

Dec. 31, 1935.

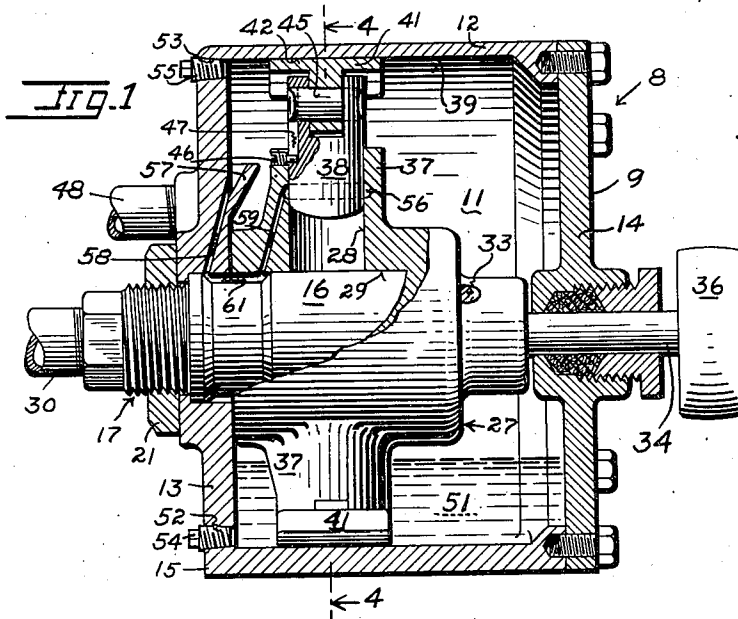
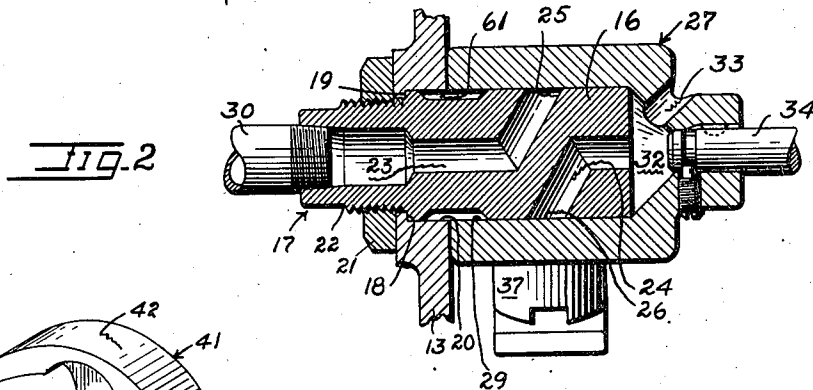
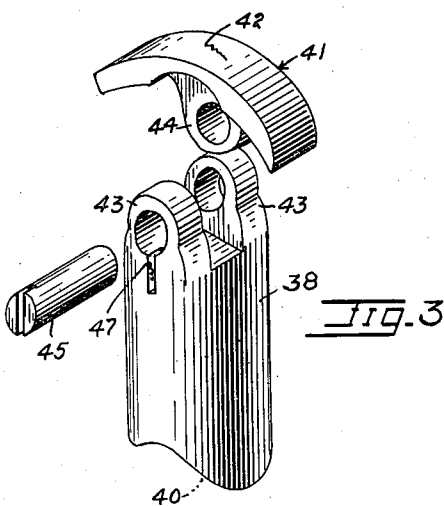
R. H. LONG

2,025,758

COMPRESSOR

Filed July 5, 1932

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

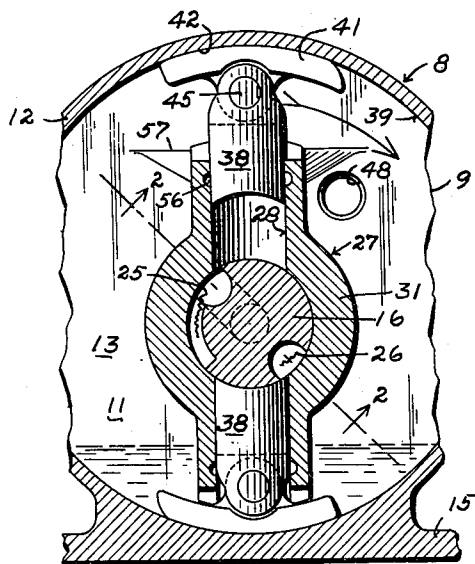


Fig. 4

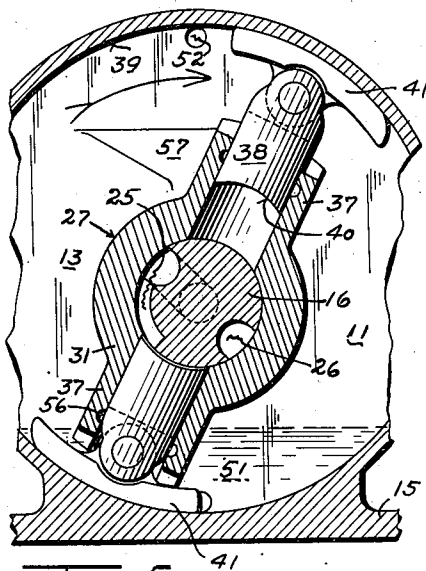


Fig. 5

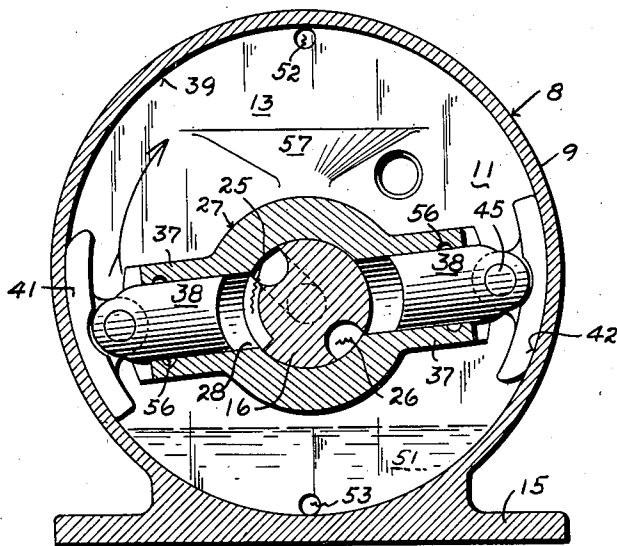


Fig. 6

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UNITED STATES PATENT OFFICE

2,025,758
COMPRESSOR

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Application July 5, 1932, Serial No. 620,871

2 Claims. (Cl. 230-177)

The invention relates to a pneumatic compressor.

A general object of the invention is to provide an improved compressor of the class wherein free pistons are utilized.

Another object of the invention is to provide for the adjustment of the valve action of the compressor whereby its operation may be most efficient under different operating conditions.

A further object is to provide an improved lubricating means for a compressor of the class described, said means incorporated in the compressor and automatically operated therewith and thereby.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth or be apparent in the following description of a typical embodiment of the invention, and in the accompanying drawings, in which,

Figure 1 is a vertical axial section through a compressor embodying the features of present invention.

Figure 2 is a fragmentary sectional view at 2-2 in Figure 4.

Figure 3 is a perspective view showing the elements comprising a piston assembly of the compressor.

Figure 4 is a vertical section at 4-4 in Figure 1.

Figures 5 and 6 are views similar to Figure 4 but showing the rotor of the compressor disposed in different operative positions thereof.

As particularly illustrated, the invention is embodied in the structure of a compressor 8 having a casing 9 within which is provided a closed cavity or chamber 11 of cylindric outline. In the present structure, the side walls 12 and one end 13 are integrally related, while the other casing end wall 14 is removably attached to the opposed end of the side wall portion. The compressor is arranged to be operated with the axis of the chamber 11 horizontally disposed, and a base 15 is provided for the casing as an integral portion of its structure and for disposing the casing cavity 11 in the indicated position.

A cylindrical stator 16 extends from a casing end into the casing chamber. As particularly illustrated, the stator 16 comprises the inner portion of an element 17 which is fixed in and extends through the casing end 13 for rotative adjustment in its mounting, the reason for the latter being hereinafter brought out. The axis of the stator 16 lies to one side of and is parallel to the axis of the chamber 11; in the present instance the two axes lie in a vertical plane with the axis of the stator lowermost.

The element 17 is circumferentially reduced at the outer end of the stator 16 to define a radial shoulder 18 and is arranged for mounted engage-

ment in a stepped bore through the casing end 13, said bore providing an inwardly facing seat 19 against which the shoulder 18 is arranged to bear. The outer end of the stator snugly fits the larger bore portion 20 for centering the stator in its place. For fixing the element in its mounted position, a nut 21 is threadedly mounted on the reduced portion 22 of the element for engagement with the outer face of the casing end whereby to releasably clamp the element in place in rotatively adjusted position. As shown, the outer end of the portion 22 is polygonal for engagement by a wrench to hold the element 17 against rotation while the nut 21 is tightened or loosened, the present arrangement providing for adjustment externally of the casing and while the compressor is operating.

Passages 23 and 24 are provided in the element 17, said passages extending respectively from ports 25 and 26 at diametrically opposed points of the stator surface to the opposite ends of the element. The outer end of the bore of the passage 23 is threaded for connection with a pipe 30.

A rotor 27 is mounted on the stator 16, said rotor providing a plurality of cylinder bores 28 extending radially outwardly from its central bore 29 which receives the stator. Preferably, and as shown, the cylinder bores 28 extend in full section from the rotor bore, and their axes are mutually concurrent in the axis of rotation of the rotor and make equal angles with said last axis; in the present instance, said angles are right angles whereby the cylinder axes lie in a common plane perpendicular to the axis of rotation. The inner ends of the cylinder bores 28 are arranged to alternately register with the ports 25 and 26 of the stator as the rotor revolves thereabout. In the present instance, but two cylinders are shown, though more might be provided.

As particularly disclosed, the rotor is formed with a cylindrical hub portion 31 having the rotor-receiving bore 29 therein conically contracted beyond the stator end therein whereby to define a space 32 opposite said stator end and having its greatest diameter at the stator. The space 32 is arranged to be in constant communication with the space of the chamber 11 and such is effected by providing a duct 33 through the rotor hub. For a reason to be hereinafter brought out, the duct 33 extends from an intermediate point of the circumferential wall of the space 32, the relation being particularly brought out in Figures 1 and 2.

An operative rotation of the rotor is arranged to be effected through the operation of a shaft 34 fixed to and extending axially from the hub 31, said shaft journaled in the removable casing end wall 14. As shown, the shaft 34 is detachably fixed to the rotor hub 31, is extended through a stuffing box 35 for maintaining the seal of the

chamber 11, and is provided with a belt pulley 36 at its free end for use in effecting its actuation. It is noted that the stator 16 and shaft 34 jointly support the rotor in its operative position.

5 The outer portions of the two cylinder bores 28 are particularly disclosed as defined in oppositely directed integral and radially directed extensions 37 of the hub, said extensions of cylindrical outline. Pistons 38 are mounted in the cylinder bores 28, said pistons arranged to be freely slidable in their cylinders and urged outwardly solely by centrifugal force as the rotor is actuated whereby to maintain an engagement with the cylindrically curved inner face 39 of the casing side wall 12. 10 As the rotor is turned, the face 39, owing to the eccentricity of its generating axis with respect to the rotor axis, will variably limit the outward disposal of the pistons in their cylinders whereby each piston will move through a reciprocative cycle in its cylinder at each revolution of the rotor. 20 Preferably, the inner piston faces 40 are cylindrically concave whereby they are complementary to the stator and are arranged to closely approach the stator when the pistons are at their innermost positions; in this manner, the cylinder-head clearance may be a minimum during piston operation.

Bearing members 41 are provided on the outer piston ends for engagement with the inner face 39 of the chamber wall 12, said members designed to distribute the pressure engagement of the pistons with said face. Accordingly, the members 41 comprise arcuate shoes hingedly mounted on the pistons and presenting cylindrically convex faces 42 against the casing face 39. As shown, 35 the outer end of each piston is axially kerfed to define spaced ears 43 for receiving between them an ear 44 extending radially inwardly from a shoe 41, a pin 45 extending through said ears to complete the hinged jointure.

40 For preventing a rotation of the pistons 38 in their cylinders, screws 46 are mounted in and extended through the outer cylinder ends for the engagement of their inner ends in axial slots 47 provided in the piston sides. With the present piston structure, each slot 47 extends longitudinally in an ear 43 and diametrically across the end of a pin 45, the latter being secured against rotation in the piston ears which carry 50 it. It is noted that the cylinders would preferably be extended equally and to a maximum degree for permitting a full piston retraction in the cylinders.

It will now be noted that in the disclosed form 55 of the invention, the pump cylinders are arranged to receive a gas through the passage 23 and to discharge the compressed gas through the passage 24, and that under these circumstances the ports 25 and 26 must bear a definite relation to the plane defined by the chamber and rotor axes and to the direction of rotation of the rotor. Referring to Figure 4, in which a clock-wise rotation of the rotor is indicated and the cylinders are 60 disposed with their axial lines vertical, it is seen that the diametral line through the ports 25 and 26 makes an angle of about forty-five degrees with said plane, and the cylinders are in advance thereto. Since the upper piston is in fully extended position while the lower piston is fully 70 withdrawn in its cylinder, the port 25 is adjacent the upper cylinder and the port 26 is adjacent the lower cylinder.

75 If now the rotor be turned in a clock-wise direction, the different cylinders will approach reg-

istration with the other ports. Preferably, and as shown in Figures 4 to 6, the inlet port 25 is extended circumferentially of the stator in a counterclockwise direction whereby it is arranged to register with an approaching cylinder when the rotor has moved through but a relatively small angle from the previous cutoff position of said cylinder—in this manner substantially the entire outward stroke of the piston of said cylinder is effective as a suction stroke. The discharge port 26, on the other hand, is relatively short circumferentially thereof whereby discharge therethrough occurs only during the last part of the compression stroke of the piston of a passing cylinder. It is noted that the relations 15 of the parts just before inlet and discharge are disclosed respectively in Figures 5 and 6. From the foregoing, it will be clear that the stator 16 with its ports 25 and 26 functions as a two-way valve with respect to the cylinders, and that the 20 stator and the rotor cooperate to effect a delivery of gas to the receiving chamber 11 by way of said cylinders.

The chamber 11, it will now be noted, is provided with a discharge pipe 48 for connection 25 to a compressed-gas receiver (not shown), while the inlet pipe 30 is arranged for connection to a source of the gas to be compressed. When air is to be compressed, the pipe 30 would be opened to the atmosphere and the chamber 11 would 30 receive the air as an equalizing reservoir therefor.

Since the valve action provided by and between the rotor and stator must be accurately timed with respect to the piston cycles, the previously described provision for rotatively adjusting the 35 stator 16 in its mounting will now be understood as a valuable and necessary feature for insuring an operation of the compressor at maximum efficiency under a given service requirement as to the pressure or quantity of discharged gas. As 40 each piston cycle is constant with respect to the rotation of the rotor, the advancing or retarding of the valve action through the adjustment of the rotor solely effects any desired or required operative adjustment of the valve action.

Means are provided for lubricating the various 45 contacting and relatively moving surfaces of the present compressor, said means entirely incorporated in the compressor structure and operative by and during an operation of the compressor. 50 The casing cavity 11 is arranged to constantly contain a supply of a liquid lubricant 51 for distribution where and as needed; for convenience in maintaining a proper and adequate supply of the lubricant in the compressor, drain and supply 55 openings 52 and 53 are shown provided in the casing end 13, said openings normally closed by means of screw plugs 54 and 55 respectively. Externally thereof, the rotor and exposed piston 60 parts are kept lubricated by reason of their passage through the lubricant liquid in the cavity 11 and the splashing of said liquid as a result thereof. The movement of the shoes 41 through said liquid is arranged to carry the lubricant 65 around for functioning between the shoes and the casing bore face 39. By reason of the fact that the operation of the present rotor creates no end thrust thereon, the lubrication at the ends of the rotor, which engages between the casing end walls, is primarily and satisfactorily accomplished through said splashing of the lubricating 70 liquid within the chamber.

A circumferential oil-distributing groove 56 is formed in each cylinder bore and at a point 75 thereof which constantly opposes the piston, and 75

means are provided for supplying the lubricant to said groove from a catch-basin or cup 57 which is provided at the inner side of the end wall 13 for receiving lubricant which is splashed within the cavity in the previously described manner. As particularly shown, a duct 58 extends from the bottom of the cup 57 through the wall 13 to the larger bore portion 20 at the outer stator end, while a duct 59 extends from each cylinder groove 56 through the rotor body to the central rotor bore 29. The stator is annularly reduced between the inner ends of the ducts 58 and 59 whereby to provide a groove 61 therearound and constantly connecting said ducts. Preferably, and as shown, the inner side of the groove 61 is bevelled and extends inwardly of the mouths of the ducts 59 whereby to define an annular space of triangular section inwardly of the circle of said duct mouths. It is noted that the bearing between the stator and the casing wall 13 occurs opposite the groove 61 whereby this bearing may receive some lubricant from the groove.

It will now be noted that the rotation of the rotor is constantly operative to urge a centrifugal flow of lubricant outwardly in the ducts 59 and so from the stator groove 61, duct 58 and cup 57. Since the lubricant enters the cup 57 at the same pressure as that in the casing, its discharge pressure at the cylinder grooves 56 will exceed the first pressure whereby to insure a pressure distribution of lubricant at the pistons. A similar excess pressure condition will exist at the previously mentioned V space at the inner end of the stator groove 61 whereby lubricant may be forced axially along the stator bore face for lubricating the same. It will, of course, be understood that the distributed lubricant also functions to seal the pistons in their cylinders and the stator in the rotor.

By reason of the described disposition of the duct 33 for the space 32 within the rotor and at the end of the stator, there will also be found an undrained zone of triangular section at the outer periphery of this space and at the stator end. Since any lubricant in the space 32 will tend to revolve with the rotor, centrifugal force will tend to force the lubricant into said zone and thence along the stator at a pressure exceeding the pressure in the casing cavity. Any excess of lubricant in the cylinders may escape through the duct 33 into the space 32 and so back to the lubricant supply.

It will now be clear that the present compressor itself provides by its structure and operation a complete pressure lubrication for the pistons and rotor. Furthermore, the effective lubrication pressure will increase with the speed of operation of the compressor, thereby insuring a constant and sufficient lubrication and seal at all times.

The present compressor is particularly adapted for high speed operation, such operation thereof being primarily made possible by the fact that the free pistons move in an unvarying circle while contacting the chamber wall. In this manner, neither the pistons nor cylinders produce impacts in the compressor structure, and the desired high pressure operative speed for the increased efficiency of the compressor is thus possible without the creation of the vibrations which limit the permitted operation speeds of usual types of pumps. It is to be noted that in terms of the

casing axis, the cylinders are reciprocated on the pistons, while in terms of the rotor axis the pistons are reciprocated in the cylinders as the rotor revolves, it thus being clear that either the cylinders or pistons may be thought of as reciprocative for producing the relative movement thereof.

While the foregoing description is drawn specifically to a pressure pump or compressor, it will be obvious that certain features thereof are equally applicable to suction pumps. Furthermore, the present structure may be used as a suction pump without compression by opening the pipe 48 to the atmosphere.

From the foregoing description taken in connection with the accompanying drawings, the advantages of the construction and method of operation will be readily understood by those skilled in the art to which the invention appertains, and while I have described the principle of operation, together with a device which I now consider to be a preferred embodiment thereof, I desire to have it understood that the structure shown is merely illustrative, and that such changes may be made, when desired, as fall within the scope of the appended claims.

Having thus described my invention, I claim as new and desire to secure by Letters Patent of the United States the following:

1. In a compressor, a casing defining a working chamber having end walls, a cylindrical stator engaged in a bore through a said wall and extending into the chamber, a rotor mounting a radially directed cylinder and provided with an axial bearing bore enclosing the extending stator portion and for a supported rotation of the rotor thereabout, a piston in said cylinder, an annular groove for lubricant in the circumferential face of said stator and opposite mutually coterminous wall and rotor bore portions, a catch basin at the inner face of said wall and above said rotor, a duct for lubricant extending within said wall and connecting said catch basin with the wall bore portion opposite said groove, and a duct for lubricant extending within the rotor and connecting a point of the rotor bore opposite the groove with an intermediate point of the cylinder opposite the piston therein.

2. In a pump or the like, a casing defining a working chamber having end walls, a cylindrical stator engaged in a bore through a said wall for rotative adjustment therein and extending into the chamber, means fixing the stator in rotatively adjusted position in said bore, a rotor mounting a radially directed cylinder and provided with an axial bearing bore enclosing the extending stator portion and for a supported rotation of the rotor thereabout, a piston in said cylinder, an annular groove for lubricant in the circumferential face of said stator and opposite mutually coterminous wall and rotor bore portions, a catch basin at the inner face of said wall and above said rotor, a duct for lubricant extending within said wall and connecting said catch basin with the wall bore portion opposite said groove, and a duct for lubricant extending within the rotor and connecting a point of the rotor bore opposite the groove with an intermediate point of the cylinder opposite the piston therein.

RICHARD H. LONG.