Dec. 12, 1967 S. F. KING 3,357,449

VALVE UNIT FOR NON-LUBE AIR COMPRESSORS

Filed June 24, 1965 2 Sheets-Sheet 1

FIG. 1

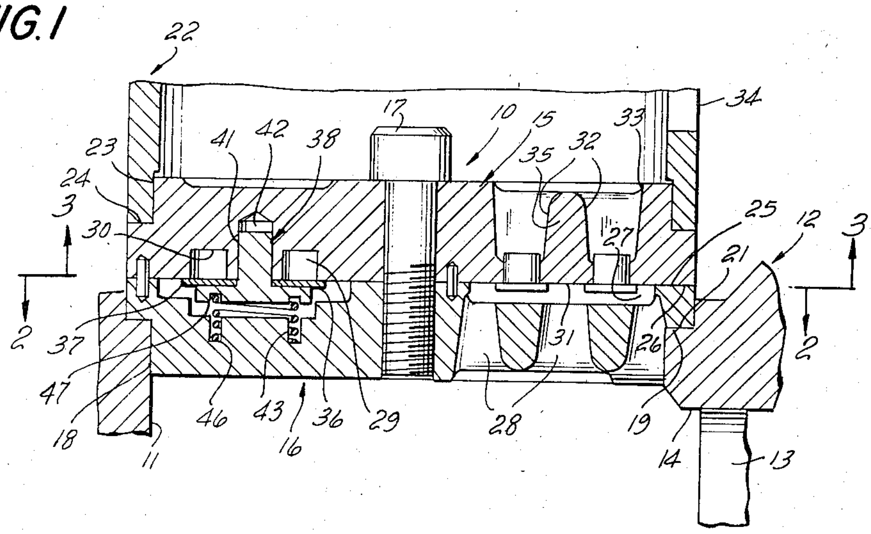

FIG. 2

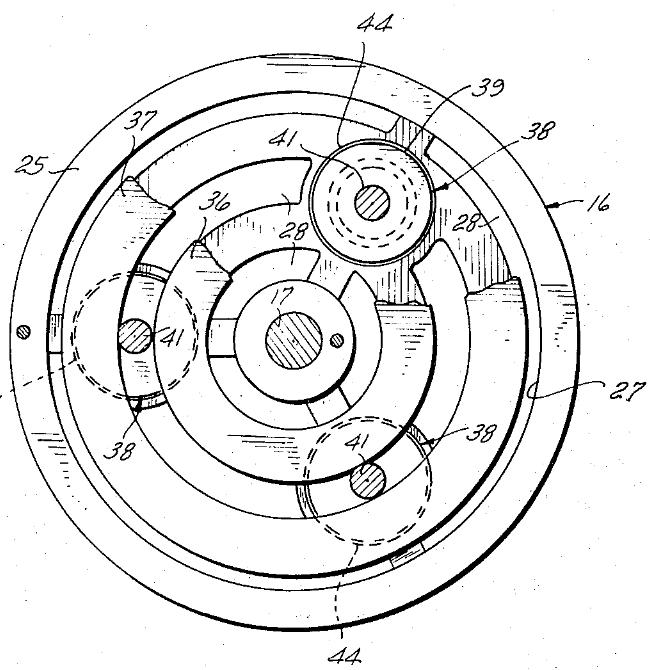

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FIG. 3

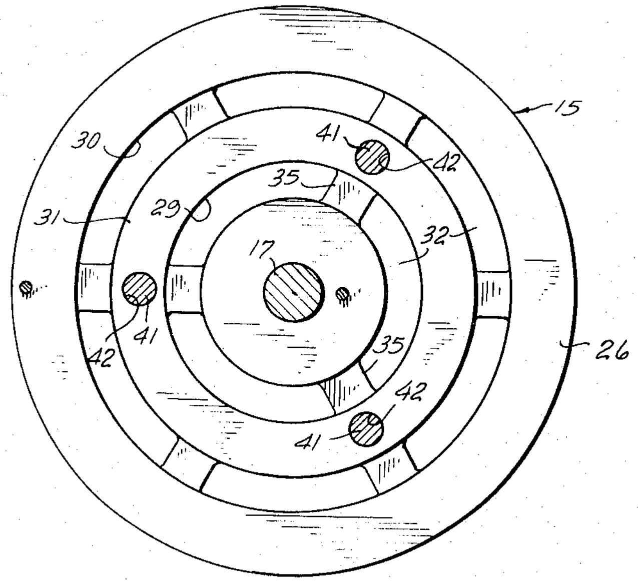


FIG. 4

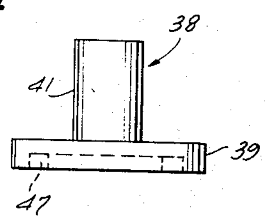


FIG. 6

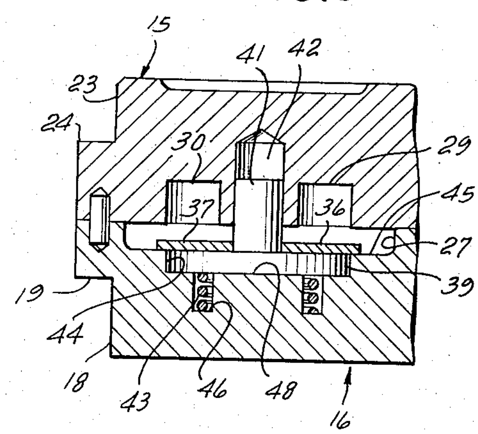
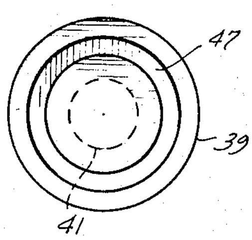


FIG. 5



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VALVE UNIT FOR NON-LUBE AIR COMPRESSORS

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7 Claims. (Cl. 137—512.1)

This invention relates to ring plate valve units for use in air compressors of the piston type, particularly non-lube air compressors.

The present invention represents an improvement over the valve units disclosed in my Patent 3,177,893, dated Apr. 13, 1965. The subject valve units are of simpler construction and display improved operating characteristics over the valve units of my prior patent. More particularly, the valve units of the present invention utilize disc guides each having a single cylindrical guiding portion which is positionable in a pilot hole arranged in the valve seat. Such an arrangement allows for provision of a flat surface on the keeper beneath each disc guide, which flat surface will absorb impact load upon valve opening thus greatly reducing the incidence of disc guide breakage. Long life of the disc guides is achieved by use of a special material which is substantially wear resistant.

The main object of this invention is to provide an improvement in valve units and more particularly in valve guide means for use in valve units of the type used in air compressors.

A more specific object is to provide a valve guide means of simplified construction and improved operating characteristics.

Another object is to provide a valve guide means having superior wear characteristics.

The foregoing and other objects and advantages of this invention will appear more fully hereinafter from a consideration of the detailed description which follows, taken together with the accompanying drawings wherein an embodiment of the invention is illustrated. It is to be expressly understood, however, that the drawings are for purposes of illustration and description and they are not to be construed as defining the limits of the invention.

In the accompanying drawings:

FIG. 1 is a cross section of a ring plate valve unit embodying the invention and showing the valve unit seated in the intake opening of a non-lube type air compressor of the piston type, only a fragmentary portion of the compressor being shown;

FIG. 2 is a section taken on line 2—2 of FIG. 1;

FIG. 3 is a section taken on line 3—3 of FIG. 1;

FIG. 4 is an elevational view of the guide member;

FIG. 5 is a bottom plan view of the guide member; and

FIG. 6 is a fragmentary sectional view of the valve unit, showing the ring plate valves in open condition.

In the drawings is disclosed a valve unit, generally designated **10**, embodying the invention. This unit is shown seated in the intake opening **11** of a conventional non-lube type air compressor, generally designated **12**. The compressor is of a type having a piston **13** reciprocable in a chamber **14**. As the piston moves on its intake stroke in one direction it draws air through the valved intake opening **11** into the piston chamber; and as the piston moves in the opposite direction, it forces the air through a valved discharge opening (not shown). The function of a non-lube type compressor is to supply oil-free compressed air through its discharge end. While the valve unit embodying the present invention may also be used in lube type compressors, it is particularly suited for use in the non-lube type compressor because of the wear resistance of its parts.

The valve unit **10** includes (FIGS. 1, 2, 3) a housing or or body comprising a circular valve seat member **15** and

a complementary mating valve keeper member **16** tightly bolted to the seat member in face to face contact by means of a screw **17**. When the valve unit is assembled in the compressor, as in FIG. 1, a reduced cylindrical portion **18** of the keeper member fits into the intake opening **11**, and an annular shoulder **19** of the keeper member rests upon a complementary shoulder **21** of the compressor housing. The valve unit is anchored fast in the intake opening **11** by means of a conventional sleeve clamp **22** which sleeves over a reduced cylindrical portion **23** of the seat member and presses tightly upon an annular shoulder **24** of the latter.

The keeper member **16** further has an inner level face **25** which is held by the screw **17** in contact with an opposed inner level face **26** of the seat member. Formed in the face **25** of the keeper member is an annular shallow airflow channel or recess **27** which communicates by means of a plurality of recessed arcuate ports **28** through the bottom of the keeper with the piston chamber **14** of the air compressor, as in FIG. 1. Recessed in the face of the seat member (RIGS. 1, 3) is a pair of annular air-flow channels, comprising an inner channel **29** and an outer channel **30**. These channels are concentric to one another and are spaced apart by an annular portion **31** of the face of the seat member. These channels are centered above and are concentrically arranged relative to the air-flow recess **27** so as to open directly into the latter. The radial extent of the air-flow recess **27** of the keeper member is greater than the combined radial extent of channels **29**, **30**, and the space **31** between them. A plurality of arcuate ports **32** formed in the body of the seat member communicate channels **29**, **30** through the outer face **33** of the seat member whereby intake air entering through a port **34** of the clamping sleeve may flow through the arcuate ports **32** into the channels **29**, **30**. Ports **32** are separated from one another by radial rib portions **35** of the body of the seat member.

The area of the inner face of the seat member bordering channels **29**, **30** defines a seat which is common to a pair of radially spaced concentric ring plate or disc valve elements **36**, **37**. These valve elements are confined between the keeper and seat members for axial movement in the air-flow recess **27**. These valve elements are also concentric with channels **29**, **30**, and the air-flow recess **27**. The valves control flow of intake air from channels **29**, **30** of the seat member to the air flow recess **27** of the keeper member. Valve **36** is adapted to seat flat over channel **29**; and valve **37** is adapted to similarly seat over channel **30**. These valves are rigid and are formed of hardened stainless steel. The structural nature of the valves avoids not only rusting and distortion thereof, but also avoids consequent undesirable valve seating.

A plurality of spring biased valve guides **38**, here three in number and spaced circumferentially 120 degrees apart, yieldably hold the valves in seated condition (FIGS. 1, 2, 4, 5). Each guide comprises a flat surfaced circular base portion **39** from the upper surface of which axially extends a cylindrical reduced guide stem **41**. Each guide is common to both valves. The stem of each guide passes slidably between both valves and extends with a slide fit into a cylindrical bore **42** centered between channels **29**, **30** of the seat member. The guide stem **41** cooperates with the bore **42** in providing a fixed path of movement for the guide **38**. And the guide in turn guides movement of the valves in a fixed axial path.

Both valves lie flat in a common plane upon the upper surfaces of the base portions **39** of the guides. Each guide is yieldably biased by a coil spring **43** toward the seat member to hold both valves seated. The air flow recess **27** has a shallow depth substantially equal to the combined thickness of the base **39** of a guide and the thickness of a valve member. To allow for axial movement of the valves to open condition and to enable consequent movement of each guide, a separate flat-bottomed well 44 is provided in the keeper member at the bottom of the annular recess 27 to receive the base portion of a corresponding guide. Each well is centered in the recess and is coaxial with the corresponding guide bore 42. The well is slightly greater in diameter than the base of the guide so as to allow rapid escape of air from the well as the guide moves down into it. By means of this arrangement, air does not become trapped at the bottom of the well to check movement of a guide or the valves; and a vacuum is not created in the well below the guide to retard return movement of the valves and guide. The extent to which the valves open is limited by the bottom wall 45 (FIG. 6) of the air flow recess. The valves extend slightly beyond the periphery of the guide base and are adapted to limit upon the bottom wall of the recess 27 as the guide limits at the bottom of its well. So that the valves will not tilt relative to the guides as they move from their seat, a major portion of the radial extent of each valve rests upon the surfaces of the guide bases 39.

The axial depth of each well is preferably not greater than that of the guide base 39 so that when the latter is fully received in the well, the upper surface of the guide base will lie flush with the bottom wall 45 of the air flow recess 27 and the marginal outer portion of the valves will overlie the bottom wall of the air flow recess. The biasing spring 43 is a coil spring which is seated at its bottom end in an annular groove 46 formed in the bottom of the well and is seated at its upper end in an annular groove 47 formed in the underside of the guide base. The grooves are coaxial with the guide. The spring grooves provide a desirable advantage in that they maintain the spring in coaxial relation to the guide and as a consequence prevent the spring from wandering about the well. By means of this arrangement, the biasing force of the spring on the guide is centered on the latter.

In the operation of the device: as the piston 13 moves on an exhaust stroke, a resultant strong suction action is created in the piston chamber. In response to this action, intake air rushing rapidly through channels 29, 30 of the seat member forces the valves to open condition against the resistance of the spring biased guides 38. The incoming air then flows to the air-flow recess 27 and through the ports 28 of the keeper member to the piston chamber 14. Toward the end of the exhaust stroke of the piston, the springs 43 are caused to relax whereupon they act through the guides to return the valves to seated condition. In this opening and closing action the valves and guides do not move relative to one another but move together as a unit. Accordingly, there is no friction action between them. As the valves move away from their seat, they carry the guides with them against the resistance of the springs; as the guides are returned by the spring, they carry the valves with them. The stem portion 41 of the guide moves at all times in its bore 42 as the valves move; it restrains the valves against relative radial movement; and the base portion 39 supports the valves as they move. By means of this arrangement, the valves are guided in their movement at all times relative to their seat.

During operation of the compressor, the piston 13 cycles at high speed. Accordingly, it is desired that the valves open and close as nearly as possible in timed relation to the cycling of the piston to obtain a desirable high efficiency of compressor operation. It has been found that if the biasing springs 43 are too strong, they will cause the valves to close too soon, and if they are too weak they will undesirably slow closing of the valves. It has been found that desirable results are obtained in the operating efficiency of the compressor when the biasing springs 43 are just strong enough to hold the valves closed upon their seat when the compressor is at rest.

When the valves are opened by the in-rushing air, each guide is forced into contact with the bottom 48 of its well.

So as to provide room for retraction of the spring, groove 46 is of sufficient depth to fully receive the spring when the guide is seated at the bottom of the well, as appears in FIG. 6.

In view of the limited resistance offered by the springs 43, the force with which the valves are opened by the inrushing air causes the guides to impact forcefully against the bottoms of the wells. The bottom 48 of each well is flat and level and cooperates with the corresponding flat underside of the guide base to uniformly absorb the impact and thus prevents damage to the guide. As a further protective measure to avoid impact damage to the guide, the groove 46 at the bottom of the well is deep enough to fully receive the spring as the guide impacts against the bottom of the well. This enables the base 39 of the guide to impact evenly over the corresponding flat bottom of its well and thus spread the reaction of the impacting force evenly over the surface of base 39 of the guide.

Because the valves and valve guides move together as a unit, there is no wearing action of the valves or the guides relative to one another. However, there is a sliding relation of the stem portion 41 of each guide relative to the wall of its bore 42. To avoid frictional wear here, the wall of the bore has a smooth bearing surface and the guide is substantially friction-free in that it has an inherently greasy or slippery surface. Here, the guide is a one-piece structure. It is preferably formed from material which is light in weight, tough, has an inherently greasy or slippery property, and which can withstand the high temperatures encountered in compressor applications. A plastic commonly known as Teflon is suitable for this part because it has a low coefficient of friction without lubricant; its mechanical properties are maintained at temperatures of 450–500 degrees F.; it is substantially inert to chemical action; and it is light in weight. It is preferred, however, that the Teflon be blended with a suitable filler, such as glass, to give it added strength and rigidity.

While an embodiment of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes might possibly be made in the design and arrangement of the part without departing from the spirit and scope of the invention. It is intended, therefore, to claim the invention not only as shown and described, but also in all such forms and modifications thereof as may be reasonably construed to fall within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a valve unit for a piston type air compressor, comprising a valve seat member having an inner level face and a pair of concentric air intake channels recessed in said face, a keeper member complementing the seat member having an inner level face and having an annular channel recessed therein in opposed parallel relation to the intake channels, and a pair of concentrically arranged ring plate valves axially movable in the annular channel to open and closed condition over the intake channels, the improvement comprising: a plurality of wells spaced circumferentially equally apart at the bottom of the annular channel of the keeper member and each centered relative to the intake channels, a separate guide bore coaxial with each well formed in the seat member between the intake channels, a valve guide associated with each well having an annular base portion abutting undersurface portions of both valves, a guide stem portion extending axially from the base portion having slidable movement in the guide bore and extending between the valves and in close relation thereto, a spring seated in each well pressing upwardly against the underside of the base portion of the related guide member so as to yieldably hold the valves by means of the base portion seated over the intake channels, the base portion of each guide member being forcefully movable into its corresponding well upon opening of the valves, each well having a flat level bottom surface, and the base portion of each guide member having a

complementary flat undersurface impactable against the bottom surface of its well upon opening of the valves.

2. The improvement as in claim 1, wherein the diameter of each well is slightly greater than that of the base portion of the related guide member.

3. The improvement as in claim 2, wherein the bottom of the annular channel is flat and level, the valves overhang the base portion of each guide member slightly beyond the radius of the well, and the axial depth of each well corresponds to the axial thickness of the base portion of the related guide member, whereby the upper faces of the base portions of the guide members are flush with the bottom of the annular channel when the base portions are fully received in the wells and the valves overlie the bottom of the annular channel.

4 The improvement as in claim 1, wherein the springs are substantially identical and the strength of the several springs is just enough to hold the valves seated when the compressor is at rest.

5. The improvement as in claim 1, wherein the axial depth of each well corresponds to that of the base portion of the related guide member, the spring is a coil spring received at its upper end in a shallow annular groove at the underside of the base member and is seated at its opposite end in an annular groove at the bottom of the well, the latter groove being of sufficient depth to fully receive the spring when the base portion of the guide member is fully received in the well.

6. The improvement as in claim 1, wherein the guide member is formed of material having an inherent slippery and greasy surface, and is resistant to high temperature.

7. The improvement as in claim 1, wherein the guide member is formed of glass filled plastic material, the plastic material being of a nature having a property of being slippery and greasy to the touch, and resistant to high temperatures in a range of 450–500 degrees F.

No references cited.

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