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MULTISTAGE SELF-SUCTION TYPE CENTRIFUGAL PUMP

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Fig. 1 ~

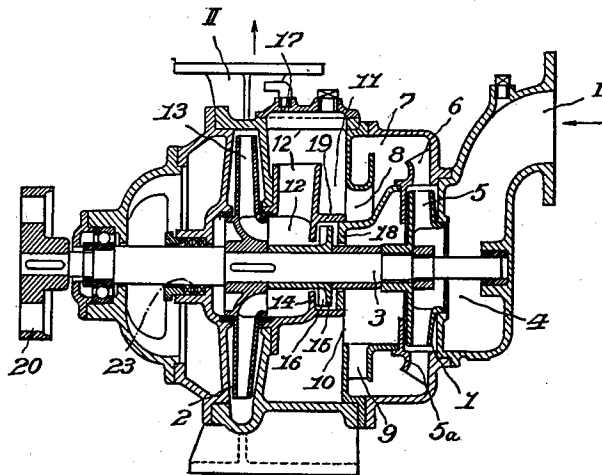


Fig. 2 ~

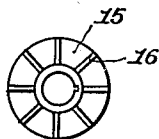
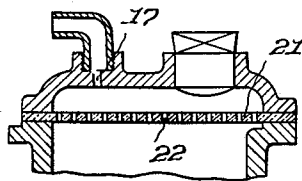


Fig. 3 ~



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MULTISTAGE SELF-SUCTION TYPE CENTRIFUGAL PUMP

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2 Claims. (Cl. 103—108)

The present invention relates to improvements of multistage self-suction type centrifugal pumps.

Ordinarily, the so-called self-suction type centrifugal pump achieves an effective self-sucking function in the case only, in which the lift head is remarkably lower than the ordinary lift head of the normal nonself-suction type centrifugal pump having an impeller the circumferential velocity of which is made uniform.

Accordingly, for the purpose of lifting a large amount of a liquid up to a sufficiently high position by use of self-suction type pump while maintaining the liquid at a state to be easily sucked, a multistage self-suction type pump consisting of several self-suction type centrifugal pumps must be adopted. However, the construction, efficiency and centrifugal action of said multistage self-suction type pump are, respectively, extremely large and complex, very low, and relatively weak.

Therefore, an essential object of this invention is to provide an improved multistage self-suction type centrifugal pump which has not such disadvantages as described above.

Another object of this invention is to provide an improved multistage self-suction type centrifugal pump which is very simple and compact in its construction and very high in its efficiency and which is able to lift any liquid up to a very high level.

Said objects and other objects of this invention have been attained by skillful combination of a first stage self-suction type centrifugal pump with a second stage normal centrifugal pump, the former having a lift capacity not larger, in principle, than that of the latter within the range sufficient to exhibit a large self-sucking ability, and by providing an air discharge outlet being communicated with the atmosphere in the intermediate passage formed in the zone between the self-sucking liquid level at the outlet port of the first stage pump and inner end of the accelerating passage of the second stage pump.

According to the above construction of this invention, when liquid lifting action is ceased by the complete suction of the liquid, the second stage pump acts as a hydrodynamic valve so as to maintain the liquid pressure in the liquid lifting pipe, because the first stage and second stage pumps are so designed that the lift capacity of the second stage pump is not smaller than that of the first stage pump, whereby the pressure at the intermediate passage between the first stage and second stage pumps become the state capable of being lowered to the atmospheric pressure and the self-sucking action of the first stage pump becomes very easy.

The novel features which we believe to be characteristics of our invention are set forth with particularity in the appended claims. Our invention itself, however, both as to its manner of construction and manner of operation together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing, in which the same members are indicated by the same numerals, and in which:

FIG. 1 is a vertically sectional elevational view of an example of this invention.

FIG. 2 is a front view of the seal plate used in the example in FIG. 1.

FIG. 3 is an enlarged view of the screen filter in the example in FIG. 1.

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Referring to FIG. 1, the runner 1 of the first stage self-suction type centrifugal pump and the runner 2 of the second stage normal centrifugal pump are supported by a common rotary shaft 3 having a driving coupling 20. The first stage self-suction type centrifugal pump comprises a fluid passage consisting of an inlet opening I, an inlet chamber 4, an accelerating passage 5 formed in the runner or impeller 1, a guide passage 6 formed in a guide vane 5a, a separation chamber 7 for the centrifugal separation of air from the liquid, a passage 8 for the discharge of the air separated from the liquid due to centrifugal action by the impeller in said chamber 7, a passage 9 for the collection of the liquid separated in said chamber 7, a discharge passage 10 for discharging the liquid collected in said chamber 7, and an intermediate passage 11 which forms a chamber for accumulating the liquid to be sucked in the second stage centrifugal pump, said chamber being designed so that the liquid of an amount sufficient to the self-suction of said second stage centrifugal pump may be accumulated in said chamber. The second stage centrifugal pump comprises a duct 12' forming a fluid passage having an inlet opening 12, an accelerating passage 13 formed in the runner 2, and an outlet opening II. An air discharge outlet port 17 is equipped on the intermediate passage 11 and an impeller type seal plate 15 which is attached to the rotary shaft 3 is arranged between said passage 11 and the inlet opening 12. The plate 15 is provided, at its one side surface facing the wall 14 of the inlet passage 11, with such vane type projectors 16 as clearly shown in FIG. 2, said projectors being used for the acceleration of the centrifugal action of said plate 15.

The seal plate 15 may be covered at its outer periphery and side surface having no said projectors by means of a cylindrical member 19 attached to the wall 14 and a side plate 18 supported by the wall of the discharge passage 8.

In the above embodiment, the first stage pump is constructed so as to have such a most efficient self-sucking ability that liquid and air can be always sucked up. On the other hand, the second stage pump is designed so as to lift up liquid of an amount not smaller than the amount being sucked by the first stage pump in such a manner that the total amount of the liquid sucked in the first stage pump can be effectively lifted and discharged out of the outlet opening of the second stage pump. According to the above-mentioned construction, it is possible to obtain a simple and compact pump capable of achieving a sufficient self-suction with a large lifting head. Moreover, even when a large amount of air is charged into the intermediate passage 11 from the first stage pump, this charged air can be effectively discharged out through the discharge outlet port 17, whereby said air does not disturb the liquid lifting function.

As a whole, in this invention, the first stage and second stage pumps are designed so as to be mostly suitable, respectively, for the self-sucking function and liquid lifting function, so that the pump of this invention is remarkably different from the ordinary multistage pump consisting of several pumps, each having the same impeller.

In the above construction, when the seal plate 15 is removed and the pump is started after filling an amount of the self-suction liquid, the liquid in the passage 11 leaks gradually into the inlet opening 12 of the second stage self-suction type centrifugal pump through the gap between the wall 14 and the rotary shaft 3, whereby the liquid leaked from the passage 11 is discharged by the runner 2 and the liquid level in the passage 11 lowers. Accordingly, the air in the outlet side may be recycled into the discharge outlet port 17, whereby the self-sucking function is made impossible. For the purpose of avoiding the above-mentioned disadvantage, a strictly designed packing must be equipped between the wall 14 and the

rotary shaft 3. Such an ideal packing is very difficult in its construction and moreover has no reliable function. According to this invention, however, the sealing between the first stage and second stage centrifugal pumps can be effectuated by the special seal plate 15.

In the pump of such a type as described above, size of the air discharge outlet port 17 must be matched with various use-conditions of the pump, because, for example, when the outlet port 17 designed so as to be matched with a certain suction stroke is used for any other suction stroke smaller than the former suction stroke, discharge pressure of the first stage centrifugal pump becomes too high, whereby the liquid will leak through said outlet port 17 and power loss will occur. Accordingly, in the pump designed so as to be matched with a low suction stroke, size of the air outlet port 17 must be suitably decreased so as to increase the resistance of said port against the fluid passing to restrict discharge of the liquid from said port.

On the other hand, however, when the outlet port 17 is designed so as to be too small, said port will be clogged with impurities such as dust, sand and the like unless the velocity of the air is made very large and the liquid not containing said impurities is used.

According to this invention, the above-mentioned disadvantage has been avoided by combination of the air outlet port 17 having a sufficient wide cross-sectional area with such a screen filter 21 having many small holes 22 and arranged in front of said port 17 as shown clearly in FIG. 3, size of each of said holes being selected so as to filtrate the impurities to protect said port 17 from clogging and to moderate the velocity of the fluid in said port. According to adoption of said screen filter 21, clogging of the outlet port 17 and adhering of the impurities on said holes can be effectively avoided because of relatively low velocity of the fluid.

In the embodiment in FIG. 1, it is possible to provide the inlet opening 12 of the second stage centrifugal pump at the coupling side. Furthermore, the air discharge outlet port 17 in the embodiment in FIG. 1 may be substituted with a slit equipped at the position 23 between the portion of the casing-wall where the rotary shaft passes through said wall and the surface of the rotary shaft facing said portion.

In this invention, the pump or pumps following to the first stage pump is not limited to a single stage centrifugal pump and it is not always necessary to arrange all of the pumps on a common shaft or to combine all of the pumps as one body so far as all of the pumps are arranged in series.

While we have described particular embodiments of our invention, it will, of course, be understood that we do not wish our invention to be limited thereto, since many modifications may be made and we, therefore, contemplate by the appended claims to cover all such modifica-

tions as fall within the true spirit and scope of our invention.

We claim:

1. A multi-stage self-suction type centrifugal pump comprising a casing having a pair of spaced partitions therein to form three successive chambers, said casing having an inlet opening for the fluid into the first chamber and an outlet opening from the casing for the liquid from the third chamber, a rotatable shaft in the casing extending through the chambers, a first self-priming pump stage including an impeller mounted on the shaft within the first chamber, the first partition having an opening therein above the shaft for the flow of liquid and air from the first chamber to the second chamber, and a second opening in the first partition at a level below the shaft but above the bottom of the casing for the return of liquid only from the second chamber to the first chamber for trapping liquid therein whereby a self-priming action is carried out by the first pump stage upon the starting thereof, a second non-self priming pump stage including a second impeller within the third of the chambers mounted on the shaft and having a lift not smaller than the first pump stage, the second partition having an opening therein for the passage of liquid from the second chamber to the second pump stage, a duct in the second chamber having an inlet opening above the second opening and leading to the opening in the second partition, said casing having a further opening at a level not lower than the inlet opening of the duct for communication of the second chamber with the atmosphere for discharge of the air separated from the liquid in the second chamber, and a filter screen positioned within the casing and confronting the opening.

2. A multi-stage pump as defined by claim 1 including deflecting means formed adjacent to the periphery of the impeller of the first stage for directing fluid along the peripheral wall of the casing forming the first chamber and toward the first partition.

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