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A review paper on Drum brake

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Abstract:
In the automobile, there is a most common and important factor is safety like, braking system, airbags, good suspension, good handling, and safe cornering, etc. from the all safety system the most important and critical system is a brake system. A brake is a mechanical device that inhibits motion. A drum brake is a brake that uses friction caused by a set of shoes or pads that press against a rotating drum-shaped part called a brake drum. In this paper, we have studied the brake shoe of motor vehicles. A brake shoe is the part of a braking system which carries the brake lining in the drum brakes used on automobile or brake block in train brakes and bicycle brakes. A brake shoe is also known as a device which can be slow down railroad cars.

Keywords: *Breaking system, Suspension, Brake shoe, Brake lining.*

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I. Introduction

We know about the braking system, there are few types of brakes like a drum brake, disc brake. The drum brake consists of backing plates, brake drum, wheel cylinder, brake pads, brake shoe, etc. The drum brake is used in various motor vehicles like passenger cars, lightweight trucks, most of the two-wheelers. A brake is a mechanical device that is used to absorb the energy from the moving system. The basic purpose of the braking system is to stop the moving body or slow down the moving body also it use to hold the body when there is no driver in the vehicle (hand brakes). A braking system generally absorbs kinetic energy or potential energy and converts it into heat energy. A drum brake is defined as a brake that uses friction caused by a set of shoes or pads that press against a rotating drum-shaped part called a brake drum. It rotates with a wheel and is generally made up of cast iron. When we applied brakes, the inner surface of the drum, and the ensuring friction slows or stops rotating the wheels of the vehicle. Brake shoes are mainly used for the braking system. Some brake shoes are uses like Internal expanding and external contracting shoe brake and these shoes are arranged in pair along with lining brake. Brake lining is fitted with each shoe and it is connected by a pin called an anchor pin. These are fitted with one end and on another end, we connected a cam which is operated the shoe to expand out against the brake drum. When we applied a brake the spring would be expanded and after relies on it, it gains its original position with the shoes. As we know that the whole assembly would be mounted on the backing plate. This backing plate is mounted on the axel of the wheel and it prevents the mechanism from dust. For some conditions like deformation, various stresses, etc. in both drum brake and disc brake we use Finite element methods for calculations.

History

In 1900 Maybach use the drum brake in a car but in 1902 this principle was patented by Renault. The first time he uses the woven asbestos lining. At that time brake work mechanically with the help of cables, rods, and levers but around 1930 wheel cylinders and pistons should be used for operation and use oil as a medium. In 1950 the self-adjusting drum brake is used, before that, we adjust it manually. But in 1953 disc brake are introduced in three cars of Jaguar. Due to their superior braking system increases its demand and many cars use the disc brake in the place of a drum brake. Gradually drum brake was replaced by a disc brake "between 1960 to 1980" at this time disc brake is used on the front wheel of vehicles.

II. Literature Review

K. Radhakrishna et al (2008) -He had used fly ash and aluminum with copper as reinforcements and concluded that up to 15% of the reinforcements are successfully dissipated in the matrix and hardness, wear resistance increases up to 15 wt.% addition of reinforcements.

K. Deepika et al (2013) -Brake lining generally made by asbestos, metals, non-asbestos organic such as palm kernel shell (PKS), and ceramics materials. Asbestos during application releases hazardous gases, which causes damage to the health. Palm kernel shell (PKS) which is agro-waste to use for brake lining. The average

disk temperature and average stopping time for a pass are increased and it has weak dimensional stability. Hence nowadays several alternative materials are being replaced.

Pascu LV et al (2015) -For making brake shoes are used frequently gray cast iron with lamellar graphite and nodular cast iron, which is good thermal conductivity, good mechanical properties, good wear resistance. Cast iron brake block possesses much superiority including hardness, impact strength, and so on.

Nicholson (1995) - Herbert Frood is credited with inventing the first brake lining materials in 1897. It was a cotton-based material saturate with bitumen solution and was used for wagon wheels as well as early automobiles. His invention said that the first brake lining materials are woven, but in the 1920s, these material replaced with molded materials that contained chrysotile asbestos fibers.

The brake system with four new design brake shoes produce a higher torque compared to the existing brake shoes because the total contact pressure is higher and has more contact points. By adding the contact pressure and contact point at the drum, it can help to improve the stability and braking performance of the drum brake. The brake system with four new design brake shoes produce a higher torque compared to the existing brake shoes because the total contact pressure is higher and has more contact points. By adding the contact pressure and contact point at the drum, it can help to improve the stability and braking performance of the drum brake. The brake system with four new design brake shoes produce a higher torque compared to the existing brake shoes because the total contact pressure is higher and has more contact points. By adding the contact pressure and contact point at the drum, it can help to improve the stability and braking performance of the drum brake. The brake system with four new design brake shoes produce a higher torque compared to the existing brake shoes because the total contact pressure is higher and has more contact points. By adding the contact pressure and contact point at the drum, it can help to improve the stability and braking performance of the drum brake. The brake system with four new design brake shoes produce a higher torque compared to the existing brake shoes because the total contact pressure is higher and has more contact points. By adding the contact pressure and contact point at the drum, it can help to improve the stability and braking performance of the drum brake. The brake system with four new design brake shoes produce a higher torque compared to the existing brake shoes because the total contact pressure is higher and has more contact points. By adding the contact pressure and contact point at the drum, it can help to improve the stability and braking performance of the drum brake. The brake system with four new design brake shoes produce a higher torque compared to the existing brake shoes because the total contact pressure is higher and has more contact points. By adding the contact pressure and contact point at the drum, it can help to improve the stability and braking performance of the drum brake. The brake system with four new design brake shoes produce a higher torque compared to the existing brake shoes because the total contact pressure is higher and has more contact points. By adding the contact pressure and contact point at the drum, it can help to improve the stability and braking performance of the drum brake.

Analysis of Drum brake system for improvement of braking performance (2018) by Siti Nor Nardirah Baba, Muhammad Najib Abdul Hamid, Shahril Nizam Mohamed Soid, Mohd Nurhidayat Zahelem, and Mohd Suyerdi Omar- In this paper presented a study to improve the existing drum brake based on the dynamics properties and brake torque by a proposed new design. This study found generally that modifying the length of the shoe can increase the natural frequency, brake torque, and contact pressure of the drum brakes.

Study on brake performance of new drum brake (2019) by T Liu Y L Li- In this paper the finite element analysis shows that the better performance compared with traditional drum brake by the floating shoe drum brake. Firstly, the mathematical analysis proved that in the former's leading shoe, the contact area tends to move to the middle of the friction plate, so the stress should be distributed more. Secondly, the total braking moment is larger so that it could provide efficient braking performance. Thirdly, it is proved that there is an optimal floating angle, and with respect to angle friction torque is maximum.

The finite element analysis shows that the floating shoe drum brake own better braking performance compared with traditional drum brake. Firstly, the mathematical analysis proved that in the former's leading shoe, the contact area tends to move to the middle position of the friction plate, thus the stress distribute more even and its' maximum is smaller. Secondly, in the floating shoe drum brake, the total braking moment is larger so that it could provide efficient braking performance. Thirdly, it is proved that there is an optimal floating angle, and the friction torque is maximum with the angle

Jinchun Huang -This paper used a numerical modeling approach in a drum brake system. For the specific brake components the brake system model is based on the modal information take out from finite element models. The component models of drum and shoes are coupled by the shoe lining material which is modeled as springs located at the center of discretized drum and shoe interface elements. The developed multi-degree of freedom coupled brake system model is a linear non-self-ad joint system. By using complex eigenvalue analysis its vibrational characteristics should be determined. Due to static coupling both the frequency separation between two system modes and it play an important role in the mode merging. Mode merging and veering are

important features of modes exhibiting strong interactions, and those modes are likely candidates that lead to coupled-mode inconstancy. Techniques are developed for a parameter sensitivity analysis concerning lining stiffness and the stiffness of the brake actuation system. The influence of the lining friction coefficient on the propensity to squeal is also discussed.

J. M. LEE - This paper describes that the stability of drum brake squeal may be due to a change of cross-section of the shoes. The squeal is considered as a noise produced by the self-excited vibration of the drum brake which makes the brake unstable. The drum and the shoes are assumed as a uniform ring and non-uniform arches, respectively, for modeling the brake. For a sensible method of modeling, the vibration characteristics of the brake and their relations to the squeal are discussed based on the results of modal tests. The influences of brake design parameters upon the squeal are investigated, and a minor change of the cross-section is proposed to reduce the squeal. The effect of the minor change is verified through noise dynamometer tests.

DRUM BRAKE

A drum brake is a brake that uses friction caused by a set of shoes or pads that press outward against a rotating cylinder-shaped part called a brake drum. The drum brake usually means a brake in which shoes press on the inner surface of the drum. In 1900 in the car, the first modern automobile drum brake was used. Drum brakes are used in most heavy trucks, light trucks, and few cars, dirt bikes, and ATVs. Drum brakes are often applied to the rear wheels since most of the stopping force is generated by the front brakes of the vehicle and therefore symbolically the heat generated in the rear is less. Drum brakes are also occasionally fitted as the parking (emergency) brake even when the rear wheels use disc brakes as the main brakes. A drum brake is one of the most commonly used brakes in vehicle design; it can be categorized into leading and trailing shoe brake, two leading shoe brake, two trailing shoe brake, and servo brake relative to the arrangement of the brake shoes.

Drum brake components

- Backing plate - The backing plate is the base component which that provides a base for the other components. The back plate also increases the toughness of the whole set-up, supports the housing, and protects it from foreign materials like dust and other road debris. From the braking action, it absorbs the torque, so it also known as the "Torque Plate".
- Brake drum - The brake drum is generally made of a special type of cast iron that is heat-conductive and wear-resistant. It rotates with the wheel and axle. When a driver applies the brakes, the lining pushes radially outward against the inner surface of the drum, and the friction slows or stops rotation of the wheel and axle, and thus the vehicle.
- Lining - Linings must be resistant to heat and wear and have a high friction coefficient unaffected by fluctuations in temperature and humidity.
- Brake shoe - Brake shoes are typically made of two pieces of steel welded together. The friction material is riveted to the lining table or attached with adhesive. The crescent-shaped piece is called the Web and contains holes and slots in different shapes for return springs, hold-down hardware, parking brake linkage, and self-adjusting components.
- Wheel cylinder - One wheel cylinder operates the brake on each wheel. Two pistons operate the shoes, one at each end of the wheel cylinder. The leading shoe (closest to the front of the vehicle) is known as the primary shoe. The trailing shoe is known as the secondary shoe.
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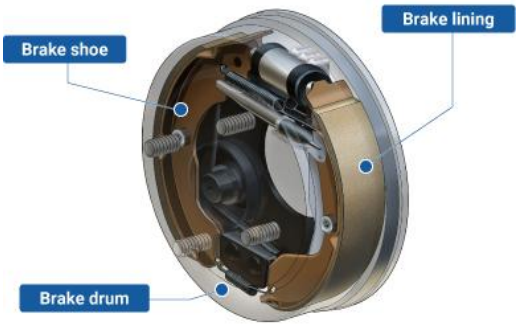

Fig. Drum brake

BRAKE SHOE

The brake shoe is one of the key parts of an automobile, which is directly related to the safety of drivers. A brake shoe is the part of a braking system that carries the brake lining in the drum brakes used on automobiles or the brake block in train brakes and bicycle brakes. A brake shoe is also known as a device which can be slow down railroad cars. Brake shoe and lining are riveted or glued to each other. When we applied a

brake, the shoe moves and presses the lining against the inside of the drum between the lining, and drum friction is produced that provides the braking effort. In modern vehicles, disc brakes are generally used but due to more effective as working of parking brake we use the drum brake instead of disc brake. With the shortening of automobile parts research and development, it is of practical significance to design the brake shoe of drum brake quickly and efficiently. Therefore, the optimization and improvement of the brake is a very meaningful research direction.

Brake shoe specifications

Drum inner diameter (mm) = 110
For each shoe, the contact angle is 120 degrees.
Shoe Width (mm) = 25
Lining thickness (mm) = 4
Anchor pin diameter (mm) = 8.50
Cam thickness (mm) = 6.22
Hub outer dia. (mm) = 46.46
Number of shoe 2
Force exerted on paddle will rotate the cam, that force exerts the pressure on brake shoe so brake shoe will exert the same force on drum, so that according to newton's third law the same reaction force will exert on the brake shoe.

Material properties of a brake drum and Brake shoe

Material	Density (g/cm^3)	Tensile strength (Mpa)	Young's Modulus ($x10^3$ N/mm^2)	Poison's ratio
LM28	2.68	165	82	0.33
HT200	7.20	170	80	0.25
A6063	2.69	165	68.3	0.33

III. Conclusion

Hence, this paper studied the drum brake its components, material, and specification of the brake shoe. Using fly ash and aluminum with copper as reinforcement is concluded that reinforcements are successfully dissipated in the matrix and hardness and wear resistance increases. Brake lining is generally made up of asbestos, non-asbestos, metal, PKS, and ceramic material. Asbestos materials are hazardous for health so PKS which are made by agro waste is the main element to use for brake lining. The first brake lining is inventing in 1897 by cotton-based material. Gray cast iron with lamellar graphite and nodular cast iron is used to make brake shoes. For improving the existing drum brake by modifying the length of the shoe. By the finite element analysis shows a better braking performance compared with the traditional drum brake. For a parameter sensitivity analysis for lining stiffness and the stiffness of the brake actuation system, some techniques are developed is also discussed. Based on the result of a modal test, discussed the vibration characteristics of the brake and their relations to the squeal. Also studied some material properties, drum brake components, and specification of the brake shoe.

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