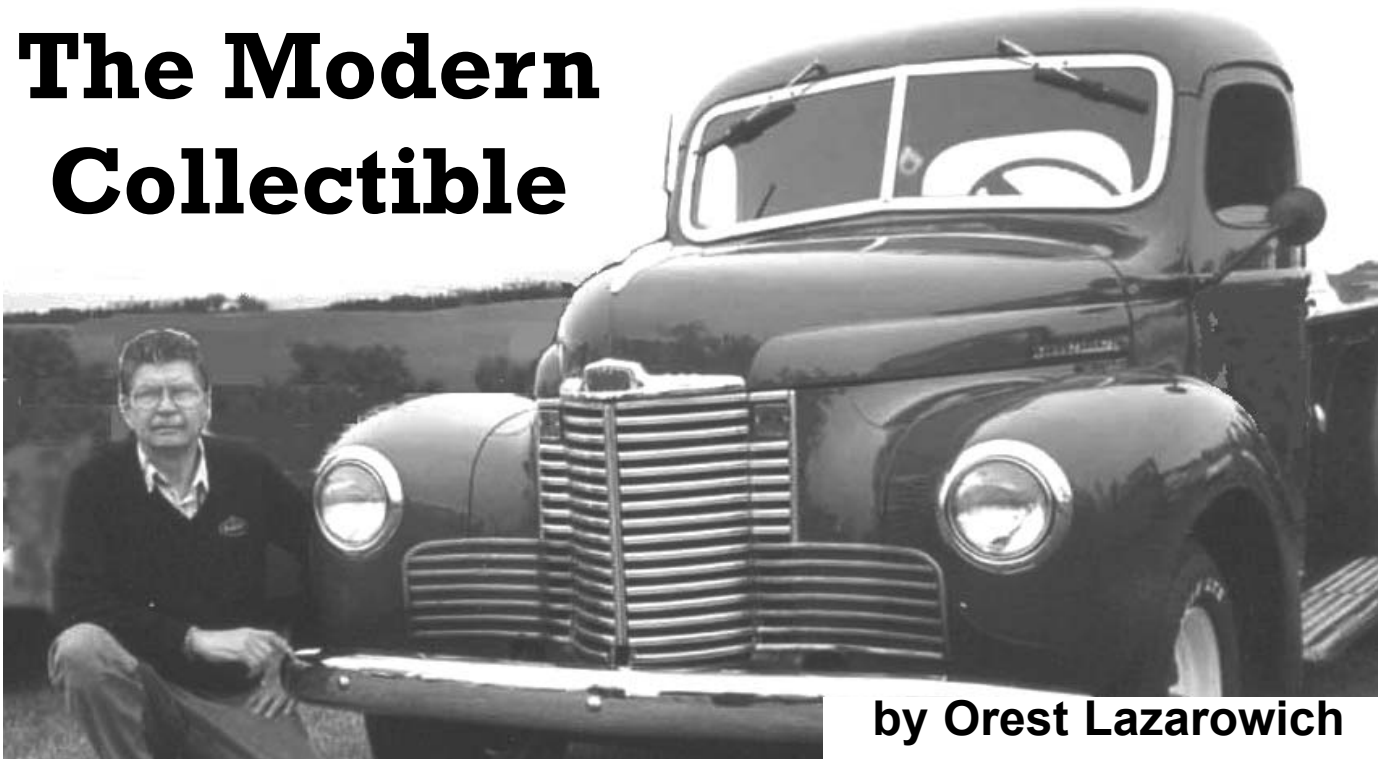


# The Modern Collectible



by Orest Lazarowich

*A DETAILED TECHNICAL COLUMN INTENDED TO TARGET MANY MAKES AND MODELS OF POST-WAR CARS AND PICK-UP TRUCKS*

## The Brake System, Part 2

The hydraulic brake system works on the principle that pressure on a liquid in a closed system is equal throughout the system. When the driver pushes the brake pedal, a piston or pistons in the master cylinder move the brake fluid through steel lines and apply equal force at all four wheel cylinders. The pressure of the brake fluid causes the pistons in the wheel cylinders to be forced outward pressing the linings against the discs or drums. In the older braking systems, the master cylinder has only one piston. The dual braking system - since the mid-1960s - has a master cylinder with two pistons, set in tandem, a pressure-differential valve assembly, and a dash warning light switch. One part of the dual master cylinder operates the front wheel brakes, and the other operates the rear wheel brakes. Failure of one system does not impair the operation of the other. The brake warning light signals a failure of either the front or rear brakes.

The frictional drag of the brake shoes against the brake drums tends to prevent the wheels from rotating, stopping the vehicle. The front wheel drum brakes usually have larger frictional areas than the rear wheel brakes, and the wheel cylinders are larger. This is to take advantage of the transfer of weight to the front wheels from the rear wheels when the brakes are applied. Many vehicles use disc brakes at the front wheels to place the most braking power and fade resistance up front where the traction is greatest during a hard stop because of the shift of vehicle weight forward.

The disc brake has a metal disc instead of a drum and two flat brake shoes (pads) located on each side of the disc. A caliper holds the brake shoes in place and houses the wheel cylinder. In a single piston caliper when the brakes are applied, the brake fluid flows to the cylinder in the caliper and pushes the piston out. The piston then forces the inner shoe against the disc and the opposing force pulls the caliper over to apply the shoe on the other side. The friction between the shoe and the disc slows and stops the disc, providing the braking action. The sizes of the reservoirs differ depending on the type of braking sys-

tem. Vehicles with disc brakes have larger master cylinder reservoirs for the disc brake side (rear). A proportioning valve located in the hydraulic system between the master cylinder and the rear brake wheel cylinders, meters the hydraulic pressure to provide a balance between the front and rear braking systems. The valve prevents premature lockup of the front wheels when the brakes are applied. This valve cannot be adjusted or serviced; if defective, it must be replaced.

## Power Brakes

For hard braking and fast stops, considerable pressure must be exerted to activate the brakes. Also, the heavier the vehicle, the greater the braking effort required. A vacuum-assisted braking system - commonly known as 'power brakes' - lessens the foot pressure required to apply the brakes. When the brake pedal is moved to apply the brakes, a valving arrangement is actuated. The valves admit atmospheric pressure on one side of a diaphragm and apply vacuum to the other side. The diaphragm then moves toward the vacuum side. This movement supplies most of the hydraulic pressure, through the brake fluid, to the wheel cylinders, thereby increasing the total force being applied, which in turn increases the braking action.

In case of vacuum failure, the brakes can still be applied, but since there is no power assist, more brake-pedal pressure is required.



**Master cylinder with vacuum booster assembly which supplies power assist to brakes.**

## Brake Failure

The hydraulic brake system is quite reliable. However, any leak in the system can result in a complete loss of the vehicle's braking ability. Brake failure can be a killer! This is the main reason for the dual brake system. It is not likely that both systems would fail at the same time. If you notice that the brake pedal gradually goes to the floor boards, it may be the result of normal wear of the brake linings. It can be corrected by a minor adjustment unless the brake linings are worn out, and then they should be replaced. A

springy or spongy brake pedal can be a sign that the brake shoes need adjusting, or that there is air in the hydraulic system. Check the brake shoe adjustment and make the necessary corrections. If pedal action is still soft, bleed the brake system.

In the single piston master cylinder, if the brake pedal goes to the floor suddenly, there is a leak in the hydraulic system or the pedal linkage is broken or disconnected. Bring the vehicle to a safe stop even if you have to side swipe the plastic road markers. Do not hit anything dead on. Check for broken or leaking lines or connections, especially the flexible lines. Check the master cylinder and the wheel cylinders for leakage. Brake fluid leaking at the bottom of the brake drum probably means a defective wheel cylinder. Do not attempt a roadside repair; get the vehicle home or to a service shop with the assistance of a tow truck. Don't risk driving.

The dual braking system uses a pressure-differential switch to operate a warning light. The purpose of this light is to let the driver know that one half of the braking system has failed. Front wheel brake loss increases the stopping distance noticeably, while rear wheel brake loss does not affect it as much. You can safely drive the vehicle home or to a service shop with the rear brakes inoperable.

## Maintenance

Check the master cylinder, and if it is empty, there is a leak in the hydraulic system. Look for signs of leaking brake fluid. Pull back the rubber boot that is around the brake push rod (at the master cylinder). If there is evidence of brake fluid, remove the master cylinder for rebuilding or replacement. If this vehicle has not been a daily driver and if the master cylinder is not seized, fill the master cylinder with brake fluid and pump the brake pedal. Locate the brake fluid leak. If a hydraulic line is leaking, it must be replaced. Do not splice a short piece of new line into an old line. Replace the entire line with a new steel brake line. Try and buy a new line that is already bent to shape from the vehicle manufacturer. If this is not possible, follow the excellent article in *Skinned Knuckles* June 2007 to bend a line to shape. *Brake and Equipment* now stocks an EZiBend brake line tubing to simplify this job. See ad on page 48 and 'Unusual

*Products' on page 24.* They can also supply many of the parts for a complete brake job as well as resleeving of cylinders.

If the master cylinder is seized, remove it and service or replace it. You will probably find that the wheel cylinders are also in about the same state of disrepair. They will have to be serviced or replaced before you can operate the brake system.

### Master Cylinder (single system)

If the master cylinder is located under the floor boards, raise the vehicle to a comfortable working height. Roll back the floor mat on the driver's side and remove the floor board access plate which is just above the master cylinder. Slide under the vehicle and disconnect the hydraulic line(s) at the master cylinder. Remove the wires from the stop light switch, if applicable, and tape each wire separately to avoid a short circuit. If the line is rusty and covered with road dirt, clean the outside of the line with a wire brush or emery cloth. Spray some rust penetrant around the fitting. To prevent damage to the fittings, use two flare wrenches when loosening the connections. Do not twist the line off. If the fitting does not come free of the line, spray more penetrant around the fitting. Give it time to work. Remove the brake line and plug the end with a plastic golf tee. Remove the cotter key and clevis pin from the push rod at the brake pedal. Remove the bolts holding the master cylinder in place, and lift the cylinder from the frame.

If the master cylinder is under the hood, cover the fenders with fender covers or any rubber backed matting. Even if you just love your big belt buckle, you won't be too happy if you score the front fender with it.

Disconnect the brake line(s). Plug the ends. Remove the fasteners that hold the master cylinder to the firewall or the power brake assembly. Cover the open end of the master cylinder with a shop cloth. Lift the master cylinder out of the engine compartment. Do not drip brake fluid on painted surfaces. It will remove the paint.

Do not remove the filler cap or cover. Wash the outside of the master cylinder and blow it dry. Remove the rubber boot and push rod. Before you disassemble the master cylinder,

make sure you can purchase a rebuild kit. If a kit is not available, check to see if the brake shop has a replacement master cylinder. Place the master cylinder in a vise so that the lock ring can be removed from the small groove in the inside diameter of the bore. Clean the outer end of the bore with emery cloth. Remove the lock ring and the piston assembly. If you cannot remove the



***Sometimes it makes more sense to buy a new master cylinder than to rebuild yours.***

piston assembly, you have a problem. It probably means that the rear part of the bore is corroded. You might be lucky if the hydraulic line enters the master cylinder in direct line with the bore, or if the master cylinder has an end plug. You could drive the piston out. If the hydraulic line enters the master cylinder at a right angle, scrap the cylinder. You would probably find the cylinder bore pitted and corroded, and it could only be rebuilt by fitting a brass sleeve. This is expensive, but if you can't find another cylinder it is one way of repair. Try the auto parts supplier before you visit the machine shop.

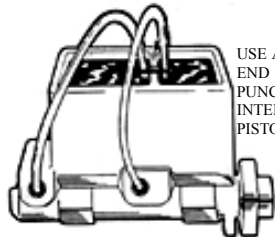
If the master cylinder comes apart properly, wash all the parts in brake cleaner or soap and water and blow it dry. Make sure the compensating and bypass ports in the cylinder body are clean and open. Inspect the cylinder bore for pits and foreign matter. Very light pits can be honed out with a brake cylinder hone, but check piston fit in the cylinder bore. Maximum clearance is 0.005 inch. Rebuild the cylinder by installing a new master cylinder kit. If you have a new old stock (NOS) master cylinder kit, make sure the rubber parts have not deteriorated. If you cannot rebuild the master cylinder, go for an exchange or an outright purchase of a new one.

Do not assemble the parts dry. Lubricate them with fresh brake fluid. Never allow grease or oil to come in contact with the rubber parts, since this would cause them to swell. Install the valve seat in the cylinder bore so that the flat portion of the seat rests against the end of the cylinder bore. Position the check valve and the spring into the bore. Dip the primary cup into clean brake fluid and install over the end of the spring with the lip of the cup facing toward the check valve. Assemble the piston and secondary seal

so that the bypass holes face the primary cup. Install the piston stop and ring. Check the clearance between the edge of the primary cup and the center of the compensating port in the master cylinder. Use a wire and insert it through the reservoir and into the piston chamber. The primary cup must not cover any of the compensating port. Install the stop light switch, if it is mounted to the master cylinder.

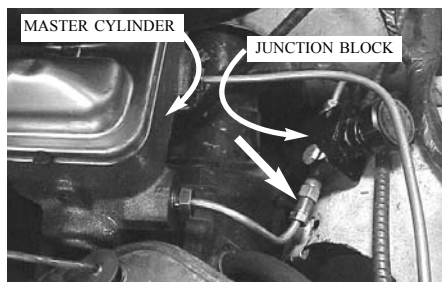
Bleed the air out of the master cylinder before you mount it back in place. Attach a short

piece of brake line or tubing to the master cylinder and direct it into the master cylinder filler hole. Mount the brake cylinder in



the vise. Fill the reservoir with fresh brake fluid. Use a punch to push the secondary piston in and slowly bring it back. Continue operating the piston until there is no air coming out of the bleeder tube. Screw in the filler cap or mount the cover. Use new gaskets. Mount the master cylinder in the vehicle. Connect the brake light switch. Remove the golf tee from the hydraulic line and connect the hydraulic line to the master cylinder. If the brake pedal rod is adjustable, allow about 1/8"-3/8" brake pedal free play. Before you make the adjustment, make sure the brake pedal returns to the fully released position with no binding and that the pedal retracting spring has not lost its tension. Make the adjustment and tighten the check nut. If there is no sign of brake fluid leaks at the wheel cylinders, bleed the wheel cylinder lines.

Now, here is where a little bit of luck can enter into the bleeding operation. Locate the short brake line that goes from the master cylinder to the junction block. The junction block may be bolted to the frame. Clean the hydraulic line



**Bleed the line between the master cylinder and the junction block from the brass fitting at the junction block.**

around the fitting. Fit a flare wrench to the fitting and try to loosen this fitting. If you can loosen it, tighten it up before pro-

ceeding. Have a buddy pump the brake pedal and hold the brake pedal down. Loosen the fitting and let the air out that is trapped in this short line. Tighten the fitting. Try the brake pedal. If you have hard pedal on the first try, there is probably no any air in the brake system. If the pedal is spongy, bleed the wheel cylinders, starting with the one farthest from the master cylinder. Do not run the master cylinder dry. Check the brake fluid level after bleeding two wheel cylinders.

## Two Wheel Cylinders

The front wheels of Chrysler products through 1961 make use of two wheel cylinders at each wheel, each having a single piston. Each cylinder operates only one of the brake shoes. One cylinder is at the top of the brake assembly and operates the front shoe. The other cylinder is at the bottom of the brake assembly and operates the rear shoe. Each cylinder is mounted by means of an anchor pin for the opposite shoe. A steel brake line connects the two cylinders. Follow the service manual procedure when rebuilding these cylinders. A single-cylinder is used at the rear wheels. The cylinder is equipped with two pistons which operate in opposite directions. The parking brake is on the drive shaft at the rear of the transmission.

## Single Wheel Cylinder

Locate the wheel that is showing signs of a brake fluid leak. The bottom of the backing plate will be wet with brake fluid. Loosen the wheel studs or nuts while the wheel(s) are on the floor surface. Raise the vehicle to a comfortable working height and set it on safety stands. If you are servicing the front wheel cylinders, raise the front of the vehicle. Raise the rear of the vehicle to service the rear wheel cylinders. Raise the vehicle on four stands if you are servicing all the wheel cylinders. Block the brake pedal in the released position to prevent operation of the brake pedal and avoid the loss of brake fluid. If servicing the front wheel cylinders, remove the wheel and then the brake drum. It may be necessary to loosen the brake shoe adjuster to free the drum for removal.

On some styles the front wheel hub is part of the brake drum. Remove the dust cap, cotter key and axle nut. Pull the brake drum outward and remove the front wheel bearing. Wrap the

bearing in a clean cloth and set it aside. Pull back the rubber dust boot, and if there is brake fluid in the boot, then the wheel cylinder is leaking. Make a detailed drawing or take a photograph of the placement of all parts to help in installation later. Don't trust your memory. Remove the brake-shoe return spring, and spread the brake shoes outward away from the wheel cylinder. Loosen the flexible brake line from the wheel cylinder. Remove the screws or bolts that hold the wheel cylinder to the backing plate. Turn the wheel cylinder to unscrew it from the flexible brake line. Plug the brake line. Wash the brake cylinder with brake-system cleaning fluid and blow the wheel cylinder dry. Service one wheel cylinder at a time, whether front or back.

To remove some rear brake drums, it is often necessary to use a brake drum puller. On other styles, the drum fits on the axle shaft and comes off more easily. If the brake drums are worn, it may be necessary to retract the adjusting screw. On styles that have a rubber or metal plug in the adjusting hole, remove the plug, and use a brake adjusting tool to retract the adjusting screw. Some vehicles may not have the metal in this area of the backing plate removed. Use a chisel to knock out the lanced area of the backing plate. A new hole cover must be installed when the drum is reinstalled. Some vehicles use a cam adjustment bolt to adjust the brake shoes. Move this bolt upward on most models to move the brake shoes away from the drum. Remove the brake drum.

Disconnect the hydraulic line at the rear of the wheel cylinder. Do not twist this line off. Clean the line around the fitting and use penetrating oil to break down the rust between the fitting and the brake line. Remove the line and plug the end. Remove the brake shoe retracting spring, and pull the brake shoes out of the wheel cylinder. Remove the bolts that hold the wheel cylinder to the backing plate, and remove the wheel cylinder. Clean the outside of the wheel cylinder. Check for a rebuild kit or a new wheel cylinder. It is not worth the shop time to have a wheel cylinder rebuilt. If you can not do the rebuild yourself, buy new wheel cylinders.

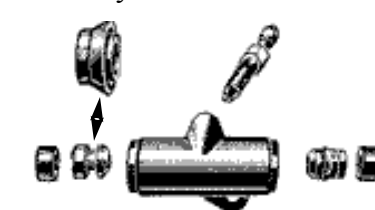
### Wheel Cylinder Rebuild

Disassemble the wheel cylinder if a rebuild kit is available. Remove the bleeder screw. Do not twist it off. Examine the cylinder walls. If they are scored or rusted, a brake hone

should clean them up. Do not hone any more than is required. Check the fit of the pistons in the cylinder. Clearance between the two pistons and the cylinder wall should be under 0.003" when checked with a flat feeler gauge. Wash the cylinder with hot water and soap and dry thoroughly. Replace the cylinder assembly if the bore is scored or damaged.



**Carefully, remove wheel cylinder.**



**There aren't many parts to a wheel cylinder, but they have to be clean before reassembly.**

Install the bleeder screw. Dip the pistons and cups in fresh brake fluid. Place the spring in the center of the housing. Install the rubber cups at each end of the spring with the cupped side toward the spring. Install the pistons with the flat side against the flat side of the rubber cup. If necessary, lubricate with fresh brake fluid. Never use oil or grease. Replace the boots. Connect the flex brake line to the front wheel cylinder before you mount the wheel cylinder to the backing plate. Replace the flexible lines if they are cracked, chafed or show signs of leakage. Connect the rear wheel cylinder to the hydraulic line and then to the backing plate. Tighten the screws or bolts securely. On both front and rear, replace the brake shoe retracting springs. Install the rear brake drum, and adjust the brake shoes. Install the front drum, and adjust the wheel bearings. Adjust the front brake shoes.

Top off the master cylinder with fresh brake fluid, and bleed the air out of the brake system. If you only repaired one wheel cylinder, bleed this wheel cylinder first. Do not let the master cylinder run dry. There must be hard pedal on the first pedal application. If it is spongy, there is still air in the system.



**Always use fresh, clean brake fluid, never used fluids. DOT 4 is the normal fluid; DOT 5 is silicone and should not be mixed with DOT**

If any of the brake lines are rusted or show evidence of leaking, replace them. Use brand new steel brake lines. Do not use copper\*.

Do not trust your life to a brake system that is not operating properly. If you feel that you can not do brake repair safely yourself, have it done at a brake shop. Happy motoring.

\* *A new product, copper-nickel brake lines, has been tested by and is reportedly in use by Volvo, Audi, Porsche and Aston-Martin. This material, known as CNF stands for Copper Nickel Ferrous (iron) alloy C70600; copper with the addition of 10% nickel, 1.4% iron and 0.8% manganese. Besides the ease of handling, the ability to run one full length of tubing without splices, and the fact that it can be easily flared, the big advantage seems to be the corrosion resistance. Most testing that I have read about at this point indicate excellent resistance to salt and other de-icing materials. They also indicate a much greater strength than copper (not alloyed) or brass tubing alone.*

*Having said this though, I must look at the product realistically. Granted, ease of installation is a big plus. So is the return to the type of material often used in our antique (pre-1930) cars. But generally these same antique and classic cars are removed from the roads prior to snow, ice and the use of salts to remove them.*

*I will, over the next several months, research this material and its application before making any blanket recommendation for its use. I will report back to you with my findings. Editor*

*Editor's note: As long as you already have the wheels off, be sure to check and repack the wheel bearings. With the wheels off, it's a simple job. See SK August 2007 for details.*

Often, when doing a complete brake job on an antique or classic car, parts are not readily available at your local spares store. A specialist is necessary to help you with the right parts for the job. Don't play games or take half-measures with your brakes. Brake and Equipment Warehouse is a long-time advertiser with *Skinny Knuckles* and brakes are their only business. They can supply virtually any part that you might need for your brake job, including brake lines (they have the new EZiBend brake lines in standard diameters), a full range of obsolete and obscure fittings, custom fabricated brake hoses, shoes and pads, and cylinder resleeving services. Give them a call. See their ad on page 48 of this issue.

*Brakes feel fine, Dear*



Coming Next Month:  
Dualmaster cylinder and caliper repair

## UNUSUAL PRODUCTS

### BENDABLE BRAKE LINE

Here's a new product that we can get a bit excited about: a brake line that can be readily bent, flared and installed in one-piece. EZiBend brake tubing is sold by Brake and Equipment Warehouse of Minneapolis. The manufacturer has advised us that this new copper-nickel alloy brake line is sold by the foot; a brake line can be fabricated in one piece rather than having to patch a long run as was necessary with traditional steel brake lines purchased at the local auto parts store. It has the ease of handling of copper, and it's hand-bendable, but with the special nickel alloy it has enhanced corrosion resistance and durability.



*This column is designed to showcase a product which can make your restoration job a little better, a little faster, or just a little easier. Products shown here are not necessarily new, but they might fall into the less-than-common usage category. We are not necessarily endorsing the product or the manufacturer, but just passing the information along to you.*

For an older car, one with obsolete or unusual brake fittings, they can be restored using the original or original-type brake fittings. The line can be flared - single flare, double flare, bell flare, mushroom or ball flare - all do-able with this product. And Brake and Equipment Warehouse can supply a wide range of fittings to complete your brake job. EZiBend tubing can be polished to give a bright nickel appearance, painted or just left as-is. It is available in sizes of 3/16", 1/4" 5/16" & 3/8" OD. and is completely compatible with DOT 3, DOT 4 and DOT 5 (silicone) brake fluids.

**BRAKE & EQUIPMENT WAREHOUSE** (see ad page 48)  
**1-800-233-4053**      **www.brakeplace.com**

This article originally appeared in the September 2007 issue of *Skinned Knuckles* magazine. *Skinned Knuckles* is dedicated to the authentic restoration of cars and trucks and to the preservation of vehicles from the brass era through the early 1970s. It is available by subscription only. Articles are copyrighted and all rights reserved. Reprinting authorized by written permission of the publisher only.

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