



The Development of the Braking System; Part 1 - Steve Bullôt

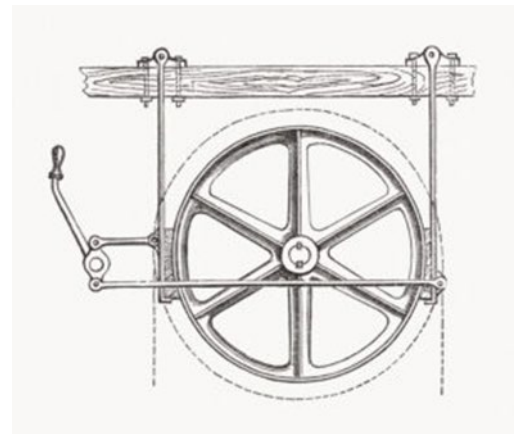
Why brakes? When it comes to vehicles, whether they be cars, trucks, bicycles or any other of the myriad vehicle types calling themselves 'transport', the first thing to consider is Newton's First Law of Motion: an object that is put into motion will stay in motion unless it is acted upon by some external force. This is why brakes are needed. Vehicles change the stored energy in fuel or batteries into kinetic energy (movement). When the operator wants to stop then there has to be a way to dissipate that kinetic energy. Obviously, some environmental factors help with this: air resistance, gravity, drivetrain loss, and even just friction with the ground, but in most cases slowing or stopping needs to be faster and more controlled than leaving the process to nature, so, brakes.

The evolution of vehicle brake systems has been impressive and has included many new technologies throughout the years. In all new developments to the brake system, the number one priority has been to improve efficiency and safety, or at least to keep pace with increase of the weight of vehicles and the increasing speeds they can achieve.

Since the earliest cars and trucks, many braking systems have been used. As the story of brakes progressed, each new system was built on the knowledge and experience of its predecessor. Brake system evolution began in the 19th century and continues today. Early braking systems included;

Wooden block brakes

The earliest brake system applied the same physical principles used to design brakes today, that of using friction between a fixed pad or block and the rotating mass of the wheel. However, the early systems consisted of a single, or sometimes two, wooden blocks, later updated with leather facings, operated by the driver using a lever operating through a pivot or a series of pivots to give sufficient mechanical advantage to effectively apply the brake to the outer rim of the wheel. This form was sufficient while powered vehicles were slow and the outer rim or tire of the wheel was a steel band, however both increasing speeds and the invention of the rubber tyre rendered this brake system, a carryover from horse-drawn vehicles, obsolete.

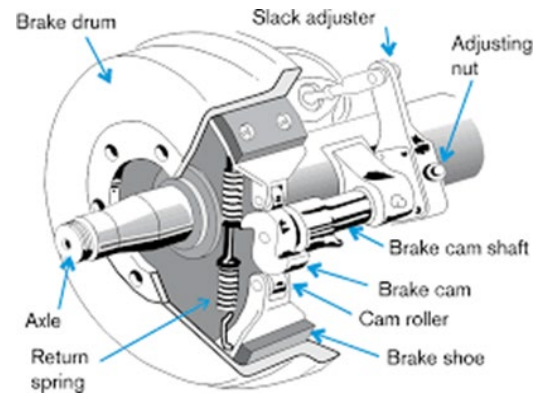


Mechanical drum brakes (External)

Considered to be the foundation of the modern braking system, the mechanical drum brake was commercially developed in 1902 by French vehicle manufacturer Louis Renault but had been invented earlier by Gottlieb Daimler. While Daimler and another German automotive pioneer, Maybach, had theorized that anchoring a cable-wrapped drum to the vehicle's chassis could be used to stop momentum, thus creating the first concept of the drum brake, Renault, however, applied a much more efficient solution where the brake shoes, fitted with sacrificial friction material and operated by a system of levers or cables, were pressed onto a rotating drum fitted to the wheel hub. Among the advantages of this system was the fact that brakes could be fitted to more than one wheel while being operated using a single control effectively doubling or more the braking effect without the driver having to do additional work.

Expanding internal shoe brakes (Drum Brakes)

Before the expanding internal shoe brake, the modern drum brake, was invented, all brake systems had been external and open to the elements. Those systems were vulnerable to their environment, being affected by dust, dirt and moisture and by fluctuations in temperature, all of which made the brake less effective. The internal shoe brake was the first to be encased and protected from external factors, an important innovation in the history of braking systems. The major drawback for the internal shoe drum brake was heat build-up leading to a loss of efficiency, brake fade. This phenomenon led to the rapid development of more heat-resistant friction materials.



Disc brakes

The disc brake was invented long before becoming popular. Frederic Wilhelm Lanchester patented the disc brake in 1902. The system consists of a caliper mounted to the vehicle while the disc mounted to the rotating mass of the wheel rotates inside it. When the brake is applied pistons within the caliper exert pressure on the friction lining and, consequently, on the brake disc. The system did not become popular until the auto industry began to boom in the mid-20th century, Jaguar proving the system by winning at the Le Mans 24hr with its disc brake equipped C Type sports racers. The rise of disc brakes as a popular option is attributed to the increasing weight and speed capabilities of vehicles, which caused drum brakes to become less efficient in distributing heat. The first system to use disc brakes integrated both disc and hydraulic functions and was introduced in the Chrysler Imperial. In heavy vehicles the disc brake was introduced in the 1970s. Uptake was good in European markets where there were large numbers of dedicated combinations, but they didn't prove as popular in North America where the 'mix and match' role of trucks regularly towing different trailers led to significant issues with compatibility of brake systems. There was also a significant cost differential between disc and drum brake systems although this is often offset by the reduced maintenance costs of disc brake systems. Another key advantage of the disc brake is dissipation of heat. Disc brakes are cooled by air movement across their surface and internally using ventilation channels cast into the discs, they also transfer heat to the wheel rims further dissipating heat. Disc brakes are ideal for driving in difficult terrain, dynamic driving and emergency braking. Disc brake systems are also more compatible with the driver assist systems such as ABS or ESP. Squeezing turns out to be a better braking method than pushing. Calipers are better than shoes.



In Part 2 we will look at the development of brake operating and advanced control systems.

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