BRAKE SYSTEM

WAGNER LOCKHEED HYDRAULIC self-centering and self-energizing brakes are used on all models. The total effective braking area on the Champion and Flighthawk models is 166 sq. in. (1071,0 sq. cm.) and on all other models it is 195.25 sq. in. (1259,7 sq. cm.).

A brake power unit is standard on the Goldenhawk model and is available as optional equipment on all other models.

SPECIFICATIONS

	CHAMPION FLIGHTHAWK	POWERHAWK SKYHAWK COMMANDER PRESIDENT	GOLDENHAWK
Make	Wagner	Wagner	Wagner
Type	Self-Centering—Self-Energizing	Self-Centering—Self-Energizing	Self-Centering—Self-Energizing
Brake lining	Marshall-Eclipse	Marshall-Eclipse	Marshall-Eclipse
Drum type	Conventional	Conventional***	Air Cooled Rib
Drum size—front	10" (254 mm.)	11" (279,4 mm.)	11" (279,4 mm.)
—rear	9" (228,6 mm.)	10" (254 mm.)	10" (254 mm.)
Lining—length per wheel—front	10-29/32" (277 mm.)	12" (305 mm.)	12" (305 mm.)
—rear	9-27/32" (250 mm.)	10-29/32" (277 mm.)	10-29/32" (277 mm.)
—width—front	2" (50,8 mm.)	2¼" (57,2 mm.)	2¼" (57,2 mm.)
—rear	2" (50,8 mm.)	2" (50,8 mm.)	2" (50,8 mm.)
—thickness	3/16" (4,76 mm.)*	3/16" (4,76 mm.)**	3/16" (4,76 mm.)**
Total braking area	166 sq. in. (1071,0 sq. cm.)	195.25 sq. in. (1259,7 sq. cm.)	195.25 sq. in. (1259,7 sq. cm.)
Brake power—front	62%	62%	62%
—rear	38%	38%	38%
Parking brake lever operates	Rear Service Brakes	Rear Service Brakes	Rear Service Brakes

*Front wheel secondary shoe lining is ¼" (6,35 mm.) thick.
**Front wheel secondary shoe lining is 7/32" (5,56 mm.) thick.
***Air cooled rib drum on Skyhawk and President models.

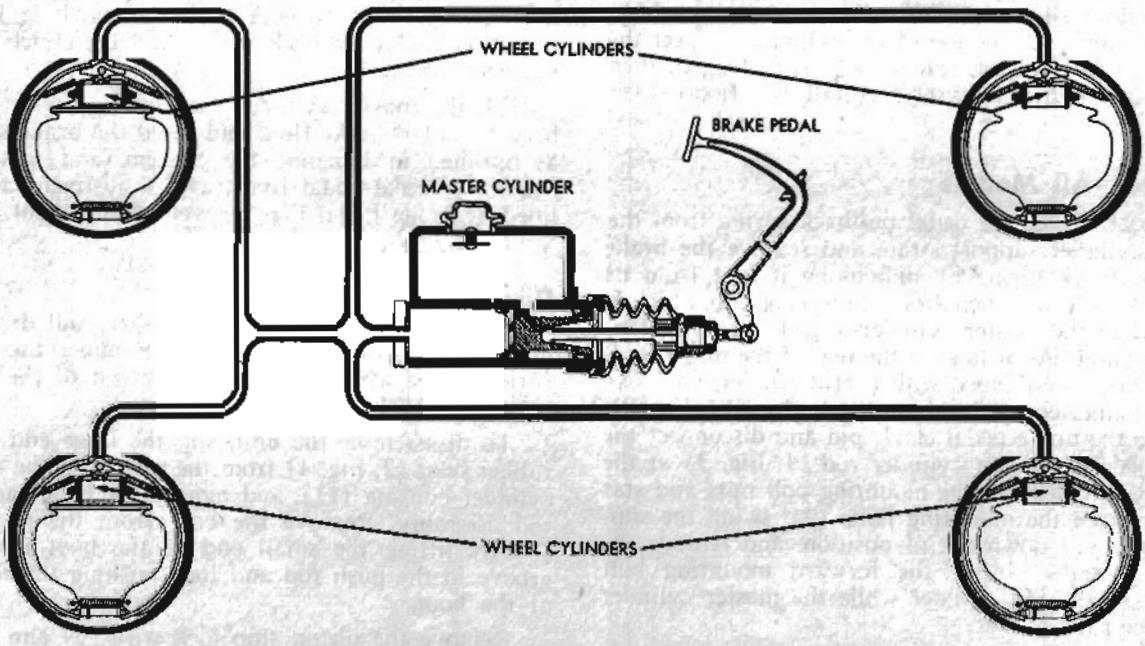


FIG. 1 SCHEMATIC DIAGRAM OF HYDRAULIC SYSTEM

HYDRAULIC SYSTEM

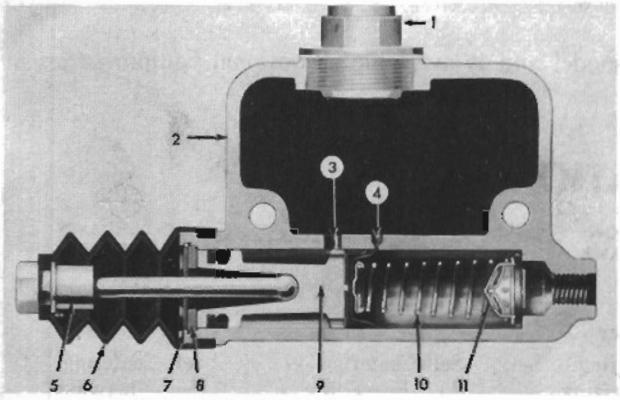


FIG. 2

1. Filler plug
2. Housing
3. Intake port
4. Compensating port
5. Push rod
6. Boot
7. Lock wire
8. Piston stop
9. Piston assembly
10. Return spring
11. Check valve

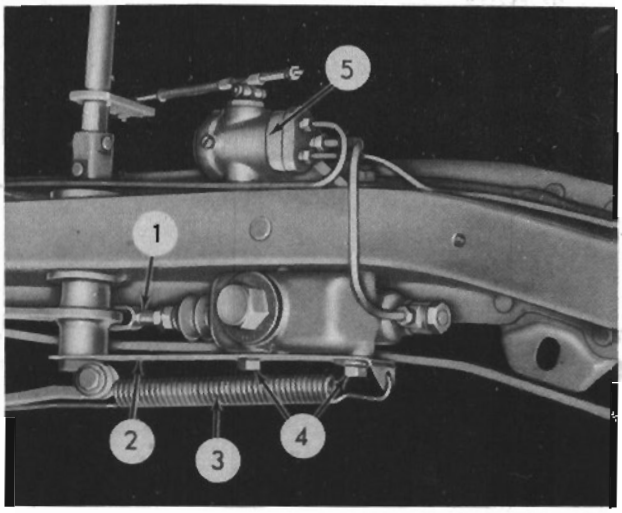


FIG. 3

1. Master cylinder rod
2. Support plate
3. Clutch pedal spring
4. Cylinder mounting bolts
5. Hill holder

MASTER CYLINDER

The master cylinder body on all models is a one-piece iron casting, containing both the fluid reservoir and the cylinder barrel (see Fig. 2). The filler plug contains a vent which prevents any buildup of pressure within the fluid reservoir.

Filling—All Models

Remove the floor cover plate and clean the top of the master cylinder thoroughly. Remove the filler plug. Fill the master cylinder with heavy-duty brake fluid (Lockheed No. 21-B) until the level is within ½" (12,7 mm.) of the top of the cylinder. Inspect the plug to make sure the vent hole is not clogged, then install and tighten securely. Install the floor cover plate.

Removal—All Models

Unhook the clutch pedal pullback spring from the master cylinder support strap, and remove the brake pedal pullback spring by unhooking it first from its frame bracket and then from the spring clip which is attached to the master cylinder-to-pedal rod. Disconnect the fluid line or lines at the rear of the master cylinder. On cars equipped with a Hill Holder, only one line is connected to the master cylinder (see Fig. 3). Remove the brake pedal clevis pin and disconnect the brake pedal-to-master cylinder rod (1, Fig. 3) at the brake pedal. Remove the mounting bolt nuts and star washers from the mounting bolts (4), swing the support strap (2) down out of position, and remove the master cylinder. Insert the forward mounting bolt to support the Hill Holder while the master cylinder is off the car.

Installation—All Models

Place the master cylinder in position on the outside of the frame side rail and swing the support strap up into position. Insert the mounting bolts through the support strap, the master cylinder, the cylinder mounting holes in the frame side rail, and the Hill Holder if the car is so equipped. Install the mounting bolt star washers and nuts.

Connect the brake fluid line or lines. Position the brake pedal-to-master cylinder rod at the brake pedal and install the clevis pin. On the W, F, D, and Y models, connect the rod to the pedal in the forward hole. On the C and K models, use the rear hole. Install the brake pedal pullback spring and the clutch pedal pullback spring.

Fill the master cylinder (see Filling) with Lockheed No. 21-B brake fluid and bleed the brake system as outlined in Bleeding the System, and make the necessary brake pedal free travel adjustment as outlined in Brake Pedal Free Travel—Adjustment.

Disassembly—All Models

Remove the filler plug and gasket, and drain the brake fluid from the reservoir. Remove the outlet fitting screw which allows the removal of the outlet fitting and gaskets.

To disassemble the unit, slip the large end of the rubber boot (2, Fig. 4) from the groove of the master cylinder housing (11), and remove the boot and push rod assembly. Remove the boot from the push rod (1) by lifting the small end of the boot from the groove in the push rod and then pushing the rod out of the boot.

Remove the piston stop lock wire (3) and piston stop (4). The piston (6) and secondary cup (5) assembly, primary cup (7), return spring (8), check valve (9), and valve seat (10) can then be removed.

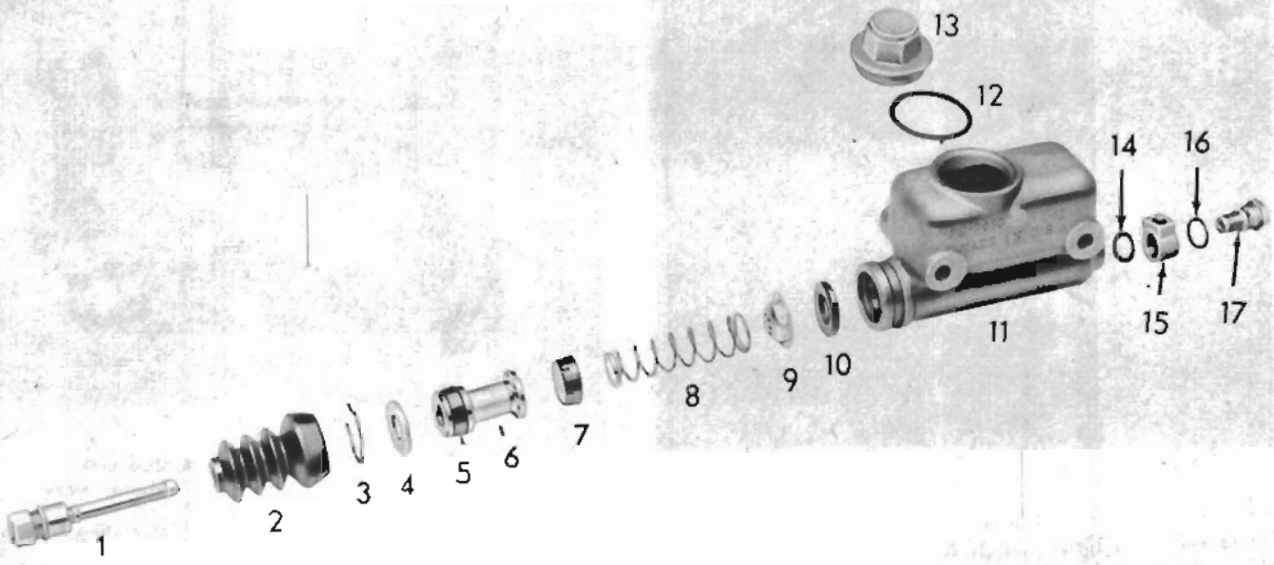


FIG. 4

1. Push rod
2. Boot
3. Lock wire
4. Piston stop
5. Secondary cup
6. Piston
7. Primary cup
8. Spring
9. Check valve
10. Valve seat
11. Housing
12. Gasket
13. Filler plug
14. Copper gasket
15. Outlet fitting
16. Copper gasket
17. Outlet fitting bolt

Inspection—All Models

Inspect the master cylinder bore. If the bore is pitted or scratched, the cylinder wall should be honed to restore the highly polished surface necessary for efficient operation (see Fig. 5). Do not hone away more than is necessary to remove pits and scratches and smooth up the cylinder wall. After honing, check the cylinder bore with an approved No-Go gage to insure that the diameter is not more than .005" (0.127 mm.) oversize. The bore diameter of the master cylinder used on all models is 1" (25,4 mm.). If the bore is oversize, replace the housing. Use a burring tool to remove any sharp edges which may be left around the compensating port after honing.

Make sure that the compensating port is open by passing a small wire through the hole to dislodge any foreign substance.

Check the vent passage in the filler plug and clean it out if necessary.

The cylinder and parts must be washed in clean alcohol or brake fluid; never use gasoline, kerosene, or oil. Presence of mineral oil in the system causes deterioration, softening, and expansion of the rubber parts, and necessitates the replacement of all rubber parts throughout the entire system.

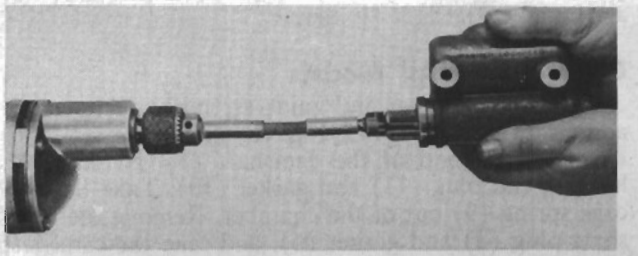


FIG. 5

Before the unit is reassembled, the parts should be dipped in Lockheed No. 21-B heavy-duty brake fluid. Every precaution must be taken to keep parts clean during the reassembly. Use only new gaskets.

Reassembly—All Models

Install the valve seat (10, Fig. 4), making sure that the radius on the seat faces the closed end of the cylinder.Install the check valve (9) on the return spring (8) and install in the cylinder bore. Install the secondary cup (5) on the piston (6). Place the primary cup (7) and the secondary cup and piston assembly in the master cylinder bore and install the piston stop (4) and piston stop lock wire (3). Be sure the stop lock wire is well seated in the groove. Install the boot (2) on the push rod (1) and install the assembly on the master cylinder. Install the filler plug and new gasket. Place the outlet fitting and new copper gaskets on the outlet fitting screw and install on the master cylinder.

STOP LIGHT SWITCH

The stop light switch (see Fig. 6) is located on the inner side of the left frame rail just forward of the steering gear housing on all models except those equipped with power brakes. On the latter, it is screwed into the hydraulic cylinder of the power brake unit, which is mounted under the hood on the left front fender apron.

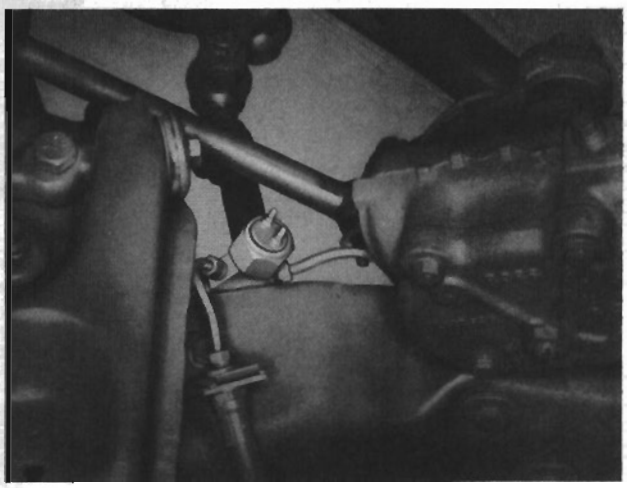


FIG. 6

If the stop light switch has been removed, it may be necessary to bleed the front brakes after reinstalling the switch. Bleed the brakes as outlined under Bleeding the Hydraulic System.

HILL HOLDER

If the brakes are applied while the clutch is depressed and the car is stopped on an upgrade, the Hill Holder will retain the same amount of pressure in the brake lines as was used in stopping, and will not be released until the clutch pedal is released. This permits the operator to use his right foot to operate the accelerator only, when ready to resume forward motion.

Operation—All Models

When the clutch pedal is released, the cage (4, Fig. 7) holds the seal (3) away from its seat so that brake fluid may return from the outlets (2) through the inlet (1) to the master cylinder.

When the clutch pedal is depressed, the cage moves to the rear. If the car is on an upgrade, the steel ball (5, Fig. 8) will roll to the rear and cover the hole in the seal, preventing fluid from returning to the master cylinder.

If the car is on a level or a downgrade, the steel ball will roll away from the seal, and the fluid can return to the master cylinder through the hole in the seal even though the action of the clutch pedal holds the cage to the rear.

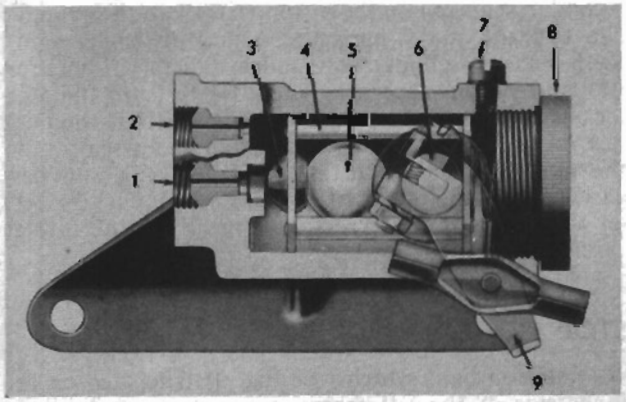


FIG. 7

1. Inlet
2. Outlet
3. Rubber seal
4. Ball cage
5. Ball
6. Camshaft
7. Bleeder screw
8. Plug
9. Operating lever

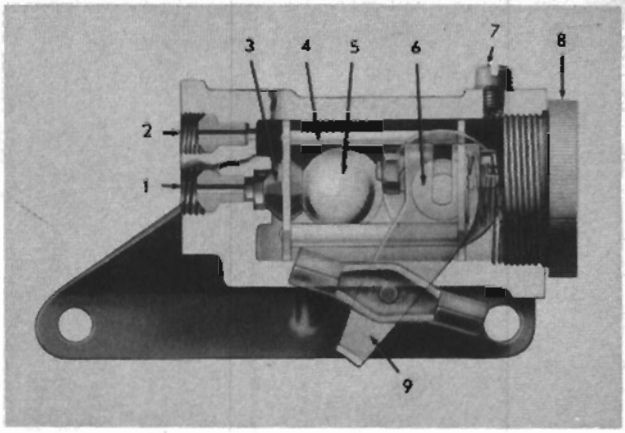


FIG. 8

1. Inlet
2. Outlet
3. Rubber seal
4. Ball cage
5. Ball
6. Camshaft
7. Bleeder screw
8. Plug
9. Operating lever

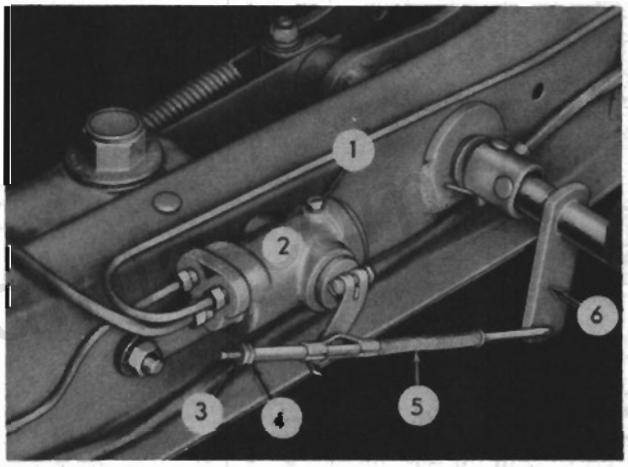


FIG. 9

1. Bleeder screw
2. Hill holder
3. Lock nut
4. Adjusting nut
5. Operating rod
6. Clutch release shaft lever

Removal—All Models

Disconnect the Hill Holder operating rod (5, Fig. 9) from the clutch release shaft lever (6). Disconnect the brake fluid lines. Remove the mounting bolt nut and remove the Hill Holder.

Disassembly—All Models

Remove the lever and guide assembly clamp screw and remove the lever (12, Fig. 10) and guide assembly (1) from the end of the camshaft (5). Remove the housing end plug (11) and gasket (10). Take the ball cage spring (9) out of the chamber. Remove the camshaft plug (2) and gasket (4), and take the camshaft end seal (3) out of the plug. Turn the camshaft (5) to disengage the cam from the slot in the ball cage

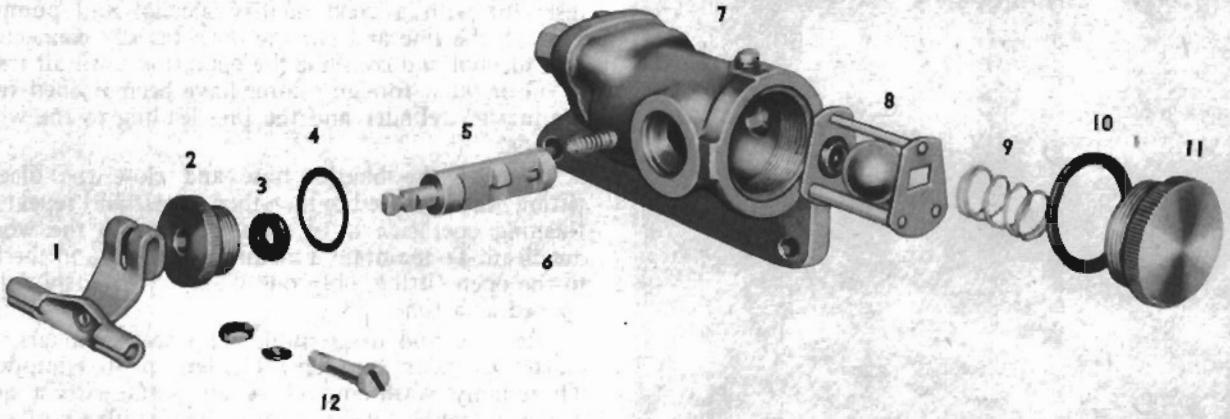


FIG. 10

1. Guide assembly
2. Camshaft plug
3. Sealing washer
4. Copper gasket
5. Camshaft
6. Spring
7. Housing
8. Cage and ball assembly
9. Spring
10. Gasket
11. Plug
12. Lever screw

(8) and pull the camshaft out of the housing. Remove the spring (6) from the end of the camshaft. Then remove the ball cage assembly from the chamber.

Servicing—All Models

The Hill Holder is serviced with a repair kit which consists of the ball cage assembly (8), housing end plug gasket (10), camshaft plug gasket (4), and camshaft sealing washer (3). The ball cage assembly consists of the seal (3, Fig. 7 or 8), cage (4), and steel ball (5).

Use clean alcohol or brake fluid to wash all parts. Do not use gasoline, kerosene, or any other solvent which might introduce mineral oil into the system. Dip all parts in Lockheed No. 21-B heavy-duty brake fluid before reassembly. Be very careful to keep all parts clean during reassembly.

Reassembly—All Models

Insert the ball cage assembly into the chamber, seal end first, with the slot in the end plate toward the top of the unit. Insert the small spring (6, Fig. 10) in the end of the camshaft (5), and install the camshaft in the housing, engaging the projection on the camshaft in the slot on the end plate. Seat the new camshaft sealing washer in the camshaft end plug, and install the new metal gasket on the plug. Then install the plug in the housing. Place the ball cage assembly spring (9) in the housing, put a new metal gasket (10) on the housing end plug (11), and install the plug.

Turn the camshaft clockwise as far as possible to make sure that the projection on the cam is in the slot of the ball cage, and that the ball cage is seated on the valve chamber inlet in the applied position. Install the lever and guide assembly on the end of the camshaft, with the lever pointing downward.

Installation—All Models

Place the new copper gasket on the outlet fitting bolt and insert the bolt in the Hill Holder. Then install another new copper gasket on the bolt and install the assembly on the master cylinder. Always use new gaskets. Connect the brake fluid lines to the Hill Holder, tightening the line fittings and master cylinder outlet fittings securely. Connect the Hill Holder operating rod to the Hill Holder. There are two holes in the Hill Holder lever of the clutch operating shaft. The forward hole is used on W, F, D, and Y models, and the rear hole is used on C and K models.

Fill and bleed the brake system as outlined in Bleeding the System and check the adjustment of the Hill Holder operating rod.

Adjustments—All Models

To adjust the Hill Holder, loosen the lock nut (3, Fig. 9) on the end of the operating rod (5) and turn the adjusting nut (4) either to the right or left to provide simultaneous Hill Holder release and clutch pedal adjustment. When the correct adjustment is obtained, tighten the lock nut securely.

BLEEDING THE HYDRAULIC SYSTEM

The proper operation of the hydraulic brakes requires a solid column of fluid in the system. Whenever any connection is opened or a leak occurs admitting air into the system, it is necessary to bleed the system. The presence of air is indicated by a soft or spongy pedal.

Note.—*If the car is equipped with Studebaker Power Brake and/or Hill Holder, these units should be bled before the rest of the brake system.* Instructions for bleeding the Studebaker Power Brake unit are given on page 22. Bleed the Hill Holder at the screw provided at the top of the unit.

Manual Bleeding—All Models

The master cylinder reservoir must be full at all times during the bleeding operation. The Automatic Refiller J-713 shown in Fig. 11 maintains the fluid at

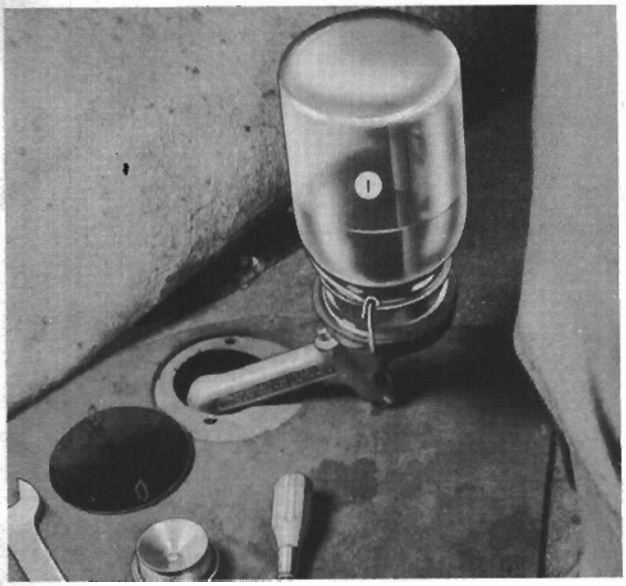


FIG. 11
1. Automatic Refiller J-713

the proper level and eliminates the possibility of air entering the system because of lack of fluid.

Bleed the Hill Holder first, by loosening the bleeder screw at the top of the unit while there is pressure applied to the system, and when retightening the screw before the pressure is released. No drain hose is used.

Slip the bleeder drain hose over the bleeder screw of the wheel cylinder and allow the bleeder hose to hang in a clean container, preferably glass. Loosen the bleeder screw not more than one full turn and depress the brake pedal slowly, then allow the pedal to return to the released position. This operation should be repeated several times at each wheel. Watch the flow of fluid from the hose, being sure that the hose is submerged in the fluid in the container. When the air bubbles cease to appear, depress the brake pedal and close the bleeder connection.

Bleeding a particular wheel cylinder will expel the air from that branch of the system only. Whenever the system connection at the master cylinder is opened or the master cylinder removed, the entire system must be bled.

After bleeding the system, fill the master cylinder reservoir to within ½" (12,7 mm.) from the top and replace the filler plug. Fluid withdrawn from the system should not be used again.

Pressure Bleeding—All Models

If pressure brake bleeder equipment is used, the sequence and procedure are the same as described under Manual Bleeding, except that it is not necessary to operate the brake pedal during the operation, since constant pressure is maintained by the equipment. If compressed air is used in the pressure bleeding equipment, be sure that the brake fluid supply is adequate before starting.

FLUSHING THE SYSTEM

To flush the system, attach the bleeder drain hose to the fitting on one wheel cylinder, open the fitting, and pump out all fluid by alternately depressing and releasing the brake pedal. Fill the master cylinder reservoir with a good quality alcohol and pump it through the line and out the open bleeder connection. Add alcohol and continue the operation until all traces of oil or other foreign matter have been flushed from the master cylinder and the line leading to the wheel cylinder.

Remove the bleeder hose and close the bleeder fitting; then proceed to the other wheels and repeat the flushing operation until all four lines to the wheels are clean. To maintain a maximum pressure in the line to the open fitting, only one bleeder fitting should be opened at a time.

Remove and disassemble all wheel cylinders, the master cylinder, and Hill Holder (if so equipped). Thoroughly wash and clean all parts with a good quality alcohol. In every case where evidence of mineral oil has been found in the system, install new rubber parts even though there is no visible sign of failure.

Reassemble the units and install. Fill the system with Lockheed Fluid No. 21-B and then air bleed the entire system.

WHEEL CYLINDER

Removal and Disassembly—All Models

Remove the wheel and hub assembly as outlined in the Wheels and Tires section.

Disconnect the tubing or hose at the wheel cylinder inlet. Set the wheel cylinder clamp in place. Use a screw driver to force the upper end of the shoe away from the anchor block far enough to permit the shoe to slip back over the edge of the anchor block bracket. In this way, the shoe will be held away to provide additional clearance between the wheel cylinder push rod and the shoe web. Reposition both shoes in the same manner. Disengage the push rods from the shoes. Remove the cap screws which hold the cylinder to the backing plate. Remove the cylinder from the backing plate. Caution—*Do not allow the brake fluid to come in contact with the brake lining.*

To disassemble the cylinder, remove the cylinder clamp and remove the rubber boot (2, Fig. 12) and push rod (1) from one end of the cylinder (5). Removal of the boot permits the spring (6) to push out the cup (4) and piston (3). Then, remove the boot and push rod from the other end and slip the other cup and piston out of the cylinder.

Servicing—All Models

Inspect all parts thoroughly. If the cylinder bore

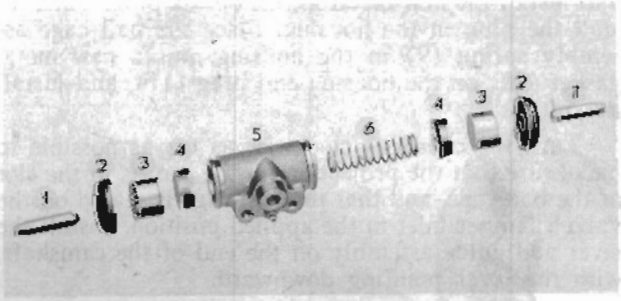


FIG. 12
1. Push rod
2. Boot
3. Piston
4. Cup
5. Cylinder body
6. Spring

is slightly pitted or scratched, hone the cylinder wall. After the honing operation, remove all burrs with a burring tool. Use a No-Go gage to check the diameter of the bore to make sure it is within the service limits. On the Champion models the diameter of the bore of the rear wheel cylinder is 13/16" (20,6 mm.), the front wheel cylinder is 1" (25,4 mm.) with the maximum oversize allowable of .005" (0,127 mm.). On all other models, the bore of the front wheel cylinders is 1-1/16" (27,9 mm.) and the rear wheel cylinder is 7/8" (22,2 mm.), with the maximum oversize allowable of .007" (0,178 mm.). If the bore is oversize after honing, replace the cylinder.

Rubber boots which have been in contact with grease or oil will no longer adequately protect the wheel cylinder from foreign matter and should be replaced. Mineral oil will cause softening, expansion, and deterioration of the cups and they will no longer hold the hydraulic pressure exerted upon them. If mineral oil is present in the system, all rubber parts throughout the system must be replaced and the entire system flushed.

The wheel cylinder and parts must be washed in clean alcohol or brake fluid. Never use gasoline, kerosene, or oil. All parts must be dipped in Lockheed No. 21-B heavy-duty brake fluid before reassembly. Every precaution should be taken to keep parts clean during reassembly.

Reassembly and Installation—All Models

Install a cup and piston in one end of the cylinder. Slip the boot into place in the groove of the cylinder and then install the spring. Install the other cup and piston in the other end of the cylinder and install the other rubber boot. Slip the push rods into the boots. Before installing the cylinder, make sure that it is the correct size. The front wheel cylinder bore is larger than the bore of the rear wheel cylinder. Position the cylinder on the backing plate, and install the retaining cap screws. Turn the cylinder push rods so that the slots are properly positioned, and start the push rods on the shoe webs. Using a screw driver, lift the end of each shoe back into position.

Connect the wheel cylinder to the system and bleed the cylinder as outlined in Bleeding the System.

SERVICE BRAKES

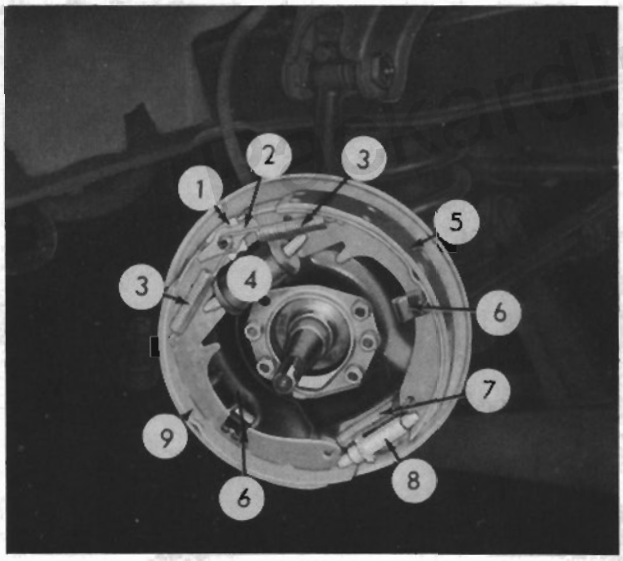


FIG. 13

1. Anchor block
2. Anchor plate
3. Return spring
4. Wheel cylinder
5. Primary shoe
6. Guide clip
7. Adjusting screw spring
8. Adjusting screw
9. Secondary screw

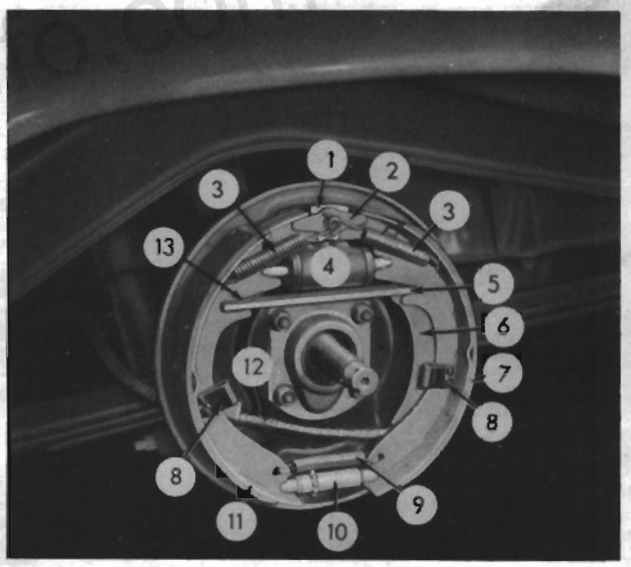


FIG. 14

1. Anchor block
2. Anchor plate
3. Return spring
4. Wheel cylinder
5. Parking brake link
6. Parking brake lever
7. Secondary shoe
8. Guide clip
9. Adjusting screw spring
10. Adjusting screw
11. Primary shoe
12. Parking brake cable
13. Antirattle spring

Figures 13 and 14 illustrate the front and rear brake assemblies respectively. Although brake assemblies vary in size as to front and rear, they are basically the same. On all models except the Champion and Flighthawk the rear brake parking brake lever (6, Fig. 14) is mounted on the inner side of the rear shoe, whereas on the Champion and Flighthawk rear brake the parking brake lever is mounted on the outer side of the shoe.

The edge of each shoe table rests against three pads on the backing plate, and the upper shoe ends rest upon a single swiveling anchor block mounted on a fixed anchor pin which acts as a stop for both shoes. The anchor block permits radial movement of the shoes to achieve the self-centering action of the shoes. Upon brake application, the lining surface pressures

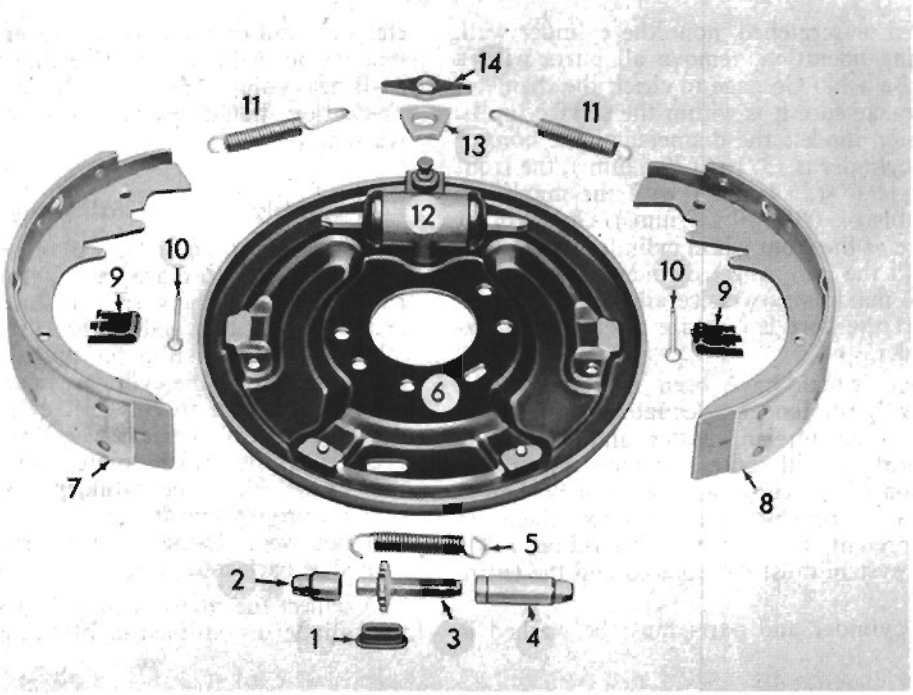


FIG. 15

1. Slot cover
2. Adjusting screw guide
3. Adjusting screw
4. Adjusting screw nut
5. Adjusting screw spring
6. Backing plate
7. Primary shoe
8. Secondary shoe
9. Guide clip
10. Guide
11. Return spring
12. Wheel cylinder
13. Anchor block
14. Anchor plate

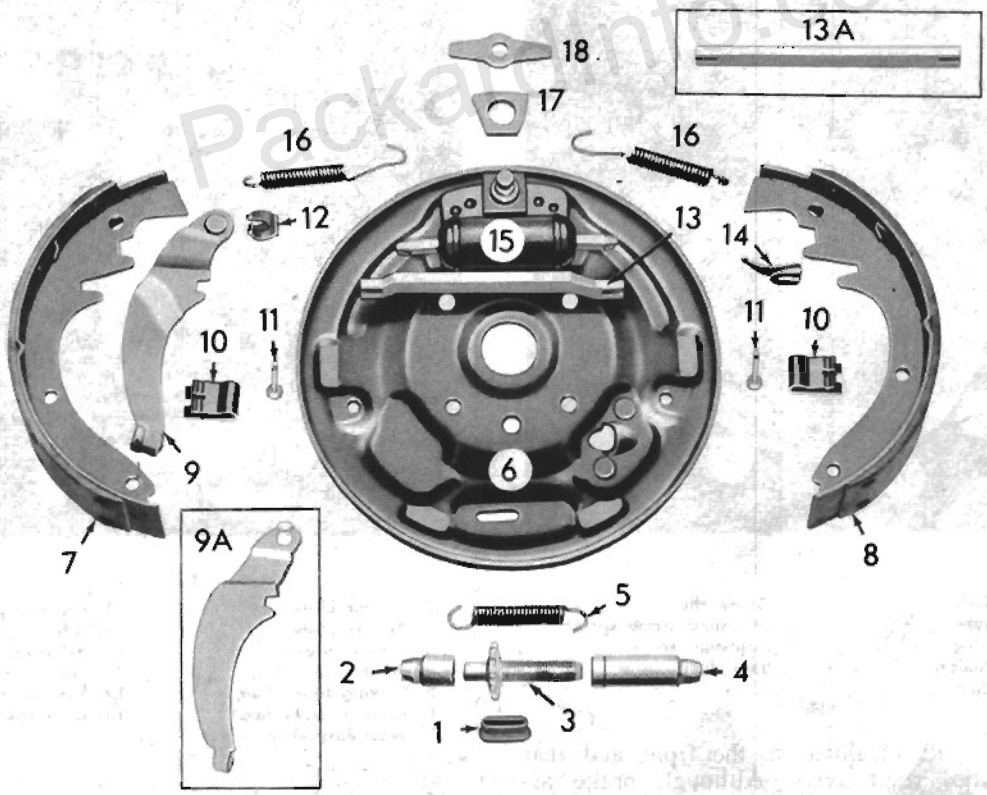


FIG. 16

1. Slot cover
2. Adjusting screw guide
3. Adjusting screw
4. Adjusting screw nut
5. Adjusting screw spring
6. Backing plate
7. Secondary shoe
8. Primary shoe
9. Parking brake lever (56G)
9A. Parking brake lever (all except 56G)
10. Guide clip
11. Guide
12. Lever clip
13. Parking brake link (56G)
13A. Parking brake link (except 56G)
14. Antirattle spring
15. Wheel cylinder
16. Return spring
17. Anchor block
18. Anchor plate

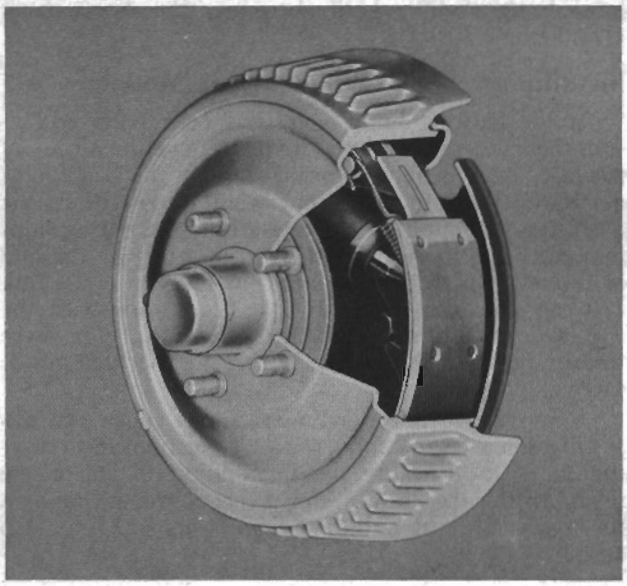


FIG. 17

force the shoe to adjust its position on the block and center itself within the drum. The centering action is a continuous process such as from light to severe brake application or during drum expansion.

The anchor plate (2) aids in keeping the shoes properly aligned at the self-centering block (1). The adjusting screw (starwheel) assembly consists of an adjusting screw (3, Figs. 15 and 16), nut (4), and guide (2). The adjusting screw spring, while holding the shoes against the screw assembly, also bears against the notches of the screw with enough tension to act as a lock for the screw.

On the front wheel brakes of all models, the secondary shoe lining is thicker than the lining on the primary shoe to provide longer wear.

The ribbed drum as shown in Fig. 17 is used on the President, Skyhawk and Goldenhawk models, while the other models use the conventional drum. On all models the brake assembly is effectively sealed against the entrance of dirt and mud by a flange joint between the brake backing plate and the drum (see Fig. 17).

When the brakes are applied, the pistons of the wheel cylinder, acting on the brake shoes through the push rods, force the shoes against the drum. Since the shoes float free, friction between the shoes and the rotating drum turn the entire assembly in the direction of wheel rotation. The primary shoe moves downward, and the secondary shoe is carried upward until its upper end contacts the flat face of the centering (anchor) block. The end of the shoe adjusts its position on the centering block so that the shoe is centered in relation to the drum. The friction between the drum and the shoes now tends to roll both shoes toward the drum with increased pressure. The secondary shoe and the centering block pivot around the block pin; the primary shoe tends to pivot about the adjusting screw assembly at the bottom which is held stationary by the secondary shoe. Inasmuch as the brake shoes are connected at the bottom by the adjusting screw assembly, the self-energizing force applied to the primary shoe is also transmitted to the secondary shoe. The self-energizing effect derived from the rotating drum increases the pressure of the shoes against the drum and reduces the physical effort required during the brake application.

When the car is backing, the brake action is reversed, otherwise the action is the same.

BRAKE SHOES

Removal (Front Wheels)—All Models

Place a wheel cylinder clamp across the cylinder boots. Using brake spring pliers, remove the adjusting screw spring (7, Fig. 13) and slip the adjusting screw assembly off the shoes. Hold the guide pin (10, Fig. 15) securely against the backing plate, compress the guide pin clip, and slip the clip off the pin. Remove the clip from the shoe which has its return spring mounted on top at the anchor pin. Pull the bottom end of the shoe outward, pivoting the shoe at the block, and stretch the spring enough to disengage the wheel cylinder push rod from the shoe. Then, move the shoe away from the backing plate to allow the shoe to slip off the block to take the tension off the spring. Remove the spring and shoe. Remove the other shoe in the same manner.

If Brake Spring Remover and Replacer J-1681 is available, remove the shoes by first removing the return springs. Then remove the guide clips. Spread the shoes and slip both shoes out of the wheel cylinder push rods. Allow the shoes to come together at the top and overlap enough to take the tension off the adjusting screw spring. Then, slip the adjusting screw off the shoes and remove the adjusting screw spring.

Installation (Front Wheels)—All Models

Apply a small amount of Lubriplate to the wear surfaces on the backing plate. Make sure that the anchor block is properly installed. There are two means of checking the installation; the curved side must contact the primary shoe and the arrow must point toward the primary shoe.

Hook the return spring on the tab of the shoe table. Hook the other end of the spring on the anchor block pin and at the same time place the end of the shoe against the anchor block (see Fig. 18). Then move the lower end of the shoe down, allowing the anchor block to pivot on the pin. Start the web of the shoe into the wheel cylinder push rod. Then push the

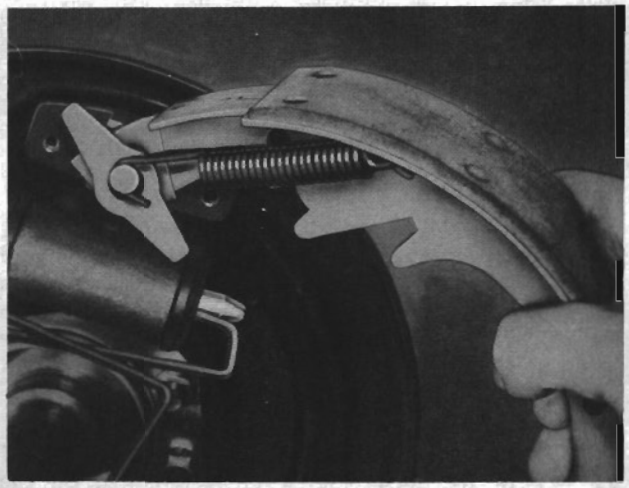


FIG. 18

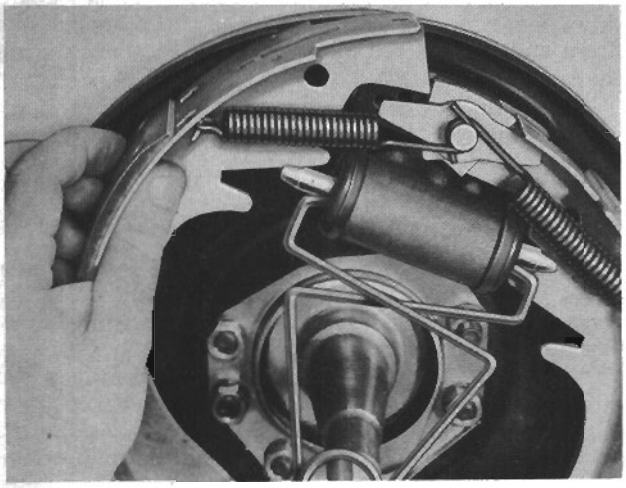


FIG. 19

shoe toward the backing plate, keeping the upper end of the shoe on the anchor block and stretching the spring. Align the guide pin holes and install the guide pin and clip. Make sure that the end of the pin is properly seated in the notch of the clip.

Hook the other return spring on the other shoe. Then hook the spring on the anchor block pin and position the shoe as shown in Fig. 19. Move the lower end of the shoe away from the spindle to stretch the spring and permit the upper end of the shoe to slip down the anchor block and behind the anchor block guide. While moving into position, insert the web of the shoe in the slot of the wheel cylinder push rod. Install the guide pin and clip. Spread the shoes and install the adjusting screw assembly. Using brake spring pliers, install the adjusting screw spring. Be careful not to chip or break out the lining at the rivet hole with the brake spring pliers.

If the Brake Spring Remover and Replacer J-1681 is available, first hook the adjusting screw spring to the shoes and place the adjusting screw in position between the shoes. Then place the shoes on the backing plate, engage the shoes in the wheel cylinder push rods, and install the guide pins and clip. Install the anchor block and guide and use the tool to install the return springs.

Remove the wheel cylinder clamp. Rotate the adjusting screw to the fully released position and center the shoes to facilitate the installation of the brake drum. Install the drum and adjust the wheel bearings. Adjust the brake shoe clearance as outlined under Adjustment.

Removal (Rear Wheels)—All Models

Install the wheel cylinder clamp. Pull the parking brake lever (6, Fig. 14) toward the axle shaft and unhook the cable (12). Spread the shoes. Disengage the parking brake link (5) from the shoes and remove the link and antirattle spring (13). Then remove the shoes in the same manner as outlined for the front wheel shoes.

To remove the parking brake lever from the shoe, remove the spring clip and slip the lever pin out of the web of the shoe. The lever is mounted on the outer side of the shoe web of the Champion and Flighthawk brake and on the inner side of the shoe web on all other models.

Installation (Rear Wheels)—All Models

If the parking brake lever has been removed, install the lever, making sure the retaining clip is securely in place. Then install the brake shoes in the same manner as outlined for the front wheel shoes. Place the antirattle spring on the actuating link. On the Champion and Flighthawk, the spring is installed on the end of the link which has the larger offset. Insert the link between the shoes, engaging the front shoe with the end which has the antirattle spring. Pull the lever toward the axle shaft and connect the parking brake cable.

Remove the wheel cylinder clamp. Turn the adjusting screw to the fully released position and center the shoes to facilitate the installation of the brake drum. Install the drum. Using a torque wrench, tighten the axle shaft nut to 170 to 200 ft-lbs (23,5 to 27,6 kg-m).

Adjustment—All Models

Check the fluid level in the master cylinder and, if necessary, fill the cylinder to within ½" (12,7 mm.) of the top. Check the brake pedal free travel and adjust if necessary. Make sure that the parking brake handle is in the fully released position and the cables are released.

Remove the adjusting screw slot cover from the backing plate. Using a screw driver or a suitable adjusting tool to turn the adjusting screw, engage the end of the screw driver with the teeth on the screw; use the slot edge as a fulcrum and move the handle of the screw driver upward (see Fig. 20). Turn the adjusting screw until the shoes are locked against the drum. Then turn the adjusting screw back eight notches or more as required to free the drum. Each notch can be felt as the tooth slips past the adjusting screw spring.

Relining—All Models

Remove the old lining. Position the new lining on the shoe. *Note.—The linings for the front wheel secondary shoes on all models are thicker than the linings for the other shoes.* The special linings are identified

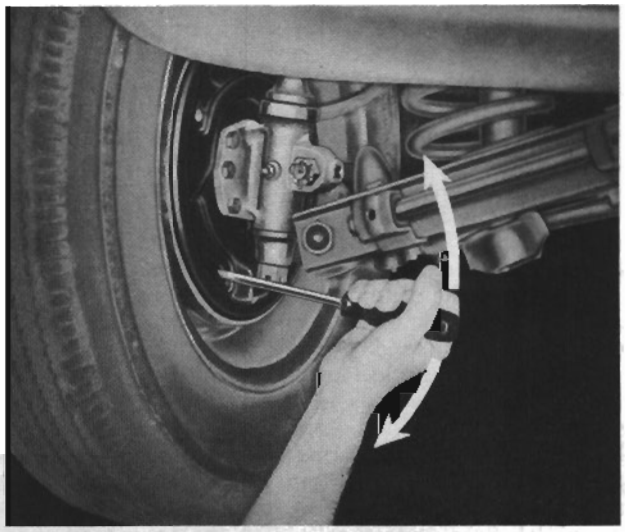


FIG. 20

by the words "Secondary" and "Top" which are painted on the wearing surface. Be sure to install the lining on the shoe so that the word "Top" will be at the top of the wheel when installed.

The center rivets must be set first, then work toward both ends of the lining. It is important that a snug fit exist between the lining and the shoes. When linings are applied loosely, only a small part of the area contacts the drum due to humps between the rivets. If the linings are loose, the braking load will be placed on the rivets, causing them to wear and eventually shear.

Only rivets which insure a close fit between the rivet shank and the drilled hole in the lining and the shoes should be used. Rivets with small shanks, which are loose in the holes, permit the lining to shift on the shoe when under pressure, resulting in unsatisfactory brakes and premature failure. The rivets should be long enough to properly upset the end and securely bind the lining. Should the rivet be too long, the upset end will split, weakening the riveting job.

If high spots are present on the lining, they should be removed before assembling the shoes on the backing plates.

BRAKE DRUMS

Inspect the brake drums and if found to be scored, rough, or out-of-round, they should be machined or replaced.

Even though the drum is not scored, it should be checked for an out-of-round condition. A drum with a total runout of .010" (0,254 mm.) or less does not require machining.

The drum should also be checked for a bell-mouthed condition which exists when the contact surface of the drum is not parallel to the hub of the drum. If the maximum diameter required to true the drum is less than .100" (2,54 mm.) over the original diameter, the drum can be machined. Otherwise, it must be replaced. The diameter must be the same throughout the entire contact surface of the drum.

The drums may be machined up to .020" (0,508 mm.) more than the original diameter without having to shim the lining. If necessary to machine beyond the .020" (0,508 mm.) limit, insert shims between the brake lining and the brake shoe.

The following chart shows the recommended maximum diameters to which brake drums may be turned in service.

WHERE USED	BASIC DIAMETER	MAX. TURNED DIAMETER
Rear—Champion & Flighthawk	9" (22,9 cm.)	9.100" (23,1 cm.)
Front—Champion & Flighthawk	10" (25,4 cm.)	10.100" (25,7 cm.)
Rear—All other models	10" (25,4 cm.)	10.100" (25,7 cm.)
Front—All other models	11" (27,6 cm.)	11.100" (28,2 cm.)

BRAKE PEDAL

Free Travel Adjustment—All Models

Brake pedal free travel should be checked before making any brake adjustments. Adjust the free travel by loosening the lock nut on the brake pedal-to-master cylinder rod and turning the master cylinder push rod until the correct pedal free travel exists before the pressure stroke starts. The pedal free travel limits are ¼" to ⅜" (6,35 mm. to 9,53 mm.), measured at the brake pedal pad (see Fig. 21). The pedal free travel on models equipped with power brakes should be ⅛" to ¼" (3,18 mm. to 6,35 mm.).

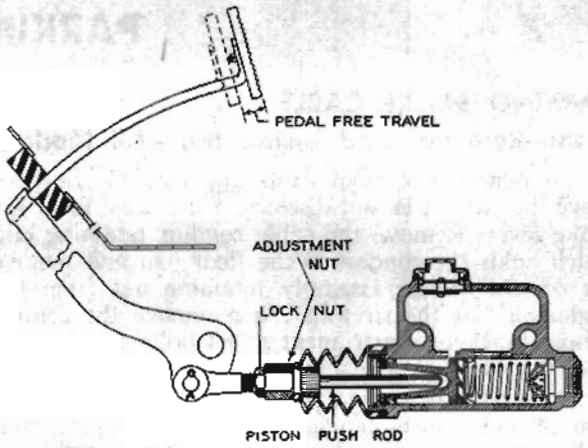


FIG. 21

Removal—All Models

Remove the brake pedal pad, turn back the floor mat, and remove the pedal hole cover plate and seals. Remove the pedal protector shield under the left front fender. Except on models equipped with automatic transmission, remove the clutch pedal from the pedal shaft as outlined in the Clutch section. Remove the brake pedal return spring and disconnect the brake pedal-to-master cylinder push rod at the clevis. Loosen the master cylinder bolts and pull the front end of the master cylinder side support strap from the pedal shaft. Slide the brake pedal hub from the pedal shaft and remove the pedal by pulling it down through the floor board. Remove the under-floor grommet from the pedal.

Installation—All Models

Before installing the brake pedal, grease the pedal shaft. Install the under-floor grommet on the brake pedal and install the brake pedal by pushing it up through the floor board and sliding the hub on the pedal shaft. Slip the end of the master cylinder support strap over the pedal shaft and tighten the master cylinder attaching bolts. Install the brake pedal-to-master cylinder push rod and the pedal return spring. On all models except those equipped with automatic transmission, install the clutch pedal, pedal linkage, and pedal return spring as described in the Clutch section. On models equipped with automatic transmission, install the pedal shaft spacer. Install the pedal protector shield, and install the pedal hole seals and cover plate. Install the floor mat and brake pedal pad.

PARKING BRAKE

PARKING BRAKE CABLE

Front—Removal and Installation—All Models

To remove the front cable and conduit, first remove the clevis pin and disconnect the cable from the brake lever. Remove the cable conduit retaining clip which holds the conduit to the floor pan and remove the control handle assembly retaining nut from the engine side of the firewall. Then remove the control handle bracket-to-instrument panel bolts and remove the assembly from the car.

To install the front cable, insert the threaded section of the control handle through the engine firewall and install the control handle assembly retaining nut and tighten. Then thread the front cable down along the firewall and floor pan and install the cable conduit retaining clip and nut. Position the clevis of the front cable on the parking brake lever and install the clevis pin and cotter key.

Rear—Removal and Installation—All Models

Remove the adjusting nut (6, Fig. 22), slide the equalizer (5) rearward, and slip the rear cable (8) off the equalizer. Loosen the sheet metal screws holding the cable brackets to the frame side rails just ahead of the brake cable return springs, and slip the cable out of the brackets. Remove the rear wheel hub assemblies. If it is necessary to hammer on the wrench to remove the rear axle shaft nut, do it before raising the car off the ground, and with the brakes released. Remove the cable shield bracket retaining nuts holding the bracket to the backing plate. Remove the clip from the forward end of the shield and slip the shield out of the frame bracket. Push the parking brake operating lever toward the center of the brake and unhook the end of the cable from the lever. Then pull the cable forward and out of the backing plate. The rear brake cable cannot be further disassembled and must be serviced as a unit. The procedure is the same for both wheels.

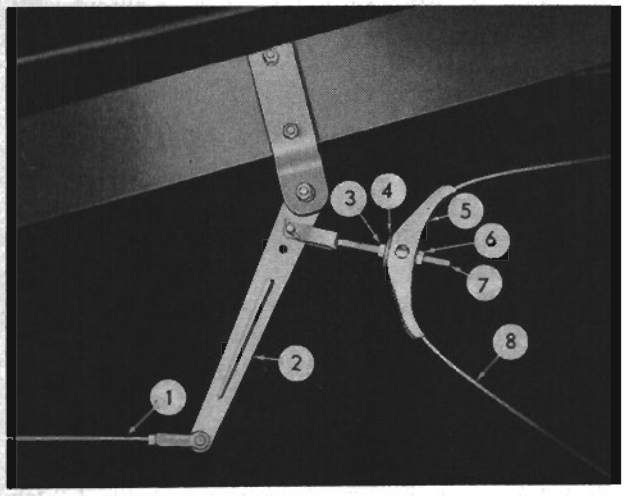


FIG. 22

1. Front cable
2. Lever
3. Lock nut
4. Plain washer
5. Equalizer
6. Adjusting nut
7. Equalizer rod
8. Rear cable

Insert the end of the cable in the backing plate. Hook the cable to the operating lever. Insert the cable shield in the frame bracket and install the retaining clip. Position the shield bracket at the backing plate and install the retaining nuts. Install the cable end at each wheel in the same manner. Slip the cable into the frame guides and install the sheet metal screws into the frame side rail. Position the equalizer on the cable, insert the connecting bolt of the parking brake lever through the equalizer, and install the adjusting nut. Install the rear wheel hub assemblies. When installing the rear drums, use a torque wrench to tighten the rear axle shaft nut to 170 to 200 ft-lbs (23,5 to 27,7 kg-m) torque. If using the brakes to hold the rear drum while tightening the axle shaft nut, do not use a hammer to set the nut.

Adjustment—All Models

When making the parking brake adjustment, the rear wheels must be off the ground. Set the control handle four notches from its fully released position. The adjustment is made at the rear cable equalizer (5, Fig. 22) located underneath the transmission. Loosen the lock nut (3) and tighten the adjusting nut (6) until the slack is taken out of the rear cable and a heavy drag is felt when rotating the rear wheels by hand. Tighten the front nut securely to maintain the adjustment. Release the control handle and check the rear wheels to make sure that a drag does not exist.

PARKING BRAKE CONTROL HANDLE

Removal and Disassembly—All Models

Disconnect the lower end of the cable from the parking brake lever. Loosen the cable conduit retaining clip and slip the cable and conduit out of the clip. Unscrew the conduit retaining cap from the end of the plunger guide. Remove the retaining nut from the engine side of the firewall. Then remove the guide bracket-to-instrument board bolts. Pull the handle and plunger assembly out far enough to align the plunger pin (3, Fig. 23) with the hole at the upper end of the plunger guide. Using a suitable drift, remove the

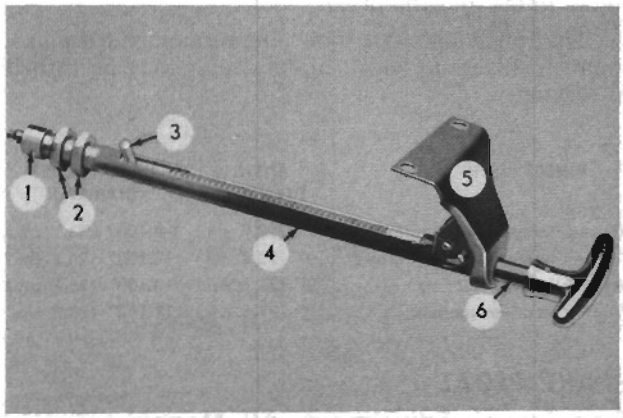


FIG. 23

1. Cable conduit cap
2. Retaining nuts
3. Pin
4. Plunger guide
5. Guide bracket
6. Plunger and handle assembly

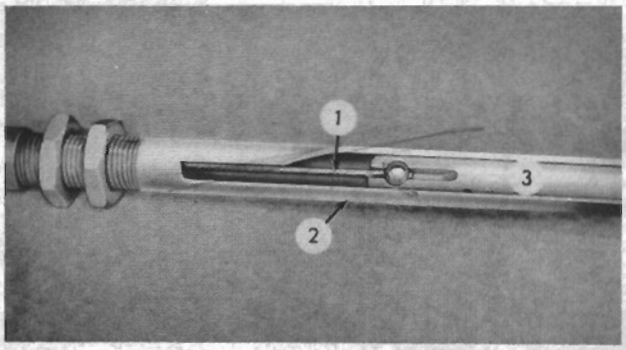


FIG. 24
1. Cable 2. Guide 3. Plunger

pin. Turn the handle to expose the end of the cable in the plunger (see Fig. 24). Pick the end of the cable out of the plunger and pull the cable and conduit assembly out of the plunger guide. Then slip the plunger and handle assembly out of the guide.

To remove the latch (1, Fig. 25), push it forward as far as possible. Slip it out of the guide enough to pick off the spring (2). Then remove the latch.

Reassembly and Installation—All Models

Start the latch into the guide and place the spring in position on the latch. Then slip the latch into the opening on the other side of the guide.

Insert the cable in the guide. Lift the latch up as far as possible and slip the plunger into the guide. Place the end of the cable in the groove of the plunger.

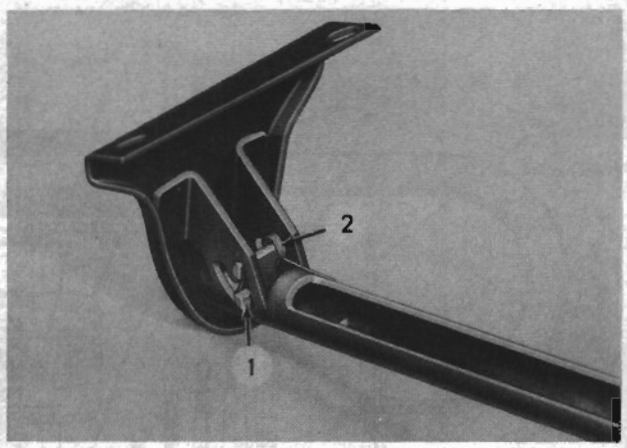


FIG. 25
1. Latch 2. Spring

Turn the plunger and install the pin. Install one of the retaining nuts on the plunger guide and insert the guide through the firewall. Install the guide bracket-to-instrument board bolts.

Install the other guide retaining nut on the engine side of the firewall and tighten both nuts to maintain the position of the guide. Install the cable conduit retaining cap. Position the lower end of the cable conduit under the retaining clip and tighten the clip nut securely. Connect the lower end of the cable to the parking brake lever.

BRAKE POWER UNIT

DESCRIPTION

The Studebaker power brake is a completely self-contained booster unit, connected into the hydraulic brake system between the master cylinder and the wheel cylinders. It utilizes engine vacuum and atmospheric pressure to boost the hydraulic pressure generated in the master cylinder, so that a higher pressure is delivered to the wheel cylinders. When the engine is not operating, and no vacuum is available, the brake system will function as a conventional system.

Cars which are equipped with power brakes at the factory have a special pedal which has less travel than the conventional pedal. However, the pedal linkage is the same as that on conventional models.

CONSTRUCTION

Internally the Studebaker power brake unit is composed of the following major sections (see Fig. 26):

1. Vacuum power cylinder.
2. Hydraulic cylinder.
3. Hydraulically actuated control valve.

The vacuum power cylinder consists of the cylinder shell (1) clamped to the end plate (5) by four hook bolts (15). The cylinder shell contains the power piston (2), piston return spring (14), and push rod (13). The control tube (3) connects the left chamber of the power cylinder to the right side of the diaphragm assembly (8) of the control valve. The right chamber of the power cylinder is connected to the vacuum inlet port and check valve assembly (16). A

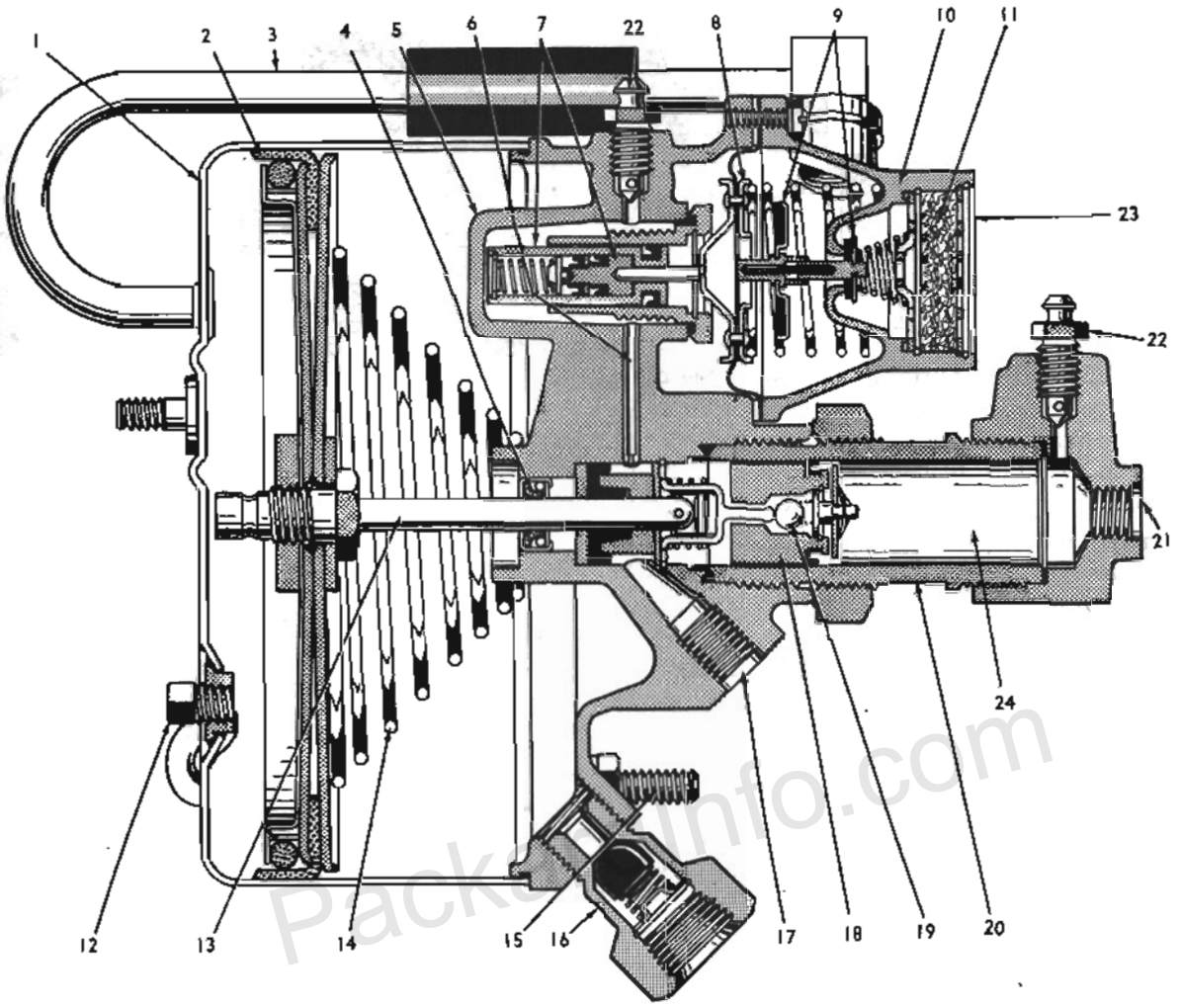


FIG. 26

1. Cylinder shell
2. Power piston
3. Control tube
4. Seals
5. End plate
6. Passage
7. Control valve piston
8. Diaphragm assembly
9. Poppet assembly
10. Valve cover
11. Air cleaner
12. Plug
13. Push rod
14. Piston return spring
15. Hook bolts
16. Check valve
17. Fluid inlet
18. Hydraulic piston
19. Ball check valve
20. Slave cylinder
21. Fluid outlet
22. Bleed screws
23. Air cleaner retainer

connection is made from the vacuum check valve to the intake manifold. The right chamber of the power cylinder is also connected to the left side of the diaphragm assembly (8).

The hydraulic cylinder consists of a slave cylinder tube (20) and hydraulic piston (18) which is pinned to the end of the push rod (13). Integral with the piston is a ball check valve assembly (19). Hydraulic and vacuum seals (4) are provided in the end plate to seal around the push rod. The hydraulic line from the master cylinder is attached at the port (17) in the end plate, and the hydraulic line to the wheel cylinders is attached at the port (21) in the cylinder end cap. The passage (6) in the end plate connects the cylinder chamber at the left of the piston (18) with the left side of the control valve piston (7).

The control valve contains a two-stage hydraulic piston (7) which is in contact with the diaphragm assembly (8). Within the valve cover (10) is found the vacuum and atmosphere poppet assembly (9) and air cleaner (11). As mentioned before, the control tube (3) connects the left power cylinder chamber to the right side of the diaphragm assembly (8).

For bleeding purposes, bleed screws (22) are placed at the top of the end plate and in the slave cylinder end cap. The plug (12) is placed in the end of the cylinder shell to provide for lubrication of the power cylinder.

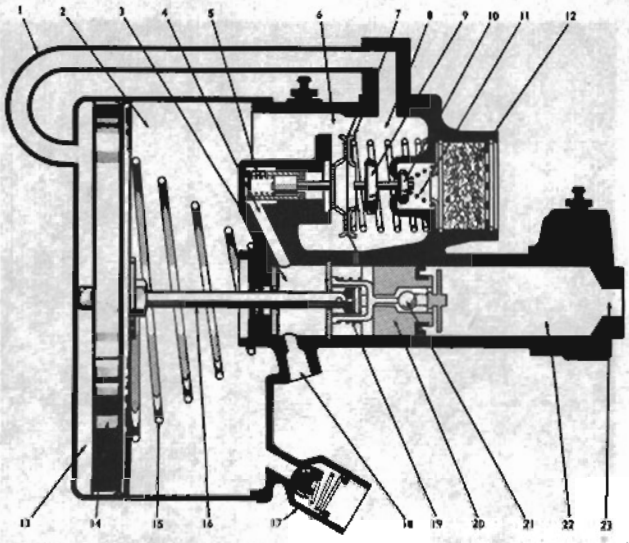


FIG. 27 POWER UNIT IN RELEASED POSITION

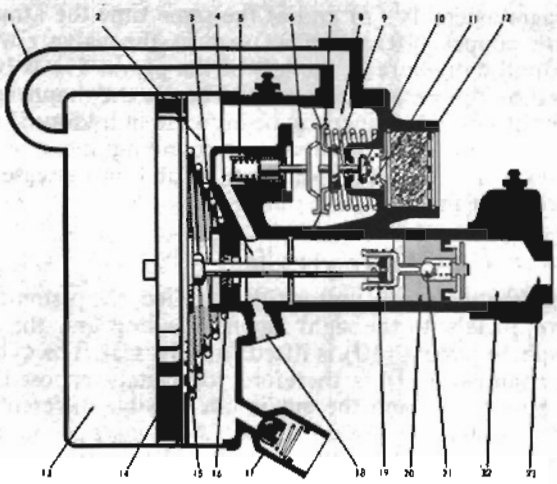


FIG. 28 POWER UNIT IN APPLIED POSITION

KEY TO FIGURES 27 AND 28

1. Control tube
2. Power cylinder chamber
3. Slave cylinder chamber
4. Passage
5. Valve piston
6. Valve chambers
7. Diaphragm assembly
8. Valve chamber
9. Vacuum poppet
10. Atmospheric poppet
11. Poppet spring
12. Air cleaner
13. Power cylinder chamber
14. Power piston
15. Piston return spring
16. Push rod
17. Vacuum check valve
18. Fluid inlet port
19. Yoke
20. Hydraulic piston
21. Check valve
22. Slave cylinder chamber
23. Fluid outlet port

PRINCIPLE OF OPERATION

Power Unit In The Released Position (See Fig. 27)

The brake fluid line from the master cylinder is attached at the port (18). Fluid is ported to the left side of the valve piston (5) by the passage (4) and past the ball check valve (21) of the hydraulic piston (20) into the cylinder chamber (22). Vacuum from the engine intake manifold is transmitted through the vacuum check valve (17) to the cylinder chamber (2). Vacuum enters the valve chamber (6) and is communicated through the center of the diaphragm assembly (7), past the vacuum poppet (9), to the valve chamber (8). The atmosphere poppet (10) is held on its seat in the valve cover by the poppet spring (11) —(and atmosphere pressure), closing the atmosphere off from the chamber (8). The chamber (8) is connected to the cylinder chamber (13) by the tube (1), thus transmitting manifold (constant) vacuum to both sides of the power piston (14). The unit is thereby referred to as being "vacuum suspended."

In the released position, the power piston (14) is held to the left in the vacuum cylinder by the piston return spring (15). In this position, the yoke (19) of the hydraulic piston (20) is against the piston stop washer and the ball of the check valve (21) is lifted from its seat. The valve piston (5) is at its leftward position, allowing the seat at the center of the diaphragm assembly (7) to break its seal with the poppet (9).

Power Unit Applying (See Fig. 28)

When the brake pedal is applied, fluid under pressure by-passes the ball check valve (21) and enters the cylinder chamber (22) and the line to the wheel cylinders. At the same time pressure is built up at the left of the valve piston (5), moving the piston to the right, contacting the diaphragm seat with the vacuum poppet (9), and opening the atmosphere poppet (10) (see Fig. 28). Atmosphere passes through the air cleaner (12), past the open poppet (10), into the valve chamber (8), and then through the tube (1) to the cylinder chamber (13).

The vacuum differential across the power piston (14) moves the power piston, push rod (16), and hydraulic piston (20) to the right, compressing the return spring (15). With the initial movement of the hydraulic piston (20), the yoke (19) allows the ball of the check valve (21) to seat, trapping fluid in the cylinder chamber (22). The hydraulic fluid under pressure is transmitted through the brake lines, attached at the outlet (23), applying the brakes.

The vacuum differential across the power piston (14) is the same as that across the diaphragm assembly (7). The differential across the diaphragm is balanced by the master cylinder hydraulic pressure at the left side of the valve piston (5). In this way the hydraulic output pressure in the cylinder chamber (22) is in proportion to the master cylinder input pressure. The total output pressure is equal to that from the power piston (14) plus the pressure in the cylinder chamber (3) from the master cylinder. Since the fluid displacement ahead of the piston (20) in the chamber (22) is the same as that behind the piston in the chamber (3), the driver has both "pressure" control and "position" control, giving him the "feel" of the brakes.

Power Unit Holding

After the degree of brake application desired has been obtained, the control valve portion of the power unit will reach a "lap" or "holding" position. In this position, the vacuum poppet (9) is seated on the dia-

phragm assembly (7) and at the same time the atmosphere poppet (10) is on its seat in the valve cover. Hydraulic pressure at the left of the piston (5) is balanced by the vacuum differential across the diaphragm assembly (7). Any increase or decrease in hydraulic input pressure will cause a corresponding increase or decrease in the vacuum differential and an increase or decrease in the hydraulic output pressure.

Power Unit Fully Applied

When the power unit is fully applied, the piston (5) is completely to the right against its stop and the atmosphere poppet (10) is lifted from its seat. The cylinder chamber (13) is therefore completely exposed to the atmosphere and the maximum possible differential exists across the power piston. Any increase in the hydraulic output pressure comes from the master cylinder only.

Power Unit Releasing

When the pressure is released from the left side of the piston (5), the piston moves to the left (see Fig. 27) seating the atmosphere poppet (10), after which the vacuum differential pushes the seat on the diaphragm assembly (7) away from the vacuum poppet (9). The manifold vacuum from the chamber (6) is again communicated to the cylinder chamber (13) through the valve chamber (8) and the tube (1). The spring (15) returns the power piston (14) and hydraulic piston (20) to the released position. The yoke (19) lifts the ball of the check valve (21) from its seat, opening chamber (22) to chamber (3). This allows for any fluid expansion or contraction in the lines to be compensated for from the master cylinder reservoir.

Operation of Two-Stage Control Valve Piston

The valve piston is of a two-stage design which is incorporated in the power unit to allow smoother initial operation. During the initial application, the valve piston and the piston sleeve act together to provide a larger effective piston area. This allows the atmospheric poppet to open under lower fluid pressure from the master cylinder and brings the power piston into its initial operation at a lower pedal pressure. After initial application, however, the piston sleeve moves to the right against its stop and the unit is controlled by the small inner piston.

Removal—All Models

Disconnect the manifold vacuum supply hose (2, Fig. 29) at the power unit and disconnect the stop light switch wires (4). Disconnect the hydraulic lines from the master cylinder (1) and to the wheel cylinders (3). Remove the power unit-to-bracket mounting bolts and remove the unit from the car.

Disassembly—All Models

Hydraulic Cylinder—Loosen the lock nut (5, Fig. 30) and unscrew the hydraulic cylinder (4) from the end plate (1). Hold the end cap (2, Fig. 31) in a vise and, using an open-end wrench on the flat part of the cylinder (4), unscrew the hydraulic cylinder. Remove the gasket (3) and bleed screw (1) from the end cap. Remove the lock nut (5) from the cylinder.

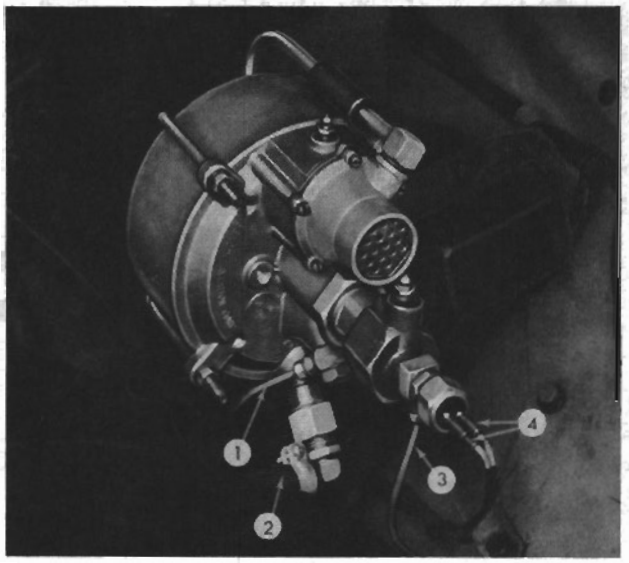


FIG. 29

1. Fluid inlet (from master cylinder)
2. Vacuum hose
3. Fluid outlet (to wheel cylinder)
4. Stop light switch wires

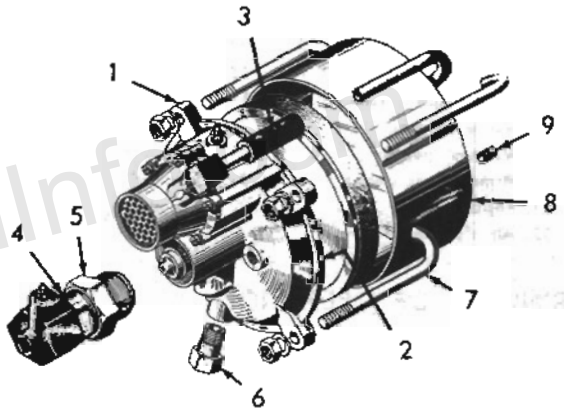


FIG. 30

1. End plate
2. End plate gasket
3. Control tube hose
4. Slave cylinder
5. Lock nut
6. Check valve
7. Hook bolt
8. Cylinder shell
9. Plug

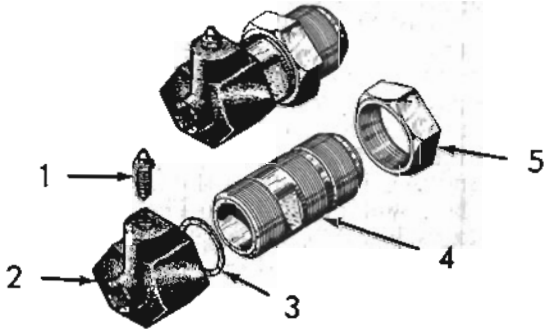


FIG. 31

1. Bleeder screw
2. End cap
3. Gasket
4. Slave cylinder
5. Lock nut

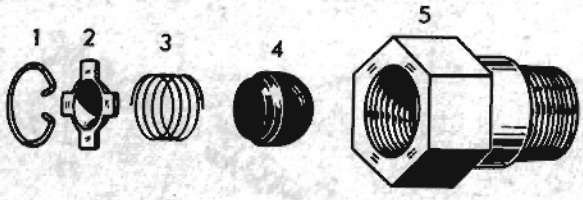


FIG. 32

1. Snap ring
2. Retainer
3. Spring
4. Ball
5. Valve body

Vacuum Check Valve—Remove the check valve (6, Fig. 30) from the end plate. With a small nose pliers remove the snap ring (1, Fig. 32). Then lift the spring retainer (2), spring (3), and ball (4) out of the valve body.

Hydraulic Piston—Scratch alignment marks on the cylinder shell (8, Fig. 30) and the end plate (1). Take out the hooks bolts (7) and remove the cylinder shell and gasket. If the shell sticks to the end plate, tap the shell with a fiber mallet to loosen.

Compress the piston return spring by pressing down on the end plate (4, Fig. 33). Two wire hooks and plate (see inset) can readily be made to hold the piston in position. Remove the hydraulic piston assembly (1) from the push rod (3) by sliding the snap ring or retainer spring of the piston assembly back and removing the pin (2). The hydraulic piston assembly may be disassembled if necessary. Remove the speed nut (1, Fig. 34) and washer (2). Remove the piston cup (7). Then remove the snap ring (3), spring retainer (4), spring (5), and ball (6). Remove the cushion (9). The balance of the piston should not be further disassembled.

Power Piston—Remove the hook clamps, allowing the vacuum piston and spring to be removed. Remove the large gasket from the end plate. Using care to protect the finished surface of the rod, remove the nut (10, Fig. 35) which holds the vacuum piston assembly to the push rod (1) and remove the vacuum piston assembly. From the push rod separate the wick retainer plate (9), packing ring (8), packing wick (7), rear packing plate (6), leather packing (5), push rod seal (4), front packing plate (3), and push rod washer (2).

Air Cleaner—Remove the outer snap ring (1, Fig. 36) and take out the screen (2) and the hair filter (3).

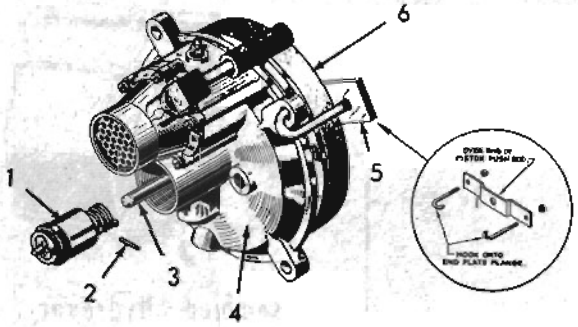


FIG. 33

1. Hydraulic piston
2. Pin
3. Push rod
4. End plate
5. Piston holding fixture
6. Piston

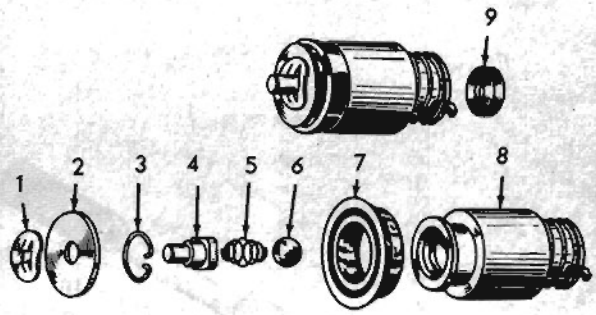


FIG. 34

1. Speed nut
2. Washer
3. Snap ring
4. Spring retainer
5. Spring
6. Ball
7. Piston cup
8. Piston
9. Cushion

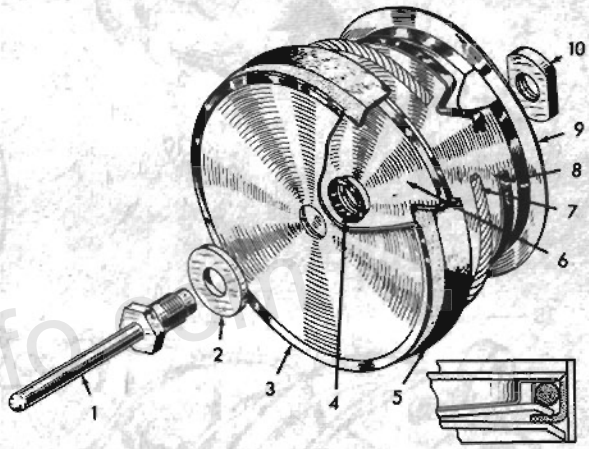


FIG. 35

1. Push rod
2. Washer
3. Front packing plate
4. Push rod seal
5. Leather packing
6. Rear packing plate
7. Packing wick
8. Packing ring
9. Wick retainer plate
10. Nut

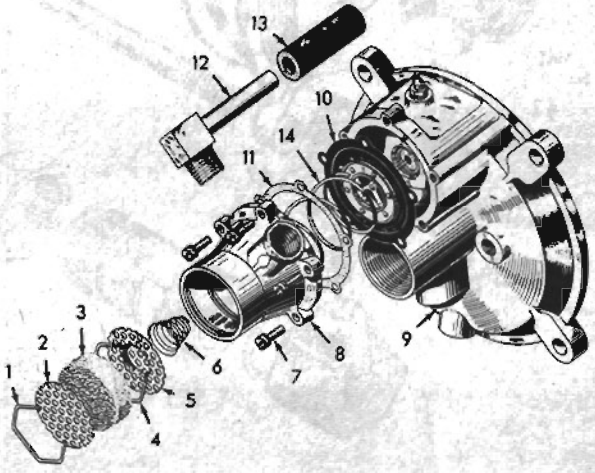
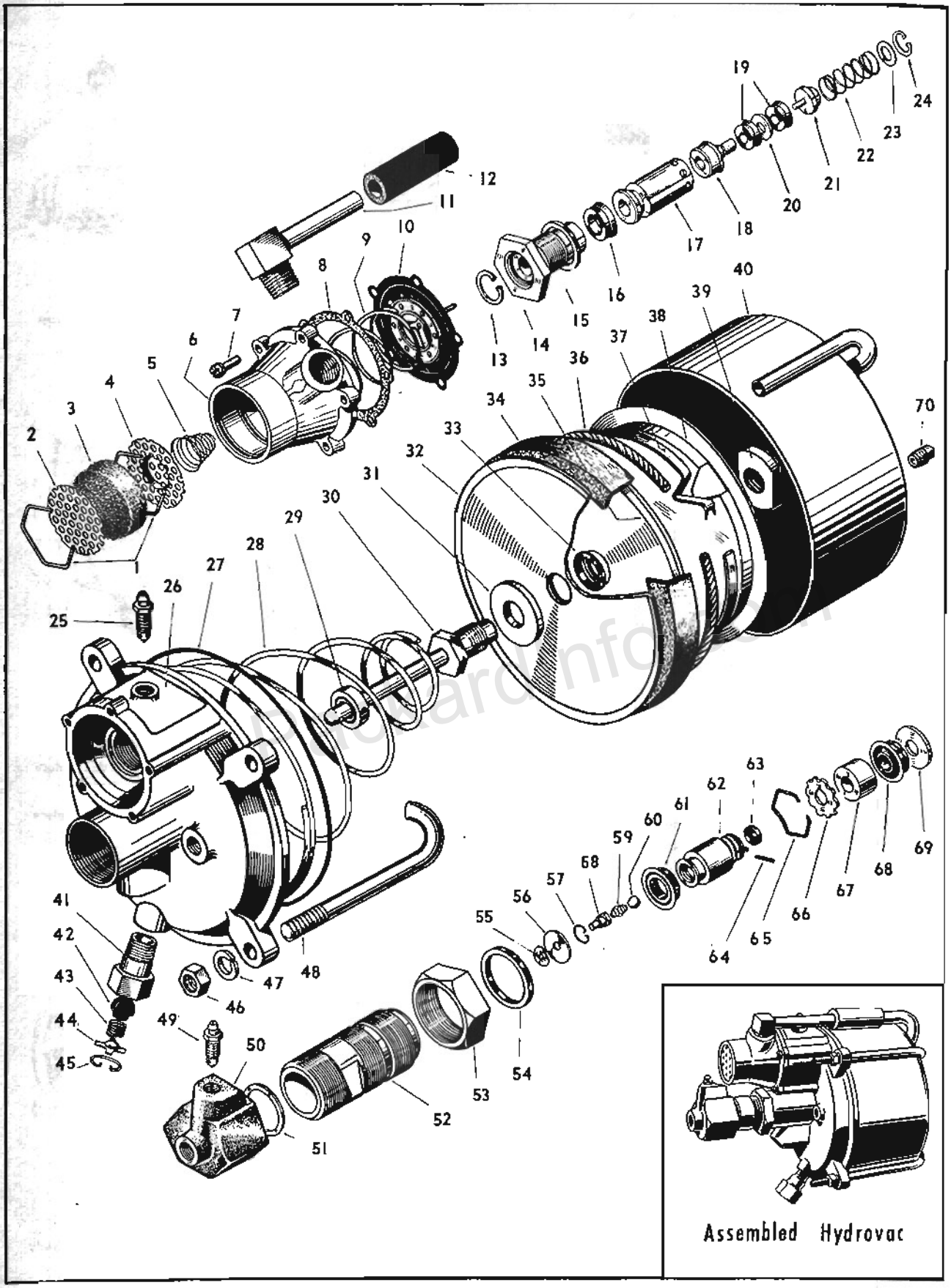


FIG. 36

1. Snap ring
2. Screen
3. Hair filter
4. Snap ring
5. Spring retainer
6. Poppet return spring
7. Body screw
8. Control valve body
9. End plate
10. Diaphragm
11. Gasket
12. Elbow
13. Hose
14. Diaphragm spring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Assembled Hydrovac

FIG. 37

KEY TO PARTS IN FIG. 37

1. Snap ring
2. Hair retainer
3. Hair filter
4. Spring retainer
5. Poppet spring
6. Control valve body
7. Retaining screw
8. Valve body gasket
9. Diaphragm spring
10. Diaphragm
11. Elbow
12. Hose
13. Snap ring
14. Valve fitting
15. Gasket
16. Hydraulic cup
17. Piston sleeve
18. Piston
19. Hydraulic cup
20. Washer
21. Spring retainer
22. Spring
23. Washer
24. Snap ring
25. Bleeder screw
26. End plate
27. End plate gasket
28. Piston return spring
29. Push rod seal
30. Push rod end
31. Washer
32. Piston plate, front
33. Push rod seal
34. Leather packing
35. Piston plate, rear
36. Wick
37. Packing ring
38. Wick retainer
39. Nut
40. Cylinder shell
41. Check valve body
42. Ball check
43. Spring
44. Retainer
45. Snap ring
46. Hook bolt nut
47. Lock washer
48. Hook bolt
49. Bleeder screw
50. End gap
51. Gasket
52. Slave cylinder
53. Lock nut
54. Gasket
55. Speed nut
56. Deflector washer
57. Snap ring
58. Spring retainer
59. Spring
60. Ball check
61. Piston cup
62. Hydraulic piston and yoke assembly
63. Cushion
64. Pin
65. Snap ring
66. Stop washer
67. Retainer
68. Piston cup
69. Push rod washer
70. Plug

Valve Cover and Diaphragm—Disengage the inner snap ring (4, Fig. 36) and take out the spring retainer (5) and poppet return spring (6). Scratch alignment marks on the control valve body (8) and the cylinder end plate (9). Take out the attaching screws (7) and remove the control valve cover and diaphragm spring (14). Remove the diaphragm (10) and valve cover gasket (11). Do not disassemble the valve cover. If the poppet assembly is worn or damaged, replace the complete assembly.

Control Valve—Using a 1⅛" (28,58 mm.) socket wrench, remove the hydraulic control valve fitting (7, Fig. 38) and gasket from the end plate. With a snap ring pliers, remove the snap ring (1, Fig. 39). Push the piston and sleeve assembly out of the fitting and remove the hydraulic cup (4) from the piston sleeve (5). Remove the snap ring (12) from the end of the sleeve and remove the washer (11), spring (10), spring retainer (9), and piston (6). Remove the two hydraulic cups (7) and washer (8) from the piston.

End Plate Seals—Remove the hydraulic cylinder end seal (10, Fig. 38). Remove the snap ring (2) and then remove the stop washer (3), retainer (4), seal

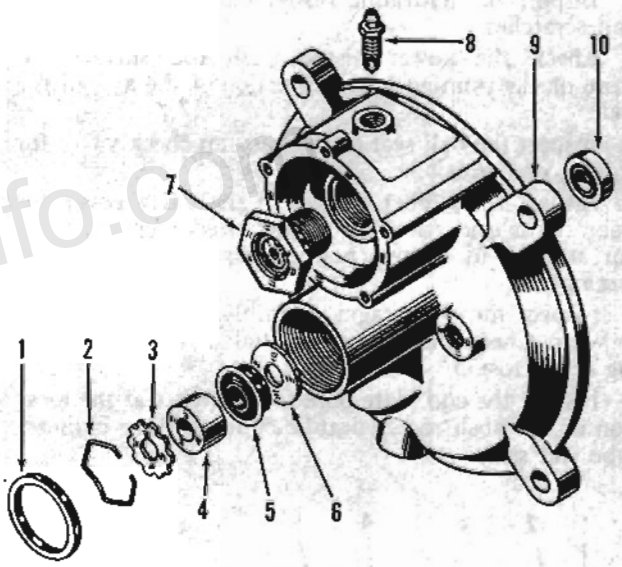

FIG. 38

1. Gasket
2. Snap ring
3. Stop washer
4. Seal retainer
5. Cup
6. Push rod washer
7. Valve fitting assembly
8. Bleeder screw
9. End plate
10. Push rod seal

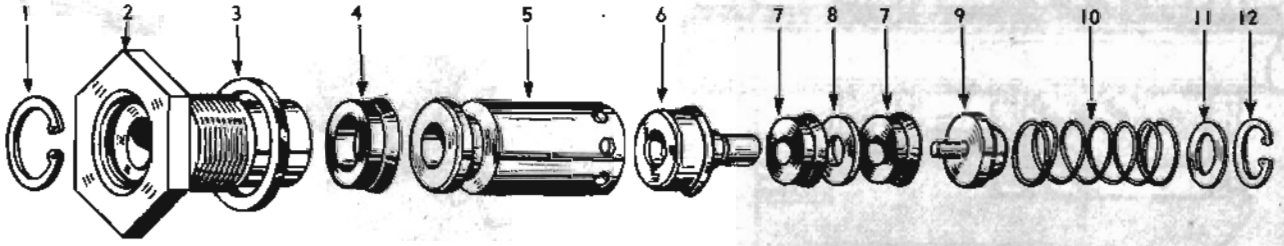

FIG. 39

1. Snap ring
2. Valve body
3. Gasket
4. Cup
5. Piston sleeve
6. Piston
7. Cups
8. Washer
9. Spring retainer
10. Spring
11. Washer
12. Snap ring

cup (5), and stop washer (6). Place the end plate upon two wooden blocks; drive out the push rod leather seal assembly (10) with a flat-end rod or drift, 9/16" (14,3 mm.) in diameter.

Cleaning and Inspection—All Models

Wash all parts in alcohol or a cleaning solvent such as Bendix Metalclene Parts Cleaner. Use only alcohol on rubber parts or parts containing rubber. With compressed air, blow dirt and cleaning solvent out of all internal passages. It is very important that parts are kept clean.

Use all new parts as furnished in the repair kit which includes new rubber parts. Inspect the following parts which are not in the kit and would not normally be replaced unless found defective.

Inspect the bore of vacuum cylinder for scoring or dents. If rust or corrosion is found in the bore, it can be removed with fine emery cloth.

The slave cylinder bore should be inspected for scoring or points of excessive wear. Also check the gasket surfaces at the ends of the tube and in the slave cylinder and cap.

Inspect the hydraulic piston ball seat for scoring and scratches.

Check the power piston push rod surface for score marks running in the direction of the axis of the rod.

Inspect the ball seat of the vacuum check valve for scoring or corrosion.

Inspect the rubber poppet in the valve cover for wear or deterioration. If poppet needs replacing, do not attempt to remove poppet; replace the complete assembly.

Inspect the diaphragm assembly for deterioration or wear. Check the bore of the valve fitting for scoring or corrosion.

Inspect the end plate bore for scratches at the location of the push rod hydraulic cup and slave cylinder tube end seal.

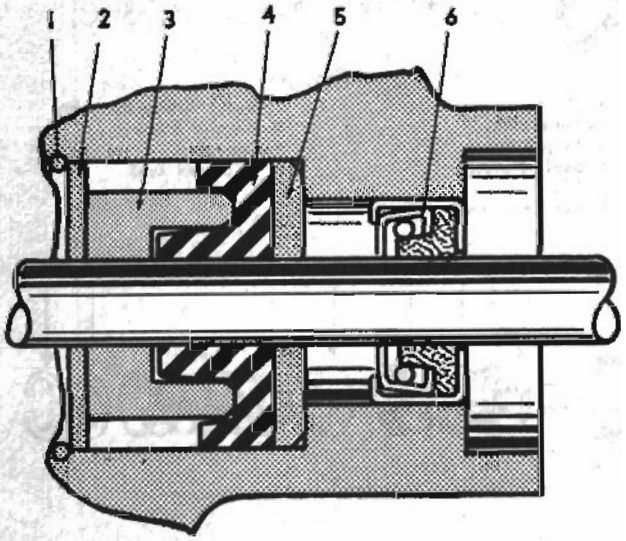

FIG. 40

1. Snap ring
2. Stop washer
3. Retainer
4. Seal cup
5. Stop washer
6. Push rod seal

Reassembly—All Models

Before assembling rubber parts such as hydraulic cups or seals, the part should be dipped in brake fluid. This will facilitate the assembly and prevent damage to the part.

End Plate Seals—Press the push rod leather seal (6, Fig. 40) into the end plate with the lip of the leather seal toward the hydraulic cylinder side of the end plate. Use a length of ¾" (19,0 mm.) rod, having a smooth end. Turn the end plate over and install the push rod hydraulic seal parts. Insert a new stop washer (5) with chamfered side down, new hydraulic seal cup (4) with the lip of the cup up, and the retainer (3) with the flat side up. Place the stop washer (2) against the retainer and install the snap ring (1) in the groove.

Control Valve—Coat the piston cups (7, Fig. 39) with brake fluid and assemble the cups and washers (8) on the piston (6). Assemble the cups with the lips pointing toward the small end of the piston. Install the spring retainer (9) at the end of the piston and insert the parts into the piston sleeve (5). Place the spring (10) and washer (11) inside the sleeve and install the snap ring (12). Coat the hydraulic cup (4) with brake fluid and install the cup in the recess of the sleeve with the cup lip pointing toward the snap ring end of the sleeve. Coat the bore of the fitting (2) with brake fluid and insert the assembled part. Install the snap ring (1). Coat the seal (3) with brake fluid and slip it over the threads of the fitting. Install the fitting into the end plate and tighten with a 1⅛" (28,58 mm.) socket wrench.

Valve Cover and Diaphragm—Install the poppet return spring (6, Fig. 41) with the small end down over the end of the poppet, and center the retainer (5) in the large coil of the spring. Install the snap ring (4) in the control valve cover. Install the new hair filter (3), screen (2), and outer snap ring (1).

Place three guide pins in the control valve body screw holes in the end plate; guide pins can be made by cutting the heads from No. 8-32x2½" machine

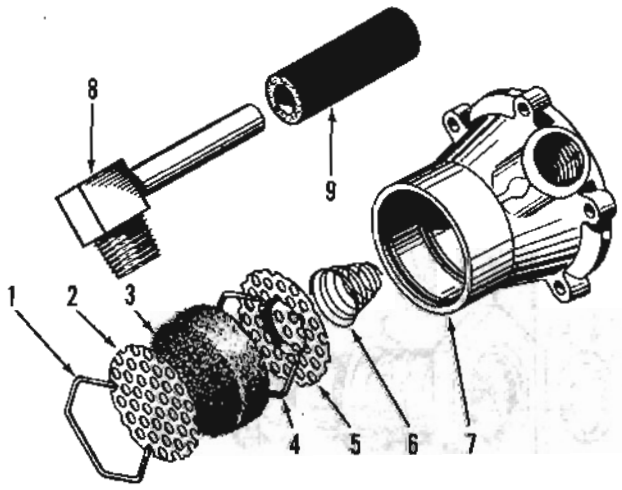

FIG. 41

1. Snap retainer
2. Screen
3. Hair filter
4. Snap ring
5. Spring retainer
6. Spring
7. Valve body
8. Elbow
9. Hose

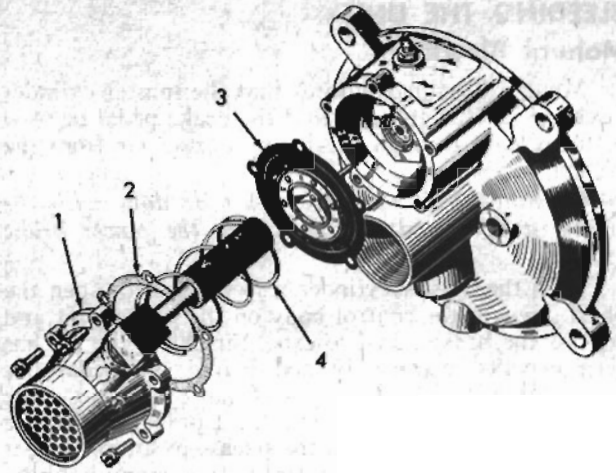

FIG. 42

1. Control valve cover
2. Gasket
3. Diaphragm
4. Diaphragm spring

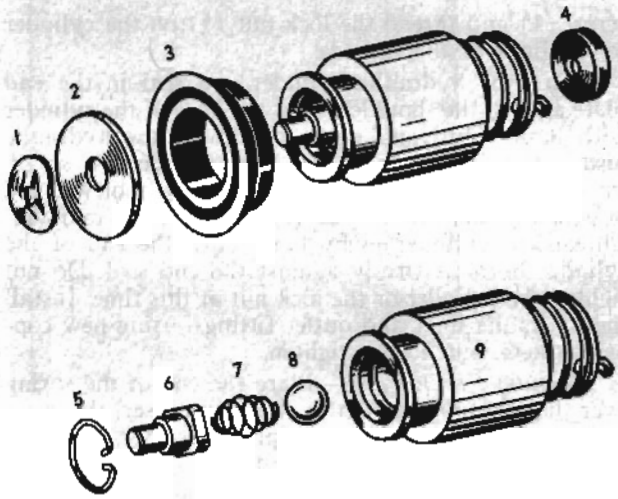

FIG. 43

1. Speed nut
2. Deflector washer
3. Piston cup
4. Cushion
5. Snap ring
6. Spring retainer
7. Spring
8. Check ball
9. Piston

screws. Install the gasket (2, Fig. 42), diaphragm (3), diaphragm spring (4), and control valve cover (1) on the guide pins, aligning the marks made at disassembly. Move the assembly into position, allowing the cylinder tube to slide into the connecting hose. When assembling the diaphragm, spring, and control valve body, extreme care should be taken not to distort the diaphragm when compressing the spring. Remove the guide pins one at a time and install the screws and lock washers. Install the hose clamps.

Power Piston—When assembling the vacuum piston components, Bendix assembly ring tool No. SER-432 or SER-434 should be used, to insure that the inner diameter of the leather packing is not forced out of the piston plates when the assembly is tightened and to insure good contact when installed.

Place the assembly ring flat on a clean bench, and place the front piston plate (3, Fig. 35) in it, with the lip down (see cross section in Fig. 35). Place the new leather packing (5) on the plate with the lip up, and place a new rubber seal (4) in the center of the plate. Install the rear piston plate next, with the lip down. Coil the new wick inside the lip of the packing and cut it to the proper size. Soak the wick in cylinder oil (not ordinary oil)and allow it to drain thoroughly. Install the wick, place the packing ring (8) inside of it with the gripper points up, and engage the notch at the loop end of the ring with the hook at the opposite end. Install the wick retainer plate (9) with the cutout portion over the loop of the expander ring. Place the flat washer (2) over the threaded end of the push rod (1), and insert the push rod through the assembled piston parts, being careful not to damage the inner seal ring (4). The large piston plate should rest against the flat washer.

Clamp the hex on the push rod in a vise, being careful not to damage the polished surface of the rod. Install the nut (10) and tighten securely, being careful not to allow either piston plate to turn while the nut is being tightened. Stake the nut to hold it securely. Do not remove the assembly ring tool until ready to install the piston in the cylinder shell.

Place the vacuum piston return spring over the push rod with the small end of the spring next to the vacuum piston and carefully guide the push rod through the leather seal in the end plate. Use hook clamps and plate to hold the end plate and the piston together.

Hydraulic Piston—Wash the hydraulic cylinder piston parts in alcohol. Place the check valve ball (8, Fig. 43) on the seat in the end of the piston. Insert the spring (7), spring retainer (6), and snap ring (5). Dip the hydraulic piston cup (3) in brake fluid, then install it on the piston (9). The lip of the cup must point toward the check valve end of the piston. Install the deflector washer (2) and speed nut (1). Install the rubber cushion (4) in the opposite end of the piston with concave side of the cushion facing out. Attach the hydraulic piston assembly (2, Fig. 44) to the push rod (4) with the retainer pin (3). Slide the retaining spring over the hole in the piston to hold the retainer pin in place.

Hydraulic Cylinder—Place a new copper gasket (3, Fig. 31) in the end cap (2), and thread the hydraulic cylinder into the end cap with the milled flats next to the end cap. Tighten securely. Install the bleed

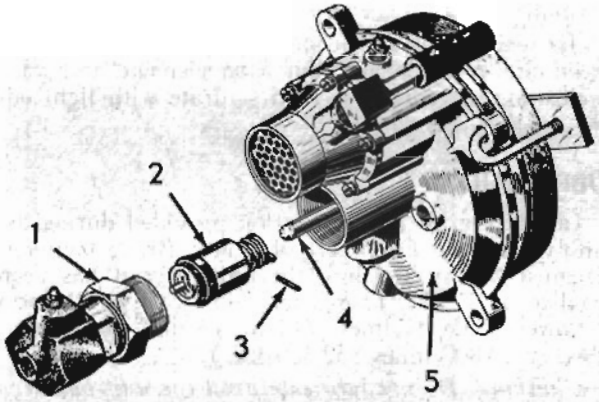

FIG. 44

1. Lock nut
2. Piston assembly
3. Retaining pin
4. Push rod
5. End plate

screw (1) and thread the lock nut (5) on the cylinder to the limit of the threads.

Place the hydraulic cylinder end seal in the end plate against the shoulder. Coat the bore of the cylinder with brake fluid and guide the lip of the hydraulic piston cup into the bore of the cylinder. A small, smooth-edged screw driver or a scribing tool will aid in starting the lip of the piston into the cylinder. Thread the cylinder in by hand until the end of the cylinder bottoms firmly against the end seal. Do not tighten the cylinder or the lock nut at this time. Install the hydraulic inlet and outlet fittings, using new copper gaskets, but do not tighten.

Vacuum Check Valve—Place the end of the spring over the retaining step on the ball, and insert the parts in the valve body. Install the spring retainer, centering it in the end of the spring. Install the snap ring, making sure it is seated in the groove of the valve body.

Apply thread compound to the check valve threads and install the valve in the end plate.

Before installing the vacuum piston assemblies in the cylinder shell, place a new gasket on the end plate. Dip the piston leather in Power Brake Cylinder Oil (do not use ordinary oil) and allow excess oil to drain. Coat the inside of the cylinder shell with Power Brake Cylinder Oil. Insert the piston in the cylinder by tipping the piston. Be very careful to avoid scoring or cutting the lip of the piston seal. Align the end plate with the scribed marks made during disassembly. Attach the hook bolts and tighten each bolt evenly until all bolts are uniformly tight.

Tighten the hydraulic cylinder to align the bleed screw in the end cap with the bleed screw in the end plate. Tighten the lock nut securely.

Inspect the power brake unit to see that all bolts, nuts, washers, and screws are in place and all tubes, clamps, and fittings are securely tightened. If a Bendix Analyzer is available, bench test the unit according to the procedure outlined in the manual provided with the analyzer. If a power brake analyzer is not available, install the power brake unit on the vehicle, lubricate it, bleed the hydraulic system, and test as outlined under Testing.

SERVICING THE AIR CLEANER

The air cleaner should be cleaned or replaced every 1000 miles (1.609 km.). Where operating conditions are unusually dusty, clean more frequently.

To service the air cleaner, remove the air cleaner screen clip, retainer, and hair filter element, and wash in cleaning solvent. Dry, then saturate with light engine oil and reassemble.

LUBRICATION

In addition to the lubrication provided during assembly, 1 ounce (29.6 cc.) of Power Brake Cylinder Oil must be injected into the unit after it has been installed in the car. Thereafter, add 1 ounce (29.6 cc.) of Power Brake Cylinder Oil to the unit every year, or every 20,000 miles (32,180 km.).

Caution.—Do not lubricate until the unit has been permanently installed on the vehicle. Otherwise, handling of the unit may cause the oil to flow into the hydraulic portion of the unit and damage the rubber parts. The unit should be lubricated only when the engine is stopped and the brakes are released.

BLEEDING THE UNIT

Manual Bleeding

Manual bleeding requires that the master cylinder reservoir be kept full and that the brake pedal be used to force fluid through the lines to expel air from the system.

Caution.- This operation must be done with the engine stopped and no vacuum in the power brake system.

With the master cylinder reservoir filled, open the bleed screw at the control body on the power unit and depress the brake pedal to expel air. After the air has been expelled completely and before the pedal has reached the toeboard on the final cycle, close the bleed screw while holding the fluid pressure with the pedal. Return the pedal to the release position. Repeat this procedure until solid fluid, free from bubbles, comes from the bleed screw. Check the master cylinder reservoir frequently to insure an ample supply of fluid. Using this method, then bleed at the bleed screw located on the hydraulic end cap of the power unit and proceed to the vehicle wheel cylinders.

Pressure Bleeding

Caution.—This operation must be done with the engine stopped and no vacuum in the power brake system.

Be sure there is sufficient brake fluid in the bleeder tank before starting pressure bleeding and that the pressure is from 10 to 30 p.s.i. (0,703 to 2,109 kg. per sq. cm.).

With the bleeder tank thus prepared, fill the master cylinder reservoir before attaching the hose from the bleeder tank to the reservoir. With the pressure from the bleeder tank applied to the master cylinder, bleed the power unit first, starting with the bleed screw on the control valve. When a solid stream of fluid, free from bubbles, is obtained, close this bleed screw securely and bleed the power unit hydraulic cylinder at the bleed screw. Finally, proceed to the vehicle wheel cylinders and bleed the longest line first and the shortest line last.

TESTING

Road test the brakes by making a brake application at about 20 mph (32 km. p.h.) to determine if the vehicle stops evenly and quickly. If the pedal has a spongy feel when applying the brakes, air is present in the hydraulic system. To check, with the engine off, pump the brake pedal until all vacuum has been eliminated from the power cylinder. The pedal should have a firm feel; if not, air is present in the system.

With the engine stopped, hand brake applied, and the transmission in neutral, apply the brakes several times to exhaust all vacuum in the system. Depress the pedal, hold foot pressure on the pedal, and start the engine. If the vacuum system is operating, the pedal will tend to fall away under foot pressure and less pressure will be required to hold the pedal in the applied position. If no action is felt, the vacuum system is not functioning.

Stop the engine and again exhaust all vacuum in the system. Depress the brake pedal and hold foot pressure on the pedal. If the pedal gradually falls away, the hydraulic system is leaking.

If the brake pedal travels to within one inch (25,4 mm.) of the floor pan, the brake shoes require adjustment or relining.

VACUUM CHECK VALVE

The vacuum check valve is screwed into the power brake unit at the vacuum line connection. The purpose of the check valve is to seal the vacuum in the unit, thereby maintaining the highest available vacuum in the power unit at all times.

If the check valve fails to operate satisfactorily, it should be disassembled and parts replaced as outlined in the disassembly of the power unit.

DIAGNOSIS

Power Brake Unit

BRAKES DRAG OR WILL NOT RELEASE

CAUSES

1. Master cylinder operating improperly.
   a) Compensating port plugged or covered.
   b) Faulty valve.
   c) Pedal free travel incorrect.
2. Brake pedal sticking on shaft.
3. Broken power piston return spring.
4. Defective control valve.
   a) Dirt under atmospheric poppet.
   b) Valve piston sticking.
   c) Broken or improperly assembled diaphragm return spring.
5. Power piston friction.
6. Hydraulic piston yoke not releasing ball check.

PEDAL GOES TO FLOOR (OR ALMOST TO FLOOR)

CAUSES

1. Fluid leak at inlet or outlet.
2. Hydraulic cylinder leaking at end plate or end plug.
3. Internal leakage past control valve piston, fitting seal, or push rod seals.

HARD PEDAL

CAUSES

1. Collapsed, restricted, or disconnected vacuum line.
2. Low manifold vacuum at engine.
3. Defective control valve.
   a) Defective diaphragm or poppet.
4. Restricted air cleaner.
5. Power piston sticking.

GRABBY BRAKES

CAUSES

1. Control valve piston sticking.
2. Power piston sticking.

BRAKE PEDAL KICKBACK

CAUSES

1. Defective or damaged hydraulic cylinder piston cup.
2. Improperly seated hydraulic cylinder ball check valve caused by defective seat or dirt.

LOSS OF FLUID FROM BRAKE SYSTEM

CAUSES

1. Defective or damaged hydraulic cylinder cup or seal.
2. Defective or damaged control valve piston cup (crack or split in the lip at center of cup).
3. Dirt chips or other foreign matter under lip of piston cups.
4. Improperly tightened or defective gaskets or rubber seals.

POWER UNIT FAILS TO OPERATE

CAUSES

1. Low or no vacuum.
   a) Clogged or restricted lines.
   b) Defective check valve.
2. Clogged air filter.

BRAKES APPLY WHEN ENGINE IS STARTED

CAUSES

1. Broken or improperly assembled control valve diaphragm return spring.
2. Broken or improperly assembled atmospheric poppet return spring.
3. Sticking control valve piston.

Brake System

INSUFFICIENT PEDAL RESERVE

CAUSES

1. Normal lining wear.

   Brake adjustments are required periodically to compensate for lining wear. The initial wear on new linings is relatively rapid and one or two brake adjustments may be required until the linings are burnished into full contact area.

2. Excessive lining-to-drum clearance.

   Wheel bearings should be checked, and adjusted if necessary, before adjusting the brakes. Adjust the brakes following the procedure outlined for the particular model car. Brake adjustments should be made carefully so as to provide the minimum running clearance at each shoe.

3. Air in hydraulic system.

   Normally, air will enter the hydraulic system only when the system is opened during repairs or if the fluid level in the master cylinder reservoir is allowed to fall below the compensating port. Bleeding with an approved bleeder will remove this air. Small amounts of air which may remain because of emulsification in the fluid or entrapment in pockets, will disappear during normal operation of the brakes.

4. Excessive pedal free travel.

   The length of the master cylinder push rod must be carefully adjusted to provide the proper pedal free travel. Adjust the pedal free travel as outlined in the Brakes section.

5. Loose master cylinder mounting bolts and/or push rod lock nut.

   Movement of the master cylinder because of loose mounting bolts or lost motion in the threads of the push rod because of a loose lock nut is multiplied several times at the pedal pad.

6. Poor lining fit.

   Linings must be riveted tightly to the shoes with no bulging between the rivets and must be of the proper radius to fit the drum for full contact area. If a drum has been turned to remove scoring, wear step, or out-of-roundness, the new lining must be shimmed up from the shoes to compensate for the amount turned out of the drum. Suitable shim stock can be secured from local sources. To assure lining surface being square with the drum surface, the shim stock MUST be the full length and width of the lining. Bent, twisted, or otherwise damaged shoes should be replaced.

7. Drum heat expansion.

   During heavy braking, such as when descending long grades, the drums may become very hot and expand. Some loss in pedal reserve is then normal. This pedal reserve loss can quickly and easily be compensated for by "pedal pumping." Each time the pedal travels too far to the floor board, releasing the brakes completely and then quickly re-applying them will restore full pedal reserve. It is not necessary to pump the pedal more than once for each application. The process is similar to "double-clutching." Brake heating in long hill descents can be greatly minimized if (a) the proper transmission gear is used and (b) the car is snubbed with short, hard brake applications rather than holding the vehicle speed down by dragging the brakes.

PEDAL GOES TO FLOOR BOARD

CAUSES

1. Causes listed under Insufficient Pedal Reserve.
2. Fluid level in master cylinder below the compensating port.

   The master cylinder fluid level must be checked periodically and fluid added to within ½" (12,7 mm.) of the top to make up for the fluid lost by normal seepage and evaporation.

3. Fluid leakage in system.

   a) Loose fittings, defective wheel cylinder cups, chafed lines, etc., will result in leaks that can be detected by appearance of fluid at the point of leakage and by loss of fluid from the master cylinder reservoir. Leakage past the master cylinder primary cup cannot be detected by loss of fluid from the system. A leaking master cylinder primary cup can usually be detected by:

      (1) Occasional complete loss of pedal reserve.

      (2) A slow loss in pedal reserve while holding a prolonged light pressure on the pedal.

   b) Causes listed under the Loss of Fluid From Brake System in the Power Brake Diagnosis section.

4. Fluid vapor lock.

   Under exceptionally severe braking, the brakes may become so hot that the fluid in the wheel cylinders vaporizes. When this occurs, the pedal reserve can be restored by the driver by pedal pumping, as explained under Drum Heat Expansion. Always check the fluid level in the master cylinder after vapor locking has occurred. If vapor locking occurs repeatedly, drain, flush, and refill the hydraulic system with Lockheed No. 21-B heavy-duty brake fluid.

ALL BRAKES DRAG

CAUSES

1. Insufficient pedal free travel.
2. Items listed under Brakes Drag or Will Not Release (Power Brake Unit).
3. Items listed under Brakes Apply When Engine Is Started (Power Brake Unit).
4. Brakes adjusted with insufficient lining-to-drum clearance.

   New linings should be adjusted with some extra

clearance (about 2 extra clicks of the starwheels) to allow for initial swelling which may occur.

5. Mineral oil in system.

   Mineral oil in the brake hydraulic system causes all rubber parts to soften and expand. The system must be flushed and all rubber parts replaced.

ONE BRAKE DRAGS

CAUSES

1. Broken shoe return spring.
2. Clogged or crimped brake line or hose.
3. Insufficient lining-to-drum clearance.
4. Corrosion has caused wheel cylinder piston to seize in the cylinder.
5. Hand brake cable frozen or maladjusted.
6. Swollen cups retard the return action of the shoes.

CAR PULLS TO ONE SIDE

CAUSES

1. Grease or fluid on lining of one brake.
2. Dragging brake—see causes under One Brake Drags and All Brakes Drag.
3. Backing plate loose on axle.
4. Tire:
   a) Underinflated.
   b) Unequal tread wear.
5. Loose steering linkage, spring shackles, U bolts, etc.
6. Different makes of lining or lining on one wheel newer than that on opposite side.
7. Weak springs or faulty shock absorbers.
8. Improper wheel bearing adjustment.

SPRINGY—SPONGY PEDAL

CAUSES

1. Air in hydraulic system.
2. Shoe surface not square with drum.

EXCESSIVE PEDAL PRESSURE—POOR STOP

CAUSES

1. Improper replacement lining.
2. Grease or fluid on lining.
3. Inoperative power brake unit (if so equipped).
4. Lining glaze.

   Under certain types of operation, linings may glaze over causing loss of friction. This condition may occur temporarily following severe usage of new linings or linings may glaze because of prolonged light usage. The glazing can usually be removed by intentionally heating the brakes by repeated stops rather than by continuous application. The brakes should be thus heated until strong hot lining odor is produced and then allowed to cool.

5. Lining fade in new linings.

   This is evidenced by progressively increasing pedal pressure with each brake application in descending or by the brakes tending to "wash out" toward the end of high speed stops. The condition is caused by newness in the linings. Maximum efficiency for hard brake usage cannot be expected from linings until they are burnished into full contact area and also conditioned by some severe braking. That is, fade is apt to occur the first few times that linings are subjected to hard usage, but this condition will disappear as the linings are "cured" by usage.

6. Lining making only partial contact.

   If the linings are not properly shimmed for a turned drum, only the center of the lining arc will contact the drum. Hard pedal pressure will then result until the linings are worn into full contact.

7. Improper mounting of master cylinder or brake pedal rod.

OVERLY SENSITIVE BRAKES

CAUSES

1. Grease-soaked or fluid-soaked linings.
2. Improper replacement lining.
3. Shim stock too thick.
4. Temporary lining condition after hard brake usage.
5. Brake shoes not properly adjusted.
6. Loose brake backing plates.

SERVICE BULLETIN REFERENCE

NUMBER	PAGE	SUBJECT

ADDITIONAL NOTES