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FLUID HANDLING APPARATUS

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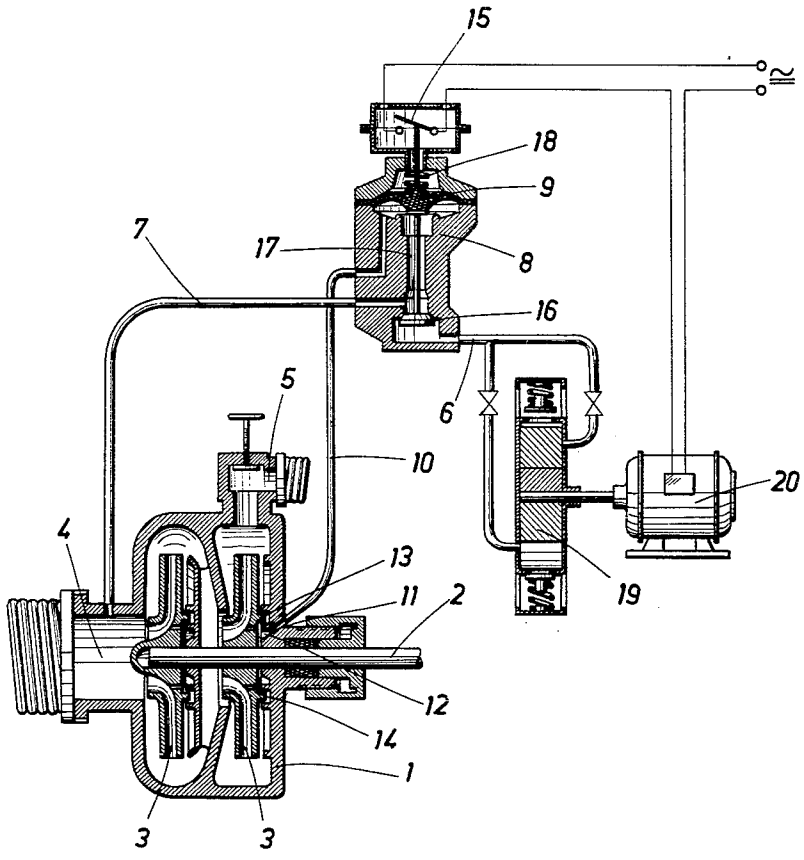

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FLUID HANDLING APPARATUS

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Because centrifugal pumps are not self-priming, an air pump is required, which operates until the centrifugal pump has sucked liquid; then the air pump can be disconnected. To facilitate the operation, it is already known to provide a control device which automatically energizes and deenergizes the air pump in dependence on the liquid pressure in the centrifugal pump. This control device comprises in most cases a spring-loaded control member, which consists of a piston or diaphragm and to which liquid under pressure is supplied from the centrifugal pump. When the centrifugal pump has been filled with water and the pressure in the centrifugal pump rises above a certain minimum value, the piston or diaphragm is moved against the force of the spring to deenergize the air pump. When the suction column breaks down during the operation of the centrifugal pump, the liquid pressure will drop and the movement of the piston or diaphragm in the opposite direction under the action of the spring will cause the air pump to be re-energized. In pumps which must often handle impure water, such as fire pumps, this control device tends to become soiled after a short time and must often be cleaned or may sometimes become entirely useless. Most dangerous are hard and granular impurities, such as sand, which are not emulsified in the water and tend to settle.

It is an object of the invention to provide a centrifugal pump which even when handling highly contaminated water does not result in soiling of the automatic control device or in a disturbance of its operation so that the pump has an increased reliability and for this reason is particularly suitable as a fire pump.

The invention is based on a centrifugal pump comprising an air pump which is automatically energizable and deenergizable by means of a control device in dependence on the liquid pressure in the centrifugal pump. The invention resides essentially in that the tap for the liquid under pressure for actuating the control device is disposed close to the impeller shaft of the centrifugal pump. Because the particularly undesirable, hard and granular impurities have a higher specific gravity than water, they will accumulate near the outer periphery of the path of the water gyrating in the pump whereas their occurrence decreases progressively toward the impeller shaft. According to the invention, the water under pressure is taken from a point near the impeller shaft, i.e., from a region when no grains of sand or the like, which might cause a disturbance of the function of the control device, are to be expected, and the control device is fed only with water which has been freed from such impurities to a considerable extent.

A further improvement is achieved in that the tap is disposed in a space which communicates with the remaining space of the pump only through a narrow gap defined by a wall and an annular rib on the rear face of the impeller. To avoid a settling even of fine particles of mud in the control device and to prevent the same from freezing in the cold season, the control device has gaps or the like which are open to permit of a flow of the liquid underpressure through them when the air pump is deenergized; these gaps are somewhat wider than the gap between the tap space and the remaining space of the centrifugal pump. This results in a continuous, slight flow through the control device whereby any mud particles passed through the gap between the pump chambers are washed out and the danger of freezing is greatly reduced.

On the rear side of the impeller there is not the full pressure of the pump but only the pressure transmitted through the gap; this pressure is greatly reduced if the impeller has also the usual thrust balancing bores. Because it is desired to deenergize the air pump immediately when the centrifugal pump has been filled with water and because the control device should not be too sensitive, the tap in a centrifugal pump comprising two or more stages is preferably disposed in a pump space associated with a higher pump stage so that a sufficiently high liquid pressure will be available for actuating the control device.

The drawing is a diagrammatical axial sectional view showing an illustrative embodiment of the invention.

The two impellers 3 of a two-stage centrifugal fire pump are mounted on a shaft 2 in the housing 1. The suction inlet and the discharge outlet of the pump are indicated 4 and 5, respectively. An air pump 19 driven by an electric motor 20 communicates through conduits 6, 7 with the suction inlet 4 of the centrifugal pump. The conduits 6, 7 are connected by a valve 8 which is actuated by a spring-loaded diaphragm 9 mounted in the valve casing. Liquid under pressure is supplied from the centrifugal pump through a conduit 10 to the diaphragm 9. The liquid is withdrawn through a tap 11 close to the impeller shaft 2 from a chamber 12 in the housing which communicates with the remaining pump cavity only through a narrow gap 14 between an axial end wall of the housing 1 and an annular rib 13 on the rear face of the impeller in the second pump stage.

When the valve 8 is in the closed position shown in the drawing, the diaphragm 9 is lifted against the force of a spring 18. The movable contact of a switch 15 is attached to the diaphragm. The switch controls the motor 20 and is open. The conduits 6, 7 are separated by the movable valve member 16 which is also attached to the diaphragm 9. The stem of the valve member 16 passes freely through a bore 17, which is wider than the gap 14 and permits continuous limited flow of water through the conduit 10 and the valve casing into the conduit 7 and back to the suction inlet 4. When there is no pressure in the centrifugal pump or when the pressure drops below a certain value, the diaphragm 9 is depressed by the action of its spring 18 so that the switch 15 is closed and the air pump 19 is started; at the time, the valve member 16 is lifted from its seat so that the conduits 6, 7 are connected. During the operation of the air pump 19, the diaphragm 9 is sufficiently lowered to close the bore 17 between the orifices of the conduits 7 and 10.

What I claim is:

1. Fluid handling apparatus comprising, in combination:

(*a*) a centrifugal pump including
  (1) a housing defining a cavity therein, and adapted to hold a liquid;
  (2) an impeller shaft rotatably mounted in said cavity, said shaft having an axis, and
  (3) an impeller mounted on said shaft in said cavity,
  (4) said housing being formed with a discharge outlet remote from said axis, with a suction inlet, and with a tap therethrough adjacent said axis and remote from said inlet;

(*b*) an air pump communicating with said cavity; and

(*c*) control means connected to said tap for receiving fluid therethrough from said cavity,
  (1) said control means being responsive to the pressure of the received fluid for operating said air pump.

2. Apparatus as set forth in claim 1, wherein said impeller divides said cavity into two portions, one of said portions directly communicating with said discharge outlet and with said suction inlet, the other portion directly communicating with said tap, said two portions communicating with each other through a gap circumferential about said axis, said one portion extending radially outward from said gap, and said other portion extending radially inward from said gap.

3. Apparatus as set forth in claim 2, wherein said other cavity portion is axially defined between respective wall portions of said impeller and of said housing, said apparatus further comprising an annular rib on one of said wall portions about said axis, said rib axially extending from said one wall portion toward the other wall portion and defining said gap therewith.

4. Apparatus as set forth in claim 2, further comprising a conduit connecting said air pump with a portion of said cavity spaced from said tap.

5. Apparatus as set forth in claim 2, wherein said control means include a valve interposed between said air pump and said cavity, and pressure-responsive actuator means for operating said valve in response to the pressure of said received fluid.

6. Apparatus as set forth in claim 2, wherein said air pump is electrically operated, and said control means include a switch in circuit with said air pump, and actuator means for operating said switch in response to the pressure of said received fluid.

7. Apparatus as set forth in claim 2, wherein said air pump is electrically operated, and said control means include a valve interposed between said air pump and said cavity, a switch in circuit with said air pump, and actuator means for operating said valve and said switch in response to the pressure of said received fluid.

8. An apparatus as set forth in claim 2, wherein said control means include a casing formed with a bore therein, a first conduit connecting a first portion of said bore to said cavity, a second conduit connecting a second portion of said bore to said air pump, and a third conduit connecting a third portion of said bore to said tap, first valve means movable in said bore toward and away from a closing position in which said first valve means separates said second bore portion from said first and third portions, and actuator means responsive to the pressure of the fluid received in said third portion for operating said valve means.

9. An apparatus as set forth in claim 8, wherein said first and second valve means are operatively connected for joint movement of one valve means toward said closing portion thereof when the other valve means moves away from the closing position of said other valve means.

10. An apparatus as set forth in claim 9, wherein said air pump is electrically operated, and said control means include switch means in circuit with said air pump and operable for energizing and deenergizing said air pump, said switch means being connected to said actuator means for operation thereby in response to said pressure of the received fluid.

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