Oct. 6, 1942. L. L. COLLINS 2,297,944

COMPRESSOR AIR VALVE

Filed March 28, 1941 3 Sheets-Sheet 1

Fig. 1.

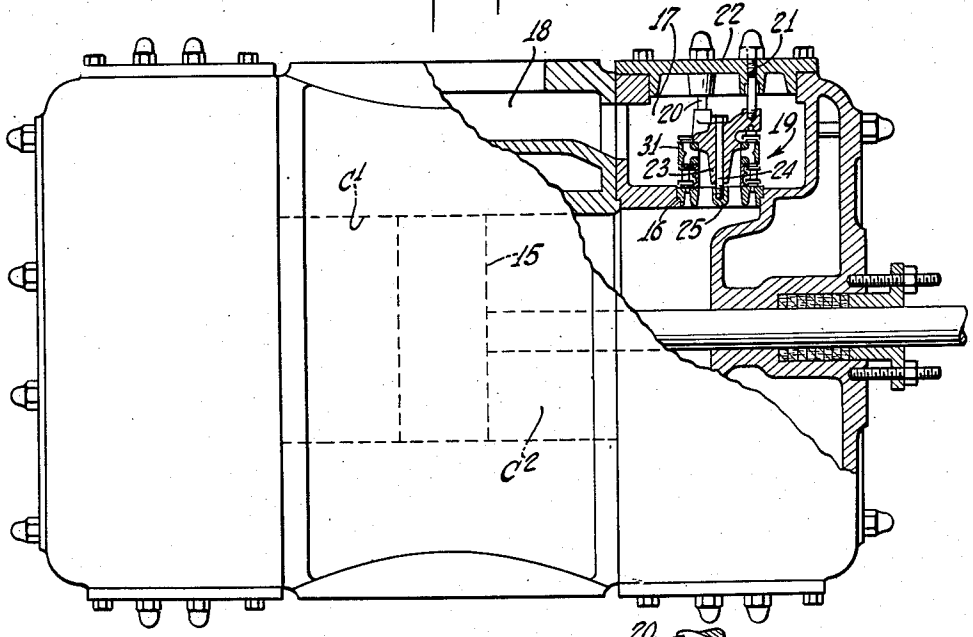
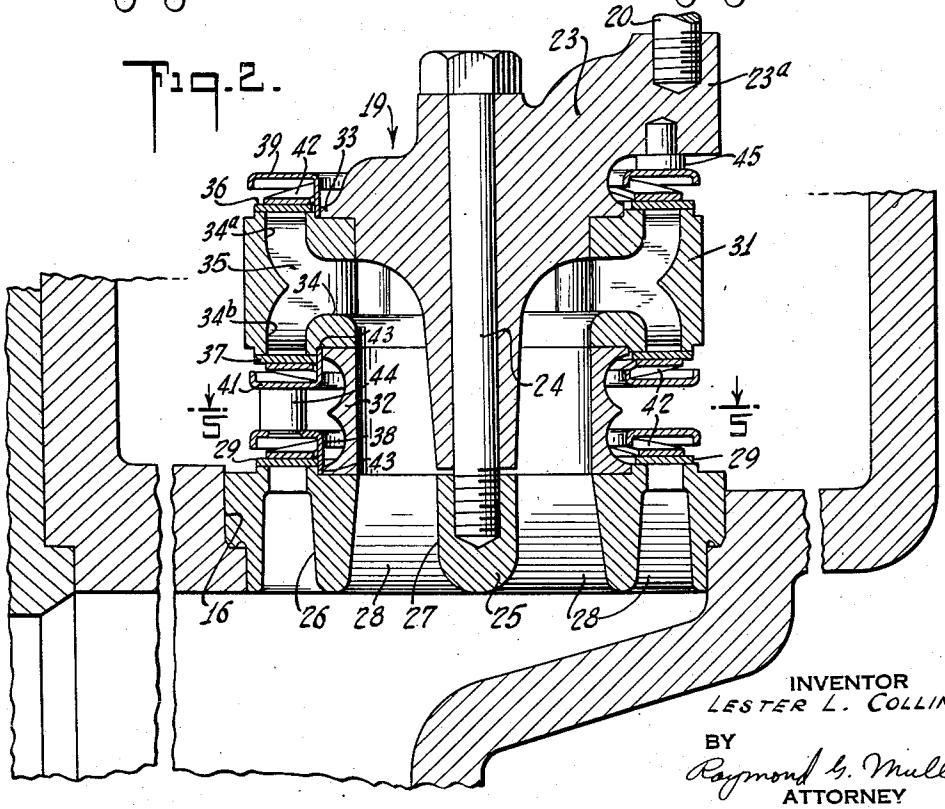


Fig. 2.



INVENTOR
LESTER L. COLLINS.

BY
Raymond G. Mullee
ATTORNEY

Oct. 6, 1942. L. L. COLLINS 2,297,944

COMPRESSOR AIR VALVE

Filed March 28, 1941 3 Sheets-Sheet 2

Fig. 3.

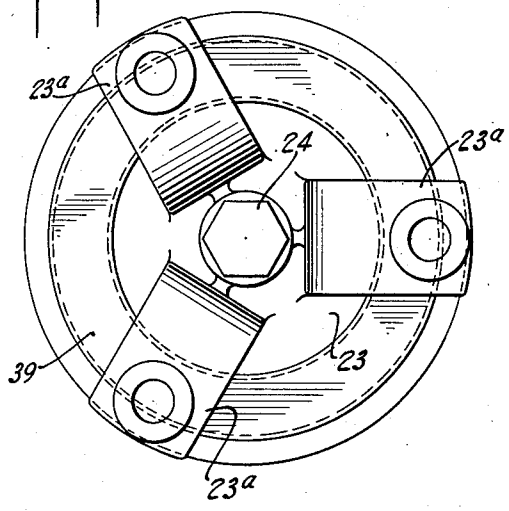


Fig. 4.

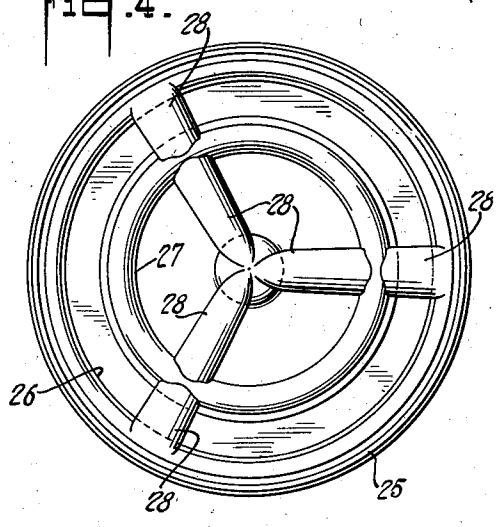


Fig. 6.

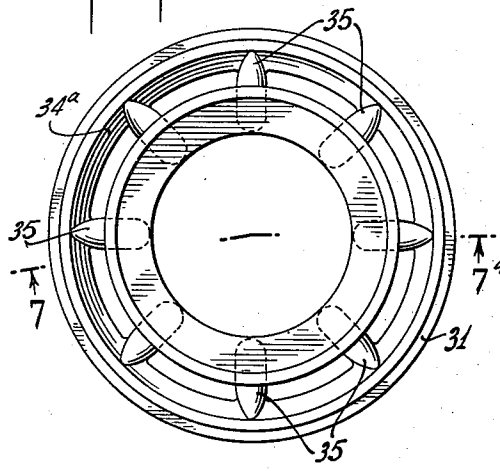


Fig. 5.

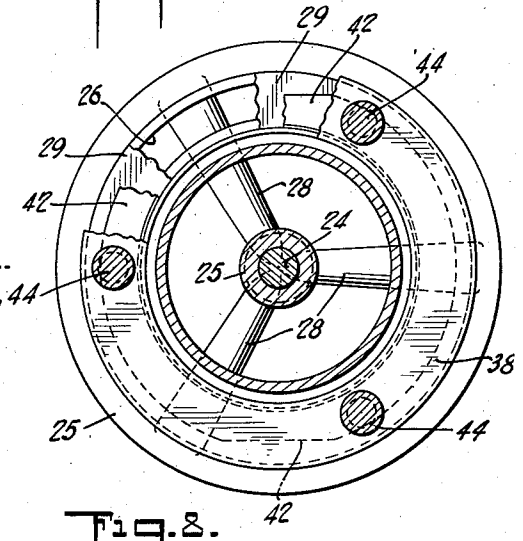


Fig. 7.

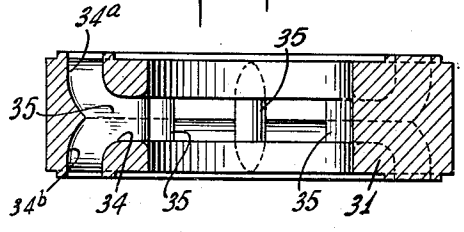
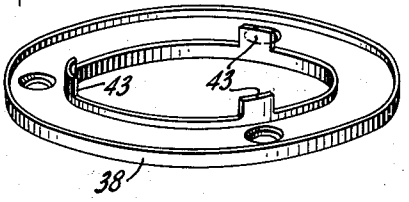


Fig. 8.



INVENTOR
LESTER L. COLLINS.

BY
Raymond G. Mullee
ATTORNEY

Oct. 6, 1942. L. L. COLLINS 2,297,944

COMPRESSOR AIR VALVE

Filed March 28, 1941 3 Sheets-Sheet 3

Fig. 9.

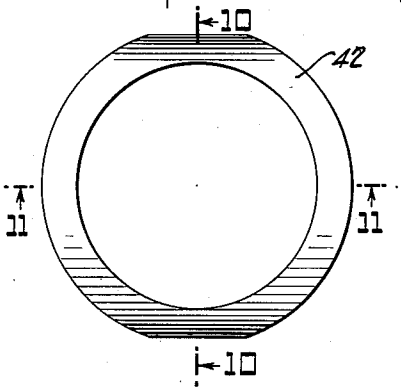


Fig. 10.



Fig. 12.

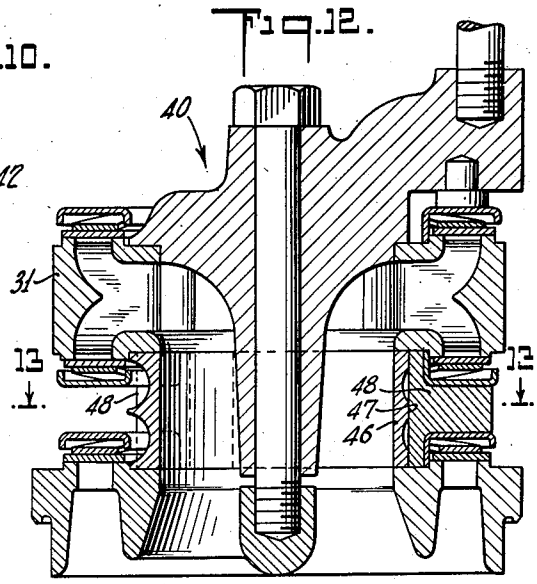


Fig. 11.

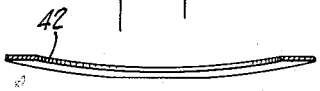


Fig. 13.

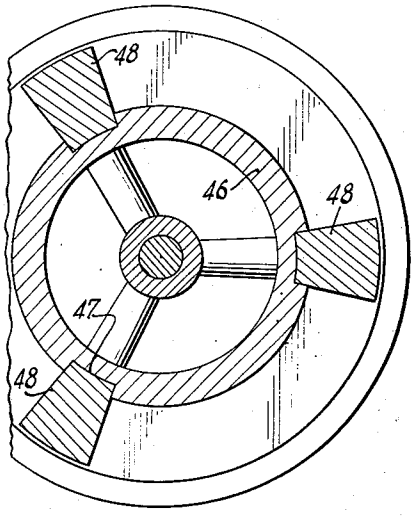
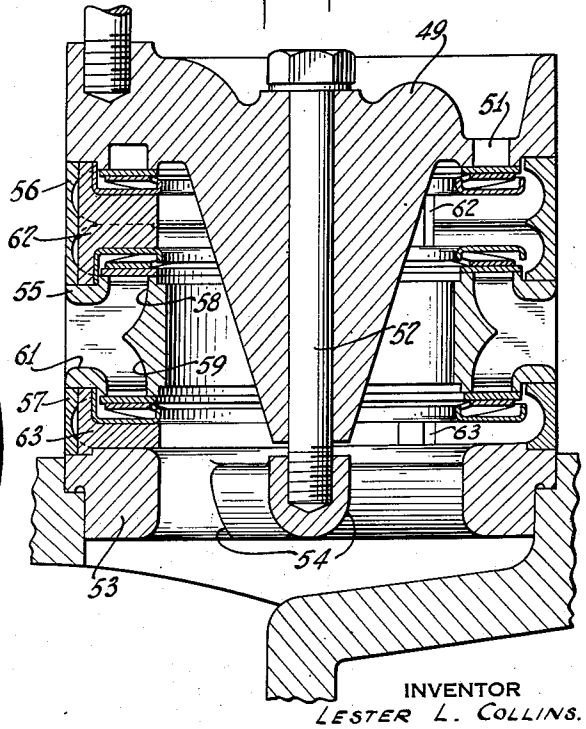


Fig. 14.



INVENTOR
LESTER L. COLLINS.
BY
Raymond G. Mullee
ATTORNEY

Patented Oct. 6, 1942 2,297,944

UNITED STATES PATENT OFFICE

2,297,944

COMPRESSOR AIR VALVE

Lester L. Collins, Franklin, Pa., assignor to Chicago Pneumatic Tool Company, New York, N. Y., a corporation of New Jersey

Application March 28, 1941, Serial No. 385,632

13 Claims. (Cl. 277—60)

This invention relates to valve assemblies in which one or more ring or plate type valves control the passage of air or other fluid through the assembly by movement in response to pressure variations of a determined degree on opposite sides of the assembly.

Valve assemblies of this kind are widely used in air compressors and like machines to control the admission and discharge of air to and from a compression chamber. They may be adapted to function as inlet or discharge valves and are used in sufficient numbers to insure a flow of air proportional to the capacity of the compression chamber. It is desirable for efficient operation of the compressor that the ported or valve lift area of each valve assembly be as great as possible and that the flow of air through each assembly be substantially unrestricted while the valves are open. It is contemplated by this invention to provide a valve assembly improved in such respects as will permit the formation of a larger ported area in the assembly and facilitate the flow of air therethrough.

One object of the invention is to increase the capacity of a valve assembly by increasing the ported or valve lift area thereof.

Another object of the invention is to increase the valve lift area of a compressor valve assembly without increasing the diameter of the valve seat nor of the space in the wall of the compression chamber occupied by the assembly.

In carrying out these objects a novel valve construction has been obtained in which a plurality of valve seats are stacked in spaced parallel planes, each seat having a ported area adapted for communication with the compression chamber and controlled by an individual pressure responsive valve ring.

Other objects and structural details of the invention will be apparent from the following description when read in conjunction with the accompanying drawings, wherein:

Fig. 1 is a view of a compressor cylinder embodying the valve mechanism of the invention, part of the cylinder being broken away to show a discharge valve assembly in longitudinal section;

Fig. 2 is an enlarged view of a portion of Fig. 1, showing only the valve assembly and the mounting therefor in the compressor cylinder;

Fig. 3 is a top plan view of the valve assembly of Figs. 1 and 2;

Fig. 4 is a bottom plan view of the valve assembly of Figs. 1 and 2;

Fig. 5 is a view of the valve assembly in cross section, taken substantially along the line 5—5 of Fig. 2;

Fig. 6 is a detail plan view of an auxiliary valve seat comprised in the assembly of Figs. 1 and 2;

Fig. 7 is a view in cross section of the auxiliary valve seat of Fig. 6, and is taken substantially along the line 7—7 thereof;

Fig. 8 is a detail view, in perspective, of a combination guide and buffer plate embodied in the valve assembly of the invention;

Fig. 9 is a detail plan view of a valve spring embodied in the assembly of the invention;

Figs. 10 and 11 are cross sectional views taken along the respective lines 10—10 and 11—11 of Fig. 9;

Fig. 12 is a view, in longitudinal section, of a valve assembly of alternative construction;

Fig. 13 is a view, in cross section, of the valve assembly shown in Fig. 12, and is taken substantially along the line 13—13 thereof; and

Fig. 14 is a view similar to Fig. 2, showing the invention as embodied in an inlet valve assembly.

The compressor cylinder of Fig. 1 is of the double acting type in which an independent compression chamber is formed on each side of a reciprocable piston 15. The flow of air to and from the compression chambers, indicated at C—1 and C—2, is controlled by respective sets of pressure responsive inlet and discharge valves located adjacent the opposite ends of the cylinder within the periphery thereof. A portion of the cylinder is broken away to show one of the control valves and the manner in which it is mounted within the cylinder. This valve, arranged to function as a discharge valve, is constructed in accordance with the invention and is positioned within an opening 16 connecting the compression chamber C—2 to a valve chamber 17 communicating with a discharge passage 18. Indicated generally at 19, the valve rests upon a ledge in the opening 16 and is further supported by three rods 20 projecting from a closure plate 22 and secured against outward movement by the usual set screws 21. The closure plate is removable to permit easy access to the valve chamber 17.

Referring to Fig. 2, the valve 19 is comprised of an assembly of parts including body member 23 acting as a keeper, the upper end of which is formed with three spaced arms 23a (see also Fig. 3) each adapted to receive a respective rod 20. The keeper 23 is centrally positioned within the valve assembly and has an inwardly projecting stem through which a bolt 24 is passed. The bolt 24 extends through and beyond the

stem of keeper 23 and has a threaded connection with a valve seat 25 to secure the keeper and valve seat in fixed relative positions. The valve seat 25 has a circular shape (see Fig. 4) and is formed with separate annular openings or ported areas 26 and 27 interrupted only by a series of ribs 28 extending inward to the midpoint of the seat from spaced peripheral positions. The valve seat 25 lies for the most part wholly within the opening 16 and the outer periphery thereof is cut away to form a shouldered portion engageable with the previously described ledge extending into the opening 16. The ported areas 26 and 27 thus communicate directly with the cylinder chamber C—2, and, upon the compression stroke of the piston 15, air is discharged from the chamber C—2 through the ported areas of the valve seat. The passage of air through the opening or ported area 26 is controlled by a ring valve 29 which engages the outer surface of the valve seat 25 to close the ported area 26 and is movable to open position by the force of accumulated pressure acting on the underside of the valve. The central opening or ported area 27 is free of restrictions and air entering this area may pass through the valve seat and outward along the stem of the valve keeper 23. The area surrounding the stem of keeper 23 is enclosed by an auxiliary valve seat 31 and a spacing ring 32 intermediate the valve seats 25 and 31. The auxiliary valve seat 31 encircles the keeper 23 and is held in fluid-tight engagement with an annular flange 33 formed on the keeper near the upper end thereof. The spacing ring 32 is smaller in diameter than the valve seats 25 and 31 and fits within shallow recesses formed in the adjacent surfaces of the respective seats. The several circular elements 31, 32 and 25 are thus held by the keeper 23 in an assembled position in which the central openings of the two outer elements are axially aligned with the ported area 27 of the inner valve seat 25. There is thereby formed, in cooperation with the keeper 23, an enclosure or chamber within the auxiliary valve seat and spacing ring, connected through the valve seat 25 to the compression chamber C—2.

Referring also to Figs. 6 and 7 it will be noted that the inner periphery of the auxiliary valve seat 31 is formed with an annular channel 34 having communicating branches or ports 34*a* and 34*b* opening respectively through the outer and inner surfaces of the seat. In cross section the channel 34 has a T-shape, the ports 34^a and 34^b being aligned at opposite ends of the cross of the T. A plurality of radially disposed ribs 35 intersect the channel 34 and associated ports 34*a* and 34*b* and form in effect a series of ported areas through which air may be discharged from the valve assembly. The inner surface of the channel 34 is formed with curved deflecting surfaces in order that the air may flow to the oppositely disposed outlet ports in smoothly diverging currents. The ported areas 34*a* and 34*b* are controlled by respective ring valves 36 and 37 similar in construction and mode of operation to the previously described valve 29. The relation of the valve seats 25 and 31, and of the ported areas 26 and 34*a*—34*b* thereof, is such that the seats may be described as inner and outer circular valve seats having aligned ported areas adjacent their respective peripheral edges.

Each of the ring valves 29, 36 and 37 has associated therewith a channel-shaped combination guide and buffer plate, indicated respectively at 38, 39 and 41, and a ring-shaped spring 42 (see also Figs. 9–11) which is bowed in the form of an arc and resists with a yielding pressure any force tending to flatten or straighten it. The several buffer plates are spaced slightly from their associated valves and a spring 42 is interposed between each plate and its valve in such manner that oppositely disposed points on the outer edge of the spring are engaged with the valve, which is thereby urged to seated or closed position. As shown in Fig. 9, the outer edge of each spring 42 is flattened at those points which are engaged with the valve in order to increase the area of contact between the valve and spring. The several buffer plates are each formed with projecting tongues or lugs 43 on their inner peripheries (see Fig. 8) which serve to guide the valve rings and are adapted to fit in individual grooves formed between valve seats 25 and 31 and spacer 32, and between a ledge on the outer surface of seat 31 and keeper 23. The pair of adjacent buffer plates 38 and 41 are held in position within the assembly by a plurality of intermediate spacing studs 44 (Fig. 5). The studs 44 are preferably connected to the plate 38 by riveting or other means. The outer buffer plate 39 is held against movement by similar studs 45, one of which is mounted within each of the radial arms 23*a* of the keeper 23.

On the compression stroke of the piston 15 through the chamber C—2 air is discharged simultaneously through the ported areas 26, 34*a* and 34*b*, the several valve rings 29, 36 and 37 being forced off their respective seats when the air pressures mount to a height sufficient to overcome the springs 42. As the piston 15 reaches the end of the compression stroke the pressure within the ported areas of the valve assembly drops below the peak discharge pressure and the springs 42 are permitted to return their associated valves to closed position. As shown in Fig. 2 the outer periphery of the spacing ring 32 is formed with annular grooves which present curved deflecting surfaces to the air discharged from the oppositely disposed ports 26 and 34*b* and prevent to a large extent impingement of these air currents upon each other.

In Figs. 12 and 13 is shown a discharge valve assembly 40 of alternative construction which differs from the assembly of Fig. 2 chiefly in the form of the spacing means provided between the inner and outer valve seats. The modified structure includes a spacing ring 46 generally similar to the ring 32 but having three vertical grooves 47 (see Fig. 13) formed at equidistant points in the outer periphery of the ring. Positioned within each groove 47 is a block segment 48 which projects outward between the buffer plates of the respective valve seats. Conjointly the blocks 48 serve the same purpose as the similarly positioned studs 44 of Fig. 2.

Fig. 14 illustrates the invention as embodied in a valve assembly adapted to function as an inlet valve. This assembly maintains the principles of construction and operation disclosed in Figs. 2 and 12, but necessarily differs somewhat in the formation and arrangement of parts. The inlet assembly has a valve seat 49 occupying the same relative position as the keeper 23 of the discharge assembly, and having a ported area 51 through which air flows to the interior of the assembly. The seat 49 has a central stem through which a bolt 52 is passed to connect the valve seat to a circular plate 53 which acts as a keeper. The keeper 53 is adapted to be

positioned within an opening in the compressor cylinder and has a ported area 54 establishing communication between the interior of the valve assembly and the compression chamber. Disposed between the keeper 53 and the outer head portion of the valve seat 49 is an auxiliary valve seat 55 held in an intermediate position by spacing rings 56 and 57 arranged on the opposite sides thereof. The rings 56 and 57 are of the same diameter as the valve seat 55 and enclose the respective ported areas 58 and 59 of the valve seat. An annular channel 61 is formed in the outer periphery of the auxiliary valve seat and admits air from the exterior of the assembly to the ported areas 58 and 59. The several ported areas 51, 58 and 59 are controlled by pressure responsive ring valves in the same manner as the corresponding areas of the discharge valve. The buffer plates associated with the valve rings are held against movement in this instance, however, by sets of block segments 62 and 63 located in grooves within the inner peripheries of the respective spacing rings 56 and 57.

It will be evident that the valve assembly may be modified in respects other than those shown herein without departure from the spirit of the invention. For example, the assembly might be enlarged to comprise a greater number of valve seats than two. Such a change involves merely a duplication of elements and an extension of the principle of stacking the seats in longitudinal spaced relation.

What is claimed is:

1. A valve assembly, comprising a plurality of annular valve seats stacked one upon another about substantially the same longitudinal axis and each having a ported area to permit the passage of air therethrough, means for holding said valve seats spaced from one another and in substantial alignment, an annular plate valve reciprocable toward and from each of said valve seats for controlling the passage of air through the ported area thereof, a pair of said plate valves being disposed on the adjacent sides of a pair of said valve seats, and means intermediate said pair of valves for limiting movement thereof from their respective valve seats.

2. A valve assembly, comprising a plurality of valve seats, means for holding said valve seats spaced from one another and in substantial alignment, plate valves reciprocable toward and from said valve seats, a valve guide associated with each of said valve seats, a pair of said guides being disposed on the adjacent sides of a pair of said seats, and spacing blocks intermediate said pair of guides acting to prevent displacement of said guides relative to said valve seats.

3. A valve assembly, comprising an annular first valve seat having a ported area to permit the passage of air therethrough, an annular first valve cooperable with the ported area of said first valve seat to control the flow of air therethrough, an annular second ported valve seat spaced from the said first seat and stacked thereupon about substantially the same longitudinal axis, an annular second valve cooperable with the ported area of said second valve seat, said first and second valves being disposed on the adjacent or inner surfaces of the respective valve seats, and a stop element intermediate said first and second valve for limiting the movement thereof away from their respective valve seats.

4. A valve assembly, comprising an annular valve seat having separate ported areas on opposite sides thereof, recesses in the periphery of said valve seat communicating with said ported areas, independently operable valves reciprocable toward and from said valve seat to control the passage of fluid through said ported areas to and from said recesses, a guide plate for each of said valves, said guide plates acting also to limit movement of said valves away from the valve seat, a mounting for each of said guide plates, and means for securing said valve seats and said guide mountings in fixed relative positions.

5. A valve assembly, comprising inner and outer annular valve seats, an annular spacing element between said valve seats, said spacing element and said valve seats having registering openings forming a longitudinal chamber through the assembly, a valve keeper for holding said valve seats and said spacing element in assembled position, said keeper comprising a head portion engageable with the outer one of said valve seats to close one end of said longitudinal chamber, an annular channel formed in the inner periphery of said outer valve seat, aligned ported areas on opposite sides of said outer valve seat communicating through said annular channel with the said longitudinal chamber, and valves controlling the ported areas of said valve seats.

6. A valve assembly, comprising inner and outer annular valve seats, an annular spacing element between said valve seats, said spacing element and said valve seats having registering openings forming a longitudinal chamber through the assembly, a valve keeper for holding said valve seats and said spacing element in assembled position, said keeper comprising a head portion engageable with the outer one of said valve seats to close one end of said longitudinal chamber, ported areas in each of said valve seats located at points outside the circumference of said spacing element and extending longitudinally through said seats, means for providing communication between the ported area of the outer of said valve seats and said longitudinal chamber, and valves controlling the ported areas of said valve seats.

7. A valve assembly, comprising inner and outer circular valve seats having aligned ported areas adjacent their respective peripheral edges, a spacing ring disposed between said valve seats and lying inside the circle represented by said aligned ported areas, a valve ring for each of said ported areas encircling said spacing ring and reciprocable to open and closed positions relatively to its respective ported area between said valve seats, a guide for each of said valve rings, and circumferentially spaced blocks mounted without said spacing ring for holding said guides in cooperative relation with their associated valve rings.

8. A valve assembly, comprising first and second spaced circular valve seats having axially aligned central openings, means for holding said valve seats in spaced relation including an intermediate spacing element of less diameter than said valve seats, said element having a central opening registering with the openings in said valve seats whereby a longitudinal chamber is formed within the assembly, separate ported areas in the said first valve seat opening through the opposite sides thereof at points outside the circumference of said spacing element, means providing communication between said separate

ported areas and said longitudinal chamber, a ported area within the said second valve seat opening through the outer surface thereof in substantial alignment with the separate ported areas of said first valve seat, and valves controlling the ported areas of said valve seats.

9. A valve assembly, comprising spaced inner and outer circular valve seats, said valve seats having aligned ported areas near their respective outer edges and recessed portions in their adjacent surfaces formed inside the circle represented by said aligned ported areas, a valve ring for each of said ported areas and reciprocable to open and closed positions relatively to its respective ported area, a guide for each of said valve rings, said guides being shaped in correspondence with said valve rings and having tongues positioned in the recessed portion of a respective valve seat, and means for holding said guides in cooperative relation with said valve rings, said means including spacing blocks interposed between an adjacent pair of said guides to prevent axial movement thereof and a ring member encircled by said guides and cooperable with said valve seats to prevent lateral movement of said guides.

10. A valve assembly, comprising inner and outer annular valve seats stacked one upon another about substantially the same longitudinal axis, said seats having aligned central openings, a keeper holding said valve seats in assembled position and comprising a cover closing the central opening in the outer of said valve seats and a stem extending longitudinally through said valve seats from said cover into cooperative relation with the inner of said seats, ported areas extending longitudinally through each of said valve seats, recesses in the inner periphery of said outer valve seat communicating with the ported area thereof, and valves controlling the ported areas of said valve seats.

11. A valve assembly, comprising annular valve seats and annular spacing elements stacked alternately one upon another about substantially the same longitudinal axis, said elements having aligned central openings forming an internal chamber in the assembly, a body member extending within said internal chamber and formed with an annular flange restricting the passage of fluid from one end of said internal chamber, ported areas in said valve seats extending longitudinally therethrough, peripheral recesses in an outer one of said valve seats communicating the ported areas thereof with said internal chamber, and valves controlling the ported areas of said valve seats.

12. A valve assembly, comprising a body member, a removable ring member encircling said body member and supported thereby, a T-shaped conduit in said ring member providing aligned valve ports at the ends of the cross of the T on opposite sides of said ring member, annular valves for the ports, and removable annular members surrounding said body member and supported on said ring member to provide guides for the valves.

13. A valve assembly according to claim 12, characterized by springs recessed in said annular members normally to maintain the valves seated on said ring members closing said valve ports.

LESTER L. COLLINS.