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A review on Design of Vehicle Brake Pedal assembly.

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ABSTRACT

The purpose of this paper is to elaborate the design and manufacturing of pedal box assembly for a vehicle. In order to perform well in a race it has to accelerate and decelerate as fast as possible. The pedal box is researched by viewing previous designs, followed by the process to make ergonomics considerations essential. Other important factors such as material selection, analysis are also discussed, as driver directly interacts with it. The work begins with a review of research carried out on pedal box system. A braking system must be versatile enough to adapt to different road conditions such as wet weather.

The cars have been evolving and changing and there has been no single design that stands out as "the best". Every car is necessarily equipped with a system to convert a small form of energy exerted by the driver into braking and accelerating the motor vehicle at high speeds. The cars are designed to be fast, safe as the tracks are designed to run on have a very high frequency and range of corners, as slowing down quicker is an important factor. The goal is to create an optimal pedal assembly. The installation of pedal above the floor as per its geometry, is the important factor. The pedal has to sustain high loads without deformation, as there is huge amount of bending stress acting. Adjustability of pedal box is the highest importance as it can fit any driver and helps to give them a good ergonomic feel about the car. The final manufactured product must satisfactory work and should stop the vehicle when actuated by operator.

Keywords-*Brake pedal design, driver, force, mounting, Pedal box system,vehicle.*

I INTRODUCTION

Pedal Box is a recent innovation in the automobile sector. The main purpose of pedal box is to provide comfort and efficient working for the driver. Pedals are mounted into the box type structure rather than mounting directly to the Chassis. Another merit is that the driver does not need to apply full pressure for throttle, less amount of force is enough to give full throttle. As disc brakes have maximum accuracy, they are widely used nowadays in almost all ofvehicles. Every car is necessarily equipped with a system to convert a small form of energy exerted by the driver into braking and accelerating the motor vehicle at high speeds.

This concept has the pedal actuating above the axis of rotation, which is cost effective, reliable, safe for use and easy to implement. One pedal applies force to the master cylinders used in the hydraulic braking system. A balance bar is used to allow for the calibration of hydraulic breaking system.

For optimum performance, in race it has to accelerate and decelerate as fast as possible. A braking system must be versatile enough to adapt to different road conditions such as wet weather. The cars have been evolving and changing and there has been no single design that stands out as "the best".

The cars are designed to be fast, safe as the tracks are designed to run on have a very high frequency and range of corners, as slowing down quicker is an important factor. The principles of operation are important to take into consideration. The goal is to create an optimal pedal assembly. The final assembly must be effectively integrated into the frame and interact with the hydraulic brake system and the electrical system of the racecar. The final manufactured product must satisfactory work and should stop the vehicle when actuated by operator.

II METHODOLOGY

The aim is to lock all the 4 wheels at the same time in a lightweight car. Adjustability of pedal box is the highest importance as it can fit any driver and helps to give them a good ergonomic feel about the car. For designing the pedal box various parameters are considered such as weight, operating climate, driver's effort, serviceability, packaging, material and geometry. By considering the various values of above mentioned parameters the number of iterations are carried out.

The design has a simple geometry with a special mounting acting as supporting member as well as being a positive stop itself, which restricts the pedal after particular degrees of movement. This design is simpler, if viewed from manufacturing aspect and cost effective. The orientation of the brake pedal follows the orientation of the accelerator and the clutch pedal. The master cylinders returns the brake pedal to its resting position. Thus, the other two pedals need a spring to return to their original position.

As per the norms, the material to be selected is Aluminum and Steel. The pedal has to sustain high loads without deformation, as there is huge amount of bending stress acting. The aluminum selected has high resistance to shock loads, high strength to weight ratio, and excellent machinability. For multiple mountings, mild steel is selected. A prototype from wood can also be made to see the actual pedal travel. So the initial and final position of the pedal at same pivot point can also be observed.

As per the basics, the optimum pedal height for driver's foot size is 8 inches. The installation of pedal above the floor as per its geometry, is the important factor. Hence in order to comply with the above objective, the mounting for pedals are made in such a way that it acts as a positive stop and throttle pedal itself, and provide a required leverage ratio. With this mounting, the leverage ratio of pedal can be varied, with reduced driver's effort to actuate brakes.

III FINITE ELEMENT ANALYSIS

The final results were obtained by analyzing the product. Forces acting on brake pedal are only the force exerted by driver and the opposed force against the driver. For the clutch and throttle pedal, only the driver's force is acted for actuation of clutch or accelerator by cable. And a fixed support is provided at the bottom pivot point. The mounting for pedals are made in such a way that it acts as a positive stop and throttle pedal itself, and provide a required leverage ratio.

Force considerations for Brake pedal-

The force applied by the driver on accelerator, clutch and brake pedal is taken as the weight of driver.

(Justification- As the human self-weight is the maximum force which can be exerted).

The brake pedal has to withstand load of 2000N without failure. So considering this, the design of pedal is carried out. Hence, it can be considered 2000 N force is applied at the top of the pedal surface.

Another force, coming from the Master Cylinder against pedal, which is calculated as-

Pressure= force/area. (r = radius of bore for Cylinder)

(Area of Cylinder can be calculated by).

IV CONCLUSION

Observation of finite element analysis is conducted for the pedals and its mountings.

The various conclusions carried are as-

- The maximum stresses are generated on the surface of mounting plates and on base surfaces.
- For pedals, the maximum stresses are found at the top surface of the pedal
  (At the point of contact where driver applies force, for actuation).

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