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Fabrication Of Air Brake System Using Exhaust Gas

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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. Two stoke petrol engine is used in the proposed exhaust gas braking system. Petrol engine is chosen because it produces less impurity in exhaust than diesel engines. This study can also be extended for diesel engines also with suitable design. The main aim of this project is to reduce the work loads of the engine drive to operate the air compressor. In this project, we used exhaust gas from the engine to rotate the generator turbine. Then the power is loaded to the D.C compressor and it is used to the pneumatic cylinder to apply brake.**

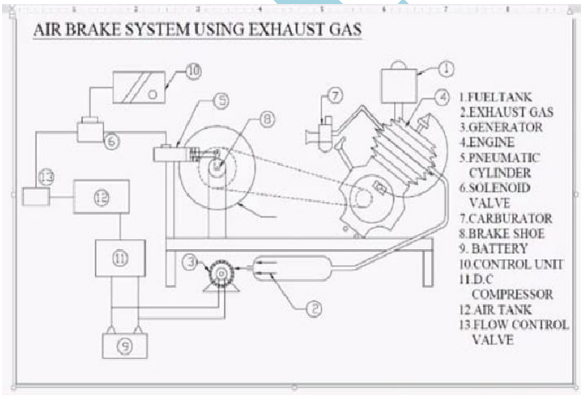
I. INTRODUCTION

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. Modern vehicles are equipped with hybrid system in order to preserve the non-renewable energy sources.

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.

Two stroke engines have high power too weight ratio and less moving parts. It is also lighter compared to the four stroke engines. Comparing to the cost two stroke engines are cheaper. Hence two stroke engine is used in the proposed model. This brake uses exhaust gas pressure, thus it improves the efficiency of the engine compared to default air brake system.

BLOCK DIAGRAM:



2.COMPONENTS DESCRIPTION:

FUEL TANK:

The fuel tank will supply the petrol in to injector. This tank is made up of plastic material.

A fuel tank (or petrol tank) is a safe container for flammable fluids. Though any storage tank for fuel may be so called, the term is typically applied to part of an engine system in which the fuel is stored and propelled (fuel pump) or released (pressurized gas) into an engine. Fuel tanks range in size and complexity from the small plastic tank of a butane lighter to the multi-chambered cryogenic Space Shuttle external tank.

Typically, a fuel tank must allow or provide the following: Storage of fuel: the system must contain a given quantity of fuel and must avoid leakage and limit evaporative emissions Filling: the fuel tank must be filled in a secure way, without sparks.

Provide a method for determining level of fuel in tank, gauging (the remaining quantity of fuel in the tank must be measured or evaluated).Venting (if over-pressure is not allowed, the fuel vapors must be managed through valves).

Feeding of the engine (through a pump).

Anticipate potentials for damage and provide safe survival potential.

Plastic (high-density polyethylene HDPE) as a fuel tank material of construction, while functionally viable in the short term, has a long term potential to become saturated as fuels such as diesel and gasoline permeate the HDPE material.

Considering the inertia and kinetic energy of fuel in a plastic tank being transported by a vehicle, environmental stress cracking is a definite potential. The flammability of fuel makes stress cracking a possible cause of catastrophic failure. Emergencies aside, HDPE plastic is suitable for short term storage of diesel and gasoline. In the U.S., Underwriters Laboratories approved (UL 142) tanks would be a minimum design consideration.

EXHAUST GAS:

An exhaust system is usually piping used to guide reaction exhaust gases away from a controlled combustion inside an

engine or stove. The entire system conveys burnt gases from the engine and includes one or more exhaust pipes. Depending on the overall system design, the exhaust gas may flow through one or more of:
Cylinder head and exhaust manifold
A turbocharger to increase engine power.
A catalytic converter to reduce air pollution.
A muffler (North America) / silencer (UK/India), to reduce noise.
Now in our project we are using the Exhaust Gas system.The Exhaust gas or flue gas is emitted as a result of the combustion of fuels such as natural gas, gasoline, petrol, biodiesel blends, diesel fuel, fuel oil, or coal. According to the type of engine, it is discharged into the atmosphere through an exhaust pipe, flue gas stack, or propelling nozzle. It often disperses downwind in a pattern called an exhaust plume.
It is a major component of motor vehicle emissions (and from stationary internal combustion engines), which can also include:
Crankcase blow-by
Evaporation of unused gasoline
Motor vehicle emissions contribute to air pollution and are a major ingredient in the creation of smog in some large cities. A 2013 study by MIT indicates that 53,000 early deaths occur per year in the United States alone because of vehicle emissions.[2] According to another study from the same university, traffic fumes alone cause the death of 5,000 people every year just in the United Kingdom.

3.DESIGN CRITERIA:

An exhaust pipe must be carefully designed to carry toxic and/or noxious gases away from the users of the machine. Indoor generators and furnaces can quickly fill an enclosed space with poisonous exhaust gases such as hydrocarbons, carbon monoxide and nitrogen oxides, if they are not properly vented to the outdoors.

Also, the gases from most types of machines are very hot; the pipe must be heat-resistant, and it must not pass through or near anything that can burn or can be damaged by heat. A chimney serves as an exhaust pipe in a stationary structure. For the internal combustion engine it is important to have the exhaust system "tuned" (refer to tuned exhaust) for optimal efficiency. Also this should meet the regulation norms maintained in each country. In China, China 5; In European countries, EURO 5; In India, BS-4, etc.,

COMPOSITION:
The largest part of most combustion gas is nitrogen (N2), water vapor (H2O) (except with pure-carbon fuels), and carbon dioxide (CO2) (except for fuels without carbon); these are not toxic or noxious (although carbon dioxide is a greenhouse gas that contributes to global warming). A relatively small part of combustion gas is undesirable, noxious, or toxic substances, such as carbon monoxide (CO) from incomplete combustion, hydrocarbons (properly indicated as CxHy.
But typically shown simply as "HC" on emissions-test slips) from un-burnt fuel, nitrogen oxides (NOx) from excessive combustion temperatures, and particulate matter(mostly soot).

EXHAUST GAS TEMPRATURE:
Exhaust gas temperature (EGT) is important to the functioning of the catalytic converter of an internal combustion engine. It may be measured by an exhaust gas temperature gauge. EGT is also a measure of engine health in gas-turbine engines.

POLLUTION REDUCTION:
Emission standards focus on reducing pollutants contained in the exhaust gases from vehicles as well as from industrial flue gas stacks and other pollution exhaust sources in various large-scale industrial facilities such as petroleum refineries, natural gas processing plants, petrochemical plants and chemical production plants. However, these are often referred to as flue gases. Catalytic converters in cars intend to break down the pollution of exhaust gases using a catalyst.
Scrubbers in ships intend to remove the sulfur dioxide (SO2) of marine exhaust gases. The regulations on marine sulfur dioxide emissions are tightening, however only a small number of special areas worldwide have been designated for low sulfur diesel fuel use only.
One of the advantages claimed for advanced steam technology engines is that they produce smaller quantities of toxic pollutants (e.g. oxides of nitrogen) than petrol and diesel engines of the same power. They produce larger quantities of carbon dioxide but less carbon monoxide due to more efficient combustion.

HEALTH STUDIES:
Researchers from the University of California, Los Angeles School of Public Health say preliminary results of their statistical study of children listed in the California Cancer Registry born between 1998 and 2007 found that traffic pollution may be associated with a 5% to 15% increase in the likelihood of some cancers. A World Health Organization study found that diesel fumes cause an increase in lung cancer.

LOCALISED EFFECTS:
The California Air Resources Board (C.A.R.B.) found in studies that 50% or more of the air pollution (smog) in Southern California is due to car emissions.
It causing premature death in extreme cases. Inhalation of NO species increases the risk of lung cancer and colorectal cancer and inhalation of such particles may cause or worsen respiratory diseases such as emphysema and bronchitis and heart disease.
In a 2005 U.S. EPA study the largest emissions of NOx came from on road motor vehicles, with the second largest contributor being non-road equipment which is mostly gasoline and diesel stations.
The resulting nitric acid may be washed into soil, where it becomes nitrate, which is useful to growing plants.
Particulate matter (PM10 and PM2.5)
The health effects of inhaling airborne particulate matter have been widely studied in humans and animals and include asthma, lung cancer, cardiovascular issues, premature death. Because of the size of the particles, they can penetrate the deepest part of the lungs.

A 2011 UK study estimates 90 deaths per year due to passenger vehicle PM. In a 2006 publication, the U.S. Federal Highway Administration (FHWA) state that in 2002 about 1 per-cent of all PM10and 2 per-cent of all PM2.5 emissions came from the exhaust of on-road motor vehicles (mostly from diesel engines).

Carbon dioxide (CO2)

Carbon dioxide is a greenhouse gas. Motor vehicle CO2 emissions are part of the anthropogenic contribution to the growth of CO2 concentrations in the atmosphere which according to the vast majority of the scientific community is causing climate change.

Motor vehicles are calculated to generate about 20% of the European Union's man-made CO2 emissions, with passenger cars contributing about 12%.European emission standards limit the CO2 emissions of new passenger cars and light vehicles.

The European Union average new car CO2 emissions figure dropped by 5.4% in the year to the first quarter of 2010, down to 145.6 g/km.

EXHAUST GAS TEMPRATURE GAUGE:

An exhaust gas temperature gauge (EGT gauge) is a meter used to monitor the exhaust gas temperature of an internal combustion engine in conjunction with a thermocouple-type pyrometer. EGT gauges are found in certain cars and airplanes. By monitoring EGT, the driver or pilot can get an idea of the vehicle's air-fuel ratio.

At a stoichiometric air-fuel ratio, the exhaust gas temperature is different from that in a lean or rich air-fuel ratio. At rich air-fuel ratio, the exhaust gas temperature either increases or decreases depending on the fuel. High temperatures (typically above 1,600 °F or 900 °C) can be an indicator of dangerous conditions that can lead to catastrophic engine failure.

4.APPLICATIONS:

EGT meters are used for tuning turbo-equipped cars. If the sensor is installed at the manifold collector before the turbo, the turbine inlet temperature can be monitored. If the sensor is installed after the turbo, the exhaust temperature can be monitored. Because EGT typically drops 200–300 °F (110–170 °C) across the turbine, installers try to put the thermocouple as close to the cylinder head as possible to give a true reading, and a reading that will react faster to the engine's condition compared to an installation after the turbo.

ENGINE:

In this project, we use 110 cc SPARK IGNATION four stroke single cylinder engine. it consists of a piston that moves within the cylinder fitted with two valves. The distance moved in one direction is called stroke and the cylinder diameter is bore. The piston is said to be at the top dead centre position the volume of the cylinder is minimum . The piston is at bottom dead centre when the cylinder volume is maximum; the volume swept out by the piston between TDC and BDC is called swept volume.

A spark-ignition engine is an internal combustion engine, generally a petrol engine, where the combustion process of the air-fuel mixture is ignited by a spark from a spark plug. This is in contrast to compression-ignition engines, typically diesel engines, where the heat generated from compression together with the injection of fuel is enough to initiate the combustion process, without needing any external spark.

FUELS:

Spark-ignition engines are commonly referred to as "gasoline engines" in North America, and "petrol engines" in Britain and the rest of the world. However, these terms are not preferred, since spark-ignition engines can (and increasingly are) run on fuels other than petrol/gasoline, such as autogas (LPG), methanol, ethanol, bioethanol, compressed natural gas (CNG), hydrogen, and (in drag racing) nitromethane.

WORKING CYCLE:

The working cycle of both spark-ignition and compression-ignition engines may be either two-stroke or four-stroke.

A four-stroke spark-ignition engine is an Otto cycle engine. It consists of following four strokes: suction or intake stroke, compression stroke, expansion or power stroke, exhaust stroke. Each stroke consists of 180 degree rotation of crankshaft rotation and hence a four-stroke cycle is completed through 720 degree of crank rotation. Thus for one complete cycle there is only one power stroke while the crankshaft turns by two revolutions.

FOUR-STROKE SPARK IGNITION ENGINE In this gasoline is mixed with air, broken up into a mist and partially vaporized in a carburetor .The mixture is then sucked into the cylinder. There it is compressed by the upward movement of the piston and is ignited by an electric spark. When the mixture is burned, the resulting heat causes the gases to expand. The expanding gases exert a pressure on the piston (power stroke). The exhaust gases escape in the next upward movement of the piston. The strokes are similar to those discussed under four-stroke diesel engines.

GENERATOR:

Generator is a machine that converts mechanical energy into electrical energy. It works based on principle of faraday law of electromagnetic induction. The faradays law states that whenever a conductor is placed in a varying magnetic field, EMF is induced and this induced EMF is equal to the rate of change of flux linkages. This EMF can be generated when there is either relative space or relative time variation between the conductor and magnetic field. So the important elements of a generator are:

Magnetic field

Motion of conductor in magnetic field

5. WORKING OF GENERATORS:

Generators are basically coils of electric conductors, normally copper wire, that are tightly wound onto a metal core and are mounted to turn around inside an exhibit of large magnets. An electric conductor moves through a magnetic field, the magnetism will interface with the electrons in the conductor to induce a flow of electrical current inside it.

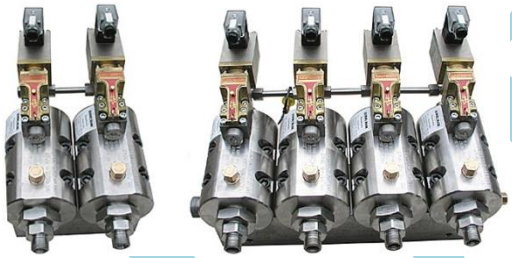
PNUEMATIC CYLINDER:

1. Design of pneumatic cylinders (double acting)

A pneumatic cylinder is designed for converting pressure energy into useful work (motion). A double acting cylinder is operated by the reciprocal input of compressed air.
When compressed air is applied to the rear port of the cylinder while the other side is open to the atmosphere, the cylinder starts to advance. To return the piston to its initial position the air supply has to be connected to the front port while the rear chamber of the cylinder has to be exhausted. The switching of air is done by means of a directional control valve. If large masses are moved by a cylinder, cushioning is used in the end positions. Before reaching the end position, a cushioning piston interrupts the direct flow of air to the outside.
The air is forced to flow through flow control valve. Therefore the speed of the piston is slowed down for the last part of the stroke to reduce impact on the cylinder.
Traversal force on piston rod:
Traversal forces on the piston rod will cause a surface pressure on the bearing bush of the cylinder. The piston rod acts like a lever. The longer the stroke the higher the surface pressure on the bush. High surface pressure will cause excessive wear of the bush.
If the traversal force exceeds the maximum permissible load of the cylinder bush, a external guide or support has to be provided (e.g. Festo FEN guide unit).

SOLENOID VALVE:

Solenoid valve is an electro-mechanical valve that can be used to control the flow of liquid or gas. The solenoid converts an electrical signal in to a mechanical movement. The signal is sent to a coil and the movement occurs inside the valve. Solenoids valves are usually described as pilot operated or direct operated (or direct acting).



HOW DO PILOT OPERATED SOLENOID VALVES WORK:

Two Way Pilot Operated Solenoid Valves have two chambers separated by a diaphragm. The upper chamber is connected to upstream through a pilot hole in either the cover or diaphragm. The media exerts a pressure that acts on the upper side of the diaphragm and keeps the valve closed.
When the coil is charged the core lifts off the orifice seat allowing the operating chamber to de-pressurize. The thrust of the upstream pressure under the diaphragm continues, lifting the diaphragm and opening the valve.
When the solenoid is energized in a direct acting valve, the core directly opens the orifice of a Normally Closed valve or closes the orifice of a Normally Open valve.

APPLICATIONS OF THE SOLENOID VALVES

The solenoid valve are used extensively in large number of devises that are used in various industries like refrigeration, air conditioning, automobiles, hydraulics, pneumatics, and many more. Only a few of the applications of the solenoid valves have been described here
In refrigeration:
One of the most popular applications of the solenoid valve is in the refrigeration systems. They are used in air conditioners to change the direction of the flow of the refrigerant so that they can be used for the cooling purpose in the summers and for heating purpose in the winters.
In summers the cooling coil of the air conditioner is located inside the room and the condenser outside the room while their functions are reversed in the winters as the machine acts as the heat pump.

In hydraulics and pneumatics:

The pneumatic valves are operated by the pressure of the compressed air. They comprise of the piston and cylinder arrangement or some rotating parts called as the actuator. The solenoid valve controls the pressure of air flowing to the actuator and thus controls the action brought about by the actuator.
The arrangement of the hydraulic systems is similar to the pneumatic systems. In hydraulic systems the fluid used is liquid, which is called as the hydraulic fluid. The solenoid valve controls the direction of the flow of the hydraulic fluid inside the cylinder, which controls the motion of the piston or the ram.

BRAKE SHOE:

Brake Shoe is the part of a braking system which carries the brake lining in the drum brakes used on automobiles, or the brake block in train brakes and bicycle brakes.

How Brake Shoes Work

In a car, the most vital piece of equipment is the brake system, and brake shoes, which are part of the brake drum, are an essential feature of this system. Most modern brake shoes come in a set of four, with two shoes for each side of the car. These shoes differ on each side, with one brake shoe the primary, which has less friction on it, and the secondary brake shoe, which has more friction and faces to the back of the car. It is the difference between these two shoes, and the different pattern on them, which makes the shoes so effective when braking. In order to get the best from your shoes, it is important that you know exactly how they work.
The brake shoes are fitted alongside the brake drum, and it is contact with this drum that causes the car to stop. When you apply your foot to the internal brake, the hydraulic fluid inside the brake pipes causes pressure on the shoes, which are then pushed to the inside of the drum. This friction stops the drum, and thereby prevents the car from moving forward. The brake shoes are also used during the emergency brake, as this uses direct pressure to force the shoes onto the drum. If you have a rear brake, the shoes will still be used to stop the car in the event of an emergency, so they are still vital for any kind of car.

CONTROL UNIT:

The control unit (CU) is a component of a computer's central processing unit (CPU) that directs the operation of the processor. It tells the computer's memory, arithmetic/logic unit and input and output devices how to respond to a program's

instructions.

It directs the operation of the other units by providing timing and control signals. Most computer resources are managed by the CU. It directs the flow of data between the CPU and the other devices. John von Neumann included the control unit as part of the von Neumann architecture. In modern computer designs, the control unit is typically an internal part of the CPU with its overall role and operation unchanged since its introduction.

FUNCTION OF THE CONTROL UNIT:

The Control Unit (CU) is digital circuitry contained within the processor that coordinates the sequence of data movements into, out of, and between a processor's many sub-units. The result of these routed data movements through various digital circuits (sub-units) within the processor produces the manipulated data expected by a software instruction (loaded earlier, likely from memory). It controls (conducts) data flow inside the processor and additionally provides several external control signals to the rest of the computer to further direct data and instructions to/from processor external destinations (i.e. memory).

Examples of devices that require a CU are CPUs and graphics processing units (GPUs). The CU receives external instructions or commands which it converts into a sequence of control signals that the CU applies to the data path to implement a sequence of register-transfer level operations.

More precisely, the Control Unit (CU) is generally a sizable collection of complex digital circuitry interconnecting and controlling the many execution units (i.e. ALU, data buffers, registers) contained within a CPU. The CU is normally the first CPU unit to accept from an externally stored computer program, a single instruction (based on the CPU's instruction set).

The CU then decodes this individual instruction into several sequential steps (fetching addresses/data from registers/ memory, managing execution [i.e. data sent to the ALU or I/O], and storing the resulting data back into registers/memory) that controls and coordinates the CPU's inner works to properly manipulate the data.

6. WORKING:

A two stroke engine powered by petrol is used to produce exhaust gas. Here we are placing a turbine in the path of exhaust from the silencer.

The turbine is connected to a dynamo, which is used to generate power.

Depending upon the airflow the turbine will start rotating thus rotating the dynamo.

A dynamo is a device which is used to convert the kinetic energy into electrical energy. The generated electric power is stored in a battery after rectification.

Thus the stored electrical power is use to run the DC compressor the compressor compresses the atmospheric air and it is stored in an air tank.

When the brake is applied the 5/2 solenoid valve is activated and it allows the air to actuates the pneumatic cylinder thus the brake is applied.

When pneumatic cylinder is actuated, brake lever is operated and applies the brake to the wheels.

Environmental protection:

Using complete brake shoe repair kits avoids additional repairs. The avoidance of unnecessary repair work is a major advantage for the environment: additional trips to the garage and further consumption of resources and energy are thus avoided.

Brake shoes are an integral part of the braking system of a motor vehicle. When a driver steps on the brake, the brake shoe is the mechanical part that he or she is ultimately controlling to bring the car to a stop.

The backing of a brake shoe is a metal part, but the area that actually comes in contact with the brake is padded to provide friction to stop the car without damaging the brake itself. Brake shoes are found inside of drum brakes; disc brakes have calipers, which serve the same function in a slightly different way.

Drum brakes work using hydraulic pressure. When a driver steps on the brake, brake fluid under pressure travels to the individual wheel brakes, and small hydraulic pistons push the shoes onto the inside of the spinning surface of the wheel.

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ADVANTAGES:

It reduces the battery power.
It increases the engine efficiency.
It occupies less floor space.
It reduces the air pollution.

APPLICATION:

For automobile application

