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DESIGN AND FABRICATION MODEL OF WATER PUMPING WINDMILL

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CHAPTER 1

INTRODUCTION

1.1.Energy

As a source of energy, green energy often comes from renewable energy technologies such as solar energy, wind power, geothermal energy, biomass and hydroelectric power. Each of these technologies works in different ways, whether that is by taking power from the sun, as with solar panels, or using wind turbines or the flow of water to generate energy.

In order to be deemed green energy, a resource cannot produce pollution, such as is found with fossil fuels. This means that not all sources used by the renewable energy industry are green. For example, power generation that burns organic material from sustainable forests may be renewable, but it is not necessarily green, due to the CO_2 produced by the burning process itself.

Green energy sources are usually naturally replenished, as opposed to fossil fuel sources like natural gas or coal, which can take millions of years to develop. Green sources also often avoid mining or drilling operations that can be damaging to eco-systems.

1.2.GREEN ENERGY

Green energy is important for the environment as it replaces the negative effects of fossil fuels with more environmentally-friendly alternatives. Derived from natural resources, green energy is also often renewable and clean, meaning that they emit no or few greenhouse gases and are often readily available.

Even when the full life cycle of a green energy source is taken into consideration, they release far less greenhouse gases than fossil fuels, as well as few or low levels of air pollutants. This is not just good for the planet but is also better for the health of people and animals that have to breathe the air.

Green energy can also lead to stable energy prices as these sources are often produced locally and are not as affected by geopolitical crisis, price spikes or supply chain disruptions. The economic benefits also include job creation in building the facilities that often serve the communities where the workers are employed. Renewable energy saw the creation of 11 million jobs worldwide in 2018, with this number set to grow as we strive to meet targets such as net zero.

Due to the local nature of energy production through sources like solar and wind power, the energy infrastructure is more flexible and less dependent on centralised sources that can lead to disruption as well as being less resilient to weather related climate change.

Green energy also represents a low cost solution for the energy needs of many parts of the world. This will only improve as costs continue to fall, further increasing the accessibility of green energy, especially in the developing world.

There are a few types of green energy that come from different types of natural sources and these are:

1.2.1.Solar energy

As the name suggests, solar is a clean source of energy that comes directly from the sun. Generally, the stars produce a vast amount of energy with the help of nuclear fusion. This is a process by which smaller atoms are fused together by pressure and heat to generate heavier atoms. A whole lot of energy is emitted in the process of fusion, which reaches us via solar radiation. We can then collect and convert it into usable electrical power.

A Genus solar system for home can be the best pick if you wish to save limited energy resources and switch to green power. However, solar energy is the most common way of harvesting solar energy. There are plenty of photovoltaic cells. So when sunlight hits the cells, they generate an electrical current through the photoelectric effect. Then the current generated is passed through an inverter to turn it into an alternating current. From there, it can be utilized to power up your home.

1.2.2. Hydroelectric energy

Hydroelectric energy is generated by capturing the energy from flowing water. Experts force water to flow through a narrow space, thereby increasing the energy per square meter. Generally, in this process, water is stored in a dam or reservoir and purged selectively by opening an intake. And the procedure follows through with some critical applications.

However, hydroelectricity is one of the most popular and efficient forms of green energy. This energy is very versatile and can be produced using both large-scale projects and small-scale projects. Hydroelectric power does not emit pollution and hence it’s very much friendly to the entire ecosystem.

1.2.3. Biogas

Biogas is made of waste products and is another great source of green power. It is produced as a by-product when organic matter decomposes and comes from materials like food, sewage, manure, agricultural waste, and so on. These materials are stored in a container where oxygen cannot reach. This causes them to ferment and generate carbon dioxide, methane, and other gases. The methane then is used to fuel vehicles, produce electricity, heat homes, and so on. Also, the waste is put into a biogas digester and is turned into nutrient-rich fertilizer for home and farm use.

1.2.4. Biomass

Biomass, just like biogas, is a source of clean energy that is generated from recently living organisms and plants. They both contain energy that they get from the sun. Although the burning of these materials emits greenhouse gases, these emissions are still lesser than those from fossil fuels.

Biomass can be utilized in a variety of ways in our daily lives. Its usage is not limited to personal consumption, businesses also can get benefit from this energy source. However, switching to the best solar products for home can help you save the limited energy sources as well as your electricity bills. And consuming more green energy for your daily lives can save the planet in the long run.

1.2.5. Wind energy

Wind is the movement of air caused by the uneven heating of the Earth by the sun. Differences in atmospheric pressure generate winds. At the Equator, the sun warms the water and land more than it does the rest of the globe. Warm equatorial air rises higher into the atmosphere and migrates toward the poles. This is a low-pressure system. At the same time, cooler, denser air moves over Earth's surface toward the Equator to replace the heated air. This is a high-pressure system. Winds generally blow from high-pressure areas to low-pressure areas

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Another major energy source is wind energy which is powered by the sun. Since winds are caused by the uneven heating of the atmosphere, the sun is somewhere responsible for generating wind energy. However, on that unevenness, the topology of our planet, its spin, and how the entire living species orbit around the sun have an impact. Further, winds are modulated by the surface they are passing through – either water or land. Wind power does not generate carbon dioxide or emit any harmful products that negatively impact the environment.

Sustainable:

Wind energy is continuous reproduced renewable energy and much abundant in nature this massive energy makes the financiers to make a stable investments for our energy consumption demand likewise for our future generation.

Affordable:

Generating power from wind energy per unit is cheap as compared to conventional process and it can be extracted highly with the help of new technologies. It is onetime investment and the running cost is very less so the power generating machines are manufactured in large scale.

Wind turbine is operating on the simple principle which is energy in the air stream are rotate the bladed turbine around the rotor .The rotor is fixed on main shaft which rotates the generator/dynamo by transmission system to produce electrical power The terms wind energy or wind power defines the process by which the wind is used to produced motorized power or electrical power.

Wind turbines translate the KE in the wind into motorized power. This motorized power can be used for specified tasks(such as grinding grain or pumping water) or a generator can convert this motorized power into electrical power. Wind Energy for power generation wind energy , like solar is a free energy resource . but is much intermittent than solar.

The Kinetic energy of Wind is changing continuously with respect to velocity of wind so the speed of wind shows main criteria.

1.3. India's market in wind energy:

Based upon survey of"REN21-Global Status Report 2011(GSR-2011)",an Indian company named SUZLON Energy Ltd Company is top ten manufactures of wind turbine manufacturers throughout world and having of market share of 6.7%.Also major world company which is fast evolving Wind Energy market in India. India got third place in world in annual capacity and fifth position in terms of total wind energy installed capacity. India have fast growth in wind energy installations and took down the costs of power generations .A notable less tax feature of Indian programme has been the interest to private sector developers in setting up commercial wind power projects.

Considerable manufacturers have recognised themselves in wind technology manufacturing . The gross potential is 48.561 MW and total of about 9875MW of commercial projects have been established until March 31,2011.The break-up of projects implemented in prominent wind potential states(as on March 31,2011) is tabulated.2.1.

Table1.1:Prominent wind potential states to generate power

State	Gross potential(MW)	Total capacity(MW)
Andhra Pradesh	8968	200.2
Gujarat	10645	2175.6
Karnataka	11531	1730.1
Kerala	1171	32.8
Madhya Pradesh	1019	275.5
Maharastra	4584	2310.7
Rajasthan	4858	1524.7
Tamil Nadu	5904	1621.1
Others	-	4
Total	48680	9874.7

CHAPTER 2

LITERARTURE REVIEW

According to **Mr.Thangaraj**, Dept. of Mechanical Engineering, Lakshmi Ammal Polytechnic College, Tamil Nadu, India **[**FABRICATION OF WATER PUMPING SYSTEM USING VERTICAL AXIS WIND MILL**]** By considering the various parameters of wind energy and wind water pumps it is noted that performance by combining both will get more advantage. As the pumping water can be stored in tanks, used for later purpose. If necessary any one mode can be used for pumping the water or production of electricity, so overflowing of water and current can be controlled. The global environment is changing day by day and becoming more polluted, by using renewable energy we can reduce it. So, people and companies must focus on renewable energy rather than non-renewable energy.

B. Alkali and **B. S. Elkanah**, Department of Mechatronics Engineering, Federal University of Technology. Minna, Niger State **[**DEVELOPMENT OF A WINDMILL FOR PUMPING WATER USING POSITIVE DISPLACEMENT PUMP**]**. A modified slider-crank mechanism was used to convert the rotary motion from the wind into a linear motion required to operate a positive displacement pump. The analysis and synthesis of the forces acting in the components of the windmill were carried out. Also, the kinematic analysis of the mechanism was performed in order to estimate the maximum speed and acceleration of the slider mechanism during operation. This research will be more beneficiary in the rural areas where strong wind speed is available to operate the mechanism. This design can be used to replace the hand operated pump water borehole widely used presently in the rural area for water supply.

CHAPTER 3

BACKGROUND OF WINDMILLS

Water pumping windmills may be found on farms and ranches worldwide and provide critical water supply for domestic and livestock use, especially in areas where electrical and fuel driven pumps are not practical. The type of technology associated with these windmill water pumps has enjoyed continuous use since the late 19th Century and may be generally illustrated by U.S. Pat. No. 1,632,188 assigned to the Dempster Mill Manufacturing Company (1927).

This type of windmill pumps water by means of a positive displacement, reciprocating pump, submerged below the static water level of a drilled well. The pump is conventionally connected and supported by a water discharge pipe which leads to the surface and a reservoir for the water. The pump is driven by a reciprocating rod, typically made of wood or fiberglass, which reaches down from the windmill's transmission to the pump through the discharge pipe. It is typical in reciprocating water pumps of this type to utilize a barrel or cylinder within which a piston is moved in a reciprocating motion by the pump rod. Both the piston and the bottom of the pump barrel incorporate check valves that allow water to flow only in the upper direction. The check valve at the bottom of the cylinder is commonly called the foot valve, while the valve in the piston is commonly called the lift valve. When the piston is lifted by the pump rod attached to the surface windmill, the lift valve closes and the piston lifts the entire column of water above it until water overflows out of the discharge pipe at the surface. At the same time a slight suction is formed under the piston causing the foot valve to open and water to flow in under the piston. During the next half

of the cycle the piston moves down causing the foot valve to close and the lift valve to open such that water flows through the piston into a position to be lifted during the next half cycle. Water flow valves, such as those described above, must be periodically replaced.

The lift valve, which is typically made of leather or rubber, eventually wears due to particles of sand or earth in the water. Other check valves involved with the system also have finite useful lives and must be replaced on a regular basis. Replacement typically involves the removal of the pump rod, discharge pipe and pump by lifting the entire assembly up from the drilled well in order to access the valves. Such replacement efforts involve considerable labor and expense and greatly affect the down time of the windmill pumping system. Obviously many efforts have been made in the past to replace the windmill pumping system powered by electrical motors and internal combustion engines.

The present concern relates only to such efforts that have sought to improve upon wind driven pumping systems. One effort in the past is described in U.S. Pat. No. 3,367,281 issued to Gray on Feb. 6, 1968 entitled apparatus for pumping water from wells using wind power. The Gray patent discloses a water pumping device in which compressed air is generated by a windmill, stored in a tank, controlled through a pressure regulator, and delivered to a displacement type water pump. This invention, although not overly complex, is not directly adaptable to the typical windmill structure.

The Gray disclosure describes a down stroke of a windmill pump rod as the compression stroke which does not lend itself well to application in conjunction with typical windmills that are designed to apply force and power on the upstroke of the pump rod. The pump rod conventionally made of wood would likely snap if used to compress air on the down stroke. The Gray invention also utilizes solenoid valves that are electrically controlled to effectuate the air compression cycle. Such electrically controlled valves are typically not practical in remote windmill locations. Finally, the Gray invention further requires the use of an air hold-up means and a pressure regulator. U.S. Pat. Nos. 4,385,871 and 4,358,250 provide further examples of inventions generally related to the conversion of wind energy into compressed air for the purpose of water pumping. These earlier efforts, however, also do not address an appropriate adaptation of the air compressing mechanism to the typical windmill structure or to the utilization of the same in conjunction with an air injection type water pump.

CHAPTER 4

WIND TURBINES

4.1. HISTORY OF WIND MILL:

The increase is costs of fossil fuels has greatly lead to the development of alternative sources of Green Energy that are environmental friendly and cheaper to produce. The major resource in this category is wind energy. The exact origin of the first use of wind power is not known, however one of the earliest known uses dates back to 3500 B.C where they were used to drive sailboat using aerodynamic lift. The advancements of this design were adapted to China where the first windmill was developed and it was a

vertical axis type that used sheet like wings to capture the wind. This setup was the connected to pulleys or other transmission mechanisms to be used for pumping water or grinding.

In the middle ages, wind energy was introduced in Northern Europe where Horizontal axis windmills were used where the sails connected to a horizontal shaft attached to a tower with gears and axles that were used to translate the horizontal motion into rotational motion. This type of windmill used drag forces for similar purposes of grinding and sawing timber.

In the 19th Century, wind energy developed in the United States where horizontal axis windmills were used for farms, ranches and to generate electricity. This is where the first multi-blade was developed for irrigation purposes.

The wind power technology has evolved greatly and this has been motivated by the incredible benefits resulting from wind energy. Very efficient and technologically up-to- date designs have been developed and are used all over the country especially in arid and semi-arid areas to pump water for domestic and irrigation purposes. Viability of windmills is however practical only in areas with free flow of air and therefore site selection is very critical in the initial design process.

The power generated from the wind can be supplied directly to the national grid system or used to drive other mechanical devices such as windmills and grinders. This has greatly reduced the levels of pollution resulting from the use of fossil fuels. This project is mainly based on the design of a windmill for water pumping.

4.2. Classifications:

Wind turbines are separated as of two basic types named by which way of turbine spins that is axis of turning .Wind turbine axis pivoted in horizontal axis is most normal wind mill, and it called of Horizontal Axis Wind Turbine, while Wind turbine axis pivoted in vertical axis is called as Vertical axis wind mill, this type of turbines more preferable for low speed areas.

4.2.1. Horizontal Axis Wind turbine:

It has blades that are similar in design to aircraft propellers where air flow over the airfoil shaped blades produces a lifting force that turns the rotor. They should be placed on towers to ensure maximum use of the winds at higher levels. For large scale types, they have an active yaw mechanism with wind direction sensors and motors that will rotate the nacelle.

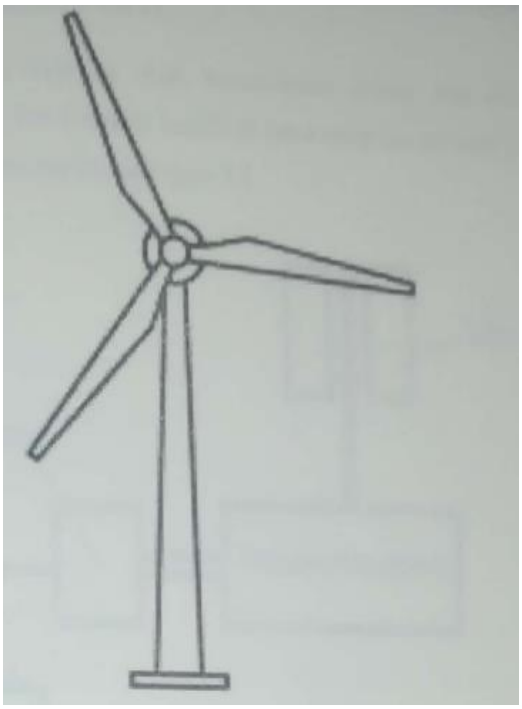

Fig 4.1: Horizontal axis wind turbine

In both upwind and downwind the rotors should be perpendicular to the direction of wind and if the rotor is held in a fixed position, only 21% of the wind energy will be captured (Wortman, 1983). For upwind type, the rotor rotation is accomplished by using a vane to measure the direction of the wind and then the information is communicated to the yaw drive. The yaw drive then drives the rotor so that the turbine is facing the direction of wind for maximum harness. They don't suffer from wind shade phenomenon as the wind is tapped early enough before obstruction by the tower. For downwind types, they don't use a yaw drive because the wind itself orients the turbine. The blades are situated on the downwind side and therefore capture the wind and rotate following its direction. These designs are prone to "wind shade" a process in which the wind flow is obstructed by an object e.g. the tower thus reducing amount of wind and therefore a reduction in the power output.

4.2.2. Vertical Axis Wind Turbine:

This has blades which are arranged on the vertical axis and are rotated by wind and therefore it doesn't require a yaw mechanism since it can harness wind from any direction. It does not rely on the direction of the wind to generate power as in the case of the horizontal axis. They usually operate closer to the ground which has an advantage of allowing for placement or replacement of heavy equipment. However this is a disadvantage as winds are lower near ground level hence less power output.

There are two main types of the VAWT namely:

4.2.2.1. Savonius

it operates like a water wheel which uses drag forces. It has a simple design and is therefore relatively simple and cheaper to build. It is mostly used in situations that do not require large amounts of power. However, it is less powerful than most HAWT because it uses drag to rotate itself and has a higher power to weight ratio. The total amount of turning torque of the mechanism relies on the drag force on each blade.

4.2.2.2. Darrieus:

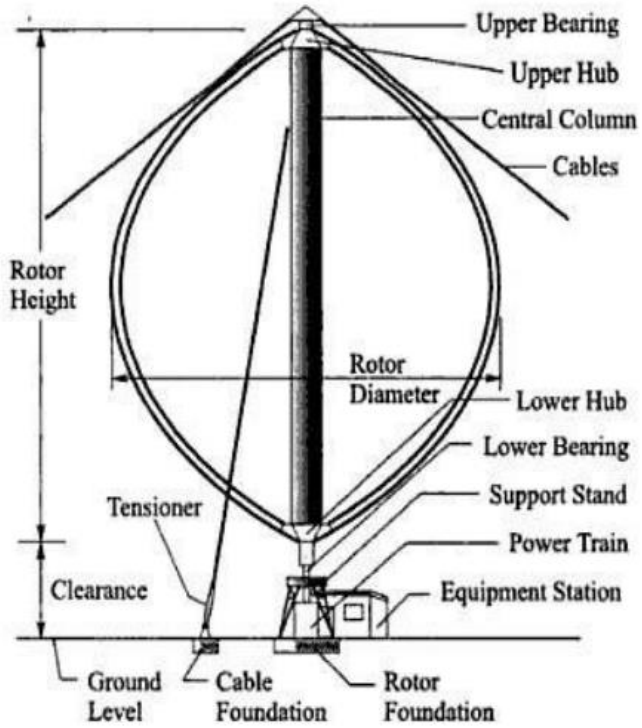

Fig 4.2: Darrieus wind turbine

It uses blades similar to those used in the horizontal axis wind turbine (HAWT). It has two or more curved blades that depend on wind in order to revolve around a central column. It functions by generating a lift using the rotating motion of the blades. The wind acting on the blade creates a rearward momentum change which propels the blade in the direction of rotation. This cannot occur unless the blades are already rotating and therefore they require a separate means of starting i.e. they are not self-starting.

CHAPTER 5

MACHINERIES

To accomplish the work need several machineries , in that the following machineries are required more. those are

5.1. Arc welding machine:

Arc welding is a type of welding process using an electric arc to create heat to melt and join metals. A power supply creates an electric arc between a consumable or non-consumable electrode and the base material using either direct (DC) or alternating (AC) currents.

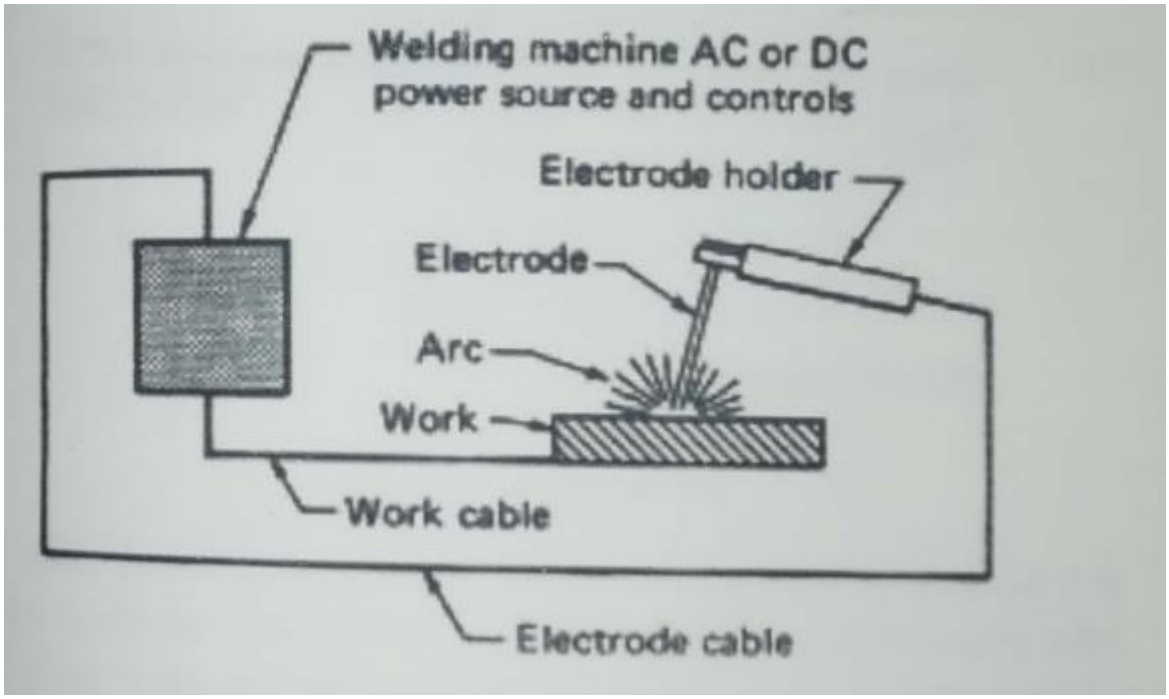

Fig 5.1: Line diagram of Arc welding machine

Arc welding is a fusion welding process used to join metals. An electric arc from an AC or DC power supply creates an intense heat of around 6500°F which melts the metal at the join between two work pieces.

The arc can be either manually or mechanically guided along the line of the join, while the electrode either simply carries the current or conducts the current and melts into the weld pool at the same time to supply filler metal to the join.

Because the metals react chemically to oxygen and nitrogen in the air when heated to high temperatures by the arc, a protective shielding gas or slag is used to minimise the contact of the molten metal with the air. Once cooled, the molten metals solidify to form a metallurgical bond.

5.1.1. Working principle:

When the power is supplied and optimum space is kept among cathode and anode the very great velocity negatively charged electron will be caused at electron, they are attracted by the anode, then moving to side anode. when this very great velocity of electrons are impinging on work piece, the KE transmitted as heat energy. therefore heat is created at anode simultaneously the positively of charged ions also will be created at anode possess in high velocity which are Adhere by cathode and moving towards cathode .When this high velocity ions are impinging onto the cathode the KE transmuted as heat energy Therefore the heat is getting produced at cathode also, but because the velocity of electron is absolutely bigger than the ions , the heat produced at anode is higher than at cathode is "2:1 ratio" .During this instant certain volume of the electrons and ions will be getting cooling in between. So the KE possessed by both the element will be instinctively transmuted as heat energy. The process is exposed on below figure

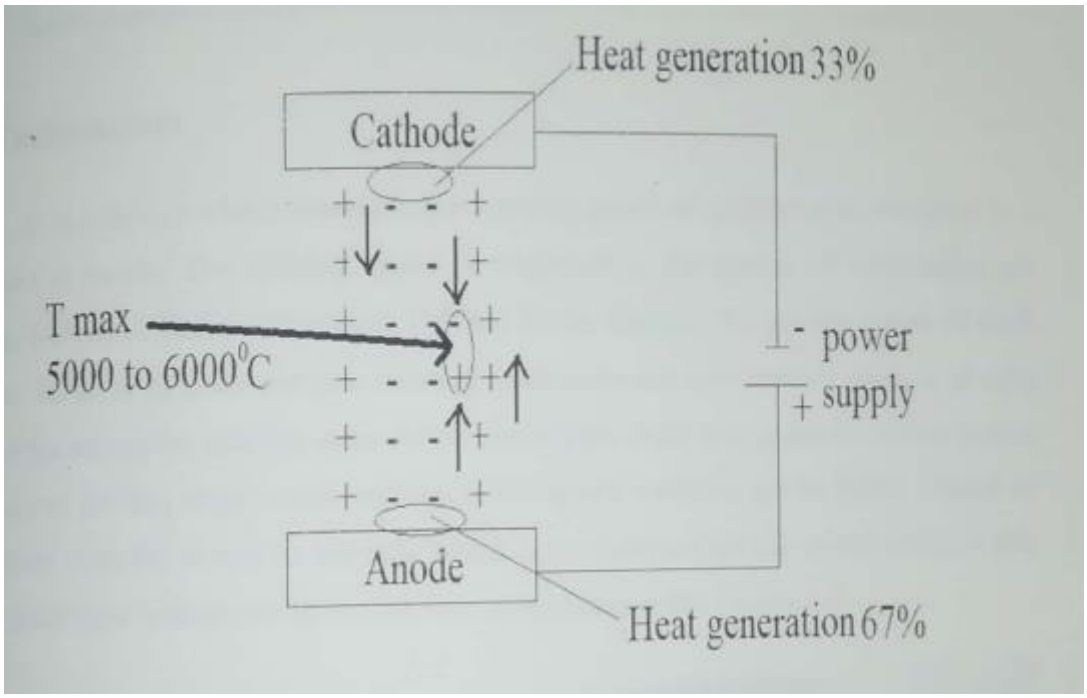

Fig 5.2: Working principle

Therefore the bigger amount of heat is produced at this location, and it is absorbed as sparking. At this point the extreme temperature is induced is about 5000-6000 degree Celsius .Due to this high temperature the ultraviolet race will be generated from sparking zone . When the arc welding operation directly seen through human eyes, the Ultra violet rays will impinging on to the bare eyes due to this is starting paining after little actions of time. To avoid this arc welding process is always seen only through safety goggles. The average temperature of arc welding technique is found about 2500-2800 degree Celsius because the heat lost by radiation is very high.

In this work Arc welding machine THYRISTOR -400A used, The specifications are list out in table 5.1.

Table 5.1: Specifications of THYRISTOR-400A

Model	THYRISTOR-400A
Supply voltage	440V
Frequency	50HZ
Phase	3 ϕ
Open circuit voltage (OCV)	80V DC,30-380A

5.2. Tachometer:

A tachometer is an electromagnetic device that produces an analog,voltage that is proportional to motor speed. Tachometers or *tachs* provide highly resolved, low-phase-lag velocity signals that are ideal for closing velocity loops. A Tachometer is a device that is useful in measuring the operating speed of an engine at the revolution of RPM and is helpful for planes, both cars, and other types of vehicles.

These device Gauges come in analog and digital forms. It indicates the engine speed, which plays a vital role in determining the engine's power output. It helps measure the rotation speed of a shaft or disk, frequently that of a machine.

It is usually measured in rotations per minute (RPM) and sometimes in revolutions per second (RPS).

Fig 5.3: Contact type digital tachometer

We can use Tachometers to view the RPMs on cars, boats, motorcycles, and other machines with engines. There are several types of Tachometers, including mechanical, electronic, and magnetic.

A digital meter helps measure and indicate the speed of a rotating object. It is an optical encoder that helps determine the velocity of the motor for the rotating shaft and is helpful in automobiles, medical instruments applications, and more.

It is also popularly known as the Revolution Counter.

The word Tachometer originates from the Greek words tachos and Metron, which means “speed” and “to measure,” respectively. The device works on the principle of a Tachometer generator, and it also works on the operating principle from electronic, optical-based.

Table 5.2: Specifications of Contact type digital tachometer

Type	**Contact type**
Ranges	1 to 50000 RPM / 0.1 to 5000 MPM
Display	5 digits with 10mm red light
Accuracy	±0.05%+ 1 digit
Memory	Last, Max and Min values stored automatically for 2 min
Power source	Four 1.5 V batteries
Operating temperature	0º to 60ºC
Size	200×75×40mm

5.3. Anemometer:

Anemometer is a device which measures the wind speed and pressure. It is the most important tool for a weather predictor to predict wind speed. The utmost common anemometer having three or four cups , which are attached to arms. This arms are mounted on vertical shaft. When wind drafts the cups rotates and rod spins. The speed of cups increases by the stronger wind drafts and on the other hand vice versa. Speed of wind is calculated with following equipment’s namely,

1.Thermo Anemometer

2.Cup type Anemometer

3.Vane type Anemometer

Fig 5.4: Anemometer

Table 5.3: Specifications of Thermo Anemometer

Company name	Equinox EQ-618
Type	Thermo anemometer
Velocity range	0-45m/s
Resolution	0.1m/sec
Accuracy	±(2%+1d)
Temperature range	0-60ºC
Power supply	9V battery
Meter size	150×72×35mm
Weight	210g

5.4. Gas Welding:

Gas welding is the process of using heat generated from burning a fuel gas (like acetylene) to cut and/or join metals together. Gas welding is one of the most important types of welding because of its scope of application.

It is one of the oldest forms of heat-based welding and remains the go-to option for many industries. The reason why this welding technique is still very popular is because of its ease of use and low-cost nature. Carrying out a welding process with gas welding is relatively easy and does not necessarily require expert welders.

When a fuel such as acetylene is used, the flame can reach temperatures of just over 5,700°F (3200°C). This temperature is lower than what we get from an arc drawback for various types of repair and construction work

5.4.1. Working principle:

When metals are welded using gas welding equipment, fuel gases are mixed with oxygen to produce a concentrated flame at a high temperature. This flame directly strikes a weld area and melts the materials in question (often, but not always, with the addition of filler material).

The melted section of each piece of metal forms something called a melt or weld pool where the liquid metals diffuse into one another and, once cooled, form a strong joint. This form of welding can be used for many common types of metals.

Fig 5.5: Gas welding equipment

Completion of weld requires the welder to slowly remove the flame from the joint, giving it time to harden without oxidation.

Most commonly, oxygen is mixed with gases like acetylene, hydrogen, propylene, butane, and others. The choice of gas used for welding depends on the type of project, cost, and flame control.

CHAPTER 6

LIST OF COMPONENTS

6.1.VERTICAL AXIS WIND TURBINE:-

Vertical-axis wind turbines (or VAWTs) have the main rotor shaft arranged vertically. Important advantages of this arrangement is that the turbine does not need to be pointed into the wind to be effective. This is an advantage on sites where the wind direction is highly variable, for example when integrated into buildings. The key disadvantages include the low rotational speed with the consequential higher torque and hence higher cost of the drive train, the inherently lower power coefficient, the 360 degree rotation of the aerofoil within the wind flow during each cycle and hence the highly dynamic loading on the blade, the pulsating torque generated by some rotor designs on the drive train, and the difficulty of modeling the wind flow accurately and hence the challenges of analyzing and designing the rotor prior to fabricating a prototype.

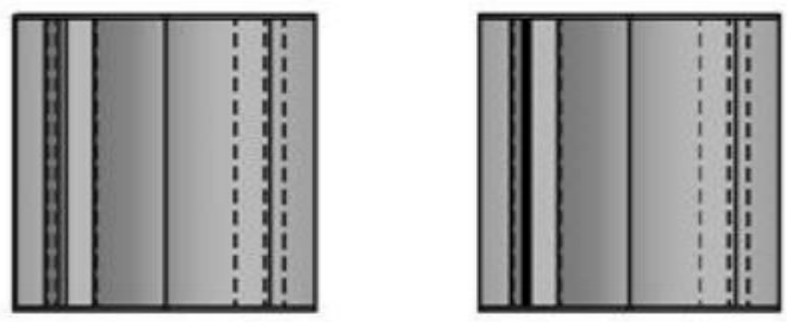

Fig 6.1: Vertical axis wind turbine

6.2.Chain and sprocket mechanism:

Chain and Sprocket

A sprocket is a toothed wheel that fits onto a shaft. It is prevented from rotating on the shaft by a key that fits into keyways in the sprocket and shaft.

A chain is used to connect two sprockets. One sprocket is the driver sprocket. The other sprocket is the driven sprocket. Motion and force can be transmitted via the chain from one sprocket to another, therefore from one shaft to another. Chains that are used to transmit motion and force from one sprocket to another are called power transmission chains.

There are 6 major groups of power transmission chains:

- standard general purpose roller chains, widely used in industry
- high performance roller chains, these roller chains are stronger than general purpose roller chains
- lube-free chains, these chains can be used without lubrication
- environmentally resistant chains with special corrosion resistance
- specialty chains, Type 1. used as bicycle chains, motor cycle chains, automotive chains
- specialty chains, Type 2. including miniature chains, leaf chains and inverted tooth chain, i.e. silent chains.

Most of these chains are the roller type, i.e. they are composed of link plates, pins that join the link plates and also rollers and bushes.

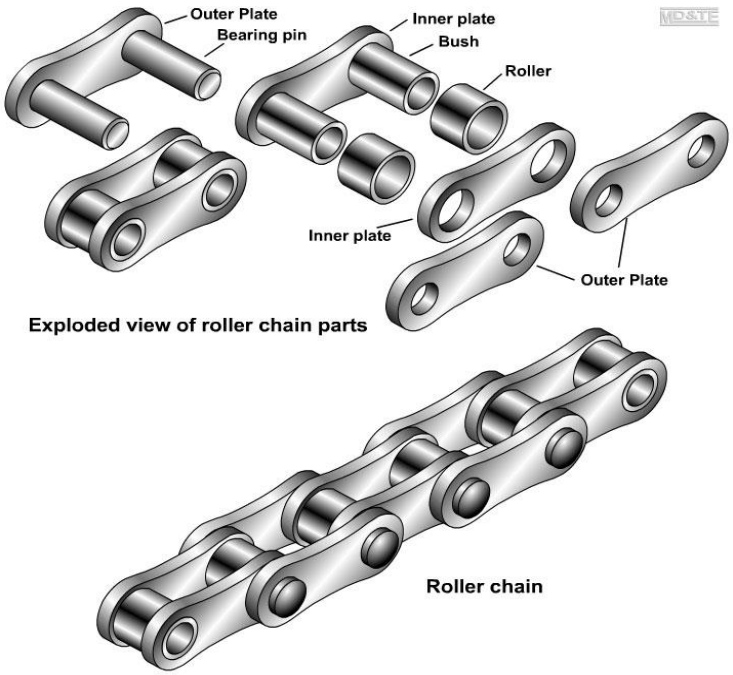

Fig 6.2: Chain Linkage

The size of the chain links must match precisely the size and spacing of the sprocket teeth.

6.2.1. Advantage of chain drives:

An advantage of chain drives over most belt drives is that the chain cannot slip on the sprocket, so the chain and sprocket provides a positive, non-slip drive, i.e. the chain cannot slip on the sprocket because the sprocket teeth prevent the chain from slipping.

Some belt and pulley drives also have teeth. These toothed belt and pulley drives are used in applications where it is important that the belt does not slide on the pulley, e.g. timing belts in internal combustion engines and the drive belts that replace the chain on some motorcycles.

Fig 6.3: Sprocket

6.3 **PUMP**

Pump is a mechanical device used to transfer different fluids from one position to another. It is a hydraulic device that lifts a fluid from a low to a high level and moves it from a low-pressure area to a high-pressure area. Pumps transfer fluids by converting the mechanical energy of the fluid into pressure energy (hydraulic energy).

The type of pump, as well as selection, mainly depend on our requirement. The application mainly includes the type of fluid you desire to pump, the distance you desire to move the fluid, and the quantity you require to get over a particular time frame. However, it is complicated to recognize accurately what kind of pump you must select. The identifying of the pump can be done with the design as well as positions. To make simpler things while seeking to choose your exact pump, and the pumps can be classified into two types which function in extremely dissimilar ways & generally summarize most of the pump designs.

6.3.1. Types of Pumps

Pumps are classified into two types namely Dynamic pumps as well as Positive Displacement Pumps.

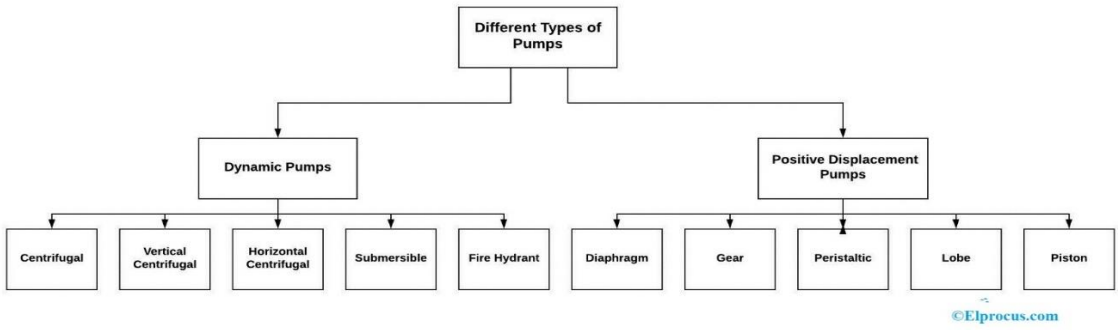

Fig 6.4: Classification of pumps

6.3.2.Dynamic Pumps

Dynamic pumps are classified into different types but some of them are discussed below like Centrifugal, Vertical centrifugal, Horizontal centrifugal, Submersible, and Fire hydrant systems.

6.3.2.1.Centrifugal Pumps

These types of pumps are the most commonly used in the world. The work is very simple, well described and carefully tested. These pumps are robust, efficient and fairly inexpensive to manufacture. Whenever the pump is running, the fluid pressure will increase from the pump's inlet to its outlet. The change in pressure will drive the fluid throughout the system.

Fig 6.5: Centrifugal pump

Ig This pump produces an enhanced force by transferring the mechanical power of the motor to the fluid throughout the rotating impeller. The fluid flow will enter the center of the impeller and flow out with its vanes. Centrifugal force thus increases the velocity of the fluid and energy like kinetic energy can be changed into force.

6.3.2.2. Vertical Centrifugal Pumps

Vertical centrifugal pumps are also known as cantilever pumps. These pumps use a unique shaft and maintenance design that allows the volume to fall into the pit because the bearings are on the outside of the pit. This pump model does not use a filled container to cover the shaft, but uses a throttle bushing in its place. Parts washers are a common application for this type of pump

Fig 6.6: Vertical centrifugal pump

6.3.2.3. Horizontal centrifugal pumps

These types of pumps include at least two otherwise more impellers. These pumps are used for pumping services. Each stage is basically a manifold pump.

All phases are in a similar bunker and mounted on a similar shaft. At least eight additional phases can be installed on separate horizontal shafts. Each phase enhances the head by approximately equal amounts. A multi-stage pump can also be a single-stage pump, or else a double suction pump on the first impeller. Various pumps have been supplied and repaired for this type of centrifugal pump.

6.3.2.4. Submersible Pumps

These pumps are also known as stormwater, sewage and septic pumps. Applications for these pumps include primarily building services, domestic, industrial, commercial, rural, municipal and stormwater recycling applications.

Fig 6.7: Submersible pump

These pumps are apt for shifting stormwater, subsoil water, sewage, black water, grey water, rainwater, trade waste, chemicals, bore water, and foodstuffs. The applications of these pipes mainly include in different impellers like closed, contra-block, vortex, multi-stage, single channel, cutter, otherwise grinder pumps. For different applications, there is an extensive selection is accessible which includes high flow, low flow, low head, otherwise high head.

6.3.2.5. Fire Hydrant System

Fire hydrant pump systems are also named as hydrant boosters, fire pumps, & fire water pumps. These are high force water pumps intended to enhance the capacity of fire fighting of construction by increasing the force within the hydrant service as mains is not sufficient. The applications of this system mainly include irrigation as well as water transfer.

6.3.2.6. Positive Displacement Pumps

Positive displacement pumps are classified into different types but some of them are discussed below like diaphragm, gear, peristaltic, lobe, and piston pumps.

6.3.2.6.1. Diaphragm Pumps

Diaphragm pumps also known as AOD pumps (Air operated diaphragms), pneumatic, and AODD pumps. The applications of these pumps mainly include in continuous applications like in general plants, industrial and mining. AOD pumps are particularly employed where power is not obtainable, otherwise in unstable and combustible regions. These pumps are also utilized for transferring chemical, food manufacturing, underground coal mines, etc.

Fig 6.8: Diaphragm pump

These pumps are responding pumps and include two diaphragms which are driven with condensed air. The section of air by transfer valve applies air alternately toward the two diaphragms; where every diaphragm contains a set of ball or check valves.

6.3.2.6.2.Gear Pumps

These pumps are a kind of rotating positive dislocation pump, which means they force a stable amount of liquid for every revolution. These pumps move liquid with machinery coming inside and outside of mesh for making a non-exciting pumping act. These pumps are capable of pumping on high forces & surpass at pumping high thickness fluids efficiently.

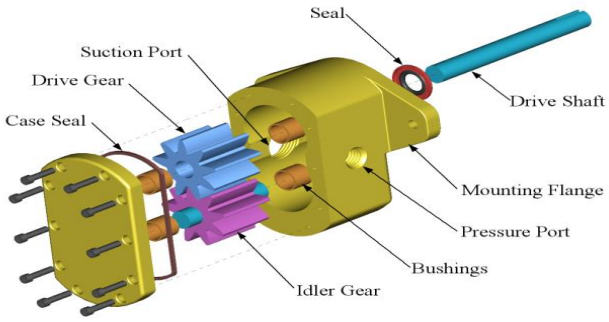

Fig 6.9: Gear pump

A gear pump doesn't contain any valves to cause losses like friction & also high impeller velocities. So this pump is compatible for handling thick liquids like fuel as well as grease oils. These pumps are not suitable for driving solids as well as harsh liquids.

6.3.2.6.3.Peristaltic Pumps

Peristaltic pumps are also named as tube pumps, peristaltic pumps. These are a kind of positive displacement pumps and the applications of these pumps mainly involve in processing of chemical, food, and water treatment industries. It makes a stable flow for measuring & blending and also capable of pumping a variety of liquids like toothpaste and all kinds of chemicals.

Fig 6.10: Peristillatic pump

6.3.2.6.4.Lobe Pumps

These pumps offer different characteristics like an excellent high efficiency, rust resistance, hygienic qualities, reliability, etc. These pumps can handle high thickness fluids & solids without hurting them. The working of these pumps can be related to gear pumps, apart from the lobes which do not approach into contact by each other. Additionally, these pumps have superior pumping rooms compare with gear pumps that allow them to move slurries. These are made with stainless steel as well as extremely polished.

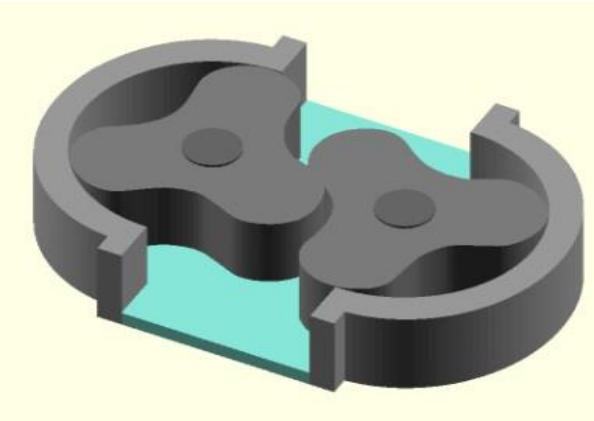

Fig 6.11: Lobe Pump

6.3.2.6.5. Piston Pumps

Piston pumps are one kind type of positive dislocation pumps wherever the high force seal responds through the piston. These pumps are frequently used in **water irrigation,** scenarios requiring high, reliable pressure and delivery systems for transferring chocolate, pastry, paint, etc.

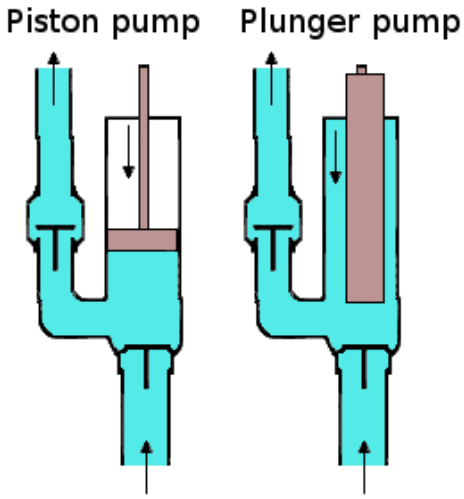

Fig 6.12: Piston pump

6.4.Clamp:

A clamp is a fastening device used to hold or secure objects tightly together to prevent movement or separation through the application of inward pressure.

There are many types of clamps available for many different purposes. Some are temporary, as used to position components while fixing them together, others are intended to be permanent.

6.4.1.Angular bracket:

An angle bracket or angle brace or angle cleat is an L-shaped fastener used to join two parts generally at a 90 degree angle. It is typically made of metal but it can also be made of wood or plastic.

The metallic angle brackets feature holes in them for screws. Its typical use is to join a wooden shelf to a wall or to join two furniture parts together.

Retailers also use names like corner brace, corner bracket brace, shelf bracket, or L bracket.

When the holes are enlarged for allowing adjustments, the name is angle stretcher plates or angle shrinkage.

Fig 6.13: Angular bracket

6.6. Screw:

A screw is similar types of fastener typically made of metal and characterized by a helical ridge, called a *male thread* (external thread).

Screw is used to fasten materials by the engagement of the screw thread with a similar *female thread* (internal thread) in a matching part.

Screws are often self-threading (also known as self-tapping) where the thread cuts into the material when the screw is turned, creating an internal thread that helps pull fastened materials together and prevents pull-out.

There are many screws for a variety of materials; materials commonly fastened by screws include wood, sheet metal, and plastic.

Fig 6.14: Screw

6.7. Aquatherm Green Pipe:

Aquatherm green pipe is made up of polypropylene. Aquatherm green pipe doesn't react with the water. This prevents leaching, corrosion, scaling and erosion—major causes of water contamination and long - term piping failure. Aquatherm green pipe is also installed using heat fusion. Aquatherm green pipe is used a inlet of the pump which sucks the water from the ground

Fig 6.15: Aquatherm green pipe

6.8. Bolt:

A bolt is a form of threaded fastener with an external male thread requiring a matching pre-formed female thread such as a nut. Bolts are very closely related to screws.

Bolts use a wide variety of head designs, as do screws. These are designed to engage with the tool used to tighten them. Some bolt heads instead lock the bolt in place, so that it does not move and a tool is only needed for the nut end.

Fig 6.16: Bolt

6.9. Wheel rims:

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 the bead of the tire casing.

Fig 6.17: Wheel rim

6.10. Hose clamp:

Screw clamps consist of a band, often galvanized or stainless steel, into which a screw thread pattern has been cut or pressed. One end of the band contains a captive screw. The clamp is put around the hose or tube to be connected, with the loose end being fed into a narrow space between the band and the captive screw. When the screw is turned, it acts as a worm drive pulling the threads of the band, causing the band to tighten around the hose (or when screwed the opposite direction, to loosen). Screw clamps are normally used for hoses 1/2 inch diameter and up, with other clamps used for smaller hoses.

Fig 7.2: Hose clamp

6.11. FRAME

It is a Base Of wind-mill structure, Frame is made up of mild-steel material. The mild-steel metal rod is joined by using arc welding. Frame is main component which gives rigid support for the blades. Base is important in the construction of the windmill because not only do they have to support the windmill, but they must also be subject to their own weight and the drag of the wind.

Fig 7.3: Frame structure

CHAPTER-7

MATERIAL CONSIDERATION FOR WINDMILL

The efficiency of a wind mill changes thus for good output it is important to check material and its property for different material the property are shows in fig 7.1

Property	Aluminum Extrusions	Molded Plastic	Wood	Vinyl (Polyvinyl Chloride)
Strength (Tensile)	Very good mechanical properties.	Wide variation in properties from 0.08 to 8 tensile strength of aluminum extrusions for glass filled compounds.	Good compressive properties, variable with the species of wood and moisture content.	Low mechanical properties.
Density	Lightweight about 1/3 that of copper or steel.	Very lightweight about 60% the weight of aluminum.	Very lightweight about 1/3 the density of aluminum.	Very lightweight about 60% the density of aluminum.
Strength	Very Good.	good.	good.	good.
Formability	Easily formable and extruded in a wide variety of complex shapes including multi-void hollows.	Easily formed or molded into complex shapes.	Poor; cannot be routinely formed.	Easily formed or molded into complex shapes.
Electrical Conductivity	Excellent; twice as efficient as copper, used in bus bar and electric connector applications.	Poor; used as an insulator, high dielectric capability.	Poor; cannot be used as an electrical conductor Usually cannot be employed as an insulator.	Poor; electrical and thermal insulating characteristics.
Thermal Conductivity	Excellent; ideal for heat exchanger applications.	Poor; low coefficient of thermal (heat) transfer.	Poor.	Poor.
Finishing	A finishes can be applied including mechanical and chemical prefinishes, anodic coatings, paints and electroplated finishes.	Color can be integral with material as well as plated, painted, and hot stamped.	Paint and stain coatings can be employed.	Color can be integral with material.

7.1. PVC Pipe:-

The cutted PVC pipe at an angle of 32 degree is use to make turbine. The pipe used for turbine is a PVC material. The pipe is 110 mm in diameter and 3, in thickness. These are the light weight pipes which rotate freely by wind.

Fig 7.1: Pvc pipes

CHAPTER-8

STEPS IN DESIGNING:-

A) First a base chase has been built by using angles and channels it has been properly welded so as to bear the weight of wind mill.

B) Then a vertical shaft was fitted on it.

C) Two cycle rims were fitted at the ends of shaft and pvc pipes were cut and fitted at circular curvature of two rims.

D) A water pump and valve assembly was installed at other.

CHAPTER-9

SETUP LOCATION

To pump water more effectively, the selection of site is taking more criteria. To select location of plant the following conditions should be satisfy. Those are:

1. Keep away from obstructions throughout surroundings because obstructions slows down the velocity of air and creates turbulence.
2. The height of setup location should be at high compared to ground.

Installing the windmills needs little bit research, even it is a small windmill used for house or commercial wind farm or any offshore installation, for all first search the wind resources for proposed sight. Wind resource data obtained by averaging high speed and low speed at particular location by metrological.

After selecting location check the availability of water resources, where the water has to be pumped and stored in any reservoir. And it's also important to survey the effect of installing windmill on the community and wildlife in that location.

Before fix the assembly need to collect the wind report for last one years to get average value of windspeed for constant water pumping output, in this work last one year's wind speed reports are collected from AWS means automatic weather station which is located in "Yogi Vemana University" – Kadapa. AWS measures different parameter present atmospheric weather those are wind speed along with rain density, barometric pressure, humidity ratio etc. The fig shows automatic registration machine.

From this machine annual wind reports are obtained with every one hour results. By taking these readings here the average wind speed are calculated and tablet in table.

The annual reports are taken by anemometer which is at the height of 7.5m, above the ground and the maximum, minimum and average velocities of wind throughout seasons is tabulated in table 9.1

But in this work the setup is placed at the altitude of 10.5m so the annual wind report information is vary to get original values wind gradient technique is useful. The velocity of wind is changing when going from ground to top in vertical direction. The phenomena is called wind gradient.

Table 9.1: Season wise wind reports @YUV

S.No	Season	Months	Min wind speed (m/s)	Max wind speed (m/s)	Avg wind speed (m/s)
1	Winter	Dec, Jan, Feb	0.1	5.2	2.78
2	Summer	March, April, May	0.1	5.5	2.9
3	Monsoon	June - Nov	0.1	6.4	2.66

CHAPTER-10

WIND GRADIENT

The velocity of air changing from ground to top in vertical direction is with phenomena of wind gradient. It is the vertical gradient goes top in the horizontal direction of wind speed in the lower atmosphere. It is rate of increase in height above ground level. It's also called wind speed gradient, Shear wind.

10.1. POWER LAW:

A power law is a relation between two quantities, where a relative change in one quantity results in a proportional relative change in the other quantity independent of the initial size of those quantities. One quantity varies as a power of another.

$$V_2 = V_1 \left(\frac{Z_2}{Z_1}\right)^{\alpha}$$

Where V1 = Velocity @height Z1

V2 = Velocity @height Z2

Z1 = Height 1(i.e. Lower height)

Z2 = Height 2(i.e. Upper height)

Wind gradient exponent is varies from one place to another. The values of wind gradient exponent for different places is tabulated in table 10.1

Table 10.1: Wind gradient exponent for different places

Place	Wind gradient exponent
Sea level	0.10
Gross covered smooth land	0.15
Small bushes with less tress	0.20
Row cops	0.20
No of buildings	0.25
Heavy trees	0.25
Hilly and mountain area	0.25

The setup location consists of heavy trees & no of buildings. So the wind gradient exponent taken as 0.25 from the tabulated data.

Z1 = Anemometer height at YVU = 7.5 meters

Z2 = Turbine Height at JNTU = 10.5 meters

V1 = is taken from seasonal velocity from calculation

V2 = Velocity in JNTU

By using velocity gradient exponent the season wise velocities are calculated and tabulated in table 10.2

Table 10.2: Detailed season wise wind speed report

S. No	Season	Months	Minimum wind Speed(m/sec)		Maximum wind Speed(m/sec)		Average Wind speed (m/sec)	
			AWS	JNTU	AWS	JNTU	AWS	JNTU
1	Winter	Dec, Jan, Feb	0.1	0.107	5.2	5.587	2.78	2.98
2	Summer	March, April, May	0.1	0.107	5.5	5.91	2.9	3.116
3	Monsoon	June-Nov	0.1	0.107	6.4	6.87	2.66	2.858

CHAPTER-11

RESULTS AND DISCUSSION

11.1.Final Structure

After assembling all the parts the final view of the vertical axis wind turbine with water pumping is demonstrates in

After the installation the experiment examined using the air compressor with wind pressure. The windmill revolutions are taken from non contact type tachometer and the amount of water pumped by the pump is noted at different air pressures. The obtained values are listed out in the table 11.1

Table 11.1: Experiment results

S. No	Air pressure (in Bar)	No of windmill revolutions (in RPM)	Quantity of water discharged(in liters)
1	1bar	90	2
2	2bar	107	4.5
3	3bar	128	6.3
4	4bar	135	9
5	5bar	169	12.6
6	6bar	173	14
7	7bar	192	17.5
8	8bar	204	20

11.2. GRAPHS:

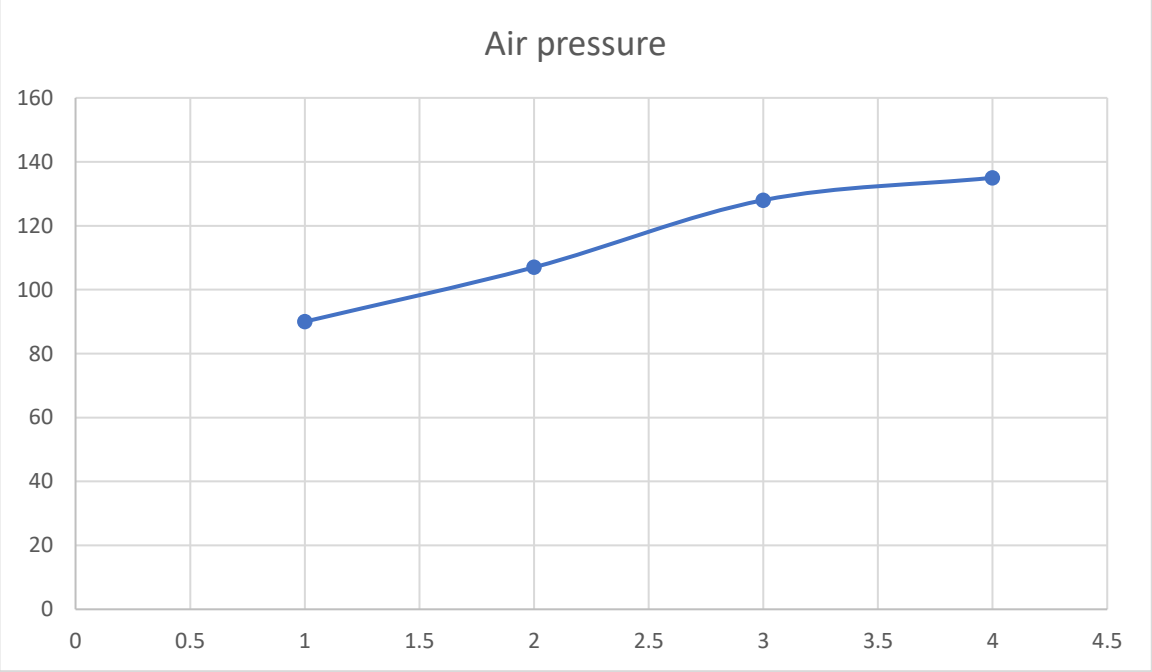

Fig : Air pressure Vs no of windmill revolutions

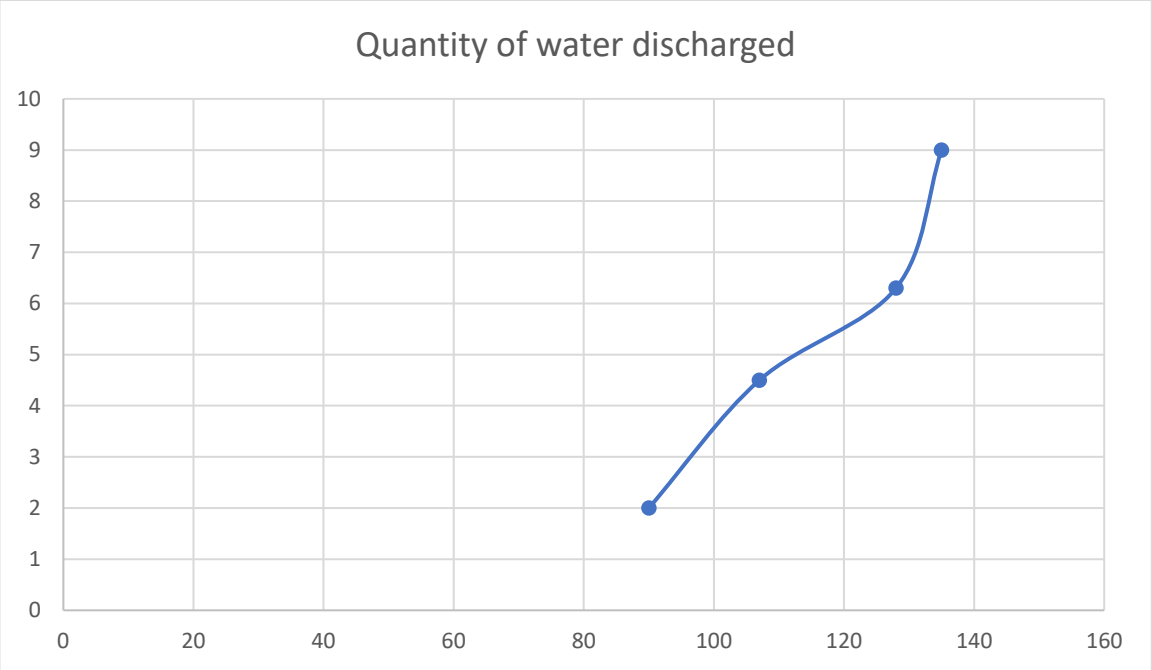

Fig : No of windmill revolutions Vs quantity of water discharged

CHAPTER-12

CONCLUSION

Our work is to show that the vertical axis wind energy conversion system are practical and potentially very contributive. At the low wind pressure the quantity of water discharged is not so much effective, however with the increase of the wind pressure the quantity of water discharged also considerably increased.

After comparing all the performance evaluation test values, it can be concluded from the results obtained from graphs that as the wind speed increases the water discharge also increases.

All materials used are locally available and at a low cost making the model economically viable.

CHAPTER-13

SCOPE FOR FUTURE WORK

Efficiency or power output of the pump can be improved by optimizing the pipe parameters and by keeping solar panels to rotate the windmill we can pump easily where no power consumption is required to pump the water.

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