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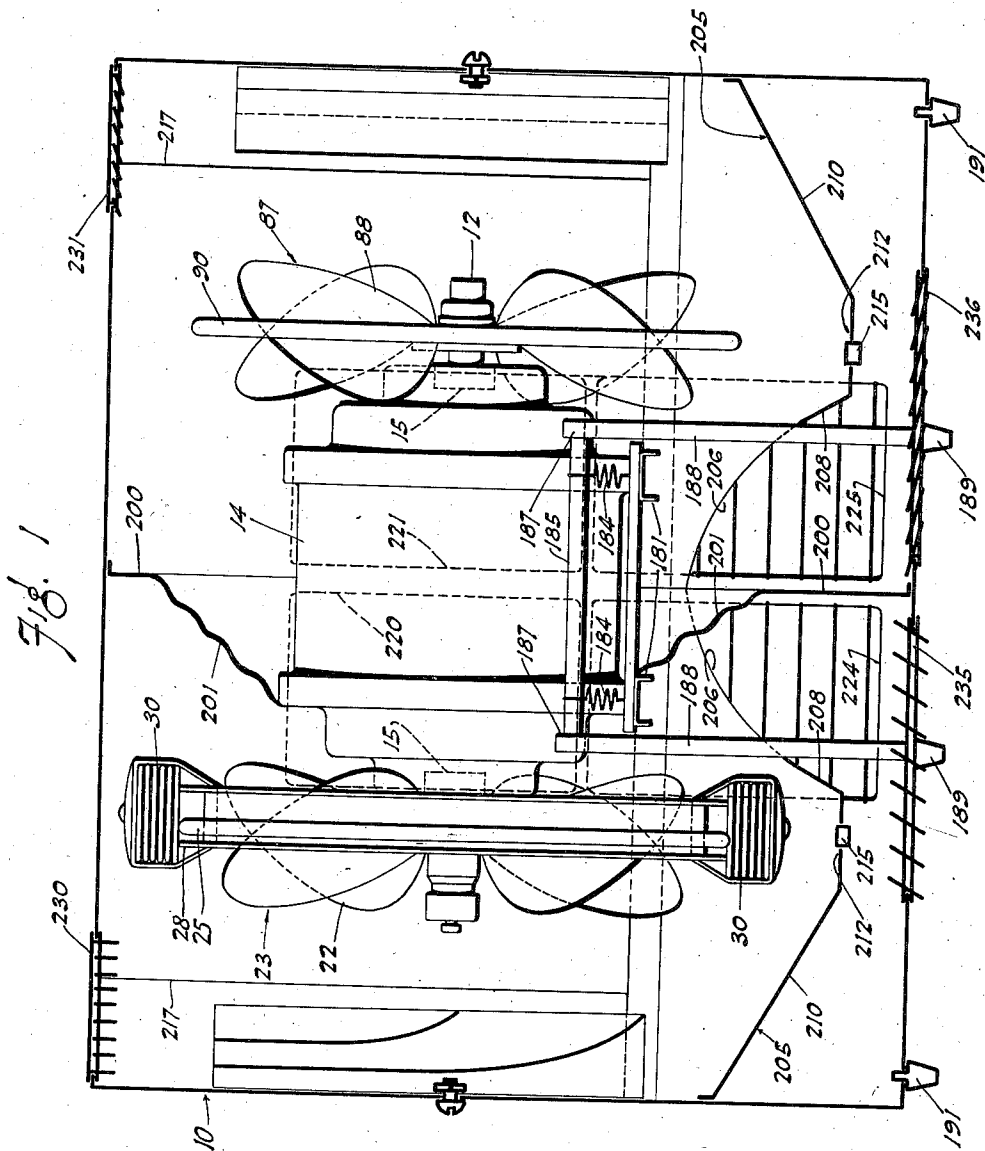
J. F. CARLSON

2,111,750

AIR CONDITIONING MACHINE

Filed Feb. 13, 1937

3 Sheets-Sheet 1



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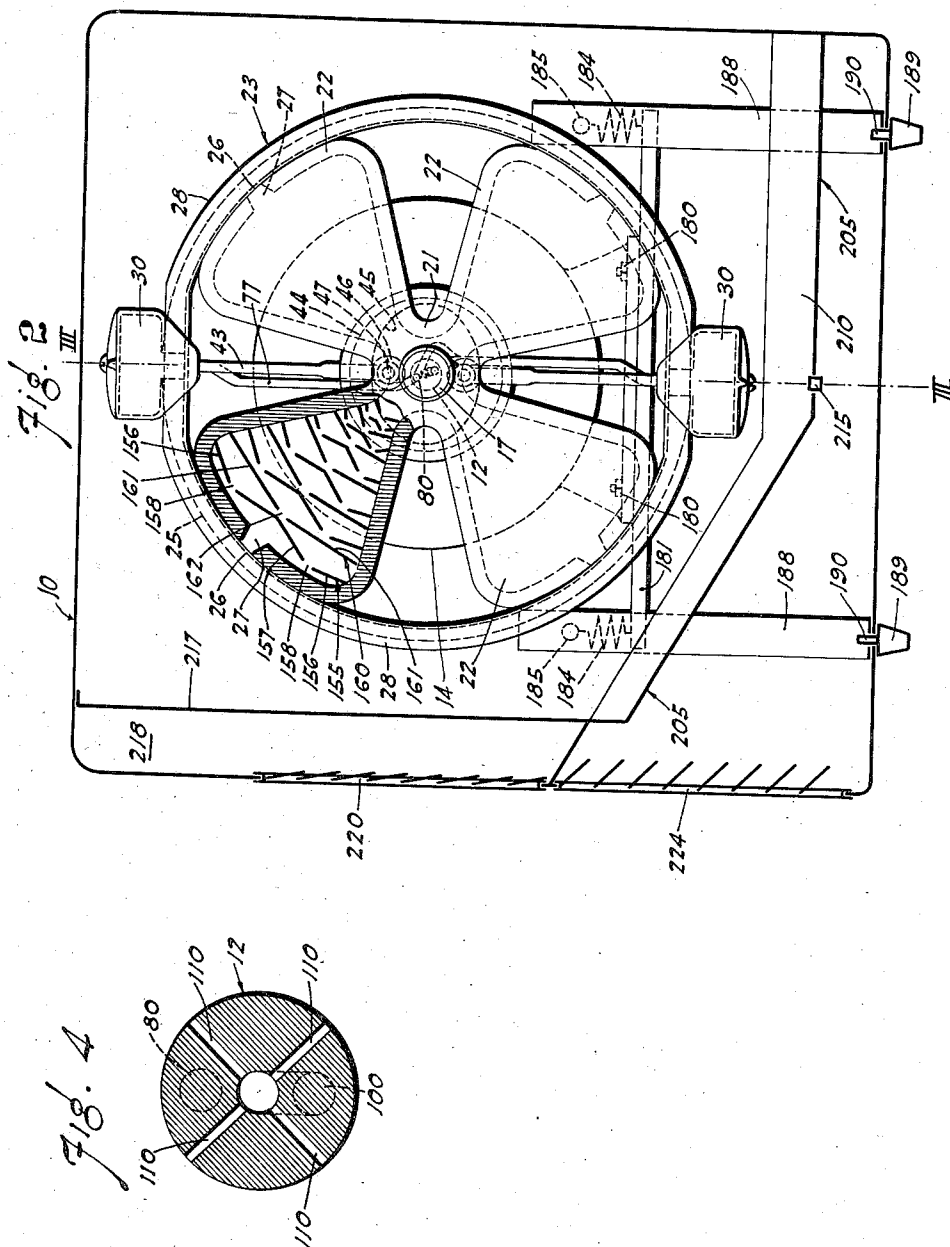
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3 Sheets-Sheet 2



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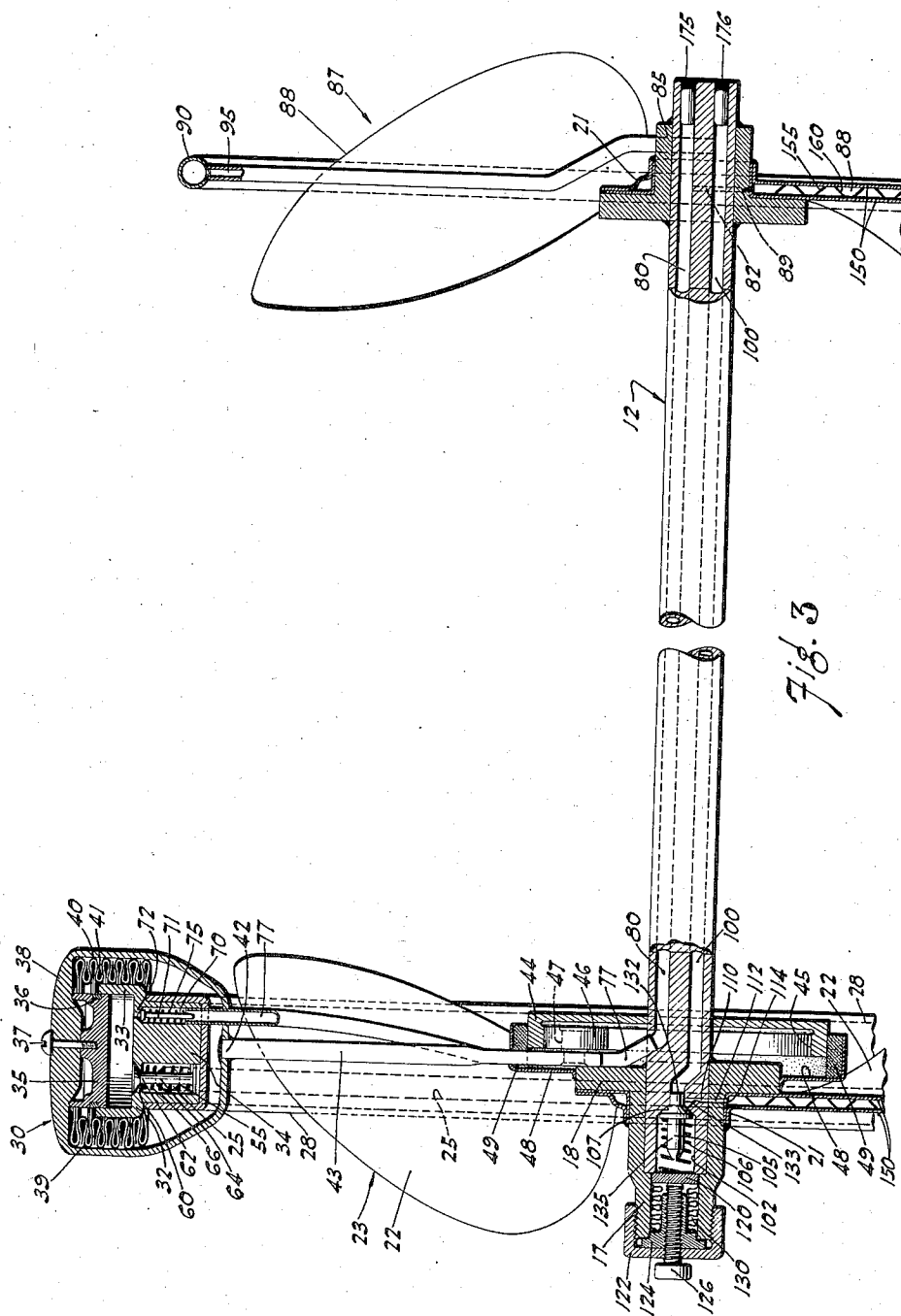
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UNITED STATES PATENT OFFICE

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AIR CONDITIONING MACHINE

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8 Claims. (Cl. 62—129)

This invention relates to heat exchange apparatus, and more particularly to apparatus for causing circulation of air and at the same time heating or cooling the air as may be desired.

One object of the invention is to provide an improved mechanism for compressing evaporating and condensing refrigerant fluid used in such apparatus.

Another object of the invention is to provide an improved means for governing the flow of air through the apparatus.

Another object of the invention is to provide an improved heat exchange apparatus which is so designed as to be relatively inexpensive to manufacture and of compact self-contained form so as to be readily portable for the convenience of the user.

The invention is exemplified in a structure in which a shaft mounted centrally in and forming a part of an electric motor of any conventional type extends beyond each end of said motor and is fitted at one of its extending ends with a combination propeller and evaporator, and at its other end with a combination propeller and condenser unit. This mechanism is enclosed in a rectangular casing provided with a transverse partition dividing the casing into two compartments, and shuttered inlet and outlet ports are provided in the walls of each of the compartments. Baffle plates positioned within the casing guide the circulation of air through the device in connection with its various functions.

Reference may now be had to the accompanying drawings forming a part of this specification, of which

Fig. 1 is a diagrammatic front elevation of the operating elements of the invention and a section of a housing in which the elements are mounted;

Fig. 2 is an end view partially in elevation and partially in section for illustrating the structure and manner of mounting a heat exchange unit in a housing;

Fig. 3 is a fragmentary substantially vertical section of compressor and condenser units taken substantially along the line III—III of Fig. 2; and

Fig. 4 is a cross section of a motor shaft, on a larger scale, and illustrating an arrangement of passageways therein.

Referring to the drawings, the apparatus comprises generally a casing 10, a shaft 12, a motor 14, an evaporator member 23, a plurality of compressors 30, and a condenser 37.

The shaft 12 forms a part of a conventional

motor 14 (Fig. 1) and is journaled therein by means of bearings 15. The shaft 12 extends beyond each of the ends of the motor 14 and is fitted at one of its ends with a hub 17 (Fig. 3) which is rigidly fastened thereon as by soldering or any other suitable means. The hub 17 is provided with an annular flange 18 upon which is fastened by means of soldering, or some other suitable means, the evaporator 23 which is in the form of a propeller comprising a hub portion 21 and a plurality of chambered blades 22 extending radially therefrom. The blades 22 are deflected at an angle from the general plane of the evaporator in any conventional manner so as to provide an air propeller effect when rotated.

A collector tube 25 connects the outer ends of the blades 22 and is provided with openings 26 (Fig. 2) that communicate in fluid tight relation with outlet ports 27 in the outer edges of the blades 22 for communication with the interiors of the blades 22. An annular ring 28 of channel-like sectional shape, is provided to connect the outer ends of the blades 22 to support them and the collector tube 25 in assembled relation. The ring 28 also provides a support for the plurality of compressors 30 (Fig. 3) which are arranged in diametrically opposed relation about the shaft 12 as a center. While any number of compressors may be employed, only one pair is shown in the drawings to provide a complete exemplification of the invention.

Each compressor 30 comprises a cylinder 32 which is open at one end and provided with cylinder walls 33 and a closed end or base portion 34. The base portion 34 is supported upon the ring 28 and is securely fastened thereto by soldering or some other suitable means. The cylinder 32 is thereby supported radially of the shaft 12. A piston 35 provided with conventional piston rings 36 is slidably fitted within the cylinder walls 33 for reciprocal motion in the cylinder for refrigerant compressing purposes. The piston 35 is connected at its upper end by means of a screw 37 to a yoke member 38 which extends diametrically of the piston and thence in spaced relation along the outer walls 33 of the cylinder 32 and thence around and under the adjacent portion of the ring 28 thus encircling these elements of the mechanism.

A resilient bellows-like sealing member 39 comprising a series of folded elements 40 is soldered at one end about the upper end of the piston 35 and at its opposite end about the cylinder base 34 to normally urge the piston 35 outwardly

of the cylinder 32 and to prevent escape of refrigerant fluid from the apparatus. Rings 41 of metal or rubber or any other suitable material are disposed between the folds 40 to support them in spaced relation against the action of external atmospheric pressure whenever low pressure conditions exist within the cylinder 32. The yoke 30 is rigidly connected at 42 to one end of a rod 43 which extends radially toward the shaft 12 to a position between the inner face of the flange 18 and a cup member 44 which is mounted rigidly upon the stationary supporting structure for the motor 14. The cup member 44 is formed with an internal elliptical shaped camming track 45 (Figs. 2 and 3), the surface of which is parallel to the shaft 12, but at varying distances therefrom. A roller 46 is pivotally mounted upon the lower end of the rod 43 by means of a headed pin 47 for rolling engagement upon the track 45. Thus rotation of the shaft 12 and the rigidly connected portions, including the hub 17, the evaporator 23, the ring 28, the cylinder 32, the piston 35, the yoke 38 and the rod 43 about the axle 12 as a center will cause the roller 46 to traverse the stationary track 45 and to follow its elliptical curvature, with the result that the rod 43 will be oscillated radially with respect to the shaft 12 to produce reciprocative movement of the piston 35 relative to the cylinder member 32. A casing member 48 is mounted upon the flange 18, and a sealing ring 49 made of felt or other suitable material is fitted therein for bearing against the inner walls of the casing 48 and the outer walls of the cup 44 to prevent escape of lubricant from the cup member 44 and the casing 48.

The collector ring 25 communicates through the base 34 to the cylinder 32 by means of an inlet port 55 formed in this base. The port 55 terminates in the upper face of the base 34 at an intermediate portion of the cylinder base 34. The port 55 is provided at its upper end with a reduced annular shoulder 60 which is beveled at its upper face to provide a seat for a conventional poppet valve 62. The valve 62 is provided with a headed stem 64 for connection with a coil spring 66 which is confined under compression between the headed portion of the stem 64 and the shoulder 60 to resiliently urge the valve 62 towards a seated position upon the shoulder 60.

An outlet port 70 is provided in the base 34 and is fitted with a valve 71 which is resiliently urged toward a seated position against a valve seat 72 by means of a spring 75. An outlet tube 77 is connected in fluid tight relation at one end to the outer end of the outlet port 70, and at its opposite end to a duct 80 extending longitudinally through the shaft 12. Transverse ports 82 formed in the shaft 12 adjacent its opposite end extend laterally from the duct 80 to points at the outer wall of the shaft 12 for communication through the hub portion 21 with the interiors of chambered blades 88 of the condenser unit 87. A hub member 85 carrying the condenser 87 which is in the form of an air propeller is positioned upon the shaft 12 in such manner that the ports 82 are in open communication with the interiors of the blades 88 through the medium of ports 89 which are formed in the hub member 85.

The outer ends of the blades 88 are interconnected by means of a circular collector tube 90 which communicates with the interiors of the blades 88. A pair of discharge tubes 95, extending diametrically of the tube 90 are each con-

nected at one of their ends to the collector tube 90 and communicate at their other ends with a duct 100 which extends longitudinally through the shaft 12 in parallel spaced relation to the duct 80.

The opposite end of duct 100 is provided with an enlarged opening 102 to receive the outer end of a conventional poppet valve 105 and a coil spring 106 resiliently urges the valve 105 towards a seat 107 which is provided by the shoulder formed at the connection of the duct 100 to the opening 102. A port 110 connecting the duct 100 at a point slightly spaced from its connection to the opening 102 extends laterally through the shaft 12 to a point of connection with a corresponding similar port 112 formed in the hub 17, which in turn communicates through an opening 114 with the interiors of the blades 22.

One end of the spring 106 bears against the valve 105 and the other end bears against a circular plate 120 which is fitted within the bore of the hub 17 adjacent the outer end of the shaft 12. An adjustable cap member 122 which is mounted in screw-threaded relation upon the end of the hub 17 supports a retaining member 124 in abutting relation against the end of the hub 17. An adjusting screw 126 is carried by the member 124 in screw-threaded relation and bears against the plate 120 at its inner end. Adjustment of the screw 126 thereby regulates the pressure of the plate 120 against the spring 106, which in turn varies the pressure of the spring against the valve 105. A circular bellows-like sealing member 130 is soldered to the outer end of the hub 17 and the plate 120 to prevent leakage of refrigerant fluid from the apparatus, regardless of the position of the plate 120 relative to the hub 17.

The valve 105 is provided with an axially extending stub portion 132 of such shape as to slidably fit within the duct 100 and to close the opening of the port 110 whenever the valve 105 is in a seated position. An auxiliary bleeder port 133 extending from an intermediate point in the face of the valve seat 107 to the port 110 provides a by-pass to convey fluid which may escape past the stub portion 132 into the opening 102. This prevents accumulation of fluid at this point which would otherwise prevent the proper operation of the valve 105. A stem 135 extending from the valve 105 cooperates with the plate 120 to confine the movement of the valve 105 within proper limits during operation of the mechanism.

The blades 22 and 88 of the compressor and 55 condenser units 23 and 87 (Figs. 2 and 3) are similar in construction and each comprises a pair of wall plates 150 which are spaced one from the other at their intermediate points but converge at their marginal edges where they are secured in fluid tight relation by means of soldering or some other suitable method. There is thus provided at opposite end portions of the motor shaft a plurality of chambered propeller blades radiating from chambered similar hub-like portions 21 with which such blades are in open communication. Arranged between the spaced walls of the blades are a series of baffle members 155 and 160 which extend between the wall plates 150 substantially transversely of the radial axes of the blades. The baffles are arranged in pairs and extend outwardly from the hub portions 21. Each baffle 155 consists of outwardly inclined end portions 156 and inwardly inclined center portions 157. Openings 158 are provided at the

junctures of the portions 156 and 157. Baffles 160 consist of a pair of inclined portions 161, and an opening 162 is provided at the central juncture point thereof.

5 There is thus provided a combination of chambered elements which when assembled provides a unitary structure rotatable in the bearings 15. The open spaces provided in the various elements of the combination are in open communication one
10 with the other, except as may be interrupted by operation of the valve members 62, 71 and 105. This system of intercommunicating fluid containing elements is then filled with any suitable kind of refrigerant fluid, as for example, by forcing the
15 fluid into the duct 80 at its end adjacent the condenser unit 87 until all of the air in the system is displaced and the fluid issues from the corresponding end of the duct 100. The ends of the ducts 80 and 100 are then sealed by means of suitable plugs 175 and 176 (Fig. 3). All of the rigid
20 connections between the elements of the rotating mechanism are made fluid tight, and the plugs 175 and 176 therefore complete the hermetical sealing of the refrigerant fluid within the device.

25 The motor 14 is rigidly mounted at 180 upon a pair of beams 181 which are, in turn, suspended at their outer ends by means of coil springs 184 from cross bars 185. The cross bars 185 are connected at 187 to the upper ends of posts 188 which
30 are rigidly mounted upon the casing 10 by rubber headed screws 189, the threaded shank portions of which extend through suitable openings in the casing to engage threaded sockets 190 in the ends of the posts 188. There is thus provided a
35 cushion support for the motor 14 in the casing 10 whereby vibration of the motor will not be transmitted to the casing.

Screws 191 similar to screws 189 are threaded into suitable openings in the casing 10 to co-
40 operate with the heads of the screws 189 to support the casing uniformly throughout its extent in spaced relation from the surface upon which the device may be placed.

The casing 10 comprises a rectangular box like
45 structure completely enveloping the motor 14 and the rotating unit comprising the evaporator 23, condenser 87 and supporting shaft 12. A central partition 200 extending transversely and completely across the interior of the casing and about
50 the motor 14 divides the casing into two separate compartments within which the evaporator and condenser units, respectively, are adapted to rotate. The marginal portion 201 of the partition
55 200 disposed adjacent the motor 14 is formed of some flexible air-tight fabric or other suitable material to provide an air-tight partitioning effect without interfering with the slight rocking movement of the motor 14 upon its cushioning supports 184.

60 Each end compartment is provided with a partition 205 extending substantially horizontally between the side and end walls of the casing 10, adjacent the bottom wall of the casing but spaced therefrom and at the rear inclining upwardly
65 toward the rear side wall of the casing. Each partition is provided with an opening 206 adjacent the central partition 200 and along the marginal edges thereof is provided with an upturned flange 208. At their outer ends the partitions 205 are
70 formed with downwardly and inwardly inclined end portions 210, thus providing wells 212 for collecting condensed moisture thrown off by the mechanism. Connections for drawing off this accumulated moisture may be made to nipples 215
75 extending through suitable openings through the

well portion of the partition 210. Vertical longitudinal partitions 217 are provided adjacent, but spaced from the rear side wall of the casing 10 within each of the end compartments. They extend vertically from the lower partitions 205 to
5 the top wall of the casing 10, and laterally from the central partition 200 toward each end wall of the casing 10, but terminate at points spaced from the end walls.

A pair of chambers 218 are thus formed between
10 the rear wall of the casing, the top wall of the casing, the partitions 217, and portions of the partitions 205. These chambers are closed at their ends adjacent the central partition 200 but are in communication with the open compart-
15 ments of the casing through the openings left at each of the ends of the partitions 217.

A pair of openings 220 and 221 are provided through the rear side wall of the casing 10 above
20 the line of connection with the partitions 205 and 20 to either side of the vertical partition 200. Another pair of openings 224 and 225 through the rear side wall of the casing below the partition 205 and one to each side of the partition 200 is provided. A pair of openings 230 and 231 are
25 formed in the top wall of the casing 10 adjacent each end wall, and a pair of openings 235 and 236 are provided through the bottom wall of the casing 10 to each side of the partition 200. Each
30 of the openings leading from the casing is provided with a shutter arrangement which may be opened or closed by any conventional connecting means for adjusting the flow of air through the mechanism.

When the device is to be used for air cooling
35 purposes, the shuttered openings 230 and 235 are opened, and the shuttered openings 231 and 236, as well as the shuttered openings 220 and 224, are closed. The motor is turned on and the blades of the evaporator unit 23 induce a current
40 of air up through the opening 235, through the opening 206 in the partition 205 and thence through the propeller blades 22 and against the end wall of the casing 10 which deflects the current of air upwardly and out of opening 230. At
45 the same time, the propeller 87 induces a flow of air into the casing through opening 225, through the opening 206 in the partition 205 and thence through propeller 87 against the opposite end wall of the casing 10, and thence laterally into the
50 chamber 218 and thence back and through the opening 221.

When the operation of the mechanism is for such cooling purposes, the air drawn into the casing chamber about the propeller 87 is taken
55 from an outside source through the opening 225 for heat absorbing purposes and is returned to the outside through the opening 221.

It is to be understood that the operation of the apparatus can be reversed with regard to control
60 of air therethrough, and that the air circulated about the propeller blades of the condenser 87 can be employed for heating purposes, while the body of air circulated about the propeller blades of the evaporator unit 23 can be taken from an
65 outside source and returned to the latter. In fact, the openings in the casing compartments can be connected and arranged in various combinations to secure the desired treatment and disposition of a given volume of air passing about
70 the evaporator or condenser blades.

During the rotation of the shaft 12, centrifugal force generated in the elements connecting the compressor to the cam track 45 constantly exerts force tending to maintain the roller 46 in contact
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with the cam track without the necessity of an inner track portion for the roller.

Although only one form of the invention has been shown and described in detail, it will be apparent to those skilled in the art that the invention is not so limited, but that various changes can be made therein without departing from the spirit of the invention or from the scope of the appended claims.

10 I claim:

1. In a heat exchange unit, a housing having a substantially fluid tight partition dividing it into two chambers, a motor mounted in the housing and having a rotatable drive shaft extending at opposite end portions into the chambers, an evaporator mounted rigidly on one end portion of the shaft in one of the chambers and including fan blades extending radially from the shaft, a compressor mounted upon the outer radial portion of the evaporator, means connected to said motor and compressor for operating the latter in response to rotation of said shaft, and a condenser mounted on the other end portion of said shaft and including fan blades extending radially from the shaft; said fan members and shaft having a system of intercommunicating conduits containing refrigerant and connected to inlet and outlet sides of the compressor to provide refrigerant circulation in cycles through the system to and from the compressor, each chamber having inlet and outlet openings for admitting and discharging air in response to operation of the fan blades in the chamber.

2. In a heat exchange unit, a housing, a motor having a rotatably driven shaft therein, an evaporator including fan members disposed rigidly and radially with respect to the shaft, a tubular ring arranged circumferentially about the outer extremities of the fan members and connected therewith, a compressor connected at an outer radial portion of the fan members and having inlet and outlet connections to the tubular ring, means connected to the motor and compressor for operating the latter in response to rotation of the shaft, a condenser mounted upon the shaft for rotation therewith, said compressor, shaft and condenser having intercommunicating passages communicating through the tubular ring with inlet and outlet sides of the compressor for circulation of refrigerant through the condenser and compressor in response to operation of the motor.

3. In a heat exchange unit, a housing a substantially fluid tight partition dividing it into two chambers, a motor mounted in the housing and having a rotatably driven shaft extending at opposite end portions into the chambers, an evaporator mounted rigidly on one end portion of the shaft in one of the chambers and including fan blades extending radially from the shaft, a compressor mounted upon the outer radial portion of the evaporator, means connected to said motor and compressor for operating the latter in response to rotation of said shaft, and a condenser mounted on the other end portion of said shaft and including fan blades extending radially from the shaft; said fan members and shaft having a system of intercommunicating conduits containing refrigerant and connected to inlet and outlet sides of the compressor to provide refrigerant circulation in cycles through the system to and from the compressor, each chamber having two sets of controlled inlet and outlet openings for selectively admitting and discharging air from each chamber.

75 4. In a heat exchange unit, a housing, a

motor mounted in the housing and including a rotatably driven shaft, an evaporator mounted rigidly on the shaft and including fan blades extending substantially radially of the shaft, a compressor connected to the evaporator and disposed substantially radially of the shaft, means connected to said motor and compressor for operating the latter in response to rotation of the shaft, and a condenser mounted on said shaft substantially coaxially with respect to the evaporator and including condenser members extending substantially radially of the shaft; said evaporator, condenser and shaft having a system of intercommunicating conduits containing refrigerant and connected to inlet and outlet sides of the compressor to provide refrigerant circulation in cycles through the system to and from the compressor, said housing having inlet and outlet openings for admitting and discharging air in response to operation of the unit.

5. In a heat exchange unit, a housing, a motor having a rotatably driven shaft therein, an evaporator including chambered fan members disposed radially and rigidly with respect to the shaft, said fan members having a series of baffles therein disposed angularly outwardly whereby fluid in the chambered fan members is urged outwardly of the latter in response to centrifugal force generated in rotation of the evaporator, a compressor connected to an outer radial portion of the evaporator and having inlet and outlet connections, means connected to the motor and compressor for operating the latter in response to rotation of the shaft, a condenser mounted upon the shaft for rotation therewith, said compressor, shaft and condenser having intercommunicating passages communicating with the inlet and outlet connections of the compressor for circulation of refrigerant through the condenser and compressor in response to operation of the motor.

6. In a heat exchange unit, a housing having a central partition dividing the housing into two compartments, a driving shaft extending through the partition, means for driving the shaft, an evaporator including fan structure disposed on one end portion of the shaft in one compartment, a condenser including fan structure disposed on the other end of the shaft in the other compartment, a compressor connected to the evaporator; said evaporator, condenser and shaft having intercommunicating passages containing refrigerant and connected to inlet and outlet sides of the compressor, means for operating the compressor, each compartment having a shuttered inlet port adapted to be opened or closed for admitting air, a partial partition in each chamber and disposed between an end portion of the shaft and said port to provide an opening to admit air from the inlet port to the intake side of the fan structure in the compartment, an auxiliary chamber formed in the housing and having an opening disposed substantially at the outlet side of the fan structure for receiving air blown from the blade structure, said secondary chamber having an outlet port leading from the housing.

7. In a heat exchange apparatus, a shaft having means for rotatably supporting it, means for driving the shaft, fan members mounted rigidly on and extending substantially radially from opposite end portions of said shaft, conduits connected circumferentially about the outer end portions of the fan members, diametrically opposite compressors disposed adjacent outer extremi-

ties of fan members at one end portion of the shaft; said shaft, fan members, conduits and compressors having inter-communicating passages containing refrigerant and constituting a continuous circuit therethrough, and driving means connected to the shaft and compressors and responsive to rotation of the shaft for operating the compressors whereby the refrigerant is compressed and circulated through the passages.

10 8. In a heat exchange apparatus, a shaft having means for rotatably supporting it, means for driving the shaft, fan members mounted rigidly on and extending substantially radially from opposite end portions of said shaft, conduits connected circumferentially about the outer end por-

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tions of the fan members, diametrically opposite compressors disposed adjacent outer extremities of fan members at one end portion of the shaft; said fan members, conduits and shaft having intercommunicating passages containing refrigerant and connected to inlet and outlet sides of the compressors to provide circulation of the refrigerant recurrently to and from fan members at opposite end portions of the shaft, driving means connected to the compressors and shaft and responsive to rotation of the shaft for operating the compressors whereby the refrigerant is compressed and circulated in recurrent cycles through said intercommunicating passages.

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