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## DEVELOPMENT OF PEDAL OPERATED RECIPROCATING PUMP

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### Abstract

India is the second most populous nation in the world. Like many other countries where agriculture is the main source of income. Around 85.49 percent of Indian villages are electrified and Many will not be electrified. Our project is focus on area where electrification is not possible. We design and develop pedal operated reciprocating water pump.

A Water system includes a reciprocating pump operated by pedaling power. Pumps are a common means of lifting water from a clean ground water source to a useful point of access, but all pumps have moving parts and are therefore destined to break proper selection of a pump will reduce undesirable downtime and will empower the local community to manage their water source. Here we use the foot pedal pump, powered by our legs instead of arms to lift the water from a depth range of six meters.

*Index Terms:* pedal operated, water pump

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## 1. INTRODUCTION

Water is a very essential commodity for the survival of mankind. Apart from being used for drinking, it is also used as a source of energy and as a mode of transport. Unfortunately, it is not always readily available. While almost 70% of the earth's surface is covered by water, fresh water accounts only for 2.5% with the rest being ocean based and saline. Add to this the fact that of the 2.5% fresh water, only 1% is easily accessible in the form of rivers and other fresh water source whereas the rest is trapped in snowfields, glaciers or as underground water and you realize that it is important to device mechanisms to get it from places that would normally not be possible. These places include boreholes and shallow wells.

A pedal powered pump is one of these mechanisms as it enables us to draw water from shallow wells, especially in

areas where electricity is either non-existent or is too costly to afford.

The idea of pumping water has been in existence since the evolution of man. Pumping plays a very pivotal role in the day to day existence of mankind and as a result, different methods have evolved over the years to pump or displace water. Water supply has been a very critical issue, mostly affecting the rural areas. Water is one of nature's most important gifts to mankind. It is one of the most essential elements to good health and as such, it should be readily available to everybody. To address this problem, different methods and techniques have been used over the years ranging from man-powered operated ones down to the more efficient one.

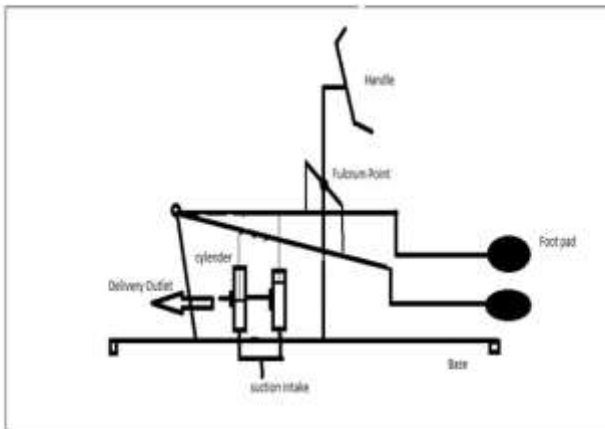
### 1.1 DEVELOPEMENT BACKGROUND

The history of positive displacement reciprocating pumps goes back as far as 275 BC in Ancient Rome. In the sixteenth century, great lift and force pumps, driven by water wheels became the principle method for pumping water to be piped in

Europe. As late as 1987, the World Bank estimated that, throughout the world, 1.8 billion people would need improved water supplies, and that wells equipped with hand pumps would be an appropriate choice to meet the needs of this number of people. Most of the reciprocating hand pumps commonly used in developing countries have their origins in designs developed during the late 19th and early 20th Centuries in the United States and in Europe. In the United States, about 42 million hand pumps were made until 1920, when electric pumps began to replace them. While the basic design of the reciprocating hand pump has not changed much in this century, its typical use has changed greatly. In the early part of this century, in the United States and Europe, the big market for pumps was for small backyard pumps used for ten to thirty minutes per day by individual families or farmers. In a developing country today, a single pump may have to supply more than 500 villagers and may be in continuous operation for ten or more hours per day.

What is needed in a developing country is a manually operated pump which can be easily operated by a person for relatively long periods of time and which lifts significant volumes of water with as little effort as possible. Because of the high usage requirements, and because the pump must operate as a practical device far from cities having maintenance facilities and personnel, the pump must be both reliable and easily repaired

## 1.2. LINE DIAGRAM



**Fig 01** line diagram of reciprocating pedal pump

## 2. LITERATURE REVIEW

- [1] David Gardon Wilson, this paper deals with the understanding of pedal power. A person can generate four times more power (1/4 horsepower (hp)) by pedaling than by hand-cranking. The power levels that a human being can produce through pedaling depend on how strong the peddler is and on how long he or she needs to pedal. If the task to be powered will continue for hours at a time, 75 watts mechanical power

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- [2] K.S. Zakiuddin, state the importance of human power from earliest time to the present and its necessity to different machine with future scope
- [3] J.P. Modak In this paper , human power bricks making machine has been designed and development machine consist of three sub system i.e. 1.energy unit 2. appropriate transmission 3. process unit
- [4] Sermaraj. Explain different water lifting pump and state the importance of cycle operated water pump which works on rotation of bicycle wheel.

## 3. CONCEPT

The These types of pump operate by using a reciprocating piston. The liquid enters a pumping chamber via an inlet valve and is pushed out via a outlet valve by the action of the piston . Reciprocating pumps are generally very efficient and are suitable for very high heads at low flows. This type of pump is self priming as it can draw liquid from a level below the suction flange even if the suction pipe is not evacuated. The pump delivers reliable discharge flows and is often used for metering duties delivering accurate quantities of fluid. The reciprocating pump is not tolerant to solid particles and delivers a highly pulsed flow. If a smooth flow is required then the discharge flow system has to include additional features such as accumulators to provide even flows. Reciprocating pumps designed for delivering high pressures must include methods for releasing excessive fluid pressures. The Pumps are a common means of lifting water from a clean ground water source to a useful point of access. we use the foot pedal pump, powered by our legs instead of arms to lift the water from a depth range of seven meters. Throughout history human, energy has generally been applied through the use of the arms, hands, and back. A person can generate four times more (1/4 horse power (hp)) by pedaling than by hand – cranking. At the rate of 1/4hp, continuous pedaling can be done for only short periods, about 10 minutes. However, pedaling at half this power (1/8 hp) can be sustained for around 60 minutes. The main use of pedal power today is still for reciprocating at least in the high- power range (75 watts and above of mechanical power). In the lower-power range there are a number of use of pedal power for agriculture, construction, water pumping, and electrical generation that seem to be potentially advantages, at least when electrical or internal

## 4 .TEST CARRIED ON MATERIAL OF MECHANISUM

### 1] Tensile Test on round bar

### 2] Bending stress on M.S. rectangular plate

#### 4.1 Tensile test on round bar

- Total length of bar 32cm.
- Bar diameter 12 mm.
- Load 50 kg

#### Deflection:-

In MM	Weight in KG
1	150
5	650
10	4250
20	4650
40	6000
60	6650
80	6750 (break)

(0.94m)

Force at point B we assume the weight of human normally 60 kg. 588N (downward)

Force at point A is reaction force act on link (upward)

Force act at point c is changes its direction (upward/downward) and same magnitude during pedaling

$$\begin{aligned} \Sigma f_x &= 0 \\ \Sigma f_y &= R_a - (R_c + R_b) = 0 \\ R_a &= R_c + 588 \text{ N} \\ \text{moment at point A} &= 0 \\ \text{Bending moment (B.M) at point A} \\ 0 &= R_c \times 0.28 + 588 \times 0.94 \\ R_c &= 1974 \\ R_a &= 1974 + 588 \\ R_a &= 2562 \end{aligned}$$

**4.2 Bending stress for M.S. rectangular plate:**

[Analytical method]

Thickness = 5mm.

area = 5mm × 38mm  
= 190 mm<sup>2</sup>

Width = 38mm

E = 2 × 10<sup>5</sup> N/MM<sup>2</sup> (constant)

e = strain

σ = bending stress

Change in length = 3mm

Original length = 32mm

$$\text{Strain (e)} = \frac{\text{change in length}}{\text{original length}} = \frac{\Delta L}{L}$$

$$e = \frac{3 \text{ mm}}{32 \text{ mm}} = 0.093$$

$$E (\text{young's modules}) = \frac{\text{STRESS}}{\text{STRAIN}} = \frac{\sigma}{e}$$

Stress = E (young's modules) × strain

$$\sigma = 2 \times 10^5 \times 0.093 = 18600 \text{ N/mm}^2$$

$$\text{Stress} = \frac{\text{force}}{\text{area}} = \frac{f}{a}$$

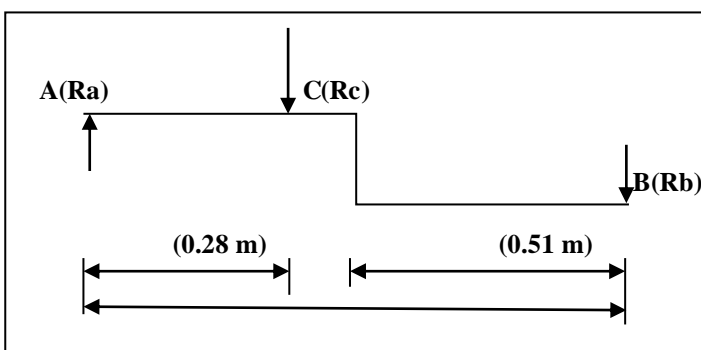
Force = stress × area

$$= 18600 \text{ N/mm}^2 \times 190 \text{ mm}^2$$

$$= 3534000 \text{ N}$$

$$= 3534 \text{ KN.}$$

**4.3 FORCE DEVELOPED ON LINKS:-**



**6. Working**

As per the expert point of view farmers should adopt new technique in their farm. And for new technique of forming they required basic resource like water, fertile land, electricity and effective equipment. In 2017 Indian farmer contribute 17.35 % in GDP. But now a days Indian former face shortage of basic resources. In Vidharbh region there is more problem of electricity so this kind of pedal operated reciprocating concept are helpful for pumping water.

The traditional water pumping process are based on electric and manual, manual water pump used in pulley on wells or hand pumping machine. The traditional manual water pumping process are physically exhausting and time demanding. After thoroughly researching, designing and experimenting a final machine was developed which work on reciprocating motion. The energy consumption was successfully reduced to calories. Development of mechanism was focused reducing human effort, increasing discharge, time reducing in most economic way as we saw that by other processes human needs more power or efforts for doing same work. So the prime task was to developed piston cylinder arrangement main frame so that we required maximum

discharge in minimum human effort then we refer the traditional method for the development of mechanism of water pump.

Working of this pump is simple. Two footrests are attached with each other through hinge support . This arrangement is done such that when 1<sup>st</sup> cylinder is in upward direction, 2<sup>nd</sup> is in downward direction. These two cylinder's suction is attached with tank of water using pipe and delivery exit pipe When 1<sup>st</sup> cylinder is in upward direction, it means it sucks the water from storage into cylinder. When this cylinder goes down, it delivers the water through delivery pipe and this time 2<sup>nd</sup> cylinder sucks the water from storage

## 7. Conclusion

The whole study over the topic that the pedal operated water pump is a very advantageous especially for rural areas. The problem of energy crises is very big in India and many rural powered water pump by use of this project we save electricity and get a particular water head and we supply

the water in irrigation. We will operate a water pump by using reciprocating motion mechanism in the project and we can fill the water tank of housing power and get construction work So we operate the pump and deliver the water at a particular head.

This project Create a simple and efficient way of pumping water utilizing a human powered device for communities where electricity is unavailable or impractical.

## 8. REFERENCES

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