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Power Generation Using Exhaust Gases

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Abstract:

Now a day in automobile field many new innovating concepts are being developed. In this paper by using power from vehicle exhaust for generation electricity which can be stored in battery for the later consumption. In this project, we are demonstrating a concept of generating power in a moving vehicle by the usage of turbines. Here we are placing a turbine in the path of exhaust in the silencer. An engine is also placed in the chassis of the vehicle. The turbine is connected to a dynamo, 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 is stored to the battery. It can be stored in the battery after rectification. The rectified voltage can be inverted and can be used in various forms of utilities. The battery power can be consumed for the users comfort.

I. INTRODUCTION:

The study aims at developing a system which makes use silencer for rural electrification. The system also used to control the devices.

Air blowers generally use centrifugal force to propel air forward. Inside a centrifugal air blower is a wheel with small blades on the circumference and a casing to direct the flow of air into the center of the wheel and out toward the edge. The design of the blades will affect how the air is propelled and how efficient the air blower is. The project makes use of a Silencer Setup, turbine and DC Generator. The energy obtained is stored to a battery. The battery supply is fed to pulse generator and in turn to a MOSFET which is capable of generating ON/OFF pulses of different frequencies. This is fed to a step up transformer to generate a low voltage AC. This AC is fed to electrical appliance. The study “Power Generation Using Exhaust Gases” can be done using MOSFET, Mono stable multi vibrator, DC motor we can generate voltage with inverter using energy through Silencer The paper explains the implementation of “Power Generation Using Exhaust Gases”.

II. HARDWARE DESCRIPTION:

In this chapter the block diagram of the project and design aspect of independent modules are considered. Block diagram is shown in figure.

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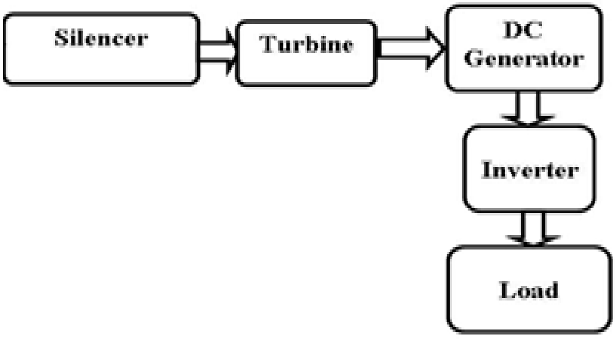

Fig 1: block diagram

Motor as a Generator:

Before the connection between magnetism and electricity was discovered, electrostatic generators were used. They operated on electrostatic principles. Such generators generated very high voltage and low current. They operated by using moving electrically charged belts, plates, and disks that carried charge to a high potential electrode. The charge was generated using either of two mechanisms:

- Electrostatic induction
- The turboelectric effect, where the contact between two insulators leaves them charged.

Motor as a generator

A motor-generator (an M-G set or a dynamotor for dynamo-motor) is a device for converting electrical power to another form. Motor-generator sets are used to convert frequency, voltage, or phase of power. They may also be used to isolate electrical loads from the electrical power supply line. Large motor-generators were widely used to convert industrial amounts of power while smaller motor-generators (such as the one shown in the picture) were used to convert battery power to higher DC voltages. Low-powered devices such as vacuum tube mobile radio receivers did not use motor-generators. Instead, they would typically use an inverter circuit consisting of a vibrator (a self-exciting relay) and a transformer to produce the B+ voltages required for the vacuum tubes. While a motor-generator set may consist of distinct motor and generator machines coupled together, a single unit motor-generator will have both rotor coils of the motor and the generator wound around a single rotor, and both coils share the same outer field coils or magnets. Typically the motor coils are driven from a commutator on one end of the shaft, when the generator coils output to another commutator on the other end of the shaft. The entire rotor and shaft assembly is smaller in size than a pair of machines, and may not have any exposed drive shafts. In electricity generation, an electric generator is a device that converts mechanical energy to electrical energy. A generator forces electric current to flow through an external circuit. The source of mechanical energy may be a reciprocating or turbine steam engine, water falling through a turbine or waterwheel, an internal combustion engine, a wind turbine, a hand crank, compressed air, or any other source of mechanical energy. Generators provide nearly all of the power for electric power grids.

Electromagnetic generators

Dynamo

A dynamo is an electrical generator that produces direct current with the use of a commutator. Dynamos were the first electrical generators capable of delivering power for industry, and the foundation upon which many other later electric-power conversion devices were based, including the electric motor, the alternating-current alternator, and the rotary converter. Today, the simpler alternator dominates large scale power generation, for efficiency, reliability and cost reasons. A dynamo has the disadvantages of a mechanical commutator. Also, converting alternating to direct current using power rectification devices (vacuum tube or more recently solid state) is effective and usually economic.

Alternator:

Without a commutator, a dynamo becomes an alternator, which is a synchronous singly fed generator. Alternators produce alternating current with a frequency that is based on the rotational speed of the rotor and the number of magnetic poles. Automotive alternators produce a varying frequency that changes with engine speed, which is then converted by a rectifier to DC. By comparison, alternators used to feed an electric power grid are generally operated at a

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speed very close to a specific frequency, for the benefit of AC devices that regulate their speed and performance based on grid frequency. Some devices such as incandescent lamps and ballast-operated fluorescent lamps do not require a constant frequency, but synchronous motors such as in electric wall clocks do require a constant grid frequency.

Output of the Dynamo

- Output Voltage : 6-12 V
- Output Current : 0.5 A
- Output Power : 3-6

LED

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. The internal structure and parts of a led are shown in figures 3.15 and 3.16 respectively.

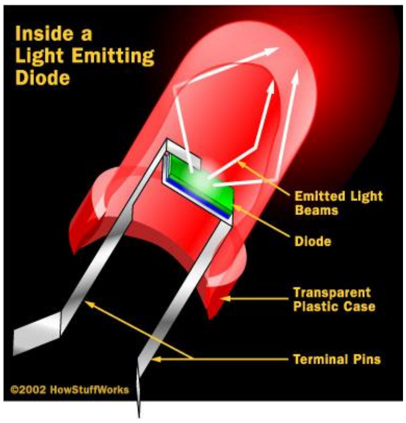

Fig 2: LED

Silencer:

A muffler is a device for reducing the amount of noise emitted by the exhaust of an internal combustion engine. Mufflers are installed within the exhaust system of most internal combustion engines, although the muffler is not designed to serve any primary exhaust function.

The muffler is engineered as an acoustic soundproofing device designed to reduce the loudness of the sound pressure created by the engine by way of Acoustic quieting. The majority of the sound pressure produced by the engine is emanated out of the vehicle using the same piping used by the silent exhaust gases absorbed by a series of passages and chambers lined with roving fiberglass insulation and/or resonating chambers harmonically tuned to cause destructive interference wherein opposite sound waves cancel each other out. An unavoidable side effect of muffler use is an increase of back pressure which decreases engine efficiency. This is because the engine exhaust must share the same complex exit pathway built inside the muffler as the sound pressure that the muffler is designed to mitigate.

Components That Influence Airflow into the Engine Are

1. Air filter intake
2. Air piping
3. Mass air sensor (if applicable)
4. Throttle body or carburetor
5. Intake manifold
6. Camshaft
7. Intake port and valve of cylinder heads
8. Turbo's compression, section, and supercharger (if applicable

Components That Influence Airflow Out Of the Engine Are

1. Exhaust valve and exhaust ports of the cylinder heads
2. Camshafts
3. Exhaust manifolds
4. Turbo's turbine (if applicable)
5. Exhaust tubing catalytic converters
6. Muffler

When these components are modified to increase flow out of the engine, pumping losses are reduced. Pumping losses refer to the amount of horsepower (HP) used to push the exhaust gases out of the cylinders on the engine's exhaust stroke. Since less HP is used to get the exhaust out of the engine, more horsepower is available at the flywheel.

An added benefit of reducing pumping losses is that fuel mileage will also increase.No matter how much additional air is forced into the engine, no additional HP will be made unless additional fuel is also added. The energy that makes HP in an engine comes from the combustion of the fuel, not only the air. In general, every two HP produced requires one pound of fuel per hour. The combustion of the additional fuel is what translates into additional HP.

III. ANALYSIS OF THE EXHAUST SYSTEM IN AN AVERAGE CAR

Exhaust system components are designed for a specific engine. The pipe diameter, component length, catalytic converter size, muffler size, and exhaust manifold design are engineered to provide proper exhaust flow, silencing, and emission levels on a particular engine. In this section, I will go over the function and specifics of each component.

Wind Turbine:

A wind turbine is a device that converts kinetic energy from the wind, also called wind energy, into mechanical energy; a process known as wind power. If the mechanical energy is used to produce electricity, the device may be called a wind turbine or wind power plant. If the mechanical energy is used to drive machinery, such as for grinding grain or pumping water, the device is called a windmill or wind pump. Similarly, it may be referred to as a wind charger when used for charging batteries.The result of over a millennium of windmill development and modern engineering, today's wind turbines are manufactured in a wide range of vertical and horizontal axis types. The smallest turbines are used for applications such as battery charging or auxiliary power on boats; while large grid-connected arrays of turbines are becoming an increasingly important source of wind power-produced commercial electricity.

Horizontal axis:

Horizontal-axis wind turbines (HAWT) have the main rotor shaft and electrical generator at the top of a tower, and must be pointed into the wind. Small turbines are pointed by a simple wind vane, while large turbines generally use a wind sensor coupled with a servo motor. Most have a gearbox, which turns the slow rotation of the blades into a quicker rotation that is more suitable to drive an electrical generator.

Since a tower produces turbulence behind it, the turbine is usually positioned upwind of its supporting tower. Turbine blades are made stiff to prevent the blades from being pushed into the tower by high winds. Additionally, the blades are placed a considerable distance in front of the tower and are sometimes tilted forward into the wind a small amount.

Blades

Lifts and rotates when wind is blown over them, causing the rotor to spin. Most turbines have either two or three blades.

Wind direction

Determines the design of the turbine upwind turbines—like the one shown here—face into the wind while downwind turbines face away.

Fig 3: Blades

Rechargeable battery

A rechargeable battery, storage battery, or accumulator is a type of electrical battery. It comprises one or more electrochemical cells, and is a type of energy accumulator. It is known as a secondary cell because its electrochemical reactions are electrically reversible. Rechargeable batteries come in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of chemicals are commonly used, including: lead–acid, nickel cadmium (NiCd), nickel metal hydride (NiMH),

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lithium ion (Li-ion), and lithium ion polymer (Li-ion polymer).

Fig 4: Rechargable Battery

Applications:

Rechargeable batteries are used for automobile starters, portable consumer devices, light vehicles (such as motorized wheelchairs, golf carts, electric bicycles, and electric forklifts), tools, and uninterruptible power supplies. Emerging applications in hybrid electric vehicles and electric vehicles are driving the technology to reduce cost and weight and increase lifetime. Traditional rechargeable batteries have to be charged before their first use; newer low self-discharge NiMH batteries hold their charge for many months, and are typically charged at the factory to about 70% of their rated capacity before shipping.

Grid energy storage applications use rechargeable batteries for load leveling, where they store electric energy for use during peak load periods, and for renewable energy uses, such as storing power generated from photovoltaic arrays during the day to be used at night. By charging batteries during periods of low demand and returning energy to the grid during periods of high electrical demand, load-leveling helps eliminate the need for expensive peaking power plants and helps amortize the cost of generators over more hours of operation.

Inverter Circuit Explanation

The only difference between the previous and the present design is in the output stage. The previous circuit involved power transistors whereas here we have utilized mosfets making the configuration much easier and straightforward.

Rest of the stages are pretty much the same, in the earlier circuit we saw the involvement of a transistor based a stable multivibrator for the generation of the required 50 Hz oscillations, here too we have incorporated a transistor operated AMV. The earlier circuit had a couple of 2N3055 transistors at the output and as we all know driving power transistors efficiently requires proportionate amount of base drive, relative to the load current, because transistors depend on current drive rather than voltage drive, in contrast to mosfets.

Meaning, as the proposed load becomes higher, the base resistance of the relevant output transistor also gets dimensioned accordingly for enabling optimal amount of current to the base of the transistors, Due to this obligation, in the previous design a additional driver stage had to be incorporated for facilitating better drive current to the 2N3055 transistors. However when it comes to mosfets, this necessity becomes completely insignificant. As can be seen in the given diagram, the AMV stage is instantly preceded by the relevant gates of the mosfets, because mosfets have very high input resistance, which means the AMV transistors wouldn't be unnecessarily loaded and therefore the frequency from the AMVwouldn't be distorted due to the integration of the power devices.

The mosfets are alternately switched, which in turn switches the battery voltage/current inside the secondary winding of the transformer. The output of the transformer gets saturated delivering the expected 220V to the connected loads.

Parts List
R1,R2=27K,
R3,R4,R5,R6=470Ohms,
C1,C2=0.47uF/100Vmetallized
T1,T2=BC547,
T3,T4=any30V,10ampmosfet,N-channel.
Transformer=9-0-9V, 8amp
Battery = 12V, 10AH

Advantages

- This system helps in energy generation from the silencer

- Storing of Wind Energy in battery
- Efficient and low cost design.
- Low power consumption.
- Easy to operate.

Disadvantages

1. This system requires periodic monitoring and maintenance.
2. This system fails to work if the load is heavy.
3. Status of operated devices is not known.

Applications

- In industries, streets, etc which can be practically implemented in real time.

IV. CONCLUSION:

The paper "Power Generation Using Exhaust Gases" was designed such that which makes use of silencer for power generation and also for rural electrification. The system was also used to control the devices. Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

Future Scope

"Power Generation Using Exhaust Gases" is mainly intended to design a silencer based energy generation system based inverter. Air blowers generally use centrifugal force to propel air forward. Inside a centrifugal air blower is a wheel with small blades on the circumference and a casing to direct the flow of air into the center of the wheel and out toward the edge. The design of the blades will affect how the air is propelled and how efficient the air blower is. The paper makes use of a Silencer Setup, turbine and DC Generator. The energy obtained is stored to a battery. The battery supply is fed to pulse generator and in turn to a MOSFET which is capable of generating ON/OFF pulses of different frequencies. This is fed to a step up transformer to generate a low voltage AC. This AC is fed to electrical appliance.

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