Oct. 11, 1932. A. J. KERCHER 1,882,220

REFRIGERATOR SYSTEM AND APPARATUS

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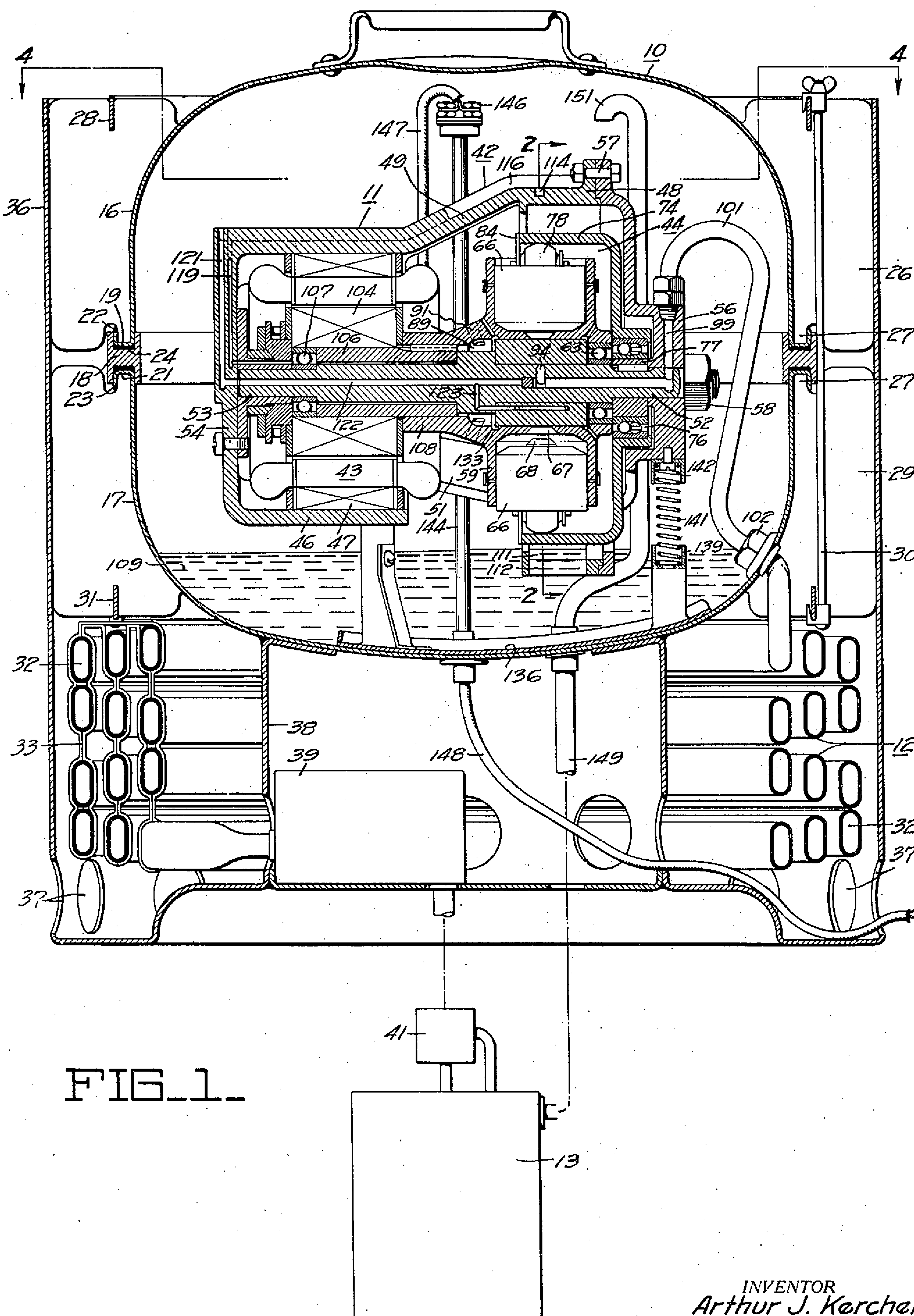

FIG_1_

INVENTOR
Arthur J. Kercher
BY White, Prost & Fryer
ATTORNEYS

Oct. 11, 1932. A. J. KERCHER 1,882,220

REFRIGERATOR SYSTEM AND APPARATUS

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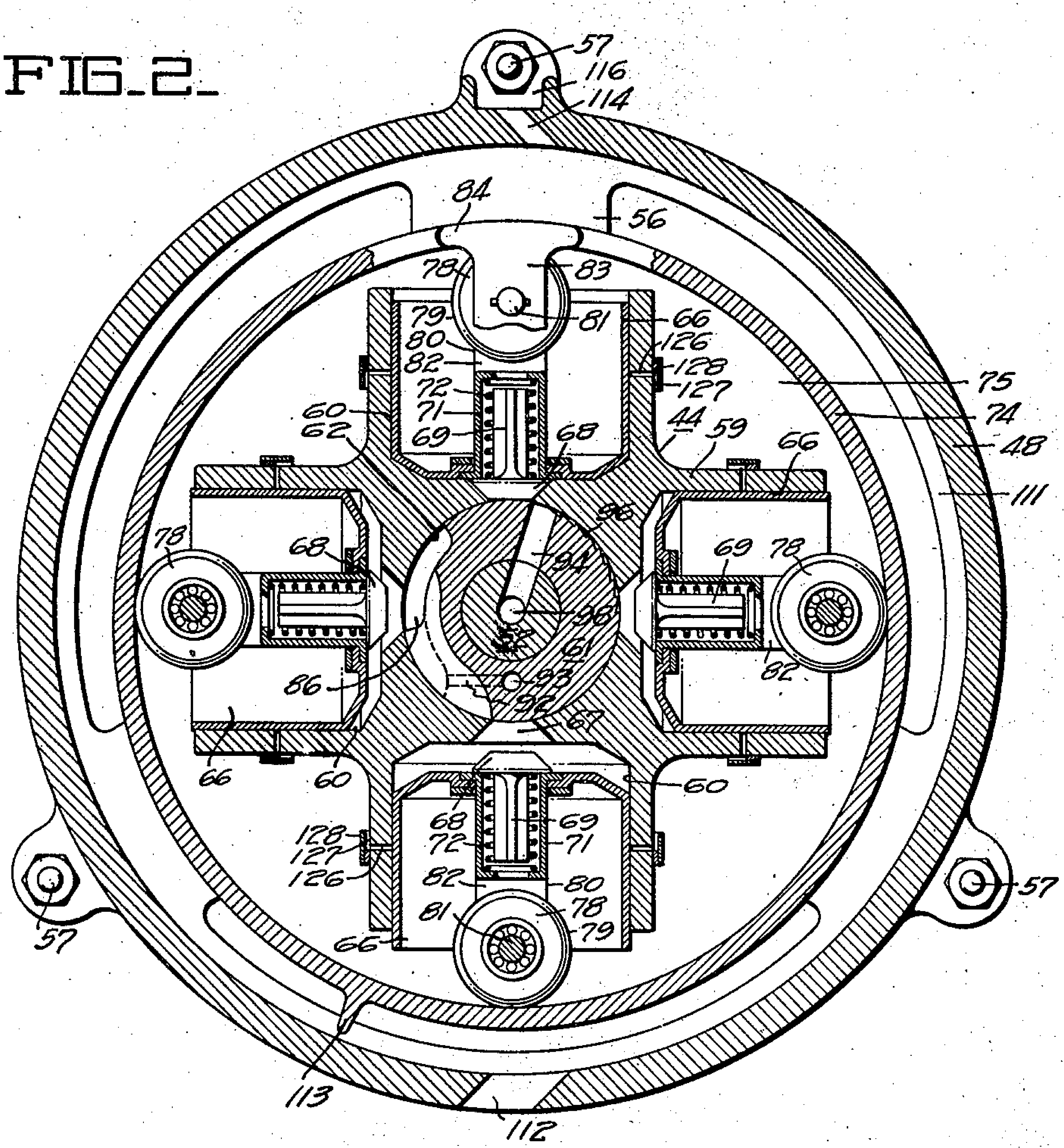
FIG. 2.



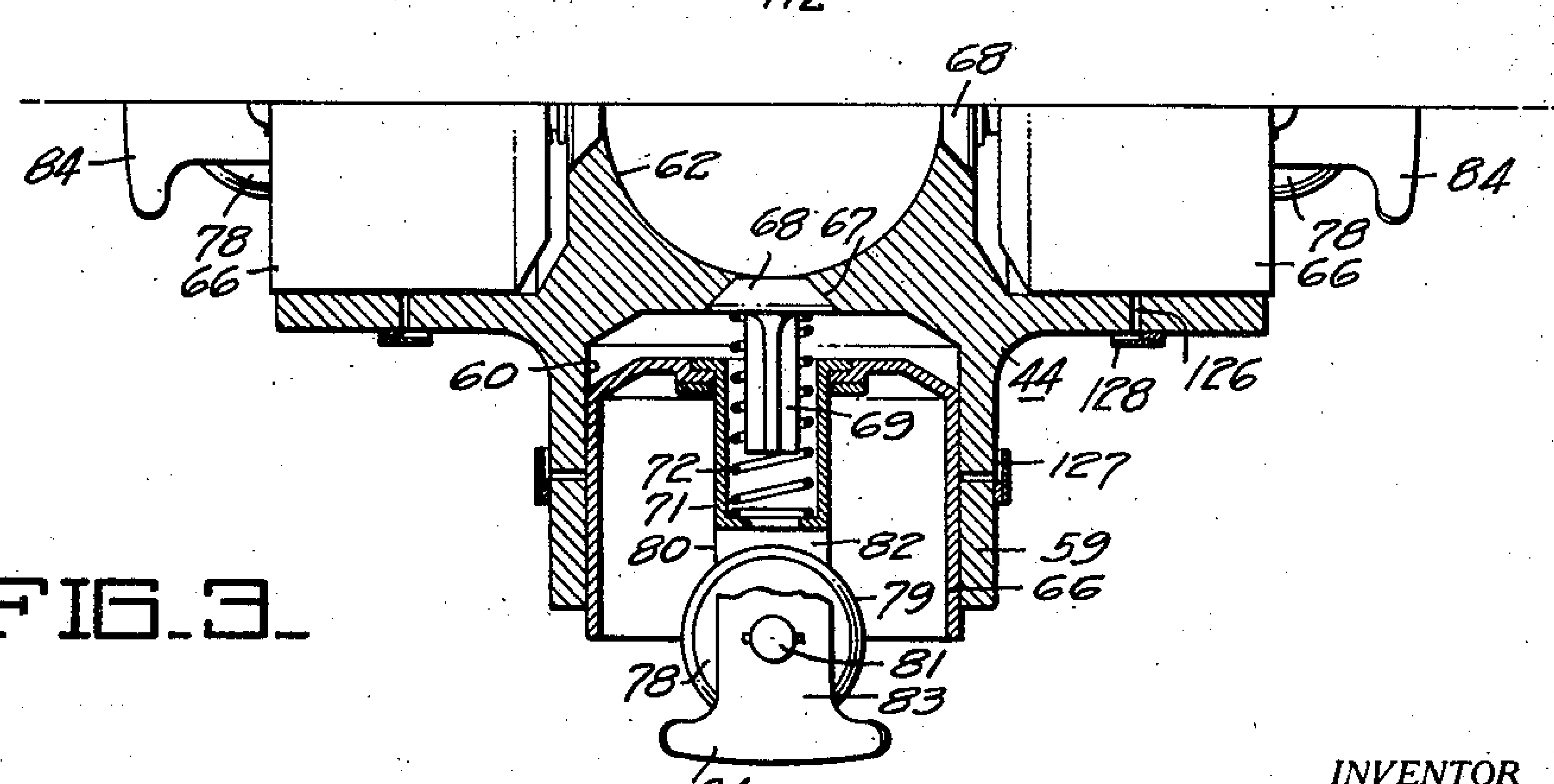


FIG. 3.

INVENTOR
Arthur J. Kercher
BY White, Prost & Fryer
ATTORNEYS

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REFRIGERATOR SYSTEM AND APPARATUS

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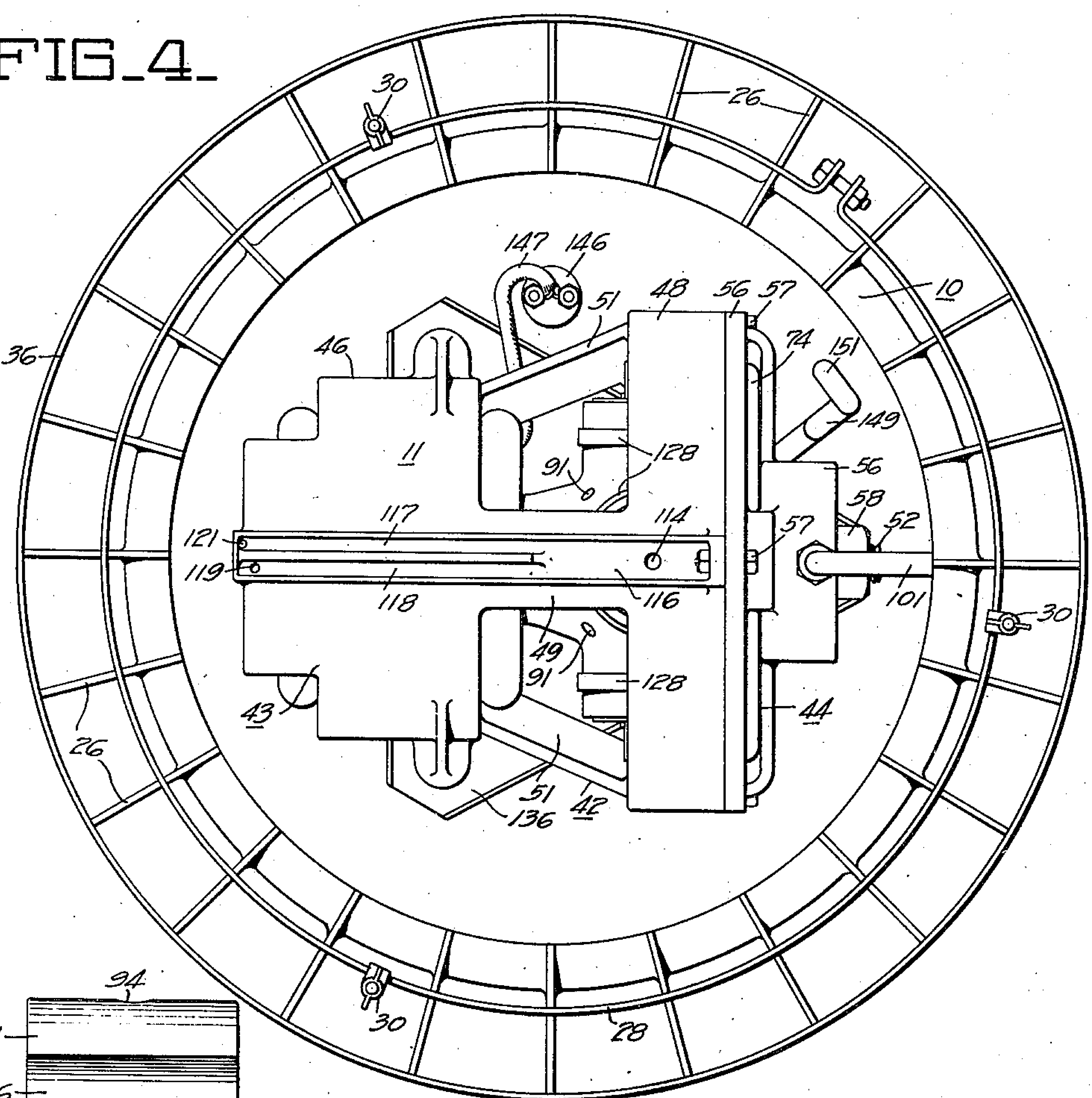
FIG_4_



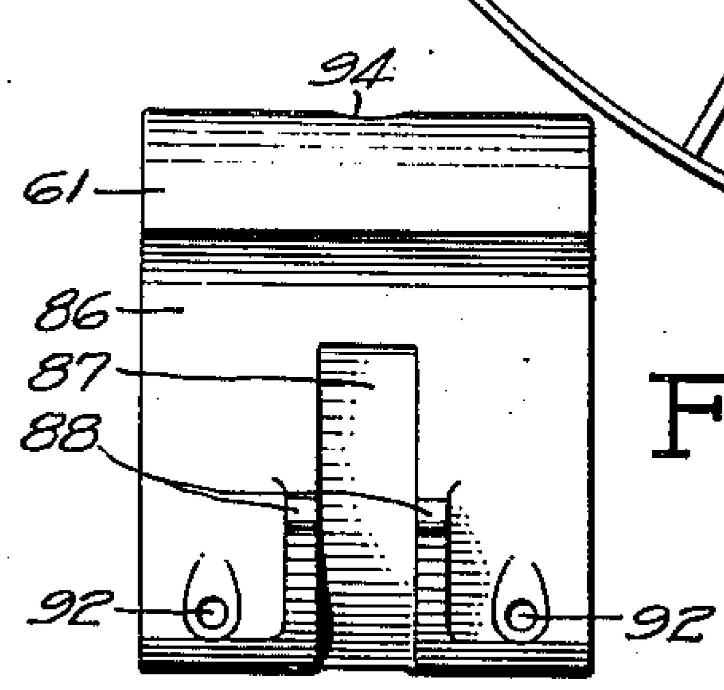


FIG_5_

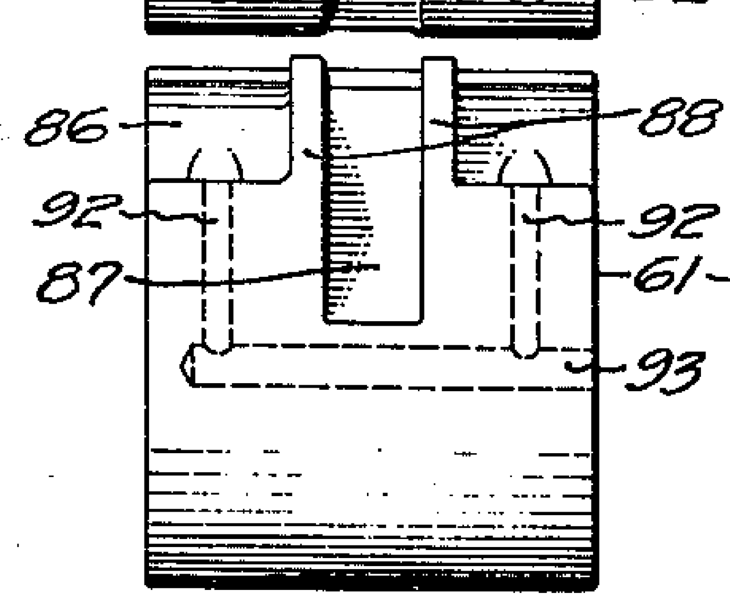


FIG_6_

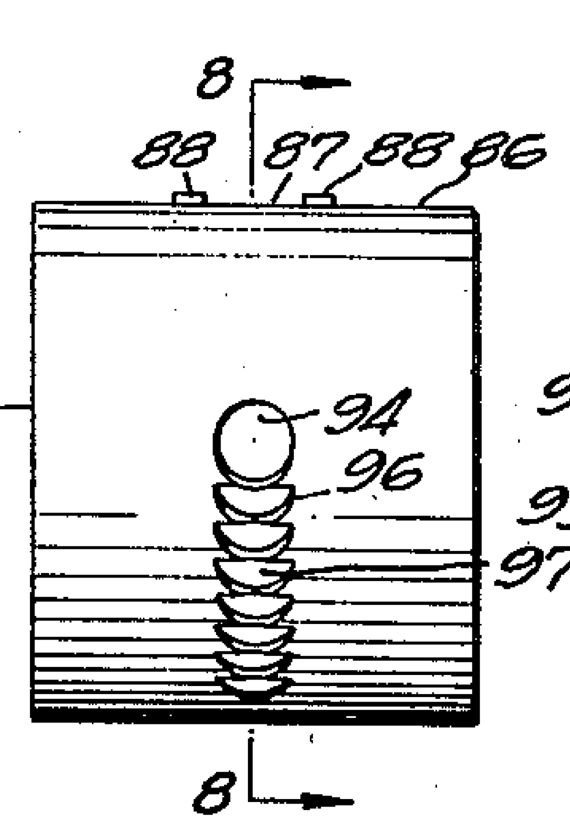
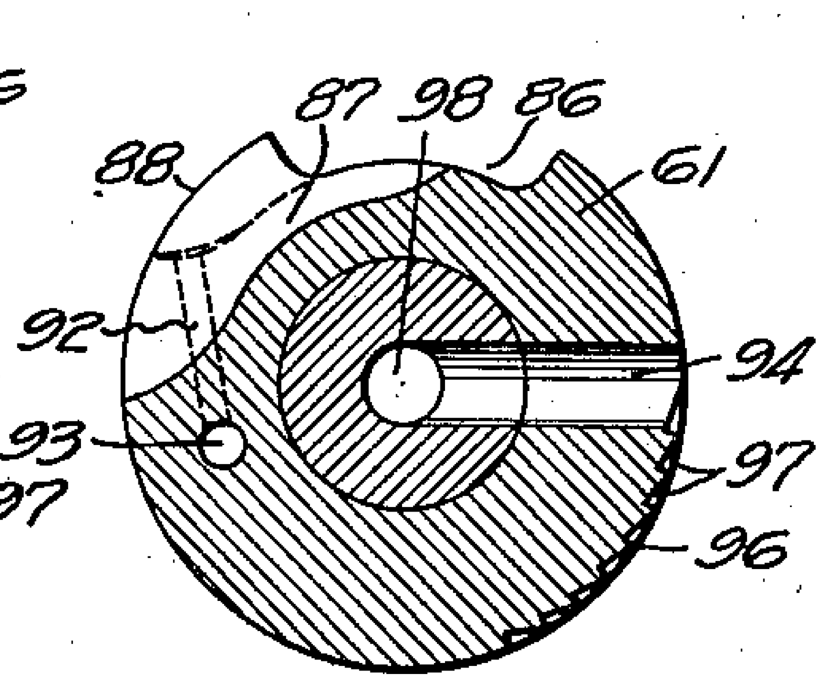


FIG_7_

FIG_8_



INVENTOR
Arthur J. Kercher
BY White, Prost & Fryer
ATTORNEYS

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A. J. KERCHER

1,882,220

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FIG_9_

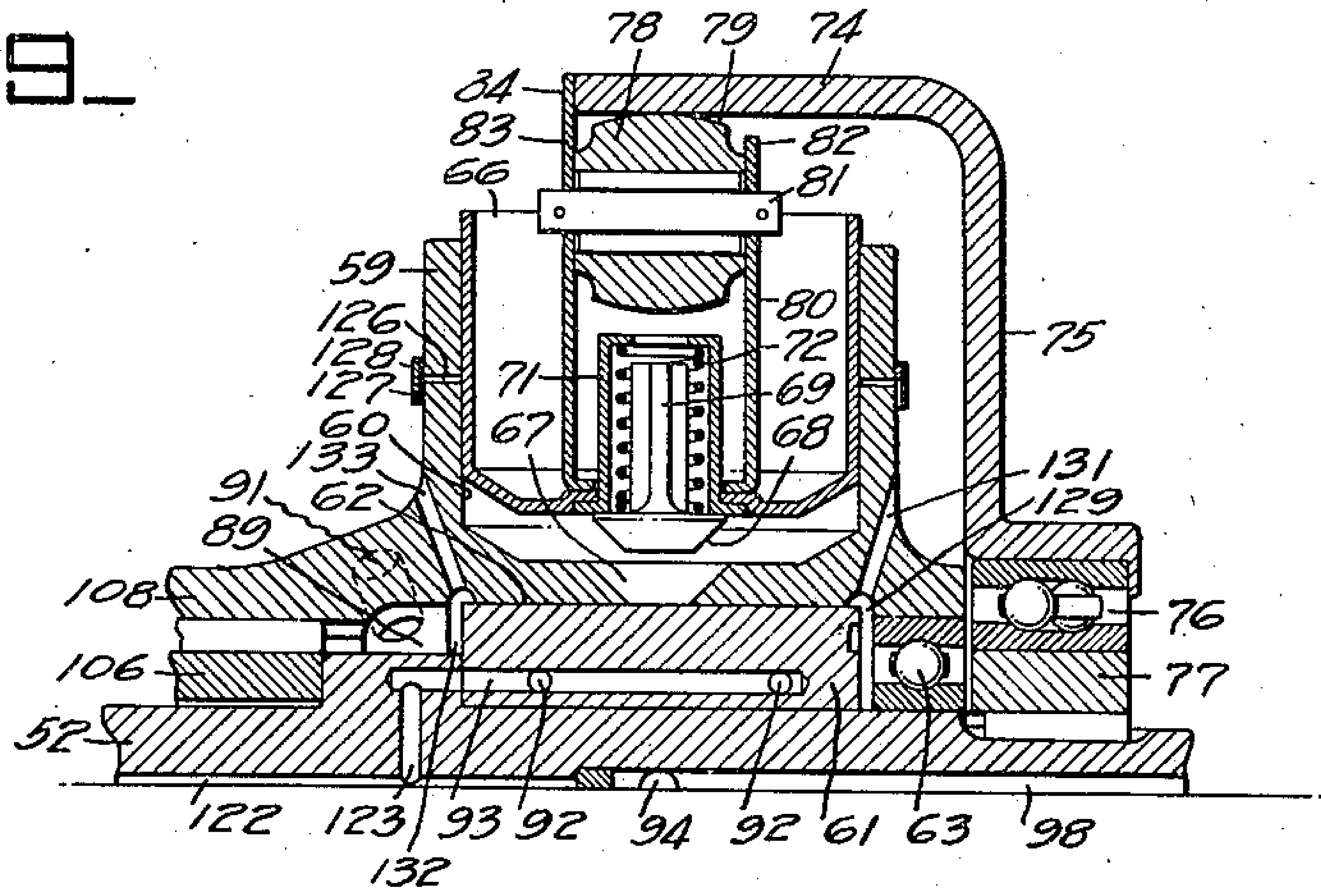


FIG_10_

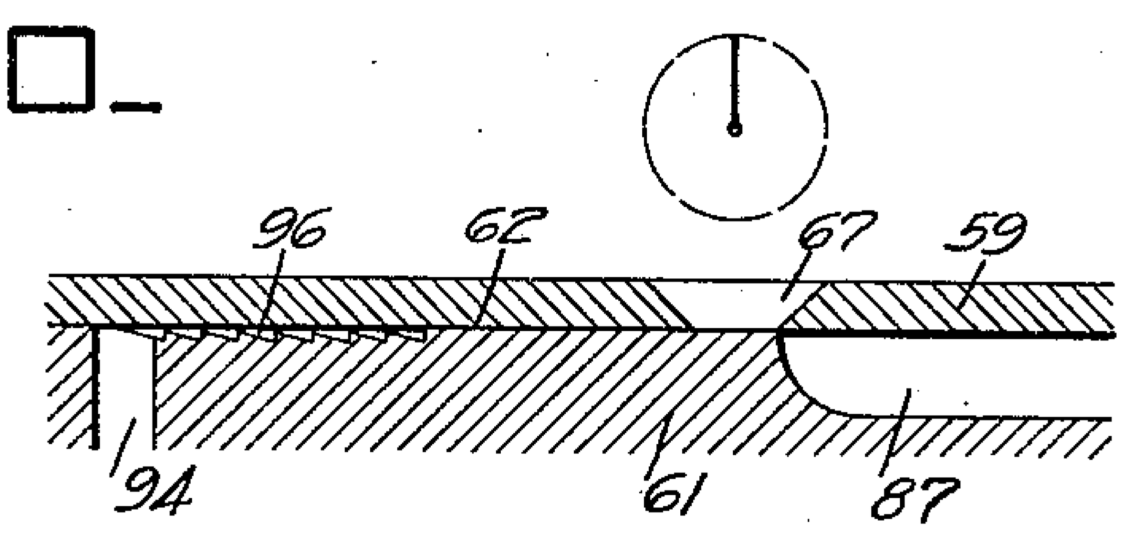


FIG_11_

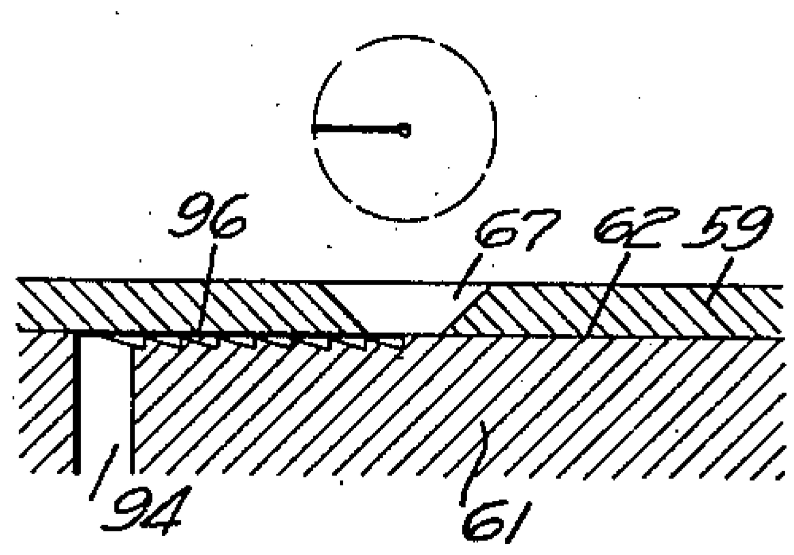
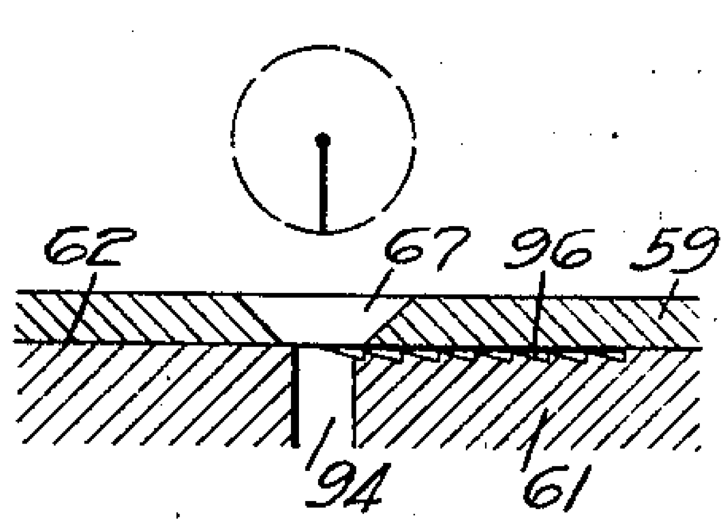


FIG_12_



INVENTOR
Arthur J. Kercher
BY White, Prost & Fryer
ATTORNEYS

Patented Oct. 11, 1932

1,882,220

UNITED STATES PATENT OFFICE

ARTHUR J. KERCHER, OF BERKELEY, CALIFORNIA

REFRIGERATOR SYSTEM AND APPARATUS

Application filed January 23, 1929. Serial No. 334,571.

This invention relates generally to refrigerating systems utilizing a compressible fluid refrigerant, and to apparatus suitable for use in such systems.

It is a general object of this invention to devise apparatus for use in refrigerating systems, which is simple in construction, comparatively efficient in operation and which can be readily serviced or repaired.

It is a further object of this invention to devise a compressor of novel and simplified construction, and in which is incorporated novel means for minimizing the starting torque required for the same.

It is a further object of this invention to devise a compressor of the rotary reciprocating piston type, having novel means for effecting actuation of the pistons.

It is a further object of this invention to devise a fluid compressor which will give efficient operation over a variety of pressure requirements.

It is a further object of this invention to devise a fluid compressor having a valve member provided with a novel form of intake valve port which will provide a minimum resistance to flow of fluid and which will tend to prevent mixing of oil or other fluid lubricant with the fluid being compressed.

It is a further object of this invention to devise novel means in a compressor for effecting adequate lubrication of the moving parts.

Further objects of the invention will appear from the the following description in which I have set forth the preferred embodiment of my invention. It is to be understood that the appended claims are to be accorded a range of equivalents consistent with the state of the prior art.

Referring to the drawings:

Figure 1 is a side elevational view in cross section, illustrating my apparatus incorporated in a refrigerating system.

Fig. 2 is a cross sectional detail of the compressor taken thru the lines 2—2 of Fig. 1.

Fig. 3 is a detail showing parts of the cylinder and piston structure incorporated in my compressor, showing the position of parts when the compressor is not in operation.

Fig. 4 is a sectional view of the apparatus taken along the line 4—4 of Fig. 1.

Figs. 5 and 6 are plan and side elevational views respectively of the valve member incorporated in my compressor.

Fig. 7 is a rear side view of the valve member as shown in Fig. 6, showing the nature of the intake ports.

Fig. 8 is a cross sectional view taken along the line 8—8 of Fig. 7.

Fig. 9 is an enlarged cross-sectional view showing one cylinder and its associated parts in an inverted position.

Figs. 10, 11 and 12 are schematic diagrams illustrating operation of the valve member in controlling discharge of compressed fluid.

Refrigerator systems of the type with which the apparatus of this invention can be utilized, employ a suitable compressible fluid refrigerant as sulphur dioxide, ethyl chloride, or other such gas. This fluid is compressed by a suitable pump or compressor, and then delivered to a condenser where heat is removed, generally to the point of effecting condensation. From the condenser the fluid is delivered to a heat absorber, where it is permitted to expand and thus absorb heat. The expanded fluid from the absorber is then returned to the compressor, so as to form a closed system. When apparatus of this character is utilized for domestic refrigeration, it is highly desirable to reduce all noise and vibration to a minimum, and to obviate frequent servicing and repairs. The apparatus which I have disclosed herein is not only comparatively noiseless in operation and reliable in operation over long periods, but is comparatively simple in construction and can be manufactured in large quantities at relatively low cost.

A complete description of my apparatus is as follows: In Fig. 1 I have shown a casing 10 which is preferably fluid tight, and which houses a novel form of motor compressor unit 11. Connected to the compressor there is an external condenser 12, which in turn is connected to a suitable heat absorber 13, this absorber being generally located within the space to be cooled.

The casing 10 has certain novel features and preferably consists of upper and lower sections 16 and 17, which are formed of suitable material such as spun or pressed sheet metal. For joining together the edges of sections 16 and 17, I have shown a ring 18 made of suitable material such as metal, this ring being provided with upper and lower annular grooves 19 and 21. The turned back edge portions 22 and 23 of sections 16 and 17 are arranged to fit within the grooves 19 and 21. Suitable gaskets 24 arranged within grooves 19 and 21 effect adequate sealing.

The motor compressor unit within the casing 10 develops considerable heat, and for dissipating this heat from the casing I have shown the outer periphery of section 16 provided with a plurality of circumferentially spaced cooling fins 26. Fins 26 are made of some suitable metal having good heat conductivity, such as copper, and have their inner edges soldered, braized, or otherwise secured to the outer periphery of section 16. For convenience I have shown each fin 26 provided with a projection 27 interfitting with the turned back edge portion 22, while the upper portions of the fins are interconnected by common annular ring or band 28. The lower casing section 17 is similarly provided with a plurality of circumferentially spaced fins 29 interconnected by a common metal ring or band 31. Casing sections 16 and 17 are preferably substantially dome-shaped so that they can be readily manufactured and so that they can withstand considerable external pressure.

The condenser 12 can be located at any point from which connection can be conveniently made to the compressor and heat absorber, and in which it can be adequately cooled. However in order to take advantage of certain cooling convection currents of air, as will be presently explained, I prefer to locate this condenser directly below the cooling fins 26 and 29 as shown. Thus the condenser can be formed of a coiled pipe or tube 32 formed of suitable metal of good conductivity, such as copper. This tube is shown supported by suitable brackets 33, these brackets in turn being supported by the ring 31. A plurality of removable clamps 30 serve to detachably retain the upper casing section 16 upon the lower.

The casing 10 and condenser 12, and their associated parts can be conveniently positioned within an outer housing 36, this housing being shaped to conform to the peripheral contour of fins 26 and 29. The lower portion of housing 36 is provided with suitable openings 37, while the upper portion is likewise open to the atmosphere. Thus the spaces between fins 26 and 29, in conjunction with the outer housing 36, form a series of upwardly positioned flues which induce upwardly moving convection currents of air. Inflowing cool air induced in this manner is caused to flow over the condenser 12 and thus cool the same. In connection with casing 10, I have shown a suitable base or supporting structure 38, which can either be formed in conjunction with or separate from the outer housing 36. Connected to the discharge end of condenser 12, I have shown a suitable vessel 39 for accumulating condensed refrigerant, and interposed between vessel 39 and heat absorber 13, I have shown a suitable automatically controlled expansion valve indicated generally at 41. Automatically controlled expansion valves suitable for this purpose are well known in the art and need not be described in detail.

Certain features of my motor compressor unit 11 have been described and claimed in copending applications No. 159,053 filed January 5, 1927; No. 206,441 filed July 18, 1927; and No. 225,117, filed October 10, 1927. Certain features of this unit together with its association with other apparatus of the refrigerating system, have been described and claimed in my Patent No. 1,614,676. However additional features are disclosed and claimed herein as will be presently apparent. The unit which I have disclosed in the drawing utilizes a suitable frame 42, serving as a mounting for a suitable prime mover, such as an electric motor 43, and for a compressor designated generally at 44.

A suitable form for the frame 42 consists of a ring shaped member 46, within which the motor stator 47 has a forced fit. Another ring shaped member 48 serves to encompass the moving parts of compressor 44, and is rigidly connected to ring member 46 by the upper connecting member 49 and side connecting members 51. Mounted within the frame 42 there is a relatively stationary shaft 52, about which both motor 43 and compressor 44 are disposed. One end of shaft 52 is inserted within a socket member 53, which in turn is carried by an end portion 54 of frame 42, while the other end of the shaft is extended thru an end spider plate 56, this plate being removably secured to the main frame structure as by means of bolts 57. The end of the shaft extended thru plate 56 is preferably threaded and engaged by a suitable clamping nut 58.

The compressor 44 preferably consists of a cylinder structure 59, disposed upon the shaft 52 and rotatable about the same. As shown in Fig. 2 cylinder structure 59 is provided with a plurality of cylinder bores 60, which preferably extend radially with respect to the shaft 52 and to the axis of rotation. Any convenient number of cylinder bores can be provided as desired, depending upon the capacity of the compressor and upon the conditions under which the compressor is to operate. For convenience I have shown only four cylinder bores, as this number has been found sufficient when the compressor is employed in a domestic refrigerator. Fixed upon the shaft 52 within the cylinder structure 59, there is a valve or distributor member 61. While this member can be made integral with shaft 52, it is preferably formed as a separate member which can be positioned about the shaft and retained in fixed relationship with respect to the same, by means of a suitable centering pin or key. Valve member 61 has a peripheral surface which is preferably cylindrical in contour, and which closely fits a complementary bore in the cylinder structure 59, thus providing a cylindrical sealing surface 62 as shown in Fig. 2. To avoid forming a bearing directly upon valve member 61, one end of cylinder structure 59 is suitably journaled upon shaft 52 as by means of ball bearing assembly 63, while the other end can be supported by the drive connection to motor 43, as will be presently described.

Disposed within each of the cylinder bores 60, there is a piston 66, and these pistons are reciprocated in a manner to be presently explained. While separate ports may be employed for introduction and discharge of fluid into each cylinder bore, I preferably employ a single port 67, which communicates between the inner end of each cylinder bore and the sealing surface 62. In order to prevent any actual pumping of fluid until the compressor has attained a predetermined speed, and thus permit starting under substantially no load, I preferably provide means in conjunction with the pistons 66 for effecting automatic control according to the speed of rotation of the cylinder structure. This means preferably takes the form of a valve member 68 which is movably carried by each piston 66. Each valve member 68 is provided with a fluted stem 69, which normally extends into a sleeve 71. Sleeve 71 is fixed to the bottom wall of a corresponding piston 66, and is substantially in alinement with the port 67 of the corresponding cylinder bore. Positioned within sleeve 71 there is a compression spring 72, which normally tends to urge valve member 68 and piston 66 apart, and to cause this valve member to seat within its corresponding port 67 as shown in Fig. 3. Spring 71 is of such strength that it serves to keep the valve member 68 within the port 67 until the speed of rotation of the cylinder structure has attained a predetermined value, after which the centrifugal force exerted by virtue of the mass of valve member 68, and its associated stem, serves to overcome the tension of spring 72 and thus move valve member 68 outwardly to seat upon the bottom surface of piston 66 as shown in Fig. 2. It will be noted that when valve member 68 is in the position shown in Fig. 3, the interior of sleeve 71 forms a bypass between opposite sides of the pistons 66, while in the position shown in Fig. 2, this bypass is closed. Thus when the compressor is started into operation and the cylinder structure is rotating at a relatively slow speed, inflow and discharge of fluid thru ports 67 is interrupted by valve members 68, and pistons 66 are free to reciprocate by virtue of the fact that fluid is bypassed into and out of the cylinder bores thru the interior of sleeves 71. However after the compressor has attained normal speed and the valve members have been moved by centrifugal force to the position shown in Fig. 2, fluid is free to enter and to be discharged from the cylinder bores through ports 67 but cannot bypass thru the sleeves 71.

For effecting reciprocation of the pistons I preferably utilize an actuator ring 74 which extends about or substantially encompasses the cylinder structure 59. This ring is preferably rotatable with respect to both the cylinder structure 59 and the stationary shaft 52, and about an axis which is eccentric to the axis of rotation of the cylinder structure. For example it is shown formed integral with an end plate or disc 75, which in turn is journaled about a suitable ball bearing assembly 76. Ball bearing assembly 76 is disposed upon a sleeve 77 fixed to shaft 52, adjacent to the ball bearing assembly 63 for the cylinder structure 59. Sleeve 77 has an eccentric periphery to provide the required eccentricity for the actuator ring 74. The other face of actuator ring 74 is preferably left open so as to permit the pistons and other exposed moving parts of the compressor to be subjected to a spray of lubricating oil. Interposed between each piston 66 and the actuator ring 74, I preferably provide a roller 78 having a curved or arcuate outer periphery 79 which engages the inner periphery of the actuator ring 74. For transmitting stress from each roller to its associated piston, I have shown a U-shaped member 80 which is apertured so as to be insertable over the sleeve 71 of the corresponding piston. A pin 81 is inserted thru the branches 82 and 83 of this U-shaped member, and serves as a journal pin for the roller 78. One branch 83 is preferably extended beyond the roller 78 and is widened to form a guide shoe 84. Shoe 84 serves to engage the edge of actuator ring 74, and thus maintains the axis of roller 78 substantially in alinement with the axis of rotation of cylinder structure 59 and with the axis of rotation of actuator ring 74. It may be noted at this point that the engagement between shoe 84 and the actuator ring is sufficiently light as to occasion substantially no frictional losses, and so as to permit the actuator ring to rotate with respect to the cylinder structure.

It should also be noted that connection between U-shaped member 80 and the corresponding piston 66 is formed by abutting contact only and that relative rotation between these parts is permitted. In actual operation it has been found that due possibly to slight inaccuracies in alinement of the parts, the pistons are caused to continually rotate within their respective bores, so that scoring of the pistons and cylinders is obviated and wear is adequately distributed. Furthermore slight inaccuracies in the alinement of the actuator ring 74 with the cylinder structure and pistons has no detrimental effect, because of the curving or crowning of the peripheries of rollers 78.

Valve member 61 is provided with certain recesses or ports which cooperate with the ports 67 to control inflow and discharge of fluid being compressed. The recesses provided in valve member 61 can best be understood by reference to Figs. 5 to 8 inclusive. Along one segmental portion of the periphery of this valve member, there is provided a recess or port 86 for inflow of fluid into the cylinders. In addition to the recess 86 and communicating therewith, there is a groove 87, this groove being alined with respect to and of substantially the same width as the ports 67. Groove 87 is substantially deeper than the recess 86 as shown in Fig. 8 to permit flow of fluid into ports 67 with a minimum of resistance. Vanes 88 are located upon opposite sides of groove 87, and serve to isolate a portion of this groove from recess 86. As shown in Figs. 1 and 2 recess 86 communicates with an annular pocket 89 in the cylinder structure 59, and this pocket in turn communicates with the interior of casing 10 thru a plurality of radially extending ports 91. The radial positioning of ports 91 is a distinct advantage in that it serves as centrifugal means for effecting separation of oil from refrigerant fluid drawn into the compressor. Certain lubricating features of my compressor will be presently explained, but it may be noted at this point that oil ducts 92 are formed within valve member 61, and communicate with recess 86 at points located between vanes 88 and the ends of valve member 61, as shown in Figs. 5 and 6. Ducts 92 communicate with a common duct 93, to which oil is supplied as will be presently explained.

For controlling the discharge of compressed fluid, there is provided a port 94 which communicates with the periphery of valve member 61 at a point spaced from the recess 86. Port 94 is substantially the same diameter as and is alined with the ports 67 of the cylinder structure. In addition to the port 94, the periphery of valve member 61 is interrupted by a circumferentially extending groove 96, one end of which communicates with port 94 as shown in Fig. 8. This groove is of restricted area compared to the cross sectional area of port 94. Furthermore it is in the form of a labyrinth so that flow of fluid along groove 96 toward port 94 can occur with less attenuation and resistance than flow backwards from port 94 along groove 96. As will be presently explained this characteristic is for the purpose of preventing re-expansion under certain operating conditions. A labyrinth groove of this character can be conveniently provided by forming a plurality of pockets 97 faced towards the discharge port 94, thereby producing a serrated channel in the groove, as illustrated in Figs. 7 and 8.

The manner in which ports 67 and 94, and groove 96 cooperate, can be best understood by reference to Figs. 10, 11 and 12. Figure 10 represents the relative position of a port 67 when the associated piston is just commencing its down or compression stroke. Figure 11 shows the position of port 67 during an intermediate part of the compression stroke, in which it will be noted that port 67 is in communication with groove 96. Assuming that the pressure within port 94 is at this time substantially less than the pressure within the associated cylinder, a certain amount of the fluid from the cylinder will be bled thru the groove 96. At the end of the compression stroke, the ports 67 and 94 are in registry as shown in Fig. 12. Under certain operating conditions, as are encountered when a compressor is employed in a refrigerating system, the pressure in the fluid system supplied by the compressor may reach a relatively high value. Under such conditions when a port 67 is initially in registry with groove 96, as for example as shown in Fig. 11, the pressure in port 94 may exceed the pressure within the associated cylinder. Thus there will be a tendency for fluid to re-expand and flow back thru groove 96. Such re-expansion causes a loss of efficiency and is minimized by my invention because of the labyrinth character of groove 96. For the opposite extreme operating condition, as for example when the pressure in port 94 is atmospheric or below, the extent of groove 96 automatically causes a lowering of the mean effective pressure within the associated cylinder. Thus my compressor not only gives good efficiency when operating under normal optimum conditions, but is also comparatively efficient for extreme operating conditions. This characteristic is of particular value when the compressor is employed in refrigerator systems, where there is variable pressure in the condenser into which the compressor discharges.

Referring now to Fig. 2, discharge port 94 communicates with a discharge passage 98 in shaft 52, when valve member 61 is in normal position. Passage 98 in turn communicates with the passage 99 in the end plate 56 of frame 42, from which fluid is conducted to a discharge pipe 101. The condenser tube 32 is connected to discharge pipe 101, thru a suitable fitting 102, this fitting being sealed in the wall of casing section 17.

Since my compressor is of such a character that it performs practically no work upon the fluid until its speed is increased above a certain value, comparatively small starting torque is required for the motor 43. This motor can therefore be a simple induction type single phase motor connected to a phase splitting or other convenient form of starter. The rotor 104 of this motor is shown mounted upon a sleeve 106, this sleeve being journaled upon shaft 52 as by means of ball bearing assembly 107. One end of sleeve 106 is keyed or otherwise rigidly connected to the projecting portion 108 of the cylinder structure 59.

When the compressor is in operation it is preferably subjected continuously to a spray of lubricating oil. This spray of oil not only affords lubrication for exposed moving parts, but also serves to conduct away heat from the compressor motor unit and to transfer this heat to the casing 10. For this purpose I have shown a quantity of lubricating oil 109 in the lower portion of casing 10, the level of this oil being preferably above the lower portion of ring member 48. The inner periphery of ring member 48 is preferably formed to provide an annular concavity 111, into which oil can be drawn thru a slot 112. A lug 113 projecting from the periphery of ring 74, serves to dip into the oil and splash the same over the motor and compressor, and in addition causes oil to flow along the inner periphery of member 48 within concavity 111. The upper portion of ring member 48 is provided with an inclined slot 114, thru which oil can flow into a groove 116 formed upon the upper side of frame 42. This groove 116 is shown more clearly in Fig. 4. Due to the shape of frame 42, groove 116 is inclined towards the motor end, where the oil flows downwardly thru oil ducts 117 and 118. Duct 118 supplies duct 119, which in turn supplies oil to the motor ball bearing assembly 107, while duct 117 communicates with passage 121. By means of a duct 122 in shaft 52, passage 121 communicates with duct 93 thru duct 123, and thus with ducts 92 of the valve member 61. Ball bearing assemblies 63 and 76 are lubricated by oil splashed upon the same and by oil escaping from the sealing surface 62, which is supplied thru ducts 92.

To provide adequate lubrication for the pistons I prefer to provide one or more ducts 126 thru the side walls of each cylinder, as shown in Fig. 2. As convenient means for supplying oil to these ducts, I have shown an inwardly faced pocket 127 preferably formed by means of a ring 128 extending about the exterior of the cylinder. Oil can be supplied to pocket 127 from excess lubricant which is supplied to the sealing surface 62. For this purpose I have shown an annular groove 129 near that end of valve member 61 which is farthest from the motor, and this groove is in communication with the exterior surface of the cylinder structure 59 thru one or more ducts 131. Likewise at the other end of valve member 61, I have shown an annular groove 132 connected to the exterior surface of the cylinder structure thru one or more ducts 133. Oil which flows thru ducts 131 and 133 moves outwardly by centrifugal force along the side walls of the cylinders and is collected by pockets 127, from which it is delivered to the inner cylinder walls thru ducts 126.

In order to minimize transmission of noise and vibration to the casing 10, and thus to the outer casing 36, I preferably provide a resilient or shock absorbing mounting for the motor compressor unit 11. Such a mounting is shown in the drawing and consists of a plate 136 resting on the bottom of casing section 17. A plurality of standard members, three in this case, are secured to and extend upwardly from plate 136, and are provided at their upper ends with sockets 139. Supporting springs 141 are positioned within sockets 139, and the upper ends of springs 141 carry socket members 142 which are secured to the frame 42 of the motor compressor unit. The entire motor compressor unit is therefore out of direct contact with the side walls of the casing 10, except for the connection thru the springs 141.

For making electrical connections to the motor, I have shown a sealed conduit 144 extending upwardly thru the bottom of casing 10 and carrying a terminal block 146. The motor windings are connected to this terminal block thru a flexible electrical cable 147. An electrical cable 148 extends from terminal block 146 down thru a conduit 144, and connects to a suitable external current supply line.

As has been previously described, I preferably draw the fluid to be compressed into the compressor directly from the interior of the casing 10. I have therefore shown the return pipe 149, leading from the absorber 13, extending upwardly into casing 10 thru the bottom thereof. The upper portion of this pipe has a downwardly directed open end portion 151. I prefer to adjust the control valve 41 so that when the compressor is in normal operation, it produces a comparatively low sub-atmospheric pressure within the casing. A rarefied atmosphere of this character will not readily transmit noise from the motor compressor unit to the casing walls and therefore materially assists in producing noiseless operation.

Operation of the complete apparatus can be briefly reviewed as follows: When current is supplied to the motor, the cylinder structure 59 of the compressor starts rotating about shaft 52, and the rotaton is accelerated until the motor reaches its normal speed. Since there is no rigid connection between the ring 74 and the cylinder structure 59, this ring may initially lag behind rotation of the cylinder structure, but will eventually pick up speed and rotate substantially in unison. Until the compressor has reached a predetermined speed, valve members 68 are retained within the ports 67, so that there is no pumping action. Therefore very little torque is required to start the compressor into rotation. After a predetermined speed has been attained, which speed is substantially less than the normal rate of rotation, valve members 68 are moved outwardly by centrifugal force and the compressor begins to circulate and compress the refrigerant fluid. The refrigerant as it is drawn thru ports 91 is subjected to centrifugal action which effects separation of entrained oil from the same. It may be noted that when the speed of the compressor is relatively low, as when starting the same, this centrifugal separating action is negligible, but at this time the compressor does not circulate the refrigerant. By the time the centrifugal force has caused the compressor to start its pumping operation, the centrifugal separating effect of passages 91 is effective. Referring to Fig. 2 and assuming that the compressor is rotating in a counter-clockwise direction as viewed in this figure, the intake stroke for a particular piston occurs when this piston is moved thru an angle of 180° from, for example, its upper position in this view to its lower position. During the greater portion of this movement, port 67 of this particular cylinder is in communication with recess 86 of the stationary valve member 61. For the remaining 180° movement of this cylinder, the piston is moved downwardly on its compression stroke. For about the last 90° of the compression stroke, port 67 is in communication with the discharge of the compressor thru labyrinth groove 96 and port 94. The moving parts of the motor compressor unit are properly lubricated both by oil which is splashed upon the external parts when the compressor is in operation, and by positive circulaton of oil thru ducts previously described.

The compressed fluid refrigerant is delivered to the condenser 12, from which it is discharged into the accumulating vessel 39. From this vessel it is passed thru the control or expansion valve 41 and permitted to expand in the heat absorber 13 after which it is returned to the interior of casing 10. A substantial amount of heat is imparted to the casing 10 by operation of the motor compressor unit. This heat is dissipated to convection currents of air by the fins 26 and 29. These currents of air however are first caused to flow over and cool the pipes of the condenser 12.

If the motor or compressor should require servicing or repairs, the upper casing section 16 can be removed by loosening the clamps 30. By disconnecting cable 147 from connection block 146, the entire compressor unit can then be bodily removed from the casing, thus facilitating repair or replacement.

I claim:

1. In a compressor, relatively rotatable parts, one of which is a cylinder structure, said structure having a cylinder bore and a fluid port communicating with the same, a piston disposed within said cylinder bore, and means mounted on said piston and movable relative thereto for controlling the effective area of said port according to the relative speed of rotation between said parts.

2. In a compressor, relatively rotatable parts, one of which is a cylinder structure, said structure having a cylinder bore, a piston disposed within said bore, said piston having a passage communicating between opposite ends of the same, and means for automaticallly controlling the effective area of said passage according to the speed of rotation between said parts.

3. In a compressor, relatively rotatable parts, one of which is a cylinder structure, said structure having a cylinder bore and a port communicating with said bore near one end of the same, a piston disposed within said cylinder for effecting flow of fluid into and out of said cylinder thru said port, means for effecting reciprocation of said piston upon relative rotation between said parts, and valve means mounted on said piston and movable relative thereto for controlling said port according to the rate of said relative rotation.

4. In a compressor, relatively rotatable parts, one of which is a cylinder structure, said structure having a cylinder bore and a port communicating with said bore near one end of the same, a piston disposed within said cylinder for effecting flow of fluid into and out of said cylinder thru said port, means for effecting reciprocation of said piston upon relative rotation between said parts, and centrifugally operated valve means movable relative to said piston for opening said port only after the rate of said relative rotation has attained a predetermined value.

5. In a compressor, relatively rotatable parts, one of which is a cylinder structure, said structure having a cylinder bore and a port communicating with said bore near one end of the same, a piston disposed within said cylinder for effecting flow of fluid into and out of said cylinder thru said port, means for effecting reciprocation of said piston upon relative rotation between said parts, said piston having a passage communicating between opposite ends of the same, and centrifugally

operated valve means for controlling both said port and said passage.

6. In a compressor, relatively rotatable parts, one of which is a cylinder structure, said structure having a cylinder bore and a port communicating with said bore near one end of the same, a piston disposed within said cylinder for effecting flow of fluid into and out of said cylinder thru said port, means for effecting reciprocation of said piston upon relative rotation between said parts, said piston having a passage communicating between opposite ends of the same, and centrifugally operated valve means for effecting opening of said port and closing of said passage only after the speed of said relative rotation has increased beyond a predetermined value.

7. In a compressor, relatively rotatable parts, one of which is a cylinder structure, said structure having a cylinder bore and a port communicating with said bore near one end of the same, a piston disposed within said cylinder for effecting flow of fluid into and out of said cylinder thru said port, means for effecting reciprocation of said piston upon relative rotation between said parts, said piston having a passage communicating between opposite ends of the same, and a single spring pressed valve member for automatically controlling both said port and said passage.

8. In a compressor, a rotatable cylinder structure having a cylinder bore extending substantially radially with respect to the axis of rotation, a ring encompassing said structure and rotatable relative to the same, said ring having an axis of rotation eccentric to the axis of said structure, a piston disposed within said bore, a roller carried by said piston and bearing upon said ring, and a guide member extending from said roller having slidable engagement with said ring for maintaining the axis of rotation of said roller substantially parallel to the axis of rotation of the ring.

9. In a compressor, a rotatable cylinder structure having a cylinder bore extending substantially radially with respect to the axis of rotation, a ring encompassing said structure and rotatable relative to the same, said ring having an axis of rotation eccentric to the axis of said structure, a piston disposed within said bore, a roller carried by said piston, said roller having an arcuate periphery engaging one peripheral surface of said ring, and a guide member extending from said roller having slidable engagement with said ring for maintaining the axis of rotation of said roller substantially parallel to the axis of rotation of said ring.

10. In a compressor, a rotatable cylinder structure having a cylinder bore extending substantially radially with respect to the axis of rotation of the structure, a ring encompassing said structure and rotatable relative to the same, said ring having an axis of rotation eccentric to the axis of rotation of said structure, a piston disposed within said structure, a roller bearing upon a peripheral surface of said ring, a guide member extending from said roller having slidable engagement with said ring for maintaining the axis of rotation of the roller substantially parallel to the axis of rotation of said ring, and means connecting said roller and said piston, said last means allowing rotation of the piston with respect to said structure.

11. In a device of the character described, a rotatable cylinder, a piston disposed within said cylinder, a plurality of lubricating ports extending thru the side wall of the cylinder, and an annular pocket surrounding the exterior of said cylinder and concentric with said cylinder adjacent the outer ends of said ports, said pocket being faced toward the axis of rotation.

12. In a compressor, two members relatively movable for compressing an elastic fluid, said members having a sealing surface formed between the same, ports formed in said members for discharge of compressed elastic fluid, said ports communicating with said sealing surface and adapted to recurrently come into registry, a passage formed in said sealing surface and serving to establish communication between said ports in advance of their registry, and means for minimizing re-expansion back thru said ports.

13. In a compressor, two members relatively movable for compressing an elastic fluid, said members having a sealing surface formed between the same, ports formed in said members for discharge of compressed elastic fluid, said ports communicating with said sealing surface and adapted to recurrently come into registry, a passage formed in said sealing surface and serving to establish communication between said ports in advance of their registry, and labyrinth pockets formed in said passage to minimize re-expansion back thru said ports.

14. In a compressor, relatively moving members, one of which is a valve member and the other of which effects compression of a fluid when moved in one direction relative to the valve member, said members having a sealing surface formed between the same, a plurality of discharge ports formed in one of said members and communicating at said sealing surface at spaced points, a discharge port formed in the other of said members and likewise communicating with said sealing surface, and a labyrinth groove interrupting said sealing surface and extending for a substantial distance from said last named port, said groove serving to establish communication successively between the ports in said one member and the port in the

other member as said members are moved relative to each other.

15. In a compressor, relatively moving members, one of which is a valve member and the other of which effects compression of a fluid when moved in one direction relative to the valve member, said members having a sealing surface formed between the same, a plurality of discharge ports formed in one of said members and communicating with said sealing surface at spaced points, a discharge port formed in the other of said members and likewise communicating with said sealing surface, a passage interrupting said sealing surface serving to establish successive communication between the ports in said one member and the port in the other member in advance of the position of registry of such ports, and means for preventing re-expansion of fluid from the port in said other member back into the ports of said one member..

16. In a compressor, members relatively rotatable for compressing an elastic medium, said members having a peripheral sealing surface between them, cooperating ports in said members adapted to recurrently register for inflow of fluid to be compressed, means for introducing oil between said members, and means for deflecting lubricant away from said ports.

17. In a compressor, a rotatable cylinder structure, said structure having a cylinder bore and a fluid port communicating with the same, a piston disposed within said cylinder bore, and means mounted on said piston and movable relative thereto for controlling the effective area of said port in accordance with the angular velocity of said cylinder structure.

18. In a compressor, a valve member having a peripheral surface, a fluid port having an opening at said surface, and a groove communicating with said opening, said groove having a serrated channel to present higher impedance to fluid flow in one direction than in the opposite direction.

In testimony whereof, I have hereunto set my hand.

ARTHUR J. KERCHER.