E. M. NIEBLING.

COMPRESSOR.

APPLICATION FILED DEC. 22, 1915.

1,233,693. Patented July 17, 1917.

Fig. 1.

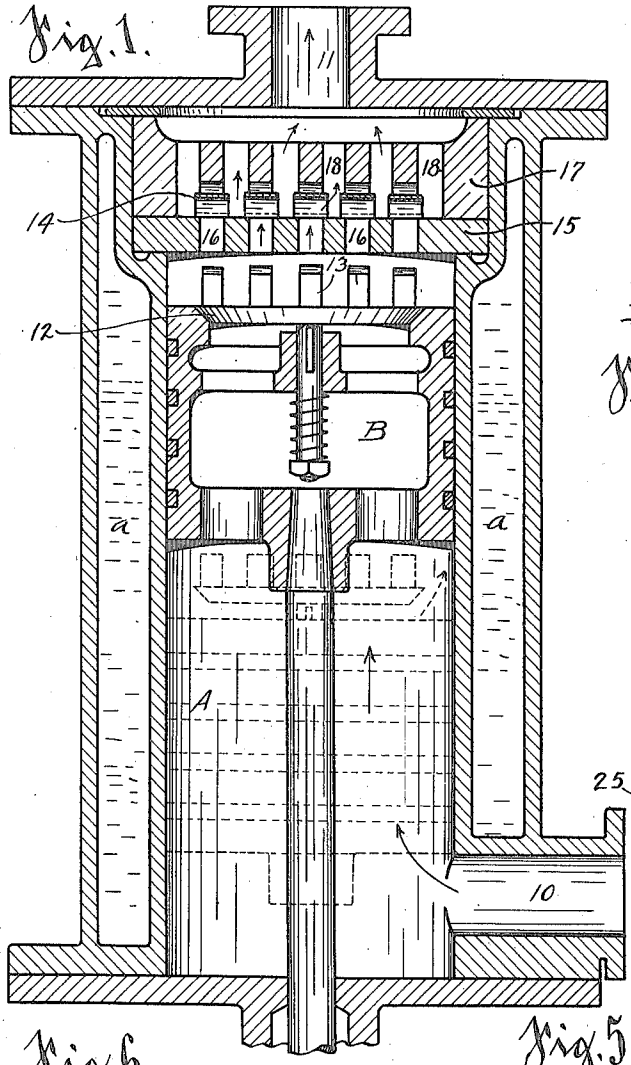


Fig. 2.

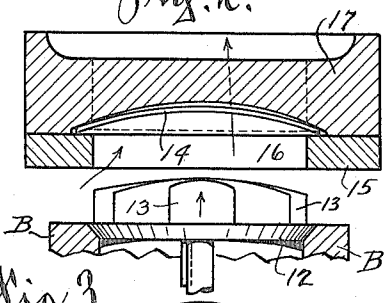


Fig. 3.

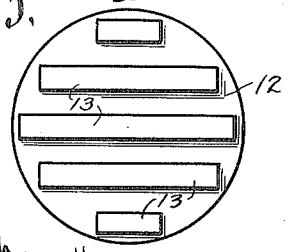


Fig. 4.

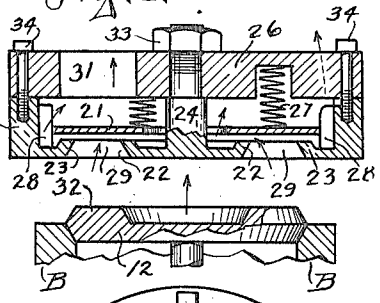


Fig. 6.

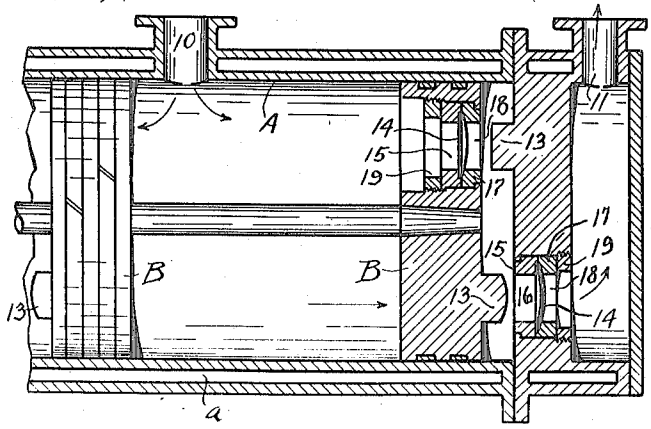
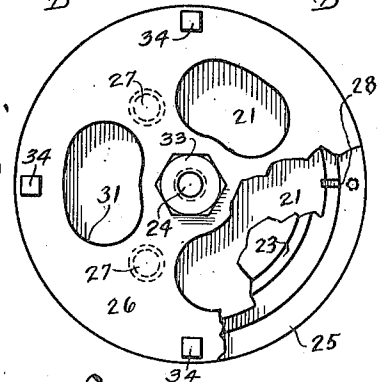


Fig. 5.



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UNITED STATES PATENT OFFICE.

EDWIN M. NIEBLING, OF CINCINNATI, OHIO.

COMPRESSOR.

1,233,693. Specification of Letters Patent. Patented July 17, 1917

Application filed December 22, 1915. Serial No. 68,119.

To all whom it may concern:

Be it known that I, EDWIN M. NIEBLING, residing at Cincinnati, Hamilton county, State of Ohio, have invented certain new and useful Improvements in Compressors, of which the following is a clear, full, and exact description, attention being called to the drawing which accompanies this application and forms a part thereof.

This invention concerns pumps used for compressing fluids like gases or air. It relates more particularly to pumps operating against heavy pressure such as for instance occurs in refrigerating plants and where the pumps are used to manipulate the refrigerating agent. This is usually ammonia which, in form of expanded gas, is drawn into the cylinder of the pump through an opening controlled by a suction valve. It is then compressed by the piston of the pump and expelled through another opening in the cylinder controlled by a discharge valve.

In the interest of economical operation it is essential that most and if possible all the gas which is compressed ahead of the piston is expelled from the cylinder, otherwise, as soon as the piston starts on its return stroke, any gas which remains will reëxpand and reduce the capacity of the cylinder for receiving gas to be compressed by the next piston stroke. In other words, part of the same charge of gas remains in the cylinder and is repeatedly compressed therein without producing any useful effect.

In order to overcome any defects of this kind in the operation of compression pumps, it has been the aim to cause the piston to move as close as possible against the discharge valve so as to reduce and if possible prevent the presence of any dead spaces or pockets between the face of the piston and the discharge valve where gas may remain out of operative reach of the piston. This expedient is not applicable in all forms of valves used in compression pumps and particularly not in valves of the types known as plate-valves, disk-valves or feather-valves and where certain features peculiar to their construction produce a gas pocket on one side of them.

Otherwise valves of these types would be very satisfactory and in many cases preferable to the valves now used in compression pumps operating under the conditions named.

Therefore the object of my invention is to provide certain means which make it possible to use valves of the types referred to on pumps operating under heavy pressure-conditions but without subjecting this use to the objections mentioned above.

The invention consists of certain features of construction which are described hereinafter and pointed out in the claims.

The construction is also illustrated in the accompanying drawing, in which:

Figure 1 illustrates my invention as applied to a single-acting compression-pump which is shown in vertical longitudinal section.

Fig. 2 is a section taken at right angle to the plane of section presented in Fig. 1, and shows the valve-part of the compressor.

Fig. 3 is a top view of one of the valves shown in the preceding figure.

Fig. 4 in a view similar to Fig. 2, shows the same part of the compressor with a valve of different type.

Fig. 5 is a top view of this valve with parts broken away.

Fig. 6 illustrates part of a double-acting compression pump with the feature of my invention applied to it.

The drawing shows conventional types of pumps merely for the purpose of illustrating the invention.

Character A, indicates the pump cylinder provided with a water jacket indicated at *a* and B indicates the piston.

Referring to the form shown in Fig. 1, the matter to be moved, expanded ammonia gas for instance, enters at 10 and after compression is expelled at 11. This gas, on the up-stroke of the piston, passes into the cylinder and when the piston moves down, it passes to the other side of said piston which latter is hollow and controlled by a suitable valve 12 of the suction-valve type. On the next up-stroke of the piston the gas above the latter is compressed and forced out of the end of the cylinder, said outlet being controlled by discharge valves provided in the cylinder head.

Valves of various types are used in this connection. In some kinds of pumps so-called feather-valves, as shown in Figs. 1 and 2, are used and disk-valves, as shown in Figs. 4 and 5, have also been used.

In these types of valves the valve member proper is yieldingly confined in a space provided between two superposed members which latter are provided with openings in

front of the valve and back of the same to clear the matter passing. By reason of the presence of one of these members on each side of the valve, the piston can move only as far as one of said members permits, but it cannot closely approach the valve and therefore not all of the gas after compression is forced beyond the valve and out of the cylinder.

The openings in one of these members, the one which is between the valve and the piston form pockets in which compressed gas is retained and on reversal of the piston-motion this gas reëxpands and fills part of the cylinder, thereby reducing the receiving capacity of the same and imposing unnecessary work upon the pump required by the repeated compression of the same gas. While such working conditions are objectionable in all cases for the reasons stated, the objection becomes more pronounced when pumps operate against heavy pressure because the retained part of the highly compressed gas after released from the pockets occupies a correspondingly larger part of the cylinder.

To overcome these objections I provide members which, as the piston nears the end of its stroke, enter these pockets on one side of the valve and by doing so necessarily displace the gas therein and force it out of them. By reason of their particular function these members are hereafter designated as displacers.

Referring now to Figs. 1, 2, 3 and 6, these displacers, indicated at 13, are shown as used in connection with feather-valves, which latter are shown at 14. These valves consist substantially of thin, elongated blades of elastic metal, normally seated against seat-member 15, as shown in dotted lines, so as to close ports 16 therein. These valves are held in place by another member 17 which engages them at their ends and is provided with ports 18. When the piston approaches the discharge end of the cylinder, the rising pressure of the gas flexes these blades as shown in Fig. 2, permitting the compressed gas to pass through ports 16, around the edges of the blades into ports 18 and through them to outlet 11. Now under conditions when my improved construction is not used, the face of the piston, represented in this case by the closed suction valve which is carried in the piston, cannot approach the face of the feather valves any closer than member 15 permits and as a result compressed gas remains pocketed in ports 16 which on the return of the piston reëxpands into the cylinder.

This objection is overcome by my improved construction which provides displacers 13 adapted to enter ports 16 so that practically all the compressed gas is forced beyond feather valves 14.

These displacers consist of projections shaped substantially to correspond to the space which they are intended to occupy, allowance for necessary clearance under working conditions being made.

In Fig. 6, part of a double-acting pump is shown using a double piston, the inlet 10 to the cylinder being between the pistons and each end is provided with an outlet.

One or more nests of feather valves are seated in the end of the cylinder, also in each piston, they being held in position by bushings 19. Gas is drawn into the cylinder between the pistons at each stroke of them and also passes at each stroke alternately into one or the other of the spaces outside of the pistons and through the valves in them which act as suction valves.

As shown in Fig. 6 the pistons are presumed to move so that the piston on the right compresses the gas between it and the end of the cylinder and forces the same out of the latter through the feather-valves carried in said end.

To expel the gas in the pockets formed by ports 16 the same displacers 13 are provided on the face of both pistons. It of course is also necessary to displace the gas which occupies the pockets formed by ports 18 in the valves carried in the pistons. This is accomplished by other displacers 13 which are located in proper position so as to project from the end of the cylinder into these ports as the piston approaches the end of the cylinder.

Practically the same arrangement would be employed in a double-acting pump which operates with a single piston and where no valves are provided in the piston, all valves being located in the ends of the cylinder, inlet valves as well as discharge valves. In that case displacers would be provided on both sides of the piston as is now shown on one side of the pistons illustrated in Fig. 6.

In that event it is immaterial whether the suction valves are of the feather valve type, and instead they may be of the usual type as shown in Fig. 1, in which case of course, as to the suction valves, no displacers would be required.

The displacers provided by my invention are also applicable in cases where so-called plate or disk valves as shown in Figs. 4 and 5 are used in place of the feather valves as they are shown for instance in Figs. 1 and 6. The valves of this type consist of one or more ring-shaped plates of limited thickness, concentrically arranged in the latter case, and yieldingly confined in a space which contains the seats for these plates. In Fig. 4 one of these valves having one plate is shown at 21, raised from its seat which consists of two annular, concentrically spaced shoulders 22 and 23 each form-

ing respectively part of seat members 24 and 25 and each of which members is secured in a suitable manner to the valve head 26. Springs 27, confined between this head and plate valve 21 keep this latter yieldingly seated against shoulders 22 and 23, being held properly while so moving by guides 28.

The port controlled by this plate valve is formed by the annular opening or space 29 between these shoulders 22 and 23 and when this port is open, that is when valve 21 is raised as shown in Fig. 4, the gas passes through this port, around the edges of valve 21 and through port openings 31 in head 26.

As will be seen, this port forms a pocket or dead space, inaccessible to the piston the same as do ports 16 in case of the feather valves shown in Fig. 1. To displace the gas in this pocket, I follow the same principle applied in the case of the feather valves, that is to say, I provide displacers which conform to the required shape and carry out the same function for the same purpose in the same manner. Accordingly the displacer is in form of an annular projection or ridge 32 as shown in Fig. 4.

Thus when such plate valves take the place of the feather valves shown in Figs. 1 and 6, the complementary displacers, correspondingly located, would be of the shape shown in Fig. 4.

While broadly considered neither feather valves nor plate valves are new with me, I have nevertheless devised certain improvements in the construction of plate valves whereby their manufacture is simplified and which permits me to increase the port-capacity of the valves by having a number of annular plates similar to and concentric with the single plate valve 21 now shown and without complicating the construction or encumbering the free area of the added ports. Thus for instance if another plate valve were to be added to a valve as shown in Fig. 4, it would only be necessary to have a correspondingly larger valve head 26.

Annular member 25 would be provided with an additional shoulder around its outside to form one of the two annular valve seats, the inner one, for the added plate valve, and a member similar to present member 25, only larger in diameter, would be attached to the head in the same place where it is now to provide the outer annular seat-shoulder.

These individual valve-seat-forming members are all secured to valve head 26 by suitable means. The upper part of central member 24 may assume the form of a bolt as shown and be secured by a nut 33. Screws 34 may be used to attach the other seat-forming members. Another annular displacing ridge similar to ridge 32 would be provided on the piston to displace the gas in the added port.

Having described my invention, I claim as new:

1. In valve construction, the combination of a flat annular valve of limited thickness, a valve-seat-forming member having an annular shoulder to form a seat for the valve at its inner edge, another annular seat-forming member having also a shoulder which is concentrically spaced from the shoulder first mentioned to form a port between them and constituting a seat for the valve near its outer edge, springs to hold the valve to these seats, a valve head provided with openings and means to attach the seat-forming members to this head.

2. In valve construction, the combination of a valve-head provided with ports, annular, valve-seat-forming members concentrically spaced from each other to form an annular port between them and secured to the valve-head with a space between them and said head, an annular valve contained in said space and springs to yieldingly hold this valve seated.

In testimony whereof, I hereunto affix my signature this 18th day of December, 1915, in the presence of two witnesses.

EDWIN M. NIEBLING.

Witnesses:
C. SPENGEL,
A. JOHNSON.