June 25, 1929. F. L. COOK 1,718,530

REFRIGERATING APPARATUS

Filed July 16, 1926 6 Sheets-Sheet 1

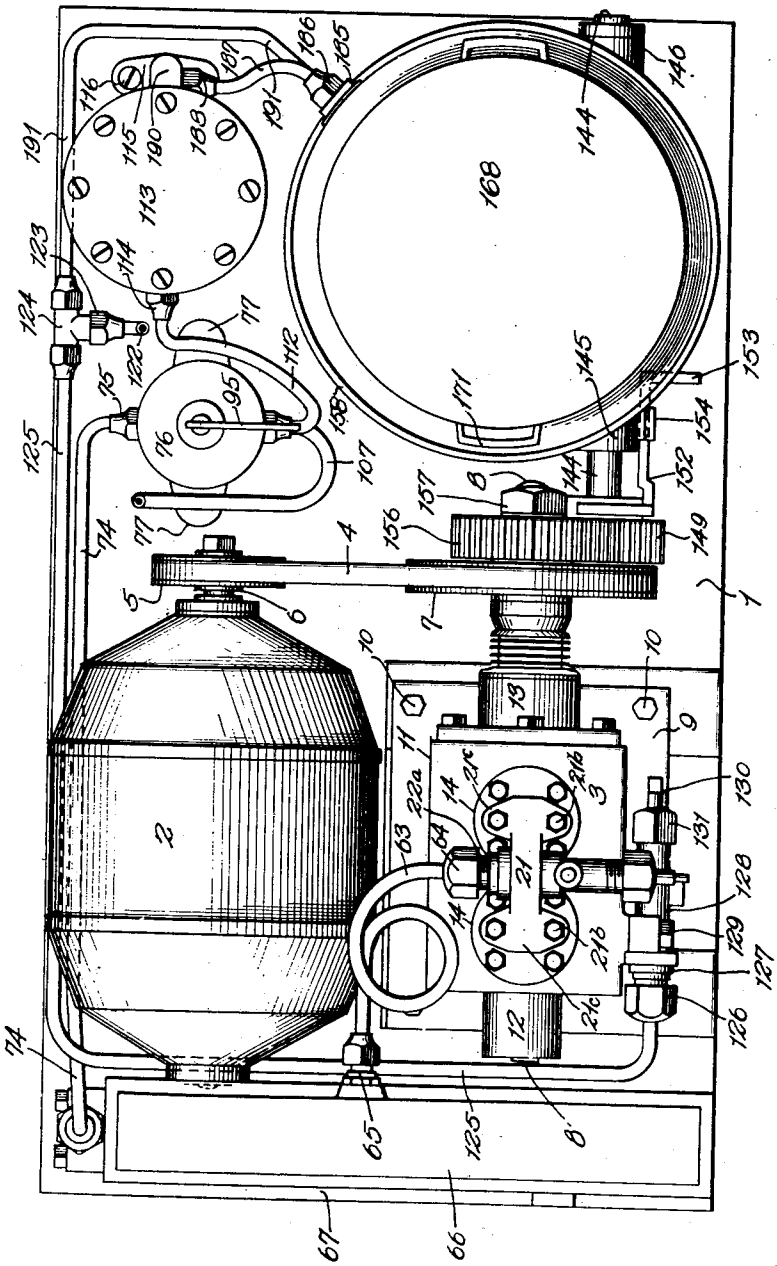


Fig. 1.

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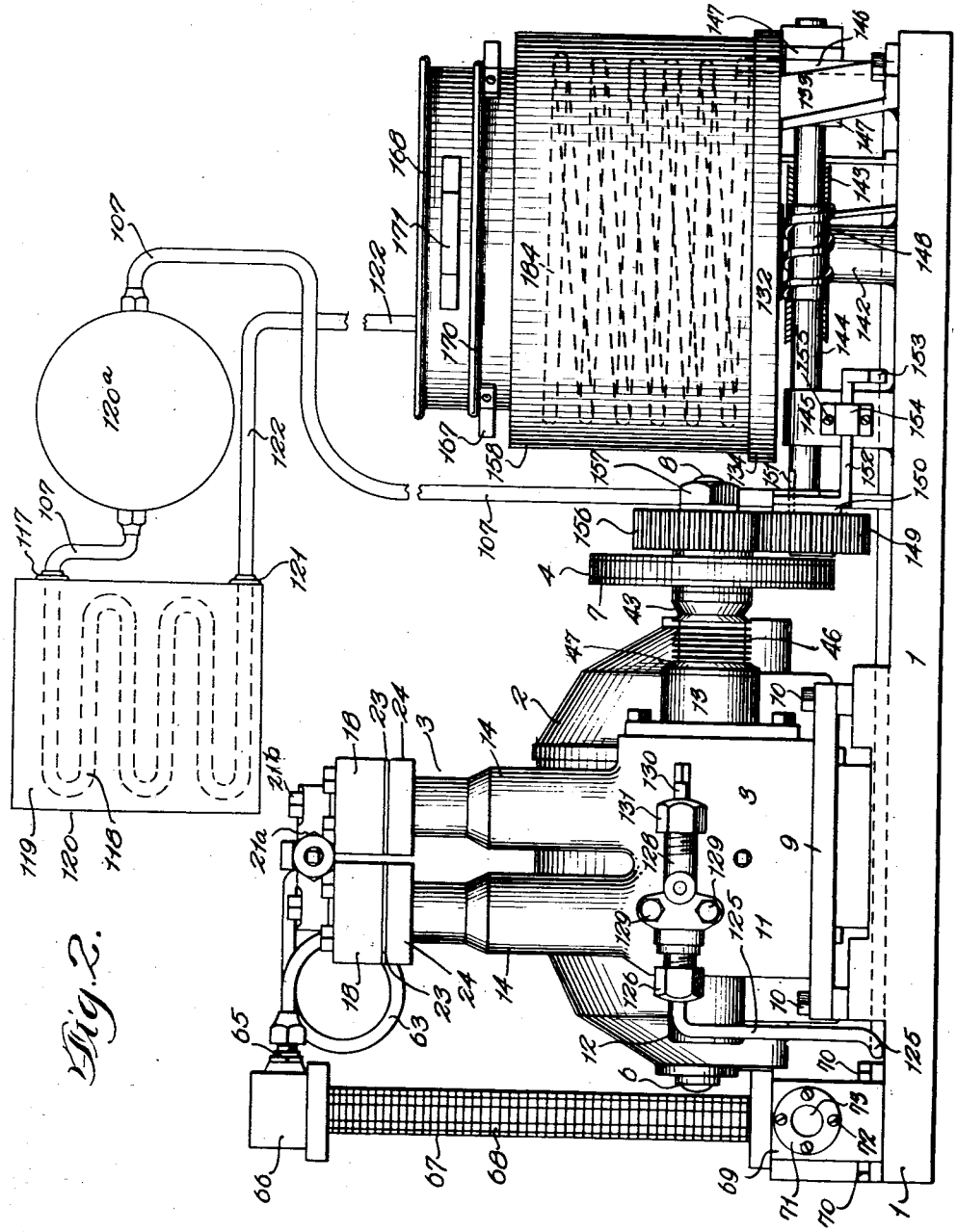


Fig. 2.

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Fig. 3.

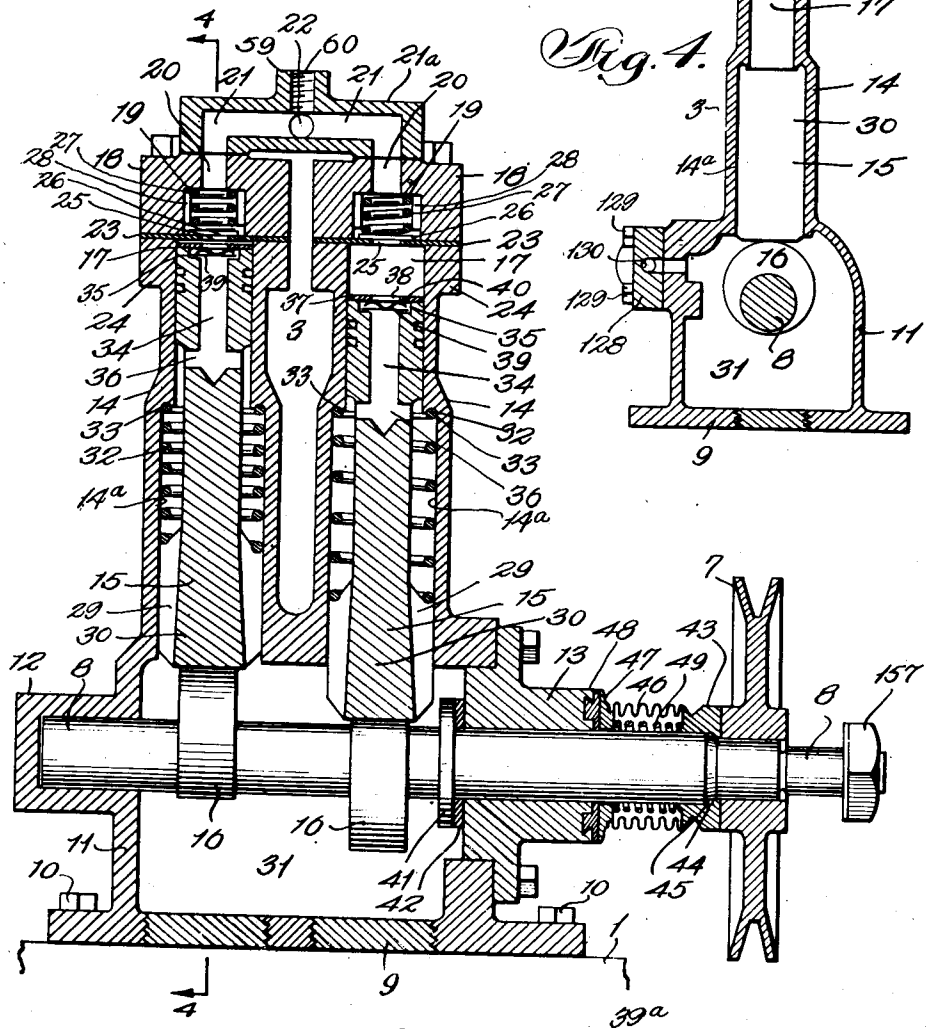


Fig. 4.

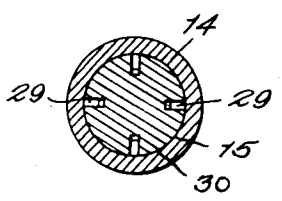


Fig. 5.

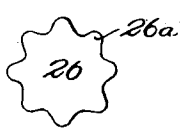


Fig. 12.



Fig. 13.

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REFRIGERATING APPARATUS

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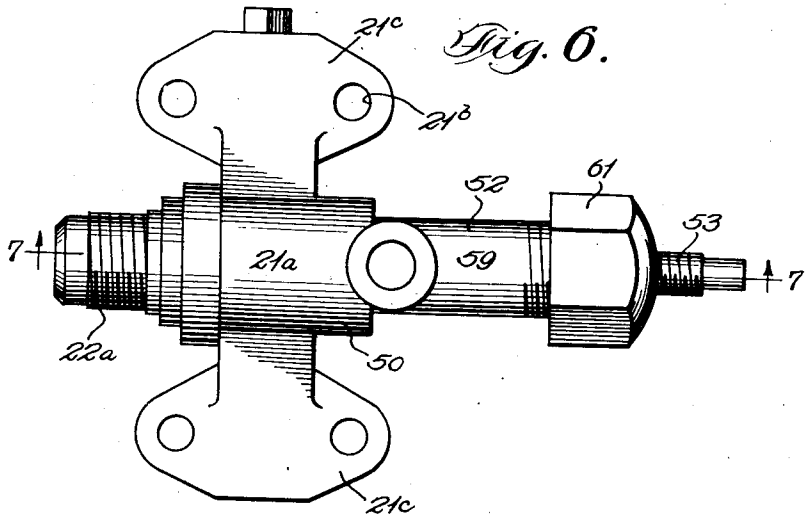


Fig. 6.

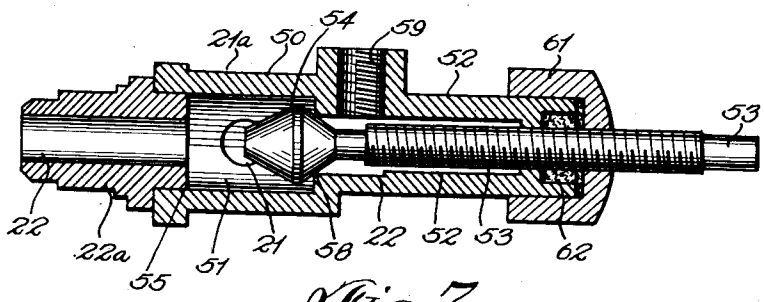


Fig. 7.

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Fig. 8.

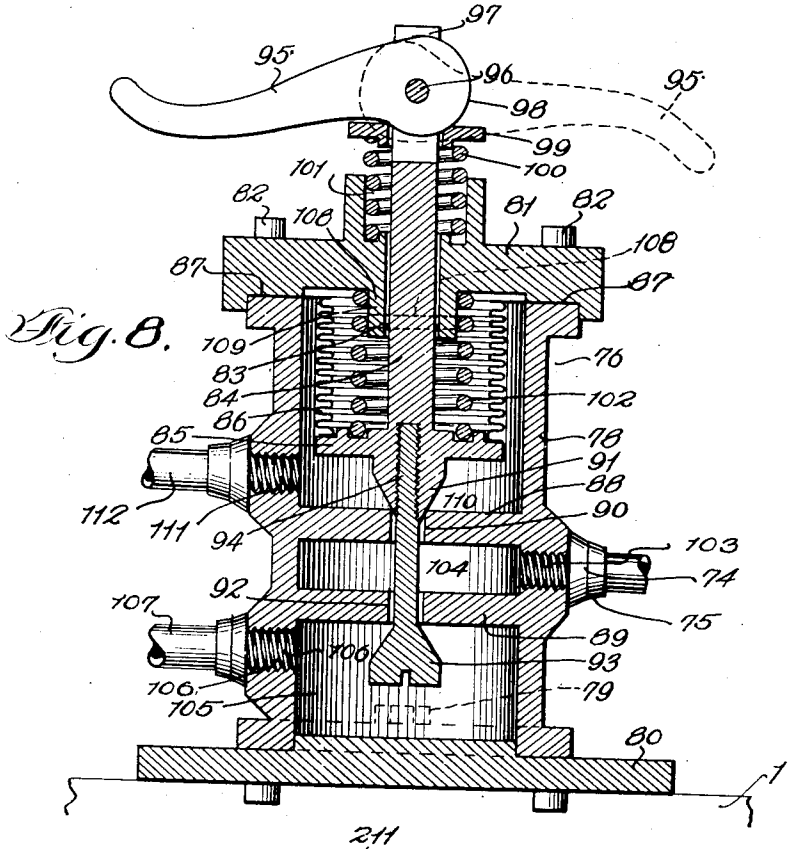
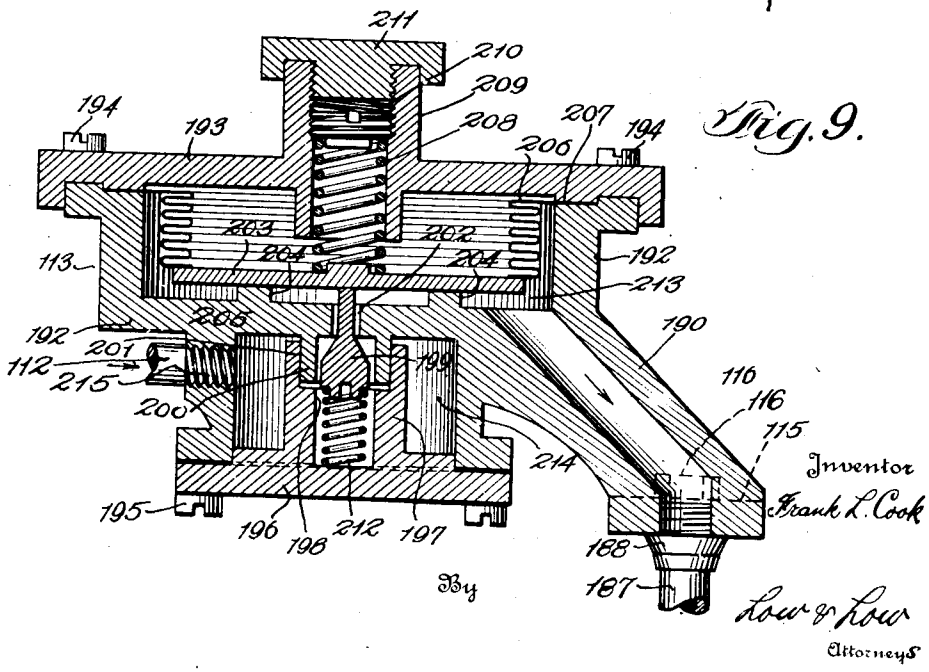


Fig. 9.



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Fig. 10.

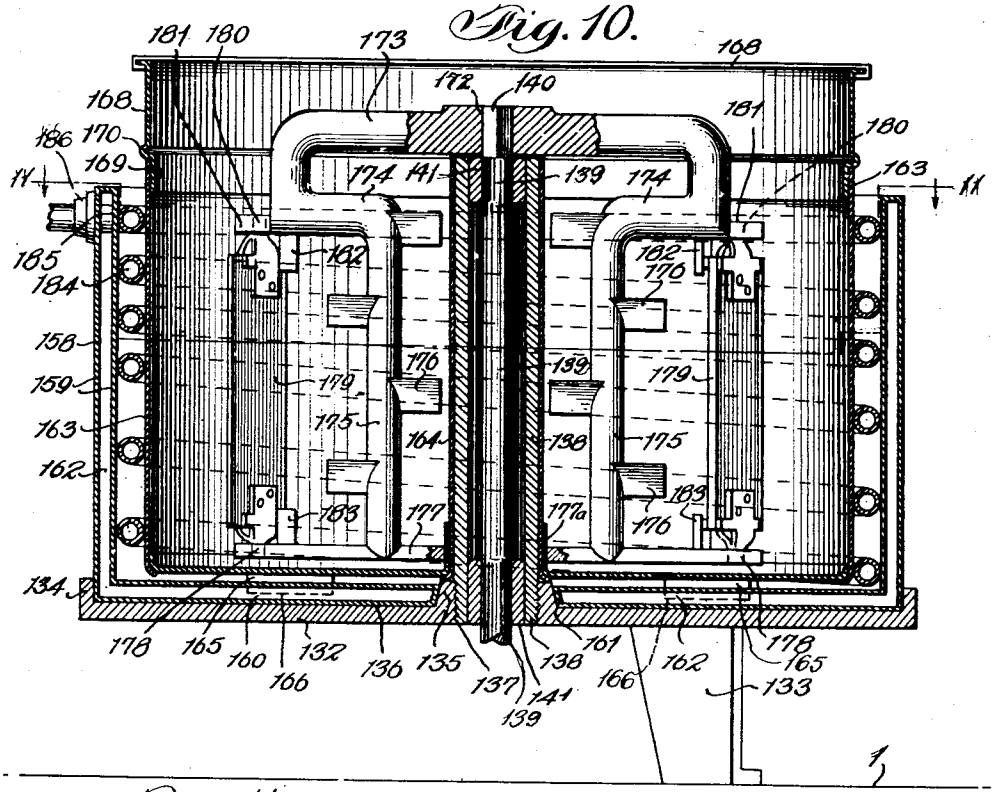
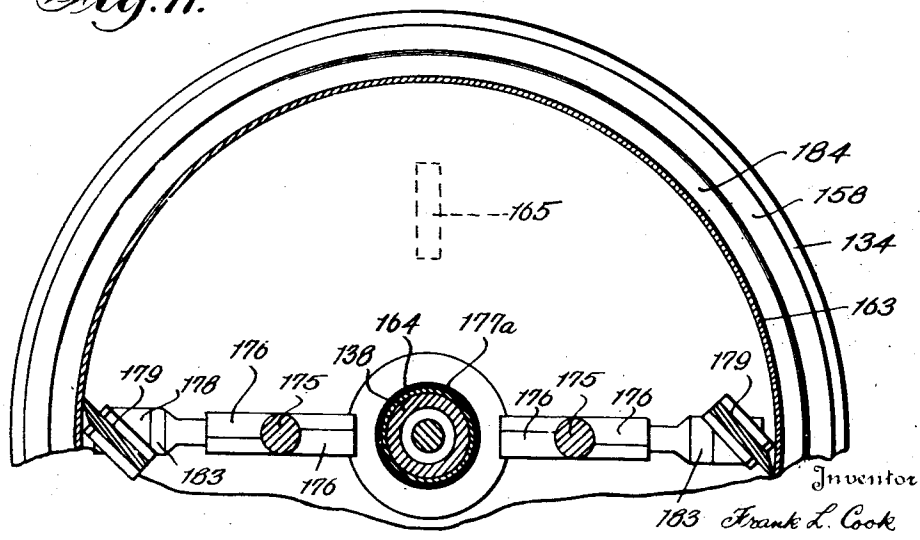


Fig. 11.



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UNITED STATES PATENT OFFICE.

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REFRIGERATING APPARATUS.

Application filed July 16, 1926. Serial No. 122,935.

The invention relates to refrigerating apparatus and relates more particularly to household refrigerating systems where a liquid or gaseous refrigerant of low boiling temperature is employed and circulated under pressure through suitable coils in a refrigerator chamber, the expansion and evaporation of the liquid in the coils when released from the high pressure zone, serving to take up or absorb heat to thereby chill the refrigerator chamber and freeze ice cubes and the like. The liquids or gases commonly used as refrigerants are ammonia, carbon dioxide, ethyl chloride, freezol, methyl chloride, propane and sulphur dioxide.

In refrigerating systems of the character described the household refrigerator is provided with a suitable brine tank having a boiling coil therein through which coil the refrigerant is circulated through an expansion valve by means of a compressor driven by a suitable motor. The spent refrigerant in the form of gas saturated with heat is conducted back to the compressor where it is compressed and thence conducted to a condenser where the compressed refrigerant is cooled and transposed from gaseous to liquid form. From a suitable receptacle connecting with the condenser the cooled and liquid refrigerant is again conducted under pressure through the boiling coils of the refrigerator brine tank. The process is continuous and the same refrigerant may be utilized over and over in the manner described for chilling and freezing purposes for an unlimited period of time.

There are now on the market and in general use a considerable number of various refrigerating systems of the general character outlined above, certain of which have proved satisfactory in performing the objects stated. While satisfactory to the extent that the refrigerating chambers are chilled for the preservation of food products, and ice cubes are formed, these systems perform no other useful service.

A principal object of the present invention is to provide an improved self-contained refrigerating unit which is designed to be conveniently utilized in connection with the boiling coil of the usual household refrigerator, and provided with means for circulating a liquid refrigerant through the said boiling coil to cool the food chambers and freeze ice cubes in the manner described.

A further object is to provide a refrigerating unit having included as an element thereof novel and efficient means for freezing any liquid, such as ice cream, custard, sherbert, ices and the like, to any desired degree of hardness within a reasonably short time, and utilizing for this purpose the same liquid refrigerant which is also utilized for cooling the household refrigerator.

A further object of the invention is to provide as an element of the self-contained unit, means for establishing a relatively lower pressure zone in the freezer unit than that which obtains in the household refrigerator, thereby rendering it possible to economically freeze liquid foods when desired and which foods cannot be frozen by the household brine tank due to the construction and nature of the usual refrigerator of this type.

A further object of the invention is to provide as an element of the self-contained refrigerating unit, means for controlling as desired the circulating system of the refrigerant, said means being operative to conduct said refrigerant either through the boiling coil of the household refrigerator or through the freezing coil of the freezing unit, according to whether or not it is desired to use the liquid freezing unit of the apparatus.

A further object of the invention is to provide an improved compressor element constituting an independent element of the self-contained unit and which compressor is of novel and improved construction to more efficiently and economically carry out its purpose in the refrigerating system, and in which the usual connecting rods and wrist pins have been eliminated.

A further object of the invention is to provide as an element of the unitary construction, agitating means which cooperate with the liquid refrigerant in freezing the liquid commodity in the freezer unit, together with driving means for said agitating mechanism and means for establishing and discontinuing a driving engagement between the compressor driving means and

the driving means for said agitator mechanism.

A further object of the invention is to provide a new and improved arrangement and communication between the compressor and refrigerant receptacle, together with means for readily determining the amount of liquid refrigerant present in the receptacle.

A further object of the invention is to provide novel and improved valve constructions which are manually and automatically operated to maintain the high and low pressure zones of the refrigerant system at the proper presures to facilitate the continuous and desired circulation of the refrigerant through the apparatus.

Another object of the invention is to provide a common and single source of power for driving the compressor of the refrigerating apparatus at the desired speed to produce the required pressure in the system, which source of power is utilized by speed reducing means for operating the agitating device of the freezer unit at a considerably slower speed necessary for the required agitation of the liquid in the freezer unit.

With such objects in view, as well as other advantages which may be incident to the use of the improvements, the invention consists in the parts and combinations thereof hereinafter set forth and claimed, with the understanding that the several necessary elements constituting the same may be varied in proportions and arrangement without departing from the nature and scope of the invention.

In order to make the invention more clearly understood there are shown in the accompanying drawings means for carrying the same into practical effect, without limiting the improvements in their useful applications to the particular constructions which, for the purpose of explanation, have been made the subject of illustration.

In the said drawings:—

Figure 1 is a plan view of my improved refrigerating unit designed to be communicably secured to the usual boiling coils of a household refrigerator. The latter, together with the refrigerator, are shown more or less diagrammatic in character.

Fig. 2 is a side elevation of the same.

Fig. 3 is an enlarged central vertical longitudinal section through the compressor element of the apparatus.

Fig. 4 is a transverse vertical section on line 4—4 of Fig. 3.

Fig. 5 is a transverse section on line 5—5 of Fig. 3.

Fig. 6 is a plan view of the upper compressor cylinder head valve housing.

Fig. 7 is a longitudinal section through the same on line 7—7 of Fig. 6.

Fig. 8 is a vertical sectional view of the two-way valve which is secured to the base casting.

Fig. 9 is an enlarged central vertical section through the expansion valve secured to the base casting.

Fig. 10 is a central vertical sectional view through the freezer unit secured to the base casting showing the manner of assembling the various elements thereof.

Fig. 11 is a fragmentary horizontal sectional view taken on line 11—11 of Fig. 10.

Fig. 12 is a detail plan view of one of the cylinder head valves of the compressor.

Fig. 13 is a similar view of one of the piston head valves of the compressor.

Referring to the drawings, the base of the refrigerating unit is indicated at 1, and is preferably formed of cast metal having suitably disposed bosses or projections to which the various elements of the apparatus are designed to be bolted, or otherwise securely clamped. The power unit comprises a motor 2, which is secured to the base casting, and which is designed to drive a compressor indicated generally at 3, through the medium of a belt 4 extending from a pulley 5 on the armature shaft 6 of the motor and passing over a speed reduction pulley 7 keyed or otherwise secured on the shaft 8 of the compressor.

As best seen in Fig. 3, the compressor 3 comprises a suitable base portion 9 secured as by bolts 10 to the base casting, a crank casing 11, having a bearing portion 12 for the inner end of the shaft 8, and an outer removable bearing portion 13 for said shaft. The compressor further comprises a plurality of vertically disposed cylinder castings 14—14 formed integrally with, or otherwise secured to the crank case 11, and the cylinders are longitudinally bored for the reception of vertically reciprocable piston members 15—15. The latter are alternately reciprocated vertically by means of oppositely disposed eccentrics 16—16, preferably integrally formed on the horizontal shaft 8 of the compressor. The shaft 8 may be composed of a drop forging which is suitably hardened by well known methods. The upper ends of the cylinder castings 14—14 are, or may be, of reduced external diameter and are provided at their upper ends with compression chambers 17—17. The compressor element further comprises top members or castings 18—18 internally bored to provide fluid chambers 19—19 communicating at their upper ends as by ports or channels 20—20 with a common horizontal duct or passage 21 in a manifold member 21^a removably secured to the members 18 as by bolts 21^b passing through ears 21^c. The duct 21 is provided with a central horizontal port 22, in a nipple 22^a (Fig. 6) through which compressed fluid may be conducted from the compressor 3 to a suitable

condenser in a manner to be described. A cylinder head valve plate 23 is interposed between each head casting 18 and the enlarged head 24 of each cylinder. Each valve plate is centrally apertured as at 25, to form a port communicating with the interior bore of the cylinder and with the interior of one of the pistons 15—15. A cylinder head valve 26 having peripheral serrations 26ª normally rests on each valve plate 23 to close the valve ports 25, and is pressed normally thereagainst by means of a coiled spring 27 housed within each fluid chamber 19 and bearing at its upper end against a shouldered portion of said chamber. A cylindrical bushing or packing member 28 of fiber, or other suitable material, is interposed in each fluid chamber 19, between the compression springs 27, and the walls of said chambers, and the object of which bushings, is to muffle or deaden any appreciable noise or clatter incident to the opening or closing of the disk valves 26.

The piston members 15—15 are identical in construction and each piston is provided at its lower end with a plurality of radially disposed, vertically extending ports or channels 29, formed in the enlarged lower end 30 of the piston member. As illustrated, four such ports 29 are provided, which afford communication between the interior of the cylinder 14 and the crank case chamber 31 of the compressor. A coil spring 32 is housed within each cylinder 14 and bears at its lower end against the enlarged lower portion 30 of each piston 15, said spring bearing against a suitable annular shouldered seat 33 on the interior of the upper portion of the cylinder bore. The springs 32 act in conjunction with gravity in maintaining the pistons 15—15 in engagement with the eccentrics 16—16 during the operation of the compressor, and particularly when the pistons are descending.

Each piston 15 is provided at its upper end with a central longitudinal bore 34, terminating at its upper end in an enlarged annular valve seat 35, and communicating at its lower end with one or more transverse radially extending ports 36, which in turn communicate with the interior of the cylinder 14. The top of each piston member 15 has secured thereto by screws or other fastening means, a piston valve plate 37 centrally apertured as at 38 and affording means of communication at the desired interval between the compression chamber 17 and the central port 34 of the piston. A piston valve 39 having a serrated periphery 39ª normally rests on the valve seat 35 in each piston member and is yieldably pressed thereagainst by a tension or leaf spring 40 housed between the valve and the apertured piston valve plate 37. It will be apparent from the construction and arrangement described, that when the piston 15 moves downwardly the pressure beneath the valve 39 lifts the latter from its seat to permit gases or vapors to pass through the serrations 39ª and thence through the central port 38 of the piston valve plate into the compression chamber 17. On this downward movement suction is prevented at the upper end of the compression chamber by the spring 27 forcing cylinder head valve 26 against cylinder head valve plate 23, and the vacuum thus created aids in permitting the incoming gases to pass through the piston valve 39 into the compression chamber 17. On the up stroke of the piston the gases are compressed in the compression chamber, the piston head valve 39 is pressed firmly closed against its seat, and the compressed gases force cylinder head valve 26 upwardly against the pressure of the coiled spring 27, to permit the compressed gases to escape from the compression chamber through ports 25 in cylinder head valve plate 23, and past the serrated periphery 26ª of the open cylinder head valve 26, through the ports or ducts 20, 21, and 22, to be conducted from the compressor. The gases admitted to compression chambers 17 are supplied from the fluid tight crank case chamber 31 of the compressor, through radial ports 29 of the piston, cylinder bore 14ª, and ports 36 and 34 in the upper portion of the piston.

The drive shaft 8 of the compressor may be provided with an integral annular flange 41 bearing against an annular packing member 42 to limit the outward movement of said shaft and aid in preventing the escape of vapors or fluid from the crank case chamber 31 of the compressor. Sealing means are provided exteriorly of the compressor to prevent the escape of gases from the crank case chamber. The speed reduction pulley 7 is keyed to the shaft 8 and has welded or otherwise secured thereto an annular collar 43 of bronze, the latter having an internal shoulder 44 engaging an adjacent shouldered portion 45 of the shaft 8 to limit the inward movement of the collar 43 and pulley with respect to said shaft. The inner face of the collar member 43 has soldered or otherwise secured thereto one end of a cylindrical sylphon bellows member 46, formed of copper and provided with exterior flutes or corrugations to permit longitudinal expansion and contraction of the bellows member during rotation of the drive shaft 8. The inner end of the bellows member is soldered or otherwise secured to an annular ring member 47 of hardened steel having a central aperture providing a clearance for the shaft 8, and the inner face of said ring member bears against and rotates relative to an outer bearing surface 48 of Babbitt metal provided on the exterior face of the hub or bearing portion 13 of the compressor casing. A coiled

spring 49 is housed within the bellows member 46, bears at one end against the collar member 43 and bears at its other end against the steel ring member 47 to maintain the latter in close engagement with the bearing surface 48 of Babbitt metal, thereby preventing the escape of gases between said elements 47 and 48. The bellows 46 prevents the escape of gases which may pass through the central aperture in the steel ring member 47, and the bronze collar 43 is tightly shrunk on the shaft 8 to effectually guard against the escape of gases at this point.

The manifold 21ª on top of the compressor is provided with a central enlargement 50 (Figs. 6 and 7) having an internal valve chamber 51 communicating with the ducts 21—21 of the manifold, and the latter is further provided with a reduced outer tubular portion 52 centrally apertured for the reception of a longitudinally reciprocable valve stem 53 having a valve head 54. The latter in its innermost or closed position is designed to register with a valve seat 55 formed on the nipple 22ª which is threaded or otherwise secured to the manifold 21ª and having the central port 22 communicating with the valve chamber 51. In its outermost or open position the valve 54 is designed to register and seal a seat 58 provided in the valve chamber and communicating with a port 59 which is normally closed during operation of the compressor as by a threaded screw 60 (Fig. 3), but which port may be open when desired to apply a pressure gauge to ascertain the pressure on the high pressure side of the compressor. A suitable stuffing box or gland 61, having a packing 62, is provided on the outer end of the tubular portion 52 of the manifold to prevent the escape of fluid around the stem 53 of the reciprocating valve 54.

A pipe connection 63 is threaded or otherwise tightly secured as by a jam nut 64 to the nipple 22ª, Fig. 1, and the other end of said pipe connection communicates as at 65 with the upper chamber 66 of a condenser indicated generally at 67. The latter is of any desired or approved type and includes the usual cooling tubes 68 having a large surface exposure to the atmosphere. The lower portion of the condenser tubes communicate with a tank or receptacle 69 designed to contain the liquid refrigerant, which in the present instance is methyl chloride. Any other appropriate refrigerant of low boiling temperature may be employed if desired. The refrigerant receptacle which supports the condenser element 67, is removably secured as by bolts 70 to the base casting 1 and is preferably provided with a sight gauge 71 through which the level of the liquid refrigerant in the tank may be visibly ascertained. The sight gauge 71 comprises a ring element secured as by screws 72 to the tank 69 and having a transparent panel 73 disposed centrally thereof and registering with a suitable aperture in the tank 69.

The condensed or liquefied refrigerant is conducted from the tank 69 by means of a pipe connection 74 (Fig. 1) communicating at its other end as at 75 with one side of a manually operated two-way valve generally designated at 76 and having ears 77 by means of which the valve structure is bolted or secured to the base casting 1 of the refrigerating unit. Referring more particularly to Fig. 8 the two-way valve 76 comprises a substantially tubular casing 78 tightly secured as by bolts 79 to a base plate 80 which in turn is secured as described to the base casting. A cover portion 81 is tightly secured as by bolts 82 to the body portion 78 and said cover portion is centrally apertured at 83 for the reception of the upper portion 84 of the valve stem. The latter is provided with an annular portion 85 having soldered or otherwise secured thereto the lower portion of a copper sylphon bellows 86 and the upper portion of said bellows is soldered to the body portion 78 or rigidly clamped as at 87 between said body portion and the cover member 81 of the valve housing. The valve housing 78 is further provided with upper and lower spaced partition members 88 and 89, the former being centrally apertured at 90 to provide a seat for the upper valve member 91 formed integrally with the valve stem 84, and the latter partition member 89 being centrally apertured at 92 to provide a seat for the lower valve member 93 having an adjustable screw thread connection 94 with the upper valve member 91. The upper and lower valves 91 and 93 are reciprocated vertically to alternately open and close the valve ports 90 and 92, by means of a hand operated cam lever 95 pivoted at 96 within a recessed portion 97 of the valve stem and having a cam or eccentric portion 98 designed to cooperate with an apertured plate member 99 yieldably pressed upwardly by means of a cushion spring 100 bearing at its upper end against said plate and housed at its lower end within a central recess 101 preferably formed integrally with the cover portion 81 of the valve housing. When the lever 95 is in the position illustrated in Fig. 8 the upper valve 91 is forced against its seat 90 by means of a coiled spring 102 of somewhat less strength than the spring 100 bearing at its upper end against the cover portion 81 and bearing at its lower end against the annular portion 85 of the valve stem, said spring being housed within the sylphon bellows 86. In the position described the lower valve 93 is open and the liquid refrigerant is admitted from pipe 74 through port 103 to intermediate chamber 104, through port 92 into lower

valve chamber 105 and thence is conducted through port 106 into pipe connection 107 threaded or otherwise secured to the walls of the port 106. Rotation of the valve stem with possible resulting damage to the sylphon bellows, is prevented by means of a transverse pin 108 extending through the valve stem and registering at its outer ends with suitable diametrically opposed grooves or recesses formed in an internal boss 109 of the cover member 81.

When the lever 95 is thrown to its opposite position, as illustrated in dotted lines, the engagement of cam face 98 with plate 99 compresses cushion spring 100 to permit valve stem 84 to rise a slight distance. This movement opens valve 91 and closes valve 93. Liquid refrigerant admitted at 103 cannot now pass into lower chamber 105 but enters upper chamber 110 from which said refrigerant is conducted through port 111 into pipe connection 112 having a threaded engagement with the walls of said port. From the pipe connection 112 the liquid refrigerant is conducted to an expansion valve indicated generally at 113 (Fig. 1), the said refrigerant entering the expansion valve through the screw connection 114. The expansion valve casing 113 is provided with a projecting ear portion 115 by means of which the valve casing is removably secured to the base casting as by bolts 116. The structure and purpose of the expansion valve 113 will be hereinafter described in detail.

Referring to Figs. 1, 2, and 8 and assuming that lever 95 of two-way valve 78 is again in the position indicated in full lines, the refrigerant is prevented by closed valve 91 from entering pipe connection 112 through port 111. The refrigerant enters lower valve chamber 105 through open valve 93 and passes through ports 106 into lower pipe connection 107. The other end of said pipe connection communicates as at 117 with one end of a boiling coil 118 disposed in the brine chamber 119 of the usual household refrigerator indicated generally at 120, (Fig. 2). The boiling coil and chamber 118 and 119 are of standard construction and are commonly employed in household refrigerators where a liquid refrigerant of low boiling temperature is utilized to freeze ice cubes and chill food compartments for the preservation of perishable food products. An expansion valve 120ª of usual or preferred construction is provided at or near the intake end of the boiling coil 118 and the purpose of which is to permit and insure expansion of the liquefied refrigerant at the desired pressure determined by the setting of the expansion valve, to cause the refrigerant to traverse the boiling coil 118 in the form of heat absorbing vapor which chills the refrigerator and freezes ice cubes in the usual manner. The expansion valve 120ª is similar in character to the expansion valve 113, which will be hereinafter described in detail with the exception that the expansion valve 120ª is set for a relatively high pressure sufficient to permit the refrigerant to form ice cubes. The expansion valve 113 is set to permit the refrigerant to expand and vaporize at a considerably lower pressure to obtain a high degree of chilling or freezing action in a manner and for the purpose to be hereinafter described in detail. The other end of the refrigerator boiling coil 118 is communicably secured as at 121 with the upper end of a pipe connection 122 which in turn communicates with a fluid tight connection as at 123 with a T-union 124. A pipe connection 125 is secured to one end of the T-union 124 and conducts the spent or vaporized refrigerant from the refrigerator boiling coil to the crank case chamber 31 of the compressor 3. The pipe 125 is secured as by a flanged coupling 126 to a nipple 127 which is in turn secured to or forming a part of a manifold or valve housing 128 secured as by bolts 129 to one side of the crank casing 11 of the compressor.

A reciprocating valve similar to the valve 54 at the top of the compressor, and having a valve stem 130, is mounted in the valve housing 128, and is adapted when in its innermost position to register with a suitable seat to prevent the admission of spent or vaporized refrigerant to the crank case of the compressor, said valve, when in its outermost position, being designed to open, and permit the vaporized refrigerant to enter the crank case chamber 31 of the compressor to be compressed in a manner hereinbefore described. A stuffing box 131 of usual construction is provided on the outer end of the valve housing 128 to prevent the escape of vapor around the reciprocating valve stem 130. The latter and its valve is designed to be manually controlled during the operation of the refrigerating apparatus.

Broadly stated, in conjunction with the elements heretofore described and including the household refrigerator 120 and boiling coil 118, I propose to utilize a cooperative supplemental freezing unit secured to the base casting and utilizing under different pressure conditions the refrigerant employed in the boiling coil 118 of said household refrigerant apparatus indicated generally at 120. This cooperative supplemental freezing unit will now be described.

Referring to Figs. 1 and 10, a freezer base casting 132 having legs or supports 133 is secured by suitable bolts to the base casting 1 of the refrigerating unit. The casting 132 is provided with an upstanding peripheral wall 134 and a central hub portion 135 forming a depressed annular cham-

ber or seat 136. The hub portion is further provided with a central threaded aperture 137 in which a central vertical hollow sleeve member 138, preferably of brass or copper, is designed to be threaded. A vertical shaft 139 having a squared upper end 140 is rotatably mounted within the sleeve member 138 and upper and lower packing members or bushings 141 are interposed between the shaft and the casing to form noiseless bearing portions for the shaft 139. The lower end of the freezer shaft is journaled in a central boss or bearing member 142, preferably integrally formed with the base casting 1 (Fig. 2). A worm wheel 143 is keyed to the shaft 139 and rotatably bears on the top surface of the bearing member 142. A longitudinally extending horizontal drive shaft 144 is journaled at either end in suitable bearings 145, 146, which in turn are secured to or formed integrally with the base casting 1. Spaced collar members 147—147 are secured or keyed to the shaft 144, one on each side of the bearing 146 to prevent endwise or longitudinal movement of the drive shaft 144. The latter has keyed thereon between the bearings 145 and 146, a worm member 148, having a driving engagement with worm wheel 143 on vertically disposed freezer shaft 139. The drive shaft 144 is further provided at or near one end with a gear or pinion 149 having suitably secured thereto a clutch member or collar 150, and the gear 149 and clutch collar 150 are splined to shaft 144 by a longitudinal spline 151 carried by the shaft and registering with suitable alined keyways in the gear and collar members. The gear and clutch collar are designed to be manually reciprocated relative to the drive shaft 144 by means of a clutch lever 152, having a handle portion 153 and longitudinally reciprocable within a bearing member 154 secured as at 155 to the bearing member 145 on the base casting. From the described construction it will be apparent that gear or pinion 149 may be manually moved as desired into and out of driving engagement with a gear or pinion 156 suitably keyed on the drive shaft 8 of the compressor 3 and maintained in position thereon by means of a jam nut 157 threaded onto the end of said shaft. It will be observed that the reduction pulleys 5 and 7 respectively mounted on the armature and compressor shafts result in a reduced speed of the compressor desirable for its operation in compressing the spent refrigerant, while the worm and worm wheel engagement with freezer shaft 139 results in appreciably further reduced speed of the latter and affording the desired operation for performing its office in connection with the freezer unit on the base casting.

A freezer tank 158 is provided having double walls 159 of preferably circular formation, and is designed to be seated in the depressed portion 136 of the freezer base casting 132, the double walled bottom portion 160 of said freezer tank being centrally apertured at 161 to snugly fit around the hub portion 135 of the freezer base casting. The double walls of the side and bottom of the freezer tank provide a dead air space 162 which prevents frosting on the outside of the tank, or said space may be filled with any suitable heat insulating material to promote the effective operation of the device.

A can or container 163 is provided having a centrally disposed tubular portion 164 which is designed to snugly fit over and surround the sleeve member 138 carried by the freezer base casting with the result that the container 163 is firmly centered against rotation within the freezer tank 158. The container 163 is further prevented from rotating relative to the freezer tank by means of one or more radially extending lugs or projections 165 on the bottom of the container and which register with and engage correspondingly located recesses or depressions 166 formed in the bottom wall of the freezer tank. The container 163 is further provided with handles 167 on its body portion and a cover portion 168 having a lower flange 169 adapted to be inserted within the side walls of the container, and a peripheral bead 170 rests upon the periphery of the container walls to limit downward movement of the cover. Handles 171 are provided on the cover to facilitate opening and closing of the container.

The upper squared portion of the freezer shaft 139 is designed to be centered with a non-slipping engagement in a squared aperture 172 centrally formed in a transverse or horizontal arm 173 of an agitator member. The latter is designed to be inserted within the container 163, is suitably offset as at 174, and terminates in two vertically depending arms 175. The latter are provided with suitable staggered lugs or projections 176 the purpose of which is to agitate and circulate the contents of the container 163 as the same are being frozen and in the usual manner. The agitator member further comprises a lower transverse member or bar 177 secured to or formed integrally with the lower portions of the arms 175 and recessed at its outer ends to receive the lower trunnions 178 of external agitator blades or stirrers 179. The bar 177 is further provided with a central aperture 177a forming a lower bearing portion for said rotatable agitator member upon the tubular portion 164 of the stationary container 163. The blades 179 at their upper ends are provided with trunnions 180 engaging suitably apertured projections 181 on the agitator member. The stirrers 179 are permitted to oscillate upon their trunnions and suitable up-

per and lower projections 182—183 are provided on the agitator member to limit the oscillatory movement of the stirring members. The location of the stops 182, 183 is such that the stirring blades 179 are maintained in an oblique position relative to the transverse axis of the agitator member to facilitate scraping the interior wall of the container and to insure proper agitation and circulation of the contents to be frozen. It will be noted that the construction is such that ample clearance is provided within the cover portion 168 of the container for the unrestricted rotation of the agitator member within the stationary container when the freezer shaft 139 is driven by worm wheel 143 and worm 148.

A suitable coil 184 for the refrigerant, preferably constituted of copper tubing, is provided and is designed to be inserted within the freezer tank 158 and adjacent to the circular wall 163 of the container. The purpose of the coil 184 is to conduct the expanding refrigerant as the latter vaporizes and absorbs heat from the contents of the container as the same are being agitated. The upper end of the coil 184 passes through an aperture 185 in the freezer tank and is suitably secured to said tank by means of a union 186. A pipe connection 187 connects with said union and connects at its other end as by a union 188 to a suitable nipple communicating with an aperture or valve port 189 provided in an extension 190 of the casing of the expansion valve 113. The lower end of the refrigerant coil 184 extends through a suitable aperture in the freezer tank and is secured to said tank in a manner similar to the upper portion of said coil. A pipe connection 191 communicates with the lower end of the coil 184 and conducts the spent refrigerant to the T-union 124. Thence the refrigerant is conducted through pipe connection 125 to the valve controlled port communicating with the compressor crank case chamber 31 in a manner heretofore described.

Referring particularly to Fig. 9, the expansion valve 113 secured to the base casting 1 comprises a body portion 192 having a cover portion 193 rigidly clamped or secured thereto by screws or bolts 194 to effect a fluid tight union. The extension 190 of the body portion of the valve is communicably connected as above described with the pipe connection 187 in turn communicating with the upper portion of the refrigerant coil 184. The expansion valve casing has removably secured thereto as by screws or bolts 195 a base plate 196 to form a fluid tight union as by an interposed gasket, and the base plate embodies a central hub portion 197 centrally apertures as at 198 to slidably house the expansion valve member 199. An integral depending boss portion 200 of the valve casing is designed to snugly fit within a shouldered recess 201 in the hub portion 197 and the valve casing is further apertured at 202 to form a valve seat and port for the vertically disposed stem of the valve 199. The upper end of the valve stem normally contacts with a valve plate or diaphragm 203 formed preferably of steel and normally resting on a plurality of radially disposed lugs or projections 204 integrally formed with the intermediate horizontal wall 205 of the valve casing. A sylphon bellows 206 is soldered or otherwise secured at its lower end to the valve diaphragm 203 and is soldered or otherwise secured at its upper end at 207 to the valve casing or clamped with a fluid tight connection between said casing and the valve cover 193. The valve diaphragm 203 is normally forced downwardly against the projections 204 by means of a coil spring 208 housed within a centrally apertured hub portion 209 of the valve cover and designed to be adjusted as to tension by means of a screw plug 210 having a threaded engagement with said central aperture. After the tension of the spring 208 has been adjusted, the valve is sealed by means of a screw cover 211 having an internal threaded engagement with the central aperture of the boss portion 209. The valve 199 in its normal position as illustrated in Fig. 9 is maintained in its downward position by the plate 203 of the sylphon to provide a slight clearance at its port or seat 202. The valve is normally urged upwardly by a coil spring 212 engaging the under side of the valve head and housed within the central bore or aperture 198. The spring 212 is of less strength than the spring 208 with the result that the valve 199 is maintained in slightly open position until the pressure on the low pressure side of the valve, or above the valve port 202 is decreased to such an extent as to slightly lift diaphragm 203, and under this condition this decreased pressure, together with the pressure exerted by the lower coil spring 212, operates to close valve 199 and prevent the passage of liquid or vaporized refrigerant through the expansion valve 113. In this connection it will be understood that the high pressure side of expansion valve 113 is below the valve 199 within lower valve chamber 214 and compressed or liquid refrigerant enters lower high pressure valve chamber 214 through port 215 communicating with pipe connection 112 leading from the upper valve chamber 110 of two-way valve 78. After passing through open valve port 202 the liquid refrigerant immediately expands and vaporizes within low pressure chamber 213 controlled by diaphragm 203, and this expansion is aided materially by the suction exerted from the crank case chamber 31 of the compressor,

which communicates with low pressure chamber 213 of expansion valve 113 through pipe connections 125, 191, refrigerant coil 184 and pipe connection 187. The rapid expansion of the refrigerant commencing in low pressure valve chamber 213 rapidly vaporizes the refrigerant which enters the high pressure valve chamber in the form of liquid, and such expansion is accompanied by great loss of heat with the result that the vaporized refrigerant enters freezer coil 184 at an extremely low temperature at or below its boiling temperature −11.36° F. In this condition the refrigerant rapidly absorbs large quantities of heat which are present in the liquid desired to be frozen in the container 163. After leaving the refrigerating coils 184 the refrigerant has absorbed a large quantity of heat and is ready to be compressed in the compressor, relieved of its heat, cooled and liquefied in the condenser, the refrigerant being conducted thereto from the coil 184 by means of pipe connections 191 and 125 in a manner heretofore described.

Operation.—The operation of the apparatus above described, and assuming that the same is not used to freeze any commodity in the container 163 of the base freezer unit, is as follows: The cooled and liquefied refrigerant consisting of methyl chloride, is forced by the compressor 3 or is conducted out of the lower portion of the refrigerant receptacle 69, through pipe 74 and into intermediate chamber 104 of the two-way valve 78. Under this condition the valve is in the position shown in Fig. 8 and the liquid refrigerant is prevented by closed valve from entering upper valve chamber 110. The refrigerant passes through open valve 93, port 106, into pipe connection 107, passes through expansion valve 120ª in the usual household refrigerator boiling coil 118. The refrigerant immediately expands or vaporizes and circulates through the boiling coil 118 in the form of gas, being aided in this respect by the suction exerted from the crank case chamber of the compressor 3. The refrigerant which is now volatilized and in gaseous form absorbs a sufficient amount of heat from the various chambers of the refrigerator 120 to chill the food products contained therein and form ice cubes. It will again be noted in this regard that the usual expansion valve 120ª is set for a relatively high pressure with the result that there is relatively little expansion of the refrigerant in the boiling coil 118, but this expansion is sufficient to perform the offices described, and in a manner usual in known methods where a liquid refrigerant is employed. The spent refrigerant, after leaving boiling coil 118 passes through pipe connection 122, union 124, pipe 125, valve housing 128 and into the crank case chamber 31 of the compressor, its admission being controlled by the manually operated reciprocating valve 130. The spent refrigerant is compressed by the reciprocating pistons of the compressor and relieved thereby of a considerable portion of its accumulated heat and is thence forced from the top of the compressor through pipe connection 63 into the top of the condenser 66. The partially cooled and compressed refrigerant is further cooled and becomes liquefied during its downward passage through the condenser tubes, and is again stored in the receptacle 69. During the described cycle of operation it will be understood that the refrigerant is prevented from passing to the auxiliary freezer unit by the position of the two-way valve 78.

When it is desired to utilize the household refrigerant to freeze ice-cream, custard, or any desired and appropriate commodity, in freezer unit on the base casting, the container 163 is filled with the fluid commodity to be frozen and inserted into the freezer tank adjacent the freezing coil 184. The two-way valve 78 is reversed by throwing cam lever 180° from the position illustrated in Fig. 8, thereby opening valve port 90 and closing valve port 92 by reversing the position of the respective valves controlling the ports. This action cuts off temporarily further admission of the liquid refrigerant through the brine tank boiling coils 118 of the household refrigerator 120. Instead the refrigerant passes from tank 69, through pipe 74, two-way valve 78 and pipe 112 to the expansion valve 113. The latter as heretofore stated is set at a relatively lower pressure than expansion valve 120ª or approximately two and one-half to three pounds per square inch on the low pressure side as distinguished from ten pounds to the square inch on the low pressure side of expansion valve 120ª. The pressure of the liquid refrigerant on the high pressure side of each expansion valve regardless of the position of the two-way valve 78 varies according to atmospheric conditions, but may be stated as approximately 65 pounds to the square inch under normal conditions. Owing to the lower pressure at which valve 113 is set there is a considerably greater expansion or vaporization of the refrigerant in passing through this valve in a manner heretofore described. The fluid expands and vaporizes on the low pressure side of the valve 113 and is conducted immediately through port 190ª, pipe connection 187, to the top of the freezer coil 184 in the freezer tank. The refrigerant which is now vaporized and aided in its progress by suction from the compressor, rapidly absorbs heat from the fluid in the container 163 with the result that the latter becomes frozen to any desired degree of hardness. The spent

refrigerant, as before described, is returned to the crank case of the compressor through pipe connections 191, 125, and valve housing 128. It will be understood that at the same time two-way valve 78 is reversed to establish communication with the freezing coil 184, clutch lever 152 is shifted to mesh gears 149 and 156. This results in power from the motor 2 being transmitted through the compressor shaft 8 to the longitudinal drive shaft 144. This power is in turn transmitted to freezer shaft 139 through worm 148 and worm wheel 143. The agitator member 173 is thereby driven to efficiently circulate and agitate the liquid in the container 153 to cooperate with the vaporized refrigerant in freezing the contents of the container. It will be understood that suitable automatic circuit breakers of well known character are provided on the motor 2 to automatically shut off the motor and throw the apparatus out of operation in the event that the operation is neglected or unusual load conditions are encountered. The original liquid refrigerant is placed in the receptacle 69 as through a suitable valve controlled cock, and the quantity of the liquid refrigerant in circulation may be readily ascertained by means of the sight gauge 71. It will be further apparent that the expansion valves 120[a] and 113 are automatic in operation, depending upon which valve is placed in circuit, and serve to maintain the proper and desired high and low pressure zones on each side of the valve to insure constant and continued circulation of the refrigerant through the apparatus for the purposes described.

The freezer tank 158 is or may be provided with a solution of liquid, such as glycerine, surrounding the freezer coils and exterior to the liquid container 163.

The provision of the various packings and gaskets, as well as fiber bushings, in various portions of the apparatus, as above described, serve not only to assist in maintaining a fluid tight system for the refrigerant, but further serve to eliminate noise and vibration in the operation of the apparatus. This is particularly true where these bushings and gaskets are provided in the compressor and freezer tank, with the result that the unit is practically noiseless in operation which is an added advantage incident to its use.

What I claim is:—

1. A refrigerating unit adapted to be used in conjunction with the brine tank and boiling coil of a household refrigerator for the boiling expansion and circulation of refrigerant for the purpose of freezing and chilling liquids and creams in a freezing receptacle, comprising in combination: a base, a compressor mounted on said base, a condenser communicably connected with said compressor, a refrigerant receptacle communicably connected with said condenser, a two-way valve mounted on said base and communicably connected with said receptacle and with the boiling coil of said refrigerator, the other end of said refrigerator boiling coil being communicably connected with the low pressure side of said compressor, an expansion valve mounted on said base and communicably connected with said two-way valve, a freezer unit mounted on said base and having a freezing coil communicably connected at one end with said expansion valve, the other end of said freezing coil being communicably connected with said low pressure side of said compressor, a motor mounted on said base for driving said compressor, agitating means for stirring the contents of said freezer unit, said two-way valve being adapted to alternately conduct the refrigerant through said refrigerator boiling coil and the freezing coil of said freezer unit, and means for establishing a driving connection between said motor and said agitating means when said refrigerant is being conducted through said freezing coil.

2. A refrigerating unit adapted to be used in conjunction with the brine tank and boiling coil of a household refrigerator for the boiling expansion and circulation of refrigerant for the purpose of freezing and chilling liquids and creams in a freezing receptacle, comprising in combination: a base, a compressor mounted on said base, a condenser communicably connected with said compressor, a refrigerant receptacle mounted on said base and communicably connected with said condenser, a two-way valve mounted on said base and communicably connected with said receptacle and with the boiling coil of said refrigerator, the other end of said refrigerator boiling coil being communicably connected with the low pressure side of said compressor, an expansion valve mounted on said base and communicably connected with said two-way valve, a freezer unit mounted on said base and having a freezing coil communicably connected at one end with said expansion valve, the other end of said freezing coil being communicably connected with said low pressure side of said compressor, means for driving said compressor, agitating means for stirring the contents of said freezer unit, said two-way valve being adapted to alternately conduct the refrigerant through said refrigerator boiling coil and the freezing coil of said freezer unit, and means for establishing a driving connection between said driving means and said agitating means when said refrigerant is being conducted through said freezing coil.

3. A refrigerating unit adapted to be used in conjunction with the brine tank and boiling coil of a household refrigerator, comprising in combination: a base, a compressor mounted on said base, a condenser com-

municably connected with said compressor, a refrigerant receptacle communicably connected with said condenser, a two-way valve mounted on said base and communicably connected with said receptacle and with the boiling coil of said refrigerator, the other end of said refrigerator boiling coil being communicably connected with the low pressure side of said compressor, a freezer unit mounted on said base and having a freezing coil communicably connected at one end with said two-way valve, the other end of said freezing coil being communicably connected with said low pressure side of said compressor, a motor mounted on said base for driving said compressor, agitating means for stirring the contents of said freezer unit, said two-way valve being adapted to alternately conduct the refrigerant through said refrigerator brine coil and the freezing coil of said freezer unit, and means for establishing a driving connection between said motor and said agitating means when said refrigerant is being conducted through said freezing coil.

4. In a refrigerating apparatus, the combination with a unit for forming ice, said unit including an expansion valve and means for conducting liquefied refrigerant to said valve to form said ice: a freezer unit including a stirrer for agitating the contents of said unit during freezing thereof, said freezing unit having pipe connections with said refrigerating apparatus, a two-way valve for affording access of the refrigerant to said freezing unit when desired, and an expansion valve located in said pipe connection between said freezing unit and said two-way valve to afford the desired low temperature of the refrigerant necessary in said freezing unit, said two-way valve permitting selective delivery of the refrigerant to said ice unit or said freezing unit.

In testimony whereof I affix my signature.

FRANK L. COOK.