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Disc Brakes

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Abstract:
A disc brake assembly is provided that includes a camshaft extending from a slack adjuster. A disc brake rotor and a brake caliper bridge having an outer plate and an inner plate are provided. A brake caliper carrier is provided with an outer brake pad contained by the brake caliper carrier and an inner brake pad contained by the brake caliper carrier. A cam carrier having two openings is provided along with a pusher plate having a first surface in contact with the cam and a second surface in contact with the inner brake pad. A first and a second slide pin each extend through an opening in the cam carrier and an opening in the pusher plate and an opening in the inner plate of the brake caliper bridge and into the brake caliper carrier. A cam is mounted onto the camshaft such that rotation of the camshaft will rotate the cam, and the brake caliper bridge inner plate having a surface in contact with the cam. The brake caliper bridge outer plate having a surface in contact with the outer brake pad, such that upon rotation of the camshaft and the cam, the pusher plate adjusts the axial position of the inner brake pad and the brake caliper bridge outer plate adjusts the axial position of the outer brake pad, actuating the brake.

Introduction
Disc brakes are a brake system that slows a wheel's rotation by squeezing an attached metal disc in a viselike hydraulic caliper [1-2]. Disc brakes use the same principle as bicycle handbrakes, but on a bike the brake pads press against the wheel itself. On a car, the disc is part of the hub to which the wheel is mounted [3]. The disc, technically called a rotor, is clearly visible through spoked wheels.

How They Work
A disc brake system consists of a brake disc, a brake caliper and brake pads. When the brake pedal is applied, pressurised hydraulic fluid squeezes the brake pad friction material against the surface of the rotating brake disc [4]. The result of this contact produces friction which enables the vehicle to slow down or stop.

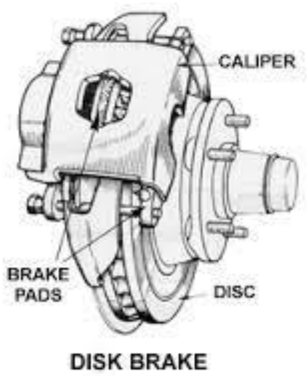

Fig.1.disc brake model

HISTORY OF DISK BRAKES
Ever since the invention of the wheel, if there has been "go" there has been a need for "whoa." As the level of technology of human transportation has increased, the mechanical devices used to slow down and stop vehicles has also become more complex [5-7]. Before there was a "horse-less carriage," wagons, and other animal drawn vehicles relied on the animal's power to both accelerate and decelerate the vehicle. Eventually there was the development of supplemental braking systems consisting of a hand lever to push a wooden friction pad directly against [8-10] the metal tread of the wheels. In wet conditions these crude brakes would lose any effectiveness.

The early years of automotive development were an interesting time for the designing engineers, "a period of innovation when there was no established practice and virtually all ideas were new ones and worth trying. Quite rapidly, however, the design of many components stabilized in concept and so it was with brakes; the majority of vehicles soon adopted drum brakes, each consisting of two shoes which could be expanded inside a drum."

BRAKE BASICS

When you depress your brake pedal, your car transmits the force from your foot to its brakes through a fluid. Since the actual brakes require a much greater force than you could apply with your leg, your car must also multiply the force of your foot.

It does this in two ways:

- Mechanical advantage (leverage)
- Hydraulic force multiplication The brakes transmit the force to the tires using friction, and the tires transmit that force to the road using friction also. Before we begin our discussion on the components of the brake system, let's cover these three principles:

- Leverage
- Hydraulics
- Friction

LEVERAGE

The pedal is designed in such a way that it can multiply the force from your leg several times before any force is even transmitted to the brake fluid.

In the figure above, a force F is being applied to the left end of the lever. The left end of the lever is twice as long (2X) as the right end (X). Therefore, on the right end of the lever a force of 2F is available, but it acts through half of the distance (Y) that the left end moves (2Y). Changing the relative lengths of the left and right ends of the lever changes the multipliers [11].

HYDRAULIC SYSTEMS

The basic idea behind any hydraulic system is very simple: Force applied at one point is transmitted to another point using an incompressible fluid, almost always an oil of some sort. Most brake systems also multiply the force in the process

FRICTION

Friction is a measure of how hard it is to slide one object over another. Take a look at the figure below. Both of the blocks are made from the same material, but one is heavier. I think we all know which one will be harder for the bulldozer to push. Friction force versus weight To understand why this is, let's take a close look at one of the blocks and the table: Even though the blocks look smooth to the naked eye, they are actually quite rough at the microscopic level. When you set the block down on the table, the little peaks and valleys get squished together, and some of them may actually weld together. The weight of the heavier block causes it to squish together more, so it is even harder to slide [12-13]. Different materials have different microscopic structures; for instance, it is harder to slide rubber against rubber than it is to slide steel against steel.

The type of material determines the coefficient of friction, the ratio of the force required to slide the block to the block's weight. If the coefficient were 1.0 in our example, then it would take 100 pounds of force to slide the 100-pound (45 kg) block, or 400 pounds (180 kg) of force to slide the 400-pound block. If the coefficient were 0.1, then it would take 10 pounds of force to slide to the 100-pound block or 40 pounds of force to slide the 400-pound block. So the amount of force it takes to move a given block is proportional to that block's weight. The more weight, the more force required. This concept applies for devices like brakes and clutches, where a pad is pressed against a spinning disc.The more force that presses on the pad, the greater the stopping force.

WHY DISK BRAKES?

Why disk brakes in a truck or bus that travels in excess of 65 mph? Improved road handling, higher engine ratings and torque, reduced drag and rolling resistance resulting in faster acceleration and higher average

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speeds Higher vehicle speeds with full loads Higher traffic density, greater chances of emergency braking Extremely high kinetic energy needed to brake on wet roads, high front axle loads effecting vehicle directional stability The power and behaviour of drum brakes cannot be improved Disk brakes provide optimum braking while retaining directional stability.

Why are disk brakes more efficient?

Flat brake disk (axial brake) under high pressure versus round brake drum (radial brake) during braking Full friction surface of the brake pad on the plane brake disk No loss of brake power due to overheating or partial contact from brake drum parts expansion Disk brakes can withstand higher loads and its efficiency is maintained considerably longer even under the highest stresses Higher residual brake force after repeating braking Brake disks can withstand extremely high temperatures Full contact of brake pads achieve maximum effect No vitrification of brake pads. Dangerous fading or slipping is almost completely eliminated.

Why do disk brakes have a better braking behavior?

Driver friendly braking behavior. Sensitive braking in all situations and better Sensitive brake application and better brake feeling Uniform braking from small fluctuations in brake forces Retardation values retained even under heavy stresses Minimal "pulling to one side" due to uneven brake forces Disk brake axial arrangement permits a simple and compact design Linear characteristics lead to an even progression of brake force Basic design principle makes for higher efficiency Low hysteresis is particularly suitable to ABS control cycles.

Why are disk brakes more economical?

Clear economic benefits due to long service life and reduced maintenance downtime Long service life of disks and pads versus drum brakes shorter service downtime due to quick pad changes. Good access for visual brake components checks.

Maintenance free brake components

Optimized installation space in the wheel rim resulting in the largest possible brake disks and pads Optimized cooling resulting from open sliding caliper design with internally ventilated brake discs Even and safe brake pad wear resulting from simple pad guide with level braking faces

Why do disk brakes have higher safety reserves?

Minimal braking effect from high temperatures and extreme driving requirements Minimal heat fading No brake disk distortion from extreme heat due to internal ventilation with directional stability and large power reserve under high stress. The decisive safety aspects of the disk brake design are shorter braking distances.
High power and safety reserves for emergencies Constant braking power under high stresses

Types of Disk Breaks

Disc Brakes

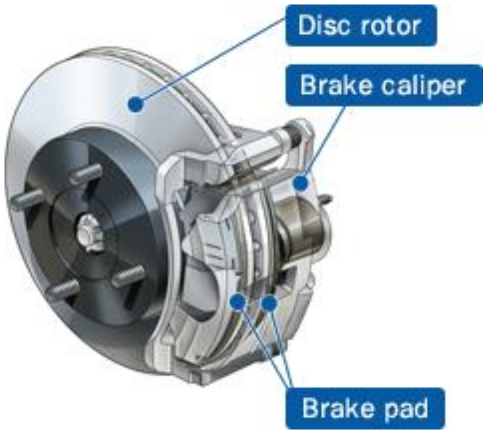

Fig.2. disc brake with motor

This type of brake consists of a disc rotor that is rotating together with the wheel and a stationary brake caliper assembly equipped with brake pads. When pads are forced against the rotor from both sides, friction that is generated converts kinetic energy into heat, which causes the rotor and attached wheel to slow or stop. Since major disc brake components are exposed to air, heat generated during braking can dissipate efficiently, which offers high resistance to brake fade (heat-induced degradation of braking

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performance). In addition, since water is flung off the rotor due to its rotation, the phenomenon of water fade (significant loss of braking performance caused by buildup of water on the disc) becomes less likely to occur, which in turn provides safer and more stable braking performance.

- Opposed Piston Type
- Floating Caliper Type

Opposed Piston Type Disc Brakes

Fig.2. brake motor

This type of disc brake has pistons on both sides of the brake rotor, and there are no moving parts in the caliper assembly other than the pistons themselves. This type of caliper provides very even pressure distribution between pads and rotor providing better braking performance, especially under severe braking conditions. To further improve the performance of opposed piston type brakes, it is possible to increase the number of pistons (often referred to as the number of "pots") - there exist, for example 4-pot or 6-pot models. Apart from the regular passenger cars, Akebono also supplies opposed-piston disc brakes for high-performance vehicles.

Floating Caliper Type Disc Brake
For Passenger Cars

Fig.3.caliper

Floating caliper type disc brakes have a piston (or pistons) only on the inner side of the rotor. When the brake is engaged, a piston pushes the inner brake pad against the rotor. This generates a reaction force that moves the caliper itself along the slide pin, pushing the outer pad against the rotor to clamp it from both sides and achieve braking action. Many passenger car disc brakes use the floating caliper design, since its simplicity and low weight result in low manufacturing cost.

For Commercial Vehicles

Fig.4.clipper

Disc brakes are used mainly in passenger cars, but due to their stable performance at higher speeds and resistance to brake fade, they are gradually spreading into the commercial vehicle segment, where drum brakes were traditionally chosen for their long lining life.

Advantages of Disk Brake

1. Disk brake requires less effort (brake torque) to stop the vehicle compare to drum brake.
2. It generates less heat compare to drum brake for the same brake torque.
3. Ease of maintenance as disk brake is outside the wheel rim.
4. It cools down faster compare to drum brake.
5. If worn out brake shoes are not changed at proper time it can cut the brake drum in drum brake. Disk brake does not have such problem.
6. It is less likely to skid compare to drum brake in wet condition.

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7. It is much safer than drum brake in hard braking condition. Under such condition drum brake can lock up the rear wheel.
8. It has brake pad wear indicator which is not there in drum brake.

Disadvantages of Disk Brake

1. It is expensive compare to drum brake.
2. More skills require to operate disk brake compare to drum brake that's the reason why some people are not comfortable with disk brake
3. If any air remains in disk brake system, it can cause accident as the brake will not work effectively.
4. Disk brake assembly has more moving parts and much complex than drum brake.
5. It requires lot of effort at maintenance front like brake fluid (bleeding), change of brake pads etc compare to drum brake.

Results

Fig.5. disc brake.1

Fig.6.disc brake 2

Fig.7.disc brake

CONCLUSION

Many trucks and buses are equipped with air actuated sliding caliper disk brakes The high contact forces are transmitted mechanically via needle mounted actuating device Depending on size the actuating pressure is transmitted evenly to the brake pads via one or two plungers The easy action, fully sealed guides between the axially moving sliding caliper and fixed brake anchor plate are maintenance free. Integrated automatic adjustment with wear display. There are no brake shafts, external levers or cylinder brackets, as the brake cylinders are directly attached. The high efficiency of 95% is achieved by only a few moving parts and low friction bearings Asbestos free brake pads 19 to 23 mm thick, depending on version extremely heat resistant brake disks (34 to 45 mm) made of special gray cast iron with internal ventilation The brake disks are 330 to 432 mm in diameter and permissible wear of 6 to 10 mm allowed; depending on version .The service and parking brakes use the same actuating unit and differ only in the shape of the brake cylinder.

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