Power Generation System By Using Waste Exhaust Heat

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Abstract- *The internal combustion engine (ICE) does not efficiently convert chemical energy into mechanical energy. Current ICEs are on average approximately 25% efficient under typical driving conditions (i.e.: European driving cycle) but can range from 20% to 45% depending on the engine type and operating conditions. The remaining 55%–80% will be wasted as heat in both the coolant and the exhaust gases. The burned gases are exhausted through outlet valve in the normal IC engine system, and also have some heat in the exhaust gases. The heat conducting reservoir having CFC 134a gas is placed into the silencer manifold, then the CFC 134a gas absorbs the heat from the exhaust gas and hits the turbine. The turbine rotates and the power is generated, the remaining gas from the turbine is compressed by the compressor. While compressing the CFC 134a gas is converted into low pressure gas to high pressure gas then it again goes to the reservoir and repeats the above process. The generated power from the turbine is stored in the battery.*

I. INTRODUCTION

An innovative technique of generating power in a moving vehicle by the usage of dynamo. The self-power generating vehicle is the new innovative one which is going to replace all the drawbacks of the present electric production units. Here we are going to produce the electric energy while we are running the vehicle and saving it in the batteries. And whenever it's needed we can utilize it with the help of step up transformer and inverters. There is a cyclic process of energy transfer to avoid the failure of power supply in homes. The power cut period we are utilizing power through two wheeler connections with inverter circuits. In this approach has also reduced the cost involved in the concern and also three main components involved to produce power generation.

Before a new bike is released to the market, testing is undertaken to ensure it meets the latest emissions regulations. The regulations differ from country to country, but they are always getting more stringent. Cogeneration of electricity by means of waste-heat recovery is indisputably one of the biggest potentials in energy conservation. IC engines convert chemical energy of the fuel into heat energy through combustion and by utilizing the thermodynamic cycle and some part of the heat energy is converted into effective work.The single largest amount of unused heat from the engine is the exhaust heat, which contains about 30% of the fuel energy.

A waste heat recovery system has the potential to convert some of this waste heat into electricity and consequently reduce the fuel consumption of the car by reducing the load on the car alternator. Exhaust gas from engines can provide an important heat source that may be used in a number of ways to provide additional power and improve overall engine efficiency.

The performance of the heat exchanger using butane fluid as the working fluid was then conducted. Heat exchanger was then simulated to generate super-heated vapor. Their compact size and solid state design make them ideal for automotive applications.

II. LITERATURE REVIEW

1. B. Orr a, A. Akbarzadeh a, M. Mochizuki b, R. Singh b (2015) "A review of car waste heat recovery systems utilizing thermoelectric generators and heat pipes"

Based on experimental the internal combustion engine (ICE) does not efficiently convert chemical energy into mechanical energy. A majority of this energy is dissipated as heat in the exhaust and coolant. Rather than directly improving the efficiency of the engine,efforts are being made to improve the efficiency of the engine indirectly by using a waste heat recovery system. Two promising technologies that were found to be useful for this purpose were thermoelectric generators (TEGs) and heat pipes. Both TEGs and heat pipes are solid state, passive, silent, scalable and durable. The use of heat pipes can potentially reduce the thermal resistance and pressure losses in the system as well as temperature regulation of the TEGs and increased design flexibility. TEGs do have limitations such as low temperature limits and relatively low efficiency. Heat pipes do have limitations such as maximum rates of heat transfer and temperature limits. When used in conjunction, these technologies have the potential to create a completely solid state and passive waste heat recovery system.

2. S. N. Hossain, S Bari (2011) "Effect of different working fluids on shell and tube heat exchanger to recover heat from exhaust of an automotive diesel engine"

In this research, experiments were conducted to measure the exhaust waste heat available from a 60 kW automobile engine. The performance of an available shell and tube heat exchanger using water as the working fluid was conducted.. Two heat exchangers were used: one to generate saturated and the other to generate super-heated vapours. These two heat exchangers can be arranged in parallel or series. In series arrangement, the exhaust gas was first passed through superheated heat exchanger and then through the saturated heat exchanger. Whereas, in parallel arrangement, the exhaust gas was divided to pass through saturated and superheated heat exchangers. In both cases, working fluid was passed first through saturated heat exchanger and then through superheated heat exchanger. Diesel additional 15%, 13% and 8% power can be achieved by using water, HFC-134a and ammonia as working fluid respectively.

III. WORKING PRINCIPLE

When the bike is started the air and fuel mixture passes through the inlet valve of the petrol engine .in the compression stoke this air fuel mixture is compressed at high pressure and temperature due to this the temperature and pressure increases now in power stroke spark is produce from the spark plug due to this spark. The air fuel mixture burns and forms exhaust gas.

The exhaust gas is now sent out through exhaust valve. The exhaust system is connected to the engine through a manifold. Next to the manifold a reservoir is attached. The reservoir is placed over the exhaust pipe. This reservoir has inlet and outlet valve. It also as a subtracted inlet valve for supplying CFC134a gas.

The CFC134a gas fill inside the reservoir. When the engine is started heat exhaust gas passes through the exhaust pipe on the passage of this hot gas the CFC134a gas in the reservoir also gets heated. A pressure gauge is fixed in the reservoir. When required amount of pressure is up trained the CFC134a is relished with the help of a gate valve. The high pressure gas is now sent to a turbine, this makes the turbine to run. The dynamo which is connected to the turbine also starts running in this process. The power produced in the dynamo storied in a battery. The unused gas in the turbine is send to the compressed through a non-return valve. The gas is now compressed here and it is sent to the reservoir. The supply of CFC134a gas to the reservoir is continuous and it is a cycle process.

3.1 CONSTRUCTION

A cylindrical reservoir is placed over the exhaust pipe**.** This reservoir used to stored CFC134a. This reservoir has two inlet and one outlet valve. The main inlet valve used to supply CFC134a gas another inlet valve used to supply the compressed cfc134a. The exhaust valve senses the high pressure CFC134a gas to the turbine. The outlet valve opened using a gate valve. When the required pressure is uptained which measured by a pressure gauge.

A compressor is connected to the turbine with a non-return valve which placed between them. This compressor unused gas from the turbine. The compressor is connected to the reservoir through the inlet valve.

IV. MAJOR COMPONENTS

- RESERVOIR
- GATE VALVE
- BATTERY
- TURBINE
- GENRETOR
- COMPRESSOR
- SHAFT
- BALL BERAING

4.1 RESERVOIR

The reservoir is generally made of stainless steel pipe for machining, suitable for lightly stressed components including plate, connector. It can be case-hardened to improve wear resistance. Suitable machining allowances should therefore be added when ordering. It does not contain any additions for enhancing mechanical or machining properties.

4.1.1MANUFACTURING PROCESS

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the material. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.

4.1.2 SAWING

Cold saws are saws that make use of a circular saw blade to cut through various types of metal, including sheet metal. The name of the saw has to do with the action that takes place during the cutting process, which manages to keep both the metal and the blade from becoming too hot. A cold saw is powered with electricity and is usually a stationary type of saw machine rather than a portable type of saw.

The circular saw blades used with a cold saw are often constructed of high speed steel. Steel blades of this type are resistant to wear even under daily usage. The end result is that it is possible to complete a number of cutting projects before there is a need to replace the blade. High speed steel blades are especially useful when the saws are used for cutting through thicker sections of metal.

4.1.3 WELDING

Welding is a process for joining similar metals. Welding joins metals by melting and fusing the base metals being joined the filler metal applied. Welding employs pinpointed, localized heat input. Most welding involves ferrous-based metals such as steel and stainless steel. Weld joints are usually stronger than or as strong as the base metals being joined.

Welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.

4.1.5 DRILLING

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips (sward) from the hole as it is drilling.

4.2 GATE VALVE

A gate valve, also known as a sluice valve, is a valve that opens by lifting a barrier (gate) out of the path of the fluid. Gate valves require very little space along the pipe axis and hardly restrict the flow of fluid when the gate is fully opened. The gate faces can be parallel but are most commonly wedge-shaped (in order to be able to apply pressure on the sealing surface).

4.2.1 VALVE CONSTRUCTION

Common gate valves are actuated by a threaded stem that connects the actuator (e.g. hand wheel or motor) to the gate. They are characterized as having either a rising or a nonrusting stem, depending on which end of the stem is threaded. Rising stems are fixed to the gate and rise and lower together as the valve is operated, providing a visual indication of valve position. The actuator is attached to a nut that is rotated around the threaded stem to move it. Nonrusting stem valves are fixed to, and rotate with, the actuator, and are threaded into the gate. They may have a pointer threaded onto the stem to indicate valve position, since the gate's motion is concealed inside the valve. Nonrusting stems are used where vertical space is limited. Gate valves may have flanged ends drilled according to pipeline-compatible flange dimensional standards.

Gate valves are typically constructed from cast iron, cast carbon steel, ductile iron, gunmetal, stainless steel, alloy steels, and forged steels.

All-metal gate valves are used in ultra-high vacuum chambers to isolate regions of the chamber.

Bonnets provide leak proof closure for the valve body. Gate valves may have a screw-in, union, or bolted bonnet. A screw-in bonnet is the simplest, offering a durable, pressure-tight seal. A union bonnet is suitable for applications requiring frequent inspection and cleaning. It also gives the body added strength. A bolted bonnet is used for larger valves and higher pressure applications.

4.3BATTERY

In isolated systems away from the grid, batteries are used for storage of excess solar energy converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage. In fact for small units with output less than one kilowatt.

Batteries seem to be the only technically and economically available storage means. Since both the photo-voltaic system and batteries are high in capital costs. It is necessary that the overall system be optimized with respect to available energy and local demand pattern. To be economically attractive the storage of solar electricity requires a battery with a particular combination of properties.

4.3.1 LEAD-ACID WET CELL

Where high values of load current are necessary, the lead-acid cell is the type most commonly used. The electrolyte is a dilute solution of sulfuric acid (H_2SO_4). In the application of battery power to start the engine in an auto mobile, for example, the load current to the starter motor is typically 200 to 400A. One cell has a nominal output of 2.1V, but lead-acid cells are often used in a series combination of three for a 6-V battery and six for a 12-V battery.

The lead acid cell type is a secondary cell or storage cell, which can be recharged. The charge and discharge cycle can be repeated many times to restore the output voltage, as long as the cell is in good physical condition. However, heat with excessive charge and discharge currents short ends the useful life to about 3 to 5 years for an automobile battery. Of the different types of secondary cells, the lead-acid type has the highest output voltage, which allows fewer cells for a specified battery voltage.

4.3.2 CHARGING THE LEAD-ACID BATERY

The requirements are illustrated in figure. An external D.C. voltage source is necessary to produce current in one direction. Also, the charging voltage must be more than the battery e.m.f. Approximately 2.5 per cell are enough to over the cell e.m.f. so that the charging voltage can produce current opposite to the direction of discharge current.

Note that the reversal of current is obtained just by connecting the battery VB and charging source VG with + to + and –to-, as shown in figure. The charging current is reversed because the battery effectively becomes a load resistance for VG when it higher than VB. In this example, the net voltage available to produce charging currents is 15-12=3V.

A commercial charger for automobile batteries is essentially a D.C. power supply, rectifying input from the AC power line to provide D.C. output for charging batteries.

Float charging refers to a method in which the charger and the battery are always connected to each other for supplying current to the load. In figure the charger provides current for the load and the current necessary to keep the battery fully charged. The battery here is an auxiliary source for D.C. power.

It may be of interest to note that an automobile battery is in a floating-charge circuit. The battery charger is an AC generator or alternator with rectifier diodes, driver by a belt from the engine. When you start the car, the battery supplies the cranking power. Once the engine is running, the alternator charges he battery. It is not necessary for the car to be moving. A voltage regulator is used in this system to maintain the output at approximately 13 to 15 V.

The constant voltage of 24V comes from the solar panel controlled by the charge controller so for storing this energy we need a 24V battery so two 12V battery are connected in series. It is a good idea to do an equalizing charge when some cells show a variation of 0.05 specific gravity from each other. This is a long steady overcharge, bringing the battery to a gassing or bubbling state. Do not equalize sealed or gel type batteries. With proper care, lead-acid batteries will have a long service life and work very well in almost any power system. Unfortunately, with poor treatment lead-acid battery life will be very short. Worm and Worm Wheel.

4.4 TURBINE

A turbine is a rotary mechanical device that extracts energy from a fluid flow and converts it into useful work. The work produced by a turbine can be used for generating electrical power when combined with a generator.

Gas, steam, and water turbines have a casing around the blades that contains and controls the working fluid. Credit for invention of the steam turbine is given both to Anglo-Irish engineer Sir Charles Parsons (1854–1931) for invention of the reaction turbine, and to Swedish engineer Gustaf de Laval (1845–1913) for invention of the impulse turbine. Modern steam turbines frequently employ both reaction and impulse in the same unit, typically varying the degree of reaction and impulse from the blade root to its periphery.

A working fluid contains potential energy (pressure head) and kinetic energy (velocity head).The fluid may be compressible or incompressible. Several physical principles are employed by turbines to collect this energy.

4.5 GENRETOR

An electric generator is a device that converts mechanical energy obtained from an external source into electrical energy as the output. It is important to understand that a generator does not actually ‘create’ electrical energy. Instead, it uses the mechanical energy supplied to it to force the movement of electric charges present in the wire of its windings through an external electric circuit. This flow of electric charges constitutes the output electric current supplied by the generator. This mechanism can be understood by considering the generator to be analogous to a water pump, which causes the flow of water but does not actually 'create' the water flowing through it.

The modern-day generator works on the principle of electromagnetic induction discovered by Michael Faraday in 1831-32. Faraday discovered that the above flow of electric charges could be induced by moving an electrical conductor, such as a wire that contains electric charges, in a magnetic field. This movement creates a voltage difference between the two ends of the wire or electrical conductor, which in turn causes the electric charges to flow, thus generating electric current.

4.6 COMPRESSOR

An air compressor is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air (i.e., compressed air). By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When tank pressure reaches its upper limit, the air compressor shuts off. The compressed air, then, is held in the tank until called into use. The energy contained in the compressed air can be used for a variety of applications, utilizing the kinetic energy of the air as it is released and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank.

4.7 SHAFT

4.7.1 Specifications

Shaft diameter: 15mm
Material: Aluminium

4.7.2 Shaft

Shaft is a common and important machine element. It is a rotating member, in general, has a circular cross-section and is used to transmit power. The shaft may be hollow or solid. The shaft is supported on bearings and it rotates a set of gears or pulleys for the purpose of power transmission. The shaft is generally acted upon by bending moment, torsion and axial force. Design of shaft primarily involves in determining stresses at critical point in the shaft that is arising due to aforementioned loading. Other two similar forms of a shaft are axle and spindle. Axle is a non-rotating member used for supporting rotating wheels etc. and do not transmit any torque. Spindle is simply defined as a short shaft.

4.8 BALL BEARING

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races.

The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least three races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary andthe other is attached to the rotating assembly (e.g., a hub or shaft). As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other.

Ball bearings tend to have lower load capacity for their size than other kinds of rolling-element bearings due to the smaller contact area between the balls and races. However, they can tolerate some misalignment of the inner and outer races.

4.8.1 ANGULAR CONTACT

An angular contact ball bearing uses axially asymmetric races. An axial load passes in a straight line through the bearing, whereas a radial load takes an oblique path that acts to separate the races axially. So the angle of contact on the inner race is the same as that on the outer race. Angular contact bearings better support combined loads (loading in both the radial and axial directions) and the contact angle of the bearing should be matched to the relative proportions of each.

4.8.2 CONSRUCTIVE TYPE

The Conrad-style ball bearing is named after its inventor, Robert Conrad, who was awarded British patent 12,206 in 1903 and U.S. patent 822,723 in 1906. These bearings are assembled by placing the inner ring into an eccentric position relative to the outer ring, with the two rings in contact at one point, resulting in a large gap opposite the point of contact. The balls are inserted through the gap and then evenly distributed around the bearing assembly, causing the rings to become concentric. Assembly is completed by fitting a cage to the balls to maintain their positions relative to each other. Without the cage, the balls would eventually drift out of position during operation, causing the bearing to fail. The cage carries no load and serves only to maintain ball position.

V. ADVANTAGES AND APPLICATIONS

5.1 ADVANTAGES

- Its increase the bike mileage.
- To use the exhaust waste heat.
- To transfer the thermal energy converted into electrical energy**.**
- Low maintenance cost.

5.2 APPLICATIONS

- Used in two wheeler and four wheelers

VI. CONCLUSION

Investigations have found that an appropriate way of improving the overall efficiency of the fuel use in a bike is to recover some of the wasted heat. The experimental and simulation results of the current project proved the concept of heat recovery from waste heat from the exhaust of petrol engines by using working fluids. This technique can increase the overall efficiency of petrol engine. Hence, this technology will reduce the fuel consumption and thereby will also reduce Green HouseGases. Additional 13% and then more power can be achieved with the proposed copper coil heat exchanger by using CFC 134a.

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