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HYDRAULIC BRAKE SYSTEM

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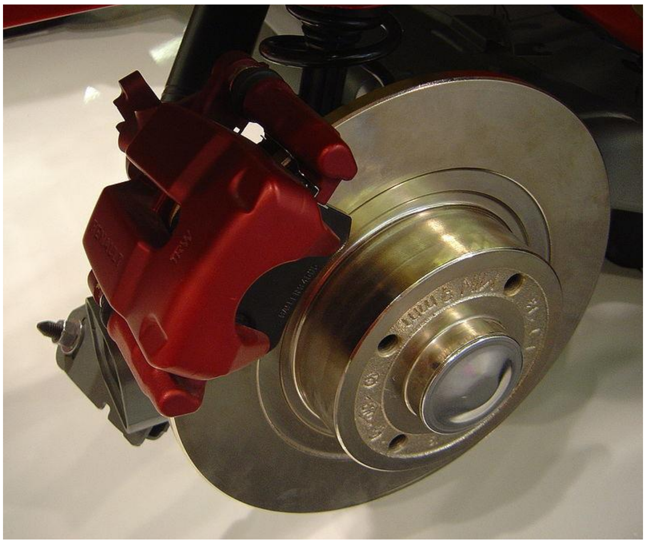
ABSTRACT

The objective of this project was to create a physical model to demonstrate the transfer of forces from the mechanical domain to the hydraulic domain, and back to the mechanical domain. To do this, a spinning wheel was designed to be stopped using a hand brake connected hydraulically to a set of calipers and a brake rotor. A wheel on a dead axle was spun up via a motor and once the wheel was at speed, mechanical force was applied to the hand brake to bring the wheel to a stop. Calculations for the model were made to determine flexure, stress concentrations, natural frequency and the mechanical advantage of the braking system. The calculations showed that under normal operating conditions, the whole assembly will not have any noticeable flexure, the stress concentrations in the axle will not lead to catastrophic failure, the natural frequency of the rotating wheel on a simply supported axle is far above that of the operating frequency, and the hydraulic brake has ample mechanical advantage to safely bring the wheel to a stop. Once all these calculations ensured that the model would not fail during operation, a physical model was constructed. Testing and operation of the physical model showed that the calculations were accurate. The final model successfully shows the transfer of mechanical force (the user squeezing the handle) to hydraulic force (moving a piston) to mechanical force , which generates friction between the calipers and the brake rotor to stop a rotating wheel.

1. INTRODUCTION

The purpose of the project was to demonstrate the flow of energy from mechanical to fluid back to mechanical. The Goal of the project was to create a working classroom model that will last up to ten years. The mechanical force comes from the operator's hand squeezing the brake lever, which compresses hydraulic fluid. The hydraulic fluid in the line becomes pressurized and pushes on a piston that squeezes the brake pads onto the brake disk. The model will be able to show different braking scenarios by applying differing amounts of force to the handle. For example the motor can be run with minimal braking and the wheel will spin at a slower speed than without braking. Another extreme is stopping the wheel instantaneously by applying rapid firm pressure to the brake handle.



2. DESIGN

The development of disc-type brakes began in England in the 1890s. In 1902, the Lanchester Motor Company designed brakes that looked and operated in a similar way to a modern disc-brake system even though the disc was thin and a cable activated the brake pad. Other designs were not practical or widely available in cars for another 60 years. Successful application began in airplanes before World War II, and even the German Tiger tank was fitted with discs in 1942. After the war, technological progress began to arrive in 1949, with caliper-type four-wheel disc brakes on the Crosley line, and a Chrysler non-caliper type. In the 1950s, there was a critical demonstration of superiority at the 1953 24 Hours of Le Mans race, which required braking from high speeds several times per lap.The Jaguar racing team won, using disc brake-equipped cars, with much of the credit being given to the brakes' superior performance over rivals equipped with drum brakes.[4] Mass production began with the 1949-1950 inclusion in all Crosley production, with sustained mass production beginning in 1955 Citroën DS

3. METHODOLOGY

When the project was first presented, the group was given a preliminary sketch of what the desktop model was going to look like. This simple sketch involved a piece of 90 degree angled metal that would support one side of a shaft. The other side of the shaft would be supported by a simple piece of metal thus creating a simply supported beam. The flywheel that was proposed would be a common wheelbarrow wheel with a bearing already pressed in place. The flywheel would then be electrically spun and stopped using a commercially available brake. With this brief sketch, the second revision of the assembly was created in SolidWorks.

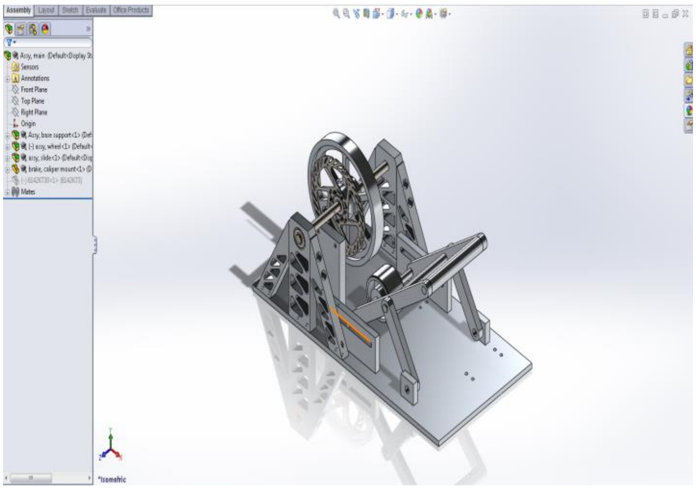


Figure 9: Second Revision of the Assembly

The second revision, shown in Figure 9, had some significant changes from the initial sketch. The supports that were originally sketched had been changed two to ‘A’ frame supports with cuts made within the structural member to reduce the weight of the overall system. The ‘A’ frame support was made from three different members that would ultimately bolt together forming a solid support that would be able to withstand the braking forces of the wheel. In addition, another change that was made from the first to second revision was the wheel being used. Although it was far simpler to buy something already made, due to the fact that a disk brake needed to be attached to the wheelbarrow wheel, a custom hub needed to be machined and the wheelbarrow wheel altered to accept the new hub attachment. Based on this new information, it was decided that a new flywheel would be machined. This way, attaching hubs to the flywheel would be easier since the design of the flywheel could allow for simple implementation. In addition, a smaller drive wheel was added to the assembly attached to a sliding linkage. Although not displayed in the solid model, a electric motor would be attached to the sliding linkage to power the drive wheel.

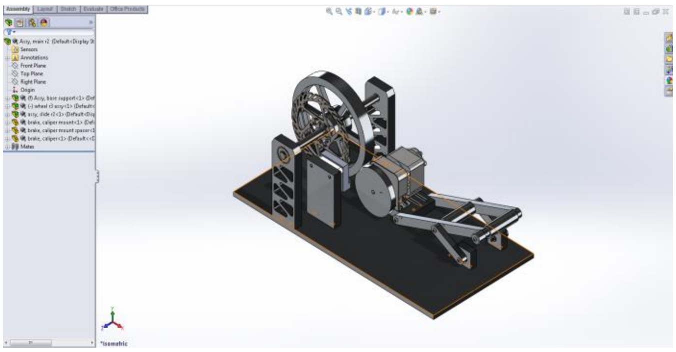


Figure 10: Third and Final Revision of the Assembly

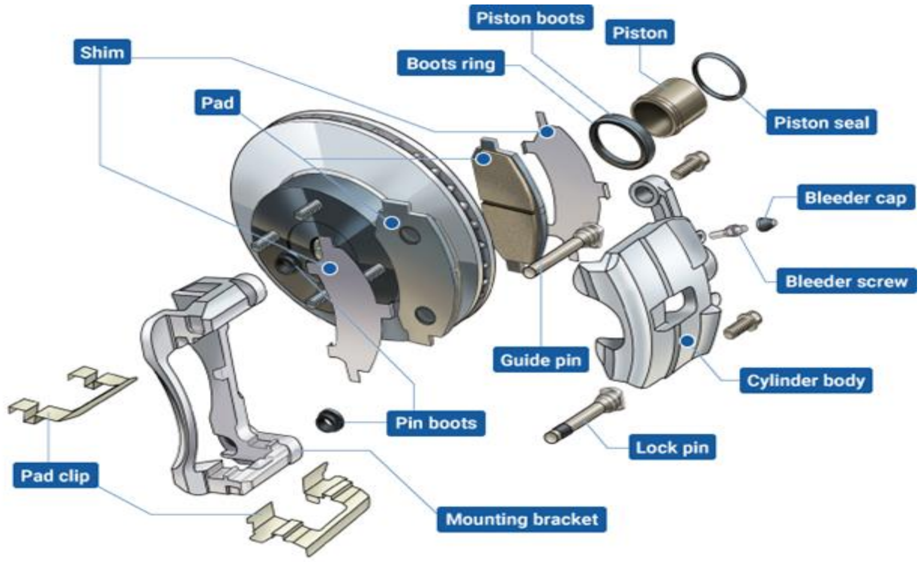
After careful design reviews and calculations, Figure 10, was the final revision of the assembly. Two of the most distinctive changes from the second revision to the final revision are the ‘A’ frame supports and the mechanism that is used to power the drive wheel. After bending and deflection simulations, the side supports of the ‘A’ frame design were deemed not needed. By removing the four supports, the overall weight of the assembly dropped by over 2 lbs. The main reason why the mechanism that was to power the flywheel changed so much was because of the motor that was specified. After an exhaustive search for a simple 120V AC motor, the motor shown in the final assembly was the smallest and the fastest; all other motors were either DC or required multiphase electricity. Due to its relatively large size to the assembly, it became impractical to mount the motor on the linkage assembly. Instead, a motor plate was created to hold the motor while an identical sliding linkage would move the motor to engage the flywheel. In addition, by using this method, the need to both support the motor on the linkage assembly and connect the output shaft of the motor to the drive wheel from the second revision was eliminated.

Furthermore, the new linkage assembly shown in the final revision was far simpler than the second revision thus leading to a significant reduction in the possibility for the linkage assembly to both seize and fail. Finally, stress and deflection simulations showed that all other components within the assembly surpassed acceptable tolerances.

4. DISC BRAKES: CONSTRUCTION, WORKING PRINCIPLE

Brake rotors of disc brakes rotate with the wheels, and brake pads, which are fitted to the brake calipers, clamp-on these rotors to stop or decelerate the wheels. The brake pads pushing against the rotors generate friction, which transforms kinetic energy into thermal energy.

This thermal energy generates heat, but since the main components are exposed to the atmosphere, this heat can be diffused efficiently. This heat-dissipating property reduces brake fade, which is the phenomenon where braking performance is influenced by the heat. Another advantage of disc brake is its resistance to water fade, which occurs when the water on the brakes significantly reduces braking force. When the vehicle is in motion, the rotor spins at high speeds and this rotational motion discharges the water from the rotors themselves, resulting in stable braking force.



5. DISC BRAKE ADVANTAGES

Disc brakes offer better stopping performance as compared to drum brakes. They provide better resistance to "brake fade" caused by the overheating of brake pads, and are also able to recover quickly from immersion (wet brakes are less effective). Unlike a drum brake, the disc brake has no self-servo effect—the braking force is always proportional to the pressure applied on the braking pedal lever. However many disc brake systems have servo assistance ("Brake Booster") to reduce the driver's pedal effort.

Disc brake pads are easier to inspect and replace than drum brake friction lining.

6. APPLICATIONS

Though Hydraulic Brakes are most familiar to us as they are used in our cars, they are present in many other transportation and rolling stock industries such as aerospace, heavy transport, marine, and off-highway. Hydraulic brakes are also found in industrial equipment like conveyors, machine tools, motors, pumps, robotics, and automation. Hydraulic brakes are significantly easier to modulate than mechanical brakes; you get more force delivered to the pads, and, as a result, more stopping power for the same input. Additionally, you will experience faster and more consistent pad withdrawal upon release.

7. RESULTS

The Hydraulic Operated Material Handling Equipment was developed. The equipment was tested to ensure satisfactory results as expected. The experimentation on the equipment provided the output result of the equipment. The working of the equipment was found to be satisfactory. However, the capacity of materials handling of the equipment was less compared to the designed load handling capacity.

8. CONCLUSION

1. By using hydraulic Operated Material Handling Equipment, it is possible to reduce the effort on the labour.
2. By using Pneumatic Operated Material Handling Equipment, it is possible to reduce the idle time. Hence possible to increase the overall efficiency fo the plant.
3. By using Pneumatic Operated Material Handling Equipment, it is possible to keep the clean space which is one more aspect and and point for getting ISO-9000.
4. The labour is operating the system gets more interest, while operating it. Hence it is possible to bost up the overall performance of the plant.
5. It possible to control the velocity of the piston hence gives good results.
6. As the compressed air is available hence indirectly it gives the saving of the power.
7. Though even the initial cost is more it is possible to compensate it as the extra earning in the form of saving of idle time and by minimizing the efforts of the labour.

REFERENCES

[1] Anthony Esposito, Fluid Power with Applications, Fourth Edition, Prentice-Hall of India Private Limited (1980), New Delhi. pp. 423-452 & 460-481.

[2] EurIng Ian C. Thrner, Engineering Applications of Pneumatics and Hydraulics,Butterworth-Heinemann, Jordan Hill, Oxford. pp. 57-63, 72-76 & 87-93.

[3] Siddhartha Ray, Introduction to Materials Handling, New Age International (P) Limited, Publishers; pp. 1-8 & 185-190.

[4] Design and Implementation of multi-handling Pick and Place Robotic Arm, S. Premkumar, K. Surya Varman, R. Balamurugan, Volume 33, Number 3, International Journal of Engineering Trends and Technology (IJETT)-March 2016.

[5] Design, Analysis & Fabrication of Pneumatic Materials Handling Systems, Nilesh Bodkhe, Sanghshil L. Kanekar and Tushar G. Bhore, Volume 6, Issue 8, pp. 12-23, International Journal of Engineering Trends and Technology (IJETT)-August 2015.

[6] Pneumatic Driving in Materials Handling Systems, Catrina CHIVU, Transilvania University of Brasov, Romania, Volume 15, Number 3(43), pp. 155-159, November 2014.

[7] Design and Fabrication of Pneumatic Arm for Pick and Place of Cylindrical Objects, Santosh C, Manoj C S, Akshay Peddarajula and Abhishek R Shetty, Volume V, Issue VI, June 2016 | ISSN 2278-2540, International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS).

[8] D.S. Kumar, Fluid Mechanics & Fluid Power Engineering, S. K. Kataria & Sons.

[9] PSG Design Data Book for Engineers, published by Kalaikathir Achchagam, Kalaikathir Buildings, Coimbatore-641 037, Tamil Nadu.

[10] Festo Didactic KG – Fundamentals of control technology, Esslingen-1998, Festo Pneumatic Catalogue, Festo Private Limited, Bangalore.

[11] Catalogue of Janatics pneumatic product, Janatics Private Limited Coimbatore.