Nov. 16, 1943. R. E. LAMBERTON 2,334,633

UNLOADING MECHANISM

Filed June 26, 1942

Fig. 1.

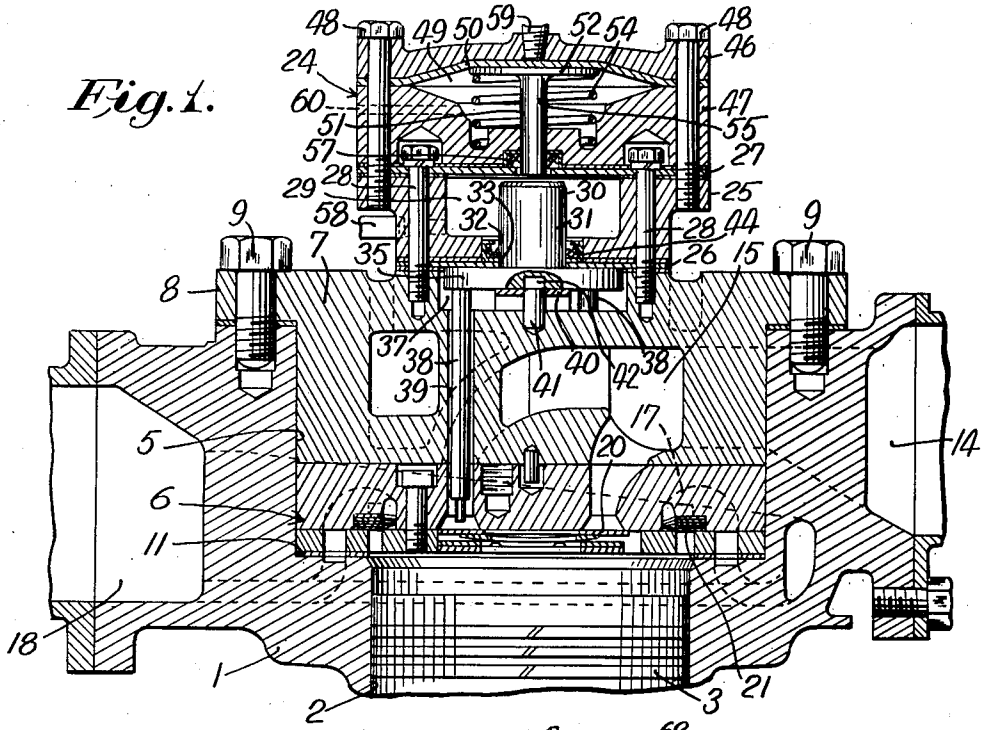
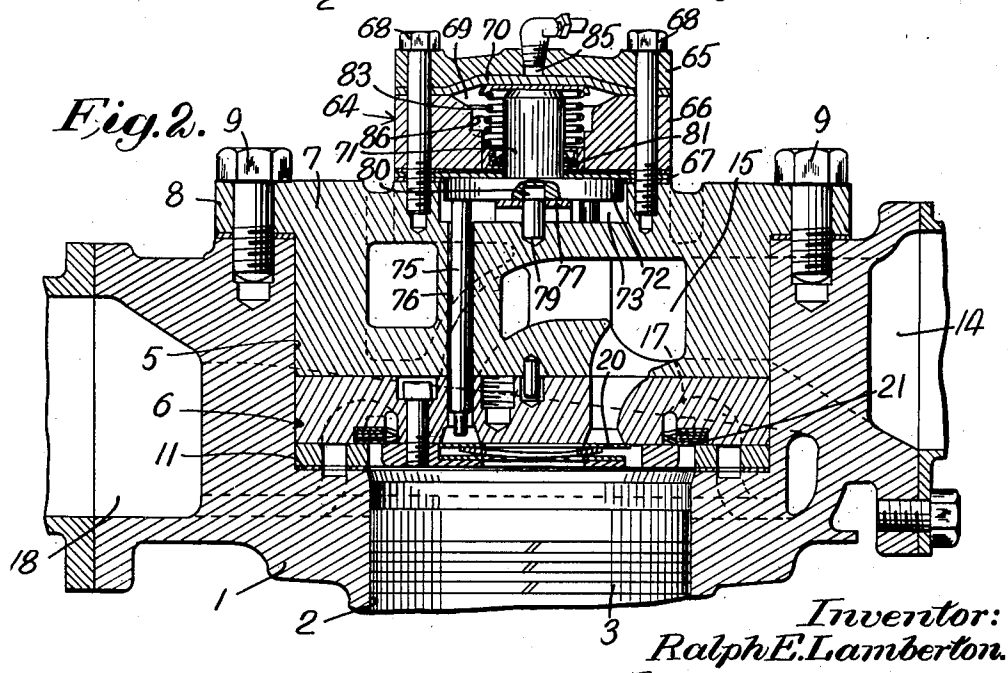


Fig. 2.



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UNLOADING MECHANISM

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15 Claims. (Cl. 230—30)

This invention relates to pump unloading mechanisms, and more particularly to fluid actuated unloading mechanisms for compressors.

It is sometimes desirable that means be provided for unloading a compressor when different operating conditions exist. For example, when a mechanism other than the compressor is to be driven by the same power unit that drives the compressor and the power unit is unable to carry the load of both, then it may be desirable that the compressor be unloaded. Again, when the compressor is being driven and the discharge pressure reaches a predetermined maximum value, the compressor should be unloaded. In order that each of these functions may be effectively performed, it is desirable that separate operating devices, for example, expansible chamber type devices for operating the valve which is to be moved to effect unloading, be provided; and the structures and relations of the parts are desirably so arranged that different operating media may be utilized, and media from different sources and at different pressures. It is also desirable that when one device has acted to effect unloading, the other may also act in such a manner that, upon cessation of action of the first, the second may preclude reloading if this would be undesirable.

As an illustration, it may be noted that with an internal combustion engine employed to drive an air compressor or other pump and to operate a hoist, and with the the hoist connectible at will to the engine, it would be relatively undesirable in some installations to have a situation where the engine might be driving the compressor unloaded and then to have the hoist connected to the engine and to have the separate controls for the valve which is moved to effect unloading so related that the control designed to be effected on connection of the part to the engine could not function until the compressor discharge pressure governed control became inactive. Accordingly, in a preferred embodiment of the invention, the controls are so arranged that even with an operating fluid under less pressure than is used for unloading upon the attainment to maximum desired operating pressure, the control associated with hoist connection can assume an operative position instantly on the supply of operating fluid thereto. In another embodiment illustrated an arrangement effective in a different manner to prevent an undesired reloading will be disclosed.

In the illustrative embodiments shown coaxial valve operating devices one acting, when effective, through the other will be disclosed, but it will be obvious that neither the coaxial arrangement—the aligned arrangement—nor the operation of one device through the other is essential, and that each operating means can be arranged for direct coaction with the valve or for direct coaction independently of the other with a common valve moving element.

An object of this invention is to provide an improved unloading mechanism for a compressor. Another object is to provide an improved unloading mechanism adapted to be actuated when different operating conditions exist for unloading a compressor. Still another object is to provide an improved fluid actuated unloading mechanism responding to pressure fluid or fluids supplied thereto on the occurrence of different operating conditions for unloading a compressor. Yet another object is to provide an improved unloading mechanism responsive to fluid, or different fluids, supplied under pressure from different sources for effecting unloading of a compressor. Other objects of the invention will hereinafter more fully appear.

In the accompanying drawing in which for purposes of illustration two forms of the invention have been shown:

Fig. 1 is a vertical cross sectional view through a working end of a compressor cylinder and the valve mechanism associated therewith, illustrating a preferred embodiment of the invention.

Fig. 2 is a similar view showing another embodiment.

It will be appreciated that the invention is applicable to intake closure, to discharge venting, and to inlet valve opening types of unloading systems, but for purposes of illustration it will suffice to show the same associated with the last type of unloading.

In each of the illustrative embodiments of the invention shown, a compressor cylinder 1 is provided with a bore 2 having a piston 3 reciprocably mounted therein. Formed in the cylinder coaxially with the bore 2 is an enlarged bore 5 receiving a valve mechanism, generally designated 6, and a cylinder head 7. The cylinder head is provided with a flange 8 which is clamped to the upper end of the cylinder, as by bolts 9, and the lower end of the cylinder head rests upon the valve mechanism 6 and holds the latter firmly against a shoulder 11 at the junction between the bores 2 and 5. Extending laterally through the cylinder is an intake passage 14 communicating with a passage 15 which extends through the cylinder head 7 and the valve mechanism 6 into communication with the bore 2. Formed in the

valve mechanism is a discharge passage 17 communicating with a passage 18 extending laterally through the cylinder at the side of the latter opposite the intake passage 14. An inlet valve 20 controls the flow of fluid between the intake passage 15 and the cylinder bore, and a discharge valve 21 controls the flow of fluid between the cylinder bore and the discharge passage 17. The piston 3 is caused to reciprocate by means not shown and fluid moves past the inlet valve into the cylinder bore and is then forced out past the discharge valve to the discharge passage 18.

Supported on the cylinder head 7 in Fig. 1 is an unloading mechanism, generally designated 24. This unloading mechanism includes a member 25 and plates 26 and 27 attached to the cylinder head as by bolts 28. Formed between the plate 27 and the member 25 is a chamber 29 within which a reduced portion 30 of a plunger 31 projects through openings 32 and 33 formed in the member 25 and the plate 26, respectively. An enlarged portion 35 of the plunger is received in a recess 37 in the cylinder head and carries rods or fingers 38 extending through openings 39 in the cylinder head into the intake passage 15 where they are adapted to engage the inlet valve to move the latter from its seat and unload the compressor. The plunger 31 is normally held in its raised position by a spring 40 arranged in the recess 37. The spring 40 and the plunger are guided by a pin 41 fixed to the cylinder head and projecting upwardly through an opening in the spring into a recess 42 formed in the plunger. Surrounding the reduced portion 30 of the plunger just above the plate 26 is a packing 44 sealingly engaging the plunger for preventing the escape of pressure fluid from the chamber 29 into the recess 37. Mounted on the plate 27 are members 46 and 47 held by bolts 48 extending through openings in the plate 27 and in a flange on the member 25. Formed between the members 46 and 47 is a chamber 49, and a flexible diaphragm 50 is received in this chamber and is clamped between the members 46 and 47. A plunger 51 is arranged in the chamber 49 and has an enlarged head 52 which is held in engagement with the diaphragm 50 by a coiled spring 54. A reduced portion 55 of the plunger 51 extends downwardly through openings in the member 47 and the plate 27 into the chamber 29 in axial alinement with the plunger 31. A packing 57 fits within a recess in the member 47 surrounding the reduced portion 55 and sealingly engages the latter for preventing escape of pressure fluid from the chamber 29 to the chamber 49. Communicating with the chamber 29 is a conduit 58 through which pressure fluid may be supplied to act on the plunger 31 and force the latter downwardly. Communicating with the chamber 49 at the upper side of the diaphragm 50 is a conduit 59 through which pressure fluid may be supplied for forcing the diaphragm 50 downwardly and effecting an unloading movement of the plunger 31 through the plunger 51. The space in the chamber 49 beneath the diaphragm 50 is vented to atmosphere through a vent port 60. It will be seen that the unloading mechanism is adapted to operate at any time by supplying pressure fluid through either of the conduits 58 and 59 to the chambers 29 and 49, and the presence of pressure fluid in either one of these chambers has no effect upon the operation of the mechanism by the supply of fluid to the other.

It will be noted that the effective area of the diaphragm 50 greatly exceeds the cross sectional area of the plunger portion 55 and hence the presence of fluid under pressure in the chamber 29 will not preclude the downward movement of the plunger 51 even if the operating pressure for the diaphragm be lower than that in chamber 29, as may be the case if the oil pressure from the engine or compressor be used to operate the diaphragm 50 and pump discharge pressure be used to actuate the plunger 31. The mode of operation of this form of the invention may be readily understood when it is considered that if there be pressure supplied through passage 58 when pump discharge pressure reaches the desired maximum, and the compressor be unloaded, and the engineer decides to connect his hoist for drive by the engine, and fluid is then automatically supplied through connection 59, the plunger or stem 51 will move down and engage the plunger 31 and accordingly, if the compressor discharge pressure falls off enough to occasion reloading, with resultant venting of pump discharge pressure from the chamber 29, the compressor will still be held unloaded, and the load of the working compressor will not be thrown onto the then hoist actuating engine.

Now referring to the other illustrative embodiment of the invention and to Figure 2, it will be seen that attached to the cylinder head 7 is an unloading mechanism generally designated 64. This unloading mechanism comprises members 65 and 66 and a plate 67 fixed to the top of the cylinder head as by bolts 68. Formed between the members 65 and 66 is a chamber 69, and a flexible diaphragm 70 clamped between the members 65 and 66 is movable within the chamber. A plunger 71 projects through an opening in the plate 67 into the chamber 69 and has an enlarged portion 72 received within a recess 73 formed in the cylinder head beneath the plate 67. Attached to the portion 72 are rods or fingers 75 which extend through openings 76 of the cylinder head into the intake passage 15 and are engageable at their lower ends with the inlet valve 20 to move the latter from its seat and unload the compressor cylinder. A spring 77, shown herein as a bowed plate type spring, acts between the bottom of the recess 73 and the plunger 71 to hold the latter normally in its upper position. A guide pin 79 fixed to the cylinder head extends through an opening in the spring 77 into a recess 80 in the plunger 71 to guide the moving parts. Surrounding the plunger just above the plate 67 is a packing 81 sealingly engaging the plunger to prevent the passage of pressure fluid from the chamber 69 to the recess 73. A spring 83 rests upon the packing 81 and acts against the lower surface of the diaphragm 70 to hold the latter normally in its raised position. Opening into the chamber 69 at the upper and lower sides of the diaphragm 70 are ports 85 and 86 through which pressure fluid may be supplied for effecting actuation of the plunger 71. Pressure fluid supplied through port 85 acts on the upper surface of the diaphragm to force the latter toward a lower position moving with it the plunger 71 for unseating the inlet valve 20, thereby unloading the compressor cylinder. Pressure fluid supplied through the port 86 to the chamber 69 beneath the diaphragm 70 acts directly upon the plunger 71 and moves the latter to its unloading effecting position.

It will be observed that the effective area of the plunger 71 is comparatively small compared with that of the diaphragm and so, if the plunger 71 is held down by a dropping pressure as the pilot

valve bleeds off the compressor discharge pressure from within chamber 69 through connection 86, the diaphragm 70 may be moved down and act to hold the unloading fingers in effective position before the pressure within chamber 69 becomes so low that the inlet valve will reclose and assume normal operation. If desired, and indeed preferably, any suitable means may be provided to enable fluid admitted through passage 85 to have immediate access to a large area of the upper surface of diaphragm 70 even when the latter is in top position.

As a result of this invention, there is provided an improved unloading mechanism operable to effect unloading of a compressor on the occurrence of different operating conditions. It will be noted that the unloading mechanism is adapted to be operated by fluid supplied under pressure to different pressure chambers, and any one of the pressure chambers may be vented without effecting the operation of the mechanism by fluid supplied to another of the pressure chambers. Different fluids, and similar fluids under different pressures may be used if desired, and by reason of the features of the invention, the desired automatic control of the load on the compressor driving motor may be maintained.

This application is a continuation-in-part with respect to each of the following applications, to wit: Ser. No. 379,943, filed Feb. 21, 1941, and Ser. No. 415,958, filed Oct. 21, 1941, a portion of its subject matter having been carved out of one of said earlier applications and another portion from the other.

While there are shown in this application two forms which my invention may assume in practice, it will be understood that these forms are shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

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

1. A compressor unloading mechanism comprising a lower chamber, an unloading plunger extending within said chamber, valve means controlled by said plunger and movable to a position for effecting unloading, means for supplying pressure fluid to said chamber for acting on said plunger and moving it in a direction to effect movement of said valve means to its unloading position, a chamber arranged above said lower chamber and containing a diaphragm dividing it into separate chamber spaces, a plunger received within one of said chamber spaces and having a portion projecting downwardly into said lower chamber, means for yieldably holding said last mentioned plunger against said diaphragm, and means for supplying fluid under pressure to the other of said chamber spaces for forcing said diaphragm downwardly and moving said plungers in an unloading direction.

2. A compressor unloading mechanism comprising a lower chamber, an unloading plunger extending within said chamber, valve means controlled by said plunger and movable to a position for effecting unloading, means for supplying pressure fluid to said chamber for acting on said plunger and moving it in a direction to effect movement of said valve means to its unloading position, a chamber arranged above said lower chamber and containing a diaphragm dividing it into separate chamber spaces, a plunger received within one of said chamber spaces and having a portion projecting downwardly into said lower chamber in axial alinement with said unloading plunger, means sealingly engaging the projecting portion of said last mentioned plunger for preventing the escape of pressure fluid from one of said chambers to the other, and means for supplying fluid under pressure to the other of said chamber spaces for forcing said diaphragm downwardly and moving said plungers in an unloading direction.

3. A compressor unloading mechanism comprising an upper and a lower chamber, an unloading plunger extending into said lower chamber, valve means controlled by said plunger and movable to a position for effecting unloading, means for supplying to said lower chamber a fluid under pressure for acting on said plunger and moving it in a direction to effect movement of said valve means to its unloading position, means for yieldably urging said plunger toward said lower chamber, a diaphragm clamped within said upper chamber and dividing the latter into upper and lower chamber spaces, a plunger received within said lower chamber space and having a reduced portion extending within said lower chamber above said unloading plunger, means sealingly engaging said reduced plunger portion for preventing the passing of pressure fluid between said chambers, and means for supplying a fluid under pressure to said upper chamber space for acting on said diaphragm and effecting movement of said plungers in an unloading direction.

4. A compressor unloading mechanism comprising an upper and a lower chamber, an unloading plunger extending within said lower chamber, valve means controlled by said plunger and movable to a position for effecting unloading, means for supplying pressure fluid to said lower chamber for forcing said plunger in a direction to effect movement of said valve means to its unloading position, a diaphragm clamped within said upper chamber and dividing the latter into upper and lower chamber spaces, means for transmitting an operating force from said diaphragm to said plunger, means for supplying a fluid under pressure to said upper chamber space, and means for venting said lower chamber space.

5. A compressor unloading mechanism comprising a chamber, a diaphragm dividing said chamber into separate chamber spaces, an unloading plunger extending within one of said chamber spaces, valve means controlled by said plunger and movable to a position for effecting unloading, means for supplying to said chamber space containing said plunger a fluid for acting on said plunger and moving it in a direction to effect movement of said valve means to its unloading position, and means for supplying to said other chamber space a fluid for acting on said diaphragm and effecting movement of said plunger in an unloading direction.

6. A compressor unloading mechanism comprising a chamber, a diaphragm dividing said chamber into separate chamber spaces, an unloading plunger extending into one of said chamber spaces against said diaphragm, means for yieldably urging said plunger toward said chamber space, valve means controlled by said plunger and movable to a position for effecting unloading, means for supplying to said chamber space containing said plunger a fluid under pressure for acting on the end of said plunger and moving

it in a direction to effect movement of said valve means to its unloading position, and means for supplying to said other chamber space a fluid under pressure for acting on said diaphragm and effecting movement of said plunger in an unloading direction.

7. In a compressor unloading mechanism, in combination, an unloading plunger, a chamber receiving a portion of said unloading plunger, valve means controlled by said plunger and movable to a position for effecting unloading, means for supplying a pressure fluid to said chamber for forcing said plunger in a direction to effect movement of said valve means to its unloading position, fluid actuated means supported above said plunger for transmitting an operating force to said plunger, and means for supplying pressure fluid to said fluid actuated means.

8. In a compressor unloading mechanism, in combination, an unloading plunger, a chamber receiving a portion of said unloading plunger, valve means controlled by said plunger and movable to a position for effecting unloading, means for supplying a pressure fluid to said chamber for forcing said plunger in a direction to effect movement of said valve means to its unloading position, means including a diaphragm supported above said plunger for transmitting an operating force to said plunger, and means for supplying pressure fluid to said diaphragm.

9. In a pump unloading mechanism, in combination, a valve movable to unload a pump, means for transmitting movement to said valve to move it to unloading position, a plurality of means each operative independently of operating medium supply to any other, upon operating medium supply thereto, to move said movement transmitting means to effect unloading, and means for conducting operating medium to said last mentioned means.

10. In a pump unloading mechanism, in combination, a valve movable to unload a pump, means for transmitting movement to said valve to move it to unloading position, a plurality of means each operative independently of operating medium supply to any other, upon operating medium supply thereto, and one exerting its force through the other, to move said movement transmitting means to effect unloading, and means for conducting operating medium to said last mentioned means.

11. In a pump unloading mechanism, in combination, a valve movable to effect unloading, a plurality of fluid operated devices for actuating said valve, said actuating devices operable each by fluid supplied thereto independently of fluid supply to any other, and means for conducting operating fluid to and venting fluid from said actuating devices.

12. In a pump unloading mechanism, in combination, valve means movable to effect unloading of a pump, and operating means for said valve means including fluid operated actuating devices for said valve means independently suppliable with operating fluid, one of said devices superimposed on the other, and said devices having separate sources of operating fluid.

13. In a pump unloading mechanism, in combination, valve means movable to effect unloading of a pump, and operating means for said valve means including fluid operated actuating devices for said valve means, one device exerting its valve means operating force through the other device, and said devices having separate sources of operating fluid.

14. In a pump unloading mechanism, in combination, a valve movable to effect unloading, a plurality of actuating means for said valve, said actuating means each being responsive to the action of an operating medium, and having a valve actuating element in common, and independent means for delivering operating medium to said actuating means whereby each may be actuated by its operating medium independently of operating medium delivery to any other.

15. In combination, valve means whose positioning determines whether or not a pump is loaded, means for transmitting movement to said valve means to move it from one operating position to another, a plurality of means for moving said movement-transmitting means to effect movement of said valve means, each of said plurality of moving means operative on operating medium supply thereto to effect valve means movement and one operative on fluid operating medium supply thereto to move and to exert its force through the other, and means for conducting operating medium separately to said means for moving said movement-transmitting means.

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