**AUTOMATIC WATER LIFTING DEVICE AND APPROACH**

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**Abstract**

The removal of water from well, rivers and lakes by the use of an electric motor and pipes for domestic purpose and agricultural use is an common scenario in day to day life. Considering the fact following investigation was done and advantages of using hydraulic ram pump for drawing water from rivers and wells was examined. Many drawbacks where seen in the traditional method of drawing water, some of them includes non availability of power, requires human efforts, money required for the maintenance, etc. Above drawbacks can be successfully overcome by using hydraulic ram pump which have an advantage like no consumption of any form of energy like Electricity for carrying out work, requires less maintenance, continuous work output, pollution free, etc. Keeping this in mind a study was carried out regarding its working, advantages, e.t.c

**Keyword**: Hydraulic ram pump (Hydram).

1. **INTRODUCTION:**

Recognizing that the hydraulic ram pump (hydram) can be a viable and appropriate renewable energy water pumping technology in developing countries, So we decided to do a complete study of its working, its advantages to get a complete knowledge about it. The hydram shares several characteristics in common with other renewable energy technologies used in the water supply sector such as wind power pumping, hand pumps, stream-driven turbines and solar driven devices. Many of these devices have the capability of being manufactured locally using local skills and materials. These technologies are relatively simple compared to fossil fuel devices that require heat resistant metals, and electrical devices that require an electrical network or an electrical generator. Most renewable energy devices can be operated independently with minimal spare parts needed for regular maintenance. They can therefore functions reasonably well even if the transportation and communications network in a country is not highly developed. This factor makes these devices well suited to rural populations that are widely scattered. A hydraulic ram (also called Hydram) is a pump that uses energy from a falling quantity of water to pump some of it to an elevation much higher than the original level at the source. No other energy is required and as long as there is a continuous flow of falling water, the pump will work continuously and automatically. 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 (Hydram) 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.



**Fig 1: Components of hydraulic ram installations**

With reference to fig 1, the momentum provided by the flow (Qs), caused by the low supply head (Hs), is used to pump a part of flow (q) to a higher elevation (hd),Qw is the wasted flow which may be considered as the “drive flow” and h is the head gained by the suction of the pump. The hydram can be used in places where there is a steady and reliable supply of water with a fall sufficient to operate it. Commercial hydram’s which are mainly manufactured in developed countries are known for many years. However, commercial hydram’s are expensive and there is a growing trend to develop anddesign smaller, lighter and low cost model which can be fabricated in developing countries. The hydraulic ram pump (hydram) though simple in design with only two moving parts, its operation is not well understood. As a result, it has attracted many researchers who have tried to derive analytical models for its operation. Because the researchers have been based in developed countries, the developing countries did not get access to the information readily and the hydram technology is therefore not widely used and the research has not benefited the developing countries. This project was intended to redress this anomaly. A hamlet in a village setting can be supplied with water using hydram as below. The system includes storage and in some cases may include a treatment (chlorination, filtration etc) plant.

1. **Literature Review:**
* Shuaibu Ndache mohammed, in his paper titled “ DESIGN AND CONSTRUCTION OF HYDRAULIC RAM PUMP”, he carried out the Design and Fabrication of a Hydraulic Ram Pump (Hydram).
* E.J. Schiller, in his paper titled “THE HYDRAULIC RAM PUMP (HYDRAM)”, he explained that the hydram can be introduced as one of a series of renewable energy technologies in rural water supply which can be used for domestic purpose and to develop a low cost hydram.
* Mzee, in his paper titled “THE APPLICATION OF HYDRAM IN RURAL WATER SUPPLY SCHEMES IN TANZANIA”, he tried to determine the detail potential for hydram development in Tanzania.
* D. Tulapona, in his paper titled “THE USE OF HYDRAM FOR WATER PUMPNG IN TANZANIA”, he tried to explain the need of more renewable energy technologies in the rural water supply sector and he did an detail study on performance of hydram.
* W.T. Weerakoon and V. Liyanage, in his paper titled “HYDRAULIC RAM PUMP TECHNOLOGY AND PRACTICE IN ZAMBIA”, he carried out experiments on the locally built hydram and the improvements to be carried out.

* P.O. Kahangire, in his paper titled “THE THEORY AND DESIGN OF THE AUTOMATIC HYDRAULIC RAM PUMP”, he carried out study on the principles of hydraulic ram operation a simple approximate analysis of the operation of the hydraulic ram pump and the resultant operating characteristics were determined and were compared with the results obtained by experimentations.
* Dr. Abiy Awoke Tessema, in his paper titled “HYDRAULIC RAM PUMP SYSTEM DESIGN AND APPLICATION”, he carried out study of designing different aspect of a hydraulic-rain pump system and he presented the various application and limitation of hydraulic-ram pump.
1. **WORKING OF HYDRAM:**

 As already discussed in previous section hydram 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 hydram operates automatically and continuously with no other external energy source. A hydram is a structurally simple unit consisting of two moving parts: refer fig: the waste valve and delivery (check) valve. The unit also consist of an air chamber and an air (snifter) valve. The operation of a hydram 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 air valve allows air into the hydram to replace the air absorbed by the water due to the high pressures and mixing in the air chamber.

 The cycle can be divided into three phases; acceleration, delivery and recoil.

1. **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.

1. **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.

1. **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 vale to reopen. The recoil also sucks a small amount of air in through the snifter valve. 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 smoothes the pulsing flow through the delivery valve into an even outflow up the delivery pipe. The pumping cycle happens very quickly, typically 40 to 120 times per minute. During each pumping cycle only a very small amount of water is 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. The term' waste' water needs to be understood. Although waste' water is not delivered by the ram pump, it is the energy of this water that pumps the water which is delivered.

1. **Operation Sequence of Hydram:**

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**Sequence 1**

SEQUENCE 1:

Water from the source flows through the drive pipe (A) into the ram pump body, fills it and begins to exit through the waste or “impetus” valve (B). The Check Valve (C) remains in its normally closed position by both the attached (No water in the tank prior to startup) At this starting point there is no pressure in Tank (D) and no water is being delivered through exit Pipe (E) to the holding tank destination.



SEQUENCE 2:

Water is entering the pump through the Drive Pipe (A). The velocity and pressure of this column of water is being directed out the Waste Valve (B) which is overcome, causing it to close suddenly. This creates a momentary high pressure “water hammer” that in turn forces the Check Valve (C) to open allowing a high pressure “pulse” of water to enter the Pressure Tank (D). The air volume in the pressure tank is compressed causing water to begin flowing out of the Delivery Pipe (E) and at the same time closing the Check Valve (C) not allowing the water a path back into the pump body. As the air volume in the Pressure Tank (D) continues to re-expand, water is forced out of the Delivery Pipe (E) to the holding tank.



**Sequence 3**

SEQUENCE 3:

Water has stopped flowing through the Drive Pipe (A) as a “shock wave” created by the “water hammer” travels back up the Drive Pipe to the settling tank (depicted earlier). The Waste Valve (B) is closed. Air volume in the Pressure Tank (D) continues expanding to equalize pressure, pushing a small amount of water out the Delivery Pipe (E).



**Sequence 4**

SEQUENCE 4:

The “shock wave” reaches the holding tank causing a “gasp” for water in the Drive Pipe (A). The Waste Valve (B) falls open and the water in the Drive Pipe (A) begins to flow into the pump and out the Waste Valve (B). The Check Valve (C) remains closed. The air volume in the Pressure Tank (D) has stabilized and water has stopped flowing out the Delivery Pipe (E). At this point Sequence 1 begins all over again.

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