Design of Self Made Pneumatic Air Braking System Odisha, India

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Abstract— In today's world vehicle accident is the major problem. To avoid this we developed a self-made pneumatic air breaking system in our innovative project. Our system is a manually controlled system known as "Self-made pneumatic-air braking system". This system is used in four wheeler vehicle & heavy vehicles. This system consists of two mechanisms i.e self-made air compressor system and pneumatic braking system. Automatic braking system use the infrared sensor (IR), which is used to sense the vehicle coming from front of our vehicle and which is responsible for accident. Then sensor sends feedback signal to engine through the relay control to stop the working of engine. During the working of Automatic braking system simultaneously the driver also try to stop the vehicle by applying brake pedal. Limit switch is placed below the brake pedal which activates the pneumatic braking system and brake to reduce the damage to vehicle which occurs in accidents. This system provide pre-crash safety to the vehicle. As well as it improves the response time of vehicle braking to keep safe distance between the vehicles. By using this system we can obtain control over the speed of vehicle in short distance. Also we used here very low cost equipments in order to make our cost friendly.

Key words: IR, Self-Made Pneumatic Air Braking System, Braking Torque

I. INTRODUCTION

This is a self–assessment to access the competency in creativity. The braking system mainly transforms the energy from one form to another form. This self-designed braking system mainly inhibits the motion by absorbing the energy from a moving system. This system really helpful in practical applications as the sensors attached to the wheels immediately send signals to the operator so that to prevent any accidental hazard. From the design point of view also this braking system is meeting all the specific requirements. Hence this braking system is obeying the fail-safe approach and each components of the braking system is considered to be safe from the design point of view. This report discuss the necessity of the project in various aspects of design, selection of materials, fabrication, erection, estimation and testing. The practical application and testing of this braking system is considered to be giving satisfactory results.

II. WORKING PRINCIPLE

A brake which uses air as working fluid is a pneumatic brake. The system actuated to apply this phenomenon is known as pneumatic brake system. A pneumatic brake or compressed air brake system, is a type of friction brake for vehicles in which compressed air pressing on a piston is used to the brake pad needed to stop the vehicle.

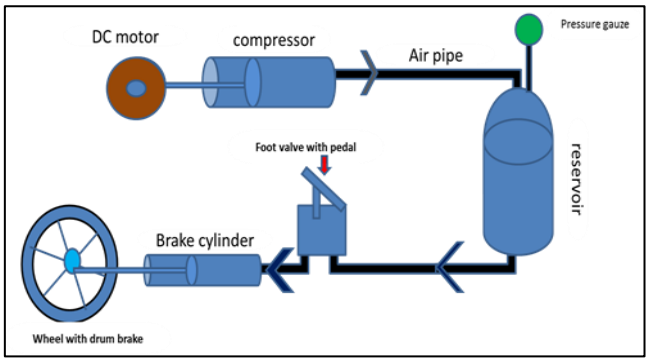


Fig. 1: Block diagram of our experimental set up

Fig. 2: Actual experimental set up

III. CALCULATION OF BRAKING TORQUE AND NORMAL REACTION AT DIFFERENT PRESSURES

A. *Observed Data:*

Length from the centre of the wheel to fixed (X) = 86 Cm = 860 mm
Length from the centre of the wheel to the effort application (L) = 123.5 Cm=12350 mm
Diameter of Piston (DP) = 10.2 mm
Diameter of Tyree (DT) = 56 Cm = 560 mm
Radius of Tyree (RT) = 28Cm = 280 mm
1Psi = 0.00689 N/mm2
From pressure gauge reading,we found
P1= 9Psi = 0.06201
Piston Diameter (Dp) = 10.2mm
Tyree Radius (Tr) = 280mm
Load (W) = P × A
= $0.06201 \times \pi/4 \times (10.2)^2$
= 5.06 N
Normal Reaction (R_N) = (W× L)/X
= (5.06×1235)/860
= 7.26 N
Frictional Force (F_T) = μ × R_N
= 0.25 × 7.26
= 1.815 N

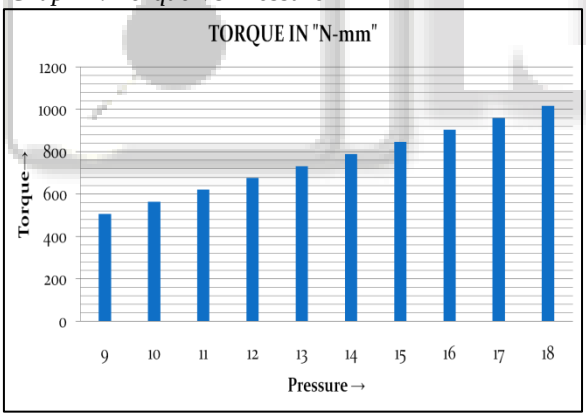
Torque (T) = F_T× Tr = 1.815 × 280
= 508.2 N-mm

By using same procedure we found different torque and Normal reaction value for different pressure gauge readings:

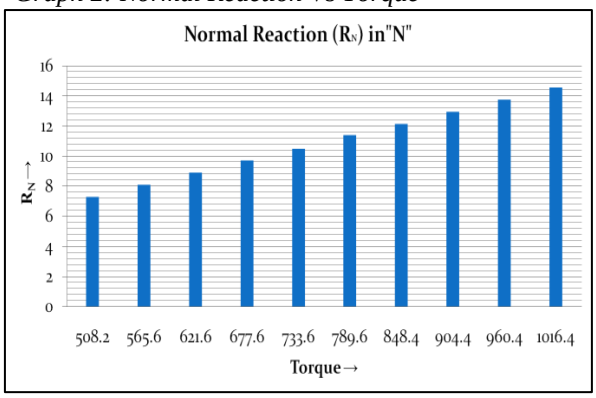
sl no.	pressure in "Psi"	1Psi = 0.00689N/mm^2	Load (w) in "N"	NORMAL REACTION (R_N) IN "N"	FRICTION FOR (F_T) IN "N"	TORQUE (T) IN "N-mm"
1	9	0.06201	5.06	7.26	1.815	508.2
2	10	0.0689	5.63	8.08	2.02	565.6
3	11	0.07579	6.19	8.88	2.22	621.6
4	12	0.08268	6.75	9.69	2.42	677.6
5	13	0.08975	7.31	10.49	2.62	733.6
6	14	0.09646	7.38	11.31	2.82	789.6
7	15	0.10335	8.44	12.12	3.03	848.4
8	16	0.11024	9.008	12.93	3.23	904.4
9	17	0.11713	9.57	13.74	3.43	960.4
10	18	0.12402	10.13	14.54	3.63	1016.4

Table 1: Observation and Calculation Table

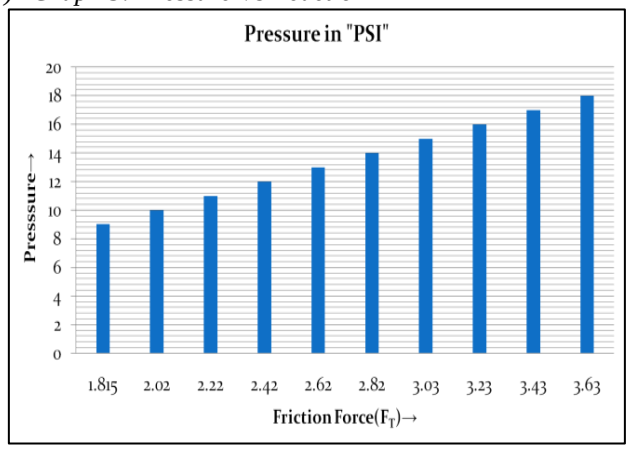
1) Graph 1: Torque Vs Pressure



2) Graph 2: Normal Reaction Vs Torque



3) Graph 3: Pressure Vs Reaction



IV. ADVANTAGES

1) Air doesn't corrode the metals so the life of pneumatic brake is more.
2) Airline couplings are easier to attach detach than hydraulic lines there is no danger of letting air into a pneumatic circuit.
3) Pneumatic brake has got emergency brake which gets activated when the service brake fails, so it is very safe.

V. CONCLUSION

This experiment was successfully done. In this experiment we successfully made the experimental set up along with all safety measures. After completion of our braking system, we took different readings for different values of pressure which can be located in our observation table. According to our calculated values various graphs has plotted showing the effectiveness of our system. The characteristics graphs clearly show that the braking torque gradually increases with the increase in pressure. It is concluded that normal reaction & frictional force is also directly proportional to the pressure. Hence as the pressure applied to the brake increases, braking torque on the system will increase effectively. Basically braking torque is the force exerted on an object and this force exerted on the brake tends to cause the object to change its speed of rotation .A vehicle always relies on the braking torque to come to rest. The brake bads exert a frictional force on the wheels, which creates a BRAKING TORQUE on the main axle. This force impedes the axle's current direction of rotation and thus stopping the car's forward movement. Hence in this way the braking torque is being the most important part for the design of the braking system. As the braking torque produced is more, it will be easier for the braking system to stop the vehicle.

REFERENCES

[1] IS 11852_4 "Automotive Vehicles - Brakes and Braking system", Indian Standard, 2001
[2] Sridhar,S., Narayanan,S., Kumaravel,B., "Dynamic Simulation of Brake valve in Air Brake System" SAE paper No.2009-28-0030.
[3] Jinglai, Wu, Hongchang, Zhang, Yunqing, Zhang. and Liping, Chen., "Robust Design of a Pneumatic Brake

System in Commercial Vehicles" SAE paper No.2009-01-0408

[4] Li He, Xiaolong Wang, Yunqing Zhang, Jinglai Wu, Liping Chen" Modeling and Simulation Vehicle Air Brake System" Proceedings 8th Modelica Conference, Dresden, Germany, March 20-22, 2011

[5] Zbigniew, Kulesza., Franciszek, Siemieniako.," Modeling the air brake system equipped with the brake and relay valves" Scientific Journals, Maritime University of Szczecin Vol.24,pp 5-11,2010.

