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Analysis of Drum Brake Review Article

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Abstract - *The brake is a mechanical device which converts the kinetic energy of the vehicle into heat energy to stop the vehicle or to reduce the motion. Set of shoes are press against the drum to create sufficient friction to stop the vehicle. In working condition, brake drum experience high temperature and subjected to high thermal stress. Hence material for brake drum is choosing such way that can withstand high pressure and temperature. For comfortable working, it is require designing drum brake having less vibration and less noise.*

Key Words: Drum Brake, Drum, AL Alloys, Grey Cast iron, Thermal Exposure, Corrosion, Vibration, Noise

1. INTRODUCTION

A brake is a device which is used to bring to rest or slow down a moving body. Drum brakes are the first types of brakes used on automobiles. Even after 100 years of the first usage, drum brakes are still used on the rear wheels of most vehicles. [3]

The brake is used to absorb the kinetic energy of moving parts. Due to friction, kinetic energy converts into heat energy. The heat energy is dissipating to surrounding environment by means of convection. For smoother operation and long life, the brake should be the following requirement:

- Heat generated during application of brake must be dissipated immediately to reduce the temperature. Because due to high-temperature drum expands and it increases effective pedal traveling.
- The material having a high thermal coefficient of convection and conduction.
- The material having a low thermal coefficient for expansion.
- It should have sufficient strength but minimum weight.
- It should be able to be accommodated within the wheel space available.
- The brake should have grate anti-wear properties.
- The brake should design such a way that has less noisy and produce less vibration. [8]

2. LITERATURE SURVEY

2.1 Introduction

Putti Srinivas Rao et al. [1] in his research concluded that the amount of heat flow from outer drum can be increased by providing fin on the outer surface of a drum brake. Drum brake with a rectangular cross-section annual fin with the highly conductive material is suitable for maximum heat transfer, but it also increases its weight. Hence triangular fin is most suitable for more heat transfer with reducing weight.

Prof. Vidyadhar R Bajaj et al. [2] proposed two design of brake drum of existing one. All designs are made of special gray cast iron FG260, SS: 4404. In proposed design-1, the material of drum is removed from an outer surface such a way that increases heat transfer area. Weight reduction in this design is 4.74% compared to existing drum. In proposed design-2, the section is optimized by reducing wall thickness to 7 mm from 13 mm. In 2nd design, weight reduction of the drum is 4.06% compared to existing drum. By performing CAE analysis, it is proved that by using this method, drum weight can be significantly reduced without failure.

Anup Kumar et al. [3] in his structural and thermal analysis of drum brake research conclude that the drum brake is a critical component, brakes are commonly used to bring to rest or slow down moving body, reducing velocity and acceleration. The transient temperature it is observed that the temperature is increasing with each cycle. This shows that the cooling time provided is not sufficient to cool the drum. And the structural analysis is probably the most commonly used the finite element method. The energy absorbed by brakes is dissipated in the form of heat. This heat is dissipated in the surrounding atmosphere to stop the vehicle. The design check has been done by comparing the maximum obtained stress. It was found that the design is safe and the drum brake function properly under the given load condition.

Bako Sunday et al. [4] in research use fin or extended surface to increase the heat transfer rate. One forth weight of existing drum brake is converted into fins. Gray cast iron is select for brake drum analysis. In the model, the width of fins is 7 mm, the distance between fins taken as 20 mm and uses 6 fins on the outer drum surface. Kicreyco drum brake catalog is used to create brake drum design in Solid works 2013. By analysis, it is concluded that at 150 N brake shoe force and 120 degree Celsius internal temperature, proposed drum model with fin have more heat transfer capacity and subjected to less stress compared to existing one.

Amit Phatak et al. [5] conducts research on the noise of drum brake. FRF (Frequency Response Function) is a fundamental measurement function for NVH analysis, and it provides displacement output to force input relation in frequency domain like a transfer function for a given structure under test. By virtue of this function, one can

determine structural resonances, material damping and deformation pattern at resonances. All these are extremely vital information for NVH analysis and mitigation. The stringent competition in automobile market of passenger vehicle segment exists on account of With respect to critical attributes like vehicle comfort, fuel efficiency, and cost. Noise, Vibration, and Harshness are of critical issues and largely depend upon a number of components in an assembly. The interface between Liner and drum during braking condition can't have control. Reducing the coefficient of friction result in adverse effect on Braking performance. So the finest way to achieve the squeal noise reduction by structural modification of components in the design stage for stiffening and adopting FRF quality check method before manufacturing. Taking all analysis into account shows an easy to way to reduce squeal of Brake to shift Natural frequencies pattern by increasing stiffness. Considering with rib structure of Back plate shows improved results.

K.Gowthami and K. Balaji et al. [6] concludes a thermal analysis of different materials such as aluminum alloy, cast iron and stainless steel 304 for a brake drum will be done. The maximum temperature obtained for aluminum alloy brake drum is 32.83°C which is less compared to the maximum temperature prevailing in cast iron brake drum and stainless steel brake drum. The weight of a cast iron brake drum cross section is 11.305 kilograms. The percentage reduction in weight when using aluminum alloy material is 58.52% and the percentage increment in weight when using stainless steel 304 material is 9.53%. Thermal deformation of aluminum alloy brake drum is 0.006329 millimeters which is less than the thermal deformation of cast iron brake drum but slightly more than the thermal deformation of stainless steel brake drum which has 0.004328 millimeters. From all the three materials, Aluminum alloy material is proved better than the other materials considered in this investigation.

Meenakshi Kushal et al. [7] conducts an experiment to optimize the design of drum brake (through reverse engineering approach). From the analysis, it is observed that the deformation in CE (Control expansion) alloy brake is considerably less than the aluminum alloy drum brake. Also, the temperature rise in CE alloy brake drum surface is less than the AL alloy brake drums, it increases the life of lining material and also increases braking performance. It is also found that due to instant breaking the temperature rise in drum brake is 65% to 66% more compared to gradual braking. Hence it is concluded that due to lighter weight, less deformation, and less temperature rise, the CE alloy material is better for drum brake application for the light commercial vehicle.

2.2 Problem identification

As we know that there are several issues like vibration, Noise, Less efficient, Drum corrosion, Drum deformation. These are the parameters we have to control or reduced it during the operation. This is the proposed Problem definition which we have assumed during the detailed literature survey.

2.3 Objectives

The main objective of our proposed research to reduce the heating problem in a drum brake, increase the efficiency of braking, change the material of shoes, provide fins on the drum, reduce the cost and increase reliability.

2.4 Proposed Conclusion and Future Work

For proposed experimental investigation we shall use for different types of fins. I.e. Rectangular, circular, Triangular. It can be extended to different cross sections of fins.

3. EXPERIMENTAL METHODOLOGY

3.1 Testing setup

Fig -3.1: temperature rise in drum

We measure the outer drum temperature of the bike at different rpm using temperature gun. Maximum temperature we measure from the bike is 358 K and on another bike is 385 K.
By using Vernier caliper, we measure dimensions of a drum brake to create Computer Aided Design in Solid works.

3.2 CAD work in Solid works

Existing drum brake design is created in Solid works for further analysis. Drum with rectangular, triangular and circular fins are also designed for thermal analysis.

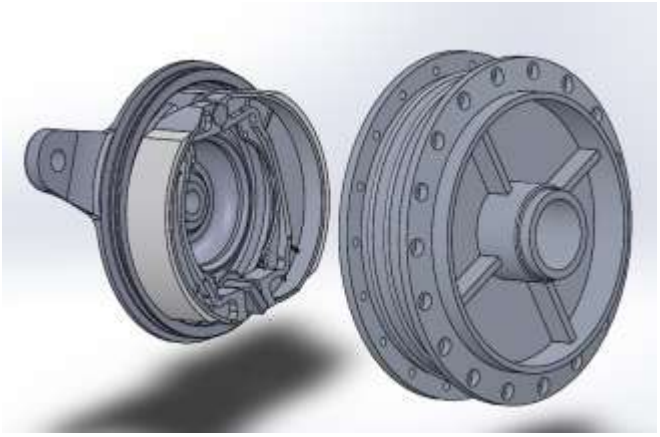

Fig -3.2: Design of drum brake

3.2 Thermal Analysis

For better heat dissipation, Al 2024 T6 alloy is used for drum and shoe design, for pad design, the ceramic material is used.

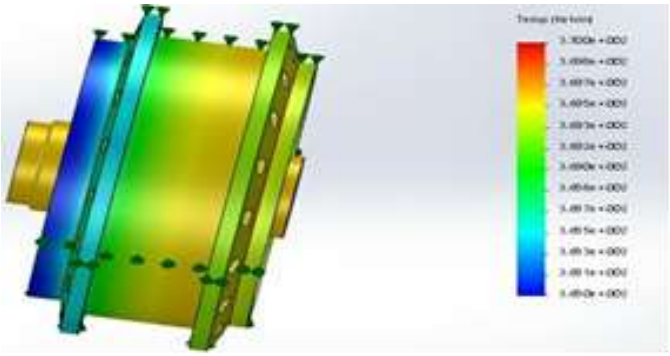

Fig -3.3: Drum without fins

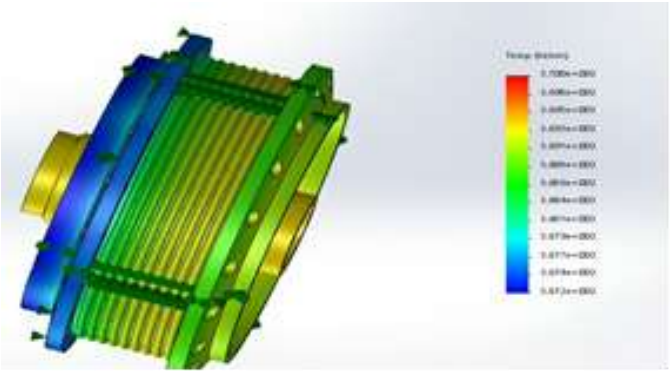

Fig -3.4: Drum with circular fins

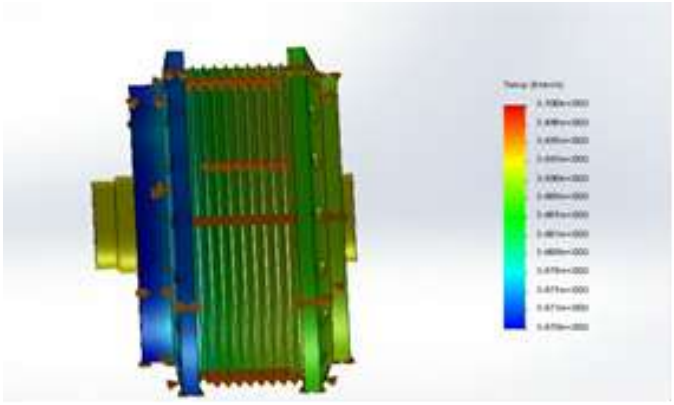

Fig -3.5: Drum with triangular fins

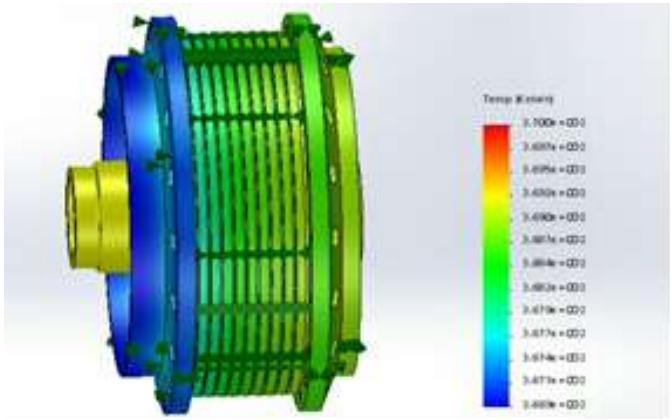

Fig -3.6: Drum with rectangular fins

3. CONCLUSIONS

As above results in fig. 3.4, 3.5 and 3.6; temperature is reduced as per our assumption. As per fig. 3.3 and fig. 3.4 heat dissipation is increased during the simulation analysis of drum brake in Solid works.

As per the analysis of different fin design, it is proved that

1. In rectangular fins, we got high heat transfer rate in the form of dissipation.
2. While circular fins the heat transfer rate of dissipation is comparatively low to rectangular fins.
3. Similar in triangular fin the heat transfer rate of dissipation is intermediate flow of above two fins which shows at a glance in figures 3.3, 3.4, 3.5 and 3.6.

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