Feb. 4, 1941. I. C. JENNINGS 2,230,405

PUMPING SYSTEM

Filed April 20, 1938 4 Sheets-Sheet 1

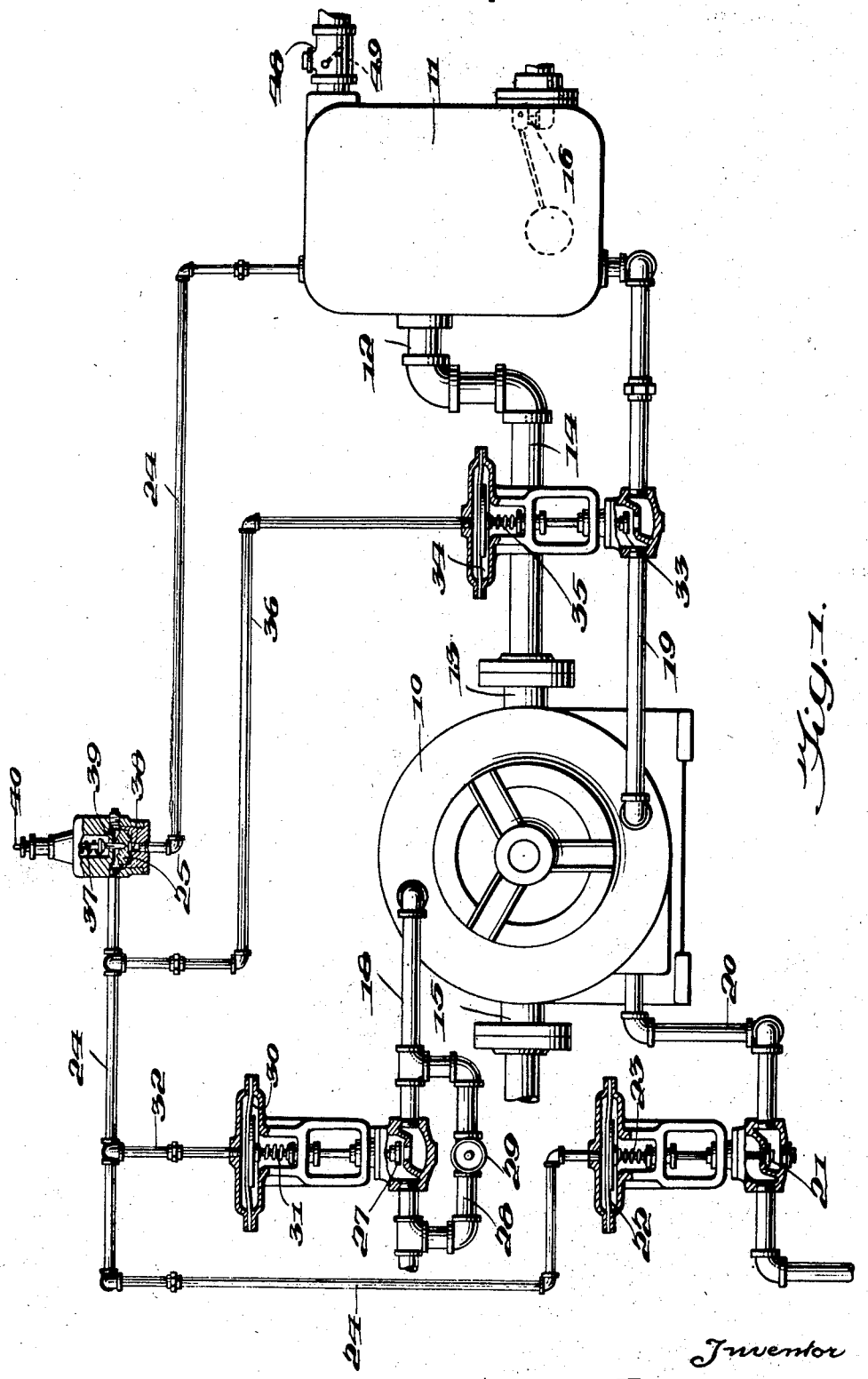


Fig. 1.

Inventor
Irving C. Jennings
By Riordan & Riordan
Attorney

Feb. 4, 1941. I. C. JENNINGS 2,230,405

PUMPING SYSTEM

Filed April 20, 1938 4 Sheets-Sheet 2

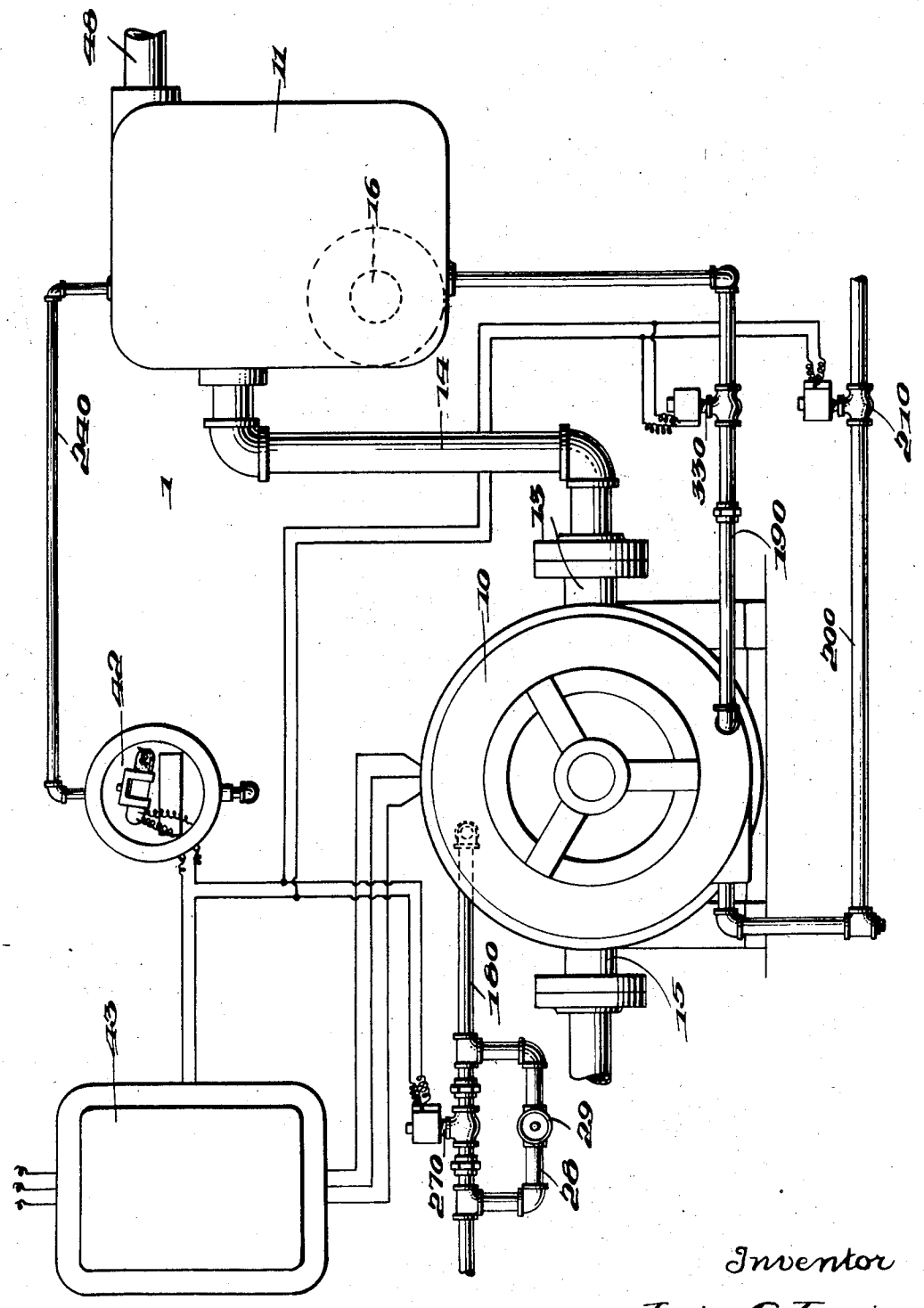


Fig. 2.

Inventor
Irving C. Jennings
By Riordon & Riordon
Attorney

Feb. 4, 1941. I. C. JENNINGS 2,230,405

PUMPING SYSTEM

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Fig. 5.

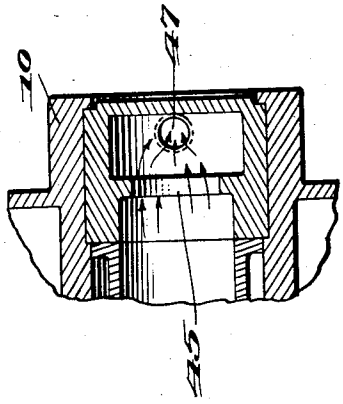


Fig. 6.

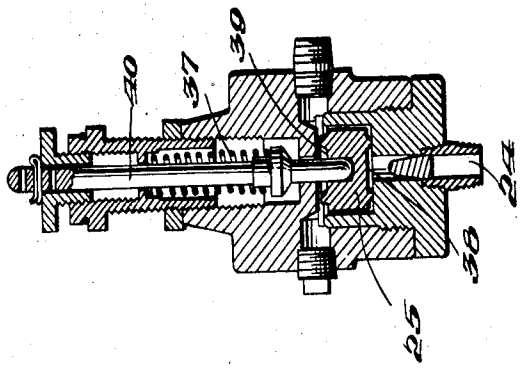
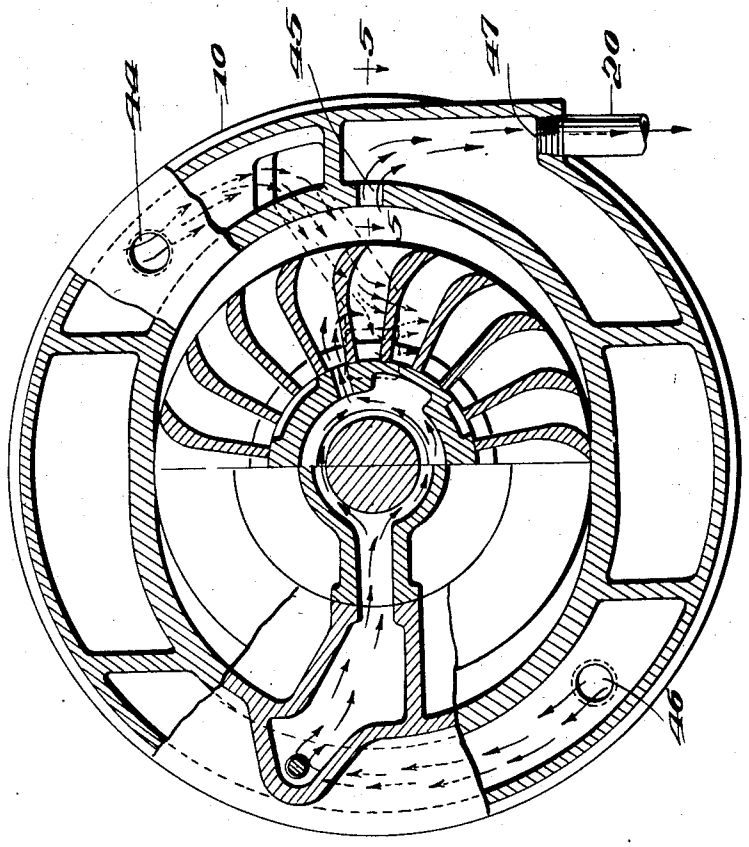


Fig. 3.



Inventor
Irving C. Jennings,
By Riordan & Riordan
Attorney

Feb. 4, 1941. I. C. JENNINGS 2,230,405

PUMPING SYSTEM

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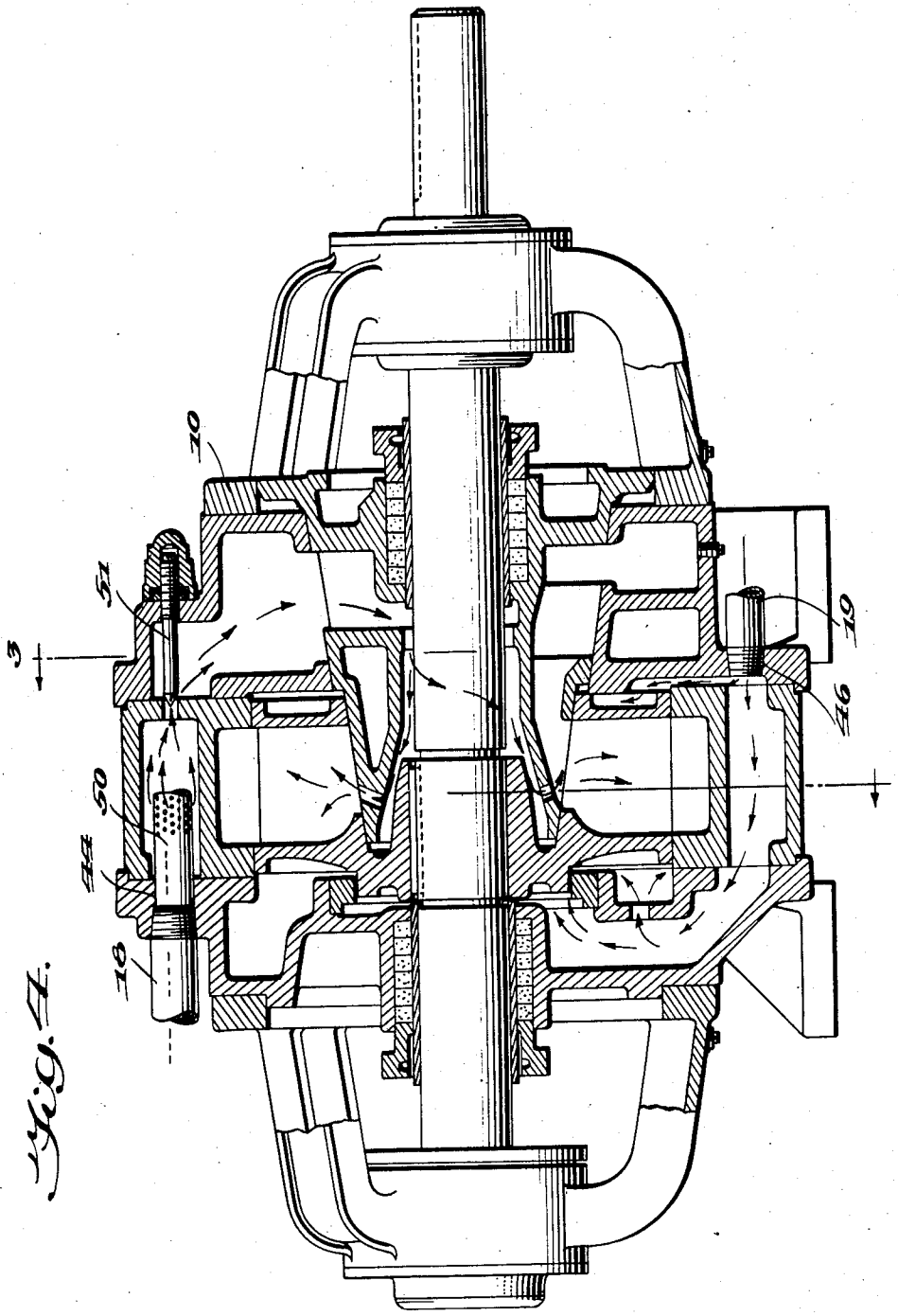


Fig. 4.

Inventor
Irving C. Jennings

By Riordan & Riordan
Attorney

Patented Feb. 4, 1941 2,230,405

UNITED STATES PATENT OFFICE

2,230,405

PUMPING SYSTEM

Irving C. Jennings, South Norwalk, Conn.

Application April 20, 1938, Serial No. 203,169

40 Claims. (Cl. 230—79)

This invention is directed to fluid piston pumps, of both the vacuum and compressor type, and to pumping systems utilizing such pumps; more particularly, the invention is directed to an arrangement and means for unloading such pumps and systems.

The well-known "Nash" type of compressor furnishes a good illustration of a pump having displacement chambers operating in a ring of liquid, and specifically, the invention herein is directed to improvements and developments in Nash type pumps and systems of the style disclosed in the co-pending applications of Irving C. Jennings, Serial No. 56,815, patented Mar. 26, 1940, #2,195,174, and Harold E. Adams, Serial No. 56,813, patented Mar. 26, 1940, #2,195,375, both filed December 30, 1935, for Pumps. The invention is not limited to this type of pump, however, reference being made thereto solely for illustrative purposes.

Pumps of this nature have been found very satisfactory in the handling of air and gas, although they will also handle denser fluids. The entire action of the Nash type of pump depends on a ring of liquid revolved by the rotor in an eccentric casing, and when it is desired to stop the pumping action, and to reduce the horsepower required for operating the pump, the desired result can be obtained by unloading or removing the displacing liquid from the pump casing while permitting the pump rotor to continue its rotation. When pumping action is again required the liquid can be returned to the pump and normal pumping action resumed.

A principal object of this invention contemplates such removal and replacement of the displacing or pumping fluid, and the provision in the system of an organization by means of which same may be readily effected.

When the pump is unloaded, and the displacing fluid eliminated, pumping action ceases and the pump rotor revolves freely, taking almost no power. It would not be practical, however, to run the pump dry for any length of time, as the rotor might seize at the points of closest clearance with the casing.

Therefore, it is another object of the invention to maintain a small amount of liquid in the pump, or to run a small amount of liquid through the pump during the unloading period. The amount of liquid used is much less than the usual make-up water, normally used for sealing. This is to further reduce the power and to save water during the unloaded period.

Other objects include the provision of means for introducing make-up water to the liquid ring, recirculating a portion of the make-up water through a part of the system and back to the pump, thereby to maintain the operating parts at a cool, desirable temperature, to circulate liquid through the pump through predetermined paths and at proper pressures effective to seal the clearances in the pump against leakage, to maintain pressures in the lines when the pump is unloaded and under atmospheric pressure, and to generally improve pumping systems of this nature.

To the attainment of the foregoing and other objects which will appear as the description proceeds, reference may be made to the accompanying sheets of drawings showing certain forms and modifications of the invention, and in which

Figure 1 is a diagrammatic layout showing certain parts in elevation and other parts in section, of a system using compressed air as a means to unload the pump;

Fig. 2 is a diagrammatic layout of a modified form of system showing the use of electrical means for unloading the pump;

Fig. 3 is a section through a typical Nash pump taken on the line 3—3 of Fig. 4.

Fig. 4 is a section through the pump taken at right angles to Fig. 3.

Fig. 5 is an enlarged fragmentary section taken on the line 5—5 of Fig. 3.

Fig. 6 is a section, somewhat enlarged, of a pilot unloader control valve.

Referring now more particularly to the drawings in which like reference numerals designate like parts, and with particular reference to Fig. 1, it will be observed that the system comprises a pump, illustrated as compressor 10 having an inlet 15, and a separator 11, the inlet 12 of which is connected to the discharge 13 of the compressor by suitable piping 14. The separator 11 is provided with a ball float relief valve 16 to permit escape of excess seal liquid.

A supply line 18 serves to furnish make-up water to the pump, same being obtained from any convenient source, or from the system itself, and a pipe line 19 connecting the pump 10 with the separator 11 is effective to recirculate liquid to and from the pump during the operation.

When the pump has produced the required pressure in the connected system it is then desirable to reduce the power consumption by unloading the pump, which is done by draining the displacing liquid from the pump through a pipe line 20, which line is controlled by an air-motivated valve 21, the valve being actuated in an

opening direction by a diaphragm 22, and in the opposite direction by spring 23. One side of the diaphragm 22 is connected by a pipe line 24 to the separator 11, this line being controlled by a spring pressed pilot unloader valve 25.

Another air-motivated valve 27 controls the make-up line 18, and is utilized to reduce the amount of make-up water when the compressor is unloaded. The line 18 is provided with a valve-controlled by-pass 28 around the valve 27, the by-pass being controlled by a manual valve 29. The valve 27 is provided with a diaphragm 30 for actuation in a closing direction and a spring 31 for actuation in the opposite direction. One side of the diaphragm 30 is connected by a pipe 32 to the line 24.

The recirculating line 19 is also provided with an air-motivated valve 33 which is effective to cut off the recirculation from the separator 11 back to the compressor or pump 10, this line being closed during the unloading condition for the purpose of reducing power required to operate the pump. The valve 33 is actuated in a closing direction by a diaphragm 34, and opened by a spring 35, one side of the diaphragm 34 being connected by piping 36 to the line 24.

The operation of the system is as follows:

Assume that the compressor 10 is operating normally, and forcing air through the discharge line 14, through the separator 11, and thence to a point of use. When the pressure in the separator 11 arrives at a predetermined point, the pressure transmitted through the pipe line 24 to the pilot valve 25 will then be sufficient to raise the valve from its seat, overcoming the resistance of the spring 37. When the valve leaves its seat, air under pressure is introduced through the line 24 beyond the valve, to the diaphragms 22, 30 and 34 of the valves 21, 27 and 33, respectively, this operation causing the valves 27 and 33 to close and the valve 21 to open. Opening of the valve 21 lets the displacing or pumping liquid rapidly run out of the compressor under the influence of centrifugal force of the revolving liquid ring in the compressor, and the air pressure behind it. At the same time, with the valves 27 and 33 closed, recirculation of liquid from the separator 11 back to the pump 10 is stopped, and the bulk of the make-up water which normally flows to the pump through the line 18 is cut off. The by-pass 28 allows a small amount of water to pass through the pump, this amount being regulated by the valve 29, and being sufficient only to cool the rotating part of the pump at points of close clearance, to prevent galling.

It will be observed that the bottom area 38 of the valve 25, where it closes off the air introduced in the pipe line 24, is smaller than the area at 39 on the opposite side of the valve, where it seats against the valve casing. With this arrangement, when the valve has once opened it will be held open by the pressure against increased area at the top of the valve. Therefore, the pressure in the line 24 behind the valve must drop an appreciable amount before the spring 37 can again force the piston back to its original position and close off the air coming up through the line 24 from the separator. These areas 38 and 39 are usually adjusted for a range of five or ten pounds.

When the pressure drops the desired amount in the line 24, the piston valve 25 will drop and close off air coming up through the line, and also cut off the air under pressure going to the diaphragms of the valves 21, 27 and 33. The air under pressure beyond the valve 25 will be vented up around the valve stem 40 to the atmosphere. The springs 31 and 35 will act upon the valves 27 and 33 to open same, and the spring 23 will close the valve 21. Liquid then rapidly flows into the pump working space through the valves 27 and 33, filling the pump casing, and the pump resumes its pumping operation.

Referring now to Fig. 2 it will be seen that the same action is made to take place electrically. In lieu of the pilot unloader valve 25, there is substituted a switch 42, preferably of the Mercoid type, which is controlled and actuated by pressures in the separator 11, through the line 240.

The valve 21 is replaced with a solenoid valve 210 in the escape line 200, the valve 27 is replaced by a solenoid valve 270 in the make-up line 180 and the valve 33 is replaced by a solenoid valve 300 in the recirculation line 190. When the pressure in the separator gets sufficiently high to close the switch 42, current will be supplied to the solenoid valve 210, and the valve will open to drain the pump. The solenoid valves 270 and 330 will close to shut off the make-up and recirculating liquid, and the small amount of water required to keep the pump from seizing flows through the adjustable by-pass 28, past valve 29. When the pressure drops to a predetermined amount, the switch 42 will open, and hence the valve 210 will close and the valves 270 and 330 will open, the pump will fill with liquid, and normal pumping action resumed.

Current for actuating the solenoid valves, and for operating the pump motor will be supplied from any convenient source through a controller and transformer 43 and suitable leads to the desired points.

Broadly speaking, it is immaterial what particular means are used to control the system, and the showings of Figs. 1 and 2 are intended to be illustrative rather than limiting. The principal feature of the invention consists in removing the displacing liquid from a Nash type compressor or vacuum pump when a required pressure or vacuum is attained to stop the pumping action and unload the pump while the pump continues to rotate. At the same time liquid may be allowed to flow through the pump in reduced quantities to keep the rotating parts from seizing.

Figs. 3 and 4 illustrate the path or flow of liquid into and out of the pump, and the circulation through various parts thereof. The make-up liquid will enter through the port 44, which communicates with the make-up line 18 and by-pass 28, and circulate through the close clearances, as indicated by the arrows. If desired, a suitable strainer 50 may be inserted at the port. This liquid is allowed to escape from the lobe of the pump by a port 45 from whence it passes freely to the discharge pipe 20.

The recirculation line 19 terminates in a port 46, and the path of the recirculated liquid is also illustrated by arrows. The discharge connection 20 is connected to a port 47. The separator discharge line 48 will be provided with an outwardly opening check valve 49 to hold the pressure in the line, when the pump is unloaded and under atmospheric pressure. The details of the circulation and recirculation of liquid through the pump, and path of travel thereof through the pump, broadly form no particular part of the present invention and for a more complete description thereof reference is made to the co-pending applications above mentioned. This flow may be controlled as set out in said applications.

by the use of adjustable valves such as indicated at 51 in Fig. 4.

While the invention is illustrated herein as applied to a pump of the compressor type, it will be appreciated that this is but illustrative, as the invention is just as applicable to a vacuum pump. The only change which would be necessary in applying same to a vacuum pump would be a modification of the controls for the valves 25, 21, 27 and 33, to operate on vacuum instead of pressure, and connection thereof to the inlet side of the pump instead of the discharge side. Hence it will be obvious that when the term "pressure" is used in the specification and claims, it is intended to cover negative pressures of vacuum, as well as positive pressures.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, a discharge line from said unit, means to supply liquid to said unit, and means for unloading said pumping unit during operations at normal speed, comprising an additional discharge line, a valve in said additional line, and pump pressure controlled means to open said valve.

2. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, a discharge line from said unit, means to supply liquid to said unit, and means for unloading said pumping unit during operations at normal speed, comprising an additional discharge line, a valve in said additional line, pump pressure controlled means to open said valve, and means to cut off the bulk of the liquid supplied to said unit.

3. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, a discharge line from said unit, means to supply liquid to said unit, means for unloading said pumping unit during operations at normal speed, comprising an additional discharge line, a valve in said additional line, and means automatically operable upon a predetermined pressure condition in said system to open said valve, and means to cut off the bulk of liquid supplied to said unit.

4. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, means to supply liquid to said unit, a separator, a discharge line from the pumping unit to the separator, and means for unloading said pumping unit during operations at normal speed, comprising a valved discharge connection, and pump pressure controlled means operable to open the valve of said connection.

5. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, means to supply liquid to said unit, a separator, a discharge line from the pumping unit to the separator, and means for unloading said pumping unit during operations at normal speed, comprising a valved discharge connection, and means automatically operable upon a predetermined pressure condition in said system to open the valve of said connection, and means to cut off the bulk of liquid supplied to said unit.

6. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, means to supply liquid to said unit, a separator, a discharge line from the pumping unit to the separator, and means for unloading said pumping unit comprising a valved discharge connection, and pump pressure controlled means automatically operable by pressure in said separator to open the valve of said connection.

7. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, valved means to supply liquid to said unit, a separator, a discharge line from the pumping unit to the separator, and means for unloading said pumping unit comprising a valved discharge connection, and means automatically operable by pressure in said separator to open the valve of said connection, and to close the valve of the supply means whereby to cut off the bulk of liquid supplied to said unit.

8. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, means to supply liquid to said unit, means including said pumping unit to develop pressures in said system, means for unloading said pumping unit comprising a valved discharge connection, and means automatically operable by said developed pressures to open the valve of said connection.

9. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, valved means to supply liquid to said unit, means including said pumping unit to develop pressures in said system, means for unloading said pumping unit comprising a valved discharge connection, and means automatically operable by said developed pressures to open the valve of said connection, and to close the valve of the supply means whereby to cut off the bulk of liquid supplied to said unit.

10. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, means to supply make-up liquid to said unit including a valved connection, a separator, a discharge from the pumping unit to the separator, means for unloading said pumping unit comprising a valved discharge connection, means automatically operable upon a predetermined pressure condition in said system to open the valve of said connection, means automatically operable upon a predetermined pressure condition in said system to close the valve of said make-up supply connection, and means to by-pass the valve of said make-up supply connection.

11. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, means to supply make-up liquid to said unit including a valved connection, a separator, a discharge from the pumping unit to the separator, means for unloading said pumping unit comprising a valved discharge connection, means automatically operable upon a predetermined pressure condition in said system to open the valve of said connection, means automatically operable upon a predetermined pressure condition in said system to close the valve of said make-up supply connection, means to by-pass the valve of said make-up supply connection, and valve controlled means for the by-pass whereby a regulated quantity of liquid may be supplied to said pumping unit when said unit is unloaded.

12. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, a separator, a discharge line from the pumping unit to the separator, a recirculation line between said separator and said unit effective to recirculate liquid passing from the pumping unit to the separator, back to the

pumping unit, and means for unloading said pumping unit comprising a valved discharge connection and means automatically operable upon a predetermined pressure condition in said system to open the valve of said connection, and means to stop recirculation through said recirculation line.

13. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, means to supply make-up liquid to said unit, a separator, a discharge line from the pumping unit to the separator, a recirculation line between said separator and said unit effective to recirculate liquid passing from the pumping unit to the separator, back to the pumping unit, and means for unloading said pumping unit comprising a valved discharge connection and means automatically operable upon a predetermined pressure condition in said system to open the valve of said connection, means operable by said automatic means to stop recirculation through said recirculation line, and means operable by said automatic means to cut off the bulk of the make-up liquid supplied to said unit.

14. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, valved means to supply liquid to said unit, means including said pumping unit to develop pressures in said system, and means for unloading said pumping unit comprising a valved discharge connection, means automatically operable to open the valve of said connection and to close the valve of the liquid supply means, including a pressure line effective to transmit said developed pressures to said valves, and a pilot unloader control valve in said pressure line.

15. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, means to supply liquid to said unit, a diaphragm valve controlling said means, means including said pumping unit to develop pressures in said system, means for unloading said pumping unit comprising a discharge connection, a diaphragm valve controlling said connection, and means automatically operable to open the valve of said connection and to close the valve of the liquid supply means, including a pressure line effective to transmit said developed pressures to the diaphragms of said valves, and a pilot unloader control valve in said pressure line.

16. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, means to supply make-up liquid to said unit, means including said pumping unit to develop pressures in said system, means for unloading said pumping unit comprising a valved discharge connection, and electric means automatically operable by said developed pressures to open the valve of said connection.

17. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, means to supply liquid to said unit, means including said pumping unit to develop pressures in said system, means for unloading said pumping unit comprising a discharge connection and electric means automatically operable by said developed pressures for controlling said supply means and said discharge connection, including a pressure actuated electric switch, and a solenoid valve in each of said supply means and discharge connection, electrically connected to said switch.

18. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, means to supply liquid to said unit, a solenoid valve in said supply means, means including said pumping unit to develop pressures in said system, means for unloading said pumping unit comprising a discharge connection, a solenoid valve therein, and means automatically operable to open the valve of said connection and to close the valve of the liquid supply means including a pressure operable electric switch, a pressure line effective to transmit said developed pressures to said switch, and electric connections from said switch to said solenoid valves.

19. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, means to supply liquid to said unit, a solenoid valve in said supply means, means including said pumping unit to develop pressures in said system, means for unloading said pumping unit comprising a discharge connection, a solenoid valve therein, and means automatically operable to open the valve of said connection and to close the valve of the liquid supply means including a pressure operable electric switch, a pressure line effective to transmit said developed pressures to said switch, electric connections from said switch to said solenoid valves, and valve controlled means for by-passing said solenoid valve in the supply means, whereby a regulated quantity of liquid may be supplied to the pumping unit, when said unit is unloaded.

20. In an air compressor using liquid for its pumping action, compressor pressure controlled means to unload the compressor by removing said liquid, during operations at normal speed, and means to supply liquid to the compressor for subsequent pumping action.

21. In an air compressor using liquid for its pumping action, compressor pressure controlled means to unload the compressor by removing said liquid, during operations at normal speed, means to supply a sufficient flow of liquid through the compressor to keep it cool during unloading and unloaded periods, and means to supply liquid to the compressor for subsequent pumping action.

22. In an air compressor using liquid for its pumping action, means to recirculate such liquid through the compressor, means to unload the compressor by removing said liquid, means to close off the recirculation means, means to supply a sufficient flow of liquid through the compressor to keep it cool during unloading and unloaded periods, and means to supply liquid to the compressor for subsequent pumping action.

23. In an air compressor using liquid for its pumping action, means to recirculate such liquid through the compressor, means to unload the compressor by removing said liquid, means to close off the recirculation means during unloading and unloaded periods, and means to supply liquid to the compressor for subsequent pumping action.

24. In an air compressor using liquid for its pumping action, compressor pressure controlled means to unload the compressor by removing said liquid during operations at normal speed, and means to provide a flow of liquid through the compressor in reduced quantity over that required for pumping action, during unloading and unloaded periods, thereby to keep the compressor cool.

25. The method of operating an air com-

pressor of the type using liquid for its pumping action, which comprises operating the compressor to create a required pressure, and then unloading the compressor by removing said liquid, and reloading the compressor by supplying liquid thereto, upon a predetermined drop in pressure, during operations at normal speed.

26. The method of operating an air compressor of the type using liquid for its pumping action, which comprises operating the compressor to create a required pressure, then unloading the compressor by removing said liquid, and reloading the compressor by supplying liquid thereto, upon a predetermined drop in pressure, during operations at normal speed, and providing a flow of liquid through the compressor during unloading and unloaded periods in sufficient quantity to keep the compressor cool.

27. The method of operating an air compressor of the type using liquid for its pumping action, which comprises operating the compressor to create a required pressure, recirculating liquid through the compressor during the building up of such pressure, then unloading the compressor by removing said liquid, and providing a flow of liquid through the compressor in quantity sufficient to keep it cool, and at the same time stopping the recirculation of liquid, during the unloading and unloaded periods.

28. The method of operating an air compressor of the type using liquid for its pumping action, which comprises operating the compressor to create a required pressure, then unloading the compressor by removing said liquid, during operations at normal speed, and providing a flow of liquid through the compressor during unloading and unloaded periods in reduced quantity over that required for pumping action, and cooling the compressor by said reduced flow of liquid.

29. In a pumping system of the type using a liquid pump, the combination of a liquid ring pumping unit, a discharge line from said unit, means to supply liquid to said unit, means for unloading said pumping unit comprising an additional discharge line, and means automatically operable upon a predetermined pressure condition in said system to open said additional line, and to cut off the bulk of liquid supplied to said unit.

30. In a pumping system of the type using a liquid pump, the combination of a liquid ring pumping unit, a discharge line from said unit, means to supply liquid to said unit, means for unloading said pumping unit comprising an additional discharge line, and means automatically operable upon a predetermined pressure condition in said system to close said additional line and to open the liquid supply means to said unit.

31. In a pumping system of the type using a liquid pump, the combination of a liquid ring pumping unit, a discharge line from said unit, means to supply liquid to said unit, means for unloading said pumping unit comprising an additional discharge line, and means automatically operable upon a predetermined pressure condition in said system to open said additional line, and to cut off the bulk of liquid supplied to said unit, and to close said additional discharge line and to open the liquid supply means to said unit upon occurrence of a different predetermined pressure condition in said system.

32. Means to operate an air compressor of the type using liquid for its pumping action comprising means to operate the compressor to create a required pressure, and compressor pressure controlled means to unload the compressor and remove the pumping liquid during operations at normal speed.

33. Means to operate an air compressor of the type using liquid for its pumping action comprising means to operate the compressor to create a required pressure, and compressor pressure controlled means to unload the compressor and remove the pumping liquid during continued operation of the compressor.

34. Means to operate an air compressor of the type using liquid for its pumping action comprising means to operate the compressor to create a required pressure, compressor pressure controlled means to unload the compressor and remove the pumping liquid during continued operation of the compressor, and means to load the compressor upon change in pressure after an unloading of the compressor.

35. Means to operate an air compressor of the type using liquid for its pumping action comprising means to operate the compressor to create a required pressure, compressor pressure controlled means to unload the compressor and remove the pumping liquid, during operations at normal speed, and means to provide a flow of liquid through the compressor during unloaded and unloading periods in sufficient quantity to keep the compressor cool.

36. Means to operate an air compressor of the type using liquid for its pumping action, comprising means to operate the compressor to create a required pressure, means to recirculate a portion of said liquid through the compressor during the building up of such pressure, means to unload the compressor and remove the pumping liquid, during operations at normal speed, means to provide a flow of liquid through the compressor in quantity sufficient to keep it cool, and means, effective at the same time, to stop the recirculation of liquid during unloading and unloaded periods.

37. Means to operate an air compressor of the type using liquid for its pumping action comprising means to operate the compressor to create a required pressure, compressor pressure controlled means to unload the compressor and remove the pumping liquid, during operations at normal speed, and means to provide a flow of liquid through the compressor during unloading and unloaded periods in reduced quantity over that required for pumping action whereby to cool the compressor by the reduced flow of liquid.

38. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, a separator, a discharge line from the pumping unit to the separator, a recirculation line between said separator and said unit effective to recirculate liquid passing from the pumping unit to the separator, back to the pumping unit, and means for unloading said pumping unit including an additional discharge connecton, and means automatically operable upon a predetermined pressure condition in said system to open said additional discharge connection, and to stop recirculation through said recirculation line.

39. In a pumping system of the type using a liquid ring pumping, the combination of a liquid ring pumping unit, means to supply make-up liquid to said unit, a separator, a discharge line from the pumping unit to the separator, a recirculation line between said separator and said unit effective to recirculate liquid passing from the pump-

ing unit to the separator, back to the pumping unit, and means for unloading said pumping unit, including an additional discharge connection, and means automatically operable upon a predetermined pressure condition in said system to open said additional discharge connection, to stop recirculation through said recirculation line, and to cut off the bulk of the make-up liquid supplied to said unit.

40. In a pumping system of the type using a liquid ring pump, the combination of a liquid ring pumping unit, a discharge line from said unit, means to supply liquid to said unit, and compressor pressure controlled means for loading and unloading said pumping unit during operations at normal speed, comprising an additional discharge line, a valve in said additional line, means to open said valve, and valved means to supply liquid for loading purposes.

IRVING C. JENNINGS.

CERTIFICATE OF CORRECTION.

Patent No. 2,230,405. February 4, 1941.

IRVING C. JENNINGS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 15, for the word "of" read --or--; same page, second column, line 2, claim 6, strike out "pump pressure controlled"; 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 18th day of March, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)