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COMPRESSOR

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Fig. 1

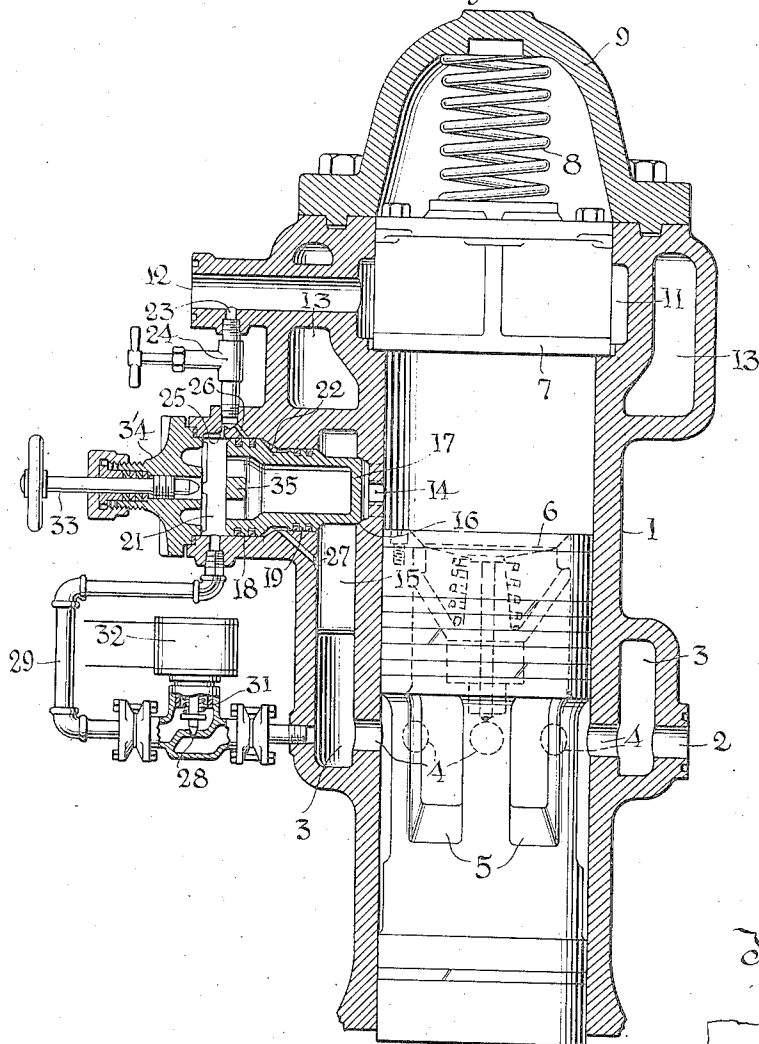
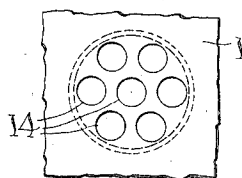
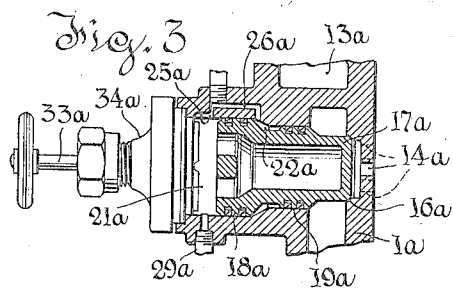


Fig. 2



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COMPRESSOR

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10 Claims. (Cl. 230—22)

This invention relates to compressors, and particularly to unloading means therefor.

It has heretofore been proposed to actuate an unloading valve, and specifically an unloading valve controlling a port located at part stroke in the cylinder wall, by means of a small single-acting piston motor, to which pressure fluid is supplied at a restricted rate from the compressor discharge, and from which pressure fluid is at times vented to compressor suction at a rate exceeding the rate of supply.

Venting of the motor caused the unloading valve to open under the urge of cylinder pressure, and, since the motor was single-acting, the valve was unrestrained when open. Under certain conditions, because of fluctuating cylinder pressure, such valves were found to reciprocate and produce an objectionable knocking noise.

The object of the present invention is to impart to such a valve, when open, a moderate opening tendency, and to do this by means of pressure derived from compressor discharge, and preferably controlled by motion of the valve motor itself. In its preferred form, the invention contemplates the use of a differential piston motor to actuate the unloading valve, the piston performing certain distributing valve functions.

The invention will now be described by reference to the accompanying drawing, in which:—

Fig. 1 is a vertical axial section through the cylinder of a compressor equipped with the invention;

Fig. 2 is an enlarged face view of the unloading ports; and

Fig. 3 is a fragmentary view showing a modification.

In the drawing, 1 represents the cylinder of the compressor, having a suction connection 2 leading to the chamber 3 encircling the cylinder. From chamber 3 suction ports 4 lead through the cylinder wall and communicate throughout the piston stroke with slots 5 in the trunk piston 6.

The piston 6 is reciprocated in any usual manner and carries the inlet valve (shown in dotted lines), which, according to familiar practice, is mounted in the piston head. The safety head 7 of the cylinder 1 is seated by spring 8 confined by removable head 9. The discharge valves are mounted in the safety head 7 and control flow to chamber 11 and discharge connection 12. A water jacket is shown at 13.

The compressor, as so far described, conforms to standard practice in the refrigeration art.

Formed in the wall of cylinder 1 in position to be overtraveled by the piston at part stroke, is a group of unloading ports 14 which, when open, communicate by way of passage 15 with suction chamber 3.

Controlling ports 14 is a valve seat 16 with which coacts valve head 17 formed in the end of a differential piston having a large head 18 and a slightly smaller head 19. Both heads are provided with piston rings. Piston head 18 works in a cylinder 21 and pressure acting on its outer face urges the valve 17 closed. Piston 19 works in a smaller cylindrical bore and defines an annular working space 22 in cylinder 21 in which pressure fluid reacts in a valve-opening direction against the peripheral portion of the large piston 18.

A branch 23 leads from discharge passage 12, through a stop valve 24 (normally open) to deliver gas under discharge pressure to two ports 25 and 26.

Port 25 is a constantly open but quite restricted port leading to cylinder 21 at the outer side of piston 18.

Port 26 leads to cylinder space 22, but is so located as to be blanked by piston head 18 when valve 17 is closed, and in fact until the valve nears its fully open position. There is also a related exhaust port 27 leading from space 22 to passage 15, and so located as to be open when valve 17 is closed, and to be blanked by piston head 19 as valve 17 opens and before port 26 is exposed by head 18.

Hence, as valve 17 approaches fully open position, the motor acts to hold it open. If the valve be forced a short distance toward closed position, the motor ceases to exert this opening tendency.

To control the pressure on the outer side of piston 18, a normally closed valve 28 is interposed in a vent connection 29 leading from cylinder 21 to chamber 3. The capacity of valve 28, when open, exceeds the capacity of port 25. Valve 28 is urged closed by a spring 31 and may be held open by exciting the electric winding 32. This excitation may be subjected to control by any physical quantity responsive to compressor performance, such as discharge pressure, suction pressure, temperature in a refrigerated space (when the compressor is in a refrigerating circuit), or the like. Such controls are conventional and, hence, are not illustrated.

To lock the valve 17 closed, a stem 33 is threaded in bonnet 34 and may be screwed in manu-

ally to engage a lug 35 and force the valve 17 to its seat.

While the described arrangement of ports is preferred, port 27 can be omitted and port 26 can then be relocated so as to be constantly open to space 22. Such an arrangement is shown in Fig. 3, where parts similar to those in Fig. 1 are identified by the same reference numerals with the letter *a*. In the device of Fig. 3, the pressure in 22a exerts a continuous opening force, which is overpowered by pressure acting inward on head 18a when the vent from space 21a is closed. The effective piston area in a closing direction is consequently the area of head 19a.

Both devices are characterized by the use of a differential piston motor with pressure from a supply common to the two, but the arrangement first described is preferred because the closing force on the valve, when the valve is closed, is greater, and because there is better protection against leakage of high pressure gas past the valve actuating piston heads.

What is claimed is:—

1. The combination of a compressor; means for unloading the same; a reversible pressure motor connected to actuate said unloading means and comprising reversely acting movable abutments of unequal areas; means for delivering pressure fluid from the discharge of said compressor to react in opposite directions against said two abutments, the supply to the larger of said abutments being restricted; and means operable alternately to retain the pressure fluid acting upon the last-named abutment or to vent it at a greater rate than the restricted rate of supply.

2. The combination of a compressor; means for unloading the same; a reversible pressure motor connected to actuate said unloading means and comprising reversely acting movable abutments of unequal areas; means for delivering pressure fluid from the discharge of said compressor at a restricted rate to react against the larger of said abutments; means operable alternately to retain the pressure fluid acting against the larger of said abutments or vent it at a rate greater than the restricted rate of supply of pressure fluid thereto; and valve means operated by the reverse motions of said motor alternately to admit pressure fluid from said discharge connection to act against the smaller of said abutments and to terminate such supply and exhaust said pressure fluid therefrom.

3. The combination of a compressor; an unloader valve associated therewith; a differential piston head connected to shift said valve and having a larger effective area in a valve-closing direction than in a valve-opening direction; means for supplying pressure fluid at a restricted rate to react on the larger area of said piston head in a valve-closing direction; means operable alternately to retain or to vent such pressure fluid at a rate greater than the rate of supply; and means for supplying pressure fluid from the same source to react against the smaller area of said piston head in a valve-opening direction.

4. The combination of a compressor; an unloader valve associated therewith; a differential pistonhead having a larger effective area in a valve-closing direction than in a valve-opening direction; means for supplying pressure fluid at a restricted rate to react on the larger area of said piston head in a valve-closing direction; means operable alternately to retain or to vent such pressure fluid at a rate greater than the rate

of supply; and means controlled by motion of said piston head for admitting pressure fluid from the same source to react against the smaller area of said piston in a valve-opening direction when the valve is open and to cut off such supply and vent such pressure fluid when the valve is closed.

5. The combination with a compressor having an unloading valve adapted to vary the weight of air compressed in a working stroke, of pressure operated means for actuating said valve, said means having a valve-opening and a valve-closing position; and means responsive to the fluid pressure against which the compressor discharges for biasing the valve actuating means to valve-opening position.

6. The combination of a compressor; an unloader valve associated therewith and urged in an opening direction by pressure developed in the working space of the compressor; means operable to hold said valve closed; and means for retaining said valve in its fully open position comprising an abutment operatively related to said valve and ports controlled by said abutment for subjecting said abutment to pressure developed by the compressor when said valve is open.

7. The combination of a compressor having a discharge connection and a suction connection; an unloader valve associated with said compressor; a double-acting motor connected to actuate said valve in reverse directions; and valve means controlling the supply of pressure fluid from said discharge connection to said motor and the exhaust of pressure fluid from said motor to said suction connection, said valve means being operable to cause said motor to shift said unloader valve in reverse directions.

8. The combination of a compressor having a suction connection and a discharge connection; an unloader valve associated with said compressor; a double-acting motor of the differential piston type arranged to exert a relatively heavy closing force on said valve and a relatively light opening force on said valve; and valve means controlling the supply of pressure fluid from said discharge connection to said motor and the exhaust of pressure fluid from said motor to said suction connection, said valve means being operable to cause said motor to hold said unloader valve closed or retain said unloader valve in open position.

9. The combination of a compressor; an unloading valve associated therewith and urged in an opening direction by pressure developed in the working space of the compressor, said unloading valve comprising a combined poppet valve and piston head, the latter having a large effective area upon which pressure may act in a valve closing direction and a smaller annular area upon which pressure may act in a valve opening direction; and means operable selectively to subject said large area to pressure while relieving the smaller area of pressure to hold the unloading valve closed and to subject said smaller annular area to pressure while relieving pressure from said large area to hold said unloading valve open.

10. The combination of a compressor having a discharge connection and a suction connection; an unloading valve associated with said compressor, said unloading valve comprising a valve element arranged to control unloading flow from the working space of the compressor to said suction connection, and a piston head having a relatively large effective area in a valve closing

direction and a relatively small effective area in a valve opening direction; and valve means operative selectively to subject said large area to pressure derived from said discharge connection while venting said smaller area to said suction connection to hold the unloading valve closed

and to connect said smaller area with said discharge connection while dissipating pressure from said large area to said suction connection to hold said unloading valve open.

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