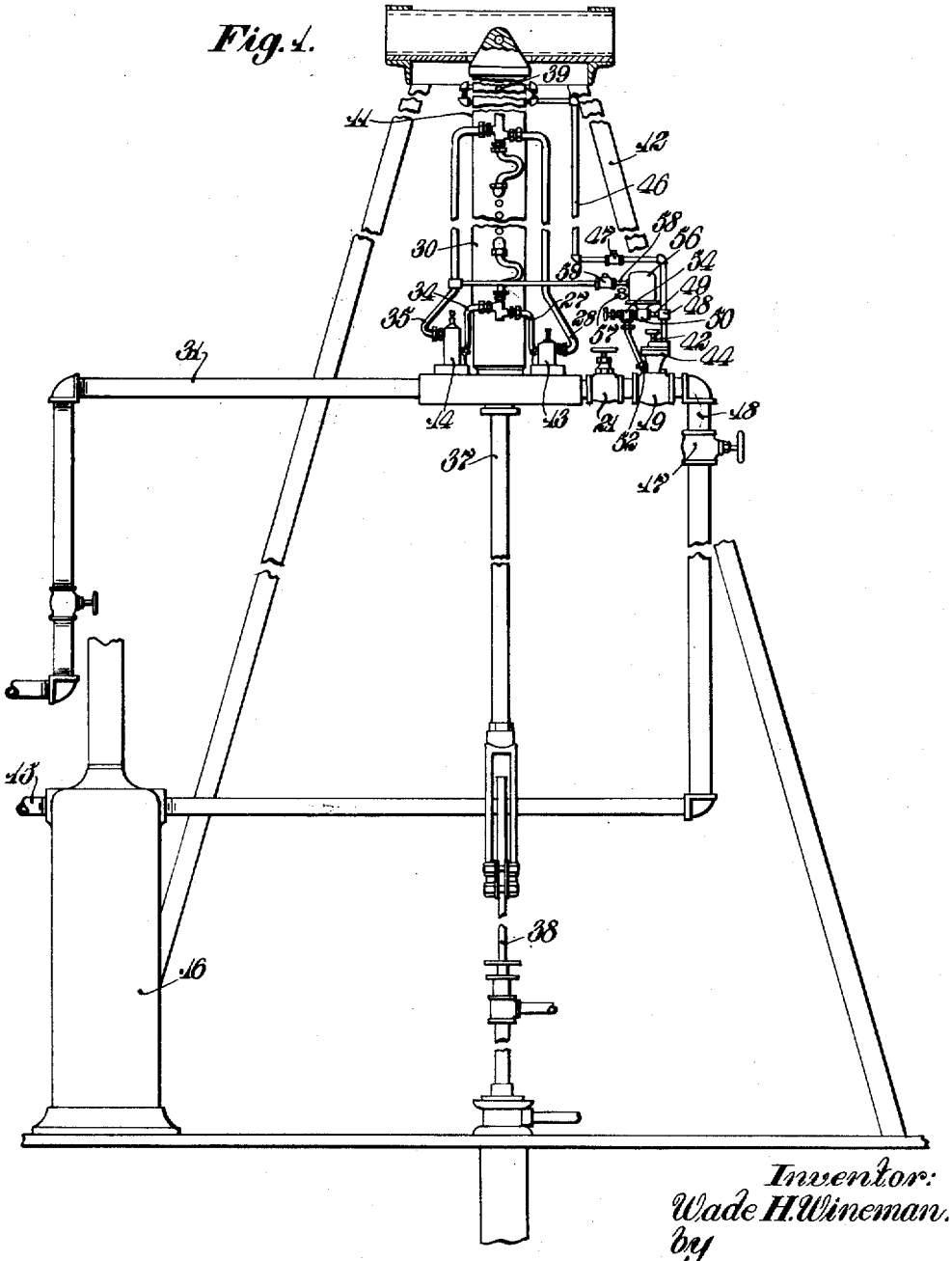
Nov. 2, 1937. W. H. WINEMAN 2,098,122

MOTOR

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Fig. 1.



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MOTOR

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Fig. 2.

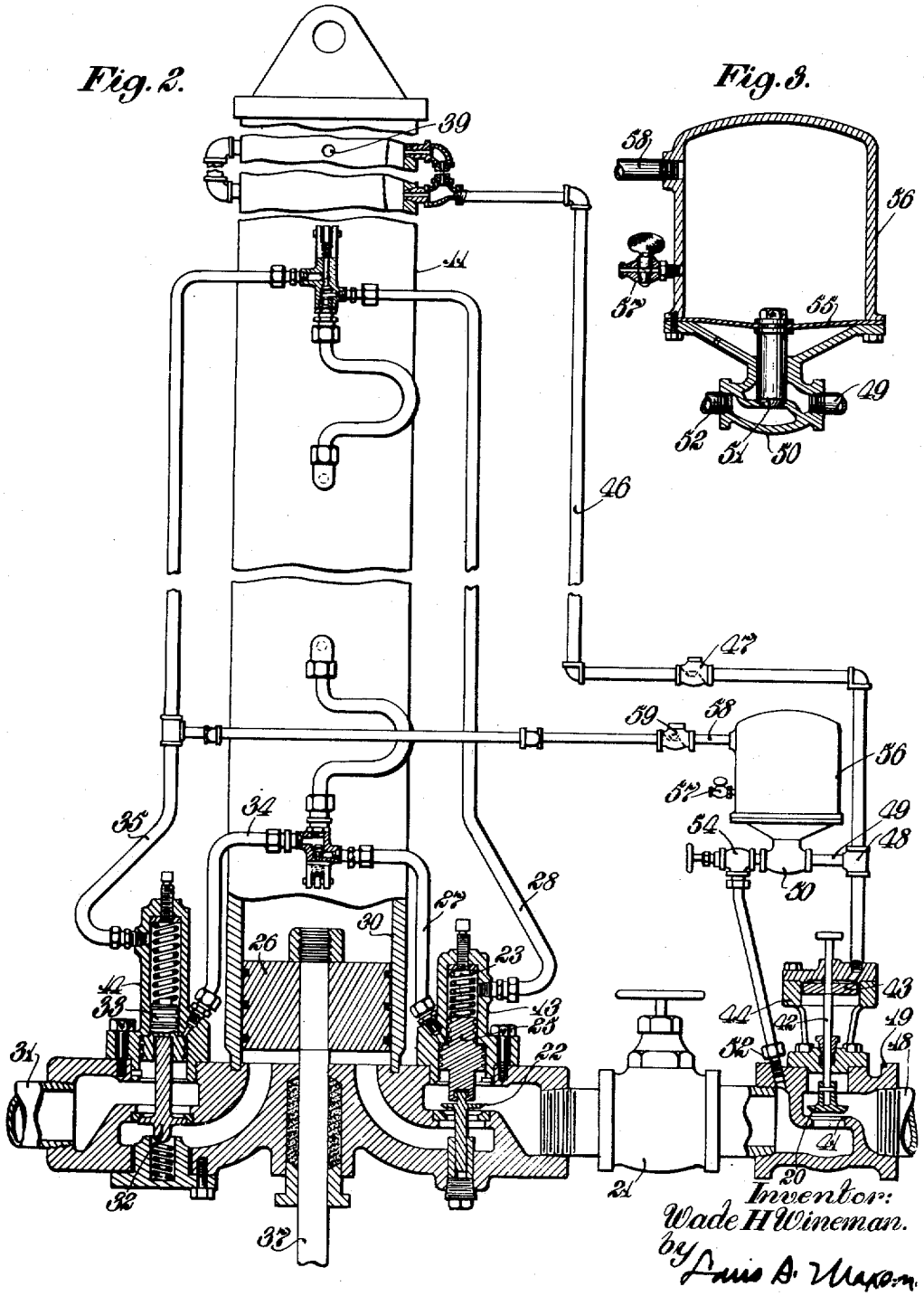


Fig. 3.

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Fig. 4.

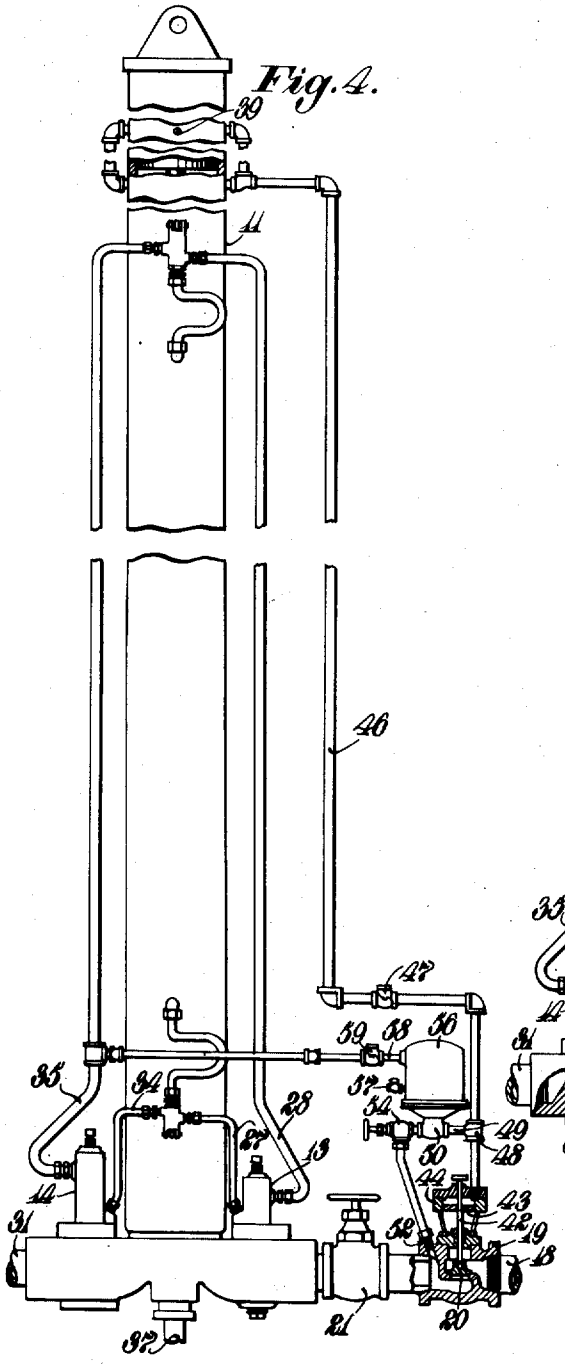
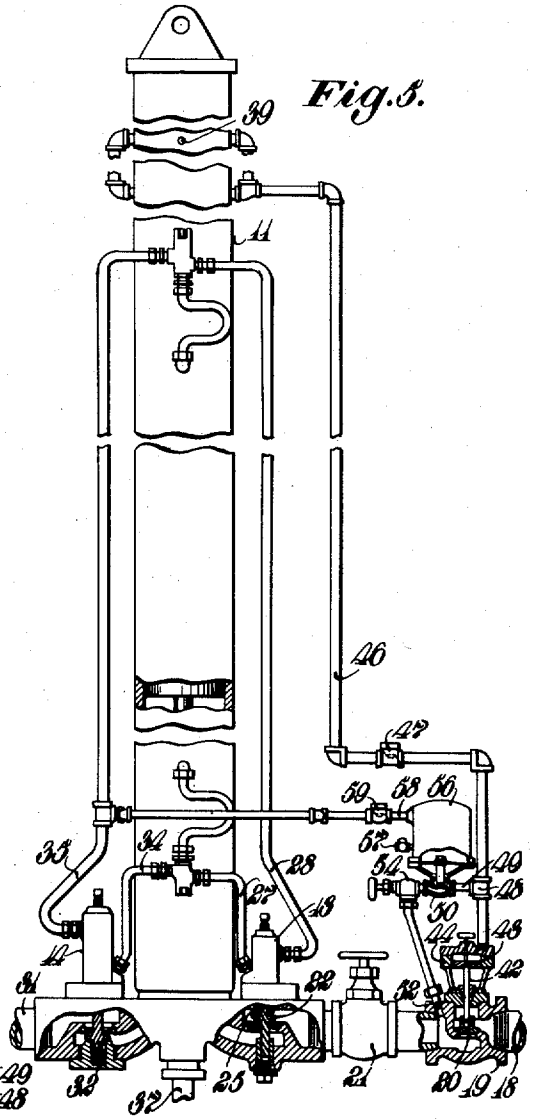


Fig. 3.



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Patented Nov. 2, 1937

2,098,122

UNITED STATES PATENT OFFICE

2,098,122

MOTOR

Wade H. Wineman, Michigan City, Ind., assignor to Sullivan Machinery Company, a corporation of Massachusetts

Application January 25, 1934, Serial No. 708,260

27 Claims. (Cl. 121—47)

My invention relates to motors and more particularly to automatic controlling means for motors particularly adapted for pumping apparatus.

There are a number of oil fields in which there is a substantial quantity of oil available but where the pressure of the oil is insufficient to raise the latter to the surface, and accordingly pumping devices are necessary. One highly satisfactory system includes a plurality of pumping units all arranged within a reasonable area and each supplied with an operating medium from a central compressor having pipes leading out to the pumping units.

In a preferred form of such apparatus the unit at each well includes a pump head in the form of an expansible chamber motor connected with a piston type pump in the well and having fluid actuated inlet and exhaust valve mechanisms. In the interest of economy, the air is customarily preheated at the well and is exhausted from the motor cylinders against a considerable back pressure and returned at that back pressure to the intake of the compressor for recompression there.

As it is not practicable to keep an operator at each well, it is important not only that the pumping apparatus shall be of a regular and positive type and subject to minimum danger of derangement, but, moreover, to provide automatic devices which will operate to shut down the pump in the event of the breakage of the pump rod line or damage to the pump packings or any derangement of the pumping motor which might permit a flow of pumping fluid continuously from the supply line to the discharge line, such an event obviously being likely to cause disturbance of more than one unit of the system.

It is an object of my invention to provide an improved controlling mechanism for a pump unit of the character just mentioned, which shall operate automatically to interrupt the supply of motive fluid to the pump when necessary. It is another object of my invention to provide an improved controlling mechanism for a pumping unit of the type referred to which shall be responsive to both damage to the liquid pump and derangement of the pump motor proper. It is a further object of the invention to provide an improved controlling apparatus for a pump unit of the character described which shall automatically shut down the pump motor whenever fluid for the actuation of the motor exhaust valve shall not be supplied to the latter for a substantially longer period than usual. Other objects and advantages of the present invention will subsequently appear.

In the accompanying drawings, in which I have shown my invention embodied in one illustrative form,

Fig. 1 is a diagrammatic view showing the illustrative embodiment installed at one of the pumping sub-stations.

Fig. 2 is a view on an enlarged scale, partially in section, showing details of the controlling mechanism.

Fig. 3 is a small detail sectional view through a portion of the controlling mechanism.

Fig. 4 is a view generally similar to Fig. 2, but on a reduced scale, showing the controlling apparatus made effective in one of the ways hereinafter described.

Fig. 5 is a generally similar view showing the controlling apparatus rendered operative under different circumstances.

Referring to the drawings it will be noted that the pumping motor 11, which is shown as of the type disclosed in my copending application Serial No. 612,538, filed May 20, 1932, issued as Patent No. 2,004,146, June 11, 1935, is supported in a suitable manner from a tower 12 of structural steel or the like. The motor 11 has an automatic inlet valve mechanism 13 and an automatic discharge valve mechanism 14. Motive fluid is supplied from a central compressor system (not shown) through a pipe 15, passes through a preheater 16, through a manually controllable stop valve 17, and a line 18 into a valve casing 19 where a valve 20 is arranged for control by automatic mechanism hereinafter described; and from the casing 19 the air is conducted through another stop valve 21 to the admission valve mechanism 13. The admission valve mechanism comprises a valve member 22 whose position is controlled by the conjoint action of a spring 23 and a piston mechanism 25, to different surfaces upon which piston fluid is supplied under control of the motor piston 26 through connections 27 and 28 as more fully described in my copending application mentioned above. It will suffice to say for the purposes of this application that after fluid has been supplied through both the connection 27 and the connection 28, the admission valve 22 will be closed unless there be some derangement of the mechanism. The working fluid flows past the valve 22 into the motor cylinder 30 in which the piston 26 just mentioned reciprocates, and is normally discharged from the cylinder 30 at the designed time to an exhaust line 31 under the

control of an exhaust valve 32 having a controlling piston mechanism 33 and moved to opened position when fluid has been supplied through both of two control lines 34 and 35, as described in my copending application referred to above. The piston 26 is connected through a piston rod 37 and a rod line 38 with pumping mechanism (not shown) and is adapted to move upwards during normal operation to a point in its cylinder just above the point of communication with the bore of the cylinder of the pipe 35. Should the packings of the pump plunger blow out or should the pump rod break, means is provided for cushioning the movements of the piston 26 including a dash pot mechanism in the form of an extension of the cylinder and permitting a restricted discharge of the fluid above the piston, as through one or more ports 39.

Now referring more particularly to the control valve mechanism, and more particularly still to the apparatus for controlling the position of the valve 20, it will be observed that this valve is adapted to cooperate with a seat 41 and that it closes in the direction of flow of the fluid supplied to the pumping motor. The valve 20 has a valve rod 42 by means of which it can be raised to open position, and which is connected to a plunger 43 which is adapted to close the valve when fluid pressure is admitted to the upper side thereof. The valve is normally maintained open by the small unbalanced pressure produced by the action of the fluid in the supply line upon an area equal to the cross sectional area of the rod 42. The plunger 43 is reciprocable in and has a close but not tight fit with a cylinder 44, which is supported above and in line with the valve member 20. Fluid may be supplied to act upon the plunger 43 to effect closing of the valve 20 whenever the piston 26 substantially over-travels (as would occur if the rod line broke) and enters the cushion at the upper end of the cylinder 30. A suitable pipe connection 46 having a check valve 47 to prevent flow except from the top end of the cylinder 30 toward the cylinder 44 is provided to supply the actuating fluid to the piston 43 to effect downward movement thereof and closure of the valve 20. Fig. 4 shows the stop valve closed as a result of over-travel of the motor piston 26.

There is also provided another controlling mechanism for supplying fluid pressure to the piston 43 in the event of derangement of the pumping motor, of a character which will shortly be described in detail. A T 48 in the connection 46 has one of its openings connected by a pipe 49 with a valve casing 50 in which a valve 51 is arranged to control the flow from a connection 52 at the motor side of the valve seat 41 to the cylinder 44. A stop valve 54 is arranged in the connection 52 and can be closed to discontinue fluid supply to the cylinder 44. Obviously, however, when the valve 51 is closed, even if the valve 54 is open, no fluid will flow from the connection 18 to the piston 43. The valve 51 is connected to a diaphragm 55 arranged at the lower end of a chamber 56 of substantial size. This chamber is provided with a bleeder valve 57 to permit controlled venting of the fluid therefrom and receives fluid periodically through a passage 58 connected with the line 35 leading to the exhaust valve of the pumping motor. Obviously each time that the piston 26, in its upward travel, uncovers the upper end of the passage 35, fluid will be supplied to the passage 58, and a check valve 59 is provided in this passage to prevent reverse flow from the chamber to the line 35. The bleeder valve 57 is adjusted in such manner as to preclude venting of the fluid admitted to the chamber 56 at a rate sufficient to lower the pressure therein below that necessary to maintain the valve 51 closed, during normal pumping operation. Should, however, the motor fail for any reason to admit fluid to the passage 35 with the normal frequency and duration, then, obviously, the bleeder valve 57 will reduce the pressure within the chamber 56 and allow the pressure fluid from the supply line which has passed the valve 20 and is acting upon the lower end of the end seating valve 51 to lift the latter and flow through the connection 49 to the top of the piston 43 and close the automatic shut off valve 20. The resulting condition is illustrated in Fig. 5. Obviously the valve 51 is kept closed so long as the pressure in chamber 56 is at or above a predetermined value.

There are various contingencies which might set in operation this last described automatic closing of the shut off valve. It may be said that any abnormal occurrence which might result in a simultaneous open position of both the admission and exhaust valves of the motor would result in the piston 26 not assuming a position to readmit to connection 35, and thereby the longer-interrupted flow to chamber 56 would permit bleeding of the fluid to allow opening of valve 51.

Suppose for example that the admission valve spring broke. Then the valve 22 would not close before the exhaust valve opened and the piston 26 moved down to a position to cut off supply to line 35. Again, suppose that the exhaust valve stuck open with the piston 26 nearing the lower end of the cylinder. In each case fluid would blow straight through the motor, and closing of the valve 20 would be very important.

From the foregoing description it will be clear that I have provided improved automatic shut down means operative to protect the system against derangements either of motor, pump, or motor-pump connections. After repairs, valve 20 can be easily opened by the means provided, by closing valve 17 and awaiting leakage away of the small amount of fluid beyond it, or a vent valve for the line between valves 17 and 20 may be provided, or, again, valve 20 may itself provide a small leak port, inadequate to permit substantial loss of air with valve 20 closed, but permitting the pressure to drop when valve 17 is closed.

While there is in this application specifically described one form which the invention may assume in practice it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In combination, a motor, a supply line therefor, and means for closing said supply line upon predetermined deviation from its normal operating cycle by said motor including a stop valve in said supply line, means operative on supply of operating medium thereto for closing said stop valve, operating medium supply means for said stop valve closing means, pressure fluid controlled controlling means for said operating medium supply means operative when subjected to a predetermined pressure to preclude operating me-

dium supply, and means for periodically supplying pressure fluid to said pressure fluid controlled controlling means during motor operation at a rate varying with the operation of the motor.

2. In combination, a motor, a supply line therefor, and means for closing said supply line upon predetermined deviation from its normal operating cycle by said motor including a stop valve in said supply line, means operative on supply of operating medium thereto for closing said stop valve, operating medium supply means for said stop valve closing means, and means for precluding operating medium supply to said stop valve closing means except upon such predetermined deviation by said motor and for thereupon effecting such supply including pressure fluid controlled controlling means for said operating medium supply means, means for periodically supplying pressure fluid to said pressure fluid controlled controlling means during motor operation at a rate varying with the operation of the motor, and means for bleeding pressure from said pressure fluid controlled controlling means.

3. A motor, a supply line therefor, and means for closing said supply line upon predetermined deviation from its normal operating cycle by said motor including a stop valve in said supply line, and means for rendering said closing means effective including means for controlling supply of operating medium to said closing means, governed by operation of said pumping motor and wholly precluding such supply during normal pumping motor operation, said last mentioned means including a periodic fluid supply means.

4. A motor, a supply line therefor, and means for closing said supply line upon predetermined deviation from its normal operating cycle by said motor including a stop valve in said supply line, closing means therefor operable on supply of an operating medium thereto, and means for rendering said closing means effective including means for controlling supply of operating medium to said closing means governed by operation of said pumping motor and precluding such supply during normal pumping motor operation and further including a reservoir the pressure conditions within which control such supply, and means, one intermittent and the other continuous, for supplying and venting fluid with respect to said reservoir.

5. A motor, a supply line therefor, a stop valve for said line, actuating means for said valve, means for controlling supply of operating medium to said actuating means, and controlling means for said first mentioned controlling means including a fluid moved member controlling the same, means dependent on motor operation for supplying fluid to act on said member, and means for continuously venting the fluid supplied, at a controlled rate.

6. In combination, a motor, a supply line therefor, a stop valve for said supply line, said motor having a piston and fluid distribution means including at least one fluid actuated distribution valve, and means for actuating said stop valve to closed position in the event of concurrence of admission and exhaust, governed by fluid supplied with the actuating fluid for said distribution valve.

7. In combination, a motor, a supply line therefor, a stop valve for said supply line, said motor having a piston and fluid distribution means including at least one fluid actuated distribution valve, and means for actuating said stop valve to closed position having controlling means governed by fluid supplied with the actuating fluid for said distribution valve and determined in its controlling function by the rate of such fluid supply.

8. In combination, a motor having a piston and distributing means including a valve having a piston controlled actuating-fluid supply passage, a fluid supply line for said motor, a stop valve therefor, and means automatically maintained stationary in inoperative position during normal motor operation for closing the same automatically either on substantial overtravel of said piston, or on decreased frequency of admission to said valve-actuating fluid supply passage.

9. In combination, a motor having a piston, a fluid supply line leading to said motor, a stop valve therein, and means automatically maintained stationary in inoperative position during normal motor operation for automatically closing said valve either upon excess travel, or upon incomplete travel, of said piston.

10. In combination, a motor having a piston, a fluid supply line leading to said motor, a stop valve therein, and fluid pressure actuated means for automatically closing said valve upon excess travel, or upon incomplete travel of said piston, said fluid pressure actuated means having for said different operations different sources of operating pressure.

11. In combination, a motor, a supply line therefor, a stop valve for said supply line, said motor having a piston and fluid distributing means including at least one piston-controlled fluid actuated distribution valve, and means for actuating said stop valve to closed position in the event of the passage of fluid past the same at an excessive rate, governed by fluid supplied with the actuating fluid for said distribution valve.

12. In combination, a motor, a supply line therefor, a stop valve for said supply line, said motor having a piston and fluid distributing means including at least one piston-controlled fluid-actuated distributing valve, and means for actuating said stop valve to closed position having controlling means governed by fluid supplied with the actuating fluid for said distributing valve, and precluding stop-valve actuation only during normal motor operation.

13. In combination, a motor, a supply line therefor, a stop valve for said supply line, said motor having a piston and motive fluid distributing means including at least one fluid actuated distribution valve, and means for actuating said stop valve to closed position upon predetermined deviation from its normal operating cycle by said motor, governed by fluid supplied with the actuating fluid for said distribution valve and including means dependent upon a predetermined rate of operation of said pumping motor for precluding closure of said stop valve.

14. In combination, a motor, a supply line therefor, a stop valve for said supply line, said motor having a piston and motive fluid distributing means including at least one fluid actuated distribution valve, and means governed by fluid motor having a piston and motive fluid distributbution valve for closing said stop valve upon incomplete travel of said piston.

15. In combination, a motor, a supply line therefor, a stop valve for said supply line normally held stationary in open position during normal motor operation, said motor having a piston and motive fluid distributing means including at least one fluid actuated distribution valve, and means for actuating said stop valve

to closed position governed and normally maintained inactive by fluid supplied once in each cycle of motor operation and operative upon a predetermined variation in the net rate of such fluid supply to cause stop valve closure.

16. In combination, a motor, a supply line therefor, a stop valve for said supply line, said motor having a piston and motive fluid distributing means including at least one fluid-actuated distribution valve, and means for actuating said stop valve to closed position including controlling means supplied with fluid once in each cycle of motor operation and ineffective to cause stop valve closure while the mean rate of fluid supply thereto exceeds a certain value but effective after such fluid supply rate falls below such value.

17. In combination, a motor, a supply line therefor, a stop valve for said line, and means for automatically effecting closure of said stop valve upon predetermined deviation of said motor from its normal cycle, including a pressure-fluid-movable member, means for supplying fluid to the same at a rate dependent on the rate of motor operation, and means for venting the fluid supplied, at a controlled rate.

18. In combination, a single-acting motor having fluid distribution means effective to maintain the same normally continuously operative as long as fluid supply thereto is maintained, a supply line therefor, and means for closing said supply line upon a predetermined abnormality in the working stroke of said motor including a stop valve in said supply line, closing means therefor operative upon supply of operating medium thereto, and means for rendering said closing means effective including means for controlling supply of operating medium to said closing means precluding supply except upon such predetermined abnormality and governed by operation of said pumping motor and dependent upon operation of said motor at at least a predetermined rate to preclude operation of said closing means.

19. In combination, a single-acting motor having fluid distribution means effective to maintain the same normally continuously operative as long as fluid supply thereto is maintained, a supply line therefor, and means for closing said supply line upon occurrence of a predetermined abnormality in the working stroke of said motor including a stop valve in said supply line, closing means therefor operative upon supply of operating medium thereto, and means for rendering said closing means effective including means for controlling supply of operating medium to said closing means governed by operation of said pumping motor during normal operation thereof and precluding such supply during normal pumping motor operation.

20. In combination, a motor, a supply line therefor, a stop valve for said line, and means for automatically effecting closure of said stop valve upon predetermined deviation of said motor from its normal cycle including a pressure-fluid-movable member and means, one intermittent and the other continuous, for supplying and venting fluid with respect to said member.

21. In combination, a motor having a piston and fluid distribution means effective automatically upon operating-fluid supply to maintain said motor in continuous operation, a fluid supply line leading to said motor, a stop valve therein held stationary during normal motor operation, and means for automatically closing said valve upon incomplete travel of said piston, including a fluid-operated device and means for automatically energizing the same on such incomplete travel of the piston.

22. In combination, a motor, a supply line therefor, and means for closing said supply line upon predetermined deviation from its normal operating cycle by said motor including a stop valve in said supply line, means operative on supply of operating medium thereto for closing said stop valve, means for supplying operating medium to said stop valve closing means, and controlling means for said operating medium supply means including a device operative in one position to preclude operating medium supply, and means for maintaining it in such position during normal motor operation including a fluid operated holding member therefor, means for supplying pressure fluid to said holding member once during each cycle of the motor, and means for bleeding away the pressure fluid so supplied at a controlled rate.

23. In combination, a motor having a piston, a supply line therefor, and means for closing said supply line upon predetermined deviation from its normal operating cycle by said motor including a stop valve in said supply line, means operative on supply of operating medium thereto for closing said stop valve, means for supplying operating medium to said stop valve closing means upon over-travel of said motor piston, and controlling means for said operating medium supply means including a device operative in one position to preclude operating medium supply, and means for maintaining it in such position during normal motor operation including a fluid operated holding member therefor, means for supplying pressure fluid to said fluid operated member once during each cycle of the motor, and means for bleeding away the pressure fluid so supplied at a controlled rate.

24. In combination, a motor having a piston and distributing means including a valve having a piston controlled actuating fluid supply passage, a fluid supply line for said motor, a stop valve therefor, and means operable by pressure fluid flowing through said fluid supply passage and automatically maintained stationary in inoperative position during normal motor operation for closing said stop valve automatically either on substantial overtravel of said piston, or on decreased frequency of admission to said valve actuating fluid supply passage.

25. In combination, a motor having a piston and means for providing a cushion pressure upon an excess rate of piston travel, a fluid supply line leading to said motor, a stop valve therein, and fluid pressure actuated means operable alternatively by line and cushion pressures and having motor-piston-controlled controlling means for automatically closing said valve upon excess travel, or upon incomplete travel of said piston.

26. In combination, an expansible chamber motor, a supply line therefor and means for closing said supply line upon predetermined deviation from its normal operating cycle by said motor including a stop valve in said supply line, controlling means for said stop valve, and means for controlling said stop valve controlling means to cause the latter to maintain said stop valve open during normal motor operation but to cause closure thereof upon predetermined deviation from its normal operating cycle by said motor including a device operative when subjected to a predetermined fluid pressure to preclude said controlling means from causing stop valve closure, and means for maintaining such a pressure on said device

during normal motor operation but not on the predetermined deviation from its normal operation by said motor including pressure fluid supply means for said device effective once in each cycle of the motor and means for bleeding away the pressure fluid so supplied at a controlled rate inadequate to reduce the pressure below said predetermined value during normal motor operation but sufficient to reduce the pressure below said predetermined value upon the predetermined deviation specified.

27. A motor having a cylinder, a piston, and distribution means including independent admission and exhaust valves, a supply line for said motor, a valve in said supply line, actuating means for said valve for closing the same, and controlling means for said actuating means including means effective during normal motor operation for precluding operation of said valve actuating means to move said valve in a closing direction but operative upon interruption of normal motor operation resulting in concurrent admission to and exhaust from one end of said cylinder to cause said valve actuating means to become effective to close said valve.

WADE H. WINEMAN.

CERTIFICATE OF CORRECTION.

Patent No. 2,098,122. November 2, 1937.

WADE H. WINEMAN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 66, claim 14, for the words "motor having a piston and motive fluid" read supplied with the actuating fluid for said; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of December, A. D. 1937.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.

during normal motor operation but not on the predetermined deviation from its normal operation by said motor including pressure fluid supply means for said device effective once in each cycle of the motor and means for bleeding away the pressure fluid so supplied at a controlled rate inadequate to reduce the pressure below said predetermined value during normal motor operation but sufficient to reduce the pressure below said predetermined value upon the predetermined deviation specified.

27. A motor having a cylinder, a piston, and distribution means including independent admission and exhaust valves, a supply line for said motor, a valve in said supply line, actuating means for said valve for closing the same, and controlling means for said actuating means including means effective during normal motor operation for precluding operation of said valve actuating means to move said valve in a closing direction but operative upon interruption of normal motor operation resulting in concurrent admission to and exhaust from one end of said cylinder to cause said valve actuating means to become effective to close said valve.

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