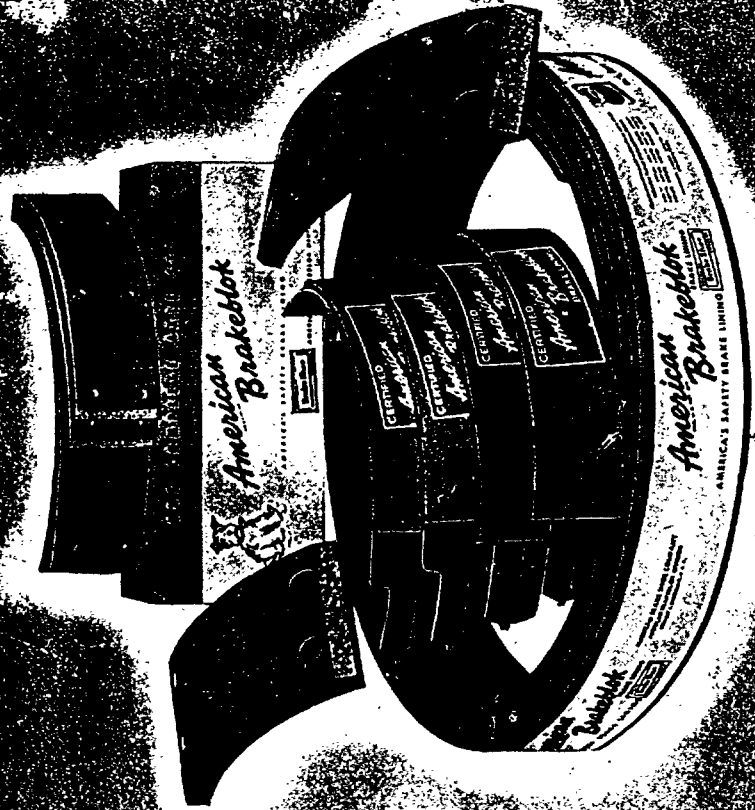


**American
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AMERICA'S SAFETY BRAKE LINING

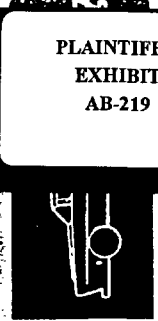
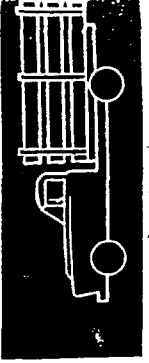
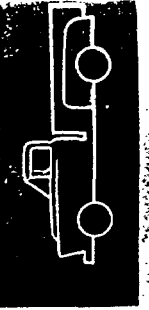
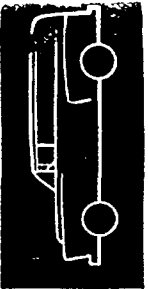
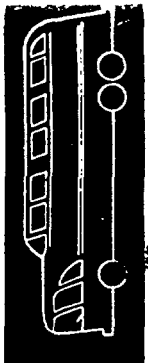
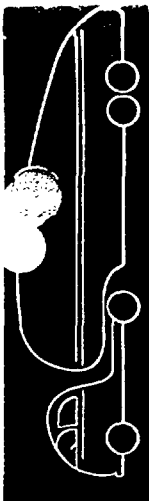
AMERICAN Brake Shoe
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Quick Reference

BRAKE SERVICE GUIDE



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AMERICA'S SAFETY BRAKE LINING

Quick Reference Brake Service Guide



CHULA VISTA AUTO PARTS
290 E St., GA 2-6238
Chula Vista, California

**AMERICAN BRAKEBLOK DIVISION
AMERICAN BRAKE SHOE CO.**

Members Society of Automotive Engineers

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Quick Reference Brake Service Guide

Foreword

THIS Brake Service Guide has been prepared for the assistance and information of brake service stations and other organizations and individuals interested in the relining and maintenance of automotive brakes.

No attempt has been made to go into complete details of the full maintenance of the various types of brakes. The instructions and recommendations have been confined entirely to friction recommendations, adjustments, and service helps.

In preparing this guide an effort has been made to so arrange the contents that information is easily available and is not complicated. All of the principal

types of brake equipment have been covered. Those found only on a few makes or models of cars or cars produced some years ago have been omitted. Adjustment instructions and recommendations for these can be supplied on request.

All mechanical recommendations such as clearances, etc., are based on the practice of the American Brakeblok Service Engineers and will be found to be practically the same as those recommended by the brake manufacturers.

We are grateful to all the Brake Engineers and Brake Manufacturers for their assistance in helping us prepare this Guide.

American Brake Shoe Co.

American Brakeblok Division

BASIC SERVICE BRAKE SYSTEMS

Basic Service Brakes are divided into two divisions, Foundation Brakes and Actuating Systems.

FOUNDATION BRAKES

Foundation brakes are composed

of backing plate, spider, springs, shoes, lining and other components mounted on the vehicle axles as stationary members, actuated by forces to retard the rotation of the drums.

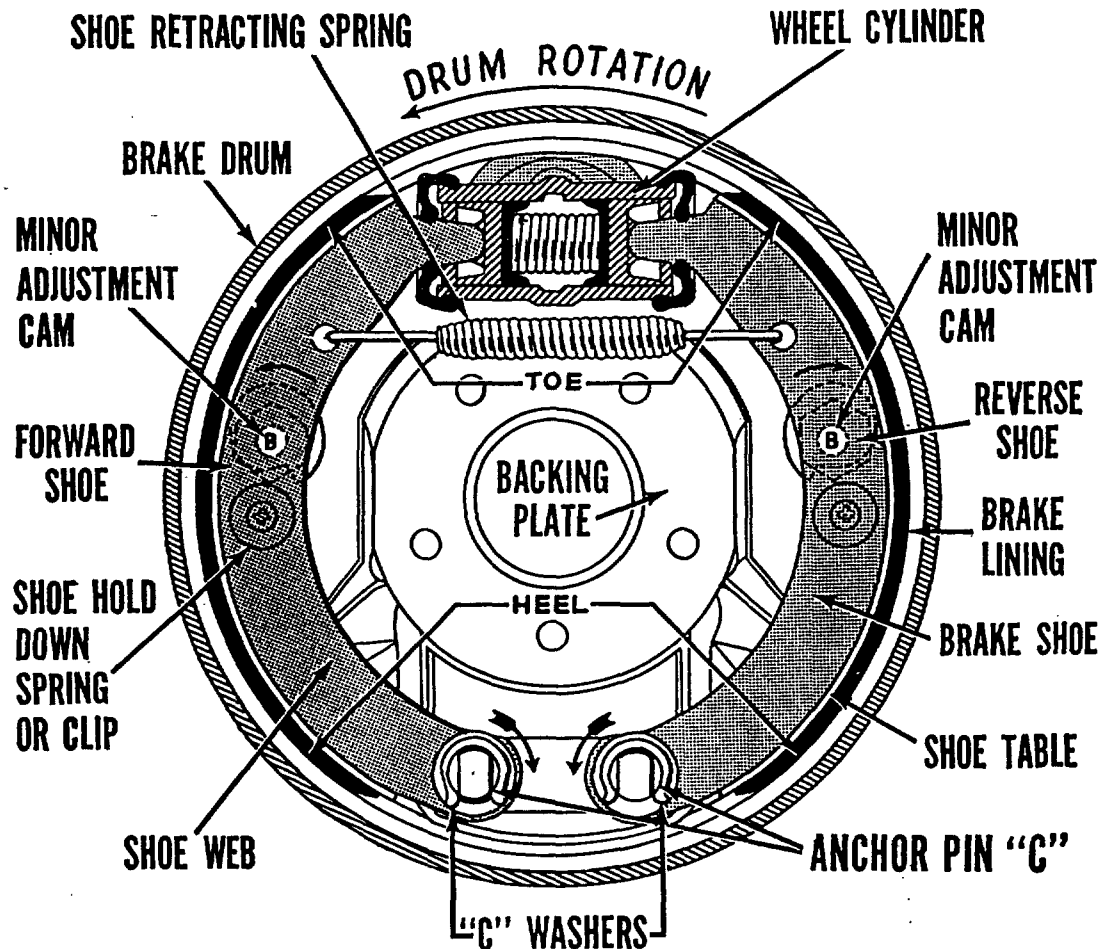


Figure 1

FOUNDATION BRAKE NOMENCLATURE

The outward movement of the brake shoe against the drum results in friction which retards the drum rotation. This retarding action generates heat in varying degrees according to speed and pressure applied. This heat must all be absorbed by the drum and dissipated into the atmosphere. Vehicle speed de-

creases as this stored heat energy is diminished, and the vehicle stops when all energy of motion is converted to heat. Most of the heat is outwardly dissipated from the drum as the linings practically insulate the brake shoes.

THE ACTUATING SYSTEM

The actuating system is the means by which a force is applied either mechanical, hydraulic, vacuum or air and by which the operator controls the foundation brake.

Figure 2 shows the component parts of a standard hydraulic brake actuating system.

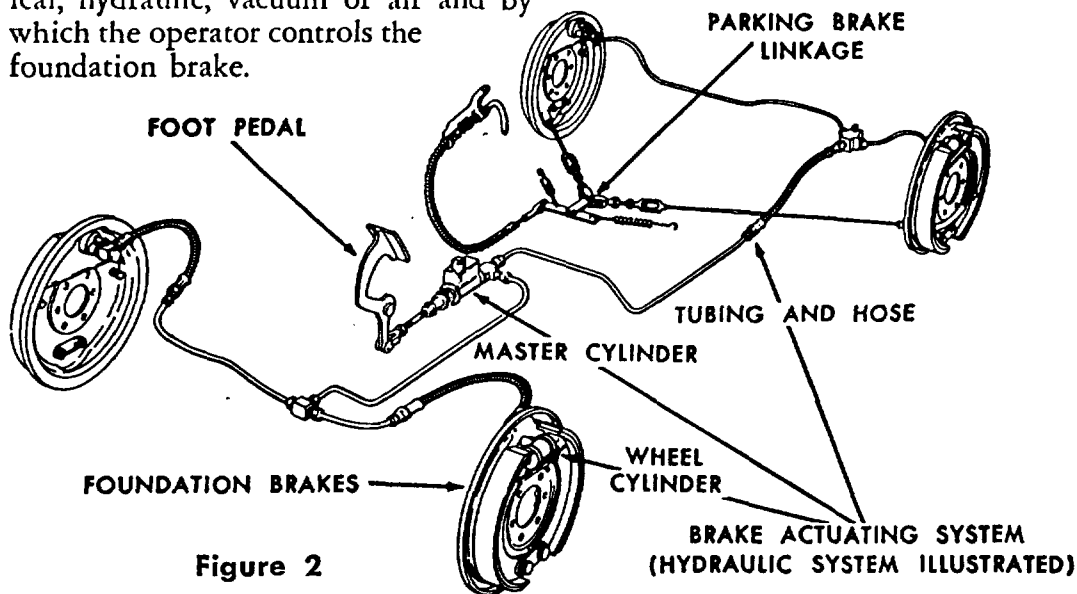


Figure 2

GENERAL BRAKE INFORMATION

The effectiveness and efficiency of any brake system is governed by the maintenance it receives, the quality of brake lining and brake parts used, and the operating conditions to which it is subjected.

We will briefly discuss the component parts of the various braking systems and their recommended maintenance procedure. If these recommendations are followed, maximum braking effectiveness should be attained.

Brake Control System — A freely operating brake control system allows the shoes to return to the stop provided. This may be the toe-board, a set screw at the foot pedal, or some sort of lever return rest at a point on the chassis. When a brake control system returns to its maximum released position a longer period of operation can

be expected before adjustment is necessary. On mechanical brake systems, it is very important to obtain the correct angle between the various rods and levers. **For the best brake operation, the angle between a rod and lever should be 90 degrees (Right Angle) when the brake is applied.** On mechanical brakes no backlash or play should be present at the brake pedal or at the operating lever. On Bendix two-shoe brakes, when shortening linkage to remove backlash the mechanic must be sure that he does not expand the shoes from the anchor pins. The cam should just come in contact with the ends of the brake shoes.

On hydraulic brake systems, there should be about 1/4" free play in the brake pedal before piston in the master cylinder begins to move.

The hook-up linkage on both mechanical and hydraulic brake systems should be carefully examined. Sometimes the brake levers have more than one hole in which the clevis pin may be placed.

Lubrication — Regular lubrication of the necessary parts of a brake system is important, in order to get free operation of the system. Such parts as the cross shaft bearings, clevis connections, cable and conduit controls, or any other moving part must be lubricated. Over-lubrication of the front wheel bearings, outer rear axle bearings, and differential must be guarded against to insure against grease-soaked brake lining. **When doing a brake job, the mechanic should replace all the old grease retainers with new ones.**

BRAKE SPRINGS

There are two common classes of springs used in the Foundation and Actuating brake system, namely **compression and tension springs**.

Their functions are most important in the application and return of the systems. These springs should be checked for, free length, height, rust deterioration, compression and tension, also stretch. Spring hooks and eyes should conform to manufacturers specifications. To hasten the release action of a brake control system that has been in long service, the uninformed mechanic sometimes will install additional return springs at various points in the brake control system. This is detrimental to satisfactory brake performance, increases the pedal pressure and is unnecessary. It usually will be found that correct lubrication, and proper adjustment, will produce satisfactory operation of the brake actuating system. All return springs should be checked and weak or broken ones replaced.

BRAKE DRUMS

Automotive manufacturers are giving much attention to drum materials. Modern practice indicates the use of high grade cast iron alloy drums.

Where foreign abrasive materials enter the brake assembly and where low carbon pressed steel or cast iron drums are used under high temperatures, the drum surface tears out. Splinters become embedded in the brake lining acting as cutting tools scoring and eroding the brake drums.

A brake drum can perform only up to the critical temperature of the drum metal from which it is made. With inferior drum metals, flaking conditions cannot be cured by friction material. Friction material will maintain proper frictional values while drum metals will disintegrate from the high heats generated at the rubbing surface. As a consequence, high grade alloy drums are most necessary to good brake performance.

Practical limit of foundation brake capacity is reached when heat is created much faster than it can be dissipated and abnormally high temperatures occur. Then extreme drum expansion due to heat, prevents full contact of shoe linings against the drum surface, causing localized high pressure and high temperature areas (hot spots) on drum and lining surfaces. Extreme heat also changes the normal friction characteristics of the lining. Liners glaze and char; drums heat check and distort. "Fade" may occur and, if brakes are not permitted to cool, efficiency drops rapidly (See Fig. 3).

When brakes are serviced, the drums should be carefully examined for scoring, heat checking or pitting of the surface. In addition, the drums should be inspected for signs of distortion including warping, bell-mouthing, barrel-shaping and out-of-roundness (See Figs. 4 and 5).

HEAT AND PRESSURE DISTORTION

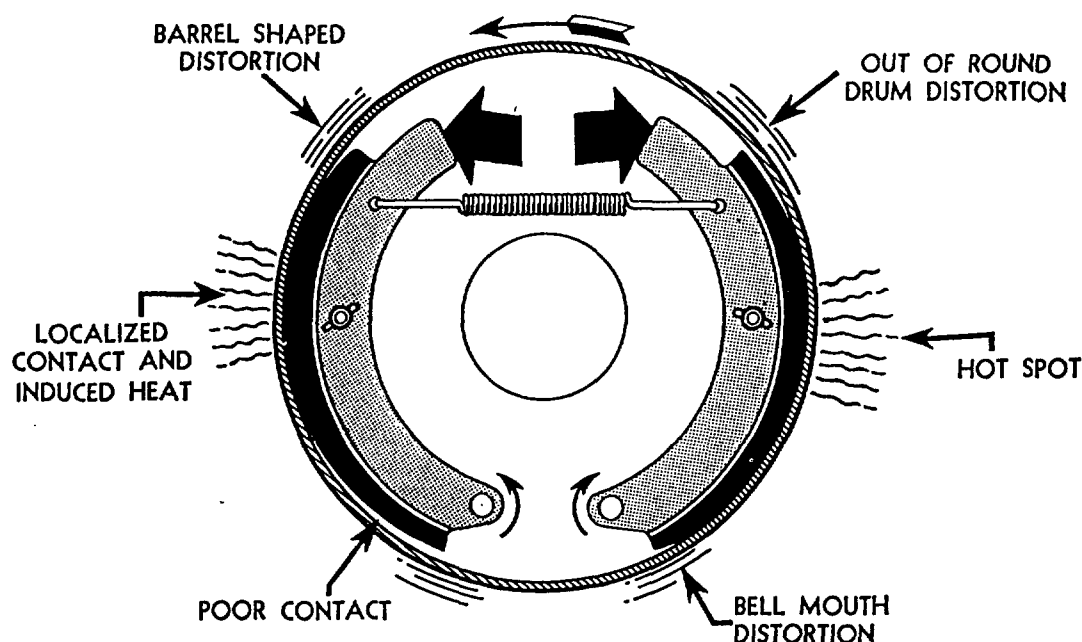
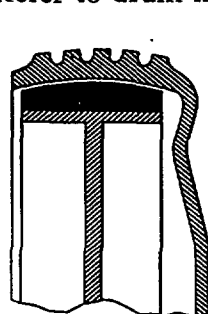
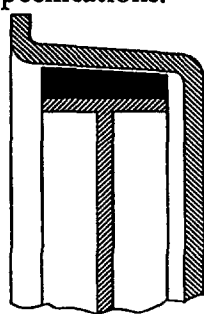


Figure 3

Brake drums can be reconditioned, providing the score marks are not too deep and the drums are not too much out of shape. Care should be taken not to remove too much metal because drums which are too thin heat up rapidly and distort under braking pressures. Refer to drum mfg. specifications.



BARREL SHAPED DISTORTION
Figure 4



BELL MOUTHED DISTORTION
Figure 5

It is extremely important to obtain the smoothest finish possible on reconditioned brake drums. Whenever possible, they should be ground to a smooth finish.

Before replacing the drums, all abrasive and metal particles should be re-

moved. During the first few hundred miles of driving, the brakes should not be applied any harder than necessary for a reconditioned brake drum is similar to a rebored engine and must be "broken in" gently.

Brake drums should be reconditioned equally in pairs, so that the two front drums are similar and the two rear drums are the same. Otherwise, the braking effect on one side of the car may not be equal to that on the other side.

BRAKE SHOE RELINE

When brake drums have been turned out, it is necessary to use brake lining which is oversize in thickness or else place shim stock between the lining and shoes. If shim stock is used, care should be taken to choose a shim stock which is not compressible and will not soften under brake temperatures.

The brake shoes should be thoroughly cleaned and a brake lining clamp should be used to hold the lining tightly against the shoe for the drilling and riveting operation.

Drill the lining so that rivet heads may be placed down in the material as deeply as it is safe to go without danger of the lining pulling off the shoes. By following this procedure, we leave as much usable thickness as possible for wear purposes. The depth at which rivets may be safely placed varies, depending upon the make and type of brake lining. With some linings, it is safe to drill to a depth of from only about one-half to two-thirds of the total thickness of the material. With American Brake-blok, some applications of which have wire mesh reinforcing back, it is best to drill until the wire back is just barely visible. Then the head of the rivet will seat squarely on the reinforcing back, the riveting job will be tight, there will be a maximum of friction material for wear purposes and the braking strains will be evenly distributed throughout the entire segment of lining.

It is especially important to obtain 100% contact between the brake lining surface and the brake drum. Whenever possible, it is helpful to grind the lining on the shoes to the correct drum radius. Machines which mount on the axle spindle and grind the lining on the shoes while they are in place in the assembly do an especially fine job, providing a good quality machine is used.

On rivet sets chamfer the ends of each brake lining segment back past the centerline of the end rows of rivets. This eliminates end contact which is a frequent cause of brake squeaks. All bolts and nuts in the brake, wheel and drum assembly should be securely tightened.

ENERGIZING EFFECT

Friction causes the rotating drum to drag on the shoe linings. If the drag exerts a pulling force it "energizes" the shoe, helping to force it into the drum. This "self-energization" multiplies the effect of the controlled actuating force

to produce additional braking effort or to reduce the amount of force required. If the drag exerts a pushing force it "de-energizes" the shoe, resisting the effort to force it into the drum. "De-

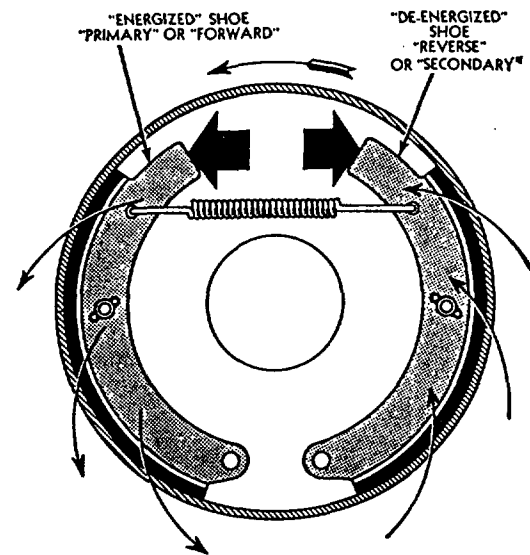


Figure 6

energization" reduces the braking effect. If the brake shoes are individually anchored (suspended), a shoe energized by forward drum rotation is a "primary" or "forward-acting" shoe. A shoe de-energized by forward drum rotation is a "reverse-acting" shoe (Fig. 6).

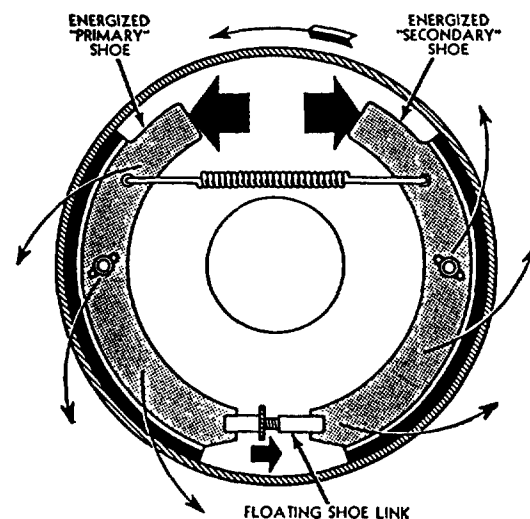


Figure 7

If the brake shoes are linked together by a floating link, actuating force is transmitted from one shoe to the other creating a wedging or servo action. **The first shoe from the source of actuating force in the direction of forward drum rotation is the "primary" shoe. The shoe linked to the primary shoe is the "secondary" shoe (Fig. 7).**

Some systems have two forward acting shoes, actuated by dual hydraulic cylinders (Fig. 8).

Self-energization is important in all motor vehicles as it provides powerful braking action controllable with light pedal pressure. The advantage of this design is offset to a degree by one disadvantage. Variation of friction on one wheel and that on the opposite wheel, due to contact, grease, foreign matter, drum make and design or other causes,

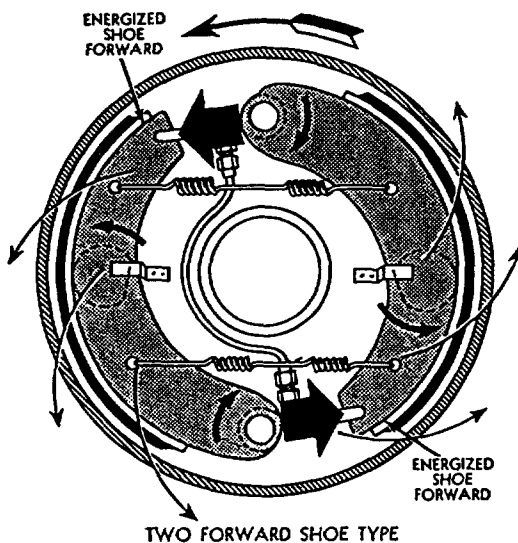


Figure 8

will magnify through the self-energizing principle and will cause **pulling** to the right or left side. Equal brake effort at each wheel is essential to efficient and effective stops. Equalization is dependent upon anchor pin adjustment, condition of drum, and lining contact, tire tread wear, and camber limits.

BRAKE LINING MATERIALS

Brake linings are of several types, are manufactured by a wide variety of methods, use many different materials—in various combinations—to obtain the strength and frictional characteristics desired. The principal types in use today are the woven, molded and block varieties. It is a hard, dense material and is held to the brake shoes by rivets or by cementing or "bonding" with adhesive of a special type which is heat cured on the shoe.

Materials used in the manufacture of brake linings include asbestos, rubber (natural or synthetic), resins, drying oils, coke, coal, brass, zinc, lead and others. These materials are baked, cured and vulcanized by the application of heat and pressure to form linings of any desired shape, texture, density, hardness and frictional characteristics wanted.

Similar to the molded linings used on passenger cars but much thicker and wider, the brake blocks used on heavy duty trucks are shaped to fit either inside or outside of the drums and are attached to heavy pressed steel or cast iron shoes or bands. Such brakes are usually power operated by means of air pressure tanks, vacuum cylinders or electricity.

Therefore brake linings should have the following qualities:

Constant friction value throughout its service life.

Recovery from effects of water and oil.

Non-compressible.

Suitable for existing cast alloy drums.

Uniformity of material and quality of control in production.

Noise and fade-free and long wear life.

It is important to use a high quality brake lining on all jobs. This insures

that the final result will be *safe* brakes, which after all, are one of the greatest features which a motor vehicle can have.

Not only does high quality brake lining produce the maximum degree of *safety* because of its better performance, but it also gives longer life and freedom from noise and scoring. Customer satisfaction is greater and there are fewer complaints and requests for no-charge adjustments.

For best results it is important to reline all shoes of all brakes of a vehicle at the same time. Even though the old brake lining is not completely worn out, it is difficult to obtain the correct adjustment and the proper braking power distribution unless all shoes are relined at the same time.

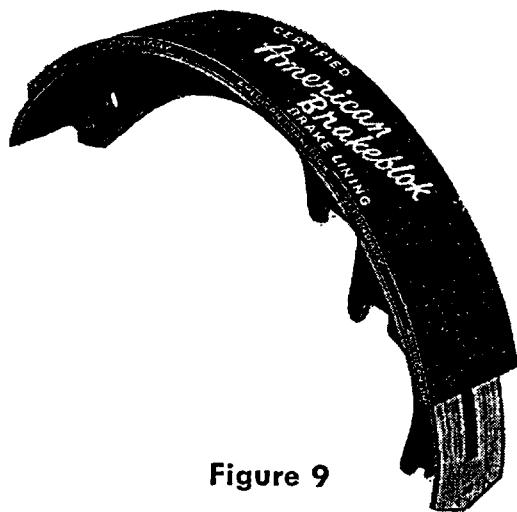


Figure 9

Bonded Lining—Lining is bonded to the shoe table by the action of heat and pressure on a bonding agent, located between the lining and shoe. The bonding agent may be a liquid, applied as used; a tape, cut to size and applied as used; or it may be pre-applied by the lining manufacturer or rebuilders.

In the bonding operation, heat, pressure and time of bonding are critical factors and depend upon the size of the shoe and the type of bonding equip-

ment used. Carefully follow the equipment manufacturer's instructions.

For best results, the new linings on the shoes should be ground (not buffed) concentric with the brake drums. If this is not done, high spots may prevent proper lining to drum contact and proper adjustment. Charring, burning, or glazing with symptoms of hard pedal, fade, or pull to one side may also occur until linings are "worn in." Additional adjustments may then be necessary. Linings are ground before or after the relined shoes are installed on the axles, depending upon the type of grinding equipment in use.

Removing Brake Lining which has been cemented to the shoes—Some vehicles are in service which have brake lining cemented to the brake shoes. One company which has manufactured vehicles of this kind, recommended that the following method be used for removing the brake lining from the shoes.

The most satisfactory way to remove the lining from the shoes is by heat. Clamp the shoe in a vice. Grip it by the center reinforcing rib with the toe end of the shoe pointing up. Apply heat evenly on the under side of the flange at each side of the rib. Distribute the heat as evenly as possible so that the shoe will not warp.

When the shoe and the lining are evenly heated, the lining is easily pried loose with a screwdriver or by means of similar tool. Buff the shoe clean so that all trace of the old lining and cement is removed before applying the new lining.

Some mechanics prefer to remove lining which has been cemented on to the shoes by grinding it off.

However it is recommended that the old brake shoes be exchanged for certified American Brakeblok factory bonded, radius ground



brake shoes which duplicate all original equipment specifications. (Fig. 9).

Greasy Linings—Much braking trouble will be avoided if the lubrication of the rear axle and front wheel bearings is held to the correct amount and not overdone. Where it is found that the brake lining has become excessively saturated with oil or grease, heavy pedal pressure or possible sensitive brake action will result and the only cure is replacing the brake lining.

Other Factors Affecting Brake Systems—A motor vehicle should leave the service station with the brake control system bearings well lubricated, each wheel free of brake drag and the four brakes balanced. The U-bolts holding the chassis springs to the axle must be tight. The wheel bearings must be

accurately adjusted to prevent brake drag, due to loose bearings.

Braking sometimes is unjustly blamed when the fault lies with the steering apparatus of the motor vehicle. Front wheels are mounted with a definite amount of caster, camber, and toe-in. After considerable mileage or due to accidents these necessary adjustments become disturbed. Therefore, when the brakes are applied the motor vehicle swerves and becomes difficult to control. Caster and camber as well as toe-in of the front wheels should be periodically checked to insure proper brake performance.

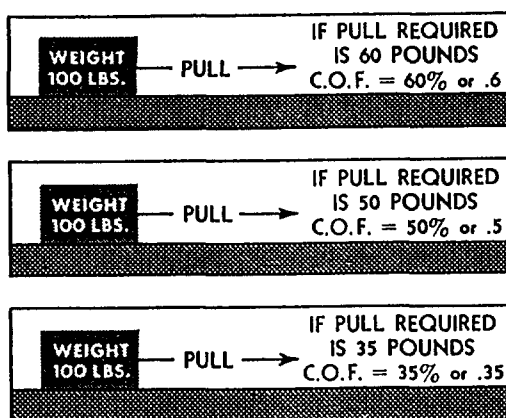
Tire inflation, tire tread wear, condition of brake drums, one front or rear spring more flexible than the other, improperly adjusted road shock dampeners, etc., affect brake systems. These items should always be checked. See trouble shooting chart (Page 67).

An explanation of the term COEFFICIENT OF FRICTION

COEFFICIENT OF FRICTION

Friction is the resistance to relative motion between any two bodies in contact, and it varies not only with different materials but also with the condition of the materials. The amount of friction developed by any two bodies in contact is said to be their coefficient of friction, and this is expressed by stating the amount of force required to move the one body while it remains in contact with the other; the amount of force being expressed in relation to the weight of the moving body.

Thus, if the moving body weighs 100 pounds, and a force of 60 pounds is



C.O.F. = COEFFICIENT OF FRICTION

PULL = FORCE REQUIRED TO KEEP WEIGHT MOVING AT CONSTANT SPEED

Figure 10

required to keep it moving while it remains in contact with another body, the coefficient of friction between the two bodies is said to be 60% or .6. If 50 pounds force is necessary to keep it moving, the coefficient of friction is said to be 50% or .5. If only 35 pounds force is required, the coefficient of friction is 35% or .35 (Fig. 10).

The coefficient of friction between any two surfaces changes with any variation in the condition of one or both surfaces. As an example, the introduction of oil or grease between two dry, flat metal surfaces will greatly reduce the friction between them.

While most friction material manufacturers make brake linings having different coefficients of friction, there are some manufacturers who produce various "grades" of brake materials, to sell at different prices. Although the

friction level of one grade may be exactly the same as the friction level of another grade, **there may be a vast difference in the wear rates, based on the amount of work done.** Care should be taken not to judge the quality of a lining by the coefficient of friction which it may have.

The important thing to remember is that it is not always the brake lining with the highest "coefficient of friction" which is wanted, but instead the lining with the *correct* coefficient of friction for the particular brake which is being relined.

The use of brake lining having too high a coefficient of friction will cause the brakes to grab and lock up with just a little pressure on the brake pedal. The use of a brake lining having too low a coefficient of friction will result in what is known as "hard pedal."

ACTUATING SYSTEMS

There are five actuating systems in use today.

1. Mechanical
2. Hydraulic
3. Vacuum
4. Air
5. Electrical

Each system will be treated briefly as to its function as an actuating system.

MECHANICAL SYSTEM

To assure maximum braking efficiency all brake cables, slack adjusters and rods should be so adjusted that the greatest mechanical advantage is obtained (see Fig. 12) which means that all levers with brake applied will be at right angles to the pull or push rod. Fig. 12 also shows that a reserve travel to compensate for wear of lining should be made in any setup. Figs. 11 and 13 show the wrong position of levers.

In the case of Fig. 11 the lever is pulled and pushed beyond the center, thus decreasing efficiency at the time when it is needed most, that is, at the greatest pedal pressure, or when making an emergency stop. Fig. 13 shows the leverage too far backward. A lever set in this position would require unusually severe pressure even to start the brake mechanism moving. Same principle applies to slack adjusters.

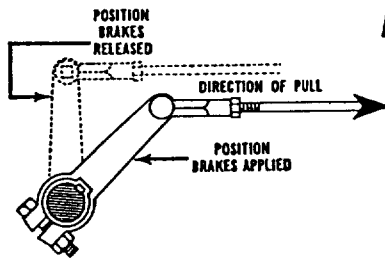


Figure 11
WRONG

position of levers—
lever pulling beyond
center.

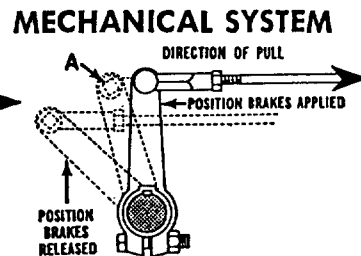


Figure 12
CORRECT

position of levers to assure maximum braking efficiency. To maintain some reserve travel to compensate for wear of lining, levers should be in position (A) with brakes fully applied.

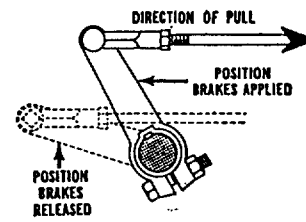


Figure 13
WRONG

position of lever—
lever too far back-
ward.

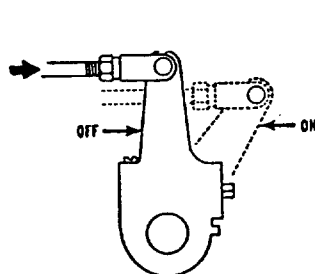


Figure 11A
WRONG

lever pushing beyond
center (right angle).

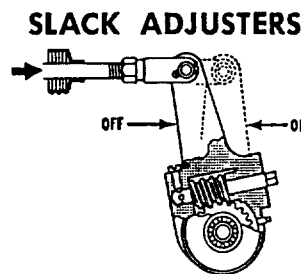


Figure 12A
CORRECT

the rod should be adjusted at its clevis so that the cam lever or slack adjuster sets back with brakes off and is at right angles to rod (indicated by dotted lines) when brakes are fully applied.

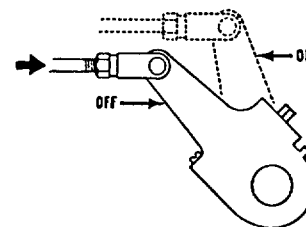


Figure 13A
WRONG

lever in off position
too far backwards.

HYDRAULIC BRAKE SYSTEMS

Internal Type Hydraulic Brakes—

The later models of this type of hydraulic brake use a master cylinder which is always in direct contact with the source of supply of the brake fluid. Fig. 14 shows a typical master cylinder of late model cars using Internal Hydraulic Brakes.

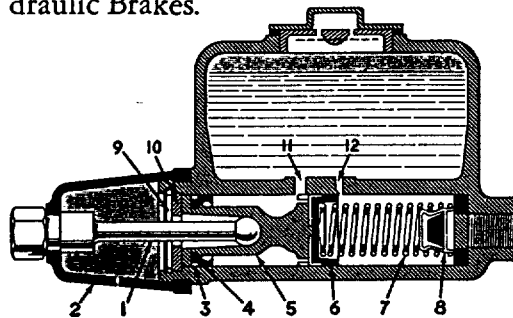


Figure 14.

Popular Type of Compensating Master Cylinder.

(1) Master cylinder link (2) Rubber boot (3) Cup ring (4) secondary cup in position on rear of (5) metal piston. (6) Primary cup is held securely against face of piston (5) by return spring (7) which also holds check valve (8) in position. Retainer spring (9) anchors piston stop (10). Piston stop (10) controls position of piston (5) so that when brakes are released intake port (11) and by-pass port (12) are open.

- **Be sure that all port holes within the cylinder itself are free of obstructions.**
- **See that the rubber cup on the piston is firm and clean and has not been affected by any mineral oil which might cause swelling or sticking.**

A cross-sectional view of the wheel cylinder used to actuate the brake shoe is shown in Fig. 15.

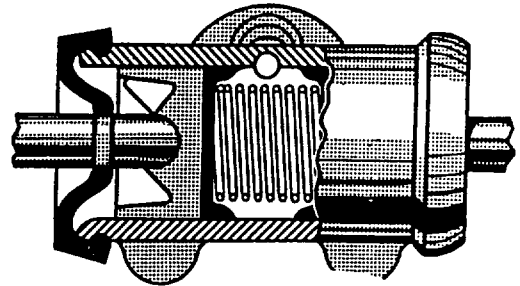


Figure 15

Equal bore Wheel Cylinder as used on Bendix and early Lockheed Brakes.

Some cars are equipped with straight bore wheel cylinders using a piston of the same diameter for operating each shoe. Other cars are equipped with

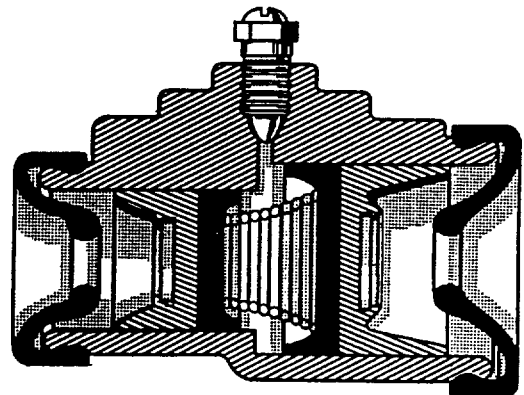


Figure 16

Sectional view of the step-bore Wheel Cylinder

stepped bore wheel cylinders which have pistons of different diameters (Fig. 16).

In cases where the manufacturer has attempted to secure more equal wear on the two shoes, we find the larger diameter piston operating the reverse shoe. In cases where the manufacturer has attempted to obtain a softer brake pedal we find the larger piston operating the forward shoe. Often the diameters of the front wheel brake cylinders are

larger than those of the rear wheel brake cylinders in order to obtain better brake distribution.

For the above reasons, it is always important to make sure that wheel cyl-

inders are put back in place properly in cases where they have been removed.

The hydraulic fluid should be non-compressible assuring equal pressure to each brake.

VACUUM SYSTEMS

There are two general types of vacuum power brake systems. One is known as the air suspended or single line system and the other is known as the vacuum suspended or double line system. However, both types use the vacuum in the engine manifold as the source of power which helps the driver's foot apply the brakes.

It should be remembered that when it is said that a vehicle has vacuum power brake equipment, it is meant that the engine vacuum is used to help the driver apply the brakes. Vacuum power brake equipment does not mean a certain type of brake assembly. In fact, the vacuum brake equipment has nothing to do with the type of brake shoes or brake drums used. A vacuum power brake system may be used on a vehicle equipped with any type of mechanical or hydraulic brake. When it is used on a vehicle fitted with mechanical brakes, the vacuum equipment is used to help apply the brakes by adding its power to the driver's force applied to the brake cables or rods. When a vacuum system is used on a vehicle fitted with hydraulic brakes the vacuum equipment adds its power to the driver's push on the master cylinder piston rod, thus making it easier for the driver to build up a high pressure in the hydraulic brake system.

ATMOSPHERIC SUSPENDED (SINGLE LINE) SYSTEM

Figure 17 shows the layout of a single line (atmospheric suspended) vacuum power brake system. When the driver presses the brake pedal the brake valve is opened and the vacuum from the engine manifold causes the piston in

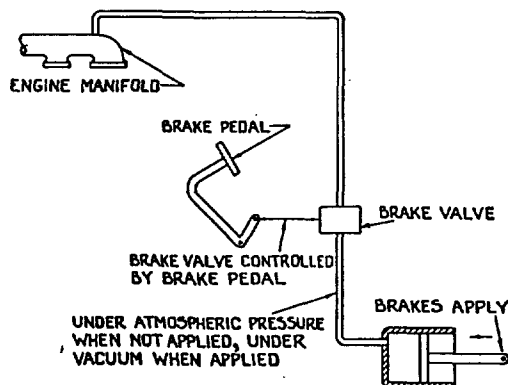


Figure 17

Layout of Atmospheric Suspended Vacuum Brake System (Single Line)

the booster cylinder to move and thus help apply the brake. This system is called "Atmospheric suspended" because when the brake is off there is atmospheric pressure on both sides of the booster cylinder piston. When the driver presses the brake pedal opening the brake valve there is vacuum on one side of the piston and atmospheric pressure on the other side. Naturally under these conditions the piston moves and

helps apply the brakes. As can be seen from the diagram this atmospheric system can be set up using only a single line from the brake control valve to the booster cylinder. Instead of "single line" or "atmospheric suspended," this system is sometimes referred to as simply an "air suspended" system. In certain installations, especially on trailers, the brake valve is controlled by a hand lever rather than by the driver's foot operating through the brake pedal.

From an examination of the layout shown in Figure 17, it can be seen that each time the brakes are applied there is a quantity of raw air which travels into the engine manifold from the booster cylinder. It can be easily seen why this occurs when we remember that with this system, there is ordinary air pressure on both sides of the booster cylinder piston with the brakes not applied. Pressing the brake pedal opens the brake valve and removes the air from one side of the booster piston and this raw air travels into the engine manifold. With a large booster cylinder the amount of raw air traveling into the engine manifold is considerable and there is quite likely to be detrimental effects upon engine carburetion since the engine is usually at low gas throttle position when the brakes are applied. Therefore, in order to avoid this, we find that large booster cylinders can not be used successfully with the "atmospheric suspended" or "single line" system. Since large booster cylinders can not be used successfully with this system, we find that the "Atmospheric suspended" system's use is limited to passenger cars, light trucks and in a few cases, light trailers.

VACUUM SUSPENDED (DOUBLE LINE) SYSTEM

Figure 18 shows a layout of the "vacuum suspended" or "double line" vacuum power brake system. This system is called

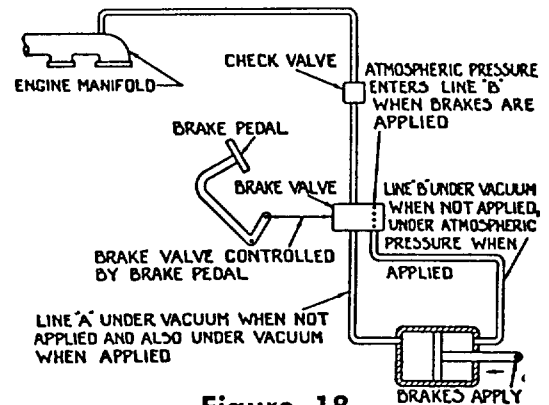


Figure 18

Layout of Vacuum Suspended Vacuum
Brake System (Double Line)

ed "vacuum suspended" because there is vacuum on both sides of the booster cylinder piston when the brakes are not applied. The brake valve is therefore open to both lines A and B, thus admitting vacuum to both sides of the booster cylinder piston when the brakes are off. When the driver presses on the brake pedal he operates the brake valve which shuts off the vacuum to line B and admits atmospheric pressure to this line. There is now vacuum on one side of the piston and atmospheric pressure on the other side and the piston therefore moves and helps apply the brakes. It will be noted that there is a check valve used between the brake valve and the engine manifold. This seals the system at maximum vacuum and permits at least one power brake application even if the engine should stall. It will also be noted that the vacuum suspended system requires two lines from the brake control valve to booster cylinder, thus giving it the name "double line" system.

With the vacuum suspended system there is also a quantity of air which travels from the booster cylinder to the engine manifold. However, this occurs when the brakes are released with this system instead of when the brakes are applied as with the atmospheric suspended system. When the brakes are re-

leased the engine is usually starting to pull with an advanced gas throttle position and the admission of air to the carburetor does not have as much effect as it does under the air suspended system with the engine at low throttle position. Therefore large booster cylinders can be used with the double line system and this system can be used on trucks and trailers where the single line system does not work out as well.

A vacuum booster cylinder can be installed on a trailer and the two lines coming from the trailer are hooked on to a tee connection in line A and to a tee connection in line B on the trailer. In this case the trailer brakes would be controlled by the same brake valve which controlled the tractor brakes. In many cases however, the trailer brakes are controlled by a hand control valve mounted in the tractor cab. Many state laws require that the trailer brake system be capable of applying the trailer brakes in case of a trailer breakaway. This can best be accomplished by using a vacuum reservoir tank and a trailer emergency valve which is merely a separate check valve for the trailer. Thus, if the trailer should break away from the tractor the emergency valve seals the vacuum in the one line and the atmospheric pressure entering the other line causes the booster to apply the trailer brakes.

In addition to the foot control valve, hand control valve, check valve and emergency check valve mentioned above, there are a number of other valves used in vacuum brake work.

A relay valve is used on a trailer brake system to speed up the application of the trailer brakes. Without a relay valve the air to apply the trailer brakes would have to travel all the way from the control valve to the power cylinder on the trailer before the trailer brakes would begin to apply. Since the

control valve, either foot type or hand type is mounted near the driver and the power cylinder may be near the trailer rear wheels, this represents considerable distance and lost time in the case of a long tractor-trailer combination. The relay valve is mounted near the trailer power cylinder and there is little time lost since the air only has to travel from the relay to the power cylinder in order to apply the trailer brakes.

A regulating valve may be installed on the dash, so that the driver may control the amount of vacuum in the system.

A pneumatic relay valve is used when it is desired to operate a trailer equipped with vacuum brakes in conjunction with a tractor equipped with air brakes.

A conversion relay valve is used when it is desired to operate a trailer equipped with an atmospheric suspended vacuum brake system in conjunction with a tractor equipped with a vacuum suspended power brake system.

A synchronizer valve is occasionally used to obtain the proper relative amounts of braking between tractor and trailer on tractor-trailer combinations.

In some cases a vacuum chamber and diaphragm are used instead of a vacuum cylinder and piston but the operation of the power system is the same in either case.

SERVICE HELPS

In order to check a vacuum power brake system for leaks, it is necessary to have a vacuum gauge, hose and fittings. The vacuum gauge is graduated from 0 to 30 inches of mercury. Atmospheric pressure is normally equal to about 15 pounds per square inch and this pressure will support a column of mercury 30" high. Therefore a perfect vacuum would show a reading of 30" mercury on the vacuum gauge. However, the vacuum in automotive engines is never

perfect but in engines in good condition it should range between 20" and 26" of mercury. For satisfactory brake operation a vacuum booster system should show a reading of 16" on the test gauge. On a truck or bus installation the vacuum leakage when tested should not exceed 3" per minute. In the case of a tractor-trailer combination which must conform to trailer break-away laws the leakage should not exceed $\frac{1}{3}$ " per minute. (1" in 3 minutes.)

Vacuum power units of the piston-cylinder type should be lubricated with about 2 ounces of vacuum cylinder oil for every 5,000 miles of operation.

Vacuum power units of the diaphragm-chamber type require no lubrication but the diaphragm and seal

should be inspected regularly and replaced if necessary.

In cold weather, there is always danger of moisture condensing and freezing in the lines and other parts of a vacuum power brake system. In order to prevent freezing, we recommend placing a small amount of permanent type anti-freeze in the lines and a small amount in the power unit. In diaphragm-chamber type units about $\frac{1}{2}$ ounce of anti-freeze is sufficient, while in the piston-cylinder type units, it is best to place about 2 ounces on each side of the piston.

The air cleaners used at different points on a vacuum power system should be cleaned regularly to insure efficient operation of the brakes.

AIR BRAKE SYSTEM

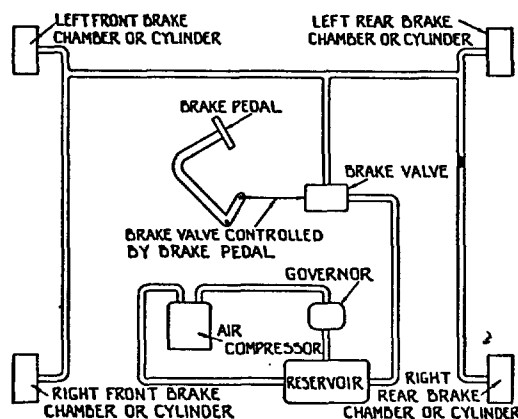


Figure 19
Layout of Typical Automotive
Air Brake System

The layout of a typical air brake system is shown in Figure 19. This layout shows what is commonly called a "straight air" system. It will be noted that a power unit is used at each wheel brake and that these power units may be

either the diaphragm—chamber type—or the piston-cylinder type. The power units in this straight air system are attached to levers which operate the brake cams of mechanical brakes. These levers are usually referred to as "slack adjusters" since the brake adjusting mechanism is built into these levers.

Some air brake systems operating mechanical brakes have a hydraulic cam brake actuator in place of the slack adjuster. The air from the compressor is used to operate an air piston which in turn operates a hydraulic master cylinder. The pressure from the hydraulic master cylinder is then transmitted through the hydraulic fluid lines to the hydraulic cam brake actuators at each wheel brake. The hydraulic cam brake actuators then turn the cams of the mechanical brakes. Thus, it can be seen that this system is a combination

air-hydraulic-mechanical brake system. However, it is generally referred to as an "air-hydraulic" system for mechanical brakes.

There is another air brake system which uses the air from the compressor to operate an air piston which in turn operates a hydraulic master cylinder. However, in this case the pressure from the master cylinder is transmitted through the hydraulic fluid lines to ordinary hydraulic brake wheel cylinders in standard type hydraulic brake assemblies. Thus, it can be seen that this system is merely a regular hydraulic brake system operated by compressed air pressure. It is generally referred to as simply an "air-hydraulic" system for hydraulic brakes.

There are a number of valves used in air brake work and it is well for the mechanic to understand the function of each.

Air brake application valves are divided into two general types, that is, foot-operated brake valves and hand-operated brake valves. The hand-operated brake valve is usually used in tractor-trailer operation.

A two-way valve, or double check valve, is used in tractor-trailer operation so that the hand control valve may be used to control only the trailer brakes while the foot control brake valve will apply both the tractor and trailer brakes. This type of installation gives added safety, for, in normal driving the foot pedal will apply both tractor and trailer brakes and on slippery pavements or in mountain driving, the driver can apply the trailer brakes alone through use of the hand control valve.

In some cases a pressure distributing valve is used on tractor-trailer combinations in order to provide for application of the trailer brakes before the application of the tractor brakes.

A quick release valve is used to provide faster release of the brakes. One or more quick release valves are used and they are mounted near the brake assemblies on which the quick release is desired. Without the quick release valve the exhaust air must travel from the brake assembly to the brake application valve before the brake releases. Using the quick release valve, the exhaust air must travel only from the brake assembly to the quick release valve before the brake release.

A relay valve is used to speed up the application of brakes which are a long distance from the brake application valve such as the rear brakes of long wheelbase vehicles.

A relay emergency valve is used in trailer operation to speed up the application of the trailer brakes and at the same time it provides a method of automatically applying the trailer brakes in case of a break-away. Of course, it is necessary to have an air reservoir tank mounted on the trailer and connected to the relay emergency valve in order to provide the air power for the automatic application of the trailer brakes.

There is also a special relay emergency valve which can be mounted on trucks to provide for automatic application of the rear brakes in case any hose or tubing of the air brake system should become broken. Here, too, it is necessary to have a special air reservoir tank to supply air for the automatic application of the brakes. This system is only used on heavy duty equipment operated in special types of service.

A relay-quick-release-emergency valve is used in trailer operation to speed up application of the trailer brakes and provide for quick release of the trailer brakes and at the same time provide for automatic application of the trailer brakes in case of a trailer

breakaway. Here, too, it is necessary to have an air reservoir tank mounted on the trailer and connected to the relay-quick-release-emergency valve to provide for the automatic application of the brakes.

A safety valve is mounted at the air reservoir connection to prevent the building up of too great a pressure in the system. The safety valve is usually set to release any air pressure above 150 pounds per square inch.

In some cases a pressure regulator valve is used to govern the air pressure in an air brake system and to prevent loss of air due to too much use of other air operated devices, such as horns, windshield wipers, door openers, etc. The pressure regulator valve is also used in brake systems requiring a rapid build up in air pressure in order to provide brake power in the case of stops made a few minutes after starting. This condition is particularly prevalent in fire engine operation.

A limiting valve is frequently mounted on the instrument panel so that the driver may control the amount of brake pressure and thus reduce the brake power when driving on wet or ice-covered roads.

On some vehicles an air supply valve is installed in the system to provide air pressure for emergency tire inflation or other uses.

SERVICE HELPS

Although the safety valve is usually set for 150 pounds per square inch, it is recommended as a general rule, to keep the line pressure below 105 pounds per square inch on air brake systems.

The air cleaners used throughout the system should be cleaned regularly.

In the case of self-lubricated air compressors the oil should be checked daily and drained at the proper intervals.

In the case of engine lubricated air compressors, the oil line feeding the compressor should be checked regularly.

In average service the diaphragms in brake chambers should be replaced at least once a year. In severe service the diaphragms should be replaced more often.

Power units of the piston-cylinder type should be inspected regularly and in extreme heat or dust or in winter operation two ounces of S.A.E. 10 oil should be put into the atmospheric end of the power cylinder.

If an air brake system is not operating properly, it is advisable to first check the entire system for leaks and attempt to determine which unit is causing the trouble. Ordinary soap suds are generally used for locating leaks in an air brake system.

All air brake reservoir tanks should be drained daily in order to eliminate any condensation from the system.

ELECTRIC BRAKE SYSTEM

The advantages of electrical brakes are that they are simple in design and installation, and that the necessary connection between tractor and trailer can be easily made and broken. As com-

pared with brakes that are applied by air pressure, electric brakes also have the advantage that they operate practically without lag. While they consume power only while they are being ap-



plied, this is not a serious disadvantage, as the power consumption is quite small.

One type of electric brake, which has an annular magnet core of U-section concentric with the brake drum, a cut of which will be shown later in the instruction section. This makes a rather efficient form of magnet, as the magnetic circuit has a large cross-section

and is quite short. The driver applies the brake by moving the handle of a controller, which first closes the battery circuit through the magnet coil and the controller resistance, and upon further motion cuts out the resistance step by step, thus increasing the braking power. The actuating mechanism has sufficient range so no adjustments are required throughout the life of the lining.

NOTES

**Service
Technique
of
Modern
Brakes**

The Lockheed hydraulic brake consists of two shoes, each separately pivoted on a rigidly held, adjustable anchor pin. These anchor pins can be turned to control the drum-to-lining clearance at the heel of the shoe. The clearance at the toe of the shoe is controlled by an eccentric cam near the actuating cylinder and can be adjusted from the reverse side of backing plate. The shoes are held against the adjusting cams by the tension of the retracting spring.

Since 1935 many cars have been equipped with step-bore wheel cylinders. In one case the large cylinder end is used on reverse shoe to equalize lining wear. In another case the large cylinder end is used on the forward shoe to reduce pedal effort.

MINOR ADJUSTMENT

1. Cam adjustments are provided on each brake shoe to compensate for lining wear. Jack up car and turn cam B (Fig. 20), outward at the top, away from the center of the axle, until the lining contacts the drum sufficiently to stop the wheel from spinning. Back off on cam until lining clears drum and wheel just turns freely. The adjusting cams are held in position by friction springs on some cars and locking is not required. A lock nut is used on other models.

2. Check master cylinder for correct fluid level. The fluid supply tank should be filled to within $\frac{1}{2}$ " of the top.

MAJOR ADJUSTMENT

1. The eccentric mounting of the two anchor pins C (Fig. 20), allows recentering of the brake shoes. If there are no inspection holes in the brake drums they should be removed and a ring gauge used (Fig. 21), or a brake gauge.

2. Place gauge in position and insert a .005-inch feeler between gauge and lining about 1 inch from the lower end of the shoe. Leave feeler gauge in place and turn eccentric anchor C (Fig. 20), until gauge is gripped.

3. At a point 1 inch from upper end of lining insert a .010-inch feeler gauge. If this cannot be done turn cam B (Fig. 20), a little and try again. Correct adjustment is obtained when the .010-inch gauge just enters at the toe or upper end of lining and the .005-inch at the lower end. Both shoes of each wheel are adjusted in this manner.

4. Replace brake drums and proceed as outlined above for "MINOR ADJUSTMENT."

If a gauge is not available a major adjustment can be made by turning the eccentric anchor from outside the backing plate. On some cars it is not possible

to turn the eccentric anchors from the outside without removing the anchor pins and slotting them for a screw driver. In order to do this it is necessary to grind off the case-hardened surface and slot the end by using two hacksaw blades placed side by side in the same handle. The anchor pins are then replaced and the adjustment made as follows:

1. Turn anchor pins C (Fig. 20), and cams B (Fig. 20), until shoes are as far as possible away from drums.

2. Adjusting one shoe at a time, turn cam B until a slight drag is obtained. Then turn eccentric anchor C until this drag has been relieved. Thus it is seen that the movement of eccentric anchor C not only affects the position of the

CLEARANCE CHECKED BETWEEN
LINING AND
RING
GAUGE

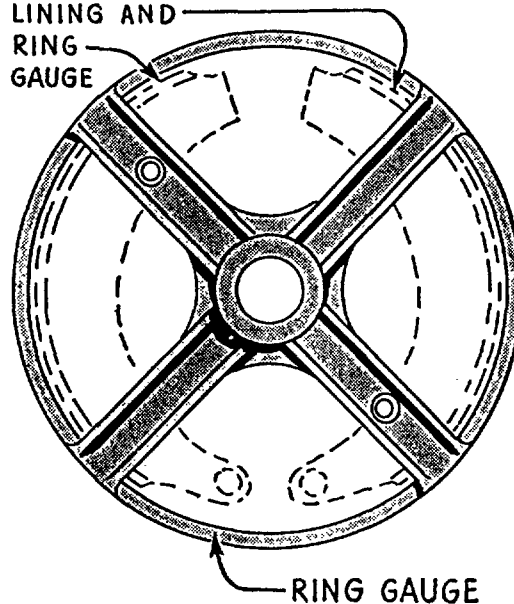


Figure 21

Ring Gauge in Place

heel of the shoe, but also the toe of the shoe near cam B.

3. Repeat these operations of obtaining a drag by turning cam B and relieving the drag by turning anchor C, until further turning of anchor C will not relieve the drag.

4. Then back off cam B and anchor C just slightly until wheel turns freely.

5. Repeat at other wheels. This method produces clearances very close to the recommended values of .005 and .010 inch.

6. Check fluid level in master cylinder and add fluid if necessary.

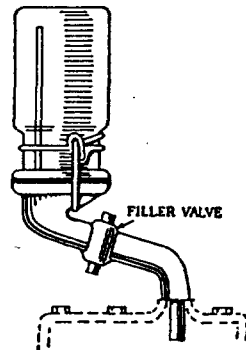


Figure 22

Automatic Refiller for Master Cylinder

BLEEDING

Air can be removed from the brake lines by bleeding. This is necessary after lines have been disconnected or if the fluid in the master cylinder has been allowed to run too low.

Bleeding can be done through a rubber tube, the end immersed in a clean (1-pint glass bottle) container partially filled with brake fluid.

When bleeding, the bleeder valve A (Fig. 23), in the wheel cylinder should be opened one-half to three-quarter turn, but not completely removed.

Bleeding is done by pressing the brake pedal slowly to half the limit of its travel after making sure that master cylinder reservoir (Fig. 14) is full of fluid. If reservoir filler opening plug is left out during the bleeding the fluid can be watched to see that it does not get below the half way point. An automatic refiller for master cylinders (Fig. 22), prevents the master cylinder from running dry during the bleeding operation.

With master cylinder reservoir full the brake pedal can be given 6 or 10 half strokes before it is necessary to refill the reservoir.

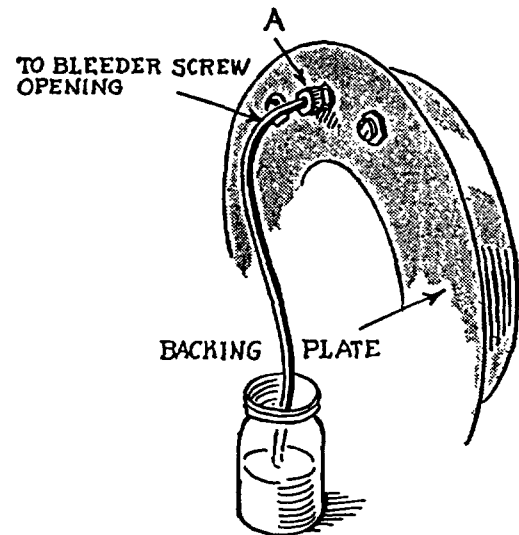


Figure 23

Method of Bleeding Hydraulic Brakes

This pumping action forces the liquid and air through the system and out of the bleeder hose. The process is continued until the fluid runs clear without air bubbles.

It is best to bleed one wheel cylinder at a time in this sequence, RF, LF, LR, RR, to make sure all air is expelled.

Bleeding tanks are available which permit the bleeding to be done under air pressure in a much shorter time than by pumping with the brake pedal.

SERVICE HELPS

If, after bleeding, the pedal still feels spongy, the condition may sometimes be relieved by holding bleeder valve A (Fig. 23) open until fluid appears, with the rubber tube not screwed in place. Bleeder valve is then closed. This operation should be performed with a pedal pressure of only a few pounds.

When removing the shoes from a hydraulic brake assembly it is best to clamp the wheel cylinders in order to prevent the accidental blowing out of

the pistons, making a bleeding operation necessary.

On all hydraulic brake systems only an approved hydraulic fluid should be used.

If there is any doubt about the purity or quality of the fluid in the lines, it is best to flush out the entire hydraulic system using an approved flushing fluid. In some cases, it is necessary to remove the master and wheel cylinders and clean them thoroughly, using alcohol or brake fluid. Inferior brake fluids damage the rubber parts of a hydraulic system and it is often necessary to replace the rubber caps. If the cylinders have been scored or pitted, they should be honed to a mirror finish.

After adjusting the cams always press the brake pedal two or three times after spinning the wheel by hand. Then check the wheel to make sure that it is still free of drag.

On Hydraulic Brakes, there are sometimes cases of squeaks caused by binding of the tops of the Reverse Shoes where the Reverse Shoe lining is the same length as the Forward Shoe lining. This squeak can be eliminated by using a shorter piece of lining on the Reverse Shoe.

Sometimes this shorter piece of lining is placed so that the open space is at the toe, and in other cases the open space is at the heel end of the shoe.

TWO CYLINDER Hydraulic Brake

Chrysler Products—1949-55

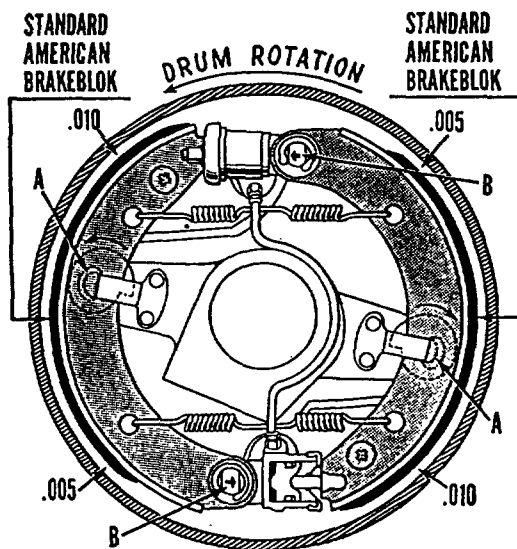


Figure 24

The brake (Fig. 24) has two forward acting shoes and each shoe operates in a manner similar to the forward acting shoe on the conventional two-shoe

Lockheed Brake. The adjusting procedure is very similar to that for other Lockheed Brakes except that anchor pins are in different positions and slightly different clearances are recommended. The conventional one cylinder brake is used on rear wheels.

The two cylinder brake uses a new type wheel cylinder and cup. The lower cylinder in the drawing above is cut away to illustrate its construction.

MINOR ADJUSTMENT

1. With wheel jacked up turn cam adjustment "A" in the direction shown by arrow in illustration until the drum drags. (This is always clockwise on the right hand adjuster and counter-clockwise on the left hand adjuster as you face the brake assembly). Back off until drum is just free of drag. Repeat this operation on all shoes.

2. Check fluid supply in master cylinder and fill if necessary.

3. If pedal has a spongy or springy action the fluid lines should be bled.

MAJOR ADJUSTMENT

1. Remove front wheel and hub assemblies. The use of a drum gauge is employed at this point.

2. Loosen anchor pin lock nuts and examine arrow heads of both upper and lower anchor bolts "B". The high side of the eccentric anchor is indicated by an arrow head. These arrows should point towards the adjacent wheel cylinder before starting the anchor adjustment.

3. From this anchor setting turn anchor pin so as to decrease clearance $1\frac{1}{2}$ " from the anchor end of the lining to .005" and lock anchor pin lock nut. Turning anchor pins on the left side of the car clockwise and on the right hand side of the car counterclockwise decreases clearance.

4. Adjust cam "A" on each shoe to .010" clearance at $1\frac{1}{2}$ " from the cylinder end of the lining.

5. Recheck clearance at the anchor end and readjust anchor if necessary.

6. Install wheel and hub assemblies. New grease seals are recommended.

7. In bleeding these front wheel brakes, bleed the top cylinders first and then bleed the lower cylinders.

FORD Hydraulic Brakes 1939-48

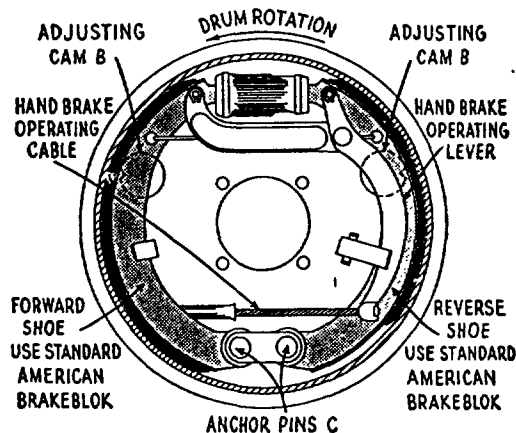


Figure 25

1939-1942 Ford Hydraulic Brake Showing Mechanical Operation of Rear Wheel Brakes for Parking

Ford cars are equipped with hydraulic brakes which are very similar to the Lockheed brakes just described. A left rear 1939-42 Ford brake assembly is illustrated in Figure 25 and shows the mechanism which operates the shoes through the hand brake lever for parking or emergency purposes.

ADJUSTMENTS

The major and minor adjustments on Ford hydraulic brakes through 1942 models are made in the same manner as on the Lockheed brake described on page 24. Figure 20.

The 1946-48 Ford brakes have brake shoes which are self centering at the anchor pins and therefore there is no anchor pin adjustment to be made on these brakes.

SERVICE HELPS

The hand brake lever on all recent Ford passenger car and light trucks operates the brake shoes in the two rear wheels for parking or emergency purposes. When making service brake adjustments, it is advisable to disconnect the hand brake cables.

In order to adjust the hand brake on these vehicles, proceed as follows:

1. Release the hand brake lever completely and then place it in the first notch.

2. Apply a pressure of about 30 pounds to the brake pedal and hold at approximately this pressure throughout the hand brake adjustment.

3. Take all slack out of the hand brake cables and adjust conduits so that cables are exactly the right length.

4. Remove the pressure from the brake pedal and release the hand brake lever completely and check the rear wheels to make sure they do not drag.

The 1½-ton Ford trucks have separate brake bands located in the rear wheels and operated through the hand brake lever for parking or emergency

purposes. The hand brakes on the 1½-ton trucks are adjusted as follows:

1. Release hand brake lever completely.

2. Adjust brake rods so that an equal drag is produced at each rear wheel when hand brake is applied.

American Brakeblok, as well as most other brake lining manufacturers, recommend the use of a fairly high friction lining on both shoes of the Ford hydraulic brakes.

In addition to material in rolls, American Brakeblok also furnishes brake lining segments in boxed car sets especially prepared for these brakes.

LOCKHEED Self-Centering Hydraulic Brakes

Self-Adjusting and Non-Self-Adjusting

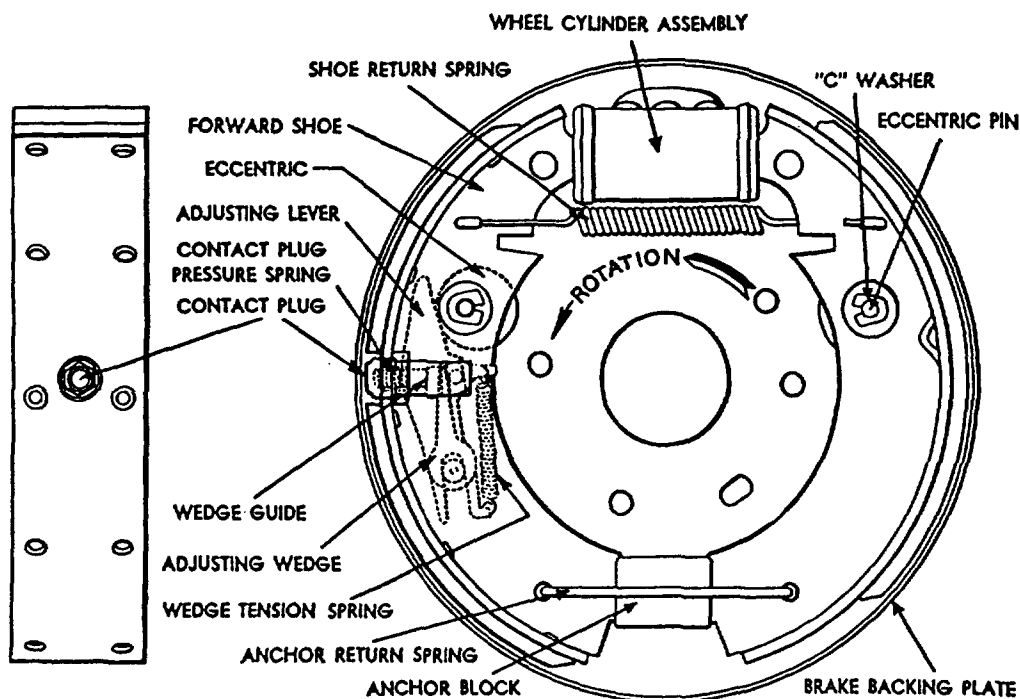


Figure 26
Lockheed Self-Adjusting Hydraulic Brake

In this type brake, conventional brake shoe anchor pins have been eliminated. The lower ends of the shoes butt

against a solid block rigidly attached to the backing plate. This block is machined so that its sides are aligned ra-

dially to the axle. Rounded abutments on the lower ends of the shoes, allow the shoes to rock laterally on the sides of the blocks. When the brake is applied, the shoes center themselves by moving radially until the shoes are in their proper positions in relation to the drum. This self-centering feature requires no maintenance.

SELF-ADJUSTING DEVICE

The self-adjusting device automatically compensates for the lining wear and virtually maintains the original pedal travel throughout the entire life of the lining. As shown in Figure 26, the device is located on the Forward Shoe only. Since the lining on the Reverse Shoe wears so slowly, it is usually unnecessary to adjust it until relining of the Forward Shoe is required. Basically, the self-adjusting device consists of a contact plug, one end of which extends through a hole in the center of the shoe and lining. The other end of the plug is centrally pinned to a lever, which in turn, is pinned at its lower end to the brake shoe. The upper end of the lever bears upon the brake eccentric, when the brake is in the released position. A spring actuated wedge is inserted between the plug and lever pin and a wedge guide fastened to the shoe.

The function of the self-adjusting device is to closely maintain constant shoe clearance by advancing the shoe toward the drum as lining wear occurs. The brake eccentric is adjusted when the brake is installed, and no further manual adjustment of the eccentric is necessary until the shoes need relining.

Assuming no drum distortion or expansion, the contact plug and lever always move the same distance from the brake eccentric when the shoes are applied. During a brake application, the shoe is forced against the drum by fluid pressure, and carries with it the contact plug which is held at its original posi-

tion in relation to the lining surface by means of a light holding spring (Figure 26). For the purpose of explanation, we can assume that the contact end of the plug does not wear, inasmuch as the actual wear has been found to be very slight, and is compensated for by the lever.

With subsequent brake applications, and as lining wear occurs, the contact plug moves the adjusting lever in relation to the wedge guide, allowing the adjusting wedge to advance upward by spring action, thereby taking up the clearance between the plug and lever pin and the wedge guide. The wedge holds the lever in its adjusted position in relation to the shoe.

When the brake is released, the adjusting lever resumes contact with the brake eccentric, this limits shoe return to its original drum clearance. Thus, the shoe has been adjusted in an amount equal to the lining wear. This action continues with the wedge gradually advancing upward until the lining has worn to the point where the contact plug has reached maximum travel, at which time the plug contacts the web of the shoe.

WHEN TO RELINE BRAKES

After the plug contacts the web of the shoe, additional brake applications will force the shoe and plug against the drum with equal pressure causing the plug to wear at the same rate as the lining. The contact end of the plug is made of an anti-frictional material which permits this wear and prevents drum scoring. The shoe clearance will therefore increase with lining wear, and the brake pedal travel will also begin to increase. When this occurs, the driver is warned that the brakes need relining.

Drum distortion or expansion has no effect upon the self-adjusting device, since the mechanism is attached to the

shoe and does not alter its position, even when the shoe is forced into the distorted or expanded contour of the brake drum. The movement of the contact plug depends entirely upon the lining wear. Over-adjustment is thereby prevented.

REMOVING BRAKE SHOES

First place a wheel cylinder clamp across the wheel cylinder boot on each brake, before attempting to remove the brake shoes.

A. Front wheel brakes

Remove anchor return spring and shoe return spring (Figure 26). Remove "C" washers from shoe eccentric cams. Each shoe is removed by pulling the heel of the shoe away from the anchor block, lifting from the backing plate until clear of the eccentric cam spindle, and then pulling away from the wheel cylinder.

B. Rear wheel brakes

Remove the anchor return spring, and shoe return spring and pull the parking lever towards center of the brake and unhook cable. Remove hairpin cotter from the shoe adjusting eccentric cam. Remove each shoe in the same manner as followed for the front wheel brakes.

C. Disassembly of the self-adjusting device

Remove the hairpin cotter. Press the contact plug inward until the plug contacts web of shoe. Maintain pressure on contact plug while removing wedge tension spring and while withdrawing adjusting lever. Remove wedge, wedge guide, contact plug and contact plug pressure spring.

RELINING BRAKE SHOES

A. Remove the old lining

B. Reline the shoes. American Brakeblok carsets for these brakes are provided with contact plug clearance holes

already cut in the brake lining for use on the forward shoes.

Rivet the linings to the shoes.

If the lining is to be ground on the shoes do not reassemble the self-adjusting mechanism until after the grinding operation unless special grinding equipment is used which provides a means for clamping the self-adjusting mechanism.

C. Reassemble the self-adjusting device as follows:

Step 1: Use a new contact plug. Each car-set of American Brakeblok Brake Lining, for use on these brakes, contains four new contact plugs for use in the self-adjusting mechanisms on each of the forward shoes. Insert the pressure spring in the contact plug, and slip the contact plug into place making sure that the contact plug is on the correct side of the shoe.

Step 2: Replace the wedge guide.

Step 3: Place the wedge into position so that it clears the lever pin hole in the shoe.

Step 4: Replace the adjusting lever while depressing the contact plug. Make sure the wedge is flat against the shoe between the adjusting lever and the wedge guide.

Step 5: Fully advance the wedge, and replace the wedge tension spring. To avoid damaging the wedge tension spring, use a hook to stretch the spring from wedge to lever.

Step 6: Complete the reassembly of the self-adjusting device by turning the shoe over and installing the hairpin cotter.

D. Completely retract the adjusting wedge while pressing the contact plug. Clamp the shoe in a vise so that the jaws of the vise are directly beneath and bearing against the adjusting lever to prevent movement of the contact plug. Then file the contact plug to within .005" of the lining surface.

INSPECTION OF SELF-ADJUSTING DEVICE

A. For the self-adjusting device to function properly, the end of the contact plug must either be level with or extend not more than .005" above the lining surface.

B. To test the wedge action, press the end of the contact plug while completely retracting the wedge. Release the contact plug, and then the wedge. Manually push the contact plug inward, at the same time noting whether the wedge advances. Repeat test.

C. To test contact plug pressure spring, depress contact plug, fully retract wedge, and hold it in fully retracted position while pressing and releasing contact plug.

Both tests B & C should reveal positive spring action. Worn, or defective parts should be replaced when there is failure of either the contact plug pressure spring or the wedge tension spring to function properly.

BRAKE ASSEMBLY AND INITIAL ADJUSTMENT

Do not lubricate any part of the brake. Before mounting the shoes upon the backing plate, fully retract the ad-

justing wedge while pressing on the contact plug. Then mount the shoes. Remove wheel cylinder clamps. Rotate shoe adjusting eccentric cams to the released position. Approximately centralize the shoes.

The initial adjustment is made by manually setting the forward and reverse shoe eccentric cams (Figure 27). Caution—Parking brake must be in released position during adjustment. Adjust lining clearance by rotating the eccentric cam adjustment away from the wheel cylinder with the wrench handle pointed outward. (Figure 27). **Use screw driver if cam eccentric adjustment has slot instead of hex type head.**

To centralize the brake shoes, the drums must be rotated forward while adjusting the forward shoes and must be rotated backwards while adjusting the reverse shoes. Bring each shoe into contact with the drum, noted by a decided drag, then back off until the drum turns freely.

PARKING BRAKE ADJUSTMENT

On all rear wheel brakes equipped with mechanical linkage to operate the brake shoes for parking, the cables

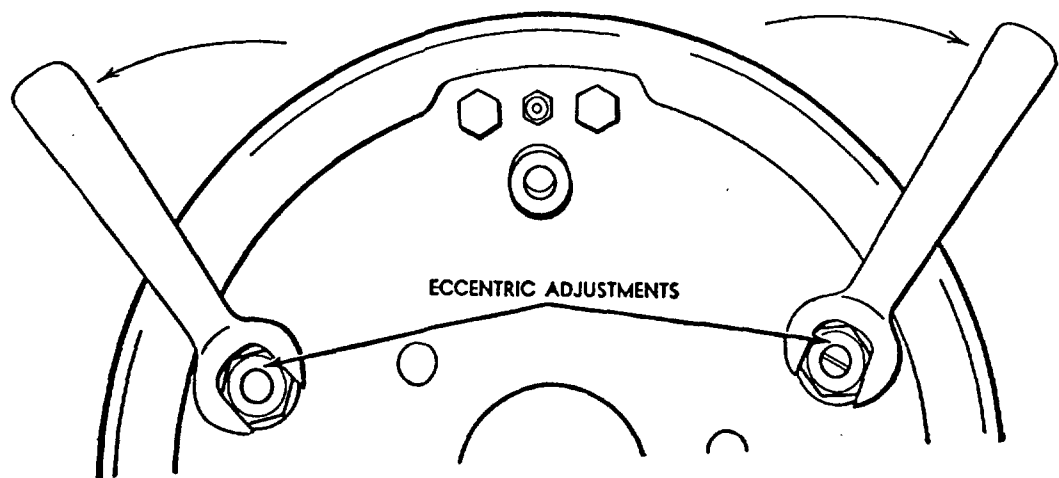


Figure 27

Method of adjusting eccentric cams on Lockheed Self-Adjusting Brakes

should be adjusted whenever new or re-lined shoes are installed. The hydraulic brake adjustment should be made first in accordance with the adjustment procedure recommended. Never attempt parking brake adjustment without first adjusting for proper brake pedal operation.

Make certain that the parking brake cables operate freely. Disconnect the cables and work them back and forth by hand to be sure the cable is not binding. Set the hand brake lever four or five

notches from the released position. Then loosen the nut on the threaded end of the cable at the cable clip and tighten the rear nut until a heavy drag is felt when rotating the rear wheels by hand.

Tighten the front nut to maintain the adjustment. Release the hand brake fully and make sure there is no brake shoe drag as the rear wheels are rotated.

The hydraulic system is serviced the same as the standard Lockheed hydraulic system previously described.

BENDIX Hydraulically Operated Brakes

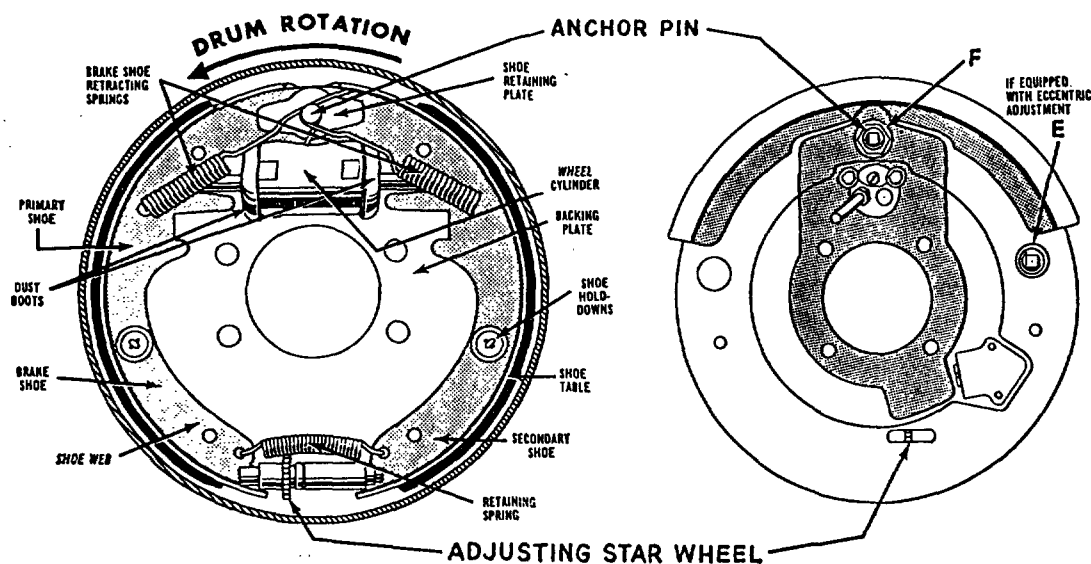


Figure 28

Left hand rear brake assembly

MINOR ADJUSTMENT

1. Jack up all wheels. See that brakes are fully released. Pedal should have $\frac{1}{4}$ " play.

2. Loosen locknut E (Fig. 28) on eccentric adjustment and place a .010-inch feeler between lining and drum at ad-

justing screw end of that shoe which bears against eccentric.

3. Turn E in forward direction of wheel travel until feeler gauge just tightens. Tighten locknut on eccentric adjustment E. Repeat at each wheel.

4. Turn star wheel (Fig. 28) until

a slight drag is felt at each car wheel. Back off one notch at a time until off until wheel is free of drag, or 14 clicks.

5. Hand or parking brake cables should be checked and adjusted, if necessary, by disconnecting them at the cross shaft, expanding the shoes by means of star wheel until it is impossible to turn car wheel, and then removing slack in cable. Star wheel should then be backed off until wheel is free.

MAJOR ADJUSTMENT

1. Disconnect parking brake cables and proceed as in 1, 2, and 3 under "MINOR ADJUSTMENT."

2. Loosen anchor locknut F (Fig. 28) one turn and insert a .010 feeler gauge between lining and drum at anchored end of eccentric-controlled shoe.

3. On sliding anchor type tap anchor slightly with soft hammer until feeler gauge just tightens. Recheck clearance at adjusting screw end of shoe and if correct tighten locknut F with a large wrench. Repeat at each wheel. See Fig. 28.

4. Turn star wheel (Fig. 28) until a slight drag is felt at car wheel. Back off until wheel is free of drag, or 14 clicks.

5. Check and reconnect parking brake cables as described in 5 under "MINOR ADJUSTMENT."

6. The hydraulic part of the system is serviced the same as with Lockheed Hydraulic Brakes.

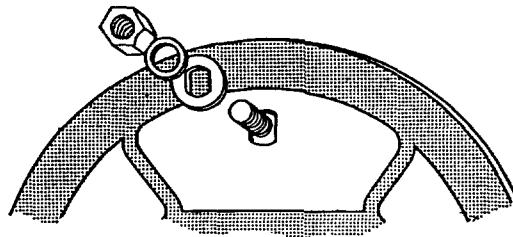


Figure 29

The sliding adjustable type anchor pin

Most of the late model Bendix Hydraulic Brakes do not have the eccentric adjustment "E" shown in Figure 28. On these brake assemblies, all the mechanic has to do is adjust the star wheel (Fig. 28) and the anchor pin F (Fig. 28). For a major adjustment the drum inspection hole is placed opposite the center of the Secondary Shoe. A screw driver is placed between the Secondary Shoe and the brake drum in order to force the Primary Shoe tightly against the drum. The adjusting screw is turned

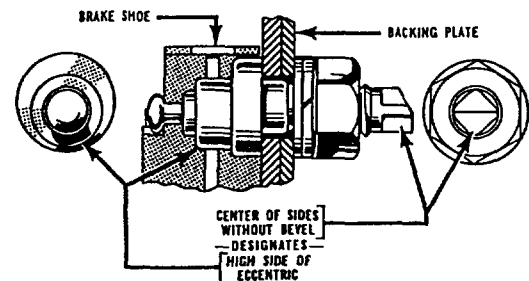


Figure 30

The eccentric type with square end

and the anchor pin moved if necessary in order to obtain .015" clearance between the drum and each end of the Secondary Shoe. The Primary Shoe is kept in close contact with the drum throughout the adjustment procedure. In some cases the anchor pin is eccentric and in other cases it is movable in an elongated slot (Fig. 29).

On the type of Bendix Hydraulic Brakes used on some Hudson cars, there are two floating anchors instead of a single eccentric anchor pin. These two floating anchors are used only to absorb the braking strains and they are not adjustable. In place of the adjustable anchor pin there are two eccentric cams, one for each shoe. The clearances at the anchor ends of the Primary and Secondary shoes are controlled by these eccentric cams and the clearances at the other ends of the shoes are controlled by the star wheel adjustment.

SERVICE HELPS

On Bendix Two-Shoe Brakes, both hydraulically and mechanically controlled types, one shoe is known as the Primary Shoe and the other as the Secondary Shoe. Primary and Secondary brake shoes are usually marked with a "P" and "S" respectively. Irrespective of the position in which the brake assembly is mounted on the axle, the Primary or Forward Shoe is always the one "ahead" of the anchor

in the direction of forward rotation of the drum.

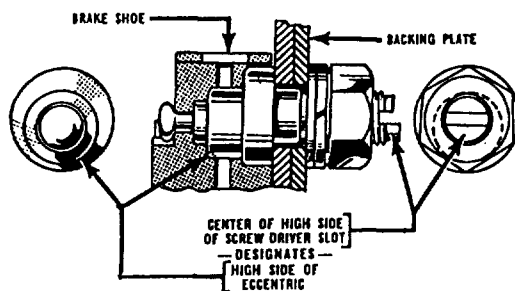


Figure 31

The eccentric type with slotted end

HUCK Brakes—Hydraulically Operated

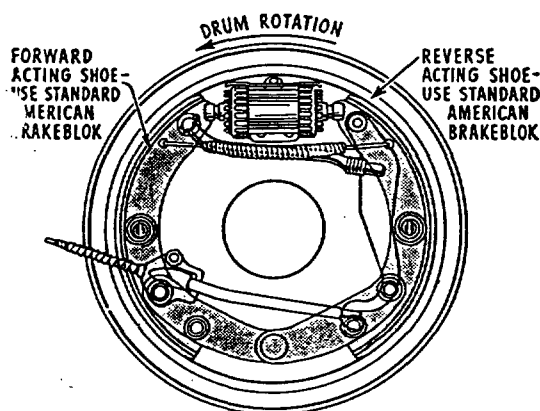


Figure 32

Chevrolet Huck Brake, Hydraulically Operated, Showing Mechanical Operation of Rear Brakes for Parking

The recent Chevrolet cars are equipped with Huck brakes having two long shoes and hydraulically operated, (Fig. 32). Figure 33 shows a sectional view of the wheel cylinder. The pistons press against an end cap which is piloted over a machined surface of the cylinder. The adjusting screw has a slotted end which fits over the web of the shoe and prevents the screw from turning. The

screw threads into the hub of the end cap which has an adjusting wheel welded to it. The adjusting wheel has teeth on its flanged periphery which are used for adjusting the shoes.

The end caps are locked by a steel lever which is riveted to the brake cylinder and engages flutes on the outside diameter of each end cap. The wheel cylinder is mounted on the backing

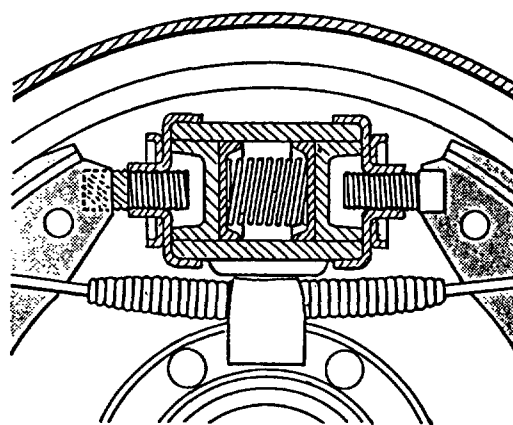


Figure 33

Sectional View of Hydraulic Wheel Cylinder on Huck Hydraulically Operated Brakes

plate by means of two cap screws, with bleeder valve and fluid line connection extending through the backing plate.

Shoe adjustment is very simple, in fact not even a feeler gauge is required. Adjustment is confined to turning the adjusting wheels at each shoe. The operation is performed by turning the adjusting wheels with an adjusting wrench inserted through the adjustment opening as shown in Figure 34. This opening is located in the web of

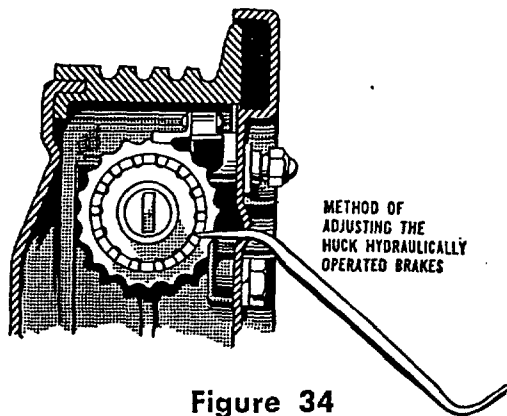


Figure 34

the drum on some models and in the backing plate as shown in Figure 34 on other models.

In adjusting the shoes, the adjusting wheels are turned to back the shoes away from the drum to be sure there is no drag at either shoe. One adjusting wheel is then turned to bring its shoe into contact with the drum with just sufficient drag so that the car wheel can just be turned by hand, then backed off until the wheel is just free of drag. The same procedure is followed with the other shoe. Check the shoe adjustment by applying the brake two or three times and making sure that each shoe is set as close to the drum as possible without dragging. The hydraulic system on these brakes is serviced in the same manner as described under Lockheed brakes.

American Brakeblok furnishes boxed car sets of brake lining especially engineered for these brakes.

CHRYSLER DISC BRAKE 1950 - 55

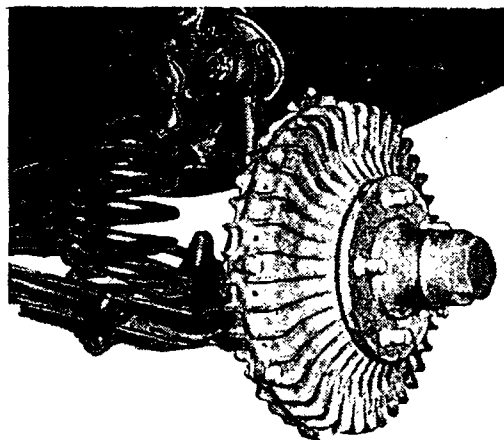


Figure 35

A radical departure from conventional brake design has appeared this year—the Chrysler self-energizing disc brake.

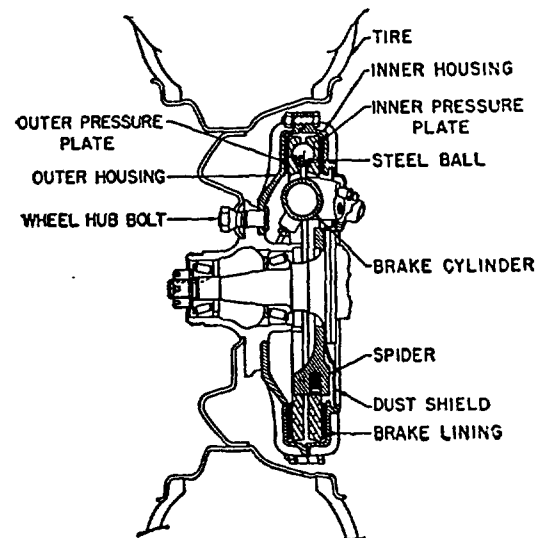


Figure 36

Cross-section of the Chrysler disc brake

The degree of success which this brake achieves may have a far reaching effect on brake design in the future. And if they should be more widely adopted there will be many changes in the general brake servicing procedure. Therefore no attempt will be made to establish a service procedure at this time.

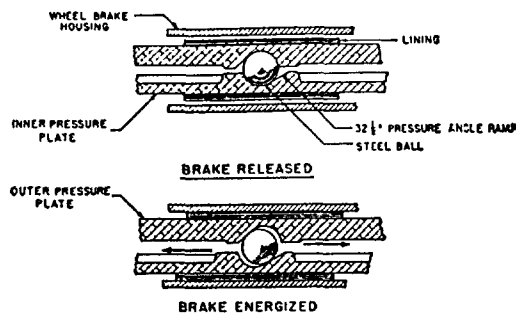
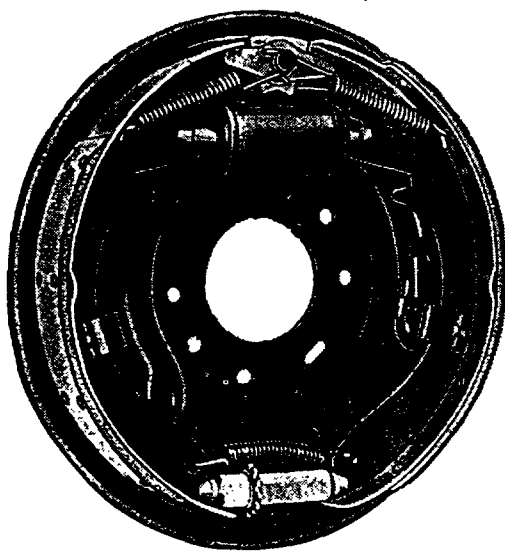


Figure 37

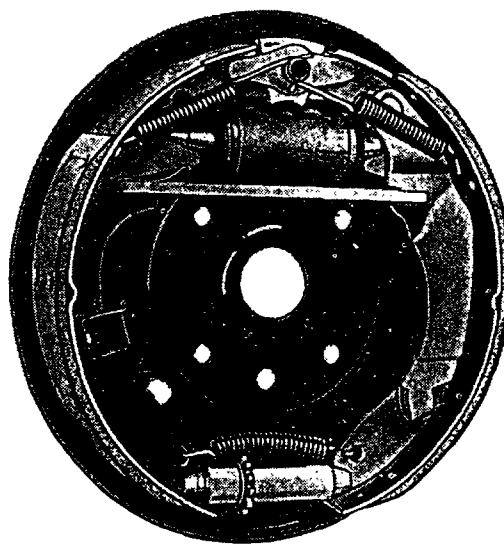
Action of the separating balls in the ramped pockets

WAGNER SERIES CF, CFR, CFRE

Compound Shoe Hydraulic — Self Centering



CFR TYPE



**CFRE TYPE (with Parking Brake)
9 - Inch Drum**

Wagner series CF, CFR and CFRE Compound Shoe foundation brakes utilize two brake shoes which hang loosely on hold-down pins and spring clips and rest against pads formed on the brake backing plate. The shoe anchor, located at the shoe toes, serves

only as a stop. Shoe toes rest against the surfaces of an anchor block pivoted on a fixed anchor pin. Individual shoe return springs, each hooked between the anchor pin and the underside of one shoe table, hold the shoes against the

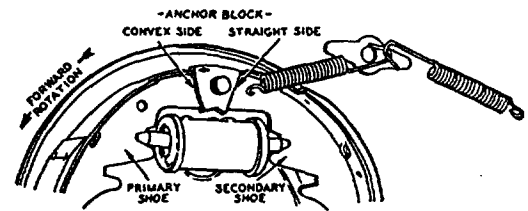
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anchor. Depending upon the direction of drum rotation, either the primary or secondary shoe is free to move away from the anchor when the brake is applied. The anchor is a self-centering type, permitting inward or outward shoe movement to center the shoes in accordance with drum surface pressures exerted on the lining. Opposite the anchor, brake shoes are linked by means of a floating star wheel adjuster and a single retracting spring hooked between the shoe webs so that it engages and locks the adjuster star wheel. The star wheel adjuster link is used to expand the shoes into the drum, thus adjusting the lining clearance. It also transmits the actuating force from one shoe to the other. This servo action causes the shoes to function as a single unit in which the total braking force developed on one shoe is compounded in the action of the second shoe. Series CF brakes are provided with a **single-end wheel cylinder** and self-energization and servo action occurs only during forward movement of the vehicle. This brake has reduced effectiveness when the vehicle is backing, consequently **is used only on the front axle**. Series CFR and CFRE brakes are equipped with standard double-end straight-bore wheel cylinder.

Series CFRE brakes, used on rear axles, incorporate a cable-operated parking brake working independently of the hydraulic service brake, but utilizing the same brake shoes. Shoes are expanded by a toggle lever, pinned to the rear (secondary) shoe, and a link, suspended between this lever and the opposite shoe. The cable, operated through an equalizer, passes through the backing plate and is connected to the free end of the lever. **On CFRE brake, parking brake lever** is installed between the backing plate and shoe web, on 10" or larger drum diameters.

ASSEMBLY

Shoe pads on backing plate must be clean, smooth and free from rust. Dress rough spots and burrs with a file, otherwise shoes may tend to "hang" and unbalance the braking effort. Paint pads with a thin coat of Lubriplate or equivalent before installing shoes. **CAUTION: ARROW STAMPED ON THE ANCHOR BLOCK (indicating the convex anchor surface) INDICATES PROPER DIRECTION OF ASSEMBLY. ARROW MUST FACE IN FORWARD DIRECTION OF DRUM ROTATION (usually toward front of vehicle) SO THAT CONVEX ANCHOR SURFACE OF BLOCK FACES THE PRIMARY SHOE TOE AND FLAT ANCHOR SURFACE FACES THE SECONDARY SHOE TOE.**



ADJUSTMENT

1. Set parking brake pedal or lever in first notch.
2. Tighten star wheel adjuster until adjustment feels solid with linings tight against drum.
3. Back off star wheel by rotating star wheel at least eight notches in the opposite direction. With new lining installed, back off at least ten notches.
4. Adjust parking brake, with lever or pedal in first notch, adjust cable length to remove slack. Apply parking brake to check travel and then release brake to make sure that sufficient slack remains in cable so that brakes will not drag. Lubricate cable and pivot pins.

WAGNER HI-TORK BRAKES

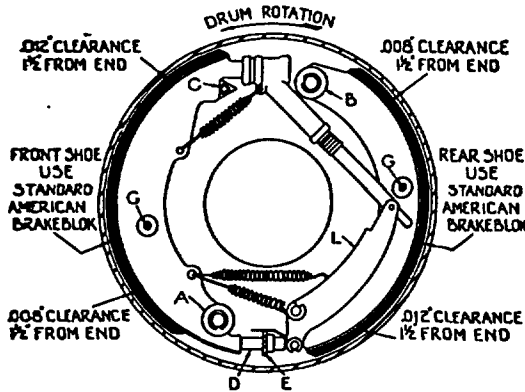


Figure 38
Wagner Hi-Tork Brake

The Wagner Hi-Tork brake is used at the present time on the rear wheels of certain models of trucks, in conjunction with standard Wagner Lockheed hydraulic brakes on the front wheels. The bleeding of the hydraulic system is done in the same manner as with the standard Lockheed system described in the early part of this booklet.

In the Wagner Hi-Tork brake (Figure 38), both shoes operate as Forward Acting Shoes when a stop is made with the vehicle going in the forward direction. During such a stop the front shoe anchors against the anchor pin (A) and the rear shoe is anchored by the anchor pin (B). When a stop is made in reverse, the front shoe operates as a Forward Acting Shoe and anchors up against the reverse anchor pin (C). During a reverse stop, the rear shoe operates as a Reverse Acting Shoe and is anchored in the conventional manner by the anchor pin (B). This action can be better understood by referring to the cutaway diagram (Figure 39)

It will be noted that the wheel cylinder used in the Wagner Hi-Tork brake

is different than the conventional stepped-bore cylinder in that the cylinders are at an angle. It will also be noted that the small wheel cylinder piston does not operate directly against the rear shoe but instead transmits its force to the rear shoe through a system of levers consisting of the lever (L) and the star wheel connector shaft (D). This action can also be more clearly understood by referring to Figure 39.

On a forward stop the force from the small piston operating through (L) and

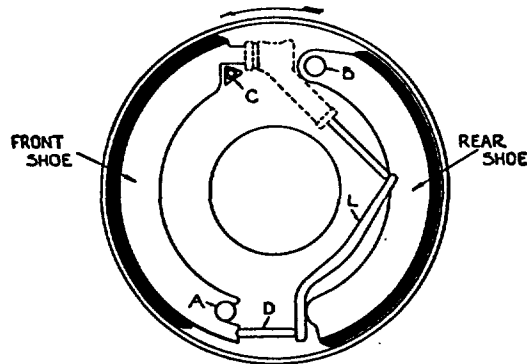


Figure 39

Diagram Showing Action of the Wagner Hi-Tork Brake on a Forward Stop

(D) will cause the rear shoe to move into contact with the drum, but it will not cause the front shoe to leave the anchor pin (A) because the large piston has forced the toe of the front shoe into the drum and the front shoe is held tightly against the anchor (A) by the energizing force of the rotating drum. However, when a stop is made in reverse, there is no energization of the front shoe and the small piston is able to force the heel of the front shoe into the drum and the front shoe anchors up

against the reverse anchor pin (C). Thus, it can be seen that on a reverse stop, the small piston operates both the front and the rear shoe.

Although there is considerable difference in the size of the large and small pistons used on the Wagner Hi-Tork brake, the leverages used and the diameters of the piston are such that the pressure on the toe of the front shoe is exactly the same as the pressure on the toe of the rear shoe. This results in both shoes doing the same amount of work in forward stops where both shoes operate as Forward Acting Shoes and this tends to keep the lining wear practically equal on both shoes. The brake is also very effective because all of the lining is energized on forward stops, due to the two forward shoe action.

The Wagner Electric Corporation, manufacturers of the Wagner Hi-Tork Brake, have published the following instructions covering the servicing of this brake:

MINOR ADJUSTMENT

These adjustments should be carried out in sequence as outlined below. First make sure that wheel bearings are in good condition and properly adjusted and that the lining is free from grease.

1. Loosen reverse anchor nut (C) (Fig. 40) sufficiently to allow rotation of anchor pin. It will be necessary to tap anchor pin to loosen it in the backing plate before it can be rotated. With a wrench, turn anchor pin in direction of forward wheel rotation, as shown by arrow, until a brake drag is felt. Then back off anchor until drag is relieved and a .012 feeler gauge can be inserted through the drum inspection hole $1\frac{1}{2}$ " from the toe end of the lining. Lock anchor nut securely. Rotate drum to check for high spots or drum eccentricity.

2. Remove adjusting hole cover (F) (Fig. 40), insert a screwdriver and ro-

tate the star wheel (E) (Fig. 38), moving the handle of the screwdriver upward in direction of the axle, until a

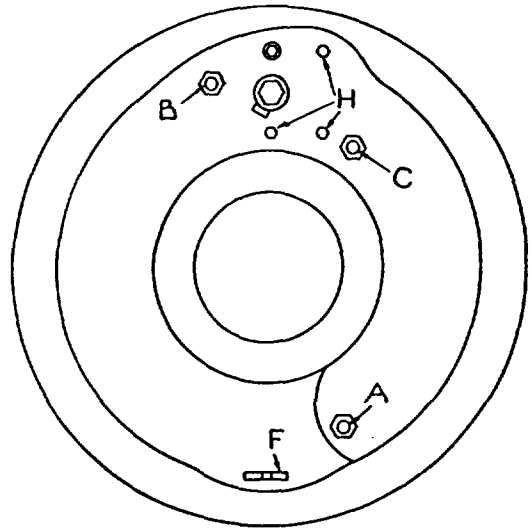


Figure 40

View from Backing Plate Side of
Wagner Hi-Tork Brake

drag is felt. Release rear shoe (Fig. 38) from drag by rotating star wheel (E) in opposite direction from above, moving screwdriver handle downward away from axle, until the drag is relieved and a .012 feeler gauge can be inserted through the drum inspection hole $1\frac{1}{2}$ " from the toe end of the lining adjacent to the star wheel. Rotate drum to check for high spots or drum eccentricity. Replace adjusting hole cover.

Note: Anchor pins (A) and (B) are not to be disturbed unless new lining is installed or other adjustments fail to give results. No adjustments should be made unless drums are at normal temperature.

MAJOR ADJUSTMENT

It is imperative that the following adjustments be carried out in sequence as follows:

1. Loosen the rear shoe heel anchor pin nut (B). Loosen the front shoe heel

anchor pin nut (A) and reverse anchor nut (C) sufficiently to allow rotation of the anchor pins. With an Allen wrench, turn the anchor pins (B) and (A) to their off positions, which may be determined by observing the brake shoe movement. It will be necessary to tap reverse anchor pin (C) to loosen it in the backing plate before it can be rotated. With an adjustable wrench, turn reverse anchor (C) to its off position. Remove adjustment hole cover (F). Insert a heavy screwdriver through the adjustment hole in the backing plate and engage star wheel (E). Move screwdriver handle downward away from the axle and rotate the star wheel (E) (Fig. 38) to contracted position. This position of anchors and shoes permits the assembly of hub and drum over newly relined shoes.

2. Insert .012 feeler gauge through inspection hole in drum approximately $1\frac{1}{2}$ " from toe end of front shoe lining. Rotate anchor pin (C) in direction of forward rotation of the drum until feeler gauge is just free between the lining and the drum.

3. Move drum inspection hole to approximately $1\frac{1}{2}$ " from heel end of front shoe lining. Insert .008 feeler gauge between drum and shoe. Rotate anchor pin (A) in reverse drum rotation until the feeler gauge is just free. Recheck toe end of lining. If clearance of .012 does not exist, repeat operations until .012 is obtained at toe and .008 clearance at the heel of front shoe lining. Tighten anchor pin nuts securely with 18" or 24" box wrench.

4. Insert screwdriver through adjusting hole in the backing plate and rotate star wheel (E) by moving handle of screwdriver upward in direction of axle until a .012 feeler gauge is just free $1\frac{1}{2}$ " from toe end of rear shoe. Place .008 feeler gauge $1\frac{1}{2}$ " from heel end of lining of rear shoe and rotate

anchor (B) in reverse drum rotation until the feeler gauge is just free. Recheck the toe end of lining. If proper clearance does not exist, repeat above operation until .012 clearance is obtained at the toe and .008 clearance at the heel of rear shoe.

Tighten anchor pin nut securely, using 18" or 24" box wrench. Replace adjusting hole cover in the backing plate.

DISASSEMBLY OF BRAKE SHOES FROM BACKING PLATE

1. Remove all springs and the two shoe guides (G) (Fig. 38). The brake must be fully collapsed before the springs are removed. The front shoe may now be removed from the backing plate.

2. Care must be exercised in removing the lever actuating push rod from the small bore of the hydraulic cylinder to eliminate any chance of scoring the cylinder wall, which would result in a fluid leak.

To remove the rear shoe, first remove the ("C") washer at anchor pin (A) (Fig. 38). Then compress the shoe actuating lever (L), which is attached to the rear shoe and actuating push rod, downward. Move this lever in extreme applied position in direction of the drum. Holding the lever in this position, rotate the brake shoe outward. This allows the actuating push rod to leave the cylinder bore without interference. The shoe may now be removed from anchor pin (B).

To reassemble, reverse the above operations, making sure that the toe end of the front shoe web is in the slot of the hydraulic piston. Lubricate all bearing surfaces sparingly, with approved type lubricant. Do not lubricate the tapered seat of the anchor pin (C). Care should be taken in rehooking the shoe return springs so as not to stretch them.

Adjust the shoe guides (G) so that a "U" shaped .010 feeler gauge may be inserted between the shoe guide washer and the shoe web. Lock jam nuts securely.

To Remove Cylinder—After removal of brake shoes, disconnect tubing or hose at wheel cylinder inlet. Remove the three cap screws (H) (Fig. 40) which hold wheel cylinder to the backing plate and the cylinder may be withdrawn for inspection. Caution must be exercised to prevent brake fluid from coming in contact with the brake lining, during the service operations, either from dripping or from soiled hands.

The use of a cylinder clamp is recommended.

Disassembly of Wheel Cylinder—

Remove boots from cylinder casting. The large piston is readily removed. To remove the small piston, form a short right angle bend in a length of small wire and engage the hole provided in the inside body of the piston. Withdraw the piston and cup. The cup, of the collar-button type, is attached to the piston and is easily removed. **CAUTION**—When removing the small piston, ex-

ercise care and do not scratch the cylinder bore with the tool employed.

Cylinder Inspection—After Dismantling the cylinder, inspect for the following:

(a) If mineral oil is present in the system, the rubber cups will be enlarged and very soft. They must be discarded and replaced with new parts.

(b) Cylinder walls must be smooth and not pitted or scratched. If these conditions exist, the cylinder must be renewed.

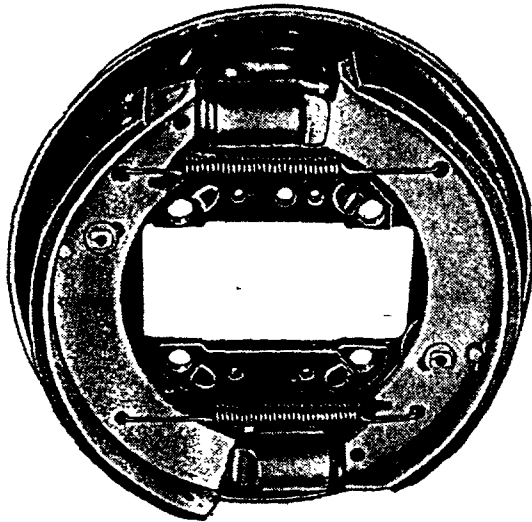
(c) Pistons must be free from burrs.

(d) Occasionally, grease retainers become worn, allowing the grease from the wheel bearing to leak through into the brake drums. When grease comes into contact with the rubber boots, they become soft and enlarged, preventing them from protecting the cylinder from foreign matter. In cases of this nature, replace boots and grease retainers.

Cylinders and parts must be washed in clean alcohol and dipped in an approved hydraulic fluid. **Do not wash cylinder or parts in gasoline, kerosene, or oil.**

WAGNER SELF-CENTERING BRAKES

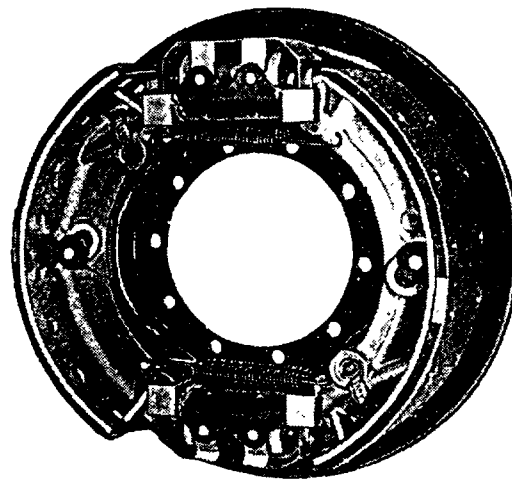
Types F, FR, FR2, FR2S, FR2SD



F

DESCRIPTION AND APPLICATION OF "F" BRAKE

Type "F" self-centering brake is a Floating Shoe type, having two identical shoes, so arranged that their toes are diagonally opposite. Two single end wheel cylinders are placed diagonally opposite between the shoes. The cylinders are open at one end for activation. The other end closed and designed to provide an anchor block for the opposite shoe heel, thus providing a fulcrum around which the shoe heel pivots when the brakes are applied. Due to this action both shoes are forward acting, (Primary shoes) self-energizing in the forward direction of drum rotation. This type brake is generally confined to front axle application in conjunction with FR type brakes on the rear axle, which provides a more effective brake in reverse than the "F" type.



FR

ADJUSTMENT OF "F" TYPE BRAKE

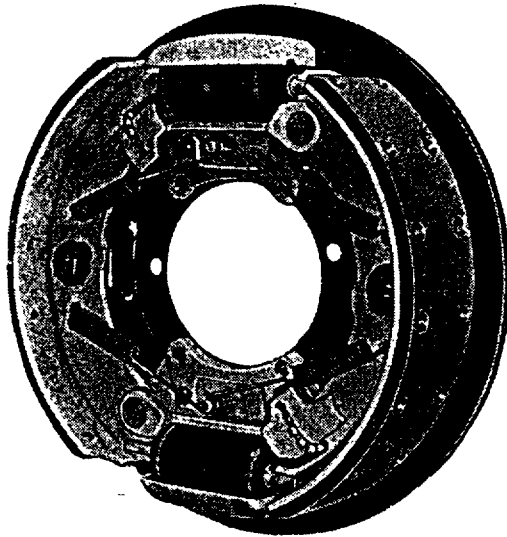
Make all adjustment with drums cool and wheel bearing properly adjusted. On back side of the backing plate, located diagonally opposite each other, are $\frac{5}{8}$ " hex bolt heads attached to a cam lift. Place wrench on hex head and rotate in direction of FORWARD wheel rotation until lining drags. Move wrench in opposite direction for working clearance ($1''$ to $1\frac{1}{2}''$ movement through arc swung by $8''$ wrench). Repeat adjustment on other shoe.

Bleeding, follow instructions outlined in FR-2 Brakes.

DESCRIPTION AND APPLICATION OF "FR" BRAKE

The type FR self-centering brake with floating shoes is activated by two double end wheel cylinders arranged diagonally between the two shoes. The wheel cylinders are held in position by shoe anchor blocks which, in turn, are fastened to the backing plate, providing

WAGNER SELF-CENTERING BRAKES



FR2

the fulcrum around which the shoes pivot. Both shoes are Primary shoes (forward acting) in either direction of drum rotation. The adjusting screw is housed within the toe end of the shoe and has a worm wheel with a $\frac{3}{8}$ " allen head which is accessible through slots in the backing plate.

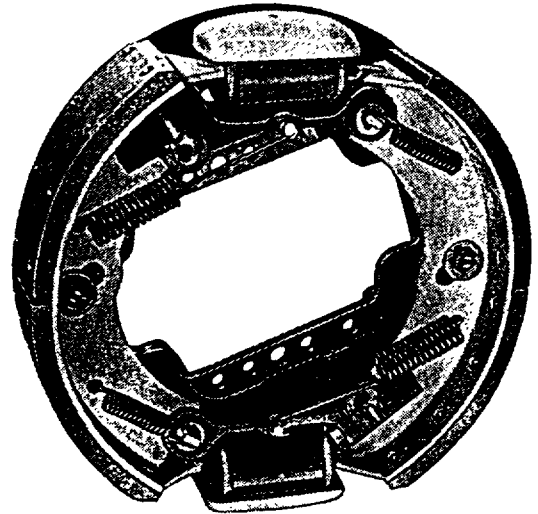
Due to the construction of this type of brake, it is capable of producing the maximum torque output in either the forward stop or reverse stop, and is always automatically self-centering.

ADJUSTMENT OF "FR" TYPE BRAKE

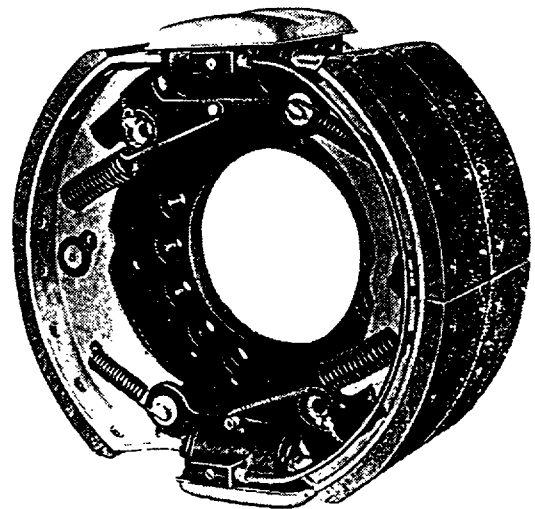
With the drums cool and wheel bearings correctly adjusted—remove slot adjustment covers and insert $\frac{3}{8}$ " allen. Rotate in the direction of *FORWARD* wheel rotation until brakes drag. Rotate wrench in opposite direction until drag is relieved. The clearance should be sufficient to avoid "brake drag" and yet close enough to afford a good "pedal reserve."

To bleed brake, follow instructions as outlined in FR-2 type brake.

DO NOT LUBRICATE SHOE ADJUSTMENT MECHANISM OR OTHER PARTS OF THE BRAKE.



FR2S



FR2SD

Lubrication will cause dust and dirt to collect and solidify in the adjustment mechanism.

All three types—FR2, FR2S, and FR2SD, by virtue of the wrapping action caused by drag of the rotating drum on the lined shoes, makes each shoe individually self-energized regardless of the direction of drum rotation. This action, it is claimed, provides greater stopping power for a given brake size with more even heat distribution dur-

ing braking to reduce high localized pressures on portions of the lining, which otherwise may lead to heat checking and scoring of drums, out-of-roundness of drums, and charring of the brake lining. Minimization of these ill effects lead to longer lining and drum life, it is said.

DESCRIPTION AND APPLICATIONS OF "FR2" BRAKES

The plain FR2, without following letter, is generally applied to medium weight trucks, while the FR2S and the FR2SD are used in the heavy-duty truck field; the "2S" being primarily used for the front axle, with the "2SD" in the rear.

The basic appearance of all FR2's is similar. The FR2 and the FR2S each have two identical shoes and two identical wheel cylinders. The main difference between these two types is that the plain "2" uses a backing plate, while the "2S" is mounted on a spider. The "2SD" is a dual-type brake with four shoes. The latter, in appearance, is comparable to two "2S's" placed back to back. It employs two Siamese-twin-type wheel cylinders to actuate the dual shoes.

The shoes on all the "2" brakes are arranged with their toes opposite each other on the brake diameter, and the double-end wheel cylinders are placed between the toe of one shoe and the heel of the other. An equal amount of hydraulic pressure is thus applied at each end of each shoe. All shoes are forward-acting, independently actuated in the direction of rotation of the wheel. All shoes anchor at either the toe or heel, depending upon the direction of rotation of the wheel and its drum. Each anchor and adjusting support carries a removable anchor pin at the heel end of the shoe; there is a star wheel and adjusting screw at the toe end of the shoe.

The shoes on all "2" brakes are the floating type. Each shoe is held in position by a shoe guide pin, washer, shoe guide spring "C" clip, and two shoe retracting springs. In regard to differences in shoe retracting springs, the plain "2" springs are all the same; however, on the "2S" and the "2SD," the heel-end spring is short, and the toe-end spring, long.

ADJUSTMENT OF "FR2" TYPE BRAKE

To adjust the plain FR2 type brake, remove adjustment slot covers and insert wrench or screw driver into slot to contact star wheel. Rotate star wheel toward axle, using outer edge of slot as fulcrum for the tool. Decrease clearance between shoe and drum in this manner until shoe drags. Then, turn star wheel "three clicks" in the reverse direction to provide correct clearance. This procedure is repeated, of course, on each of the shoes. Replace adjustment slot covers.

ADJUSTMENT OF "FR2S" AND "FR2SD" TYPE BRAKES

Adjustment of these types is similar to the FR2 except that there is an adjusting worm instead of a star wheel. Insert $\frac{3}{8}$ in. hex-head wrench through adjusting hole in dust shield enclosure to fit firmly in adjusting worm. Rotate wrench in forward direction of wheel rotation to decrease clearance, until wheel drags. Then, reverse direction of turning wrench until drag is relieved. Now, rotate wrench one additional turn to provide correct working clearance.

On the 2SD, the dual shoes may be adjusted individually or simultaneously.

MISCELLANEOUS ADJUSTMENT TIPS

Make all adjustments with the brake drums at normal temperature, and see that the wheel bearings are correctly adjusted.

Manually-operated and vacuum-hydraulic-actuated brakes require adjust-

ment, or relining, when the pedal reserve is about 2 in. on hard application of the pedal. Air-hydraulic brakes require adjustment when the application stroke of the power unit and master cylinder is close to maximum travel.

Shoe adjustments can be made with the wheels on jacks or on the road. When on jacks, brake drag is tested by feel of drag as the wheel is rotated; with the wheels on the road, drag is checked by sound when tapping drum with a hammer. A deadened sound means the shoes are dragging on the drum.

BLEEDING "FR2" BRAKES

In the plain FR2 and the FR2S, bleed cylinder nearest the road surface first, then bleed the one farthest from the road. In the FR2SD, the twin bores of the dual-type wheel cylinders are

connected by a passage. The two cylinders on each brake are joined by a connecting tube to complete a series connection to the four wheel cylinder chambers. Bleeding both cylinders is accomplished through one bleeder screw, which is usually located on the high cylinder.

Where the brake is so mounted that the wheel cylinders are in nearly vertical direction, an extra step in bleeding may be required for complete bleeding. First bleed all brakes in the conventional manner as outlined. Then, at each wheel in turn, open the bleeder screw and kick the brake pedal down sharply several times. Close the bleeder screw, and proceed to the next wheel. This action forces out any remaining trapped air.

BENDIX "TWINPLEX" HYDRAULIC

Self-Centering

Chevrolet, GMC and IHC—1950-1955

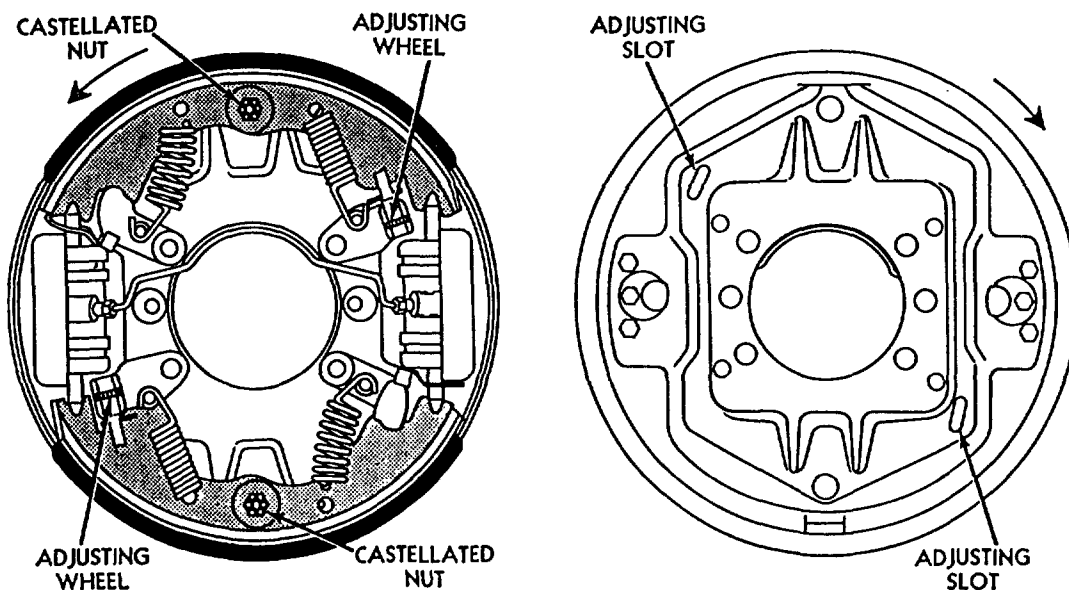


Figure 41

Twinplex hydraulic foundation brakes are equipped with two double-end type wheel cylinders through which hydraulic pressure is applied to both toe and heel of identical self-centering shoes. Both shoes are always energized (forward-acting), anchoring at toe or heel depending upon the direction of drum rotation. Brake shoe heels rest on half-moon shaped anchor pivots which, in turn, slide in slots provided in the anchor supports. Adjusting screws, serving as shoe toe anchors, are provided with star wheel type heads which make it possible to thread the screws out of or into the anchor supports as required to secure the desired lining clearance.

On assembly note spring color code so that springs may be replaced in proper positions. **Shoe ledges on backing plates should be dressed smooth with a file before assembly, otherwise shoes may tend to hang up and unbalance the braking effort.**

When installing shoe hold-down nuts, place .006" feeler gauge between center shoe ledge and edge of shoe table and draw hold-down nut tight against its washer. Back nut off one

castellation, remove feeler gauge, and insert cotter pin. Replace shoe retracting springs according to color code:

**CHEV-
ROLET**

I.H.C. G.M.C.

SPRING

Shoe toe spring
(at adjusting screw
end)

Yellow Green

Shoe heel spring
(at anchor pivot end) Black Black

ADJUSTMENT

Remove adjustment slot covers.

At one adjustment slot insert clicker wrench or screwdriver and engage star wheel. Rotate star wheel away from axle, using inner edge of slot as fulcrum to move tool handle toward axle, to decrease lining clearance until lining drags on drum.

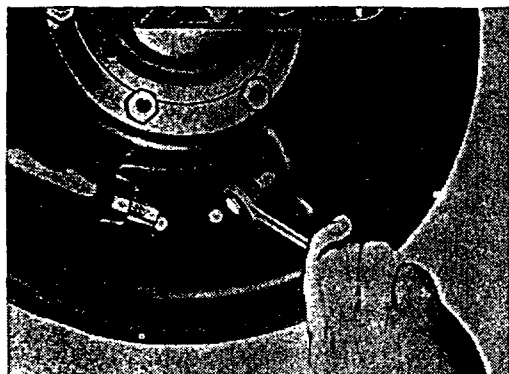
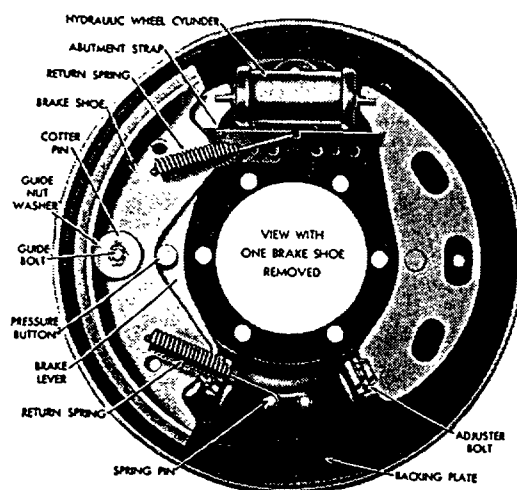
Relieve drag by rotating star wheel six notches (clicks) in opposite direction. This setting should relieve drag and provide sufficient working clearance.

At second adjustment slot, repeat steps 2 and 3 to adjust remaining shoe.

Replace adjustment slot covers.



TIMKEN "DH" DUPLEX BALANCED BRAKE



the wheel cylinder to the center of the shoe. The return springs, of which there are four, hold the brake released when not in use. The adjuster bolt, used to adjust the brake, acts as the lever pivot and as the lower shoe abutment. The guide nut and washer hold the shoe square with the drum.

Each shoe is floating or self-centering and is actuated by a lever which is in turn actuated by the wheel cylinder. By means of the levers, the force can be applied to the center of the shoes through the pressure button. Each shoe is then free to move against an abutment (upper or lower) which anchors and energizes the shoe. This movement is dependent on the direction of drum rotation.

Assembly of this brake is very simple. When the shoe and guide washer are in place, tighten the guide nut snugly and back off 4 castellations or $\frac{2}{3}$ turn. The four return springs are identical and can be used at any one of the four positions.

ADJUSTMENT

This brake has been designed as simply as possible. Except for a standard straight bore wheel cylinder, there are only eight different parts. These are the backing plate assembly, the lever, the shoe assembly, the return spring, the adjuster bolt, and the guide nut, cotter and washer. The backing plate assembly serves as the support member of the brake and holds it to the axle. It contains the upper abutments, or anchors, for each shoe, the guide bolts, and the bushing for the adjuster bolt. The lever serves to transmit force from

1. Set foot pedal. With pedal against its stop, adjust pedal push rod to give $\frac{1}{8}$ " free play before engaging piston in master cylinder.

2. With standard $\frac{1}{2}$ " wrench, adjust one shoe tight against drum by rotating clockwise.

3. Back off on the adjuster bolt until there is a light drag between lining and drum.

4. Repeat steps 2 and 3 on the other shoe.

HEAVY DUTY BRAKES

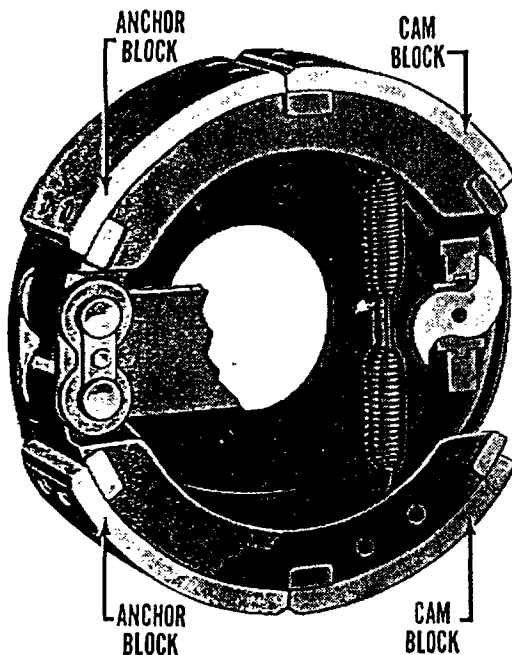


Figure 42

CONVENTIONAL TYPE BRAKE

In the brake shown on Fig. 42 a full $\frac{3}{4}$ " block is used at both cam and anchor ends.

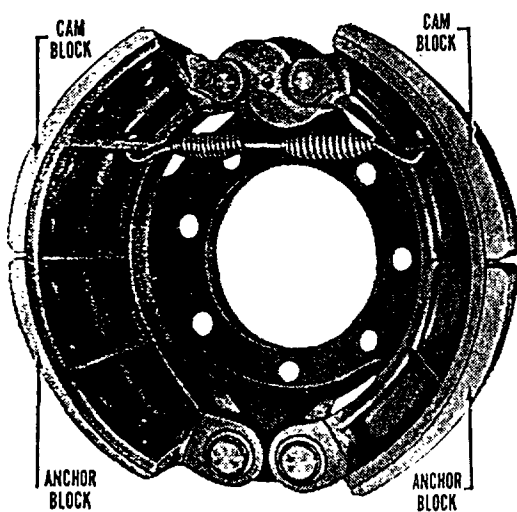


Figure 43

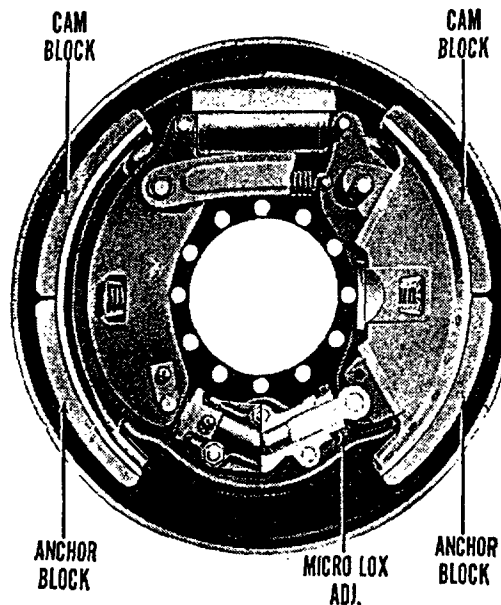


Figure 44

Timken-Detroit heavy-duty "DP" dual Primary Brake for Hydraulic Actuation with Micro Lox Adjustment

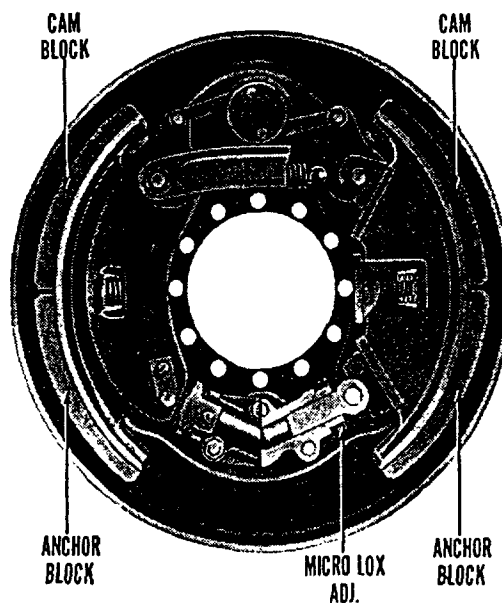


Figure 45

Timken-Detroit heavy-duty "DP" Dual Primary Brake for Compressed Air Actuation with Micro Lox Adjustment

This brake is adjusted by the slack adjuster only, a clearance of approximately .020 should be maintained.

"P" Series Timken Brake (Fig. 43) are equipped with tapered cam and anchor blocks. Blocks are marked and should be installed in their proper positions.

In Figs. 44 and 45 are shown the heavy duty Timken DPH (hydraulically

operated) and DPA (air actuated) brakes which use four tapered blocks of the same taper at the cam and anchor ends. The thick ends should be installed at the center of the shoe.

The DP series is the standard model for light truck application, and is equipped with strip lining of uniform thickness.

TIMKEN "DP" (Dual Primary) BRAKES

Standard Plate Mounted

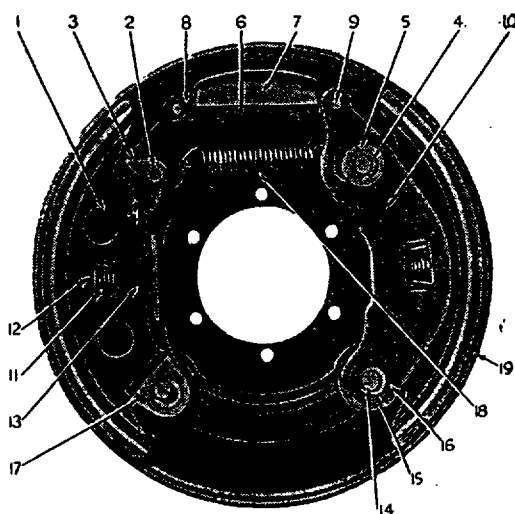


Figure 46

Timken Standard sized "DP" type brake. Half of left brake lever has been removed to show brake shoe abutment blocks, pressure blocks, and other parts which otherwise would be concealed from view.

The design of the Timken Dual Primary hydraulic brakes provides easy maintenance not complicated by special tools or heel and toe adjustments. As illustrated in Figure 46, the shoes are fitted with liners of equal length and identical material and are not anchored

but "float" in the lever arms. The single straight bore hydraulic wheel cylinder actuates the lever arms which in turn apply pressure at the center of the shoes by means of the movable pressure blocks. The shoes are self centered at the time of contact with the drums. Shoe rotation is prevented by the self aligning abutment blocks which bear against the angled face of the shoes. The principal parts of the Timken "DP" brake are shown in Figure 46 as follows:

1. Brake Shoe and Lining Assembly.
2. Brake Shoe Anchor Pins—stationary.
3. Brake Shoe Anchor Pin Abutment Blocks.
4. Brake Shoe Anchor Pin "C" Washer.
5. Brake Shoe Anchor Pin Washer—Plain.
6. Wheel Cylinder Assembly.
7. Wheel Cylinder Cover.
8. Wheel Cylinder Push Rod.
9. Wheel Cylinder Push Rod Pin.
10. Brake Shoe Lever Assembly.

11. Brake Shoe and Lever Spring.
12. Brake Shoe and Lever Spring Retainer.
13. Brake Shoe Lever Pressure Block.
14. Brake Shoe Anchor Pin—Lower—Adjustable.
15. Brake Shoe Anchor "C" Washer.
16. Brake Shoe Anchor Pin Washer—Plain.
17. Brake Shoe Abutment Block—Lower.
18. Brake Shoe and Lever Spring—Upper.
19. Brake Dust Shield Assembly.

MINOR ADJUSTMENTS

In Figure 47 the letter "A" indicates the eccentric anchor pins that control the shoe movement toward or away from the drum. To decrease the lining to drum clearance—proceed as follows:

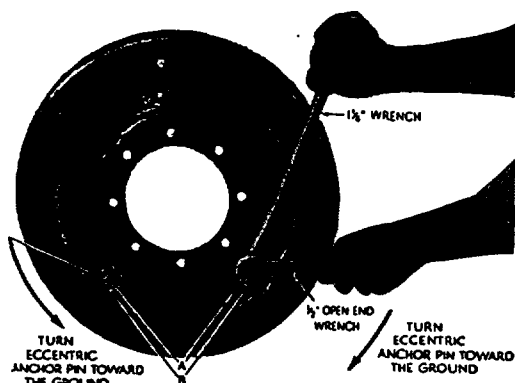


Figure 47

Method of Adjusting Timken "DP" Brakes

1. Raise vehicle so wheels are free to rotate.
2. Use $1\frac{1}{4}$ " wrench to loosen nut "B."
3. Position a $\frac{1}{2}$ " open end wrench on the flat section of anchor pin "A" so that the wrench hand extends away from the vertical line of the brake. Apply pressure toward the ground until shoe contacts drum, then back off to a

minimum running clearance. (Approximately $1\frac{1}{2}$ " travel at end of 8" wrench.)

4. Lock adjustment with nut "B" and rotate wheel in both directions and check for free running clearance.

5. Each brake is equipped with two brake shoes and eccentric adjusting pins. Adjust each shoe in the manner described above, which is illustrated graphically in Figure 47.

CAUTIONS

1. Make sure wheel bearing adjustment is correct before attempting brake adjustment.
2. Make sure the adjustment is securely locked.
3. Make sure liners are not worn excessively permitting rivets to contact drums.

MAJOR ADJUSTMENTS

As illustrated in Figure 48, it is not necessary to disturb the main retracting spring when removing shoes for relining. Shoe assemblies are removed as follows:

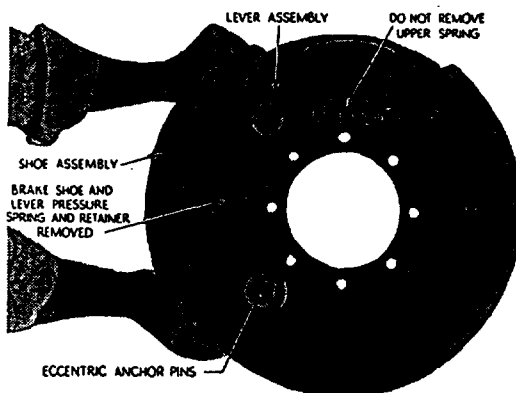


Figure 48

Removing Brake Shoes for Relining

1. Remove brake shoe and lever pressure spring and retainer by inserting a screw driver under the side of the spring near the retainer and prying them out of the recess. Do not remove main retracting springs.

2. Shoes can now be removed from levers. The pressure block may also be removed if desired.

3. When re-assembling the shoes, apply brake grease lubricant to both angle faces and the pressure block surface of the shoe. If the pressure block has been removed, it can be "stuck" in position on the shoe by means of the grease.

4. Rotate the eccentric pins to full release position.

5. Insert the shoe spring and retainer in the lever slot and force into central position.

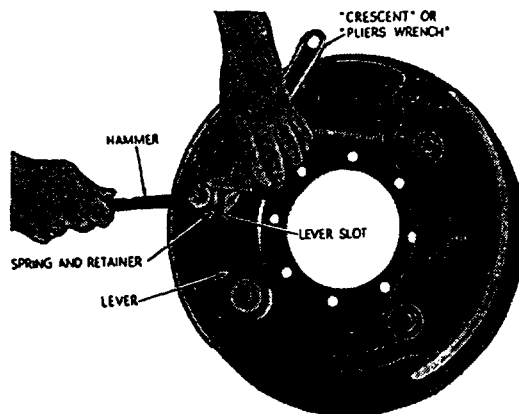


Figure 49

Installing Brake Shoe and Lever Spring and Retainer

NOTE:

As illustrated in Figure 49, the spring and retainer must be compressed completely to permit insertion in the slot. For field servicing where a tool with a square tapered hole is not available, the use of a "plier wrench" or "crescent wrench" will be found very satisfactory for compressing and holding the spring and retainer. With the compressed spring in the wrench, it can be placed against the lever and aligned with the slot. A small hammer can be used to tap the spring and retainer from the wrench into the lever slot.

CAUTIONS

Make sure there is a free movement of abutment blocks on the upper and lower anchor pins. Make sure the spring retainer is properly seated in the lever arms. The retainer should be flush with the outside of lever arm.

ARM REMOVAL INSTRUCTIONS

To disassemble the lever arm, first remove the brake shoes as described under "MAJOR ADJUSTMENTS." Then remove upper, or stationary anchor pin "C" washer No. 4 and flat washer No. 5 shown in Figure 46. Remove "C" washer No. 15 and flat washer No. 16 which will permit the removal of the arms and links from the upper and lower anchor pins, No. 2 and No. 14.

Heavy Duty Type Timken "DP" Hydraulic Brakes

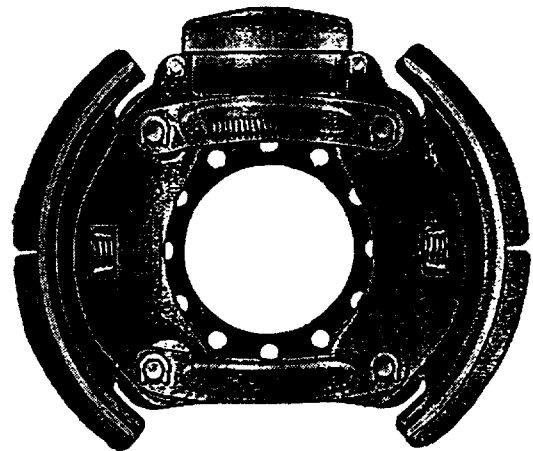


Figure 50

Heavy Duty "DP" Brakes

Figure 50 is an illustration of the heavy duty "DP" hydraulic brake. It will be noted that this brake is similar to the standard "DP" brake, Figure 46 except that it is larger. The service instructions are the same for both type brakes, except for a few additional operations to be made on the larger brake to compensate for slight variations in design.

While the smaller brakes are mounted on backing plates incorporating dust

shields as an integral part, the larger brakes are mounted on a flat plate spider with the dust shield being manufactured separately as an optional feature. These dust shields are secured to the spider by means of the stationary anchor pin locking nuts and the eccentric anchor pin adjusting nuts.

The heavier type brakes are equipped with two anchor pin straps secured to the anchor pins with "C" washers. To remove the brake levers it will be necessary to remove the "C" washers and then lift the strap off the anchor pins.

The wheel cylinder push rod on the heavier type brake is secured to the brake lever by a push rod pin which is inserted through the brake lever and the drilled end of the push rod is fastened with a "C" washer.

It should be noticed that in Figure 46 showing the standard "DP" brake, the push rod, No. 8, is designed with an open end that is not secured to the brake lever, but has free movement on the push rod pin.

Although the method of adjustment of the anchor pin is the same on both brakes, larger wrenches will be required on the heavy duty type "DP" brake. A $\frac{5}{8}$ " open end wrench will be required on the flat section of the anchor pin, and a $1\frac{5}{8}$ " wrench will be required to loosen the anchor pin locking nut. Because of the increased sizes of the brake shoes, wheels and tires on the heavier brake, it will also be necessary to use wrenches with a greater offset to obtain clearances for this adjustment.

Note: The disassembly and assembly of DPH and DPA as shown in Fig. 44 and 45 is similar to the plate mounted type (Fig. 46).

MICRO LOX ADJUSTMENT

This type is adjusted by rotating the notched adjusting caps which are reached through the backing plate.

The specified tolerance on DP brakes should be sufficient to avoid brake drag and yet close to afford a good pedal reserve.

WARNER ELECTRIC BRAKE

Brakes applied by an attractive force exerted by an electro-magnet on its armature are being used in the automotive field, especially on trailers.

Electric trailer brakes can be synchronized with air, or hydraulically operated tractor brakes, also they have the advantage that they operate without lag on actuation or release. The system is composed of three basic parts:

Controller; magnet and armature; brake shoe and drum.

The electric brake circuit can be installed in any of the present-day automotive electrical circuits. The hot lead is taken from the live terminal on the starter switch; ground is at the battery.

Controller and load control are variable rheostats, and together with socket are wired into electric circuit same as horn, heater, fan etc.

Trailer brake circuit consists of a single electric cable to each wheel. Each brake draws approximately same amperage as a stoplight.

How Electric Brake Works

Instead of a hydraulic wheel cylinder, as in hydraulic brakes, or air cylinder, in air brakes, electric brakes utilize an electro-magnet and armature for shoe-applying force. Magnet is mounted in brake assembly and is free to rotate a limited number of degrees on its pilot.

Poles of magnet press against armature, depressing it slightly against armature springs. Armature is mounted in brake drum and turns with wheel (Fig. 51).

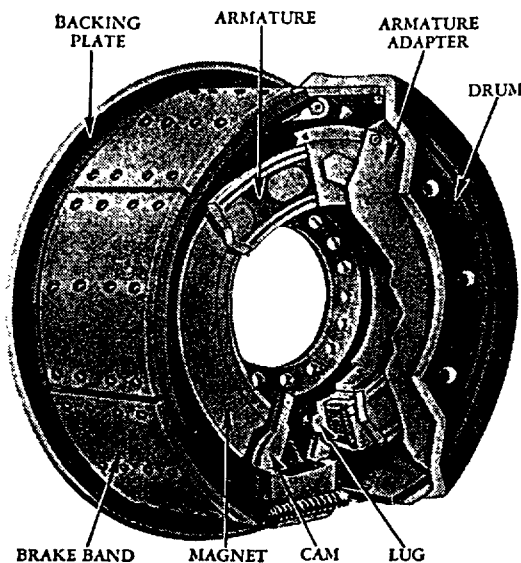


Figure 51

Cutaway view of typical Warner Electric brake assembly.

When current flows through magnet, magnet tends to cling to turning armature, with result magnet turns on its pilot. As it turns, lug on back of magnet moves against brake cam, which forces

brake shoe towards brake drum. From this point in brake operation, brake is self-energizing in its application.

Greater the amount of current supplied to magnet, harder brakes are applied. When brake is released, by cutting off current, magnet loses its attraction for armature, lug releases cam, cam releases shoe, and shoe return springs pull shoes back to released position.

No adjustment of shoe-drum clearance is required throughout useful life of lining, since magnet will supply sufficient actuation of shoes down to rivet heads of lining. At this point, magnet comes against an automatic stop, preventing contact of rivet heads with brake drum.

Checking An Electric Brake System

There are six checks that can be made in inspecting an electric brake system: (1) amperage; (2) loose wheel bearings; (3) brake drum; (4) brake lining; (5) magnet and armature relationship; and (6) armature depression.

For further service details consult Manufacturer.

HAND BRAKE CONTROLS

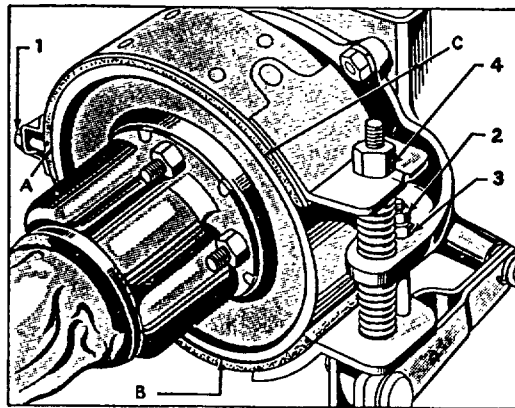


Figure 52

The most commonly used passenger car and light truck hand brake is shown in Fig. 52. For service adjustment maintain .030 clearance between the band and the drum at all points. Insert a .030 feeler gauge between the band and drum at point A. Adjust No. 1 adjusting screw to this clearance. Rewire this screw. Then loosen lock nut No. 2 and adjust point B to .030 with nut No. 3 relock with lock nut No. 2. Then adjust nut No. 4 for a .030 clearance at point C.

TIMKEN DUAL-GRIP BRAKE (DOUBLE FORK)

NEW OR RELINED ADJUSTMENT

A. Turn adjusting screw to raise shoe to clearance (.006" to .008") with brake released.

B. When relined shoes are installed the identification marks on the eccentric bolts should be on the fork centerline away from the drum. As the brake is applied, the toe (end toward brake anchor pin) of the inner shoe will contact the drum first. To adjust, loosen lock nut "B" on operating lever and turn eccentric counter-clockwise until the heel of the inner shoe contacts the brake drum. Tighten lock nut.

TIMKEN DUO-GRIP BRAKE (DOUBLE FORK)

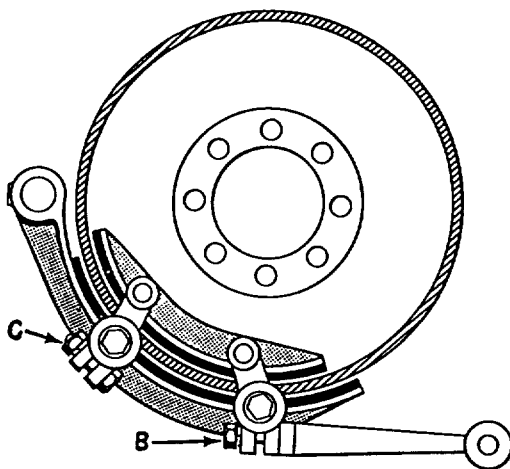


Figure 53

WEAR ADJUSTMENT

A. Place hand brake lever in second notch. Loosen lock nut "B" on operating lever and turn eccentric counter-clockwise until toe of inner shoe contacts drum. Tighten lock nut.

B. Loosen lock nut "C" on clamp bolt and turn eccentric counter-clockwise until heel of inner shoe contacts drum. Tighten lock nut on clamp bolt.

TIMKEN DUO-GRIP BRAKE (SINGLE FORK)

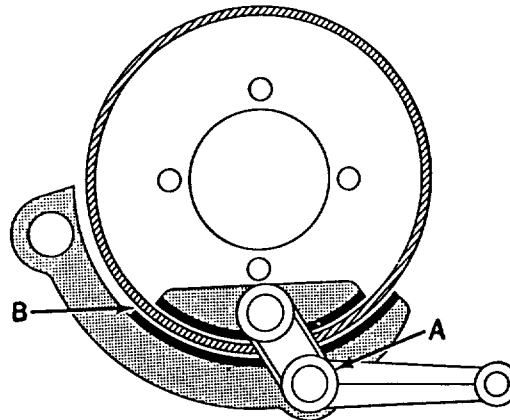


Figure 54

A. Turn adjusting screw "A" to raise shoe to minimum clearance (.006" to .008") with brakes released. Tighten lock nut.

B. Place hand brake lever in second notch and adjust linkage between hand lever and fork sufficiently to bring lower lining "B" in contact with drum. Tighten lock nut.

C. Turn down nut above spring sufficiently to prevent rattles.

EXTERNAL DRIVE SHAFT SHOE TYPE

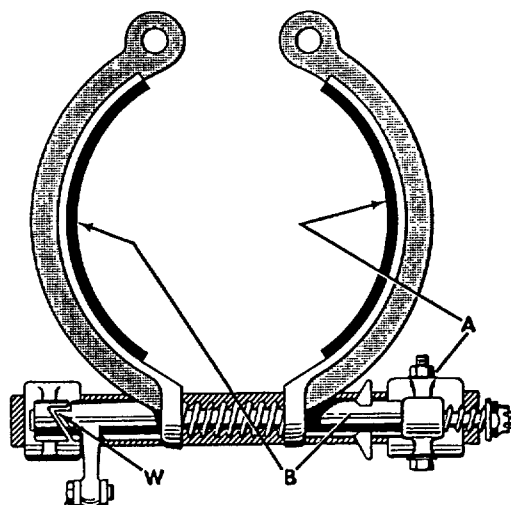


Figure 55

These shaft brakes vary greatly in design. A popular type is shown, the clearance being similar for all.

Disconnect pull rod and allow wedge "W" to bottom.

A. Loosen jam bolt and set bracket "A" on torque tube to obtain .050" clearance between block and drum at arrow.

B. Turn adjuster "B" to obtain .050" clearance between block and drum at arrow.

Adjust pull rod at its clevis and connect to wedge lever, so clevis pin just enters without moving wedge "W" from its stop.

MACK JACK SHAFT

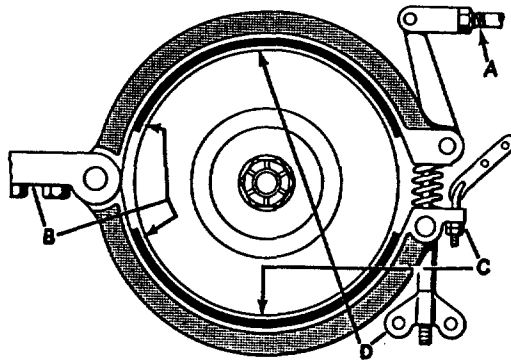


Figure 56

A. Adjust lever rod "A" at its clevis to set lever back, as shown with brake in off position.

B. Loosen bolts and move bracket "B" in desired direction to center shoes around drum.

C. Adjust hanger nut "C" to obtain .012" clearance between block and drum at arrow.

D. Adjust wing nut "D" to obtain .018" clearance between block and drum at arrows.

NOTE: Make certain that shoe expanding spring coils do not meet when brakes are fully applied.

TRU-STOP DISC BRAKE

This emergency brake may be either single or double pairs. Adjust as follows for either type (Fig. 57).

A. With brake handle fully released against its stop adjust length of rod "A" at its clevis to obtain .060" clearance between front segment and drum at arrow.

NOTE: Make certain that expanding spring on rod "B" pulls lever against its stop while adjusting "A".

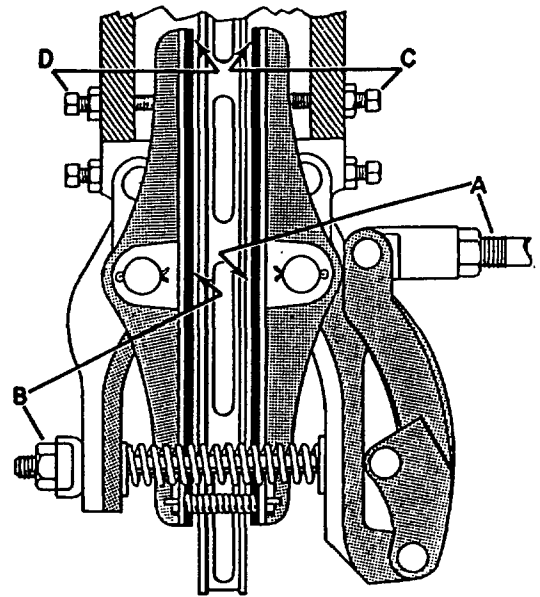


Figure 57

B. Turn nut "B" to obtain .060" clearance between Rear Segment and drum at arrow.

C. & D. Turn shoe stops "C & D" to obtain .060" clearance at top of shoes. Retaining Spring at bottom of shoes will then keep shoes parallel. In double type Rod "A" is connected to a cross shaft (not shown). After setting cross shaft lever back with brakes off, adjust each pair of shoes separately at "A, B, C, & D" and balance each pair equalizing length of Rods "A" at each lever.

CHRYSLER HAND BRAKE

(1951-1955 With Gyromatic Transmission)

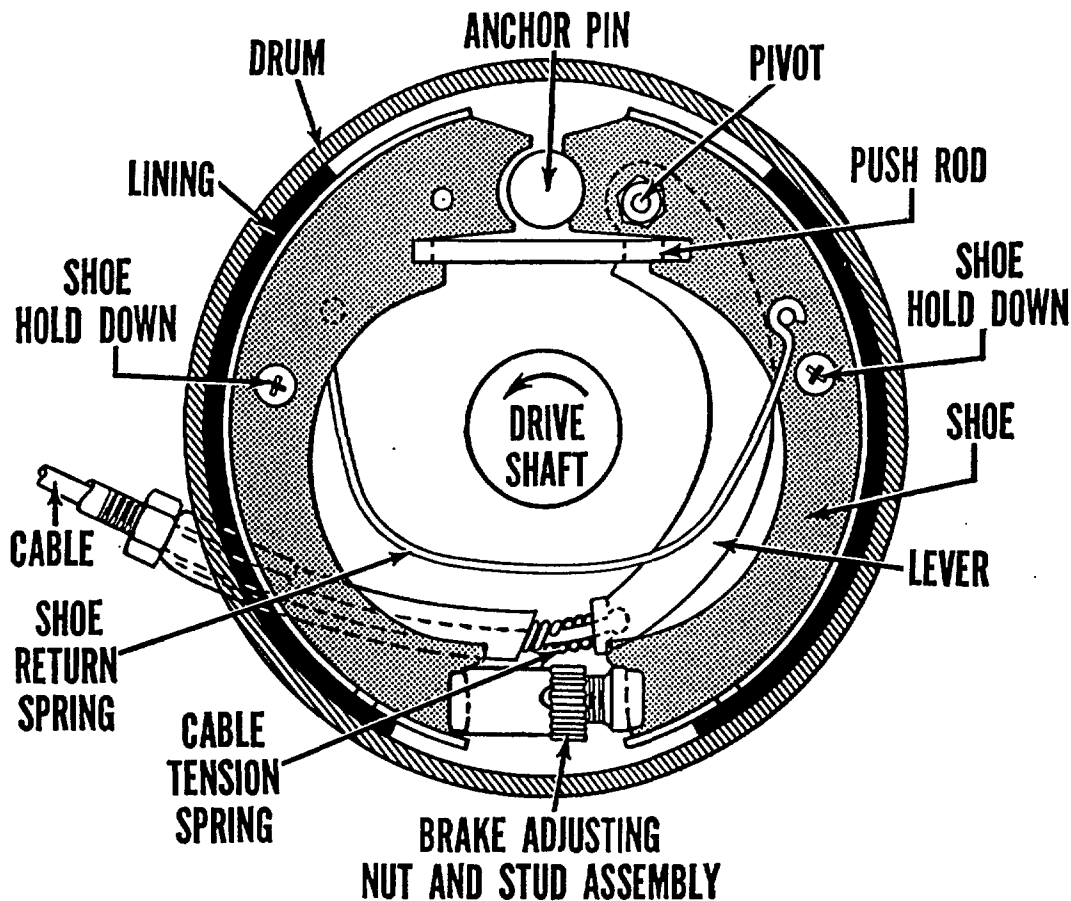


Figure 58

ADJUSTMENT

Note: Incorrect adjustment will affect automatic shifting.

Place transmission in neutral and release hand brake lever.

Disconnect front end of drive shaft so that brake drum can be turned by hand.

Remove adjusting screw cover on lower section of brake. Loosen cable guide clamp bolt so that cable adjusting nut may be backed off.

Turn shoe adjusting nut, advancing shoes until they drag. Back nut off to provide .010" clearance (at least one notch). Make sure that two shoulders on the adjusting nut are seated in grooves on the adjusting sleeve.

Position cable adjusting nut against cable housing to provide .005"-.010" lining clearance. Lock by tightening cable housing clamp and adjusting nut against housing.

Install adjusting screw cover plate and connect drive shaft.

NOTES

**Power
Brakes**

POWER BRAKES

Passenger Cars and Light Trucks

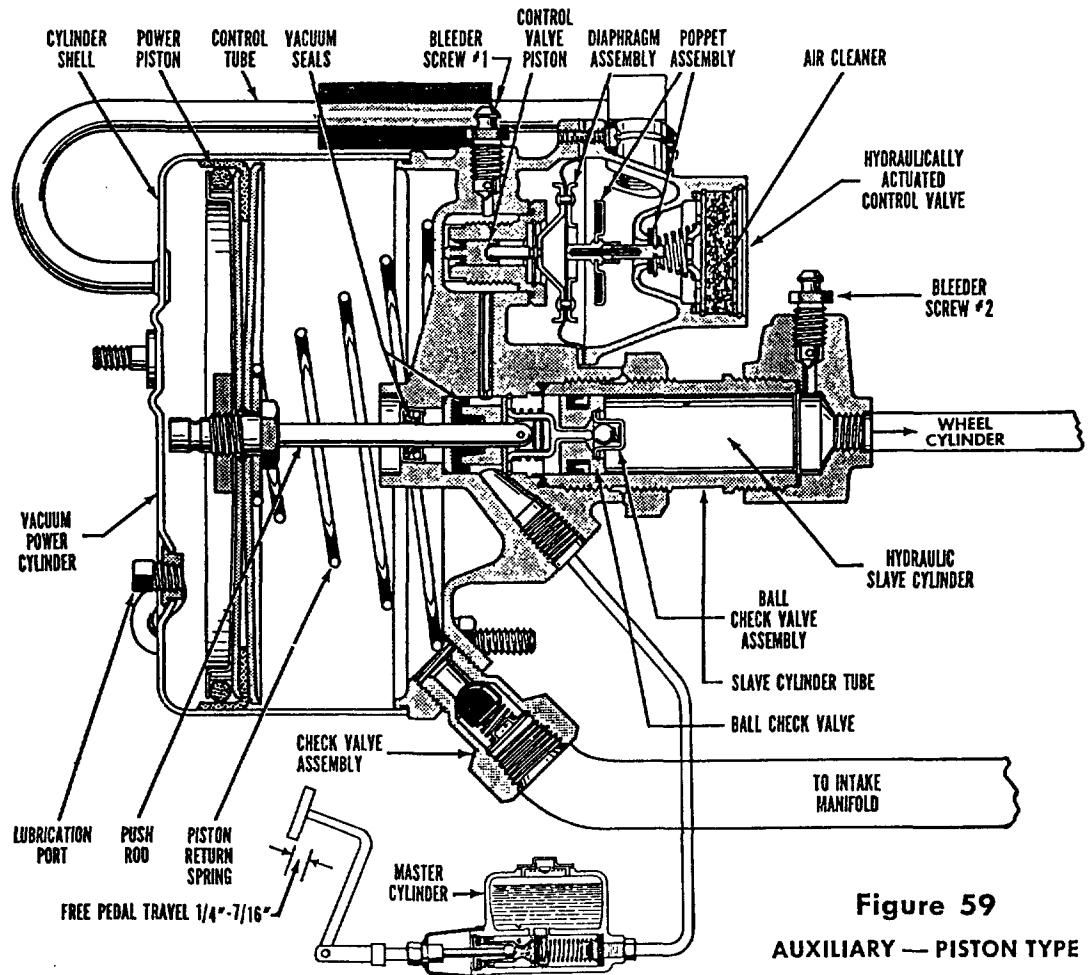


Figure 59
AUXILIARY — PISTON TYPE

Generally speaking, there are two types of vacuum power assist units—auxiliary (Figs. 59 and 60), and integral (Figs. 61 and 62). These are further subdivided into 1) piston class (Figs. 59 and 61), and 2) diaphragm class (Figs. 60 and 62). Auxiliary units are operated by the vehicle master cylinder while integral units have a self-contained master cylinder. These units all function in general the same, and

have three operating units in one assembly, vacuum power cylinder, power piston or diaphragm control mechanism, and master or slave cylinder.

It is well to note the safety factor in conjunction with all of these units. Figure 63 shows the **vacuum reservoir which stores sufficient vacuum for several brake applications in the event of engine failure result-**

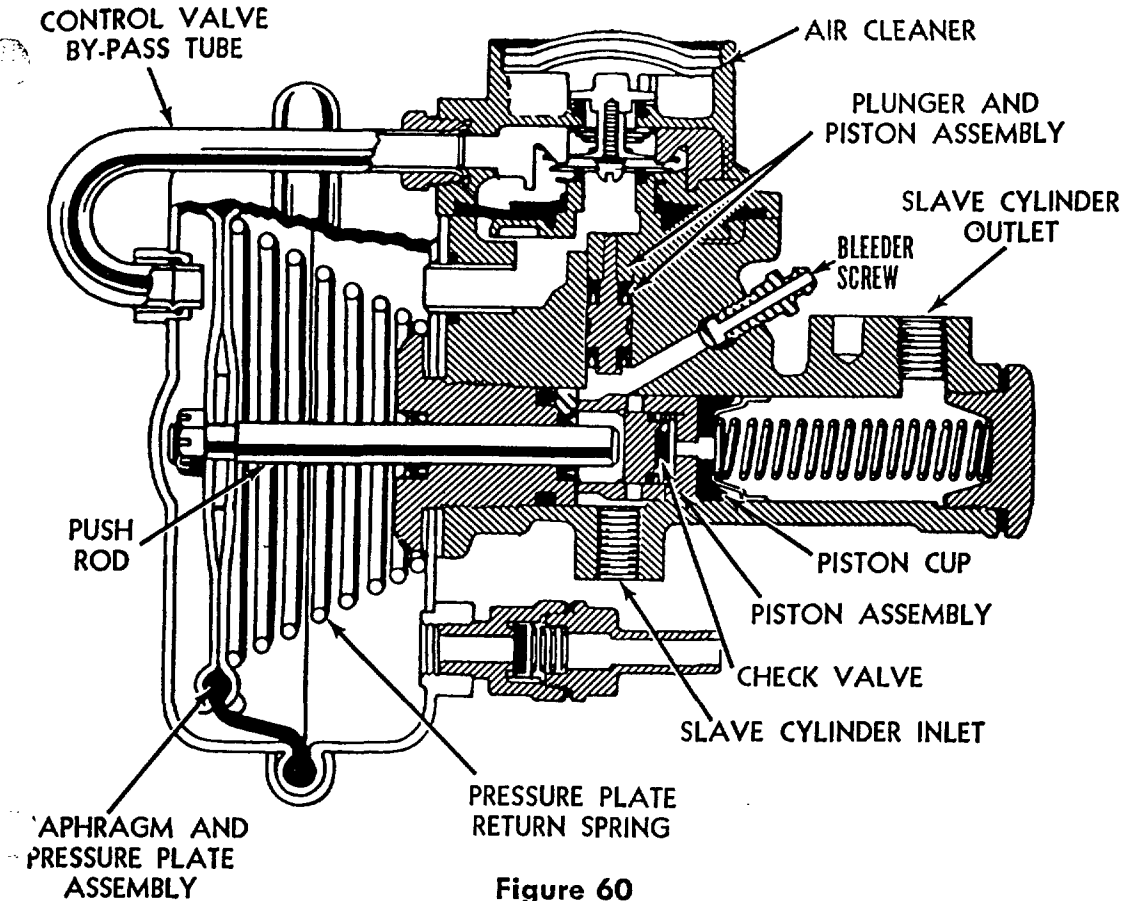


Figure 60

AUXILIARY — DIAPHRAGM TYPE

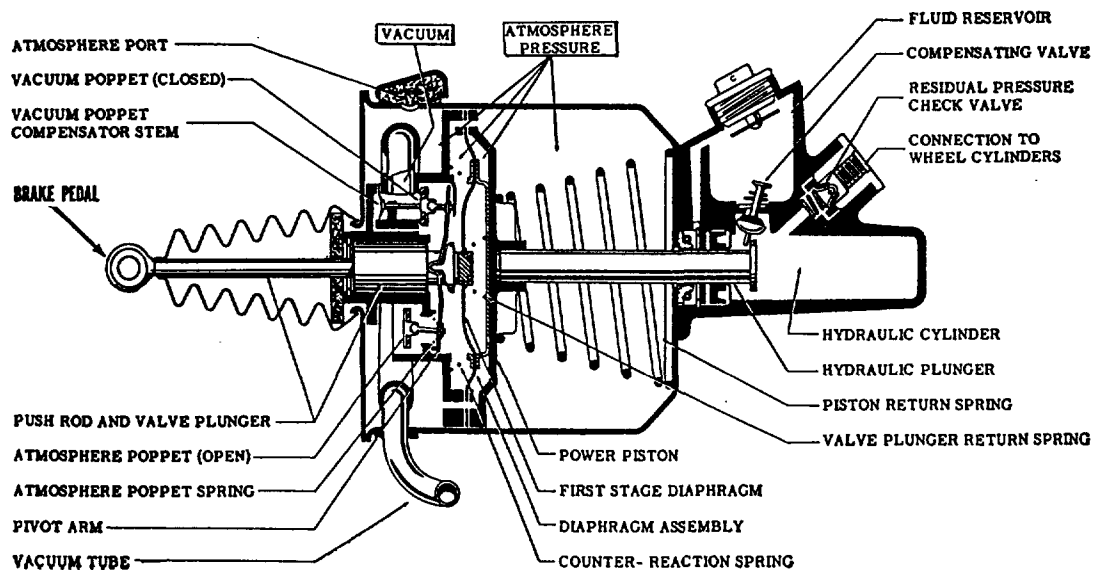


Figure 61

INTEGRAL — PISTON TYPE

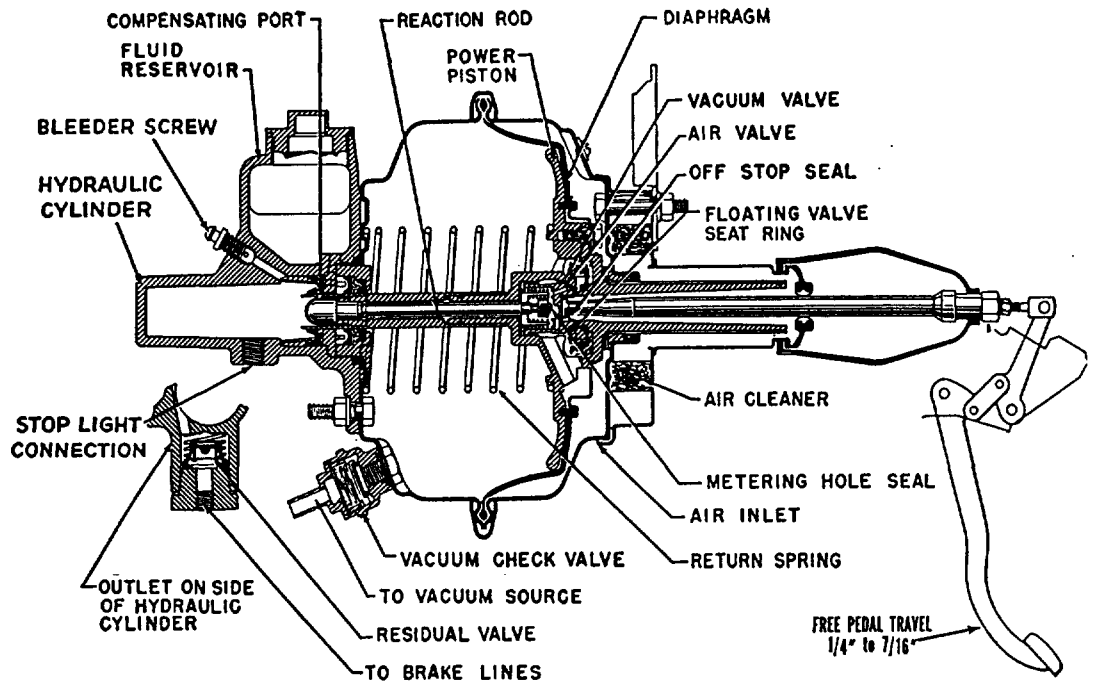


Figure 62

INTEGRAL — DIAPHRAGM TYPE

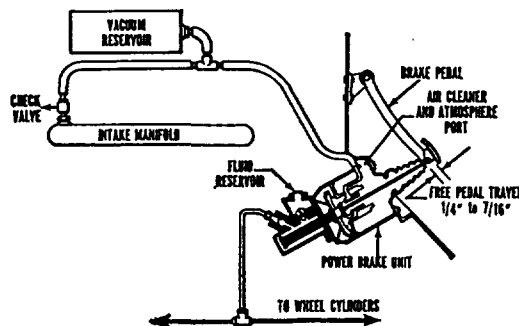


Figure 63

ing in loss of vacuum. Further power unit failure is compensated for by adequate by-pass ports in the power units to allow the brakes to be applied hydraulically.

Complete servicing details cannot be given here hence only important highlights and inspection are presented. Consult manufacturers' distributors for complete details of service and replacement.

Manufacturers of units in use on present cars and light trucks are as follows: Moraine, Bendix, Kelsey-Hayes, Midland and Borg-Warner.

Factory Installed Passenger Car Power Brakes

Buick	Kelsey-Hayes (cylinder type)
Cadillac	Bendix Hydrovac
Chevrolet	Bendix Treadle-Vac
Chrysler	Kelsey-Hayes Vacddraulic (except disc brake model)
De Soto	Kelsey-Hayes Vacddraulic
Dodge	Kelsey-Hayes Vacddraulic
Ford	Midland Hy-Power
Hudson	Bendix Treadle-Vac
Lincoln	Bendix Treadle-Vac
Mercury	Bendix Treadle-Vac
Nash (some models)	Bendix Treadle-Vac
Oldsmobile	Bendix Treadle-Vac
Packard	Bendix Treadle-Vac
Plymouth	Kelsey-Hayes Vacddraulic
Pontiac	Bendix Treadle-Vac

Note: Since power brake installations may be made in the field, it is possible that some types of cars may have units other than that listed above.

Testing and Adjusting Power Brakes

Road test by making brake application at 20 mph to see if car stops evenly and quickly. If brakes are spongy, bleeding of hydraulic lines is in order.

With engine stopped and transmission in neutral, apply brakes several times to remove all vacuum in system. Depress brake pedal, hold light foot pressure on pedal and start engine. If vacuum system is functioning properly, pedal will tend to fall away under foot pressure, and less pressure will be required to hold pedal in applied position. If no action is felt, vacuum system is not working. Stop engine and again remove all vacuum in system. Depress brake pedal and hold pressure on pedal. If pedal gradually falls away, hydraulic system is leaking.

There are no special adjustments for power brakes. Before investigating power system for trouble, check conventional hydraulic brake system for usual sources of trouble. However, at same time as conventional braking system is being checked, make following inspections on power system. Check vacuum lines and connections between intake manifold, check valve, vacuum reserve tank (Fig. 63) and vacuum power cylinder for possible vacuum leaks. Check fluid in master cylinder reservoir; level should be $\frac{1}{2}$ in. from top of filler plug opening. Check condition of air cleaner hair and insert clean hair if necessary. Check mechanical connections between foot pedal and power unit. Use only recommended brake fluid for refill.

Observe brake pedal height when brakes are fully applied and engine is running. If clearance between pedal pad and floor is less than one inch, adjust shoe-drum clearance to proper setting.

Spring and fall, or at least every 10,000 mi., remove intake manifold tee connector (vacuum supply) and clean.

This connector tends to "coke up" and restrict vacuum line if not cleaned periodically.

Brake troubles especially peculiar to power brake system are as follows:

Bleeding Power Brakes

The bleeding of the integral type is the same as conventional hydraulic system. Bleeding of auxiliary system differs in that the slave cylinder must be bled first, then the wheel cylinders. (See Figs. 59 and 60 for location of bleeder point, some have one, others two as shown.)

Pedal Almost Goes To Floor: (1) Fluid reservoir needs replenishing; (2) Power brake hydraulic leakage due to compensating valve leak, hydraulic plunger seal leak, compensating port or output port fitting seal leak, leaks at wheel cylinders or in pipes and connections.

Brakes Fail To Release (Or Slow Release): (1) Bound up brake pedal mechanism; (2) Power brake unit trouble due to faulty residual check valve, excessive hydraulic plunger seal friction, faulty compensating port, excessive piston packing friction, restricted air passage, piston stroke interference, sticky sliding valve, broken piston return spring.

Hard Pedal: (1) Vacuum failure due to faulty vacuum check valve, collapsed vacuum hose, plugged vacuum fittings; (2) Bound up pedal mechanism; (3) Power brake unit trouble due to internal vacuum hose looseness or restriction, jammed sliding valve, vacuum leaks in unit caused by loose screws in piston plate or faulty packing and seals, broken reaction spring.

Grabby Brakes: Power brake unit valve trouble due to reaction diaphragm leakage of faulty rubber bumper pad, sticking sliding valve action, restricted diaphragm passage.

Power Brake Service Tips

Pedal Goes to Floorboard (or Nearly)

Possible Cause	Correction
Brakes need adjustment	Major adjustment or minor adjustment
Air in hydraulic system	Bleed lines and fill reservoir
Hydraulic leak	Locate and correct leak; bleed lines and fill reservoir
Fluid reservoir needs refilling	Fill reservoir; bleed lines
Cracked drum	Replace drum; minor brake adjustment

Brakes Fail to Release (or Slow Release)

Compensating valve leak	Replace valve assembly; bleed lines; fill reservoir
Hydraulic piston seal leak	Recondition master cylinder; bleed lines; fill reservoir
Compensating port or output fitting seal leak	Replace seal; bleed lines; fill reservoir
Brakes improperly adjusted	Major adjustment
Bound up brake pedal linkage	Free pedal linkage
Restricted air passage	Eliminate restriction
Excessive hydraulic seal friction	Replace seal; bleed lines; fill reservoir
Compensator port plugged	Clean port; bleed lines; fill reservoir
Faulty residual check valve	Replace valve; bleed lines; fill reservoir
Piston stroke interference	Be sure coiled vacuum line at vacuum connection to valve is not striking intake end; push piston in and out to check creeping and fouling—if so, relocate piston return spring by moving 120 deg.
Sticky vacuum valve	Touch up lightly with crocus cloth; do not oil
Sticky compensating valve	Replace valve; bleed lines; fill reservoir
Broken piston return spring	Replace spring
Dry ledges on backing plate	Lubricate ledges

Hard Pedal

Possible Cause	Correction
Glazed linings	Reline; major brake adjustment
Grease or brake fluid on linings	Stop source of leak; reline; major adjustment
Bound up pedal linkage	Free linkage
Faulty vacuum check valve	Clean if dirty or sticky; replace if damaged
Collapsed vacuum hose	Replace hose
Plugged vacuum fittings	Clean fittings; eliminate source of dirt
Leaking vacuum tank	Replace tank
Jammed vacuum cylinder piston	Locate and correct cause of jamming; replace damaged parts
Vacuum leaks caused by loose piston plate screws	Tighten screws
Faulty diaphragm	Replace diaphragm
Faulty vacuum cylinder piston seal	Replace seal

Grabbing Brakes

Grease or brake fluid on linings	Reline; major brake adjustment
Scored drums	If slight, dress with fine emery cloth; if deep, turn drums and use oversize lining
Diaphragm leakage	Replace diaphragm
Broken counter-reaction spring (vacuum system)	Replace spring
Restricted diaphragm passage	Check by-pass hole in gasket for alignment with hole in casting; clean passage
Sticking vacuum valve action	Clean valve lightly with crocus cloth; do not oil

TROUBLE	CAUSE	REMEDY
1. Dragging Brakes (All Wheels)	(a) Pedal improperly adjusted (b) Fluid can't return to master cylinder.	Set pedal to proper clearance. Clear dent or obstruction in line at master cylinder.
2. Dragging Brakes (One Wheel)	(a) Brake shoe bearing seized to anchor pin. (b) Swollen wheel cylinder cups. (c) Dented metal line or restricted flexible line preventing return of fluid. (d) Sprung brake shoes binding on backing plate. (e) Weak or incorrect shoe retractor springs. (f) Wheel bearings out of adjustment so drum drags on shoes. (g) Drum out of round.	Free bearing—Lubricate. Replace with new wheel cylinder cups. Replace bad line. Replace shoes. Replace with correct tension—compare with other wheel. Pull wheel. Wash and grease bearing. Reinstall. If worn—replace. Turn in lathe or replace.
3. Hard Pedal— Brakes ineffective	(a) Lining old and hard. (b) Mechanical resistance at pedal or shoes.	Reline. Lubricate—free up.
4. Soft Pedal— Brakes ineffective	(a) Air in fluid. (b) Flexible line rotten from chassis oil and grease. (c) Brake shoes improperly adjusted.	Bleed hydraulic system. Replace bad lines. Adjust brakes.
5. Brake pulls to one side	(a) Weak retracting spring. (b) Lining on that side gummy from oil or grease. (c) Drums out of round. (d) Incorrect lining to drum clearance at one or more wheels. (e) Restriction in fluid line to opposite side.	Replace with correct tension. Reline both fronts or rears or all four. Turn or replace. Set as per instructions for car. Clear lines or replace.
6. One Wheel Locks	(a) Gummy lining. (b) Tire tread slick. (c) Loose backing plate.	Reline in pairs—both fronts, rears, or all four. Match up tire treads from side to side. Tighten and readjust brakes.
7. Brakes Chatter	(a) Lining not well cemented or riveted to shoes. (b) Loose backing plate or shoe support. (c) Front system loose. (d) Lining greasy. (e) Poor lining to drum contact.	Reline. Tighten. Rebush. Reline in pairs—replace wheel grease retainers. Adjust to proper clearance as specified.
8. Shoe click after release	"Threads" left by drum turning tool—pull shoes sideways — then let them snap back.	Grind or hone drums after turning.

IMPORTANT: Always fill and then bleed system after opening any lines or cylinders.

STOPPING DISTANCE CHART

With brakes in perfect operating condition, the stopping distance depends upon the friction between the tire and road surface. It can be readily understood that even with perfect brakes a vehicle cannot make a very rapid stop on a slippery pavement. The stopping distances from various speeds for a vehicle with perfect brake equipment and tire treads operating on the average dry, concrete, brick or cold asphalt road surface would be as shown below. Incidentally, a vehicle with perfect brake equipment must have a sufficiently powerful brake on each wheel so that all wheels may be brought up to the locking point. The vehicle is stopping at the fastest rate just as skidding is impending at all four wheels.

In order to find the actual total stopping distances from the various speeds it is necessary to add from 20 to 80 feet, depending on the car speed, to take care of the distance the car travels during the time interval between the instant the driver decides to stop and the instant his foot actually applies the brake.

The stopping distances after the brakes are applied and the total stopping distances which take into account the average driver reaction time of $\frac{3}{4}$ second are as follows:

Speed of Car	Reaction Distance	Braking Distance	Total Stopping Distance
20 M.P.H.	22 ft.	18 ft.	40 ft.
30 M.P.H.	33 ft.	40 ft.	73 ft.
40 M.P.H.	44 ft.	70 ft.	114 ft.
50 M.P.H.	55 ft.	110 ft.	165 ft.
60 M.P.H.	66 ft.	160 ft.	226 ft.
70 M.P.H.	77 ft.	220 ft.	297 ft.

It should be remembered that the above figures are for a vehicle with perfect brakes and tire treads operating on a dry brick, concrete or cold asphalt road. Under less favorable conditions, the vehicle could not be stopped in as short a distance as shown here.

INDEX OF BRAKES USED ON VARIOUS PASSENGER CARS

Make	Year	Model	Type of Brakes	Page
Buick	1955-36	All	Bendix Hydraulic	33-35
Cadillac	1955-36	All	Bendix Hydraulic	33-35
Chevrolet	1955-51	All	Bendix Hydraulic	33-35
Chevrolet	1950-36	All	Huck Hydraulic	35-36
Chrysler	1955-30	All	Lockheed Hydraulic	24-28
Chrysler	1955-50	Imperial	Disc Brake	36-37
De Soto	1955-30	All	Lockheed Hydraulic	24-28
Dodge	1955-30	All	Lockheed Hydraulic	24-28
Ford	1955-49	All	Bendix Hydraulic	33-35
Ford	1948-39	All	Ford Hydraulic	28-29
Frazer	1953-47	All	Lockheed Hydraulic	24-27
Hudson	1955-36	All	Bendix Hydraulic	33-35
Kaiser	1954-47	All	Lockheed Hydraulic	24-27
Lincoln	1955-39	All	Bendix Hydraulic	33-35
Mercury	1955-49	All	Bendix Hydraulic	33-35
Nash	1955-40	Ambassador	Bendix Hydraulic	33-35
Nash	1955-40	"600" Series	Lockheed Hydraulic	24-27
Nash	1939-37	Some	Bendix Hydraulic	33-35
Nash	1939-37	Some	Lockheed Hydraulic	24-27
Oldsmobile	1955-34	All	Bendix Hydraulic	33-35
Packard	1955-37	All	Bendix Hydraulic	33-35
Plymouth	1955-30	All	Lockheed Hydraulic	24-28
Pontiac	1955-35	All	Bendix Hydraulic	33-35
Studebaker	1953-35	All	Lockheed Hydraulic	24-27, 29-33
Studebaker	1955-54	All	Wagner Self Centering	37-38
Willys	1955-41	Some	Lockheed Hydraulic	24-27
Willys	1949-41	Some	Bendix Hydraulic	33-35