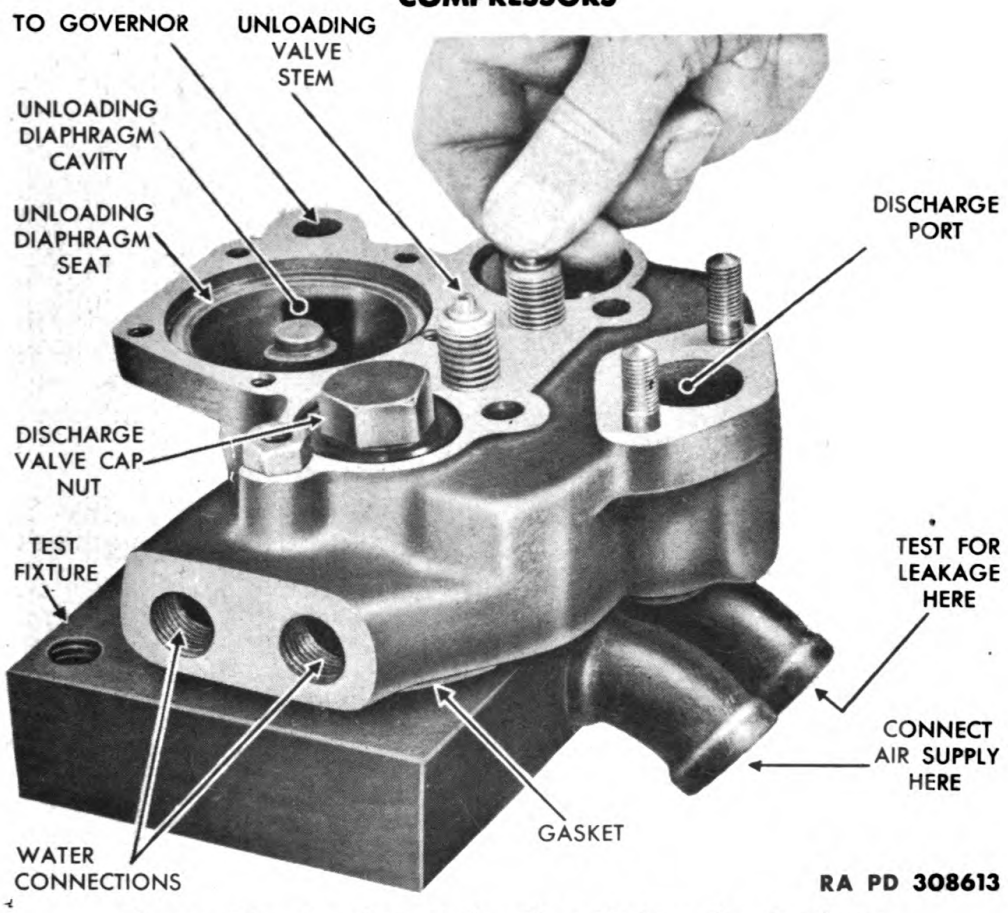



***Figure 24 — Testing Unloading Valves for Leakage***

**d.** After the discharge valves, discharge valve springs, and cap nuts are installed, the discharge valves must be tested for leakage.

**e.** To test for leakage, apply 75-pound air pressure through the discharge port of the cylinder head, and apply soap suds to the discharge valve openings (fig. 26). Leakage in excess of a 1-inch soap bubble in 1 second is not permissible.

**f.** If excessive leakage is found, leave the air pressure applied and, using a fiber or hardwood dowel and light hammer (fig. 27), tap the discharge valves off their seats several times to improve the seal between the valve and its seat. Leakage will be decreased if the valves and valve seats have been reconditioned correctly.

**g.** Leakage tests must also be made by applying soap suds around the top of the discharge valve cap nuts. Leakage here must not exceed a 1-inch soap bubble in 5 seconds.

## 15. OIL PUMP RELIEF VALVE.

**a.** Assemble oil pump relief valve (fig. 9), and check its operation by applying air pressure to assembly. Threads for attaching oil

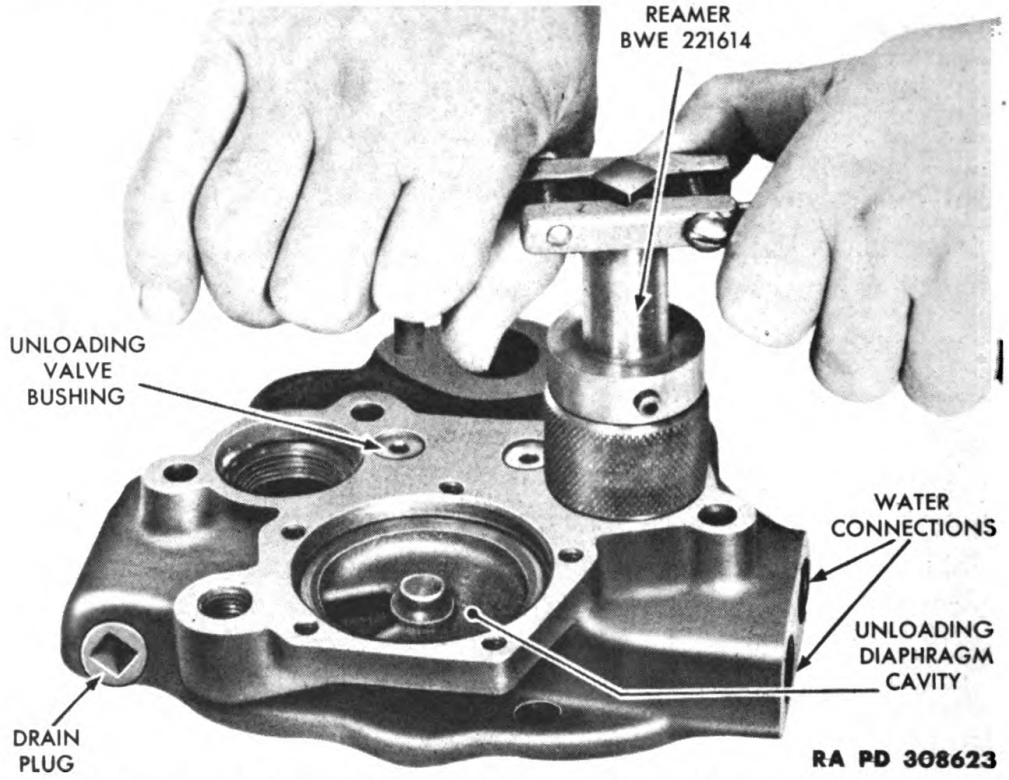



***Figure 25 — Reaming Discharge Valve Seats, Using Reamer 41-R-1396***

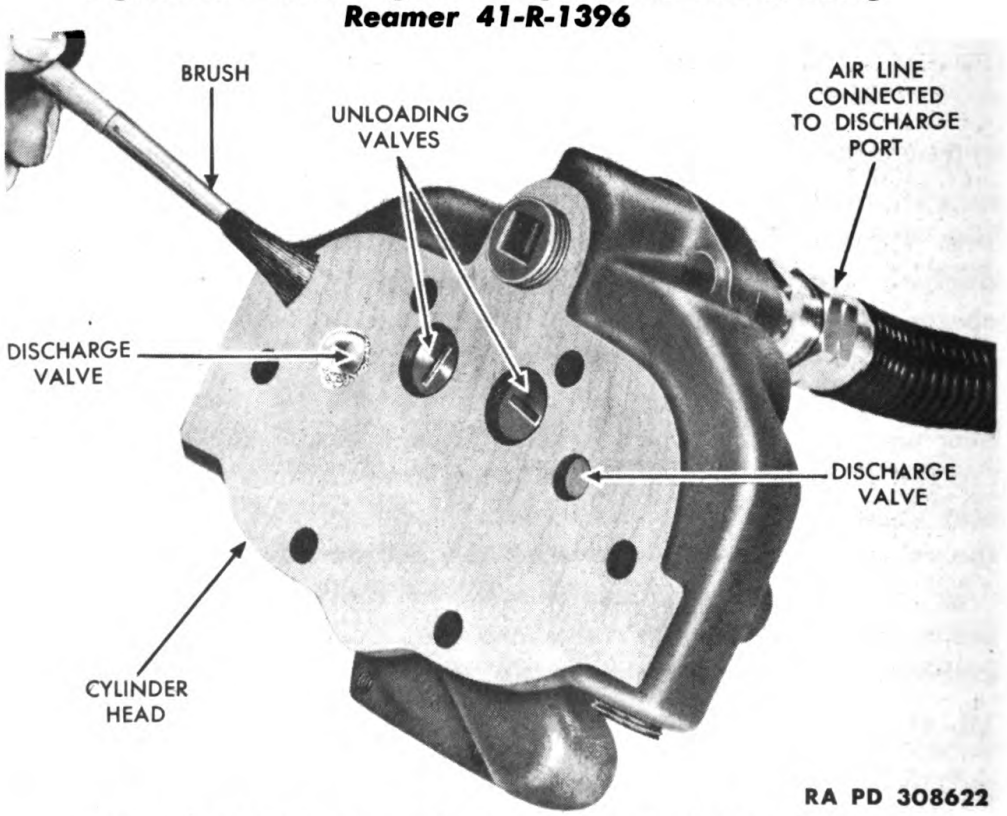



***Figure 26 — Testing Discharge Valves for Leakage***

pump relief valve assembly to base plate are $^{9}/_{16}$-18 SAE. Oil pump relief valve piston must rise sufficiently to begin to uncover the ports in the side of the body when air pressure is between 14 pounds minimum and 24 pounds maximum. If oil pump relief valve operation is correct, prick punch the spring retaining pin and body to lock the pin in place.

## Section V

## ASSEMBLY



### 16. INSTALLING CYLINDER BLOCKS.

**a.** Place new cylinder block gasket in position over crankcase studs. Position cylinder block on crankcase in accordance with markings made before disassembly. Install nuts and lock washers securing cylinder block to crankcase.

### 17. INSTALLING CRANKSHAFTS.

**a.** If the crankshaft is fitted with oil seal rings, install rings.

**b.** Position ball bearings and crankshaft in crankcase. Make sure the drive end of the crankshaft is positioned at the end of the crankcase marked with one punch mark before disassembly. If one end of the crankcase is counter-bored for holding bearing, be sure the crankshaft is entered through the correct end of the crankcase. Press crankshaft and bearings into crankcase (fig. 28).

**c.** If compressor assembly includes a special lock washer and lock nut at either or both ends of the crankshaft, install lock washers, lock nuts, and tighten lock nuts. Then bend one lug on each lock washer into one of the slots in each lock nut to prevent lock nut from coming loose.

**d.** Place a new rear end cover gasket in position over studs on rear end of crankcase being sure the oil hole in the gasket lines up with the oil hole in the crankcase.

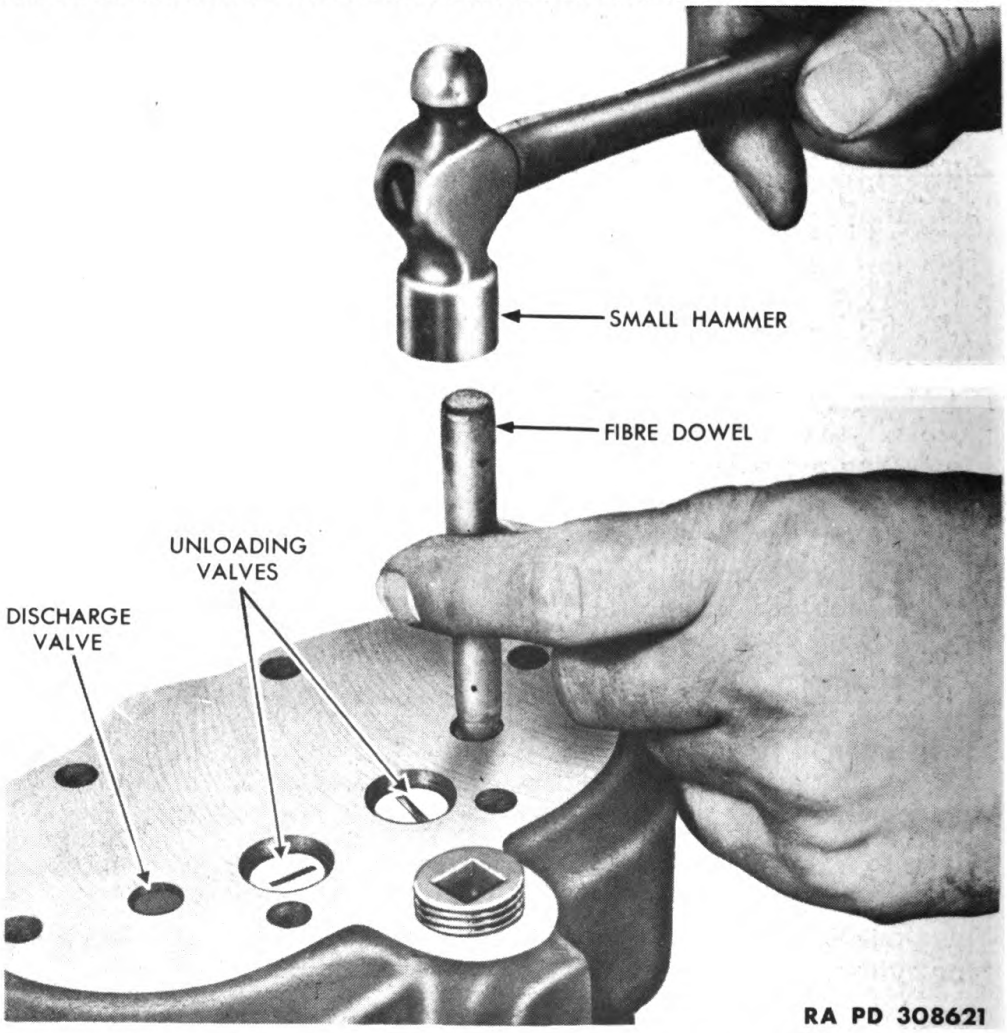


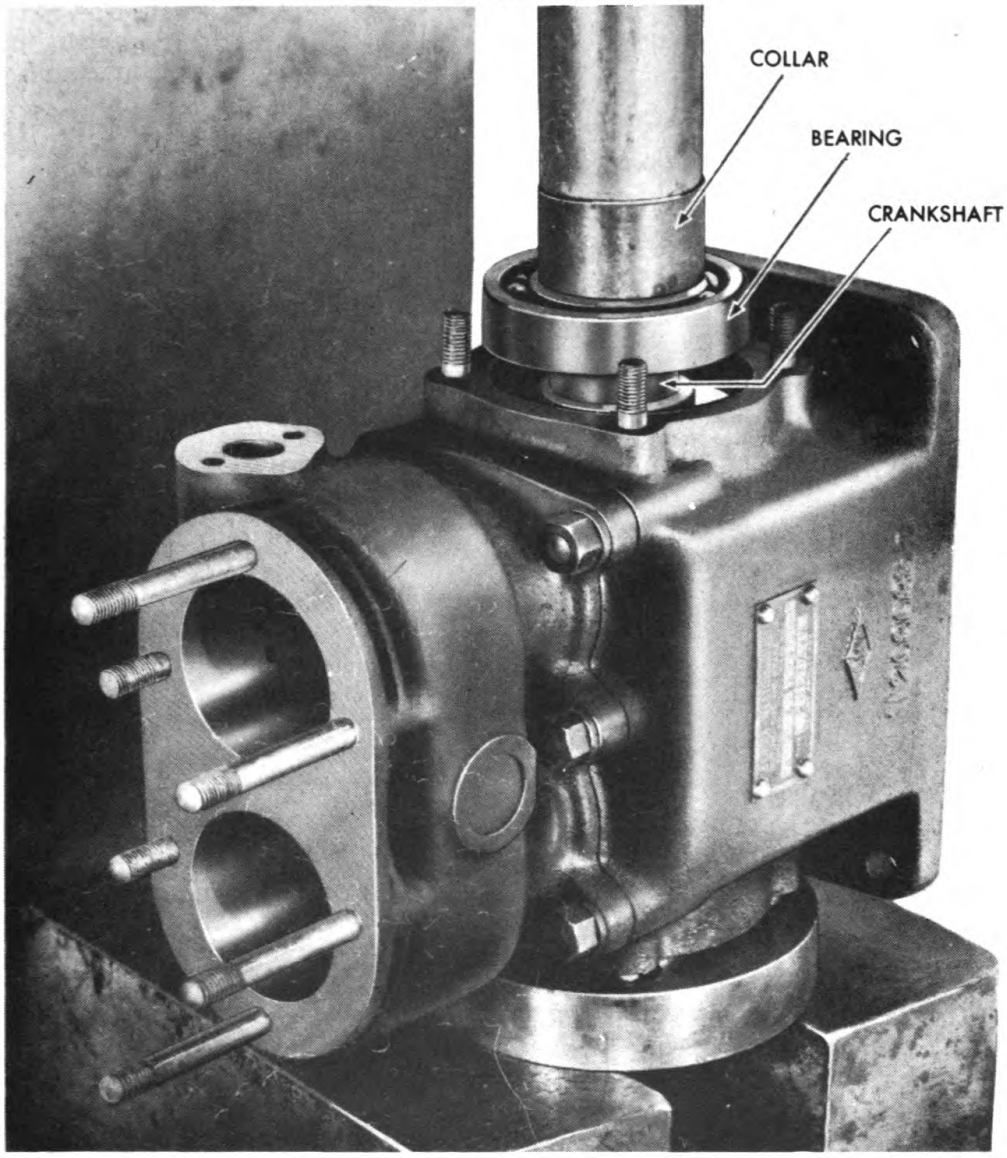

***Figure 27 — Seating Discharge Valves with Dowel***

**e.** If rear end cover includes an oil seal ring, install oil seal ring. Then position rear end cover over studs in crankcase being sure that the oil hole in the rear end cover lines up with oil hole in the gasket and crankcase. Install nuts and lock washers securing end cover in place. Install pipe plugs in any oil openings in end cover.

**f.** If front end cover includes an oil seal and oil seal has been removed from end cover, press a new oil seal into end cover. Install a new gasket. Carefully position front end cover so as not to damage oil seal, and install nuts and lock washers securing end cover in place.

## 18. ASSEMBLING PISTONS AND CONNECTING RODS.

**a.** If wrist pin bushings have been removed from connecting rods, press new bushings into place making sure that the oil holes in the bushings line up with the oil holes in the connecting rods. Bushings must then be reamed, honed, or bored, to provide between 0.0005-inch

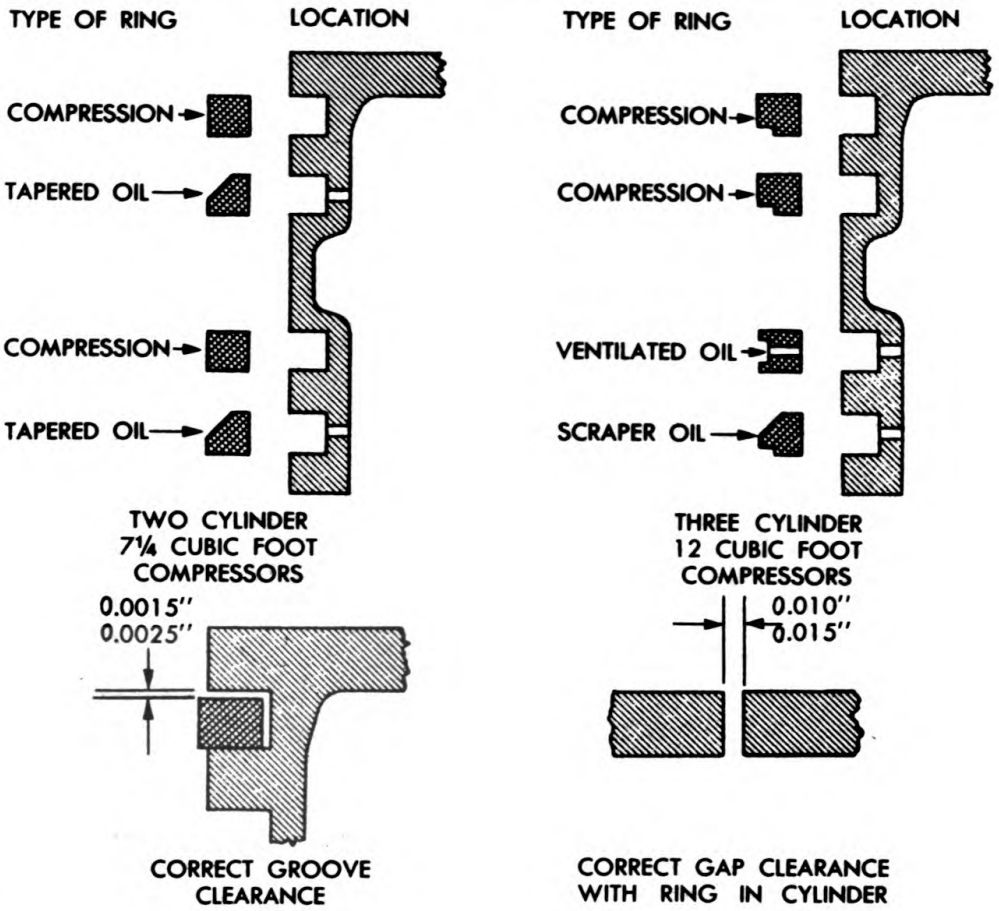



RA PD 308620

***Figure 28 — Installing Crankshaft and Bearings Using Arbor Press***

and 0.001-inch clearance on the wrist pin. Position connecting rod in piston, and press wrist pin into piston with lock wire hole in pin alined with lock wire hole in piston. Install new wrist pin lock wire in wrist pin so that the end of the wire engages the hole in the piston. Do not use pistons in which the wrist pin is loose.

**b.** Install piston rings by hand (fig. 30). Four rings are used in each piston and they must be installed in their proper location (fig. 29). Careful inspection is necessary to determine which side of the tapered oil ring used in 7¼-cubic foot compressors has the largest




NOTE
CAREFUL INSPECTION IS NECESSARY TO OBSERVE TAPER ON TAPERED OIL RINGS **RA PD 308601**

***Figure 29 — Position of Piston Rings***

diameter. Tapered oil rings are marked with a small diamond shaped trademark on the top side of the ring opposite the gap, and must be installed with the trademark side of the ring towards the top of the piston. Compression rings for 7¼-cubic foot compressors are marked with a small diamond shaped trademark near the gap in the ring and must also be installed with the trademark side towards the top of the piston. Piston rings for three-cylinder compressors are easily identified by their shape so the compression rings and oil scraper rings may be installed with the proper side uppermost. Ventilated oil rings are installed with either side uppermost. The location and correct positioning of all piston rings is very important.

## 19. INSTALLING PISTONS AND CONNECTING RODS.

**a.** Before installing pistons and connecting rods, thoroughly lubricate pistons, piston rings, wrist pin bearings, and connecting rod bearings with clean engine oil.


*Figure 30 — Installing Piston Rings* RA PD 308614

**b.** Turn crankshaft so as to position No. 1 crankshaft journal downward. Remove bearing cap from No. 1 connecting rod leaving connecting rod bolts in the rod. Connecting rods are installed so that the center punch markings on the connecting rods are at the front or name plate side of the compressor.

**c.** Insert No. 1 connecting rod and piston through top of No. 1 cylinder being sure the connecting rod bearing engages the connecting rod journal in the same position as that in which it was fitted.

**d.** Position and attach lower bearing cap to connecting rod, and install two castellated nuts and cotter pins.

**e.** Install other pistons and connecting rods in the same manner.

## 20. ASSEMBLING AND INSTALLING CYLINDER HEADS.

**a.** If the unloading valve bushings have been removed, press new bushings into place. Unloading valve bushings in two-cylinder compressors must be pressed in from the top of the cylinder head. Unloading valve bushings in three-cylinder compressors must be pressed in from the bottom of the cylinder head. Unloading valve bushings must be reamed after being pressed into place (par. 13).

**b.** Insert each unloading valve into cylinder head body from bottom side. Place small wooden block or a nut under valve to keep it

## ORDNANCE MAINTENANCE—POWER BRAKE SYSTEMS (BENDIX-WESTINGHOUSE)

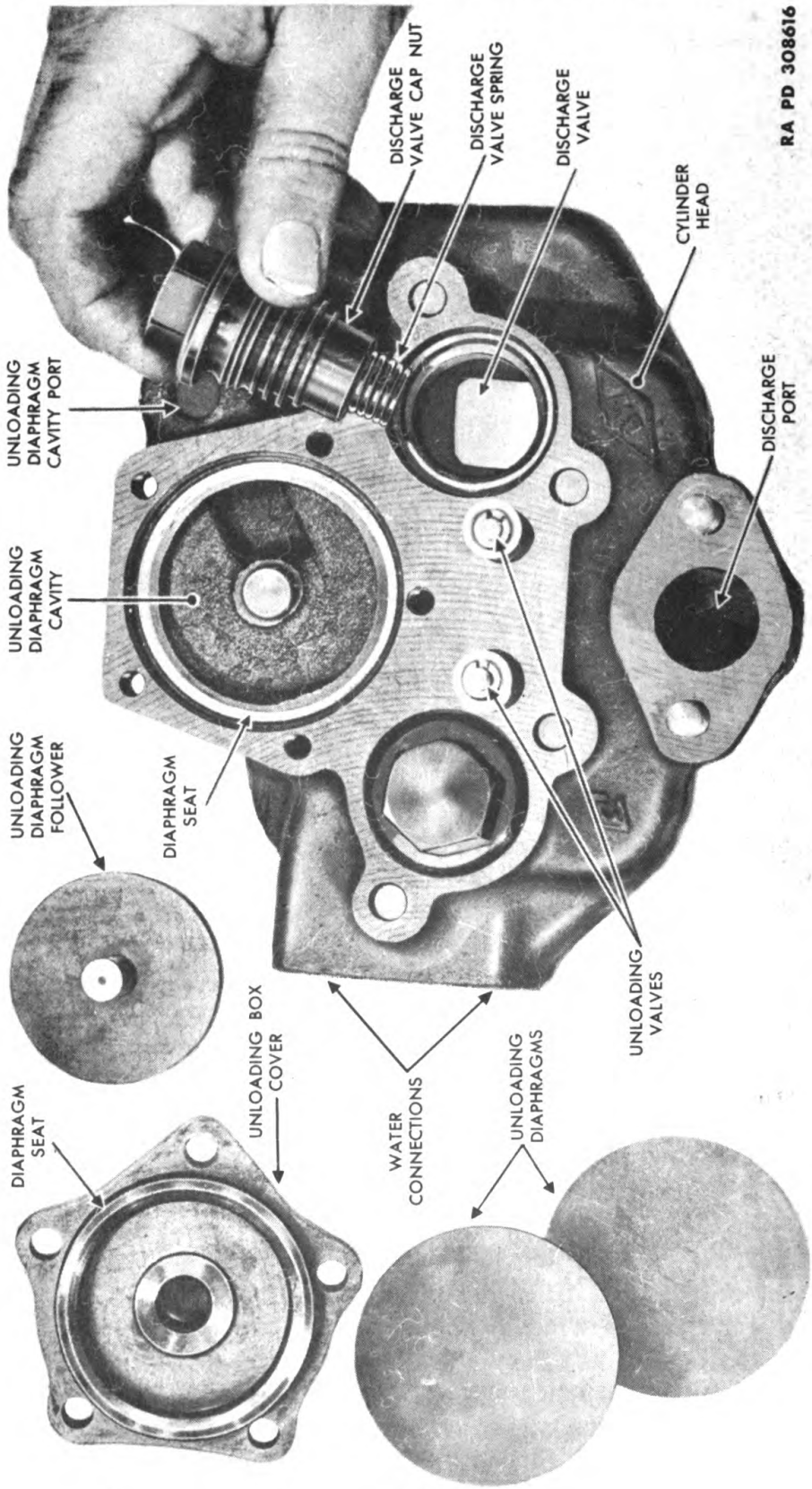



***Figure 31 — Installing Discharge Valves***

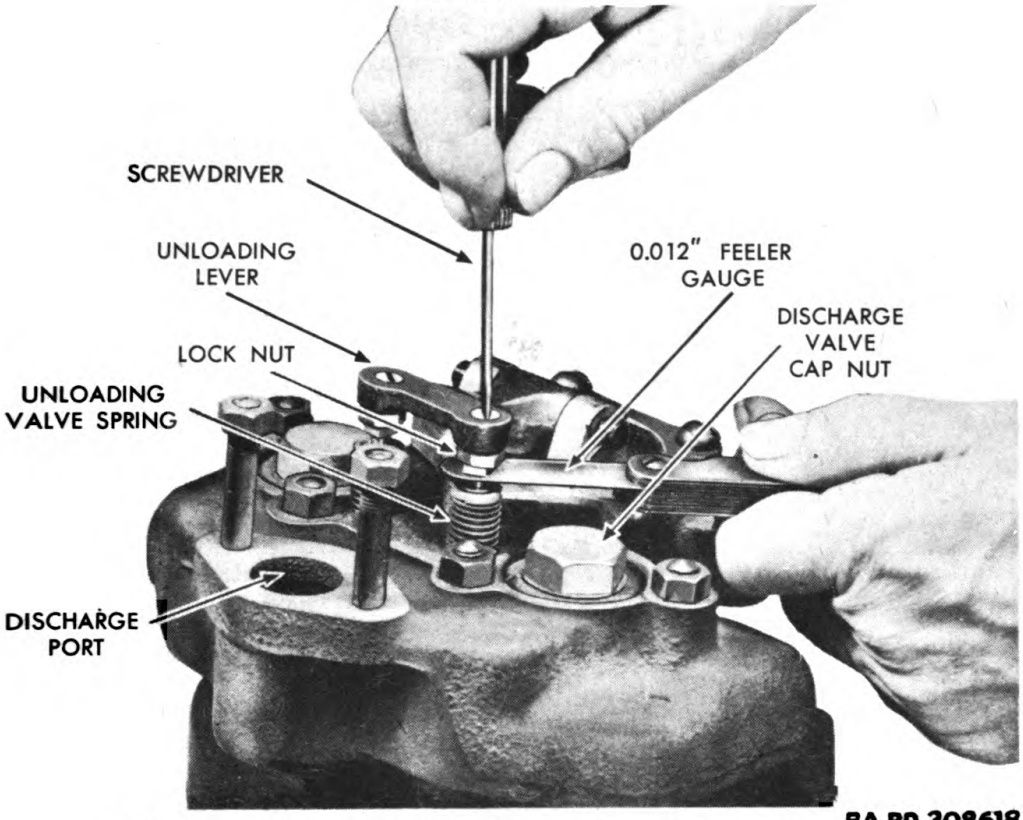



***Figure 32 — Adjusting Unloading Valve Clearance***

in position. Then install unloading valve spring over each unloading valve and place unloading valve stop over each spring. Then compress each unloading valve spring by hand until spring retainer washer can be inserted over stop (fig. 23).

**c.** Position each discharge valve on its seat through the opening in the top of the cylinder head ((fig. 31). Then place discharge valve spring in discharge valve cap nut and insert them into cylinder head body over discharge valve. Tighten each discharge valve cap nut.

**d.** Position two unloading diaphragms in opening in top of cylinder head body after lubricating the diaphragms with a thin coating of light engine oil. Place diaphragm follower in position on diaphragms with post upward. Place unloading box cover in position over diaphragm follower post. Attach unloading box cover to cylinder head body with machine screws and lock washers. Tighten all machine screws evenly.

**e.** Check for leakage past the unloading diaphragms by applying 100-pound air pressure through the unloading diaphragm cavity port, and applying soap suds all over the unloading box cover. Leakage in excess of a 1-inch soap bubble in 3 seconds is not permissible.

**f.** Place dust guard in position on unloading box cover.

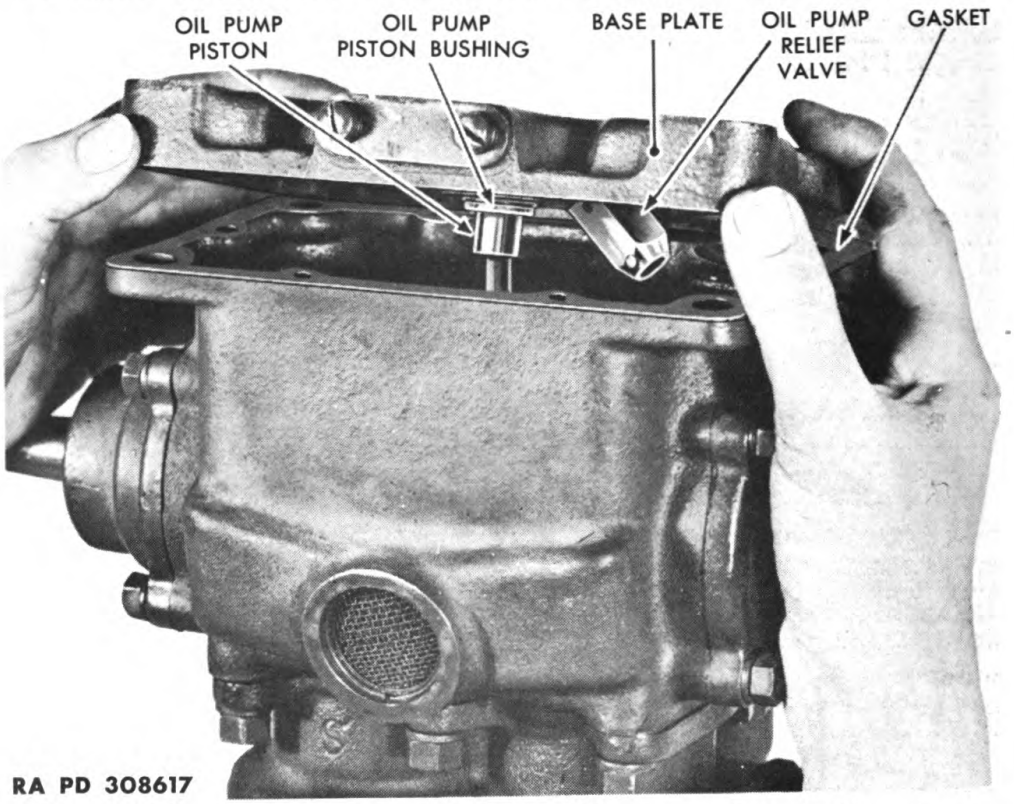



***Figure 33 — Positioning Oil Pump Piston and Installing Base Plate of Self-lubricated Compressors***

**g.** Install adjusting screws and lock nuts in unloading lever.

**h.** Place unloading lever spring in position on unloading box cover, and position unloading lever over spring. Insert unloading lever pin through unloading box cover and unloading lever. Install cotter pins in the ends of unloading lever pin.

**i.** Turn adjusting screws in unloading lever until clearance between the head of the adjusting screws and the end of the unloading valves is 0.010-inch minimum, 0.015-inch maximum (fig. 32). Tighten lock nuts when desired clearance is obtained. If there is too much clearance at this point, the unloading valves may not be opened sufficiently to unload the compressor. If there is no clearance, the unloading valves may be held open continuously and the compressor will not compress air.

**j.** Install drain plug in cylinder head, if it has been removed.

**k.** Install a new cylinder head gasket so the cut-away portions of the gasket will line up with the unloading valves when the cylinder head is in position.

**l.** Position cylinder head on cylinder block in accordance with markings made before disassembly, and install and tighten nuts on cylinder head studs.

## COMPRESSORS

### 21. ASSEMBLING AND INSTALLING BASE PLATES (SELF-LUBRICATED COMPRESSORS ONLY).

**a.** Install oil pump piston and rod on crankshaft. Oil pump rod bearing fit must be the same as specified for connecting rod bearings. Be sure to install cotter pins in nuts attaching bearing cap.

**b.** Install oil pump relief valve in compressor base plate and tighten securely.

**c.** Position oil pump screen in base plate and install retaining ring.

**d.** Install oil filler drain fitting and blanking cover on sides of base plate, if they have been removed, being sure the oil filler fitting is positioned as marked before disassembly.

**e.** Install a new oil pump check valve gasket in bottom of crankcase, and position a new base plate gasket on bottom of crankcase.

**f.** Position base plate assembly on bottom of the crankcase being sure the oil pump piston engages the oil pump bushing in the base plate (fig. 33). Install dowel screw at end of base plate, and remaining attaching machine screws, and tighten securely.

### 22. ASSEMBLING AND INSTALLING AIR STRAINERS.

**a.** If the compressor assembly includes an air strainer, assemble air strainer (fig. 17). Using a new gasket, position and install strainer on cylinder block as marked before disassembly. Install inlet chamber blanking covers and new gaskets on remaining openings in intake manifold.

### 23. INSPECTION OF REBUILT UNIT.

**a.** Check to be sure all threaded openings to oil passages such as may be found in the end covers or base plate are properly plugged.

**b.** If the compressor is not to be immediately installed on a vehicle, plug the air connection to the unloading mechanism and the water connections to the cylinder head. Protect the discharge port against the entrance of dirt by fitting it with a temporary blanking cover.

**c.** Fit the ends of all crankshafts with cotter pins, nuts, and keys, when such parts are required, and then protect against damage during handling by wrapping with friction tape or some other similar material.

**d.** The unloading lever and valve mechanism must be well lubricated with lubricating oil.

**e.** Protect the open bottom of engine-lubricated compressors against the entrance of dirt during handling or storage by installing a temporary wooden cover.

## Section VI

# TEST OF REBUILT COMPRESSORS



## 24. TEST OF REBUILT COMPRESSORS.

**a.** In order to properly test compressors under operating conditions considerable equipment is necessary for mounting, lubricating, and driving the compressor during the tests. Such tests are not compulsory provided the unit has been carefully rebuilt by an experienced mechanic.

**b.** If facilities for making such tests are available, be sure the crankcase of all self-lubricated compressors is properly filled with lubricating oil before the compressor is operated. Engine-lubricated compressors must be connected to an oil supply line of at least 15-pound pressure during all tests. Facilities must be provided for keeping the compressor crankcase free of oil during the tests. Water-cooled compressors must be connected to a water circulating system.

**c.** The following tests are recommended:

(1) A run in test is made by running the compressor at 1,250 revolutions per minute for one-half hour with the discharge port open to atmosphere. Check during this run for oil leaks, overheated bearings, and excessive noise.

(2) An oil passing test is made by running the compressor for one half-hour at 1,250 revolutions per minute, pumping against 50-pounds air pressure, with an oil trap connected in the discharge line. The oil passed during this test must not exceed 2 cubic centimeters.

(3) An efficiency test is made by running the compressor for one half-hour at 1,250 revolutions per minute connected to a reservoir fitted with an orifice type exhaust fitting. Two-cylinder 7¼-cubic foot compressors should maintain at least 47-pound pressure in the reservoir with a $\frac{1}{16}$-inch diameter orifice in the exhaust fitting. Three-cylinder 12-cubic foot compressors must maintain at least 55-pound pressure in the reservoir with a $\frac{5}{64}$-inch diameter orifice in the exhaust fitting.

(4) Oil pressure tests on self-lubricated compressors are made by connecting an accurate oil pressure test gage to the compressor lubricating system. With the compressor running at 1,250 revolutions per minute the oil pressure must not be less than 14 pounds nor more than 24 pounds.

## Section VII
# TABULATED DATA



## 25. TABULATED DATA.

| | Two-cylinder 7¼ cu ft compressors | Three-cylinder 12 cu ft compressors |
|---|---|---|
| Displacement in cubic feet per minute at 1,250 rpm | 7¼ | 12 |
| Number of cylinders | 2 | 3 |
| Bore | 2 1/16 in. | 2 3/16 in. |
| Stroke | 1½ in. | 1½ in. |
| Lubrication | Self-lubricated or engine-lubricated | Self-lubricated or engine-lubricated |
| Cooling | Water or air | Water or air |
| Horsepower required at 1,250 rpm against 90 pounds per square inch air pressure | 1.6 | 2.6 |
| Recommended maximum speed for water-cooled compressors | 1,800 rpm | 1,800 rpm |
| Recommended maximum speed for air-cooled compressors | 1,250 rpm | 1,250 rpm |
| Minimum oil pressure required at engine idling speed | 5 lb per sq in. | 5 lb per sq in. |
| Minimum oil pressure required at maximum governed speed of engine | 15 lb per sq in. | 15 lb per sq in. |

# CHAPTER 3
# GOVERNOR

## Section I
## DESCRIPTION AND OPERATION



### 26. DESCRIPTION.

**a.** The purpose of the compressor governor (fig. 34) is to automatically control the air pressure being maintained in the reservoir of the air brake system by the compressor, between the maximum pressure desired (100-105 lb) and the minimum pressure required for safe brake operation (80-85 lb). To understand this function of the governor, it should be remembered that while the compressor may run continuously, actual compression of air is controlled by the governor, which, acting in conjunction with the compressor unloading mechanism, stops or starts compression when these maximum and minimum reservoir pressures are reached.

**b.** The design of the compressor governor is based on the principle of a Bourdon tube which is a flattened metal tube bent to a curve that tends to straighten under internal pressure (fig. 35). This reaction by the tube, due to changes in the air pressure in the tube, increases or decreases the spring load on the valve mechanism of the governor and makes the valve mechanism assume its "cut-in" or "cut-out" positions in accordance with the air pressure in the reservoir. Two types of governor cases will be found in service, one being a die-cast case and the other a pressed-steel case. Both types of cases are interchangeable with each other and the working parts of the governor used in both types of cases are identical.

### 27. OPERATION (fig. 35).

**a.** Air pressure from the reservoir enters the governor through the strainer and is always present below the lower valve and in the spring tube. As the air pressure increases, the load exerted on the lower valve by the spring tube, decreases because the spring tube tends to straighten out.

**b.** When the reservoir air pressure reaches the cut-out setting of the governor (100 to 105 lb) the spring load of the spring tube on the upper and lower valves has been reduced enough to permit air pressure to raise the lower valve off its seat. This movement of the lower valve raises the upper valve to its seat which closes the exhaust

**GOVERNOR**

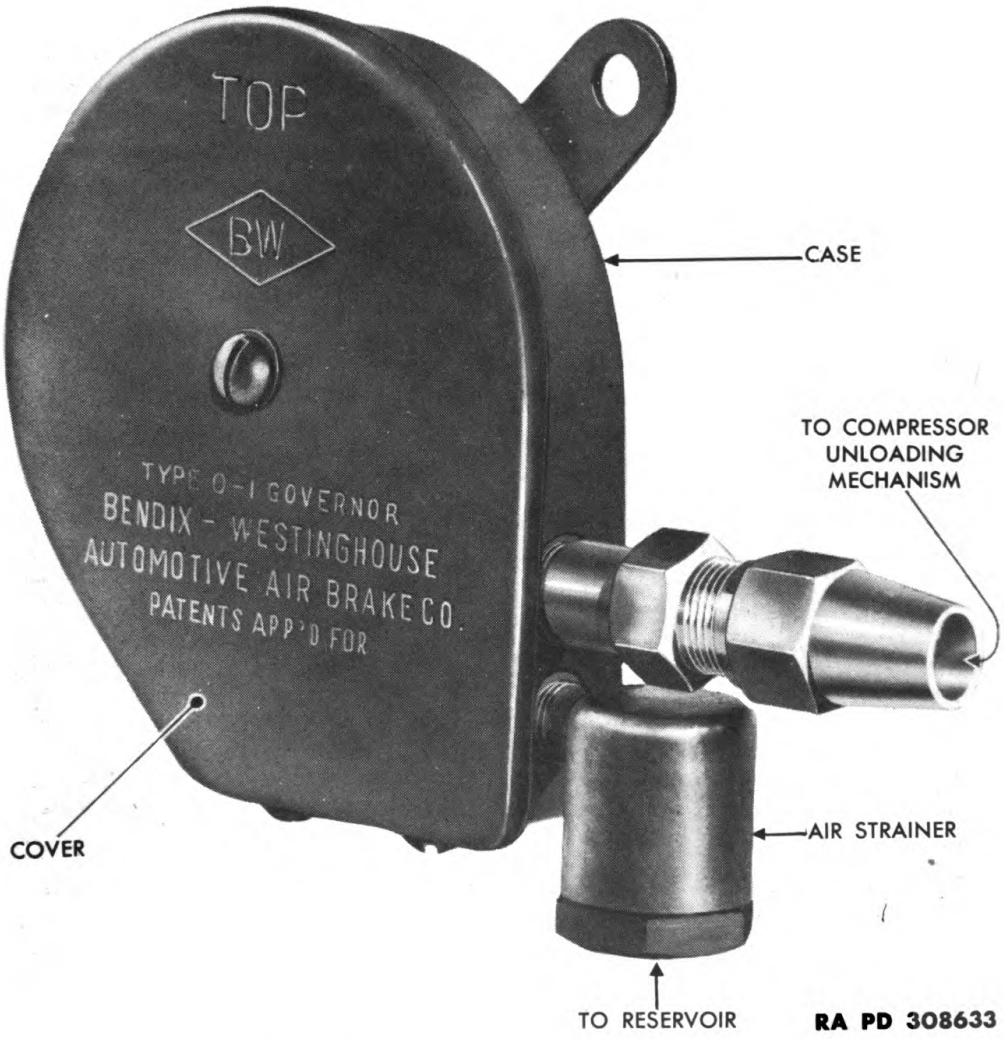



***Figure 34 — Type-0-1 Governor***

port. Air then flows up through the small hole in the lower valve and out the upper connection to the unloading mechanism of the compressor cylinder head. When this occurs, the unloading valves in the compressor cylinder head are opened and further compression of air is stopped.

c. As the air pressure in the reservoir drops to the cut-in setting of the compressor governor (80 to 85 lb), the pressure of the spring tube on the upper valve increases and forces the upper valve down off its seat. This movement also seats the lower valve preventing reservoir air pressure from passing through the governor. With the upper valve off its seat, air pressure in the unloading diaphragm cavity in the compressor cylinder head escapes through the exhaust

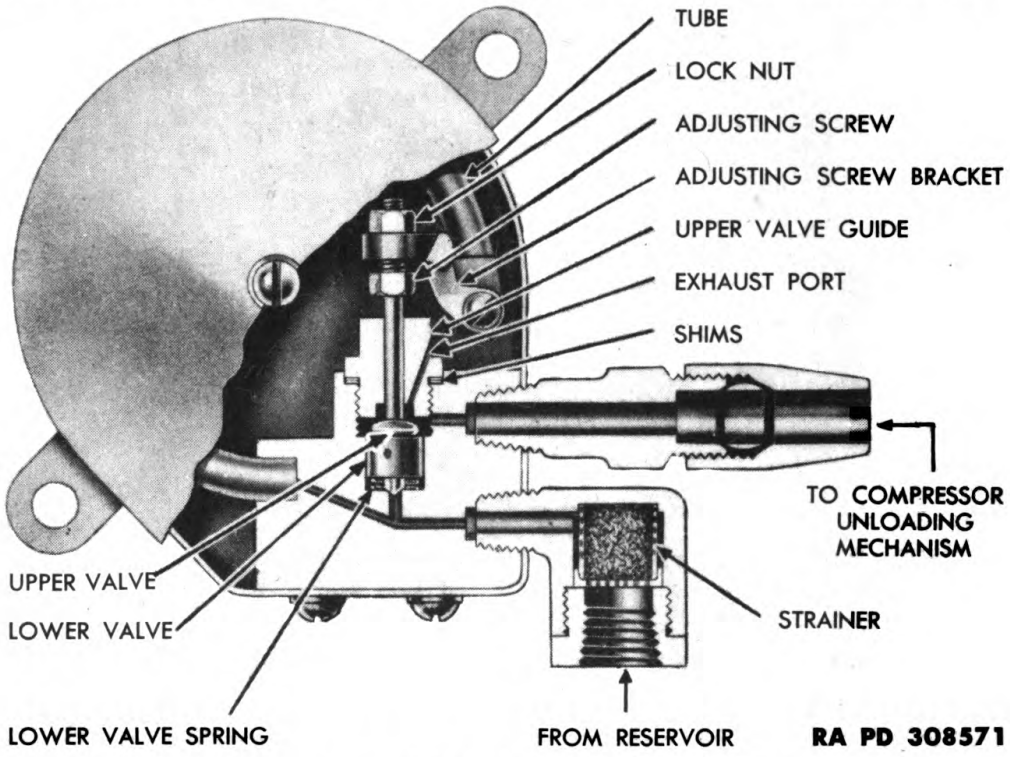



***Figure 35 — Sectional View of Governor***

port in the governor. This permits the unloading valves in the compressor cylinder head to close. Compression is resumed until reservoir pressure again rises to the cut-out setting of the governor.

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## Section II

## CLEANING, INSPECTION, AND DISASSEMBLY



### 28. CLEANING, INSPECTION AND DISASSEMBLY.

**a. General.** If testing equipment is available, the governor may be tested before disassembly by following the procedure outlined in paragraph 32.

**b. Cleaning and Inspection.**

(1) Remove all dirt or grease from exterior of case using dry-cleaning solvent, and a brush.

(2) Inspect case and cover for breakage or other damage. Case or cover must be replaced if damaged in any way.

**GOVERNOR**

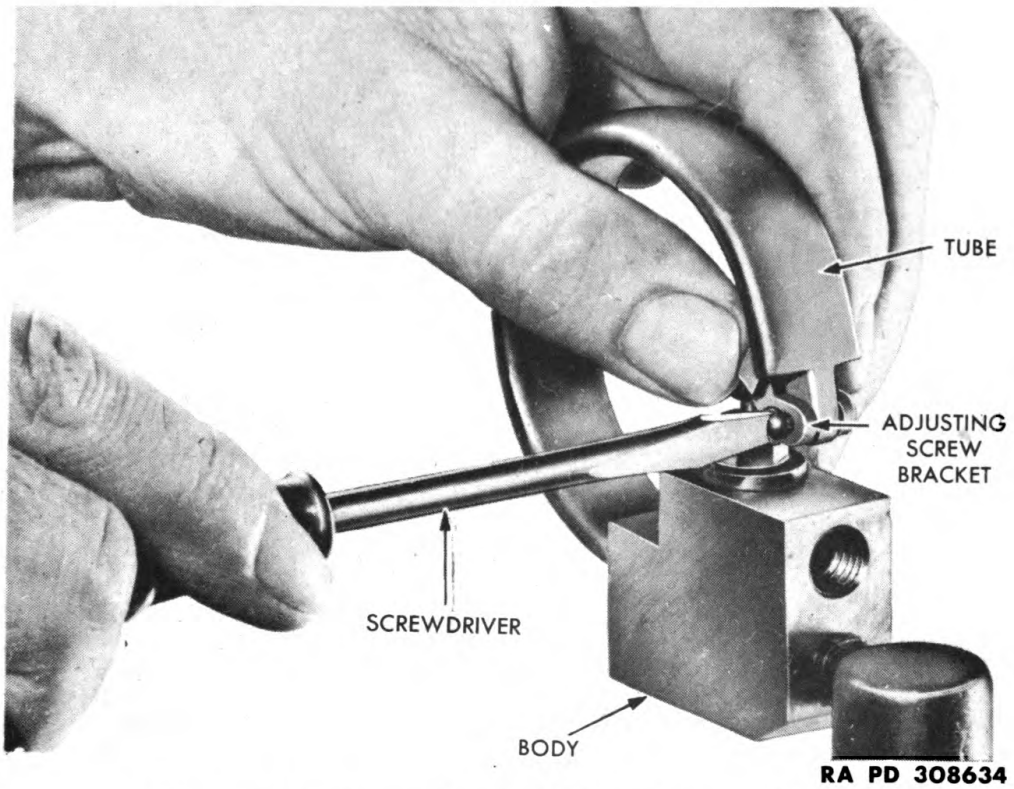



***Figure 36 — Removing Adjusting Screw Bracket***

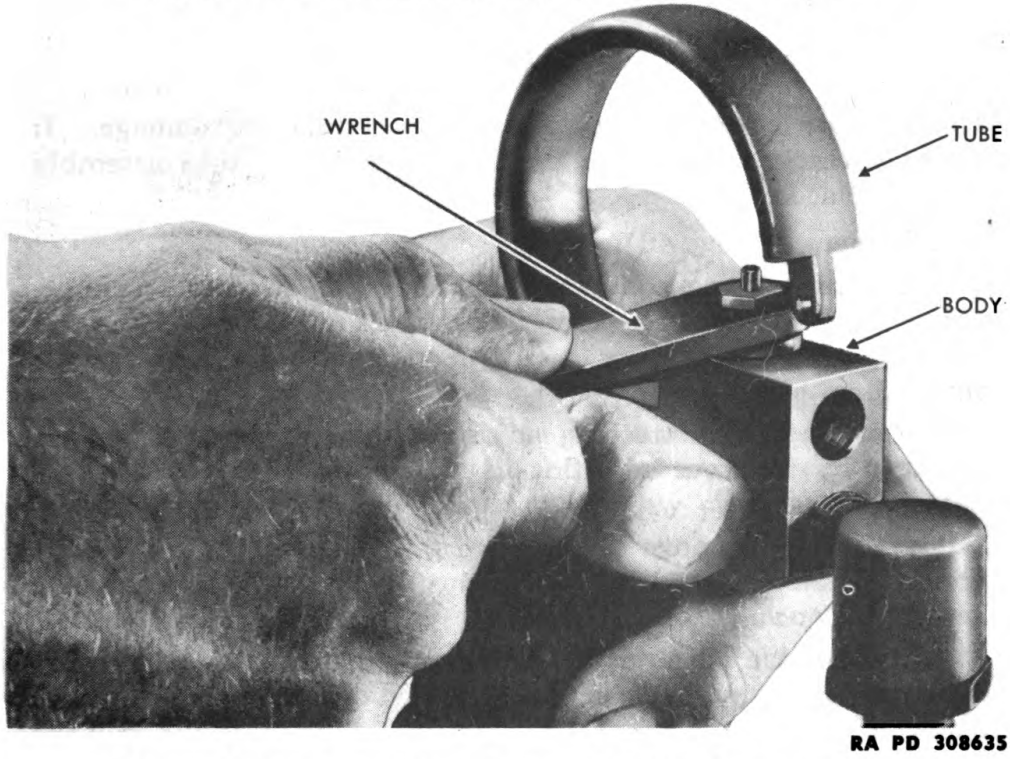



***Figure 37 — Removing Upper Valve Guide, Using Wrench 41-W-867-265***

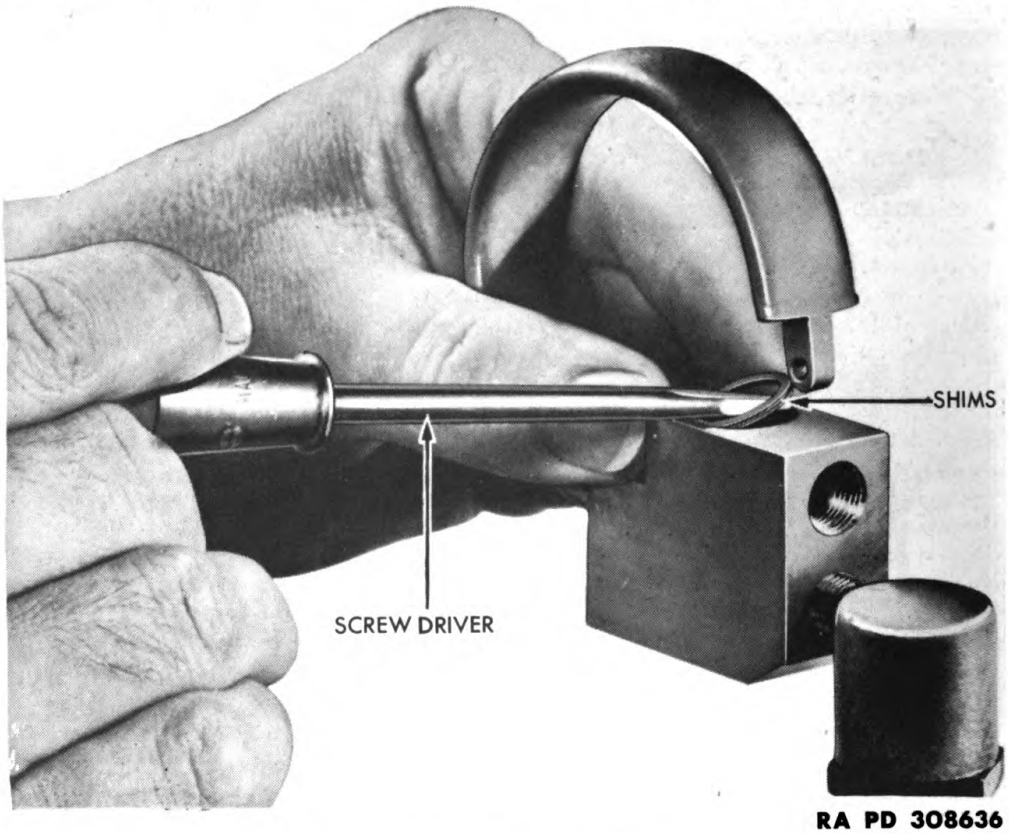



***Figure 38 — Removing Shims***

(3) Remove cover from case and inspect tube for damage. If the tube is cracked, dented, or broken, the body and tube assembly must be replaced.

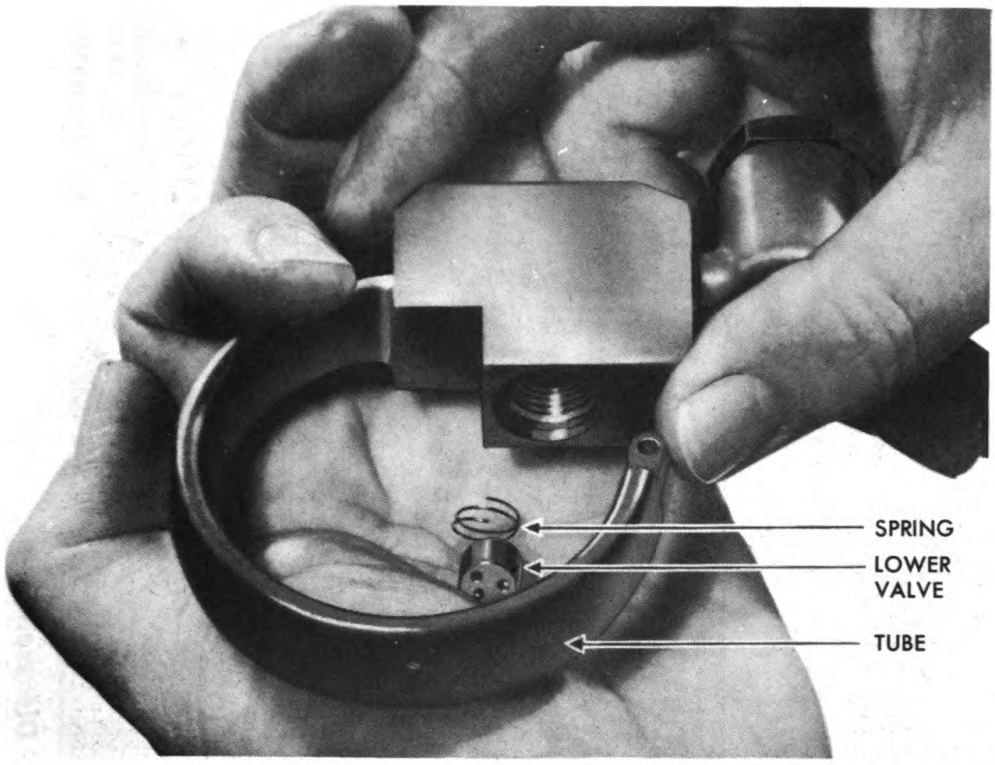
**c. Disassembly** (fig. 40).

(1) Unscrew tubing connector. Unscrew air strainer assembly. Remove screw attaching cover to case and remove cover. Remove four screws and lock washers located at bottom of case, and remove governor from case.

(2) Remove screw attaching adjusting screw bracket to end of tube (fig. 36). Remove adjusting screw bracket.

(3) Unscrew upper valve guide using wrench (41-W-867-265), or equivalent, and remove upper valve guide and upper valve (fig. 37). Lift out shims from governor body (fig. 38). Shake out lower valve and lower valve spring (fig. 39).

(4) Disassemble air strainer. Unscrew cap nut from air strainer body and remove cup screen, lamb's wool, and cylindrical screen, from strainer body.




RA PD 308637

*Figure 39 — Removing Lower Valve and Spring*

## Section III
## CLEANING AND INSPECTION OF PARTS



### 29. CLEANING AND INSPECTION OF PARTS.

**a. Clean all parts.** Clean all parts in dry-cleaning solvent, and be particularly sure that all passages through the body are not obstructed in any way. Also be sure small drilled passage through lower valve is clean and open. Lamb's wool in the air strainer may be used again if it can be washed thoroughly clean in dry-cleaning solvent, otherwise it must be replaced.

**b. Spring Tube.** If the spring tube is damaged in any way, if it leaks, or if it has become loose at the soldered joint at the body, the body and tube assembly must be replaced.

**c. Upper Valve and Upper Valve Guide.** Inspect seat on upper valve and upper valve guide for wear or damage. Also check fit of upper valve stem in upper valve guide. If the seat on the upper

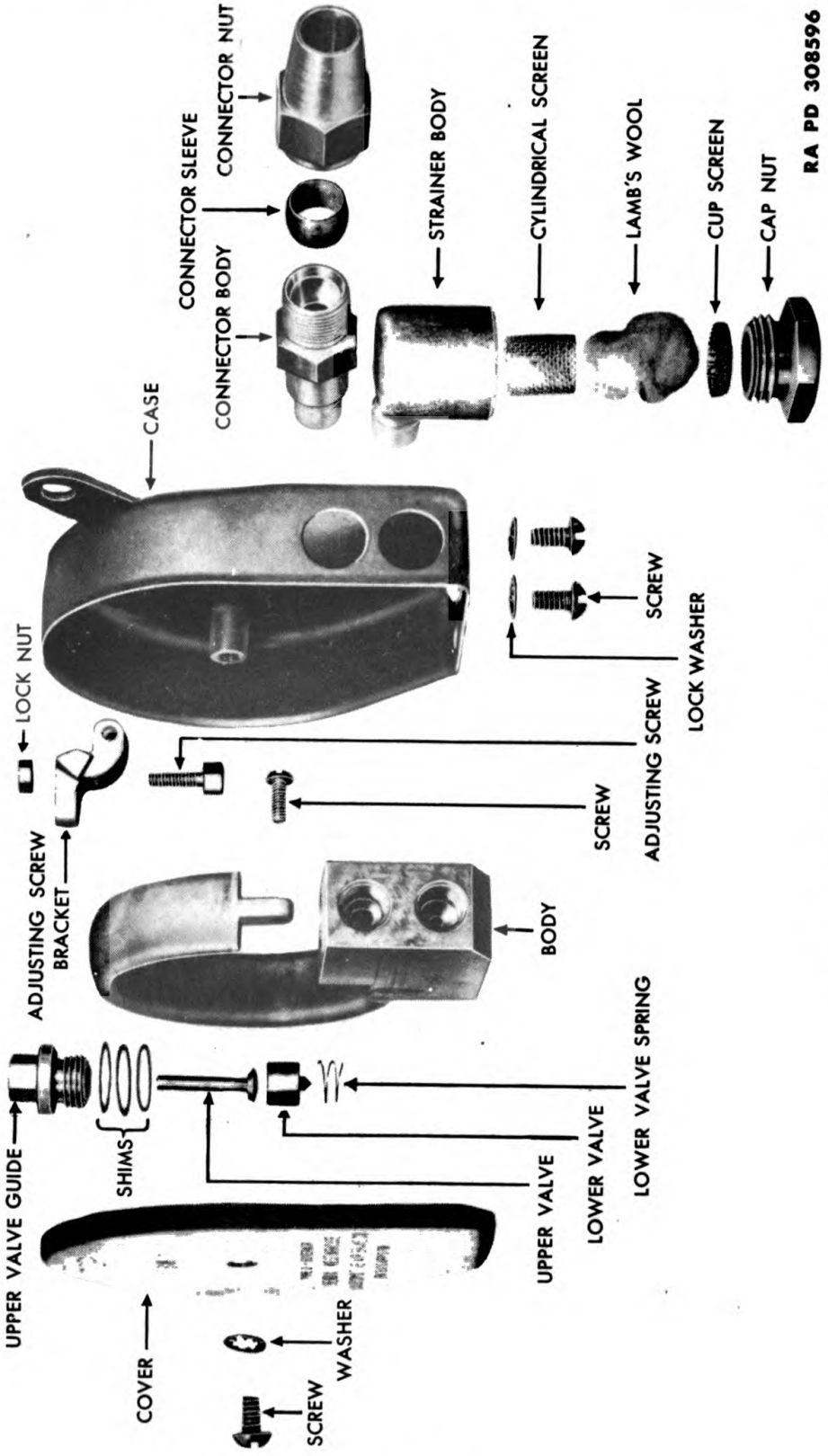



***Figure 40 — Governor Disassembled***

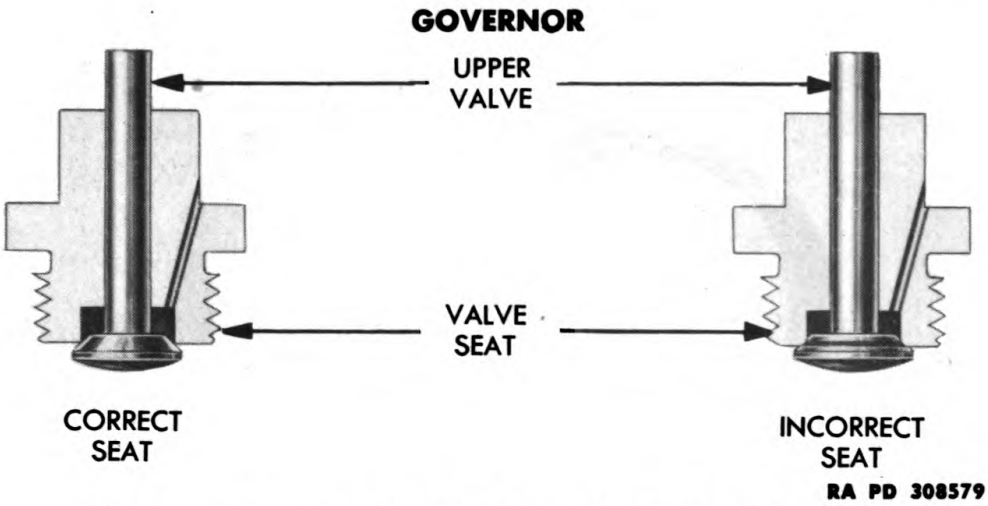



***Figure 41 — Correct and Incorrect Upper Valve Seats***

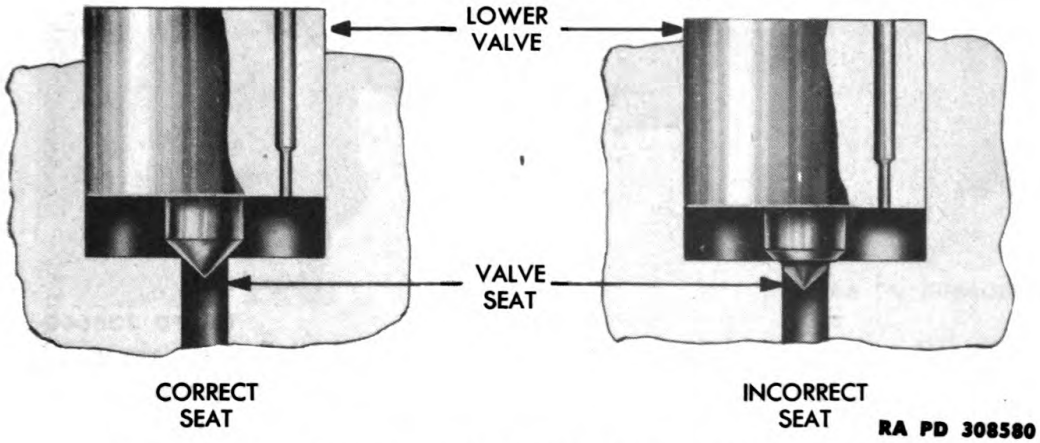



***Figure 42 — Correct and Incorrect Lower Valve Seats***

valve shows a decided groove from wear (fig. 41) or if the upper valve stem is not a neat sliding fit in the upper valve guide, the upper valve and upper valve guide must be replaced as an assembly.

**d. Lower Valve and Lower Valve Seat.** Inspect lower valve for wear or damage. If the valve is grooved excessively (fig. 42), it must be replaced. Check fit of lower valve in body. It must be a neat sliding fit. If excessive clearance is evident, the lower valve must be replaced.

## Section IV
## REPAIRS



### 30. REPAIRS.

**a. Upper Valve and Upper Valve Guide.** If the upper valve and seat are not too badly worn, they are repaired by carefully grinding

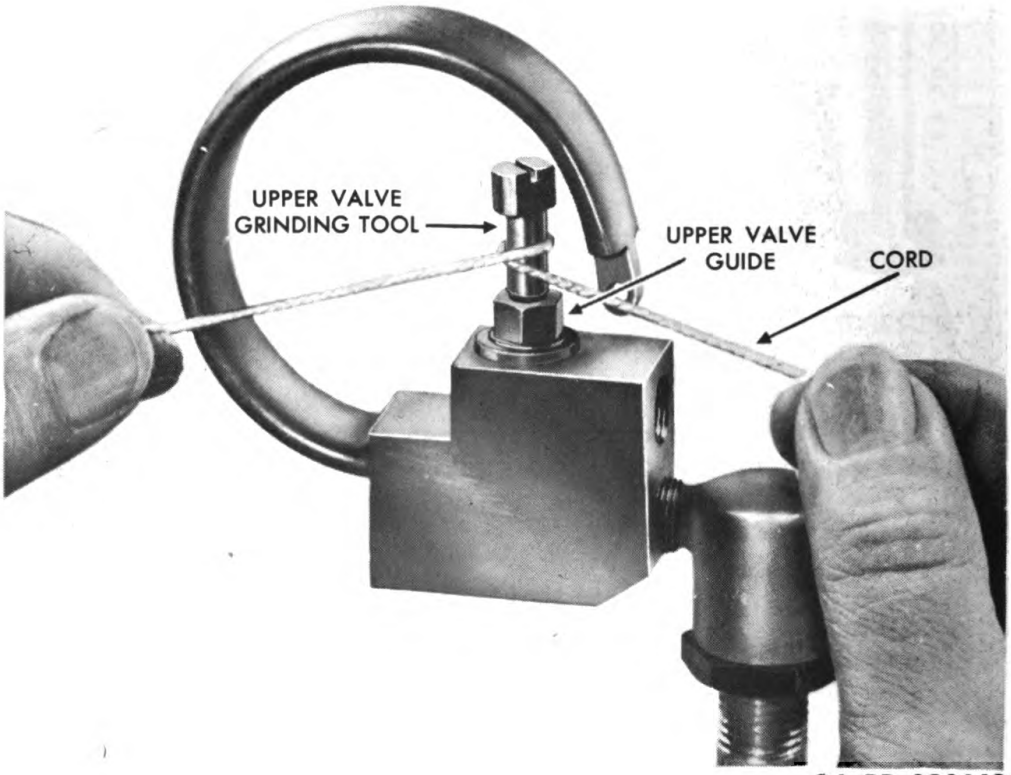



***Figure 43 — Grinding Upper Valve, using tool 41-T-3381-20***

the valve to its seat using grinding tool (41-T-3381-20) and (BWE grade 1,000) grinding compound or its equivalent (fig. 43). When grinding upper valve, temporarily screw upper valve and upper valve guide in place in body (fig. 37). Do not use ordinary valve grinding compound as this cuts too fast and it is impossible to obtain a good seal. The valve must be turned back and forth during the grinding operation by using a piece of cord. The cord should be pulled in such a manner as to keep the upper valve contacting the upper valve guide during the grinding operation. Clean valve and valve seat after grinding in dry-cleaning solvent.

**b. Lower Valve and Valve Seat.**

(1) If leakage is due to a worn or damaged lower valve and seat, and the wear or damage is not excessive, the lower valve must be ground to its seat using grinding tool (41-T-3381-10) and (BWE grade 1,000) grinding compound (fig. 44). Do not use ordinary valve grinding compound.

(2) If a new lower valve is being installed, tapping the valve to its seat before grinding is usually helpful. To do this put lower valve in place, and install upper valve and upper valve guide. Then using

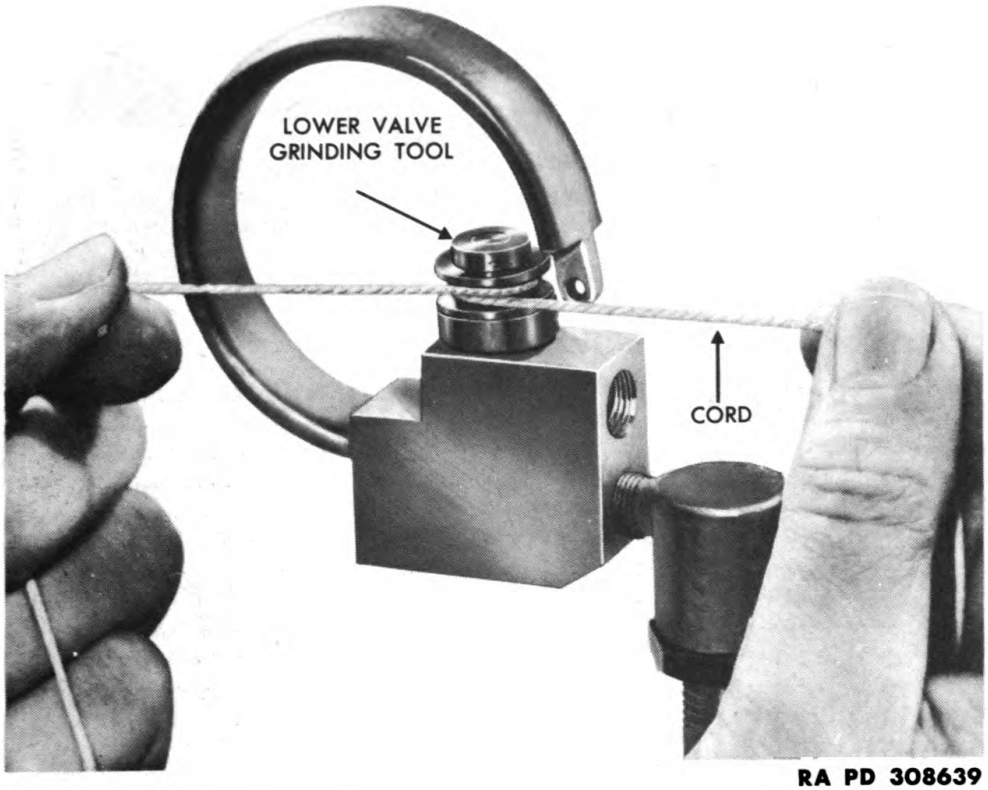



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***Figure 44 — Grinding Lower Valve, Using Tool 41-T-3381-10***

valve seating tool (41-T-3383-10) and a small hammer, lightly tap the lower valve to its seat a few times (fig. 45).

(3) Clean valve and governor body thoroughly after grinding with dry-cleaning solvent.

(4) If leakage of the lower valve cannot be corrected by the above procedure, the complete governor must be replaced.

---

## Section V

## ASSEMBLY



### 31. ASSEMBLY.

**a.** Parts must be thoroughly clean.

**b.** Install lower valve spring and lower valve in lower valve recess of governor body. Install shims in governor body. Insert upper

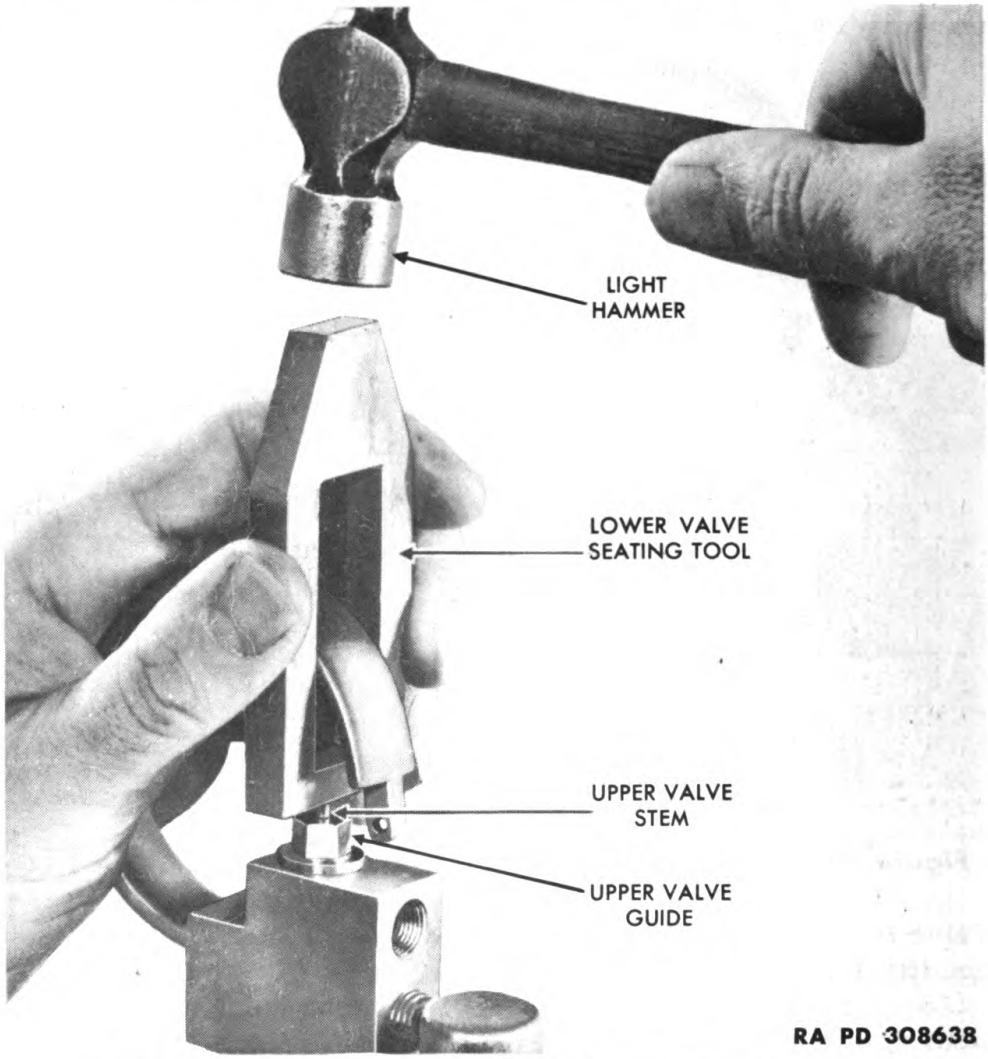


***Figure 45 — Seating Lower Valve with Seating Tool 41-T-3383-10***

valve stem through upper valve guide and screw upper valve and guide into place. Tighten securely using wrench (41-W-867-265) or equivalent. Install adjusting screw and adjusting screw lock nut in adjusting screw bracket. Position adjusting screw bracket in place on ends of spring tube, and install attaching screw.

**c.** Pack cylindrical strainer screen with new or cleaned lamb's wool and place cylindrical strainer screen in strainer body. Position cup strainer screen over the end of cylindrical screen in strainer body, and install strainer cap nut. Screw strainer assembly into lower connection of governor (fig. 35).

**d.** Adjust and test governor on test rack (par. 32).

**e.** If governor passes all tests, remove strainer, position governor

in case, and install four mounting screws and lock washers. Position cover on case and install attaching screw and lock washers.

**f.** Screw air strainer into lower connection in governor body and position (fig. 35).

**g.** Install tubing fitting in top connection of governor and plug both air connections against the entrance of dirt during storage or shipment.

---

## Section VI

# TEST AND ADJUSTMENT OF REBUILT GOVERNOR



## 32. TEST AND ADJUSTMENT OF REBUILT GOVERNOR.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 120 pounds pressure.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4, and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 5, No. 6, and No. 7.

**b. Connect Governor to Test Rack.**

(1) With governor removed from its case, connect hose No. 2 to reservoir (lower) port of governor.

(2) Connect hose No. 4 to compressor unloading mechanism (upper) port of governor.

**c. Adjust Pressure Settings and Pressure Range.**

(1) Open cock No. 3 and observe at what pressure on gage No. 2 the governor cuts out (tube lifts). Governor must cut out when gage No. 2 registers between 100 and 105 pounds. The cut-out pressure is raised by loosening the lock nut and turning the adjusting screw clockwise. The cut-out pressure is lowered by turning the adjusting screw counterclockwise. If adjustment is made, tighten lock nut before again checking cut-out pressure.

(2) To check cut-out pressure after adjustment, close cock No. 3 and open cock No. 4 until governor cuts in. Then close cock No. 4, and open cock No. 3, and again observe at what pressure on gage No. 2 the governor cuts out. Continue adjustment and test until governor cuts out when pressure registered by gage No. 2 is between 100 and 105 pounds.

(3) With governor adjusted to cut out between 100 and 105 pounds, close cock No. 3, open cock No. 4, and observe at what pressure registered by gage No. 2, the governor cuts in. The tube then

resumes normal position. Governor must cut in when pressure registered by gage No. 2 is between 80 and 85 pounds. NOTE: *If governor cuts in above 85 pounds, the range must be increased by removing one or more shims from beneath the upper valve guide. If governor cuts in below 80 pounds, the range must be decreased by installing one or more shims.*

(4) Continue tests and adjustment until governor cuts out at between 100 and 105 pounds and cuts in at between 80 and 85 pounds.

**d. Leakage Tests.**

(1) With governor adjusted, close cock No. 4 and open cock No. 3. After governor cuts out, coat the exhaust port with soap suds to check for leakage of the upper valve.

(2) Then close cock No. 3 and open cock No. 4 until governor cuts in. When governor cuts in, close cock No. 4 and coat the exhaust port with soap suds to check for leakage of the lower valve.

(3) Leakage in excess of a 1-inch soap bubble in 5 seconds, in either of these tests, is not permissible. If leakage is excessive, the valves must be reground or replaced, whichever is necessary.

**e. Disconnect Governor from Test Rack.**

(1) If governor passes all tests, blow off all traces of soap suds and disconnect hose lines.

(2) Install governor in case (par. 31e), and plug both ports with pipe plugs to prevent the entrance of dirt during shipment or storage.

# CHAPTER 4
# BRAKE VALVES

## Section I
## TYPE-B4B BRAKE VALVES (PEDAL OPERATED)



### 33. DESCRIPTION AND OPERATION.

**a. Description.**

(1) Standard B4B brake valves (fig. 46-47) are fitted with a lever which is connected to and operated by a foot pedal. Movement of the lever by the brake pedal controls the movement of an inlet valve and an exhaust valve which in turn control the air pressure being delivered to or released from the brake chambers. To fully apply the brakes on a vehicle, the foot pedal is fully depressed, whereas when the pedal is only partially depressed, correspondingly less braking force is developed. In other words, the farther the driver depresses the foot pedal, the higher the air pressure delivered to the brake chambers and the more severe the brake application. The brakes of the vehicle are partially released by the driver partially releasing the foot pedal or they are entirely released by the driver permitting the foot pedal to return to full released position. In this manner, the air pressure passing through the brake valve to the brakes of the vehicle is always under control of the driver.

(2) Special type-B4B brake valves (fig. 48) are exactly the same in outward appearance as the standard type. The only difference is that the special type has a steel sleeve to depress the diaphragm instead of a pressure regulating spring assembly. The use of a sleeve instead of a spring is desirable because this type of brake valve is only intended to be operated by a hand grip control such as used on the steering levers of some track laying tractors.

**b. Operation.**

(1) As the driver depresses the foot pedal and the brake valve lever moves toward its fully applied position, pressure is put on top of the metal diaphragm in the brake valve. This occurs through the action of the plunger and the spring located in the upper chamber above the diaphragm. As the diaphragm moves downward, pressure is exerted on the middle of the rocker arm. Because the exhaust valve spring is weaker than the inlet valve spring, the exhaust valve

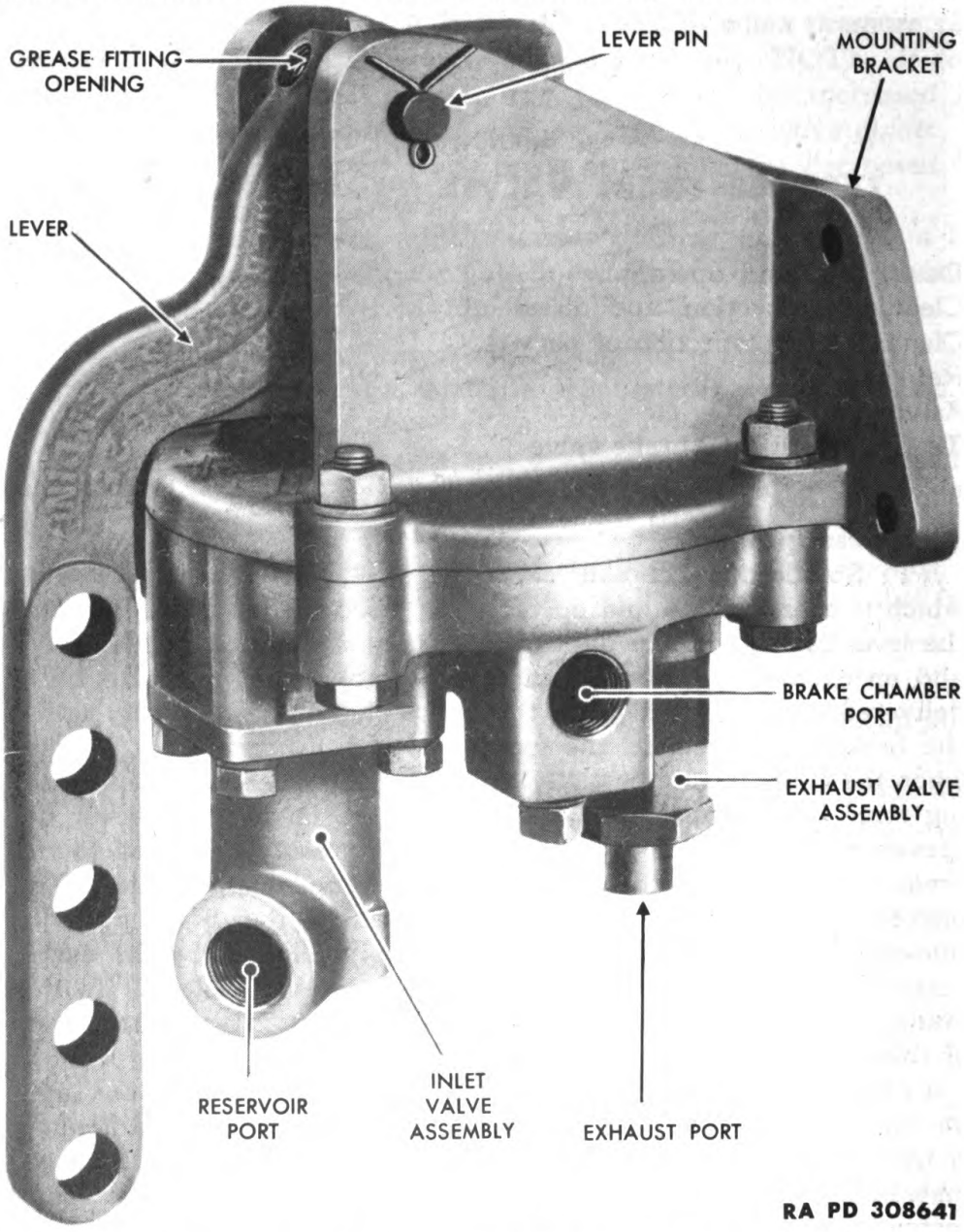


***Figure 46 — Type-B4B Brake Valve***

is forced downward to its seat before the inlet valve is forced downward to open. When the inlet valve opens, air pressure is permitted to flow from the reservoir through the brake valve to the brake chambers applying the brakes. When the air pressure being delivered to the brake chambers from the cavity below the diaphragm overcomes the mechanical force being exerted on top of the diaphragm, the diaphragm lifts and the inlet valve closes preventing any further rise of air pressure in the brake chambers, while the exhaust valve

**BRAKE VALVES**

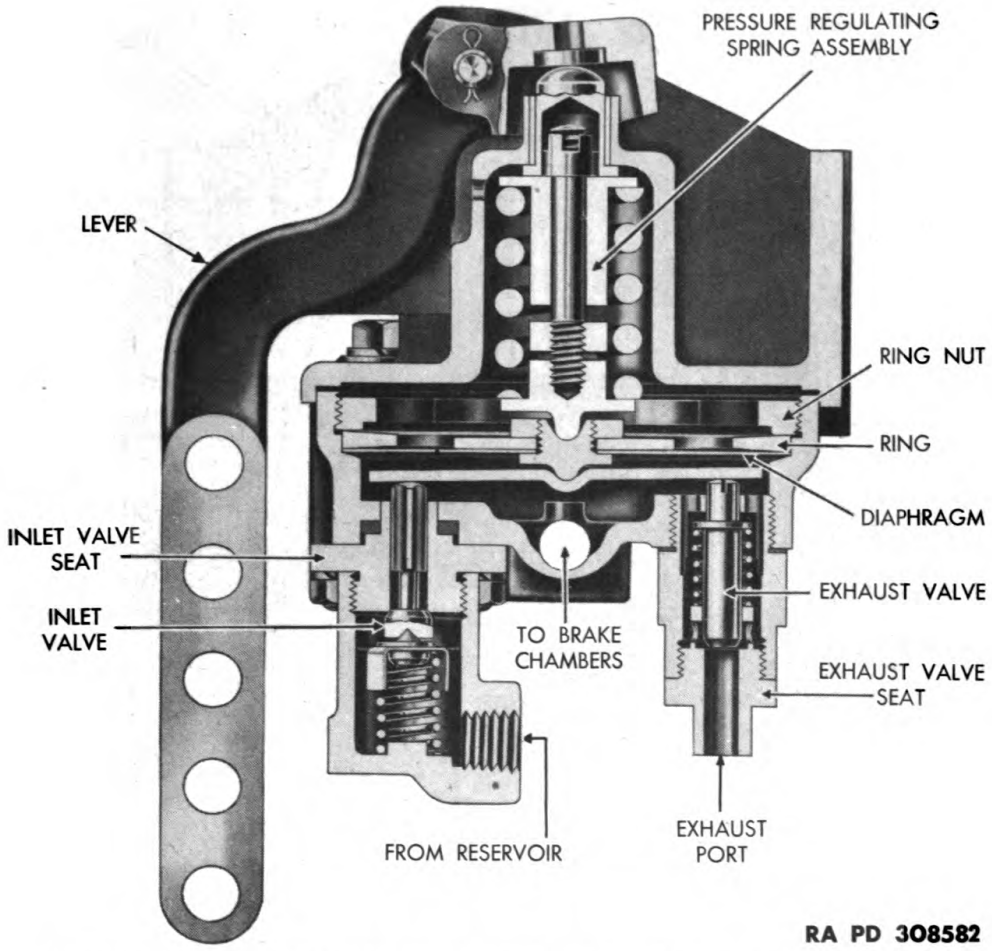


***Figure 47 — Sectional View of Standard Type Brake Valve***

remains closed, preventing any escape of air pressure. Should the driver depress the foot pedal further and put additional mechanical force on top of the diaphragm, the air pressure being delivered to the brake chambers is correspondingly increased.

(2) If the driver permits the foot pedal to partially return toward its fully released position, thus reducing the load on top of the diaphragm, air pressure below the diaphragm overcomes the mechanical force on top of it, and the diaphragm lifts still further. Under these conditions, the inlet valve remains closed and the exhaust valve opens to exhaust air pressure from the brake chambers until the air pressure below the diaphragm again balances the mechanical pressure on top of it. If the driver permits the foot pedal to return to full release position, the exhaust valve remains open, all pressure from the brake chambers is exhausted, and the brakes on the vehicle are fully released.

(3) If the driver depresses the foot pedal to fully applied position, the pressure regulating spring is compressed until the spring guide

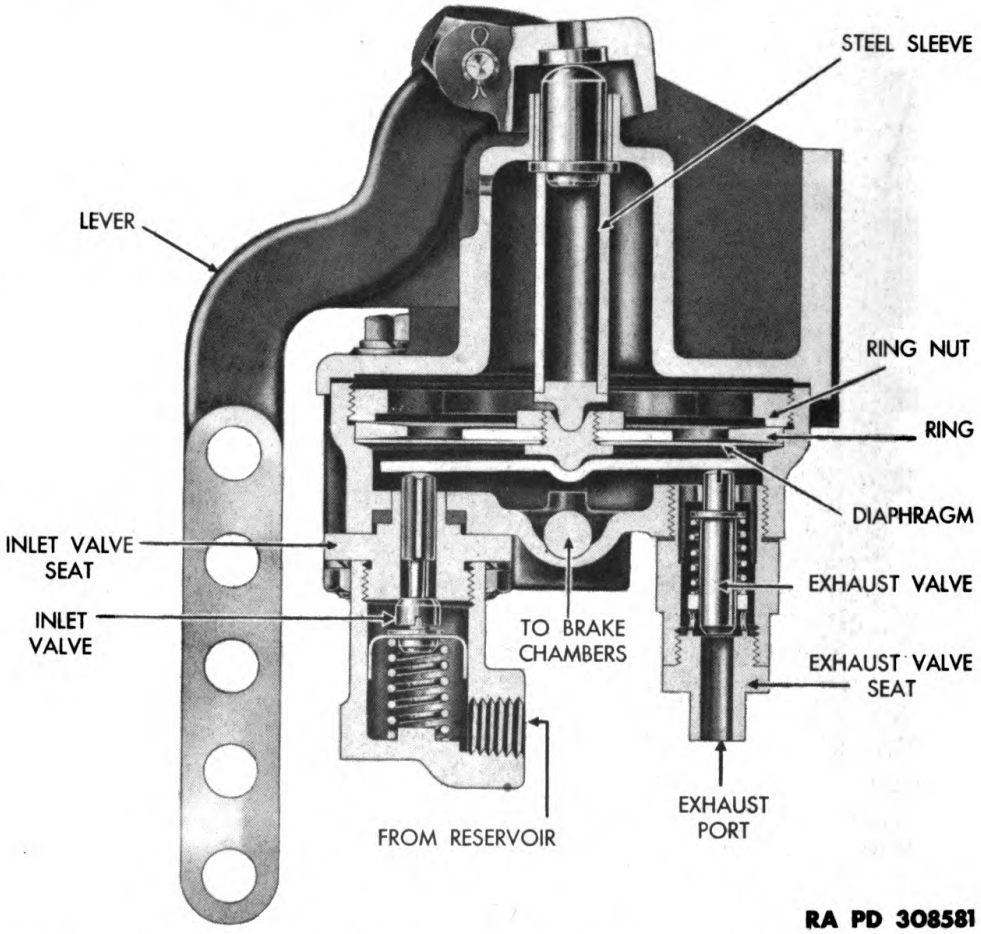


***Figure 48 — Sectional View of Special Type-B4B Brake Valve Used on Some Track Laying Tractors***

strikes the spring seat. Under these conditions the inlet valve is held open, and full reservoir pressure is permitted to pass through the brake valve to the brake chambers.

(4) Operation of the special type brake valve (fig. 48) is very similar to that of the standard type, except this type of valve is operated by a hand grip control. It has a steel sleeve above the diaphragm instead of a graduating spring. Reaction of the valve mechanism is totally controlled, and cushioned by the driver's hand grip rather than by the pressure regulating spring.

## 34. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. General.** If testing equipment is available, the brake valve may be tested before disassembly by following the procedure outlined in paragraph 38.

**b. Cleaning and Inspection.** Remove all dirt or grease from exterior of valve using dry-cleaning solvent and a brush. Inspect

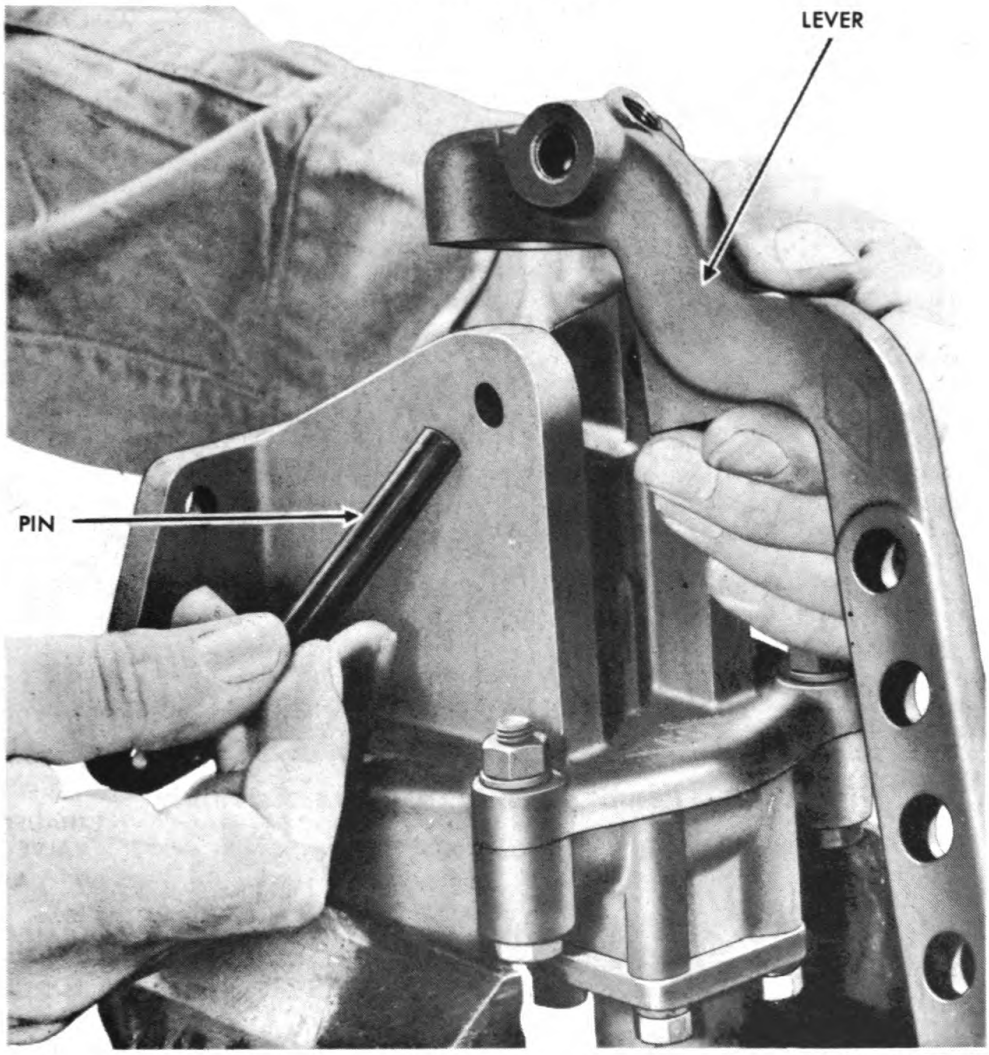


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***Figure 49 — Removing Lever***

exterior of valve for broken or damaged parts. All broken or damaged parts must be replaced.

**c. Disassembly.**

(1) MARKING BEFORE DISASSEMBLY. The inlet valve assembly may be installed on the body of the brake valve in several different positions to meet installation requirements. Before disassembly, the location of the inlet opening in relation to the body of the brake valve is marked with a center punch to facilitate assembly.

(2) REMOVE AND DISASSEMBLE LEVER (fig. 49). Remove cotter pins from ends of lever fulcrum pin, and drive out pin. If lever pin bushings are to be replaced, they are pressed or driven out. The lever button must not be removed unless replacement is necessary. A new button is driven into place.

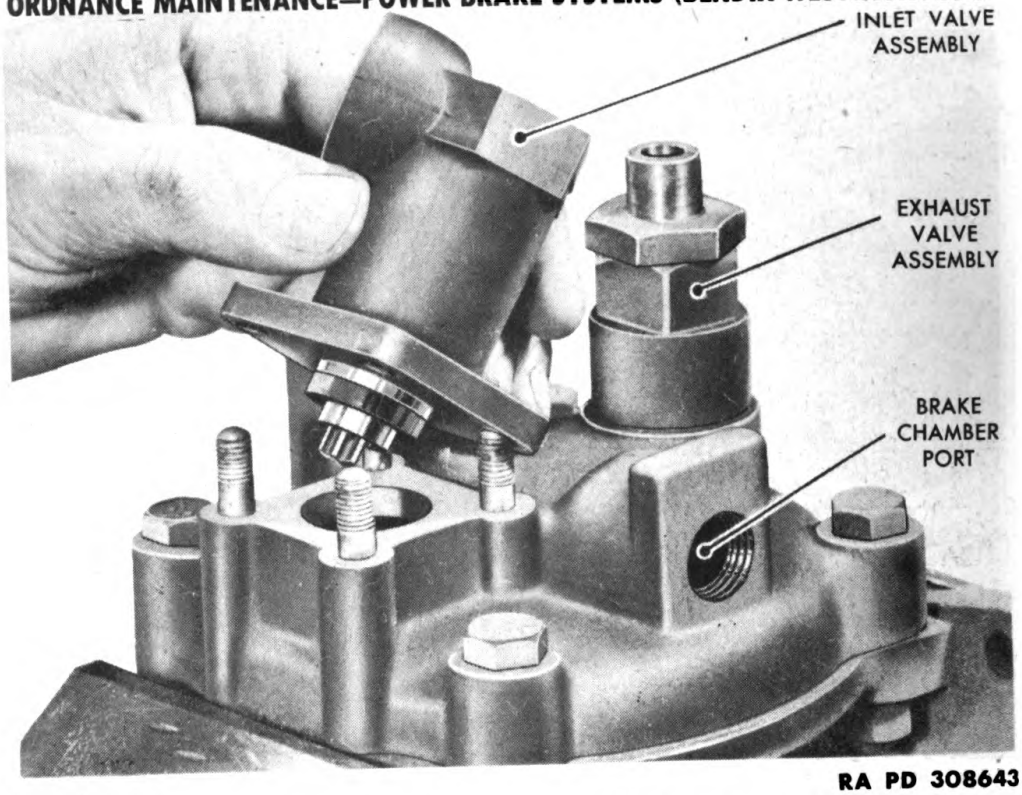


*Figure 50 — Removing Intake Valve Assembly*

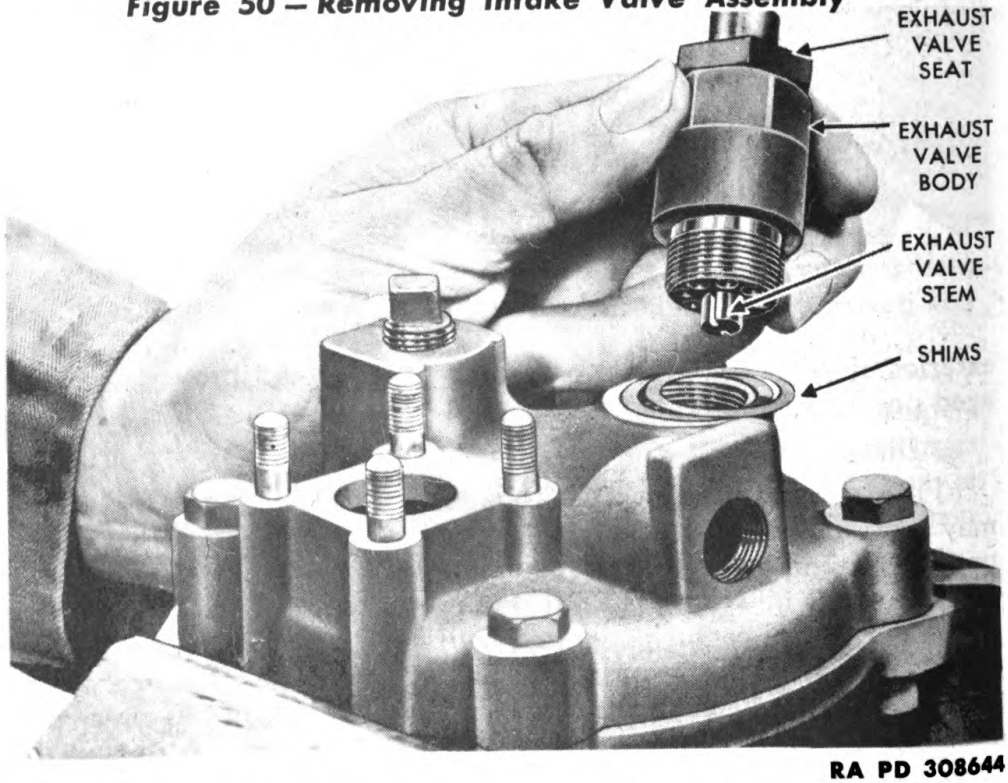


*Figure 51 — Removing Exhaust Valve Assembly*

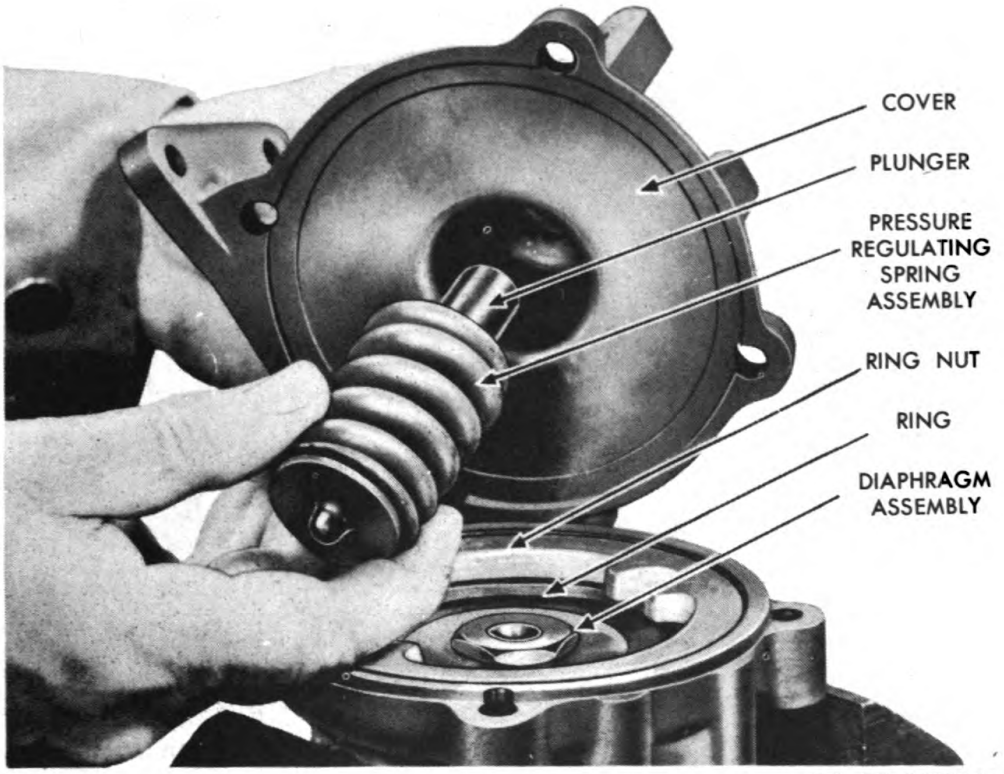


***Figure 52 — Removing Cover***

(3) REMOVE AND DISASSEMBLE INTAKE VALVE ASSEMBLY. Remove four nuts and lock washers, and remove intake valve assembly from brake valve body (fig. 50). Remove intake valve gasket. Unscrew spring cage from intake valve seat, and remove shim washer from top of spring cage. Remove intake valve from intake valve seat. Remove spring seat, dampner, and intake valve spring, from intake valve spring cage.

(4) REMOVE AND DISASSEMBLE EXHAUST VALVE ASSEMBLY. Unscrew exhaust valve assembly, and remove exhaust valve shims (fig. 51). Unscrew exhaust valve seat from spring cage, and lift out exhaust valve spring and exhaust valve.

(5) REMOVE AND DISASSEMBLE COVER. Remove the four bolts, nuts, and lock washers, that attach the cover to the body. Lift off cover (fig. 52). Lift out pressure regulating spring assembly and plunger from cover. Do not disassemble pressure regulating spring assembly.

(6) REMOVE DIAPHRAGM ASSEMBLY. The diaphragm ring nut may best be removed by using a wrench, such as shown in figures 53 and 54. If such a wrench is not available the ring nut can be removed

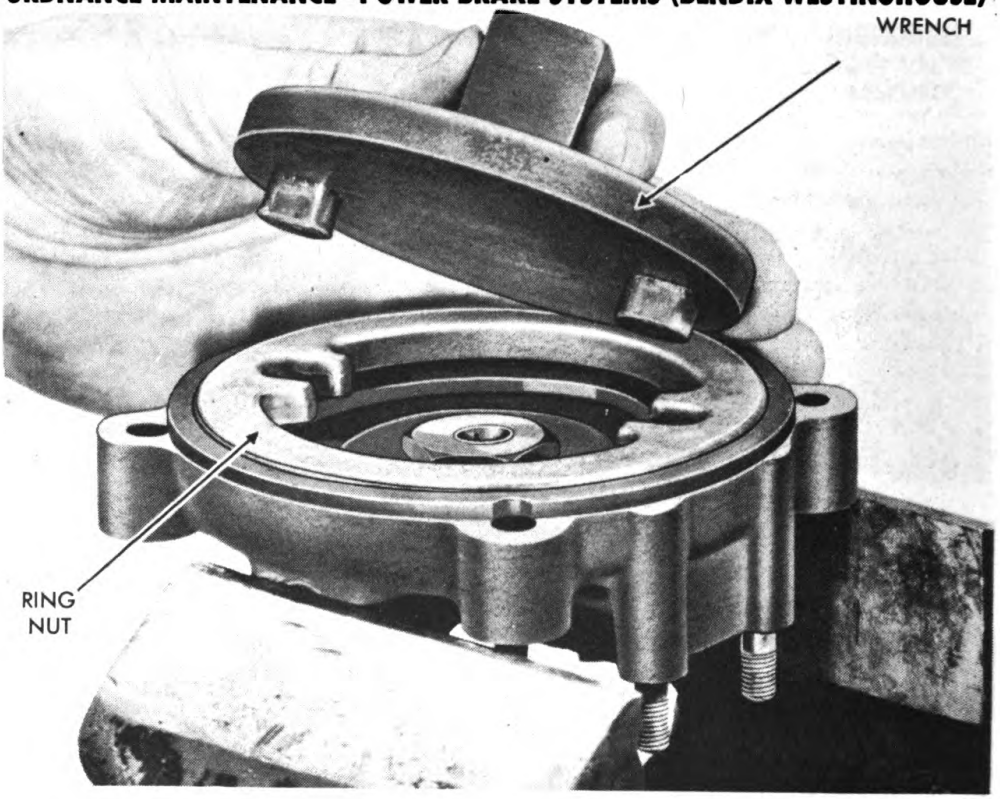


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***Figure 53 — Positioning Wrench for Removing Diaphragm Ring Nut***

with a piece of stock and an adjustable wrench. Lift diaphragm ring and diaphragm assembly out of body. Unscrew pivot nut from diaphragm pivot, and lift off diaphragm washer and diaphragms. Remove rocker arm from body (fig. 55).

## 35. CLEANING AND INSPECTION OF PARTS.

**a. Clean All Parts.** Wash all metal parts in dry-cleaning solvent.

**b. Diaphragms.** Carefully inspect both diaphragms to be sure they are not bent or distorted in any way. If ridges or cracks are found, the diaphragms must be replaced.

**c. Lever.** Inspect lever for cracks or breaks and if any are found, replace. Inspect lever button for signs of wear where it engages the plunger. If signs of wear are present, replace button. Check fit of lever pin in lever bushings. Pin must be a neat fit in bushings. Replace pin or bushings or both if necessary.

**d. Cover.** Inspect cover for cracks or breaks and if any are found, replace. Check fit of plunger in plunger bushing. Plunger must be a neat sliding fit. Replace bushing if excessive clearance is found.

**e. Body.** Inspect body for breaks, cracks or other damage. Also check diaphragm seat for dents or pitting. Replace body if damaged in any way.

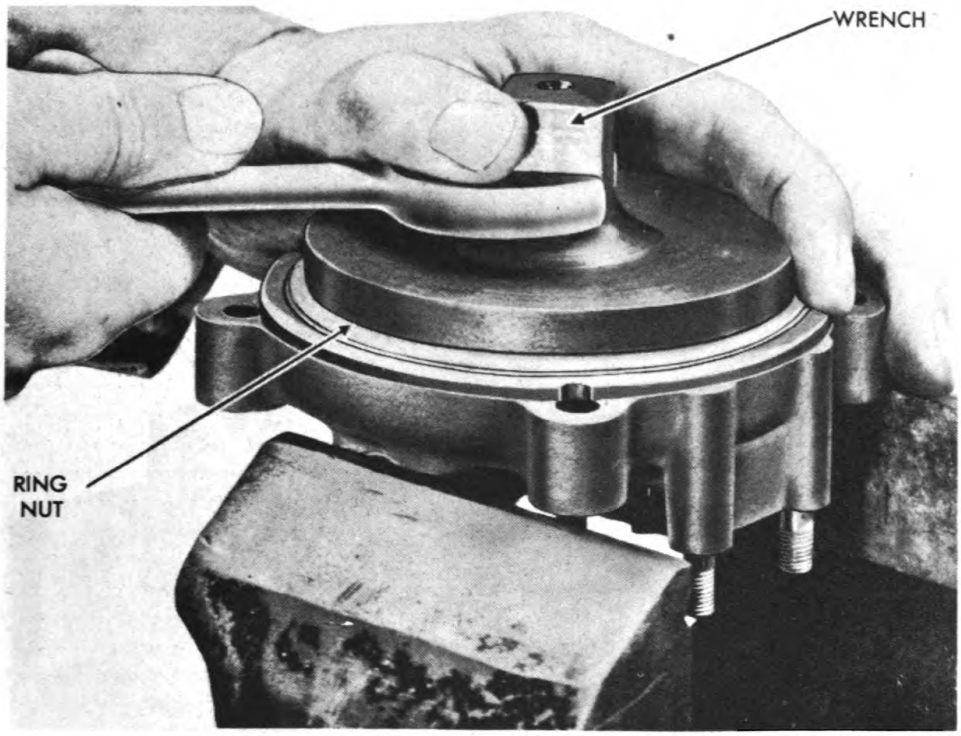


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***Figure 54 — Removing Diaphragm Ring Nut***

**f. Pressure Regulating Spring Assembly.** The pressure regulating spring assembly is adjusted and set for preloading the brake valves and special scales are necessary to make this setting. Make no adjustment to this assembly. If visual inspection shows excessive wear or damage, replace the complete assembly.

**g. Rocker Arm.** Check to be sure rocker arm is not bent. Bottom of rocker arm must be smooth and flat (at points where it contacts the inlet and exhaust). Straighten or replace as necessary.

**h. Inlet Valve Assembly and Components.** Inspect inlet valve and seat for scoring, pitting, or excessive wear (fig. 57). Valve must be a neat sliding fit in bore of valve seat. If valve or seat is rounded, pitted, worn, or scored, leakage will be excessive and valve or valve seat or both must be replaced.

**i. Exhaust Valve Assembly and Components.** Inspect exhaust valve and valve seat for scoring, pitting, or excessive wear. If valve or seat is rounded, pitted, or scored, leakage will be excessive and valve, valve seat, or both, must be replaced.

## 36. REPAIRS.

**a. Lever.** Lever button is driven out using a drift pin through the hole in top of lever cap. A new button must be driven in place.

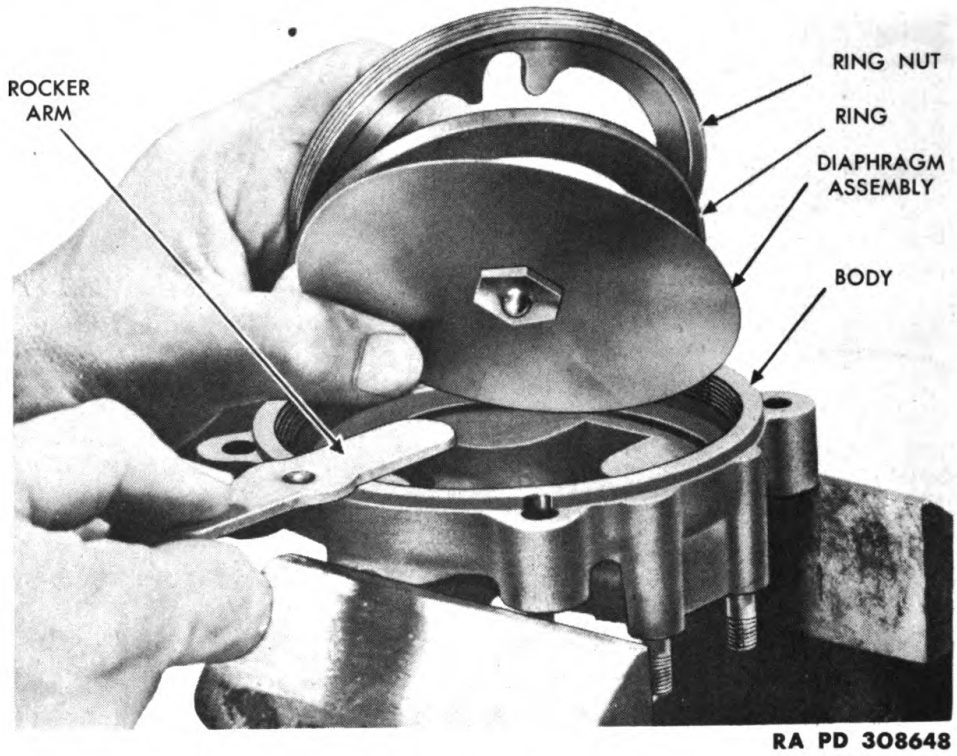


***Figure 55 — Removing Ring Nut, Ring, Diaphragm Assembly and Rocker Arm***

Drive out worn lever pin bushings, and press new ones into place. Bushings must be reamed to 0.375-inch minimum, 0.376-inch maximum after pressing in place.

**b. Cover.** Drive out plunger bushing and press a new bushing in place. Bushing must be reamed in place to 0.624-inch minimum, and 0.626-inch maximum bore diameter.

**c. Inlet Valve Assembly.**

(1) If the valve or valve seat is only slightly scored, pitted or worn, excessive leakage is corrected by grinding the valve to its seat using valve grinding tool (41-T-3381-15), driver tool (41-B-662), and (BWE grade 1,000) grinding compound (fig. 58). Only light pressure is used when grinding, and the valve and valve seat must be washed clean in dry cleaning solvent after grinding.

(2) If the valve or valve seat is badly scored, pitted or worn, either the valve, valve seat or both, must be replaced. New valve seats are reamed using reamer (41-R-834) or a standard 0.3475 inch diameter hand reamer. After reaming, seating reamer (41-R-2178) is used to lightly face the valve seat (fig. 59). When using seating reamer, merely remove the sharp corner of the seat as a wide seat will not seal. The flutes of the intake valve must be a neat sliding

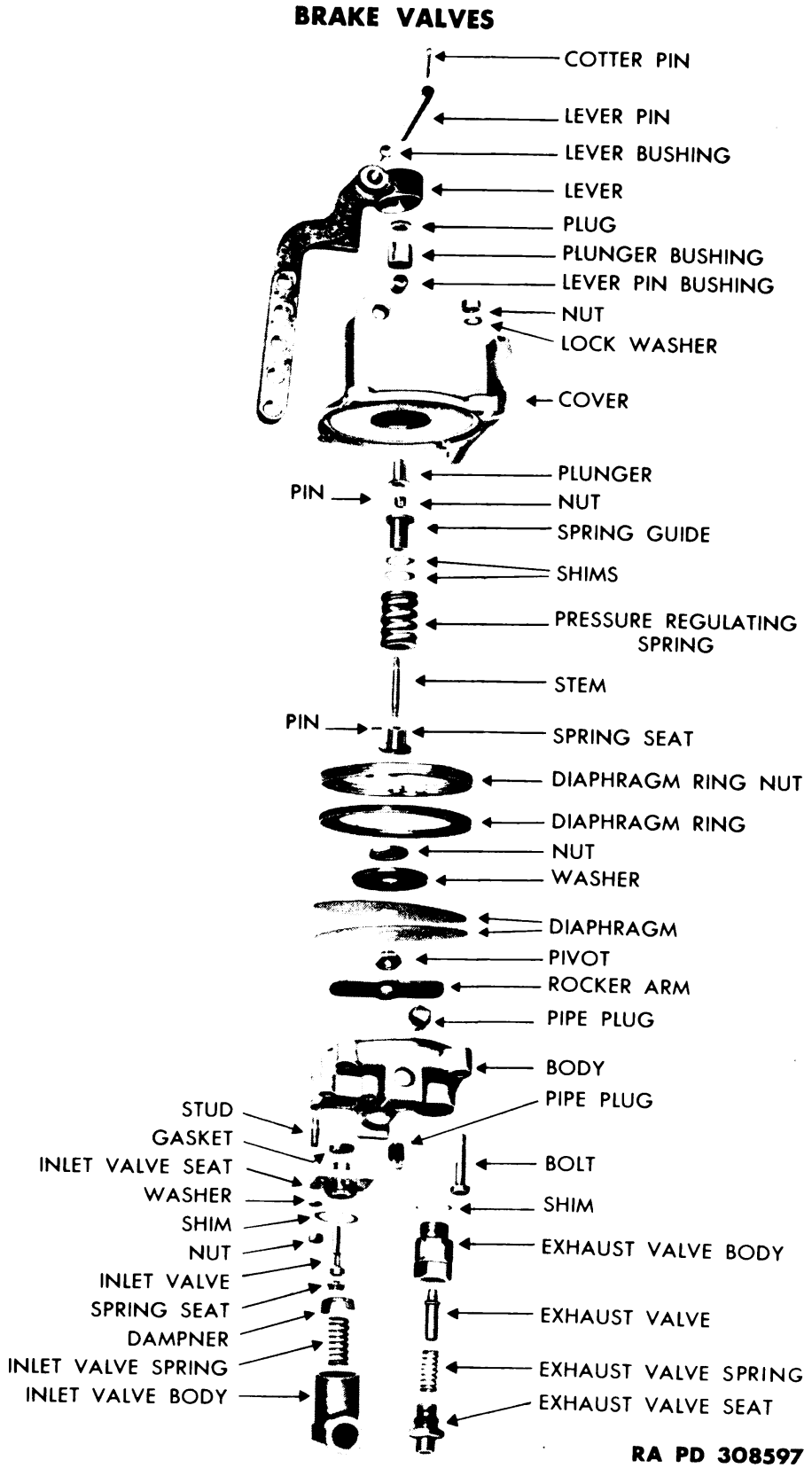


***Figure 56 — Standard Type-B4B Brake Valve Disassembled***

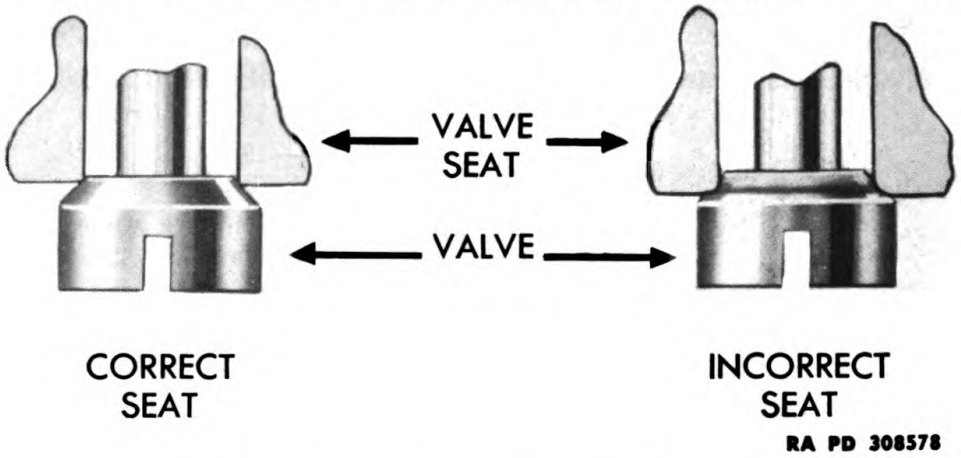


*Figure 57 — Correct and Incorrect Valve Seats*

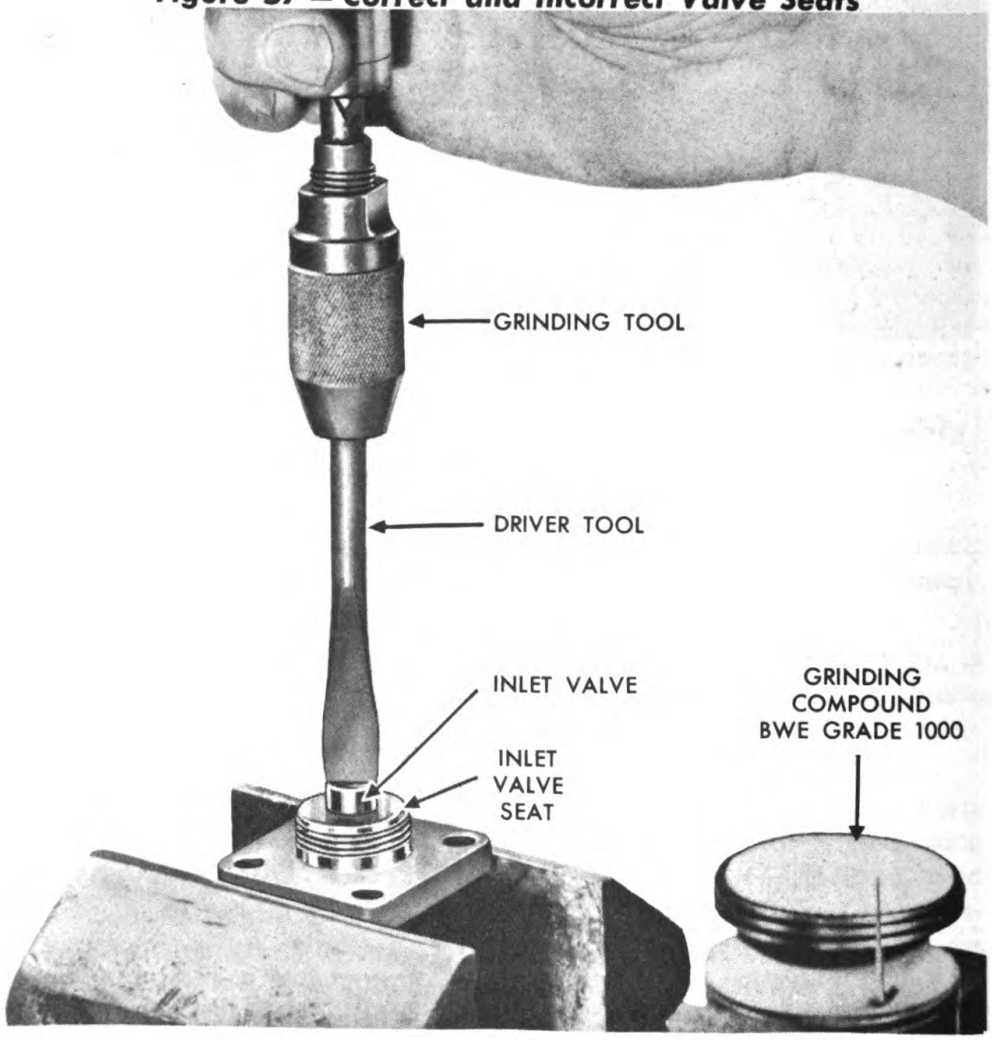


*Figure 58 — Grinding Intake Valve, Using Tools 41-T-3381-15 and 41-B-662*

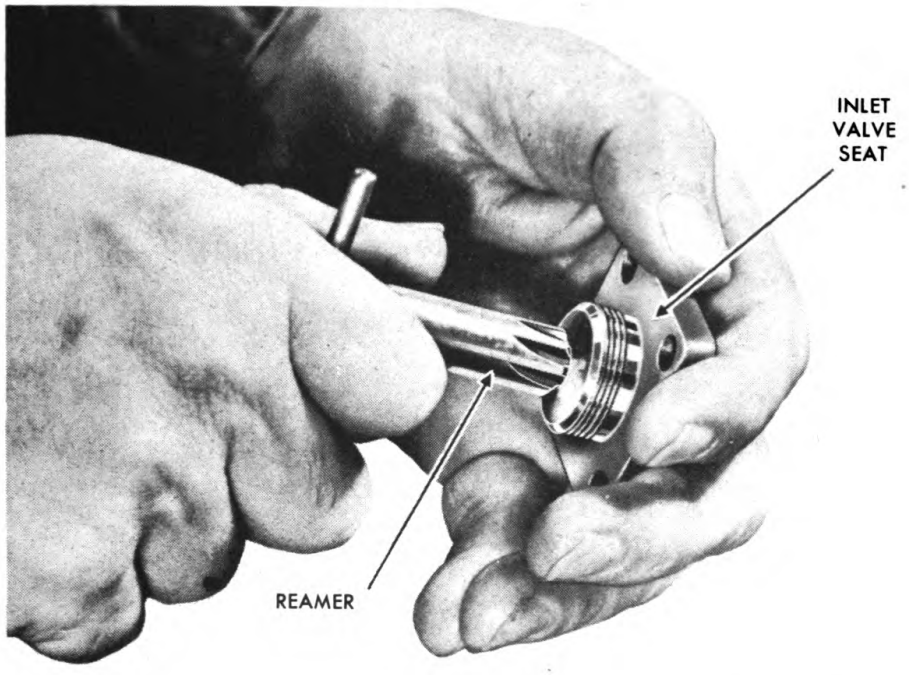


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***Figure 59 — Reaming Intake Valve Seat, Using Reamer 41-R-2178***

fit in the valve seat. After reaming, the valve must be ground to its seat as outlined above.

(3) The intake valve assembly must be tested for leakage before attaching it to the brake valve by connecting it to an air supply of 75-pound pressure. Use soap suds to test for leakage from the top of the assembly around the valve stem. Leakage in excess of a 1-inch soap bubble in 5 seconds is not permissible. If leakage is excessive, the valve must be reground to its seat.

**d. Exhaust Valve Assembly.**

(1) If the valve or valve seat is only slightly scored, pitted or worn, excessive leakage is corrected by grinding the valve to its seat using valve grinding tool (41-T-3381-15), driver tool (41-B-661), and (BWE grade 1,000) grinding compound (fig. 60). Light pressure must be used when grinding and the valve and valve seat must be washed in dry-cleaning solvent after grinding.

(2) If the valve or valve seat is badly scored, pitted or worn, either the valve, valve seat, or both must be replaced. New valve seats must be reamed using reamer (41-R-832) or a standard 0.3125 inch diameter hand reamer. After reaming, seating reamer (41-R-2175) is used to lightly face the valve seat (fig. 61). When using seating reamer merely remove the sharp corner of the seat as a wide seat

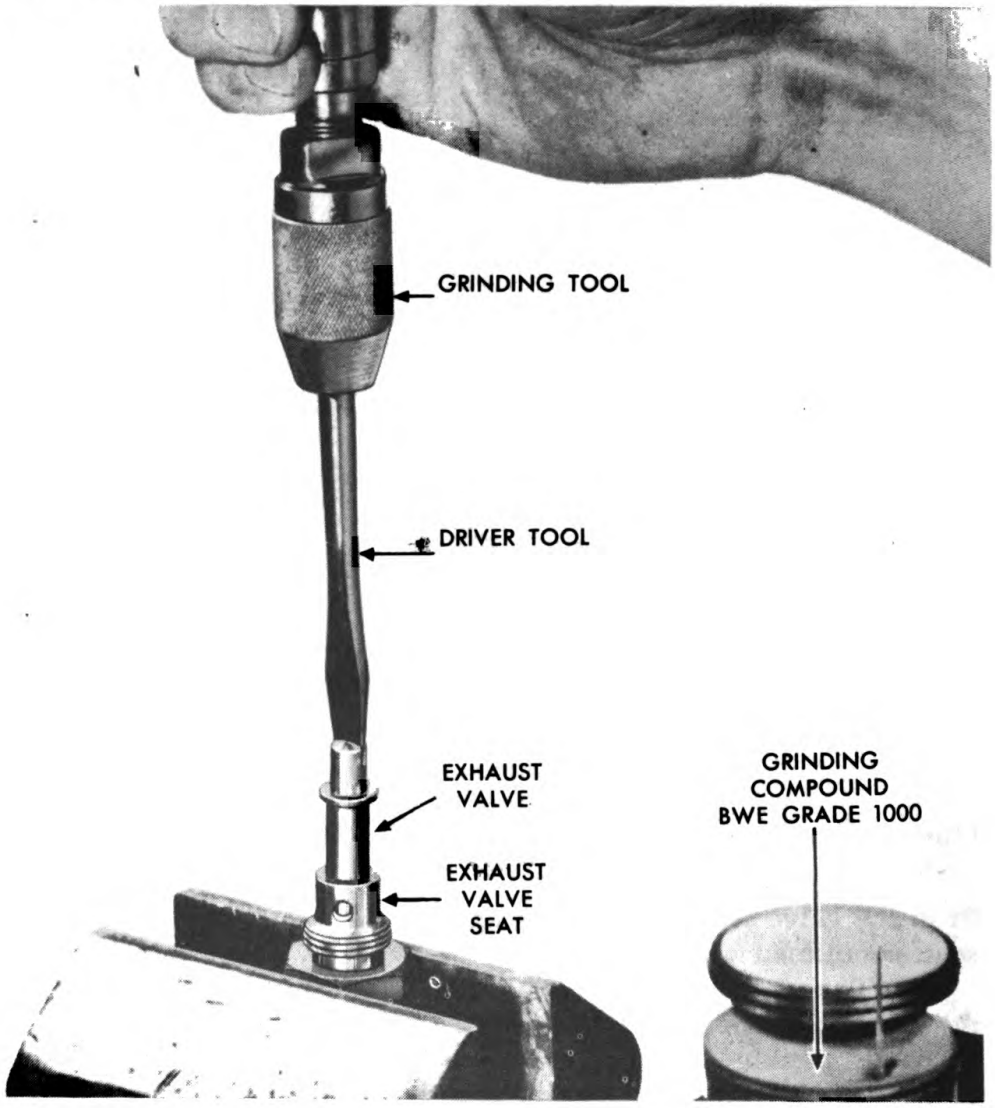


***Figure 60 — Grinding Exhaust Valve, Using Tools 41-T-3381-15 and 41-B-661***

will not seal. After reaming, the valve must be ground to its seat as outlined above.

(3) Exhaust valve assemblies must be tested for leakage after they are installed in the brake valve.

## 37. ASSEMBLY.

**a. Assemble and Install Intake Valve Assembly.** Install intake valve spring in spring cage, and place dampner and spring seat in position. Install a new rubber intake valve gasket on top of intake valve seat. Install intake valve seat shim on top of spring cage. Place intake valve spring cage and seat in position, and tighten spring cage on intake valve seat securely. Position intake valve assembly

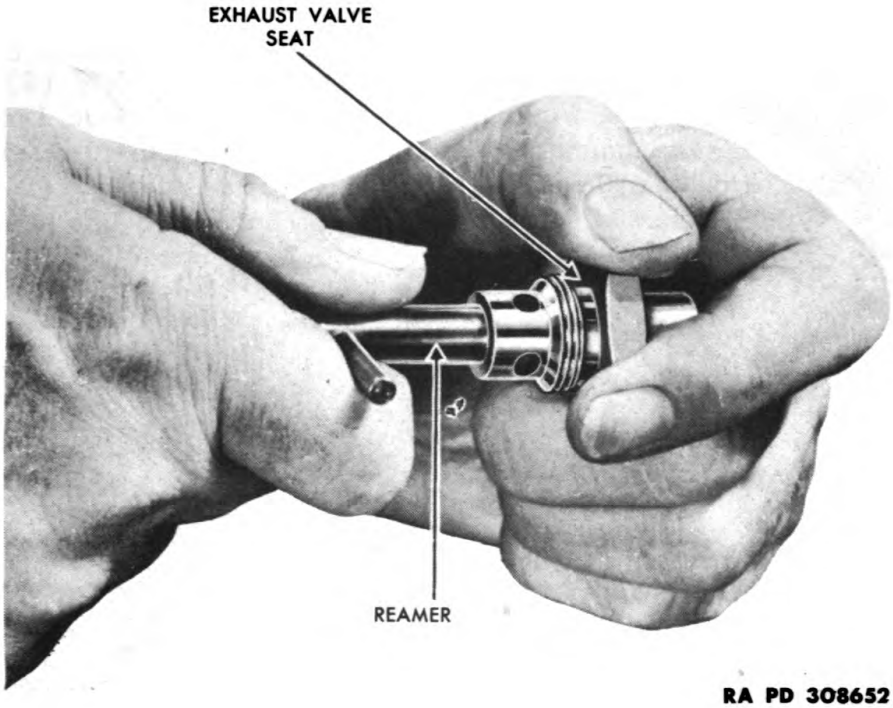


***Figure 61 — Reaming Exhaust Valve Seat, Using Reamer 41-R-2175***

at correct angle on the brake valve body as marked before disassembly, and install four nuts and lock washers holding it in place. Tighten the four nuts holding the intake valve assembly in place evenly in order not to distort the intake valve seat, otherwise leakage will occur.

**b. Assemble and Install Exhaust Valve Assembly.** Position exhaust valve in spring cage. Install exhaust valve spring in spring cage, and screw spring cage and exhaust valve seat together. Place shims on top of exhaust valve assembly and install exhaust valve assembly into body. Tighten securely.

**c. Assemble and Install Diaphragm Assembly.** Lubricate the two surfaces of the diaphragms which will contact each other with a light coating of lubricating oil. Place one diaphragm on the other so that the grain of the first diaphragm makes a 90-degree angle with the grain of the second diaphragm. Position pivot, diaphragm washer, and pivot nut, and tighten pivot nut securely being careful not to distort the diaphragms. After tightening pivot nut, prick punch the threads of the pivot and pivot nut to lock the nut in place. Place rocker arm and diaphragm assembly in position in body, and place diaphragm ring in body on top of diaphragm. Place a thin coating of cup grease on bottom of the ring nut to prevent diaphragm ring

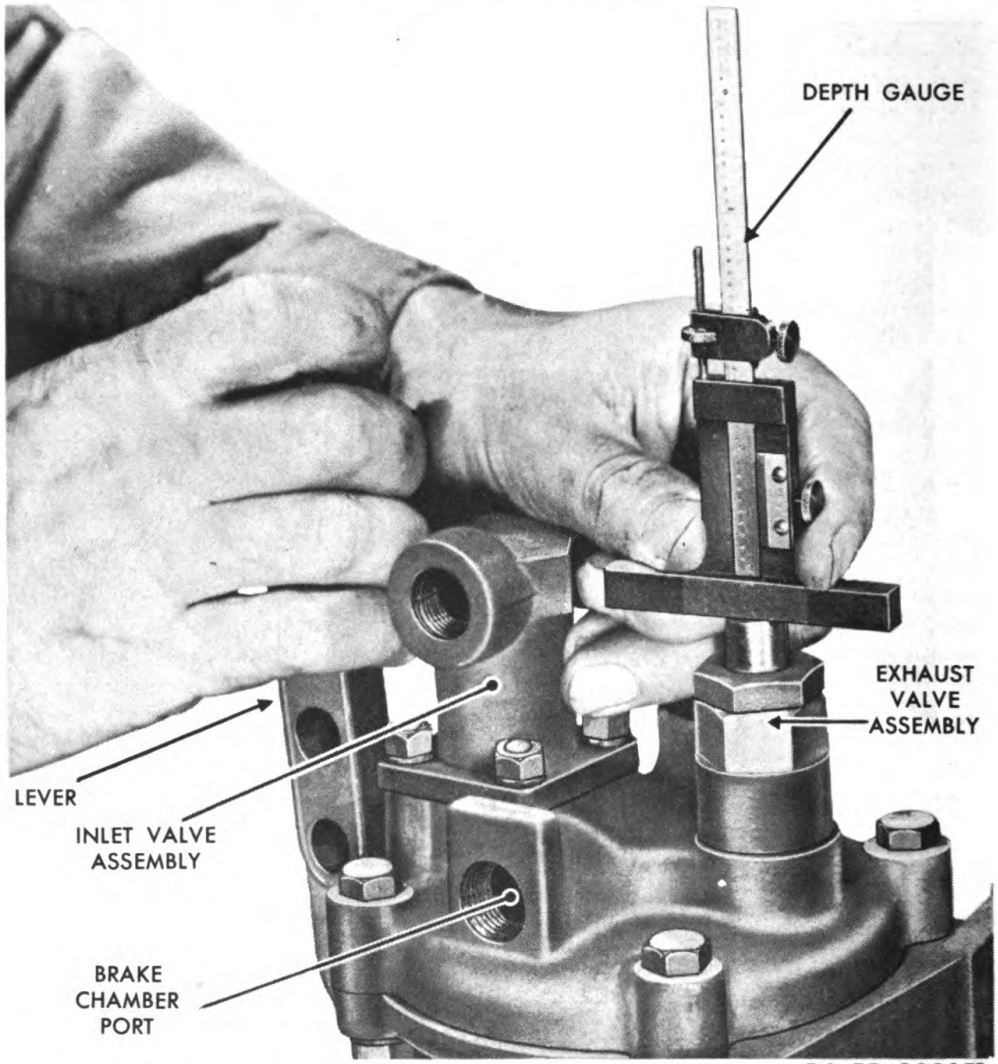


***Figure 62 — Checking Exhaust Valve Travel***

from turning when diaphragm ring nut is tightened. Use special diaphragm ring nut wrench (fig. 169 or 172) to install diaphragm ring nut in body. Tighten diaphragm ring nut securely.

**d. Install Cover.** Position cover so that lever will be directly over inlet valve assembly (fig. 47). Install plunger and pressure regulating spring assembly in cover, and install cover on body. Install four bolts, lock washers, and nuts, attaching cover to body.

**e. Install Lever.** Position lever and install lever fulcrum pin. Install cotter pins in ends of lever pin and spread them to lock them in place.

**f. Checking Exhaust Valve Travel.** Check exhaust valve travel by measuring the movement of the exhaust valve when the lever is moved to applied position (fig. 62). Exhaust valve travel must not be less than $\frac{3}{64}$ inch nor more than $\frac{1}{16}$ inch. Exhaust valve travel

is reduced by increasing the number of shims between the exhaust valve assembly and the body of the brake valve, or increased by reducing the number of shims.

## 38. TEST OF REBUILT B4B BRAKE VALVE.

**a. Prepare Test Rack for Test.**

(1) With test rack brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90-pounds pressure.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7 until gages No. 2, No. 4, and both hands of gage No. 3, read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Connect Brake Valve to Test Rack.**

(1) Connect hose No. 4 to one brake chamber port. Plug other brake chamber port.

(2) Connect hose No. 2 to reservoir port.

**c. Leakage Tests.**

(1) Open cock No. 2 causing the pressure registered by gage No. 2 to rise to 90 pounds.

(2) Pull brake valve lever between applied position and released position several times, finally letting the lever return to released position.

(3) Coat the exhaust port of the brake valve with soap suds to determine leakage of the inlet valve. Leakage of more than a 1-inch soap bubble in three seconds is not permissible.

(4) Pull lever to fully applied position and wedge it in this position with a block of wood. Then coat the exhaust port with soap suds to determine leakage of the exhaust valve. Leakage of more than a 1-inch soap bubble in three seconds is not permissible.

(5) Coat the entire valve with soap suds to detect leakage through the castings. No leakage is permissible.

(6) Remove block and permit lever to return to released position.

**d. Operating Tests.**

(1) Pull brake valve lever to fully applied position and observe that the pressure registered by the red hand of gage No. 3 rises from zero to 50 pounds in less than 1 second.

(2) Permit brake valve lever to return to released position and observe that the pressure registered by the red hand of gage No. 3 drops from 60 to 10 pounds in less than 1 second. Red hand of gage No. 3 must drop to zero. If the time required for the red hand of gage No. 3 to drop from 60 to 10 pounds is more than 1 second, it indicates the exhaust valve is not opening sufficiently (par. 37 f).

(3) Pull the brake valve lever towards fully applied position and observe that at each step, a corresponding increase in the pressure registered by the red hand of gage No. 3 is obtained within the graduating range of from 6 to 75 pounds.

(4) Release the brake valve lever in steps toward released position and observe that at each step, a corresponding decrease in the pressure registered by the red hand of gage No. 3 is obtained within the graduating range of from 75 to 6 pounds.

(5) Pull brake valve lever slowly toward applied position, and check to determine the lowest pressure that can be maintained on the red hand of gage No. 3. Brake valve should be capable of maintaining seven pounds or less.

(6) Pull brake valve lever to its fully applied position and check to be sure the red hand of gage No. 3 rises to 90 pounds to register the same as gage No. 1.

**e. Disconnect Valve From Test Rack.**

(1) If valve passes all tests, blow off all traces of soap suds and disconnect hose lines.

(2) Plug all ports with pipe plugs and wrap a piece of friction tape around the exhaust port to prevent dirt entering the valve during shipment or storage.

## Section II

## TYPE-HP BRAKE VALVES (HAND OPERATED)



### 39. DESCRIPTION AND OPERATION.

**a. Description.** Type-HP brake valves (fig. 63) are usually used for controlling the brakes on a towed vehicle independently of the brakes on the towing vehicle. They are usually mounted on the steering column or on the dash. The driver may set the ratchet type handle in any one of several positions between brakes released and brakes fully applied position so the brakes on the towed vehicle are kept applied until the brake valve handle is returned to release position. The distance the brake valve handle is moved in a clockwise direction toward applied position determines the severity of the brake application. The driver may, therefore, control the brakes on the towed vehicle as the speed, load, and road conditions, require.

**b. Operation** (fig. 64).

(1) As the brake valve handle is moved toward applied position, pressure is exerted on the top of the pressure regulating spring and the piston assembly moves downward. As this happens, the exhaust valve seat engages the exhaust valve and closes the passage to the

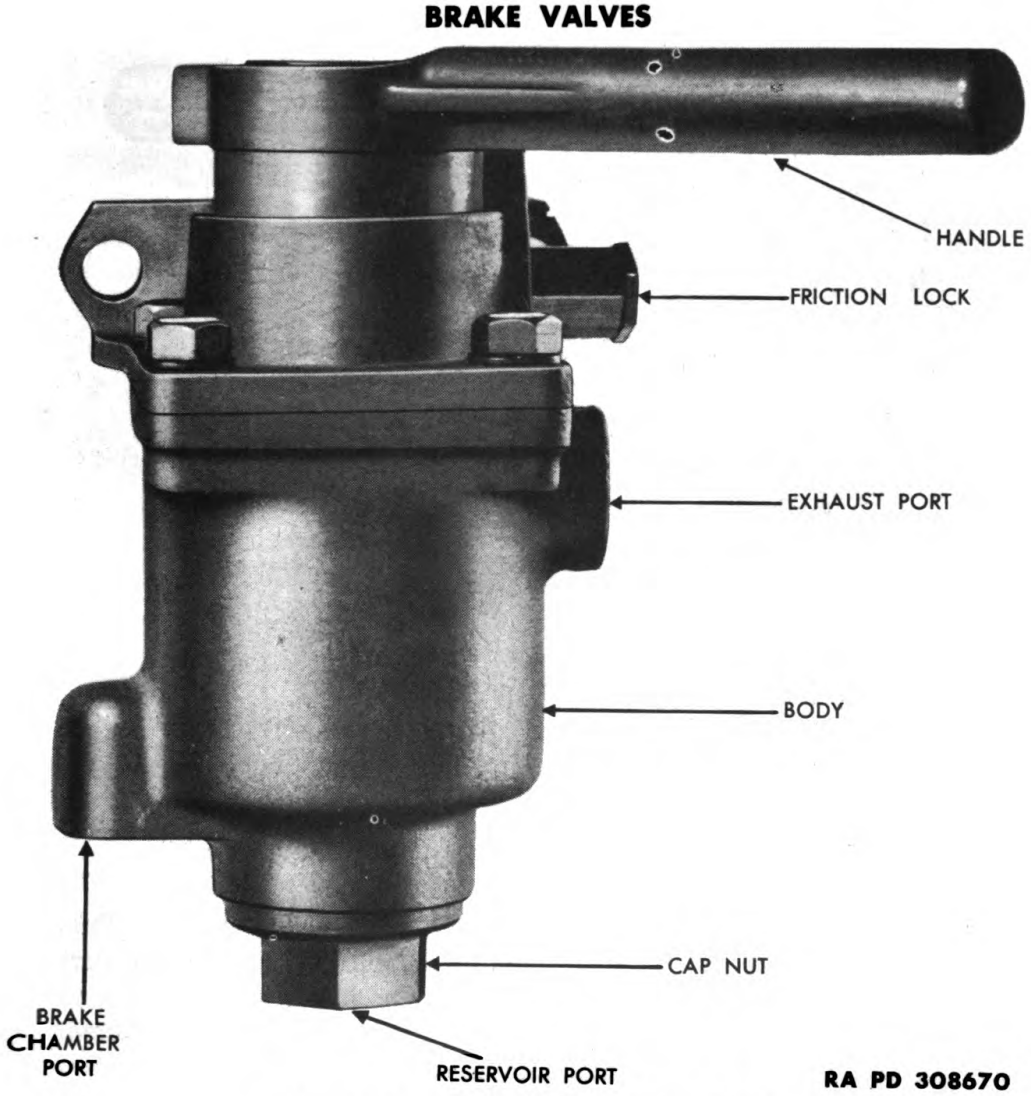


***Figure 63 — Type-HP Brake Valve***

exhaust port. The exhaust valve and the inlet valve are part of the same assembly, therefore, after the exhaust valve is closed and the piston assembly continues its movement downward, the inlet valve is forced off its seat. This permits air pressure from the reservoir to pass through the inlet valve, out the connection leading to the service line and the brakes on the towed vehicle.

(2) As soon as the air pressure below the piston assembly overcomes the mechanical load on top of it, the piston assembly lifts. The intake valve closes, cutting off any further air supply, and the exhaust valve remains closed, preventing any loss of air pressure through the exhaust port. Any further movement of the handle toward fully applied position adds additional mechanical force on top of the piston assembly, and correspondingly increases the delivered air pressure.

(3) If the brake valve handle is moved toward released position,

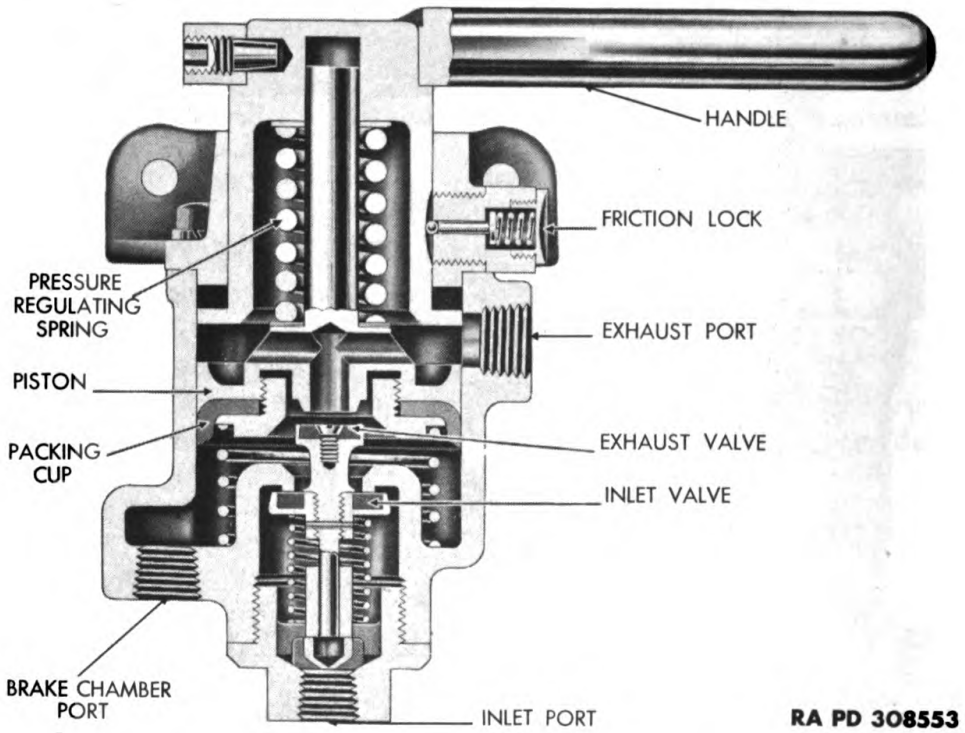


***Figure 64 — Sectional View of Type-HP Brake Valve***

the mechanical force on top of the piston assembly is decreased. This permits the air pressure below the piston assembly to lift it still further, thus opening the exhaust valve and permitting air pressure to exhaust from the service line until a lower air pressure is established. This will balance the lesser mechanical force acting on top of the piston assembly.

(4) In this manner, the brake application on the towed vehicle may be graduated during both application or release of the brakes. The position of the brake valve handle always determines the air pressure being delivered through the service line to the brake equipment on the towed vehicle.

(5) The handle of the brake valve is fitted with a friction lock so it will remain in whatever position it is placed by the driver. The brake valve should never be used, however, to hold the brakes applied when the vehicles are being parked or when the driver is off duty. If the vehicles are parked on a hill or grade, other precautions such as blocking the wheels must be taken. There is a possibility the air pressure in the system may be depleted due to leakage, and the brakes release after a reasonable lapse of time.

## 40. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. General.** If testing equipment is available, test the brake valve

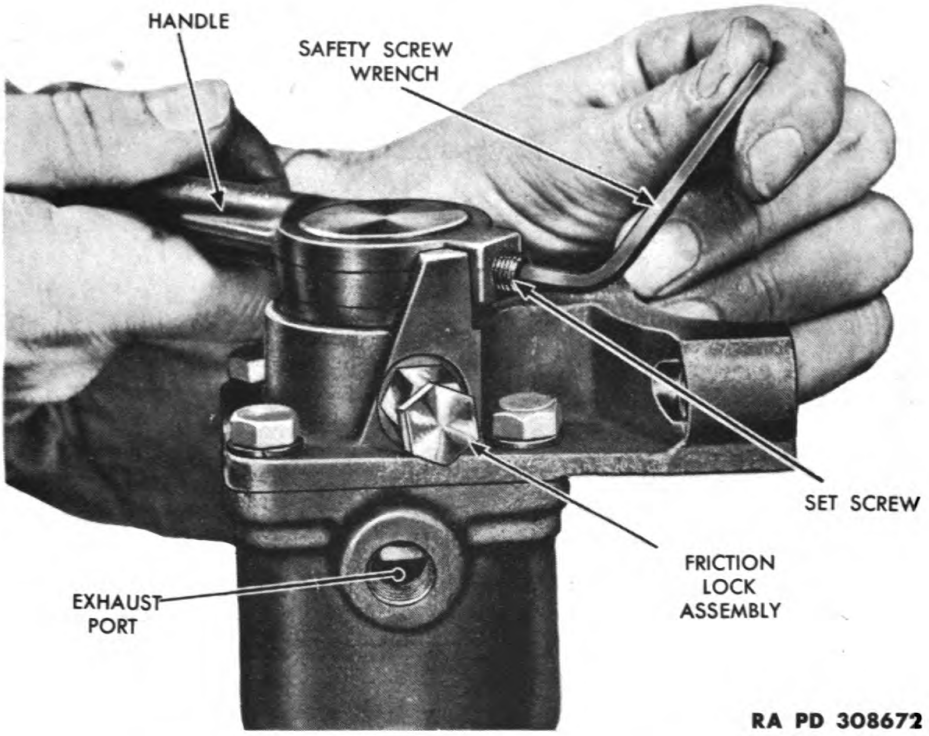


***Figure 65 — Removing Handle, Using Safety Screw Wrench 41-W-2449***

before disassembly by the following procedure outlined in paragraph 43. If the valve fails to pass leakage tests, install a new inlet and exhaust valve assembly (par. 42). Repeat tests as this may be all that is necessary to make the valve again fit for service.

**b. Cleaning and Inspection.** Remove all dirt and grease from exterior of valve using dry-cleaning solvent and a brush. Inspect exterior of valve for broken or damaged parts. All broken or damaged parts must be replaced.

**c. Disassembly.**

(1) Remove set screw from handle and lift off handle using Safety screw wrench (41-W-2449) (fig. 65).

(2) Remove four cap screws and lock washers attaching cover to body, and lift off cover. Unscrew friction lock assembly from cover and disassemble. Remove washer, pressure regulating spring, and shims from piston. Pull piston assembly out of body, and lift out exhaust valve spring.

(3) Disassemble piston by engaging the slots in the piston follower with a steel bar and unscrewing the piston using a steel rod (fig. 66).

(4) Remove cap nut from bottom of body and lift out inlet and exhaust valve assembly and spring.

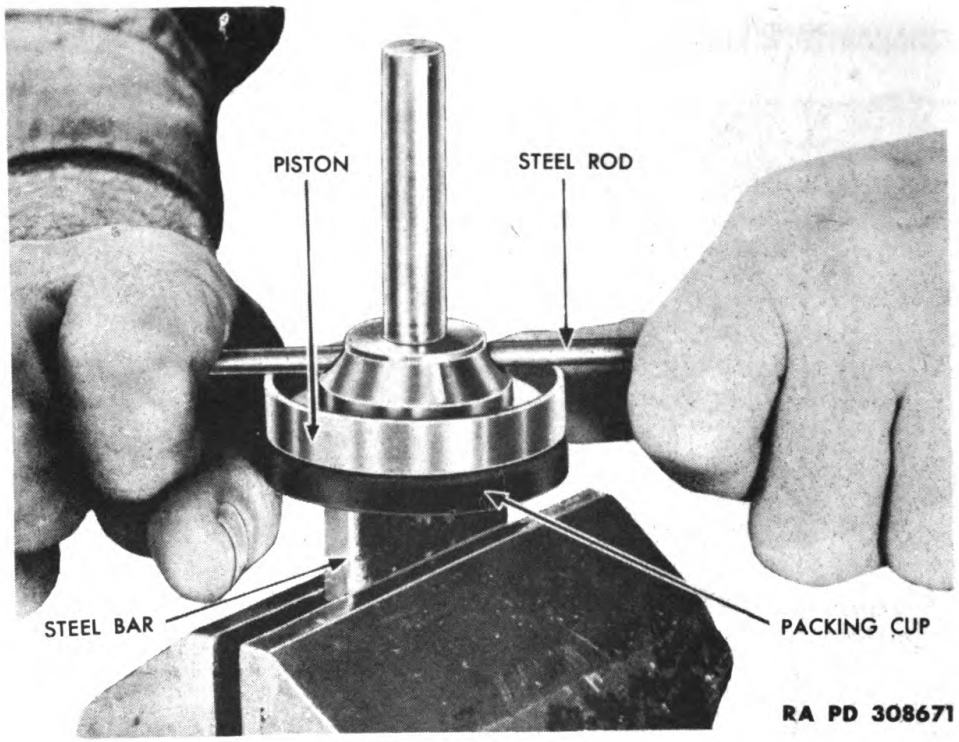


***Figure 66 — Disassembly of Piston***

## 41. CLEANING, INSPECTION OF PARTS AND REPAIRS.

**a.** Clean all metal parts using dry-cleaning solvent. Replace all damaged or excessively worn parts. Inspect condition of packing cup and replace with new cup if it is worn thin or damaged in any way. Check piston bore in body for excessive wear, scoring or out-of-roundness. Bore must be smooth and round. If diameter of bore exceeds 2.133 inches, the body must be replaced. Check fit of piston in body. Piston must be a neat sliding fit.

**b.** Inspect inlet and exhaust valve assembly to be sure rubber seats are in good condition. Do not attempt to replace seats. If seats are worn or damaged, replace the complete inlet and exhaust valve assembly.

## 42. ASSEMBLY (fig. 67).

**a.** Position piston packing cup in bottom of piston. Screw piston follower into piston sufficiently tight to make a good air seal at the piston packing cup, but not sufficiently tight to distort or damage the packing cup (fig. 66). Place inlet and exhaust valve spring over inlet and exhaust valve assembly. Position the two parts in the cap nut and enter the assembled parts into the valve body with the seats of the valves toward the top of the body. Tighten cap nut

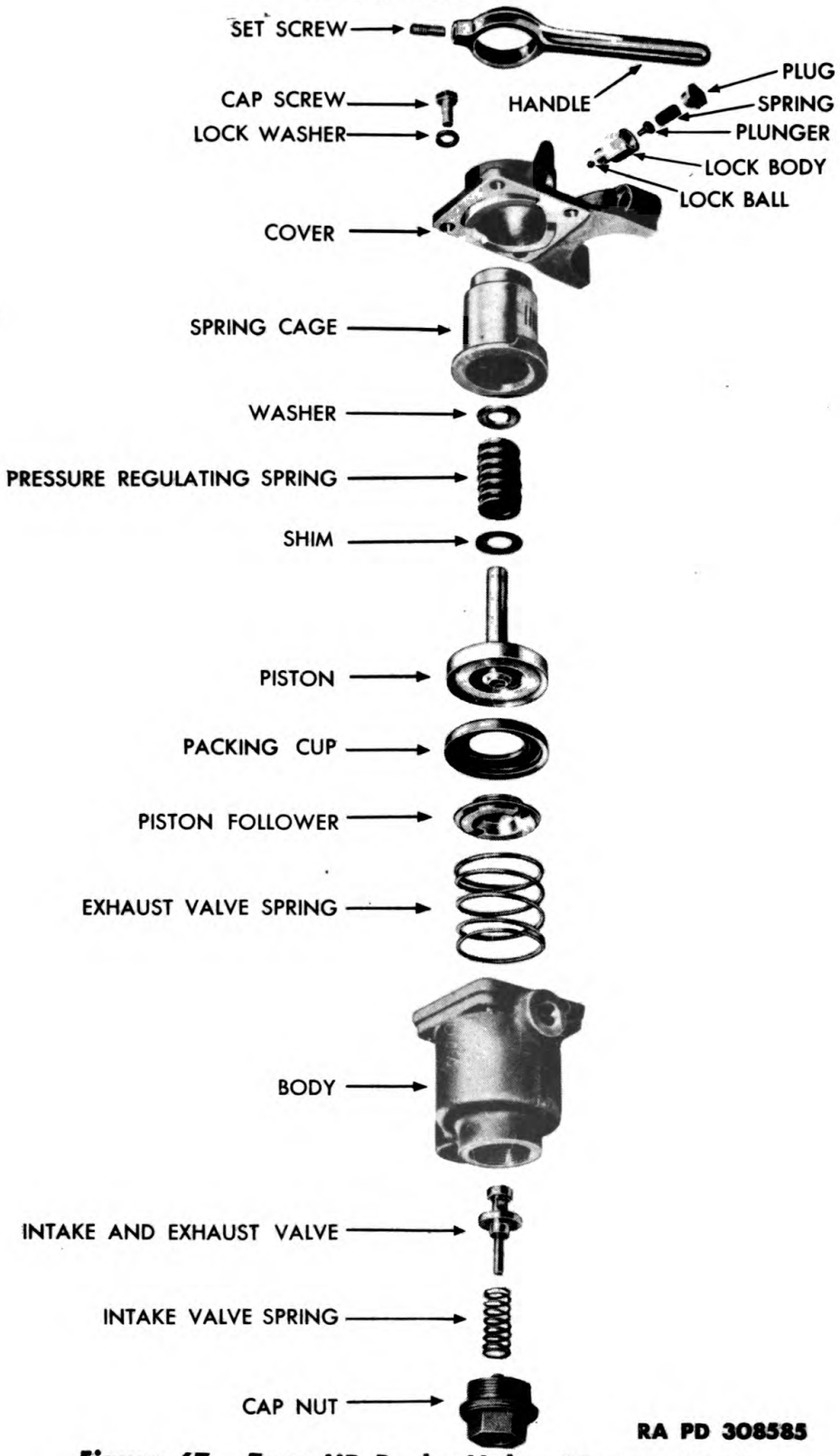


***Figure 67 — Type-HP Brake Valve Disassembled***

securely. Lubricate the piston packing cup with graphite grease, then place exhaust valve spring into top of body and enter piston assembly into body over exhaust valve spring. Exercise extreme care so as not to damage the piston packing cup. Place the shim washers (thin) over piston stem and install pressure regulating spring. Then place washer (thick) over piston stem and on top of spring. Enter spring cage into bottom of cover. Place cover in position on body with spring cage over end of piston next to washer. Position cover so the mounting bracket is at the rear when the brake chamber port is at the left (fig. 64). Install four cap screws and lock washers attaching cover to body. Assemble and install friction lock assembly. Place handle in position over spring cage and secure it in position with set screw.

## 43. TEST OF REBUILT HP BRAKE VALVE.

**a. Prepare Test Rack for Test.**

(1) With test rack brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90 pounds pressure.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4 and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Connect Brake Valve to Test Rack.**

(1) Connect hose line No. 2 to reservoir port.

(2) Connect hose line No. 4 to brake chamber port.

(3) Be sure exhaust port is not plugged.

**c. Leakage Tests.**

(1) Open cock No. 2 causing gage No. 2 to register 90-pound pressure.

(2) Move handle of brake valve being tested back and forth several times between released and applied positions finally leaving it in released position.

(3) Coat the exhaust port with soap suds to check for leakage of the inlet valve.

(4) Move handle of brake valve being tested, to fully applied position. Coat the exhaust port with soap suds to check for leakage of the exhaust valve.

(5) Leakage in excess of a 1-inch soap bubble in five seconds is not permissible in either test.

(6) Coat the entire valve with soap suds to detect casting leakage. No leakage is permissible.

(7) Move handle of brake valve being tested back to released position.

**d. Operating Tests.**

(1) Move handle of brake valve being tested to fully applied position and observe that the pressure registered by the red hand of gage

No. 3 rises from zero to 50 pounds in less than one second. Also note the pressure registered by the red hand of gage No. 3 rises to a point somewhere between 70 and 80 pounds. If pressure will not rise to 70 pounds, additional shims may be needed beneath the pressure regulating spring or the pressure regulating spring may need replacing.

(2) Move the handle of the brake valve being tested from fully applied position to released position and observe that the pressure registered by the red hand of gage No. 3 drops from 60 pounds to 10 pounds in less than two seconds. If the pressure does not drop in less than two seconds, it indicates the exhaust valve travel is not sufficient.

(3) Move the handle of the brake valve being tested to several positions between released position and fully applied position. Check to be sure the pressure registered by the red hand of gage No. 3 corresponds to the position in which the brake valve handle is placed.

(4) Move the handle of the brake valve being tested toward applied position until the red hand of gage No. 3 registers about 50 pounds. Then open cock No. 6, and note that the red hand of gage No. 3 continues to register the initial pressure within four pounds. Close cock No. 6 and move brake valve handle to released position.

**e. Disconnect Valve from Test Rack.**

(1) If brake valve passes all tests, blow off all traces of soap suds and disconnect hose lines.

(2) Plug all ports, including the exhaust port, with pipe plugs to prevent dirt from entering the valve during shipment or storage.

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## Section III

# TYPE-D BRAKE VALVES (TREADLE OPERATED)



## 44. DESCRIPTION AND OPERATION.

**a. Description.** The type-D brake valve (fig. 68) is used on some vehicles instead of the type-B4B brake valve. Fundamentally the only difference between the two brake valves is that the type-D brake valve is operated by a foot treadle, (which is part of the brake valve) while the B4B brake valve is operated by a conventional foot pedal. Movement of the treadle controls the movement of an inlet valve and an exhaust valve which in turn control the air pressure

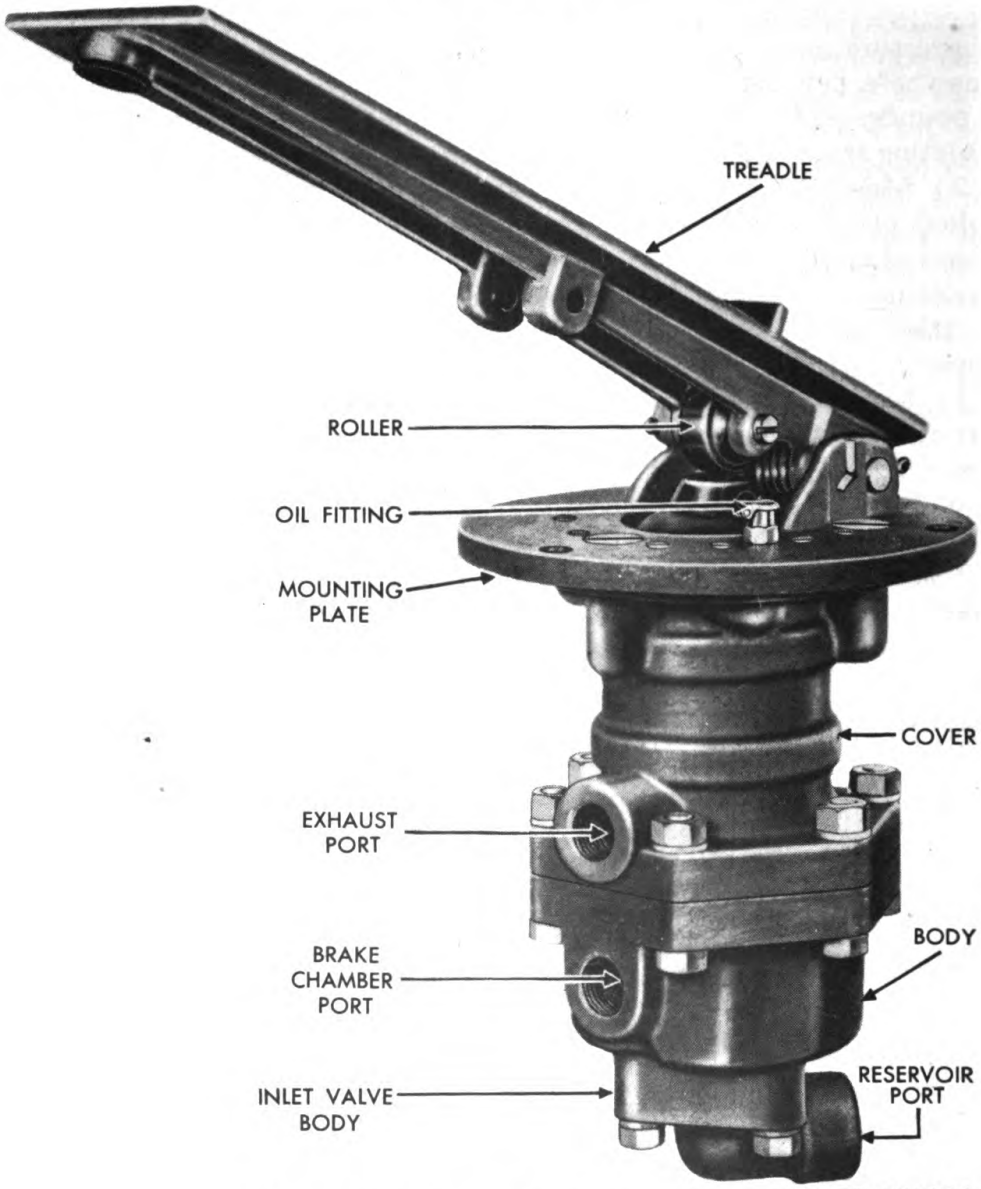



***Figure 68 — Type-D Brake Valve***

being delivered to or released from the brake chambers on the vehicle. To fully apply the brakes on a vehicle fitted with a type-D brake valve, the treadle must be fully depressed; whereas, when the treadle is only partially depressed, correspondingly less braking force is developed. In other words, the farther the driver depresses the treadle, the higher the air pressure delivered to the brake chambers, and the more severe the brake application. At any time the brakes of the vehicle may be partially released by the driver permitting the treadle to partially return towards released position. Also they may be entirely released by the driver permitting the treadle to return to

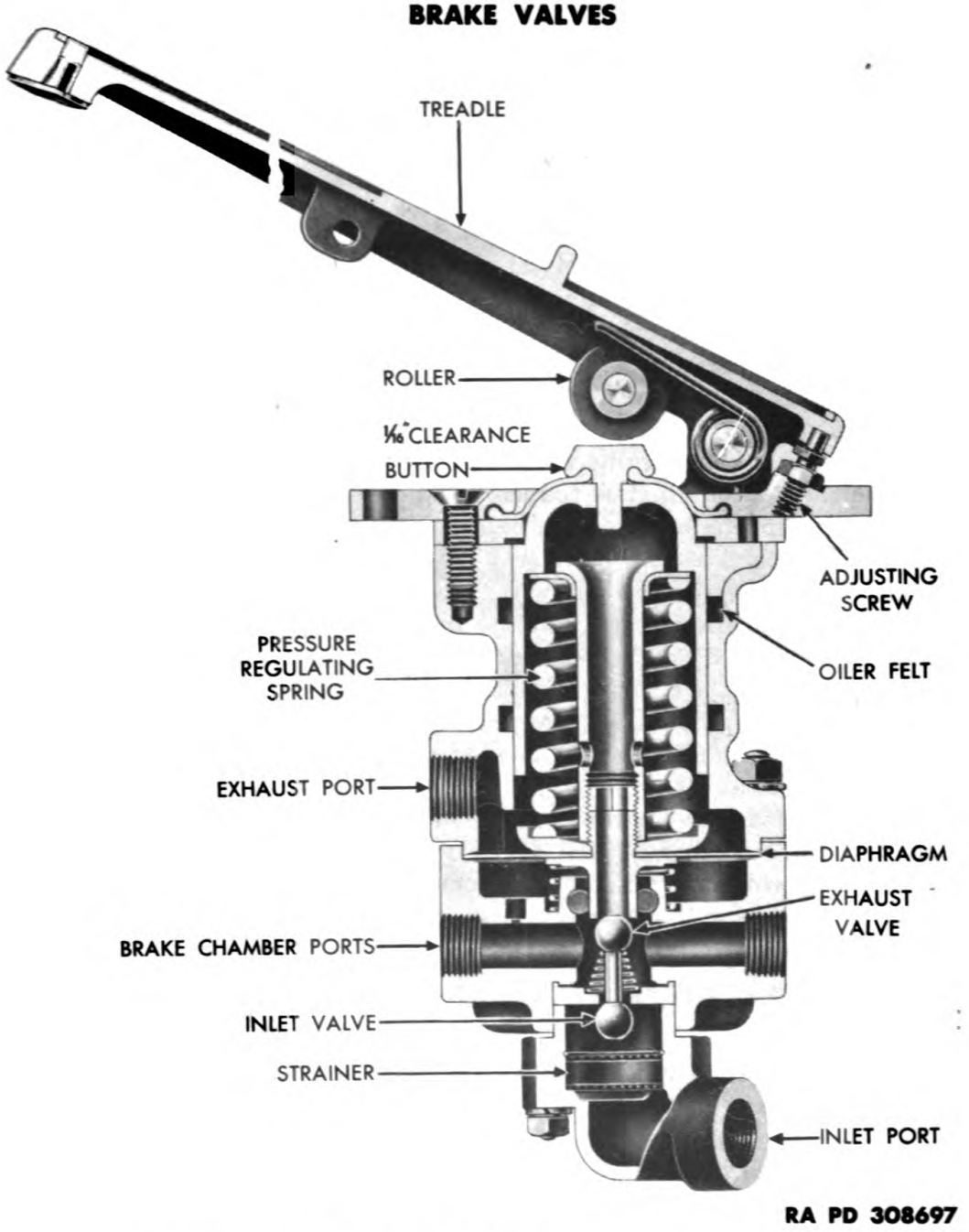



***Figure 69 — Sectional View of Type-D Brake Valve***

full released position. In this manner the amount of force being applied to the brakes of the vehicle is always under control of the driver.

**b. Operation** (fig. 69).

(1) As the driver depresses the treadle, pressure is exerted on the top of the pressure regulating spring and diaphragm. As the diaphragm moves downward, the exhaust valve seat moves downward against the exhaust valve and closes it. Continued movement of the

diaphragm downward pushes the inlet valve off its seat. Reservoir pressure therefore flows through the inlet valve and out the brake chamber ports to the brake chambers applying the brakes. When the air pressure being delivered to the brake chambers from the cavity below the diaphragm overcomes the mechanical force being exerted on top of the diaphragm, the diaphragm lifts and the inlet valve closes, cutting off further supply of air pressure to the brake chambers while the exhaust valve remains closed preventing any escape of air pressure through the exhaust port. Should the driver depress the treadle further and put additional force on top of the diaphragm, a corresponding increase in the air pressure being delivered to the brake chambers results.

(2) If the driver permits the treadle to partially return toward its fully released position thus reducing the mechanical force on top of the diaphragm, the air pressure below the diaphragm overcomes the mechanical force on top of it and the diaphragm lifts still further. When this happens, the inlet valve remains closed and the exhaust valve opens to exhaust air pressure from the brake chambers until the air pressure below the diaphragm again balances the mechanical force on top of it. If the driver permits the treadle to return to full released position, the exhaust valve remains open and all air pressure from the brake chambers is exhausted and the brakes on the vehicle are fully released.

(3) If the driver depresses the treadle to fully applied position, the pressure regulating spring is compressed and the spring cage strikes the spring seat. Under these conditions, the inlet valve is held open permitting full reservoir pressure to pass through the brake valve into the brake chambers.

## 45. CLEANING, INSPECTION, AND DISASSEMBLY.

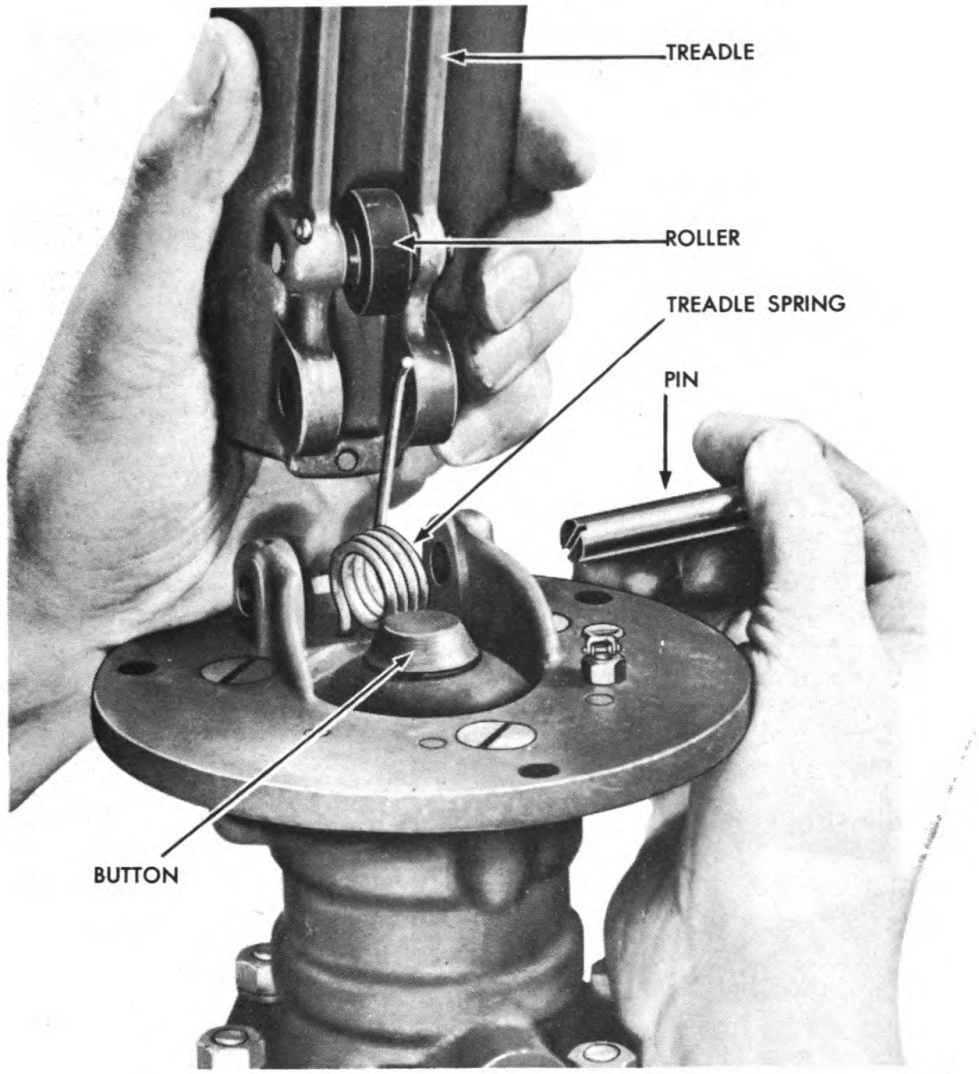
**a. General.** If testing equipment is available, the brake valve is tested before disassembly by following procedure outlined in paragraph 48.

**b. Cleaning and Inspection.** Remove all dirt and grease from exterior of valve using dry-cleaning solvent and a brush. Inspect exterior of valve for broken or damaged parts. All broken or damaged parts must be replaced.

**c. Disassembly.**

(1) MARKING BEFORE DISASSEMBLY. Mark position of inlet valve body in relation to brake valve body to facilitate proper assembly. Center punch both parts.

(2) REMOVE AND DISASSEMBLE TREADLE (fig. 70). Remove cotter pin from end of treadle fulcrum pin. Drive out treadle fulcrum pin and remove treadle and treadle spring. If treadle roller is to be removed, remove cotter pin from end of treadle roller pin. Drive out treadle roller pin and remove roller.




RA PD 308702

***Figure 70 — Removing Treadle***

(3) REMOVE MOUNTING PLATE AND FILLING PLATE. Remove three countersunk head machine screws attaching mounting plate to body. Lift off mounting plate and filling plate.

(4) REMOVE DIAPHRAGM AND SPRING ASSEMBLY. Remove the six bolts, nuts and lock washers, attaching cover to body. Remove cover (fig. 71). Lift out diaphragm and spring assembly. Do not disassemble the pressure regulating spring and diaphragm assembly unless the diaphragms or the exhaust valve seat have to be replaced. If the diaphragm assembly is disassembled, extreme care must be used to be sure the same shims are replaced during assembly. Lift out exhaust valve spring, and pull rubber grommet out of body.

(5) REMOVE SPRING CAGE FROM COVER. Push spring cage,

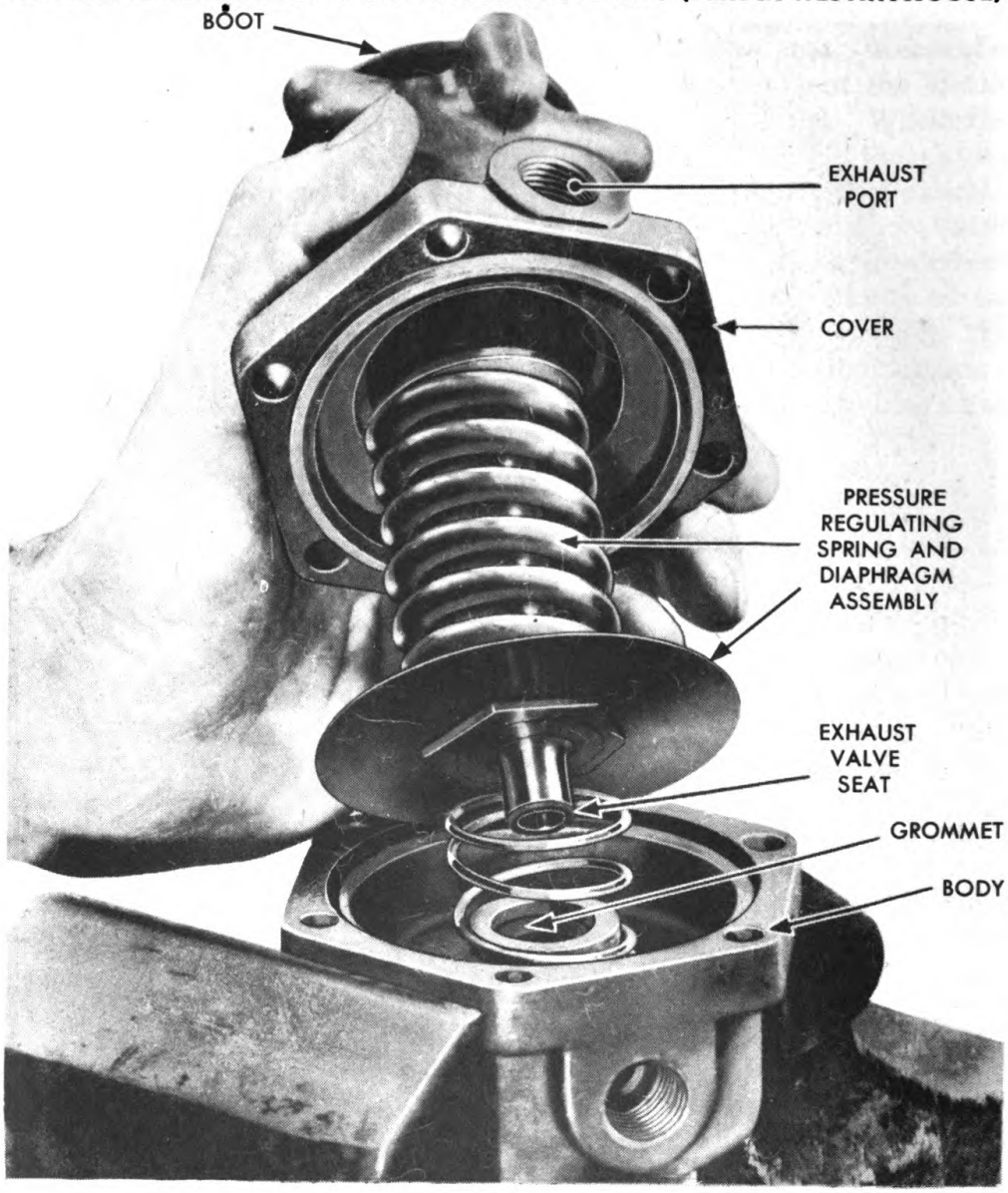



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***Figure 71 — Removing Cover from Body***

button, and boot, out of cover (fig. 72). Drive button out of spring cage and remove boot. Remove two felt oilers from cover.

(6) REMOVE INLET AND EXHAUST VALVE ASSEMBLY (fig. 73). Remove three nuts and lock washers attaching inlet valve body to brake valve body. Lift rubber grommet, intake and exhaust valve assembly and shims out of brake valve body. Do not disassemble the inlet and exhaust valve assembly.

## 46. CLEANING, INSPECTION OF PARTS, AND REPAIRS (fig. 74).

**a. Clean all Parts.** Wash all metal parts in dry-cleaning solvent.

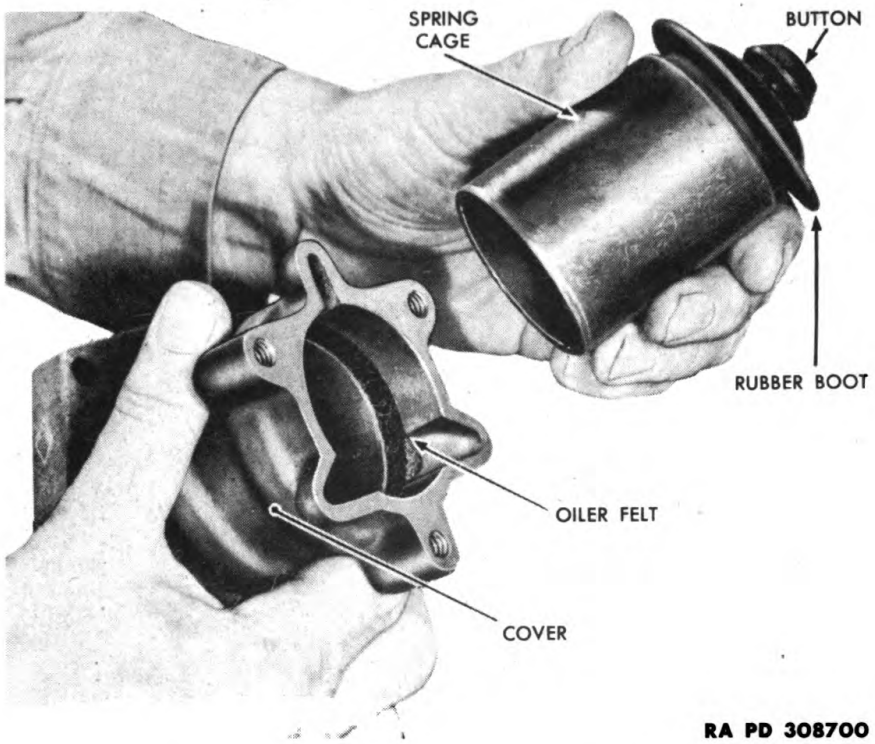


*Figure 72 — Removing Spring Cage*

Remove and thoroughly wash curled hair strainer in inlet valve body.

**b. Pressure Regulating Spring and Diaphragm Assembly** (fig. 75). Carefully inspect both diaphragms to be sure they are not bent or distorted in any way. If ridges or cracks are found, the diaphragms must be replaced. Inspect condition of exhaust valve seat. If seat is worn excessively (fig. 77), or if it is damaged in any way, it must be replaced. If the pressure regulating spring is damaged in any way, the complete diaphragm and spring assembly must be replaced.

**c. Replacing Diaphragms and Exhaust Valve Seats.**

(1) If it is necessary to replace the diaphragms or the exhaust valve seat, extreme caution must be used to be sure the same shims are again used in the pressure regulating spring assembly. To disassemble the pressure regulating spring assembly, loosen the lock plug by entering an Allen set screw wrench down through the tube. Hold the hexagon portion of the exhaust valve seat in a vise. After the lock plug is loosened, unscrew the tube from the exhaust valve seat.

(2) Install new diaphragms so the grain of one is at right angles to the grain of the other. After all parts are positioned, the tube and exhaust valve seat must be screwed together until the distance be-

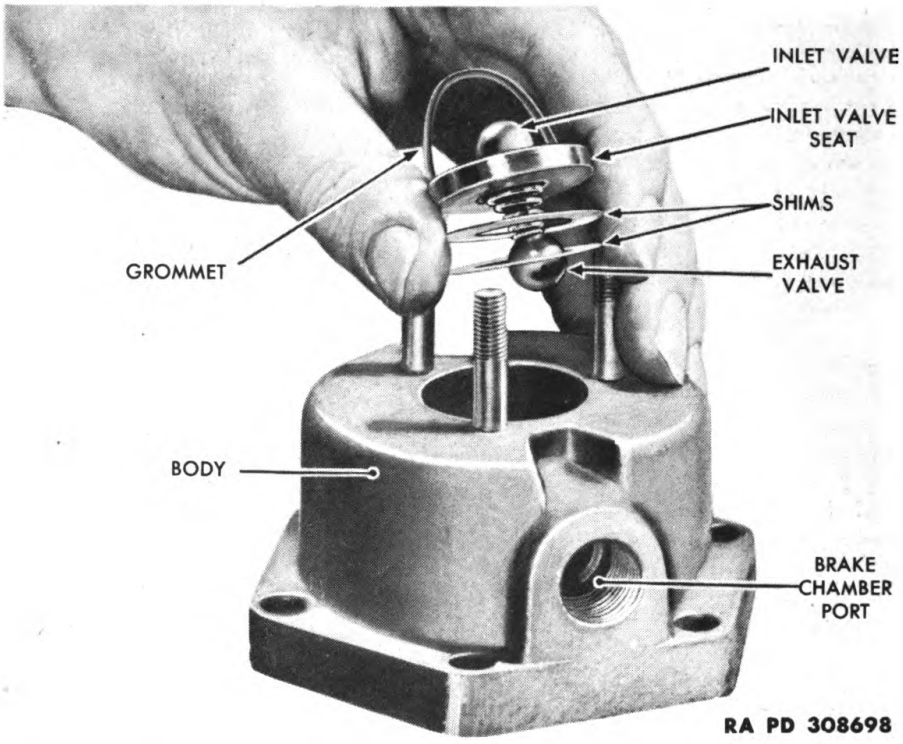


***Figure 73 — Removing Inlet and Exhaust Valve Assembly***

tween the end of the exhaust valve seat and the top of the guide is between 3.498-inches minimum and 3.508-inches maximum (fig. 75). After this dimension has been established, the lock plug must be securely tightened.

**d. Treadle Assembly.** Check fit of treadle fulcrum pin in treadle bushings and mounting plate. Pin must be a neat free fit. If bushings in treadle are worn, they must be pressed out and replaced. Inspect treadle roller for fit on roller pin, also for flat spots. Roller must be a free rolling fit on pin. If excessive wear is found or if the roller has any flat spots, the pin, the roller, or both must be replaced. Check to be sure the stop button at the toe of the treadle, and the stop pin at the heel of the treadle, are in place and in good condition. Replace if necessary. Check to be sure treadle spring is not broken or damaged in any way.

**e. Inspect Cover.** Check fit of spring cage in cover. Spring cage must be a neat sliding fit in cover. Check to be sure the diaphragm seat on the bottom of the cover is not nicked or damaged in any way to prevent perfect contact with the diaphragm. If diaphragm seat is only slightly damaged, lap flat with a fine aluminum abrasive oxide cloth on a flat surface (fig. 76).

## BRAKE VALVES

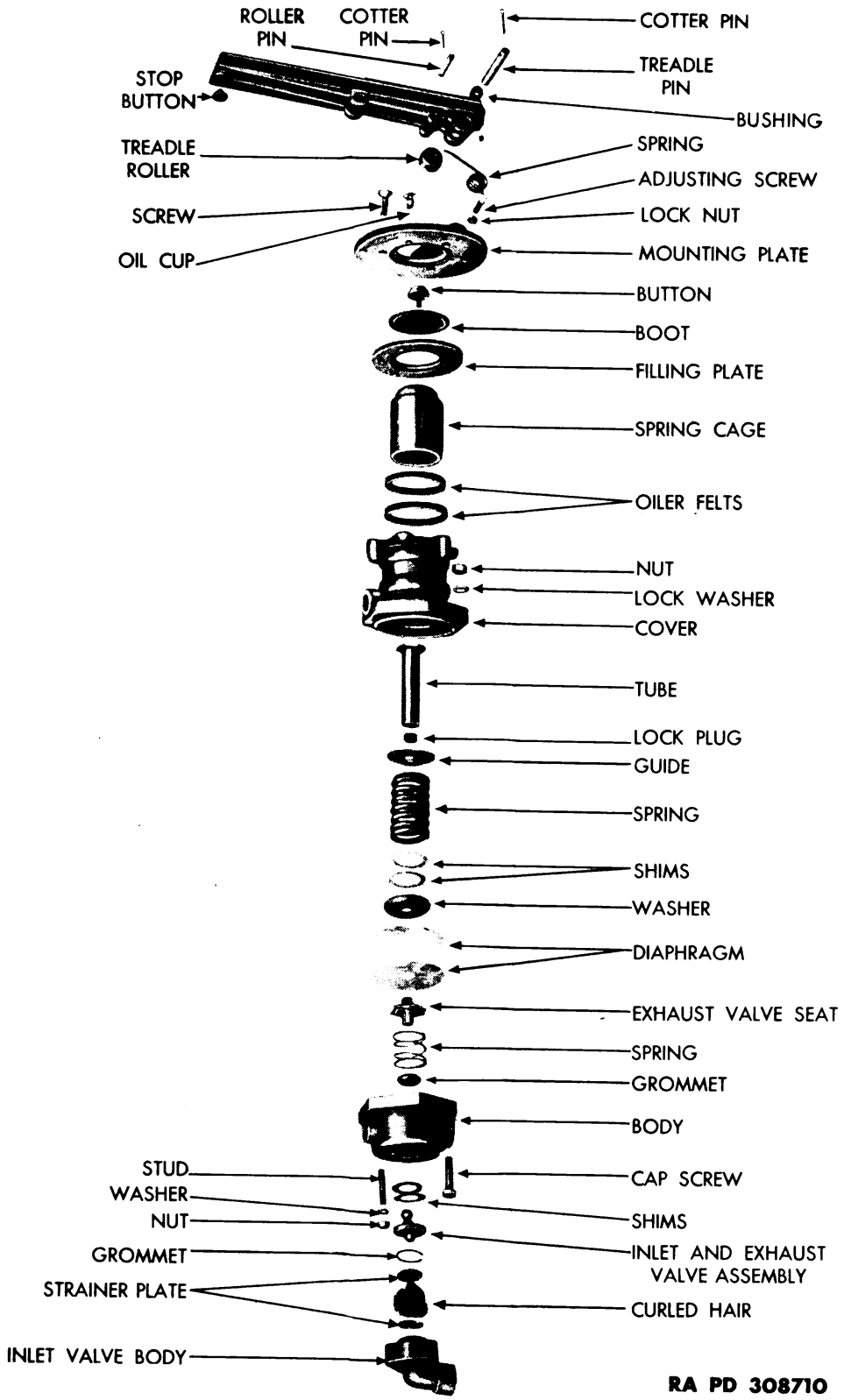


***Figure 74 — Type-D Brake Valve Disassembled***

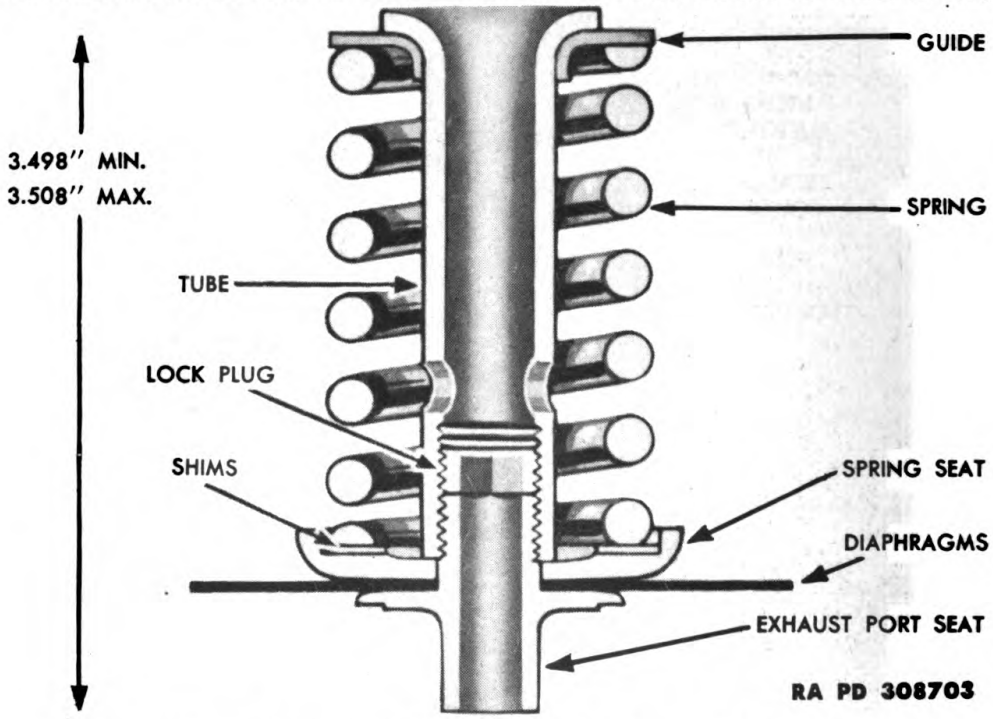


***Figure 75 — Pressure Regulating Spring and Diaphragm Assembly***

**f. Inspect Body.** Inspect diaphragm seat in top of body. Be sure it is flat and smooth. If the diaphragm seat is damaged in any way, replace body. Inspect small bleed hole leading to brake chamber port in body to be sure it is open and not obstructed in any way.

**g. Inspect Inlet and Exhaust Valve Assembly.** Inspect inlet and exhaust valve assembly for broken spring, worn or damaged valves, and seat. If it is damaged or worn excessively (fig. 77), it must be replaced.

## 47. ASSEMBLY.

**a. Install Diaphragm Assembly.** Install a new grommet in body. Position exhaust valve spring in body. Apply a thin coating of grease on the top and bottom of the diaphragms.

**b.** Dip new oiler felts in clean engine oil and install them in the cover.

**c.** Position filler plate on spring cage being sure the recessed side is against top of the spring cage. Position dust guard on top of spring cage and drive button into place. Push spring cage into cover. Place diaphragm assembly in position in spring cage. Position cover, spring cage, and diaphragm assembly, on top of body and carefully push in place so that exhaust port seat properly enters grommet in the body. Position cover on body so that the exhaust port is in line with brake

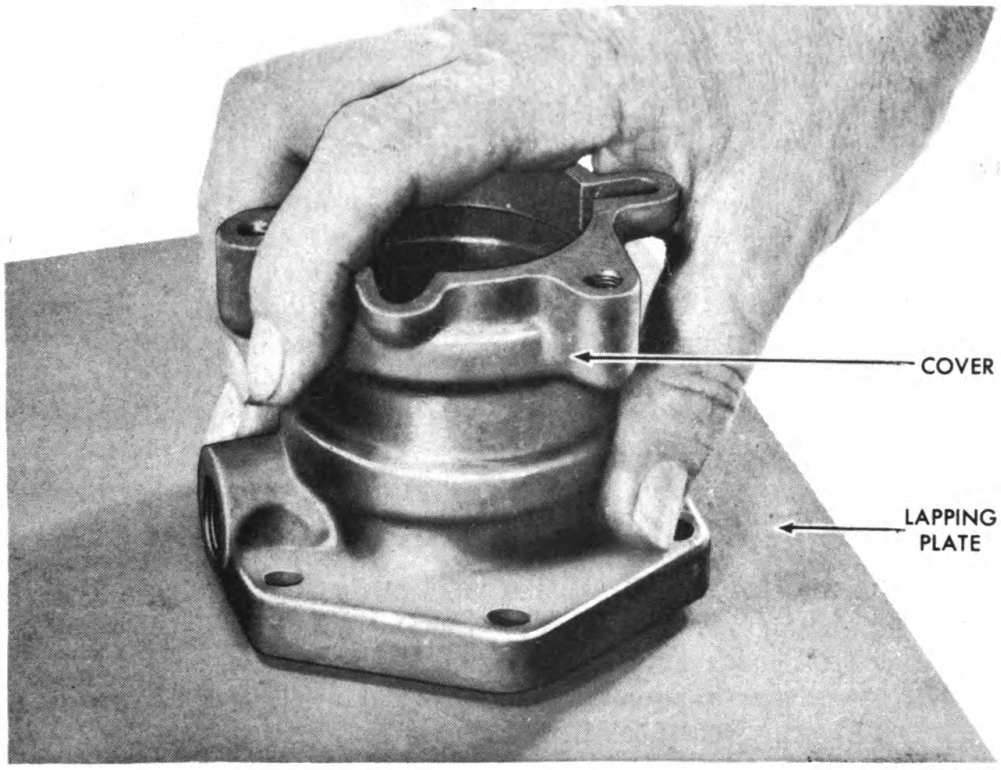


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***Figure 76 — Lapping Cover Diaphragm Seat***

chamber port in the body closest to the bleed hole. Install six bolts, nuts, and lock washers, attaching cover to body. Tighten securely.

**d. Install Mounting Plate.** Position mounting plate on top of filling plate so that treadle will extend over the exhaust port in the cover. Aline holes in mounting plate, filling plate with holes in cover, and install machine screws.

**e. Install Inlet and Exhaust Valve Assembly.** Install shims in recess at bottom of body. Install inlet and exhaust valve assembly with spring and exhaust valve uppermost in the body. Position grommet in place against inlet valve seat. Position inlet valve body elbow as marked before disassembly, and install three nuts and lock washers attaching inlet valve body. Tighten securely.

**f. Install Treadle Assembly.** Position treadle spring so the short, projecting end of spring engages the hole near the treadle adjusting screw in the mounting plate. Position treadle so that the long, projecting end of spring is at the side of roller and so the fulcrum pin holes in treadle mounting plate and spring are alined. Install treadle fulcrum pin being sure it passes through the coiled part of the spring. Aline cotter pin hole in mounting lug with hole in pin, and install cotter pin.

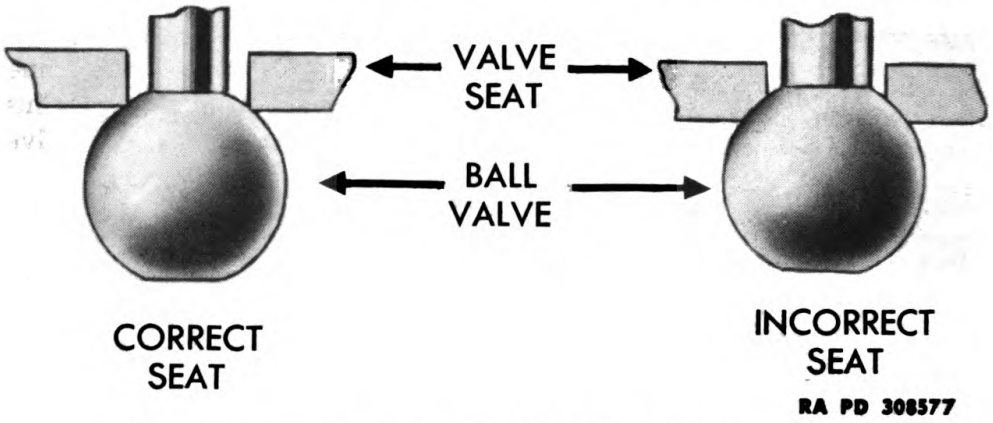


*Figure 77 — Correct and Incorrect Valve Seats*

## 48. TEST OF REBUILT TYPE-D BRAKE VALVE.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90-pound pressure.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4 and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Connect Brake Valve to Test Rack.**

(1) Connect hose No. 4 to one brake chamber port. Plug other brake chamber port.

(2) Connect hose No. 2 to reservoir port.

(3) Be sure exhaust port is not plugged.

**c. Leakage Tests.**

(1) Open cock No. 2 causing the pressure registered by gage No. 2 to rise to 90 pounds.

(2) Depress treadle of brake valve several times, finally letting it return to released position.

(3) Coat the exhaust port of the brake valve with soap suds to determine leakage of the inlet valve. Leakage of more than a 1-inch soap bubble in two seconds is not permissible.

(4) Depress treadle to fully applied position and coat the exhaust port with soap suds to determine leakage of the exhaust valve. Leakage of more than a 1-inch soap bubble in 2 seconds is not permissible.

(5) With treadle depressed to fully applied position, coat the entire valve with soap suds to detect leakage through the casting. No leakage is permissible.

(6) Permit treadle to return to released position.

**d. Operating Tests.**

(1) Depress treadle to fully applied position, and observe that the pressure registered by the red hand of gage No. 3 rises from 0 to 50

pounds in less than one second. If the time required for the red hand of gage No. 3 to rise from zero to 50 pounds is more than one second, it indicates the inlet valve is not opening sufficiently. This is corrected by reducing the number of shims between the inlet valve seat and the body of the valve.

(2) Permit treadle to return to released position and observe that the pressure registered by the red hand of gage No. 3 drops from 60 to 10 pounds in less than one second. Pressure registered by red hand of gage No. 3 must drop to zero. If the time required for the red hand of gage No. 3 to drop from 60 to 10 pounds is more than one second, it indicates the exhaust valve is not opening sufficiently. This is corrected by increasing the number of shims between the inlet valve seat and the body of the valve.

(3) Depress the treadle in steps toward fully applied position and observe that with each stop, a corresponding increase in the pressure registered by the red hand of gage No. 3 is obtained within the graduating range of from 7 pounds to 60 pounds.

(4) Release the treadle in steps towards released position and observe that with each step a corresponding decrease in the pressure registered by gage No. 3 is obtained within the graduating range of from 60 pounds to 7 pounds.

(5) Depress the treadle slowly, and check to determine the lowest pressure that can be maintained on the red hand of gage No. 3. Brake valve should be capable of maintaining seven pounds or less.

(6) Fully depress the treadle and check to be sure the pressure registered by the red hand of gage No. 3 rises to 90 pounds, to register the same as gage No. 1.

**e. Disconnect Valve from Test Rack.**

(1) If valve passes all tests, blow off all traces of soap suds and disconnect hose lines.

(2) Plug all ports, including the exhaust port, with pipe plugs to prevent dirt from entering the valve during shipment or storage.

# CHAPTER 5

# QUICK RELEASE VALVE, RELAY VALVE, AND RELAY EMERGENCY VALVES

## Section I

## QUICK RELEASE VALVE



### 49. DESCRIPTION AND OPERATION.

**a. Description.** The purpose of the quick release valve (fig. 78) is to reduce the time required to release the brakes by hastening the exhaust of air pressure from the brake chambers. It is most commonly used with front wheel brake chambers. The valve consists of a body containing a spring loaded diaphragm so arranged as to permit air pressure to flow through the valve in one direction. When the supply pressure is reduced, the air which has passed through the valve is permitted to escape through the exhaust port.

**b. Operation.**

(1) The quick release valve assumes three positions during nor-

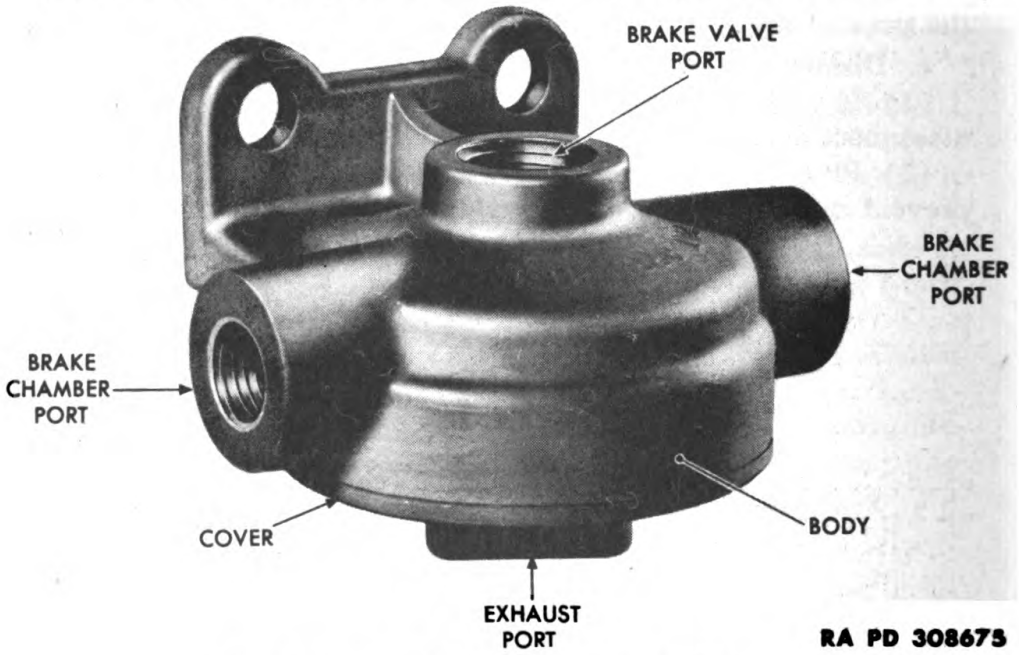


*Figure 78 — Quick Release Valve*

## QUICK RELEASE VALVE, RELAY VALVE, AND RELAY EMERGENCY VALVES

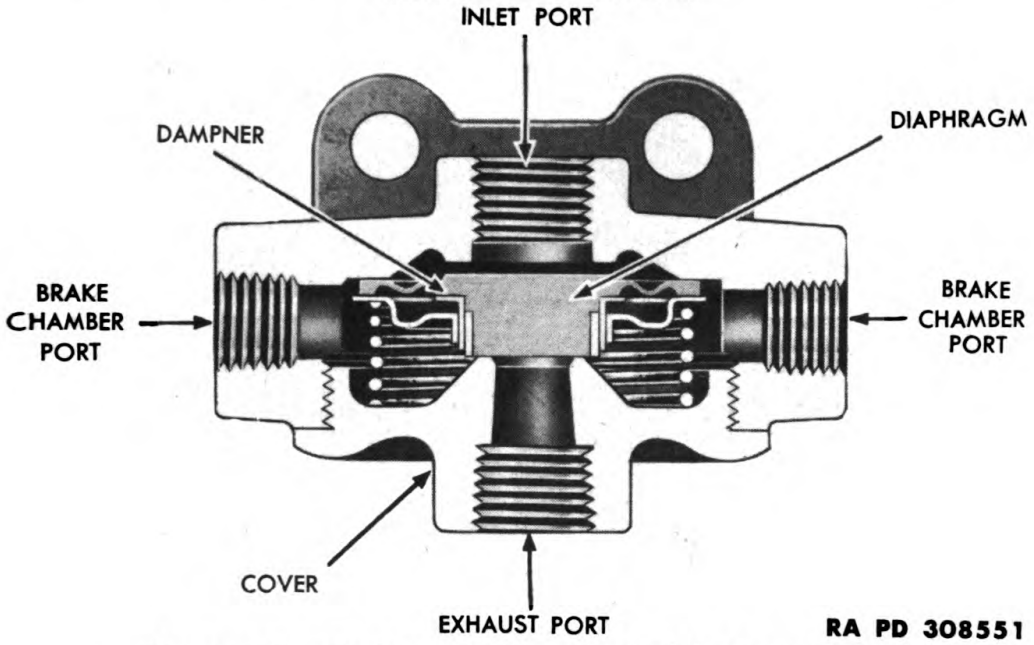


***Figure 79 — Sectional View of Quick Release Valve***

mal operation. These three positions are the applying position, when air pressure is passing through the valve into the brake chambers; the holding position, when pressure is being held in the brake chambers; and the releasing position, when brake chamber pressure is being exhausted.

(2) When air pressure from the brake valve enters the top connection of the valve, the diaphragm moves down and closes the exhaust port. Air pressure then deflects the outer edges of the diaphragm downward and flows out the side connections to the brake chambers applying the brakes.

(3) As soon as the brake chamber pressure below the diaphragm equals the brake valve pressure above the diaphragm, the force of the spring below the diaphragm forces the outer edge of the diaphragm back up against the body, although the center of the diaphragm keeps the exhaust port closed. This is the holding position.

(4) If the brake valve pressure on top of the diaphragm is reduced, the brake chamber pressure below the center of the diaphragm raises it. This opens the exhaust port and permits brake chamber pressure to be released through the exhaust port.

(5) If the brake valve pressure on top of the diaphragm is only partially released, the diaphragm assumes its holding position as soon as the pressures above and below it are equalized.

(6) In this manner the quick release valve reacts to pass any increased brake valve pressure through it to the brake chambers, or quickly releases the brake chamber pressure when the brake valve

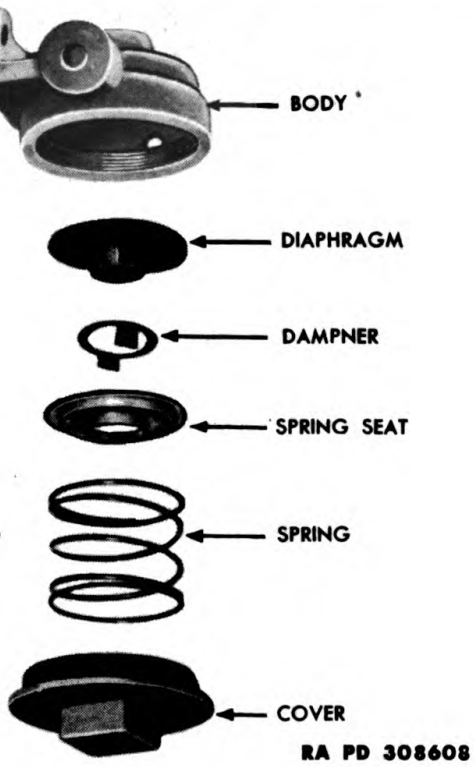


*Figure 80 — Quick Release Valve Disassembled*

pressure is reduced. It thus maintains the same pressure in the brake chambers as delivered by the brake valve.

## 50. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. General.** If testing equipment is available, test the valve before disassembly by following the procedure outlined in paragraph 53.

**b. Cleaning and Inspection.** Remove all dirt and grease from exterior of valve using dry-cleaning solvent and a brush. Inspect exterior of valve for broken or damaged parts. All broken or damaged parts must be replaced.

**c. Disassembly** (fig. 80). Unscrew cover, lift out diaphragm spring, diaphragm spring seat, dampner, and diaphragm.

## 51. INSPECTION OF PARTS AND REPAIRS.

**a.** Clean all parts thoroughly. Wash all metal parts in dry-cleaning solvent.

**b.** Examine diaphragm for signs of cracking, wear or damage. Carefully examine the lower face of the diaphragm which contacts the exhaust port seat in the cover for signs of pitting or grooving. Replace diaphragm if any of these conditions are found.

**c.** Inspect condition of exhaust port seat on cover for signs of

## QUICK RELEASE VALVE, RELAY VALVE, AND RELAY EMERGENCY VALVES


***Figure 81 — Lapping Exhaust Port Seat***

pitting. The seat must be smooth and flat. If the exhaust port seat shows scratches or pitting, it can sometimes be repaired by carefully lapping the seat using a piece of fine aluminum abrasive oxide cloth on a flat surface (fig. 81).

**d.** Replace any broken parts.

### 52. ASSEMBLY.

**a.** With dampner positioned on diaphragm, position diaphragm and dampner in body (fig. 79). Install spring seat, spring, and cover. Tighten cover securely.

### 53. TEST OF REBUILT QUICK RELEASE VALVE.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90-pound pressure.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7 until gages No. 2, No. 4 and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Connect Quick Release Valve to Test Rack.**

(1) Connect hose No. 5 to brake valve port.

(2) Connect hose No. 4 to one brake chamber port. Plug other brake chamber port.

(3) Be sure exhaust port is not plugged.

**c. Leakage Tests.**

(1) Move brake valve handle toward fully applied position until red hand of gage No. 3 registers 10-pound pressure. Coat the exhaust port with soap suds to check for leakage. Leakage in excess of a 1-inch soap bubble in three seconds is not permissible.

(2) Move brake valve handle toward fully applied position until red hand of gage No. 3 registers 50-pound pressure. Coat the entire valve with soap suds to detect casting leakage. No leakage is permissible. Move brake valve handle back to released position.

**d. Operating Tests.**

(1) Move brake valve handle to fully applied position, and observe that the pressure registered by the red hand of gage No. 3 rises from 0 to 50 pounds in not more than one second.

(2) Move brake valve handle back to released position and observe that the pressure registered by the red hand of gage No. 3 drops from 60 to 10 pounds in not more than two seconds.

(3) Move brake valve handle toward applied position until black hand of gage No. 3 registers about 20 pounds. Red hand of gage No. 3 must register the same pressure as the black hand within three pounds.

(4) Move brake valve handle back to released position.

**e. Disconnect Valve from Test Rack.**

(1) If quick release valve passes all tests, blow off all traces of soap suds and disconnect hose lines.

(2) Plug all ports with pipe plugs to prevent dirt from entering the valve during shipment or storage.

## Section II

# RELAY VALVE



## 54. DESCRIPTION AND OPERATION.

**a. Description.**

(1) The relay valve (fig. 82) speeds up the application and release

## QUICK RELEASE VALVE, RELAY VALVE, AND RELAY EMERGENCY VALVES

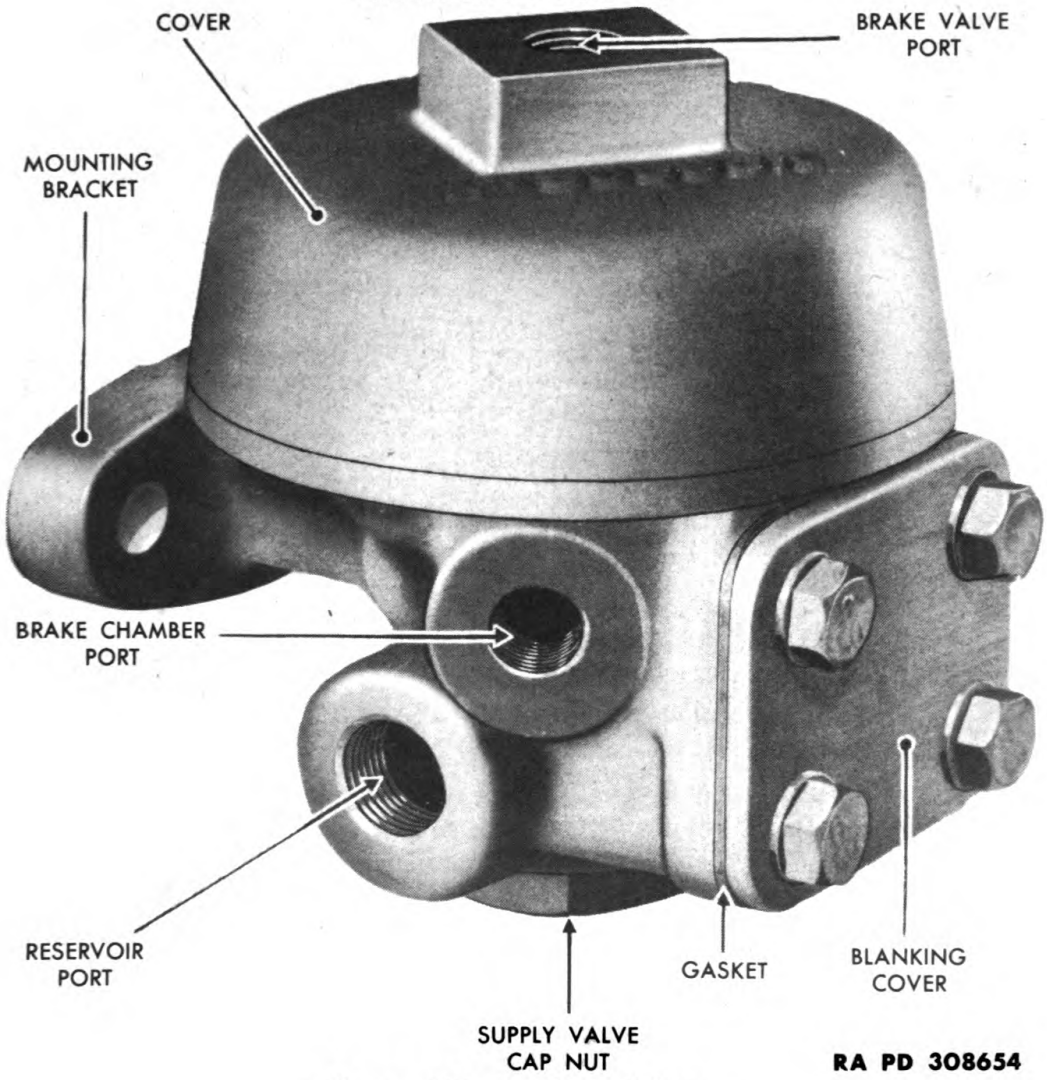


***Figure 82 — Relay Valve***

of the rear wheel brakes. It is controlled by the brake valve, and keeps the air pressure in the rear brake chambers the same as the pressure being delivered by the brake valve. It reacts to even slight changes in pressure and raises, lowers, or completely exhausts, pressure from the rear brake chambers as the brake valve raises, lowers, or completely exhausts air pressure from it.

**b. Operation** (fig. 83).

(1) GENERAL. The operation of the relay valve is controlled by the air pressure delivered to it by the brake valve. Air pressure from the brake valve is delivered to the cavity above the rubber diaphragm. Because this cavity is comparatively small and therefore subject to quick changes in air pressure, the action of the valve in changing its delivered pressures is also very rapid. The mechanism inside the

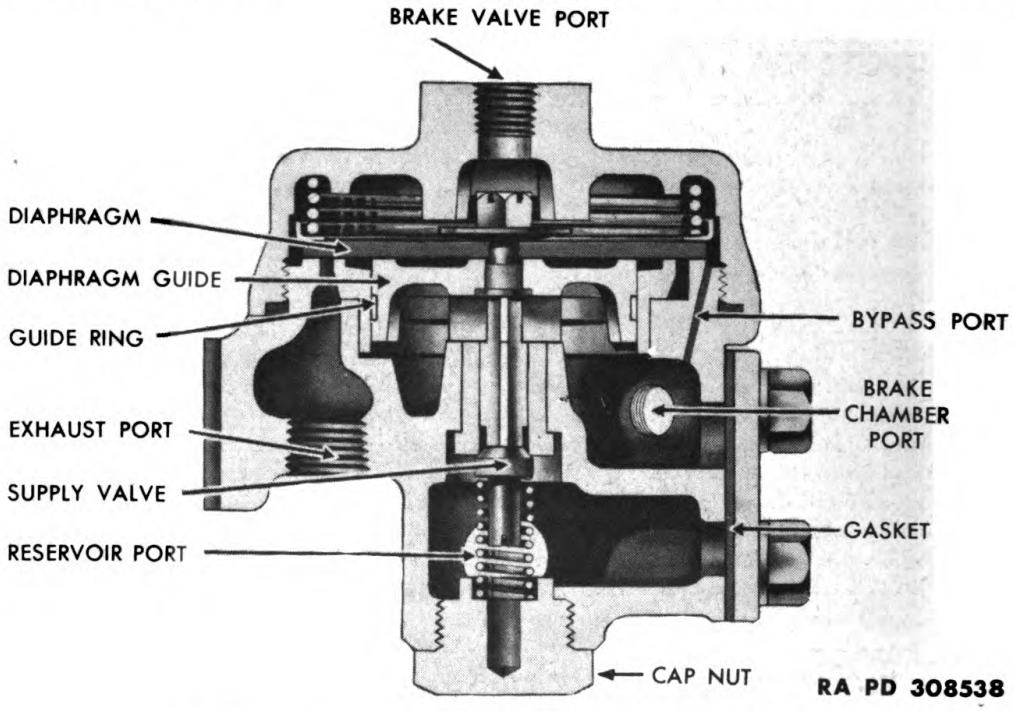


***Figure 83 — Sectional View of Relay Valve***

valve assumes three positions during normal operation. These three positions are the applying position, when the valve is actually delivering air pressure to the brake chambers; the holding position, when the valve is maintaining or holding a constant pressure in the brake chambers; and the releasing position, when the valve is releasing or reducing the air pressure in the brake chambers.

(2) APPLYING POSITION. As air pressure from the brake valve enters the cavity above the diaphragm, the pressure developed depresses the diaphragm. The diaphragm thus seals the exhaust port beneath its outer edge and its center is deflected, forcing the diaphragm guide down against the top of the supply valve. Further movement forces the supply valve off its seat and air pressure from the reservoir flows through the supply valve into the cavity below the diaphragm which is connected to the brake chambers. In this position, air pressure is flowing direct from the reservoir through the relay valve into the brake chambers, applying the brakes.

(3) HOLDING POSITION. As soon as the air pressure on top of the diaphragm stops rising, the air pressure below the diaphragm equals it and pressures on both sides of the diaphragm being equalized. The diaphragm then lifts and assumes its normal position. This permits the supply valve spring to close the supply valve, limiting the air pressure being delivered to the brake chambers by the relay valve, to the same pressure as that being delivered by the brake valve to the relay valve. In this position, the supply valve is closed, and action

## QUICK RELEASE VALVE, RELAY VALVE, AND RELAY EMERGENCY VALVES

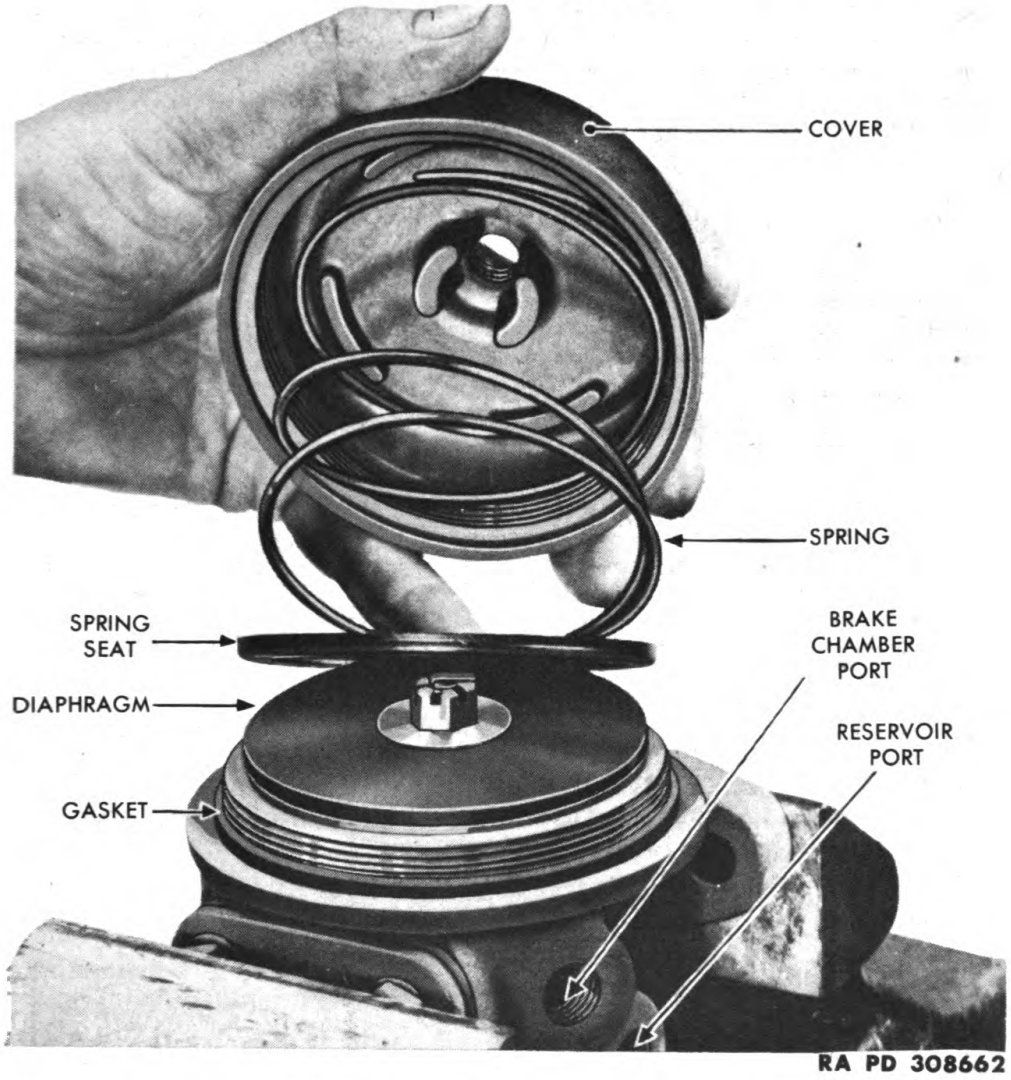


***Figure 84 — Removing Cover***

of the spring on top of the diaphragm and the balanced air pressures on both sides of the diaphragm keep the outer edge of diaphragm sealing the exhaust port. Thus, the valve is in its holding position maintaining the same air pressure in its brake chambers as the brake valve is delivering to it. A rise in brake valve pressure causes the same action until the higher pressure in the brake chambers is similarly established.

(4) RELEASING POSITION. If the brake valve pressure above the diaphragm is reduced, the brake chamber pressure below the diaphragm overcomes the pressure above the diaphragm and the diaphragm lifts still further. This opens the exhaust port under the outer edge of the diaphragm permitting the pressure in the brake chambers to exhaust until a lower balanced pressure is reached. If

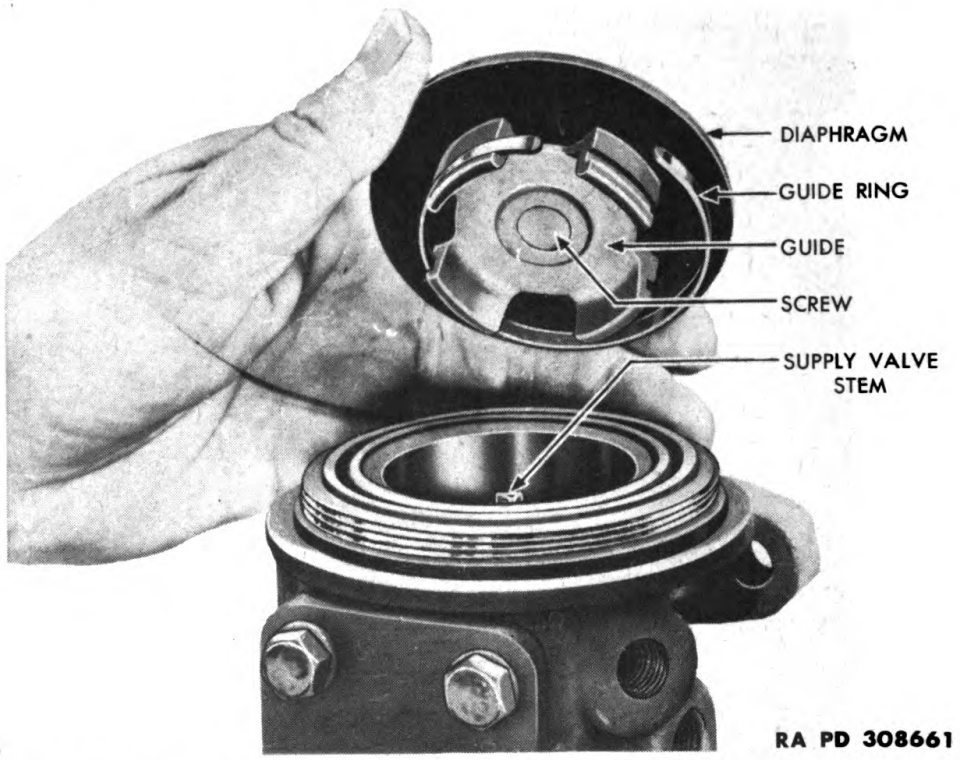


***Figure 85 — Removing Diaphragm and Guide Assembly***

the brake valve pressure is released entirely, the relay valve also releases all pressure from its brake chambers, thus fully releasing the brakes. The purpose of the by-pass port in the valve is to be sure the air pressure delivered to the brake chambers is always exactly the same as the air pressure delivered to the relay valve by the brake valve.

## 55. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. General.** If testing equipment is available, test the valve before disassembly by following procedure outlined in paragraph 59.

**b. Cleaning and Inspection.** Remove all dirt and grease from exterior of valve using dry-cleaning solvent and a brush. Inspect exterior of valve for broken or damaged parts. All broken or damaged parts must be replaced

**c. Disassembly** (fig. 86).

(1) Unscrew cover and lift out diaphragm spring and spring seat. Remove cover gasket (fig. 84).

(2) Using fingers, lift outer edge of diaphragm and pull out diaphragm assembly and guide ring (fig. 85).

(3) Remove cotter pin from diaphragm screw nut. Unscrew nut and lift washer, diaphragm and guide, off of screw.

## QUICK RELEASE VALVE, RELAY VALVE, AND RELAY EMERGENCY VALVES

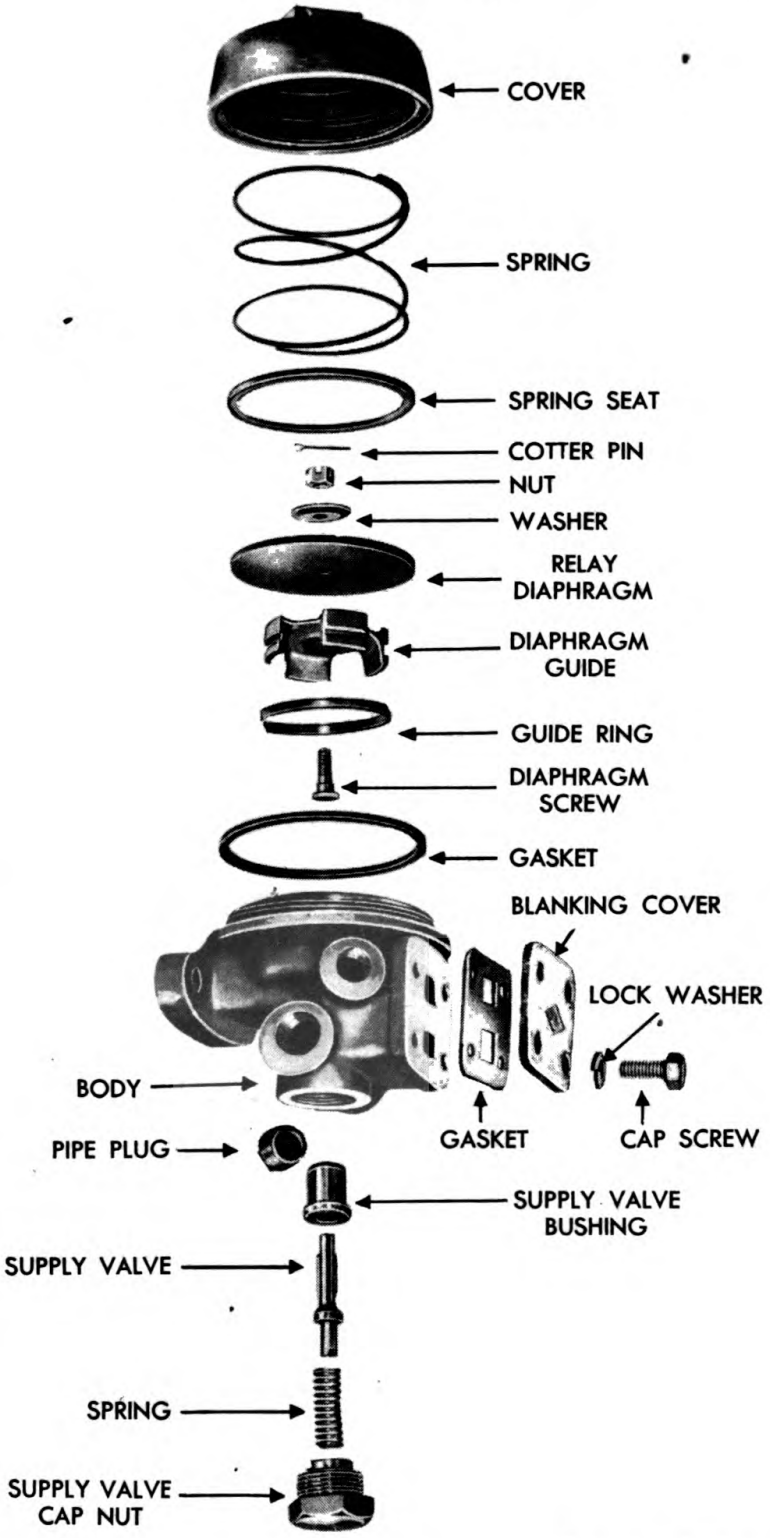


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***Figure 86 — Relay Valve Disassembled***

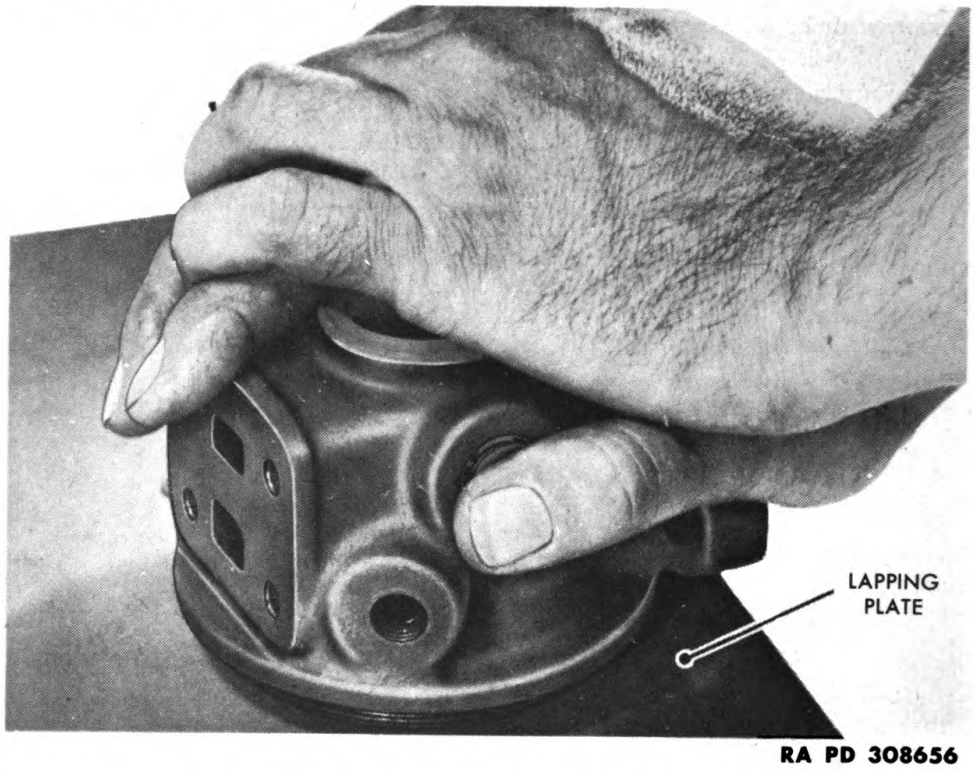


*Figure 87 — Lapping Diaphragm Seat*

(4) Unscrew supply valve cap nut and remove supply valve spring, and supply valve.

(5) Remove four cap screws and lock washers attaching blanking cover, and lift off cover and gasket.

## 56. CLEANING AND INSPECTION OF PARTS.

**a. Clean all Parts.** Wash all metal parts in dry-cleaning solvent. Be sure by-pass port is open and clean.

**b. Diaphragm.** Replace all used diaphragms.

**c. Diaphragm Guide.** Check fit of diaphragm guide in diaphragm guide bushing. It must be a neat sliding fit.

**d. Diaphragm Guide Ring.** Check condition of diaphragm guide ring. When lying on a flat surface the ends of the ring should not be in line like the ends of a piston ring. The ring must be twisted so one end is about ⅜ inch higher than the other.

**e. Diaphragm Guide Bushing.** If the diaphragm guide bushing is damaged or loose, no attempt should be made to replace it. Use a new body complete with bushing.

**f. Supply Valve and Seat.** Inspect condition of supply valve and seat (fig. 57). Check fit of supply valve in supply valve bushing. It must be a neat sliding fit. If valve or seat is worn excessively, they must be replaced.

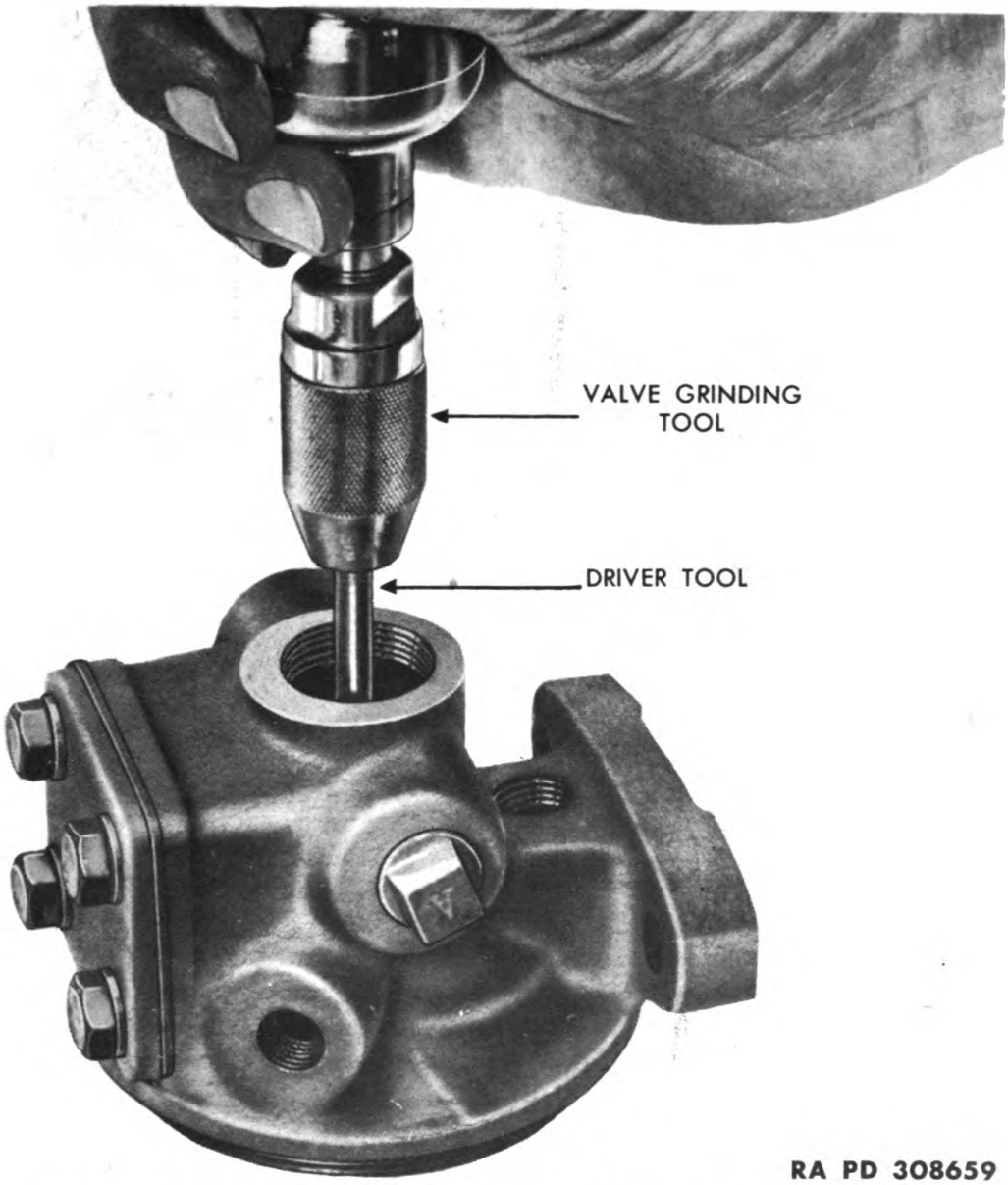


***Figure 88 — Grinding Supply Valve, Using Tools 41-T-3381-15 and 41-T-660***

**g. Diaphragm Seat.** Inspect diaphragm seat on top edge of body and diaphragm guide bushing. Seat must be smooth, flat, and free, from dents or scratches.

## 57. REPAIRS.

**a. Diaphragm Seat.** If diaphragm seat on top of body and guide bushing is only slightly scratched or dented, repair by lapping the body on a flat surface covered with fine aluminum abrasive oxide cloth (fig. 87).

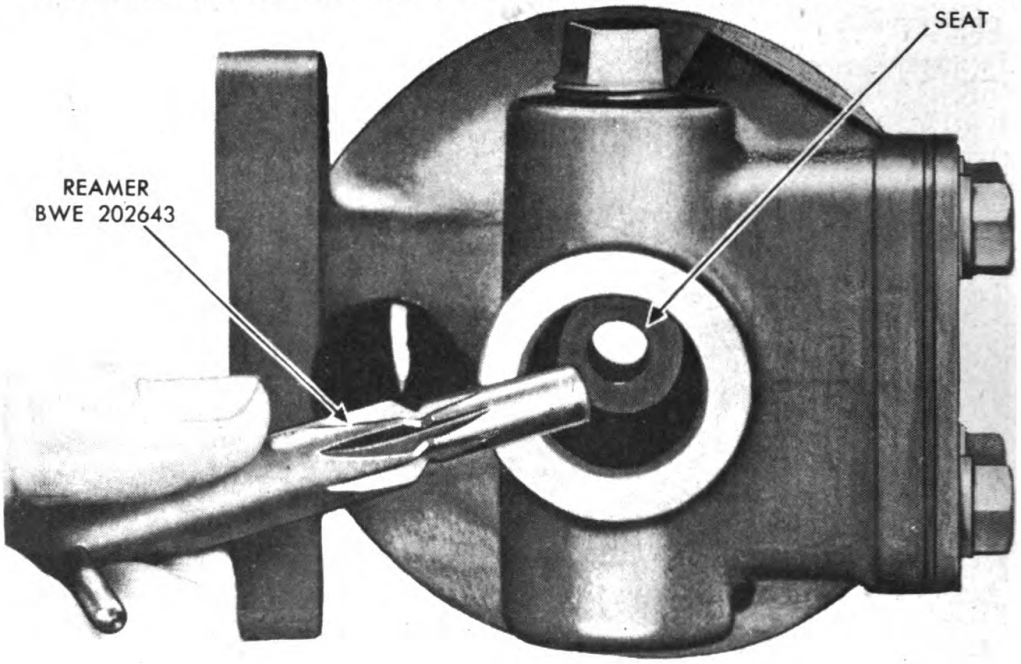


*Figure 89 — Reaming Supply Valve Seat, Using Reamer 41-R-834*

**b. Supply Valve and Seat.**

(1) If the supply valve and seat are not too badly worn (fig. 57) and leakage is excessive, repair by carefully grinding the valve to its seat (fig. 88) using grinding tool (41-T-3381-15), driver tool (41-T-660) and (BWE grade 1,000) grinding compound. Do not use ordinary valve grinding compound.

(2) Excessively worn valves or valve seat bushings must be replaced. A worn bushing is pressed or driven out through the bottom of the body. A new bushing must be pressed into place. After being pressed into place, the bushing must be reamed using reamer (41-R-834) and seating reamer (BWE 221625). When using seating reamer (BWE 221625), only the sharp corner of the supply valve seat must be removed (fig. 89). After reaming, a new valve must be ground to the seat (fig. 88).

(3) After grinding, clean the supply valve and seat thoroughly with dry-cleaning solvent and test for leakage. To test for leakage, install supply valve, spring and cap nut. Then install blanking cover and gasket. Plug one reservoir port and connect an air line with 75-pound air pressure to the other reservoir port. Test for leakage by applying soap suds around the top of the supply valve stem (fig. 90). Leakage in excess of a 1-inch soap bubble in five seconds is not permissible. If leakage is excessive, grind the valve to its seat. Sometimes leakage is reduced by tapping the top of the supply valve stem

QUICK RELEASE VALVE, RELAY VALVE, AND RELAY EMERGENCY VALVES

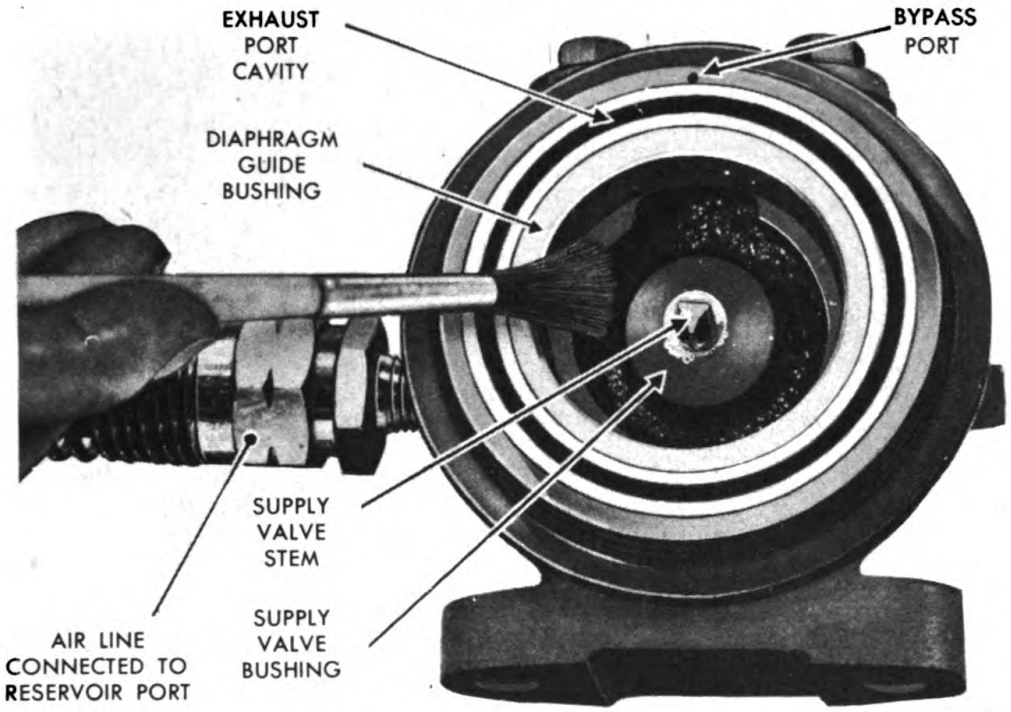


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***Figure 90 — Testing Supply Valve for Leakage***

several times with a light rawhide hammer while the air pressure remains applied.

(4) CHECKING LENGTH OF SUPPLY VALVE STEM (fig. 91). After leakage has been reduced to the maximum permitted, place diaphragm screw in diaphragm guide, and diaphragm guide and screw in body. Use a straight edge to check the height of the center and edges of the diaphragm guide in relation to the diaphragm seat on the body. The top of the diaphragm guide must not be above the top of the diaphragm seat, otherwise when the relay valve is assembled, the supply valve will be held off its seat and leakage will occur. The top of the diaphragm guide must not be more than 0.005 inch below the top of the diaphragm seat. Otherwise the relay valve will not deliver the correct air pressure. Supply valve stems which are too long must be carefully filed to proper length. Supply valves of insufficient length must be replaced.

## 58. ASSEMBLY.

**a.** Position blanking cover and gasket, and install four cap screws and lock washers attaching blanking cover to body.

**b.** Position supply valve and spring, and install supply valve cap nut. Tighten supply valve cap nut securely.

**c.** Position diaphragm screw in diaphragm guide, and diaphragm on diaphragm screw. Install diaphragm washer with convex side of

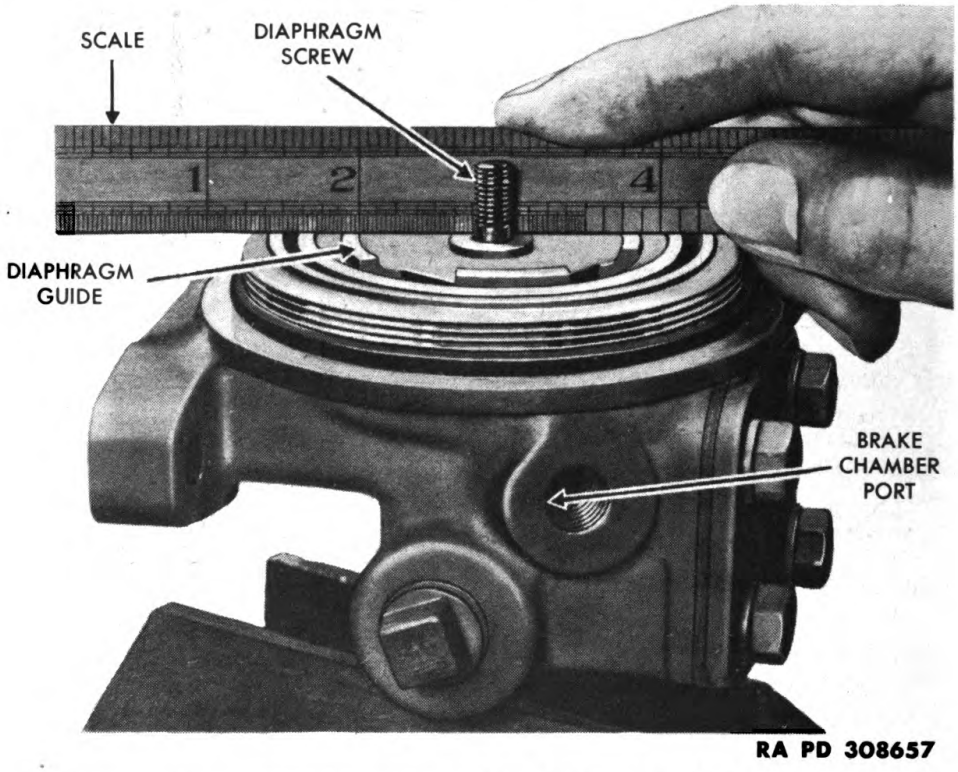


***Figure 91 — Checking Length of Supply Valve Stem***

washer next to the diaphragm. Install diaphragm screw nut but only tighten sufficiently to prevent leakage and not sufficiently to distort the diaphragm. When the nut is tightened correctly, it is still possible to turn the diaphragm with the guide held stationary. Install cotter pin securing diaphragm nut.

**d.** Position guide ring in groove of diaphragm guide and holding it in place with the fingers (fig. 92) push diaphragm and guide assembly into place.

**e.** Position a new cover gasket in place. Position diaphragm spring seat and spring on top of diaphragm and install cover. Tighten cover securely.

## 59. TEST OF REBUILT RELAY VALVE.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90-pound pressure.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4, and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Connect Valve to Test Rack.**

## QUICK RELEASE VALVE, RELAY VALVE, AND RELAY EMERGENCY VALVES

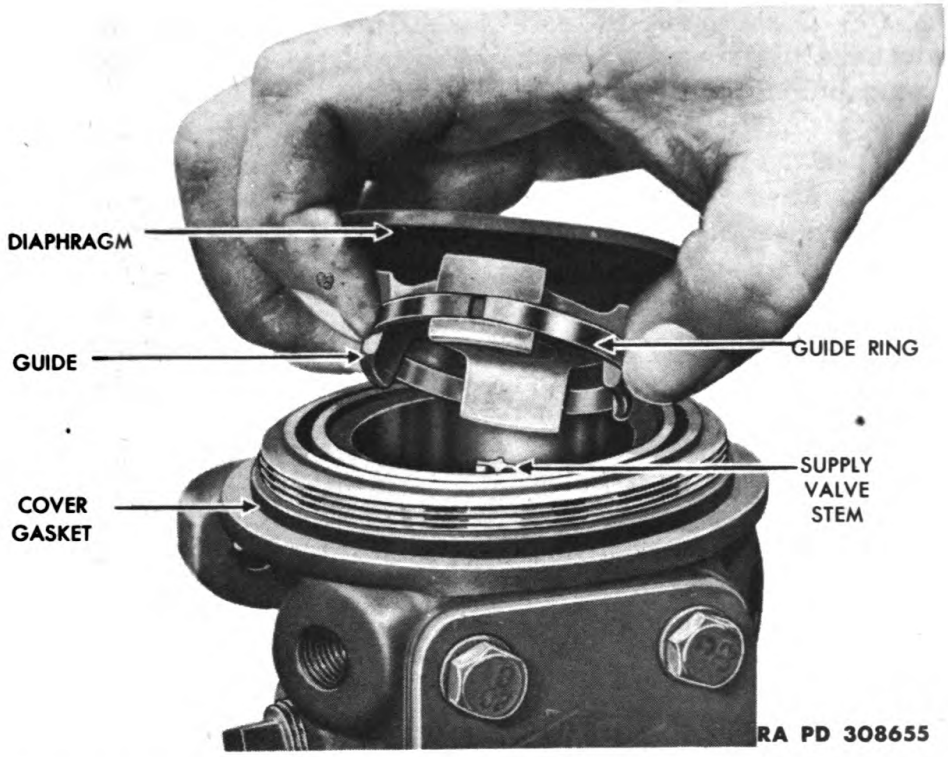


***Figure 92 — Installing Diaphragm and Guide Assembly***

(1) Connect hose line No. 2 to reservoir port. Plug other reservoir port.

(2) Connect hose line No. 4 to one brake chamber port. Plug other brake chamber port.

(3) Connect hose line No. 5 to brake valve port.

(4) Be sure the exhaust port is not plugged.

**c. Leakage Tests.**

(1) Start tests with brake valve handle in released position, cocks No. 1 and No. 5 open, cocks No. 2, No. 3, No. 4, No. 6, and No. 7 closed, gage No. 1 registering 90-pound pressure and gages No. 2, No. 3, and No. 4, registering 0.

(2) Open cock No. 2 causing gage No. 2 to register 90-pound pressure.

(3) Move brake valve handle back and forth between released and applied positions several times to operate relay valve finally leaving it in released position.

(4) Disconnect hose No. 5 and hold finger over brake valve port. Then coat the exhaust port of the valve with soap suds to determine leakage of the supply valve. Leakage of more than 1-inch soap bubble in three seconds is not permissible.

(5) Reconnect hose No. 5 to brake valve port.

(6) Move the brake valve handle toward applied position until the red hand on gage No. 3 registers 50 pounds.

(7) Coat the exhaust port of the valve with soap suds to determine leakage past the diaphragm seal. Leakage of more than a 1-inch soap bubble in three seconds is not permissible.

(8) Coat the valve all over with soap suds to check for leakage through the walls or past the gaskets. No leakage is permissible.

(9) Move brake valve handle back to released position.

**d. Operating Tests.**

(1) Start tests with brake valve handle in released position. Cocks No. 1 and No. 2, also No. 5, must be open. Cocks No. 3, No. 4, No. 6, and No. 7, must be closed. Gages No. 1 and No. 2 must register 90-pound pressure. Both hands of gage No. 3 and gage No. 4 must register zero.

(2) Move brake valve handle to fully applied position, and observe that the time required for the red hand of gage No. 3 to rise from zero to 50 pounds is not more than 1 second.

(3) Move brake valve handle from fully applied position to released position, and observe that the time required for the red hand of gage No. 3 to drop from 60 to 10 pounds is not more than two seconds.

(4) Move brake valve handle toward fully applied position until the red hand of gage No. 3 registers 50 pounds. Open cock No. 6 and observe that the pressure registered by the red hand of gage No. 3 does not drop more than 5 pounds below the black hand of gage No. 3. Move brake valve handle back to released position and close cock No. 6.

(5) Move brake valve handle slowly toward fully applied position until black hand of gage No. 3 registers 10 pounds. Observe that the pressure registered by the red hand of gage No. 3 rises at approximately the same rate. The pressure registered by the red hand of gage No. 3 must not be more than 3-pounds less than the pressure registered by the black hand and the pressures registered by both hands must equalize. If the pressure registered by the red hand of gage No. 3 is more than 3 pounds below the black hand, it indicates there is too much clearance between the top of the supply valve stem and the bottom of the diaphragm screw (fig. 91). With the pressures registered by both hands of gage No. 3 remaining at 10 pounds, coat the exhaust port of the relay emergency valve with soap suds. Leakage of more than a 1-inch soap bubble in one second is not permissible. Excessive leakage usually indicates there is not sufficient clearance between the top of the supply valve stem and the bottom of the diaphragm screw (fig. 91).

**e. Disconnect Valve from Test Rack.**

(1) If valve passes all tests, blow off all traces of soap suds and disconnect hose lines.

(2) Plug all ports including the exhaust port with pipe plugs to prevent dirt from entering the valve during shipment or storage.

## QUICK RELEASE VALVE, RELAY VALVE, AND RELAY EMERGENCY VALVES

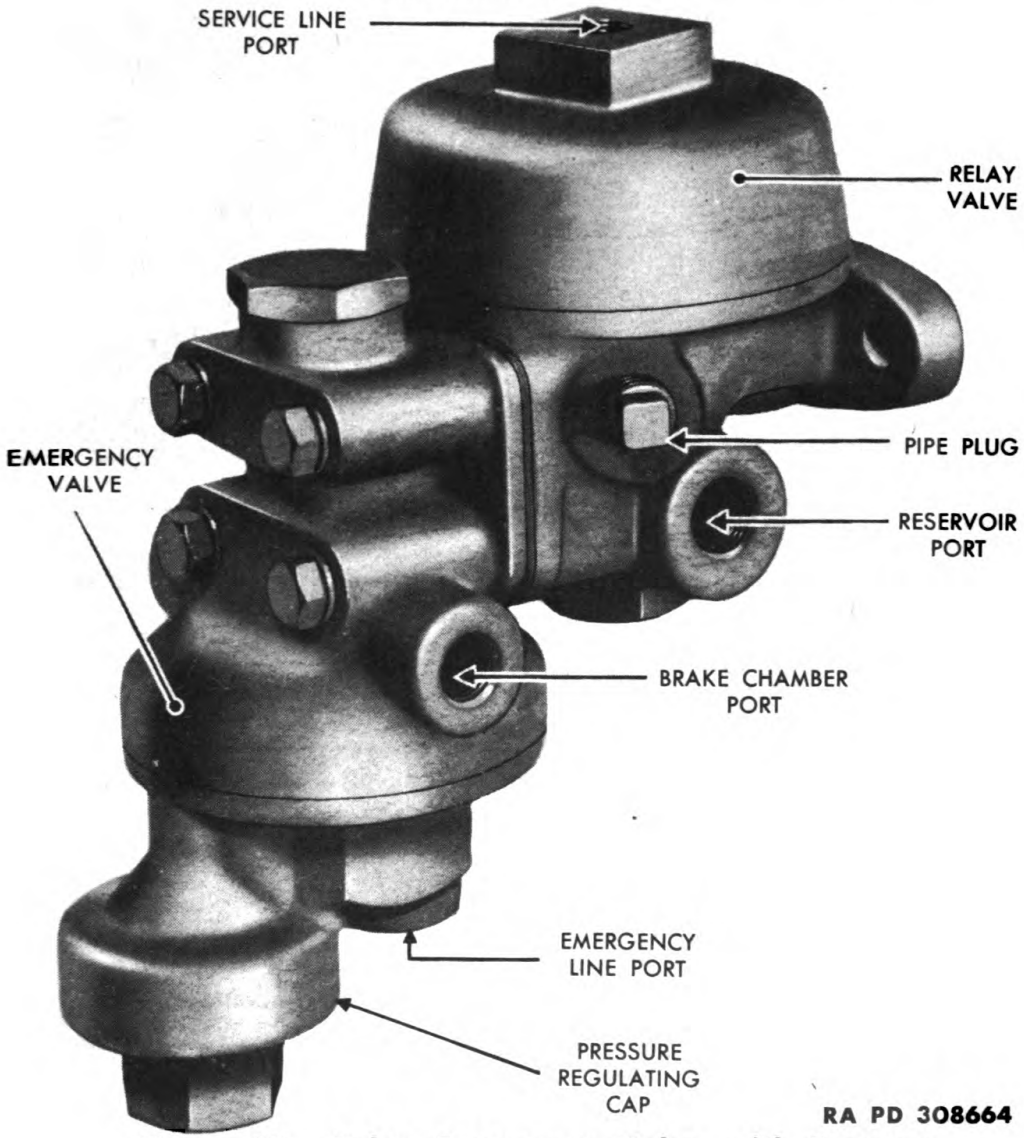


***Figure 93 — Relay Emergency Valve with Pressure Regulating Valve***

### Section III

## RELAY EMERGENCY VALVES

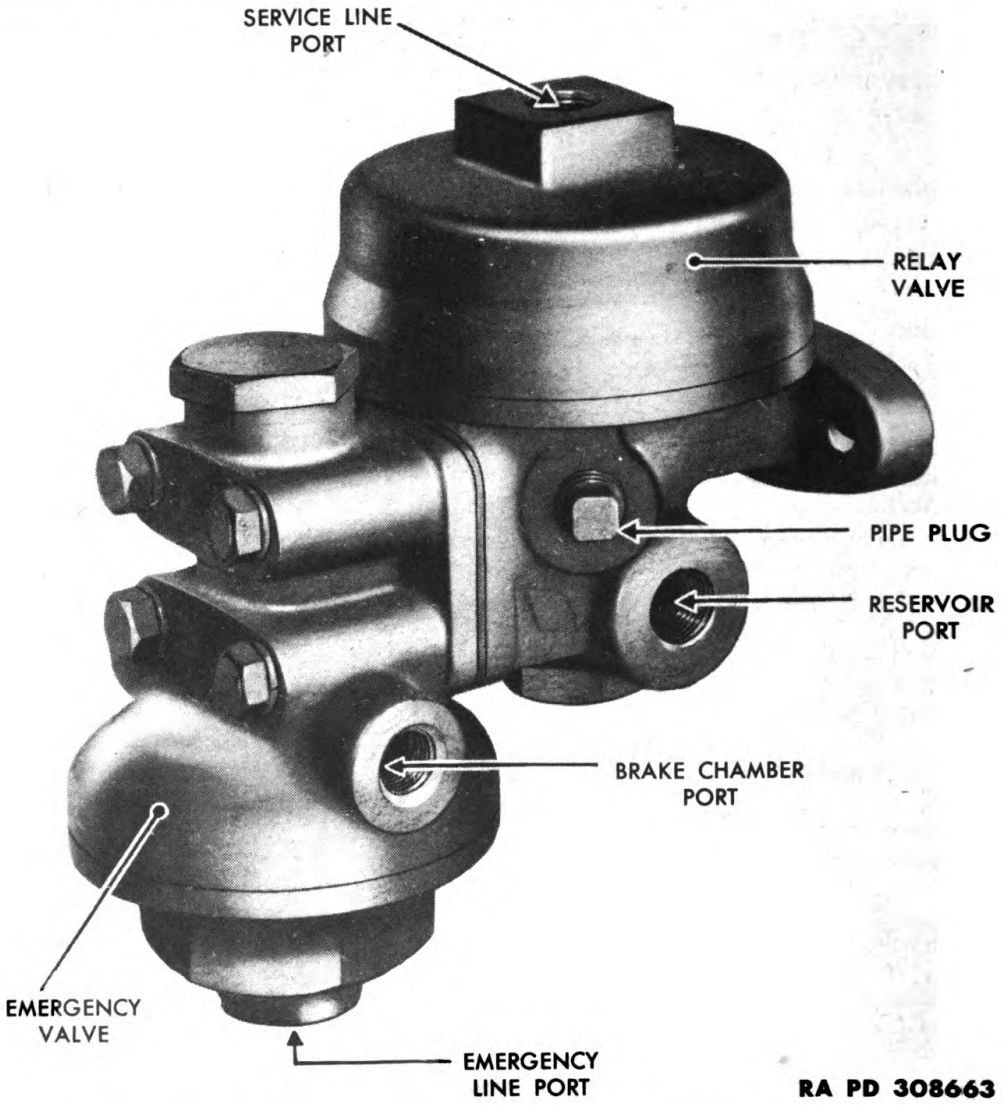


***Figure 94 — Relay Emergency Valve Without Pressure Regulating Valve***

## 60. DESCRIPTION AND OPERATION.

**a. Description.**

(1) The relay emergency valve consists of a relay valve (pars. 54 to 59) to which has been added an emergency valve. They are included in the air brake equipment on such vehicles as trailers and gun mounts.

(2) The function of the relay emergency valve is to act as a relay station to control the brakes on a towed vehicle and to also automatically apply the brakes on the towed vehicle in the event the towed vehicle breaks away from the towing vehicle. As well as providing this safety feature, the relay emergency valve speeds up the operation of the brakes both during application and release.

## QUICK RELEASE VALVE, RELAY VALVE, AND RELAY EMERGENCY VALVES

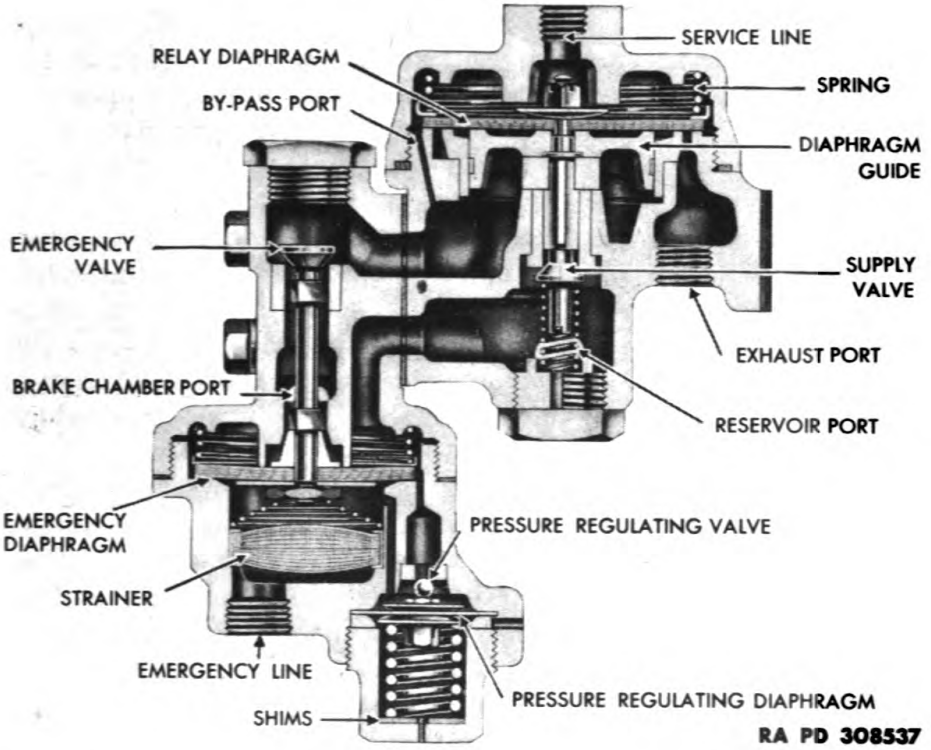


***Figure 95 — Sectional View of Relay Emergency Valve with Pressure Regulating Valve***

(3) Two types of relay emergency valves will be found in service. The only difference in the two is that the newer type includes a pressure regulating valve assembly whereas the older type does not. The two types of valves are easily identified because of the difference in their outward appearance (figs. 93 and 94). Relay emergency valves without the pressure regulating valve assembly are used exclusively on gun mounts, whereas valves which include the pressure regulating valve assembly are used exclusively on all towed vehicles other than gun mounts.

(4) The two types of valves are really interchangeable insofar as their function is concerned and either type may be substituted for the other; however, the later type which includes the pressure regulating valve assembly is preferred. In some cases it is impossible to install the later type of valve on gun mounts due to insufficient clearance.

(5) The old type valve without the pressure regulating valve assembly may be converted to the newer type by installing an emergency cover that includes the pressure regulating valve assembly.

**b. Operation** (fig. 95).

(1) The operation of the relay emergency valve is controlled by

the air pressure delivered to it by the brake valve on the towing vehicle. This brake valve pressure is delivered to the relay emergency valve through the service line connecting the towing vehicle to the towed vehicle and enters the cavity above the relay diaphragm. Because this cavity is small and therefore subject to quick changes in air pressure, the action of the valve in changing its delivered pressure is also very rapid.

(2) The mechanism inside the relay emergency valve assumes three positions during normal operation. These three positions are the applying position, when the valve is actually delivering air pressure to the brake chambers; the holding position, when the valve is maintaining or holding a constant pressure in the brake chambers; and the releasing position, when the valve is reducing or releasing air pressure from the brake chambers.

(3) The valve can also assume another position called the emergency position, but it only assumes this position when some abnormal condition such as a break-away causes a drop in the air pressure in the cavity connected by the emergency line to the air reservoir on the towing vehicle. Under these conditions, the valve permits full reservoir pressure to pass into the brake chambers applying the brakes, and at the same time prevents loss of reservoir pressure through the broken emergency line.

(4) The pressure regulating valve assembly used in the latest type of relay emergency valve consists of a spring loaded diaphragm to which is attached a ball valve. This ball valve is normally always held off its seat because the air pressure above its diaphragm overcomes the spring force below it. This spring force is such that any air pressure above approximately 70 pounds will keep the ball valve off its seat. When the ball valve is off its seat, air pressure may flow in either direction around the emergency diaphragm. It should be remembered that during normal operation, the air pressure in the brake system is above 70 pounds and that therefore, the ball valve in the pressure regulating valve normally remains open.

(5) During normal operation the relay emergency valve operates in the same manner as a relay valve (par. 54).

(6) The relay emergency valve is designed to go to its emergency position if for any reason the air pressure in the emergency line connecting the brakes systems of the two vehicles drops to a point about 20 pounds below the air pressure in the brake system of the towed vehicle. Such a condition can be brought about by excessive leakage developing in the brake system of the towed vehicle or by the towed vehicle breaking away from the towing vehicle.

(7) The only difference in the action of the two valves under these conditions is that in the case of the old type of valve not having the pressure regulating valve, such emergency brake applications can occur at any air pressure if a differential develops with the new type

of valve, having the pressure regulating valve, the air pressure in the brake systems of both vehicles is permitted to equalize as long as the air pressure in the brake system of the towed vehicle remains above approximately 70 pounds.

(8) The following explanation covers emergency brake applications under each of these conditions, the first being after a sudden drop in emergency line pressure such as would be caused by a break-away.

(9) The instant the emergency line is broken, air pressure in the brake system of the towed vehicle attempts to flow out the broken emergency line. This causes the emergency diaphragm to be depressed, and its outer edge seals off the cavity leading to the emergency line, preventing any loss of pressure past the emergency diaphragm through the broken line.

(10) As the center of the emergency diaphragm is depressed, the emergency valve is closed. Thus, air pressure from the reservoir of the towed vehicle flows across the top of the depressed emergency diaphragm into the cavity leading to the brake chamber and applies the brakes. The closed emergency valve prevents it from escaping through the cavity leading to the exhaust port. It should be remembered this action takes place in a fraction of a second so that the automatic application of the brakes begins very quickly.

(11) While this is taking place in valves having the pressure regulating valve, there is also a quick drop in pressure in the cavity above the pressure regulating diaphragm. This occurs because the port connecting this cavity with the cavity below the emergency diaphragm is larger than the port connecting the cavity above the ball valve to the cavity above the emergency diaphragm. In other words, air pressure can flow out of the cavity above the pressure regulating diaphragm faster than it can flow in, because of the difference in the size of the ports leading to and from this cavity. As soon as the air pressure above the pressure regulating diaphragm drops to about 70 pounds, the ball valve goes to its seat preventing any further passage of air through the pressure regulating valve. Thus, air pressure in the reservoir of the towed vehicle is prevented from escaping either past the emergency diaphragm or through the pressure regulating valve to the broken emergency line.

(12) If the drop in the air pressure in the emergency line takes place more gradually, the old type of relay emergency valve goes to its emergency position in the same manner as it does from a quick drop in pressure; however, with the newer type of valve the pressure regulating valve remains open until the pressure above the pressure regulating diaphragm drops to about 70 pounds. During this time, air can flow through the pressure regulating valve tending to keep the air pressure in the brake system of the towing vehicle and the towed

vehicle the same. However, after the pressure regulating valve closes, the air pressure in the two brake systems can no longer equalize. The air pressure underneath the emergency diaphragm begins to drop below the pressure above it. As this pressure differential increases to about 20 pounds, the center of the emergency diaphragm is depressed, closing the emergency valve and opening communication between the reservoir and the brake chambers on the towed vehicle, thus applying the brakes.

(13) Both types of relay emergency valves have only one emergency position. The action of the mechanism of the two valves is slightly different when the emergency brake application is caused by a more gradual drop in air pressure in the emergency line.

## 61. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. General.** If testing equipment is available, test the relay emergency valve before disassembly by following procedure outlined in paragraph 65.

**b. Cleaning and Inspection.** Remove all dirt and grease from exterior of valve using dry-cleaning solvent and a brush. Inspect exterior of valve for broken or damaged parts. All broken or damaged parts must be replaced.

**c. Disassembly.**

(1) DISCONNECT RELAY VALVE FROM EMERGENCY VALVE. Remove four cap screws and lock washers attaching relay valve to emergency valve. Remove gasket.

(2) DISASSEMBLE RELAY VALVE (par. 55 c).

(3) DISASSEMBLE EMERGENCY VALVE.

*(a) Remove Pressure Regulating Cap.* Remove pressure regulating cap and lift out pressure regulating spring and shims from the cavity in the cap nut. Lift out diaphragm seal washer. Lift out pressure regulating diaphragm assembly.

*(b) Disassemble Pressure Regulating Assembly.* Remove pressure regulating diaphragm screw nut, and lift off large washer, two diaphragms, and small washer from diaphragm screw.

*(c) Remove Emergency Valve Cover.* Hold emergency valve body in a vise, and remove emergency valve cover and gasket. Remove spring and strainer from emergency valve cover.

*(d) Remove Pressure Regulating Valve Seat Bushing.* The pressure regulating valve seat bushing should not be removed unless it has to be replaced. If this bushing has to be removed, it will have to be drilled out.

*(e) Remove Emergency Valve Cap Nut, Emergency Valve, and Emergency Diaphragm.* Remove emergency valve cap nut and using a screw driver to keep the emergency valve stem from turning, remove the emergency diaphragm retaining nut (fig. 96). Remove

## QUICK RELEASE VALVE, RELAY VALVE, AND RELAY EMERGENCY VALVES

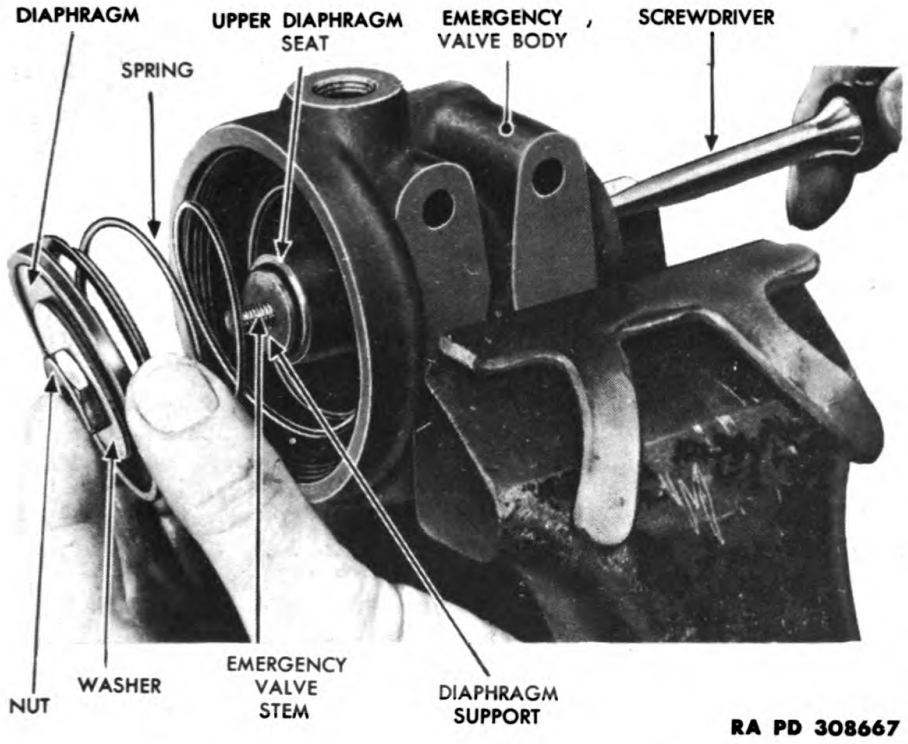


***Figure 96 — Removing Emergency Diaphragm***

diaphragm washer, diaphragm spring seat, spring and upper diaphragm seat. Remove emergency valve stem.

*(f) Remove Emergency Valve Seat Bushing.* Do not remove the emergency valve seat bushing unless replacement is absolutely necessary. Remove the bushing with a punch and a hammer by driving it out through the emergency valve cap nut hole.

### 62. CLEANING AND INSPECTION OF PARTS.

**a. Relay Valve Parts.** Clean all relay valve parts as outlined in paragraph 56.

**b. Emergency Valve Parts** (fig. 97).

(1) CLEAN ALL PARTS. Wash all metal parts in dry-cleaning solvent. Be sure passages leading to pressure regulating valve cavity are clear.

(2) DIAPHRAGMS. Replace all used diaphragms.

(3) EMERGENCY VALVE AND SEAT. Inspect condition of emergency valve and seat (fig. 57). If valve or seat is worn or damaged, it must be replaced.

(4) EMERGENCY DIAPHRAGM SEAT. Inspect emergency diaphragm seats in body and cap. Seats must be smooth, flat, and free, from scratches.

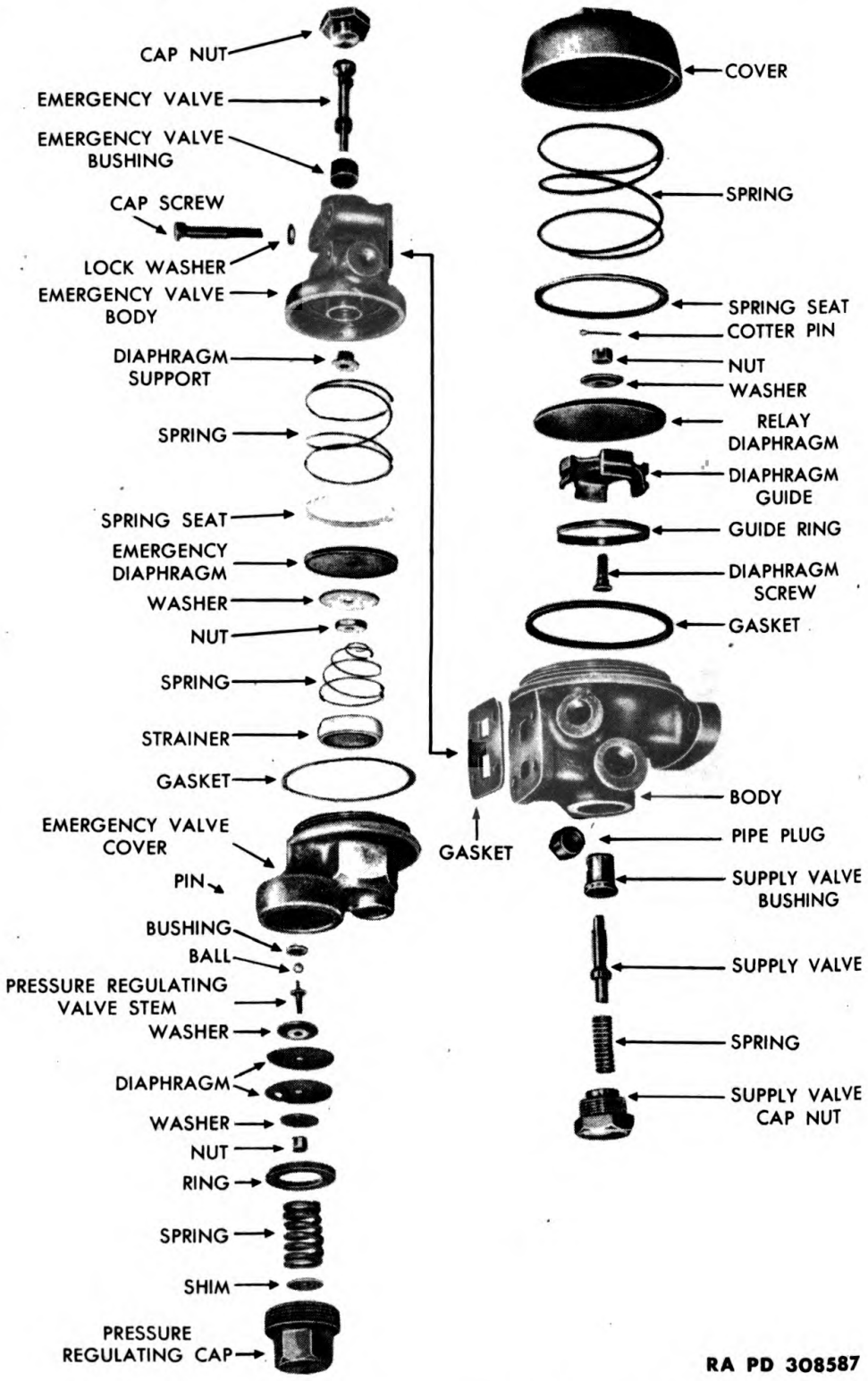


***Figure 97 — Relay Emergency Valve with Pressure Regulating Valve***

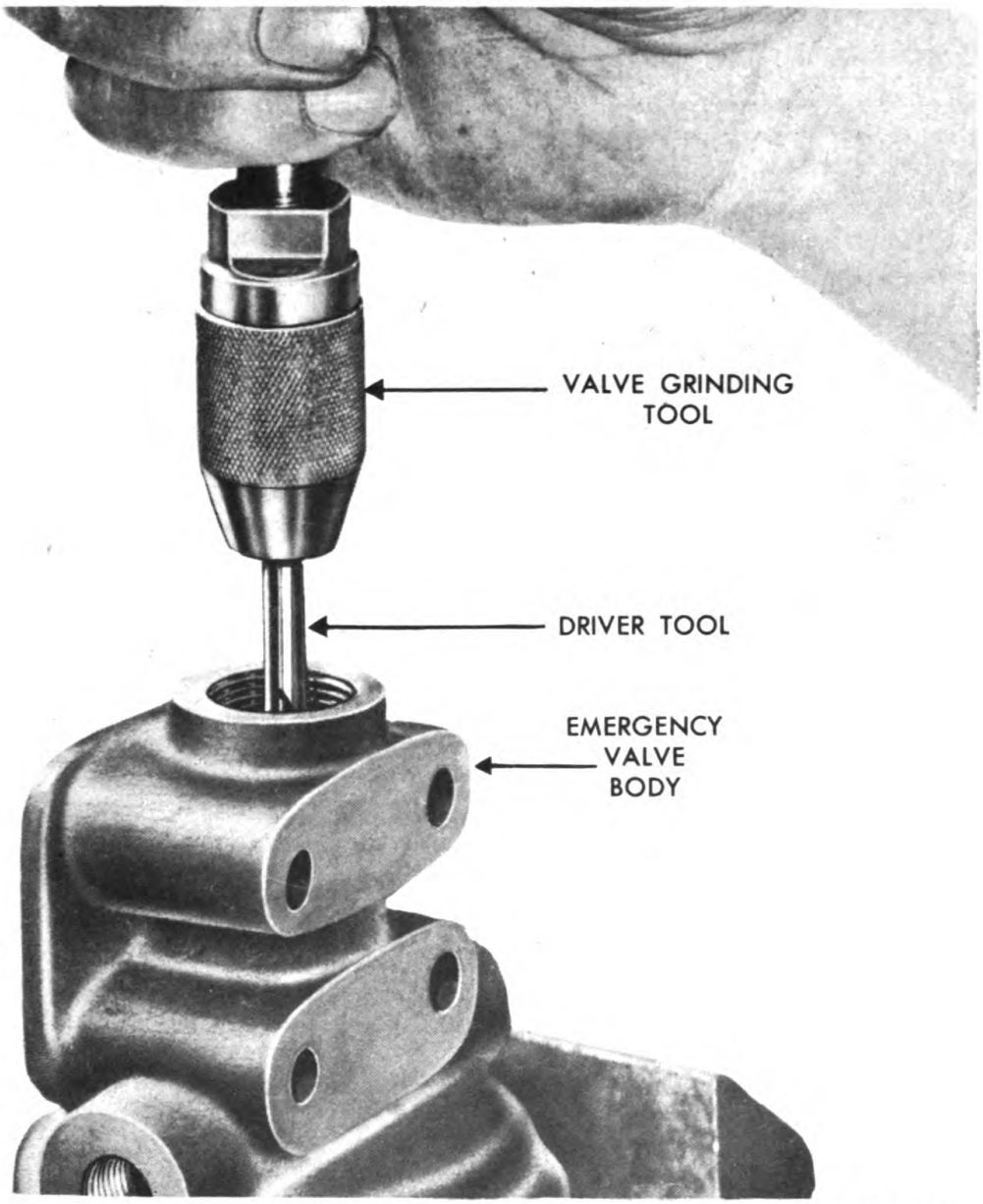


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***Figure 98 — Grinding Emergency Valve, Using Tools 41-T-3381-15 and 41-T-660***

(5) PRESSURE REGULATING VALVE AND SEAT. Inspect pressure regulating ball valve and seat for wear (fig. 77). Replace if necessary.

(6) STRAINER. Inspect strainer for rust and corrosion. Replace if necessary.

## 63. REPAIRS.

**a. Repairs to Relay Valve.** See paragraph 57.

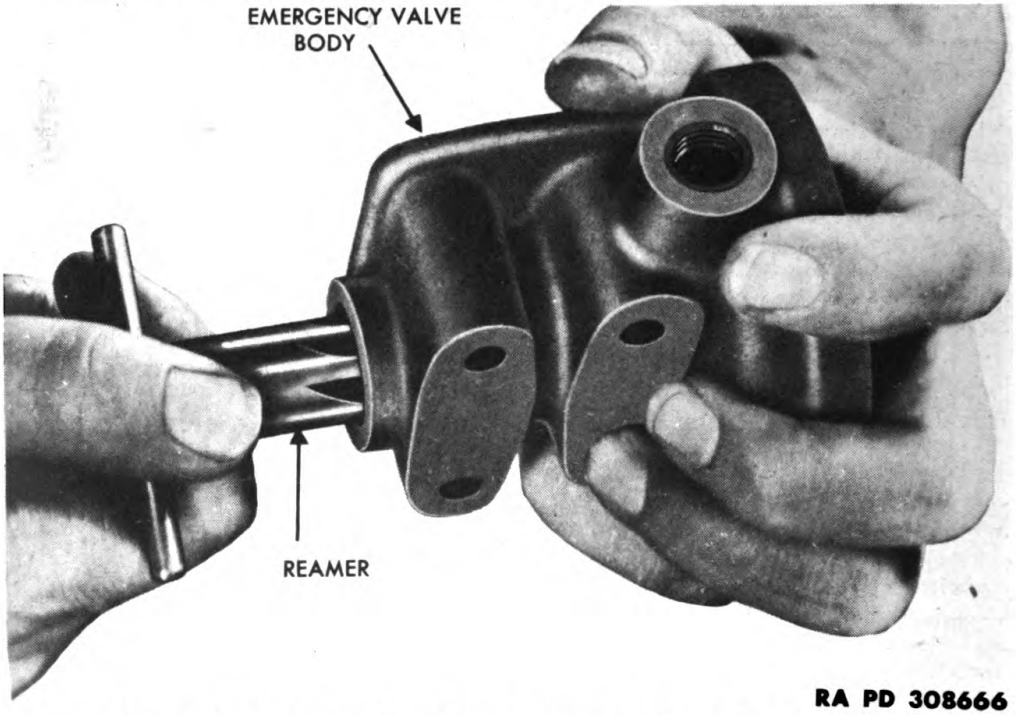


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***Figure 99 — Reaming Emergency Valve Seat, Using Reamer 41-R-2125***

**b. Repairs to Emergency Valve.**

(1) EMERGENCY VALVE AND SEAT. If the emergency valve and seat are not too badly worn (fig. 57) and leakage is excessive, repair by carefully grinding the valve to its seat (fig. 98) using grinding tool (41-T-3381-15), driver tool (41-T-660) and (BWE grade 1,000) grinding compound.

(2) Excessively worn valves or valve seat bushings must be replaced. Bushings are drilled out and must be pressed into place. After being pressed in place, the bushing must be reamed using reamer (41-R-830), and seating reamer (BWE 221629) (fig. 99). When using seating reamer (41-R-2125) only the sharp corner of the bushing must be removed. After reaming, a new valve must be ground to the seat (fig. 98).

(3) PRESSURE REGULATING VALVE AND SEAT. If the pressure regulating valve bushing is replaced, it must be pressed into place. The valve is fitted to its seat by tapping it with a light hammer.

**64. ASSEMBLY.**

**a. Assembly of Relay Valve.** See paragraph 58.

**b. Assembly of Emergency Valve.** Position emergency valve stem in emergency valve body. Place diaphragm support on emergency valve stem. Place diaphragm spring and spring seat in position, and install emergency diaphragm, washer, and nut, on

## QUICK RELEASE VALVE, RELAY VALVE, AND RELAY EMERGENCY VALVES

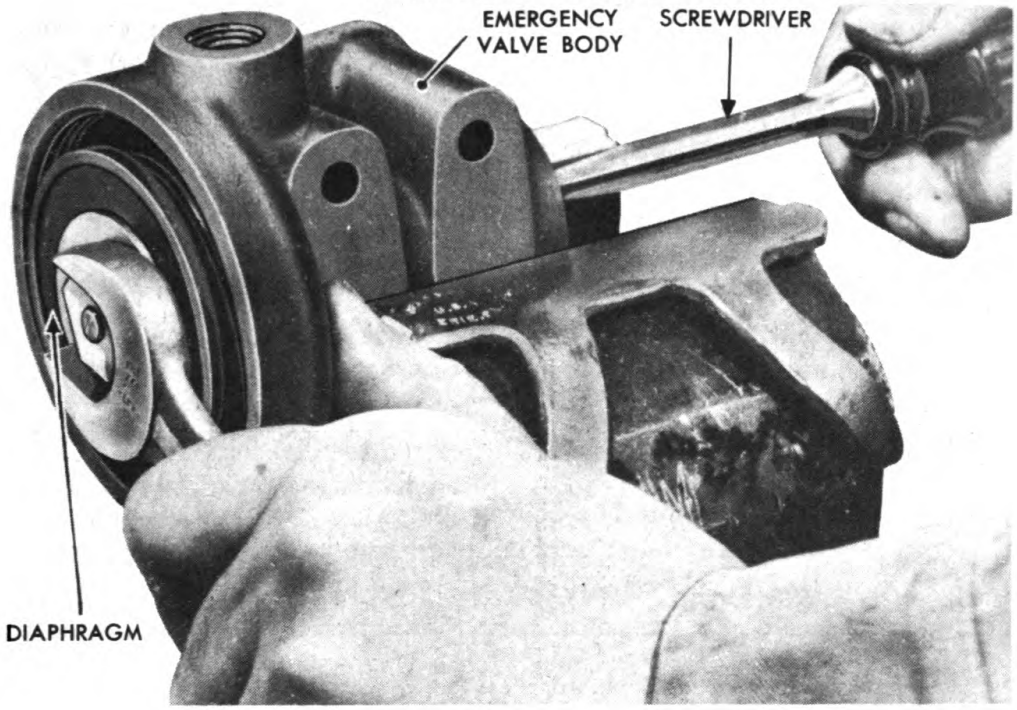


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***Figure 100 — Installing Emergency Diaphragm***

emergency valve stem. Holding valve stem from turning with a screw driver (fig. 100), tighten nut sufficiently to prevent leakage. Do not tighten nut sufficiently to distort the diaphragm. Install emergency valve cap nut. Tighten securely.

**c. Assembly of Pressure Regulating Cap.**

(1) ASSEMBLE PRESSURE REGULATING DIAPHRAGM. Position small washer, diaphragms, and large washer, on diaphragm screw, and install nut. Tighten nut sufficiently to prevent leakage but not sufficiently to distort the diaphragms. Prick punch nut and screw to lock nut securely.

(2) INSTALL PRESSURE REGULATING DIAPHRAGM. Position diaphragm assembly in pressure regulating cap being sure edges of diaphragms are beneath the end of the pin. Position diaphragm ring so the notch in the edge of the ring engages the pin. Position shims and spring in pressure regulating cap, and screw cap into position. Tighten cap.

(3) INSTALL PRESSURE REGULATING CAP. Position strainer and spring in pressure regulating cap, and use a new gasket-screw pressure regulating cap into emergency valve body. Tighten securely.

(4) CONNECT RELAY VALVE TO EMERGENCY VALVE. Using a new gasket, position relay valve and emergency valve, and install four cap screws and lock washers attaching relay valve to emergency valve (fig. 93).

## 65. TEST OF REBUILT RELAY EMERGENCY VALVE.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 100 pounds pressure.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4, and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Connect Valve to Test Rack.**

(1) Connect hose line No. 2 to emergency line port.

(2) Connect hose line No. 3 to one reservoir port. Plug other reservoir port.

(3) Conect hose line No. 4 to one brake chamber port. Plug other brake chamber port.

(4) Connect hose line No. 5 to brake valve port.

(5) Be sure the exhaust port is not plugged.

**c. Charging Test.** Open cock No. 2 and observe the rise in pressure on gage No. 4. Pressure must rise within 3 pounds of pressure registered by gage No. 1.

**d. Leakage Tests.**

(1) Start tests with brake valve handle in released position, gages No. 1, No. 2, and No. 4, registering 100-pounds pressure and gage No. 3 registering zero. Cocks No. 1, No. 2, and No. 5, must be open. Cocks No. 3, No. 4, No. 6, and No. 7, must be closed.

(2) Move brake valve handle back and forth between released and applied positions several times to operate relay emergency valve finally leaving it in released position.

(3) Disconnect hose No. 5 and hold finger over brake valve port. Then coat the exhaust port of the relay emergency valve with soap suds to determine the combined leakage past the supply valve and the emergency diaphragm upper seal. Leakage of more than a 1-inch soap bubble in 3 seconds is not permissible.

(4) Reconnect hose No. 5 to brake valve port.

(5) Close cock No. 2 and disconnect hose line No. 2 from emergency line port of relay emergency valve. Relay emergency valve must go to emergency position, which will be indicated by a quick rise of the red hand of gage No. 3. Coat the exhaust port of the relay emergency valve with soap suds to check for leakage past the supply valve and emergency valve. Also coat the emergency line port of the relay emergency valve with soap suds to determine leakage past the emergency diaphragm lower seal. (If the relay emergency valve has a pressure regulating valve, this test also shows the leakage, if any, past the pressure regulating valve.) Leakage in excess of a 1-inch soap bubble in 3 seconds in either of these tests is not permissible.

(6) Reconnect hose line No. 2 to the emergency line port and

open cock No. 2. Move brake valve handle toward applied position until the red hand on gage No. 3 registers 50 pounds. Coat the exhaust port of the relay emergency valve with soap suds to determine the leakage past the relay diaphragm seal. Leakage of more than a 1-inch soap bubble in 3 seconds is not permissible.

(7) Coat the valve all over with soap suds to check for leakage through the walls, past the gaskets, or through the vent hole in the pressure regulating cap. No leakage is permissible.

(8) Move brake valve handle back to released position.

**e. Operating Tests.**

(1) Start tests with brake valve handle in released position, gages No. 1, No. 2, and No. 4, registering 100-pound pressure and both hands of gage No. 3 registering zero. Cocks No. 1, No. 2, and No. 5, must be open. Cocks No. 3, No. 4, No. 6, and No. 7, must be closed.

(2) Move brake valve handle to fully applied position and observe that the time required for the red hand of gage No. 3 to rise from zero to 50 pounds is not more than one second.

(3) Move brake valve handle from fully applied position to fully released position, and observe that the time required for the red hand of gage No. 3 to drop from 60 to 10 pounds is not more than two seconds.

(4) Disconnect hose No. 2 from the emergency line port and observe that the relay emergency valve goes to emergency position, indicated by a quick rise of the red hand of gage No. 3. Also observe that the red hand of gage No. 3 rises from 0 to 50 pounds in not more than one second. Also observe that the pressures registered by gage No. 4 and the red hand of gage No. 3 equalize at not less than 85 pounds.

(5) IF THE RELAY EMERGENCY VALVE IS THE TYPE HAVING THE PRESSURE REGULATING VALVE, close cock No. 2 and open cock No. 4 until the pressure on gage No. 2 drops to at least 50 pounds. Then close cock No. 4 and reconnect hose No. 2 to the emergency line port. Open cock No. 3 and observe that the pressure registered by gage No. 2 rises at a uniform rate to a point between 70 and 80 pounds at which point an increased rate of rise must be noted. If the increased rate in rise occurs before gage No. 2 registers 70 pounds, install additional shims beneath the pressure regulating valve spring. If the increased rate in rise does not occur before gage No. 2 registers 80 pounds, remove one or more shims from beneath the pressure regulating valve spring. Increase or decrease the number of shims until a setting between 70 and 80 pounds is obtained. Also observe that the relay emergency valve goes to released position indicated by the red hand of gage No. 3 returning to zero. Close cock No. 3 and open cock No. 2.

(5A) IF THE RELAY EMERGENCY VALVE IS THE TYPE NOT HAVING THE PRESSURE REGULATING VALVE, close cock No. 2 and open cock No. 4 until the pressure registered by gage No. 2 drops to at least 50 pounds. Then close cock No. 4, and reconnect hose No. 2 to the emergency line port. Open cock No. 3 and observe that as the pressure registered by gage No. 2 rises, the relay emergency valve goes to released position indicated by the red hand of gage No. 3 returning to zero. Close cock No. 3 and open cock No. 2.

(6) Move brake valve handle toward fully applied position until the red hand of gage No. 3 registers 50 pounds. Open cock No. 6 and observe that the pressure by the red hand of gage No. 3 does not drop more than 5 pounds below the black hand of gage No. 3. Move valve handle to released position and close cock No. 6.

(7) Move brake valve handle slowly toward fully applied position until black hand of gage No. 3 registers 10 pounds and observe that the red hand of gage No. 3 rises at approximately the same rate. The pressure registered by the red hand of gage No. 3 must not be more than 3 pounds less than the pressure registered by the black hand and the pressures registered by both hands must equalize. If the pressure registered by the red hand of gage No. 3 is more than 3 pounds below the black hand, it indicates there is too much clearance between the top of the supply valve stem and the bottom of the diaphragm screw (fig. 91). With the pressures registered by both hands of gage No. 3 remaining at 10 pounds, coat the exhaust port of the relay emergency valve with soap suds. Leakage of more than a 2-inch soap bubble in one second is not permissible. Excessive leakage usually indicates there is not sufficient clearance between the top of the supply valve stem and the bottom of the diaphragm screw (fig. 91).

**f. Disconnect Valve from Test Rack.**

(1) If valve passes all tests, blow off all traces of soap suds and close cock No. 2, and open cocks No. 4, No. 6, and No. 7, and disconnect hose lines.

(2) Plug all ports including the exhaust port with pipe plugs to prevent dirt from entering the valve during shipment or storage.

# CHAPTER 6
# BRAKE CHAMBERS AND BRAKE CYLINDERS

## Section I
## BRAKE CHAMBERS



### 66. DESCRIPTION AND OPERATION.

**a. Description.**

(1) The purpose of a brake chamber is to convert the energy of compressed air into the mechanical force and motion necessary to operate the brakes.

(2) TYPES AND SIZES. Brake chambers are made in several different sizes. The smallest has an overall diameter of 5¼ inches whereas the largest has an overall diameter of 11 inches. Each of these sizes is made for several different mountings such as the stud-mounting types (fig. 101-102), bracket-mounting types (fig. 104) and flange-mounting types (fig. 103).

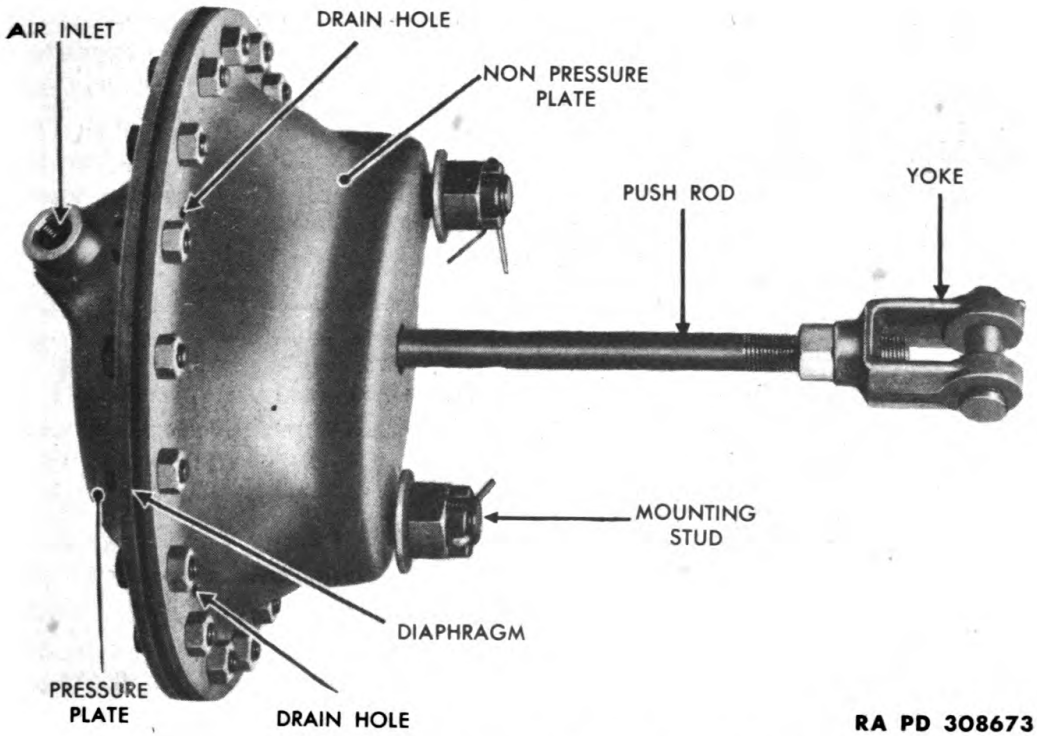


*Figure 101 — A Stud-type Brake Chamber*

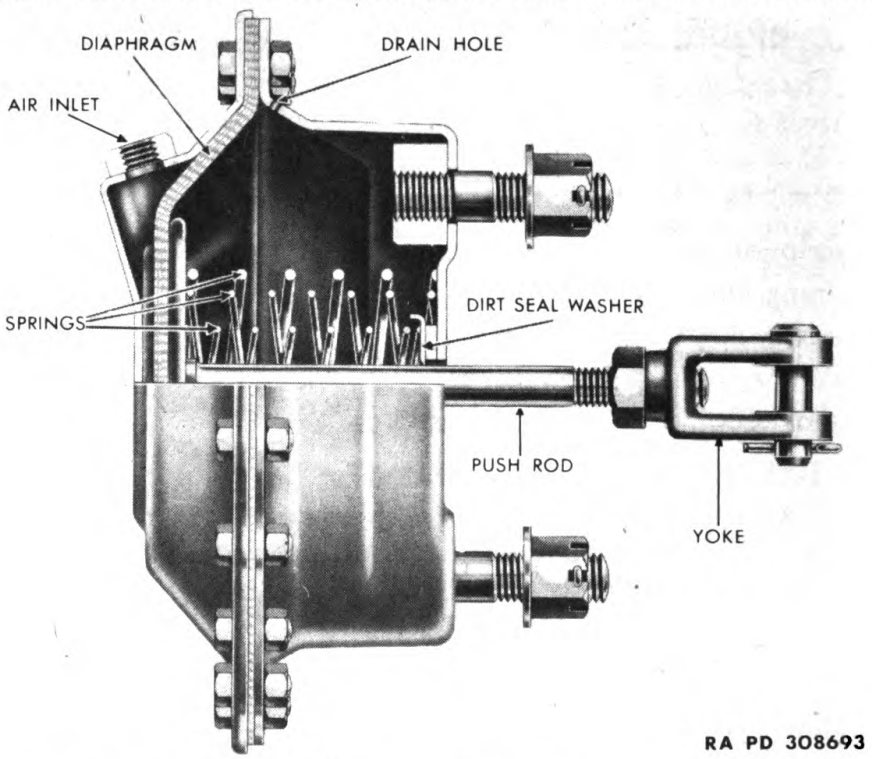


***Figure 102 — Sectional View of a Stud-type Brake Chamber***

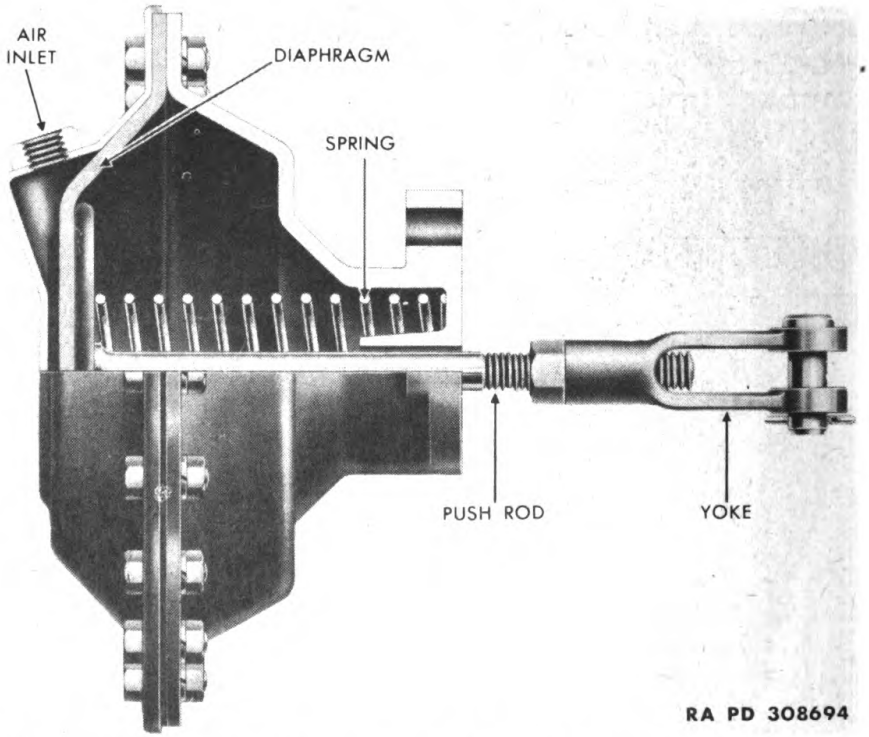


***Figure 103 — Sectional View of a Flange-type Brake Chamber***

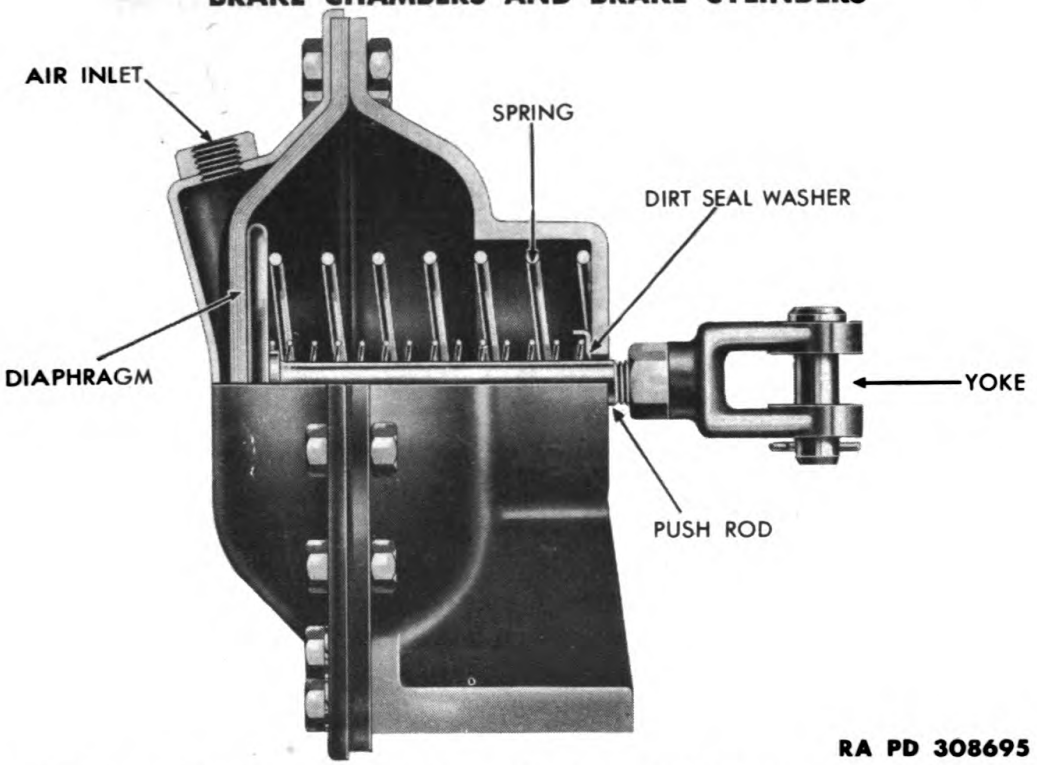


***Figure 104 — Sectional View of a Bracket-type Brake Chamber***

**b. Operation.** As air pressure enters the brake chamber behind the diaphragm, the diaphragm pushes the push rod outward, thus rotating the slack adjuster, brake camshaft and brake cam, applying the brakes. It will be seen that the higher the air pressure admitted to the brake chamber, the greater the force pushing the brake lining against the drum and the greater the retarding force. Conversely, the lower the air pressure, the lesser the retarding force. If all air pressure is released from the brake chamber, the brake shoe release springs and the brake chamber springs return the brake shoes, brake cam, slack adjuster, brake chamber push rod, and diaphragm, to released position.

## 67. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. Cleaning and Inspection.** Remove all dirt and grease from exterior of brake chamber using dry-cleaning solvent and a brush. Inspect for broken or damaged parts. All broken or damaged parts must be replaced.

**b. Disassembly** (fig. 105).

(1) Before disassembling the brake chamber, be sure to mark the pressure plate and nonpressure plate so that the air inlet opening in the pressure plate will be at the correct angle with the mounting bolt or bracket when the brake chamber is reassembled.

(2) Remove all bolts and nuts clamping the outer edges of the diaphragm between the pressure plate and nonpressure plate. Remove pressure plate and diaphragm.

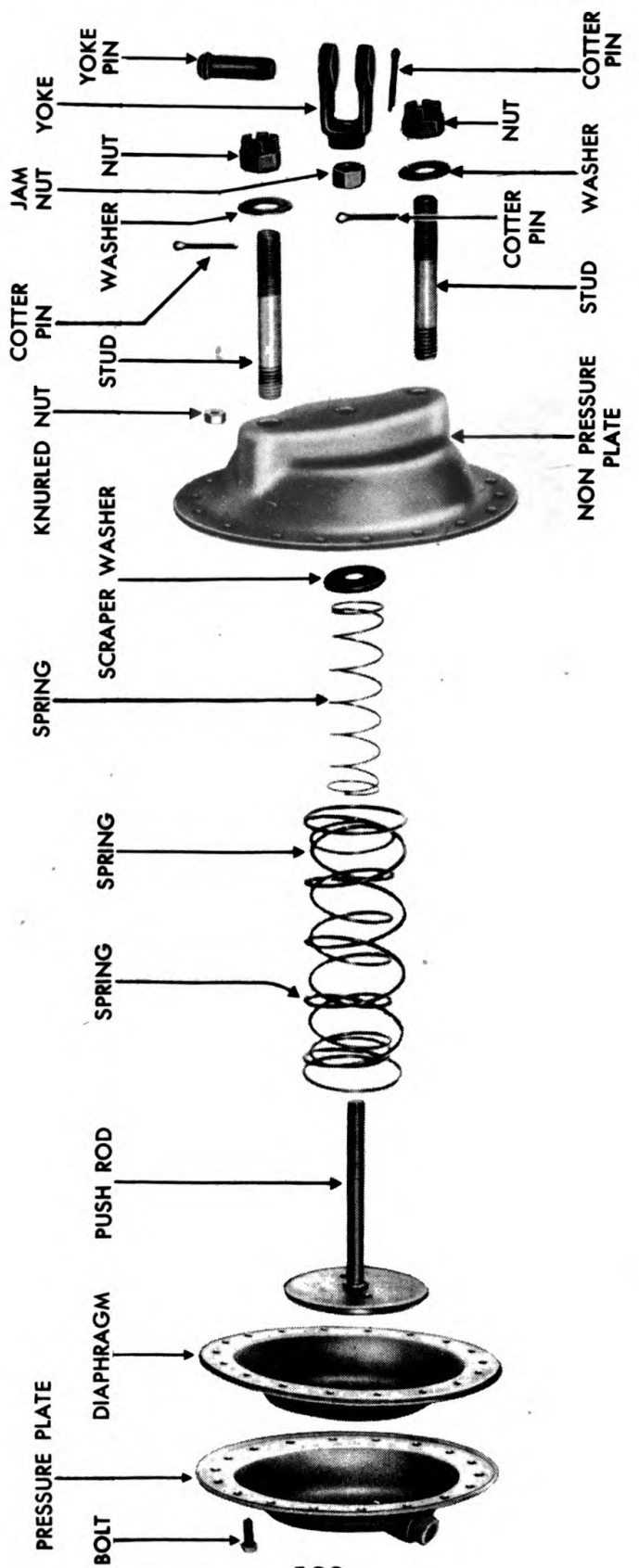


*Figure 105 — Stud-type Brake Chamber Disassembled*

(3) Loosen lock nut locking yoke in position on push rod, and remove yoke from push rod.

## 68. CLEANING, INSPECTION OF PARTS, AND REPAIRS.

**a.** Clean all metal parts thoroughly using dry-cleaning solvent, and inspect them for damage. Replace all damaged parts. Inspect rubber diaphragm for signs of checking or wear. Replace if any signs of wear or damage are found. If the brake chamber is fitted with a rubber boot, inspect for wear or damage and replace if necessary.

**b.** Some brake chambers are fitted with a spring loaded steel washer instead of a boot. In such cases, the nonpressure plate is drilled (fig. 102) to permit water to drain from the nonpressure side of the diaphragm.

**c.** It is important when replacing springs in brake chambers to be sure the correct type of spring is used, otherwise unbalanced braking may result.

## 69. ASSEMBLY.

**a.** Position push rod, springs, and dirt steel washer, if one is used in place in the nonpressure plate and install yoke, and yoke lock nut. Position diaphragm and pressure plate, being sure the air inlet opening in the pressure plate is in proper relation to the mounting bolt or mounting bracket as marked before disassembly. Install nuts and bolts holding diaphragm between the pressure plate and the nonpressure plate. It is important that all bolts be tightened evenly and not excessively. Tighten the nuts only sufficiently to insure an air tight seal between the pressure plate and the diaphragm and not sufficiently to distort the diaphragm.

## 70. TEST OF REBUILT BRAKE CHAMBERS.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90 pounds.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4, and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Connect Brake Chamber to Test Rack.** Connect hose No. 5 to the brake chamber.

**c. Leakage Tests.**

(1) Move brake valve handle to fully applied position causing black hand of gage No. 3 to register at least 60 pounds and push rod of brake chamber to move out.

(2) Coat the bolting flanges with soap suds to check for leakage. Also coat the opening around the push rod and the drain holes, if any, in the nonpressure plate to check for leakage. No leakage is permissible.

(3) Move brake valve handle back to released position and observe that push rod moves back promptly to released position.

**d. Disconnect Brake Chamber from Test Rack.**

(1) If no leakage is found, blow off all traces of soap suds and disconnect hose line.

(2) Plug inlet port with pipe plug to prevent dirt entering brake chamber during shipment or storage.

## Section II

## BRAKE CYLINDERS



### 71. DESCRIPTION AND OPERATION.

**a. Description.** Several different types and sizes of brake cylinders will be found in service. The largest of these is the 6 inch diameter by 8 inch stroke cylinder used on some low bed trailers (fig. 108). Another size and type of brake cylinder used quite extensively is the 6-inch diameter by 3-inch stroke cylinder (fig. 106-107). The larger types of brake cylinders are usually rigidly mounted and are fitted with hollow piston guides, whereas the smaller types are usually trunnion mounted which permits the push rod to serve as a piston guide. Some have cast iron bodies and end covers whereas others are made of pressed steel. All use rubber packing cups.

**b. Operation.** When air pressure enters the brake cylinder behind the piston and packing cup, the push rod is forced outward toward brakes applied position. When air pressure is released from the brake cylinder, the piston spring returns the piston and push rod to brakes released position.

### 72. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. Cleaning and Inspection.** Remove all dirt and grease from exterior of brake cylinder using dry-cleaning solvent. Inspect for broken or damaged parts. All broken or damaged parts must be replaced.

**b. Disassembly.** Remove end cover, and pull out piston and push rod assembly. Remove push rod yoke and lock nut. Remove end cover from push rod. Remove piston packing cup. Remove air strainer from end cover. Remove felt grease retainer.

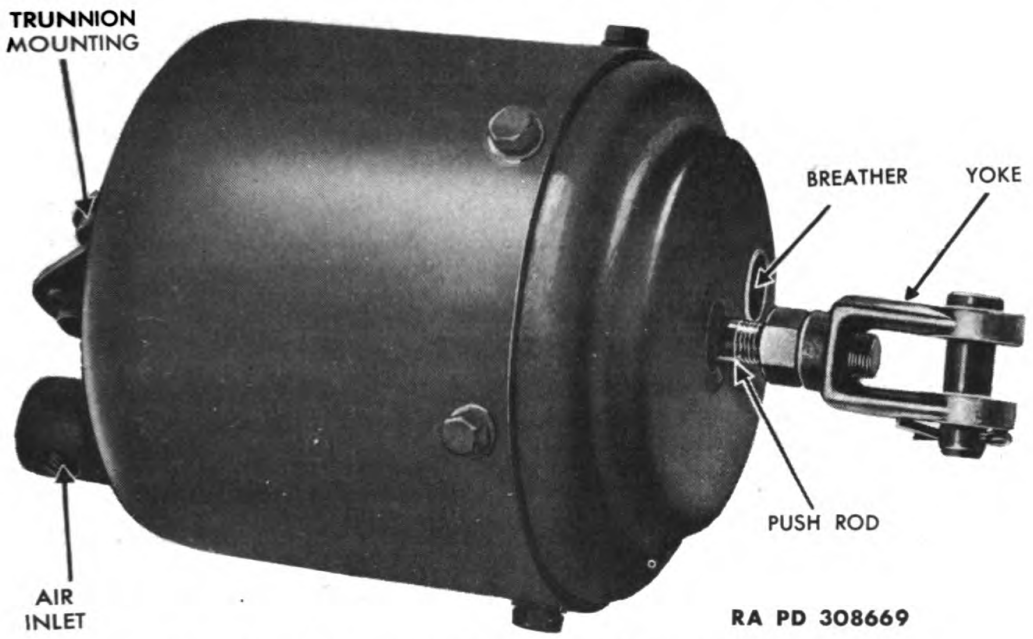


***Figure 106 — A 6-inch x 3-inch Brake Cylinder***

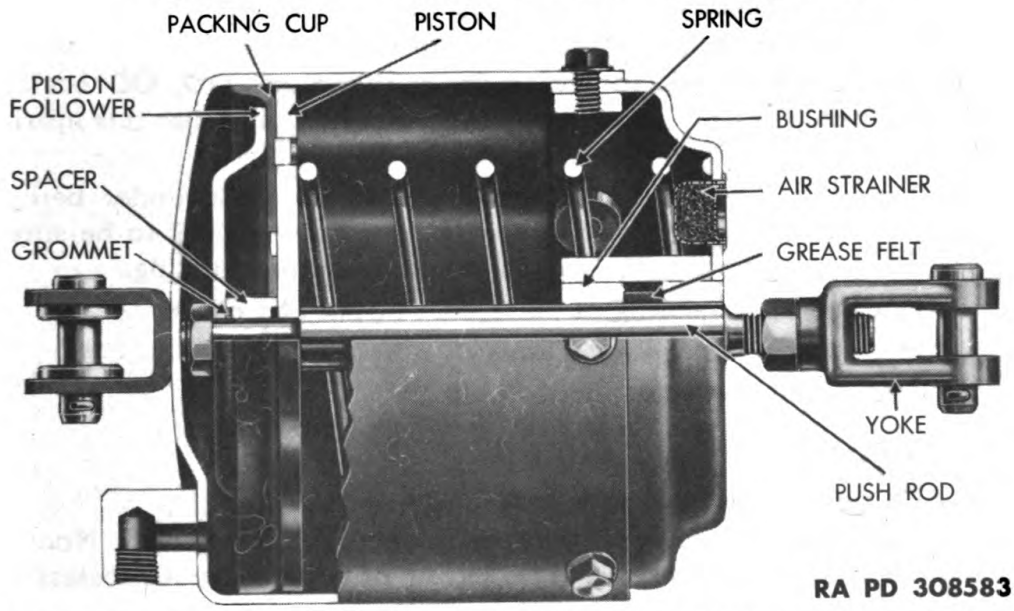


***Figure 107 — Sectional View of a 6-inch x 3-inch Brake Cylinder***

## 73. CLEANING, INSPECTION OF PARTS, AND REPAIRS.

**a.** Clean all metal parts using dry-cleaning solvent.

**b.** Examine rubber packing cup for wear or damage. If edges are worn thin or damaged, replace packing cup.

**c.** Check fit of push rod or piston guide in end cover bushings. It must be a neat sliding fit. Replace bushings if worn or damaged.

**d.** Inspect cylinder walls for scratches. Cylinder walls must be smooth.

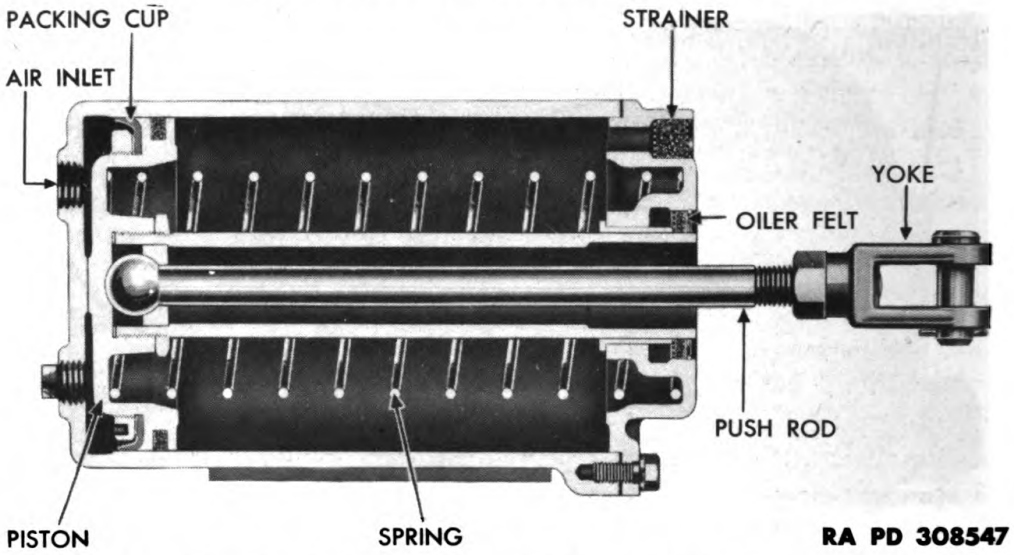


***Figure 108 — Sectional View of a 6-inch x 8-inch Brake Cylinder***

## 74. ASSEMBLY.

**a.** Assemble piston and packing cup. Be sure air seals and spacers are included when such parts are used in the assembly.

**b.** Fill grease cavity in end cover with grease, OD, OO brake cylinder lubricant, and install felt grease retainer. Also, use this lubricant on cylinder walls and packing cup.

**c.** Carefully insert piston and rod assembly into cylinder being careful not to damage the lip of the packing cup. Check to be sure piston will move back and forth in cylinder without binding.

**d.** Position piston spring in place, and install end cover.

**e.** Install air strainer in end cover.

**f.** Install push rod yoke and lock nut.

## 75. TEST OF REBUILT BRAKE CYLINDER.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90 pounds.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gage No. 2, No. 4 and both hands of gage No. 3, read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Connect Brake Cylinder to Test Rack.** Connect hose No. 5 to the brake chamber.

**c. Leakage Tests.**

(1) Move brake valve handle slowly to fully applied position, causing black hand of gage No. 3 to register at least 60 pounds and push rod of brake cylinder to move out. Brake valve handle must be

moved slowly otherwise the push rod will move out quickly and damage the cylinder.

(2) Coat the brake cylinder all over with soap suds to check for leakage. No leakage is permissible.

(3) Coat the air strainer or the opening around the push rod to check for leakage past the piston packing cup. Leakage in excess of a three inch soap bubble in 1 second is not permissible.

(4) Move the brake valve handle back to released position, and observe that the rod moves back promptly to released position.

**d. Disconnect Brake Cylinder from Test Rack.**

(1) If no leakage is found, blow off all traces of soap suds and disconnect hose line.

(2) Plug inlet port with pipe plug to prevent dirt entering the brake cylinder during shipment or storage.

# CHAPTER 7
# SLACK ADJUSTERS

## Section I
## TYPE-K SLACK ADJUSTERS



### 76. DESCRIPTION, OPERATION, AND TABULATED DATA.

**a. Description.** Slack adjusters function as adjustable levers and provide a quick and easy means of adjusting the brakes to compensate for brake lining wear. They consist of a worm and gear enclosed in a body which also serves as a lever. The type-K slack adjuster can be most easily identified by the shape of its cover plates and the location of the lock plunger plug (fig. 109-110).

**b. Operation.** During brake operation, the entire slack adjuster rotates bodily with the brake cam shaft. During brake adjustments, the worm moves the gear so as to change the position of the lever arm in relation to the brake cam shaft.

**c. Tabulated Data.**

Number of holes in arms:
1, 2, or 3
Arm lengths:
4 in., 5 in., 6 in., 7 in.
Types of bodies:
straight and with ⅝-in. offset
Splines:
SAE 10 C for brake cam shafts of 1⅛-in., 1¼-in. or 1½-in. diameter
Maximum torque:
15,000 in-lb

### 77. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. Cleaning and Inspection.** Remove all dirt and grease from exterior of slack adjuster using dry-cleaning solvent. Inspect for broken or damaged parts. All broken or damaged parts must be replaced.

**b. Disassembly** (fig. 111). Using a cold chisel, cut off riveted ends of five rivets securing covers in place. Drive out rivets and remove covers. Remove lock plug, lock spring, and lock plunger. Remove welsh plug. Insert a punch through the welsh plug opening, and drive out worm shaft. Remove worm and gear. If the arm bushings need replacing, drive or press out. Remove grease plug.

## SLACK ADJUSTERS

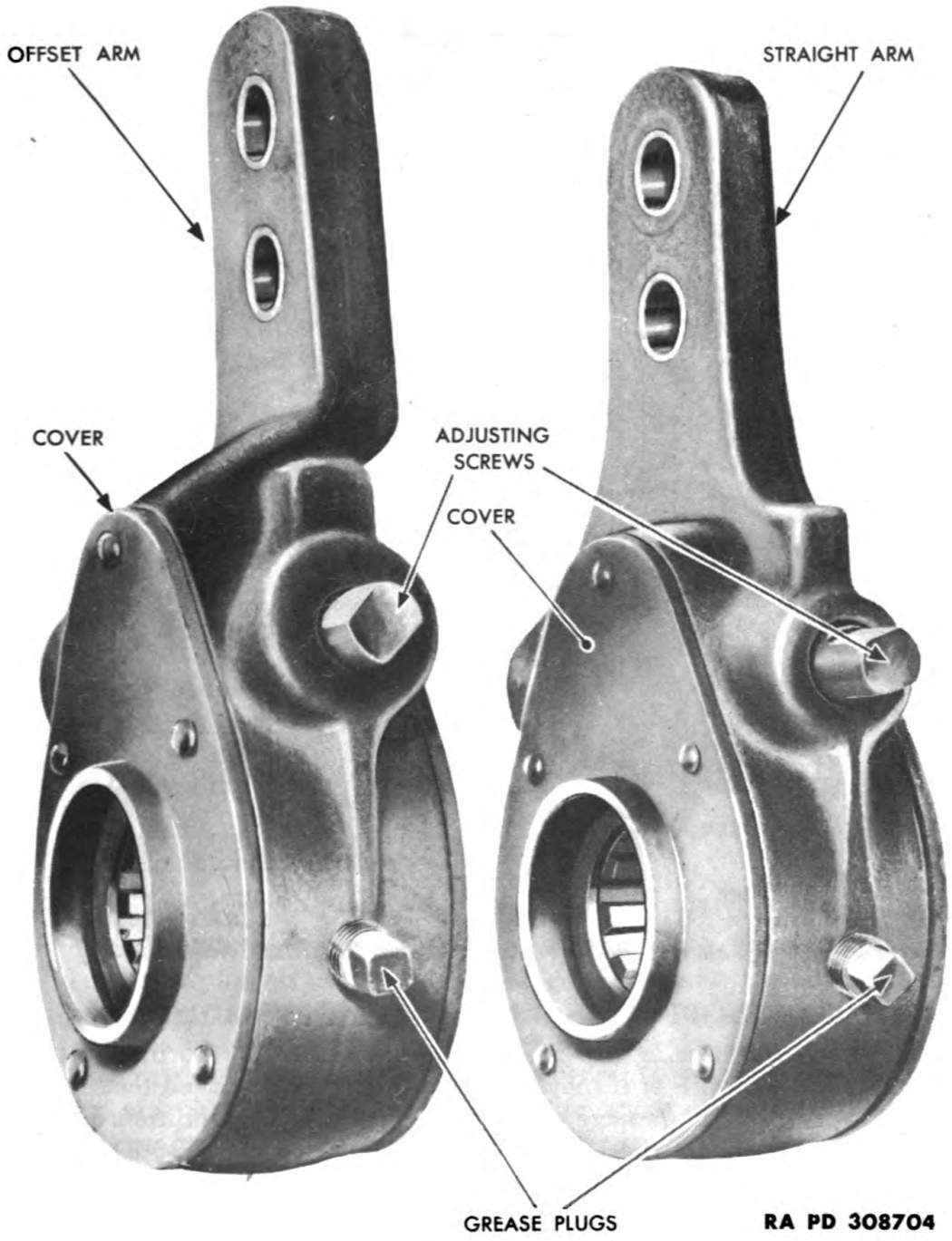


***Figure 109 — Type-K Slack Adjusters with Straight and Offset Arms***

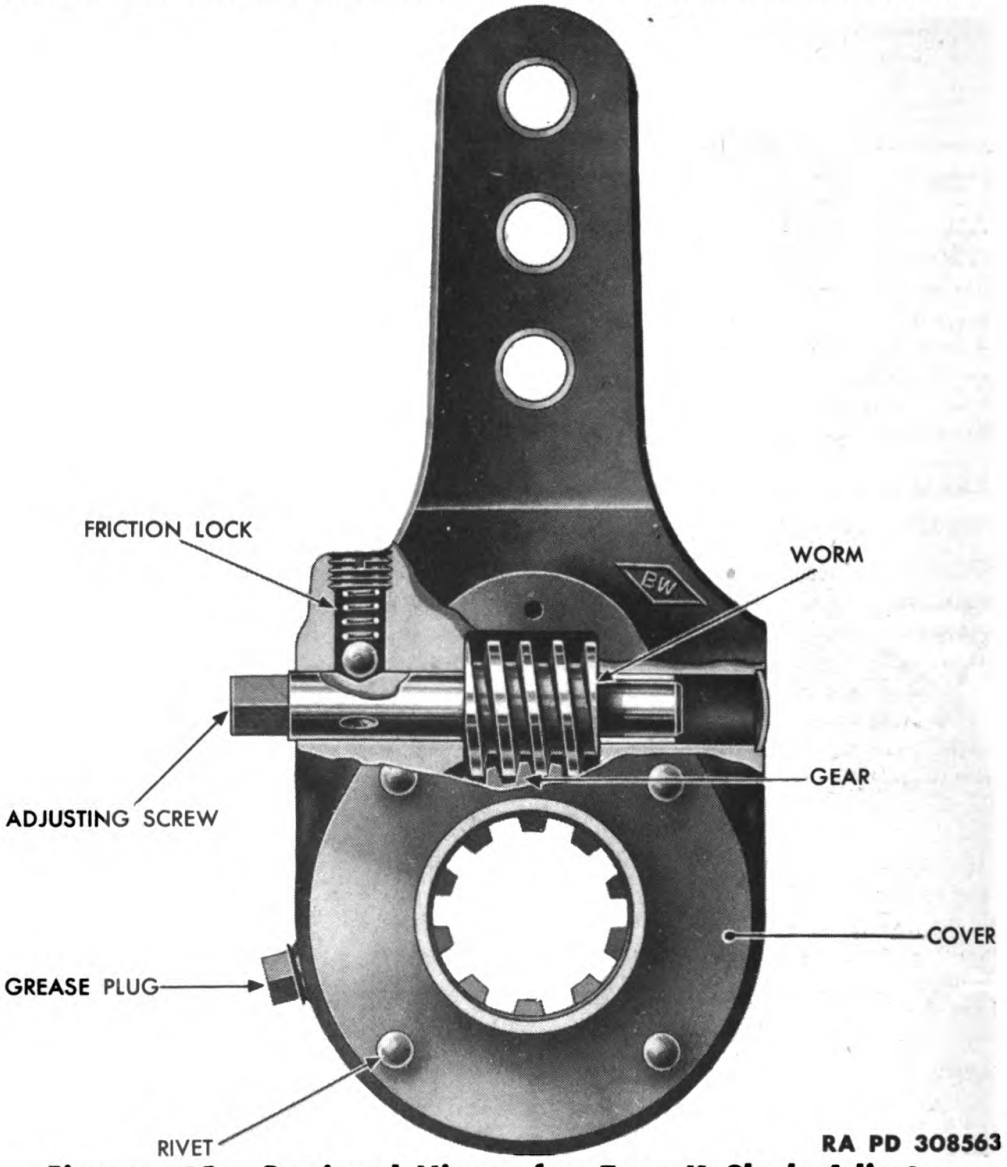


***Figure 110 — Sectional View of a Type-K Slack Adjuster***

## 78. CLEANING, INSPECTION OF PARTS, AND REPAIRS.

**a.** Clean all parts using dry-cleaning solvent. Inspect worm and gear and replace if worn or if they have any broken or damaged teeth. Inspect worm shaft for damage or wear, particularly the condition of the indents engaged by the lock plunger. All side walls of indents must be in good condition, otherwise worm shaft must be replaced. Inspect condition of bushings in the arm. If worn oblong or if they have been damaged, they must be replaced.

## 79. ASSEMBLY.

**a.** If bushings in arm have been removed, press new bushings into place. Ream bushings to 0.501-inch minimum, 0.503-inch maximum, after pressing in place.

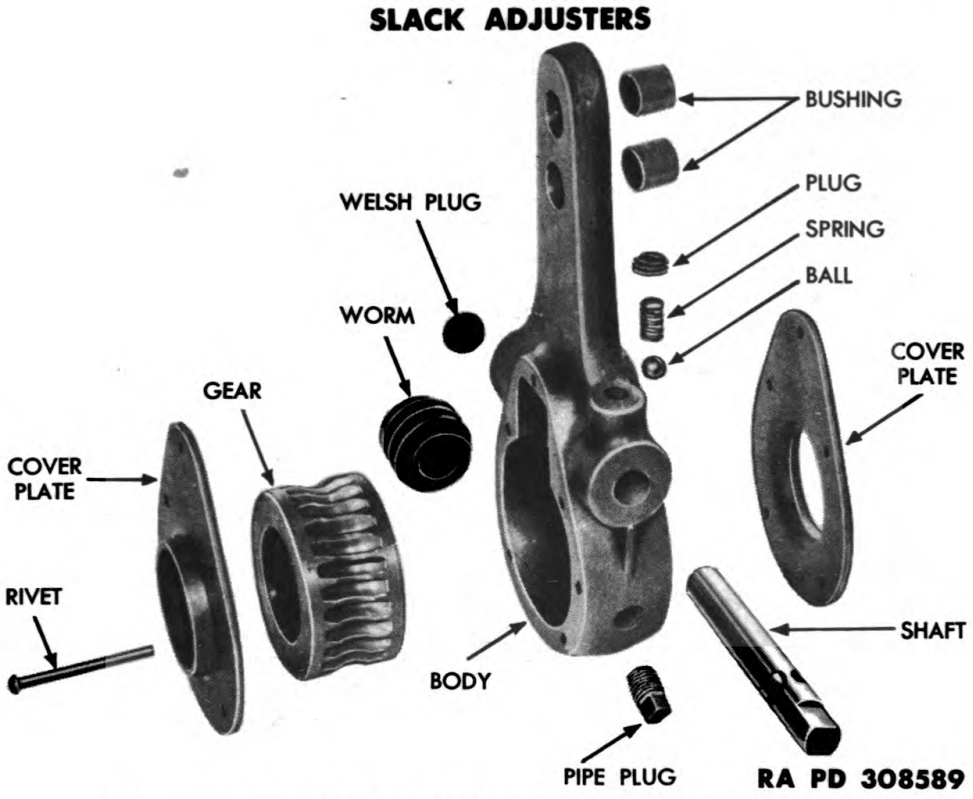


***Figure 111 — A Type-K Slack Adjuster Disassembled***

**b.** Place worm and gear in position in body. Enter small end of worm shaft through hole in body from the end nearest the lock. Position small end of worm shaft in bore of worm, and drive or press shaft into place until indents in shaft line up with bore of spring lock.

**c.** Using new rivets, rivet covers in place. Covers must be flat and make good contact with the body.

**d.** Install welsh plug in open end of worm shaft bore.

**e.** Install lock plunger, lock spring, and lock spring plug, being sure lock plunger will properly engage the indents in the worm shaft as the worm shaft is turned. Tighten lock spring plug as much as possible without locking worm shaft from turning. Turn worm shaft while tightening lock spring plug to determine the correct adjustment. Do not tighten the lock spring plug too much or the lock spring will be compressed to its solid height, preventing the lock plunger from rising out of the indents. If the worm shaft is turned under these conditions, the worm shaft or plunger or both will be damaged. When correct adjustment is obtained, prick punch the lock spring plug to prevent its getting out of adjustment.

**f.** Connect a grease gun to the lubricating port, and force chassis lubricant into the slack adjuster until it is completely filled. Install grease plug.

### 80. TEST OF REBUILT SLACK ADJUSTER.

**a.** Turn adjusting nut and worm until the gear makes one complete revolution. There must be no evidence of binding. Check for backlash between worm and gear. There must be very little backlash.

## Section II

## TYPE-RB SLACK ADJUSTERS



### 81. DESCRIPTION, OPERATION, AND TABULATED DATA.

**a. Description.** The type-RB slack adjuster (fig. 112) is used in exactly the same manner as the type-K (par. 76), the only difference being that the type-RB is capable of meeting higher torque requirements than the type-K. The type-RB slack adjuster can be most easily identified by the counter-sunk flat head rivets used to install the cover plates and the fact that the lock assemblies are hidden beneath the cover plates. Older style RB slack adjusters have only one lock assembly whereas the later type have two lock assemblies; one being located beneath each cover plate.

**b. Operation.** Operation of the type-RB slack adjuster is the same as the type-K (par. 76), the slack adjuster rotating bodily with the brake cam shaft during brake operation and the worm moving the gear so as to change the position of the lever arm in relation to the brake cam shaft during brake adjustments.

**c. Tabulated Data.** Number of holes in arms:
1, 2, or 3
Arm lengths:
5 in., 6 in., 7 in., 8 in.
Types of bodies:
straight and with various offsets from $\frac{5}{8}$ in. to $1\frac{1}{2}$ in.
Splines:
SAE 10 C for brake cam shafts having diameters of $1\frac{1}{4}$ in. or $1\frac{1}{2}$ in.
Maximum torque:
varies from 23,000 in-lb to 15,000 in-lb depending on the amount of offset in lever arm.

### 82. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. Cleaning and Inspection.** Remove all dirt and grease from exterior of slack adjuster using dry-cleaning solvent. Inspect for

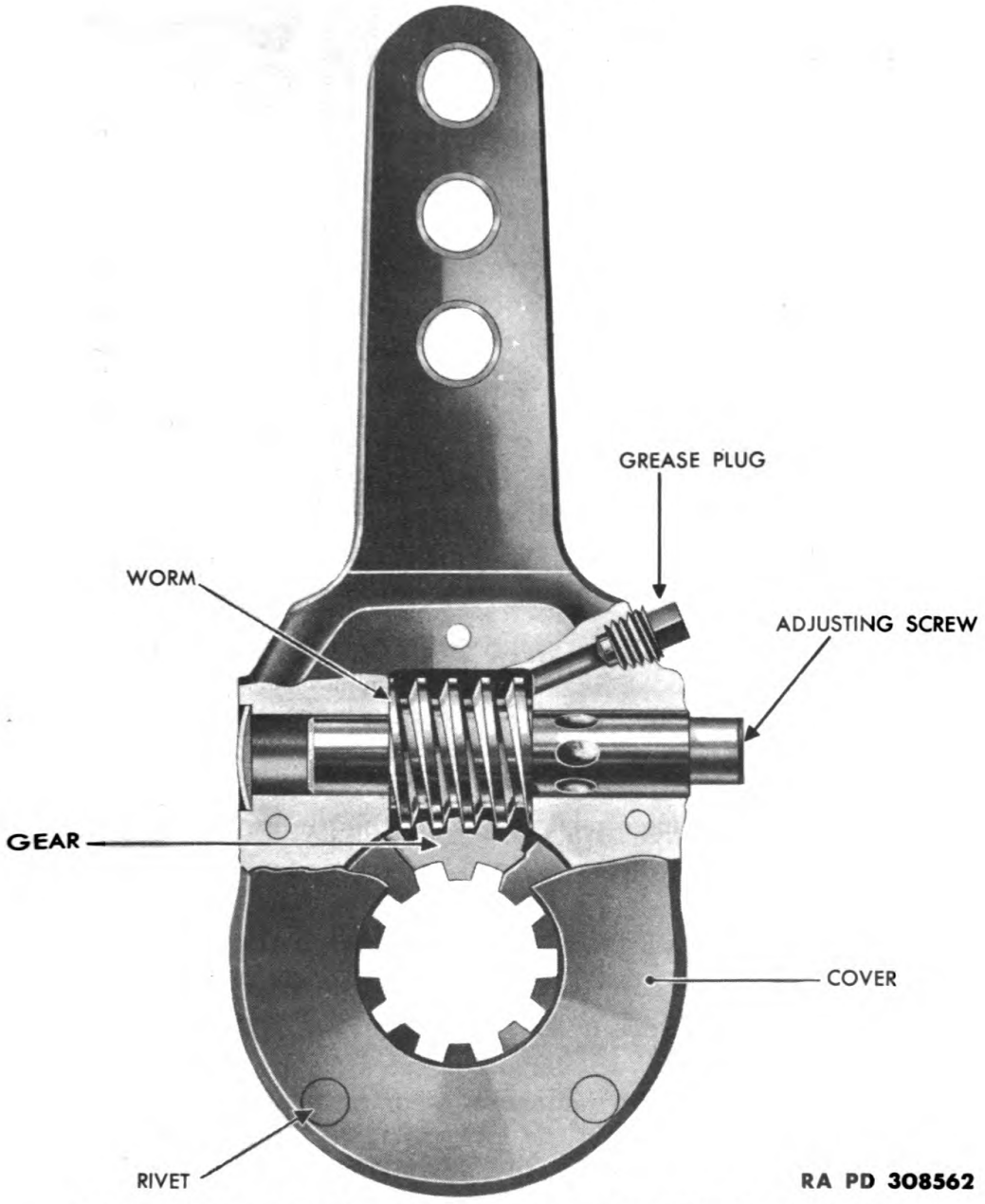


***Figure 112 — Sectional View of a Type-RB Slack Adjuster (Locks Not Shown)***

broken or damaged parts. All broken or damaged parts must be replaced.

**b. Disassembly** (fig. 113).

(1) Using a ⅛-inch drill, drill a hole in the center of the riveted end of each rivet the depth of the cover. Drive a cold chisel under the edge of the cover, and remove it. Drive out rivets and remove other cover.

(2) Remove lock springs and lock spring plungers.

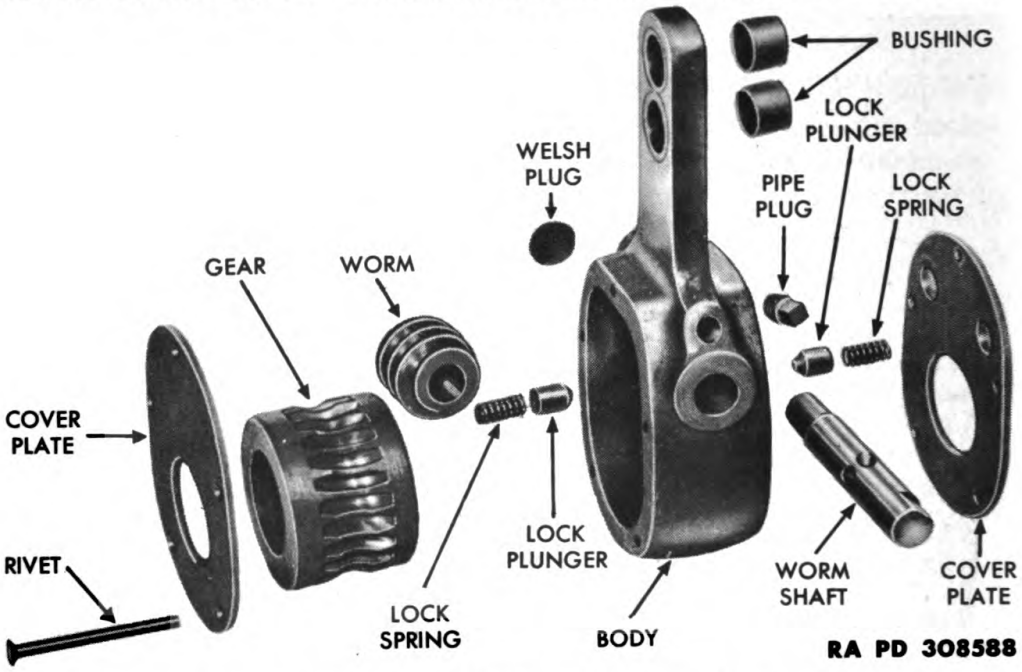


***Figure 113 — A Type-RB Slack Adjuster Disassembled***

(3) Remove welsh plug. Insert a punch through the welsh plug opening, and drive out worm shaft.

(4) Remove worm and gear.

(5) If the arm bushings need replacing, they must be driven or pressed out.

(6) Remove grease plug.

## 83. CLEANING, INSPECTION OF PARTS, AND REPAIRS.

**a.** Clean all parts using dry-cleaning solvent.

**b.** Inspect worm and gear, and replace if worn or if they have any broken teeth.

**c.** Inspect worm shaft for damage or wear particularly the condition of the indents engaged by the lock plungers. All side walls of indents must be in good condition otherwise shaft must be replaced.

**d.** Inspect condition of bushings in the arm. If worn oblong or if they have been damaged, they must be replaced.

## 84. ASSEMBLY.

**a.** If the bushings in arm have been removed, press new bushings into place. Ream bushings to 0.501-inch minimum, 0.503-inch maximum after pressing in place.

**b.** Place gear and worm in position in body. Enter small end of worm shaft through hole in body from the end nearest the grease plug opening. Drive or press shaft into place until indents in shaft line up with bore of spring lock.

c. Install lock plungers, lock plunger springs, and position covers.

d. Install rivets and rivet covers in place. Covers must be flat and make good contact with the body.

e. Connect a grease gun to the lubricating port, and force chassis lubricant into the slack adjuster until it is completely filled. Install grease plug.

### 85. TEST OF REBUILT SLACK ADJUSTER.

a. Turn adjusting nut and worm until the gear makes one complete revolution. There must be no evidence of binding. Check for backlash between worm and gear. There must be very little backlash.

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## Section III

## TYPE-R SLACK ADJUSTERS



### 86. DESCRIPTION, OPERATION, AND TABULATED DATA.

a. **Description.** The type-R slack adjuster (fig. 114) is an older design and is no longer manufactured. Quite a large number of them are still in service but they are not as widely used as the type-K or the type-RB. The type-R slack adjuster can be easily identified by the absence of riveted cover plates, a screw type cover being used instead, and by the worm stop nut used to hold the worm in place in the body (fig. 114).

b. **Operation.** During brake operation the entire slack adjuster rotates bodily with the brake cam shaft. During brake adjustments the worm moves the gear so as to change the position of the lever arm in relation to the brake cam shaft.

c. **Tabulated Data.** Number of holes in arms:
1, 2, or 3
Arm lengths:
vary from 5 in. to 8¾ in.
Types of bodies:
straight and with offsets varying from ⅝ in. to 1½ in.
Splines:
SAE 10 C for brake cam shafts of 1½ in. diameter
Maximum torque:
25,000 in-lb

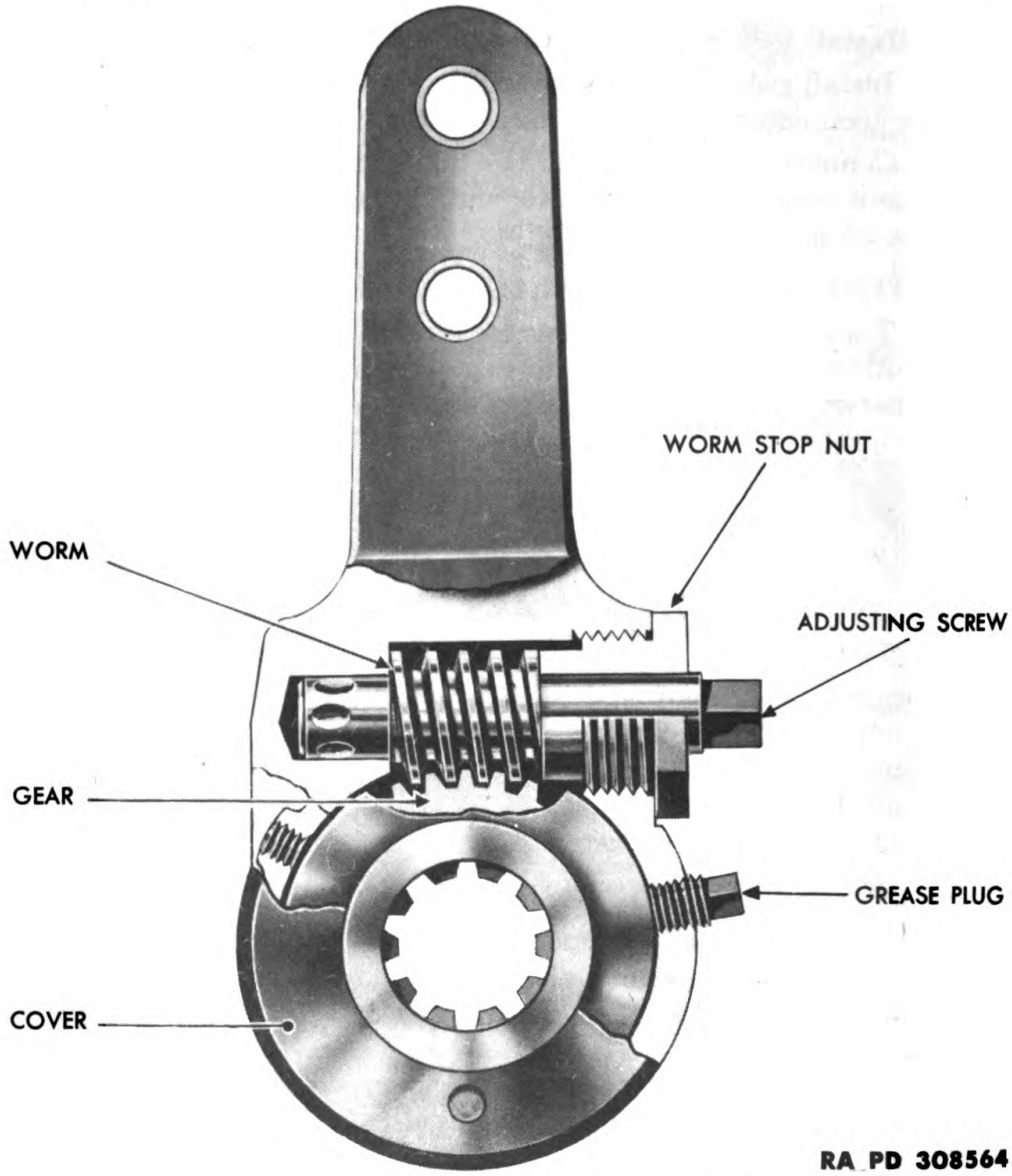



***Figure 114 — Sectional View of a Type-R Slack Adjuster (Lock Not Shown)***

## 87. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. Cleaning and Inspection.** Remove all dirt and grease from exterior of slack adjuster using dry-cleaning solvent. Inspect for broken or damaged parts. All broken or damaged parts must be replaced.

**b. Disassembly** (fig. 115).

(1) Remove lock spring plug, lock spring, and lock spring plunger.

(2) Remove set screw, locking gear cover in place, and remove gear cover.

(3) Remove set screw locking worm stop nut in place. Remove worm stop nut, worm, and gear.

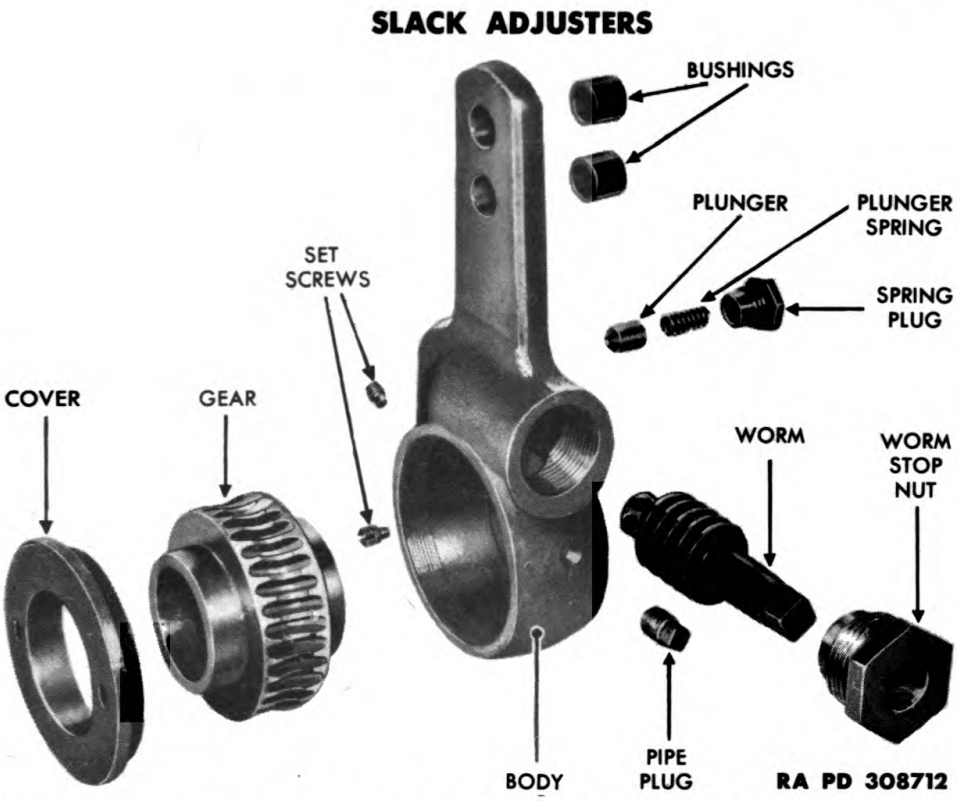



***Figure 115 — A type-R Slack Adjuster and Repairs Disassembled***

(4) If the arm bushings need replacing, they may be driven or pressed out.

(5) Remove grease plug.

## 88. CLEANING, INSPECTION OF PARTS, AND REPAIRS.

**a.** Clean all parts using dry-cleaning solvent.

**b.** Inspect worm and gear, and replace if found to be worn or if they have any broken teeth.

**c.** Inspect worm shaft for damage or wear, particularly the condition of the indents engaged by the lock plunger. All side walls of indents must be in good condition otherwise replace the worm shaft.

**d.** Inspect condition of bushings in the arm. If worn oblong or if they have been damaged, they must be replaced.

## 89. ASSEMBLY.

**a.** Place worm shaft and gear in body. Install and tighten worm stop nut. Be sure hole in worm stop nut lines up with the tapped hole in the body for the worm stop nut set screw. Install set screw locking worm stop nut in place.

**b.** Install gear cover and tighten. Be sure the hole in the cover lines up with the tapped hole in the body for the set screw locking cover in place and install the set screw.

**c.** If a new worm stop nut or a new gear cover is installed, it will

be necessary to drill a 0.182-inch diameter hole in the worm stop nut or the cover to be engaged by the set screw after the worm stop nut or gear cover have been tightened in place.

d. Install lock plunger, lock plunger spring, and lock plug. Lubricate these parts before installing in place.

e. If bushings in the arm have been removed, press new bushings into place. Ream bushings to 0.501-inch minimum, 0.503-inch maximum after pressing in place.

f. Connect the grease gun to the lubricating port and force chassis lubricant into the slack adjuster until it is completely filled. Install grease plug.

## 90. TEST OF REBUILT SLACK ADJUSTER.

a. Turn adjusting nut and worm until the gear makes one complete revolution. There must be no evidence of binding. There must be very little backlash between the worm and gear.

# CHAPTER 8
# CHECK VALVES

## Section I
## SINGLE CHECK VALVE



### 91. DESCRIPTION AND OPERATION.

**a.** The single check valve (fig. 116) is a small device containing a spring loaded ball valve so arranged as to only permit air to flow through the check valve in one direction.

**b.** It is most frequently used in the line leading to the front emergency line outlet on trucks and tractors to prevent the loss of reservoir air pressure in the event the cut-out cock in this line is left open.

### 92. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. Cleaning and Inspection.** Remove all dirt from the exterior of the valve, using dry-cleaning solvent. Inspect for broken parts. All broken parts must be replaced.

**b. Disassembly** (fig. 117). Unscrew cap nut from body and remove gasket, spring, ball valve, ball guide, and spring seat.

### 93. CLEANING AND INSPECTION OF PARTS.

**a. Cleaning.** Clean all parts using dry-cleaning solvent.

**b. Inspection of Parts.** Inspect all parts for wear or damage. Check ball valve and seat for pitting or corrosion of any kind. Replace if necessary.

### 94. ASSEMBLY.

**a.** Position ball valve, ball guide, and spring, in cap nut. Position new gasket on cap nut. Position spring seat in body and screw cap nut into body. Tighten cap nut securely.

### 95. TEST OF REBUILT VALVE.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90 pounds.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4 and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

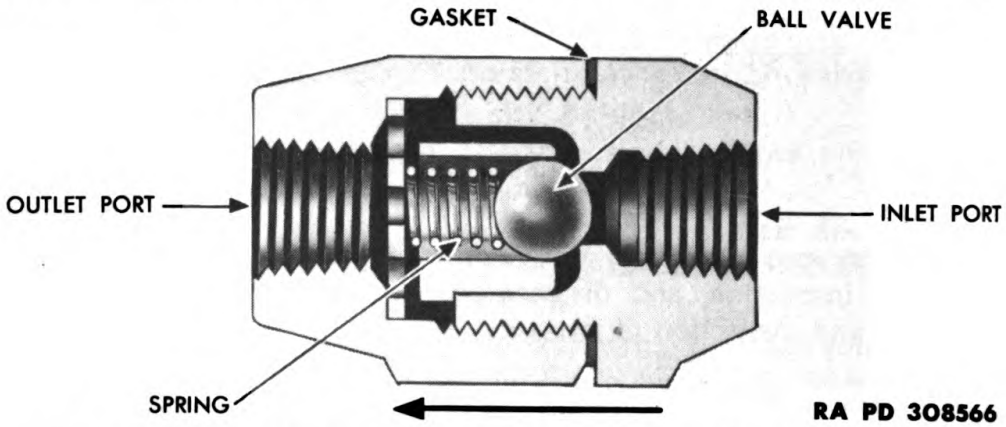



*Figure 116 — Sectional View of a Single Check Valve*

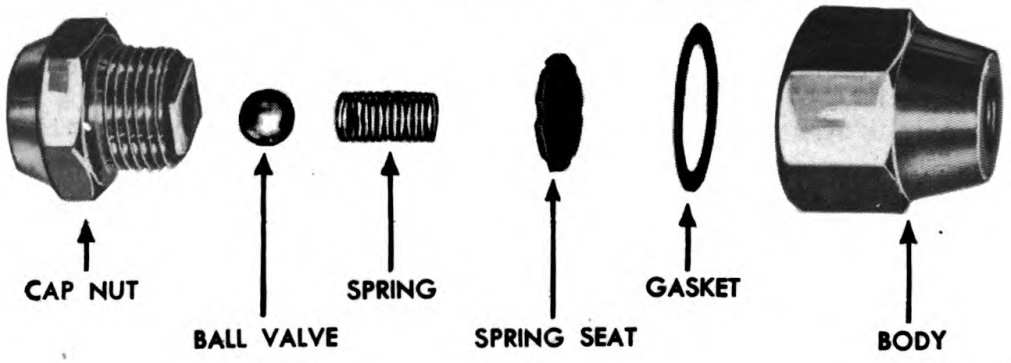



*Figure 117 — Single Check Valve Disassembled*

**b. Tests.**

(1) Connect hose No. 2 to the end of the check valve through which the ball valve can be seen.

(2) Open cock No. 2 and observe that air blows through check valve freely. Close cock No. 2.

(3) Disconnect hose No. 2 from end of check valve and connect it to the opposite end. Open cock No. 2 and test for leakage past the ball valve by coating the open end of the check valve with soap suds. Leakage in excess of a 1-inch soap bubble in 3 seconds is not permissible. Coat the outside of the valve all over with soap suds to check for leakage. No leakage is permissible. Close cock No. 2.

**c. Disconnect Valve from Test Rack.**

(1) Blow off all traces of soap suds, and disconnect hose No. 2 from valve.

(2) Plug both ends of check valve with pipe plugs to prevent the entrance of dirt during storage or shipment.

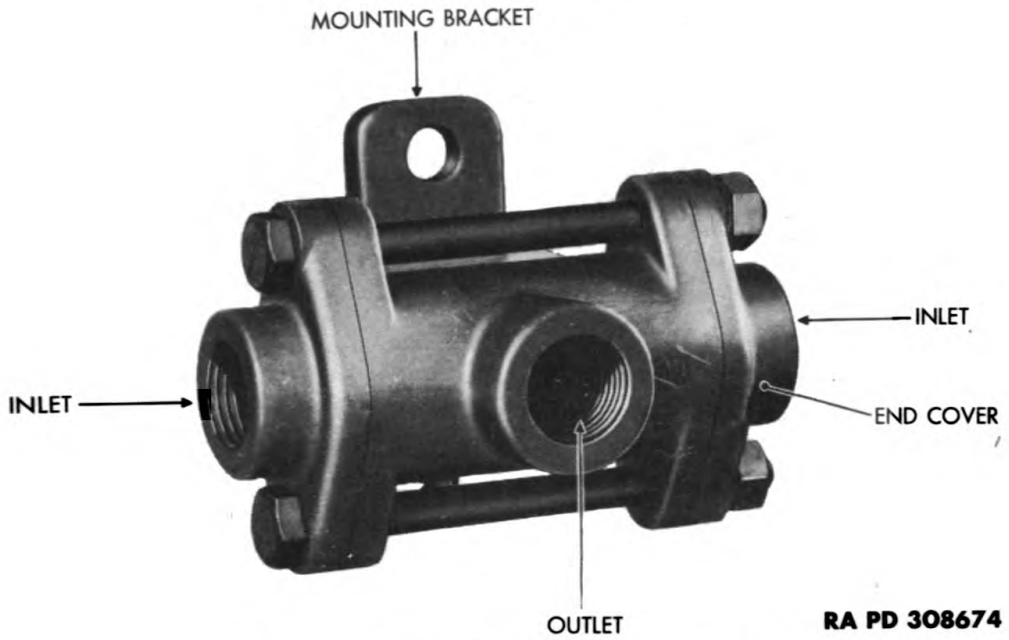



*Figure 118 — Double Check Valve*

## Section II

# DOUBLE CHECK VALVE



## 96. DESCRIPTION AND OPERATION.

**a. Description.**

(1) The double check valve (fig. 118) is a small device resembling a pipe tee used in air brake systems when two brake valves are used to control the brakes. If a double check valve was not used and one of the brake valves was moved to its applied position, air pressure from the reservoir would escape through the exhaust valve of the other brake valve. This occurs because the exhaust valve of the other brake valve would be open. The double check valve is most frequently used when a hand operated brake valve is added to the air brake system to provide independent control of the brakes on a towed vehicle.

(2) When one of the brake valves is moved to the applied position, the double check valve blocks off the line leading to the other brake valve and in this manner prevents any loss of air pressure through the open exhaust valve of the brake valve not being operated.

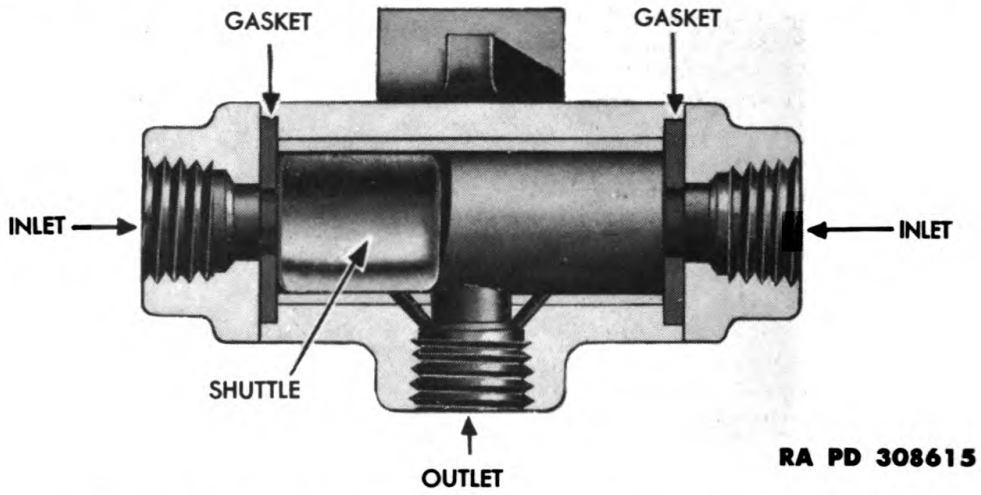



*Figure 119 — Sectional View of Double Check Valve*

**b. Operation.** Air pressure entering either end of the double check valve, causes the shuttle valve to move to the opposite end (fig. 119). Thus prevents air pressure from passing into the line connected to that end of the double check valve, and permits air to flow out through the side connection.

## 97. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. General.** If testing equipment is available, test the double check valve before disassembly by following the procedure outlined in paragraph 100.

**b. Cleaning and Inspection.** Remove all dirt and grease from exterior of valve, using dry-cleaning solvent. Inspect exterior for broken or damaged parts. All broken or damaged parts must be replaced.

**c. Disassembly** (fig. 120). Remove two bolts, nuts, and lock washers, attaching the two end covers to the body. Lift end covers off the body and remove gasket from each end of body. Slide shuttle valve out of body. Do not attempt to remove the sleeve from the body.

## 98. CLEANING, INSPECTION OF PARTS, AND REPAIRS.

**a.** Clean all metal parts in dry-cleaning solvent. Inspect inside bore of sleeve for scores or ridges. Inspect shuttle valve for wear or damage, particularly the end surfaces. Slight scratches on the bore of the body or on the shuttle valve may be corrected by polishing the part with crocus cloth. If the bore of the body or the shuttle valve are badly scratched, scored or dented, they must be replaced. Check to be sure the shuttle valve will slide freely back and forth in the body. Also be sure angular air passages to the side connection are clear and not obstructed.

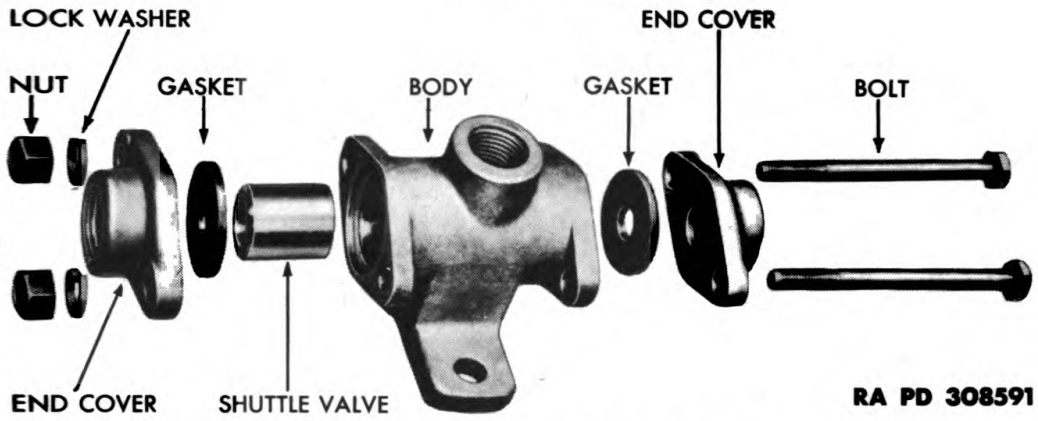



***Figure 120 — Double Check Valve Disassembled***

**b.** Inspect rubber gaskets for signs of cracking, pitting, cutting, or, swelling. Replace if any of these conditions are found.

## 99. ASSEMBLY.

**a.** Place shuttle valve in body, and position gasket and end cover on each end of body. Insert the two bolts through the end covers, body, install, and tighten, two lock washers and nuts. Tighten nuts evenly but beware of putting excessive strain on the lugs of the end covers and body.

## 100. TEST OF REBUILT VALVE.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90 pounds.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4, and both hands of gage No. 3 read zero. Then close cock No. 4, No. 6, and No. 7.

**b. Tests.**

(1) Plug the outlet port of the valve and connect hose No. 2 to one inlet port. Open cock No. 2, and coat the other inlet port with soap suds to check for leakage. Leakage in excess of a 1-inch soap bubble in three seconds is not permissible.

(2) Coat the outside of the valve with soap suds to check for leakage. No leakage is permissible.

(3) Close cock No. 2 and open cock No. 4 until gage No. 2 reads zero. Then close cock No. 4.

(4) Connect hose No. 2 to the other inlet port and repeat test (1) and (2).

**c. Disconnect Valve from Test Rack.**

(1) Close cock No. 2, blow off all traces of soap suds, and disconnect hose No. 2 from valve.

(2) Plug all ports with pipe plugs to prevent entrance of dirt during shipment or storage.

## Section III

# EXHAUST CHECK VALVE



## 101. DESCRIPTION AND OPERATION.

**a. Description.** The exhaust check valve (fig. 121) is a small rubber diaphragm type of check valve commonly used in the exhaust port of relay emergency valves to prevent the entrance of dirt or water through the exhaust port.

**b. Operation.** When air pressure is released through the exhaust port of the relay emergency valve, it escapes through the exhaust check valve by deflecting the rubber diaphragm. Unless air pressure is passing through the exhaust check valve, sufficient tension is placed on the rubber diaphragm by the diaphragm washer to keep the diaphragm in contact with the body of the exhaust check valve, thus preventing the entrance of dirt or water into the relay emergency valve.

## 102. CLEANING, INSPECTION, AND DISASSEMBLY.

**a. Cleaning and Inspection.** Remove all dirt from exterior of valve using dry-cleaning solvent. Inspect for broken or damaged parts. If the body is damaged, the complete valve must be replaced.

**b. Disassembly** (fig. 122). Remove diaphragm screw, lock washer, and lift out diaphragm washer and diaphragm.

## 103. CLEANING AND INSPECTION OF PARTS.

**a.** Clean all metal parts in dry-cleaning solvent. Inspect diaphragm seat of body, washer, and diaphragm, for wear or damage. Replace if necessary.

## 104. ASSEMBLY.

**a.** Position diaphragm and washer in place in body, and install diaphragm screw.

## 105. TEST OF REBUILT VALVE.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90 pounds.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2,

CHECK VALVES

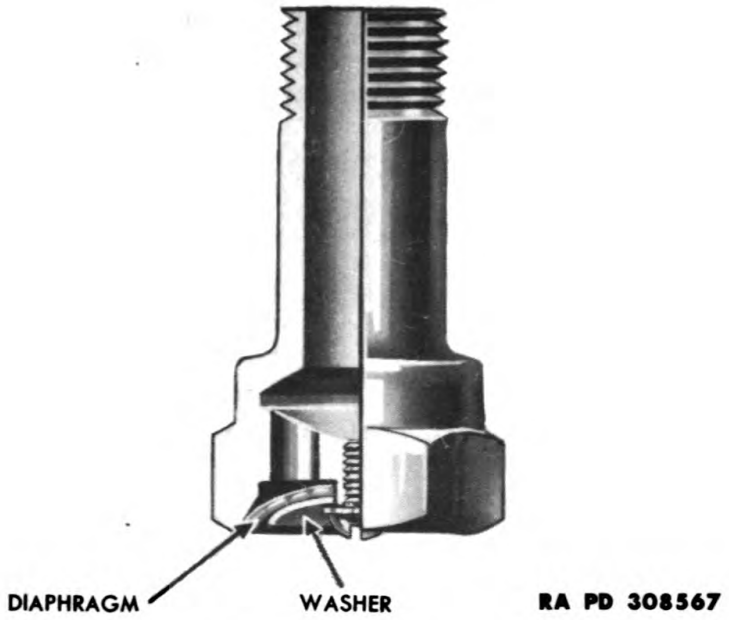



***Figure 121 — Sectional View of Exhaust Check Valve***

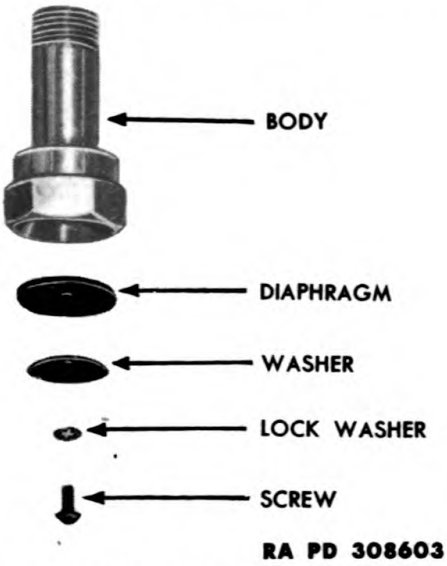



***Figure 122 — Exhaust Check Valve Disassembled***

No. 4, and both hands of gage No. 3, read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Tests.**

(1) Connect hose No. 5 to the exhaust check valve.

(2) Move brake valve handle to applied position, and observe that air pressure passes through the exhaust check valve freely.

(3) Move brake valve handle to released position, and observe that the black hand of gage No. 3 drops to zero promptly.

(4) Disconnect hose No. 5 from the exhaust check valve and immerse the diaphragm end of the exhaust check valve in water. Check for leakage of water into the exhaust check valve past the diaphragm. No leakage is permissible.

(5) Protect the exhaust check valve against the entrance of dirt during storage or shipment.

# CHAPTER 9
# COCKS

## Section I
## CUT-OUT COCKS



### 106. DESCRIPTION AND OPERATION.

**a.** Cut-out cocks (fig. 123) are usually used in the service line and emergency line on trucks and tractors to provide a method of closing off these lines when they are not being used.

**b.** The cut-out cock is open when the handle is at a 90-degree angle with the body of the cock. The cut-out cock is closed when the handle is parallel with the body of the cock. Stops are provided so that the handle cannot be turned beyond its normal open and closed positions.

**c.** Always open and close cut-out cocks by hand. Never strike the handle with a hammer or any such heavy instrume. , otherwise the cock may be damaged and leakage may develop.

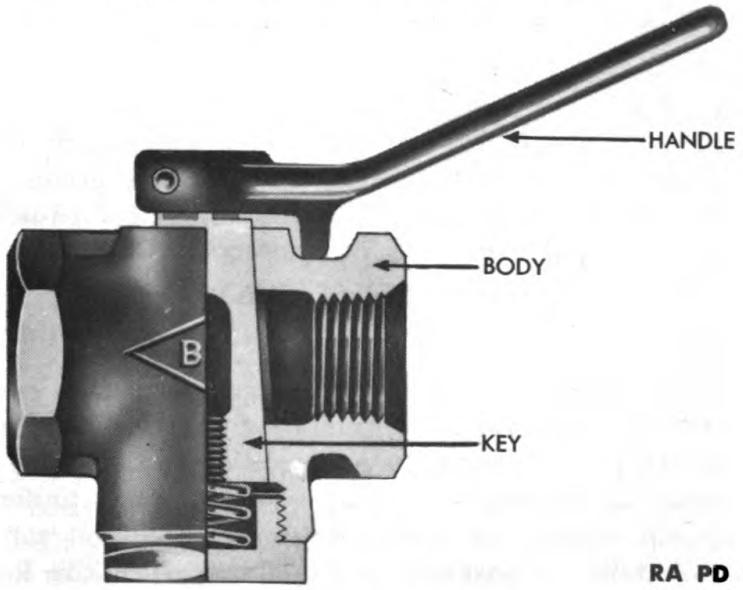



***Figure 123 — Sectional View of Cut-out Cock (Closed Position)***

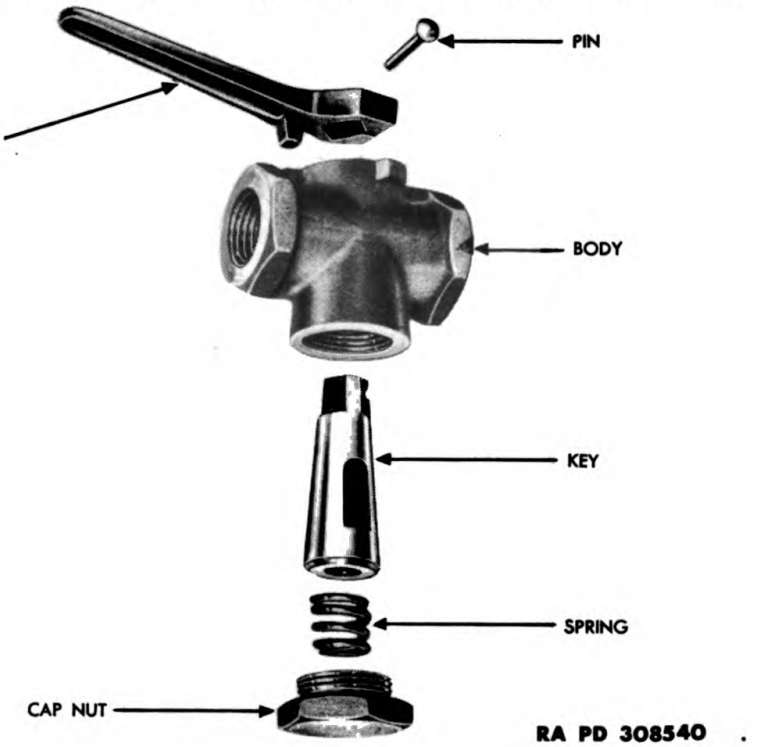



***Figure 124 — Cut-out Cock Disassembled***

**107. DISASSEMBLY** (fig. 124).

**a.** Drive out rivet pin attaching the handle to the key and lift off handle. Remove cap nut covering the lower end of the key and lift out spring. Remove key.

**108. CLEANING AND INSPECTION OF PARTS.**

**a.** Clean all parts in dry-cleaning solvent.

**b.** Inspect the outside of the key and inside bore of the body for ridges and scoring. Leakage due to slight ridges and scoring is corrected by grinding the key to the body using (BWE grade 400) grinding compound or its equivalent. If leakage has been caused by excessive scoring, replace the complete cut-out cock. Do not attempt to fit or grind a new key to an old body or vice versa.

**109. ASSEMBLY.**

**a.** Be sure all parts are thoroughly cleaned, apply a thin coating of cup grease with the fingers on the outside of the key and on the inside bore of the body. Place the key in position in the body. Install spring and cap nut putting a thin layer of cup grease under the head of the cap nut where it contacts the body. Tighten cap nut securely. Place handle in position on key being sure the key is positioned so that with the handle installed, the projection at the bottom of the handle will properly engage the stops on the top of

body in open and closed positions. Tap handle down on key so that rivet hole in key is in line with the rivet hole in the handle. Drive rivet into place and peen the end of it to make it secure.

## 110. TEST OF REBUILT CUT-OUT COCK.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 reads 90 pounds.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4, and both hands of gage No. 3, read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Tests.**

(1) Connect hose No. 2 to one end of the cut-out cock.

(2) With the cut-out cock handle in closed position, open cock No. 2 and check for leakage past the key by coating the other end of the cock with soap suds. Leakage in excess of a 1-inch bubble in three seconds is not permissible. Also coat the outside of the cock with soap suds to determine leakage through the body or around the key. No leakage is permissible.

(3) Plug the open end of the cut-out cock and move the cut-out cock handle to open position. Coat the outside of the cock all over with soap suds to check for leakage. No leakage is permissible.

**c.** If cut-out cock passes all tests, close cock No. 2, blow off all traces of soap suds, disconnect hose No. 2, and plug both ends of the cock to prevent the entrance of dirt during shipment or storage.

---

### Section II

# DRAIN COCKS



## 111. DESCRIPTION AND OPERATION.

**a.** The drain cock (fig. 125) is open when the handle is parallel to the body and is closed when the handle is at right angles to the body. Drain cocks are installed in the bottom of each reservoir in the air brake system, and their purpose is to provide a convenient means of draining the condensation which normally collects in the reservoirs.

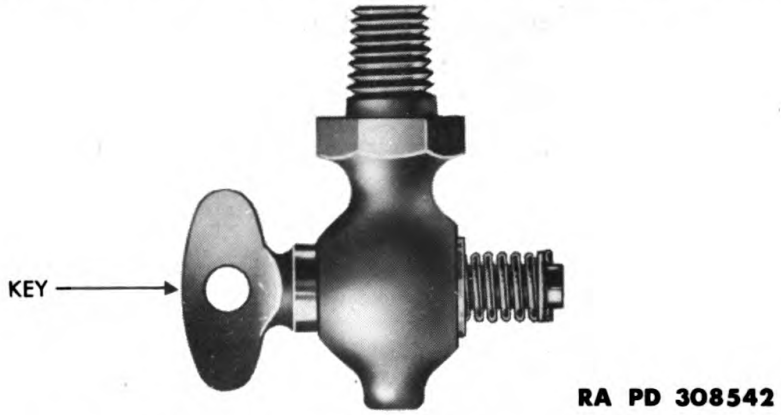



*Figure 125 — Drain Cock (Open Position)*

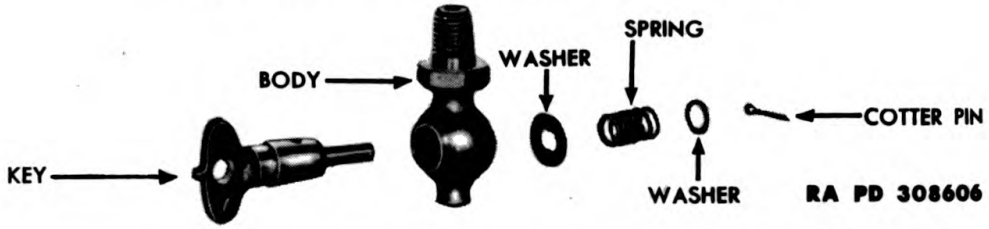



*Figure 126 — Drain Cock Disassembled*

b. Open the drain cock by hand and never strike the handle with a hammer or any other heavy instrument, as the cock may be damaged and leakage may develop.

## 112. DISASSEMBLY (fig. 126).

a. Remove the cotter pin from the end of the key, lift off small washer, spring, large washer, and remove key from body.

## 113. CLEANING AND INSPECTION OF PARTS.

a. Clean all parts with dry-cleaning solvent.

b. Inspect the key and bore of body for ridges and scoring. Slight leakage due to scoring is corrected by grinding the key to the body using (BWE grade 400) grinding compound or its equivalent.

c. Leakage due to excessive scoring cannot be corrected and the complete drain cock assembly must be replaced. Do not attempt to fit or grind a new key to an old body or vice versa.

## 114. ASSEMBLY.

a. Put a thin coating of cup grease on the outside of the key, and place the key in the body. Place the large washer, spring, and small washer, in this order over the end of the key and with the spring compressed, put the cotter pin in place through the end of the key. Spread the ends of the cotter pin to lock it in place.

## COCKS

### 115. TEST OF REBUILT DRAIN COCK.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90 pounds.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4, and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Tests.**

(1) With the drain cock closed, connect hose No. 2 to the drain cock. Open cock No. 2 and coat the drain cock all over with soap suds, to check for leakage through the body or past the key. Leakage of a 1-inch soap bubble in five seconds is permissible.

(2) If drain cock passes tests, disconnect hose No. 2 and protect the drain cock against the entrance of dirt during storage or shipment.

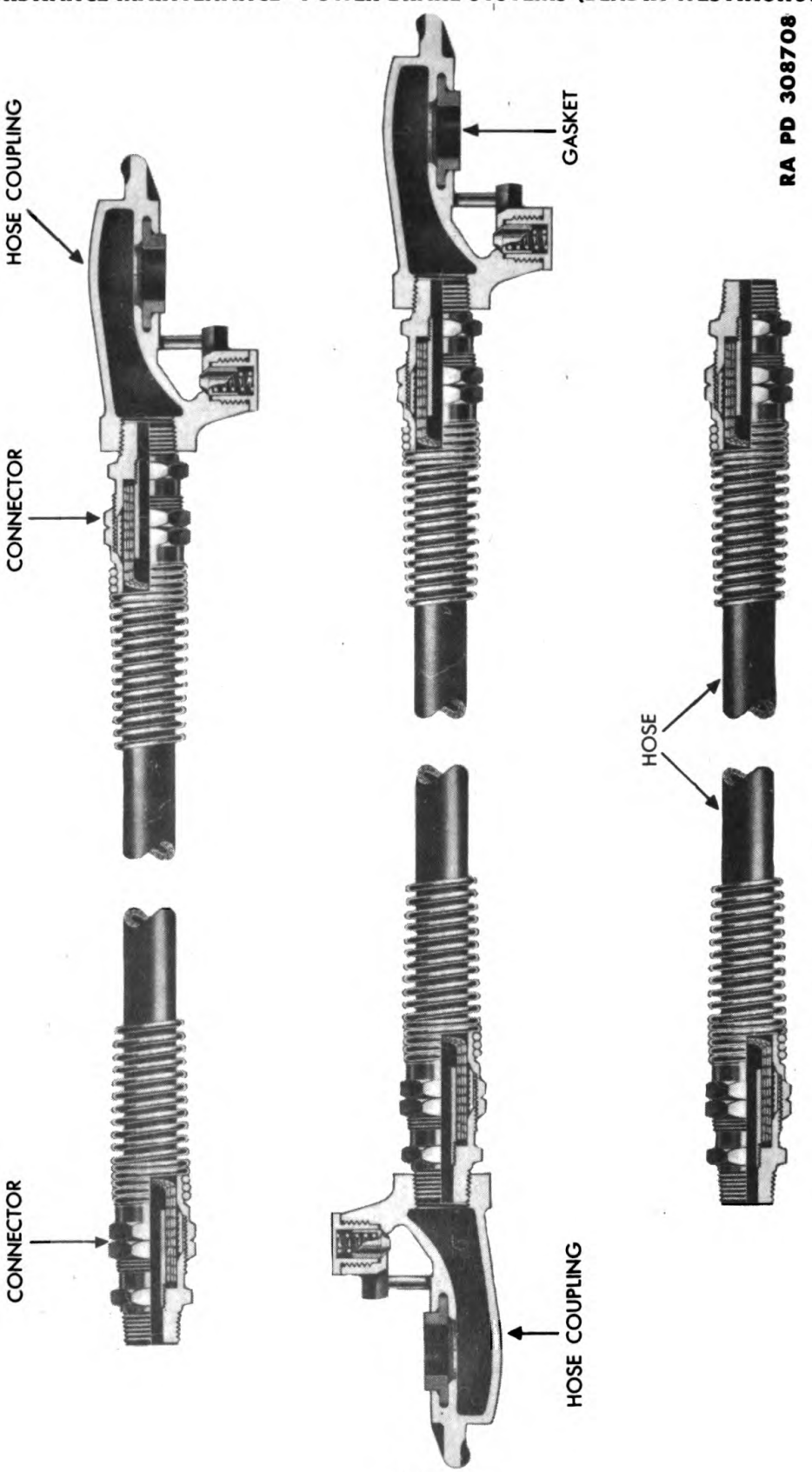



**Figure 127 — Sectional Views of Hose Assemblies**

# CHAPTER 10
# AIR LINES

## Section I
## HOSE, HOSE ASSEMBLIES, AND HOSE CONNECTORS



### 116. DESCRIPTION.

**a.** Hose and hose fittings provide a means of making flexible air connections between points on a vehicle, which normally change their position in relation to each other, or between two vehicles.

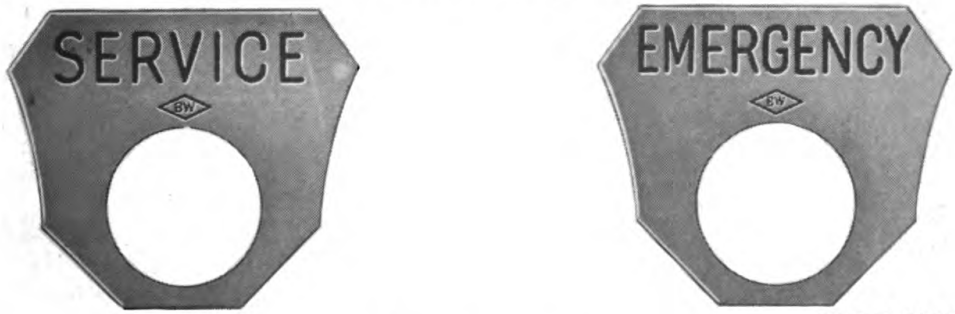
**b.** Hose assemblies used to connect the air brake system of one vehicle to the air brake system of another vehicle are fitted with hose couplings (fig. 127). Identification tags (fig. 128) are used to identify the lines.

**c.** All hose assemblies include detachable type hose fittings with spring guards (fig. 127). The special rubber hose used has an outside diameter of ¾-inch and an inside diameter of ⅜-inch. The hose is identified as BWE BW-101-M.

**d.** When installing a hose assembly where both ends are permanently connected, use the hose fitting at either end as a union, to permit tightening the hose fittings in place, by loosening the nut on one of the fittings. Turn the hose then in the loose fitting, before the fitting nut is again tightened, so the hose will not be kinked.

### 117. DISASSEMBLY (fig. 129).

**a.** Remove nut from body of fitting and pull hose out of body. Do not remove sleeve from hose. If a new piece of hose is to be installed, use a new sleeve. Do not remove hose guide, from fitting body.




RA PD 308574

***Figure 128 — Service and Emergency Line Identification Tags***


***Figure 129 — Hose Assembly Disassembled***

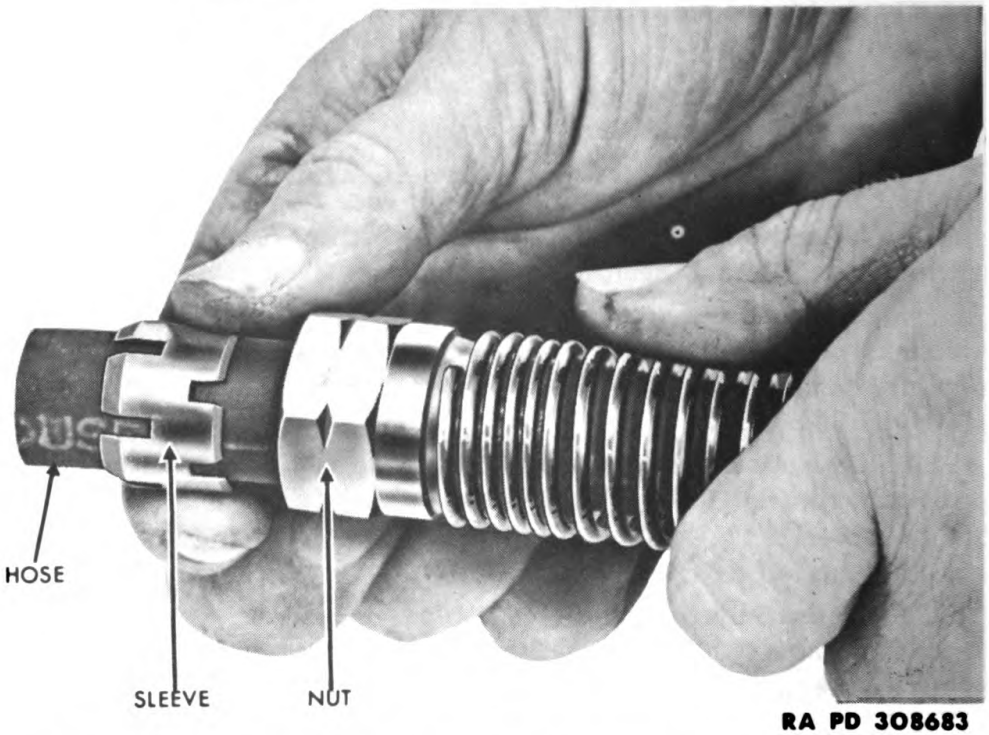



***Figure 130 — Connector Nut and Sleeve Positioned on Hose***

## 118. CLEANING AND INSPECTION OF PARTS.

**a.** Clean all metal parts in dry-cleaning solvent.

**b.** Inspect hose for abrasions, swelling, or other damage. If hose is damaged, replace with a new piece and discard sleeve and gasket.

**c.** Springs, nuts, and bodies, may be used again unless they are damaged.

## 119. ASSEMBLY.

**a.** Cut hose to desired length being sure the cut is made at right angles to the outside wall of the hose and that the end of the hose is smooth.

**b.** Blow out the hose with an air line to remove all cuttings.

**c.** Position nut and sleeve on hose (fig. 130) being sure the barbs on the inside of the sleeve point toward the end of the hose.

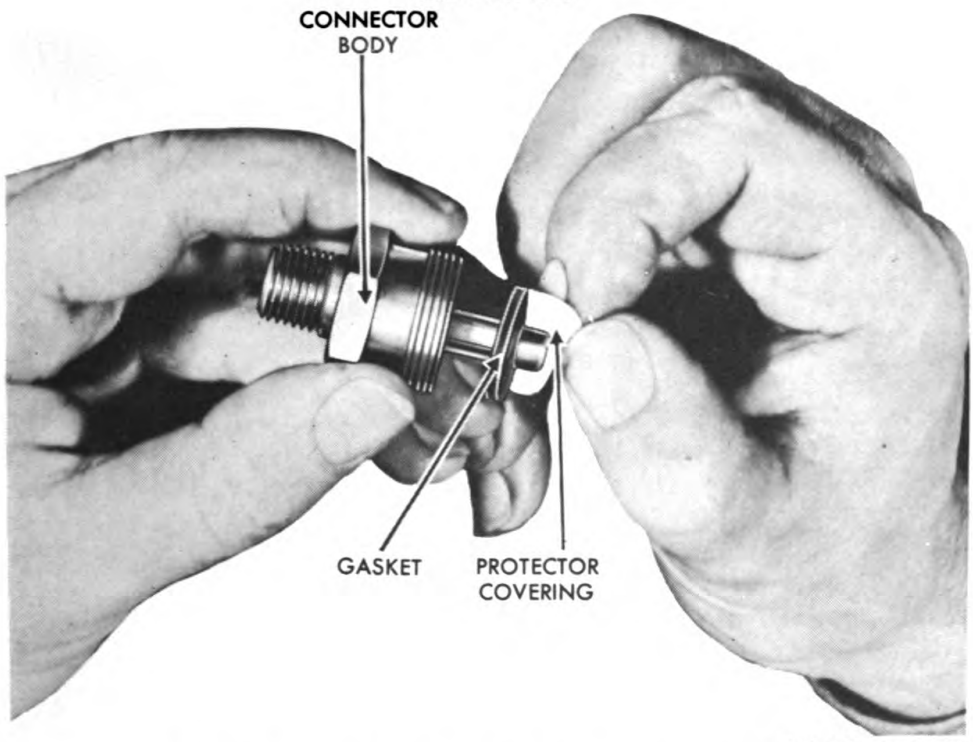



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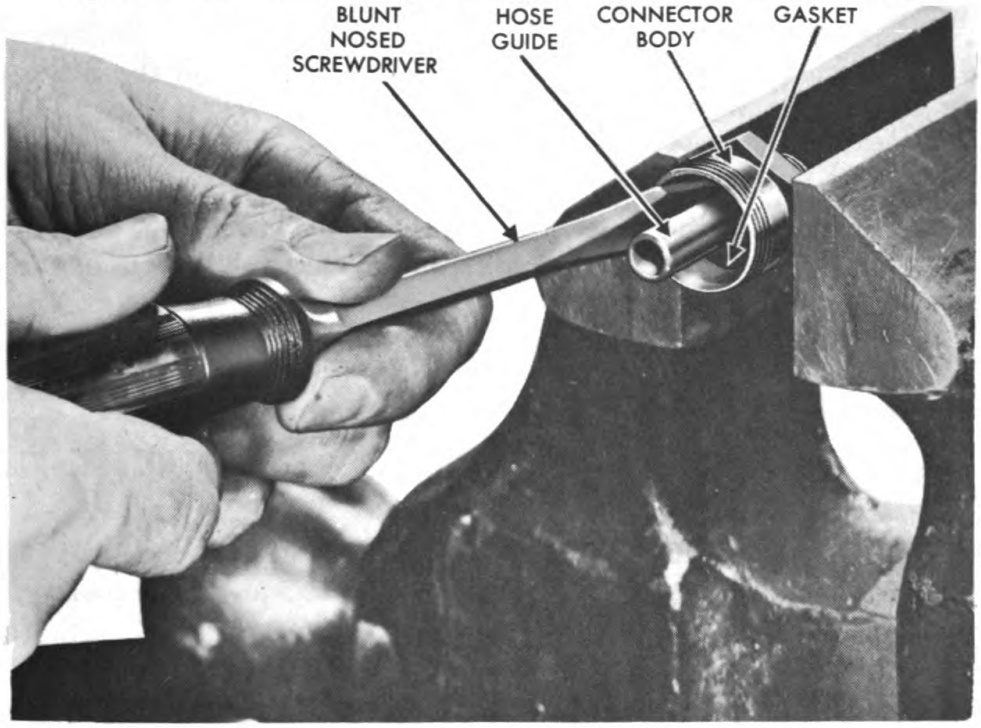
***Figure 131 — Removing Protector Covering from Gasket***




RA PD 308681

***Figure 132 — Pushing Gasket Into Bottom of Recess in Connector Body***

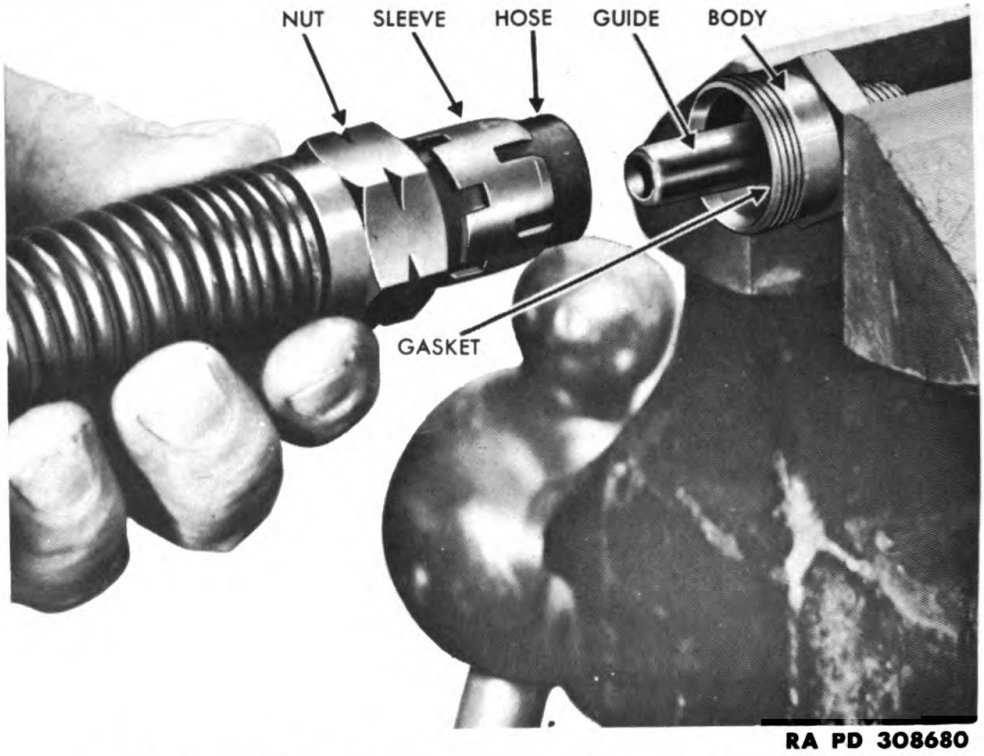



***Figure 133 — Placing Hose in Connector Body***

**d.** Position a new gasket over the end of the guide in the fitting body so the side with the removable protector covering (fig. 131) will be next to the hose.

**e.** Remove the protector covering from the gasket.

**f.** Put the end of the hose in the fitting body (fig. 133), making sure the end of the hose and the gasket are against the bottom of the recess in the fitting body (fig. 132).

**g.** Move the sleeve, if necessary, until it is against the edge of the fitting body. Then tighten the fitting nut. It is only necessary to tighten the nut sufficiently to insure a good air tight joint.

## 120. TEST OF REBUILT HOSE ASSEMBLY.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90 pounds.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4 and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Tests.**

(1) Connect one end of the hose assembly, to be tested, to hose No. 2. Plug the other end of the hose assembly.

(2) Open cock No. 2 and coat the hose assembly all over with soap suds to check for leakage. No leakage is permissible.

(3) Close cock No. 2, remove plug from the end of the hose assembly and disconnect hose No. 2.

---

## Section II

# HOSE COUPLINGS AND DUMMY COUPLINGS



## 121. DESCRIPTION AND OPERATION.

**a.** Hose couplings (fig. 134) provide an easy and convenient method of connecting and disconnecting air lines between vehicles.

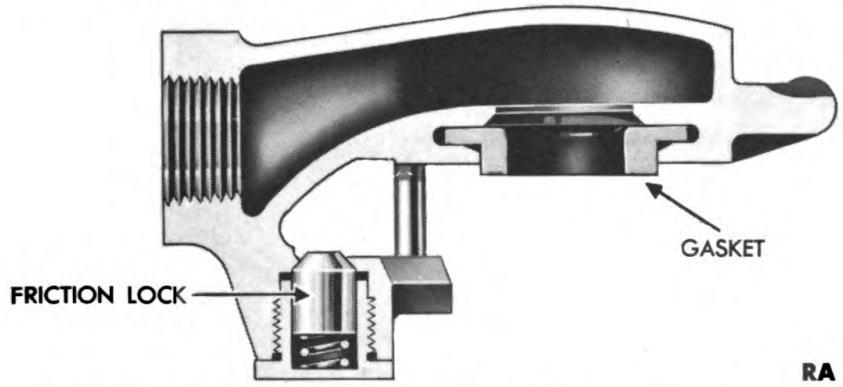



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***Figure 134 — Sectional View of a Hose Coupling***

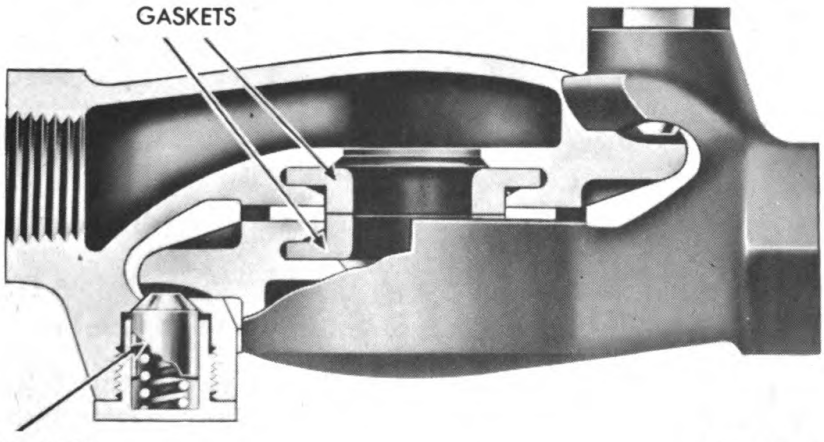


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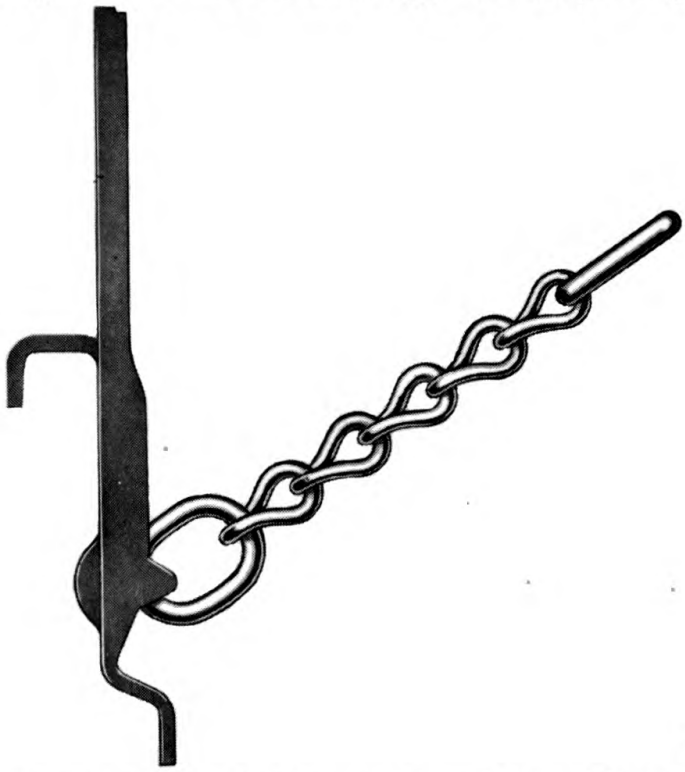
***Figure 135 — Sectional View of Hose Couplings Connected***

RA PD 308609

*Figure 136 — A Bracket Type Dummy Coupling*



RA PD 308565

*Figure 137 — A Dummy Coupling with Chain*

The design of the hose coupling is such that when two of them are coupled together, pressure is put on two rubber gaskets making an airtight seal and at the same time providing a joint which can be easily connected or disconnected by hand (fig. 135). Some types

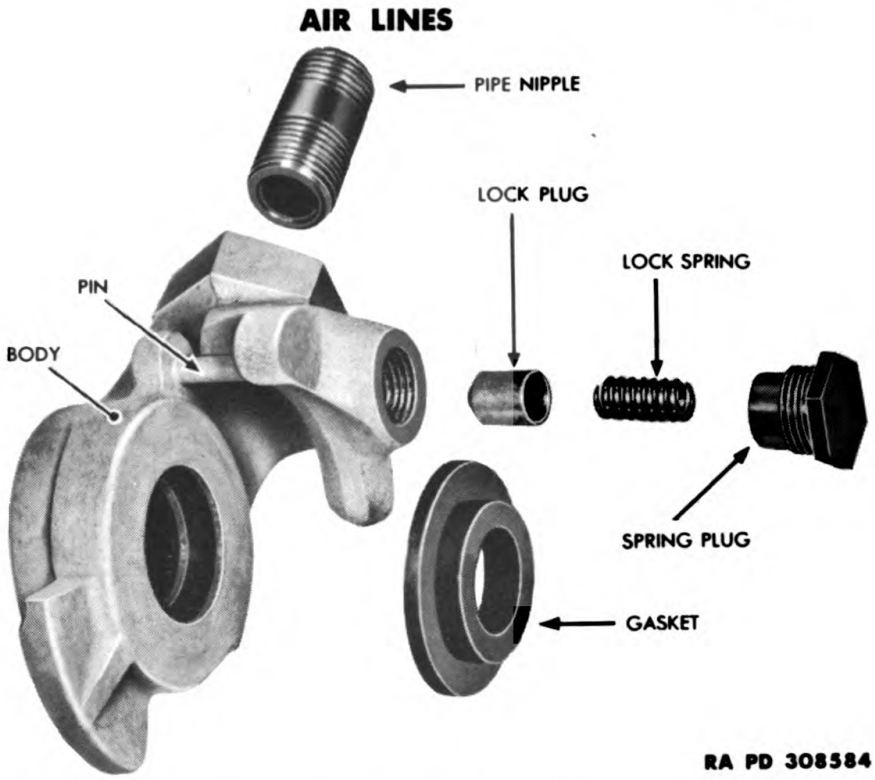



***Figure 138 — A Hose Coupling Disassembled***

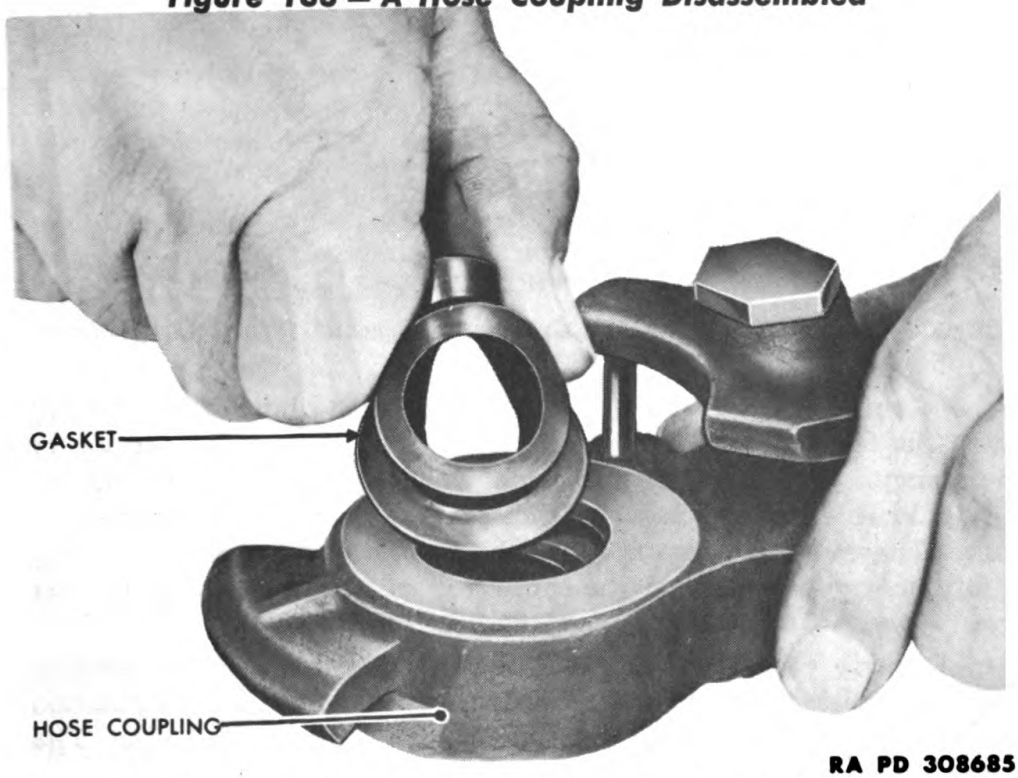



***Figure 139 — Installing Hose Coupling Gasket (First Operation)***

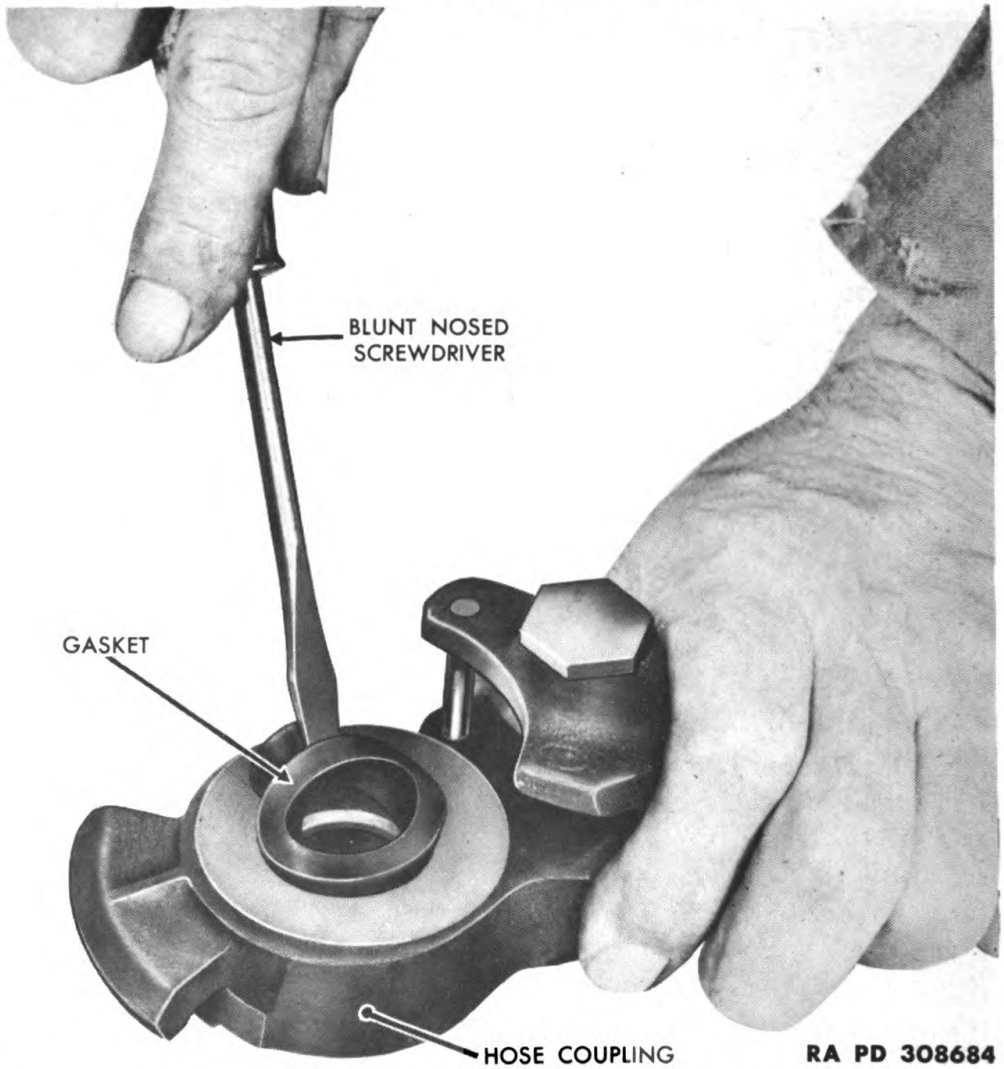



***Figure 140 — Installing Hose Coupling Gasket (Final Operation)***

of hose couplings are fitted with friction locks while others do not have this feature. Some also are marked with the word service or emergency. Couplings of this type which are marked emergency have a knob on the back while those marked service do not have a knob. However, all types are interchangeable and any hose coupling of any one type can always be connected to any coupling of another type.

**b.** Dummy couplings (fig. 136) are made in two general designs, some being fitted with brackets to permit them to be rigidly mounted on the vehicle while others are fitted with a chain (fig. 137). The bracket-type is used where the dummy coupling is to serve as a fastening for holding hose lines when not in use, whereas the type fitted with a chain is used for blanking off hose couplings rigidly mounted on the vehicle. The primary purpose of all dummy-couplings is to

prevent the entrance of dirt or other foreign matter into the air brake lines when they are not being used. Dummy-couplings used to protect the service line coupling at the front of a truck or tractor are drilled with a small vent hole. This prevents air being trapped in this line and keeps brakes applied.

**122. DISASSEMBLY** (fig. 138).

**a.** If the hose coupling is fitted with a friction lock, remove the lock spring plug, lock spring, and lock spring plunger.

**b.** Remove the gasket by prying it out with a screw driver.

**123. CLEANING AND INSPECTION OF PARTS.**

**a.** Discard old gasket and clean all other parts in dry-cleaning solvent. Examine friction lock spring and lock spring plunger for wear or damage and replace if necessary. When cleaning the hose coupling body, give particular attention to the groove into which the flange of the hose coupling gasket fits. This groove must be scraped thoroughly clean, otherwise the new gasket will not go into place properly.

**124. ASSEMBLY.**

**a.** To install a new gasket, partially collapse it with the fingers and enter one side of the gasket flange in the groove of the coupling (fig. 139). Then use a blunt nose screw driver or some similar instrument to complete pushing the gasket in place (fig. 140). When properly installed, the exposed face of the gasket will be flat and not twisted or bulged at any point.

**b.** With a new gasket installed, the assembly of the hose coupling is completed by installing the friction lock parts, when these parts are included in the assembly.

# CHAPTER 11

# TUBING AND TUBING FITTINGS



## 125. DESCRIPTION.

**a. General.** Tubing and fittings (figs. 141, 142, 143, 144, 145) are used to connect the various devices in the air brake system where it is not necessary to use flexible hose.

**b. Tubing Sizes.** Three sizes of copper tubing are used in air brake systems. The largest size has an outside diameter of ¾ inch and is most frequently used in the compressor discharge line. Tubing used to carry the air supply to such devices as brake valves, relay valves and relay emergency valves, usually has an outside diameter of ½ inch. Lines which handle a comparatively small quantity of air or where the rate of flow is not important usually have an outside diameter of ⅜ inch. The inside diameter of these tubing lines is not the same as standard commercial tubing and it is important that tubing of the correct inside and outside diameter be used. Otherwise operation of the air brake equipment will be seriously affected.

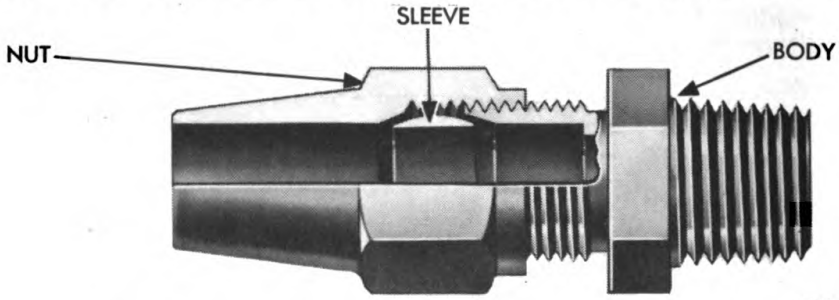



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***Figure 141 — Sectional View of a Tubing Connector***

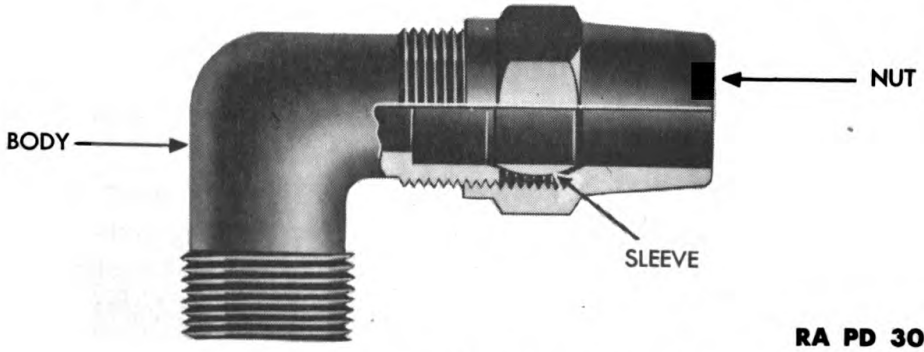


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***Figure 142 — Sectional View of a Tubing Elbow***

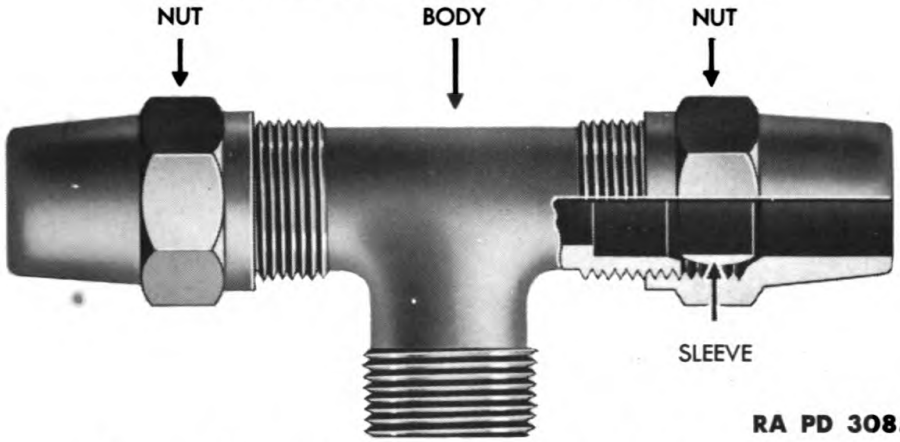



*Figure 143 — Sectional View of a Tubing Tee*

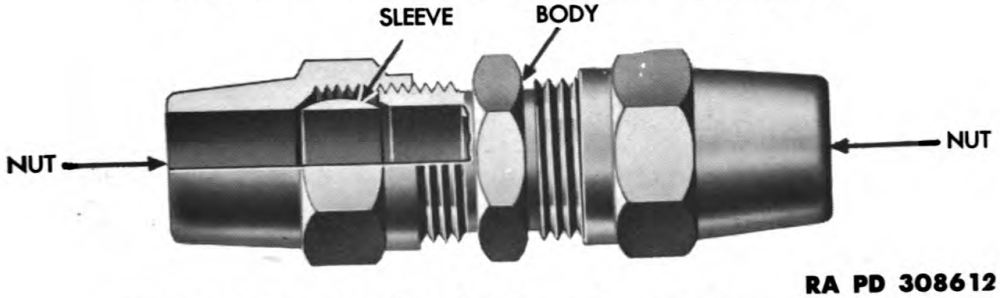



*Figure 144 — Sectional View of a Tubina Union*

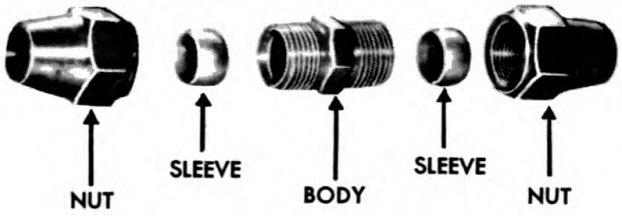



*Figure 145 — A Tubing Union Disassembled*

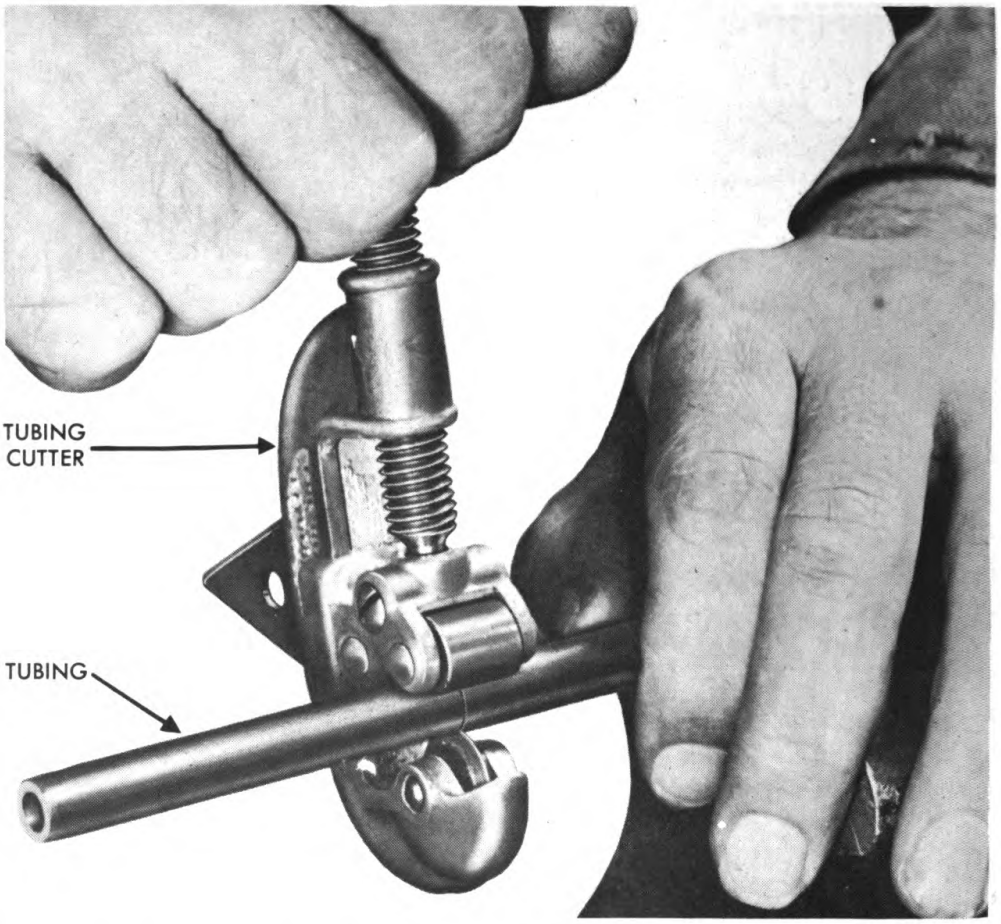
**c. Fitting Types.** Tubing fittings used in the air brake system are the three piece compression type (figs. 141, 142, and 143). Flared type fittings such as are used in gasoline lines, etc. must not be used in the air brake system.

## 126. CLEANING AND INSPECTION.

**a.** All tubing must be clean and free from dents or kinks. All tubing fittings must be cleaned using dry-cleaning solvent and must not be damaged in any way.

## 127. ASSEMBLY.

**a.** When replacing tubing lines, cut tubing to required length with a hack-saw or tubing cutter (fig. 146). As the cut is made, make sure the end of the tubing is smooth and that it is cut squarely with




RA PD 308678

***Figure 146 — Cutting Tubing to Length, Using Tool 41-C-2825***

the outside wall. Make sure the ends of the tubing are not crimped or partially closed. Ream (fig. 147) or file the ends of the tubing if necessary.

**b.** Blow out tubing with an air line to remove all cuttings and filings. This is very important.

**c.** Place nut and sleeve on tubing and put the end of the tubing in the recess in the tubing fitting body (fig. 148).

**d.** Hold tubing at bottom of recess and tighten nut to seal the joint against leakage. It is only necessary to tighten the nut until sufficient pressure is placed on the sleeve to prevent leakage. Always use a new sleeve when replacing tubing lines. Tubing, fitting nuts, and bodies, may be used again provided they are in serviceable condition.

## TUBING AND TUBING FITTINGS

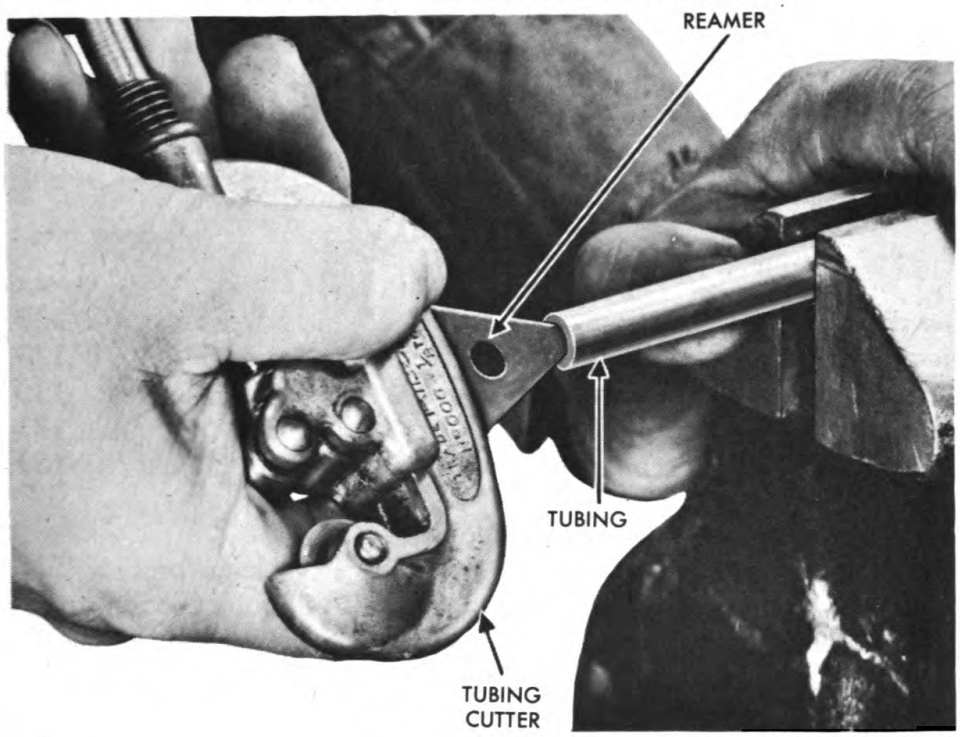



***Figure 147 — Reaming Tubing After Cutting, Using Tool 41-C-2825***

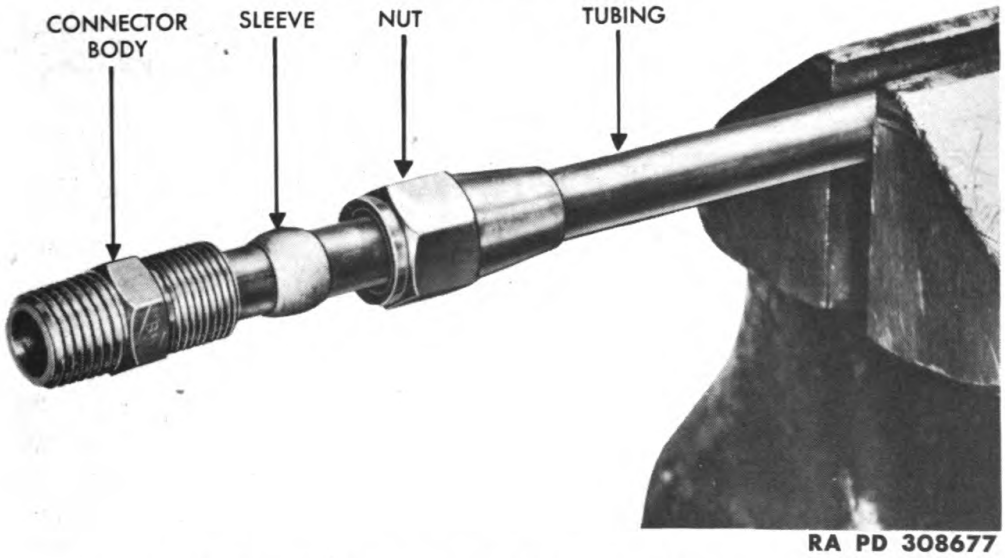



***Figure 148 — Tubing and Fitting Ready for Assembly***

# CHAPTER 12
# MISCELLANEOUS AIR BRAKE DEVICES

## Section I
## SAFETY VALVE



### 128. DESCRIPTION AND OPERATION.

a. The purpose of the safety valve (fig. 149) is to protect the air brake system against excessive air pressure. Should the air pressure in the reservoir rise above the setting of the safety valve (150 lb),

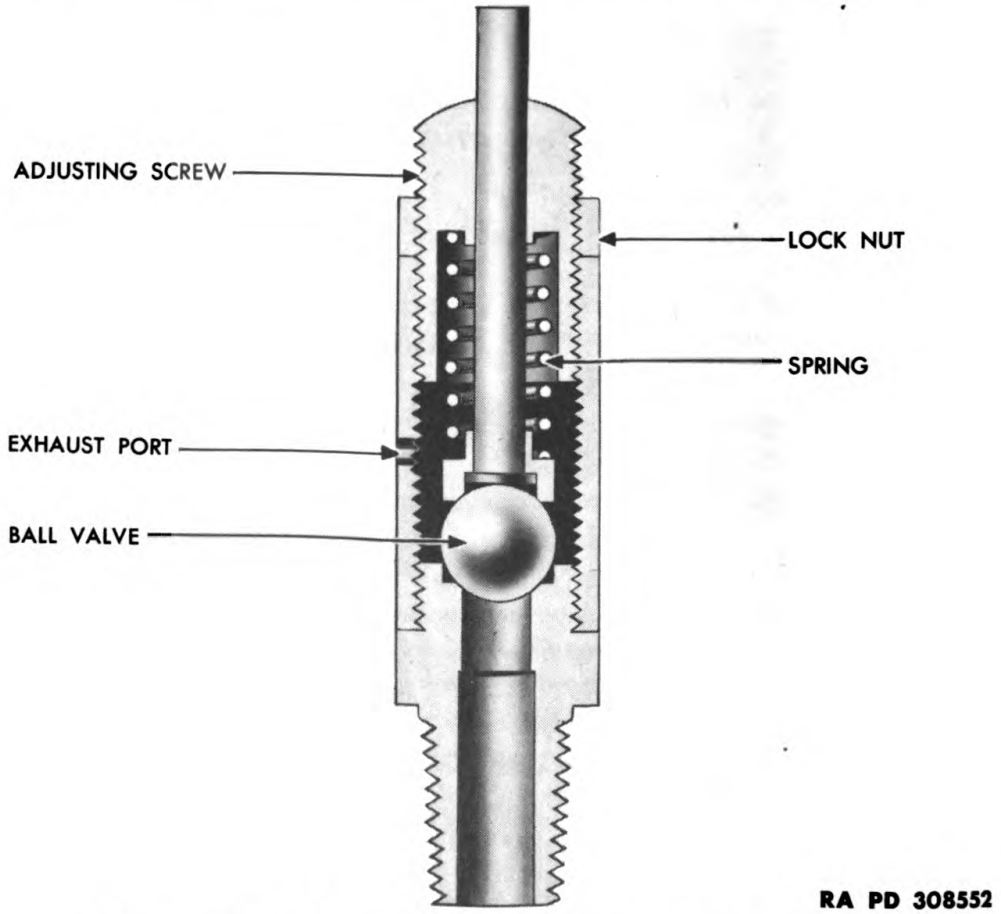



*Figure 149 — Sectional View of Safety Valve*

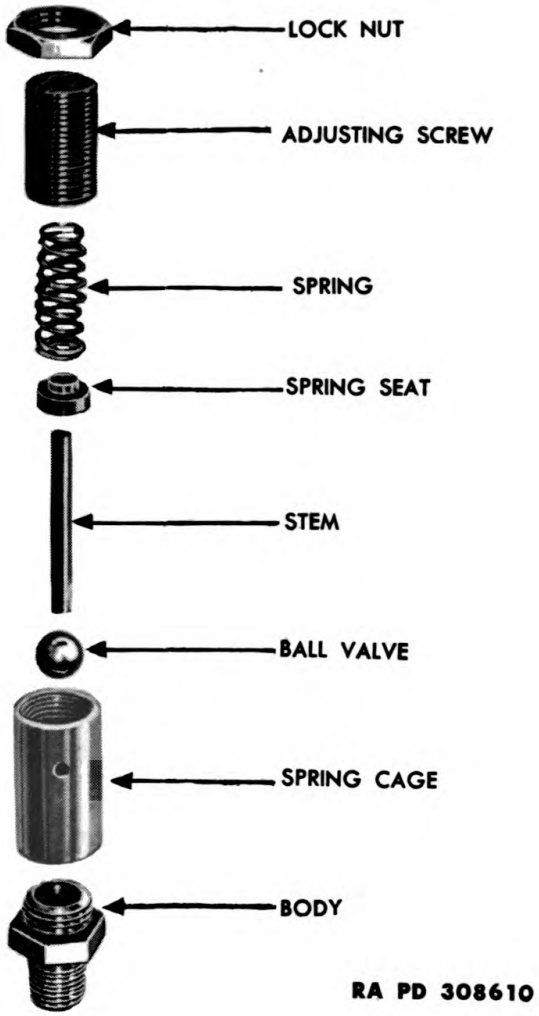



***Figure 150 — Safety Valve Disassembled***

the safety valve opens and permits excessive pressure above 150 pounds to be exhausted.

**b.** The safety valve consists of a spring loaded ball check valve which is set to "blow off" at 150-pound air pressure.

**c.** Reservoir pressure is always present below the ball valve and the force of the pressure regulating spring keeps the ball valve on its seat unless the air pressure rises above 150 pounds. When this happens, the air pressure below the ball valve overcomes the spring pressure above it and the ball valve lifts off its seat. Reservoir pressure then escapes through the exhaust port until the pressure is lowered to the pressure setting of the valve. When this happens, the pressure regulating spring forces the ball valve back to its seat, preventing further escape of reservoir pressure.

**129. DISASSEMBLY** (fig. 150).

**a.** Loosen lock nut on adjusting screw. Remove adjusting screw,

release pin, pressure regulating spring, spring seat, and ball valve. Do not remove spring cage from body unless one of these parts is to be replaced.

## 130. CLEANING, INSPECTION OF PARTS, AND REPAIRS.

**a.** Clean all parts in dry-cleaning solvent. Inspect all parts for wear or damage, particularly the ball valve and seat for corrosive action and pitting. Be sure release pin is not bent. Check fit of release pin in adjusting screw. It should be a free sliding fit.

**b.** If slight leakage is found, sometimes it can be corrected by lightly tapping the ball valve to its seat. If leakage is excessive, the ball valve or body, or both, must be replaced.

## 131. ASSEMBLY.

**a.** With the spring cage and body assembled, position spring seat on release pin with head of pin in the recess of the spring seat. Drop ball valve into spring cage. Position release pin and spring seat in place with large end of spring seat contacting the ball valve. Place spring in position being sure lower end of spring properly engages the spring seat. Install adjusting screw and lock nut.

## 132. TEST OF REBUILT SAFETY VALVE.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary until gage No. 1, reads 150 pounds.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7 until gages No. 2, No. 4 and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Tests.**

(1) Connect hose No. 2 to the safety valve, and open cock No. 3. Loosen adjusting screw lock nut and turn adjusting screw until safety valve blows off. Pressure setting is raised by turning the adjusting screw clockwise. Pressure setting is lowered by turning the adjusting screw counterclockwise. Tighten lock nut after adjustment.

(2) Adjust setting of feed valve until gages No. 1 and No. 2 read 125 pounds. Coat the outside of the safety valve all over with soap suds to check the leakage. Leakage in excess of a 1 inch soap bubble in 5 seconds is not permissible.

(3) Close cock No. 3 and disconnect hose No. 2.

RA PD 308557

*Figure 151 — A Reservoir*

## Section II

## RESERVOIRS



### 133. DESCRIPTION.

**a.** Reservoirs are cylindrical in shape and are made of sheet steel with electrically welded seams. The heads or ends are steel stampings and are securely held in place by the sides being spun over the ends before the end seams are welded (fig. 151). Pipe tapped ferrules are used at the openings and are welded in place. Some reservoirs used on gun mounts are fitted with mounting flanges and a few are made of cast iron.

**b.** The function of a reservoir is to provide a place to store compressed air so there will always be an ample supply available for immediate use in brake operation. It also provides storage for sufficient compressed air to permit several brake applications even after the motor has stopped.

**c.** Another function of a reservoir is to provide a place where the air, heated during compression, may cool and the oil and water vapors condense.

**d.** The total reservoir volume used on any vehicle is based on the quantity of compressed air required, and on the size of compressor being used.

### 134. TABULATED DATA.

**a.** The following standard sizes of reservoirs will be found in service.

| Size Dia Length | Volume Cu In. |
|---|---|
| 7 x 24 in. | 846 |
| 7 x 36 in. | 1,268 |
| 7 x 48 in. | 1,692 |
| 8 x 24 in. | 1,145 |
| 8 x 26 in. | 1,240 |
| 8 x 41½ in. | 1,975 |

### 135. CLEANING, INSPECTION, AND REPAIRS.

**a.** Clean reservoir thoroughly inside and out. The use of steam and hot water is recommended for cleaning. Inspect inside and outside surfaces for damage from corrosion. A small flashlight is helpful when inspecting the interior.

**b.** If corrosion or any other damage has weakened the reservoir, it must be replaced.

**c.** Except in unusual cases, reservoirs must be replaced rather than repaired. Welding of small holes is not recommended. The outside of the reservoir must be kept painted. If the reservoir is to be stored for any length of time, the inside is treated with an approved rust preventative and all openings plugged.

### 136. TESTING.

**a.** Pressure tests are made, if desired, by using water pressure. New reservoirs will withstand 200 pounds of water pressure without leaking. CAUTION: *Do not use air pressure when making pressure tests of reservoirs as this is dangerous.*

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## Section III
## AIR FILTERS



### 137. DESCRIPTION AND OPERATION.

**a.** Air filters (fig. 152) are used in the service line and the emergency line on trailers to trap any dirt or foreign matter which might get into these lines when the trailer is not connected to a towing vehicle.

**b.** Two very similar types will be found in service. The older style includes flange type connections and a curled hair strainer. The

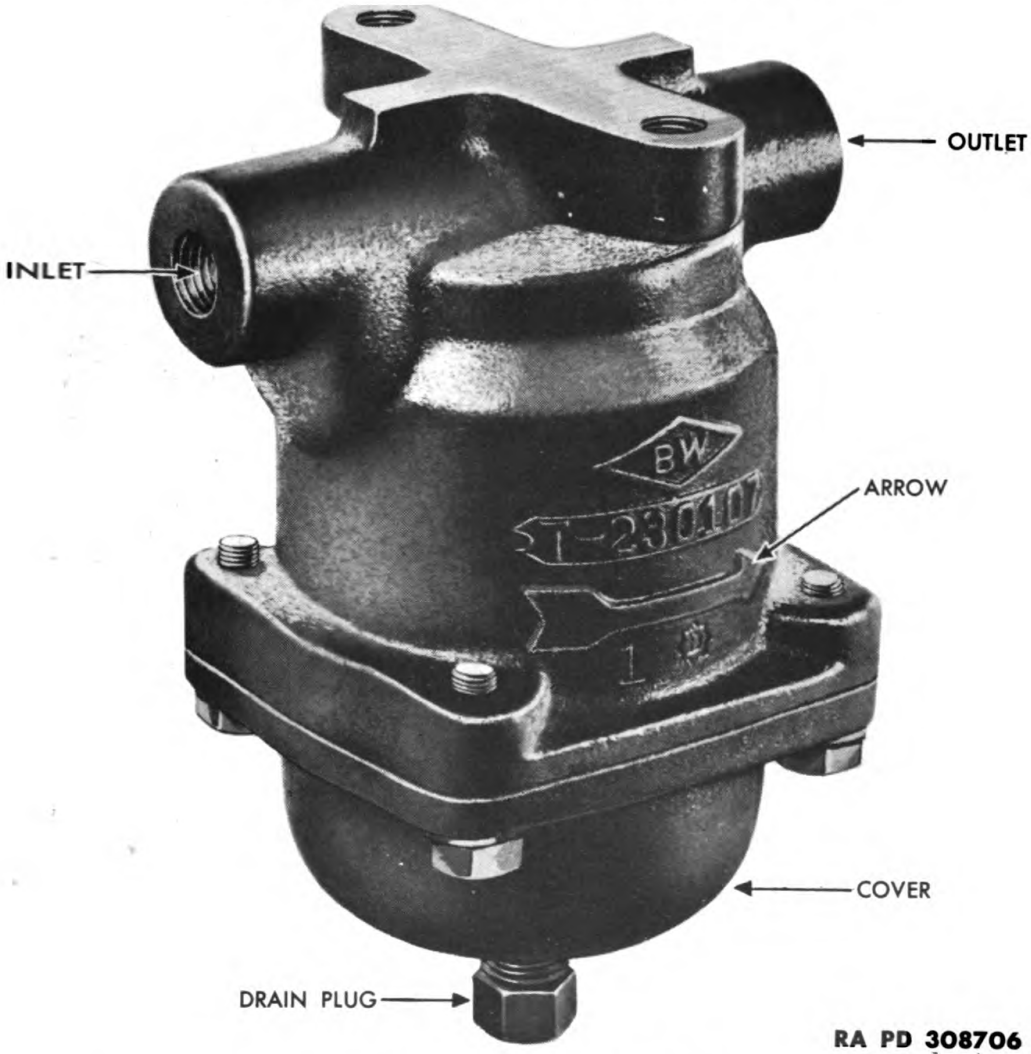


***Figure 152 — Air Filter***

newer style does not include flange type connections and uses a wound cotton strainer. The cotton type strainer is used as a replacement element in either style of filter.

**c.** Both styles of filters have removable dirt chambers or covers and these covers are fitted with drain plugs (fig. 153).

**d.** The correct direction of the air flow through the filter is indicated by an arrow cast on the body. Air flowing from the truck or tractor to the trailer must pass through the filter in the direction indicated by the arrow.

**e.** Air flowing through the filter readily passes through the strainer but any dirt which might be present in the air stream is stopped by the strainer. Moisture or dirt which may collect in the filter is eliminated by removing the drain plug.

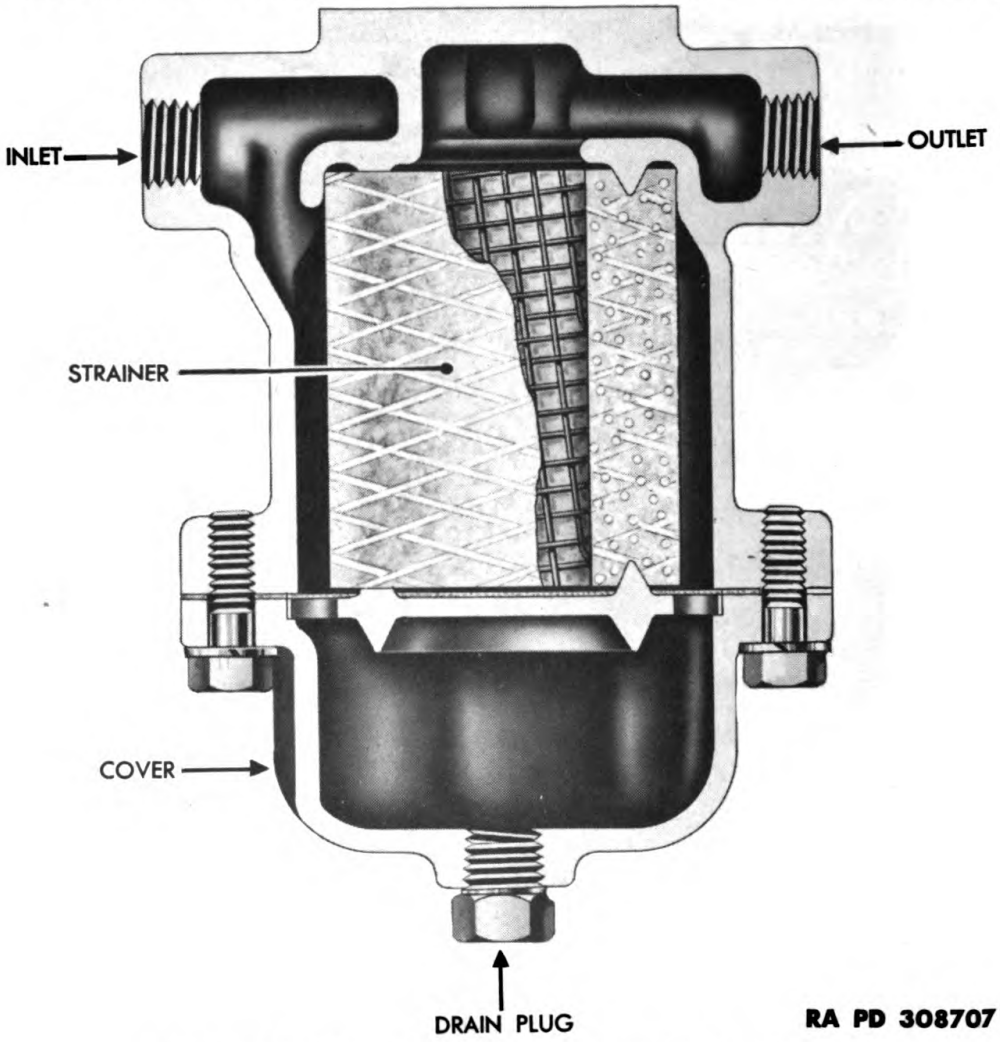


***Figure 153 — Sectional View of Air Filter***

**138. DISASSEMBLY** (fig. 154).

**a.** Remove cap screws and lock washers attaching cover to body. Remove gasket, strainer support, and strainer.

**b.** On old style filters, remove bolting flanges and gaskets.

**139. CLEANING AND INSPECTION OF PARTS.**

**a.** Clean all metal parts using dry-cleaning solvent.

**b.** If strainer is merely dusty, clean by brushing. If an oily or gummy deposit is found, the strainer must be replaced. Curled hair type strainers are washed in dry-cleaning solvent.

**c.** Replace gasket unless it is in good condition.

**140. ASSEMBLY.**

**a.** Position strainer in place in body. Position gasket and strainer support on cover and install cover.

## MISCELLANEOUS AIR BRAKE DEVICES

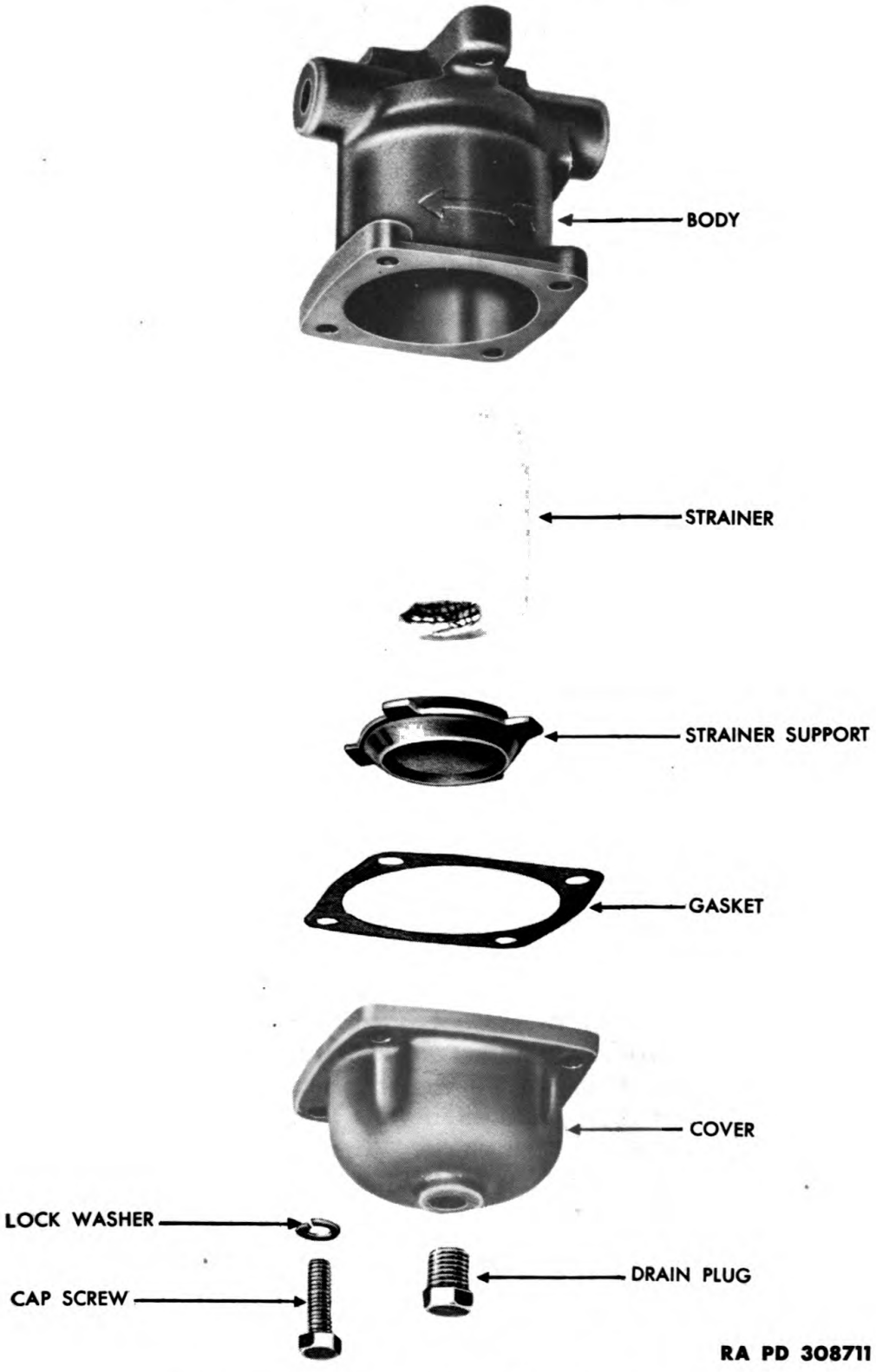


***Figure 154 — Air Filter Disassembled***

**b.** On old style filters, install flange type connections using new gaskets.

## 141. TEST OF REBUILT FILTER.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve until gage No. 1 reads 90 pounds.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4 and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Tests.**

(1) Plug the outlet port of filter and connect hose No. 2 to the inlet port. Open cock No. 2 and coat the outside of the air filter all over with soap suds to check for leakage. No leakage is permissible.

(2) Blow off all traces of soap suds, close cock No. 2, and disconnect hose No. 2 from the filter.

(3) Plug the inlet and outlet ports of the filter to prevent the entrance of dirt during storage or shipment.

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# Section IV
# AIR PRESSURE GAGES



## 142. DESCRIPTION AND OPERATION.

**a.** Two types of air pressure gages are used in connection with air brake systems.

**b.** The most common types are frequently referred to as dash gages because they are usually installed on the dash (instrument panel) to tell the driver the air pressure in the air brake system. The appearance and style of dash gages often vary with the design of the instrument panel used on the vehicle. A common type is illustrated in figure 155.

**c.** While air gages of this type are commercially accurate, they should never be confused with or substituted for test type air gages intended primarily for accurately checking air pressures in an air brake system. Only test gages known to be accurate are used for checking brake valve delivery pressures, governor pressure settings, etc.

**d.** Test gages merely differ from ordinary dash gages in that they

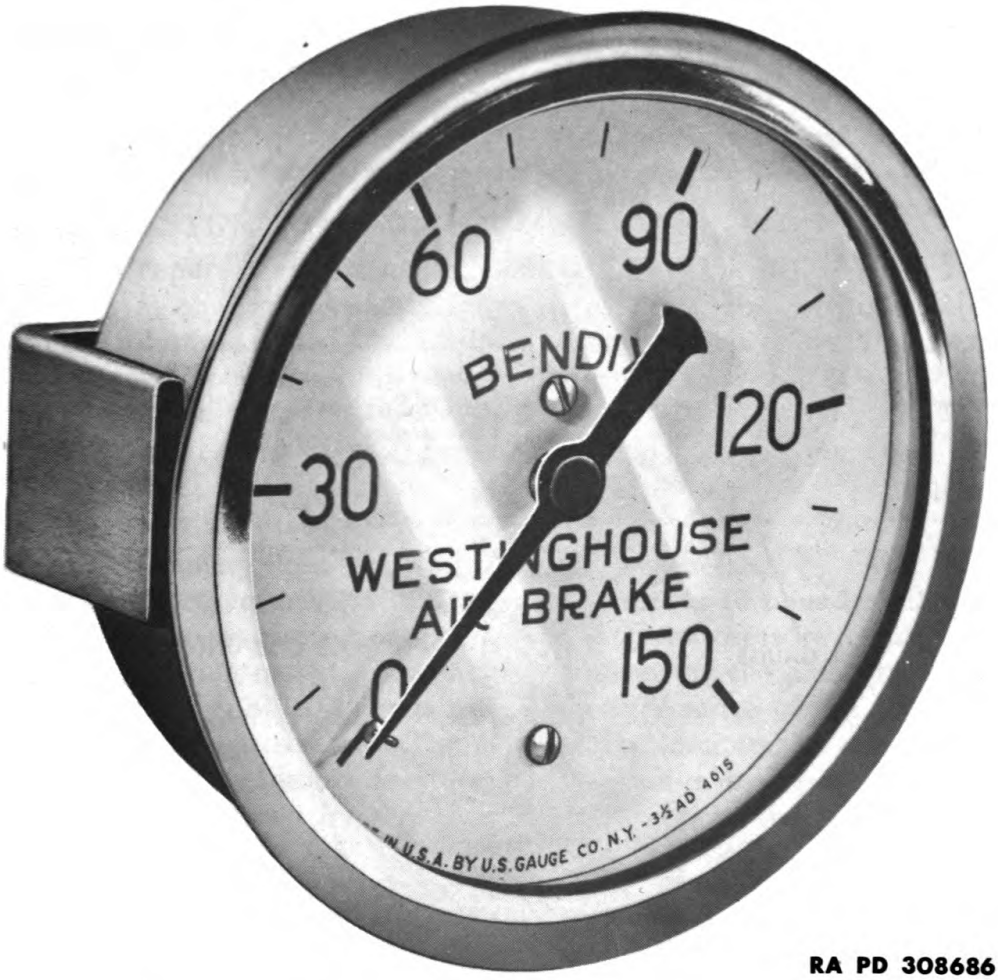


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***Figure 155 — A Dash Gage***

are more accurate over their entire range and maintain their accuracy over longer periods. A typical test gage is illustrated in figure 156.

**e.** Extreme care must be used when attaching air connections to air gages because if they are strained during this operation, their rather delicate mechanism will be disturbed and their accuracy impaired.

## 143. INSPECTION.

**a.** Periodically it is advisable to check the accuracy of any air gage. The simplest way to do this is to compare the pressure registered by the gage over its normal pressure range with the pressure registered by another gage known to be accurate.

**b.** Dash gages may lose their accuracy after long periods of service and may require replacing. The continued use of dash gages showing an error of more than five pounds high or low is not recommended.

**c.** The mechanism of most air pressure gages is contained in a

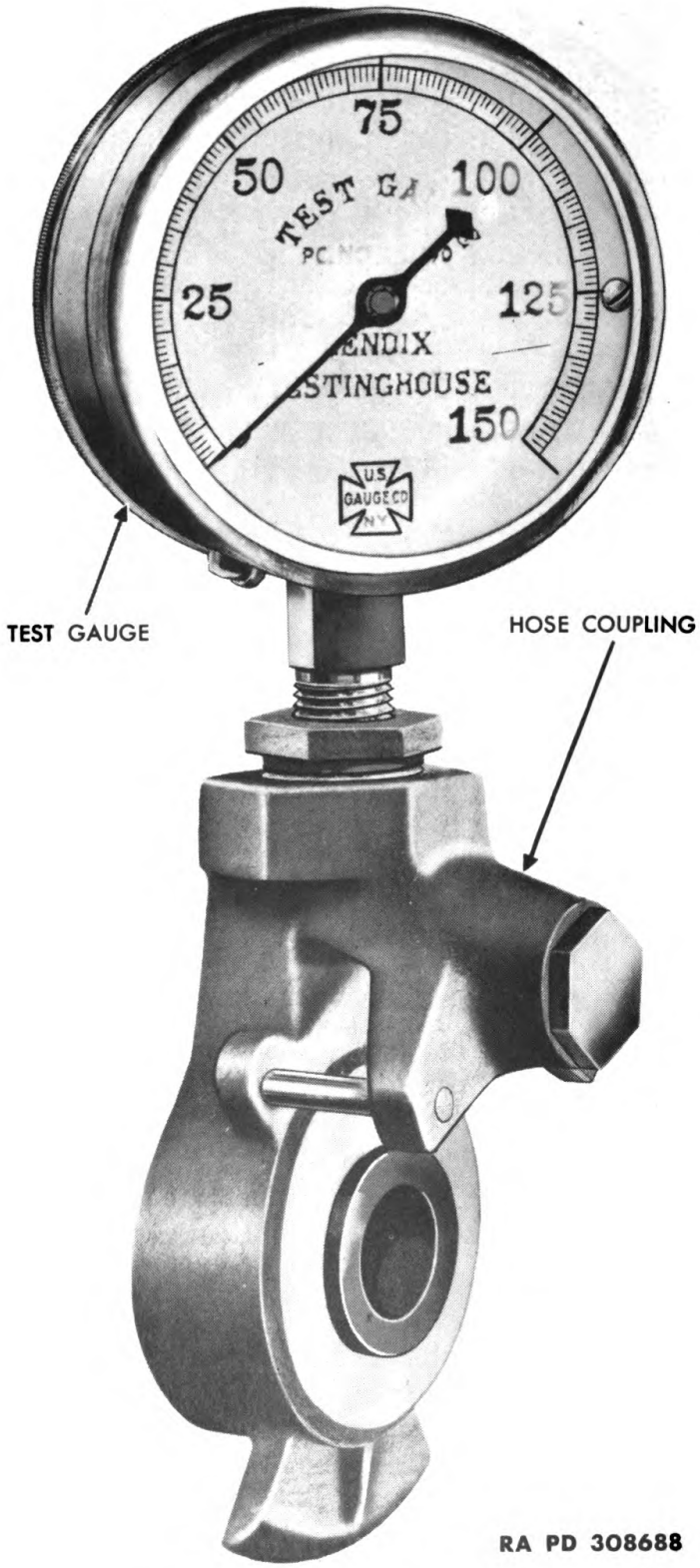


***Figure 156 — A Test Gage***

sealed case to protect it which makes adjustment impossible; therefore, when they lose their accuracy beyond the permissible limit, they must be replaced. Test gages can usually be recalibrated but this work must not be attempted by anyone who is not qualified or who does not have the necessary special equipment.

## 144. TESTING AIR GAGES.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary until gage No. 1 reads 150 pounds.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2 No. 4 and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Tests.**

(1) Connect hose No. 2 to the gage being tested.

(2) Open cock No. 3 until gage No. 2 reads 10 pounds. Compare the pressure registered on gage No. 2 with the pressure registered on the gage being tested. Repeat this test, raising the pressure on gage No. 2 in steps of 10 pounds until the entire range of the gage being tested has been covered. Then close cock No. 3 and by opening cock No. 4, reduce pressure in steps of ten pounds, again comparing the pressure registered by the gage being tested, to the pressure registered by gage No. 2 at each station. Close cock No. 4. Dash gages must be accurate within five pounds of their entire range. Test gages must be accurate within 1 pound of their entire range.

(3) Disconnect hose No. 2 and pack all gages in cartons to prevent damage from handling and against the entrance of dirt.

# CHAPTER 13
# AUXILIARY AIR DEVICES

## Section I
## AIR SUPPLY VALVE



### 145. DESCRIPTION AND OPERATION.

**a.** The air supply valve (fig. 157) is installed in the line between the compressor governor and the reservoir. The compressor governor is therefore not connected in the brake system when the handle of the air supply valve is turned to its air supply position. This means the compressor operates continuously under these conditions and pressures as high as the setting of the safety valve (150 lb) may be obtained.

**b.** The handle of the air supply valve under normal conditions must be turned so as to be parallel with the body of the valve. With the handle in this position, air supplied to the governor is normal and the air supply valve does not interfere with the operation of the governor. When the handle of the air supply valve is turned to its air supply position, that is, at right angles to the body of the valve, air pressure from the reservoir will flow out the side connection. At the same time, any air pressure in the governor is permitted to exhaust through the small vent hole in the key of the air supply valve. When the handle of the air supply valve is turned to its air supply position, the governor cannot operate and air pressures as high as the setting of the safety valve can be obtained through the air supply connection.

**c.** Turn the valve handle by hand. Never strike it with a hammer or any other tool, otherwise the body of the valve may be distorted and leakage will result.

### 146. DISASSEMBLY (fig. 158).

**a.** Remove cotter pin from end of key. Lift off small washer, spring and large washer, and remove key. Remove cap from air supply fitting at side connection of valve.

### 147. CLEANING, INSPECTION OF PARTS, AND REPAIRS.

**a.** Clean all parts using dry-cleaning solvent. Check key and bore

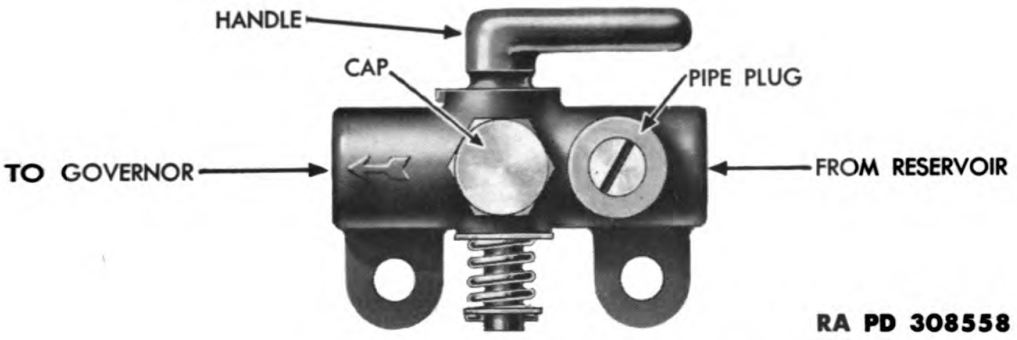


*Figure 157 — Air Supply Valve*

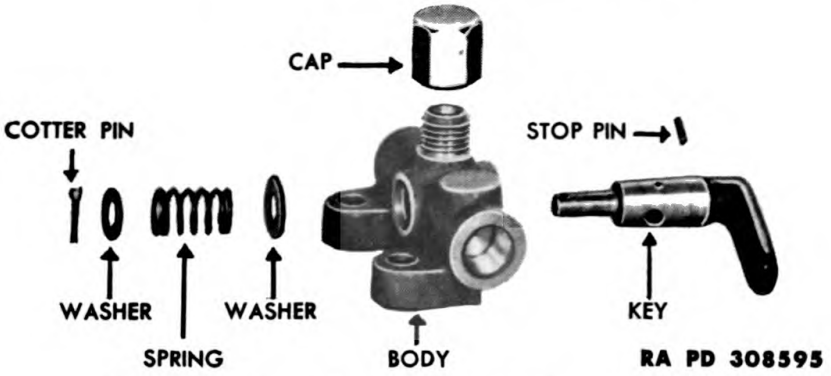


*Figure 158 — Air Supply Valve Disassembled*

of body for grooving or scoring. Be sure small drilled passage through top of key is not blocked.

**b.** If the key and body are only slightly scored, leakage is corrected by carefully grinding the key to the body using (BWE grade 400) grinding compound or its equivalent. If the key and body are badly scored, the complete assembly must be replaced. Do not attempt to grind a new key to an old body or vice versa.

## 148. ASSEMBLY.

**a.** Put a thin coating of cup grease on the key and in the bore of the body. Position key in body and install large washer, spring and small washer. Install cotter pin in key.

## 149. TEST OF REBUILT AIR SUPPLY VALVE.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90 pounds pressure.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4 and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Connect Valve to Test Rack.**

(1) Connect hose line No. 2 to reservoir port of valve.

(2) Connect hose line No. 4 to governor port of valve.

**c. Tests.**

(1) Turn handle back and forth several times and then with handle in normal position (fig. 157), open cock No. 2 and observe that red hand of gage No. 3 quickly rises to 90 pounds. (Gage No. 2 will also rise to 90 pounds.)

(2) Coat valve all over with soap suds to check for leakage. Leakage in excess of a one inch soap bubble in five seconds is not permissible.

(3) Remove cover cap from side outlet of valve. Close cock No. 2 and turn valve handle to air supply position. Note that gage No. 2 drops to zero immediately and that the red hand of gage No. 3 also drops to zero.

**d. Disconnect Valve from Test Rack.**

(1) If valve passes all tests, blow off all traces of soap suds and disconnect hose lines.

(2) Replace cover cap and plug other ports with pipe plugs to prevent dirt entering the valve during shipment or storage.

## Section II

# LOW PRESSURE INDICATOR



## 150. DESCRIPTION AND OPERATION.

**a.** The low pressure indicator (fig. 159) is a safety device designed to give an automatic warning when the air pressure in the air brake system is below, approximately, 60 pounds. Operating as an air controlled switch of an electrical circuit, the low pressure indicator automatically lights a warning light or sounds a buzzer when the air pressure drops below approximately 60 pounds and automatically opens the electrical circuit to the light or buzzer when the air pressure rises above this point.

**b.** As long as the reservoir pressure on one side of the diaphragm is above approximately 60 pounds, the electrical contacts remain open because the air pressure overcomes the force of the spring on the other side of the diaphragm keeping the contact closed (fig. 160).

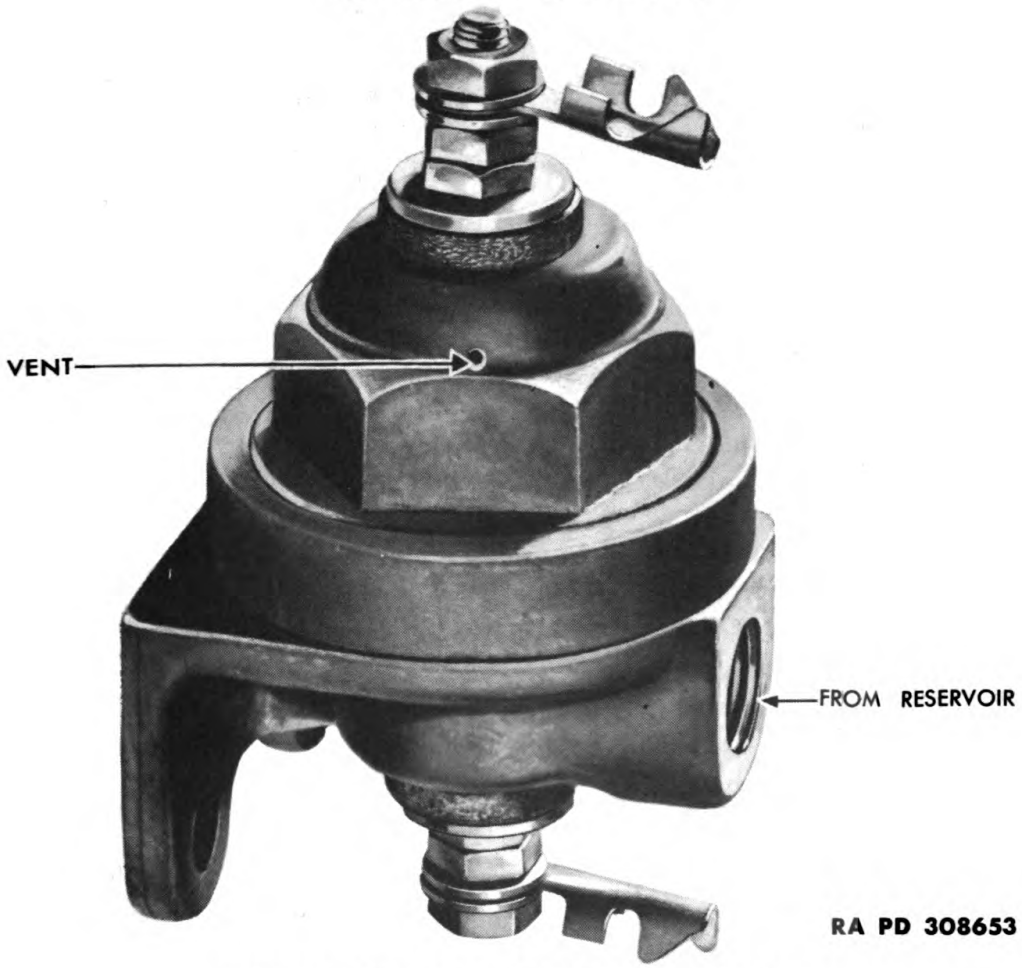


***Figure 159 — Low Pressure Indicator***

**c.** When the reservoir air pressure drops below, approximately, 60 pounds, the spring force on one side of the diaphragm overcomes the air pressure on the other side and the contacts close.

**d.** The normal pressure setting of 60 pounds is subject to a tolerance of plus or minus 6 pounds so that the actual operating point of the low pressure indicator may vary between 66-pounds maximum and 54-pounds minimum.

## 151. DISASSEMBLY (fig. 161).

**a.** Unscrew top cover from body. Lift off top cover. Remove spring, diaphragm washer, and diaphragm assembly from body. Disassemble diaphragm assembly by removing diaphragm screw nut from diaphragm screw and lift off washers and diaphragm. Remove terminal screw nuts from the terminal screw in the cover. Lift off flat brass washer and flat fiber washer, and remove terminal screw with special fiber bushing and special flat washer. Remove terminal screw from body by removing the nuts from the terminal screw, lift-

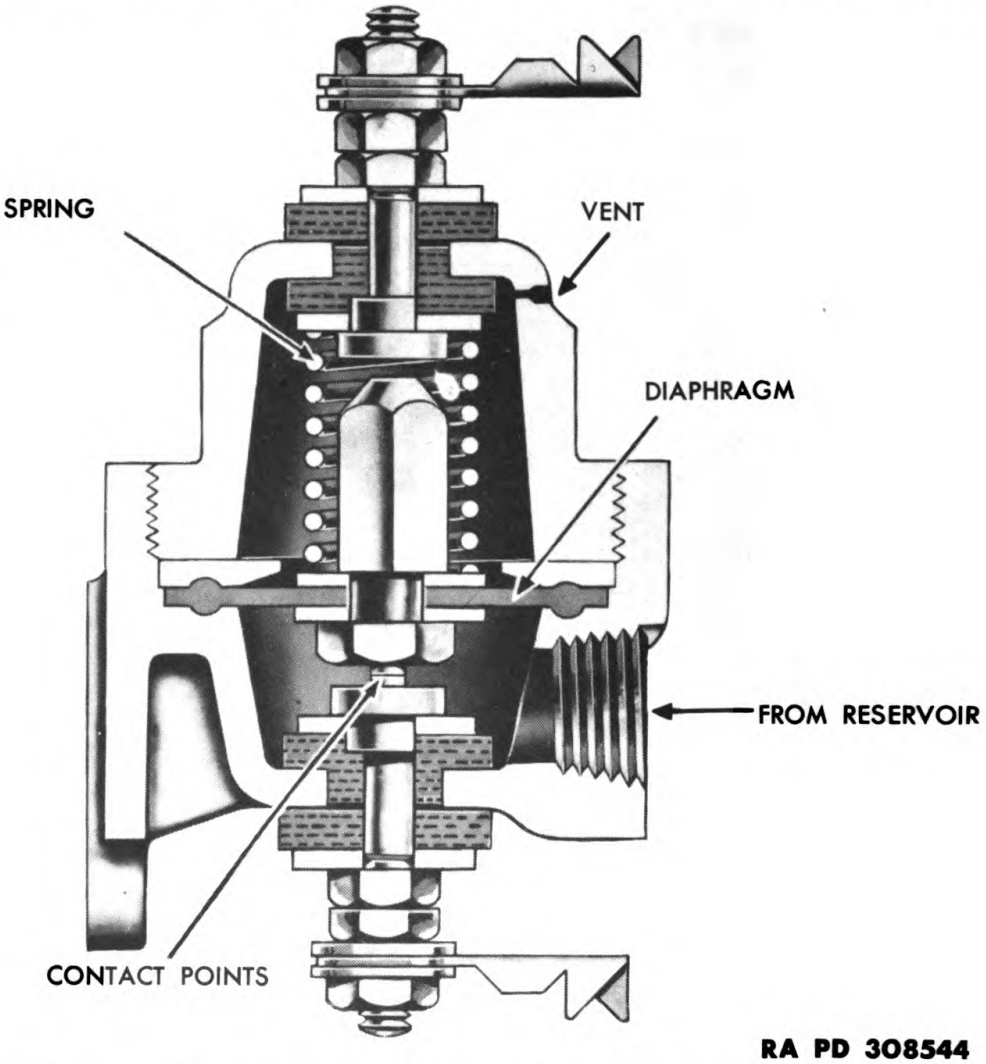


***Figure 160 — Sectional View of Low Pressure Indicator***

ing off flat brass washer and flat fiber washer, also rubber seal washer. Remove terminal screw with special fiber bushing and special flat washer.

## 152. CLEANING, INSPECTION OF PARTS, AND REPAIRS.

**a.** Clean all metal parts in dry-cleaning solvent. Inspect the diaphragm for signs of wear or cracking and replace with new one if necessary. Inspect contact points on lower contact screw and diaphragm screw for pitting and corrosion.

**b.** If contact points are only slightly pitted or corroded, they can be reclaimed by carefully filing them with a fine distributor point file. If points are badly corroded or pitted, both the contact screw and the diaphragm screw complete with new contact points must be replaced.

## AUXILIARY AIR DEVICES

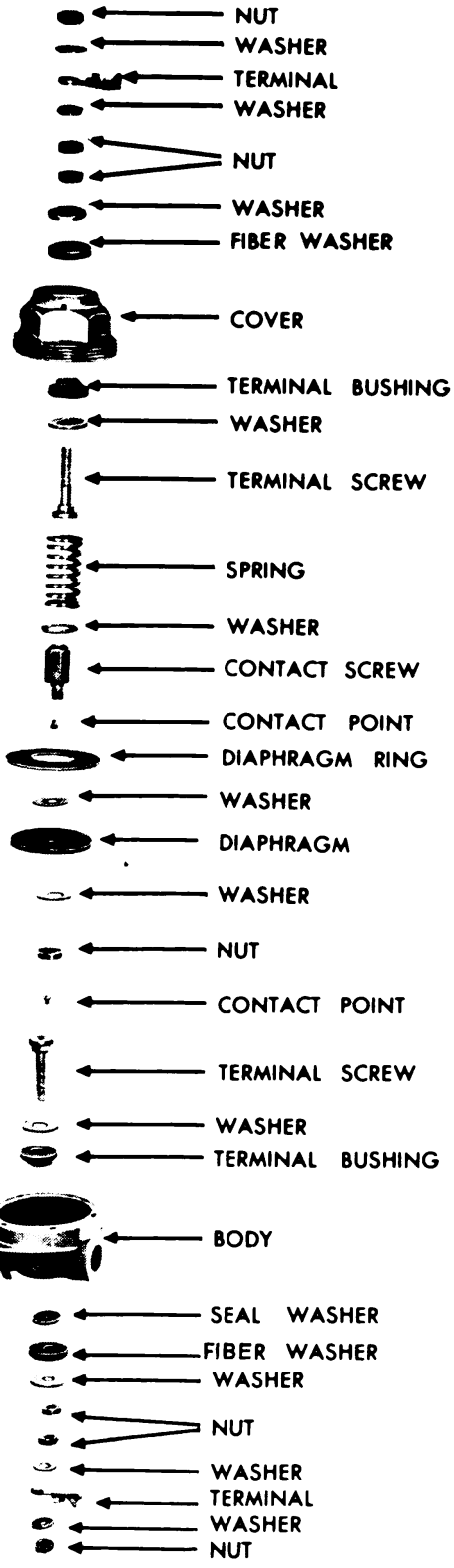


***Figure 161 — Low Pressure Indicator Disassembled***

## 153. ASSEMBLY.

**a. Install Terminal Screw in Body.** Select lower contact screw having contact points. Install special flat metal washer with D-shaped hole on contact screw. Then install special fiber bushing on contact screw with D-shaped hole positioned to fit over the D-shaped shoulder under the head of the screw. Place contact screw with washer in place in the body, positioning the square shoulder of the fiber bushing to fit in the square hole in the body. Install a new soft rubber air seal washer. Then install flat fiber washer and flat plate metal washer. Hold the head of the contact screw in place in the body with the fingers and install terminal nut and tighten securely. Next install a second terminal nut and tighten to act as a lock nut.

**b. Install Terminal Screw in Cover.** Select terminal screw without contact point and position special flat washer and fiber bushings in place so that the D-shaped hole in washer and bushing fit over the D-shaped shoulder on the terminal screw. Place screw with washer and bushing in cover positioning the square shoulder of the fiber bushing so it fits the square hole in the cover. Holding the head of the contact screw with the fingers, install flat fiber washer and flat metal washer. Install and tighten terminal screw nut, then install and tighten second terminal screw nut to act as a lock nut.

**c. Assemble Diaphragm.** Place diaphragm beveled plate washer on diaphragm screw so that the flat side of the washer is against the shoulder of the screw. Place diaphragm on screw and then install other diaphragm beveled plate washer so the beveled side is next to the diaphragm. Install diaphragm screw nut but only tighten nut sufficiently to make an air tight seal between the washers and the diaphragm. If the diaphragm screw nut is tightened too tightly, the diaphragm will be distorted. Prick punch the threads of the nut and screw to lock the nut in place.

**d. Install Diaphragm Assembly.** Place diaphragm assembly in position in body so the contact point in the diaphragm screw is in line with the contact point on the lower terminal screw. Press the edges of the diaphragm down with the fingers so the ridge on the bottom of the diaphragm engages the groove in the body. This will help prevent the diaphragm-assembly from getting out of position when the cover is being installed. Install diaphragm-washer so that the beveled and grooved side is next to the diaphragm. Press the diaphragm washer down on the diaphragm with the fingers to be sure the groove in the lower side of the diaphragm washer engages the ridge on the top of the diaphragm. Place spring in position over the hexagon portion of the diaphragm-screw. Place cover in position and compressing the spring with the hands, screw cover in place and tighten securely. After tightening cover, check to be sure the contact points contact each other properly by making a visual inspection through the air connection port.

## 154. TEST OF REBUILT LOW PRESSURE INDICATOR.

**a. Prepare Test Rack for Test.**

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 90 pounds.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4 and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Tests.**

(1) Connect hose No. 2 to the low pressure indicator. Connect wires between the rack terminals and the terminals on the low pressure indicator. Indicator light on test rack should light when wires are connected.

(2) Open cock No. 3, causing the pressure registered by gage No. 2 to rise. Indicator light on test rack should remain lit until pressure registered by gage No. 2 reaches a point between 54 pounds and 66 pounds, at which point the light should go out.

(3) When light goes out, close cock No. 3 and open cock No. 4 causing the pressure registered by gage No. 2 to drop. Light should light when the pressure drops to a point between 66 pounds and 54 pounds. Close cock No. 4.

(4) The pressure at which the contact points open and then light goes out is raised by installing shims beneath the spring. The pressure at which the contacts open is lowered by removing spring from beneath the springs.

(5) Open cock No. 2 and coat the small vent hole in the cover end all over the outside of the low pressure indicator with soap suds to check for leakage. No leakage is permissible. Close cock No. 2.

(6) If the low pressure indicator passes all tests, disconnect wires and hose No. 2. Plug air inlet port to prevent the entrance of dirt during storage or shipment.

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## Section III
# STOP LIGHT SWITCH



## 155. DESCRIPTION AND OPERATION.

**a.** Stop light switches (fig. 162) are electro-pneumatic switches

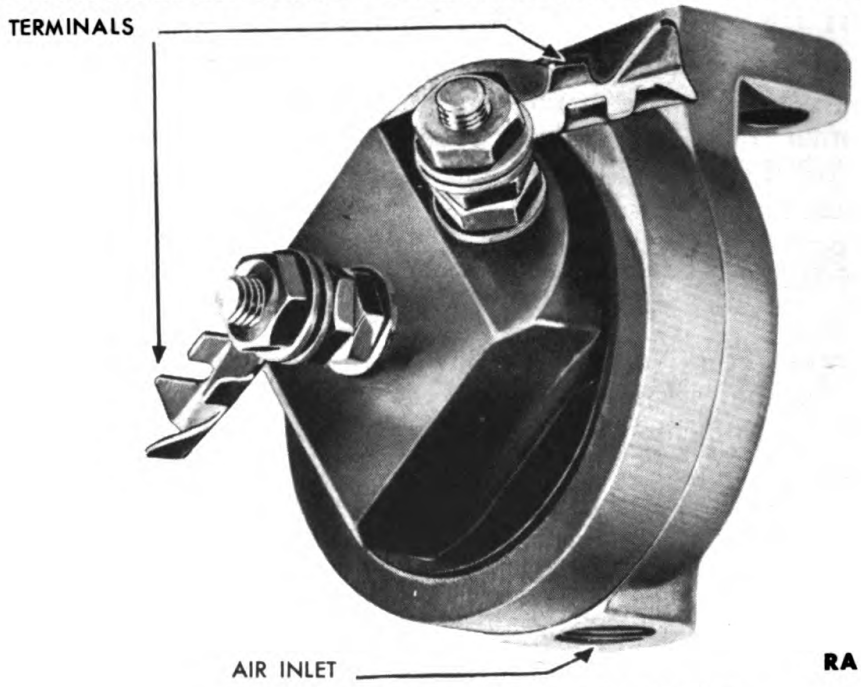


***Figure 162 — Stop Light Switch***

which operate in conjunction with the brake valve to close the stop light electrical circuit when the brakes are applied.

**b.** Inside the switch above the diaphragm, a contact plunger plate fitted with a contact point makes contact with the contact point on one terminal screw when air pressure enters the switch below the diaphragm (fig. 163). The coil spring is in the electrical circuit and connects the contact plunger with one of the electrical terminals.

**c.** Stop light switches are designed to handle a maximum electrical load of six 21 candlepower lamps at 12 volts or three 21 candlepower lamps at 6 volts.

**d.** When air pressure from the brake valve enters the cavity on one side of the diaphragm, the diaphragm changes its position, overcomes the force of the spring and moves the contact plunger until the contacts close. This closes the stop light electrical circuit. The switch is designed to close as soon as five pounds air pressure is delivered to it. This means the stop light circuit closes immediately a brake application is made.

**e.** When air pressure acting on the diaphragm is exhausted by the brake valve, the spring forces the diaphragm and the contact plunger back to their normal position and the stop light circuit is opened.

## 156. DISASSEMBLY (fig. 164).

**a.** Remove cover from body and lift out spring, contact plunger diaphragm ring, and diaphragm. Remove terminal screws and terminal connector strip.

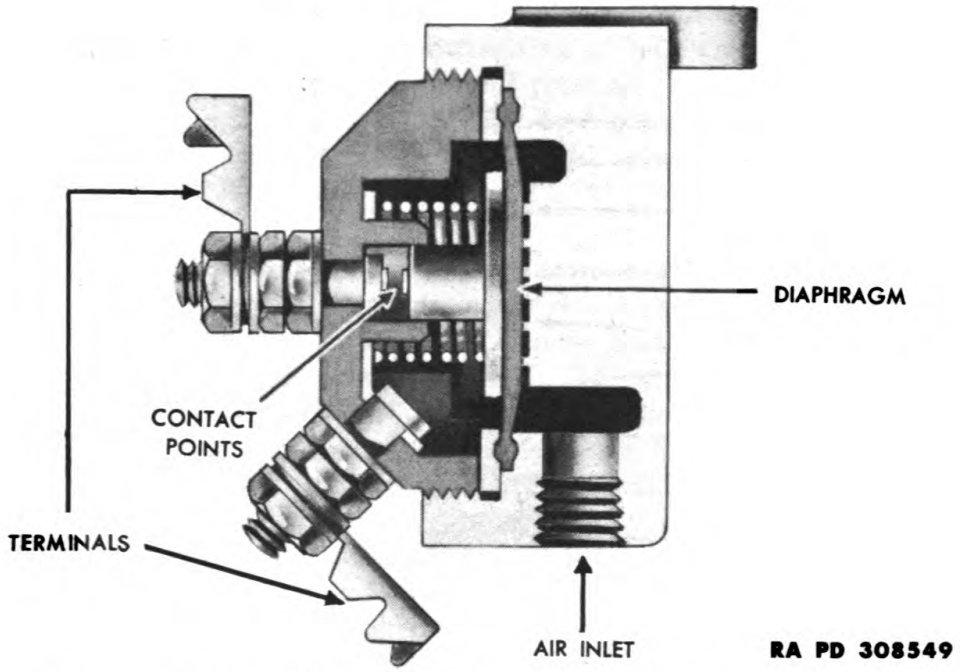


***Figure 163 — Sectional View of Stop Light Switch***

## 157. CLEANING, INSPECTION OF PARTS, AND REPAIRS.

**a.** Clean all parts except the diaphragm, using dry-cleaning solvent.

**b.** Inspect diaphragm for cracks or other damage. Replace if damaged in any way.

**c.** Inspect condition of contact points on terminal screw and follower plate. If contact points are only slightly burned or pitted, recondition by carefully filing them with a fine file. If contact points are badly burned or pitted, a new terminal screw and contact plunger, having new contact points, must be installed.

**d.** Examine spring for evidence of heating and loss of tension. Loss of tension or evidence of heating indicates the stop light switch has been subjected to an electrical overload. This is usually caused by a short in the stop light switch circuit. Replace spring if damaged in any way.

## 158. ASSEMBLY.

**a.** Select terminal screw having contact point and install it in center hole in cover. Position terminal connector strip in cover and install terminal screw not having contact point in angular face of cover.

**b.** Position diaphragm and diaphragm ring in body. Position contact plunger and spring on top of diaphragm and install cover.

## 159. TEST OF REBUILT STOP LIGHT SWITCH.

**a. Prepare Test Rack for Test.**

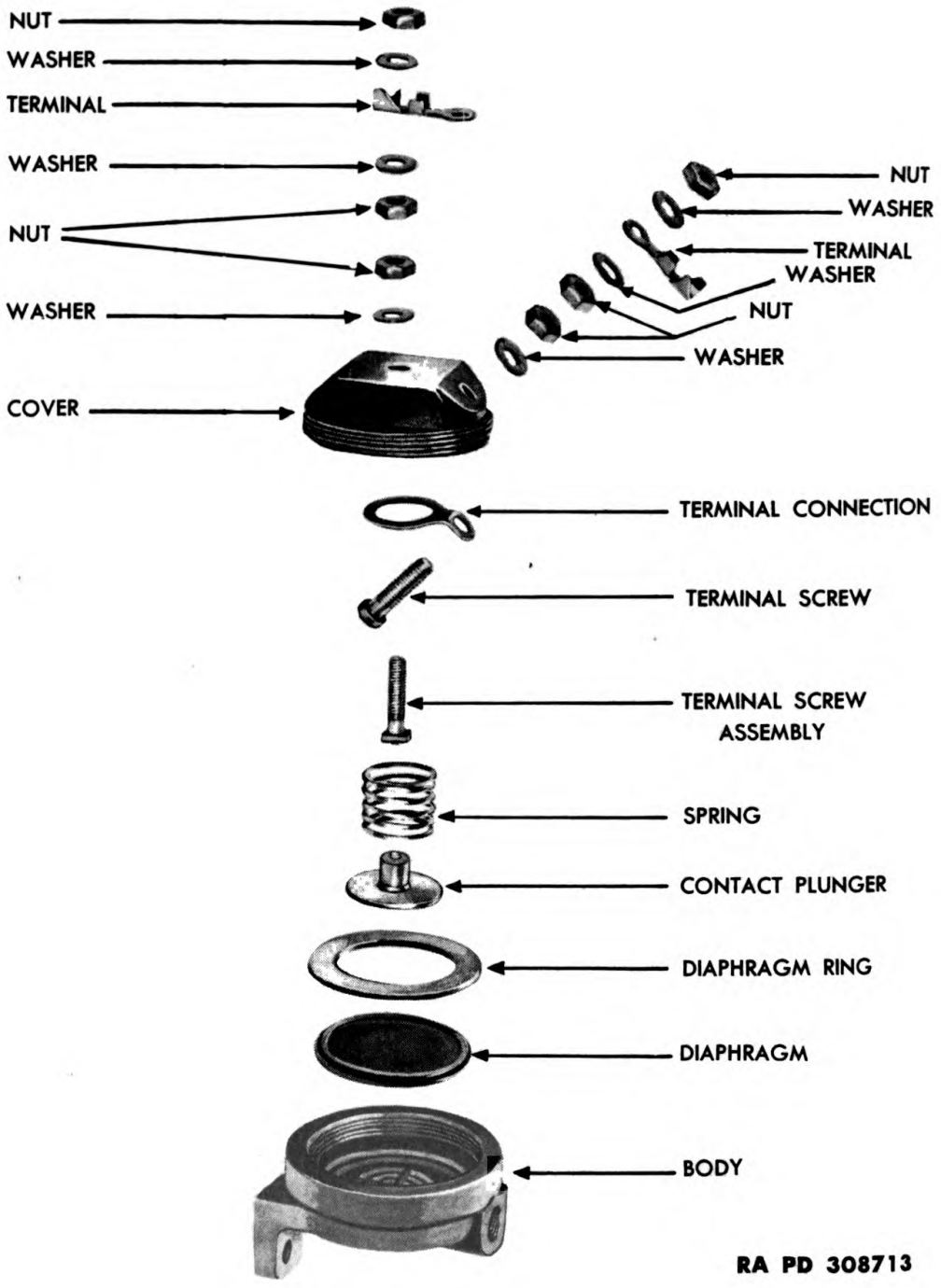


***Figure 164 — Stop Light Switch Disassembled***

(1) With brake valve handle in released position, cock No. 1 open, all other cocks closed, adjust setting of feed valve, if necessary, so that gage No. 1 registers 90-pound pressure.

(2) Open cocks No. 4, No. 5, No. 6, and No. 7, until gages No. 2, No. 4, and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

**b. Tests.**

(1) Connect hose No. 2 and wires from the test rack terminals to the stop light switch. Open cock No. 3, causing the pressure registered by gage No. 2 to rise. Observe that the contacts of the stop light switch close and the indicator light on the test rack lights before the pressure on gage No. 2 rises to six pounds.

(2) When indicator light lights, close cock No. 3 and open cock No. 4. Observe that the indicator light remains lit as long as the pressure, registered by gage No. 2, is above 6 pounds and that the light goes out when the pressure drops to zero. Close cock No. 4.

(3) Open cock No. 2 and coat the outside of the stop light switch to check for leakage. No leakage is permissible.

(4) If the stop light switch passes all tests, disconnect the wires and hose No. 2, and plug the air inlet port to prevent the entrance of dirt during storage or shipment.

## Section IV
# AIR HORN



## 160. DESCRIPTION AND OPERATION.

**a.** When air pressure enters the horn (fig. 165), it enters the cavity in front of each diaphragm. As the air pressure on each diaphragm increases, the diaphragm is deflected and the air escapes through the horn bells. This action sets up a vibration of the diaphragm in each horn bell. The two different lengths of horn bells give the horn a dual tone and because the vibrations are set up in an air column, (which is denser than the atmosphere due to the escaping compressed air), the horn has good tone carrying qualities.

## 161. DISASSEMBLY.

**a.** Remove the two covers from the body and lift out diaphragms. Remove spring contacts, springs, spring seats, set screws, and set screw lock nuts. The horn bells should not be removed from the

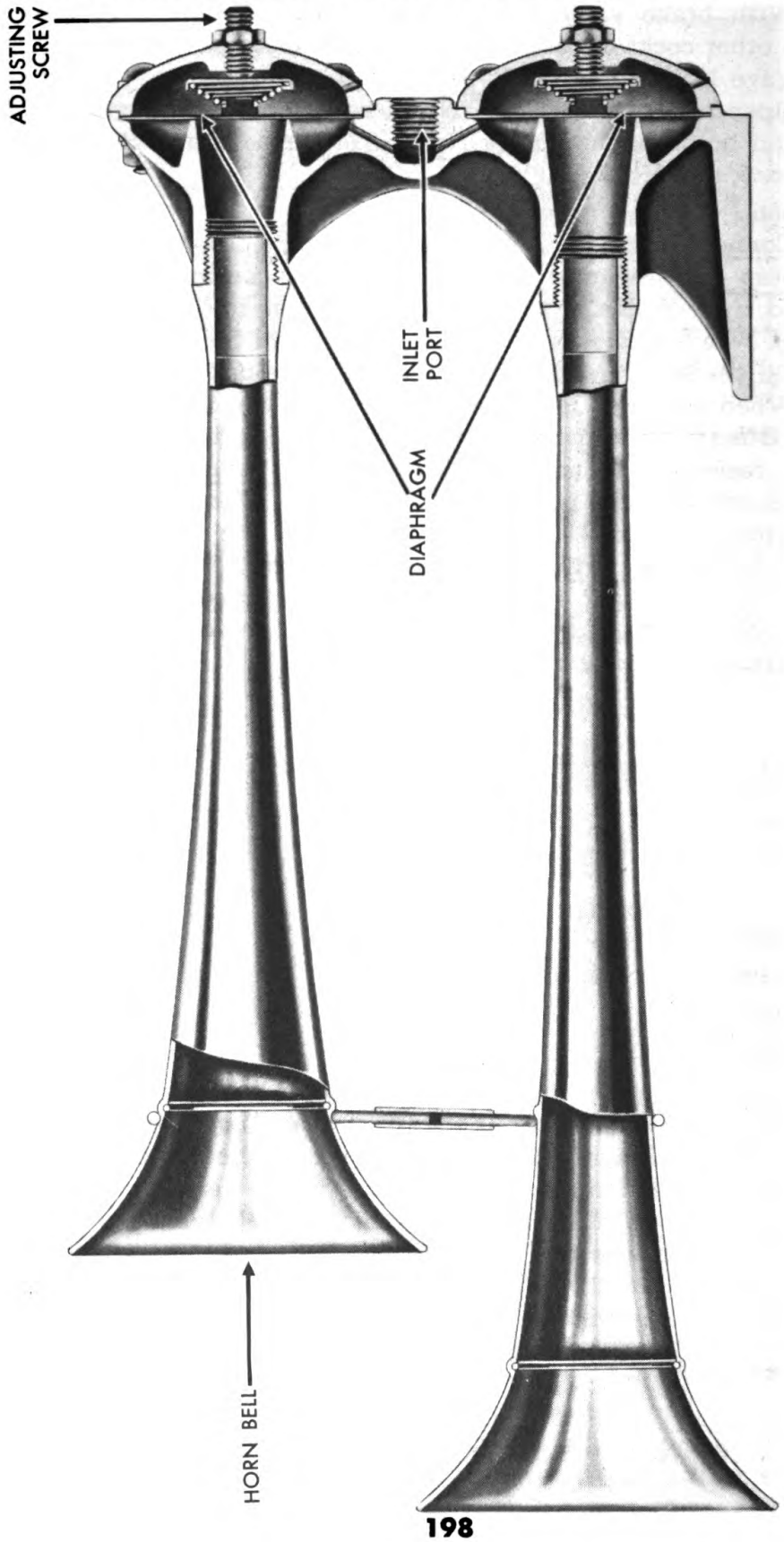


*Figure 165 — Sectional View of Air Horn*

body unless they are to be replaced. If they are to be replaced, apply heat to clamp connector to melt soldered joint and remove clamp connector. The horn bells may then be unscrewed from the body. Remove screens and screen retainer rings from horn bells.

### 162. CLEANING AND INSPECTION OF PARTS.

**a.** Clean all parts, using dry-cleaning solvent. Carefully inspect diaphragms for signs of cracking or other damage. Replace if necessary. Examine condition of diaphragm seats in body. Replace body if seats are damaged.

### 163. ASSEMBLY.

**a.** If horn bells have been removed, install them in body and install connector clamp. Install screens and screen retaining rings in horn bells. Install adjusting screws and lock nuts in covers. Position diaphragms in place in body. Position spring contacts, springs and spring seats in covers and install covers. Tighten all cover screws evenly.

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## Section V
# ALCOHOL EVAPORATOR



### 164. DESCRIPTION AND OPERATION.

**a.** The alcohol evaporator (fig. 166) is used to permit vaporized alcohol to be drawn into the air brake system. Thus guard against the freezing of moisture in the air brake system when the vehicle is operating in freezing temperatures.

### 165. DISASSEMBLY.

**a.** Unscrew mason jar from cover and remove gasket. Remove strainer and filler cap from cover.

### 166. CLEANING AND INSPECTION OF PARTS.

**a.** Wash all parts in dry-cleaning solvent. Be sure passage through tube and cover to the strainer is not blocked. Blow through tube to be sure this passage is clear.

### 167. ASSEMBLY.

**a.** Install strainer in cover and using a new gasket screw cover on jar.

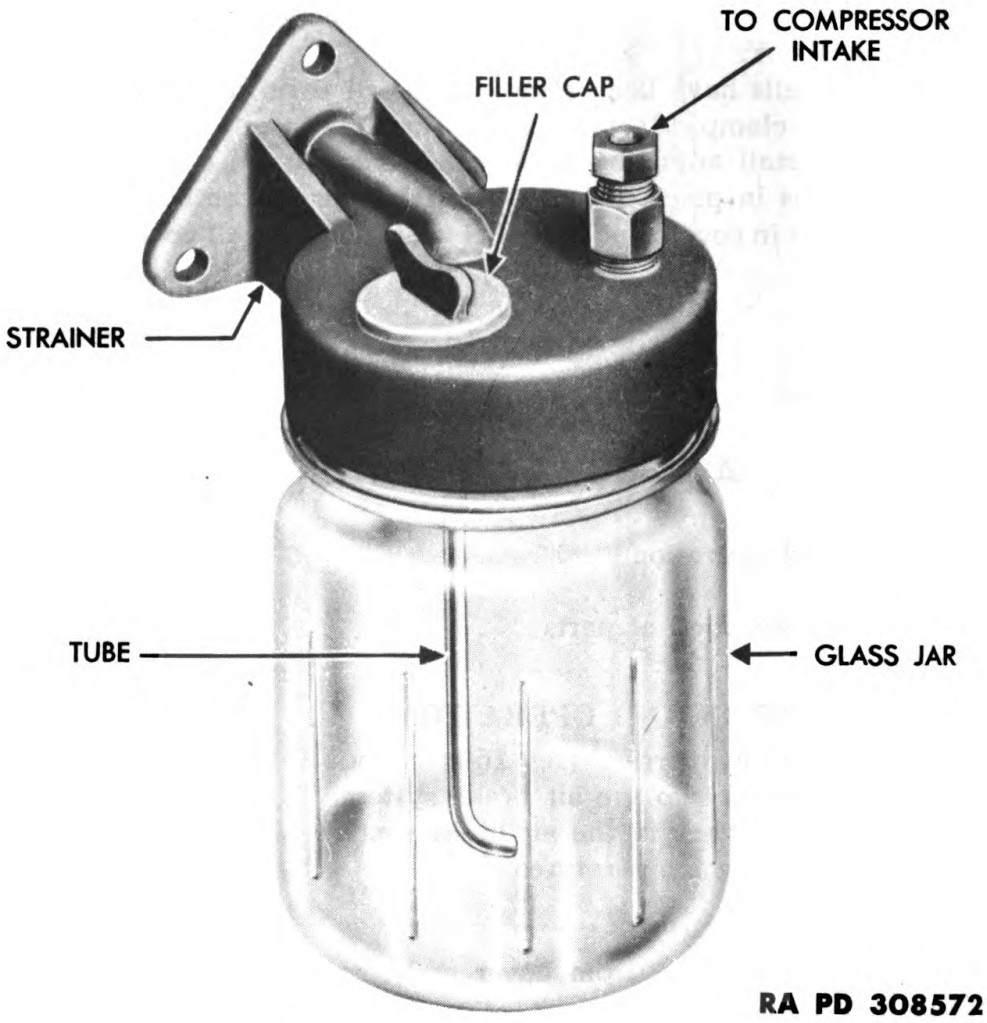



***Figure 166 — Alcohol Evaporator***

## CHAPTER 14

# SPECIAL TOOLS AND TEST EQUIPMENT



**168. SPECIAL TOOLS** (figs. 167, 168, 169, 170, 171).

**a. Maintenance Tool Sets.** The tool sets available to individuals (specialists) and organizations, dependent upon the allocation in the table of equipment are listed in SNL G-27. The components of these tool sets are also illustrated.

**b. Special Tools.**

| NAME | Manufacturers Symbol and Tool Number | Federal Stock Number | LOCATION 3rd Echelon Set for Light Medium and Heavy Maint Companies or Post Shops | LOCATION 4th Echelon Set for Heavy Maint Co and Ordnance Service Comd Shops | LOCATION 5th Echelon Base Shop Set |
|---|---|---|---|---|---|
| Bit VLV grinding application VLV exhaust. | BWE 230202 | 41 B 661 | | 1 | 1 |
| Bit unloading VLV grinding. | BWE 230197 | 41 B 660 | | 1 | 1 |
| Bit VLV grinding application VLV intake. | BWE 230212 | 41 B 662 | | 1 | 1 |
| Disk lap discharge VLV seat. | BWE 230194 | 41 D 1261 | 500 | 1 | 1 |
| GA air 0 to 150 lb | BWE 216390 | 41 G 140 | | 1 | 1 |
| RMR hand exhaust application VLV | BWE 202645 | 41 R 832 | | 1 | 1 |
| RMR hand relay emergency VLV intake | BWE 202643 | 41 R 834 | | 1 | 1 |
| RMR hand emergency VLV exhaust | BWE 221626 | 41 R 2175 | | 1 | 1 |
| RMR hand relay emergency VLV | BWE 203213 | 41 R 830 | | 1 | 1 |

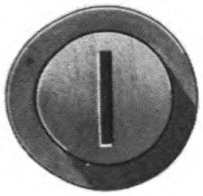
## ORDNANCE MAINTENANCE—POWER BRAKE SYSTEMS (BENDIX-WESTINGHOUSE)

| NAME | Manufacturers Symbol and Tool Number | Federal Stock Number | LOCATION 3rd Echelon Set for Light Medium and Heavy Maint Companies or Post Shops | 4th Echelon Set for Heavy Maint Co and Ordnance Service Comd Shops | 5th Echelon Base Shop Set |
|---|---|---|---|---|---|
| RMR hand relay emergency VLV reseating | BWE 221629 | 41 R 2125 | | 1 | 1 |
| RMR hand unloading VLV reseating. | BWE 213606 | 41 R 2309 | | 1 | 1 |
| RMR INT LV seat relay emergency valve. | BWE 221625 | 41 R 2178 | | 1 | 1 |
| RMR hand unloader VLV seat reseating. | BWE 213778 | 41 R 2309 | 25 | 1 | 1 |
| RMR seating disk type VLV compressor | BWE 221614 | 41 R 1396 | | 1 | 1 |
| Tool lap disk type VLV cyl hd | BWE 221622 | 41 T 3224 | | 1 | 1 |
| Tool VLV grinding. | BWE 202812 | 41 T 3381 | 15 | 1 | 1 |
| Tool VLV grinding lower gov | BWE 221609 | 41 T 3381 | 10 | 1 | 1 |
| Tool VLV grinding upper gov | BWE 211398 | 41 T 3381 | 20 | 1 | 1 |
| Tool VLV seating gov | BWE 211397 | 41 T 3383 | 10 | 1 | 1 |
| Wrench box 3/8 in. open end 1/4 in. gov adj | BWE 202637 | 41 W 867 | 265 | 1 | 1 |

**c. Valve Grinding Compound.** Valve grinding compound (BWE grade 1,000) (fig. 171) or its equivalent must be used when grinding the valves of all air brake units. Valve grinding compound commonly used to grind engine valves cannot be used successfully.

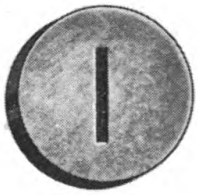
**d. B4B Brake Valve Diaphragm Ring Nut Wrench.** A special wrench not listed in the tool list is needed when removing or installing

## SPECIAL TOOLS AND TEST EQUIPMENT

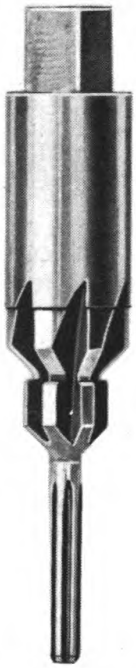


LAPPING
41-T-3224

DRIVER TOOL
41-B-660



LAPPING
DISC
41-D-1261-500



UNLOADING VALVE
SEAT REAMER
41-R-2309

DISCHARGE VALVE
SEAT REAMER
41-R-1396

UNLOADING VALVE
SEAT REAMER
41-R-2309-25

RA PD 308604

***Figure 167 — Special Tools for Repairing Compressor Cylinder Heads***

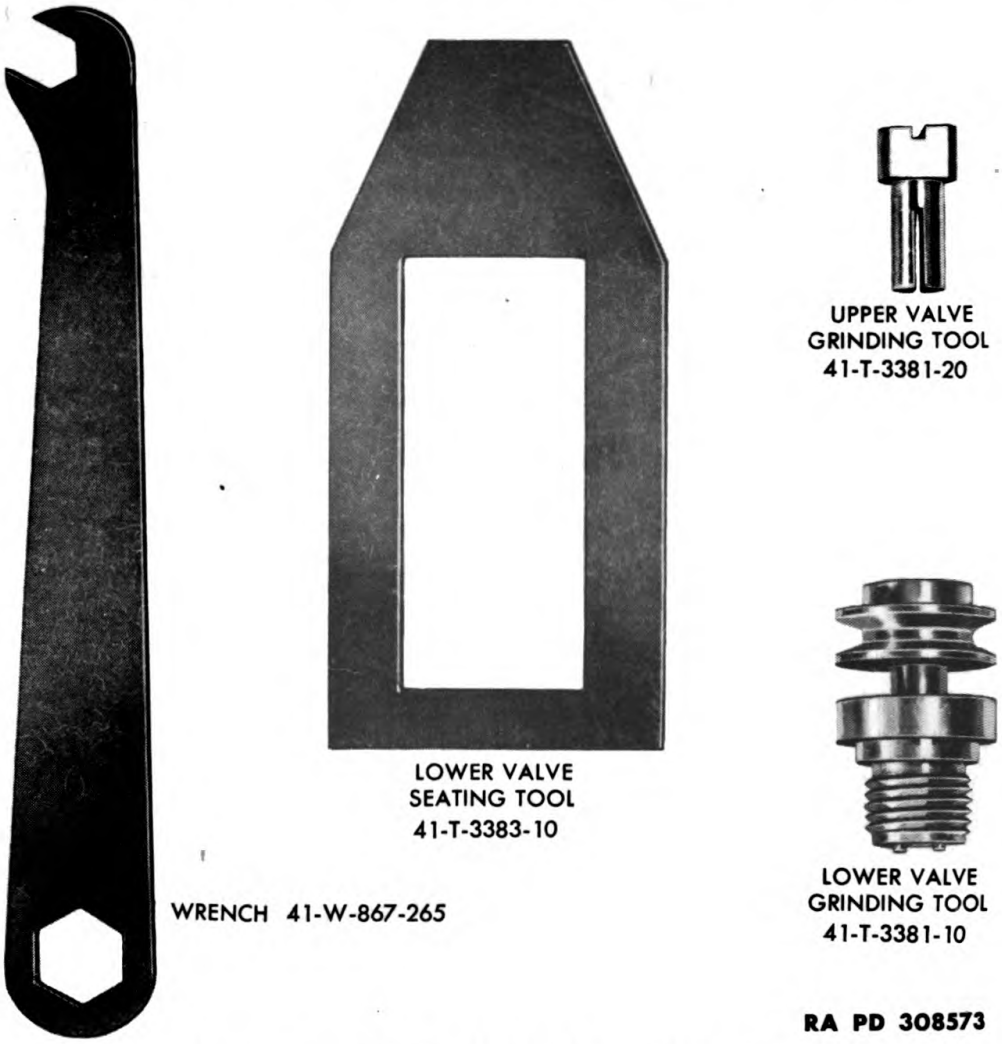



***Figure 168 — Special Tools for Repairing Governors***

the diaphragm ring nut of B4B brake valves (fig. 169). A wrench can be made for this purpose (fig. 172).

## 169. TEST EQUIPMENT.

**a. Compressor Unloading Valve Test Fixtures.** When testing unloading valves of compressors, special test fixtures, not listed in the tool list are required. One fixture (figs. 173 and 174) is used for testing the unloading valves of two-cylinder compressors. Another fixture (fig. 175) is used for testing the unloading valves of three-cylinder compressors.

**b. Test Racks.**

(1) All rebuilt air brake units must be tested before being returned to service, otherwise proper functioning of the unit will not be assured.

SPECIAL TOOLS AND TEST EQUIPMENT

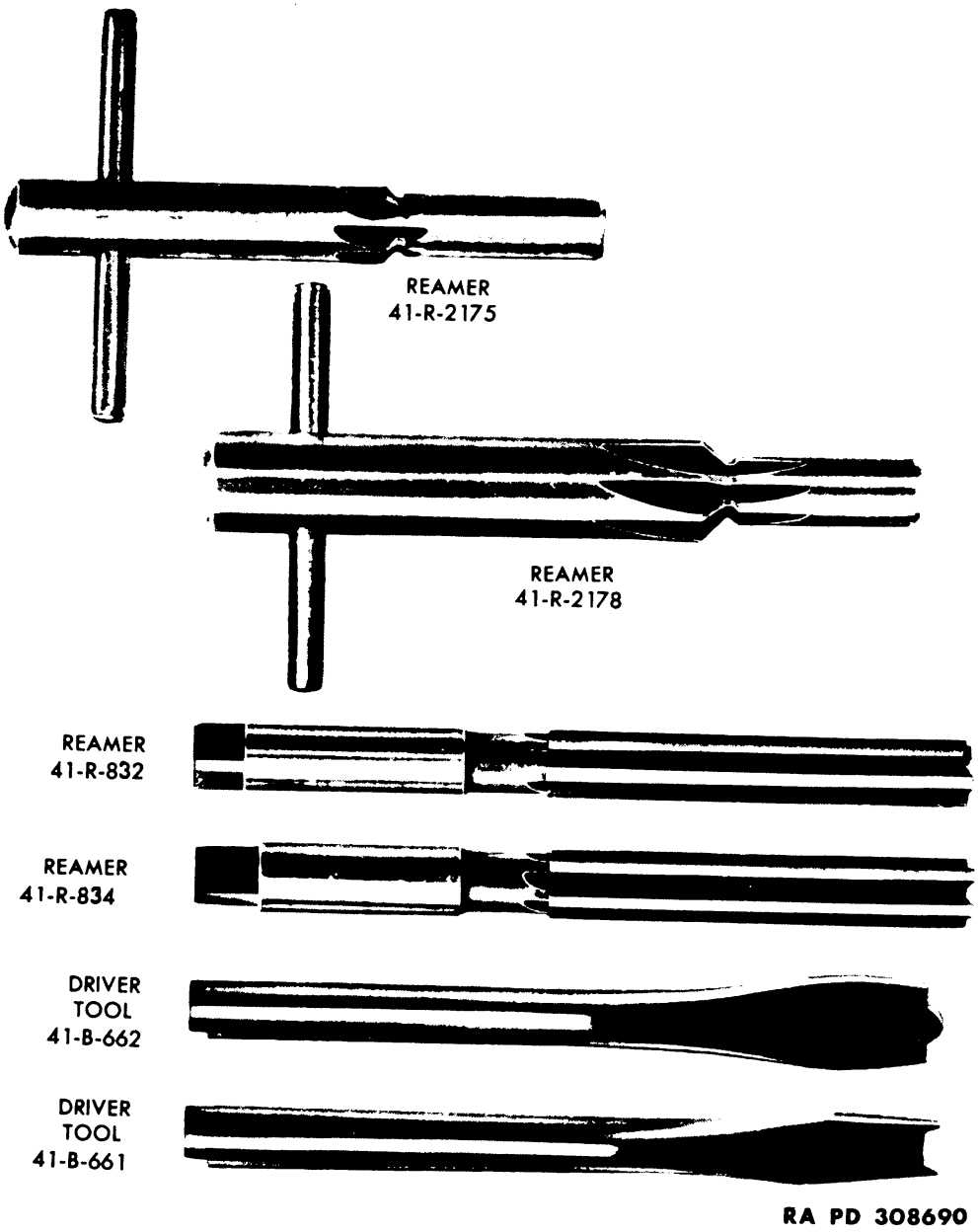



***Figure 169 — Special Tools for Repairing B4B Brake Valves***

(2) A piping-diagram of a suitable test rack is shown in figure 176. Figure 177 illustrates such a test rack of the portable type.

(3) Test codes outlined in this manual are for use with a test rack having a piping arrangement (fig. 176).

**c. Maintenance of Test Racks.** All test racks must be drained and tested for serviceability once each week they are in operation.

**d. Maintenance of Test Rack BWE SA-1561-23.**

(1) WEEKLY MAINTENANCE.

*(a)* With brake valve handle in released position, cock No. 1 open

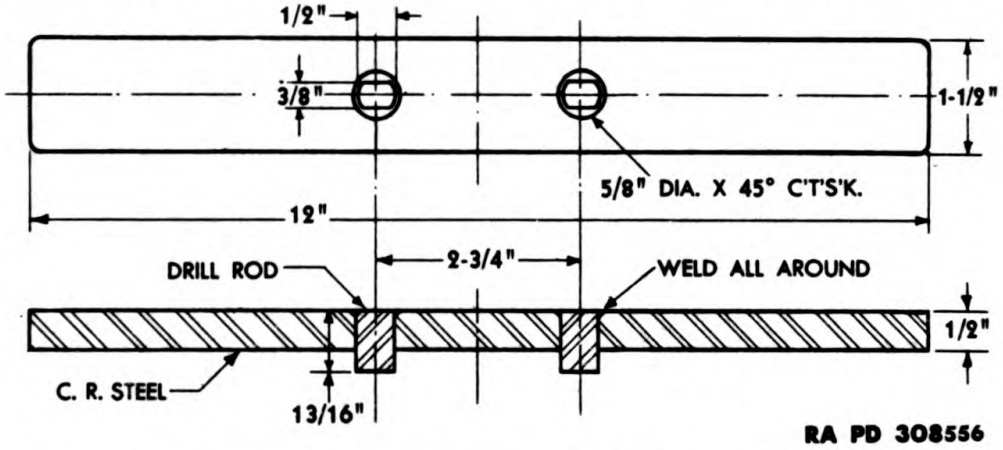



***Figure 172 — Diaphragm Ring Nut Wrench for B4B Brake Valve***

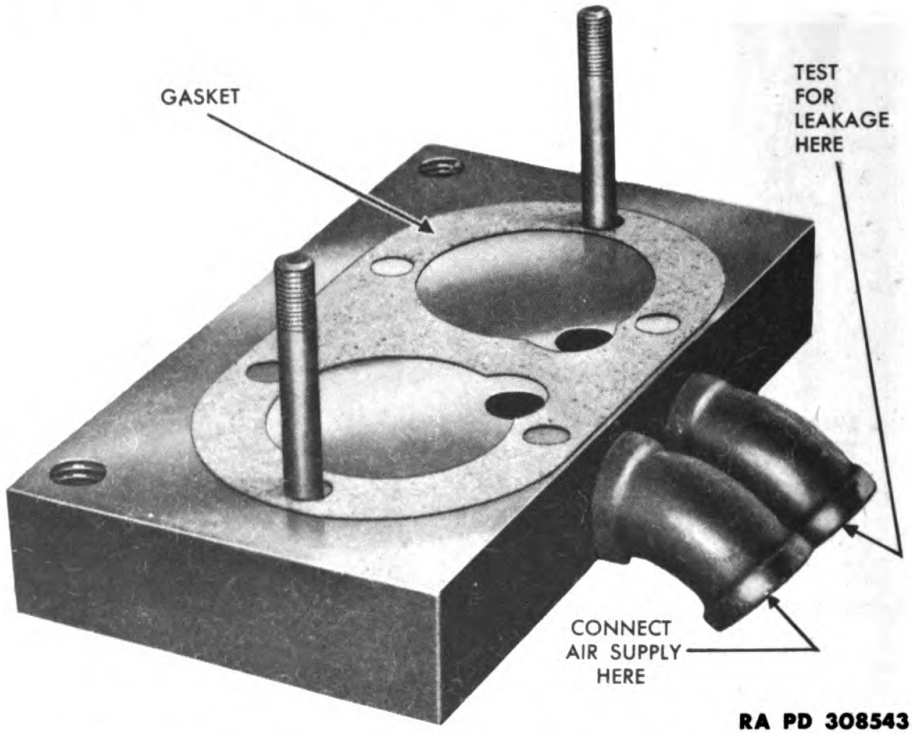



***Figure 173 — Fixture for Testing Unloading Valves of Two-cylinder Compressors***

and all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers at least 50 pounds pressure.

*(b)* Open cocks No. 4, No. 5, No. 6, and No. 7 until gages No. 2, No. 4 and both hands of gage No. 3 read zero. Then close cocks No. 4, No. 6, and No. 7.

*(c)* Connect hoses No. 2, No. 3, and No. 4, together using a pipe tee. Then open cock No. 2.

*(d)* Open and close the five drain cocks installed in the filter and four reservoirs, one at a time, permitting the air pressure to blow out

## SPECIAL TOOLS AND TEST EQUIPMENT

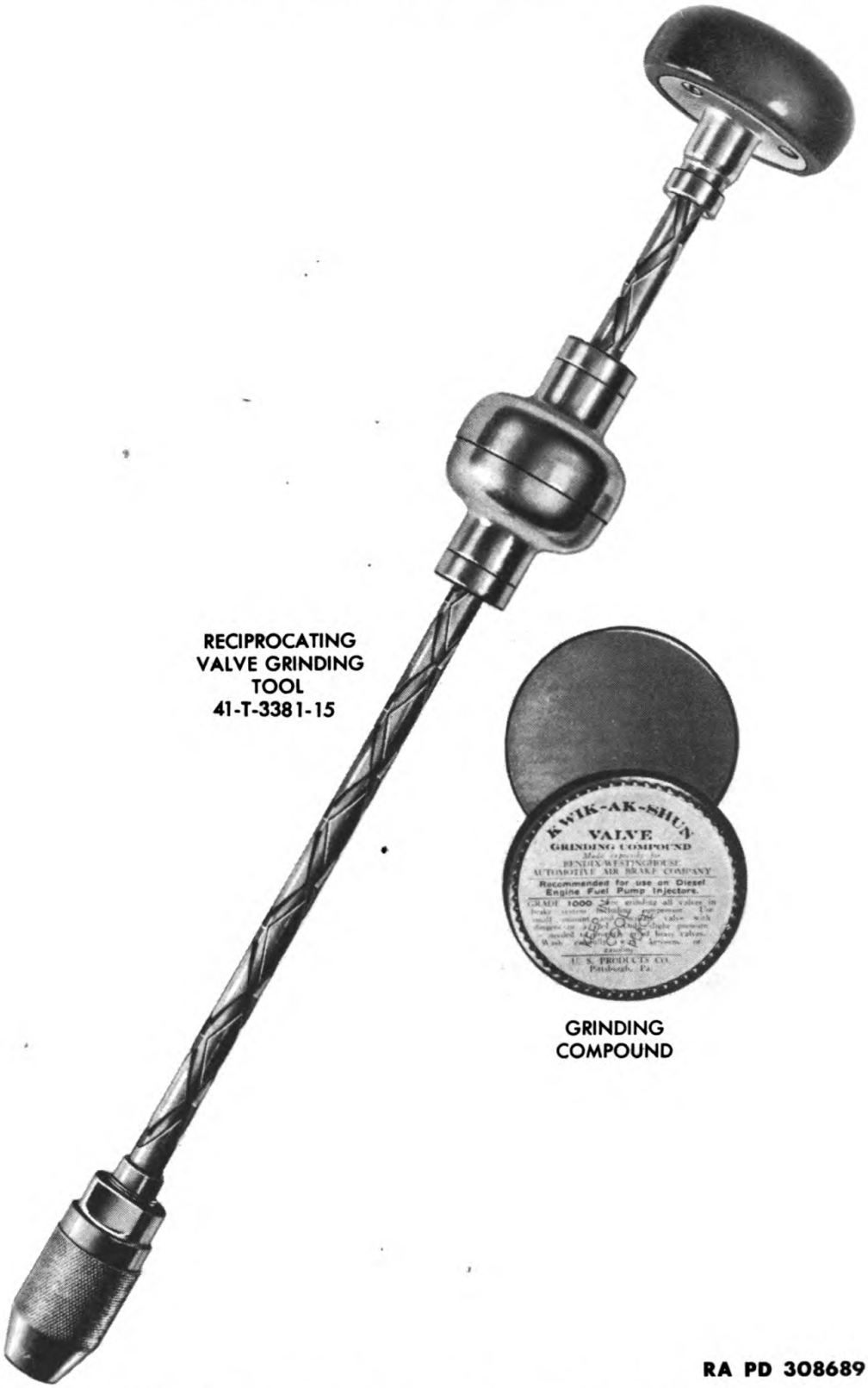



***Figure 171 — Reciprocating Valve Grinding Tool and Special Valve Grinding Compound***

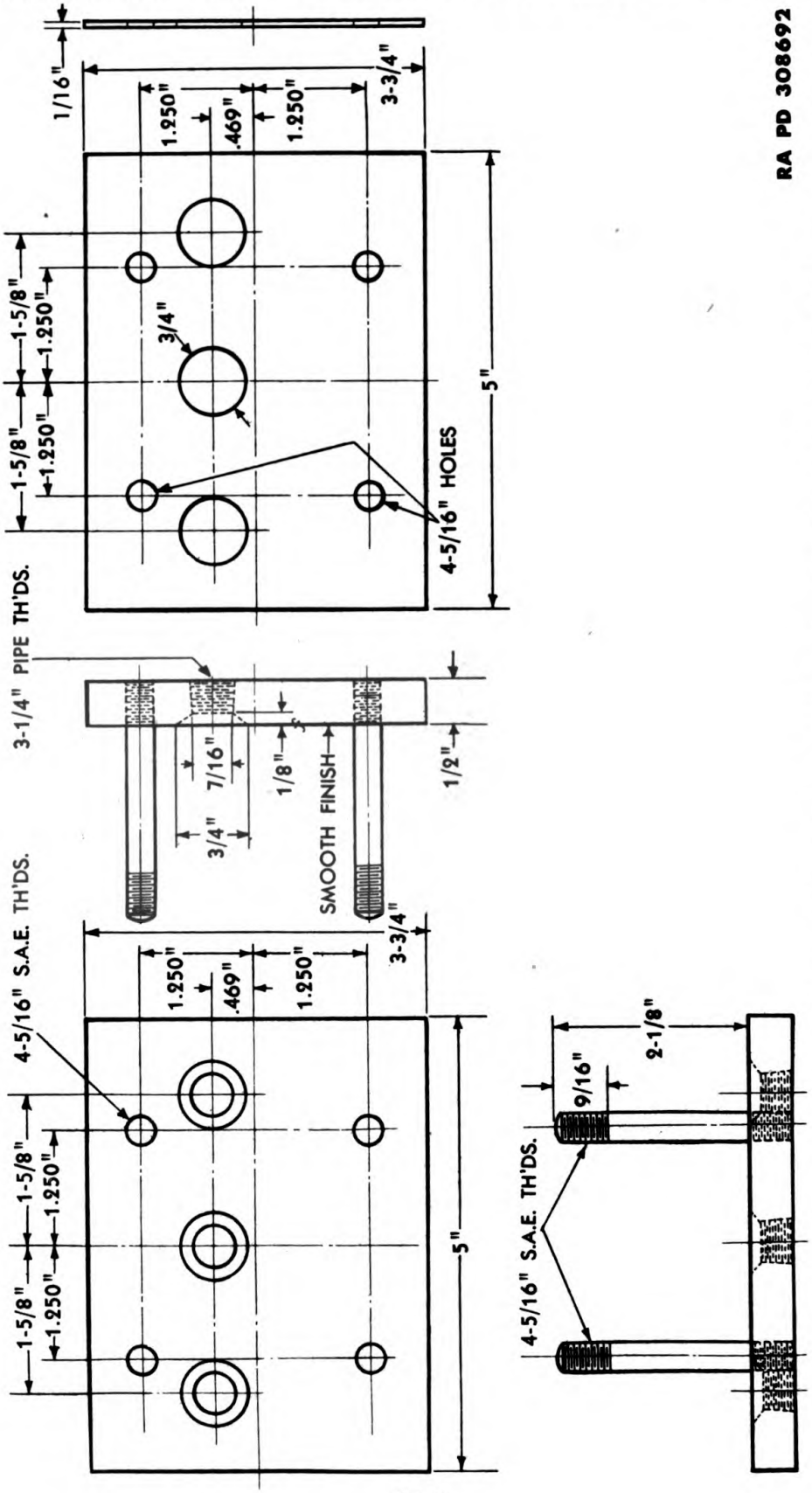



Figure 175 — Line Drawing of Fixture for Testing Unloading Valves of Three-cylinder Compressors

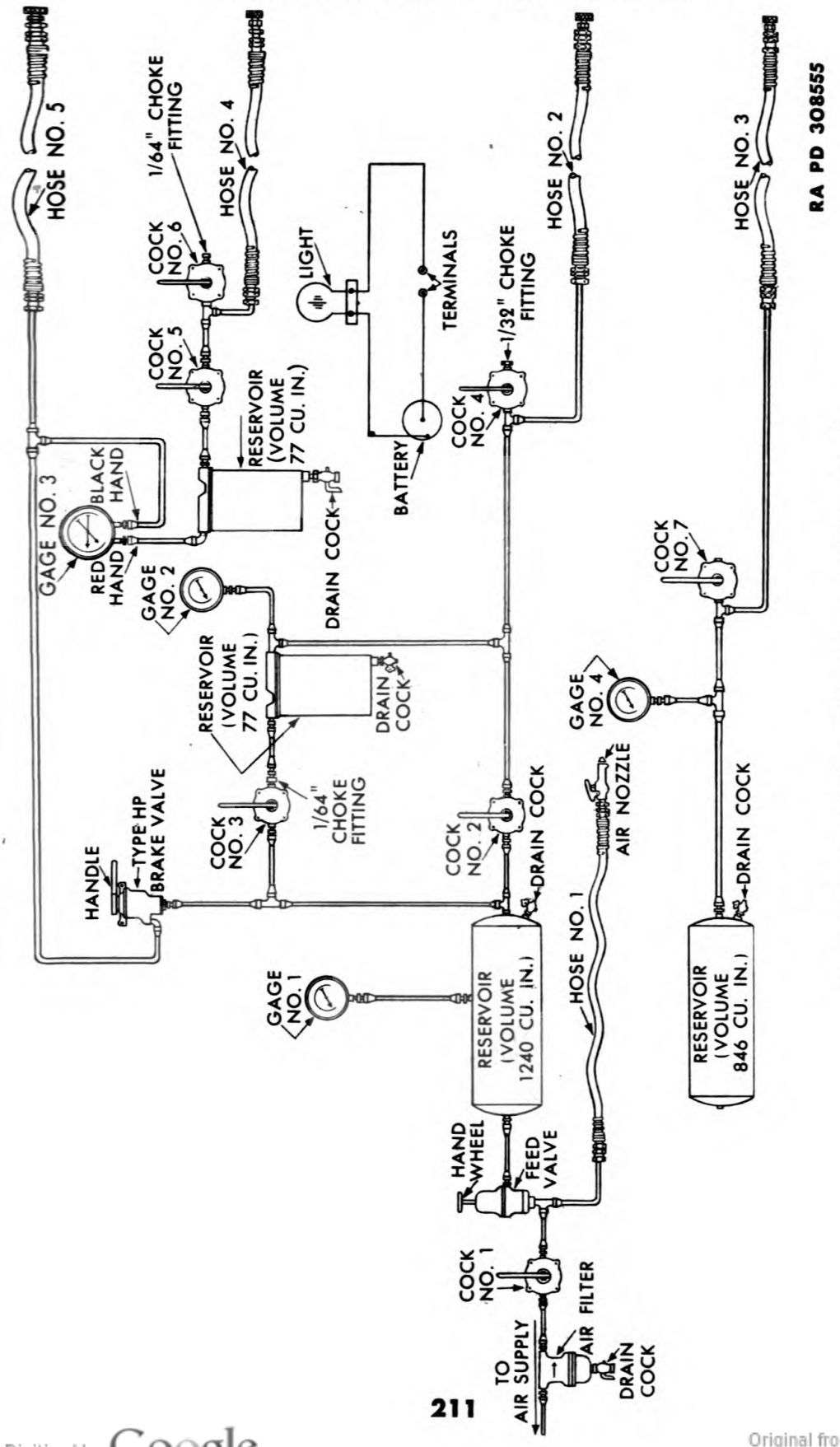



*Figure 176 — Piping Diagram of a Test Rack*

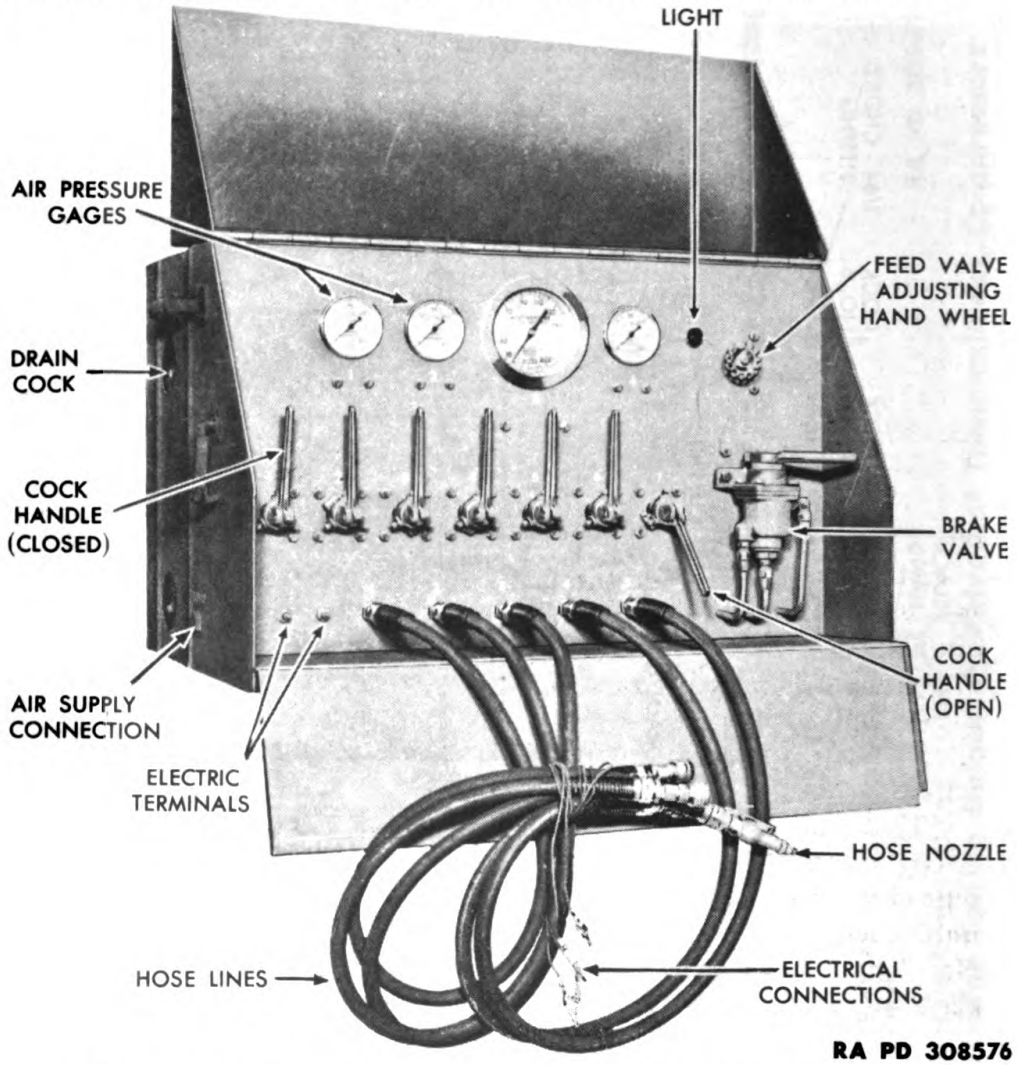



***Figure 177 — Portable Test Rack BWE SA-1561-23***

all moisture. Hand holes are provided in the side and back of the test rack to make the drain cocks accessible.

*(e)* Close cock No. 1. Open cocks No. 4, No. 6, and No. 7 until the red hand of gage No. 3, and gages No. 2, and No. 4, read zero. Then disconnect hose lines from pipe fitting and close all cocks.

**e. Testing Test Rack BWE SA-1561-23 for Serviceability.**

(1) PREPARE TEST RACK FOR TEST.

*(a)* With brake valve handle in released position, cock No. 1 open, and all other cocks closed, adjust setting of feed valve, if necessary, until gage No. 1 registers 15-pound pressure.

*(b)* Open cocks No. 4, No. 5, No. 6, and No. 7 until gages No. 2, No. 4 and both hands of gage No. 3 read zero Then close cocks No. 4, No. 6, and No. 7.

*(c)* Connect hoses No. 2, No. 3, and No. 4, together using a pipe tee.

(2) CHECK AIR GAGES.

*(a)* Open cock No. 2 and observe that the red hand of gage No. 3 and gages No. 1, No. 2, and No. 4, register the same pressure.

*(b)* Raise setting of feed valve until gage No. 1 registers 20 pounds. Again observe that the red hand of gage No. 3, and gages No. 1, No. 2, and No. 4, register the same pressure.

*(c)* Continue tests raising the feed valve setting in steps of 10 pounds making the last test at a pressure of 100 pounds.

*(d)* The red hand of gage No. 3 and gages No. 1, No. 2, and No. 4, must all register the same pressure in each test within two pounds.

*(e)* Close cock No. 2. Open cocks No. 4, No. 6, and No. 7, until the red hand of gage No. 3 and gages No. 2 and No. 4 read zero. Then disconnect hoses No. 2, No. 3, and No. 4, from the pipe tee.

*(f)* With brake valve handle in released position, connect hose No. 2 to hose No. 5. Then close cock No. 4.

*(g)* Raise the pressure registered by the black hand of gage No. 3 in steps of 10 pounds by moving the brake valve handle towards applied position. Compare the pressure registered by the black hand of gage No. 3 at each step with the pressure registered by gage No. 2. Move brake valve handle to released position.

*(h)* Gages showing an error in excess of three pounds must be replaced.

(3) LEAKAGE TESTS.

*(a)* Connect hoses No. 2, No. 3, No. 4, and No. 5 together, using a pipe cross or similar pipe fitting. Adjust pressure setting of feed valve until gage No. 1 registers 50 pounds. Close cocks No. 4, No. 6, and No. 7 and move brake valve handle to fully applied position. All gage hands should register approximately 50 pounds. Then close cock No. 1 and observe the rate of drop in pressure.

*(b)* Pressure must not drop at a rate faster than 1 pound per minute. If leakage is excessive, coat all units and connections with soap suds to detect leakage and service or replace leaking unit or connection. Open cocks No. 4, No. 6, and No. 7, until both hands of gage No. 3 and gages No. 1, No. 2, and No. 4, read zero. Disconnect hose lines, close all cocks, and move brake valve handle to released position.

(4) ELECTRICAL TEST. Connect a wire between the two electrical terminals to check battery and light. If light fails to light, replace light or battery.

## REFERENCES

### PUBLICATIONS INDEXES.

| | |
|---|---|
| **a. Ordnance Publications for Supply Index.** (Index to SNL's). | ASF Cat. ORD-2 OPSI |
| **b. Index to Ordnance Publications.** (A listing of FM's, TM's, TC's, and TB's of interest to Ordnance personnel; FSMWO's, BSD, S of SR's, OSSC's and OFSB's; including the Alphabetical List of Major Items with Publications Pertaining Thereto) | OFSB 1-1 |
| **c. List of Publications for Training.** (A listing of MR's, MTP's, T/BA's, T/A's, and FM's, TM's, and TR's concerning training) | FM 21-6 |
| **d. List of Training Films, Film Strips and Film Bulletins.** (A listing of TF's, FS's, and FB's by serial number and subject) | FM 21-7 |
| **e. Military Training Aids.** (A listing of Graphic Training Aids, Models, Devices, and Displays) | FM 21-8 |

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