This invention relates to compressors, and more particularly to an unloader for a compressor driven by a constant-speed driver, such as a synchronous electric motor, which is not readily adapted for varying the capacity of the compressor.

One object of the invention is to unload a compressor in such a manner that the discharge pressure is held relatively constant, regardless of the demand for pressure fluid from said compressor.

Another object is to permit the degree of unloading of a compressor to be selectively obtained through the complete range from no-load to full load.

Still a further object is to provide a means for adjusting the pressure on a spring-loaded discharge valve for a compressor so that it will close during each piston cycle when the piston reaches a particular point on its suction stroke. In other words, by varying the spring pressure on the valve, it is allowed to close at correspondingly varying positions of the piston during the suction stroke.

These objects will be in part obvious and in part pointed out hereinafter.

In the accompanying drawings in which similar reference numerals refer to similar parts,

Figure 1 is a top view, partly broken away, of a portion of a compressor embodying one form of the present invention, and

Figure 2 is an enlarged view, partly broken away, of the discharge valve mechanism shown in Figure 1.

Referring more particularly to the drawings and at first to Figure 1, a portion of a compressor designated, in general by 26, is shown as having a casing 21 forming a compression chamber 22 within which is a reciprocating piston 23 for compressing the fluid medium. A cylinder head 24 covers the end of the compression chamber 22 and has an inlet port 25 and a discharge port 26 for the compression chamber located adjacent thereto.

Air is conveyed by an intake line 29 to an inlet chamber 27 in the head 24, whence it passes through the inlet port 25 into the compression chamber 22. The flow of air through the port 25 is controlled by a typical compressor inlet valve 28. The air compressed in the compression chamber 22 passes through the port 26 into a clearance chamber 30 in the cylinder head 24 and is conveyed therefrom by a discharge conduit 31 which, in this instance, is provided with a flap-type check valve 32 for checking the rushback of compressed air into the clearance chamber 30 from a receiver (not shown).

To control communication between the compression chamber 22 and the clearance chamber 30 and to serve the additional function of unloading the compressor, a valve mechanism 33 is adapted to be held firmly seated in the discharge port 26 by adjustable push rods 34 threadedly connected into a head plate 35. The valve mechanism 33 selected for the purpose of illustrating a practical application of the invention is of the type forming the subject matter of the Baker patent for Compressor Valve No. 2,112,875, granted April 5, 1938. Accordingly, the valve mechanism 33 comprises a body 36 having a plurality of ports 37 and a cover 38 having ports 39 therein through which all of the air from the compression chamber is discharged. Channel valves 33 positioned between the body 36 and cover 38 and adapted to control the flow of compressed fluid through the ports 37 and 19 are normally held seated over the ports 37 by arcuate shaped springs 40 acting between the valves 33 and members 41 on the cover 38. Each channel valve 33 has the usual side flanges 42 which, in this case, have apertures for receiving the hooked open ends of a U-shaped hanger 43 which is connected at the mid-point of its arcuate portion to an arm 44 of a lifter member 45.

Situatated adjacent the clearance chamber 30 and in line with the valve mechanism 33 is a tubular housing 46 which is attached to the cylinder head 24 by bolts 47 and is partitioned by a member 50 to form a cup-shaped opening in the outer end of the housing to receive a piston 48. The piston 48 is provided with a stem 49 which extends through an aperture in the partition 50 into a chamber 54 defined by that portion of the housing closest to the clearance chamber 30. An abutment 51 on the stem 49 is designed to constantly maintain a chamber 52 between the piston 48 and the partition 50.

The piston 48 is constantly urged toward the partition 50 by a spring 55 acting between the piston and a plate 57 secured over the open end of the housing 46 by bolts 58. However, connected into the chamber 52 is a pipe 53 which conveys a fluid whose pressure may be varied to the chamber 52 from an outside source (not shown) for moving the piston 48 away from the partition 50 a distance corresponding to the pressure of said fluid. Communication between the chamber 52 and chamber 54 which opens directly into the clearance chamber 30 is prevented by
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a seal 55 in the partition 50 surrounding the piston stem 49.

In order to permit rapid motion of the channel valves 39, a coil spring 59 extends through an opening in the head plate 36 and forms a compressed member between the cross bar 48 and the piston stem 49. The spring 59 has its ends projecting through apertures in the opposed ends of the member 45 and stem 49 and is further adapted to transmit any tension which may be exerted on the piston 48 by the pressure fluid in the chamber 52, through the cross bar 45 to the valves 49.

In normal operation, the air compressed in the compression chamber 22 on the compression stroke of the piston 23 urges the valves 39 from their seats and passes through the valve mechanism 53 into the clearance chamber 30, from whence it travels into the discharge conduit 31 through the check valve 32 and on into a receiver (not shown). In such operation the valves 39 have a certain closed period during each piston cycle. However, when the occasion arises where less compressed air output is required from the compressor, a fluid having a selected pressure is fed into the chamber 52 through the pipe 53 by any suitable means (not shown), thus moving the piston 48 from its seated position against the partition 55. This consequently exerts a tension on the spring 59 which is transmitted through the cross bar hanger arrangement to the valves 39 and will overcome some of the pressure exerted on the valves 39 by the springs 40 which normally hold the valves seated during all of the suction stroke of the piston 23.

Now the force tending to hold the valves seated is considerably less than that normally exerted by the springs 40 and the piston 23 must move over a portion of its suction stroke before the pressure differential between the clearance chamber 30 and the compression chamber 22 is great enough to overcome the tension holding the valves 39 open. The closed period of the valve is thereby shortened during this type of operation. However, the air compressed in the compression chamber 22 will still pass into the clearance chamber 30, but a portion of that air will be allowed to travel back into the compression chamber during part of the suction stroke of the piston 23 thereby partially unloading the compressor.

It will be noted that by introducing a very high pressure fluid into the chamber 52 the valves 39 may be held unseated at all times, thereby unloading the compressor completely. By varying the pressure of the fluid in the chamber 52 then, the degree of unloading is likewise varied, since the valves 39 may be caused to operate during each piston cycle at times corresponding to varying positions of the piston 23 on the suction stroke.

It will be further understood that the spring 59 not only allows the free movement of the valves 39 each piston cycle but also transmits a certain tension from the piston 48 which tends to overcome the pressure of the springs 40 on the valves 39. Moreover, this tension does overcome the pressure of the springs 40 during portions of the suction stroke of the piston when partial unloading of the compressor is desired.

With the present invention then, infinite degrees of compressor unloading may be attained and selective control of said unloading is made possible. Also, since the degree of unloading may be varied between successive piston cycles it is possible to maintain a practically constant discharge pressure regardless of the load on the compressor.

It will be apparent to those familiar with the art to which this invention pertains that various modifications and changes may be made without departing from the spirit of the invention or the scope of the claims.

I claim:

1. In an unloader for a compressor, a casing having a compression chamber, a reciprocative piston therein, a clearance chamber, a valve for controlling communication between the compression chamber and the clearance chamber, a spring normally exerting pressure on the valve, a housing adjacent the clearance chamber and forming a chamber, a pressure fluid operated piston in said chamber, and resilient means connecting the last said piston to the valve to allow the piston to partially relieve the spring pressure on the valve to vary the closed period of the valve during the suction stroke of the piston.

2. In an unloader for a compressor, a casing having a compression chamber, a reciprocative piston therein, a clearance chamber, a discharge valve for controlling communication between the compression chamber and the clearance chamber, a spring normally acting to seat the valve, a housing adjacent the clearance chamber and forming a chamber, a piston in said chamber, a stem for the piston, a spring attached to the stem and to said valve, and means for introducing a variable pressure fluid into said chamber to actuate said piston and partially relieve the pressure of the first-mentioned spring on the valve to vary the closed period of the valve during the suction stroke of the piston.

3. In an unloader for a compressor, a casing having a compression chamber, a reciprocative piston therein, a clearance chamber, a discharge valve for controlling communication between the compression chamber and the clearance chamber, a spring normally acting to seat the valve, a lifter member attached to said valve, a housing adjacent the clearance chamber and forming a chamber, a piston in said chamber, a stem for the piston, a spring connected between the stem and lifter member, and means for introducing a variable pressure fluid into said chamber to actuate said piston and vary the closed period of the valve.

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