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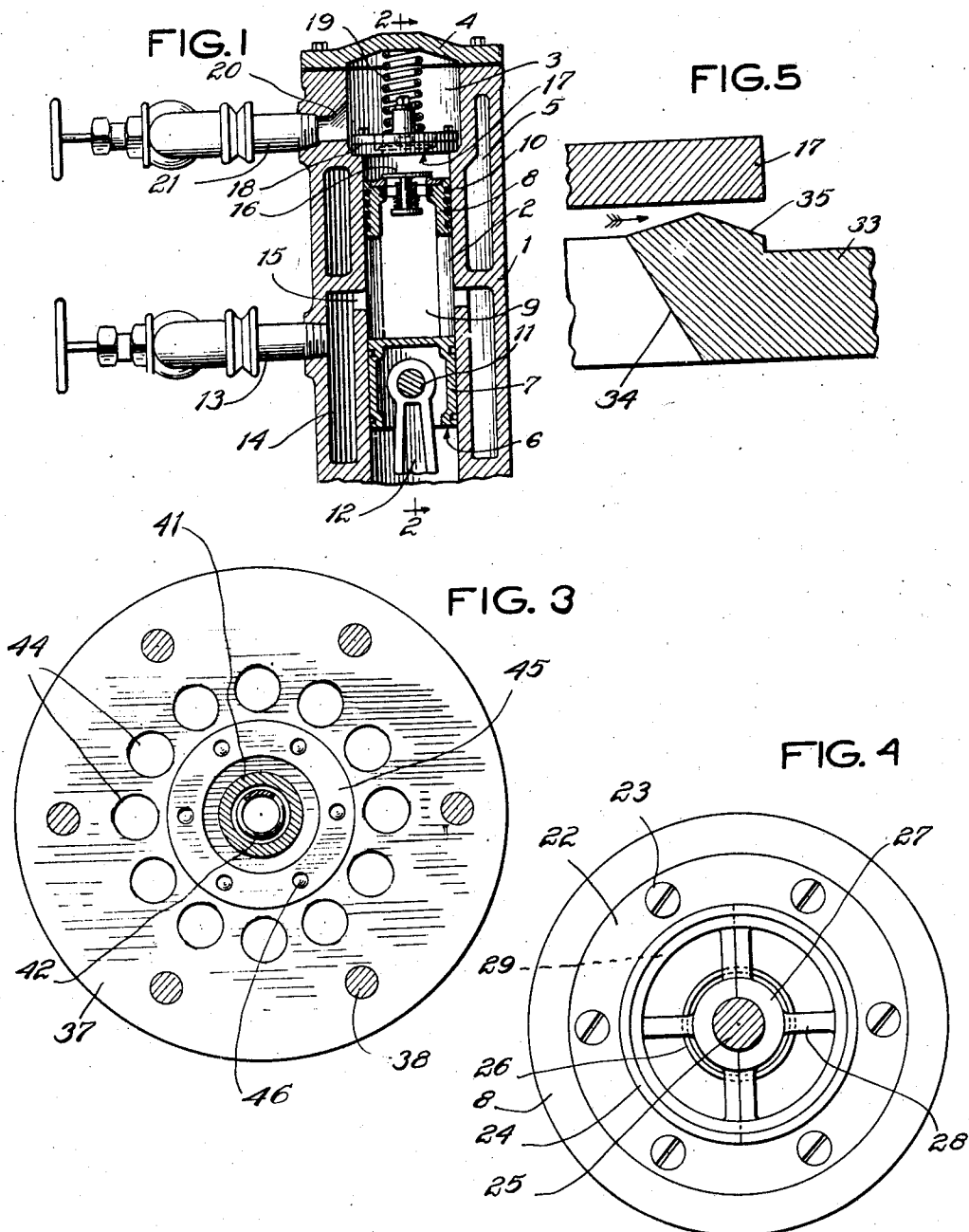
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J. C. SCOVEL, JR

COMPRESSOR

Filed June 16, 1922

2 Sheets-Sheet 1



Inventor
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by Hewitt S. Dixon
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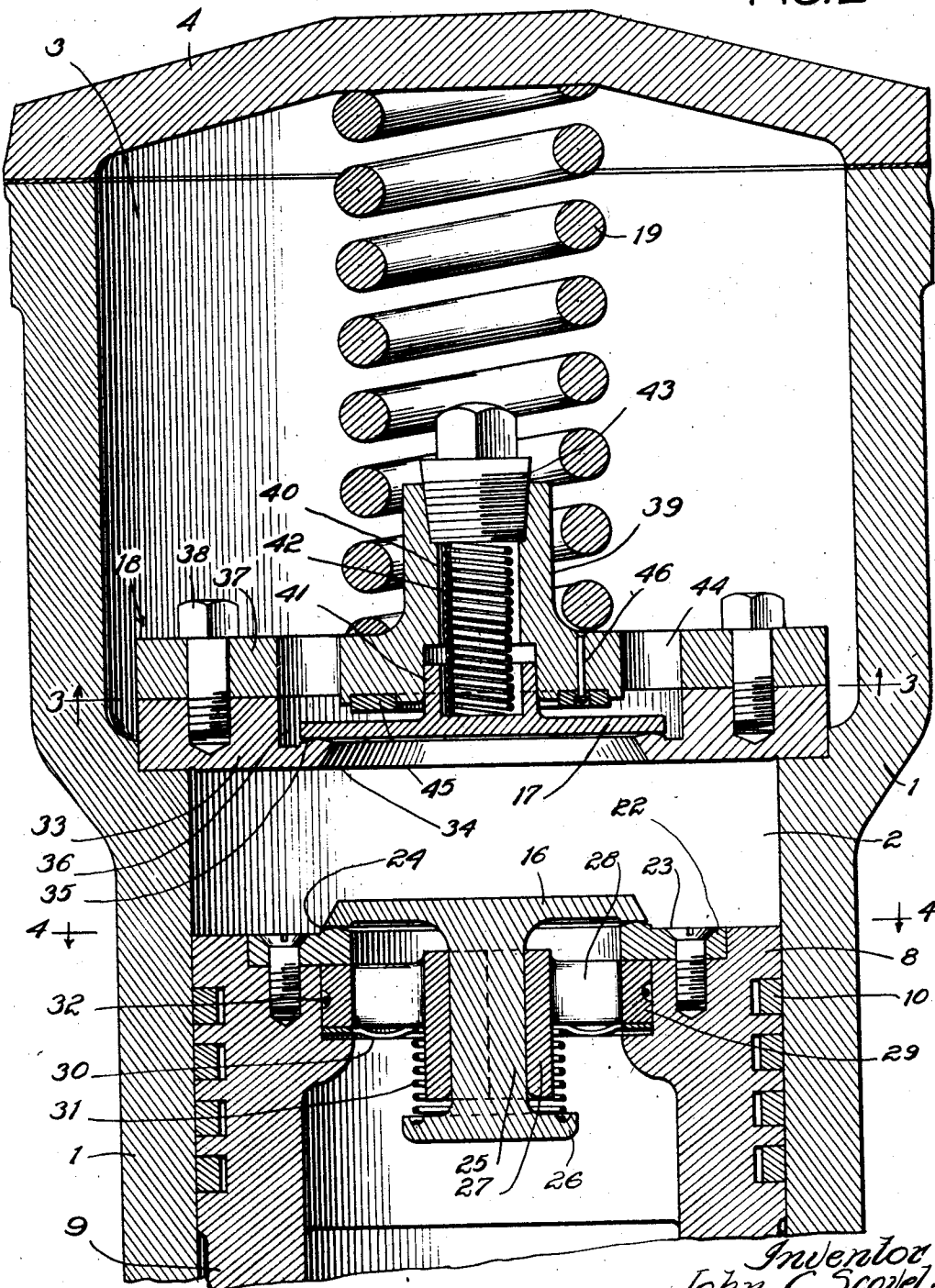
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FIG. 2



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UNITED STATES PATENT OFFICE.

JOHN C. SCOVEL, JR., OF CHICAGO, ILLINOIS, ASSIGNOR TO THE CREAMERY PACKAGE MFG. CO., OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

COMPRESSOR.

Application filed June 16, 1922. Serial No. 568,759.

To all whom it may concern:

Be it known that I, JOHN C. SCOVEL, JR., a citizen of the United States, residing at Chicago, in the county of Cook and the State of Illinois, have invented certain new and useful Improvements in Compressors, of which the following is a specification.

The invention relates to fluid compressors, and more particularly to the construction and arrangement of the suction and discharge valves in compressors of the reciprocating piston type.

It is highly desirable in compressors of this type, especially when employed to compress volatile refrigerant gases, that the volumetric efficiency of the machine be high. In the more compact machines of comparatively small piston displacement and high speed, their efficiency has been limited by the difficulty of securing sufficient rapidity of action of the valves and a sufficient degree of sensitiveness in the latter to variations of pressure so that the full displacement capacity of the piston might be utilized. A further limitation in utilizing the displacement capacity of the piston has occurred with the difficulty of securing large valve capacity in a construction which eliminates clearance between the piston and cylinder head at the end of the compression stroke and completely discharges the compressed gas. Also, an objectionable clatter of the valves upon their seats has heretofore attended the operation of such machines at high speed.

It is one of the objects of the present invention to provide a compressor in which the suction and discharge valves are of large capacity quickly and fully effective with a minimum of operative movement.

Another object is to provide valves in such a machine which are sensitive to and immediately operable by slight differences between the variable opposing pressures sustained by them in the operation of the piston.

Another object is to provide a construction of valve and seat which minimizes friction in the passing gas, and which maintains a tight seal when closed over a long period of operative use.

Another object is to provide a valve construction in the piston and in the cylinder

head which permits the operation with an inconsiderable amount of clearance therebetween, and which permits full utilization of piston displacement capacity together with efficient valve action.

Further objects include practically noiseless operation; a rigid construction of valve members which avoids damage from displaced separable parts; and a simple durable construction of operative parts permitting ready replacement.

Other objects and advantages will be apparent in the following detailed description of a preferred embodiment of the invention which I have chosen for illustration in the accompanying drawings, and which shows an application of the invention to a compressor adapted for use with refrigeration apparatus.

In the drawings, Fig. 1 represents a sectional elevation of a compressor cylinder and piston. Fig. 2 is an enlarged sectional elevation of the upper portion of the piston and cylinder, taken on the plane of the line 2—2 in Fig. 1 and illustrating the structural detail of the valves. Fig. 3 is a cross sectional view as taken on the line 3—3 in Fig. 2. Fig. 4 represents a cross sectional view taken on the plane of the line 4—4 in Fig. 2. Fig. 5 is a fragmentary sectional view of the discharge valve and seat.

The general organization of the mechanism, as set forth in Fig. 1, comprises a cylinder 1 having a longitudinal bore 2 terminating at its upper end in an enlarged chamber 3. A removable cover plate 4 effects a closure of the chamber 3. A water circulating chamber 5 having suitable supply connections may surround the upper portion of the walls of the bore 2 to remove the heat of compression developed in operation.

Operatively positioned in the bore 2 is a piston 6 preferably of the double trunk type comprising a bottom part 7 serving as a cross-head and an upper part 8 serving as a compression head. The upper and lower parts of the piston are rigidly connected, preferably by means of a pair of spaced parallel bars 9 extending between and integral with the two heads. The bars 9 are preferably oppositely positioned adjacent the circumferential edges of the heads to pro-

vide a large central open space between them, but having clearance from the walls of the bore 2. Conventional packing or compression rings 10 may be provided in both heads. The cross head 7 is illustrated as carrying a wrist pin 11 and connecting rod 12 actuated by a conventional power driven crank shaft (not shown) and by which the piston 6 is reciprocated.

The refrigerant gas, or other fluid to be compressed, may be conducted to the cylinder through a pipe 13 opening into a suction chamber 14 surrounding the wall of the bore 2, the chamber 14 providing a large supply of gas to draw from during the suction stroke of the piston. Preferably several inlet ports 15 open from the upper portion of the chamber 14 into the bore 2 of the cylinder, the ports being positioned between the ranges of travel of the two piston heads so that the gas flows freely into the open space therebetween. The flow of gas from the latter space during the suction stroke of the piston to the compression space above the piston is controlled by a suction valve 16, centrally positioned in the upper wall of the pumping head 8, and described in detail hereinafter.

During the compression stroke of the piston the suction valve 16 is closed and the gas thereabove is compressed and forced into the high pressure chamber 3 through a discharge valve 17 (to be described in detail hereinafter) preferably carried by a cylinder head 18 forming an end closure of the cylinder bore 2 and partitioning the compression space in the latter from the chamber 3.

The cylinder head 18 is preferably of the "safety" type resiliently secured in abutment with the end of the cylindrical wall of the bore 2 by means of a compression spring 19 confined between the upper side of the cylinder head and the cover plate 4, the spring tension being sufficient to maintain the head 18 in sealed abutment under normal conditions, but permitting outward movement of the head in case of any obstruction between it and the piston due to liquid in the cylinder, a breakage of parts or any other cause, thus preventing extensive damage and the escape of gas in the event of such accident. The compressed gas may be led out of the chamber 3 through a port 20 and discharge pipe 21.

Describing now the construction and arrangement of the suction and discharge valves, reference is had to Fig. 2. The compression head 8 of the piston is provided with an opening through its end wall communicating with the space between the piston heads. The end face of the compression head preferably is recessed to receive a removable annular plate 22 flush with the face of the head and secured thereto as by

means of screws 23. Adjacent the inner perimeter of the plate 22 a raised annular valve seat 24 is provided, preferably integral with the plate. The seat and its supporting plate may be constructed of material better suited to withstand the wear of the valve action than that of which the piston is commonly constructed and is readily removable for replacement. The annular seat 24 is formed with a pyramidal cross section having a wide angle at the apex, and is arranged to receive the co-operative plane face of the valve 16 upon its annular apex.

The valve 16 is preferably a flat plate permitting the reduction of its weight to a minimum. Depending from the center of the valve 16 is a stem 25 terminating in a flange 26, the stem and flange preferably being integral with the valve. The stem 25 is supported and guided for longitudinal movement within a sleeve 27 having radial arms 28 terminating in a ring 29 removably fitted within an inner recess in the compression head structure below the plate 22. The ring 29 is secured in position by the plate 22, and may be maintained in snug abutment therewith by means of a resilient member 30, preferably an annular spring, interposed between the ring 29 and the shoulder formed at the bottom of its recess. A compression spring 31 confined between the arms 28 and the flange 26 normally holds the valve 16 in contact with its seat in closure of the passage through the compression head. The opening of the valve in operation is limited by abutment of the flange 26 with the lower end of the sleeve 27.

The guide sleeve 27 and its supporting elements are of split construction as illustrated in Fig. 4, in order to permit making the valve member of fixed construction, in the present instance integral, thus avoiding the use of lock nuts or other detachable stop means in place of the flange 26, such detachable stops being liable to work off from the valve stem to the damage of the machine. The assembling and replacement of the valve parts may be facilitated by providing a groove about the outer periphery of the ring 29 adapted to receive a binding wire 32 (Fig. 2) to hold the parts of the guide structure in assembled relation about the valve stem.

It will be apparent that the large exposed areas and light weight of the plate valve 16 assures a very sensitive and fast action of the valve between the compression and suction strokes of the piston. The extremely narrow width of the valve seat contact surface causes a substantial balance between the surface areas of the valve subjected to opposing pressures when in closed position, and permits the valve to open without an excessive difference in pressures above and

below the valve. Also, the large perimeter of the valve opening with its venturi-like radial cross section permits a very short distance of valve lift to give free passage to the gas, thereby further increasing the speed rate of efficient piston operation.

The discharge valve 17 is positioned in the cylinder head 18, preferably with its axis in continuation of that of the suction valve. As herein illustrated, the head 18 comprises a lower plate 33 removably seated in a suitable recess provided in the side wall of the enlarged portion of the cylinder and forming an abutment for the plate 33 in sealed end closure of the cylinder bore 2. A discharge passage 34 is opened centrally through the plate 33, the passage preferably being of conical peripheral contour of like diameter with that of the suction valve 16, the latter also having a similar conical periphery.

It will here be apparent that the plate 33 may be positioned immediately adjacent the position of the piston at the end of the compression stroke, so that with the entry of the valve 16 within the discharge passage 34 the piston may approach the cylinder head to the limit of slight operating clearance and completely discharge all of the gas from the cylinder bore. This arrangement permits the utilization of the full displacement capacity of the piston, as when any portion of compressed gas remains in the bore a proportionate part of the suction stroke is ineffective until the pressure above the suction valve is reduced to the point that the valve may be opened by the pressure in the suction chamber below.

A discharge valve seat 35 is provided contiguous to the upper edge of the passage 34 and preferably integral with the plate 33, the latter being recessed on its upper side to provide an operating space 36 for the discharge valve 17. The discharge valve 17 is also of the flat plate type, and its seat 35 is of pyramidal cross section similar to that of the suction valve seat.

The valve seat construction, as applied in both suction and discharge valves and illustrated in enlarged cross section in Fig. 5, is especially advantageous in the discharge valve by reason of the high velocity of the compressed gas being forced therethrough and because of waste of power which occurs when there is high frictional resistance to the passing gas. Efficient valve action at high speed necessitates a minimum of valve lift and a sufficient valve opening to avoid material resistance to the flowing gas. The cooperating surfaces of the valve and valve seat, formed in an angular relation approximate to that illustrated in Fig. 5, give a very high discharge coefficient of the orifice between them. The radial cross section of the annular passage between the open valve

and its seat approximates a venturi, the action of which is to permit maximum increase of velocity at the neck of the passage without materially increasing friction. The inclined sides of the seat eliminate eddies and their consequent constriction of the flow of the gas through the orifice, and permit a considerable reduction in the valve lift, as compared with the usual poppet and other types of valves, without reducing the effective capacity of the valve orifice. The consequent advantageous result is that a very low valve lift may be used and a high operative speed may be efficiently attained without increasing the power necessary to drive the compressor.

The seat construction also reduces to a minimum the liability of scale becoming lodged thereon and preventing a tight closure of the valve. The wire edged apex of the seat assures a sealing contact at all points with the valve surface closed upon it. The removable construction of the valve parts also permits the use of a minimum amount of the more costly material preferably employed in those parts to prolong their effective life.

In the preferred construction herein illustrated, a guide and cover plate 37 forms the upper portion of the head 18 and overlies the plate 33, being secured thereto as by means of bolts 38. The guide plate 37 carries a centrally positioned boss or collar 39 defining an axial passage 40 extending through the plate 37. The lower end of the passage 40 may be enlarged to form a guide way operatively receiving a guide collar 41 fixed centrally upon the discharge valve 17. A compression spring 42, preferably positioned within the passage 40 between the valve 17 and a preferably removable end closure or plug 43 secured in the collar 39, tends to hold the valve 17 in contact with its seat. A series of holes 44 opening through the guide plate 37 into the valve operating space affords passage for the gas flowing through the discharge valve into the chamber 3.

The position of the holes 44 in relation to the discharge valve 17 is important in that, by approximately centering the holes over the edge of the valve, eddy currents are produced therein which react upon the upper surface of the open valve to partially counter balance the pressure below, thus increasing the rapidity with which the valve will close upon completion of the compression stroke of the piston. This action occurs only when the gas is flowing through the open valve, and does not add resistance to the operative movement of the valve from its seat in opening.

An annular ring 45 of fibre or other suitable material may be secured as by rivets 46 to the under side of the guide plate 37

above the valve 17, thus providing a slightly resilient stop limiting the upward movement of the valve and further reducing the noise commonly attending the operation of the discharge valves in compressors.

The collar 39 also serves as a positioning retainer for the "safety" head compression spring 19 bearing thereabout upon the plate 37 and normally securing the cylinder head assembly in sealed abutment with the end wall of the cylinder bore 2.

It will now be apparent that I have provided a compressor having an improved valve arrangement which embodies superior advantages in operation, and which is of simple durable construction.

I claim as my invention:

1. A fluid compressor comprising a cylinder, a piston head therein having a longitudinal passage, a shoulder formed in the passage, a plate removably secured to the end of said head having an orifice opening into said passage, said plate forming a valve seat, a ring in said passage removably secured between said plate and said shoulder, a resilient annulus interposed between said ring and said shoulder, and a valve supported by said ring in cooperative relation to said valve seat to control said passage.

2. A fluid compressor comprising a cylinder, a piston head therein having a longitudinal passage, a shoulder formed in the passage, a plate removably secured to the end of said head having an orifice opening into said passage, said plate forming a valve seat, a ring in said passage removably secured between said plate and said shoulder, and a valve supported by said ring in cooperative relation to said valve seat to control said passage.

3. In a fluid compressor, a piston head having a passage therethrough, a shoulder formed in the passage, a plate removably secured to the end of said head having an orifice opening into said passage, a valve seat formed on said plate about said orifice, a valve co-operating with said seat to control said passage and having a guide stem, a flange fixed on the end of said stem, a sleeve operatively supporting said stem and limiting its longitudinal movement in one direction by abutment with said flange, a ring in said passage removably secured between said plate and said shoulder, spaced supporting members rigidly connecting said sleeve and said ring to form a unitary structure, said structure being divided through said sleeve into parts separable to receive said stem, and a binding element positioned

about said ring to secure said divided parts in assembled relation.

4. In a fluid compressor having a cylinder with its bore terminating in an enlarged chamber, a head in said chamber effecting an end closure of the bore and comprising, a plate abutting the end of the wall of said bore having a recess in its outer face and having an orifice opening from said recess into said bore, said plate having an integral valve seat formed at the bottom of said recess about said orifice, a second plate overlying and removably secured to said first mentioned plate having a circular series of passages therethrough communicating with said recess and said chamber, an upwardly extending annular boss integrally formed on said second mentioned plate having an inner guide bearing opening into said recess centrally of said passages, a valve in said recess adapted to co-operate with said seat to control said orifice and having a guide collar operably positioned in said guide bearing, the lateral periphery of said valve extending beneath said passages in substantially centered relation thereto, resilient means within said annular boss tending normally to hold said valve in contact with its seat, and a stop of resilient material secured to said second mentioned plate in position to limit the movement of said valve from its seat.

5. In a fluid compressor having a cylinder with its bore terminating in an enlarged chamber, a head in said chamber effecting an end closure of the bore and comprising, a plate abutting the end of the wall of said bore having a recess in its outer face and having an orifice opening from said recess into said bore, said plate having a valve seat formed at the bottom of said recess about said orifice, a second plate overlying and removably secured to said first mentioned plate having a circular series of passages therethrough communicating with said recess and said chamber, a guide bearing in said second mentioned plate positioned centrally of said passages, a valve in said recess adapted to co-operate with said seat to control said orifice and having a guide member operatively positioned in said guide bearing, the lateral periphery of said valve extending beneath said passages in substantially centered relation thereto, and resilient means normally tending to retain said valve in contact with said seat.

In witness whereof I have hereunto set my hand.

JOHN C. SCOVEL, JR.