

June 30, 1942.

C. G. PUCHY

2,287,902

REFRIGERATION

Filed Feb. 5, 1940

3 Sheets-Sheet 1

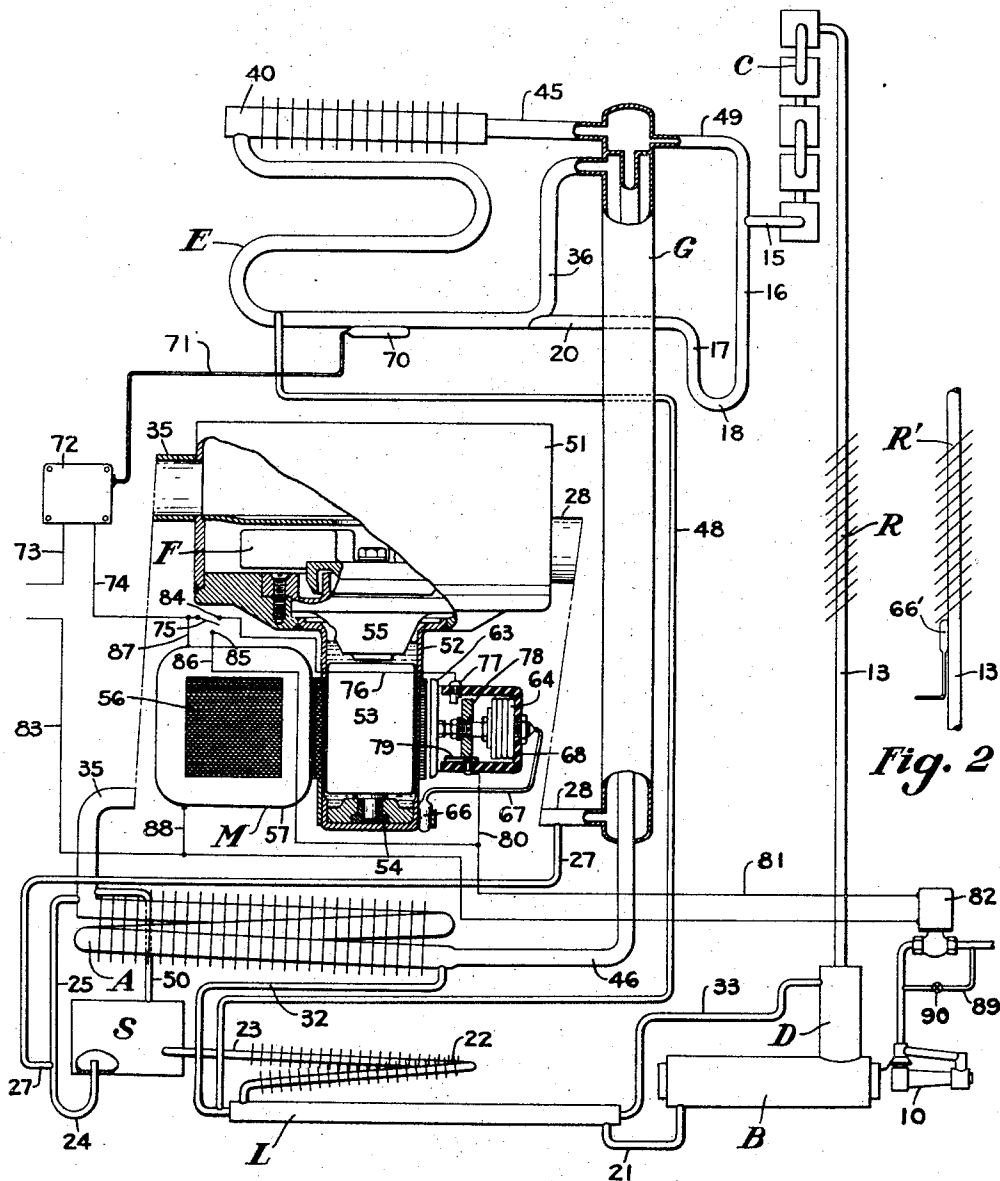


Fig. 1

Fig. 2

INVENTOR
Clarence G. Puchy

BY

Harry S. Dumas

ATTORNEY

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C. G. PUCHY

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3 Sheets-Sheet 2

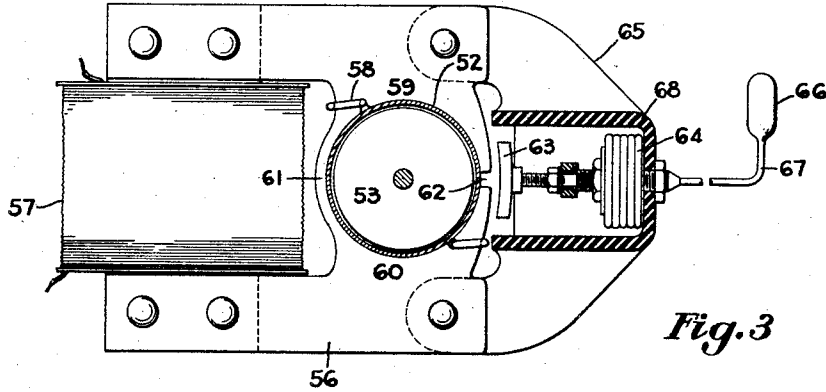


Fig. 3

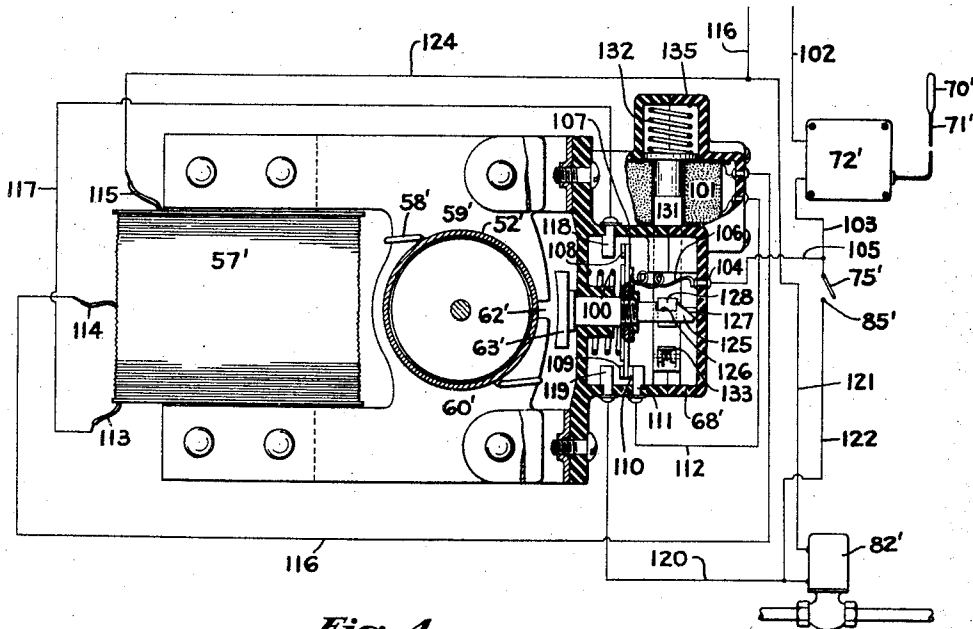


Fig. 4

INVENTOR

Clarence G. Puchy

BY

Harry S. Dumas

ATTORNEY

June 30, 1942.

C. G. PUCHY

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3 Sheets-Sheet 3

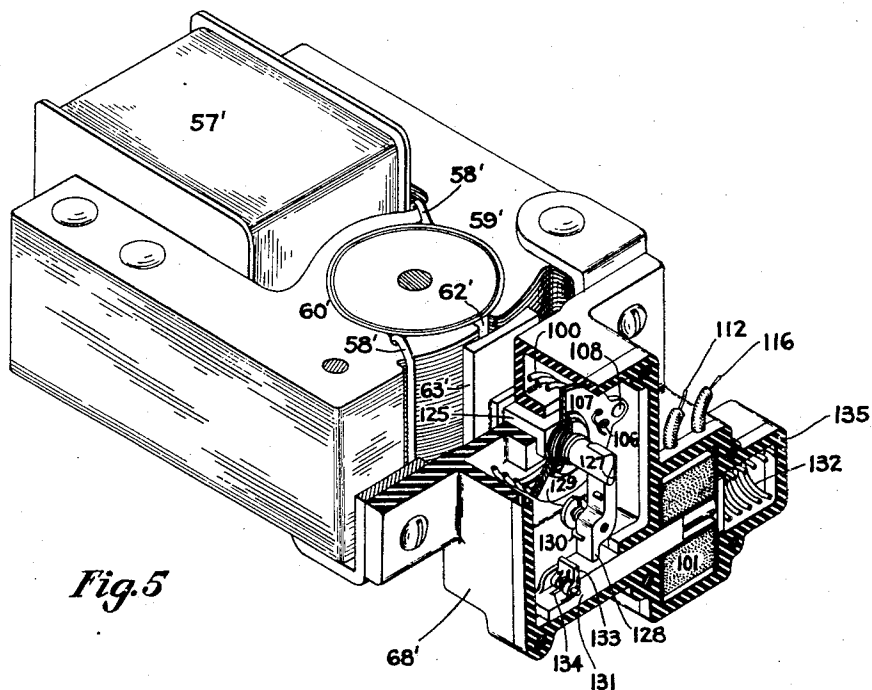


Fig. 5

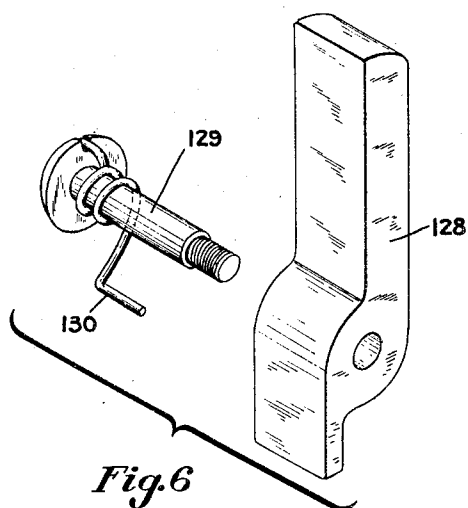


Fig. 6

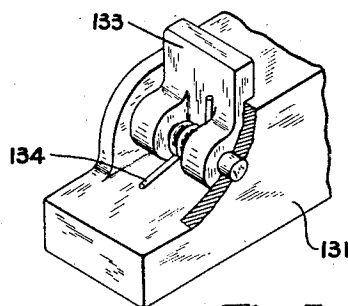


Fig. 7

BY

INVENTOR
Clarence G. Puchy
Harry S. Duvarre
ATTORNEY

UNITED STATES PATENT OFFICE

2,287,902

REFRIGERATION

Clarence G. Puchy, North Canton, Ohio, assignor
to The Hoover Company, North Canton, Ohio

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33 Claims. (Cl. 62—5)

This invention relates to refrigeration apparatus and control means therefor and more particularly to an absorption refrigerating apparatus of the three fluid type using power driven means for circulating the mediums within the apparatus with control means for energizing both the heater for the boiler and the power driven means and in which the rotor of the power driven means is submerged in a lubricant to protect it from the corrosive action of the refrigerant and to provide lubrication for the moving parts in the apparatus.

The rotor of such an apparatus may be submerged or immersed in a lubricant solid at ordinary temperatures and fluid at the operating temperature of the motor or the rotor may be submerged in a lubricant fluid at all times. In the latter case, the burner may be constantly heated with a minimum flame which keeps the boiler at substantially an operating temperature during idle periods. The power driven means and the burner may then be simultaneously energized to cause the circulation of the mediums and to provide a maximum heat input to the boiler for operating conditions.

When the rotor is submerged or immersed in a lubricant solid at ordinary temperatures and fluid at the operating temperature of the motor, there are two ways to operate such a system.

The first is to provide a minimum flame of such value that the boiler is maintained at substantially operating temperatures during idle periods. The motor is then energized prior to energizing the heater to a maximum value so that the lubricant will be melted and the power unit ready for operation when the boiler is energized to its maximum operating condition.

The second is to provide a completely on and off control for the boiler with merely a pilot flame for igniting the burner. In this case the motor and boiler are energized simultaneously and the heat of fusion of the lubricant utilized to delay the operation of the power operating means until the boiler reaches an operating temperature.

It is therefore an object of this invention to provide an absorption refrigerating apparatus utilizing a power unit for circulating mediums within the apparatus in which the power means includes a rotor submerged in a lubricant, either fluid at all times or fluid under the operating temperature of the motor and solid at normal temperatures with control means therefor which may operate to simultaneously energize the

motor and heater or energize the motor prior to the energization of the heater.

It is another object of this invention to provide an absorption refrigerating apparatus in which the boiler is normally energized to a minimum value to maintain the boiler at approximately the operating temperature during idle periods and in which the medium is circulated by a motor fan unit having its rotor submerged or immersed in a solid lubricant and a control therefor which energizes the motor prior to energizing the boiler to a maximum value for operating conditions.

In absorption refrigerating apparatus of the type using a pressure equalizing medium the pressures throughout all portions of the system are substantially equal. Therefore, only a small motor fan unit is necessary to circulate the mediums in the system since there is no pressure head to overcome. It has been found that a small fractional horse power induction motor is suitable for this purpose.

Small fractional horse power induction motors of this type have better starting characteristics if a gap is left between adjacent pole tips and have better running characteristics if the gap between the adjacent pole tips is bridged by a magnetic bridge.

It is therefore another object of this invention to provide a small fractional horse power induction motor for circulating the medium in an absorption refrigerating apparatus of the pressure equalized type in which a movable bridge member is provided between the adjacent pole tips which is opened under starting conditions and closed when the rotor approaches running speed and also to utilize the movable bridge member for energizing the boiler as the rotor approaches running speed as well as to de-energize starting windings and energize running windings.

It is also another object of this invention to provide a motor fan unit for circulating the mediums in an absorption refrigerating apparatus of the pressure equalized type in which the motor has a movable bridge across adjacent pole tips which is open during starting and closed during running in which the bridge is closed either by the heat generated by the boiler or by that generated by the motor.

It is another object of this invention to provide a motor fan unit for circulating the mediums in an absorption refrigerating apparatus in which the motor has a movable bridge across adjacent pole tips and in which the rotor is

blocked during starting and to utilize the increased current due to the rotor being blocked and the gap between adjacent pole tips to hold the bridge away from the poles during starting and being so arranged that the bridge will close due to the magnetic flux leakage across the gap as the rotor approaches running speed combined with the decreased field current as the rotor approaches running speed.

It is another object of this invention to provide a method of operating absorption refrigerating apparatus of the type using a motor fan unit for circulating the mediums in which the motor rotor is submerged or immersed in a solid lubricant which comprises maintaining the boiler at substantially an operating temperature during idle periods and energizing the motor prior to the energization of the boiler at a maximum rate whereby the lubricant in the motor shell will be melted before the boiler begins operation.

It is another object of this invention to provide an absorption refrigerating apparatus using power means for circulating the medium in which the power means includes a magnetic path and in which the power means and boiler are simultaneously energized and the completion of the magnetic path is delayed until the boiler reaches an operating temperature.

It is another object of this invention to provide an absorption refrigerating apparatus using power means for circulating the mediums in the apparatus and a heater for the boiler with a control therefor which will selectively energize the power means and heater simultaneously or energize the power means prior to the energization of the heater.

Other objects and advantages of this invention will become apparent as the description proceeds when taken in connection with the accompanying drawings in which:

Figure 1 is a diagrammatic representation of an absorption refrigerating apparatus and control therefor with the motor fan unit of this invention applied thereto broken away from the other parts of the apparatus and shown on a large scale;

Figure 2 is a detailed view of an alternate position for positioning the control of the motor;

Figure 3 shows the motor of this invention partly in section;

Figure 4 shows a modified form of control for the motor and burner valve, and

Figures 5, 6 and 7 show details of construction of the modification shown in Figure 4.

Referring to Figure 1 of the drawings, there is disclosed a three fluid absorption refrigerating system comprising a boiler B, an analyzer D, an air cooled rectifier R, a tubular air-cooled condenser C, an evaporator E, a gas heat exchanger G, a tubular air cooled absorber A, a solution reservoir S, a liquid heat exchanger L, and a circulating fan F which is driven by an electric motor M.

The above described elements are interconnected by various conduits to form a plurality of gas and liquid circuits constituting a complete refrigerating system to which reference will be made in more detail hereinafter.

The refrigerating system will be charged with a suitable refrigerant, such as ammonia, a suitable absorbent, such as water, and a suitable pressure equalizing medium, such as nitrogen.

The boiler B will be heated in a suitable manner as by an electrical heater or by a gas burner 10 as may be desired.

The application of heat to the boiler B liberates refrigerant vapor from the strong solution contained therein. The vapor so liberated passes upwardly through the analyzer D in counterflow relationship to strong solution flowing downwardly through the analyzer. Further refrigerant vapor is generated in the analyzer by the heat of condensation of absorption solution vapor generated in the boiler. The refrigerant vapor is conducted from the upper portion of the analyzer D to the upper portion of the condenser C through a conduit 13 which includes the air cooled rectifier R wherein any vapor of absorption solution passing through the analyzer is condensed and returned to the analyzer through the conduit 13.

The refrigerant vapor is liquefied in the condenser by heat exchange relation with atmospheric air and is discharged from the bottom portion thereof through a conduit 15 into a downwardly extending conduit 16. The bottom portion of the conduit 16 connects to the bottom portion of an upwardly extending conduit 17 through a U-bend 18. The conduit 18 is appreciably longer than the conduit 17 for a purpose to be described later. The conduit 17 opens at its upper end into a conduit 20 which discharges into the evaporator in a manner to be described more fully hereinafter.

The weak solution formed in the boiler by the generation of refrigerant vapor therefrom is conveyed from the boiler through a conduit 21, the outer pass of liquid heat exchanger L, through a pre-cooler 22 and a conduit 23 into the solution reservoir S. The weak solution is conveyed from the solution reservoir S through a U-shaped conduit 24 opening into an upwardly extending tube 25 of small diameter, forming a gas lift pump which discharges into the top of the absorber A. It is apparent that the top of the absorber is materially above the solution level normally presiding in the boiler-analyzer-reservoir system wherefor some means must be provided to elevate the absorption solution to the top of the absorber A. For this purpose a small bleed conduit 27 is connected to the discharge conduit 28 of the circulating fan F and leads to the junction of the conduits 24 and 25 which is below the solution level normally presiding in the reservoir whereby the weak solution is elevated to the top of the absorber by gas lift action.

In the absorber, the weak solution flows downwardly by gravity in counterflow to the rich pressure equalizing medium refrigerant vapor mixture flowing upwardly therethrough. The refrigerant vapor content of the mixture is absorbed in the absorption solution and the heat of absorption is rejected to the surrounding air by air cooling fins which are mounted on the exterior walls of the absorber vessel. The strong solution formed in the absorber discharges into conduit 32 which opens into the inner pass of the liquid heat exchanger L. From the inner pass of the liquid heat exchanger L, the strong solution is conveyed to the upper portion of the analyzer D by conduit 33 whereby it flows downwardly through the analyzer in counterflow to the rising vapors generated in the boiler.

The weak pressure equalizing medium refrigerant vapor mixture present in absorber A is taken from the upper portion thereof through the conduit 35 into the suction side of the circulating fan F in which it is placed under pressure and discharged through conduit 28 into the outer pass of the gas heat exchanger G and therefrom

through a downwardly extending conduit 36 into the bottom of the evaporator E.

The conduit 20 opens into the bottom portion of the conduit 36 whereby the liquid refrigerant supplied to the evaporator enters simultaneously with the pressure equalizing medium which is placed under pressure by the circulating fan F. The diameter of the conduit of the evaporator is relatively small whereby the pressure equalizing medium flows through it at a relatively high velocity. The rapidly flowing pressure equalizing medium sweeps or drags the liquid refrigerant with it through the evaporator into the box cooling conduit 40 as the refrigerant is evaporated by diffusion into the pressure equalizing medium to produce refrigeration. In the conduit 40 the velocity of the inert gas stream is relatively slow by reason of the large diameter of that conduit and the liquid refrigerant flows therethrough by gravity. Any liquid refrigerant not evaporated in the evaporator will flow through conduit 45, the inner pass of the gas heat exchanger G and pass by conduit 46 to the bottom of the absorber so as not to interfere with the operation of the motor fan unit.

The rich pressure equalizing medium refrigerant vapor mixture formed in the evaporator is conducted therefrom into the inner pass of the gas heat exchanger G through a conduit 45. The opposite end of the gas heat exchanger G communicates with the bottom portion of absorber A through a conduit 46. In the absorber A the rich pressure equalizing medium refrigerant vapor mixture flows upwardly in counterflow to absorption solution whereby the refrigerant vapor content of the mixture is absorbed by the weak solution.

The bottom coil of evaporator E is provided with a drain conduit 48 which opens into the strong solution discharge conduit 32. The conduit 48 opens into the top portion of the bottom coil of the evaporator whereby it will not completely drain such conduit. The upper portion of discharge conduit 15 of the condenser is vented through a vent conduit 49 into the inner pass of the gas heat exchanger G. The solution reservoir is vented through a conduit 50 into the suction conduit 35 of the circulating fan.

The circulating fan F places the pressure equalizing medium discharged therefrom under small pressure in the neighborhood of a pressure of $4\frac{1}{2}$ inches of water over that prevailing at the suction side of the fan. In order to prevent this pressure, which also prevails in the conduit 36, from being carried back through to the condenser discharge conduit, the condenser and conduit 13 to the analyzer, the conduit 16 is made appreciably longer than the conduit 17 whereby a pressure balancing column of liquid is formed in the conduit 16 which extends above the point of connection between the conduits 17 and 20 a distance sufficient to overcome the pressure produced by the circulating fan in the conduit 36.

The motor fan unit comprises a fan casing 51 and a cylindrical shell 52 forming a housing for the fan F and the motor rotor 53. The motor rotor 53 is rigidly connected to the fan F and is suitably supported for rotation by bearing assemblies 54 and 55. On the exterior of the shell 52, opposite the rotor 53, is a field stack 56 having main energizing coil 57 and shading coil 58.

As shown in Figure 3, the poles 59 and 60 are connected at one side by a rigid bridge element 61 formed as a part of the field laminations and at the opposite side the adjacent pole tips are

separated by a gap 62. This gap 62 is adapted to be closed by a magnetic bridging element 63. The bridge may be moved into contact with the adjacent tips of the poles 59 and 60 by Sylphon bellows 64 secured on the interior of an insulating casing 68 which is suitably supported on the field stack 56 by a bracket 65. The Sylphon bellows 64 is adapted to be actuated by a thermostatic bulb 66 joined thereto by flexible tube 67. The interior of the bulb 66, tube 67 and bellows 64 is filled with any expansible and contractible fluid in a well known manner.

As shown in Figure 1 the thermostatic bulb 66 is positioned in contact with the shell 52 so as to be responsive to the heat generated by the motor. In Figure 2, the thermostatic bulb 66' is positioned in contact with the tube 13' immediately below the rectifier R' so as to be responsive to the temperature of the rectifier and thus responsive to the heat generated in the boiler.

A thermostatic bulb 70 is positioned in contact with the coils of the evaporator E and is connected by a tube 71 to a control device 72 of conventional construction. One side of the control device 72 is connected to one side of the power line by conductor 73. The other side of the control device 72 is connected by conductor 74 to a manual switch 75. The manual switch 75 is adapted to be swung so as to make contact with either the contact 84 or the contact 85. With the switch contacting the contact 85, the control device 72 is connected by conductors 74, 86 and 81 to a magnetically operated gas valve 82 which supplies gas to the burner 10. The contact 84 is connected by a conductor 76 to a contact member 77 suitably supported on the insulating member 68 which supports the Sylphon bellows 64. A member 78 is reciprocated by the bellows 64 and makes sliding contact with contact 79 on the opposite side of the insulating housing 68. The contact 79 is connected by conductors 80 and 81 to the magnetically operated gas valve 82. The opposite side of the magnetically operated gas valve is connected by conductor 83 to the other side of the power line. The conductor 74 is connected by conductor 87 to one side of the motor field coil 57, the opposite side of which is connected by conductor 88 to the conductor 83 and thus back to the opposite side of the power line.

A low flame by-pass 89 by-passes the magnetically operated gas valve 82 to supply a minimum flame to the burner 10. The minimum flame may be regulated by a valve 90 in the minimum flame by-pass 89. The valve 90 may be regulated to supply a constant flame to the burner 10 of such value that the boiler B will be heated to substantially operating temperature during idle periods or it may be regulated to supply merely a very low flame to the burner 10 to act as a pilot or lighter flame.

The shell 52 of the motor is filled with a lubricant to the level shown which lubricant may be fluid at all times or it may be solid at ordinary temperature and fluid at the operating temperature of the motor. One such lubricant is paraffin which may be had in a wide range of melting points and specific gravity. By mixing paraffin with other lubricants almost any melting point desired may be obtained.

The fan F builds up a very small pressure difference, approximately $4\frac{1}{2}$ inches of water, and of a consequence the motor M can be made very small and in fact has a power input of approximately 12 to 15 watts. It has been found that these small motors have better starting charac-

teristics if a gap is left between adjacent pole tips but have much better running characteristics if the adjacent tips of the poles are bridged by a magnetic bridging member. This may be partially accomplished by making the portion of the shell 52 between the field stack 56 of magnetic material, but if desired, the entire shell 52 may be made of none-magnetic material. In any case, the poles 59 and 60 are bridged on one side at 61 by making the stack laminations extend across the adjacent pole tips. At the opposite sides the gap 62 is left to give the motor good starting characteristics, which gap is adapted to be closed by the magnetic bridge member 63 when the motor approaches operating speed. When the magnetic bridge is closed the reluctance of the magnetic circuit is decreased and therefore a smaller current will flow in the field coils and when the magnetic bridge is open the reluctance of the magnetic path will be increased and a larger current will flow in the field coil.

If the shell 52 is filled with a solid lubricant and the valve 90 is set so as to maintain the boiler at approximate operating temperature during idle periods, the bulb 66 will be placed against the shell 52, as shown in Figure 1. The switch 75 will be set to contact with the contact 84. When the control 72 operates, the field coil 57 will be energized, and due to the fact that the rotor is blocked and the gap 62 is open, a high current will flow through the coil and melt the lubricant in the shell 52. The bulb 66 and the bellows 64 will be set to move the bridge 63 against the adjacent tips of the poles 59 and 60 by the time the lubricant has melted, and the rotor has approached operating speed. This will also move the member 78 into contact with the contact 77 to close the circuit to the magnetic valve 82 so as to supply a maximum flame to the boiler B for operating conditions. Thus, the boiler B will begin operation at the same time as the motor reaches an operating speed, whereby the mediums will be circulated at the same time the liquid refrigerant is being supplied to the evaporator E.

With the shell 52 filled with a solid lubricant and the valve 90 set to supply merely a pilot flame to the burner 10, the bulb 66' is placed against the rectifier R' as shown in Figure 2. The switch 75 should then be set so as to contact with the contact 85. The melting point of the lubricant in the shell 52 should be selected relative to the heating effect of the field coil 57 and the maximum heating rate of the boiler that the lubricant is melted by the time hot vapors are passing through the rectifier R'. When the control 72 operates, the field coil 57 and the magnetic valve 82 are energized simultaneously. The high current passing through the field coil 57 will operate to melt the lubricant in the shell and the opening of valve 82 will supply a maximum flame to the boiler B to heat it to operating temperature. When hot gases pass rectifier R' the bulb 66' will be heated and will operate to move the magnetic bridge 63 across the gap 62 by the time the lubricant has melted. Thus the mediums will be circulated in the system by the time liquid refrigerant is being supplied to the evaporator E.

If the shell 52 is filled with a lubricant which is fluid at all times and the valve 90 is set to maintain the boiler at approximately operating temperature during idle periods, the bulb 66 is positioned against the shell 52 as shown in Figure 1. The switch 75 is set to contact element 84. When

the control 72 operates, the field coil 57 of the motor will be energized. Due to the fact that the gap 62 is open, a high current will flow through the field coil 57 and quickly heat the bulb 66.

This will operate the bellows 64 and move the magnetic bridge member 63 to close the gap 62 across the adjacent pole tips 59 and 60 when the rotor has approached operating speed. Thus the starting characteristics, as well as the running characteristics of the motor will be maintained. The movement of the bellows 64 will also move member 78 so as to contact the contact element 77 and close the circuit to the magnetic valve 82 and thus supply a maximum flame to the boiler B for best operating conditions.

Due to the fact that the boiler is maintained at approximately operating temperature during idle periods, the valve 82 need not be opened until the motor has come up to operating speed. Thus the mediums will be circulated just as the boiler begins operation and liquid refrigerant is being supplied to the evaporator E.

If the shell is filled with a lubricant which is fluid at all times and the valve 90 is adjusted to supply merely a pilot flame to the burner 10, the bulb 66' should be positioned on the tube 13' as shown in Figure 2. The switch 75 should be set to make contact with the contact element 85. When the control operates, the valve 82 will be immediately opened to supply a maximum flame to the boiler and quickly heat the boiler to an operating temperature. When hot, refrigerant vapor is passing through the rectifier R', a bulb 66' will be heated and operate bellows 64 and close the gap 62 by moving the magnetic bridge member against the adjacent tips of the poles 59 and 60. Thus the starting characteristics, as well as the running characteristics of the motor will be maintained and the mediums will be circulated as liquid refrigerant is being supplied to the evaporator.

Figure 4 shows a device similar to that just described except for the means for closing the gap between adjacent poles and the means for energizing the gas valve. Similar parts will be given the same reference characters primed.

The magnetic bridge member 63' is biased to its outer position by spring 100. The rod 125 to which the magnetic bridge 63' is attached is provided with a notch 126 and a tapered end portion 127. Cooperating with the notch 126 is a latch 128 pivotally mounted on the casing 68' by a pin 129. A spring 130 is coiled about the pin 129 and biases the latch to a position to hold the upper end of the latch 128 in the notch 126 in the position shown in Figure 4.

The latch is adapted to be actuated by a plunger 131 which is reciprocated by a solenoid coil 101 attached to the housing 68' by means of an insulating housing 135. The plunger is normally held in the position shown in Figure 5 by means of a spring 132. Pivotally mounted on the inner end of the plunger 131 is a latch 133 normally held in a vertical position by a spring 134 surrounding the pivot pin as shown in Figure 7.

One side of the control 72' is connected to the power line by conductor 102. The other side of the control is connected by conductors 103 and 105 to a metallic insert 104 extending through the insulating housing 68'. The insert 104 is connected by a flexible conductor 106 to a member 107 attached to the rod 125.

The member 107 has two contacts 108 and 109 on one side and one contact 110 on the opposite side. The contact 110 cooperates with a contact

111 extending through the housing 68' and connected by conductor 112 to one side of the solenoid coil 101. The field coil 57' has a plurality of lead in wires 113, 114 and 115. When the lead in wires 113, 114 and 115 are connected in the circuit only a portion of the coil is in such circuit and this part of the coil serves as starting windings. When the lead in wires 113 and 115 are connected in circuit, all of the coils of the field coil 57' are in the circuit and serve as running windings. The side of the solenoid coil 101 opposite that connected to conductor 112 is connected to lead in wire 114 by a conductor 116. The lead in wire 113 is connected by a conductor 117 to contact 118 extending through the insulation housing 68' to cooperate with contact 108. Contact 119 extends through the insulation housing 68' and is connected by a conductor 120 to one side of the magnetically operated gas valve 82', the opposite side of which is connected to the other side of the power line by conductor 121. Contact 85' is connected by conductor 122 to the conductor 120 and is adapted to be connected to the conductor 103 by a manually actuated switch 75'. The lead in wire 115 is also connected to the opposite side of the power line by a conductor 124.

The shell 52' may be filled with a lubricant solid at ordinary temperatures and fluid at the operating temperature of the motor or with a lubricant which is fluid at all times as in the modification of Figure 1.

The boiler may be maintained at approximately an operating temperature during idle periods or the burner may be supplied merely with a pilot flame as in the modification of Figure 1.

If the shell 52' is filled with solid lubricant and the burner is operated to maintain the boiler at substantially operating temperature during idle periods, the manual switch 75' is turned out of contact with the contact element 85'. Now if the control operates, a circuit will be set up through the conductor 102, control 72', conductors 103 and 105, insert element 104, conductor 106, member 107, contacts 110, 111; conductor 112, solenoid coil 101, conductor 116, lead in wire 114, the starting portion of the coil 57', lead in wire 115 and conductor 124 to the other side of the power line.

Due to the fact that the rotor is blocked and that the gap 62' is open, a high current will flow through the starting part of the field coils and consequently through the solenoid coil 101. The current through the coil 101 will cause a large pull outwardly on the plunger 131 in opposition to the spring 132 so as to move the plunger to the right as viewed in Figure 5. During this movement the latch 133 will contact with the lower end of latch 128 but since the latch 128 is held rigid in the notch 126 the latch 133 will move outwardly against the action of spring 134 until it passes the lower end of latch 128 at which time it will again be moved to its vertical position by spring 134.

During this period the heat generated in the field coil will melt the lubricant in the shell 52' and the rotor will eventually approach operating speed. When the rotor has approached its operating speed, the current through the field coil and consequently through the coil 101 will be reduced. The solenoid coil 101 is so made that when the rotor approaches operating speed, the reduced current through the coil will reduce the pull on the plunger 131 to such an extent that the spring 132 will force it to the left to the position shown in Figure 5. During this movement

the latch 133 is rigid with the plunger 131 due to the fact that it lies against a shoulder thereon and will consequently move the lower end of the latch 128 so as to move the upper end thereof out of the notch 126 in the rod 125. The magnetic flux leakage across the gap 62' will then pull the magnetic bridge 63' into contact with the adjacent tips of poles 59' and 60' against the action of spring 100. In the meantime the plunger 131 will have moved to the position shown in Figure 5 allowing the latch 128 to return to its upright position shown in Figure 5, in which position it is held by means of a suitable stop opposing the action of the spring 130.

The movement of the member 107 to the left with the rod 125 will break the contact 110—111 and make contacts 108—118 and 109—119 de-energizing the coil 101 and the starting portion of the windings 57'. At the same time two circuits will be closed as follows: First, conductor 102, control 72'; conductors 103 and 105; insert member 104, conductor 106, member 107, contacts 108—118, conductor 117, lead in wire 113, coil 57', lead in wire 115 and conductor 124 back to the opposite side of the power source; and second, conductor 102, control 72', conductors 103 and 105, insert member 104, conductor 106, member 107, contacts 109—119; conductor 120, magnetic valve 82' and conductor 121 back to the other side of the power source.

This will open the gas valve 82' to maximum operating position, at the same time the rotor is at operating speed so that the mediums will be circulated in the system by the time refrigerant vapor is being produced in the boiler.

When the control 72' operates to cut off the machine, the spring 100 will return the magnetic bridge member 63' to its original position. This will cause the tapered portion 127 of the rod 125 to move the latch 128 against the action of the spring 130 until the upper end of the latch snaps into the notch 126 at which time the parts will be in the position shown in Figure 5.

If the shell 52' is filled with a lubricant which is fluid at all times and the boiler is maintained at approximately operating temperature during idle periods, the switch 75' will remain in the position just described. The same cycle of operation will be gone through as before with the exception that the motor will come up to speed almost immediately. The starting windings will be de-energized, the running windings energized and the magnetic gas valve energized very shortly after the control calls for refrigeration.

If the shell 52' is filled with solid lubricant and the burner provided with merely a pilot flame during idle periods, the switch 75' is turned to a position to make contact with contact element 85'. Under these conditions, the burner valve 82' and the motor field will be simultaneously energized. The solid lubricant will act to block the rotor and delay the operation of the motor until the boiler comes up to operating temperature. Thus it is necessary to select a lubricant with a proper melting point relative to the heating effect of the field coil 57' and the heating rate of the boiler that such condition will be realized. As far as the starting of the motor is concerned, the same cycle of operation takes place as previously described except that the closing of contacts 109 and 119 produces no effect since the gas valve 82' is already energized.

Thus, a condition depending upon the energization of the motor serves to delay the operation thereof until the boiler comes up to temperature

and thereafter de-energizes the starting windings and energizes the running windings.

From the foregoing it can be seen that this invention provides a refrigerating apparatus with a motor fan unit for circulating the medium in the apparatus and controlling means therefor in which the motor is energized prior to the boiler so as to allow the motor to come to an operating condition or to selectively, simultaneously energize the motor and boiler to utilize the delay of the motor in reaching an operating condition, to allow the boiler to reach an operating temperature.

While the motor fan unit of this invention has been shown as positioned in the inert gas circuit of a refrigerating apparatus and as circulating both the inert gas and the solution, it is to be understood that it could be positioned in the solution circuit of any continuous absorption refrigerating apparatus and utilized to circulate the absorption solution alone.

While I have shown but two embodiments of my invention, it is to be understood that these embodiments are to be taken as illustrative only and not in a limiting sense. I do not wish to be limited to the specific structure shown and described but to include all equivalent variations thereof except as limited by the claims.

I claim:

1. An absorption refrigerating apparatus of the type having an inert pressure equalizing medium circuit, a power-driven means for circulating said medium in said circuit, said power-driven means comprising a two-pole induction motor of the type having a gap between adjacent pole tips, a control for energizing the apparatus and means responsive to a temperature rise incident to the energization of the apparatus for closing the gap between adjacent pole tips.

2. An absorption refrigerating apparatus comprising, a closed circuit for a medium, power operated means for circulating said medium in said circuit, said power operated means comprising a multi-pole induction motor of the type in which the poles completely embrace the rotor, the portion between adjacent pole tips being movably mounted, a control for energizing the apparatus and means responsive to a condition incident to the energization of the apparatus to move the movably mounted portion against adjacent pole tips.

3. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for a medium, power operated means for circulating said medium in said circuit, said power operated means comprising a multi-pole induction motor having a gap between adjacent pole tips, a control for energizing said apparatus including said heater and means responsive to a condition incident to the energization of the heater for closing the gap between adjacent pole tips.

4. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for a medium, power operated means for circulating said medium in said circuit, said power operated means comprising an induction rotor interiorly of said circuit and a multi-pole field structure of the type having a gap between adjacent pole tips, exteriorly of said circuit and surrounding said rotor, said rotor being submerged in a solid fusible lubricant, a control for energizing the apparatus and means responsive to a condition incident to the energization of said

apparatus for closing the gap between adjacent pole tips.

5. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for a medium, power operated means for circulating said medium in said circuit, said power-operated means comprising an induction rotor interiorly of said circuit, a multi-pole field structure of the type having a gap between adjacent pole tips, exteriorly of said circuit and surrounding said rotor, said rotor being immersed in a solid fusible lubricant, a control for energizing said apparatus including said heater and means responsive to a condition incident to the energization of the heater for closing the gap between adjacent pole tips.

6. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for a medium, power operated means for circulating said medium in said circuit, said power operated means comprising a multi-pole induction motor of the type having a gap between adjacent pole tips, a control for energizing said motor and means responsive to a condition incident to the energization of said power operated means for simultaneously closing the gap between adjacent pole tips and energizing the heater.

7. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for circulating a medium in the apparatus, power operated means for circulating said medium in said circuit, said power operated means comprising a rotor interiorly of said circuit and immersed in a solid lubricant and a field structure having a starting condition and a running condition, said heater being constantly energized to a minimum value to maintain said boiler at approximately operating temperature during idle periods, a control for energizing said field structure and means responsive to a condition incident to the energization of said field structure for changing the field structure from starting condition to running condition and simultaneously energizing said heater to a maximum operating condition.

8. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for circulating a medium in the apparatus, power operated means for circulating said medium in said circuit, said power operated means comprising a field structure of the type having a gap between adjacent pole tips and an induction rotor immersed in a lubricant solid at ordinary temperatures and fluid at the operating temperature of the motor, said rotor being positioned interiorly of the apparatus walls and said field structure being positioned exteriorly thereof and surrounding the rotor, a magnetic bridge member movably mounted adjacent said gap, means for simultaneously energizing the field structure and the heater and means responsive to the heating effect of the field structure for moving the magnetic bridge member against adjacent pole tips, said lubricant having a heat of fusion of such value relative to the heating rate of the boiler and the heating effect of the field structure that the lubricant will be fluid by the time the boiler reaches an operating temperature.

9. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for circulating a medium in the apparatus, power operated means for circulating said medium in said circuit, said power operated means

comprising a field structure of the type having a gap between adjacent pole tips and an induction rotor submerged in a lubricant solid at ordinary temperatures and fluid at the operating temperature of the motor, said rotor being positioned interiorly of the apparatus walls and said field structure being positioned exteriorly thereof and surrounding the rotor, a magnetic bridge member movably mounted adjacent said gap, means for simultaneously energizing the field structure and the heater and means responsive to the heating effect of the boiler for moving said magnetic bridge member against the adjacent pole tips, said lubricant having a melting temperature of such value relative to the heating rate of the boiler and the heating effect of the field structure that the lubricant will be melted by the time the magnetic bridge is moved against adjacent pole tips.

10. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for circulating a medium in the apparatus, power operated means for circulating said medium in said circuit, said power operated means comprising a field structure of the type having a gap between adjacent pole tips and an induction rotor submerged in a lubricant solid at ordinary temperatures and fluid at the operating temperature of the motor, said rotor being positioned interiorly of the apparatus walls and said field structure being positioned exteriorly thereof and surrounding said rotor, a magnetic bridge member movably mounted adjacent said gap, means for energizing said field structure and means responsive to the high current induced by the blocking of the rotor for holding the magnetic bridge member away from adjacent pole tips until the lubricant has melted and thereafter allowing the magnetic flux leakage across said gap to draw said magnetic bridge member against adjacent pole tips and means operated by the movement of said magnetic bridge member for energizing the heater.

11. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for circulating a medium in the apparatus, power operated means for circulating said medium in said circuit, said power operated means including a field structure having a magnetic path, means for simultaneously energizing the heater and the power means and means for delaying the completion of the said path until the boiler reaches a predetermined operating temperature.

12. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, closed circuits for circulating mediums in the said apparatus, power operated means for circulating said mediums in said circuits, said power operated means comprising a field structure having a gap between adjacent pole tips and having starting and running windings, a magnetic bridge movably mounted adjacent said gap, means for energizing the starting windings, means responsive to the energization of said starting winding for moving the bridge across adjacent pole tips and means operated by the movement of said bridge for de-energizing the starting winding, and energizing the running winding and the heater for the boiler.

13. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for a medium in the apparatus, power operated means for circulating said medium in said circuit and control means for said power means

and heater, said control means being responsive to a demand for refrigeration and operable to simultaneously energize the heater and power means and selectively operable to energize said power means prior to the energization of the heater.

14. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for mediums in said apparatus, power operated means for circulating said mediums in said circuit, said power operated means comprising a field structure having a gap between adjacent pole tips, a magnetic bridge movably mounted adjacent said gap, means for energizing said field structure, and means responsive to the energization of the field structure to move the magnetic bridge against adjacent pole tips when the motor approaches an operating condition, switch means operated by said bridge member to energize the heater and manual means to cut said switch means from the circuit and connect the energy supply means of the heater directly to said energizing means whereby the field structure and heater are simultaneously energized when the control means operates.

15. The method of operating an absorption refrigerating apparatus of the type having power means for circulating the mediums in the apparatus and a heater for the boiler in which the power means is constructed to change from starting to running operation comprising, energizing the power means responsive to a demand for refrigeration and energizing the heater when the power means is in running operation.

16. The method of operating an absorption refrigerating apparatus of the type having power means for circulating the medium in the apparatus and a heater for the boiler in which the power means includes a motor rotor submerged in a solid lubricant and a motor field structure constructed to change from starting to running operation comprising, energizing the heater by a minimum amount to maintain the boiler at approximately its operating temperature during idle periods, energizing the field structure responsive to a demand for refrigeration and utilizing a condition caused by the energization of the field structure to change the field structure from starting to running operation and to energize the heater to a maximum operating temperature.

17. An induction motor of the type having better starting characteristics when an air gap is provided between adjacent pole tips and better running characteristics when the gap is closed by a magnetic bridge comprising a salient field structure with a gap between adjacent pole tips, a magnetic bridge member movably mounted adjacent the gap between adjacent pole tips, means for energizing the field structure whereby the magnetic bridge member is drawn against the adjacent pole tips by the magnetic flux leakage across said gap to close said gap and means operated by the movement of said bridge member to energize an auxiliary device.

18. An electric motor of the type having better starting characteristics when an air gap is provided between adjacent pole tips and better running characteristics when the gap is closed by a magnetic bridge comprising, a field structure having a gap between adjacent pole tips, a starting winding, a running winding, a magnetic bridge member movably mounted adjacent said gap, means for energizing said starting winding to cause the magnetic flux leakage

across the gap to draw the magnetic bridge against adjacent pole tips and means operated by the movement of said bridge for de-energizing the starting winding and energizing the running winding.

19. An electric motor comprising, an induction rotor, a multi-pole field structure of the type having a gap between adjacent pole tips surrounding said rotor, said rotor being submerged in a lubricant solid at ordinary temperatures but fluid at the operating temperature of the motor; a magnetic bridge member movably mounted adjacent said gap, means for energizing the motor and means responsive to the high current induced by the motor being blocked for holding the magnetic bridge member away from adjacent pole tips and allowing the magnetic flux leakage across said gap to move the magnetic bridge member into contact with adjacent pole tips when the lubricant has melted.

20. An electric motor comprising an induction rotor, a multi-pole field structure of the type having a gap between adjacent pole tips surrounding said rotor, said rotor being submerged in a lubricant solid at ordinary temperatures but fluid at the operating temperature of the motor, a magnetic bridge member movably mounted adjacent said gap, said field structure including starting windings and running windings, means for energizing said starting windings, means responsive to the high current induced by the rotor being blocked for holding the magnetic bridge member away from adjacent pole tips and allowing the magnetic flux leakage across said gap to move said magnetic bridge member into contact with adjacent pole tips when the lubricant has melted and means operated by the movement of said bridge member for deenergizing said starting windings and energizing said running windings.

21. The method of operating a multi-pole electric motor of the type having a gap between the adjacent pole tips and a magnetic bridge member movably mounted adjacent the gap and having an induction rotor comprising, energizing the motor, blocking the motor to produce a high starting current, utilizing means responsive to the high starting current to hold the magnetic bridge away from the pole tips and for releasing the rotor and utilizing the reduced running current to cause the bridge member to move against the adjacent pole tips when the rotor approaches operating speed.

22. The method of operating a multi-pole electric motor of the type having a gap between the adjacent pole tips and a magnetic bridge member movably mounted adjacent the gap comprising, energizing the motor and utilizing the heat generated thereby to move the magnetic bridge against adjacent pole tips.

23. The method of operating an alternating current multi-pole electric motor of the type having a gap between adjacent pole tips, a magnetic bridge member movably mounted adjacent the gap and an induction rotor, comprising energizing the motor, blocking the rotation of the rotor, utilizing the heat generated by the energization of the motor to move the bridge member against adjacent pole tips and to release the rotor.

24. The method of operating a salient pole induction motor of the type having a gap between adjacent pole tips in which the motor has better starting characteristics when the gap is open and better running characteristics when

the gap is closed by a magnetic bridge, a magnetic bridge member movably mounted adjacent the gap and having a starting and running winding comprising, energizing the starting winding, utilizing the flux leakage caused thereby to draw the bridge member against adjacent pole tips and utilizing the movement of the bridge member to cut out the starting winding and cut in the running winding.

25. In an absorption refrigeration apparatus of the type having a closed circuit for a medium, a power unit for circulating said medium in its circuit and a second energy consuming device, in which the power unit comprises a field structure with a gap between adjacent pole tips, a magnetic bridge member movably mounted adjacent the gap between the adjacent pole tips, means for energizing the field structure whereby the magnetic bridge member is drawn against adjacent pole tips by the magnetic flux leakage across said gap and means operated by the movement of said bridge member for energizing said second energy consuming device.

26. In an absorption refrigerating apparatus of the type having a closed circuit for a medium and power operated means for circulating the medium in its circuit, in which said power operated means comprises an electric motor having an induction rotor, a field structure of the type having a gap between adjacent pole tips surrounding said rotor, said rotor being submerged in a lubricant solid at ordinary temperatures and fluid at the operating temperature of the motor, a magnetic bridge member movably mounted adjacent said gap, said field structure including starting windings and running windings, means for energizing said starting windings, means responsive to the high current induced by the rotor being blocked for holding the magnetic bridge member away from adjacent pole tips and allowing the magnetic flux leakage across said gaps to move said magnetic bridge member into contact with adjacent pole tips when the lubricant has melted and means operated by the movement of said bridge member for de-energizing said starting windings and energizing said running windings.

27. An absorption refrigerating apparatus comprising, a boiler, a closed circuit for circulating the medium in the apparatus, power means for circulating the medium in said circuit, said power means comprising a field structure having a gap between adjacent pole tips, a starting winding, a running winding, a magnetic bridge member movably mounted adjacent said gap, control means for energizing the starting windings in response to refrigeration demand to cause the magnetic flux leakage across the gap to draw the magnetic bridge member against adjacent pole tips and means operable by movement of said bridge for de-energizing the starting windings and energizing the running windings.

28. An absorption refrigerating apparatus comprising, a boiler, a closed circuit for circulating a medium in the apparatus, power operated means for circulating said medium in said circuit, said power operated means comprising an induction rotor, a field structure of the type having a gap between adjacent pole tips surrounding said rotor, said rotor being submerged in a lubricant solid at ordinary temperatures but fluid at the operating temperature of the motor, a magnetic bridge member movably mounted adjacent said gap, control means for energizing said motor

in response to refrigeration demand and means responsive to the high current induced by the rotor being blocked for holding the magnetic bridge member away from adjacent pole tips and for allowing the magnetic flux leakage across said gap to move the magnetic bridge member into contact with adjacent pole tips when the lubricant has melted.

29. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for circulating a medium, power operated means for circulating said medium in said circuit, said power operated means comprising a motor assembly, said motor assembly being constructed to change from starting to running operation, means for energizing said motor assembly and means responsive to a condition incident to the energization of said motor assembly for changing said motor assembly from starting to running operation and to simultaneously energize the heater.

30. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for circulating a medium in the apparatus, power operated means for circulating said medium in said circuit, said power operated means being constructed to change from starting to running operation, means responsive to a demand for refrigeration for energizing said power operated means and means responsive to the high starting current of said power operated means for changing said power operated

means from starting to running operation and to simultaneously energize said heater.

31. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for circulating a medium, power operated means for circulating said medium in said circuit, means for energizing said power operated means and means responsive to a condition incident to the energization of said power operated means for energizing said heater.

32. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for circulating a medium, power operated means for circulating said medium in said circuit, means responsive to a demand for refrigeration for starting said power operated means and means incident to the starting of said power operated means for energizing said heater.

33. An absorption refrigerating apparatus comprising, a boiler, a heater therefor, a closed circuit for circulating a medium in said apparatus, power operated means for circulating said medium in said circuit, means for energizing said power operated means, means operative upon energization of said power operated means for sequentially changing said power operated means from starting to running operation and means responsive to a condition incident to the running operation of said power operated means for energizing said heater.

CLARENCE G. PUCHY.