DC HEATER

A Project Report

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MECHANICAL ENGINEERING

Submitted by

PRATEEK PATEL (1512640033)

HARVEER SINGH (1512640016)

ROHIT RAJPUT (1512640040)

SAURAV ANAND (1512640045)

VIKKI (1512640057)

Under the supervision of

Mr. Sumit Kumar

(Assistant Professor)

TO THE FACULTY OF

SACHDEVA INSTITUTE OF TECHNOLOGY, FARAH, MATHURA

(Formerly Dr. A.P.J. Abdul Kalam Technical University, Lucknow)

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CERTIFICATE

Certified that **Prateek Patel, Harveer Singh, Rohit Rajput, Saurav Anand, Vikki** has carried out the project work presented in this project entitled **"DC Heater"** for the award of **Bachelor of Technology** from Dr. A.P.J. Abdul kalam Technical University, Lucknow under my supervision. The report embodies results of original work, and studies are carried out by the student themselves and the contents of the report do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution.

Date: (Sumit Kumar)

Place: Mathura Assistant Professor, MED

S.I.T.,Mathura

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Prateek Patel (1512640033)

Harveer Singh (1512640016)

SauravAnand (1512640045)

Rohit Rajput (1512640040)

Vikki (1512640057)

ABSTRACT

DC Heater aims at developing a highly cost effective natural cooking heater which would cater to the needs of the people of the rural as well as urban society.

This uses non-polluting natural resources and so is eco friendly. It can easily be customized as per requiredments and available resources to suit the needs of different rural households.

Solar energy is the most readily available source of energy. It is one of the most important of the conventional sources of energy becauase it is non-polluting. So this DC Heater has bettery connected which can also be charged by solar energy.

It is easy to construct and operate and can even be built by a farmer himself as per his needs. This idea has been successfully tested and a working prototype has been under developed.

LIST OF FIGURES

Chapter 1
Introduction

1.1 Introduction to DC Heater:-

DC Heater aims at developing a highly cost effective natural cooking heater which would cater to the needs of the people of the rural as well as urban society. Electric heating is a process in which electrical energy is converted to heat energy. Common applications include space heating, cooking, water heating and industrial processes. An electric heater is an electrical device that converts an electric current into heat. The heating element inside every electric heater is an electrical resistor, and works on the principle of Joule heating: an electric current passing through a resistor will convert that electrical energy into heat energy. Most modern electric heating devices use nichrome wire as the active element; the heating element, depicted on the right, uses nichrome wire supported by ceramic insulators. A warning that these can go to very high temperatures and create excruciating burns.

Fig 1.1: Model of DC Heater

1.1.1 Four main component systems form the basis of a modern heater

i. the control system, control panel, or ON / OFF switch; in some cases this system can be absent

ii. the power unit (power inverter)

iii. the work head (transformer)

iv. and the heating coil (inductor)

1.2 Solar Panel:-

Solar power is the conversion of energy from sunlight into electricity, either directly using photovoltaics (PV), indirectly using concentrated solar power, or a combination. Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaic cells convert light into an electric current using the photovoltaic effect.

Fig 1.2: Model of Solar Panel

Photovoltaics were initially solely used as a source of electricity for small and medium-sized applications, from the calculator powered by a single solar cell to remote homes powered by an off-grid rooftop PV system. Commercial concentrated solar power plants were first developed in the 1980s. The 392 MW Ivanpah installation is the largest concentrating solar power plant in the world, located in the Mojave Desert of California.

As the cost of solar electricity has fallen, the number of grid-connected solar PV systems has grown into the millions and utility-scale photovoltaic power stations with hundreds of megawatts are being built. Solar PV is rapidly becoming an inexpensive, low-carbon technology to harness renewable energy from the Sun. The current largest photovoltaic power station in the world is the 850 MW Longyangxia Dam Solar Park, in Qinghai, China.

The International Energy Agency projected in 2014 that under its "high renewables" scenario, by 2050, solar photovoltaics and concentrated solar power would contribute about 16 and 11 percent, respectively, of the worldwide electricity consumption, and solar would be the world's largest source of electricity. Most solar installations would be in China and India.[2] In 2017, solar power provided 1.7% of total worldwide electricity production, growing at 35% per annum.[3] As of 2018, the unsubsidisedlevelised cost of electricity for utility scale solar power is around $43/MWh.

1.3 Heating Element:-

A heating element converts electrical energy into heat through the process of Joule heating. Electric current passing through the element encounters resistance, resulting in heating of the element. Unlike the Peltier effect, this process is independent of the direction of current flow.

1.3.1 Heating Elements Types:-

(a) Metal:-

Resistance Wire: Metallic resistance heating elements may be wire or ribbon, straight or coiled. They are used in common heating devices like toasters and hair dryers, furnaces for industrial heating, floor heating, roof heating, pathway heating to melt snow, dryers, etc. The most common classes of materials used include:

Nichrome: Most resistance wire heating elements use nichrome 80/20 (80% nickel, 20% chromium) wire, ribbon, or strip. Nichrome 80/20 is an ideal material, because it has relatively high resistance and forms an adherent layer of chromium oxide when it is heated for the first time. Material beneath this layer will not oxidize, preventing the wire from breaking or burning out.

Kanthal (FeCrAl) wires

Cupronickel (CuNi) alloys for low temperature heating

Etched Foil: Etched foil elements are generally made from the same alloys as resistance wire elements, but are produced with a subtractive photo-etching process that starts with a continuous sheet of metal foil and ends with a complex resistance pattern. These elements are commonly found in precision heating applications like medical diagnostics and aerospace.

(b) Ceramic And Semiconductor:-

Molybdenum disilicide (MoSi2) an intermetallic compound, a silicide of molybdenum, is a refractory ceramic primarily used in heating elements. It has moderate density, melting point 2030 °C, (3,686 degrees F)and is electrically conductive. At high temperatures it forms a passivation layer of silicon dioxide, protecting it from further oxidation. The application area includes glass industry, ceramic sintering, heat treatment furnaces and semiconductor diffusion furnaces.

Silicon carbide, see Silicon carbide § Heating elements

PTC ceramic elements: PTC ceramic material is named for its positive thermal coefficient of resistance (i.e., resistance increases upon heating). While most ceramics have a negative coefficient, these materials (often barium titanate and lead titanate composites) have a highly nonlinear thermal response, so that above a composition-dependent threshold temperature their resistance increases rapidly. This behavior causes the material to act as its own thermostat, since current passes when it is cool, and does not when it is hot. Thin films of this material are used in automotive rear-window defrost heaters, and honeycomb-shaped elements are used in more expensive hair dryers and space heaters.

(c) Polymer PTC heating elements:-

Resistive heaters can be made of conducting PTC rubber materials where the resistivity increases exponentially with increasing temperature.[1] Such a heater will produce high power when it is cold, and rapidly heat up itself to a constant temperature. Due to the exponentially increasing resistivity, the heater can never heat itself to warmer than this temperature. Above this temperature, the rubber acts as an electrical insulator. The temperature can be chosen during the production of the rubber. Typical temperatures are between 0 and 80 °C (32 and 176 °F).

It is a point-wise self-regulating heater and self-limiting heater. Self-regulating means that every point of the heater independently keeps a constant temperature without the need of regulating electronics. Self-limiting means that the heater can never exceed a certain temperature in any point and requires no overheat protection.

Fig 1.3: Nichrome Heating Element

The above figure is a diagram of the dynamic equation of the tricopter in which the lower right side is the diagram of the dynamic equation of yaw control. That is because in yaw control, RC servomotor drives the tail axis to change the declination angle of the tail axis. The tricopter motion control can be decomposed into altitude, roll, pitch, and yaw control. The control strategies of tri-rotors the altitude control and that increasing the speed of each rotor will increase the altitude, and vice versa. Shows the roll control; the approach towards roll control is that given the same rotor-1 speed, varying the rotor speeds of the two front rotors will generate roll control. Shows the pitch control; given the same angular velocities for the front two rotors, varying the rotor speed of rotor 1 will generate pitch control. Regarding the yaw control, by using the natural yawing moment from the reaction torque and also from the tilt angle, yaw control can be successfully generated. The tilt angle is very useful when encountering a sudden danger of collision because by tilting the rotor, sudden turning control would be possible.

1.4 Hot Plate:-

A hot plate is a portable self-contained tabletop small appliance cooktop that features one, two or more electric heating elements or gas burners. A hot plate can be used as a stand-alone appliance, but is often used as a substitute for one of the burners from an oven range or a kitchen stove. Hot plates are often used for food preparation, generally in locations where a full kitchen stove would not be convenient or practical. A hot plate can have a flat surface or round surface. Hot plates can be used for traveling or in areas without electricity.

In laboratory settings, hot plates are generally used to heat glassware or its contents. Some hot plates also contain a magnetic stirrer, allowing the heated liquid to be stirred automatically.

In a student laboratory, hot plates are used because baths can be hazards if they spill, overheat or ignite because they have high thermal inertia (meaning they take a long time to cool down) and mantles can be very expensive and are designed for specific flask volumes.

Chapter 2
Working

2.1 Working Principle:-

An electric heater is an electrical device that converts an electric current into heat. The heating element inside every electric heater is an electrical resistor, and works on the principle of Joule heating: an electric current passing through a resistor will convert that electrical energy into heat energy. Most modern electric heating devices use nichrome wire as the active element; the heating element, depicted on the right, uses nichrome wire supported by ceramic insulators. A warning that these can go to very high temperatures and create excruciating burns.

i. The solar panel of rating 80 Watts is used lorthe solar chulha. This solar panel converts the solar energy into electrical energy and it provides an output of 19V and 4.5 Amps
ii. Another source for generating power which is used that is hand wheel with dc generator, when the hand wheel is rotated the mechanical energy converted into electrical energy. This energy is stored in DC battries.
iii. This heater is made up of plaster ofparis in which Nichrome is used as heating element. This heating element is used to make four spiral coils. Each coil uses approximately 4 to 5 amp. current.
iv. Thus the total amount of current taken by four spiral coils is 16 to 20 amp. As we have two DC battries of rating 12V, 42Ah each, therefore we can work on the chulha for four hours approximately.

2.2 Space Heating:-

Space heating is used to warm the interiors of buildings. Space heaters are useful in places where air-handling is difficult, such as in laboratories. Several methods of electric space heating are used.

2.2.1 Radiant Heaters:-

Electric radiant heating uses heating elements that reach a high temperature. The element is usually packaged inside a glass envelope resembling a light bulb and with a reflector to direct the energy output away from the body of the heater. The element emits infrared radiation that travels through air or space until it hits an absorbing surface, where it is partially converted to heat and partially reflected. This heat directly warms people and objects in the room, rather than warming the air. This style of heater is particularly useful in areas through which unheated air flows. They are also ideal for basements and garages where spot heating is desired. More generally, they are an excellent choice for task-specific heating.

Radiant heaters operate silently and present the greatest potential danger of ignition of nearby furnishings due to the focused intensity of their output and lack of overheat protection. In the United Kingdom, these appliances are sometimes called electric fires, because they were originally used to replace open fires.

The active medium of the heater depicted in this section is a coil of nichrome resistance wire inside a fused silica tube, open to the atmosphere at the ends, although models exist where the fused silica is sealed at the ends and the resistance alloy is not nichrome.

2.3 Convection Heaters:-

In a convection heater, the heating element heats the air in contact with it by thermal conduction. Hot air is less dense than cool air, so it rises due to buoyancy, allowing more cool air to flow in to take its place. This sets up a convection current of hot air that rises from the heater, heats up the surrounding space, cools and then repeats the cycle. These heaters are sometimes filled with oil. They are ideally suited for heating a closed space. They operate silently and have a lower risk of ignition hazard if they make unintended contact with furnishings compared to radiant electric heaters.

2.4 Fan Heaters:-

A fan heater, also called a forced convection heater, is a kind of convection heater that includes an electric fan to speed up the airflow. They operate with considerable noise caused by the fan. They have a moderate risk of ignition hazard if they make unintended contact with furnishings. Their advantage is that they are more compact than heaters that use natural convection and are also cost-efficient for portable and small room heating systems.

2.5 Storage Heating:-

A storage heating system takes advantage of cheaper electricity prices, sold during low demand periods such as overnight. In the United Kingdom, this is branded as Economy 7. The storage heater stores heat in clay bricks, then releases it during the day when required. Newer storage heaters are able to be used with various tariffs. Whilst they can still be used with economy 7, they can be used with day-time tariffs. This is due to the modern design features that are added during manufacturing. Alongside new designs the use of a thermostat or sensor has improved the efficiency of the storage heater. A thermostat or sensor is able to read the temperature of the room, and change the output of the heater accordingly. Water can also be used as a heat-storage medium.

Chapter 3
Power supply

3.1 DC Battries:-

A battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved to include devices composed of a single cell.
Primary (single-use or "disposable") batteries are used once and discarded; the electrode materials are irreversibly changed during discharge. Common examples are the alkaline battery used for flashlights and a multitude of portable electronic devices. Secondary (rechargeable) batteries can be discharged and recharged multiple times using an applied electric current; the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium-ion batteries used for portable electronics such as laptops and smartphones.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to small, thin cells used in smartphones, to large lead acid batteries or lithium-ion batteries in vehicles, and at the largest extreme, huge battery banks the size of rooms that provide standby or emergency power for telephone exchanges and computer data centers.

According to a 2005 estimate, the worldwide battery industry generates US$48 billion in sales each year,[5] with 6% annual growth.

Fig 3.1: DC Battery (12V,42Ah)

3.1.1 Principle Of Operation:-

Batteries convert chemical energy directly to electrical energy. In many cases, the electrical energy released is the difference in the cohesive or bond energies of the metals, oxides, or molecules undergoing the electrochemical reaction. For instance, energy can be stored in Zn or Li, which are high-energy metals because they are not stabilized by d-electron bonding, unlike transition metals. Batteries are designed such that the energetically favorable redox reaction can occur only if electrons move through the external part of the circuit.

A battery consists of some number of voltaic cells. Each cell consists of two half-cells connected in series by a conductive electrolyte containing metal cations. One half-cell includes electrolyte and the negative electrode, the electrode to which anions (negatively charged ions) migrate; the other half-cell includes electrolyte and the positive electrode, to which cations (positively charged ions) migrate. Cations are

reduced (electrons are added) at the cathode, while metal atoms are oxidized (electrons are removed) at the anode.[15] Some cells use different electrolytes for each half-cell; then a separator is used to prevent mixing of the electrolytes while allowing ions to flow between half-cells to complete the electrical circuit.
Here, two DC bettries of 12V,42Ah are used to lit up the heater coils.

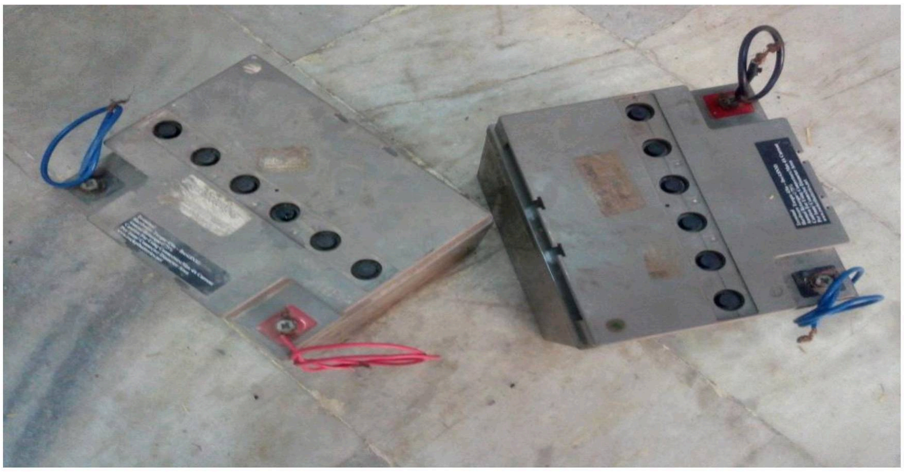


Fig. 3.2: Combination of Two Battries

3.2 Charging Of Battries:-

This DC is fed to an electronic circuit which regulates the voltage into a constant level and is applied to the battery under charge, where the energy is stored through an internal process of chemical reaction.
The charging protocol (how much voltage or current for how long, and what to do when charging is complete, for instance) depends on the size and type of the battery being charged. Some battery types have high tolerance for overcharging (i.e., continued charging after the battery has been fully charged) and can be recharged by connection to a constant voltage source or a constant current source, depending on battery type. Simple chargers of this type must be manually disconnected at the end of the charge cycle, and some battery types absolutely require, or may use a timer, to cut off charging current at some fixed time, approximately when charging is complete. Other battery types cannot withstand over-charging, being damaged (reduced capacity, reduced lifetime), over heating or even exploding. The charger

may have temperature or voltage sensing circuits and a microprocessor controller to safely adjust the charging current and voltage, determine the state of charge, and cut off at the end of charge. Here, we charge both the battries with two methodes.

3.2.1 Charging The Battries With Solar Panel:-

The sun provides peak power of about 1,000 watts per square meter (93W/sqft) and a solar panel transforms this power into roughly 130W per square meter (12W/sqft). This energy harvest corresponds to a clear day with the solar panel facing the sun. Surface dust on the solar panels and high heat reduce the overall efficiency.

Generating electricity by sunlight goes back to 1839 when Edmond Becquerel (1820–1891) first discovered the photovoltaic effect. It took another century before researchers understood the process on an atomic level, which works similar to a solid-state device with n-type and p-type silicon bonded together.

Commercial photovoltaic (PV) systems are 10 to 20 percent efficient. Of these, the flexible panels are only in the 10 percent range and the solid panels are about 20 percent efficient. Multi-junction cell technologies are being tested that achieve efficiencies of 40 percent and higher.

At 25°C (77°F), a high quality monocrystalline silicon solar panel produces about 0.60V open circuit (OCV). Like batteries, solar cells can be connected in series and parallel to get higher voltages and currents. (See BU-302: Series and Parallel Battery Configurations) The surface temperature in full sunlight will likely rise to 45°C (113°F) and higher, reducing the open circuit voltage to 0.55 V per cell due to lower efficiency. Solar cells become more efficient at low temperatures, but caution is necessary when charging batteries below freezing temperatures. (See BU-410: Charging at High and Low Temperatures) The internal resistance of a solar cell is relatively high: with a commercial cell, the series resistance is typically one ohm per square centimeter (1Ωcm2).

A solar charging system is not complete without a charge controller. The charge controller takes the energy from the solar panels or wind turbine and converts the voltage so it's suitable for battery charging. The supply voltage for a 12V battery bank is about 16V. This allows charging lead acid to 14.40V (6 x 2.40V/cell) and Li-ion to 12.60 (3 x 4.20V/cell). Note that 2.40V/cell for lead acid and 4.20V/cell for lithium-ion are the full-charge voltage thresholds.

Charge controllers are also available for lithium-ion to charge 10.8V packs (3 cells in series). When acquiring a charge controller, observe the voltage requirements. The standard Li-ion family has a nominal voltage of 3.6V/cell; lithium iron phosphate is 3.20V/cell. Only connect the correct batteries for which the charge controller is designed. Do not connect a lead acid battery to a charge controller designed for Li-ion and vice-versa. This could compromise the safety and longevity of the batteries as the charge algorithms and voltage settings are different.

A lower-cost charge controller only produces an output voltage when sufficient light is available. With a diminishing light source, the charge controller simply turns off and resumes when sufficient levels of light are restored. Most of these devices cannot utilize fringe power present at dawn and dusk and this limits them to applications with ideal lighting conditions.

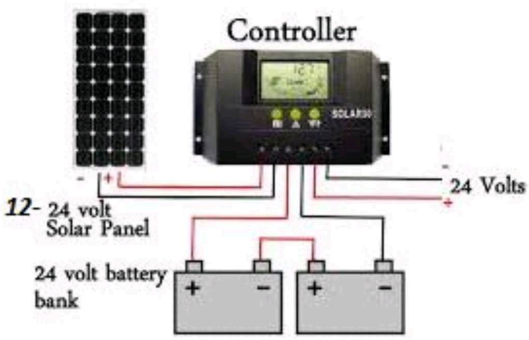


Fig. 3.3: Solar Charging Setup

3.2.2 Charging Of Battries With Alternator Setup:-

The alternator, as the name implies, produces an alternating current (AC) output, which is rectified to direct current (DC) to provide the correct type of voltage to replenish the battery, to keep it at full charge.

The field current, approximately six to eight amps, energizes the rotor which then induces an electric current in the stator as it rotates. The rating of the alternator tends to be vehicle-specific, as a base model has less electrical demand than a vehicle with typical top-of-the-range accessories, such as electric front and rear heated screens, heated mirrors, additional lighting, heated and electrical adjusted seats, etc.

The alternator stator has three internal windings wound 120 degrees between phases and it requires nine diodes in 'bridge' configuration to rectify the output. The voltage is controlled by a solid-state regulator that maintains the output in the range stated in the notes above. The output current is determined by the requirement at the time. For example, a battery that has just been subject to prolonged cranking draws a higher output from the alternator than when the battery is fully charged.
A good charging system has the following characteristics:
A fall in battery voltage should be accompanied by an increase in charging current and vice versa.

The regulated voltage can be measured with a multimeter, but this reading can appear correct even if the alternator has a diode fault that reduces the output by 33%. The only true way to monitor the alternator output is to observe the output voltage and current waveforms using an oscilloscope.

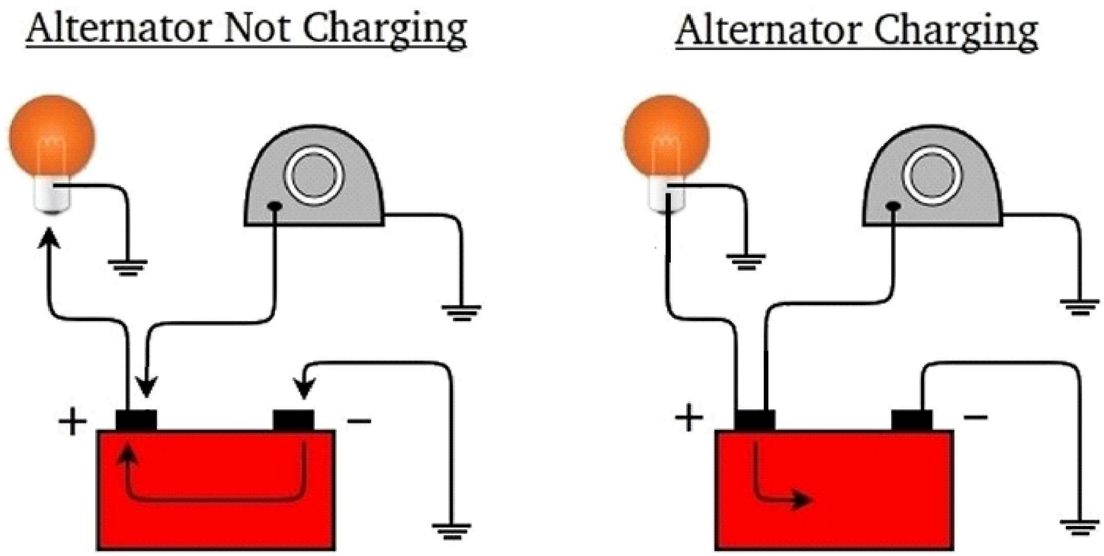


Fig. 3.4: Battery Charging by Alternator

Chapter 4
CONSTRUCTIONAL DETAILS

4.1 Design of Heater Frame:-

One of the most integral part of heater is its frame. The frame supports the heating coils and prevents it from fire. This frame is made up of iron and consists a hot plate over. This hot plate is made up of plaster of paris (POP). The frame and the hot plate both have square shape. The heating coils are mounted on hot plate in four spiral rings. All four coils are connected to each an other in parellel. Each pair of coils is connected with one battery . The frame is of 18.5 cms by each side. Each spiral ring has length of 32 cms.

Fig. 4.1: Frame Design

4.1.1 Selection of Coil Material:-

Nichrome wire is used as a heating element because it is very stable, even at high temperatures. Unlike other metals, it will not melt even when generating large amounts of heat. Ironically, nichrome actually has low electrical resistance, the property that causes the wire to heat.

Nickel-Chromium chromel A (80-20) is one of standard alloys for electrical resistance wire for heaters and electrical appliances. Various trade names and compositions exist for these alloys. The composition is 78.4 percent Nickel, 20 percent Chromium, 1 percent Silicon and 0.05 percent Iron. Chromel A has a continuous service temperature of 2150 degrees F (1177 degrees C), which is higher than the more common Iron rich alloys on the market. Chromel A also performs better in high temperature corrosive environments and is used in the medical device industry. The smaller gauge wires are used to make inoculating needles and loops that are used in microbiology labs. Cauterizing instruments can also be made utilizing this alloy. Other applications include resistors, rheostats, resistance thermometers and potentiometers.

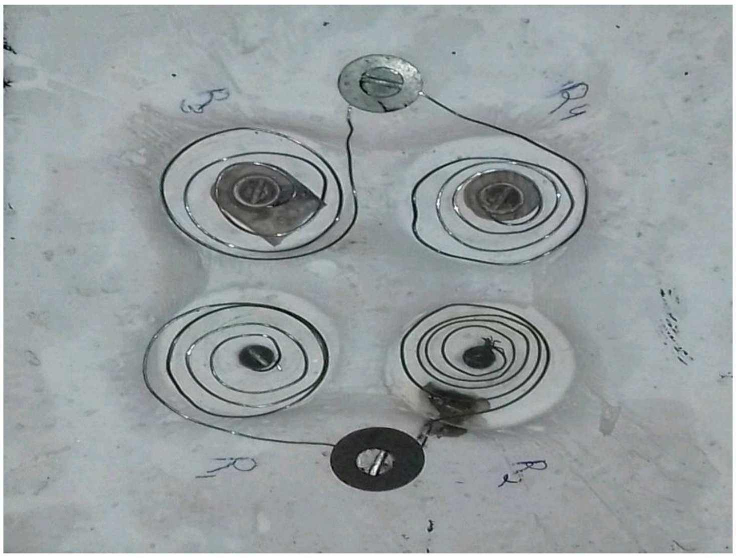


Fig. 4.2: Heaing Coils on Plate

As the nichrome is used to make four spiral coils. Each coil uses approximately 4 to 5 amp. current. Thus the total amount of current taken by four spiral coils is up to 16 to 20 amp. As we have two DC battries of rating 12V, 42Ah-42Ah, Therefore we can work on heater for four hours approximately.

4.2 X-Y Table:-

X-Y tables help provide horizontal motion for automated machinery such as assembly DC generator in facilities. The generator or automated machinery have only a limited range of motion while their bases remain stationary; X-Y tables allow these basis to move horizontally along X and Y axis. Also known as XY stages, XY tables are linear slides with linear motion based in linear slides which are driven by a hand, typically a linear motor. XY tables are built and configured to provide high-performance positioning along multiple axis. The DC generator is mounted on this table and a belt is connected to this generator. This table is made up of Iron.

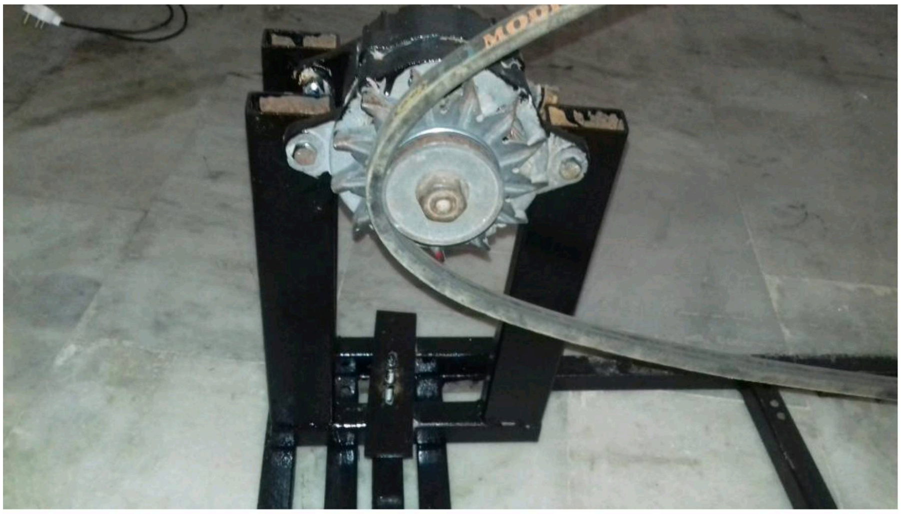


Fig. 4.3: Alternator Mounted on X-Y Table

A digitizer for recording positional data of a line traced by hand on a work place comprises a baseboard for receiving a work place containing a traced line, a cross slide consisting of a carriage and slide with an actuator, transmission elements between the cross slide and the position of the position element which governs the position of the actuator relative to signal receivers, and a manually operated release element which transmits the positional data recorded by the signal receivers to a circuit.

The X slide of the cross slide which is displaceable in the X direction is displaceably arranged inside an outer, Y slide which is displaceable in the Y direction. A first group of evaluating units for evaluating diffraction structures is located on the X slide with a laser and an optical evaluation system, while a second group of evaluating components, e.g. for evaluating a text, an IR field and/or a photo field, is located on the Y slide.

4.3 Belt:-

A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel. Belts may be used as a source of motion, to transmit power efficiently or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel. In a two pulley system, the belt can either drive the pulleys normally in one direction (the same if on parallel shafts), or the belt may be crossed, so that the direction of the driven shaft is reversed (the opposite direction to the driver if on parallel shafts). As a source of motion, a conveyor belt is one application where the belt is adapted to carry a load continuously between two points. B section V-belt is used in this device for power transmission.

V belts (also style V-belts, vee belts, or, less commonly, wedge rope) solved the slippage and alignment problem. It is now the basic belt for power transmission. They provide the best combination of traction, speed of movement, load of the bearings, and long service life. They are generally endless, and their general cross-section shape is roughly trapezoidal (hence the name "V"). The "V" shape of the belt tracks in a mating groove in the pulley (or sheave), with the result that the belt cannot slip off. The belt also tends to wedge into the groove as the load increases—the greater the load, the greater the wedging action—improving torque transmission and making the V-belt an effective solution, needing less width and tension than flat belts. V-belts trump flat belts with their small center distances and high reduction ratios. The preferred center distance is larger than the largest pulley diameter, but less than three times the sum of both pulleys. Optimal speed range is 1,000–7,000 ft/min (300–2,130 m/min). V-belts need larger pulleys for their thicker cross-section than flat belts.

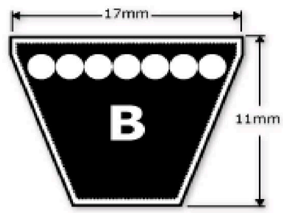


Fig. 4.3: V-belt, B section

4.3.1 Power Transmission:-

Belts are the cheapest utility for power transmission between shafts that may not be axially aligned. Power transmission is achieved by specially designed belts and pulleys. The demands on a belt-drive transmission system are huge, and this has led to many variations on the theme. They run smoothly and with little noise, and cushion motor and bearings against load changes, albeit with less strength than gears or chains. However, improvements in belt engineering allow use of belts in systems that only formerly allowed chains or gears.

Power transmitted between a belt and a pulley is expressed as the product of difference of tension and belt velocity:

$$P = (T1 - T2)v,$$

$$T1/T2 = e^{\mu \beta}$$

where, T1 and T2 are tensions in the tight side and slack side of the belt respectively.

4.3.2 Belt Selection Criteria:-

Belt drives are built under the following required conditions: speeds of and power transmitted between drive and driven unit; suitable distance between shafts; and appropriate operating conditions. The equation for power is

Power [kW] = (torque [N·m]) × (rotational speed [rev/min]) × (2π radians) / (60 s × 1000 W).

Factors of power adjustment include speed ratio; shaft distance (long or short); type of drive unit (electric motor, internal combustion engine); service environment (oily, wet, dusty); driven unit loads (jerky, shock, reversed); and pulley-belt arrangement (open, crossed, turned). These are found in engineering handbooks and manufacturer's literature. When corrected, the power is compared to rated powers of the standard belt cross-sections at particular belt speeds to find a number of arrays that perform best. Now the pulley diameters are chosen. It is generally either large diameters or large cross-section that are chosen, since, as stated earlier, larger belts transmit this same power at low belt speeds as smaller belts do at high speeds. To keep the driving part at its smallest, minimal-diameter pulleys are desired. Minimum pulley diameters are limited by the elongation of the belt's outer fibers as the belt wraps around the pulleys. Small pulleys increase this elongation, greatly reducing belt life. Minimal pulley diameters are often listed with each cross-section and speed, or listed separately by belt cross-section. After the cheapest diameters and belt section are chosen, the belt length is computed. If endless belts are used, the desired shaft spacing may need adjusting to accommodate standard-length belts. It is often more economical to use two or more juxtaposed V-belts, rather than one larger belt.

In large speed ratios or small central distances, the angle of contact between the belt and pulley may be less than 180°. If this is the case, the drive power must be further increased, according to manufacturer's tables, and the selection process repeated. This is because power capacities are based on the standard of a 180° contact angle. Smaller contact angles mean less area for the belt to obtain traction, and thus the belt carries less power.

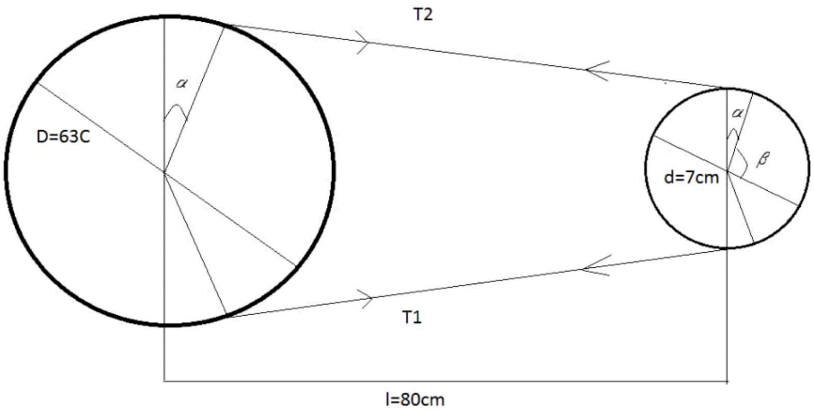
4.4 Bicycle Wheel Frame:-

In its primitive form, a wheel is a circular block of a hard and durable material at whose center has been bored a circular hole through which is placed an axle bearing about which the wheel rotates when a moment is applied by gravity or torque to the wheel about its axis, thereby making together one of the six simple machines. When placed vertically under a load-bearing platform or case, the wheel turning on the horizontal axle makes it possible to transport heavy loads; when placed horizontally, the wheel turning on its vertical axle makes it possible to control the spinning motion used to shape materials (e.g. a potter's wheel); when mounted on a column connected to a rudder or a chassis mounted on other wheels, one can control the direction of a vessel or vehicle (e.g. a ship's wheel or steering wheel); when connected to a crank, the wheel produces or transmits energy. The belt is conneted to alternator pully to rim or wheel of bycle.

The rim is the "outer edge of a wheel, holding the tire".It makes up the outer circular design of the wheel on which the inside edge of the tire is mounted on vehicles such as automobiles. For example, on a bicycle wheel the rim is a large hoop attached to the outer ends of the spokes of the wheel that holds the tire and tube. In cross-section, the rim is deep in the center and shallow at the outer edges, thus forming a "U" shape that supports for the bead of the tire casing.

Fig. 4.4: Bicycle Wheel Frame

4.4.1 Analysis of Parameters:-



4.4.2 Some Parameters:-

D = Diameter of driver wheel (mm),

d   = Diameter of driven wheel (mm),

l= center distance between driver and driven wheels (mm),

L =   total belt length (mm),

T1 = Tight side tension (N),

T2 = Slack side tension (N),

β =Angle of lap or Angle o acr of contact of the belt over pulley,

α = Belt inclination angle,

μ = Coefficent of friction

We have,

D = 63cm = 630mm

d = 7cm = 7mm

l = 80cm = 800mm

μ= 0.35

Sin$\boldsymbol{\alpha}$ = (D-d)/2l

= (630-70)/2×800

Sin$\boldsymbol{\alpha}$= 0.35

$\boldsymbol{\alpha}$= 20487315deg

L = 2l+(p/2)(d+D)+$(D - d)^2$/4l

= 2×800+(p/2)(630+70)+$(630 - 70)^2$/4×800

= 2797.5574mm

Or 279.755cm

β= 180-2a

= 139.0254deg or 2.4264 radian

T1/T2 =$e^{\mu\,\beta}$

= $e^{0.35*2.4264}$

T1/T2 = 2.3379 ....(1)

4.4.3 For Alternator and Belt:-

P = Power generated by alternator(watt),

N =No.ofr.p.m by alternator (r.p.m),

N = 2450r.p.m (min) & N= 2700r.p.m(max),

V = voltage given by alternator(volt),

V = 12v (min)

I = current given by alternator (amp),

I = 4.5amp (min) & I= 7apm(max),

T = torge (N-M)

For min value-

Power(P) = VI

P(min) = 12×4.5 = 54w,

P(min) = (2πNT)/60

54 = (2π×2 450×T)/60

T = 0.21047 N-M

We know

T = (T1-T2)d/2 (d=7cm =0.07m)

(T1-T2) = (2×0.21047)/0.07

(T!-T2) = 6.01355 ……….……….(2)

By solving eq (1)&(2)

T1(min) = 10.50831 N

T2(min) = 4.49476 N

For max value-

P(max) = VI =98 w

P(max) = (2pNT)/60

98 = (2p×2700×T)/60

T = 0.34660 N-M

T = (T1-T2)d/2

(T1-T2) = 9.90297 ……….(3)

By solving eq (1)&(3)

T1(max) = 17.30484 N

T2(max) = 7.40187 N

Efficiency for alternator (η)

= power out of alternator / (power out of alternator+losses of alternator)

=98/(98+15.95)

η =86.4%

For Heater :-

I= Input current in the Heater (amp),

I1= Input current in first elementof the Heater(amp),

$I1 = 6.2$ (amp),

I2= Input current in secont element of the Heater(amp),

$I2 = 5.9$ (amp),

I3= Input current in third element of the Heater(amp),

$I3 = 5.7$ (amp),

I4= Input current in fourth element of the Heater(amp),

$I4 = 6.1$ (amp),

V= The Voltege applied by batter (v),

$V = 12$,

P= Power input to the Heater (w).

The total current in the Heater:

$I = I1+I2+I+I4$

$= 6.2+59+5.7+6.1$

$= 23.9$ (amp).

Power input to the Heater:

$P = VI$

$= 12*23.9$

$= 286.8$ (w).

Chapter 5
CONCLUSIONS AND SCOPE OF FUTURE WORK

5.1 Conclusion:-

DC Heater aims at developing a highly cost effective natural cooking heater which would cater to the needs of the people of the rural as well as urban society. Electric heating is a process in which electrical energy is converted to heat energy. An electric heater is an electrical device that converts an electric current into heat. The heating element inside every electric heater is an electrical resistor, and works on the principle of Joule heating: an electric current passing through a resistor will convert that electrical energy into heat energy. Most modern electric heating devices use nichrome wire as the active element; the heating element, depicted on the right, uses nichrome wire supported by ceramic insulators. A warning that these can go to very high temperatures and create excruciating burns.This heater is able to cook lights food like rice, pulses, oats, milk etc.

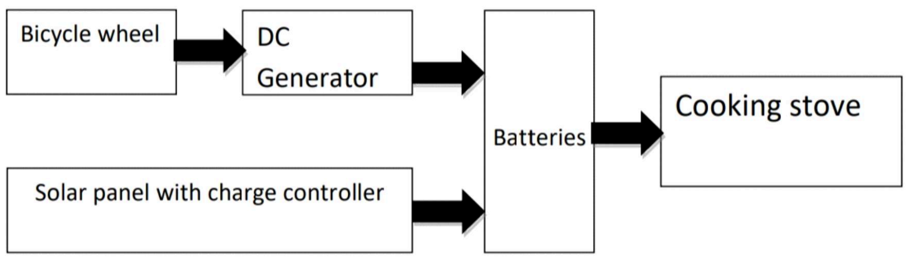


Fig. 5.1 Block Diagram of Working

5.2 Scope of Future Work:-

- Reducing the power of heating coil and increasing number of coils will increasing heating capacity and efficiency of the heater.
- Reducing power of the coils will take less amount of energy from battries and battries will work for more time to lit up the coils.
- If we increase the number of solar panels and fulfill the power required to the coils, it can directly work without need of battries.

5.3 Benefits of using DC Heater:-

- This system is shock proof so no risk of shocking.
- Electric heater is quick to respond.
- Since dust and ash are completely eliminated in this heater, it keeps sorroundings clean.
- The substance can be heated uniformly throughout wheather it may be conducting or non-conducting material.
- As there are no flue gases, atmosphere arround is pollution free.