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C. D. BOWER

2,455,552

TURBINE PUMP

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Fig. 1.

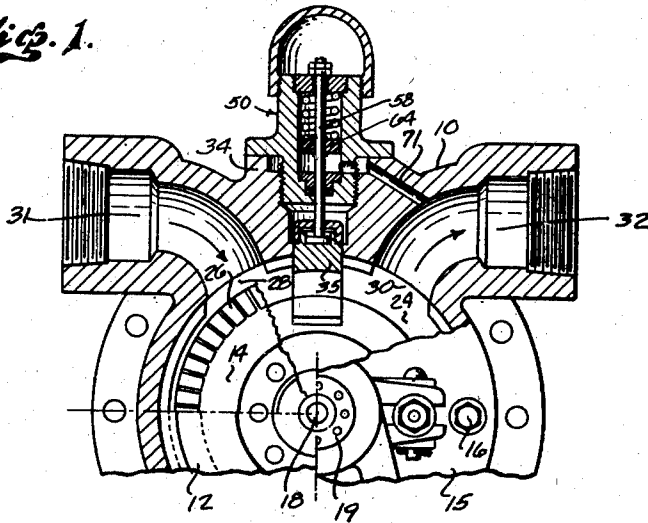


Fig. 2.

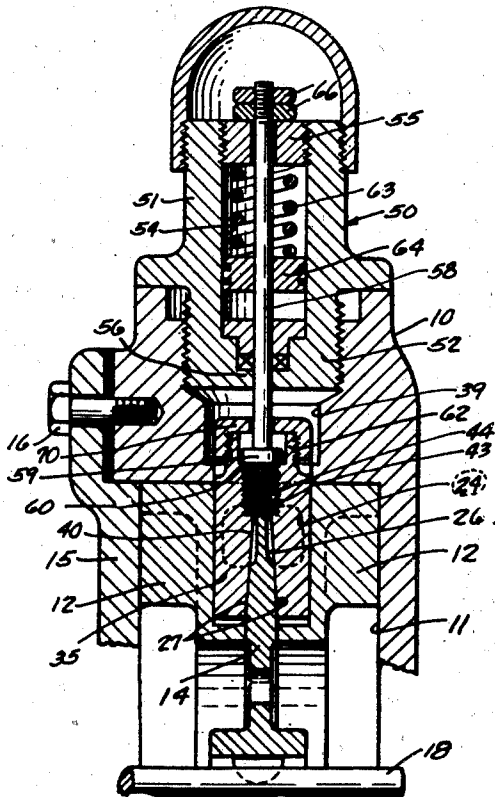


Fig. 3.

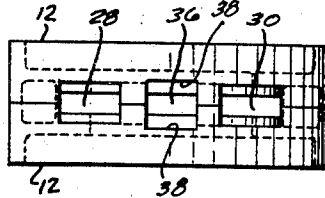
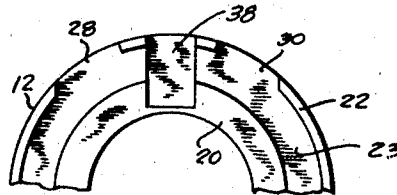


Fig. 4.

INVENTOR.

CLARK D. BOWER.

BY

Paul L. Krohn

ATTORNEY.

UNITED STATES PATENT OFFICE

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TURBINE PUMP

Clark D. Bower, Pomona, Calif., assignor to Fairbanks, Morse & Co., Chicago, Ill., a corporation of Illinois

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4 Claims. (Cl. 103—97)

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This invention relates to improvements in rotary pumps of the turbine type, and has particular reference to the provision in a pump of this character, of a channel stop and relief valve device arranged between the pump inlet and outlet in association with the pump pressure developing channel and pump rotor, the device serving in normal pump operation to divert fluid from the channel to the outlet and to seal the channel and rotor against fluid by-pass leakage, and being effective through displacement thereof upon the occurrence of an abnormal condition of pump operation, to open the channel sufficiently to permit fluid by-pass between the inlet and outlet.

The principal object of the invention resides in the provision in a turbine pump having a circular pressure developing channel, relatively adjacent inlet and outlet passages open to the channel and a rotor having marginal buckets operative in the channel, of a stop and relief valve device movably mounted in the pump between the inlet and outlet passages to extend transversely of the channel, wherein the device in one position obtaining during normal pump operation, serves to block the channel such as to divert fluid therefrom to the outlet passage, and to closely embrace the rotor at the buckets and importantly also, at the opposite side faces of the rotor inwardly from the buckets, such as to seal the rotor against fluid by-pass leakage. Moreover, in its relief valve function, the device upon movement to a determined extent from the aforesaid normal position thereof, and which is here effected automatically in response to abnormal fluid pressure in the pump outlet passage, serves to unblock or open the channel sufficiently to permit by-pass of fluid between the outlet and inlet passages, whereby to relieve or unload the pump such as to avoid undue strain on or possible damage to the pump mechanism.

In connection with the foregoing object the present improvements provide automatic control means for the stop and relief valve device, serving to position and maintain the same in its channel stop and rotor sealing position during normal pump operation, and effective in response to abnormally high fluid pressure in the pump outlet or discharge passage such as would result in the event for any reason the discharge passage should become partially or wholly blocked, to produce displacement of the device from its normal position, for opening the channel to permit direct fluid by-pass from the outlet to the inlet side. The control means maintains the stop device in its position to unload or relieve the pump so long as

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abnormal pressure exists in the discharge passage, and return the stop device to its normal position upon correction of the condition producing the abnormal pressure on the discharge side of the pump.

Other objects and advantages attending the present invention will appear from the following description of a preferred embodiment thereof as such as illustrated by the accompanying drawings, wherein:

Fig. 1 is a partial transverse sectional view of a turbine pump having the present stop and relief valve provisions embodied therein;

Fig. 2 is an enlarged fragmentary section axially of the pump in the zone of the stop and valve;

Fig. 3 is a view at the inlet and outlet port zone of the pump stator, and

Fig. 4 is a fragmentary view of a part of the stator.

With reference now to the drawing, the pump shown includes a frame 10 centrally recessed at 11 (Fig. 2) to receive therein the pump stator comprising complementary disc-like casing or liner members 12. Members 12 embrace the pump rotor or impeller 14 and are retained in assembly in frame 10 by a frame closure plate 15 suitably secured to the frame as by bolts 16. Rotor 14 is mounted on a shaft 18 and the latter is suitably journaled in a bearing 19 (Fig. 1) in cover plate 15, and a like bearing (not shown) in the frame 10.

Each stator member 12 is formed to present inner and outer annular lands 20 and 22 respectively, in one face thereof, defining therebetween an annular or circular recess 23. In stator assembly, the recesses 23 cooperate to provide a circular pressure developing channel 24 (Fig. 2) in which operate the marginal buckets 26 of the rotor 14, while the inner lands 20 are closely opposed to and in substantial leakage sealing relation with the opposite side faces 27 of the rotor, these lands being bevelled to accommodate the bevelled faces 27 of the rotor as shown. The outer lands 22 of the stator members are interrupted at relatively adjacent points to provide an inlet port 28 and outlet port 30 (Fig. 3) for the channel 24. Casing or frame 10 as appears in Fig. 1, affords relatively adjacent inlet and outlet passages 31 and 32 respectively, in communication with the channel through the respective inlet and outlet ports thereof.

In accordance with the present improvements, located in the pump in the casing zone 34 between the inlet and outlet passages 31 and 32, is a stop and relief valve device here comprising a plug like

member 35 which is received in a pocket 36 formed by cooperating recesses 38 formed as by a milling operation, in the stator members 12, the pocket as shown extending radially of the pump across the channel 24 and having its upper end open to a recess 39 provided in the frame 10. The member 35 is slotted to accommodate the rotor therethrough, with the slot shaped in its side faces 40 to conform to the bevel or taper of the rotor buckets and rotor side faces 27 (Fig. 2), whereby the member is thus adapted for close sealing embrasure of the rotor. Moreover and as presently preferred, the plug member carries an element 43 threaded in a central opening 44 in the plug to overlie the rotor periphery (Fig. 2).

With the plug member positioned as shown in Figs. 1 and 2, which is the position thereof during normal pump operation, it effectively blocks the channel 24 such as to cause fluid diversion from the channel to the outlet passage 32 through port 30. Furthermore, in closely embracing the rotor, the plug serves to seal the latter against fluid leakage by-pass not only in the zone of the rotor buckets, but also at the rotor side faces 27 opposed to the stator lands 20, and at the rotor periphery through the element 43 which as appears, is adjustable relative to the latter.

The aforesaid normal position of the stop member is here effected and yieldingly maintained by a spring loaded plunger device indicated generally at 50. The device 50 comprises a casing 51 mounted on the pump frame 10 through threading of the lower casing end 52 in the frame recess 39, the casing providing a chamber 54 therein closed at the upper end by a wall element 55 preferably threaded to the casing, and closed at the bottom by casing wall 56. A plunger rod 58 is projected through the chamber and walls 55 and 56 and has its lower end provided with a head flange 59 for seating against a shoulder 60 in the recessed outer end 62 of the stop member 35. A spring 63 bearing between the chamber head wall 55 and a piston 64 secured on the rod and slidable in the chamber 54, serves to displace the rod 58 in the direction to effect through the rod head flange 59 in engagement with the shoulder 60 of the stop member, positionment of the stop in its normal sealing relation to the pump rotor. The extent of rod displacement for this purpose, is here adjustably determined and limited by lock nuts 66 on the rod externally of chamber 54 at the head wall 55.

As sometimes happens in pump operation, the discharge line from the pump may become partially or wholly blocked, as for example by inadvertent or accidental closure of a valve in the line. In such event, the fluid pressure in the pump discharge passage 32 will become abnormal, rising to a high value with the result that undue strain may be imposed on the pump in continued pump operation under this condition. Accordingly, the present provisions afford relief or unloading of the pump upon the occurrence of abnormally high fluid pressure in the pump discharge passage, through displacement of the stop device, 35 such as to open the pump channel for direct by-pass of fluid from the outlet to the inlet side of the pump.

Referring to Figs. 1 and 2, a cap element 70 is secured or threaded onto the outer end 62 of the stop member and through which the rod 58 passes. The cap thus provides an abutment for the rod flange 59, so that upon lift of the rod the stop member 35 will be displaced radially outwardly from its sealing position relative to the

channel and rotor, to an extent such as to open the channel about the rotor buckets and rotor periphery, for fluid by-pass relief of the pump. Since the bucket section and the inner side faces 27 of the rotor are tapered convergently toward the rotor periphery, and the inner faces 40 of the slot in the stop member 35 are similarly tapered, it is obvious that movement of the stop member outwardly relative to the rotor will establish an appreciable clearance between the rotor and stop, so that the desired relief opening of the channel will obtain.

Actuation of the plunger rod to produce pump relief displacement of the stop member 35, is effected through the action of abnormal fluid pressure admitted from the pump discharge passage 32 into the chamber 54 below the piston 64 therein, through a passage 71 (Fig. 1). The fluid pressure displaces the piston and with it the rod 58, upwardly against the spring 63, and in so moving, the rod flange 59 abuts the cap 70 and lifts the stop member to establish said by-pass relief opening of the channel. Upon correction of the condition causing abnormal discharge line pressure, the spring 63 then serves through the rod 58, to return the stop member to its normal sealing position.

In order to avoid pump relief displacement of the stop member 35 during relatively momentary fluctuations in discharge line pressure which may rise at times, to values greater than normal full capacity discharge pressure, the operative connection between the rod 58 and stop member is preferably of the lost-motion character. The cap 70 is spaced from the shoulder 60 against which the rod head flange 59 seats in normal pump operation, such that stop lifting abutment of the rod flange with the cap will occur only after an initial but appreciable fluid pressure responsive displacement of the piston and rod has taken place.

With further reference to the stop and sealing member 35, this member may be and preferably is formed of a suitable material softer than the material from which the pump rotor is constructed, whereby to reduce wear of the rotor and hence prolong the life of the same. Moreover, in extending the seal member to leakage sealing coaction with the rotor side faces 27 in the zone of the stator lands 20, fluid by-pass leakage between the inlet and outlet side of the pump is thereby materially reduced, which thus enhances the efficiency of the pump. Also by reason of the cooperating tapered surfaces of the stop and rotor, the stop may be adjusted automatically to maintain an effective seal as wear of the stop may occur, through radial inward displacement of the stop under the urge of the spring 63.

From the foregoing description of the presently illustrated preferred embodiment of the invention, it will be now appreciated that the present improvements afford an effective fluid diversion stop and seal device for the rotor in the pump zone between the inlet and outlet, and an automatic positionment control for the stop, effective to determine the stop and seal position thereof during normal pump operation, and to cause pump relief displacement of the stop upon the occurrence of an abnormally high fluid pressure in the pump discharge passage.

While only a single preferred embodiment is shown and described, it is to be understood that various modifications of the parts and arrangement thereof may be made without departing

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from the spirit and full intended scope of the invention as defined by the appended claims.

I claim:

1. In a rotary pump, a casing assembly providing a circular pressure developing channel therein and relatively adjacent fluid inlet and outlet passages open to the channel, a rotor having marginal buckets operative in the channel, stop means adapted for embracing the periphery and sides of the rotor and being selectively positionable relative to the channel and rotor in the casing zone between the inlet and outlet passages, said stop means being effective in one position for diverting fluid from the channel to the outlet passage, and in a second position for permitting channel by-pass of fluid between the inlet and outlet passages, and means normally urging the stop means to said one position, operable responsively to abnormal pressure in one of said passages for effecting said second position of the stop means.

2. In a rotary pump, a casing assembly providing a circular pressure developing channel therein and relatively adjacent fluid inlet and outlet passages open to the channel, a rotor having marginal buckets operative in said channel and opposite side faces inwardly of the buckets, a displaceable stop member in the casing zone between the inlet and outlet passages, extending transversely of the channel and normally closely embracing the rotor buckets and said rotor side faces, said stop member as so positioned serving to divert fluid from the channel to the outlet passage and to prevent fluid leakage past the rotor between the inlet and outlet passages, and yieldable means normally urging said stop member to said position, said yieldable means being operable in response to abnormal fluid pressure in the outlet passage, for displacing the stop member to a position opening the channel in the casing zone between the inlet and outlet passages for permitting fluid by-pass between said passages.

3. In a rotary pump, a casing assembly providing a circular pressure developing channel therein and relatively adjacent fluid inlet and outlet passages open to the channel, a rotor having marginal buckets operative in said channel and opposite side faces inwardly of the buckets, the sides of said buckets and said rotor side faces being tapered convergently toward the rotor periphery, a displaceable stop in the casing zone between the inlet and outlet passages, extending transversely of the channel and normally positioned to closely embrace the rotor buckets and

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said rotor side faces, the stop as so positioned serving to divert fluid from the channel to the outlet passage and to seal the channel and said rotor buckets and rotor side faces against fluid leakage between the outlet and inlet passages, said stop upon displacement thereof from said normal position to a second position, opening said channel about the rotor buckets to permit fluid by-pass between the inlet and outlet passages, and yieldable means having a lost-motion connection with said stop, urging said stop to said normal position and effective in response to abnormal fluid pressure in said outlet passage, to displace the stop to said second position.

4. In a rotary pump, a casing assembly including casing elements providing cooperating inner and outer annular lands defining therebetween an annular pressure developing channel, the casing assembly providing relatively adjacent fluid inlet and outlet passages each open to said channel, a rotor having marginal buckets operative in said channel and opposite side faces in close running clearance with the inner lands of the casing elements, a movable stop arranged transversely of said channel and casing lands in the casing zone between the inlet and outlet passages, adapted for embracing the rotor periphery, the buckets and the rotor side faces in a normal operative position thereof, to effect diversion of fluid from the channel to the outlet passage and to seal the channel, casing lands and rotor against fluid leakage by-pass between the inlet and outlet passages, said stop further being adapted for effecting upon displacement thereof to a second position, to open said channel laterally of the rotor buckets and over the rotor periphery for permitting fluid by-pass between the inlet and outlet passages, and yieldable means having a lost-motion connection with said stop, normally acting thereon to effect said normal operative position of the stop, said yieldable means responding to abnormal fluid pressure in the outlet passage, to displace said stop to said second position.

CLARK D. BOWER.

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