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ROTARY PUMP WITH OUTPUT PRESSURE LIMITER

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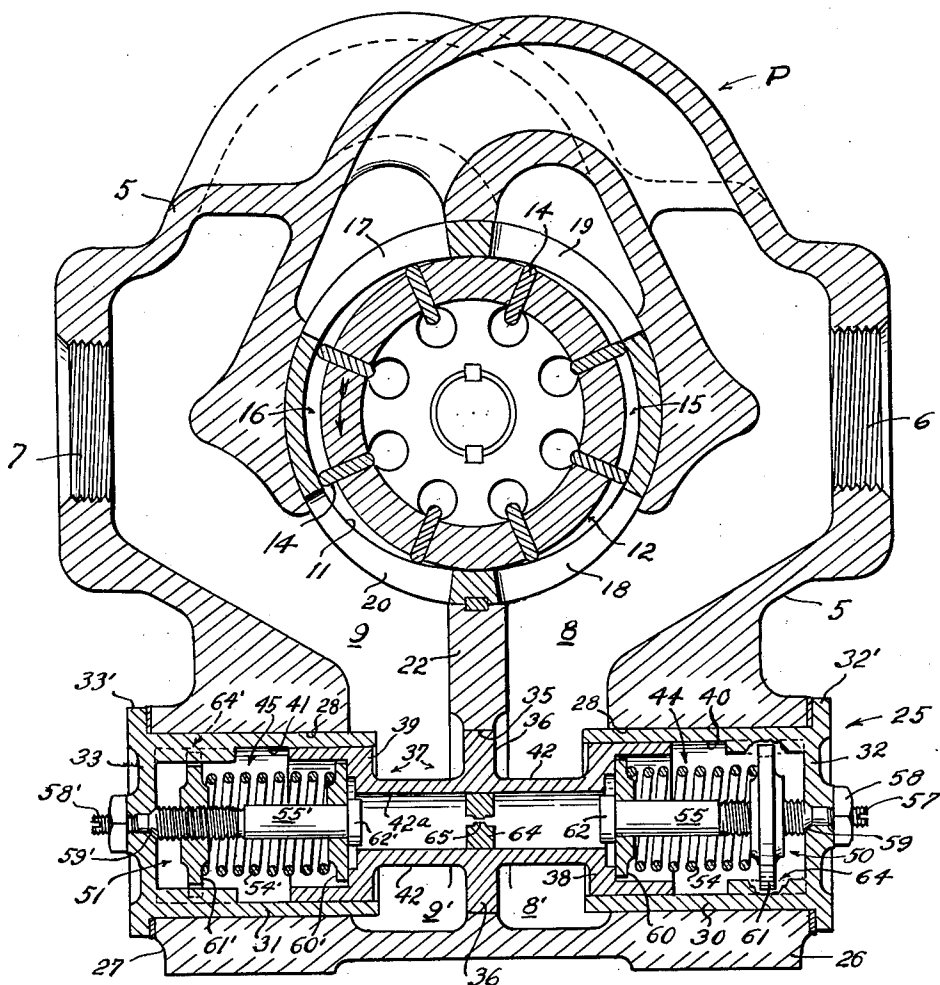


FIG.-1

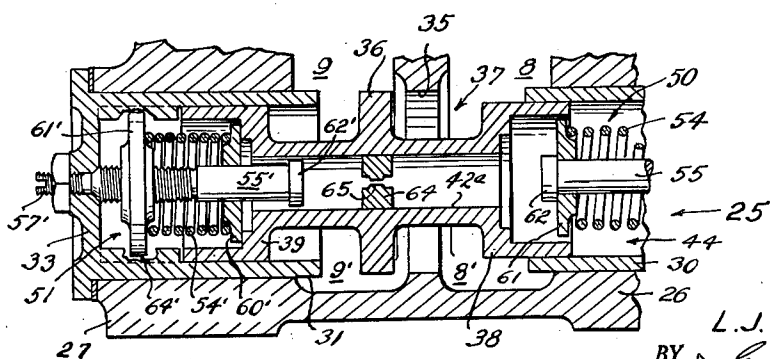


FIG.-2

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ROTARY PUMP WITH OUTPUT PRESSURE LIMITER

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4 Claims. (Cl. 103—42)

The drawing partially shows one known type of rotary pump which is reversible in operation in the sense that the main inlet and outlet passages of the pump become reversed (inlet becoming outlet and vice versa) whenever the direction of rotation of the impeller means of the pump is reversed. One object is to provide an improved pump output fluid pressure limiting bypass valve mechanism for a reversible pump such as outlined above, which mechanism, particularly, is capable of reversible action, in situ, to limit the pump output or discharge pressure by short-circuiting of fluid from whichever side of the pump may be serving as outlet or discharge side to the suction or intake side. A further object is to provide a double or reversibly acting, spring loaded, pump pressure relief valve mechanism which limits the output or discharge fluid pressure of the pump through a single bypass port and enables independent adjustment of spring loading or valve closing force. Another object is to provide an improved pump discharge pressure limiting, two-way-acting, spring loaded, pressure relief bypass valve mechanism for liquid pumps, which mechanism has a simple and readily applicable means for damping oscillations or fluttering actions of the valve in event such tend to occur.

Other objects and features will become apparent from the following description of the illustrative form, as shown more or less schematically in the accompanying drawing, wherein:

Fig. 1 is a sectional view through a known type of rotary fluid pump incorporating the present invention in the form of a built-in valve mechanism assembly, nearly all parts of which are shown in longitudinal central cross section.

Fig. 2 is a similar fragmentary assembly sectional view of the valve mechanism whose principal parts are in fluid bypassing position relative to the pump.

Pump housing 5 of illustrative pump P has a main inlet (or outlet) 6, main outlet (or inlet) 7, a correspondingly connected supply or suction passage 8 and a delivery or pump output passage 9. A pump-chamber-forming sleeve 10 contains a circular rotor or impeller 12 having radially movable vanes 14 which, during operation of the pump, are suitably maintained in wiping or fluid-impelling contact with the interior peripheral surface 11 of the sleeve 10 and with axial end walls of the chamber (not shown). When the rotor is turned in the counterclockwise direction, as indicated by the arrow thereon, fluid to be pumped is received into the crescent shaped pump chamber portions 15 and 16 through radial ports 17 and 18 in the wall of the sleeve 10 and is propelled, by conventional action of the rotor 12 and its vanes 14, through radial discharge ports 19 and 20 in the wall of the sleeve which ports are connected to pump discharge passage 9. Passages 8 and 9 are separated from each other, in part, by a partition wall portion 22 of housing 5, at respective sides of which wall portion 22 portions 8' and 9' of the passages form inlet and discharge chambers for the bypass valve mechanism hereof

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generally indicated at 25. Mechanism 25, as shown, is arranged as follows.

Identical pump base portions 26 and 27 of the housing 5 are provided with cylindrical aligned bores 28 intersecting the chambers 8' and 9' respectively. The bores 28 are snugly occupied by cup-shaped, cylinder-forming members 30 and 31 whose mutually adjacent ends are open into the valve chambers 8' and 9' and whose outer ends are closed by wall portions 32 and 33. Flange portions 32' and 33' at the closed ends provide for conventional attachment of the members 30 and 31 to the pump housing, as by screws, not shown. For enabling intercommunication of the relatively high and low pressure passages 8 and 9 of the pump through the partition wall 22 a relatively smooth bore 35 through said wall, aligned with bores 28, constitutes a bypass valve port, shown in Fig. 1 as closed by a disc-like valve plug 36 slidably and sealingly fitting the bore 35.

The valve plug 36 is a central portion of a double headed shuttle member or unit 37 (shown as one piece), having piston or head portions 38 and 39 slidably and sealingly occupying respective cylinder bores 40 and 41 of the cup-shaped members 30 and 31. The piston portions 38 and 39 are joined together and to the plug by a tubular stem 42 which is open from end to end (bore 42a), so that fluid can move from one cylinder/piston chamber (e. g. 44) into the other (e. g. 45) through the hollow stem.

The valve plug 36 is normally maintained generally centered in sealing relationship to the bypass port 35 (see Fig. 1) by spring and abutment assemblies 50 and 51 (hereinafter usually called centering spring assemblies) within the respective cup-shaped cylinder forming members 30 and 31. Each centering spring assembly 50 and 51 resists movement of the plug 36 theretoward, but enables port opening and closing movement of the valve plug and piston unit 37 in either of two directions under the influence of fluid pressure in passage portions 8' or 9' (whichever contains fluid at pump output or discharge pressure as determined by the direction of operation of the pump). The springs (described later) are capable of being independently preloaded to resist movement of the valve plug 36 out of its centered position, which among other advantages, allows the plug to be made with only sufficient length to provide adequate sealing surface in contact with the wall which defines the coacting port.

The effective cross sectional area of the plug 36, exposed to fluid pressure in the acting pump discharge passage portion (8' or 9'), is greater than the effective cross sectional area of the pistons 38 and 39 exposed in the discharge passage, so that, when, for example, the fluid pressure in right hand space 8' (which is simultaneously exposed to both the plug 36 and piston 38) reaches a predetermined, desired maximum, value, the shuttle unit 37 will be moved toward the left (see Fig. 2) against the restraint of the centering spring assembly 51, opening the port 35 for spill or bypassing of pumped fluid to the intake side of the pump. The pressure relief or limiting action is exactly the same as just described if space 9', at the left of wall 22, contains pump discharge or output pressure, except that the shuttle unit 37 moves to the right from bypass-port-sealing position against the resisting force of centering spring assembly 50.

The centering spring assemblies 50 and 51 are identical in construction and only one (50, right, Fig. 1) will therefore be described in detail. Coil spring 54 surrounds a stiff supporting pin or rod 55 mounted in a bore 56 in cylinder wall 32, the pin having a reduced diameter partly threaded portion 57 exposed beyond said wall 32 which renders the pin accessible for rotary adjustment (purpose given later) by a suitable tool. Pin

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55 is normally secured in axially fixed position on the cup-shaped cylinder-forming member 30 by a suitable externally exposed nut 58 on the outer end of the pin, which nut forces a conical sealing shoulder 59 of the pin against a mating shoulder on the wall 32 of member 30. The coil spring 54 is maintained under predetermined axial strain, properly to resist port-opening movement of valve plug 36 theretoward, by supporting discs 60 and 61 carried by the pin 55. Disc 60 is slidably mounted on its supporting pin, and, in the centered position of the valve plug 36 in the valve port 35, a head 62 of the pin abuts the disc 60. Disc 61 is threaded on pin 55 and is slidably keyed, as at 64, to the cylinder member 30, so that turning of the pin 55 by the operator (assuming nut 58 is temporarily loosened), will adjust the disc 61 axially on the pin 55 and thereby set the spring force at proper value. The head 62 on the inner end of the pin 55 is smaller than the inner diameter of the hollow stem 42 so that the head can freely enter the hollow stem when the unit 37 moves toward the right to allow pressure relief valve action (not illustrated) as to passage 9, 9'.

The return or valve-centering spring assembly 51, at the left of wall 22, is, as already mentioned, the same as the assembly 50 just above described and the same characters (primed) are applied thereto. Fig. 2 shows the valve plug and piston unit 37 in pressure relieving or fluid bypassing position in respect to pump output or discharge passage portions 8, 8'.

As is well known, a spring loaded valve mechanism of the general type herein shown is apt to be subject to fluttering action or chatter under somewhat unpredictable circumstances. Flutter can be damped or eliminated by flow rate control commonly known as dash-pot action. In the present mechanism, assuming the various spaces within shuttle unit 37 and cylinders 30 and 31 are filled with the liquid being pumped (or other liquid) the liquid has to move from one piston cylinder space (e. g. 44) into the other (e. g. 45) in order to permit opening and closing movement of the valve plug 36. The rate of movement can be governed by provision of an orificed member 64 shown as occupying the bore 42a of the hollow stem 42 of unit 37. The orifice 65 (diameter and length selected by trial) forms with the rest of the assembly a double acting, flutter damping, dashpot.

I claim:

1. In and for a rotary pump of the type having inlet and outlet passages which, respectively, become outlet and inlet passages upon reversal of direction of input rotation to the pump; a two way acting pump pressure relief valve having wall means forming two valve chambers respectively connected to said passages and a generally cylindrical port through a portion of said wall means for intercommunication of said chambers, a generally cylindrical plug slidably occupying the port and having a normal position sealing the port, pistons connected to the plug at each side thereof along its axis and

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having effective piston areas smaller than the effective areas of the plug which can be exposed to pump output fluid pressure in the respective chambers, so that the net fluid pressure acting on the plug and one piston tends to move the plug out of the port, cylinders slidably mating the pistons, springs in each of the cylinders each capable of exerting force axially on its associated piston whenever the plug is moved out of its normal port-sealing position in a direction to return the plug to sealing position, and fluid-passage-forming means connected to enable fluid communication between the cylinders at all times.

2. The arrangement according to claim 1 wherein the pistons are connected to the plug by a hollow stem member which is always open from end to end for fluid communication between respective cylinders.

3. The arrangement according to claim 2 wherein fluid flow restricting orifice means in the interior of the hollow stem is provided for damping valve oscillation or flutter.

4. In combination with a fluid pump having a hollow casing, an impeller therein, and chambers which serve as relatively high and low pressure spaces, rigid wall means defining portions of both said chambers and having a generally cylindrical by-pass port therethrough, the casing having generally cylindrical openings on opposite sides of said wall means along the axis of the port, cup shaped sleeves closing respective said openings and adapted to constitute cylinders with open ends adjacent respective chambers, a relief valve member having a plug portion slidable in said port and capable of sealing it, the valve member having piston portions respectively occupying the open ends of the sleeve cylinders and slidable therein, spring means connected to act axially in opposite directions upon the valve member and capable of normally holding its plug portion in sealing relationship to the port, the plug portion having relatively oppositely facing effective transverse areas exposed to pressures in respective chambers for movement of the plug portion to unsealing positions in opposition to the spring means, and the piston portions having effective transverse areas smaller than those of the plug portion and exposed to pressures in the chambers in a manner to assist the spring means, whereby the plug portion will be moved to port unsealing positions by predetermined fluid pressure difference in the chambers, and venting means for the cylinder-constituting spaces of the two sleeves.

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