THE DESIGN AND DEVELOPMENT OF PEDDLING WATER PUMPING MACHINE

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(MEE/11/0409)

A PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR IN ENGINEERING (B.ENG.) DEGREE IN MECHANICAL ENGINEERING

TO

DEPARTMENT OF MECHANICAL ENGINEERING,

FACULTY OF ENGINEERING,

FEDERAL UNIVERSITY OYE EKITI, EKITI-STATE NIGERIA

SEPTEMBER 2016

DECLARATION

I **MOHAMMED, USMAN AYO** hereby declare that this project work carried out is the result of my personal effort under the supervision of Dr. B.O. Olorunfemi of the department of Mechanical Engineering, Federal university Oye-Ekiti, Ekiti State, as part of the requirement for the award of Bachelor Degree of Mechanical Engineering, and has not been submitted elsewhere for this purpose. All sources of information are explicitly acknowledged by means of reference.

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27/09/2016

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MOHAMMED, USMAN AYO **Date**

(MEE/11/0409)

CERTIFICATION

This is to certify that this project was prepared by MOHAMMED USMAN AYO (MEE/11/0409) under my supervision, in partial fulfillment of the requirement for the award of Bachelor of Engineering (B.Eng) in Mechanical Engineering, Federal University Oye-Ekiti, Ekiti State, Nigeria

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DEDICATION

This Project is solely dedicated to Almighty God for the wisdom and strength He gave to me during the reseach and design period and to all the students of Federal University Oye-Ekiti.

ACKNOWLEDGEMENT

My profound gratitude goes to Almighty God, who made my existence a possibility and has so far been in the control of my life and has been protecting me from all unseen evil.My profound gratitude goes to the HOD department of mechanical engineering as well as all the lecturers and non-teaching staffs.

My acknowledgement also goes to my parents Mr. and Mrs. MOHAMMED, MRS Oloruntegbe Oluwafunmilayo, my elder brother Alfred Adeniyi, and my friends Adeleye Ifeoluwa, Saliu Adetayo Emmanuel , Adejumo Idris, Damisa Rasaq, Ogbebor Alex, Okeke Obinna, Ajah Grace, Odediran Yetunde, Temide Tuase and Mr Seun Krisogonus for all their prayers and supports. I pray they live to reap the fruit of their labour.

Finally my supervisor,Dr. B.O. Olorunfemi for all his advises and supports and also my gratitude goes to my lecturers as well as my fellow students for their humanly attention and lovely gestures.

ABSTRACT

The objective of this paper is to design, fabricate and experimentally investigate the working of Pedal Powered Centrifugal Pump (PPCP) which is used in small drinking water supply and garden irrigation.PPCP consists of a centrifugal pump operated by pedal power. The centrifugal pump is positioned on its stand insuch a way that driven shaft of the centrifugal pump is butted to the bicycle wheel. By pedaling the bicycle, thebicycle wheel rotates, thereby rotating the centrifugal pump which in turns discharges water from the sump or bucket.PPCP provides drinking water and irrigation in remote areas where electricity is not available. PPCP is notonly free from pollution but also provide healthy exercise. PPCP reduces the rising energy costs. PPCP isdesigned as a portable one which can be used for irrigation in various places. The experimentalinvestigation was executed and performance of the PPCP was carried out at different rpm. The results indicatethat the PPCP had given a considerable amount of discharge and head. The PPWP requires only manual powerthereby reducing the utility bill considerably.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 GENERAL BACKGROUND

A pump is basically a device which uses mechanical actionto move fluids and in some instances slurries. Pumps fallinto three main groups based on the method used to movethe fluid. These groups are gravity, lift anddisplacement. A pump is thus defined as a machine used to add energy to a liquid. Pumps comes in many types and sizes. The type depends on the function the pump is to perform and the size (and speed) depends on the amount (volume) of liquid to be moved in a given time (R K Bansal, 2005).

To move the fluid, the pump takes upenergy in one form or the other including electricity,wind power and manual labour.Pedal powered water pumps falls into the manual labourcategory and are mostly applied in rural areas to pumpwater either for domestic use or for irrigation.

Pedal Powered Centrifugal Pump (PPCP) is aneco-friendly water pump which works onmechanical energy without electricity to provide drinking water and irrigation inremote areas whereelectricity is not available. PPCP is notonly free from pollution but also providehealthy exercise and reducesthe rising energy costs. PPCP is designedas a portable one which can be used forirrigation in variousplaces and it consists of a centrifugal pumpoperated by pedal power. The centrifugalpump is positioned on itsstand in such a way that driven shaft ofthe centrifugal pump is butted to thebicycle wheel. By pedaling thebicycle, the bicycle wheel rotates, therebyrotating the centrifugal pump which inturns discharges water fromthe sump.

What is Pedal Power?

Human are using their powers for different purposes from ancient time. Today this power is giving ways for generating power. Pedal power means transfer of human energy from one body part that is leg to power generating system. After pedaling the bicycle, energy is transferred from human body to equipment that works with electric power.

What pedal power does?

Pedal power uses bicycle power generator to lighten bulbs or supply power to many other appliances. Production of power under this method completely depends on human capabilities. As more and more appliances are attached with power generator, it becomes tough for the person to maintain the supply. Pedal power generating system is the combination of different technologies including man power and bicycle as most important. Other technologies used with this system include voltage and current meters, capacitors, display board and transmitters etc. Pedal power is very easy and simple to use so a non-technical person or even a kid can also try using it.

Pedal power energy concept is not newer just renewed in the modern times because once again there is need to shift towards protecting the environment. It does not mean that the advancement in technology will not proceed. It provides a secure environment to do positive work. It will increase the efficiency level of man power. Pedal power is very easy and simple to use so a non-technical person or even a kid can also try using it. Pedal power works under three main principles, power levels, pedaling rate and gear ratios. Power level depends on how strong the peddler is and how long he can pedal. It is considered that a healthy non-athlete can easily generate up to 75 watts of mechanical power while an athletic person can give twice to this

value. A smaller and weaker person can probably produce 50 watts in same time period. This analysis shows that power level varies with health of peddler.

1.2 AIM

To develop a peddling powered water pumping machine

1.3 OBJECTIVES

The main objective of this project is to develop the bicycle powered water pump. Basically the development of the bicycle powered water pump consist of the designing process, fabrication, and lastly will come out with analysis base on the gearing system and power of the pump itself to produce maximum output.

1.3 PROBLEM STATEMENT

Nowadays, the current water pump did not compete with a best future which is meeting the ergonomic and economic requirement. Therefore, there is need to solve;

- Farming and other irrigation activities at third world countries suffering from supply of water.
- The need to develop other means of pumping water for places that suffers from availability of electricity.

1.4 PROJECT SCOPE

The study is aimed at producing a pedal water pumping machine with low cost and readily available parts.Basically the scope of the project is functioning as a guidance to achieve the objective. The scopes of project are listed such as below;

- Design bicycle powered water pump system
- Fabricate support system and assemble between bicycle and water pump
- Test the result on pumping water with different water head, different gearing size, and different human categories

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

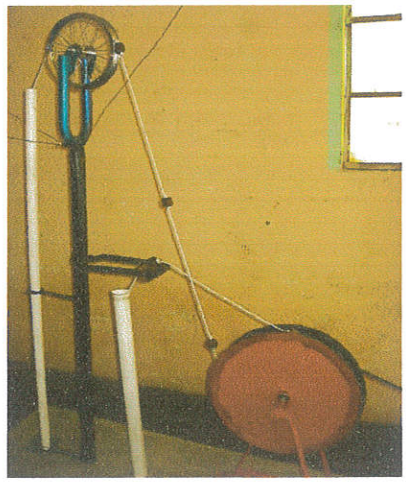


Fig 2.1: pedal water pump

This is basically a lift pump with a piston and a checkvalve on each side of the pedals. On pedaling, analternate up and down movement of the plunger occurswith the upward movement causing a negative pressure orrather a vacuum to occur. This causes a check valve atthe bottom to open, drawing water inside the chamber.

During the downwards movement, positive pressure iscreated closing the check valve and opening a rubberflap allowing the water to flow out. This can be thenchanneled for the intended use.

Peddling water pumping machine comprises of single centrifugal pump which is fixed with the rear wheelbicycle and runs by rotating the pedal of a cycle at a particular rpm. Paddling for just a minute or two is enough to pump 5-10 litres of water to a height of 10-15 feet. The complete system includes a bicycle rim, impeller, an inlet and delivery pipes. The finalssupporting shaft is

connected with an impeller. The wheel rotates the impellers of the centrifugal pump by sliding action between wheel and friction roller. In this process liquids and their movement from place to place, plays an important role. Liquid can only flow under its own power from a higher elevation to a lower elevation or, from a high pressure system to a lower pressure system. The flow of liquid is also affected by friction, pipe size, liquid viscosity and the bends and fittings in the piping. This project could be highly useful for rural areas which are facing load shedding problem. It can be used mainly for irrigation, filtration and water drawing water from wells and other water bodies (M Serazul Islam *et al.*, 2007). Using this process of peddling water can be useful for pumping water from river, ponds, wells and similar water sources enabling poor farmers for pumping water for irrigation and cultivation. To overcome flow problems and to move liquids from place to place, against a higher pressure or to a higher elevation, energy must be added to the liquid. To add the required energy to liquids a pump is used.

Atul.P.Ganorkar, K.S.Zakiuddin, H.A.Hussainconducted an experiment on "Developmentof pedal operatedwater pump". Their machine consists ofthree subsystems namely;

(1) Energy Unit :Comprising of a suitablepeddling mechanism, speed rise gear pairand Flywheel conceptualized as Human PoweredFlywheel Motor(HPFM)

(2) Suitable torsionally flexibleclutch and torque amplification gear pairand

(3) A water pump unit.Though human capacity is 0.lhp continuousduty, the processes needing power even upto 6.0hp can beenenergized by such a machine concept.

Vishal Garg, NeeleshKhandare, GautamYadavconducted an experiment on "Pedalpowered water pump".They found pedal operated pump can beconstructed using local material and skills.This bicycle pedal operatedpumps water at 2-3 gallons per minute fromwells and boreholes

up to 23 in feet depth. Provides irrigation anddrinking water where electricity is notavailable. They can be built using locallyavailable materials and can beeasily adapted to suit the needs of localpeople. They free the user from risingenergy costs, can be usedanywhere, produce no pollution and providehealthy exercise.

Ademola Samuel Akinwonmi, Stephen KwasiAdzimah, Fredrick Oppong conducted anexperiment on"Pedal powered centrifugal pump for purewater supply device". This paper analyzes the design of a pedalpowered purified water supply device to beused by local dwellers. M.Serazul Islam, M.ZakariaHossai andM.AbdulKhadir conducted an experimenton "Design anddevelopment of pedal pump for low-liftirrigation". A study was undertaken todesign and construct a low-liftpedal pump for use in small irrigationproject areas. For this purpose, differenttypes of piston valves and checkvalves were constructed and tested atdifferent suction heads in the laboratory toevaluate their performances.During pedal pump operation, less inputpower was needed and it can be operated byone adult man for a longtime (more than 2 hours) continuouslywithout being tired. Efficiency of the pumpwas 46.53 percent against ahead of 1.65 m. The pedal pump can beconstructed using local materials and skill.It would be suitable toirrigate small and fragmented land holdings,especially to pump water from a shallowdepth (up to 2 m) toirrigate small plots like vegetables andseed beds with less physical effort.

2.2 Types of Manually Energized Machines

There are three types of Manually Energized machines.

Type 1: Power demand far in excess of continuous duty human capacity of 0.13 hp. This needs Fly-wheel and hence H.P.F.M. Possible applications could be water lifting, bricks making,

threshing, food grains crushing, Chaff cutting etc.

Type 2: Power demandsame as that of human capacity continuous duty. Possible applications could be winnowing, wood strips cutting, algae manufacturing etc.

Type 3: Power requires same as that of human capacity but cyclic speed fluctuations are not desired. A small fly wheel is desired in such cases.

2.3 Principle of Lifting and Moving Water

Water may be lifted by any one of the following mechanical principle;

- Direct lift which is involve physical lifting water in a container
- Atmospheric pressure where the water is lifted by atmospheric pressure by creating a vacuum in a chamber which sucks water up to a maximum pressure head of one atmospheric pressure (approximate 10 m)

Positive displacement with involve pushing or displacement of water from a lower to a higher level Creating a velocity head which is the momentum created by propelling or rotating water at high speed is utilized to create a flow or pressure

Using the buoyancy of a gas where the air bubbled through water will cause movement of columns of water due to the difference in specific gravity

Using the impulse(water hammer) effect which is water hammer effect result in sudden sharp rise in water pressure to carry a small part of the supply up to a considerably higher level. Base on the list of the principle lifting and moving water above, bicycle powered water pump is one of the positive displacements with involve pushing or displacement of water from a lower to a higher level. Here, the centrifugal pump inner the modifying electric water pump will be rotate

by the rear wheel of bicycle to pump the water. The water will transfer from some level to other level of water head.

2.4 Water Distribution Pump

Water-lifting devices fall into two main sub-categories depending on where the water is being lifted from:

- Groundwater – Rainfall seeps into the ground and collects in an underground reservoir. The upper limit of the reservoir is known as the water-table and can be just below the surface (as with a spring or oasis) or much deeper. The only way to get at this water is via a natural spring or to dig/drill down and use a water lifting device to bring the water to the surface.
- Surface Water – Water from a lake, river or well may need to be transported to where it is required. Water-lifting devices can be used to make the water more accessible for purposes such as irrigation, drinking or bathing.

2.5 Working mechanism of a rotary pump

In any process plant, a centrifugal pump is used to first convert energy of an electric motor or turbine into velocity or kinetic energy and then into pressure energy of a fluid that is being pumped. The energy change occurs due to the impeller and the diffuser of the pump. The impeller is the rotating part that converts driver energy into the kinetic energy. The diffuser is the stationary part that converts the kinetic energy into pressure energy. All of the forms of energy involved in a liquid flow system are expressed in terms of feet of liquid that is the head (R K Bansal, 2005).

2.6 Energy output and uses for pedal power

The circular pedaling motion at speeds of 60-80 revolutions per minute and transmitting power by sprocket –and chain mechanisms and ball bearing can convert about 95% of muscle energy of bicycle by pedaling, a person can produce four times more energy than by hand movements. Torque is produced from the operator's feet and is transferred to a sprocket and chain that ranges from one third of the maximum torque produced. The use of stationary bicycle, flywheel, elliptical sprocket and gear ratios can minimize torque and increase the amount of generated energy. According to the tests done at oxford university, an average bike rider travels at speed of 12mph.ths speed can produce 1/10 hp. speeds of 18 mph can produce ¼ hp. at a rate of ¼hp, the human body can pedal continuously for 10 min, but at a rate of 1/8hp, continuous pedaling can last up to one Most blenders use between 600-1500 watts of energy, which clearly shows that besides burning calories, pedal power can significantly contribute to reducing energy bills. Pedal power can provide energy to the following operations: meat grinder, wood carver, stone polisher and buffer, jewelers lathe, pottery wheel, juicer, potato peeler, meat slicer, cherry pitter,a butter churn and many more items.

2.7 Conversion of Kinetic Energy to Pressure Energy

The key idea is that the energy created by the centrifugal force is kinetic energy. The amount of energy given to the liquid is proportional to the velocity at the edge or vane tip of the impeller. The faster the impeller revolves or the bigger the impeller is, then the higher will be the velocity of the liquid at the vane tip and the greater the energy imparted to the liquid. This kinetic energy of a liquid coming out of an impeller is harnessed by creating a resistance to the flow. The first resistance is created by the pump volute (casing) that catches the liquid and slows it down. In the discharge nozzle, the liquid further decelerates and its velocity is converted to pressure according

to Bernoulli's principle. Therefore, the head (pressure in terms of height of liquid) developed is approximately equal to the velocity energy at the periphery of the impeller expressed by the following well-known formula:

$$H = \frac{VXV}{2g}$$

Where, H = total head developed in feet

v = velocity at periphery of Impeller in ft/sec

g = acceleration due to gravity-32.2 feet/sec2.

2.8 Development of Human Powered Pump

Standard bicycle gearing components can be assembled with a flexible coupling to create an inexpensive human powered flywheel power unit.As the user pedals, power is stored in the flywheel. The flywheel axle is connected to a transmissiontransfer gear that turns a transmission input gear for a transmission with multiple gears. The power generated by the process of pedaling the bicycle is used to lift the water and push the water from a pipe into the farm for cultivation. The farmers can use this to pump water for irrigation. When the flywheel is not being sped up, it idles. It can maintain a very nearly constant speed for a long time, because thelosses (equivalent to friction) in the bearings are very small. It is sped up to its idling speed, it veryslowly loses speed over some period of time, andthen it is sped up to idling speed again

The suggested machine system uses human energyachieved by pedaling and stores this energy in aflywheel at an energy-input rate convenient to the peddler. After storing the maximum possible energyin the flywheel (pedaling time could be 1-2 minutes)the same can be made available for the actuation ofany process unit by making available the energystored in the flywheel through a suitable couplingand torque- amplification if needed. Thus theflywheel will decelerate depending

on the actualresisting torque offered by the process. It implies that the peddler does not pedal while the flywheel issupplying energy to the process-unit.

2.9 Pump Selection

The most suitable type of pump for this application was found to be a centrifugal pump. Its compact size, simplicity of design, relatively low cost, light weight and widespread availability of pumps and spare parts make it ideal for use in this project. Centrifugal pumps are a well-established technology and consequently their performance is well understood. The performance of a centrifugal pump is governed by the impeller diameter, rotational speed, input power and the output piping system. The pump affinity laws give the relationship between head, flow rate, input power, rotational speed and impeller diameter for centrifugal pumps. Equations below show the pump affinity laws for a pump of constant impeller diameter:

$$\frac{Q_1}{Q_2} = \frac{\omega_1}{\omega_2}$$

$$\frac{H_1}{H_2} = \left(\frac{\omega_1}{\omega_2}\right)^2$$

$$\frac{P_1}{P_2} = \left(\frac{\omega_1}{\omega_2}\right)^3$$

Q = flow rate (l/min)

H = head (m)

P = power (W)

ω = rotational speed (rpm)

CHAPTER THREE

METHODOLOGY

3.1 DESIGN AND EXPERIMENTAL SETUP OF PEDAL OPERATED WATER PUMP

The PPCP consists of mainly three parts,the first is centrifugal pump, thesecond is the bicycle,and the third is the stand. PPCPconsists of a centrifugal pump operated bypedal power and the centrifugalpump is positioned on its stand in such away that driven shaft of the centrifugalpump is butted to the bicyclewheel. By pedaling the bicycle, the bicyclewheel rotates, thereby rotating thecentrifugal pump which in turnsdischarges water from the sump

3.2 Design of Equipment

A bicycle pumping system that can be used to pump water for irrigation and small sector area like gardening, floor cleaning works etc...It is a very small mechanism on which our project is based on. The mechanism consists of single centrifugal pump which is fixed with the rear wheel bicycle. Paddling for just a minute or two is enough to pump water. Project could prove helpful for rural areas. Which are facing load shedding problem? It can be used mainly for irrigation and water drawing, water from wells and other water bodies. This is a centrifugal water pump which is run by rotating the pedal of a cycle. The system comprises a bicycle, rim, impeller, pulley and inlet and delivery pipes. A wheel is connected to another gear with a smaller diameter the final supporting shaft is connected with an impeller through this process of paddling is used to lift water from a pipe into the form for cultivation. This innovation is useful for pumping water from river, ponds, wells and similar water sources thus enabling poor formers for pumping water for

irrigation and cultivation. I drove a bicycle by using a paddling the wheel of the bicycle rotates a particular rpm and this wheel rotates the impellers of the centrifugal pump

3.3 Working Mechanism

The rare wheel of the bicycle is rotated with the help of driver and driven gear of the bicycle. The chain drive of the centrifugal pump is connected to the rare wheel hub of the bicycle; it also rotates when the rare wheel of the bicycle is rotated with the help of the rotation system. The shaft of the centrifugal pump rotates up to 3700rpm.With the rotation of the great speed the vacuum is created in the centrifugal pump and this vacuum in this centrifugal pump suck the water from the water tank and it discharge the water through outlet with some amount of pressure.

MAIN COMPONENTS OF PEDAL POWERED WATER PUMP

The pedal powered water pump consists of the following components they are:

1. Centrifugal pump
2. Gear
3. Bicycle
4. Power transmitting unit (Chain drive from rear wheel hub to pump shaft)
5. Inlet and outlet tubes of the centrifugal pump
6. Bucket of water
7. Axle lift(stand)

Fig 3.1 Main components of ppwp

3.4 Definition of Pump

Pumps convert mechanical energy into fluid energy which can be explained as a pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. A pump is a device used to raise, compress, or transfer fluids from one place to another. When a fluid, be it hot or cold, has to be "moved" in a system, pumps are used. In other words, in a more technically appropriate manner, the pump is a machine which has the function of increasing the total (mechanical) energy of a liquid; this means that the pump transfers energy to the fluid that it receives f room the driving motor.

Fig 3.2 A pump

3.4.1 Classification of Pump

Pumps can be classified into two major groups according to the method by which mechanical energy is transferred to the fluid.

1. Rotor dynamic typed pumps

2. Positive displacement pumps,

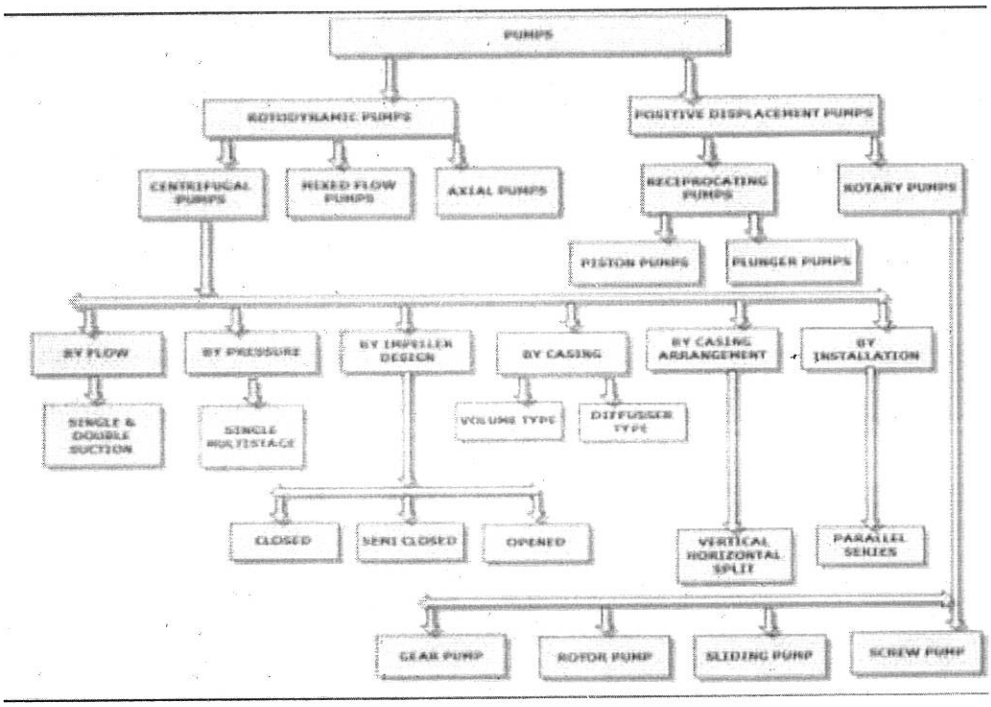
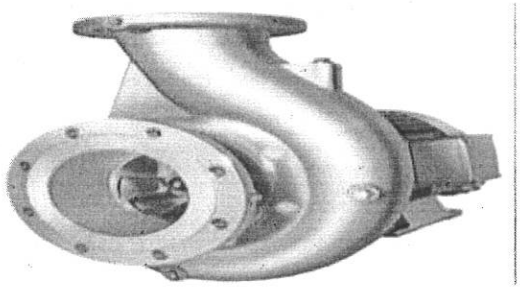


Fig 3.3 Block diagram representation of classification of pumps

3.4.2. Centrifugal Pump

A centrifugal pump is a rot dynamic pump that uses a rotating impeller to increase the pressure and flow rate of a fluid. Centrifugal pumps are the most common type of pump used to move liquids through a piping system. The fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward or axially into a diffuser or

volute chamber, from where it exits into the downstream piping system. Centrifugal pumps are typically used for large discharge through smaller heads. Centrifugal pumps are most often associated with the radial-flow type. However, the term "centrifugal pump" can be used to describe all impeller type rot dynamic pumps including the radial, axial and mixed-flow variations.



3.4.2.1 Main Parts

A centrifugal pump is of a very simple design. The two main parts of the pump are the impeller and the diffuser. Impeller, which is the only moving part, is attached to a shaft and driven by a motor. Impellers are generally made of bronze, polycarbonate, cast iron, stainless steel as well as other materials. The diffuser (also called as volute) houses the impeller and captures and directs the water off the impeller.

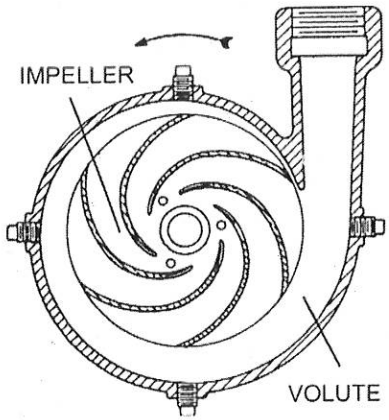


Fig 3.4 main parts of a centrifugal pump

3.5 BUILDING THE PEDAL POWERED WATER PUMP

The first thing is to acquire a normal bike which thenneeds to be modified so as to double up as a pedalpowered water pump. Since we don't want to lose the transportation capabilities of the bike, it is designed tohave two modes, a transportation mode and a pumpingmode. The overall design is composed of the followingparts;

1. The supporting frame

A triangular shaped supporting frame can be designed using CAD software as shown in Figure 3.5. It can then befabricated using steel and incorporated to the bicycleaxle.

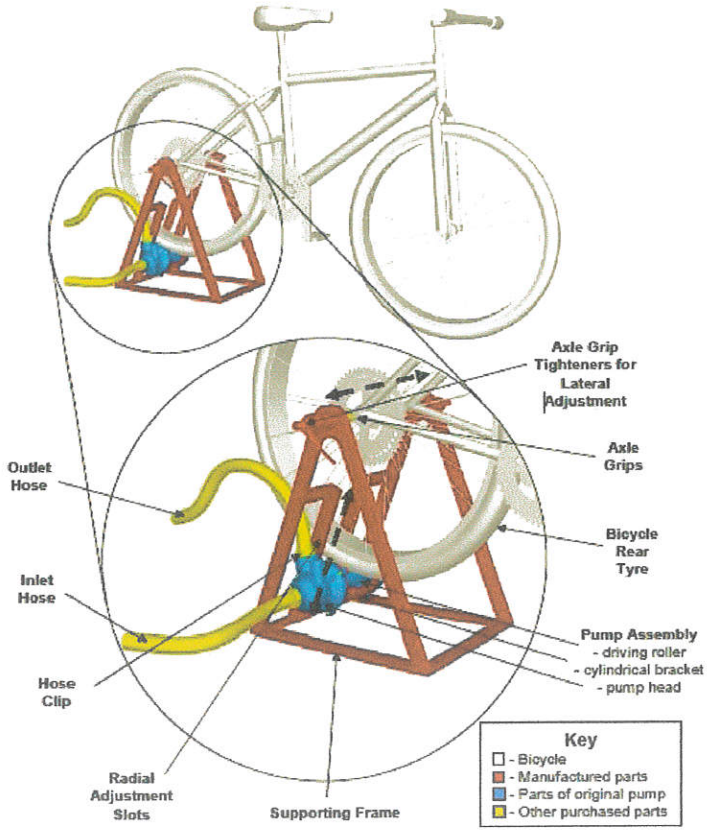


Fig 3.5 Annotated CAD illustration of the prototype in use

To fabricate the supporting frame, a few tools will beneeded including a chop saw for cutting the pieces tosize, an arc welding machine for welding the frame, abench grinder to smoothen the welded joints and a drillpress to bore the slots used to attach the supportingframe to the rest of the bicycle. Modifications can bedone depending on the available materials andequipment. As mentioned earlier, the supporting frame isdesigned such that it can be flipped up to act as a rackwhen the bicycle is in the transportation mode.

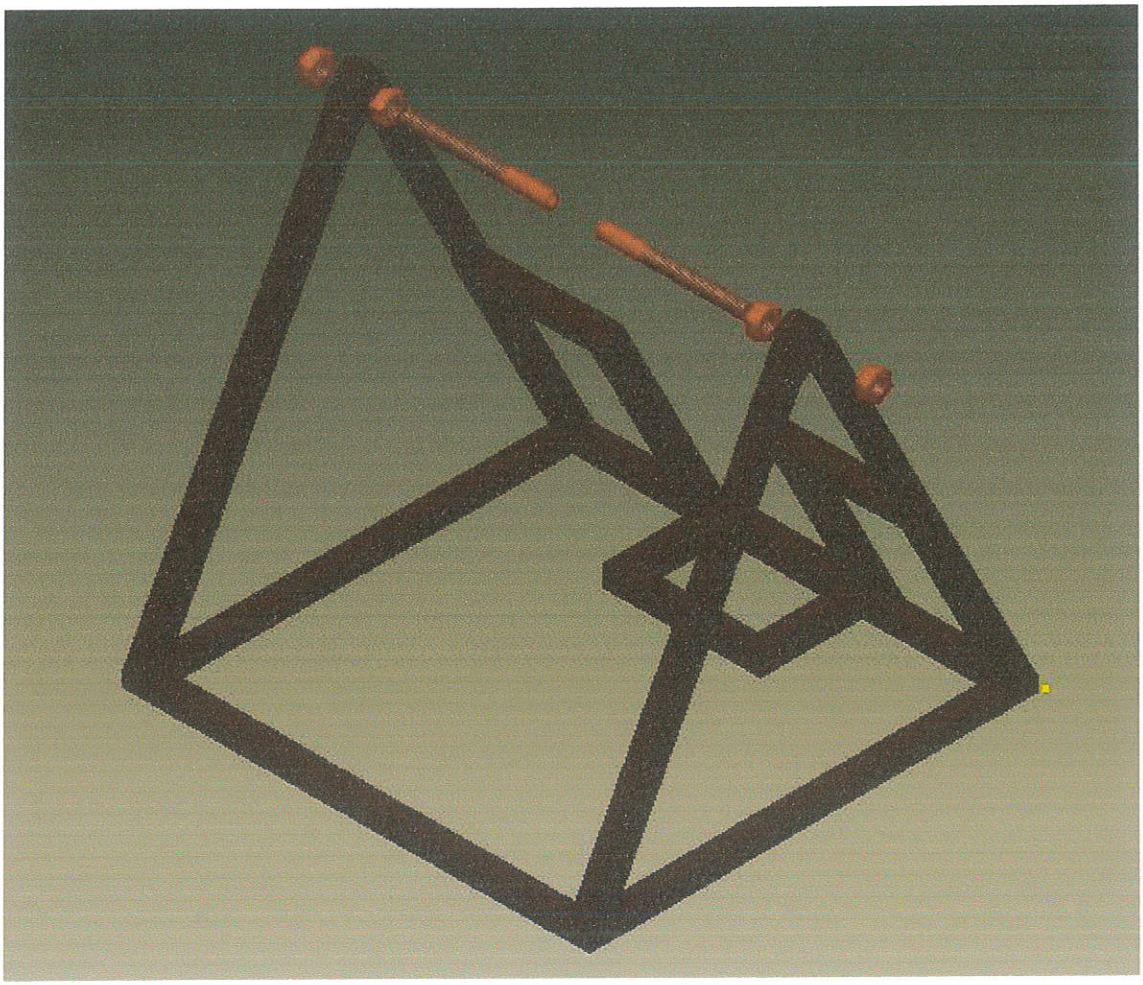


Fig 3.6: Annotated CAD illustration of the exploded frame.

2. Centrifugal pump

This should be sized based on the exact purpose of thepedal powered pump. Specifications of the requiredhead, intended flow rate and the depth of the watersource are needed in order to accurately specify thesuitable pump. A suggestion would be a pump withapproximately a 35m head, 350Wpower and a flow rateof 40litres per minute. The pump then needs to beincorporated in the rear end of the bike with itsarmature used as a roller which is friction driven by the tyre at the rear end. This setup helps to rotate the pump at the required speed

3. Fabrication, testing and optimization

After fabrication of the pump as shown in Figure 4, thenext phase is testing and making modifications tooptimize the performance. Among the parameters to betested include the depth up to which the pump canretrieve water simply called the suction head as well asthe maximum height to which the pump can lift the water is simply called the water head.

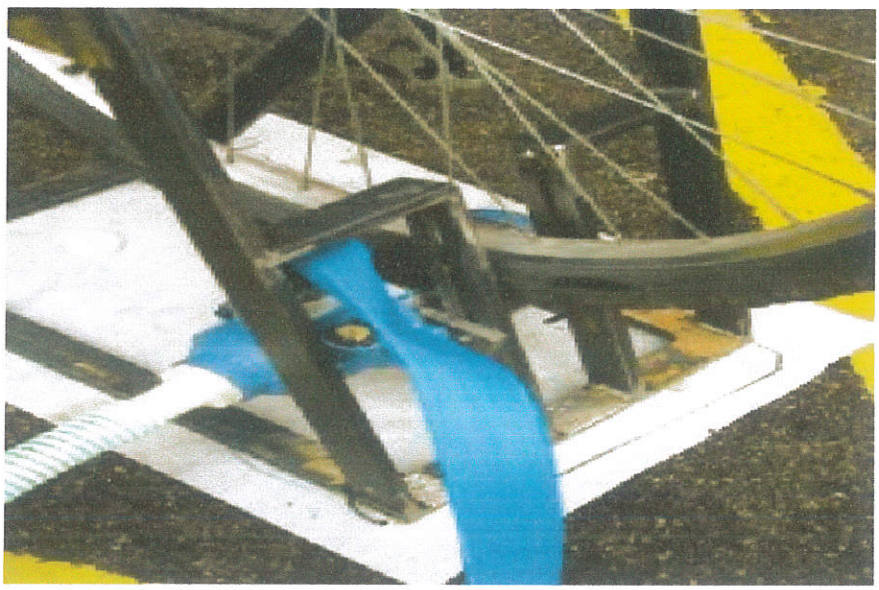


Fig 3.7: fabricated pedal water pump

Assembly of Pedal Powered Water Pump

The pedal powered water pump includes the pump chain drive with driver and driven. The driver of the pump chain drive consists of 50 numbers of teeth and it is placed on the centre hub of the rare wheel of the bicycle and the driven gear is consisting of 18 number of Teeth's.

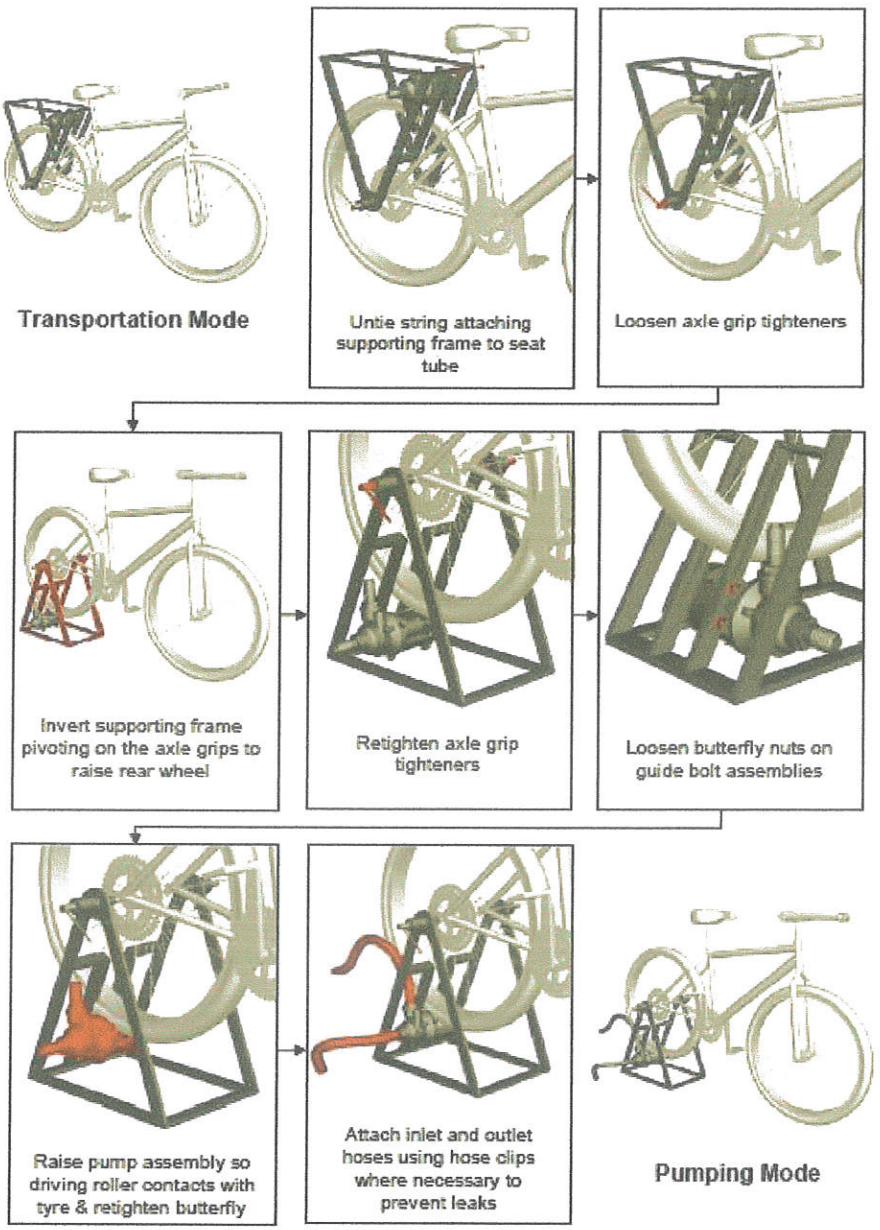


Fig 3.8: Process flow diagram showing the steps needed to go from transportation Mode to pumping mode

It is connected to the shaft of the centrifugal pump the single station stage pump of 0.5hp. The shaft diameter of 3.3 cm and length of the shaft 22 cm without electric winding is placed on the carriage of the bicycle. The carriage of the bicycle is placed on the rare wheel of the bicycle.

- Diameter of the driven d2=5.5cm
- Maximum speed of the driver N1=2850rpm
- Maximum speed of the driven N2=3700rpm
- Teeth of the driver Td1=50 numbers
- Teeth of the driven Td2=12 numbers
- The center length between driver and driven x=47.5cm

MODEL CALCULATION:

L1=(for cycle)

Where,

R1= radius of the driver= 8cm

R2=radius of the driven=3.6cm

X1=the centre length between driver and driven=45cm

$L1= (8+3.6) +2*45+ (8+3.6)^2/45$

L1=126.42 cm

Where L2=(for pump)

R1= radius of the driver=10cm

R2=radius of the driven=2.75cm

X2=the centre length between driver and driven=47.5cm

$L2=+2\times47.5+(10-2.75)^2/47.5$ L2=138.9cm

Speed ratio :- (for cycle chain drive)

Speed of the driver/speed of the driven= number of teeth on the driven/no. of teeth on driver=

N2/N1=d1/d2=t1/t2

=450/80=16/7.2=40/18

Speed ratio= 56.25: 2.2: 2.2

Where

N1=Speed of the driven =450rpm

N2=Speed of the driver=80rpm

D1=diameter of the driver=16cm

D2=diameter of the driven=7.2cm

T1=teeth of the driver=40numbers

T2=teeth of the driven=18numbers

Speed ratio (for pump chain drive):

Seed of the driver/speed of driven=number of teeth on driven/number of teeth on driver=

N2:N1=d1:d2=t1:t2

3700/2100=20/5.5=50/12

Speed ratio= 1.3: 3.6: 4.1

- Power (p) =$2\pi NT/60$ KW

Where

N=speed of the motor shaft=3700 rpm

T=total torque produce in the motor shaft

3.6 ADVANTAGES OF PEDAL POWERED WATER PUMP

1. It is needed till the human existence on this planet and the ultimate source is the human himself.

2. Pedal renewable is cost-effective so everyone can access to its advantages. There is only need to set pedal with crank system attached to the drive.

3. It is pure energy zero percent carbon emission so clean and healthy surroundings.

4. It keeps the body system well and increases the efficiency level if used to a certain extent. Excess use of anything is bad for health.

5. It does not harm the socio-political benefits as it is the personal property of every individual.

6. The conventional centrifugal pump needs either electricity or diesel engine, but the present innovation works on pedaling. This is a non-polluting and environment friendly device. Since it is made of commonly available materials and costs less. It is affordable to common people. It requires less maintenance Minimum input energy is required to get the maximum output of water. This device can be transported easily from one place to another.

3.7 DISADVANTAGES

Continuous pedaling action is required for system operation so that lot of work cannot be executed.

It is not suitable for maximum lift water.

High man power required.

3.8 MATERIALS USED AND COST ESTIMATION

➢ Bicycle	#10000
➢ Atlas self-priming pump	#12500
➢ Hoes and valve	#4,000
➢ Axle lift construction	#5,500
➢ PVC pipe	#500
➢ Miscellaneous	#10,000
Total cost of production rounded up	#42,500

3.9 DESIGN SPECIFICATION

A design specification was drawn up to ensure that the water distribution pump would meetthe requirements of the peddling water pumping machine

Essential Features:

Must be pedal powered

Must be cheap and easy topartsmaintain by local people

· Must be hygienic if used fordrinking water

· Must not require electricity different situations or fuel

· Must not require electricity or fuel

· Must be robust

· Must be easy to use

· Must be stable when in use

· Must be affordable

Desirable Features:

• Should be easily transportable·

• Should use standardized parts to reduce cost and allow easy maintenance

• Should be made entirely from bike

• Should require a person to operate

• Should be adaptable for many different situations

• Should pressurize the water for distribution

• Should be usable by men, women and children of varying sizes

3.10 DESIGN DRAWINGS

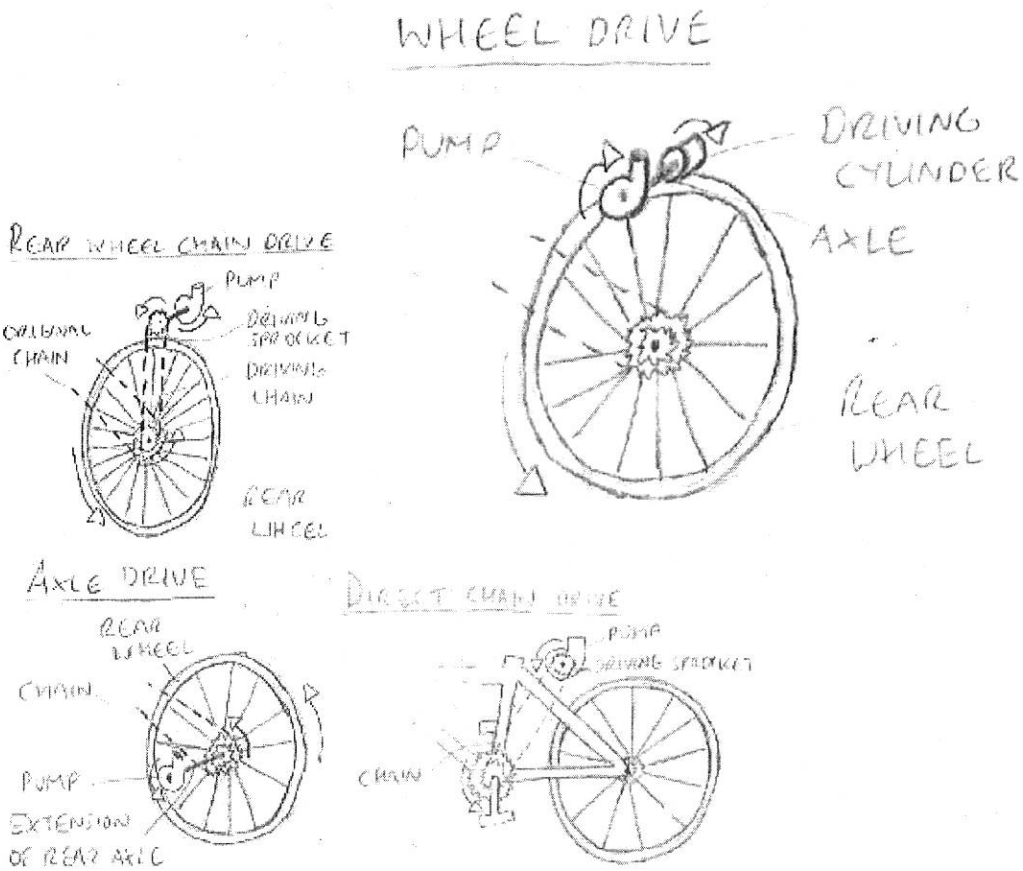
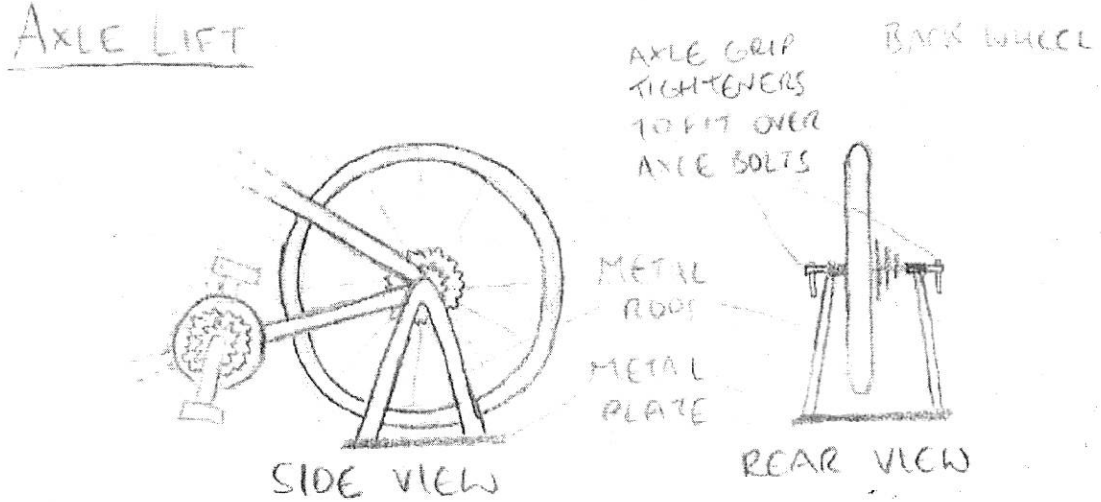


Fig3.9 Sketch diagrams of the wheel drive and other possible driving mechanisms



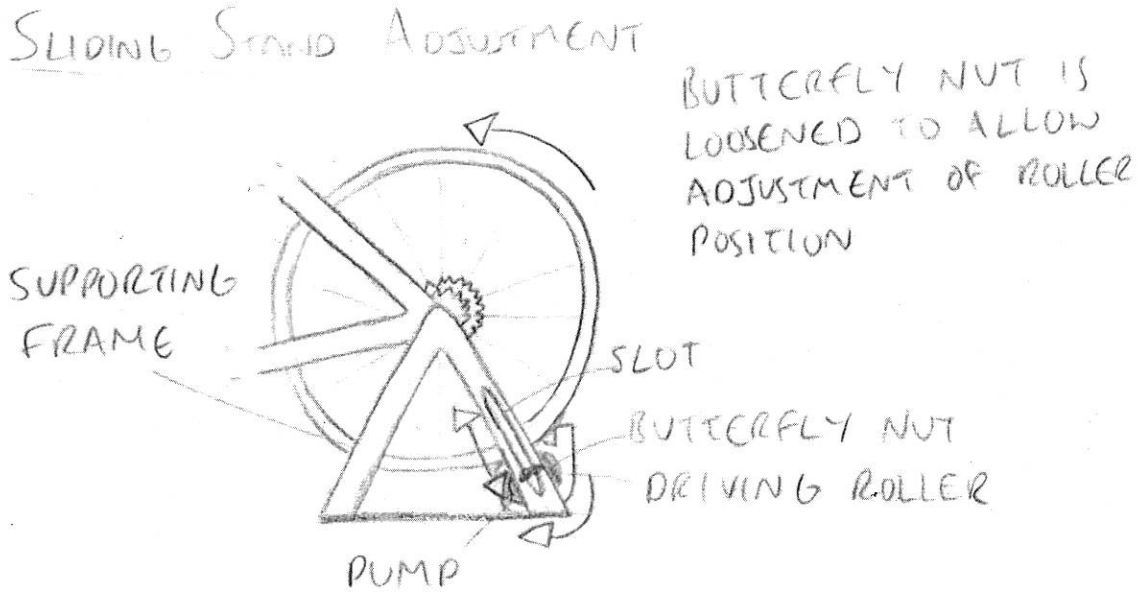


Fig3.10 Sketch of the sliding stand adjustment design and axle lift

CHAPTER FOUR

RESULTS AND DISCUSSIONS

The Figure gives the variation of discharge with rotor shaft rpm of pedal power centrifugal pump. It is observed that the discharge increases uniformly with the rpm. Experimental result shows that discharge of about 0.0025m3/scc can be obtainecd for around 140rpm. Thc variation in the obtained plot is due to errors in observation and due to power transmission losses.

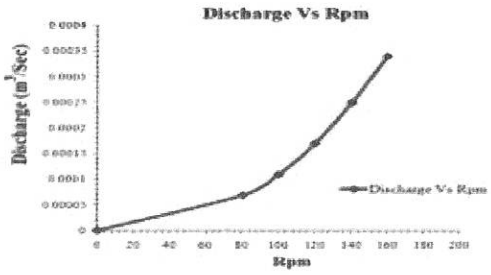


Figure 4.1: Variation of Discharge with Rpm

Figures shows the variation of head with discharge of PPCP. It is observed that the head decreases uniformly with discharge. Experimental result shows that head of 8m can be obtained with discharge of about 0.00007m3/sec. The variation in the obtained plot is due to errors in observation and due to power transmission losses.

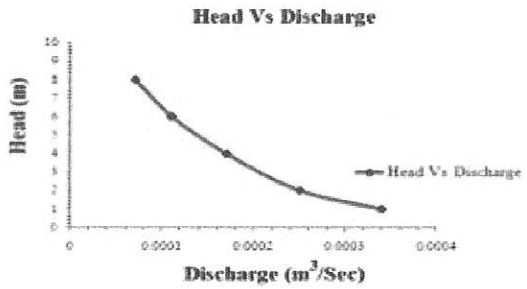
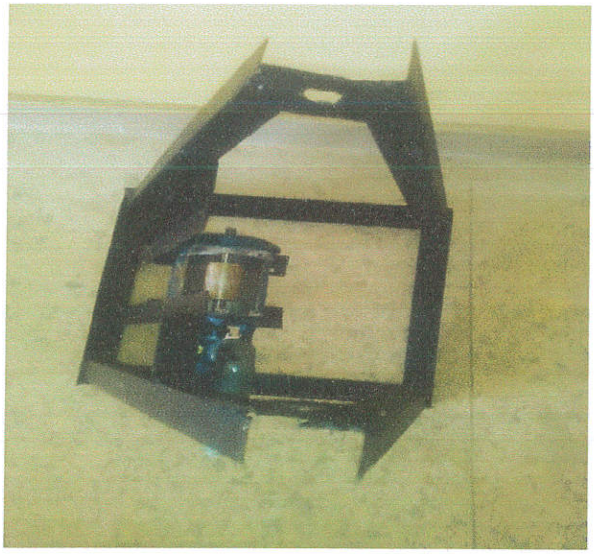


Figure 4.2: Variation of Head with Discharge

Motor rating: 0.5 HP

Head Range: 2-10m **Horizontal Range**: 5-7m

Suction head: 1.5-4m **Discharge**: 0.8-12.3 m3/hr



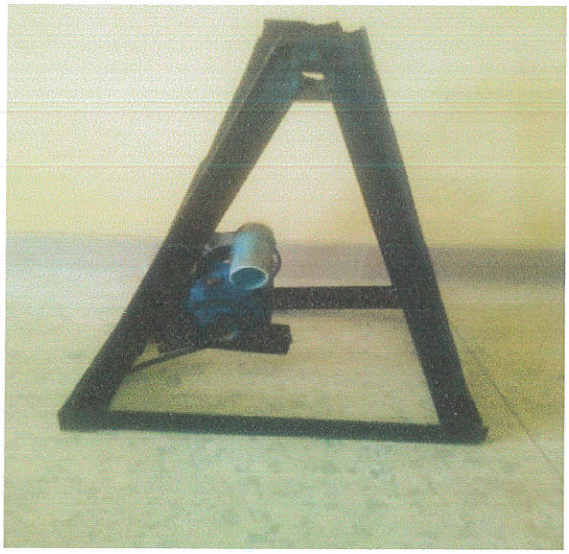


Fig4.3 Design results

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

At a time when there is energy crisis casting its shadow all over the world, one has to look into alternate renewable energy resources. One such alternate way to generate power is presented in this paper. The Kinetic energy of the gear in terms of velocity ratio is generated by pedaling, which can be used to operate small powered devices. The various applications where this power could be used are also discussed in this paper. Villagers who use bicycles are going to be benefited the most. I have successfully proven the calibration and working of centrifugal pump with pedal power of bicycle type for gardening purpose and it is also suitable for small scale work.

5.2 LIMITATIONS AND RECOMMENDATIONS

5.2.1 LIMITATIONS

The limitations are as follows;

- Purchasing of 0.5HP pump rather than 1.0HP pump due to the current financial situation of the country.
- Fabrication of axle lift(parts and material selection) which took longer time due to the current electricity situation in the state.
- Availability and cost of bicycle in this vicinity
- Poor electricity to conduct further research

5.2.2 RECOMMENDATIONS

With regards to the process undertaken in the compilation of this project; the observations made and the system developed, the following recommendations have been drawn

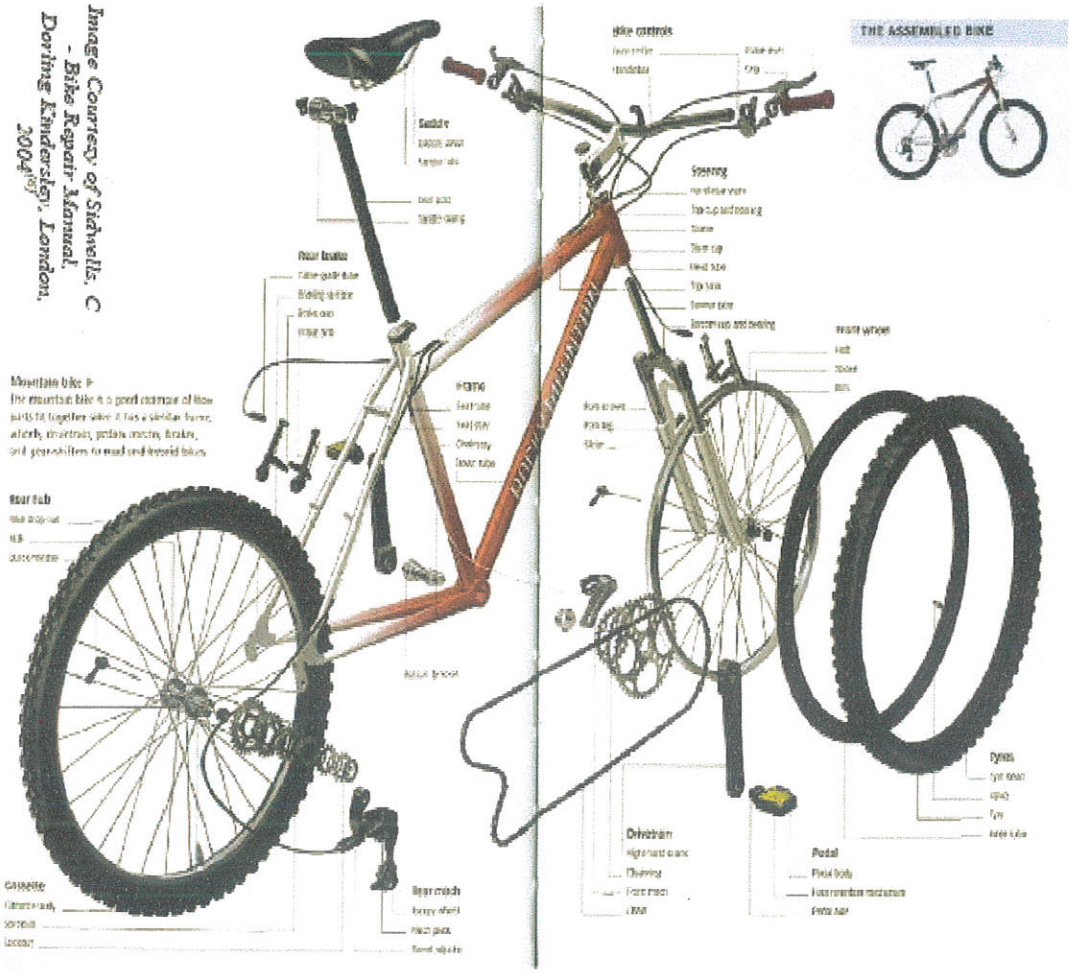
- The design method should be adopted by government especially for places with inadequate or no power supply as this will enhance agricultural production and ease living.
- In order to improve the performance of this design, a standard bicycle with full function should be used as well as higher pumps ranging from 1.0HP-2.0HP so as to increase the pumping range of the design.

REFERENCES

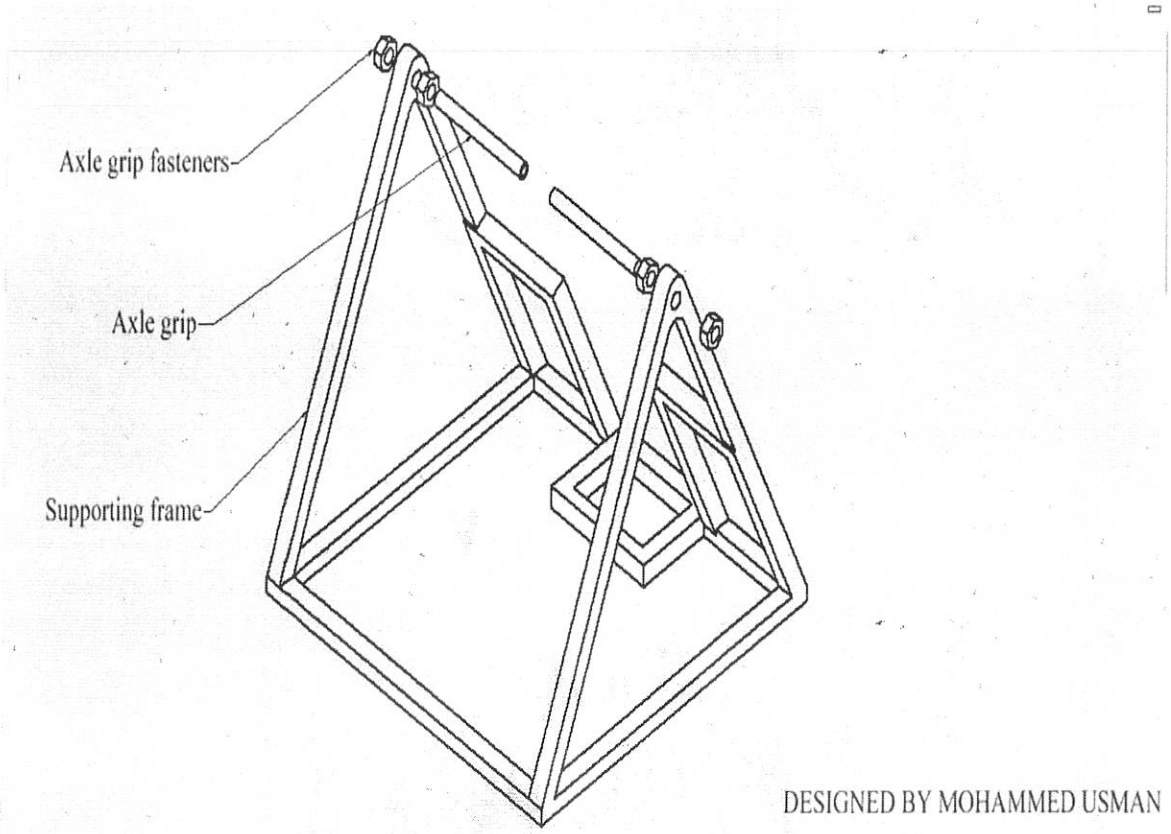
1. M Serazul Islam, M ZakariaHossain and M Abdul Khair (2007), "Design and Development of Pedal Pump for Low-Lift Irrigation" Publisher JARD
2. R K Bansal (2005), "A Text Book of Fluid Mechanics and Hydraulic Machines".
3. Whitt, F R and Wilson, D G - Bicycling Science (2nd edition), MA: MIT Press,Cambridge, 1982
4. Dixon, S L - Fluid Mechanics, Thermodynamics of Turbomachinery (4th edition),Butterworth-Heinemann, Oxford, 1998
5. Burke, E R – High Tech Cycling (2nd edition), Champagne (USA), 2003
6. Parry-Jones, S - Optimising the Selection of Demand Assessment Techniques for WaterSupply and Sanitation Projects, London School of Hygiene & Tropical Medicine andWEDC, Loughborough University, 1999
7. Colin, J - VLOM for RuralWater Supply: Lessons from experience, WELL, London,1999
8. Sidwells, C - Bike Repair Manual, Dorling Kindersley, London, 2004
9. Aderibigbe, D.A.; and Fei, C. 1987. The Development of the Niger Pump Model (HO-2) A Hand Operated Deep Well Pump Suitable for Rural Community. Proc. Ann. Conf. Nigerian Soc. Engineers.
10. Bamiro, O.A. 1987. Design and Construction of water hand pump for rural water supply. Proc. Ann. Conf. Nigerian Soc. Engineers.
11. Ernest, J.M.; and Mark, S.S. 1982. Human Factors in Engineering and Design. McGraw-Hill, New York, NY, USA.

12. M. ZakariaHossain, M. Serazul Islam And M. Abdul Khair "Design and Development of Pedal Pump for Low-Lift Irrigation" Publisher *JARD*
13. Stephan KwasiAdzimah, AdemoloSumuelAkinwanmi, Fredrick Oppong "Pedal Powered Centrifugal Pump Purified Water Supply Device" Published by *Innovative System Design And Engineering*.
14. www.mayapedal.org

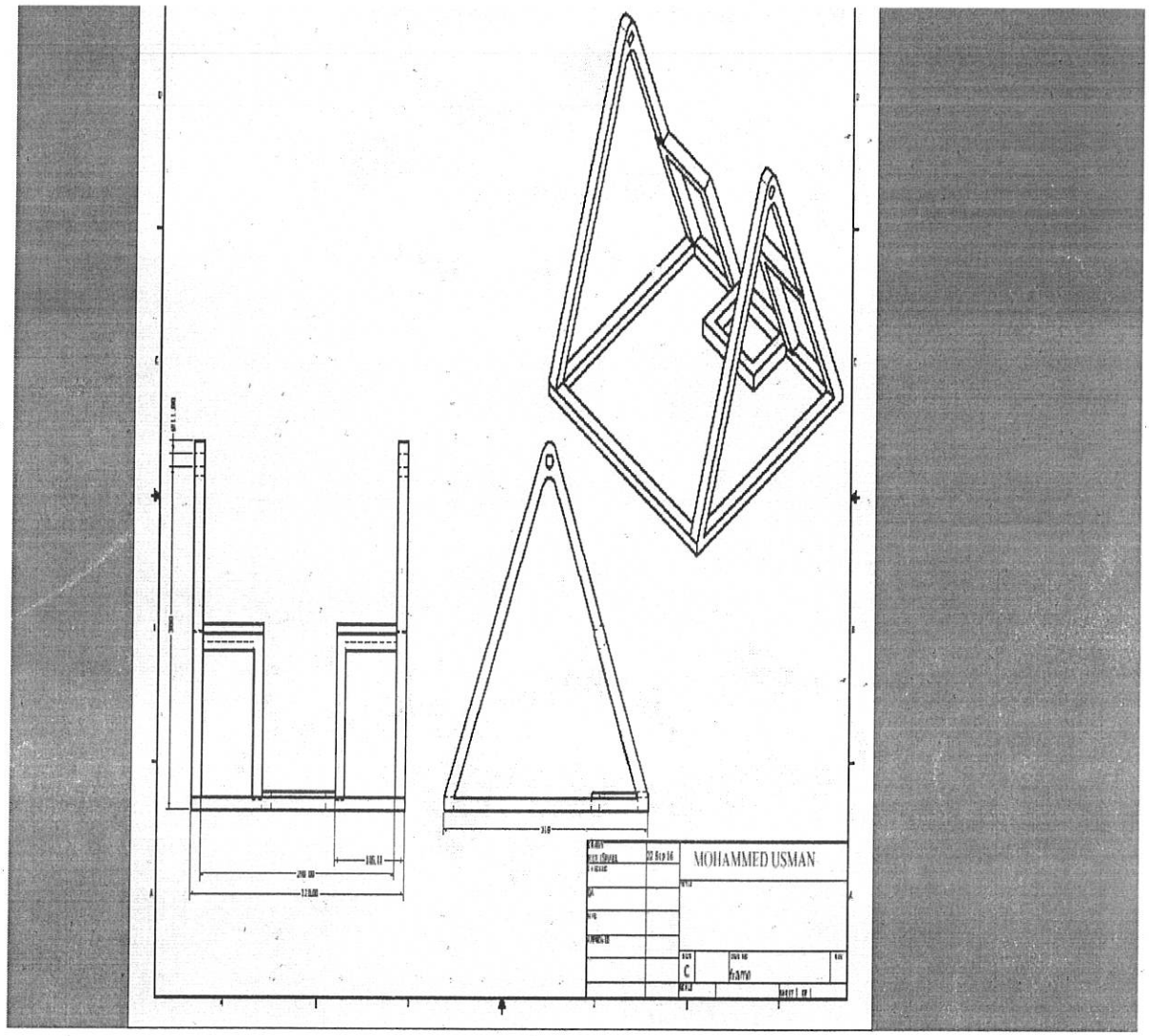
APPENDIX



Anatomy of the modern bicycle



Exploded view of frame assembly



Projection view of the frame