July 3, 1951 A. H. KEHOE 2,559,217

AIR-CONDITIONING APPARATUS

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Fig. 1.

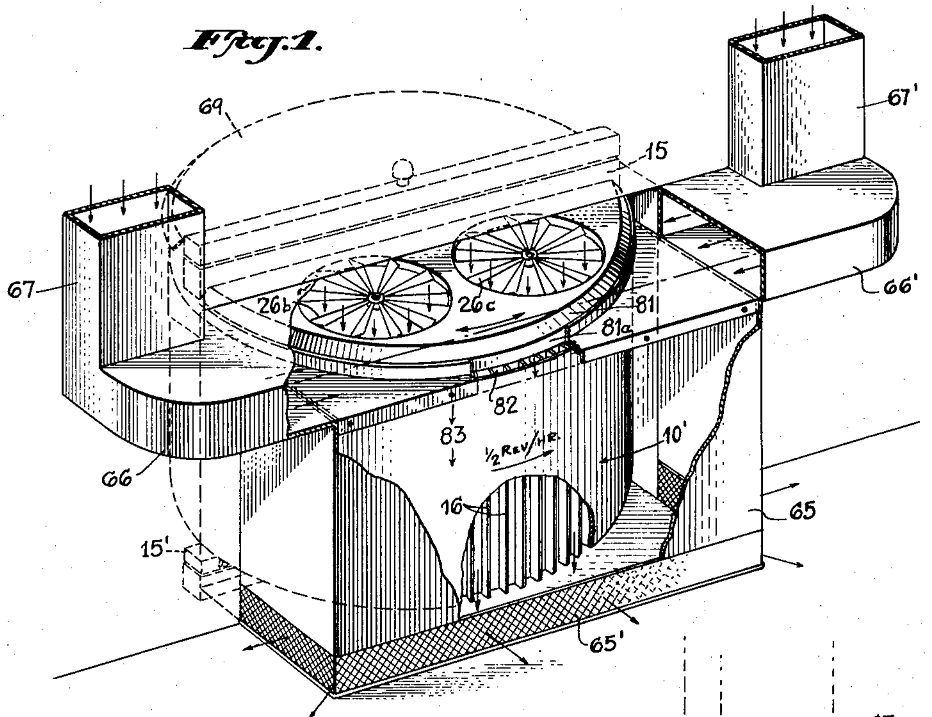
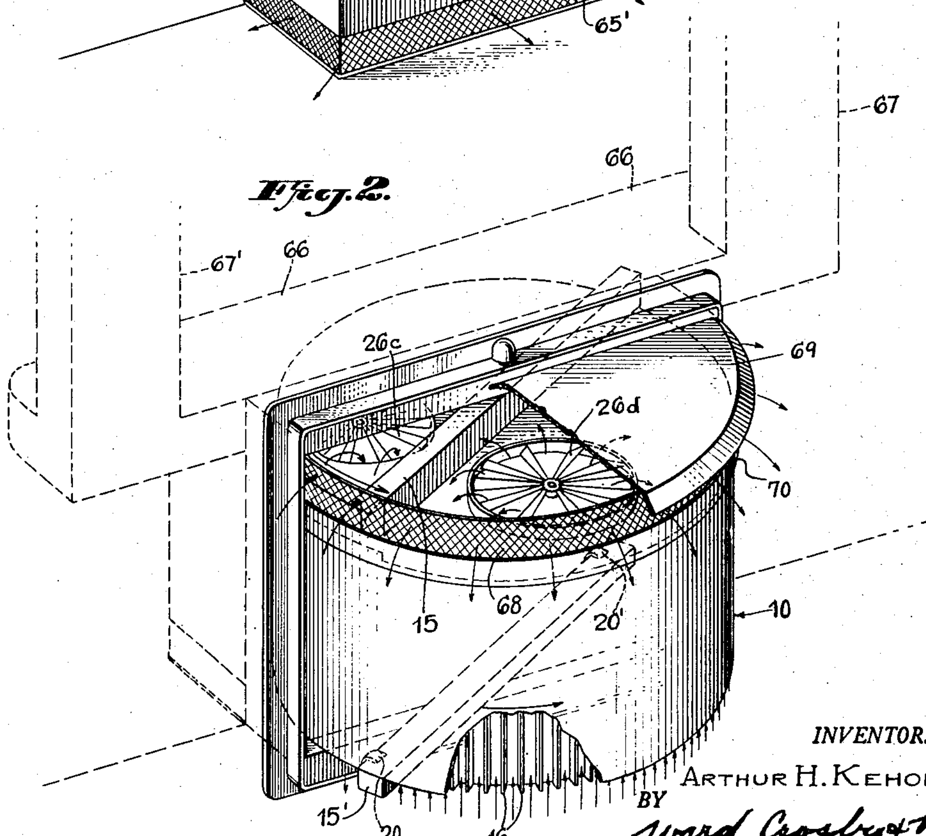


Fig. 2.



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AIR-CONDITIONING APPARATUS

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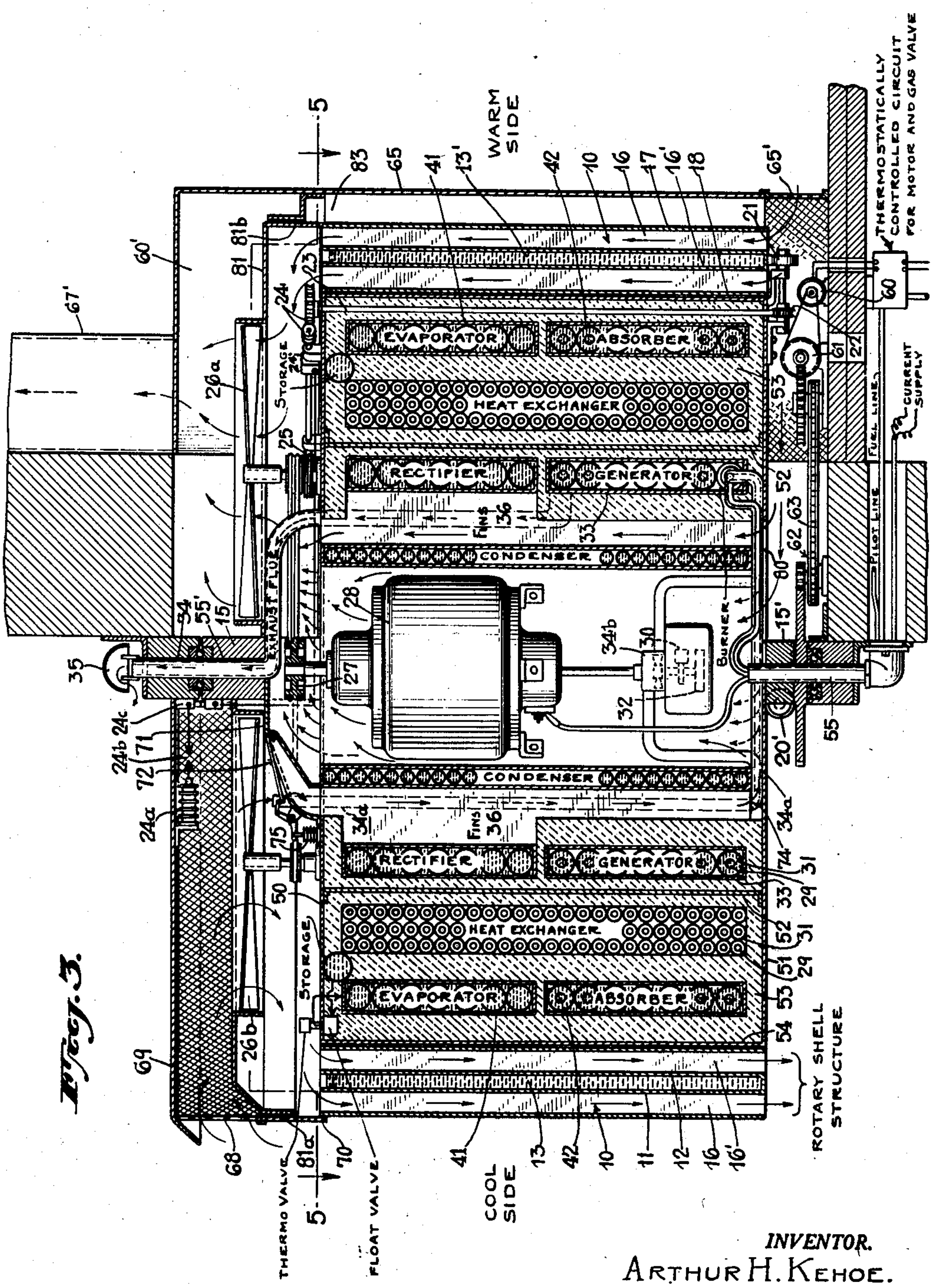

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AIR-CONDITIONING APPARATUS

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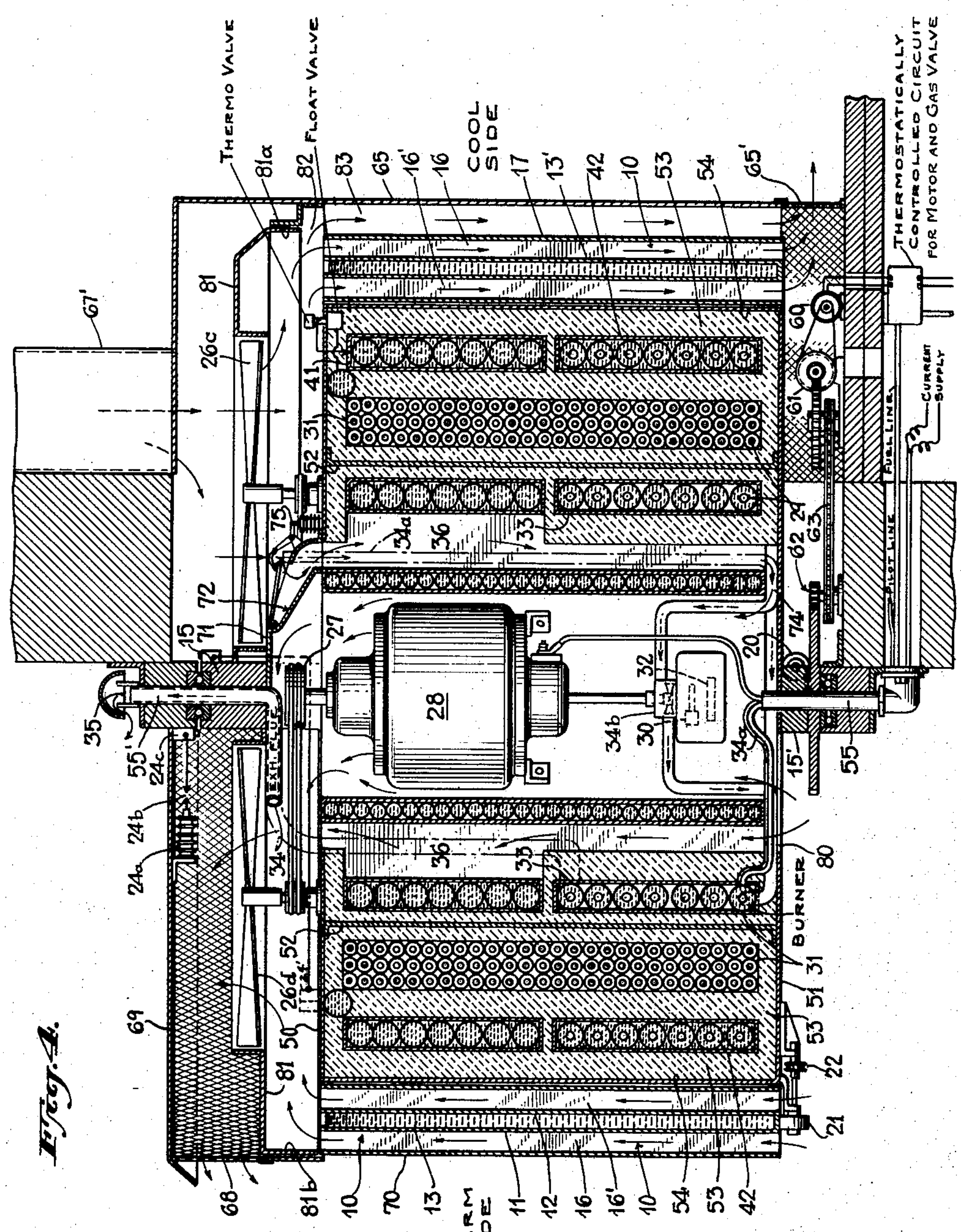

Fig. 4.

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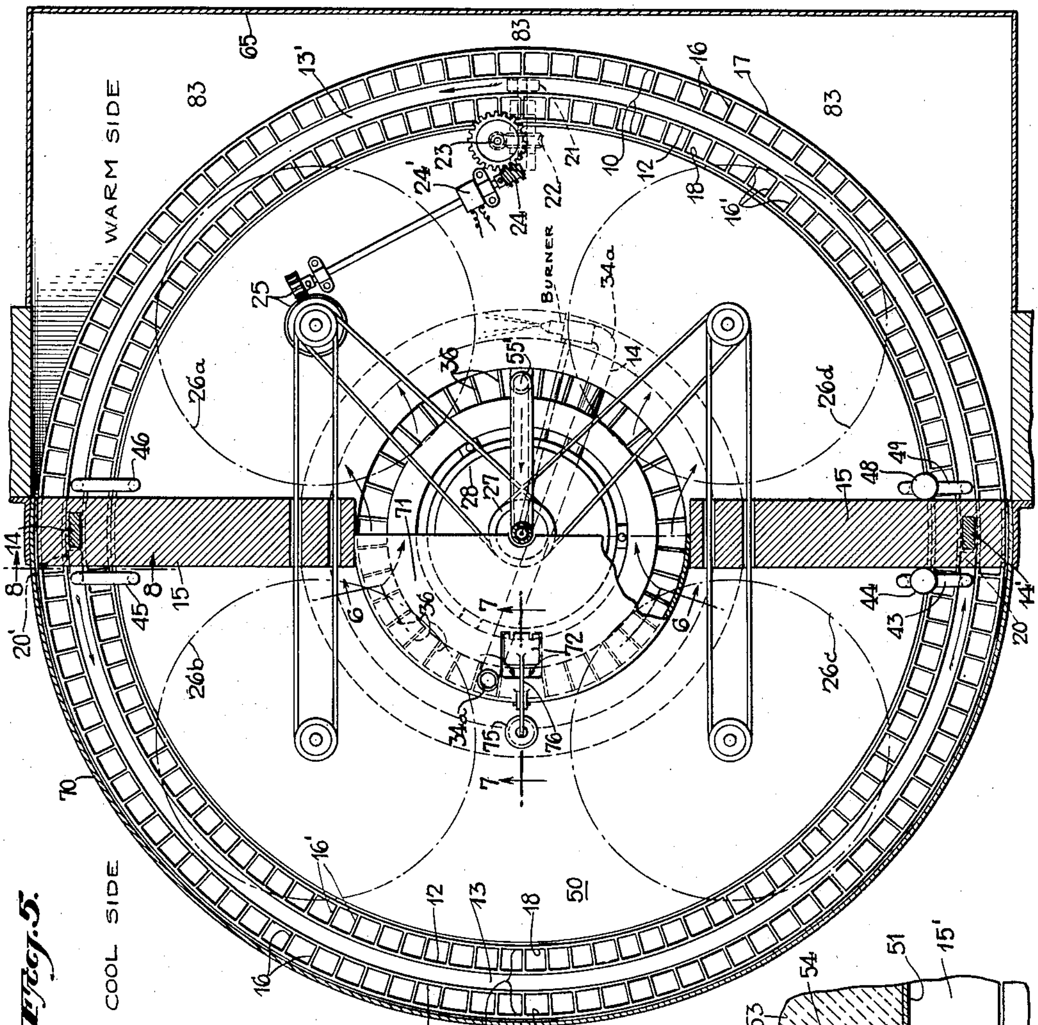

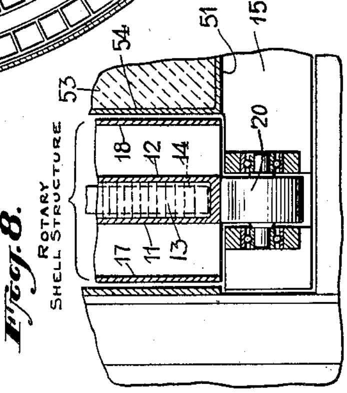

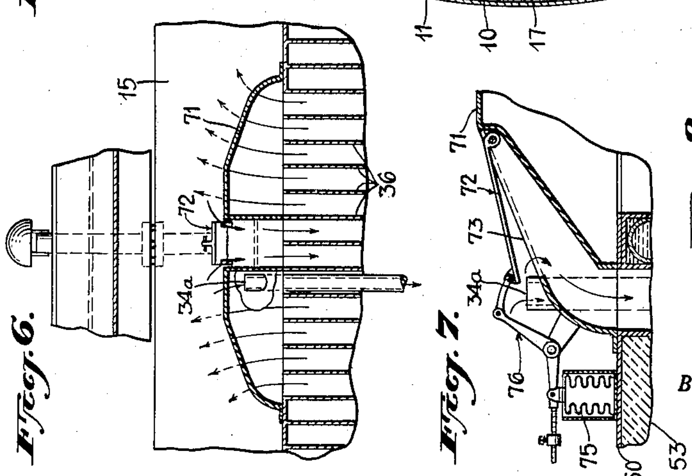

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AIR-CONDITIONING APPARATUS

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Fig. 9.

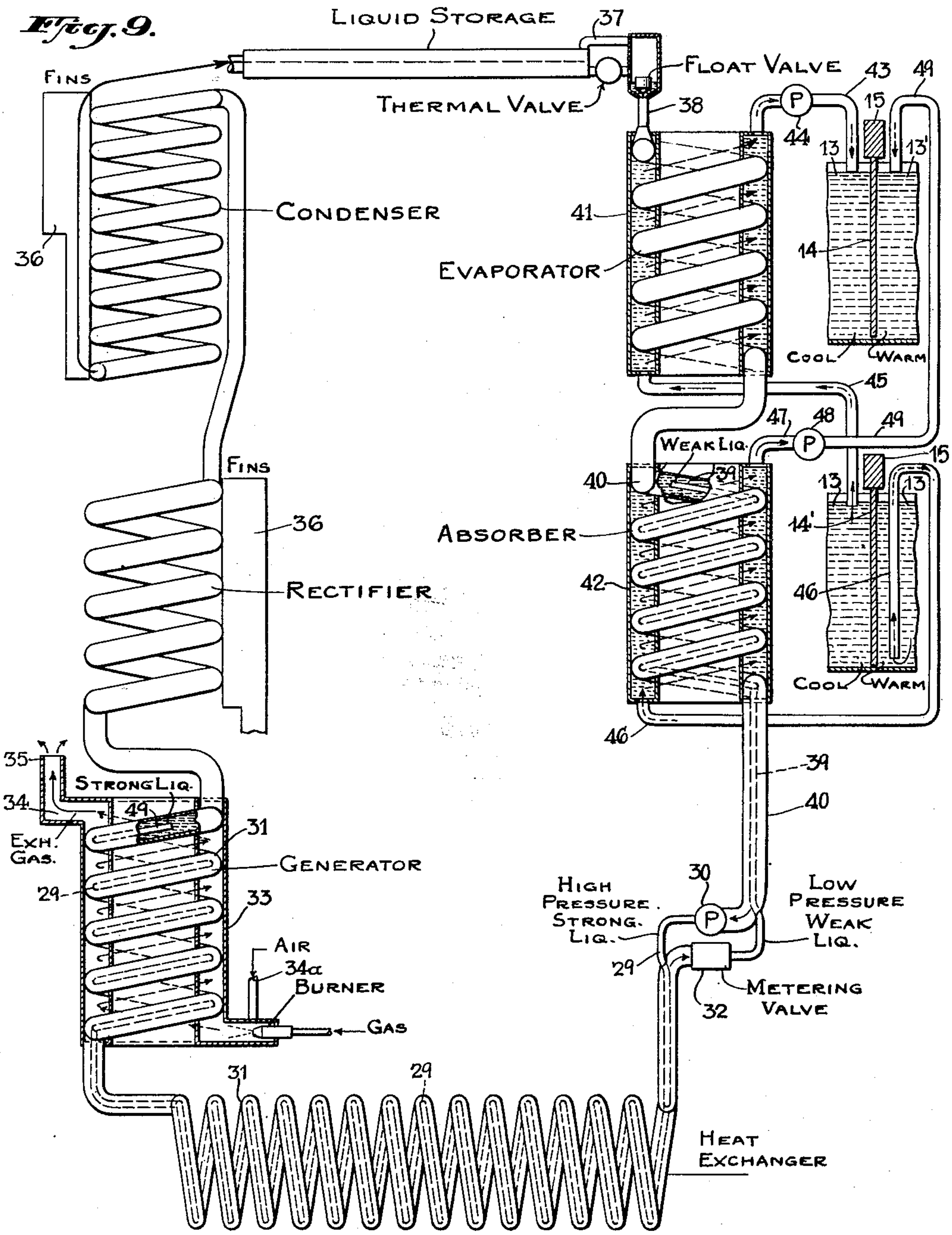
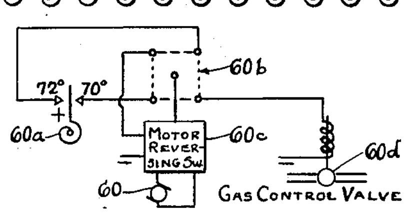


Fig. 10.



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Patented July 3, 1951 2,559,217

UNITED STATES PATENT OFFICE

2,559,217

AIR-CONDITIONING APPARATUS

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Application April 1, 1949, Serial No. 84,917

14 Claims. (Cl. 62—129)

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This invention relates to air conditioning apparatus of a type particularly intended, among other possible uses, for either heating or cooling, as desired, spaces adapted for human occupancy, as well as for controlling the humidity of, and for ventilating such spaces.

According to a preferred form of the invention, the air conditioning apparatus is located at an aperture through a partition or the like which confines the space to be air conditioned, and so that about one half of the apparatus protrudes within such space and the remainder extending outside. The apparatus may conveniently be located, for example, within a window opening or in an opening cut just below a window. The apparatus includes an outer shell-like structure generally cylindrical in form and mounted to be slowly rotatable about a vertical axis positioned within or parallel to the partition. Such shell structure contains around within its peripheral regions assemblies of radiating fins or the like which are fixed to the shell structure so that they are carried along arcuate paths alternately inside and outside the partition as the shell rotates. Such fin assemblies are positioned in heat-transfer relationship with two separate bodies of heat-transfer fluid also arranged around within the peripheral regions of the shell structure, and one of which is inside and the other of which is outside the partition. Refrigerating apparatus, preferably of an improved and highly efficient vapor absorption type may be mounted within the inner regions inside the shell structure, such apparatus having its "warm" and "cool" sides respectively connected for communication with said two bodies of heat-transfer fluid. These two bodies of fluid may, if desired, comprise the fluid confined within the enclosed hot and cold units of the refrigeration cycle, but in the presently preferred example herein disclosed, these bodies of fluid are separate from the fluid in the refrigeration system per se, and are circulated into heat exchanging relation with the hot and cold units of the system.

The apparatus preferably includes fans or the like for blowing external air over the radiating fins outside the partition, and other fans or the like may be provided for circulating indoor air over the radiating fins inside the partition.

The refrigerating part of the apparatus as contained within the inner regions inside the shell structure is preferably also mounted to turn about the above-mentioned axis, whereby its "warm" and "cool" sides may be turned respectively to either inside or outside positions under the control of automatic means, so as to utilize the apparatus for either heating or cooling the living space, depending upon the season of the year, or relative inside and outside temperatures desired. For the generator of the refrigerating

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apparatus, heat energy is preferably provided by a small gas burner, although steam or other types of heat sources may be used. Since when the apparatus operates for heating the room, the equipment serves as a "heat pump," it derives a considerable portion of the required heat by utilizing the external atmosphere as a "heat bank." When the apparatus is used for cooling the room, it operates as a heat pump taking heat from the atmosphere of the room and radiating same to the external atmosphere. Provision is preferably made when the apparatus operates as a heater to also utilize for heating the room the small amount of heat radiated by an electric motor or motors used to rotate the outer shell structure, the fans and pumps; and when the device is used to cool the room, such heat is discharged outdoors.

Arrangements are also provided for diverting or by-passing portions of the air streams which pass over the radiating surfaces in a manner so as to introduce controlled amounts of fresh air into the living space.

It has heretofore been a troublesome problem with air conditioning apparatus having refrigerating means, to dispose of the difficulty of frosting of, or the dripping of moisture from the cold heat-transferring surfaces on which large amounts of moisture will accumulate and seriously interfere with the operation or efficiency of the apparatus, thus either requiring periodic shutting down of the equipment to allow for defrosting, or in some cases involving difficulties due to the dripping of water from the moisture accumulations. With the present invention, this problem is eliminated by reason of the fact that the fin structures or the like on which the moisture accumulates, viz. the structure of the outer shell above referred to, gradually turns, so that each portion thereof alternately passes along arcuate paths inside and outside of the space to be air conditioned. Thus, for example, when the apparatus is used for heating purposes in the winter, as the radiating fins accumulate frost or moisture on the outdoor side, they are successively and progressively brought around inside, where the atmosphere ordinarily is relatively lacking in moisture, so that the moisture on the fins is there evaporated and serves to humidify the room, at the same time gradually eliminating the moisture from the fins without dripping of water. On the other hand, when the apparatus is being used to cool the room during warmer weather, at which time frost or moisture will tend to accumulate on the fins while located inside the room, the fins will be similarly gradually and progressively carried outdoors before any excessive amount of moisture accumulates thereon, and in their outdoor position they will become free of moisture before re-entering the room.

Thus at times, as during summer weather, when the room atmosphere tends to be excessively humid, moisture will be taken from the room and evaporated outdoors.

The above and other novel features of the invention will appear more fully from the following detailed description when taken in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are employed for purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings:

Figure 1 is a perspective view, partly broken away, showing the indoor portions of the apparatus according to a preferred embodiment of the invention;

Fig. 2 is a perspective view showing the outdoor side of the apparatus and with the internal parts in the process of turning from the cooling to the heating position;

Fig. 3 is a vertical sectional view taken substantially along a plane perpendicular to the wall of the room and showing the apparatus in condition for heating, ventilating and humidifying the atmosphere of the room;

Fig. 4 is view similar to Fig. 3, showing the apparatus in condition for cooling the room and dehumidifying and ventilating same;

Fig. 5 is a horizontal sectional view taken substantially along the line 5—5 of Fig. 3;

Fig. 6 is a broken sectional view taken substantially along the line 6—6 of Fig. 5 and showing certain details;

Fig. 7 is a broken sectional view taken substantially along the line 7—7 of Fig. 5 and showing certain further details;

Fig. 8 is a broken sectional view taken substantially along the line 8—8 adjacent the base of the apparatus as shown in Fig. 5 and showing certain further details;

Fig. 9 is a schematic diagram showing the way in which the various units of the heating and cooling system are associated and interconnected; and

Fig. 10 is a schematic wiring diagram of a control circuit used in the apparatus.

Referring to the drawings in further detail and more particularly to Fig. 5, a top plan view of the above-mentioned rotary shell structure is indicated at **10**. That is, this structure in the form shown, comprises a pair of concentric spaced-apart cylindrical walls **11**, **12**, between which there are located semi-cylindrical spaces **13** and **13'**, providing receptacles for the above-mentioned two bodies of heat-transfer fluid (preferably any suitable well-known antifreezing mixture). The body of liquid at **13** is within the outdoor portion of the rotary shell structure, whereas that at **13'** is within the indoor side, and these two bodies of liquid are separated one from the other, for example, as by baffles **14**, **14'**, which are mounted on a rigid crosspiece **15** to extend down into the space between cylindrical walls **11** and **12**, so as to prevent the fluid in the outdoor side from mixing with the fluid in the indoor side while the whole shell structure **10** is left free to be rotated. Cylindrical wall **11** is provided with a series of spaced vertically extending fins **16** thereon protruding outwardly, and cylindrical wall **12** is similarly provided with a series of spaced vertical fins **16'** thereon extending inwardly. The outer edges of fins **16** are embraced by an outer cylindrical wall **17** and the inner edges of the fins **16'** may be affixed to or abut a cylindrical wall **18**, forming the inner wall of the rotary shell structure.

As shown in Figs. 3, 5 and 8, the rotary shell structure **10** may be supported at the bottom by three rollers **20**, **20'** and **21**. Rollers **20**, **20'** may be mounted in bearings carried by a bottom cross piece **15'**. For the purpose of rotating the shell structure about the remaining parts of the equipment contained inside thereof, the roller **21** may be driven by suitable gearing at **22**, driven by shaft **23**, which extends up to gearing **24** on the upper side of the apparatus, the latter gearing in turn being driven from gearing at **25** connected to the same drive means as provided for fans **26a**, **26b**, **26c**, **26d**. That is, as appears from Figs. 3 and 5, these fans are mounted on vertical shafts respectively driven by suitable belts which run over a central pulley **27**, driven by an electric motor **28**. The above-described drive connections for turning the rotary shell structure **10** are so proportioned, considering the speed of the motor, that the shell structure rotates one-half revolution per hour, for example. When the apparatus is being used for heating purposes, viz. with the parts in the positions shown in Fig. 3, the conditions will be such that there is no necessity or advantage in rotating the rotary shell structure at times when the outdoor temperature is at 35–40° F. or higher and at such times it is advantageous to disconnect the drive for such shell structure, whereas at all other times, that is, when the outdoor temperature is below about 35–40° F. and when the apparatus is being used for cooling purposes (as per Fig. 4) such drive connections should be retained in operation to secure the advantages above indicated. The automatic disconnection of this drive at proper times may, of course, be accomplished in a variety of ways. By way of example, for that purpose a suitable magnetic clutch **24'** (Fig. 5) may be interposed in the shaft connecting gearing **24**, **25**, and this clutch may be controlled by a Sylphon capsule **24a** (Fig. 3) located on the outdoor side, for example beneath the cover for the apparatus, and arranged to operate contacts at **24b** connected in a simple series circuit for the magnetic clutch, which circuit is also under the control of a switch at **24c**, one side or contact of which is mounted on a stationary part and the other side or contact of which is carried on a part which turns with the heat absorption system. The clutch **24'** may be designed and arranged to disconnect the drive shaft when this circuit is completed at both contacts **24b** and **24c** viz. when the temperature acting on capsule **24a** is about 35° or 40° or higher outdoors and the system is in condition for use for heating as per Fig. 3. On the other hand, when the system is in condition for cooling as in Fig. 4, the circuit will be open at switch **24c** and the clutch **24'** will be in condition to maintain the drive connection for the rotary shell structure.

In order to show the way in which the various units of the presently preferred type of vapor absorption system are interconnected, reference will now be had to the schematic diagram (Fig. 9). These various units, although connected one to another according to the sequence shown in this diagram, are structurally arranged in the manner more clearly shown in Figs. 3 and 4, where the various units are identified by the same names or reference characters as in Fig. 9. It will be understood that each of the coil-shaped units of the diagram of Fig. 9 are structurally shaped and positioned as per Figs. 3 and 4, so as to all concentrically encircle the vertical axis of the machine.

The generator of the system preferably comprises a pair of concentric tubes, the inner tube **29** running from the high pressure strong liquor pump **30**, through the heat exchanger and through the inside of the generator coil up to near the top interior thereof. The outer tube **31** of the generator runs from the rectifier around the strong liquor tube contained therein at the generator and heat exchanger, on to a metering valve **32**, which may take the form of a pump. As indicated in Figs. 3 and 4, the pump **30** and valve **32** conveniently may be located in the central chamber beneath, and be driven by, the motor **28**. The generator tubing is located in an annular chamber **33** at the bottom of which the heat for providing the energy for operating the system may be introduced, the heat source being here shown in the form of a small gas burner from which the hot products of combustion of the gas and heated air pass up along the turns of the generator coil and thence as indicated in Fig. 3, through an exhaust flue **34** extending up through the central axis of the machine and opening to the outdoor atmosphere at the top as at **35**. A supply of air for the burner is provided through a tube **34a** having its inlet in the space beneath fans **26b** and **26c** for receiving air therefrom under some pressure. If desired such pressure may be increased by interposing a small centrifugal blower **34b** in the tube **34a**. As shown in Figs. 3 and 4, such blower may conveniently be located upon a housing for the pump **30** and metering valve **32** and connected to be driven by the motor **28** through the same shaft which drives the latter. The blower casing may thus surround the stuffing box for the pump and metering valve drive shaft so that in the event any refrigerant tends to escape this point, it will be blown along to the burner and thence up and out through the flue **34** to the outside atmosphere.

The upper end of the generator coil is connected to the lower end of the rectifier coil, the latter being, as shown in Fig. 3, preferably of the same diameter as the generator coil and positioned just above the latter. The rectifier coil may be accompanied on its inner side by a series of spaced vertical fins **36**, providing air passages therebetween for purposes hereinafter explained. The upper end of the rectifier coil, as shown, is connected to the condenser, which, as indicated in Fig. 3, may actually be a coil of smaller diameter than the rectifier and located concentrically inside the latter, and in close heat-exchange relationship to the same fins **36** as above mentioned. The outlet end of the condenser coil is connected to a liquid storage tank or coil, which, as indicated in Fig. 3, may comprise one turn or a partial turn of tubing, its discharge end communicating through a thermal valve with a float valve chamber. An overflow connection **37** also connects the discharge end of the liquid storage tube to the float valve chamber. The thermal valve may, for example, be adjusted to close the passage therethrough whenever the prevailing temperature is 35° F. or lower, in which event the only remaining connection between the liquid storage and the float valve chamber comprises the overflow connection **37**. The float valve discharges through a somewhat restricted tube **38** into the upper end of the evaporator coil, and the lower end of the latter discharges into the upper end of the absorber coil. As in the case of the generator, the absorber coil is formed with concentric inner and outer tubes **39** and **40**. The inner tube **39** terminates within and near the top of the outer tube **40** as shown in Fig. 9, providing there an outlet into the space within the larger tube **40** for the low pressure weak liquor which has passed through the metering valve **32**. As shown in Fig. 9, the outer absorber tube **40** is connected into the high pressure strong liquor pump **30**. The evaporator and absorber coils respectively are contained within annular chambers **41** and **42** and the liquid above-mentioned at **13** and **13'** respectively, is made to circulate through these annular chambers **41** and **42** in the manner indicated in the upper right hand portion of Fig. 9. There are here shown somewhat diagrammatically, the "cool" and "warm" bodies of liquid at the opposite sides of the barriers **14**, **14'** above mentioned. Liquid from near the surface of the "cool" side body is drawn through a connection **45** into the lower portion of annular chamber **41**, and from the upper portion of this chamber, such liquid is drawn through an impeller pump **44** back through a connection **43** into the "cool" body. Liquid from near the bottom of the "warm" side body is withdrawn through a connection **46** into the bottom of annular chamber **42**, thence out through a connection **47** at the top of this chamber through an impeller pump **48** and connection **49** back into the upper portion of the "warm" side body of liquid. These connections are in part shown in Fig. 5, but to avoid confusion, are omitted from Figs. 3 and 4.

The manner in which the system, as shown in Fig. 9, will function when containing a suitable known refrigerant, will be readily apparent to those skilled in the heat exchanger art, without further explanation.

As hereinabove indicated, the assembly of units comprising the vapor absorption system may be turned as a unit around inside the rotary shell structure **10** from the position shown in Fig. 3 through 180° to the position shown in Fig. 4. It will be understood that in that event the body of liquid **13** will then be in the "warm" side, whereas the liquid at **13'** will be on the "cool" side. The barriers **14**, **14'** and the connections as indicated at the upper right hand portion of the diagram of Fig. 9, will all turn with the vapor system as a unit, so that there will be no necessity of disconnecting and reconnecting any liquid conduits in changing the machine from a heater to a cooling apparatus.

As shown in Figs. 3 and 4, the supporting structure for the vapor absorption system may comprise upper and lower metal plates **50** and **51** interconnected by a cylindrical structural supporting wall **52**. The four fans, as shown, may be mounted on the top plate **50**. The various units of the absorption system may be surrounded, except as otherwise shown, by suitable insulation material **53**. If desired the outside of this structure may be covered by a metal cylindrical wall **54** around which the rotary shell structure **10** rotates. The structure comprising the plates **50**, **51** and cylinders **52**, **54**, and the parts contained therein, are rotatably mounted about the central vertical axis of the apparatus on hollow shafts as at **55**, **55'**, carried in lower and upper bearings as indicated in Fig. 3, shaft 55′ also serving as the flue 34 from the gas burner. The lower hollow shaft 55, as also indicated in Fig. 3, may provide an inlet opening for the main gas fuel pipe, a pilot gas pipe, and electrical connections.

In order to turn the heat exchanging system from heating to cooling position or vice versa, a reversible motor 60 is provided, connected through suitable reduction gearing 61, 62 and a chain 63 to rotate the shaft 55 (bottom Fig. 3). As indicated by the legend on this figure, the motor 60, as well as a valve in the gas supply line for the burner, may be controlled by a thermostatically controlled circuit, for example a circuit such as schematically indicated in Fig. 10. This circuit is arranged to control the apparatus as follows. Assuming that the parts of the equipment are in the position shown in Fig. 3, that is, for heating the room, and that the room temperature is, for example, about 70° or below, then the gas supply valve is in open condition, so that the burner will be on to supply the necessary energy for operating the equipment as a heater. Then, if the room temperature rises and exceeds say 70° (or some other predetermined desired comfortable limit) the gas supply is shut off and the burner flame is thus extinguished, except for a small pilot light supplied through a separate pilot supply pipe (as indicated at the bottom of Fig. 3). Assuming that the room temperature then continues to rise, say to 72° (or some other predetermined desired upper limit beyond which it is desired to cool the room) then the control circuit will act to start the motor 60 and thereby turn the absorption system through 180° to cooling position, and at the same time open the gas supply valve to re-establish the main flame at the burner to provide energy for the operation of the cooling equipment, so long as the room temperature is above 72° or other desired upper limit. At this time the parts of the apparatus will be in the position shown in Fig. 4. Later on, if the room temperature again falls to say 72°, so that it is no longer necessary to cool the room, the circuit will act to close the gas burner control valve. And if the room temperature falls still further, say to 70°, the circuit will then act to operate the motor 60 in the reverse direction for restoring the parts to the positions shown in Fig. 3 and to turn on the gas burner again.

The circuit (as shown in Fig. 10) may comprise a thermostat 60*a* adapted to apply a polarity alternatively to either of the two contacts designaed 70° and 72° respectively. A rotatable limit switch 60*b* is provided to make connections according to the dash lines, when the equipment is in the condition shown in Fig. 3, and according to the dotted lines when the equipment is as per Fig. 4. The limit switch 60*b* may be mechanically connected, as indicated, to a motor-reversing switch 60*c* to reverse the motor connections whenever the limit switch 60*b* is reversed in position. The switch 60*b* may be positioned at any convenient point so that it will be actuated by reason of engagement with a part carried on the rotatable absorption system at the moment such system completes its arcuate travel in either direction through 180° from one position to the other. In Fig. 10 a solenoid operated gas control valve is indicated at 60*d*. The manner in which this circuit operates will be apparent from the above description of its functions.

While for simplicity in the diagram of Fig. 10 only a single pair of control contacts are shown at the thermostat for operating the gas valve

either to its closed or open positions, it will be understood that by the use of additional contacts corresponding to different temperatures respectively, a variably operable motor controlled gas valve might be provided in various ways well known in the art of thermostatically controlled valves, so that as either a larger or smaller burner flame is desired, the gas control valve may be thermostatically adjusted accordingly.

As best shown in Fig. 1, the indoor side of the equipment may be enclosed in a housing 65 having inlets 66, 66′ at either side of its upper portion through which air is drawn down through conduits 67, 67′ from higher regions in the room at times when the equipment is being used for cooling. That is, this air is withdrawn from the upper part of the room by the action of the fans 26*b*, 26*c* and passes down through the apparatus in the manner hereinafter described, and thence out through a suitable grillwork 65′ at the floor. When the apparatus is being used for heating purposes, the paths of travel of these streams of air are reversed. Fig. 2 shows the apparatus just as it is being turned from indoor heating to cooling position. As indicated in this figure, when the room is to be heated, outdoor air enters through grillwork as at 68 located around beneath a stationary outdoor top cover 69 for the device. This air is drawn by the fans 26*b*, 26*c* down into the machine, such air being largely directed down through the vertical channels between the fins 16, 16′, in heat-transfer relationship with the body of liquid at 13, the air being discharged at the bottom of the channels between these fins. The upper outside portion of the apparatus down to the level of the top of fins 16 may be enclosed by a semi-cylindrical stationary casing 70.

As will be noted from Figs. 3 and 5, the central chamber area which contains the motor 28, at its upper end, by a semi-circular dome-shaped cover 71, is closed off against the flow of air into same from the outside atmosphere, but in order to provide entrance of small controlled amounts of fresh air for ventilating the room, a damper means 72 is provided (see details in Figs. 5–7 inc.). This damper means has an aperture 73 communicating with the vertical channels located between several of the fins 36. Thus through this damper aperture a small amount of fresh outdoor air is bypassed and forced down through a small number of these channels, thence around the lower edge of the condenser at 74 (Fig. 3) and thence up into the central chamber past the motor 28 and past the fans as at 26*a*, up into the room. As best shown in Figs. 7 and 4, the damper 72 may be automatically and thermostatically controlled, for example by a Sylphon capsule 75 connected by suitable linkage 76 to the damper, so that when the apparatus is being used for cooling purposes, if the weather is hot and humid and the room temperature is relatively high, the damper will close or tend to close, thus minimizing or shutting off the escape of cold air from the room.

Reference will now be had to the right hand side of Fig. 3 in explaining the paths of travel of the air streams on the "warm" side when the apparatus is used for heating. At this time the fans 26*a* and 26*d* serve to draw air in through the floor grill 65′ up through the channels between the fins 16, 16′ within the indoor side of the rotary shell structure, this air then passing up through outlets 67, 67′. At the same time, part of the air coming in through the grill 65′

will flow in beneath the apparatus and thence through an opening 80 up through the central part thereof and through the fans 26a, 26d. A part of this latter air stream passes up through the vertical channels between the fins 36 which surround the condenser, and another portion passes up through the central chamber over the surface of the motor 28. Thus all of the indoor air which passes up through the internal channels of the device at this time will flow over heated surfaces.

Referring now to Fig. 4, when the vapor absorption system is turned around through 180° to provide for cooling the room, the fans 26a and 26d will be on the outside and serve to draw outdoor air up through the semi-circular opening 80 in the bottom plate 51, thence up through the channels between fins 36 surrounding the condenser and also up through the central cavity past the motor 28, out through the fans 26a, 26d and outdoors through the grill 68. At the same time, other outdoor air will be drawn into the bottom ends of the channels between fins 16, 16′ on the outdoor portion of the rotary shell structure and in heat-transfer relationship with the body of fluid at 13. This air will also pass up through the fans and out through the grill 68. At this time it will be noted that the semi-circular dome member 71 covers the inside half of the upper end of the chamber containing the motor 28 so that this chamber as well as most of the cavities between fins 36 are separated from the streams of air on the indoor side. However, a small amount of indoor air will be blown by the fans 26b, 26c (which are now on the indoor side) down through the damper 72 through the channels between several of the fins 36 and around beneath the lower edge of the condenser at 74 into and up through the cavity surrounding the motor 28 and outdoors through fans 26a, 26d. Thus by this means a small amount of air will be constantly displaced from the room to insure proper ventilation, the amount depending upon the position or adjustment of the damper 72.

Referring now to the right hand side of Fig. 4, when the apparatus is operating to cool the room, it will be apparent that air from the conduits 67, 67′ will be drawn by the fans 26b, 26c down through the cavities between fins 16, 16′ on the indoor side of the rotatable shell structure in heat-exchanging relation with the cold fluid at 13′ and thence out through the floor grill 65′. The top of the assembly comprising the fans and the absorption system has an internal cover 81 which is fixed in relation to this assembly to turn therewith and has apertures in which the four fans are located. As shown with the parts in the position of Fig. 4, the periphery of this internal cover has a semi-circular depending lip 81a, the lower edge of which is spaced from the upper edge of the rotary shell structure far enough to provide a passage 82 through which some air may pass down through a by-pass cavity or space 83 to the floor grill 65′. As is known in the art of air conditioning where a stream of air is circulated past a cooling surface, for maintenance of desirable moisture and temperature conditions in the resulting stream, it is desirable to pass only a portion of the stream in close heat-exchanging relation with the cold surfaces, and to by-pass the remaining part of the stream from such surfaces so that the latter part of the stream will remain at a higher temperature when it is mixed with the issuing cold portion of the stream. The by-pass cavity or space 83 enables this practice to be carried out with this apparatus.

As will appear from the left hand side of Fig. 4 and the right hand side of Fig. 1, the internal cover 81 on its side opposite from the depending lip 81a, is formed with a more extensive depending lip 81b, so that when the apparatus is in the condition shown in Fig. 3, the passage at 83 will be blocked off.

It will be apparent that the apparatus in the form above described has a number of important advantages in providing a highly efficient unitary structure for either heating or cooling a room as required, and at the same time either humidifying or dehumidifying the room atmosphere as required, and providing controlled means for ventilating the room.

The units of the vapor absorption system are arranged in an exceptionally compact concentric well balanced relationship, and at the same time a relationship such that the indoor and outdoor streams of air which pass in heat-exchanging relationship thereto are efficiently heated or cooled as required, with little opportunity for loss of energy. The constant turning of the rotary shell structure insures that parts which bear moisture outdoors in the winter time will become progressively made free of moisture indoors, thereby utilizing such moisture to humidify the room; and conversely, when the apparatus is being used to cool the room, to the extent that the parts of the rotary shell structure become covered with moisture on the indoor side, they will be progressively made free of moisture on the outdoor side, thus carrying moisture from the room at times when the humidity in the room is prone to be excessive. The provision of the apparatus in such a form that substantially half of it protrudes outdoors, makes it possible to utilize the equipment in places where space requirements are limited. And the apparatus is well adapted to be positioned, for example, in an aperture beneath a window, so that the top surface of the casing 65 may provide a convenient wide window ledge or table area.

While the invention has been described in detail with respect to a particular preferred example, it will be understood by those skilled in the art after understanding the invention, that various changes and further modifications may be made without departing from the spirit and scope of the invention, and it is intended, therefore, in the appended claims to cover all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent is:

1. Air conditioning apparatus comprising in combination, a rotatable shell structure, means for mounting and gradually rotating same about a central axis adapted to be located along a partition or the like which confines the space to be air conditioned, and whereby the arcuate path of each portion of said structure will be partly inside and partly outside the partition, means providing extensive radiating surfaces mounted around within the peripheral portions of said shell structure and rotatable therewith, container means for two separate bodies of heat transfer fluid extending respectively around within the inside and outside peripheral portions of said shell structure and in heat transfer relation to said radiating surfaces, and refrigerating apparatus having its warm and cool sides respectively connected for communication with said two bodies of fluid.

2. Air conditioning apparatus comprising in combination a rotatable annular structure, pivotal mounting means adapted to support said structure for rotation about an upright axis and in a position partially within and partially outside of the space to be air conditioned, said structure including a pair of substantially concentric cylindrical walls adapted to retain heat-transfer fluid therebetween, barriers for separating such fluid into two bodies respectively which will be located inside and outside said space, and refrigerating apparatus mounted within the space about which said annular structure is rotatable, connections for circulating the fluid of said two bodies respectively in heat-transfer relationship with the warm and cool elements of said apparatus, and means for slowly rotating said structure about said axis whereby moisture accumulating on the cold side thereof will be carried around to the warm side thereof for evaporation.

3. Air conditioning apparatus comprising in combination a rotatable annular structure, pivotal mounting means adapted to support said structure for rotation in a position partially indoors and partially outdoors, said structure including chamber portions adapted to retain separate indoor and outdoor bodies of heat-transfer fluid, refrigerating apparatus with connections for circulating the fluid of said two bodies respectively in heat-transfer relationship with elements of contrasting temperatures in said apparatus, and a series of radiating surfaces mounted in spaced-apart relation around within such structure and providing passages therebetween for bringing outdoor and indoor currents of air respectively in heat exchanging relation to said fluid bodies, and means for slowly rotating such structure to carry said surfaces successively through indoor and outdoor positions.

4. Air conditioning equipment comprising in combination a rotatable annular structure, means for mounting and gradually rotating same about a central axis adapted to be located in a position whereby the arcuate path of each portion of said structure will be partly inside and partly outside the space to be air conditioned, container means in said structure for inside and outside bodies of heat-transfer fluid, refrigerating apparatus, connections for bringing warm and cool elements of said apparatus respectively in heat-interchanging relation with said two bodies of fluid, and thermostatically controlled means for causing an automatic interchange of the relationship of said connections with said two bodies of fluid responsive to temperature changes in said space, whereby the equipment may operate either to heat or cool said space.

5. In apparatus of the class described, the combination comprising an absorption type refrigeration system having an assembly of generally concentrically arranged coils constituting respectively principal elements of the system, and pivotal supporting means for mounting said assembly to turn about a central axis, said system including receptacle means for separate bodies of fluid which are to be heated and cooled respectively by the system and which are located on opposite sides of said axis respectively in heat-transferring relationship to hot and cold parts of the system, whereby the assembly may be used for heating or cooling purposes at either side thereof upon turning same about said axis.

6. Equipment of the class described comprising in combination an assembly of refrigerating apparatus, pivotal mounting means adapted for supporting said apparatus with either side thereof alternatively inside or outside the space to be air conditioned, a plurality of fans mounted on said assembly for blowing separate inside and outside streams of air over various elements of the apparatus in heat-transferring relationship thereto, casing structure and passages being provided for directing the outdoor air stream over a cooled element of the refrigerating apparatus and the indoor air stream over a heated element of the apparatus, whenever the apparatus is at one angular position in respect to its mounting, and the same casing structure and passages being constructed and arranged, when the apparatus is at another angular position with respect to its pivotal mounting, to direct the outdoor stream and a first part of the indoor stream of air respectively over heated and cooled elements of the refrigerating apparatus and to cause a second part of the indoor stream to bypass said cooled element and to join said first part after the latter has passed said cooled element.

7. Equipment of the class described comprising in combination an assembly of refrigerating apparatus, pivotal mounting means adapted for supporting said apparatus with either side thereof alternatively inside or outside the space to be air conditioned, a plurality of fans mounted on said assembly for blowing separate inside and outside streams of air over various elements of the apparatus in heat-transferring relationship thereto, casing structure and passages being provided for directing the outdoor air stream over a cooled element of the refrigerating apparatus and the indoor air stream over a heated element of the apparatus, whenever the apparatus is at one angular position in respect to its mounting, and the same casing structure and passages being constructed and arranged to direct the outdoor and indoor streams of air respectively over heated and cooled elements of the refrigerating apparatus when the latter is at another angular position with respect to its pivotal mounting, motor driven means for turning the apparatus to either of said angular positions, and thermostatically controlled circuit means for said motor driven means to cause the latter to turn the apparatus to said first named position when the temperature of said space falls below a predetermined level and to turn the apparatus to said other position when the inside temperature rises above a predetermined level.

8. In apparatus of the class described, the combination comprising refrigerating apparatus having warm and cool elements, radiating structure and drive means for moving same continuously along a circuitous path extending partially inside and partially outside of a space the temperature of which is to be controlled, means for bringing one of said elements of the refrigerating apparatus into heat-transfer relationship with a portion of said radiating structure while inside said space and other means for bringing the other of said elements of the refrigerating apparatus into heat-transfer relationship with portions of said radiating structure when outside said space.

9. In apparatus of the class described, the combination comprising refrigerating apparatus having warm and cool elements, radiating structure and a drive therefor acting to move same continuously along a circuitous path ex-

tending partially inside and partially outside of a space the temperature of which is to be controlled, means for bringing one of said elements of the refrigerating apparatus into heat-transfer relationship with portions of said radiating structure while inside said space and other means for bringing the other of said elements of the refrigerating apparatus into heat-transfer relationship with portions of said radiating structure when outside said space, said first mentioned means and said other means being interchangeable with respect to such inside and outside portions of said radiating structure, whereby said warm and cool elements respectively may be brought into heat-transfer relation to said inside and outside portions, or said cool and warm elements respectively may be brought into heat-transfer relation to said inside and outside portions.

10. In apparatus of the class described, the combination comprising refrigerating apparatus having warm and cool elements, radiating structure and drive means for normally moving same continuously along a circuitous path extending partially inside and partially outside of a space the temperature of which is to be controlled, means for bringing alternatively either one of said elements of the refrigerating apparatus into heat-transfer relationship with a portion of said radiating structure while inside said space and other means for then bringing the other of said elements of the refrigerating apparatus into heat-transfer relationship with portions of said radiating structure when outside said space, and thermostatically controlled means for automatically stopping the operation of said drive means when the outside temperature exceeds a predetermined level and if said other means is then operative to bring said cool element into heat-transfer relation with said portions of the radiating structure outside said space.

11. In apparatus of the class described, the combination comprising an absorption type refrigeration system having an assembly of generally concentrically arranged coils constituting elements of the system, pivotal supporting means for mounting said assembly for rotation in a position partly inside and partly outside a space to be air conditioned, radiating means inside said space and constructed and arranged to have a heat transfer relationship with either a warm or cool element of said assembly depending upon the angular position thereof, and additional radiating means outside said space and constructed and arranged also to have heat transfer relationship with either a cool or warm element of said assembly.

12. In apparatus of the class described, the combination comprising a refrigeration system having an assembly of coils constituting elements of the system, pivotal supporting means for mounting said assembly for rotation in a position partly inside and partly outside a space to be air conditioned, radiating means inside said space and constructed and arranged to have heat transfer relationship with either a warm or cool element of said assembly depending upon the angular position of said assembly, additional radiating means outside said space and constructed and arranged also to have heat transfer relationship with either a cool or warm element of said assembly depending upon the angular position thereof, and motor driven fans mounted for rotation with said assembly about said pivotal supporting means and positioned respectively to force streams of air over said inside and outside radiating means in opposite generally vertical directions, the construction and direction of rotation of said fans respectively being such that when said assembly is at an angular position for transferring heat to said space, the direction of flow of the indoor air stream will be upward, and when the angular position of said assembly is such as to transfer heat from said space, the direction of the indoor air stream will be downwardly.

13. In apparatus of the class described, the combination comprising a refrigeration system having an assembly of generally concentrically arranged coils constituting elements of the system, pivotal supporting means for mounting said assembly for rotation about a generally vertical axis and in a position partly inside and partly outside a space to be air conditioned, radiating means both inside and outside said space and within which said assembly is rotatable, means for bringing said inside and outside radiating means respectively into heat-transfer relationship each with either a warm or cool element of said assembly depending upon the angular position thereof, motor driven fans mounted for rotation with said assembly about said pivotal supporting means, said fans being positioned at opposite sides of said pivotal means and being constructed and rotatable in directions respectively such as to force a stream of air downwardly over said inside radiating means when the latter is in heat-transfer relationship with a cool element and upwardly over said inside radiating means when the latter is in heat-transfer relationship with a warm element of the assembly.

14. In apparatus of the class described, the combination comprising a refrigeration system having an assembly including warm and cool elements, pivotal supporting means for mounting said assembly for rotation in a position partly inside and partly outside a space to be air conditioned and whereby the cool element may be moved to a position to receive heat from said space or alternatively said warm element may be moved to a position to transfer heat to said space, a source of heat for providing energy for operating said system thermostatically controlled means for automatically turning said assembly to a position for transferring heat to said space when the temperature thereof falls below a predetermined limit and to a position for transferring heat from said space when the temperature thereof rises above a predetermined limit, and means acting under the control of said thermostatically controlled means to shut off said source of heat when the temperature in said space is within a predetermined intermediate range.

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The following references are of record in the file of this patent:

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