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Design and Fabrication of Gravity Pump

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ABSTRACT: The aim of the project is to pump the water by gravity. The aim of the project is to pump the water by gravity The components used in this project are non-return valve or check valve T-joint, L-joint, reducer ,air tank, water tube ,PVC pipe arrangement .It is a cyclic water pump powered by hydropower. It takes in water at one hydraulic head(pressure) , flow rate, output water at a higher hydraulic rate and lower rate flow this device uses the water hammer effect to develop pressure that lower the portion of the input water that powers that pump to be lifted to the point higher then where the water originally started. Spontaneous anti-gravitational transportation of liquid across long distances has been widely discovered in nature, such as water transportation from the root to the crown of a tree.

KEYWORDS: Hydraulic Ram Pump Is Based On The First Law Of Thermodynamics, Where The Kinetic Energy Of Water At Inlet Is Being Converted Into Pressure Energy Using The Pump Setup.

I. INTRODUCTION:

The Hydraulic Ram Pump, Hydram, or simply a Ram Pump is a pump that uses the water hammer effect from built up water pressure.Using this pressure that has been created by a water source above the pump, it is able to lift water to an elevation higher than the pump.Using just two moving parts, simple fluid mechanics and the energy within the water the Hydraulic Ram Pump is able to run without electricity or any other power source.

A hydraulic ram pump is a pump that makes use of kinetic energy of water at inlet and converts it into pressure energy and this pressure is used to lift water to higher elevations. No other energy is required and as long as there is a continuous flow of falling water, the pump will work continuously and automatically. Unlike other pumps that use electricity for its working, this pump doesnt make use of any electrical input for its operation and hence it can be used in areas where there is lack of electrical connections but have unlimited source of flowing water bodies like rivers, lakes etc. The pump can be used in agricultural areas for pumping of water to farm lands and providing water to livestock.

Provision of adequate domestic water supply for scattered rural populations is a major problem in many developing countries. Fuel and maintenance costs to operate conventional pumping systems are becoming prohibitive. The hydraulic ram pump is an alternative pumping device that is relatively simple technology that uses renewable energy, and is durable. The Hydram has only to moving parts and can be easily maintained. This pump is already in operation in countries like Nepal, Sri Lanka and Nigeria.

The hydraulic Ram pump or hydram is a complete automatic device that uses the energy in 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 water 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 consists of an air chamber and an air valve. The operation of a hydram is intermittent due to the cyclic opening and cloning 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.Pumps are among the oldest of the machines. They were used in ancient Egypt, China,

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India, Greece and Rome. Today, pumps are the second most commonly used kind of industrial equipment after the electric motors (Working, 1996).The first pumps were force pumps and it is interesting that the earliest known example, a pump used by the Greeks in 300 B.C incorporated an air vessel. The use of this device was suspended in the middle-ages and revived in the 16th century when a German translation of the Greek work describing the pump was published. The earliest pump to be used was the hand pump. More advanced pumps were, however, known to the Romans, as shown by the double cylinder force pump now preserved in the British museum, but their use was apparently lost in this century at the end of the Roman Empire.

In Roman times, the first reciprocating pump appeared (250-0 BC) and this remained the main pump type in use for several centuries, operated by hand, animal, water or wind power, mechanical skill developed, and metals came more into use, but the limiting factor with all these older pumps was the relatively low power output which is delivered by them.

The working of a hydraulic ram pump is based on the first law of thermodynamics, where the kinetic energy of water at inlet is being converted into pressure energy using the pump setup. A Hydraulic ram pump is a unique device that uses the energy from a stream of water falling from a low head as the driving power to pump part of the water to a head much higher than the supply head. With a continuous flow of water, a hydraulic ram pump operates automatically and continuously with no other external energy source.

A hydraulic ram pump is a simple unit consisting of two moving parts, the waste valve and delivery (check) valve. The unit also consist an air chamber in which pressure is build up. The operation of a hydraulic ram pump is intermittent due to the cyclic opening and closing of the waste and delivery valves. The closure of the waste valve creates a high pressure rise in the drive pipe. An air chamber is necessary to prevent these high intermittent pumped flows into a continuous stream of flow.

The working cycle of a hydraulic ram pump can be divided into three phases; acceleration, delivery and recoil. Acceleration- When the waste valve is open, water accelerates down the drive pipe and discharges through the open valve. As the flow increases it reaches a speed where the drag force is sufficient to start closing the valve. Once it has begun to move, the valve closes very quickly.

Delivery – As the waste valve slams shut, it stops the flow of water through it. The water that has been flowing in the drive pipe has considerable ..

momentum which has to be dissipated. For a fraction of a second, the water in the body of the pump is compressed causing a large surge in pressure. This type of pressure rise is known as water hammer. As the pressure rises higher than that in the air chamber, it forces water through the delivery valve (a non- return valve). The delivery valve stays open until the water in the drive pipe has almost completely slowed and the pressure in the pump body drops below the delivery pressure. The delivery valve then closes, stopping any back flow from the air vessel into the pump and drive pipe.

I. Recoil – The remaining flow in the drive pipe recoils against the closed delivery valve- rather like a ball bouncing back. This causes the pressure in the body of the pump to drop low enough for the waste valve to reopen. The air sits under the delivery valve until the next cycle when it is pumped with the delivery water into the air vessel. This ensures that the air vessel stays full of air.
II. When the recoil energy is finished, water begins to accelerate down the drive pipe and out through the open waste valve, starting the cycle again. Throughout the cycle the pressure in the air vessel steadily forces water up the delivery pipe. The air vessel smoothens the pulsing flow through the delivery valve into an even outflow up the delivery pipe. The pumping cycle happens very quickly.
III. During each pumping cycle only a very small amount of water is

IV. pumped. However, with cycle after cycle continuing over 24 hours, a significant amount of water can be lifted. While the ram pump is operating, the water flowing out the waste valve splashes onto the floor or the Pump house and is considered' waste' water. Although waste' water is not delivered by the ram pump, it is the energy of this water that pumps the water which is delivered.

The principle of a Hydraulic Ram pump. Water flowing down the drive pipe speeds up until the water pushes the waste valve closed. The water in the pipe is still moving, and for a short time creates a high pressure in the pump body (water hammer effect), which causes a small amount of water to be pumped through the check valve to the air chamber. The air in the air chamber pushes the water up the delivery pipe, to a height which can be 30 times larger than the height difference of the drive pipe.

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The water in the inlet pipe starts to flow under the force of gravity and picks up speed and kinetic energy until the increasing drag force lifts the waste valve's weight and closes it. This pressure differential now opens the delivery valve, and forces some water to flow into the delivery pipe. Because this water is being forced uphill through the delivery pipe farther than it is falling downhill from the source, the flow slows; when the flow reverses, the delivery check valve closes.

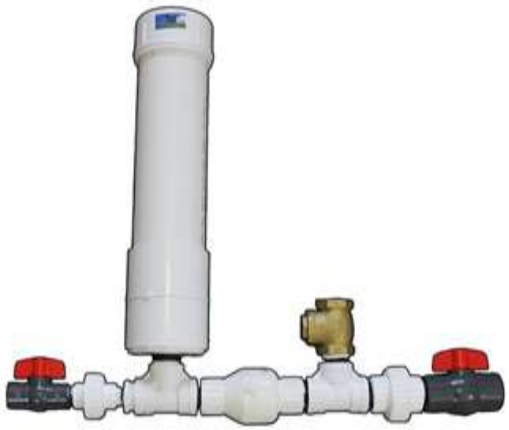

Fig.1.simplified diagram of the ram pump.

It's a redistribution of energy, converting low head and high flow into high head and low flow. And this type of pump can really create a lot of head. I ran my discharge line up to well above the roof of my shed, and my pump is still able to get the water up there. Sometimes an air chamber is included in the pump to smoothing out those sharp spikes in pressure and provide a more even flow rate out of the delivery pipe, reducing wear and tear on the pump components

A Hydraulic ram pump is a unique device that uses the energy from a stream of water falling from a low head as the driving power to pump part of the water to a head much higher than the supply head. With a continuous flow of water, a hydraulic ram pump operates automatically and continuously with no other external energy source. A hydraulic ram pump is a simple unit consisting of two moving parts, the waste valve and delivery (check) valve. The unit also consist an air chamber in which pressure is build up. The operation of a hydraulic ram pump is stays open until the water in the drive pipe has almost completely slowed and the pressure in the pump body drops below the delivery pressure. The delivery valve then closes, stopping any back flow from the air vessel into the pump and drive pipe. Recoil - The remaining flow in the drive pipe recoils against the closed delivery valve- rather like a ball bouncing back. This causes the pressure in the body of the pump to drop low enough for the waste valve to reopen. The air sits under the delivery valve until the next cycle when it is pumped with the delivery water into the air vessel. This ensures that the air vessel stays full of air. When the recoil energy is finished, water begins to accelerate down the drive pipe and out through the open waste valve, starting the cycle again. Throughout the cycle the pressure in the air vessel steadily forces water up the delivery pipe. The air vessel smoothens the pulsing flow through the delivery valve into an even outflow up the delivery pipe.

HYDRAULIC RAM PUMP

The MOSFETs used are (IRF3205) which act as current amplifiers and amplify the current from 1 amp to 3 amps. Two solenoids are placed on the inlet and exhaust valves the piston of the solenoid is directly connected to the valve using a rubber tubing for motion transfer. Each solenoid consists of two set of copper windings with 12 mm dia,20 turns and 8 layered both the solenoid are oppositely connected and when actuated two sets of opposite windings get magnetized ,the piston inside solenoid moves up closing the valve the alternate valve is opened. The solenoids are rigidly placed over the cylinder head with the help of wood powder and glue which turns into concrete strong upon drying up. A solenoid is simply a specially designed electromagnet. A solenoid usually consists of a coil and a movable iron core called the armature. Here's how it works. When current flows through a wire, a magnetic field is set up around the wire. If we make a coil of many turns of wire, this magnetic field becomes many times stronger, flowing around the coil and through its center in a doughnut shape. When the coil of the solenoid is energized with current, the core moves to increase the flux linkage by closing the air gap between the cores. The movable core is usually spring-loaded to allow the core to retract when the current is switched off. The force generated is approximately proportional to the square of the current and inversely proportional to the square of the length of the air gap.

APPLICATION:

Specific situations in which other technologies may prove more appropriate are in terrain where streams are falling very rapidly, it may be possible to extract water at a point above the village or irrigation site and feed it under gravity.

If the water requirement is large and there is a large source of falling water (head and flow rate) nearby, turbine-pump sets can provide the

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best solution. Many ram pumps could be used in parallel to give the required output but at powers over 2KW.

In small-scale domestic water supply, the choice can often be between using a ram pump on a stream or using cleaner groundwater. Surface water will often need to be filtered or treated for human consumption, increasing the cost of a system and requiring regular filter maintenance. Under these conditions, we select a hydram pump.

DETERMINATION OF DIFFERENT PARAMETERS

The volumetricW discharge from the drive pipe is given by, Q = r 2L n/60.
Q = volumetric flow rate through the pipe r = pipe radius, L = pipe length n =speed of revolution.
The velocity of fluid flow in the driven pipe is given by, Q = V/Ad
Vd = velocity of fluid flow Ad = area of pipe.
Head loss = fLV2/2gd g = acceleration due to gravity
L = length of the pipe
V = fluid velocity
The velocity of fluid flow in the Tjunction is given by
VT = Q/AT
Q = is the volumetric fluid discharge
AT = pipe x-sectional area at T-junction.
Velocity of fluid flow in the driven pipe is given by
Vd = Q/Ad

Q= is the volumetric fluid discharge Ad = Area of pipe
Loss due to sudden enlargement at the T junction is expressed as
HLT = (Vd Vt) 2/2g
The volumetric discharge from the drive pipe is given by, Q = r ^{2}L n/60.

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L = length of the pipe

V = fluid velocity
The velocity of fluid flow in the T–junction is given by
VT = Q/AT
Q = is the volumetric fluid discharge
AT = pipe x-sectional area at T-junction.
Velocity of fluid flow in the driven pipe is given by
Vd = Q/Ad
Q = is the volumetric fluid discharge Ad = Area of pipe
Loss due to sudden enlargement at the T junction is expressed as
HLT = (Vd – Vt) ^{2}/2g
Other losses of head in pipe fittings are expressed as
HL =KT (V/2g) ^{2}
Reynolds number for determining type of flow is given by Re = Vd /v

II. CONCLUSION

Thus the Hydraulic Ram Pump proves to be a device that is efficient in its working and at the same time is economically viable. The pump can be made domestically with the help of simple piping tools and doesnt require any sophisticated equipments.
Another advantage of the Hydraulic Ram Pump is that its adaptability to work on various terrains with simple operation.
As far as the efficiency of Hydram is considered, the amount of water delivered at outlet is comparatively low, but as the device doesnt make use of any electricity.
This process is a boon in areas where water has to be pump to greater heights without use of electricity.

SOME OF THE ADVANAGES FROM THE ABOVE RESULTS

1. Use of a renewable energy source ensuring low running cost.
2. Pumping only a small proportion of the available flow has little environmental impact.
3. Simplicity and reliability give a low maintenance requirement.
4. There is good potential for local manufacture in the rural villages.
5. Automatic, continuous operation requires no supervision or human input.
6. The valve openings are wide and that makes them self- cleansing and not easily clogged by sand, grit and debris.
7. The waste valve and discharge valve guides can be replaced in case they wear out and enlarge at a very small cost.
8. The sniffing or air valve design is easy to unclog and even replace if the hole enlarges.
9. The design is easy to fabricate and fix with minimum workshop facility and can be maintained by unskilled users.
10. The pump is low cost as compared with available commercial models.

REFERENCES

[1]. Design and analysis of hydraulic ram water pumping system. By N S M Hussin, S A Gamil, N A M Amin, M J A Safar, M S A Majid, M N F M Kazim and N F M Nasir.
[2]. Design and Construction of a Hydraulic Ram Pump by Shuaibu Ndache Mohammed.
[3]. A textbook of Fluid Mechanics by R.K. Rajput.
[4]. A textbook of Fluid Mechanics by R.K Bansal.
[5]. Hydraulic Ram Pumps: A Guide to Ram Pump Water Supply System by T.D. Jeffery.