VACUUM PUMPS FOR DIRTY WATER.

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The design and operation of pumps which work on the vacuum principle, are not generally understood by engineers, contractors, mine superintendents and men interested in irrigation work. It is fitting, therefore, to discuss the general features of vacuum pumps as well as the particular improvements in the latest addition to this type of pumping machinery known as the Emerson Steam pump, manufactured by the Emerson Steam Pump Company, of Alexandria, Va.

A pump operating on the vacuum principle possesses decided advantages where sand or other gritty material is contained in the water, and the remarkable lightness of weight and ease with which its location can be changed as excavation work shifts or mine shafts are sunk lower and lower, make this type of pump particularly useful in unwatering cofferdams, caissons, mines, quarries and isolated work of all kinds.

History.

The idea of raising water by the condensation of steam in a chamber and then forcing it up to a still higher level by the direct pressure of steam on the surface of this water in the same chamber, originated with Capt. Thos. Savery, who in 1698 patented his celebrated "fire engine." Properly speaking, his device was not an engine but a sort of pump, a forerunner of the present Emerson steam pump. In operating Thos. Savery's engine one cylinder was filled with steam, the steam valve was closed by the operator and a spray of water was then injected into the steam. The continual services of a man were needed to operate the steam valve and an almost continuous stream of water was delivered. A great sale was built up for this pump until Newcomens' atmospheric engine displaced it and piston pumps began to come into the field. The displacing of Savery's pump was largely due to the fact that the expansive power of the steam was wasted, and the steam consumption was hence enormous. No progress was made in vacuum steam pumps for nearly 200 years when in 1872 and 1881 Mr. Chas. Hall patented the Pulsometer.

A saving of at least 25 per cent. in the amount of fuel, one of the main advantages of the Emerson pump, is the result of early steam cut-off which is made possible by the design of the rotary slide valve steam ports.

Operation.

In general, as shown in the sectional cut, the Emerson pump consists of two long cigar-shaped cylinders or receiving tanks, each connected at the bottom through upward opening valves with the suction pipe; and also connected, again with upward opening valves, with the discharge pipe, thus having but four valves in all for the average standard pump.

In the Emerson pump the steam is used twice. First it presses directly down on the surface of the water in the chamber and forces it out through the discharge pipe. Second, this same steam is itself then suddenly condensed, creating a vacuum which re-fills that chamber with a new charge of water. Where two cylinders are used as shown in the picture one of them (which we will call cylinder No. 1) with full boiler pressure acting on the top of the water, is discharging; while at the same time the other cylinder (which we will call No. 2) has just created an almost perfect vacuum and is sucking in the water. Filling the vacuum requires less than two seconds, and after an interval of only a fraction of a second the next inrush of steam into that chamber empties it in about two more seconds. After an interval of but a small fraction of a second, the water having been expelled and cylinder No. 1 full of live steam, a jet of cold water as shown in the picture, is forced from cylinder No. 2 into this steam, condensing it and creating an almost perfect vacuum, thus completing the cycle for cylinder No. 1. This cycle can be summarized as follows:—

A. Steam admitted to cylinder No. 1, forces out liquid.

B. Same steam condensed by jet of cold water from cylinder No. 2, creates vacuum.

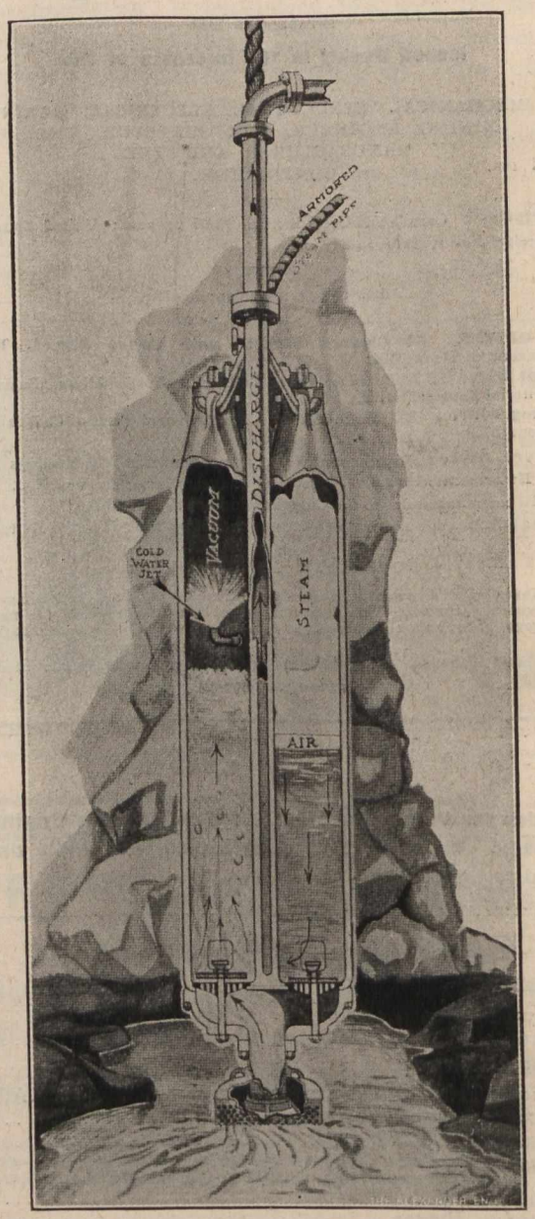
C. Vacuum thus formed refills No. 1 with water from the suction pipe, regardless of possible inrushing air, until the vacuum is relieved.

These items take place alternately in the two chambers. That is, comparing this pump with the human heart, one cylinder is acting as an auricle while the other is acting as a ventricle, and vice versa.

A number of conditions, however, must be properly dealt with in order to obtain a pump on the vacuum principle which operates satisfactorily.

Durability.

As all users of pumps realize, the wear and tear created by sand, grit, loam or any foreign matter, is a very serious item. By studying the pictures herewith it will be noticed that the liquid being pumped never comes into contact with any-



thing which moves, except the four round rubber valves, two in the suction and two in the discharge pipes. Thus the gritty material can be handled without the necessity of frequent repairs because the Emerson pump employs no plungers, pistons, piston rods, glands, stuffing boxes nor any other moving parts come in contact with the water being pumped.

Weight.

The weight per given capacity is considerably lower than that of any other pump on the market. A pump with a capacity of 1,200 G.P.M. against a 25-ft. head weighs only 2,700 lbs. It should be remembered, too, that there is no engine to be brought in order to furnish power to the Emerson pump, since the steam from the boiler is made to act direct, both in expelling the water and, by means of a vacuum, in sucking in the supply from the sump. Since this pump is self contained and operates entirely on the principle of steam expansion against a column of liquid, it follows that its weight is less than the weight of other pumps plus the weight of the engine necessary to drive them.