

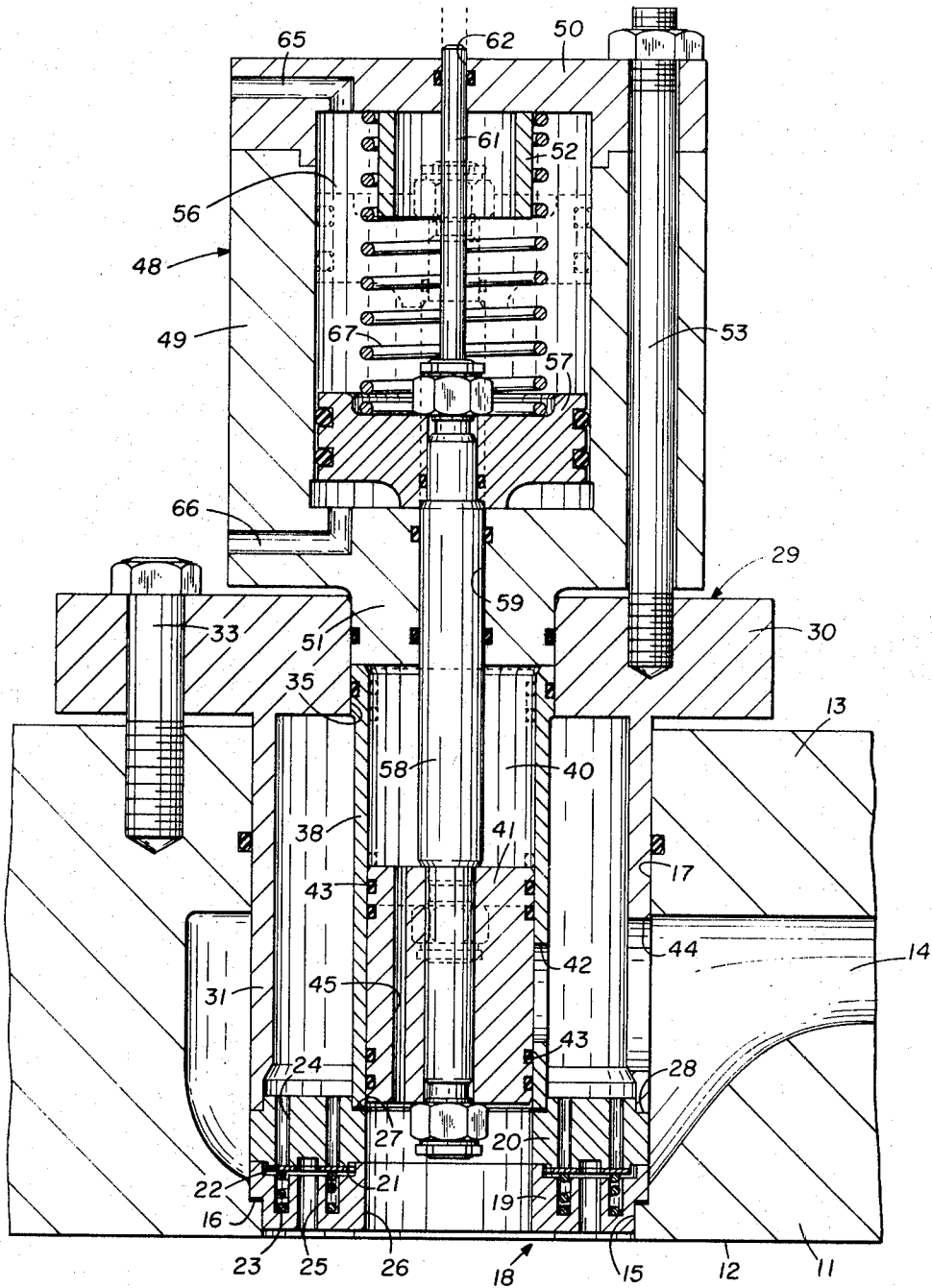
June 30, 1970

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3,518,032

COMPRESSOR CYLINDER UNLOADER

Filed May 24, 1968



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COMPRESSOR CYLINDER UNLOADER

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Filed May 24, 1968, Ser. No. 740,418

Int. Cl. F04b 21/02, 49/00, 49/02

U.S. Cl. 417-440

8 Claims

ABSTRACT OF THE DISCLOSURE

An unloader assembly for a gas compressor cylinder includes an open-throated suction valve and a sleeve having one end abutting the valve and communicating with the valve throat. The sleeve defines a chamber for a reciprocating control piston, and has a port which communicates with the suction chamber of the compressor cylinder. In the unloaded position, the piston uncovers the port to provide a flow path between the suction chamber and the cylinder compression chamber through the valve throat; and in the loaded position the control piston covers the sleeve port to close this flow path. The control piston is vented to equalize the pressure acting across it, and is shifted between the loaded and unloaded positions by a fluid operated actuator piston.

BACKGROUND OF THE INVENTION

In gas compressors having a well known type of suction valve assembly which includes a seat member, a stop plate member, and valve closures in the form of disks, rings, or reeds which are normally urged against associated seats on the seat member, it is conventional practice to unload the compressor cylinder by mechanically lifting and holding the valve closures off their associated seats. This is usually accomplished by a reciprocable member having fingers which extend through the air passages in the valve seat member to engage the closures. This type of unloader mechanism operates very effectively at low differential pressures; however, at pressure differentials of 500 p.s.i. and above, this type of unloader mechanism is not so effective. At the higher pressures, the valve assembly may become overheated due to the relatively low orifice coefficient, the force necessary to unseat the valve closures from their valve seats may become excessive, and the valve closures may become damaged because of the high impact forces of the valve closures on the seats at the time of loading. Excessive temperature is a particular problem at higher differential pressures, due to the restricted and tortuous flow paths through valves of this type; and this condition is aggravated by the fingers of the unloader mechanism which necessarily extend through the valve passages and further restrict air flow through both the loaded and unloaded conditions.

An object of the present invention is to provide an improved unloader assembly for a compressor cylinder which is particularly effective at higher differential pressures, and which requires minimum force for operation.

SUMMARY OF THE INVENTION

An unloader assembly according to the invention includes a conventional suction valve which is provided with a central passage or throat. A tubular member engaging the outboard face of the valve communicates with the valve throat, and includes a wall port which communicates with the cylinder suction chamber. A control piston, slidable within the tubular member, closes communication between the valve throat and the port in one position and opens communication between the valve passage and port in another position.

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BRIEF DESCRIPTION OF THE DRAWING

The invention is illustrated by way of example in the attached drawing consisting of a fragmentary sectional view of a compressor cylinder, the section being taken axially through a suction valve and unloader assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawing there is shown a fragmentary portion of a compressor cylinder including an inner wall portion 11 which defines a wall 12 of the compressor chamber, and an outer wall portion 13 which defines an exterior wall. A cylinder suction chamber 14 is defined between the walls 11 and 13.

A suction valve opening 15 is provided in the inner wall 11 communicating the suction chamber 14 and the compression chamber; and this opening 15 is provided with an outward facing shoulder 16 which accommodates the suction valve 18. The outer wall 13 includes a larger opening 17, aligned with the valve opening 15.

The suction valve 18 is of conventional design, consisting of a stop plate member 19 and a seat member 20 defining a valve lift chamber 21, and a pair of concentric valve closure rings 22 urged against their respective valve seats by springs 23. Radially and angularly spaced transverse passages 24 in the valve seat member communicate the valve lift chamber 21 with the suction chamber 14; and radially and angularly spaced transverse passages 25 in the stop plate member communicate the valve lift chamber 21 with the compression chamber. On the suction stroke, then, the closure rings 22 are unseated, and the gas flows into the compression chamber through the passages 24 past the closures 22, then through the passages 25. On the compression stroke, of course, the closure rings 22 seat against the valve seats preventing flow through the valve in the reverse direction.

The valve 18 is seated on the shoulder 16, and sealed relative thereto with a suitable gasket; and the valve is provided with a transverse central passage or throat 26 which provides an alternative flow path through the valve between the suction chamber 14 and the compression chamber. The outer face of the valve defined by the seat member 20 includes an inner peripheral shoulder 27, adjacent the throat 26, and an outer peripheral shoulder 28.

The suction valve 18 is secured against the cylinder shoulder 16 by a valve chair 29 consisting of a flange portion 30 and an integral downwardly extending sleeve portion 31. The sleeve portion 31 extends through the opening 17 in the outer cylinder wall 13; and the lower end of the sleeve portion 31 seats on the valve shoulder 28. The valve chair is secured to the cylinder wall 13 by means of suitable bolts 33 which pass through openings in the flange portion 30. The sleeve portion provides a close fit with the cylinder wall opening 17, and is sealed relative thereto by a suitable O-ring received in an annular groove in the sleeve portion.

The valve chair flange portion 30 is provided with a central opening 35 which is aligned with the throat 26 of the valve 18. The opening 35 accommodates tubular sleeve 38, the lower end of which seats on the inner valve shoulder 27 and is sealed to the valve by means of a of a suitable gasket. The upper end of the sleeve 38 provides a close fit with the opening 35, and is provided with an external annular groove accommodating a suitable O-ring to provide a seal between the sleeve and opening.

The sleeve 38 defines a cylindrical chamber 40 for an elongated cylindrical control piston 41; and is provided with one or more wall ports 42 which communicate the interior and exterior of the sleeve. The piston 41 has an axial length greater than the axial span of the ports 42;

and is provided with piston rings 43 adjacent its ends for the purpose of providing a seal between the piston and sleeve both above and below the ports 42, when the piston is in the position as illustrated in solid lines in the drawing. This is the loaded position of the control piston 41, wherein the piston 41 closes off communication between the valve throat 26 and the sleeve ports 42. The valve chair sleeve portion 31 is also provided with one or more ports 44, so that the sleeve ports 42 are continuously communicated with the cylinder suction chamber 14.

The control piston 41 is actuated by a fluid operated actuator 48 including a generally cylindrical housing defined by a cup-shaped body 49 and a cover 50. The bottom wall of the body 49 includes a downwardly extending cylindrical boss 51 which is received with a close fit within the valve chair opening 35, and is sealed relative to the opening by means of an O-ring received in an external annular groove in the boss 51. The actuator 48 is secured to the valve chair flange portion 30 by means of studs 53, which pass through the actuator body 49 and cover 50, and associated nuts. The actuator 48, then, secures the sleeve 38 against the valve shoulder 27 and closes the upper end of the sleeve.

The actuator body and cover define a closed cylinder chamber 56 for an actuator piston 57 which reciprocates within the chamber in sealed relation with the chamber walls. The actuator piston 57 and the control piston 41 are coupled together in axially spaced relation by means of a spindle 58, the spindle passing through a bore 59 in the actuator body boss 51 and being sealed relative thereto by a suitable O-ring. The spindle 58 is provided with an outer extension 61 which passes through a suitable bore 62 in the actuator cover 50 in sealed relation therewith.

Suitable passages 65 and 66 are provided in the actuator housing for directing operating fluid to and from the chamber 56, respectively above and below the actuator piston 57, for the purpose of shifting the assembly of the pistons 57 and 41 between upper and lower positions. In the drawing the piston assembly is shown, in solid lines, in the lower position, in which the unloader assembly is in the "loaded condition." The piston assembly is shifted to and maintained in this position by fluid under pressure directed to the chamber 56 through the passage 65. In this position, the control piston 41 spans the sleeve ports 42; and the piston rings 43 provide seals between the piston and sleeve both above and below the ports 42. The control piston 41 is provided with one or more vent passages 45 which provide communication between the opposite faces of the piston and serve to equalize the pressures acting on the opposite faces. With this arrangement, it is not necessary to overcome the compression chamber pressure in order to shift the control piston 41 to the loaded position. With the unloader assembly in the loaded condition, the suction valve 18 functions in the usual manner to admit gas to the compression chamber.

In order to shift the piston assembly to the upper position, in which the unloader assembly is in the "unloaded condition," fluid under pressure is directed to the chamber 56 through the passage 66, while the chamber 56 above the actuator piston 57 is vented. The piston assembly then moves to an upper limiting position which is defined by a stop sleeve 52 secured to the actuator cover 50. This stop sleeve 52 limits the upward movement of the piston assembly to a position where the sleeve port 42 is completely uncovered. Full communication is then provided between the cylinder suction chamber 14 and the cylinder compression chamber through the valve chair port 44, the sleeve port 42, the sleeve 38, and the valve throat 27.

The stop sleeve 52 also serves as a positioning boss for one or more compression springs 67, which serve to urge the piston assembly to the lower or loaded position.

The spindle extension 61 serves as an external visual indicating for the position of the control piston 41.

Because the above-described unloader assembly employs an open-throated suction valve, the orifice coefficient of the unloaded valve is very greatly improved. This provides the advantages that the valve operates much cooler during the unloaded condition and that less engine horsepower is required during the unloaded condition because there is less restriction to the flow of air into and out of the cylinder compression chamber. Also, the orifice coefficient of the suction valve is improved during the loaded condition because of the absence of unloader fingers in the valve passages. Because of the design wherein the pressures are balanced on the opposite sides of the control piston, the forces necessary to move the mechanism to either the loaded or unloaded position are only those necessary to overcome the seal friction. The mechanism, therefore, is particularly well adapted for operation with cylinders at higher differential pressures; and permits the design of an unloader mechanism for compressor units where it was not heretofore feasible.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a gas compressor having a compressor cylinder, a compressor piston slidable in said cylinder, a suction chamber, and a suction valve communicating said suction chamber and said cylinder: an unloader assembly for said cylinder comprising:

a tubular member engaging the outboard side of said suction valve; said suction valve being open-throated to define an air passage therethrough communicating with said tubular member; said tubular member having a wall opening defining a port communicating with said suction chamber;

a control piston slidable in said tubular member; said control piston cutting off communication between said port and said air passage in a first position, and opening communication between said port and said air passage in a second position; and means for moving said control piston between said first and second positions.

2. The assembly set forth in claim 1:

means closing the outboard end of said tubular member; said control piston having a longitudinal extent greater than that of said port, and said piston covering said port in said first position; and passage means extending between the opposite faces of said control piston to equalize the pressures acting thereon.

3. The assembly set forth in claim 1:

an actuator for said control piston including housing defining a closure wall for the outboard end of said tubular member; an actuator piston slidable within said actuator housing; spindle means coupling said control piston and said actuator piston, said spindle means extending through said closure wall in sealed relation therewith; and means for directing an actuating fluid to the opposite faces of said actuator piston.

4. The assembly set forth in claim 3:

an indicator rod extending outwardly from said actuator piston in parallel relation to said spindle; said indicator rod extending through the outboard wall of said actuator housing to visually indicate the position of said control piston within said tubular member.

5. The assembly set forth in claim 3:

spring means in said actuator housing engaging said actuator piston to urge said control piston to said first position.

6. The assembly set forth in claim 1:

said cylinder defining an outward facing shoulder for receiving said suction valve; the outboard face of said suction valve defining an outward facing peripheral shoulder; a valve chair engaging said valve shoulder; means securing said valve chair to said cylinder,

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whereby said valve is retained against said cylinder shoulder;
 said valve chair defining a wall opening axially aligned with said valve passage and axially spaced therefrom; and said tubular member engaging said suction valve in sealed relation at its inboard end and engaging said valve chair wall opening in sealed relation at its outboard end.

7. The assembly set forth in claim 6:

an actuator housing defining an outboard closure wall for said tubular member;

said actuator housing defining an actuator cylinder; an actuator piston slidable in said actuator cylinder; a spindle coupling said actuator piston and said control piston, said spindle passing through said closure wall in sealed relation; and means for directing an actuating fluid to the opposite faces of said actuator piston to shift said control piston between said first and second positions.

8. The assembly set forth in claim 7:

means for securing said actuator housing to said valve

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chair; said actuator housing engaging the outboard end of said tubular member to maintain said member in engagement with said valve.

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U.S. Cl. X.R.

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