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TECHINICAL ARTICLE OF SCIENCE AND MECHAICAL ENGINEERING

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Utilization of Biogas for SI engine.

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The current global interest in harnessing renewable sources of energy is largely prompted by sheer economic necessity. As long as the pricing of fossil fuels was maintained at levels, which made energy, derived from them cheaper than from any other source, the need for a quest for alternative sources tended to remain largely academical. We should view any alternate sources of energy primarily from the point of view of its easy and universal unavailability and its economic viability.

Going by the above criteria, most of the countries have, in greater or smaller measure, begun expending development efforts on solar, wind and biomass energy greatest for solar energy, somewhat lesser for wind energy and the least amount the three, for biogas.

DIFFERENT FOSSILE FUELS: -

- Gasoline
- Diesel
- Kerosene
- Coal
- Mineral Oils

By above fuels the world is facing numerous pollution problems. These fuels are emitting hazardous pollutants such as Sulphur Dioxide, Carbon Monoxide, Carbon Dioxide, Hydrocarbons, Oxides of nitrogen and particulate matters.

Due to above severe problems the entire world is searching new fuels, which would be environment friendly, cost effective, renewable source, less hazardous for human being.

Countries most active in developing biogas as an energy source are India and China, whose agro-based economies lend themselves for widespread adoption of these alternate sources of energy.

RELEVANCE

Now a day the prices of conventional fuel such as petrol are touching to sky and sources of petrol are becoming scarce day by day. So more research is going on alternative fuels. Out of number of alternative fuels on which research is going on Biogas is promising one due to its own advantages.

Its use in automobiles will be cheaper with compared to petrol. The emissions after the combustion of Biogas are less than petrol.

The main advantage of biogas is that it can be produced in rural areas from readily available material. Biogas consists mainly of Methane and carbon dioxide. Its calorific value is low but its knock resistance (Octane number) is high and ignition quality (Cetane number) is low.

BIOGAS AS AN ALTERNATIVE FUEL FOR I.C. ENGINE

The composition and calorific value of Biogas is as follows:

1. Methane (CH_4) = 50.08%
2. Carbon Dioxide (CO_2) = 42.21%
3. Hydrogen Sulfide (H_2S) = 4.37%
4. Water Content (H_2O) = 3.21%
5. Trace of Hydrogen

The value of Biogas as fuel stems from its Methane content. Efforts are underway in various research agencies to increase the percentage content of Methane. On the other hand, it has been argued that the presence of Carbon Dioxide confers the anti- knock characteristics to Biogas as I.C. engine fuel. If pure Methane were to be used, it would call for safety precautions against explosions. Hence, a happy balance needs to be struck regarding the percentage of Methane and Carbon Dioxide for achieving the most favourable stoichiometric ratio commensurate with acceptable levels of anti-knock.

The added attraction of using of using Biogas, as fuel is that it is a byproduct of a system of producing enriched manure and therefore it has a double advantage. This should be borne in mind when cost estimates are made of Biogas for comparison purposes with solar and wind energies, which have no byproducts.

The prime movers for pump sets used by marginal farmers are either C.I. or S.I. engines of around 5 H.P. or less. The work of adapting such engines to Biogas has so far veered in the direction of diesel engines. The reason is not so far to seek, because gas can be directly fed into the inlet manifold of the diesel engine and the operating cycle is such that in the suction stroke the gas can be aspirated in place of air and hence even the initial charge has a calorific value, which is further supplemented by an injection of diesel at the top of the compression stroke. The system of combustion and flame propagation remains unaltered. In the process, however, it is obviously possible to reduce the amount of diesel injected for the same power generation, the engine in good stead while it operates with biogas as a dual fuel. There have been claims of saving upto 80% of diesel in C.I. engines.

As far as petrol run S.I. engines are concerned, the compression ratio is between 6.5 and 8.0 compared to 14 to 18 of the diesel engines. When the S.I. engines are operated on kerosene, a still lower compression ratio of about 4.5 to 5.0 has to be adopted. Thus if such an engine is to be operate either wholly or partly on Biogas, the modification work will be correspondingly more involved.

4.1 (A) COMPOSITION OF BIOGAS:

1. CH_4 = 50.08%
2. CO_2 = 42.21%
3. H_2S = 4.37%
4. H_2O = 3.21%

4.1 (B) IMPORTANT PROPERTIES OF BIOGAS: -

Biogas consists essentially of Methane and Carbon Dioxide with small concentration of Hydrogen, Nitrogen, and Hydrogen Sulphide etc. The calorific value is around 5500 kcal/M3 and has a density of 1.1 kg/M3. It can be seen that Biogas has a relatively low calorific value and the presence of carbon dioxide in the gas lowers the calorific value but increases the knock resistance. Biogas is a valuable fuel of energy. It is almost 20 percent lighter than air and has an ignition temperature of 650°C to 750°C.Biogas burns with blue flame, which is soot free. It is a clean and efficient fuel. It is a safe. Biogas is a zero waste technology. Biogas is a non-poisonous and non-toxic gas easy to handle not require of special precautions.

After studying the various renewable sources we feel that the Biogas is the most promising one because it has certain advantages such as

4.2 ADVANTAGES OF BIOGAS

It is renewable source of energy

It is clean and efficient fuel

It is safe

Biogas is a Zero waste technology

Biogas is a non poisonous and non toxic Gas

Easy to handle

Not require any special precautions

Very low production cost

The waste after the production of Biogas can be used as a Good fertilizer for farm

4.3 POSSIBLE SOURCES OF BIOGAS

By treatment of any of the following

Animal wastes

Agricultural wastes (Crop, trees)

Industrial wastes

Municipal wastes

Waste food

4.4 BIOGAS GENERATION: -

ANAEROBIC DIGESTION PROCESS OF BIOGAS:

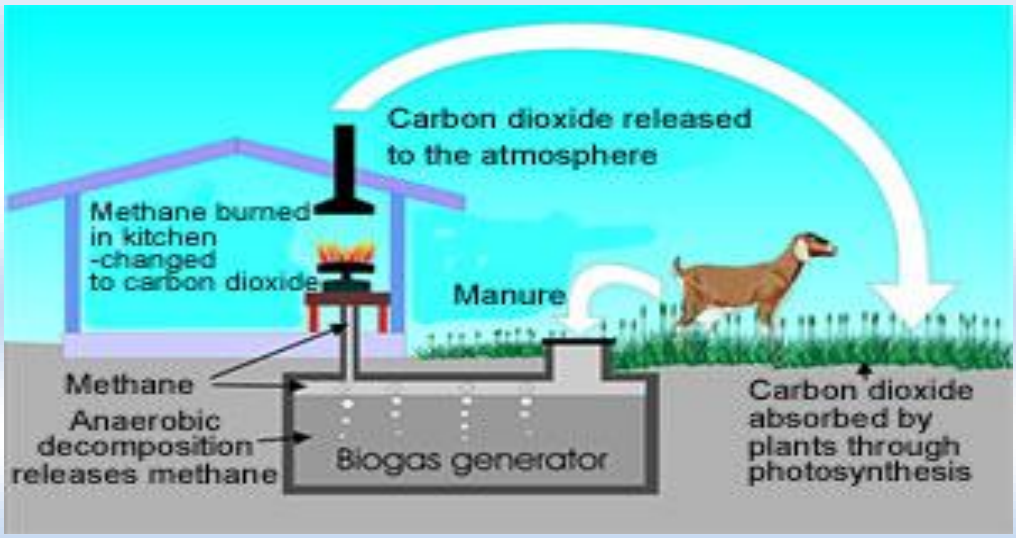

Fig1:

Anaerobic digestion process of bio-gas

The gasification of the biomass is a fermentation process carried out under anaerobic digestion. The biomass contains organic materials like carbohydrates, proteins acids by non- methanogenic bacteria. The methanogenic bacteria in turn convert these alcohols aldehydes and acids into CH_4 and CO_2. The methanogenic bacteria are methanobacterium methanobacillus, methanococcus and methanosarin.

The process is represented as

Biomass → anaerobic Digester → Biogas

The reaction during the generation of biogas is listed below.

a) Organic material + Moisture $\xrightarrow{\text{Bacteria}}$ Acids + Alcohols + Aldehydes + H_2 + CO_2

b) (i) Acids + Alcohols + Aldehydes + CO2 $\xrightarrow[\text{Methanogenic Bacteria}]{\text{(Days)}}$ CH_4 + CO_2

(ii) $4H_2 + CO_2 \xrightarrow[\text{Methanogenic Bacteria}]{} CH_4 + 2H_2O.$

(ii) $CH_3 + COOH \xrightarrow[\text{Fermentation}]{} CH_4 + CO_2.$

The other wastes, which can also be used for producing biogas, are waste from pulp and paper industry, braveries, sugar industry and municipal waste also.

When anaerobic decomposition takes place, CH_4 and CO2 are formed as shown by the above equations its generation requires the knowledge of biology and biochemistry of methane bacteria. The anaerobic bacteria cannot survive with even the slight trace of O_2 in the manure mixture fed to the in the manure mixture fed to the digester, there is a long interval before methane forming digestion takes place. During aerobic period, the traces of O_2 are used by O_2 loving bacteria and large amount of CO_2 is released. Once O_2 disappears, the process of producing CH_2 starts. Anaerobic digestion starts consists the following steps.

THE FACTORS AFFECTING THE FORMATION OF BIOGAS

The optimum production of methane depends upon the factors discussed below:

1. THE PH OF SLURRY

The nature of slurry below pH of 7 is acidic and above 7 is alkaline. The pH value has profound effect on the biological activity. The most desirable value of pH is in between 7.2 to 8.2. The acid forming

bacteria even van operate at pH= 5.5. But the methane fomenters are very sensitive and do not remain below 6.5. The optimum lies in between 6.8 to 7.2.

During the initial acid phase (two weeks), the pH drops to 6 and great deal of CO_2 is released. This is followed by another two weeks during which volatile acids and nitrogen compounds (fertilizer) are formed and pH rises to 7 and CH_4 percentage increases. Then the pH rises to 7.2 to 8.2 and mixture becomes well buffered. Once the mixture becomes well buffered, it is possible to add small amount of raw material periodically and maintain constant supply of gas. If pH is too acidic, it can be brought to normal by adding fresh effluent.

2. TEMPERATURE

The CH_4 producing bacteria work best in the temperature range of 35 to 40^0 C and production starts falling at 20^0 C and totally stops at 12^0C. The gas production at 35^0 C is 15 times more with same mass of manure compared with at 20^0 C. The gas production fall to 50% in winter compared with summer at places like Delhi. The effect of temperature of gas yield with respect to time is shown if Fig.

3. RAW MATERIAL

The amount of CH_4 produced bears direct relationship to the raw material. The amount and quality of digestible material, type of feed to the animals and method of collection.

Form biologic point of view, a digester is a culture of bacteria feeding upon and converting organic waste. It is a symbolic relationship between food and energy. The element carbon (in the form of Carbon-hydrates) and N_2 (as protein and nitrates) are the main foods for anaerobic bacteria. Carbon is used for energy and N_2 for building cell. These bacteria use-up carbon about 30- times faster than N_2.

Anaerobic acts well then C/N ratio of manure lies in between 20 to 30 as it permits digestion to proceed at an optimum rate. If there is too much carbon (C/N =2), the carbon soon become exhausted and fermentation stops. Speeding up the decomposition, more carbon rich wastes are to be added.

The values of C/N ratio for some common dung are listed below:

Cow dung = 18, Horse dung = 25 Human = 6 to 10.

4. INTIMATE CONTACT

Bacteria are microscopic organisms and hence have a limited reach to obtain their food. Therefore, in order to ensure maximum efficiency, it is essential that they are intimately mixed with the food that is

available to them. Any segregation of bacterial cell from their food reduces the rate of reaction. This can be avoided either by gas circulation or using mechanical stirring.

5. POINT OF SUPPLY

The density of fresh slurry is more than decomposed slurry and tends to stay at pushed higher up. The rate of generation can be increased if the used hurry is made out of hot water earliest possible. Loading rate (dung is kg/day/m^3 of digester) has also predominant effect on gas generation. If it is heavily loaded, acids accumulated and fermentation will stop.

The following points should be kept in mind for higher production of the biogas:

1. Free O_2 should be excluded.
2. Dung should contain sufficient N_2
3. (C/N) ratio = 30
4. The optimum temperature = 35^0 C
5. The pH range should lies in between 7.2 to 8.2.
6. The percentage of solid in the input slurry should be 8 to 10% only.
7. Seeding the slurry can improve the digestion process. Wheat powder with 1% urea in water can be used as seeding material which can increase the gas production by 30% in winter.

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Principle & Working of Thermocouple

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A thermocouple is comprised of at least two metals joined together to form two junctions. One is connected to the body whose temperature is to be measured; this is the hot or measuring junction. The other junction is connected to a body of known temperature; this is the cold or reference junction. Therefore the thermocouple measures unknown temperature of the body with reference to the known temperature of the other body.

Working Principle

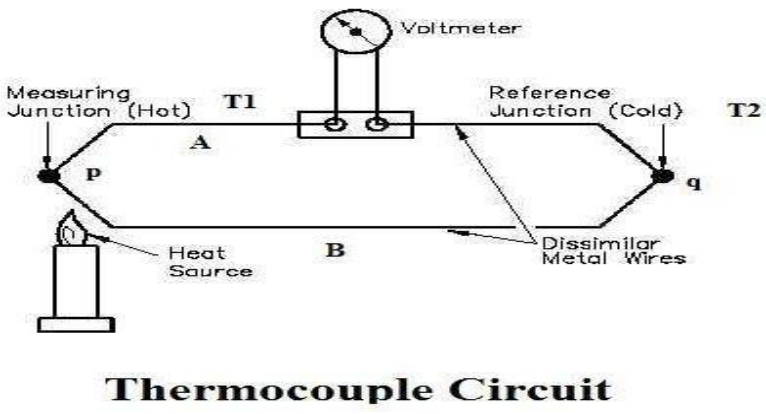
The working principle of thermocouple is based on three effects, discovered by Seebeck, Peltier and Thomson. They are as follows:

1) Seebeck effect: The Seebeck effect states that when two different or unlike metals are joined together at two junctions, an electromotive force (emf) is generated at the two junctions. The amount of emf generated is different for different combinations of the metals.

2) Peltier effect: As per the Peltier effect, when two dissimilar metals are joined together to form two junctions, emf is generated within the circuit due to the different temperatures of the two junctions of the circuit

3) Thomson effect: As per the Thomson effect, when two unlike metals are joined together forming two junctions, the potential exists within the circuit due to temperature gradient along the entire length of the conductors within the circuit.

In most of the cases the emf suggested by the Thomson effect is very small and it can be neglected by making proper selection of the metals. The Peltier effect plays a prominent role in the working principle of the thermocouple.



Thermocouple Circuit

How it Works

The general circuit for the working of thermocouple is shown in the figure 1 above. It comprises of two dissimilar metals, A and B. These are joined together to form two junctions, p and q, which are maintained at the temperatures T_1 and T_2 respectively. Remember that the thermocouple cannot be formed if there are not two junctions. Since the two junctions are maintained at different temperatures the Peltier emf is generated within the circuit and it is the function of the temperatures of two junctions.

If the temperature of both the junctions is same, equal and opposite emf will be generated at both junctions and the net current flowing through the junction is zero. If the junctions are maintained at different temperatures, the emf's will not become zero and there will be a net current flowing through the circuit. The total emf flowing through this circuit depends on the metals used within the circuit as well as the temperature of the two junctions. The total emf or the current flowing through the circuit can be measured easily by the suitable device.

The device for measuring the current or emf is connected within the circuit of the thermocouple. It measures the amount of emf flowing through the circuit due to the two junctions of the two dissimilar metals maintained at different temperatures. In figure 2 the two junctions of the thermocouple and the device used for measurement of emf (potentiometer) are shown.

Now, the temperature of the reference junctions is already known, while the temperature of measuring junction is unknown. The output obtained from the thermocouple circuit is calibrated directly against the unknown temperature. Thus the voltage or current output obtained from thermocouple circuit gives the value of unknown temperature directly.

Advantages & Disadvantages of Thermocouple

The advantages include the following.

- Accuracy is high
- It is Robust and can be used in environments like harsh as well as high vibration.
- Thermal reaction is fast
- The operating range of temperature is wide.
- Wide operating temperature range
- Cost is low and extremely consistent

The disadvantages include the following.

- It has low-accuracy.
- The thermocouple recalibration is hard

Devices Used for Measuring EMF

The amount of emf developed within the thermocouple circuit is very small, usually in millivolts, therefore highly sensitive instruments should be used for measuring the emf generated in the thermocouple circuit. Two devices used commonly are the ordinary galvanometer and voltage balancing potentiometer. Of those two, a manually or automatically balancing potentiometer is used most often.

The potentiometer connected in the thermocouple circuit. The junction p is connected to the body whose temperature is to be measured. The junction q is the reference junction, whose temperature can be measured by the thermometer. In some cases the reference junctions can also be maintained at the ice temperature by connecting it to the ice bath This device can be calibrated in terms of the input temperature so that its scale can give the value directly in terms of temperature.

Thermocouple Applications

Some of the applications of thermocouple include the following.

- These are used as the temperature sensors in thermostats in offices, homes, offices & businesses.
- These are used in industries for monitoring temperatures of metals in iron, aluminum, and metal.

- These are used in the food industry for cryogenic and Low-temperature applications. Thermocouples are used as a heat pump for performing thermoelectric cooling.
- These are used to test temperature in the chemical plants, petroleum plants.
- These are used in gas machines for detecting the pilot flame.

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X-RAYS

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Origin of X-rays

On November 8, 1895, German physics professor Wilhelm Röntgen stumbled on X-rays while experimenting with Lenard tubes and Crookes tubes and began studying them. He wrote an initial report "On a new kind of ray: A preliminary communication" and on December 28, 1895 submitted it to Würzburg's Physical-Medical Society journal. This was the first paper written on X-rays. Röntgen referred to the radiation as "X", to indicate that it was an unknown type of radiation. The name stuck, although (over Röntgen's great objections) many of his colleagues suggested calling them Röntgen rays.

X-rays were discovered by the scientist Roentgen in the year 1895.

While performing the experiment to study cathode rays he found photographic plate get affected by unknown highly penetrating radiation. Photographic plates were blackened due to these unknown radiations. These rays were unknown so named as X-rays.

Origin “When high velocity cathode rays strike a target, these rays penetrates into an atom of target and collides with the electrons in the inner shells of atom. After collision electrons knocked out of the atom. Electrons from outer shell jumps into this vacancy and radiations in the form of X-rays are given out.”

X-rays: (Definition): X-rays are electromagnetic radiations, which having very short wavelength in range of 10-10m to 10-11m

Range of X-rays: wavelength of X-ray :- 10-10m to 10-11m

Minimum wavelength of X-rays

For a given potential difference, X-rays produced has different wavelength, but there is certain minimum value of wavelength.

Definition: **“For a given potential, wavelength of X-rays cannot be less than certain minimum value called as minimum wavelength of X-ray (λmin)”**

where h = Planck's constant = 6.63 x 10-34Js

c = speed of light = 3 x 108m/s

e = charge on electron = 1.6 x 10-19C

V = applied voltage

If the values of h, c, e are substituted then,

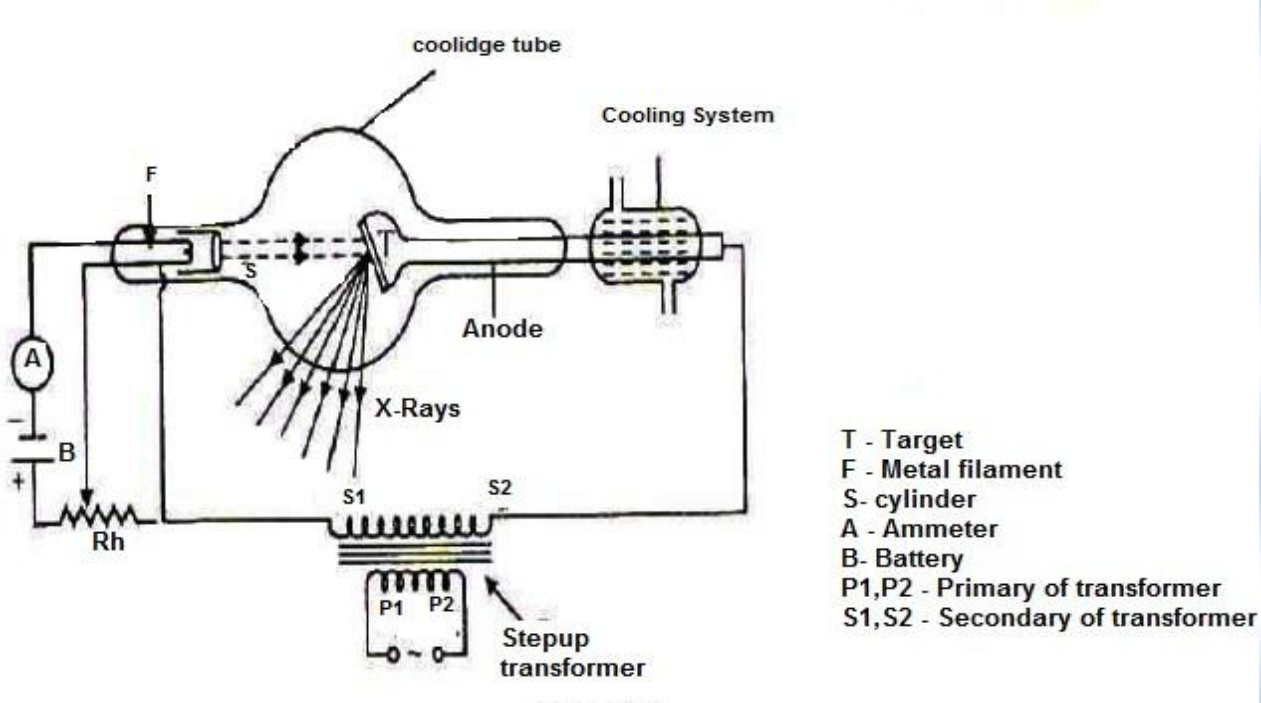
$\lambda min = \frac{12400 \times 10\text{-}10 \ldots\ldots \text{in meter}}{V}$

$\lambda min = \frac{12400 \ldots\ldots \text{in Ao}}{V}$

Production of X-rays using Coolidge's X-ray tube,

Principle: When fast moving electrons are suddenly stopped then X- rays are produced.

Diagram :



Construction: Coolidge's tube consists of highly evacuated hard glass bulb with cathode filament and anode. The cathode i.e. metal filament is surrounded by metal cylinder kept at –ve potential to the filament. The target T consist of copper block in which a piece of tungsten is fitted. The target is placed at angle 45o with the path of electron beam

Working:

When the cathode is heated by electric current it produced electron due to thermionic emissions. The beam of electron is then focused on the anode (target). The electrons from cathode are accelerated by applying of high voltage between cathode & anode using step up transformer. When these fast moving electrons are suddenly stopped by tungsten anode, they lose their kinetic energy and x rays are produced from the target. Some amount of Kinetic energy is converted to large amount of heat.

By controlling the filament current, the thermionic emission of electron hence intensity of X- rays can be controlled

Properties of X-rays:

They are electromagnetic waves of very short wavelength

They travel with speed of light.

They affect photographic plates.

They produce fluorescence in many substances.

They can be reflected or refracted under certain conditions.

They are not deflected by magnetic or electric field.

They have high penetrating power.

They produce photoelectric effect.

They are invisible to eyes.

X-ray kills some form of animal cell.

Applications of X-Rays

I) Engineering Applications

1. X- rays are used to detect the cracks in the body of aero plane
2. X- Rays are used to detect the manufacturing defects in rubber tyres
3. X – rays are used to detect flows or cracks in metal jobs

X- Rays are used to distinguish real diamond from duplicate one.

X- Rays are used to detect smuggling gold at airport and docks (ship) yard.

X-rays are used to detect cracks in the wall.

X- Ray radiography is used to check the quality of welded joints.

Scientific Applications

X-rays are used to study structure of crystal.

They are used in a chemical analysis.

They are used to study structure of rubber, plastic, cellulose.

They are used for analysis of structure of organic molecules.

Medical Applications

X – Rays are used in surgery to detect bone fractured.

X- Rays are used to cure skin diseases and destroy tumors.

X – Rays are used to cure diseases like cancer.

X – Rays are used to detect bullets position inside the body.

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Black Smithy

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A blacksmith is a metal smith who creates objects from wrought iron or steel by forging the metal, using tools to hammer, bend, and cut (cf. whitesmith).

Black-smithy is, therefore, a. process by which metal may be heated and shaped to its requirements by the use of blacksmith tools either. by hand or power hammer.

Basic Blacksmithing Tools :

- The Forge. A forge is a fire or a type of hearth, and it is where you heat your work. ...
- The Anvil.
- The Hammers.
- The Tongs.
- Vice or Clamps.

Blacksmiths still exist :

Iron was the metal early **blacksmiths** used, but steel is more common in the 2000s. ... Although most **blacksmiths** now work with steel, the product is **still** called wrought ironwork, according to **blacksmith** Simon Grant-Jones on his website

Need for blacksmith Operation:

Depending on the type of blacksmithing, this job could include:

- working with a forge or furnace.
- using traditional hand tools, such as hammers, punches and tongs or anvils.
- using power tools, such as power hammers, drills, grinders, air chisels and hydraulic presses

Tools used For blacksmiths-

Blacksmiths work by heating pieces of wrought iron or steel until the metal becomes soft enough for shaping with hand tools, such as a **hammer**, **anvil** and **chisel**. Heating generally takes place in a forge fueled by propane, natural gas, coal, charcoal, coke or oil.

Black smithy needed for education :

Few colleges offer a bachelor's or master's degree in blacksmithing or metal smithing, but there are a number of trade or vocational schools that offer courses which can help an **aspiring** blacksmith with training and provide basic **introductory** information like the history of the trade, basic terminology, and introduction ..

Blacksmiths makes :

A blacksmith is a person who works with iron and steel. The blacksmith hammers hot iron on an anvil to **change** its shape. Blacksmiths make iron and steel tools. A smith is a person who works in metal.

Blacksmiths are in the world:

There are between **5,000** and **10,000 blacksmiths** in the U.S., and of those, only about 10 percent do it professionally — they make things like custom railings or artistic hardware for homes

Blacksmith's shop:

Blacksmith, also **called** smith, craftsman who fabricates objects out of iron by hot and cold forging on an anvil. **Blacksmiths** who specialized in the forging of shoes for horses were **called** farriers. The term **blacksmith** derives from iron, formerly **called** “black metal,” and farrier from the Latin ferrum, “iron.

Different hammers used for blacksmithy:

Aluminum Hammers – These are **soft** faced hammers that are used for molding metal without damaging the surface being molded. Blocking Hammers – Used for shaping metal on a block or **anvil**. Copper and Hide Hammers – This hammer's head has copper at one end and rawhide at the other

Blacksmiths wear:

Cotton work clothes, close fitting at neck and sleeves with no cuffs. Pants over boot tops. Clothing in good repair: no frayed edges that could catch a spark and ignite. A **leather apron** is handy to spare the clothes (often clothing turns black in color).

Blacksmiths make in the 1700s

Horseshoes were the most important thing to make for the blacksmith. They made tools for farmers like **shovels** and nails. They made stuff for life in their homes like door knobs and hooks. They were more important in the **revolutionary** war because they made cannons,guns and knives.

Blacksmiths make weapons:

A variety of **weapons** and instruments **made** by a medieval **blacksmith** included **swords** and daggers, door nails and knobs, locks and keys, knives, horseshoes, amours and arrowheads, and others

Importants of Blacksmith:

Medieval **blacksmiths** were **important** in the community because they provided people with a variety of metal tools. They fabricated weapons for war and constructed household items. **Blacksmiths** not only created these tools by molding raw metals, but they also repaired and maintained them.

Blacksmith gets his name:

Iron is one of the common materials that **blacksmiths** forge, and when it is heated it turns black providing the first part of the **name**. There are various sources that describe the origination of the second part of the **name**, but generally it's believed to come from the word 'smite', which means 'to hit'

Blacksmiths still exist:

Iron was the metal early **blacksmiths** used, but steel is more common in the 2000s. Although most **blacksmiths** now work with steel, the product is **still** called wrought ironwork, according to **blacksmith** Simon Grant-Jones on his website

Blacksmiths work:

A Blacksmith forge is a workplace where metal is worked by a blacksmith by heating and hammering via a furnace consisting of a special hearth where metal is **heated** before shaping The name of a forge was also referred to as a a smithy

Need to be a blacksmiths:

Depending on the type of blacksmithing, this job could include:

- working with a forge or furnace.
- using traditional hand tools, such as hammers, punches and tongs or anvils.
- using power tools, such as power hammers, drills, grinders, air chisels and hydraulic presses.

Blade smith :

Blade smithing is the art of making knives, swords, daggers and other blades using a forge, hammer, anvil, and other smithing tools. **Blade smiths** employ a variety of metalworking techniques similar to those used by blacksmiths, as well as woodworking for knife and sword handles, and often leatherworking for sheaths

Uses of hammers :

A hammer is a handheld tool used to strike another object. It consists of a handle to which is attached a heavy head, usually made of metal, with one or more striking surfaces. There are dozens of different types of hammers. The most common is a **claw hammer**, which is used to drive and pull nails.

Difference between a blacksmith and a Blade smith :

As nouns the **difference between blade smith** and **blacksmith**. is that **blade smith** is a maker of knives and swords while **blacksmith** is a person who forges iron.

Kind of Hammers used for blacksmith :

The **hardy** is a **chisel** designed to fit the tool hole in the anvil. It is used with a hand hammer for cutting both hot and cold metal. The blacksmith uses many different types and styles of tongs.

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RO PLANT

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Reverse osmosis is a way to get clean water out of dirty water or salt water by forcing water under pressure through a membrane. A process by which a solvent such as water is purified of solutes by being forced through a semipermeable membrane through which the solvent, but not the solutes, can pass. Reverse osmosis (RO) is a water purification technology that uses a partially permeable membrane to remove ions, molecules and larger particles from drinking water. In reverse osmosis, an applied pressure is used to overcome osmotic pressure, a colligative property, that is driven by chemical potential differences of the solvent, a thermodynamic parameter. Reverse osmosis can remove many types of dissolved and suspended chemical species as well as biological ones (principally bacteria) from water, and is used in both industrial processes and the production of potable water. The result is that the solute is retained on the pressurized side of the membrane and the pure solvent is allowed to pass to the other side. To be "selective", this membrane should not allow large molecules or ions through the pores (holes), but should allow smaller components of the solution (such as solvent molecules, i.e., water, H2O) to pass freely.

In the normal osmosis process, the solvent naturally moves from an area of low solute concentration (high water potential), through a membrane, to an area of high solute concentration (low water potential). The driving force for the movement of the solvent is the reduction in the free energy of the system when the difference in solvent concentration on either side of a membrane is reduced, generating osmotic pressure due to the solvent moving into the more concentrated solution. Applying an external pressure to reverse the natural flow of pure solvent, thus, is reverse osmosis. The process is similar to other membrane technology applications.

Reverse osmosis differs from filtration in that the mechanism of fluid flow is by osmosis across a membrane. The predominant removal mechanism in membrane filtration is straining, or size exclusion, where the pores are 0.01 micrometers or larger, so the process can theoretically achieve perfect efficiency regardless of parameters such as the solution's pressure and concentration. Reverse osmosis instead involves solvent diffusion across a membrane that is either nonporous or uses nan filtration with pores 0.001 micrometers in size. The predominant removal mechanism is from differences in solubility or diffusivity, and the process is dependent on pressure, solute concentration, and other conditions.[2] Reverse osmosis is most commonly known

for its use in drinking water purification from seawater, removing the salt and other effluent materials from the water molecules.

BRIEF INTRODUCTION

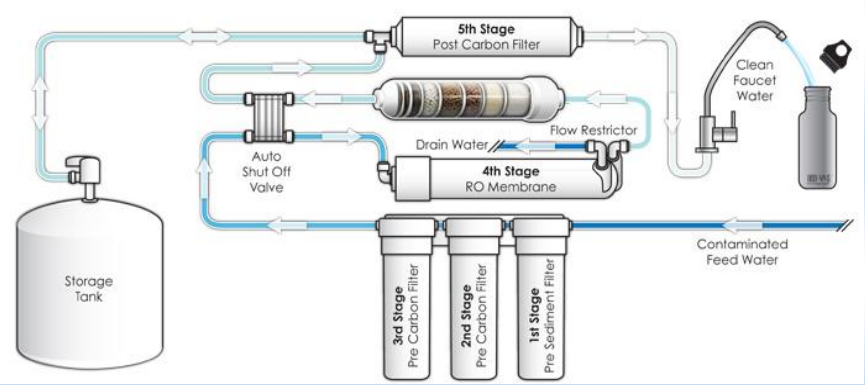
A process of osmosis through semipermeable membranes was first observed in 1748 by Jean-Antoine Knolled. For the following 200 years, osmosis was only a phenomenon observed in the laboratory. In 1950, the University of California at Los Angeles first investigated desalination of seawater using semipermeable membranes. Researchers from both University of California at Los Angeles and the University of Florida successfully produced fresh water from seawater in the mid-1950s, but the flux was too low to be commercially viable until the discovery at University of California at Los Angeles by Sidney Loeb and Srinivasan at the National Research Council of Canada, Ottawa, of techniques for making asymmetric membranes characterized by an effectively thin "skin" layer supported atop a highly porous and much thicker substrate region of the membrane. John Cadott, of Film Tec, discovered that membranes with particularly high flux and low salt passage could be made by interfacial polymerization of m-phenylene demine and trimesoyl chloride. Cadott's patent on this process was the subject of litigation and has since expired. Almost all commercial reverse-osmosis membrane is now made by this method.

Reverse osmosis production train, North Cape Coral Reverse Osmosis Plant

In 1977 Cape Coral, Florida became the first municipality in the United States to use the RO process on a large scale with an initial operating capacity of 11.35 million liters (3 million US gal) per day. By 1985, due to the rapid growth in population of Cape Coral, the city had the largest low-pressure reverse-osmosis plant in the world, capable of producing 56.8 million liters (15 million US gal) per day (MGD).

Formally, reverse osmosis is the process of forcing a solvent from a region of high solute concentration through a semipermeable membrane to a region of low-solute concentration by applying a pressure in excess of the osmotic pressure. The largest and most important application of reverse osmosis is the separation of pure water from seawater and brackish waters

Drinking water purification



Around the world, household drinking water purification systems, including a reverse osmosis step, are commonly used for improving water for drinking and cooking.

Such systems typically include a number of steps:

A sediment filter to trap particles, including rust and calcium carbonate optionally, a second sediment filter with smaller pores an activated carbon filter to trap organic chemicals and chlorine, which will attack and degrade a thin film composite membrane a reverse osmosis filter, which is a thin film composite membrane optionally, a second carbon filter to capture those chemicals not removed by the reverse osmosis membrane optionally an ultraviolet lamp for sterilizing any microbes that may escape filtering by the reverse osmosis membrane

In some systems, the carbon profiler is omitted, and a cellulose triacetate membrane is used. CTA (cellulose triacetate) is a paper by-product membrane bonded to a synthetic layer and is made to allow contact with chlorine in the water. These require a small amount of chlorine in the water source to prevent bacteria from forming on it. The typical rejection rate for CTA membranes is 85–95%.

The cellulose triacetate membrane is prone to rotting unless protected by chlorinated water, while the thin film composite membrane is prone to breaking down under the influence of

chlorine. A thin film composite (TFC) membrane is made of synthetic material, and requires chlorine to be removed before the water enters the membrane. To protect the TFC membrane elements from chlorine damage, carbon filters are used as pre-treatment in all residential reverse osmosis systems. TFC membranes have a higher rejection rate of 95–98% and a longer life than CTA membranes.

Portable reverse osmosis water processors are sold for personal water purification in various locations. To work effectively, the water feeding to these units should be under some pressure (280 KPA (40 psi) or greater is the norm).]Portable reverse osmosis water processors can be used by people who live in rural areas without clean water, far away from the city's water pipes. Rural people filter river or ocean water themselves, as the device is easy to use (saline water may need special membranes). Some travelers on long boating, fishing, or island camping trips, or in countries where the local water supply is polluted or substandard, use reverse osmosis water processors coupled with one or more ultraviolet sterilizers.

In the production of bottled mineral water, the water passes through a reverse osmosis water processor to remove pollutants and microorganisms. In European countries, though, such processing of natural mineral water (as defined by a European) is not allowed under European law. In practice, a fraction of the living bacteria can and do pass through reverse osmosis membranes through minor imperfections, or bypass the membrane entirely through tiny leaks in surrounding seals. Thus, complete reverse osmosis systems may include additional water treatment stages that use ultraviolet light or ozone to prevent microbiological contamination.

Membrane pore sizes can vary from 0.1 to 5,000 nm depending on filter type. Particle filtration removes particles of 1 µm or larger. Microfiltration removes particles of 50 nm or larger. Ultrafiltration removes particles of roughly 3 nm or larger. Nan filtration removes particles of 1 nm or larger. Reverse osmosis is in the final category of membrane filtration, hyper filtration, and removes particles larger than 0.1 nm.

Applications:-

Military use: the reverse osmosis water purification unit

Food industry

Maple syrup production

Maple syrup production

Hydrogen production

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GEARS

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Classification of gears can be done according to the relative position of the axes of revolution into three types. They are:

Gears for Parallel shafts

1.1 Spur Gears

1.2 Helical Gears

1.3 Herringbone Gears

Rack and Pinion

Gears for Intersecting Shafts

2.1 Straight Bevel Gears

Spiral Bevel Gears

Gears for Skew Shafts

3.1 Hypoid Gears

3.2 Worm Gears

Classification about these types of gears discussed below.

1. Gears for Parallel Shafts:

The motion between parallel shafts is same as to the rolling of two cylinders. Gears under this category are the following:

1.1 Spur Gears:

Straight Spur gears are the simplest form of gears having teeth parallel to the gear axis. The contact of two teeth takes place over the entire width along a line parallel to the axes of rotation.

As gear rotate , the line of contact goes on shifting parallel to the shaft.

1.2 Helical Gears:

In helical gear teeth are part of helix instead of straight across the gear parallel to the axis. The mating gears will have same helix angle but in opposite direction for proper mating. As the gear rotates, the contact shifts along the line of contact in in volute helicoid across the teeth.

1.3. Herringbone Gears:

Herringbone gears are also known as Double Helical Gears. Herringbone gears are made of two helical gears with opposite helix angles, which can be up to 45 degrees.

1.4. Rack and Pinion:

In these gears the spur rack can be considered to be spur gear of infinite pitch radius with its axis of rotation placed at infinity parallel to that of pinion. The pinion rotates while the rack translates.

2. Gears for Intersecting Shafts:

The motion between two intersecting shafts is equivalent to the rolling of two cones. The gears used for intersecting shafts are called bevel gears. Gears under this category are following:

2.1 Straight Bevel Gears:

Straight bevel gears are provided with straight teeth, radial to the point of intersection of the shaft axes and vary in cross section through the length inside generator of the cone. Straight Bevel Gears can be seen as modified version of straight spur gears in which teeth are made in conical direction instead of parallel to axis.

2.2 Spiral Bevel Gears:

Bevel gears are made with their teeth are inclined at an angle to face of the bevel. Spiral gears are also known as helical bevels.

3. Gears for Skew Shafts:

The following gears are used to join two non-parallel and non-intersecting shafts.

3.1 Hypoid Gears:

The Hypoid Gears are made of the frusta of hyperboloids of revolution. Two matching hypoid gears are made by revolving the same line of contact, these gears are not interchangeable.

3.2 Worm Gears:

The Worm Gears are used to connect skewed shafts, but not necessarily at right angles. Teeth on worm gear are cut continuously like the threads on a screw. The gear meshing with the worm gear is known as worm wheel and combination is known as worm and worm wheel.

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FORCED RINGS

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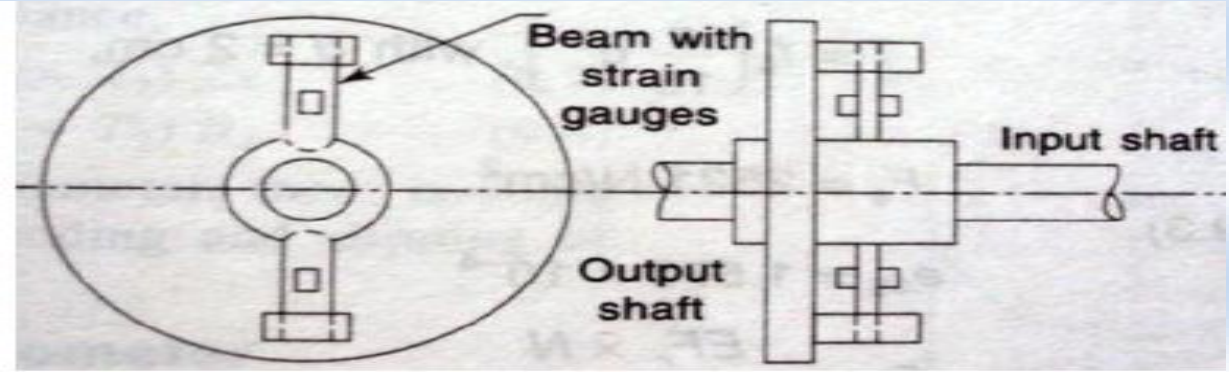

The principle involved in transmission dynamometer is that the power being transmitted either to or from the dynamometer is not absorbed or dissipated. The power after measurement is available in useful mechanical or electrical means. However, a small power is dissipated on account of friction.

Strain gauge transmission dynamometer is used to measure bending strains rather than strains due to torque at 450 and so an arrangement using beams (as shown in fig.) may be employed, in which the transmitted torque results in bending the beams.

The strain gauge transmission dynamometer utilizes the bonded strain gauges which are applied to a section of torque transmission shaft. This is inline rotating torque sensor which measures torque. This dynamometer is used as a coupling between driving machine and driven machine or between any two portions of the machine. Here strain gauges are fitted at 45˚ to shaft axis as shown in fig. In this type of arrangement, 2 strain gauges are subjected to tensile stress and while other is subjected to compressive stress. Strain gauge 1 & 3 must be diametrically opposite to strain gauge 2 & 4.Due to torsion, strain gauge senses compressive as well as tensile formation. Further these strain gauges are connected to Wheatstone circuit. the output of Wheatstone bridge is proportional to torsion and hence to applied torque on shaft. The bridge power and output of bridge is connected to the sensor through slip ring and brushes .

Advantages:

1) It is sensitive to torque.

2) it gives an instantaneous results.

3) it has full temperature compensation

4) it provides automatic compensation for bending and axial loads

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FLOOR CLEANING MACHINE

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Now a days there is lot of competition in the market so there is need of developing the new method or process for manufacturing that method or process should fulfill the requirement about accuracy and productivity etc.

It is necessary to reduce the total machining time. There are various way by which the total machining time can be effectively minimised. there are various time consuming steps or sub process which can be minimised by various methods. In mass production the time limit , a single unit job has to be attached the time factor is very important . it has to be completed for minimising the job time. the handling of job should be minimum so that labour time considerabely saved.

The project deal with the automated system consisting removes dust and dirty component on road by using road cleaner. India is a big s\country interned as the geographical expenses size and population. There is need to utilization man power in better ways especially on villages. In current year we Indian face biggest crisis in the shortage of energy and lot of crises of energy mostly in the village. ever since the industrial revolution. Human have depend on external source of energy. i.e. Electricity, Fuels (kerosine, petrol, disel, etc).

So we have to developed a new concept for energy saving techniques.

Plan is aimed to achieved economy through latest energy saving technology and innovation. The capital investment ar4e required to be studied thoroughly while finalizing the long term action plan. Construction of energy is using energy more efficiently by substituting time continence labor and capital for effective optimization of cost energy today has become an indispensable component of industrial production.

In our project there is a very simple mechanism is used and it switching over to new technologies where possible the governing principles for energy conservation emphasis on maximum conservation of efficiency and maximum cost effectiveness in energy usage.

The project report on a development of a journey level work involved in the specialized operation equipment utilized in the construction maintenance and repair of county maintained roads and property. This is the advance journey level class in the road maintenance worker series. Positions at this level are distinguished from other classes within the series by the complexity of

duties assigned and the effective operation of equipment with specialization operation of specific prise of heavy equipment.

In our project unskilled, semiskilled and skilled work in the city and country streets division. It is totally manually operated so a people who have looked at new machines as both a threat and blessing the threat is that new technique would that becomes conscious and act there own violation the blessing is that our machines could accomplished many repetitive task for us.

CONSTRUCTION & WORKING

Our project is a new approach to improve the effectiveness and flexibility of mechanical system as a whole low cost mechanization may be alternative solution for small scale industries to develop the new process. This is too much advantage in the industries having less running capital. This low cost mechanism may take less time to design manufacture and implement as compared to high cost mechanism.

Our machine consist of a structure in which gear mechanism is used. The machine consist of basically manually operated and also it can operated on motor. Quality and productivity along with job satisfaction can be increased by process management. To achieve the optimum level of productivity. workforce is of almost importance.

In structure of machine the gear mechanism is used to move scrubber and it used for cleaning purpose. The mechanical power produced by prime over ew used to drive various machines in the workshop and factories. A transmission is the mechanism which deals with the transmission of the power and motion from prime mover to shaft or from one shaft to another.

The whole machine consist of main part is SCRUBBER. It is the main hand of machine. In our project for giving the motion to scrubber. We use the gear mechanism. The gear operated forward and reverse direction. The mechanical power is transmitted to gear to scrubber.

A transmission system is the mechanism which deals with transmission to operative element to provide a operative working motion when required motion is rotary the transmission is takes place through mechanism that transfer rotary motion to another.

Our project require little investment to achieve efficiency improvement through modification of existing equipment and other operation.

The operation os trouble free due to better construction material of the component and their metallurgical control. The project require less space for installation the manufacturing and designing suitable machining for its operating. The Automatic Road Cleaner should be such that its

operation should be simple it should be work with minimum work input.

In our project, first we look frame as same as hand trolley which is utilized in construction of buildings as conveying purpose. On the frame we constructed a gear mechanism. When we moving a frame the wheel shaft is rotating on wheel shaft we mount a spur gear.

The wheel rotary motion is directly transmitted to another shaft on which scrubber is attached. This scrubber is clean the road. The dirty dust and small pollutants particles are collected in dustbin.

This has led to new set of goal for this new kind of project course one of the important goals remain this development of usual facts but it is no longer the major one more importance i.e. on increased understand intelligent behaviors.

A set of of design principles as a theoretical frame work for understanding intelligence scheme desirable for number of reasons first at least at the movement there do not seen to any real alternatives.

In our project transmission is more important part and it is necessary is to work noisy. The basic principle that has to be taken into account for the attachment on machine is the conversion of rotary motion into intermitted motion. The gear transmission gives higher accuracy. In this two shaft as said above, attached laterally both parallel to each other. Because of this machine gives high efficient work and easy to handle.

WORKING

1 Field Of Invension.

This invention is related to an apparatus and a method for automatically cleaning a road and more particularly to an important.

2 The Background Art.

This is the advance journey level class in the road maintenance works series. Positions at this level or distinguished from other classes within the series by the complexity of duties assigned and the effective operation of variety of heavy equipment.

Positions are generally filled by the advancement by the road maintenance worker level with appraise on the job training of the operation and utilization of heavy equipment or when filled from outside requires prior heavy equipment operation experience.

3 Condition of work.

Work is subject to varying post or job side assignment and may be subjected to call back. Work is also subject to travelling and performing work assignment in outline or remote areas of the county involving exposure to varying whether condition which:-

4 Desirable abilities of worker

Use and core of equipment tools and material used in road construction.

Safe and effective operation and servicing of light to heavy equipment.

Effectively service maintain and operate equipment in accordance with standard operating and safely procedures.

Oversee the activities of subordinates included assigning and directing task and determining best course of action.

The working is mainly divided into types.

1 Supporting frame.

2 Spur gear mechanism.

3 Scrubber operation.

4 Collection of dust.

1. Supporting frame.

As mentioned in the constructional parts, if it necessary to provide a better support to moving parts.

2. Spur gear mechanism.

This type is one of the most common effective device transmitting motion and power from one shaft to other by means of the intersible gear. The spur gear which have its own properly of transmission. There will be 100% positive transmission is possible without slip.

3. Scrubber operation.

Scrubber is the main heart of the machine. The various types of standard scrubber are available in market. Product design is now not confined to few creative artists, can be learned by systematic study. Fortier stress was laid on design as a synthesis of stress analysis, theory of mechanism and machines and other subject like machine design and dynamic of machinery. But current approach is to expose the student is encovared to

solve real problem with various optimization tools.

4. Collection of dust.

The neat dust collection is the main part of the machine & project.in the machine the dust is collected in dustbin which is placed or attached to the bottom frame. The dustbin is removoveable part of machine means when the dustbin is full of dust or particles we can remove it and again place it.

Advantage

1 Total body is simple in construction.

2 So it having long life and less maintenance.

3 The moving part are tempered properly to reduce wear and tear by friction It has smooth operation and not required any human effort.

4 It has minimum economic input.

5 Works on the well-known economic and business principal.

6 Not require external power supply.

7 ensuring long and smooth working.

Disdvantage

1 It is necessary to know any disturbance in the time of cleaning.

2 Because of water on surface of road we cannot clean out road properly and it may get some damage to scrubber.

Application

1 it is mainly used in city area.

2 In hospital areas it is very useful for cleaning.

3 On city road we can use to reduce man power working on road.

4 We can use as conveying machine as per applications.

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POTENTIOMETER

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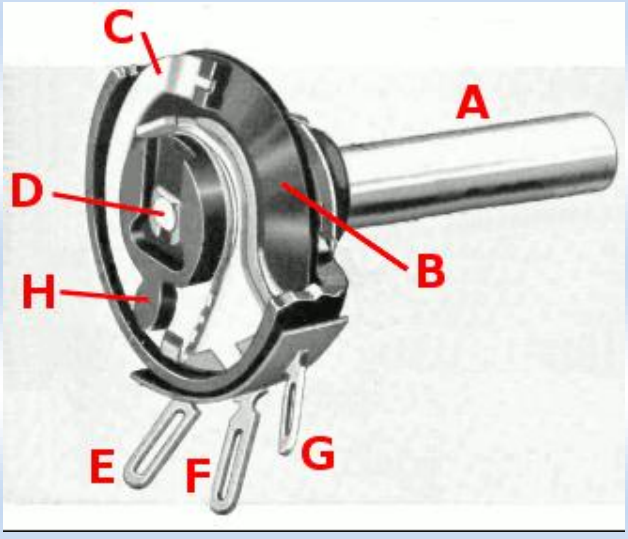
A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat.

The measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name.

Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick. Potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load.

Construction:



The labeled parts are:

A. Shaft

B. Stationary carbon composition resistance element

C. Springy phosphor bronze wiper that rides along resistance element

D. Shaft attached to wiper

E, G Terminals connected to ends of resistance element

F. Terminal connected to wiper

H. Cam that operates on-off switch, if one is included in potentiometer

Potentiometers consist of a resistive element, a sliding contact (wiper) that moves along the element, making good electrical contact with one part of it, electrical terminals at each end of the element, a mechanism that moves the wiper from one end to the other, and a housing containing the element and wiper.

Many inexpensive potentiometers are constructed with a resistive element (B) formed into an arc of a circle usually a little less than a full turn and a wiper (C) sliding on this element when rotated, making electrical contact. The resistive element can be flat or angled. Each end of the resistive element is connected to a terminal (E, G) on the case. The wiper is connected to a third terminal (F), usually between the other two. On panel potentiometers, the wiper is usually the center terminal of three. For single-turn potentiometers, this wiper typically travels just under one revolution around the contact. The only point of ingress for contamination is the narrow space between the shaft and the housing it rotates in.

Another type is the linear slider potentiometer, which has a wiper which slides along a linear element instead of rotating. Contamination can potentially enter anywhere along the slot the slider moves in, making effective sealing more difficult and compromising long-term reliability. An advantage of the slider potentiometer is that the slider position gives a visual indication of its setting. While the setting of a rotary potentiometer can be seen by the position of a marking on the knob, an array of sliders can give a visual impression of, for example, the effect of a multi-band equalizer (hence the term "graphic equalizer").

The resistive element of inexpensive potentiometers is often made of graphite. Other materials used include resistance wire, carbon particles in plastic, and a ceramic/metal mixture called cermet. Conductive track potentiometers use conductive polymer resistor pastes that contain hard-wearing resins and polymers, solvents, and lubricant, in addition to the carbon that provides the conductive properties.

Multiturn potentiometers are also operated by rotating a shaft, but by several turns rather than less than a full turn. Some multiturn potentiometers have a linear resistive element with a

sliding contact moved by a lead screw; others have a helical resistive element and a wiper that turns through 10, 20, or more complete revolutions, moving along the helix as it rotates. Multiturn potentiometers, both user-accessible and preset, allow finer adjustments; rotation through the same angle changes the setting by typically a tenth as much as for a simple rotary potentiometer.

A string potentiometer is a multi-turn potentiometer operated by an attached reel of wire turning against a spring, enabling it to convert linear position to a variable resistance.

User-accessible rotary potentiometers can be fitted with a switch which operates usually at the anti-clockwise extreme of rotation. Before digital electronics became the norm such a component was used to allow radio and television receivers and other equipment to be switched on at minimum volume with an audible click, then the volume increased, by turning a knob. Multiple resistance elements can be ganged together with their sliding contacts on the same shaft, for example, in stereo audio amplifiers for volume control. In other applications, such as domestic light dimmers, the normal usage pattern is best satisfied if the potentiometer remains set at its current position, so the switch is operated by a push action, alternately on and off, by axial presses of the knob.

Others are enclosed within the equipment and are intended to be adjusted to calibrate equipment during manufacture or repair, and not otherwise touched. They are usually physically much smaller than user-accessible potentiometers, and may need to be operated by a screwdriver rather than having a knob. They are usually called "preset potentiometers" or "trim[ming] pots". Some presets are accessible by a small screwdriver poked through a hole in the case to allow servicing without dismantling.

Applications

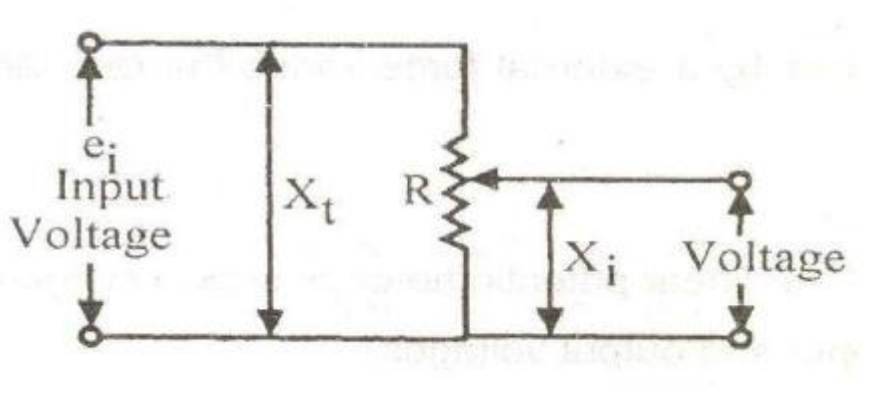
Potentiometers are rarely used to directly control significant amounts of power (more than a watt or so). Instead they are used to adjust the level of analog signals (for example volume controls on audio equipment), and as control inputs for electronic circuits. For example, a light dimmer uses a potentiometer to control the switching of a TRIAC and so indirectly to control the brightness of lamps.

Preset potentiometers are widely used throughout electronics wherever adjustments must be made during manufacturing or servicing.

User-actuated potentiometers are widely used as user controls, and may control a very wide variety of equipment functions. The widespread use of potentiometers in consumer electronics

declined in the 1990s, with rotary encoders, up/down push-buttons, and other digital controls now more common. However they remain in many applications, such as volume controls and as position sensors.

Working principle:



Basically a resistance potentiometer consists of resistance element providing with a sliding contact. The sliding contact is known as wiper. The motion of the sliding contact may be translatory or rotational. Some have a combination of both motions with resistive element in the form of helix so called heliport.

Application:

Potentiometer is passive transducer since it requires external power source for its operation. It is used for linear or rotary displacement measurement.

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LOAD CELLS

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A load cell is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the forcebeing measured. The various load cell types include hydraulic, pneumatic, and strain gauge.

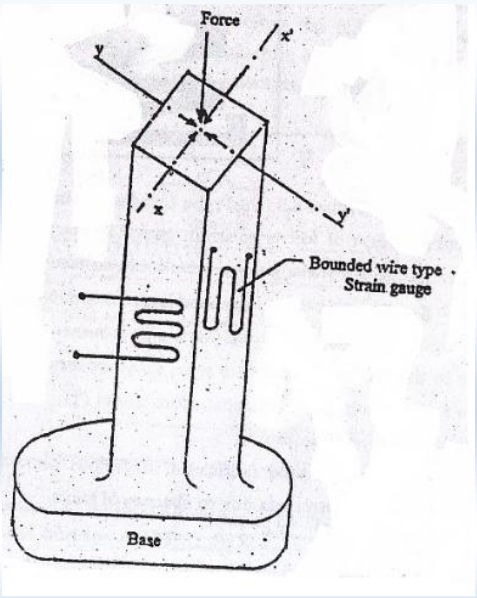
Strain Gauge Load Cell

Strain gauge load cells are the most common in industry. These load cells are particularly stiff, have very good resonance values, and tend to have long life cycles in application. Strain gauge load cells work on the principle that the strain gauge(a planar resistor) deforms when the material of the load cells deforms appropriately. Deformation of the strain gauge changes its electrical resistance, by an amount that is proportional to the strain. The change in resistance of the strain gauge provides an electrical value change that is calibrated to the load placed on the load cell.

A load cell usually consists of four strain gauges in a Wheatstone bridge configuration. Load cells of one strain gauge (quarter bridge) or two strain gauges (half bridge) are also available. The electrical signal output is typically in the order of a few millivolts (mV) and requires amplification by an instrumentation amplifier before it can be used. The output of the transducer can be scaled to calculate the force applied to the transducer. Sometimes a high resolution ADC, typically 24-bit, can be used directly.

The gauges themselves are bonded onto a beam or structural member that deforms when weight is applied. In most cases, four strain gauges are used to obtain maximum sensitivity and temperature compensation. Two of the gauges are usually in tension can be represented as T1 and T2,and two in compression can be represented as C1 and C2, and are wired with compensation adjustments. The strain gauge load cell is fundamentally a spring optimized for strain measurement. Gauges are mounted in areas that exhibit strain in compression or tension. When weight is applied to the load cell, gauges C1 and C2 compress decreasing their resistances. Simultaneously, gauges T1 and T2 are stretched increasing their resistances. The change in resistances causes more current to flow through C1 and C2 and less current to flow through T1 and T2. Thus a potential difference is felt between the output or signal leads of the load cell. The

gauges are mounted in a differential bridge to enhance measurement accuracy. When weight is applied, the strain changes the electrical resistance of the gauges in proportion to the load. Other load cells are fading into obscurity, as strain gauge load cells continue to increase their accuracy and lower their unit costs.



Load cell is application of wire type bonded strain gauge. It works on the principle of the elasticity i.e. when axial force is applied, its column gets compressed and when force is released it regain its original position .Four wire type bonded strain gauges are cemented on the column of load cell as shown in fig such that gauges along x-x are cemented in horizontal position where as along y-y in vertical position. The resistance offered by each gauge is same in magnitude. Gauges are connected to form Wheatstone bridge network. When axial force applied is zero then the resistance of each gauge is equal in magnitude, which keep bridge in balance condition and deflection shown by detector is zero. When the axial force applied is zero then the resistance of each gauge is equal in magnitude, which keep bridge in balance condition and deflection shown by detector is zero. When the axial force to be measured & resulting strain is applied on load cell then its column gets compressed. The compression of column causes decrease in resistance of strain gauge along y-y and remains unaffected along x-x.

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Wood Materials Used For the Mechanical Engineering Applications

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Wood is a porous and fibrous structural tissue found in the stems and roots of trees and other woody plants. It is an organic material, a natural composite of cellulose fibers that are strong in tension and embedded in a matrix of lignin that resists compression.

Types of Wood

Soft Wood

1.Pine:

Pine is a soft, white or light yellow wood which is light in weight, straight grained. It resists shrinkage, swelling and warping. In India, it is grown in the western Himalayas.

- **Uses:**

It is used in all kind of furniture, both indoor as well as outdoor. It is also used to make patterns, door and window frames and paving materials. Knotty pine is often used for decorative effect.

02. Ash:

Ash is a hard, heavy, ring porous wood. It has a prominent grain that looks like oak, and a white to light brown color.

- **Uses:**

Ash is widely used for structural frames and steam bent furniture pieces. It is often less expensive than other comparable hardwood.

03. Beech:

- Beech is a hard, strong and heavy wood with tiny pores. This relatively inexpensive wood has reddish brown heartwood and light sapwood.

- **Uses:**

Beech is often used for frames, a variety of bent and turned parts. Quarter sliced and half round cut beech veneers are commonly used.

04. Cedar:

Cedar is knotty softwood which has a red-brown colour with light streaks. Its texture is uniform and it is highly resistant to decay and insects. It is grown in Kashmir and Assam.

- **Uses:**

It is a popular wood for lining drawers, chests and boxes. Simple cases and storage closets are also constructed from this wood.

05. Fir:

Fir works easy and finishes well. It is uniform in texture and non-resinous. It has low resistance to decay. In India, it is found in Himachal Pradesh.

- **Uses:**

It is used for furniture, doors, frames, windows, plywood, veneer, general millwork and interior trim.

05. Spruce:

Spruce is strong and hard. It finishes well and has low resistance to decay. It has a moderate shrinkage and is light in weight. In India, it is found in Western Himalaya and Sikkim.

- **Uses:**

It is used for masts and spars for ships, aircraft, crates, boxes, general millwork and ladders.

06. Hemlock:

It is light in weight, uniformly textured. It machines well and has low resistance to decay and non-resinous. It is most commonly found in America.

- **Uses:**

It is used in the construction of lumber, planks, doors, boards, sub flooring and crates.

Hardwood:

Hardwood is a deciduous tree that has broad leaves, produce a fruit or nut and generally inactive in the winter. Here we give you different types of hardwood:

07. Teakwood:

Teakwood is the most popular type of hardwood. It is yellow to dark brown in color which is extremely heavy, strong, durable, weather resistant, warp resistant and does not decay. Often strongly figured, teak may show straight grain pattern. It is generally found in central and southern India. It is popularly used as structural wood for wooden framed house, and also for door, window, partition, etc.

- **Uses:**

It is an excellent choice for outdoor furniture like garden benches and lounge chairs. In Indoor furniture, it is used in beds and wardrobes.

02. Rosewood or Shisham:

Rosewood is very hard and has a dark reddish brown colour. It is fragrant and closely grained. It is hard to work and takes a high polish. It is generally found in Uttar Pradesh, Maharashtra, Mysore, Bengal, Assam and Orissa.

- **Uses:**

Used in musical instruments, piano cases, tool handles, art projects, veneers and furniture.

08. Oak:

Oak is the most widely used hardwood. Oak can be separated into two basic varieties: white and red. The red variety is also known as black oak (a reference to its bark). Oak is a heavy, strong, light coloured hardwood. This hardwood tree is found in the north-eastern part of India. It has a very distinct grain and finishes.

- **Uses:**

It is an excellent choice for furniture like bookshelves and cabinets, apart from outdoor furniture.

09. Maple:

Maple wood has a fine texture and great strength. It is so hard and resistant to shocks that it is often used for a pathway. Its diffuse into evenly sized pores which give the wood a fine texture and even grain. In India, you can find these trees in Ooty and other hilly regions.

- **Uses:**

It is extensively used in furniture like console tables, wall shelves and bedside tables. Maple that has a curly grain is often used for violin back.

10. Mango:

Mango is dense and strong hardwood which comes with a distinctly attractive grain pattern. Its grain is unique as it embodies several tones and colours, ranging from light shades like dark brown with hints of light pink or green. It is lighter than other wood species and is water-resistant.

- **Uses:**
- It is best used for windows, doors, living room and bedroom furniture, nesting tables, kitchen cabinets, entertainment units and book shelves.

11. Mahogany:

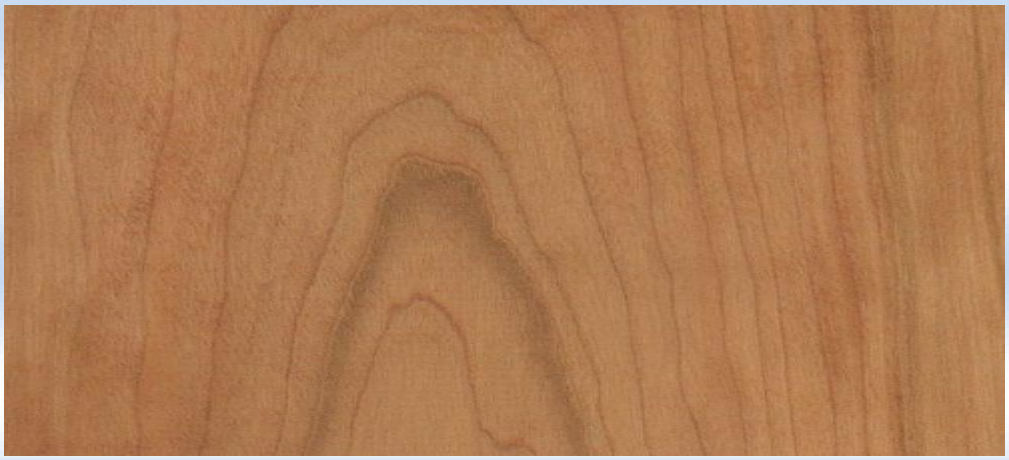
Mahogany is also known as Honduras mahogany. It has reddish-brown coloured. It is strong, with a uniform pore structure and poorly defined annual rings. It is an excellent carving wood and finishes well. One of its many advantages is that it does not warp, swell or shrink and does well under water, too. It is found all over India, particularly in Corbett National Park, Kaziranga National Park and Thattekkad Wildlife Sanctuary.

- **Uses:**

It most commonly used in fashioning cabinets, nested tables, dining table sets and other kinds of home furniture.

12. Cherry:

It is sometimes called fruitwood. It is light to red-brown in colour, hard, strong, warp resistant, closed grained wood. It resists warping and checking. It is easy to carve and polish. These trees are grown in the hilly regions of Kashmir, Uttar Pradesh and Himachal Pradesh.



- **Uses:**

It works well when used for decorative carving and for making solid furniture like cabinets, shelves and tables.

13. Walnut:

Walnut is one of the most versatile and popular wood types with a very fine texture. The wood is light to dark chocolate brown in colour with a straight grain in the trunk. Walnut is strong, hard and durable, without being excessively heavy, warp resistant. It has excellent woodworking qualities and takes finishes well. In India, it is found in Jammu and Kashmir, Uttar Pradesh and Himachal Pradesh.

- **Uses:**

It is an ideal wood choice for crafting dining table sets, coffee tables, etc.

Thus, there are many types of wood available. You can choose depending on what you want. And once you have it, do enjoy using it but care for it too.

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