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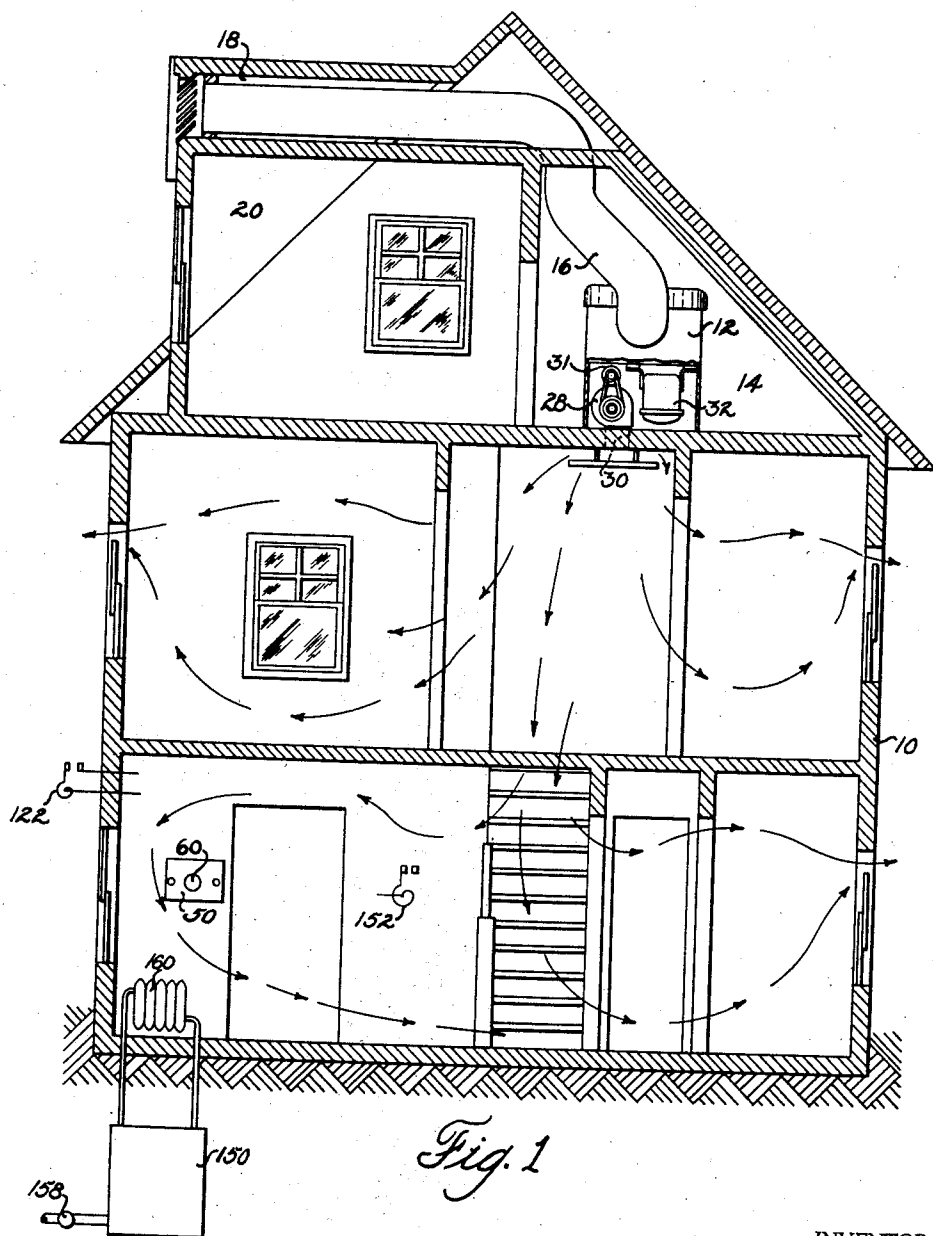
A. A. KUCHER

2,389,440

REFRIGERATING APPARATUS

Filed Nov. 30, 1940

4 Sheets-Sheet 1



INVENTOR.
Andrew A. Kucher.
BY Spencer, Hardman & Fehr.

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A. A. KUCHER

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4 Sheets-Sheet 2

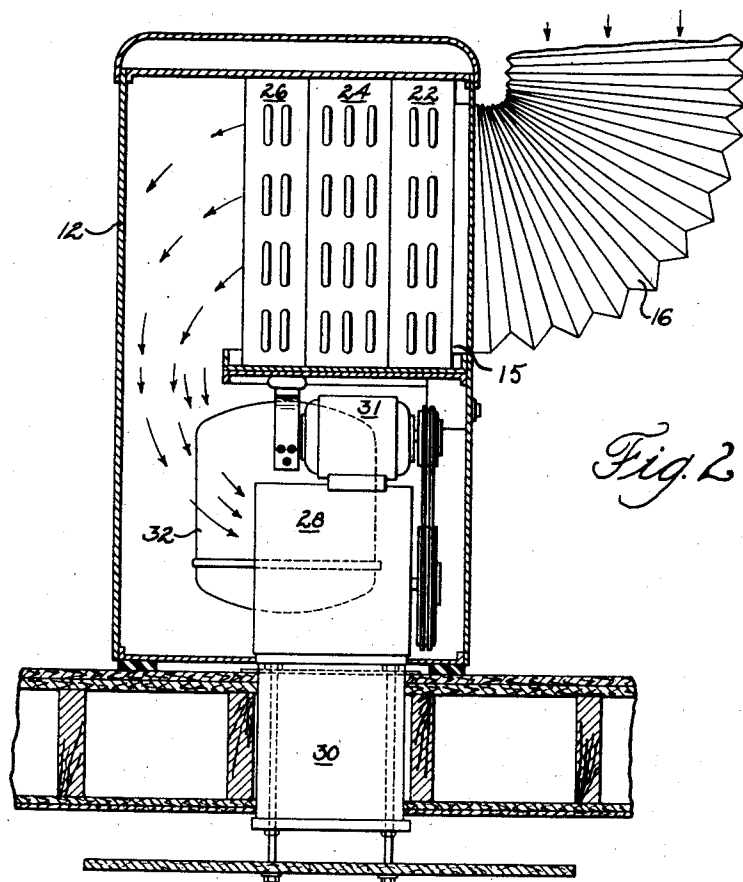


Fig. 2

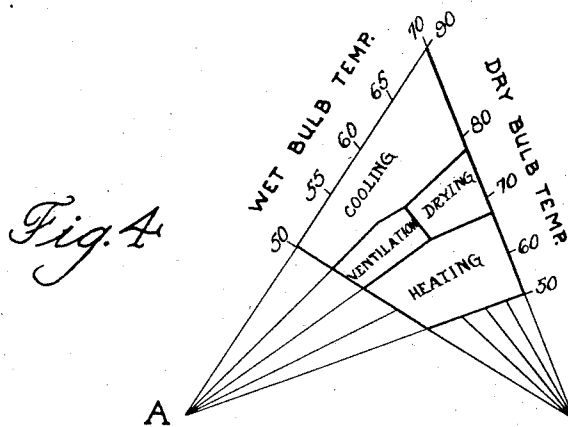


Fig. 4

INVENTOR.
BY *Andrew A. Kucher.*
Spencer, Hardman & Fehr.

Nov. 20, 1945.

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4 Sheets-Sheet 3

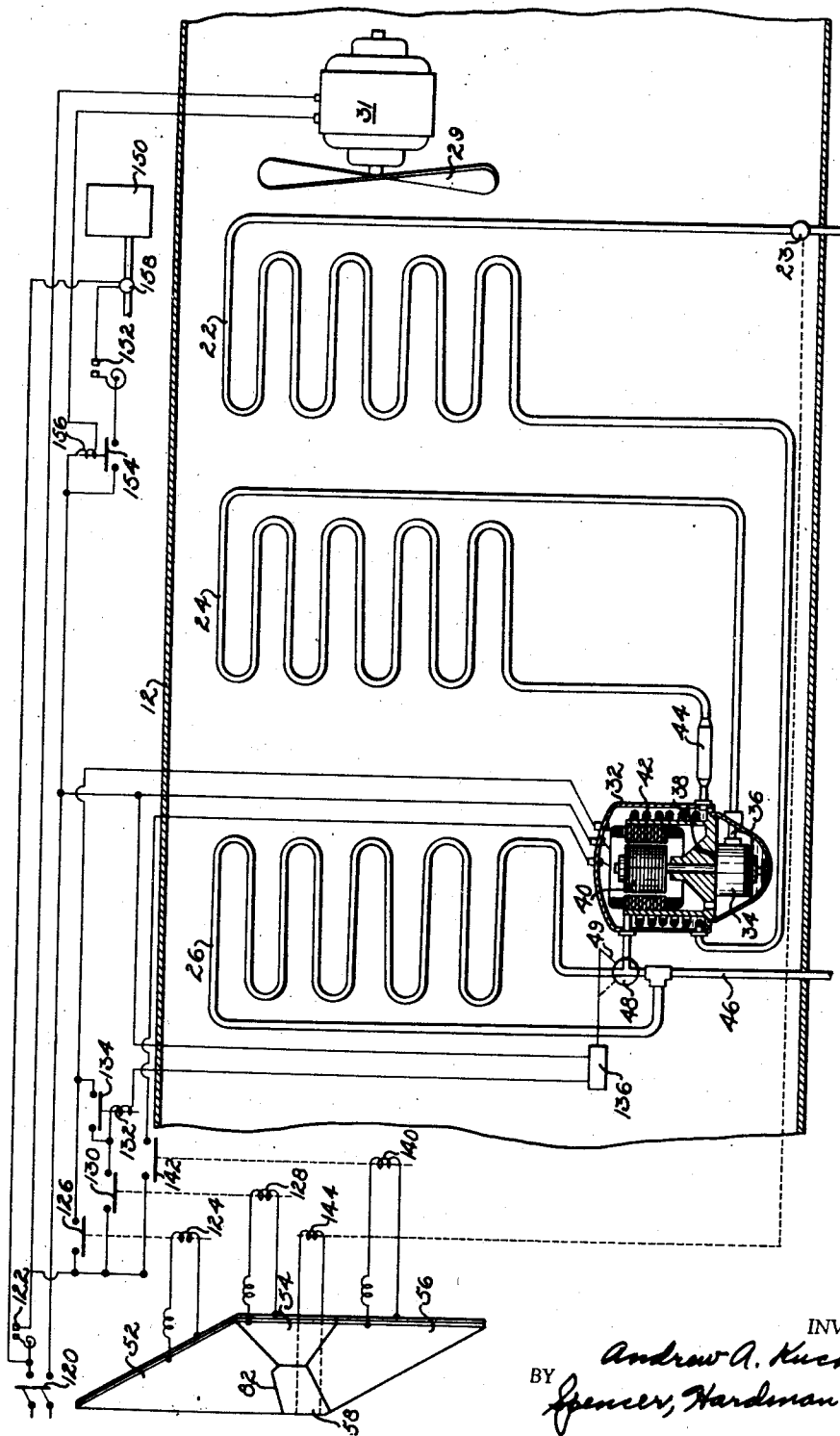


Fig. 3

INVENTOR.
Andrew A. Kucher.
BY Spencer, Hardman & Fehr.

Nov. 20, 1945.

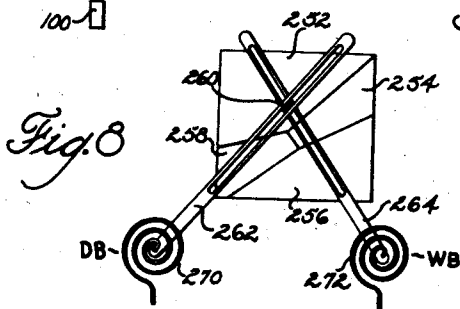
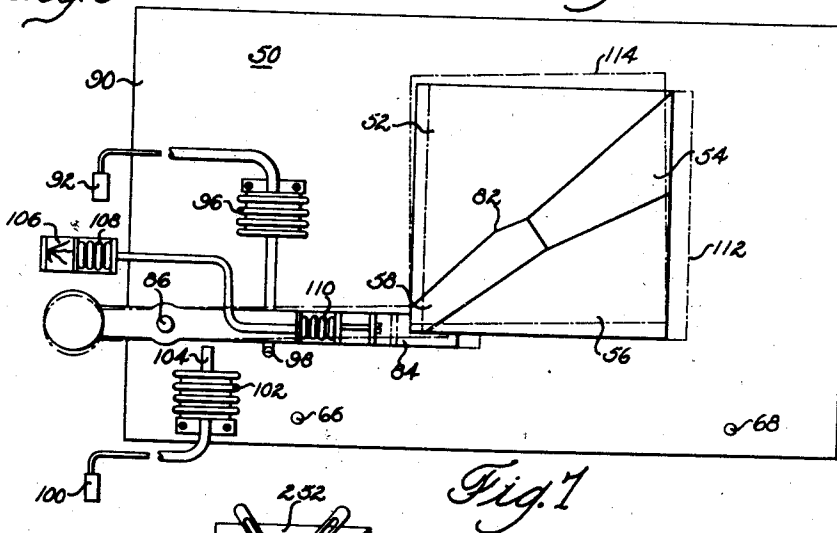
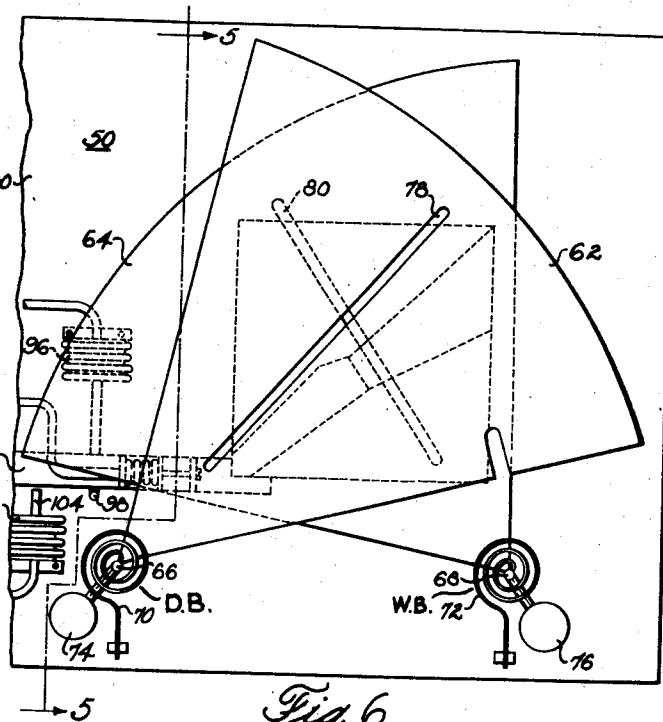
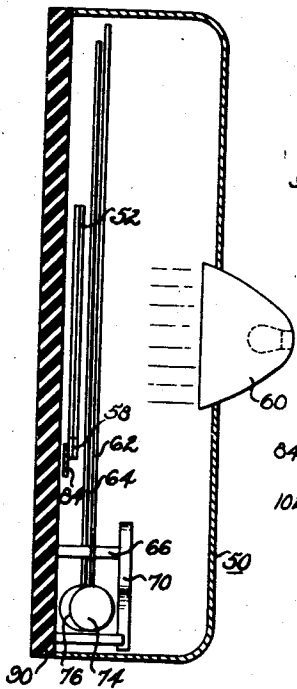
A. A. KUCHER

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REFRIGERATING APPARATUS

Filed Nov. 30, 1940

4 Sheets-Sheet 4



INVENTOR.

INVENTOR
Andrew A. Kucher.

BY *Spencer, Hardman & Fehr.*

UNITED STATES PATENT OFFICE

2,389,440

REFRIGERATING APPARATUS

Andrew A. Kucher, Oakwood, Ohio, assignor to
General Motors Corporation, Dayton, Ohio, a
corporation of Delaware

Application November 30, 1940, Serial No. 367,997

21 Claims. (Cl. 257—3)

This invention relates to refrigerating apparatus and more particularly to apparatus of the type used in conditioning air for comfort purposes.

It is an object of this invention to provide a system which is capable of conditioning the air for a private home or the like during all seasons of the year.

Another object of this invention is to provide improved means for controlling the operation of an air conditioning system.

It is a further object of this invention to provide a novel reverse cycle refrigerating system for used for conditioning the air during the cooling season and also during mild weather when heating is required.

A further object of this invention is to provide a novel reverse cycle refrigerating system for either heating or cooling the air for an enclosure.

Another object of this invention is to provide automatic means for turning on the main heating system when the heating capacity of the reverse cycle refrigerating system is insufficient to heat the air the necessary amount.

Still another object of this invention is to provide means for utilizing the condenser cooling water for reheating the air when dehumidification of the air alone is desired.

A further object of this invention is to provide an improved measuring and indicating device.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a view showing somewhat diagrammatically a preferred embodiment of my invention;

Fig. 2 is a detailed sectional view of the main air conditioning unit taken at right angles to the view shown in Fig. 1;

Fig. 3 is a diagrammatic view partly in section showing the air conditioning apparatus and the controls therefor;

Fig. 4 shows a chart which illustrates the relationship of the dry bulb temperature to the wet bulb temperature throughout a portion of the air conditioning range;

Fig. 5 is a sectional view of the control instrument taken on the line 5—5 of Fig. 6;

Fig. 6 is a fragmentary elevational view of the control instrument with the cover removed;

Fig. 7 is a fragmentary elevational view of the control instrument showing the means for adjusting for changes in outside air conditions; and

Fig. 8 is a view somewhat similar to Fig. 6 showing a modification of the apparatus shown in Fig. 6.

The most satisfactory arrangement for installing an air conditioning system in a private home or the like is to place a self-contained air conditioning unit in the attic of the home and to distribute the conditioned air through the hallways of the home.

Referring now to Fig. 1, in which I have shown such an arrangement for conditioning the air in a private home or the like, the reference numeral 10 is used to designate an entire building such as a private home or the like. Reference numeral 12 designates a self-contained air conditioning unit which is adapted to be mounted directly within the attic space 14. Fresh outside air is introduced through the unit 12 and a corresponding amount of vitiated air is allowed to escape through open windows and the like. A filter 15 is provided at the inlet to the unit 12.

Inasmuch as many attics have obstructions of various types therein which make it very difficult to install ordinary ducts, and inasmuch as it is not always desirable to dispense with ducts and to use the main attic space itself for conveying the outside air to be conditioned to the air inlet of the main conditioning cabinet, it is desirable to provide some form of flexible duct means for conveying the outside air directly to the unit. As shown in Figs. 1 and 2, a very practical and inexpensive duct such as 16 may be made from corrugated paper, canvas or the like. Fig. 2 shows in detail the arrangement of the corrugations at a bend in the duct. This duct construction very materially reduces the cost of the duct and also facilitates installation of the duct. Another advantage of a flexible duct of this type is that it serves to deaden noises. As best shown in Fig. 1, the duct may be bent around obstructions and threaded into narrow passages or the like such as the narrow passage 18 provided above the attic room 20. It will be recognized that the arrangement of rooms is different in practically every home and that the specific arrangement of rooms shown in Fig. 1, has been shown for purposes of illustration only.

In many private homes, the first and second story walls and the second floor ceiling are insulated but the attic walls are not insulated, whereby the heat filtration into the main attic is very great on a hot day. As a consequence thereof, the air within the attic will sometimes exceed 120° when the outside air is 100°. Under such circumstances, it is especially advantageous

to provide a duct such as 16 for conveying the outside air directly to the conditioning unit and it is also advantageous to coat the duct with some type of heat insulating material, such as tin foil, aluminum foil or paint so as to reduce the heat leakage from the attic air into the fresh outside air flowing through the duct 16.

As shown in Fig. 2, the fresh air entering the air conditioning unit 12 flows in thermal exchange relationship with a series of coils 22, 24 and 26, before being picked up by the blower 28 which discharges the conditioned air downwardly through the floor duct 30. In Fig. 3, I have shown somewhat diagrammatically the relationship of these coils to the rest of the system. While the preferred embodiment as shown in Fig. 2 utilizes a centrifugal type of blower unit for circulating the air, it is within the purview of this invention to utilize an ordinary fan such as 29, shown in Fig. 3. In either case, a motor 31, is used for driving the air circulating means.

Water from any suitable source, such as the city water main, is circulated through the coil 22. The temperature of the water available in most localities is such that this water may be used to advantage in precooling the air during hot weather and may also be used to temper the incoming air on cold days. This is especially true on extremely hot or extremely cold days when increased capacity is most needed. Any suitable means may be provided for, at times, bypassing the water around coil 22, in case the conditioning unit is installed in a locality where the temperature of the tap water is not suitable for use in this manner at all times.

The volatile refrigerating system of which coil 24 is a part, is of the reverse cycle type and employs a conventional reversible rotary pump 34, which is adapted to be driven by means of a conventional reversible motor 40. The pump 34 and the motor 40 are mounted within a sealed casing 32. When cooling of the air is desired, the compressor 34 serves to withdraw volatile refrigerant from the heat exchange coil 24 through the line 36 and discharges compressed refrigerant through the passage 38. Water leaving coil 22 is circulated through a coil 42 located within the casing 32. The compressed refrigerant discharged through the passage 38 is condensed when it comes in contact with the water coil 42. The condensed refrigerant collects in the cavity formed between the main motor frame and the casing 32 and from thence flows into a conventional fixed restrictor 44 from whence the refrigerant is supplied to the coil 24 which operates as an evaporator during the cooling cycle. When it is desired to use the refrigerant coil 24 for heating the air flowing through the conditioning unit 12, the direction of rotation of the motor 40 and the compressor 34 is reversed whereby the compressor serves to withdraw refrigerant vapor from the motor housing and discharge compressed refrigerant gas through the line 36 which leads to the coil 24. During the heating cycle, the compressed gas discharged by the compressor 34 will be condensed in the coil 24 and will flow through the fixed restrictor 44 before returning to the unit 32. The water flowing through the coil 42 will now serve to evaporate the liquid refrigerant coming through the fixed restrictor 44, and will have its temperature materially reduced.

During the cooling cycle, the water coil 42 serves to pick up the heat removed from the air by the coil 24. This water may be discharged

directly into the drain line 46 or it may be discharged through the reheat coil 26 so as to reheat the air flowing over the coil 26. A three-way valve 48 is provided for directing the flow of water leaving the water coil 42. When the valve operating lever 49 is in the full line position, as shown in Fig. 3, the water will flow directly into the drain 46 without passing through the coil 26. By moving the valve operating lever 49 into the dotted line position, the three-way valve will direct all of the water leaving the coil 42 into the reheat coil 26.

By virtue of the above described reverse cycle arrangement, the refrigerating system may be used for either heating the air or cooling the air. When operating as a cooling system, the refrigerant coil 24 will serve to remove a considerable amount of moisture from the air flowing thereover. If it is desired to remove moisture from the air without appreciably changing the temperature of the air, the coil 26 may be used for reheating the air leaving the refrigerant coil 24.

A special control system has been devised for regulating the operation of the reverse cycle refrigerating system and the reheat coil 26. This system employs a novel form of photoelectric control instrument generally designated by the reference character 50. In order to best understand the purpose of this control instrument, I have shown in Fig. 4, a dry bulb temperature chart superimposed upon a wet bulb temperature chart. The lines emanating from center A represent various dry bulb temperatures, whereas the lines emanating from center B represent various wet bulb temperatures. It is obvious that at high dry bulb temperatures cooling is necessary irrespective of the wet bulb temperature. The zone within which cooling alone is required has been indicated on this chart as the cooling zone. It is also obvious that at certain low dry bulb temperatures heating will be required irrespective of the wet bulb temperature. The zone within which heating alone is required has been designated as the heating zone. Intermediate the cooling zone and the heating zone there exists a zone within which neither cooling nor heating is required. However, in this intermediate zone it is desirable to provide ventilation, and, if the wet bulb temperature is high, it is desirable to provide dehumidification or drying. This intermediate zone has therefore been divided into a ventilating zone and a drying zone.

The particular zones shown in Fig. 4 have been selected for purposes of illustration only, and may be changed without departing from the spirit of this invention.

By virtue of the novel control instrument described hereinafter, it is possible to accurately control the conditioning apparatus. Referring now to Fig. 3, reference numerals 52, 54, 56 and 58 designate four separate and independent photo-voltaic cells which are shaped so as to correspond as nearly as practical to the zones as indicated in Fig. 4 of the drawings. A source of light 60 is provided directly in front of the photo-voltaic cells 52, 54, 56 and 58, as shown in Fig. 5. Intermediate these cells and the source of light 60, I have provided a pair of non transparent shields 62 and 64 respectively. These shields are mounted so as to rotate about the pivots 66 and 68 respectively. Movement of the shield 62 about the pivot 66 is controlled by the dry bulb thermostatic element 70, whereas movement of the shield 64 about pivot 68 is con-

trolled by the wet bulb thermostatic element 72. Counterweights 74 and 76 have been provided so as to counterbalance the shields 62 and 64 respectively. A light transmitting slot 78 has been provided in the shield 62 and a corresponding light transmitting slot 80 has been provided in the shield 64. By virtue of this arrangement light from the light source 60 can strike the photo-voltaic cells only at that point where the slot 78 crosses the slot 80. The size of the light beam and the distance between the various photo-voltaic cells is such that only one cell is energized at any one time.

The photo-voltaic cells 52, 54, 56 and 58 are of the type which are now extensively used in various photo-electric controlled devices. The particular composition of each cell is broadly immaterial as there are several combinations of materials which may be used and which are now well known. The cells may, for example, be of the iron-selenium type. For a more detailed description of photo-electric controls of this type, reference is hereby made to the second edition of the book "Photocells and Their Application," written by Zworykin and Wilson. These cells are insulated from one another by means of any suitable insulating material designated by the reference character 82 and are adapted to be carried by the counterbalanced arm 84, journaled on the pin 86, which in turn is carried by the main base 90.

Inasmuch as the inside air conditions should be adjusted in accordance with the outside air conditions, I have provided means for shifting the photo-voltaic cells with respect to the source of light 60. For this purpose, I have provided a first outside temperature responsive bulb 92 which communicates with bellows 96 carried by the base 90. Contraction of the bellows 96 causes the element 98 to lift the arm 84 on which the photo-voltaic cells are supported. The construction and calibration of the outside thermostat 92 is such that as the outside temperature drops below a predetermined value, such as 55° for example, the arm 84 will be lifted so as to effect an increase in the inside temperature. A second outside dry bulb thermostat has been provided which communicates with the bellows 102 carried by the base 90. The thermostat 100 is adapted to become effective for adjusting the position of the arm 84 during the hot weather when cooling is required. It is now well known that as the outdoor temperature increases during the hot weather season, it is desirable to increase the indoor temperatures in accordance with the changes in the outside temperature. Thus as the outside temperature exceeds a predetermined value such as 75°, for example, the member 104 becomes effective to lift the arm 84 and as the outdoor temperature increases above 75°, the arm 84 will be elevated the necessary amount so as to make the recommended correction in the indoor temperature.

A third adjustment may be provided for compensating for changes in the moisture content of the outside air. As the moisture content of the outside air increases, it is desirable to maintain higher relative humidities inside the enclosure. This third adjustment comprises an outside moisture responsive element 106 which serves to compress the bellows 108 as the outside moisture content of the air increases. The bellows 108 communicates with bellows 110 carried by the arm 84. The arrangement is such that expansion of the bellows 110 causes elongation of the arm

84 so as to shift the photo-voltaic cells to the right. In Fig. 7, the full line showing of the photo-voltaic cells indicates the position of these cells at low outside humidities. Reference numeral 112 designates one possible position of the cells when the outside relative humidity is high. Reference numeral 114 designates another possible position of the cells when the outside relative humidity is low and the outside temperature is either excessively high or excessively low.

Modern photo-voltaic cells develop enough current to operate small relays without the use of any special amplifying equipment. In view of this fact, no amplifying equipment has been shown. However, it is within the purview of this invention to utilize standard amplifying apparatus for amplifying the current used for operating the various air conditioning control switches. In order to simplify this disclosure no amplifying circuits have been shown.

Referring now to Fig. 3, in which I have shown the electrical circuit used for controlling the apparatus, reference numeral 120 designates a manually controlled switch which is provided in the main supply line. Reference numeral 122 designates an outside thermostat which is adapted to be closed whenever the outside temperature is above a predetermined value, at which temperature the reverse cycle refrigerating system is capable of conditioning the air. The temperature at which the thermostat 122 is adapted to be closed will be determined largely by the capacity of the refrigerating apparatus as compared with the air conditioning load in each installation. In certain homes, for example, the conditioning apparatus will have ample capacity to heat the air whenever the outside air temperature is above 40°, for example, whereas in larger homes the same size equipment may not be capable of supplying the necessary amount of heat at temperature below 50°, for example.

Whenever both switches 120 and 122 are closed, the attic air conditioning unit is placed in operation under control of the main photoelectric control instrument.

It will be noted that the motor 31 which operates the air circulating means is energized at all times that the switches 120 and 122 are closed.

As shown in Fig. 3, the photo-voltaic cell 52 controls the relay 124 which in turn controls the switch 126. Thus when the wet bulb and dry bulb temperatures within the conditioned space indicate that cooling is required, the light beam will strike the photo-voltaic cell 52 whereby switch 126 will be closed. Closing of switch 126 causes energization of the motor 40 in the normal direction in which the reverse cycle refrigerating system functions as an air cooling system.

If the dry bulb temperature in the enclosure is within the normal comfort range, but the wet bulb temperature is higher than desired, the light beam will strike the photo-voltaic cell 54 whereby relay 128 will be energized. Energization of the relay 128 causes switch 130 to close. Closing of the switch 130 energizes relay 132 which in turn closes the switch 134. Closing of the switches 130 and 134 also causes energization of the motor 40 in the normal direction whereby the coil 24 will function as an evaporator for cooling the air and consequently removing moisture from the air. Closing of the switch 130 also energizes the valve operating solenoid 136 with the result that the valve operating member 49 will be moved to the dotted line position, whereby the heated condenser water leaving the coil 42 will

be directed through the coil 26. When the coil 24 functions as an evaporator, the heat removed from the air by the coil 24 will be dissipated into the water flowing through the coil 42. Consequently the heat removed from the air by the coils 22 and 24 will be returned to the air by the coil 26 whenever the valve 48 directs the water leaving the coil 42 through the coil 26.

During the spring and fall seasons there are periods when the outdoor temperature is too cool for comfort but it is not cold enough to operate the usual winter heating apparatus. This system is designed to provide the necessary amount of heating for such periods. During such periods the switch 122 will be closed and the dry bulb temperature within the conditioned space will indicate that heating is required. Accordingly, the light beam will be directed upon the photo-voltaic cell 56 with the result that the relay 140 will be energized. Energization of the relay 140 causes closing of the switch 142. The switch 142 is arranged in series with the motor winding which causes the motor to be operated in the opposite direction from which it operates when the coil 24 functions as an evaporator. As explained hereinabove, this causes the coil 24 to function as a condenser. When the coil 24 functions as a condenser, heat will be absorbed from the water flowing through the coil 42 and will be discharged into the air stream by the coil 24.

If neither heating, cooling nor drying is required, the light beam will fall upon the photo-voltaic cell 58. This cell controls the relay 144 which when energized closes the main water valve 23.

Heat may be supplied to the conditioned space by the central heating plant 150 during the winter season.

In order to avoid operation of the refrigeration system at the same time that the main heating system operates, the control thermostat 152, for the central heating plant 150, is arranged in series with a switch 154 which is held open by the relay 156 at all times when current is flowing to the air circulating fan motor 31. In order to simplify this disclosure, the means for dissipating heat generated by the central heating plant 150 has been represented by a single heat radiator 160, as shown in Fig. 1. The thermostat 152 has been shown as controlling a valve 158 arranged in the fuel line leading to the central heating plant 150.

The operation of the above described air conditioning apparatus may be summarized as follows:

Operation of system when cooling alone is required

When cooling alone is required, the wet and dry bulb temperatures will be such that the light beam emanating from the source 60 will fall upon the photo-voltaic cell 52 whereby relay 124 will be energized. Relay 124 will then close switch 126 in the compressor-motor circuit, whereby the refrigerating system will operate as a cooling system. The air flowing through the conditioning cabinet will be partially cooled by the water flowing through the coil 22 and will be further cooled by the coil 24. The reheat coil 26 will be ineffective when cooling alone is desired by virtue of the position of the three-way valve 48.

Operation of the system when ventilating alone is required

When both the dry bulb temperature and the

wet bulb temperature in the enclosure are within the normal comfort range, the light beam will be directed toward the photo-voltaic cell 58. When the light beam falls upon the photo-voltaic cell 58, the relay 144 will be energized so as to hold closed the main water valve 23. All circuits leading to the compressor motor 40 remain open when ventilation only is required. As a consequence thereof, all of the air conditioning coils are ineffective and the fresh outside air will be discharged into the conditioned space without being conditioned. The fresh air will, however, be cleaned by the filter 15, provided at the inlet of the conditioning unit 12.

Operation of the system when drying alone is required

When the dry bulb temperature is satisfactory but the wet bulb temperature is too high, the light beam will be directed upon the photo-voltaic cell 54 whereby relay 128 will be energized. Energization of the relay 128 closes the switch 130 which in turn energizes relay 132. Energization of relay 132 causes closing of the switch 134. Under these conditions, the compressor motor will be energized so as to operate the refrigerating apparatus as an air cooling system. The relay 136 will also be energized so as to hold the three-way valve 48 into the position in which the water leaving the coil 42 will be circulated through the coil 26 before discharging into the drain pipe 46. Air flowing through the conditioning cabinet, under the above described circumstances, will be partially cooled by the coil 22 and will be further cooled by the coil 24 whereby a considerable quantity of water will be removed from the air. The air thus cooled and dried will thereafter be reheated when coming in contact with the coil 26 through which the condenser cooling water is circulated.

Operation of the system when heating alone is required

When the temperature of the inside air drops below a predetermined value, it becomes necessary to heat the air. When the outside temperature is above the value at which the outside thermostat 122 is set to operate, the outside thermostat 122 will be closed and the light beam of the inside control instrument will be directed upon the photo-voltaic cell 56. Under these circumstances, the relay 140 will be energized and the switch 142 will be closed. Closing of the switch 142 energizes the compressor motor in a reverse direction whereby the refrigerating system functions as a heating system for heating the air. When the refrigerating system functions as a heating system for heating the air, the coil 24 serves as a condenser which dissipates heat into the air stream. As pointed out hereinabove, the water flowing through the coil 22 may be used to partially heat the air, especially if the incoming air is rather cold and the incoming water temperature is relatively high. The water leaving the coil 22 will be circulated through the coil 42 wherein it will give up more of its heat before discharging into the drain line 46.

In the event that the outside temperature is so low that the reverse cycle refrigerating system lacks the necessary capacity for properly conditioning the air for the enclosure, the outside thermostat 122 will indicate that fact and will remain open whereby relay 156 will be deenergized. Deenergization of the relay 156 causes switch 154 to close whereby the thermostat 152 is placed in control of the central heating plant 150. The

thermostat 152 is located within the conditioned space and is adapted to control the circuit to the fuel valve 158 of the central heating system 150 in the usual manner.

In Fig. 8, I have shown a modified form of control instrument. This instrument incorporates a plurality of contact elements 252, 254, 256 and 258, which correspond in shape to the photo-voltaic cells 52, 54, 56 and 58, shown in Figs. 3 through 7. In lieu of utilizing a light beam movable over the various zones, I have provided a contact 260 which is adapted to be moved around into contact with the contacts 252, 254, 256 and 258 by the joint action of the dry bulb temperature responsive arm 262 and the wet bulb temperature responsive arm 264. The arm 262 is adapted to be actuated by means of a dry bulb thermostat 270 corresponding to the dry bulb thermostat 70 shown in the first described modification. The arm 264 is adapted to be actuated by means of the wet bulb thermostat 272 which likewise corresponds to the wet bulb thermostat 72, shown in the first described modification. The movable contact 260 is arranged to be guided by the slotted arms 262 and 264 so as to make contact with only one stationary contact at a time.

In order to simplify the disclosure, the outside modifiers have not been shown in Fig. 8. However, it is intended that the contact elements shown in Fig. 8 are to take the place of the photo-electric means in a combination of the type shown in Figs. 5 through 7.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. Air conditioning apparatus and control means therefor comprising in combination, a reverse cycle refrigerating system having a pair of complementary heat exchange elements, means for circulating air to be conditioned in thermal exchange with the first of said elements, means for circulating an extraneous medium in thermal exchange with the second of said elements, means for reheating the air flowing over said first heat exchange element, a plurality of photosensitive devices, a light source, means for directing light from said source onto said photosensitive devices in accordance with the temperature and moisture content of the air, means energized by one of said photosensitive devices for operating said reverse cycle system as an air cooling system, means operated by another of said photosensitive devices for energizing said reverse cycle system as a means for heating air to be conditioned, and means energized by one of said photosensitive devices controlling the supply of heat to said reheating means.

2. Air conditioning apparatus and control means therefor comprising in combination, a reverse cycle refrigerating system having a pair of complementary heat exchange elements, means for circulating air to be conditioned in thermal exchange with the first of said elements, means for circulating an extraneous medium in thermal exchange with the second of said elements, means for reheating the air flowing over said first heat exchange element, a plurality of photosensitive devices, a light source, means for directing light from said source onto said photosensitive devices in accordance with the temperature and moisture content of the air, means energized by one of

said photosensitive devices for operating said reverse cycle system as an air cooling system, means operated by another of said photosensitive devices for energizing said reverse cycle system as a means for heating air to be conditioned, means energized by one of said photosensitive devices controlling the supply of heat to said reheating means, and means responsive to one function of the psychrometric condition of the outside air for modifying the operation of said air conditioning apparatus.

3. In combination, a first heat exchange coil, means for supplying either a heating medium or a cooling medium to said first coil, a second heat exchange coil, means for supplying a heating medium to said second named coil, means for flowing air in thermal exchange with said coils, control means for controlling the supply of medium to said coils, said control means comprising a photo-voltaic cell for each of said coils, a source of light, and means for directing said light onto said cells in accordance with changes in the temperature and moisture content of the air.

4. Air conditioning apparatus comprising means for producing different air conditioning effects throughout different zones of wet and dry bulb temperatures; control means for said apparatus comprising a plurality of photosensitive elements corresponding to said different zones, a source of light, means for directing light from said source from one element to another in accordance with the air conditioning effect desired, and means whereby light striking one of said elements controls said first named means to produce one air conditioning effect, and when striking another of said elements produce a different air conditioning effect.

5. In combination with a plurality of light sensitive cells corresponding in shape to predetermined zones on a chart on which the abscissas represent one value and the ordinates another value, a source of light, and means responsive to said values for directing light onto said cells in accordance with said values.

6. In combination with a plurality of light sensitive cells corresponding in shape to predetermined psychrometric zones, a source of light, and means responsive to the psychrometric condition of the air for directing light from said source onto the cell corresponding to the psychrometric condition measured.

7. Control means for use with apparatus for producing different air conditioning effects throughout different zones of wet and dry bulb temperatures comprising a plurality of photosensitive elements corresponding to said different zones, a source of light, means for directing light from said source from one element to another in accordance with the air conditioning effect desired, and means whereby light striking one of said elements controls said apparatus to produce one air conditioning effect, and when striking another of said elements produce a different air conditioning effect.

8. Control means for controlling the supply of heat transfer medium to a plurality of coils for either heating or cooling air comprising a photo-voltaic cell for each of said coils, a source of light, and means for directing said light onto said cells in accordance with changes in the temperature and moisture content of the air.

9. Control means for a reverse cycle air conditioning apparatus having means for reheating the air during the cooling cycle comprising in combination, a plurality of photosensitive devices,

a light source, means for directing light from said source onto said photosensitive devices in accordance with the temperature and moisture content of the air, means energized by one of said photosensitive devices for operating said reverse cycle system as an air cooling system, means operated by another of said photosensitive devices for energizing said reverse cycle system as a means for heating air to be conditioned, means energized by one of said photosensitive devices controlling the supply of heat to said reheating means, and means responsive to one function of the psychrometric condition of the outside air for modifying the operation of said air conditioning apparatus.

10. Control means for a reverse cycle air conditioning apparatus having means for reheating the air during the cooling cycle comprising in combination, a plurality of photosensitive devices, a light source, means for directing light from said source onto said photosensitive devices in accordance with the temperature and moisture content of the air, means energized by one of said photosensitive devices for operating said reverse cycle system as an air cooling system, means operated by another of said photosensitive devices for energizing said reverse cycle system as a means for heating air to be conditioned, and means energized by one of said photosensitive devices controlling the supply of heat to said reheating means.

11. In combination, light sensitive means, a source of light, means for directing light from said source onto said sensitive means comprising a first light, occluding means having a light transmitting portion, a second substantially overlapping light occluding means having a light transmitting portion, means responsive to the temperature of air for operating said first named light occluding means, and means responsive to the moisture content of the air for operating said second named light occluding means.

12. In combination, a source of light, light sensitive means, a first light occluding means between said source of light and said light sensitive means and having a light transmitting slot, a second light occluding means between said source of light and said light sensitive means and having a light transmitting slot arranged to intersect said first named light transmitting slot whereby a light transmitting opening is provided at the intersection of said slots, means for actuating said first light occluding means, and means for actuating said second light occluding means whereby the point of intersection of said slots may be varied by movement of either one or both of said light occluding means.

13. Air conditioning apparatus comprising in combination; a heat transfer coil; means for selectively supplying either a heating medium or a cooling medium to said heat transfer coil; a reheat coil; a plurality of light sensitive cells corresponding in shape to predetermined psychrometric zones, one of which calls for cooling, a second of which calls for heating and a third of which calls for cooling and reheating; a source of light; and means responsive to the psychrometric condition of the air for directing light from said source onto the cell corresponding to the psychrometric condition measured; means whereby a cooling medium is supplied to said heat transfer coil when the light is directed onto said first cell; means whereby a heating medium is supplied to said heat transfer coil when the light is directed onto said second cell; means whereby a cooling medium is supplied to

said heat transfer coil, and a heating medium is supplied to said reheat coil when said light is directed onto said third cell; and means for flowing air over said coil.

14. Air conditioning apparatus comprising in combination; a heat transfer coil; means for selectively supplying either a heating medium or a cooling medium to said heat transfer coil; a reheat coil; a plurality of light sensitive cells corresponding in shape to predetermined psychrometric zones, one of which calls for cooling, a second of which calls for heating and a third of which calls for cooling and reheating; a source of light; and means responsive to the psychrometric condition of the air for directing light from said source onto the cell corresponding to the psychrometric condition measured; means whereby a cooling medium is supplied to said heat transfer coil when the light is directed onto said first cell; means whereby a heating medium is supplied to said heat transfer coil when the light is directed onto said second cell; means whereby a cooling medium is supplied to said heat transfer coil, and a heating medium is supplied to said reheat coil when said light is directed onto said third cell; and means for flowing air over said coil; said means for directing the light unto said cells comprising a first light directing element operable in response to changes in the dry bulb temperature of the air, and a second light directing element operable in response to changes in the moisture content of the air.

15. Air conditioning apparatus and control means therefor comprising in combination, a reverse cycle refrigerating system having a pair of complementary heat exchange elements, means for circulating air to be conditioned in thermal exchange with the first of said elements, means for circulating an extraneous medium in thermal exchange with the second of said elements, means for reheating the air flowing over said first heat exchange element, a plurality of photosensitive devices, a light source, means for directing light from said source onto said photosensitive devices in accordance with air conditioning requirements, means energized by one of said photosensitive devices for operating said reverse cycle system as an air cooling system, means operated by another of said photosensitive devices for energizing said reverse cycle system as a means for heating air to be conditioned, and means energized by one of said photosensitive devices controlling the supply of heat to said reheating means.

16. In combination, a plurality of light sensitive cells corresponding in shape to predetermined zones on a psychrometric chart on which the abscissae represent dry bulb temperature and the ordinates represent wet bulb temperature, a source of light shining onto said cells, means responsive to the dry bulb temperature for directing said light along said abscissae and means influenced by changes in the wet bulb temperature for directing the light along said ordinates.

17. In combination, a plurality of light sensitive cells substantially corresponding in shape to predetermined zones on a chart on which the abscissae represent one value and the ordinates represent another value, a source of light, means for directing a beam of light onto said cells so as to move along either one of said coordinates or at an angle to said coordinates, and means energized by said cells when light strikes said cells.

18. Control means for a reverse cycle air conditioning apparatus having means for reheating the air during the cooling cycle comprising in

combination, a plurality of photosensitive devices, a light source, means for directing light from said source onto said photosensitive devices in accordance with the temperature and moisture content of the air, means energized by one of said photosensitive devices for operating said reverse cycle system as an air cooling system, and means operated by another of said photosensitive devices for energizing said reverse cycle system as a means for heating air to be conditioned.

19. Air conditioning apparatus comprising in combination; means forming an air conditioning passage; means for selectively supplying either a heating medium or a cooling medium to said passage; a plurality of light sensitive cells corresponding in shape to predetermined psychrometric zones, one of which calls for cooling, a second of which calls for heating and a third of which calls for dehumidification; a source of light; and means responsive to the psychrometric condition of the air for directing light from said source onto the cell corresponding to the psychrometric condition measured; means whereby a cooling medium is supplied to said passage when the light is directed onto said first cell; means whereby a heating medium is supplied to said passage when the light is directed onto said second cell; means whereby moisture is removed from the air in said passage when said light is directed onto said third cell; and means for flowing air through said passage.

20. Air conditioning apparatus comprising in combination; a heat transfer coil; means for selectively supplying either a heating medium or a cooling medium to said heat transfer coil; a reheat coil; a plurality of light sensitive cells corresponding in shape to predetermined psychrometric zones, one of which calls for cooling, a second of which calls for heating and a third of which calls for cooling and reheating; a source of light; and means responsive to the psychrometric condition of the air for directing light from said source onto the cell corresponding to the psychrometric condition measured; means whereby a cooling medium is supplied to said heat transfer coil when the light is directed onto said first cell; means whereby a heating medium

is supplied to said heat transfer coil when the light is directed onto said second cell; means whereby a cooling medium is supplied to said heat transfer coil, and a heating medium is supplied to said reheat coil when said light is directed onto said third cell; and means for flowing air over said coils; said means for directing the light unto said cells comprising a first means operable in response to changes in the dry bulb temperature of the air, and a second means operable in response to changes in the moisture content of the air.

21. Air conditioning apparatus comprising in combination; a heat transfer coil, means for selectively supplying either a heating medium or a cooling medium to said heat transfer coil; a reheat coil; a plurality of light sensitive cells corresponding in shape to predetermined psychrometric zones, one of which calls for cooling, a second of which calls for heating and a third of which calls for cooling and reheating; a source of light; and means responsive to the psychrometric condition of the air for directing light from said source onto the cell corresponding to the psychrometric condition measured; means whereby a cooling medium is supplied to said heat transfer coil when the light is directed onto said first cell; means whereby a heating medium is supplied to said heat transfer coil when the light is directed onto said second cell; means whereby a cooling medium is supplied to said heat transfer coil, and a heating medium is supplied to said reheat coil when said light is directed onto said third cell; and means for flowing air over said coils; said means for directing the light unto said cells comprising a first means operable in response to changes in the dry bulb temperature of the air, and a second means operable in response to changes in the moisture content of the air, said means for directing the light onto said cells comprising a first means operable in response to changes in the dry bulb temperature of the air, and a second means operable in response to changes in the moisture content of the

ANDREW A. KUCHER.