Oct. 5, 1937. J. F. KOWAN 2,094,951

VALVE FOR COMPRESSORS AND THE LIKE

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Fig. 1.

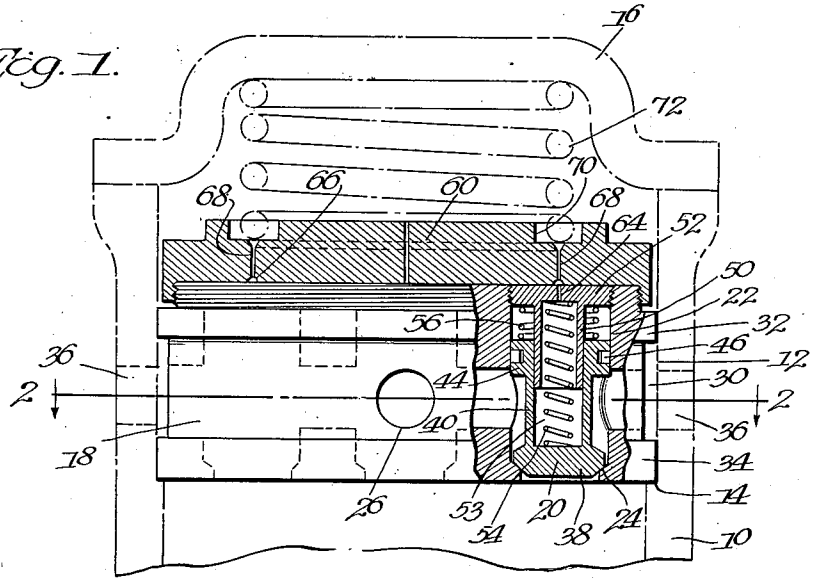


Fig. 2.

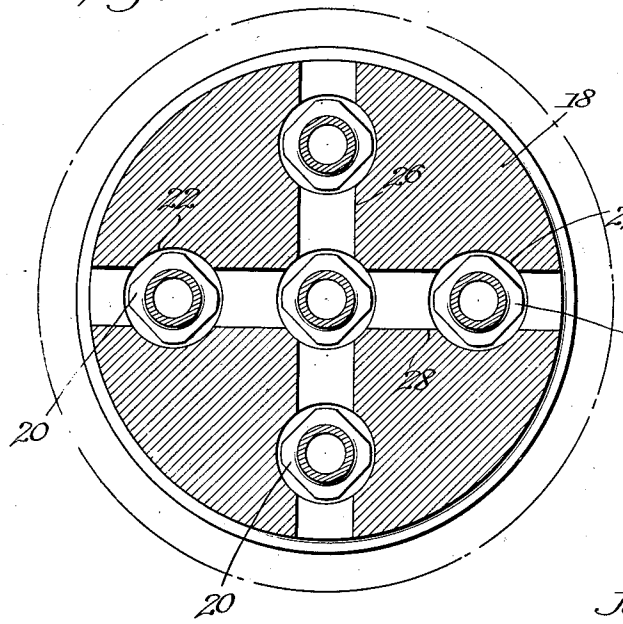
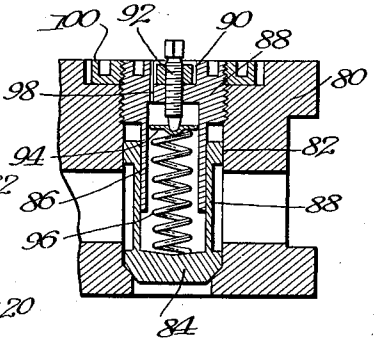


Fig. 3.



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VALVE FOR COMPRESSORS AND THE LIKE

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In Canada December 30, 1935

1 Claim. (Cl. 251—146)

The present invention relates to valves for compressors and the like, and the principal object of the invention is to provide such a valve of improved construction which will be positive yet noiseless in operation.

The valves disclosed herein are intended to be used as discharge valves for a compressor, and they are characterized by their simplicity of construction and accessibility for repair or replacement.

Another object of the invention is to provide valves of the above character which are adapted to operate effectively over a long period of time without repair, the working parts of the valves and the valve actuating means being shielded from the gases being controlled.

A further object of the invention is to provide valves of the above character, including means for balancing the same during the actuation thereof, as well as means for cushioning the movements of the valves from and toward their seats, so that the valves are substantially noiseless.

Another object of the invention is to provide a valve assembly for compressors and the like which will permit adjustment of the flow area from the compressor depending upon the capacity of the machine.

Various other objects and advantages of the invention disclosed herein will be apparent as the specification progresses.

In the drawing, which is illustrative of two forms of the invention, which drawing is in no sense restrictive:

Figure 1 is a vertical sectional view through the valve assembly of the present invention, showing the cylinder in which the assembly is mounted in dotted lines;

Figure 2 is a horizontal sectional view taken along the line 2—2 of Figure 1;

Figure 3 is a partial vertical sectional view of a modified form of the valve assembly.

Referring to Figure 1, the cylinder or casing of the compressor or the like is shown at 10, the cylindrical interior of said compressor being counter-bored at the upper end thereof as at 12 to provide a chamber of greater diameter than the interior diameter of the cylinder proper. Where the counterbore debouches from the main bore, an annular shoulder 14 is formed, said shoulder being adapted to retain the valve assembly of the present invention against inward movement as will hereinafter appear. The upper end of the cylinder or casing is provided with a top member or head 16, which may be of ordinary construction.

Mounted within the counter-bore 12 of the cylinder is the valve assembly, which includes a cylindrical valve block 18 housing a plurality of valve members 20, said valve members controlling the flow of fluid from the interior of the compressor to the discharge lines.

The valve members are carried within a plurality of valve chambers comprising cylindrical bores 22 which extend through the valve block, each bore having a conical ledge 24 just above the inner end thereof, which constitutes a valve seat.

In Figures 1 and 2, I have shown the valve block equipped with five valve chambers and corresponding valve members, one chamber being located in the center of the cylindrical block, while the other bores are disposed a quadrant's distance apart around the block between the center and periphery thereof.

Connecting the chambers 22 and providing outlet passages from the compressor, are two diametrical passages 26 and 28, which extend entirely through the valve block, said passages being at right angles to one another and meeting at the centrally disposed bore or chamber. The outer periphery of the valve block is cut away between the top and bottom thereof to provide an annular manifold 30 between the block and the inner wall of the counter-bore 12, said chamber being bounded at its upper and lower ends by the flanges 32 and 34, respectively, said circular flanges being finely machined to fit in sealing engagement with the wall of the counter-bore.

Suitable outlets 36 are provided through the cylinder wall, which outlets may connect with conduits to convey the fluid to any desired point. Each valve member is of spool-like configuration and comprises a head 38 including an outwardly disposed substantially square extension having a conical inner face for engagement with the valve seat 24, and a hollow cylindrical valve stem 40 extending outwardly within the chamber 22, the valve stem terminating at its outer end in an annular flange 44 comprising a guiding head which may be equipped with an external groove provided with a sealing ring 46, to prevent the fluid being discharged from passing beyond said flange.

The hollow interior of the valve stem fits around and is guided by a hollow guide sleeve 50, which terminates at its outer end in a threaded plug closure or head 52 which is screwed into the outer end of the bore 22. Disposed within

the guide sleeve 50 and the valve stem 40 is valve actuating means comprising a spring 54, which serves to return the valve to its seat at the termination of the stroke of the piston of the compressor. This spring is held between the outer face of the valve head 38 and the inner face of the guide stem head 52.

The valve stem and guide stem together define a vacuum-pressure chamber 53 to cushion the valve during its operation in a manner hereinafter described. To augment the effect of the spring 54, a second spring 56 may be provided surrounding the guide stem 50 and disposed between the guide stem head 52 and the valve stem head 44.

It will be noted that the inner pressure area of the valve stem head 44 within the chamber 22 is substantially equal to the outer pressure area of the valve head 38, so that when the valve is moved from its seat by pressure of fluid within the cylinder, the outward pressure on the valve member against head 44 will be substantially equal to the inward pressure on the valve head 38, resulting in a balanced valve effect.

To retain the above described valve members in position, a retaining cap 60 is threaded onto the outer end of the valve block. Each of the guide stem heads 52 is provided with a relatively small aperture 64 extending therethrough, said apertures opening into an annular groove 66 in the inner face of the retaining cap 60. Connecting with the annular groove 66 at diametrically opposite points, are a pair of relatively small passages 68 passing through the cap. Passages 64, 66 and 68 provide a restricted channel of flow for cushioning fluid from and to the chambers 22.

The cap member 60 is also provided on its outer face with an annular groove 70 to receive a relatively heavy spring 72, the outer end of said spring engaging the cylinder head 16. This spring retains the valve assembly in position at the outer end of the cylinder against the shoulder 14.

In operation, and when pressure is applied within the cylinder against the lower face of the valve block, all of the valves 20 will be simultaneously lifted from their seats, and fluid will pass into the chambers 22 and passages 26 and 28 of the valve assembly and outwardly toward the perimeter thereof to the annular manifold 30, then outwardly through the openings 36 in the wall of the cylinder. By reason of the square contour of the valve heads 38, the flow of fluid through the valves will be free at the instant each valve member leaves its seat.

When each of the valves is lifted, fluid within the cushioning chamber 53 formed by the valve stem and valve guide will be compressed, thus providing a cushioning action for the valve. It will be apparent that pressure built up within this chamber will not be extremely high, due to the fact that the fluid therein may escape through the passages 64, 66 and 68. There will be no premature tendency for the fluid in chamber 22 to return said valves to their seats, by reason of the fact that the outward pressure against the valve stem head 44 equalizes the inward pressure on the upper side of the valve heads 38.

It will be evident that the stroke of the piston may be such that substantially all of the fluid from the cylinder is discharged. Furthermore, all of the fluid discharged passes radially through the valve block and none if it is trapped in the upper end of the cylinder.

When the discharge operation of the valve has terminated, and the pressure below the same has dropped by reason of the discharge, the springs 54 and 56 serve to return each valve to its seat. This return movement will not be so rapid as to cause sufficient impact of the valve member with its seat to result in noisy operation, due to the vacuum effect caused within the cushioning chamber 53, it being evident that upon inward movement of each valve member, a partial vacuum will result in said chamber, thus retarding the movement of the valve member towards its seat. This retardation will not be pronounced enough to cause an undesirable lag in the return of the valve member to its seat, due to the fact that fluid will be slowly drawn into chamber 53 through the passages 64, 66 and 68.

It will be noted that both of the springs 54 and 56 are enclosed, the former within the chamber 53 formed by the valve stem and valve guide, and the latter within the bore 22 above the valve stem head 44, so that the fluid or gases from the compressor cannot contact with said springs, and resulting injurious effects on said springs are prevented. Furthermore, the fluid utilized within the chamber 53 for the cushioning effect is not drawn from the chamber 22 or the passages 26 and 28, and consequently the spring 54 is not injuriously affected. The valve stem head and seal 46 prevent the discharged fluid from contaminating the guiding surfaces between the valve stem 40 and valve guide 50. By reason of the fact that the chambers 53 are not connected with the outlet passages 26 and 28 for the fluid, there is no tendency for the rapid rush of gases outwardly through these passages causing a vacuum effect within the chambers 53 when the valves are being lifted from their seats, at which time it is desirable to have a pressure effect in said chamber.

In Figure 3 a modification of the invention is disclosed in which a valve block 80 is provided with a plurality of cylindrical valve bores 82 for the reception of the valve members 84 in the manner similar to that described in connection with Figure 1. Each hollow valve guide 86 is provided with a relatively large head 88 threaded into the valve block at the upper end of bore 82, and this head is recessed centrally at 90 to receive a nut threaded onto a spring adjusting screw 92, which is in turn threaded through the head 88. This adjusting screw extends into the cushioning chamber defined by the interior of the valve stem and valve guide and engages a follower 94 carried upon the outer end of a valve spring 96, which spring at its inner end engages the outer face of the valve member 84 as previously described in connection with Figure 1. As in the former embodiment, the cushioning chamber is provided with an outlet passage 98 which extends through the head 88. A locking ring 100 is threaded exteriorly onto the guide head 88 to lock the same within the valve block. Suitable openings or other devices may be provided in the upper faces of the ring 100 and the block 88, to facilitate removal and insertion of the guide.

The operation of this embodiment is substantially similar to the preferred embodiment disclosed in Figure 1, in that the valve is moved from its seat by pressure and is returned to its seat by the force of the spring 96. The interior of the valve stem and the interior of the valve guide provide a vacuum-pressure chamber to cushion the operation of the valve, and it will be noted that the valve is balanced by the inner face of the valve stem head, which provides a pressure

area to counter-act the pressure effect on the outer face of the valve member **84**.

It will be evident that the valve members of the present invention provide a construction of extreme simplicity, and one outstanding in its accessibility to permit repair or replacement of any of the valve members. The entire valve assembly may easily be removed from the cylinder and any one or all of the valve members repaired or replaced as desired.

The valve assembly disclosed herein may be used in association with a compressor or the like of any capacity, and the total area of flow through the valves may be regulated by permanently closing any one or a number of them; this operation being performed by substituting a solid bar or spacer for the spring **54** extending between the valve member and the valve guide head, so that the desired valve or valves will be permanently retained upon their seats.

It is apparent that various changes may be made in the constructions disclosed herein without departing from the scope of the invention.

I claim:—

Apparatus of the character described comprising a casing and a casing head therefor, a valve block in said casing and closing off the upper portion thereof so that a top chamber bounded upwardly by said casing head is provided, said valve block having a vertical bore therethrough and a discharge passage communicating with said bore intermediate the ends of the latter, an annular valve seat at the lower end of said bore, a valve member in said bore and comprising a hollow stem provided at one end with a solid head for cooperation with said seat and at the other end with an annular flange, said flange being slidably guided in said bore and the opposed surfaces of said flange and head having substantially the same area, a closure for the upper end of said bore carrying a sleeve in coaxial relation with the latter and slidably engaged in said hollow stem to guide the latter, and a compression spring enclosed in said stem and sleeve and bearing with its ends against said closure and said head respectively, said closure being provided with a small passage which extends from its outer surface to its lower surface within said sleeve whereby the interior of the latter is placed in communication with said chamber, said chamber being isolated from said bore and passage.

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