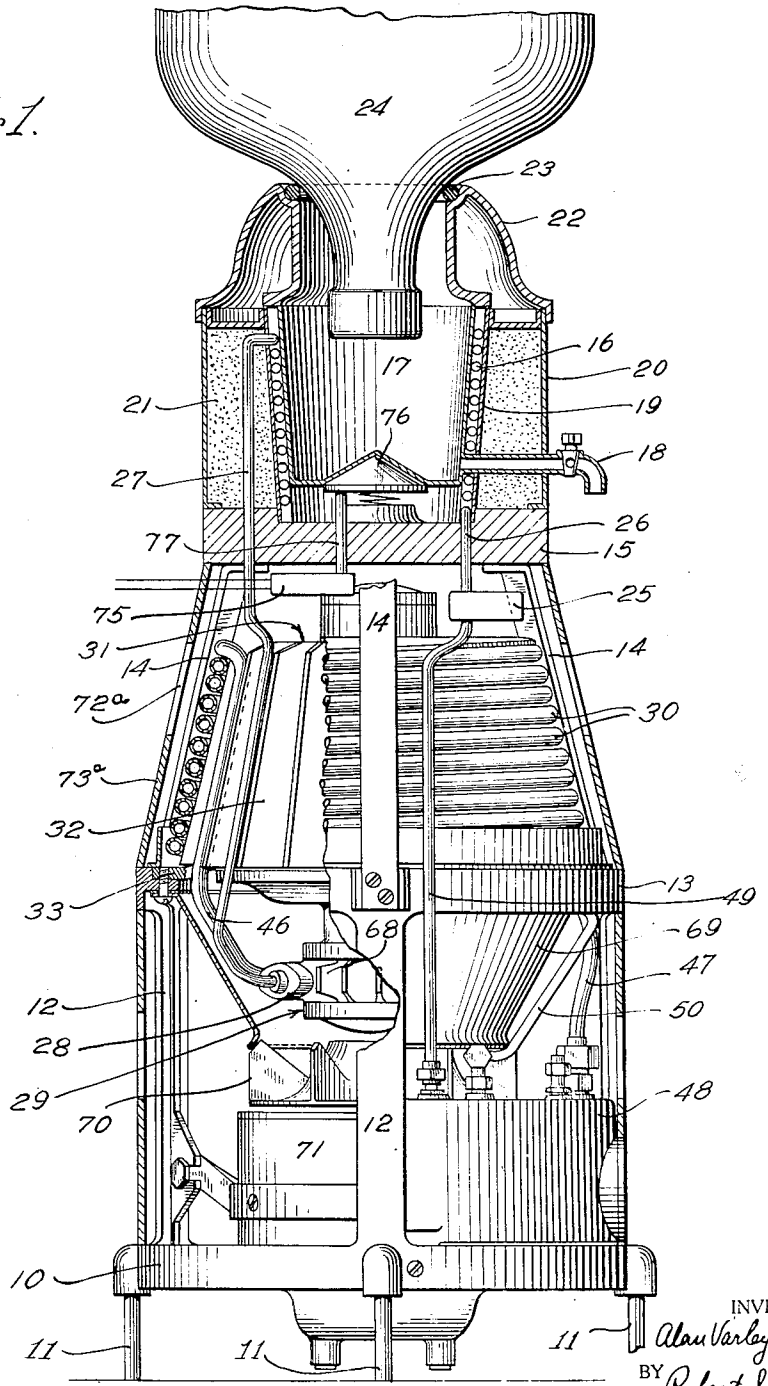
April 9, 1929. A. V. LIVINGSTON 1,708,625

REFRIGERATION

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Fig. 1.



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Fig. 2.

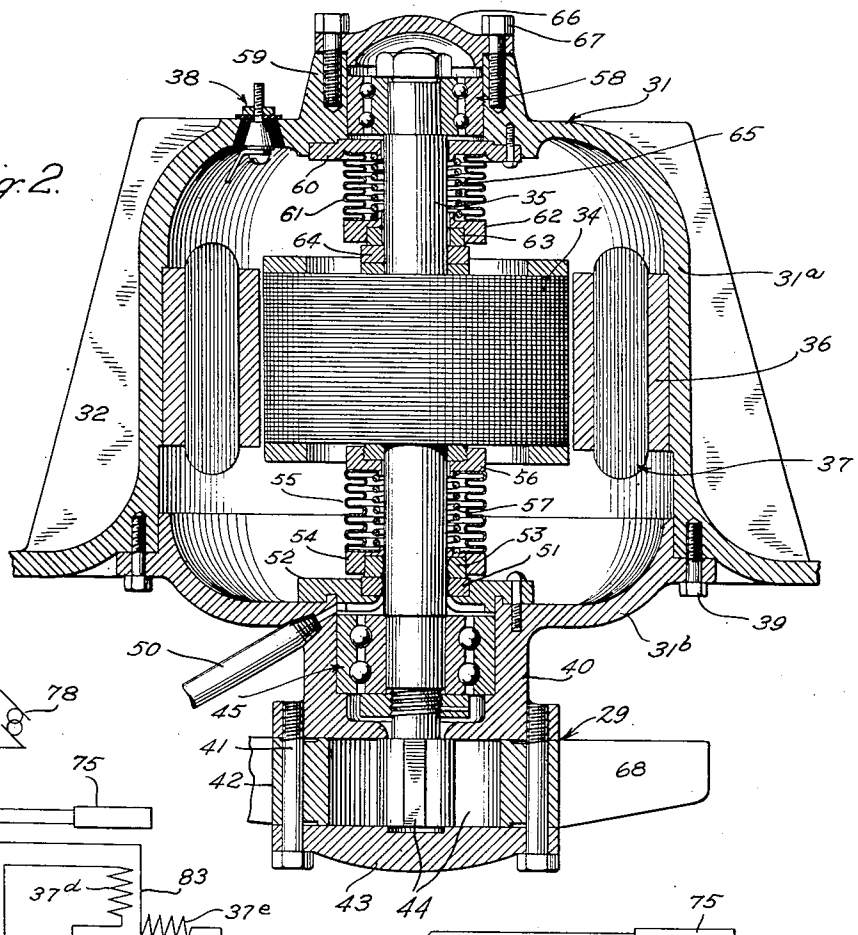


Fig. 4.

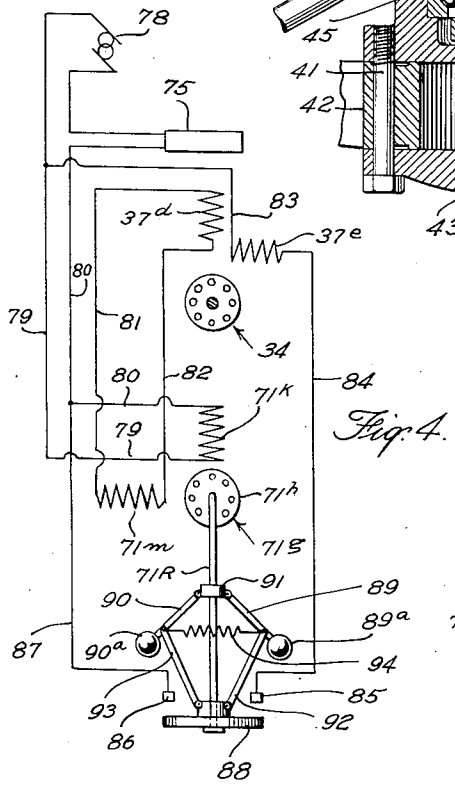
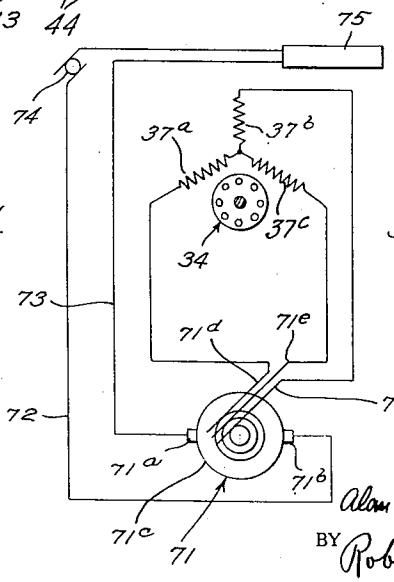


Fig. 3.



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Patented Apr. 9, 1929. 1,708,625

UNITED STATES PATENT OFFICE.

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REFRIGERATION.

Application filed March 7, 1925. Serial No. 13,702.

This invention relates to cooling or refrigerating apparatus and more particularly to apparatus of this character intended for household use.

One of the objects of this invention is to provide a thoroughly practical and dependable refrigerating apparatus capable of reliable and efficient action throughout long-continued use. Another object of this invention is to provide apparatus of the above character which will be of simple construction and hence attain greater reliability of operation and which will be capable of compact arrangement and ready and convenient assembly. Another object is to provide a refrigerating apparatus of the above type of automatic action throughout, and in certain parts of which the desirable characteristics of polyphase electric driving motor may be incorporated even though the supply of energy may be of such a character as is available over a two-wire circuit with which electrical energy is usually distributed. Another object is to provide an efficient and thoroughly reliable power drive for refrigerating apparatus of the above-mentioned character and further to provide such refrigerating apparatus capable of long-continued use in practice without manual attention. Other objects will be in part obvious, or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter described and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings,

Figure 1 is a side elevation of the apparatus in assembled relation, certain parts being shown in section and certain other parts being broken away in order to show the construction and arrangement more clearly.

Figure 2 is a central vertical sectional view of a motor-compressor unit forming part of the apparatus shown in Fig. 1, this sectional view of Figure 2 being shown on a larger scale.

Figure 3 is a diagrammatic representation of the preferred form of driving units of the apparatus, of the control apparatus and of the circuits therefor, and

Figure 4 is a diagrammatic representation of a modified form which the driving units of the apparatus, of the control devices, and of the circuits therefor, may take.

Similar reference characters refer to similar parts throughout the several views of the drawing.

As conducive to a clearer understanding of certain features of this invention and referring first to Figure 1 of the drawings, it may first be noted that the cooling or refrigerating apparatus is shown in Figure 1 in the form of a water cooler arranged for dispensing cooled drinking water; in Figure 1 the apparatus will be seen to be suitably mounted upon and supported by a skeleton frame work. This skeleton frame work may comprise a bottom ring-member 10 provided with suitable legs 11 adapted to rest upon the floor and having connected thereto in any suitable manner a number of vertically extending upright members 12 supporting at their upper ends the ring-like frame member 13. From this ring-like member 13 there extend upwardly but inclined inwardly a suitable number of supporting members 14 at the upper ends of which is secured a plate member 15. This plate member 15 carries the heat exchange device and the latter may comprise a cooling or expansion coil 16 arranged in any suitable manner to be in intimate thermal contact with a container 17, the latter being provided with a suitable outlet or faucet 18 for withdrawing the cooled contents therefrom. The cooling coil 16 and the container 17 may be housed, or supported, within a suitable retaining or supporting container 19 between which and an outer casing member 20, supported upon the plate member 15 is packed a suitable heat insulating material generally indicated at 21.

Resting upon the upper ends of the members 19 and 20 is a ring-like member 22 shaped at its upper end to provide a seat for a rubber ring 23, thus to receive and hold in inverted position a water bottle 24, the neck of which extends downwardly into the container 17 to maintain a substantially constant amount of water or liquid to be cooled within the container 17.

The expansion coil 16 is arranged to have expanded into it a suitable refrigerant or cooling fluid which may take the form, for example, of sulphur dioxide. The sulphur dioxide or refrigerant may be expanded into the cooling coil 16 from an expansion device generally indicated at 25 and connected to the

coil 16 as by the pipe 26; after passing through the coil 16 and obtaining its heat of evaporation from the contents of the container 17 the relatively warm refrigerant passes from the coil 16 through the pipe 27 to the intake side or port of a compressor generally indicated at 29, there to be compressed, subsequently cooled and liquefied, as in the condenser coils generally indicated at 30, and thus to be conditioned for the repetition of the above-mentioned cycle.

The compressor 29 is preferably enclosed with its prime mover within a fluid-tight casing generally indicated at 31, this casing being provided with a suitable number of radially extending heat radiating fins 32 and provided with suitable lugs 33 adapted to rest upon and to be secured to the ring-like member 13 of the main frame. These heat radiating fins 32 are preferably of progressively greater expanse in a radial direction as their lower ends are approached, and may conveniently form a tapered support about which the condenser coils 30 are positioned.

In order that the construction and arrangement of the prime mover-compressor unit may be more clearly understood, these parts, together with certain details thereof, are shown on enlarged scale on vertical section in Figure 2. Turning now to Figure 2, the fluid-tight casing generally indicated at 31, will be seen to comprise an upper shell 31^a within which is housed the driving motor preferably taking the form of a polyphase induction motor. In this preferred form, the motor may comprise a rotor 34 supported upon a shaft 35 for rotation therewith and a stator, the magnetic-circuit-forming part thereof being indicated at 36, and the polyphase windings being generally indicated at 37. With this arrangement, the motor is free from rotating contacting portions, such as slip rings or commutators, the advantages of which arrangement will be pointed out more clearly hereinafter. The energized windings will be seen to be supported upon the stationary part of the motor, and electrical energy may be supplied thereto through a suitable number of binding posts passing through the shell 31^a in fluid-tight relation therewith. This binding post construction may take any suitable form, and one of these binding posts is generally indicated at 38.

The lower end of the shell 31^a is closed by means of a flange member 31^b secured to the shell 31^a as by means of the screws 39, and upon the underside of the flange member 31^b is formed a lower compartment in which are housed the operative portions of the compressor generally indicated at 29. Thus, the member 31^b may be extended downwardly as at 40, and upon this extension 40 are secured, as by the cap screws 41, the outer casing of the compressor 29, a cylindrically shaped member 42 and an end-closing cap 43 to form a lower compartment for the fluid-tight casing 31 within which is housed and made operative the impellor members 44 of the compressor, the latter being thus preferably of the rotary type. The impellor members 44 are mounted upon the lower end of the shaft 35 of the motor 34—36, the lower end of the shaft 35 being supported in a suitable ball bearing generally indicated at 45.

The ball bearing 45 and the moving parts of the compressor 29 are lubricated by means of a suitable lubricant which may take the form of glycerine or of a suitable oil if the refrigerant is ethyl-chloride or sulphur-dioxide, respectively. During the operation of the compressor, lubricant will be passed off with the compressed refrigerant, and passing upwardly through the pipe 46 (see Fig. 1) connected to the outlet of the compressor 29 passes with the refrigerant through the condenser coil 30; a suitable cooling fluid, as hereinafter more clearly described, is passed in thermal contact with the condenser 30 so as to condense or liquefy the compressed refrigerant, the condensed refrigerant passing with the lubricant from the condenser coil 30 through the pipe 47 into a receiver 48 suitably supported upon the lower ring-like member 10 of the main frame. In this receiver 48 a separation takes place between the condensed refrigerant and the lubricant by reason of their difference in density, a pipe 49 leading from below the refrigerant level in the receiver 48 to the expansion device 25 to supply the cooling coil 16 with expanded refrigerant; a pipe 50, extending from below the lubricant level within the receiver 48 returns the lubricant to the ball bearing 45 and the moving parts of the compressor (see Fig. 2). Thus, these last-mentioned moving parts may be dependably supplied with lubricant.

The upper compartment of the fluid-tight casing 31 and within which upper compartment is housed the motor 34—36 is sealed from the lower compartment of the casing 31 within which lower compartment is housed the compressor. This sealing arrangement preferably takes the form of a hardened steel bearing ring 51 fixedly seated within a plate member 52 secured to the inner side of the flange member 31^b. In rotating contact with this bearing ring 51 is a like bearing ring 53 fixedly seated within the supporting member 54 secured to the lower end of an expansible sleeve member 55; the upper end of this sleeve 55 is secured to the collar 56 fixedly secured in fluid-tight relation to the shaft 35. The expanding tendency of the sleeve 55 may be supplemented, if desired, by means of a coil spring 57 interposed between the members 54 and 56; thus, as the motor shaft 35 rotates, the bearing rings 53 and 51 are held in fluid-tight relation and thus prevent the passage of lubricant or of compressed refrigerant from the compressor compartment into

the motor compartment. Should any refrigerant escape into the upper compartment of the casing 31, it is trapped within this upper compartment, there being ultimately established a balance of pressures between the gas within the upper compartment and the gas undergoing compression within the compressor compartment. The motor being free from exposed and relatively moving contacts is incapable of producing any sparking, and is thus prevented from initiating combustion or explosion and hence endangering the apparatus.

The upper end of the shaft 35 is supported by a ball bearing generally indicated at 58, the outer race of which is supported within the upwardly directed extension 59 of the shell 31a. Secured to the under and inner end side of the extension 59 is a plate member 60 to which is secured in fluid-tight relation an expansible sleeve 61 carrying at its lower end in the supporting member 62 a bearing ring 63, of hardened steel, for example. This bearing ring 63 is held against a bearing ring 64, rigidly secured to the shaft 35, by the expanding tendency of the sleeve 31, the action of which may be supplemented by means of the coil spring 65, if desired. The relatively rotating bearing rings 63—64 thus form an effective seal to prevent movement of refrigerant gas, should any be contained within the upper compartment of the casing 61, into the upper bearing housing and likewise prevent movement in reverse direction of lubricant. The lubricant for the bearing 58 preferably takes the form of a heavy oil or grease, a cap 66 permitting the packing of the bearing with an ample quantity of this lubricant. The cap 66 is held in position by means of the cap screws 67 and forms a fluid-tight seal for the upper end opening of the casing 31. Thus, escape of refrigerant is effectively prevented, while at the same time an effective lubrication of the moving parts is assured throughout long continued periods of use.

The parts forming the lower compartment of the fluid-tight casing 31, and within which lower compartment are housed the moving parts of the compressor, are provided with radially extending radiating fins 68 (see also Fig. 1). Suspended from the ring member 13 of the frame is a sheet metal guide member 69 in the shape of a frustum of a cone, open at the top and at the bottom. A blower or fan 70 is positioned at the lower opening of the guide member 69, and upon being rotated by the prime mover generally indicated at 71 acts to throw air outwardly in a substantially transverse direction, thus causing a rarification of the atmosphere within the guide member 69, and thus causing a downward movement of air through the guide member 69. By a like action, the air is drawn inwardly through suitable openings 72a in the upper casing member 73a which surrounds the condenser coil 30, and thus the air is passed in thermal contact with the condenser coils 30 to bring about a condensation of the refrigerant therein, in thermal contact with the radiating fins 32 of the casing 31, thus to prevent abnormal rises in temperature in the compressor-motor, and also in thermal contact with the compressor compartment itself. The air discharged by the fan 70 may find its exit through the bottom of the apparatus.

The prime mover 71 for driving the fan 70 is suitably supported within the lower portions of the frame, and is preferably mounted so that its shaft extends vertically to permit the direct mounting upon the shaft of the fan 70. The prime mover 71 preferably takes the form of an electric rotary device arranged to have a direct current input and a polyphase output. It may thus be energized from a direct current source of supply which may be connected to its input side, whereas the output side thereof is directly connected to the polyphase energizing windings 37 of the compressor motor 34—36 (see Fig. 2). Preferably, this prime mover 71 takes the form of an inverted converter, and in Figure 3 this prime mover is thus diagrammatically indicated. Turning now to Figure 3, it will be seen that this rotary device or prime mover 71 has a direct current input represented by the brushes 71a and 71b coacting with the commutator 71c. Conductors 72 and 73 lead to a suitable direct current source of supply 74 through a switch diagrammatically shown at 75. This switch is preferably thermostatically controlled, and in Figure 1 will be seen to be connected to a thermostatic vessel 76 through a pipe 77. The thermostatic vessel 76 is arranged to be in intimate thermal contact with the contents of the container 17, so as to be responsive to temperature changes therein, and the hydraulic system formed by the vessel 76, the pipe 77 and parts of the switch 75 may be charged with a suitable liquid such as ethyl-chloride, the changes in vapor tension of which in accordance with temperature changes being made effective to open or close the circuit leading to the source of direct current 74. In this manner the supply of energy to the apparatus may be controlled in accordance with the temperature changes of the substance to be cooled.

Returning to Figure 3, the rotary device 71, as above noted, taking the form preferably of an inverted converter, will be seen to have a polyphase output diagrammatically illustrated by the brushes 71d, 71e and 71f, each coacting with an appropriate slip ring. Preferably, the polyphase output is three-phase and the polyphase windings 37 of the compressor motor 34—36 are preferably also three-phase; these motor windings are indicated in Figure 3 at 37a, 37b and 37c, and are shown as Y-connected. The rotor is indicated at 34. From each brush a suitable con-

ductor leads to the free terminal of one winding of the polyphase motor.

As a temperature increase arises so as to effect a closure of the switch 75, the inverted converter 71 is at once set into operation and first initiates the movement of the cooling fluid or air past the condenser coil, the radiating fins 32 and the compressor 29; as soon as the inverted converter 71 achieves a substantial speed, the polyphase output thereof through the brushes 71^d, 71^e and 71^f at once energizes the polyphase windings of the compressor motor 34—36, and the compressor motor is set in operation. The motor being polyphase is self-starting, and it will be noted that, being directly connected to the inverted converter, the starting current and hence the starting action of the polyphase motor progressively increases as the speed of the rotary device 71 increases to its normal value. Thus, the self-starting characteristics of the polyphase motor are used to good advantage, and a great simplicity of arrangement conducive not only to simplicity of construction, but also to great reliability of action is achieved.

As soon as the refrigerant has been put through the cycle hereinbefore set forth for a sufficient length of time to bring the temperature of the substance to be cooled to the desired value, the switch 75 is operated to open the circuit leading from the direct current source of supply 74. The rotary device 71 is thus stopped, and similarly the supply of polyphase energy to the compressor motor cut off.

It should be pointed out, however, that certain other marked advantages are achieved by this arrangement; among these may be noted the fact that the operation of the compressor motor is dependent directly upon the operation of the rotary device 71 which drives the fan 70 for passing the cooling fluid in thermal relation to the condenser coil and other parts. Thus, should a failure of the prime mover driving the fan 70 take place for any reason, the operation of the compressor motor is halted at once so that continued compression of refrigerant without the attendant cooling of the compressed refrigerant cannot take place. Thus, the apparatus is safeguarded against undesired action while as already hereinbefore noted the polyphase character of the compressor motor permits the elimination of danger of explosion of refrigerant gas or a mixture thereof with the air within the upper compartment of the fluid-tight casing 31.

Should the source of energy supply be single phase alternating current, the driving arrangements may take the form diagrammatically shown in Figure 4. In this figure, the source of single phase alternating current is indicated at 78 and the two-wire circuit leading therefrom may comprise the conductors 79 and 80 with the thermally responsive switch 75 interposed in one of these conductors. The rotary device 71 which drives the fan 70 takes the form preferably of a two-phase induction motor generally indicated at 71^g; this motor 71^g may comprise the rotor 71^h and the two stator windings 71^k and 71^m. These windings are displaced one with respect to the other by ninety electrical degrees, so that if they were to be energized from a two-phase source of alternating current, the requisite rotating magnetic field to initiate the starting of the motor will be produced. If such a motor, on having been brought up to substantially full speed, were to have one of the stator windings open-circuited, it will continue operation on the remaining or single phase winding, but will induce in the open-circuited winding an alternating electromotive force which will be displaced from that energizing the operating winding by ninety electrical degrees. This one winding may thus be utilized as a source of alternating E. M. F. which will be in quadrature with that of the force energizing the one winding of the motor.

The rotary device 71 has been above assumed, for the sake of clearer explanation, to take the form of a two-phase induction motor; it may, however, be embodied in the form of a single phase motor having a main winding, such as the winding 71^k and an auxiliary or starting winding which may take the form of the winding 71^m. These two windings are, as above noted, suitably displaced electrically to bring about the action above described more clearly in connection with the assumed two-phase form of the motor.

The one winding 71^k is connected directly to the main line conductors 79—80 so that upon a closure of the thermostatically controlled switch 75 the winding 71^k will be energized. To produce a current flow in the electrically displaced winding 71^m, the latter is connected to a suitable impedance acting in effect to short-circuit the winding 71^m upon itself but through this impedance. Specifically, conductors 81 and 82 connect the winding 71^m to the stator winding 37^d of the compressor motor, the latter taking the form preferably of a two-phase motor and having hence in addition to the rotor 34 and the one stator winding 37^d, another stator winding 37^e. These two stator windings are preferably displaced from one another by ninety electrical degrees, and are preferably mounted upon the stator. The one winding 37^d is thus utilized to effect the short-circuiting of the auxiliary or starting winding 71^m of the motor 71^g, and with this condition existing and the main winding 71^k of the motor 71^g energized, the motor 71^g commences operation. The induced currents in the circuit of the starting winding 71^m act together with the energizing winding 71^k to produce the

necessary rotating field to bring the motor 71^g up to substantially normal speed, and as the motor continues to operate at this speed, the voltage induced in the quadrature winding 71^m will energize the quadrature winding 37^d of the compressor motor with a voltage which will be substantially quadrature with the voltage of the main source of supply.

If the other winding 37^e of the compressor motor were now to be energized by the alternating E. M. F. of the main line, the compressor motor will at once start and continue operation as a two-phase motor. The one terminal of the winding 37^e will be seen to be connected by conductor 83 to the main line 79; the other terminal of this winding is connected by conductor 84 to a stationary contact 85. Another contact 86 is connected by conductor 87 to the other main line conductor 80.

Coacting with the contacts 85—86 is a contact disk 88 slidably mounted upon the shaft 71^r of the motor 71^g; the movement of the contact disk 88 into bridging relation with respect to the fixed contacts 85—86 is controlled by a centrifugal device operated by the motor 71^g and diagrammatically shown as supported upon and by the shaft 71^r of the motor 71^g. This device may include a pair of arms 89—90, hingedly secured to a collar 91 fixed upon the shaft 71^r and suitably weighted at their outer ends as at 89^a and 90^a. Adjacent their outer ends the arms 89—90 are hingedly connected to links 92—93 respectively, the other ends of these links being connected to the contact disk 88. A suitable spring 94 connecting the arms 89—90 tends to urge these arms inwardly and hence urge the contact disk 88 downwardly (as viewed in Fig. 4) and hence in a direction away from the contacts 85—86.

As soon, however, as the motor 71^g has attained substantially full speed, as hereinabove described, the centrifugal forces acting through the weights 89^a—90^a overcome the spring and move the contact disk 88 upwardly to bridge the contacts 85—86 and to hold these parts in good electrical contact throughout the further operation of the motor. The bridging of contacts 85—86 by contact disk 88 completes the circuit of the stator winding 37^e of the compressor motor, and the other stator winding 37^d of this motor being already energized by a voltage which is in quadrature substantially with that of the source to which the winding 37^e is now connected, the resultant rotating field produced in the compressor motor stator effects at once the starting of the compressor motor, the latter thereafter continuing to operate as a two-phase motor.

The motor 71^g, acting as a phase converter, will thus be seen to be permitted freely to achieve substantially normal speed without having imposed upon it an electrical load such as would be imposed upon the phase converter if the main winding 37^e of the compressor motor 34 were not held open-circuited at contacts 85—86 as the motor 71^g starts and increases in its speed; but as soon as the motor 71^g has achieved normal speed and has thus been placed in condition to carry an electrical load, the centrifugally controlled device completes the circuit of the main winding 37^e of the compressor motor 34 so that the latter may be set in operation. It will also be noted that, should the motor 71^g fail to continue in its operation after once being started, the main winding 37^e of the motor 34 is at once deenergized at the contacts 85—86, thus to prevent the motor 34 from continuing operation as a single phase motor.

The compressor motor being thus supplied with quarter-phase energy, is self-starting and at once is placed in operation. And it will be noted that before the compressor motor is set in operation the cooling action of the fan 70 upon the condenser coil 30 and associated parts has already been initiated. Both driving devices continue operation, putting the refrigerant through the cycle hereinbefore described, and as soon as the temperature has been brought down to the desired degree, the switch 75 is operated to open the circuit leading to the source of alternating current supply 78. The energizing winding 71^k of the motor 71^g thus becomes deenergized, the motor stops, and the circuit of the polyphase motor opened by the centrifugally-acting device, it being noted, however, that the deenergization of the winding 71^k of the motor 71^g (by the opening of the switch 75) cuts off the supply of polyphase energy to the compressor motor. It will also be seen that the advantageous characteristics of the polyphase motor for driving the compressor as it is related thereto, are retained in a thoroughly practical way, achieving certain of the advantages already noted in connection with the arrangement shown in Figure 3, and that a failure of the motor driving the cooling fan 70, for any reason, at once effects a halting of the operation of the compressor motor so as to avoid the dangers attendant upon continued compression of refrigerant without accompanying cooling of the compressed refrigerant.

It will thus be seen that there has been provided in this invention an apparatus in which the several objects hereinbefore noted as well as many thoroughly practical advantages are achieved. It will be seen that the apparatus is of compact construction, thoroughly dependable and reliable action, and well adapted to meet the varied conditions of hard and long-continued practical use.

As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that

all matter hereinbefore set forth or shown in the accompanying drawings, is to be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In apparatus of the nature of that herein described, in combination, a compressor, a polyphase induction motor for driving said compressor, means forming a substantially fluid-tight casing having included therein said compressor and said motor, a condenser for receiving compressed fluid from said compressor, means for passing a cooling fluid in thermal contact with said condenser, means for driving said last-mentioned means and for supplying said motor with energy comprising rotary means adapted to be operated from a two-wire source of current and having a polyphase output connected to said motor for driving the latter, a cooling device adapted to have expanded into it condensed fluid from said condenser, and means responsive to temperature of said cooling device for controlling the operation of said last-mentioned driving means.

2. In apparatus of the nature of that herein described, in combination, a compressor, a polyphase induction motor for driving said compressor, means forming a substantially fluid-tight casing having included therein said compressor and said motor, a condenser for receiving compressed fluid from said compressor, means for passing a cooling fluid in thermal contact with said condenser, means for driving said last-mentioned means comprising an inverted converter adapted to derive energy from a direct current source and to supply polyphase energy to said motor, a cooling device adapted to have expanded into it condensed fluid from said condenser, and means responsive to the temperature maintained by said cooling device for controlling the operation of said inverted converter.

3. In apparatus of the nature of that herein described, in combination, a compressor, an alternating current motor for driving said compressor, means forming a substantially fluid-tight casing having included therein said compressor and said motor, a condenser for receiving compressed fluid from said compressor, means for passing a cooling fluid in thermal contact with said condenser, means for driving said last-mentioned means comprising electric rotary means having a direct current input to receive energy from a direct current source of energy and having an alternating current output for supplying said motor with alternating current, a cooling device adapted to have expanded into it condensed fluid from said condenser, and means responsive to the temperature produced by said cooling device for controlling the operation of said electric rotary means.

4. In apparatus of the nature of that herein described, in combination, a compressor, an alternating current motor for driving said compressor, means forming a substantially fluid-tight casing having included therein said compressor and said motor, a condenser for receiving compressed fluid from said compressor, means for passing a cooling fluid in thermal contact with said condenser, means for driving said last-mentioned means comprising an inverted converter adapted to derive energy from a direct current source and to supply alternating current to said motor, a cooling device adapted to have expanded into it condensed fluid from said condenser, and means responsive to the temperature produced in said cooling device for controlling the operation of said inverted converter.

5. In apparatus of the nature of that herein described, in combination, a compressor, a polyphase induction motor having its stator provided with polyphase windings and adapted to drive said compressor, means forming a substantially fluid-tight casing having included therein said compressor and said motor, a condenser for receiving condensed fluid from said compressor, means for passing a cooling fluid in thermal contact with said condenser, electrically operated rotary means for driving said last-mentioned means adapted to be operated from a two-wire source of current supply and having a polyphase output for supplying polyphase energy to the stator windings of said motor, a cooling device adapted to have expanded into it condensed fluid from said condenser, and means responsive to the temperature produced in said cooling device for controlling the supply of energy to said rotary means from said two-wire source of current supply.

6. In apparatus of the nature of that herein described, in combination, means forming a supporting frame and having supported thereon means forming a substantially fluid-tight casing means, a compressor included within said casing means, an alternating current motor included within said casing means for driving said compressor, a condenser for receiving compressed fluid from said compressor means for passing a cooling fluid in thermal contact with said condenser, means supported by said frame for driving said last-mentioned means comprising an electrically driven rotary means adapted to derive energy from a two-wire source of supply and having an alternating current output for supplying energy to said alternating current motor within said casing, a cooling device adapted to have expanded into it condensed fluid from said condenser, and means responsive to the temperature produced by said cooling device for controlling the flow of energy from said two-wire source to said rotary means.

7. In apparatus of the nature of that herein described, in combination, a compressor,

a polyphase motor for driving said compressor, means for passing a cooling fluid in thermal contact with said compressor, and electrically operated rotary means adapted to be operated from a two-wire source of current and having a polyphase output for supplying polyphase energy to said motor.

8. In apparatus of the nature of that herein described, in combination, a compressor, a polyphase motor for driving said compressor, means for passing a cooling fluid in thermal contact with said compressor, and means for driving said last-mentioned means comprising electrically operated rotary means having a direct current input for receiving energy from a direct current source of supply and having a polyphase output for supplying energy to said polyphase motor.

9. In apparatus of the nature of that herein described, in combination, a compressor, an alternating current motor for driving said compressor, means for passing a cooling fluid in thermal contact with said compressor, and means for driving said last-mentioned means comprising an inverted converter having a direct current input and an alternating current output for supplying energy to said alternating current motor.

10. In apparatus of the nature of that herein described, in combination, a compressor, an alternating current motor having its energizing windings disposed upon the stator thereof, means forming a substantially fluid-tight casing having included therein said compressor and said motor, means for passing a cooling fluid in thermal contact with said compressor, and electrically operated rotary means for driving said last-mentioned means having a direct current input for receiving energy from a direct current source of supply and having an alternating current output for supplying energy to said alternating current motor.

11. In apparatus of the nature of that herein described, in combination, a compressor, a polyphase motor having its energizing windings disposed about the stator thereof, means forming a substantially fluid-tight casing and having included therein said compressor and said motor, means for passing a cooling fluid in thermal contact with said compressor, and means for driving said last-mentioned means comprising electrically operated rotary means adapted to receive energy from a two-wire source of current and having a polyphase output for supplying the windings of said motor with polyphase alternating current.

12. In apparatus of the nature of that herein described, in combination, a compressor, a polyphase motor for driving said compressor and having its energizing windings disposed upon the stator thereof, means forming a substantially fluid-tight casing and having included therein said compressor and said motor, means for passing a cooling fluid in thermal contact with said compressor, and means for driving said last-mentioned means comprising an inverted converter adapted to receive energy from a direct current source and to supply the windings of said motor with polyphase alternating current.

13. In apparatus of the nature of that herein described, in combination, a compressor, a condenser for receiving compressed refrigerant from said compressor, means for passing a cooling fluid in thermal contact with said condenser, an electric rotary device for driving said last-mentioned means having input and output terminals, said device being arranged to receive at its input terminals energy in one form and to deliver at its output terminals energy in different form, and a motor for driving said compressor and arranged to receive energy from the output terminals of said rotary device.

14. In apparatus of the nature of that herein described, in combination, a compressor, a condenser for receiving compressed refrigerant from said compressor, means for passing a cooling fluid in thermal contact with said condenser, an electric rotary device for driving said last-mentioned means having input and output terminals, said device being arranged to receive at its input terminals energy in one form and to deliver at its output terminals energy in different form, a motor for driving said compressor and arranged to receive energy from the output terminals of said rotary device, a heat exchange device adapted to have expanded into it condensed refrigerant from said condenser, and means responsive to the temperature of said heat exchange device for controlling the operation of said electric rotary device.

15. In apparatus of the nature of that herein described, in combination, a compressing device, a condenser for receiving compressed refrigerant from said device, a device for passing a cooling fluid in thermal contact with said condenser, driving means for one of said devices comprising an electric rotary device having input terminals and output terminals and arranged to receive at its input terminals electrical energy in one form and to deliver at its output terminals energy in different form, and means for driving the other of said devices comprising a motor receiving energy from the output terminals of said electric rotary device.

16. In apparatus of the nature of that herein described, in combination, a compressing device, a condenser for receiving compressed refrigerant from said device, a device for passing a cooling fluid in thermal contact with said condenser, driving means for one of said devices comprising an electric rotary device having input terminals and output terminals and arranged to re-

ceive at its input terminals electrical energy in one form and to deliver at its output terminals energy in different form, means for driving the other of said devices comprising a motor receiving energy from the output terminals of said electric rotary device, a heat exchange device adapted to have expanded into it condensed refrigerant from said condenser, and means responsive to the temperature of said heat exchange device for controlling the operation of said electric rotary device.

17. A refrigerating system having included therein two mechanically actuated devices, one of which is a compressor, an alternating current motor for driving one of said devices, and means for driving the other of said devices, said means comprising an electric rotary device having a direct current input for receiving energy from a direct current source of supply and having an alternating current output for supplying energy to said alternating current motor.

18. A refrigerating system having included therein two mechanically actuated devices, one of which is a compressor, a polyphase motor for driving one of said devices, and means for driving the other of said devices comprising electrically operated rotary means adapted to receive energy from a two-wire source of current supply and having a polyphase output for supplying said motor with polyphase alternating current.

19. A refrigerating system having included therein two mechanically actuated devices, one of which is a compressor, a polyphase motor for driving one of said devices, and an inverted converter for driving the other of said devices, said converter having a polyphase output for supplying energy to said polyphase motor.

20. A refrigerating system having included therein two mechanically actuated devices, one of which is a compressor, an alternating current motor for driving one of said devices, means for driving the other of said devices, said means comprising an electric rotary device having a direct current input for receiving energy from a direct current source of supply and having an alternating current output for supplying energy to said alternating current motor, and means forming a substantially fluid-tight casing and having included therein said compressor and the driving means therefor.

21. A refrigerating system having included therein two mechanically actuated devices, one of which is a compressor, a polyphase motor for driving one of said devices, means for driving the other of said devices, comprising electrically operated rotary means adapted to receive energy from a two-wire source of current supply and having a polyphase output for supplying said motor with polyphase alternating current, and means forming a substantially fluid-tight casing and having included therein said compressor and the driving means therefor.

22. A refrigerating system having included therein two mechanically actuated devices, one of which is a compressor, a polyphase motor for driving one of said devices, an inverted converter for driving the other of said devices, said converter having a polyphase output for supplying energy to said polyphase motor, and means forming a substantially fluid-tight casing and having included therein said compressor and the driving means therefor.

23. In apparatus of the nature of that herein described, in combination, a compressing device, a condenser for receiving compressed refrigerant from said device, a device for passing a cooling fluid in thermal contact with said condenser, driving means for one of said devices comprising an electric rotary device having input terminals and output terminals and arranged to receive at its input terminals electrical energy in one form and to deliver at its output terminals energy in different form, means for driving the other of said devices comprising a motor receiving energy from the output terminals of said electric rotary device, and means forming a substantially fluid-tight casing for enclosing said compressor and the said driving means therefor.

24. The combination in a heat transferring system, of a hermetically sealed motor pump unit, a condenser, an evaporator, and means for passing a cooling fluid into thermal contact with said unit, said means being driven by an electrically operated rotary means adapted to receive energy from a two-wire source of current supply and having output terminals for delivering polyphase energy, the motor of said motor pump unit being a polyphase motor and receiving polyphase energy from said output terminals.

25. A refrigerating apparatus comprising a compressing device for compressing a refrigerant, an alternating current motor for operating said compressing device, a condensing device for receiving compressed refrigerant from said compressing device, and means for passing a cooling fluid into thermal contact with at least one of said devices, said means being operated by an electric rotary means having a direct current input for receiving energy from a direct current source of supply and having an alternating current output for supplying alternating current to said alternating current motor.

26. A refrigerating apparatus comprising a compressing device for compressing a refrigerant, a polyphase motor for operating said compressing device, a condensing device for receiving compressed refrigerant from said compressing device, and means for pass-

ing a cooling fluid into thermal contact with at least one of said devices, said means being operated by an electric rotary means having a direct current input for receiving energy from a direct current source of supply and having a polyphase output for supplying energy to said polyphase motor.

27. A refrigerating apparatus comprising a compressing device for compressing a refrigerant, a polyphase motor for driving said compressing device, a device in the form of means forming a substantially fluid-tight casing for enclosing said compressing device and said motor, a condensing device for receiving compressed refrigerant from said compressing device, means for passing a cooling fluid into thermal contact with at least one of said devices, and means for driving said last-mentioned means comprising electrically operated rotary means adapted to receive energy from a two-wire source of current supply and having a polyphase output for supplying said motor with polyphase alternating current.

In testimony whereof, I have signed my name to this specification this 24th day of February, 1925.

ALAN VARLEY LIVINGSTON.