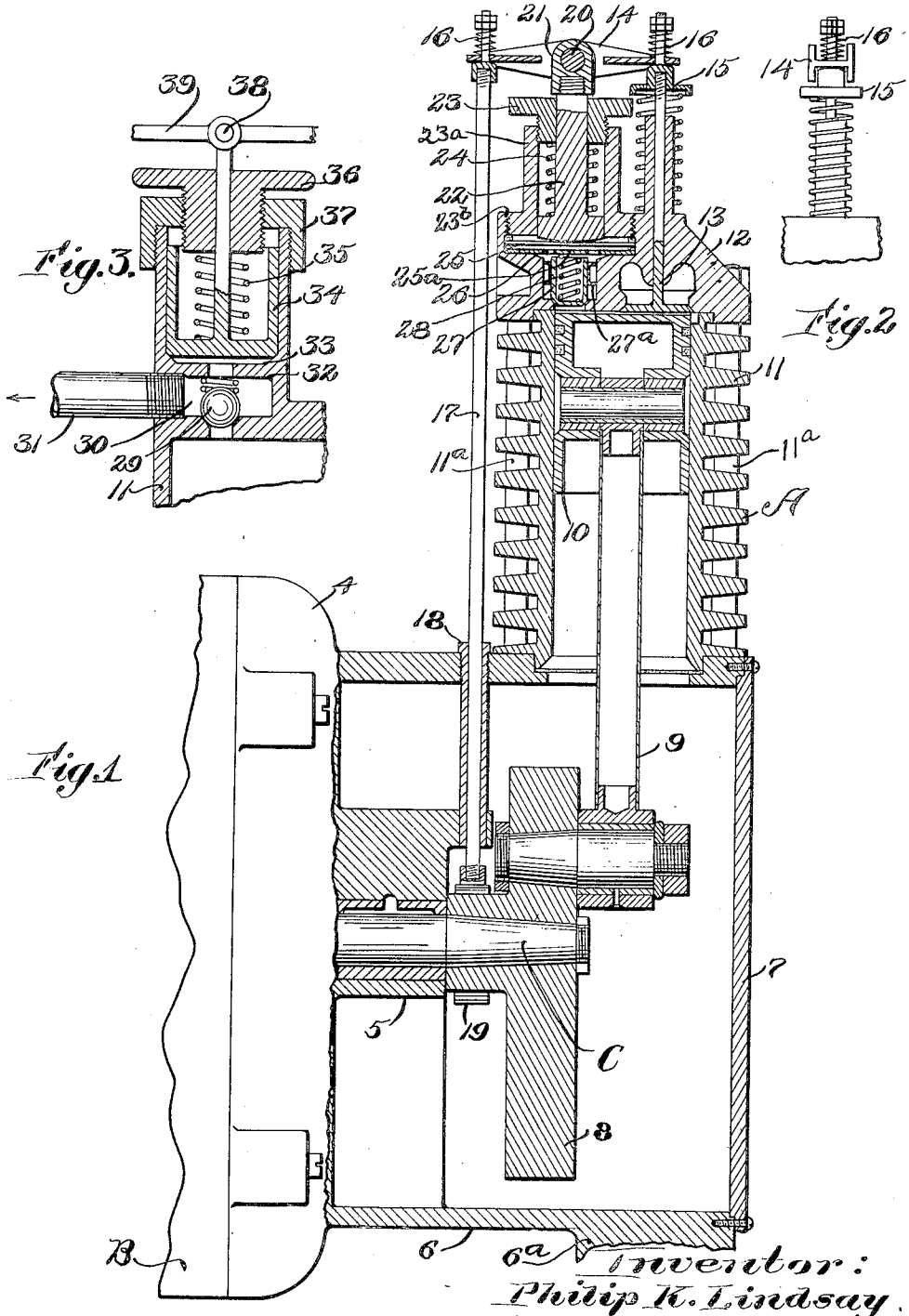
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AUTOMATIC CONTROL FOR PUMPS AND THE LIKE

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AUTOMATIC CONTROL FOR PUMPS AND THE LIKE.

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To all whom it may concern:

Be it known that I, PHILIP K. LINDSAY, citizen of the United States of America, and resident of West Somerville, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in Automatic Controls for Pumps and the like, of which the following is a specification.

This invention relates to fluid pumps and in particular to an improved method and apparatus for automatically controlling or regulating the volumetric efficiency of such pumps. While of general application it is especially adapted to small portable high speed outfits.

Objects of the invention are to regulate fluid pumps by varying the amount of opening of the inlet, to control the amount of opening of the inlet by fluid conditions outside of the pump, to accomplish the above objects automatically, to produce a pump structure which can be assembled directly upon a power source such as an electric motor, and in general to improve, simplify and make more reliable devices of this character.

In its broad aspect the invention comprises regulating the supply of fluid to the pump by fluid conditions outside the pump such as the positive pressure developed by a compressor or the negative pressure produced by a suction pump. In a more specific aspect it comprises varying the extent of opening of the intake valve of a fluid pump. This may be accomplished automatically by varying the operative relation of the valve and the actuating mechanism therefor as by shifting the position of the member which positively operates the valve or which limits the opening of suction operated valve. Suitable means acted upon by the discharge pressure of the pump (or pressure at some point in a system of which the pump forms a part), such as a piston or diaphragm, is utilized to shift the valve operating or controlling member. The invention further comprises a special end plate for electric motors, to be substituted for the usual end bell, which has assembled thereon the complete pump mechanism, so that the pump may be mounted directly upon the motor with the motor shaft serving as the pump shaft.

In order to illustrate the invention, one concrete embodiment thereof is shown in the accompanying drawings, in which,—

Figure 1 is a vertical section of a fluid pump embodying the features of the invention;

Figure 2 is a front elevation of the upper part of said pump; and

Figure 3 is a vertical section of a modification.

The particular embodiment of the invention shown for the purpose of illustration comprises an air compressor A connected directly to an electric motor B running at a constant speed. The connection is made by means of a special end plate 4, substituted for the regular end bell, which has integral therewith a bearing projection 5 for the shaft C of the motor and a crank casing and base 6 upon which is provided a removable plate 7 for assembling a counterweighted crank disk 8 upon motor shaft C. A support 6^a is preferably provided upon base 6. To disk 8 is pivotally attached pitman 9 which reciprocates piston 10 in pump cylinder 11, the latter being provided with the usual air cooling fins and held fast on base 6 by means of studs 11^a.

Mounted in the cylinder head 12 are the controlling elements for inlet valve 13 which comprise the essential parts of the invention. Spring-pressed valve 13 is positively actuated through rocker 14, having one arm held in yielding contact with stop 15 on the end of the valve stem by means of spring arrangement 16 on a spindle extending upwardly from stop 15 through a hole in the rocker arm. The other arm of rocker 14 is held by a similar spindle and spring arrangement 16 in contact with a push rod 17 reciprocated in a guide 18, extending within casing 6, by means of cam 19 on the reduced axial portion of the crank disk 8. Rocker 14 is pivoted at 20 to a nut 21 attached to actuator 22 slidably mounted in cap nut 23 which has threaded engagement with annular projection 23^a for adjustably tensioning spring 24 to press downwardly against the head of actuator 22. The lower end of actuator 22 is in contact with a diaphragm 25 mounted in a recess 26 in the cylinder head into which the compressed fluid is forced by a piston 10 through the opening closed normally by check valve 27, slidable between guide ribs 27^a, the spring 28 of which bears against perforated stop

plate 25ª as an abutment. Projection 23ª has threaded engagement at 23ᵇ with cylinder head 12 to permit the insertion of check valve 27 and diaphragm 25 within the cylinder head. In the modified form shown in Fig. 3, the compressed fluid from the cylinder 11 enters into the cylinder head by displacing ball check valve 29. From the chamber 30 in the cylinder head pipe 31 leads to a reservoir for the fluid and another opening 32 leads into a chamber 33 containing a piston 34 normally held by spring 35 in sealing contact with the beveled lower sides of chamber 33. The tension of spring 35 is regulated by a nut 36 screw threaded in an opening in cap 37 closing the top of chamber 33. An axial rod integral with piston 34 extends through the axial opening in adjusting nut 36, the top of the rod having a pivot 38 on which is mounted rocker 39 to be connected to an outlet valve after the manner disclosed in Fig. 1.

The operation of the device is as follows:

The motor operates at constant speed. The fluid taken in through valve 13 is compressed by piston 10, forced out past check valve 27 or 29 and into cylinder head chamber 26 or 30. When the built-up pressure exceeds the amount predetermined by the adjustment of the tension of springs 24 or 35, diaphragm 25 or piston 34 is displaced upwardly lifting pivot 20 or 38 of rocker 14 or 39. As the rocker arm pivot is raised, the positive throw of inlet valve 13 is gradually decreased and eventually ceases altogether. In other words, discharge pressure of the pump in excess of spring pressure on the actuator or piston raises the rocker arm and so reduces the lift of the inlet valve. By adjusting the tension of the actuator or piston springs 24 and 35, it is possible to set the compressor to deliver fluid at any predetermined pressure, the unloading of the motor taking place between demands by the closing of the inlet valve.

By proper proportioning of these springs it is also possible to cause the inlet opening to vary inversely with the pressure so that the compressor will maintain a constant power consumption under varying pressures and hence large capacity can be obtained at low pressures without overloading the motor as the pressure is increased.

This invention is also applicable to other mechanism having a pumping action in which the charge is drawn in by suction, such as internal combustion engines.

I claim:—

1. In a pump of the type having a positively actuated valve means for regulating the pressure in the pump, said means adjusting the movement of the valve in response to the difference of pressure between the interior and exterior thereof.

2. In a pump of the type having a valve and mechanical connections for operating the valve in timed relation with the driving mechanism for the pump, means for controlling the pressure in the pump which comprises means for varying the operative relationship between the mechanical connections and the valve in response to variations in pressure between the interior and the exterior of the pump.

3. In a fluid pump of the type having a valve and means mechanically operated in timed relation with the pump for actuating the valve, means for regulating the pressure built up by said pump which comprises means for adjusting the operative range of said mechanically operated means relative to the valve in response to variations in fluid pressure built up by the pump as compared with fluid pressure outside the pump.

4. A pump of the type having a valve for controlling the flow of fluid between the interior and the exterior thereof and mechanical connections for operating the valve in timed relation with the pump, which comprises means for varying the operative relationship between said connections and said valve positively to limit the throw of the valve in response to fluid conditions outside of the pump.

5. A pump of the type having a valve for controlling the flow of fluid between the interior and the exterior thereof and mechanism for actuating the valve in timed relation with the pump, which comprises means for adjusting the operative range of said mechanism positively to vary the throw of the valve in response to changing fluid conditions outside of the pump, said means operating automatically.

6. A pump of the type having a valve for controlling the flow of fluid between the interior and exterior thereof and mechanism for actuating the valve in timed relation with the pump, which comprises means for reducing the effective range of said mechanism thereby positively to reduce the throw of the valve as fluid conditions outside of the pump approach a predetermined condition.

7. In a fluid pump or the like having a positively operated valve, a member for actuating said valve, and means responsive to fluid conditions outside said pump for changing the location of said member whereby the throw of said valve is varied.

8. In a fluid pump or the like having a positively operated valve, an arm for actuating said valve, a movable member to which said arm is pivoted, and means automatically responsive to fluid conditions outside said pump for moving said member whereby the throw of said valve is varied.

9. Control mechanism for fluid pumps and the like comprising a valve for regulating the supply of fluid and means for au-

tomatically varying the opening of said valve in response to the fluid pressure built up by the pump.

10. Control mechanism for fluid pumps and the like having a positively operated valve comprising a spring pressed member, means subjecting said member to the fluid pressure built up by the pump, and means connecting said member to the valve operating mechanism whereby movement of the member varies the throw of the valve.

11. Control mechanism for fluid pumps and the like having a positively operated valve comprising a spring pressed member, means for adjusting the spring pressure on the member, means subjecting said member to the fluid pressure built up by the pump, and means connecting said member to the valve operating mechanism whereby movement of the member varies the throw of the valve.

12. Control mechanism for fluid pumps and the like having a positively operated valve comprising a spring pressed member, means for adjusting the spring pressure on the member, means subjecting said member to the fluid pressure built up by the pump, and means connecting said member to the valve operating mechanism comprising a rocker pivoted to said member whereby movement of the member automatically varies the throw of the valve.

13. Control mechanism for fluid pumps and the like having a positively operated valve comprising a movable member, a spring for moving said member in one direction, a diaphragm for moving said member against said spring under the impulse of fluid pressure received from the pump, and a member attached to said first named member and connected to said valve whereby movement of said first named member changes the throw of said valve.

14. The combination with a fluid pressure pump or the like of control mechanism therefor including parallel guides, a valve stem slidable in one of the guides and bearing a control valve, a fulcrum bearing member slidable in the other guide, positive operating mechanism for the valve carried by said fulcrum member and pressure connections between the pump and fulcrum bearing member to vary the position of the fulcrum and operation of the valve.

15. The combination with a fluid pump or the like of control mechanism therefor including an inlet valve, an actuating mechanism for the inlet valve including a shiftable fulcrum, resilient means for normally holding the fulcrum in adjusted position, and pressure actuated means for overcoming the resilient force to vary the operative position of the valve actuating means proportionate to the pressure developed.

16. The combination with a fluid pump or the like of control mechanism therefor including an inlet valve, an actuating mechanism for the inlet valve including a shiftable fulcrum, resilient means for normally holding the fulcrum in adjusted position, pressure actuated means for overcoming the resilient force to vary the operative position of the valve actuating means proportionate to the pressure developed, and means for varying the tensile force of said resilient means.

17. The combination with a fluid pump or the like having a positively actuable inlet valve of means for varying the opening movement of said valve, said means including a pressure shiftable plunger bearing a fulcrum, a rock lever swinging on the fulcrum and means for actuating the lever.

18. The combination with a fluid pump or the like having a positively actuable inlet valve of means for varying the opening movement of said valve, said means including a pressure shiftable plunger bearing a fulcrum, a rock lever swinging on the fulcrum, means for actuating the lever, and means for varying the resistance of the plunger and fulcrum to such pressure shifting movement.

19. The combination with a fluid pump or the like having a valve, of positive actuating means for the valve, a pressure chamber and valve operating means operatively associated with said chamber whereby excess of pressure in the chamber proportionately shifts the valve operating mechanism into inoperative position.

20. A mechanism of the character described including a pump cylinder, a piston and a valve actuating tappet, means for operatively shifting the pump piston and the tappet, a normally closed inlet valve for the pump and an intermediately pivoted rock lever operatively connecting the valve and tappet for actuation of the former, a pressure chamber in communication with the pump, and means actuated by pressure generated in the pump for shifting the rock lever fulcrum to vary the actuation of the valve proportionate to the increase of pressure in the pressure chamber.

21. A mechanism of the character described including a pump cylinder, a piston and a valve actuating tappet, means for operatively shifting the pump piston and the tappet, a normally closed inlet valve for the pump and an intermediately pivoted rock lever operatively connecting the valve and tappet for actuation of the former, a pressure chamber in communication with the pump, means actuated by pressure generated in the pump for shifting the rock lever fulcrum to vary the actuation of the valve proportionate to the increase of pressure in the pressure chamber, said pressure actuated means including a reciprocating plunger

and connections between the plunger and the fulcrum.

22. A mechanism of the character described including a pump cylinder, a piston and a valve actuating tappet, means for operatively shifting the pump piston and the tappet, a normally closed inlet valve for the pump and an intermediately pivoted rock lever operatively connecting the valve and tappet for actuation of the former, a pressure chamber in communication with the pump, and means actuated by pressure generated in the pump for shifting the rock lever fulcrum to vary the actuation of the valve proportionate to the increase of pressure in the pressure chamber, said pressure controlled means including a plunger, pressure actuated in one direction and operatively connected with the fulcrum and a compression spring opposing the movement of the plunger.

23. A mechanism of the character described including a pump cylinder, a piston and a valve actuating tappet, means for operatively shifting the pump piston and the tappet, a normally closed inlet valve for the pump and an intermediately pivoted rock lever operatively connecting the valve and tappet for actuation of the former, a pressure chamber in communication with the pump, and means actuated by pressure generated in the pump for shifting the rock lever fulcrum to vary the actuation of the valve proportionate to the increase of pressure in the pressure chamber, said pressure controlled means including a plunger, pressure actuated in one direction and operatively connected with the fulcrum, a compression spring opposing the movement of the plunger, and means for varying the compression of the spring to regulate the yielding movement of the plunger produced by said pressure.

Signed by me at Boston, Mass., this 27th day of October, 1921.

PHILIP K. LINDSAY.