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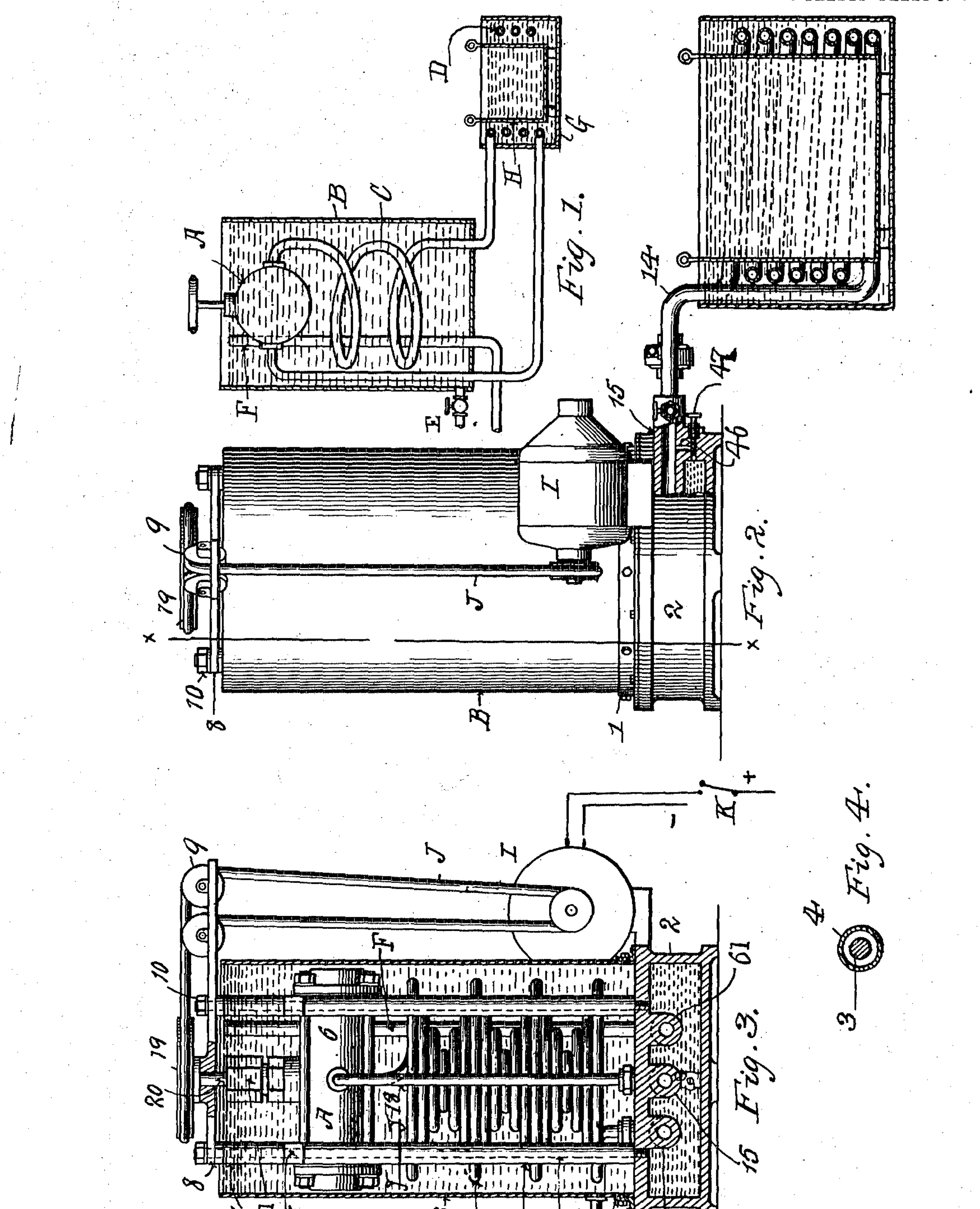
T. E. MURRAY & A. W. H. GRIEPE.

REFRIGERATING APPARATUS.

APPLICATION FILED NOV. 8, 1912.

1,120,220. Patented Dec. 8, 1914.

3 SHEETS—SHEET 1.



Witnesses:
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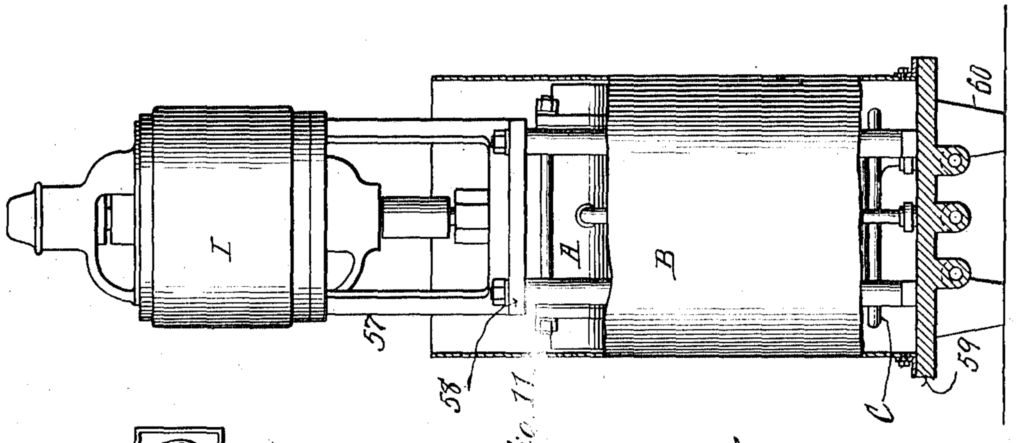

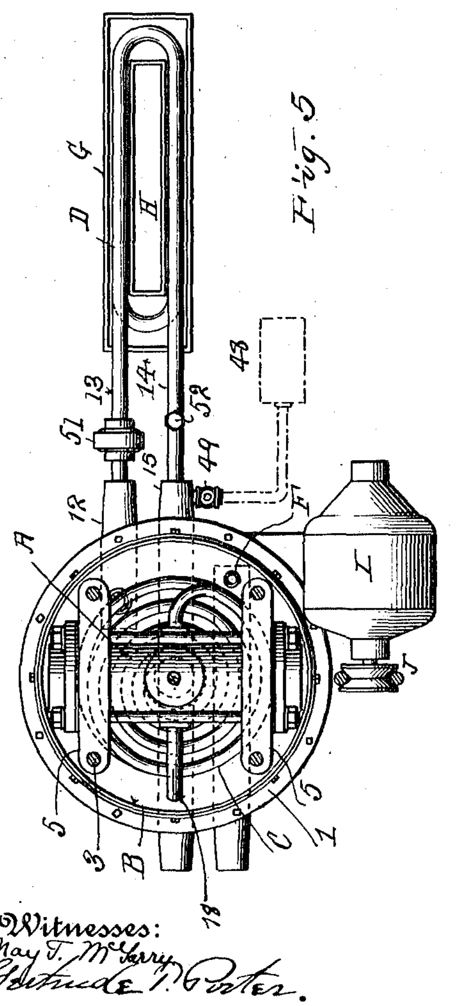

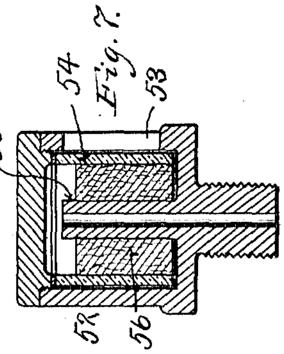

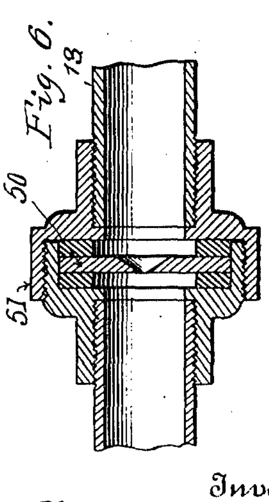

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3 SHEETS—SHEET 3.

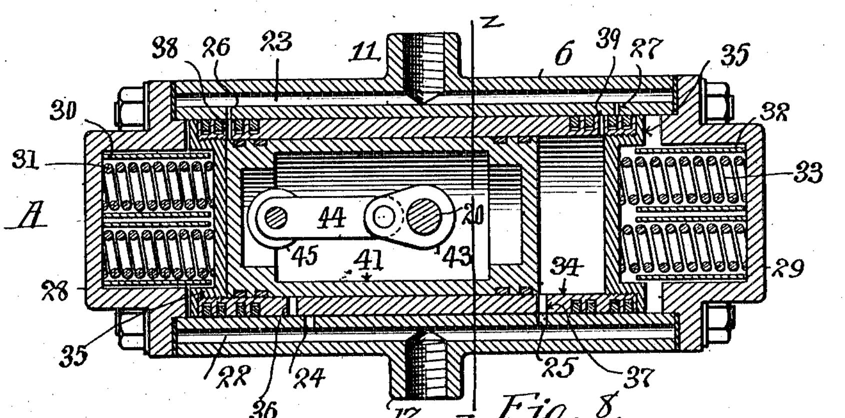

Fig. 8.

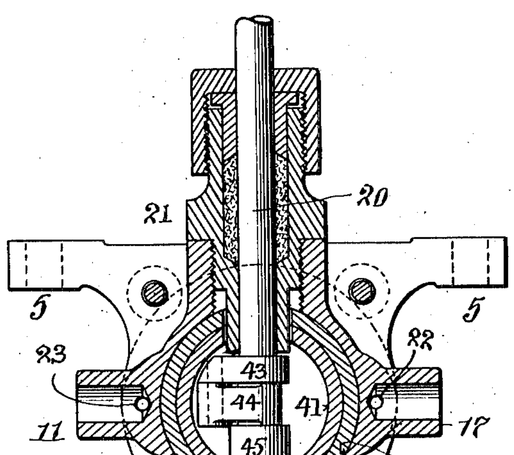

Fig. 9.

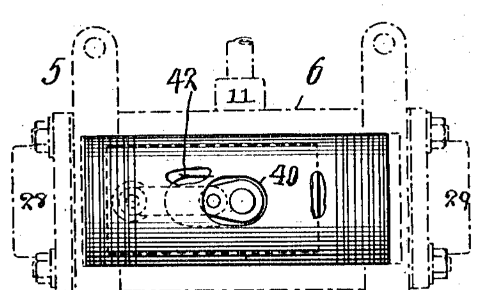

Fig. 10.

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UNITED STATES PATENT OFFICE.

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REFRIGERATING APPARATUS.

1,120,220. Specification of Letters Patent. Patented Dec. 8, 1914.

Application filed November 8, 1912. Serial No. 730,137.

To all whom it may concern:

Be it known that we, Thomas E. Murray and August W. H. Griepe, citizens of the United States, residing at New York, in the county of New York and State of New York, have invented a certain new and useful Improvement in Refrigerating Apparatus, of which the following is a specification.

The problem for solution is to devise a refrigerating apparatus which can be installed in a dwelling or apartment and be operated by the electrical current from an ordinary house outlet. The following requirements are involved: The apparatus must be of small dimensions; it must work automatically and without skilled care; it must be controllable by the simple opening or closing of the switch governing the current; it must use a refrigerating medium which is not dangerous to persons or property; it must work under a low and safe pressure; it must be capable of freezing water into blocks or cakes of ice of dimensions suitable for domestic use within a few hours; it must be noiseless; it must have no valves in the pipe system and no joints whereof one member is movable; it must be incapable of leakage either of gas from or of air into the circulating system.

The present invention accomplishes these requirements. It is a refrigerating apparatus of the vapor compression type, and therefore comprises a compression cycle system, wherein a compressor after compressing the gas forces it into a condensing coil where it is cooled, and then passes to a device which reduces the flow prior to its entrance into and expansion in an evaporator coil. Expansion in the coil abstracts heat from a non-congealable liquid, such as brine, and this in turn determines the freezing of the water in a suitable containing can immersed in said brine. From the evaporator the gas passes to the suction end of the compressor, thus completing the cycle.

The principal novel features are the construction of the system whereby the same is controlled simply by the switch which controls the electric motor; the construction of the circulating system with no joint, having a moving member, excepting the joint between the driving shaft and the compressor cylinder; the disposition of said cylinder and said joint below the orifice of the outlet duct and hence below the water level maintained in the condenser shell and in proximity to the orifice of said duct, so that any gas escaping at said joint will be at once entrained by the water flowing into and down said duct; the inclosure of the controlling valve for the compressor within the bore of the compressor cylinder, and of the fixed reducing device for the liquid flow prior to expansion within the duct leading to the evaporator; the reservoir for volatile liquid, from which an additional supply can be drawn to enrich the refrigerant in the system in case of weakening; the construction of the condenser, so that the shell can be removed without disturbing the compressor or coil inclosed therein, to permit ready access to said parts; the supporting of the compressor within the condenser shell independently of the coil; together with the various combinations and instrumentalities more particularly set forth and pointed out in the claims.

In the accompanying drawings—Figure 1 is a simplified vertical section of the apparatus illustrating the cycle performed therein. Fig. 2 is an elevation showing the evaporator, freezing can, and part of the base reservoir in section. Fig. 3 is a vertical section on line *x*, *x* of Fig. 2. Fig. 4 is a section of one of the compressor supports on line *y*, *y* of Fig. 3. Fig. 5 is a top view of the apparatus. Fig. 6 is an enlarged section of the regulating partition. Fig. 7 is a vertical section of the device for indicating the condition of the gas employed in the system. Fig. 8 is a longitudinal section of the compressor. Fig. 9 is a cross section of the compressor on line *z*, *z* of Fig. 8. Fig. 10 is a top view of the sleeve valve of the compressor, with parts broken away to show the piston and slot therein. Fig. 11 is an elevation of a modification of our compressor, showing the motor supported above the condenser.

Similar letters and numbers of reference indicate like parts.

Referring first to Fig. 1, which illustrates without details and in simplified form the compression cycle system employed, the compressor A is disposed in the condenser shell B, in which is also the condensing coil C, leading from compressor A to coil evaporator D. The return pipe from the evaporator leads to the inlet of compressor A. Water is admitted to condenser shell B, near the bottom thereof, at E, and escapes by the overflow pipe F which extends nearly to the top of the shell. The tank G containing evaporator D is supplied with brine or other non-congealable liquid, and receives a can H, in which is placed the water to be frozen. The volatilizable liquid is expanded in the evaporator D, and reduces the temperature of the brine in tank G to a degree sufficient to cause freezing of the water in can H. The gas from the evaporator passes to the compressor A, and thence is delivered to the condensing coil, where it is condensed to a liquid and returns to the evaporator, thus completing the cycle. We will now describe in detail our apparatus embodying this system: The shell B is of sheet metal, and is removably secured by bolts or other suitable means in a flange 1 bolted on the hollow base 2. Secured to the upper side of said base are four posts 3, upon which are placed sleeves 4, Fig. 4. The compressor A is provided with brackets 5, Figs. 3 and 9, preferably formed integrally with its cylinder 6, in which brackets are openings to receive the posts 3, so that said brackets when in place rest upon the upper ends of sleeves 4, and thus support the compressor A. On the posts 3, above the brackets 5, are short sleeves 7, and upon these sleeves rests the plate 8, in which are journaled the belt pulleys 9. The upper ends of posts 3 above plate 8 are threaded to receive the securing nuts 10. The outlet duct 11 of compressor A is united to the condensing coil C. The other end of coil C is connected to a duct 12 which may be integrally formed on the under side of the upper plate of the base 2, and said duct is connected by a pipe 13 to the upper end of coil evaporator D. The lower end of said evaporator is connected by pipe 14 to a duct 15 formed similarly to duct 12, and said duct communicates with the inlet duct 17 of compressor A by a vertical pipe 18.

Supported on a bracket on base 2 is an electric motor I, a belt J from which passes over pulleys 9, and a pulley 19 on a vertical driving shaft 20. Said shaft extends through plate 8 and through a stuffing-box 21 in the cylinder 6 of compressor A. The motor I is controlled by any suitable switch K, Fig. 3. The compressor A, the mechanism of which is driven by shaft 20, is constructed as follows, Figs. 8, 9, 10: In the wall of cylinder 6 are passages 22, 23. Passage 22 communicates with inlet duct 17 and has ports 24, 25. Passage 23 communicates with the outlet duct 11 and has ports 26, 27. Bolted to the cylinder ends are recessed heads 28, 29. Secured in head 28 are tubes 30, containing helical springs 31. Secured in head 29 are tubes 32, containing helical springs 33. The resiliency of springs 31 is to be the same as that of springs 33.

In the bore of cylinder 6 is a sleeve valve 34, having heads 35 recessed to receive the ends of springs 31, 33. In valve 34 are inlet ports 36, 37 and outlet ports 38, 39. Also in the upper side of said valve is an elongated slot 40, Fig. 10. The hollow cylindrical piston 41 is placed within valve 34 and is everywhere closed except at the top, where there is an elongated slot 42, Fig. 10.

The lower portion of stuffing-box 21 extends through the slot 40 in valve 34 and the slot 42 in piston 41. The shaft 20, passing through box 21, enters piston 41, and at its lower end carries a crank arm 43 which is pivoted to one end of a pitman 44, the other end of which pitman is pivoted to a lug 45 on the inner side of piston 41. By this mechanism, the rotation of shaft 20 by electric motor I causes the piston 41 to reciprocate in sleeve valve 34.

Assuming the parts to be in the position shown in Fig. 8, when the piston starts to the right, the sleeve 34 moves to the right until equilibrium is established between springs 31 and 33, and this movement will throw ports 25 and 37 and likewise ports 26 and 38 out of register. As the piston continues to move to the right, the pressure of the gas will force the sleeve 34 still farther to the right so that ports 24 and 36 and ports 27 and 39 will register. The compressed gas can then escape through passage 23 and outlet 11 to the condensing coil C, and a new charge of gas is drawn in through the registering ports 36 and 24. When the piston begins its reverse stroke, the springs 33 force the sleeve valve 34 to move to the left and follow the piston for a certain distance, so closing the inlet ports 36, 24 and outlet ports 27, 39. The gas is then compressed on the left hand side of the piston until the resistance of springs 31 is overcome, when the outlet ports 26, 38 and inlet ports 25, 37 open, thus bringing the parts back to the position of Fig. 1.

The base 1 may be made hollow, as shown in Figs. 2 and 3, to serve as a reservoir for an additional supply of volatilizable liquid. In order to fill this reservoir a passage 46, Fig. 2, is made in its wall, to connect said reservoir with duct 15, and a valve 47 is arranged in said passage. When the refrigerant is supplied to the system from a portable cylinder 48, indicated in dotted lines, Fig. 5, said cylinder may be connected to an offset on duct 15. During the filling of the pipe system, the valve 49 in said offset is opened, so that the reservoir in the base is filled at the same time. The valve 49 is then closed, and opened only as may be required to permit additional refrigerant to pass from the reservoir to the pipe system.

Instead of the usual expansion valve, we use a diaphragm 50, Fig. 6, of sheet brass of about $\frac{1}{8}$ inch in thickness, with an opening of invariable area less than that of the connection in which the partition is placed, and preferably flared out toward the evaporator. The diaphragm is secured in a standard screwed union 51, as shown. The opening permits only a small amount of liquid to pass to the evaporator, at each stroke of the compressor, said amount being sufficiently small to be readily evaporated in the expansion coil.

In event of weakening of the refrigerant in the system, it is desirable to provide means for recognizing that fact by simple inspection. To this end, we connect to the duct 14 a metal cup 52, Fig. 7, having a sight-opening 53 in its wall, closed by a cylindrical lining 54 of glass. Between the glass lining and a riser pipe 55, through which the gas is admitted, we place a body 56 of absorbent material, such as paper, dyed with a substance capable of changing color when acted upon by the gas employed, and of varying in color according to the condition of the gas. Thus we may use paper dyed with a litmus solution, which when acted upon by sulfur dioxid becomes blue. If the sulfur dioxid becomes weakened or adulterated by air containing moisture, the color will change from blue to purple, and will approximate more nearly to a reddish tone as the adulteration increases. The color of the paper is easily seen through the sight-opening 53, and furnishes an indication when the strength of the refrigerant in the system needs increasing.

Instead of mounting the electric motor I on a bracket on the base as in Fig. 1, we may place it upon standards 57, Fig. 11, connected by a plate 58 secured to the top of posts 3, the shaft of the motor I then being directly coupled to the driving shaft of the compressor A. The reservoir in the base may, if desired, be omitted, also as shown in Fig. 11, and a bed plate 59 with supporting legs 60 substituted. The overflow pipe F in condenser B is connected to a duct 61, similar to ducts 12, 15, which leads to waste.

It will be obvious that there is no exposed valve or other exposed joint having a moving member externally operable in any of the conduits through which the gas or liquid circulates, and hence there can be no leakage of gas from the system if the refrigerant be above atmospheric pressure, and no leakage of air into the system if the refrigerant be below atmospheric pressure.

The only valve in the system is the sleeve valve 34 which lines the cylinder bore and is wholly inclosed therein. It moves only after the piston (which in turn is inclosed in it) has sufficiently compressed the gas to over-balance the resistance of the opposing springs. This is after the piston has completed a large part of its stroke. Hence its movement is very small.

The only joint in which there is a moving member is between the stuffing-box 21 on cylinder 6 and the driving shaft 20. This is submerged in the water in the condenser shell B. Any possible leakage of gas at once mingles with the water and immediately passes with that water to the overflow pipe, where it is entrained and drawn off with the water current descending said pipe. Hence said gas cannot escape from said joint to the atmosphere. The condenser coils are also submerged and are disposed below the compressor, which is independently supported on the posts 3. Plate 8 and shell B, being readily removable, the compressor and coils are easily reached for repairs, without further disassembling of the apparatus.

The valveless construction permits of the successful use of sulfur dioxid as the refrigerant. This fluid has a pressure of 4.4 pounds below atmosphere at a temperature of 0° Fahr. Hence into a system in which leakage at joints or valves is possible, air is liable to enter, thus weakening the refrigerant. This condition has hitherto seriously interfered with the working of apparatus using said refrigerant. By the use of sulfur dioxid which is safe and cheap, we are enabled to get rid of the deleterious effects of ammonia fumes and carbon dioxid, and to work the machine at the very low pressure of from 35 to 40 lbs.

The construction of the compressor is such that the pressure will not increase since it is regulated only by the number of strokes per minute of the piston. This in turn is determined by the speed of the electric motor, which may be governed by any suitable means. Hence the whole system automatically operates as long as current supply is maintained to the motor, and is controlled solely by the switch K, Fig. 3, which controls said current supply.

We claim:

1. A refrigerating apparatus of the vapor compression type, comprising a condenser shell having an inlet and an outlet for water, a compression cylinder within said shell and below said water outlet, a piston in said cylinder, and a driving shaft for said piston, the joint between said shaft and the wall of said cylinder being submerged in the water in said shell.

2. A refrigerating apparatus of the vapor compression type, comprising a base, a condensing coil, a compressor, the said coil and compressor being independently supported on said base, a shell having an inlet and an outlet for water and inclosing said coil and compressor, and means for detachably securing said shell in position on said base.

3. A refrigerating apparatus of the vapor compression type, comprising a base, vertical posts thereon, a compressor cylinder, side brackets on said cylinder supported on said posts, a condensing coil disposed below said cylinder, and a shell having an inlet and an

outlet for water, inclosing said coil, posts and compressor cylinder and secured on said base.

4. A refrigerating apparatus of the vapor compression type, comprising a base plate, ducts extending across the under side thereof, a compressor, means for supporting said compressor on said base plate, a condensing coil between said compressor and said base plate having one end connected to the compressor outlet, and the other end, to one of said ducts, and a pipe connecting the other of said ducts to the inlet of said compressor.

In testimony whereof we have affixed our signatures in presence of two witnesses.

THOMAS E. MURRAY.
AUGUST W. H. GRIEPE.

Witnesses:
GERTRUDE T. PORTER,
MAY T. MCGARRY.