Papa Pump®

Rejuvenating 200 year old 'powerless' pump technology

The hydraulic ram pump isn't exactly the sort of technology that one could call new. In fact the ram pump is a device that dates back over 200 years to the era of the Montgolfier brothers, famous for their ballooning escapades. Since then, developments in hydraulic ram pumps have been slow. In some respects, the technology has been overshadowed by the widespread proliferation of electric and engine driven pumps. What is more, owing to their conventional design and cast iron construction, traditional hydraulic ram pumps have been large, heavy and unnecessarily complicated.

In more recent years, however, environmental concerns have created the need for greener pumps. With it has come the need to redesign the traditional pump to make them more compact and simpler to use. How do they work? Water powered hydraulic pumps are designed to enable users to harness the power of h natural flowing water supply to pump water without the need for an external power source. The ram effect used to power the pump is very simple. It works by intermittently restricting the outflow of a pipe through which a fluid (normally water) is flowing, thereby causing high pressure pulses.

A ram pump uses this effect by allowing natural water from a river or stream to be piped to a lower level under gravity, thereby causing velocity of flow within the pipe. The pump itself is fixed to the lower end of this pipe and consists of two valves. The first valve, commonly referred to as the waste or pulse valve is an adjustable flow-sensitive valve that creates the high pressure pulses by intermittently allowing water to be either pumped at low pressure when open, or delivered or delivered to a higher altitude when closed The second valve is a non-return valve that prevents the draining back of the higher pressure or delivery head water during the waste or low pressure cycles. Traditionally, both these valves have been poppet or flat diaphragm designs encompassed in a castiron housing.

Affixed to the valve housing and normally on top of the non-return valve on the traditional ram pump is a air vessel This vessel intercepts the high pressure delivery pipe to act as a air cushion, smoothing out the pulses, thereby allowing a regular flow through the pipe to the point of storage or use. The PAPA pump uses a patented concentric design. Because it is compact, it can be manufactured in quality materials without prohibitive cost.

Resizing and rethinking

Nevertheless, when design engineers at PAPA pumps were considering redesigning the existing unit it became obvious that the size had to be reduced to where it was comparable to a typical modern electric pump. It was felt that this would establish the credibility of the design and consequently its acceptance in the market. The redesigned pump also had to be . compatible for the use with modern plastic pipe and fittings which were widely available, lightweight, user friendly and inexpensive. Another major design objective was to standardise on the pump sizes so that one pump could cope with large variations of flow. This was achieved by designing a waste valve that would have a wide

operating range. By adopting a concentric approach and by using the venturi effect, a waste valve was developed that would not only pass large volumes of water through a comparatively small open area, but, as a result would operate with little movement thus reducing wear.

Being toroidal, the valve member has a smaller cross sectional area than a conventional flat diaphragm. It also has less mass and remains unstressed in the open position regardless of the adjustment requirements. This allows the elasticity of the material to remain constant for longer. This is important, as it is the elastic qualities that govern the operation of the valve and it is the consistency of this that prevents the need for regular adjustment. These are variable for different supply so that the travel of the member can be restrained. This is because a higher supply head will enable a higher velocity of water through the valve, so a low elasticity member used for a given adjustment will cause the valve to close sooner than if a higher elasticity member were used at that same adjustment.

The smooth surfaces and the profile of the valve also reduces the chance of solids building up, also making it tolerant to water with a high solids or material content. For ease and simplicity, the valve member has no mechanical fixing and is held in a groove by virtue of its elasticity. This enables replacement of the valve member by simply sliding the old one off and pushing the new one on.

Simplicity and robustness was paramount in all aspects of the design. When looking for a system to smooth out the pulsed flow, the designers at PAPA decided to use modern pre-pressurised vessels. These are lightweight units that consist of an elastic bladder or membrane internally held in a steel vessel. One side of the bladder contains the water while the other is pressurised by air. The air pressure is pre-set to slightly less than the delivery head pressure through the schrader valve. The unit is normally screwed into a T' close to the delivery end of the pump. When the pressure pulse occurs the bladder expands inside the vessel against the air pressure and releases back again sustaining a continuous flow through the delivery pipe. These pressure vessels are widely available in a large range of sizes and are relatively inexpensive.

Water Disposal

Another area for improvement was getting rid of waste water. On conventional rams, this was simply a matter of allowing the water to flow out of the waste valve and to then drain the floor area on which the ram was mounted. However, this means that the ram had to be positioned to the lowest point to create the maximum flow velocity through it. As a result, it was often in a bogged and water logged situation.

By providing a coupling to the waste outlet, however, the redesigned PAPA pump enables a air tight connection to be made allowing a pipe to be fitted directly to the pump to carry the waste water away. Providing the end of this pipe is submerged (to prevent air ingress), the pump can be then kept in a water free environment, whilst maintaining the supply head.
Also considered as a key design criterion was the system of adjustment. The design team at PAPA considered that it was important to allow the user to adjust the pump without the need for tools. The use of knurled adjuster nuts enables adjustment by hand, although after a long period in use it may be necessary to use a simple hand grip wrench to initially loosen.

The result of the design effort is that the older 200 year technology has been brought firmly into the 21st century. The newly designed hydraulic ram pump is a cost effective pollution free alternative to electric pumps that can be used wherever a supply of water is available.