Feb. 8, 1966 RYOICHIRO OSHIMA 3,233,551

WESTCO PUMP

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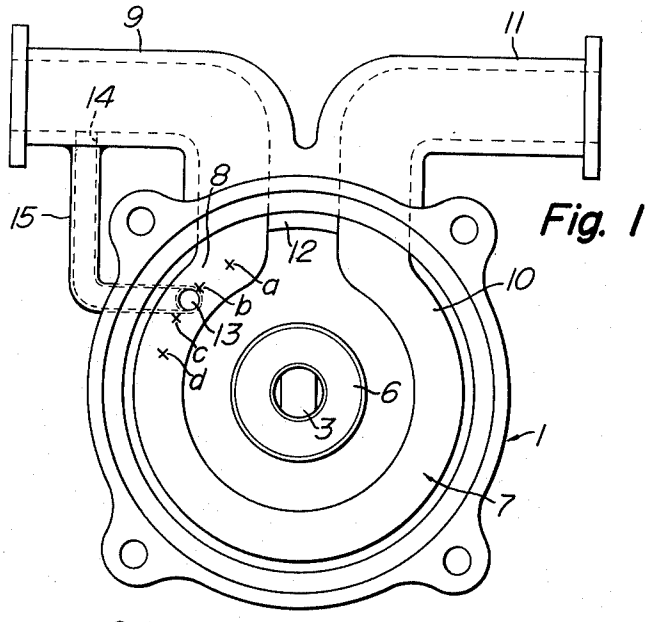


Fig. 1

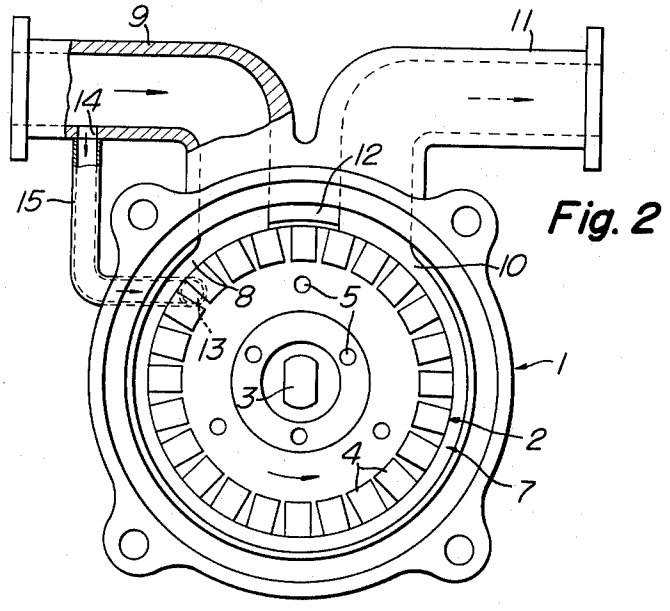


Fig. 2

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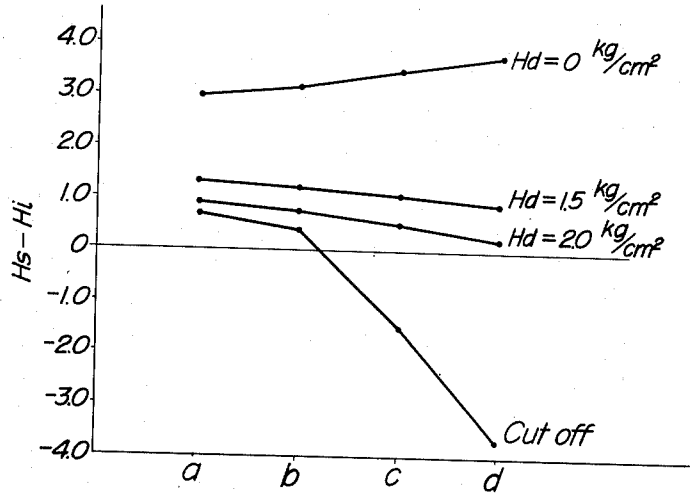
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Fig. 3



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United States Patent Office 3,233,551 Patented Feb. 8, 1966

3,233,551

WESTCO PUMP

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Filed Feb. 3, 1964, Ser. No. 342,008
3 Claims. (Cl. 103—96)

The present invention relates to a Westco pump used for shallow wells or for conveying oil.

In recent years pumps of this type have been made smaller and smaller in size and made to rotate at higher speed. Additionally, a larger suction head is normally required, and today pumps with water head of some 7 m. are required. Conventional Westco pumps, however, are incapable of meeting such requirements. If it is tried with conventional Westco pumps to meet such requirements, it will cause cavitation in the beginning portion of the water passage of the runner means. The cavitation reduces the pumping efficiency, causes erosion of the runner and gives noise and vibration.

It has now become clear as the result of experimental research, what causes the cavitation. As the sectional area of the beginning portion of the water passage in the runner means is far smaller than that of the suction port of the pump, the speed of the current becomes high and the pressure is reduced. The reduction of the pressure is further promoted by the fact that the fluid is stirred within the tooth spaces of the runner around the beginning portion. Those two facts cause the cavitation. The situation of the pressure reduction in the beginning portion of the water passage is diagrammatically explained in FIG. 3. Reference symbols *a*, *b*, *c* and *d* respectively refer to four points around the beginning portion of the water passage (see FIG. 1); H*i* indicates measured pressure values at each of the four points; H*s* indicates the suction head; and H*d* refers to the discharge head. The diagram, in which pressure difference values *Hs—Hi* at each point *a*, *b*, *c* or *d* are plotted employing the discharge head H*d* as a parameter, represents curves for the pressure characteristics. As is readily discernible from the diagram, at points *a* and *b* pressure is lower than H*s* even when the discharge pipe is shut off, and lower than H*s* by about 3 meters at *Hd*=0. Therefore, it can be concluded that cavitation chiefly takes place at points *a* and *b*.

The present invention has been devised with the intention of doing away with such defects. The object of the present invention is to destroy cavitations by automatically pouring water under pressure into the beginning portion of the water passage in the runner means according to the degree of cavitation around the beginning portion.

In detail, high pressure water is ejected directly into the beginning portion of the water passage from the suction pipe where pressure is higher than in said beginning portion of the water passage. The injected high pressure water increases pressure in the beginning portion of the water passage, and reduces the volume of water streaming in the beginning portion from the suction port, and thereby destroys cavitations formed in the current upstream of the ejection port. Furthermore, the volume of water under pressure to be ejected is automatically controlled in response to the degree of the occurrence of cavitation or the degree of pressure reduction. Therefore, cavitation can be automatically and completely destroyed, and thereby the pump characteristics are remarkably bettered.

Consequently, the present invention can provide a Westco pump far smaller in size and with larger head than conventional ones.

An embodiment of the present invention will be explained in reference to the drawings, in which,

FIG. 1 is a side elevational view of a Westco pump

embodying the present invention with its casing cover and runner removed;

FIG. 2 is a side elevational view partly in section of the same with its casing removed; and

FIG. 3 is a diagram showing static pressure differences between some static pressure measuring points in the beginning portion of the water passage and the suction port of a conventional Westco pump employing the discharge head as a parameter.

A runner **2** is rotatively supported within the pump casing **1**. The runner **2** is mounted not rotatively but movably in the axial directions on a rotary shaft **3** extending within the casing **1**. In the circumferential portions of the opposite sides of the runner **2** a number of tooth spaces **4** are formed to provide blades. Further in the runner **2** a plurality of balance holes **5** are provided which extend therethrough. The balance holes **5** operate as circulation holes to substantially equalize water pressures on the opposite sides of the runner **2**. Numeral **6** is a sealing means to seal the clearance between the casing **1** and the rotary shaft **3**. In general, mechanical seals are employed for this purpose. In the inner wall of said casing **1** a ring shaped water passage **7** is formed opposite to the tooth spaces **4** of the runner **2**. The beginning portion **8** and the ending portion **10** of the water passage **7** are in communication with a suction pipe **9** and a discharge pipe **11**, respectively. A similar water passage **7** is formed in the front cover of the casing **1** (not shown). Between the beginning portion **8** and the ending portion **10** of said water passage **7** there is fixed a partition wall **12**. Numeral **13** indicates an ejection part for water under pressure located near the beginning portion **8** of the water passage **7** and communicating with a branch hole **14** formed in the suction pipe **9** by way of a water pipe **15**. According to the actual operation it is most effective to position the ejection port between the points *a* and *b*.

When runner **2** rotates in the direction of the arrow, water is pumped up. At that time, as stated above, pressure in the beginning portion **8** of the water passage **7** forming the pumping space is far lower than that in the suction pipe **9**. The pumped-up water in the suction pipe **9** passes through the water pipe **15** and is discharged out of the ejection port **13** in a jet-like manner in accordance with the pressure changes to increase the pressure within the beginning portion **8**, and thereby to prevent the occurrence of cavitation. As the volume of water to be ejected from the ejection port **13** varies with the change of the rotation of the runner **2** or with the pressure changes of the beginning portion caused by the change of water head, pumping efficiency with this pump is much higher than that of conventional Westco pumps.

What is claimed is:

1. A pump comprising a circular casing, a circular runner rotatively provided within said casing, a nearly annular spacing formed around the periphery of the runner, said spacing forming a pumping passage, a suction pipe opening into the casing and communicating with the pumping passage, said suction pipe having an upstream section upstream of its opening into said pumping passage, a discharge pipe opening into the casing in side-by-side relation with the suction pipe and communicating with the pumping passage, and abutment means in said pumping passage between said discharge and suction pipes, means for preventing cavitations resulting from the pressure decrease in the beginning portion of said pumping passage relative to the pressure prevailing in said upstream section by ejecting water at relatively higher pressure into the said beginning portion including a water pipe, one end of which communicates with the pumping passage in the said beginning portion thereof and the other end of which communicates with the upstream sec-

tion of said suction pipe, so that the pressurized water enters the said beginning portion of the pumping passage in by-passing relationship to the flow of liquid through said opening of said suction pipe into said pumping passage.

2. In a regenerative pump having a circular casing, a runner provided with radial blade means along the circumference thereof, said runner being rotatably supported within said casing, an annular channel being formed about the peripheral edge of the runner, said channel forming a pumping chamber, a suction conduit having an upstream section and in communication with said pumping chamber through an inlet aperture, a discharge conduit in communication with said pumping chamber through a discharge aperture, and abutment means in said pumping chamber and located between said discharge and inlet apertures,

the improvement essentially consisting of means for preventing cavitations in the beginning portion of said pumping chamber adjoining said inlet aperture in the normal direction of rotation of said runner, which result from the pressure decrease in said beginning portion relative to the pressure prevailing in said upstream section, including a by-pass conduit, one end of which is in communication with said beginning portion and the other end of which communicates with said upstream section of the suction conduit whereby pressurized water is supplied from said upstream section directly to said beginning portion of the pumping chamber to compensate for said pressure decrease.

3. A regenerative pump, comprising a circular casing, a circular runner provided with peripheral blade means

and rotatably supported within the casing with a nearly annular pumping chamber formed within said casing about the periphery of the blade means of said runner, a suction conduit having an upstream portion opening into the casing and communicating with said pumping chamber through an inlet aperture, a discharge conduit opening into the casing and communicating with said pumping chamber through a discharge aperture located downstream of said pumping chamber, abutment means in said pumping chamber intermediate said discharge aperture and inlet aperture, and means for supplying water at relatively higher pressure from the upstream portion of said suction conduit to the beginning portion of said pumping chamber disposed close to and downstream of said inlet portion to prevent cavitations caused by the pressure decrease in said beginning portion relative to the pressure prevailing in said upstream portion including auxiliary conduit means operatvely connected with one end thereof with said upstream portion and in direct communication at the other end thereof with the beginning portion of said pumping chamber where cavitations might occur.

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