

Dec. 19, 1967

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3,358,710

VALVE CONSTRUCTION FOR RECIPROCATING TYPE COMPRESSOR

Filed April 1, 1964

2 Sheets-Sheet 1

Fig. 1.

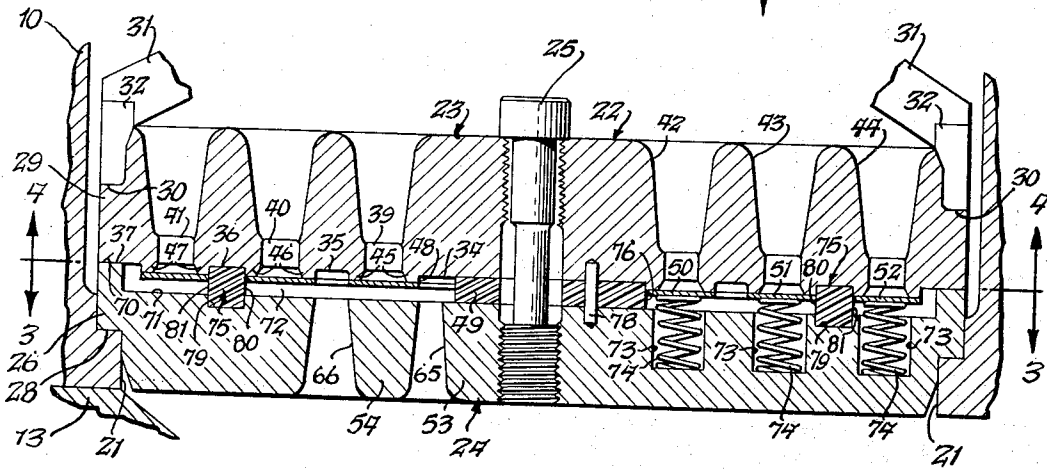
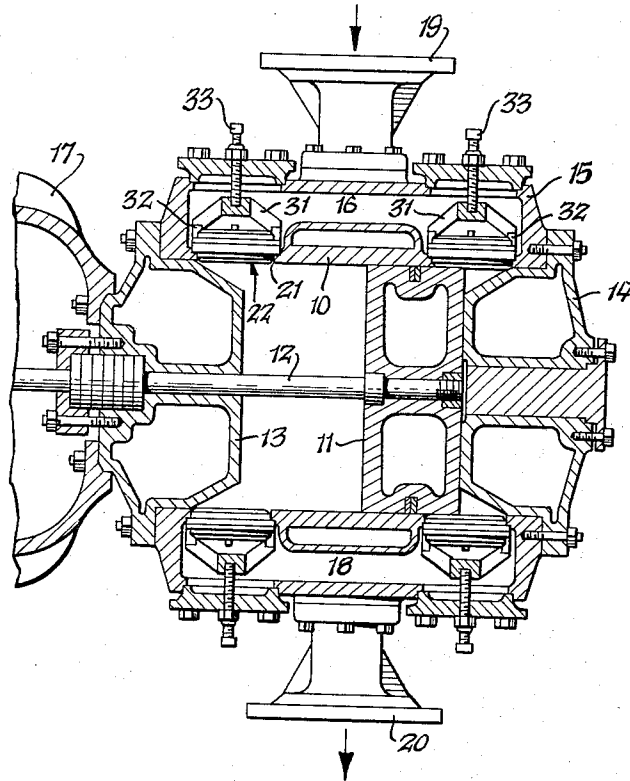


Fig. 2.

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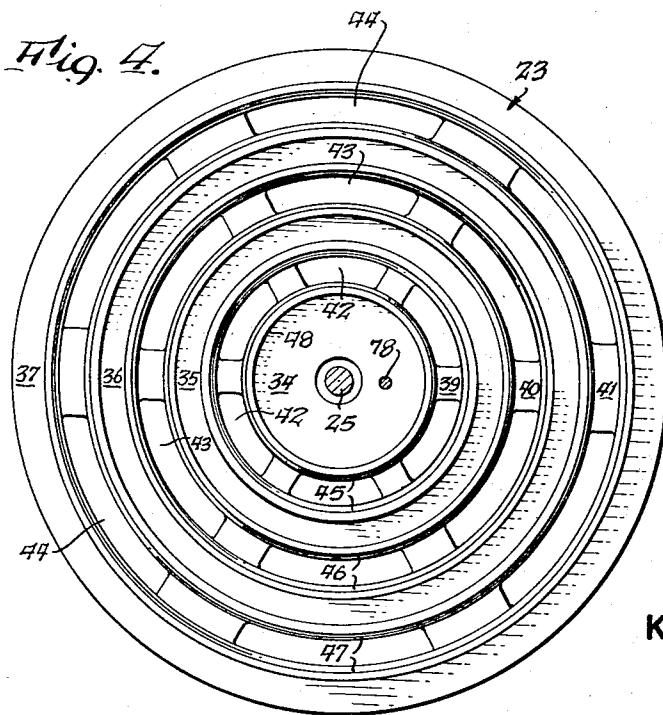
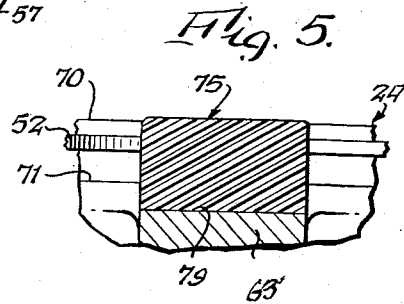
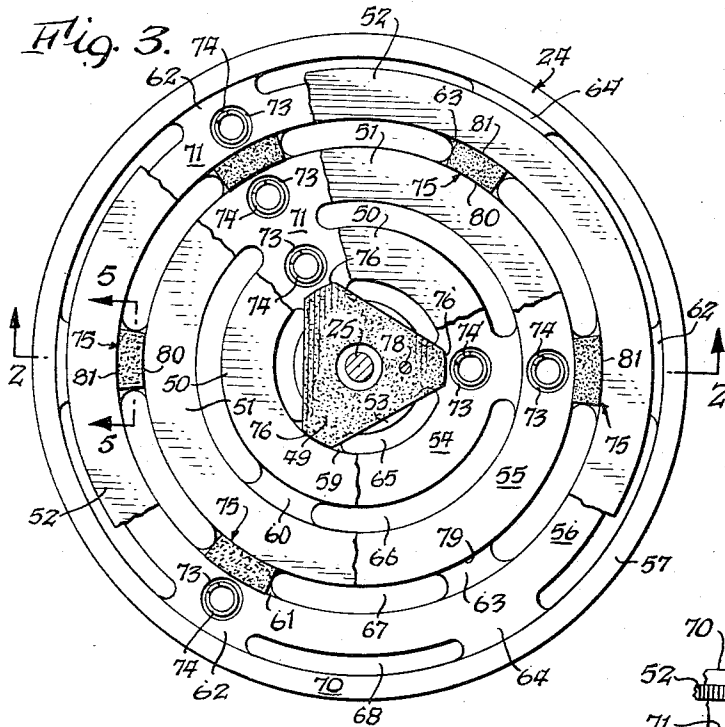
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Filed Apr. 1, 1964, Ser. No. 356,551
2 Claims. (Cl. 137—512.1)

This invention relates to an improved construction of a valve assembly for use in compressors of the reciprocating piston type.

The primary purpose of the present invention is to provide a valve assembly so constructed as to be suitable for use in reciprocating type compressors intended for handling a gas of such nature that the moving parts of the valve assembly cannot be lubricated. Cryogenic gases or pharmaceutical gases are examples where the content of lubricant oil is undesirable. Even in the case of compressed air the absence of vapor from a combustible lubricant oil may be desired to eliminate a fire hazard otherwise present. If a conventional valve assembly is used without lubrication excessive wear results.

Another object is to provide such a valve construction requiring no lubrication which is not subject to excessive wear and therefore has a long life, provides trouble-free service, is simple and relatively inexpensive to manufacture.

Other objects and advantages of the invention will be apparent from the following detailed description of a preferred embodiment illustrated in the accompanying drawings in which:

FIG. 1 is a vertical central longitudinal sectional view through a compressor cylinder assembly of the reciprocating double acting piston type and shown as provided with suction and discharge valves severally constructed in accordance with the principles of the present invention.

FIG. 2 is a greatly enlarged vertical central sectional view through one of the upper or suction valve assemblies shown in FIG. 1 and this view may also be considered as taken along line 2—2 of FIG. 3.

FIG. 3 is a horizontal sectional view on a reduced scale of the valve assembly taken generally on line 3—3 of FIG. 2 and showing in effect a top plan view of the stop plate member and valve rings arranged thereon, portions being broken away to reveal hidden structure.

FIG. 4 is a horizontal sectional view on a reduced scale of the valve assembly taken generally on line 4—4 of FIG. 2 and showing in effect a bottom plan view of the seat member.

FIG. 5 is an enlarged fragmentary vertical sectional view of the stop plate member taken on line 5—5 of FIG. 3.

Briefly, the invention is directed to the feature of arranging valve guides constructed of a polymer of ethylene such as tetrafluoroethylene opposite the peripheral edge of an annular valve so that such edge is guidingly engaged by a segmental surface portion on each guide which is generally concentric with such valve edge thereby guiding the valve during its opening and closing movements between a seat member and a stop member.

Referring to FIG. 1, the numeral 10 represents a cylinder member in which a piston 11 is reciprocably arranged. This piston 11 is suitably fast to one end of a piston rod 12 which extends outwardly through an inner end wall member 13 for the cylinder 10. This end wall 13 is suitably secured to the inner end of the cylinder and is also suitably secured to a cylinder support 17 which is connected to the crankcase (not shown) of an engine or other suitable prime mover. The outer end of the cylinder 10 is shown as closed by an end head 14. As is well known, the cylinder is also surrounded by a spaced casing 15 suitably partitioned to provide a suction chest 16 in the upper half of the space between the cylinder 10 and cas-

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ing 15 and a discharge chest 18 in the lower half. The suction chest 16 is arranged for communication through the fitting 19 with an inlet header (not shown). Similarly, the discharge chest 18 is arranged for communication through the fitting 20 with an outlet header (not shown).

Since the piston 11 is of the double acting type, the cylinder wall 10 adjacent each end is provided with a plurality of valve assembly openings such as shown typically at 21. In a typical compressor cylinder six such valve assembly openings may be provided at each end of the cylinder and arranged at circumferentially spaced intervals, three to accommodate suction valve assemblies in the upper half and the other three to accommodate discharge valve assemblies in the lower half.

The suction valve assembly 22 as shown at the upper left of FIG. 1 has been selected as a representative valve assembly embodying the present invention and will be described in detail.

Referring to FIG. 2, the valve assembly 22 is shown as comprising an upper seat member 23 and a lower stop plate member 24 secured together by fastening means including screw means indicated generally at 25 in FIG. 2.

The stop plate member 24 is shown as formed with an outwardly extending annular flange 26 adapted to engage a shoulder or step 28 formed in the cylinder 10 above the opening 21 therein. The upper member 23 is also shown as provided with an outwardly extending annular flange 29 which provides a horizontal upwardly facing shoulder 30. Any suitable device may be provided for holding the valve assembly 22 against its seat 28 on the cylinder wall 10. As shown such device comprises one or more yokes or bridges 31 which span the valve assembly diametrically and have feet 32 at their ends to engage the shoulder 30. A hold-down screw 33 suitably carried by the casing 15 can be adjusted to hold the valve assembly 22 against its seat; or the screw can be backed off to permit withdrawal of the valve assembly. The hold-down device forms no part of the present invention.

Referring to FIGS. 2 and 4, the upper or seat member 23 is generally a flat plate of disc shape including a plurality of radially spaced annular portions or ribs concentric with one another, four being shown and designated in order from the inner to the outer 34, 35, 36 and 37, respectively. These annular portions 34—37 are shown connected by a series of integral inner, intermediate and outer aligned radial portions or ribs 39, 40 and 41, respectively. Six series of such radial ribs 39—41 are shown as arranged at equal circumferentially spaced intervals. This provides a plurality of arcuate inlet passages arranged in three concentric circular rows, those in the inner row being designated 42, those in the intermediate row being designated 43 and those in the outer row being designated 44.

Preferably, as shown, the lower surface of the seat member 23 is integrally formed with downwardly projecting annular beads or narrow lands on radially opposite sides of each of the three rows of circumferentially interrupted annular passages 42, 43, 44. Such beads or ridges on the radially inner and outer sides of the inner row of passages 42 are designated 45; those for passages 43 are designated 46; and those for passages 44 are designated 47. The salients or land surfaces of these annular beads 45—47 are preferably coplanar.

The innermost annular portion 34 of seat member 23 is shown as having a relatively shallow recess 48 to receive partially a center valve guide 49.

A valve or closure element is provided for each annular series of passages 42—44, that for passages 42 being designated 50, that for passages 43 being designated 51 and that for passages 44 being designated 52. Each of the valves 50—52 is shown as a flat-sided continuous metal ring of uniform thickness and circular outline and hav-

ing a width in a radial direction greater than the radial spacing between the corresponding pair of seat beads 45-47 so that when seated as shown in FIG. 2 each of these valves will overlap the pair of beads against which it is seated.

Referring to FIGS. 2 and 3, the lower or stop plate member 24 is also generally a flat plate of disc shape including a plurality of radially spaced annular portions or ribs concentric with one another, five being shown and designated in order from the inner to the outer 53, 54, 55, 56 and 57, respectively. These annular portions 53-57 are shown connected by a series of four integral alined radial portions or ribs 59, 60, 61 and 62, respectively. Three series of such radial ribs 59-62 are shown as arranged at equal circumferentially spaced intervals. Alternating therewith is a second series of two integral alined radial portions or ribs 63 and 64 arranged only between the outer three annular portions 55-57. Three series of such radial ribs 63 and 64 are shown as arranged between adjacent series of radial ribs 59-62 and equidistant circumferentially therefrom. This provides a plurality of arcuate outlet passages arranged in four concentric circular rows, those in each row being designated in order from the inner to the outer 65, 66, 67 and 68, respectively.

The upper surface 70 of the outermost annular portion 57 of stop plate member 24 is higher than the upper and coplanar surfaces of annular and radial portions 53-56, 59-62 and 64. These coplanar surfaces are collectively designated 71. Radial portions 63 are recessed for a purpose explained later herein. Surface 70 is adapted to engage the bottom flat surface 37 of seat member 23. A space designated generally 72 is therefore provided between most of the opposing surfaces.

It is in this space 72 that the valve rings 50-52 are arranged and they are severally thinner in a vertical direction than the height of such space 72. As a consequence the valves 50-52 can move downwardly off their seats until limited in downward travel by engagement with surface 71. When so engaging this surface 71 the valves 50-52 are fully open and gas can pass downwardly through upper inlet passages 42-44, thence laterally through the vertical space now existing between valves 50-52 and the respective seat beads 45-47, and thence downwardly through lower outlet passages 65-68.

Spring means are provided for urging the various valves 50-52 upwardly toward their seats. As shown, each of the annular portions 54-56 of stop plate member 24 at each of the three series of radial ribs 59-62 is provided with a cylindrical recess 73 in which a preloaded helical compression spring 74 is arranged. The lower end of spring 74 bears against the floor of its recess 73 and the upper end bears against the lower surface of the corresponding one of valve rings 50-52.

The important feature of the present invention is to provide guide means requiring no lubrication for the various valve rings 50-52 during their opening and closing movement. While such means may be variously constructed the same is shown as including the central valve guide 49 and a series of circumferentially spaced guide blocks 75. Valve guide 49 is shown as being in the form of a flat sided member having three salient vertical segmental faces 76 which are spaced uniformly from each other circumferentially. The segmental faces 76 are not only concentric but have the same radius which corresponds to that of central recess 48 in inner annular portion 34 of seat member 23. Valve guide member 49 partially occupies recess 48 and projects axially across the space 72 between members 23 and 24. A dowel pin 78 is shown as passing through a hole provided in central valve guide 49 and has its opposite ends received in alined recesses provided in members 23 and 24.

The inner valve ring 50 is guided in its vertical movement by the vertically disposed segmental faces 76 of

central guide member 49. The necessary clearance is provided between the inner peripheral edge surface of valve ring 50 and guide surfaces 76 to allow the valve to move freely.

Each of guide blocks 75 is shown as being in the form of a segmental bar having its lower portion occupying a groove 79 provided by recessing the upper surfaces of radial ribs 63 below surface 71 of stop plate member 24. Although the guide blocks 75 may be secured in their respective grooves in any suitable manner, as by being held adhesively or by a mechanical fastening, it is preferred to press them into their grooves. For this purpose an interference fit of about 0.005 inch is provided. This has been found effective in holding the blocks 75 against circumferential movement.

The upper portion of each guide block 75 above its groove 79 provides an inner arcuate guide surface 80 and an outer arcuate guide surface 81. These surfaces 80 and 81 are concentric with each other and with the peripheral edges of valve rings 51 and 52, and may be rendered true by machining after the blocks have been pressed into their grooves. Inner surface 80 opposes the outer peripheral edge surface of intermediate valve ring 51. Outer surface 81 opposes the inner peripheral edge surface of outer valve ring 52. Here also, the necessary clearance is provided between the opposing surfaces of valve rings 51, 52 and guide blocks 75.

In this manner each of valve rings 50-52 is guided during vertical movement at circumferentially spaced intervals thereabout.

Central valve guide 49 and segmental guide blocks 75 are constructed of a polymer of ethylene such as tetrafluoroethylene. This material as made by one manufacturer is known as "Teflon." Bronze filled Teflon is preferred. It has good self-lubricating properties and renders valve guide means 49 and 75 serviceable over a long period of time.

From the foregoing it will be seen that the embodiment of the present invention achieves the objects stated hereinabove. Inasmuch as modifications and changes may occur to those skilled in the art without departing from the spirit of the present invention the embodiment shown and described is illustrative and not limitative of the invention the scope of which is to be measured by the appended claims.

What is claimed is:

1. In a valve construction, the combination comprising a seat member including radially spaced annular portions connected by radially extending portions to provide a plurality of circumferentially interrupted annular inlet passages, an annular valve for each of said passages and closing the same when seated against said seat member, said valves having opposed generally concentric peripheral edges, a stop member limiting movement of said valves away from said seat member, spring means operatively interposed between said stop member and valves for urging the latter toward said seat member, said stop member having grooves in its face which opposes said seat member and also having outlet passages which communicate with said inlet passages when said valves are unseated, and elongated segments constructed of a polymer of ethylene such as tetrafluoroethylene removably disposed partially in said grooves and being dimensioned for a press fit with the walls of said grooves, said segments having exposed arcuate circumferentially elongated surface portions generally concentric with said peripheral edges and guidingly engaging the same during movement of said valves.

2. In a valve construction, the combination comprising a seat member including radially spaced annular portions connected by radially extending portions to provide at least an inner, intermediate and outer series of circumferentially interrupted annular inlet passages; inner, intermediate and outer annular valves for said inner, intermediate and outer series of passages, respectively, and closing the same when seated against said seat member,

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said inner valve having an inner peripheral edge and said intermediate and outer valves having opposing generally concentric peripheral edges; a stop member limiting movement of said valves away from said seat member; spring means operatively interposed between said stop member and valves for urging the latter toward said seat member; said stop member having outlet passages which communicate with said inlet passages when said valves are unseated; a center valve guide arranged between said members and having segmental faces generally concentric with said inner peripheral edge of said inner valve and guidingly engaging the same during movement of said inner valve; one of said members having an annular groove in its face concentric with said peripheral edges of said intermediate and outer valves, and elongated segmental valve guides dimensioned to be partially received in said groove and for a press fit with the walls thereof, said valve guides having elongated arcuate surface portions general-

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ly concentric with said opposing peripheral edges and guidingly engaging the same during movement of said intermediate and outer valves; said center and segmental valve guides being constructed of a polymer of ethylene such as tetrafluoroethylene.

References Cited

UNITED STATES PATENTS

	2,622,949	12/1952	Cotchett	-----	251—368 X
10	3,175,577	3/1965	King	-----	137—512.1
	1,251,420	12/1917	Richards	-----	137—454.4
	1,553,323	9/1925	Parks	-----	137—516.21 X

FOREIGN PATENTS

15	815,186	6/1959	England	-----	251—368 X
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