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Design and Fabrication of Air Brake System Using Engine Exhaust Gas

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ABSTRACT: In this braking system, exhaust gas from the engine is used to operate air brake in auto-mobile. The aim of this project is to improve an air brake system based on gas produced by the engine is called "Development and Fabrication of air brake system using engine exhaust gas". The aim 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 drive. 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 vehicles service brakes.

KEYWORDS: Two stroke engine, exhaust gas, pressure relief valve, braking system, engine, cylinder.

I.INTRODUCTION

BRAKING SYSTEM

A brake is a mechanical device that inhibits motion by absorbing energy from a moving system. It is used for slowing or stopping a moving vehicle, wheel, axle, or to prevent its motion, most often accomplished by means of friction.

Most brakes commonly use friction between two surfaces pressed together to convert the kinetic energy of the moving object into heat, though other methods of energy conversion may be employed.

With the development of highways, logistics and the pace of life, weight and velocity of vehicle has become more and larger, which has reduced the safety of driving an auto mobile. The braking load of vehicles increases quickly so that the primary brake system is easily overloaded and can be damaged by overheating possibly resulting in brake failure.

In addition, for vehicles in the mountains, hills and city, the driver will need to use the main braking system frequently for security reasons, which leads to a reduction of average speed, which affects the operating cost. The road hazards related to heavy goods vehicles are partly due to inefficient system, or the failure of brakes.

The commonly used braking system in these heavy duty trucks is the 'jake' brake used on diesel big rigs and dump trucks. A jake brake words by using hydraulic pressure to momentarily open the exhaust valve at the end of the compression stroke, venting off the compressed air into the exhaust system.

We waste so much energy. As much as 60 percent of energy is wasted as heat. Our laptops, nuclear power plants, chemical factories and cars all contribute to this waste heat. General motors to create thermoelectric generators to turn the waste heat directly into electrical energy for cars. The idea is to be use the heat from the car engines exhaust to generate braking system.

A huge of amount of energy is consumed through the waste exhaust gas in IC. this can be represented in percentage in below figure. It was found that the percentage of fuel energy converted to useful work only 10.4 % and also found the

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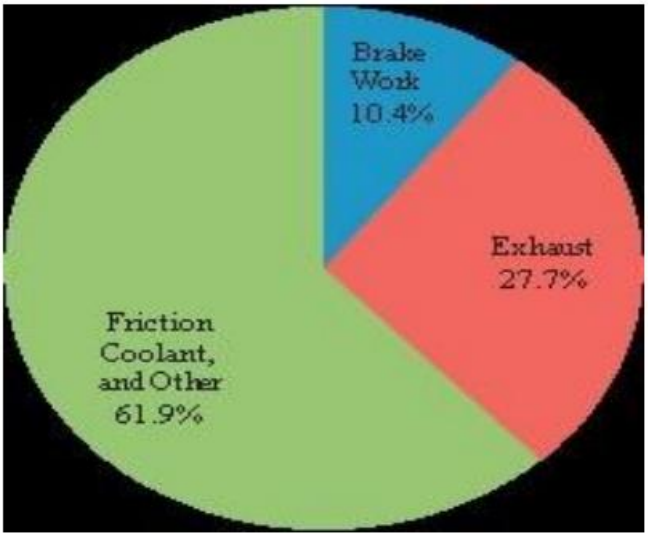
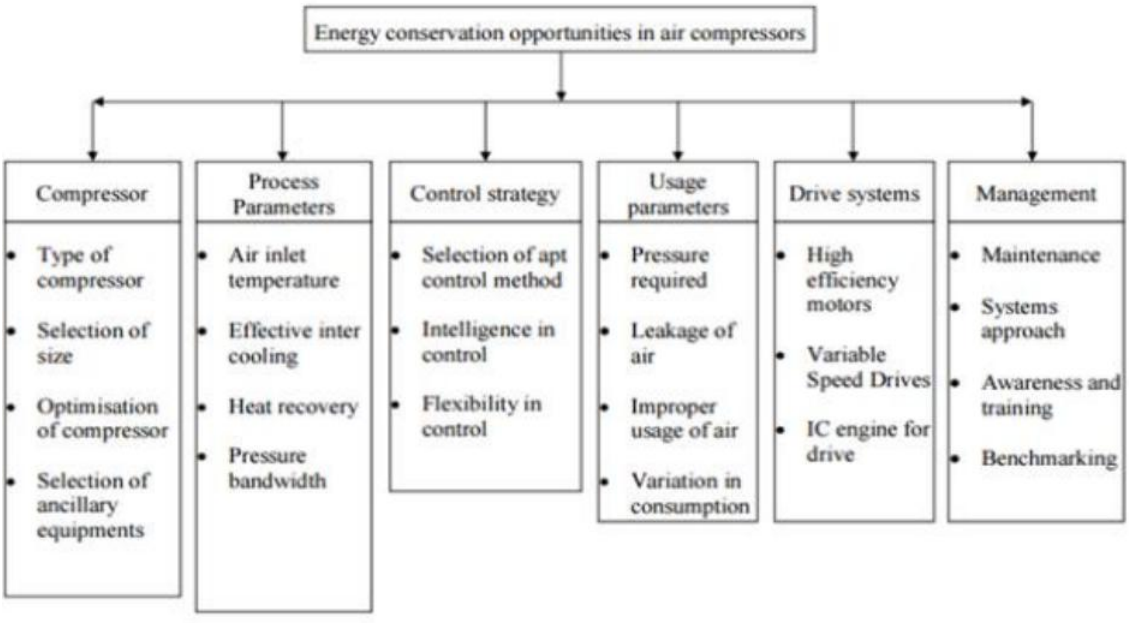
thermal energy lost through exhaust gas about 27.7 %. In the given second law states that fuel energy is converted to the brake power about 9.7 %. And the exhaust about 8.4 %. In another research the value of exhaust gases mentioned to be 18.6 % of total combustion energy. It is also found that by installing heat exchanger to recover exhaust energy of the engine could be saved up to 34 % of fuel saving.





Block diagram showing energy opportunities in air compressors

Figure 1: Energy Distribution

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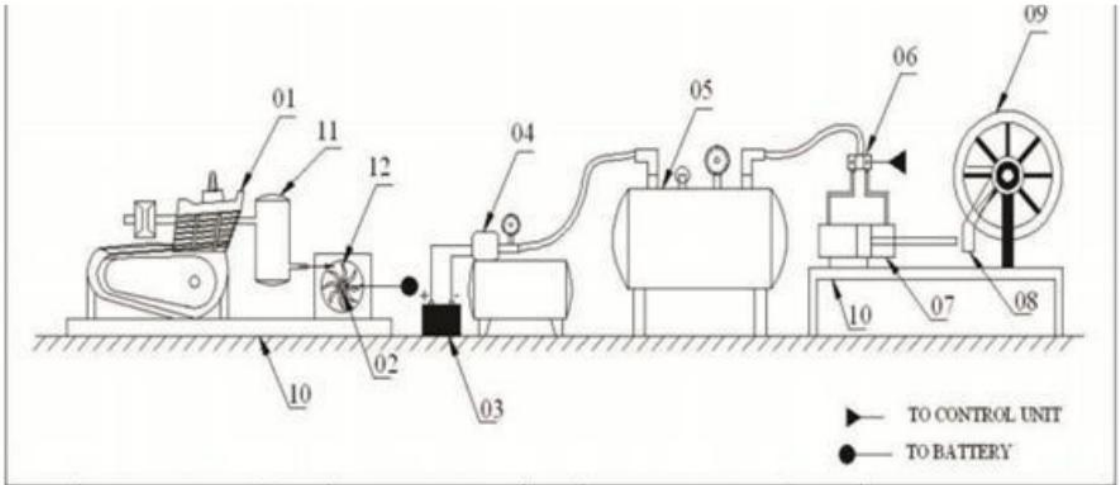
II.LITERATURE SURVEY

The various research works attempted in the area of energy conservation and specifically in the area of air compressor and pneumatic systems have been referred and discussed here.

1. According to John (1995), the opportunities for cost savings in compressed air supply system includes but not limited to waste heat recovery, compressed air leakage reduction, use of outside air for compressor, compressor control, air pressure control, compressor selection and usage of IC engine for compressor driving.

2. The solution for compressed air leaks is to make leak finding and correcting as a part of the normal maintenance process and repeating leak survey at least once a year (John Holdsworth 1997). Over pressurization can also result from short sighted selection of ancillary equipments. Bill Howe and Bill Scales (1998) report that the opportunities for improved compressed air efficiency where air is used internally, but uneconomically are less understood.

WORKING PRINCIPLE:



S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME
01	ENGINE	04	12V COMPRESSOR	07	PNEUMATIC CYLINDER	10	BASE FRAME
02	DYNAMO	05	AIR TANK	08	BRAKING PLATE	11	SILENCER
03	BATTERY	06	SOLENOID VALVE	09	WHEEL	12	TURBINE

Air from exhaust gas is forced in to a turbine which acts as a dynamo, the turbine fan is made of light material which will rotate for even minimum force of air. The turbine thus produces millivolts of charge which is shown using a LED. A diode is connected to the circuit of the dynamo which is connected to a battery to have a one-way flow of current. Thus, charge stored in a battery is used to run a 12v dc compressor which actuates flow of air through solenoid valve. The solenoid valve acts as switch for braking mechanism.
Hence braking facility is obtained by using pneumatic cylinder to a drum brake. Air brakes are very efficient as only solenoid valve has to be actuated for braking which requires only a small amount of force compared to any other braking systems.

III.METHODOLOGY

The experiment contains two stroke petrol engine, that will be connected to the wheels in which exhaust braking arrangement is attached. The turbine will be operating in exhaust gas and then it is connected to the dynamo. Pressure tank is used to store the exhaust gas under required pressure. The braking capacity is adjusted by the valve is called flow control valve.

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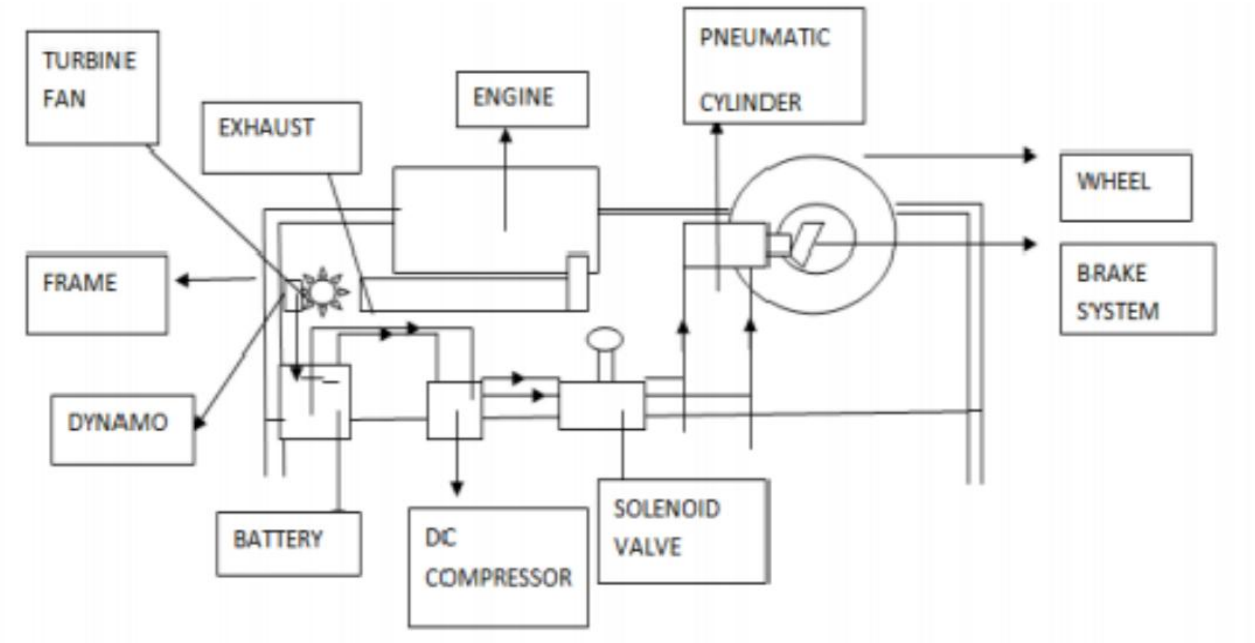

2-D VIEW OF AIR BRAKE SYSTEM USING EXHAUST GAS

The project is based on using the exhaust coming out from the combustion chamber to be used in braking system. the exhaust gas from combustion chamber is made to pass through turbine which cool exhaust gas and to compressor which compress the air store it in a storage tank, which provide air to air shocks in the path of exhaust from the silencer.

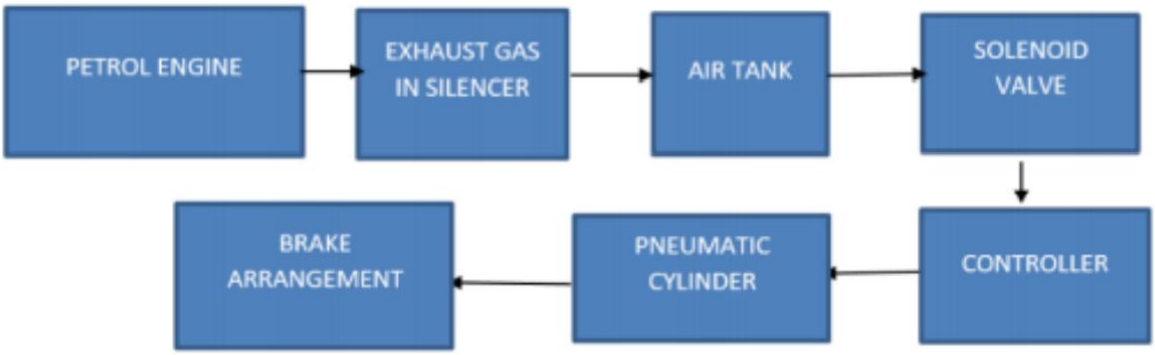

Figure 2: Working flow chart

A two stroke engine powered by the petrol is used to produce exhaust gas. Here we are placing a turbine in the path of exhaust from thus rotating the dynamo. A dynamo is a device is used to convert the kinetic energy into electrical energy, the generated electrical power is stored in a battery after rectification. Thus the stored electrical power is used to run the DC compressor, the compressor compress the atmospheric air and it is stored in the air tank. When the brake is applied the solenoid valve is activated and it allows the air to actuates the pneumatic cylinder thus the brake is applied.

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IV.RESULTS

BRAKING PERFORMANCE:

It is the most important in consideration to vehicle safety. Brake system design is an important parameter for braking force. Fb=Tb/rw Where, Fb = braking force Tb= braking torque rw= wheel radius As Tb increases Fb also increases but up to the limit of road adhesion. So, Fb max = ubW Where, ub= coefficient of road adhesion Braking performance test provides the intuitive knowledge of braking distance and stability of vehicle during braking. Generally, best braking performance is referred to the condition where vehicle stops within minimum possible distance without diverting from its original course. There is dynamic transfer of weight due to acceleration and braking. To counter act the effect of weight transfer we need to design braking system in such a way that will enable us to distribute the force required to apply the brake.

ADVANTAGES OF AIR BRAKE SYSTEM:

Air brake can transfer high braking effort with ease.
1. The system is flexible to mount on the chassis.
2. Air from compressor can be utilized for other pneumatic accessories.
3. The response of air brake is very fast.
4. The working principle of an air brake system is similar to that of a hydraulic system except that in air brakes, the medium used to transmit braking effort is compressed air.
5. Air brakes are faster in response and can transmit high braking effort.
6. They are employed on heavy vehicles such as trucks, buses, etc.

V.CONCLUSIONS

In this project we have obtained a revolutionary process in the field of mechanical and auto-mobile. In this project also use waste energy released in the engine to useful work and that will be used for the braking application. This system can also be used for hybrid vehicles. The shaft power was mostly limited by the turbine operating pressure, indicated that modification on the turbine was needed for performance improvement. 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.

VI.FUTURE SCOPE

1. A generator mounted on the shaft of the turbocharger can generate electricity from exhaust gases from the engine and later stored in battery. This system can be used in hybrid combination vehicle with internal combustion engine and battery.

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