



TRENDS IN BREAKING SYSTEM OF SURFACE MOVING VEHICLES: A TECHNICAL REVIEW

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ABSTRACT

Globalization increases rapidly over the years along with the technology. But the Economic growth of the countries lies in its transportation capabilities. Transportation plays a vital role in today's world. It may through air, water or surface mediums. But the most essential one and reliable one is surface transportation. Whenever the surface transport comes into picture it comprise of various vehicles like bike to a bullet trains. Here comes the factor called safety. The safety of a vehicle depends upon its own Braking system. Breaking is the most deciding element in the design of vehicle in automobile industry. Over the years many breaks like Disc brakes, Drum Brakes, hydraulic Brakes, Vacuum brakes are introduced but a new era has begun to develop more advanced braking systems like Anti-lock braking systems which ensure more safety and stability of a vehicle. Here we discuss about the advanced systems like ABS in detail.

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INTRODUCTION

The main purpose of the brakes is to slow and stop the vehicle. These are mandatory for the safe operation of a vehicle. when a car is in motion the generated kinetic energy is reduced by converting it into heat energy. This phenomenon is applied in case of brakes.

History

Over the years new techniques and trends are adopted to develop new breaking systems. The key breaks are as follows.

- **Wooden block brake:** This was the oldest and first braking system. It consists of a block of wood and a lever system. Whenever driver needs to stop, he pulls the lever located next to him then the block will bear against the wheel. This method used effective in horse drawn or steam powered vehicles.
- **Drum brake:** It is a forefather of modern day brake. These breaks become popular because of their advantages over other breaks. This could keep the brake out from water and dust materials that could damage disc brakes. These require less pressure as compared to that of disc brakes.
- **Hydraulic brakes:** One more advancement in brake technology came in 1918. Invention of hydraulic system by Malcom loughhead. It replaced mechanical brake system at that time.

The main disadvantage in mechanical brake system is its difficult to brake all the wheels evenly, often causing a loss of control. In addition it requires tremendous amount of force on the brake pedal to slow the car. This system multiplies the force that was applied to the brake, lessening the amount of force required to be applied to the brake pedal by the driver.

- **Disc brakes:** As the vehicle technology increases the vehicles become faster and heavier. The hydraulic brakes were effective but they had tendency to ineffectively distribute heat. This made room for creation of new breaking system. Even it is brought at the same time along with drum brake but it became popular in 1950's. First patented by William Lanchester. When these are assembled along with power breaking systems the efficiency of a vehicle increased a lot.
- **ABS:** After a rapid growth in the industry a new system called anti lock braking system(abs) is designed in aerospace industry in the early 1930s. But the use of this system in automobiles started in 1960s. It offers stability during heavy braking moments by preventing wheel lock. It is known that wheels will slip and lock up during severe breaking or when breaking on a slippery road. This causes a long stopping distance and sometimes the vehicle will lose steering stability.

The main purpose of abs is to manipulate the wheel slip so that a maximum friction is obtained and steering stability is maintained. Hence the vehicle stop in the shortest distance possible while maintaining the directional control. The future

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depends more on the abs. ABS components include - physical brakes, wheel speed sensors (up to 4), an electronic control unit (ecu), brake master cylinder, a hydraulic modulator unit with pump and valves. This paper present a literature review of research works done by many researchers concerning various aspects of abs technology to improve its efficiency and applications.

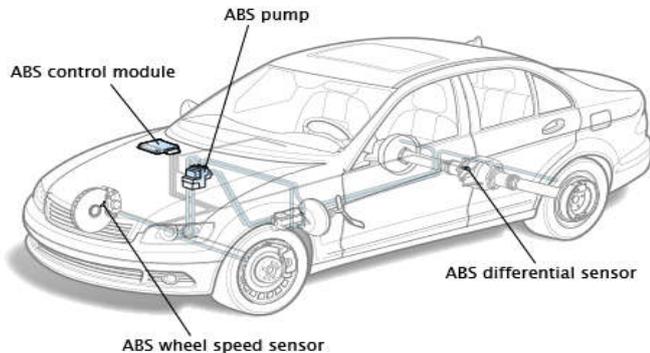


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Typical ABS Components

Principle of operation

ABS includes a central electronic unit (ECU), four wheel speed sensors, and at least two hydraulic valves within the brake hydraulics. The ECU monitors the rotational speed of each wheel, if it detects any change it actuates the valves to reduce hydraulic pressure to the brake at the affected wheel, thus reducing the braking force on that wheel then the wheel turns faster. Conversely, if the ECU detects a wheel turning significantly faster than the others, brake hydraulic pressure to the wheel is increased so the braking force is reapplied, slowing down the wheel. Here the pressure applied is normally 15 times per second. Hence the cars equipped with ABS are practically impossible to lock even during extreme situations.

Components & Operation

Speed sensors

The purpose of the sensor is to sense a change. A speed sensor is used to detect the acceleration or deceleration of the wheel. These sensors use a magnet and a coil of wire to generate a signal. The rotation of a wheel induces a magnetic field around the sensor. The fluctuations of this magnetic field generate a voltage in the sensor. Since the voltage induced in the sensor is a result of the rotating wheel, this sensor can become inaccurate at slow speeds. The slower rotation of the wheel can cause inaccurate fluctuations in the magnetic field and thus cause inaccurate readings to the controller.

Valves

There is a valve the brake line of each brake controlled by the ABS. on systems the valve has three positions.

- In first case, the valve is open; pressure from the master cylinder is passed right through to the brake.
- In second case, the valve blocks the line, isolating that brake from the master cylinder. This prevents the pressure from rising further should the driver push the brake pedal harder.

- In position three, the valve releases some of the pressure from the brake.
- The major problems occurred due to clogged valves.

Pump

The purpose of the pump is to restore the pressure to the hydraulic brakes after the valves have released it. A signal from the controller will release the valve at the detection of wheel slip. After a valve release the pressure supplied from the driver, the pump is used to restore a desired amount of pressure to the braking system. The controller will modulate the pumps status in order to provide the desired amount of pressure and reduce slipping.

Controller

The controller is an ECU type unit in the vehicle which receives information from each individual wheel speed sensor, in turn if a wheel loses control the signal is sent to the controller, the controller will then limit the brake force (EBD) and activate the ABS modulator which actuates the braking valves on and off.

- The controller monitors the speed sensors during rotation. It decelerates before the wheel lock whenever a situation arises.
- This pumps (pressurizes) the brakes while driving a slippery road surface.
- Some of the ABS systems can cycle up to 16 times per second.

Conclusions

ABS system is a complicated system due to the complicated relationship between its components and parameters. The research in ABS control systems covers a wide range of issues and challenges. Wide variety of control methods for ABS has been developed and research on improved control methods is continuing. Still there is a gap in application of these systems at various levels. To avoid that gap research work is going on to reduce the gap or in accuracy.

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