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Improving the Brake Efficiency of Racing Vehicle

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***Abstract*: Aim of our project is to increase the efficiency of disc brake by doing various iterations on the disc size, brake pad material and brake oil. This project is strictly concern with disc brake of bike. At vehicles technical inspection stations, the braking system of a load-carrying vehicle is tested when the vehicle is free of any load; however, such tests do not reflect the operation of the brakes in loaded vehicles. The braking system of a load-carrying vehicle are discussed upon; other related to operation and testing of brakes. For the evaluation of the effectiveness of the brake system, most countries have a system of technical review. The test of brake inspection is done on a machine called brake tester. This checkpoint is uncomfortable for the user and it consumes sometime of inspection that results in longer waiting time. To minimize this problem arises in this article a methodology to predict, in many occasions, the result of the inspection of the braking system without having to resort to testing inspection by brake tester.**

***Keywords*: Brake Efficiency, Racing Vehicle**

1. Introduction

Braking performance is one of the main performances of automobile, which directly affects its safety. Braking often leads to traffic accidents due to severe side, wandering, too long braking distance or poor stability of going down the long slope. Good braking performance is the guarantee of safe driving. The evaluation indexes of the vehicle braking performance are mainly the braking efficiency, the constancy of braking performance and the stable direction of the vehicle when braking. Braking efficiency is the basic indicators of braking evaluation. The braking performance is an important factor that should be considered when designed.

Genetic algorithm is a kind of modern intelligent optimization algorithm with reference to biological natural selection and genetic mechanism. The traditional genetic algorithm takes complex regulatory requirements as constraint conditions, adding penalty functions to the objective function with complex and trivial programming. In this paper, the traditional genetic algorithm is improved, and regulatory requirements as selection conditions for individual elimination is put forward. The optimization parameter value range is divided into several intervals and given fitness value for evolution, and the programming is simplified, and the efficiency of the evolution is improved.

2. Braking system

A. *Purpose*

- To decrease the speed of a vehicle using kinetic friction and keep it from rolling when stopped using static friction.
- To design a braking system which take least time to bring the vehicle to stop.
- To ensures safety of the driver.

B. *Selection of brakes*

We had used a Hydraulic Disc Brake considering the following advantages, availability and their limitations.

For selection of best braking system in go-kart you have to keep some points in your mind:

a) Hydraulic system
b) Disc brake – pulsar 150 rear 200mm
c) Master cylinder

Fig. 1. Reference Joes Racing Product

3. Literature survey

A. *Problem definition*

Extreme thermal environments are an important issue in the design of sliding contact systems such as brakes and clutches. Thermal stresses due to high temperatures may induce several unfavorable conditions such as surface cracks and permanent distortions. Frictional heating, thermal deformation and elastic contact in sliding contact systems affect the contact pressure and temperature on the friction surfaces. If the sliding speed is excessively high, these coupled thermal and mechanical behaviors can be unstable leading to localized high temperature

contact regions called “hot spots” on the sliding interface.

The appearance of these hot spots is known as frictionally excited thermo elastic instability or TEI and is observed in many practical applications, especially brakes and clutches. Hot spots can cause material damage and thermal crack, and induce an undesirable frictional vibration known as “hot judder” in automotive disk brake systems.

B. Objectives

- Design of the disc for a disc brake system using load analysis, stress analysis and thermal analysis system approach.
- The disc brake rotor is to be rigidity and stability.
- Heat absorption and dispersion.
- Federal safety requirements.
- Increase the rotor and pad life.

4. Calculations

Height of center of gravity=1.01746m
h=0.08824m

Let us assume the static weight distribution ratio be 40:60
Stopping distance=2 m

1) Gross weight = g * weight of vehicle
   =9.81*140
   =1373.4
2) Brake line pressure (P)
   =force on brakes / area of master cylinder
   =4*350/0.785*(0.01)2
   =17.83 MPa
3) Clamping force
   = Brake line pressure* area of caliper piston*2
   =17.8343*0.785*(25.4*10^{-3}) 2 *2
   = 18073.09 Nm
4) Rotating force
   =CF * no of caliper piston*coefficient of friction
   =18064.6825*2*0.8
   =10838.6825 N
5) Static weight on front axle
   = (0.4xvehicle weight)
   = (0.4x1372.94) =549.17N

Static weight on rear axle
= (0.6x vehicle weight)
= (0.6x1372.94)
= 823.76N

Fig. 2. Reference Car Bibles

5. Scope of review

- When the linings on the rotor disc get wear, the piston slides forward to the bore to self-adjust with the slack though it consumes more fluid from the reservoir.
- They also have a mechanism of parking brake that will automatically adjust the piston to thread forward to manage the clearance.
- They are relatively light in weight, less costly and better heat dissipation.
- Disc brakes are good to be used as front brakes, due to the effect it applies on each side of vehicle avoiding pull along one particular direction, where as it is not possible in drum braking which results in unequal lining wear due to uneven size of the drum diameters.

6. Conclusion

- It has been shown that the stopping distance can be reduced by 20% for light loads (110kg) and 15 % for heaviest loads, compared with conventional braking system (r = 110mm) at the vehicle speed of 40kmph.
- It has been determined that the stopping distance can be reduced by 11% for light loads (110kg) and 12 % for heaviest loads, compared with conventional braking system (r = 110mm) at the vehicle speed of 50kmph.
- The percentage reduction in the stopping distance at 40kmph speed is more compared with 50kmph speeds because the vehicle velocity influences the stopping distance. i.e., at vehicle velocity of 40kmph, the vehicle has better braking force coefficient between the tyre and the ground.
- Furthermore, the stopping distance of a vehicle also depends on rider reaction time, brake application time, and brake actuation time which are assumed to be constant for the entire testing. The stopping distance also depends on wheel lock.
- Wheel should not lock (wheel speed gradually reduces from the initial angular velocity to zero angular velocity) right from the beginning of the braking operation to its end for achieving the minimum stopping distance.

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