R. E. BECHTOLD & A. W. MELLOWES.

COOLING APPARATUS.

APPLICATION FILED JUNE 10, 1916.

1,276,612. Patented Aug. 20, 1918.

4 SHEETS—SHEET 1.

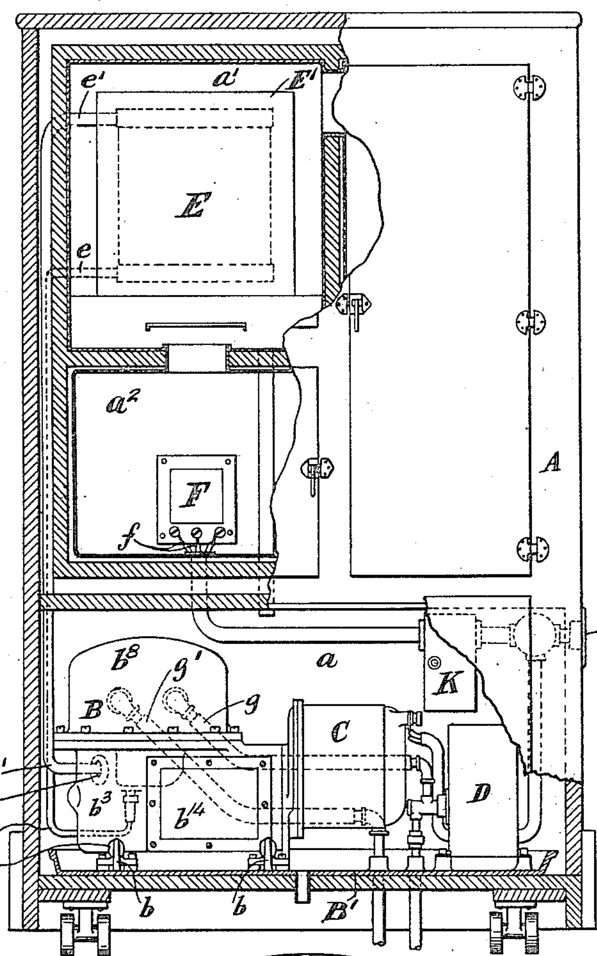

Fig. 1

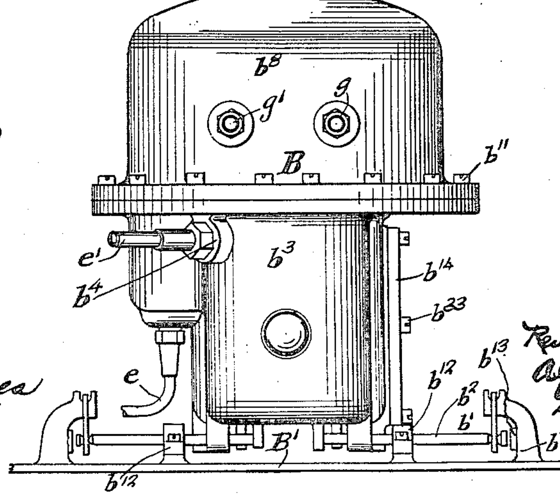

Fig. 2

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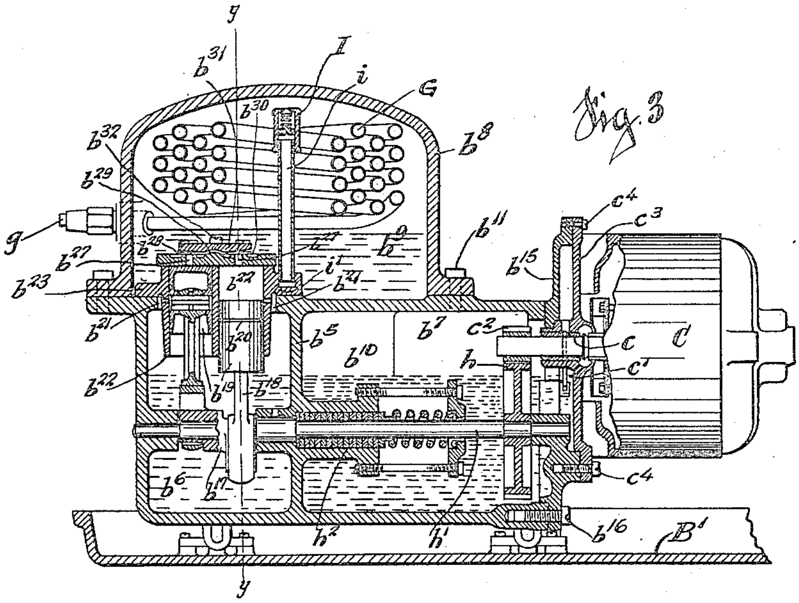

Fig. 3

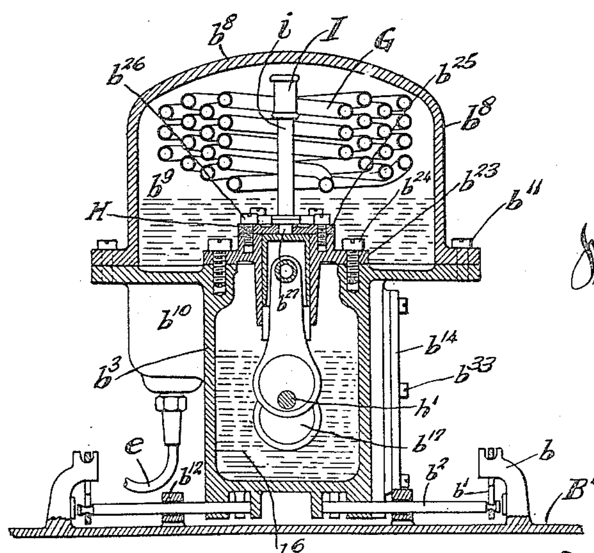

Fig. 4

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4 SHEETS—SHEET 3.

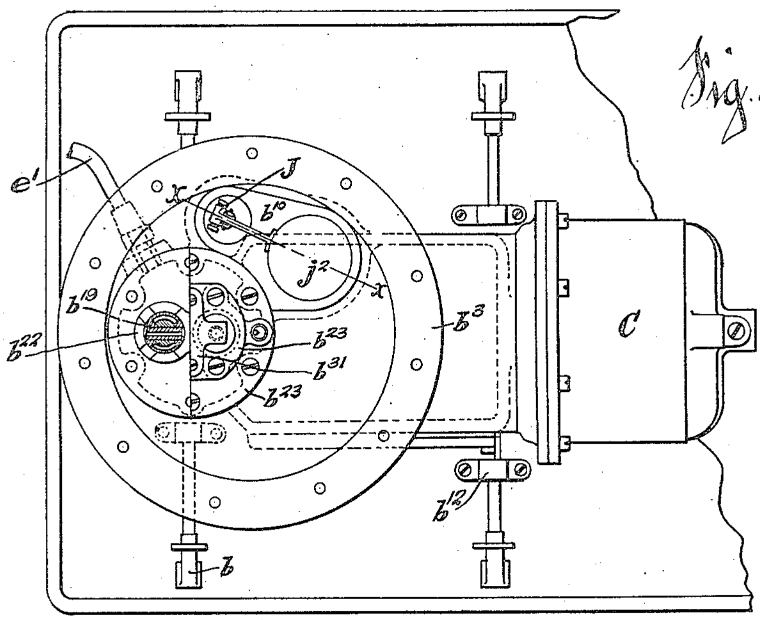

Fig. 5

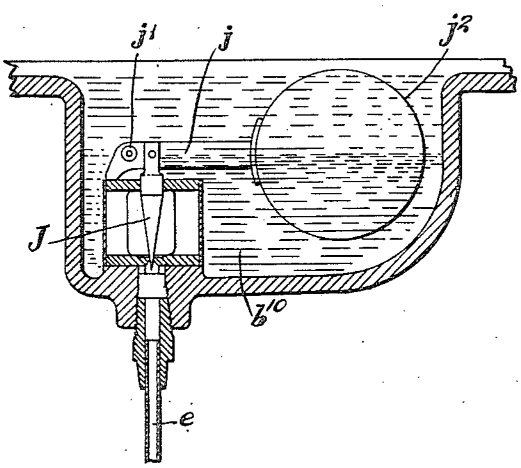

Fig. 6

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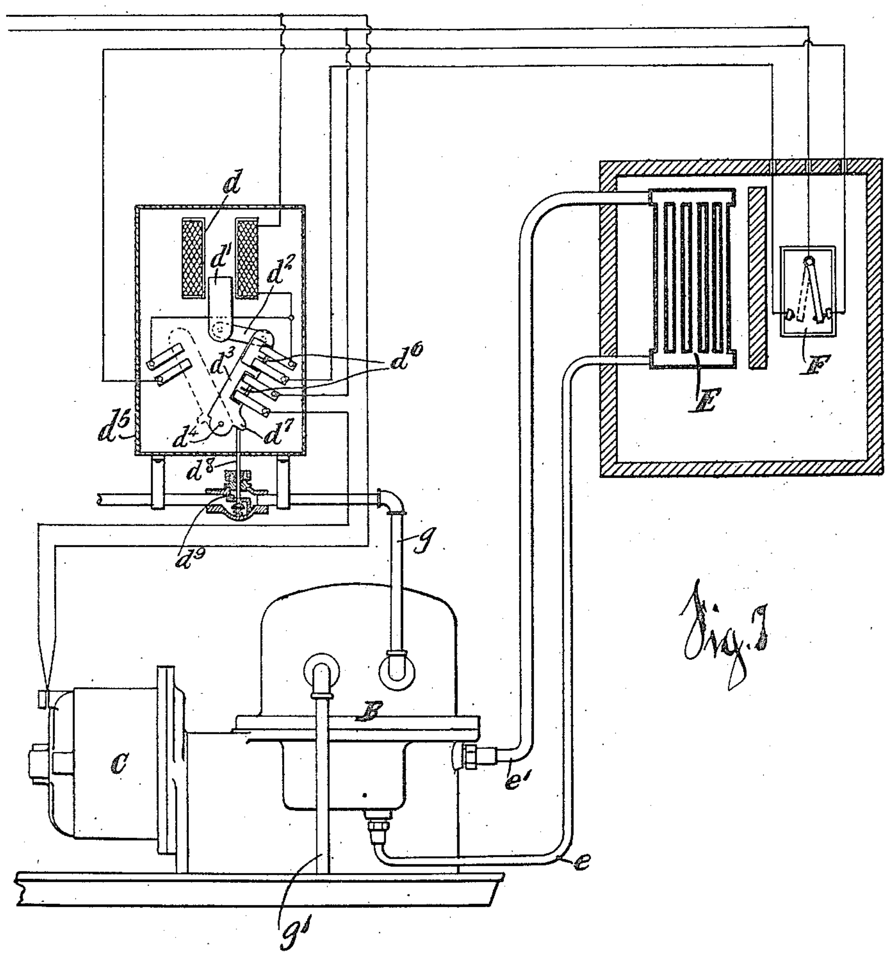

Fig. 7

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UNITED STATES PATENT OFFICE.

REUBEN E. BECHTOLD, OF FORT WAYNE, INDIANA, AND ALFRED W. MELLOWES, OF DETROIT, MICHIGAN, ASSIGNORS TO THE GUARDIAN FRIGERATOR COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

COOLING APPARATUS.

1,276,612. Specification of Letters Patent. Patented Aug. 20, 1918.

Application filed June 10, 1916. Serial No. 102,912.

To all whom it may concern:

Be it known that we, REUBEN E. BECHTOLD and ALFRED W. MELLOWES, citizens of the United States, residing, respectively, at Fort Wayne, in the county of Allen and State of Indiana, and Detroit, in the county of Wayne and State of Michigan, have invented new and useful Improvements in Cooling Apparatus, of which the following is a specification.

Our invention relates to cooling apparatus of the compression type, and is especially adapted to produce and maintain such temperatures as are required in refrigerators for domestic use, and in groceries, meat shops, soda-fountains, and for a wide range of industrial uses.

Any of the usual refrigerating fluids may be used, but we prefer sulfur dioxid (SO_2); and we prefer to use as a lubricant, an anhydrous, neutral mineral oil.

Our apparatus is very compact and combines in one casing all the essential parts of a compressing and condensing system. The casing is constructed to contain a pair of compressor pistons, cylinders, cranks and connections, a reservoir for the refrigerant vapor and lubricant below the compressor valves and another reservoir for the refrigerant and lubricant above, a pocket for the separated refrigerant, and the condenser. Low temperature is secured by the continuous use of the same body of refrigerant. The lower reservoir receives the gaseous refrigerant and entrained lubricant, the compressor compresses the refrigerant and delivers it directly into the upper reservoir where the compressed gaseous refrigerant is condensed by contact with the water-cooled condenser-coils, and when so condensed falls, passes through the body of lubricant into a pocket in the casing which acts as a separator, and thence passes in liquid form through a valve to the expansion coils, where it vaporizes and absorbs heat, and from there is returned to the suction side of the compressor. No pipes or pipe connections are used within the casing in forwarding the refrigerant and lubricant from the compressor chamber to the condenser chamber.

The operation of the device is automatic, being thermostatically thrown into and out of operation as the contents of the receptacle it is set to cool rises above the fixed high temperature, or falls below the fixed low temperature respectively.

All the working parts of the apparatus, except the thermostat expansion coil and connections and the motor, are inclosed in the casing which is compact and adapted to be assembled complete, and when so assembled, with the motor attached, is ready to be placed for use either in a compartment of the refrigerator or at any convenient place without, and then connected with the expansion coil, electrical connections and thermostat, and water connections. The air is exhausted from the system when assembled, the system charged with a sufficient quantity of the refrigerant and lubricant, and the system hermetically sealed. During operation a sufficient quantity of the lubricant is carried through the system to make the device effectually self-lubricating, so that when completely assembled for operation the machine will require no further care for a very long period, it being necessary to supply electric current and running water only.

To this end our invention comprises throughout mechanism of the simplest possible character, all working parts being automatically thoroughly lubricated and all joints made permanently tight by sealing.

Apparatus complete within a refrigerator, as shown herein, is readily portable, requiring only disconnection of the electric wires and water pipes at one location and reconnection of them again at the new location, ordinarily the work of an hour by any reasonably competent mechanic. This is of great commercial importance as any householder can buy a complete domestic cooling apparatus assembled as a unit ready for connection, and remove and relocate it at pleasure.

A household apparatus of this character can be operated for about half the cost of an ice-cooled refrigerator, and uniformly lower temperatures maintained, while avoiding the slime, dirt, and bacteria from ice within the refrigerator, and the trouble and annoyance of getting ice, and slop in filling the refrigerator with ice. This apparatus makes the air in the refrigerator dry by freezing the moisture out of it.

How the apparatus can readily be adapted to "built in" refrigerators or other receptacles to be cooled will be apparent to any skilled mechanic.

A cooling apparatus for domestic and many other uses must be substantially noiseless in operation, and our invention provides means to this end.

In apparatus of this type, it is important that danger of accident arising from the unforeseen cessation of the flow of water to the condensing coil must be automatically eliminated; and our apparatus provides means for automatically preventing an explosion if such a condition should arise.

The particular embodiment of our invention selected for illustration is a cooling apparatus made for a refrigerating fluid heavier than the lubricating fluid, and the whole apparatus installed in a refrigerator of the ordinary type for household use.

Figure 1 is a front elevation of a domestic refrigerator with a complete cooling apparatus installed within; parts of the front being broken away and removed to show the apparatus.

Fig. 2 is an end elevation of the casing at the compressor end.

Fig. 3 is a vertical, longitudinal, axial section through the casing and contents.

Fig. 4 is a vertical, axial, lateral section through the casing and contents, looking toward the motor.

Fig. 5 is a top plan view of the casing and attached motor, with the dome of the casing removed and one-half the valve, valve stop, and cylinders' head removed and the uncovered cylinder and piston shown in cross section along the line Y—Y of Fig. 4.

Fig. 6, a detail, is a vertical section through the refrigerant pocket along the line X—X of Fig. 5.

Fig. 7 is a diagrammatic sketch of our complete cooling system and means for thermally controlling same.

Referring now to the drawings, A is a refrigerator suitable for domestic use, in which the entire cooling apparatus is housed. The compressing and condensing mechanism is inclosed in an air tight casing B, located in the bottom compartment a of the refrigerator. The compartment a also contains the motor C which is secured to the casing B, and the usual fuse-block and cut-out K for the motor and an automatic switch and water supply valve D, together with the necessary water and electrical connections. An electrical plug receptacle k is provided on the outer wall of the refrigerator.

The expansion coils E are located in an upper compartment a^1 of the refrigerator. The refrigerant is supplied from the casing B, as will hereinafter be described, to these coils through the flexible pipe e and refrigerant in gaseous state will be returned from the expansion coils to the casing through the flexible pipe e^1. The expansion coils E are here shown emersed in a brine tank E^1.

In one of the food compartments a^2 is located the thermostat F, to which are connected the wires f from the fuse block and cut-out.

The casing B is provided with a base B^1 having posts b from which are suspended links b^1, and the lower end of each of these links carries the free end of a resilient rod b^2, the other end of which is fixed to the casing B. This arrangement dissipates the shocks from the operation of the compressor whether the movement is vertical, lateral or gyratory; and also the vibration from the motor so that there will be no annoyance from noise or vibration transmitted to the refrigerator. The vertical movement and the end to end movement of the casing is limited by the size of the hole in the stops b^{12}; and the side to side movement of the casing is limited by the bosses b^{13} on the posts b.

The casing is made in two parts and fastened together by bolts b^{11}. The lower portion b^3 is divided by a vertical wall b^5 into a reservoir b^6 adapted to be nearly filled with refrigerant in gaseous form and lubricant, and in which the compressor cylinders, pistons, piston rods, and cranks are located; and a reservoir b^7 partially filled with lubricant in which is located a stuffing box and the driving connections with the motor. The pipe e^1 empties the gaseous refrigerant on the suction side of the compressor at b^4, into the reservoir b^6. To the motor end of the lower portion of the casing is fastened an extension plate b^{15} by bolts b^{16}. This extension plate is so formed as to be adapted to have the casing c^3 of the motor fastened to it by bolts c^4.

The extension plate b^{15} and motor casing c^3 together close the outer end of the reservoir b^7.

The upper portion b^8 of the casing B is a dome open at the bottom, and forming when in position on the lower portion, a chamber b^9 into which the valve end of the compressor H projects. This chamber contains the condenser coil G, the relief valve mechanism I, and in one portion of the floor of which is formed the pocket b^{10} in which is located the float operated needle valve J.

The motor bearing c, has a ring oiler c^1 dipping into the reservoir b^7. The motor pinion c^2 meshes with the driven gear h fixed to shaft h^1 journaled in the lower portion of the casing. The shaft h^1 passes through the partition b^5 and a leak tight joint is made by the spring-held stuffing-box h^2. The chamber b^7 is closed by the plate b^{14} held securely in position by bolts b^{33}, so as to confine a sufficient quantity of lubricating oil in the reservoir b^7 to lubricate all moving parts and to seal the stuffing box.

The portion of the shaft h^1 that extends through the reservoir b^6 carries the two eccentrics b^{17} made integral, and their connecting rods b^{18} are pivoted to the inside of the trunk pistons b^{19}. These pistons have one or more oil rings b^{20}. Inlet ports b^{21} admit gaseous refrigerant to the cylinders b^{22} above the pistons.

The two cylinders are formed from a single casting b^{23} secured to the lower part b^3 of the casing by the bolts b^{24}. The head for the two cylinders is formed from a single casting b^{25} secured to the cylinder casting by bolts b^{26} and have outlet ports b^{27}.

The cylinder head casting is machined off to form raised valve seats b^{28} and has a ridge b^{29} midway between the ports. A flat resilient strip b^{30} is bent over this ridge and held against the valve seats with an initial pressure by a valve stop b^{31} formed at the middle to conform to the shape of the ridge and provided with bolts b^{32} threaded into the cylinder head casting b^{25}.

The condenser coils G are within the chamber b^9 formed by the dome b^8 above the level of the lubricant and body of refrigerant under it. Water enters the condenser coil through the flexible pipe g and leaves through the flexible pipe g^1.

A relief valve I is adapted to be opened by excess gas pressure in the chamber b^9, admitting gas through the pipe i, and the vent passage i^1 to the chamber b^6.

The pocket b^{10} holds the refrigerant that condenses and falls through the body of lubricant above, and a needle valve, J, adapted to be opened and closed through the lever j, fulcrumed at j^1 by the float j^2, weighted so as not to be operated by the lubricant, admits refrigerant from time to time to the pipe e and through it to the expansion coils, whenever the accumulation of liquid refrigerant is sufficient to raise the float.

The water supply valve and automatic switch D constitute a device for automatically cutting off and throwing on the supply of electric current and the flow of water, so as to fully start and stop the apparatus. This part of the apparatus consists of a synchronized combination relay switch and water supply valve. The switch consists of a solenoid d, having a soft iron core d^1 pivoted at its lower end through a link d^2 to an arm d^3 made heavy enough to attain considerable momentum when set in motion. This arm is pivoted at d^4 to the housing d^5. The arm carries the usual contact plates d^6 to make electric connections with the thermostat F and the motor C. The arm d^3 has a lug d^7 adapted to contact with the operating stem d^8 of the water supply valve opening the spring closed valve d^9 and holding it open so long as electricity is supplied to the motor. When by thermostatic action the arm d^3 is thrown to the position indicated by dotted lines, the valve closes and the motor stops at the same time, so that the machine is completely closed down.

After the apparatus is assembled, and charged with refrigerant and lubricant, its operation is automatic and no attention is required. The operation is as follows:

Suppose that the thermostat is set to operate at 42° Fahrenheit, and discontinue operation at 38°, and that the temperature in the food compartment in which the thermostat is placed rises to 42°, the apparatus being at the time inactive, the water supply valve d^9 closed, and the arm d^3 in the position shown by dotted lines. The electric current in the coils d will jerk up the core d^1 and momentum will carry the arm d^3 into the position shown by full lines simultaneously supplying electric current to the motor C and starting it and opening the water supply valve d^9 supplying water through the pipe g to the condenser coils G. The motor, through the pinion c^2 and the gear h rotates the shaft h^1 and operates the compressor pistons b^{19}. The reciprocation of these pistons splashes lubricant in the crank case reservoir b^6 and lubricates all working parts not emersed in the lubricant of this reservoir. The lubricant is sufficient in quantity to seal the inner end of the stuffing box. The gaseous refrigerant which has returned through the pipe e^1 to the suction side of the compressor passes through the ports b^{21} into the cylinders b^{22} above the pistons, and on the up-stroke of each piston this gaseous refrigerant is compressed and forced through the port b^{27} into the reservoir b^9 within the dome, by lifting the end of the flap valve covering the port. This valve immediately returns to its raised seat b^{28}, closes it and the opening is sealed by the body of lubricant in the reservoir b^9.

The compressed gaseous refrigerant is discharged up through the lubricant, comes in contact with the condenser coils G through which cool water is flowing, is cooled, condenses and drops into the body of lubricant passing through it and into the pocket b^{10}. The upper end of the cylinders being surrounded by the lubricant, the heat of compression is absorbed by the lubricant which in turn causes some of the liquid refrigerant with which it is in contact to gasify, and this gas rises and contacts with the condenser coils where it is again condensed. When enough refrigerant has accumulated in the pocket to raise the float j^2, the valve J will open and permit some refrigerant to flow out the pipe e into the expansion coils E. As the refrigerant and lubricant in the reservoir b^9 are separated only by reason of their different specific gravity, the refrigerant always carries some lubricant with it, and so small quantities of the lubricant will be carried through the entire system, including the expansion coils. In our device, we find this keeps all the working parts thoroughly lubricated so as to insure against wear while the apparatus has proved of great practical efficiency. In the pipe *e* and coils E, the cold liquid refrigerant being unconfined and rising in temperature, gasifies and takes up the heat from the brine in the tank E^1, or the air in the compartment if a brine tank is not used, lowering the temperature. Circulation of air between the compartment a^1 and the food compartments of the refrigerator tends to equalize the temperatures in all compartments, but it is an advantage for ordinary domestic use to have the refrigerator so constructed that the temperature of the several compartments will vary, as meats and the like require a lower temperature than fruits, and these lower than vegetables.

The gaseous refrigerant flows from the expansion coils E through the pipe e^1 to the suction side of the compressor chamber b^6, carrying particles of lubricant with it, and thus completing the circuit. The operation continues until the temperature next the thermostat has fallen to 38°, when the thermostat throws the switch, the arm d^3 is thrown back into the position shown by dotted lines, and the valve d^9 closed and electric motor connection broken simultaneously, shutting down the apparatus.

It will be observed that while our device is very compact, it is simple in design and easily assembled. The finished cylinder's casting is put in place upon the lower casing part b^3 and secured, the finished cylinder's head casting superimposed and secured; upon this is placed the flap valve and valve stops and it is secured; the float valve mechanism is put in place and the whole covered with the dome or upper casing part b^8. The whole assembled casing is mounted on the base B^1.

Obviously the operating mechanism need not be within any part of the refrigerator, but could be placed at any convenient place, as in the cellar under the refrigerator and connected by suitable pipes.

We claim as our invention and desire to secure by Letters Patent of the United States:

1. In cooling apparatus of the character indicated, a containing casing embodying in a single compact structure, a motor-casing, a compartment for the power transmitting mechanism and stuffing box, a compartment for a compressor, a compartment for condenser coils containing also a pocket for accumulated refrigerant, having a valve controlled exit.

2. A cooling apparatus embodying a general containing casing consisting of (1) a horizontally extended base-portion divided by a vertical partition into two chambers, one containing the power transmitting mechanism and a driven shaft extended thence horizontally through the said partition, the other being the crank case with compressor cylinder secured in and extending through the upper wall of said base portion; and (2) a condensing-coil portion located upon and above said base portion.

3. A cooling apparatus embodying a containing casing having a horizontally disposed base portion partitioned into two chambers; with a drive shaft extended horizontally through the said partition, and a stuffing-box-bearing for said drive-shaft in and through the said dividing partition adapted to be sealed at both ends by a body of oil contained in said chambers.

4. In cooling apparatus, the combination of a rigidly connected casing having a plurality of chambers, compressing and condensing means within said casing, a motor fixed to the casing, a support for the casing and a resilient connection between the casing and the support.

5. In cooling apparatus of the character indicated, the combination of the condensing-coil, its containing chamber located above the crank case; the compressor cylinders secured in and extending above the bottom wall of the condensing chamber; and the drainage pocket for refrigerant formed in said bottom wall and provided with a float-controlled valve.

6. A cooling apparatus embodying a general containing casing consisting of (1) a horizontally extended base portion divided by a vertical partition into two chambers; one containing the motor gears and a driven shaft extended horizontally through the said partition, and the other being the crank-case with compressor cylinder secured in and extending through the upper wall of said base portion; and (2) a condensing-coil-portion located upon and above said base portion and provided with a valve-pocket extending below the general level of the condensing-coil-portion; said pocket provided with an exit controlled by a float-valve; an expansion coil outside of the mechanism casing; a fluid connection from said outlet to said expansion coil and a fluid connection from said expansion coil to the second mentioned chamber of the base portion.

7. In a cooling apparatus, the combination of a casing having a compressor-chamber and a compressor therein; a condenser chamber connected with said compressor chamber by valve controlled openings and a condensing coil therein; a valve pocket integral with and extending below the general level of the floor of the condenser chamber, and a float-valve therein controlling an out-

let therefrom; an expansion coil outside the casing and a flexible fluid connection from said outlet to said expansion coil; a flexible fluid connection from said expansion coil to the compressor chamber in said casing; a support for said casing and a resilient connection between the said casing and said support.

8. In a cooling apparatus of the character indicated, the combination of a horizontal partition forming the top of a compressor chamber and a part of the floor of a condenser chamber, said partition having compressor cylinders integral therewith and extending up into the condenser chamber so that when the condenser chamber contains sufficient lubricant to act as a seal for the valve controlled openings of the compressor, the body of lubricant is sufficient to absorb and carry away the heat of compression.

9. In a cooling apparatus, the combination in a rigidly connected casing of a compressor chamber and a drive shaft chamber contiguous thereto, but sealed therefrom by a stuffing box within said drive shaft chamber; each of said chambers adapted to contain a quantity of lubricant sufficient to act as a seal for said stuffing box; a condenser chamber connected with said compressor chamber by valve controlled openings; a condensing coil within said condenser chamber; said condenser chamber adapted to contain a quantity of lubricant sufficient to act as a seal for said valve-controlled openings; and a valve pocket integral with and extending below the general level of the floor of the condenser chamber and having a float valve controlling an outlet therefrom.

10. In a cooling apparatus, the combination in a rigidly connected casing of a compressor chamber and a drive-shaft chamber contiguous thereto but sealed therefrom by a stuffing box within said drive-shaft chamber, each of said chambers adapted to contain a quantity of lubricant sufficient to act as a seal for said stuffing box; a condenser chamber connected with said compressor chamber by valve controlled openings; a condensing coil within said condenser chamber; said condenser chamber adapted to contain a quantity of lubricant sufficient to act as a seal for said valve controlled openings; a valve pocket integral with and extending below the general level of the floor of the condenser chamber and having a float valve controlling an outlet therefrom; an expansion coil outside of the casing; a flexible fluid connection from said outlet to said expansion coil; a flexible fluid connection from said expansion coil to the compressor chamber in said casing; a support for said casing and a resilient connection between the said casing and support.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

REUBEN E. BECHTOLD.
ALFRED W. MELLOWES.

Witnesses:
FREDRICK O. SMITH,
WESLEY J. CLAXTON.