

March 15, 1955

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 APPARATUS FOR CONTROLLING THE FLUID PRESSURE
 WITHIN A VISCOUS LIQUID DELIVERY SYSTEM
 Filed May 22, 1951

2,704,086

Fig. 1

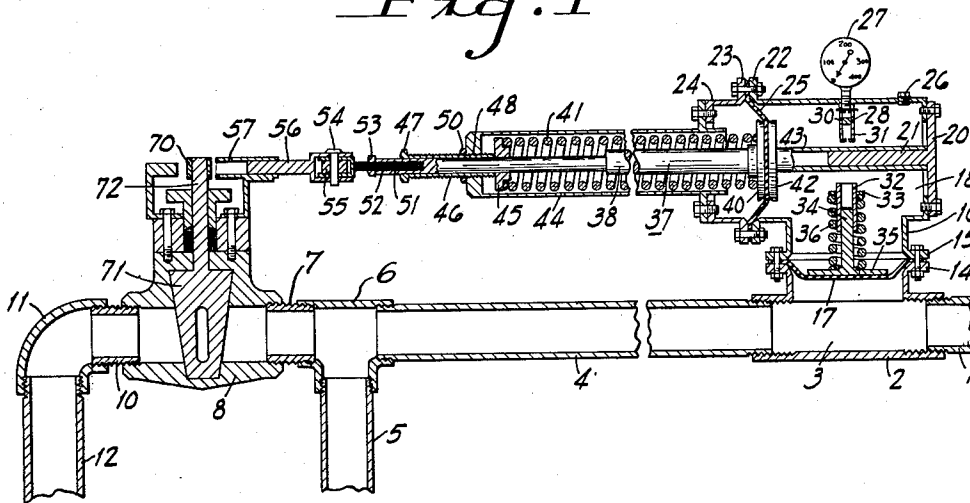


Fig. 2

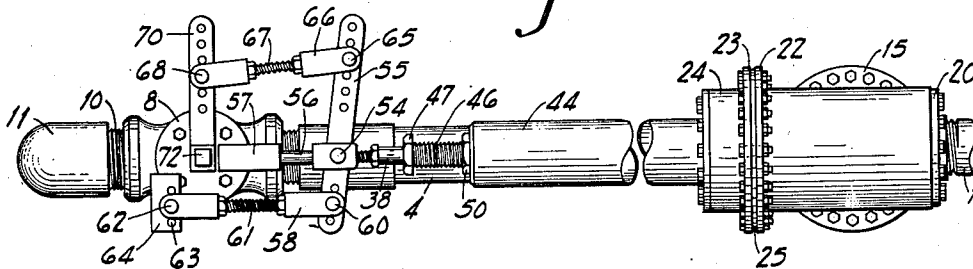
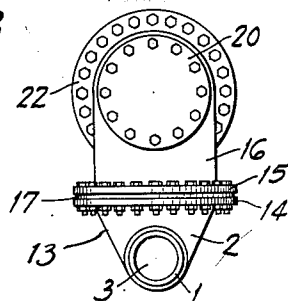


Fig. 3



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1

2,704,086

APPARATUS FOR CONTROLLING THE FLUID PRESSURE WITHIN A VISCOUS LIQUID DELIVERY SYSTEM

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Application May 22, 1951, Serial No. 227,714

3 Claims. (Cl. 137—116)

This invention relates to apparatus for controlling the pressure of a viscous liquid in a system for supplying the same.

Heavy liquid mixtures such as cement, concrete, tar, molasses and other viscous liquids are difficult to convey and, if stopped for a few minutes, they settle or harden making the conveying system useless without frequent cleaning. It is impossible to clean cement or concrete systems if allowed to stand too long and they become destroyed. One has to thoroughly flush a cement or concrete supply system immediately after use and the system cannot contain a circuitous path. Nor could one employ any intricate parts exposed to the cement mixture. It is best to dismantle the system after flushing it, to thoroughly clean the separate parts otherwise a very light coat may persist even after a thorough water flushing and subsequent use rapidly builds the coating until the whole system is rendered inoperative. Thus one of the objects of this invention is the provision of a simple system that can be readily flushed and need not be dismantled for cleaning.

Pressure by-pass valves are very old in fluid systems and they are ordinarily placed closely adjacent the pump or source of pressure. In a viscous liquid delivery system, such as the cement or concrete system disclosed herein, the pressure by-pass valve functions with a better degree of safety when it is adjacent the pump or pressure source and only one operator is required. The flowing concrete requires a predetermined pressure to keep it moving through the system and there may or may not be any head pressure at the discharge pipe owing to the nature of the form being filled with concrete. But if the form being poured is closed or if one is pumping concrete behind a wall, such as a tunnel wall, then there may be a little resistance to delivery, until the void is filled. When filled the pressure rises so fast that one can hardly anticipate the pressure rise in order to open a hand operated by-pass valve in time. The by-pass valve is adjacent the pump and the pressure may build up so fast that the wall or the tubing connections break before the by-pass valve can be manually opened. When the by-pass valve is automatically actuated it can be partially opened as the pressure is building up, and when the surge comes it becomes fully opened and avoids any rupture in the system or the wall. This represents an important factor of this invention.

The use of different character of pressure responsive devices may be employed to open the by-pass valve, but it is important to provide a flexible diaphragm in the chamber exposed to the viscous liquid mixture for expanding and contracting with variations in pressure for the purpose of providing actuating means to operate the relief valve. If a piston is employed the cement coats the cylinder wall and prevents its operation. If bellows are used they cannot be cleaned without completely dismantling them, and any slight delay in feeding the liquid past the bellows is sufficient to collect cement on them and prevent their operation. An open chamber with a flexible diaphragm is easily cleaned by flushing at night and leaves no corners or intricate passages to clog or to be cleaned. The valve operating servomotor that is actuated by the diaphragm may be fluid, electrical or mechanical and it may be constructed to operate the control valve in degrees or by fully opening and closing the same. It may be found preferable to employ a mechani-

2

cal servomotor as it may be employed on installations not equipped with electric service.

A mechanical servomotor for actuating the control valve has been chosen to illustrate this invention. In order to apply this control to a valve in a straight pipe length, that can be readily flushed, a liquid was selected to transmit the pressure at ninety degrees. A bell crank lever could be employed, but the liquid transmitter provides a simple mode of applying a pressure at ninety degrees and a pressure gauge may also be used to measure or indicate the pressure of the cement in system without fouling the gauge mechanism by the liquid.

A multiplying leverage is employed to operate the control valve. Sufficient pressure is available, but the movement is slight. Thus it is important to employ a multiplier for actuating the control valve and thus provide accurate control for slight variations in pressure which is an important feature of this invention. It is believed to be preferable to continuously actuate the valve for slight pressure changes, so that it is free to function when a high pressure change takes place.

Other objects and advantages appear hereinafter in the following description and claims.

The accompanying drawings show, for the purpose of exemplification without limiting the invention or claims thereto, certain practical embodiments of the invention wherein:

Fig. 1 is a view in vertical section of the control apparatus illustrating this invention.

Fig. 2 is a plan view of the structure shown in Fig. 1.

Fig. 3 is an end view of the housing.

Referring to the drawings a concrete control apparatus comprises the supply pipe 1 which is maintained as straight as possible and terminates in one end of the lower control unit 2, which has a chamber 3 passing directly therethrough. The material discharges out of the unit through the pipe 4 and through the discharge outlet 5. The discharge outlet 5 is preferably closely adjacent the cribbing or cement work, such as a tunnel or a wall, into which the outlet pipe passes for the purpose of supplying the concrete to the void or space between the wall and the earth. The outlet pipe 5 as shown is connected through the T member 6 and the other connection of the T is made by means of the nipple 7, which connects it to the valve 8 and thence to a second nipple 10, the elbow 11 and the discharge return pipe 12 which, when the valve 8 is opened, permits the concrete to be returned to the source which may be a tank from which the pump withdraws the concrete and flows it through the system. The concrete may recirculate through the system several times before being consumed. In some instances, when the source is remote, it may be preferable to catch any overflow in improvised containers for that purpose and return it to the source by vehicle.

The chamber 3 of the control unit 2 flares upwardly, as indicated in Fig. 3 at 13, where it terminates in an annular flange 14 and mates with the complementary annular flange 15 on the lower end of the upper control unit 16. A diaphragm 17 preferably made of a suitable flexible material, such as rubber or similar synthetic materials having like properties, is bolted in place as indicated and thus separates the chamber 3 from the chamber 18 in the upper control unit 16.

The upper control unit 16 is also provided with a plate 20 which closes the chamber 18 and provides a plunger or diaphragm stop member 21. The opening closed by the plate 20 is disposed on an axis at right angles to that of the upwardly open chamber 3. The end of the control unit 16 opposite that of the plate 20 is provided with the annular flange 22 which mates with the complementary flange 23 of the head member 24 and a flexible diaphragm member 25 similar to that indicated at 17 is provided between these flanges for closing the chamber 18 at that end of the control unit.

The plug 26 is provided in the top of the unit 16 for the purpose of filling the same with an oil such as a hydraulic brake liquid. It is preferable that the whole of the chamber 18 be filled with oil. A gauge such as illustrated at 27 is connected to the liquid chamber 18 through the pressure snubber 28 which represents the

plunger 30, slidable in the guide member 31 that is opened into the interior of the chamber.

A guide 32 is supported from the walls of the upper control unit by means of the bridge 33. This guide is preferably circular in cross section to receive the circular stem 34 on the equalizing plunger 35. A spring 36 is initially compressed to some degree between the bridge 33 and the head of the equalizing plunger 35 for the purpose of maintaining the diaphragm 17 in its extended position as shown in Fig. 1. When the spring 36 is compressed by the fluid pressure in the chamber 3, it functions as a stop for the plunger 35.

A second diaphragm plunger as indicated at 37 has a stem member 38 and a head 40 which presses against the outside of the diaphragm 25. A heavier spring 41 is seated against the head 40 and the plunger 37 to force the diaphragm into the chamber 18. In view of the fact that the spring 41 is materially heavier, it is necessary to provide a stop on the other side of the diaphragm 25 which is indicated by the plunger 42, which has an integral hollow guide sleeve 43 telescoping over the guide member 21 on the plate 20. The inner end of the sleeve 43 functions as a stop limit when engaged by the head 40 to prevent the diaphragm 25 from flexing beyond its breaking point.

The head 24 has attached thereto a cylindrical case 44 for enclosing the spring 41. The outer end of the spring 41 engages the washer member 45 which is slidably mounted on the stem 38 of the plunger 37 and is engaged by the inner end of the threaded pressure adjusting sleeve 46 which has a squared outer end as indicated at 47 for turning in the threaded opening 48 and which may be locked by the lock nut 50.

The outer end of the plunger 37 has a threaded bore as indicated at 51 to receive the clevis bolt 52. The clevis bolt 52 is locked within the threaded bore 51 by the nut 53. The clevis is provided with an opening to receive the pivot pin 54 which provides the pivotal connection to the equalized lever 55 and to the guide plunger 56, which is guided in the tubular guide socket 57 as shown in Fig. 2. The equalizing lever 55 has its one end pivoted to the adjustable fulcrum 58 by means of the pin 60. The adjustable fulcrum lever is provided with a turnbuckle member 61 which adjusts the relative position of the pivotal pin 60 to the pin 62, which is adjustably mounted in one of the holes 63 of the fixed plate 64 on the valve 8.

The other end of the equalizer lever 55 has a series of holes in which the pivot pin 65 may be positioned for pivotally attaching the link 66 thereto. The link 66 is likewise adjustable by the turnbuckle arrangement shown at 67. The opposite end of the link 66 is pivotally secured by the pins 68 to the valve operating lever 70 which has a series of holes in which the pin 68 may be adjusted.

One can thus adjust the pressure of the spring 41 to properly bias the closing of the valve 8, and one can also adjust the linkage through the equalizing lever, the fulcrum and the operating link 66 for the purpose of providing full operation of the valve 8 for the pressure under which the material is to be transmitted through the pipe system.

The valve 8 is provided with an ordinary plug type valve 71 having an upwardly projecting stem 72 for receiving the lever 70. This valve may, of course, be operated by hand by throwing the lever 70 in a counter-clockwise direction which will compress the biasing spring 41 and withdraw the head 40 and the plunger 37 from the diaphragm 25.

Owing to the fact that the chamber 18 is filled with liquid, any pressure in the chamber 3 will be transmitted through the flexible diaphragm 17 and cause the latter to move upwardly into the chamber. This pressure on the liquid in the chamber 18 will be readable directly by the gauge 23 and will force the diaphragm 25 outwardly thereby moving the plunger 37 and the equalizer lever 55 through its linkage to open the valve 70.

If the pressure in the system approaches that which will overcome the pressure of the spring 41 by applying pressure through the liquid in the chamber 18, it will be effective in either partially opening or fully opening the valve depending upon the pressure applied in the chamber 3.

This pressure control apparatus is closely adjacent the

pump and concrete supply tank, and the pressure builds up from the discharge pipe 5 and is effective on the liquid chamber 18 before it reaches the pump. The pump, the concrete supply tank and control valve are all mounted on the same frame which may be made mobile. It is advisable to periodically open the by-pass control valve when the system is in operation to prevent any settling or hardening of the concrete in the valve and return line 12. At the end of the day these lines are flushed backwards to clean them.

It will be noted from Figs. 1 and 3 that the chamber 3 provides a smooth discharge to the lower end of the chamber, wherein the materials may be readily cleaned by flushing after the apparatus has been in use. It is not necessary to remove the valve 8 to clean it. It need only be flushed with the piping system by forcing water back through the system for cleaning out the same. However at the end of a job, when the apparatus is apt to be allowed to stand idle, it is best to dismantle the same and clean all the parts so that the cement will not adhere to the walls and prevent its operation.

While, for clarity of explanation, certain embodiments of this invention have been shown and described, it is to be understood that this invention is capable of many modifications and many changes in the construction and arrangement of parts may be made therein and certain parts may be employed without the conjoint use of other parts and without departing from the spirit and scope of this invention.

I claim:

1. A by-pass control mechanism for cement which comprises a first discharge, a second discharge and a control valve therefor, a control housing having a passage connected to the valve and the first discharge for conducting thereto cement under pressure, a flexible diaphragm exposed to the cement in said passage and capable of being flexed in response to the pressure of the cement, an actuating means responsive to the flexing of the diaphragm for operating said valve to control the flow of cement therethrough and to control the pressure of the cement in the passage.

2. A cement delivery system comprising a pump to supply cement under pressure, an unobstructed conduit to convey and discharge the cement from the pump, a by-pass line connected to said conduit to provide a second discharge therefor, a by-pass valve in said line, a by-pass valve control having a housing that forms a part of said conduit between the pump and said by-pass line, a flexible diaphragm in said housing having one side exposed to the cement and the other side forming a liquid chamber, a spring-biased plunger mounted in the liquid chamber to press the diaphragm toward the cement, a second diaphragm enclosing said liquid chamber, a second spring-biased plunger mounted outside of said housing to press the second diaphragm into the liquid chamber, means to connect said second plunger to said by-pass valve to operate the same in response to pressure on the cement in said conduit.

3. A system for delivering and maintaining the flow of cement under pressure from a supply which comprises, a control housing, an unobstructed conduit to convey the cement straight through said control housing to discharge, a by-pass line connected to said conduit between said discharge and said control housing to provide a second discharge of the cement to waste, a valve in said by-pass line to control the flow of cement to waste, pressure responsive means mounted in said housing in sealed relation to the cement passing therethrough but operable by the pressure thereof to open said valve in the by-pass line and discharge the cement to waste when the pressure on the cement exceeds a predetermined amount that prevents its continued flow through said control housing.

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