

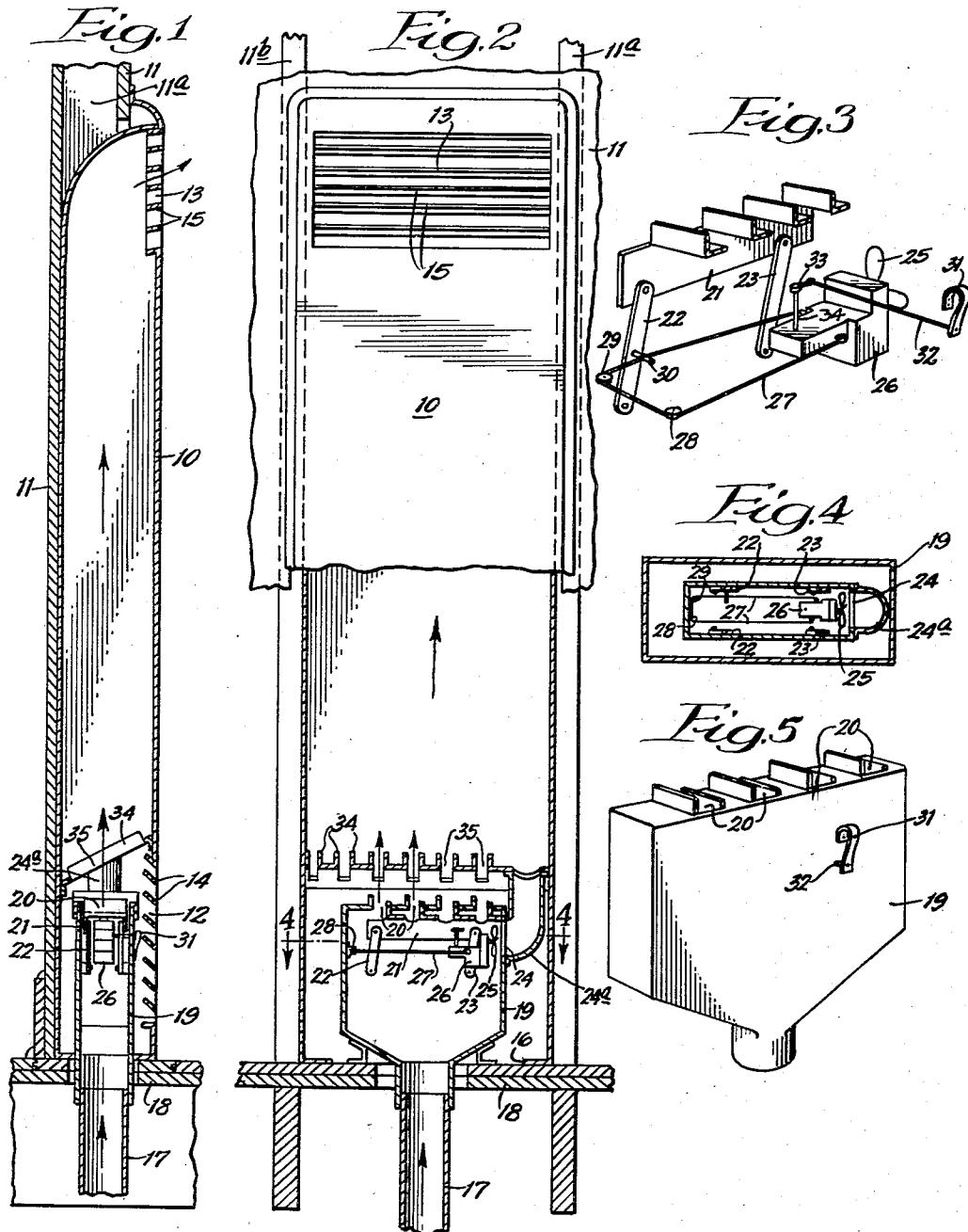
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AUTOMATICALLY CONTROLLED AIR-MIXING CABINET

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AUTOMATICALLY CONTROLLED AIR-MIXING CABINET

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This invention relates to an automatically controlled air-mixing cabinet, which has particular utility for use in supplying either heated or cooled air to rooms of a dwelling house.

So-called air-mixing cabinets are used most commonly in connection with forced air heating systems. The air-mixing cabinets are commonly mounted between the studing in the various rooms of a house, being connected to the furnace by means of air supply ducts. Such cabinets usually are in the form of hollow metal casings with openings at the upper and lower end portions of the front wall. These openings may be provided with a grill for directing the desired flow of air, one of the openings serving as the inlet for room air into the cabinet and the other opening has an outlet for the mixed air from the cabinet to the room. The duct from the furnace discharges the heated air into the cabinet at a point adjacent the room air inlet opening, thereby aspirating the room air into the cabinet and causing it to be mixed with the heated air before it is discharged into the room through the mixed air outlet opening. Cooled air can also be supplied in the same way.

While air-mixing cabinets of the type just described are quite advantageous for achieving and maintaining uniform air temperatures in the rooms of a house, they have not heretofore provided a satisfactory answer to the problem of maintaining approximately uniform air temperatures between different rooms. Consequently, there is a need for providing automatic control means for air-mixing cabinets which will make it possible to achieve this result, or to maintain a selected temperature in a particular room of a house substantially independently of the temperature being maintained in other rooms of the same house.

It is therefore a general object of this invention to provide an automatically controlled air-mixing cabinet which provides a means for overcoming the problems and difficulties and achieving the results which have just been discussed. More specifically, it is an object to provide an automatically controlled air-mixing cabinet which delivers mixed air for either heating or cooling the room in response to the existing temperature of the room air, and which is adapted to terminate or reduce the delivery of the mixed air to the room when a predetermined temperature is reached, thereby preventing overheating in winter and overcooling in summer. Further objects and advantages will appear as the specification proceeds.

This invention is shown in an illustrative embodiment in the accompanying drawing, in which—

Figure 1 is a vertical sectional view of a wall-mixing cabinet embodying the present invention, as it might appear installed in the wall of a room; Fig. 2, a front view of the installed mixing cabinet of Fig. 1, the front wall of the cabinet being partially broken away to disclose the elements of particular importance in connection with this invention; Fig. 3, a perspective view of certain key elements in the cabinet of Figs. 1 and 2, the elements being related to each other as in the assembled structure;

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and Fig. 4, a sectional plan view of the mixing cabinet, taken on line 4—4 of Fig. 2; and Fig. 5, a perspective view of the conditioned air duct extension in the structure of Figs. 1 and 2, showing the temperature-sensing element on the front wall thereof.

This invention is based in part on the concept of controlling the quantity of mixed air discharged into a room from an air-mixing cabinet by means of a damper associated with the outlet from the conditioned air duct into the mixing cabinet, and providing means for automatically positioning this damper in response to the temperature condition of the room air. The novel features, cooperative relationship, and specific functions embraced within my invention, as reduced to practice, will be brought out in the following detailed discussion of the embodiment thereof illustrated in the accompanying drawing.

Looking first at Figs. 1 and 2, there is shown a cabinet 10 which is adapted for the mixing of room air at one temperature with conditioned air at another temperature and then discharging the mixed air into the room at an intermediate temperature. As shown, cabinet 10 is installed in a wall 11 between studs 11a and 11b, the cabinet 10 extending vertically therebetween. On the front wall of cabinet 10 there extends a room air inlet opening 12 and a mixed air outlet opening 13. While the room air inlet is preferably at one end of the cabinet and the mixed air outlet at the other end of the cabinet, as shown, the relative positions of these inlet and outlet openings can be reversed. Usually, however, the wall cabinets will be installed with the room air inlet adjacent the bottom end portion thereof and the mixed air outlet adjacent the top end portion thereof. Also, these openings will usually be provided with grills, such as the grill 14 for opening 12 and the grill 15 for opening 13, in the embodiment shown in the drawing. It will be understood, however, that the present invention can be used in combination with other forms and types of mixing cabinets and air blenders. The recirculated air inlet may be closely associated with the mixed air outlet.

In the bottom wall of the cabinet 10 there is provided a conditioned air inlet 16, which is adapted to communicate with an air duct 17. In the illustration given, duct 17 extends downwardly from floor 18 to a furnace or airconditioning unit (not shown). It will be noted that duct 17 is of relatively small cross-sectional area compared to cabinet 10, thereby being adapted for supplying conditioned air under pressure to the interior of cabinet 10. In other words, the furnace or airconditioning unit would be equipped with a blower for delivering air through distribution ducts therefrom, such as duct 17, at a relatively high pressure and velocity compared to a gravity distribution system.

In the illustration given, duct 17 has an extension 19 within cabinet 10 terminating in a conditioned air outlet 20 adjacent the room air inlet 12. As is preferred, the conditioned air outlet 20 is oriented to discharge the conditioned air in the direction of the mixed air outlet 13, thereby aspirating a stream of room air into the cabinet through room air inlet 12.

There is also provided mechanically operable damper means disposed across the conditioned air outlet 20 for controlling the discharge of conditioned air into cabinet 10. In the illustration given, the damper means consists of a swingably supported plate 21, which is mounted for horizontal or transfer swinging movements on pivot arms 22 and 23. The open position of the plate damper 21 is shown in Fig. 2 of the drawing, and it will be understood that the damper can move to the left as shown in this figure to substantially close the outlet 20 from duct extension 19.

In addition to conditioned air outlet 20, duct extension 19 provides a by-pass opening or outlet 24 through which

a portion of the conditioned air from within extension 19 can pass into cabinet 10. By-pass opening 24 is also arranged so that the portion of the conditioned air discharged therethrough will also tend to aspirate a stream of room air into cabinet 10 through room air inlet 12. An air turbine 25 is arranged in relation to by-pass 24 so that the conditioned air discharged through the by-pass drives the air turbine. With the construction shown, air will be discharged through by-pass 24, thereby operating turbine 25, whenever air is being supplied through duct 17, since the by-pass 24 is open at all times and is not subject to damper control.

Any suitable mechanical means can be provided in accordance with this invention for operably connecting turbine 25 with the damper 21 which is constructed and arranged so that the turbine can selectively shift the damper to any position between its open and closed positions. Since the specific mechanical means for accomplishing this result are not critical for the present invention, and since a variety of such mechanical means are well known in the art, it is not believed that it will be necessary to describe a specific mechanical means in detail. However, in the embodiment shown in the drawing, I have illustrated a mechanical means which was heretofore developed by me, and is described in my Patent No. 2,537,367, issued January 9, 1951. Reference is thereby made to this patent for the specific constructional details. For present purposes it should be sufficient to point out that the rotary motion from turbine 25 is transferred through a gear box 26, and is applied to a cord loop 27 which extends from gear box 26 around pulleys 28 and 29, and is attached to pivot arm 22 by means of a pin 30. With this arrangement, when cord loop 27 is pulled in one direction, damper 21 will be opened, while upon the cord loop being moved in the other direction, damper 21 will be closed. As a substitute actuating means, reference is made to my Patent No. 2,533,175, issued December 5, 1950.

A mechanical selector means is also provided and associated with the mechanical actuating means, as described in my cited Patent No. 2,537,367. This selector means includes a temperature-sensitive element 31, which in the illustration given consists of a hook-shaped bimetallic strip, which has its upper end rigidly connected to the front wall of duct extension 19. The lower free end of strip 31 thus moves toward or away from the front wall of duct 19 as its temperature varies due to the differential expansion and contraction of its metallic components, as is well known in the art. Extending into duct 19 and connected to the free end of strip 31 is a connecting rod 32 which operates a crank arm 33 that is connected to the top of a control shaft 34, as shown more clearly in Fig. 3. In the manner described in detail in my Patent No. 2,537,367, the rotation of control shaft 34 produced by the temperature-responsive movements of strip 31 deflects the selective reversal of the gear drive within gear box 26, so that the rotation of turbine 25 will selectively open and close damper 21 in response to the movements of strip 31. It will be understood that gear box 26 also includes a clutch device which allows turbine 25 to continue to rotate after it has either completely opened or completely closed damper 21, and this is also described in detail in my Patent No. 2,537,367.

For best results, it is preferred that the front wall of duct extension 19, as shown in the drawing, should be spaced from the front wall of cabinet 10 and directly opposite the room air inlet 12. Also, the temperature-sensitive element 31 should be mounted on the front wall of duct extension 19 so that it will be directly in the path of the incoming room air through opening 12 for responding to the temperature of the room air. In this way, the selector means can operate to selectively open and close the damper means automatically at certain predetermined temperature conditions of the temperature-sensitive element and thereby of the room air. It is also

desirable to have at least one other wall, and preferably all of the other walls of the duct extension 19 spaced from the adjacent walls of cabinet 10. This permits the by-pass 24 to be located in one of the other walls of the duct extension 19 than the front wall, while at the same time assuring that the air discharged through by-pass 24 will flow upwardly towards the mixed air outlet 13, rather than coming into contact with the temperature-sensitive element 31. If desired, a small duct 24a can extend from opening 24 in an upwardly direction to minimize mixing of the by-passed air with the air entering opening 12.

As just indicated, it is important that the temperature-sensitive element 31 during all of the time when air is being supplied to duct 17 should be kept in contact with and at substantially the same temperature as the air in the room. To prevent the conditioned air discharged through outlet 20 or the mixed air from coming into contact with the temperature-sensitive element 31, it is desirable to provide a backflow control plate 34 within cabinet 10, as shown more clearly in Figs. 1 and 2. Plate 34 is disposed across cabinet 10 inwardly of but closely adjacent to room air inlet 12 and conditioned air outlet 20, and also inwardly of the temperature-sensitive element 31. Plate 34 is provided with a plurality of openings 35 therethrough which are arranged to promote a unidirectional flow of mixed air towards the mixed air outlet 13, thereby tending to prevent the contacting of the temperature-sensitive element 31 with the mixed air.

The slots of opening 20 preferably should be vertically aligned with slot openings 35. In the illustration given, duct 24a extends through one side of plate 34.

The operation of the air-mixing cabinet of this invention has already been largely indicated, but it will now be briefly summarized for purpose of clarity. Whenever air is being supplied under pressure through duct 17 to duct extension 19, it will flow through by-pass 24, thereby causing turbine 25 to rotate. The by-passed air will also flow upwardly through duct 24a toward the mixed air outlet 13, thereby tending to aspirate some of the room air into cabinet 10 through inlet 12 and over sensitive element 31. Thus, for example, if the room air is at a lower temperature than that desired and heated air is in duct 17, damper 21 will automatically be shifted to its open position by the effect of the room air on temperature-sensitive element 31, the movement of temperature-sensitive element 31 transferred through rod 32 and crank 33 to control shaft 34 which sets the gear within gear box 26 to move cord loop 27 in the necessary direction to open damper 21 by means of the power generated with turbine 25. On the other hand, whenever the temperature of the incoming room air reaches a predetermined maximum temperature, the temperature-sensitive element 31 will have moved sufficiently to reposition shaft 34 for the reversal of the gear drive within gear box 26, and thereby cord loop 27 will be driven in the opposite direction to close damper 21. However, damper 21 will automatically open again as soon as the temperature in the room falls to the minimum temperature for causing element 31 to return to its original position. This is due to the fact that air continues to flow through by-pass 24, driving turbine 25, and aspirating sufficient room air to inlet 12 to keep the temperature-sensitive element 31 directly responsive to changes in room air temperature exteriorly to cabinet 10.

If cooled air is being supplied through duct 17, the action will be reversed. Instead of the slots at 20 being closed by a temperature rise in the room, they are opened. This reversing can also be effected through the action of temperature-sensitive element 31, as described more fully in my Patent No. 2,537,367. Further, the changeover from heating to cooling is automatically effected.

One of the important advantages of the construction just described is that the temperature-sensitive element can be located inside the air-mixing cabinet and need not be visible within the room, while at the same time it remains

fully and directly responsive to changes in room air, whenever forced air is being supplied to the duct communicating with the air-mixing cabinet. Another advantage is that relatively high pressure air is available for driving turbine 25, thereby providing additional power for the mechanical actuation of the damper. Still another desirable feature of the preferred embodiment, as shown in the drawing, is that the temperature-sensing element is protected against coming into contact with the incoming conditioned air or the mixed air.

As can be seen from the above description, this invention is based on a new principle. The heated or cooled air is delivered to the blender at a relatively high pressure, higher than that at which it can be delivered directly to the room. This added pressure is used to operate a damper means to control the quantity of air in response to changes in room air aspirated past a sensing element by flow from the high pressure air system.

While in the foregoing specification this invention has been described in relation to a specific embodiment thereof and many details have been set forth for purpose of illustration, it will be apparent to those skilled in the art that the invention is susceptible to other embodiments and that many of the details described herein can be varied considerably without departing from the basic concepts of the invention.

I claim:

1. In combination with a cabinet adapted for the mixing of room air at one temperature with conditioned air at another temperature and then discharging the mixed air into the room at an intermediate temperature, said cabinet providing a room air inlet, a mixed air outlet, and a conditioned air inlet adjacent said room air inlet, a duct communicating with said conditioned air inlet thereof and being adapted for supplying conditioned air under pressure to the interior of said cabinet, said duct having an extension within said cabinet terminating in a conditioned air outlet adjacent said room air inlet, said conditioned air outlet being oriented to discharge the conditioned air in the direction of said mixed air outlet, thereby aspirating a stream of room air into said cabinet through said room air inlet, mechanically-operable damper means disposed across said conditioned air outlet for controlling the discharge of conditioned air into said cabinet, said duct extension also providing a by-pass for a portion of the conditioned air from within said extension to within said cabinet arranged and disposed adjacent said room air inlet so that the portion of the conditioned air discharged through said by-pass also tends to aspirate room air into said cabinet, air turbine means arranged in relation to said by-pass so that the conditioned air discharged through said by-pass drives said air turbine means, mechanical means operably connecting said means and said damper means, said mechanical means being constructed and arranged so that said turbine means can selectively shift said damper means between its open and closed positions, mechanical selector means associated with said mechanical means and including a temperature-sensitive element positioned within said cabinet in the path of the incoming room air so as to be directly responsive to the temperature thereof, and said selector means operating to automatically and selectively direct the opening and closing of said damper means by said turbine means in response to variations in the temperature of incoming room air at said room air inlet.

2. The combination of claim 1 in which there is also provided within said cabinet a mixed air backflow control

plate, said plate being disposed across said cabinet inwardly of but closely adjacent to said room air inlet and said conditioned air outlet and also inwardly of said temperature-sensitive element, said plate having openings therethrough arranged to promote a unidirectional flow of mixed air towards said mixed air outlet, thereby tending to prevent the contacting of said temperature-sensitive element with said mixed air.

3. The combination of claim 1 in which said duct extension has its front wall spaced from the front wall of said cabinet and facing said room air inlet, said temperature-sensitive element being mounted on the front wall of said duct extension, said duct extension having at least one other wall spaced from the adjacent wall of said cabinet, and said by-pass extending through said other spaced wall.

4. In combination with a mixing cabinet having a room air inlet and a spaced mixed air outlet, said cabinet also providing a conditioned air inlet through the bottom wall thereof, a duct communicating with said conditioned air inlet and being adapted for supplying conditioned air under pressure to the interior of said cabinet, said duct having an extension within said cabinet terminating in a conditioned air outlet adjacent said room air inlet, said duct extension also having a by-pass outlet, adjacent said room air inlet, both said conditioned air outlet and said by-pass outlet being disposed and arranged to direct air toward said mixed air outlet and to aspirate room air into said cabinet through said room air inlet, mechanically-operable damper means disposed across said conditioned air outlet for controlling the discharge of conditioned air into said cabinet, air turbine means arranged in relation to said by-pass so that the conditioned air discharged therethrough drives said air turbine means, mechanical means operably connecting said turbine means and said damper means, said mechanical means being constructed and arranged so that said turbine can selectively shift said damper means between its open and closed positions, mechanical selector means associated with said mechanical means and including a temperature-sensitive element positioned within said cabinet in the path of the incoming room air so as to be directly responsive to the temperature thereof, and said selector means operating to control the operation of said mechanical means so that said turbine means will selectively open and close said damper means automatically at certain predetermined temperature conditions of room air at said room air inlet.

5. The combination of claim 4 in which there is also provided within said cabinet a mixed air backflow control plate, said plate being disposed across said cabinet above but closely adjacent to said conditioned air outlet and also above said temperature-sensitive element, said plate having openings therethrough arranged to promote a unidirectional flow of mixed air toward said mixed air outlet, thereby tending to prevent the contacting of said temperature-sensitive element with the mixed air.

6. The combination of claim 5 in which there is also provided duct means extending from said by-pass outlet to a point adjacent said backflow control plate.

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