

March 20, 1962

R. S. McLain ET AL
REFRIGERATING MACHINE

3,025,684

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3 Sheets-Sheet 1

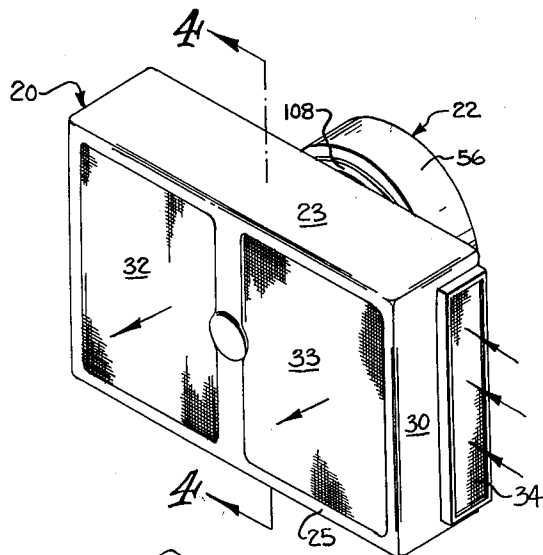


Fig-1

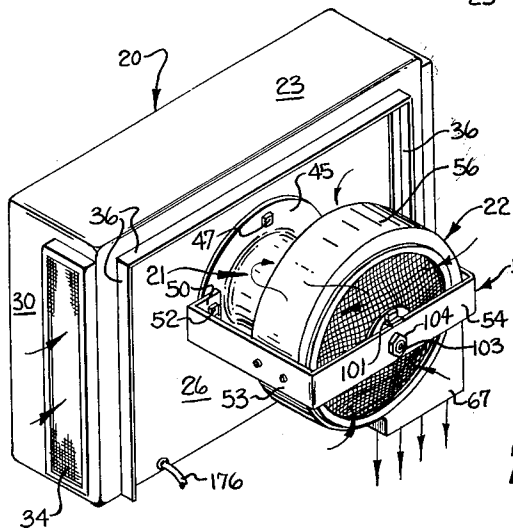


Fig-2

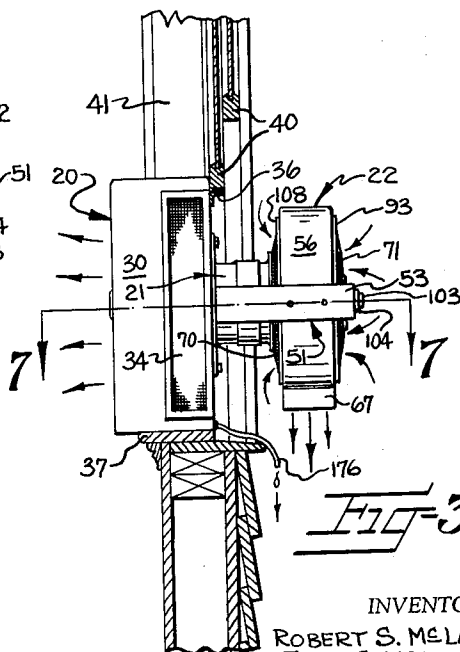


Fig-3

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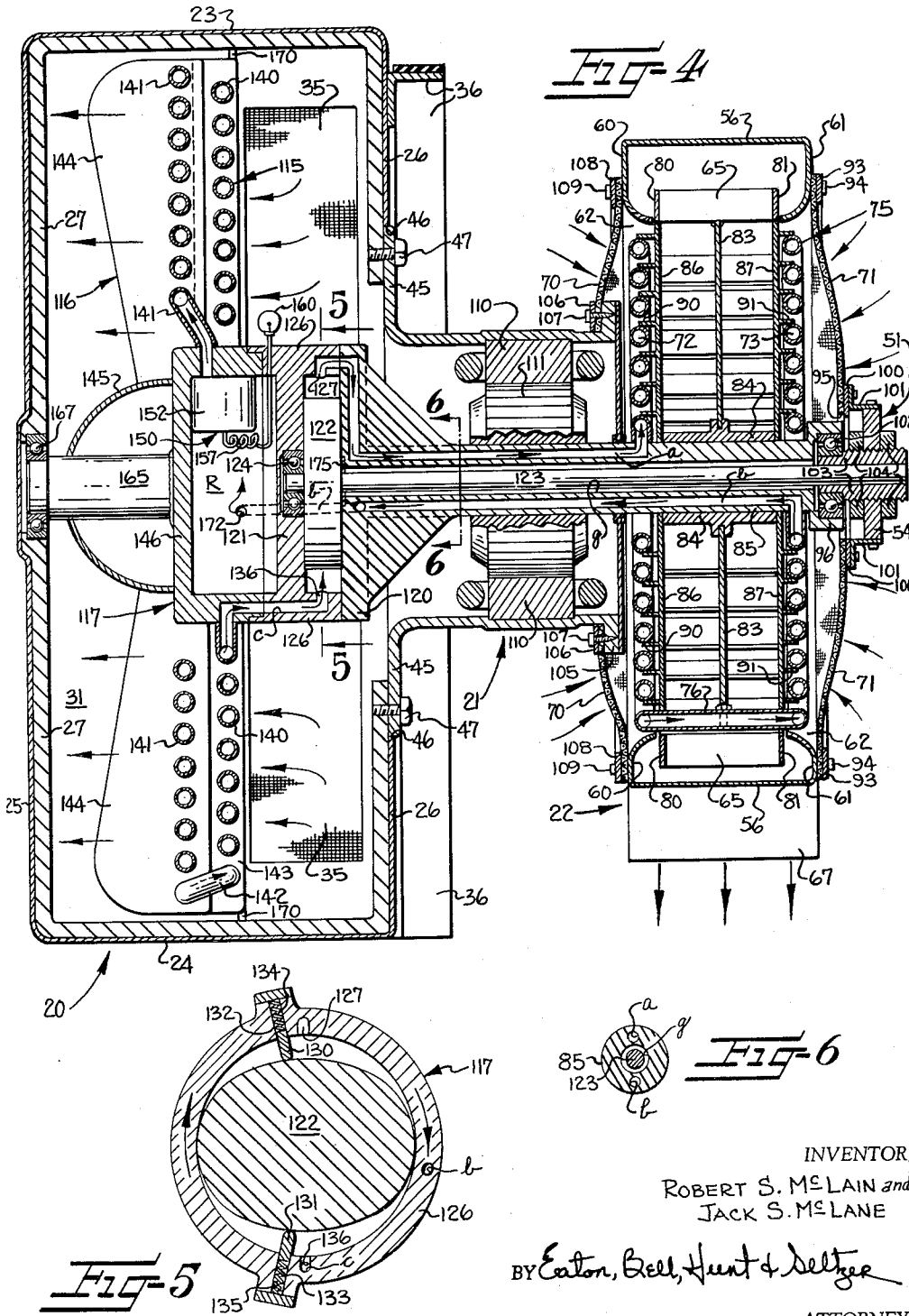
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REFRIGERATING MACHINE

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22 Claims. (Cl. 62-499)

This invention relates to refrigeration apparatus and is particularly concerned with room air conditioners.

It is an object of this invention to provide an improved refrigerating apparatus of efficient, compact, economical and balanced construction and which is particularly adapted for use as a room air conditioning unit.

It is a further object of this invention to provide an air conditioning apparatus of the character described which comprises a rotary condenser, a rotary evaporator, a compressor and a driving motor, all of which are coaxially arranged, and wherein the evaporator and the condenser are each in the form of two parallel, spirally wound coil sections provided with respective blowers, air circulating means or fans which rotate in unison with the evaporator and condenser.

It is still another object of this invention to provide a refrigerating apparatus or air conditioner of the character described wherein the drive motor is spaced between the evaporator and the condenser and the refrigerant is carried between the condenser, the evaporator and the compressor through channels or passageways provided in the shaft or rotary core of the drive motor.

It is still another object of this invention to provide an apparatus of the character described wherein the evaporator and condenser each comprises a spirally wound coil supported by a rotary fan, which coils communicate with a housing of the compressor, and wherein said housing rotates while the pump element of the compressor remains stationary, thus eliminating the major cause of vibration present in prior types of mechanical refrigerating devices.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which—

FIGURE 1 is an isometric view looking at the front, right-hand side and top of the improved air conditioning unit prior to installation thereof;

FIGURE 2 is an isometric view looking at the rear, right-hand side and top of the air conditioning unit shown in FIGURE 1;

FIGURE 3 is a reduced vertical sectional view through a typical window construction of a building showing the improved air conditioning unit mounted therein;

FIGURE 4 is an enlarged vertical sectional view taken along line 4—4 in FIGURE 1, with portions broken away for purposes of clarity;

FIGURE 5 is a transverse sectional view through the compressor taken substantially along line 5—5 in FIGURE 4;

FIGURE 6 is a transverse sectional view through the drive motor core or shaft taken substantially along line 6—6 in FIGURE 4;

FIGURE 7 is an enlarged sectional plan view taken substantially along line 7—7 in FIGURE 3, but showing the condenser, compressor, evaporator and the rotor or armature of the drive motor in elevation;

FIGURE 8 is an enlarged fragmentary view of the fluid flow control apparatus shown in the central left-hand portion of FIGURE 4.

Referring more specifically to the drawings, the novel refrigeration apparatus comprises a main casing or evaporator casing 20, a tubular motor casing 21, and a condenser casing 22. Evaporator casing 20 is preferably of substantially rectangular or cubicle shape and the condenser casing 22 is preferably of volute shape. Casing 20

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comprises top and bottom walls 23, 24, front and rear walls 25, 26 and opposed side walls 30, 31, all of which are suitably interconnected and which enclose a frame 27 (FIGURE 4). Front wall 25 is preferably foraminated or provided with suitable screens or louvers indicated at 32, 33. Right-hand and left-hand side walls 30, 21 are each provided with suitable filters or filtered openings 34, 35.

Rear wall 26 of evaporator casing 20 may be provided with a suitable rearwardly projecting frame 36 to assist in mounting the air conditioning unit in a window as shown in FIGURE 3. It will be noted that, as is usual, the building structure shown in FIGURE 3 includes a sill or stool portion 37 on which the lower wall 24 of main casing 20 may rest. The upper portion of frame 36 may be engaged by one of the sashes 40 of the window construction shown in FIGURE 3. Suitable spacing members, not shown, may be provided between opposed side walls of the window frame 41 and the side portions of the frame 36.

Motor casing 21 is provided with a flange 45 which fits in an opening 46 (FIGURES 4 and 7) formed in rear wall 26 of evaporator casing 20. Flange 45 may be secured in opening 46 by screws 47 threaded into the rear portion of frame 27. Thus, tubular motor casing 21 communicates with evaporator casing 20.

As best shown in FIGURES 2, 3 and 7, inturned foot portions 50 of a substantially U-shaped bracket 51 are suitably secured to the outer or rear surface of flange 45, as by screws 52. The inturned portions 50 are formed integral with respective leg portions 53 of bracket 51, the rear ends of leg portions 53 being interconnected by a lateral or web portion 54.

Condenser casing 22 includes an outer substantially circular or volute wall 56, substantially diametrically opposed portions of which are suitably secured to leg portions 53 of bracket 51. Wall 56 along with end walls 60, 61 and an inner wall 62 forms an air circulation chamber 63 within which extend vanes 65 of a squirrel-cage radial-flow air impeller or centrifugal fan 66.

Inner wall 62 is annular and substantially concentric with impeller 66 so that rotation of impeller 66 causes air to flow inwardly at the front and rear portions of condenser casing 22 and the air flows through chamber 63 and is exhausted through an air outlet 67 on condenser casing 22. In so doing, the air is drawn through front and rear foraminated shields or screens 70, 71 and between front and rear convoluted sections 72, 73 of a condenser coil generally designated at 75. Condenser coil sections 72, 73 are each spirally arranged tubular portions and are interconnected by a tubular portion 76 extending through impeller 66.

In addition to vanes 65, impeller 66 comprises annular vane-supporting rings 80, 81 and a centrally located disk 83. Disk 83 is provided with a hub 84 fixed on a main shaft or motor core 85. Annular rings 80, 81 have respective pairs of radial spokes or bars 86, 87 connected thereto, whose inner ends are connected to hub 84.

Spokes 86, 87 are provided with outwardly projecting tabs or spacer elements 90, 91 for supporting respective convolutions of said sections 72, 73 of the condenser coil 75. Opposed ends of condenser coil 75 are suitably connected to the rear portion of shaft 85 for communication with respective offset axial channels or passageways *a*, *b* extending longitudinally of shaft 85. Passageway *a* serves as communicative means between one end of condenser coil 75 and the outlet of a compressor in housing 117, and passageway *b* serves, in part, as communicative means between corresponding ends of condenser coil 75 and an evaporator coil 115, as will be later described.

Now, referring to FIGURE 4, it will be noted that rear screen 71 may be suitably secured to rear wall 61 of con-

denser casing 22 by means of an annular ring 93 and screws 94. The central portion of screen 71 is provided with an opening 95 to accommodate an enlarged hub portion 96 on the rearmost end of core shaft 85. The central portion of the rear screen 71 is provided with an annular reinforcing ring 100 suitably connected thereto. Ring 100 may be fixed to the web portion 54 of bracket 51 by means of angle clips 101.

Said enlarged portion 96 of core shaft 85 is mounted on the outer race of a ball bearing 102 whose inner race is fixed on the reduced front or inner portion of an externally threaded sleeve 103. Sleeve 103 loosely penetrates web portion 54 of bracket 51 and is secured therein by means of a pair of lock nuts 104. It is thus seen that sleeve 103 rotatably supports the rear end of core shaft 85.

The front screen 70 encircles the tubular motor casing 21 and is suitably secured to a rear flange 105 of motor casing 21 by means of a ring 106 and screws 107. The outer portion of front screen 70 may be attached to wall 60 of condenser casing 22 by a ring 108 and screws 109.

The motor within motor casing 21 comprises field coils or a stator 110, suitably secured to the inner wall of the tubular casing 21. A rotor 111 rotates within stator 110 and is fixed on a medial portion of the motor shaft or core 85 so that energization of stator 110 rotates rotor 111 to impart rotation to the motor or core shaft 85, impeller 66 and condenser coil 75. This also imparts rotation to an evaporator coil 115, an axial-flow air impeller or fan 116, and a housing or casing member 117 of a compressor or pump to be later described.

It will be noted that casing 117 is carried by shaft 85, a flange 120 on the front end of shaft 85 serving as the rear wall of compressor casing 117. A partition 121 within pump casing or compressor casing 117 serves as a front wall to the compressor and a stationary pump element or cam 122 is disposed between and preferably engages the proximal surfaces of flange or wall 120 and wall 121.

Cam 122 is fixed on a stationary shaft 123 which loosely extends axially through a central bore *g* in tubular core shaft 85, and whose rearmost end is fixed in sleeve 103. The other end of shaft 123 is journaled, as by an anti-friction bearing 124, in the central portion of partition 121, thus concentrically supporting cam 122 while shaft 85 and casing 117 rotate about shaft 123 and cam 122.

It will be noted that passageway *a* extends from one end of condenser coil 75, through a portion of shaft 85, through wall or flange 120 and thence through the composite annular wall 126 of pump casing 117, where it is formed as an outlet 127 communicating with a compressor chamber or pump chamber defined between walls 120, 121 and the circular inner surface of wall 126.

Referring to FIGURE 5, cam 122 of the compressor or pump has an irregular peripheral surface shown as being oval-shaped, and its periphery is engaged by a pair of circularly spaced, spring-loaded reciprocating vanes or baffle plates 130, 131 mounted for substantially radial movement in respective slots or cavities 132, 133 formed in the wall 126 of compressor casing 117. Vanes 130, 131 are of substantially the same width as the width of the pump chamber between walls 120, 121. Vanes 130, 131 are urged against the periphery of cam 122 by respective compression springs 134, 135. Thus, vanes 130, 131 rotate with compressor casing 117 and relative to cam 122.

Since inlet 136 and outlet 127 are disposed within the plane of an arc formed of said inner surface of the casing 117 and which arc terminates at said vanes 130, 131, fluid is compressed by vane 130 and caused to flow through outlet 127 into channel or passageway *a*, thus forming communicative means between the compressor and one end of condenser coil 75. Conversely, vane 131 produces negative pressure between the corresponding peripheral surface of cam 122 and the inner surface of wall 126 to

draw fluid inwardly through an inlet 136. This occurs twice with each revolution of compressor casing 117. Inlet 136 is formed in the inner surface of wall 126 and communicates with a channel or passageway *c* extending parallel to the axis of housing 117 and within the composite wall 126. Passageway *c* communicates with one end of evaporator coil 115, said end of evaporator coil 115 being suitably attached to casing 117. Thus, channel *c* serves as communicative means between one end of evaporator coil 115 and the compressor inlet 136.

Evaporator coil 115 also comprises two parallel coil sections 140, 141, each of which includes a plurality of spirally arranged convolutions which are interconnected by a pipe or tube section 142. The inner or rear evaporator coil section 140 is mounted in circularly arranged fins 143 which are arranged in alternation with radial blades 144 of the propeller type fan 116 (FIGURES 4 and 7). The inner ends of blades 144 are attached to a rounded hub member or nose cone 145, and they are also attached, along with fins 143, to the wall 126 of pump casing 117. Coil section 141 is mounted in fan blades 144.

It will be noted that pump casing 117 includes a front wall (FIGURE 4) 146 to which nose cone 145 is suitably connected, as by welding. Wall 146 with walls 121, 126 forms a reservoir *R* within which a fluid control or expansion valve 150 is positioned. Valve 150 comprises a closed housing having an inner or bottom wall 151, and a side wall 152. This housing is also defined by corresponding portions of front wall 146 and side or annular wall 126 of compressor housing 117 (FIGURES 4 and 8).

Wall 152 of valve 150 is provided with a port *d* which is, at times, closed by a valve member 153 movably mounted within the housing of valve 150. Valve member 153 is in the form of a disk or plate and is also provided with a passageway *e* therethrough, through which fluid may flow when port *d* is open. Thus, the fluid, which is then in liquid form, may flow outwardly through a passageway *f* provided in composite wall 126 of housing or casing 117, from whence the fluid flows into the other end of evaporator coil 115, this end being opposite from that end which communicates with passageway *c*.

Here again, the end of evaporator coil 115 which communicates with passageway *f* is suitably attached to wall 126 of compressor casing 117. Valve member 153 is normally urged to closed position by any suitable means, such as a compression spring 155, one end of which engages valve member 153. The other side of valve member 153 engages one end of a bellows 156 which is in sealing engagement with the corresponding side of valve member 153, and which is also in sealing engagement with the inner wall 151 of valve assembly 150.

Communicating with the interior of bellows 156 is a conduit or tube 157 which is connected to wall 151 of valve assembly 150 and extends outwardly, in the form of a capillary tube, through wall 126 of compressor casing 117. The outer end of conduit 157 has a suitable thermal reactive element thereon for varying the pressure on a highly expansive gas or fluid which will expand and contract under relatively slight temperature changes. In this instance, the conduit 157 is connected to a suitable temperature-responsive control bulb of well known construction.

It is thus seen that, when the ambient or room temperature exceeds a predetermined point, the gas or fluid in conduit 157 and bellows 151 expands so that bellows 156 may open valve member 153. Thus, refrigerant flows from reservoir *R* into coil 137 when room temperature is relatively high. Conversely, when the ambient or room temperature decreases to a certain predetermined point, the pressure of the fluid in bulb 160, conduit 157 and bellows 156 decreases so that spring 155 then overcomes the pressure in bellows 156 to move valve member 153 to closed position over port *d*.

Since the rear end of shaft 85 is the only point thus

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far described which is rotatably supported, it will be observed in FIGURES 4 and 7 that front wall 146 of compressor casing 117 has a shaft 165 suitably secured thereto and projecting outwardly or forwardly in axial alinement with core shaft 85. The front end of shaft 165 is journaled in a bearing 167, which bearing is shown in the form of an anti-friction bearing, and is mounted in the front portion of frame 27.

Since evaporator casing 20 is substantially rectangular in construction, a partition 170 (FIGURE 7) may be provided adjacent the rear surface of impeller 116 and extending between walls 23, 24, 30, 31. Partition 170 may have an opening 171 therein of substantially the same diameter as impeller 116 for passage of the air therethrough.

It will be noted that the passageway *b* in core shaft 85 extends outwardly in the flange portion 120 of shaft 85 and then within wall 126 where it forms an inlet 172 communicating with reservoir R.

In operation, it is to be assumed that reservoir R is filled with a suitable liquid refrigerant, such as ammonia, sulfur-dioxide, Freon or the like. As a matter of fact, the entire system, including the evaporator, condenser and pump, contains a suitable refrigerant. Stator 110 within motor casing 21 is then energized to drive rotor 111, core shaft 85, compressor casing 117, the fans 116, 66 and coils 115, 75. The refrigerant then enters the pump chamber, between walls 120, 121 from passageway *c* through inlet 136, the refrigerant then being in the form of a vapor or hot gas. As casing 117 rotates about cam 122, the vapor is compressed as vane 130 causes the gas to flow through outlet 127 and passageway *a* into the condenser coil 75. The flow of air past the convolutions in the two sections 72, 73 of condenser coil 75 absorbs heat from the condenser coils, and rotation of the fan or blower 66 carries the heated air into chamber 63 to exhaust the same exteriorly of the building through outlet 67 as shown in FIGURES 3 and 4. Thus, the refrigerant vapor is cooled and condenses into a liquid prior to its entering passageway *b* from condenser coil 75.

The liquid refrigerant continues through passageway *b* and passes through inlet 172 into reservoir R where it remains under pressure. As has been explained heretofore, when the room temperature or ambient temperature is above a predetermined point, valve member 153 (FIGURE 8) is raised or moved outwardly to open port *d*. Port *d* is relatively small so the compressor of FIGURE 5 pumps faster than the refrigerant can flow through port *d*. It is apparent that the relatively small size of port *d* causes the refrigerant to enter section 141 of evaporator coil 115 at relatively low pressure so that it is free to boil under the influence of the higher room temperature, thus removing heat from the room and ultimately converting the liquid refrigerant into a gas or vapor as it leaves section 140 of evaporator coil 115 and again passes through passageway *c* and inlet 136 into said pump chamber, to complete a cycle in the operation.

In order that the refrigerant may not leak into the central bore or chamber *g* through which shaft 123 extends from compressor chamber C, a suitable seal 175 may be provided between shaft 123 and the wall of bore *g* adjacent the compressor chamber defined between walls 120, 121. Also, since the moisture in the surrounding air in the room condensates as the air flows through coil 115 under the impetus of rotating fan 116, such moisture may collect on the bottom wall 24 of evaporator casing 20 and may be evacuated from evaporator casing 20 through a pipe 176. As shown in FIGURE 3, pipe 176 may extend rearwardly from the rear wall 26 of evaporator casing 20 and extend outwardly of the window frame 41.

It is thus seen that we have provided a novel and efficient air conditioning unit of light weight construction in which the condenser 75, evaporator 115, motor 21 and

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compressor 117 are arranged in axial relationship, and wherein a novel compressor is provided and so arranged that all passageways between the pump and the coils of the evaporator and condenser may extend through the shaft of the electric motor and the pump element 122 remains stationary so the entire unit is substantially free from vibration.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. A refrigerating apparatus comprising a rotary condenser, a rotary evaporator and a compressor arranged in coaxial relationship, said condenser and evaporator comprising respective condenser and evaporator coils, means for moving air past each coil, said compressor comprising a compressor casing rotating with and on the same axis as said coils, said casing having a pump chamber therein provided with a circular inner surface and having an inlet and an outlet therein, a stationary pump element within said chamber and having an irregular peripheral surface engaging at least a portion of said inner surface, said pump element also being partially spaced from said inner surface, at least one vane yieldably engaging said pump element and carried by said casing, first communicative means between corresponding ends of said coils, a second communicative means between the other end of said condenser coil and the outlet of said pump chamber, and a third communicative means between the other end of said evaporator coil and the inlet of said pump chamber.

2. In a refrigerating system, a rotary condenser, a rotary evaporator and a compressor arranged in coaxial relationship, said condenser and evaporator comprising respective substantially flat spirally wound condenser and evaporator coils, a rotary fan supporting at least one of said coils, said compressor comprising a compressor casing rotating with and on the same axis as said coils, said casing having a pump chamber therein provided with a circular surface and having an inlet and an outlet therein, a stationary pump element within said chamber and engaging at least a portion of said surface, said element also being partially spaced from said surface, at least one vane movable between said pump element and said casing, first communicative means between corresponding ends of said coils, second communicative means between the other end of the condenser coil and the outlet of said pump chamber, and third communicative means between the other end of said evaporator coil and the inlet of said pump chamber.

3. In a refrigerating apparatus comprising a rotary condenser, a rotary evaporator and a compressor arranged in coaxial relationship, a motor between said condenser and said evaporator, a shaft extending from said motor, said condenser and evaporator comprising respective spirally wound condenser and evaporator coils, said condenser coil being mounted on said shaft and a separate rotary fan for each coil; the combination of said compressor comprising a compressor casing fixed on said shaft and rotating with and on the same axis as said coils, said casing having a pump chamber therein provided with a circular inner surface, a stationary cam within said chamber and having its periphery engaging at least a portion of said surface, the periphery of said cam being partially spaced from said surface, at least one vane yieldably engaging the periphery of said cam and carried by said casing, said shaft having a first channel therein forming first communicative means between corresponding ends of said coils, said shaft having a second channel therein forming second communicative means between the other end of said condenser coil and the outlet of said pump chamber, and a third communicative means be-

tween the other of said said evaporator coil and the inlet of said pump chamber.

4. A refrigerating apparatus comprising, in combination, an electric motor, a shaft extending from the motor, a compressor comprising a casing carried by and rotatable with said shaft, an irregularly-shaped stationary cam in said casing and having at least a portion thereof engaging the inner surface of said casing and another portion thereof spaced from said casing, at least one vane yieldably supported by said casing and engaging the periphery of said cam, a combination fan and tubular evaporator coil mounted on said casing, a combination fan and tubular condenser coil mounted on said shaft and spaced from said combination fan and evaporator coil, said shaft having at least two longitudinal passageways therein, one of said passageways serving as communicative means between corresponding ends of said evaporator and condenser coils, the other of said passageways serving as communicative means between the outlet side of the compressor and the other end of the condenser coil, and said casing also having a passageway therein serving as communicative means between the inlet side of the compressor and the other end of the evaporator coil.

5. In a refrigerating apparatus, an evaporator casing, a condenser casing spaced rearwardly from the evaporator casing, a motor casing fixed between said evaporator and condenser casings, an electric motor in said motor casing, a tubular shaft extending from front and rear ends of said motor, a compressor casing having a circular inner surface defining a pump chamber therein and being mounted on a front portion of said shaft, a fan mounted on said compressor casing, a spirally wound evaporator coil carried by said fan and disposed within said evaporator casing, means supporting said compressor casing and the shaft for rotation within said evaporator, motor and condenser casings, a condenser coil in said condenser casing and being carried by said tubular shaft, a stationary cam shaft mounted within and extending longitudinally of said tubular shaft, means fixedly supporting said cam shaft independently of said tubular shaft, a cam fixed on the front end of said cam shaft and disposed within said pump chamber, said cam being substantially oval-shaped, the inner surface of said pump chamber having a diameter substantially the same as the larger diameter of said oval-shaped cam, at least one vane carried by said compressor casing and yieldably engaging the periphery of said cam, said inner surface of the compressor casing being provided with an inlet and an outlet, said tubular shaft having a pair of longitudinally extending first and second passageways therein, said first passageway communicatively connecting one end of said condenser coil with said outlet, said second passageway communicatively connecting the other end of said condenser coil with one end of said evaporator coil, and said compressor casing having a third passageway therein establishing communication between the other end of the evaporator coil and said inlet.

6. A structure according to claim 5 including an expansion valve interposed between said one end of the evaporator coil and said second passageway.

7. A structure according to claim 5 having a radial-flow fan mounted on said tubular shaft adjacent said condenser coil, and said condenser coil comprising two interconnected, spirally wound coil sections straddling opposed ends of the radial-flow fan.

8. A structure according to claim 5 in which said fan is an axial-flow propeller having radially extending blades, said evaporator coil including two parallel, intercommunicating coil sections, a plurality of radial fins spaced between and projecting rearwardly of said blades, one of said coil sections being mounted in said blades, and the other of said coil sections being mounted in said fins.

9. A structure according to claim 5 in which said compressor casing is provided with a reservoir for containing a refrigerant therein and said second passageway com-

municates with said one end of the evaporator coil through the medium of said reservoir.

10. A structure according to claim 5 in which said pump chamber is provided with at least one additional vane therein, said additional vane being carried by said compressor casing and yieldably engaging the periphery of said cam in substantial circularly spaced relation from said first-mentioned vane, said outlet and said inlet being positioned within the plane of an arc formed of said inner surface in which said arc terminates at the two vanes.

11. A structure according to claim 5 in which said fan carrying the evaporator coil is in the form of a plurality of circularly arranged radially extending propeller blades, a fan supporting said condenser coil and being in the form of a squirrel cage fan, said condenser casing being in the form of a volute casing, said squirrel cage fan having circularly arranged blades projecting into said condenser casing, and said condenser casing having an outlet thereon whereby the squirrel cage fan draws air inwardly past said condenser coil and causes the air to flow through said volute condenser casing to be discharged through said condenser casing outlet.

12. A structure according to claim 11 in which said condenser coil comprises two axially opposed coil sections mounted on opposed sides of said squirrel cage fan.

13. A refrigerating apparatus comprising a rotary condenser, a rotary evaporator and a compressor arranged in coaxial relationship, said condenser and evaporator comprising respective condenser and evaporator coils, means for moving air past each coil, said compressor comprising a compressor casing rotating with and on the same axis as said coils, said casing having a pump chamber therein provided with a circular inner surface and having an inlet and an outlet therein, a stationary pump element within said chamber and engaging at least a portion of said surface, said pump element also being partially spaced from said surface, at least one vane yieldably engaging said pump element and carried by said casing, first communicative means between corresponding ends of said coils, a second communicative means between the other end of said condenser coil and the outlet of said pump chamber, a third communicative means between the other end of said evaporator coil and the inlet of said pump chamber, a rotary shaft on which said compressor casing and said coils are mounted, said air moving means for the condenser coil comprising a centrifugal-flow fan mounted on said shaft adjacent said condenser coil, and said condenser coil comprising two interconnected, spirally wound coil sections straddling axially opposed ends of said centrifugal-flow fan.

14. A refrigerating apparatus comprising a rotary condenser, a rotary evaporator and a compressor arranged in coaxial relationship, said condenser and evaporator comprising respective condenser and evaporator coils, means for moving air past each coil, said compressor comprising a compressor casing rotating with and on the same axis as said coils, said casing having a pump chamber therein provided with a circular inner surface and having an inlet and an outlet therein, a stationary pump element within said chamber and engaging at least a portion of said surface, said pump element also being partially spaced from said surface, at least one vane yieldably engaging said pump element and carried by said casing, first communicative means between corresponding ends of said coils, a second communicative means between the other end of said condenser coil and the outlet of said pump chamber, a third communicative means between the other end of said evaporator coil and the inlet of said pump chamber, said pump chamber having at least one additional vane therein, said additional vane being carried by said compressor casing and yieldably engaging said pump element in substantial circularly spaced relationship from said first-mentioned vane, and said outlet and said inlet being positioned within the

plane of an arc formed of said circular surface, which arc terminates at the two vanes.

15. A refrigerating apparatus comprising a rotary condenser, a rotary evaporator and a compressor arranged in coaxial relationship, said condenser and evaporator comprising respective condenser and evaporator coils, means for moving air past each coil, said compressor comprising a compressor casing rotating with and on the same axis as said coils, said casing having a pump chamber therein provided with a circular inner surface and having an inlet and an outlet therein, a stationary pump element within said chamber and engaging at least a portion of said surface, said pump element also being partially spaced from said surface, at least one vane yieldably engaging said pump element and carried by said casing, first communicative means between corresponding ends of said coils, a second communicative means between the other end of said condenser coil and the outlet of said pump chamber, a third communicative means between the other end of said evaporator coil and the inlet of said pump chamber, said air moving means for said coils comprising a first fan supporting the evaporator coil and being in the form of a plurality of circularly arranged radially extending propeller blades, a second fan supporting said condenser coil and being in the form of a squirrel cage fan, a volute condenser casing, said squirrel cage fan having circularly arranged blades projecting into said condenser casing, and said condenser casing having an air outlet thereon whereby the squirrel cage fan draws air inwardly past said condenser coil and causes the air to flow through said volute condenser casing to be discharged through the outlet of said condenser casing.

16. A refrigerating apparatus comprising a rotary condenser, a rotary evaporator and a compressor arranged in coaxial relationship, said condenser and evaporator comprising respective condenser and evaporator coils, means for moving air past each coil, said compressor comprising a compressor casing rotating with and on the same axis as said coils, said casing having a pump chamber therein provided with a circular inner surface and having an inlet and an outlet therein, a stationary pump element within said chamber and engaging at least a portion of said surface, said pump element also being partially spaced from said surface, at least one vane yieldably engaging said pump element and carried by said casing, first communicative means between corresponding ends of said coils, a second communicative means between the other end of said condenser coil and the outlet of said pump chamber, a third communicative means between the other end of said evaporator coil and the inlet of said pump chamber, said compressor casing having a reservoir for containing a refrigerant therein, and said reservoir being interposed between said first communicative means and the corresponding end of said evaporator coil.

17. A structure according to claim 16, including an expansion valve within said reservoir and also being interposed between said first communicative means and the corresponding end of said evaporator coil.

18. A refrigerating apparatus comprising a rotary condenser, a rotary evaporator and a compressor arranged in coaxial relationship, said condenser and evaporator comprising respective condenser and evaporator coils, means for moving air past each coil, said compressor comprising a compressor casing rotating with and on the same axis as said coils, said casing having a pump chamber therein provided with a circular inner surface and having an inlet and an outlet therein, a stationary pump element within said chamber and engaging at least a portion of said surface, said pump element also being partially spaced from said surface, at least one vane yieldably engaging said pump element and carried by said casing, first communicative means between corresponding ends of said coils, a second communicative means between the other end of said condenser coil and the outlet of said

pump chamber, a third communicative means between the other end of said evaporator coil and the inlet of said pump chamber, a rotary shaft on which said condenser coil and said compressor casing are mounted, said evaporator coil including two parallel, spirally wound, intercommunicating coil sections, an axial-flow fan comprising a plurality of substantially radially extending blades connected to said compressor casing, and at least one of said coil sections being attached to said blades.

19. A structure according to claim 18 wherein said fan also comprises a plurality of substantially radially projecting fins spaced between certain of said blades and projecting rearwardly of said blades, and the other of said coil sections being mounted in said fins.

20. A refrigerating apparatus comprising a fixed motor casing, a motor in said casing, said motor comprising a stator and a rotor rotatable in said stator, a tubular shaft extending from front and rear ends of said rotor, a compressor casing member having a substantially circular inner surface defining a pump chamber therein and being carried by a front portion of said shaft for rotation therewith, an evaporator coil also carried by said front portion of said shaft, a condenser coil carried by a rear portion of said shaft, means for moving air past said coils, means supporting said compressor casing and said shaft for rotation relative to said stator and said motor casing, a stationary shaft disposed within and extending longitudinally of said tubular shaft, means fixedly supporting said stationary shaft independently of said tubular shaft, a stationary pump member fixedly connected to said stationary shaft and disposed within said pump chamber and engaging at least a portion of said surface, said pump member also being partially spaced from said surface, at least one reciprocating vane mounted on one of said members and engaging the other of said members, first communicative means between corresponding ends of said coils, second communicative means between the other end of said condenser coil and the outlet of said pump chamber, and third communicative means between the other end of said evaporator coil and the inlet of said pump chamber.

21. A condenser unit and an evaporator unit for use in a refrigerating apparatus having a compressor, at least one of said units comprising a centrifugal-flow fan including a rotary squirrel-cage impeller, and a tubular coil comprising a pair of interconnected spirally wound coil sections straddling and carried by axially opposed ends of said impeller.

22. An evaporator for use in a refrigerating apparatus having a compressor and a condenser, said evaporator comprising an axial-flow fan including a plurality of substantially radially extending blades and a plurality of substantially radially extending fins spaced between certain of said blades and projecting rearwardly thereof with respect to the direction of flow of air effected by the blades, means supporting the inner ends of said blades and said fins for rotation therewith, and an evaporator coil including two substantially parallel, spirally wound and intercommunicating coil sections, one of said coil sections being attached to said blades and the other of said coil sections being attached to said fins.

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