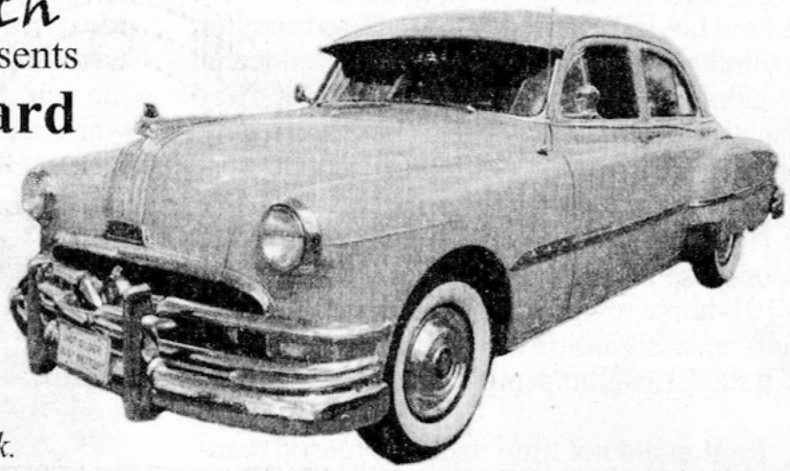
Orest Lazarowich
Presents

Looking Backward
but
Moving Forward

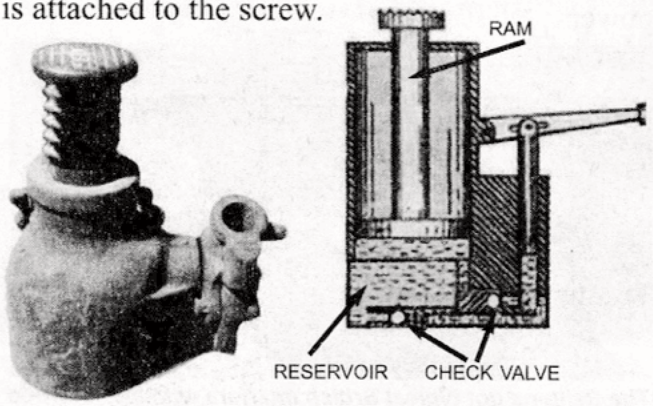
A Continuing Series focused on the Repair and Restoration of your old Car and Truck.



The Hydraulic Brake System

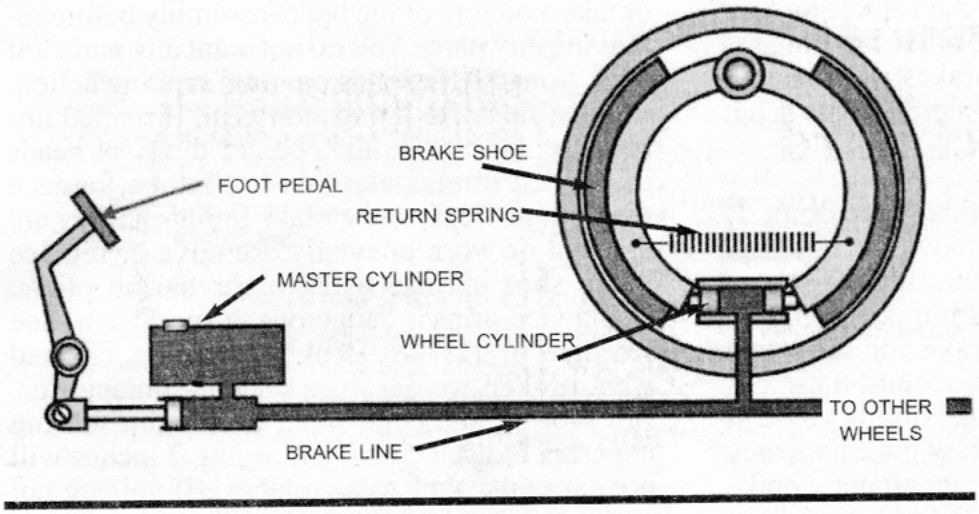
Around the mid 1600s a French scientist and mathematician, Blaise Pascal, formulated the principle that the pressure on a fluid at rest exerts a force perpendicular to the surface and independent of the direction of orientation of the surface. It also stated that additional pressure applied to the fluid would be transmitted equally to every point in the fluid. These principles are known as Pascal's Law. Pascal demonstrated these principles in 1647 using a tank of water with a lid which included two cylinders of different cross-sectional areas, in which sat two pistons. A pressure exerted on the smaller piston will produce an equal increase in pressure on the larger piston. If the larger piston has an area ten times that of the smaller piston, the force on the larger piston is ten times greater, though the pressure on the smaller piston is the same.

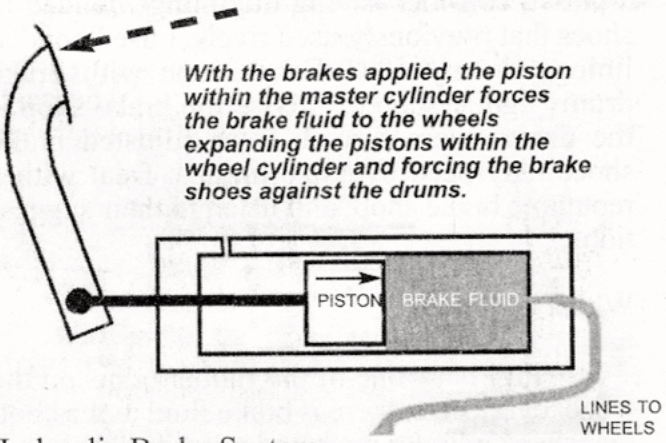
Pascal's law sat around for quite some time but was never repealed. In 1795 Joseph Bramah applied these principles and designed (patented) the hydraulic press. This was during the industrial revolution a period when new manufacturing processes were being introduced. By 1850 hydraulic elevators were installed in hotels that were taller than three stories. When the automobile industry started to develop in the early 1900s the hydraulic bottle jack appeared giving competition to the mechanical jack. The name refers to the shape of the milk bottle of the time. Bottle jacks feature an extension screw which allows for height adjustment. A bearing pad that directly bears the weight of the object is attached to the screw.



On the down stroke of the handle this oil is delivered to the large cylinder (ram). The pressurized oil lifts the ram and the load upwards.

There are two cylinders in the bottle jack (a large one and a small one) that are connected to a common hydraulic oil reservoir. When the release valve at the bottom is closed and the handle is moved up it draws hydraulic oil into the small cylinder (plunger) through a check valve. On the downstroke of the handle this oil is delivered to the large cylinder (ram). The pressurized oil lifts the ram and the load upwards. When the work is completed, the pressure in the ram is released by valve at the base, and the hydraulic oil released into the reservoir. Never work under a vehicle that is only supported by a hydraulic jack. Use safety stands to support the vehicle.





Hydraulic Brake System

Fred Duesenberg originated hydraulic brakes on his 1914 racing cars; however he did not patent the idea. In 1918 Malcolm (Lougheed later changed to Lockheed) applied the Pascal principles of hydraulics to mechanical brakes. He used a master cylinder and tubing to transmit fluid pressure to four small wheel cylinders located at each wheel. Pushing on the brake pedal caused a force on the piston in the master cylinder and pressure on the brake fluid. This pressure forced the pistons in the wheel cylinders to push one end of each brake shoe out against the drum. The other end of the brake shoes pivoted on the anchor pins and the shoes stopped the drum and wheel from moving. The resulting friction stopped the vehicle. The original Lockheed brakes leaked because of the use of rawhide cups which dried up and they shrank over time. Chrysler redesigned the original Lockheed brakes, and replaced the rawhide cups with rubber cup seals. This new brake type, known as the Chrysler-Lockheed hydraulic brake, was used from 1924 - 1962 on Chrysler products. Lockheed also used this improved design on his original Lockheed brake.

In 1926 Stutz used a system called Hydrostatic Brakes using a 50/50 solution of alcohol and water to prevent freezing. The system was used for only one year, and in 1927 Stutz switched to Lockheed hydraulic brakes.

The Huck Axle Company began development of the mechanical Huck brake, and in 1926 it licensed the brake patents to General Motors. In 1931 Huck patented the hydraulic Huck brake. Chevrolet and GMC trucks used the hydraulic Huck brake from 1936 to about 1953. In 1953 trucks converted to Bendix brakes. The Bendix corporation also manufactured four-wheel mechanical brake systems for the GM cars. In 1930 they purchased the Lockheed company, and by the mid 1930s General Motor's vehicles started using hydraulic brakes. Wagner Electric company developed a Lockheed-Wagner hydraulic brake that Ford used from 1939 to 1945. In 1939 Bendix introduced a duo-servo brake design, and by the mid-fifties it became the industry standard.

Brake Service

There is a limited amount of travel in the master cylinder's piston stroke. If the brake shoes are not properly adjusted, you will not get a firm pedal because the brake fluid pressure is exhausted. So you quickly 'pump' the brake pedal to get more brake fluid to the wheel cylinders. The vehicle stops but the next time you apply the brakes there is no hard pedal. You might think this is a problem with air in the brake lines, it is not. Air in the lines gives a soft pedal. The brake shoes need adjustment. If you hear a scraping noise when applying the brakes, the brake shoes

may need to be relined Raise the vehicle on four safety stands. Spin the wheel that the noise is coming from. Front wheel brakes wear sooner because during braking more inertial force is put on the front wheels.

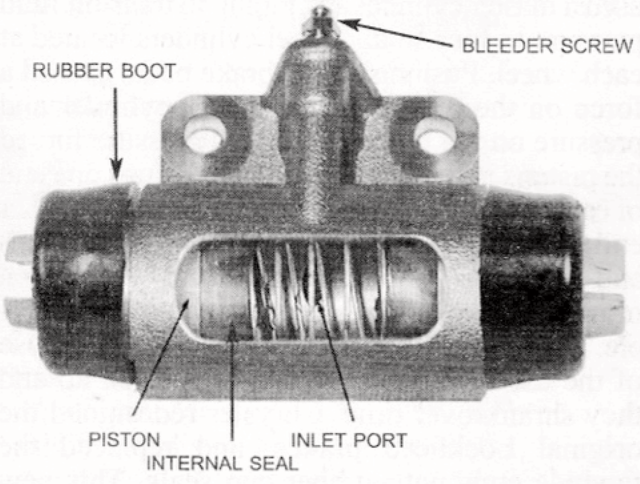
Remove the wheel at this brake drum. If this is a front brake drum, remove the hub cap, cotter key, axle nut and washer. Slide the drum off the spindle. If the brake drum is binding on the brake shoes, locate the brake adjusters, and turn them in the proper direction until the shoes do not bind. On some rear brake drums you will need a brake drum puller. Release the emergency brake cable completely, if the emergency brake is located at the rear brakes. If the brake shoes are oily at either location, replace the axle seals before you put the drums on. Inspect the braking surface inside the drum. If it shows excessive scoring, have the drum turned on a brake drum lathe. If there is not enough metal to clean up the scoring, the drum must be replaced. On some older vehicles the linings can be asbestos, and as the linings wear they produce asbestos dust. Asbestos is a leading cause of cancer. Do not inhale any brake dust. Do not clean this area with an air gun. Wet this dust down with brake cleaner, and remove it using a wet cloth. Wash and scrub down the brake shoe assembly with brake cleaner. Use an approved filtering mask to prevent health problems.

Identify the brake shoe design. Some brake shoes are arranged so that one shoe helps to apply the other. This is called a duo-servo design. It is a single fixed anchor, and it automatically centers the brake shoes as they are applied. In a non-servo design both shoes are anchored, and one shoe cannot assist the other during the application of the brakes. Lockheed supplied brakes for both Ford and Chrysler using this design. There can be one or two anchors and a dual piston wheel cylinder or a single end cylinder for each shoe. In the Huck design, the anchored ends of the brake shoes are free to move up and down. To maintain equal braking action on both sides of the vehicle always replace brake shoes in pairs (front or rear), and never replace the shoes on only one wheel. Work on one brake assembly at a time to prevent mixing up the parts. Sketch or take a picture of the brake assembly before removing any parts. You do not want any parts left over. Your life depends on good braking action. Inspect the brake linings for wear. If riveted linings are worn to within 1/32" of the rivet heads or bonded linings measure 1/16" thick, replace the linings. Replace the brake linings, if they are cracked or worn unevenly. Remove or replace brake shoe springs using brake spring pliers. Using vice-grips is dangerous. Inspect each shoe for signs of damage. Look for twisting, cracked web, broken welds, worn anchor contact area, rim scoring and edge wear. Minor rim scoring covering a distance not exceeding 2 inches will not cause the shoe to be rejected. If you are not a purist, consider having the linings bonded to shoes that previously used rivets. I used bonded linings on my 1941 Ford coupe with brake drums lightly scored. Advise the brake shop if the drums were turned. Cam adjusted brake shoes may need oversize linings. Deal with a reputable brake shop, and listen to their suggestions.

Wheel Cylinders

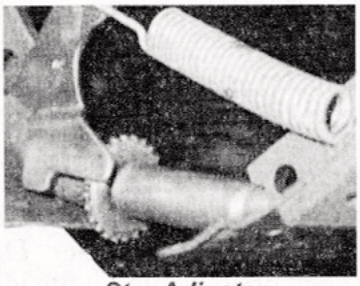
Pull back one of the rubber boots on the wheel cylinder. If there is brake fluid in the boot, the wheel cylinder must be repaired or replaced. Remove the wheel cylinder, and disassemble it. Clean all the parts. If the cylinder is rusted, pitted or scored, it must be rebuilt or replaced. The maximum clearance between cylinder and piston

HYDRAULIC WHEEL CYLINDER



is 0.005". Check this first. Then check on the availability of a rebuild kit. If you have a brake hone to clean up the pits and keep under the maximum clearance, rebuild the wheel cylinder. If you cannot rebuild the cylinder, buy good quality American Made cylinders. If new cylinders are not available, be prepared to spend a considerable $$$$ on having the old cylinders relined with stainless steel sleeves. Coat the bleeder screws with anti-seize compound before installing them. Install the wheel cylinder. Use copper gaskets with the flexible brake lines.

Install the brake shoes using new springs. Dab a small amount of Lubriplate at the toe and heel ends of the brake shoe. On Bendix starwheel adjusters lightly lubricate the threads and the button end. Adjusters are marked L (left) and R (right); do not mix them up. Keep greasy fingers off the brake shoe linings. Align the marks on the anchor pins to face each other. On Chrysler products with two wheel cylinders in the front brake assembly the marks (arrows) face toward the wheel cylinder. When installing front brake drums carefully inspect the inner and outer bearings. Check for cracks, worn rollers, heat discoloration etc. If defects are found, replace the wheel bearings. Replace the grease seals. Pack the front bearings with fresh grease, and adjust as per the service manual instructions. On rear brakes inspect the bearings which can be located in the rear axle housing or in the brake drum. Replace as necessary. Always replace the rear oil seals. Check the master cylinder for leaks, and rebuild/replace as necessary. These master cylinders are single piston. Some master cylinders are located under the floor pan. Turn back the floor mat on the driver's side, and look for the inspection hole cover in the floor pan. Steel brake lines with lots of outside rust must be checked carefully for leaks. Steel brake lines corrode from the inside-out because brake fluid absorbs moisture from the atmosphere. Replace flexible lines that are cracked. Bleed the air out of the wheel cylinders and lines. The brake pedal should have up to ½ inch free movement before the master cylinder piston starts to move. There must be hard pedal on the first application of the brake pedal.



Star Adjuster

The following procedures are the brake adjustments for various types of brakes. From 1939 to 1945 a Lockheed or Lockheed Wagner double anchor brake design was used on most Ford vehicles. The wheel cylinders are stepped with the larger piston acting on the forward shoe. Raise the vehicle on four safety stands. Brake drums must be cold. Release the hand brake. To make the minor (toe) brake adjustment, locate the brake adjusting cams at about the 10 and 2 o'-clock positions on the back of the backing plates. Pull down on the wrench until the brakes drag. Then back off in the reverse direction until the wheel is free to turn. Repeat this adjustment on each shoe of all wheels. If the brakes have been relined, it will be necessary to adjust the anchors (heel) before you adjust the cams. They are located at the bottom of the backing plate. Loosen the lock nuts, and align the marks (dots) on the pins to face one another. Use a pedal jack or a buddy to apply approximately 25 pounds of pressure to the brake pedal, and maintain this pressure while the anchors are being adjusted. This will move the shoes just in contact with the drum.

Turn each pin slowly in a downward direction until you feel the shoe has just touched the drum. Hold the anchor pin in this position, and tighten the lock nut, making sure the alignment does not change. Release the pressure on the brake pedal. Adjust the cams so the wheel is free to turn. Repeat these procedures on both shoes of each wheel. Check brake fluid level. In 1946 to 1948 the anchor ends of the brake shoes are free floating. The elongated anchor hole in the brake shoe slides along the flat-sided bushing on the anchor pin causing the brake shoes to center themselves in the brake drum. The brake shoe adjusting cams are used to obtain the correct lining-to-drum clearance. To adjust the parking brake remove the slack or sag in the cables coming out of the rear drums by tightening the nut at the brake flange evener.

Make sure the emergency brake cable is not sticking. If it is, apply some lubricant from the top of the cable housing. Rear wheels must spin freely after making the cable adjustment. Lower the vehicle, and brake test.

From 1946 to 1956 Chrysler Corp used the Chrysler Lockheed two forward shoe brake with two single-end wheel cylinders on the front wheels of their vehicles. Each cylinder is mounted on the anchor pin of the other shoe (top cylinder mounted on rear shoe anchor pin actuates forward shoe, bottom cylinder mounted on forward shoe anchor pin actuates rear shoe). All shoes are of the self-energizing type. The conventional double end wheel cylinder is used on the rear wheels. The shoes are pivoted on anchors at the bottom of the backing plate.

Remove the front wheels. The following procedure can be used to adjust the brake anchors with the brake drum on: loosen the locking nuts on the anchor bolts. Turn the top anchor bolt down until the heel of the shoe just touches the drum. Now turn the adjusting cam bolt to bring the toe of the shoe against the drum. This will loosen the heel contact. Readjust the heel and the toe until there is no more heel adjustment. Tighten the anchor bolt locking nut. Adjust the bottom anchor bolt by turning it upwards. Adjust the toe with the cam bolt to move the shoe against the drum. Readjust the heel as above. Tighten the locking nut. Adjust the other front wheel. Mount the front wheels. Rear wheel brakes are Lockheed double anchor. The anchor adjustments are similar to Ford. For a minor adjustment turn the cam bolt down until the wheel is locked. Then turn the cam bolt in the opposite direction until no drag is felt. Repeat on the other cam bolt. Adjust the other rear wheel. Check the brake fluid level.

The parking brake used on Chrysler manual shift vehicles is adjusted at the transmission. Release the hand brake all the way. Disconnect the brake cable and pull back the spring. Adjust cam arm so it is fully released. Remove anchor cap screw wire, and adjust the cap screw until 0.025" clearance exists between the lining and the drum. Adjust the lower half of the band to the same clearance by turning the lower adjusting nut. Recheck clearances. Clearance must be 0.025" at all points, since the brake drum will expand from heat and cause the brake band to seize. Replace the locking wire, and tighten the guide bolt locknut. Adjust the cable length to fit the clevis pin. Use a new cotter key. Replace the pull back spring.

General Motors used the Huck Hydraulic brake on Chevrolet cars and GMC half-ton trucks from 1936 to 1950 as well as on the Oldsmobile and Pontiac. The brake shoes are connected to a single, non-adjustable anchor pin by pairs of brake shoe connecting links. The toe ends of the brake shoes fit into the brake shoe adjusting caps. The brake shoe adjusting caps fit over the ends of the wheel cylinder, and they move outward with the wheel cylinder pistons when the brakes are applied. The adjustment for lining wear is made by turning the adjusting caps on the wheel cylinder. Disconnect the emergency brake cables at the idler lever. Remove the adjusting hole covers at one wheel, and use a stubby screwdriver through one of the adjusting holes. Turn the adjusting cap in a clockwise direction looking at the end of the wheel cylinder. All threads in the adjusting covers are right hand threads. Turn the cap until the shoe causes a slight drag on the brake drum, then turn it back four clicks to provide running clearance. Repeat for the other brake shoe. Repeat for the other brake drums. Snap the covers back in place.

Adjust the parking brake after fully releasing the brake lever. Loosen the adjusting nuts at the cable ends, and pull the cables until a positive stop is felt. Hold the cable, and adjust the nuts against the clevis plates. Tighten securely. There are no other adjustments for this type of brake.

The Bendix brake has become the industry standard. It is a self energizing duo-servo brake. There is a single, fixed anchor pin at the top of the backing plate and a dual-piston wheel cylinder mounted below the anchor. The bottoms of the brake shoes are not fixed to the brake backing plate. A threaded star adjuster links the lower ends of the shoes. Springs at the top and

bottom keep the shoes together. When the brake is applied the bottom of the primary shoe contacts the drum and presses against the secondary shoe. This increases the mechanical advantage and makes these brakes more efficient. Self-adjusting mechanisms for the Bendix brake were introduced on the 1957 Mercury.

Step on the brake pedal a few times to center the brake shoes. To adjust the brakes remove the rubber plug or spring plate from the backing plate. Use a screwdriver or brake spoon to move the starwheel wheel in the correct direction to expand the shoes. Turn the wheel in the direction of travel, and continue adjusting the brakes until the wheel locks. Back off the starwheel to allow the wheel to rotate freely. Count the number clicks, and adjust the other wheel to the same number. This will prevent the brakes from pulling side to side when applied. When all four brakes are adjusted, check and adjust the brake pedal travel and brake fluid level.

There are two types of parking brake cable adjustments that cause the rear brakes to be applied mechanically for parking. A vehicle will use only one type. When the handbrake is operated it pulls the cables that operate a set of levers in the rear wheel brakes. The levers force the brake shoes outward, causing the brakes to be applied. Over time the cables will stretch, and they have to be adjusted (shortened). One adjustment is done from underneath the vehicle, and the other is adjusted at the hand brake handle. To adjust from under the vehicle trace the brake cables that come out of the rear backing plates. The cables must be free in the conduit, and not kinked or frayed. They will meet under the transmission at an equalizer bracket. Look for a threaded rod and an adjusting rod attached to the equalizer bracket. Loosen the jam nut, and turn the adjusting nut until the cables tighten. Rotate the rear wheels to make sure they are not binding. Now tighten the jam nut. Lubricate the pivot points. Engage the parking brake. Rear wheels must not turn. Release the parking brake. Rear wheels must turn freely with no brake drag.

To adjust the parking brake cable at the handle disconnect the clevis from the hand brake assembly. Hold the cable with vise-grips, and turn the clevis inwards one or two turns. Connect the clevis but do not install the cotter pin. Check the rear wheels for binding. Apply the parking brake to make sure the brake is holding. Spray some lubricant into the conduit. Install the cotter pin. Lower the vehicle, and equalize the brake shoes by applying the brakes a few times. Set the parking brake. The vehicle should not move. Readjust as necessary. Happy motoring.

S.K.

NEXT MONTH
Front Suspensions

EVENTS

CALIFORNIA

Oxnard, March 29, Studebaker Car Show, Murphy Auto Museum, by LA Chapter Studebaker Driver's Club. Info (818) 606-0267

Bakersfield, April 15-16, Swap Meet, Kern County Fairgrounds, by Kern County Model T Club and Horseless Carriage Club. Info 661-706-5263.

NEBRASKA

Lincoln, Mar 6, Swap Meet, Lancaster Events Center, by Eastern Nebraska/Western Iowa Car Council. Info 402-786-2427

NEW YORK

Peconic, Feb. 21, Indoor Swap Meet, Southold Town Recreation Center, by PBR AACA. Info 631-495-8619

OHIO

Jefferson, March 19, Swap Meet, Ashtabula County Fairgrounds, by Western Reserve Chapter AACA. Info 440-997-7751

WISCONSIN

West Bend, Feb 28, Indoor Swap Meet, Washington County Fairgrounds by Wisc MAFCA. Info 414-491-3260