May 7, 1935. R. E. KEYES 2,000,597

AIR DISTRIBUTION UNIT

Filed Jan. 17, 1934 2 Sheets-Sheet 1

Fig. 1.

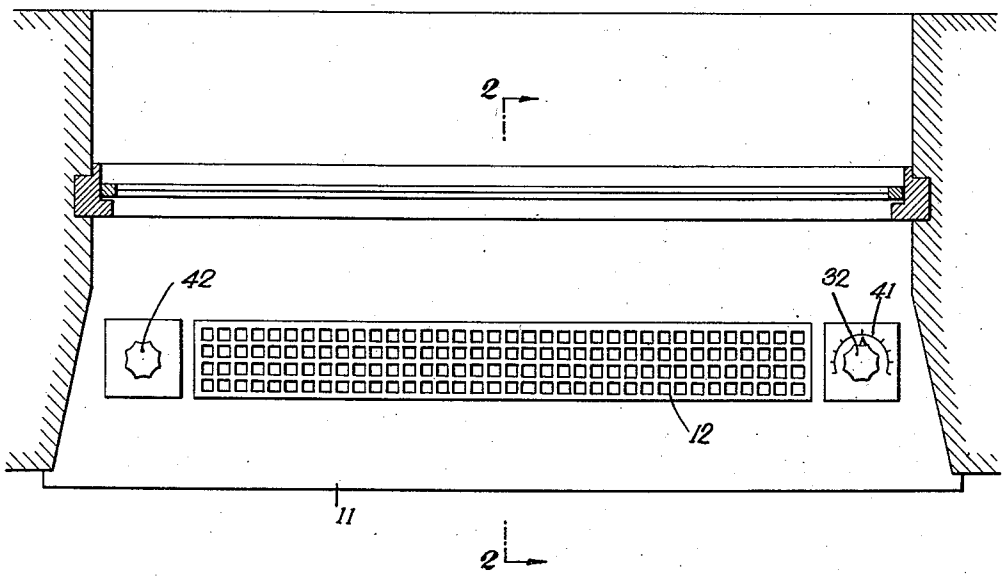

Fig. 3.

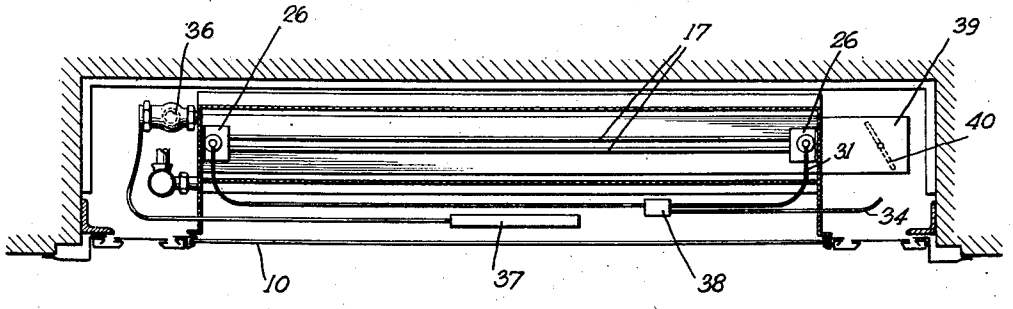

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Fig. 2.

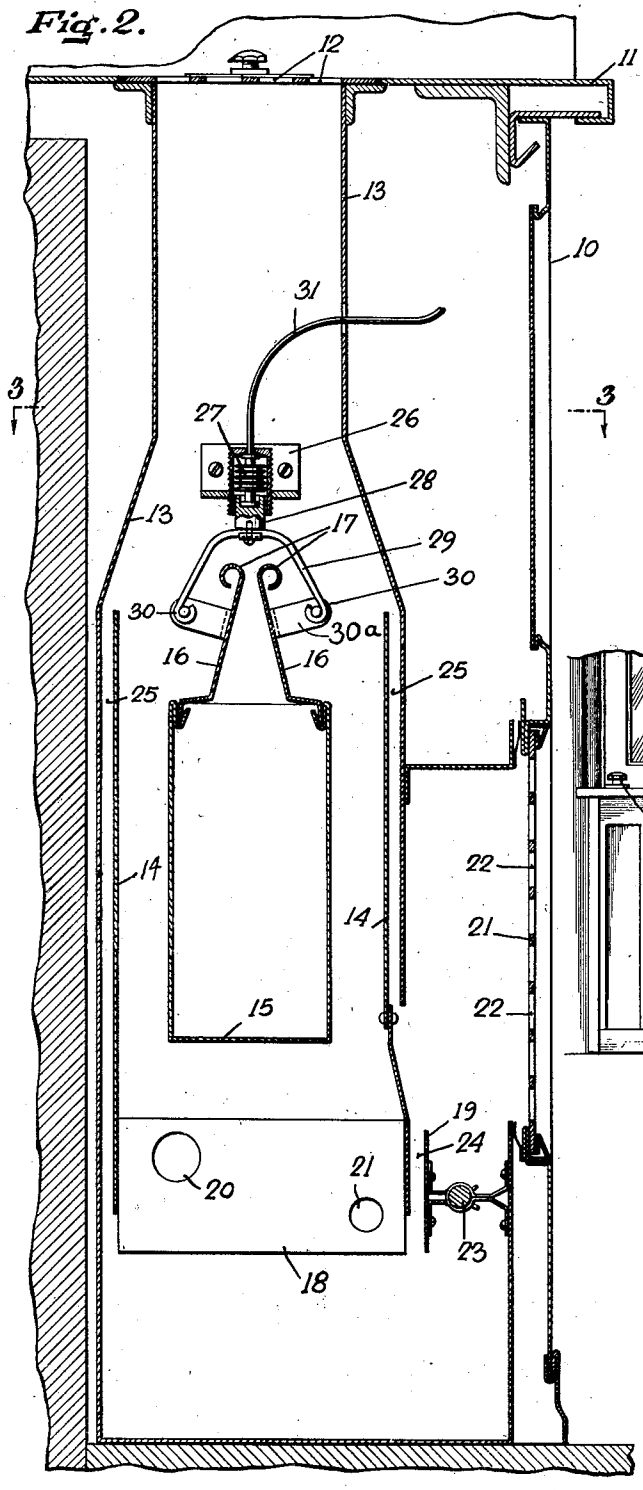


Fig. 4.

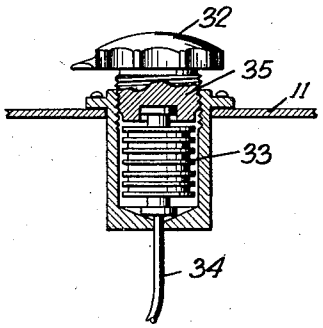
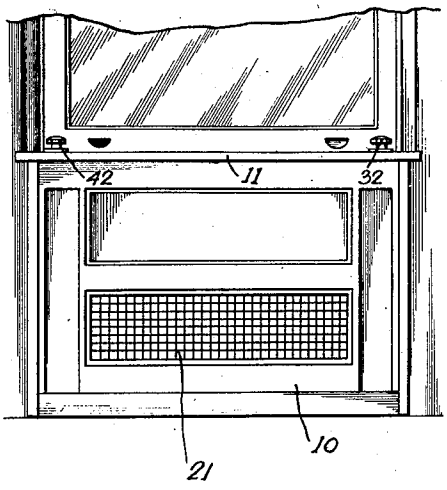


Fig. 5.



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UNITED STATES PATENT OFFICE

2,000,597

AIR DISTRIBUTION UNIT

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Application January 17, 1934, Serial No. 707,000

9 Claims. (Cl. 257—8)

This invention relates to air conditioning systems and relates more particularly to a combined heating and cooling unit, a number of which may be used with a central unit to supply cooled and dehumidified air in summer and warm and humidified air in winter.

To maintain comfort conditions in enclosures where people are accustomed to assemble there are a number of factors to be considered. In summer, the air usually needs to be cooled and dehumidified and in winter the air supplied usually has to be heated and water vapor added. Another important factor in addition to temperature and humidity is air movement or circulation. It is not sufficient to inject a conditioned air stream into a room, but, for best results, circulation throughout the room must take place without drafts and without inequalities of temperature in different portions of the room. In large enclosures, such as theater auditoriums, circulation is produced by having large supply ducts carry conditioned air to the room and to withdraw air from the room which is recirculated back to the conditioning unit external the room where it is mixed with the conditioned air. This, however, requires the use of not only a large and expensive supply duct for supplying the required amount of conditioned air to the room, but also another similar duct for withdrawing the recirculated air from the room. This invention contemplates the use of a central air conditioning system which serves to clean and adjust the moisture and heat content of outside air and to force this air through a small duct to one or more efficient distribution units which are mounted at the space being served and in which recirculated air from the room is mixed with conditioned air prior to its discharge into the room. The energy of the high velocity conditioned air causes, by injector action, indrawing of the recirculated air.

According to a feature of this invention, a distribution unit is provided which contains a compartment in which the conditioned air from the central unit is supplied, and this compartment has along its upper portion a pair of injector nozzle lips, the distance between which may be adjusted from external the unit at a point remotely located from the injector.

According to another feature of the invention, the conditioned air compartment in the remote distribution unit is provided with an enclosure through which recirculated air is drawn to surround the conditioned air compartment, and which serves to provide an air blanket when cold air is supplied to the compartment to prevent the condensation of moisture upon any walls of the unit.

An object of the invention is to supply cooled air in summer and warm air in winter.

Another object of the invention is to provide an improved local recirculation unit for supply and distribution of conditioned air.

Another object of the invention is to provide in a local distribution unit an injector for supplying conditioned air and for indrawing recirculated air, together with means for adjusting the injector to compensate for reduced velocities from the air supply source.

Another object of the invention is to provide a hydraulic control for enabling an air injector, in a local distribution unit, to be adjusted from a remote point.

Another object of the invention is to provide an insulating layer of recirculated air around the cold air supplied to prevent the condensation of moisture on the walls of the enclosure in which a local distribution unit is mounted.

Other objects of the invention will be apparent from the following discussion and the drawings.

Reference will now be had to the drawings, of which:

Fig. 1 is a plan view looking downwardly on an air distribution unit according to this invention;

Fig. 2 is an elevational, sectional view taken along the lines 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view taken along the lines 3—3 of Fig. 2;

Fig. 4 is a view, partially in section, of a bellows control for adjusting the injector shown by Figs. 2 and 3, and

Fig. 5 is an elevational view of the unit.

The present invention relates to what may be called a local recirculation unit. This type of unit is adapted to be mounted in rooms of private homes, schools, hospitals, of offices, or the like. Ordinarily, a plurality of these units would be mounted, one or more to each room of a building being supplied with conditioned air. These units may be supplied with cold air in summer or heated air in winter by a central air conditioning unit of the type disclosed in Patent No. 1,670,656, issued May 22, 1928. Where the system of the central unit, such as is described in the patent, is used with units according to the present invention, it is preferred that no recirculated air be returned to the central conditioning unit, since the units ac-

cording to this invention provide, themselves, for the mixing of recirculated air with conditioned air at the space being served.

Referring now to the drawings, a local recirculation unit is shown which is adapted to be associated with the sill of a window. The unit 10 has its sides and upper walls formed preferably from sheet metal, and has its upper portion 11 flush with the window sill as shown. Within the unit is mounted the conditioned air compartment 15 which is supplied with high velocity conditioned air from a central supply source. The duct 40 controls, at the unit, the volume of conditioned air supplied thereto. The conditioned air compartment has mounted at its upper portion the two injector nozzle lips 17, the distance between which may be varied at will by a unique form of bellows control which is a feature of this invention and which will be described later.

Mounted underneath the conditioned air compartment 15 is the extended surface steam heater 18 to which steam may be supplied through the pipe 20 and returned through the pipe 21. The walls 14 enclose the heater 18 and extend upwardly and surround the conditioned air compartment 15.

The recirculated air inlet 21, comprising a grille provided with openings 22, communicates with the space beneath the heater 18 by way of the space between the walls 14 and 19, the latter being supported to the housing by the longitudinal bar 23. External the walls 14 are arranged the outer walls 13 which extend all the way to the top of the unit and at the upper portion of which is arranged the grille 12 for the air discharged from the unit. A space 25 is formed around the walls 14 by the spacing of the walls 13, and recirculated air from the recirculated air inlet passes through this space to surround the walls 14, which recirculated air, as will be explained later, forms effectively an air blanket between the walls 14 and the walls 13, which, when cold air is supplied to the compartment 15, prevents condensation of moisture on the walls of the unit. The walls 13 come together above the ends of the walls 14 to form a reduced air passage, and the injector nozzle lips are arranged between the walls 13 at the point where they converge to form the reduced air passage.

The injector nozzle lips 17 are hinged at their lower portions to the conditioned air compartment 15. Each nozzle lip has attached to it, adjacent its upper portion, the lever arms 30*a*, to each of which, at its outer end, is attached one arm 30 of the bellows control lever 29. At each end of the injector nozzle lips 17, as shown by Fig. 3, there is mounted a hydraulic adjusting mechanism 26 which serves to adjust the position of the two nozzle lips relative each other. Each adjusting mechanism comprises a lever 29 which is attached to the member 28, which, in turn, is fixed to the spring bellows 27 so as to move therewith upon the expansion and contraction thereof. Connecting with the spring bellows 27 is the fluid tube 31 which leads to the junction box 38 (Fig. 3) and from this junction box the fluid tube 34 leads to the control bellows 33 (Fig. 4) which, in turn, is mounted with its control knob 32 in one end of the upper portion of the local recirculation unit (Fig. 1). Contained within the bellows 33 and 27 and in the tubes 31 and 34 and the junction box 38, is suitable hydraulic fluid, such as alcohol, which serves to transmit motion from the bellows 33 to the bellows 27. The control bellows 33 has associated with it the control dial 32, which, when rotated, compresses the bellows 33 through the rotation of the compression member 35 in the bellows housing. Associated with the dial 32 is the calibrated scale 41 which serves to show the position of the dial 32 and the corresponding spacing of the nozzle lips 17 of the injector of the local recirculation unit. Upon rotation of the dial 32 in a clockwise direction, the spring bellows 33 is compressed. This forces the hydraulic fluid through the tubes 34 and 31 and causes the actuating bellows 27 to expand, causing, through the intermediate action of the levers 29 and 30*a*, the injector nozzle lips 17 to move further apart. Likewise, rotation of the dial 32 in a counterclockwise direction permits the spring bellows 33 to expand and this in turn causes contraction of the spring bellows 27 and the movement of the injector nozzle lips 17 towards each other.

In order that a small movement of the control bellows may cause a correspondingly large movement of the injector nozzle lips 17, a magnifying action at the nozzle lips is obtained by means of the levers 30*a* and the lever 29, which has its two ends connected at the outer ends of the levers, and which has its center connected to the control bellows 27.

In operation, in summer, high velocity cold and dehumidified air is supplied through a duct 39 past the damper 40 to the conditioned air compartment 15. This cold air passes between the injector nozzle lips 17, and induces, by injector action, the flow of recirculated air through the recirculated air inlet 21, which recirculated air takes two paths, one through the passage 24, through the heater 18 and around the compartment 15 between the spaces existing between the walls 14 and the compartment 15. The other path of the recirculated air is between the spaces existing between the outer walls 13 and the inner walls 14. The recirculated air in this latter path provides an air blanket to prevent the condensation of moisture contained within the relatively warm and humid recirculated air upon the walls 13 and 14 and the outer walls of the unit.

The heater 18 has a steam valve 36 which is controlled in the well known manner by a thermostate which may be mounted within the path of the recirculated air within the unit (Fig. 3). Thus, the supply of heat to the unit may be controlled automatically, as weather conditions require. Where desired, the thermostat 37 may be replaced by a manual control, or a manual control may be used to adjust and cooperate with the thermostat. Such a manual control 42 (Fig. 1 may be mounted in the top of the cabinet of the unit at the other end of the discharge outlet 12 from that occupied by the injector control 32. Likewise, the damper 40 in the conditioned air duct may be controlled automatically or manually as desired.

The success of local recirculation systems, such as the one herein described and in which the flow of recirculated air is produced by the supply of high velocity conditioned air, depends largely upon its ability to produce adequate air circulation throughout a room. It is believed that it is highly desirable that in a unit of this type the air discharged from the discharge outlet 12 pass with high velocity and considerable energy towards the upper portion of the room to impact with air within the room with relatively great force so as to insure ade-

quate air mixture and the production of air movement within the room. Where temperature conditions warrant the reduction of conditioned air supplied to the compartment 15, obviously the volume of air passing through the compartment 15 and between the injector nozzle lips 17 is reduced, with the result that the air discharged from the unit has less force. According to this invention, however, in the event that the volume of conditioned air supplied to the compartment 15 is reduced, it is intended that the injector nozzle lips 17 be moved closer together to produce an increased injector action, thus producing a greater velocity through the injector, compensating for the reduced volume of conditioned air supplied from the central supply source. By utilizing the form of hydraulic control illustrated, the nozzle control, if intended to be operated manually, may be mounted in any convenient location, which, for the purpose of illustration, is shown at the top of the unit cabinet. While the control has been shown to be manual, it can, of course, be made automatic, either thermostatically or the movement of the injector nozzles co-ordinated automatically with the movement of the control damper 40.

The local recirculation unit according to this invention may be used for either winter or summer operation. In summer, cold air may be supplied to the unit, which induces the flow of warmer recirculated air within the room. In summer, the heater 18 may or may not be used, depending upon the temperature requirements. In winter, warm and humidified air may be supplied from the central supply source to the local recirculation unit, and this warm and humidified air may induce the flow of recirculated air at the room. Where the operation of the central supply source is not warranted, the heater 18 may be used without the supply of conditioned air to the compartment 15, and when the heater 18 is used alone, recirculated air flow from the room is induced by thermal-circulation through the recirculated air inlet 21, over the surfaces of the heating unit 18, and out the discharge outlet 12.

Whereas one embodiment of the invention has been described for the purpose of illustration, it should be understood that the invention is not limited to the exact disclosure described, as many modifications may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. A combined heating and cooling unit comprising a cold air compartment, an injector nozzle connected with said compartment, a heater below said compartment, an opening in said unit for the reception of recirculated air, a recirculated air passage connecting with said opening, passing through said heater, around said compartment, and in injector relationship past said nozzle, and a second recirculated air passage by-passing said heater and surrounding said first air passage in the area where same passes said compartment.

2. A cooling unit comprising a cooling compartment having means for passing cold air through an injector nozzle to induce the flow of warm air, an opening in said unit for the reception of recirculated air, a recirculated air passage connecting with said opening and surrounding said compartment, and another recirculated air passage surrounding said first passage and said compartment, both of said passages feeding air in injector relationship past said nozzle.

3. A combined heating and cooling unit comprising a heater, a cooling compartment, an opening in said unit for the reception of recirculated air, a recirculated air passage connecting with said opening, passing through said heater and around said compartment, and another recirculated air passage by-passing said heater, surrounding said first passage in the vicinity of said compartment, and terminating therewith to form a single passage above said compartment.

4. A combined heating and cooling unit comprising a heater, a cooling compartment supported above said heater, an opening in said unit for the reception of recirculated air, a recirculated air passage connecting with said opening, passing through said heater and around said compartment, a discharge air passage above said compartment, and another recirculated air passage by-passing said heater, surrounding said first passage in the vicinity of said compartment, and joining therewith to discharge into said outlet passage.

5. A combined heating and cooling unit comprising a heater, a cooling compartment supported above said heater, an opening in said unit for the reception of recirculated air, a recirculated air passage connecting with said opening, passing through said heater and around said compartment, a discharge air passage above said compartment, another recirculated air passage by-passing said heater, surrounding said first passage in the vicinity of said compartment, and joining therewith to discharge into said outlet passage, and an injector nozzle in the upper portion of said compartment arranged adjacent the point of junction of said two recirculated air passages with said discharge passage.

6. A combined heating and cooling unit comprising a cold air compartment, an injector nozzle connected with said compartment, a heater below said compartment, an opening in said unit for the reception of recirculated air, a recirculated air passage connecting with said opening, passing through said heater, around said compartment, and in injector relationship past said nozzle, a second recirculated air passage by-passing said heater and surrounding said first air passage in the area where same passes said compartment, a duct for supplying cold air to said compartment, a damper in said duct for varying the volume of cold air supplied, and means for increasing the velocity of air flow through said injector nozzle when said damper is adjusted to decrease the volume of air supplied to said compartment.

7. A combined heating and cooling unit comprising a cold air compartment, an injector nozzle connected with said compartment, a heater below said compartment, an opening in said unit for the reception of recirculated air, a recirculated air passage connecting with said opening, passing through said heater, around said compartment, and in injector relationship past said nozzle, a second recirculated air passage by-passing said heater and surrounding said first air passage in the area where same passes said compartment, a duct for supplying cold air to said compartment, a damper in said duct for varying the volume of cold air supplied, and hydraulically operated means for increasing

the velocity of air flow through said injector nozzle when said damper is adjusted to decrease the volume of air supplied to said compartment.

8. A local recirculation unit comprising a conditioned air compartment, a pair of injector nozzle lips connecting with said compartment to form an injector for inducing the flow of recirculated air, an opening in said unit for the reception of recirculated air, a recirculated air passage connecting with said opening and passing said nozzle in injector relationship thereto, a fluid filled spring bellows attached to said nozzle lips for varying the spacing therebetween, a remotely located fluid filled control bellows, a fluid line connecting said bellows, and means for adjusting said control bellows and indicating the degree of adjustment thereof for adjusting and indicating the degree of adjustment of said nozzle lips of said injector.

9. A local recirculation unit comprising a conditioned air compartment, a pair of injector nozzle lips connecting with said compartment to form an injector for inducing the flow of recirculated air, an opening in said unit for the reception of recirculated air, a recirculated air passage connecting with said opening and passing said nozzle in injector relationship thereto, levers attached to said nozzle lips, another lever attached to the outer ends of said levers and to a fluid filled spring bellows attached to said nozzle lips for varying the spacing therebetween, a remotely located fluid filled control bellows, a fluid line connecting said bellows, and means for adjusting said control bellows and indicating the degree of adjustment thereof for adjusting and indicating the degree of adjustment of said nozzle lips of said injector.

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