PHASE 12
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IF AIR LEAKS FROM EXAUST OF TROLLEY VALVE CHECK, DOUBLE CHECK VALVE (DCV)

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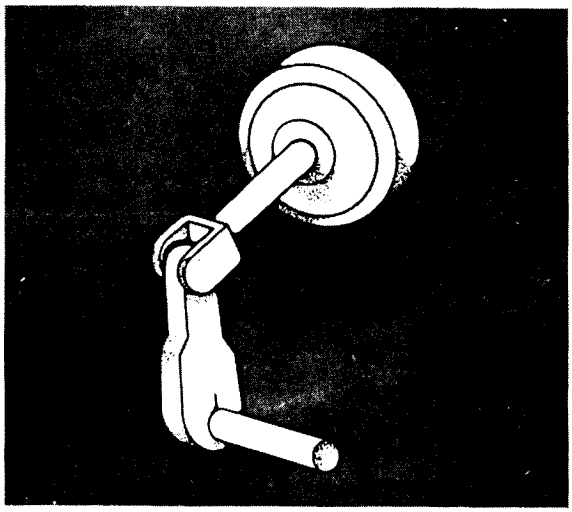
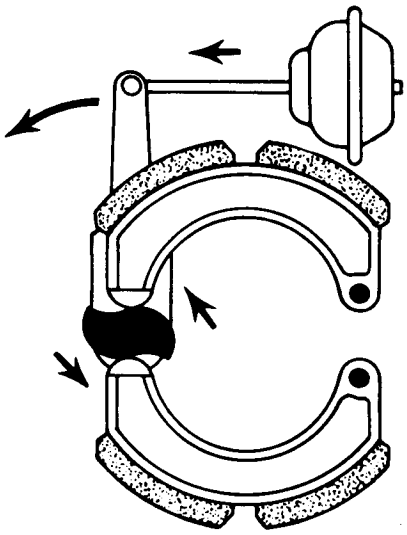
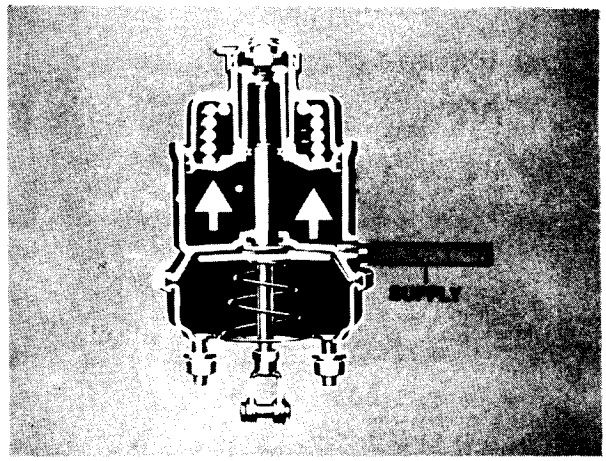
On some steering axle brakes and most drive axle brakes, a cam brake is used. With this type of brake, the pushrod is attached to a slack adjuster. A cam shaft is splined into the slack adjuster, and as the pushrod moves, the slack adjuster pivots around the center line of the shaft.



An S-cam is attached to the other end of the shaft and as the shaft turns with the movement of the slack adjuster, the S-cam forces the brake shoes into contact with the drum.



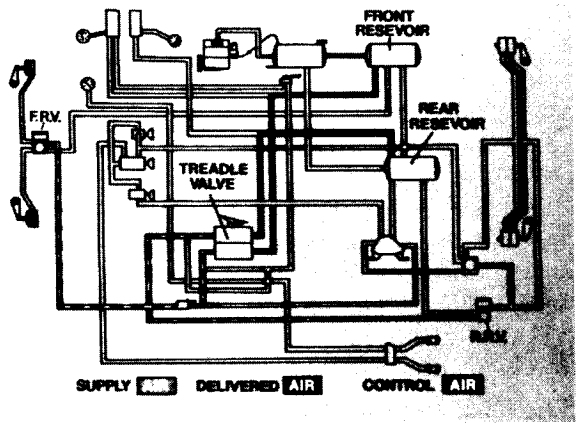
As an extra safety precaution, a spring brake chamber was added to many rear brakes. In the spring brake chamber, a spring loaded pushrod is held in check by a rubber diaphragm as long as the system maintains 40 psi.



The spring brake control valve is normally kept open to supply the spring brake chambers with air pressure. This valve can be closed to use the spring brakes as parking brakes. If the air braking system develops a leak, the spring brakes will automatically apply.

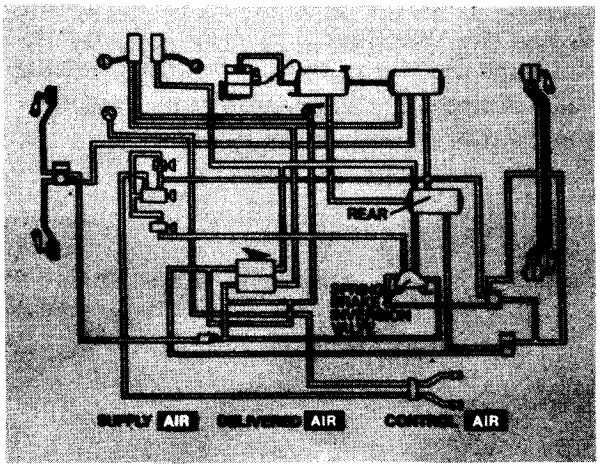
Dual Air Braking System

Our new Dual Air Braking System is similar to our previous system in many ways. The main difference is that the Dual Air Braking System has two separate air routing systems, one for the front brakes, and one for the rear brakes. Two service reservoirs have been added to the previous air supply system. One for the front system and one for the rear system.



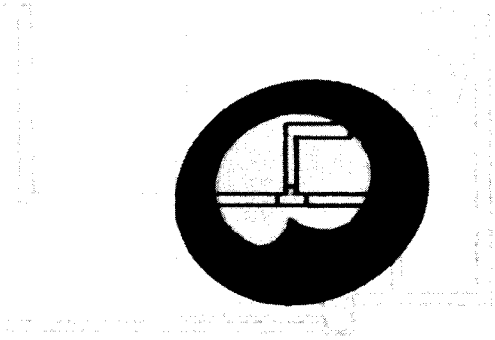
A dual treadle valve has replaced the old style treadle valve. The top part of the dual treadle valve regulates the control pressure to the rear relay valve, and the bottom part regulates the pressure to the front relay valve.

However, a direct line to the inversion valve from the rear service reservoir keeps the valve inactive as long as the pressure in this line is greater than 55 psi.

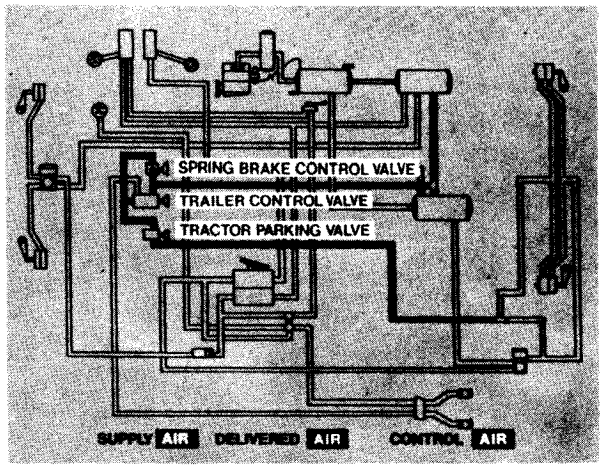


On all chassis manufactured before October 1st, 1976, and on trucks manufactured after October 1st, 1976, the Dual Air Braking system is the same as I've described. But on tractors manufactured after October 1st, 1976, the system has been changed.

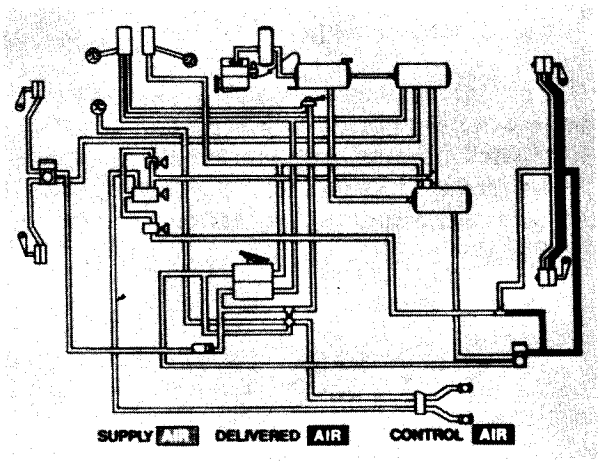
The spring brake inversion valve and the spring brake relay valve have been replaced by a double check valve.



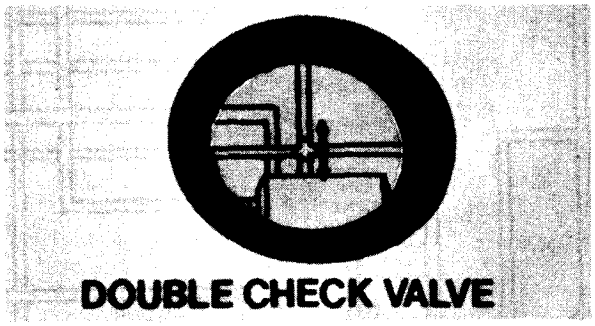
The double check valve receives air from the tractor parking valve, . . .



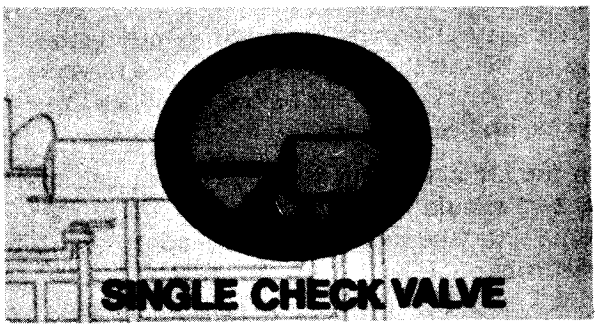
. . . and from the delivery line to the rear service brake chambers.



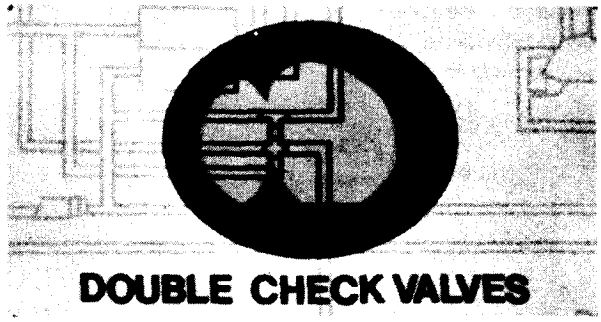
The normal operation of the Dual Air Braking System is very similar to the old system, except there are two braking systems working at the same time. But the special thing about the Dual Air Braking System is that one of the systems can fail and the driver still has some braking power left. For instance, suppose the rear system looses its pressure. First of all, the double check valve on the rear service reservoir snaps shut so that the air in the front system supplies the trailer service brakes and the tractor spring brakes.


DOUBLE CHECK VALVE

Also the single check valve on the front service reservoir closes to prevent the air from bleeding back through the main supply tank.

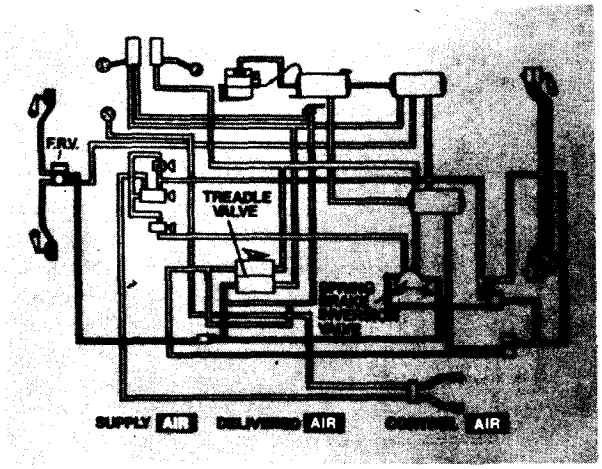

SINGLE CHECK VALVE

The other double check valves shut so that air from the front system feeds the trailer control line.


DOUBLE CHECK VALVES

When the driver presses down on the dual treadle valve, there is no rear service control pressure, but the front control air goes through the limiting valve to the front relay valve which applies the steering axle service brakes.

On all trucks, and on tractors built before October 1, 1976, the front control air also goes to the spring brake inversion valve.



Since there's no pressure in the line to the rear service reservoir, the spring brake inversion valve signals the spring brake relay valve to exhaust air from the spring brake chambers in proportion to the front control pressure.

The trailer control valve supplies high pressure air to the trailer service reservoir. A control line from the spring brake control valve ensures that whenever the spring brake control valve is closed, the trailer control valve also closes.

The tractor parking valve applies the tractor spring brakes without automatically closing the trailer control valve. This allows the trailer reservoir to become fully pressurized while the tractor spring brakes are used as parking brakes.

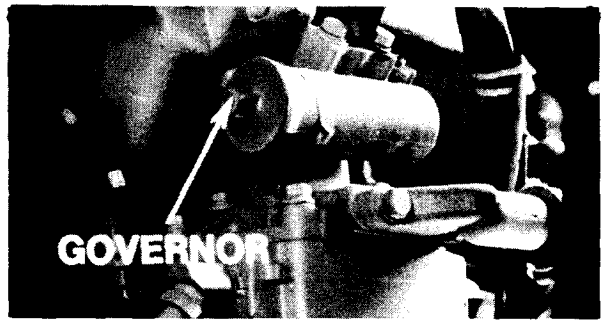
And the trailer brake hand control applies the trailer service brakes without applying the tractor service brakes.

TROUBLESHOOTING

There are four reasons for malfunction in the dual air braking system: air pressure problems; the brakes can pull; the brakes can drag; or the brakes can be out of balance.

Air Pressure Problems

If there is a problem with the air pressure, start the engine and watch the two service reservoir pressure gauges in the instrument panel. The air pressure should build-up to a full pressure of 100 - 120 psi, in approximately five minutes. If the air pressure is not within the limits, check the setting of the governor. It should cut in at 100 psi and out at 120 psi.



After five minutes, if both gauges still indicate low pressure - check the supply line for leaks. Now, if you haven't found the reason for the low air pressure, T a shop gauge into the supply line and make sure the service reservoir gauges are accurate. Oil pressure gauges are more sensitive and accurate than conventional air pressure gauges, and just as easy to us. Before using the test gauges, check their accuracy with a regulator. Then use one of the test gauges to check the accuracy of the instrument panel gauges. If the gauges are accurate, and read continuously low, the air compressor is malfunctioning.

However, if the gauges finally register full pressure, there is a restriction in the air line from the compressor to the supply reservoir.

Both gauges may not register low pressures. If only one gauge indicates low pressure and the other shows normal pressure, and the gauges are accurate, there is a restriction in the supply line to the gauge that reads low.

You should also check the pressure readings at the front relay valve against the application pressure readings. Up to forty psi application pressure, the front control pressure is fifty per cent of the application pressure. Above sixty psi, application pressure and front control pressure should be the same.

Application Pressure psi		Front Control Pressure psi
10	----------	5
20	----------	10
30	----------	15
40	----------	20
50	----------	40
60	----------	60
70	----------	70

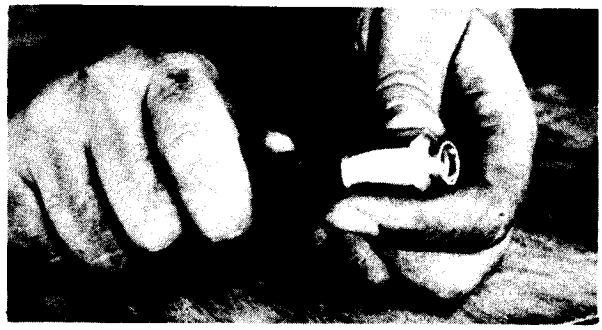
If the pressures don't match up the limiting valve is defective, or there is a leak, or a restriction in the front system.

New Air Lines

Should you have to replace any air lines, there are a few precautions you must take. Cut the new hose to the exact length of the old hose. Trim the ends of the new hose square.

Ream the ends of the hose slightly to prevent the fittings from digging into the rubber and blocking the lines.

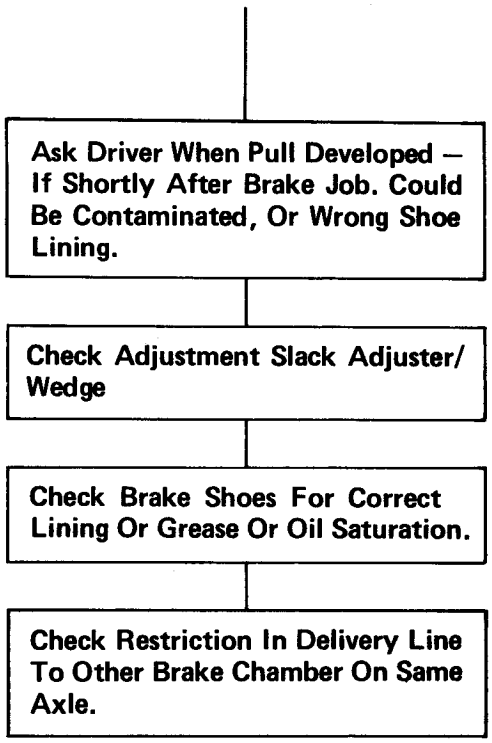
When installing, first install the female shoulder - with the left-hand threads - over the hose.



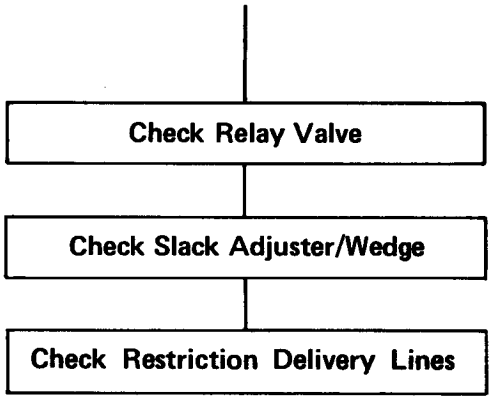
Then install the male fitting - it has right-hand threads - and tighten securely.

Purge the hose with compressed shop air before installing to clean out any loose debris that could later block up the system.

BRAKE PULL



BRAKE DRAG



FUNCTIONAL TEST OF MVSS 121 DUAL AIR SYSTEM

With all three (or two, or one, if so equipped) instrument panel air control valves pulled to the "out" position, charge the vehicle air systems to the maximum of 120 psi. Both gauges to be equal. Check both front and rear service air gauges to be sure they do read 120 psi. Shut down engine.

Open the petcock on the front service reservoir and bleed off air pressure until front air gauge reads "0". Only the front service system should bleed down. Verify this with the instrument panel service air gauges. The low air warning light should come on when either front or rear system pressure drops to approximately 70 psi. Depress foot treadle valve, there should be no front brake application. The rear brakes will continue to modulate until the rear service reservoir pressure drops to 40 - 45 psi. The spring brakes will lock the rear wheels at that time.

Close all reservoir petcocks. Rebuild complete system pressure in both front and rear systems. Shut down engine. Block vehicle wheels. Push in yellow spring brake and blue tractor parking valves.

Open the drain petcock on the rear service reservoir and bleed off air pressure until rear air gauge reads "0". Only the rear service reservoir should bleed down. NOTE: Spring brakes should not apply automatically. The low air warning light should come on at approximately 70 psi.

When the rear service reservoir is completely empty, apply service brakes with the foot valve. At this point observe the front and rear brake operation. They should be modulating as the foot valve is depressed and released. Continue this procedure until the forward service reservoir pressure reaches 40 - 45 psi. At this point, the spring brakes should automatically apply themselves.

If the brake system functions as described above, you may proceed. NOTE: If when bleeding either the front or rear system, the front and rear service gauges go down simultaneously, a complete check of the system and correction will be required. Do not proceed with Sequence No. 2 until corrections are complete and Sequence No. 1 rechecked.

With vehicle air systems charged to the maximum and all three (two, or one, if so equipped) air control valves pulled to the "out" position, push in the red trailer supply valve only. No air should be delivered through the valve to the trailer supply line. Pull out the red trailer supply valve.

Push in the yellow spring brake control valve. NOTE: Vehicle spring brakes should not release on a three valve installation. They will release on the one or two valve system. Push in red trailer supply valve. At this point, trailer supply air should be delivered through the red supply valve to the trailer reservoir.

Pull all three valves to the "out" position. Push in the blue "tractor parking only" valve. No air exhaust or brake action should occur. Push in red trailer supply valve. Again, nothing should happen. Pull all three valves to the "out" position.

Push in the yellow spring brake control valve. The spring brakes should not release on a three valve installation. Push in the blue tractor parking valve only. Vehicle spring brakes should release.

Quiz 3. Fill in the blanks.

1. There are 4 reasons for malfunctions in the dual air braking system: _____ _____, the brakes can _____, the brakes can _____, or the brakes can be _____ _____ _____.

2. When the truck is first started, the air pressure should build up to a full pressure of (PSI) 50 PSI TO 90 PSI psi in approximately 5 min or less minutes.

3. If only one service gauge indicates low pressure and the other shows normal pressure, and the gauges are accurate, there is a _____ in the supply line to the gauge that reads _____.

4. If brake pull started shortly after a brake repair on the truck, it's possible the wrong _____ _____ were installed, or that the linings were contaminated with _____ or _____.

5. If a driver complains of brake drag, check the air PRESSure _____ on the malfunctioning axle to make sure the air pressure is being exhausted from the delivery lines.

6. If the relay valve functions properly, check the adjustment of the _____ _____ or _____ on the brake that is dragging.

7. If a driver complains that his brakes are out of balance, connect _____ _____ into the control pressure lines of the relay valves on each braked axle.

8. Have a mechanic slowly depress the _____ _____ _____ to various positions, and take readings on the pressure gauge in the truck.

9. Check the readings at the _____ _____ _____ and the _____ _____ _____ against the application pressure readings.

10. If you have to replace any air lines, cut the new hose to the _____ _____ of the old hose.

11. Trim the ends of the new hose. _____

12. _____ the ends of the hose to prevent the fittings from digging into the rubber and blocking the line.

13. First install the _____ shoulder - with _____ hand threads.

14. Then install the _____ fitting - it has _____ hand threads.

15. _____ the hose with compressed air before installing to clean out any loose debris that could later _____ _____ the system.

DESCRIPTION AND OPERATION

GENERAL

The function of the air compressor is to build up and maintain the air pressure required to operate air powered devices in air brake or air auxiliary systems.

DESCRIPTION

Tu Flo Type 400, 500, and 1000 compressors are single stage, reciprocating piston type compressors. Tu Flo 400 (Fig. 1) and 500 (Fig. 2) compressors have two cylinders while the Tu Flo 1000 (Fig. 3) is a V-type design having four cylinders. The rated capacity of all Bendix compressors is their piston displacement in cubic feet per minute when operating at 1250 RPM. The rated capacity of the Tu Flo 400 compressor is 7-1/4 cubic feet per minute. The Tu Flo 500 is rated at 12 cubic feet per minute and the Tu Flo 1000 has a rating of 24 cubic feet per minute.

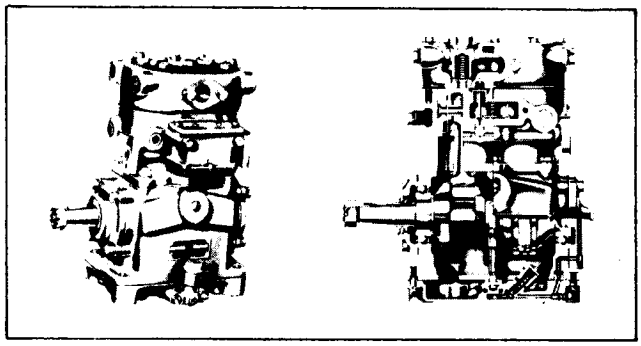


FIGURE 1 – TU FLO 400

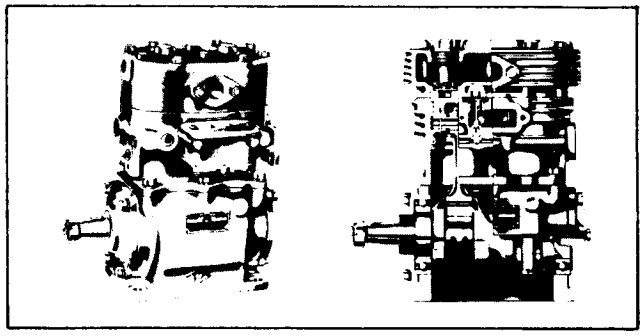


FIGURE 2 – TU FLO 500

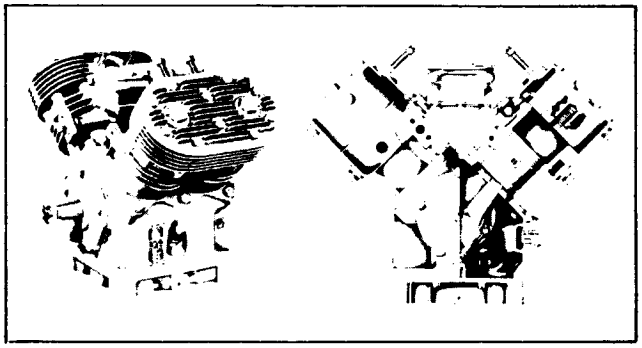


FIGURE 3 – TU FLO 1000

Tu Flo type compressors have automatic type inlet valves. Their unloading mechanisms are located in the cylinder block and they have no external moving parts. Both air and water cooled type compressors are available. Various mounting and drive adaptations are used as required by different vehicle engine designs (Fig. 4).

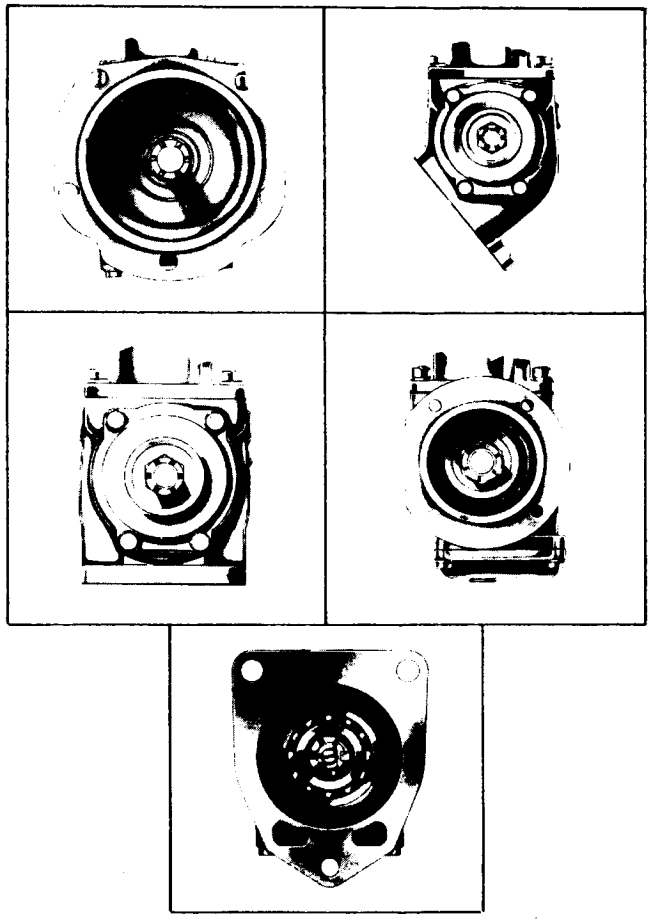


FIGURE 4 – VARIOUS COMPRESSOR MOUNTINGS

Compressors are either engine or self-lubricated. The majority used are the engine lubricated types (Fig. 5) which obtain the oil necessary to lubricate their moving parts from the engines on which they are mounted. To meet the requirements of some manufacturers and for field installations, self-lubricated types (Fig. 6) are available. They are compressors having a self-contained oil supply and pumping system.

The method of lubricating the moving parts of the compressor is the same in either type. Oil is forced through the oil passage in the crankshaft and out around each connecting rod journal. The turning motion of the crankshaft throws the oil that is forced out at the journals, against the cylinder bores and crankcase walls, lubricating the bores and crankshaft bearings.

As the piston reaches the top of its stroke and starts down, the discharge valve spring returns the discharge valve to its seat. This prevents the compressed air in the discharge line from returning to the cylinder bore as the intake and compression cycle is repeated.

NON-COMPRESSION (Unloaded)

When the air pressure in the reservoir reaches the high pressure setting of the governor, the governor opens, allowing air to pass from the reservoir through the governor and into the cavity beneath the unloader pistons. This lifts the unloader pistons and plungers. The plungers move up and hold the inlet valves off their seats (Fig. 11).

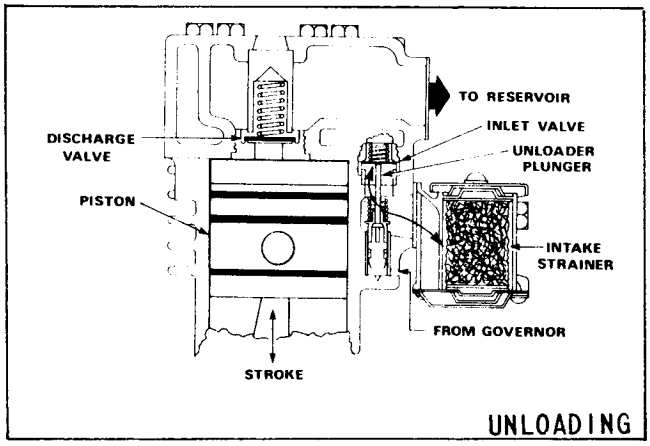


FIGURE 11

With the inlet valves held off their seats by the unloader pistons and plungers, air is merely pumped back and forth between the two cylinders. When air is used from the reservoir and the pressure drops to low pressure setting of the governor, the governor closes and in doing so exhausts the air from beneath the unloader pistons. The unloader saddle spring forces the saddle, pistons and plungers down and the inlet valves return to their seats. Compression is then resumed.

COOLING

Tu Flo 400, 500 or 1000 compressors may be air-cooled or water-cooled and in some instances will have air-cooled blocks and water-cooled heads. The air-cooled versions are easily recognized by the external fins. The water-cooled versions are cooled by vehicle coolant.

PREVENTIVE MAINTENANCE

If the compressor is a self-lubricated type, its oil level should be checked daily. The oil level should be kept between the bottom of the dip-stick threads and the bottom of the dip-stick (Fig. 12).. Every 8000 miles or 300 operating hours the oil should be drained and refilled with SAE 10-20-30.

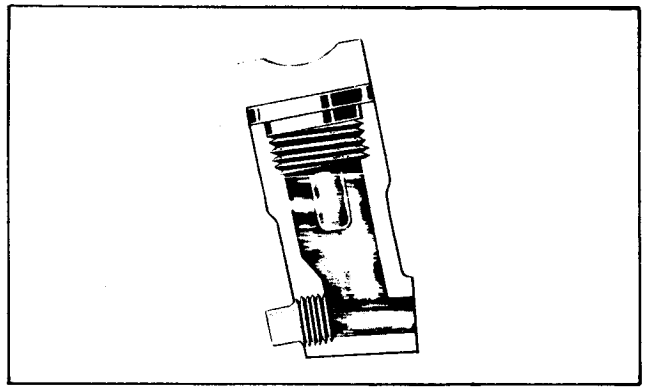


FIGURE 12
OIL LEVEL - SELF-LUBRICATED COMPRESSOR

POLYURETHANE SPONGE STRAINER (Fig. 13)

Remove and wash all of the parts. The strainer element should be cleaned or replaced. If the element is cleaned, it should be washed in a commercial solvent or a detergent and water solution. The element should be saturated in clean engine oil, then squeezed dry before replacing it in the strainer. Be sure to replace the air strainer gasket if the entire air strainer is removed from the compressor intake.

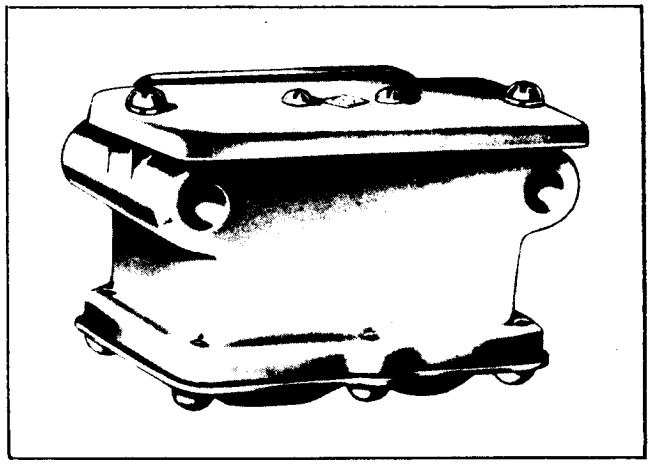


FIGURE 13 – POLYURETHANE SPONGE STRAINER

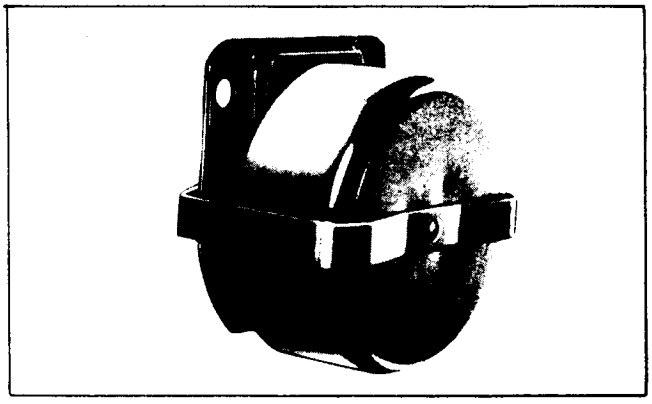


FIGURE 14 – DRY ELEMENT - PLEATED PAPER AIR STRAINER

Tighten mounting bolts securely and evenly.

After installation run compressor and check for air, oil, or water leaks at compressor connections. Also check for noisy operation.

REMOVING AND DISASSEMBLY

REMOVING

These instructions are general and are intended to be a guide. In some cases additional preparations and precautions are necessary. Chock the wheels of the vehicle and drain the air pressure from all the reservoirs in the system. Drain the engine cooling system and the cylinder head of the compressor. Disconnect all air, water and oil lines leading to and from the compressor. Remove the drive gear(s) or pulley from the compressor crankshaft using a gear puller. Inspect the pulley or gear and associated parts for visible wear or damage. Since these parts are precision fitted, they must be replaced if they are worn or damaged.

DISASSEMBLY

GENERAL

Remove road dirt and grease from the exterior of the compressor with a cleaning solvent. Before the compressor is disassembled, the following items should be marked to show their relationship when the compressor is assembled. Mark both the front and rear end cover in relation to the crankcase. Mark the drive end of the crankshaft in relation to the front end cover and the crankcase. Mark the cylinder head in relation to the block and block to crankcase. Mark the base plate or base adapter in relation to the crankcase.

A convenient method to indicate the above relationships is to use a metal scribe to mark the parts with numbers or lines. Do not use a marking method that can be wiped off or obliterated during rebuilding, such as chalk. Remove all compressor attachments such as governors, air strainers or inlet fittings, discharge fittings and pipe plugs.

CYLINDER HEAD

Remove the cylinder head cap screws and tap the head with a soft mallet to break the gasket seal. Remove the inlet valve springs form the head and inlet valves from their guides in the block. Remove inlet valve guides from around the inlet valve seats on the block taking care not to damage seats. Scrape off any gasket material from the cylinder head and block. Unscrew the discharge cap nuts from the head and remove the discharge valves and springs. Inspect the discharge valve seats for nicks, cracks, and excessive wear and remove and replace if necessary.

The discharge valve cap nuts should be inspected for wear and replaced if excessive peening has occurred. To determine if excessive peening has occurred, measure the discharge valve travel. Discharge valve travel must not exceed .056 in. for the Tu Flo 400 and .046 in. for the Tu Flo 500 and 1000.

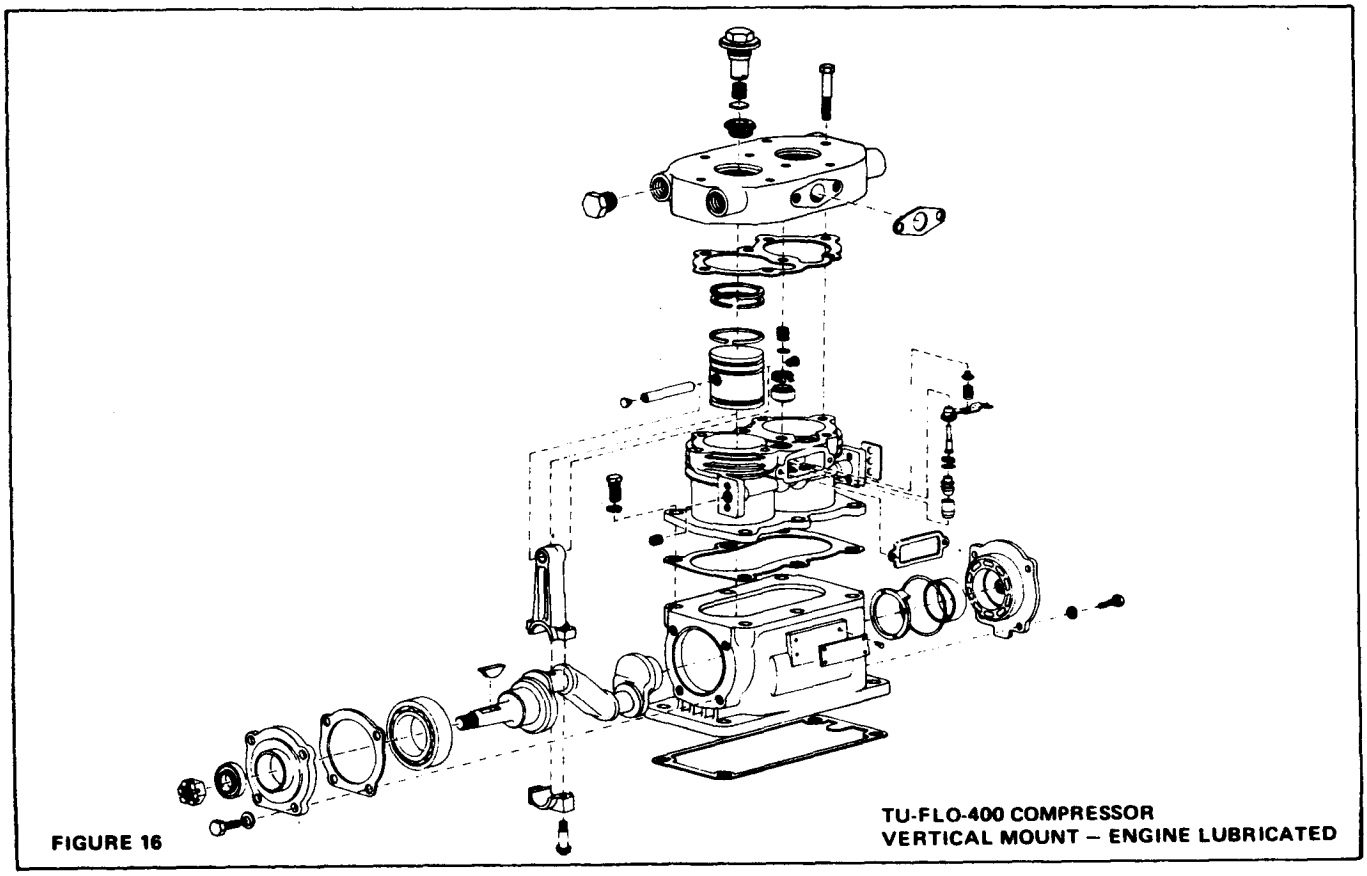


FIGURE 16

TU-FLO-400 COMPRESSOR
VERTICAL MOUNT – ENGINE LUBRICATED

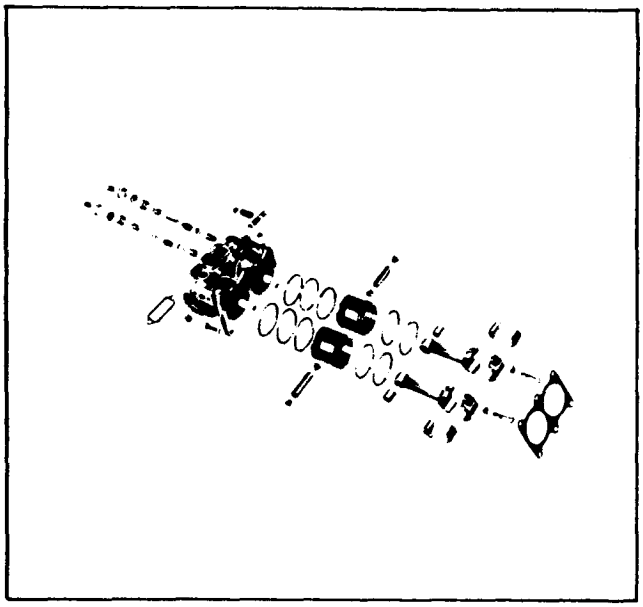


FIGURE 19 – CYLINDER BLOCK - EXPLODED VIEW

CLEANING AND INSPECTION OF PARTS

CLEANING

All parts should be cleaned thoroughly in a good cleaning solvent before inspection.

CYLINDER HEAD ASSEMBLY

Remove all carbon deposits from discharge cavities and all rust and scale from cooling cavities of cylinder head body. Scrape all foreign matter from body surfaces and use air pressure to blow dirt particles from all cavities.

Discharge valves can be dressed by lapping them on a piece of fine crocus cloth on a flat surface, provided they are not excessively worn.

CYLINDER BLOCK

Clean carbon and dirt from inlet and unloader passages. Use air pressure to blow carbon and dirt deposits from unloader passages.

Inlet valves, as in the case of discharge valves, not worn excessively, can be cleaned by lapping them on a piece of fine crocus cloth on a flat surface.

OIL PASSAGE

Clean thoroughly all oil passages through crankshaft, connecting rods, crankcase, end covers and base plate. If necessary inspect passages with a wire and blow foreign matter out with air pressure.

CRANKCASE - SELF-LUBRICATED TYPE

The breather should be thoroughly washed and cleaned.

The oil pump check valve in the base should be removed and replaced. It is important when the oil pump check valve is replaced that it be installed correctly with the ball stop pin end pressed in first. When installed, the ball and its seat should be visible from the crankcase base.

INSPECTION OF PARTS

CYLINDER HEAD BODY

Inspect cylinder head body for cracks or damage.

WATER-COOLED TYPE

Use air pressure to test water jackets of cylinder head and block for leakage. Replace unit if leakage is found.

DISCHARGE VALVES AND SEATS

If discharge valves are worn and grooved where they contact the seats, they should be replaced. If the discharge valve seats are worn excessively so that there is no longer enough metal left to reclaim them by lapping, the seats should be replaced.

DISCHARGE VALVE SPRING AND CAP NUTS

Replace all used discharge valve springs and cap nuts.

CRANKCASE AND END COVERS

Check for cracks or broken lugs in crankcase and end covers. Also check their oil passages to make sure they are open and clean.

If an oil seal ring is used in the end cover, check fit of ring in ring groove. There should be 0.008 in. to 0.015 in. clearance at the gap when placed in the end bore of the crankshaft. If the oil ring is worn thin or is damaged, it should be replaced. Inspect oil ring groove in end cover; if groove is worn excessively replace end cover or machine groove for next oversize oil seal ring.

If the crankshaft main bearings are installed in the end cover, check for excessive wear and flat spots and replace if necessary.

CYLINDER BLOCK

Check for cracks or broken lugs on cylinder block. Also check unloader bore bushings to be sure they are not worn, rusted or damaged. If these bushings are to be replaced they can be removed by running a 1/8 in. pipe thread tap inside the bushing, then inserting a 1/8 in. pipe threaded rod and pulling the bushing straight up and out. Do not use an easy-out for removing these bushings.

INLET VALVES AND SEATS

If inlet valves are grooved or worn where they contact the seat, they should be replaced. If the inlet valve seats are worn or damaged so they cannot be reclaimed by facing, they should be replaced.

CONNECTING ROD BEARINGS

Check connecting rod bearings on crankshaft journals for proper fit. Used bearing inserts should be replaced. Connecting rod caps are not interchangeable. The locking slots of the connecting rod and cap should be positioned adjacent to each other.

Clearance between the connecting rod journal and the connecting rod bearing must not be less than 0.0003 in. or more than 0.0021 in. after rebuilding.

MAIN BEARINGS

Check for wear or flat spots; if found, bearings should be replaced. If type with sleeve bearing, this bearing should be checked for scores and wear and replaced if necessary.

UNLOADER MECHANISM

Used unloader mechanism should be replaced by unloader kits 265014 for Type Tu Flo 400 compressors and 265015 for Types Tu Flo 500 and 1000 compressors. The Tu Flo 1000 compressor requires two kits per compressor.

The new unloader pistons should be a loose sliding fit in the unloader piston bores of the cylinder block.

PARTS SPECIAL TO SELF-LUBRICATED TYPE COMPRESSORS

OIL PUMP SCREEN

Check oil pump screen to be sure it is clean and not damaged; replace if damaged.

OIL PUMP PISTON AND BUSHING

Check fit of oil pump piston in base plate pump bushing. It must be a medium sliding fit. If excessive clearance is found the oil rod and/or bushing must be replaced.

OIL PUMP RELIEF VALVE

If the oil pump relief valve is defective, it should be replaced.

OIL PUMP CHECK VALVE

The check valve should be replaced. It can be checked by applying air pressure back through the pin stop end and noting that ball check seals on its seat.

REPAIRS

DISCHARGE VALVES AND SEATS

If discharge valve seats merely show signs of slight wear, they can be dressed by using a lapping stone, grinding compound and grinding tool. Install new discharge valves and valve springs.

To test for leakage by the discharge valves apply about 100 pounds of air pressure through the cylinder head discharge port and apply soap suds at the discharge valves and seats. Leakage which will permit the formation of bubbles is permissible.

If excessive leakage is found, leave the air pressure applied, and with the use of a fibre or hardwood dowel and hammer, tap the discharge valves off their seats several times. This will help the valves to seat and should reduce any leakage.

With the air pressure still applied at the discharge port of the cylinder head, check for leakage at the discharge valve cap nuts. No leakage is permissible.

INLET VALVES AND SEATS

If inlet valve seats show sign of slight nicks or scratches, they can be redressed with a fine piece of emery cloth or by lapping with a lapping stone, grinding compound and grinding tool. If the seats are excessively damaged to the extent that they cannot be reclaimed, they should be replaced. The dimension from the top of the cylinder block to the inlet valve seat should not exceed 0.118 in. nor be less than 0.101 in.

Slightly worn or scratched inlet valves can be reclaimed by lapping them on a piece of fine crocus cloth on a flat surface, but it is suggested that new inlet valves be installed.

ASSEMBLY

INSTALLING CYLINDER BLOCK

Position cylinder block gasket and block on crankcase according to markings made prior to disassembly. Using cap screws with lock washers, secure cylinder block to crankcase.

INSTALLING CRANKSHAFT

If the crankshaft is fitted with oil seal rings, install rings. Position ball bearings and crankshaft in crankcase, making sure the drive end of the crankshaft is positioned as marked before disassembly.

If one end of the crankcase is counterbored for holding a bearing, be sure the crankshaft is installed through the correct end of the crankcase.

Carefully press crankshaft and bearings into crankcase using arbor press.

Position a new rear end cover gasket, when used, over the rear end of the crankcase, making sure the oil hole in the gasket lines up with the oil hole in the crankcase. Position end cover with oil seal ring, if used, installed over crankcase and end cover gasket. The end cover should be positioned correctly in relation to the oil holes in the gasket and crankcase. Secure end cover to crankcase with cap screws and lock washers.

If the opposite end cover requires an oil seal which was removed on disassembly, a new seal should be pressed into

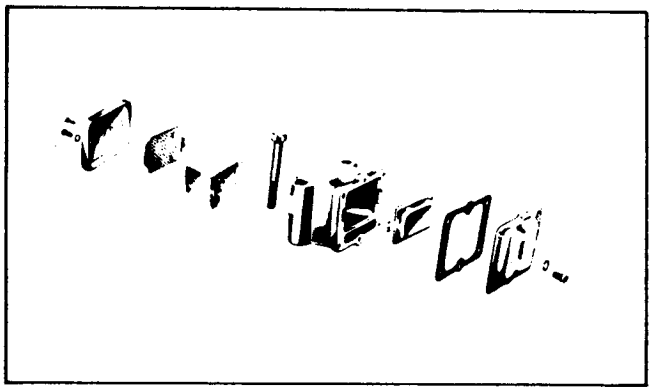


FIGURE 25
AIR STRAINER - EXPLODED VIEW

AIR STRAINER

If the compressor is type with air strainer, assemble strainer (Fig. 25). Using a new strainer gasket, install strainer on cylinder block.

GOVERNOR

If compressor is type with pad mounted governor, install a new or factory rebuilt governor using a new governor gasket.

INSPECTION OF REBUILT UNIT

Check to be sure that covers, plugs or masking tape are used to protect all ports if compressor is not to be installed immediately.

Fit the end of all crankshafts with keys, nuts and cotter pins as required and then protect the ends against damage by wrapping with masking or friction tape.

The open bottom of engine lubricated compressors should be protected against the entrance of dirt during handling or storage, by installing a temporary cover over base.

TESTING REBUILT COMPRESSOR

In order to properly test a compressor under operating conditions, a test rack for correct mounting, cooling, lubricating and driving the compressor is necessary. Such tests are not compulsory if the unit has been carefully rebuilt by an experienced person.

A compressor efficiency or build-up test can be run which is not too difficult. Before the test the crankcase of a self-lubricated type compressor should be properly filled with lubricating oil. An engine lubricated compressor must be connected to an oil supply line of at least 15 pounds pressure during the test and an oil return line must be installed to keep the crankcase drained. The compressor (when tested) should be tested without a strainer.

To the discharge port of the compressor connect a reservoir or reservoirs whose volume plus the volume of the connecting line equals 1300 cubic inches. Run the compressor between 1700 and 1750 RPM. Elapsed time that the compressor takes to build up from 0 to 100 psi depends on the type compressor as follows:

TYPE COMPRESSOR	BUILD-UP TIME 0 TO 100 PSI
TU FLO 400	47 SECONDS MAXIMUM
TU FLO 500	30 SECONDS MAXIMUM
TU FLO 1000	15 SECONDS MAXIMUM

During the above test the compressor should be checked for oil leakage and noisy operation.

IMPORTANT! PLEASE READ

When working on or around air brake systems and components, the following precautions should be observed:

1. Always block vehicle wheels. Stop engine when working under a vehicle. Depleting vehicle air system pressure may cause vehicle to roll. Keep hands away from chamber push rods and slack adjusters; they may apply as system pressure drops.
2. Never connect or disconnect a hose or line containing air pressure. It may whip as air escapes. Never remove a component or pipe plug unless you are certain all system pressure has been depleted.
3. Never exceed recommended air pressure and always wear safety glasses when working with air pressure. Never look into air jets or direct them at anyone.
4. Never attempt to disassemble a component until you have read and understand recommended procedures. Some components contain powerful springs and injury can result if not properly disassembled. Use only proper tools and observe all precautions pertaining to use of those tools.

SYMPTOMS	CAUSE	REMEDY
	B. Restricted oil return (to engine).	B. Oil return to the engine should not be in any way restricted. Check for excessive bends, kinks, and restrictions in the oil return line. Minimum recommended oil return line size is 5/8" O.D. tubing or equivalent I.D. (1/2" minimum). Return line must CONSTANTLY DESCEND from the compressor to the engine crankcase. Make certain oil drain passages in the compressor and mating engine surfaces are unobstructed and aligned. Special care must be taken when sealants are used with, or instead of, gaskets.
	C. Poorly filtered inlet air.	C. Check for damaged, defective or dirty air filter on engine or compressor. Check for leaking, damaged or defective compressor air intake components (i.e., induction line, fittings, gaskets, filter bodies, etc). The compressor intake should **not** be connected to any part of the exhaust gas recirculation (E.G.R.) system on the engine.
	D. Insufficient compressor cooling (compressor runs hot).	D. For air-cooled compressor or air-cooled portions of the compressor: 1. Remove accumulated grease, grime, or dirt from the cooling fins. Replace components found damaged. 2. Check for damaged cooling fins. Replace components found damaged. 3. Air-cooled compressors should not be used on engines equipped with fan clutches. For water-cooled compressor or water-cooled portions of the compressor: 1. Check for proper coolant line sizes. Minimum recommended size is 1/2" O.D. tubing. 2. Check the coolant flow through the compressor. Minimum allowable flow is 2.5 gallons per minute at engine governed speed. If low coolant flow is detected, inspect the coolant lines and fittings for accumulated rust scale, kinks and restrictions. 3. Water temperature should not exceed 200° F. 4. Optimum cooling is achieved when engine coolant flows into the compressor cylinder block at one end and out the compressor cylinder head at the opposite end.
	E. Contaminants not being regularly drained from system reservoirs.	E. Check reservoir drain valves to insure that they are functioning properly. It is recommended that the vehicle should be equipped with functioning automatic drain valves, or have all reservoirs drained to zero (0) psi daily, or optimally to be equipped with a desiccant-type air dryer prior to the reservoir system.

SYMPTOMS	CAUSE	REMEDY
	E. Faulty compressor.	E. Replace or repair the compressor after determining none of the preceding installation defects exist.
3. Excessive build-up and recovery time. Compressor should be capable of building air system from 85-100 psi in 40 seconds with engine at full governed rpm. Minimum compressor performance is certified to meet Federal requirements by the vehicle manufacturer. Do not downsize the original equipment compressor.	A. Dirty induction air filter.	A. Inspect engine or compressor air filter and replace if necessary.
	B. Restricted induction line.	B. Inspect the compressor air induction line for for kinks and restrictions and replace as necessary.
	C. Restricted discharge line or compressor discharge cavity.	C. Inspect the compressor discharge port and line for restrictions and carbon build-up. If a carbon build-up is found, check for proper compressor cooling. Replace faulty sections of the discharge line.
	D. Slipping drive components.	D. Check for faulty drive gears and couplings and replace as necessary. Check the condition of drive belts and replace or tighten, whichever is appropriate.
	E. Excessive air system leakage.	E. Test for excessive system leakage and repair as necessary. Use the following as a guide: Build system pressure to governor cutout and allow the pressure to stabilize for one minute. Using the dash guage, note the system pressure and the pressure drop after two minutes. The pressure drop for Pre-1975 vehicles should not exceed: 1. 4 psi for a single vehicle. 2. 6 psi for a tractor trailer. 3. 10 psi for a tractor and 2 trailers. The pressure drop for Post-1975 vehicles should not exceed: 1. 2 psi in **each** reservoir for a single vehicle. 2. 6 psi in **each** reservoir for a tractor and trailer. 3. 8 psi in **each** reservoir for a tractor and 2 trailers.
	F. Sticking unloader pistons and plungers.	F. Check the operation of the unloading pistons in the inlet cavity of the compressor. Both pistons should have the plunger flanges resting on the inlet cavity floor when the compressor is loaded (pumping air). If the pistons and plunger are not fully retracted, check for proper operation of the compressor air governor. If the governor is operating properly, replace the unloader pistons and plungers and inspect their bores in the cylinder block. Clean lubricate as necessary. Inspect for bent, kinked or blocked tubing leading to or from the governor.

SYMPTOMS	CAUSE	REMEDY
	C. Faulty compressor (porous castings).	C. If casting porosity is detected, replace the compressor.
8. Compressor head gasket failure.	A. Restricted discharge line.	A. Clear restriction or replace line.
	B. Loose head bolts.	B. Tighten evenly to a torque of 25-30 foot pounds.
	C. Faulty compressor or head gasket.	C. Check for rough or poorly machined head or block surfaces. Replace necessary components.

FORCES INVOLVED IN BRAKING

It is surprising to note the comparatively small number of people who really appreciate the tremendous forces involved in stopping a modern commercial vehicle, particularly from higher speeds quite common today.

A simple method of explaining this is to make a comparison between the horsepower required to accelerate a vehicle and the horsepower required to stop it. The average truck having an engine capable of developing 100 horsepower, requires about one minute to accelerate to a speed of 60 miles per hour, whereas, the same vehicle should be capable of easily stopping from 60 miles per hour in not more than six seconds. Ignoring the unknown quantities, such as rolling friction and wind resistance which admittedly play a part in all stops, the brakes must develop the same energy in six seconds as the engine develops in 60 seconds; in other words, the brakes do the same amount of work as the engine in one-tenth the time.

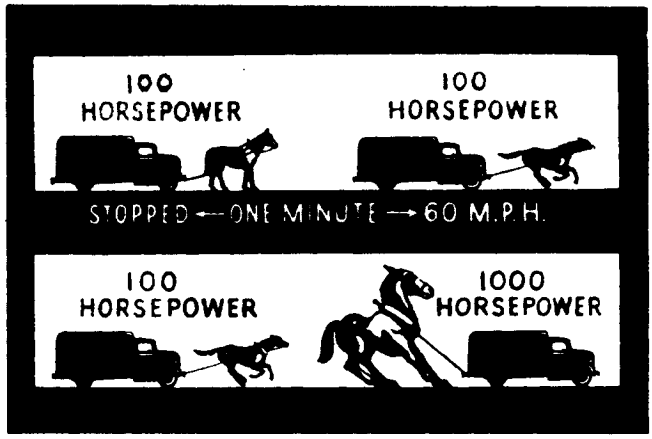


FIG. 3--Forces Involved in Braking

This means they must develop approximately 1,000 horsepower during the stop.

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EFFECT OF WEIGHT AND SPEED ON BRAKES

Another factor to be considered is the effect on braking when the weight and speed of a vehicle are increased. Obviously, no brake designed to control a vehicle having a gross weight of 5,000 pounds is capable of properly controlling such a vehicle if this gross weight is exceeded because, if the weight of a vehicle is doubled, the energy of motion to be changed into heat energy is also doubled; in other words, if the weight is doubled, the amount of heat to be dissipated and absorbed is also doubled, and the brake which is only capable of handling the 5,000 pounds weight is not only incapable of properly stopping twice as much weight, but cannot properly dissipate and absorb the double amount of heat.

The effect of higher speeds on braking is much more serious. Not so many years ago the average speed of a commercial vehicle was only 20 miles per hour. Today, under normal operating conditions, even conservative estimates place the average speed of commercial vehicles at 40 miles per hour. Comparing stops from a speed of 20 miles per hour with stops from a speed of 40 miles per hour, engineering mathematics show there is actually four times as much energy of motion to be changed to heat energy during a stop from 40 miles per hour as there is during

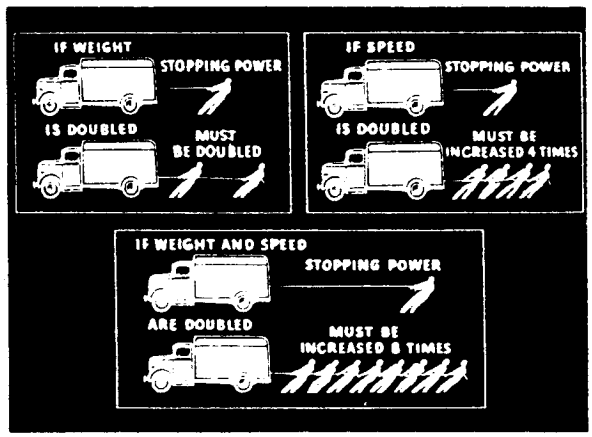

FIG. 4 Effect of Weight and Speed on Brakes

a stop from 20 miles per hour. Thus, if the speed is doubled, four times as much stopping power must be developed, and the brakes must absorb or dissipate four times as much heat.

It naturally follows that if both the weight and speed of a vehicle are doubled the stopping power must be increased eight times and the brakes must absorb or dissipate eight times as much heat.

Therefore, the delivered force of any lever is determined by multiplying the applied force by the distance it is from the fulcrum and then dividing this answer by the distance the delivered force is from the fulcrum.

In determining the distance at which any force is acting on a lever, the true length of the lever arm is the perpendicular distance from the force to the fulcrum, regardless of the shape of the lever. The lever arm is always measured at right angles to the direction of the force.

The product of the force acting on a lever, multiplied by the distance the force is from the fulcrum, is called the turning moment, and when this relates to a shaft it is called **torque.** The turning moment or torque is usually expressed in inch pounds, foot pounds, foot tons, etc., depending upon whether the force is measured in pounds or tons and whether the distance is measured in inches or feet. As an example—a force of 100 pounds acting on a lever arm five inches long would result in a turning moment or torque of 500 inch pounds.

The most easily recognized lever used with our Air Brake Equipment is the slack adjuster. The length of the lever arm of a slack adjuster is always the perpendicular distance between the center line of the brake camshaft opening and the center line of the clevis pin opening in the arm.

Another form of lever—not always recognized—is the brake cam. All brake cams are levers and are used to transmit and modify the torque and turning motion of the brake camshaft in such a way that the brake shoes are spread and forced against the brake drum, not only in the proper direction but also with the proper force. Spreading the shoes in the proper direction, of course, depends on the proper location of the cam in respect to the location of the brake shoes. The transmission of the proper force is partially determined by the effective lever length of the cam. If the effective lever length of the cam is not considered and is too long or too short, the brake shoe force will be correspondingly too little or too much. Full consideration must therefore be given to the effective lever length of any brake cam, if the final shoe pressure is to be correct. It is also important that the effective lever length of the cam remains constant as the lining wears and the shoes have to be spread further; otherwise, the brake performance will vary as the lining wears.

Another form of lever found in all forms of braking systems is the brake shoe. This is one of the simpler forms because it is easily recognized as a beam, fulcrumed at one end on the hinge pin, which forces the brake lining against the drum when the brake cam force is applied to the other end.

Perhaps the least easily recognized lever in a brake system is the relation of the brake drum diameter to the tire diameter. In order to understand this fully it must be remembered that although the brakes stop the brake drums and wheels, it is always the tires and road surface that stop the vehicle. This is clearly demonstrated when quick stops are attempted on wet or icy roads. Under these conditions the brake equipment may still be as efficient as ever in stopping the wheels, but its ability to stop the vehicle quickly disappears because there is not sufficient friction between the tire and road to develop the necessary retarding force.

Returning to the principles of leverage involved in the relation of the tire and brake drum size, the retarding force developed by the brake shoes acting against the drum is working on an effective lever length of the brake drum radius, whereas counteracting this is the retarding force developed between the tire and the road, working on an effective lever length of the rolling radius of the tire. Since it is not practical to have brake drums as large as the tires, the principles of leverage therefore require development of a greater retarding force between the brake shoes and the drums than between the tire and the road. Also, since a rubber tire on a good road surface has a higher coefficient of friction than brake lining against a brake drum, it is necessary to develop additional retarding force between the brake shoes and brake drum in order to overcome the difference in friction.

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DECELERATION

In discussing brakes, the term deceleration is often used. This term expresses the actual rate at which a vehicle is losing speed and usually denotes the speed being lost each second, in terms of miles per hour or feet per second.

As an example as shown in Figure 7—if a vehicle is moving at the rate of 20 miles per hour, and one

stopping distance is to be kept at a minimum, since the distance being travelled each second during the stop is always greater at the beginning of the stop.

Any time lost between the instant the brake pedal is depressed and the instant actual deceleration begins is serious, because the vehicle continues to travel at close to its initial speed. In this typical case, the loss of only one second between the instant the driver depresses the brake pedal and the point where the brakes are really applied will result in lengthening the actual stopping distance by 30 feet. Thus, if four seconds instead of three elapse between the instant the driver depresses the brake pedal and the instant the vehicle stops, the actual stopping distance will be increased from 45 feet to 75 feet. In other words, by reducing the stopping time under these conditions by only one second or 25%, the actual stopping distance is reduced by 30 feet or 40%.

It is this part of brake fundamentals which is not often enough considered in judging brake performance, particularly when different forms of brakes are involved. The most common method of testing brakes is by the use of a decelerometer—a device that determines the maximum rate of deceleration developed during a stop and which shows a calculated stopping distance from a speed of 20 miles per hour based on the maximum rate of deceleration developed during a stop. Such intruments do not, however, make allowances for lost time before the braking system develops full power and they are therefore not suitable for analyzing time lag factors in brake performance.

The true performance of any type of brake system in terms of stopping time or stopping distance can only be determined by actually measuring the time and distance the vehicle travels from the instant the driver depresses the brake pedal to the point where the vehicle actually stops. Such tests can, of course, be made comparative only by using intruments to determine accurately tiie speed of the vehicle at the instant the brake pedal is depressed.

In so far as brakes are concerned, a driver is mainly interested in the amount of time and the distance required to bring his vehicle safely to a stop under emergency conditions as measured from the instant that he depresses the brake pedal. Any lag in the time between the instant he does his part and the instant the brakes become effective increases the odds against the danger being averted.

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THE FUNDAMENTALS OF COMPRESSED AIR

Compressed air is air which has been forced into a smaller space than that which it would ordinarily occupy in its free or atmospheric state.

Free air which we breathe—or atmosphere—is normally always under pressure because of the weight of the air above it. This pressure amounts to 14.7 pounds per square inch at sea level, and it decreases as the altitude increases.

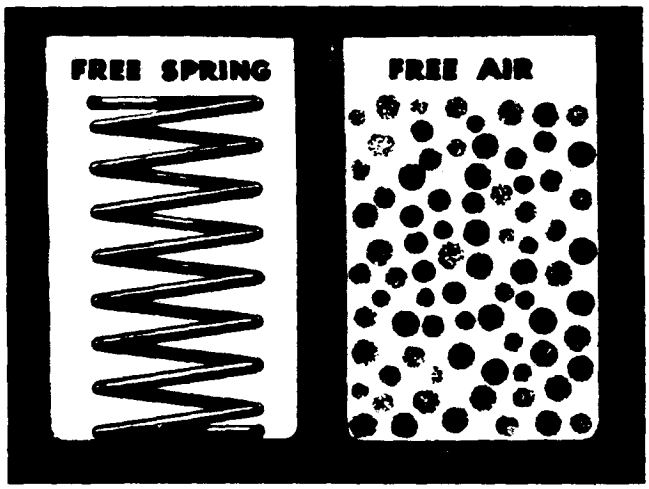

FIG. 1 Free Spring Free Air

The normal atmospheric pressure of 14.7 pounds per square inch is usually ignored, however, and the atmosphere is considered as being free air under no pressure. Thus, the pressure of compressed air is commonly indicated by stating the amount the pressure, in pounds per square inch, is above the atmosphere. This is the reason air pressure gauges register zero when connected only to atmosphere.

FREE SPRING—FREE AIR

The energy of compressed air is best compared to the energy of a coiled spring. Figure 1 shows a coiled spring in its free position and air in its free or atmospheric state.

pressure equally in all directions against the entire inside surface of the reservoir, the pressure of the compressed air being overcome by the mechanical strength of the reservoir. Similarly, the force developed by the air pressure acting on one side of a piston or a diaphragm may be overcome by an opposing force acting on the opposite side, and the opposing force may be compressed air or it may be mechanical. If the opposing forces are equal, a balanced condition is reached and there is no movement of the piston or diaphragm. If the opposing forces are not equal, the piston or diaphragm will move, if possible, to assume a position where the opposing forces are equal.

This law of balanced pressures and forces is the basic principle governing the design and operation of the control and actuating devices in an air brake system.

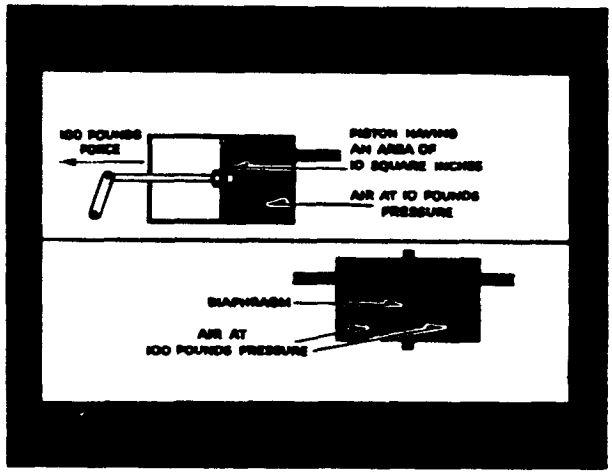

FIG. 4 Fundamentals of Compressed Air

THE FUNDAMENTALS OF COMPRESSED AIR BRAKES

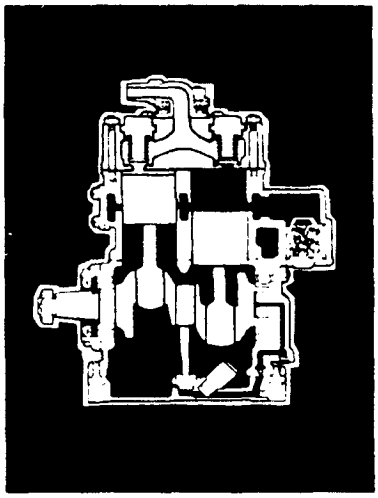

FIG. 1—Compressor

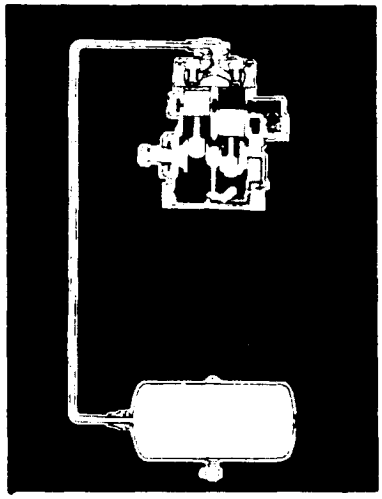

FIG. 2 —Compressor and Reservoir

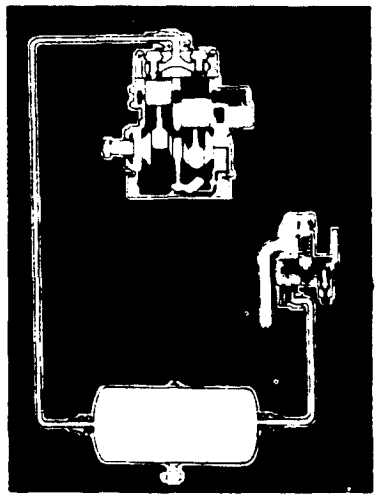

FIG. 3 —Compressor, Reservoir and Brake Valve

COMPRESSOR

In an Air Brake system, the compressor furnishes the compressed air for brake operation by taking free air or atmosphere and compressing it to a pressure approximating 100 pounds per square inch.

COMPRESSOR AND RESERVOIR

The compressed air passes from the compressor into the reservoir where it and its energy are stored until needed for operation of the brakes.

COMPRESSOR, RESERVOIR AND BRAKE VALVE

The compressed air is held in the Reservoir until released by the driver operating the Brake Valve.

when supplied with air pressure at 60 pounds per square inch. The effective area of the different brake chambers varies from six square inches to 36 square inches and their developed force at 60 pounds air pressure varies from 360 pounds to 2,160 pounds. This permits the choice of a brake chamber suitable for properly operating any size or type of brake assembly used today.

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BRAKING FORCES—EFFECT OF SLACK ADJUSTER ARM LENGTH

Figure 7 illustrates how the principles of leverage apply when a brake chamber and slack adjuster combination is being selected to meet specific requirements. With the same brake chamber force of 1,000 pounds, the torque on the brake camshaft can be increased from 4,000 inch pounds to 6,000 inch pounds merely by using a slack adjuster with a 6″ arm instead of one with a 4″ arm.

Thus, in so far as air brake equipment is concerned, the full range of braking forces for any vehicle is provided by the use of different sizes of brake chambers and slack adjusters.

A term which is used to express the relation of the brake chamber size and slack adjuster arm length is **"AL" factor.** The "AL" factor differs from torque or turning moment in that only the variable factors which determine the force are expressed. The reason for this is that an air pressure of 60 pounds is always used in calculating air braking forces and therefore, this is considered constant, whereas the length of the slack adjuster lever arm and the size or effective area of the brake chamber acting on the slack adjuster are the two variables altered to meet braking requirements. Thus, the product of the effective area of the brake chamber and the length of the slack adjuster

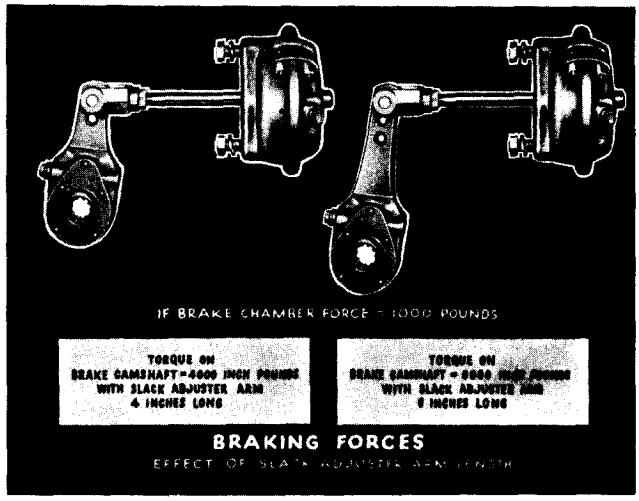
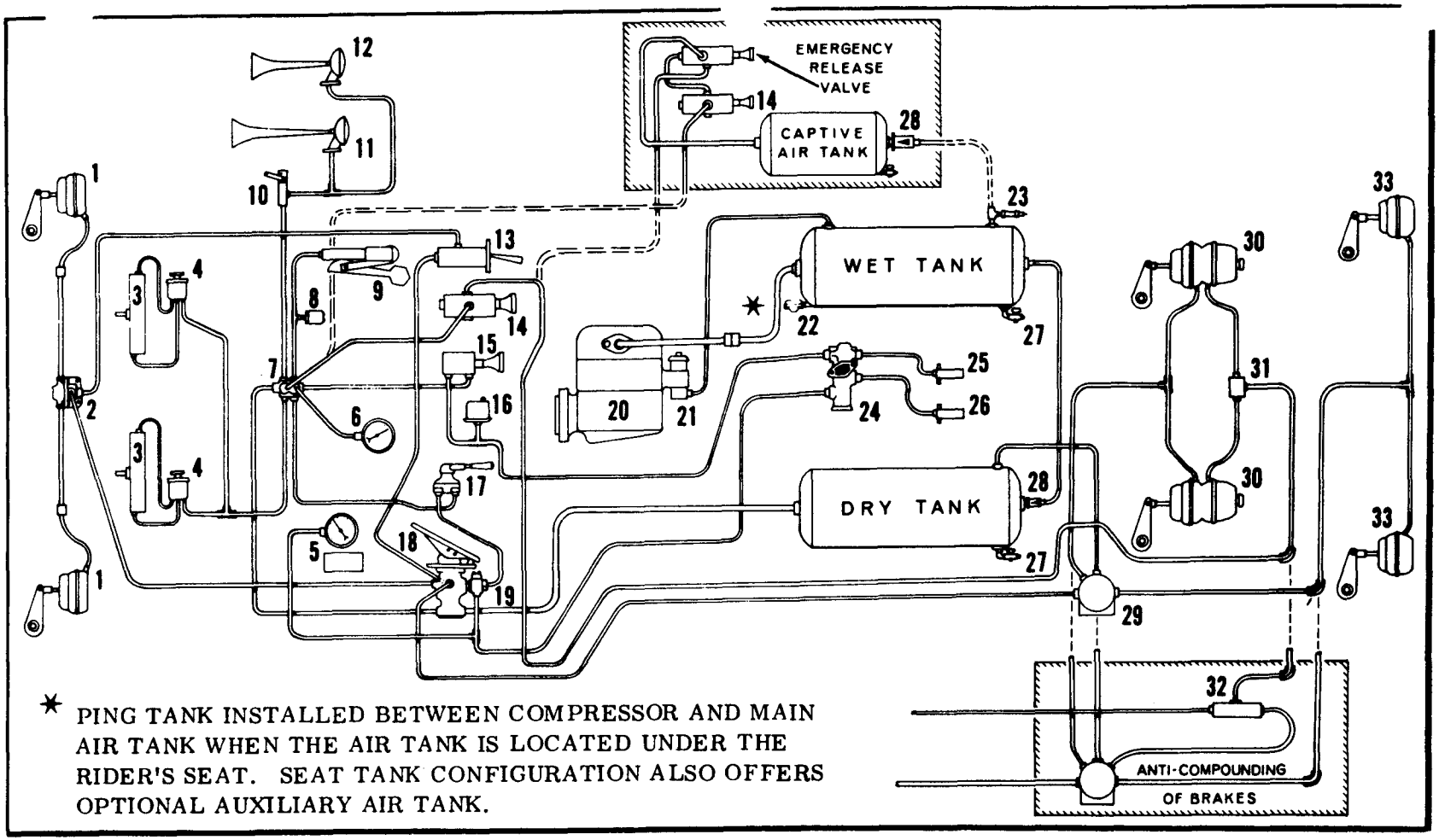


FIG. 7—Braking Forces—Effect of Slack Adjuster Arm Length

arm is expressed as the "AL" factor, which, when multiplied by the 60 pounds air pressure used in making brake calculations, determines the torque on the brake camshaft. As an example: If a brake chamber having an effective area of 16 square inches is acting on a slack adjuster having an arm length of five inches, the "AL" factor is 80. The actual torque on the brake camshaft is therefore the "AL" factor (80) multiplied by the air pressure used in making brake calculations (60), or 4,800 inch pounds.

TYPICAL AIR PIPING DIAGRAM



* PING TANK INSTALLED BETWEEN COMPRESSOR AND MAIN AIR TANK WHEN THE AIR TANK IS LOCATED UNDER THE RIDER'S SEAT. SEAT TANK CONFIGURATION ALSO OFFERS OPTIONAL AUXILIARY AIR TANK.

1. Service Brake Chamber - Front
2. Quick Release Valve - Limiting
3. Windshield Wiper Motor
4. Windshield Wiper Control
5. Application Pressure Gauge
6. System Air Pressure Gauge
7. Air Manifold
8. Low Air Warning Buzzer
9. Low Pressure Warning Device *
10. Air Horn Control Valve
11. Air Horn
12. Second Air Horn *
13. Limiting Control Valve
14. Spring Brake Control Valve
15. Trailer Protection Control Valve *
16. Trailer Emergency Stoplight Sw. *
17. Trailer Brake - Hand Control *
18. Brake Valve - Foot Control
19. Stoplight Switch - Double Check Valve *
20. Compressor
21. Governor
22. Automatic Drain Valve *
23. Safety Valve
24. Tractor Protection Valve
25. Emergency Hose Coupling
26. Service Hose Coupling
27. Drain Valve
28. Single Check Valve
29. Relay Valve
30. Service and Spring Brake Chambers
31. Quick Release Valve
32. Double Check Valve *
33. Service Brake Chamber - Rear

* Optional Equipment

TESTING FOR SERVICEABILITY

STOP LIGHT SWITCH

Drain reservoirs of all pressure. Start engine and apply brake pedal. Observe system air pressure gauge reading when stop light goes on. This should be at approximately 5 PSI. Release brakes.

COMPRESSOR

Run engine at fast idle (approx. 1000 RPM), and record time required for pressure to build from 50 to 90 PSI. This should not exceed 5 minutes.

LOW PRESSURE INDICATORS

Observe pressure when low pressure indicators reset. This should be approximately 70 PSI.

GOVERNOR

With engine still running, note pressure at which governor cuts out. This should be approximately 120 PSI. Reduce air pressure by a series of brake applications. Governor should cut in at approximately 105 PSI.

LEAKAGE

Run engine until the governor cuts out. Stop engine. With brakes released, system air pressure gauge pressure should not drop more than 2 PSI per minute. With brakes fully applied, pressure should not drop more than 3 PSI per minute.

TRACTOR PROTECTION EQUIPMENT

If equipped with Bendix-Westinghouse tractor protection valves, first check both panel-mounted air pressure gauges against a test gauge of known accuracy before performing tests. Connect the test gauge to a spare "glad-hand" hose coupling for use in the following tests.

INITIAL TEST CONDITIONS

a. Tractor Air Reservoir at atmospheric pressure.
b. Tractor Protection Valve Control in NORMAL position.
c. Emergency and Service line couplings disconnected from trailer.

TEST 1:

a. Connect Test Gauge assembly to Tractor Service coupling.
b. Start engine to build up air pressure.
c. When Air Pressure reads 30 to 40 PSI, apply brakes by foot or hand control.
d. Note Air Pressure reading on Test Gauge it should read same as Application Pressure Gauge.
e. Release Brakes, allowing air pressure to continue to build
f. Check carefully for air leakage at Emergency coupling -- there should be NO leakage until air pressure reaches 45 to 55 PSI, then air should pass through Emergency coupling.

TEST 2:

a. Pull Tractor Protection Control Valve to EMERGENCY position.
b. Connect Test Gauge to Tractor Emergency line coupling.
c. Push Tractor Protection Control Valve to NORMAL position.
d. Allow air pressure to build up to full charge.
e. Stop engine.
f. Pull Control Valve to EMERGENCY position.
g. Note Emergency line pressure reading on Test Gauge--it should drop to zero.
h. Disconnect Test Gauge.
i. Check for air leakage at Emergency line coupling--there should be NO leakage.

(Continued)

TYPE E-3 BRAKE VALVE

OPERATION

APPLYING BRAKES

As the driver depresses the pedal, force is exerted on the pressure regulating rubber spring and piston. When the piston moves downward, it contacts and closes the inlet-exhaust valve. Continued downward movement of the piston forces the inlet valve off its seat. Air pressure from the reservoir then flows through the inlet valve and out to the relay valve which applies the brakes.

BALANCING

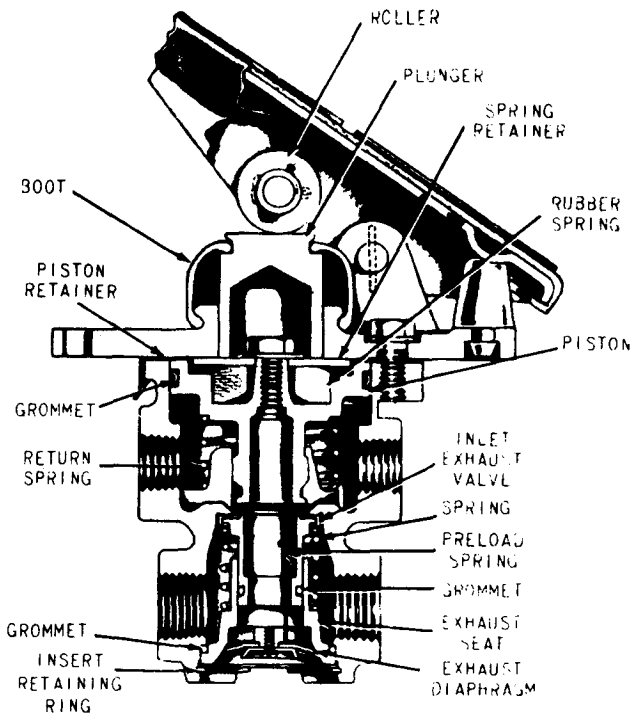
When air pressure is delivered to the relay valve from the cavity below the piston, it overcomes the mechanical force being exerted on top of the piston. The piston then lifts slightly and closes the inlet valve, cutting further supply of air pressure to the brakes. The exhaust valve remains closed, preventing any escape of air pressure. Should the driver depress the pedal further, exerting additional force on top of the piston, a corresponding increase in air pressure is delivered to the relay valve which then applies the brakes with more force.

RELEASING BRAKES

If the driver permits the pedal to partially return, reducing the force on top of the piston, the air pressure below the piston overcomes the force on top of it and the piston lifts. The inlet valve remains closed, but the exhaust valve opens to exhaust air pressure until the forces again balance. If the driver permits the pedal to return all the way, the exhaust valve opens and all air pressure in the relay valve is exhausted, thus fully releasing the brakes.

FULL APPLICATION

If the driver depresses the pedal to a fully applied position, the rubber pressure regulating spring is compressed and the piston strikes its guide in the body. The inlet valve is held open, permitting 90 PSI air pressure to pass to the relay valve which creates a severe brake application.



SECTIONAL

PREVENTIVE MAINTENANCE

EVERY 6 MONTHS or 15,000 MILES:

Lubricate lever roller and hinge pin with SAE 20 engine oil.

Lift boot away from mounting plate and put a few drops of SAE 20 engine oil between mounting plate and plunger.

EVERY 2 YEARS or 100,000 MILES:

Disassemble the brake valve and clean all parts. Replace inlet-exhaust valve and piston grommets.

BRAKE CHAMBERS

OPERATION

Brake chambers and slack adjusters convert the energy of compressed air into mechanical force and motion, which forces brake shoes against the drum.

Slack adjusters provide a quick, easy method of adjusting brakes to compensate for lining wear. The entire slack adjuster operates as a unit, rotating with the brake camshaft as the brakes are applied or released.

Most efficient brake action will be obtained when the slack adjuster arm travel is held to a minimum. The adjustments, necessary to maintain proper slack adjuster arm travel, are made by turning the adjusting screw. This rotates the worm gear, camshaft and cam, which expands the brake shoes so that slack caused by brake lining wear is taken up and the slack adjuster arm travel is returned to a minimum setting.

PREVENTIVE MAINTENANCE

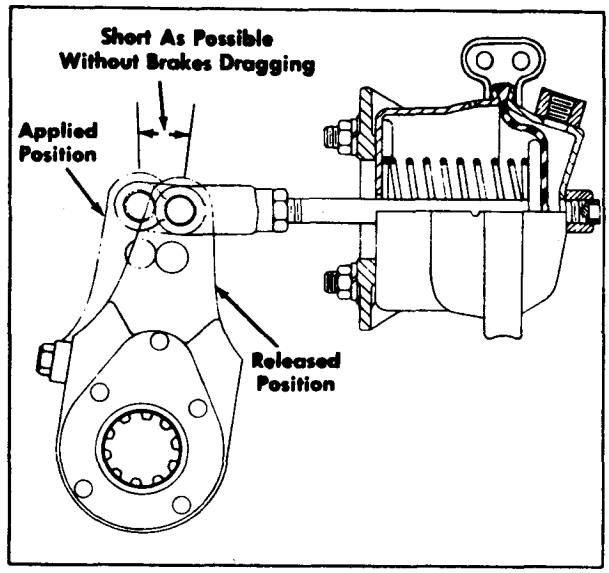
EVERY 2,000 MILES:

Check brake chamber push rod travel and adjust if needed. (Refer to chart.) Push rod travel should be kept as short as possible without brakes dragging. Excessive push rod travel shortens diaphragm life, gives slow braking response and wastes air.

NOTE: Use either an open end or socket wrench in making adjustment. Make certain that locking sleeve is held in, thereby disengaging the locking mechanism. Never use a wrench on the sleeve portion.

EVERY 2,000 MILES:

Check alignment of the push rod to the slack adjuster, to make sure there is no binding. Check this in both the applied and released positions.



Brake Adjustment at Slack Adjuster

BRAKE CHAMBER DATA
(Dimensions in Inches)

Type	Effective Area (Sq. In.)	* Outside Diameter	Maximum Stroke	Maximum Stroke With Brakes Adjusted	Maximum Stroke at Which Brakes Should Be Readjusted
12	12	5-11/16	1-3/4	Should Be	1-3/8
16	16	6-3/8	2-1/4	as short as	1-3/4
20	20	6-25/32	2-1/4	possible	1-3/4
24	24	7-7/32	2-1/4	without	1-3/4
30	30	8-3/32	2-1/2	brakes	2
36	36	9	3	dragging	2-1/4

*Dimensions listed do not include capscrew head projections for roto-chambers and bolt clamp projections for clamp type brake chambers.

EVERY 2,000 MILES:

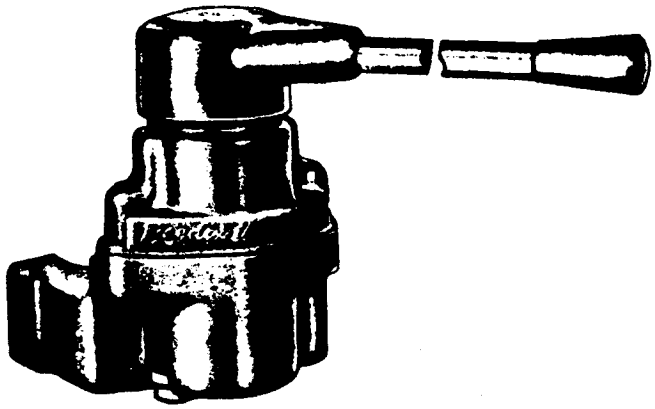
To prevent rusting of slack adjuster gears, remove pipe plug or cover and fill slack adjuster with chassis grease.

EVERY YEAR or 50,000 MILES:

Check diaphragm. With brakes applied, cover edges of clamp ring with soap suds to detect leakage. NO LEAKAGE IS PERMISSIBLE. Tighten clamp ring nuts until leakage is eliminated. Replace the diaphragm annually, or sooner if worn or leaking.

NOTE: When replacing diaphragm and/or spring on one side of an axle, they MUST also be replaced in brake chamber on other side of same axle.

HAND OPERATED BRAKE VALVE



OPERATION

Independent control of trailer brakes is valuable under adverse conditions, when it is sometimes desirable to apply the brakes on the trailer without applying the brakes on the truck or tractor. The independent trailer control valve, conveniently located in the cab, provides the operator with perfect control of his trailing load at all times.

PREVENTIVE MAINTENANCE

EVERY YEAR or 50,000 MILES:

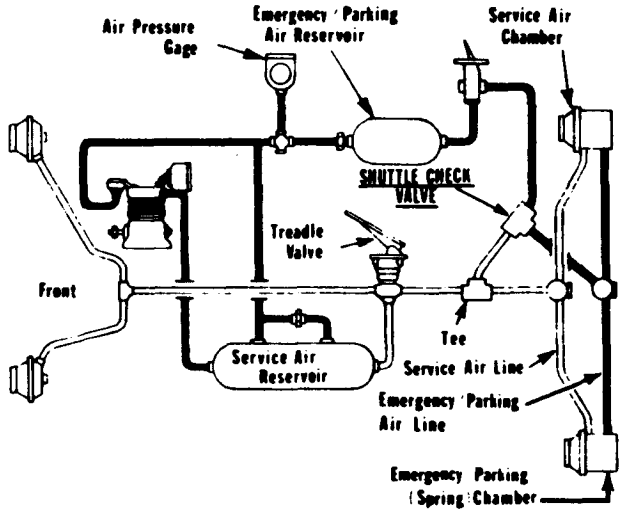
Disassemble and clean all parts. Install new inlet and exhaust valve assembly.

Leakage Test -- Coat exhaust port with soap suds with brakes applied and released. Leakage may be caused by dirt or worn parts which may be corrected by cleaning and/or replacing parts.

BRAKE ANTI-COMPOUNDING

Applying service brakes and the emergency/parking system simultaneously (compound brake application) can cause damage to brake actuating components. When air pressure from the service system is actuating the brakes, and the emergency/parking system is actuated by exhausting hold-off air pressure, the spring can exert enough additional pressure on the push rod to generate input forces of over 25,000 lb. ins. to the brakes.

To eliminate the possibility of accidental brake compounding, it is recommended that the optional anti-compounding system be installed, as shown in the diagram.



OPERATION

With this optional system, if the spring chamber is applying brake pressure and the service system is actuated, the shuttle check valve by-passes enough service air into the emergency/parking system to relieve spring chamber pressure.

PREVENTIVE MAINTENANCE

Remove the shuttle check valve, disassemble, clean thoroughly, and replace worn or deteriorated parts.

FRONT AXLE QUICK-RELEASE LIMITING SYSTEM

OPERATION

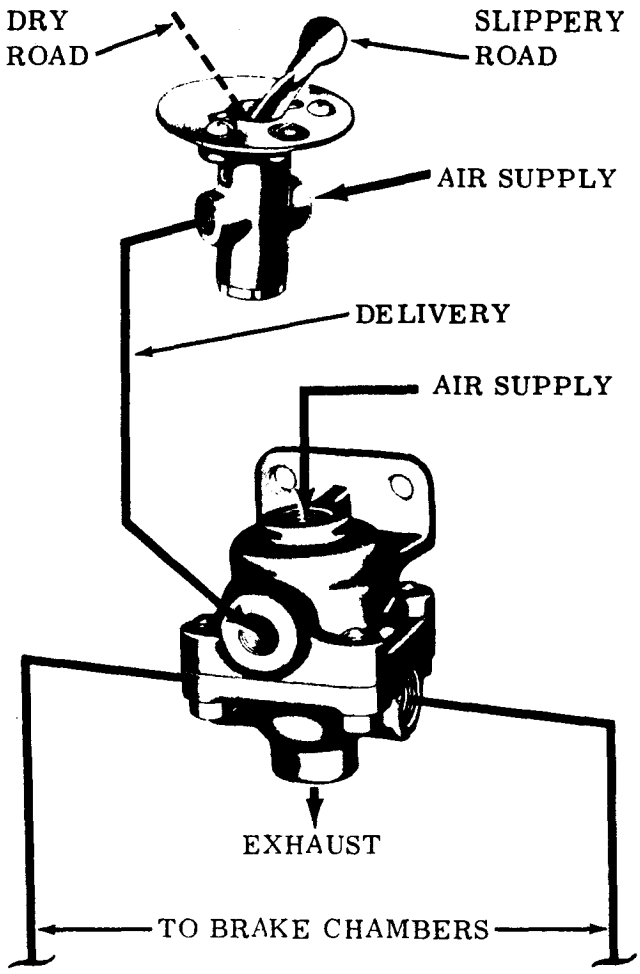
The front axle Quick-Release and Limiting Valve, normally mounted near the steering axle, is used in combination with a dash-mounted two-way Control Valve which allows the driver to select either 100% or 50% brake action at the front wheels, depending on road conditions. The Control Valve positions are labeled "Dry Road" and "Slippery Road".

DRY ROAD POSITION

When the two-way control valve lever is in the DRY ROAD (Release) position, the inlet valve is open and the exhaust valve closed, allowing air to the side inlet port of the Quick-Release Limiting Valve. When a brake application is made, air enters the side inlet port and the top inlet port of the Quick-Release Limiting Valve, causing pressure to build up on the top and side areas of the piston. The piston moves down, closing the exhaust port and opening the delivery ports to the two brake chambers. When pressure beneath the Quick Release Valve piston and in the brake chambers equals application pressure, the piston raises slightly, closing the inlet valve to maintain a constant, balanced pressure force. Upon release of the foot brake, air pressure on the top and sides of the piston is exhausted through the foot valve. Air pressure beneath the piston raises it, opening the exhaust valve and allowing brake chamber pressure to exhaust immediately through the Quick-Release Valve exhaust port.

SLIPPERY ROAD POSITION

Placing the two-way control valve lever in the SLIPPERY ROAD (Delivery) position closes its inlet valve and opens the exhaust valve, thus cutting off air pressure to the Quick-Release Limiting Valve side inlet port. Now, only the top inlet port admits air pressure, reducing the actuating pressure force by 50% because the piston's upper inner area is only half that of the total area beneath the piston.



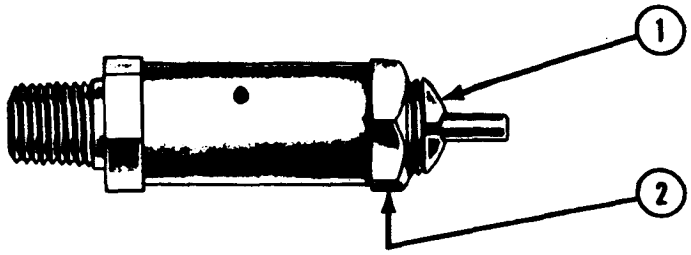
When the pressure beneath the piston reaches approximately half the application pressure, the piston raises to close the inlet valve earlier, thus delivering half the application pressure to the front brake chambers. Release action is identical to that above.

PREVENTIVE MAINTENANCE

ANNUALLY OR EVERY 50,000 MILES:

Disassemble Quick-Release Limiting Valve and Two-Way Control Valve. Clean with a cleaning solvent having no detrimental effect on metal or rubber material. The inlet and exhaust valve boots and piston grommets should be checked and replaced as necessary.

SAFETY VALVE



OPERATION

The safety valve protects the air brake system against excessive pressure and should be connected to the same reservoir as the compressor discharge line. Should reservoir pressure go above 150 pounds, the ball is forced off its seat, thus permitting air to escape. When pressure drops to 150 pounds the spring forces the ball to its seat, preventing any further escape.

ADJUSTMENT

After cleaning, or if replacing the safety valve, it should be bench-tested & adjusted before installation. Pressure setting may be raised by turning the adjusting screw (1) clockwise or lowered by turning the adjusting screw counter-clockwise. Always loosen lock nut (2) before adjusting, and make certain it is tightened after adjustment has been made. The safety valve should "blow off" at approximately 150 pounds.

AIR HORN & VALVE

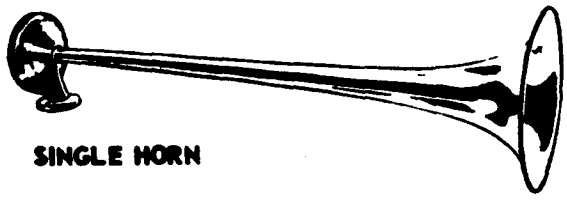
PREVENTIVE MAINTENANCE

EVERY SIX MONTHS:

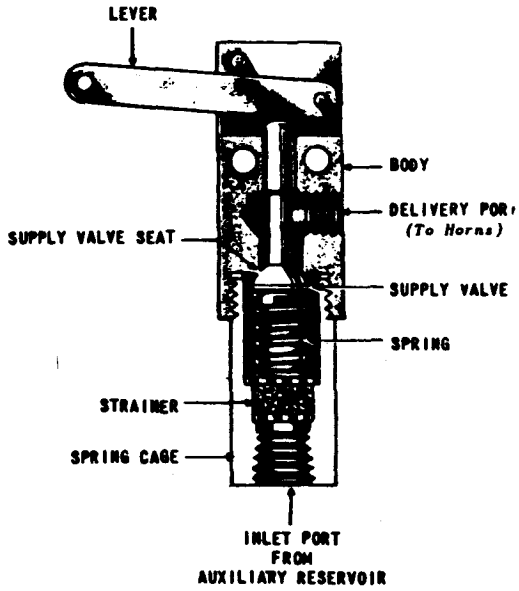
Remove and clean dirt screens in horn bells. Remove strainer in bottom of horn valve and clean thoroughly in cleaning solvent.

EVERY YEAR:

Disassemble air horn and valve and clean all parts.



SINGLE HORN



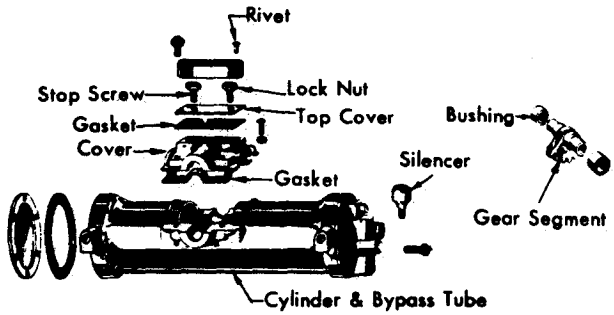
The instructions below must be carefully followed, otherwise the stop screws will be improperly set and the valves may be damaged.

1. In most installations, the wiper motor will have to be removed and connected to an air hose.
2. Turn on a slight amount of air to the motor, to let it operate at its slowest possible speed.
3. Remove cap, by prying up with a screwdriver and forcing out rivets.
4. Loosen locknut and run down stop screw (on one side) until the wiper motor stops. Back out stop screw just enough (approx. 1/2 turn) to permit motor to operate, then tighten locknut.
5. Repeat foregoing procedure on other stop screw (approx. 1/2 turn).
6. Replace cap and rivets.

PREVENTIVE MAINTENANCE

Periodically, the wiper motor should be completely disassembled, cleaned and lubricated (with special "Trico Wiperlube") or replaced with a reconditioned unit.

For complete repair and rebuild instructions on the Trico Windshield Wiper, contact the Kenworth Factory, Field Service Department.



NOTE 1: If operating in Sub-freezing temperatures, it is recommended that an alcohol evaporator be installed to prevent moisture from freezing in the drain valve.

NOTE 2: A constant bleed-off of air through this valve indicates an excessive air leak in the system.

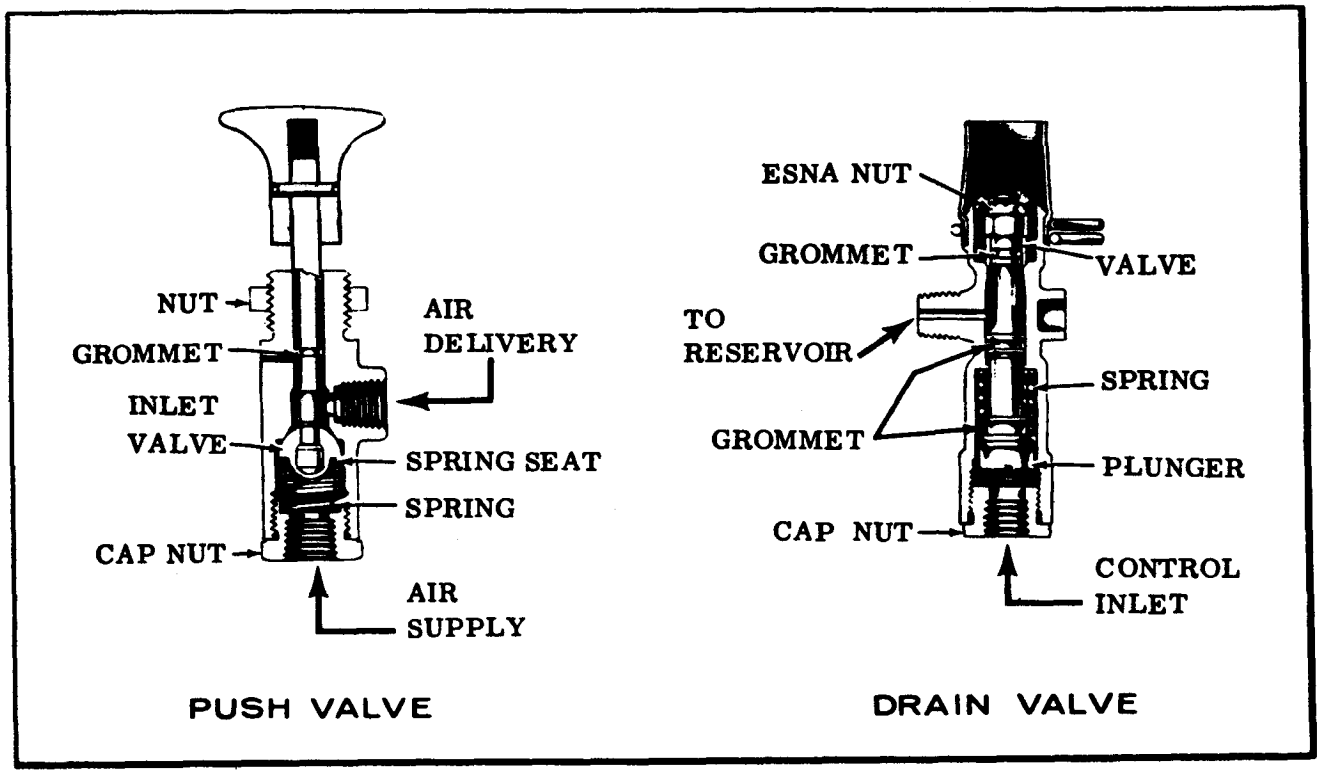
EVERY 6 MONTHS or 25,000 MILES:

Remove, disassemble, clean and inspect parts for wear or deterioration. Replace worn or deteriorated parts. Lubricate before assembly.

Give special attention to the filter. The filter MUST be clean. If it is clogged or damaged, it should be replaced.

NOTE: NEVER install an automatic drain valve without a filter. To prevent early clogging of the filter, thoroughly flush out and clean the air tank before installing the drain valve. If any solvents are used in the tank cleaning process, blow the tank out with air until it is dry internally.

REMOTE CONTROL



BENDIX WEDGE ACTUATED BRAKES

Bendix wedge actuated brakes are mechanical brakes for use with air or hydraulic brake systems on heavy duty vehicles. The brake system can be changed from air to hydraulic or vice-versa by using an air brake chamber or hydraulic cylinder, as required.

Bendix Wedge Brakes are furnished in two basic types. One is a non-servo single actuator type used on front wheels only. (Fig. 1). Brake shoes are not pinned to the backing plate, but contact an anchor block which is riveted to the backing plate. Since shoes anchor at one end and are operated by a single wedge, there is one forward acting or leading shoe and one reverse acting or trailing shoe.

The brake having two wedges or actuating mechanisms is known as the Bendix Twinplex Wedge brake (Fig. 2). Both shoes are forward acting regardless of the direction of wheel rotation. (Fig. 2)

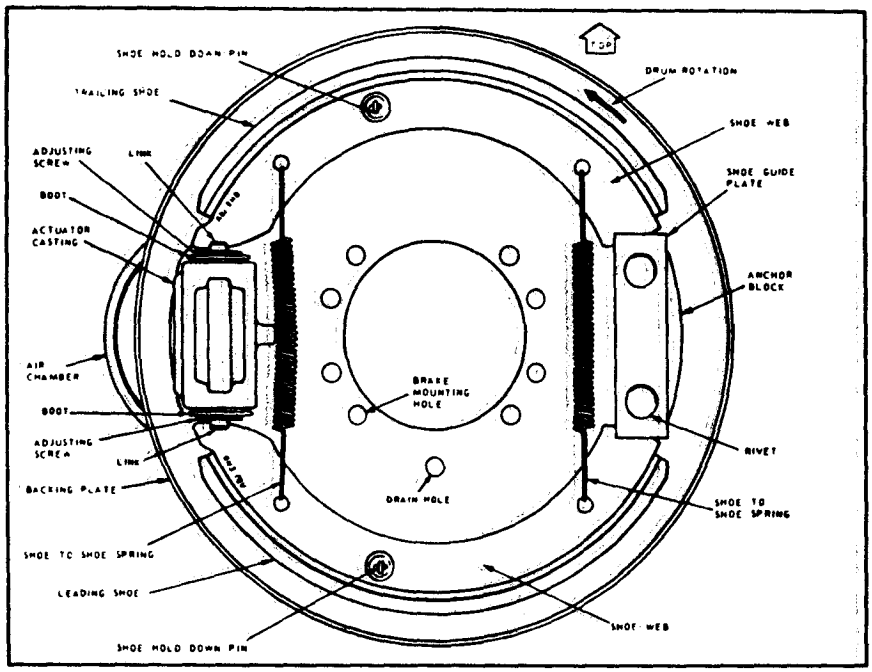


FIG. 1 FRONT NON-SERVO WEDGE BRAKE

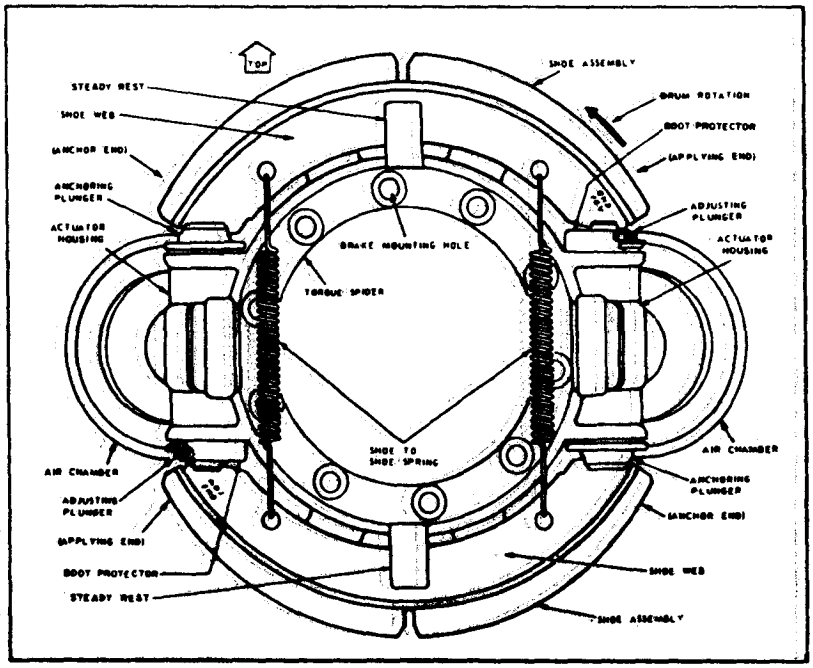


FIG. 2 FRONT & REAR BENDIX TWINPLEX WEDGE BRAKE

SERVICING BRAKE MECHANISM AND AIR CHAMBERS

DISASSEMBLY

1. After removing brake shoes disconnect air hoses from brake chambers.
2. Use a drift and hammer to remove peened sections of retainer from spanner nut. Loosen nut and unscrew air chamber (or hydraulic cylinder) from actuator casting.
3. Remove wedge and return spring assembly, being careful not to damage surfaces of wedge and rollers.
4. Refer to exploded view. (Fig. 3) Disengage dust boot protectors (1) and dust boots (6 and 18) from the actuator casting (25). Pull plunger assemblies (10 and 17) from the casting bore. On Non-Servo type, remove actuator housing (25) from backing plate. *DO NOT REMOVE ROLLER STOP SPRING FROM ACTUATOR. (SEE FIG. 4).*
5. Remove adjuster lever and lever spring from actuator. (See Fig. 7)
6. Disassemble adjuster mechanism. Thread adjusting screw (5) from nut (8). Remove boot. Remove overload spring from top of adjusting nut. (Fig. 5). Separate adjuster tooth ring from adjusting nut. Pry link (2) out of adjusting screw. Separate detent spring (3) from link. Remove retainer ring (4) from link.
7. Clean metal parts in suitable solvent. Replace rubber parts whenever brake is disassembled. Replace damaged or worn metal parts. Do not use gasoline or hot water solutions on metal parts.
8. Inspect the following. Repair or replace defective parts.

Wedge assembly (13) — Check wedge shaft and wedge surfaces for scoring. Check rollers for scoring, cracks or flat spots. Check spring clip for fatigue cracks.

Pistons—Check outside surface for scoring. Check shoe web slot of anchor piston for roughness.

Adjusting screw and adjusting nut — Check for sheared threads. Check that screw turns easily in nut. Check adjuster tooth ring teeth (9) for wear.

Link — Check shoe web slot for roughness and cracks.

Adjuster lever (12) — Check lever for fatigue cracks and distortion.

Spider assembly (16) — Twinplex design — Inspect machined bores of actuators for roughness. Use emery cloth to remove any rough areas which interfere with piston movement. Check adjuster lever pin for corrosion or distortion. Check shoe guide pads and guide brackets for roughness on the rubbing surfaces. Inspect area around mounting holes for cracks.

Actuator — Non-Servo design — Inspect bores for roughness. Use emery cloth to remove any rough areas which interfere with piston movement. Check adjuster lever pin for corrosion or distortion.

Backing plate (26) — Non-Servo design — Check shoe guide bosses for roughness.

Air Chamber — Inspect air chamber diaphragm for fatigue cracks, wear and deterioration. Replace with new diaphragm if necessary.

ASSEMBLY

1. Reverse the disassembly process to reassemble unit. Make certain that Twinplex anchoring plungers are assembled correctly, left and right, and that new dust boots (6 and 18) fit into groove or under adjusting nut on end of plunger. With the plungers assembled in the cylinder bores, press retainer of boot assemblies into the cylinder housings. Use approved lubricant on adjusting screw threads (5), on outside diameter of adjusting screw nuts (8), on the internal portion of wedge boots on wedges, rollers, lever (12), spring (11), and outside diameters of plungers (10 & 17). Use brick Lubriplate to coat slots in plunger links (2), backing plate and spider shoe guide bosses, anchor rubbing surfaces and, on Non-Servo type, the shoe hold-down springs and pins.
2. When installing plungers in cylinder bores, make certain the guide pin in the side of each plunger is aligned in cylinder slot.
3. When installing air chamber, be sure the end of the wedge shaft is seated in the diaphragm push-rod of the air chamber. Thread air chamber into wedge housing until chamber bottoms, then back out less than one turn to align chamber for hose connections. Be sure atmosphere vent hole in chamber points downward.

TROUBLE SHOOTING

NOTE: When brake trouble develops, it is often caused by something other than the foundation brake or the brake lining. Check the entire actuating system as well as the brakes themselves.

1. Brakes will not apply
   a. Broken air line
   b. Defective brake application valve
   c. Defective relay emergency valve (trailer only)
   d. Ruptured brake chamber diaphragm
   e. Corroded or frozen plungers
   f. Air chamber not completely threaded into actuator housing
2. Braking inadequate
   a. Vehicle overloaded
   b. Low air pressure
   c. Glazed linings
   d. Incorrect brake lining type
   e. Brakes not correctly adjusted
3. Brakes apply too slowly
   a. Restriction in air lines
   b. Low air pressure
   c. Defective brake application valve
   d. Defective relay emergency valve
   e. Water, oil or ice in air system
   f. Excessive leakage at air chambers
   g. Rusted or corroded plungers
4. Brakes will not release or release slowly
   a. Defective brake application valve
   b. Defective relay emergency valve (trailer brakes)
   c. Restricted air lines
   d. Broken or weak wedge return spring in actuator housing
   e. Weak or broken shoe-to-shoe springs in foundation brake
   f. Brake shoes adjusted too close to drum
   g. Shoe guide ledges or corroded
   h. Binding of wedge actuating mechanism because of inadequate lubrication
   i. Plungers corroded and sluggish or frozen in cylinder bore
5. Grabby brakes or uneven braking
   a. Defective brake application valve
   b. Defective relay emergency valve (trailer brakes)
   c. Grease on linings
   d. Scored, cracked or broken brake drum
   e. Bent brake shoes
   f. Cracked lining or lining loose on shoes
   g. Incorrect wheel bearing adjustment
   h. Eccentric brake drum
   i. Binding of wedge actuating mechanism

Fig. 6 is an exploded view of the adjusting plunger showing all parts used in the adjusting mechanism of the Wedge Actuated, Non-servo Brake.

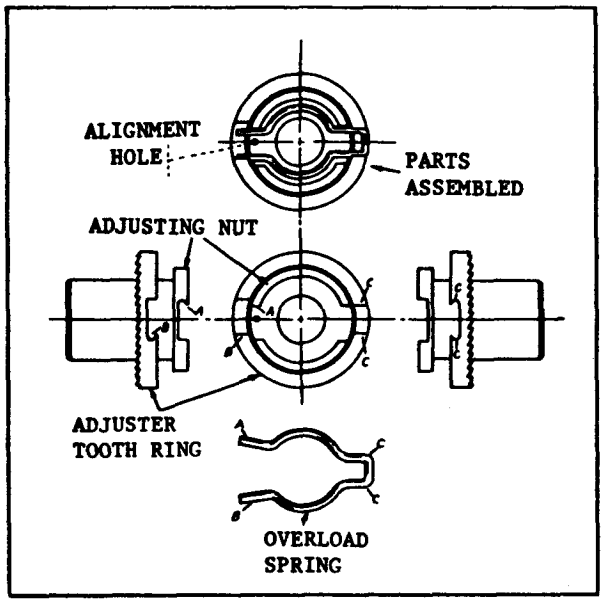
VEHICLE "ROCK-BACK"

If the lever engages a new tooth just before a vehicle "rock-back" condition, damage to the lever is prevented during "rock-back" by the action of the overload spring. This spring is installed between the adjuster tooth ring and the adjusting screw nut. Vehicle "rock-back" occurs at the end of the brake stop when the suspension members and the deflected tires cause the wheels to rotate slightly in the reverse direction. During "rock-back" the brakes are held applied and the shoes are held firmly expanded against the drum. This condition prevents rotation of the adjusting nut around the adjusting screw. During "rock-back" the applying end of the brake shoe moves back against the adjusting screw to force the plunger back into the casting. In order to prevent the lever from being damaged when this situation develops, the tooth ring rotates against the overload spring which absorbs the tooth ring movement.

CLEANING AND INSPECTION ASSEMBLY OF BRAKE AND ADJUSTER MECHANISM

NOTE: Use Texaco EP-1 lubricant.

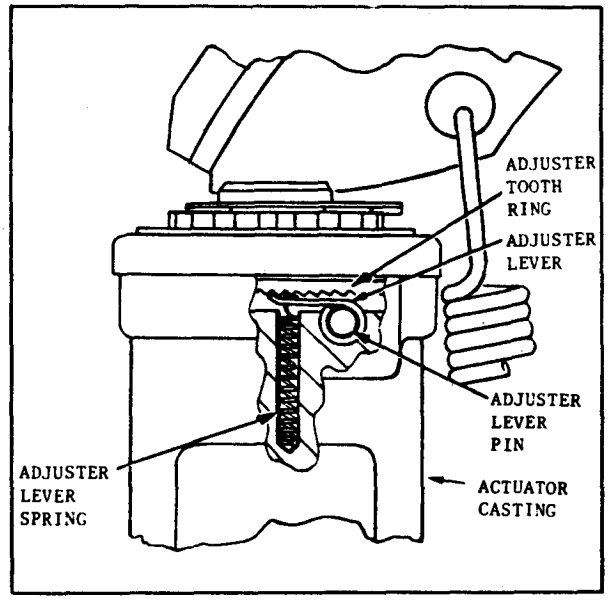
1. Install actuator casting to backing plate being sure the shoe return spring boss, on the side of the casting, is toward center of brake.



Adjusting Nut, Tooth Ring, and Overload Spring

FIG. 6

2. Assemble adjuster tooth ring over adjusting screw nut, aligning slots as shown in Fig. 6. The overload spring, adjusting screw nut, and adjuster tooth ring must be assembled correctly for proper functioning of the unit. Align the hole in the nut with the notch in the ring. Insert a rod or drill in the hole to insure alignment. Install spring with open end of spring toward alignment hole. Engage overload spring in tooth ring slot and hook ends of spring in nut and ring respectively. Be sure spring is securely engaged and seated. Check the assembly by turning tooth ring clockwise relative to nut. The ring should move clockwise (against the overload spring), but should not move counterclockwise.
3. Place detent springs on links and align flat sides of hole with flats on link. Press link into adjusting screw and align detent between starwheel teeth.
4. Install dust boots over threads of adjusting screws. Coat screw threads with lubricant. Install adjusting screws into nuts finger tight. Back off one turn.
5. Coat O.D. of adjusting screw nut with lubricant, then install nut into plunger.



Lever and Lever Spring Installed — Cutaway View

FIG. 7

6. Hook lever spring in hole in the lever. Coat lever and spring with lubricant. Install parts in actuator casting.
7. Lubricate O.D. of plungers. Install plungers into actuator casting. Align guide pin with slot in casting.
8. Press dust boot assembly into actuator casting.

FAIL-SAFE UNIT

MGM "Shortstop" Spring Brake units provide mechanical actuation of Bendix Wedge Brakes in the event of air pressure failure. During normal operation the power spring is held compressed by air pressure under the piston. When air pressure falls to the point where force under the piston is overcome by the power spring, brakes are mechanically applied. The power spring forces the piston downward. The movement is transmitted to the release bolt which in turn moves against the pushrod and pressure plate assembly. This forces the wedge between the rollers, applying the brake.

If air pressure fails and brakes are applied by the Spring Brake, the brakes can be released either by re-establishing air pressure or by the following procedure:

ROCKWELL STOPMASTER BRAKES

DESCRIPTION

The Stopmaster Brake is a compact unit designed to incorporate all the desirable features required in a heavy duty brake. It is furnished for either air or hydraulic actuation with no basic change in brake design. An automatic adjusting device is optional in either the air or hydraulic version. A fail-safe unit can be incorporated into the air actuated brake.

The Stopmaster brake can be either spider mounted or backing plate mounted. It has two shoes which are expanded against the brake drum by forcing a wedge between them. The wedge is actuated by direct thrust of either a hydraulic piston or an air chamber. (See Fig. 1)

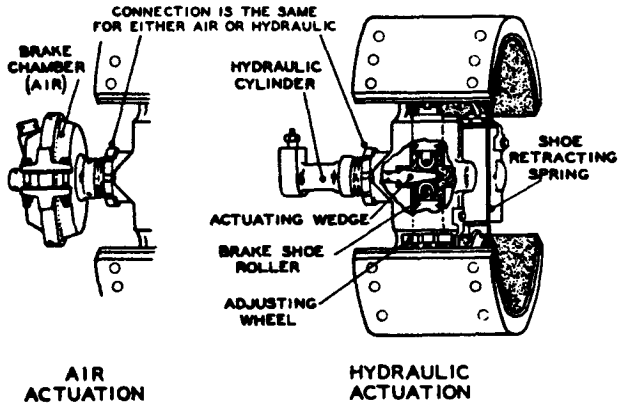


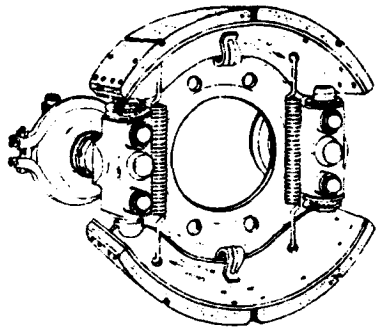
FIG. 1

Some brakes have two wedges, one between each end of each shoe, while other models have one wedge.

Where two actuating units are used there may be a Fail-Safe on one unit or both. On cast spiders the plunger housings (actuators) may be either integral or bolted on.

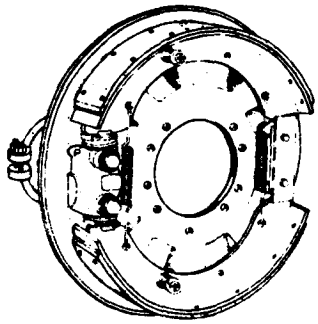
The various basic Stopmaster brakes are identified as Model RDA, RDH, RSA, or RSH with letters denoting the following:

R — Stopmaster Brake, Wedge Actuated
D — Double Actuated
S — Single Actuated
A — Air Operated
H — Hydraulic Operated



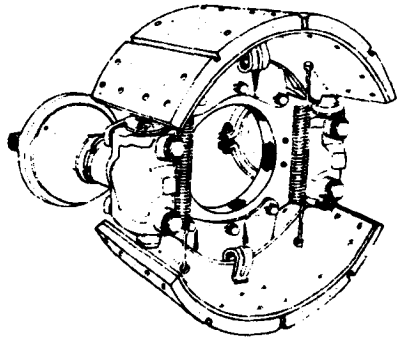
RDA

Bolted on Spider Mounted
Integral Plunger Housings



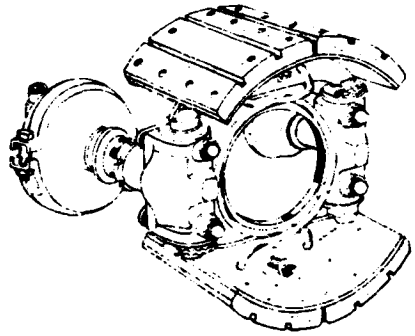
RSA

Backing Plate Mounted
Bolted on Plunger Housings



RDA

Welded on Spider Mounted
Bolted on Plunger Housings

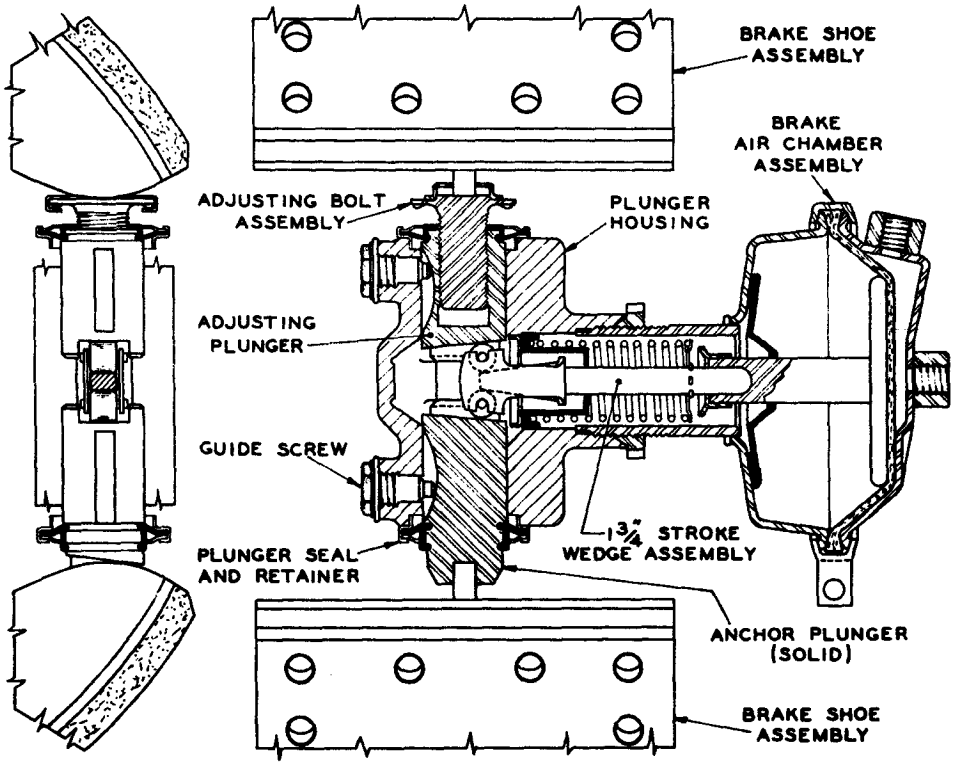


RDA

Welded on Spider Mounted
Bolted on Plunger Housings

STOPMASTER ACTUATING SYSTEM

Fig. 3 shows a cross-section of one of the actuators of a model RDA Stopmaster Brake. All parts are shown in the off position.



MANUAL ADJUSTING PLUNGER

FIG. 3

This system has an air chamber power unit threaded into the wedge bore of the plunger housing. The wedge rod fits into a socket in the end of the diaphragm pushrod. The wedge retracting spring acts as the return spring for both the wedge and the diaphragm. A pair of rollers is held in place on the wedge head by a retaining cage. The rollers are also engaged in corresponding slots in the inner ends of the plungers. The unslotted portions of the inner ends of the plungers rest on abutments in the plunger housing. The outer ends of the plungers engage with and support the brake shoes.

On a double-actuated brake, each of the two actuating systems has one anchor (solid) plunger and one adjustable plunger (as illustrated). On a single actuated brake the one actuating system would have two adjustable plungers. All of the plungers are retained in the housings and the roller slots are kept in proper alignment by means of guide screws which engage slots in the side of the plungers. A hydraulic brake would have a hydraulic cylinder threaded into the plunger housing (in place of the air chamber). The hydraulic piston would connect with the wedge rod.

When the brake is actuated, the air chamber pushes the wedge deeper between the rollers. This spreads the rollers and plungers and pushes the brake shoes outward. Initially all plungers are lifted off the plunger abutments and are momentarily suspended. As the shoes (linings) contact the drum, the drum drags the shoes and the suspended plungers around with it. This causes the plunger at the trailing end of each shoe to reseat on its abutment and thus absorb and transfer the brake torque to the brake support. When the brake is released, the wedge spring returns the wedge and diaphragm to the off position. At the same time, the shoe return springs push the raised plungers back into their housings.

SERVICING THE STOPMASTER BRAKE

Condensed Instructions are Given Below.
Detailed Instructions are on Pages 28 to 34.

DISASSEMBLING BRAKE

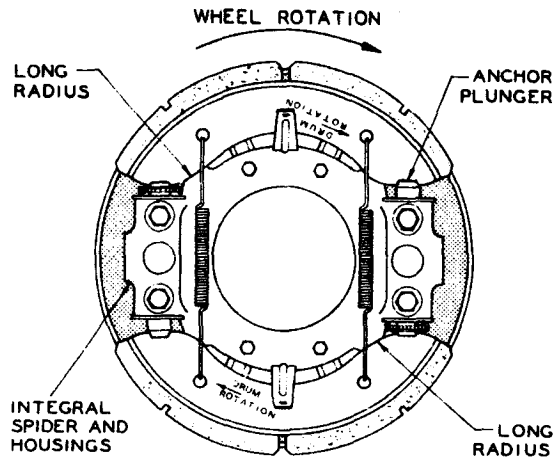
NOTE: Before removing brake chamber (or hydraulic cylinder) mark with chalk or scribe its position to be sure the assembly is reinstalled in the same position.

1. Remove backing plate.
2. Use a spanner wrench to loosen spanner nut and retainer. Screw air chamber assembly out of brake spider.
3. Remove wedge, spring and roller assembly.
4. Remove brake shoe return springs and shoes.
5. Unscrew plunger guide screws and remove plungers (Fig. A). (Do not mix solid plungers from R.H. and L.H. brakes).
6. Disassemble air chamber for inspection of diaphragm.

(against the spring). When the brake is released, all parts return to their starting points. As lining wears, the plunger stroke and resulting pawl lift gradually increase until the pawl climbs over and drops into the next tooth space. This time, when the brake is released and the plunger is pushed back in its bore, the upright face of the pawl teeth causes the adjusting sleeve to rotate and advance the adjusting bolt. This reduces the lining clearance and the cycle starts over again. The automatic adjuster operates only in forward vehicle direction.

PLUNGER AND SHOE POSITION

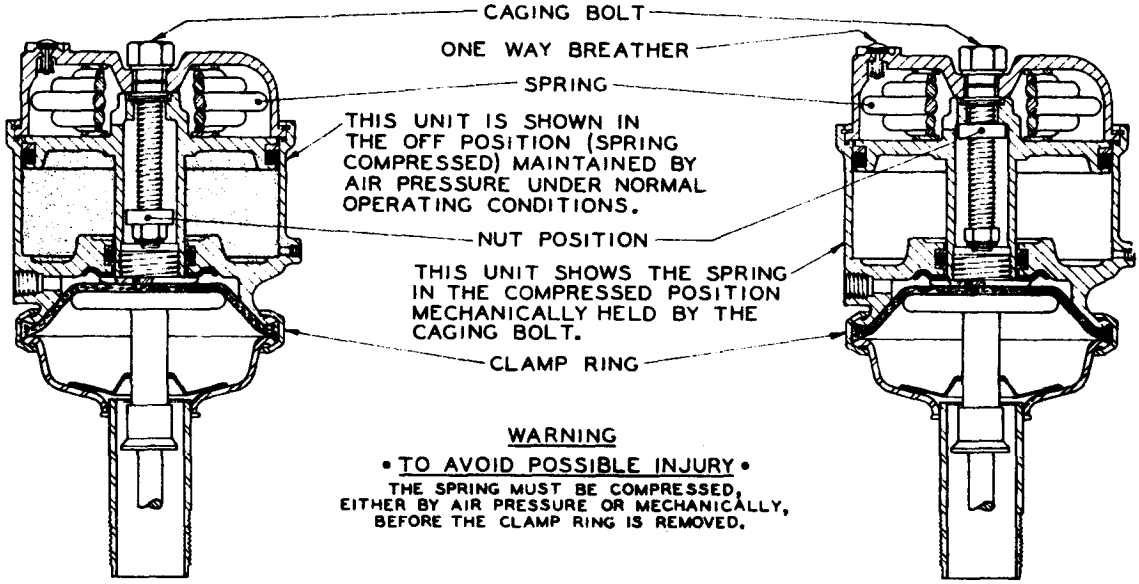
On double-actuated brakes, the anchor (solid) plungers should be positioned at the trailing end of each shoe (where they will absorb the brake torque during forward wheel rotation). This will position the adjustable plungers at the leading end of the shoes. The shoe web is unsymmetrical. The *long radius end* should be engaged with the *adjustable plungers.* An Arrow stamped in the shoe web must point in the direction of forward wheel rotation. (See Fig. 5)



RIGHT HAND BRAKE

PLUNGER AND SHOE POSITION

FIG. 5



SUPER FAIL-SAFE UNIT

FIG. 6

FAIL-SAFE UNITS FOR STOPMASTER BRAKES

The Fail-Safe unit is a spring powered brake actuator assembled piggy-back on the air chamber. In normal service when there is at least 70 p.s.i. air pressure in the system, air pressure against the bottom of the piston keeps the spring compressed. When pressure drops below 70 p.s.i. the spring expands and applies the brake by pushing on the diaphragm plate.

On the Super Fail-Safe units an internal venting system working in conjunction with a one-way breathing arrangement on the cap allows system air to fill the vacuum behind the piston when the Fail-Safe is actuated and keeps the unit sealed from direct atmospheric contamination.

SERVICE RECOMMENDATIONS

Safety Precaution: When the brakes are equipped with Fail-Safe units (or other auxiliary spring power units), cage the power springs before starting any disassembly or removal of wheels and drums. After parts are all reassembled and in place, uncage the power springs before returning the vehicle to service.

When a vehicle is disabled due to low or lost air pressure, block wheels and cage the power springs before moving the vehicle.

Manually Caging and Uncaging Fail-Safe Units: On the custom Fail-Safe, the head of the caging bolt is exposed at all times beyond the plastic cap. However, the cap should be backed off 3 turns before turning caging bolt — otherwise the bolt may damage the cap. On the standard Fail-Safe, first loosen the boot clamp screw and remove the rubber boot (if one is used). Then loosen the caging bolt-lock screws and swing the lock out of the way.

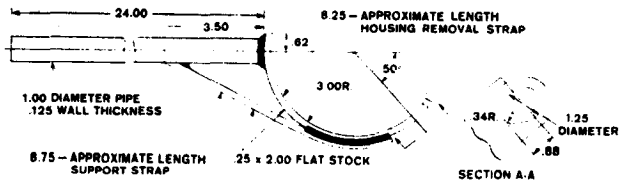


FIG. 9

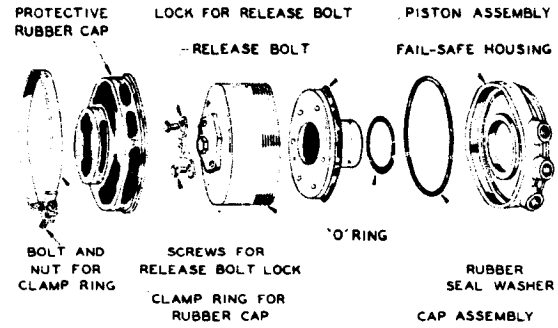
STRAP WRENCH CAN BE FABRICATED ACCORDING TO DRAWING ABOVE OR MAY BE PURCHASED FROM ROCKWELL STANDARD, ASHTABULA, OHIO UNDER PART NO. 3787-E-707

ASSEMBLE
(PRECAUTIONARY NOTES)

Inspect and check for worn parts that may need replacement. Inspect the threads, bore and the end of the cap and spring assembly carefully for nicks or scratches that would affect sealing. Clean all parts. DO NOT use solvent to clean leather piston seal, rubber boot, back-up rings, "O" rings or plastic cap (on Custom Fail-Safe units). Use hot soapy water.

Wipe the internal parts clean with a soft cloth and re-grease thoroughly with recommended grease. The power spring and all mating parts should be packed with grease.

A. Install new rubber washer and "O" ring seal in proper grooves of Fail-Safe housing. The rubber washer must fit completely and squarely in its groove.
B. Install piston and seal assembly half way into the cap.



FAIL-SAFE UNIT
STANDARD AND CUSTOM

FIG. 10

C. Clamp hexagon part of cap securely in a vise and place Fail-Safe housing onto piston and seal assembly. Push housing down to engage threads on cap.
D. Tighten housing onto cap until it bottoms, using wrench used for disassembly.
E. Bench test for leaks. Plug one Fail-Safe port and apply air pressure (150 psi maximum) to other Fail-Safe port. Apply soapy water to check for leaks in three places. Bubbles at release bolt indicate leakage at leather piston seal and bubbles at piston plunger indicate leakage at "O" ring. These leaks can generally be corrected by cycling the piston (with spring uncaged) by applying and releasing air pressure. Bubbles at the cap threads indicate leakage past the rubber washer. This leakage is corrected by reassembling cap and housing and properly installing the rubber washer.
F. To install Fail-Safe unit onto non-pressure half of power unit assemble in the reverse manner in which it was disassembled.

SUPER FAIL-SAFE — DISASSEMBLE

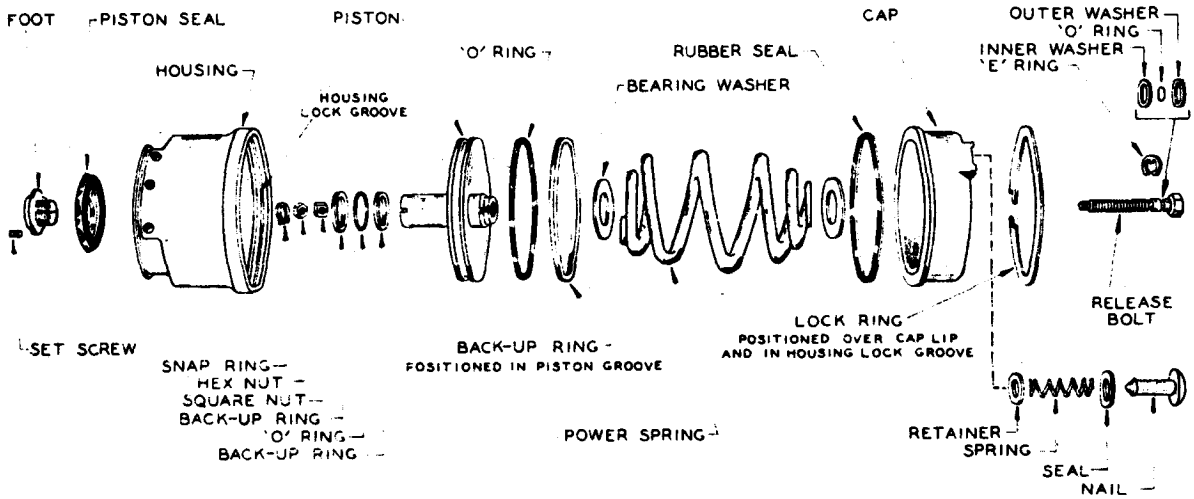


FIG. 11

A. Follow procedures A thru D of diaphragm replacement.
B. Release foot set screw and unscrew foot from piston. Remove piston seal and sealing compound if used, located at front joint between cap and housing.
C. Take out lock ring and separate cap, spring and piston assembly from housing. Remove rubber seal from housing if used.
D. Remove hex nut and snap ring from release bolt. Secure cap, spring and piston assembly in arbor press or disassembly fixture (as shown in Fig. 12).

D. Install spring retainer over wedge shaft and position centrally over cage and roller assembly. Install rubber boot when used.
E. Install wedge spring over wedge shaft, large coil diameter first. Add spring washer and compress spring by hand far enough to expose cotter key hole or "E" lock groove and install lock (cotter key or "E" washer).
F. Install the wedge assembly into the plunger housing. Check for correct roller-plunger engagement by (1) pushing on wedge rod by hand while checking for plunger and shoe lift, and (2) measuring the standout of the wedge rod from the end of the threaded housing bore. When properly assembled, the wedge standout is 2-1/4".

INSTALLING POWER UNIT ONTO BRAKE ASSEMBLY

A. Check position of the wedge in plunger housing to make certain wedge assembly is properly seated. Be sure to replace automatic adjusting identification ring (if used) on power unit tube. Thread spanner nut or collet nut onto power unit tube and install spanner nut retainer if used. Apply a non-hardening sealer to the first three threads of the chamber tube.

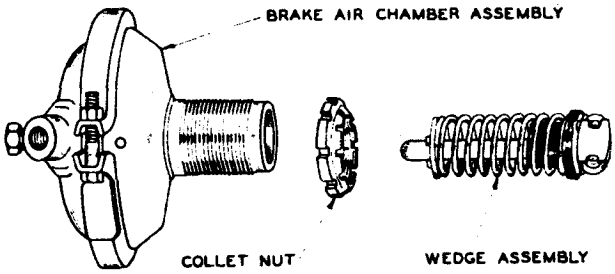


FIG. 14

This is the correct position of the collet nut when used with current brake spider having a conical counterbore. (Fig. 14)

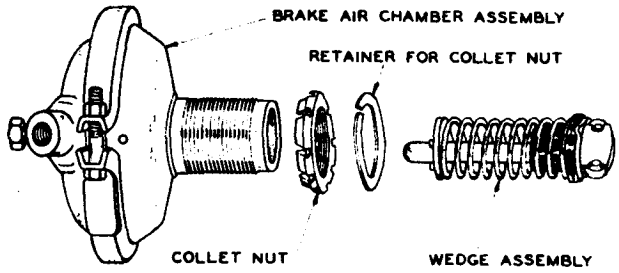


FIG. 15

This is the correct "reversed" position of collet nut and retainer when brake spider *does not* have conical counterbore. (Fig. 15)

B. INSTALLING BOTTOMING TYPE POWER UNIT
1. Screw the power unit into the plunger housing until it bottoms (collet nut loose).
2. Align connection ports with brake lines. If necessary, unscrew power unit not more than one full turn.
3. Connect brake lines.
4. Make and hold a full pressure brake application. (At this time position spanner nut retainer if used so it will engage plunger housing slot.) Hand tighten collet nut.
5. On current assemblies, drive collet nut with a drift and hammer 1-1/2 teeth (or 3/16 turn). Release brake pressure.
6. On older assemblies using retainer and "reverse" collet nut, drive collet with drift and hammer until it is tight against retainer. Using a drift or other blunt tool, peen section of the retainer into one slot of the collet nut. Release brake pressure.
7. Check for leaks at all connections.
8. On hydraulic brakes bleed system.
9. After installing drums, uncage Fail-Safe units.

C. INSTALLING ADJUSTING TYPE POWER UNIT WITH DEPTH MARK
1. Follow procedures in paragraph "A."
2. Screw power unit into the plunger housing several turns. Turn spanner nut toward plunger housing so depth mark on threads is just exposed. Continue turning power unit into plunger housing until it bottoms on spanner nut and retainer. (collet nut can be substituted for spanner nut when needed.)
3. Follow procedures 3 thru 7 of Installing Bottoming Type Power Units.

D. INSTALLING ADJUSTING TYPE POWER UNIT WITHOUT DEPTH MARK
1. Follow procedures in paragraph "A".

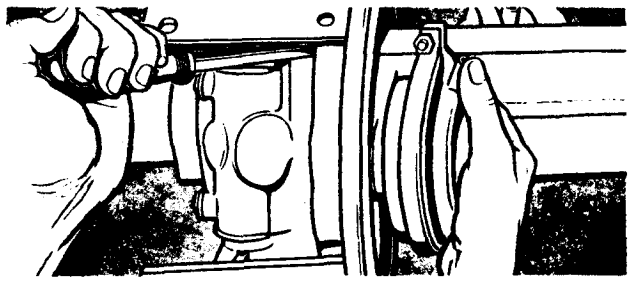


FIG. 16

2. Screw the power unit into the plunger housing until it bottoms. This will push wedge assembly between plungers and lift them off their seats inside the housing. By pushing on one shoe or plunger, the second shoe or plunger will be seen to move. (Fig. 16)
3. Unscrew the power unit one turn. Push on one shoe or plunger and then the other alternately, observing movement of the opposite plunger. If there is movement of the opposite plunger, unscrew the power unit another turn and continue this procedure until no plunger movement can be detected. This point is usually two or three turns from the bottomed position.
4. Follow procedures 3 thru 7 of Installing Bottoming Type Power Units, Page 31.

SERVICING BRAKE SHOES

REMOVE SHOES

A. Cage the power spring if Fail-Safe unit is used. NOTE: If necessary back shoes away from drum manually by turning adjusting bolt assemblies.
B. Remove wheel, hub and drum assemblies.
C. Remove brake shoe return springs, using one of the following two methods.

"COIL" RETURN SPRING

1. Use brake spring pliers. (*DO NOT* use screwdriver.) On backing plate mounted brakes, re-

TROUBLE SHOOTING — AIR BRAKES

TRUCKS, TRACTORS, BUSES

1. **Insufficient brakes**
   Brakes need adjusting, lubrication or relining.
   Wrong type brake lining.
   Poor fit between lining and drum.
   Low air pressure (below 80 PSI).
   Brake valve defective — not delivering pressure.
   Incorrect angle between slack adjuster and brake chamber pushrod.
2. **Brakes apply too slowly**
   Brakes need adjusting or lubricating.
   Low air pressure in the brake system (below 80 pounds).
   Brake valve delivery pressure below normal.
   Excessive leakage with brakes applied.
   Restricted tubing or hose line.
   Binding in camshaft or anchor pins.
   Binding in brake linkage.
3. **Brakes release too slowly**
   Brakes need adjusting or lubricating.
   Brake valve not returning to fully released position.
   Restricted tubing or hose line.
   Exhaust port of brake valve or quick release valve restricted or plugged.
   Defective brake valve or quick release valve.
   Binding in camshaft or anchor pins.
   Binding in brake linkage.
4. **Brakes grab**
   Grease on brake lining — reline brakes.
   Brake drum out of round.
   Defective brake valve.
   Brake rigging binding.
   Wrong type brake lining.
5. **Uneven brakes**
   Brakes need adjusting, lubricating or relining.
   Grease on lining.
   Brake shoe return spring or brake chamber spring weak or broken.
   Brake drum out of round.
   Leaking brake chamber diaphragm.

TROUBLE SHOOTING — AIR BRAKES

TRAILERS

1. **Insufficient brakes**
   Same as for trucks except may also be caused by defective relay-emergency valve.
   Restricted tubing (service line).
2. **Brakes apply too slowly**
   Same as for trucks.
   Excessive air leakage with brakes applied.
3. **Brakes release too slowly**
   Same as for trucks.
   Exhaust port of relay-emergency valve restricted or plugged.
4. **Brakes do not apply**
   Cut-out cocks not properly closed.
   Brake system not properly connected to brake system of tractor.
   Tractor protection valve malfunctioning.
   No air pressure.
   Plugged tubing or hose.
5. **Brakes do not release**
   Brake system not properly connected to towing vehicle.
   Relay emergency valve in emergency position.
   Cut-out cocks not closed properly.
   Tractor protection valve malfunctioning.
6. **Brakes grab**
   Same as for trucks.
   Defective relay emergency valve.
7. **Uneven brakes**
   Same as for trucks.

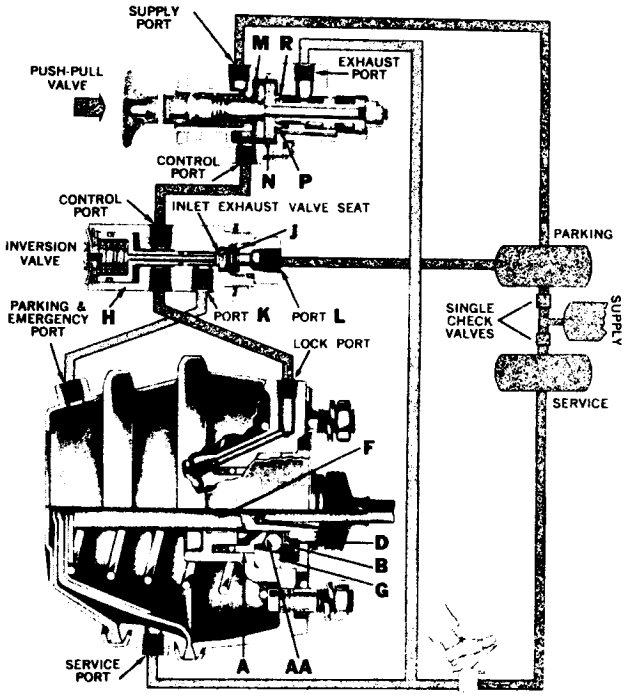
NOTES

BENDIX-WESTINGHOUSE DD3 AND SD3 SAFETY ACTUATORS

This unit is automatically applied by air pressure if pressure in the system drops below 40 psi. It can be manually applied for parking by pulling out the handle of the Push-Pull Valve. The difference between the DD3 and SD3 actuators is that the DD3 (Fig. 1) has two diaphragms, one for service brakes and the other for parking and emergency use. The SD3 (Fig. 2), for trailer application, has only one diaphragm which serves both purposes.

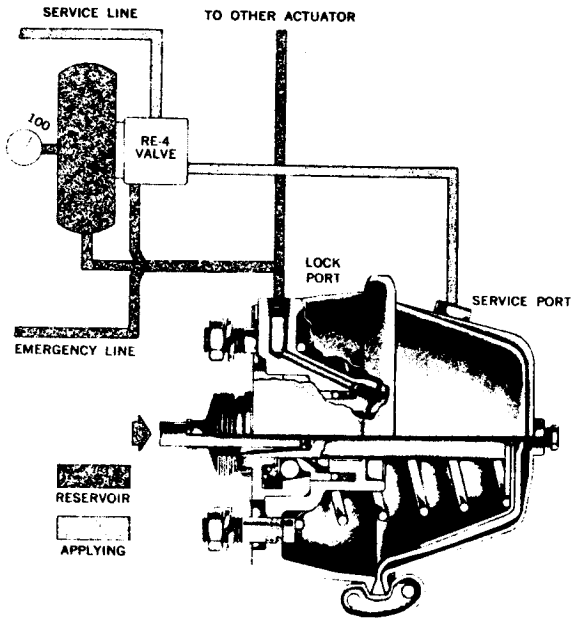
Applying Pressure .....

Reservoir Pressure .....



DD3 SAFETY ACTUATOR

FIG. 1



DSD3 SAFETY ACTUATOR

FIG. 2

OPERATION

1. NORMAL SERVICE

With the handle of the Push-Pull Valve pushed in, air pressure from the parking reservoir is delivered through the push-pull valve to the control port of the inversion valve, then to the lock port of the actuator. Air pressure acting against piston "A" holds it against rollers "B" which are kept away from shaft "F" by ramp "AA."

2. PARKING

Pulling out the handle of the push-pull valve, seats inlet valve "N" on seat "M," closing off air supply to control port. At the same time, exhaust valve "R" is opened, releasing air from the actuator through the lock port, through the inversion valve, then to the push-pull valve where it is discharged through the exhaust port.

When the DD3 lock port is vented, spring "D" forces rollers "B" against collar ramp "G" thereby engaging rollers with shaft "F."

When the central part of the inversion valve is vented, air pressure is removed from piston "H," allowing the spring to move it forward contacting inlet-exhaust valve "J" and moving it off the inlet-exhaust valve seat. This permits full pressure from the parking reservoir to be delivered through the inversion valve to the parking and emergency port of the safety actuator, thereby applying the brake.

3. RELEASING

If pressure in the parking tank has not dropped more than 4 psi (due to leakage) after applying the parking brake, the brakes can be released by pushing in the handle of the push-pull valve.

If pressure has dropped more than 4 psi, first push in the handle of the push-pull valve. This applies reservoir pressure to the lock port of the actuator. At the same time reservoir pressure is applied to the control port of the inversion valve which causes air to be exhausted from the parking diaphragm. A heavy service brake application will then produce sufficient forward motion of the shaft to disengage the lock mechanism.

4. EMERGENCY OPERATION

The parking reservoir and service reservoir are protected by single check valves. If air is lost from parking reservoir and supply reservoir, a service application can be made from the service reservoir. If air is lost slowly from the parking reservoir, the push-pull valve and inversion valve will trip at about 40 psi, thereby applying the brakes with the remaining pressure in the tank.

HYDRAULIC BRAKES — OPERATION OF COMPONENTS

BRAKES RELEASED

With brakes released (Fig. 1), all parts of the master cylinder are open to atmosphere. The portion between the check valve and the primary cup is vented through the compensating port while the portion between the primary and secondary cups is vented through the supply port. The check valve is closed and maintains a pressure of 8-16 pounds per square inch in the lines and wheel cylinders. This pressure is not sufficient to overcome the tension of the brake shoe return springs, so the wheel cylinder cups and pistons remain in their retracted positions.

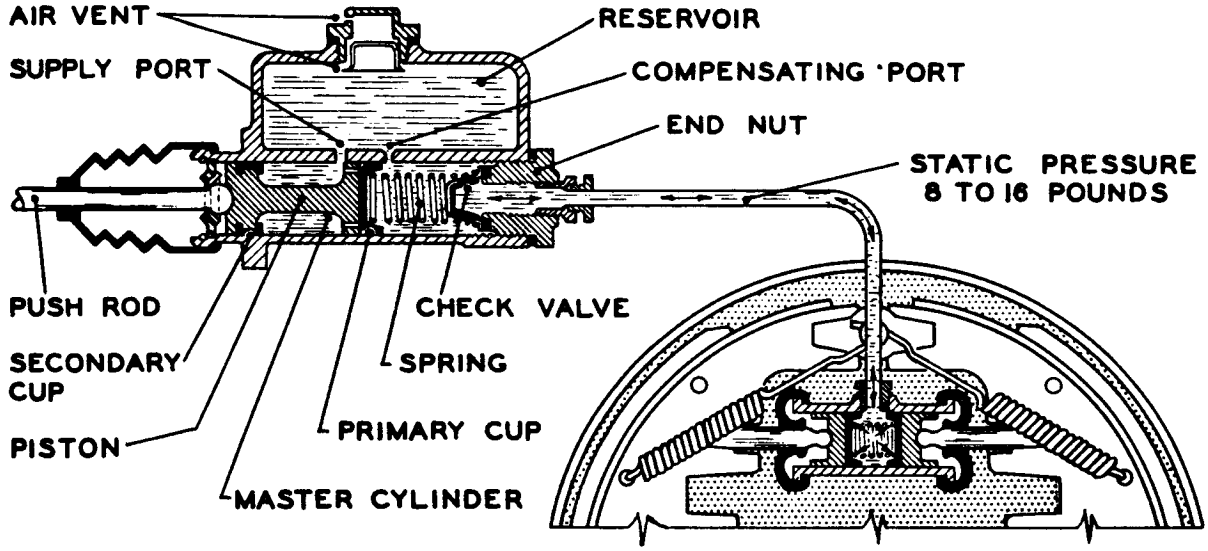


FIG. 1. BRAKES RELEASED

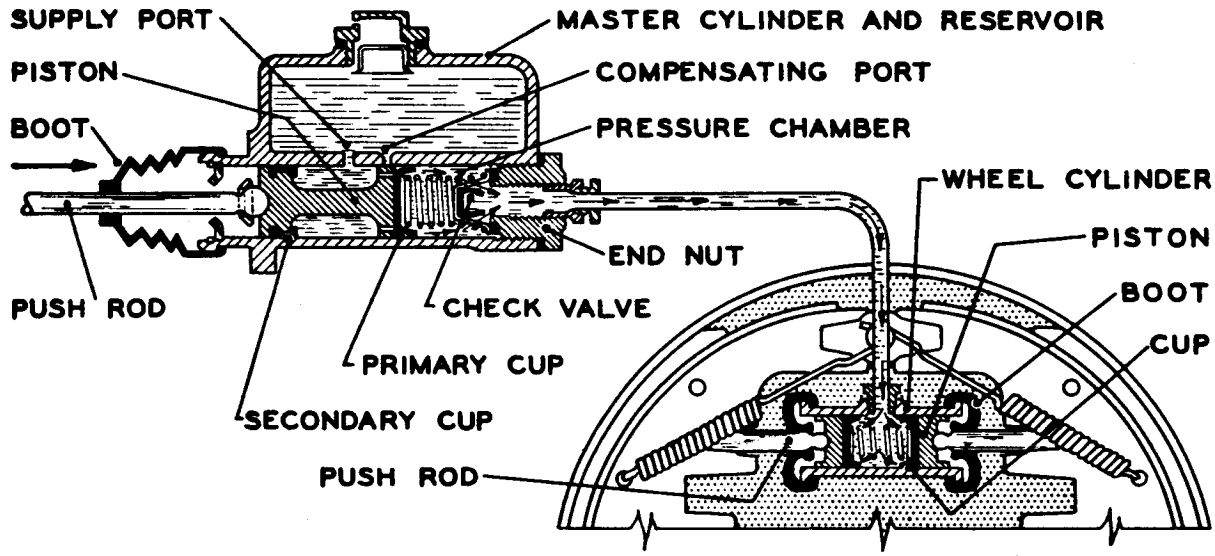
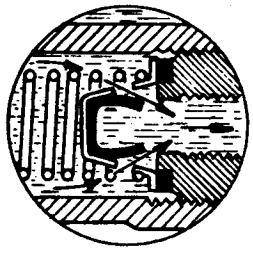


FIG. 2. BRAKES APPLYING



FLOW THRU CHECK VALVE (APPLYING)

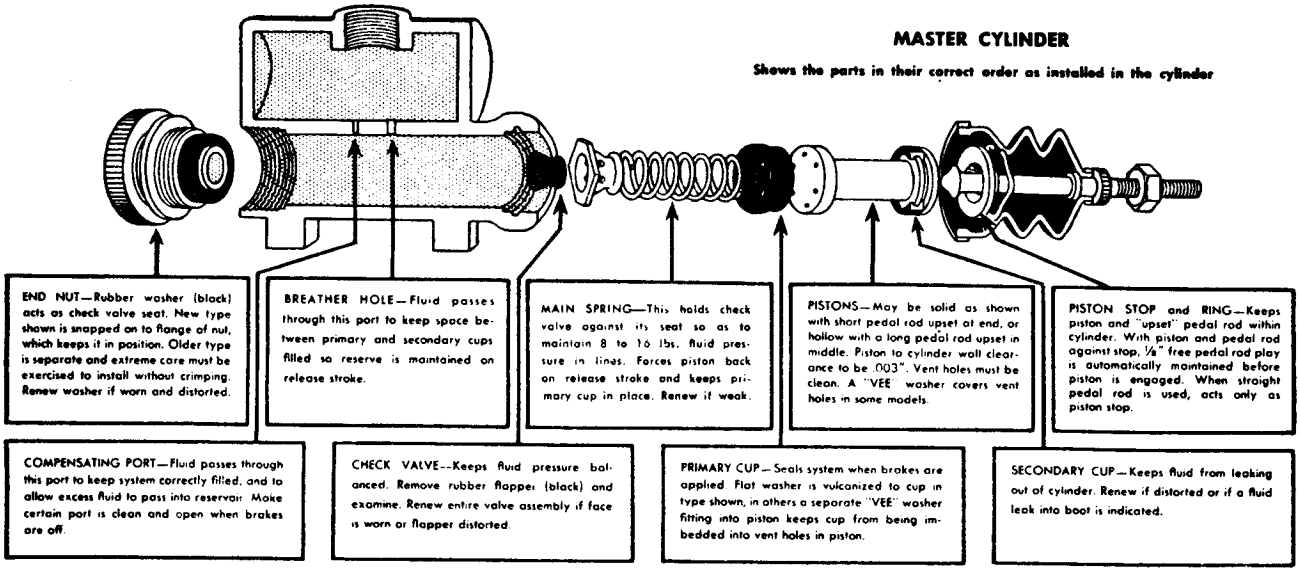
FIG. 3

BRAKES APPLYING

Pedal pressure on the pushrod moves the piston forward (Fig. 2). The primary cup moves past the compensating port sealing the system. Further movement of the piston forces fluid through the check valve (see Fig. 3), into the lines and wheel cylinders. When sufficient fluid has been moved into the wheel cylinders to bring the shoes out against the drums, any further increase in pedal pressure will result in a corresponding increase in pressure holding the shoes against the drums.

COMPONENTS OF THE HYDRAULIC BRAKE SYSTEM

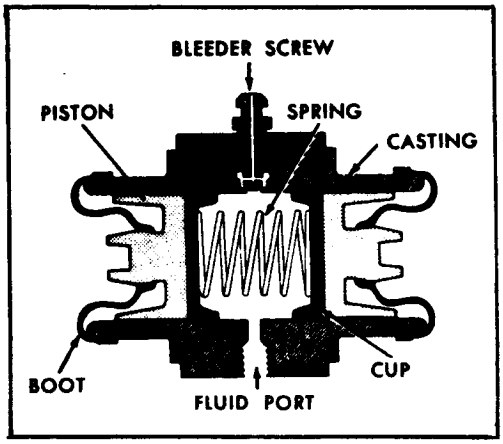
MASTER CYLINDER



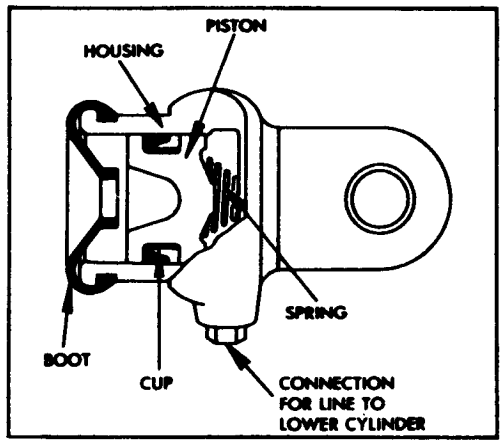
Master cylinders may vary in design, but the principles of operation are the same for all. A casting is bored out to form a cylinder. Above the cylinder, and usually part of the same casting, is a reservoir. The wall between the reservoir and master cylinder has two holes drilled in it, one of which is the supply port and the other the compensating port. A piston, free to slide back and forth in the master cylinder, controls fluid displacement and pressure. Two rubber cups move with the piston and prevent leakage. A piston return spring, a residual pressure check valve and a valve seat complete the assembly. With brakes released, the check valve maintains about 12 pounds per square inch pressure in the lines and wheel cylinders to prevent air being drawn into the system.

WHEEL CYLINDERS

DOUBLE PISTON



SINGLE PISTON



Each brake assembly contains one or more wheel cylinders. A wheel cylinder contains one or more pistons or cups. Usually a spring is used between the cups to keep them in position and tight against the pistons. A bleeder valve is provided as a means of removing air or gas from the cylinder.

Single end wheel cylinders, used to actuate one shoe, contain only one piston and cup. Where a cylinder operates two shoes, either simultaneously or one at a time, it will have a piston and cup at each end.

So called "expanders" are sometimes used behind the cups. Their function is to support the lips of the cups to keep them from collapsing. Correctly designed cups made of high quality, high temperature compound should not need expanders. Furthermore, expanders may slow brake release because of their tendency to cock in the cylinders.

BRAKE FLUID

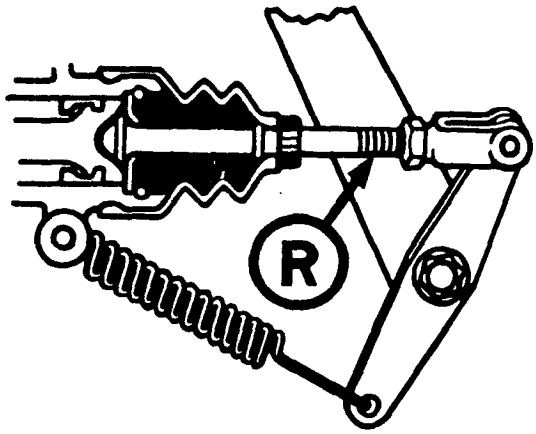
Since brake fluid deteriorates with use the system should be flushed and refilled once a year or at each reline. Extra heavy duty fluid that meets or exceeds S.A.E. Spec. 70R3 should be used.

Fluid should be kept in a sealed container or bleeder tank. Do not use fluid that has rust or dirt in it.

Always clean the reservoir cap and the area around it before removing cap to keep dirt from getting into system.

MASTER CYLINDER & PEDAL ADJUSTMENT

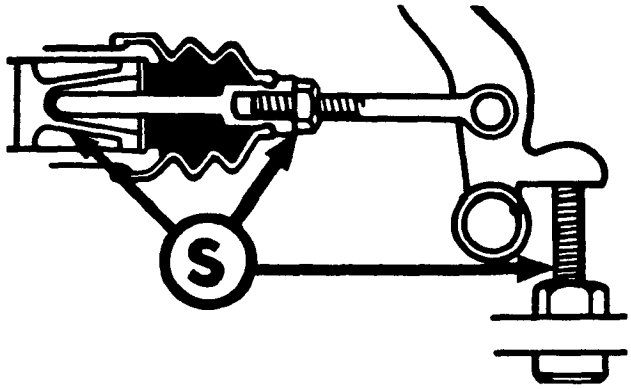
The adjustments below are necessary to assure the master cylinder piston returning to its stop thereby opening the relief ports.



Adjustable Pedal Stop Type

With this type 1/8" clearance is automatically maintained between the pushrod and the piston, the washer acting as a stop for both the piston and the rod. Some rods are upset at end as shown, when used with solid piston; some are upset in middle when used with hollow piston.

To adjust: With both piston and upset portion of rod "R" against the washer stop, turn pedal rod in desired direction to maintain 3/8" clearance between pedal and floor board.



Upset Push Rod Type

With this type 1/8" clearance between pushrod and piston must be maintained by setting both the pedal stop and the pushrod as indicated at "S."

To adjust: Turn pedal stop to maintain 3/8" clearance between pedal and floor board, then adjust pedal pushrod to give 1/8" clearance at arrow before pushrod engages piston in master cylinder.

The split system hydraulic master cylinder is designed to maintain a certain percentage of brake effectiveness even though a part of the system fails. If a front brake or a line leading to a front brake fails, the rear brakes are still effective.

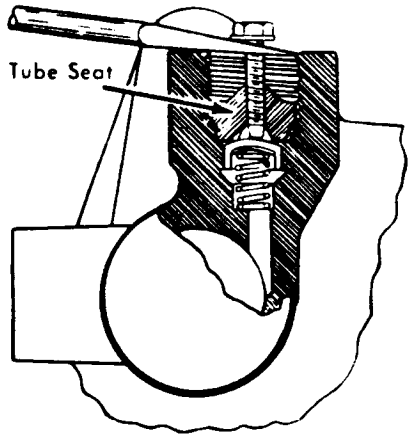
If the failure occurs in the rear brakes, or rear brake lines, the front brakes are still operative. There are separate fluid reservoirs for front and rear so that loss of fluid in one portion of the system will not affect the portion that remains in operation.

There can be a complete loss of fluid in either portion of the brake system but brakes will still be available for a controlled stop under most conditions. The driver will become aware of the failure immediately because:

1. Longer pedal travel will be required.
2. Brake effectiveness will be substantially reduced.
3. A warning light on the dash will signal the driver in the event of failure of a portion of the system.

The split system master cylinder is somewhat more complicated than ordinary master cylinders. When rebuilding is necessary, the correct procedure must be carefully followed. Use all parts furnished in the repair kit. Disassemble and assemble units in accordance with instructions contained in this manual.

2. Remove cover assembly and reservoir seal. Drain fluid from reservoirs.
3. Remove floating piston stop bolt from front reservoir.
4. Remove lock ring from open end of cylinder bore and take out the primary piston assembly.
5. Rap the cylinder on a piece of wood to dislodge the floating piston assembly. Apply compressed air through the rear brake outlet hole, if necessary, to help push the piston out.
6. Remove the fluid outlet tube seats. See Fig. 3 for method.



Place flat washer over 1"x#8-32 screw. Thread screw into seat and pry washer with small screwdriver.

METHOD OF REMOVING OUTLET TUBE SEATS

FIG. 3

7. Remove check valves and springs from under tube seats.

BENDIX ONLY

8. Remove cups, seals, retainers and washers from primary and secondary pistons.

DELCO-MORAINE ONLY

8. Remove primary cup, protector washer and secondary seals from the floating piston.
9. Unscrew the piston extension screw from floating piston stop. Remove the stop and spring from the primary piston.
   NOTE: On older models the piston extension is not removable. Unsnap retainer ring from end of extension, then remove stops and spring.
10. Remove spring retainer, primary cup, protector seal and secondary seal from the primary piston. This completes the disassembly.

BOTH

CLEANING & INSPECTION

1. Discard all rubber parts and such additional parts as are replaced by those furnished in a repair kit.
2. Clean all metal parts including cylinder casting in alcohol, brake fluid or an approved brake system cleaner.
   WARNING — Do not use kerosene, gasoline or any liquid that contains mineral oil. Mineral oil will deteriorate rubber parts.
3. Inspect master cylinder bore for evidence of pitting, scoring or etching. Install new cylinder if walls are not smooth.
4. Check piston for excessive wear and for scoring.
5. After cleaning, blow out all passages and orifices. Place parts on clean paper to dry.

ASSEMBLY

1. Lubricate all rubber parts with clean brake fluid.
2. Place a check valve spring in each outlet hole. Be sure it is seated in the depression at the bottom of the hole. Install check valves over the springs.
   NOTE: With springs in place, and the check valves correctly installed, the end of each valve will be even with the top of the outlet boss.
3. Install a new tube insert in each hole. Thread a tube nut into the hole until the insert bottoms in the outlet hole. After removing tube nuts, check threads in outlet bores for burrs or loose shavings.

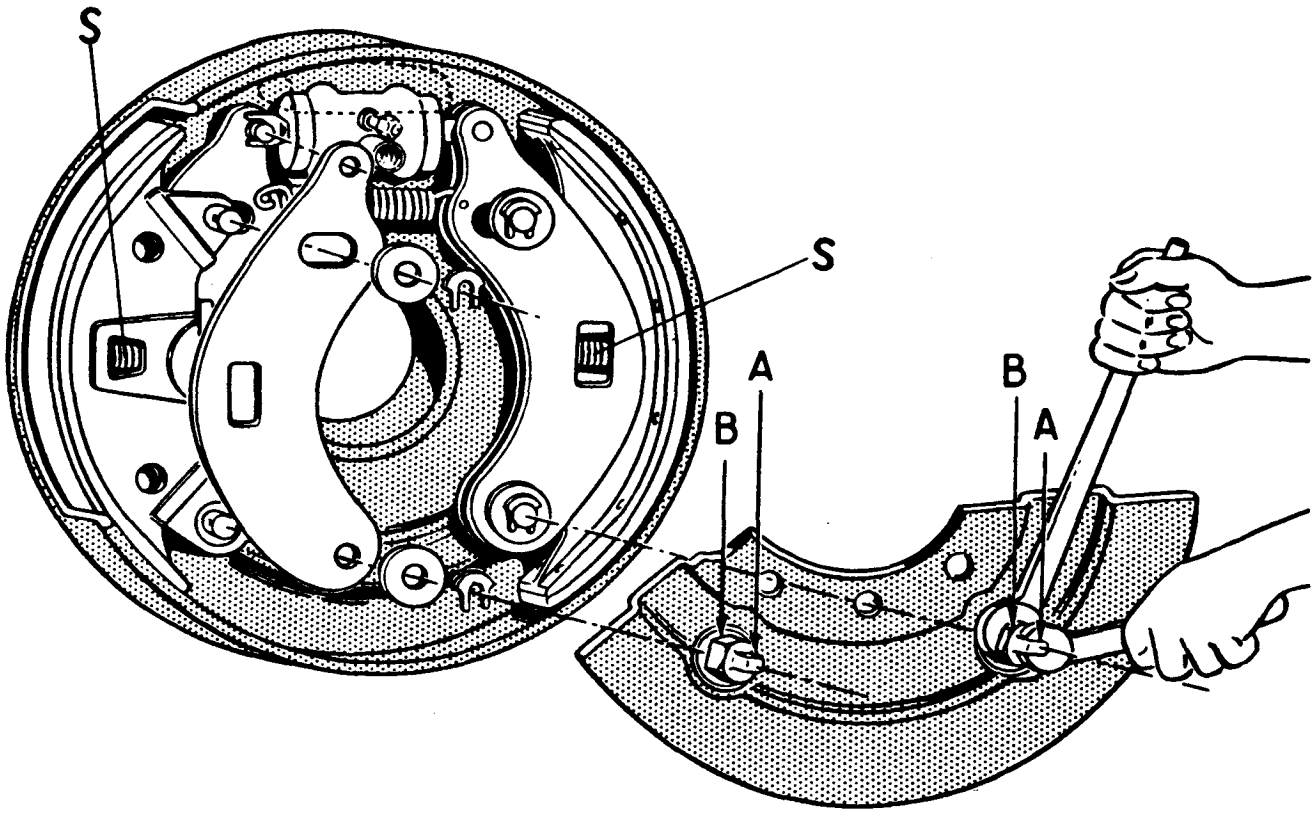
DELCO-MORAINE ONLY

4. Place a new secondary seal in the center groove of the floating piston with the lip of the seal toward the compensating holes in the opposite end of the piston. Install another secondary seal in the groove at the end of the floating piston. The seals should have the backs toward each other on the new piston.
5. Install a new protector washer and primary cup over the end of the floating piston opposite the second seals. The protector washer should seat against the flange of the piston containing the compensating holes. The flat side of the cup should seat against the washer.
6. Install a new secondary seal in the groove at the pushrod end of the primary piston. The lip of the seal should be toward the compensating holes at the opposite end. Install a new protector washer and primary cup on the other end of the piston.
7. Place the spring retainer on one end of the primary spring and the floating piston stop on the other end. Place this assembly on the primary piston with the spring retainer seated inside the lip of the primary cup.
8. Compress the primary spring and start the piston extension screw in the hole at the end of the piston. Release spring and torque the screw to 80-100 inch pounds.
9. Place the retainer in the floating piston spring and put the spring assembly on the floating piston. The retainer should be seated inside the lip of the primary cup.
10. Place the master cylinder in a vise and coat cylinder bore with clean brake fluid. Install floating piston assembly in bore, — spring end first. Install primary piston assembly, spring end first, and seat lock ring in the groove at end of bore.
11. Install the floating piston stop bolt in the front fluid reservoir. Torque bolt to 25-40 inch pounds.
12. Install a new filter and reservoir seal. Replace cover and install unit on vehicle.

BENDIX ONLY

4. Place a new seal in the center groove of the secondary piston with lip of the seal toward the compensating holes in the opposite end of the piston.
5. Install new secondary "O" ring and secondary seal. Install new protector washer and seal on primary piston.

TIMKEN D P H BRAKE



DISASSEMBLY

1. Remove wheels and brake drums.
2. Remove "E" washers flat washers, links (if present) and brake shoe levers.
3. Remove brake shoe and lever springs and spring retainers using small screw-driver as pry.
4. Remove brake shoes and "D" blocks.

ASSEMBLY

1. Install brake shoes and "D" blocks.
2. Completely compress spring (S) and retainer in an adjustable open end wrench or vise grip pliers. Hold with retainer toward drum and tap spring and retainer into position with a small hammer.
3. Install brake shoe levers, links, washers and "E" washers.

ADJUSTMENTS

1. Loosen anchor pin lock nuts "B" and rotate each eccentric anchor pin "A" to bring lining into contact with drum. Back off to allow minimum running clearance.
2. Actuate service brakes several times to again properly position shoes and readjust eccentric anchor pins to give .005" to .010" clearance at center of shoes.
3. Tighten anchor pin lock nuts to 175-200 ft. lbs. torque and recheck lining clearance.

IMPORTANT NOTES

If brakes drag or fail to release, check the following:

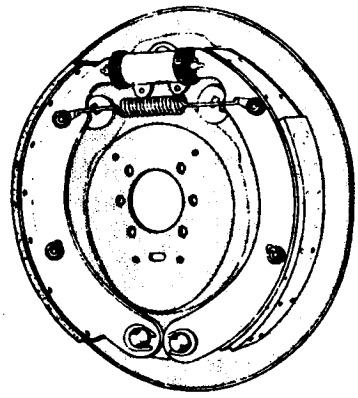
1. Abutment blocks and "D" shaped pressure blocks for scoring or wear. Replace if necessary. Clean and lubricate parts with high temperature lubricant.
2. Return springs: Replace if stretched or broken.
3. Retainer springs: Replace if weak or broken.
4. Depth of retainer spring slots: If spring seats in ends of lever arm slots toward axle, clean out or file if necessary. Springs must seat in brake shoe slots at this point, and in lever arm slots at edges away from axle.

IMPORTANT NOTES

1. Do not interchange star adjusting wheel from right to left sides of vehicle. They have opposite threads and the automatic adjusting device will loosen, instead of tightening, brakes. Adjuster nuts for right side have two grooves machined around the body, those for left side have one groove.
2. Adjusting levers and adjuster screws are marked "R" for right side application and "L" for left.
3. With the brake assembly centered on the backing plate, the adjusting lever should engage the star wheel approximately 3/16" above the centerline of the adjusting screw. If it engages below the centerline the adjusting mechanism will not function.
4. Adjusting mechanism must be lubricated at all metal-to-metal surfaces to protect from rust and corrosion. Use Lubriplate or equivalent.
5. Brake shoe return springs must be correctly installed. Incorrect installation may cause brakes to drag or the adjusting device may fail to function.
6. On rear brakes install parking brake link before installing return springs.

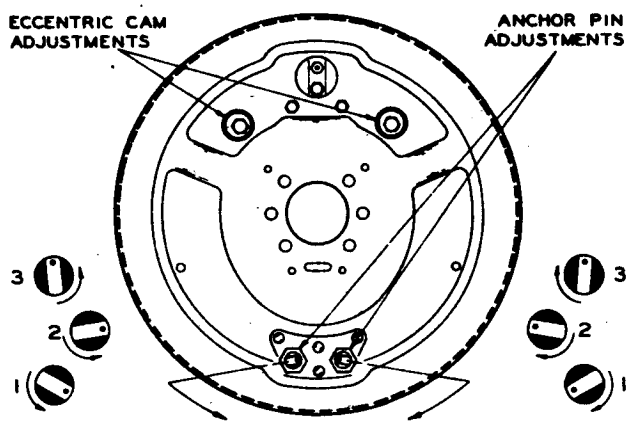
LOCKHEED TYPE BRAKE-TIMKEN "H" SERIES

This is a two shoe, light duty brake with shoes mounted to a backing plate which also serves as a dust shield. Anchors are adjustable to provide a means of centering the shoes on the drum. Adjustments for wear are made by rotating eccentric cams that bear on the brake shoe flange or a pin in the shoe web.



TIMKEN 'H' SERIES BRAKE

FIG. 1



TIMKEN 'H' SERIES BRAKE ADJUSTMENT

FIG. 2

DISASSEMBLY

A. Disconnect brake shoe return spring.
B. Remove anchor pin "C" washers and guidepin locks and washers.
C. Remove brake shoe and lining assemblies.
D. Remove anchor pin lock nuts, lock washers and anchor pins.
E. For complete disassembly remove cap screws, washers and wheel cylinder assembly.

REASSEMBLY

A. Position wheel cylinder, install cap screws and lock washers and tighten securely.
B. Insert anchor pins and install washers and lock nuts.
C. Position shoe and lining assemblies and install washers and lock rings. Back off anchor pins to full release position.
D. Back off adjusting cams and position shoes through guides into wheel cylinder.
E. Hook shoe return spring in brake shoe web holes.

ADJUSTMENT

After an overhaul or reline each shoe must be centered to provide maximum contact between lining and drum and to correctly locate curvature of lining to that of the drum.

1. Back off completely on both the anchor pins and adjusting cams.
2. While rotating wheel, adjust cam until drum drags on lining.
3. Rotate anchor pin until drag is relieved.
4. Repeat steps 2 and 3 until rotation of anchor pin will no longer relieve drag.
5. Tighten anchor pin lock nut and back off on cam until wheel is just free.
6. Repeat at other shoe.

MINOR ADJUSTMENT

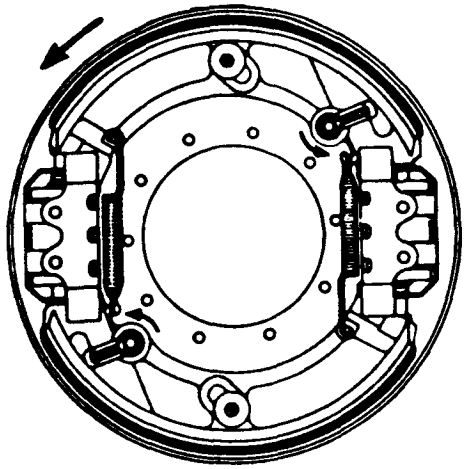
(To compensate for lining wear)

1. Rotate cam until drum drags.
2. Back off until drum is just free.
3. Repeat at other shoe.

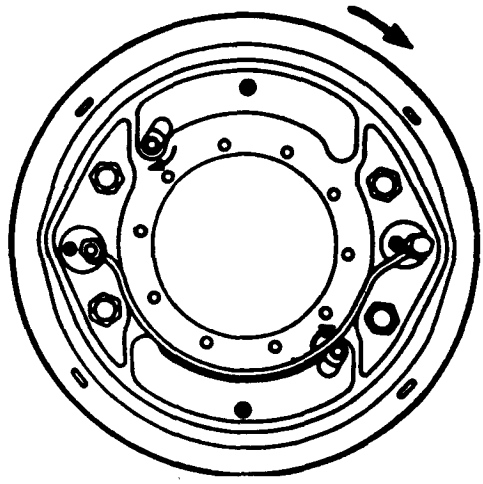
1. Thoroughly clean, but do not lubricate shoe adjustment mechanism or other parts of brake assembly.
2. When wheel cylinder connecting tube is removed, note position of tube and fittings on the brake to avoid error in reassembling. Difficulty may be encountered in bleeding system if tube is assembled in wrong location.

ADJUSTMENTS

1. Set foot pedal. With pedal against its stop, adjust pedal pushrod to give 1/8" free play before engaging piston in master cylinder.
2. Place 5/8" wrench on one of the two cam and shoe guide studs, "a" and "b," then rotate wrench in the direction of forward wheel rotation until lining drags on drum.



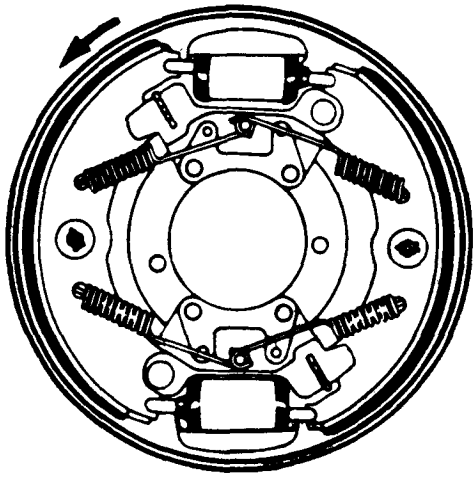
3. Move wrench slightly in opposite direction until drum is free, then move the wrench an additional 7° to 10° (1" to 1-1/2" movement through arc swung by 8" wrench) to provide working clearance. Place wrench on opposite cam and shoe guide stud and adjust second shoe by repeating this procedure.
4. Repeat steps 2 and 3 on the other shoe.



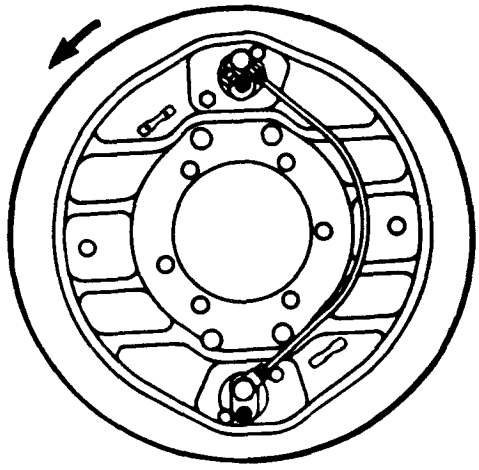
WAGNER TYPE FR

See notes on Page 60 pertaining to this brake.

The Wagner Type FR brake is of balanced design, and both shoes are self centering and forward acting regardless of the direction of wheel rotation. Abutment blocks are located at both ends of each wheel cylinder. These blocks act as anchors at the toe or heel of each shoe, depending upon the direction of wheel rotation. A worm and wheel arrangement at the toe of each shoe, accessible through the backing plate provides a means of regulating the lining to drum clearance.



1. Remove adjustment slot covers and insert 3/8" Allen wrench to engage one shoe adjusting worm. Rotate wrench in direction of forward wheel rotation until lining drags on drum.
2. Back off until drag is relieved, then rotate adjustment one additional turn to provide working clearance.
3. Repeat on second shoe then place adjustment slot covers.



WAGNER TYPE FR2

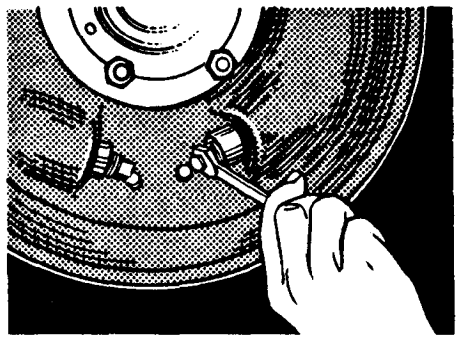
See notes on Page 60 pertaining to this brake.

Operation is similar to Type FR, but the heel of each shoe has a removable, slotted anchor pin and the adjusting screw, at the toe, acts as an anchor in reverse rotation. Adjustment is made by means of a star wheel which threads the adjusting screw in or out, as desired, to increase or decrease lining to drum clearance.

1. Remove adjustment slot covers, and at one adjustment slot, insert clicker wrench or screwdriver to engage star wheel.
2. Using edge of slot as fulcrum, move tool handle toward axle, rotating star wheel until lining drags on drum.
3. Back off three notches for worn lining, five notches for new lining.
4. Repeat at other shoe and replace adjustment slot covers.

"DH" DUPLEX BALANCED BRAKE

ADJUSTMENT

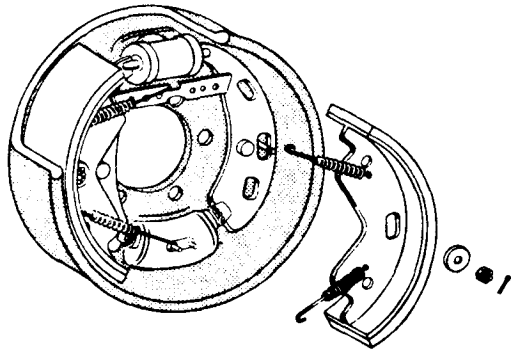


1. With standard 1/2" wrench, adjust one shoe tight against drum by rotating clockwise.
2. Back off on the adjuster bolt until there is a light drag between lining and drum.
3. Repeat steps 2 and 3 on the other shoe.

NOTE: Some designs use a star-wheel adjuster for each shoe. Procedure is same except adjusting spoon is inserted through access holes in backing plate.

Note: All metal-to-metal rubbing surfaces must be smooth and free of burrs. Smooth with file or emery cloth if necessary.

DISASSEMBLY



1. Remove wheels and brake drums.
2. Remove cotter keys from guide bolts.
3. Clamp wheel cylinder to prevent movement of pistons.
4. Hold shoe against backing plate with one hand and remove guide nut and washer with the other.
5. Rotate shoe slowly away from backing plate and out of brake assembly until spring tension is released.
6. Unhook springs from shoe and backing plate.

NOTE: All four springs are identical and interchangeable.

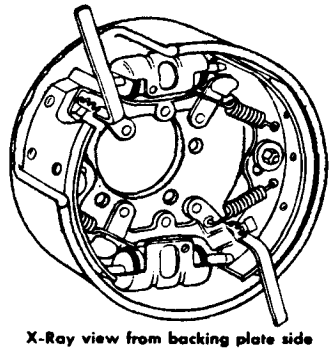
ASSEMBLY

1. Back off both shoe adjusting bolts.
2. Reverse operations listed under "disassembly."

BENDIX TWINPLEX

The Twinplex is a balanced brake having two double acting wheel cylinders so that equal force is exerted at each end of both shoes. Shoes are self centering and forward acting. One end of each brake shoe pivots on a half-moon anchor, the other end has an adjusting screw which serves as an anchor. Lining clearance is obtained by turning the star wheel adjuster on each shoe which threads the anchor into the support as required.

NOTE: When installing new shoes, tighten shoe hold-down bolts to allow .010" clearance between shoe edge and flange contact faces. Check with feeler gauge.



X-Ray view from backing plate side

ADJUSTMENT

If shoes are top and bottom, top shoe must be adjusted first. If shoes are fore and aft, front shoe must be adjusted first.

1. Jack wheel off floor, remove slot cover and insert clicker wrench or screwdriver. Using edge of slot as fulcrum, move tool toward center of wheel to decrease clearance until there is a heavy drag on the drum.
2. Back off until wheel can just be turned by hand. Back off four additional notches to provide running clearance.
3. Repeat at other shoe. Install slot covers.

The inboard half of the caliper contains two pistons, each of which as a heat insulator on the front and a seal on the back lip. A shouldered cap screw holds a friction ring to the back of each piston. The anchor plate is bolted to the spindle and positions the caliper assembly over the rotor forward of the spindle.

When hydraulic pressure is applied to the pistons, they move outward forcing the inner brake shoe assembly against the inner face of the rotor. Hydraulic pressure then reacts against the back of the cylinder housing moving the caliper assembly and brake shoe inward on the caliper mounting pins. This forces the outer brake shoe and lining assembly against the outer surface of the rotor. Any increase in hydraulic pressure is exerted equally on both shoes. Braking torque is transmitted from the brake shoes to the caliper, then from the caliper to the anchor plate.

When brakes are released and the rotor rotates freely, the slight runout on the rotor surfaces pushes the pistons back into their bores, thus maintaining slight clearance between lining and rotor faces. The friction ring prevents excessive piston "knock back."

Automatic adjustment for lining wear is achieved by the piston and friction ring moving outward in the cylinder bore. The piston is kept from moving back into the cylinder bore by the friction ring and correct brake adjustment is maintained.

A metering valve is located in the line between the master cylinder and the front brakes. The metering valve prevents front brakes from applying until pressure in the master cylinder reaches about 120 p.s.i. By delaying application of the front brakes, the metering valve keeps front brakes from doing all the braking at low pressure applications.

At about 120 p.s.i., the metering valve is in a balanced position, maintaining a lower pressure in the front brakes than master cylinder pressure. At approximately 500 p.s.i., the metering valve opens completely so that pressure in the front brake cylinder is the same as master cylinder pressure.

A bleeder button is built into the lower portion of the metering valve. It is necessary to depress the button and hold the valve open when bleeding the front brakes by means of a pressure bleeder.

LINING REPLACEMENT

Brake linings should be replaced when they are worn to 1/16" thickness (combined shoe and lining thickness — ¼").

1. Remove brake shoe mounting pins, anti-rattle springs, shoe and lining assemblies.
2. Remove master cylinder cover and remove some fluid from the master cylinder. This is to prevent overflow of fluid when the pistons are reset.
3. Loosen piston housing-to-caliper mounting bolts sufficiently to slide in new shoe and lining assemblies. Do not move pistons.
4. After installing new shoe and lining assemblies, install brake shoe mounting pins and anti-rattle springs. The spring tangs *must* be located in the holes provided in the shoes.
5. Torque brake shoe mounting bolts 17-23 ft. lbs.
6. Reset pistons in cylinders by inserting .030" feeler gauges between back of outboard shoe and the caliper. Tighten piston housing-to-caliper mounting bolts. Keep cylinder housing square with caliper.
7. Loosen piston housing-to-caliper mounting bolts sufficiently to remove feeler gauges, then torque the bolts to 155-185 ft. lbs.
8. Fill master cylinder reservoirs with approved fluid and replace cover.

CALIPER MOUNTING PIN BUSHINGS

The caliper mounting pin bushings in the anchor plate are presized, with two-piece bushing seal retainers that are replaceable.

1. After removing old bushings, install the bushing portion from the outer side of the anchor plate boss.
2. Place the inner seal retainer over the end of the bushing protruding from the anchor plate.
3. Peen the end of the bushing to hold the retainer to the bushing.

BRAKE OVERHAUL

If it is necessary to rebuild the caliper assembly, remove it from the vehicle and disassemble it on a workbench.

1. Remove boot retainers and boots.
2. Pull piston assemblies from cylinder housing. There are piston pullers available specially made for this purpose.
3. Thoroughly clean all metal parts in solvent.
4. Check piston for scratches or pitting. Since the sealing surface is between the piston and the piston seal, even the slightest scratch on the piston may result in a leak. If there is any doubt as to the condition of a piston, replace it.
5. Check friction rings for wear. Replace if necessary.
6. Check cylinder bores. The walls may be honed to remove deposits or slight imperfections in the surface. If walls are badly pitted or scored, replace cylinder housing.
7. Install new boots, boot retainers and piston seals.
8. When installing pistons, do not permit them to cock. Push them into their bores until they bottom. It may be necessary to tap them in with a mallet. Do not permit brake fluid to contaminate insulators.

GENERAL INSTRUCTIONS APPLYING TO ALL DISC BRAKES

1. Rotor runout must be within manufacturer's specified tolerances. Check runout with an indicator that reads to .001". All end play must be removed prior to checking runout by tightening wheel bearing nut. Re-adjust bearing after checking runout.
2. Rotors must be checked for parallelism at each reline or if a complaint exists. Check thickness of rotor in at least four places equally spaced, about one inch in from edge.
3. When resurfacing a rotor equal amounts of material must be removed from both sides of the disc.
4. Never re-chuck a rotor after starting to machine it. Both surfaces must be refinished before loosening arbor nut.
5. Do not use a rotor that has cracks extending to the hub or to the edge.

VACUUM POWER SYSTEMS

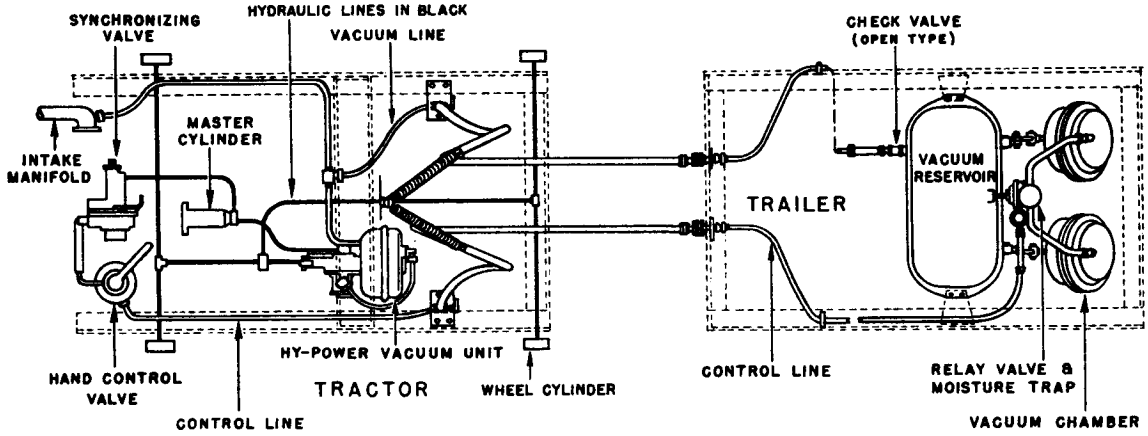
Vacuum assist units or vacuum "boosters" use engine vacuum on one side of a piston or diaphragm and atmospheric pressure on the other side. By using valves to meter this pressure differential, accurate control is maintained so that increased pressure can be exerted on the fluid in the hydraulic system without a proportional increase in pedal force requirements. Pages 67 to 77 carry a detailed description of how the units operate.

Where a tractor is equipped with a vacuum-hydraulic unit, trailer brakes are vacuum actuated. Air is exhausted from a tank located on the trailer so that the vacuum is instantly available for trailer brake application. Trailer brakes are applied by means of power chambers connected to slack adjusters. When air is exhausted from one side of the diaphragm in the power chamber, the diaphragm moves, pulling on the slack adjuster, rotating the brake camshaft and applying the brakes.

VACUUM POWER SYSTEM

(Hydraulic on Tractor, Vacuum on Trailer)

This installation shows the basic units used in a system incorporating hydraulic brake actuation of the tractor and vacuum actuation of the trailer. Pedal pressure through the master cylinder energizes the vacuum unit which delivers increased hydraulic pressure to the tractor wheel cylinders and applies the trailer brakes by actuating the vacuum chambers or vacuum cylinder. Trailer brakes can be independently operated by means of the hand control valve.



POWER BRAKES (Vacuum Assist Units)

CHECKING POWER BRAKES

The first step in diagnosing and correcting brake trouble in a vehicle equipped with power brakes is that of determining whether the unit itself is at fault or whether the trouble is in the brakes or hydraulic system.

1. HARD PEDAL

A. Connect vacuum gauge at engine manifold. Allow engine to run at idle speed. Gauge should show 18-20 inches of vacuum. If vacuum reading is low, adjustments or repair to engine may be required. Shut off engine. If the vacuum gauge shows a drop of more than 2 inches in three minutes the vacuum check valve should be replaced.

B. Disconnect vacuum hose connection at power unit. Connect vacuum gauge to hose and check to see that there are no leaks at vacuum reservoir, hose or connections. Reading should be approximately the same as that at engine intake manifold. If leaks are indicated by drop in vacuum with engine off, replace hose, connections or tank, if necessary.

C. With engine shut off, apply brake pedal several times to exhaust all vacuum from system. Depress brake pedal and hold while starting engine. Pedal should tend to "fall away" from foot. If not, it indicates the vacuum portion of the power unit is not functioning. It should be replaced with a new or rebuilt unit that has been checked on a test bench.

2. DRAGGING BRAKES

Check brake pedal to be sure it is fully released and is not binding. Exhaust vacuum from system by applying brakes several times with engine shut off. Jack up both front wheels. Adjust brakes and wheel bearings. Spin both wheels to be sure they are free. With wheels spinning, start engine but do not apply brakes. When wheels stop spinning check to see if there is a drag on either wheel. If brake drag is present, power unit is defective and should be replaced.

3. LOSS OF BRAKE FLUID WITH NO SIGN OF EXTERNAL LEAKS

Remove hose between intake manifold and power unit. Check for signs of hydraulic fluid. If inside of hose is wet from fluid, the power unit is defective.

4. OTHER COMPLAINTS

If after checking the engine vacuum, power unit and connections, the trouble is not located, it will be in the hydraulic system or foundation brake assembly.

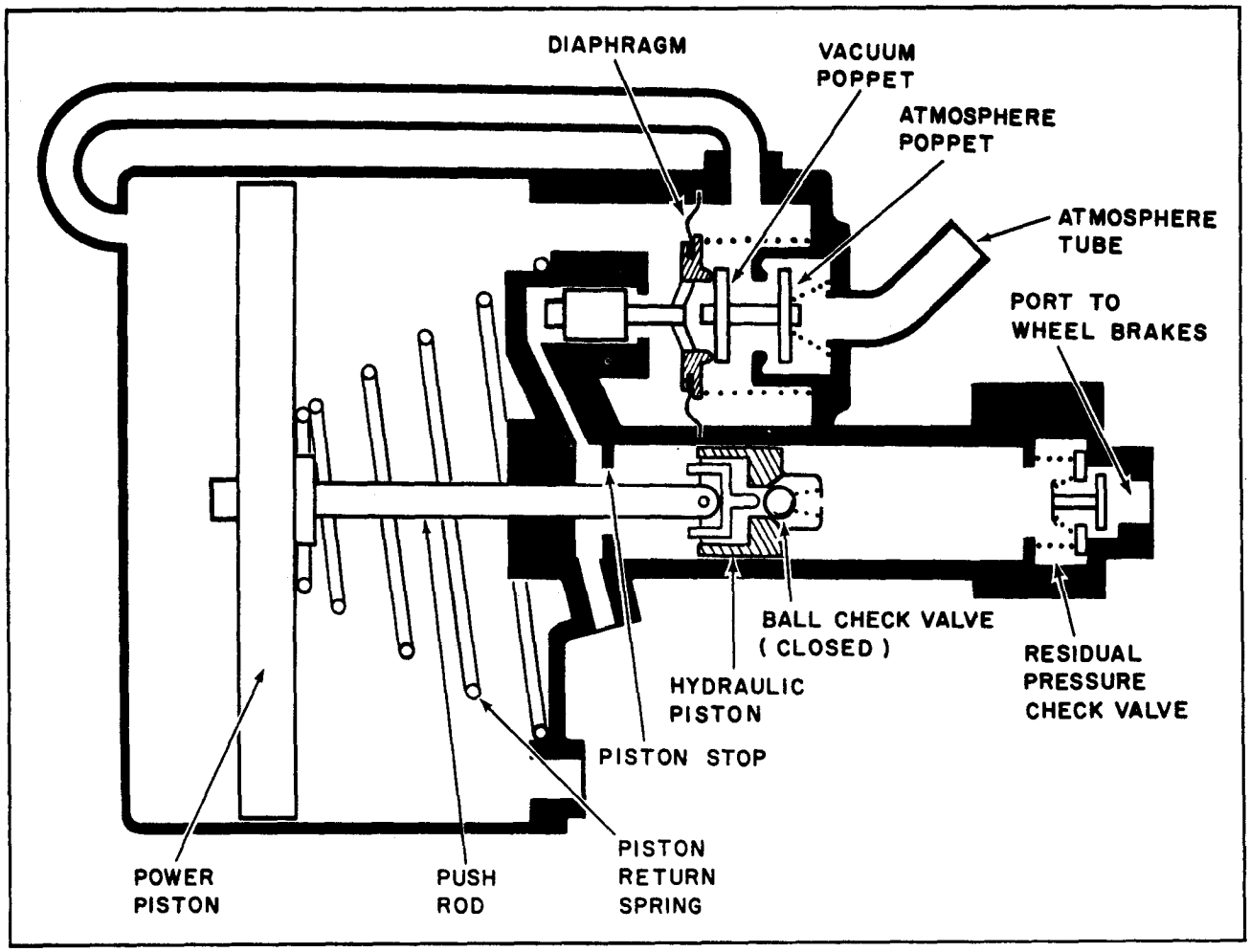
To check hydraulic system, exhaust vacuum by applying brakes several times with engine shut off. Then hold steady pressure on pedal. If pedal sinks gradually, check wheel cylinders, nose and connections for external leaks and master cylinder for both internal and external leaks.

If the hydraulic system is in good operating condition, check lining, drums, springs, adjustments, etc.

to the left side of the power piston. Vacuum is present on both sides of the power piston and the Hydrovac is, therefore, referred to as being "vacuum suspended." When equal vacuum exists on both sides of the power piston, the piston return spring holds the power piston and the hydraulic piston to the left in their released position.

When the hydraulic piston is in the released position, the stem of the "Y" shaped yoke unseats the ball of the piston check valve. This provides an open passage through the center of the piston and connects the hydraulic cylinder to the brake master cylinder.

APPLYING THE BRAKES

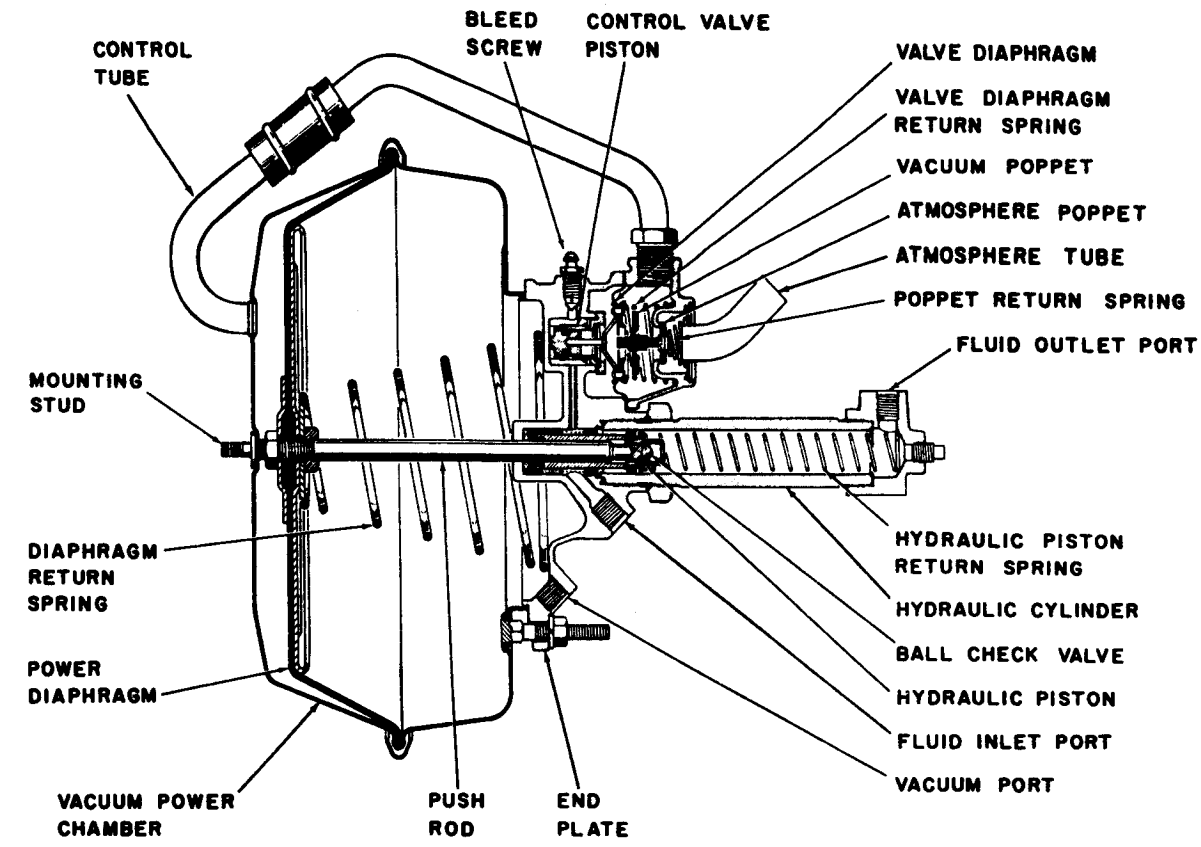


HYDROVAC IN THE APPLYING POSITION

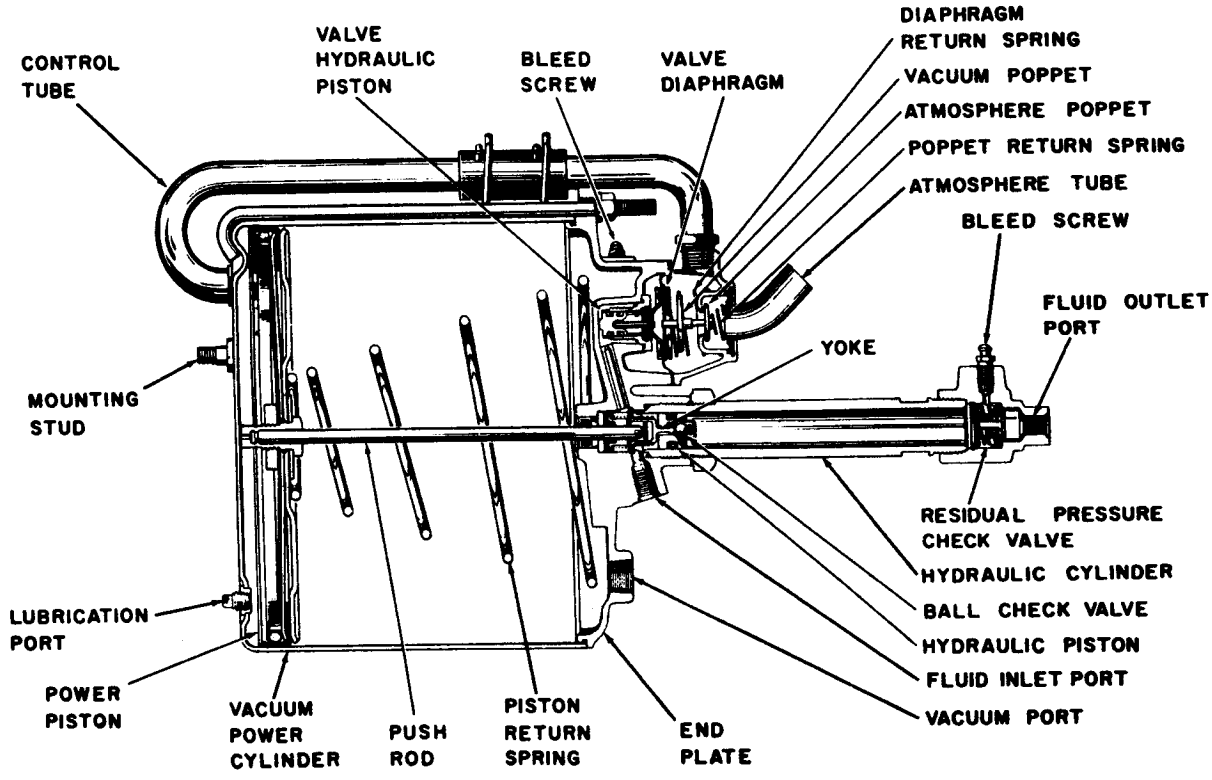
FIG. 2

When the master cylinder is applied, fluid pressure is transmitted through the center of hydraulic piston to the hydraulic cylinder. At the same time, pressure is transmitted through the fluid passage in the end plate to the left side of the valve piston compresses the diaphragm return spring and moves the diaphragm to the right, as shown in Figure 2. The vacuum port at the center of the diaphragm plate contacts the vacuum poppet and closes the control tube off from the vacuum supply. The atmosphere poppet is then lifted from the atmosphere port allowing air from the atmosphere tube to enter the control tube.

The air that is admitted to the control tube decreases the vacuum at the left side of the power piston forming a pressure differential across the piston. The force on the power piston moves the piston, the pushrod and the hydraulic piston to the right and compresses the piston return spring. The initial movement of hydraulic piston allows the yoke to move away from the piston stop. This allows the ball check valve to close and hydraulic fluid is trapped in the hydraulic cylinder. High pressure fluid is forced through the residual pressure check valve to the pressure brake lines and wheel cylinders. The total pressure obtained in the hydraulic cylinder, at the right of the hydraulic piston, is the sum of the pressure developed by the power piston acting through the pushrod, and the pressure from the master cylinder applied to the left side of the hydraulic piston.



DIAPHRAGM HYDROVAC — SECTIONAL VIEW

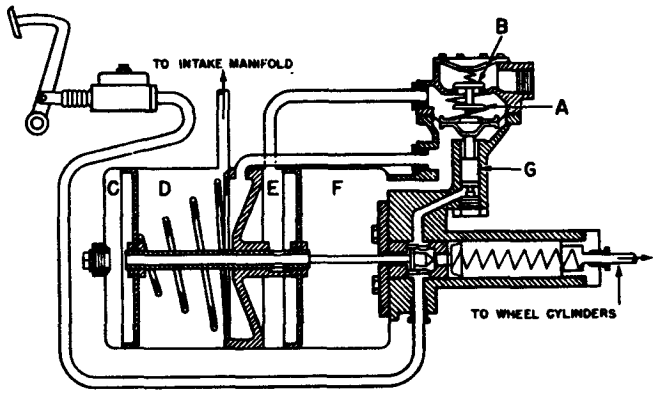


SINGLE PISTON HYDROVAC (9½ INCH VACUUM POWER CYLINDER) — SECTIONAL VIEW

HYDROVAC (Double Piston Type)

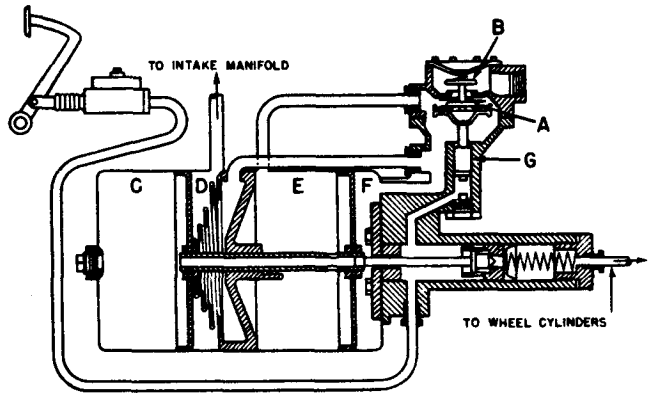
RELEASED POSITION

Vacuum valve "A" is open, atmospheric valve "B" is closed, thus vacuum is present on both sides of power cylinder pistons (Chambers "C," "D," "E" and "F"). In this position, cone shaped valve on end of pushrod has been withdrawn from its seat, thus opening passage through slave cylinder piston to wheel cylinders and allowing master cylinder to compensate hydraulic system.



APPLIED POSITION

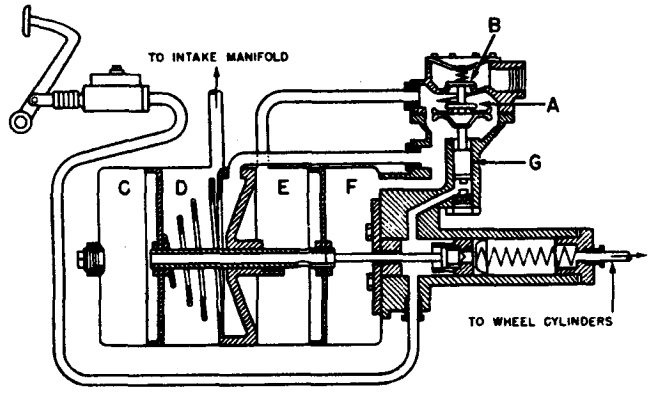
Hydraulic pressure from master cylinder is applied to control valve piston "G" moving valve diaphragm and seat up against vacuum valve "A" closing it and opening atmospheric valve "B." This admits atmospheric pressure to chambers "C" and "E," forcing piston assembly to right, causing slave cylinder to apply increased hydraulic pressure to wheel cylinders.



HOLDING POSITION

With brake pedal partially applied and physical pressure held constant, the master cylinder line pressure at point "G" remains constant since both valves are closed. If pressure on brake pedal is reduced, then vacuum valve "A" opens reducing the atmospheric pressure in chambers "C" and "E," thereby reducing the force of the vacuum piston assembly against the slave cylinder. Should vacuum system become inoperative, Hydrovac assumes released position, and pressure from Master Cylinder is transmitted through opening in slave cylinder piston to wheel cylinders.

NOTE: Operation of single piston type is identical. One vacuum piston is mounted on the rod instead of two, and the unit delivers half the power of a double piston type of same diameter. Used on smaller vehicles.



MIDLAND HY-POWER
(Trouble Shooting)

COMPLAINT	PROBABLE CAUSE	REMEDY
NOTE: If following tests are made on a tractor, shut-off valves at trailer must be closed.		
Loss of fluid in brake master cylinder.	Brake wheel cylinder leaking.	Replace necessary parts.
	Loose hydraulic tube connection.	Tighten or repair.
	Hypower leaking.	Remove and repair.
Brake fluid in Hypower vacuum chamber.	Seals leaking.	Overhaul unit.
Brake pedal kicks back against foot when applied.	Defective parts in Hypower.	Service unit.
Engine runs uneven on idle with brakes released.	Vacuum leaks.	Check all connections between manifold and Hypower unit.
	Dirt or damaged parts in unit.	Check unit.
NOTE: Before applying following tests, vehicles should be jacked up to determine whether all wheels are dragging. If all wheels do not drag, trouble is not in Hypower, but in the dragging wheels.		
Brakes release slowly.	Incorrect pedal linkage adjustment.	Adjust brake pedal free play.
	Brake shoes sticking.	Remove rust and corrosion.
	Weak or broken brake shoe return spring.	Replace.
	Residual pressure in master cylinder too high.	Make certain control valve plunger moves in and out freely. Start engine; apply brakes and release. If brakes do not release, open bleeder screw at Hypower unit. If brakes release, master cylinder is at fault. If they do not release, repair Hypower.
Engine runs unevenly with brakes applied combined with hard pedal.	Defective diaphragm, valve seats, or dirt under valves.	Service Hypower.
Hard pedal at different intervals.	Defective manifold check valve.	Replace.
	Obstructed air cleaner.	Service Hypower air cleaner.
	Slave cylinder piston sticking due to dirt or inferior brake fluid.	Clean out slave cylinder. Flush system with alcohol. Install recommended fluid and bleed. Replace damaged parts.

NOTE: Most of the above tests can be applied to any make of vacuum booster.

VACUUM-HYDRAULIC POWER BRAKE SYSTEM
(Trouble Shooting)

In this section only those troubles that can be attributed to the vacuum power unit will be covered. The Foundation brakes and hydraulic system must be checked to see if the difficulty exists in a component other than the power unit.

A. HARD PEDAL

1. Low engine vacuum — engine needs service.
2. Low vacuum caused by restriction in vacuum lines.
3. Loss of vacuum due to leaks in vacuum lines — loose fittings.
4. Collapsed vacuum hose or tubing.
5. Defective check valve.

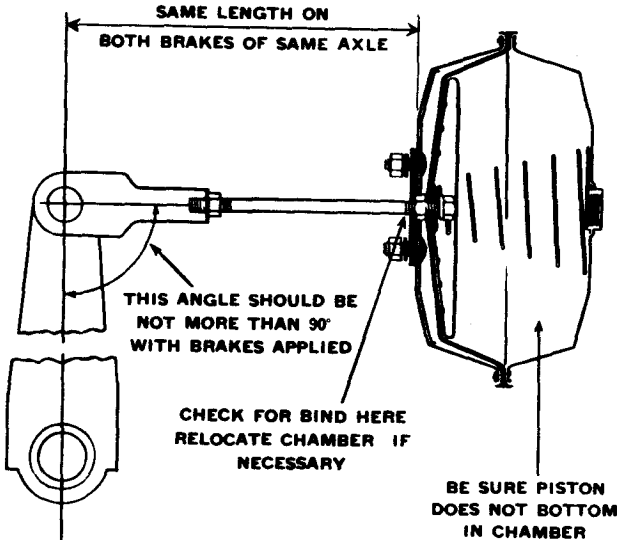
B. BRAKES FAIL TO RELEASE

1. Control valve hydraulic piston binding in fitting.
2. Clogged hydraulic passage to control valve piston.

VACUUM POWER SYSTEMS

BALANCING BRAKE INPUT

In order to balance brake output, the brake input must be equal on opposite brakes of the same axle. This means that mechanical connections between the power chamber and brake camshaft must be correct.



POWER CHAMBER and BRAKE LEVER

Check the following:

1. Binding of rod in power chamber housing. Be sure it operates freely when connected to brake lever.
2. Distance between top of power chamber and clevis connection to brake lever must be equal on both brakes of same axle. Readjust clevis if necessary.
3. Angle between power chamber rod and brake lever must never be over 90° with brakes applied. Readjust lever on spline, if necessary. Angles at both brakes must be equal.
4. Be sure same length brake levers are used.

LEAKS IN BRAKE SYSTEM

Test system by installing gauge at any location in tractor behind engine check valve. Start engine and record gauge reading. Shut off engine. Gauge must not drop more than 5" in fifteen minutes. Leaks may occur at:

Hose Couplings.
Engine Check Valve.
Hand Control Valve.
Tractor Power Chamber.
Relay Valve.
Trailer Power Chambers.
Vacuum Reserve Tank.
Tubing and Piping.

NOTE: Vacuum suspended units may leak at both "on" and "off" positions. Air suspended units will leak in "on" position only.

TROUBLE SHOOTING ON BRAKES — ALL TYPES

Brake Systems consist of three primary components . . .

CONTROL—Hydraulic

The hydraulic system from the foot pedal to and including the wheel cylinders. Also the mechanical emergency brake linkage when used on rear wheels.

Mechanical

The linkage from the foot pedal to the backing plate, including frame brackets, cross shaft levers, rods, cables and conduits.

Booster

The vacuum system from the intake manifold (or pump) to the power cylinders including all valves and reserve tanks.

Air

The compressor and its governor to the wheel chambers or pistons including all valves and reservoir tanks. The slack adjusters are considered a part of the control and must be thoroughly inspected.

BRAKE ASSEMBLY

The brake itself. The backing plate with the anchors. The shoes and linings with pull back springs and drums, links and wheel bearings.

CHASSIS

Every part of the vehicle through which the torque set up by braking is absorbed. This includes tires, steering mechanism, suspension and connections, rear axle housing with its connections.

THE FIRST STEP in trouble shooting is to localize the fault to one of these three components, then correct that part as a whole, since all items in that part are closely related and all are usually impaired by the failure of one.

Most troubles follow the same pattern. The chart below will help to locate the parts at fault. The method of correction is noted. These methods are given in detail on reference pages indicated in the index.

NOTE: CHECK INDEX FOR BRAKE TYPE AND ADDITIONAL INFORMATION. SEE SPECIAL SECTIONS ON TROUBLE SHOOTING, AIR AND VACUUM BRAKES.

HYDRO-BOOST POWER BRAKES

All 1976 hydro-boost vehicles will incorporate an accumulator which is integral with the booster (fig. 6).

INTEGRAL ACCUMULATOR/BOOSTER

The booster power section includes three ports (fig. 6):

1. Pressure Port (11/16-18 thread)--the high pressure line from the power steering pump is connected to this port.
2. Gear Port (5/8-18 thread)--the high pressure line leading to the power steering gear is connected to this port.
3. Return Port (for 3/8 I.D. Hose)--the return line to the power steering pump is connected to this port.

The pressure port and the gear port each contains an aluminum tube seat insert.

The accumulator valve components are assembled in the accumulator valve bore which is machined in the housing. This bore is connected by passages to the accumulator and to the pressure port.

The integral spring accumulator (fig. 7) is used in conjunction with the hydraulic brake booster. The accumulator piston assembly and spring are assembled in the accumulator bore which is machined in the housing.

WARNING: Do not attempt to disassemble or cut into the accumulator. The accumulator contains a spring compressed under high pressure.

BLEEDING HYDRO-BOOST/POWER STEERING HYDRAULIC SYSTEM

The following procedure should be used to bleed the power steering hydraulic system on hydro-boost vehicles.

NOTE: If the power steering fluid has foamed due to low fluid level, it will be necessary to park the vehicle for approximately one hour (reservoir cap loose) so that the foam can dissipate.

1. Raise the front of the vehicle on a hoist so that the tires are clear of the floor.
2. Check reservoir and fill with GM Power Steering Fluid (or equivalent).

NOTE: Leave the reservoir cap off during entire bleed procedure.

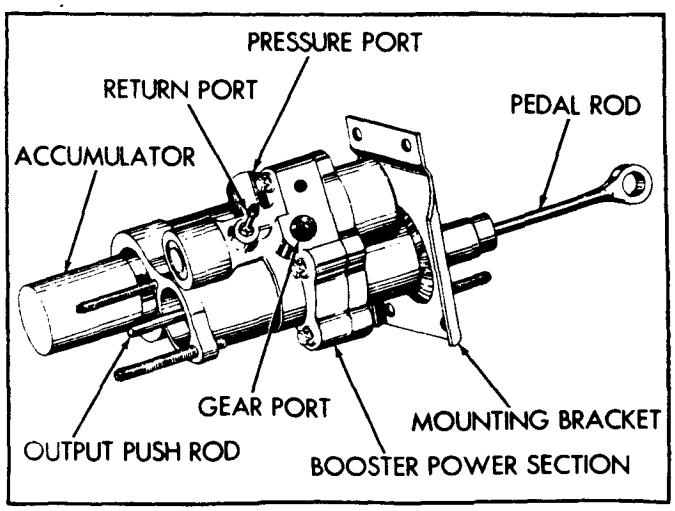


Fig. 6--Hydro-Boost With Integral Accumulator

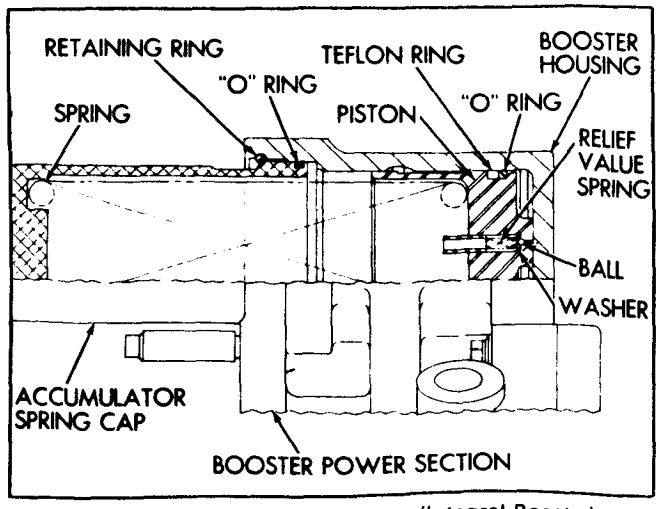


Fig. 7--Accumulator Components (Integral Booster)

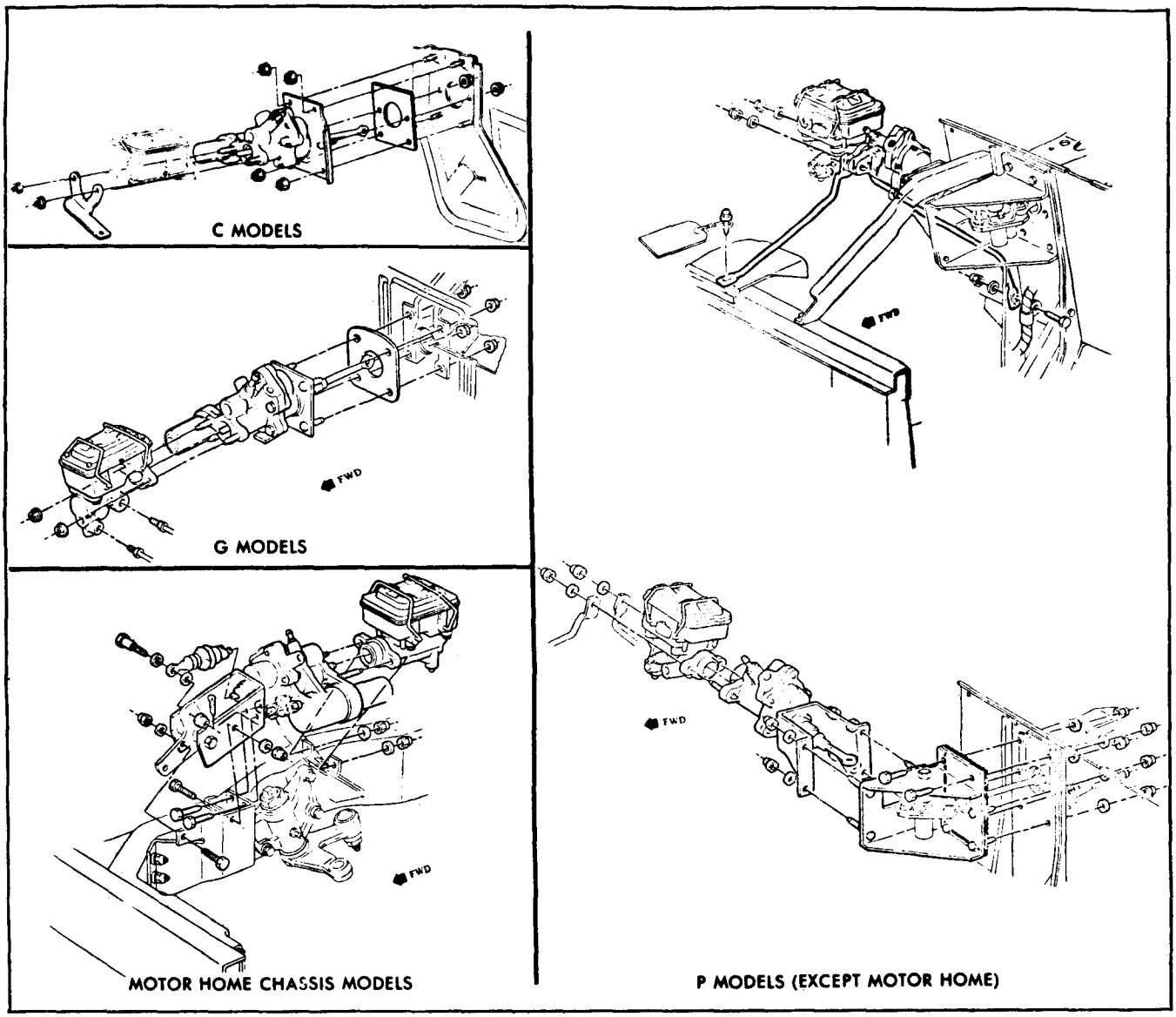


Fig. 8–Hydro-Boost Installation

Assembly

1. Lubricate the secondary piston assembly and the master cylinder bore with clean brake fluid.
2. Assemble the secondary spring (shorter of the two springs) in the open end of the secondary piston actuator, and assemble the piston return spring (longer spring) on the projection at the rear of the secondary piston.
3. Insert the secondary piston assembly, actuator end first, into the master cylinder bore, and press assembly to the bottom of the bore.
4. Lubricate the primary piston assembly with clean brake fluid. Insert the primary piston assembly, actuator end first, into the bore.
5. Place the snap ring over a smooth round ended tool and depress the pistons in the bore.
6. Assemble the retaining ring in the groove in the cylinder bore.
7. Assemble the compensating valve seals and the small "O" ring seal in the recesses on the bottom of the reservoir. Be sure that all seals are fully seated.
8. While holding the pistons depressed, assemble the compensating valve springs and the compensating valve poppets in the compensating valve ports.
9. Holding the pistons compressed, position the reservoir on the master cylinder body and secure with the four mounting bolts. Tighten the bolts to 12-15 ft. lbs.

Bench Bleeding

1. Plug the outlet ports and fasten the master cylinder in a vise with the front end tilted slightly down.
2. Fill the reservoir with clean brake fluid. Use any tool with a smooth rounded end to depress and release the

TIRE DEMOUNTING AND MOUNTING PROCEDURES

CAST WHEELS WITH DEMOUNTABLE RIMS

DEMOUNTING TIRE/RIM ASSEMBLIES

Always deflate tires prior to demounting. If there is any evidence of damage to the rim and lock ring, or if the lock ring appears to be unseated, the tire should be completely deflated prior to removal of the tire and rim assembly from the vehicle.

After removal of the tire and rim assembly, clean and carefully inspect the spokes for cracks, especially after long, hard use. Inspect wheels nuts and clamps as well. It pays to check these vital parts. Damage in these areas can result in a dangerous condition and possible accidents.

WHEN NEW

After the truck has made its first run of 50 to 100 miles, the tire and rim assemblies will have "seated in" to the cast wheel. As a result, the stud nuts will have lost their initial torque. It is very important at this time that the nuts AGAIN be brought up to their recommended torque. The wheel/rim assemblies should then remain tight, barring such accidents as stud and clamp breakage, or cracked spokes.

INSTALLATION

The correct installation and tightening of tire and rim assembly on the wheel is probably one of the most important operations in wheel maintenance. When tire and rim problems occur, incorrect installation and tightening practice is nearly always found to be the cause of trouble. The following procedure must be followed carefully to insure safe and dependable service.

PROCEDURE

1. Using a wire brush, clean the wheel and rim mounting surfaces making sure they are free from dirt and paint (Fig. 2).

   NOTE: Mounting surface of the wheel is the inboard 28° taper on the spokes.

2. Slide inside tire and rim assembly over the cast wheel and push back into position. Make certain that valve stem points out and is centered between two spokes.

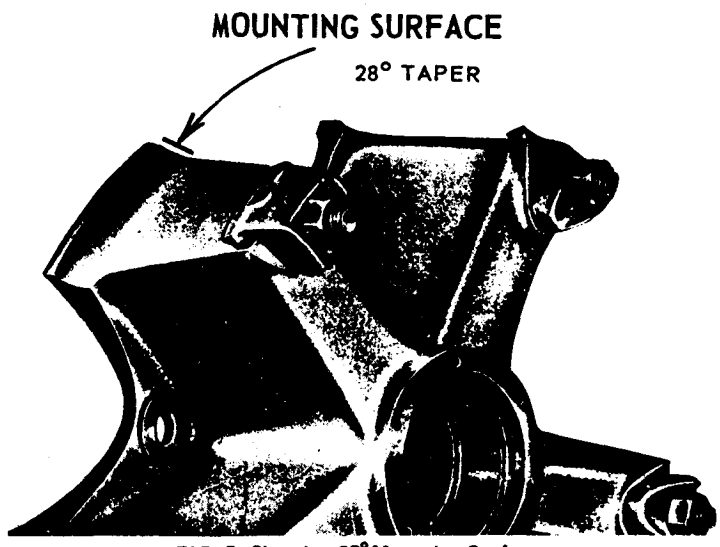


FIG. 2: Showing 28° Mounting Surface.

3. Slide rim spacer in place (Fig. 3).

4. Slide outside tire and rim assembly over the cast wheel and push into position. Make certain that valve stem points in and is located at the opposite spoke to which inner tire valve stem is placed. By placing the valve stems in this manner, both the inner and outer valve stems are more accessible for tire inflation.

5. Install all rim clamps and nuts. Run nuts down until end of stud is flush with face of nut, then revolve the wheel one-half turn to allow parts to seat naturally.

6. Using the triangulation method shown in Figure 4, torque the stud nuts as follows:
   - Turn nut #1 until snug.
   - Rotate wheel/rim assembly until nut #3 is in top position. Turn nut until snug.
   - Again rotate wheel/rim assembly until nut #4 is in top position. Turn nut until snug. (Note: This method provides an even application of force against three points of the rim for proper rim alignment).
   - Repeat the above procedure, bringing each nut to recommended torque.
   - Bring the remaining nuts to the recommended torque.

TIRE DEMOUNTING AND MOUNTING PROCEDURES

ALUMINUM WHEELS

Follow the safety practices recommended by the National Wheel & Rim Association. These can be found in the *Wheel & Rim Operating Manual* published by the National Wheel & Rim Association. Request a copy from your Alcoa wheel distributor.

TUBE-TYPE TIRES

To insure long life and trouble-free service, a reasonable amount of care must be exercised when mounting or demounting tires. Nicks or gouges should be avoided on the surface of the wheel. Wheels should be inspected regularly for damage, before mounting and during service.

Mounting

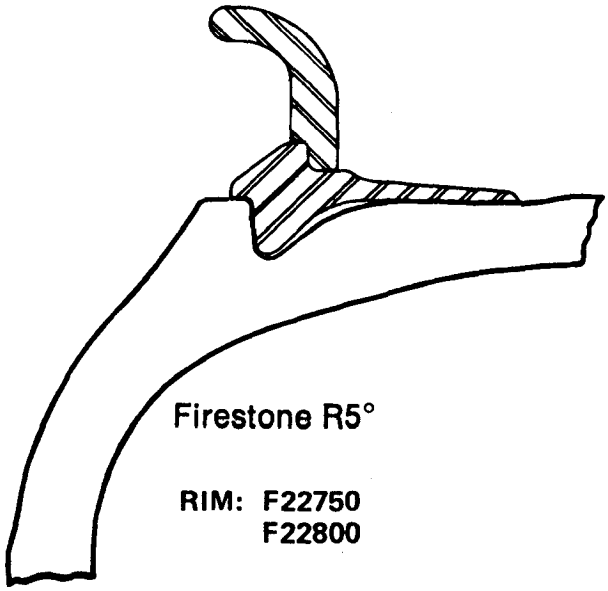
The tire with tube and flap is placed on the wheel in such a position that the air valve can be inserted through the slot in the rim. The air valve should always point toward the hand-hole in the disc part of the wheel, regardless of the position of the wheel when mounted. Then the tire is pushed "home" on the rim.

Side and Lock Rings

The steel side rings should be carefully installed. Care should be taken to see that the wheel is equipped with the proper side rings, avoiding any possibility of an assembly of a ring of another make or size which will not work properly or safely. The wheel and its components should also be cleaned and examined for cracks or defects. During inflation of the tire, the rings should be checked to *make sure they are seated.*

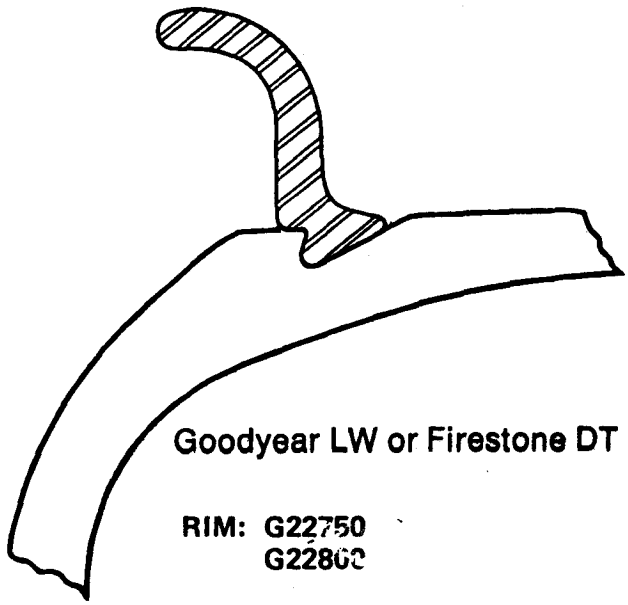
Alcoa® Aluminum Forged Disc Wheels are available to take (1) Firestone R5° side and lock rings or, (2) Goodyear LW and Firestone DT split side rings. The proper selection of side and lock rings may be made by referring to the sketches below which illustrate the manner in which the gutters are machined for the two types of rings.

During inflation, the wheel should be in a safety cage; if one is not available, the wheel should be lying flat with the side rings down. This safety precaution will protect the operator in case the rings blow off because of improper seating or the use of incorrect types.



Firestone R5°

RIM: F22750
F22800



Goodyear LW or Firestone DT

RIM: G22750
G22800

**SIDE AND LOCK RINGS MUST BE PROPERLY MATCHED TO RIMS AS SHOWN.
A WHEEL MACHINED FOR FIRESTONE R5° SIDE AND LOCK RINGS SHOULD NEVER BE USED WITH A GOODYEAR LW SIDE RING AND VICE VERSA.**

4. BE SURE INSIDES OF WHEEL AND TIRE ARE DRY BEFORE MOUNTING.
5. USE OF FREYLUBE*, OR EQUIVALENT IS RECOMMENDED AS A TIRE MOUNTING LUBRICANT.
   Do not use water base lubricants during mounting.
   *Trade name of Freylube Corporation.
6. IT IS ABSOLUTELY ESSENTIAL THAT AIR USED FOR TIRE INFLATION BE DRY.
   Therefore, use of moisture traps or air lines leading from compressors is recommended.
7. DO NOT OVERINFLATE.
   Use tire manufacturers recommended inflation pressures. Under no circumstances exceed 100 psi.

Demounting

Be sure the tire is completely deflated. The tire beads can then be loosened by pushing them toward the center. The difficult part of removing the tire from the wheel is usually the loosening of the tire beads. Tire beads loosen on Alcoa wheels more easily than on other makes, but considerable force may still be required.

The tire beads are now pried over the rim edge one at a time, using two tire tools. These tools must be smooth and must be used with care to avoid gouging the rim. Do not drive down into the rim area.

Rules for Proper Handling of Wheels When Demounting Tubeless Tires

1. DO NOT GOUGE OR NICK THE WHEEL.
   It is best to handle wheels on a wooden floor or rubber mat. Use only plastic, rubber or leather-faced hammers.
2. KEEP TIRE TOOLS SMOOTH—USE THEM WITH CARE.
   Rim gouges or nicks may cause cracks.

WHEEL INSTALLATION

The mounting flange thickness on Alcoa Aluminum Forged Disc Wheels is greater than most wheels, so attention must be given to the choice of stud and nuts to insure adequate thread engagement. Ideally, the end of the stud and the outer flat face of the nut should be approximately flush. This results in a good-looking assembly with the male threads protected against road damage and usually gives a sufficient length of thread engagement to develop the full strength of the stud without danger of thread stripping. However, there are many types of nuts and studs in use, and their design and specification are not standardized. For this reason, the actual length of thread engagement that is present in an assembled wheel cannot be determined by inspection or measurement of a tightened assembly, since the distance from the ball seat of the wheel mounting flange to the first (inside) nut thread may vary. If there is any doubt that enough thread engagement is present, the number of engaged threads may be counted by tightening all nuts in the regular manner, then loosening one to the hand-tight position. Then, the number of turns to disengage from the stud may be counted as it is backed off. **At least seven full turns should be required to disengage a ¾-in. nut and at least five full turns should be required to disengage a 1⅛-in. nut.** With most of the nuts in use today, a few unengaged threads at the outer end will not cause a problem. Cap nuts made to Alcoa's specification, usually give more thread engagement on a given stud.

Cap nuts must be kept tight and studs and nuts should be checked at tire changes to be sure they are in good condition. If nuts require frequent tightening, studs break frequently, or wheel ball seats are pounding out, hardware and mounting practices should be reviewed.

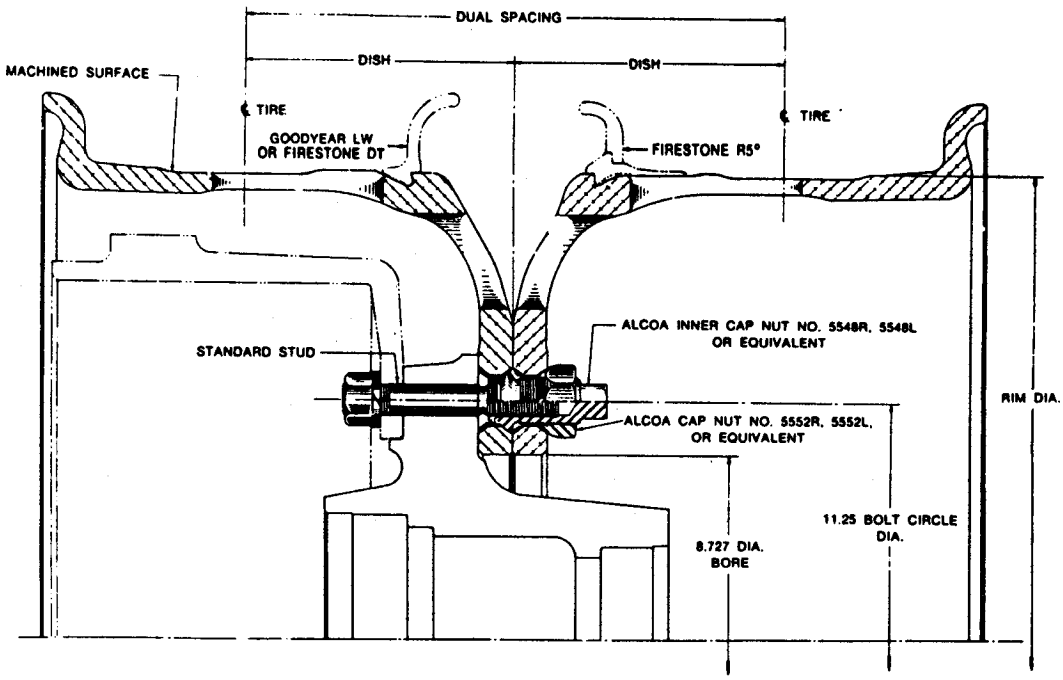
Studs on the right hub of a vehicle have right-hand threads and studs on the left hub have left-hand threads. The letter "R" or "L" on the cap nut indicates right or left-hand threads.

Front Wheel Mounting

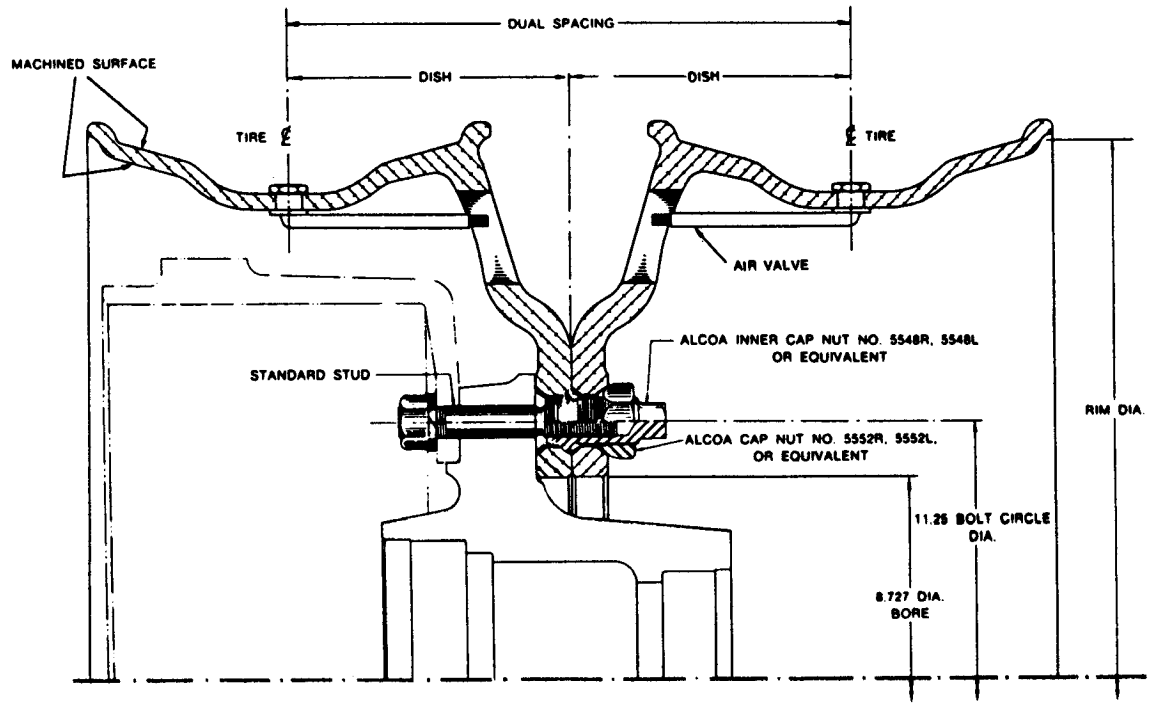
Front wheels are mounted as singles. Many vehicles have large 1⅛-in., bus-type studs on the front hubs. Alcoa single cap nuts, part No. 5552 L or 5552 R or equivalent, should be used. Some front hubs have ¾-in. studs. On these hubs, use Alcoa single cap nuts, part No. 5554 R or 5554 L or equivalent.

SINGLE CAP NUT 5552 R
5552 L

SINGLE CAP NUT 5554 R
5554 L



TYPICAL DUAL MOUNTING—TUBED TIRES



TYPICAL DUAL MOUNTING—TUBELESS TIRES

MAINTENANCE AND PROTECTION IN CORROSIVE ENVIRONMENTS

Due to aluminum's natural resistance to corrosion, Alcoa Aluminum Forged Disc Wheels do not need to be painted for most operating conditions. Simply washing them (do not use highly alkaline cleaning agents) when washing the rest of the rig will be enough to keep wheels looking good for many years. Certain environments, as created by some operations, can lead to corrosion. Some of these are: livestock hauling, salt, chloride compounds used for snow removal and highly alkaline materials.

WHEN THESE CONDITIONS ARE ENCOUNTERED, THIS MAINTENANCE PRACTICE IS RECOMMENDED:

1. Clean frequently with steam or high-pressure water from a hose. Use of a mild detergent will speed up the cleaning process.
2. When tires are removed, the entire wheel should be cleaned and inspected.

For maximum protection, there are various types of coatings which give good results. The following procedures are suggested:

Surface Preparation

1. Remove all soil and oil from wheel surface with either high-pressure steam or solvent. Suitable solvents would be mineral spirits and regular paint thinner, obtained in paint stores.
2. Remove any adherent soil or oxidation products by using a wire brush.
3. Clean the surface again with solvent, using mineral spirits to remove loose products.
4. Apply a clear protective or pigmented product as follows:

Clear Protective Coating

Spray apply about 1½ to 2 mils wet film thickness, air curing clear epoxy polyamide meeting Military Specification MIL-C-22750 (WEP) or equivalent. This coating can be obtained through E. I du Pont de Nemours & Company, Inc., Glidden, PPG Industries, Sherwin-Williams and other reputable paint companies. To properly spray this particular coating, mix components A and B of the two-part organic coating and thin where necessary with 10 percent toluol. Spray apply with a spray gun at a pressure of 30–40 pounds (suction feed).

Pigmented Protective Coating

Primer—Spray apply inhibited primer, meeting Military Specification MIL-C-23377 (SEP) or equivalent, which can be obtained from the companies mentioned above. Spray this primer at a 1 to 2 mil wet film thickness. Allow to air dry from 2 to 4 hours before top-coating.

Top Coat—Spray at 1½ to 2 mils wet film of a leafing aluminum pigmented epoxy. Allow enough time to air dry before handling; overnight will usually be sufficient. This coating can be obtained from sources such as:

Co-Polymer Chemicals, Inc.
12350 Merriman Road
Livonia, Michigan 48150
Reliance Universal, Inc.
6901 Cavalcade
Houston, Texas 77028

In the foregoing, several proprietary compounds have been suggested. This does not necessarily constitute endorsement of these products.

TIRES (BIAS PLY)

Some tires are not approved for installation on disc wheels or demountable rims used on vehicles covered by this manual, they are as follows:

RADIAL PLY TIRES

Do not install radial ply tires on standard disc wheels or demountable rims. To do so could cause wheel or rim failure.

STEEL BELTED RADIAL AND
BIAS PLY STEEL CORD TIRES

These tires are not to be installed on any GM supplied disc wheel or demountable rim.

Tube-type tires are either standard or optional on all vehicles covered in this manual.

One of the most important factors of economical and safe truck operation is systematic and correct tire maintenance. The tires must not only support the weight of the loaded vehicle, but they also serve to transmit driving and braking forces to road surface. Therefore, the tires used on all trucks should receive the same amount of careful systematic, and regular maintenance as do other operating units.

Periodically check the valve stem cores and caps for leakage. Also, check around tires for embedded steel, rock, or glass. If any of these objects are allowed to remain in tread, they may eventually reach the tube.

NOTE: In some instances the tube of an inflated tire may already be punctured and pressure will be lost only when object is removed.

OVERLOAD

Overloading is the cause of many kinds of cord body breaks. Such breaks are due to abnormal flexing or overworking of the cord body of the tire.

Overload flex breaks occur in the sidewall or in the shoulder of a tire and run with the circumference of the tire. Sometimes they are only two or three inches long.

Other times they will extend partly around the tire, resulting either in a large blowout or a pinched tube which allows the tire to go flat.

Normally flexing of a tire can go on for long periods of time without causing any appreciable damage to the cords. But if the tire is overworked or overflexed from overload, abnormal heat is generated and the cords become fatigued and break.

Underflation will cause this same result. In addition, sprung axles, mismatched duals and poor load distribution tend to produce flex breaks. This can be avoided if trucks are equipped with tires and rims of the proper size and type, large enough to carry the load. The rated carrying capacity of a tire cannot be increased by inflating it beyond the maximum recommended pressure.

Valve Stem

After installation of tires, make sure valve stem does not rest on brake drum. If brass stems are too close to the brake drums, excessive heat may damage valve and cause possible loss of air pressure.

SYNTHETIC TUBES AND FLAPS

TUBES CHAFED OR PINCHED
BY FABRIC BREAKS

Tubes may fail as a result of being chafed or pinched by fabric breaks inside the tire. The direction and shape of the tube injuries have rather closely followed the pattern of the fabric breaks. A tire does not necessarily go flat immediately when a fabric break occurs on the inside of the tire because it may take some time for the injury to chafe completely through the tube.

TUBES DAMAGED BY
MISMOUNTED FLAPS

The tube may become chafed by a fold at the edge of the flap. In mounting tires requiring flaps, it is essential that the flaps be properly centered between beads to prevent folds or wrinkles. Flaps which have once become twisted, creased, or folded over at edges, should not be used again.

TUBES AND CASINGS DAMAGED BY
FOREIGN MATERIALS IN CASINGS

Any foreign material between the casing and tube will cause a chafing action. In time, one or both will become badly damaged and fail.

Grit, pebbles, or other hard substances which become embedded in the tube wall, will chafe tube and finally cause failure.

TUBES STRETCHED AND CREASED

When a tube is larger than the inside of the casing it has become stretched and can become creased. Creasing can also happen to a new tube of proper size when incorrectly mounted. If the crease occurs in the flexing area of the tire, the resulting additional thickness of the tube where folded causes a hinging action which cuts the tube and frequently damages the fabric - resulting in a costly failure.

CREASES CAUSED BY
REMOUNTING USED TUBES

Tubes usually undergo some stretch or growth in service. This is particularly true of truck tubes because of the high temperatures which develop. When a used tube is remounted in a new, or nearly-new tire, a folded condition will usually result, and eventually will cause both tube and tire to fail.

TUBE BREAKS NEXT TO THE VALVE

Improper inflation procedure may cause a

the valve core. This is extremely important to prevent tube buckling.

6. Reinflate tire to recommended pressure.

NOTE: Used flaps may cause tube failure UNLESS mounted with the size tire and rim originally used. When tube and flap are not properly lubricated and mounted, they will be stretched thin in the tire bead and rim region (fig. 16, View 3). This will cause premature failure.

Always clean rims thoroughly to remove rust.

Certain precautions must be taken when mounting used flaps, or damage to the tire and tube will result.

New truck and bus flaps can be used with any one of several different tire and rim sizes as recommended. But once used, the flap must be remounted in the same size tire and on the same size rim from which it was removed. Always use flap of adequate width to prevent tube pinching.

As a precaution against flap failure, mark the tire and rim size on the flap at the time of removal - if inspection shows that it is not damaged and can be used again. When the flap is again mounted, this marking protects against the danger of misusing the flap with the wrong size tire and rim.

New flaps and tubes should be used after tire or rim repairs. It is inexpensive insurance since small wear spots and imperfections in tubes and flaps are hard to see. This could prevent future tire failures.

TUBE RECOMMENDATIONS

1. Long life and high mileage received from present day tires exhaust the useful service life of tubes. Therefore, when a casing is worn to the point of being unsafe, the tube generally is in the same condition and should be replaced with a new one.

2. If valve cap is lost, clean end of valve before applying air hose to prevent dust and dirt from being blown into the tube. Apply new cap.

3. When tubes are inflated for inspection, they should not be inflated to the point of "ballooning." When a tube is "ballooned," it thins out in the stretched area, making the tube too large in that area and resulting in folds or wrinkles when remounted.

INFLATION OF TIRES

(Refer to Figure 17)

Inflate to correct pressure when tires are cool. If tires are continually carrying less than the recommended maximum load, adjust air pressure downward to correspond to the actual load carried.

Never "bleed" tires to relieve build-up of pressure. Tire temperature will increase when the tire is in service and allows for the normal build-up in air pressure. Tire temperature and air pressure will remain within limits that are not harmful to the tire when used in accordance with the recommendations for load and air pressure.

If excessive build-up of air pressure occurs, overload, underflation, speed, or a combination of these is responsible. Use the size and type of tire that has the capacity to carry the load at recommended cold starting pressure.

The fabric, rubber, bead, contour, and size of tires used on these vehicles are designed to

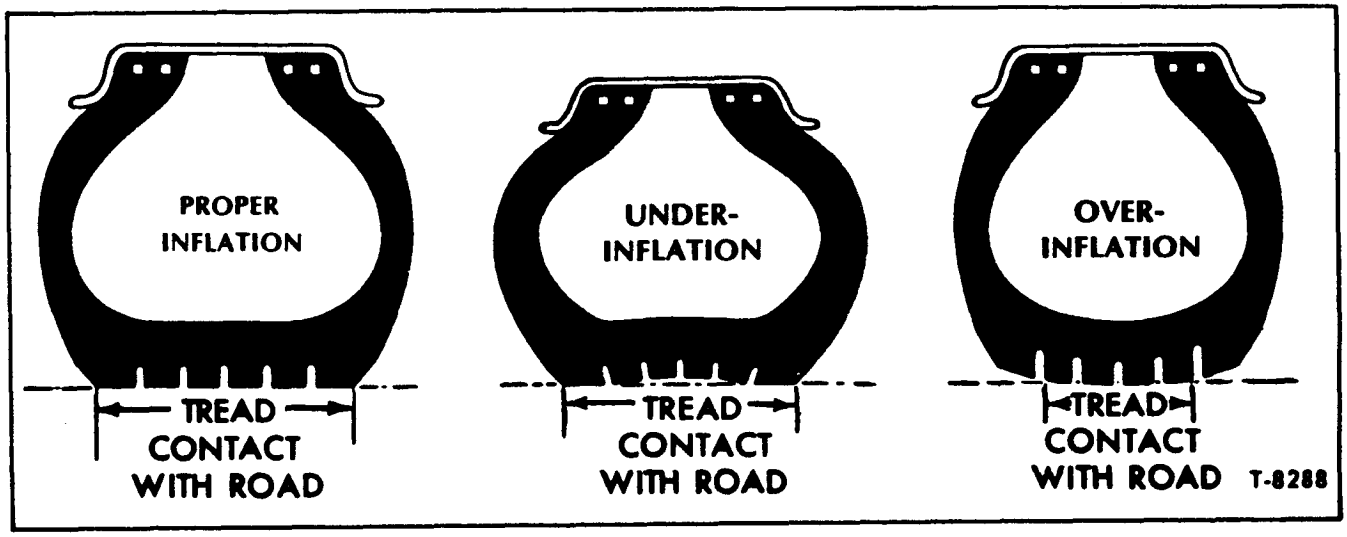


Figure 17—Inflation of Tires

There is, of course, no correction for high cambered roads. Cornering wear is discussed further on.

Misalignment Wear -- This is wear due to excessive toe-in or toe-out. In either case, tires will revolve with a side motion and scrape the tread rubber off. If misalignment is severe, the rubber will be scraped off both tires; if slight, only one will be affected.

The scraping action against the face of the tire causes a small feather edge of rubber to appear on one side of the tread and this feather edge is certain indication of misalignment. The remedy is readjusting toe-in, or rechecking the entire front end alignment if necessary.

Cornering Wear -- When a truck makes an extremely fast turn, the weight is shifted from an even loading on all wheels to an abnormal load on the tires on the outside of the curve and very light load on the inside tires, due to centrifugal force. This unequal loading may have two unfavorable results.

First, the rear tire on the inside of the curve may be relieved of so much load that it is no longer geared to the road and it slips, grinding off the tread on the inside half of the tire at the excessive rate. This type of tire shows much the same appearance of tread as tire wear caused by negative camber.

Second, the transfer of weight may also overload the outside tires so much that they are laterally distorted resulting in excessive wear on the outside half of the tire, producing a type of wear like that caused by excessive positive camber.

Cornering wear can be most easily distinguished from abnormal camber wear by the rounding of the outside shoulder or edge of the tire and by the roughening of the tread surface which denotes abrasion.

Cornering wear often produces a fin or raised portion along the inside edge of each row in the tread pattern. In some cases this fin is almost as pronounced as a toe-in fin, and in others, it tapers into a row of tread blocks to such an extent that the tire has a definite "step wear" appearance.

The only remedy for cornering wear is proper instruction of operations. Driving more slowly on curves and turns will avoid grinding rubber off tires. To offset normal cornering wear as much as possible, tires should be rotated at regular intervals.

Uneven Wear -- Uneven or spotty wear is due to such irregularities as unequal caster or camber, bent front suspension parts, out-of-balance wheels, brake drums out-of-round, brakes out of adjustment or other mechanical conditions. The remedy in each case consists of locating the mechanical defect and correcting it.

Power and Speed -- Excessive speed has always been harmful to tires. Speed creates heat - heat softens tires.

Stops and Starts -- Quick stops and starts grind off tread in a hurry, may cause flat spots which continue to grow for the life of the tire.

Temperature -- Considerably less mileage can be expected from a tire used in all warm weather driving as compared to all cool weather driving, or from a tire first put into service in warm weather.

MECHANICAL IRREGULARITIES

(Refer to Fig. 18)

Following are some wheel or vehicle irregularities which may cause rapid or uneven tread wear:

Toe-In -- The wheels on the same axle are closer together in the front than they are in the rear. When toe-in is excessive the tire wear shows feathered edges on inside edge of the skid design.

Toe-Out -- The wheels on the same axle are closer together in the rear than they are in the front. Tire wear shows feathered edges on outside edge of the skid design.

Camber -- This designates the tilt of the wheel. Positive camber is when wheels are closer together at point of road contact. Negative camber is when wheels are closer together at top. Too much camber results in excessive wear on one side of tire.

Caster -- This is the backward tilt of the axle or inclination of the kingpin at the top. Too little caster causes wheel to wander or weave - result, spotty wear. Excessive caster may cause wheel "flight" or shimmy wear. Unequal caster causes wheel to pull to one side, resulting in excessive and uneven wear.

Sprung or Sagging Axle -- Either of these conditions causes uneven distribution of the load. A sprung or sagging axle will cause the inside dual tire to carry the greater load.

Tandem and Spread Axle Wheels -- Fast tire wear often occurs on tandem wheels because of side scuffing when the vehicle rounds a curve and the tires are not moving in a straight path. The same thing happens when spread axle tires are dragged or pushed sideways; for example, while spread axle trailers are being spotted at or pulled away from loading docks.

Sprung or Twisted Frame -- Will cause rapid or uneven tread wear.

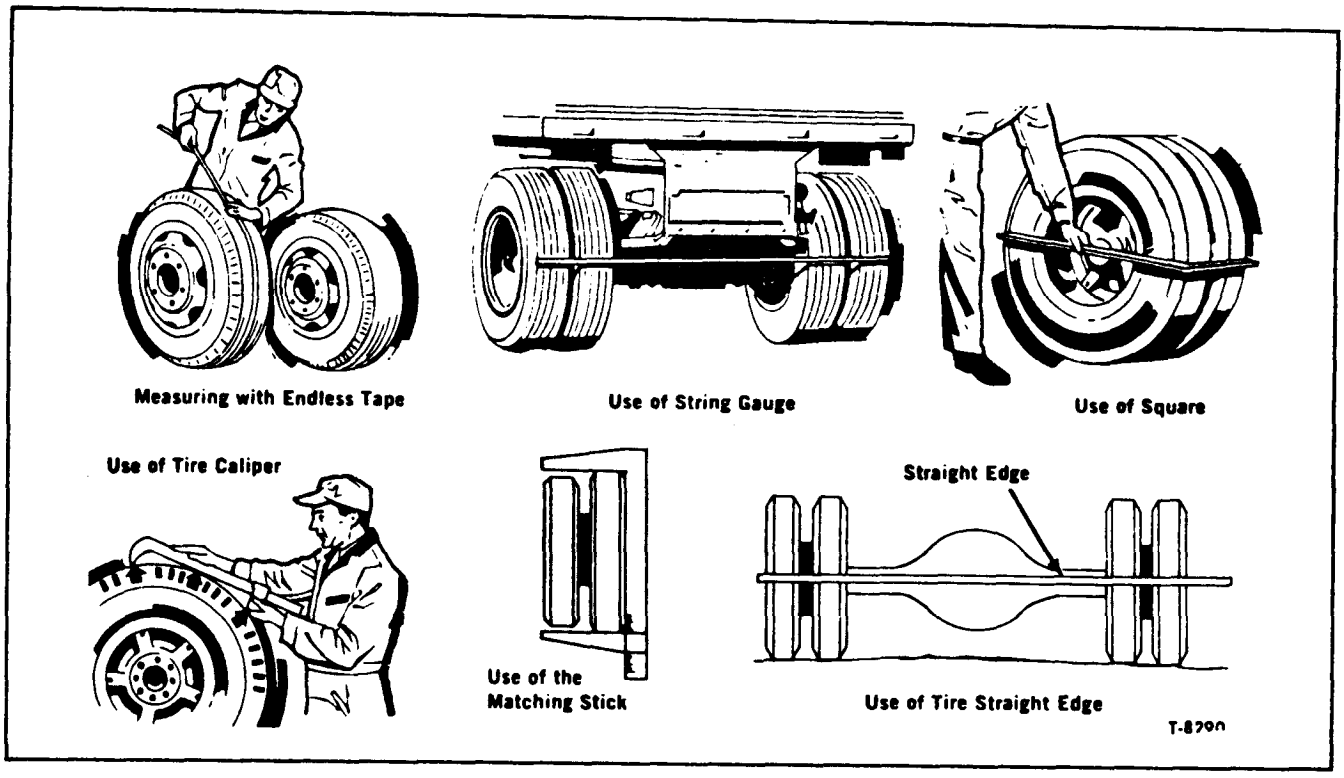


Figure 19—Types of Tire Measurement

7. Vary tire air pressure, within the tire manufacturer's recommended range, so the lubricant temperature of both axles is within 30°F, of each other and not in excess of 220°F. This will usually result in uniform tire loading and good tire life.

Follow the same procedure (Items 1 thru 7) for matching tires on a Tandem Unit. Arrange the tires in order of size. The two largest and two smallest go on one axle, the next two largest and smallest on the second axle, and the remaining four on the third axle.

Measuring the circumferences of the tires with a steel tape after they are on the rims and inflated but before they are applied to a vehicle is the most accurate method.

Measuring in this manner takes into account any irregularities in wear. In checking tires already on a vehicle, either a square, similar to but larger than a carpenter's square, a string gauge, a large pair of calipers, or a wooden straight-edge long enough to lie across the treads of all four tires, may be used.

TIRE ROTATION

Generally, it is the best practice to "break in" new tires on front wheels. "Breaking in" on an easy position generally increases the overall tire life.

The movement of the tires from front to various rear wheel positions depends upon the type of unit being operated. It is generally necessary to use tires with good non-skid tread design on drive wheels.

Tires with least tread design should be used on trailer wheels, and particularly on the rear of tandem wheels. This is due to the fact that cuts are found more often on the trailer and rear tandem tires and by using well worn tires on these wheels, loss on tires due to road hazards is minimized.

NOTE: When rotating any tire, follow the recommendations in "Selection of Tires" as covered previously.

TWO-AXLE TRUCK

Tires should be moved from front to rear wheels (fig. 20) after 1/3 of the tread design is worn off. If there is uneven front wheel tire wear, rotate tires immediately and check vehicle for mechanical irregularities. When tires are moved to the rear, follow recommendations in matching them with other tires.

TRUCK WITH TANDEM AXLE DRIVE

Follow the same practice as described for single-drive axle except tires must be removed from the front at less service in order to provide eight tires for the rear wheels instead of four for the single-axle drive. Since there are five tires on each side of the vehicle (fig. 20) the front tires should be moved to the rear

It is desirable from the standpoints of tire wear and vehicle handling ease to maintain proper balance of front wheel and tire assemblies on all models. All wheels intended for use on front of vehicle, such as those switched during periodic tire rotation and those installed as new or repaired replacement equipment should be accurately balanced. This may be accomplished by either of two types of balancing systems in current use which balance wheels either on the vehicle or off. The "on-the-vehicle" type, however, is the more desirable in that all rolling components (brake drums, bearings, seals, etc.), are included in the balancing procedure and thereby have any existing unbalance corrected.

Wheel balance is the equal distribution of the weight of the wheel and tire assembly around the axis of rotation. There are two ways in which the wheels can be balanced -- statically and dynamically. Wheels must be statically balanced before they can be balanced dynamically.

STATIC BALANCE

Static balance (sometimes called still balance) is the equal distribution of weight of the wheel and tire assembly about the axis of rotation in such a manner that the assembly has no tendency to rotate by itself, regardless of its position. For example: A wheel with a chunk of dirt on the rim will always rotate by itself until the heavy side is at the bottom. Any wheel with a heavy side like this is statically out-of-balance. Static unbalance of a wheel causes a hopping or pounding action (up and down) which frequently leads to wheel "flutter" and quite often wheel "tramp."

DYNAMIC BALANCE

Dynamic balance (sometimes called running balance) means that the wheel must be in static balance, and also run smoothly at all speeds on an axis which runs through the center line of the wheel and tire and is perpendicular to the axis of rotation.

To ensure successful, accurate balancing, the following precautions must be observed:

Wheel and tire must be clean and free from all foreign matter. The tires should be in good condition and properly mounted with the balance mark on the tire, if any, lined up with the valve.

Bent wheels that have run-out over 3/32" should be replaced.

Inspect tire and wheel assembly to determine if an eccentric or out-of-round condition exists. Note that this condition, if severe, cannot be "balanced out." An assembly which has an out-of-round condition exceeding 5/16" is not suitable for use on the front of the vehicle. Its use on the rear should be governed by its general condition and whether the roundness defect seriously detracts from overall ride quality.

WHAT HAPPENS WHEN TIRES GET HOT

As a tire becomes heated, the air in the tire expands and the air pressure is raised. This is normal unless the pressure build-up is excessive. Build-ups of over 20 pounds are excessive, indicating underinflation, overload, too much speed, too small a tire or, more often, a combination of these factors. Therefore, pressure build-ups of over 20 pounds should be studied to determine cause and proper corrective action. Normal pressure build-ups (not over 20 lbs.) reduce flexing. Thus, the amount of heat generated allows the tire to reach a heat balance (the temperature at which the rate of heating equals the rate of cooling) at a lower temperature than if the inflation pressure were maintained uniformly by frequently bleeding out air. Tires should never be bled. When the pressure builds up excessively - reduce the speed or the load instead.

A tire operated for a considerable distance at sustained highway speeds, in a severely underinflated or flat condition, becomes extremely hot due to internal friction, and this heat transmits to the tire's outer surface. If, and when, the outer surface temperature reaches the combustion point, the tire bursts into flame. This usually occurs after the vehicle has stopped. Such an occurrence usually involves a dual assembly where one of the tires is flat and the other is, therefore, extremely overloaded (possibly also underinflated even for normal load). In such cases, either the tire which is severely underinflated or completely flat, or the tire which is extremely overloaded, could get so hot as to reach the point of spontaneous combustion.

PREVENTION OF TIRE FIRES

Regardless of the cause of a tire fire, the tire's internal temperature is so high that even if the flames are extinguished, repeated spontaneous ignition may occur until internal temperature decreases sufficient capacity to control the fire until the burning tire can be removed. Operators should carry special asbestos blankets which, in case of fire, are useful in preventing the fire from spreading to

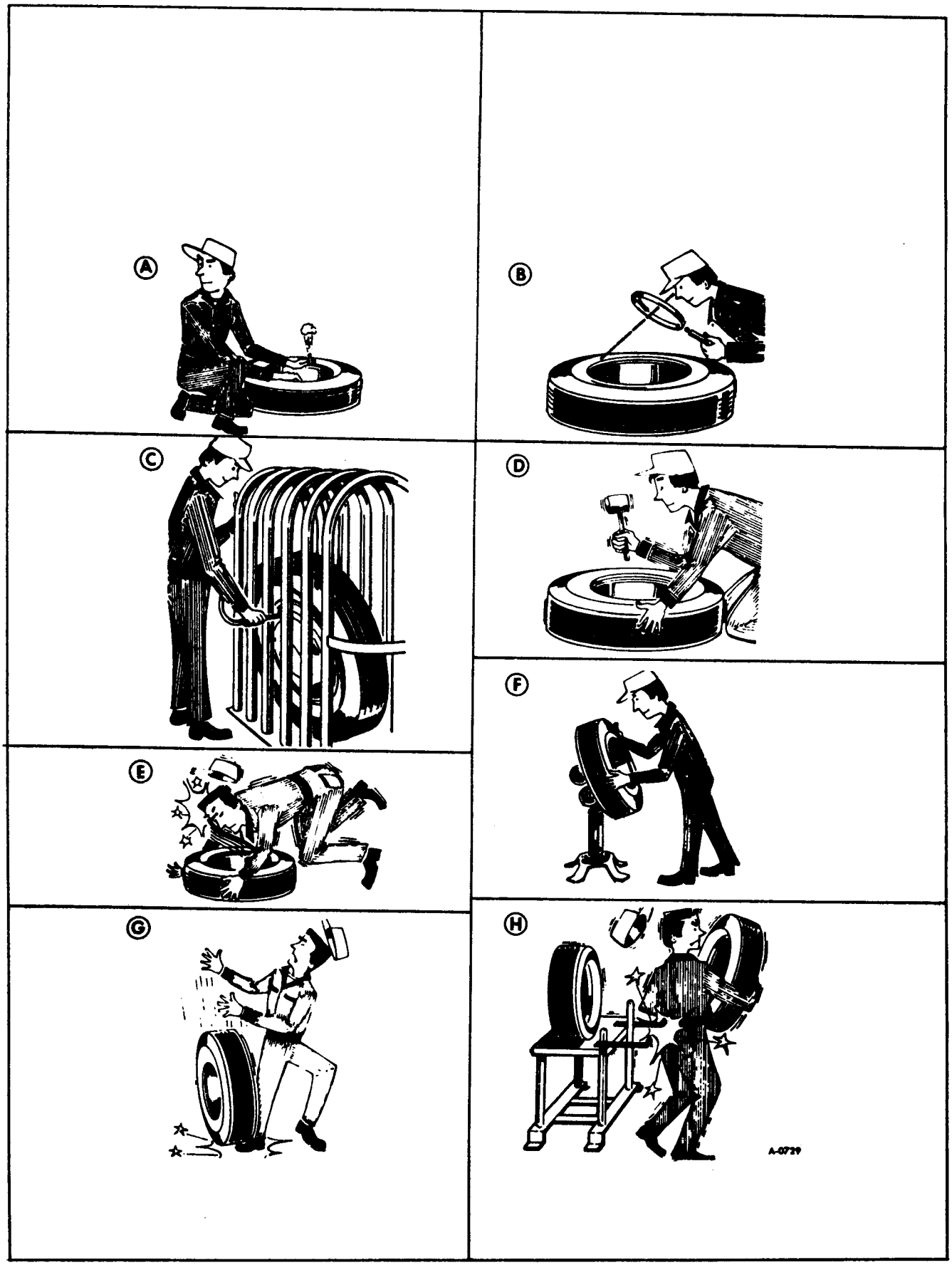


Figure 22—Rim and Wheel Safety Precautions

Use only standard tire mounting tools and equipment. The use of makeshift tools, screwdrivers or pliers to force tires on or off rims or wheels is dangerous.

All Wheel and Rim Assemblies
Refer to Fig 22, View G

IN THE SERVICING OF ALL TIRES use caution not to drop them, or the wheels or assemblies, on the feet, hands, or body, or heavily on the floor.

Learn how to lift properly -- use your legs as well as your body. This can help prevent painful, internal injury or rupture.

Changing Equipment (Fig. 22, View H)

TIRE SPREADER ARMS CAN BE DANGEROUS. Keep them closed when machine is idle and use care in all respects while operating spreader.

Face and Eye Protection

ALWAYS WEAR GOGGLES or face shields when buffing rims or tires, or when hammering rings.

DURING VEHICLE OPERATION

Do Not Overload Tires

Ensure that the combination of load and vehicle weight does not exceed the rated load of the tires used. Rims are designed to sustain the maximum rated load of the maximum tire size recommended for that rim (see "Tires For Trucks in Highway Service Load and Inflation Table" at end of this section).

Do Not Exceed Maximum Inflation Pressures

Inflation pressures are determined by the size and ply rating of the tire (see "Tires For Trucks in Highway Service Load and Inflation Table" at end of this section). It is also important to maintain uniform inflation in both tires of a dual assembly so that weight is equally sustained.

Do Not Run Vehicle on One Tire of Dual Assembly

When there is loss of air in a dual tire the carrying capability is reduced and the load must be sustained by the other tire and rim. Both tires should be inflated to balanced, recommended pressures before further operation.

Never Re-Inflate a Tire That Has Been Run Flat Without First Thoroughly Inspecting It and The Rim and Wheel Assembly

It is especially important to make sure the lock ring is secure in the gutter and has not been damaged prior to re-inflation.

Periodically Check Clamps and Wheel Nuts

Loose clamps can cause dangerous rim slippage or detachment of rim and tire from the vehicle while in motion. Loose wheel nuts can cause dangerous wheel shimmy and loss of vehicle control. Excessive torque is also dangerous in that it can cause stud and ring breakage. Refer to "Specifications" at end of this section.

ALUMINUM DISC WHEELS

To insure long life and trouble-free service, a reasonable amount of care must be exercised when mounting or demounting tires. Nicks or gouges should be avoided on the surface of the wheel. Wheels should be inspected regularly for damage, before mounting and during service.

NOTE: Illustrations at the end of this section are applicable to tire mounting and demounting for aluminum disc wheels. The following information will also apply:

TUBE TYPE TIRES

Mounting

The tire with tube and flap is placed on the wheel in such a position that the air valve can be inserted through the slot in the rim. The air valve should always point toward the handhole in the disc part of the wheel, regardless of the position of the wheel when mounted. Then the tire is pushed "home" on the rim.

WARNING: DURING INFLATION, THE WHEEL SHOULD BE IN A SAFETY CAGE. THIS WILL PROTECT THE OPERATOR IN CASE THE RINGS BLOW OFF BECAUSE OF IMPROPER SEATING OR THE USE OF INCORRECT TYPES.

Side and Lock Rings (Fig. 23)

The steel side rings should be carefully installed. Care should be taken to see that the wheel is equipped with the proper size rings, avoiding any possibility of an assembly of a ring of another make or size which will not work properly or safely. The wheel and its components should also be cleaned and examined for cracks or defects. During inflation of the tire, the rings should be checked to make sure they are seated.

rubber mat. Use only plastic, rubber or leather-faced hammers.

2. Keep Tire Tools Smooth - Use Them With Care. Rim gouges or nicks may cause cracks.

Rules For Proper Handling of Wheels When Mounting Tubeless Tires

1. Do Not Gouge Or Nick The Wheel. It is best to handle wheels on a wooden floor or rubber mat. Use only plastic, rubber or leather-faced hammers.

2. Be Sure Rim Is Clean When Tire Is Mounted.

3. Before Mounting Tire - Always Inspect For Damage.

4. Be Sure Insides of Wheel and Tire Are Dry Before Mounting.

5. Use An Approved Tire Mounting Lubricant. Do not use water base lubricants during mounting.

6. It Is Absolutely Essential That Air Used For Tire Inflation Be Dry. Therefore, use of moisture traps or air lines leading from compressors, is recommended.

7. Do Not Overinflate. Refer to "Tires For Trucks in Highway Service Load and Inflation Table" at end of this section, or use manufacturer's recommendations. Under no circumstances exceed 105 psi.

Demounting

Be sure the tire is completely deflated. The tire beads can then be loosened by pushing them toward the center. The difficult part of removing the tire from the wheel is usually the loosening of the tire beads.

RADIAL TRUCK TIRES

All information under the heading "TIRES (BIAS PLY)" covered earlier in this section is applicable to Radial Truck Tires except the following:

SYNTHETIC TUBES AND FLAPS

The inherent flexing characteristics of a radial truck tire require a special inner tube. Never use a tube in a radial truck tire that has not been specifically designed and manufactured for such use. Tubes should be identified as being suitable for use with radial ply tires.

The radial tube size must be the same as the tire size. For example, a 10.00R20 tube must be used with a 10.00R20 tire. Always check the tube size designation to be sure the tube is for a radial tire.

When ordering flaps, specify radial flaps. These are also especially manufactured for use with radial truck tires. For correct radial flap sizes, check the tire manufacturer's specifications. Always check for the correct designation before installing a flap in a radial truck tire.

Always use new radial tubes and flaps when mounting new tube-type radial tires.

MIXING RADIAL AND BIAS PLY TRUCK TIRES

Never mix tires of different size or construction on vehicles covered in this manual.

CHART 2. EFFECT OF VARYING INFLATION PRESSURE. CONSTANT LOAD.				
LOAD, POUNDS	AIR PSI	STATIC LOADED RADIUS	WHEEL REVS PER MILE	TOTAL DIFFERENCE IN REVS PER MILE
5220	50	18.9	526	
5220	65	19.3	515	
5220	80	19.7	504	39
5220	90	20.0	496	
5220	100	20.3	487	

Taking note of the different Revs. per Mile under controlled conditions, let's add some reality: Big loads, high speeds, heat, steep grades. Now we begin to see how mismatched tires can affect not only their own useful life, but the life of wheel bearings, drive shafts, U-joints, tandem axles, and inter-axle differentials as well. Let's look at this problem further.

TIRES ON DUAL REAR WHEELS

This is where it begins. Proper care here will return many miles of profitable operation. Neglect could open a "whole can of worms".

Refer to FIG. 3.

This drawing exaggerates the condition of mis-matched tires,because if it was drawn to scale you would not be able to see the difference. Yet this small difference can generate big numbers as the miles reel off.

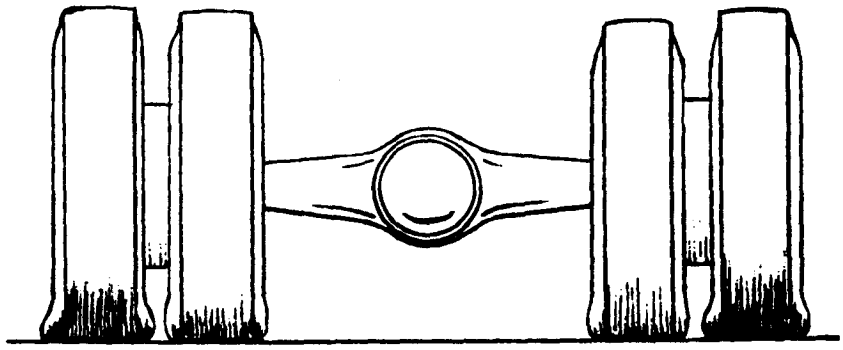


FIG. 3. MISMATCHED TIRES

Mis-match two new tires by only 5/16" on a pair of dual rear wheels, and two of the four tires will grind along for 81 feet in the first mile of driving. During the first thousand miles, they will slip 15 miles. At the end of ten thousand miles they will have slipped 150 miles. Tire treads have sometimes been completely ground off in less than 10,000 miles. Convert that into dollars, and it's something to think about. That's why it PAYS to hold well within the prescribed tolerances when matching tires. Something else to think about when hauling long distances on high-speed runs: Those tires are the only SAFE contact between the truck and the road.

This would overload the outer wheel bearing to FOUR times its rated capacity. If the outside tire went flat, the inner wheel bearing would have to carry THREE times its rated capacity.

Mismatched tires overload wheel bearings too. Naturally, not to the extremes in the example above. But if mismatched tires are ignored over an extended period of time, then chances are the overloaded bearings will go unnoticed until it's too late. So check tire pressures frequently, and periodically match-up the tires. This will eliminate unequal load stresses that can ruin the wheel bearings.

HOW TIRE MATCHING AFFECTS THE DIFFERENTIAL

The differential gearset is designed to balance power between the two axle shafts, and act as a speed balancer ONLY when the truck is taking corners. If both pairs of rear tires are not the same size (due to wear, unequal tire pressures, or mis-matching), then the differential is going to be working constantly, even when the truck is running in a straight line. This alone will shorten the life of the differential under the best conditions. Now, what if the rig is loaded to max gross, on a long, high-speed haul? And the road temperature is up around 120°F? (And nobody knows it, but the oil level in the rear axle is low). Odds are, that at the end of the run, the differential pinions will be self-welded to the spider.

The differential is not designed to compensate for mismatched tires. Matching tires of equal size on both ends of the rear axle is much better. It helps prevent expensive noises in the differential.

TIRES AND TANDEM AXLES

On trucks built with tandem axles, the two axles are connected mechanically by a propeller shaft. It is essential that all four wheels rotate at the same speed. Therefore, ALL TIRES MUST BE MATCHED.

Imagine a set of tandem axles, directly connected by the prop-shaft, rolling on eight tires all of a different radius: The rear axle is trying to over-run the forward axle--the forward axle is trying to hold back the rear axle--the tires are squirming and scrubbing. This is "WHEEL FIGHT". It tries to wind up the prop shaft and twist the axle shafts. Ring and pinion gear teeth are grinding under extreme pressures. Bearings are working beyond their normal limit. If these conditions are allowed to continue, internal mechanical damage will surely result.

Tire matching becomes more critical on tandem axles equipped with an inter-axle differential, and equally so on tri-drive rear axles. Engagement and disengagement of the forward axle while the truck is running requires that all wheels be rotating at the same speed. If wheels and axles are not synchronized during engagement or disengagement, serious damage can be done to the inter-axle splined shaft and collar. If it takes physical force to shift the forward axle in or out of gear, check for a difference in the rolling radius of tires between axles. When all tires are the same radius, engagement and disengagement of the forward axle can be made smoothly at any speed with very little effort.

SINGLE TIRES ON FRONT WHEELS

Attention to tire pressures on the front wheels is as important to safe control of the truck as is tire balance and front-end alignment. With lower pressure, tire contact area with the road increases. More contact area means more resistance against rolling. If front tire pressures are unequal, the wheels will tend to steer to the side of lowest pressure. This may not be noticed

TIRE AND TUBE STORAGE

Tires and tubes can be stored for long periods of time without affecting their performance or life, provided the proper methods and practices are adhered to. This is not difficult to do, and is worth the small extra expense required to protect valuable tires and tubes from harmful conditions.

NEW TIRES

Ideally, tires should be stored in a cool, dry, clean, dark environment. Lacking a storage shed designed for keeping tires, choose an inside area that most nearly incorporates the following conditions:

1. TEMPERATURE: 40° to 60°F. is the ideal range for a storage area. Do not store tires near any heat source such as heaters, radiators or hot-air ducts.
2. HUMIDITY: The storage area should be dry. Tires are best stored on special racks, off the floor, and away from any walls which tend to "sweat".
3. CLEANLINESS: Don't store tires in the same area with bulk oil and solvents, or near such machinery as grinders, brake drum lathes, etc. Keep unwrapped tires covered with a tarpaulin.
4. DARKNESS: A windowless area is best, but if the area incorporates windows which admit direct sunlight, paint the glass black or gray.
5. OZONE AND CIRCULATING AIR: These two conditions tend to oxidize stored tires more rapidly. Avoid using electrical equipment near tires. If possible, panel off the storage area to prevent air circulation.

USED TIRES

If trucks are to be stored for an extended time, they should be jacked up and blocked to take the load off the tires. The tires should be deflated to about 5 psi to keep them rounded out and well seated on the rims. If the trucks are not to be raised and blocked, keep tires inflated and check air pressure at frequent intervals.

When storing used tires inside, first clean them, inspect thoroughly, and make repairs as necessary.

Tires stored outside should be kept off the ground and covered or wrapped with weather proof (and light proof) canvas or plastic.

NEW TUBES

Tubes require even greater care than tires. They should be kept in the original package and stored in a cool, dry place until ready for use. Unboxed tubes should be covered and protected from the same conditions that damage tires. Don't inflate tubes before storing. Don't pile them up, or their weight will cause creasing.

Where tubes are received in the tires, deflate the tubes leaving only enough air in them to keep them in the tires. The tires, with tubes inside, can then be stored in the recommended manner.

USED TUBES

Used tubes in good condition should be removed from tires, and completely deflated by removing the valve core. Make necessary repairs before storing. Powder them well with talc, fold carefully, and store in the same manner as new tubes.

Tire Mounting and Demounting

Follow the safety practices recommended by the National Wheel & Rim Association. These can be found in the *Wheel & Rim Operating Manual* published by the National Wheel & Rim Association. Request a copy from your Alcoa wheel distributor.

TUBE-TYPE TIRES

To insure long life and trouble-free service, a reasonable amount of care must be exercised when mounting or demounting tires. Nicks or gouges should be avoided on the surface of the wheel. Wheels should be inspected regularly for damage, before mounting and during service.

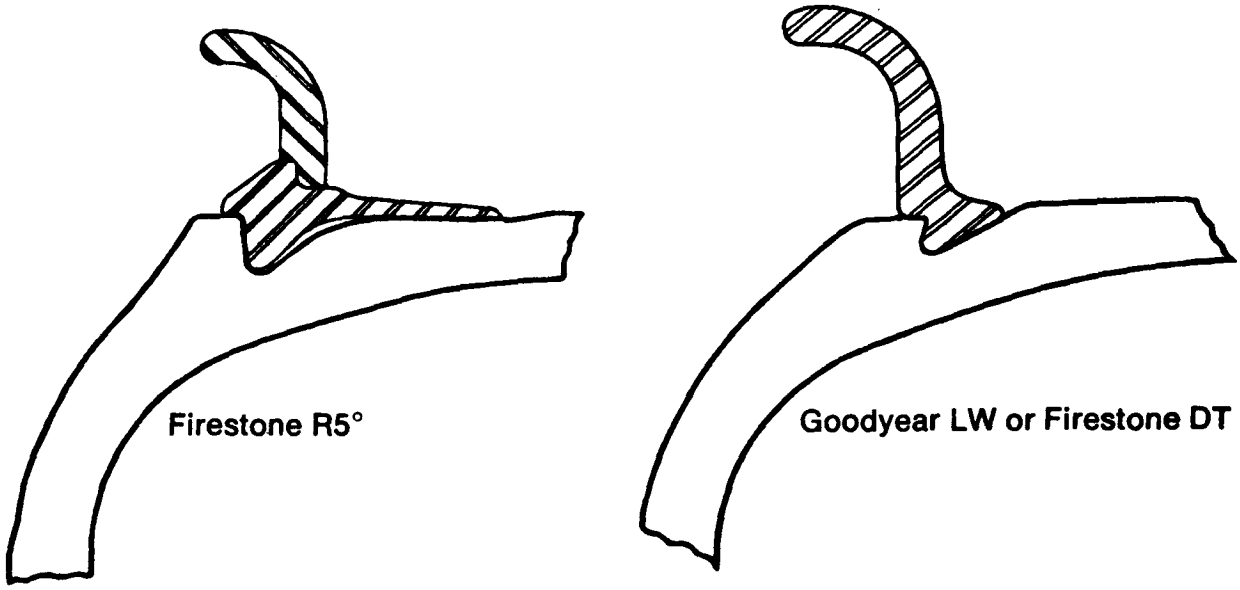
Mounting

The tire with tube and flap is placed on the wheel in such a position that the air valve can be inserted through the slot in the rim. The air valve should always point toward the hand-hole in the disc part of the wheel, regardless of the position of the wheel when mounted. Then the tire is pushed "home" on the rim.

Side and Lock Rings

The steel side rings should be carefully installed. Care should be taken to see that the wheel is equipped with the proper side rings, avoiding any possibility of an assembly of a ring of another make or size which will not work properly or safely. The wheel and its components should also be cleaned and examined for cracks or defects. During inflation of the tire, the rings should be checked to *make sure they are seated.*

Alcoa® Aluminum Forged Disc Wheels are available to take (1) Firestone R5° side and lock rings or, (2) Goodyear LW and Firestone DT split side rings. The proper selection of side and lock rings may be made by referring to the sketches below which illustrate the manner in which the gutters are machined for the two types of rings.



SIDE AND LOCK RINGS MUST BE PROPERLY MATCHED TO RIMS AS SHOWN. A WHEEL MACHINED FOR FIRESTONE R5° SIDE AND LOCK RINGS SHOULD NEVER BE USED WITH A GOODYEAR LW SIDE RING AND VICE VERSA.

During inflation, the wheel should be in a safety cage; if one is not available, the wheel should be lying flat with the side rings down. This safety precaution will protect the operator in case the rings blow off because of improper seating or the use of incorrect types.

3. BEFORE MOUNTING TIRE—ALWAYS INSPECT FOR DAMAGE.

4. BE SURE INSIDES OF WHEEL AND TIRE ARE DRY BEFORE MOUNTING.

5. USE OF FREYLUBE*, OR EQUIVALENT IS RECOMMENDED AS A TIRE MOUNTING LUBRICANT.

   Do not use water base lubricants during mounting.

   * Trade name of Freylube Corporation.

6. IT IS ABSOLUTELY ESSENTIAL THAT AIR USED FOR TIRE INFLATION BE DRY.

   Therefore, use of moisture traps or air lines leading from compressors is recommended.

7. DO NOT OVERINFLATE.

   Use tire manufacturers recommended inflation pressures. Under no circumstances exceed 100 psi.

Demounting

Be sure the tire is completely deflated. The tire beads can then be loosened by pushing them toward the center. The difficult part of removing the tire from the wheel is usually the loosening of the tire beads. Tire beads loosen on Alcoa wheels more easily than on other makes, but considerable force may still be required.

The tire beads are now pried over the rim edge one at a time, using two tire tools. These tools must be smooth and must be used with care to avoid gouging the rim. Do not drive down into the rim area.

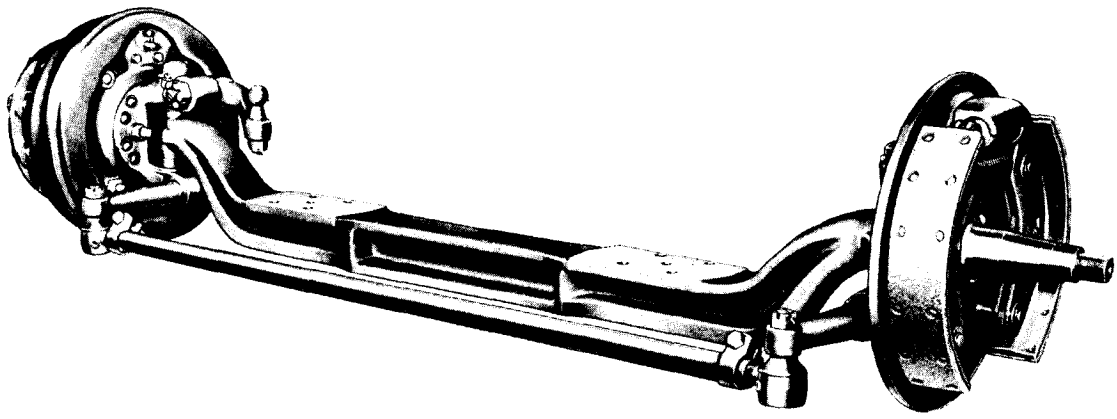
Rules for Proper Handling of Wheels When Demounting Tubeless Tires

1. DO NOT GOUGE OR NICK THE WHEEL.

   It is best to handle wheels on a wooden floor or rubber mat. Use only plastic, rubber or leather-faced hammers.

2. KEEP TIRE TOOLS SMOOTH—USE THEM WITH CARE.

   Rim gouges or nicks may cause cracks.



NON-DRIVING FRONT AXLES

(MODEL SERIES TYPE — 900 & 901)

Component Description

AXLE CENTERS

All "I-beam" type non-driving front axle centers, though varying in size, are machined from heat-treated steel forgings with "I-beam" section and spring pads integral.

All tubular type non-driving front axle centers are built of tempered seamless steel tube center sections with heat-treated steel forged knuckle pin ends. The knuckle pin ends and spring pads are electrically welded in position on the tube and become integral parts of the axle center.

Both the "I-beam" and the tubular type are of the "Reversed Elliot" design.

STEERING KNUCKLE PINS

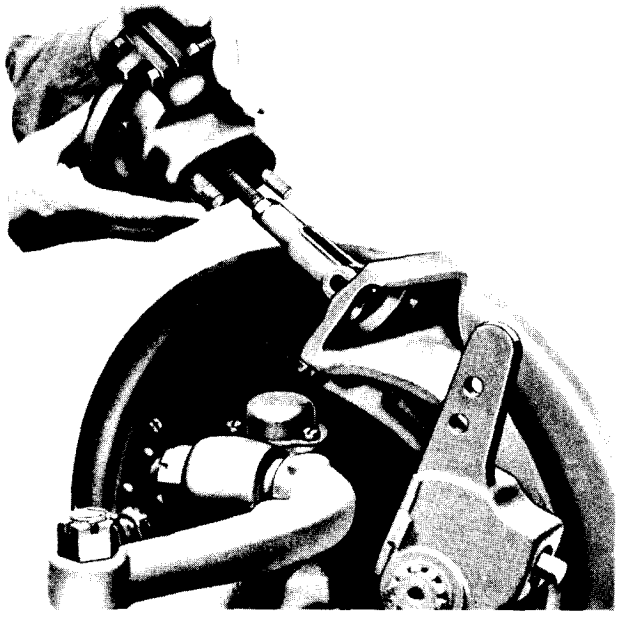
Rockwell non-driving front axles may be equipped with tapered knuckle pins (900 Series) or straight knuckle pins (901 Series), depending on model. Tapered knuckle pins are drawn into the axle center by tightening the nut at the upper end of pin, while the straight pins may employ one or two flats and are held in the axle center by means of tapered dowel keys. Both the tapered pins and the straight pins effectively become an integral or rigid part of the axle center.

STEERING KNUCKLE AND BUSHING ASSEMBLY

Steering knuckles are bushed in the upper and lower pin bosses so that they may turn freely about the pins. Bushings, depending on model, may be bronze, steel backed bronze, or plastic material, all of which contain grooves to allow grease to flow uniformly to the high-pressure areas. Grease fittings are installed in both upper and lower knuckle pin bosses.

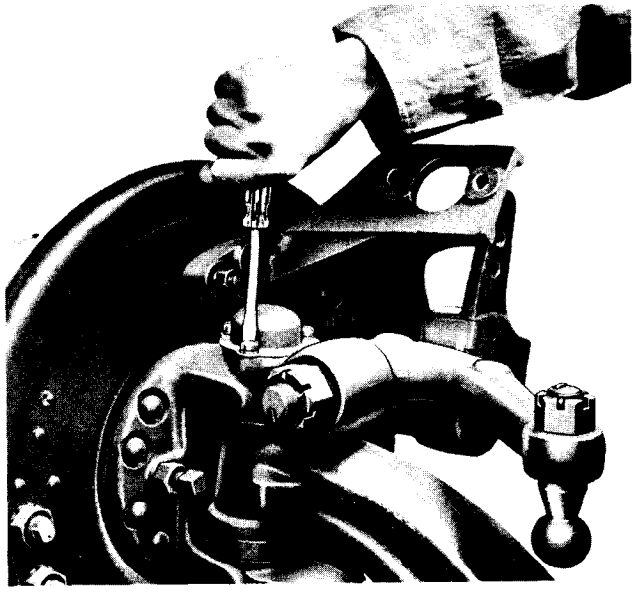
TIE ROD

The two steering knuckle assemblies are connected to each other by a tie rod. The tie rod is threaded at each end and held securely in position by clamp bolts. Right and left hand or "differential" threads are provided on the tie rod to facilitate toe-in adjustment.

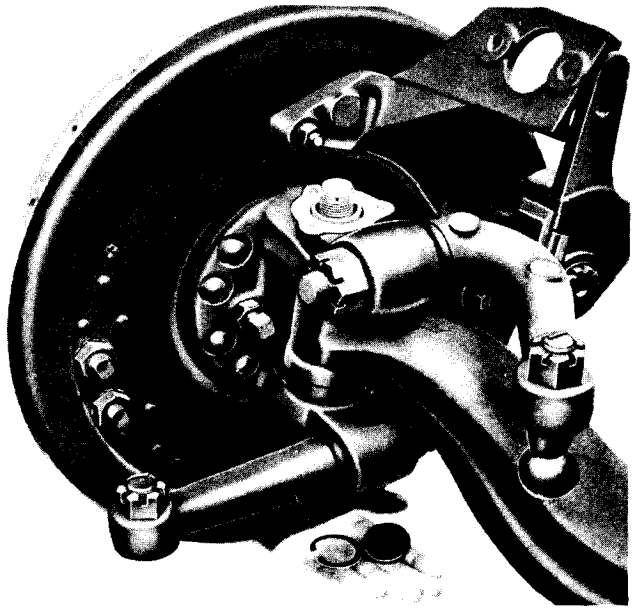


A. Tapered knuckle pins must be removed from the bottom side of the knuckle.

1. Disconnect push rod and remove brake chamber on units equipped with air brakes where clearance is needed for knuckle pin removal.
2. Remove cylinder brake fluid adapter fitting on units equipped with hydraulic brakes where clearance is needed for knuckle pin removal.



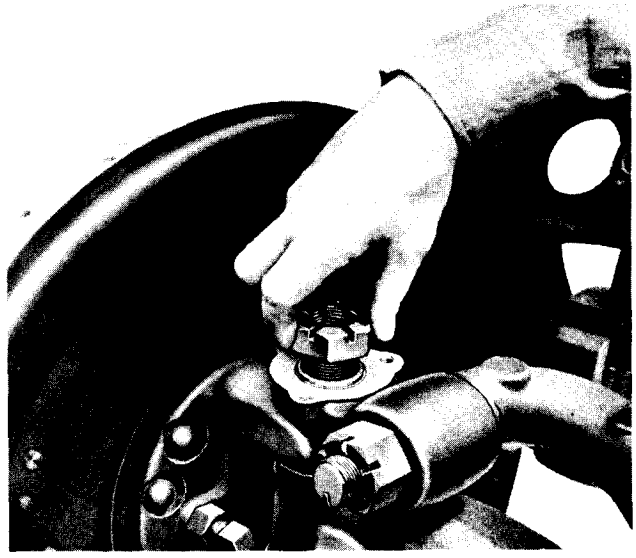
3. On some models it will be necessary to remove the brake shoe assembly and backing plate to provide clearance for knuckle pin removal.



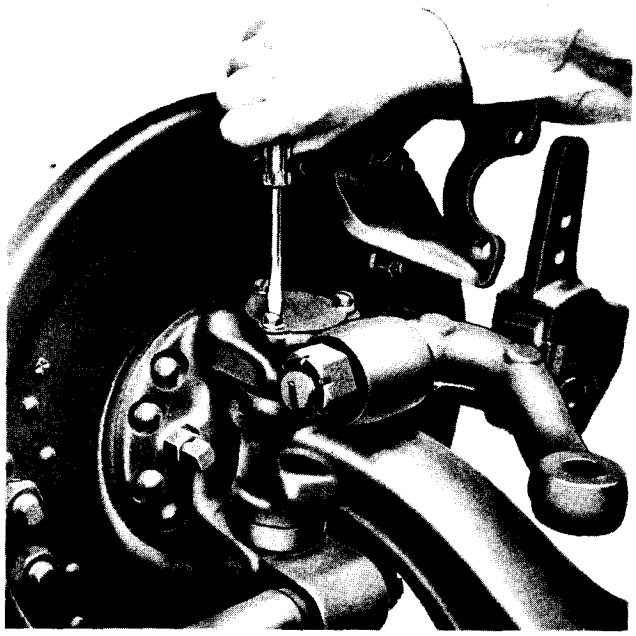
B. Remove the knuckle pin cover cap screws, cover and cover gasket.

C. Knuckles employing expansion plugs and lock rings:

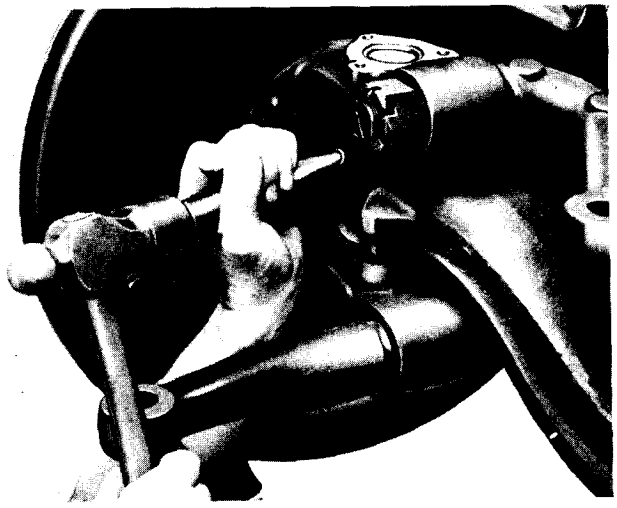
1. Remove the lock ring with a pair of snap ring pliers.
2. Dislodge and remove expansion plug with a small drift.



D. Remove knuckle pin cotter key and nut.



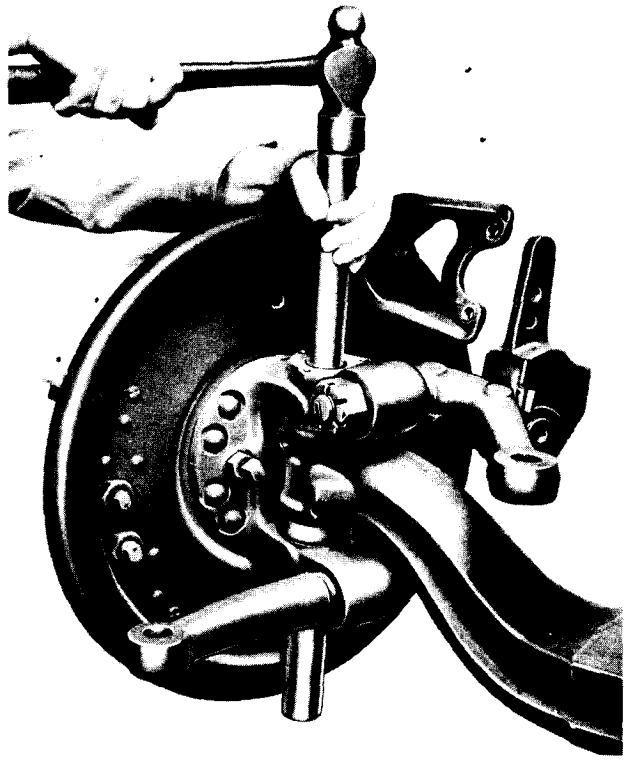
C. Remove the cap screws, cover plate and gasket from top of knuckle or remove lock ring retainer and seal, depending on model.



D. Tap out the knuckle pin draw key (or keys) from the small end using a suitable small slender drift.

CAUTION: Do not strike these hardened steel pieces directly with a steel hammer.

(Older models may employ tapered draw keys that are threaded on the small end and drawn into place by a nut. On these models, remove the nut and lock washer. Drive the draw key out by use of brass hammer on threaded end.)



E. Tap out the knuckle pin by use of a bronze drift.

CAUTION: Do not strike these hardened steel pieces directly with a steel hammer.

F. Lift off the knuckle assembly, thrust bearing and spacing washers. Retain shim, thrust bearing and seal for reassembly.

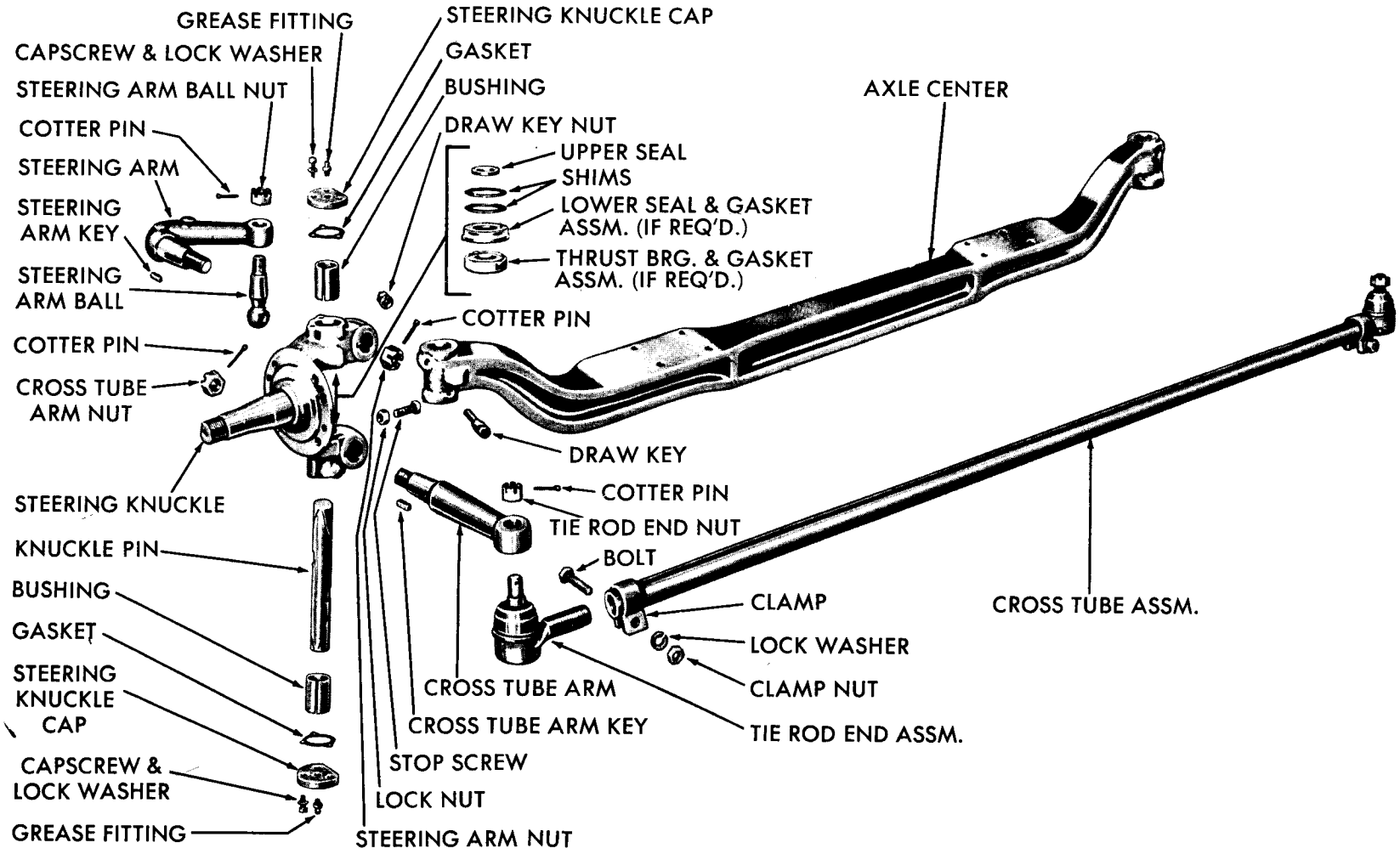
G. Refer to Section 2 for cleaning, inspection and component repairs.

REPLACEMENT OF BRONZE OR STEEL BACKED BRONZE STEERING KNUCKLE BUSHINGS

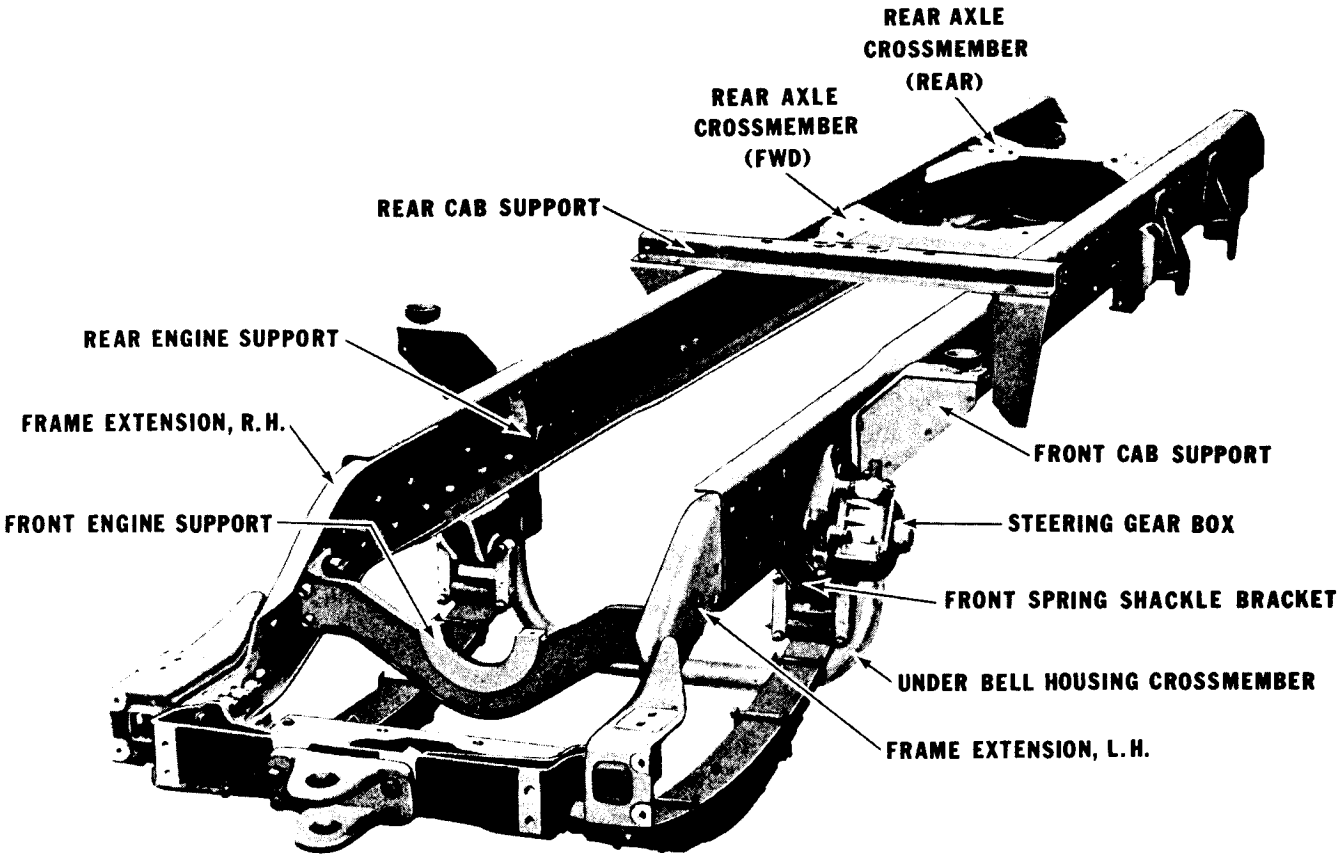
When it is desirable to service the steering knuckle bushings the following procedure is recommended and the tools shown in the sketches will facilitate this operation.

The tool utilized for removal of old and installation of new steering knuckle bushings is shown on the following page. The tool can be made from a piece of round bar stock which is ground with a step to serve as a pilot.

TYPICAL "SEALED KNUCKLE PIN" TYPE FRONT AXLE



FRAME CARE and SERVICE



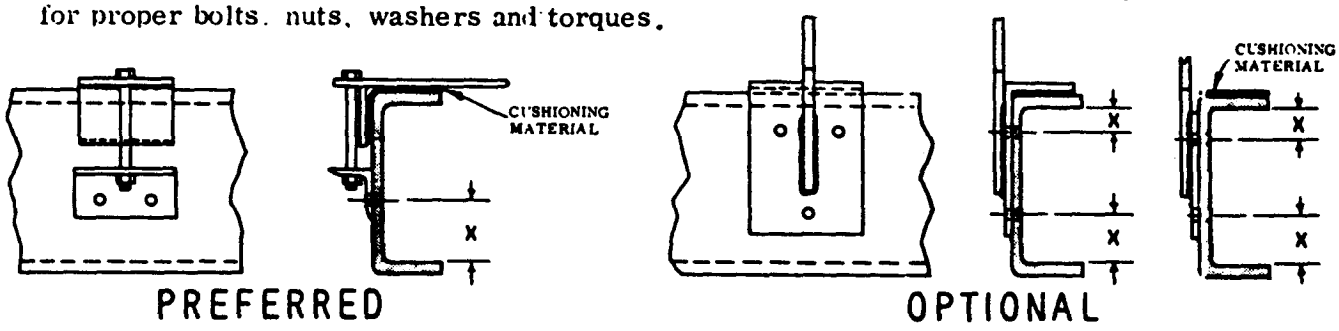
TYPICAL CONVENTIONAL FRAME

The frame requires less maintenance than any other part of the truck. However, when you are raising the frame, adding bodies or accessories to the frame, or when you are making temporary frame repairs, always follow the instructions on pages 2, 3 & 4 of this write-up. These instructions play an important part in preventing premature and costly frame failures.

BODY MOUNTING INSTRUCTIONS

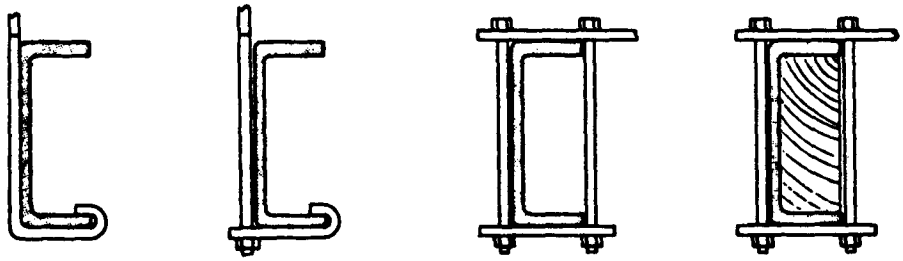
When mounting bodies or other accessories to frames, certain procedures and methods must be followed to achieve satisfactory results. Disregarding these instructions could result in frame failure. Kenworth Motor Truck Company will assume no warranty for frame failures that are a result of improperly mounted bodies or accessories.

Below are illustrations of proper and improper methods. These are followed by specifications for proper bolts, nuts, washers and torques.



PREFERRED OPTIONAL

"X" Do not locate holes closer to flanges than present bolt pattern.



IMPROPER

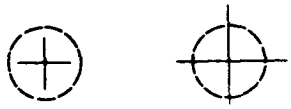
BRACKETS

All brackets, additions or reinforcements attached to frame MUST be bolted in place, not welded.

LAYOUT

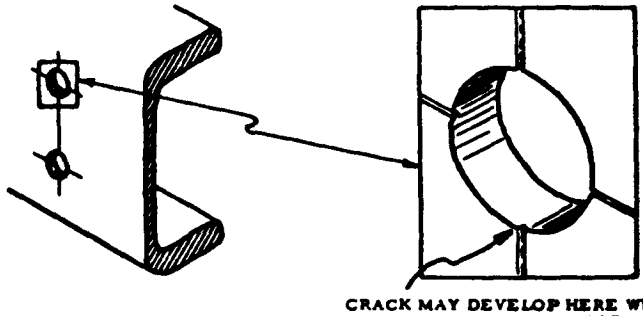
Bolt holes in frame MUST NOT be located any closer to the frame flanges than the present bolt pattern.

If possible, use a lead pencil for laying out the hole pattern for the bolts. If a scribe must be used, then be sure the entire length of the scribe mark lies within the circumference of the drilled hole, as shown below.



DO DON'T

Incipient cracks develop where scribe marks intersect the holes in the frame rail, as shown below. Aluminum frame rails are particularly susceptible to this type of progressive failure.



CRACK MAY DEVELOP HERE WHERE SCRIBE MARK MEETS HOLE.

Bolt holes in frame must be made 1/32" larger than bolts used. Bolts are to fit freely and should not be forced into place.

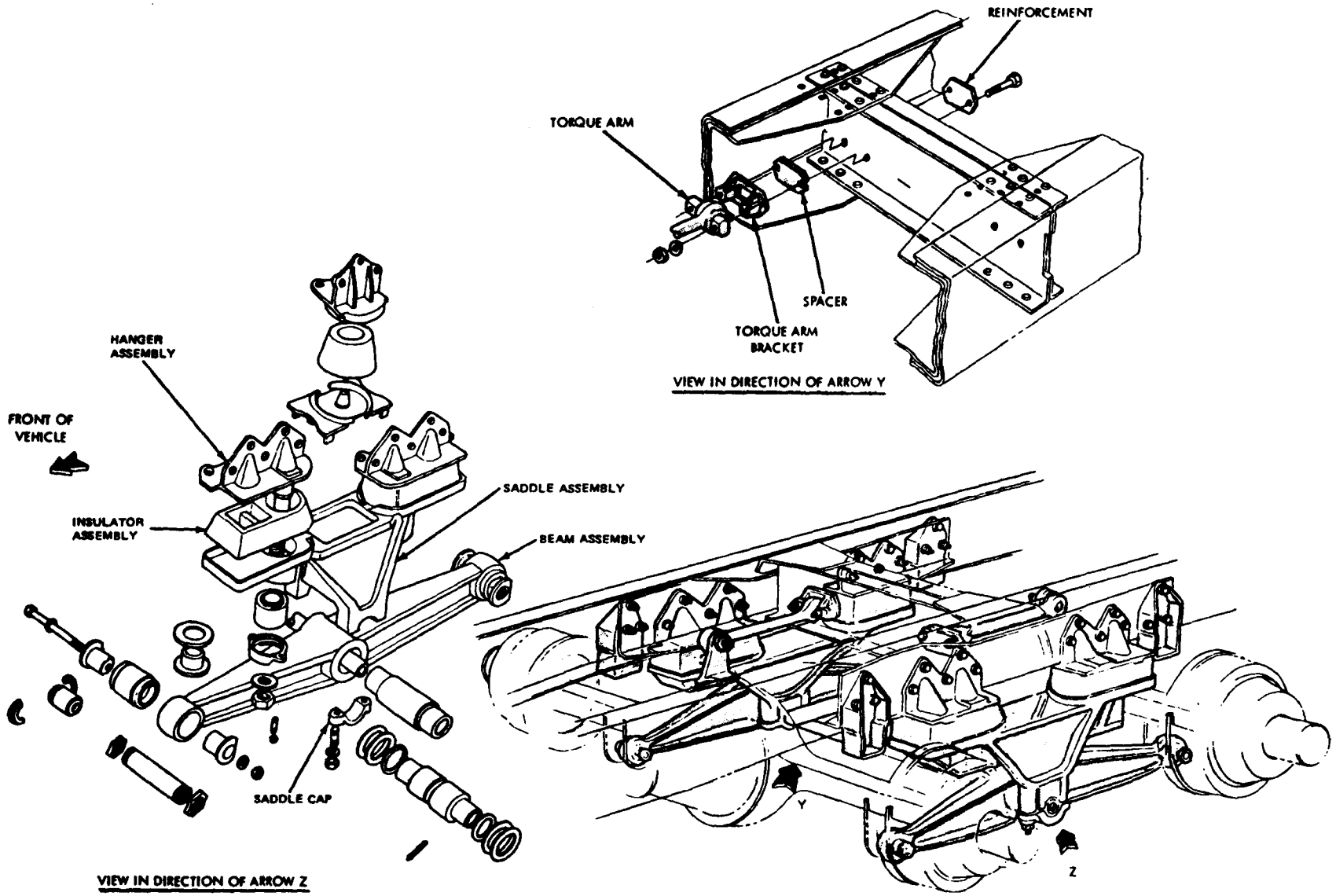


FIG. 2 RS Tandem Suspension

SINGLE AXLE SUSPENSION ON-VEHICLE SERVICE

REAR SPRING REPLACEMENT (RADIUS LEAF TYPE)

REMOVAL

1. Raise vehicle frame to remove the weight from the spring assembly.
2. Support the rear axle on a floor jack.
3. Remove rear dual wheels using a wheel dolly (figure 3) to allow access to spring assembly.
4. Install a C-clamp (figure 4) on the radius leaf to relieve the load on the radius leaf eye bolt.
5. At the front and rear hanger brackets, bend the retainer tab up remove the rebound pin retainer bolt. Remove the retainer, and the rebound pin.
6. Remove spring U-bolts nuts, shock absorber bracket (when used) U-bolt anchor plate, U-bolts and spacer. remove auxiliary spring(s) (when used), then lower axle slightly.
7. Remove radius leaf eye bolt and nut at front hanger bracket.

NOTE: When tapered shim is used, the position of shim thin and thick edge should be noted so that shim can be installed properly at assembly.

8. Raise frame to clear hanger brackets. Using a suitable hoist remove spring assembly.

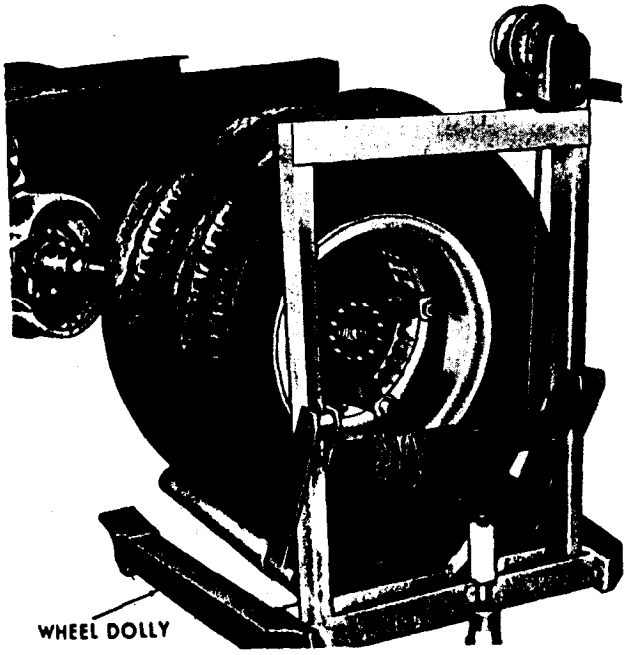


Figure 3—Using A Typical Wheel Dolly

9. Inspect spring and replace bushing or spring leaf as described later in this section.

INSTALLATION

CAUTION: See "Caution" on page two of this section.

1. Set the spring assembly and tapered shim or spacer (if used) on the axle pad.

NOTE: A tapered shim must be installed on the axle in the same position that was noted during removal.

If auxiliary spring(s) are used, place spacer and spring(s) onto main spring assembly.

2. Install U-bolt spacer over center bolt.
3. Seat U-bolts in spacer grooves, then secure spring to axle by installing anchor plates, shock absorber bracket (when used) and nuts on U-bolts. Tighten nuts to torque listed in "Specifications" at the end of this section.
4. Lower the frame until the hangers touch the cam surface of the spring. Compress the radius leaf with a C-clamp (figure 4) until the radius leaf eye and the hanger holes are in alignment.

a. Radius leaf using eye pin, install spring eye pin with notches for clamp bolts indexed with clamp bolt holes in brackets. Install clamp bolts, nuts, and lock washers. Tighten nuts to torque listed in "Specifications" at end of this section.

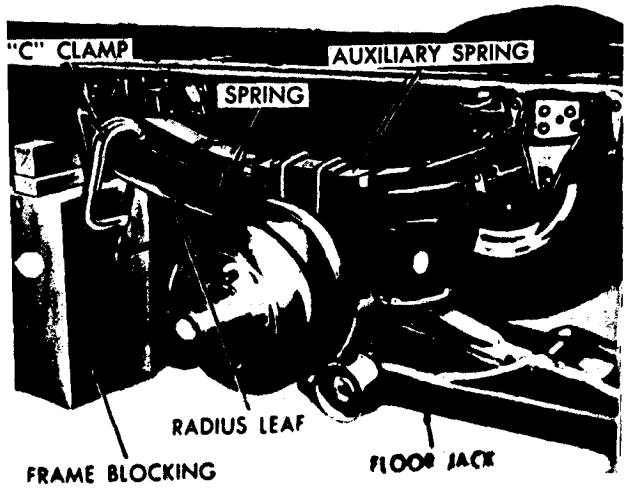


Figure 4—Using a C-Clamp At Radius Leaf

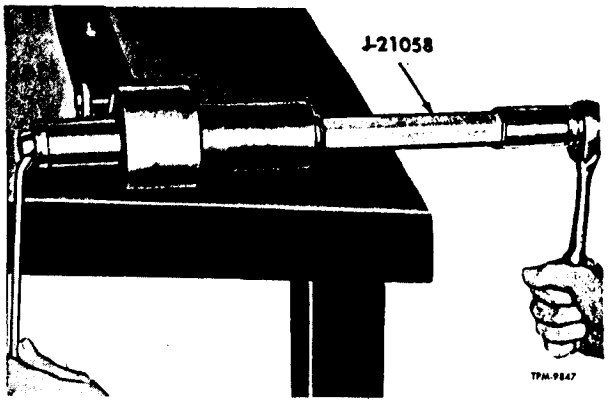


Figure 5—Removing Rubber Type Eye Bushing (Typical)

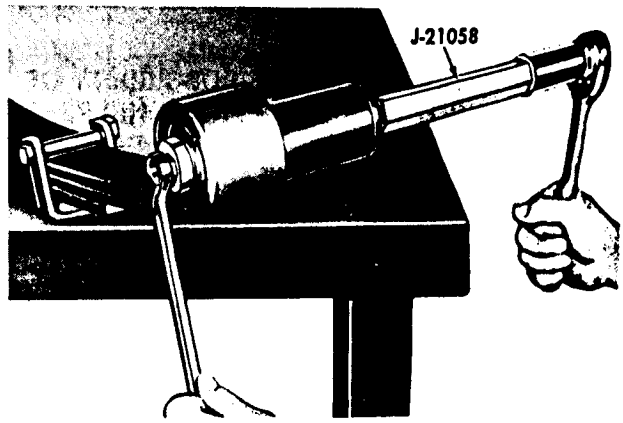


Figure 6—Installing Rubber Type Eye Bushing

RADIUS LEAF EYE BUSHING REPLACEMENT

SPRING REMOVED FROM VEHICLE

Remove and replace steel backed rubber bushing in radius leaf using bushing remover and installer (J-21058 Tool Set) as shown in figures 5 and 6.

SPRING INSTALLED ON VEHICLE

Removal

1. On forward rear spring hanger bend up retainer from rebound bolt and remove retainer bolt and retainer.
2. Install a C-clamp on the radius leaf (figure 4) to relieve load on radius leaf eye bolt.
3. Slowly release C-clamp and remove from spring.
4. Raise frame at rear until radius leaf clears spring bracket.
5. Using bushing remover and installer (J-21058) (figure 5) remove bushing.

Installation

CAUTION: *See "Caution" on page two of this section.*

1. Using bushing remover and installer (J-21058) install bushing.
2. Lower frame and install a C-clamp on the radius leaf (figure 4) and tighten until radius leaf and spring bracket align. Install eye bolt and torque to "Specifications" listed at the end of this section and remove C-clamp.
3. Install rebound pin, retainer and bolt. Torque bolt to "Specifications" listed at the end of this section. Bend retainer over bolt head.

RADIUS LINK EYE BUSHING REPLACEMENT

LINK REMOVED FROM VEHICLE

Remove and replace steel backed rubber bushings in radius link using bushing and installer (J-21058 Tool Set) as shown in figures 5 and 6.

TANDEM AXLE SUSPENSION ON-VEHICLE SERVICE

HENDRICKSON TANDEM AXLE SUSPENSION REPLACEMENT

NOTE: Complete tandem unit removal (figures 7, 8, and 9) from frame is possible with the following procedure; however, torque rods, springs, equalizing beams, and other parts may be removed separately as required, as covered separately later in this section.

Before removing the tandem unit use jacks and other equipment to block vehicle securely to prevent axle assemblies from rolling or pivoting at equalizer beam ends when torque rods are disconnected.

REMOVAL

1. Block front wheel and disconnect all applicable rear brake lines or hoses, differential lock lines or electrical wiring from rear axles.

NOTE: On air brake models, cage the parking brake spring as described in AIR BRAKES (SEC. 5B) in this manual.

INSTALLATON

CAUTION: *See "Caution" on page two of this manual.*

1. With floor jack under front axle differential carrier, roll axles and wheels with equalizer beams, springs and brackets under frame.

WARNING: TO AVOID THE POSSIBILITY OF PERSONAL INJURY IN THE NEXT STEP, USE HELPERS TO LIFT UP AND POSITION FRONT SPRING BRACKETS.

2. Carefully lower frame into position, lining up holes for spring brackets. Replace spacers (if used) and install nuts, bolts and washers and tighten to "Specifications" listed at the end of this section.
3. Install rear spring brackets rebound bolts and tighten to "Specifications" listed at the end of this section.
4. Install torque rod mounting bolts to axle bracket and torque to "Specifications" listed at the end of this section.
5. Connect propeller shaft and check drive line alignment as covered in PROPELLER SHAFTS (SEC. 4B) in this manual.
6. Connect all brake lines or hoses, differential lock lines or electrical wiring as removed. Release parking brake spring and test air lines and brakes as covered in AIR BRAKES (SEC. 5B) in this manual.

SPRING REPLACEMENT

REMOVAL (U/UE-340 TYPE SUSPENSION)

1. Place floor jacks under both rear axles and remove dual wheels using a wheel dolly (figure 3) from both rear axles on one side. This will allow access to the forward eye pin and the rear rebound bolt. Raise and support vehicle frame to remove load from the spring.
2. Remove saddle cap stud nuts and caps.
3. Remove rebound bolt from bottom of rear spring bracket (figure 7).
4. Remove clamp bolt securing spring eye pin in front bracket (figure 10). Remove lubrication fitting from inner end of pin, pin may be removed with an adapter and slide hammer. In some cases it may be necessary to drive pin out with a drift and soft hammer from outer side.
5. Lower axles until spring will clear spring brackets and remove spring and saddle assembly using a suitable hoist.
6. Remove spring U-bolt nuts and separate spring and saddle.

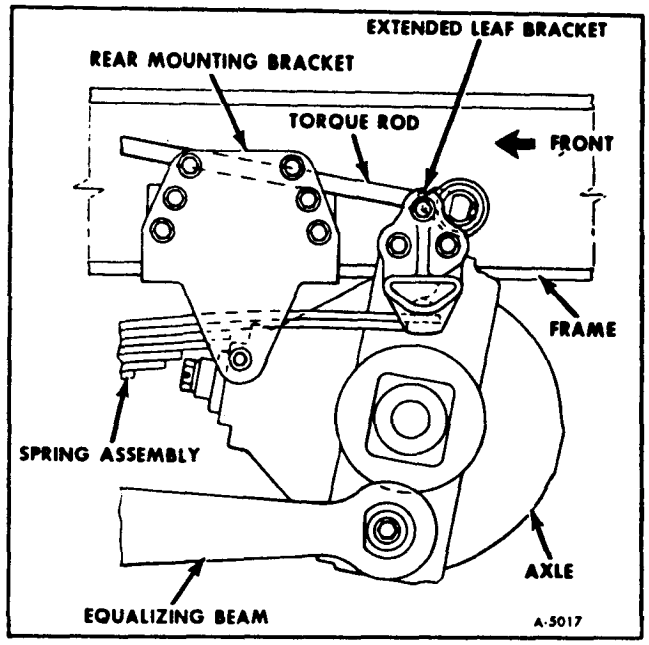


Figure 8—Hendrickson UE-340 Suspension

INSTALLATION (U/UE-340)

CAUTION: *See "Caution" on page two of this section.*

NOTE: To obtain proper torque on top pad to spring saddle U-bolts nuts, assemble spring saddle and top pad to spring assembly prior to installing spring assembly in vehicle.

1. Position spring saddle on spring assembly with head of center bolt in locating hole in saddle.
2. Position top pad on spring assembly, then place U-bolts over top pad and through saddle assembly. Place nuts on U-bolts and tighten to "Specifications" at end of this section.
3. Position spring and saddle assembly over equalizer beam. Raise axle to align spring to front bracket. Install spring front eye pin through bracket and spring eye, with milled flat near end of pin aligned with clamp bolt hole in bracket. Use a soft hammer to drive pin in from outer side.
4. Install spring front pin clamp bolt, nut and torque nut to "Specifications" listed at the end of this section. Install lubrication fitting.
5. Install rebound bolt in lower end of rear bracket and torque nut to "Specifications" listed at the end of this section. Lubricate spring ends with chassis lubricant as described in LUBRICATION (SEC. 0B) in this manual.
6. Position axles in operating position, then check to be sure spring saddle is properly positioned over equalizer beam and beam

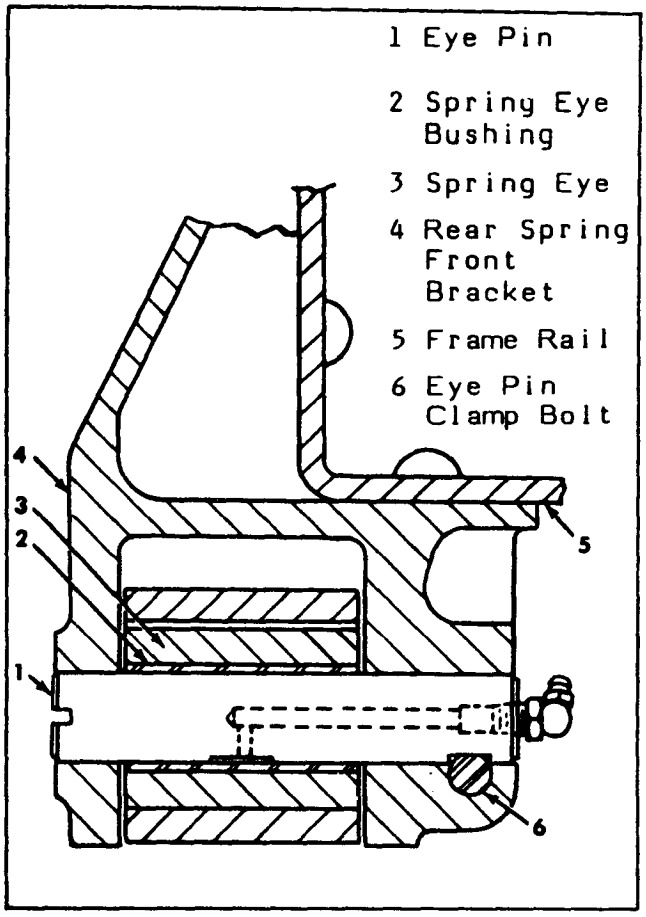


Figure 10—Section Through Front Spring Bracket and Eye Pin

at end of this section. Tighten setscrew jam nut.

NOTE: The top pad setscrews must be tightened to specified torque to properly seat the spring against machined face of saddle before torquing top-pad-to-saddle bolts.

6. Tighten top-pad-to-saddle bolts in sequence (figure 11) to torque listed in "Specifications" at the end of this section. Hold nuts at bottom while using torque wrench on bolt heads at top.

7. Raise axle and install saddle caps and stud nuts and torque nuts to "Specifications" listed at the end of this section.

8. Replace duals using wheel dolly (figure 3) and remove support from frame, then lower and remove jacks.

INSPECTION
(U/UE-340 OR RT-380 TYPE SPRING)

1. Wash spring eye bushing and pin to remove all old lubricant. Make sure lubricant passages in pin are open.

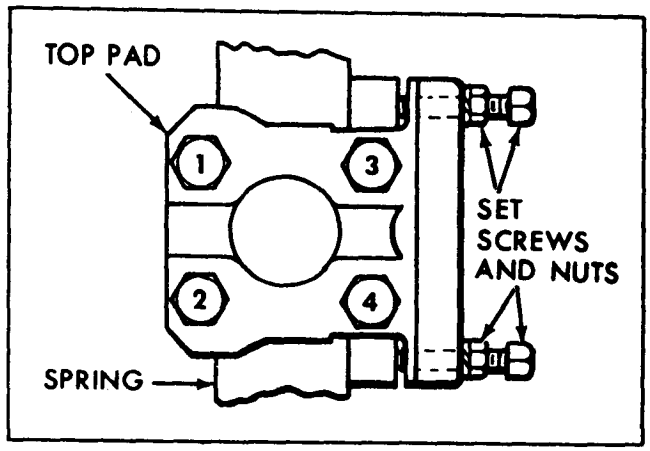


Figure 11—Top Pad Bolt Torque Sequence

2. Insert pin into clean eye bushing in spring and into spring bracket and check for looseness. If excessive looseness is evident, pins, bushings or spring bracket can be replaced as described later in this section.

3. Inspect spring assembly for broken leaves. Nos. 1 and 2 leaves can be replaced. If other leaves are broken, replace complete spring assembly. Replace broken leaves as directed later in this section.

4. Inspect spring for loose or broken rebound clips. Rebound clips should be tight enough to hold spring leaves in alignment, but not tight enough to restrict free movement of leaves.

5. Check for broken or loose spring center bolt. Replace or tighten as necessary.

6. Make sure machined surfaces of spring saddle are clean. Spring leaves must be free of rust and scale build-up if they are to be retained securely by clamp bolts.

SPRING LEAF REPLACEMENT (U/UE-340 OR RT-380 TYPE SPRING)

CAUTION: *See "Caution" on page two of this seciton.*

1. Mark with chalk or grease pencil down one side of springs to assure original position of springs when assembling later, then place spring in a vise or arbor press, next to center bolt.

2. Remove nuts and bolts from spring rebound clips. Use a cold chisel to remove weld from bolt head and rebound clip (if welded).

3. File off peened end of center bolt, then remove nut and bolt.

4. Release vise or arbor press slowly to avoid possible injury. Separate spring leaves

1. Install frame spacer (if used) and crossmember to bracket spacer and bracket to frame using bolts with washers on the inside and outside of the frame. Torque nuts to "Specifications" listed at the end of this section.

2. Lower frame down onto spring and install rebound bolt and torque to "Specifications" listed at the end of this section.

3. Install dual wheels, lower axle and remove floor jack.

REMOVAL (FRONT BRACKET)

1. Place a floor jack under the forward rear axle and remove the dual wheels using a wheel dolly (figure 3). This will allow access to the eye pin. Raise the vehicle frame to remove the load from the spring and eye pin.

2. Remove clamp bolt securing spring eye pin. Remove lubrication fitting from inner end of pin, pin may be removed with an adapter and slide hammer. In some cases it may be necessary to drive pin out with a drift and soft hammer from outer side.

3. Raise frame and lower axle as necessary until bracket clears spring (figure 10).

4. Remove bracket nuts, washers and bolts and remove bracket and spacer (if used).

INSTALLATION (FRONT BRACKET)

CAUTION: *See "Caution" on page two of this section.*

1. Install spacer (if used) and bracket to frame using bolts with washers on the inside and outside of the frame. Torque nuts to "Specifications" listed at the end of this section.

2. Lower frame and raise axle as necessary to align spring eye and bracket. Install spring eye pin through bracket and spring eye, with milled flat near end of pin aligned with clamp bolt hole in bracket. Use a soft hammer to drive pin in from outer side. Install spring eye pin clamp bolt, washer and nut. Torque nut to "Specifications" listed at the end of this section.

Lubricate eye pin with chassis lubricant as described in LUBRICATION (SEC. 0B) in this manual.

3. Install dual wheels, lower axle and remove floor jack.

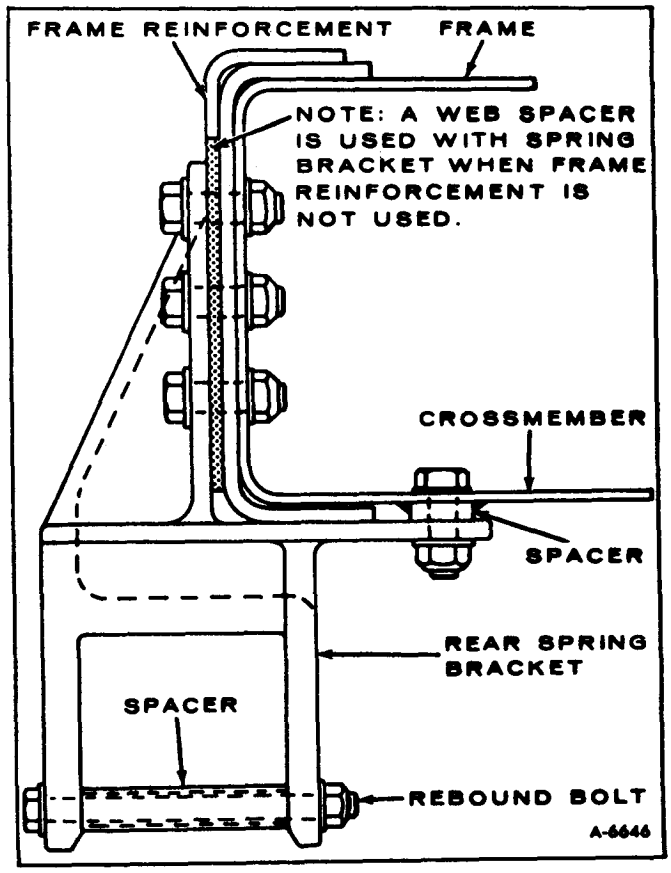


Figure 13—Rear Spring Bracket and Rebound Bolt

EQUALIZING BEAM REPLACEMENT

The following procedures cover removal and installation of either equalizing beam without removing any other units of the suspension system. When removing an axle assembly, accomplish only steps required to loosen axle at each end of beam.

REMOVAL

1. Raise and support frame to remove weight from beams (figure 14).

2. At axle brackets (figure 15), remove

NOTE: Install bolt and washer from inner side with nut located toward wheels (figure 15). Tighten nuts or bolts to torque listed in "Specifications" at the end of this section.

3. Install spring saddle caps to attach beam center bushing to spring saddle. Install saddle cap stud nuts and tighten to torque listed in "Specifications" at the end of this section.

EQUALIZING BEAM INSPECTION

1. Inspect beam end bushings and beam center bushing for evidence of damage or deterioration of the rubber. If any damage is evident, replace bushings.
2. Inspect cross tube and replace if bent or worn.

EQUALIZING BEAM BUSHING REPLACEMENT (BEAM REMOVED)

CAUTION: *Under no circumstances is a cutting torch, chisel or tools which would damage the bore, to be used in removing the equalizing beam bushings. To do so could result in the failure of the walking beam caused by the reduction of strength of the part in the bushing area due to localized heating or gouging by the torch, or tools.*

Press old bushing out, using a suitable driver or press to exert force on bushing outer sleeve. Press new bushing into place, exerting force on bushing outer sleeve until outer sleeve extends an equal distance through beam at both sides.

TORQUE ROD REPLACEMENT

REMOVAL

1. Remove nuts and bolts from torque rod mounting bracket to crossmember and axle bracket (figure 7) and remove torque rod. To remove crossmember mounting bracket, remove bracket to crossmember nuts and bolts.

NOTE: To maintain proper drive line alignment, some models may use spacers or shims between torque rod and torque rod mounting bracket or between mounting bracket and crossmember. Note the number and positions of spacers or shims for proper installation.

INSTALLATION

Install torque rod bracket on frame crossmember (if removed), and torque rod to axle bracket. Torque nuts to "Specifications" listed at the end of this section.

NOTE: Use same number of spacers or shims as previously used to assure original drive line alignment.

REYCO TANDEM AXLE SUSPENSION REPLACEMENT

NOTE: Complete tandem unit removal from frame is possible with the following procedure; springs, hangers, and other parts may be removed separately as required, as covered separately later in this section.

Before removing the tandem unit, use jacks and other equipment to block vehicle securely.

NOTE: Whenever tandem unit removal or suspension component removal involves the radius leaves, the eccentric bushings should be replaced as described later in this section.

REMOVAL

1. Block all wheels and disconnect all applicable brake lines or hoses, differential lock lines, wheel lock control cables or electrical wiring from rear axles.
2. Refer to "Brake Chamber Replacement" in AIR BRAKES (SEC. 5B) in this manual to cage the power spring in the parking brake chamber as described.
3. Support forward rear axle differential with a hydraulic floor jack. Disconnect propeller shaft from forward rear axle as described in PROPELLER SHAFT (SEC. 4B).
4. Remove forward spring hanger (figure 18) rebound bolts, spring rollers, radius leaf eye bolts, large flat washers and eccentric bushings.

NOTE: Radius leaf eye bushing is a two-piece unit. Insert a punch to inside of bushing and drive one-half of bushing out. Repeat operation from opposite side to remove remaining half of bushing.

5. Remove rebound bolts and spring rollers from center frame hanger equalizer. Remove radius leaf eye bolts and remove eccentric bushings. Refer to the "Note" under Step 4 previously.
6. Secure all radius leaves to spring assemblies.
7. Remove rear spring hanger rebound bolts, spring rollers and rubber bushings.
8. Using a suitable hoist, raise the frame high enough to remove tandem assembly out from under the frame.

THIS LIST FOR USE WITH THE FOLLOWING KITS:

SPRING ATTACHING KIT	SPRING HANGER KIT
1. TK9971	2. TK9970

SPRING ATTACHING KIT
SPRING HANGER KIT
REYCO 102

ITEM NO.	PART NUMBER	PART DESCRIPTION	QTY.	APPLICATION/REMARKS
	NOTED ABOVE	ATTACHING KIT - Spring	1	1/ *Includes items 1 thru 22*
1	T1843	BOLT - Torque Leaf	4	1
2	T2243	BOLT - Torque Leaf	4	1
3	T3016	BUSHING - Rear Hanger	2	1
4	T1842	BUSHING - Torque Leaf	8	1
5	T2242	BUSHING - Torque Leaf	8	1
6	09120-01	EQUALIZER & BUSHING ASSY.	2	1/ *Includes item 7*
	08917-01	EQUALIZER, Only	1	1/ *Was T5742*
7	08363-01	BUSHING - Equalizer	1	1/ *Was T5644*
8	T1704	NUT - Hex (1/2)	10	1
9	T1722	NUT - Lock (1)	8	1
10	08687-01	NUT - Equalizer Shaft	2	1
11	T2106	ROLLER - Spring	8	1
12	T3099	SCREW, Cap (1/2-20x4-1/2)	2	1
13	T5544	SCREW, Cap (1/2-20x4-3/4)	4	1
14	T5549	SCREW, Cap (1/2-20x5-1/2)	2	1
15	T2306	SCREW, Cap (1/2-20x1-3/4)	4	1
16	08686-01	SHAFT - Equalizer	2	1
17	T7434	TORQUE ARM - Adjustable	2	1/ *Used on L.H. Side*
18	09481-01	TORQUE ARM - Rigid	2	1/ *Used on R.H. Side*
19	T1705	WASHER, Lock (1/2)	12	1
20	T2224	WASHER - Compression, Torque Arm	8	1
21	T1724	WASHER - Torque Arm	8	1
22	T5551	WASHER, Lock	2	1
	NOTED ABOVE	SPRING HANGER KIT	1	2/ *Includes items 23 thru 29*
23	09910-01	HANGER - Center Spring	2	2/ *6 Hole - Straight Pattern*
24	09909-01	HANGER - Forward Spring(L.H.)	1	2/ *6 Hole - Straight Pattern*
	09908-01	HANGER - Forward Spring(R.H.)	1	2/ *6 Hole - Straight Pattern*
25	09913-01	HANGER ASSY-Rear Spring(L.H.)	1	2/ *Includes items 26 thru 29 - Was 08418-01*
	09914-01	HANGER ASSY-Rear Spring(R.H.)	1	2/ *Includes items 26 thru 29 - Was 08418-01*
26	09911-01	HANGER - Rear Spring (L.H.)	1	2
	09912-01	HANGER - Rear Spring (R.H.)	1	2
27	T7658	PAD - Rubber	1	2
28	T7659	PLATE - Clamp	2	2
29	10194-01	SCREW-Hx.Wshr.Hd(1/4-20x1-1/2)	4	2/ *Was T3359*
30	K174-575	PAD - Axle Stop	4	*Used on Early Style Axle Stop Only*
31	K221-2089-8	SPACER	4	*Use w/3/8" 5th Wheel Angles - Used w/Item 33*
	K221-2089-9	SPACER	4	*Use w/1/2" 5th Wheel Angles - Used w/Item 33*
	K221-2089-11	SPACER (21/32 I.D.)	4	*Use w/5/16" 5th Wheel Angles - Used w/Item 33*
32	09475-01	SPRINGS	4	*52" Axle Spacing - 32 - 36,000 Lbs. Capacity*
	09884-01	SPRINGS	4	*52" Axle Spacing - 36 - 44,000 Lbs. Capacity*
33	K230-872	STOP - Axle	4	*Used w/Item 31*
	TK10587	*REBUSHING KIT*	*1*	*Includes items 1, 2, 4, 5, 9, 20, 21*

NOTE: Items 30 thru 33 are not included with above kits.

position, through eye bolt opening. Install remaining flat washer and nut to eye bolt. Tighten nut firmly.

6. Install rebound bolt, sleeve, washer and nut to hanger bracket. Tighten nut firmly.

7. Check axle to frame alignment as detailed later in this section under heading "Alignment Adjustment of Axle to Frame". Adjust axle alignment if necessary, if alignment is all right tighten bolts to "Specifications" listed at the end of this section. Remove frame supports, lower jacks, and remove from vehicle.

SPRING LEAF REPLACEMENT

1. Mark down one side of springs with chalk to assure original position of springs when assembling later, then place spring in a vise or arbor press, next to center bolt.

2. Remove nuts and bolts from spring rebound clips.

3. File off peened end of center bolt, then remove nut and bolt.

4. Release vise or arbor press slowly to avoid possible injury. Separate spring leaves and clean thoroughly, using a wire brush if necessary. All new radius leaf eye bushings should be used, if any wear, deterioration, or distortion exists.

5. Replace any broken rebound clips.

6. Replace broken leaf and stack leaves in correct order, applying a thin film of graphite grease to each leaf. Align center bolts holes in spring leaves with long drift, then compress spring leaves in vise or arbor press.

7. Inspect center bolt for distortion and wear. Replace bolt if not in perfect condition.

8. Install center bolt and nut and tighten nut. Peen end of bolt to prevent nut loosening.

9. Remove spring from vise or arbor press. Align spring leaves by tapping with hammer, then install rebound clips, bolts, and nuts. Tighten enough to hold spring leaves in alignment, but not enough to restrict free movement of leaves.

10. Inspect the U-bolts and spring spacer plates, replace if damaged or cracked.

11. Inspect hanger brackets at reinforcing webs, and in corners of casting. Do not weld or braze cracks. If casting is cracked it should be replaced.

Center hanger pivot bushing, can be replaced using conventional methods and equipment. All components which are secured with bolts and nuts, should be torqued to correct specifications, listed in "Specifications" at end of this section.

CLEANING, INSPECTION AND REPAIR

Thoroughly wash spring leaves, and all component parts in a suitable solvent. Carefully inspect all leaves for breaks, and minute cracks. If any are found, leaf should be replaced. Remove any scale, rust, or deposits which may have accumulated on leaves.

INSPECTION OF SPRING

1. Insert eye bolts into bushings in spring eyes and bracket and check for looseness. If excessive looseness is evident, eye bolts and bushings must be replaced. Refer to "Replacing Radius Leaf Eye Bushing" in this section for bushing replacement procedure.

2. Inspect spring assembly for broken leaves. No. 1 and No. 2 leaves can be replaced. If other leaves are broken, replace complete spring assembly. Replace broken leaves as directed later under "Replacement."

3. Inspect spring for loose or broken rebound clips. Rebound clips should be tight enough to hold spring leaves in alignment, but not tight enough to restrict free movement of leaves.

4. Check for broken or loose spring center bolt. Replace or tighten as necessary.

5. Make sure machined surfaces of spring saddle are clean. Spring leaves must be free of rust and scale build-up if they are to be retained securely by U-bolts.

ASSEMBLY OF SPRING

1. Stack spring leaves in correct order using care to position leaves in proper sequence.

2. Align center bolt holes using a long punch or suitable tool. Place spring leaves in vise or arbor press, adjacent to center bolt and tighten securely. Remove drift tool.

3. Install center bolt and nut. Tighten the nut firmly and peen end of bolt.

4. Install bolts, nuts, and spacer sleeves to spring clips, and tighten nuts firmly, peen ends of bolts if desired. Remove from vise or arbor press.

ALIGNMENT ADJUSTMENT OF AXLE TO FRAME

If axle is suspected to be out of alignment, the following procedure must be followed to inspect, adjust, and ensure that both axles are correctly aligned with frame, and that they are parallel with each other (refer to figure 19).

1. Position vehicle on level floor and rock back and forth several times with brake applied lightly, while using vehicle engine power. This will release any set condition of suspension.

components sufficiently so adjustment can be readily made.

10. Jack up frame on side to be corrected to relieve weight on springs. Axle can then be adjusted by one man. In most cases, axle alignment can be corrected by adjusting rom one side; however if necessary, additional adjustment can be made from other side of axle.

Eye bolt can then be easily moved by this method. Maximum adjustment of 7/16" can be made on each side of vehicle.

When axle adjustment has been completed and determined to be correct, torque radius leaf eye bolt nut to torque listed in "Specifications" at end of this section.

SPRING HANGER REPLACEMENT

FRONT HANGER REMOVAL

1. Raise frame until all weight is off spring and safely block it in position.
2. Remove rebound bolt, washer, and spring roller from front spring hanger.
3. Remove radius leaf eye bolt nut, and large flat washer from eye bolt. Using a soft drift tool, drive eye bolt with remaining flat washer from hanger.
4. From inside of rubber bushing, and using a suitable drift tool drive one-half of bushing out of opening. Reverse the position of drift tool and drive other half of bushing from opposite side of hanger.
5. Remove all bolts, nuts, and washers securing spring hanger to frame.
6. Hanger and spacer plate may now be removed by moving it away from spring end and lifting it straight up from frame.

CENTER SPRING HANGER REMOVAL

1. Raise frame until all weight is off springs and safely block in position.
2. Remove rebound nuts, washers, bolts, and spring rollers from ends of equalizer.
3. Remove radius leaf eye bolt nut and large flat washer from eye bolt. Using a soft drift tool drive eye bolt with remaining flat washer from hanger.
4. From inside of rubber bushing, and using a drift tool, drive one-half of bushing out of opening. Reverse the position of drift tool and drive other half of bushing from opposite side of hanger.
5. Remove equalizer pivot nut, washer and bolt.
6. Slide equalizer back and forth as necessary to gain access to mounting bracket bolts.
7. Remove all bolts, nuts, and washers which secure center hanger to frame.
8. Remove hanger and spacer plate.

REAR SPRING HANGER REMOVAL

1. Raise frame until all weight is off spring and safely block it in position.
2. Remove bolts, nuts, and washers, which secure rear hanger to frame. Remove hanger and spacer plate.

REAR SPRING HANGER PAD REPLACEMENT

Remove two cap screws from each end of hanger, remove retaining straps, and rubber pad. To install new rubber pad, reverse the above procedure.

INSTALLATION OF ALL SPRING HANGERS

Spring hanger may be installed by reversing the previous removal procedure. Install units with spacer plates between frame and hanger. Alignment adjustment of axles should be checked and adjusted if necessary before final torquing of radius leaf eye bolt nut.

EQUALIZER ASSEMBLY BUSHING REPLACEMENT

REMOVAL

1. Raise frame until all weight is off springs and safely block in position.
2. Remove rebound nuts, washers, bolts, and spring rollers from ends of equalizer.
3. Remove radius leaf eye bolt nut and large flat washer from eye bolt. Using a drift tool, drive eye bolt with remaining flat washer from hanger.
4. From inside of rubber bushing, and using a drift tool, drive one-half of bushing out of opening. Reverse the position of drift tool and drive other half of bushing from opposite side of hanger.
5. Remove equalizer pivot nut, washer and bolt.
6. Slide equalizer forward over spring and raise frame. Slide equalizer rearward through hanger up and out.
7. Using a suitable press, press equalizer bushing out in direction shown in figure 20.

INSTALLATION

NOTE: Coat bushing with soap solution.

1. Press bushing into equalizer in the

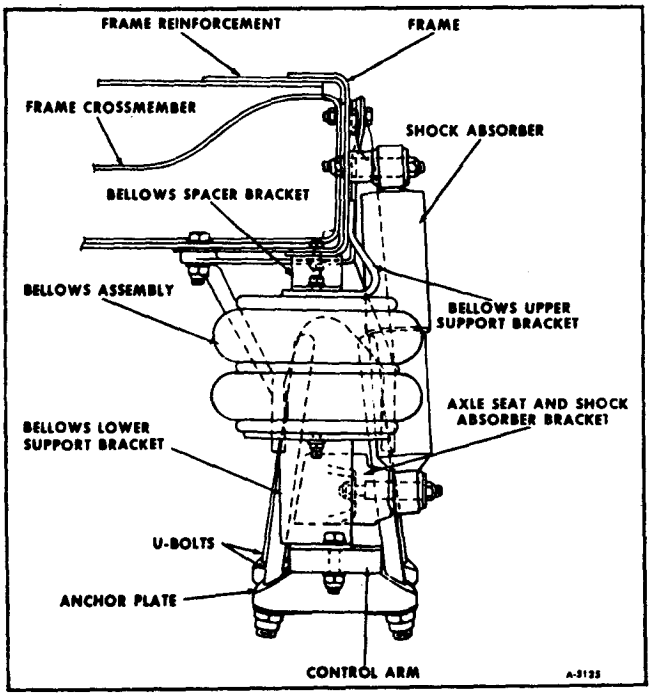


Figure 22—Air Suspension End View

6. Stress Absorbers and Wear Washers. Stress absorbers and wear washers should be replaced each time control arms are removed.

NOTE: Complete tandem unit removal from the frame is possible with the following procedure; however height control valve, bellows, control arm, and other parts may be removed separately as required, as covered later in this section.

1. Block all wheels and disconnect all applicable brake lines or hoses, differential lock lines, wheel lock control cables or electrical wiring from rear axles.

2. Refer to "Brake Chamber Replacement" in "AIR BRAKES" (SEC. 5B) in this manual to cage the power spring in the parking brake chamber as described.

3. Support forward rear axle differential with a hydraulic floor jack. Disconnect propeller shaft from forward rear axle as described in "PROPELLER SHAFTS" (SEC. 4B).

4. Remove height control valve link from control valve.

5. Remove upper shock absorber stud nuts and pull out shock absorbers at the top enough to clear stud and move shocks against axles.

6. Remove nuts and bolts from all bellows support brackets to the frame.

7. Raise the frame to remove the load from the control arms.

8. Remove the control arm pivot bolts (eye bolts) and wear washers.

9. Raise vehicle until frame brackets clear suspension conponents and remove tandem assembly out from under the frame.

AIR BELLOWS REPLACEMENT

REMOVAL

1. Jack up vehicle and secure frame with blocking.

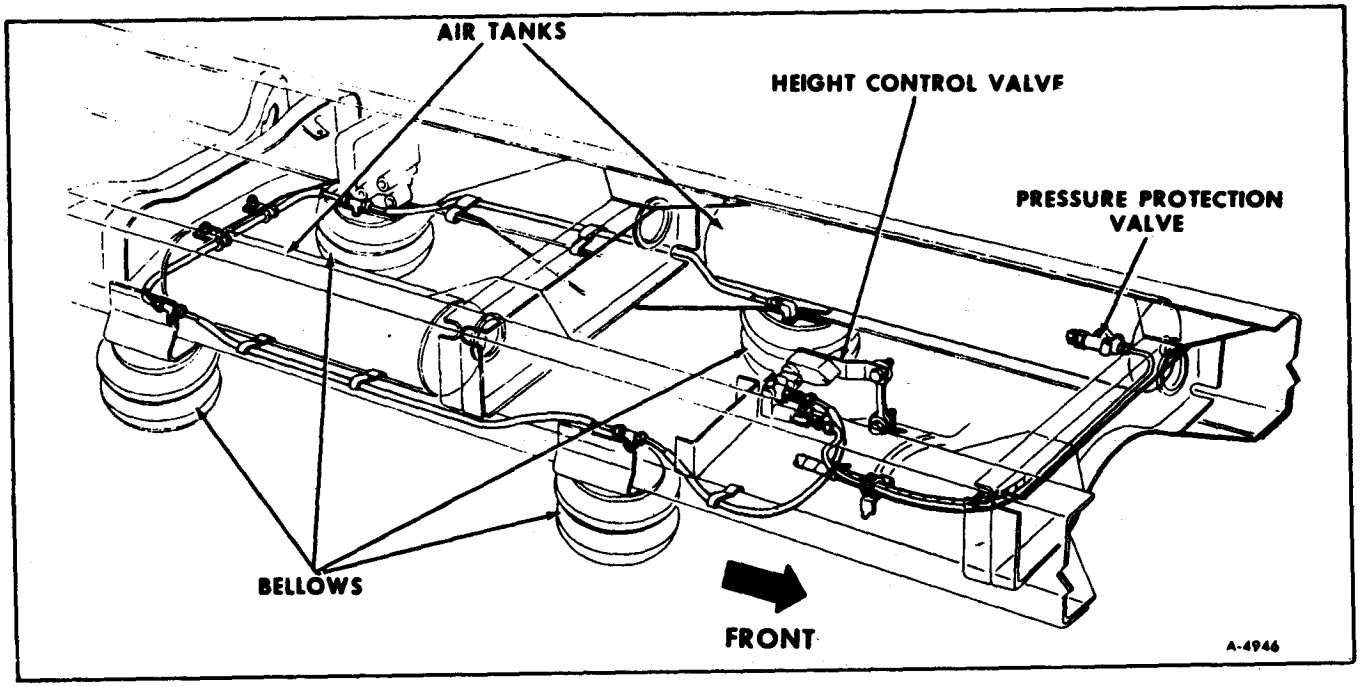


Figure 23—Air Suspension Diagram (Typical)

bead plates, under girdle hoop, or in the rubber section itself, replace the bellows assembly.

CONTROL ARM REPLACEMENT

NOTE: All suspension repairs should be made on level surface.

REMOVAL

1. Raise frame to remove load from rear suspension units, then block frame securely.
2. Loosen control arm jam nut and bolt to remove clamping effect on casting.
3. Remove two bolts which attach bellows support bracket to control arm.
4. Loosen control arm pivot bolt.
5. Remove U-bolt nuts, lower control arm, then remove pivot bolt, and wear washer, then discard wear washers.

INSTALLATION

NOTE: Before final torquing of control arm-to-frame bracket pivot bolts and nuts, the rear suspension should be at normal ride height. If connectinos are tightened without first obtaining this adjustment, a torsional preload will be imposed on rubber bushings when the frame assumes normal height relative to axle.

1. Position new stress absorber liners, one on top and one at bottom of control arm. These can be held in place with masking tape while installing control arm. TAPE MUST NOT BE BETWEEN BRACKET AND LINER.
2. See that the dowel pin holes are clean in control arm, axle seat and anchor plate bracket. Install upper dowel pin and raise control arm into position at frame bracket and loosely install pivot bolt with new wear washers. Raise control arm at axle, then loosely install anchor plate with dowel pin installed and attaching U-bolts and nuts.

NOTE: Stress absorber (figure 24) must extend past the edges of the axle seat and past edges of anchor plate.

3. Install bolts and nuts attaching bellows support bracket to control arm and torque to "Specifications" listed at the end of this section.
4. Establish vehicle at normal ride height by jacking up frame.
5. Initially tighten control arm pivot bolts and U-bolt nuts.

CAUTION: *See "Caution" on page one of this section.*

6. Tighten both control arm setscrew approximately equal distance and torque to "Specifications."
7. Final torque control arm pivot bolts and U-bolt nuts to "Specifications" listed at end of this section.

CONTROL ARM REPAIR

BUSHING REPLACEMENT

Press bushing from end of control arm. Clean inside surface of control arm eye, making sure bushing bore is smooth. Press bushing into control arm until bushing outer sleeve is flush with each side of control arm eye. Use no lubricant on bushings. Press in load should be approximately 7,000-9,000 pounds.

PRESSURE PROTECTION VALVE REPLACEMENT

REMOVAL

1. Drain air from system.
2. Remove air lines from valve.
3. Remove valve from air tank.

NOTE: Refer to AIR BRAKES (SEC. 5B) in this manual for valve repair information.

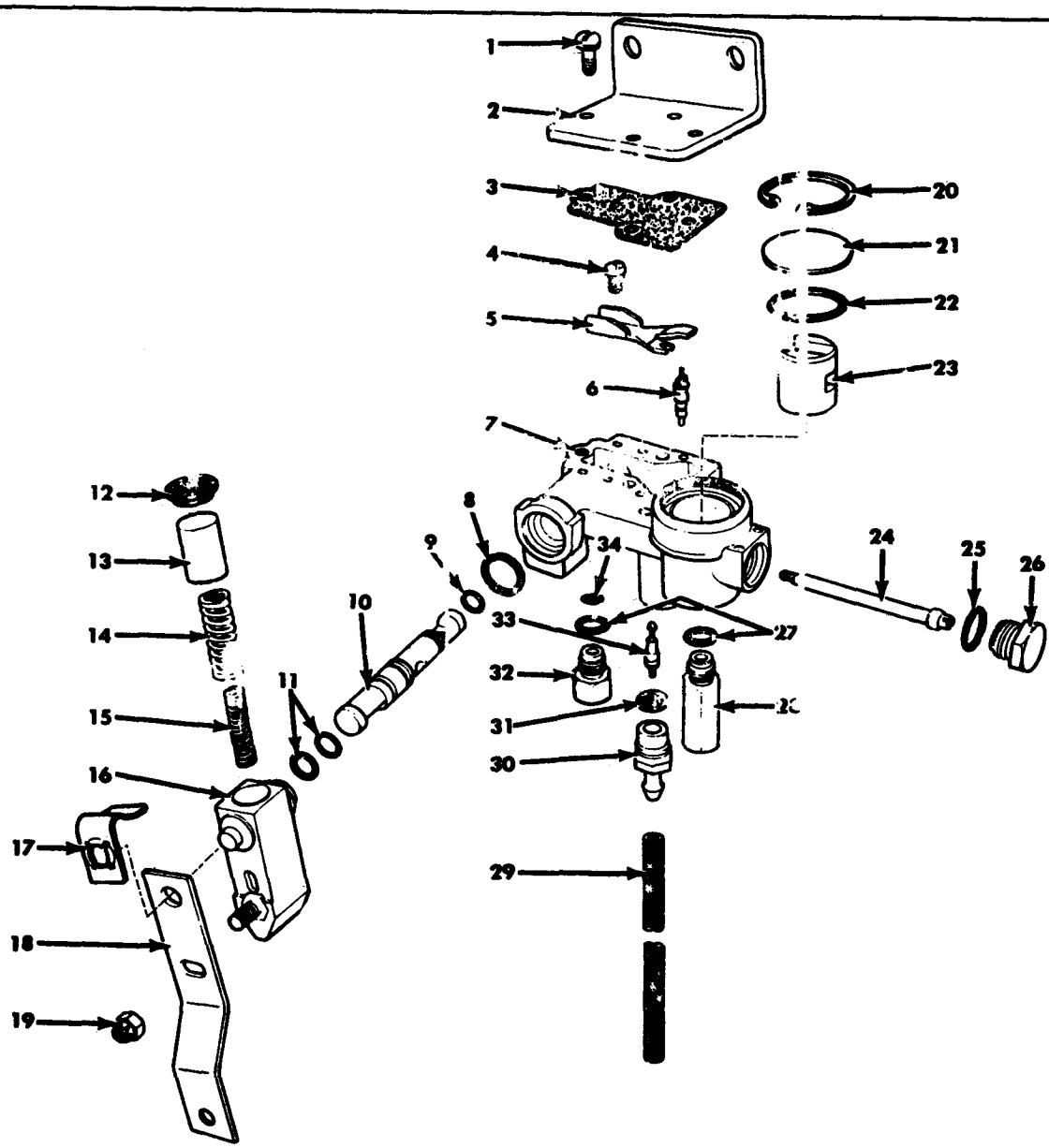
INSTALLATION

1. Check air lines to valve for damage, clean or replace as required.
2. Place valve into position and connect air lines.
3. Build up system air pressure and check for leaks.
4. Exhaust air pressure in system below 65 psi and check to determine if valve has shut off air supply to applicable units.
5. Build up system air pressure, remove wheel blocks and check brake and accessory operation.

HEIGHT CONTROL VALVE REPLACEMENT

REMOVAL

Before disconnecting any height control valve air lines, securely support frame by placing blocks between frame and axles. Exhaust air from air supply system by opening drain cock on air tank. After the above



1. Cover Screw and Washer
2. Cover
3. Cover Gasket
4. Valve Lever Screw
5. Intake and Exhaust Valve Lever
6. Intake Valve Core
7. Valve Body
8. Overtravel Control Body Seal
9. Shaft O-ring (Medium)
10. Overtravel Control Shaft
11. Shaft O-ring (Large)
12. Overtravel Body Plug
13. Overtravel Piston
14. Overtravel Spring (Large)
15. Overtravel Spring (Small)
16. Overtravel Control Body
17. Plug Retainer
18. Overtravel Lever
19. Lever Stud Nut
20. Delay Cover Retainer
21. Delay Cover
22. Delay Cover O-ring
23. Delay Piston
24. Piston Pin
25. Plug O-ring
26. Delay Plug
27. Adapter O-ring
28. Inlet Adapter and Check Valve Assembly
29. Exhaust Tube
30. Exhaust Fitting
31. Exhaust Screen
32. Outlet Adapter
33. Exhaust Valve Core
34. Outlet Adapter Screen

A-6019

Figure 27—Height Control Valve Components

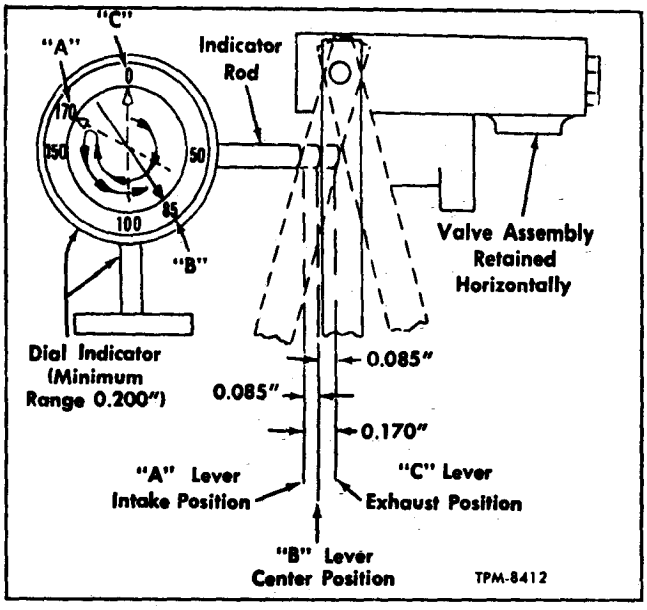


Figure 29—Locating Valve Overtravel Lever Center Position

the overtravel lever must be centered as explained previously.

Two methods of adjustment can be done using either the air pressure and vacuum method or the air pressure method only. If a vacuum source is available, this method will take less time to perform. The vacuum source is used to make the exhaust valve lever gap check only.

When the air pressure only method is used, it will take longer to perform adjustments as the valve cover must be in place each time air pressure is applied and then removed to permit adjustment of exhust valve lever.

Valve levers must be bent to proper setting. In the valve both exhaust and intake levers are part of one unit which contains "score" marks to permit easy bending. This operation may be done with lever in the valve body, or lever may be removed and bent on the bench.

Method Using Air Pressure and Vacuum

1. If air supply and vacuum lines were not connected to valve assembly as directed previously when centering valve overtravel lever, connect lines.

2. Apply air pressure and regulate it to 80 to 110 psi. Apply vacuum and regulate it at approximately 15 inches.

3. Move overtravel lever fore and aft several times and then back to true center position.

4. Starting at true center position, slowly move lever to where air intake valve just

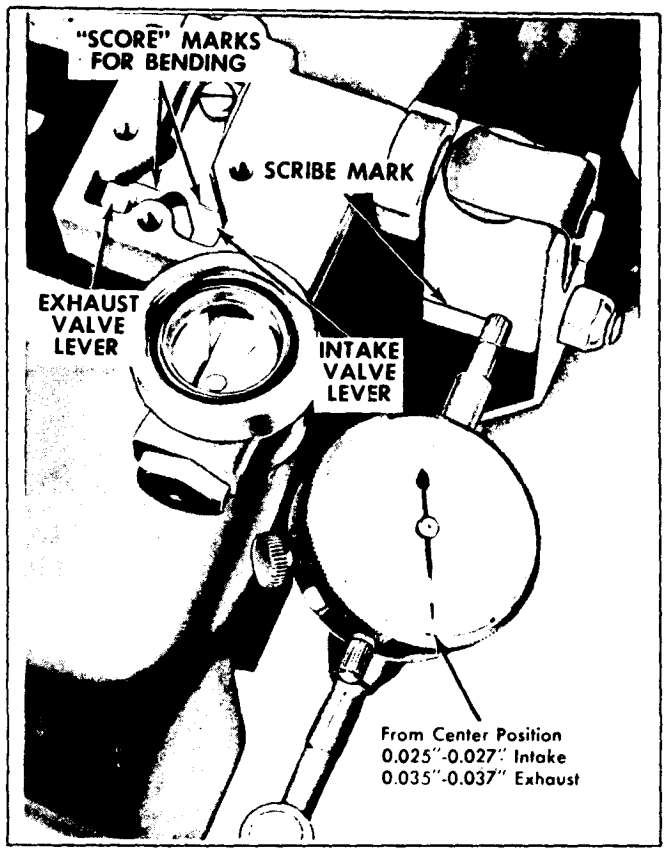


Figure 30—Adjusting Air Valve Lever Gap

begins to open. Listen for escaping air. Note reading on dial at this point. Reading should be 0.025" to 0.027" from lever center position. If necessary, bend intake valve lever to correct setting (figure 30).

5. Return overtravel lever to center position. Slowly move lever to exhaust side and at same time note the vacuum gauge reading.

When vacuum just begins to fall off, the exhaust valve has opened. Valve should open when overtravel lever is moved 0.035" to 0.037" from center position. If necessary, bend exhaust valve lever to correct setting (figure 30).

6. Recheck intake and exhaust valve lever gaps, then proceed with "Time Delay Check" explained later.

Method Using Air Pressure Only

NOTE: This method may be performed when a vacuum source is not available.

1. Connect air supply hose (80 to 110 psi to air inlet port.

2. To adjust air intake valve lever gap:

a. Move the overtravel lever slowly from true center position to point where intake valve just begins to open. Listen for escaping air. Note reading on dial at this point which should register 0.025" to 0.027".

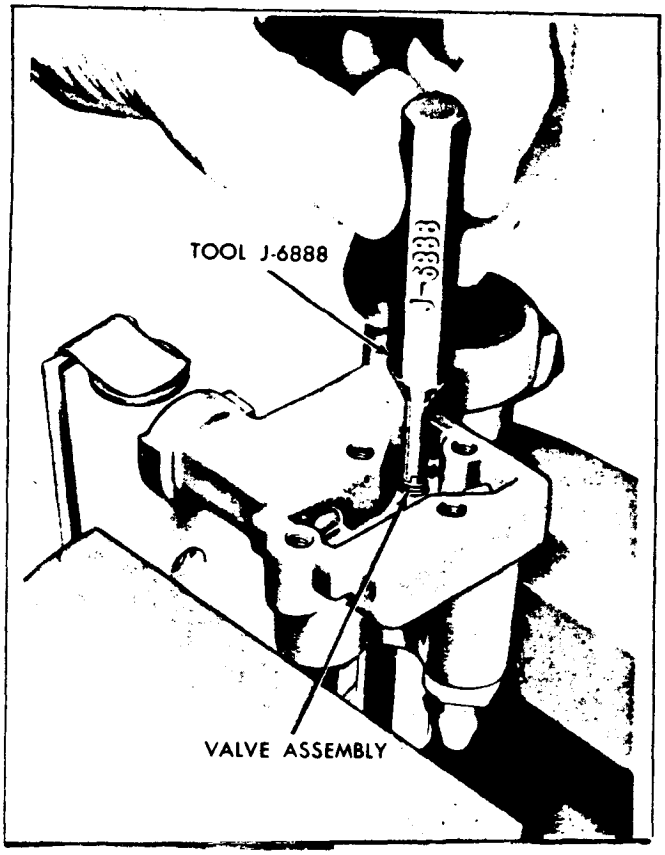


Figure 34—Replacing Typical Valve Core Assemblies

2. Move the overtravel lever upward (quickly) approximately two inches and simultaneously start counting the number of seconds before air starts to escape from bellows port. A delay of 2 to 9 seconds should exist. Repeat this check.

Air Exhaust Time Delay Check

To time the delay for exhaust, two methods can be used; one using vacuum source and one using air pressure.

Method Using Vacuum

1. Connect vacuum hose to air exhaust port. Adjust vacuum to 15 inches.
2. Move the overtravel lever downward (quickly) approximately two inches and simultaneously start counting the number of seconds before the vacuum gauge starts to drop off. A delay of 2 to 9 seconds should exist. Repeat this check.

Method Using Air Pressure

1. Install valve cover with new gasket on valve assembly.
2. Connect air pressure supply hose to bellows port.
3. Move overtravel lever downward (quickly) approximately two inches and simultaneously start counting the seconds before air starts to escape from the exhaust port. A delay of 2 to 9 seconds should exist.

NOTE: A time delay over 9 seconds could mean too large a valve lever gap adjustment and a time delay under 2 seconds would mean too small a valve lever gap adjustment. If the time delay is not within 2 to 9 seconds, first recheck the fluid level. If fluid level is satisfactory, the valve lever gap adjustment must be repeated, step by step.

4. After abtaining proper valve adjustments, install valve cover using new gasket. Install new screen in bellows port, then using new O-ring, install outlet adapter into bellows port. If screen was removed from exhaust port, install new screen and exhaust fitting. Install air line gaskets.

NOTE: Place tape over ends of air line ports until such time as valve assembly is installed on vehicle.

DISASSEMBLY

NOTE: Repair parts kit is available which contains all parts usually requiring replacement.

NOTE: Key numbers in following text refer to figure 27 unless otherwise indicated.

1. Remove inlet adapter and check valve assembly (28) from valve body (7). Remove outlet adapter (32). Remove adapter O-rings (27). Remove air line fitting gasket from adapters. Remove outlet adapter screen (34).
2. Remove four cover screws and washers (1) from cover (2). Remove cover and gasket (3).
3. Position valve with delay plug (26) at top. Unscrew delay plug from valve body (7). Drain silicone fluid from cavity. Remove plug O-ring (25). Unscrew piston pin (24) from control shaft (10).
4. Remove delay cover retainer (20), cover (21) and cover O-ring (22). Remove delay piston (23). Discard O-ring.
5. Remove valve lever screw and washer (4) from valve lever. Remove exhaust valve and intake valve lever (5) from valve body.
6. Pull overtravel assembly and shaft from valve body.
7. Remove intake valve core (6) with tool J-6888) as shown in figure 34.
8. Remove exhaust fitting (30) and screen

around stem of exhaust valve core (33). Fork should be high enough on stem so that stem will not be held open. Insert valve lever screw (4) and tighten.

5. Using new O-ring (27), install air inlet adapter and check valve assembly (28) into valve body.

6. Make all of the valve assembly adjustments explained under "Height Control Valve Adjustments" previously in this seciton.

REAR HUBS AND BEARINGS ON-VEHICLE SERVICE

REAR HUBS AND BEARINGS REPLACEMENT

REMOVAL (FIGURE 36)

1. Jack up rear axle and remove tire and rim assembly on vehicles having cast wheels. Remove tire and wheel assembly from vehicles having disc wheels.

NOTE: It is recommended that a wheel dolly, as shown in (figure 3), be used to remove wheel and drum assembly.

2. If brake drum is demountable type, remove brake drum.

3. Remove rear axle shaft as described in REAR AXLE (SEC. 4A) of this manual.

4. Refer to figure 37 and remove lock nut, nut lock (type A and B) or lock ring (type C) and adjusting nut from axle housing tube.

5. With cast wheels, lift wheel (hub) and drum assembly straight off axle housing, using care to prevent outer cone and roller assembly from dropping out of hub. Remove outer bearing cone and roller from hub. With disc wheels carefully pull hub assembly straight off axle housing, using care to prevent outer cone and roller assembly from dropping out of hub. Remove outer bearing cone and roller from hub.

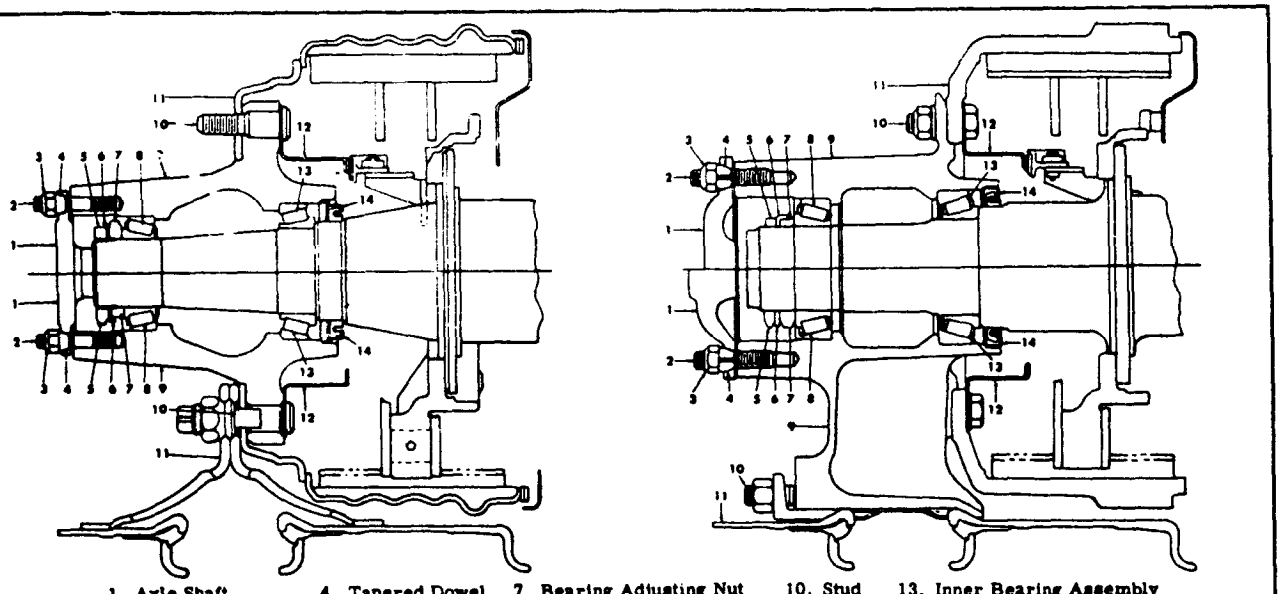
6. Pull inner oil seal out of hub, then lift out inner bearing cone and roller assembly. Discard oil seal.

7. Clean, inspect, and repair parts as directed later under "Cleaning, Inspection, and Repair".

INSTALLATION

After completing "Cleaning, Inspections, and Repair" operations described later in this section, lubricate bearings, axle housing tube, and inside of hub with chassis lubricant as described in LUBRICATION (SEC. 0B) previously in this manual. Coat the lip of inner oil seal and surface contacted by lip with wheel bearing grease, or equivalent.

1. Position inner bearing cone and roller in hub or wheel (hub) and drum assembly. Coat oil seal case with a thin layer or nonhardening sealing compound; using (J-25376) (figure 38) install seal in hub until seal lip seats against hub. Seal lip must point inward and driving



1. Axle Shaft
2. Shaft to Hub Stud
3. Nut
4. Tapered Dowel
5. Locknut
6. Nut Lock
7. Bearing Adjusting Nut
8. Outer Bearing Assembly
9. Hub
10. Stud
11. Wheel
12. Rotor
13. Inner Bearing Assembly
14. Seal

A-3875

Figure 36—Typical Rear Hub and Bearing Installation

3. While rotating the hub and drum assembly in both directions to seat bearings properly in recesses of hub, tighten the adjusting nut to 50 ft. lbs. torque.

4. Back off the adjusting nut 1/4 to 1/3 turn to assure 0.001" to 0.007" end plat.

5. Install bearing adjusting nut lock, referring to figure 37.

a. If vehicle is equipped with type shown in View A, figure 37, align flat on adjusting nut with nearest lip of nut lock. Make sure wheel turns freely, then install nut lock and lock nut. Tighten lock nut to 100-150 ft. lbs. Bend one lip of nut lock over one flat flat on each nut.

b. If vehicle is equipped with type shown in View B, figure 37, align nearest slot in adjusting nut with short tang on nut lock and bend tang into slot in nut. Install lock nut with slots outward and tighten to 100-150 ft. lbs. torque. Bend tangs of nut lock into slots in lock nut and adjusting nut.

c. If vehicle is equipped with type shown in View C, figure 37, align dowel pin of adjusting nut with nearest hole in lock ring. Lock ring may be turned on either side to facilitate alignment of hole with least movement of adjusting nut. Install lock nut and tighten to 250 to 300 ft. lbs.torque.

6. After completing bearing adjustment, recheck adjustment to make sure wheel turns wide with 0.001" to 0.007" end play.

7. Install axle shaft as directed in REAR AXLE (SEC. 4A) of this manual.

BEARING MAINTENANCE

All wheel bearings are adjustable for wear. Satisfactory operation and long life of bearings depend upon proper adjustment and correct lubrication. If bearings are adjusted too tight, they will overheat and wear rapidly. Loose adjustment will cause pounding and will also contribute to stteering difficulties uneven tire wear, and inefficient brakes. Bearing adjustment, should be checked at regular inspection periods.

Hubs and bearing should be cleaned, inspected, and lubricated with chassis lubricant whenever hubs are removed, or at intervals indicated in LUBRICATION (SEC. 0B) of this manual.

CLEANING

With a stiff bristle brush and cleaning solvent, thoroughly clean bearings and hubs, making sure that all old lubricant and dirt is removed. Check bearings and cups, replace damaged parts.

PACKING

Some wheel bearings are lubricated from axle differential after the initial lubrication. However, whenever wheel hub is removed, bearings should be cleaned, inspected, and relubricated. Some rear wheel bearings require cleaning, inspection, and lubrication at regular intervals as specified on lubrication charts.

When packing by hand, be sure that lubricant is kneaded between rollers and races. A mechanical lubricator can be used; however, bearings must be thoroughly lubricated.

DO NOT FILL HUB. Coat inside hub and axle spindle with thin coat (1/8" thick) of chassis lubricant to retard rusting. Allow some excess grease at inner side of bearings and around adjusting nut. DO NOT PACK HUB WITH GREASE. The lubricant applied to bearings is sufficient to provide lubrication until next service period.

New hub oil seals should be installed when servicing bearings if there is the slightest indication of wear or damage.

CAUTION: *An imperfect seal may permit bearings lubricant to reach brake linings, resulting in faulty brake operation and necessitating premature replacement of linings.*

WHEEL SPEED SENSOR REPLACEMENT

REMOVAL (INTERNAL EATON)

1. Jack up rear axle and remove axle shaft as directed in REAR AXLE (SEC. 4A) of this manual.

2. Remove lock nut, nut lock and adjusting nut.

3. Using a wheel dolly (figure 3), remove wheel and drum assembly.

NOTE: Different axles may have different sensor mounting positions. It may be necessary to perform additional steps to remove sensors, and retorque of screw packs. It may be necessary to release shoe return spring or total removal of brake shoes as described in AIR BRAKES (SEC. 5B) of this manual.

4. Loosen and remove screw packs using hex head wrench. Sensor may now be remove from bracket. Bracket may be removed by removing two brake spider mounting bolts.

5. Unscrew wiring connector and remove wiring clamps and remove sensor assembly.

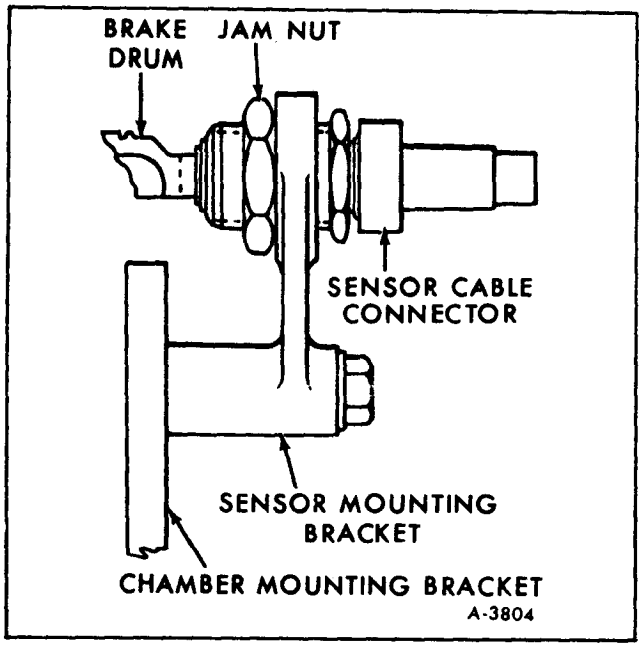


Figure 40—Speed Sensor Adjustment

vehicle operation, therefore it is recommended they be replaced after sensor repositioning takes place 4 or 5 times or whenever wear indicator grooves indicate replacement should be made. (Sensor gauge blocks should be replaced when wear indicator grooves are no longer visible.)

1. Insert screwdriver blade in slot behind gauge block pry outward (figure 39).
2. Snap new gauge block into place over positioning post.

NOTE: The gauge blocks are set 20 thousandths (0.020") above the sensor face and physically contact the rotor face as the wheel is positioned on the axle.

REMOVAL (EXTERNAL AC)

1. Loosen or remove jam nut from sensor mounting bracket.
2. Remove sensor from bracket and remove clips or ties from harness. Disconnect harness connector and remove sensor assembly. If necessary to remove sensor mounting bracket, remove two bracket mounting bolts.

INSTALLATION

1. Install sensor harness to connector and install clips and ties (if used).
2. Install sensor mounting bracket, if removed, and install sensor into bracket and adjust sensor.

ADJUSTMENT

New Sensor

Assembly sensor (figure 40) to bracket so sensor is in contact with drum edge. Torque jam nut to torque listed in "Specifications" listed at the end of this section. The fiber spacer is removed within the first few revolutions of the drum leaving the proper air gap.

Used Sensor

Assemble sensor to bracket so sensor is in contact with drum edge. Back sensor out one revolution which brings the sensor out to 0.040"-0.060", or it can be measured using feeler stock and set to 0.050". Torque jam nut to torque listed in "Specifications" listed at the end of this section.

ROTOR REPLACEMENT

The rotor is a one-piece stamped steel assembly which mounts to the inner surface of the brake drum, utilizing wheel/drum mounting bolts or studs.

It is recommended that the rotor be visually checked during periodic wheel removal, or when a brake job is to be done. If it is visually evident thatthe rotor is damaged, indented or distorted, it should be replaced.

REMOVAL

1. Refer to "Rear Hub and Bearing Replacement" previously in this section for removal of drum.

2. With hub removed, press out wheel studs using a suitable arbor press or remove nut and bolt as necessary to remove rotor.

INSTALLATION

NOTE: After hub, bearing, seal or rotor is removed, or whenever the hub assembly is removed form the axle, the brake sensor must be adjusted.

1. Install rotor to hub with either nuts and bolts or using a suitable arbor press, press studs into hub.

2. Refer to "Rear Hub and Bearing Replacement" for "Internal (Eaton)" and adjust sensors as described.

NOTE: It is recommended that a wheel dolly be used for wheel, hub and drum installation that a minimum of "rocking the wheel position" be done; rather, after placement of wheel, use the adjusting nut to draw the wheel to it's running position.

CAUTION: *If any wheel experiences a single stud failure caused by a loose-running wheel all studs should be replaced.*

A loose running wheel may cause only one stud to break, but several more studs may become fatigued to the point of failure, but not actually breaking. Replacing only the one broken stud and remounting wheel will then set the stage for a second and possibly more serious failure. If holes in wheel have become elongaged or enlarged, replace wheel.

Hub Stud Replacement

Hub studs can be removed and replaced by using a conventional stud remover and replacer. Make sure that studs are firmly bottomed in holes and that threads are not damaged during installation.

SPECIFICATIONS

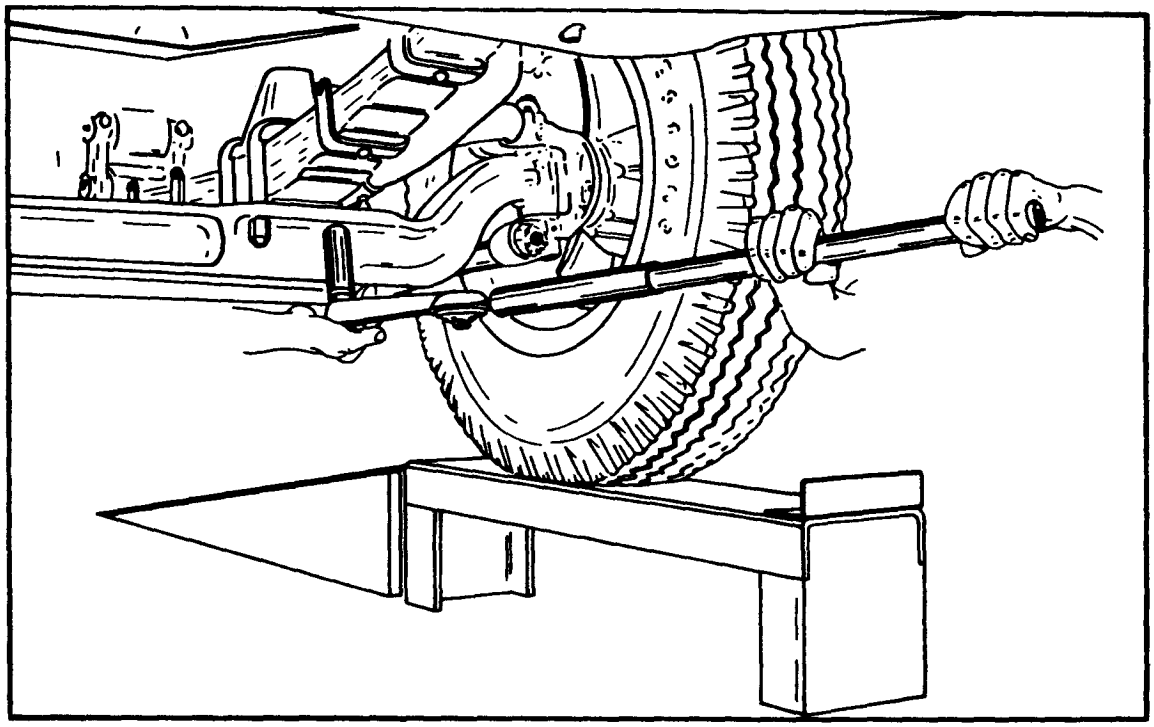
REAR SUSPENSION

AIR SUSPENSION	TYPE OF PART	TORQUE (FT. LBS.)
Control Arm-to-Frame Bracket Eye Bolt	Nut	490-520
Control Arm Frame Bracket to Frame Bolt	Nut	90-110
Control Arm Frame Bracket to Crossmember Bolt	Nut	90-110
Control Arm to-Bellows Lower Support Bracket Bolt	Nut	190-210
Bellows Mounting Stud	Nut	40-50
Bellows Upper Support Bracket to Frame Bolt	Nut	50-60
Rear Bellows Upper Spacer to Frame Bolt	Nut	50-60
Axle U-Bolt-to-Anchor Plate	Nut	490-520
Axle Seat Set Screw	Nut	110-140
Height Cotnrol Valve Link Bolt	Nut	5-8
Height Control-to-Mounting Bracket Bolt	Nut	5-8
Height Control Mounting Bracket to Frame Bolt	Nut	40-50
Shock Absorber Mounting Bracket to Frame Bolt	Nut	50-60
Shock Absorber Mounting Pin to Frame (Inside)	Nut	70-80
Shock Absorber Mounting Pin to Shock	Nut	70-80
HENDRICKSON (SERIES RT)		
Torque Rod-to-Axle Bracket Bolt	Nut	110-150
Torque Rod Bracket-to-Crossmember Bolt	Nut	50-60
Torque Rod-to-Bracket-to-Crossmember Bolt	Nut	110-150
Spring Center Bolt	Nut	65-75
Spring Saddle Top Pad Bolt	Nut	275-300
Spring Saddle Set Screw		110-150
Spring Saddle Cap Stud	Nut	225-275
Spring Saddle Cap Stud	Stud	55-65
Spring Front Eye Pin Draw Key	Nut	50-60

U-BOLT TENSION

SAE GRADE 8

FOR FRONT & REAR AXLES



Loose U-bolts are often the cause of leaf-spring breakage, axle misalignment, hard steering, and abnormal tire wear.

New springs "settle in" after being put in service which relieves the original tension on the U-bolts.

Tighten U-bolts after the first 500 miles on a new vehicle. Check U-bolt tension of On-highway vehicles every 10,000 miles. Check Off-highway vehicles weekly.

If U-bolts, or nuts, need replacing DO NOT risk an accident by using common U-bolts or standard nuts. Use only U-bolts and nuts of SAE Grade 8 specification.

The vehicle should be loaded to its normal gross weight when tightening the U-bolts. The use of a torque wrench is highly recommended.

Refer to the table on the following page which shows torque values specific to SAE Grade 8 U-bolts by size.

KENWORTH TORQUE RODS with SPHERICAL STEEL BUSHINGS

FRONT AXLES: Clark DS22500, 22610, 22710 & DS22810; Shuler 2F1, DCP34, FTC34; Rockwell FDS1600, 1800, 1801, 1805, 1808, PS270, FU910

TANDEM AXLES: KWC(B) Suspension - Clark BD Axles and Rockwell SPR270, 570; KW6-65 Split - SUD(D), SFD(D): TIMKEN HI & LO - SRD(D), SFD(D)4640, SUD(D)

MAINTENANCE

Kenworth heavy-duty torque rods are fitted with self-aligning, steel spherical bushings. At each chassis lube interval lubricate the torque rod bushings using Lithium EP chassis grease with 12 hydroxy stearate (NLGI-1). Fill the bushing with grease until it is visible at the seals.

OVERHAUL

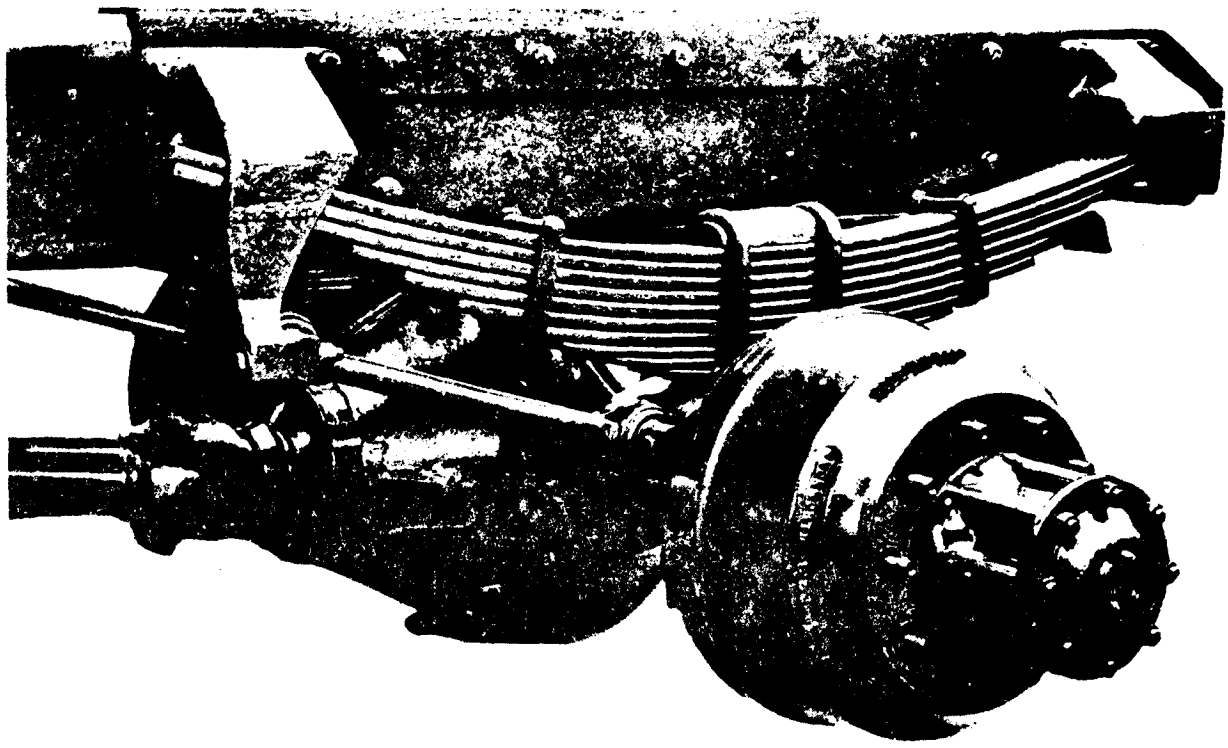
RENEWING THE SEALS AND BUSHINGS:

1. Remove the torque rod from the chassis.
2. Remove the 5/16" bolts which secure the combination bushing retainer/grease seal.
3. If the pin is to be re-used, mark the position of the bushing on the pin for exact replacement.
4. Press the bushing and pin assembly out of the torque rod end.
5. Using a suitable press, remove the spherical bushing from the pin.
6. Degrease the surface of the pin and the inside of the new bushing. Apply Loctite (Grade "A") to both surfaces.
7. Press on the bushing to the marks made on the pin in Step 3. If a new pin is used, position the bushing the same as on the old pin.
8. Insert the pin-and-bushing assembly into the torque rod end with the grease hole in the outer race aligned with the grease fitting on the torque rod end.
9. Slip on the retainer/seals and tighten the 5/16" lock nuts to 18-19 lb./ft. (24-26 N.m).
10. Grease the bushing and reinstall the torque rod.

REPLACING THE TORQUE ROD END:

1. With the part in a fixture to align the bores parallel, tack weld both sides of the torque rod end. (Use welding rod AWS E7016 or E7018).
2. Preheat the entire end to 400°F (204°C).
3. Finish weld.
4. Reheat the entire end to a uniform light blue color and allow to cool (This is necessary to avoid warping the bore from welding operations).
5. After welding, the torque rod end bores must be parallel and on the same plane within 1°.
6. Magnaflux the rod after welding.

KENWORTH
RLS SUSPENSION



Kenworth's RLS Single Axle Suspension is available in 18,000 lbs. to 23,000 lbs. ground load capacity. An optional hi-mount version of the RLS provides two inches higher frame height.

The RLS Suspension is designed with slipper brackets which give a progressive rate to the springs. As the load increases and the springs deflect, the spring centers shorten and the springs become stiffer.

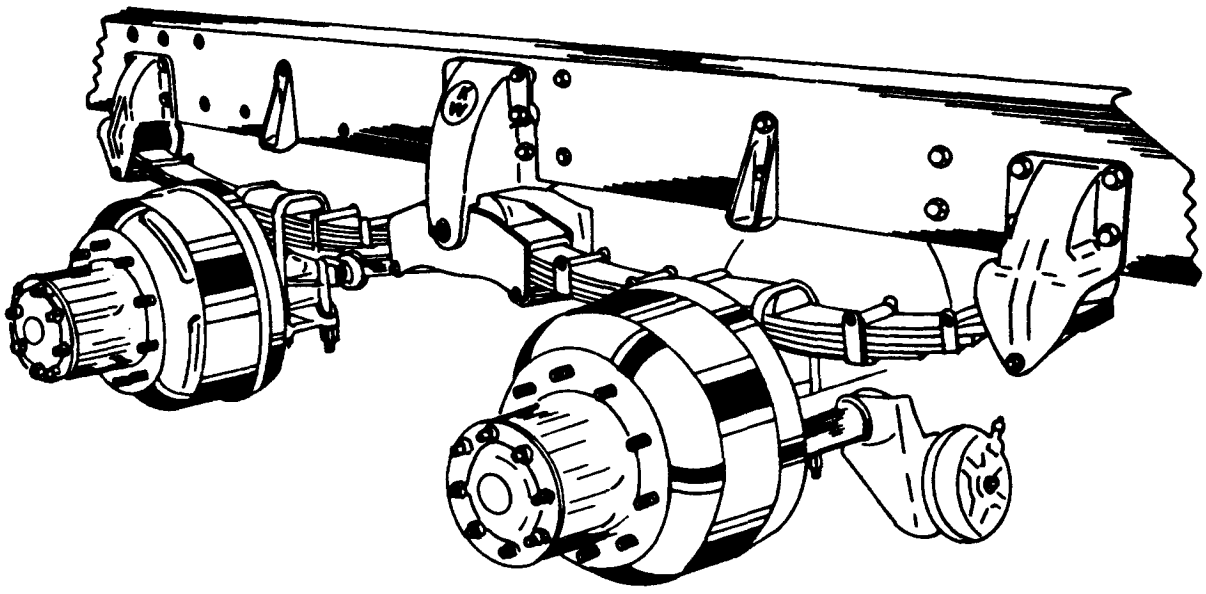
MAINTENANCE

After the first 500 miles, then every 10,000 miles for normal highway operation, check the following torque values.

Torque Rod Bolts . . .165-195 ft. lbs. (224-264 N.m)
U-Bolts . . . . . .490-565 ft. lbs. (665-766 N.m)

The torque values given are for threads lubricated with SAE 20 or SAE 30 oil.

KENWORTH
GLIDE RIDE™ SUSPENSION



Kenworth's Glide Ride bogie suspension has a ground load capacity of 38,000 lbs. A 50-50 weight distribution is standard, but the Glide Ride is also available with a 55-45 distribution for applications using a dead rear axle.

The four torque rods on the Glide Ride suspension provide positive axle alignment and control axle oscillation. Renewable rubber wear-pads in the slipper brackets prevent wear and absorb road shocks and vibration.

Many parts of the Glide Ride suspension are interchangeable. Torque rods and slipper brackets fit all four positions - as do the springs (except with 55-45 distribution). Equalizer drive brackets and equalizer beams can be used on the right or left side.

MAINTENANCE

The Glide Ride™ suspension requires a minimum of maintenance. The following service should be performed after the first 500 miles or first week of operation, then every 10,000 miles for normal highway operation.

FASTENER TORQUES

Check suspension assembly nuts and bolts for tightness using the table below.

TORQUE VALUES* Kenworth Glide Ride™ Suspension	Lb-Ft	N-m
U-Bolts (7/8-14 N.F.)	490-565	56-63
Torque Rod Mtg. Bolts (5/8-18 N.F.)	165-195	19-22
Slipper Bracket Bolts (1/2-20 N.F.)	60-65	68-73
Equalizer Pivot Pin	550-600	62-67

The torque values given are for inserted nylon lock collar nuts and bolt threads lubricated with 20 SAE or 30 SAE oil.

LUBRICATION

One zerk fitting is located on the outboard side of each equalizer beam pivot pin. Lubricate the pivot pin and bushings with NLGI Grade No. 1 Chassis Lubricant. To ensure complete grease penetration around the pivot pin, unweight the rear suspension with a forklift or hydraulic jacks prior to greasing.

SERVICE

WEAR PADS

Periodically examine the condition of the wear pads on the equalizer beam and slipper brackets. The upper wear pads in the slipper brackets are hard rubber blocks which insert into the slipper bracket housing. The roller-type wear pads must be tightened to the specified torque. The cast steel wear pads in the equalizer beam are easily replaced by breaking the spot-weld bead and welding in a new wear pad.

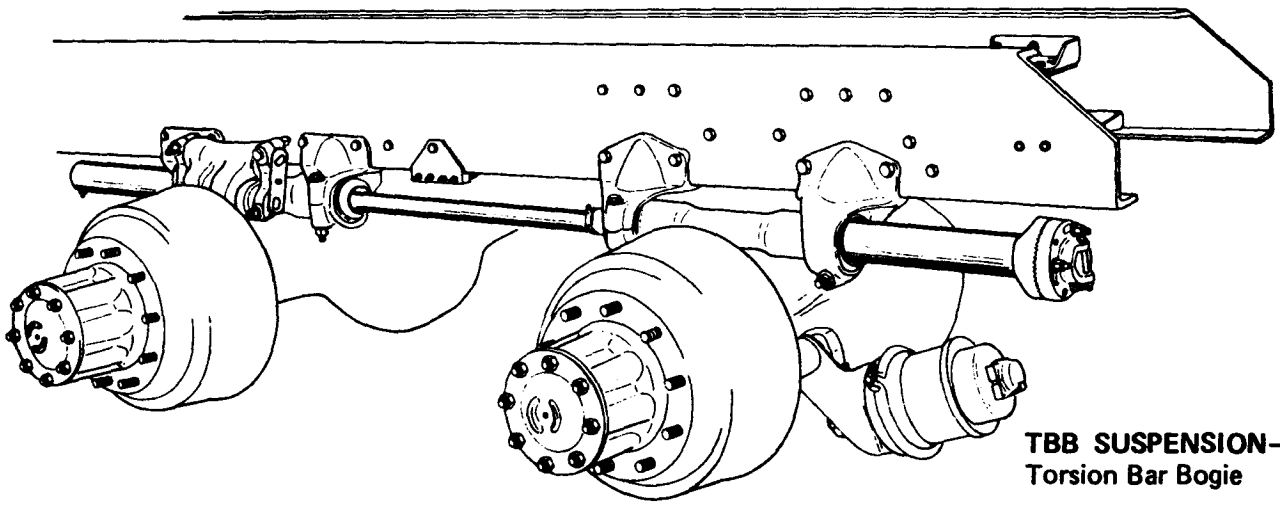
EQUALIZER BEAM PIVOT PIN AND BUSHINGS

The fiber bushings may be driven out of the equalizer beam with a suitable drift. New bushings should be driven in flush with the sides of the equalizer beam with the steel spacer inserted between the two fiber bushings. Assemble the equalizer beam in the drive bracket using new thrust washers on either side of the equalizer beam. Tighten the pivot pin nut to the specified torque.

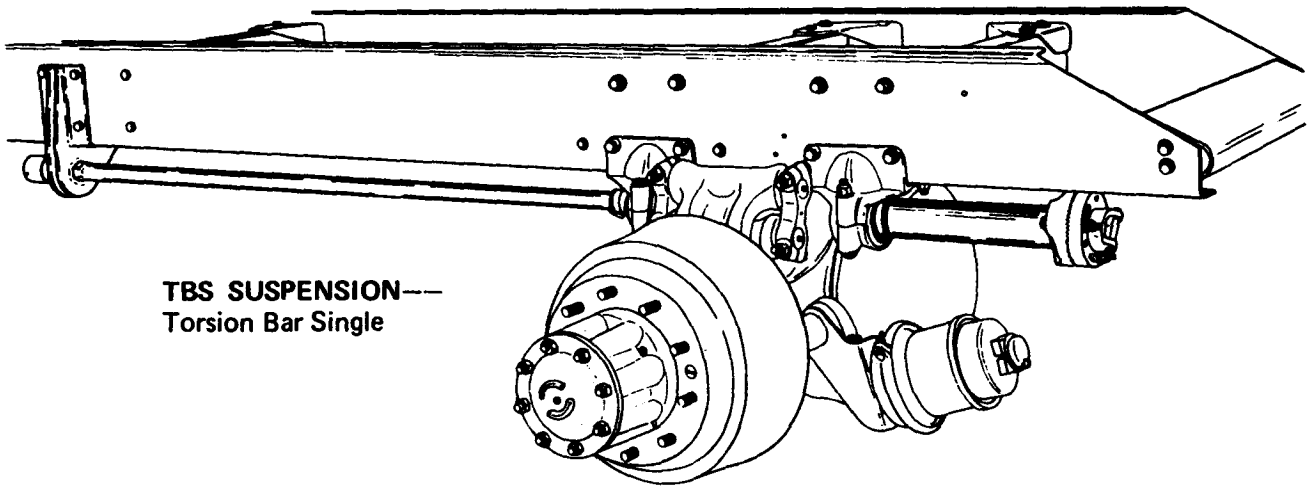
(Continued)

KENWORTH

TORSION BAR SUSPENSION



TBB SUSPENSION—
Torsion Bar Bogie



TBS SUSPENSION—
Torsion Bar Single

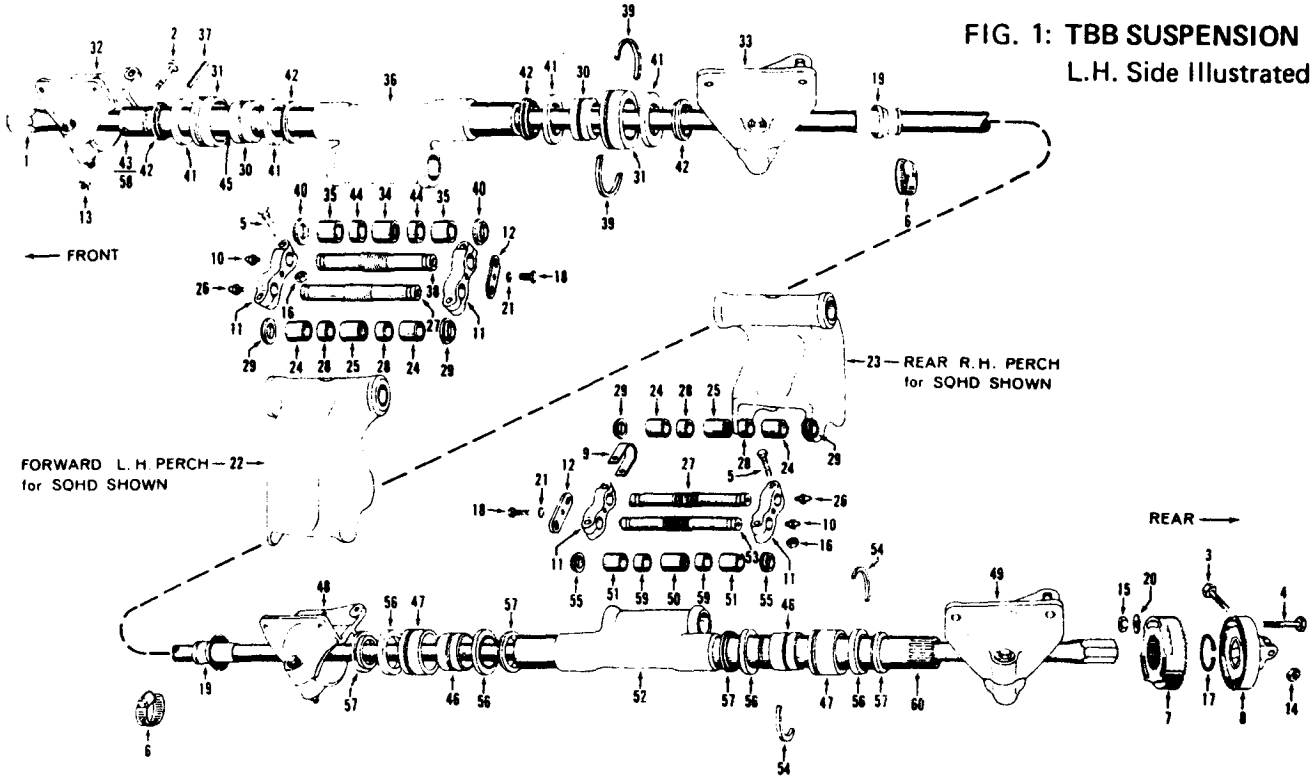


FIG. 1: TBB SUSPENSION
L.H. Side Illustrated

KEY NO.	DESCRIPTION
1	BAR - Torsion
2	BOLT - Crank Tube Socket
3	BOLT - Adjustable Coupling End
4	BOLT - Adjustable Coupling Clamping
5	BOLT - Shackle Link
6	CLAMP - Anti Rattle Rod Sleeve
7	COUPLING - Adjustable
8	COUPLING - Adjustable
9	EXTENSION - Shackle
10	FITTING, Grease - Shackle Pin
11	LINK - Shackle Pin
12	LOCK - Shackle Pin
13	NUT - Crank Tube Socket Bolt
14	NUT - Torsion Bar Adj. Coupling End Bolt
15	NUT - Torsion Bar Adj. Coupling Clamping Bolt
16	NUT - Shackle Link Bolt
17	RING, Snap
18	SCREW, Cap - Shackle Pin Link Lock
19	SLEEVE - Anti Rattle Rod
20	WASHER - Adjustable Coupling Nut
21	WASHER, Lock - Shackle Pin Link Lock Capscrew
22	BRACKET, Only - Forward Rear Axle
23	BRACKET, Only - Rear Rear Axle
24	BUSHING - Shackle Pin
25	BUSHING - Shackle Pin
26	FITTING, Grease - Shackle Pin
27	PIN - Shackle
28	SPACER - Shackle Pin Bushing
29	SEAL, Grease - Shackle Pin
	CRANK ASSEMBLY - Torsion Bar (Forward)
30	† BEARING - Crank to Frame Bracket (Inner)
31	BEARING - Crank to Frame Bracket (Outer)
32	BRACKET ASSEMBLY - Forward Frame
33	BRACKET ASSEMBLY - Rear Frame
34	BUSHING - Shackle Pin
35	BUSHING - Shackle Pin
36	CRANK, Only - Torsion Bar
37	PIN, Roll - Socket
38	PIN - Shackle
39	RETAINER - Bearing
40	SEAL - Grease
41	SEAL - Grease
42	SLEEVE - Bearing Retainer
43	SOCKET - Torsion Bar
44	SPACER
45	TUBE - Socket
	CRANK ASSEMBLY - Torsion Bar (Rear)
46	† BEARING - Crank to Frame Bracket (Inner)
47	BEARING - Crank to Frame Bracket (Outer)
48	BRACKET ASSEMBLY - Forward Frame
49	BRACKET ASSEMBLY - Rear Frame
50	BUSHING - Shackle Pin (Threaded)
51	BUSHING - Shackle Pin
52	CRANK, Only - Torsion Bar
53	PIN - Shackle
54	RETAINER - Bearing
55	SEAL - Grease
56	SEAL - Grease
57	SLEEVE - Bearing Retainer
58	SOCKET - Torsion Bar
59	SPACER
60	TUBE - Splined

DISASSEMBLY AND INSPECTION

The following procedure is suggested for complete overhaul of this suspension.

REMOVE TORSION BARS

1. Mark the position of the Adjustable Couplings so the torsion bars can be set at the same tension upon reassembly. (See Fig. 3).

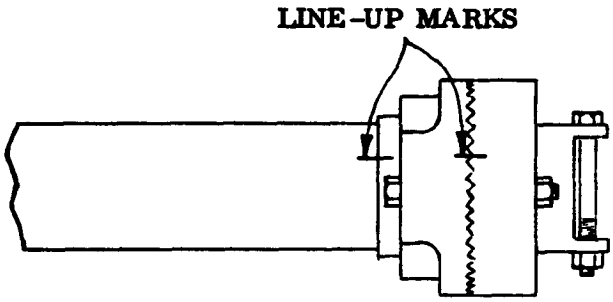


FIG. 3: MARK ADJUSTABLE COUPLING

2. Jack up the frame to relieve tension on the torsion bars (be sure to block the chassis securely).Remove outboard half of the Adjustable Couplings.
3. Remove the Anti-Rattle Sleeves from the center section of the torsion bars.
4. Remove the torsion bars from the rear end of the assembly.

REMOVE CRANK ASSEMBLIES

1. Remove Shackle Pin Locks and Shackle Links.
2. Remove the Forward Crank Assemblies by removing the Spherical Bearing Caps from the Crank Frame Brackets.

   NOTE: The Frame Brackets and Caps are machined as one unit-they are not interchangeable. Mark the caps for correct replacement. The Split Outer Race of the Spherical Bearings can now be removed (these Bearings are also machined as one unit and the halves are not interchangeable). If the Bearings are to be re-used, mark the outer race halves so they can be replaced in the same bracket.

REMOVE SPHERICAL BEARING INNER RACE

Inspect the Spherical Bearing surfaces for excessive wear or galling. If it is necessary to replace them, proceed with the steps below:

1. Break the spot welds which secure the Outer Bearing Retainment Sleeves to the Crank Assemblies with a cold chisel. Grind or file away any weld which prevents their removal.
2. Press off the Retainers and the Spherical Bearing Inner Sleeves. The Inner Races of the Spherical Bearings can usually be pressed off. In some cases, however, it may be necessary to split the Race with a cold chisel. Do not damage the crank journal.
3. Remove the Rear Crank Assemblies using the same procedure outlined above. On Slant Bar Suspensions remove the Rear Crank Bracket Draw Bolts. Using a thin pry bar, carefully spread open the Rear Crank Brackets and slide the Rear Crank Assemblies forward.

INSPECTION AND REPLACEMENT OF THE SHACKLE PINS AND BUSHINGS

Unnecessary rebuilding of the torsion bar linkage can be avoided if the components are first checked for wear (See Fig. 4).

NOTE: The clearance between new Shackle Pins and Shackle Pin Bush-

REASSEMBLY PROCEDURE

INSTALL THE SHACKLE PINS AND BUSHINGS

1. Clean the Shackle Pin Bore.
2. Scribe a mark in the center of the outside surface of the Threaded Bushing. This mark will enable you to center the Bushing fore and aft in the Perch or Crank Bore by sighting through the Plug Weld Hole.
3. Grease the Shackle Pin Threads and screw the Pin fully into the new Threaded Bushing (See Fig. 5).
4. Place the driver tool (part no. T179-218 - See Fig. 6) over the Shackle Pin end with the lock plate dog and drive the Pin into the bore until the Threaded Bushing is centered.

NOTE: Install the Shackle Pins with the lock plate dog facing forward on the rear rear axle and aft on the forward-rear axle (and the TBS axle).

5. Insert the Spacers and press in the Fiber Bushings until they are flush with the *inside* lip of the bore (See Fig. 7).
6. Cautiously weld the Threaded Bushing to the Perch or Crank. Do not penetrate too deeply, but weld all around. Use a low hydrogen, AWSE-10016 welding rod.
7. Install Neoprene Seals in each end of the Shackle Pin.

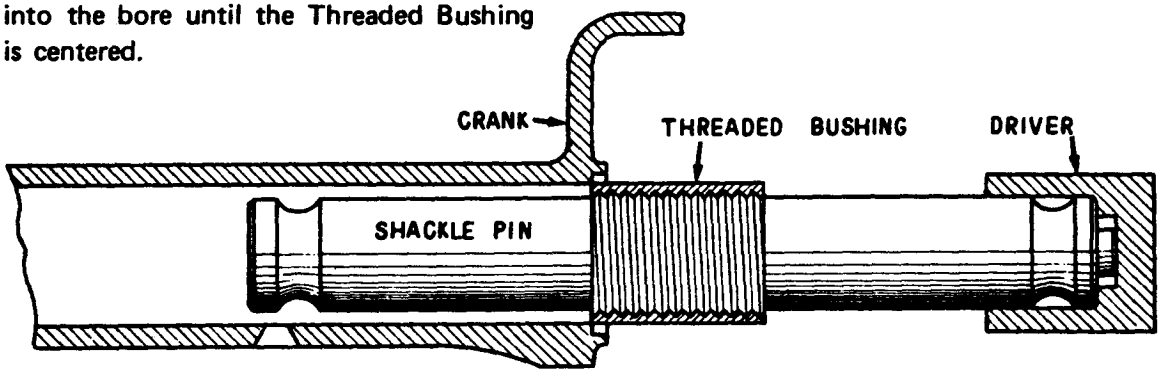


FIG. 5: PRESSING THREADED BUSHING INTO CRANK OR PERCH

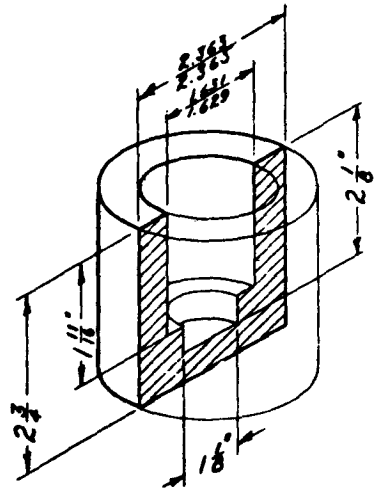


FIG. 6: SHACKLE PIN DRIVER (T179-218)

INSTALL SPHERICAL BEARINGS

1. Clean all burrs and spots of weld from the Crank Journal.
2. Install the Inner Bearing Retainer Sleeves and the Inner Grease Seal with the metal ring on the Seal facing toward the Spherical Bearing (See Fig. 8).
3. Press the Spherical Bearing Inner Race onto the crank journal.

INSTALL CRANK ASSEMBLIES

1. Clean and grease the inner races of the Spherical Bearing.

   NOTE: Each Spherical Bearing Outer Race is machined as a single piece, then split into halves. These halves are not interchangeable between sets.

2. Place two halves of the Outer Race over the Inner Race. Place one half of the Retainer Ring on the Outer Race. Use one Retainer Ring in either the forward or rear frame bracket of each Crank Assembly.

3. Place the Crank Assembly in the Frame Brackets. Install the other half of the Retainer Ring. Position the split in the Outer Races 45° to the split in the Frame Bracket (See Fig. 9).

4. Lubricate the 5/8" bolts with SAE 20 or 30 oil and snug up the bolts on the caps. Ensure that the metal rings on the Grease Seals are flush against the Outer Race.

5. Tighten the 5/8" bolts to 130-150 lb. ft. (176-203 N.m). Ensure that Retainer Ring interference does not hold the Frame Bracket halves apart.

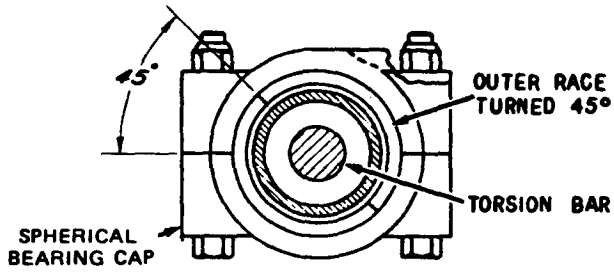


FIG. 9: POSITIONING OF THE SPHERICAL BEARING OUTER RACE

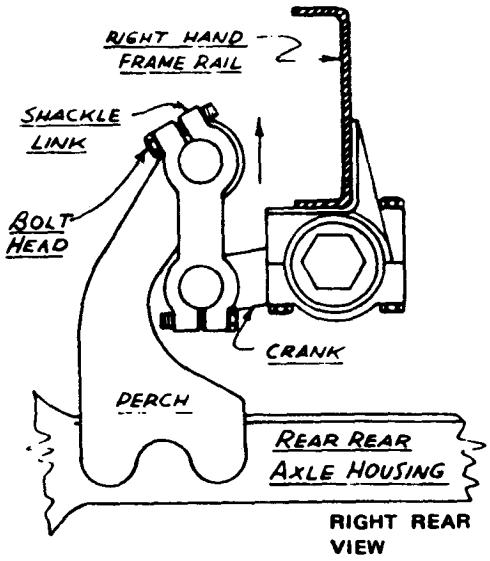
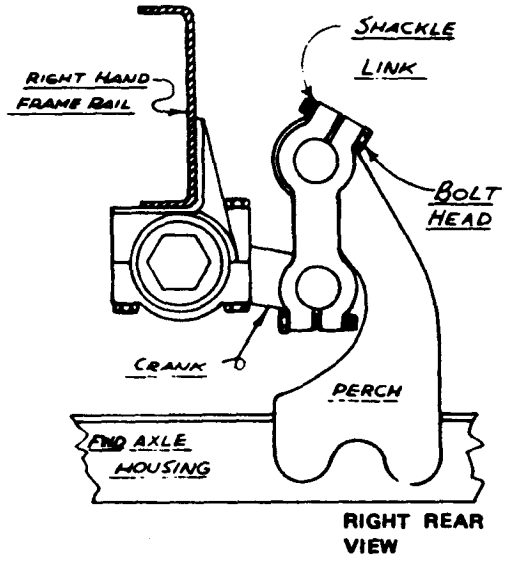
PARALLEL BAR SUSPENSIONS	SLANT BAR SUSPENSIONS (3° and 1° 15')
 RIGHT REAR VIEW	 RIGHT REAR VIEW
On the Rear-Rear Drive Axle of Parallel Bar Suspensions the upper-rear Shackle Link Bolt Head faces AWAY from the frame as illustrated above. All other Shackle Link Bolt Heads face TOWARD the frame on both the Forward-Rear and Rear-Rear Axles.	On the Forward-Rear Drive Axle of Slant Bar Suspensions the upper-rear Shackle Link Bolt Head faces AWAY from the frame. All other Shackle Link Bolt Heads face TOWARD the frame on both the Forward-Rear and Rear-Rear Axles.

FIG. 10: SHACKLE LINK PINCH BOLT INSTALLATION

2. Install the Adjustable Couplings. Adjust them to match the original setting alignment marks by raising or lowering the frame.

3. Replace the rubber anti-rattle sleeve and clamp.

4. Completely lubricate the suspension.

5. After reassembly, align the axles to the frame.

NOTE: Torsion bar installation on the TBS suspension is opposite that of the TBB suspension, because the direction of torsion bar twist is reversed.

ADJUSTING FRAME HEIGHT

1. With the truck *unloaded* and parked on a level surface measure the height for both frame rails. The height measurement is the distance "A" from the top of the center of the axle housing (directly below the frame rail) to the bottom of the frame rail (See Fig. 12).

2. From the table in Fig. 13 determine the correct height for your axle and torsion bar suspension.

3. Mark the Adjustable Coupling across the serrated teeth so you have a reference point where the adjustment began.

4. Jack up the frame enough to relieve all tension on the torsion bars.

5. Loosen the Adjustable Coupling bolts enough to disengage the teeth, then raise or lower the frame to get the desired setting on the coupling. Each notch will change the frame height approximately 5/16 of an inch (7.9 mm).

6. After adjusting the frame height tighten the 1/2" Adjustable Coupling Bolts to 65-85 lb. ft. (88-115 N.m). Lower the frame, and measure the frame height again. If the frame heights on both sides of the truck do not match exactly, the high side should be on the right side to compensate for the crown of the road.

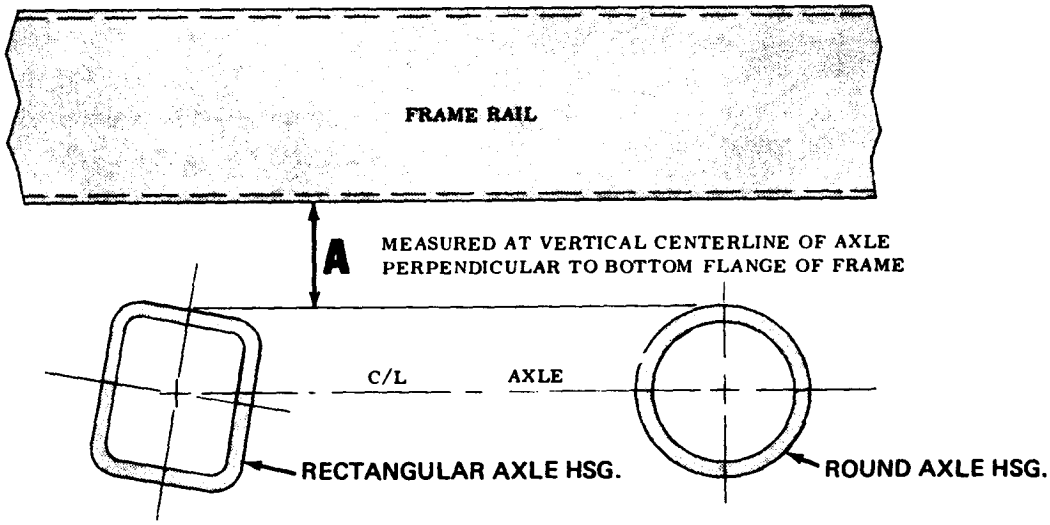
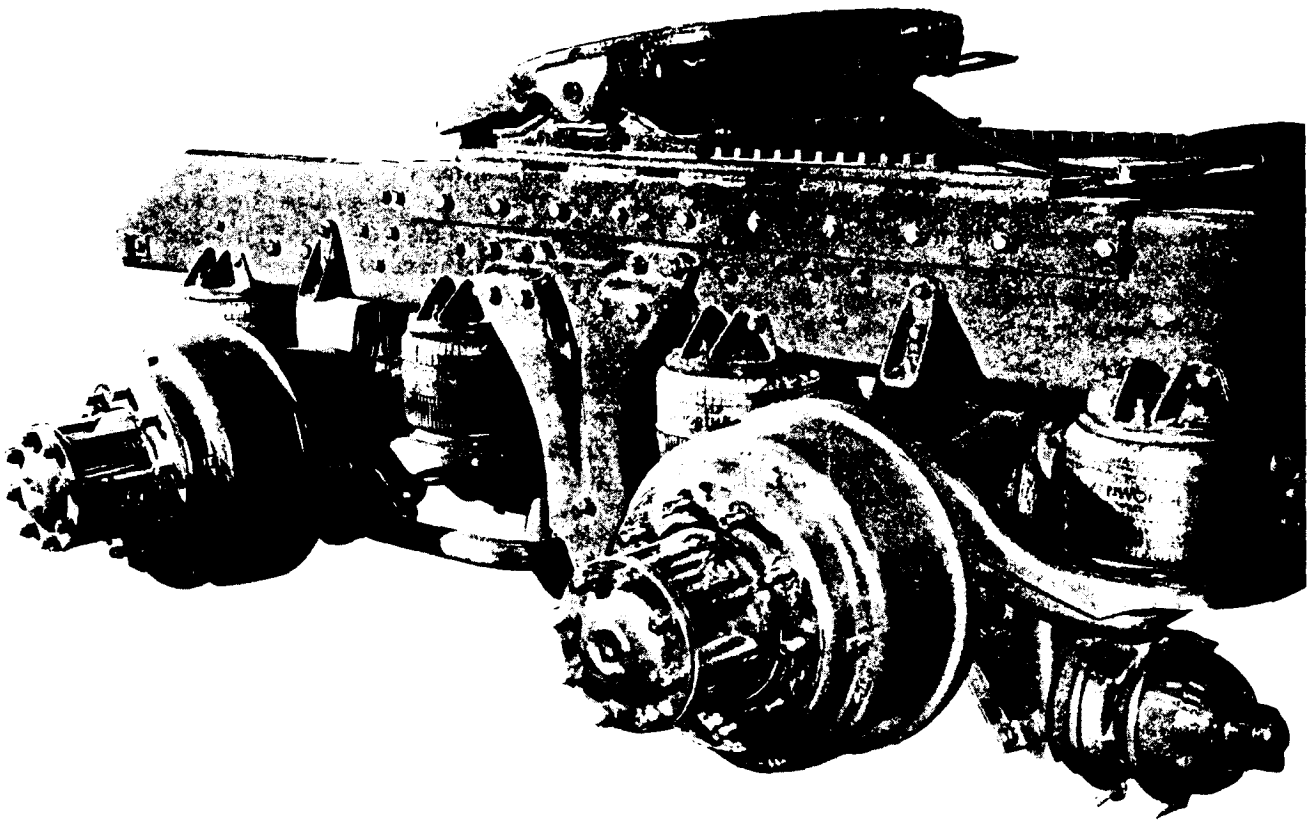


FIG. 12: MEASURING FRAME RAIL HEIGHT

AIRGLIDE 100

KENWORTH AIR-SPRING SUSPENSION



DESCRIPTION

Kenworth's Airglide 100 Suspension is a lightweight design using four air springs on each axle for load support. The chassis rides directly upon air springs, and not upon mechanical connections which would transmit vertical road-shock forces directly to the chassis.

Each axle is securely located to the chassis by two torque rods and an anti-sway bar. Two shock absorbers mounted on each axle dampen vertical road shocks.

The air suspension system consists mainly of the air springs, the height control valves and a pressure protection valve.

Air pressure in the air springs is automatically regulated to keep the frame level and at normal ride height under all loads within the GAWR.

Ground load capacity for the Airglide 100 Suspension is 38,000 to 44,000 lbs. (17,237 to 19,958 kg) for the tandem axle suspension and 18,000 to 24,000 lbs. (8,164 to 10,886 kg) for the single axle suspension. Actual ground load capacity depends upon the axles used.

MAINTENANCE

The Kenworth Airglide 100 Suspension requires little regular maintenance other than filter service and routine inspection. Normal air system maintenance must be performed because dirt or other contaminants in the air suspension system can damage the system, even though it has filters of its own.

DO NOT LUBRICATE:

No lubrication of this suspension is necessary because of the use of rubber-bushed torque rods and anti-sway bar mounts. Lubrication of these components is detrimental to their operation and service life.

TORQUE VALUES:

After the first 2,000 miles (3,218 km) or first week of operation, and periodically thereafter, check the torque values for the following fasteners:

5/8" Dia. Anti-Sway Bar Mounting Bolts . . . . . 165-195 lb. ft. (223-264 N.m)

5/8" Dia. Center Frame Bracket Bolts . . . . . 165-195 lb. ft. (223-264 N.m)

5/8" Dia. Torque Rod Mounting Bolts . . . . . 165-195 lb. ft. (223-264 N.m)

1-1/4" Dia. Transverse Torque Rod Pin . . . . . 850-900 lb. ft. (1152-1220 N.m)

Air Spring Mounting Bolts. . . . . 1/2" Dia. 20-25 lb. ft. (27-34 N.m) 3/4" Dia. 40-50 lb. ft. (50-68 N.m)

AIR TANKS:

Check the air tanks *weekly* for excessive moisture which has not been expelled by the automatic moisture ejector valve. A wet tank can be manually drained by pulling the cable attached to the release pin in the center of this valve.

NOTE: The air supply to the air suspension must be free of moisture and compressor oil. If excess moisture is encountered check for proper operation of the moisture ejector valve. If excess oil is encountered, the air compressor should be overhauled.

FILTER SERVICE:

AIR LINE FILTERS - The Sponge-type filter elements in the three air line filters must be replaced with new elements at least once a year. One filter is located just ahead of the pressure protection valve at the outlet of the front service tank. The other two filters are located on the inside of each frame rail, just above the forward air springs on the rearmost axle.

HEIGHT CONTROL VALVE FILTERS - Check periodically to ensure that the two small filter elements, located in each height control valve, are clean (See fig. 3). One screen is located under the outlet adapter; the other, and the one most likely to become clogged, is located in the intake adapter.

NOTE: If the intake adapter filter screen is plugged, replace the complete intake adapter assembly.

AIR LEAKAGE TEST:

Periodically check the air suspension system for leaks. With the vehicle preferably loaded, and the air system at normal operating pressure, coat all the air line connections, valves and air springs with a solution of soap and water. Air leakage will produce easily detected air bubbles.

HEIGHT CONTROL VALVES:

Periodically check the adjustment as outlined in "Height Control Valve Adjustment."

50,000 MILE (80,450 km) INSPECTION:

AIR SPRINGS - Inspect for cracks, gouges, distortions, bulges and chafing. Replace defective assemblies.

SHOCK ABSORBERS - Check for signs of leaking; worn, inefficient cylinders; worn rubber bushings.

ANTI-SWAY BAR AND TORQUE RODS - Check the condition of the rubber bushings.

AXLE CONNECTION WELDS - Check visually for cracks.

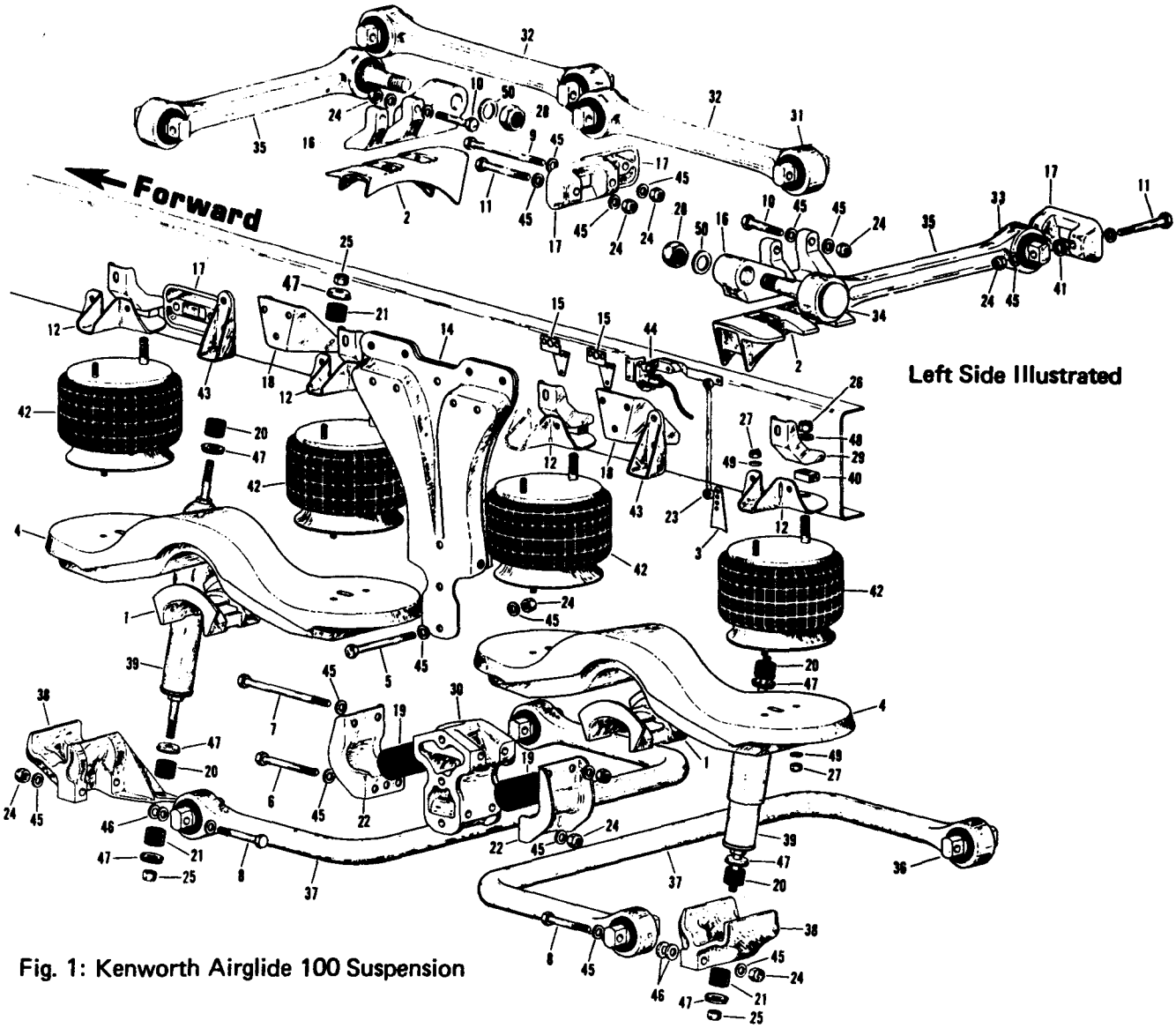


Fig. 1: Kenworth Airglide 100 Suspension

1 ADAPTER - Air Spring Beam
2 ADAPTER - Torque Rod Brkt.
3 ANCHOR - Hgt. Control Link
4 BEAM ASSY - Air Spring
5 BOLT (5/8-18UNF x 7")
6 BOLT (5/8-18UNF x 6-1/2")
7 BOLT (5/8-18UNF x 10")
8 BOLT (5/8-18UNF x 5")
9 BOLT (5/8-18UNF x 8-1/2")
10 BOLT (5/8-18UNF x 4")
11 BOLT (5/8-18UNF x 5-1/2")
12 BRACKET - Air Spring
13 Not Assigned
14 BRACKET ASSY - Frame
15 BRACKET - Leveling Valve
16 BRACKET - Torque Rod
17 BRACKET - Torque Rod
18 BRACKET - Shock Absorber
19 BUSHING - Rubber
20 BUSHING - Shock, Inner
21 BUSHING - Shock, Outer
22 CAP - Frame Bracket
23 LINK ASSY - Leveling Valve
24 NUT, Esna (5/8-18UNF-3B)
25 NUT, Esna (5/8-18UNF-3B)
26 NUT, Esna (3/4-16)
27 NUT, Esna (1/2-13)
28 NUT, Esna (1-1/4-12)
29 REINF. - Air Spring
30 REINF. - Rear Frame Brkt.
ROD ASSY. - Torque
31 ↑ PIN & BUSHING ASSY
32 | ROD, Only - Torque
ROD ASSY - Torque
33 ↑ PIN & BUSHING
34 | PIN & BUSHING - Tapered
35 | ROD, Only - Torque
ROD ASSY - Stabilizer
36 ↑ PIN & BUSHING
37 | ROD, Only - Stabilizer
38 SEAT - Axle Bottom
39 SHOCK ABSORBER
40 SPACER - Air Spring Brkt.
41 SPACER-Transverse (1/2")
42 SPRING - Air
43 STOP - Axle
44 VALVE - Leveling
45 WASHER (5/8" Ht)
46 WASHER (5/8" Ht)
47 WASHER-Shock Bushing
48 WASHER, Flat (3/4")
49 WASHER, Flat (1/2")
50 WASHER, Flat (1-1/4")

DESCRIPTION

The Kenworth Air Suspension System consists mainly of air springs, spring beams, height control valves, pressure regulating valve and shock absorbers. The Air Suspension System is schematically illustrated in Fig. 1. The system operates automatically, as the load varies, and keeps the frame at a normal ride height.

SPRING BEAMS

Spring beams are secured to the frame drive brackets by rubber insulated steel drive pins, and are trapped in rubber at the axle housing (Fig. 2). These beams serve a double purpose:

1. They transmit driving and braking forces to the frame.
2. They locate the axle longitudinally and position it laterally.

HEIGHT CONTROL VALVE

A height control valve is located on each side of the frame. These valves operate independently. When the load on the frame increases, the valve automatically meters air pressure into the air springs. Increased pressure lifts the frame back to its normal ride height.

The distance between the axle and frame will increase as the load is removed. The height control valves, in this case, will exhaust air from the air springs in proportion to the decrease in load.

The height control valves are designed to operate only when the load is increased or decreased. These valves do not respond to rapid relative motion between the axle and frame, such as that caused by road irregularities. This is due to a 2 to 6 second delay mechanism, which is built into each height control valve.

PRESSURE REGULATING VALVE

The pressure regulating valve is mounted on the frame just ahead of the shutoff valve. This valve serves two purposes. One purpose is to prevent air pressure from entering the air suspension system until pressure in the air brake system reaches 65 PSI. This provides a rapid build-up of air pressure for operation of brakes. The second purpose of this valve is to prevent loss of air from the brake system, when the air suspension system drops below 65 PSI, due to a leak in the lines or a ruptured air bag.

AIR SPRINGS

An air spring is mounted between the frame and spring beam at each axle end. Construction of the air spring is similar to that of a tubeless tire and consists of a neoprene air bag, pedestal, upper retainer and lower retainer (Fig. 8).

The air spring serves as a flexible connection between the frame and the axle. Flexing of the air spring results in an alternate increase and decrease of air pressure. This action absorbs road shock, in the same manner as an inflated rubber tire cushions shock, caused by road roughness.

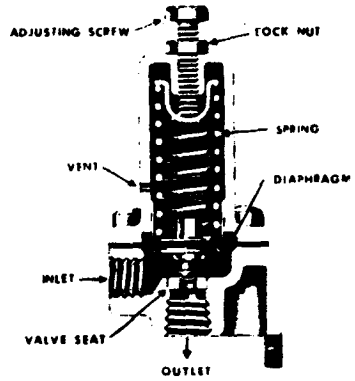


Fig. 3: Pressure Regulating Valve

MAINTENANCE

The air suspension system requires little maintenance other than filter service, routine test and inspection.

AIR LINE FILTERS

There are three small air line filters in this air suspension system. One is located just downstream of the air cleaner and one is just ahead of each set of air springs (Fig. 1).

The sponge type filter elements, in the line filters, MUST be replaced at least ONCE A YEAR with a BW #242159 element.

AIR CLEANER FILTER

The air cleaner filter is mounted on the frame just behind the shutoff valve. ONCE A MONTH, remove the 1/8" pipe plug from bottom of air cleaner and drain out the dirt and moisture (Fig. 4). The filter element in this air cleaner must be replaced at least ONCE A YEAR with a BW #235095 element.

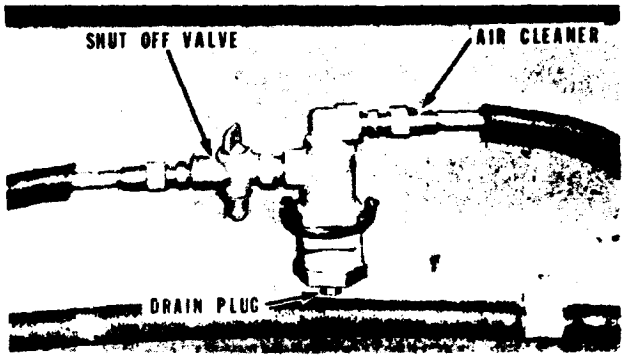


Fig. 4: Air Cleaner Filter & Shutoff Valve

AIR LEAKAGE TEST

With vehicle loaded, build up air pressure in the Main Air System to normal operating pressure. Coat all air suspension air line connections and air springs with a solution of soap and water. Air leakage will produce soap bubbles and can easily be detected. Leakage at air line connections can sometimes be stopped by tightening connections slightly. NO AIR LEAKAGE IS PERMISSABLE.

HEIGHT CONTROL VALVES

Periodically check to make sure the two small filter screens, located in each Height Control Valve, are clean (Fig. 5). One screen is located under the outlet adapter. The second screen (which is the one most likely to become clogged) is located in the intake adapter.

NOTE: If the screen in the intake adapter is plugged, replace the complete intake adapter assembly (Part #5549539).

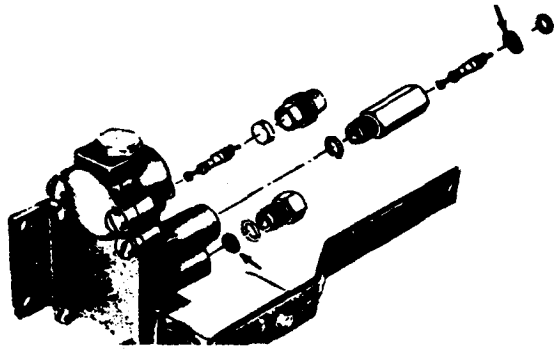


Fig. 5: Height Control Valve (Shows Screens)

If a Height Control Valve fails, it should be replaced with a new unit. The time required to overhaul the valve would be more costly than a new valve.

AIR TANKS

Air tanks should be checked at WEEKLY INTERVALS, for excess moisture which has not been expelled by the automatic moisture ejector valve. The wet tank can be manually drained by pushing in on the valve stem which is located in the center of this valve.

NOTE: The air supply to the air suspension system MUST be kept free of moisture and compressor oil.

1. If excess moisture is encountered, check the moisture ejector valve to see that it is functioning properly.
2. If excess oil is encountered, the air compressor probably needs new rings and should be overhauled.

WILL NOT MAINTAIN HEIGHT

If, after adjusting the Height Control Valves, they will not maintain this 10-5/8" ± 3/16" clearance then check for restricted air lines at the following points:

a. Check the three small air line filters to make sure the elements are clean. One filter is located just downstream of the air cleaner and one is located just ahead of each set of air springs.

b. Check air cleaner filter to make sure the element is clean. This filter is located inside of the frame rail (midway), just behind the suspension shut-off valve.

c. Check the two main air tanks to make sure they are dry.

d. Check the two small filter screens in each Height Control Valve, to make sure they are clean. One screen is located under the outlet adapter. The second screen (which is most likely to become clogged) is located in the intake adapter.

NOTE: If the screen in the intake adapter is plugged, replace the complete intake adapter assembly (Part #5549539).

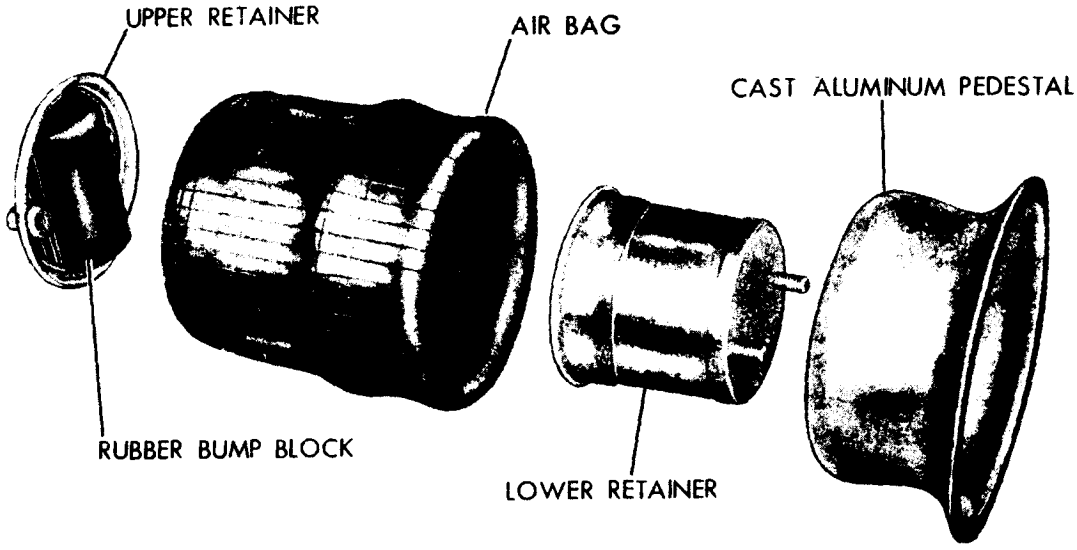


Fig. 8: Air Spring Assembly (Exploded View)

INSPECT BAG FOR DAMAGE

Clean the air bags and retainers thoroughly. Examine the air bags (inside and out) for evidence of cracks, punctures, distortion and chafing.

All sealing surfaces must be clean and smooth. Inspect the rims for dents or other damage.

If the air bag or another part of the air spring is found to be damaged, it is advisable to replace the whole air spring as a complete unit. To disassemble and assemble an air spring requires compressed air and a large press with approximately a 25" drop.

AIR SPRING DISASSEMBLY (Damaged Bag)

If the air bag is damaged and is to be replaced, disassembly is simplified by cutting and destroying the old air bag, using the following procedure:

1. Remove the upper retainer, as described in "Air Spring Inspection".
2. Cut the top half of the bag off, by cutting through it and around its full circumference. Then cut from this upper surface down to the lower sealing lip (Fig.12).

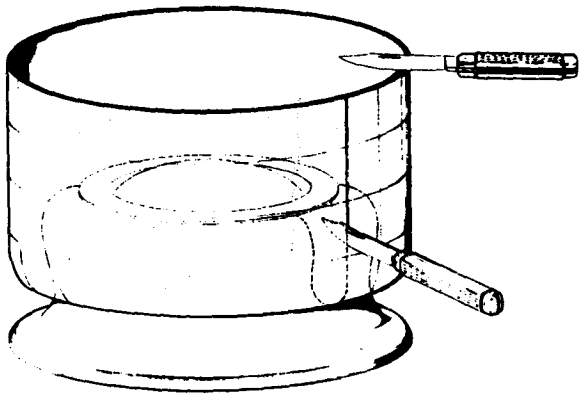


Fig. 12: Removing Damaged Air Bag

3. Remove the cast aluminum pedestal.
4. Carefully push or pry the lower retainer from the rubber bag, being careful not to damage the sealing surfaces of the retainer.

AIR SPRING DISASSEMBLY (Good Bag)

If the air bag is good and is to be used again, the air spring must be disassembled as outlined in the following procedure:

1. Remove the upper sealing retainer as described in "Air Spring Inspection".
2. Pull the air bag up and away from the aluminum pedestal (Fig.13).

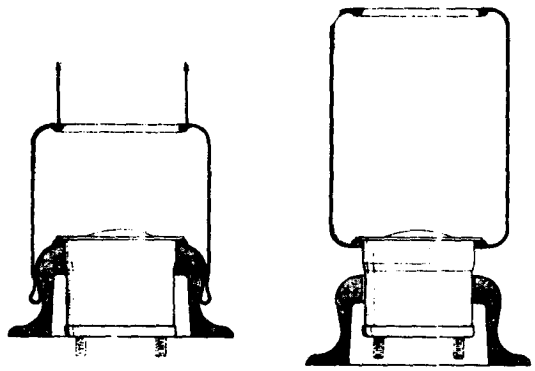


Fig. 13: Removing Good Air Bag

3. Slide the aluminum pedestal down and off the lower retainer.
4. Apply a small amount of soapy water or castor oil to the lower bead of the air bag, to aid in the removal of the lower retainer from the air bag.

   CAUTION: Use only soapy water or castor oil, as other lubricating fluids will deteriorate the rubber.

5. Separate the lower retainer from rubber air bag, by working the soapy water or castor oil into the seal and sliding the lower retainer up through the top of the bag.

AIR SPRING ASSEMBLY

Before assembling the air spring, note that in the upper sealing ring of the air bag there are two flats formed on the inside of the lip which match the flats on the upper retainer.

When installing the lower retainer in the air bag, be certain the two bolts on the retainer are positioned 90° to the two formed flats in the air bag (Fig.14).

4. Wire shims to respective axle seats for easy reassembly.

5. Lower spring beams and jack up frame, if necessary, to roll axles out from under vehicle.

REMOVE & DISASSEMBLE SPRING BEAM

1. Remove the bolts which secure the steel drive pin to the drive bracket. Wire the square washers and angle spacer to the appropriate drive bracket, to assure correct assembly.

2. Remove the channel brace that ties the lower end of the frame brackets together.

3. Remove the cotter pin from the 2" castle nut and back off this nut. Remove the brass washer and steel tapered washer (Fig. 2).

4. Knock the drive pin out of the spring beam with a brass or leather mallet.

5. Pull out the rubber drive pin bushings and inspect them for wear or damage. Replace if necessary.

REASSEMBLY OF AIR SUSPENSION

ASSEMBLE AND INSTALL SPRING BEAM

1. Insert the rubber drive pin bushings in the end of the spring beam.

   NOTE: Do not use soap or grease when assembling drive bushings. If necessary, only water should be used.

2. Insert the drive pin through the rubber bushings, using a press if necessary. Turn the drive pins so the holes will line up with the holes in the drive bracket.

3. Install the tapered washer, brass washer and 2" castle nut on the drive pin. Tighten the castle nut to a torque of 300 to 400 pound-feet and lock it with a cotter pin.

4. Mount the spring beam to the drive bracket with the special 3/4"x 8" Grade 8 heat-treated bolts. Be certain that the square washers, angle spacer, hardened washers and channel brace are in the correct order (Fig. 11).

5. Tighten the drive pin bolts to a torque of 300 to 350 pound-feet.

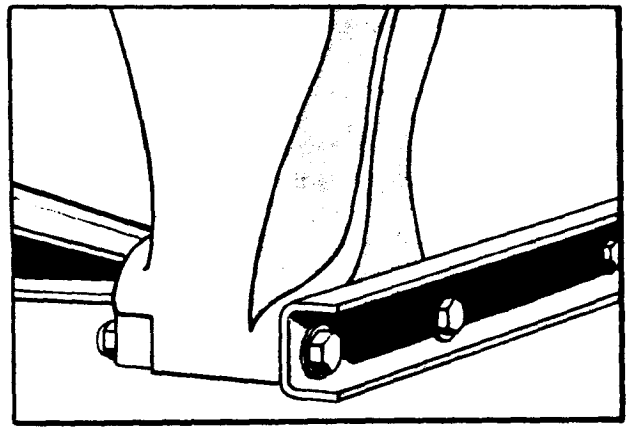


Fig. 16: Frame Bracket & Channel Brace

REINSTALL AXLES

If a different axle housing is being installed, new axle seats will have to be welded to it.

When reinstalling axles, keep the following information in mind:

1. Position the axle in the normal operating position and center the seat bores with the center beam bores.

SPRING SEAT TRUNNION

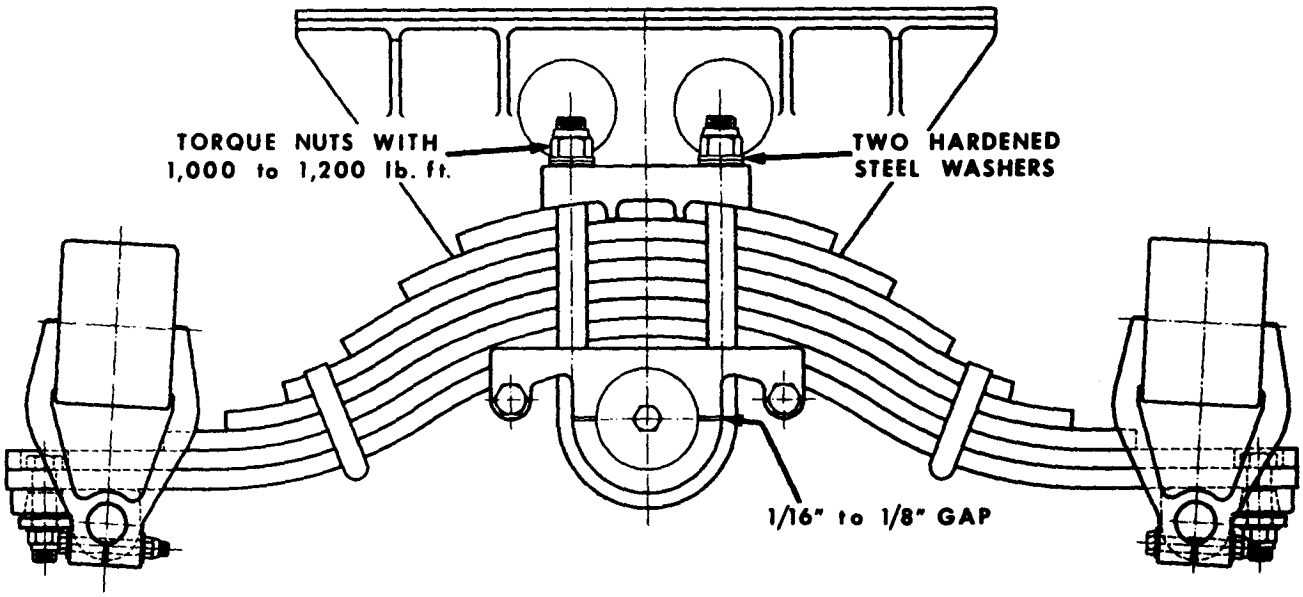
K W C SUSPENSION

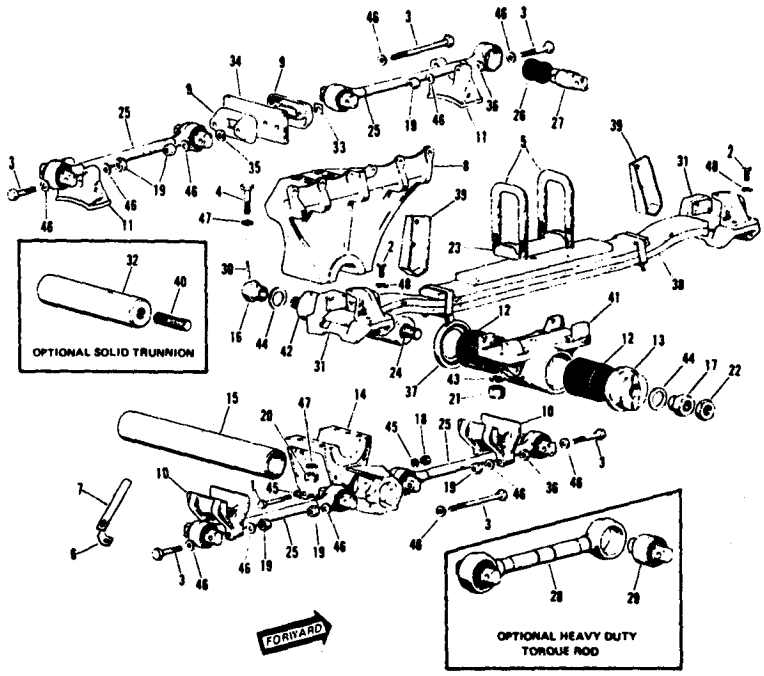
CLARK AXLES

To prevent spring breakage and rubber bushing failures, the spring U-bolts MUST be kept tight with proper clearance at split of spring seats. To obtain proper setting, use the following procedure:

1. Make sure there are two hardened steel washers underneath the nut on each U-bolt.
2. Tighten the 1-1/2" grade 8 U-bolt nuts with a torque of 1000 to 1200 pound-feet.
3. With the U-bolt nuts tightened to the above torque, check clearance between the two halves of the spring seat. This clearance MUST be from 1/16" to 1/8" to provide proper clamping of the rubber bushings.

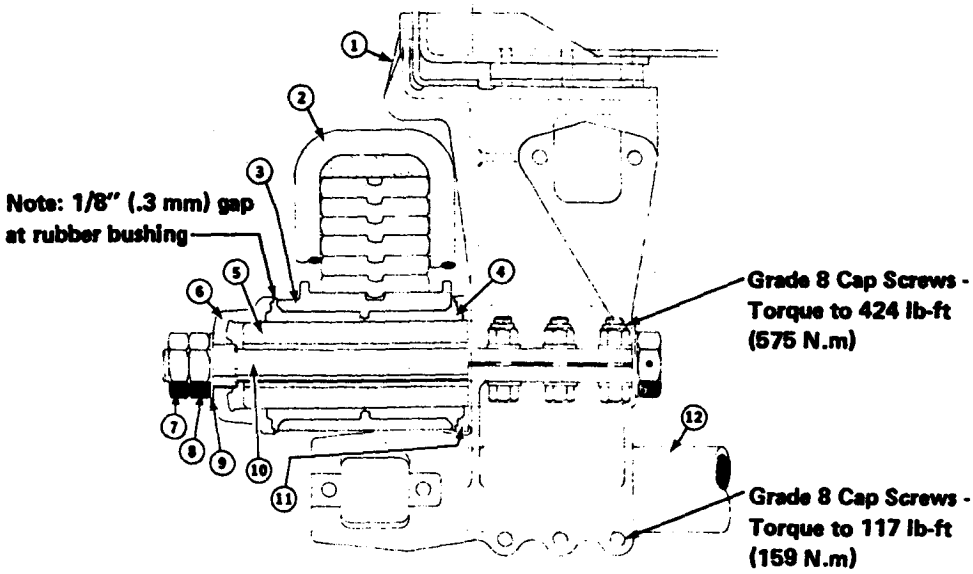
   NOTE: If this clearance does not exist, then the spring seat halves must be removed and ground away to provide the above clearance when the U-bolt nuts are tightened to the specified torque.





1	BOLT, Crosstube
2	BOLT, Spring Seat
3	BOLT, Torque Rod Mtg.
4	BOLT, Trunnion Shaft Bracket
5	BOLT, U - Rear Spring
6	BRACKET, Brake Chamber
7	BRACKET, Brake Chamber
8	BRACKET - Rear Axle
9	BRACKET - Torque Rod
10	BRACKET, Torque Rod - Axle
11	BRACKET,T/R Upper Fwd. & Rear
12	BUSHING, Rubber
13	CAP, Compression
14	CAP, Frame Rail Bracket
15	CROSSTUBE
16	NUT, Compression Rod
17	NUT, Compression Rod
18	NUT, Esna - Crosstube Clamp
19	NUT, Esna - Torque Rod Mtg.
20	NUT, Esna - Trunnion Shaft Bracket
21	NUT, Esna Hi- U-Bolt
22	NUT, Jam
23	PAD, U-Bolt
24	ROD, Compression
25	ROD, Torque - Standard
26	▲BUSHING
27	PIN
28	ROD, Torque - Heavy Duty
29	▲BUSHING & PIN ASSEMBLY
30	ROLL PIN - 3/8 x 21/2LG
31	SEAT, SPRING ASSEMBLY
32	SHAFT, Trunnion
33	SPACER, Torque Rod
34	SPACER, Torque Rod Bracket
35	SPACER, T/R Fwd. Axle
36	SPACER, T/R Rear Axle
37	SPACER, Trunnion Mtg.
38	SPRING, Rear
39	STOP, Rear Axle
40	STUD, Trunnion Shaft
41	TRUNNION, Spring
42	TUBE, Trunnion
43	WASHER
44	WASHER, Brass
45	WASHER, 1/2" H.T.
46	WASHER, 5/8" H.T.
47	WASHER, 3/4" H.T.
48	WASHER, Lock - Split

Fig. 1: R.H. Side Installation



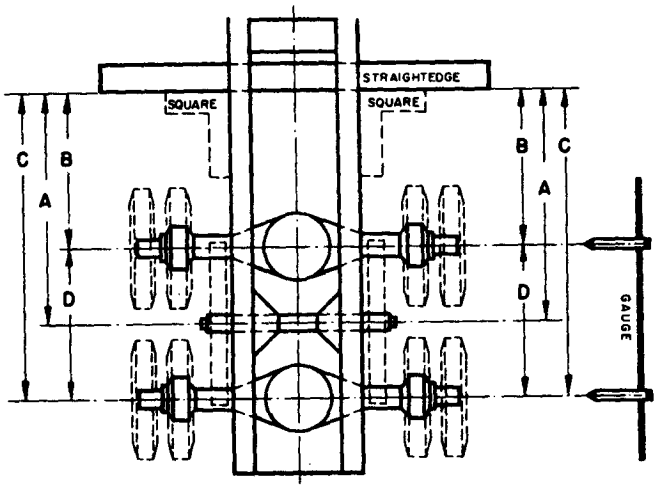
1. REAR TRUNNION MOUNTING BRACKET
2. SPRING U BOLT
3. SPRING SEAT
4. RUBBER BUSHINGS
5. TRUNNION TUBE
6. COMPRESSION CAP
7. LOCK NUT
8. COMPRESSION NUT
9. BRASS WASHER
10. COMPRESSION ROD
11. TRUNNION MOUNT SPACER
12. CROSSMEMBER TUBE

Fig. 2: Trunnion Bushing Assembly

4. Using a gauge, check the distance between both axle centers. (Measurement "D")
   NOTE: A typical gauge for checking axle centers is shown in the illustration.
5. The difference in measurements on two sides of the vehicle should not exceed the following figures:

   Measurement "A" -- 1/16"
   " "B" -- 1/8"
   " "C" -- 1/8"
   " "D" -- 1/4"

If the axles are not within the allowable tolerance, the length of all lower torque rods should be checked. Under normal circumstances, the difference between the two rods on either the front or rear axles should not exceed 1/16".

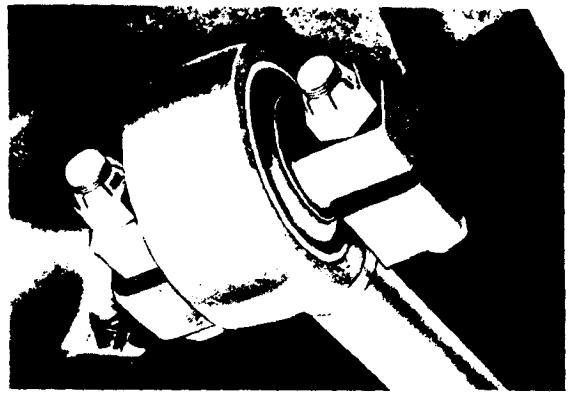


Alignment Chart

LOWER TORQUE RODS

In some cases, the alignment may be corrected by transposing torque rods. If satisfactory results cannot be obtained in this manner, it will be necessary to install one or more torque rods of the correct length.

NOTE: Military type torque rods may be adjusted by adding shims between the rod pin and the axle clamp or spring seat bracket, using SAE flat washers as shims.



Military Type

UPPER TORQUE RODS

The upper torque rods control the vertical position of the companion flange. Whenever the lower rods are altered or when the transverse alignment is satisfactory but the axles operate off center with the vehicle frame, it will be necessary to realign the upper rods. Depending upon the upper torque rod type, they should be realigned in the following manner:

TAPERED PIN TYPE:

1. Disconnect one end of both the upper rods.
2. Adjust the axles to obtain the correct companion flange angle on both drive units.
3. Measure the distance between the upper torque rod mountings and compare this distance to the upper torque rods. If this distance is not satisfactory, it will be necessary to install torque rods of the correct length.

MILITARY TYPE:

1. Disconnect one end of both the upper rods.
2. Adjust the axles to obtain the correct companion flange angle on both drive units.
3. Reinstall the torque rods, using SAE flat washers as shims to compensate for any difference in length. Be careful not to change the adjustment on the axle.

ADJUSTABLE TYPE:

1. Loosen clamp bolts on both upper rods.
2. Adjust the center bolt as required to obtain the correct companion flange angles on both drive units.
3. Tighten all clamp bolts securely.

HENDRICKSON RUBBER-BUSHED HANGER BRACKET ASSEMBLIES

PREVENTIVE MAINTENANCE

Rockwell-Standard recommends specific inspections and periodic checks to obtain maximum service life from their suspension attachments and help prevent wear or breakage of hanger brackets. Inspections should be made at maximum intervals of 100,000 miles; more frequently for equipment in severe service or off-highway operations.

Thoroughly clean the exterior of each bracket and beam end assembly, and proceed as follows:

1. Check that there is NO gap between the inner metal sleeve of the beam end bushing and the hanger bracket. If any gap is apparent, inspect the entire assembly for wear or damage. Determine the cause for this condition and replace any worn or damaged parts. *The inner sleeve of the bushing MUST be clamped tight in the hanger bracket to prevent metal-to-metal wear and possible breakage. Angular movement between the equalizer beam and the hanger bracket is taken up by the rubber portion of the bushing.*

2. Inspect rubber bushings for cuts, tears, splits or deterioration. Check for excessive bulging at the top of the rubber bushing, with the outer metal sleeve cutting into the rubber. This indicates that the suspension has been overloaded. Any rubber bushing in questionable condition should be replaced. Gaps at the bottom of the rubber bushings are normal. (See Figure 6).

CAUTION: Use only replacement parts approved by the suspension manufacturer. Do not use substitute parts. This is an important safety factor.

3. Keep the attaching parts tightened to the proper torque to prevent the inner sleeve from rotating in the bracket. Specific torque valves for the different combinations are shown in Figures 1 through 5.

NOTE: All torque valves are for threads lubricated with SAE 20 oil.

AIR DRYER
Bendix AD-2

DESCRIPTION

The air dryer (figure 14) collects and removes moisture and contaminants before air reaches the first or supply reservoir. This provides "dry air" for the braking and other air operated systems. This unit is mounted vertically under coach behind left rear wheel and connected in discharge line between compressor and supply reservoir.

A safety valve mounted in the housing assembly protects against excessive pressure build-up within the housing.

The desiccant cartridge and pleated paper oil filter are removable and comprise a complete serviceable unit.

A heater and thermostat assembly prevent freeze-up in the purge drain valve when the dryer is used in severe winter conditions.

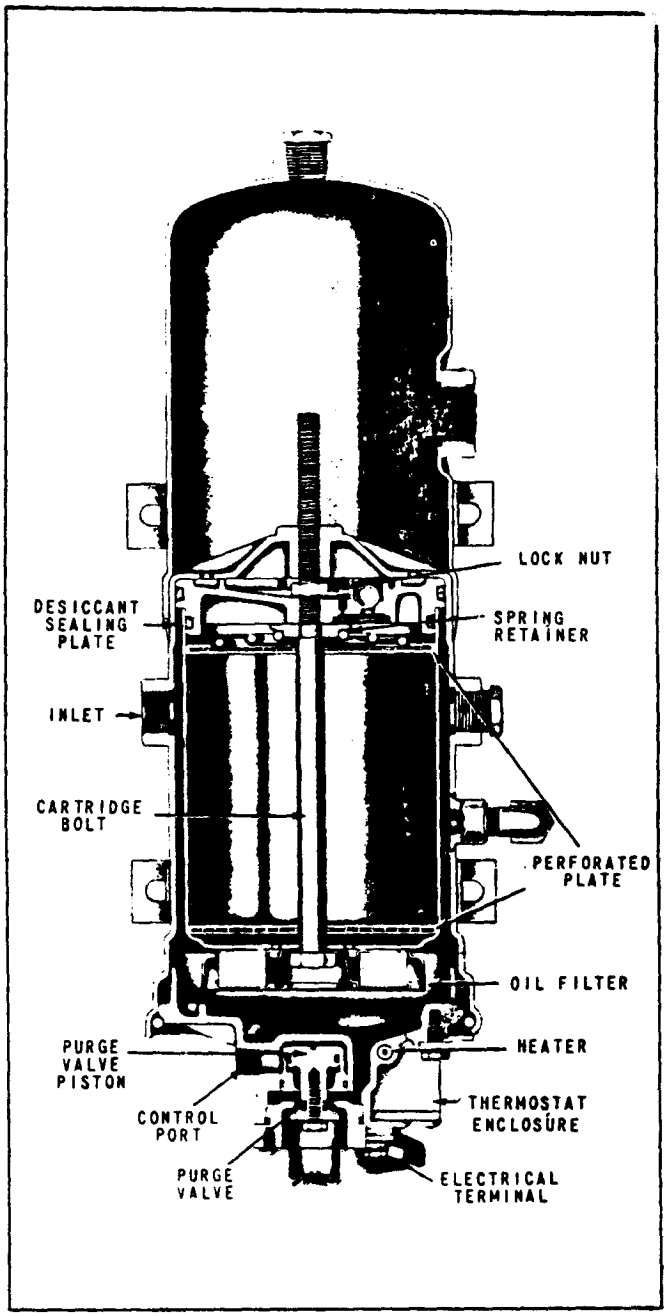


Figure 14 – Air Dryer, Sectional View

OPERATION

Operation of the air dryer occurs in two cycles, the charge cycle and purge cycle:

Charge Cycle

(Refer to Figure 15)

When the compressor is in its "loaded" or compressing cycle, air from the compressor enters the air dryer through the compressor discharge line. When the air, along with the water and contaminants, enters the air dryer, the velocity or speed of the air reduces substantially and much of the entrained liquid drops to the bottom or sump of the air dryer. The initial air flow is toward the bottom of the dryer, but air flow direction changes 180° at the bottom of the air dryer, dropping some water and oil.

The air now passes through the oil filter which removes some oil and foreign material but does not remove water vapor. At this point, the air remains saturated with water.

The filtered air and vapors penetrate the desiccant drying bed and the absorption process begins. Water vapor is removed from the air by the desiccant.

The unsaturated "dry air" passes through the ball check valve and purge orifice into the purge volume. From the purge volume air flows past an inline purge volume reservoir and check valve located outside the air dryer, into the supply reservoir.

Purge Cycle

(Refer to Figure 16)

When desired system air pressure is reached, the governor cuts out, pressurizing the unloader cavity

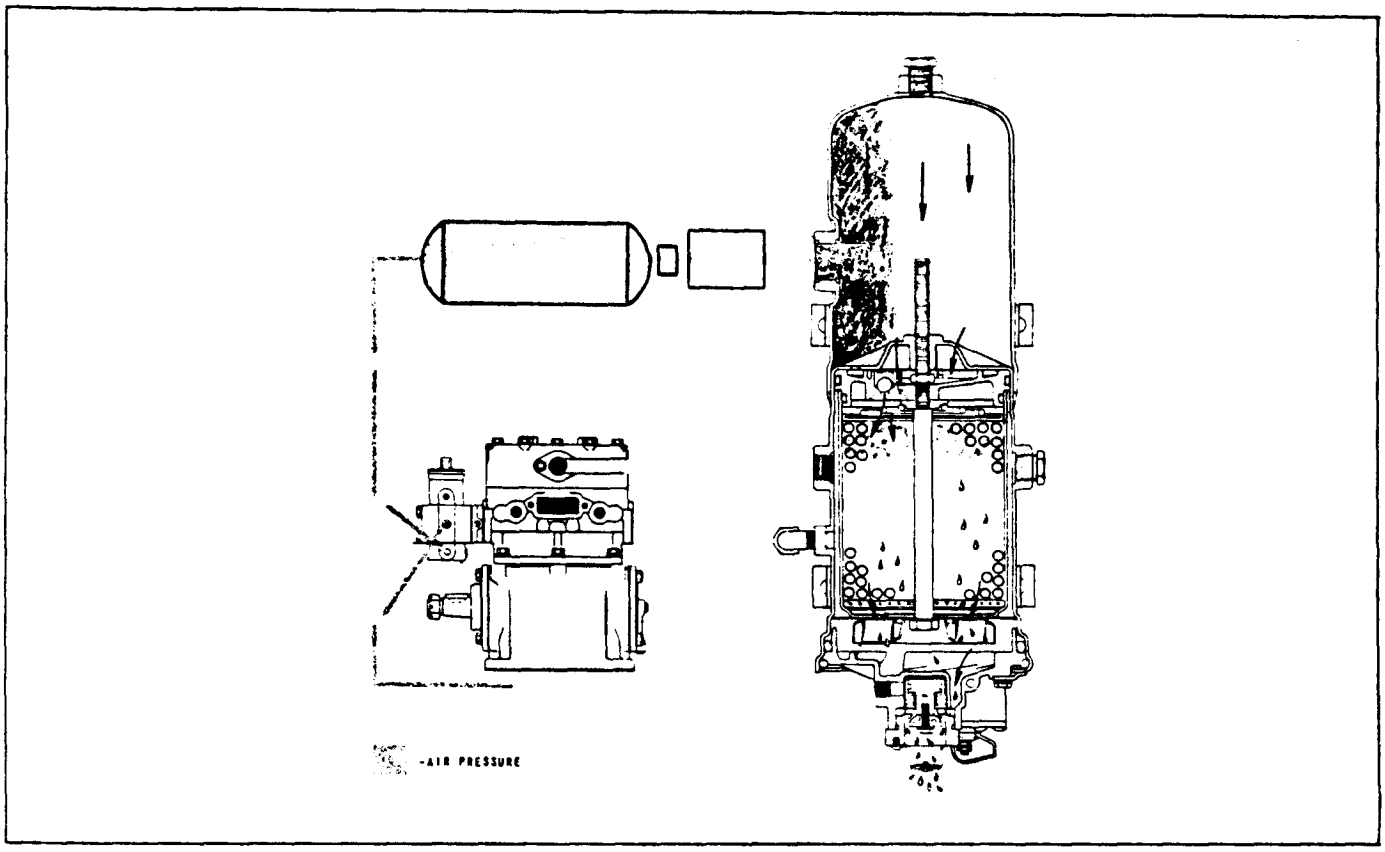


Figure 16 – Air Dryer Purge Cycle

3. Check mounting bolts for tightness. Check all air and electrical connections.

4. Check for leakage at the purge valve by coating the exhaust with a soap solution while compressor is loaded (compressing air).

5. Check operation of the safety valve by pulling the exposed stem while compressor is loaded. There must be an exhaust of air while the stem is held and the valve should reseat when stem is released.

6. Check operation of the heater and thermostat during cold weather operation. Allow the end cover assembly to cool below 50° F and feel the cover with Master switch in "Day Run" position. The end cover should be warm to the touch within a few moments. Warming should cease at about 85° F.

Every 12 months, replace the desiccant. If experience has shown that extended or shortened life has resulted for a particular installation, then the yearly interval can be increased or reduced accordingly.

DESICCANT CARTRIDGE REPLACEMENT

Removal

1. Park and hold vehicle by means other than air brakes.

2. Drain the air system completely. Make certain that lines leading into and out of the air dryer are at atmospheric pressure.

3. Disconnect the air line from the end cover and mark location of this port on the dryer.

4. Disconnect the heater wire.

5. Loosen the three cap screws on the end cover and turn the retaining clamps aside (cap screws may be left finger tight).

6. Locate the notch in the dryer shell. While pushing the end cover up into the dryer, insert the blade of a screwdriver in the notch and slowly pry out the retainer ring. Remove the end cover assembly and set it aside temporarily.

7. Using a 3/4 inch socket wrench, remove the cartridge and desiccant sealing plate assembly.

DESICCANT CARTRIDGE

Disassembly

1. Carefully remove the lock nut on top of the desiccant sealing plate.

   NOTE: The plate is spring loaded, however, the spring load is completely relieved when the nut is removed.

2. Remove the desiccant sealing plate and rebuild as outlined previously in this section.

3. Remove and retain the spring, spring seat, bolt and cartridge shell. Discard the oil separator filter.

Assembly

1. Insert one of the perforated plates into the cartridge, felt cloth up, and tap it firmly to the bottom.

   NOTE: Felt always faces the desiccant material.

2. Slide oil filter separator over the cartridge bolt with the gasket surface next to the shell.

3. Install the bolt with the oil separator into the bottom of the shell and through center hole of the perforated plate in the bottom of the shell.

4. Pour the entire package of desiccant material into the shell, making sure none is lost. Handle carefully so that the bolt does not fall out.

5. Level the desiccant material and install second perforated plate with felt cloth down. Make sure shoulder of the bolt is centered, and extends slightly above the top of the perforated plate.

   NOTE: If bolt shoulder does not extend above the perforated plate, tap the side of the desiccant container.

6. Set the conical spring on top of the perforated plate.

7. Place spring retainer on top of the spring.

8. Install the previously rebuilt desiccant sealing plate on the cartridge bolt so that the ball check retaining clip is in view.

9. Using the lock nut, draw the assembly together to approximately half of the spring's free height. While slowly turning the cartridge, tap the side of the shell with a plastic mallet. This allows the desiccant material to settle properly into place. Continue to tighten the nut making sure all items are properly aligned. Tighten nut firmly using an 11/16" socket or box wrench.

END COVER ASSEMBLY

Disassembly

1. Remove and discard the large o-ring around the end cover assembly.

2. Remove the single screw securing the exhaust diaphragm and separate the diaphragm, washer and screw. Discard the diaphragm.

3. Remove the three screws securing the exhaust cover and remove exhaust cover.

4. Remove the purge valve assembly, the large hex cap nut from the end cover and discard both o-rings around the cap nut.

5. Using a 7/16" socket wrench and a large screw driver, remove the hex head cap screw which holds the assembly together.

6. Separate the cap screw, purge valve, purge valve piston and the piston return spring.

7. Discard the piston o-ring, purge valve, and the piston return spring.

8. Clean remaining parts in a commercial solvent, making sure all surfaces, bores, ports, and passages are clean and dry before assembly.

Assembly

1. Lubricate piston o-ring and install it on the piston.

2. Lubricate piston bore and install the piston.

3. Install purge piston return spring and piston.