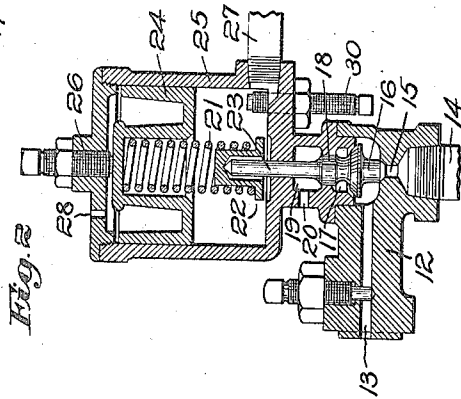
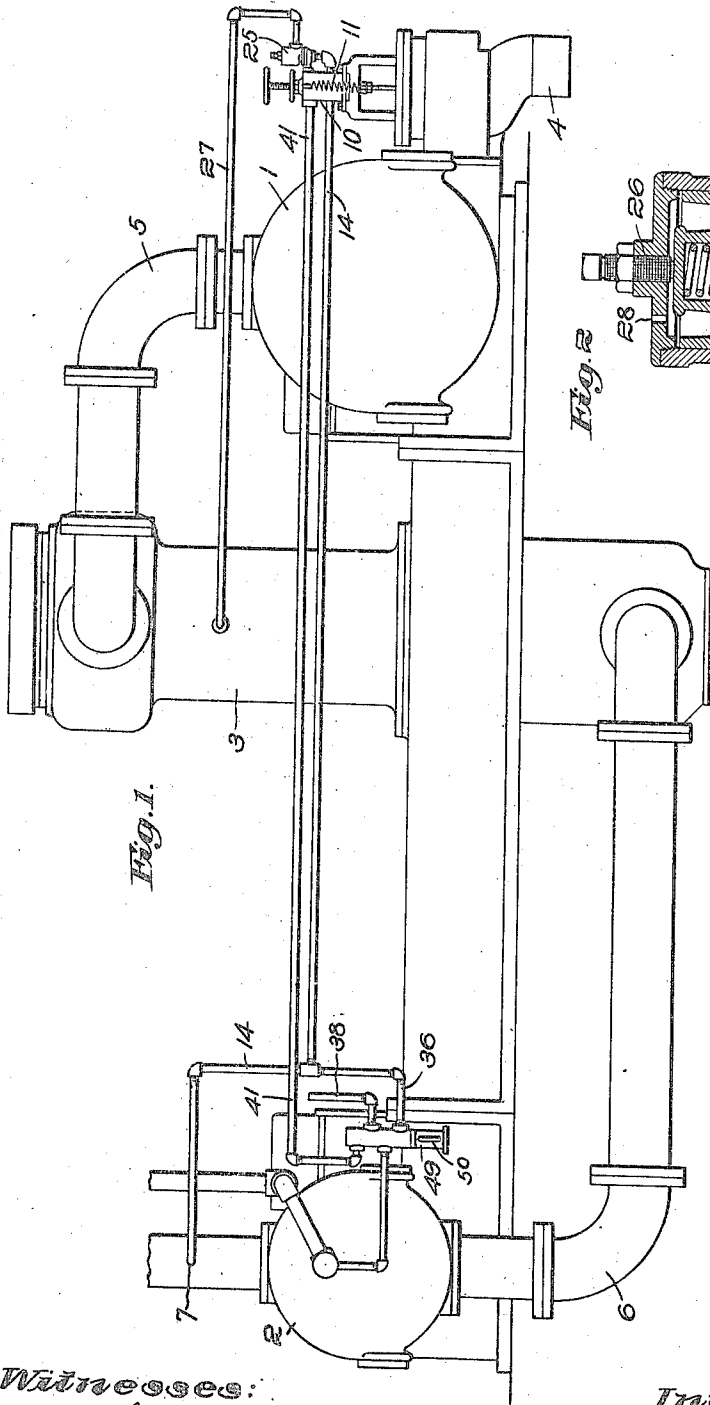


W. H. WINEMAN.
UNLOADING DEVICE FOR AIR COMPRESSORS.
APPLICATION FILED JUNE 14, 1913.

1,248,740.

Patented Dec. 4, 1917.

2 SHEETS—SHEET 1.



Witnesses:
Carl L. G. Houtte.
Herbert A. Gorenman

Inventor:
Wade H. Wineman.
By Emory Booth, Attorney

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2 SHEETS—SHEET 2.



Inventor:

Wade H. Wineman.

By Emory Booth January Varney
Higgins.

UNITED STATES PATENT OFFICE.

WADE H. WINEMAN, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO
SULLIVAN MACHINERY COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION
OF MASSACHUSETTS.

UNLOADING DEVICE FOR AIR-COMPRESSORS.

1,248,740.

Specification of Letters Patent.

Patented Dec. 4, 1917.

Application filed June 14, 1913. Serial No. 773,745.

To all whom it may concern:

Be it known that I, WADE H. WINEMAN, a citizen of the United States, and a resident of Chicago, county of Cook, State of Illinois, whose post-office address is 5437 Gladys avenue, Chicago, Illinois, have invented an Improvement in Unloading Devices for Air-Compressors, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to improvements in air compressors and more particularly to improved means for unloading air compressors. The invention will be best understood by reference to the following description when taken in connection with the accompanying illustration of one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings:

Figure 1 is a diagrammatic elevation of a compressor embodying one form of the invention;

Fig. 2 is a detail showing the air trigger or controlling valve for the unloading valve; and

Fig. 3 shows in partial section the unloading and relief valves with connected mechanism.

Referring to the drawings and to the embodiment of the invention there selected for illustration, a multiple stage compressor is shown having the low pressure cylinder 1, the high pressure cylinder 2 and the intercooler 3. The low pressure cylinder has its suction 4 and discharge 5, while the high pressure cylinder has its suction 6 connected to the intercooler and its discharge 7 connected to the receiver (the latter not shown).

The main unloading valve 8 (Fig. 3) is of common construction and is interposed in the suction 4 of the low pressure cylinder. It is moved down at appropriate times to cut off the suction by means of a piston 9 working within the cylinder 10, the spring 11 (Fig. 1) being utilized normally to elevate the valve. The piston 9 is caused to be depressed by the action of an air trigger or controlling mechanism shown in detail in Fig. 2 and constructed as follows:

Secured to the side of the cylinder 10 near

the top thereof is the casting 12 in which is formed the pressure supply port 13 opening into the cylinder space 10 above the piston 9. This port communicates with a pipe 14 through an orifice 15, the latter being controlled by the unloader controlling valve 16. When the valve is lifted, the pipe 14 being connected to the high pressure delivery 7 or the receiver, pressure fluid at the receiver pressure flows through the pipe 13 to the cylinder 10, depresses the piston 9 and cuts off the suction from the low pressure cylinder.

The valve 16 has an upper seat of greater diameter than its lower seat, the upper seat, when the valve is elevated, closing the escape orifice 17. When the valve is depressed, pressure fluid is permitted to escape through the orifice 17, grooves 18 in the valve, escape chamber 19 and opening 20 to the atmosphere. The valve 16 is normally held on its lower seat closing the orifice 15 by a spring 21 interposed between a cap piece 22 on the valve stem 23 and a piston 24, the latter being slidably mounted in a cylindrical chamber 25 on the casting 12. The downward pressure exerted by the spring can be varied by adjusting the position of the piston 24 by means of the adjustable set screw 26.

When the terminal pressure reaches the predetermined point at which the compressor is intended to unload, the pressure of the air at the orifice 15 acting on the bottom of the valve 16 will lift the valve against the pressure of the spring 21, allowing air at terminal pressure to pass through the orifice and the port 13 to the top of the piston 9. At the same time the controlling valve 16 is lifted against its upper seat, cutting off the atmospheric vent opening 20 from the port 13. This acts to unload the low pressure cylinder by depressing the unloading valve 8 and throttling the low pressure suction. The upper seat of the valve 16 is of greater diameter than the lower seat, so that the valve will continue to be held against its upper seat by the pressure of the air acting from beneath until there is a drop in the pressure of the receiver which is supplied through the pipe 14 or until an increased pressure on the valve stem from above takes place, or until both these conditions obtain.

The space within the cylinder 25 and below the piston 24 is connected by a pipe 27 with a space wherein there is produced a vacuum when the compressor is unloaded.

5 This connection may be made to the suction side of the low pressure cylinder, but herein the pipe 27 is connected to the space of the intercooler 3 so that when the compressor is unloaded and the pressure in the

10 intercooler falls below that of the atmosphere, the piston 24 tends to be depressed more or less by the atmospheric pressure acting through the opening 28 in the top of the cylinder 25. The pressure of the piston

15 therefore is added to that of the spring 21 and when a point is reached where this overbalances the receiver pressure on the lower side of the valve 16, the latter will descend closing the orifice 15 and opening

20 the port 13 to the atmosphere through the chamber 17, grooves 18, chamber 19 and passage 20. This releases pressure fluid from behind the controlling piston 9 and the latter is caused to lift through the

25 spring 11 and open the throttle and unloading valve 8, again loading the compressor. When the compressor is loaded the pressure in the intercooler is again raised and the piston 24 is forced up against the set screw 26

30 by the spring 21, reducing the pressure against the valve stem to the amount necessary to hold the valve 16 on its lower seat until the predetermined pressure is again reached, when the cycle of operations is

35 repeated.

After the vacuum has been produced in the intercooler 3, the pressure against the piston 24 is always constant and the resulting tension on the spring may be regulated by the travel of the piston. To regulate such travel the adjustable set screw 30 is provided in the bottom of the cylinder 25.

40 In order to prevent undue heating in the high pressure cylinder which might follow from compressing air taken from the intercooler at an abnormally low pressure after the low pressure cylinder has been unloaded, relief valves 31 are preferably provided for each end of the high pressure cylinder. These

50 valves are automatically opened when the low pressure cylinder is unloaded. Each relief valve (see Fig. 3) is of cylindrical form with a closed end which is pressed to its seat 33 in the cylinder head by the light spring 32. The valve is normally

55 maintained upon its seat against the internal compression by terminal pressure fluid conveyed to the interior of the valve 31 by the pipe 34, the latter being normally

60 connected to the terminal pressure pipe 14 through the valve chamber 35 and the branch pipe 36. Under normal conditions,—that is when the compressor is loaded,—the pipe 34 has communication with the pipe

65 36. When, however, the low pressure cyl-

inder is unloaded, the valve 37, which is slidably mounted in the valve chamber 35, is moved to cut off communication between the pipes 34 and 36 and open communication between the pipe 34 and the pipe 38, 70 the latter opening into the atmosphere.

To provide for this automatic movement of the valve, the latter has two piston heads 39 and 40, the latter of greater diameter than the former. When the controlling piston 75 9 for the unloading valve is moved to close the latter, a part of the pressure fluid admitted to the top of the piston 9 also passes into the pipe 41 which is connected to the rear of the cylinder 10 and is carried 80 thereby to the end of the valve piston 40 of larger diameter causing the described movement of the valve. This connects the pipe 34 to the atmosphere, placing atmospheric pressure on the valve 31 so that the 85 latter readily lifts under compression and permits the escape of the compressed air from the high pressure cylinder through the atmospheric vent 42.

So long as the unloading valve 8 remains 90 closed, terminal pressure is supplied through the pipe 41, maintaining the valve 37 in its prescribed position, wherein the pipe 34 is cut off from the terminal pressure pipe 36 and opened to the atmospheric pipe 38. 95 When the unloading valve opens, due to the air trigger mechanism cutting off the supply of terminal pressure from the top of the cylinder 10 and opening the latter to the atmosphere, the terminal pressure acting 100 through the pipe 36 on the smaller head 39 of the piston valve 37 moves the latter to the opposite end of the valve chamber and again cuts off the pipe 34 from the atmospheric pipe 38 and applies terminal pres- 105 sure through the pipe 34 to the top of the valve 31, forcing the latter to its seat. While this condition is maintained, the valve 37 is held to its seat by the terminal pressure, since the effective area of the valve 31 110 exposed to the interior pressure of the compressor is less than the effective area of the valve exposed to the terminal pressure received through the pipe 34. The valve 31 is provided with a partition wall 43 against 115 which the spring 32 seats and which is also adapted to strike an adjustable stop screw 44 having the hand wheel 45 whereby the lift of the valve may be regulated.

In order that the discharge of air from the 120 high pressure cylinder through the relief valve 31 may not take place simultaneously with the unloading of the low pressure cylinder, but may be deferred until a large portion of the air in the intercooler has been 125 compressed in the high pressure cylinder and delivered to the receiver, its movement is preferably retarded relatively to that of the unloading valve. Any suitable means may be provided for effecting this retarda- 130

tion, but herein I have shown the valve 37 provided with a retarding element in the form of a dashpot. This consists of the piston 47 connected by the piston rod 48 to the valve 37 and working in a cylinder 49 filled with oil or other suitable liquid. The opposite ends of the cylinder are connected by a pipe 50 whereby the liquid may be caused to pass from one end of the cylinder to the other when the piston is moved. The rapidity with which the liquid is transferred from one end of the cylinder to the other may be controlled by the valve 51 in the pipe 50.

It will be observed that the air trigger is provided with an adjustment both for loading and unloading. The position of the set screw 26 at the top of the cylinder determines the unloading pressure while the set screw 30 at the bottom of the cylinder determines the loading pressure. This permits a wide variation in the adjustment of the apparatus.

While I have herein shown and described for purposes of illustration one specific form of the invention, it is to be understood that the same is not limited to the specific embodiment herein shown, but that extensive deviations may be made from the described form without departing from the spirit of the invention.

Claims:

1. In an air compressor, the combination with an unloading valve, of a controlling device therefor provided with means for moving the unloading valve, valve means normally closed but adapted to open under a predetermined pressure to admit pressure fluid to move said unloading valve moving means, means for holding said valve means closed comprising a spring, a cylinder with its contained piston, the latter adapted to augment the pressure of the spring against the closing means, and means dependent on the unloading of the compressor to vary the pressure on opposite sides of the piston.

2. In a compressor, the combination with an unloading device, of a controlling device therefor comprising a piston for moving the unloading valve, valve means normally closed but adapted to open under a predetermined terminal pressure to admit pressure fluid to move said piston, means for holding said valve means closed comprising a spring, a cylinder with its contained piston, the latter adapted to augment the pressure of the spring against the closing means, and a pipe connection between the cylinder and a low pressure space of the compressor to augment the pressure of the spring after the compressor has been unloaded.

3. In a compressor, the combination with an unloading valve, of a controlling device having valve means to control said unloading valve, said valve means being adapted to move when a predetermined terminal

pressure is reached, and means for restoring said valve means dependent on a drop in pressure in a low pressure space of the compressor after the latter has been unloaded.

4. In a compressor, the combination with an unloading valve, of a controlling device having valve means to control said unloading valve, said valve means being adapted to be moved when a predetermined terminal pressure is reached, and means for restoring said valve means dependent on the drop in intercooler pressure after the compressor has been unloaded.

5. In an air compressor, the combination with an unloading valve, of means for moving the same comprising a valve adapted to be moved under a predetermined terminal pressure, a spring for restoring said valve, and means to augment said spring dependent on the drop in pressure of a low pressure space of the compressor following the unloading of the compressor.

6. In a compressor, the combination with an unloading valve, of a controlling device therefor including a valve, a spring to move the valve, a piston adapted to compress said spring, a cylinder containing said piston, a connection on one side of said piston to a low pressure space of the compressor, and a connection on the opposite side of said piston to the atmosphere.

7. In a compressor, the combination with an unloading valve, of a controlling device therefor including a valve, a spring to move the valve, a piston adapted to compress said spring, a cylinder containing said piston, a connection on one side of said piston to a low pressure space of the compressor, a connection on the opposite side of said piston to the atmosphere, and supplemental means for regulating the travel of said piston.

8. In a compressor, the combination with an unloading valve, of a controlling device therefor including a valve, a spring to move the valve, a piston adapted to compress said spring, a cylinder containing said piston, a connection on one side of said piston to a low pressure space of the compressor, a connection on the opposite side of said piston to the atmosphere, and supplemental means for regulating the travel of said piston in either direction.

9. In a multiple stage compressor, the combination with an unloading valve, of a controlling device therefor including a valve, a spring to move the valve, a piston adapted to compress said spring, a cylinder containing said piston, a connection on one side of said piston to the intercooler, and a connection on the opposite side of said piston to the atmosphere.

10. In combination, pumping mechanism, unloading means actuated by predetermined pressure for cutting off the ingress of air to said mechanism, a connection between

said pumping mechanism and the atmosphere, relief means for said pumping mechanism in said connection, and means between the unloading means and said relief means for delaying the operation of the latter.

11. In a compressor, the combination with an unloading valve, of a controlling device therefor including a valve, a spring to move the valve, a movable pressure-resisting wall adapted to open the valve on the application of sufficient pressure thereagainst, a second movable pressure-resisting wall adapted to compress said spring, and means dependent on the unloading of the compressor for varying the fluid pressure against said second wall.

12. In a compressor, the combination with an unloading device for reducing the inlet pressure, of a relief valve for the discharge end, the latter normally held to its seat by pressure fluid, a second valve adapted to lower the pressure fluid on said relief valve, means dependent on the action of said unloading device for moving said second valve, and means for retarding the action of said valve moving means.

13. In a compressor, the combination with high and low pressure cylinders, of a throttling device for the suction of the low pressure cylinder, means for moving the same under a predetermined terminal pressure, a relief valve for the high pressure cylinder opening to the atmosphere, said relief valve being normally held to its seat by terminal pressure, a second valve adapted on movement to cut off the terminal pressure from said relief valve and apply a lower pressure to the same, means connected to the moving means of said low pressure throttling device for moving said second valve, and means for retarding the action of said valve moving means.

14. In an air compressor, the combination with pumping mechanism, of unloading means actuated by predetermined terminal pressure for cutting off the ingress of air to the pumping mechanism, and means operated by, but acting subsequent to the operation of said unloading means, for permitting the discharge of air from the pumping mechanism to the atmosphere whereby the discharge of air through the discharge means to the atmosphere is deferred until after the compression of a substantial amount of the air remaining in the compressor.

15. In an air compressor, the combination with high and low pressure cylinders, of an unloading valve for the low pressure cylinder, a relief valve for the high pressure cylinder, means dependent upon a predetermined terminal pressure for moving said unloading valve, and means dependent upon said terminal pressure, but operated subsequent by an appreciable interval to the operation of said unloading valve, for opening said high pressure relief valve.

16. In a compressor the combination with an unloading valve, of a controlling device having valve means to control said unloading valve, said valve means being adapted to be moved when a predetermined terminal pressure is reached, and means for restoring said valve means dependent on the conjoint action of a valve controlling spring, the terminal pressure and the pressure of a low pressure space of the compressor.

17. In a multiple stage compressor the combination with an unloading valve controlling the suction of the low pressure cylinder, of a controlling device having valve means to control said unloading valve, said valve being adapted to be moved when a predetermined receiver pressure is reached, and means for restoring said valve means dependent on the conjoint action of the receiver pressure, the intercooler pressure and a valve controlling spring.

18. In a compressor the combination with an unloading device for reducing the inlet pressure, of a valve for the discharge end, the latter normally held closed, means dependent on an increase in receiver pressure to a predetermined point to control said unloading valve to reduce the inlet pressure and to open said relief valve, and means to retard the opening of the latter to follow the reduction in inlet pressure.

19. In a compressor the combination with high and low pressure cylinders, of a throttling device for the suction of the low pressure cylinder, a relief valve for the high pressure cylinder, pressure responsive means responsive to a predetermined terminal pressure, connections between said pressure responsive means and said throttling device to operate the same, and connections between said pressure responsive means and said relief valve to operate the latter but to retard the operation of the latter to cause the same to occur subsequently to the operation of the throttling device.

20. In an air compressor the combination with pumping mechanism, of unloading means actuated by predetermined pressure for cutting off the ingress of air to the pumping mechanism, relief means for the pumping mechanism, and connections between the unloading means and the relief means to cause the operation of the latter to occur subsequently to the operation of the former.

21. In a regulator for fluid compressors, in combination, a compressor, its receiver, a fluid operated relief valve mechanism, a fluid operated intake closing valve, means for admitting fluid to operate said valves at a predetermined receiver pressure, and means for delaying the action of said fluid in operating said relief valve mechanism.

22. In a regulator for fluid compressors,

in combination, a compressor, its receiver, a fluid operated relief valve mechanism, a fluid operated intake closing valve, means for admitting fluid to operate said valves at a predetermined receiver pressure, and adjustable means for delaying the action of said fluid in operating said relief valve mechanism.

23. In a regulator for fluid compressors, in combination, a compressor, its receiver, a fluid operated discharge line unloading valve mechanism, a fluid operated intake closing valve, means for admitting fluid to operate said valves at a predetermined receiver pressure, and means for delaying the action of said fluid in operating said discharge line unloading valve mechanism.

24. In a regulator for fluid compressors, in combination, a compressor, its receiver, a fluid operated discharge line unloading valve mechanism, a fluid operated intake closing valve, means for admitting fluid to operate said valves at a predetermined receiver pressure, and adjustable means for delaying the action of said fluid in operating said discharge line unloading valve mechanism.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

WADE H. WINEMAN.

Witnesses:

FRANK A. HALLECK,
ALBERT F. PIPENHAGEN.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."