MAT JOURNALS
Journal of Recent Trends in Mechanics
Volume 1 Issue 3

Multipurpose Pedal Operated Power Generation and Water Pumping

Shrinivas Timmanagoudar[a], Ravi Kamballa[a], Mahalaxmi K[a], Avinash a[a], S. N. Mathad[b]

[a]Department of Mechanical Engineering, K.L.E.I.T, Hubballi

[b]Department of Physics, K.L.E.I.T, Hubballi

physicssiddu@gmail.com

Abstract

Diversion is required for basically right success, for the traverse of endeavor ton of constrain is used by using human which is misused. This waste vitality is used for the workplace cycle and to run pump manhandle our attempt appear. We tend to waste gushing imperativeness into a fundamental power. With eco-pleasing methodology In this venture work an endeavor has been made to improvement of theoretical model of water pumping and battery charging cross mentor that is easy to use, easy to attempt and do work out, spare & stores the vitality of the clients muscle endeavors. Once the human works the pedal, the pump is propelled and consequently the water is wired from ground sump to the tank. Subsequently no extra water is squandered. In our venture a demo of this is frequently appeared. At indistinguishable time the associated generator (i.e., is mounted near the V-belt) works and subsequently the vitality is recover into current.This is often wont to charge the mobile exploitation mobile charging circuit. It additionally includes a separate unit known as generator, connected to back wheel of the cycle as just in case of pump through V-belt and simple machine affiliation. This generator additionally converts energy into associate current. The generated current is hold on in battery with the assistance of wires. The stored electrical energy is employed after we are required.

INTRODUCTION

The body wellness gear's had real come in routine existence of city populates. Body wellness hardware's smolders the fat and remains fit. There is appeal and utilization of body wellness gear's because of absence of sufficient space to work out. In present situation of wellness industry, parcel of research and improvement is done to convey wellness innovation to entryway steps. There are mind blowing verity of instruments is accessible in market with

verity of components. Cross coach is likewise such a wellness devise used to smolder body calories, by method for accelerating the fake wheel and brake course of action, which is connected to the hand leavers. By this, it could highlight that work out with Cross mentor has certain impediments, for example, loss of human muscle control. Cross mentors will change over the muscle control into break control (BHP) which is lurked to grating brake drum. So to beat these obstructions, cross coach are should be utilized for utilize full work. There are couple of answers for working cross mentors for helpful work, for example, water pumping and power generator. However, there are no such agreeable arrangements with an ease establishment. The building arrangement is to receive mechanically work cross coach for water pumping at a moderate cost and most extreme adaptability with least upkeep. Man developed the majority of the things for his solace and accommodation [1]. Electricity is one of them. Now a day, the production of electricity is from hydraulic power plant, thermal power plant, wind power plant etc.. In the hydraulic power plant, the kinetic energy of water is used to run turbine and convert into mechanical energy and again into electrical energy by connecting generator. In the thermal power plant, the kinetic energy of pressurized steam is used to rotate the turbine and generate electricity. In wind power plant, the kinetic energy of wind is converted into electricity. In the human power generator, it works on the principle of convert muscular or physical energy of person into the electrical vitality by method for applying pulley game plan. The pulley game plan changes over the endeavors which is connected by individual into the turning movement which is utilized to create power and this power will be utilized as a preparatory prerequisite of power furthermore utilization of sun based vitality by method for sun powered cell for era of power for use in stationary and portable condition furthermore utilization of AC machines by utilization of inverter [2].The dynamo in the bike utilizes pivoting curls of wire and attractive fields to change over mechanical revolution into a beating direct electric current through Faraday's law of acceptance. A dynamo machine comprises of a stationary structure, called the stator, which gives a consistent attractive field, and an arrangement of pivoting windings called the armature which turn inside that field. The pivot of the rotor inside the attractive field causes the field to push on the electrons in the metal, making an electric current in the wire.On small

machines the constant magnetic field may be provided by one or more permanent magnets; larger machine shave the constant magnetic field provided by one or more electromagnets, which are usually called field coils. Thus, by the above mechanism dynamo charges the battery. There are few reports available in different modified cycle[1,3-6].

Experimental setup

Firstly modified cycle frame is taken and it is mounted on the base plate as shown in below fig. on the other side of the base plate we mounted the centrifugal pump and alternator with equal distance. These two are in the same axis. Taking diameters of cycle back rim and pulley and the distance between these two, we calculate the length of V belt. This V belt is connected between pump's pulley and cycle rim when water lifting is needed. In other way we can switch it to alternator pulley when power generation is needed. This is how water pump and alternator are assembled. Alternator is connected to battery for further use of power. In addition to this a dynamo is placed below the seat, in such a way that dynamo's wheel is touching the V belt. Our project also had electrical connections such as moisture sensor circuit and mobile charging circuit. A moisture sensor circuit demo is shown in this project.

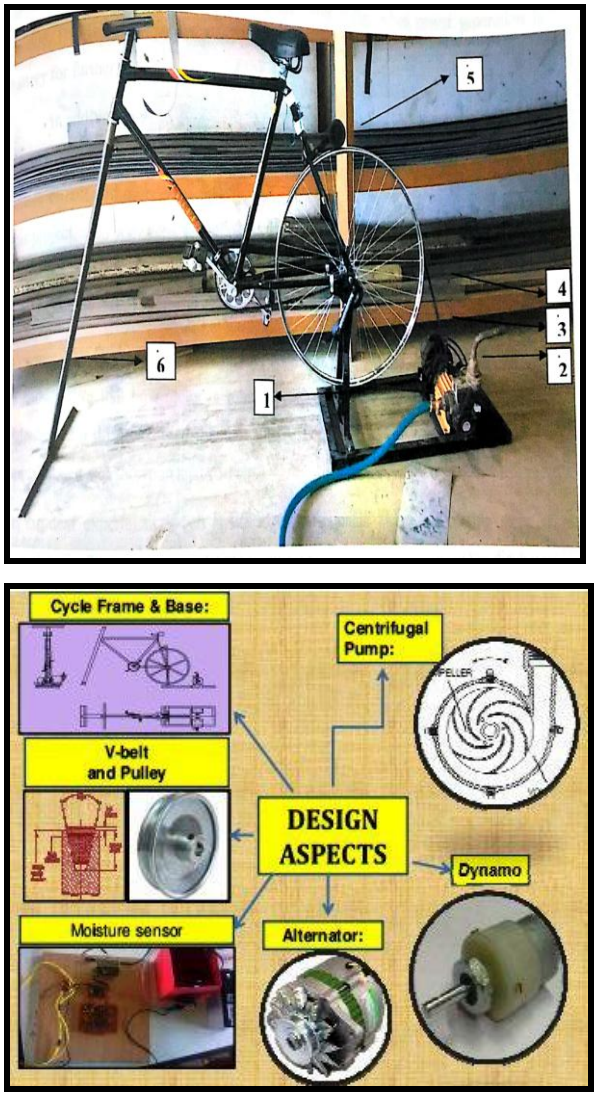


Fig.1. *Design Aspects Of Multipurpose Pedal Operated Power Generation*

METHODOLOGY

The conventional energy sources may last in future days which can create a lot of problems. The method of generation of electricity from natural resources takes a very important role now days. The method of generation of from such resources is treated as non-conventional method of

power generation. We can use the natural resources like solar and wind power is already in use these methods while implementing in real time required lot of initial cost and the method shown here uses the simple mechanical technique which converts from mechanical energy to electrical energy and also mechanical transmission required for the pump.

The methodology we used in our project is very simple which consists of cycle back wheel an alternator, a centrifugal pump, V-belt and pulley. It is simple to operate. In this methodology we are going to tell you how we did the project in step wise.

Step 1: We took an old waste bicycle and converted it into our desire requirements. In our requirements front wheel was not useful so we removed it and fixed a stand which gives a more stability while pedalling the cycle. And also it helped to get onto cycle and as well as to get down off the cycle very easily. The stand is made of MS steel and it is bit inclined as in the motorcycles to have better balance and stability. So in this first step it gives a good human comfort.

Step 2: In the next stage which is more important stage. It is that selection of alternator and centrifugal pump. We considered mainly 2 type of alternator those are AC alternator and DC alternator. In these two AC is more advantageous then the DC alternator. An alternator along with diode rectifier instead of a DC generator is better choice as the complicated commutation is absent here. The dc dynamos are replaced by more robust and light weight alternator called as AC alternator. Among all these by keeping cost, power production, and efficiency in mind we selected this alternator. Its specification and importance is given below

Step 3: Then let us come to the pump part. Initially we planned to do the reciprocating pump with piston and cylinder arrangement. It has the less efficiency and it is of non-continues type, where water flows in pulses. So the next option left is centrifugal pump which has better discharge when compared to reciprocating pump. And also it is going to give continuous discharge until you stop the pedalling. Here we not done the fabrication of the centrifugal pump, instead we used old waste centrifugal pump. Because in economy point of view, it is better to use the waste pumps instead of fabricating them. So this work made our project as eco-friendly. Hence the waste products made as useful products. Now let us see how this waste pump is going to work. The ultimate aim of the centrifugal is to make rotor to rotate. In normal pumps

it is going to be done with help of power connection. But in our project we make the rotor to rotate with help of pedalling. In waste motor, most of the cases rotor will be in good condition except for corrosion and struck of bearings. These two defects may overcome by the oiling process. Hence using of waste pumps is not so difficult one. For all these reasons we used centrifugal pump which has main idea of recycling in efficient way. But these pumps need one alteration ie the fan inside the pump need to be replaced by the pulley. So we removed the fan and mounted the pulley on rotor shaft with help of bolt. For a centrifugal pump to run, rpm is required around 1500-1600 with efficiency of 60 to 70%. This is achieved by drive system (pulley and V-belt).The specification and importance is given below Table No.

Specifications	
Suction	**3 meters**
Power	**0.5HP**
Speed	**2880rpm**
Size	**25*25 meters**
T. Head	**20 meter**
Discharge	**10501pm**

Step 4: According to the dimensions of alternator and pump we fabricated a base. On this base we mounted cycle stand, alternator and centrifugal pump.

Step 5: After this initial adjustment, a pulley is attached to the centre of back wheel ie to the sprocket. Then on conducting experiment we came to know that its efficiency is very low. It is because of the almost same diameter ratio from input to the output. (design1) So we decided to have higher diameter ratio. In between the input and output we must keep a bigger diameter pulley so that we can achieve higher diameter ratio. Instead of using other pulley we used rim of the back wheel by removing its tier. And also this acts like a flywheel. Due to this we get continuous type of output discharge. (design2)

Disadvantages of design1 are

- It has almost same diameter ratio. Hence it has no flywheel
- Desired speed of the pump is not reached
- It gives low discharge
- It is not able to meet required head as specified in the pump
- Extra pulley arrangement was needed. Whereas no need of having extra pulley in the back wheel in design2 where back rim acts as pulley as well as flywheel

Step 6: design 2 is considered the most suitable and efficient way of having output. According to this design we calculated the length of V belt. This length

should fit rigidly onto the pulley. For this calculation we considered diameter of rim and pump's pulley diameter and alternator's pulley diameter. In addition to this, we took the length between centre's of back rim and pulley of alternator or pump. Using all these date we calculated the length of V belt. This length pulley is manufactured and made it as closed one. This is inserted into rim by some adjustments like opening the support of back rim.

Step 7: in our multipurpose project we included electronic part. The electronic part such as moisture sensor and mobile charging circuit included. The reason to use this one is because of mainly two reasons. The first one is today most of water is wasted in gardens due extra flow of water. And also in opposite sense gardening is wasting due to lack of supply of water. Hence to avoid this we making use electronic part called moisture sensing circuit.

Parts involved in this are:

- Transformer
- Regulator
- Microprocessor
- Zener diode
- Relay

By using moisture sensing circuit and relay we can automatically switch on or switch off the pump once if the moisture dries. Using a microcontroller we initially set the value of soil's moisture in one of the inputs. If the soil reaches this value that means if soil dries automatically pump is going to on with help of relay. Hence automatic control is established.

Step 8: A small dynamo is taken and it is attached to the support as shown below. This is provided to have comfort for the human while pedalling. This is also same as that of alternator in working principle. But it is used for small current generation as in case of mobile charging. An mobile charging circuit is provided to use.

Step 9: after all these set up we started our experiments. Firstly we calculated the required power produced by the alternator for different speeds. Then discharge is calculated for pump for different heights. These all calculation and result analysis are calculated in the next chapter in detail.

CALCULATION AND RESULT ANALYSIS

Alternator calculations

Trail 1

Time taken for pedalling(t)= 30 seconds

No of revolutions by pedal= 27 revolutions

An average current produced= 3A

An average voltage produced= 12V

Load current rated on device(LED)= 2.5A

1. Time required to charge 12volt battery is(T_c)=

$$T_c = \frac{\text{standard Ah of battery}}{\text{average current produced}}$$

$$T_c = \frac{7.5}{3}$$

T_c= 2.5hours

2. Time required to charge 12volt battery is (T_d)= ?

$$T_d = \frac{\text{standard Ah of battery}}{\text{load current}}$$

$$T_d = \frac{7.5}{2.5}$$

T_d= 3hours

3. Power developed by the alternator

P= V×I

P=12×3

P=36AMP-HOUR

Tabular column

Observation

Time for pedalling= 30

Load current of device= 2.5

Trails	Revolutions In rpm (N)	Current In amperes (A)	Voltage In volts (V)	Time for charging In hours (T_c)	Time for discharging In hours (T_d)	Power In watts (P)
1	54	3	12	2.5	3	36
2	74	4.1	12	1.83	3	49.2
3	88	5.1	12	1.5	3	61.2

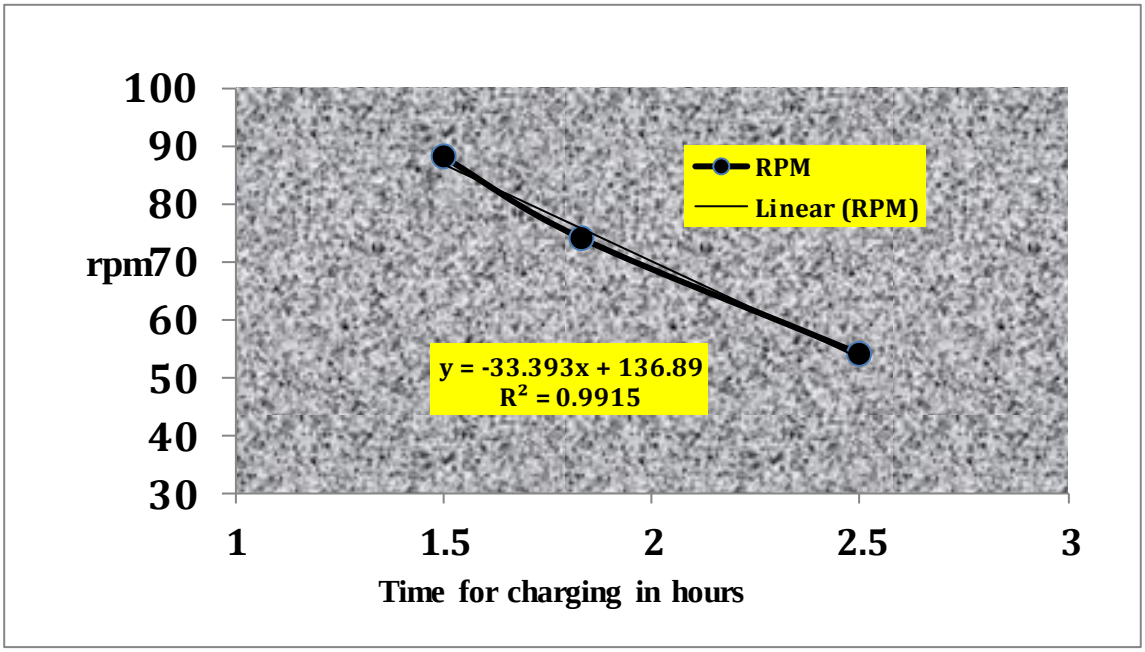


Fig.2. *Variation Of Rpm With Time For Charging.*

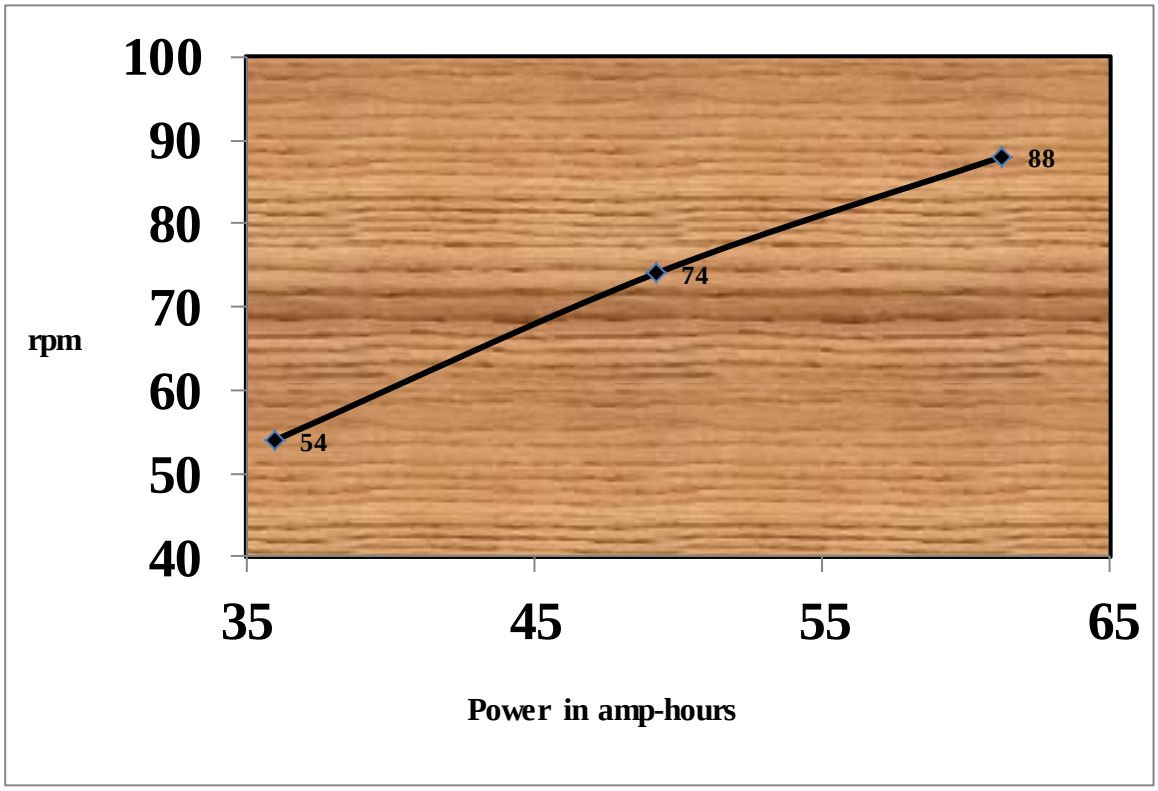
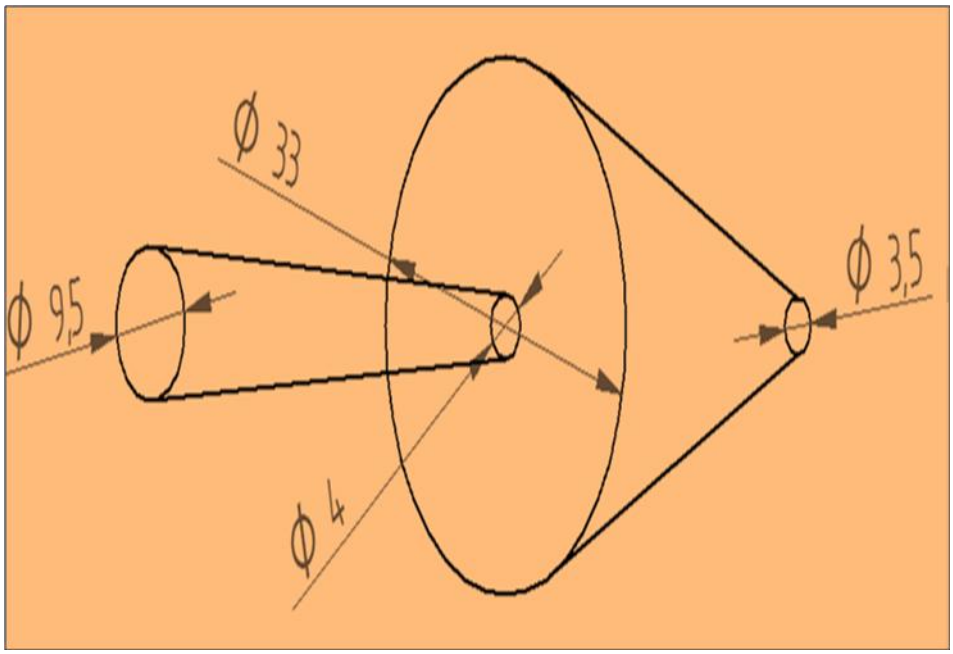


Fig. 3.*Variation Of Rpm With Power (In Amps).*

V-belt calculation



N refers to the rpm

D refers to the diameters

1 refers to the crank of cycle pedalling

2 refers to the small sprocket at back wheel

3 refers to flywheel (back rim of cycle)

4 refers to pulley at the alternator or pump

Equation for diametric ratio is given by,

$N_1 \times D_1 = N_2 \times D_2$ → I

The measured diameter of above 4 wheels is given below

$D_1 = 9.5$ cm

$D_2 = 4$ cm

$D_3 = 33$cm

$D_4 = 3.5$cm (for pump)

$D_4 = 3$cm (for alternator)

from equation I and given data, we have

$N_1 \times 9.5 = N_2 \times 4$

$$N_2 = \frac{N1 \times 9.5}{4}$$

For wheel 2 and 3 rpm is same as they mounted on the same bearing hence,

$$N_2 = N_3$$

Therefore, $N_2 = N_3 = \frac{N1 \times 9.5}{4}$ → II

Similarly for wheel 3 and 4 we have continuity equation as,

Using equation number I, we have

$N_3 \times D_3 = N_4 \times D_4$

From equation II,

$N_2 \times D_3 = N_4 \times D_4$

Substitute equation II in above equation,

$$\frac{N1 \times 9.5}{4} \times 33 = N_4 \times 3.5$$ → III

Hence speed ratio is given by,

$\frac{N4}{N1}$ = **22.39, this is for pump**

For alternator, D_4 value changes hence from equation III, we have,

$$\frac{N1 \times 9.5}{4} \times 33 = N_4 \times 3$$

Therefore speed ratio is given by,

$\frac{N4}{N1}$ = **26.125, this for alternator**

a. Pump discharge calculation

1. Discharge at ground level

Time taken for pedalling(t)= **30 seconds**

No of revolutions by pedal= **29 revolutions**

Water collected in a tank= **4.4 litres**

Standard rpm on pump = **2880rpm**

No of revolution per minute= $\frac{\text{revolutionswhilepedailing}}{\text{timetakenforpedalling}} \times 60$

$$= \frac{29}{30} \times 60$$

N=58rpm

Discharge of water= $\frac{\text{Water collected in a tank}}{\text{Time taken for pedalling}}$

$$= \frac{4.4 \times 10^{-3}}{30}$$

$=1.467\times 10^{-4}$ m^3/s

Efficiency at operated rpm, η = $\frac{\text{rpm} \times \text{speed ratio}}{\text{standard rpm of pump}}$

$= \frac{58\times 22.39}{2880}$

= 45%

Observation

Time for pedalling=30 seconds

Tabular column

Trails	Revolution by pedalling	Water collected in tank(litres)	Revolutions per minute(rpm)	Discharge at outlet(m^3/s) in 10^{-4}	Efficiency wrt rpm in %
1	30	4.4	58	1.467	45
2	48	7.6	96	2.533	74.6
3	53	8.2	106	2.733	80.97

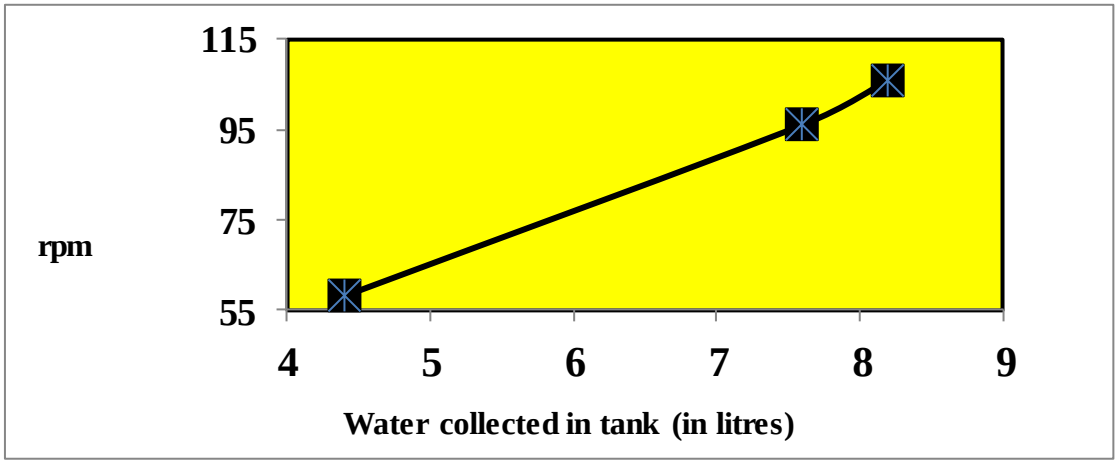


Fig.5. *Variation Of Rpm With Water Collected In Tank.*

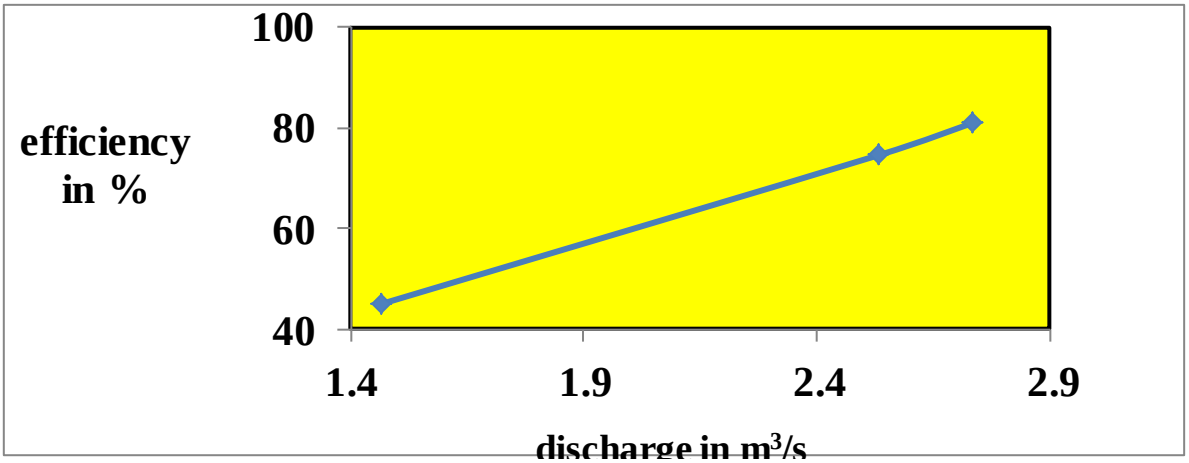


Fig.6. *Variation Of Efficiency (%) Discharge.*

Discharge at 3m high from ground level

Observation

Time for pedalling=30 seconds

Tabular column

Trails	Revolution by pedalling	Water collected in tank(litres)	Revolutions per minute(rpm)	Discharge at outlet(m^3/s) in 10^{-4}	Efficiency wrt rpm in %
1	42	1.74	84	0.58	61.25
2	49	1.81	98	0.603	76.18
3	53	1.89	106	0.63	82.40

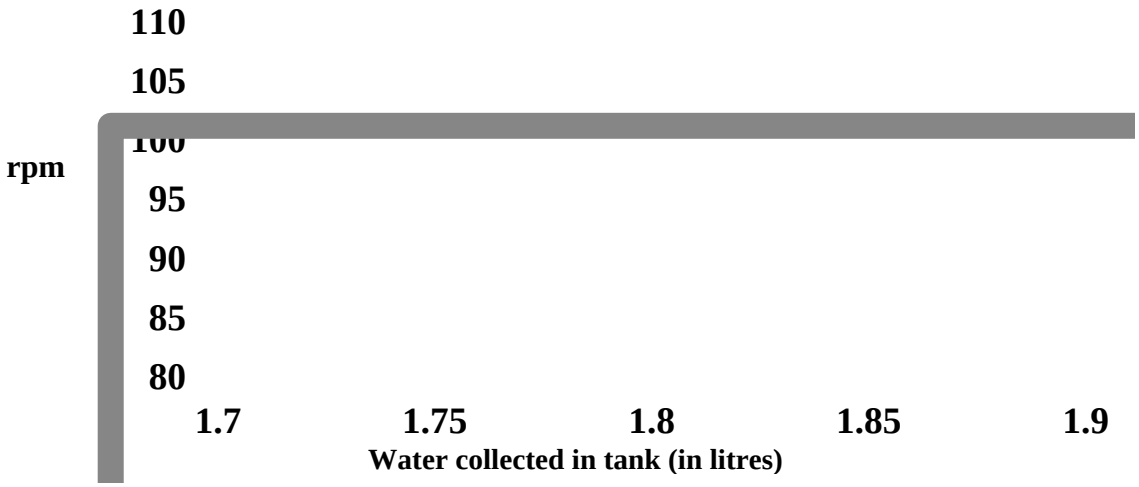


Fig.7. *Variation Of Rpm Vs Water Collected In Tank.*

Discharge by keeping 0.5m suction below ground level

Observation

Suction height = 0.5 metres , Delivery height = 14cm

Time for pedalling=30 seconds

Tabular column

Trails	Revolution by pedalling	Water collected in tank(litres)	Revolutions per minute(rpm)	Discharge at outlet(m^3/s) in 10^{-4}
1	79	3.4	158	1.133

Applications of human powered machines

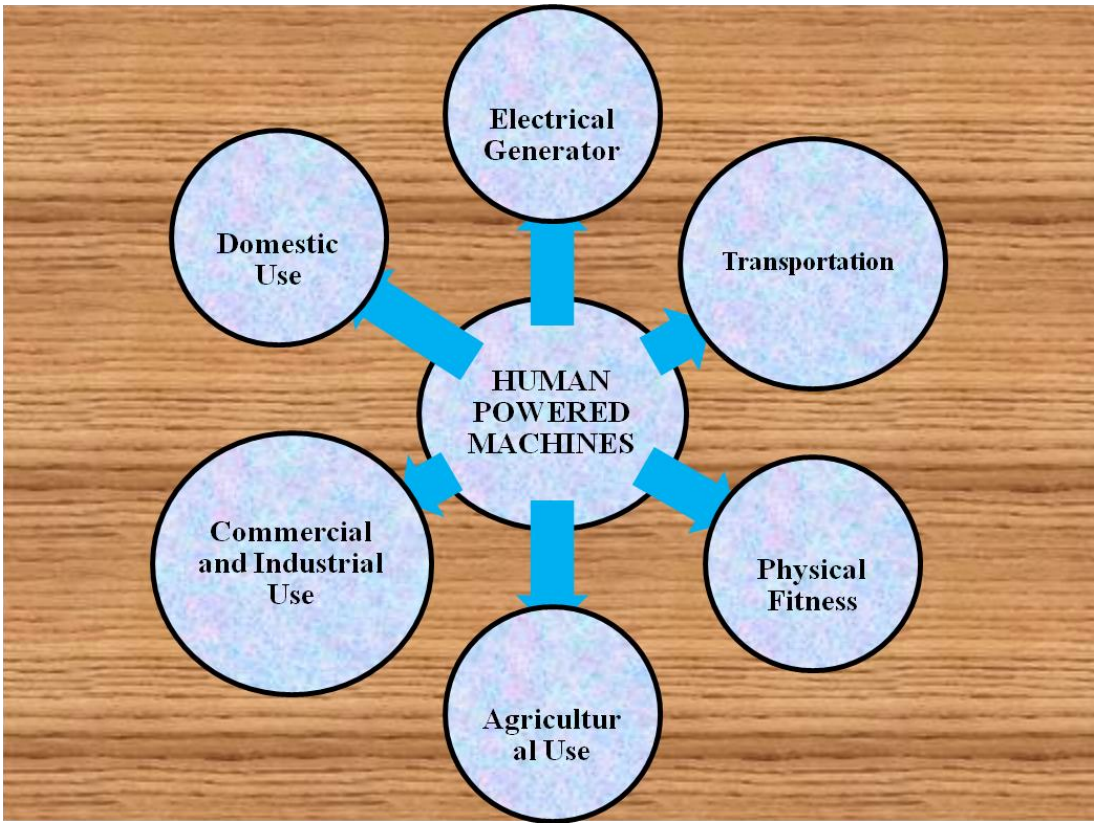


Fig.8.*Various Applications Of Human Powered Machine.*

1. Domestic Use: A bicycle-powered soap-making machine, Pedal-powered and hand-cranked grain mills, Coffee mills or Coffee pulpers, Food mills, Strainers and Juicers, Ice cream makers , Washing Machine, Sewing Machine, Water Pump, etc.
2. Commercial and Industrial Use: Hand-Cranked tool Sharpeners, Pedal Power Grinders and Tool Sharpeners, Foot Powered Scroll Saws, A Stationary Bicycle and Dual Wheel Bench Grinders, A Treadle Powered Lathe, Potter‘s Wheel, Tire Pumps, etc.
3. Agricultural Use: Pedal Operated Chaff Cutters, Hand Operated Threshers, Pedal Operated Threshers, Treadle Powered Threshers, Hand Operated Winnowers, Pedal Operated Winnowers, Pedal Operated Irrigation Pumps, Cultivators, Seeders, etc.
4. Transportation: Bicycle, Bicycle Trailers, Cycle Rickshaw, Hand Cranked Tri-cycle, etc.
5. Electrical Generator: A Pedal Operated AC/DC Electrical Generator Unit.
6. Physical Fitness: A Bicycle Unit for Physical Fitness.

CONCLUSIONS

The main aim of our work was focused on low-weight, portable appliance's modeling, design and control of pedal operated water pumping. An innovative method of minimizing manual stress and thus reliably stabilizing the pumping was also presented. This is very useful for the small scale project works may also be carried out for impressing task in the industrial purpose.

REFERENCES

1. Girish T , Parameswaramurthy D. "Development of conceptual model of cross trainer for water pumping and battery charging" International journal of Engineering Research-Online A Peer Reviewed International Journal, Vol.2., Issue.4, 2014
2. Mrs.Manisha.s.lande 1and Mrs. Rupali.s.tupkar2 "Optimum utilization of a bicycle" International journal of latest trends in engineering and technology (IJLTET),Vol. 1 issue 3 September 2011
3. A. Nasir, S.O. Ubokwe and A. Isah"Development of a Manually Operated Hand Pump for Rural Water Supply" AU J.T. 7(4):187-192 (Apr. 2004).
4. S.G.Bahaley Dr. A.U.Awate S.V.Saharkar, "Performance Analysis of Pedal Powered Multipurpose Machine" International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 5, July - 2012
5. Sermaraj. M ,Design and fabrication of pedal operator reciprocating water pump, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X PP 64-83,
6. Khan. Mohd Aqeel, Rizvi Sameer Abbas Sayed Arshad, Shaikh Irfan, "Multipurpose Exercise Cycle", JIRST –International Journal for Innovative Research in Science & Technology, Volume 1 ,Issue 11 ,April 2015