March 15, 1927. 1,620,870

J. O. CARREY

COMPRESSOR

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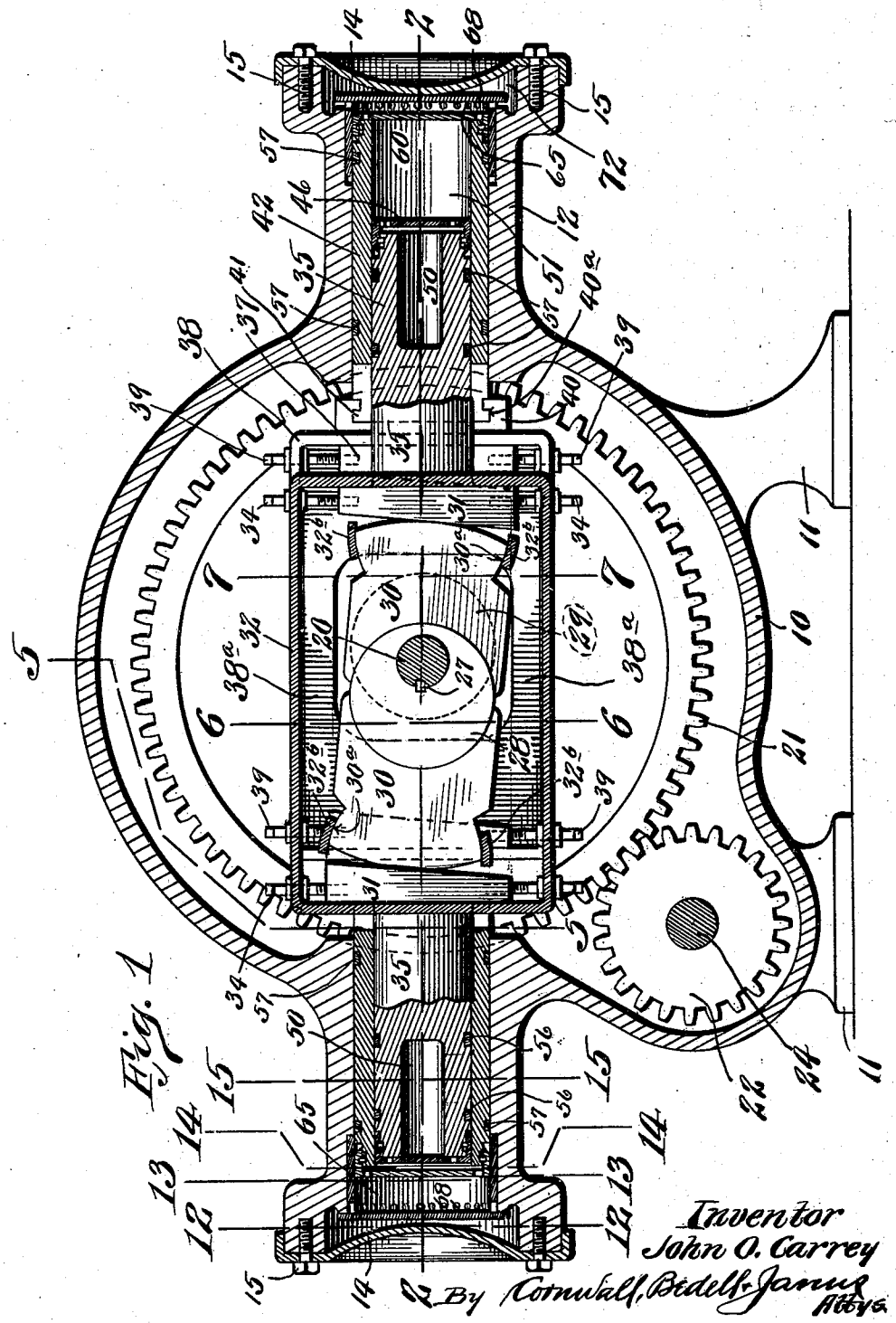


Fig. 1

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J. O. CARREY

COMPRESSOR

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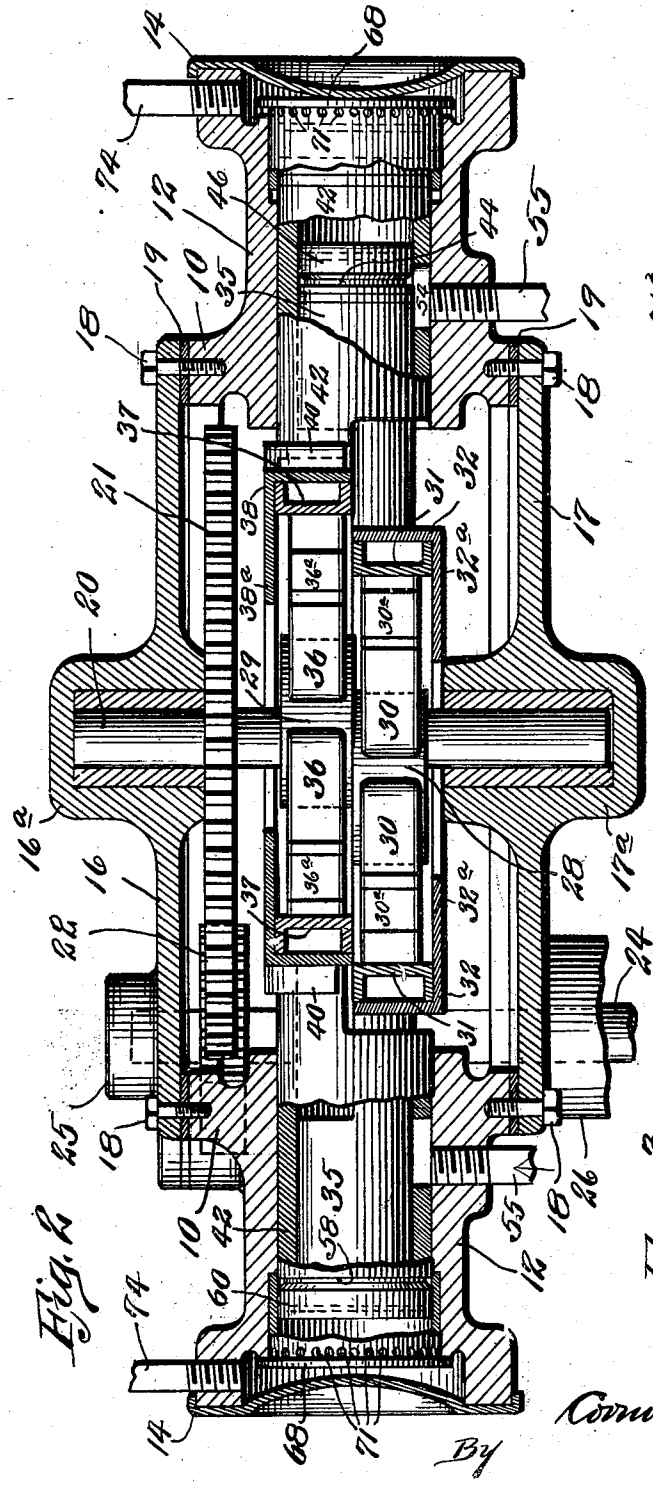


Fig. 2

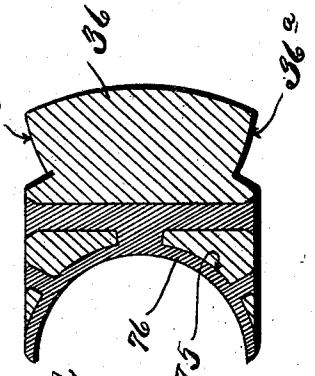


Fig. 4

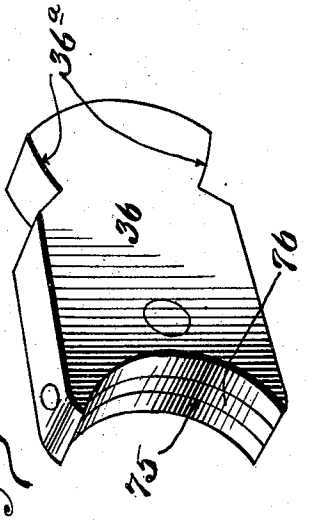


Fig. 3

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J. O. CARREY

COMPRESSOR

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Fig. 5

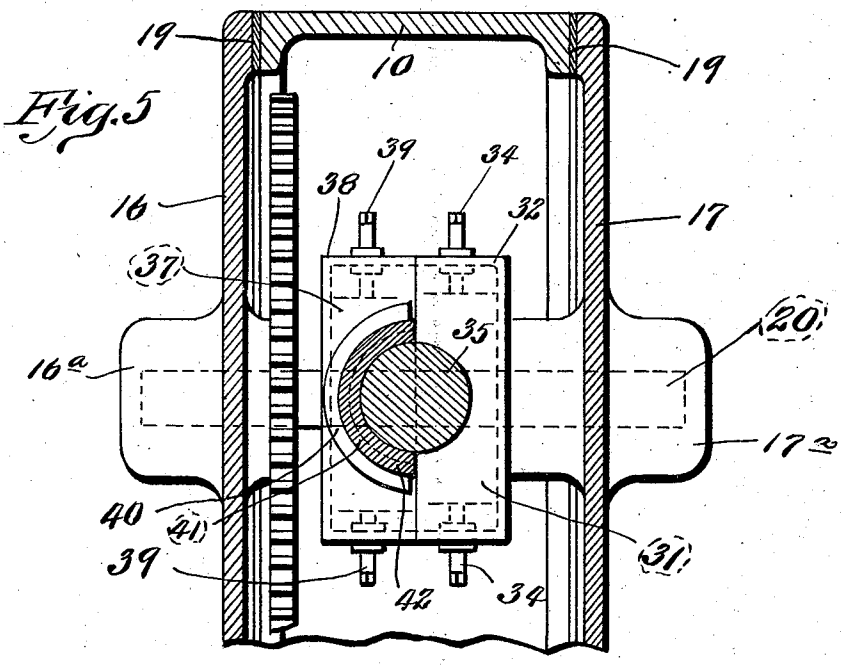


Fig. 6

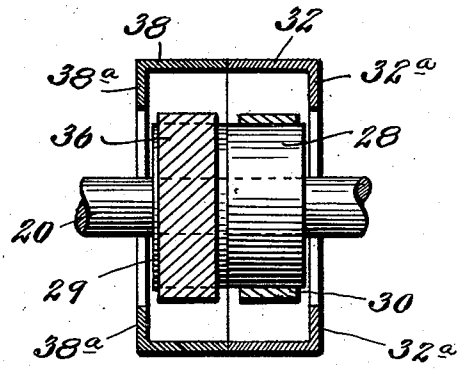
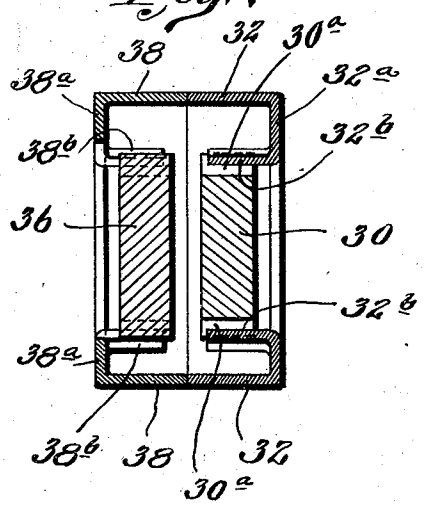


Fig. 7



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COMPRESSOR

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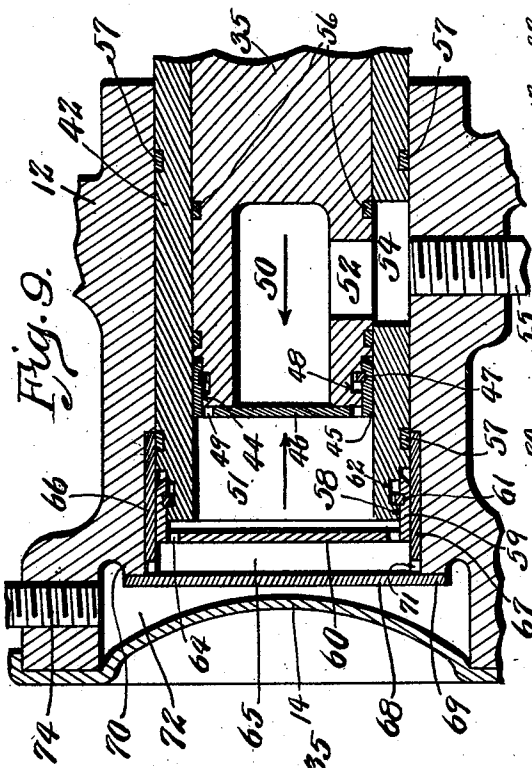


Fig. 9.

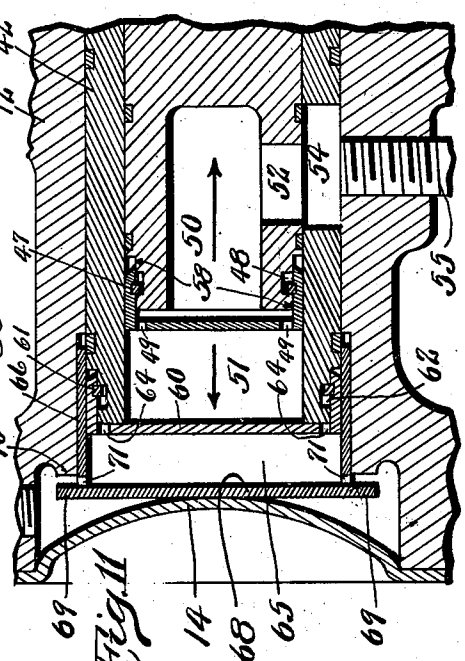


Fig. 11

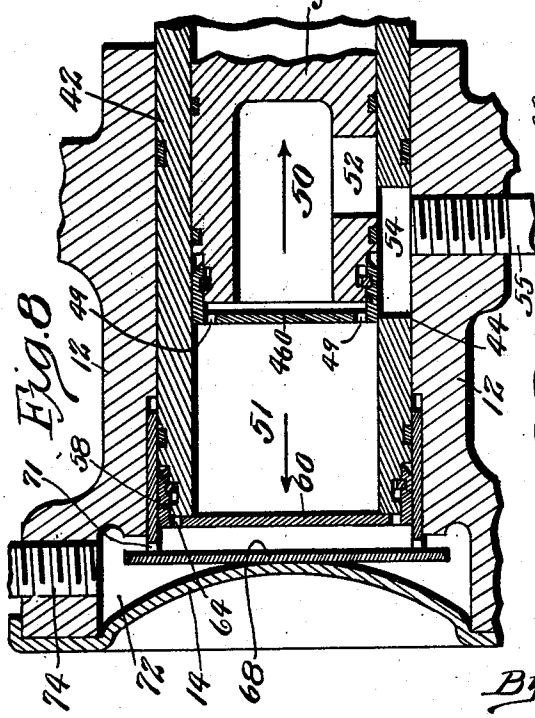


Fig. 8

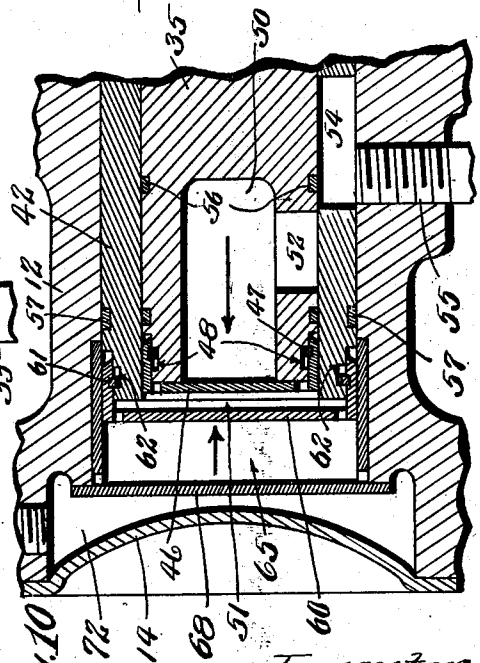


Fig. 10

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J. O. CARREY

COMPRESSOR

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Fig. 12

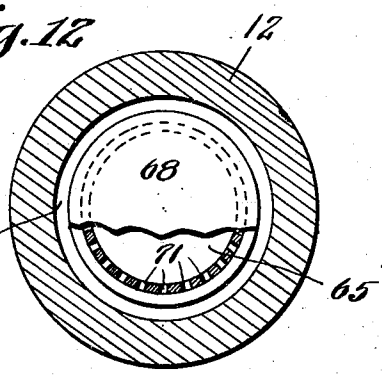


Fig. 13

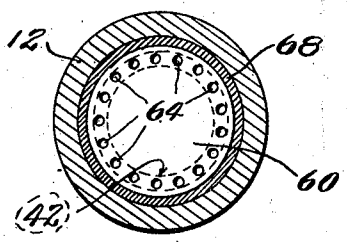


Fig. 14

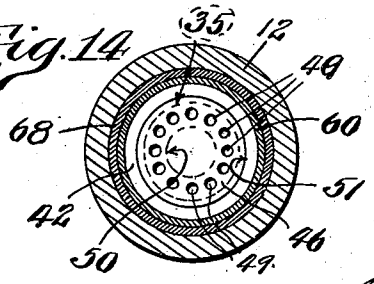


Fig. 15

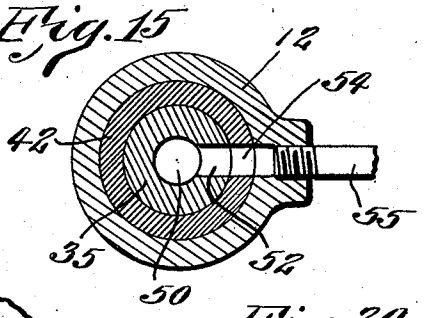


Fig. 16

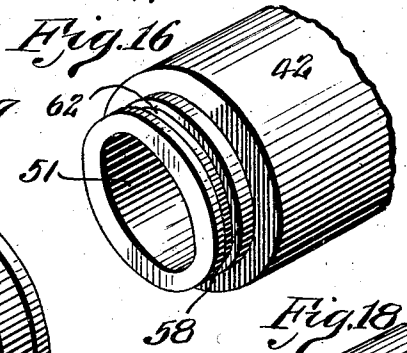


Fig. 17

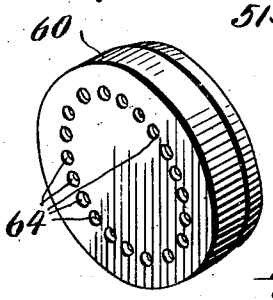


Fig. 20

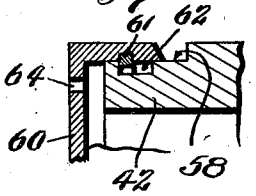


Fig. 18

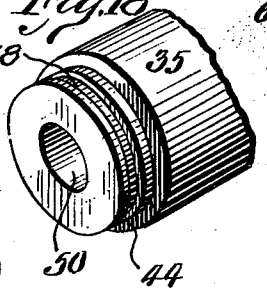


Fig. 21

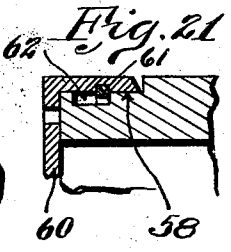


Fig. 19

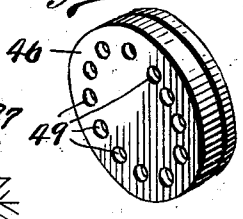
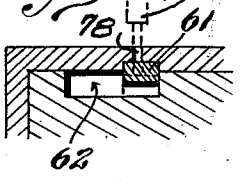


Fig. 22



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Attys.

Patented Mar. 15, 1927. 1,620,870

UNITED STATES PATENT OFFICE.

JOHN O. CARREY, OF ST. LOUIS, MISSOURI, ASSIGNOR TO CARREY-MORSE ENGINEERING COMPANY, OF ST. LOUIS, MISSOURI, A CORPORATION OF MISSOURI.

COMPRESSOR.

Application filed January 9, 1924. Serial No. 685,164.

This invention relates to new and useful improvements in fluid compressors and the objects of the invention are to provide a compressor which is compact in size, is of durable construction, and noiseless in operation, and is highly efficient in performing its intended functions.

Further objects of the invention are to provide a fluid compressor having all of its operating parts enclosed in a casing which is hermetically sealed, thereby eliminating all danger of the compressible fluid escaping into the atmosphere.

Still further objects of the invention are to provide a compressor having telescopic pistons which cooperate to partially compress the fluid before the latter is admitted to the compression chamber of the cylinder to receive its final compression, and to pro vide mechanism for operating said pistons in correlation with each other.

Other objects of the invention are to provide valves for said pistons, which valves are of simple construction and noiseless in operation and are arranged to form part of the respective pistons, said valves having lost motion relative to said pistons whereby they are positioned by the movement of said pistons to control the passage of the fluid through the latter, and to provide a simple and efficient cup valve for controlling the pressure chamber of the cylinders.

With these and other objects in view my invention consists in certain novel features of construction and arrangement of parts hereinafter more fully described and claimed and illustrated in the accompanying drawings, in which—

Figure 1 is a vertical cross section taken longitudinally through my improved compressor.

Figure 2 is a horizontal section taken on line 2—2 of Figure 1.

Figure 3 is a perspective detail view of one of the eccentric operated blocks.

Figure 4 is a vertical cross section taken longitudinally through said block.

Figure 5 is a vertical cross section taken on line 5—5 of Figure 1.

Figure 6 is a vertical cross section taken on line 6—6 of Figure 1.

Figure 7 is a vertical cross section taken on line 7—7 of Figure 1.

Figure 8 is a horizontal cross section taken longitudinally through one of the cylinders and showing the pistons and valves in position at the completion of the final compression stroke as indicated by arrows.

Figure 9 is a similar view of the cylinder and showing the pistons actuated toward each other to effect partial compression of the fluid.

Figure 10 shows the pistons occupying positions at the completion of the initial or first stage of the compression operation.

Figure 11 shows the outer or larger piston actuated to effect the second or final stage of the compression operation and the inner or smaller piston in position to receive a charge of the fluid preliminary to the initial or first stage of the compression operation.

Figure 12 is an enlarged cross section taken on line 12—12 of Figure 1 and showing the cylinder valve partly in cross section.

Figure 13 is a vertical cross section taken on line 13—13 of Figure 1 and showing the valve of the large piston in end elevation.

Figure 14 is a vertical cross section taken on line 14—14 of Figure 1 and showing the valve of the smaller piston in end elevation.

Figure 15 is a cross section taken on line 15—15 of Figure 1 and showing the port openings in the respective pistons.

Figure 16 is a perspective detail view of the compression end of the larger piston.

Figure 17 is a perspective detail view of the cup valve of said piston.

Figure 18 is a perspective detail view of the compression end of the smaller piston.

Figure 19 is a perspective detail view of the cup valve of said piston.

Figure 20 is a detail view illustrating the manner in which the valve is retained in position on the pistons and showing said valve in its displaced or discharging position.

Figure 21 is a similar view showing the valve in closed or seated position.

Figure 22 is a detail view illustrating how the valves may be removed from their positions on the pistons.

Heretofore fluid compressors and particularly compressors utilized in refrigerating apparatus were generally of the single stage type wherein only one piston was used in each cylinder to effect the complete compression. The compressors of this type are consequently comparatively large and are

noisy in operation and for these reasons not suitable for domestic purposes. The valves employed in these machines are usually held to their seats by means of springs which are noisy and liable to become broken, thereby disabling the apparatus.

In the present invention the compression is effected in successive stages, a pair of telescopic pistons being provided for each cylinder and said pistons being operable in correlation to initially compress the charge before it is admitted to the compression chamber of the cylinder for its final compression. The fluid to be compressed is admitted to the intake chamber of the first or inner one of the pistons through suitable ports and passes therefrom into the chamber in the second one of the pistons where it is partially compressed by said pistons and is then discharged into the compression chamber of the cylinder. In this chamber it receives its final compression by the action of the second or large piston and is discharged into the pressure chamber. The passage of the fluid from one piston to the other and from the piston to the cylinder is controlled by suitable ported cup valves mounted on said pistons and operable in correlation therewith. Valves have lost motion engagement with the respective pistons and are seated and unseated by the movement of said pistons so that no springs whatever are required for the operation of the valves.

Referring by numerals to the accompanying drawings, 10 indicates a casing which is preferably circular in shape and is supported in position by suitable extensions or legs 11. A pair of diametrically opposed cylinders 12 are carried by said casing and have their inner ends opening thereinto. The outer ends of said cylinders are preferably closed by caps 14 which are secured to the flanged portions of said cylinders by suitable fastening devices 15. The sides of the casing are closed by side plates 16 and 17 which are held to said casing by bolts 18, gaskets 19 of suitable material being interposed between the plates 16 and 17 and casing 10 to form a perfect seal therebetween. The side plates are provided with centrally arranged tubular extensions or bosses 16^a and 17^a, respectively, which are closed on their outer ends and are provided with bearings for the ends of a horizontally disposed shaft 20 which extends axially through the casing 10.

A large gear 21 is fixed to shaft 20 adjacent to one of the side plates and meshes with a pinion 22 which is carried by a shaft 24. This shaft has one of its ends journaled in a bearing 25 formed integral with the corresponding side plate and extends longitudinally of said casing through a suitable bearing 26 and is connected to an electric motor (not shown) or other suitable driving connection. Bearing 26 is provided with a seal to prevent the fluid contained in said casing from escaping to the atmosphere through said bearing but I do not deem it necessary to illustrate and describe the seal as it forms the subject matter of a separate application filed by me February 25, 1924, Serial Number 695,031.

Shaft 20 has fixed thereon in any suitable manner, such as a key 27, a pair of oppositely disposed eccentrics 28 and 29. Engaging eccentric 28 are the inner semi-circular ends of blocks 30 and the outer curved ends of said blocks bear against the faces of wedge members 31 which are adjustably supported in the ends of a cross head 32. This cross head is preferably box-shaped having an open inner face and an inwardly presented reinforcing flange 32^a formed on its outer face. Adjusting screws 34 are rotatably seated in the horizontal portions of frame or cross head 32 and have their threaded ends extending inwardly to engage threaded openings formed in the ends of wedge members 31. Thus by turning screws 34 in the proper direction these blocks 31 may be moved upwardly or downwardly to adjust the wedge faces thereof relative to the axis of shaft 20 and thereby take up any slack between the eccentric and the respective blocks or between the blocks and the wedge members. The outer faces of vertical portions of member 32 have fixed thereto the inner ends of longitudinally disposed pistons 35.

Eccentric 29 is in engagement with the inner ends of blocks 36 which are arranged adjacent to blocks 30 and have their outer ends bearing against wedge blocks 37 adjustably supported in a member or cross head 38 by adjusting screws 39. Cross head 38 is similar in construction to cross head 32 having an inwardly presented flange 38^a on its outer face and having its inner face open and slidingly engaging the inner face of cross head 32, as best shown in Figure 7.

The outer face of each vertical portion of member 38 is provided with a semi-circular member 40 having a semi-circular groove 40^a. This groove is adapted to receive a semi-circular flange 41 formed on the inner end of each piston 42. Pistons 42 are reciprocally mounted in cylinders 12 and are formed tubular to receive in telescopic relation the smaller pistons 35. The outer end of each piston 35 is formed with a reduced annulus 44 for receiving the cylindrical portion 45 of a cup valve 46. This cup valve has a lost motion connection with said piston and is held in position thereon by means of an expansible ring 47 which is seated in and extends inwardly from a circular groove formed in the inner face of cylindrical portion 45 and engages a peripheral groove 48 formed in the reduced annulus 44. The width of groove 48 is greater than the width

of ring 47 so as to permit a predetermined movement of valve 46 relative to piston 35. The end wall of valve 46 is provided with a series of circularly disposed openings or apertures 49 which, when the valve is seated, abut the outer end of piston 35 and are closed, thereby, as shown in Figures 9 and 10 and which, when the valve is unseated, establish communication between the interior or intake chamber 50 of piston 35 and chamber 51 of piston 42, as shown in Figures 8 and 11. Piston 35 is provided with a port 52 and piston 42 is provided with a port 54 and said ports are arranged so that when pistons 35 and 42 occupy predetermined positions the ports thereof are in register with each other and with the intake connection 55 of the compressor, as shown in Figures 9 and 11. Piston 35 is provided with packing rings 56 and piston 42 is provided with packing rings 57.

The outer end of piston 42 has a reduced annulus 58 for receiving the cylindrical portion 59 of a cup valve 60. The cylindrical portion of cup valve 60 has seated in its inner face a detachable expansible ring 61 which operates in a peripheral groove 62 formed in said reduced annulus. Cup valve 60 has lost motion with respect to piston 42 and the extent of said lost motion is controlled by the width of groove 62 and ring 61. A series of apertures or ports 64 is circularly formed in the end wall of cup valve 60 and when the cup valve 60 occupies displaced position relative to piston 42 said ports 64 establish communication between chamber 51 of piston 42 and compression chamber 65 of cylinder 12. When valve 60 is seated, the end portion thereof abuts against the end of piston 42 and the ports 64 are closed by said piston as shown in Figures 8 and 11.

The extreme outer end of each cylinder 12 is provided with an inwardly disposed annular seat 66 in which operates the cylindrical portion 67 of a cup valve 68. Valve 68 is provided with a flanged portion 69 which overhangs cylindrical portion 67 and seats itself against the annular shoulder 70 of cylinder 12. The cylindrical portion 67 is provided with a series of circumferentially disposed apertures or openings 71 which are adapted to establish communication between compression chamber 65 and pressure chamber 72. This cup valve 68 is slidingly arranged in cylinder 12 and is adapted to be unseated by the pressure created in compression chamber 65 and move outwardly whereby ports 71 establish communication between the compression chambers 65 and pressure chamber 72, as shown in Figures 8 and 11, allowing the compressed fluid to escape from said compression chamber to pressure chamber 72. When the pressure in the compression chamber 65 is removed the pressure in pressure chamber 72 causes valve 68 to move inwardly into its closed position. The extent of outward movement of valve 68 is controlled by the cap 14, the central portion of which is curved or forced inwardly and acts as a stop for said valve.

An outlet pipe connection 74 is arranged in the flanged portion of each cylinder 12 and conveys the compressed fluid away from the pressure chamber 72. The edges of the cylindrical portions of valves 46 and 60 are preferably cut on a taper as best shown in Figures 20 and 21 so as to provide sharp edges which will prevent accumulation of foreign substances in the reduced annulus of said pistons.

Blocks 30 and 36 are provided in their edges adjacent to their outward curved ends with curved portions 30^a and 36^a, respectively, and these curved portions are adapted to be engaged by lugs or ears 32^b and 38^b, which lugs are struck from the outer faces of blocks 32 and 38, respectively, and project laterally therefrom toward the corresponding blocks. These lugs serve to hold the outer ends of the blocks in their proper operative positions. Blocks 30 and 36 are preferably made of fine grain wood, such as maple, and the concave faces of said blocks are provided with grooves 75 which are designed to be filled with babbitt as indicated at 76 in Figure 3.

In the body of the blocks are formed a series of bores disposed vertically, horizontally and angularly in different portions of the blocks. These bores are filled with babbitt so as to reinforce said blocks and prevent splitting thereof. These various bores preferably communicate with the grooves 75 so that the metal filling in said grooves and in said bores tends to lead away and dissipate the heat created by friction between the concave faces of the blocks and the eccentrics operating therein.

In the operation of the compressor the compressible fluid is drawn during the suction stroke of piston 35 through intake pipe 55 and the ports 54 and 52 into the intake chamber 50 from which it then passes through ports 49 in valve 46, which occupies a displaced position, into the compression chamber 51. While the piston 55 is moving inwardly to draw in the fluid, piston 42 is moving outwardly and is exhausting the compressed fluid from the cylinder compression chamber 65 through the unseated valve 68 into the pressure chamber 72. Upon the return stroke of piston 35 valve 46 is seated, thereby closing port openings 49 and trapping the fluid in chamber 51. While piston 35 is moving outwardly piston 42 is moving inwardly toward piston 35, thereby creating partial vacuum in chamber 65 causing valve 68 to be seated and close communication between chamber 65 and pressure chamber 72.

During the inward movement of piston 42 valve 60 is unseated, thereby opening port opening 64 so that the fluid contained in chamber 51 can pass through said port openings into cylindrical chamber 65 after being partially compressed by the oppositely moving pistons 42 and 45, see Figure 10. On the next or rearward stroke of the piston 35, valve 60 is seated, closing port openings 64, thus trapping the partially compressed fluid in compression chamber 65 (see Figure 11).

While piston 35 is moving inwardly and taking in a fresh charge of the compressible fluid, piston 42 is moving outwardly and compresses the fluid contained in compression chamber 65. When the pressure in chamber 65 reaches a predetermined degree, valve 68 is unseated, thereby permitting the compressed fluid to pass from compression chamber 65 through port opening 71 into pressure chamber 72. The strokes of the pistons 42 and 35 are arranged so that at the end of inward movement of piston 42 and outward movement of piston 35 the ends of the respective pistons are in close proximity so as to eliminate dead space and effect a perfect discharge of the fluid from the chamber 51. Similarly the outward stroke of piston 42 is gauged so as to bring the outer end of each piston 42 as close as practical to the apertured portions of valve 68 and thus force the fluid from compression chamber 65.

Valves 68 are operated by pressures created in chambers 65 and 72 and are also operated by movement of the respective pistons 42 whose forward packing rings 57 frictionally engage the corresponding valves and cause them to move in accordance with the movement of the respective pistons. Thus valves 68 are positively positioned to control the passage of the compressed fluid from compression chambers 65 to pressure chambers 72. Valves 60 and 46 are retained on their respective pistons 42 and 35, by expansible rings 61 and 47, respectively. The thicknesses of these rings are less than the depths of the respective grooves 62 and 48 so that in order to remove said rings, suitable tools 77 are inserted through apertures 78 in the cylindrical wall of each valve and the ring is pressed thereby inwardly into the groove of its respective piston and out of engagement with the groove of the valve, whereupon said valve may be removed from the piston. The valves are positive in their actions and noiseless in operation and as no springs are employed to operate said valves, the possibility of valves getting out of order is reduced to minimum.

The mechanism for actuating the pistons is not claimed in the present application as it forms the subject-matter of a separate application filed by me February 9, 1924, Serial Number 691,566.

A compressor of my improved construction is simple in operation, can be manufactured at low cost and requires very little power to operate, thereby reducing the cost of operation.

While I have shown and described the preferred form of construction of my improved compressor, it is obvious that various changes in the size, form and arrangement of parts in the construction of the compressor can be made and substituted for those herein shown and described without departing from the spirit of my invention.

I claim:

1. A compressor comprising a cylinder, a pair of telescopic pistons cooperatively arranged therein, means for positively actuating each of said pistons, and cup valves enclosing the ends of said pistons and having lost motion connection therewith for controlling the communication between said pistons and the pressure chamber of said cylinder.

2. A compressor comprising a cylinder, a pair of open ended ported telescopic pistons cooperatively arranged therein, means for actuating said pistons, a cup valve forming a displaceable head for the inner piston for controlling the communication between said pistons, and a cup valve forming a displaceable head for the outer piston for controlling the communication between said pistons and the cylinder.

3. A compressor comprising a cylinder, a pair of telescopic ported pistons cooperatively arranged therein, means for separately actuating said pistons, a cup valve operatively mounted on and enclosing the outer end of the first piston, said cup valve being provided in its end wall with port openings arranged in definite relation with said piston for controlling the communication therebetween and the second piston, and a cup valve mounted on and enclosing the outer end of said second piston, said cup valve being provided in its end wall with port openings arranged in correlation with said piston for controlling the communication between said piston and the cylinder.

4. A compressor comprising a cylinder, a pair of telescopic pistons cooperatively arranged therein, means for individually actuating said pistons, a valve mounted on the end of the inner piston for controlling the communication between said pistons, a valve mounted on the end of the outer piston for controlling the communication therebetween and said cylinder, and a pressure operated valve arranged in said cylinder for controlling the discharge end thereof.

5. A compressor comprising a cylinder, a pair of telescopic pistons cooperatively arranged therein, the inner piston being wholly disposed in the outer piston, said piston being provided with loosely mounted compression ends operable to control the communi-

cation between said pistons and the compression chamber of the cylinder, and means for actuating said pistons.

6. A compressor comprising a cylinder, a pair of telescopic pistons cooperatively arranged therein and having open outer ends, and caps fitting over and enclosing said ends and having lost motion connection therewith, there being suitable port openings formed in the end walls of said caps, which when said caps are unseated permit passage of fluid from said pistons, and means for simultaneously actuating said pistons.

7. A compressor comprising a cylinder, a pair of telescopic pistons cooperatively arranged therein, means for positively actuating said pistons, cup valves enclosing the compression ends of said pistons for controlling the communication therebetween, said valves having operative lost motion engagement with said pistons, and a pressure operated valve arranged in the compression chamber of the cylinder for controlling the discharge of the fluid therefrom.

8. A compressor comprising a cylinder, a hollow open ended piston operating therein, a ported cup valve arranged exteriorly on and enclosing the compression end of said piston, said valve having lost motion engagement with said piston and being operable thereby to control the communication between said piston and the compression chamber of the cylinder, said compression end of said piston having reduced annulus to receive the annular wall of said cup valve member flush with the peripheral face of said piston, and means for actuating said piston.

9. A compressor comprising a cylinder, a tubular piston operating therein and provided with a reduced compression end, a cup-shaped member arranged on and wholly enclosing the compression end of said piston, said cup-shaped member being provided with an annulus arranged exteriorly on said reduced compression end flush with the peripheral wall of said piston and having lost motion connection with said piston and being provided in its end wall with port openings which when said cup-shaped member is displaced permit the discharge of the fluid from said piston and which when said cup-shaped member occupies normal position are closed by the edge of the compression end, and means for actuating said piston.

10. A compressor for domestic refrigerating machines comprising in combination a cylinder, a tubular piston operating therein and provided with a reduced compression end, a cup valve arranged on the compression end of said piston and operable thereby relative thereto for controlling the passage of fluid therethrough, said cup-shaped member being provided with annular walls arranged exteriorly on said reduced end flush with the peripheral wall of said piston, an element for interengaging said annular wall and said piston for forming lost motion connection therebetween, and means for actuating said piston.

11. A compressor for domestic refrigerating machines comprising in combination a cylinder, a hollow piston operating therein and provided in its periphery with an intake port communicating with the interior of said piston having a discharge opening in the compression end thereof, a displaceable cup valve mounted on the compression end of said piston for closing the interior of said piston and forming a compression head therefor, said valve having lost motion relative to said piston and there being apertures formed in said valve which when said valve is displaced establish communication between the interior of said piston and the compression chamber of the cylinder and which when said valve occupies normal position are closed by the end of said piston and shield the interior thereof, and means for actuating said piston.

12. In a compressor, the combination of a hollow reciprocating piston having an intake port in its peripheral wall and an open reduced end, a slidable cup valve exteriorly arranged on said reduced end and having openings in its end wall which are in longitudinal alinement with and are adapted to be closed by the edge of the piston when the valve is seated and which form outlet ports for said intake chamber when said valve is unseated, said piston being provided with a reduced annulus for receiving the cylindrical portion of said valve flush with the peripheral surface of said piston.

13. In a compressor, the combination of a hollow reciprocating piston provided with an open reduced end, a cup valve slidably and exteriorly arranged on the reduced end of said piston forming the compression head of said piston, said valve being provided in its end wall with port openings and having lost motion with respect to said piston whereby when said valve is unseated said port openings establish communication between the interior of said piston and said cylinder, and a retaining member extending inwardly from said valve into an annular groove formed in said piston for limiting the movement of said valve.

14. A compressor comprising a cylinder, a pair of cooperating telescopic pistons operating therein, a pair of sliding cross heads secured to respective pistons, means for actuating said cross heads in opposite directions, cup valves on said pistons, and a pressure operated valve in said cylinder for controlling the compression chamber thereof.

15. A compressor comprising a cylinder, a pair of cooperating telescopic pistons op-

erating therein, means for actuating said pistons, cup valves on said pistons for controlling the passage of fluid therethrough, and a pressure operated cup valve having its cylindrical portion extending into said cylinder and arranged flush with the inner face thereof, and movable outwardly, said cylindrical portion being provided with a series of circumferentially disposed apertures which are closed when the valve is seated and which when the valve is unseated establish communication between said cylinder and the pressure chamber.

16. A compressor comprising a pair of diametrically disposed cylinders, a pair of cooperating telescopic pistons arranged in each cylinder, a pair of cross heads one of which has secured to it the inner end of the first or smaller pistons and the other one has secured to it the inner ends of larger or secondary pistons, means for actuating said heads in opposite directions, valves on said pistons for controlling the passage of fluid therethrough, and a valve for controlling the discharge of fluid from the cylinders.

17. A compressor comprising a pair of diametrically disposed cylinders, a tubular piston operating in each cylinder, a sliding cross head connected to said pistons, a telescopic piston operating in each tubular piston, a sliding cross head connected to said telescopic pistons, means for actuating said cross heads in opposite directions, a cup valve in each cylinder and operable in correlation with the respective tubular piston, and cup valves mounted on said pistons in lost motion relative therewith and operable by said pistons.

18. In a device of the class described, the combination of a hollow piston having the compression end open, a cup valve disposed exteriorly on said open end and forming a compression head therefor, said valve having its peripheral wall slidably disposed on the peripheral wall of said piston and provided in its end wall with apertures arranged in alinement with the annulus thereof, and means for interengaging said cup valve with said piston to allow movement of said cup valve relative to said piston for opening and closing said apertures and control the communication between the interior of the piston and the cylinder in which it operates in correlation with the movement of said piston.

19. In a compressor for refrigerating apparatus, the combination of a cylinder, a hollow piston operatively arranged therein and having an open outer end, a cup valve fitting over and enclosing said open end and having lost motion connection therewith, there being suitable port openings formed in the end wall of said cup valve whereby when said cup is unseated fluid is allowed to pass from the interior of said piston into said cylinder through said port openings and said valve is seated to close said openings during the compression stroke of said piston.

In testimony whereof I hereunto affix my signature this 29th day of December, 1923.

JOHN O. CARREY.