Feb. 28, 1961 S. R. HIRSCH 2,973,132

UNLOADING MEANS FOR RECIPROCATING COMPRESSOR

Filed Oct. 20, 1958 2 Sheets-Sheet 1

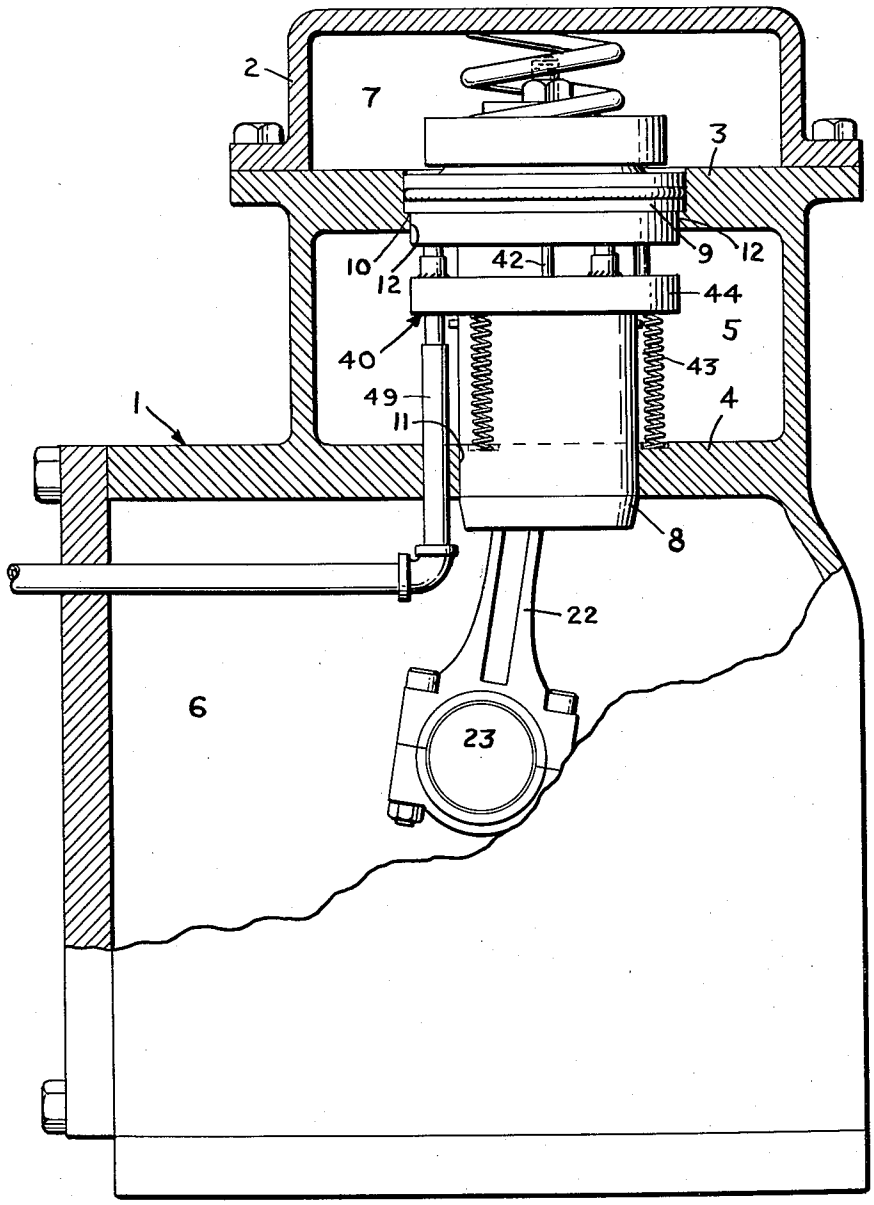


FIG. 1

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UNLOADING MEANS FOR RECIPROCATING COMPRESSOR

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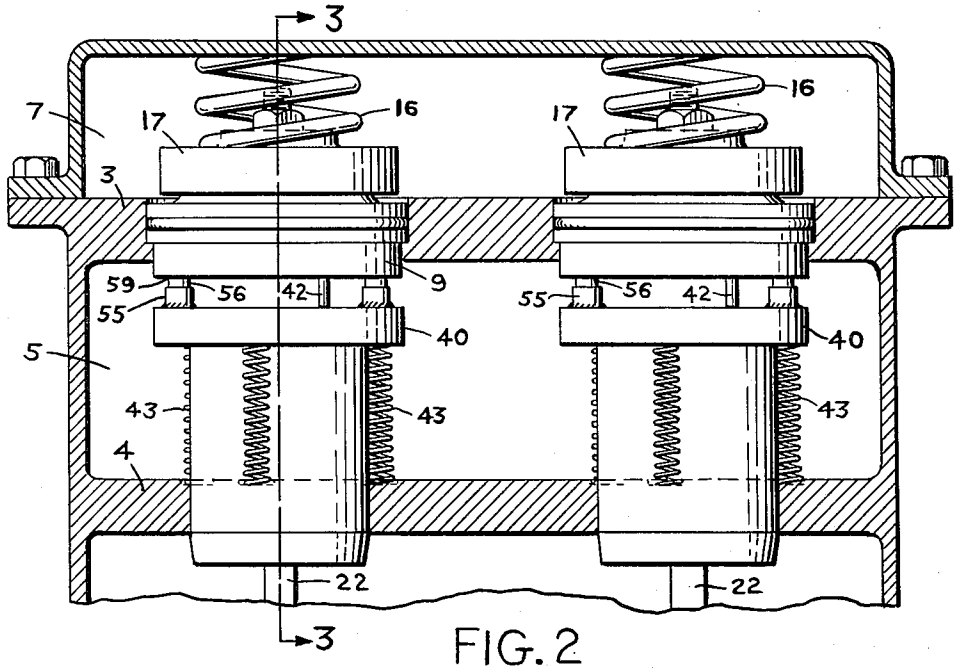


FIG. 2

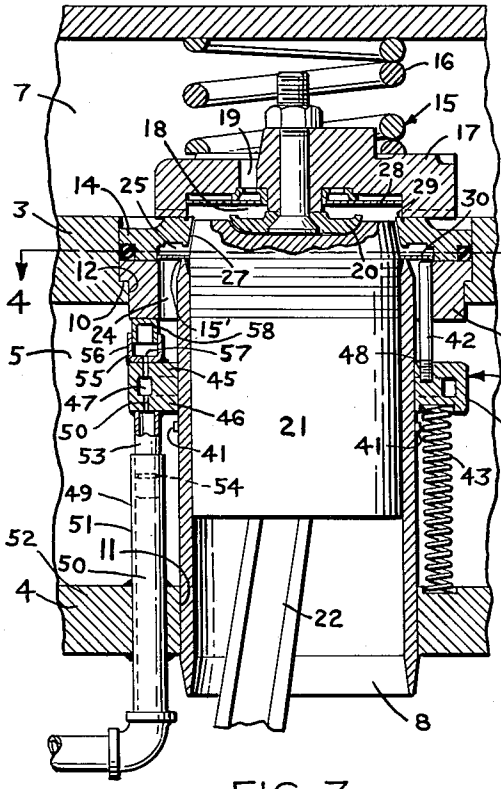


FIG. 3

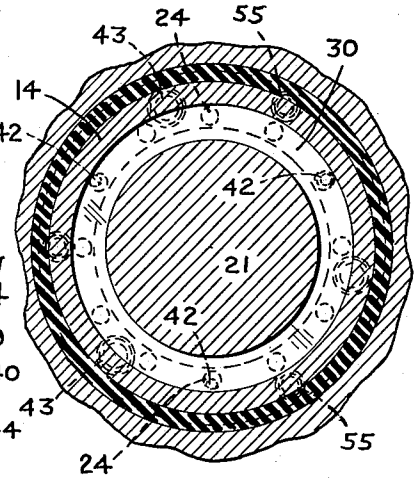


FIG. 4

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UNLOADING MEANS FOR RECIPROCATING COMPRESSOR

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6 Claims. (Cl. 230—30)

This invention relates to reciprocating compressors and more particularly to means for varying the capacity of such compressors.

In the common type of reciprocating compressor installation, the compressor supplies working fluid to a storage tank from whence the fluid passes for use. The fluid pressure and capacity within the tank varies in accordance with the demands of the compressor installation to thereby vary the required output of the compressor.

As is well known the unloading means associated with the compressor functions to regulate the fluid pressure and capacity in the storage tank within predetermined limits by loading and unloading the compressor of the installation. There are a number of unloading means employed in the art for this purpose which, together with the present invention, are rather generally based on the same fundamental conception. Thus, they have a movable means associated with an actuating arm or the like whereupon the movable means at predetermined times moves the actuating means to load or unload the compressor.

Within the broad limits just defined, there is much room for improvement in these unloading means for reciprocating compressors. From a practical standpoint, many of the compressors employ unloading means which are complex, expensive to manufacture and of an operative relationship with the compressor which befuddles the individuals charged with the proper operation of the compressor installation.

The present invention overcomes many of the difficulties in prior types of unloaders by providing a compressor with means for varying the capacity thereof wherein the unloading means is of a relatively simple design including a movable fluid receiving chamber having a telescopic tubular means associated therewith and for supplying a source of fluid thereto usually from the lubricating system of the compressor and an expansible actuating means which receives fluid from the fluid chamber at predetermined periods to regulate the capacity of the compressor with which it is associated.

Accordingly, it is an object of the present invention to provide an unloading means which has relatively few parts and hence can be manufactured at less cost, can be assembled outside the compressor as a sub-assembly, easily installed without misalignment, is easily removed and disassembled when repairs become necessary, and is fabricated with minimum moving sealing parts which seal on large surface areas to thereby substantially reduce sticking.

With these and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing the unloader means associated with a reciprocating compressor, and the features forming the invention will be specifically pointed out in the claims.

In the drawings:

Figure 1 is a transverse section through a portion of the compressor showing the unloading means in operating position.

Figure 2 is a longitudinal section through a portion of the compressor also showing the unloading means in operating position.

Figure 3 is a section taken on line 3—3 of Figure 2 showing the details of the unloading means.

Figure 4 is a section taken on line 4—4 of Figure 3.

Referring to the drawings, Figure 1 shows a portion of the casing generally designated 1 and the head 2 of a reciprocating compressor. An upper bulkhead 3 and a lower bulkhead 4 form a suction manifold 5 in the casing 1 separated from the crankcase 6. The head 2 forms a discharge manifold 7 with the upper bulkhead 3 when in assembled position.

While Figure 1 illustrates only one cylinder, it will be understood by those familiar with this art that the present arrangement may be used in single or multi-cylinder reciprocating compressors.

Broadly Figures 1 and 3 show an elongated cylindrical liner 8 having a flange 9 disposed about the upper end. The outer edge of the flange 9 being shouldered as at 10 to fit in a groove formed in the upper bulkhead 3 to thereby support the cylinder liner 8 and other elements of the valve means as hereinafter described and which are also mounted on the flange 9. The lower end of the cylinder liner 8 has a slip fit with the opening 11 in the lower bulkhead 4, of lesser diameter but in alignment with the opening 12 in the upper bulkhead 3.

A valve plate 14 is mounted on the upper end of the flange 9 so that a suction valve seat 15' is formed therebetween and in operative communication with the suction manifold 5.

The liner 8 and valve assembly are further fixedly mounted in operative position by means of a combined holding means 15 such as the spring 16 shown in the drawings and a discharge valve housing 17 disposed in engagement with the upper or outer face of the valve plate 14 and forming a discharge valve chamber 18 therebetween and in operative communication with the discharge manifold 7 through port 19.

In order to properly hold the discharge valve in operative position a discharge valve stop 20 is mounted in the discharge valve housing 17 as is clearly shown in the drawings.

A piston 21 is adapted to be reciprocated in conventional manner in the cylinder formed by the liner 8 by means of a piston rod 22 and a crankshaft 23 driven by any suitable prime mover means not shown. Inwardly of the periphery of the flange 9 a plurality of circumferentially spaced suction inlet ports 24 provide communication between the suction manifold 5 and a suction valve chamber 25. The suction valve chamber 25 communicates in turn with the cylinder and fluid will flow from the suction manifold through the ports 24 chamber 25 to the cylinder in accordance with the position of the annular suction valve strip disposed in the valve chamber and held there in position by any convenient means such as valve springs not shown.

The discharge chamber 18 communicates with the cylinder through an annular port 27 formed by the discharge valve stop 20 and in valve plate 14 and with the discharge manifold 7 through a plurality of discharge ports 19 circumferentially disposed in the clamping and discharge valve housing 17. A discharge valve strip 28 seats across the valve stop and a shoulder 29 formed on the valve plate 14.

When the compressor is loaded inward movement of the piston 21 causes the discharge valve strip 28 to close the annular port 27 and gas to flow from the

suction manifold 5 through suction inlet ports 24 and suction valve chamber 25 to the cylinder. After the piston reaches bottom dead center and starts to move upwardly the compressor compresses the gas in the cylinder causing the annular suction valve strip 30 to close the suction inlet ports 24 and the discharge valve strip 28 to open and the compressed gas to be forced out against the pressure of the gas in the discharge manifold through annular ports 27 discharge valve chamber 18 and discharge ports 19 to the discharge manifold 7 and from there to use.

In order to operate the compressor at increments of its full capacity one or more of the suction valve strips 30 are held in an open position so that the cylinder associated with this valve strip will be unable to deliver compressed gas to the discharge manifold as described hereinabove.

This is accomplished by an unloader assembly referred to as means for varying the capacity of the compressor generally designated 40 and shown in the drawings as mounted in the suction manifold 5 about the liner 8 and supported in operative position by the lower bulkhead 4. Stop means 41 taking the form of shoulders formed on the liner function to limit the movement of the unloader 40 to maintain same in spaced relation with the valves as hereinafter discussed.

The unloader assembly coacts with suction valve actuating means taking the form of pins 42 which are disposed to engage and disengage the valve depending on the action of the unloader means as is more fully described hereinafter.

Springs 43 referred to as means to resist the action of the unloader means are preferably mounted to move the pins normally into engagement with the valves to thereby hold the cylinder in the unloaded position. While the description indicates that the springs 43 normally operate to hold the valves in the unloaded position and operative action of the unloader is necessary to overcome the resistance of the springs to load the cylinder it will be understood by those familiar with this art that the present arrangement may be very easily reversed to thereby cause an unloading of the cylinder by action of the unloading means and that the description herein is purely illustrative.

The unloader assembly 40 is of relatively simple construction. It comprises a movable fluid receiving chamber 44 mounted on the outer surface of the liner 8. Specifically it is formed from two annular rings 45 and 46 mounted in a fluid sealing relation to provide a fluid chamber 47 therebetween, the pin 42 being operatively connected to one face thereof as at 48 to therefore move into and out of engagement with the suction valve 30 upon movement of the fluid chamber 44.

Accordingly, in order to provide the movement as hereinabove contemplated, a hollow expansible means 49 is connected to the chamber through port 50 to provide a source of actuating fluid thereto from, for example, the lubricating system of the compressor (not shown). The means 49 comprises a tube 51 connected in wall 52 to a source of lubricating fluid not shown and includes another tube 53 mounted in telescopic relation with tube 51 to provide and return fluid to and from the chamber 47 throughout its course of movement on the cylinder 8. An O-ring 54 is provided as is shown in the drawings to provide a positive seal between tubes 51 and 53.

Expansive actuating means 55 are associated with the fluid chamber 47 and formed thereon to receive or return fluid thereto. The means 55 takes the form of a cylinder 56 mounted on the upper face of the chamber 44 and having fluid communication therewith through port 57. A piston 58 is movably and sealably mounted in cylinder 56 and preferably bearing against the flange 9 as at 59, accordingly then it is evident that increased fluid flow from the source to fluid chamber 44 to cylinder 56 will expand means 55 to therefore move the chamber downwardly on the cylinder 8 to move the pin 42 out of engagement with the valve strip to load the cylinder 8.

As many embodiments may be made in the above invention and as many changes may be made in the embodiment above described, it is to be understood that all matter hereinabove set forth or shown in the accompanying drawings is to be interpreted as illustrative only and not in a limiting sense.

What is claimed is:

1. Means for varying the capacity of a reciprocating compressor including a casing, a cylinder in said casing, a piston slidably disposed in said cylinder, a suction inlet and discharge outlet for said cylinder and having valve means to control fluid flow into and out of said cylinder, said means for varying the capacity of said compressor comprising an annular ring movably mounted about said cylinder and concentric therewith and having a fluid receiving chamber therein, actuating means connected to one end of said chamber and at the other end adapted to engage said valve for said suction inlet, spring means mounted on the other end of said fluid chamber and to cause said fluid chamber to move said pin means into engagement with said valve for said suction inlet, a hollow extensible means connected at one end of said fluid receiving chamber for providing a source of fluid thereto, and expansible actuating means abutting said cylinder at one end and at the other end connected to the fluid receiving chamber to receive fluid therefrom to move said pin means out of engagement with said valve for said suction inlet when fluid is supplied thereto.

2. The combination claimed in claim 1 wherein the means comprising the fluid receiving chamber includes an annular ring slidably mounted about the cylinder and includes an annular fluid chamber having a port communicating with the hollow extensible means and another port communicating with the expansible actuating means.

3. The combination claimed in claim 1 wherein the hollow extensible means comprises a first and second tube means, the first tube mounted in the casing and the second tube movably disposed in the first tube and in telescopic connection with the fluid receiving chamber to provide communication therewith during movement thereof.

4. The combination claimed in claim 1 wherein the expansible actuating means comprises a piston disposed in a cylinder, the cylinder mounted on the fluid receiving chamber and the piston connected to the cylinder.

5. Means for varying the capacity of a reciprocating compressor including a casing, a cylinder in said casing, a piston slidably disposed in said cylinder, and a suction inlet and a discharge outlet for said cylinder having suction and discharge valves operatively associated therewith to control fluid flow into and out of said cylinder, said means for varying the capacity of said compressor comprising an annular ring slidably disposed about the cylinder and concentric therewith and forming an annular fluid receiving chamber therein with said cylinder, plural ports in said ring and communicating with said fluid chamber, pin means operatively connected at one end to said suction valve and at the other end to said annular ring, spring means on said casing and mounted in abutment with said annular ring to urge said pin means to open said suction valve, a tube means mounted in said casing and including other tube means mounted therein in telescoping connection with the annular ring to provide fluid communication therewith during movement thereof through one of said ports, and a cylinder means mounted on said annular ring and in fluid communication with the other of said ports, a piston means slidably disposed in said cylinder means and operatively connected to said cylinder, whereby said piston expands

in said cylinder when fluid is supplied thereto to overcome the action of said spring means.

6. Means for varying the capacity of a reciprocating compressor including a casing, a cylinder in said casing, a piston slidably disposed in said cylinder, and a suction inlet and a discharge outlet for said cylinder having suction and discharge valves operatively associated therewith to control fluid flow into and out of said cylinder, said means for varying the capacity of said compressor comprising an annular ring having an upper and lower face and being slidably disposed about the cylinder and concentric therewith, said annular ring having an annular fluid receiving chamber therein, a first port in the lower face of said ring and communicating with said fluid receiving chamber, a plurality of equally spaced ports in the upper face of said annular ring and communicating with said fluid receiving chamber, pin means operatively abutting said suction valve at one end and mounted on the upper face at the other end, spring means on said casing and abutting the lower face of said annular ring to urge said pin means to open said suction valve, a first tube means mounted in said casing and including other tube means mounted in telescoping relation with the first tube means at one end and connected to said first port at the other end, fluid supply means connected to the first tube means for supplying fluid to said annular fluid receiving chamber, cylinder means sealably mounted over each of the ports in the upper face of the annular ring, piston means slidably disposed in each of said cylinder means and in abutment with the cylinder whereby said piston expands in said cylinder when fluid is supplied thereto to move said pin means out of abutment with the suction valve.

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