

**April 29, 1941.**

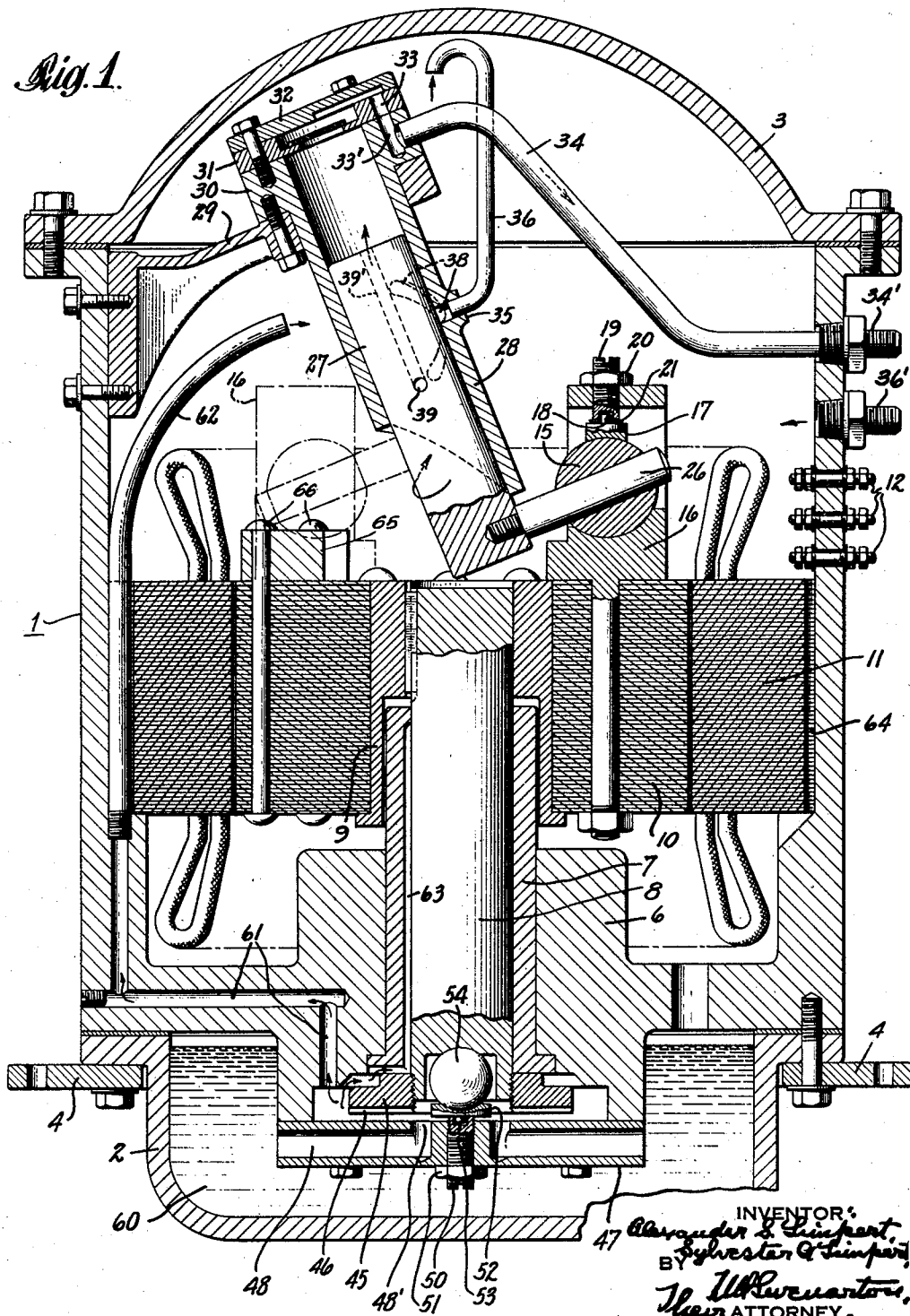
S. A. LIMPERT ET AL

**2,239,723**

## HERMETIC ROTARY-RECIPROCATING COMPRESSOR UNIT

Filed June 8, 1938

**3 Sheets-Sheet 1**



April 29, 1941.

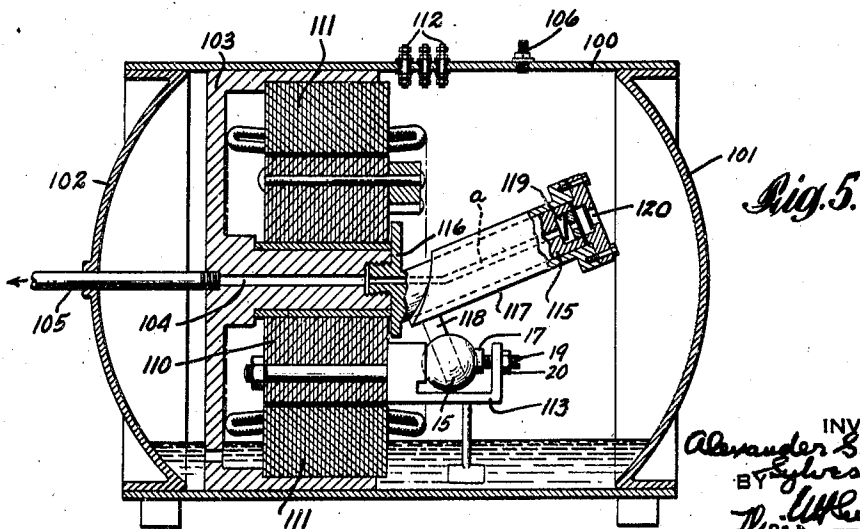
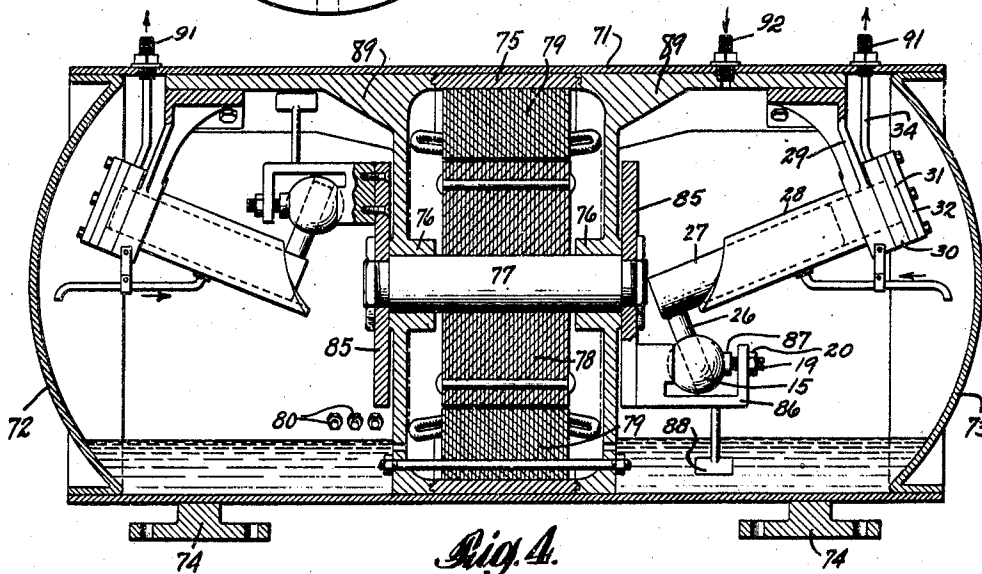
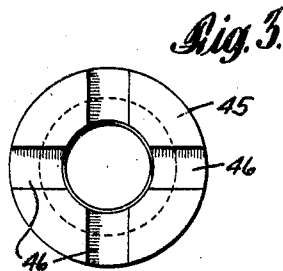
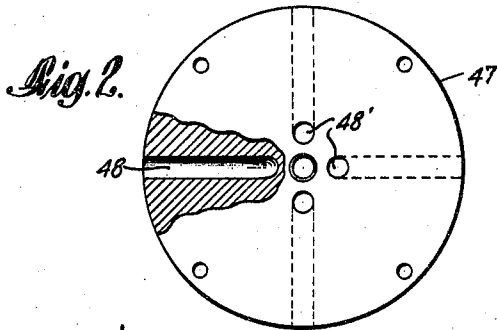
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HERMETIC ROTARY-RECIPROCATING COMPRESSOR UNIT

Filed June 8, 1938

3 Sheets-Sheet 2



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HERMETIC ROTARY-RECIPROCATING COMPRESSOR UNIT

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3 Sheets-Sheet 3

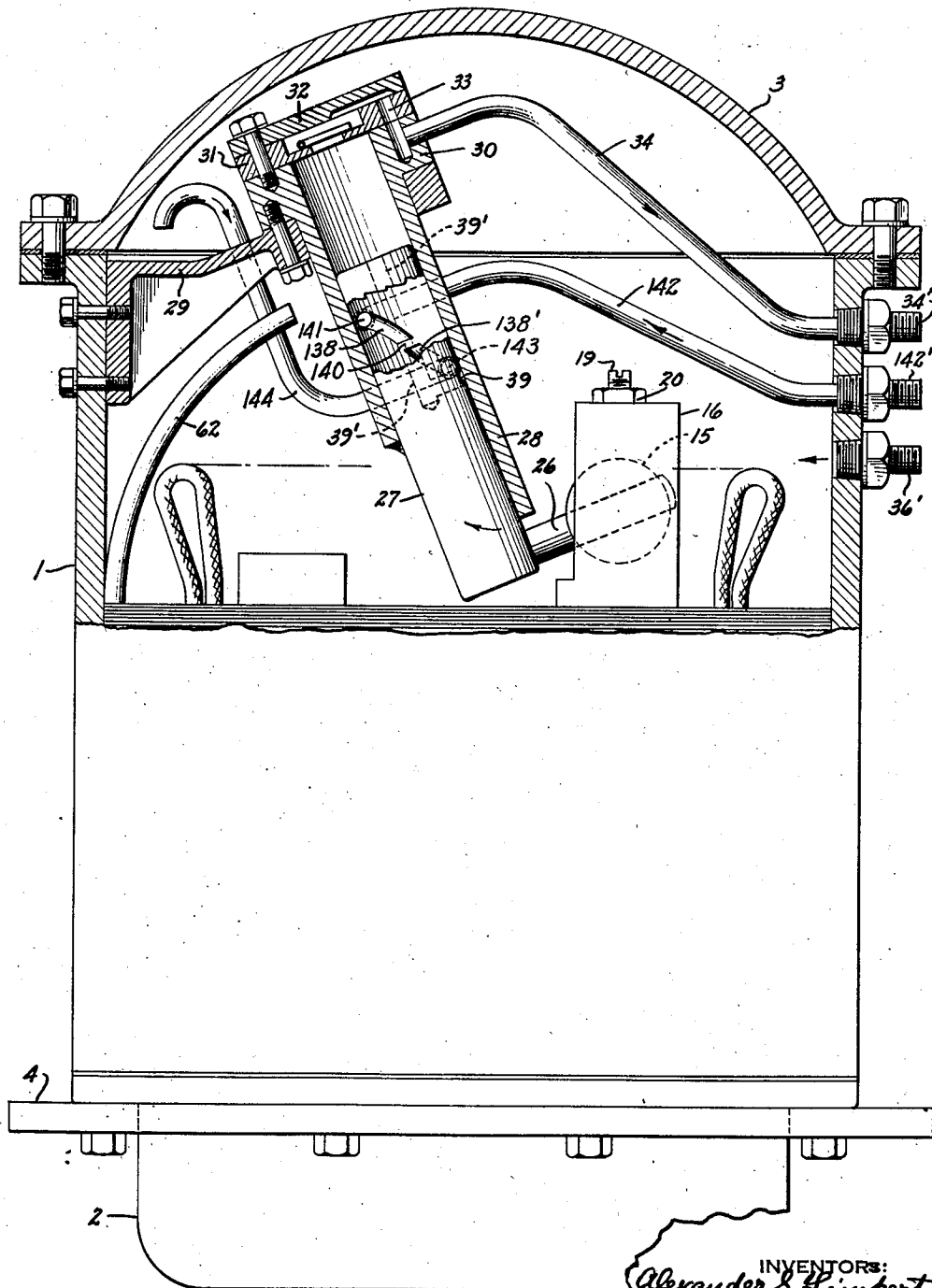


Fig. 6

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## UNITED STATES PATENT OFFICE

2,239,723

HERMETIC ROTARY-RECIPROCATING  
COMPRESSOR UNITSylvester A. Limpert and Alexander S. Limpert,  
Bay Shore, N. Y.

Application June 8, 1938, Serial No. 212,486

19 Claims. (Cl. 230—175)

This invention relates to mechanism for pumping gases and liquids and has for its particular objects the provision of a compact, cheap and unusually efficient mechanism of that type wherein the movable parts are hermetically sealed within a housing and operate on the planetary-reciprocating principle whereby it is possible to realize the essential advantages possessed by both the rotary and reciprocating types of compressors without certain of their disadvantages.

In the accompanying drawings in which we have illustrated certain preferred embodiments of our invention—

Figure 1 is a central, vertical section of a compressor unit embodying our invention and more especially designed for refrigeration purposes;

Fig. 2 is a top plan view, partly broken away of the bearing support-plate;

Fig. 3 is a bottom plan view of the locking nut which is secured to the bottom of the rotor shaft and which serves as an oil circulatory means;

Fig. 4 is a vertical, central, longitudinal section of a hermetic, twin compressor utilizing our planetary, reciprocating principle of operation;

Fig. 5 is a central, vertical section of a modification wherein the piston is stationary and the cylinder both rotates and reciprocates thereon;

Fig. 6 is a central vertical section of a compressor unit of the general type shown in Fig. 1 but constructed so as to simultaneously maintain a plurality of different pressures (absolute) in a closed circulatory system.

Referring to the drawings and the construction shown therein, the reference numeral 1 designates the body of the shell or housing of a compressor as especially adapted for refrigeration purposes, the same having a hollow bottom cap or base plate 2 and a cover plate or head 3 respectively bolted to the bottom and top of said housing in hermetically sealed relation therewith so as to form a hermetic enclosure for the movable parts of the compressor mechanism. Said compressor is mounted on a suitable supporting frame 4 to which it is securely bolted. The body 1 has an apertured central boss 5 formed thereon which serves to receive a flanged bushing 7, in which a shaft 8 is mounted. The reference numeral 9 designates a flanged fixed sleeve which is carried by the rotor 10 of a typical electric motor having stationary field coils 11, such as is used in the hermetic type of refrigeration compressors and said sleeve is in turn keyed to the shaft 8 so as to be relatively non-rotatable with respect thereto but to admit of removal or adjustment of the shaft with respect thereto. Bind-

ing posts 12 which project through the body 1 of the shell permit of the coils of the motor being connected to a suitable external source of electricity, said posts being in hermetically sealed relation with and insulated from said shell.

A ball and socket connection comprising a centrally apertured ball 15 and socket member 16 which is bolted to the rotor and whose top surface is of spherical curvature to conform to that of said ball serves, as hereinafter described, to flexibly connect the crank of the compressor with said rotor of the motor thereby admitting of the simultaneous reciprocation and rotation of said piston upon rotation of the rotor. Said ball is maintained in its socket by means of an adjustable cup member 17 that is provided with an upwardly projecting retaining pin 18 that is adapted to project in a bottom recess in an adjusting screw 19 which latter is threaded into the bracket-like top of the member 16 and adapted to be locked in any adjusted position by a lock nut 20. Interposed between said bottom of the screw 19 and said cup member 17 is a cupped disc spring 21 which latter is centrally apertured to receive the aforesaid boss 18.

A crank arm or pin 26, which is of cylindrical configuration and of a size to have a snug sliding fit within the cylindrical bore of the ball 15, is rigidly threaded into the lower end of a piston member 27 that is adapted to both longitudinally reciprocate and also rotate within a stationary cylinder member 28 carried on a bracket 29 and which latter is bolted to the body 1 of the shell. The cylinder has a flanged head 30 which serves as a seat or anchorage for the bolts by which a sealing washer 31 and a cap 32 are secured to said cylinder. The said washer 31 has an aperture 33 which is adapted to register with a port 33' in the flanged head 30 and the latter communicates with an exhaust conduit 34 which projects through the shell 1 and is provided with a nipple 34' which serves to connect the same with the high pressure side of a closed circulatory system, such for example as a refrigerant coil of an electric refrigerator. Said cylinder has a lateral apertured boss 35 whose bore is connected to an inlet conduit 36 which preferably extends to a point in proximity with the top of the head 3 whereby a minimum amount of oil is permitted to enter the circulatory system. The wall of the cylinder 28 has an arcuate groove 38 formed on its inner surface which intersects the bore of said boss 35, whereby said groove is in permanent communication with the intake conduit 36.

A fitting 36' which is threaded into a tapped aperture in the wall of the shell serves to supply refrigerant fluid to the interior of the shell from which it is drawn into the cylinder 28 through intake conduit 36 during the suction stroke of the compressor.

The shaft 8 which is supported on a ball bearing, hereinafter described, is retained in a predetermined adjusted position by a flanged washer 45 that is threaded onto the lower end of said shaft and seats against the lower face of the terminal flange on bushing 7. The lower face of the unit 45 is provided with radial grooves 46, preferably of semi-circular cross-section, whereby, as hereinafter described, said washer 45 also functions as an impeller to forcibly project oil through said grooves during rotation of the shaft 8. A circular plate 47, which is bolted to the central boss 6, is provided with a series of radial ducts 48 that are in communication through their inner terminal ports 48' with the space in which said washer 45 rotates. A screw 50 is threaded into a tapped central aperture in said plate 47 and is adapted to be locked in any desired adjusted position by a nut 51. A cup member 52, having a depending central pin 53, which projects into a recess formed in the top of said screw, serves as a support for a ball bearing 54 which is mounted in a recess formed in the shaft 8.

The curvature of the top surface of said cup member 52 and of the lower end of the shaft 8 which are in contact with the ball bearing 54, conform to that of the ball bearing engaged thereby.

Upon the rotation of the shaft 8, which is effected by closing the circuit through the motor, the nut 45 will function as an impeller and draw oil from the well 60 inwardly through ducts 48 and the ports 48' to the space below said nut 45, and thence said oil will be forcibly projected outwardly along the grooves 46 to ducts 61, 62 and 63 whereby all of the moving parts of the compressor will be effectively lubricated, the oil returning by gravity through the port 64 to the well 60.

Preferably a counter-weight 65 is secured by bolts 66 to the rotor to balance the same.

In the twin compressor illustrated in Fig. 4 wherein the same planetary-reciprocating principle of operation is utilized, twin compressors are respectively mounted in opposite ends of a tubular housing 71 which is hermetically sealed at each end by heads 72 and 73 respectively, the same being supported on feet 74. A spacing ring 75 is shrunk into the central portion of the shell 71 and the same has a tongue and groove connection with and serves to support opposing bearing-brackets 76, which are bolted together, in which the shaft 77 is rotatably mounted in hub members formed in these brackets. Oil ducts which are provided in brackets 76 admit oil to the space between the brackets. The rotor 78 of the motor is fixed to the shaft and rotates therewith and the stationary field coils 79 are rigidly snugly fitted into and supported by said ring 75. The binding posts 80 extend through the wall of the housing 71, the same being hermetically sealed therein and insulated therefrom in the well known manner. Opposing plates 85, which are locked to the opposite ends of shaft 77, serve as supports for the brackets 86 in which the ball element 15 of the universal or ball and socket joint, is mounted. The cup 87 corresponds to the cup element 17 shown in Fig. 1.

Dasher elements 88 serve to splash lubricating oil throughout the housing and over all the moving parts of the compressors during the operation of the twin compressors which preferably are mounted in tandem and arranged to operate in sequence, though if desired the same may be opposed so as to simultaneously compress and simultaneously exhaust the refrigerant fluid.

The members 76 have arcuate extensions 89 projecting outwardly therefrom which serve as supports for the cylinder-supporting brackets 29. Fittings 91 and 92 which are threaded into tapped apertures of the shell 71 serve to respectively connect the compressor with the high-pressure and low-pressure sides of a closed circulatory system of an electric refrigerator, for example, in the well known manner.

In the construction illustrated in Fig. 5, wherein the cylinder is adapted to rotate and reciprocate on a stationary piston, the reference numeral 100 designates a tubular casing which is hermetically sealed at each end by headers 101 and 102. A cylindrical motor support 103 having a central boss which serves to support the piston element, as hereinafter described, is shrunk into said shell. The boss has a central conduit 104 which is in communication with a conduit 105 that serves to discharge fluid under pressure delivered by the compressor to the high-pressure side of a closed circulatory system, as for example that of an electric refrigerator. A fitting 106 serves to admit fluid from the low-pressure side of such a system into the interior of the shell 100. Field coils 111 of an electric motor are rigidly mounted in the motor support 103 and binding posts 112 which are hermetically sealed to and insulated from the shell 100 serve to connect the motor coils to an external source of electricity in the well known manner.

The socket member 113 is similar to the socket member 16 shown in Fig. 1. The piston 115 is provided with a bottom flange 116 and is rigidly but eccentrically secured to the central boss of the motor support 103. A cylinder 117 is slidably and rotatably mounted on said piston and the crank arm 118 is rigidly connected to the cylinder, the said arm extending at right angles to the longitudinal axis of the cylinder. The piston has a central bore *a* which extends completely therethrough and registers with the duct 104 with which it is in permanent communication. Check valves of well known construction are respectively mounted in the recess 119 formed in the end of the piston and in the recess 120 that is formed in the cylinder head and which control the admission and discharge of fluid during the operation of the compressor. This valve arrangement is generally similar to that disclosed in our copending application No. 32,868, filed July 24, 1935, of which this application is a continuation in part.

In Fig. 6 wherein the compressor is adapted to maintain a plurality of different pressures (absolute) in a closed circulatory system, the compressor construction is essentially the same as that disclosed in Fig. 1, with the exception that the cylinder wall has two grooves 138 and 138' which are separated by a dam 140 whose top surface lies flush with and constitutes a continuation of the inner surface of the cylinder wall and the groove 138 intersects a port 141 in the cylinder wall which is in permanent communication with an intake conduit 142 and also the nipple 142' which latter is connected with a low temperature or low pressure (absolute) freezing unit of the refrigerator while the groove

138 intersects a port 143 in the cylinder wall which is in permanent communication with a second intake conduit 144 and nipple 36' which latter connect with the main or higher temperature and higher pressure (absolute) or evaporator unit of the refrigerator.

The nipple 34' serves to connect the common exhaust conduit 34 with the high pressure side of the circulatory system in which both said freezing unit and the main cooling unit of the refrigeration system are interposed.

In Fig. 6, for convenience of illustration, the grooves 138 and 138', which extend along the same spiral as the long groove 38 in the compressor shown in Fig. 1, are shown 90° removed from the position on the wall of the cylinder of the groove 38 shown in Fig. 1, but the relation between the port 39 in the piston with respect to the lower end of the groove 138' is essentially the same as the relation of port 39 shown in Fig. 1 to the lower end of the groove 38.

The operation of the compressor illustrated in Fig. 1 is as follows:

Assuming the fittings or nipples 34' and 36' are respectively connected to the high-pressure side and low-pressure side of a closed circulatory refrigeration system and the circuit through the motor has been closed by the controlling switch, then the rotor of the motor will rotate anti-clockwise (viewed from above) and the piston 27 will rotate spirally upward in the direction indicated by the arrow within the cylinder. During the upward stroke of the piston the charge of refrigerant in the cylinder above the piston, which has been sucked in during the prior exhaust or down stroke of the piston, will be compressed since the port 39 is sealed by the cylinder wall throughout the upward stroke. The compressed gas will be forced through the valve opening in the top of the cylinder and pass through duct 33, conduit 34 and fitting 34' to the high-pressure side of the closed circulatory system of the refrigerator. On the down stroke of the piston the port 39 will be immediately moved into registry with the manifold slot 38 in the cylinder wall and a fresh charge of refrigerant will be continually drawn in from the low-pressure side of the closed circulatory system through the intake conduit 36 and nipple 36' throughout substantially the entire down stroke of the piston, namely throughout the period the port 39 is in registry with the port 38.

The cycle will then be repeated until such time as the control switch opens the circuit of the motor. During the operation of the motor a forced circulation of lubricating oil over the moving parts and also over a considerable portion of the inner walls of housing will occur and, due to the fact that the housing is preferably air-cooled externally by a fan, the oil will not become deleteriously overheated and consequently the moving parts which are bathed in such oil will be maintained at all times within safe temperature limits and optimum working conditions can be realized. The compressor will at all times be virtually noiseless and vibrationless during such operation due to the universal joint connection between the rotor of the motor and the piston, also due to the effective lubrication of the moving parts and especially because the piston, during its cork-screw or spiral movements in the cylinder, is continually in motion and there is no inertia of rest to be overcome at each reversal of the stroke as is inevitably the case when

a conventional reciprocating compressor is employed.

The operation of the twin compressor illustrated in Fig. 4 is essentially the same as that of the single compressor just described but, as is apparent from the foregoing description, the compressors will operate in sequence, one of them effecting the compression of a refrigerant charge previously drawn from the low-pressure side of a closed circulatory system and discharging the compressed charge into the high side of said system while the other is taking in a fresh charge from such low-pressure side and vice versa on the next successive strokes of the pistons of each compressor. If desired, the compressors may be arranged so as to each compress the refrigerant charge simultaneously and discharge the same into the high-pressure side of the refrigerant system and then simultaneously draw in fresh charges of refrigerant, on the next successive stroke of each piston, from the low-pressure side of the system.

The operation of the single cylinder compressor shown in Fig. 5 is likewise generally similar to that shown in Fig. 1 except that the rotor of the motor being connected through the universal joint with the cylinder, instead of the piston, such cylinder will move spirally to and fro on the piston and, during the spiral up-stroke of the cylinder, the valve controlling the inlet 120 will be seated and the charge of refrigerant within the cylinder compressed and forced through the central bore of the piston into the conduit 105 and thence to the high-pressure side of the closed circulatory system of the refrigerator. During the spiral down-stroke of the cylinder the valve controlling the terminal port of the bore of said cylinder, which valve is mounted in the recess 119, will close said port and the refrigerant will be drawn from the low-pressure side of the said closed circulatory system, through nipple 106, thence through intake port of the cylinder and into the cylinder wherein it will be compressed on the next stroke of the cylinder and so forth.

The operation of the binary single compressor shown in Fig. 6 is also generally similar to that of the compressor shown in Fig. 1, except that during the portion of the spiral down-stroke of the piston that the manifold slot 138 is in communication with port 141 and intake conduit 142, refrigerant will be drawn in from the low side of the freezing unit or low temperature evaporator of the refrigerator and as the port 141 passes into communication with the lower slot 138', communication will be cut off between said slot 138 and said freezing unit and communication will be established between the main cooling unit or high-pressure unit of the refrigerator and said slot 138' with the consequence that an additional charge of gaseous refrigerant will be drawn into the cylinder from the main evaporator and the entire charge in the cylinder will be of the higher density that corresponds to the high-back-pressure existing in the main evaporator, whereby the amount of gas moved by the compressor per unit of time will be greatly increased as compared with that moved by a compressor of the conventional type when hooked up with a sharp freezing unit wherein a relatively low temperature is maintained and which serves the dual function of producing ice cubes when desired and of cooling the food chamber.

Such binary compressor principle, whether employed in a single or multiple unit compressor, is

particularly desirable for refrigeration purposes since it admits of an extremely low temperature, say zero Fahrenheit or less, being maintained in the cube freezing unit located in a specially insulated compartment isolated from the food chamber of the refrigerator and of a much higher temperature, say 33° F. in the main cooling unit intended for cooling the food chamber of the refrigerator and which latter can thereby be maintained with a minimum expenditure of energy at an optimum temperature of say 45° F. Furthermore, by maintaining the main cooling unit at a minimum temperature of 33° F., the collection of frost on the walls of the cooling unit will be prevented and excessive lowering of the humidity of the refrigerator will likewise be prevented or minimized.

Another important advantage of our so-called planetary-reciprocating principle described herein is that the cycle is reversible rendering it possible simply by changing the position of the two ports on the cylinder and the employment of the ported valve principle disclosed in Fig. 24 of the drawings of our aforesaid co-pending application in lieu of the check valve in the cylinder head as employed in the compressor shown in Fig. 6, to utilize an external source of fluid pressure and convert the pressure into an engine which in turn drives the rotor and serves to convert it into a generator which is especially adapted for the generation of electricity on a small scale such as is desired on farms and in households in rural communities as well as for other purposes.

In the twin compressor construction illustrated in Fig. 4, an additional fitting corresponding to the fitting 92 which is interposed between the two outlet fittings 91, may be mounted in the top of the shell for the purpose of admitting low pressure fluid directly into the opposing crank case from that into which said fitting 92 admits fluid, but this is not essential since the two crank cases of this twin compressor construction are not hermetically sealed from each other, there being always sufficient leakage around the bearings to admit of the pressures within these two crank cases being always automatically equalized, making due allowance for the difference due to the fact that the strokes of the two compressors alternate with respect to each other and therefore one would be exhausting while the other would be compressing.

While for refrigeration purposes it is particularly desirable that the compressor and the motor be hermetically sealed within the housing, our rotary reciprocating type of compressor wherein one of the elements is connected with the rotor of the motor through a universal joint connection, is adaptable for purposes wherein a hermetically sealed housing is not required, as for example for dental pumps, water pumps and the like.

The expression "plane of rotation of the rotor" as employed in certain of the claims has reference to a plane which is normal to the axis about which the rotor revolves, or in other words, which is normal to the axis of rotation of the rotor.

In the event it is desired to utilize the twin compressor illustrated in Fig. 4 as a binary compressor, it is obvious that the inlet conduit leading to one of the cylinders can be carried through the wall of the shell the same as the conduit 142 shown in Fig. 6 and in such an event, during the operation of the compressor, fluid can be admitted through such conduit as so extended through

the shell from one evaporator of a closed circulatory system, such as that of a refrigerator, for example, while fluid at a different pressure is being admitted through the intake fitting 92 into the chamber of the housing which surrounds the other compressor unit. In such event, as is apparent from the description of the operation of the compressor shown in Fig. 6, one of such twin compressors will operate solely on high pressure fluid, say that obtained from an evaporator which may be employed to maintain the food chamber of the refrigerator at an optimum temperature and the other compressor will operate solely on low pressure fluid, say that obtained from the cube freezing unit of the refrigerator, thus realizing the advantages above set forth which are obtained when employing the binary refrigerator of the type disclosed in Fig. 6.

Various changes from the construction herein described may be made without departing from the spirit of our invention as embraced within the scope of the appended claims.

Having thus described our invention, what we claim is:

1. In a compressor unit, the combination comprising hermetically sealed housing having a fluid chamber therein, co-operating piston and cylinder compressor elements mounted in said housing, means for affording periodic communication between said chamber and said cylinder during the operation of the compressor, an electric motor, including a rotor member, mounted in said housing, means, including a reciprocable slide member for loosely connecting one of said compressor elements to said rotor whereby upon rotation of the latter said compressor element so connected thereto is caused to simultaneously rotate and reciprocate with respect to said other compressor element.

2. In a compressor, the combination comprising an electric motor, including a rotor, a shaft fixed to the rotor, a compressor including co-operating piston and cylinder elements, the axis of each of which projects at an angle to the plane of rotation of said rotor, means including a reciprocable slide member, whereby rotation of said rotor effects the simultaneous rotation and reciprocation of one of said elements with respect to the other, valve controlled means for admitting fluid to said cylinder and delivering compressed fluid from said cylinder during the respective exhaust and compression strokes of the compressor, a stationary housing hermetically sealing said motor and said compressor elements and means for connecting said motor with an external source of electricity.

3. In a compressor unit, the combination comprising a hermetically sealed housing, compressor elements including a piston and cylinder mounted thereon, an electric motor, including a rotor, also mounted in said housing, means including a crank arm and a universal joint for connecting one of said compressor elements to said rotor and for effecting simultaneous rotation and reciprocation of said compressor elements relative to each other.

4. In a twin compressor unit, the combination comprising an hermetically sealed housing, an electric motor, including a rotor, mounted therein, a plurality of compressors, each having a cylinder element, and a co-operating piston element, mounted on opposite sides of said rotor, means, including a universal joint connection and a separate crank, for connecting one of the

said elements of each compressor to said rotor in such a manner that one of the elements in each of the compressors will both rotate and reciprocate with respect to the other element in the same compressor during rotation of said rotor, and means for supplying fluid from an external source to each of said cylinders and for discharging fluid under pressure externally of said housing.

5. In an hermetically sealed compressor, the combination comprising a sealed housing having inlet and discharge connections, an electric motor, including a rotor member, mounted in said housing, rotatably and reciprocally associated piston and cylinder elements, articulate means including a reciprocable slide member for operatively connecting said rotor with one of said piston and cylinder elements, whereby upon rotation of the rotor simultaneous reciprocation and rotation of the piston and cylinder elements relative to each other is effected, an interrupted superficial spiral groove on the inner wall of the cylinder and a port extending through both the side and head of piston element, a separate intake duct connected to each portion of said groove adapted to deliver fluid thereto from an external closed circulatory system and a common outlet adapted to deliver compressed fluid from said cylinder to said circulatory system.

6. In a binary compressor, the sub-combination comprising a stationary cylinder element and a piston element slidably mounted therein, a rotor element, means for effecting spiral rotation of said piston within said cylinder upon rotation of said rotor element, said cylinder having an interrupted spiral groove on its inner wall and said piston having a duct extending through the head thereof and continuing downwardly thereinto and thence through its lateral wall at a point intermediate the ends thereof, the lateral terminal port of said duct being so disposed as to successively register with different isolated portions of said groove during the exhaust stroke of the piston element.

7. In a hermetic binary compressor, the sub-combination comprising a hermetically sealed housing having a plurality of fluid inlets and a fluid outlet for connecting said housing to two different sources of fluid supply, an electric motor, including a rotor, mounted wholly within said housing, co-operating piston and cylinder elements mounted in said housing, means for effecting spiral rotation of said piston within said cylinder upon rotation and simultaneous reciprocation of said rotor, and means including an interrupted spiral groove formed on said cylinder wall and a duct having a terminal port opening through the piston head and the lateral wall of said piston for developing different pressures in said sources of fluid supply upon rotation of said rotor.

8. In a compressor, the sub-combination comprising piston and cylinder elements, one of which is mounted so as to remain stationary during the operation of the compressor and the other of which is movably mounted, a rotor member, means including a connecting rod and a universal joint connecting said movable element and said rotor and for effecting the simultaneous rotation and reciprocation of said movable element, and a housing enveloping all of the aforesaid members and hermetically sealing the same against the atmosphere.

9. In a compressor, the sub-combination comprising a motor, including a rotor, piston and cyl-

inder elements slidably associated with each other and the axis of each of which projects at an oblique angle to the axis of the rotor and articulate means including a reciprocable slide member connecting one of said elements to said rotor and a housing enveloping all of the aforesaid elements and hermetically sealing the same against the atmosphere.

10. In a compressor, the sub-combination comprising a motor, including a rotor, piston and cylinder elements slidably reciprocally and rotatably associated with each other, the axis of each of which projects at an angle to the plane of rotation of the rotor and means including a reciprocable slide member operatively connecting one of said elements to said rotor and a housing, having an inlet for fluid and an outlet for fluid, enveloping all of the aforesaid members for hermetically sealing the aforesaid elements and rotor against the atmosphere when communication between the atmosphere and such fluid inlet and fluid outlet is cut off.

11. In a hermetic binary compressor, the sub-combination comprising a hermetically sealed housing having a plurality of fluid inlets and a fluid outlet, an electric motor, including a rotor, mounted wholly within said housing, cooperating piston and cylinder elements mounted in said housing, means for effecting spiral rotation of one of said elements relative to the other upon rotation of said rotor and means, including a plurality of separated spiral surface grooves formed on at least one of said elements and co-operating ports formed in the walls of the respective elements, for periodically connecting said cylinder element to a different one of said two fluid inlets.

12. In a compressor, the sub-combination comprising a motor, including a rotor, piston and cylinder elements slidably associated with each other so as to be capable of relative to and fro movement, the axis of each of which elements projects at an angle to the plane of rotation of the rotor, a universal joint connection operatively connecting one of said elements to the rotor whereby such element is caused to rotate upon rotation of the rotor, a housing enveloping all of the aforesaid members and hermetically sealing the same against the atmosphere and inlet and outlet conduits for connecting the cylinder element to a closed fluid circulatory system.

13. A mechanism comprising a rotor mounted for rotation about a predetermined axis, concentrically disposed piston and cylinder elements extending at an angle to the plane of rotation of the rotor, said elements being both relatively reciprocable and relatively rotatable with respect to each other, means including a member slidable at an angle with respect to the axis of rotation of the rotor for operatively connecting one of said elements to said rotor whereby to constrain such element to rotate and reciprocate with respect to the other element upon the rotation of said rotor, said piston constituting valve means operable during the relative rotation of said piston element with respect to the cylinder element, and said cylinder element having a plurality of ports individually controlled by the piston element to periodically communicate with the cylinder element at different cylinder pressures.

14. In a binary compressor, the sub-combination comprising a rotor, cooperating piston and cylinder elements slidably associated with each other so as to be capable of relative to and fro movement with respect to each other, the axis

of each of which elements projects at an angle to the plane of rotation of the rotor, means for operatively connecting one of said elements to said rotor whereby spiral rotation of such element is effected upon the rotation of said rotor, a plurality of inlet ducts extending through the cylinder wall for admitting fluid under different pressures and at different times into the cylinder during the operation of said compressor and valvular means including a plurality of separated spiral grooves and cooperating ports formed on said associated piston and cylinder elements for introducing fluid at different pressures into the cylinder during different portions of the stroke thereof.

15. In a device of the character described, the combination with a rotor mounted for rotation on a predetermined axis, of piston and cylinder elements concentrically associated and both disposed at an angle to a plane that is normal to the axis about which such rotor revolves and which elements are provided with mountings upon which said elements are relatively reciprocable and relatively rotatable, means for operatively connecting one of said elements to said rotor, whereby to constrain such element to rotate and reciprocate respecting the other of said elements upon the rotation of said rotor, said piston including valve means operable upon the rotation of said piston element respecting said cylinder element, and said cylinder element having a plurality of ports individually controlled by the valve means of the piston element to periodically communicate with the cylinder element at different cylinder pressures.

16. In a binary compressor, the combination comprising a hermetically sealed housing having a plurality of fluid inlet ducts and a fluid outlet duct, cooperating concentrically associated piston and cylinder elements positioned in said housing the same being adapted to both reciprocate and to rotate relative to each other during the operation of the compressor, means, including a rotor member for effecting such reciprocation and rotation of such elements relative to each other and valvular means for controlling said inlet conduits and for preventing the simultaneous admission of fluid to both of said inlet ducts and for periodically and successively admitting fluid into the cylinder from the respective inlet ducts to afford communication with the cylinder at different cylinder pressures.

17. In a twin compressor, the combination comprising an electric motor including a rotor, a plurality of compressor units mounted respectively on opposite sides of said rotor, each com-

pressor unit having cooperating cylinder and piston elements, one of which is mounted independently of said rotor, and which compressor elements are so associated with each other as to be capable of relative reciprocation and rotation, the axis of each such element projecting at an angle to a plane that is normal to the axis of rotation of said rotor and means, including a reciprocable slide member for operatively connecting one of the piston or cylinder elements of each compressor unit to said rotor.

18. In a binary compressor, the subcombination comprising a rotor member, a compressor including reciprocally and rotatably associated cylinder and piston elements, articulate means for operatively connecting said rotor member to one of said compressor elements, including a reciprocable slide member, whereby upon rotation of the latter simultaneous reciprocation and rotation of the piston and cylinder elements relative to each other is effected and means including separated spiral grooves formed on a surface of one of said compressor elements which has frictional engagement with the surface of the other element during rotation of the rotor and also including cooperating ports extending through the walls of the respective piston and cylinder elements for periodically and successively admitting fluid through a different one of such grooves into the cylinder at different cylinder pressures during the rotation of the rotor.

19. In an hermetically sealed compressor, the combination comprising a sealed housing having two inlet ducts and a discharge duct for permitting the passage of fluid to and from said housing, an electric motor including a rotor member mounted in said housing, slidably associated piston and cylinder elements mounted in said housing, one of which is operatively connected to said rotor and adapted to rotate synchronously therewith, two superficial separated spiral grooves formed on a wall of one of the piston and cylinder elements which frictionally engages a wall of the other during the operation of the compressor, two cooperating ports extending through the cylinder wall and respectively communicating with said inlet ducts and at least one port extending through both the side and head of the piston element, said grooves and ports cooperating during the operation of the compressor to limit the admission of fluid into the cylinder so that at different cylinder pressures fluid is admitted through the two inlet ducts successively to such cylinder.

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