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Automatic Hydraulic Water Ram Pump

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Abstract: *A hydraulic ram pump is a basic, motorless device for pumping water at low flow rates. It lifts water from a stream, pond, or spring to an elevated storage tank or a discharge point using the energy of flowing water. It's ideal for situations when tiny amounts of water are needed and electricity is scarce, such as a household, garden, or animal water supply. Where the water source runs continuously and the usable fall from the water source to the pump location is at least 3 feet, a hydraulic ram pump is practical.*

Keywords: Momentum, Water Hammer Effect, Continuity, Water, Kinetic Energy

I. Introduction

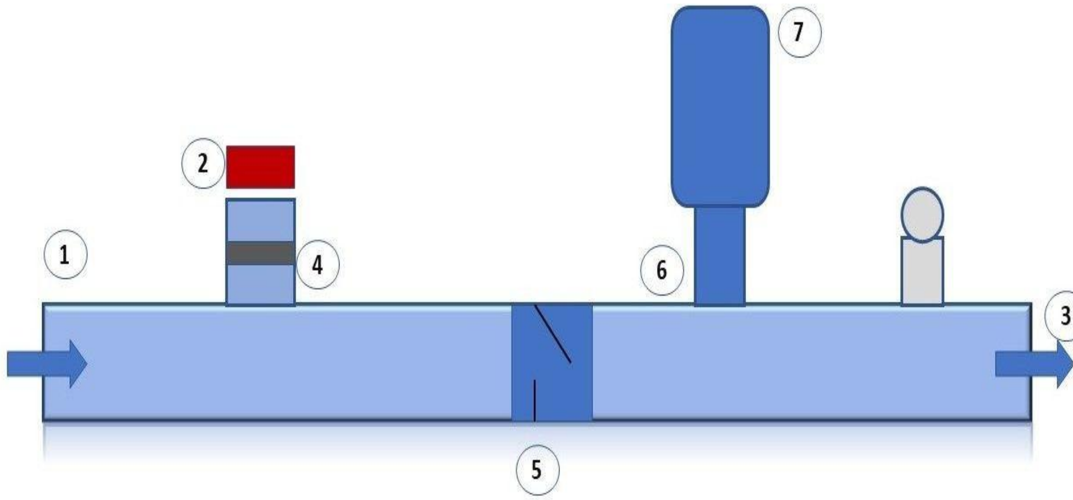
Automatic water pumps have been used in many regions of the world for more than two centuries. In the days before electrical power and the internal combustion engine became widely available, their simplicity and dependability made them commercially successful, especially in Europe. The Automatic water pump was overlooked as technology improved and became increasingly reliant on fossil-fuel-based power sources. The automatic water pump has been around for quite some time; according to legend, the first device in the modern era was invented by an Englishman named John Whitehurst in 1775. His invention was not automatic and was operated by a stopcock. It's easier than carrying water by hand, but it still sounds like a lot of labor. It's also time-consuming. In an age of national electrical systems and large-scale water sources, it was thought to be irrelevant. Small-scale Automatic water pump technology had become unfashionable as big had become beautiful. Automatic water pumps have been reassessed in recent years due to rising interest in renewable energy devices and understanding of the technological needs of a specific market in developing countries. The device is huge in hilly places with springs and steady pumping. Although there are some successful ram pump installations in developing nations, their use has just scratched the surface of its potential to yet.

An automated water pump is a hydropower-powered cyclic water pump. It takes in water at one "hydraulic head" (pressure) and flow rate and discharges it at a higher hydraulic head and lower flow rate. The gadget employs the water hammer effect to create pressure that permits a portion of the water used to power the pump to be hoisted to a higher level than it began. In distant places where there is both a source of low-head hydropower and a need to pump water to a destination higher in elevation than the source, an automated water pump is occasionally used. In this situation, the ram is often useful, since it requires no outside source of power other than the kinetic energy of flowing water. The Automatic water pump is works on the simple principle of water hammering. The concept behind the ramming idea is a "water hammer" shock wave. Water has weight, so a volume of water moving at a certain speed has momentum - it doesn't want to stop immediately. If a car runs into a brick wall the result is crumpled metal. If a moving water flow in a pipe encounters a suddenly closed valve, a pressure "spike" or increase suddenly appears due to all the water being stopped abruptly. If you turn a valve off in your house quickly, you may hear a small "thump" in the pipes that water hammer Effect.

II. Sequence of Operation

Basic Components of Automatic Water Pump

1. Inlet – drive pipe
2. Free flow at waste valve
3. Outlet – delivery pipe
4. Waste valve
5. Delivery check valve
6. Pressure vessel
7. Outlet Pressure Vessel



III. Literature Review

The Hydraulic Ram Pump has been around for quite some time, with the first contemporary mechanism being invented by an Englishman named John Whitehurst in 1775. His design was manual, with a stopcock that could be opened and closed. Although easier than carrying water by hand, it still appears to be a lot of work and time-consuming. In the late 1700s, Joseph and Etienne Montgolfier (of hot air balloon fame) invented the first completely automatic hydraulic ram (1793-1797). The original design performed well on first start-up but suffered from a design flaw that caused a loss or "dissolving" of air in its pressure chamber. This in turn caused an intensive banging in the entire mechanism. It was his son Pierce Montgolfier that solved the problem by developing and designing-in the air or "snifter" valve to reintroduce air into the chamber. For well over 100 years from the 1800s through the early 1900s rams were very popular in the United States until the general availability of publicly managed water mains and electric pumps became the mainstay of twenty-first-century life. Original ram pumps can still be occasionally found in antique stores the back of barns and other odd places. They are a subject of the search for enthusiasts to collect and restore as well as put back into use today. Rams can provide all of the water that a summer house, mountain lodge, or modern homestead requires. Some of these systems are said to have been in continuous service for the past 100 years or more, supplying water to homes and cattle with very little upkeep.

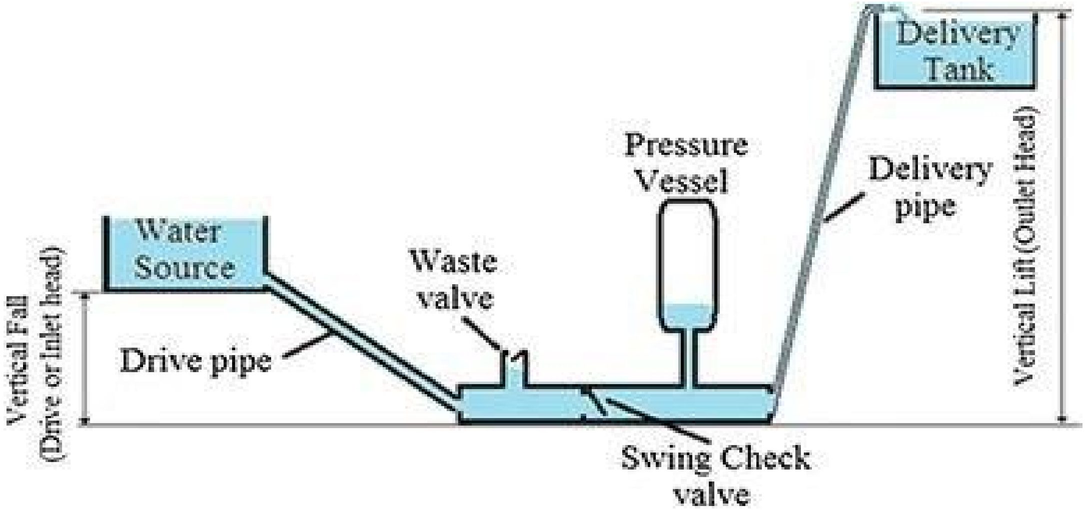
IV. Construction

The waste valve is open and the delivery valve is closed when using an automatic water pump. The water in the drive pipe begins to flow under gravity, gaining speed and kinetic energy until the waste valve is closed by the rising drag force. The water hammer is caused by the momentum of the water flow in the supply pipe against the now closed waste valve, which raises the pressure in the pump, opens the delivery valve, and forces some water 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. When the waste valve closes, a pressure vessel containing air cushions the water pressure shock and enhances pumping efficiency by permitting a more steady flow through the delivery line. Although the pump might theoretically run without it, its efficiency would plummet and it would be subjected to extreme stresses, perhaps shortening its life.

IV. Methodology

Step 1: 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 valve.

Step 2: At some point, water is moving so quickly through the brass swing check "waste" valve that it grabs the swing check's flapper, pulling it up and slamming it shut. The water in the pipe is moving quickly and doesn't want to stop. All that water weight and momentum is stopped, though, by the valve slamming shut. That makes a high-pressure spike at the closed valve. The high-pressure spike forces some water through the spring check valve and into the pressure chamber. This increases the pressure in that chamber slightly. The pressure "spike" the pipe has nowhere else to go, so it begins moving away from the waste valve and back up the pipe It actually generates a very small velocity backward in the pipe.



Step 3: As the pressure wave or spike moves back up the pipe, it creates a lower pressure situation (green arrows) at the waste valve. The spring-loaded check valve closes as the pressure drops, retaining the pressure in the pressure chamber.

Step 4: At some point this pressure becomes low enough that the flapper in the waste valve falls back down, opening the waste valve again.

Step 5: Most of the water hammer high-pressure shock wave will release at the drive pipe inlet, which is open to the source water body. Some small portion may travel back down the drive pipe, but in any case, after the shock wave has released, pressure begins to build again at the waste valve simply due to the elevation of the source water above the ram, and water begins to flow toward the hydraulic ram again.

Step 6: Water begins to flow out of the waste valve, and the process starts over once again.

V. MAIN ASSEMBLY

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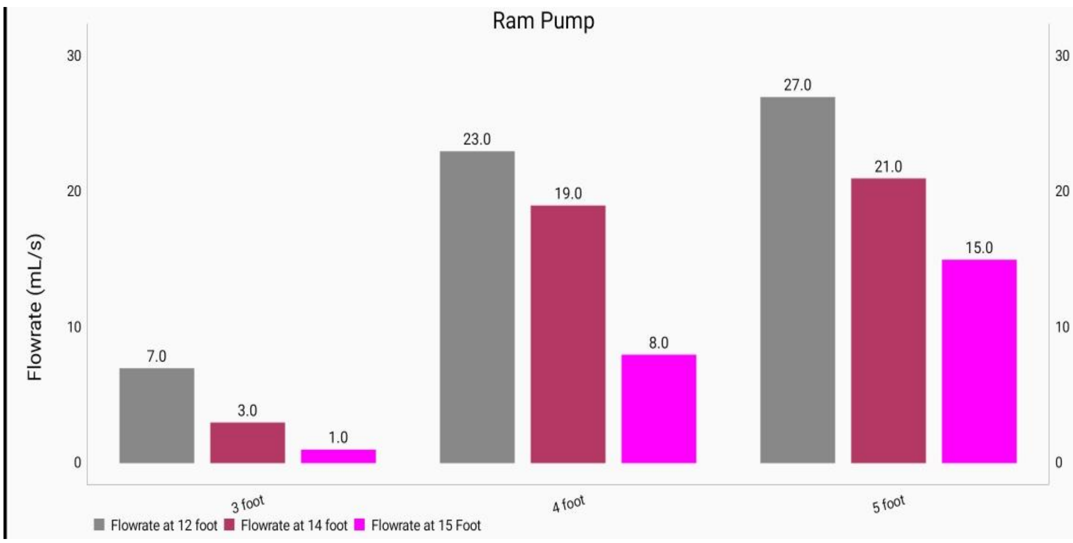
VI. Result And Analysis

	Delivery Height(meter)	Time(sec)	Flow Rate(lit/sec)
0.91	4.26	361	0.003
	3.65	140	0.007
1.21	4.57	131	0.008
	4.26	105	0.009
	3.65	46	0.023
1.52	4.57	66	0.015
	4.26	47	0.021
	3.26	36	0.027



VII. Conclusion

From the graph, we conclude that as increase the input height, the delivery flow rate increases accordingly because of the increases in the momentum of the water. we take the example from above, In 4 feet of source height we get maximum flow rate at the 12 feet and minimum at 15 feet from that conclude that if the momentum of water is directly proportional to the flow rate and inversely proportional to the delivery height of water. An automatic water pump pumps the water without using electricity or fuel. It simply works on water hammer and gravity. This pump conserves energy and it is very economical. It is simple in construction and does not requires high capital investment. Once it is set up it does not requires any human interference.

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