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L. J. CLAPP

COMPRESSOR CONTROLLING MECHANISM

Filed Oct. 7, 1918

2 Sheets-Sheet 1.

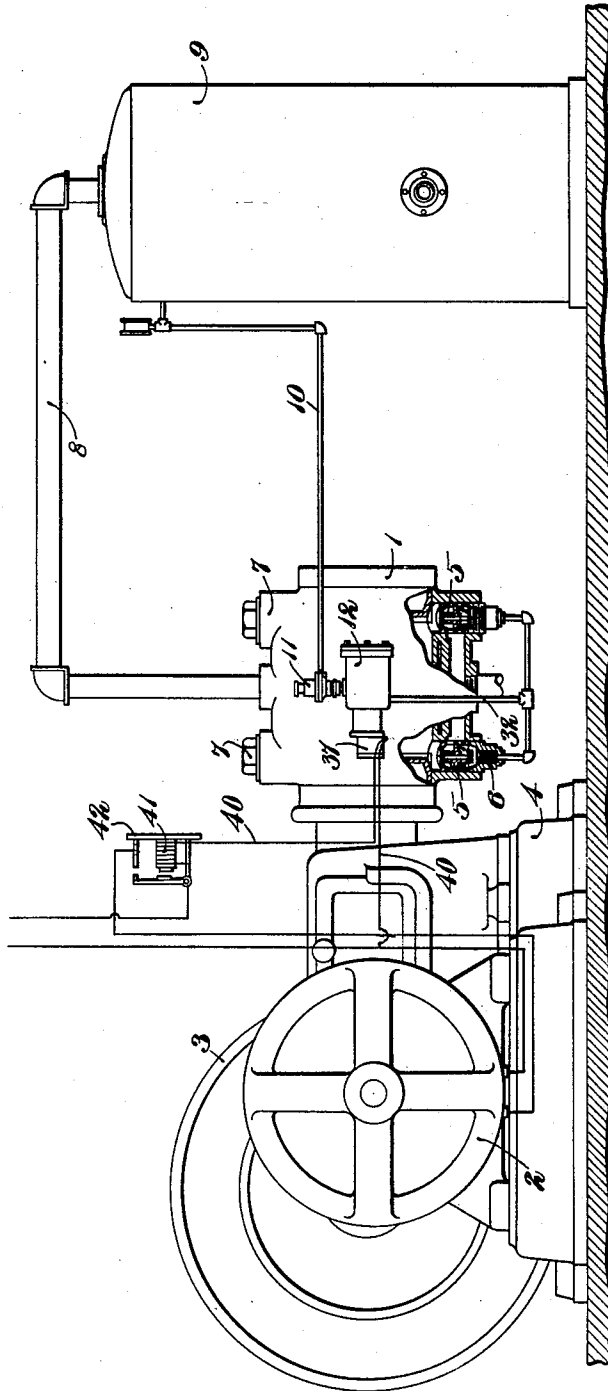


Fig. 1.

Inventor:
Lewis J. Clapp.
by *Arthur L. Talbot*
att'y.

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2 Sheets-Sheet 2

Fig. 2.

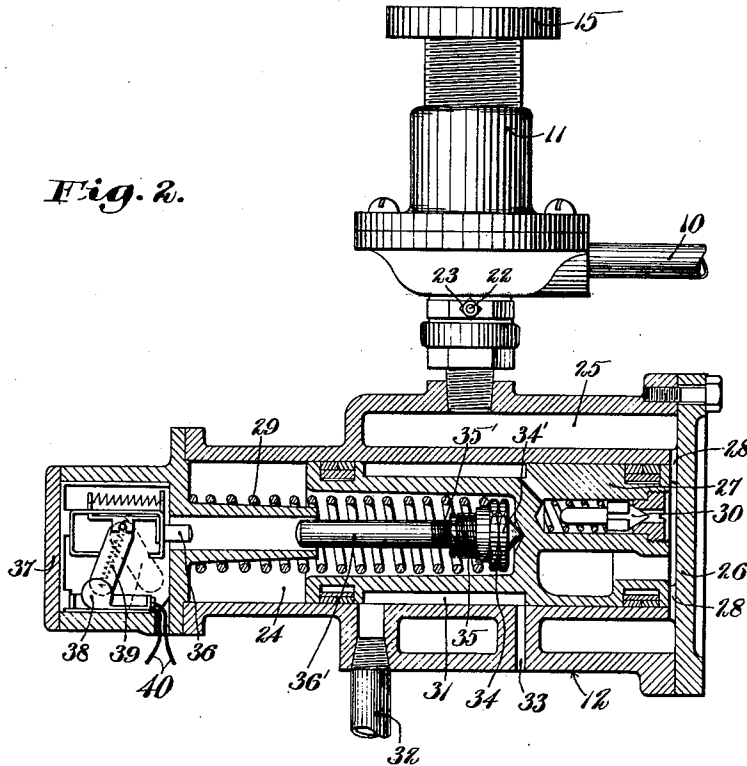
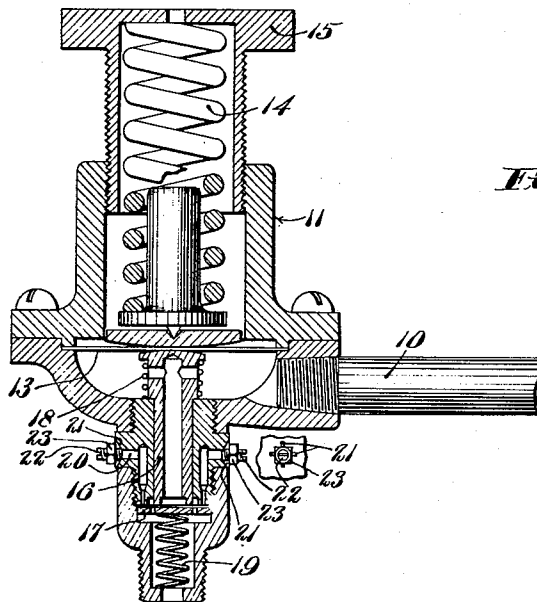


Fig. 3.



Inventor:
Lewis J. Clapp.
by
Arthur L. Abner.
Atty.

UNITED STATES PATENT OFFICE.

LEWIS JOSEPH CLAPP, OF CLAREMONT, NEW HAMPSHIRE, ASSIGNOR TO SULLIVAN MACHINERY COMPANY, A CORPORATION OF MASSACHUSETTS.

COMPRESSOR-CONTROLLING MECHANISM.

Application filed October 7, 1918. Serial No. 257,135.

To all whom it may concern:

Be it known that I, LEWIS J. CLAPP, a citizen of the United States, residing at Claremont, in the county of Sullivan and State of New Hampshire, have invented certain new and useful Improvements in Compressor-Controlling Mechanism, of which the following is a full, clear, and exact specification.

This invention relates to compressor unloading mechanism, and more particularly to a compressor unloading mechanism which is adapted not only to load and unload a compressor according to the variations in the terminal pressure, but a so to unload the compressor during the starting period of the motor which drives the compressor. When using electric motors for driving compressors, if the motor is started with a full load on the compressor, several times the normal amount of current is required during the starting period in order to get the motor up to speed, or the motor will not have sufficient power to start the compressor under this load. It is one object of this invention to devise means for unloading the compressor by terminal pressure and for unloading the compressor during the starting period of the motor, the unloading controlling mechanism operating to stop the motor when the compressor has been unloaded for a predetermined length of time.

My invention will be best understood by reference to the illustrative embodiment thereof shown in the accompanying drawings, and will be more particularly pointed out in the appended claims.

In the drawings,—

Fig. 1 is a side elevation of a compressor system having my improved controlling mechanism attached thereto.

Fig. 2 is a longitudinal section of the controlling means, parts thereof being shown in elevation.

Fig. 3 is a sectional view of an improved Judson valve.

Referring to the drawings, I have there shown, for the purpose of illustrating the principal features of the invention, a compressor system which includes a compressor

cylinder 1, a motor 2 which operates a piston in the cylinder 1, through the usual piston rod, crosshead, pitman, and crank shaft (not herein necessary to show), the latter carrying a flywheel 3, and being driven by the motor through suitable gearing, not shown, the whole being mounted on a single base 4. The cylinder 1 is provided with inlet valves 5, a common type of unloading mechanism 6, and exhaust valves 7 through which the air is forced to a pipe 8 which conducts the compressed fluid to a receiver 9. A small pipe 10 is interconnected between the receiver 9 and a Judson valve 11, the latter being mounted on my improved motor and unloader controlling valve 12.

The Judson valve 11 is, in general, of usual construction, as is shown in Fig. 3, and comprises a diaphragm 13, a compression spring 14, a regulating cap 15, and a plunger 16 adapted to be moved by the diaphragm against a disk 17. Springs 18 and 19 tend to move the plunger 16 and disk 17 upward against the action of the spring 14. When the receiver pressure overbalances the spring 14, the plunger 16 is raised out of contact with the disk 17, and the air under pressure passes through the plunger and perforations in the disk to the valve 12. As the receiver pressure falls, the plunger 16 again seats on the disk 17, and the air in the valve 12 is exhausted through the perforations in the disk 17 and suitable passageways to openings 20. These openings are provided with slots 21, screws 22 being threaded into the walls between the slots and acting as valves to govern the flow of air through the openings 20, the screws 22 being held in position by lock nuts 23.

The valve 12, which also constitutes a servo-motor as will hereinafter appear, (see Fig. 2) is composed of a centrally disposed cylinder 24 around which is an annular chamber 25 communicating with the Judson valve 11 and also communicating with the cylinder 24 through openings provided between the end of the cylinder wall and the cylinder head 26. A piston 27 slides in the cylinder 24 and is normally held to one end

thereof against bosses 28 formed on the head 26, by a spring 29. Mounted in the head of the piston is a check valve 30, of common construction, which permits a flow of air under pressure from the annular chamber 25 to an annular recess 31 formed on the piston, the annular recess 31 always being in communication with a pipe 32 which conducts the fluid under pressure to the unloading means 6, and being in communication with a small exhaust port 33 when the piston 27 is seated against the bosses 28. The spring 29 bears against a head 34 adjustably mounted on a sleeve 35, which also carries in adjustable relation therewith a stem 36'. Lock nuts 34', 35' are provided for holding these members 34, 36' in adjusted position. This stem 36' is adapted, when the piston is moved to the extreme left hand position, to contact with a pin 36 of a floor switch 37 of ordinary construction mounted on one end of the valve 12, and here shown diagrammatically as having contacts 38 and a bridge 39 for connecting the contacts, the bridge being operated by the pin 36 in a well known manner. The contacts 38 are connected with wires 40 which operate, through an electromagnet 41, the switch 42 which starts and stops the driving motor 2. The cylinder 24, piston 27, and associated parts constitute a servo-motor for controlling the switch 37. That is to say, these parts constitute an operating motor for the switch 37.

The operation is as follows: During the normal operation of the compressor, as the terminal pressure rises and passes a predetermined pressure, the Judson valve will operate and permit a flow of pressure fluid through the annular chamber 25 to the cylinder 24, where it acts on the piston to force it to the left against the action of the spring 29. It also forces the check valve 30 open and thus permits the compressed air to pass into the annular recess 31 through the pipe 32 to the unloading means to unload the compressor. The check valve 30 is normally held seated by a very light spring so that the compressed air is admitted to the unloading means before the piston 27 has been moved sufficiently to the left against the relatively strong spring 29 to bring the stem 36' into contact with the pin 36 to break the contact at 38 and so stop the motor. As the pressure in the receiver falls, the check valve 30 closes and the piston 27 moves to the right. Upon an initial movement of the piston, the pin 36 is released, the contact is made, and the motor is started. The movement of the piston to the right may be governed by regulating the escape of the pressure fluid from the cylinder and chamber 25 through the ports 20 by means of the valves or screws 22, so that the time interval between the closing of the

contact 38 and the connection of the pipe 32 with the exhaust port 33 may be made as long or as short an interval as may be desired. It will be noted that the chamber 25 constitutes a relatively large clearance volume for the cylinder 24 and so retards the fall in pressure in the cylinder. When the pipe 32 is connected to the port 33 through the recess 31, the air which has held the intake valves unseated is exhausted to the atmosphere and the compressor is again loaded.

The tension of the spring 29 is such that the terminal pressure will move the piston slowly to the left and, due to the regulation of the screws 22, the piston can move but slowly to the right, the result being that as the terminal pressure fluctuates a trifle above and below the normal receiver pressure, the piston will control the unloading and loading of the compressor without breaking the electrical contact to stop the motor. However, if the terminal pressure rises above the normal pressure desired and remains above normal for any appreciable length of time, the piston will move far enough to the left to break the electrical contact and stop the compressor. The movement necessary to bring the stem 36' into contact with the pin 36 may be regulated by an adjustment of the stem in the head which forms one abutment for the spring 29. It is essential to a proper unloading of the compressor that the pipe 10 connecting the receiver and unloader controlling valve shall be of sufficient size to prevent a rapid fall in pressure in the valve when the fluid under terminal pressure is admitted to the unloading mechanism.

Thus it is seen that I have devised a simple, inexpensive, and adjustable means for throwing the load off from a compressor before the compressor driving motor is stopped, for throwing the motor into operation again before the compressor is loaded, and for regulating the time which will elapse between the starting of the motor and the loading of the compressor.

While I have herein shown and described for purposes of illustration one specific form of my invention, it is to be understood that the same has been chosen for illustrative purposes only, and that extensive deviations may be made from the disclosed form thereof without departing from the spirit of the invention.

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

1. In a compressor unloading and motor controlling mechanism, adapted for use with a compressor system comprising a motor, a compressor, and an unloader therefor operative to discontinue the compressive action of the compressor, the combination including

means for automatically starting and stopping the motor, and means acting independently of said first named means for operating the unloader to unload the compressor.

2. In a compressor unloading and motor controlling mechanism, adapted for the control of a compressor system comprising a motor, a compressor having unloading means of the type adapted to discontinue the compressive action of the compressor, and a receiver receiving the discharge from the compressor, the combination including means for controlling the motor governed by the discharge pressure of the compressor, and means acting independently of the first named means for operating the unloader to unload the compressor.

3. In a controlling mechanism for a compressor system comprising a receiver, a motor, a compressor driven by said motor and discharging to the receiver, and an unloader for the compressor operative to discontinue the compressive action thereof, in combination, a compressor unloader and motor controlling mechanism responsive to receiver pressure and comprising means for controlling the motor, and means acting independently of the first mentioned means for operating the unloader to unload the compressor.

4. In a compressor system having a motor, a compressor and an unloader therefor, the combination including a switch for controlling the motor, means for operating the switch, and means carried by said first named means but acting independently thereof for operating the unloader to unload the compressor.

5. In a compressor system having a motor, a compressor and an unloader therefor, the combination including a fixed member, means carried thereby for controlling the motor and for controlling the unloader to load the compressor, and means acting independently of said first named means for controlling the same and the unloader to unload the compressor.

6. In a compressor system having a motor, a compressor and an unloader therefor, the combination including a fixed member, means carried thereby for controlling the motor and for controlling the unloader to load the compressor, and means acting independently of said motor controlling means but associated therewith for permitting a flow of pressure fluid to the unloader to unload the compressor.

7. In a compressor system having a compressor and an unloader therefor, the combination including a fixed member, means for admitting a fluid under terminal pressure to said member, and means associated with said member for permitting a flow of fluid only in a direction toward the unloader to unload the latter, said means being

subjected to pressure only after the normal terminal pressure is exceeded.

8. In a compressor system having a compressor and an unloader therefor, the combination including a fixed member, means for admitting a fluid under terminal pressure to said member and for exhausting fluid therefrom through a common port, and means associated with said member for permitting a flow of fluid only in a direction toward the unloader.

9. In a compressor system having a compressor and an unloader therefor, the combination including a fixed member, a movable member therein for controlling a flow of actuating fluid from the unloader, and means carried by said movable member and movable relative thereto for permitting a flow of fluid only in a direction toward the unloader to unload the latter.

10. In a compressor system having a compressor and an unloader therefor, the combination including a fixed member, means for admitting a fluid under pressure to said member, a movable member in said fixed member providing a passage to and controlling a flow of fluid from the unloader, and a check valve for permitting a flow of fluid only in a direction toward the unloader.

11. In a compressor system having a compressor and an unloader therefor, the combination including a fixed member, means for admitting a fluid under pressure to said member and for exhausting the fluid therefrom, a movable member in said fixed member for controlling a flow of fluid from the unloader, and means carried within said fixed member for permitting a flow of fluid only in a direction toward the unloader.

12. In a compressor system having a compressor and an unloader therefor, the combination including a fixed member, means for admitting a fluid under pressure to said member, a movable member in said fixed member for controlling a flow of fluid from the unloader, and means carried by said movable member for permitting a flow of fluid only in a direction toward the unloader.

13. In a compressor system having a compressor and an unloader therefor, the combination including a fixed member, compressor discharge pressure controlled means for admitting a fluid under pressure to said member and for exhausting the fluid therefrom, a movable member in said fixed member for controlling a flow of fluid from the unloader, and means carried by said movable member for permitting a flow of fluid only in a direction toward the unloader.

14. In a compressor system having a compressor and an unloader therefor, the combination including a cylinder, a chamber thereon communicating with the cylinder, a port associated with said cylinder, means

for regulating a flow of fluid to the chamber and to the cylinder, and means for exhausting fluid from the unloader through said port.

15 15. In a compressor system having a motor, a compressor and an unloader therefor, the combination comprising a fixed member, a movable member therein adapted to control the motor when said movable member is in one position and adapted to load
10 the compressor when in another position, and means acting independently of said movable member for controlling a flow of fluid toward said unloader.

15 16. In a compressor unloading mechanism, the combination including a member having an intake, an outlet, and an exhaust port, valve means for controlling a flow of fluid through the intake, and means separate
20 from said valve means for connecting the outlet with the exhaust port upon closure of the intake.

17. In a compressor unloading mechanism, the combination including a fixed
25 member, an electrical control mounted thereon, inlet, outlet, and exhaust ports formed in said member, and means carried by the fixed member for successively permitting a flow from inlet to outlet, operating the electrical control, reversing the operation of
30 the electrical control, and permitting a flow from outlet to exhaust.

18. In a compressor unloading mechanism, the combination including a fixed
35 member, an electrical control mounted thereon, a member movable in said fixed member and having adjustable means for engaging and positively actuating said electrical control, and adjustable means for
40 controlling the movement of the movable member.

19. In a compressor unloading mechanism, the combination including a fixed
45 member, an electrical control mounted thereon, an exhaust port in spaced relation to said electrical control, a movable member operative on opposite movements thereof respectively to close said exhaust and to
50 actuate said electrical control and to disengage said control and to open said exhaust port, and means for regulating the relative times of disengaging of the electrical control and opening of the exhaust port.

20. In a compressor unloading mechanism, the combination including a fixed
55 member, an electrical control mounted thereon, an exhaust port in spaced relation to said electrical control, a movable member adapted to contact with the electrical control to operate the same and to control said
60 exhaust port, and means for regulating the relative times of contact with the electrical control and operation of the exhaust port.

21. In a compressor controlling mechanism,

the combination comprising a movable
65 member responsive to variations in terminal pressure, motor circuit controlling mechanism, means carried by said movable member for engaging and moving said
70 motor circuit controlling mechanism, and a normally open exhaust port controlled by said member, said port being closed during operation of the circuit controlling mechanism.

22. In a compressor controlling mechanism, the combination comprising inlet
75 valve operating piston mechanism, a valve controlling the flow of fluid thereto, a motor circuit controlling switch, and a single member responsive to variations in terminal
80 pressure for controlling the switch and the valve operating piston mechanism, said member cooperating mechanically with said switch and constituting a supplemental
85 valve for the control of said valve operating piston mechanism.

23. In a control mechanism for a compressor system including a motor, a compressor and an unloader for the compressor
90 comprising motor controlling means, in combination, a servo-motor for actuating the motor controlling means, and means whereby a portion of said servo-motor operates as a control member for said unloader.

24. In a control mechanism for a compressor system having a motor, a compressor
95 and an unloader for the compressor, which unloader is fluid pressure controlled, in combination, motor controlling means, a servo-motor for actuating the same, and means
100 whereby a portion of said servo-motor operates as a control for the fluid pressure for said unloader.

25. In a controlling mechanism for a compressor system comprising a motor, a compressor and an unloader therefor adapted
105 for fluid pressure control, the combination including motor controlling means, and a servo-motor for actuating the same, said servo-motor having a portion thereof
110 constituting a valve for the control of the fluid pressure for said unloader.

26. In a controlling mechanism for a compressor system comprising a motor, a compressor and an unloader therefor adapted
115 for fluid pressure control, the combination including motor controlling means, and a servo-motor for actuating the same, said servo-motor being provided with valve means controlling the fluid pressure for said
120 unloader.

27. In a controlling mechanism for a compressor system comprising a motor, a compressor and an unloader therefor adapted
125 for fluid pressure control, the combination including motor controlling means, and a servo-motor for actuating the same, said servo-motor having a piston comprising a

valve for the control of the fluid pressure for said unloader.

28. In a controlling mechanism for a compressor system comprising a motor, a compressor and an unloader therefor adapted for fluid pressure control, the combination including motor controlling means, a servo-motor for actuating the same, and a plurality of valve means formed on said servo-motor and cooperating in the control of the pressure fluid for said unloader.

29. In a motor driven compressor controlling mechanism, the combination comprising a motor controlling mechanism, compressor unloading means comprising mechanism operative when actuated to control the condition of the compressor as to loading and unloading, and a member actuated by terminal pressure for controlling the motor controlling mechanism and said compressor controlling mechanism, the control of one of said first mentioned mechanisms being mechanical and that of the other being pneumatic.

30. In a motor-driven compressor controlling mechanism, the combination comprising a motor controlling member, compressor unloading means comprising an actuating member, and a member actuated by terminal pressure for controlling said motor controlling member and said actuating member, said member actuated by terminal pressure being provided with means adapted to control directly one of said first mentioned members, and with valve means operative in the control of the other thereof.

31. In a motor-driven compressor controlling mechanism, the combination comprising a motor controlling member, compressor unloading means comprising a fluid pressure actuated member, and a servo-motor having a piston adapted to actuate said motor controlling member, and provided with a groove cooperating in the supply and discharge of pressure fluid to said pressure fluid actuated member, said piston being controlled by terminal pressure.

32. In a motor-driven compressor controlling mechanism, the combination comprising a motor controlling member, compressor unloading means having an actuating member, a servo-motor having a piston adapted to actuate one of said members directly and provided with valve means cooperating in the supply and discharge of pressure fluid to the other of said members, and with supplemental valve means cooperating only with the supply of pressure fluid to said member, and terminal pressure controlled means controlling the operation of said piston.

33. In a compressor system, a compressor, fluid operated unloading means therefor operative on fluid supply thereto to unload a compressor, a driving motor for said com-

pressor, fluid operated means operative on fluid supply thereto to control the driving of said compressor by said motor, compressor discharge pressure controlled means for simultaneously supplying pressure to both of said means and interrupting the supply of pressure thereto, said compressor discharge pressure controlled means comprising exhaust means for the fluid supplied to one of said two first mentioned means, and separate exhaust means for the other of said two first mentioned means closed during interruption of the compressor drive.

34. In a compressor system, a compressor, fluid operated unloading means therefor, a driving motor for said compressor, a fluid operated controller means for the circuit of said motor, and means for controlling the operation of said two first mentioned means including a pilot valve responsive to compressor discharge pressure, said means providing a substantially simultaneous initiation of the supply of operating fluid for both of said means and interrupting supply to both and opening an exhaust for one of said means as soon as supply is interrupted while subsequently opening an exhaust for the other.

35. In a compressor system, a compressor, fluid operated unloading means associated with the inlet valves thereof, a driving motor for said compressor, means for controlling said motor operated by fluid pressure, and a single receiver pressure responsive pilot valve for controlling the supply of operating fluid for both of said means, said pilot valve controlling the exhaust from one of said means, and the latter means being constructed and arranged to control the exhaust from the other of said means.

36. In a compressor controlling means, a member whose position governs the output of the compressor, means for actuating said member to change its position including a cylinder, a piston therein, means for controlling the supply and exhaust of operating fluid to said cylinder, and a chamber of material capacity constantly communicating with the end of said cylinder to which operating fluid is admitted.

37. In a compressor controlling means, in combination, a cylinder, a piston reciprocable therein when fluid pressure is supplied thereto, and means constituting a relatively large clearance volume for said cylinder filled when said piston is moved whereby return movement of said piston is retarded by the necessity for the escape of the fluid pressure in said clearance volume.

38. In a compressor system, in combination, a compressor, a compressor driving motor, and controlling means comprising a cylinder, a piston therein, a motor controlling switch actuated by said piston adjacent

the limit of movement of the latter, and fluid operated compressor unloading means supplied with pressure on initial movement of said piston and vented as said piston returns to its initial position.

39. In a compressor controlling mechanism, in combination, means operative on fluid supply thereto to unload a compressor and operative on release of fluid so supplied

to permit reloading, means for controlling such fluid supply and exhaust including a member reciprocable under fluid pressure, and another controlling mechanism engageable by said reciprocable member but disengaged before the compressor is loaded.

In testimony whereof I affix my signature.

LEWIS JOSEPH CLAPP.