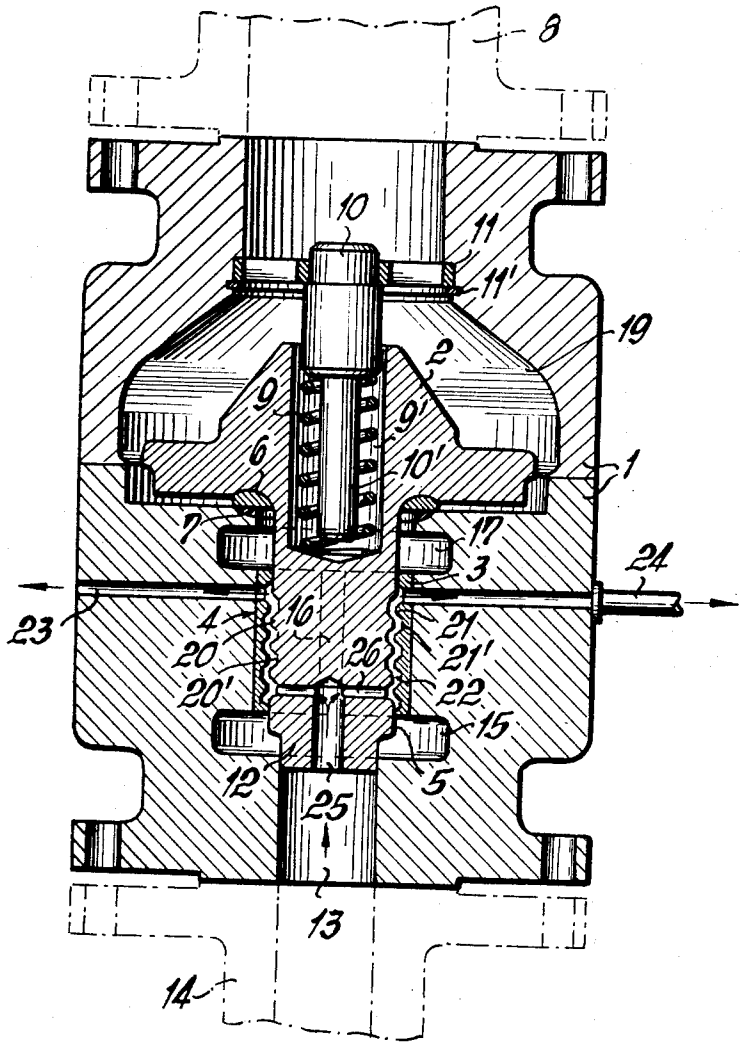
May 27, 1969 W. H. HEROLD ET AL 3,446,233

VALVES FOR CENTRIFUGAL PUMPS

Filed Nov. 15, 1966

Sheet 1 of 2

FIG. 1



May 27, 1969 W. H. HEROLD ET AL 3,446,233

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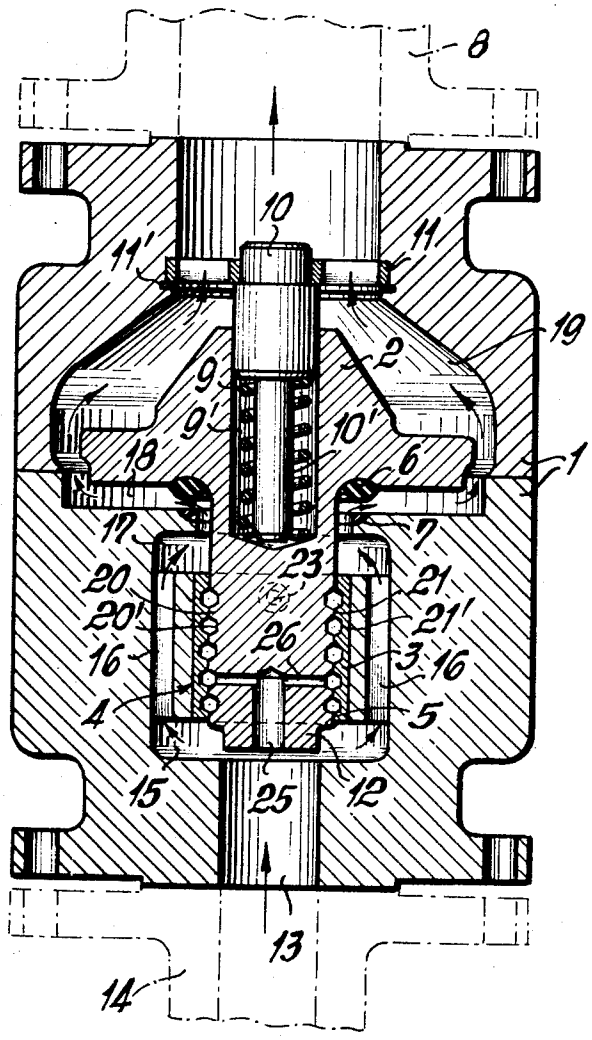
Filed Nov. 15, 1966 Sheet 2 of 2

FIG.2



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VALVES FOR CENTRIFUGAL PUMPS

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U.S. Cl. 137—119
7 Claims

ABSTRACT OF THE DISCLOSURE

A pressure responsive valve for centrifugal pumps to allow bypass flow when the pump output pressure falls below predetermined value wherein a single movable valve element having plural seating surfaces automatically controls the flow between a valve inlet and outlet and the inlet and bypass as required.

This invention relates to a free-running valve for centrifugal pumps comprising a valve body which is arranged on the pressure side and regulates the flow in a pipe for the discharge of a minimum quantity of fluid, and is adapted to be operable in dependence on a pre-determined pressure.

In centrifugal pumps which are intended to be permanently driven even at minimum load, it is necessary to make provisions to ensure that in the event of idling, damage to the pump and the devices appertaining thereto is avoided. This applies particularly to power plants, and to installations in which heated fluids are to be delivered. In the latter case difficulties arise in practice, for example when hot water pumps are to be driven at low load and, through evaporation of the pump contacts, the delivery falls below a fixed minimum level.

In order to achieve disturbance-free operation centrifugal pumps have already been proposed, which have valve arrangements in which a so-called free-running or by-pass non-return valve is provided. The latter is actuated by the stream of fluid delivered by the centrifugal pump and then controls a locking member which is arranged in a by-pass pipe connected into the circuit. As a result, when the non-return valve is closed, a certain minimum quantity of fluid is intended to be delivered by the centrifugal pump through the by-pass pipe, in order to avoid evaporation of the pump contents and resultant damage.

In the known arrangement of a free-running non-return valve, the locking member arranged in the by-pass pipe is connected to the non-return valve by means of movable intermediate members and the locking member itself is designed as a movable slide. This design means that with unavoidable manufacturing tolerances, it is impossible to avoid a minimum play between the members connecting the slide and the non-return valve. This results in certain dead spaces which may have a detrimental effect on the manner of operation of the non-return valve. Furthermore in an arrangement with additional connecting members there is the danger that the dead paths may be enlarged by wear, thus giving rise to additional difficulties.

On the other hand, other arrangements, in which a controlled discharge of a minimum quantity of fluid is dispensed with and a constant quantity of fluid flows away through a by-pass pipe, are detrimental to the efficiency of such plants.

The invention has as its object to avoid the disadvantages and imperfections of the known plants and provide a centrifugal pump having a free-running valve, in which a reliable control of the quantity of fluid to be discharged is always ensured when the stream of fluid delivered to

the pressure pipe falls below a predetermined quantity, without the use of additional intermediate members.

This object is achieved according to the invention, in principle by the feature that the valve body movable inside a housing has at least one sealing surface which exerts a direct action on the pipe for discharge of a minimum quantity of fluid and opens or closes this pipe according to the position of the valve body. In this way additional connecting members or locking members may be dispensed with, with resultant simple valve design and the reliable maintenance-free manner of operation.

The invention also makes it possible to design the sealing surface, so that hydraulic jolts are reliably avoided even if the valve is closed rapidly. Accordingly the invention provides that the sealing surface is constituted by several sealing sections arranged one behind the other, and separated from one another by intermediate recesses. The height of the individual sections of the sealing surface of the valve body and the height of the intermediate recesses are advantageously in the same order of magnitude.

The measures according to the invention bring about a stage throttling, which moreover ensures that jet wear and noises occurring during operation are reduced to a minimum.

The number of individual surface sections can be fixed and their dimensions and those of the recesses modified in order to adapt to the particular operating conditions or pump size.

The division of the sealing surface into individual sections also makes it possible to dispense with the sound-absorbing devices often required in the known arrangements.

The counter-surface in the housing or in a bushing inserted in the latter, which co-operates with the sealing face of the valve body, is according to a further proposal of the invention, stepped in the same way as the face itself and accordingly has sealing sections and recesses. The stroke of the valve body can be adapted to the height of the sealing sections and the recesses or to a greater height.

In order to avoid too rapid closing of the valve body and the occurrence of hydraulic jolts, the invention provides that the valve body has at its end facing the inlet pipe a locking section which when the valve is closed, i.e. when the pipe for the discharge of a minimum quantity of fluid is open, partly blocks the inlet pipe, and that the locking section projecting into the inlet bore has a flow channel corresponding to the flow cross-section of the pipe for the discharge of a minimum quantity of fluid, which channel is variable if necessary and is in communication with cross-bores.

In a development of this simple prefabricated free-running valve, the invention provides that the pipe for the discharge of a minimum quantity of fluid and the flow channel in the locking section each open into a recess of the sealing face and of the corresponding counter-face in the housing, respectively, that is to say into the first recess in the direction of flow.

The invention will now be described with reference to the accompanying drawings, which show one embodiment of the invention, but in no restrictive sense.

FIGURE 1 shows a valve with valve body, in sectional view in the closed position, with the pipe for the discharge of a minimum quantity of fluid open, this figure being offset through 90° in relation to FIGURE 2.

FIGURE 2 shows the valve of FIGURE 1, with valve body in the open position.

The valve housing **1** connected to a centrifugal pump, not shown, accommodates a movable valve body **2**. A downwardly pointing valve stem **3** of the valve body **2**

forms, together with a bushing 4 inserted in the housing 1, a sealing and guide face 3, the design of which will be explained later.

At the transition point from the valve stem 3 to the valve body 2, the latter widens out into a dish-shaped part and is provided with a sealing seating surface 6, which bears against a corresponding seating surface 7 in the bottom part of the housing 1, when the valve body 2 reaches the closed position shown in FIGURE 1, so that the flow through the pressure pipe 8—shown in dash-dot lines—is shut off. The closing position is obtained by a coil spring 9, which is provided in a bore 9' in the valve body 2, bears against a bolt 10 and passes round an inwardly shouldered bolt extension 10'. This extension can be utilised as stroke-limiting means for the valve body 2.

The bolt 10 is retained by means of a cross-head 11 inserted in the upper part of the housing 1 and kept in position by means of a spring ring 11' or the like.

The sealing and guide face 5 passes over at the free end of the stem 3 of the valve member 3 into a sealing section 12, the diameter of which corresponds to an inlet bore 13 located in the bottom of the housing 1 and which projects into the latter when the valve is closed, as shown in FIGURE 1. The inlet bore 13 is in direct communication with the inlet pipe 14, shown in dash-dot lines, which is supplied by a pump not shown.

When, as shown in FIGURE 2, the sealing seating face 6 of the valve body in the open position of the latter is raised from the counter seating face 7, the locking section 12 frees the inlet bore 13, and the fluid delivered by the pump flows from the latter in the housing 1 via a lower annular space 15 and vertical connecting channels 16 into an upper annular space 17. From here it reaches the pressure pipe 8 through the bore provided for the valve stem 3 via the space 18 bounded by the dish-shaped part of the valve body and an overflow space 19.

The sealing sections 20 and 21 provided on the valve stem 3 and on the bushing or directly on the housing 1, respectively, bear against one another in the open position of the valve body 2, and the grooved recesses 20' and 21' overlap.

When the delivery or delivery pressure falls below a predetermined minimum value, the valve body 2 is brought by the coil spring into the closed position as shown in FIGURE 1, the sealing surfaces 20 on the valve stem being displaced in the axial direction with respect to the sealing sections on the bushing 4, so that a channel 22 following a spiral course is formed, which comes into communication with cross-bores 23 in the housing, which are shut off in the open position of the valve body.

A pipe 24 for the discharge of a minimum quantity of fluid provided in the housing 1 is connected to the cross-bores 23, and the flow of a quantity of fluid delivered by the pump proceeds, in the closed position of the valve body 2, via the channel 22. As, however, the free end of the stem 3 of the valve body 2 designed as locking section 12 engages in the inlet bore 13 in the housing 1, a vertical flow channel 25 in communication with one or more cross-bores 26 is necessary in this locking section, the said cross-bores opening into the channel 22.

In order that the cross-bores 23 and the vertical connecting channels 16 between the annular chambers 15 and 17 should not intersect, they are arranged in vertical planes which are staggered with respect to one another.

We claim:

1. A valve construction comprising a valve body, a valve chamber in said body, a fluid inlet passage in said body leading to said chamber, a fluid outlet passage in said body leading from said chamber, a bypass passage in said body leading to said chamber, a first valve seat in said chamber, a second valve seat in said chamber, a pressure responsive movable valve element in said chamber, a first seating surface on said element adapted to co-operate with said first seat to control fluid communication between said inlet and said outlet and a second seating surface on said element comprising a series of sealing sections adapted to co-operate with the second seat to control fluid communication between the inlet passage and the bypass passage so that the bypass passage communicates with the inlet passage when the first seating surface is in seating contact with the first seat and the outlet passage communicates with the inlet passage when the second seating surface is in seating contact with the second seat.

2. The construction of claim 1 characterised in that said movable element has a generally cylindrical portion with circumferentially extending recesses defining said series of sealing sections therebetween, and said second seat surrounds said cylindrical portion.

3. The construction of claim 2 characterised in that said chamber has a cylindrical section, said bypass passage intersects said cylindrical section, and a bush is positioned in said cylindrical section, said second seat being formed internally on said bush.

4. The construction of claim 3 characterised in that said bush has internal circumferentially extending recesse providing seating portions therebetween complementary to said sealing sections on said movable element.

5. The construction of claim 2 characterised by fluid passage means formed through said cylindrical portion of said movable element for connecting said inlet to said bypass passage when said first seating surface is in contact with said first seat.

6. The construction of claim 5 characterised by an extension on said cylindrical portion of said movable element, said extension fitting into said inlet passage when the first seating surface is in contact with said first seat, and said passage means extending through said extension.

7. The construction of claim 3 characterised by passage means in said body around said bush for connecting said inlet passage with said outlet passage when said second seating surface is in seating contact with said second seat.

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137—115, 516.27, 599.2, 609, 625.13; 251—127