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AUTOMATIC UNLOADER FOR COMPRESSORS

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Fig. 1

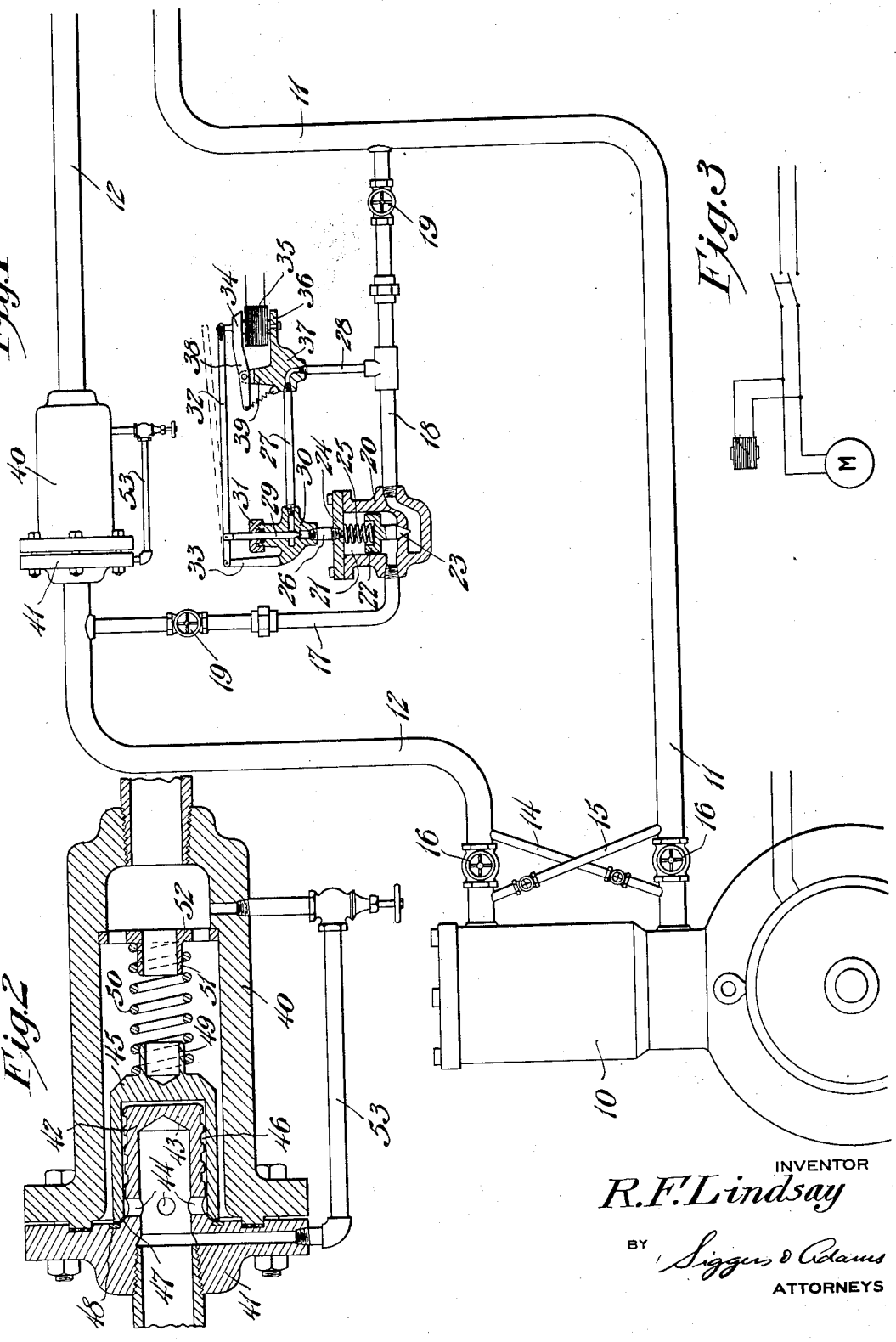


Fig. 2

Fig. 3

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AUTOMATIC UNLOADER FOR COMPRESSORS

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4 Claims. (Cl. 230—22)

This invention relates to control apparatus for compressors and, among other objects, aims to provide improved automatic, quick-acting unloading means particularly adapted for use in connection with motor driven ammonia and other compressors used in refrigerating systems.

Other aims and advantages of the invention will appear in the specification when considered in connection with the accompanying drawing, wherein:

Fig. 1 is a side elevation, partly in section, showing the preferred form of apparatus applied to an ammonia compressor;

Fig. 2 is a sectional view on an enlarged scale showing an improved check valve in the discharge pipe line; and

Fig. 3 is an electrical diagram.

Compressors for refrigerating plants must have provision for relieving the pressure in the discharge line or on the "high side" before they are started; otherwise, the pressure will build up and the resultant overload may burn out the motor and other electric equipment. Heretofore, it has been customary to provide manually controlled by-passes wherein valved conduits are connected between the discharge and intake lines. However, failure to operate such systems has resulted in serious accidents and damage to the equipment. This invention, therefore, aims to provide an improved quick-acting, automatic and reliable by-pass system whereby the pressure in the discharge line or "high side" is relieved when the compressor is stopped so that it may be started without relying upon any manual means and the memory of an operator.

Referring particularly to the drawing, there is shown an ordinary motor driven compressor 10 having an intake conduit 11 and an outlet or discharge conduit 12. The usual valved by-pass conduits 14 and 15 are connected to the conduits 11 and 12 on opposite sides of valves 16 and are adapted to be utilized for manual operation when desired.

In accordance with this invention, a by-pass 17 is connected to the inlet and discharge conduits 11 and 12 and is shown as having a horizontal portion 18. A pair of manually operable gate valves 19 are conveniently arranged in the by-pass line. In the horizontal portion 18, there is shown a differential valve including a casing 20 having a cylinder 21 forming a guide for a loosely fitting differential piston 22 which carries a tapered valve member 23, which, when seated as shown, stops flow of fluid through the by-pass. A cover plate 24 is suitably secured to the casing and a compression spring 25 of the desired strength is arranged between the cover and the piston 22. The arrangement of these parts and the spring adjustment are such that the differential valve is normally closed when the compressor is working.

A vertical pressure relief pipe or vent 26 is shown as being connected to the valve casing 20 so as to relieve the pressure above the piston 22 and permit the valve 23 to open responsively to extraordinary pressure on the lower end of the piston. This relief pipe is conveniently secured to the pipe 18 on the suction side by means of pipes 27 and 28. In this instance, a needle valve 29 is arranged in an L fitting 30 connecting pipes 26 and 27 and this valve is adapted to be opened so as to effect the operation of the automatic by-pass valve 23. Herein, the stem of the needle valve 29 projects vertically through a stuffing box 31 and has a forked end pivoted to an operating lever 32 which, in turn, is pivoted at its end to an upstanding bracket 33 on the fitting 30. The free end of the lever 32 is shown as being slotted and connected to the armature 34 of an electromagnet 35 which is supported on a bracket 36 in the form of an arm on a special union 37 for the pipes 27 and 28.

In this example, the electromagnet, when it is energized, holds the needle valve 29 closed. To lift the armature 34 and lever 32 and thereby open the needle valve, there is shown a spring-urged lever 38 pivotally connected to an upstanding bracket 39 on the union 37. Thus, the needle valve 29 will be opened automatically by the action of the spring lever when the current is cut off or the motor circuit is opened and the electromagnet is deenergized.

In the illustrated example, a special check valve is arranged within a cylindrical casing 40 in the discharge line 12 beyond the by-pass conduit connection. See Fig. 2. The casing is shown as having a flanged end closure 41 bolted to a flange on the casing and provided with suitable packing to make it leak-proof. The end closure is also connected to the discharge conduit and presents an inwardly extending cylindrical guide 42 having a closed end wall 43 and radial ports 44. A cup-shaped sleeve valve 45 is mounted on the guide 42 and the latter has a series of spaced annular grooves 46 to reduce the metallic contact and to catch any oil or scale particles so as to prevent sticking. Moreover, this provides, in effect, a labyrinth packing. The inside of the closure or cover has an annular frusto-conical valve seat 47 and the inner edge of the open

end of the sleeve valve is machined to conform to it. The sleeve valve also seats at its end against an annular, soft metal seating ring 48 pressed into a groove around the frusto-conical seat. The construction is such as to insure perfect seating of the sleeve valve after the frusto-conical surface is worn.

The sleeve valve 45 is shown as having a hollow extension 49 over which a compression coil spring 50 is inserted. The other end of the spring is mounted on a tubular boss 51 of a perforated partition 52 seated in the casing and forming a fixed abutment for the spring. The arrangement is such that the spring 50 normally tends to seat the sleeve valve. When the compressor starts, the sleeve valve will be opened quickly by the pressure of the gas against its inner end wall. When the compressor stops the sleeve valve will close gradually because the gas must be forced out its inner end around the guide 42. Thus, its closing is cushioned, dash-pot fashion, so that it will not make any noise or batter and quickly destroy its seats. Hence, the improved valve will last and seat firmly almost indefinitely.

An ordinary valved by-pass pipe 53 is conveniently connected to the valve casing for the purpose of pumping out the high side whenever desired.

The operation of the system should be apparent from the foregoing description. It will be understood that the special check valve 45 will close automatically when the compressor stops. Simultaneously, the electromagnet 35, which is connected in the motor circuit as shown in Fig. 3 and which normally holds the pressure relief valve 29 closed, is deenergized, thereby relieving the pressure on the upper side of the differential valve piston 22 and permitting the accumulated pressure in the discharge line 12 to be relieved by allowing the gas to pass through conduit 18 into the suction line 11. The compressor is ready to be started and as soon as the circuit to the motor is closed, the electromagnet is energized thereby closing the pressure relief valve 29 so that the by-pass valve will be closed as soon as discharge pressure is applied to the upper end of the differential piston 22 of the valve 23. The check valve 45 will be opened when the discharge pressure is applied to its end wall, so that the gas may pass on through the conduit 12.

From all of the foregoing description, it will be seen that the apparatus is relatively simple and that it is entirely automatic in its operation. It can be manufactured at a relatively low cost and installed in existing compressor systems. There are no extremely delicate parts which are subjected to severe treatment or wear and which will require quick replacement. Furthermore, the device is reliable in operation and affords a great protection not only to the equipment but to the operator.

Obviously, the present invention is not restricted to the particular embodiment thereof herein shown and described. Moreover, it is not indispensable that all the features of the invention be used conjointly, since they may be employed advantageously in various combinations and sub-combinations.

What is claimed is:

1. An automatic unloader for a motor driven compressor comprising, in combination, a by-pass conduit connecting the discharge side to the suction side; a normally closed differential pressure operated valve in said by-pass conduit; a normally closed valve connected to relieve the seating pressure on said differential valve; an electromagnet operatively associated with said relief valve and connected in circuit with the compressor motor and means connected between the electromagnet and the relief valve normally to hold said relief valve closed and to open said relief valve when the motor circuit is broken.

2. In combination, a discharge line; a check valve arranged in the discharge line; a by-pass conduit communicating with the discharge line between the check valve and the source of pressure and connected to the suction line; a valve in said by-pass conduit having a differential piston and arranged to be normally seated; a pressure relief conduit connected to the valve casing; a valve in the pressure relief conduit; a pivoted lever connected to operate said last named valve; an electromagnet having an armature connected to said lever, said electro-magnet being electrically connected to a motor circuit to be energized so as to hold the valve closed when the motor circuit is closed; and means automatically to open said valve when the electromagnet is deenergized whereby said differential piston will be operated to open the by-pass valve.

3. A by-pass valve for compressor systems comprising, in combination, a casing; a partition therein providing an upper pressure chamber and a lower suction chamber, said partition having an opening providing a valve seat; a differential piston in said pressure chamber having a depending valve coacting with said seat; said valve being normally closed by the increase of fluid pressure on the top of the piston; and means to relieve the pressure on top of the piston to permit pressure on the lower side of the piston to open the valve.

4. A by-pass valve for compressor systems, comprising, in combination, a casing; a partition therein providing an upper pressure chamber and a lower suction chamber; a valve seat; a differential piston in said pressure chamber having a depending valve coacting with said seat; said valve being normally closed by the increase of fluid pressure on the top of the piston; said pressure chamber having an outlet at the upper end thereof; a relief valve in said outlet; and magnetically operated control means connected to said relief valve.

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