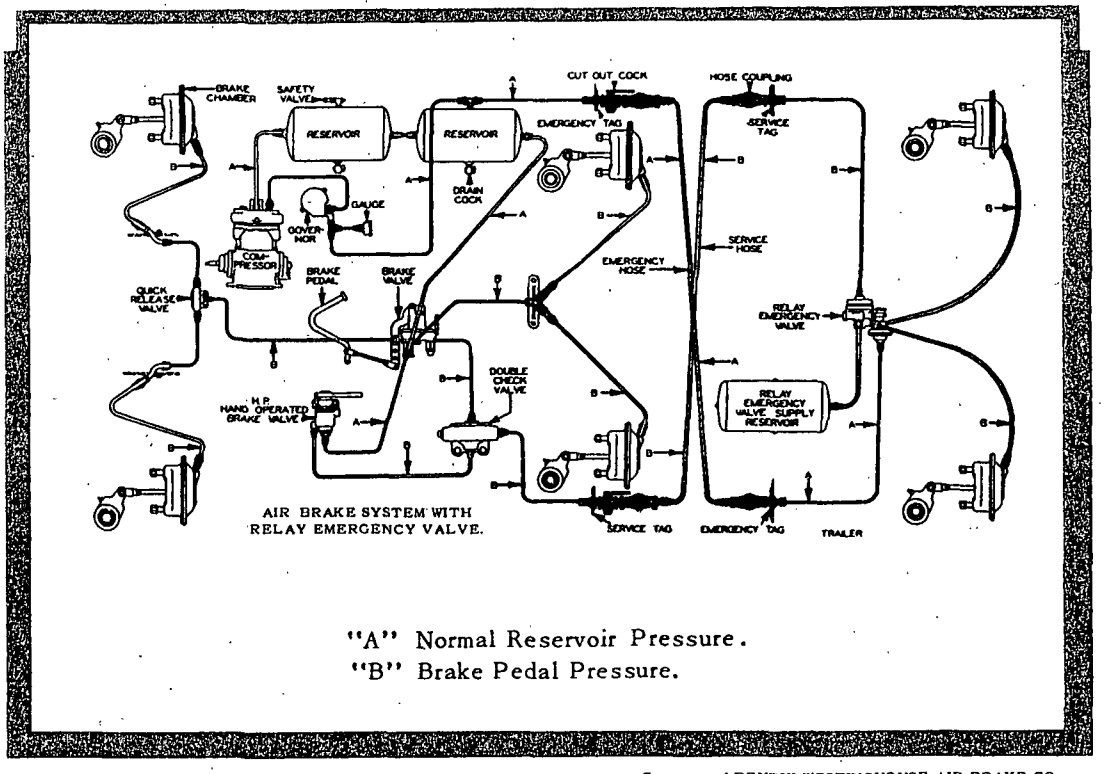
Interstate

TRAINING SERVICE

School of Diesel, Tractor and Heavy Equipment



AIR BRAKE SYSTEM WITH RELAY EMERGENCY VALVE.

"A" Normal Reservoir Pressure.
"B" Brake Pedal Pressure.

Courtesy of BENDIX WESTINGHOUSE AIR BRAKE CO.

UNIT 45

(REVISED)

MISCELLANEOUS CLUTCHES
and
BRAKING SYSTEMS

Portland, Oregon

SCF-ALLF-01406

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BRAKES (MACK TRUCK)

HAND BRAKE is of the flexible band construction mounted on the driveshaft directly behind the transmission. Three adjustments are provided, two for centering the band with respect to the drum and a third for setting the clearance between the drum and lining. The latter should be adjusted so that a .015 feeler gage can be inserted at any point without forcing.

HYDRAULIC BRAKES

THE SERVICE (FOOT) BRAKES are of internal construction and are hydraulically operated. Each wheel is fitted with a hydraulic type of cylinder acting directly on the brake shoes therein and connected by suitable lines to a compensator or, as it is sometimes called, a master cylinder. The latter, in turn, is connected to the brake pedal. Built as part of the master cylinder is a reservoir containing a supply of the special Mack Hydraulic Brake fluid through which the power is transmitted. The level of this liquid should be checked at 6000 mile intervals and added to if necessary. Do not allow the level to drop below half full. A plug is located at the top of the reservoir through which the level can be seen. Remove all dirt from around this plug before unscrewing; the presence of sand or grit in the fluid will scratch the cylinder walls and cause leakage.

BRAKE SHOE ADJUSTMENT is obtained by means of cams bearing against the shoes in such a way that when they are turned the shoe is moved either away from or toward the drum. The cams are set externally by the two hexagon screw heads located near the top of the anchor plate at the inside of the wheel. An inspection plate in the brake drum will permit measuring the clearance with feeler gage between the drum and lining. This should be a minimum of .010 at the toe (near the hydraulic cylinder) of each shoe and .005 at the heel (near anchor pins).

When new lining is installed it may be necessary to recenter the shoes, which can be accomplished by moving the eccentric anchor pins located at the bottom of the anchor plate. Ordinarily, however, the setting of these pins is not altered when simply "taking up" on the brakes.

BLEEDING or removing the air from the hydraulic system may be required at infrequent intervals due sometimes to permitting the fluid level to drop too low in the compensator reservoir, thereby admitting air in the line. A special bleeder valve is fitted in each wheel cylinder and is located just above the tube connection. When bleeding a system all four wheels should be bled, the procedure being as follows:—

Remove the small plug from the fitting and screw in a fitting attached to which is a piece of rubber hose. Submerge the end of the hose in fluid spilled into a glass receptacle; then with a suitable wrench turn entire fitting about one-half turn after making certain that there is ample fluid in the reservoir. Have an assistant apply and release the brake several times (until no air bubbles are noticed in the stream of liquid going into the glass). While the pedal is being depressed for the last time tighten the fitting. During the entire time the

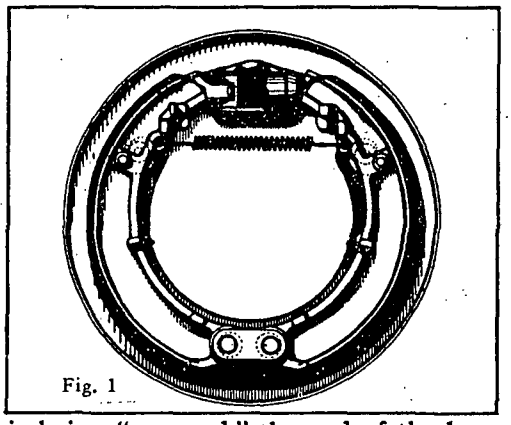


Fig. 1

pedal is being "pumped," the end of the hose must be submerged in the fluid. A clean receptacle should be used for this purpose and the fluid may be spilled back into the original container after all lines have been bled. Do not spill the fluid immediately into the reservoir since it may contain small air bubbles which will defeat the purpose of the entire operation. Upon settling for several hours the bubbles will disappear.

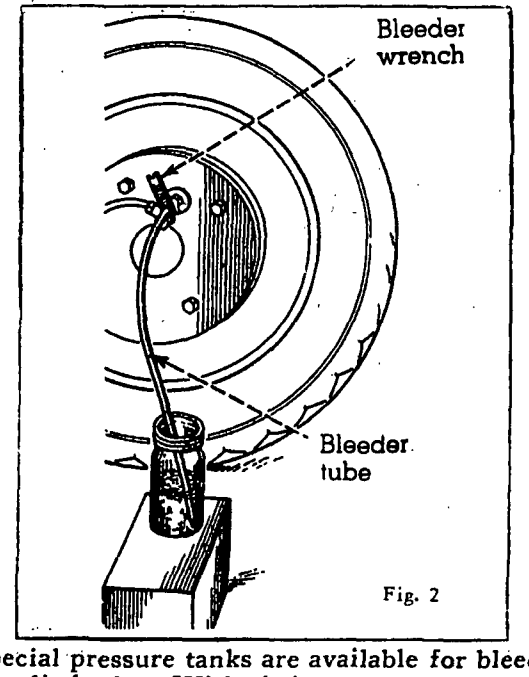


Fig. 2

Special pressure tanks are available for bleeding hydraulic brakes. With their use, one man can do the job. Fluid under pressure is contained in the tank and a special fitting enables tank to be connected to filler hole of master cylinder reservoir. This eliminates necessity of "pumping" brake pedal to cause fluid circulation.

VACUUM BOOSTER OPERATED HYDRAULIC BRAKES

REACTIONARY TYPE

A reactionary type vacuum power cylinder, permitting greater pressures to be built up in the system with less effort on the part of the operator, is explained below. The vacuum power unit "U" Figure 1. utilizes the intake manifold vacuum as a source of power. It is of the "vacuum suspended" type with both sides of the piston submerged in

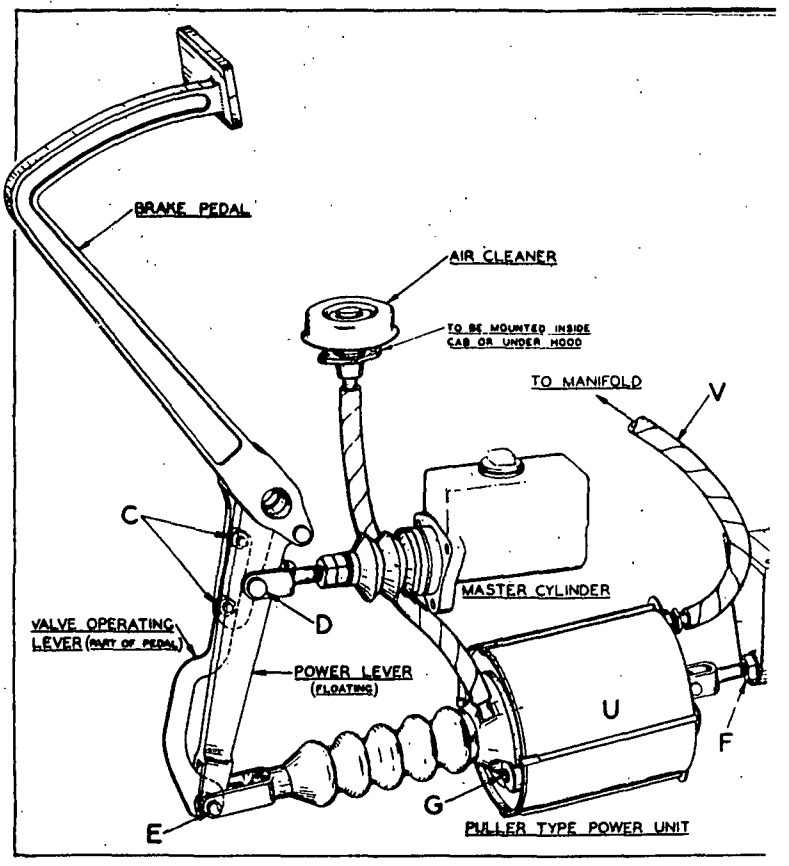


Fig. 3

vacuum when the brakes are in released position. Brake application is obtained by admitting atmospheric pressure to the rearward side of the piston *(the piston rod end of the cylinder)* without dumping a charge of raw air into the intake manifold. The vacuum line "V" connects the front of the power cylinder to the manifold (Fig. 3).

A check valve is incorporated in the intake line which maintains maximum vacuum in the cylinder during any cycle of operation and also seals the system after the engine is stopped, permitting a power brake application.

The vacuum power unit is of the reactionary type, that is, it is so connected to the master cylinder and brake pedal that it supplies approximately sixty percent of the power applied to the master cylinder, the other forty percent being supplied by manual effort on the brake pedal pad. This permits the operator to "feel" the brake at all times and to have full control of it. The deceleration of the vehicle increases in direct proportion with pedal pressure.

The valve operating the power unit is contained within the unit and is operated by a rod extending through the power unit piston rod to the valve operating lever (See Fig. 4 and 5).

If adjustments described later are made correctly, a movement of approximately ½" of the brake pedal pad pushes the valve inward, admitting atmospheric pressure to the rearward side of the piston. This air, or atmospheric pressure on the piston moves it toward the front of the cylinder and through the power lever connection applies pressure to the master cylinder.

From the remote air cleaner (Fig. 3 and Fig. 5), air enters the cylinder through a connection in the end plate dust cover holes in the hollow piston rod

and then through the valve to the rear side of the piston.

You will note in examining the construction of the vacuum power unit (Fig. 4 and 5) that it is essential that about 5/32" travel specified for the valve rod is obtained in order that the valve may open the ports admitting air to the rear of the piston — ¼" travel is required for full opening of the valve when clearance on power lever is all taken up at "A" (Fig. 5).

The amount of air admitted to the rear of the cylinder depends upon the brake pedal movement. If the operator stops the forward movement of the brake pedal, the piston will move until the valve closes off the port which admits air to the rear of the piston, the valve remaining in the "neutral" or lap position covering the ports and holding the air in the cylinder on the rearward side of the piston. To accomplish any further movement of the piston or brake application, pedal must be further depressed.

When the operator releases the pressure on the brake pedal the valve is positively moved to the release position by the valve lever attached to the brake pedal. This closes the air passage to the rear side of the piston and opens a passage across the piston, thus restoring the vacuum balance on both sides of the piston (Fig. 4).

It is important that adjustments given later be made as outlined, as will be seen from the following description of the construction, and operation of the power brake.

The valve operating lever is attached to the brake pedal by two cap screws "C" (Fig. 3) with an oversize hole at the bottom cap screw to permit adjustment. It is *absolutely necessary* that in the brake release position the clearance (about 1/32"), between the shaft hole in the power lever and the pedal shaft *must be* on the forward side of the shaft (opposite to the master cylinder) as shown at "A", "Release" Fig. 4.

Also the power cylinder piston rod clevis pin *must be* against the rearward wall of the valve link bushing, as shown at "B", Figure 4, Release.

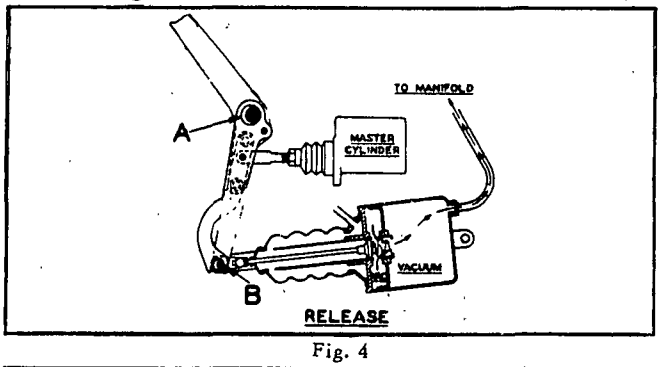


Fig. 4

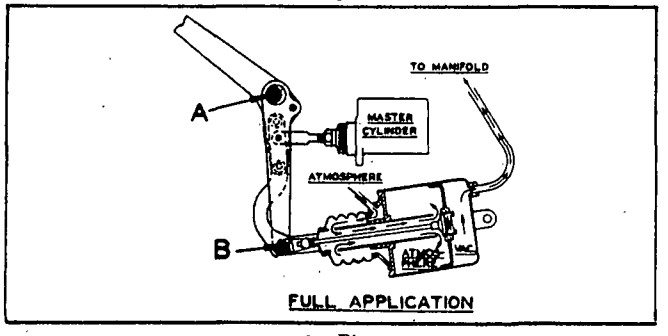


Fig. 5

From the above it will be observed that any improper adjustment will affect the application and operation of the brakes and brings out the importance of making adjustments as directed below: In making the adjustments each operation should be made in the order given:—

1. Loosen valve lever anchorage screws "C" (Figure 3), remove master cylinder and piston rod clevis pins "D" and "E" (Fig. 3). Be sure that leverage system is clean and in correct alignment, with no binding. Then, block brake pedal in release position. Be sure that clearance between power lever and pedal shaft is at the front side of the shaft, as shown on "A" (Fig. 4).

2. Adjust master cylinder clevis to permit about 1/32" lost motion in master cylinder piston rod, then insert clevis pin "D" and cotter.

3. Pull power cylinder piston rod all the way out; align piston rod clevis with power cylinder lever by adjusting cylinder position at the mounting end "F." *Never attempt to adjust piston rod clevis as this affects valve positioning*, which is correctly set at the time of factory assembly.

4. Be sure that piston rod clevis pin "E" is against sidewall of valve link bushing as shown at "B" (Fig. 4), "Release." Then tighten valve lever adjustment screws "C". Be sure that valve lever fork *is central and square on valve rod bushing to avoid binding.*

5. If adjustment has been made correctly then the brake pedal when moved by hand should move the valve rod ¼" inward before any movement of the power lever occurs. (Engine not running).

6. Check to be sure cotter pins are in place, locknuts are tightened and cap screws are tight. If these adjustments are made correctly, brake shoes are properly adjusted, and hydraulic system working correctly, the brakes will be satisfactory.

TESTING THE CYLINDER

1. Remove the pipe plug "G" (Fig. 3) at rear of cylinder and connect a vacuum gauge.

2. Start the engine and note the reading on the gauge. It should show a vacuum of 16 to 20 inches. Stop the engine and note if vacuum is retained for a reasonable length of time. If gauge shows a rapid falling off (more than 10 inches in 10 seconds), it indicates a leak which may be in the cylinder, in the line, or in the check valve in the inlet manifold connection.

Leakage in the power cylinder may often be corrected by a thorough lubrication of the unit.

Tests for leaks in cylinder or lines may be made without a vacuum gauge. If the engine idles too fast or unevenly, leakage is indicated. Disconnect manifold connection and plug manifold opening. If engine idles normally with this manifold connection plugged, then leakage is in cylinder or lines. If engine continues to idle improperly then there is probably a leak in the inlet manifold or gaskets, or throttle stop screw is improperly adjusted.

NOTE: Never attempt to replace the valve without also installing new piston rod assembly. Piston rods are furnished with undersize bore and must be reamed to "fit" after assembly in piston.

LUBRICATION

Every 6000 miles remove the pipe plug "G" (Fig. 3) in the rear end of the power unit and lubricate with two ounces of Vacuum Cylinder Oil, after which the pipe plug should be replaced. At every chassis lubrication spray the valve and power lever linkage with light oil.

The remote air cleaner should be examined and cleaned at least twice a year. Remove the hair, wash same thoroughly in kerosene, dry and then saturate with a light machine oil. Replace the hair in the cleaner and reassemble. Clean off all dirt around the rear end of the power unit.

It is suggested that for repairs and adjustments the operator secure the services of an authorized Mack Service Station.

VACUUM BOOSTER OPERATED HYDRULIC BRAKES

REACTIONARY EXTERNAL VALVE TYPE

In this type the service or foot brake system is of the vacuum suspended type employing an external operating valve "A" mounting in the brake pedal linkage and a power cylinder "B" rigidly mounted on the frame side rail to the rear of the hydraulic master cylinder (Fig. 6). With the operating valve mounted in the rod between the brake pedal and the upper end of the power lever (L) at "C", and the power cylinder attached to the lower end of the power lever at "D", all braking effort from both the brake pedal and the power cylinder is relayed through the power lever, rotating on the idle shaft "S", to the hydraulic master cylinder through its connection at "K".

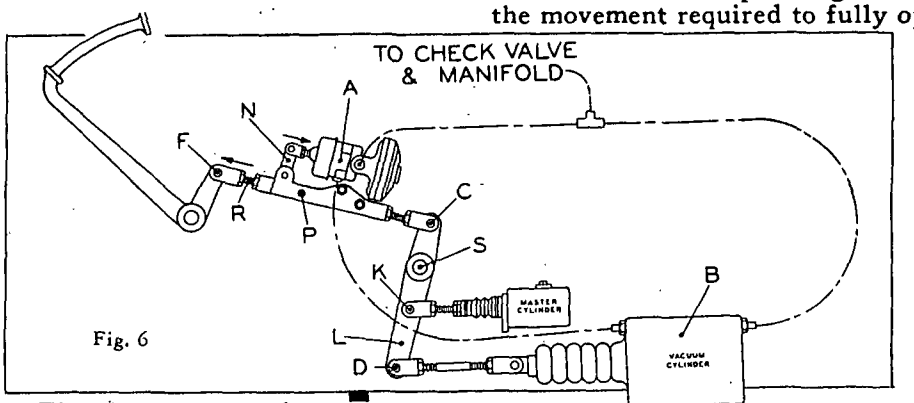


Fig. 6

The broken lines (Fig. 6) represents the vacuum connections between the engine intake manifold and check valve, the external operating valve and the power cylinder.

In the vacuum suspended type of power brake equipment, vacuum is present on both sides of the power cylinder piston when the brakes are in the released position, because of the open vacuum passage through the operating valve "A" (Fig. 7). When the brake pedal is depressed the valve rod "R" is pulled outward. Since valve operating lever (N) is pivoted to the valve linkage, the valve stem is pushed inward, thus closing off the vacuum passage and opening the atmospheric port of the valve, establishing a direct connection between the air cleaner on the valve and the piston rod end of the power cylinder (Fig. 8). With this admittance of air at atmospheric pressure to the rod end of the power cylinder, the piston moves rearward in the power cylinder applying pressure to the hydraulic system through the power lever "L". As the power cylinder piston moves rearward the upper end of the power lever, at "C", moves forward, thus causing a "follow-up" action which tends to close the atmospheric port of the operating valve (Fig. 9 showing lap position).

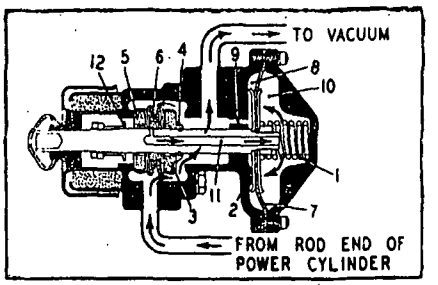


Fig. 7

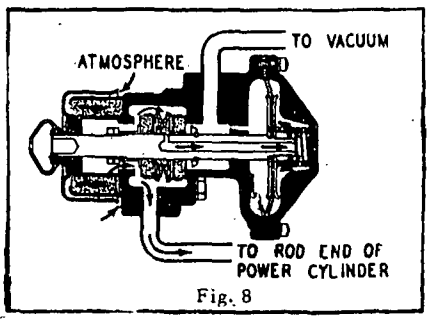


Fig. 8

EXTERNAL VALVE is of the reactionary type being incorporated with, and operated through, a special bracket and linkage assembly, whereby the load on the brake pedal rod is carried by the valve support brackets and not by the valve itself. The travel of the valve operating lever (N) is limited to the movement required to fully open and close the

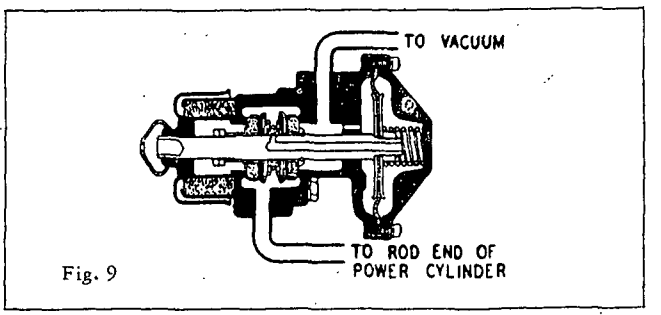


Fig. 9

valve. Any additional force exerted at the brake pedal after the valve is fully applied is transmitted directly to the brake system through pin (P) which bottoms in an elongated hole in the support bracket. The only applied force acting through the valve itself is that which is required to operate the valve.

This valve also incorporates an additional cham-

ber fitted with a diaphragm. The cavities of this chamber are connected through passages to the valve proper. A drop in vacuum to the power cylinder also causes a corresponding drop within the diaphragm chamber which unbalances the pressures on the diaphragm. This unbalance of pressures acting upon the diaphragm creates an opposing force within the valve which reacts against the force applied through the pedal tending to open the valve. This opposing force, which tends to keep closing the valve, produces what is termed a "reactionary" effect. The combination of this reactionary effect, along with the follow-up action, which takes place as soon as air is admitted to the power cylinder, is responsible for the finely balanced control obtained with this valve.

The reactionary feature combines power with physical effort throughout the range of brake application. The result is gradually increasing pedal feel in direct proportion to the degree of braking effort. This enables the driver to accurately judge the degree of brake application with the vehicle unloaded or loaded, preventing sudden lock wheel stops. Reactionary control is also a decided safety factor on wet or icy pavement.

The valve requires no greater pedal effort for maximum brake application than does a non-reactionary valve, but it will require a few hours driving time to become accustomed to the firm reaction and degree of control it provides.

VALVE OPERATION

RELEASE. In the release position, the return spring (1) holds the valve stem and diaphragm plate against release stops (2) in the valve body. The vacuum valve (3) is held fully open by the stop-washer (4) on the valve stem. This connects the control end of the power cylinder to vacuum. The atmospheric valve (5) is held in the closed position by the spring (6). Both valves are free to slide on the valve stem. Reactionary diaphragm (7) is balanced in vacuum. Chamber (8) is connected to vacuum through drilled hole (9) in the valve body. Chamber (10) is open to vacuum through drilled hole (11) in the valve stem. (Fig. 7)

LAP. When applying the brakes, the initial movement of the valve stem and stop washer (4) allows the spring (6) to close the vacuum valve (3) before the atmospheric valve (5) starts to open. Later when the brake pedal is held in a partially applied position, the power cylinder will move the brake system and valve linkage in the applied direction, to the point where the valve reaches this lap, or holding, position (both valves closed).

APPLIED. Further movement of the valve stem in the applied direction forces open the atmospheric valve (5) by contact with stop washer (12). This admits atmosphere to the control end of the power cylinder, causing the brake application. At the same time, atmosphere is admitted to the reactionary diaphragm, chamber (10), through drilled hole (11) in the valve stem. Atmospheric pressure in chamber (10) tends to force the diaphragm (7) and valves toward the release position, against the physical effort at the brake pedal, applying the brakes, thus causing the reactionary effect.

Upon releasing the brakes, the return spring (1) plus diaphragm reaction, moves the valve assembly through the lap position and into the release position with the atmospheric valve closed and the vacuum valve fully open.

ADJUSTMENT

If the vacuum power brake equipment is not functioning properly, or if it is found necessary to replace any of the parts, the following adjustment procedure should be followed:

1. Before starting the adjustment, be sure the brake pedal and valve linkage are in the *full release position*. Block the pedal.

2. Adjust the pedal rod and operating valve assembly to a length (C to F in Fig. 6) of approximately that listed in the truck manual.

3. Insert clevis pins at (C) and (F) and cotter.

4. Adjust master cylinder yoke to permit 1/32" clearance between master cylinder piston rod and piston.

5. Insert clevis pin at (K) and cotter.

6. Pull power cylinder piston rod outward until piston is bottomed against the cylinder end plate; adjust link between piston rod and power lever to align holes in yoke with hole in power lever.

7. Insert clevis pin at (D) and cotter.

8. Check all lock nuts and vacuum connections to see that they are tight.

9. Remove block from brake pedal. With engine not running, depress pedal and note if valve stem (W) travels 5/16". When the brake pedal is released, the valve stem should return immediately to the released position.

VALVE ADJUSTMENT

1. Internal adjustments to the valve should not be made in the field. Valves in need of repair should be exchanged for factory-rebuilt units at any Mack Service Station.

2. The only external adjustment of the valve is the valve rod (H), which is threaded into yoke (G). This adjustment is made with the engine *shut off*. (Fig. 10)

3. Loosen lock nut (E). Remove rubber guard (T) from the valve housing as shown. Now adjust valve rod (H) to obtain a slight clearance (approx-

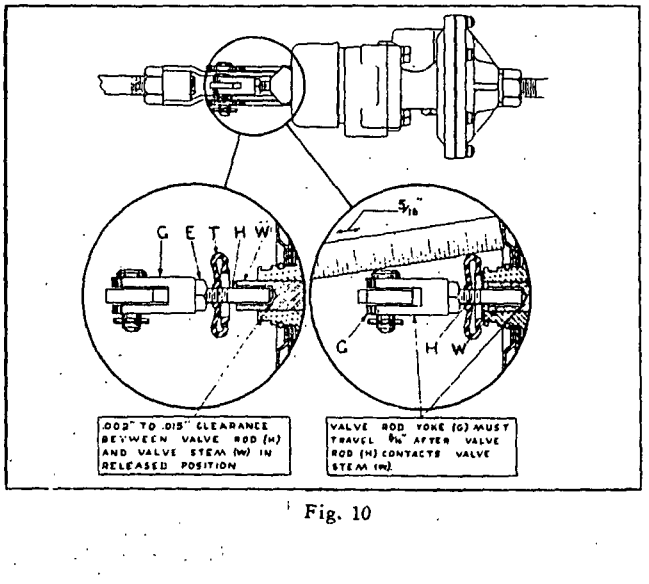


Fig. 10

imately .002 to .015") between the end of valve rod (H) and valve stem (W).

4. After making the above adjustment, check the total travel of the valve stem (W) as follows:

Place a scale, graduated in sixteenths of an inch, near the valve rod yoke with the end against the dust cover, as shown in Figure 10. Now carefully apply the brake pedal just enough to take up the clearance between the valve rod (H) and valve stem (W). At this point, note the position of the yoke (G) in relation to the scale.

Then fully apply the brake pedal and observe the distance travelled by the yoke. It is very important that the valve stem (W) travel 5/16" in order to obtain full opening of the valve in the applied position.

Failure of the valve stem to travel 5/16" is usually caused by more than .015" clearance between the valve rod and stem in the released position, or by making an adjustment of the valve rod with the brake pedal and valve linkage not in the fully released position.

MAINTENANCE

Every 6,000 miles, remove the pipe plug from the rod end of the power cylinder and inject 2 ounces of Vacuum Cylinder Oil in the cylinder, after which the pipe plug should be replaced.

Where the PDL type cylinder is used:

Every 6,000 miles, remove the pipe plug from center boss of closed end plate, and inject ½ ounce of Vacuum Cylinder Oil into cylinder through this opening. Then replace and tighten pipe plug.

At every chassis lubrication all clevis pins and lever bearings should be lubricated with light oil.

The air cleaner on the external operating valve should be removed and cleaned at least twice a year; oftener if operated in dusty sections or on gravel or dirt roads. Remove the hair cleaning element, wash in kerosene and allow to dry; then dip in light machine oil and allow to drain; after cleaning the other parts of the cleaner, reassemble the air cleaner on the valve. Inspect the rubber dust guard on the power cylinder piston rod and if damaged, replace.

It is suggested that repairs or adjustments be made by a Mack Service Station. The following tests will indicate when service is necessary.

TESTING THE SYSTEM

1. Remove the ⅛" pipe plug from the end plate on the piston rod end of the power cylinder and attach a vacuum gauge at this point.

2. Start the engine and note the reading on the vacuum gauge. It should show a reading between 16" and 20". Now stop the engine and note if the vacuum is retained for a reasonable length of time. If the gauge shows a rapid dropping off (more than 10 inches in 10 seconds) it indicates a leak which may be in the power cylinder operating valve, check valve mounted on the dash, or in the vacuum lines.

3. Start the engine again and depress the brake pedal firmly as in making an emergency stop. If the vacuum gauge reading does not drop to zero it indicates the operating valve is not functioning properly.

4. In testing the operating brake valve disconnect from the operating valve the vacuum line between the valve and the rod end of the power cylinder, and attach the vacuum gauge to the valve at this point. Start the engine and note the vacuum gauge reading. Then stop the engine and note if the vacuum is retained for a reasonable length of time. If the vacuum gauge shows a rapid drop in vacuum (more than 10 inches in 10 seconds) it indicates a leak in the operating valve, or in the check valve.

5. Test the check valve by connecting the vacuum gauge to the bottom of the valve. Start the engine and note the vacuum gauge reading. Then stop the engine. If the gauge shows a drop of more than 10 inches in 10 seconds, the check valve should be replaced.

6. Before testing the vacuum lines, inspect all vacuum hose and tubing to see that it is in good condition and check all connections to see that they are tight.

If leakage is indicated in the power cylinder, operating valve, or check valve, these units should be taken to a Mack Service Station for repairs or exchange for factory-rebuilt units.

RESERVOIR AND GAUGE

Where law requires a vacuum reservoir and dash gauge, reservoir is installed in line from manifold check valve to power cylinder. Gauge may be connected at any point between check valve and reservoir, and should register from 16 to 20 inches vacuum. If not obtained, vehicle should be stopped immediately and the trouble located before proceeding further.

TROUBLE SHOOTING CHART

(Vacuum Brakes)

CONDITION	CAUSE	REMEDY
Vacuum Drops Rapidly, Brake Action Slow	Leak in Operating Valve.	See Testing No. 4, Page 7, and Adjustment, Page 6
	Leak in Check Valve.	See Testing No. 5, Page 7
	Leak in Lines.	Inspect Lines & Fittings for tightness.
	Leak in Cylinder or Valve.	Exchange for Factory Rebuilt Unit at Mack Service Station.
	Valve Functions Improperly.	See Valve Adjustment, Page 6
	In winter—ice in system.	Thaw and dry out.
Lack of Reactionary Control, Harsh Braking With Light Load	Valve Functions Improperly.	See Valve Adjustment, Page 6
Other Conditions		See Adjustments, Pages Page 6

(Cont. on Page 8)

TROUBLE SHOOTING CHART

(Hydraulic Brakes)

CONDITION	CAUSE	REMEDY
Pedal Goes To Floorboard	Lining Wear.	See Page 2
	Brake Shoes out of adjustment.	See Page 2
	Leak in System.	Examine all wheel cylinders, line and connections. If no leaks, inspect cylinders for scored bores.
	Pedal Adjustment Improper.	See Page 6–7
	No fluid in supply tank.	See Bleeding, Page 2–3
	Air in system.	See Bleeding, Page 2–3
All Brakes Drag	Improper fluid in system.	Flush clean with alcohol. Replace any swollen cups. Bleed as shown on Page 3.
	Pedal Adjustment Improper.	See Page 5–6–7
One Wheel Drags	Weak brake shoe spring.	Replace spring.
	Brake shoe bearing seized to anchor pin.	Free up and lubricate.
	Brake shoe set too close to drum.	See Page 6–7
	Cups distorted.	Replace cups, clean and bleed.
	Loose wheel brgs.	adjust
Vehicle Swerves To One Side	Grease-soaked lining.	Renew with MACK Lining.
	Shoes improperly set.	See Page 2–3
	Dust shield loose on axle.	Tighten shield and readjust brakes.
	Front spring clips loose.	Tighten clips.
	Different makes of lining.	Linings vary in friction. Replace with proper MACK lining.
	Tires inflated improperly.	Each tire inflated to same pressure.

AIR BRAKES

When chassis is equipped with an air brake system, the brake shoe cams are actuated by linkage to brake chambers which are operated by air pressure. An Air Compressor mounted on and driven by the engine, replaces the vacuum booster cylinder as the source of power.

The service (foot) brakes are of internal, two shoe construction, applying on all four wheels. The shoes are operated by "S" shaped cams giving constant lift.

BRAKE SHOE ADJUSTMENT is made by jacking up the wheel and turning the worm shaft nut of the Slack Adjuster, which rotates the camshaft with respect to the lever or chamber push rod, until the brake shoes are tight against the drum. See Fig. 11-A

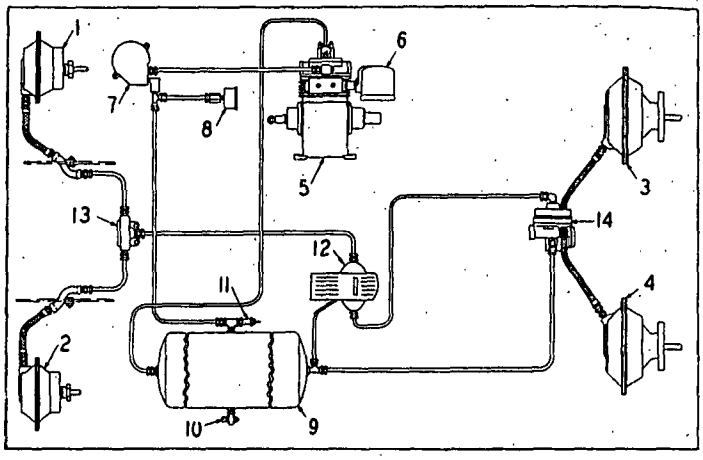


Fig. 11

1. 2. 3. 4. **Brake Chambers** 8. Pressure Gage 12. Application Valve
5. Air Compressor 9. Reservoir 13. Quick Release Valve
6. Air Filter 10. Drain Cock 14. Relay Valve
7. Governor 11. Safety Valve

Then back off on the worm until the wheel is free. Apply the brakes and note push rod travel. This should be kept to a minimum, as given on page - 9 –. As the lining wears, the worm should be readjusted to retain the minimum push rod travel. The travel should always be set accurately so as to be the same for both brake chambers on a particular axle. Maintain at least 60 pounds air pressure while making adjustments.

AIR COMPRESSOR furnishes compressed air to the reservoir. The compressor operates continuously while the engine is running, but the governor functions to unload the compressor discharge valves when 100 to 105 pounds reservoir pressure is reached, thereafter allowing the compressor to operate without any compression until the pressure drops to between 80 and 85 pounds.

Every 18,000 miles the compressor head should be detached and the carbon removed. The discharge valves, springs and seats, also the unloader valves, should be cleaned. The passage allowing the pumping of air from cylinder to cylinder when compressor operates without compression, must be kept open, otherwise the Safety Valve will blow off. The discharge line from compressor to reservoir should be checked at this time to insure unrestricted flow. The unloader diaphragm should be inspected.

The discharge valve lift is .042". The clearance between unloader valve stem and tappet should be set at .010" minimum and .015" maximum. A noticeable increase over this clearance indicates carbon accumulation on valve seat.

The compressor head is water cooled by connections to the engine cooling system. When water is drained from radiator and engine to prevent freezing, the compressor head should also be drained by removing plug.

The compressor is automatically lubricated by pressure from the engine oil circulation system. The oil pressure at compressor should be at least 5 pounds minimum at engine idling speed, and 15 pound minimum at governed speed.

AIR CLEANER is fitted to the compressor for removing foreign matter from the air. Every 1500 miles remove the filtering material, wash

thoroughly in kerosene, dry, and saturate with engine oil.

GOVERNOR regulates the air pressure in reservoir between minimum and maximum settings, working in conjunction with unloader valves of the compressor.

Every 6,000 miles the governor should be checked for leakage, and tested for correct cut-in and cut-out pressure settings. To raise the cut-in pressure increase the tension of the tube on the valve by screwing down the adjusting screw, and to raise the cut-in and cut-out range, remove one or more shims from underneath the upper valve nut. The governor air strainer is packed with lamb's wool. Every 6,000 miles remove the wool, wash in kerosene, fluff up, wet with a few drops of light engine oil, and replace.

RESERVOIR receives the air from the compressor and stores it for use in the brake system. The Drain Cock is located at the bottom of the reservoir for draining off moisture which accumulates due to condensation. All tanks should be drained daily. It will be particularly advisable to drain daily in cold weather. It is good practice to open the drain cock when the truck is laid up at night, and close again in the morning before starting out. This gives the system a chance to properly drain, and which is not completely accomplished with pressure in the units. Attention to proper draining will prevent troubles developing with the various parts of the system.

Before starting out in the morning always run engine until air pressure is built up, to at least 60 pounds or your first stop may find you without brakes. Consult gauge on instrument panel. This also allows the engine to warm up, and completely lubricate the cylinder walls before placing them under load.

SAFETY VALVE it attached to the reservoir. Every 18,000 miles this valve should be cleaned and tested to blow off at 150 pounds.

PRESSURE GAUGE mounted on the dash indicates the air pressure in the reservoir. The gauge mechanism is contained in a sealed case and there is no method for servicing it other than to return the gauge on the regular repair-exchange basis.

APPLICATION VALVE operated by foot pressure, controls brake operation by directing the flow of air from reservoir to Brake Chambers on the wheels in brake application, and from Brake Chambers to atmosphere in release. This valve should be tested for leakage and delivery pressure every 18,000 miles. The lever travel should also be checked to insure the proper operation of the Valve Mechanism, and the valve diaphragm checked for necessity of renewal. Add 8 to 10 drops of light engine oil to oil cup every 6,000 miles.

QUICK-RELEASE VALVE connects two front wheel brakes chambers and assists the application valve in release by exhausting these chambers and thereby producing speedy and simultaneous release on all wheels. This valve should be tested every 18,000 miles for leaks. The diaphragm should be replaced at this time as a rule.

RELAY VALVE connects the two rear wheel brake chambers and speeds up the application and release of same. This valve should be tested every 18,000 miles for leaks. The diaphragm should be replaced at this time, as a rule.

RELAY-EMERGENCY VALVE used on trailers, relays the braking action from tractor to trailer. This valve should be tested every 18,000 miles for leaks. The diaphragm should be replaced at this time as a rule. Occasionally remove the plug at the bottom of the valve and drain off any moisture which has collected.

STOP LIGHT SWITCH working in conjunction with the application valve, operates the stop light instantly upon even the slightest brake application. If the contact points become pitted, use a fine file to obtain a true contact between points. The diaphragm should be replaced at least once a year.

BRAKE CHAMBERS are provided, one for each wheel, to expand the brake shoes. Air pressure admitted into the brake chamber when the brake pedal is depressed moves the diaphragm, push rod and slack adjuster applying the brakes. As the brake pedal is released the air pressure is exhausted from the chamber and the spring returns the diaphragm, push rod and slack adjuster to their normal positions, releasing the brakes.

With the brakes applied, the chamber should be checked for leakage. The diaphragm should be replaced at least once a year. In order to reduce air consumption the brakes should be kept in adjustment so that the chamber push rod travel is kept to a minimum of 5/8" for 4" to 5", 3/4" for 5" to 6 1/2", and 7/8" for 6" or over slack adjusters. Maximum stroke before readjusting is 1 3/8" for 7", 1 3/4" for 8" to 10", and 2 1/4" for 11" dia. brake chambers.

SLACK ADJUSTERS are provided between each brake chamber and the brake shoe camshaft. The adjuster is a lever into which a worm and gear is built. Once a year the slack adjusters should be taken apart, thoroughly cleaned, and filled with a good grade of medium lime base cup grease.

TUBINGS AND FITTINGS should be checked under pressure for leakage every 18,000 miles.

It is suggested that major repairs be done at a Mack Service Station, where expert adjustments may be made, and where units may be exchanged for factory-rebuilt ones, when necessary. To enable the operator to obtain the maximum efficiency from his air brakes at the most economical maintenance cost, the operators, upon payment of a standard flat rate charge, may exchange any service-worn air brake unit for a genuine factory-reconditioned unit.

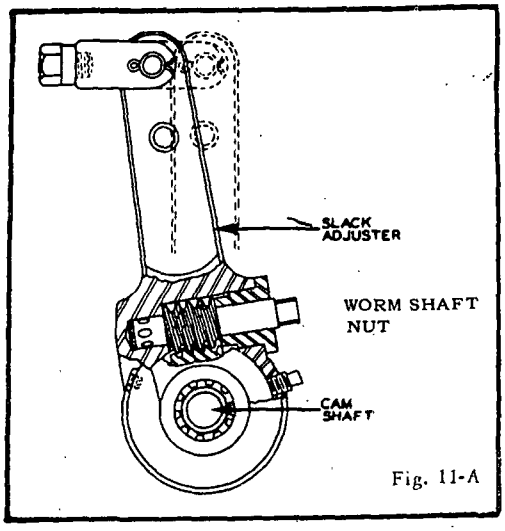


Fig. 11-A

TROUBLE SHOOTING CHART

(Air Brakes)

CONDITION	CAUSE	REMEDY
Slow Pressure Build Up In Reservoirs	Leaking application or brake valve.	Clean valves or replace with reconditioned unit.
	Leaking compressor discharge valve.	Clean valve or replace head with reconditioned unit.
	Leaking lines or connections.	Replace tubing and fittings or tighten fittings.
	No clearance on unloader valves.	Adjust valve to .010" clearance.
	Clogged air cleaner.	Clean.
	Worn piston and rings, carbon in discharge line.	Replace with reconditioned unit.
Quick Loss of Reservoir Pressure When Engine Is Stopped	Worn and leaking compressor discharge valves.	Clean valves or replace head with reconditioned unit.
	Tubing or connections leaking.	Replace tubing or tighten fittings.
	Leaking valves.	Clean or replace unit.
	Leaking governor.	Clean or replace unit.
Compressor Not Unloading	Broken unloader diaphragm.	Install new diaphragm.
	Too much clearance on unloader valves.	Adjust to .010" clearance.
	Restriction in line from governor to unloader	Replace tubing or clean.
	Governor not operating.	Replace with reconditioned unit.
Slow Brake Application	Low brake line pressure (Brake valve to chambers).	Adjust pressure thru valve.
	Brake chamber push rod travel excessive.	Adjust brakes
	Restriction in line.	Clean or replace tubing or hose.
	Leaking brake chamber diaphragm.	Replace diaphragm.
	Brake lining or Drum condition.	Replace or recondition.
	Leaking brake valve diaphragm.	Replace diaphragm or complete unit.
Slow Brake Release	Brake valve lever not returning fully to stop.	Adjust operating rod.
	Binding cam or cam shafts.	Lubricate and align properly.
	Brake chamber push rod travel excessive.	Adjust brakes.
	Restriction in tubing or hose.	Clean or replace.
	Improper seating of valves.	Clean or replace with a reconditioned unit.
Inefficient Brakes	Low brake line pressure.	Adjust pressure thru brake valve.
	Excessive push rod travel on brake chambers.	Adjust brakes.
	Lining and drum condition.	Replace or repair.
	Brake chamber diaphragm leaking.	Replace diaphragm.

WARNER ELECTRIC BRAKES

In the following pages a description of the Warner Electric Brake is given along with instructions for servicing the equipment.

A thorough understanding of the Warner Electric Brake will help you to more quickly grasp the reasons for the servicing procedures outlined in this unit. Therefore, we ask that you review the description of Warner Electric Brakes before servicing the system.

This is taken from the Warner Company's Service Manual

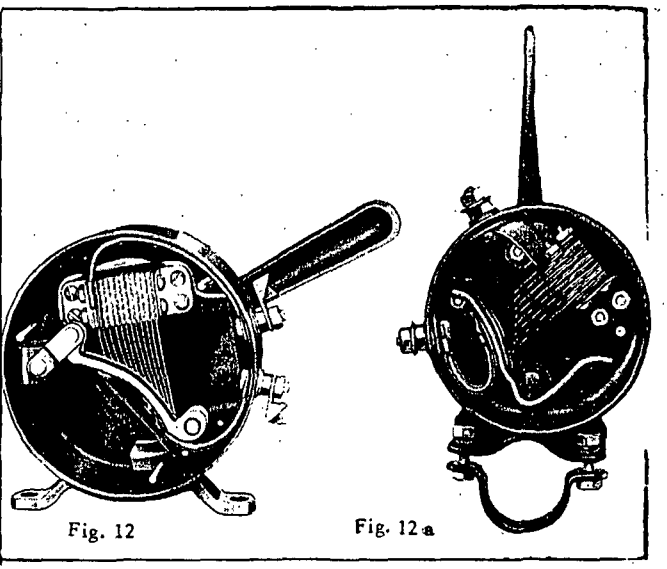


Fig. 12 Fig. 12-a

DESCRIPTION OF THE WARNER ELECTRIC BRAKE AND ITS OPERATION

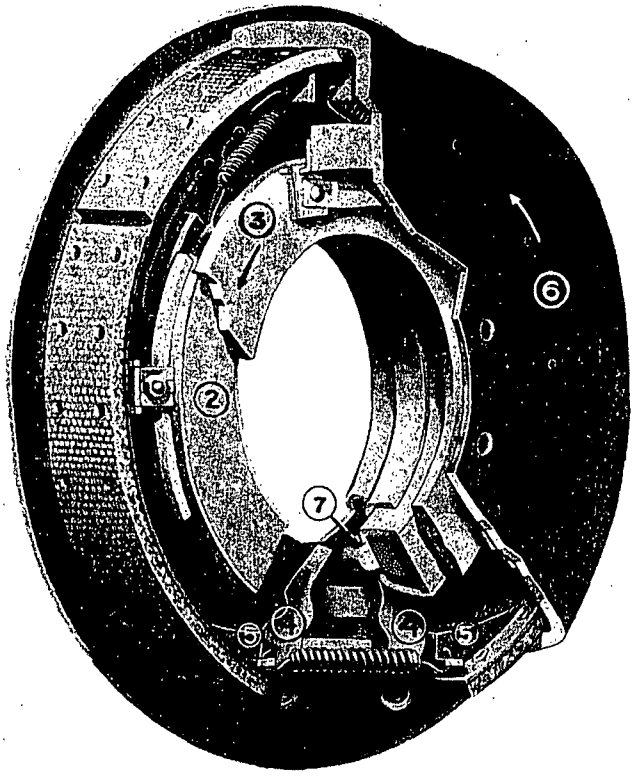
The Warner Electric Brake is a simple mechanical brake, operated by an electro-magnetic clutch. The magnet (item 2) remains stationary on the axle. The armature (item 3) is bolted to the drum, which revolves with the wheel. For maximum operation, the brake requires about the same amount of current used by a tail light. (See Figs. 13 and 15).

The controller (Fig. 12 or 12A) is operated from the driver's seat and permits the driver to apply any degree of braking power. As the hand lever is moved electric current flows through the electro-magnet (item 2). The current energizes the magnet and causes it to cling to the revolving armature disc (item 3). The more current the driver allows to reach the magnet, the tighter it clings to the armature disc. This causes the magnet to move.

On the larger brakes a lug (item 7) is attached to the magnet. When magnet moves, the lug presses the cam (item 4) against the brake band end (item 5). On the 12" and 14" brakes the lug and cam are combined (item 4) and press the brake band end (item 5) into the revolving brake drum. Grabbing is eliminated because there is a slight slipping action between the magnet and armature.

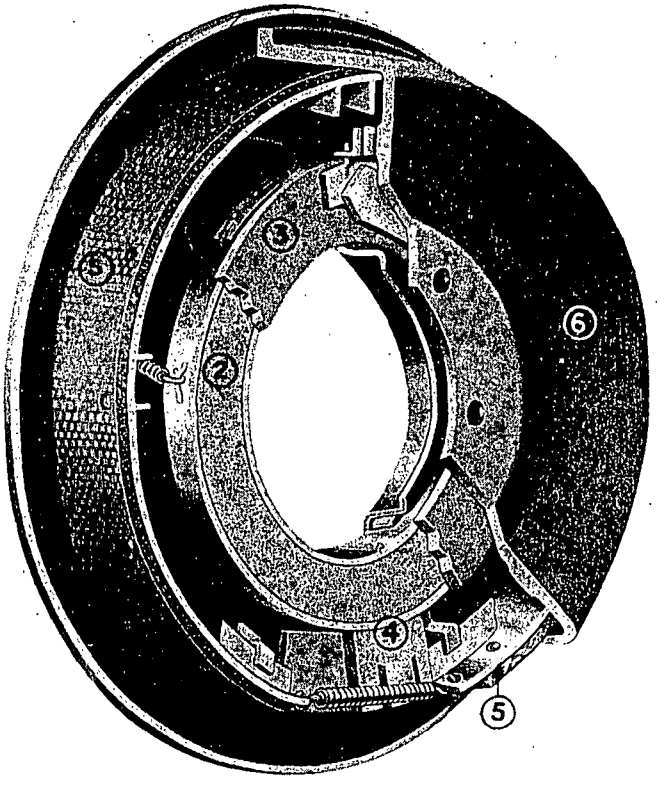
This type of brake offers several advantages. It permits the use of a flexible band that has approximately 50% more lining area than shoe brakes—thus providing longer life. It has unusual power because the rolling wheel causes the drum to multiply the lining pressure provided by the magnet.

NO BRAKE ADJUSTMENT IS NECESSARY. The magnet movement is sufficient to wear the brake lining down to the rivet heads. At this point the magnet comes against an automatic stop that prevents scoring of the drum.



16" x 2½"
17¼" x 3", 4", 5"
BRAKES

Fig. 13



12" x 1¾"
14" x 2"
BRAKES

Fig. 15

METHOD OF CHECKING AMPERAGE AT CONTROLLER

Note: Use a low reading direct current ammeter. For a 2 brake system, an ammeter should be used having a maximum scale of 10 to 15 amperes and for a 4 brake system, 15 to 25 amperes.

Ammeters having a greater capacity can be used, but the lower the capacity the more accurate the readings. See chart on page *12* for brake magnet values.

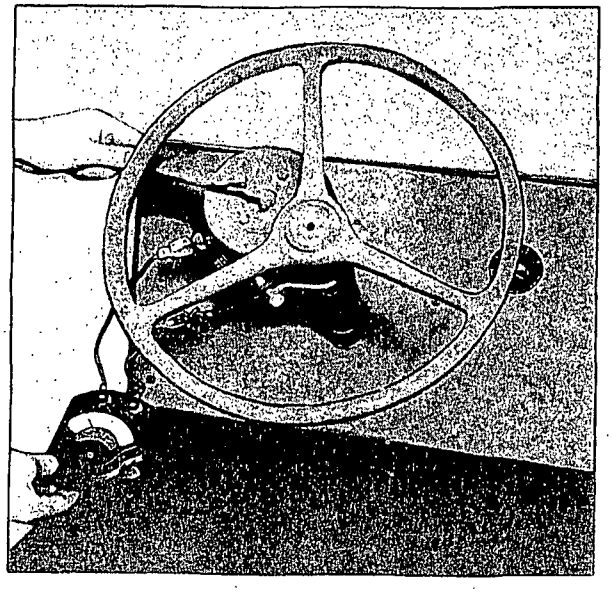


Fig. 14

METHOD OF CHECKING CONTROLLER FOR SHORT

1. Connect ammeter as shown in Fig. 14.
2. With control-lever in a released position there should be no amperage indicated on ammeter.
3. Hold controller lever in a fully applied position and take ammeter reading.
4. Disconnect both brake wires from controller.
5. Connect ammeter wires to the brake wires and take ammeter reading.
6. Amperage reading in step 5 must not be more than 5% higher than reading in step 3.

If controller does not check as indicated in steps 2 and 5, tighten terminals on controller and clean controller contactor arm and blades with fine emery cloth. If this does not correct controller condition it will be necessary to return controller to factory for reconditioning.

TESTING THE CONTROLLER DETACHED FROM VEHICLE

1. Connect controller, battery and TWENTY-ONE candlepower light bulb as shown in Fig. 16.

2. With the controller shown in illustration, the bulb should light to a glow and increase in bright-

Fig. 16

ness in ten steps as controller lever is moved through its full arc of application.

3. The small controller used with house trailer brakes can be tested in same manner except with this controller the bulb will light to a glow and increase in brightness in seven steps.

If controller does not check as indicated, clean contactor arm and blades with fine emery cloth. If contactor blades are bent, straighten them with thin flat nose pliers. If in rechecking the controller the proper results are not obtained the complete controller should be sent to the factory for reconditioning.

METHOD OF CHECKING AMPERAGE AT BRAKES

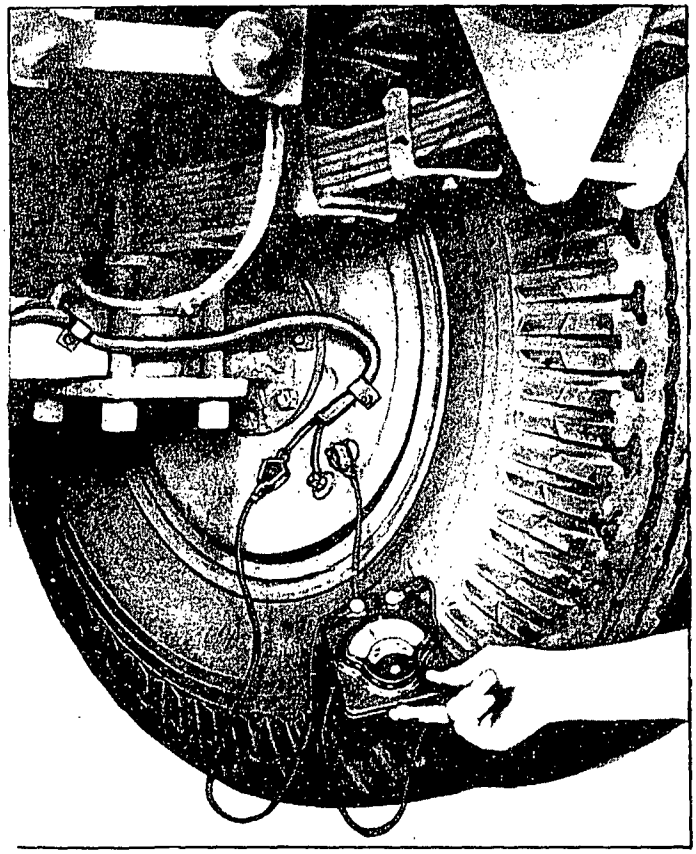


Fig. 17

Disconnect either wire from brake and connect to ammeter. Connect other lead of ammeter to brake terminal from which wire was disconnected. (TWO WIRE SYSTEM.)

AMPERAGE CHARTS

The braking power of the brakes is in direct proportion to the amount of current used by the brakes. A BROKEN WIRE, LOOSE CONNECTIONS OR POOR CONTACTS reduce the amount of current that passes through the brakes. If tow vehicle is equipped with load control, be sure it is on full capacity when making test.

NOTE: Each brake should draw no less nor more than the minimum and maximum amperes as follows:

Brake Size	Minimum Amperes	*Maximum Amperes
12 x1¾	2.5	3
14 x2	2.8	3.7
16 x2½	2.8	3.7
17¼x3	2.6	3.4
17¼x4	2.6	3.4
17¼x5	3	4.2
17¼x6	3	4.2

*Maximum amperes represent the magnet capacity when magnet is connected directly across a 6-volt battery. Due to circuit resistance, these values are not obtainable when checking the current at the controller or at the brake.

NOTE: The above values are for a two brake system. For systems having more than two brakes, the above values will be slightly less, due to line loss.

At controller, the amperage reading must be the sum of the amperages for each brake in the system. For example, a two brake system having 12x2½ brakes should not read less than 5.6 amperes nor more than 7.4 amperes. If current consumption is less than 5/6 amperes, find the defect in circuit which may include defective controller, defective load control, defective magnet, poor wiring or ground connections. If current consumption is more than 7.4 amperes, it is possible stop light is in brake circuit, controller, load control, magnet or wiring may have a short. If current consumption is within these limits and brakes are still not effective, the trouble will be found in the brake mechanism.

TESTING MAGNET FOR SHORT

Connect magnet as shown in Fig. 18. If any amperage is indicated on ammeter the magnet is shorted.

Connect second magnet wire to ammeter and touch the battery wire to magnet shell. If any amperage is indicated, the magnet is shorted. The short may be in the magnet contact wire assembly or coil may be shorted in the magnet shell. A short in the magnet wire contact assembly may be corrected by replacing magnet wire contact assembly as shown on page *19* If with a new magnet wire contact assembly, the magnet is still shorted, the short is in magnet coil and the complete magnet assembly MUST be replaced.

Fig. 18

Some of the old style magnets in the field have only one wire. These magnets CANNOT be tested as described above.

NOTE: When testing, touch battery wire to magnet shell momentarily. If magnet has a dead short it will be harmful to ammeter if connection is made for any period of time.

TESTING MAGNET FOR AMPERAGE CAPACITY

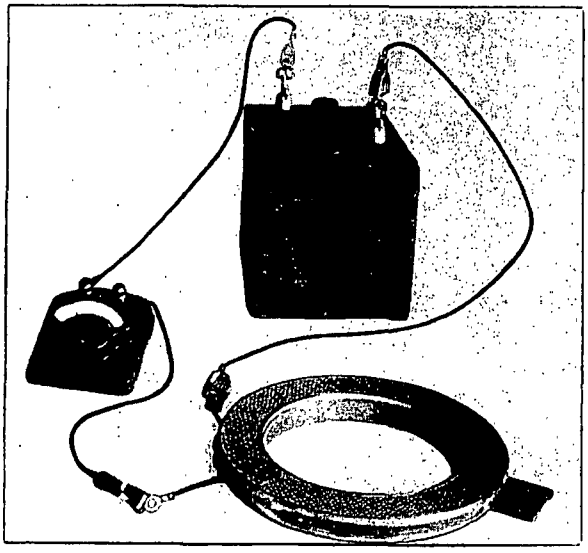


Fig. 19

Connect magnet as shown in Fig. 19. and take ammeter reading. Check the amperage reading against the amperage shown on name plate spot welded to the magnet. A variation of 10% from the amperage on name plate is permissible. The amperage on the name plate is the amperage that the magnet should show if tested with exactly 6 volts and the magnet at a temperature of approximately 70 degrees F. If the magnet is hot when tested, the resistance in the magnet coil is increased and the amperage reading may be lower than that shown in nameplate. A reverse condition would be found if magnet being tested is cold.

EXAMPLE: If a 3.7 magnet is being tested from a brake that has been exposed to 10 degrees below zero temperature, it would be allowable for magnet to test as high as 4.1.

When magnet does not check within these limits it should be replaced.

TESTING LOAD CONTROL

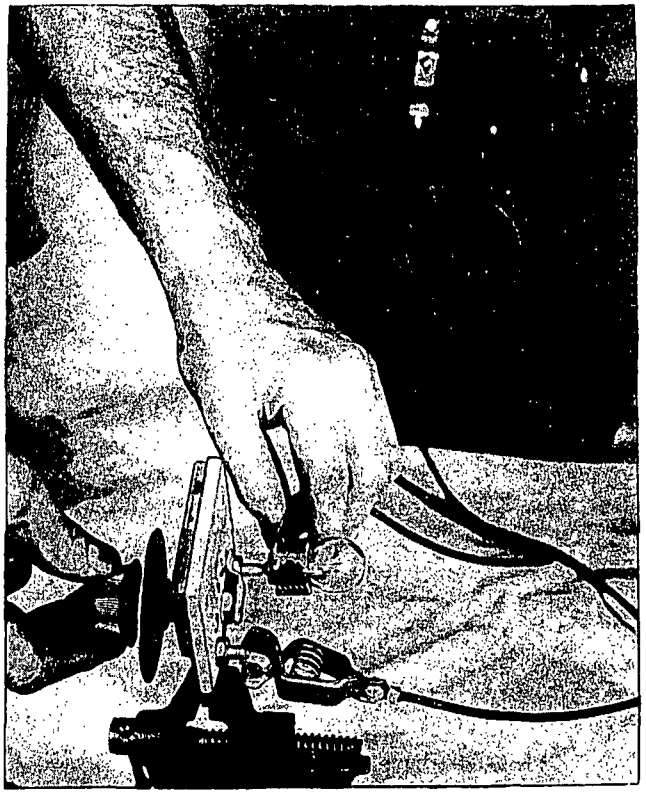


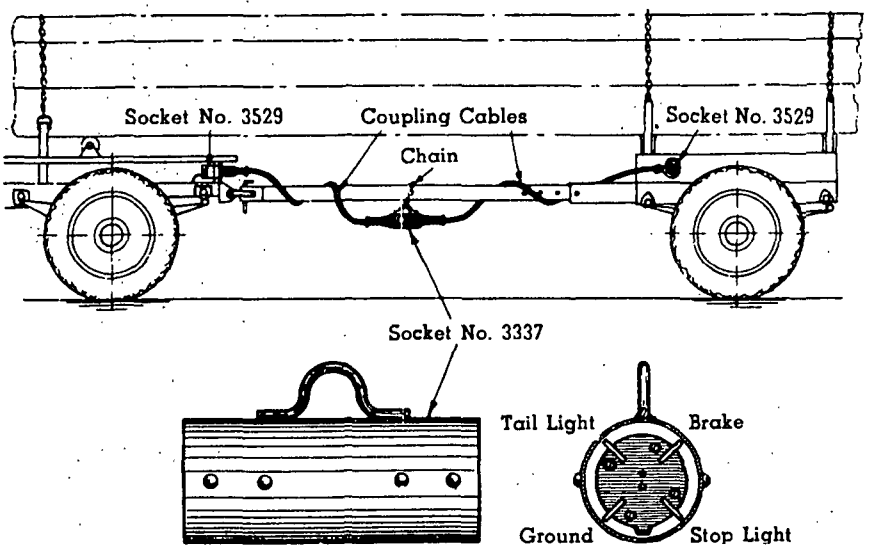
Fig. 20

Connect load control, battery and TWENTY-ONE candlepower light bulb as shown in Fig. 20. The bulb should light and increase in brightness in 3 steps as load control knob is turned to the right. The bulb MUST stay lit with knob in any position.

The load control can be tested on the job by connecting ammeter to the controller as shown on page *11*. Hold control lever in a full application position. Move load control from low to full capacity. The ammeter must show a reading with load control in any position and the amperage indicated on ammeter should increase in 3 steps as load control knob is turned to the right.

Repair or replace load control if it does not check as indicated.

DOUBLE END SOCKET



Double End Socket for making cable extensions, avoiding the necessity of long cables or reels.

Fig. 21

12 VOLT RESISTOR WIRING DIAGRAM

Electric Brakes are designed to operate from a 6 Volt System. Where a 12 Volt System is used this resistor reduces the current to the required amperage.

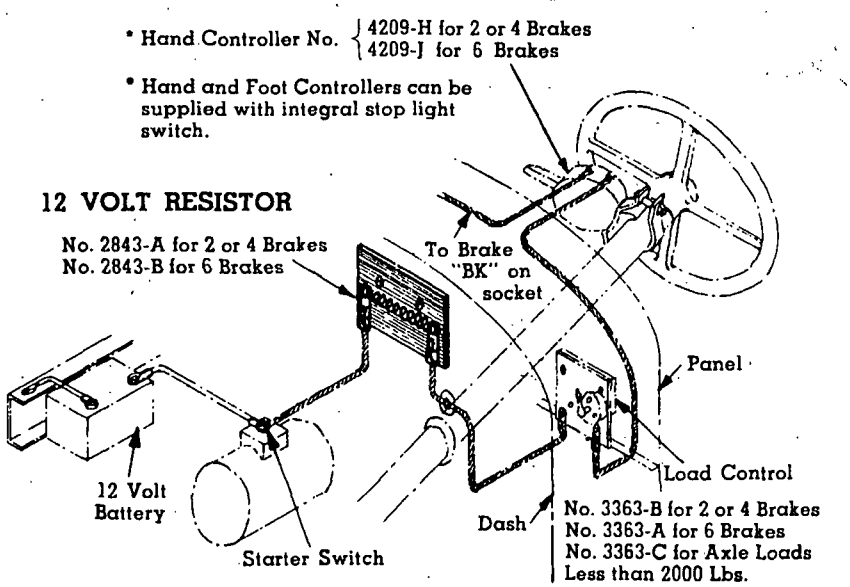


Fig. 22

SERVICING BAKELITE COUPLING PLUG

3 Wire Cable Assembly (See Fig. 23)

Remove outer cover of cable (1) 1½" back from end exposing rubber covered wires (2). Remove insulation from wires (2) 3/16" back from end. Slide cable (1) through plug handle (10). Place dust shield (12) on cable (1). Assemble cable clamp (3) as close to the end of cable as possible. Slip all wires (2) through insulating washer (4). Slide insulating sleeves (5) on wires (2). Solder terminals (6) on wires (2) and slide insulating sleeves (5) down over soldered ends of terminals (6). Place terminals (6) on bolts (7) in plug end (8) through terminal clip (13). Refer to Figure 23 for wire color code and markings on plug end (8). CONNECTIONS MUST BE ACCURATE. Tighten nuts (9) down on terminals (6). Bend terminals (6) up at a 90° angle after tightening nuts (9). If this is not done plug handle (10) will not slide down over wires. Slide plug handle (10) down to plug end (8). Turn plug handle (10) so bolt in cable clamp (3) will not rest on top of either of the two lugs inside of plug handle (10). Be sure the key on plug handle matches with key on plug end. Assemble bolts (11) through plug handle (10) and plug end (8) to hold them together.

SERVICING BAKELITE COUPLING PLUG

4 Wire Cable Assembly (See Fig. 24)

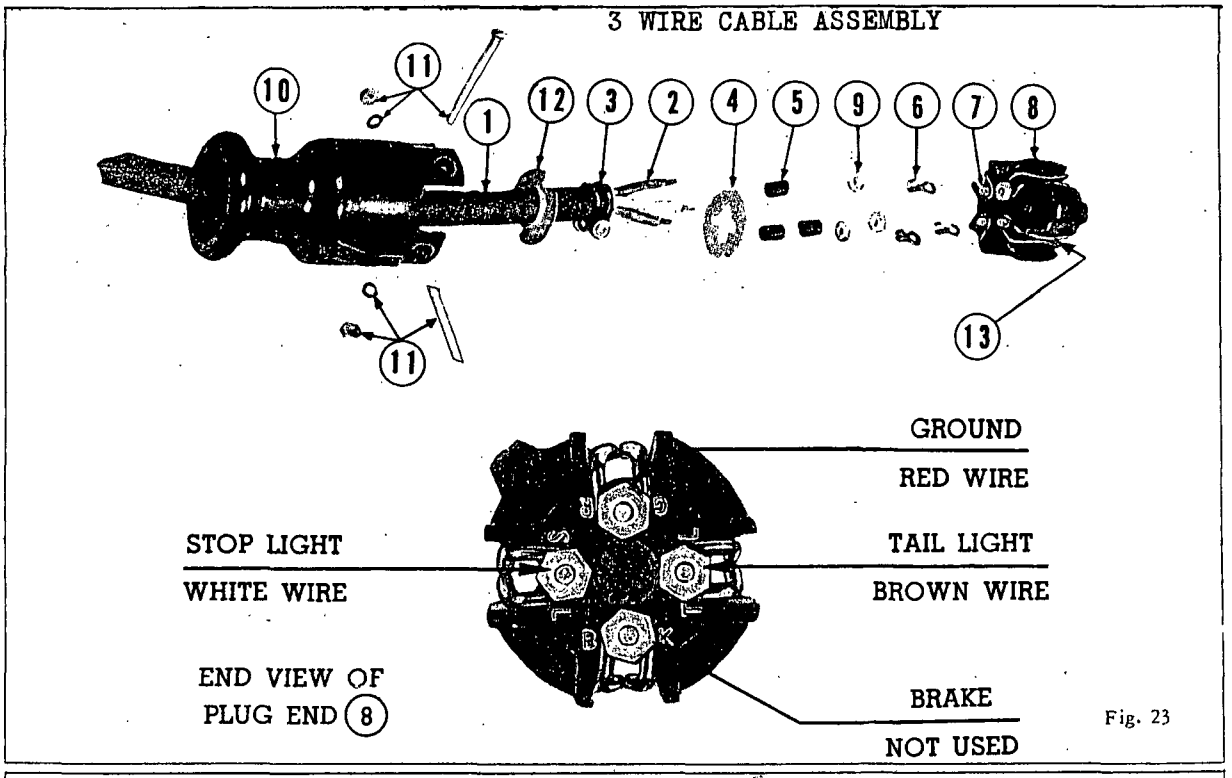


Fig. 23

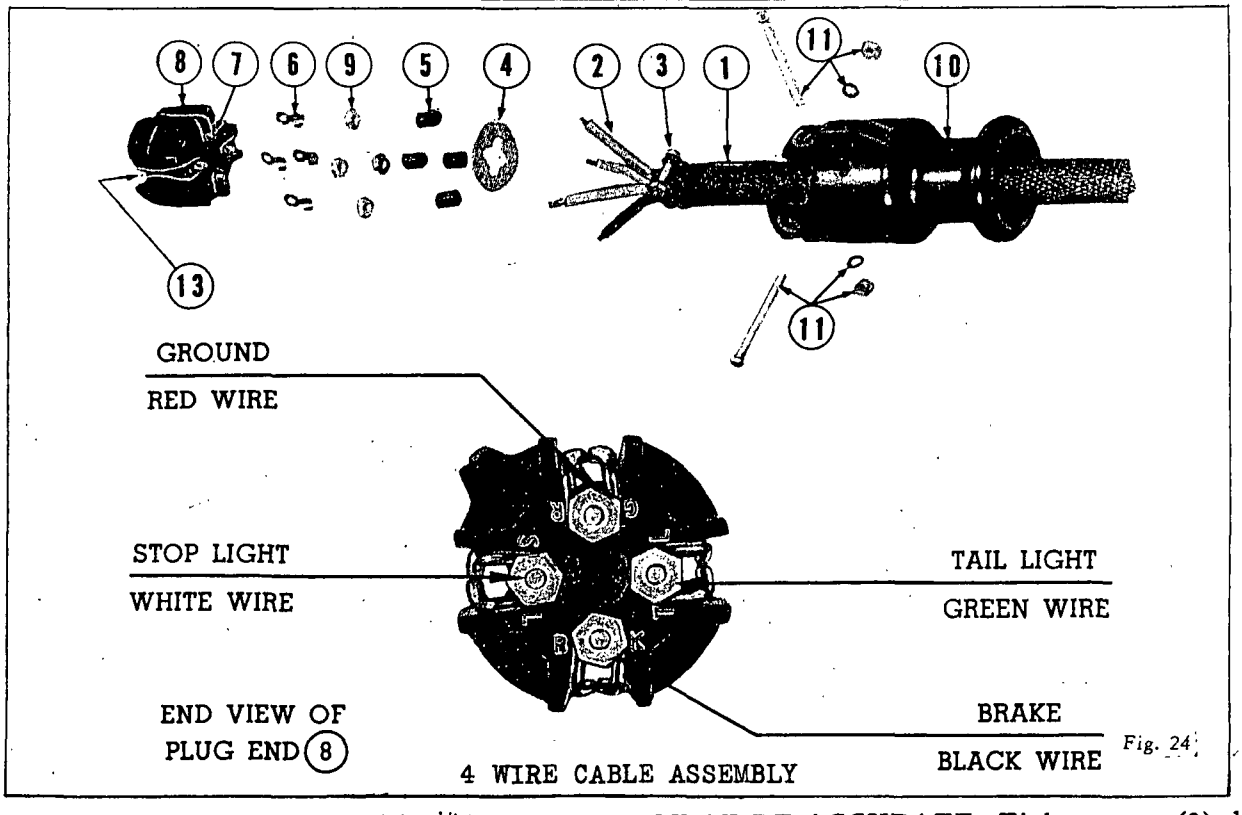


Fig. 24

Remove outer cover of cable (1) $1\frac{1}{2}$" back from end exposing individual rubber covered wires (2). Remove insulation from wires (2) 3/16" back from end. Slide cable (1) through plug handle (10). Assemble cable clamp (2) as close to the end of cable as possible. Slip all wires (2) through insulating washer (4). Slide insulating sleeves (5) on wires (2). Solder terminals (6) on wires (2) and slide insulating sleeves (5) down over soldered ends of terminals (6). Place terminals (6) on bolts (7) in plug end (8) through terminal clip (13). Refer to Fig. 24 for wire color code and markings on plug end (8). CONNECTIONS MUST BE ACCURATE. Tighten nuts (9) down on terminals (6). Bend terminals (6) up at a 90° angle after tightening nuts (9). If this is not done plug handle (10) will not slide down over wires. Slide plug handle (10) down to plug end (8). Turn plug handle (10) so bolt in cable clamp (3) will not rest on top of either of the two lugs inside of plug handle (10). Be sure the key on plug handle matches with key on plug end. Assemble bolts (11) through plug handle (10) and plug end (8) to hold them together.

SERVICE ON ALL RUBBER TYPE COUPLING CABLES

If cable plugs develop short circuits or broken wires, Warner Electric Brake Mfg. Co. will mould new ends for a nominal charge.

The cable is shortened about 8" for each new plug. If present cable uses all the slack it may be too short if new ends are made.

Cables covered with grease will not bond to new ends and therefore cannot be repaired.

BRAKE LINING SPECIFICATIONS

12x1¾ Standard lining (low friction) 3/16" thick, Kit No. BLN-15.

12x1¾ High friction lining 3/16" thick, Kit No. BLN-16.

14x2 Standard lining (low friction) ¼" thick, Kit No. BLN-19.

14x2 High friction lining ¼" thick, Kit No. BLN-20.

16x2½ Standard lining, ¼" thick, Kit No. BLN-7.

16x2½ Same as standard lining except 1/32" thicker (eliminating 1/32 shim) to be used with worn drums only, Kit No. BLN-H7.

17¼x3 Standard lining, ⅜" thick, Kit No. BLN-8.
17¼x4 Standard lining, ⅜" thick, Kit No. BLN-9.
17¼x5 Standard lining, ⅜" thick, Kit No. BLN-10.

The above kits include standard lining and rivets for 2 brakes only.

INSTRUCTIONS FOR USING BAND GAUGES

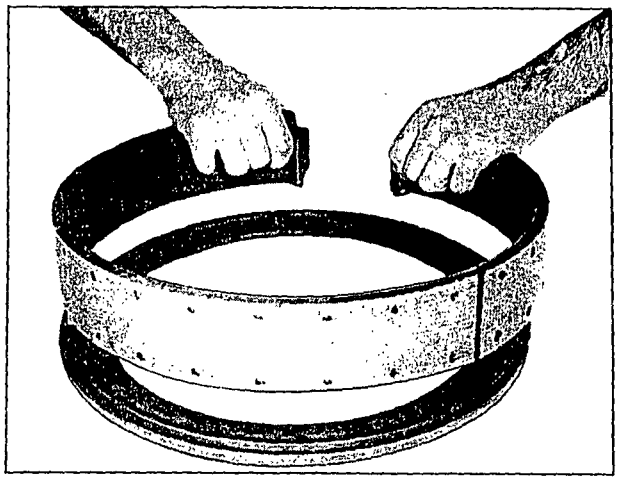


Fig. 25

Band Gauge No. 4740—Used with 12x1¾ Brakes.
Band Gauge No. 4843—Used with 14x2 Brakes.
Band Gauge No. 4698—Used with 16x2½, 17¼x3, 17¼x4, 17¼x5 Brakes.

To get the best performance out of a full wrap brake, it is necessary that the band be round. Check all bands for roundness when service work is done or the band is relined.

When band is correct, it should contact the gauge snugly over its entire circumference with a light tension holding it in place.

Bands which are out of round or have flat spots when checked on gauge should be corrected. This can be done by placing band on a wood top bench or block and striking band with a ball peen hammer where necessary. Care should be taken to avoid damaging rivet holes.

An out of round band can cause a weak brake to "grab". If the leading end (toe end) of the band is bent away from the band gauge, the brake will be strong or "grabby". When bent in toward the center the brake will be weak.

The band gauge may be used to check the clearance between the relined band and the drum. This can be done by placing the band assembly on the band gauge and fitting band (on gauge) into the drum. Where the diameter of the drum is found to be more than 1/16 of an inch larger than overall diameter of band assembly (on band gauge) it is suggested that shim stock be used under lining.

CAUTION: When replacing band on backing plate, do not spring bands out farther than necessary.

At the factory the bands are carefully fitted to a gauge before the assembly is made on the backing plate.

All shipments of separate bands are carefully packed so when they arrive at their destination they will be round and ready for installation.

ACTION OF ARMATURE ON MAGNET

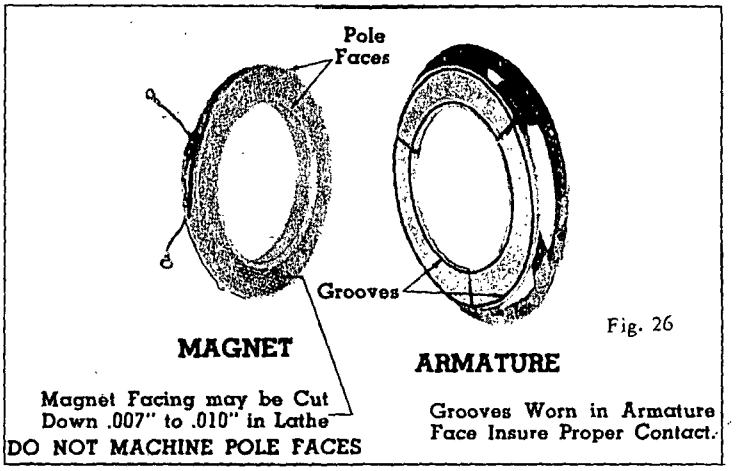


Fig. 26

Check armature depression after facing magnet. (See page 17.)

Old armature will work with an undercut magnet, if pole faces on undercut magnet have not been machined.

A new armature may be used with an old magnet, but, a new magnet MUST NOT be used with an old armature.

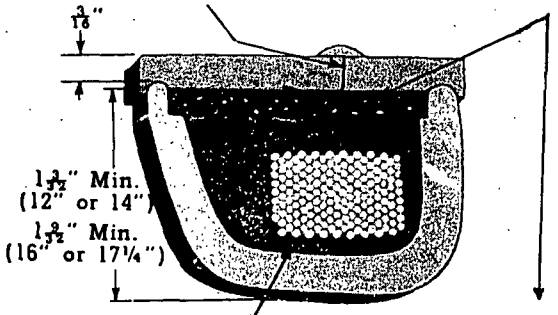
MEASUREMENTS TO DETERMINE WHETHER ARMATURE AND MAGNET ARE WORN TOO MUCH TO BE SERVICED.

See top left, next page.

Warner Electric Brake Mfg. Co. will reface armatures and magnets, if they are not worn under the dimensions shown on illustration.

NOTE: When refaced magnets and armatures are used, spacers will probably be required under the armature mounting ring in order to provide the proper armature depression. See page 17 for armature depression.

AIR GAP (Brass Strip). Its purpose is to remove excess magnetism from the armature and magnet when current is shut off, thus preventing drag between these parts.



MAGNET INSERT must not be refaced when the overall height becomes 1 3/32" or less (for 12" or 14" brakes) or 1 9/32" or less (for 16" or 17¼" brakes). The remaining thickness of insert after facing would be too thin to provide further satisfactory service. Therefore replace with a new magnet.

ARMATURES Should not be refaced in field service, unless, the proper equipment is available for holding the armature segments securely in place while machining in order to insure true surfaces.

Fig. 27

MAGNET AND ARMATURE RELATION

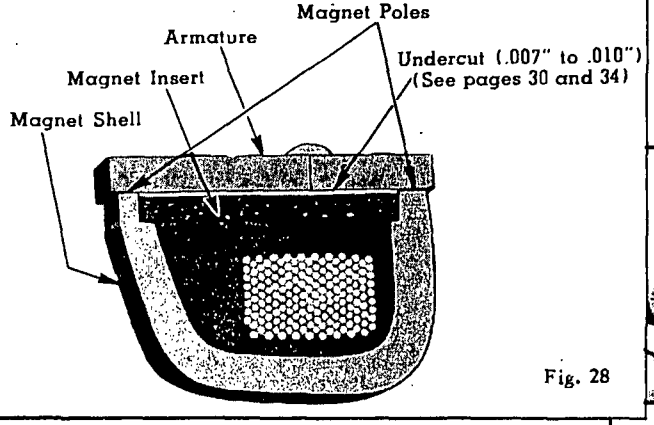


Fig. 28

NEW BRAKES: Armature in contact with magnet poles—not in contact with magnet insert, due to undercut.

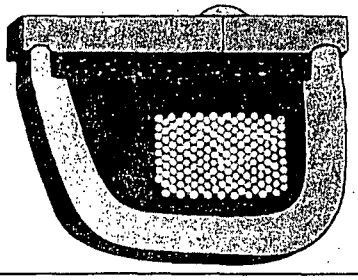


Fig. 29

AFTER FEW MILES: Magnet poles have grooved into armature allowing contact with magnet insert.

NOTE: Armature is in contact, both with magnet poles and insert.

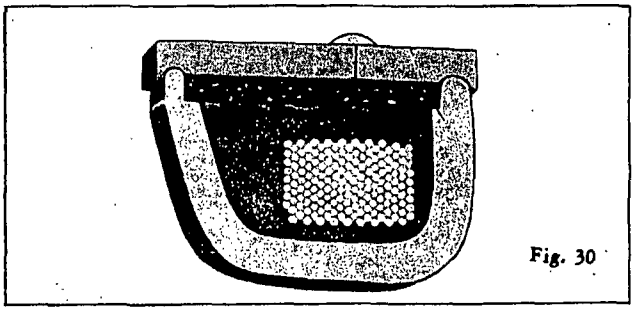


Fig. 30

AFTER MANY THOUSAND MILES: Note deeper grooves in armature and worn insert. Armature is still in contact, both with magnet poles and insert.

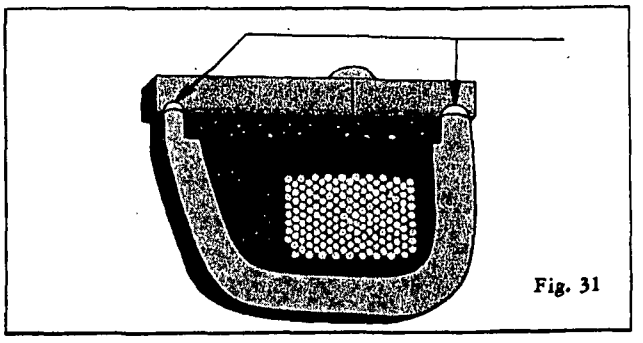


Fig. 31

NOTE—NO CONTACT: Grease or a glazed surface retards insert wear, also reduces brake applying force, resulting in reduced brake efficiency. This condition can be corrected by refacing magnet as shown on page *19*

MEASURING ARMATURE DEPRESSION DRUM AND ARMATURE ASSEMBLY ON WHEEL

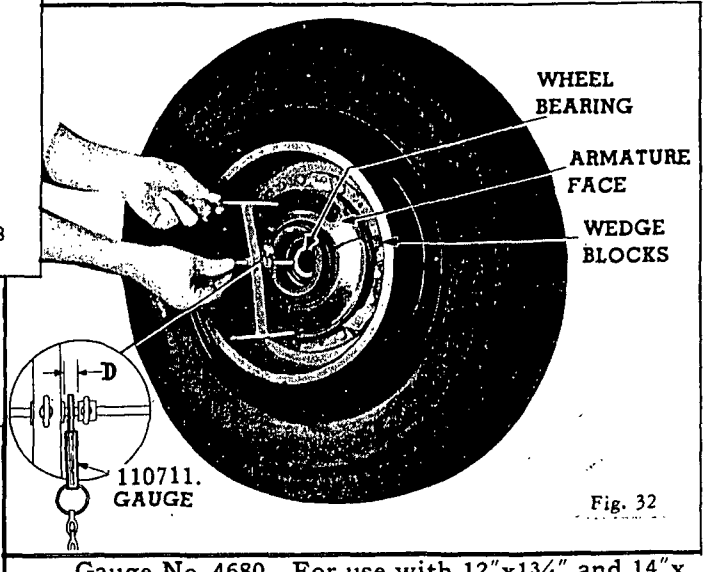


Fig. 32

Gauge No. 4680—For use with 12"x1¾" and 14"x 2" Brakes.

Gauge No. 4812—For use with 16"x2½" and 17¼"x3"-4"-5" Brakes.

The armature segments should contact the magnet and be depressed approximately 5/32" when the drum and hub are mounted in running position. This depression can be determined before the drum is placed on axle by the use of armature gauge as shown above. The gauge may be purchased from Service Department.

BRAKE ASSEMBLY ON AXLE

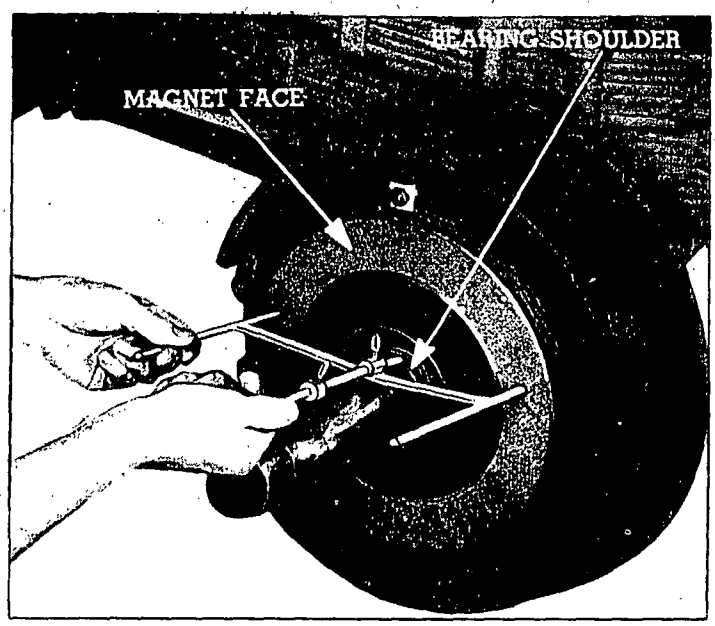


Fig. 33

SPACERS USED UNDER ARMATURE MOUNTING RING

Spacer No. 3313, 1/16" Thick
Spacer No. 3313A, 1/32" Thick
For use with 16"x2-½" and
17¼"x3"-4" and 5" brakes.

Spacer No. 3516, 1/16" Thick
Spacer No. 3516A, 1/32" Thick
For use with 12"x1¾" and
14"x2" Brakes.

INSTRUCTIONS FOR USING GAUGE

1. Loosen both thumb screws.
2. Place short ends of gauge against magnet facing.
3. Push adjustable rod against bearing shoulder.
4. Tighten thumb screw on the gauge frame.
5. Slide collar against frame.
6. Tighten thumb screw in the collar.
7. At three places wedge the armature segments away from the drum.
8. Place inner bearing in the hub.
9. Place long ends of gauge against armature face.
10. Loosen thumb screw in the gauge frame.
11. Push adjustable rod against the wheel bearing. (Be sure bearing is snug against bearing race in the hub.)
12. Tighten thumb screw in the gauge frame.

NOTE: The distance D, from collar to gauge, is the distance the armature segments will be depressed when the hub and drum is assembled on the axle. This distance should be 5/32" plus or minus 1/32" and can be checked with a scale or "go no go" gauge No. 110711. **Fig. 32**

If the distance at D is less than ⅛", then space out the armature by using spacers as required under the armature mounting ring.

If the distance at D is more than 3/16", a HARDENED spacer should be used between bearing and bearing shoulder on the axle. Bearing spacers not furnished by Warner Electric Brake Co.

1. If small end of the pin will enter slot at D and large end will not, armature depression is O. K.
2. If the small end of pin will not enter slot at D, use spacers as required under armature mounting ring.
3. If large end of pin enters slot D, use hardened spacer between bearing and bearing shoulder on the axle.

EXAMPLE: A 14" x 2" brake is being worked on. The armature depression is checked and is found to be 1/16". It would then be advisable to use one layer (three) of No. 3516 spacers, and one layer of No. 3516A spacers under the armature mounting ring. This would increase the armature depression from 1/16" to the required 5/32". In checking the depression, be sure the bearing is snug against the bearing race in the hub and the armature disc is wedged away from the armature mounting ring.

In assembling do not allow grease, however slight, to touch any part of the brake. Grease will cause grabbing, locking or loss of power. Bearings must be hand packed with a good wheel bearing grease. Under no circumstances should a grease gun be used and all grease fittings on hubs must be plugged before releasing the unit for service.

When drum is placed in running position, the axle nut must be pulled up snug to prevent loose bearings. The brake loses power if the armature is not kept firmly in contact with the magnet. R.H. armature must be mounted on right side of vehicle (facing direction of travel), L.H. armature on opposite side.

UNDERCUTTING OF MAGNET

When there is a complaint that brakes are weak and nothing is found wrong with the electrical parts of the brake system, it is often necessary to reface the magnet to correct the condition shown in Fig. 31 on page 17.

The magnet should be placed in the lathe as illustrated and from .007" to .010" removed from *facing only*. If when .010" has been removed from the facing there still is evidence of glaze, facing should be undercut until all glaze is removed.

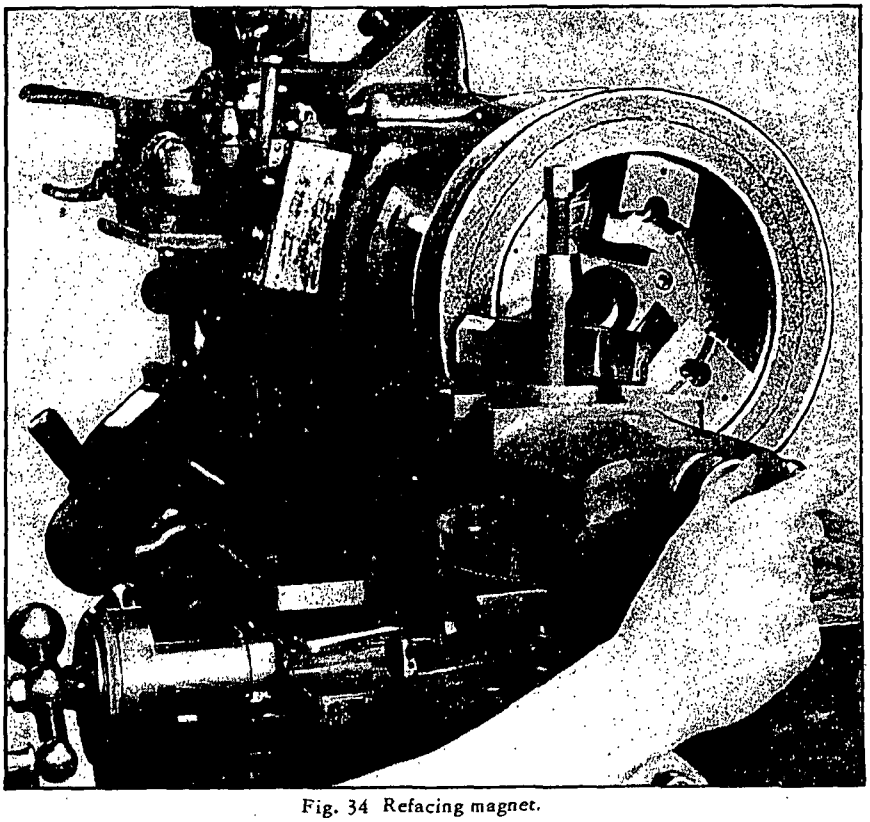


Fig. 34 Refacing magnet.

REPLACING MAGNET CONTACT WIRE ASSEMBLY

Shorts or broken wires sometimes make it necessary to replace the magnet contact wire assembly. Replace the assembly as follows: (Fig. 35)

1. Use soldering iron to melt solder on terminals. With a screw driver open the copper clips (No. 1) that are pinched against the wires (No. 2) coming from magnet coil.

2. With the screw driver bend the two wires coming from magnet coil so that coil wires (No. 2) point away from magnet shell.

3. Spread the steel clips (No. 3) that hold the assembly on the magnet shell.

4. Release the insulator and wire under the wire clips (No. 4).

5. Remove old contact assembly and replace with new one as shown in Figure 36.

6. Bend the steel clips tight against the fibre block. This may be done by tapping clips lightly with a hammer.

7. Bend the wire clips against the two insulated wires.

8. Fit the wires from coil into the copper clips and pinch the clips together.

9. Solder the coil wires into the copper clips.

CAUTION: Be sure no solder is splattered so as to short the coil wires to the magnet shell.

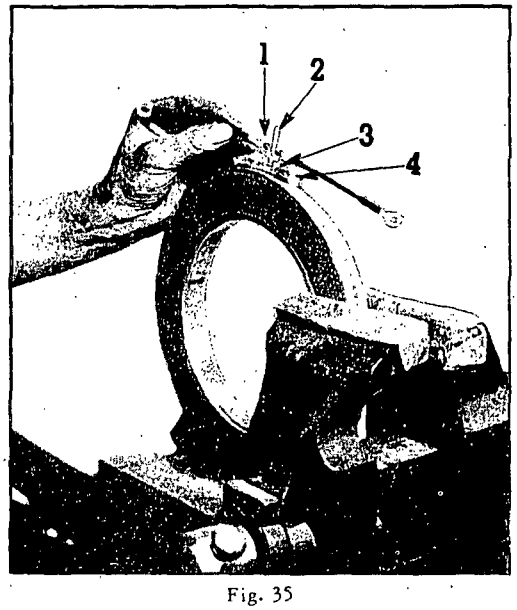


Fig. 35

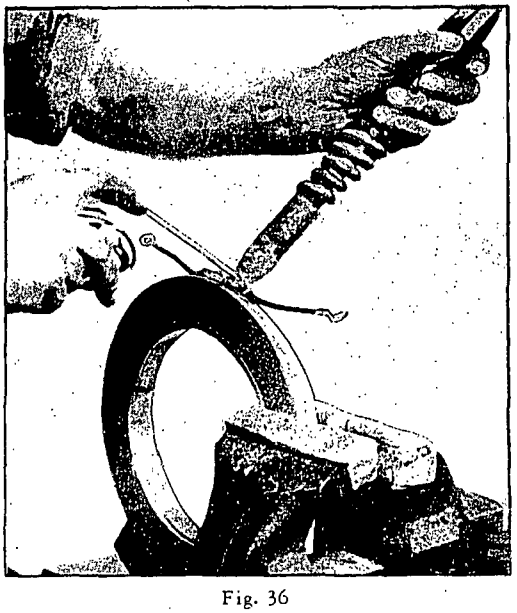


Fig. 36

CHECKING THE DRUM FOR CONCENTRICITY

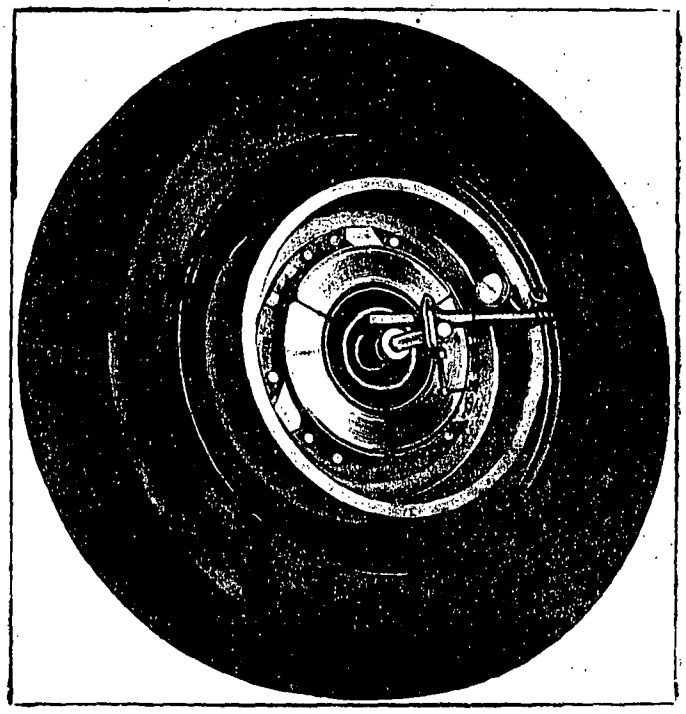


Fig. 37

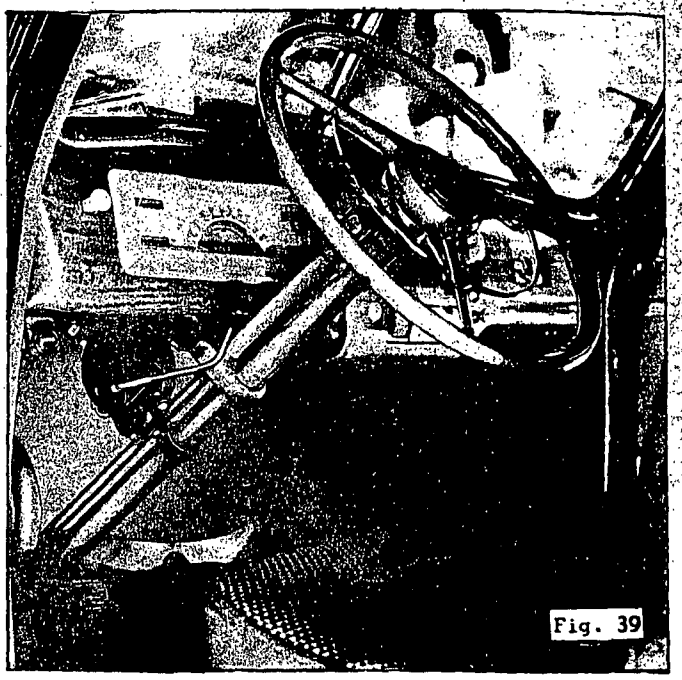
It is important that the brake drum be concentric. In the illustration an arbor with cones fitted into hub bearings is used with a dial indicator. The drum may also be checked for concentricity when set up in a drum lathe. It is considered advisable to true up drums when they show more than a .010" total dial indicator reading with the drum mounted on a hub as shown. Out of round drums cause the brakes to be "grabby". Therefore, it is important that the condition of the drums be given consideration when checking a complaint of "grabby" brakes.

It is suggested that not more than 1/16 of an inch of metal be removed from drum. Removal of more than 1/16 of an inch of metal will weaken drum to the extent that with a hard brake application drum may break and cause serious damage to the brake mechanism.

NOTE: When drums are rebored it is necessary to use shim stock between lining and brake band to compensate for the larger drum bore.

INSTALLATION OF FOOT CONTROLLER

MOUNTING 3388AR HAND CONTROLLER ON AUTOMOBILE



A. MOUNTING CONTROLLER AND CONTROLLER ROD ASSEMBLY.

1. Mount the controller on the frame as shown.

NOTE: A bracket bolted to the frame is sometimes used to permit an easier or better installation of the controller.

2. Attach long threaded rod to the center hole on the controller lever.

NOTE: Attach long threaded rod to the center hole on the controller lever.

NOTE: The threaded rod (approximately 7" long) may be cut to any desired length to make installation easier or better.

3. Have the foot brake pedal and the controller lever in a released position.

4. Attach the "clamp accessory" to the controller rod assembly and tractor brake rod as shown in **Fig. 38.** Leave clamp accessory nuts loose.

5. Place the controller lever on the serrated shaft as shown in **Fig. 38.**

NOTE: Included angle between controller lever and the controller rod assembly should be from 65 to 70 degrees as shown.

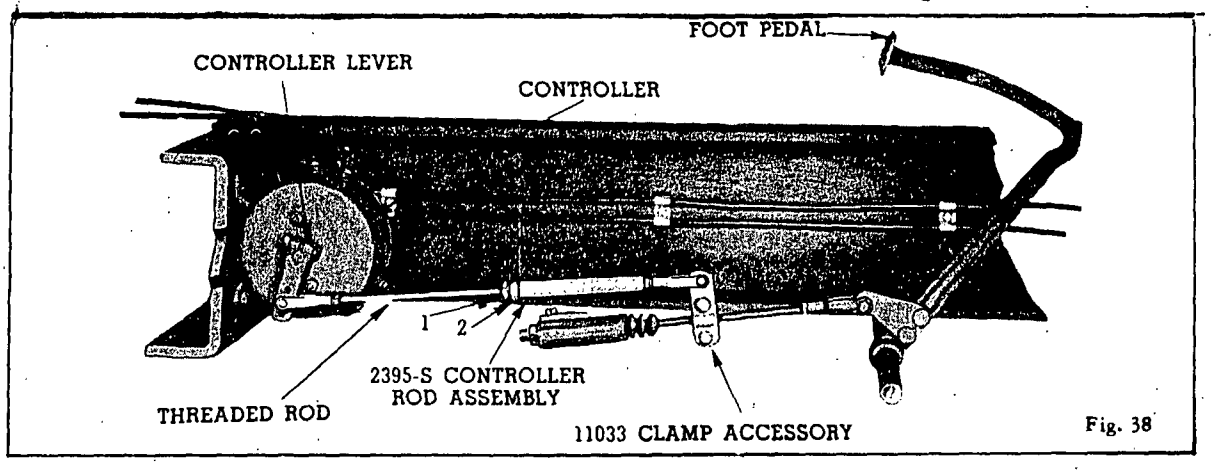


Fig. 38

6. Tighten the two clamp accessory nuts.

B. TO ADJUST THE CONTROLLER FOR FREE PEDAL TRAVEL.

1. Loosen lock nut No. 2 (Fig. 38)

2. Move the foot brake pedal back and forth through its arc of free travel.

3. Back No. 1 sleeve nut out of controller rod case until about ¾ of the free pedal travel does not move controller lever.

4. Tighten lock nut No. 2.

5. By adjusting No. 1 sleeve nut as indicated in step 3, the trailer brakes will be applied slightly ahead of tractor brakes. This is insurance against trailer "jack-knifing".

C. CONNECTING CONTROLLER ROD ASSEMBLY TO THE PROPER HOLE IN THE CONTROL LEVER.

1. Remove clevis and pin from controller lever.

2. Hold foot brake pedal in a "maximum brake application position."

3. Hold controller lever in a fully applied position.

4. Replace the clevis and pin in the hole on controller lever that will hold the controller in a fully applied position.

5. Release foot brake pedal and be sure No. 2 nut and the nuts on the clamp accessory are tight.

D. OPERATION.

1. When the free travel of foot brake is changed, it will be necessary to adjust the controller rod free travel by changing position of No. 1 sleeve nut as indicated in adjustment of free travel. DO NOT move clevis and pin to a different hole on controller lever to make an adjustment after the controller has been properly installed.

NOTE: As a safety feature, a coil spring is built into the controller rod assembly to allow overall length of controller rod to increase approximately ⅜". This spring comes in play ONLY if the controller rod is in need of adjustment.

BRAKE INSTALLATION

The performance of an Electric Brake depends entirely upon an accurate installation. Follow instructions, for accuracy is definitely demanded and a brake properly installed assures long life and dependable performance.

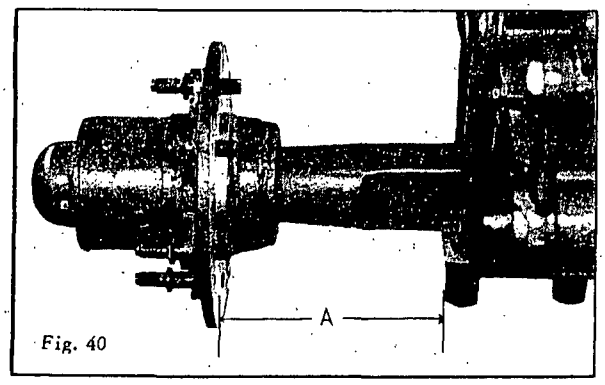


Fig. 40

The space (A) allowed between the hub and spring determine the size brake which can be mounted on an axle. Following are minimum clearance necessary:

14 x2	3-7/16"
16 x2½	5-½"
17-¼x3	7-5/16"
17-¼x4	8-⅜"
17-¼x5	9-3/16"

To accommodate the largest size brake in the minimum space allowed, drums with various overall widths are available.

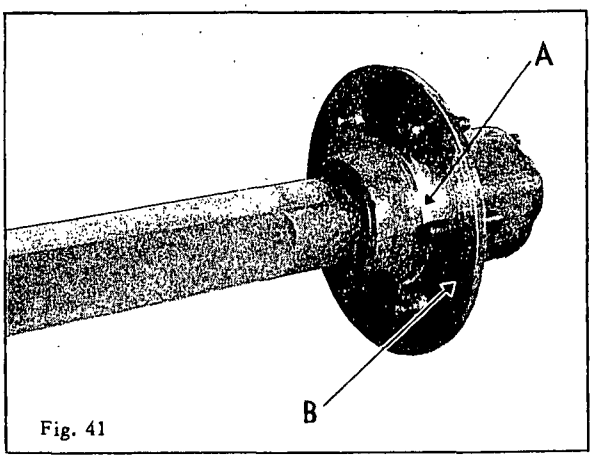


Fig. 41

In preparing for the installation remove the hub from the axle. The mounting collar (A) must run at perfect right angles with the flat surface (B). This is accomplished by placing the hub in a lathe —using its own bearings on the arbor centering. Bore the drum to fit shoulder (A) holding the limits to .002 and drill for bolt circle. Mount drum and tighten nuts securely. Peen the studs to insure permanent tightness.

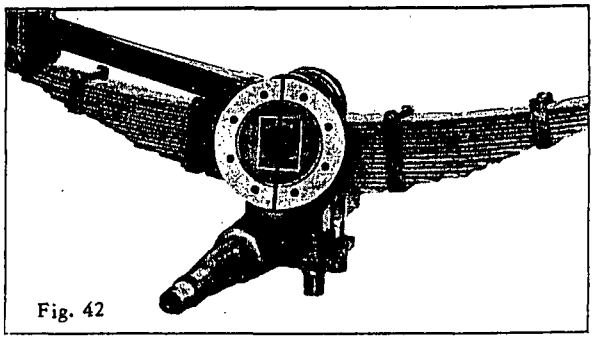


Fig. 42

The adapter or mounting collar is to be welded to the axle. As illustrated, mark the inside of the adapter 1/16" larger than actual size of axle. Cut opening with torch.

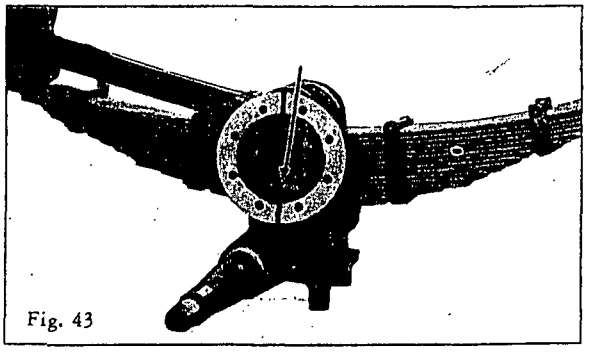


Fig. 43

Brake adapter. (To prevent possible distortion cut through the metal from the hole to shoulder illustrated by arrow). Grind rough edges slightly for in welding these rough edges provide an excellent bond.

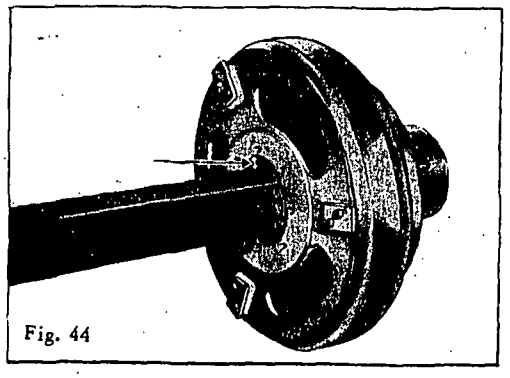


Fig. 44

Insert welding fixture inside drum and place both in running position on axle. Have wheel bearing nut tight. Revolve drum. The fixture must be held to .004 limits as it rotates on axle at location indicated by arrow. Set screws are provided to adjust plate to these limits.

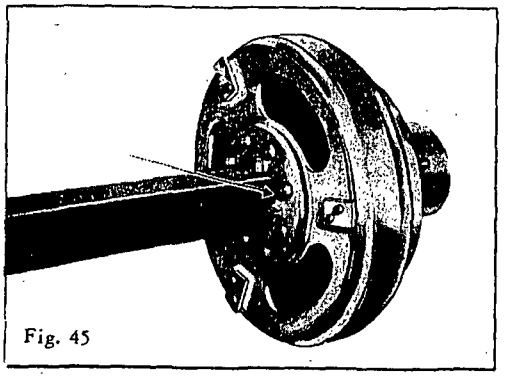


Fig. 45

Bolt adapter to welding fixture. Note in illustration the clearance between adapter and axle. Approximately 1/16" opening should be allowed to prevent binding.

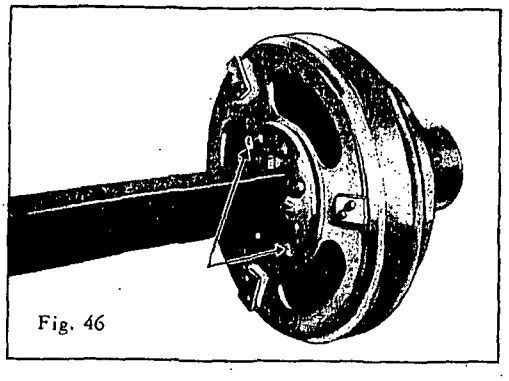


Fig. 46

With an electric arc, tack both outer edges of broken adapter as indicated by arrows.

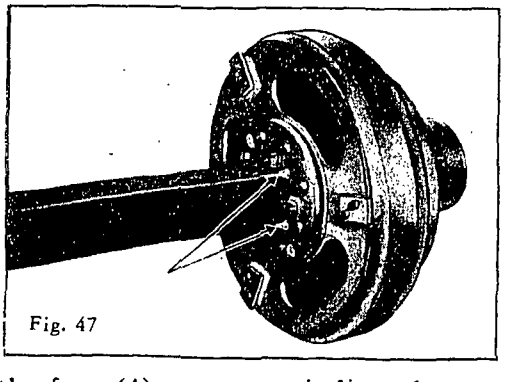


Fig. 47

Tack the four (4) corners as indicated.

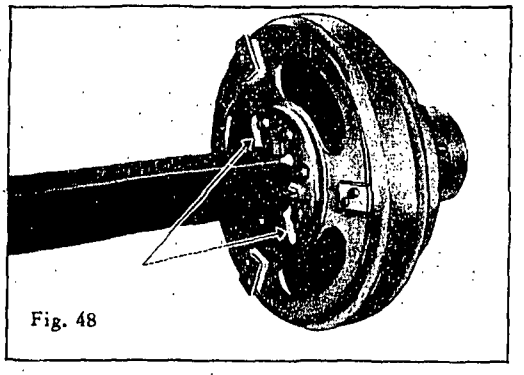


Fig. 48

Weld broken seams starting on each outer edge —working toward the axle until completed.

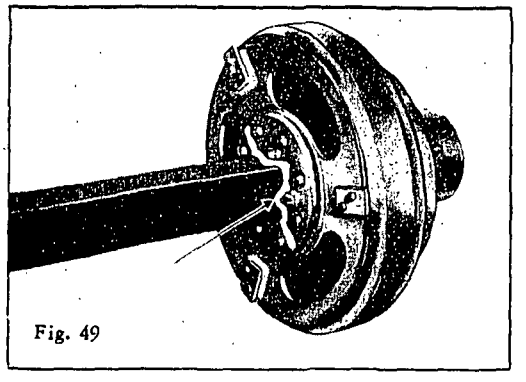


Fig. 49

To complete the welding operation start from any corner of the axle and weld to the lug on the adapter as illustrated. Turn axle and repeat. This prevents warping. Remove the bolts, welding fixture and drum from the axle. Repeat welding operation on opposite side of adapter. Mount brake in position.

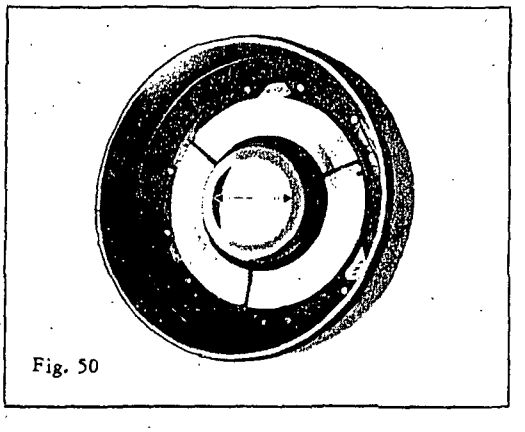


Fig. 50

Prepare grease guards by cutting hole ⅛" larger in diameter than the inner bearing, or grease retainer. Lay the grease guard in drum and place armature over it—attaching both to drum with cap screws provided. To prevent grease escaping, a gasket sealing compound is used between the grease guard and drum. WARNING: Right and left hand armatures are furnished and are so marked on armature ring.

INSTALLING BRAKES ON COACH TRAILERS

NOTE: For installing on axles which do not have brake support plates order brake No. 1210.

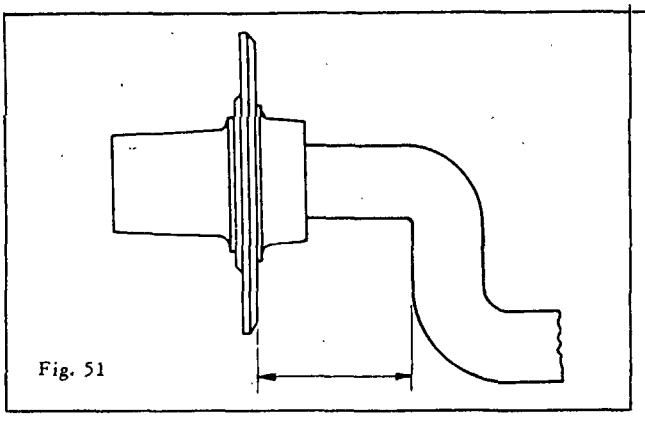


Fig. 51

A space 3-7/16" is required. Brakes can be installed at any point indicated above.

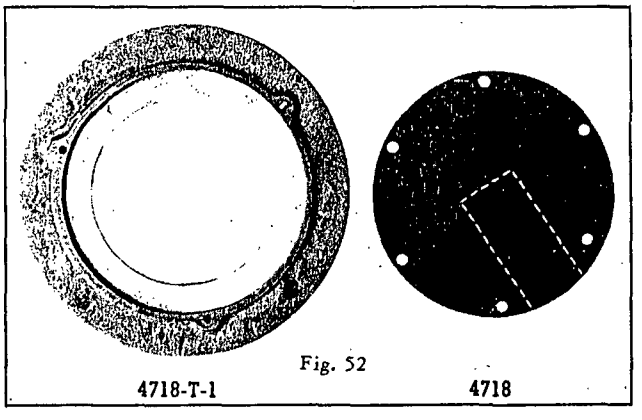


Fig. 52

4718-T-1 4718

After drums are fitted to hub, fixture No. 4718-T-1 is then inserted in drum. Hub and drum is placed on axle in normal position. Fixture automatically indicates exact position of brake support plate No. 4718 and holds it in position while it is being welded to axle. Brake support plate No. 4718 must be cut from axle clearance as indicated.

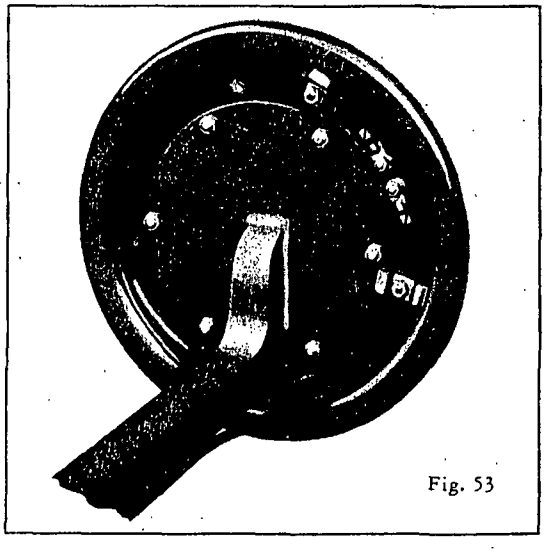


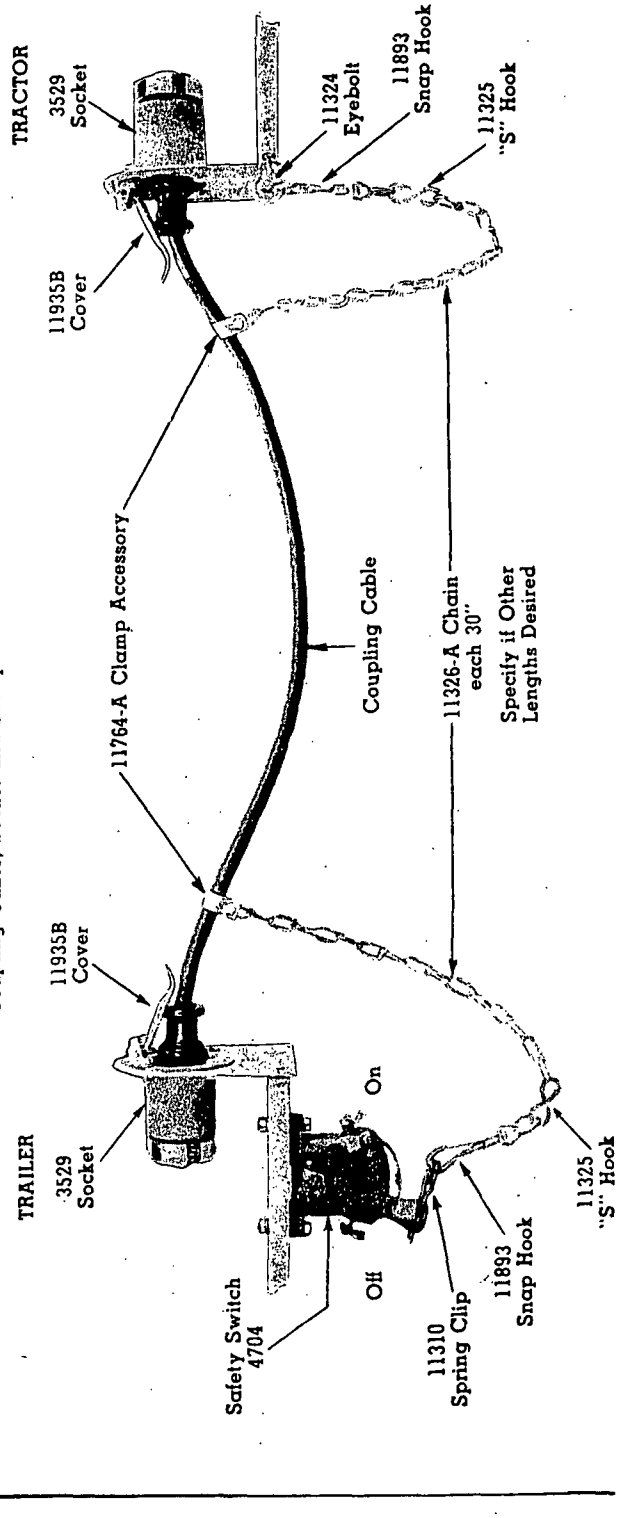
Fig. 53

Installation of brake No. 1210 completed.

EMERGENCY BREAK-AWAY ASSEMBLY

SAFETY SWITCH HOOK-UP ACCESSORY No. 3381

Coupling Cable, Socket and Safety Switch not included with accessories



WIRING DIAGRAM

TWO WIRE SYSTEM

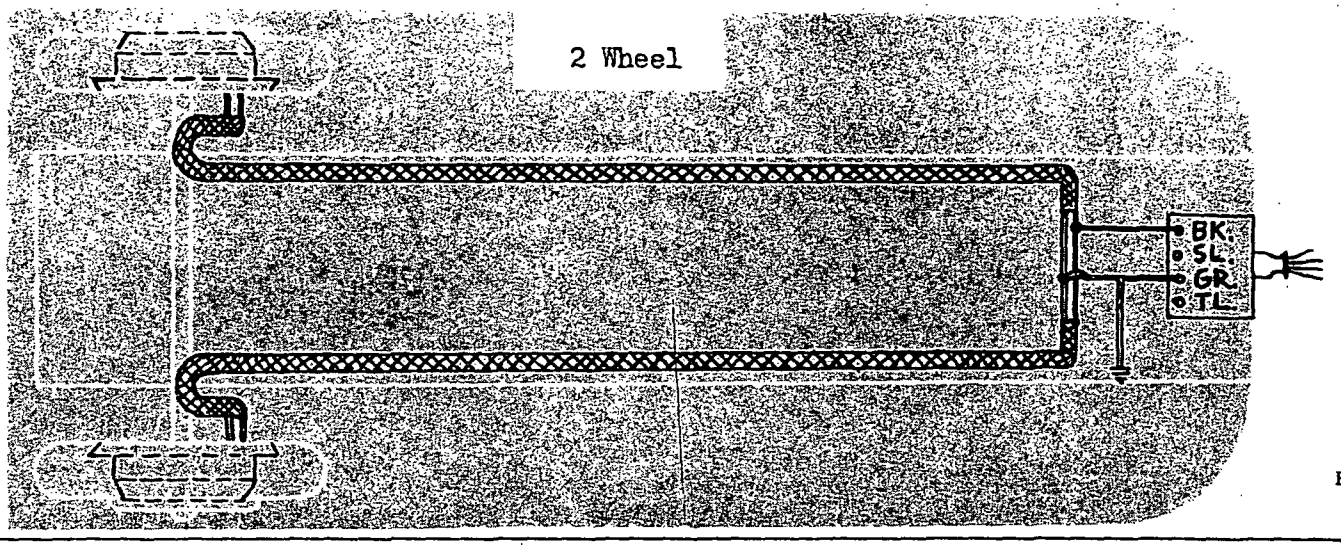


Fig. 55

EMERGENCY BREAK-AWAY ASSEMBLY

SAFETY SWITCH HOOK-UP ACCESSORY No. 3392

Coupling Cable, Socket and Safety Switch not included with accessories

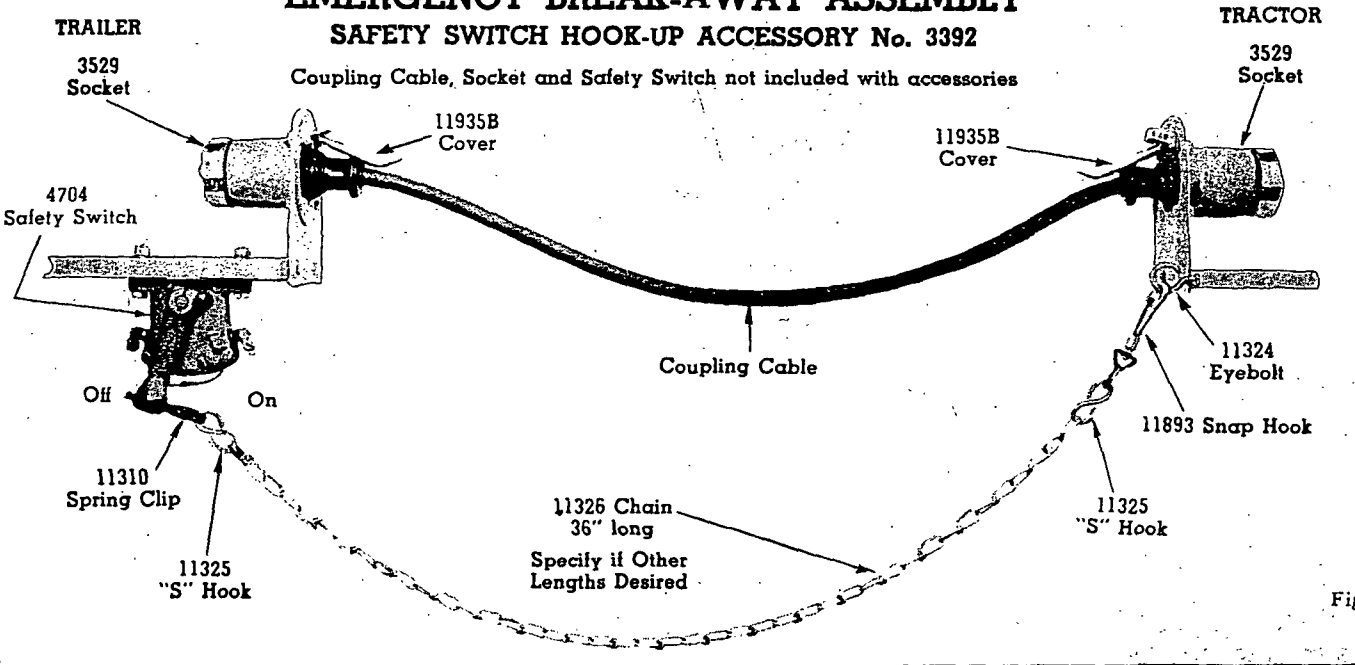


Fig. 56

WIRING DIAGRAM
TWO WIRE SYSTEM

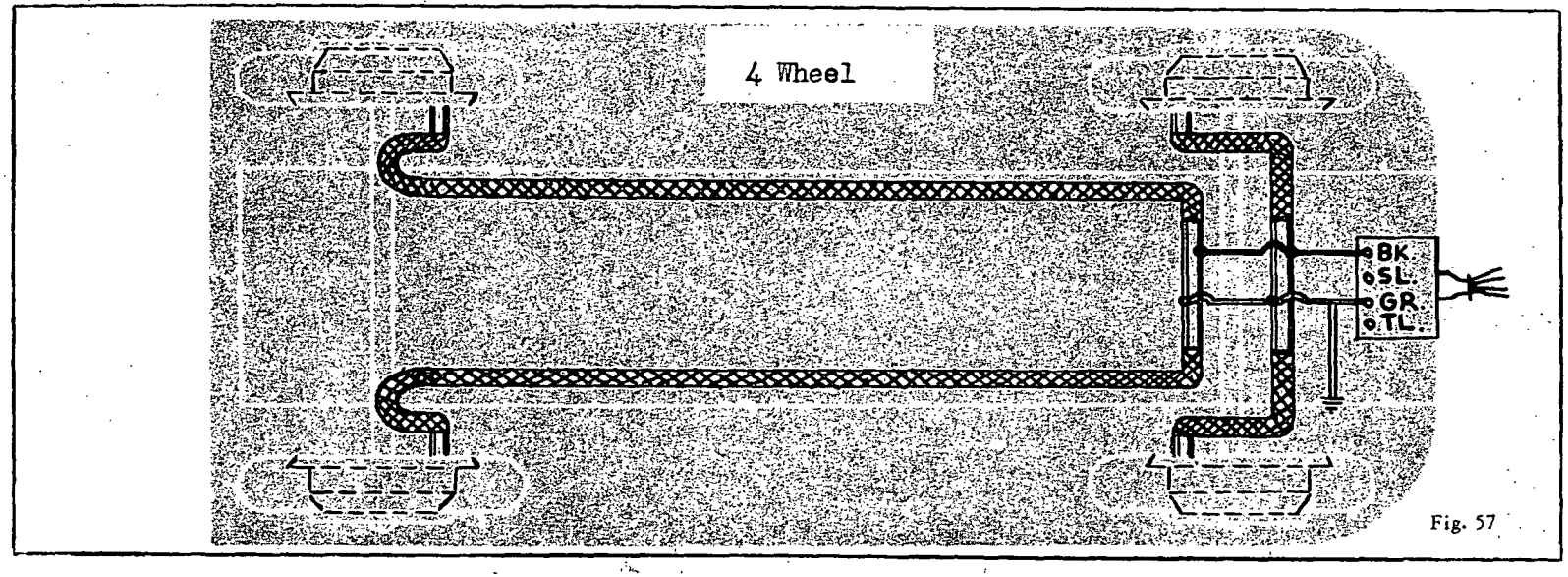


Fig. 57

WIRING DIAGRAM
SINGLE WIRE SYSTEM

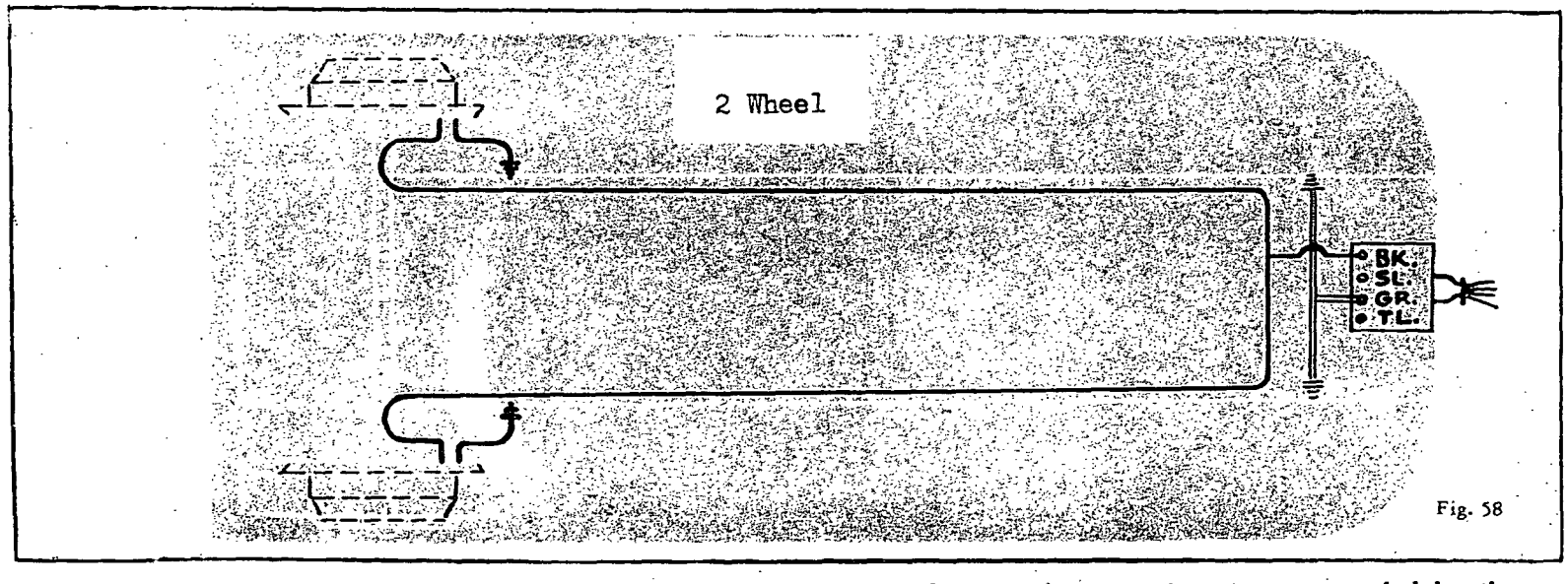
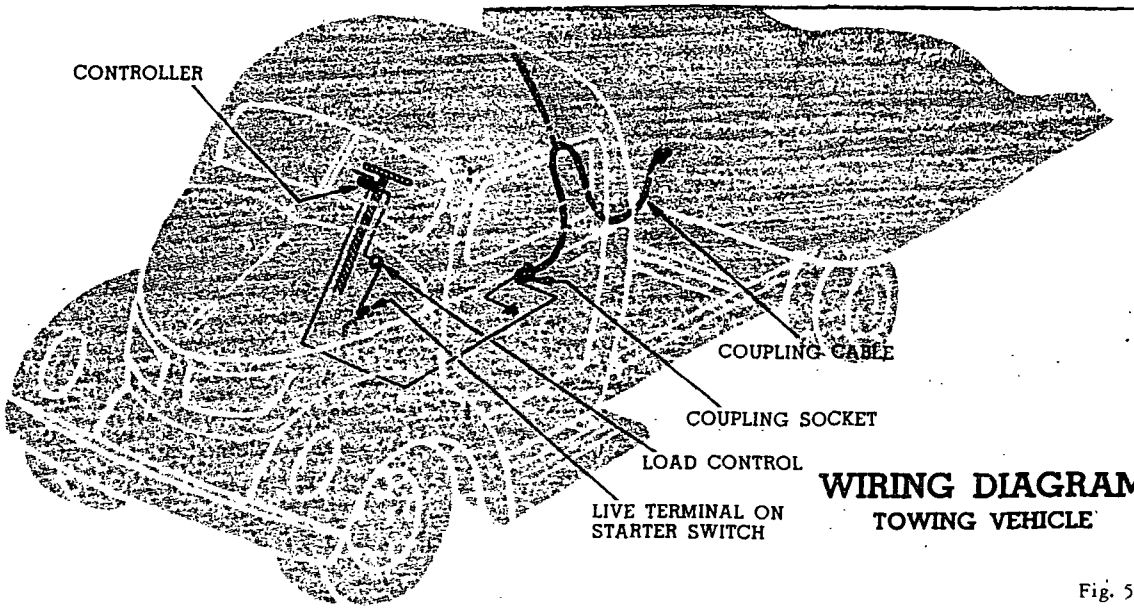


Fig. 58

The wiring diagram shown above, while followed by some trailer manufacturers, is not recommended by the WARNER ELECTRIC BRAKE MFG. CO. When servicing trailers wired as shown, make sure all ground connections on the frame are welded.



WIRING DIAGRAM
TOWING VEHICLE

Fig. 59

For best results ground Coupling Socket on frame at battery ground connection.

WIRING DIAGRAM
SINGLE WIRE SYSTEM

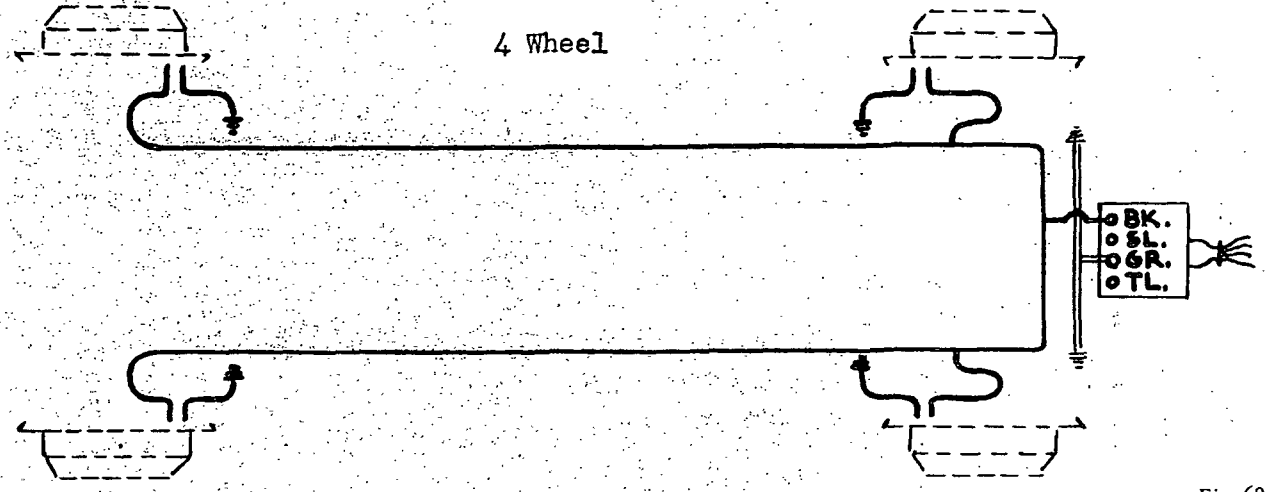
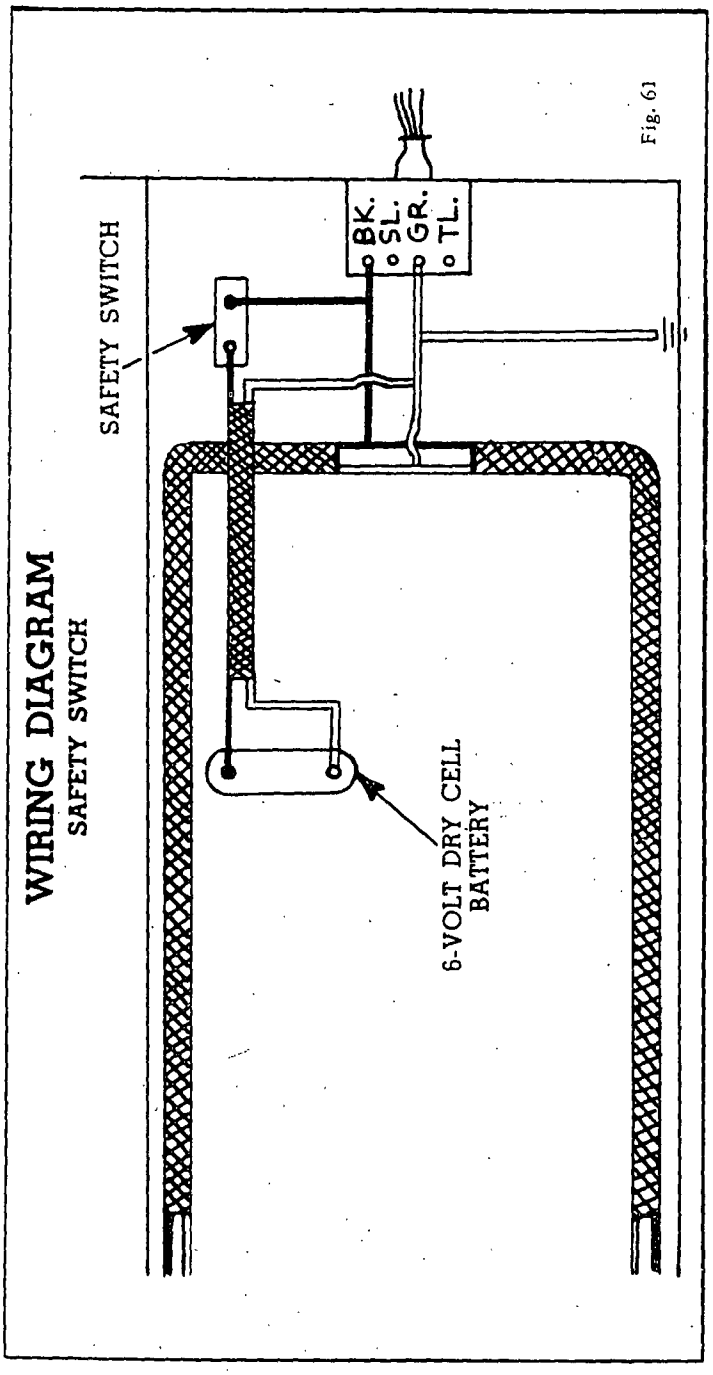


Fig. 60

The wiring diagram shown above, while followed by some trailer manufacturers, is not recommended by the WARNER ELECTRIC BRAKE MFG. CO. When servicing trailers wired as shown, make sure all ground connections on the frame are welded.



SUGGESTED BRAKE SIZES FOR GIVEN AXLE LOADS AND TIRE SIZES:

Brake Size	Max. Axle Load (Incl. Pay Load)	Max. Tire Size	
12x1-¾ (Standard lining)	2,500#	6:50x16 (Single)	6 ply
12x1-¾ (High friction lining)	3,500#	7:00x17 (Single)	8 ply
14x2 (High friction lining)	5,500#	8:25x20 (Single)	10 ply
16x2½	10,000#	7:50x20 (Dual)	10 ply
17¼x3	14,000#	9:00x20 (Dual)	10 ply
17¼x4	18,000#	11.00x20 (Dual)	12 ply
17¼x5	20,000#	11:00x20 (Dual)	12 ply

These suggestions are for normal use and conditions. If you have a specific installation under consideration, the Engineering Department will be pleased to make brake recommendations upon request. When so doing, please state type of vehicle, gross axle loads (including pay load) number of wheels, tire size and weight distribution.

TROUBLE SHOOTING

NO BRAKES OR INTERMITTENT BRAKE

PROBABLE CAUSE: Broken wire in circuit.

PROBABLE REMEDY: Check entire wiring system for broken wires and install new wire where it is found necessary. All splices or joints in the brake circuit MUST BE SOLDERED.

PROBABLE CAUSE: Poor connections.

PROBABLE REMEDY: Check, clean and tighten all connections of brake, controller, load control and socket.

PROBABLE CAUSE: Broken wire on Magnet.

PROBABLE REMEDY: If broken wire is on outside of magnet shell, replace the magnet contact wires, following instructions on page *19* –.

PROBABLE CAUSE: Poor ground connection in circuit.

PROBABLE REMEDY: Clean and tighten connections. All ground connections on frame MUST BE welded.

PROBABLE CAUSE: Defective plug or socket.

PROBABLE REMEDY: Check plug and socket for loose connections, dirty or corroded blades or broken bakelite insert in socket. When rubber plugs are found defective, repairs can be made as indicated on page *16* . Inspect and repair plastic coupling plugs as per instructions on pages *14* – and *15* -

PROBABLE CAUSE: Controller defective.

PROBABLE REMEDY: 1. With the controller in fully applied position, check the amperage as indicated on page *11* .

2. Short out the controller by connecting both ammeter wires to the two brake wire terminals. If ammeter DOES NOT show a reading with the controller connected as in paragraph 1, but DOES SHOW a reading with controller shorted out, controller is defective and should be repaired or replaced.

PROBABLE CAUSE: Load control burned out or defective.

PROBABLE REMEDY: Assuming the wire and other parts in the electrical circuit ARE NORMAL, the load control can be checked on the job as follows:

1. Connect ammeter in line as shown on page *11* .
2. Hold controller in fully applied position.
3. Turn load control counter-clockwise as far as possible and observe ammeter reading.
4. Slowly turn load control knob clockwise as far as possible.
5. Amperage should increase as load control knob is turned clockwise.
6. If ammeter fails to indicate a flow of current AT ALL TIMES during the changing of position of knob, load control is defective and must be replaced or repaired.

NOTE: The method of checking load control as shown on page *13* - is desirable for a final check or when the condition of other parts in the circuit are questionable.

PROBABLE CAUSE: Magnet shorted.

PROBABLE REMEDY: With magnet removed from backing plate, check as shown on page *13* .

PROBABLE CAUSE: Magnet burned out.

PROBABLE REMEDY: Check the magnet as shown on page *13*

PROBABLE CAUSE: Resistor burned out.

PROBABLE REMEDY: Inspect resistance coil. Replace the coil if it is broken or burned out.

WEAK BRAKES

PROBABLE CAUSE: Improper lining.

PROBABLE REMEDY: Replace with lining recommended by factory.

PROBABLE CAUSE: Worn out lining.

PROBABLE REMEDY: The brake lining may be worn to the full extent of the magnet travel. Reline brake bands with factory approved lining.

PROBABLE CAUSE: Worn brake drums.

PROBABLE REMEDY: Reline brake bands using shim stock, so there will be approximately 1/32" clearance between lining and drum. If the band is made round with a lining grinder that attaches to the axle, as little as ten thousandths of an inch clearance is allowable between lining and drum.

NOTE: Above clearances apply to drums that are concentric. If condition of drum is questionable, it should be checked as shown on page *20* or on a drum lathe.

DO NOT WELD ON BAND ENDS OR CAMS TO COMPENSATE FOR DRUM WEAR.

PROBABLE CAUSE: Glazed magnet facing.

PROBABLE REMEDY: Machine magnet as indicated on page *19* .

PROBABLE CAUSE: Greasy magnet facing.

PROBABLE REMEDY: If magnet insert is greasy use a new magnet. If there is a small amount of grease on insert, remachine as indicated on page *19* .

PROBABLE CAUSE: Greasy brake lining.

PROBABLE REMEDY: Replace with lining recommended by the factory.

PROBABLE CAUSE: Stop lights connected in brake circuit.

PROBABLE REMEDY: Wire a separate circuit for stop lights. Stop lights must not be connected into the brake circuit. This changes the graduation of the circuit as it passes through the controller resulting in weak or grabbing brakes.

PROBABLE CAUSE: Tow vehicle equipped with foot control and the foot control is out of adjustment.

PROBABLE REMEDY: When tractor brakes are adjusted the pedal travel is shortened. This throws the controller out of adjustment. Reset controller according to new pedal travel to cover full range of the controller as indicated on page *20*

PROBABLE CAUSE: Wire broken in insulation.

PROBABLE REMEDY: Check entire wiring system for defective parts. Replace wire that is found defective. All splices MUST BE SOLDERED.

PROBABLE CAUSE: Incorrect armature depression.

PROBABLE REMEDY: The correct armature depression is from 1/8" to 3/16" inclusive. Instructions for checking armature depression will be found on pages *18* .

PROBABLE CAUSE: Insufficient current.

PROBABLE REMEDY: Insufficient current may be due to poor connections as the brake, sockets, plugs, controller, load control, starter motor or ground connections. Check, clean and tighten all connections.

PROBABLE CAUSE: Poor wiring.

PROBABLE REMEDY: Rewire, following diagrams on pages *24* - and *26* .

NOTE: Brakes not having sufficient capacity for the trailer size, weight, etc., will appear weak although they may be operating correctly.

BRAKES GRABBING

PROBABLE CAUSE: Loose wheel bearing.

PROBABLE REMEDY: A loose wheel bearing is the most common cause of "Grabby" brakes. It is very important that bearings be tightened properly. Common practice is to draw the axle nut tight enough to make the bearings bind slightly when wheel is rotated. Then back the nut off from one-sixth to one-quarter turn and lock it in place.

PROBABLE CAUSE: Worn or damaged wheel bearings.

PROBABLE REMEDY: Examine the bearings. If they are worn or damaged, it will be necessary to replace the damaged bearing and its matching cup. Check the hub to see if bearing cups fit snugly and that there are no cracks in hub.

PROBABLE CAUSE: Sticky or grease coated lining.

PROBABLE REMEDY: Replace with new lining recommended by factory. Refer to page *16* . Check the concentricity of drums. One method of checking drums is shown on page *20* .

PROBABLE CAUSE: Drums out of round.

PROBABLE REMEDY: Bore out the drum concentric with axle.

NOTE: It is necessary to use shim stock under lining when drums are rebored.

PROBABLE CAUSE: Axle flange not mounted square with axle.

PROBABLE REMEDY: Reweld flange held in proper welding fixture. Refer to page *21*

PROBABLE CAUSE: Axle loose on springs or frame.

PROBABLE REMEDY: Make necessary repairs.

PROBABLE CAUSE: Lining loose on rivets.

PROBABLE REMEDY: Tighten rivets or replace with new lining and rivets.

PROBABLE CAUSE: Bands distorted.

PROBABLE REMEDY: Round up bands to fit the band gauge. Refer to page *17*

PROBABLE CAUSE: Only one brake working.

PROBABLE REMEDY: Check the amperage at each brake. Inspect the wires leading to brake where no amperage is indicated. If no defect is found in these wires, remove the magnet from backing plate assembly and check it for amperage capacity and shorts as shown on page *13*

PROBABLE CAUSE: Stop lights in brake circuit.

PROBABLE REMEDY: Rewire the stop light in a separate circuit.

PROBABLE CAUSE: Broken or weak band return spring.

PROBABLE REMEDY: Replace with new springs.

PROBABLE CAUSE: Poor electrical connections.

PROBABLE REMEDY: Check wiring for loose connections and broken wires in insulation.

PROBABLE CAUSE: Controller burned out.

PROBABLE REMEDY: Check controller as shown on pages *11* and *12* .

PROBABLE CAUSE: Contactor arm in controller pitted.

PROBABLE REMEDY: Smooth out contactor arm with fine emery cloth.

PROBABLE CAUSE: Contactor blades in controller bent.

PROBABLE REMEDY: Straighten blades with thin flat-nose pliers.

PROBABLE CAUSE: Bushing in magnet worn out.

PROBABLE REMEDY: This bushing when new is 1/16" of an inch thick. Check the thickness of bushing and if it is worn to a thickness of less than 1/32 of an inch, it should be replaced. Old bushing can be removed by driving a prick punch between magnet shell and the bushing. Install new bushing by placing magnet (magnet insert facing down) on a clean bench. Place bushing squarely on top of magnet and gradually drive bushing into magnet. Bushing should be seated ¼" below level of magnet surface that is away from bench. Rough edges caused by driving bushing into magnet, can be smoothed out by tapping them with a ball peen hammer.

BRAKES DRAG

PROBABLE CAUSE: Drums out of round.

PROBABLE REMEDY: Check drum for concentricity. Refer to page *20* .

PROBABLE CAUSE: Broken spring in controller.

PROBABLE REMEDY: Replace with new spring. (Serviceable only on small controller used with house trailer brakes). Other type controllers must be returned to the factory to service broken controller spring.

PROBABLE CAUSE: Broken or weak band return.

PROBABLE REMEDY: Replace springs. Be sure all of broken spring parts are removed from brake assembly.

PROBABLE CAUSE: Bands distorted, unequal clearance.

PROBABLE REMEDY: Refer to instructions for use of band gauge on page *16*

PROBABLE CAUSE: Tow vehicle equipped with foot controller and the foot control is out of adjustment.

PROBABLE REMEDY: When tractor brakes are adjusted the pedal travel is shortened. This throws the controller out of adjustment. Reset controller according to new pedal travel to cover full range of the controller as shown on page *20* .

PROBABLE CAUSE: Warped backing plate.

PROBABLE REMEDY: If plate is bent beyond repair, replace with new plate.

PROBABLE CAUSE: Broken or loose parts.

PROBABLE REMEDY: Remove broken parts. Replace with new parts. Check for other injuries.

NOISY BRAKES

PROBABLE CAUSE: Noisy brakes.

PROBABLE REMEDY: Clean or replace lining.

PROBABLE CAUSE: Loose or worn wheel bearings.

PROBABLE REMEDY: Tighten or replace bearings.

PROBABLE CAUSE: Drum out of round.

PROBABLE REMEDY: Check drum for concentricity. Refer to page *20* .

PROBABLE CAUSE: Band distorted.

PROBABLE REMEDY: Refer to instructions for use of band gauge on page *16* .

PROBABLE CAUSE: Drum scored.

PROBABLE REMEDY: Bore out the drum to remove as much scoring as possible without weakening the drum. Refer to page *20*

PROBABLE CAUSE: Lining loose on rivets.

PROBABLE REMEDY: Tighten rivets or replace with new lining and rivets.

PROBABLE CAUSE: Improper lining.

PROBABLE REMEDY: Replace with lining recommended by factory. Refer to page *16* .

UNEVEN BRAKES

PROBABLE CAUSE: May be due to any of previous complaints.

PROBABLE REMEDY: Check the weaker brake first to find the cause.

DODGE TRUCK BRAKES

The brakes described in this unit are of the Lockheed type and their service procedure is very similar to most other type of hydraulic brakes, such as Bendix, etc., differing only in the manner in which the shoes are adjusted to the brake drum. On the Lockheed brake the brake shoe clearance to the drum is controlled by an eccentric at or near the toe of the shoe, while on the Bendix brake the shoe to drum clearance is adjusted by a star nut located inside the backing plate and is adjusted through a hole in the outside of the backing plate with a special tool for that purpose or, in most cases, this adjustment can be made by using a wide screwdriver. As far as the master cylinder, brake cylinder, bleeding the lines, etc., the servicing on hydraulic brakes all follows the same general procedure.

REMOVAL AND INSTALLATION

BRAKE SHOES

1. Remove wheels and brake drums.
2. Remove brake shoe return springs with special pliers, to avoid bending spring ends (Fig. 62).
3. Install wheel brake cylinder clamps to prevent forcing pistons out of the wheel cylinder.
4. Remove brake shoe anchor bolt "C" washers, oil washer retainer, oil washer, guide spring retainer, guide spring and brake shoes.

To assemble, reverse operations. Also see "Adjustment."

WHEEL CYLINDERS—TO DISASSEMBLE

1. Remove wheel and hub.
2. Block brake pedal at floor board to prevent downward movement of pedal.
3. Disconnect brake line at wheel cylinder.
4. Remove brake shoe return spring.
5. Rock brake shoes so upper ends pull out of brake cylinder boots.
6. Remove cap screws which hold cylinder body to brake support.

CAUTION: Do not allow any brake fluid to come in contact with brake shoes, either from drip ping or from soiled hands.

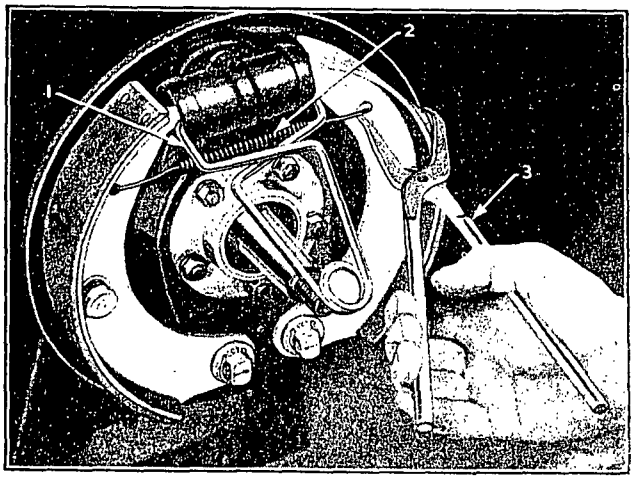


Fig. 62 —Removing Brake Shoe Return Spring

1—Tool C-416
2—Wheel brake shoe return spring
3—Tool C-812

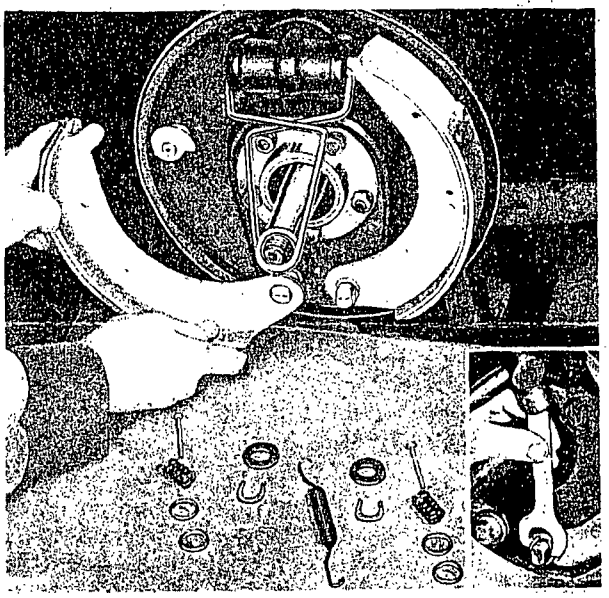


Fig. 63 —Removing Brake Shoe

Wheel cylinder clamp C-416
Anchor bolt lock removing tool C-443

7. Roll rubber boot off each end of cylinder.
8. Pistons, cups and internal parts will then come out of cylinder.

Assemble in the reverse order. Absolute cleanliness is necessary while assembling as outlined under "Master Cylinder."

MASTER CYLINDER—TO DISASSEMBLE

1. Disconnect brake line tube at master cylinder.
2. Remove cotter and clevis pin, which connect piston push rod and pedal. (On trucks equipped with booster brakes remove the cotter and clevis pin which connects the piston push rod and operating link.)
3. Remove bolts which hold master cylinder to chassis and lift out master cylinder assembly.
4. Remove large boot strap and roll large end of boot off master cylinder body. Piston push rod will then drop out of cylinder. If replacing a boot only, perform operations 2 and 4, also remove small boot strap.

Unless replacing a piston push rod or push rod end, do not change adjustment of the end piece. This is seldom, if ever, required. The factory adjustment is correct and permits the piston cup to just pass the relief port (1, Fig. 68), and yet avoid covering the supply port (3), when the pedal is in the released position.

5. Clean the outside of the cylinder assembly.
6. Remove reservoir filled plug and drain out all brake fluid.
7. Remove lock rings in open end of cylinder.
8. Pull out piston stop washer and piston.
9. Tip open end of cylinder downward and piston return spring will come out with the inlet valve assembly.

To assemble, reverse the foregoing operations, but care must be taken to clean the entire cylinder body inside and outside thoroughly, and wash all

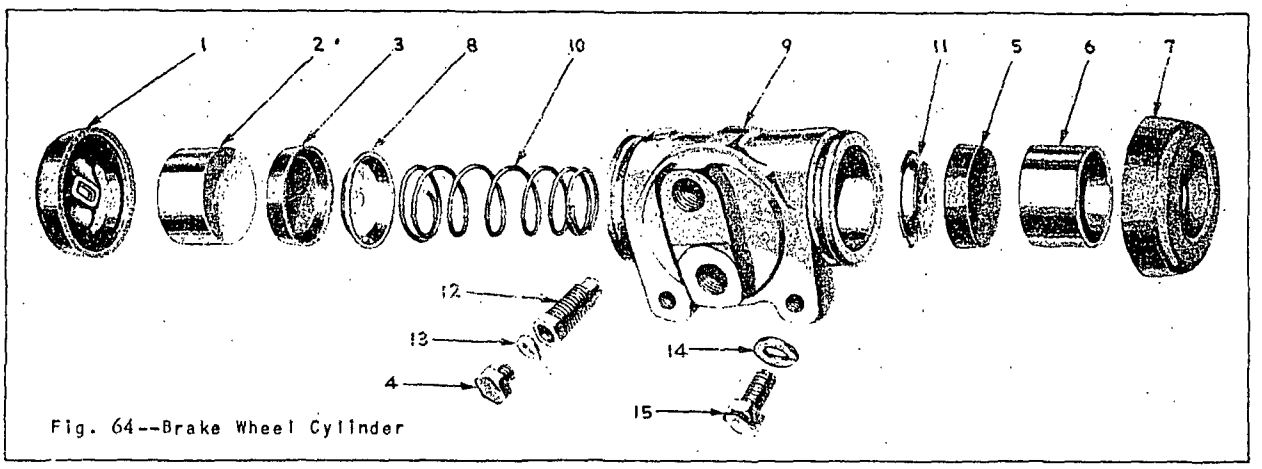


Fig. 64--Brake Wheel Cylinder

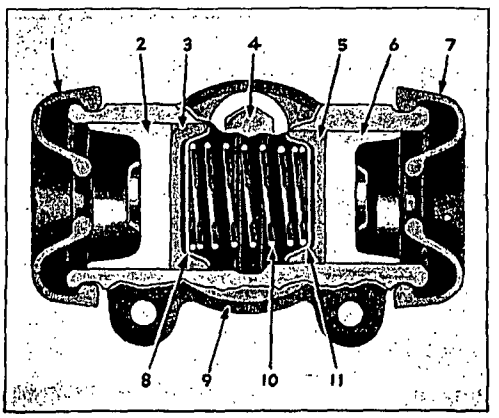


Fig. 65—Brake Wheel Cylinder

Figs. 64 and 65—Brake Wheel Cylinder

1—Boot
2—Piston (large) rear
3—Piston cup (large) rear
4—Bleeder screw cap screw
5—Piston cup (small) front
6—Piston (small) front
7—Boot
8—Piston cup expander (service only) large—rear
9—Cylinder (body)
10—Piston cup spring
11—Piston cup expander (service only) small—front
12—Bleeder screw (valve)
13—Bleeder screw cap screw lockwasher
14—Cylinder to brake support screw lockwasher
15—Cylinder to brake support screw

parts with alcohol, before starting to assemble. Absolute cleanliness is essential because the slightest trace of grit or dirt will probably cause scratches in the cylinder and piston cup, which in turn will cause the brake fluid to leak, or cause improper brake operation. The walls of the cylinder and internal parts should be coated with brake fluid just before assembling. NEVER USE A MINERAL LUBRICANT FOR THIS PURPOSE.

REPLACING BRAKE LINING

Do not install new lining on the brake shoes in *one front wheel without relining the brake shoes* in the other front wheel, or install new lining on the rear wheel shoes without also relining the shoes on the other rear wheel, with new brake shoe lining of the same material. Factory approved brake lining sets are available through the Chrysler Corporation Parts Division.

When riveting the lining to the shoes, it is important that only the proper rivets as supplied by the Chrysler Corporation Parts Division be used. Aluminum rivets should never be used. Hold the lining in the shoe with the brake shoe lining riveting template, Fig. 69.

Rivet heads should be countersunk into the lining approximately two-thirds of the thickness of the lining. Chamfer the end of the lining back about ¾" from the top and bottom, and remove high spots or burrs from around rivet holes. DO NOT USE EMERY CLOTH.

Satisfactory brakes depend upon two fundamental factors which should be checked when adjusting the brakes. These factors are:

1. The drum must be concentric with the wheel hub.

2. The brake lining must be concentric with the drum.

After the lining has been riveted to the shoes snugly and the shoes replaced on the brake support, the concentricity of the brake drum should be checked to make sure that the drum is concentric with the wheel hub. If an eccentric condition is found, the drum should be finished concentric with a drum reconditioning tool, or on a drum lathe.

ADJUSTMENT

Brake shoe adjustments are divided into two classes—minor and major.

A minor brake shoe adjustment is made by moving the "toes" of the brakes shoes. The cam for adjustment is made by moving the "toes" of the brake shoes. The cam for adjusting the "toes" of the shoes can be reached from the outside of the brake support plate.

A major adjustment is made by moving both the "heel" and "toe" of the brake shoes to centralize the shoes in relation to the drum diameter. To make a major adjustment the wheel and hub assemblies should be removed.

The "toe" of the brake shoe is the end which fits into the wheel cylinder. The "heel" is the opposite end, attached to the anchor bolt.

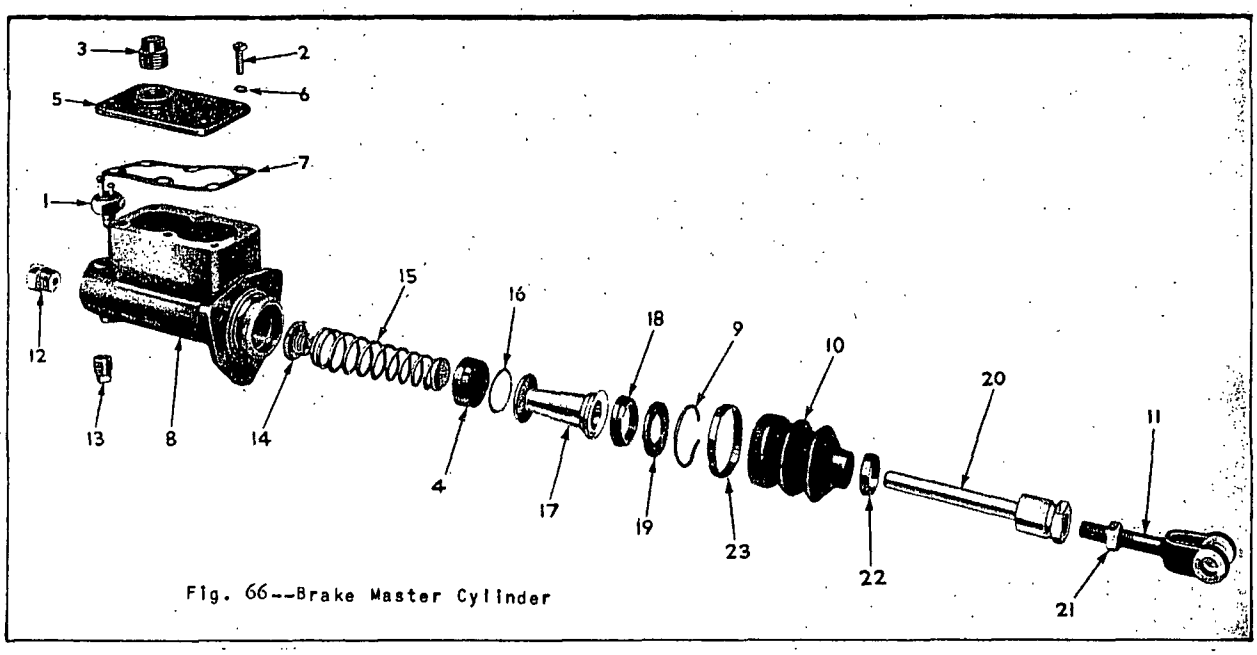


Fig. 66—Brake Master Cylinder

Figs. 66 and 67—Brake Master Cylinder

1—Signal lamp switch
2—Cover screw
3—Filler plug
4—Piston cup
5—Cover
6—Cover screw gasket
7—Cover gasket
8—Master cylinder and supply tank body
9—Piston stop lock wire
10—Boot
11—Piston push rod end
12—Outlet connection
13—Hole plug
14—Valve assembly
15—Piston return spring
16—Piston washer
17—Piston
18—Piston secondary cup
19—Piston stop
20—Piston push rod
21—Piston push rod end lock nut
22—Strap—small
23—Strap—large

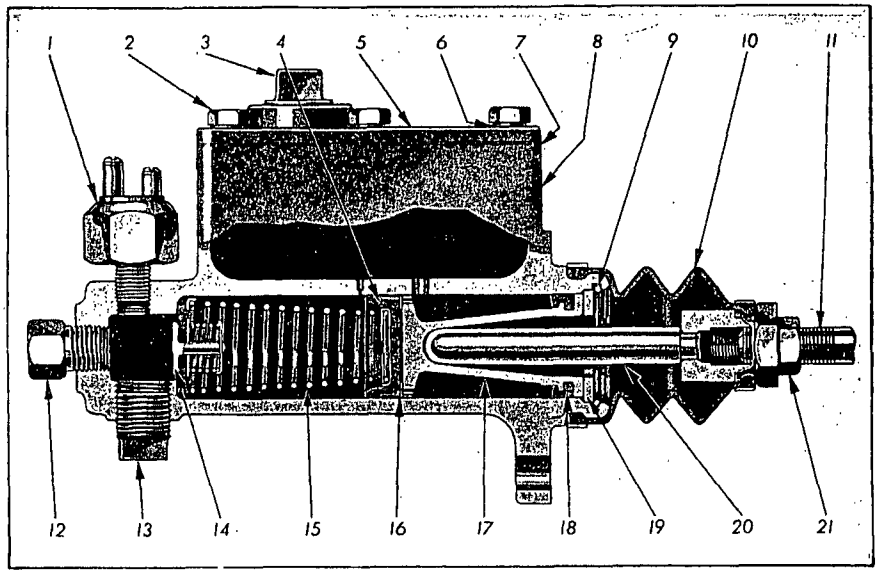


Fig. 67—Brake Master Cylinder

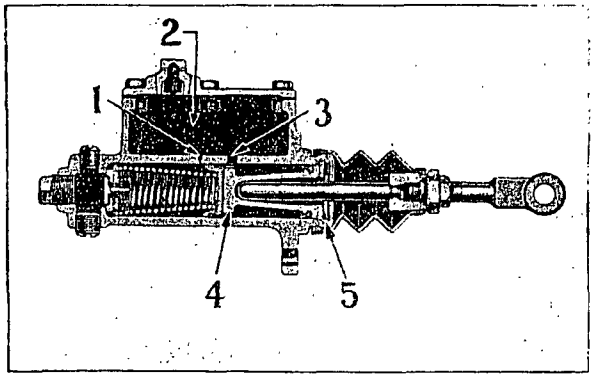


Fig. 68—Brake Master Cylinder

1—Relief port
2—Fluid chamber
3—Port
4—Piston
5—Piston stop lock wire

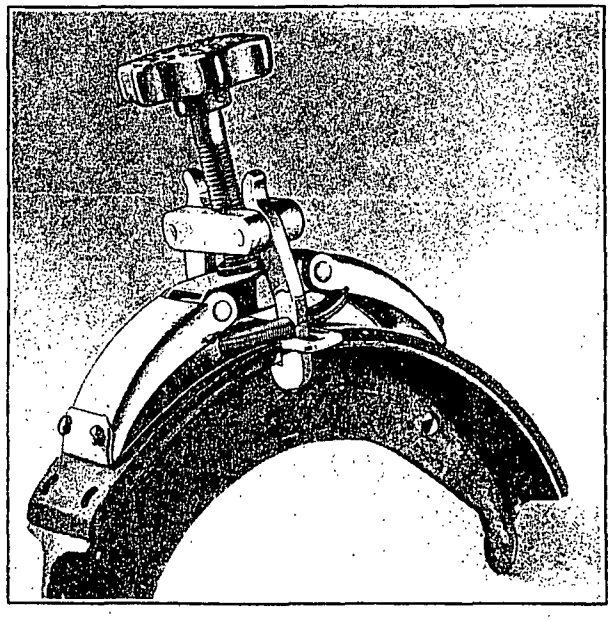


Fig. 69—Stretching Brake Shoe Facing with Tool C-557

MINOR ADJUSTMENT (except booster)

Check total pedal travel. The total travel of the brake pedal is caused by the following: (See Fig. 70).

A. Travel of the piston rod before touching the piston in the master cylinder.

B. Travel of the piston required to cover the relief port.

C. Travel of the brake shoes to contact the drums.

Pedal travel "A" is termed "Free Play" and should be approximately 1/8" to 1/4". This pedal free play may be felt readily by hand and is the movement of the pedal before the push rod touches the master cylinder piston. *If necessary*, this adjustment can be made by changing the length of the master cylinder push rod.

"B" can best be determined by looking into the master cylinder reservoir through the filler cap opening while moving the pedal *slowly*. After the

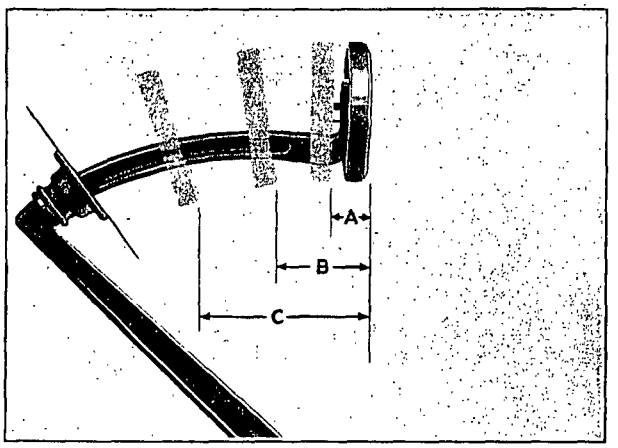


Fig. 70—Brake Pedal Free Play

"Free Play" is taken up, fluid should be forced up through the relief port (Figure 68) until the pedal has moved through an additional 5/8" to 3/4" (approximately), making an accumulated pedal travel of approximately 3/4" to 1" required to close the relief port with the primary cup. If fluid does not come up through the relief port, or if the flow stops at a pedal travel much less than 3/4", the free play should be checked. If the free play is not the cause, the master cylinder should be disassembled and inspected for swollen cups, etc.

An additional pedal travel, "C", of approximately 1" is required to move the shoes outward against the drums. The total pedal travel required to set the shoes should be approximately 1-3/4" to 2" with properly adjusted brakes. Brake shoe cam adjustment will usually rectify excessive pedal travel.

To adjust the brake shoe cams the following steps should be taken:

1. Turn the brake shoe cam adjusting nut (Fig. 72) "out" until the front shoe lining is solid against the drum and the wheel is locked, then back off the nut until the wheel may be spun without interference.

2. Turn the cam on the rear shoe "out" at the top until wheel is locked, then back off until free.

3. Follow the same procedure at all four wheels.

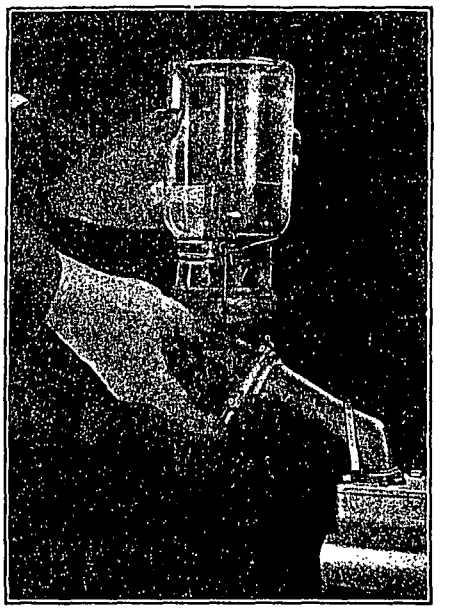


Fig. 71—Filling Brake Master Cylinder with Automatic Refiller. (Tool C-362)

A minor adjustment should be made when the brake drums are at room temperature, otherwise the brakes might drag.

MAJOR ADJUSTMENT

Before adjusting the brake shoes to their final operating clearance, remove all traces of rough or high spots on the lining.

The brake shoe adjusting gauge should be used to check the concentricity of the brake lining with the drum.

The procedure for making major brake shoe adjustments is as follows and must be applied after relining brake shoes, when shoes have been removed for any purpose, or after replacing or resurfacing the brake drums:

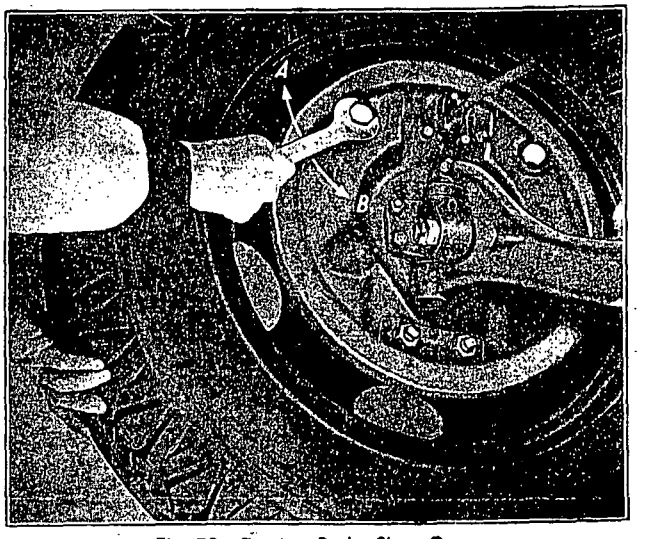


Fig. 72—Turning Brake Shoe Cams

A—Increasing clearance
B—Decreasing clearance

1. Remove wheel and hub.

2. Remove brake shoe return springs and test the spring tension by comparing with a new spring.

3. Inspect lining for exposed rivet heads, abnormal wear and glazed braking surface, also for uniform material on opposite wheel.

4. Inspect brake drums for concentricity, scoring and grease.

5. Install brake shoe return springs and set cams in released position.

6. Check the inside diameter of the brake drums with the brake drum gauge (Fig. 74). Set the brake shoe gauge arbor so that the finger marked "Drum Diameter" is just in contact with the point of the brake drum gauge pin. Place the proper adapter bushing on the spindle or axle shaft and slide the brake shoe gauge over the adapter bushing.

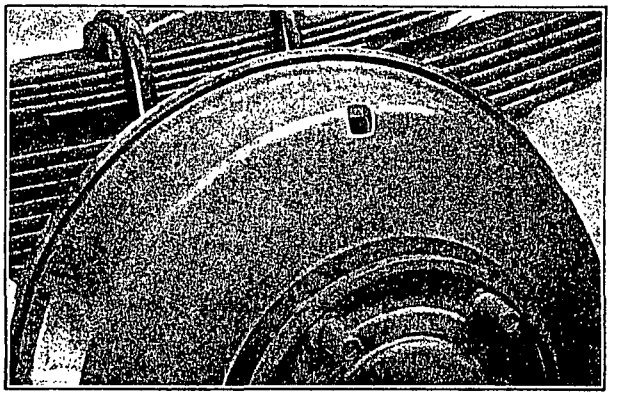


Fig. 73—Wheel Brake Inspection Hole (except WC, WD15)

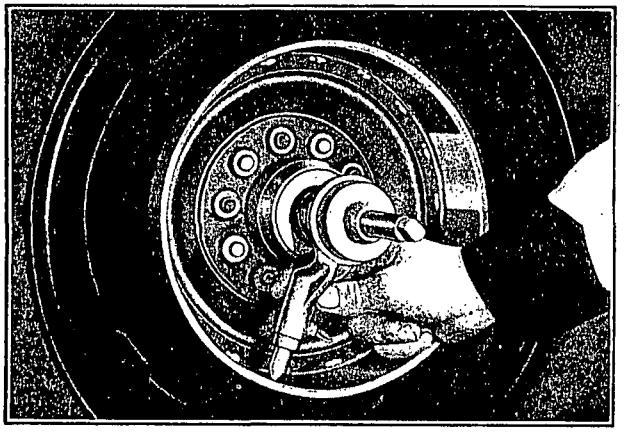


Fig. 74—Checking Brake Drum
Tool MT-84-B

7. Place the gauge on the point marked "heel" and loosen the brake shoe anchor bolt nuts. On a few models an arrow is stamped on the anchor bolts as shown in Figure 76, but on all other models a center punch mark appears as shown in Figure 77. If the arrows or center punch marks on both anchor bolts are not pointing directly toward each other, turn the bolts until they do. These marks must point toward each other before starting to adjust the shoes. The anchor bolts must be turned, from that position, in the correct directions in order to decrease the clearance between the lining and the drum at the "heels" of the brake shoes. The correct procedure is to turn the right-hand anchor bolt, of the pair, anti-clockwise and the left-hand anchor bolt, of the same pair, clockwise as viewed from the side where the wrench is applied (Figures 76 and 77). When turning the anchor bolts, as directed, the heels of the brake shoes will move downward and outward toward the gauge. Turn the anchor bolts until the heels of the brake shoes just contact the heel adjusting finger of the brake shoe gauge arbor. The correct .006" heel clearance is built into the arbor of the brake shoe gauge.

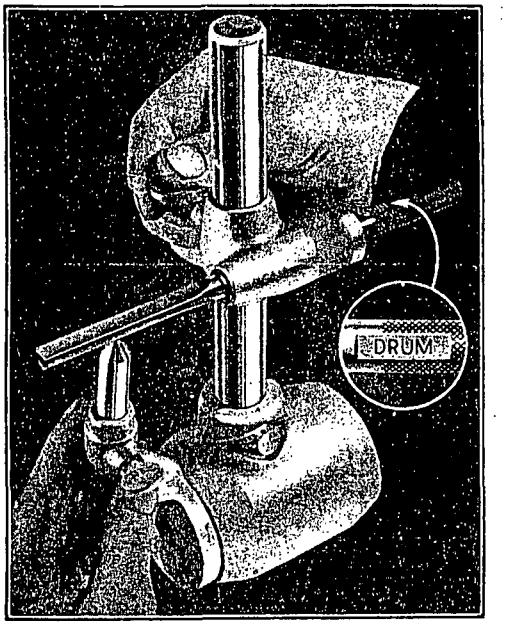


Fig. 75—Setting Brake Gauge
Tool MT-84-B

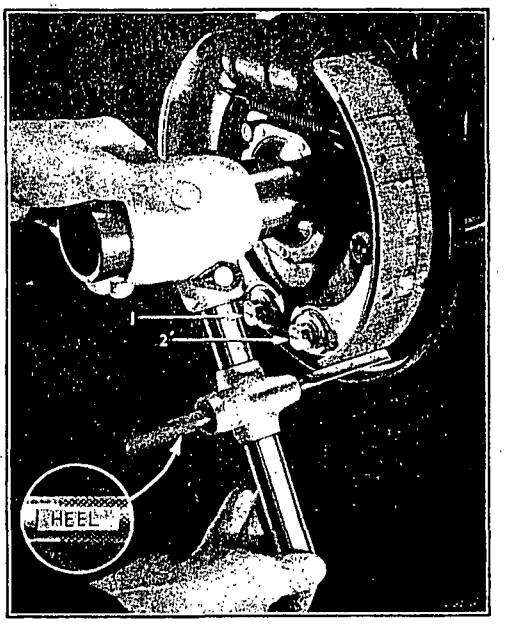


Fig. 76 – Checking Brake Shoe Heel Adjustment
Tool MT-84-B
1 and 2—Wheel brake shoe anchor bolts

8. Move the arbor of the gauge to the point marked *toe* and check the clearance between the lining and drum at the *toe* of the brake shoe. Turn the *toe* adjusting cam until the lining at the toe of the brake shoe just contacts the gauge arbor. The *toe* of the shoe is then properly adjusted, with .012" clearance between the lining and drum.

9. Recheck the clearance first at the *heel* and then at the *toe* to make sure no change has occurred in either adjustment and tighten the anchor bolt nuts securely.

10. Install wheel and hub assemblies.

11. Check and refill the master cylinder reservoir with approved fluid.

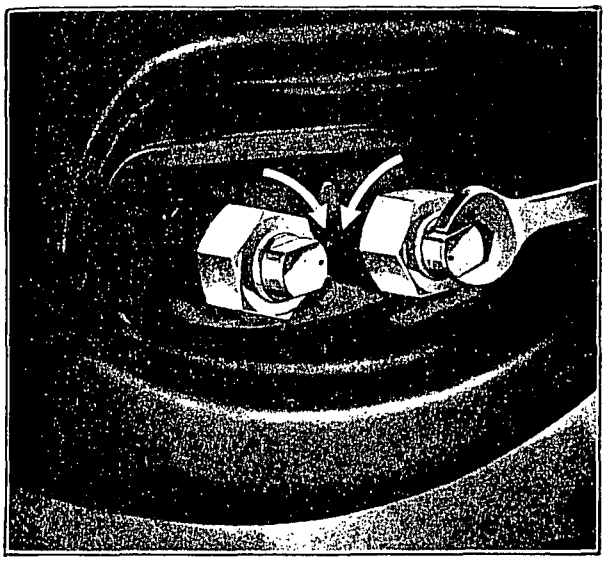


Fig. 77 Brake Shoe Anchor Bolt Adjustment (except WC. WD15)

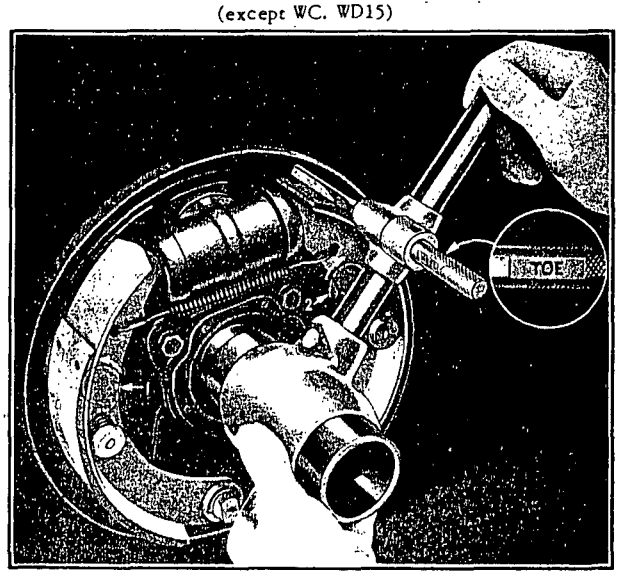


Fig. 78 Checking Brake Toe Adjustment.
Tool MT-34-B
1 and 2—Brake shoe cams

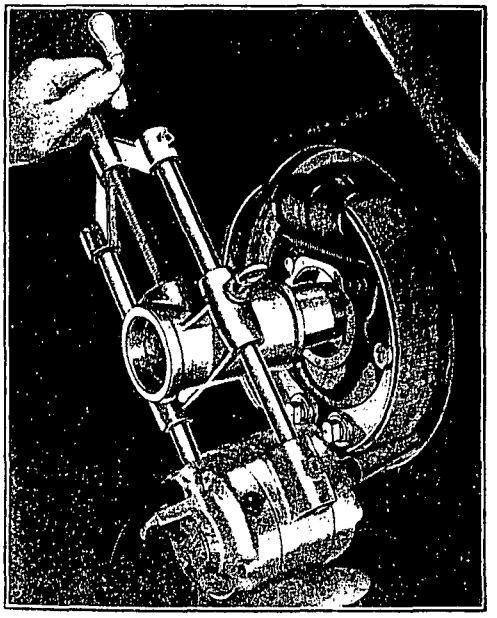


Fig. 79 Grinding Brake Shoe Facing.
Tool MT-44

BLEEDING BRAKE LINES

Air in the braking system seriously impairs braking efficiency, resulting in soft, spongy pedal action. It must, therefore, be removed by bleeding the lines if the fluid level has been allowed to get too low or any part of the braking system has been disconnected or replaced.

To bleed the brake lines, fill the reservoir with fresh Brake Fluid and replace the bleeder screw in the center of the wheel cylinder where it protrudes through the brake support with a fitting to which is attached a short length of rubber hose (Figure 80). Allow the free end of the hose to be submerged in a clean glass container of brake fluid and unscrew the bleeder valve ½ to ¾ of a turn.

The actual bleeding operation is accomplished by pressing the brake pedal slowly through half the limit of its travel. Allow the pedal to return to its released position, after which it may again be depressed until the fluid runs out of the bleeder hose in a continuous stream, without air bubbles.

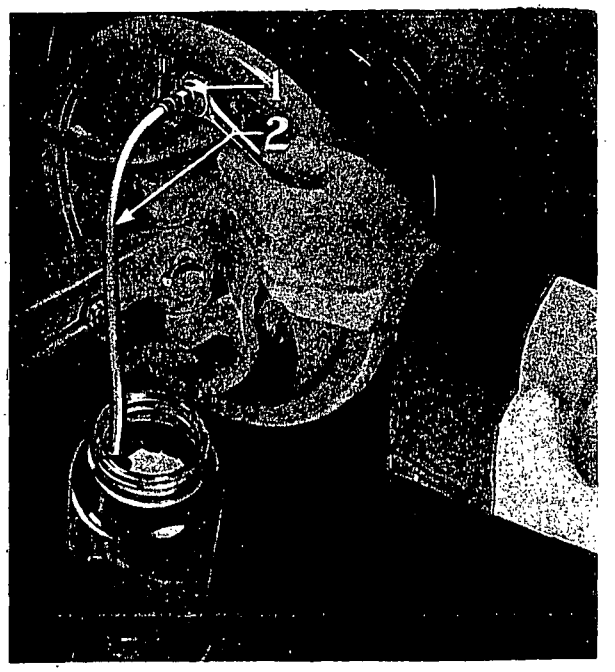


Fig. 80 Bleeding Brake Lines.
1—Bleeder screw
2—Bleeder hose

It is extremely important that the master cylinder reservoir be full of fluid and that it be refilled before being completely exhausted. If the filler cap of the reservoir is left off during the bleeding operation, it will be possible to watch the fluid to see that it does not get below the halfway point. The automatic refiller (Figure 71) for master cylinders will prevent the master cylinder from running dry during the bleeding operation.

With the master cylinder reservoir full of fluid, the foot pedal can be given from six to ten half-strokes before it is necessary to refill it.

It is best to bleed one wheel cylinder at a time in order to make sure that all air is expelled from the system.

CAUTION: Do not allow any brake fluid or grease to come in contact with the brake lining. When all air bubbles have been forced out of the

system, the bleeder valve should be closed tightly before taking the bleeder hose out of the fluid.

When any part of the braking system is disconnected for any reason, it is necessary to bleed the brake lines at all four wheel cylinders.

NOTE: See "Brake Fluid" under Maintenance.

MAINTENANCE

BRAKE SHOE RETURN SPRINGS

Brake shoe return springs should be inspected for tension every time brakes are serviced, and weak or broken springs should be replaced. Only one spring should be used for each pair of shoes, and both front and both rear return springs should be uniform in tension.

BRAKE SHOE ALIGNMENT

The maximum braking effect can only be procured if the entire length and width of the lining contacts the surface of the drum. This alignment can be upset by a sprung brake support, bent shoe or anchor bolt which does not protrude at right angles to the surface of the support.

An examination of the lining will indicate whether or not the shoe is out of alignment and the affected part should be straightened or replaced.

BRAKE LINING

Grease or oil on brake lining destroys its effectiveness, resulting in hard pedal pressure, grabbing, unequal braking and excessive noise. Cleaning an oil-impregnated lining, with gasoline or other grease solvent will only give temporary relief at the best. A complete relining is recommended when possible after eliminating the grease leaks and repacking the bearings. Brake lining obtained from the Chrysler Corporation Parts Division is practically impervious to the absorption of water. A certain amount, however, might get between the lining and the drum when washing the truck with a pressure spray. Temporary difficulty might be experienced with the brakes until this factor is removed by a few applications of the brakes. It is recommended that a brake pedal depressor be employed when washing the vehicle, to keep the water off the lining.

BRAKE FLUID

It is recommended that only approved fluid be used in the hydraulic braking system. This is a special fluid compounded for use exclusively in hydraulic brake systems.

Iso-Brake Fluid mixes with other brake fluids recommended by automobile manufacturers. However, *do not mix brake fluid with any fluids containing glycerine, sugar, glucose, mineral oil or water.*

SERVICE DIAGNOSIS

NO BRAKES

1. Worn lining, improperly adjusted brake shoes, air in system, no fluid in system.
2. Check system for fluid leaks, check master cylinder push rod adjustment.

BRAKES DRAG

1. Check master cylinder push rod adjustment to insure that the relief port is open.
2. Piston cups swollen by use of unsuitable fluid.
3. Dirt in master cylinder relief port.
4. Brake shoe clearance insufficient.
5. Check booster valve piston rod adjustment.

ONE BRAKE DRAGS

1. Weak brake shoe return spring.
2. Improperly adjusted brake shoes, too close to drum.
3. Brake shoe sticking on anchor bolts.
4. Loose wheel bearings.
5. Wheel cylinder piston or piston cups sticking in wheel cylinder.
6. Obstruction in brake lines.

TRUCK PULLS TO ONE SIDE

1. Improperly adjusted brake shoes.
2. Lining on one wheel grease soaked.
3. Brake support loose on the axle.
4. Improperly inflated tires.
5. Linings have different friction qualities on different shoes.
6. Dent or kink in lines, brake hose plugged.
7. Worn lining or scored drums.
8. Loose front spring U-bolts.

SPRINGY OR SPONGY PEDAL

1. Air in system.
2. Brake shoes improperly adjusted.

BRAKE PEDAL JAMS

1. Use of unsuitable fluids causing softening of the rubber cups, and the rubber extruding between the piston and cylinder wall or in the holes in master cylinder piston. Use new rubber cups and master cylinder piston washer (16, Figure 66).
2. Install piston cup expanders and spring in wheel cylinders, if not so equipped, for cars operating in temperatures below 0° F.

BOOSTER BRAKE OPERATION

A vacuum suspended type brake booster is supplied as standard equipment on several models. The booster equipment is not a part of the hydraulic brake system, although it is controlled by the same pedal which operates the hydraulic brakes. The sole function of the booster is to boost the pressure applied to the hydraulic brake master cylinder by the operator. It is not intended that the booster will, under all conditions, supply all the effort required to operate the hydraulic brakes.

The load applied by the booster depends upon unbalanced pressure in the booster cylinder. With the brakes released and the engine running, air is pumped out of the booster cylinder, creating vacuum in the cylinder. On Diesel trucks a vacuum pump, located on the side of the engine creates vacuum in the booster cylinder. With no atmospheric pressure on either side of the booster piston, the piston, which is connected to the brake pedal, is moved to the front end of the cylinder by the brake pedal pull-back spring and a large coil spring in the booster cylinder. When the brake pedal is depressed by the operator, the booster control valve, which is operated by the movement of the pedal, closes the vacuum line to the front of the booster cylinder and opens a port which allows air to enter the front of the cylinder only. Since there is no air in the rear end of the cylinder, the atmospheric pressure against the front side of the piston causes the piston to move toward the rear of the cylinder and apply pressure to the master cylinder through the medium of booster brake linkage.

The maximum pressure on the master cylinder which can be expected from the booster is limited by the predetermined area of the booster piston, the prevailing atmospheric pressure, and the leverage obtained through the linkage. The degree of efficiency with which the booster operates depends upon maintaining vacuum at the rear end of the booster cylinder while the brakes are being applied. This in turn depends upon the ability of the engine (or vacuum pump on Diesel trucks) to remove air from the system.

The engine or pump must remove the air from the front end of the booster cylinder, (or cylinders, if trailer is equipped with vacuum powered brakes), each time the brakes are released, as well as any air which may leak past the booster piston, control valve or faulty line connections. The engine will create ample vacuum of 18 to 21 inches at all engine speeds provided the system is closed and free from leaks. The vacuum pump on Diesel models will create 25 to 27 inches of vacuum. When the brakes are repeatedly applied and released in rapid succession, air will not be pumped out as fast as it is admitted to the system. Consequently there may not be sufficient vacuum at the rear of the cylinder to provide repeated booster application. This condition will, of course, be amplified when vacuum powered trailer brakes are used or by leakage of air in the system but will not occur if the system is free from leaks and a little time is allowed between brake applications.

CHECK VALVE (Operation)

The check valve is of the normally closed type and opens only when the vacuum is higher at the engine (vacuum pump on Diesel trucks) than in the booster system.

The check valve traps the vacuum in the system making available sufficient reserve vacuum for a brake application in case of a stalled engine.

CONTROL VALVE (Operation) (All Models Except WK, WL)

The compensating type control valve (Fig. 84) is illustrated in the "off" position. The vacuum line from the engine is connected through a tee directly to one side of the booster cylinder and through the control valve to the other side of the booster cylinder. When the control valve is in the "off" position, the connection from the booster cylinder to the engine (pump on Diesel trucks) is made through a passage in the center of the control valve diaphragm. In this position, vacuum is maintained on both sides of the diaphragm (B and C, Fig. 84) of the control valve and on both sides of the piston in the booster cylinder. Booster application is controlled as follows:

The first motion of the brake pedal moves the linkage connected to the piston in the control valve through the length of the elongated hole (18, Fig. 82 and 1, Fig. 83) in the control valve bracket. This causes the control valve piston to move into the valve body, first closing the passage in the center of the control valve diaphragm, so that vacuum is no longer maintained on the front side of the booster cylinder piston. Further movement of the control valve piston opens the air intake valve (1, Fig. 84), allowing air to rush in through the control valve air cleaner to the front of the piston in the booster cylinder. This causes the booster cylinder piston to move toward the rear of the cylinder assisting brake application.

If the brake pedal is held in this position, the control valve and linkage assembly moves forward, taking up the travel permitted by the elongated hole in the control valve bracket, due to admitting air to the rear side of the diaphragm, closing the air intake valve. The air intake valve will remain in this position until either more or less pressure is applied to the brake pedal.

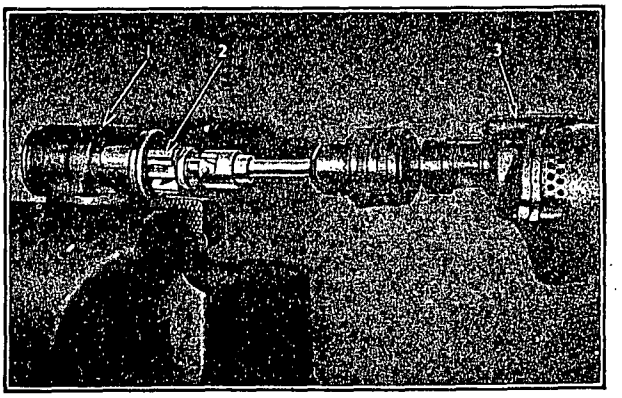


Fig. 81 Refinishing Brake Cylinder.
1—Brake cylinder
2—Tool C-815
3—Electric drill

The position of the brake pedal, therefore, determines the amount of travel of the booster piston rod, so that brake application is controlled by the driver. If greater pressure is exerted on the brake pedal, the foregoing operations are repeated until the brakes are fully applied. When the brakes are released, the control valve returns to the "off" position, restoring equal vacuum on both sides of the control valve diaphragm and the booster cylinder piston. The brake pedal pull-back spring and the coil spring in the booster cylinder will return the pedal and linkage to their normal positions.

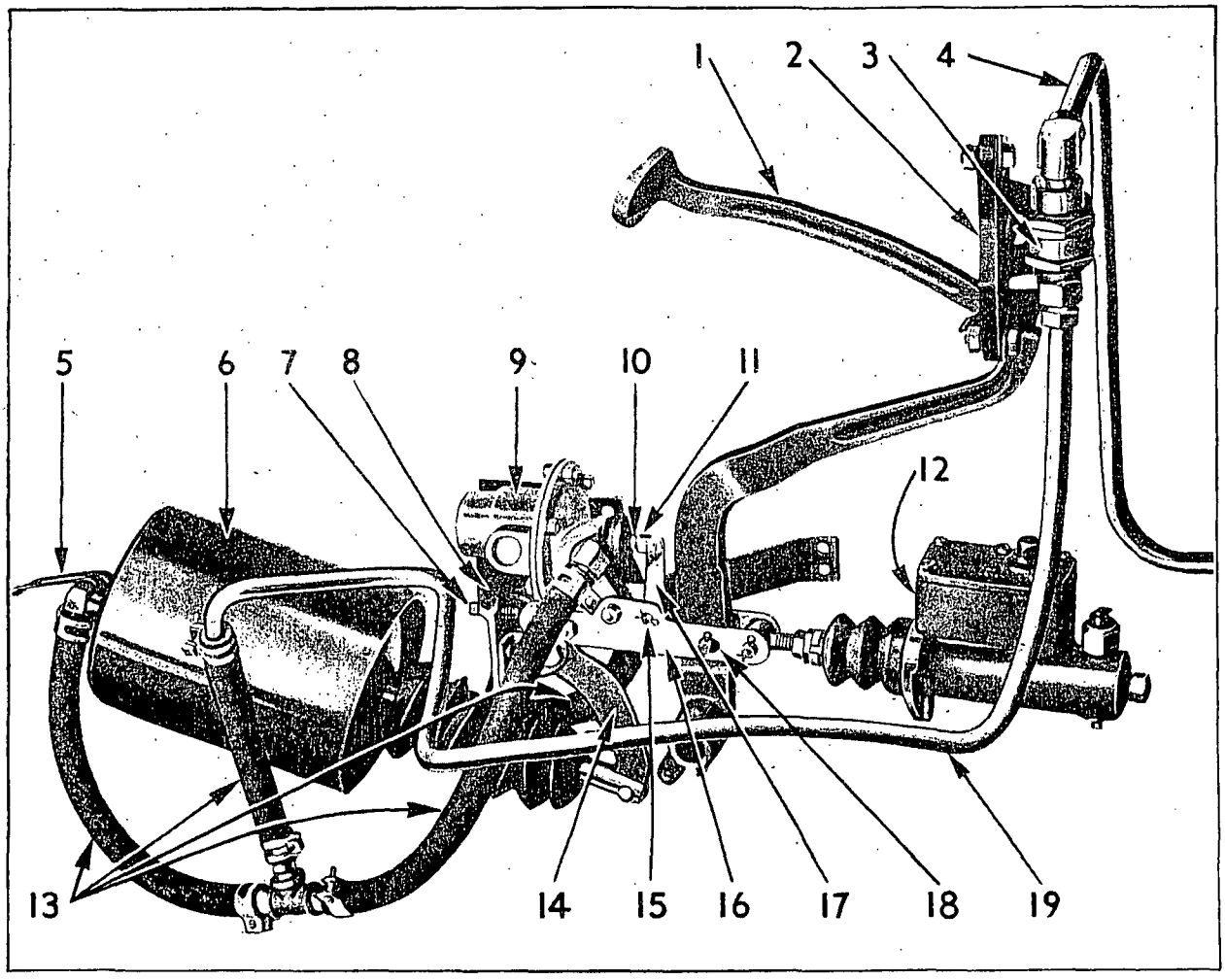


Fig. 82 Booster Brake.

1—Brake pedal
2—Check valve bracket
3—Check valve assembly
4—Tube (manifold to check valve)
5—Cylinder support spring
6—Cylinder assembly
7—Cylinder operating lever stop screw
8—Cylinder bracket
9—Control valve assembly
10—Control valve piston rod yoke lock nut
11—Control valve piston rod yoke
12—Brake master cylinder assembly
13—Hose
14—Cylinder operating lever
15—Control valve operating lever pin
16—Control valve operating link
17—Control valve operating lever
18—Elongated hole
19—Tube (check valve to tee)

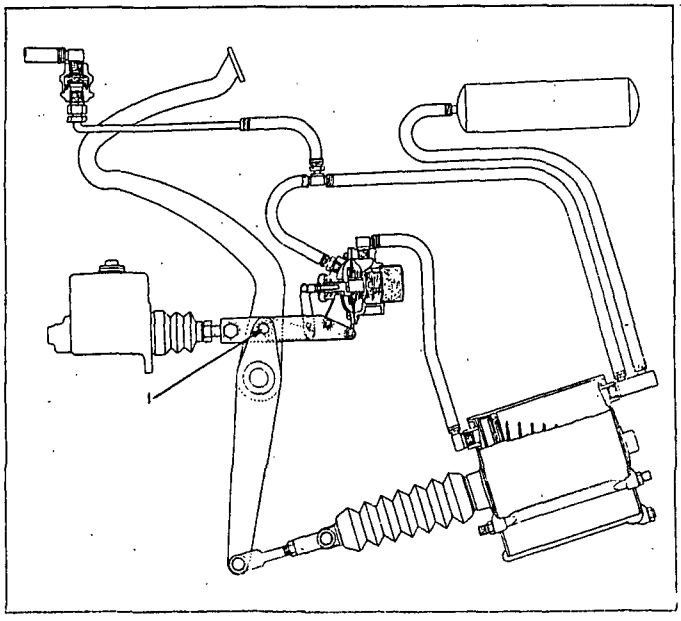


Fig. 83 Booster Brake System (Diesel Trucks)
1—Pin at front of elongated hole (clearance at rear of pin)

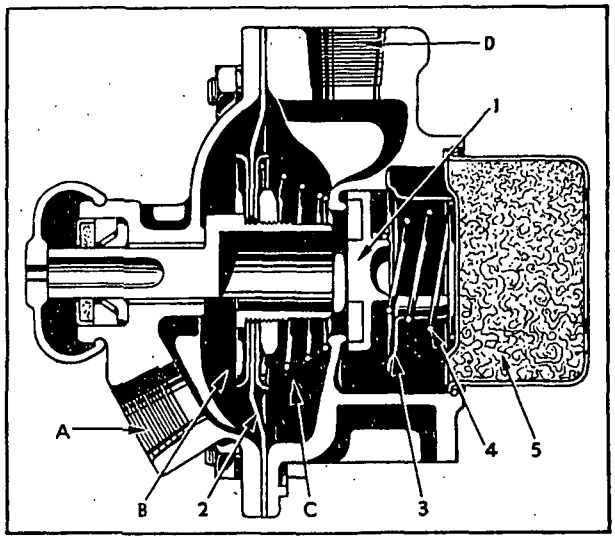


Fig. 84 Booster Brake Control Valve.

A—Connection opening to check valve
B—Front vacuum chamber
C—Rear vacuum chamber
D—Connection opening to front of booster cylinder
1—Air intake valve
2—Diaphragm
3—Valve stop plate
4—Air intake valve spring
5—Air cleaner

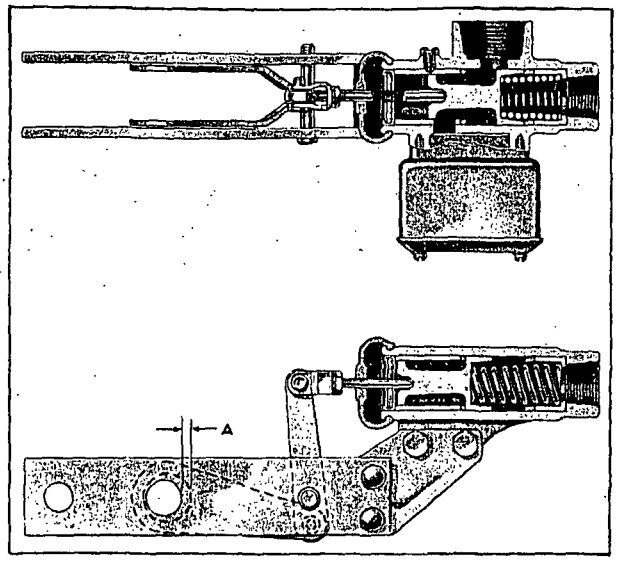


Fig. 85 Booster Brake Control Valve (WK, WL)

A—Clearance at rear of pin

CONTROL VALVE (Operation) (WK, WL)

On Models WK and WL, booster application is controlled as follows: A piston operating in the cylinder of the control valve opens and closes ports for withdrawing and admitting air to the front end of the booster cylinder. The first movement of the piston in the control valve closes the port through which vacuum is created in the front end of the booster cylinder. Further movement of the control valve piston opens the port which allows air to rush in through the control valve air cleaner to the front of the booster cylinder piston. The booster cylinder piston then moves to the rear of the cylinder assisting brake application. (See Figure 85).

VACUUM CYLINDER (Operation)

The vacuum cylinder provides the booster braking effort. The piston is the only working part in the cylinder assembly and is actuated by unbalanced pressures created through the control valve. The efficiency with which the piston operates depends upon the amount of vacuum maintained at the rear end of the cylinder. The extended piston rod end of the cylinder is known as the "front end" regardless of how installed on the vehicle.

Leakage past the piston sealing cup will rapidly reduce the vacuum when the brakes are applied.

Leakage past the piston rod seal will reduce the vacuum when the brakes are released.

REMOVAL AND INSTALLING

Vacuum Cylinder

1. Disconnect vacuum hose at front and rear of vacuum cylinder.

2. Remove clevis pin from front end of piston rod.

3. Remove rear nut from rear end of cylinder pivot support or remove booster cylinder--depending on model of truck.

Assemble in reverse order of the foregoing operations. Vacuum hose connections must be tight to avoid leakage. See "Adjustment—Booster Brake."

CONTROL VALVE

1. Disconnect the two vacuum hoses at the control valve.

2. Remove clevis pin from front end of valve operating rod.

3. Remove the two bolts and nuts holding valve to operating link.

Assemble in reverse order of the foregoing operations. Vacuum hose connections must be tight to avoid leakage. See "Adjustment—Booster Brake."

CONTROL VALVE AIR CLEANER

1. Remove snap ring (screws on WK, WL) from the body of control valve and lift off air cleaner.

2. Lift out curled hair and clean in kerosene. On all models except WK, WL, care must be used when installing the air cleaner to make sure that the prongs of the valve stop plate (3, Figure 84) are seated squarely in the recess of the air cleaner screen to prevent bending the valve stop plate prongs.

ADJUSTMENT—BOOSTER BRAKE

Adjustment will be necessary whenever the hydraulic brake master cylinder, the booster cylinder or the control valve have been disassembled or removed and replaced. The brake booster should not be adjusted to compensate for a brake shoe adjustment. Brake shoe adjustment in no way effects brake booster operation.

To adjust the booster unit, proceed as follows:

ADJUSTMENT

1. Adjust the operating lever stop screw (7, Figure 82) so that the brake pedal just clears the underside of the toe board. The purpose of this adjustment is to bring the pin in the brake lever to the *rear* of elongated slot in the control valve link (18, Figure 82).

2. Remove the booster brake cylinder pivot and cylinder from the bracket at the rear of the cylinder. Then adjust the master brake cylinder push rod against its stop so that there is no clearance between the piston of the master cylinder and push rod.

3. Insert the booster cylinder pivot in the bracket and turn the pivot check nut until the booster cylinder piston is at the forward end of the cylinder, then back off two turns to permit approximately 1/8" clearance between the piston and cylinder. Make sure that the pin in the control valve linkage remains at the *rear* of the elongated slot.

4. Tighten the booster cylinder pivot nut and the adjusting screw lock nut.

ADJUSTMENT (DIESEL TRUCKS)

1. Adjust brake master cylinder piston push rod so that the piston is against its stop.

2. Remove pin from booster cylinder lever rod.

3. Loosen lock nut and turn adjusting yoke at booster cylinder until pin can be inserted with the

piston against the forward end of the cylinder. After making the adjustment, the clearance at the sleeve in the pedal should be on the *rear* side of the pin (1, Figure 83 and A, Figure 85).

TESTING BOOSTER SYSTEM FOR LEAKAGE

To test the entire system for efficiency, install a vacuum gauge in the line between the check valve and the control valve. Start the engine and note the amount of vacuum shown on the gauge. If approximatelv 18 to 21 inches of vacuum* (27 inches on Diesel trucks) shows on the gauge with the engine running, stop the engine. If the vacuum does not drop faster than 2 inches per minute with the brakes released, or more than 8 inches after the engine is stopped and the brakes are applied and held on for 1 minute, the booster system will operate efficiently. The amount of drop in vacuum when the brakes are applied will increase with excessive brake pedal travel, therefore, the brake shoes must be properly adjusted and the hydrulic brake lines free from air when this test is made.

With the engine running and the brakes released, a maximum vacuum reading of less than 18 to 21 inches (27 inches on Diesel trucks) would indicate leaks in the system, insufficient engine vacuum, or a faulty vacuum pump on Diesel models.

If the vacuum reading is low, and the vacuum drops faster than 2 inches per minute after releasing the brakes and stopping the engine, there is a leak somewhere in the system. If the vacuum reading is low, and the vacuum does *not* drop faster than 2 inches per minute after releasing the brakes and stopping the engine, insufficient vacuum is being created by the engine or vacuum pump or there are air leaks between the check valve and engine (pump on Diesel trucks).

In case the maximum vacuum, with the engine running and the brakes released, is *not* less than 18 to 21 inches (27 inches on Diesel Trucks) and does *not* drop faster than 2 inches per minute when the engine is stopped, but does drop more than 8 inches when the brakes are applied and held on for 1 minute, there is excessive leakage past the vacuum cylinder piston or the control valve when the brakes are applied.

CHECK VALVE (Testing)

To test the check valve, connect a vacuum gauge to the port leading to the control valve and start the engine. After stopping the engine the gauge reading should remain constant for a reasonable length of time unless the valve leaks.

CONTROL VALVE (Testing)

To test the control valve, remove both hoses, place finger over the port leading to the check valve and suck on the opposite port. If no air can be drawn through, the valve does not leak.

*Diesels are equipped with vacuum pump.

VACUUM CYLINDER AND PISTON ASSEMBLY

(Testing)

To test for leakage past the piston sealing cup, disconnect the hose at the front end of the cylinder. Plug the end of the hose and start the engine. Then install a vacuum gauge in the open port of the cylinder and if the reading builds up rapidly there is excessive leak past the piston and the cylinder should be serviced.

To test for leakage past the piston rod seal, disconnect the hose from the front end of the cylinder and install a vacuum gauge in the end of the hose. Start the engine and take a vacuum reading. Then reconnect the hose with the vacuum gauge installed in the line and take another reading. If there is no leakage past the piston sealing cup, any difference in the two readings would indicate leakage past the piston rod or at the front of the cylinder.

VACUUM LINES

All connections must be sufficiently tight to prevent even the slightest leak. Hose connections should be sealed with shellac.

VACUUM PUMP (DIESEL TRUCKS)

The vacuum pump (**Figure 86**) is of the rotary type and is belt driven. It is lubricated by the engine oiling system and will require little attention other than maintenance of proper drive belt adjustment. To adjust belt, loosen the two lower hinge bolt nuts and turn adjustment screw. After adjustment is made to the vacuum pump drive belt, the generator drive belts must be readjusted.

To test the vacuum pump efficiency, disconnect the vacuum line from the pump and install a vacuum gauge in the port of the pump. A normal pump will create approximately 27 inches of vacuum at idling engine speed, but it is not expected that the pump will maintain 27 inches of vacuum in the system if the brakes are repeatedly applied and released in rapid succession.

MAINTENANCE

When installing the booster unit, care should be exercised to make certain that it is in perfect alignment. The connecting link should line up perfectly with the operating lever and it should not have to be sprung in order to assemble the clevis pin.

The booster brake unit should be lubricated every 6000 miles with ice machine oil, shock absorber fluid or transformer oil. This is accomplished by removing the hose at the front end of the cylinder and pouring in about an ounce of the recommended oil. An ounce of oil should also be added through the vacuum line connection at the rear end of the cylinder.

Periodic lubrication of the booster unit will keep the piston packing and the piston rod seal in good condition and will insure efficient operation at all times.

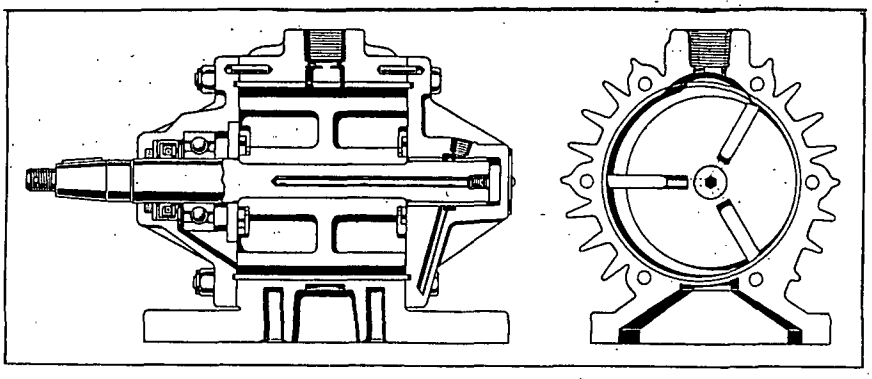


Fig. 86 Vacuum Pump (Diesel Trucks)

Dodge Truck Clutch

The clutch used in the Dodge truck is a Borg & Beck single plate, dry disc type.

As the clutch facings wear, the release levers slowly move proportionally. The outer ends of the release levers move toward the flywheel causing the inner ends to move toward the transmission. This will result in a decrease of the clutch free travel. To prevent the clutch pedal from riding on the toe board, the clutch free travel should be kept adjusted to about 1" to 1½".

Clutch Removal

Before removing clutch from flywheel, mark with a punch the flywheel, clutch cover and one pressure plate lug, so that these parts may be assembled in their same relative positions, as they were balanced as an assembly. (See fig. 87.) Loosen the holding screws a turn or two at a time in rotation to avoid bending rim of cover. When removing driven plate be sure to mark flywheel side.

Clutch Cover and Pressure Plate

Proper operation of the clutch is chiefly dependent upon accurate adjustment of the release levers. They must all be adjusted to exactly the

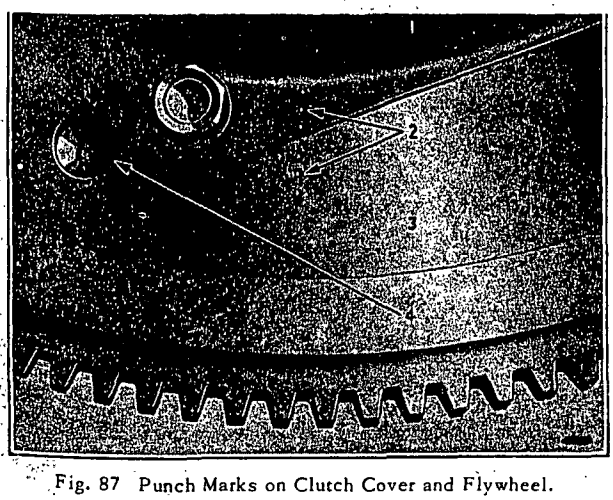


Fig. 87 Punch Marks on Clutch Cover and Flywheel.

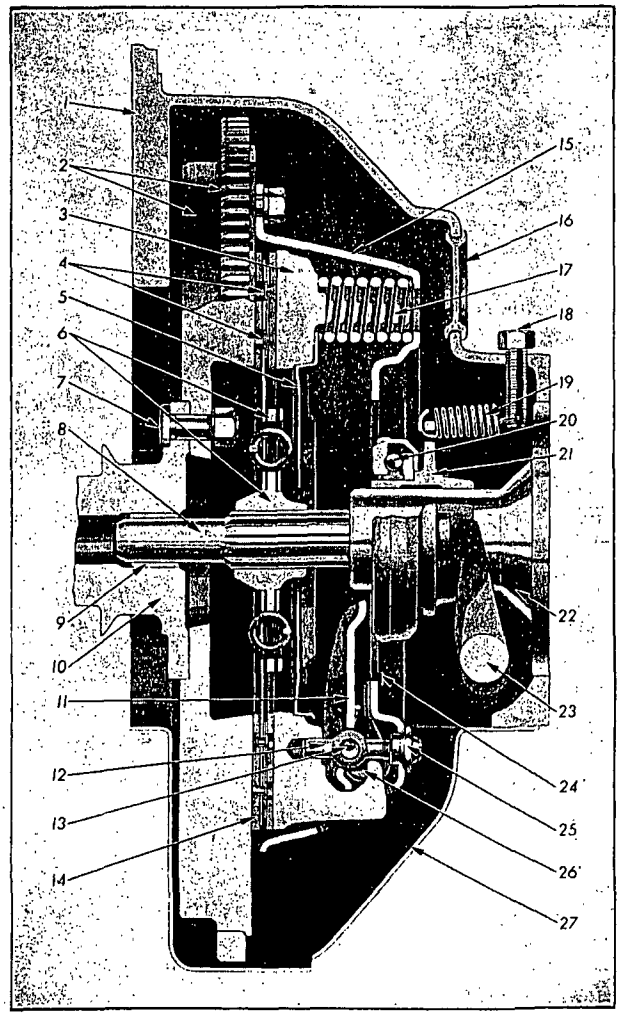


Fig. 88 Clutch

1. Housing
2. Engine flywheel and ring gear
3. Pressure plate
4. Disc facing rivets
5. Pressure plate baffle
6. Disc assembly
7. Engine flywheel bolt
8. Transmission drive pinion
9. Engine crankshaft bushing (transmission drive pinion pilot bushing)
10. Engine Crankshaft
11. Release lever
12. Release lever eye bolt
13. Release lever pin
14. Disc facing
15. Cover
16. Housing hole plug
17. Pressure spring
18. Release bearing pull-back spring screw
19. Release bearing pull-back spring
20. Release bearing
21. Release bearing sleeve
22. Transmission drive pinion bearing retainer
23. Release fork
24. Release lever spring
25. Release lever eye bolt nut
26. Release lever strut
27. Housing pan
28. Clutch release fork flange

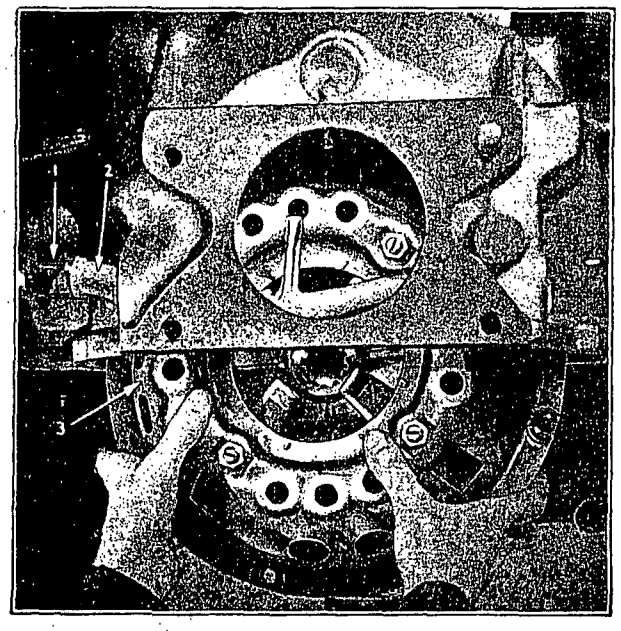
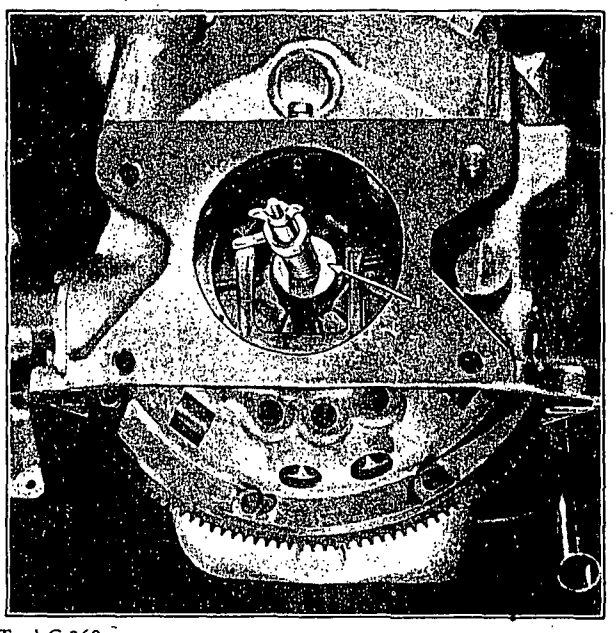


Fig. 89 Removing Clutch Assembly.
1. Clutch release fork flange 2. Release fork 3. Clutch assembly



1. Tool C-360

Fig. 90 Clutch Disc Aligning Arbor.

same predetermined height above the machined surface on the pressure plate, so that it will remain parallel with the flywheel when the clutch is being released and engaged. This adjustment cannot be made by setting the levers parallel to the face of the release bearing after the clutch has been assembled to the flywheel because of variations in thickness of the driven plate. The most accurate method is to adjust the levers by using a special clutch compressing and adjusting fixture.

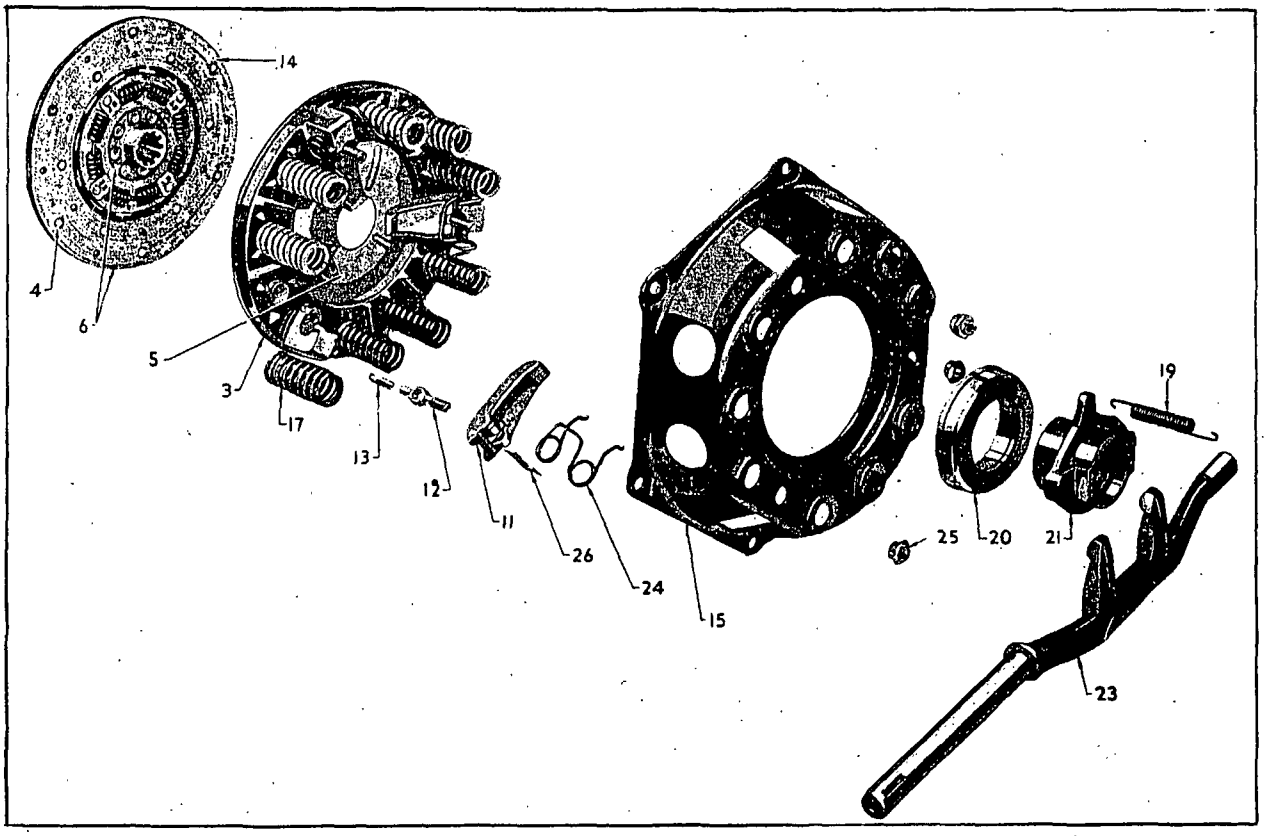


Fig. 91 Exploded View of Clutch.

3. Pressure plate.
4. Disc facing rivets.
5. Pressure plate baffle.
6. Disc assembly.
11. Release lever.
12. Release lever eye bolt.
13. Release lever pin.
14. Disc facing.
15. Cover.
17. Pressure spring.
19. Release bearing pull-back spring.
20. Release bearing.
21. Release bearing sleeve.
23. Release fork.
24. Release lever spring.
25. Release lever eye bolt nut.
26. Release lever strut.

The C-411 clutch compressing and adjusting fixture has been superseded by a new type fixture known as the C-585. This special fixture is obtainable from the Miller Tool and Manufacturing Company of Detroit, Michigan. Instructions in this unit covering the disassembling adjusting and assembling procedure are based on the use of the C-585 fixture. It accurately checks the parallel alignment of the clutch pressure plate while the clutch fingers are under load. The use of the fixture eliminates possibility of error in clutch finger adjustment due to clutch finger leverage ratios and housing strains.

Disassembly and Reassembly of Clutch Cover and Pressure Plate

(USING C-585 CLUTCH FIXTURE)

The clutch cover assembly should be removed from the truck as shown under the heading of "Clutch Disc". Then procede as follows:

1. Mark the cover and pressure plate with a prick punch (4, Figure 92) so that they may be assembled in their original position to maintain balance.
2. Mount the clutch assembly on the clutch compressing and adjusting fixture.
3. Install the three-legged spider over the center screw so that it rests directly against the top of the clutch cover.
4. Install the plain thrust washer and the hexagonal compression nut and compress the springs by turning down the compression nut (Fig. 92).
5. With the springs under compression, remove the clutch release lever eye bolt nuts and slowly relieve the spring pressure by unscrewing the compression nut.
6. The cover may then be lifted off and all parts will be available for inspection (Fig. 87 and 91).

To remove the release levers, proceed as follows:

Grasp the lever and eye bolt between the thumb and fingers, as shown in the illustration (Fig. 93), so that the flat side of the lever and upper end of the eye bolt are as close together as possible, keeping the eye bolt pin seated in its socket in the lever. The strut (1, Fig. 93) can then be lifted over the ridge on the end of the lever, making it possible to lift the lever and eye bolt off the pressure plate. It is advisable to replace any parts which show wear.

Assemble the clutch cover and pressure plate by reversing the foregoing operations, observing the following precautions:

1. Place the pressure springs in position so that they rest on the small bosses of the pressure plate and engage the embossed seats on the cover.

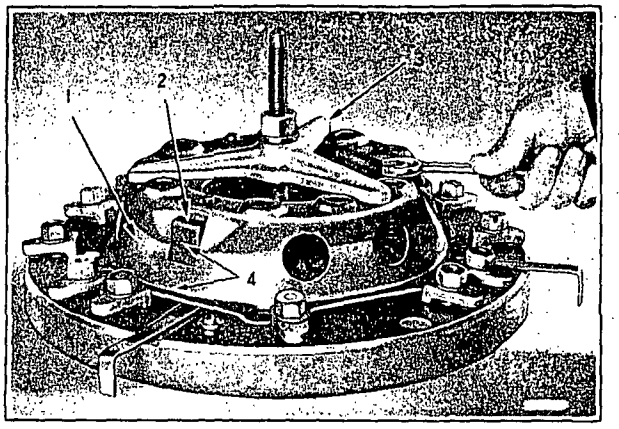


Fig. 92 Clutch Cover and Pressure Plate Assembly in Fixture.
1. Clutch cover
2. Clutch pressure plate
3. Fixture (Tool C-585)
4. Punch marks on pressure plate and cover

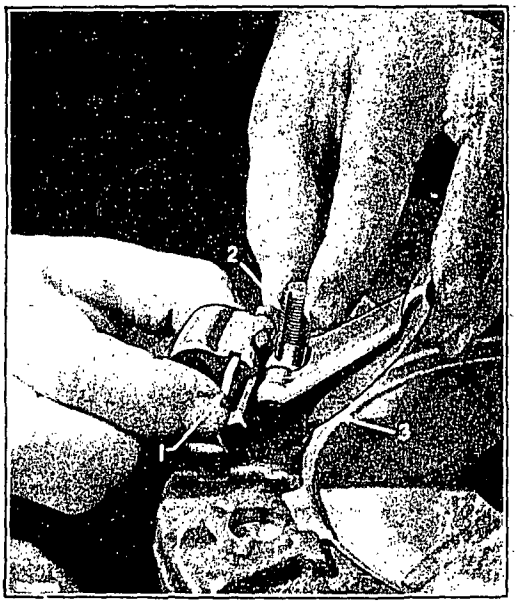


Fig. 93 Assembling Strut.
1. Release lever strut
2. Eye bolt
3. Release lever

2. Match up the prick punch marks made when disassembling, so that the cover and pressure plate will be assembled in the same position with relation to each other.
3. When installing the cover and pressure plate assembly on the flywheel, make certain that the prick punch marks on the flywheel and clutch cover are matched to keep the assembly in balance.

Adjusting the Release Levers

(USING C-585 CLUTCH FIXTURE)

1. Mount the clutch cover and pressure plate assembly on the fixture with the release levers over the feeler gauges in the base of the fixture.
2. Place the proper spacer on the center screw of the fixture, selecting it according to the diameter of the clutch plate: A No. 17 spacer should be used on a 10" clutch while both spacers Nos.

20 and 21 should be used on a 11" clutch.

3. Install the compression plate on the center screw. Make sure that it rests directly against the clutch release fingers. This plate can be reversed for proper clearance depending on the size of the clutch.

4. Install the self-aligning washer, plain thrust washer and the compression nut.

5. Tighten the compression nut until the clutch is fully compressed.

6. Install the clutch housing clamps over the bolt holes and tighten them securely.

7. Adjust the clutch release levers until each of the three feeler gauges have the same slight "drag" or "feel" while being pushed in and out. Tighten the nuts to decrease "drag" and loosen to increase "drag".

8. Recheck the release lever adjustment to make sure each one is adjusted properly.

On 11" clutches having four release levers, two of the levers should be located over two of the three feeler gauges, and adjustment made as outlined in the foregoing instructions. The clutch should then be rotated 180° on the base of the fixture so that the other two release levers can be placed over two of the feeler gauges, and adjusted so that they have the same light drag as the first two release levers.

When removing the clutch cover assembly from the fixture, loosen the housing clamps first, then remove the compression nut. This is important and will avoid throwing unequal strain on the release levers.

Clutch Re-Facing

When installing facings on the clutch disc, only new facings and rivets of the proper thicknesses, size and material should be used. Slight variations in thickness of clutch facings will inevitably result in clutch difficulties.

Clutch facings on either side of the disc are individually riveted to the plate. That is, each of two facings is fastened to the disc with a separate set of rivets to avoid the possibility of shifting on the disc or shearing off the rivet heads.

When removing the old facing, rivets must be drilled out, to punch out will damage the clutch cushion springs. Care should be taken when installing new facing to see that the clutch cushion springs are not bent from their original position. Bending the cushion springs will invariably result in clutch difficulties.

Do not allow any grease or oil to come in contact with the friction surfaces of the clutch disc. Even greasy hands touching the friction surfaces will transfer a sufficient amount of grease in many instances, to cause after a short time of driving, a glazed surface on the clutch disc which in turn results in chattering or grabbing.

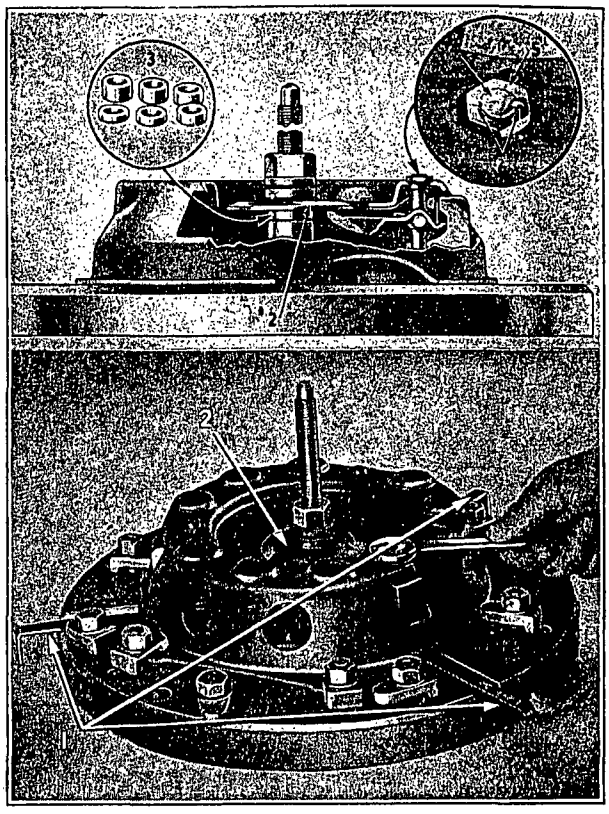


Fig. 94 Adjusting Clutch Release Levers.

1. Feeler blades (part of Tool C-585)
2. Compression plate (part of Tool C-585)
3. Spacers (part of Tool C-585)
4. Clutch release lever eye bolt
5. Clutch release lever eye bolt nut
6. Stake here to lock

Reinstalling Clutch

1. Coat the main drive pinion pilot bearing in the end of the crankshaft and the end of the main drive pinion shaft with short fibre wheel bearing grease, medium.

2. Clean the surfaces of the flywheel and pressure plate thoroughly, making certain that no oil or grease remains on these parts.

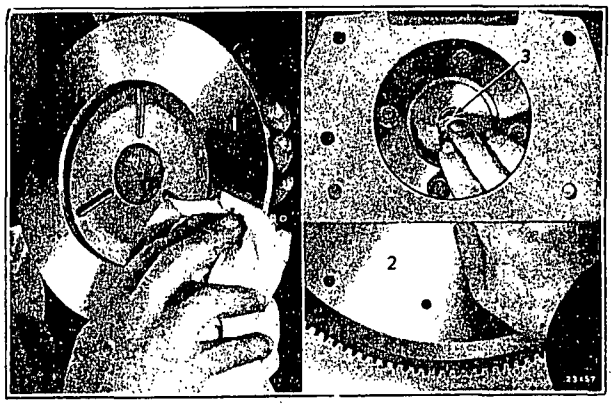


Fig. 95 Cleaning Clutch Friction Surfaces and Lubricating the Pilot Bushing.

1. Clutch pressure plate
2. Engine flywheel
3. Transmission main drive pinion pilot bushing

3. Hold the clutch cover plate and disc in place and insert the special clutch alignment tool C360 through the hub of the driving disc and into the drive pinion pilot bearing in the crankshaft, (Fig. 90).

4. Bolt the clutch cover plate loosely to the flywheel with the marks on the cover and flywheel in alignment.

5. The clutch cover bolts should then be tightened a few turns each in progression until they are all tight. If the aligning tool is not used, the transmission drive pinion (an extra part of one which has been removed from the transmission) may be used for this purpose.

The transmission may then be installed by guiding the transmission into place with pilot studs.

Adjustment Clutch Pedal Free Movement

1. Loosen pedal adjusting screw lock nuts.
2. Turn clutch pedal adjusting screws until pedal has 1" to 1½" free movement.

On some installations the adjustment for pedal free movement is made by turning the swivel on the connecting rod between the pedal and operating lever.

Free movement of the clutch pedal is necessary to compensate for wear of clutch facing and to avoid slippage. It insures proper clearance between clutch release bearing and clutch release lever.

Maintenance

CHATTER

Chatter may be due to:

1. Grease or oil on the disc, flywheel or pressure plate.
2. Binding of clutch release linkage.
3. Disc facings loose.
4. Broken disc facings or pressure plate.
5. Loose engine mountings.
6. Incorrect adjustment of release fingers.

GRABBING

Grabbing is usually caused by:

1. Oil or grease on the disc, pressure plate or flywheel.
2. Broken disc facings or pressure plate.
3. Hub of disc not sliding freely on splined shaft, or binding or release mechanism.

SLIPPAGE

Slippage may be caused by:

1. Lack of pedal free movement.
2. Binding of clutch release mechanism.

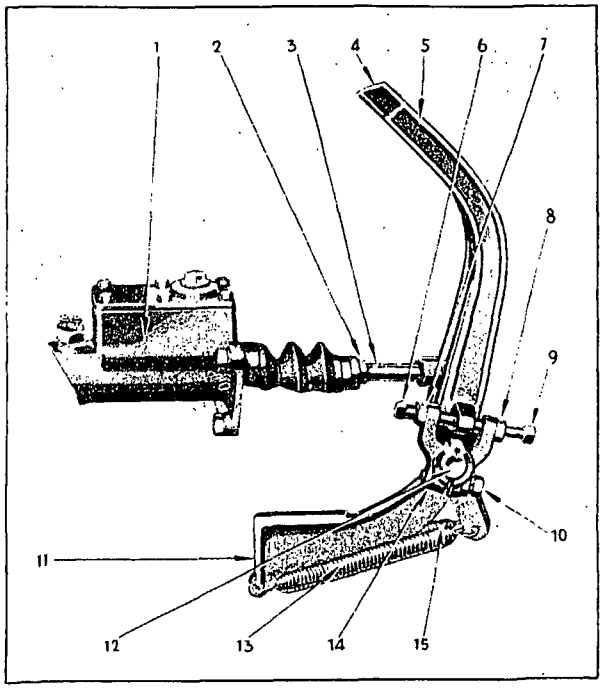


Fig. 96 Pedal Adjustments.

1. Master cylinder assembly - complete
2. Master cylinder push rod end nut
3. Master cylinder push rod assembly
4. Brake pedal assembly
5. Clutch pedal assembly
6. Clutch pedal adjusting collar set screw
7. Clutch pedal adjusting collar set screw nut
8. Clutch pedal adjusting collar set screw nut
9. Clutch pedal adjusting collar set screw
10. Clutch pedal adjusting collar clamp screw
11. Clutch and brake pedal reinforcement bracket
12. Clutch release fork
13. Clutch pedal pull-back spring
14. Clutch pedal adjusting collar
15. Brake pedal pull-back spring

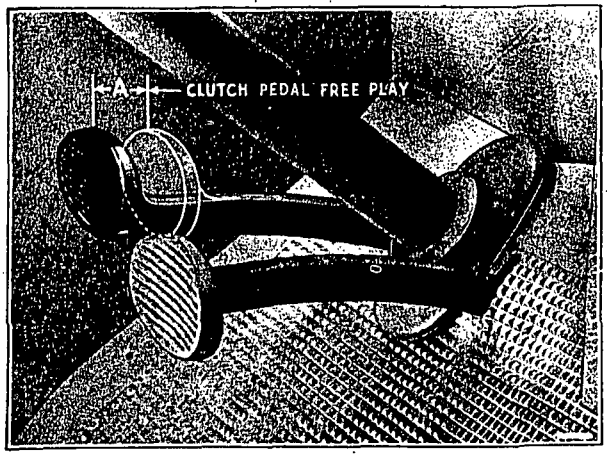


Fig. 97 Clutch Pedal Free Play.

3. Broken clutch pressure springs.
4. Worn disc facings, pressure plate or flywheel.
5. Weak pressure plate springs.

DRAGGING

Dragging or incomplete release may be caused by:

1. Excessive free movement of the pedal.
2. Incorrect adjustment of release fingers.

3. Loose or broken disc facings.
4. Bent or dished driven disc.

SPINNING

Clutch spinning is frequently confused with clutch dragging. A clutch disc which releases perfectly will naturally spin under its own weight and momentum immediately after being released if the transmission gears are in the neutral position.

Gear clash, when shifting from neutral to first speed, or to reverse, is usually caused by the clutch spinning and can be overcome only by releasing the clutch, allowing the disc to stop spinning and then shifting the gears.

Trucks equipped with four and five speed transmissions should be shifted by "double clutching".

Mack Clutch

The MACK clutch is of the single plate, "pusher" type; that is, the clutch must be pushed in order to disengage it. Models CL 20 and CL 40 are 14" in diameter and have 18 coil springs while Model CL 28 is 15" in diameter and has 36 coil springs.

A driven disk with a 3/16" thick facing riveted to each side of it, engages the flywheel, while the other face engages the pressure plate.

Disengagement of the clutch is through the action of six ball pivoted fingers on the clutch cover pulling the pressure plate away from the driven disk when the fingers are contacted and pushed toward the flywheel by the forward movement of the clutch release bearing.

CLUTCH DISC ADJUSTMENT: The release bearing clearance or gap (3) should be 5/32". As facing wears so this gap is decreased to 1/16", adjust the gap to 5/32" by use of MACK Service Gage which is available at service stations. As these adjustments are made, the clearance (2) will be eventually decreased, and should be readjusted as follows:

CLUTCH PEDAL ADJUSTMENT: When the release bearing gap of 5/32" (3) is lessened, the clutch release lever on outside of clutch should be adjusted so as to have 3/8" clearance between roller and cam, which is approximately a 2" travel of the clutch pedal at the pad. When all adjustment is used up between roller and cam, remove the clutch release lever from the serrated shaft and turn it slightly and replace on shaft. This provides more adjustments, and readjust to 3/8" clearance, as previously described.

CAUTION: Never ride the clutch pedal. Do not continue driving with a slipping clutch, it should be adjusted at once.

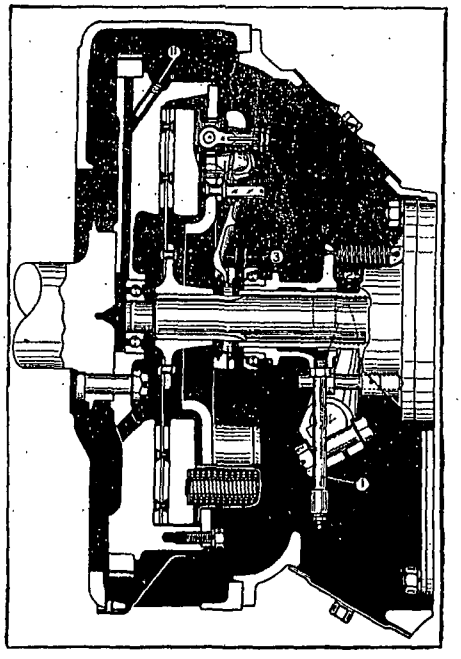


Fig. 98 Mack Clutch.

CLUTCH FINGER ADJUSTMENT should never be attempted as it is a delicate operation requiring precision tools. In unusual conditions where finger pivots might wear and repairs are necessary, arrange with MACK Service Station to exchange your assembly for a reconditioned one.

CLUTCH SPRING TENSION may decrease when flywheel or the pressure plate are faced. Washers are available to insert in spring cups to compensate for this loss of clutch spring pressure, and this compensation must never exceed 3/16". The spring tension for the different springs in the different clutches varies greatly and the local MACK Service Station has the data and tools necessary for checking these tensions.

LUBRICATION is required at the release bearing at 1500 mile intervals. (1) in illustration. A high melting point (350° F.) Ball and Roller bearing grease should be used; this is very important. Lubrication is also required at the two throwout yoke shaft bearings every 1500 miles. A good chassis lube will be satisfactory at these points.

The pilot bearing in the flywheel is of the prepacked sealed type requiring very little lubrication. Every 6,000 miles apply a small amount of high melting point (350°F. or over) semi-fluid Ball and Roller Bearing grease with hand gun, by removing plug (11) in flywheel rim, and installing pressure fitting. After lubricating, the fitting must be replaced by the plug. When clutch is disassembled for any reason, clear these passage ways of any hardened grease by inserting a soft iron wire.