Review and Proposal of Exhaust gas operated air brake system for automobile

Shriram Pawar[1], Praful Rote[2], Pathan Sahil, Mohd Sayed[4]

[1]*BE student Mechanical, SND COE & RC, YEOLA, Maharashtra,India*
[2]*BE student Mechanical, SND COE & RC, YEOLA, Maharashtra,India*
[3]*BE student Mechanical, SND COE & RC, YEOLA, Maharashtra,India*
[4]*BE student Mechanical, SND COE & RC, YEOLA, Maharashtra,India*

ABSTRACT

In this braking system, exhaust gas from the IC engines is used to operate air brake in the automobiles. Air brake is most used braking system in vehicles. In the proposed model, instead of air brake, exhaust gas is used to operate the brake lever. Exhaust gas from engine is stored in a specially designed pneumatic tank. This exhaust gas pressure is used to operate the pneumatic cylinder and brake lever. The system employs a non-return valve to charge the air tank . This study can be extended for diesel engines and petrol engines. The main aim of this project is to reduce the work loads of the engine drive to operate the air compressor. In this project pressurized air from the exhaust will be used to operate the pneumatic brake

Keyword : - *Engine Exhaust , Compressed air , Pneumatic Brake , Non-return valve*

1. Introduction

An **exhaust brake** is a means of slowing a diesel engine by closing off the exhaust path from the engine, causing the exhaust gases to be compressed in the exhaust manifold, and in the cylinder. Since the exhaust is being compressed, and there is no fuel being applied, the engine works backwards, slowing down the vehicle. The amount of negative torque generated is usually directly proportional to the back pressure of the engine.

An exhaust brake is a device that essentially creates a major restriction in the exhaust system, and creates substantial exhaust back pressure to retard engine speed and offer some supplemental braking. In most cases, an exhaust brake is so effective that it can slow a heavily loaded vehicle on a downgrade without ever applying the vehicle's service brakes. Exhaust brakes are manufactured by many companies. The brakes vary in design, but essentially operate as described above. More advanced exhaust brakes have exhaust pressure modulation (EPM) that controls the back pressure which in turn improves the braking performance across a range of engine speeds.

An exhaust brake is a valve which essentially creates a back-pressure in the exhaust system, which applies enough force onto the engine's pistons to slow the engine. In most cases, an exhaust brake is so effective that it can slow a heavily-loaded vehicle on a downgrade without ever applying the vehicle's service brakes. Under these conditions, the exhaust flow from the cylinders is bottlenecked and rapidly builds pressure in the exhaust system upstream from the exhaust brake. Depending on engine speed, this pressure can easily reach up to 60 PSI maximum working pressure. Maximum working pressure is limited as part of the design of an exhaust brake. In this example, that same 60 PSI also remains in the cylinder for the entire exhaust stroke (exhaust valve open) and exerts 60 PSI on the piston top to resist its upward movement. The produces a negative torque, slowing the engine for a braking effect. Thus, simply restricting the exhaust flow can generate substantial braking.

Although these systems are mainly used for the heavier vehicles like trucks , but there is a one more possibility to use the exhaust gases to pressure an air tank that will be used to operate the air brake.Thus a detail literature review has been done in this regard

2. Literature review :

[1] As per Mr. Prakash T et al (1) , the research work embodied an air brake system based on exhaust gas is called "fabrication of air brake system using engine exhaust gas". The main aim of this project is to reduce the workloads of the engine drive to operate the air compressor, because here the compressor is not operated by the engine drive. Here we are placing a turbine in the path of exhaust from the engine. The turbine is connected to a dynamo by means of coupling, which is used to generate power. Depending upon the airflow the turbine will start rotating, and then the dynamo will also starts to rotate. A dynamo is a device which is used to convert the kinetic energy into electrical energy. The generated power can be stored in the battery and then this electric power has loaded to the D.C compressor. The air compressor compresses the atmospheric air and it stored in the air tank and the air tank has pressure relief valve to control the pressure in the tank. The air tank supplies the compressed pneumatic power to the pneumatic actuator through solenoid valve to apply brake. The pneumatic actuator is a double acting cylinder which converts hydraulic energy into linear motion.

[2] As per Mr. Li He, Xiaolong Wang et al (2) , Air brake system has been widely used in heavy trucks and intercity buses for its great superiority over other brake system. The practical performance of air brake system may be greatly different from if we analyze it with static theory. Thus, it is necessary to build an integrate air brake system model to simulate the process of brake accurately. However, the dynamic mathematic model of air brake system is very complicate, which makes the model hard to be solved. In this paper, the components of air brake system are decomposed to several basic standard pneumatic components, and then build the system based on these basic standard pneumatic components. The standard pneumatic components which are built in the software MWorks based on Modelica language include cylinder, nozzle, air reservoir, volume, and air pipe. An air brake system which contains brake valve, relay valve, brake chambers and pipelines is made based on the standard pneumatic components. The simulation results show the dynamic characteristics of air brake system.

[3] As per Mr. S.Mithun, et al (3) An air brake system is used in heavy commercial vehicles for the purpose to stop or slow down the vehicle. The effective braking depends mainly on the response time of the entire system. The brake system layout configuration has to be designed in such a way that the response time should meet the vehicle safety standard regulations. This paper describes the detailed modeling of the individual brake system products, right from the actuating valves, control valves, actuators and foundation brakes. Response time prediction for a typical 4X2 Heavy commercial vehicle has been done. Also a study on comparing the transient torque generated by the existing drum brake and an equivalent disc brake model was carried out. The layout was modeled in one of the commercially available multi-domain physical modeling software employing bond graph technique and lumped system

[4] As per Mr. Fanping Bu., et al (4) Precision stopping is an important automated vehicle control function that is critical in applications such as precision bus docking, automated truck or bus fueling, as well as automatic intersection or toll booth stopping. The initial applications of this technology are most likely to be applied to heavy duty vehicles such as buses or trucks. Such applications require specific attention to brake control since the characteristics of a typical pneumatic brake system of a heavy vehicle is inherently nonlinear with large uncertainties. The feasibility of providing a smooth precision stopping brake control based on a conventional pneumatic brake system has not yet been demonstrated. This paper describes the precision stopping problem, verifies the pneumatic brake model, details the Indirect Adaptive Robust Control (IARC) design for a pneumatic brake system, and reports the successful implementation of a bus precision docking demonstration.

2.1 Literature Gap

From careful study of the literature pertaining to the problem of air brake by application of the compressed air from the exhaust gas has been studied how ever various researchers have studied the problem no research points towards the direct application of the exhaust gas to charge the air tanks.

Thus there is scope and possibility to try and prove the application of exhaust gases to charge the air tank for application in the air brake.

Thus the paper is aimed to proposal of an alternative technology and the system components thereby used.

3. Proposal of exhaust gas operated air brake

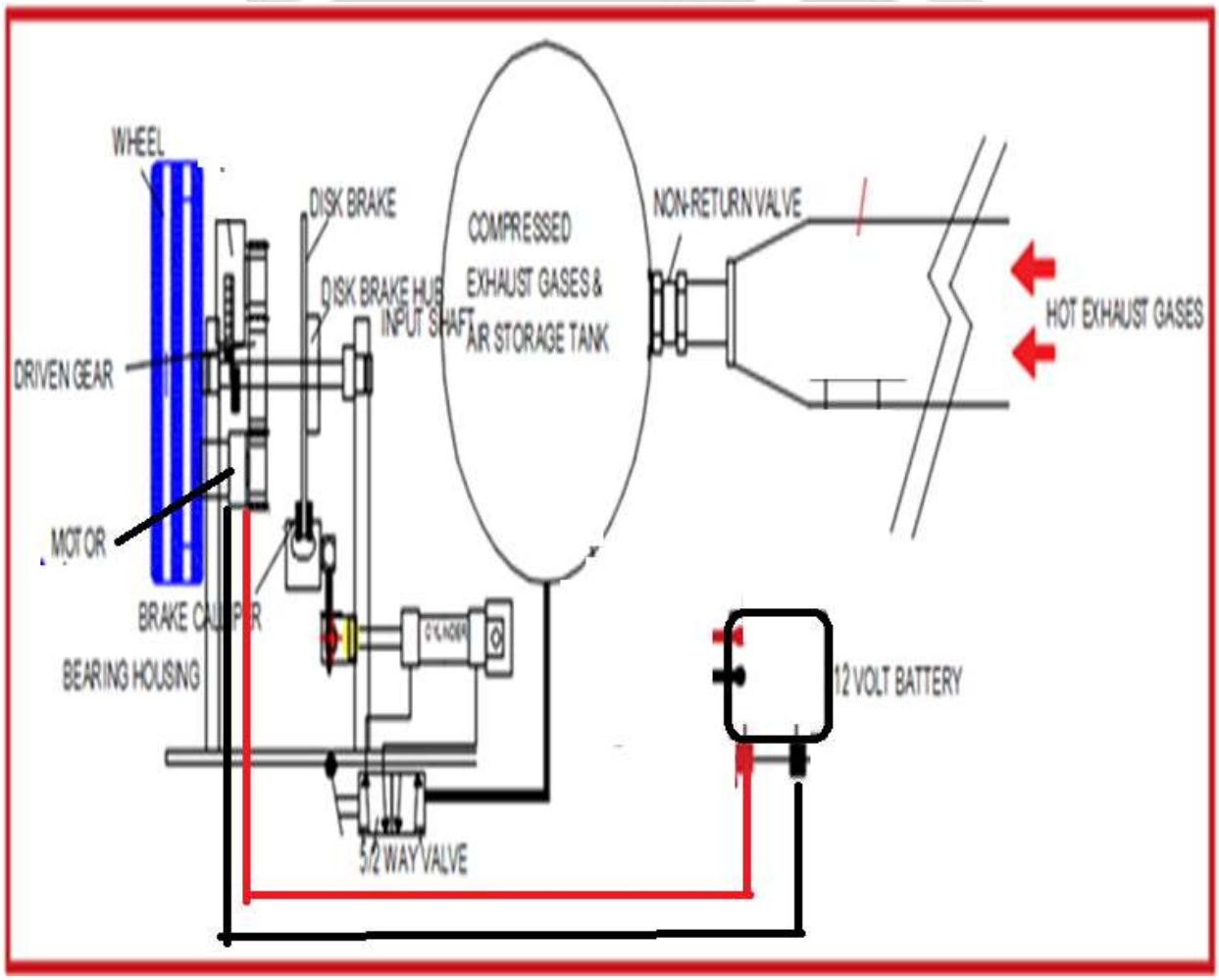
PROBLEM STATEMENT :

The conventional exhaust brake is only suitable for heavy vehicles , where as the pneumatic brakes require to compress air that in turn uses the compressor that runs on the engine power . Thus to run the pneumatic brake we are consuming engine power and more over the energy of the exhaust gases is discharged to the atmosphere which will increase pollution and so also energy is wasted.

SOLUTION :

The proposed solution is to make use of the exhaust gas pressure and compress it further to make pressure energy useful to operate the pneumatic brake.

Further more the heat carried by the exhaust gases can be used to run an Thermo-electric generator module (TEG module) that will convert the heat to useful voltage that can be used to generate electricity that can be stored in the battery which will further run a 12 volt DC compressor that will further compress air and store it in the storage tank for pneumatic braking….

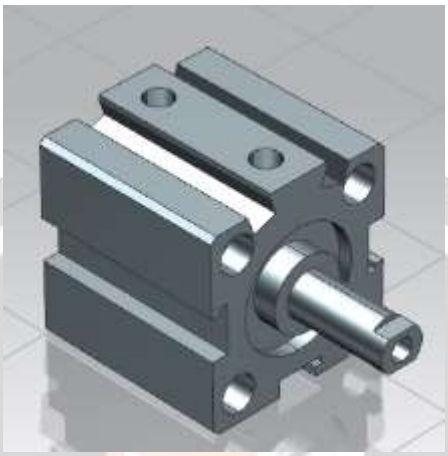


Description of Components :

1. **Air tank :**
2. **Non return valve :**

Non return valve ½ inch BSP

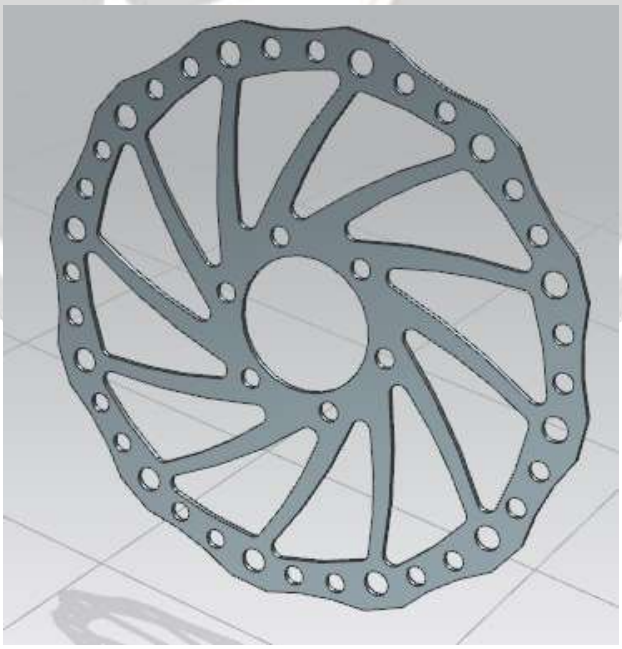
3. Pneumatic Cylinder



Compact cylinder

DNU-20-15-PPV-A.

4. Disk Brake :



60 RPM Side Shaft 37mm Diameter Compact DC Gear Motor

4. CONCLUSIONS

After careful review of literature it was found that no specific solution to apply air brake using exhaust gases was available. The project makes a proposal to apply one such system and the components thus needed to develop the unit have been discussed.

Thus the schematic is prepared and the future work will be to design and develop the unit and selection of standard components and design analysis of the system components to sustain the given system of forces will be discussed and done in the subsequent project work.

5. ACKNOWLEDGEMENT

In the due course of project with the valuable guidance of Guide Prof.Aher S.S. the project is being proceed as per schedule for achieving desirable results.

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