OBJECTIVES

When you have completed this chapter, you should be able to:

- Explain why "hydraulics" and "friction" are important to automobile brakes.
- Diagram the three types of automotive hydraulic systems.
- Define "brake ratio" and list the two brake ratios found on automobiles.

THE HISTORY OF THE AUTOMOTIVE BRAKE

The first automotive brakes were simple adaptations of the brakes used on wagons at the turn of the century. The brake, controlled by a lever, rubbed against a friction block. It didn't offer a lot of braking action, but—because the roads were poor and horsepower was limited—it was sufficient to stop the early cars.

As cars were improved, the wagon brake was replaced by the external band brake. This, as the name implies, consisted of a steel band with leather friction material. It wrapped around a hub or drum, and when it was tightened by a lever or pedal, it stopped the vehicle. As you might imagine, since the brake was external—that is, exposed—moisture and dirt and gravel from the road were a problem.

As cars, tires, and roads were improved, brakes had to be improved. The first of these major improvements were mechanical brakes, still "external" or outside the car. First, these were only on the rear wheels; later they were added to the front. A "hand brake" or "emergency brake" was added to hold the car when it was parked.

A major breakthrough came with the introduction of the internal brake. Like the brakes before it, it was mechanical, but this one used a variety of devices—cams, levers, rods, linkage, brake shoes, and a drum—to stop the car. Unfortunately, since the braking action was not distributed equally among the four wheels, the car often stopped well off the side of the road.

In the 1920's a new idea in brakes was introduced. The 1921 Dusenberg had brakes that used "hydraulics" to carry the pressure from the driver's foot to the brakes, instead of the cumbersome mechanical linkages. During the next decade other manufacturers, including Chrysler (1928) and Oldsmobile (1934), adopted hydraulic brakes. The last manufacturer to make the switch from mechanical brakes to hydraulics was Ford in 1939.

In not quite four decades, from the early years of the century until the years just before World War II, the automobile brake had developed from a simple wagon brake attached to a "horseless carriage" to a sophisticated hydraulic system capable of safely stopping a car traveling at speeds the "horseless carriage" drivers would have never thought possible.

You could make an argument that the brake system is the single most important system on a car. A brake system in need of repair will be noisy and annoying at best. At worst, it is very dangerous.

BRAKE BASICS

Basic to the operation of any automotive brake system are two well-known principles of physics. They are:

- A liquid in a closed container transmits applied pressure equally in all directions.
- Energy cannot be created or destroyed. It can, however, be converted into other forms of energy.

If the applications of these two principles to automotive brake systems are not immediately obvious, don't be concerned. That's what the rest of this chapter deals with.

To see how the first principle—hydraulics—relates to brakes, consider how the hydraulic brake system works. The driver presses the brake pedal, that pressure is applied to the non-compressible fluid in the system, the "brake fluid", and it transmits the pressure to the brake shoes.

The fact that the pressure is applied equally from the master cylinder to each wheel cylinder—remember the hydraulic principle we mentioned—is what allows properly adjusted brakes to stop the car evenly.

Another important word to remember is "non-compressible." This means that the pressure from the brake pedal is transmitted through the system instead of simply compressing the liquid. Air and water (which becomes steam at