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1,988,296

PUMP VALVE CONTROL

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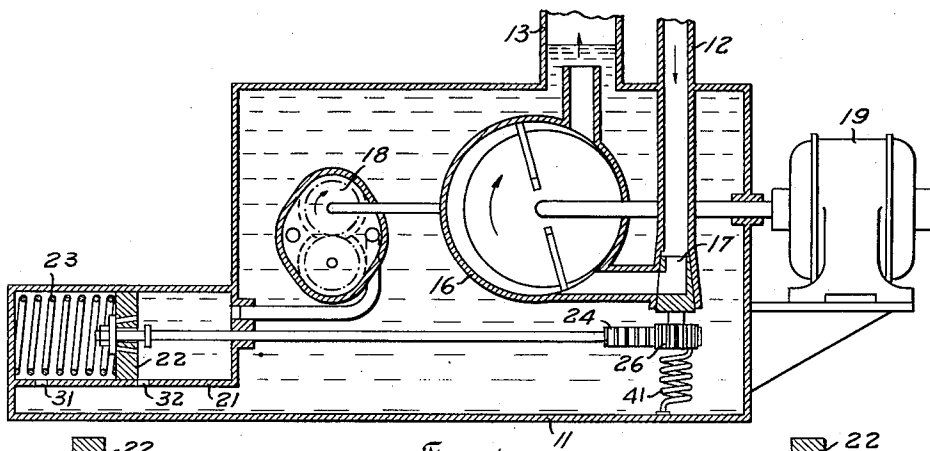


Fig. 1

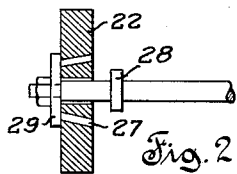


Fig. 2

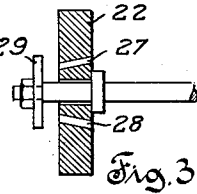


Fig. 3

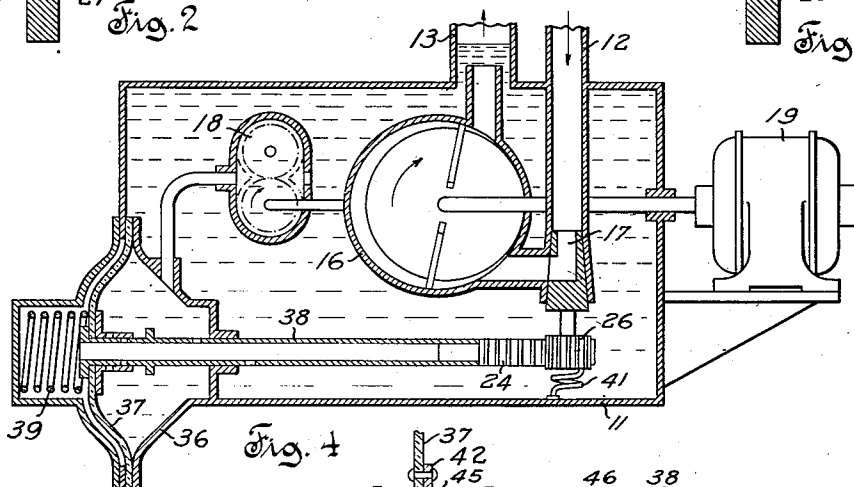


Fig. 4

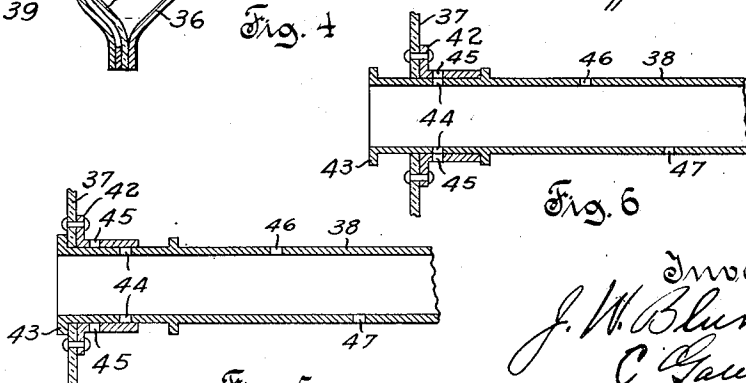


Fig. 5

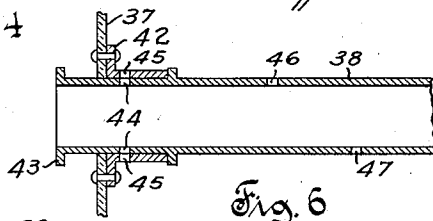


Fig. 6

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PUMP VALVE CONTROL

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8 Claims. (Cl. 230—29)

This invention relates to improvements in means for closing the intake connection to a pump in response to operation of the pump, and particularly to means for automatically closing the intake valve of a vacuum pump upon failure of the pump or upon stopping of the pump for any reason.

When a pump is operated against a back pressure as in the case of an evacuating pump discharging to atmosphere, it is necessary that either the intake or discharge connection be rapidly closed, upon stopping of the pump, to prevent the fluid discharged from returning through the pump to the vessel from which it was withdrawn. In the case of a vacuum pump, it is highly desirable that such closing of a connection take place automatically and as quickly as possible after stopping of the pump. It is also desirable that the intake valve of the pump be opened as quickly as possible when the pump has been started.

It is, therefore, among the objects of the present invention to provide a pump with an intake valve which is automatically operated in response to operation of the pump.

Another object of the invention is to provide a pump with an intake control valve which is automatically opened and closed in response to starting and stopping operation respectively of the pump.

Another object of the invention is to provide a pump with an intake valve which is automatically opened by fluid pressure produced by the pump in response to starting operation of the pump.

Another object of the invention is to provide a pump with an intake valve which is automatically opened by fluid pressure of the pump produced upon starting and in which means are provided to nullify the continuing effect of the fluid pressure upon stopping of the pump.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawing in which:

Fig. 1 is a vertical longitudinal sectional view diagrammatically illustrating a pump having a valve in the intake thereof provided with means for automatically opening the valve in response to fluid pressure produced by operation of the pump and acting on a piston and which is further provided with means for avoiding continuance of the fluid pressure effect after stopping of the pump to thereby cause automatic closing of the valve.

Fig. 2 is an enlarged detailed sectional view of the piston on which the fluid pressure produced by a portion of the pump combination acts to cause opening of the valve, the pressure relief means being shown in the closed position which is assumed when the valve is open in response to starting operation of the pump.

Fig. 3 is an enlarged detailed sectional view similar to that illustrated in Fig. 2 but showing the pressure relief means in the opened position which is assumed when the valve is closed in response to cessation of operation of the pump.

Fig. 4 is a vertical longitudinal sectional view diagrammatically illustrating a pump having a valve in the intake thereof provided with means for automatically opening the valve in response to fluid pressure produced by operation of the pump and acting on a diaphragm connected with the valve, such connection being provided with means for avoiding continuance of the effect of the fluid pressure thereon after stopping of the valve to thereby cause automatic closing of the valve.

Fig. 5 is an enlarged detailed sectional view of the connection of the diaphragm with the valve showing the pressure relief means in the closed position which is assumed when the valve is opened in response to starting operation of the pump; and

Fig. 6 is an enlarged detailed sectional view of the connection of the diaphragm with the valve showing the pressure relief means in the open position which is assumed when the valve is closed in response to stopping operation of the pump.

Referring more particularly to the drawing by characters of reference the reference numeral 11 designates a casing having an inlet 12 for connection with a vessel or chamber (not shown) from which fluid is to be removed and an outlet 13 by which the fluid removed by the pump is discharged. The casing is adapted to retain a fluid such as oil in which are immersed a main pump 16 herein shown as being of the sliding vane rotary type, a valve 17 arranged in the connection of the inlet 12 with the pump 16 and preferably a cone valve such as illustrated and an auxiliary pump 18 shown as being a gear pump arranged to act on the oil in the casing and thus to produce a fluid pressure for a purpose which will be apparent hereinafter. Both pumps 16 and 18 are preferably mounted on the same shaft driven by suitable means such as an electric motor 19 preferably mounted externally of the casing 11.

The auxiliary pump 18 discharges into a chamber or cylinder 21 formed within the casing 11 and receiving a piston 22 and a compression spring 23. The rod of the piston 22 is partially formed as a rack 24 which engages with a pinion 26 connected with the valve 17. The piston is provided with passageways 27 and is slidably mounted on the piston rod between a collar 28 and valve member herein illustrated as being a plate 29 attached to the end of the rod. The cylinder 21 is provided with a plurality of ports 31 and 32, the purpose of which will appear hereinafter.

In operation, when the motor 19 is in operation, main pump 16 and auxiliary pump 18 are both in operation. Auxiliary pump 18 draws oil from casing 11 and discharges the oil under pressure into cylinder 21. Piston 22 is then under the pressure of the oil discharged from the pump 18 and is moved toward the left against the action of spring 23. Such movement causes rotation of valve 17 into the open position thereby connecting pump 16 with the vessel containing the fluid to be withdrawn therefrom. Such movement of the piston continues until valve 17 is fully opened and until the piston uncovers port 32 after which continued discharge of oil under pressure from the auxiliary pump 18 is vented through the port 32. During movement of the piston toward the left, the oil within the cylinder 21 about spring 23 is vented through port 31 thus preventing the formation of oil pressure opposing the pressure of the oil discharged from the pump 18 and acting on the piston 22. While the piston is moving into and is being retained in its extreme left hand position, the pressure of the oil forces the piston against the valve plate 29 on the end of the piston rod thus closing the passageways 27 as may be seen in Fig. 2.

When motor 19 is stopped for any reason, pumps 16 and 18 will cease operating and valve 17 must be closed and is preferably closed as quickly as possible. Cessation of operation of auxiliary pump 18 will end the delivery of oil under pressure to cylinder 21 and spring 23 will force movement of piston 22 toward the right thus causing rack 24 to rotate pinion 26 in a direction which will cause valve 17 to shut off the inlet 12 to the pump 16. Such movement of piston 22 under the action of spring 23 forces the piston against collar 29 as may be seen in Fig. 3 in which the spring pressure acting on the piston causes the uncovering of passageways 27 through the piston. The movement of the piston 22 through cylinder 21 in the return direction for closing of valve 17 is not delayed by the oil in the cylinder because such oil is vented through port 32 until the piston has passed beyond such port and is thereafter vented through passageways 27 and port 31. The provision of the ports in the cylinder 21 and the passageways 27 opening in only one direction provides means by which the opening and closing of valve 17 takes place automatically and immediately in response to operation of the pumps.

In the modified embodiment of the invention illustrated in Fig. 4, the cylinder 21 is replaced by a chamber 36 divided into two compartments 70 by a diaphragm 37 which is connected by a hollow rod 38 with the rack 24 engaging with the valve pinion 26. A compression spring 39 is arranged in one compartment of chamber 36 and acts against the pressure of the oil discharged by the auxiliary pump 18. The valve 17 is re-

tained firmly in its seat by a compression-torsion spring 41. Reference to Figs. 5 and 6 will show that spring 39 abuts on a valve member in the form of a plate 42 with an apertured sleeve which is slidably mounted on rod 38, the diaphragm 37 being preferably secured on the plate 42. A flange 43 is formed on the end of the rod 38. The sleeve of plate 42 covers or uncovers apertures 44 in the rod 38 by which oil may discharge from the oil receiving compartment of chamber 36 through other apertures 46 and 47 in the hollow rod 38.

In operation, when motor 19 is driving pumps 16 and 18, oil under pressure is discharged by pump 18 into chamber 36 and causes diaphragm 37 to flex toward the left against the action of the spring 39. Such movement of the diaphragm causes plate 42 to be moved into the position in which the apertures 44 of rod 38 are closed as may be seen by reference to Fig. 5. Flexure of diaphragm 37 toward the left continues uninterruptedly until port 46 in rod 38 has passed into the oil receiving compartment of chamber 36 whereupon the several portions of the structure are then in the positions shown in Fig. 4 of the drawing and the valve 17 is in full opened position. Continued discharge of oil from pump 18, after the several portions of the structure are in the position shown, merely causes flow of the oil through ports 46 and 47 from the oil receiving compartment of chamber 36 back into casing 11.

After motor 19 and pumps 16 and 18 are out of operation, pressure of the spring 39 moves the valve plate 42 toward the right as may be seen in Fig. 6 thereby causing the sleeve of such valve plate to uncover ports 44. Oil then discharges from the oil receiving compartment of chamber 36 through ports 44 and 47 into casing 11 until spring 39 has forced diaphragm 37 to the extreme right hand position thereby closing valve 17. The action of the oil pressure on the diaphragm is shown in Fig. 5 which also illustrates the position of the valve plate 42 relative to the end of rod 38 and the ports 44 therein when the valve 17 is in the opened position and the action of the spring 39 is shown in Fig. 6 which likewise shows the relation of the valve plate 42 and the ports 44 when the valve 17 is in the closed position.

It will be seen from the above that the present invention provides means whereby the intake valve to a pump is automatically opened or closed, in response to the operation of the pump, by fluid pressure delivered to valve operating means from an auxiliary pump. The pressure relieving means provided secure not only a venting of the oil discharged into the chamber containing the valve operating means upon continued operation of the oil pressure producing pump after the valve operating means has reached its extreme position, but likewise constitutes means for relieving the pressure in such chamber after the pump has ceased operating thereby permitting a fluid pressure opposing spring to return the valve operating means and the valve to the closed position much more rapidly than would otherwise be possible.

Although but two embodiments of the present invention have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. A pump combination comprising a main pump, an auxiliary pump, operating means for said pumps, a valve arranged in the inlet connection of said main pump, a casing enclosing said pumps and said valve, a chamber connected with said auxiliary pump to receive fluid under pressure therefrom, means arranged for movement within said chamber in response to fluid pressure delivered thereto, and a rod connecting said means with said valve for operation thereof in response to operation of said pumps, the second said means and said rod being movably connected to permit escape of fluid pressure from said chamber through apertures opened by relative movement of the second said means and said rod upon cessation of operation of said pump.
2. A pump combination comprising a main pump, an auxiliary pump, operating means for said pumps, a valve arranged in the inlet connection of said main pump, a casing enclosing said pumps and said valve, a chamber connected with said auxiliary pump to receive fluid under pressure therefrom, means arranged for movement within said chamber in response to fluid pressure delivered thereto, a rod connecting said means with said valve for operation thereof in one direction in response to operation of said pumps, and valve means arranged on said rod to control the escape of fluid pressure from said chamber, said means and said rod being movably connected to permit escape of fluid pressure from said chamber through apertures opened by said valve means upon relative movement of the second said means and said rod due to cessation of operation of said pumps.
3. A pump combination comprising a main pump, an auxiliary pump, operating means for said pumps, a valve arranged in the inlet connection of said main pump, a casing enclosing said pumps and said valve, a chamber connected with said auxiliary pump to receive fluid under pressure therefrom, a piston arranged for movement within said chamber upon discharge of fluid under pressure thereinto from said auxiliary pump, said piston having passageways formed therein for the escape of fluid from said chamber, a rod connecting said valve with said piston, and means associated with said rod for controlling the opening of the passageways in said piston.
4. A pump combination comprising a main pump, an auxiliary pump, operating means for said pumps, a valve arranged in the inlet connection of said main pump, a casing enclosing said pumps and said valve, a chamber connected with said auxiliary pump to receive fluid under pressure therefrom, a piston arranged for movement within said chamber upon discharge of fluid under pressure thereinto from said auxiliary pump, said piston having passageways formed therein for the escape of fluid from said chamber, a spring arranged within said chamber and acting on said piston in opposition to the action of the fluid under pressure thereon, a rod connecting said valve with said piston, and

means associated with said rod for controlling the opening of the passageways in said piston.

5. A pump combination comprising a main pump, an auxiliary pump, operating means for said pumps, a valve arranged in the inlet connection of said main pump, a casing enclosing said pumps and said valve, a chamber connected with said auxiliary pump to receive fluid under pressure therefrom, a diaphragm arranged for flexure within said chamber upon discharge of fluid under pressure thereinto from said auxiliary pump, a hollow rod having ports thereinto and connecting said valve with said diaphragm, and means connecting said diaphragm and said rod to control the opening of the ports into said rod.

6. A pump combination comprising a main pump, an auxiliary pump, operating means for said pumps, a valve arranged in the inlet connection of said main pump, a casing enclosing said pumps and said valve, a chamber connected with said auxiliary pump to receive fluid under pressure therefrom, a diaphragm arranged for flexure within said chamber upon discharge of fluid under pressure thereinto from said auxiliary pump, a hollow rod having ports thereinto and connecting said valve with said diaphragm, a spring arranged within said chamber and acting on said diaphragm in opposition to the action of the fluid under pressure thereon, and means connecting said diaphragm and said rod to control the opening of the ports into said rod.

7. A pump combination comprising a main pump, an auxiliary pump, operating means for said pumps, a valve arranged in the inlet connection of said main pump, a casing enclosing said pumps and said valve, a chamber connected with said auxiliary pump to receive fluid under pressure therefrom, means arranged for movement within said chamber in response to fluid pressure delivered thereto, and a rod connected with said means for movement relative thereto and connected with said valve for operation thereof upon operation of said pumps, the movable connection of said means and said rod controlling escape of fluid pressure from said chamber upon cessation of operation of said pumps.

8. A pump combination comprising a main pump, an auxiliary pump, operating means for said pumps, a valve arranged in the inlet connection of said main pump, a casing enclosing said pumps and said valve, a chamber connected with said auxiliary pump to receive fluid under pressure therefrom, means arranged for movement within said chamber in response to fluid pressure delivered thereto, said means having ports formed therein, a rod connected with said means for movement relative thereto and connected with said valve for operation thereof upon operation of said pumps, and means arranged on said rod to close the ports through the first of said means upon operation of said pumps and to open the ports through the first said means upon starting of the said pumps.

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