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PUMP AND COMPRESSOR
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FIG. 1

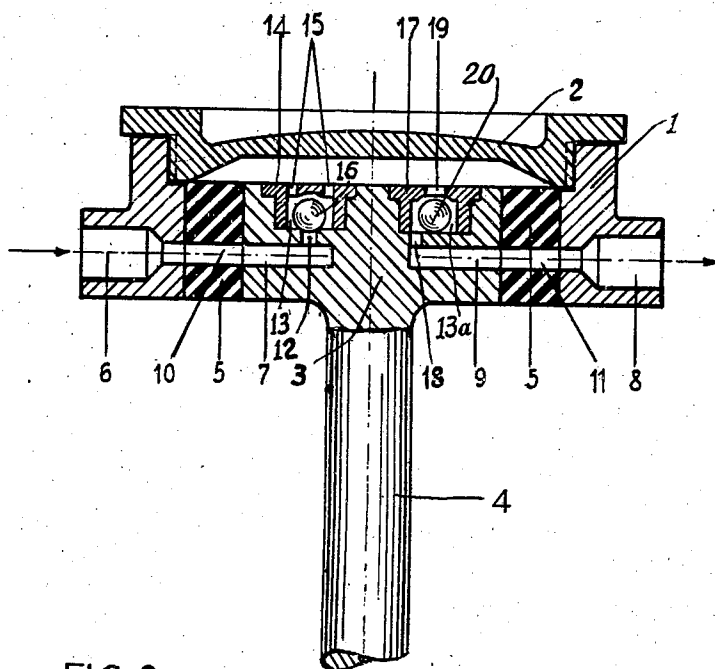


FIG. 2

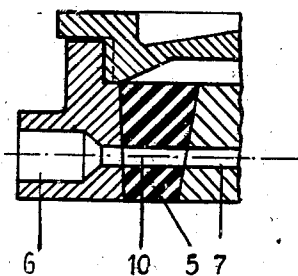
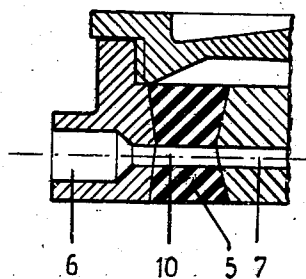


FIG. 3



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PUMP AND COMPRESSOR

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7 Claims. (Cl. 230—171)

The present invention relates to pumps and compressors, and more especially, although not exclusively, to those used in connection with refrigerating machines.

The chief object of the invention is to provide a pump or compressor which is better adapted to meet the requirements of practice than those used for the same purpose up to the present time.

More specifically, an essential object of the invention is to provide a pump or compressor in which the movable valve means for the control of the flow of fluid through the apparatus are carried by the movable element of said apparatus (for instance the piston) without causing any complication in the inflow and outflow connections.

According to the essential feature of the present invention, the packing means between the piston and cylinder consist of a sleeve of rubber or equivalent material interposed between said elements and adhering strongly to the respective surfaces thereof and the communication passages between the compression chamber of the compressor or pump and the outside consist of holes provided in said sleeve.

Other features of the present invention will appear from the following detailed description of specific embodiments thereof.

A preferred embodiment of the present invention will be hereinafter described, with reference to the accompanying drawing, given merely by way of example, in which:

Fig. 1 is a view of a compressor made according to the invention, in axial section.

Figs. 2 and 3 are partial sectional views of modifications.

This compressor includes a cylinder 1, provided with a head 2 rigid therewith, and a piston 3, mounted on a connecting rod 4.

The outer diameter of piston 3 is substantially smaller than the inner diameter of cylinder 1 so as to leave an annular space between the corresponding walls of said piston and cylinder.

This annular space is filled with an annular element made of a material which is elastic but volumetrically incompressible or of little compressibility, such, for example, as rubber, either natural or synthetic, etc.

This annular element 5 is fitted in such manner as to oppose, in view of its contact with the cylindrical faces of the piston and the cylinder, a resistance to sliding with respect thereto such that, when subjected to an axial thrust, it can

slide neither with respect to cylinder 1 nor with respect to piston 3. Thus, the axial reciprocating movement of piston 3 with respect to cylinder 1 takes place by deformation or flexing of annular element 5, the elastic material of which is subjected to shearing stresses without variation of its volume. Owing to the volumetric incompressibility of the elastic matter, the efforts which prevent the sliding of annular element 5 with respect to the piston and cylinder are distributed over the surfaces of contact.

The resistance to sliding of the annular member 5 with respect to the piston and cylinder can be obtained in any suitable manner, for instance:

(a) By subjecting the elastic material of which said member is made to a high initial compression in the annular space left between piston 3 and cylinder 1; or

(b) By gluing said member 5 to the corresponding cylindrical faces of piston 3 and cylinder 1, for instance, when said member 5 is made of rubber, by vulcanization of said rubber to the metallic faces of said piston and said cylinder; or, preferably,

(c) By a combination of the two above mentioned methods.

The thickness of annular member 5 must be proportional to the amplitude of the reciprocating movement of the piston, account being of course taken of the elastic properties of the material that is used for making this member. By way of example, in the embodiment illustrated by the drawing (made substantially to real size) the thickness of member 5, supposed to be made of rubber, is such that the total amplitude of the reciprocating movement of piston 3 is 6 millimeters, that is to say 3 millimeters on either side of the neutral position.

On the other hand, the height of annular member 5 must be proportional to the resultant of the pressures acting on the piston. The height illustrated by the appended drawing corresponds to a maximum value of the pressure in the cylinder equal to 10 kilograms per square centimeter.

It will be readily understood that a packing member such as that represented by the annular element 5 ensures perfect fluid tightness.

On the other hand, while opposing but a relatively small resistance to the reciprocating movement of piston 3, the elastic member 5 elastically urges it toward its normal intermediate position which is that shown by the drawing.

Now, cylinder 1 is provided with an inlet conduit 6 which, in this intermediate position of

piston 3, is in line with a corresponding conduit 7 provided in said piston. In a like manner, the outlet conduit 8 provided in the cylinder is in line with a conduit 9 provided in the piston.

According to the essential feature of the present invention, the rubber annular member 5 is provided:

(a) On the one hand with a radial hole 10 which permanently connects conduits 7 and 6 together, since this hole 10 will follow the deformations of member 5 the respective faces of which are applied with a nonslipping grip against the corresponding faces of cylinder 1 and piston 3, whereby the respective ends of hole 10 will always remain in register with the corresponding ends of conduits 6 and 7; and

(b) On the other hand with a radial hole 11 which permanently connects conduits 8 and 9 together, in the same manner as above explained with reference to radial hole 10.

The inner end of conduit 7 is connected through a passage 12 with a cavity 13 provided in the upper face of piston 3. In this cavity 13 is fitted a small casing 14 provided with holes 15 connecting cavity 13 with the compression chamber of cylinder 1. A ball 16 rests on the upper edge of passage 12, thus constituting an inwardly opening check valve permitting the inflow of fluid, through passages 6, 10, 7 and 12, into the compression chamber of cylinder 1.

Another cavity 13^a is provided in the upper face of piston 3. In this last mentioned cavity is fitted a small casing 17, provided, at the top, with an aperture 19 connecting said cavity with the compression chamber of piston 3, the under edge of said aperture 19 constituting a seat for a ball 20. This ball acts as an outlet check valve, the bottom of cavity 13^a communicating through a small passage 18 with outlet conduit 9.

The operation of this compressor is as follows:

The inlet and outlet valves, 16 and 20 respectively, acting in the usual manner, fluid is drawn in through passages 6, 10, 7 and 12 during the downward stroke of the piston, and this fluid is driven out under pressure through passages 18, 9, 11 and 8 during the upward stroke of the piston. It is particularly pointed out that, in view of the reciprocating movement of the piston, balls 16 and 20 are given, by inertia, impulses with respect to their seats, which are favorable to their good operation.

Thus the invention makes it possible to place the valve means on the movable element of the piston and cylinder system while ensuring a simple and reliable communication between the valve casings and the external inlet and outlet conduits.

On the other hand, the particular structure and operation of packing member 5 ensures a very important advantage in the case of compressors for use in connection with refrigerating machines, to wit that the gas to be compressed cannot in any way be soiled by oil (or any other liquid) as would necessarily be used for lubrication if another piston and cylinder system were used.

It will be readily understood that, owing to the presence of the elastic annular element 5, the piston rod 4 can be mounted directly on an eccentric or a crank, thus undergoing slight angular displacements.

Of course, the arrangement and structure of the valve means might be different from what is shown by Fig. 1, in which annular member 5 has cylindrical walls.

For instance, as in the embodiment partly shown by Fig. 2, member 5 is of greater cross section on the side which is to be subjected to higher pressures, at least one of its walls being of conical shape. Fig. 3 illustrates still another form of a cross-sectional area of the annular member 5 which may be used. The cross-sectional area is smallest at the center and gradually increases, due to the conical walls, toward both end faces of the annular member.

In a general manner, while I have, in the above description, disclosed what I deem to be practical and efficient embodiments of the present invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the appended claims.

What I claim is:

1. A device which comprises, in combination, a piston and cylinder slidable axially with respect to each other, with an annular interval between these two elements, an annular sleeve of an elastic material filling said interval and having its inner and outer surfaces applied with a high adhesion against the outer wall of said piston and the inner wall of said cylinder, respectively, inlet and outlet valve means associated with said piston and cylinder system, at least one of said valve means being carried by that of these two elements which is movable, said elements being provided with passages adapted to communicate with the last mentioned valve means, and said annular sleeve being provided with at least one transverse hole extending therethrough and interconnecting said passages of the above mentioned elements.

2. A device which comprises, in combination, a piston and cylinder slidable axially with respect to each other, with an annular interval of uniform thickness between these two elements, a cylindrical annular sleeve of an elastic material filling said interval and having its cylindrical inner and outer surfaces applied with a high adhesion against the outer wall of said piston and the inner wall of said cylinder, respectively, inlet and outlet valve means associated with said piston and cylinder system, at least one of said valve means being carried by that of these two elements which is movable, said elements being provided with passages adapted to communicate with the last mentioned valve means, and said annular sleeve being provided with at least one transverse hole extending therethrough and interconnecting said passages of the above mentioned elements.

3. A device which comprises, in combination, a piston and cylinder slidable axially with respect to each other, with an annular interval between these two elements, a conical annular sleeve of an elastic material filling said interval and having its inner and outer surfaces applied with a high adhesion against the outer wall of said piston and the inner wall of said cylinder, respectively, inlet and outlet valve means associated with said piston and cylinder system, at least one of said valve means being carried by that of these two elements which is movable, said elements being provided with passages adapted to communicate with the last mentioned valve means, and said annular sleeve being provided with at least one transverse hole extending therethrough and interconnecting said passages of the above mentioned elements.

4. A device which comprises, in combination, a piston and cylinder slidable axially with respect to each other, with an annular interval between these two elements, a bi-conical annular sleeve of an elastic material filling said interval and having its inner and outer surfaces applied with a high adhesion against the outer wall of said piston and the inner wall of said cylinder, respectively, inlet and outlet valve means associated with said piston and cylinder system, at least one of said valve means being carried by that of these two elements which is movable, said elements being provided with passages adapted to communicate with the last mentioned valve means, and said annular sleeve being provided with at least one transverse hole extending therethrough and interconnecting said passages of the above mentioned elements.

5. A device which comprises, in combination, a cylinder, a piston axially slidable in said cylinder with an annular interval between said piston and said cylinder, an annular sleeve of an elastic material filling said interval and having its inner and outer surfaces applied with a high adhesion against the outer wall of said piston and the inner wall of said cylinder, respectively, inlet and outlet valve means associated with said piston and cylinder system, at least one of said valve means being carried by said piston, said cylinder and said piston being provided with passages adapted to communicate with the last mentioned valve means, and said annular sleeve being provided with at least one transverse hole extending therethrough and interconnecting said passages in the piston and cylinder.

6. A device which comprises, in combination, a cylinder, a piston axially slidable in said cylinder with an annular interval between said piston and said cylinder, an annular sleeve of an elastic material filling said interval and having its inner and outer surfaces applied with a high adhesion against the outer wall of said piston and the inner wall of said cylinder, respectively, inlet and outlet valve means carried by said piston, said cylinder and said piston being provided with passages adapted to communicate with the last mentioned valve means, and said annular sleeve being provided with at least one transverse hole extending therethrough and interconnecting said passages in the piston and cylinder.

7. A device which comprises, in combination, a cylinder, a piston axially slidable in said cylinder with an annular interval between said piston and said cylinder, an annular sleeve of an elastic material filling said interval and having its inner and outer surfaces applied with a high adhesion against the outer wall of said piston and the inner wall of said cylinder, respectively, inlet and outlet check valve means carried by said piston so as to have their opening and closing facilitated by the reciprocating motion of said piston, said cylinder and said piston being provided with radial passages, respectively in line with one another and adapted to communicate with the respective check valve means, and said annular sleeve being provided with two corresponding radial holes extending therethrough and interconnecting said passages in the piston and cylinder.