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AIR BRAKING SYSTEM USING EXHAUST GAS

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ABSTRACT :

The main aim of this study is to reduce the workload of the existing drive by making an alternative drive using the exhaust gas in an air-brake system. A turbine is employed for generating power. Based on the flow rate of exhaust gas, the turbine function, leads to the rotation of the dynamo. Kinetic power is converted to electrical power and this is captured inside the battery and later fed to the compressor. The compressed air is stored and supplied for the process and the air pressure is regulated by a pressure relief valve. The compressed air reaches the actuator through a solenoid valve and successfully applies brakes. The air actuator converts hydraulic energy into linear motion.

One of the most important components of the vehicle is the brakes. The Brake is an essential feature in order to retard and stop the vehicle within minimum possible time. In heavy vehicles apart from the conventional frictional brakes used, some systems are used to aid the braking process and increases the efficiency of braking such as exhaust brakes. The function of an exhaust brake is to aid in slowing downvehicles running with diesel engines without the use of the wheel brakes. This paper tells us about how the exhaust braking system is used in the vehicles, their major components and their pros and cons.

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 DC 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.

KEY WORDS: Dc compressor,Air brake,Exhaust gas,Turbine,Pressure Relief Valve,Cylinder,Braking System.

1.INTRODUCTION:

The aim is to design and to develop an air brake system based on exhaust gas is called “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.This exhaust gas pressure is used to operate the pneumatic cylinder and brake lever. Filters are used to remove the impurities from the exhaust gas, and then it is allowed to store in the tank. Pressure relief valve is used achieve specific pressure in tank and helps to avoid damage in tank as well as in engine.

The function of the hand brake is to stop the car in emergency situations and also in parking conditions. In case failure in the primary braking system then hand brake can be engaged to stop the vehicles. This proposed exhaust gas braking system has primary air brake function and also exhaust gas braking also. During emergency situations exhaust gas braking will be helpful to stop the vehicles.

2.COMPONENTS USED:

- DC Compressor.
- SWITCHES FOR IGNITION ON/OFF AND SELF START.
- PNEUMATIC CYLINDER.
- 12 DC COMPRESSOR.
- SOLENOID VALVE.
- FRAME.
- AIR PIPES.
- 12 V BATTERY.
- DC GENERATOR OR DYNAMO.
- SPROCKET AND CHAINDRIVE.

2.WORKING PRINCIPLE:

The exhaust gas from the internal combustion engine is directly connected to the air tank and stored. Then it is connected to the double acting pneumatic cylinder through a solenoid valve. The pneumatic cylinder is connected to the brake pedal to apply brakes.

An airbrake system using engine exhaust gases typically operates by redirecting a portion of the engine's exhaust flow through special valves into a braking chamber. The high-pressure exhaust gases in the chamber create resistance against the vehicle's motion, effectively slowing it down. This process is controlled by the driver or automated systems to regulate braking force as needed.

3.EQUIPMENTS USED:

A. Two Stroke Petrol Engine

The mechanical simplicity, light weight and high power to weight quantitative relation and it completes full cycle in every two stroke of the piston whereas in four stroke petrol engine piston travels four stroke so the two stroke petrol engine is used in proposed model. The fuel tank will supply the pressurized gas in an engine and by the stroke of piston such as upstroke and down stroke due to this movement it will convert the chemical energy in power.

1) Fuel Tank: A fuel tank should be made up of plastic and it should be safe for flammable fluid. Plastic fuel tank must avoid leakages and limit evaporation emission.

2) Exhaust Gas: In this proposed model the exhaust gas system used to discharge exhaust gas into atmosphere. The exhaust pipe should be design properly to carry toxic exhaust gasses such as hydrocarbon, carbon monoxide (CO) and nitrogen oxide (N2). It should be heat-resistant. Exhaust gas can be pass through a catalytic converter to decrease air pollution and a muffler in (North America) /silencer (UK, India) to diminish noise pollution in atmosphere. A study in 2013 by MIT indicated that 53000 deaths occurs per year in US because of vehicle emission. The exhaust gas contains largest a part of most combustion gases that’s N2 (Nitrogen), H2O (Water vapor), CO2 (Carbon di oxide). These are not toxic though CO2 led to global warming. The toxic ones are CO (Carbon monoxide) and hydrocarbon CxHy because of incomplete combustion. The exhaust gases which discharged by engine to atmosphere can affect human being and animals health. The effect of inhaling exhaust gases or Air bone led to asthma, lung cancer, cardiovascular issues, premature death because of size of air bone particles and they can puncture the deepest part to lungs. Exhaust gas temperature gauge is used to measure the exhaust gas temperature of an IC engine in conjunction with a thermocouple type pyrometer. By measuring exhaust gas temperature the driver gets an idea of the vehicle air fuel ratio.

B. Turbine and Dynamo: The function of turbine is to rotate, here we are placing turbine in path of exhaust gas because of which it will start rotating and which will rotate the dynamo as well. Dynamo meter is a device which converts kinetic energy into electric energy.

C. Dryer: The function of dryer in this proposed model is to dry the moisture contain in the atmospheric air. So, that it will protect air tank and others from rusting.

D. Pneumatic Cylinder (Double Acting Single Piston): It consist of a cylinder in which the piston with single piston rod and reciprocate, similarly to single acting cylinder.

E. Solenoid Valve: It is electro mechanical valve which used to control flow of liquid or gas it converts the electrical signal from control unit to mechanical movement of plunger to allow the flow inside of valve. There are two chambers separated by plunger when it get electric signal, the magnetic force is produced inside because of which the plunger get attracted towards the magnetic force and valves opens.

F. Control Unit: Control unit is a part of CPU that directs the operation of processors, it tells the computer memory, arithmetic/logic unit and input output devices how to responds to programs. It operates unit by providing timing and design. In this proposed model CU operates the solenoid valves.

DIAGRAM:

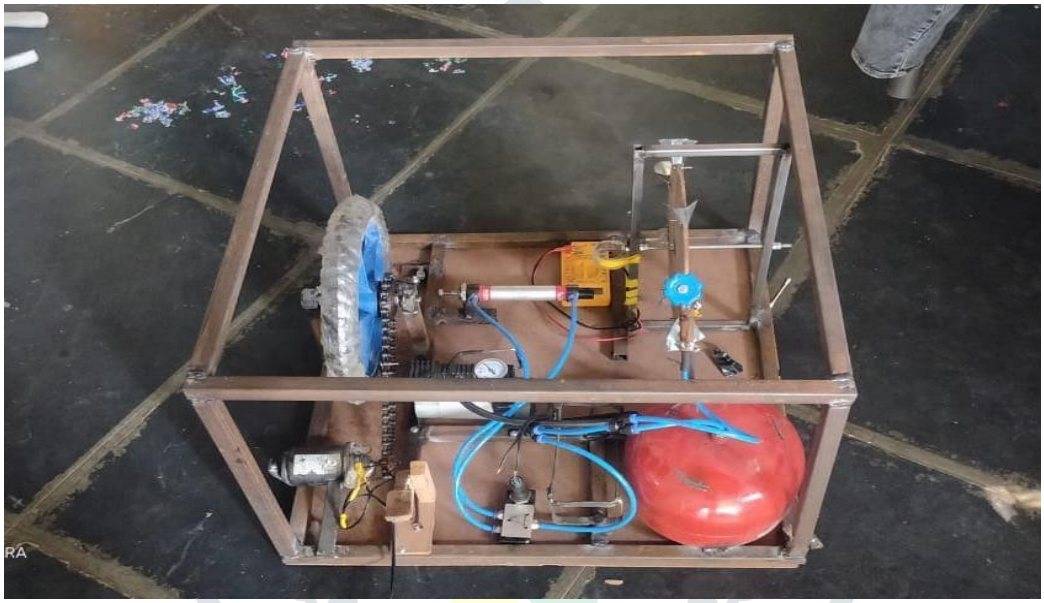

FIG: SETUP OF AIR BRAKE SYSTEM USING EXHAUST SYESTEM

4.EXPERIMENTAL PROCEDURE:

The two stroke petrol engine is connected to the wheels in which exhaust gas braking is attached. Pressure tank is used to store the exhaust gas under required pressure. The braking speed is varied by adjusting the valve is called flow control valve. Solenoid valve is used to operate the pneumatic cylinder which actuates the brake lever of the wheels. The flow chart of the experiment is given in the figure. During the operation of the engine, the exhaust gas is stored in the pressure tank. If the pressure of the tank exceeds certain limit then pressure relief valve will open. It is used to maintain the required pressure in the pressure tank.

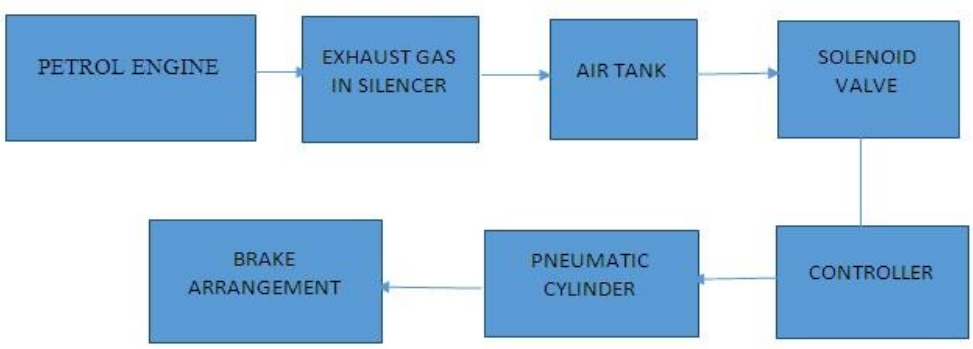

Fig: Flow Chart of Air Brake System Using Exhaust Gas

When the brake is applied, control circuit detects the signal and operates the solenoid valve. Exhaust gas stored in the pressure tank is used to actuate the pneumatic cylinder. End of the actuator is connected to the brake lever. When pneumatic cylinder is actuated, brake lever is operated and applies the brake to the wheels. Brake pad is connected to the cam mechanism. Lever turns the cam, thus opening of brake show is obtained. Brake lever will come to the original position when it is not required. DCV is used to retract the pneumatic cylinder when not required. Figure 5 shows the complete experimental setup of exhaust gas braking system.

5.ADVANTAGES,DISADVANTAGES AND APPLICATION:

1)ADVANTAGES

It reduces the battery power.

2.It increases the engine efficiency.

3.It occupies less floor space.

4.It reduces the air pollution.

2)DISADVANTAGES

1.Initial cost is high.

2.Need a separate compressor.

3.Maintenance cost is high.

3)APPLICATIONS

1.For automobile application.

2.Industrial application.

SPECIFICATIONS:

- PNEUMATIC CYLINDER – 10 Kpa.
- DC COMPRESSOR – 12 V.
- DYNAMO – 12V.
- BATTERY – 12V.

6.CONCLUSION:

The project “AIR BRAKE SYSTEM USING EXHAUST GAS” is successfully done. A lot of practical knowledge is gained while doing this project work. The work is completed with the limited time successfully. This project work has provided us an excellent opportunity and experience, to use our limited knowledge. It is understood that “AIR BRAKE SYSTEM USING EXHAUST GAS” helps to achieve more efficient method of braking system using the exhaust gas of the engine with the minimal initial cost. By using more techniques, they can be modified and developed according to the applications.In this proposed model we obtained that the brake is applied with help of engine exhaust gasses from two stroke petrol engine, It improves the efficiency of engine compared to previous air brake system. This also reduced the cost involved in the setup.it also helps to reduce the air pollution by using the air filter. This can be further study on diesel engine but with the improvement in design.

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