July 9, 1946. J. B. SMITH 2,403,688

PUMP CONTROL

Filed April 2, 1943

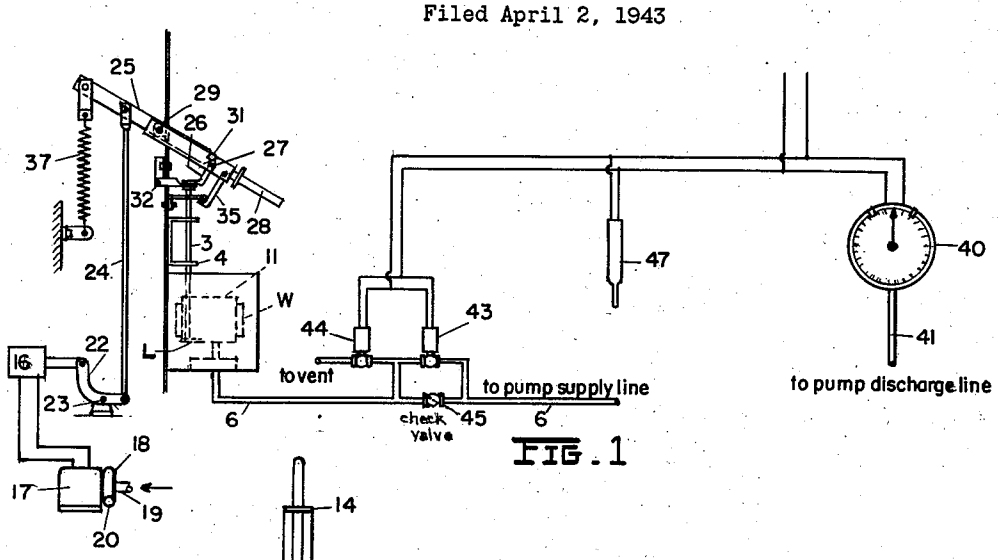


FIG. 1

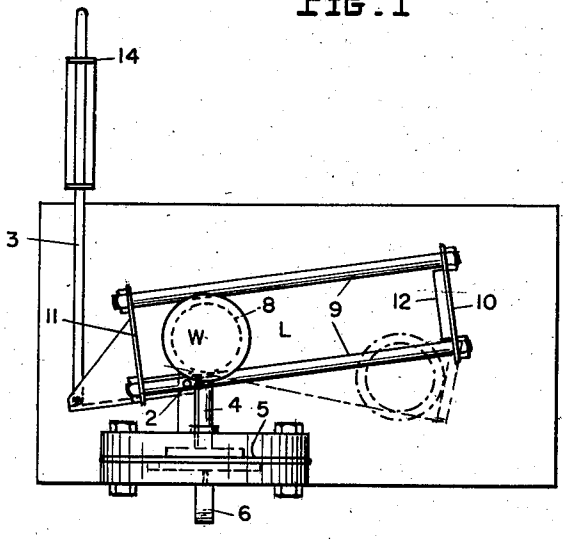


FIG. 2

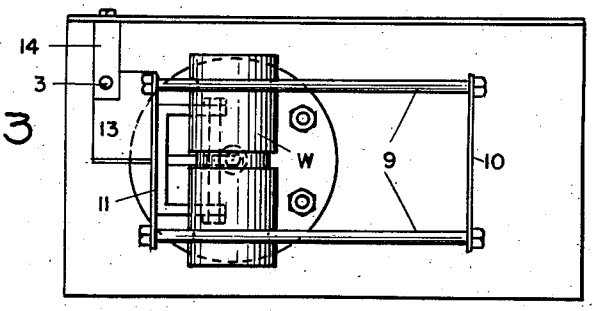


FIG. 3

INVENTOR.
JOSEPH B. SMITH

BY Oberlin, Limbach & Day.
ATTORNEYS

Patented July 9, 1946 2,403,688

UNITED STATES PATENT OFFICE

2,403,688

PUMP CONTROL

Joseph B. Smith, Elida, Ohio, assignor to The Standard Oil Company, Cleveland, Ohio, a corporation of Ohio

Application April 2, 1943, Serial No. 481,543

14 Claims. (Cl. 103—25)

1

This invention relates to pump control; and it is among the objects of the invention to provide mechanism which although sensitive is rugged and powerful. To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described, and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

Fig. 1 is a side elevational view, partly schematic, illustrating an embodiment of the invention; and Figs. 2 and 3 are enlarged side elevational and plan views respectively of detail of the control lever system.

In general, the invention involves a weight-equipped lever and trip system which is responsive to change in the pump supply or feed, such change being of magnitude as predetermined and adjusted for in any desired instance, and the lever and trip system serving to control the power driving the pump. Thus, as in the embodiment illustrated, there is a lever L, fulcrumed on a pivot bar or bolt 2, and operating a trip rod 3 to control the power driving the pump, the lever in turn being controlled by the pressure in the pump feed line. Normally, the lever is supported in upper or full line position as shown in Fig. 2, by a plunger 4 which is seated on a diaphragm 5. The diaphragm is of any suitable material, depending upon the liquid being pumped, and it may be of copper or other metal, or natural or synthetic rubber, etc. The diaphragm is in communication through a pipe 6 with the pump supply line. Preferably, the lever L is of composite form such as to provide a suitable guideway or track for a movable weight W. In the form shown, this conveniently is cylindrical, and has grooves 8 near each end, which ride along the rods or bolts 9 secured in pairs in the assembly by the end pieces 10, 11. As seen in Fig. 2 thus, when the pressure through the communicating pipe 6 from the pump supply line is sufficient to support the diaphragm 5 and plunger 4 and hold the lever L in its upper or full line position, the weight W is at the end of its path of movement adjacent the fulcrum 2, and the trip rod 3 is in its lower or inactive position, but with a pressure drop in line 6 which allows the plunger and the lever L to fall to the lower or dotted line position, the movable weight W rolls down on its guideway

2

to the far end of the lever and adds its thrust to the upward movement of the trip rod 3 which serves to cut off the power driving the pump. A buffer or shock absorber 12 of resilient material may be provided to cushion the weight W. The rear end of the lever may be formed by an extension 13 of the end piece 11 to coact with the trip rod 3, the latter being guided in suitable bracket means 14. The trip rod operates the power cut-off 16, whose detail varies, depending upon the character of the driving power in any given instance, whether current to an electric motor, current to the ignition system of an internal combustion engine, or steam supply driving the pump, etc. For example, with the cut-off 16 controlling the supply current to an electric motor 17 driving the rotary pump 18, having a supply line 19 and discharge 20, the cut-off may be a switch of any usual or preferred detail, and it may be operated by trip rod 3 through a lever 22 fulcrumed at 23, and having connections 24, 25 and 26, the latter element being a latch pivoted at 27 on member 28 which forms an extension handle and together with the member 25 is pivoted at 29 on a suitable support bracket. The two members 25 and 28 are normally held together by the latch 26 whose upper arm 31 engages a shoulder or ledge of the member 25. The latch 26 at its lower end rests on a flap which is pivoted at 32 to a suitable bracket, and the latch 26 thus normally rests passively in support on top of the trip rod 3 as in its lower or inactive position, and thereby the weight of the latch 26 allows its engaging end 31 to rest in the shoulder or ledge of the end of the member 25 and hold the two members 25 and 28 together in alignment as one lever. A hand latch 35 normally is set into position against a bracket on the general support panel. In such arrangement, it is readily seen that the trip latch 26 rests passively at the top of the trip rod 3 under normal conditions and the cut-off 16 is maintained in position maintaining power to the drive of the pump; but with a drop in the pressure in the pump supply line, the pressure supported plunger 4 allows the lever L to fall, and the movable weight W throws the lever with sufficient force to push the trip rod 3 up and trip the latch 26 and release the member 25 from the member 28 of the associated lever couple, and thereby the spring 37 can pull the member 25 and link 24 downwardly to throw the switch at 16 and cut off the power driving the pump. The limits between which the pump may be thus stopped or started depend upon the desired pressures at which such actions are to occur, and may be ad-

justed in any given case as desired by the proportion of the weight and lever. The discharge pressure from the pump is controlled through the same mechanism, with association of a pressure responsive means 40 connected by a pipe 41 to the pump discharge line, and which may for convenience also involve an indicating pressure gauge, and have contacts settable for desired pressure levels between which operation is to be effected. Connected in circuit with the pressure responsive device 40 is a secondary valve control comprising a normally open valve 43 and a normally closed valve 44. The valve 43 is in a bypass around a one-way check valve 45 which is in the pipe 6 communicating with the pump supply line, the check valve 45 permitting communication from the pump through the pipe 6 to the diaphragm 5 one way, but closing the other way on pressure unbalance. The valve 44 connects from the pipe 6 on the diaphragm side of the check valve 45 to any suitable point of venting or discharge. The valves 43 and 44 conveniently may be electro-magnetically or solenoid operated valves such as of any well-known or preferred construction. With this arrangement, it is readily seen that as long as the pressure communicated to the pressure responsive device 40 from the pump discharge line is within the limits between minimum and maximum for which the control has been set, the pressure operating also on the diaphragm 5 through the pipe 6 from the pump supply line is freely operating through the valves 43 and 45, the vent valve 44 being closed, but in the event of pressure change in the pump discharge line being such as to close the circuit in the pressure responsive device 40, the valves 43 and 44 are reversed, the former being closed and the latter being opened to vent, and the one-way valve 45 prevents communication of pressure from the pump supply line, and the result is the release of pressure supporting the diaphragm 5 and the putting in operation of the control lever and the shutting off of the power driving the pump.

In the control system also a thermal responsive element or thermostat 47 is again connected in circuit to the valves 43 and 44, such that these may also be operated to release pressure on the diaphragm lever and trip the power cut-off in event of an undue rise in temperature at a critical point. For instance, heavy duty pump bearings may be provided with such, or with an internal combustion engine driving the pump its cooling system may be provided with such temperature control, and as many such thermally-responsive elements may be provided in circuit as are desirable at any given instance.

The operation of the control is apparent from the foregoing. As long as the pump is operating under normal and predetermined conditions, the pressure communicated through the pipe 6 to the diaphragm 5 from the pump supply line maintains the lever L in supported position and the power driving the pump is maintained. Suppose the predetermined minimum limit for which the control is desired to operate is 5 pounds per square inch for example. If the feed to the pump falls below this, the diaphragm-supported plunger 4 drops and the lever L drops and the weight W rolls to the long end of the lever, and the trip rod 3 is thrown up and releases the latch 26 which holds the members 25 and 28 together, whereupon the spring 37 pulls the member 25 and link 24 down and operates the cut-out 16 and stops the pump. Or, if the pressure in the pump discharge line as communicated through pipe 41 to the pressure responsive element 40 goes out of bounds for which setting has been made, the electric circuit is closed and this operates the valves 43 and 44 to vent the pressure in the diaphragm chamber, and again the diaphragm-supported plunger 4 drops and the lever L drops and the trip rod 3 operates to shut off the power. Or, if the thermally-responsive element 47 is heated in excess of a predetermined safe temperature in bearings or cooling water system at a critical point which is being guarded, again the electric circuit is closed and the valves 43 and 44 operate to vent the diaphragm chamber and allow the diaphragm-supported plunger 4 and the weight L to drop and actuate the trip rod 3 to shut off the power. Suppose the adjustment be such that twenty pounds per square inch pressure in the pump feed line, as communicated therefrom through the pipe 6, is required to raise the lever to the height where the weight W can roll back to normal position, when the pressure in the pump feed line is up to at least 20 pounds then the lever L is raised and the pump may be started again. This differential between the shut-off and the starting pressures is an important practical advantage, and if for any reason the feed is inadequate or does not continue, there is an ample safety factor. The pressures aforementioned are of course illustrative, and may be adjusted to the precise amounts desired in any given case. This control is always in operation, and thereby is especially advantageous over controls which must be cut out while starting and then be set when the normal speed is reached. Owing to the design which allows the diaphragm to be supported against a large surface of metal when pressure is applied, operation on very high pressure lines is possible, and operating pressures on the order of several hundred pounds to 1500 pounds or more per square inch are feasible, and the setting may be such that a variation of a fraction of a pound will operate the control.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:

1. In pump control means, a lever, a plunger normally supporting said lever at an incline above a horizontal position, a diaphragm actuating said plunger and being controlled by pressure communicated from the pump suction line, guideways on said lever, a weight adapted to run on said guideways, a trip rod operated by said lever to shut off the power driving the pump, a one-way check valve between said diaphragm and the pump suction line, a valve normally open bypassing said check valve, a valve normally closed positioned between said check valve and said diaphragm to a point of discharge, means responsive to pressure change in the pump discharge line for reversing said last two valves, and a thermally-controlled element also having connections to reverse the same.

2. In pump control means, a lever, a plunger normally supporting said lever at an incline above a horizontal position, a diaphragm actuating said plunger and being controlled by pressure communicated from the pump suction line, guideways on said lever, a weight adapted to run on said guideways, a trip rod operated by said lever to shut off the power driving the pump, a one-way check valve between said diaphragm and the

pump suction line, a valve normally open bypassing said check valve, a valve normally closed positioned between said check valve and said diaphragm to a point of discharge, and means responsive to pressure change in the pump discharge line for reversing said last two valves.

3. In pump control means, a lever, a plunger normally supporting said lever at an incline above a horizontal position, a diaphragm actuating said plunger and being controlled by pressure communicated from the pump suction line, guideways on said lever, a weight adapted to run on said guideways, a trip rod operated by said lever to shut off the power driving the pump, a one-way check valve between said diaphragm and the pump suction line, a valve normally open bypassing said check valve, a valve normally closed positioned between said check valve and said diaphragm to a point of discharge, and a thermally-controlled element having connections to reverse the same.

4. In pump control means, a lever, a plunger normally supporting said lever at an incline above a horizontal position, a diaphragm actuating said plunger and being controlled by pressure communicated from the pump suction line, guideways on said lever, a weight adapted to run on said guideways, a trip rod operated by said lever to shut off the power driving the pump, means responsive to pressure change in the pump discharge line for independently releasing the pressure on said diaphragm, and a thermally-controlled element also independently releasing the pressure on said diaphragm.

5. In pump control means, a lever, a plunger normally supporting said lever at an incline above a horizontal position, a diaphragm actuating said plunger and being controlled by pressure communicated from the pump suction line, guideways on said lever, a weight adapted to run on said guideways, a trip rod operated by said lever to shut off the power driving the pump, and means responsive to pressure change in the pump discharge line for independently releasing the pressure on said diaphragm.

6. In pump control means, a lever, a plunger normally supporting said lever at an incline above a horizontal position, a diaphragm actuating said plunger and being controlled by pressure communicated from the pump suction line, guideways on said lever, a weight adapted to run on said guideways, a trip rod operated by said lever to shut off the power driving the pump, and a thermally-controlled element for independently releasing the pressure on said diaphragm.

7. In pump control means, a lever, a plunger normally supporting said lever at an incline above a horizontal position, a diaphragm actuating said plunger and being controlled by pressure communicated from the pump suction line, two pairs of parallel rods embodied with said lever, a cylindrical weight normally balanced in alignment over said plunger and having a circumferential groove near each end to ride between the pairs of rods in rolling motion, and a trip rod operated by said lever to shut off the power driving said pump.

8. In pump control means for a pump having a suction line and a discharge line, a lever, a plunger normally supporting said lever at an incline above a horizontal position, a diaphragm

actuating said plunger and being controlled by pressure communicated from the pump suction line, guideways on said lever, a weight un-connected to the lever and normally balanced in alignment over said plunger and adapted to run on said guideways, a switch controlling the power driving the pump, and a trip rod operated by said lever to open said switch.

9. In pump control means for a pump having a suction line and a discharge line, a lever, a plunger normally supporting said lever at an incline above a horizontal position, a diaphragm actuating said plunger and being controlled by pressure communicated from the pump suction line, guideways on said lever, a weight un-connected to the lever and normally balanced in alignment over said plunger and adapted to run on said guideways, and a trip rod operated by said lever to shut off the power driving the pump.

10. In pump control means for a pump having a suction line and a discharge line, a lever, a plunger normally supporting said lever at an incline above a horizontal position, a diaphragm actuating said plunger and being controlled by pressure communicated from the pump suction line, guideways on said lever, a rolling weight on said guideways normally balanced in alignment over said plunger and gravitationally changing position relative to the lever, and a trip rod operated by said lever to shut off the power driving the pump.

11. In pump control means for a pump having a suction line and a discharge line, a lever normally maintained in inactive position by pressure in predetermined amount communicated from the pump suction line, a weight un-connected to the lever and normally balanced in alignment over said plunger and movable on said lever to over-balance on failure of the predetermined supporting pressure, and a trip rod actuated by said lever to thereupon shut off the power driving the pump.

12. In pump control means for a pump having a suction line and a discharge line, means in both said lines to control the operation, the means on the suction line including a lever normally maintained in inactive position by pressure in predetermined amount communicated from the pump suction line, an over-balancing weight on said lever gravitationally moving relative to the lever, and a trip rod actuated by said lever when moved from inactive position to shut off the power driving the pump.

13. In pump control means for a pump having a suction line and a discharge line, a normally connected cut out for the power driving the pump, a trip normally held inactive by pressure communicated from the pump suction line but operating said cut out on pressure drop in such line, and means responsive to pressure change in the pump discharge line for independently operating said trip.

14. In pump control means for a pump having a suction line and a discharge line, a cut out for the power driving the pump, a lever and a weight gravitationally changing its position on the lever to operate the cut out, and control means therefor normally held inactive by pressure communicated from the pump suction line.

JOSEPH B. SMITH.