1. Remove bearing cover at tapered roller bearing end.
2. Remove outer locking nut, washer and disc.
3. Tighten inner adjusting nut until all noticeable end play of the worm shaft is eliminated. Test this adjustment which should be .000" to .002" tight, or 6-8 lbs. in. as indicated on torque wrench.
4. Install locking disc, washer and nut. Test adjustment again and bend locking washer over nut securely.

Differential Bearings & Worm Gear, Adjust

In adjusting differential bearings a combination adjustment is necessary.

1. All end play must be taken out of bearings by means of the bearing adjusters at sides of differential.
2. The worm and worm wheel must be set in proper alignment by adjusting differential bearings on both sides, end for end, moving the differential and worm wheel assembly to one side or the other as required to obtain correct alignment.

All ordinary adjustment of the differential bearings should be made on the left hand bearing. Do not disturb the right hand bearing except when it is necessary to take down the entire differential assembly. In adjusting the left bearing only, the alignment of the worm and wheel will not be disturbed.

In order to check the contact position on the worm and wheel teeth, paint the wheel teeth with a thin coat of Prussian Blue, and rotate the worm shaft.

When adjusting worm gearing, it must be remembered that each tooth consists of an entering and leaving side, Fig. 119. In other words, when worm shaft revolves, causing rotation of worm wheel, the point where worm threads enter wheel teeth is the entering side; the opposite tooth side is the leaving side.

The entering side of the tooth is the portion that has the flatest angle—the leaving side being almost straight or vertical.

The proper tooth contact is approximately 80% full, starting at the leaving side—not the entering side.

To obtain this adjustment, proceed as follows:

First set worm wheel to its maximum amount of backlash, then move wheel to right or left with the bearing adjusters until proper contact is obtained as shown in Fig. 119. Use drive sides of teeth when making adjustment as coast sides will automatically show a desirable tooth contact when drive side is correct.

To adjust differential bearings after the proper tooth contact is obtained, adjust the left bearing adjuster only. Tighten the bearings by screwing in the bearing adjuster until all end play in the differential assembly has been removed. Having obtained a good tight adjustment, unscrew the bearing adjuster one notch and lock in this position with the adjuster locks.

HYDRAULIC BRAKE SYSTEM

Fluid Level

Before checking the fluid level, examine the master cylinder and reservoir, Fig. 1, for evidence of fluid leaks, especially at the brake fluid pipe connection. Examine the rubber boot located at the end of the cylinder. A fluid leak at this point indicates that the master cylinder cup washer is leaking, in which case the cylinder must be removed and disassembled for correction.

Before removing the reservoir filler cap, clean away all dirt so none will fall into the reservoir when the cap is removed. After removing the cap, if the fluid level is more than ⅜" below the bottom of the filler neck, add sufficient fluid to bring the level to this point. Install the filler cap and tighten it firmly so that dirt and water will not enter the cylinder.

Use only approved brake fluid; never use engine oil or other mineral oils as to do so will ruin the rubber parts of the hydraulic system.

Brake Pedal Free Play

Check the amount of free pedal travel by applying a light finger pressure to the pedal. A slight resistance will be felt when the pedal travel has reached the point where it operates the master cylinder piston. This free travel should be approximately ½", Fig. 2. Adjustment is made by loosening the push rod lock nut and adjusting the travel of the push rod the necessary amount to obtain the desired pedal free play.

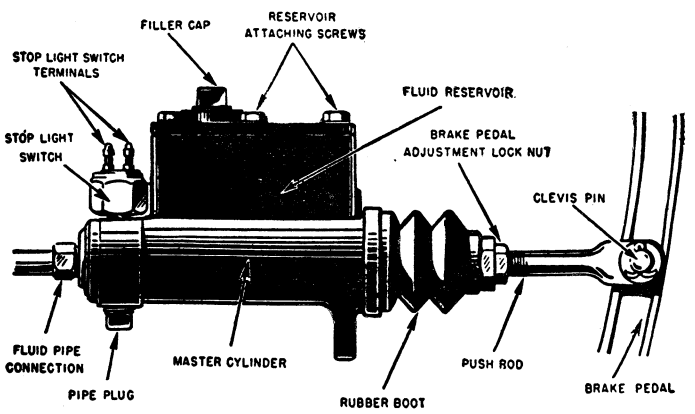

Fig. 1 Exterior view of a typical master cylinder

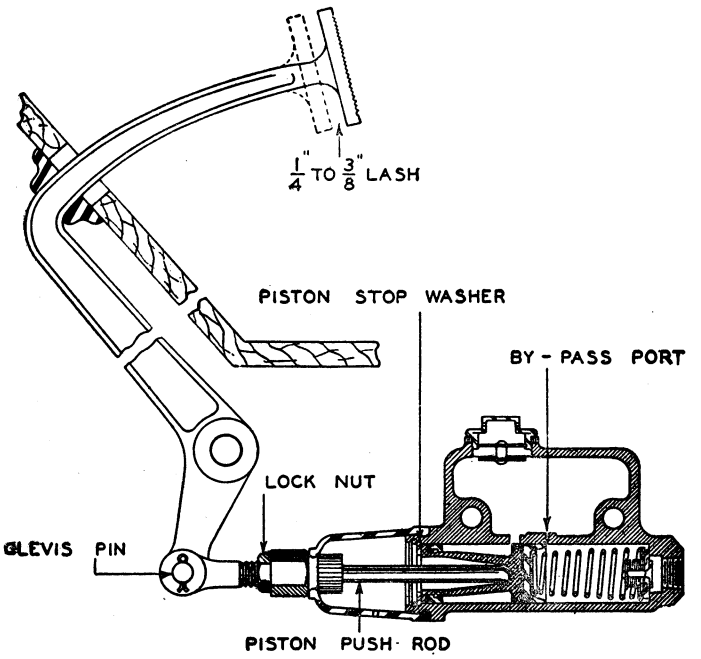

Fig. 2 Brake pedal adjustment for free play. This free play is required to prevent hydraulic pressure being applied to the master cylinder piston when brakes are released

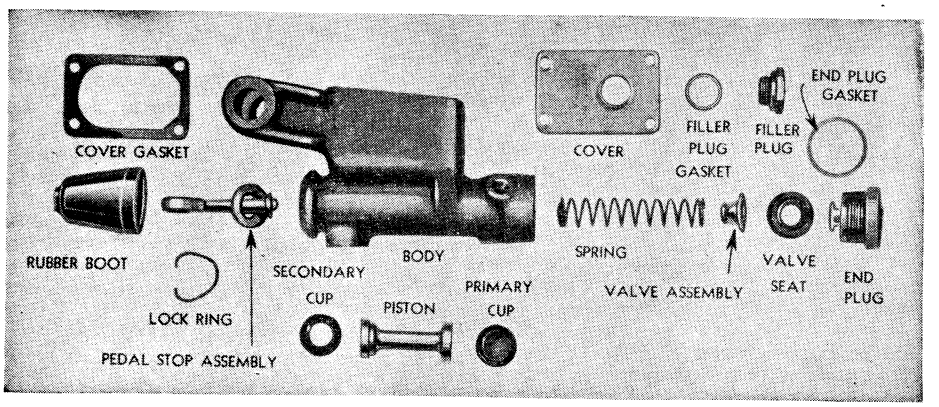

Fig. 3 Exploded view of typical master cylinder

MASTER CYLINDER

Removal

Disconnect the pipe from the master cylinder connection. Remove the wires from the stop light switch, if its location is such that this is required, and tape each wire separately to avoid a short circuit. Unfasten the push rod from the brake pedal. Remove the master cylinder mounting bolts and lift the cylinder from the vehicle.

Disassemble

Fig. 3. Before disassembling, clean all dirt from the outside of the master cylinder, then proceed as follows:

1. Remove filler cap and gasket.
2. Remove end plug and valve seat washer from end of cylinder barrel.
3. Remove rubber boot.
4. Remove pedal stop snap ring with a screw driver and take out the pedal stop and push rod.
5. Remove piston with secondary cup.
6. Remove primary cup.

Cleaning

Immerse all parts of the master cylinder in alcohol and wash thoroughly to remove old hydraulic fluid. Wipe small parts dry with clean cloth. Inside of cylinder and reservoir may be blown dry with compressed air. Do not use gasoline or kerosene for cleaning master cylinder parts.

Inspection

Examine cylinder walls. If found to be scored or rusted, cylinder must be reconditioned by honing. Fig. 4. A hone of the proper size should be placed in the chuck of an electric drill. Work the hone back and forth a few times, then inspect the cylinder to see if walls are cleaned up. Do not hone away any more than is required to remove scores and smooth up the cylinder. Remove burrs caused by honing from around the intake and compensating ports.

If available, try a No-Go gauge in cylinder, Fig. 5, using a collar of the correct diameter for the cylinder being serviced. No-Go gauge is slightly larger than the maximum allowable diameter at which the piston cups will operate satisfactorily. Therefore, if the gauge will enter the bore, the cylinder must be discarded and a new one installed.

Inspect the check valve seat on the end plug. If found to be pitted or swollen, replace plug and valve seat assembly.

Check the fit of the piston in the cylinder bore. Clearance between the piston and cylinder wall should be from .001 to .005 inch when checked with a feeler gauge, Fig. 6. If the clearance is more than .005 inch and a new piston will not provide the correct clearance, a new housing will have to be installed.

Always use new rubber parts when reconditioning a cylinder. Rubber parts which are swollen or damaged will seriously impair the proper function of parts. Repair kits which contain all the parts usually required for reconditioning master cylinders, are available. While all the parts contained in the kit may not appear to be in need of replacement, experience has proved that the added safety and braking efficiency provided by replacing these parts will offset the slight cost of the parts.

Assembly

Before assembling the master cylinder, dip all internal parts in hydraulic brake fluid, then proceed as follows:

1. Install the end plug and washer in the end of the cylinder barrel and tighten securely.
2. Install the check valve assembly in the open end of the piston return spring and insert the valve and spring into the cylinder barrel with the check valve at the outlet end.
3. Install the primary piston cup into the cylinder with the lip of the cup toward the outlet end and over the piston return spring. Insert the piston and secondary cup with the open end of the piston away from the outlet end of the cylinder.
4. Install the push rod and stop washer, forcing the piston in far enough to install the stop washer snap ring in the groove in the cylinder bore.
5. Slide the push rod boot over the end of the push rod and place the boot over the flange on the end of the cylinder.
6. Install the filler cap and gasket.
7. Plug all openings in the cylinder against the entrance of dirt during installation.

Installation

Place the master cylinder in position and install and tighten the bracket bolts so the cylinder is held firmly to the bracket and in line with the pedal push rod. Fasten the push rod to the brake pedal. Connect the brake fluid pipe to the master cylinder and firmly tighten the union to prevent a fluid leak. Remove the tape from the stop light wire terminals and connect them to the stop light switch. Fill the cylinder reservoir with brake fluid, Fig. 7, bleed the brake system and test the brake pedal clearance.

BLEEDING BRAKE SYSTEM

Bleeding, or expelling air from the hydraulic system, is necessary each time the fluid becomes so low in the master cylinder that air enters the system. This condition occurs whenever the master cylinder, or a wheel cylinder, or a brake fluid pipe or hose has been replaced or disconnected. There are two methods of bleeding a hydraulic brake system, (1) manual and (2) pressure.

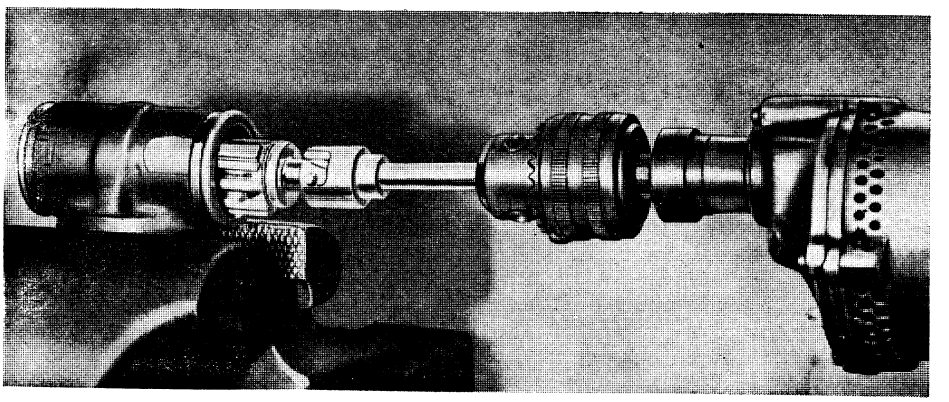

Fig. 4 Using hone to clean up master or wheel cylinder (wheel cylinder shown)

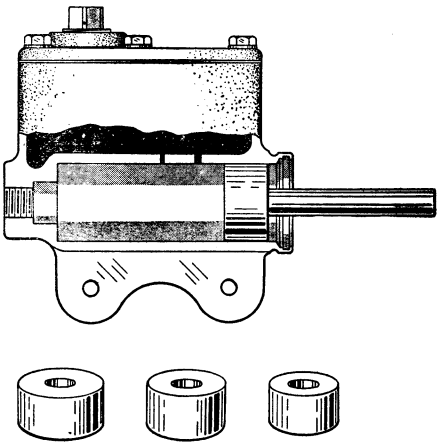

Fig. 5 Using No-Go gauge when inspecting master or wheel cylinder (master cylinder shown)

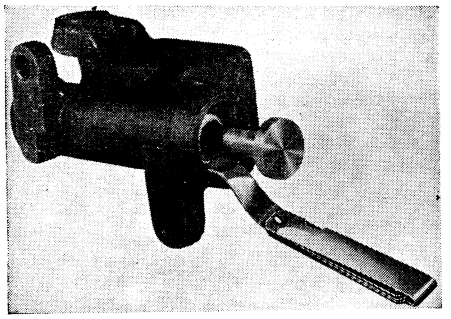

Fig. 6 Checking master cylinder piston fit with feeler gauge

Fig. 7 Adding fluid to master cylinder, using valve controlled filler

Manual Bleeding

Fig. 8. Remove the master cylinder filler cap and fill the reservoir. The reservoir must be kept full, or nearly full, of brake fluid while bleeding the brake system. Each wheel has a bleeder valve.

Start at the wheel cylinder to which the brake fluid travels the greatest distance from the master cylinder (right rear wheel). Remove the cap screw from the end of the bleeder valve near the brake fluid pipe or hose connection, Fig. 8. Attach a bleeder tube to the bleeder valve at this point, and place the free end of the bleeder tube in a clean glass jar or bottle. Place a wrench on the bleeder valve at the point where the bleeder hose is connected, and turn the valve ½ to ¾ turn to the left (counterclockwise). This opens the bleeder valve. Slowly depress the brake pedal by hand to approximately the halfway point; then let the pedal return slowly to the release position. Repeat this procedure several times, keeping the end of the hose submerged in brake fluid until the fluid expelled from the bleeder hose is free of air bubbles. Turn the bleeder valve clockwise to the closed position and remove the bleeder hose. Install and tighten the cap screw in the end of the valve, and again test the valve to be certain that it is seated firmly.

Add new fluid to the master cylinder and repeat the process on the other wheels in turn, always moving to the wheel which is the greatest distance from the master cylinder of those remaining to be bled.

Always add clean fluid to the master cylinder after bleeding each wheel. Never use the fluid drained from the brake system if there is doubt about its being clean and free from dirt.

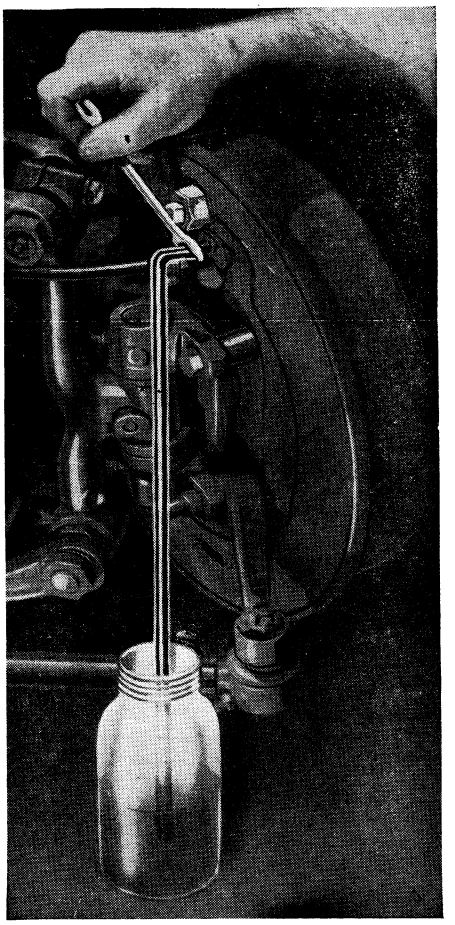

Fig. 8 Manual bleeding of hydraulic system

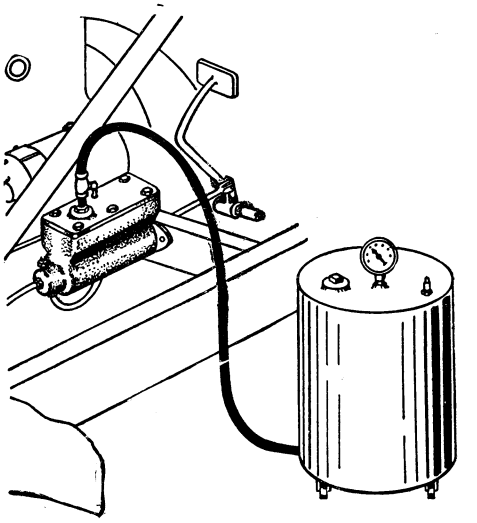

Fig. 9 Pressure bleeding of hydraulic system

Pressure Bleeding

This method of bleeding is accomplished in the same manner as manual bleeding except that the fluid is forced through the lines by air pressure in a tank containing hydraulic fluid.

A typical application of this equipment is shown in Fig. 9. With hydraulic fluid in the tank, charge the tank with 10 to 20 pounds of air pressure. Clean all dirt from around the master cylinder filler cap, remove the cap and attach the hose from the bleeder tank to the master cylinder filler cap opening. Open the bleeder hose valve.

Remove the screw from the bleeder valve at the wheel cylinder. Screw the bleeder hose into the bleeder valve and place the free end of the bleeder hose in a glass jar containing brake fluid, following the same procedure as in manual bleeding. Open the bleeder valve at the wheel cylinder and watch the flow of fluid at the end of the hose. As soon as air bubbles stop, close the valve tightly. Remove the bleeder hose and repeat the process at the other wheels.

HYDRAULIC LINES

A fluid leak at some point is indicated when the master cylinder reservoir requires the addition of fluid at frequent intervals. When this happens, inspect the pipes, connections, and cylinders for leaks while pressure is applied to the brake pedal. If a leak is evident at a tube or hose, replace the part. A leaky wheel cylinder may be indicated by the presence of fluid on the brake support plate, in which case the cylinder must be removed and overhauled.

Flaring Brake Tubing

When necessary to replace brake tubing, always use special metal tubing which is especially designed to withstand high pressure and resist corrosion. For this reason, ordinary copper tubing is not satisfactory and should not be used.

The important thing in connection

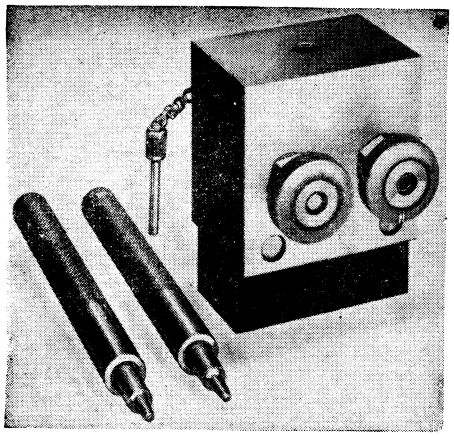

Fig. 10 Flaring tool for hydraulic brake tubing

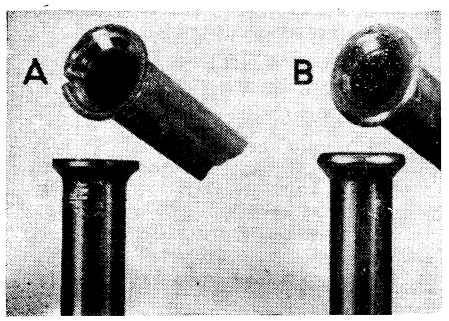

Fig. 11 Showing advantage of double lap flare (B) on hydraulic brake tubing over single lap flare (A)

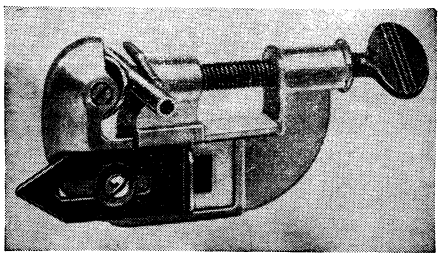

Fig. 12 Special cutting tool for hydraulic brake tubing

with making up hydraulic brake pipes is the proper flaring of the ends of the tubing for the compression couplings. Unless the tubing is properly flared the couplings will leak and the brakes will become ineffective.

This tubing must be double-lap flared at the ends in order to produce a strong, leak-proof joint. The tool shown in Fig. 10 is used to form the double-lap flare.

Fig. 11 shows two pieces of tubing—one with a single-lap flare "A" and the other with a double-lap flare "B." Note that the single-lap flare split the tubing while the one shown in "B" has a well formed joint.

To flare the tubing, cut it to the desired length, using the tube cutter, Fig. 12, to prevent flattening the tubing. Square off the end with a fine cut mill file, then ream the sharp edges with a reamer blade provided on the tube cutter.

Place new compression coupling nuts on the tubing. Dip the end of the tubing to be flared in hydraulic brake fluid. This lubrication results in a better formation of the flare. Loosen the clamping nuts on the flaring tool and insert the finished end of the tubing in the channel of the die until it bears against the stop pin, Fig. 13.

Tighten the clamping nuts by hand and place the fixture in a bench vise. Then tighten down the clamping nuts firmly with a wrench and remove the stop pin from the die. The tubing is now firmly gripped in the die and ready for the first flare forming operation.

Using the flare forming tool having the concave die, insert the forming tool in the die and strike firm blows with a one pound hammer until the shoulder of the tool contacts the top of the die.

Next, use the flare forming tool having the 45-degree die at its lower end. Insert the tool in the die and strike firm blows until the shoulder of the tool contacts the top of the die. The resulting double-lap flare is shown in Fig. 13.

To install, position the tube and start each connection by hand to be certain that the coupling threads are properly aligned. Then securely tighten each coupling with a wrench. Install and tighten the tube holding clips, then bleed the brake system.

WHEEL CYLINDER

Removal

Block the brake pedal in the released position, Fig. 14, to prevent its being moved accidentally while the cylinder is off, thus avoiding the loss of brake fluid.

Jack up the vehicle and remove the wheel and brake drum. Unfasten the brake hose or pipe from the wheel cylinder connection. Unhook the brake shoe retracting spring to permit the shoes to be moved away from the cylinder.

At this point, if step bore cylinders are used, note carefully in which direction the larger bore is facing. On some vehicles the larger bore faces the rear while on others it faces the front.

Remove the two screws which fasten the cylinder to the brake support plate and take off the cylinder.

Disassembly

Fig. 15 is an exploded view of a typical wheel cylinder used with Bendix and Lockheed brakes, while Fig. 16 shows the design used on Chevrolet brakes.

To disassemble either type, remove the end covers and push out the pistons, rubber cups and spring. Wash all parts in clean alcohol, but before doing so, wash your hands with soap and water to avoid the possibility of mineral oil or gasoline coming in contact with the parts during assembly.

Inspection

Examine cylinder walls. If found to be scored or rusted, the cylinder must be reconditioned by honing, Fig. 4. A hone of the proper size should be placed in the chuck of an electric drill. Work the hone back and forth a few times, then inspect the cylinder to see if the wall is cleaned up. Do not hone any more than is required to remove scores and smooth up the cylinder.

If available, try a No-Go gauge in the cylinder, Fig. 5, using a collar of the correct diameter for the cylinder being serviced. No-Go gauge is slightly larger than the maximum allowable diameter at which the piston cups will operate satisfactorily. Therefore, if the gauge will enter the bore the cylinder must be discarded and a new one installed.

Check the fit of the pistons in the cyl-

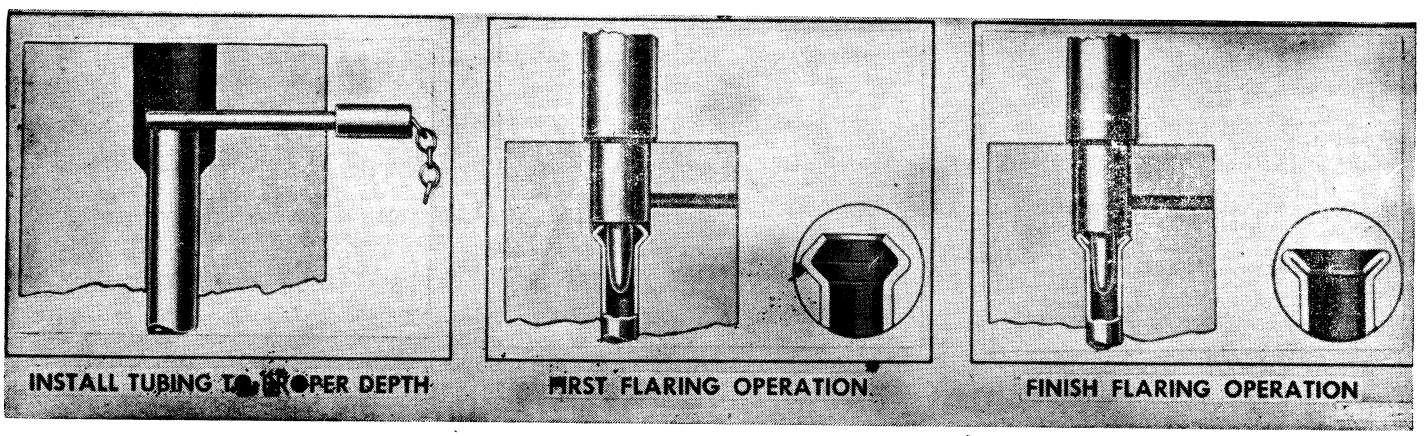

Fig. 13 Method of forming double lap flare in brake tubing

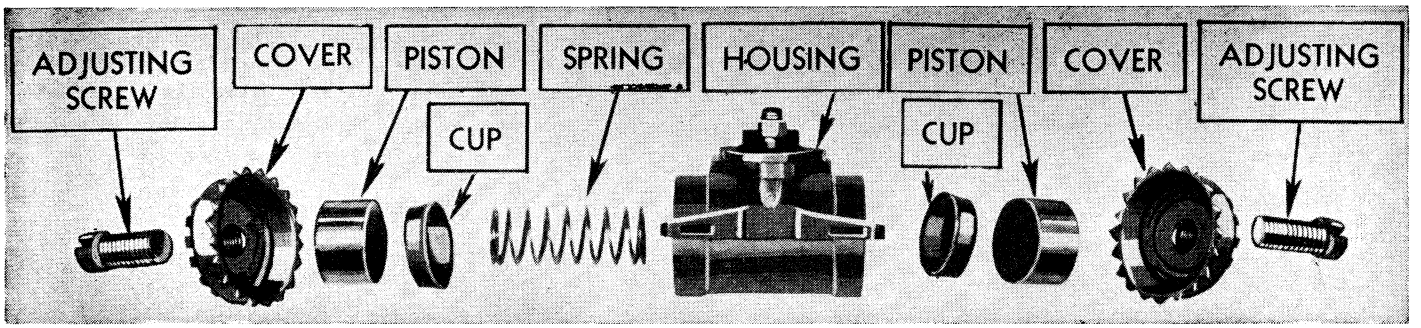

Fig. 16 Exploded view of wheel cylinder with metal end covers and adjusting screws

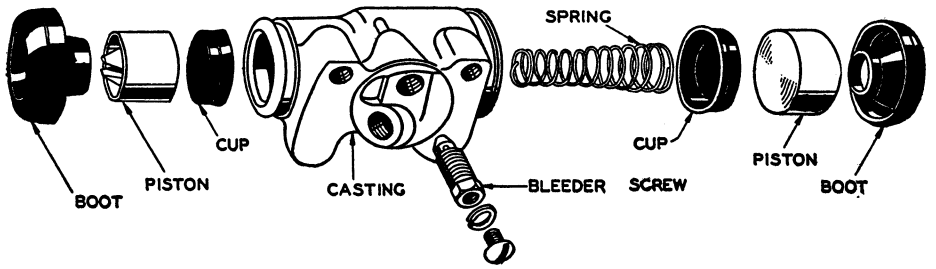

Fig. 15 Exploded view of wheel cylinder with rubber end covers or boots

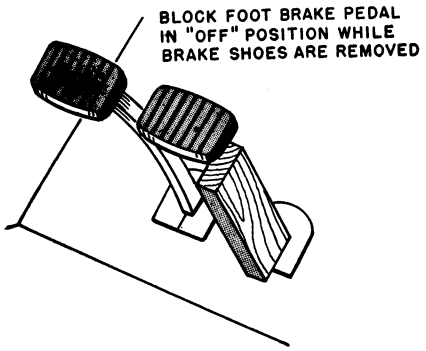

Fig. 14 Method of blocking brake pedal to avoid loss of brake fluid while hydraulic system is open

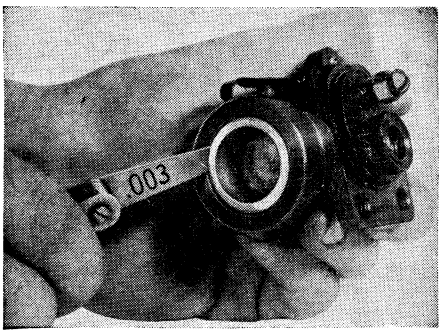

Fig. 17 Checking wheel cylinder piston fit with feeler gauge

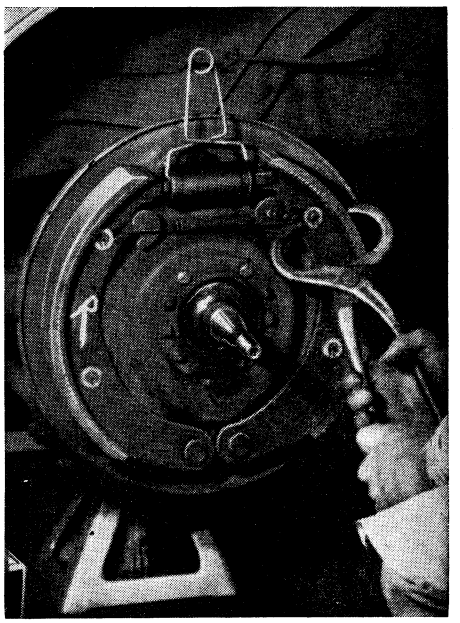

Fig. 18 When removing shoes from Bendix and Lockheed brakes, use piston clamp shown to hold pistons in cylinders. The use of the return spring removing and installing pliers are also illustrated

inder. Clearance between the pistons and cylinder wall should be from .002 to .004" when checked with a feeler gauge, Fig. 17. If the clearance is more than .004" and new pistons will not provide the correct clearance, a new housing will have to be installed.

Always use new rubber parts when reconditioning a cylinder. Rubber parts which are swollen or damaged will seriously impair the proper function of the brakes. Repair kits are available which contain all parts usually required for reconditioning wheel cylinders.

Reassembly & Replacement

Dip pistons and rubber cups in brake fluid. Place the spring in the center of the housing, the rubber cups at each end of the spring, with their cupped sides to the spring and the flat face of the cups flush with the piston. (On step bore cylinders the spring is tapered, therefore, be sure to place the small tapered end against the smaller piston). Replace the end covers.

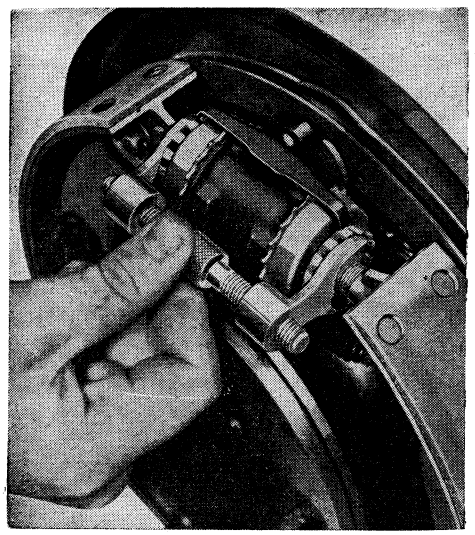

Fig. 19 Type clamp to hold pistons in cylinders of Huck-Chevrolet brakes

Assemble the wheel cylinder to the brake support plate, connect the fluid pipe or hose and hook the brake shoe retracting spring. Install the brake drum and wheel, and bleed the entire brake system.

BRAKE ADJUSTMENTS

To compensate for lining wear, which is indicated when the brake pedal travels within three inches of the floor, a minor adjustment is made to reduce the clearance between the brake lining and brake drum.

A major adjustment becomes necessary when a minor adjustment will not provide a satisfactory brake, when brake shoes have been relined or replaced, or when drums have been turned down.

Minor adjustments can be accomplished without removing the brake drums. Merely jack up the wheels to clear the floor and turn the adjuster as directed in the following text.

With a major adjustment, the drums must be removed in order to inspect the general condition of the brake system and to perform other operations necessary to complete the adjustment.

When necessary to remove brake shoes from a hydraulic system, install a brake cylinder piston clamp before removing the brake shoes, Figs. 18 and 19. This will prevent the cylinder pistons from being forced out of position and will thus prevent brake fluid loss. Remove the brake shoe return springs, using the pliers shown, Fig. 18. The same pliers are used to reconnect the springs.

AIR BRAKES

BENDIX-WESTINGHOUSE

Air brake equipment on trucks and truck-tractors provides a means of controlling the brakes through the medium of compressed air. Air brake equipment consists of a group of devices, Figs. 1 and 2; some maintain a supply of compressed air, some direct and control the flow of compressed air, and others transform the energy of compressed air into the mechanical force and motion necessary to apply the brakes. Different types and sizes of devices are used on different types of vehicles to meet the operating requirements, but they are all fundamentally the same. Following are the devices comprising a typical truck or truck-tractor air brake system, with a brief description of the function of each device.

Compressor

The compressor supplies the compressed air to operate the brakes.

Governor

The governor controls the compression of air by the compressor. Although the compressor runs continuously when the engine is running, the governor, acting in conjunction with the unloading mechanism in the compressor cylinder head, stops and starts the compression of air by the compressor when the desired maximum and minimum air pressures are present in the air brake system.

Brake Valve

The brake valve controls the air pressure being delivered to the brake chambers and in this way controls the operation of the brakes.

Quick Release Valve

This valve speeds the release of air pressure from the front wheel brake chambers.

Relay Valve

This valve speeds the application and release of air pressure from the rear wheel brake chambers.

Brake Chambers & Cylinders

Brake chambers and brake cylinders transform the energy of compressed air into the mechanical forces and motion necessary to apply the brakes. One brake chamber or one brake cylinder on each wheel.

Slack Adjusters

Slack adjusters provide a quick and easy method of adjusting the brakes to compensate for brake lining wear. One slack adjuster is used for the brakes on each wheel.

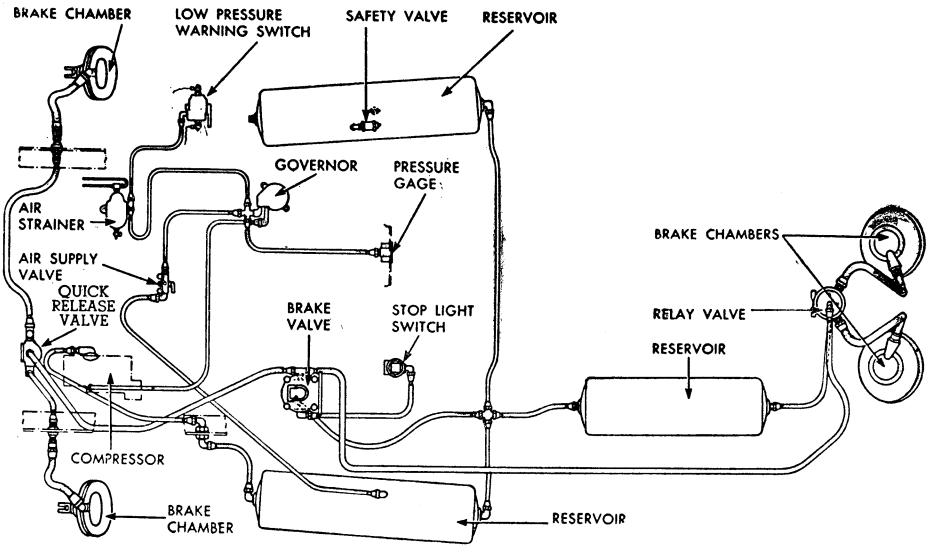

Fig. 1 Air brake diagram for a dump truck

Cocks

Cut-out cocks are used in the trailer connection lines to permit these lines to be closed when they are not being used. Reservoir drain cocks are used also, mounted at the bottom of the reservoir. The drain cocks permit draining the oil and water which collects in the reservoir.

Tubing & Fittings

Tubing and tube fittings connect the different air brake devices in the air brake system.

Hose & Couplings

Flexible hose lines and hose fittings are used where it is necessary to have an air line between two points of a vehicle which change their position in relation to one another. Hose lines also make connections between two vehicles, and in such cases they are provided with hose couplings to permit the connections to be easily connected or disconnected.

Dummy couplings seal the hose couplings against the entrance of dirt when the hose couplings are not in use. Dummy couplings on the back of tractor cabs also provide a place for attaching the free ends of connecting hose that is not being used.

Safety Valve

This valve protects the air brake system against excessive air pressure.

Reservoirs

Reservoirs store the compressed air until it is needed for brake operation and provide sufficient air pressure to make several brake applications even after the engine has stopped.

Air Gauge

The air gauge, mounted on the instrument panel, registers the pressure in the air brake system.

Air Supply Valve

In some cases, the air supply valve is included to provide an easy means of obtaining compressed air from the air brake system for such purposes as tire inflation.

Low Pressure Indicator

This indicator is often provided to warn the driver by sounding a buzzer or by lighting a warning light if for any reason the air pressure in the air brake system falls below a safe operating point.

Stop Light Switch

The air operated stop light switch provides a simple means of controlling the stop lights of the vehicle.