GENERATION OF ELECTRIC POWER BY USING ENGINE EXHAUST GASES

[1]K. PUNEETH SATYA SAI, [2]S. AJITH KUMAR , [3]U. CHIRANJEEVI CHIRUKESH VARMA , [4]V . NAGA PHANI , [5]P. MANOJ , [6]M. SURENDRA KUMAR

[1,2,3,4,5,]UG Students, [6,] Assistant Professor
Department of Mechanical Engineering, NRI Institute of Technology, Pothavarapadu,
Eluru (district), AP, India - 521212

Abstract— **There are many innovative methods for generating electricity. This project defines how electricity is generated by using exhaust gases of engine. The main aim of this project is to slightly decrease the cross- section of the exhaust. A turbine is placed at the end of the exhaust of a engine. By decreasing the cross- section of the exhaust helps to increase the velocity of the exhaust gases .A dynamo is connected to the turbine. The electrical energy is produced and stored in batteries. The power stored in the batteries may beused for various applications.**

Keywords – **Turbine, Dc motor, Lithium battery, Rocker button switch,12V dc coin led.**

I.INTRODUCTION:

Humanity has recently come to the realisation that using petroleum fuels to supply the world's energy needs continuously for more than a century has had numerous negative effects. There is a tendency to turn to alternative energy sources more frequently. But we have a long way to go until petroleum is totally replaced as a source of energy. At this point, any progress made in lowering the amount of fuel used to produce energy is beneficial and cannot be overlooked. Only 30 to 40 percent of an engine's overall output is used to power the vehicle and its accessories. The remainder is squandered as exhaust heat and noise. So, there is opportunity. recovering the engine's squandered energy. Several strategies have been proposed to lessen energy loss from car engines. Several of these techniques make use of piezoelectric generators, catalytic converters, etc. Turbine-based power generation using exhaust gases has proven to be one of the most effective ways to produce energy.

II. Literature survey:

For a very long time, fossil fuels have been the main source of energy for humans. These fuels have produced a significant amount of pollution as a result of their careless use, and their ongoing use could harm the ecosystem permanently. Under these circumstances, it is a positive step forward to make every effort to reduce the amount of fuel used or, at the at least, to make sure that the bulk of the energy produced by burning these fuels is recovered without any waste. This work suggests generating power at the silencer output using a small turbine. The results of this investigation show that any home car can be powered by the approach used to recover energy. Working Power is generated by employing automotive exhaust gas is very simple and easy non-conventional process.

Georgios Konstantinou et.al., [1] : Say's Modern ships emit a lot of energy into the environment. Internal combustion engines (ICE) of commercial and passenger ships, in particular, waste significant amounts of thermal energy at high temperatures through exhaust gases released into the atmosphere. A practical method of recovering some of this energy is to usethermoelectric generator systems, which can convert thermal energy into electrical energy when there is a significant temperature difference. The goal of this work is to propose a thermoelectric generator for recovering energy from marine ICE exhaust gases. The proposed thermoelectric generator uses the ICE manifold's outside surface as the hot side of the thermoelectric module, while the cold side is kept at a low temperature via a heat sink.**Yongming Xu et.al.,[2] :** proposed For a long time, diesel engines have been used as the primarymover in vehicles. It is known that the exhaust gas from diesel engines wastes approximately 25%-30% of the fuel energy .A turbine power generation system with a 1.8 kW 60,000 r/min high-speedpermanent magnet generator and a micro exhaust gas turbine coupled to a diesel engine is designedand tested in this study. Modeled to investigate its potential for recovering wasted energy in dieselengine exhaust gas. GT-POWER, MATLAB/SIMULINK, and ANSOFT Software are used to build computational models. The generator's, exhaust gas turbine's, and engine's performance and characteristics are investigated. According to the simulation results, the exhaust turbine power generation system was recovered.**Kiran Kumar K et.al.,[3] :** discussed Internal combustion engines have long been used for transportation and other purposes. These engines have been shown to be an efficient source of energy. However, much of the energy generated by these engines is wasted and under utilized . Wastage of energy produced by engines cannot be tolerated in this day and age of fuel crisis. Thisproject aims to recover energy that is being wasted by engine silencers. The heat energy presenton the silencer is converted into useful electrical energy using Peltier Modules. **Jerome Ignatius et.al., [4] :** proposed We are modifying an automobile to generate power by utilizing vehicle exhaust. Many new innovative concepts are being developed in the automobileindustry today. We generate electricity using the power from vehicle exhaust, which is then storedin a battery for later use. In this project, we demonstrate the use of turbines to generate power in a moving vehicle. In this case, we're putting a turbine in the path of the exhaust in the silencer. The vehicle's chassis also contains an engine. The turbine is linked to a dynamo, which is used to generate electricity. power. A dynamo is a device that converts kinetic energy into electrical

energy. The generated energy is saved.**Venkatesh et.al.,[5] :** Say's There are numerous novel ways to generate electricity. This projectexplains how to generate electricity from exhaust gas. This project makes use of a turbine and adynamometer. The dynamo is linked to the turbine, which generates power. The turbine is installedin the silencer's exhaust path. The power generated varies depending on the airflow in the exhaustpath. Using a turbine, the dynamo begins to rotate and converts kinetic energy into electrical energy. The generated power is stored in the battery. To be used in the equipment, the voltage must be inverted. Depending on our preferences, we can use the stored power. **Shubham V et.al., [6] :** discussed In this research work the modification of stationary diesel engine for producing power using turbine. Nowadays in automobile field many new innovating concepts are being developed. We are using the power from Vehicle exhaust to generate the electricity which can be stored in battery for the later consumption. In this project, we are demonstrating a concept of generating power in a stationary single cylinder diesel engine by theusage of turbines. Here we are placing a turbine in the path of exhaust in the silencer. An engineis 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 start to rotate. A dynamo is a device which is used to convert the kinetic energyinto electrical energy. The generated power is stored to the battery. It can be stored in the batteryafter rectification. The rectified voltage can be inverted and can be used in various forms of utilities. **Mohd.Quasim Khan et.al., [7] :** proposed Internal combustion engines used in automobiles have a maximum efficiency of 25%-30%, with the remainder of the heat energy burned in the combustion chamber going into the exhaust and then into the atmosphere. As a result, harmful gasemissions increased, as did globalwarming.as well as environmental issues. As a result, improving the efficiency of any industrial process has become a priority. The use of waste heat from car exhaust is the first priority for thermoelectric generators. It is a solid-state device that converts theheat energy present in a car's exhaust into electrical energy, which is then used to improve the vehicle's performance. A TEG's efficiency is 4-5%, which is quite low but not insignificant.**Shaikh Mobin et.al.,[8] :** Say's Energy is defined as the ability to perform work. There are several types of energy available in the environment, both conventional and nonconventional. energy sources. All types of energies are required for performing various mechanical operations,but there is currently a significant problem with electricity due to a scarcity of energy resources.As a result, there is no maximum electric supply in villages for performing simple operations such as mobile charging power for lamps, etc. Using the aforementioned factors, we created a model that can generate electric power by utilizing the kinetic energy of a vehicle's exhaust gas,specifically a two-wheeler. When the model iso prerational, the runner rotates due to the kinetic energy of the exhaust gas. **Kranthi Kumar Guduru et.al., [9] :** discussed In this study, a stationary diesel engine was modified to generate power using a turbine. Many new innovative concepts are being developedin the automobile industry today. We generate electricity using the power from vehicle exhaust,which is then stored in a battery for later use. In this project, we demonstrate the use of turbinesto generate power in a stationary single cylinder diesel engine. In this case, we're putting a turbinein the path of the exhaust in the silencer. The vehicle's chassis also contains an engine. The turbineis linked to a dynamo, which generates power. Depending on the airflow, the turbine will begin to rotate, and the dynamo will also begin to rotate.**Ataur Rahman et.al.,[10] :** discussed Harvesting waste thermal energy could significantly improve IC engine fuel consumption. Several methods for recovering waste thermal energy from internal combustion engines (ICE) have been investigated, including the use of superchargers, turbochargers, and/or a combination of the two. This study presents an innovative approach to generating power from IC engine waste based on coolant and exhaust. The waste energy harvesting system of coolant (we HSc) is used to supply hot air at temperatures ranging from 60 to 70 1C directly into the engine cylinder, which is useful for vaporizing the fuel. We HSc is anexhaust waste energy harvesting system that incorporates fuzzy intelligent controlled Micro- Faucet emission gas recirculation (MiF-EGR) and a thermoelectric generator (TEG). The MiF- EGR was used in this study.**Nabeelur Rahaman et.al.,[11] :** proposed Internal combustion engines have long been used fortransportation and other purposes. These engines have been shown to be an efficient source of energy. However, much of the energy generated by these engines is wasted and under utilized . Wastage of energy produced by engines cannot be tolerated in this day and age of fuel crisis. Thisproject aims to reclaim energy that is lost through engine silencers. The heat energy present on thesilencer is converted into useful electrical energy using Peltier Modules.**Jerome Ignatius et.al., [12] :** proposed They are modifying an automobile to generate power by utilizing vehicle exhaust. Many new innovative concepts are being developed in the automobile industry today. We are generating electricity from vehicle exhaust, which will be stored in a battery for later use. consumption. We are demonstrating a concept of generating powerin a moving vehicle using turbines in this project. In this case, we're putting a turbine in the pathof the exhaust in the silencer. The vehicle's chassis also contains an engine. The turbine is linkedto a dynamo, which generates power. A dynamo is a device that converts kinetic energy into electrical energy. The generated energy is saved.**P. Mohamed Shameer et.al., [13] : Say's** The engine's ability to achieve highly balanced efficiency is limited by a number of irreversible processes. High temperature differences, turbulent fluid motions, and large heat transfers from the fluid to the piston crown and cylinder walls result from the rapid expansion of gases inside the cylinder. The cylinder's rapid successionof events produces expanding exhaust gases. with pressures greater than atmospheric, and they must be released while the gases are still expanding in order to prepare the cylinder for the subsequent processes. The heated gases produced by the combustion process can then be easily channeled through the exhaust valve and manifold as a result .The large amount of energy in theexhaust gas stream could potentially be used for waste heat energy.**Bradley Orr et.al.,[14] :** discussed Thermoelectric generators (TEGs) are small solid-state devices that directly generate electricity from heat. They have the potential to be used as a primaryheat engine and generator in waste heat recovery systems. Two case studies are presented that demonstrate the potential power generation from a car engine's exhaust gases and an open loop gas turbine power plant. It was If the engine produces 150 kW, it is possible to generate 1.4 kW ofelectricity from a car exhaust heat recovery system. It was also discovered that a 500 MW gas turbine power plant waste heat recovery system can generate 5.9 MW of electricity. A design is proposed to demonstrate how TEGs could be used.

M.F Remeli et.al., [15] : Say's The investigation of power generation using the combination of heat pipes and thermo-electric generators is presented in this paper. The majority of thermal energy in the industry is lost to the environment as waste heat. This waste heat can be used to generate electricity. The related issues of global warming and dwindling fossil fuel reserves As aresult,

improving the efficiency of any industrial process has become a priority. One way to improve efficiency is to find ways to use waste heat that would otherwise be wasted. Thermoelectric generators and heat pipes were discovered to be two promising technologies for this purpose. As a result, this project entailed developing a bench-top, proof-of-concept model of power generation by thermoelectric generators using heat pipes. **R. Saidur et.al., [16] :** discussed Experiments were carried out to induce the impins' amittion under various operating conditions. The engine spent throttle opening and operating time were varied during the tests. During the experimental investigation, the operating variables (engine speed from 15000 to 2500 pm, le peromage from 25 to 30%, and opening time from 2.5 to 5 minutes) were varied according to the experimental schedule. These matin models demonstrate the effects of each parameter's significance and adepay for the deson range that wall using ANOVA Fest. The effects of each parameter in the response model are stated. The compuntive evaluation at the experimental soul for the different operating conditions reveals that the enginespent throttle position has an influence.**Govind Mishra et.al.,[17] :** proposed Currently, much of the automotive industry's R&D effortis devoted to increasing overall vehicle efficiency. Almost all internal combustion engines operateon the heat engine principle. It converts chemical energy into thermal energy, and piston movement occurs as a result of the pressure of air carrying the heat. Traditionally, only 25 to 30%of energy is used at the outset.to run the vehicle and accessories mounted on the engine, and the remaining energy is wasted in various ways such as exhaust and engine component cooling. Theuseful engine is used to power both the engine and the generator. As a result, the efficiency of those engines was extremely low.
Basel I. Ismail et.al., [18] : Say's In recent years, growing concern about environmental issuesof emissions, particularly global warming and the scarcity of energy resources, has resulted in extensive research into novel electrical power generation technologies. Because of their distinct advantages, thermoelectric power generators have emerged as a promising alternative green technology. advantages. Thermoelectric power generation has a potential application in the directconversion of waste-heat energy into electrical power, where the cost of the thermal energy inputis unnecessary. The use of this alternative green technology to directly convert waste-heat energy into electrical power can also improve the overall efficiencies of energy conversion systems. In this paper, a background on the fundamental concepts of thermoelectric power generation is presented, as well as recent thermoelectric power patents. **Gequn Shu et.al., [19] :** proposed The technical principles and application feasibility of variouswaste heat recovery technologies available onboard ships have been discussed. Basic principles, novel methods, existing designs, theoretical and experimental analyses, economics, and feasibility are all being studied. This paper discusses. The primary goal of this paper is to providea better understanding of the waste heat recovery options available for use in various applicationsonboard ocean-going ships to improve fuel economy and environmental compliance. **Marian von Lukowicz et.al., [20]** : Say's Environmental radiation in space (from the Sun, for example)and operational thermal loads cause heat flows within satellite structures. Today, these heat flows are collected, transported to a radiator, and emitted into space to keep the satellite from overheating, but theystill exist. a huge potential to generate electrical power independently of solar panels. Because of their solid-state characteristics, thermoelectric generators are a promising approach for such applications. Theydo not cause vibrations in the satellite because they do not have any moving parts. They are said to be low-maintenance and extremely dependable. Modern devices based on BiTe must be considered due to the expected small heat flows, but these devices have no flight heritage.

III. Methodology:

Again, there is an increasing trend in power output as the engine speed increases. This is because the flow rate of exhaust gases is proportional to the engine speed, which increases the power output of the turbine. From the Tapered cross section attachment it is evident that the power generated by the turbine increases with increase in the engine speed and the flow rate of the exhaust gases. There is a clear trend of increase in the output power with respect to increase in flow rate of exhaust gases. This is because as more gases impact the turbine blades, the speed of rotation of the turbine increases, giving a higher power output . A dynamo converts electrical power into a different form. The conversion of power's frequency, voltage, or phase is done using motor generator sets. Moreover, they can be used to disconnect electrical loads from the power supply line. Vacuum tube mobile radio receivers are an example of a low-power gadget that does not need a motor. To create the B+ voltages needed by vacuum tubes, they commonly employ an inverter circuit made up of a vibrator (a self-exciting relay) and a transformer. A single unit motor-generator will have both the motor and the generator's rotor coils wrapped around a single rotor, sharing the same outer field coils that are magnets, unlike a motor generator set, which may consist of several motor and generator units connected together. The generator coils output to another commutator at the opposite end of the shaft, whereas the motor coils are typically driven by a commutator at one end of the shaft. The complete rotor and shaft assembly may not have any exposed driving shafts and is less in size than two machines. An electric generator is a machine used to produce electricity that transforms mechanical energy into electrical energy. Electric current is forced via an external circuit by a generator. A reciprocating or turbine steam engine, water passing through a turbine or waterwheel, an internal combustion engine, a wind turbine, a hand crank, compressed air, or any other source of mechanical energy can be used as the source of mechanical energy. Generators supply the majority of the electricity for electrical networks.

IV. Fabrication:

The turbine is linked to the motor and is located at the tailend of the exhaust gas flow. The flow of exhaust gases aids in the rotation of theturbine. Sheet metal is folded into a taper cross-section and attached to the exhaust, which aids in the high-speed rotation of the turbine. The motor is connected to the battery via a diode, which helps to prevent current overflow. Theenergy stored in the battery as direct current that is converted to alternating currentusing a triac. Because the rocker button switch is connected to the triac, only electricity is passed while pressing the switch. As a result of using this type of equipment, efficiency will increase. The following components were required to implement the work proposed as shown in fig1.

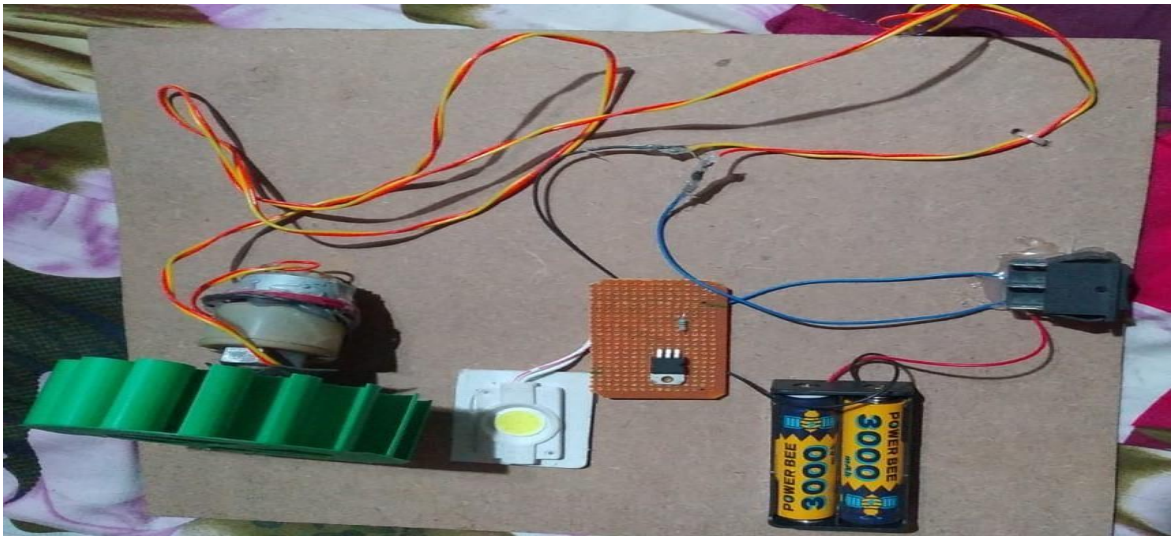

Fig1: Fabrication

A. Lithium Battery 300mah

Safety and economical Rechargeable Lithium Ion cells have a negative electrode (anode) made from lithium compounds. Lithium is a highly reactive material and is much lighter than the hydrogen- absorbing metal alloy of the NiMH negative electrode. This leads to higher gravimetric energy densities for the Li-Ion cell. Excellent discharge characteristics Have low internal resistance and high flat voltage characteristics during strong current discharge, which ensures a wider application field. Long cycle life Provide long storage life with few limiting conditions. It offers problem-free charge after long storage, permitting to use in a wide range of applications as shown in fig2.

Fig2: Lithium battery 3000mah

B. 500 Rpm Dc motor :

These motors are simple DC Motors featuring gears for the shaft for obtaining the optimal performance characteristics. They are known as Center Shaft DC Geared Motors becausetheir shaft extends through the centre of their gearbox assembly. These standard size DC Motorsare very easy to use. Also, you don't have to spend a lot of money to control motors with an Arduino or compatible board. The L298NH-bridge module with an onboard voltage regulator motor driver can be used with this motor that has a voltage of between 5 and 35V DC. This 12 Volts DC Motor – 500 RPM can be used in all-terrain robot sand a variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple toconnect it to the wheels or any other mechanical assembly as shown in fig3.

Fig3:500 Rpm dc motor

C. 12V Dc Coin Led :

In electronics, an LED circuit or LED driver is an electrical circuit used to power a light- emitting diode (LED). The circuit must provide sufficient current to light the LED at the required brightness, but must limit the current to prevent damaging the LED. The voltage dropacross an LED is approximately constant over a wide range of operating current; therefore, a small increase in applied voltage greatly increases the current. Very simple circuits are used for low-power indicator LEDs. More complex, current source circuits are required when driving high-power LEDs for illumination to achieve correct current regulation as shown in fig4.

Fig4:12V Dc coin led

D. Triac :

A TRIAC is a bidirectional, three-electrode AC switch that allows electrons to flowin either direction. It is the equivalent of two SCRs connected in a reverse-parallel arrangementwith gates connected to each other. A TRIAC is triggered into conduction in both directions bya gate signal like that of an SCR.TRIACs were designed to provide a means for the developmentof improved AC power controls. TRIACs are available in a variety of packaging arrangements.They can handle a wide range of current and voltage. TRIACs generally have relatively low- current capabilities compared to SCRs — they are usually limited to less than 50 A and cannotreplace SCRs in high-current applications as shown in fig5.

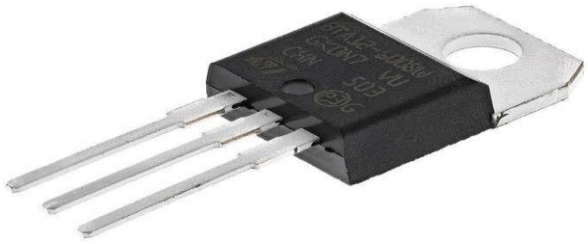

Fig5: Triac

E. Rocker Button Switch :

Rocker switches control the on/off functions of all home appliance products. On/off is the most important function of the rocker switch, Additionaly , it has different functions such as3 positions, button, changeover too. Rocker Switches constitute the actuation function that canbe pressed at both ends, like a seesaw to activate or disconnect the electrical circuit via the button. Sometimes known as a seesaw switch.The long-life of the seesaw system is a very important function for a quality product. KeyFeatures of our Rocker Switches There are some special production rules in order to provide high mechanical strength in a quality way. For instance; Welded Silver Contact components should be used in operating system of the contacts of Rocker Switches. This feature provides an extra advantage to gain greater efficiency. Inthis way, the product life and quality level of rockerswitches increases to the highest level. Another important issue is that the material used for thedegree of non-flammability has a melting property against the high temperature as shown in fig6.

Fig6:Rocker button switch

F. Turbine :

A turbine is a machine that transforms rotational energy from a fluid that is picked up by arotor system into usable work or energy. Turbines achieve this either through mechanical gearingor electromagnetic induction to produce electricity.Types of turbines include steam turbines, wind turbines, gas turbines or water turbines. Mechanical uses of turbine power go back to ancient Greece. The first wind wheels relied upongearing and shafts to power machinery.Windmills and water wheels are forms of turbines too and might drive a millstone to grindgrain, among other purposes. Thermal steam turbines driven by burning oil or coal or the use ofnuclear power are still among the most common methods of producing electricity. Green electricity applications include wind turbines and water turbines used in applications for wind power and tidal power. Because of the turbine's many applications in a wide variety of technologies, research is still ongoing to perfect turbine and rotor efficiency as shown in fig7.

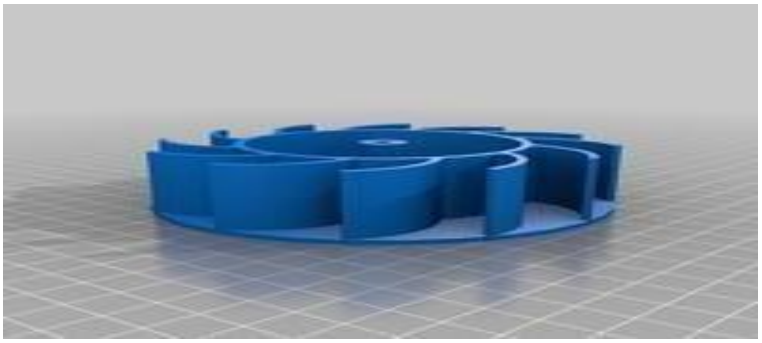

Fig7:Turbine

G. Multimeter :

A multimeter or a multi tester, also known as a volt/ohm meter or VOM, is an electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter may include features such as the ability to measure voltage, current and resistance. Multimeters may use analog or digital circuits—analog multimeters and digital multimeters (often abbreviated DMM or DVOM.) Analog instruments are usually based on a microammeterwhose pointer moves over a scale calibration for all the different measurements that can be made; digital instruments usually display digits, but may display a bar of a length proportional to the quantity measured.A multimeter can be a hand-held device useful for basic fault finding and field service work or a bench instrument which can measure to a very high degree of accuracy. They can beused to troubleshoot electrical problems in a wide array of industrial and household devices such as electronic equipment, motor controls, domestic appliances, power supplies, and wiring systems as shown in fig8.

Fig8:Multimeter

V.RESULTS & DICUSSION:

ORIGINAL CROSS SECTION OF THE EXHAUST GASES VOLTAGE READINGS :

Table1:Original cross section exhaust voltage reading

SI. NO	Multimeter reading
1	5.21
2	4.93
3	4.99

The progress towards reducing the amount of fuel consumed during energy generation is good progress and cannot be neglected. Only 30 to 40% of total energy produced in an engine is utilized to run the vehicle and engine accessories. The rest is wasted in the form of exhaust heat and noise. So, there is a scope for reclaiming the wasted power produced by the engine. Various methods to reduce the wastage of energy from automobile engines have been put forth. Some of these methods include the usage of catalytic converters, piezoelectric generators etc. Among these methods, turbine-based power generation through the exhaust gases has proven to be an efficient source of energy generation.

TAPERED CROSS SECTION OF THE EXHAUST GASES VOLTAGE READINGS:

Table2:Tapered cross section exhaust voltage reading

SI. NO	Multimeter reading
1	6.01
2	5.58
3	5.66

Again, there is an increasing trend in power output as the engine speed increases. This is because the flow rate of exhaust gases is proportional to the engine speed, which increases the power output of the turbine. From the Tapered cross section attachment it is evident that the power generated by the turbine increases with increase in the engine speed and the flow rate of the exhaust gases. There is a clear trend of increase in the output power with respect to increase in flow rate of exhaust gases. This is because as more gases impact the turbine blades, the speed of rotation of the turbine increases, giving a higher power output .

VI. CONCLUSION :

This mini project explains how we can generate electricity using exhaust gas. The turbine use waste exhaust gas and produce electricity. We use silencer for both power generation and rural electrification. The turbine produces electricity and it is stored using battery. Both turbine and batteryare carefully placed in their respective places. The stored electricity can be used for our specific purposes. Thus the project is successfully finished and implemented.

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