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Fabricating and Analysis of Water Lifting Device without Electricity or Fuel

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ABSTRACT
Hydraulic ram pump is an automatic water-pumping equipment generally used to pump drinking and irrigation water in mountainous and rural areas having short of power. In the past, it has been analysed and optimized by fabricating various prototypes and conducting experiments and comparisons. In general hydraulic pump lifts water by using electricity, fuel or manpower. There are many technologies to lift water without using electricity. As fossil fuel one of the most energy crises in the world , it is necessary to use the fuel wisely.It is Simple in construction and its reliable giving a low maintenance requirement . It is Automatic, continuous operation requires therefore no supervision or human input. Use of a renewable energy source ensuring low running cost. Experiment was carried out for the air vessel of 52cm and 22cm and comparisons were conducted with other products. The results how the outlet discharge rate and wastage rate would be affect by the difference in the length of the air vessel.
Keywords: Hydraulic ramp pump, Air Vessel, Outlet Discharge Rate , Wastage Rate

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I. INTRODUCTION

The hydraulic Ram pump or hydram is a complete automatic device that uses the energy of the flowing water such as spring, stream or river to pump part of the water to a height above that of the source. With a continuous flow of later, a hydram operates continuously with no external energy source. A hydram is a structurally simple unit consisting of two moving parts. These are the impulse valve (or waste valve) and the delivery (check) valve. The unit also includes an air chamber and an air valve. The operation of a hydram is intermittent due to the cyclic opening and closing of the waste and delivery values. The closure of the waste valve creates a high pressure rise in the drive pipe. An air chamber is required to transform the high intermittent pumped flows into a continuous stream of flow. The air valves allow air into the hydram to replace the air absorbed by the water due to the high pressure and mixing in the air chamber.

Recognising that the hydraulic ram pump can be a viable and appropriate renewable energy water pumping technology in developing countries, it has been used for over two centuries in many parts of the world due to their simplicity and reliability made them commercially successful, in the days before electrical power and the internal combustion engine become widely available. As technology advanced and become increasingly reliant on sources of energy derived from fossil fuels, the hydraulic ram pump was neglected. It was felt to have no relevance in an age of national electricity grids and large-scale water supplies. Big had become beautiful and small-scale Hydraulic Ram Pump technology was unfashionable. In recent years an increased interest in renewable energy devices and an awareness of the technological needs of a particular market in developing countries have prompted a reappraisal of hydraulic ram pump. In hilly areas with springs and reliable pumping device is large. Although there are some examples of successful ram pumps installation in developing countries, their use to date has merely scratched the surface of their potential. The main reason for this being, lack of widespread local knowledge in the design and manufacture of hydram. Hence, the widespread use of hydram will only occur if there is a local manufacturer to deliver quickly; give assistance in system design, installation and provide an after-sales service.

1.1. Objectives:

- Fabricating a Water Lifting Device working Without External Energy.
- Determine the flow rate and discharge as per time.

1.2. Methodology:

➢ **Operation Principle :**

The energy required to make a Ram lift water to a higher elevation comes from water falling downhill due to gravity. As in all other water powered devices, but unlike a water wheel or turbine, the ram uses the inertia of moving part rather than water pressure and operates in a cycle based on the following sequences.

➢ **Steps of working of the pump**

- Water starts flowing through the drive pipe and out of the "waste" valve which is open initially. Water flows faster and faster through the pipe and out of the waste valve.
- At some point water is moving so quickly through the waste valve that it pushes the valve's flapper up and slams it shut. The water in the pipe was moving quickly and had considerable momentum, but all the water weight and momentum is stopped by the valve's closure. That creates a high-pressure spike at the closed waste valve. The high-pressure spike forces some water through the check valve and into the pressure chamber. This increases the pressure in that chamber slightly.
- After the high-pressure wave reaches the drive pipe inlet, a "normal" pressure wave travels back down the pipe to the waste valve. The check valve may still be open slightly depending on backpressure, allowing water to enter the pressure chamber.
- As soon as the normal pressure wave reaches the waste valve, a low-pressure wave travels up the drive pipe, which lowers the pressure at the valves and allows the waste valve to open and the check valve to close.
- When the low-pressure wave reaches the drive pipe inlet, a normal pressure wave travels down the drive pipe to the valves. Normal water flow due to the elevation of the source water above the ram follows this pressure wave, and the next cycle begins.

➢ **Materials/Tools Used**

- **1-1/4" ball valve** : Ball valves use a metal ball with a hole bored through the center, sandwiched between two seats to control flow.

- **1/4" union** : A union is used when you are trying to join two pipes together that are fixed, thus unable to be turned.

- **1-1/4" spring check valve (customizable) :** *Spring* loaded *check valves* prevent reverse flow and ensure one flow direction.

- **¾" tee :** A cross *tee* is *used* for the extension of a single line into multiple extension ·

- **3/4” ball valve :** Ball valves use a metal ball with a hole bored through the center, sandwiched between two seats to control flow.

- **¾” union :** A union is used when you are trying to join two pipes together that are fixed, thus unable to be turned.

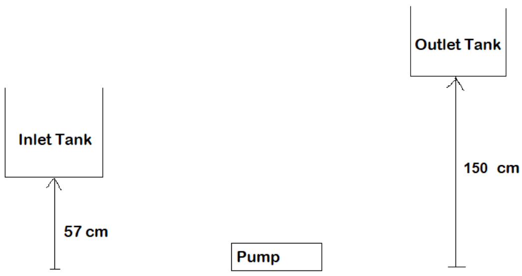
- **1-1/4” x ¾” bushing :** BUSHING fitting is used to connect two fittings together with different diameters by reducing the inner diameter of the pipe.

- **¾” X 6” nipple :** *Nipple* (*nipple* for connecting and extending *pipes*) *Pipe fittings* are components *used* for connecting, terminating, controlling flow, and changing the direction of *pipe*.

- **4” x 1-1/4” bushing 4” :** BUSHING fitting is used to connect two fittings together with different diameters by reducing the inner diameter of the pipe.

2. Design/Model:

2.1. Soft Design:



2.2. Model:

3. Calculations:

>>Discharge :
=(3.14*1.25*1.25*15)/(4*120)
=0.03 cm^3/s
>>Inlet Tank Volume :
= l*b*h
= 72*100*2
= 14400cm^3
= 14.4 liters
>>Time taken during the performance of Experiment :
= 2 min

➢ **Air Vessel Length = 52 cm**

>>Outlet Tank Volume :
= $\pi r^2 h$
= $3.14*(13)^2*9$
= 4778.36 cm^3
= 4.7 liters
>>Wastage Discharge Volume :
= Inlet –Outlet
= 14.7 - 4.7
= 9.7 liters
>>Outlet Water Volume Capacity :
= (4.7*100)/14.4
= 32.64 % (Discharge Rate)
>>Waste Discharge Rate :
= 100-32.64
= 67.36 %

➢ **Air Vessel Length = 22 cm**

>>Outlet Tank Volume :
= $\pi r^2 h$
= $3.14*(13)^2*6$
= 3183.96 cm^3
= 3.18 liters
>>Wastage Discharge Volume :
= Inlet –Outlet
= 14.7 – 3.18
= 11.22 liters
>>Outlet Water Volume Capacity :
= (3.18*100)/14.4
= 22.083 % (Discharge Rate)
>>Waste Discharge Rate :
= 100-22.083
= 77.916 %

Result Table:

Air Vessel Length	**Inlet Tank Volume (Litres)**	**Outlet Tank Volume (litres)**	**Wastage Discharge Volume (litres)**	**Time Duration (Minutes)**	**Outlet Water Volume Capacity (Percentage)**	**Waste Discharge Rate (Percentage)**
52	14.4	4.7	9.7	2	32.64	67.36
22	14.4	3.2	11.2	2	22.08	77.95

II. CONCLUSION:

- First we took an air vessel which had a length of 52cm and calculated the outlet discharge rate and waste discharge rate and then reduced the length of the air vessel to 22cm and calculated the same.
- After calculating the discharges rates for different length of air vessel we concluded that the outlet discharge rate increases as we increase the length of the air vessel and the waste discharge rate decreases as we increase the length of the air vessel and vice versa.

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