Jan. 6, 1948. R. S. SHERMAN 2,433,960

AIR CONDITIONING APPARATUS

Filed Feb. 13, 1945 4 Sheets-Sheet 1

Fig. 1

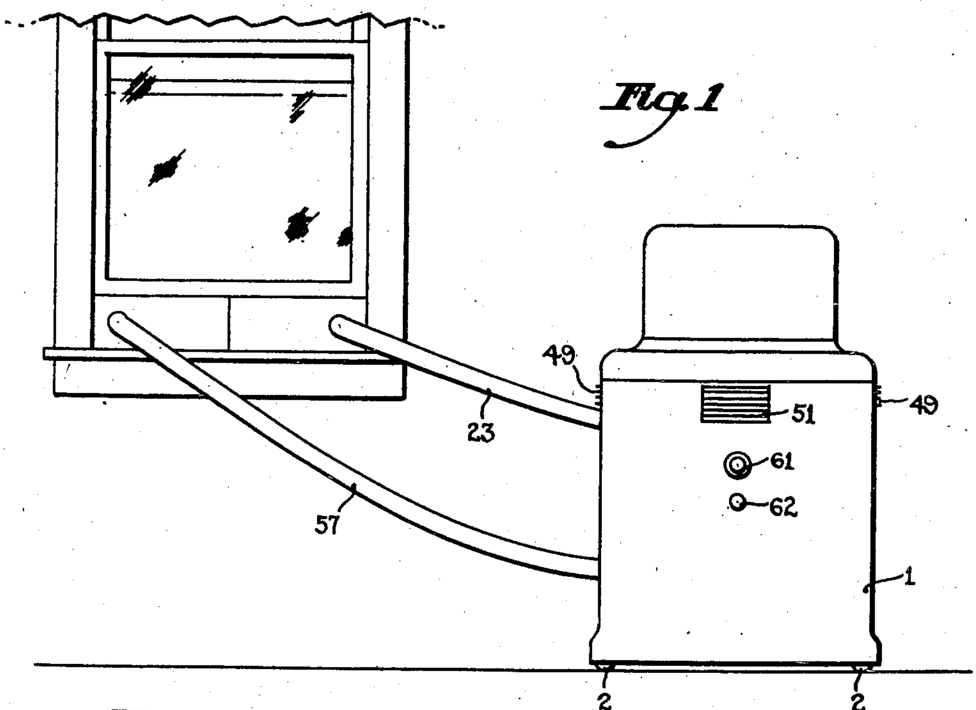
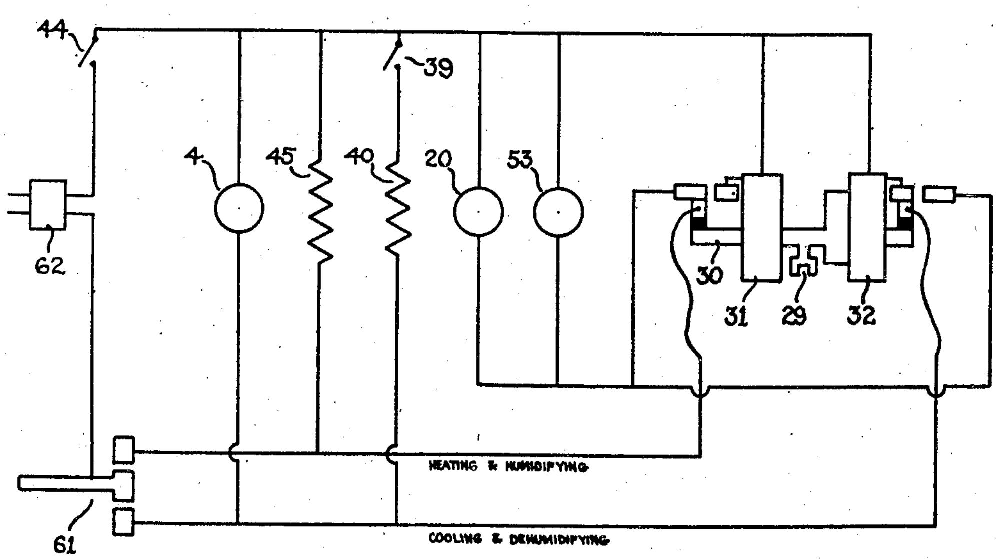


Fig. 6



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AIR CONDITIONING APPARATUS

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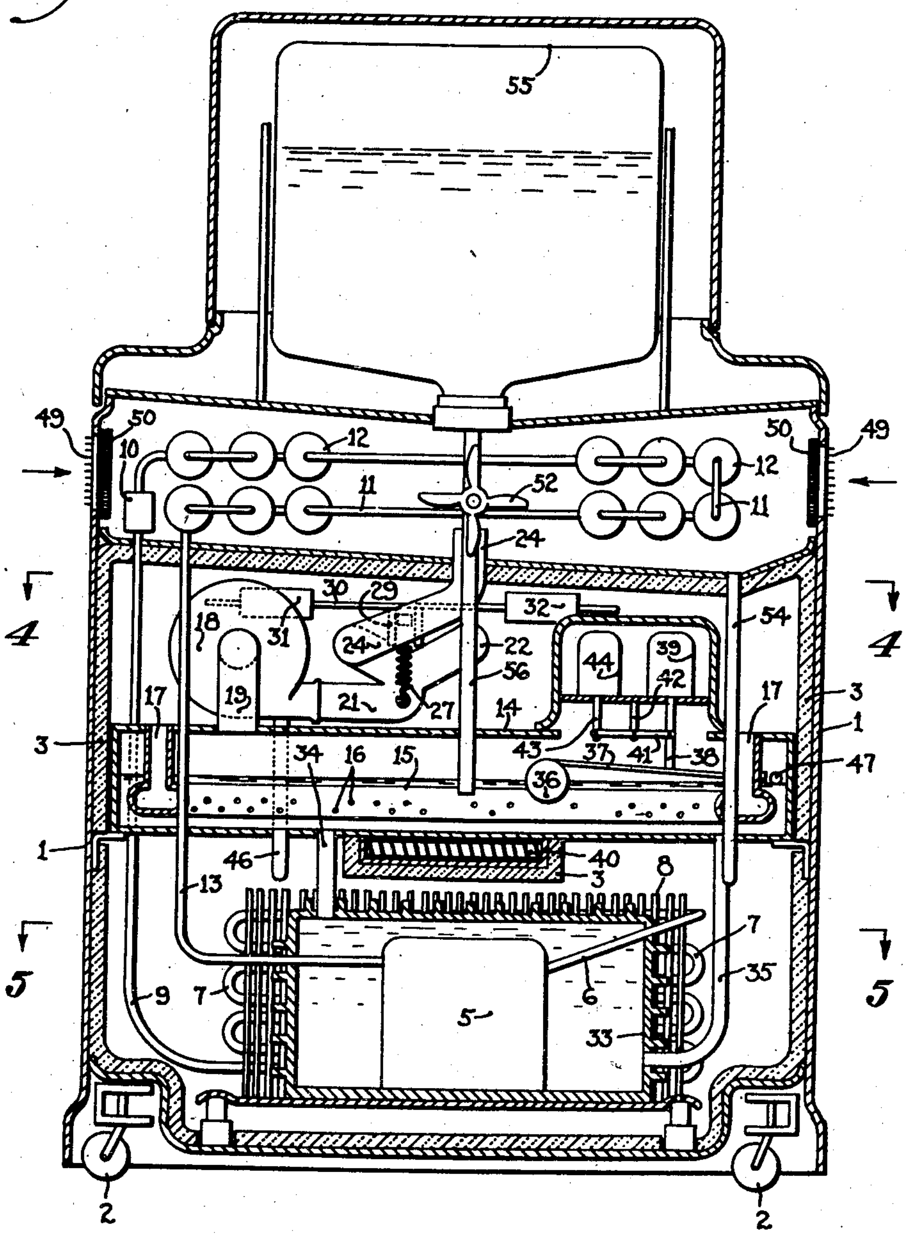
Fig. 2



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AIR CONDITIONING APPARATUS

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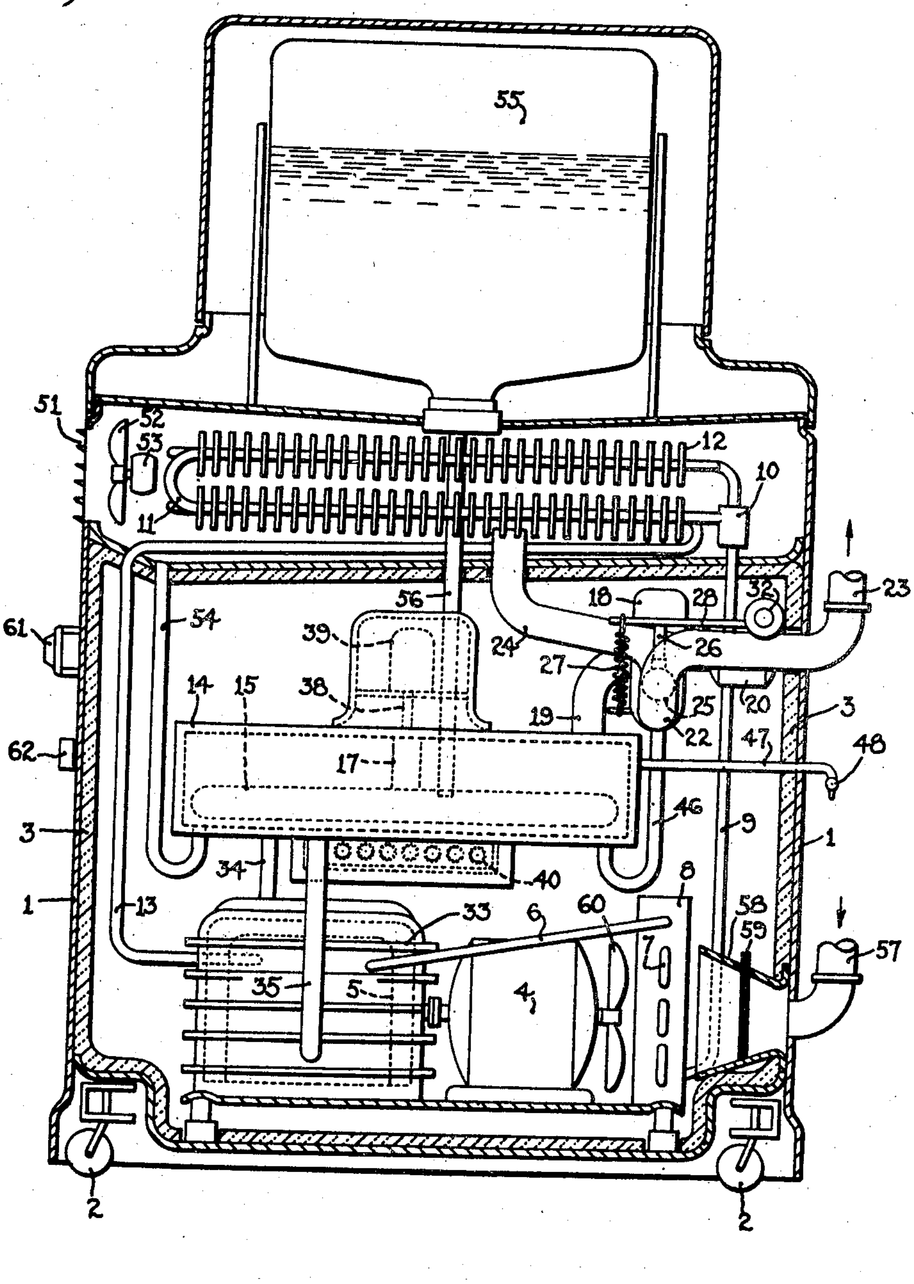
Fig. 3



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AIR CONDITIONING APPARATUS

Filed Feb. 13, 1945 4 Sheets-Sheet 4

Fig. 5

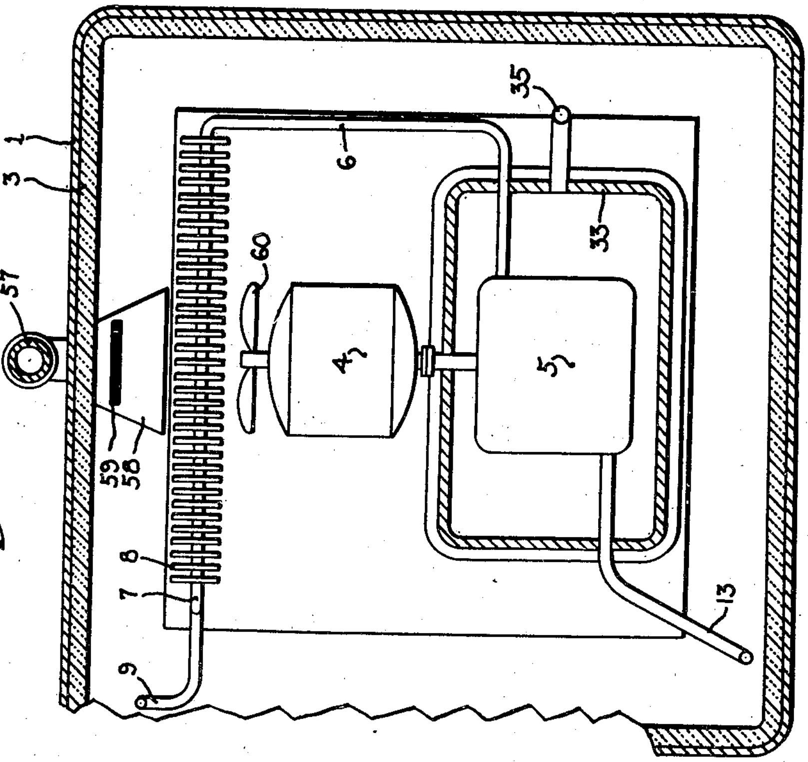
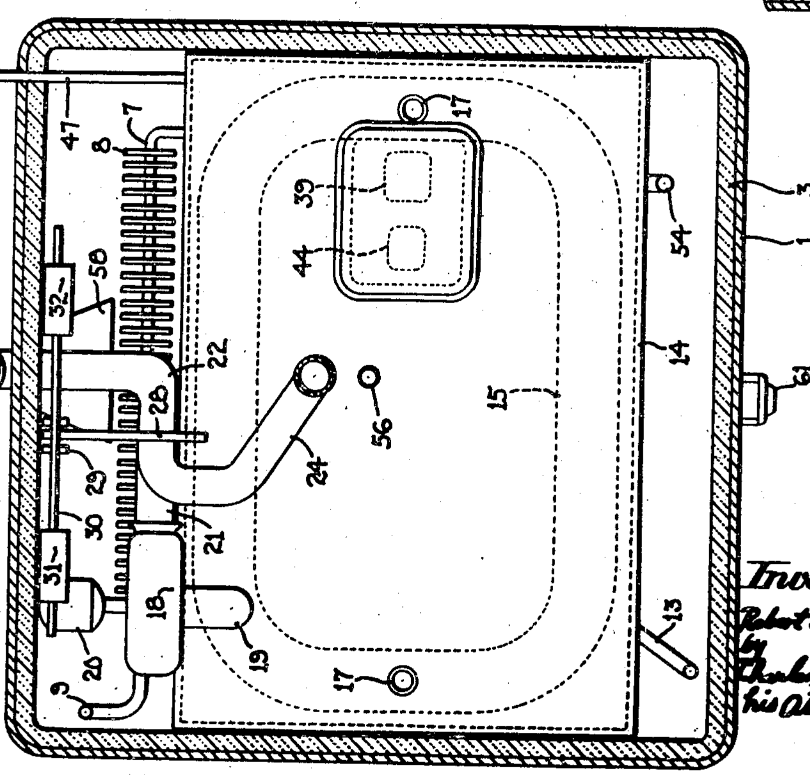


Fig. 4



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Patented Jan. 6, 1948

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UNITED STATES PATENT OFFICE

2,433,960

AIR CONDITIONING APPARATUS

Robert S. Sherman, Lynn, Mass.

Application February 13, 1945, Serial No. 577,672

7 Claims. (Cl. 257—3)

The present invention pertains generally to air conditioning apparatus of the refrigerating and/or heating type; more particularly to air conditioning apparatus of the refrigerating and/or heating type capable of being readily transported and installed wherever electrical power is available, and hence suitable for operation and use immediately, with no additional labor of installation other than the insertion of an electrical plug into an electrical socket at which electrical power is available and the provision of suitable communication with the atmosphere external to the room, the air of which is to be conditioned, for two air ducts constituting elements of the air conditioning apparatus; and specifically to air conditioning apparatus of the character described wherein the waste products resulting from the operation of the air conditioning apparatus, notably water condensed from the air and heat generated in the operation of its refrigerating mechanism in the process of cleansing, cooling and dehumidifying warm moist air, are eliminated in the course of its operation.

The principal object of the present invention is to provide an improved air conditioning apparatus capable of cleansing, cooling and dehumidifying warm moist air and capable of cleansing, warming and humidifying cool dry air.

Another object of the present invention is to provide an improved air conditioning apparatus of the character described, which will either cleanse, cool and dehumidify warm moist air or cleanse, warm and humidify cool dry air accordingly as the temperature of the atmosphere surrounding the thermosensitive element of the thermostat of the improved air conditioning apparatus is either higher or lower than a selected predetermined temperature.

Another object of the present invention is to provide an improved air conditioning apparatus of the character described, which is capable, in its operation throughout the year, of maintaining air at an equable temperature and humidity, regardless of wide variations in the temperature and humidity of the atmosphere external to the room, the air of which is being conditioned.

Another object of the present invention is to provide an improved air conditioning apparatus of the character described, which is capable of being readily transported to, and operable within, the room, the air of which is to be conditioned.

Another object of the present invention is to provide an improved air conditioning apparatus of the character described, wherein the water condensed from the air in the process of cleansing, cooling and dehumidifying warm moist air is eliminated in vapor form in the course of the operation of the improved air conditioning apparatus.

Another object of the present invention is to provide an improved air conditioning apparatus of the character described, wherein the water condensed from the air in the process of cleansing, cooling and dehumidifying warm moist air is eliminated in vapor form by the utilization of the heat generated in the operation of its refrigerating mechanism, thus simultaneously effecting the elimination of both the waste water condensed and the waste heat developed in the course of the operation of the improved air conditioning apparatus.

Another object of the present invention is to provide an improved air conditioning apparatus of the character described, wherein liquid water is vaporized and introduced into the air in the process of cleansing, heating and humidifying cool dry air in the course of the operation of the improved air conditioning apparatus.

The attainment of these and other objects of the present invention and the advantages attendant upon its use and operation will become apparent when consideration is given to the following description thereof, together with the accompanying drawings thereof, which form parts of the specification, and wherein:

Fig. 1 is a view in perspective of the improved air conditioning apparatus installed and in use and operation within the room, the air of which is being conditioned, showing the relation of the improved air conditioning apparatus and of the ancillary elements of its construction, notably the two air ducts, to its surroundings.

Fig. 2 is a front elevation of the improved air conditioning apparatus, partly in section and with the front wall of its housing removed, showing the several compartments thereof and the elements and devices located in the several compartments thereof.

Fig. 3 is a right-side elevation of the improved air conditioning apparatus, partly in section and with the right-side wall of its housing removed, showing the several compartments thereof and the elements and devices located in the several compartments thereof.

Fig. 4 is a plan view of the improved air conditioning apparatus, partly in section taken along the line **4, 4** of Fig. 2, showing the elements and devices located in the upper part of the lower compartment thereof.

Fig. 5 is a plan view of the improved air conditioning apparatus, partly in section taken along the line 5, 5, of Fig. 2, showing the elements and devices located in the lower part of the lower compartment thereof.

Fig. 6 is a schematic diagram of the electrical circuits of the improved air conditioning apparatus, showing the wiring and connections subsisting between its elements and devices rendering possible the two modes of its operation and the automatic character of such modes of operation.

In the drawings, the improved air conditioning apparatus is shown as a housing 1, mounted upon the casters 2 to render it readily movable, and divided into three compartments: the lower containing the heat-developing elements of a refrigerating mechanism and an enclosed evaporating chamber; the intermediate compartment containing the heat-absorbing elements of the refrigerating mechanism; and the upper compartment containing a receptacle for holding a supply of water.

The lower conpartment, which is lined throughout with a thick layer of heat insulating material 3 to prevent appreciable leakage of heat therefrom into the adjacent intermediate compartment and into the air surrounding the improved air conditioning apparatus, contains the electrical motor 4 driving the water-jacketed compressor 5 wherein is compressed the refrigerating fluid, which is discharged therefrom, through the pipe 6, into the condenser coils 7 suitably provided with fins 8, wherefrom it passes, through the pipe 9 and the expansion valve 10, into the evaporating coils 11 suitably provided with fins 12, located within the intermediate compartment, wherein it absorbs heat and returns, through the pipe 13, to the water-jacketed compressor 5 in the lower compartment, thus completing the refrigerating cycle.

Located midway of the height of the lower compartment is the enclosed evaporating chamber 14, a metal vessel containing the ring of pipe 15 provided with fine vents 16 on its under side and with the two inlets 17, 17, communicating with the lower compartment, while the enclosed evaporating chamber 14 is in communication with the eyelet of the centrifugal blower 18 by means of the conduit 19. The centrifugal blower 18, driven by the electrical motor 20, discharges into the double-branched Y-shaped conduit 21, one branch 22 of which is in communication with the flexible waterproof duct 23 sheathed in heat insulating material and venting into the atmosphere external to the room, the air of which is being conditioned, while the other branch 24 of which is in communication with the intermediate compartment. A butterfly valve 25 within the double-branched Y-shaped conduit 21, actuated by the arm 26 and maintainable positively in either of its two possible positions of closure by the spring 27, one end of which is secured to the double-branched Y-shaped conduit 21 at a point directly below the axis of rotation of the butterfly valve 25 and the other end of which is secured to the crossbar 28 integral with the arm 26, is operable by the fork 29 carried by the bar 30 and actuated reciprocally by the two electromagnetic switches 31 and 32 to effect the diversion of the discharge from the centrifugal blower 18 into either the conduit 22 or the conduit 24. During the operation of the improved air conditioning apparatus, the enclosed evaporating chamber 14

contains a quantity of water which is in communication with the water in the water jacket 33 of the water-jacketed compressor 5 by means of the upflow pipe 34 and the downflow pipe 35, while upon the surface of the water in the enclosed evaporating chamber 14 rides the float 36 whose arm 37, by means of the link 38, operates the electrical switch 39 controlling an electrical resistance heating coil 40 located either on the under side of the enclosed evaporating chamber 14 (as shown) or (preferably) within the enclosed evaporating chamber 14, and, by means of the link 38, the crossbar 41 and its support 42, and the link 43, operates the general cut-off electrical safety switch 44. Both of these electrical switches 39 and 44 are located within an enclosed chamber separate from, but integral with, the enclosed evaporating chamber 14, vapor sealing of the enclosed chamber from the enclosed evaporating chamber 14 being effected by the use of suitable flexible metallic bellows (not shown) encircling and united with the links 38 and 43 and united with the under side of the floor of the enclosed chamber. A second electrical resistance heating coil 45 is likewise located as is the first electrical resistance heating coil 40. The discharge duct of the centrifugal blower 18 is in communication with the water in the enclosed evaporating chamber 14 by means of the U-shaped pipe 46, while the pipe 47 and the petcock 48 render possible the draining of water from the enclosed evaporating chamber 14 when the water therein is above, and until it falls to, a certain level.

The intermediate compartment of the improved air conditioning apparatus, which contains the evaporating coils 11 suitably provided with fins 12, is in communication with the room, the air of which is being conditioned, by means of the inlet louvres 49, 49, provided with the air filters 50, 50, and the outlet louvres 51. Located within the intermediate compartment is the fan 52, driven by the electrical motor 53, for circulating over the evaporating coils 11 suitably provided with fins 12, air taken into the intermediate compartment through the inlet louvres 49, 49, and the air filters 50, 50, and for expelling such circulated air through the outlet louvres 51. The floor of the intermediate compartment is everywhere suitably sloped to drain into the U-shaped pipe 54 in communication with the water in the enclosed evaporating chamber 14 the water condensed from the air and deposited in the intermediate compartment during the process of cooling therein the air being conditioned.

The upper compartment contains an inverted receptacle 55 holding a supply of water, which is in communication with the water in the enclosed evaporating chamber 14 by means of the pipe 56, so that a minimum level of water is maintained at all times in the enclosed evaporating chamber 14 (that is, so long as water is present in the inverted receptacle 55).

The lower compartment is in communication with the atmosphere external to the room, the air of which is being conditioned, by means of the flexible duct 57 which vents into the expanding duct 58 provided with the air filter 59 and located athwart the condenser coils 7 suitably provided with fins 8, on the other side of which is located the fan 60, mounted upon the shaft of the electrical motor 4, for circulating the air with the lower compartment. The ends of the flexible duct 57 and the flexible waterproof duct 23 sheathed in heat insulating material, which are remote from the improved air conditioning apparatus, are secured in a suitable framework similar to a telescopic screen and readily insertable into a window frame, as is shown in Fig. 1.

External to the three compartments of the improved air conditioning apparatus is a thermostat 61 capable of operating alternatively either of two electrical circuits within a variable operating range of temperatures; and this variable operating range of temperatures is shiftable over a substantial latitude of temperature. Thus, the alternative operations of the two electrical circuits, and hence the operations of the improved air conditioning apparatus, are functions of the settings of the variable operating range of temperatures upon the thermostat 61. Such a thermostat, readily available on the market, is shown in Fig. 3 as positioned upon the exterior of the housing 1 of the improved air conditioning apparatus, with its thermally sensitive element disposed in the air of the room, the air of which is to be conditioned. Reference to Fig. 6 will disclose the two electrical circuits, the alternative operations of which are controlled by the thermostat 61: The closing of the cooling and dehumidifying circuit is seen to bring into operation the electrical motor 4 driving the water-jacketed compressor 5, the electrical motor 20 driving the centrifugal blower 18, the electrical resistance heating coil 40 controlled by the electrical switch 39 operated by the float 36 by means of the arm 37 and the link 38, the electrical motor 53 driving the fan 52, and the electromagnetic switch 32 actuating the bar 30 carrying the fork 29 operating the butterfly valve 25 by means of the crossbar 28 and the arm 26 to close the conduit 24: The closing of the heating and humidifying circuit is seen to bring into operation the electrical motor 20 driving the centrifugal blower 18, the electrical resistance heating coil 45, the electrical motor 53 driving the fan 52, and the electromagnetic switch 31 actuating the bar 30 carrying the fork 29 operating the butterfly valve 25 by means of the crossbar 28 and the arm 26 to close the conduit 22. Reference to Fig. 6 will disclose also the fact that the circuits energizing the electromagnetic switches 31 and 32 are broken immediately upon the operations of these electromagnetic switches: since such electromagnetic switches are readily available on the market, further description of them is deemed to be unnecessary. A controlling electrical switch 62 governing the application of electrical power to the two electrical circuits of the improved air conditioning apparatus is positioned on the exterior of the housing 1 of the improved air conditioning apparatus in proximity to the thermostat 61, as is shown in Figs. 1 and 3. This account of the two electrical circuits of the improved air conditioning apparatus concludes the description of the elements and devices of the improved air conditioning apparatus: The description of the modes of operation of the improved air conditioning apparatus will now be given.

Let the operating range of temperatures, T_2—T_1, of the thermostat 61 be set to encompass the desired temperature T of the conditioned air to be attained, so that $T_2>T>_1$ and T_2 is approximately equal to T. If now electrical power be applied to the improved air conditioning apparatus through the controlling electrical switch 62, and if the temperature of the environment of the thermally sensitive element of the thermostat 61 be greater than T_2, the cooling and dehumidifying circuit will be closed and the mechanisms and devices comprised thereby, as set forth in the preceding paragraph, will be set into operation: whereupon air from the room, the air of which is to be conditioned, will be drawn into the intermediate compartment through the inlet louvres 49, 49, and the air filters 50, 50, will be deprived of most of its content of water vapor by the condensation of such water vapor into liquid water, and will be expelled from the intermediate compartment through the outlet louvres 51 into the room, the air of which is being conditioned, by means of the fan 52; and the liquid water thus produced in the intermediate compartment by the condensation of such water vapor from the air being conditioned, will drain into the enclosed evaporating chamber 14 through the U-shaped pipe 54. Meanwhile, the centrifugal blower 18, driven by the electrical motor 20, will draw air from the atmosphere external to the room, the air of which is being conditioned, through the flexible duct 57, the expanding duct 58, and the air filter 59, into the lower compartment wherein it will be circulated by means of the fan 60, thus enabling it to absorb some of the heat developed in the lower compartment through the operations of the water-jacketed compressor 5 and the electrical motor 4, as well as the heat available in the condenser coils 7 suitably provided with fins 8; and then the thus-heated air will be drawn into the ring of pipe 15 within the enclosed evaporating chamber 14 through the inlets 17, 17, and will emerge from the fine vents 16 to take up water in the forms of water vapor and entrained liquid water from the heated liquid water in the enclosed evaporating chamber 14; and the water-laden air will then pass through the conduit 19 into the centrifugal blower 18, thence into the double-branched Y-shaped conduit 21, and thence into the branch 22 communicating with the flexible waterproof duct 23 sheathed in heat insulating material and venting into the atmosphere external to the room, the air of which is being conditioned, and thus out into the said atmosphere: whatever slight amounts of entrained liquid water and liquid water, produced by the condensation of water vapor into liquid water, that are deposited within the conduits 21, 22, 23, during the passage of the water-laden air through them will drain into the enclosed evaporating chamber 14 through the U-shaped pipe 46. The evaporation of water within the enclosed evaporating chamber 14 into the heated air being passed through the heated water therein is, in large part, effected by the heat developed in the operation of the water-jacketed compressor 5 compressing the refrigerating fluid and transferred to the liquid water in the water jacket 33 of the water-jacketed compressor 5, from whence the thus heated liquid water flows upwardly into the enclosed evaporating chamber 14. The effects of the operations of the mechanisms and devices comprised in the cooling and dehumidifying circuit are to filter and to cool, and thus to remove by condensing to liquid water water vapor from, the air of the room, the air of which is being conditioned, and to heat and to evaporate the thus-produced liquid water into air taken from and returned to the atmosphere external to the room, the air of which is being conditioned, by the utilization of the heat developed in the operations of these mechanisms and devices, thus simultaneously effecting the elimination from the room, the air of which is being conditioned, of both the thus-produced liquid water and the waste heat developed in the operations of the mechanisms and devices comprised in the cooling and dehumidifying circuit. Since the efficiency of the utilization of such waste heat may not be wholly perfect, additional heat, in accordance with the amounts that may be required for such disposal of the thus-produced liquid water, is rendered available by means of the electrical resistance heating coil 40 whose operation is governed by the electrical switch 39 operated by the float 36 by means of the arm 37 and the link 38 and hence by the level of the liquid water in the enclosed evaporating chamber 14. Should the level of the liquid water in the enclosed evaporating chamber 14 rise above a certain height through the addition thereto of liquid water produced in the intermediate compartment by the condensation of water vapor from the air being conditioned and drained into the enclosed evaporating chamber 14 through the U-shaped pipe 54, the electrical resistance heating coil 40 is brought into operation until the liquid water in the enclosed evaporating chamber 14, by virtue of an increase in its temperature and hence through increases in its vapor pressure and in its rate of evaporation into the heated air being passed therethrough, has become diminished in amount and the level of the liquid water in the enclosed evaporating chamber 14 has fallen to that certain height, whereupon the operation of the electrical resistance heating coil 40 is discontinued; but should there occur some failure in the performance of the electrical resistance heating coil 40, a marked rise in the level of the liquid water in the enclosed evaporating chamber 14 will effect the opening of the general cut-off electrical safety switch 44, which will bring to a halt the operations of the mechanisms and devices comprised in the cooling and dehumidifying circuit; and thereafter, the closing of the general cut-off electrical safety switch 44 can be effected only by the lowering of the level of the liquid water in the enclosed evaporating chamber 14 by draining off the excess of the liquid water through the drain pipe 47 and pet-cock 48. On the other hand, if the waste heat developed in the operations of the mechanisms and devices comprised in the cooling and dehumidifying circuit is in excess of the heat required for the disposal of the liquid water produced in the intermediate compartment by the condensation of water vapor from the air being conditioned and drained into the enclosed evaporating chamber 14 through the U-shaped pipe 54, the level of the liquid water in the enclosed evaporating chamber 14 will fall until it uncovers the lower end of the pipe 56; whereupon liquid water will flow from the inverted receptacle 55 containing a supply of liquid water into the enclosed evaporating chamber 14 until the level of the liquid water in the enclosed evaporating chamber 14 has risen to a height sufficient to cover the lower end of the pipe 56 and thus to terminate the flow of liquid water from the inverted receptacle 55 containing a supply of liquid water into the enclosed evaporating chamber 14. In this manner, provision is made for the production of heat sufficient to eliminate by evaporation the liquid water produced by the condensation of water vapor from the air being conditioned and for the availability of liquid water sufficient to eliminate by absorption, in the evaporation thereof, the heat developed in effecting the cooling of, and the condensation of water vapor to liquid water from, the air being conditioned.

After the mechanisms and devices comprised in the cooling and dehumidifying circuit have been in operation for a period of time determined by a number of factors comprising the amount, the temperature, and the humidity of the air being conditioned, and the setting of the operating range of temperatures, T_2—T_1, of the thermostat 61, the temperature of the environment of the thermally sensitive element of the thermostat 61 will have fallen to T_2 and slightly thereunder, i. e., to T, whereupon the cooling and dehumidifying circuit of the improved air conditioning apparatus will become opened and the operation of the improved air conditioning apparatus will cease. If the temperature of the atmosphere external to the room, the air of which is being conditioned, is greater than T_2, heat will flow into the room, and the air therein and, in consequence, the environment of the thermally sensitive element of the thermostat 61 will become heated to a temperature greater than T_2, so that after a period of time, the cooling and dehumidifying circuit will again become closed. Thus, by such intermittently repeating operation of the cooling and dehumidifying circuit of the improved air conditioning apparatus, the air in the room, the air of which is being conditioned, will be maintained at a temperature lower than the temperature of the atmosphere external to the room, the air of which is being conditioned, provided that the temperature of the atmosphere external to the room, the air of which is being conditioned, remains at temperatures greater than T_2. This state of affairs corresponds to the conditions existing during hot weather in summer when cool air of a slight but definite humidity is to be produced by the improved air conditioning apparatus.

Let it now be supposed that, on an occasional day during this period of the year, the temperature of the atmosphere external to the room, the air of which is being conditioned, is less than T_1, where T_1 may be a temperature somewhat cool. Under such condition, the effect of such temperature of the atmosphere external to the room, the air of which is being conditioned, upon the room and hence upon the air of the room, the air of which is being conditioned, is to cause heat to flow out of the room, and the air therein, and, in consequence, the environment of the thermally sensitive element of the thermostat 61, will become cooled to a temperature less than T_1, with the result that the heating and humidifying circuit will become closed and the mechanisms and devices comprised thereby, as set forth in the second paragraph preceding, will be set into operation; whereupon the centrifugal blower 18, driven by the electrical motor 20, will draw air from the atmosphere external to the room, the air of which is being conditioned, through the flexible duct 57, the expanding duct 58, and the air filter 59, into the lower compartment, and then the air will be drawn into the ring of pipe 15 within the enclosed evaporating chamber 14 through the inlets 17, 17, and will emerge from the fine vents 16 to take up water in the forms of water vapor and entrained liquid water from the liquid water in the enclosed evaporating chamber 14 being heated by the operation of the electrical resistance heating coil 45; and the water-laden air will then pass through the conduit

19 into the centrifugal blower, thence into the double-branched Y-shaped conduit 21, thence into the branch 24 communicating with the intermediate compartment wherein it will be mixed with air taken in through the inlet louvres 49, 49, and the air filters 50, 50, from the room, the air of which is being conditioned, and the thus-produced mixture of airs will then be discharged through the outlet louvres 51 into the room, the air of which is being conditioned: whatever slight amounts of entrained liquid water that are deposited within the intermediate compartment during the passage of the water-laden air through it will drain into the enclosed evaporating chamber 14 through the U-shaped pipe 54. Since the heat available in the liquid water in the enclosed evaporating chamber 14 and in the air being passed through the liquid water is insufficient for effecting the evaporation, into the air, of amounts of water sufficient to humidify adequately the air and for heating the thus-humidified air to the temperature T_1, heat is supplied to the liquid water in the enclosed evaporating chamber 14 at a rate adequate for the accomplishment of these purposes by the operation of the electrical resistance heating coil 45. And since water is evaporated continuously from the enclosed evaporating chamber 14 during the operation of the mechanisms and devices comprised in the heating and humidifying circuit, the maintenance of the liquid water at a minimum level in the enclosed evaporating chamber 14 is attained by means of the inverted receptacle 55 containing a supply of liquid water and the pipe 56. The result of the operation of the mechanisms and devices comprised in the heating and humidfying circuit is to supply warmed and adequately humidified air to the room, the air of which is being conditioned.

After the mechanisms and devices comprised in the heating and humidifying circuit have been in operation for a period of time determined by a number of factors comprising the amount, the temperature, and the humidity of the air drawn into the improved air conditioning apparatus from the atmosphere external to the room, the air of which is being conditioned, the temperature of the air in the room, the air of which is being conditioned, and the setting of the operating range of temperatures, T_2—T_1, of the thermostat 61, the temperature of the environment of the thermally sensitive element of the thermostat 61 will have risen to T_1 or slightly thereover, whereupon the heating and humidifying circuit of the improved air conditioning apparatus will become opened and the operation of the improved air conditioning apparatus will cease. Since the temperature of the atmosphere external to the room, the air of which is being conditioned, is less than T_1, heat will flow out of the room, and the air therein, and, in consequence, the environment of the thermally sensitive element of the thermostat 61, will become cooled, so that after a period of time, the heating and humidifying circuit will again become closed. Thus, by such intermittently repeating operation of the heating and humidifying circuit of the improved air conditioning apparatus, the air in the room, the air of which is being conditioned, will be maintained at a temperature higher than the temperature of the atmosphere external to the room, the air of which is being conditioned, provided that the temperature of the atmosphere external to the room, the air of which is being conditioned, remains at temperatures less than T_1. This state of affairs corresponds to the conditions existing during cool weather in summer when the air is unduly chilly.

From this description of the modes of operation of the improved air conditioning apparatus when the temperature of the environment of the thermally sensitive element of the thermostat 61 is greater than T_2 and when the temperature of the environment of the thermally sensitive element of the thermostat 61 is less than T_1, it is obvious that the improved air conditioning apparatus will establish and maintain the air in a room, the air of which is being conditioned, at temperatures within the operating range of temperatures, T_2—T_1, of the thermostat 61 and of humidities corresponding to such temperatures, even though the improved air conditioning apparatus may be in operation only occasionally. But if the operating range of temperatures, T_2—T_1, of the thermostat 61 be made quite small, say a degree or a fraction thereof, the inertial effects in the operation of the improved air conditioning apparatus will cause the opening and the closing of the cooling and dehumidifying circuit and of the heating and humidifying circuit of the improved air conditioning apparatus to occur in alternation, so that the air in the room, the air of which is being conditioned, will be established and maintained at a temperature intermediate the temperatures T_2 and T_1 and of a humidity corresponding to that temperature. In regions where the air is exceptionally dry at all times and where the most desirable kind of conditioned air is cool air of a slight but definite humidity, this mode of intermittently alternating operation of the cooling and dehumidifying circuit and of the heating and humidifying circuit of the improved air conditioning apparatus is the mode of operation to be practiced.

However, in regions where the air is not exceptionally dry at all times, i. e., in most regions, the operating range of temperatures, T_2—T_1, of the thermostat 61 will ordinarily comprise a substantial number of degrees, and the two modes of intermittently repeating operation of the cooling and dehumidifying circuit and of the heating and humidifying circuit of the improved air conditioning apparatus will be practiced, accordingly as the temperature of the atmosphere external to the room, the air of which is being conditioned, is generally higher or lower than the temperature of the air of the said room before the conditioning of the air thereof is initiated. Thus, during the summer, the operating range of temperatures, T_2—T_1, of the thermostat 61 will be set so that temperature, T_2, is the temperature desired in the conditioned air and the temperature, T_1, is well below the temperature, T_2; and the heating and humidifying circuit of the improved air conditioning apparatus will but seldom be brought into operation, since the most desirable kind of conditioned air is cool air of a slight but definite humidity, and the warm air before conditioning invariably contains water vapor in excess of such humidity, which becomes reduced in amount to the humidity corresponding to the temperature, T_2, by and in the cooling and dehumidifying process. But in winter, when the atmosphere external to the room, the air of which is being conditioned, is below the temperature of the air of the said room, and the air of the said room is being heated by any one of the common types of heating apparatus whose operation is governed by thermostatic means, the operating range of temperatures, $T_2—T_1$, of the thermostat 61 will be set so that the temperature, T_1, is identical with, or infinitesimally less than, the setting of the temperature upon the thermostatic means governing the operation of the heating apparatus heating the air of the room, the air of which is being conditioned, and the temperature, T_2, is well above the temperature, T_1, so that the cooling and dehumidifying circuit of the improved air conditioning apparatus will not be brought into operation save on an exceptional day when the temperature of the atmosphere external to the room, the air of which is being conditioned, rises to T_2. And on such an exceptional day, the heating apparatus heating the air of the room, the air of which is being conditioned, will naturally be put out of operation temporarily pending the reoccurrence of temperatures less than T_1 of the atmosphere external to the room, the air of which is being conditioned. Hence, the utilization of these two modes of intermittently repeating operation of the cooling and dehumidifying circuit and of the heating and humidifying circuit of the improved air conditioning apparatus for the production, by the improved air conditioning apparatus, of a supply of clean air of agreeable temperatures and humidities throughout the year in any region whatsoever will thus involve yearly but two settings of the operating range of temperatures, $T_2—T_1$, of the thermostat 61, namely, a setting when the heating apparatus heating the air of the room, the air of which is being conditioned, is put into operation, and a setting when the said heating apparatus is put out of operation.

Having disclosed the construction and operation of my invention, I claim:

1. In air conditioning apparatus, in combination, a refrigerating unit having heat-absorbing elements and heat-developing elements, a first fan means for circulating over the heat-absorbing elements the air being conditioned to effect the condensing of water vapor to liquid water from and the cooling of the said air being conditioned, reservoir means effecting heat-exchanging relation between the said liquid water and the heat-developing elements, a foraminous element within the said reservoir means and submerged in the liquid water therein, a second fan means for circulating over the heat-developing elements and through the foraminous element to evaporate the liquid water within the said reservoir means air drawn from the atmosphere at a location remote from the air being conditioned and for discharging such circulated air thus water-laden into the atmosphere at another location remote from the air being conditioned.

2. In air conditioning apparatus, in combination, a refrigerating unit having heat-absorbing elements and heat-developing elements, a first fan means for circulating over the heat-absorbing elements the air being conditioned to effect the condensing of water vapor to liquid water from and the cooling of the said air being conditioned, a first reservoir means for receiving the said liquid water and for effecting heat-exchanging relation between the liquid water therein and the heat-developing elements, a second reservoir means maintaining at a minimum level the liquid water in the first reservoir means, a foraminous element within the first reservoir means and submerged in the liquid water therein, and a second fan means for circulating over the heat-developing elements and through the foraminous element to evaporate the liquid water within the first reservoir means air drawn from the atmosphere at a location remote from the air being conditioned and for discharging such circulated air thus water-laden into the atmosphere at another location remote from the air being conditioned.

3. In air conditioning apparatus, in combination, a refrigerating unit having heat-absorbing elements and heat-developing elements, a first fan means for circulating over the heat-absorbing elements the air being conditioned to effect the condensing of water vapor to liquid water from and the cooling of the said air being conditioned, a first reservoir means for receiving the said liquid water and for effecting heat-exchanging relation between the liquid water therein and the heat-developing elements, a second reservoir means maintaining at a minimum level the liquid water in the first reservoir means, electrical resistance heating means in heat-exchanging relation with the liquid water in the first reservoir means, electrical switch means controlling the said electrical resistance heating means and responsive to change in the level of the liquid water in the first reservoir means, a foraminous element within the first reservoir means and submerged in the liquid water therein, and a second fan means for circulating over the heat-developing elements and through the foraminous element to evaporate the liquid water within the first reservoir means air drawn from the atmosphere at a location remote from the air being conditioned and for discharging such circulated air thus water-laden into the atmosphere at another location remote from the air being conditioned.

4. In air conditioning apparatus, in combination, a refrigerating unit having heat-absorbing elements and heat-developing elements, a first fan means for circulating over the heat-absorbing elements the air being conditioned to effect the condensing of water vapor to liquid water from and the cooling of the said air being conditioned, a first reservoir means for receiving the said liquid water and for effecting heat-exchanging relation between the liquid water therein and the heat-developing elements, a second reservoir means maintaining at a minimum level the liquid water in the first reservoir means, electrical resistance heating means in heat-exchanging relation with the liquid water in the first reservoir means, electrical switch means controlling the said electrical resistance heating means and responsive to change in the level of the liquid water in the first reservoir means, a foraminous element within the first reservoir means and submerged in the liquid water therein, a second fan means for circulating over the heat-developing elements and through the foraminous element to evaporate the liquid water within the first reservoir means air drawn from the atmosphere at a location remote from the air being conditioned and for discharging such circulated air thus water-laden into the atmosphere at another location remote from the air being conditioned, and thermostatic means governing the operations of the said refrigerating unit, the said first fan means, the said electrical resistance heating means, and the said second fan means.

5. In air conditioning apparatus, in combination, a refrigerating unit having heat-absorbing elements and heat-developing elements, a first fan means for circulating over the heat-absorbing elements the air being conditioned to effect the condensing of water vapor to liquid water from and the cooling of the said air being conditioned, a first reservoir means for receiving the said liquid water and for effecting heat-exchanging

relation between the liquid water therein and the heat-developing elements, a second reservoir means maintaining at a minimum level the liquid water in the first reservoir means, a foraminous element within the first reservoir means and submerged in the liquid water therein, a second fan means for circulating over the heat-developing elements and through the foraminous element to evaporate the liquid water within the first reservoir means air drawn from the atmosphere at a location remote from the air being conditioned and for discharging such circulated air thus water-laden into the atmosphere at another location remote from the air being conditioned, and thermostatic means governing the operations of the said refrigerating unit, the said first fan means, and the said second fan means.

6. In air conditioning apparatus, in combination with the combination set forth in claim 2 as a first sub-combination and with the combination comprising the said first fan means, the said first reservoir means, the said second reservoir means, the said foraminous element, and the said second fan means as a second sub-combination, electromagnetic switch means effecting alternatively the operations of the devices of the first sub-combination and the discharging of the water-laden air into the atmosphere at a location remote from the air being conditioned or the operations of the devices of the second sub-combination and the discharging of the water-laden air into the room, the air of which is being conditioned, and thermostatic means governing the alternative operations of the electromagnetic switch means.

7. In air conditioning apparatus, in combination with the combination set forth in claim 3 as a first sub-combination and with the combination comprising the said first fan means, the said first reservoir means, the said second reservoir means, the said foraminous element, the said second fan means, and a second electrical resistance heating means in heat-exchanging relation with the liquid water in the first reservoir means as a second sub-combination, electromagnetic switch means effecting alternatively the operations of the devices of the first sub-combination and the discharging of the water-laden air into the atmosphere at a location remote from the air being conditioned or the operations of the devices of the second sub-combination and the discharging of the water-laden air into the room, the air of which is being conditioned, and thermostatic means governing the alternative operations of the electromagnetic switch means.

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