Dec. 25, 1956 J. W. McELGIN 2,775,432

APPARATUS FOR AIR CONDITIONING

Filed July 23, 1951 5 Sheets-Sheet 1

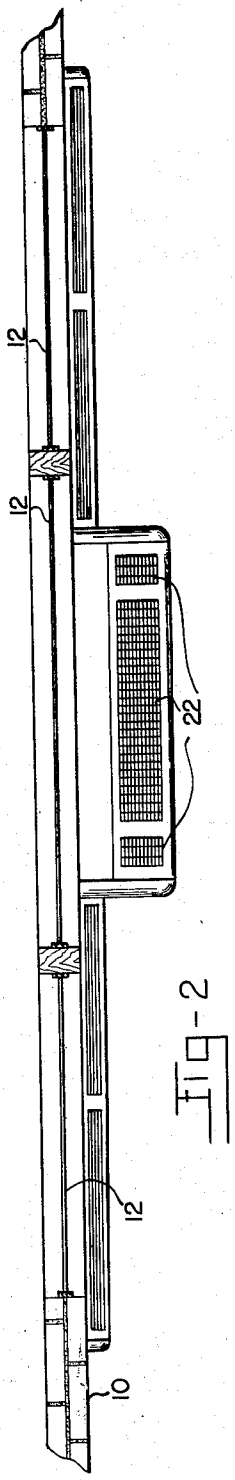


Fig-2

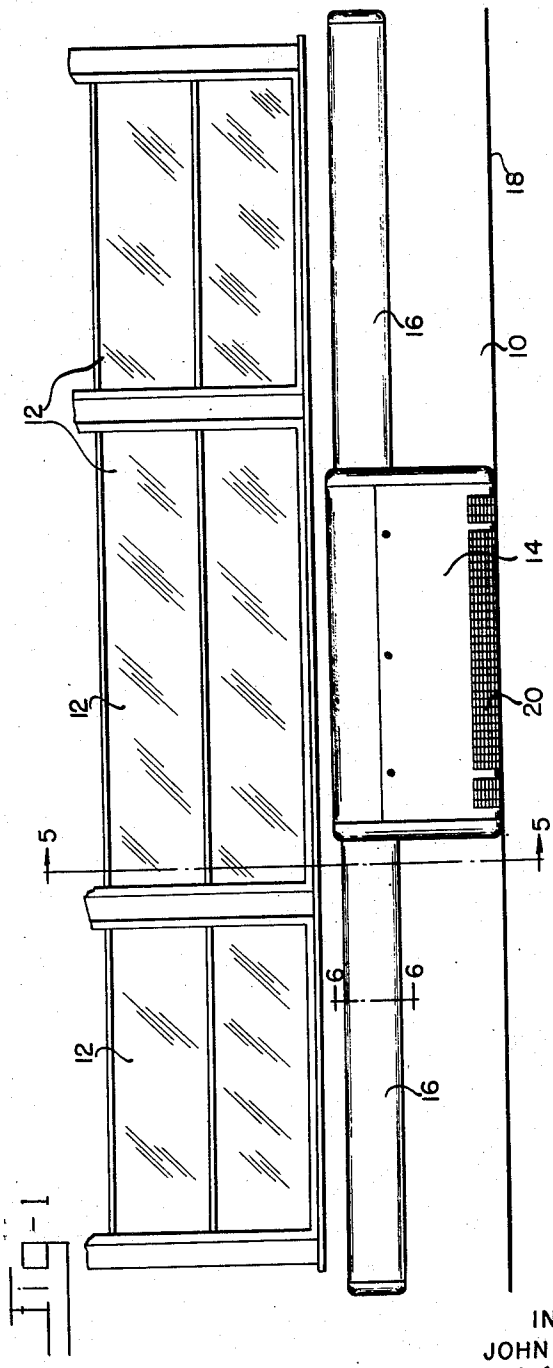


Fig-1

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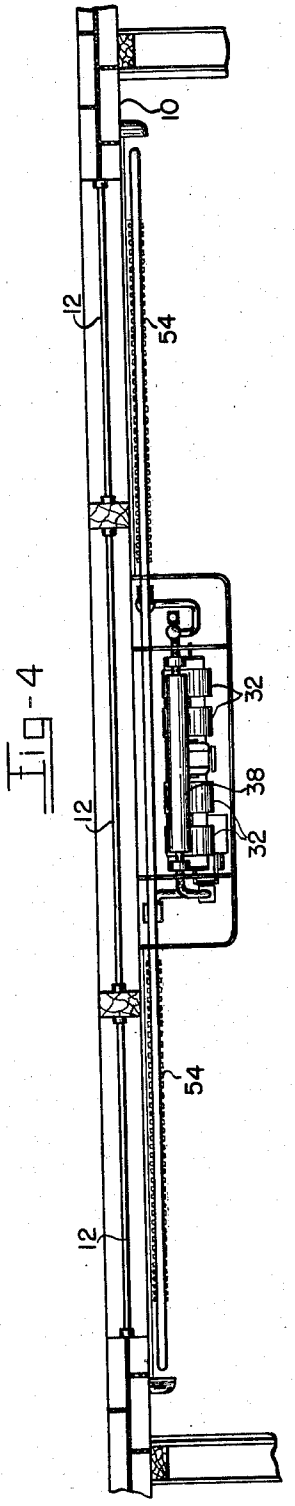


Fig-4

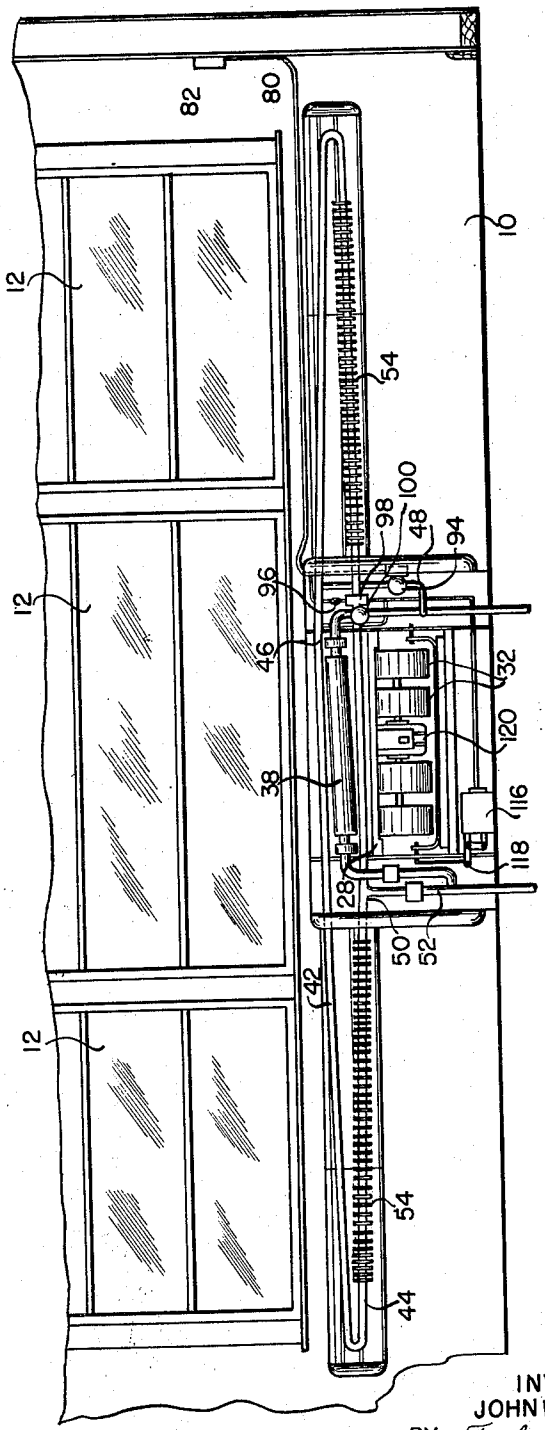


Fig-3

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APPARATUS FOR AIR CONDITIONING

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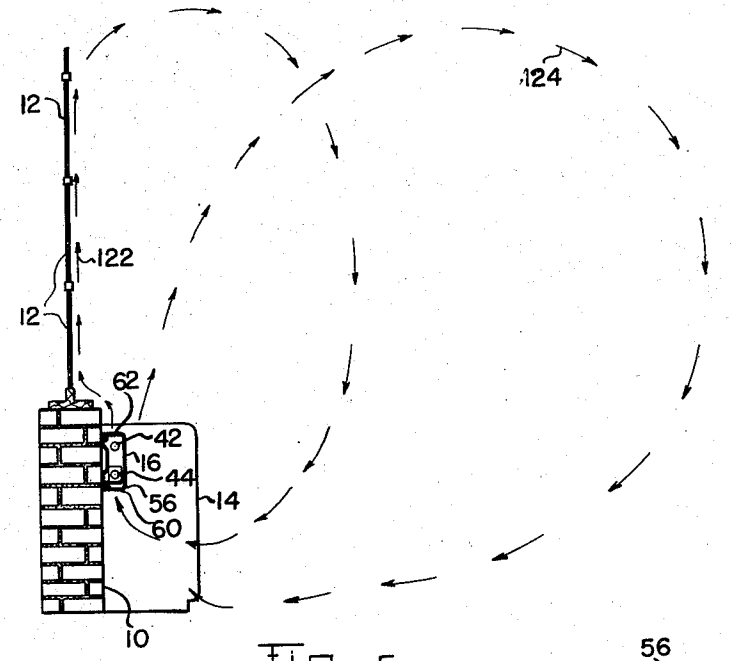


Fig-5

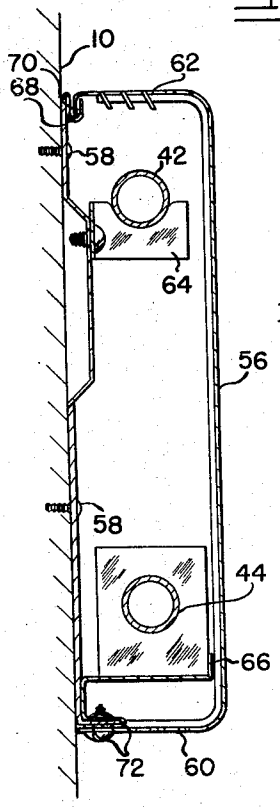


Fig-6

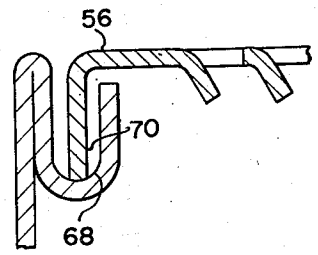


Fig-7

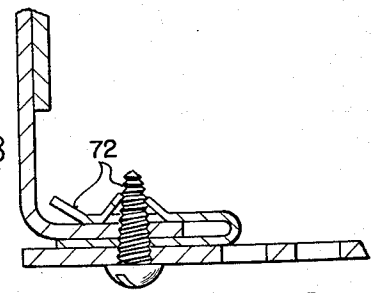


Fig-8

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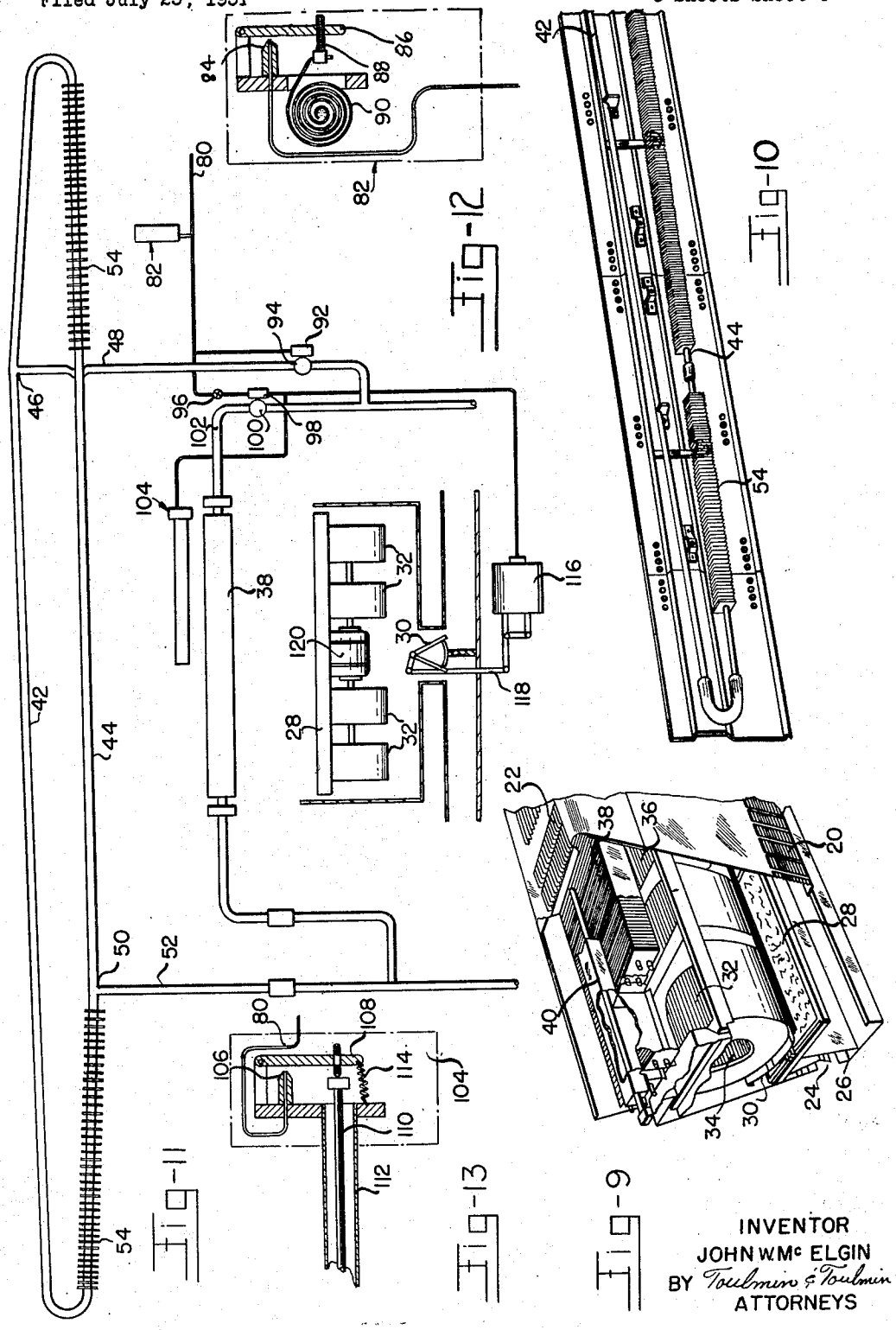


Fig-12

Fig-10

Fig-11

Fig-13

Fig-9

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APPARATUS FOR AIR CONDITIONING

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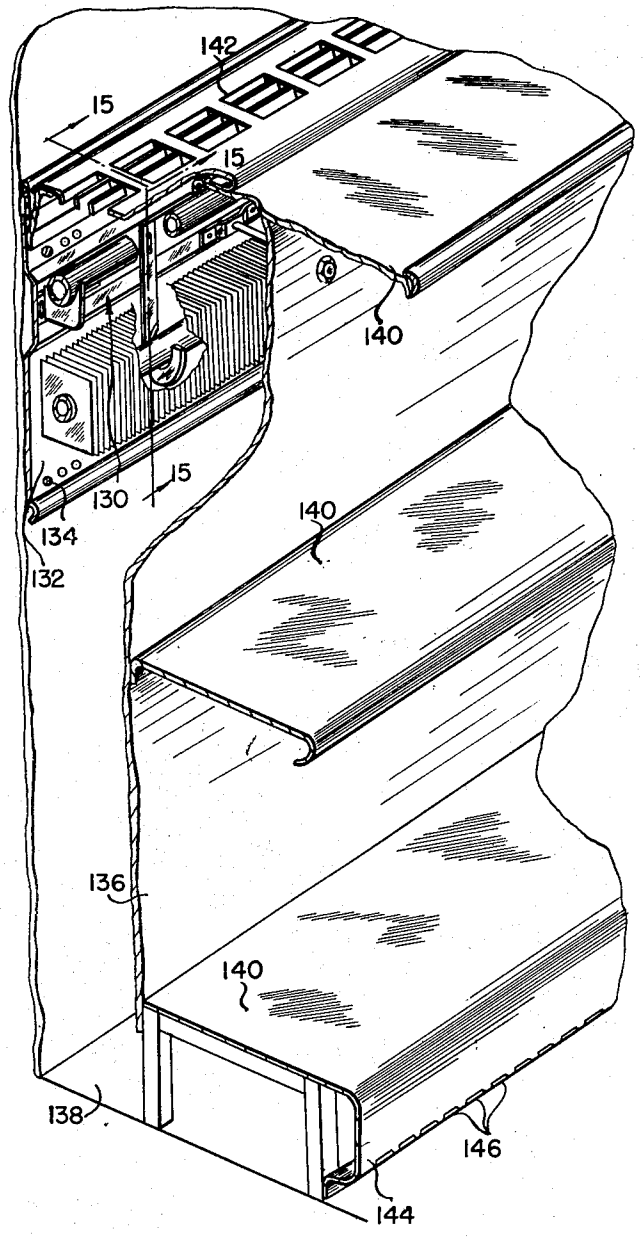
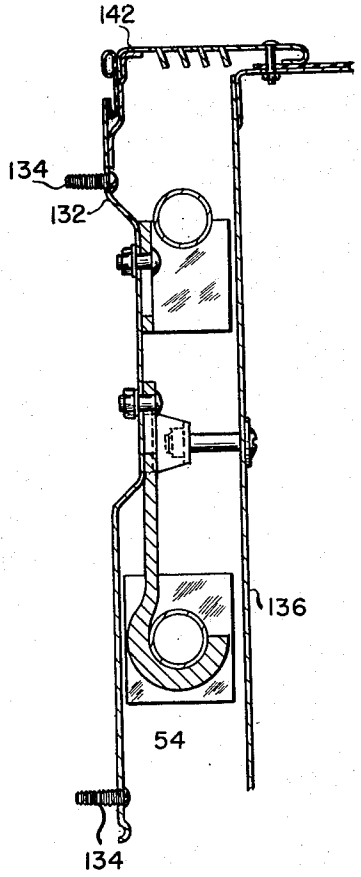


Fig-14

Fig-15



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2,775,432

APPARATUS FOR AIR CONDITIONING

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Application July 23, 1951, Serial No. 238,089
4 Claims. (Cl. 257—137)

This invention relates to air conditioning systems and control arrangements therefor, and to methods of operation thereof.

In the conditioning of the air in enclosures such as rooms, a well-known unit is one of the nature wherein both inside and outside air are blown through heating units into the enclosure being treated. Control exercised over the supply of heating medium to the heating element, and further control exercised over the proportions in which the inside and outside air are admixed enable the general temperature and air conditions of the enclosure to be regulated relatively closely.

The heating element in systems of this nature may be arranged for receiving a supply of refrigerating medium, if desired, so that the unit can either supply heat to the enclosure, can recirculate air in the enclosure and supply no heat thereto, or can exercise a cooling effect on the circulated air.

Units of the general nature referred to above and controls therefor are illustrated in my issued Patents No. 2,216,350 of October 1, 1940, No. 2,268,048, of December 30, 1941, No. 2,286,749 of June 16, 1942, and No. 2,290,985 of July 28, 1942. Also, in my copending application, Serial Number 159,009, filed April 29, 1950, now U. S. Patent No. 2,696,948 of December 14, 1954, a conditioning unit of the same general nature and arrangement is illustrated, and over which arrangement the instant invention represents an advance.

The conditioning units according to the above-identified patents and application, and also as disclosed in the present application, have proved highly satisfactory so far as reguating the temperature and condition of the air in the associated enclosure as regards average conditions throughout. However, in many instances, notably in school classrooms and the like, one, and sometimes two, walls of the enclosure may consist principally of glass. A wall of this nature, especially when it becomes relatively long, as in a modern classroom which may be upwards of fifty feet in length, can create cold downdrafts immediately adjacent the wall which have a tendency to influence the temperature of the enclosure along the wall, even though the average temperature of the enclosure is maintained at the proper degree.

Inasmuch as the air conditioning units referred to are small dimensionally relative to an enclosure for which they have sufficient capacity for conditioning the air, the supply of conditioning air from the units is necessarily discharged into the enclosure into a relatively restricted zone. An arrangement employing one or even several of the units is thus incapable of offsetting the cold drafts from the windows.

These cold drafts can be offset to a certain extent by employing a plurality of the units, but this is impractical because a great deal more conditioning capacity is embodied in an installation of this nature than is necessary.

It has been attempted to counteract the cold drafts from the windows by placing auxiliary convectors or radiators along the wall, or distributing convector units along the wall which will supply heat along the bottoms of the windows and create updrafts which will prevent the cold window drafts from influencing the room temperature along the windowed wall.

Heretofore, combination systems employing unit conditioners with blowers and auxiliary convector units without blowers have not operated particularly satisfactorily

because of the difficulty of so interlocking the units that they will always operate in unison.

Specifically, such systems, and which are known as "split systems," had a tendency toward inefficient operation because it sometimes occurred that the convector units would be supplying heat when the blower unit had gone over into its cooling cycle, thus leaving the units operating in opposition, and therefore, operating inefficiently. In other cases, where arrangements were provided for interrupting the supplied heating medium to the convector units at a predetermined temperature in the enclosure, it was found that the convector units actually were only effective during the initial warming up period for the enclosure, and thereafter became idle with all the conditioning being done by the blower unit. This, of course, left the above-mentioned cold window drafts free to upset conditions in the enclosure along the wall.

In most instances heretofore employing convector units, difficulty was experienced in providing for uniform dissipation of heat along the convector units, thereby leading to a portion of the cold window drafts being counteracted and other portions not being counteracted.

Having the foregoing in mind, the primary object of the present invention is to provide an air conditioning arrangement provided with blower type conditioning units and auxiliary convectors, such that the entire enclosure being treated by the system is at a substantially uniform temperature at all times, even along cold walls, and wherein the system operates efficiently under all conditions.

A particular object is the provision of a combination of a blower type conditioning unit and elongated convectors in which the blower type unit and convectors are prevented from ever operating in opposition.

A still further object is the provision of a convector unit of the nature described characterized in that the dissipation of heat along the length of the convector unit is substantially uniform.

A still further object is the provision of a control system for integrating the operation of a split type air conditioning system having a main blower type unit and auxiliary convector units, such that the units are always working in unison and never in opposition.

Another object is the provision of a method of operating a split type air conditioning system of the nature referred to.

A particular object is the provision of a split type air conditioning system and a control means therefor which is relatively simple and therefore inexpensive to install and easy to maintain in operating condition at all times.

These and other objects and advantages will become more apparent upon reference to the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a view looking in elevation at a conditioning arrangement according to this invention arranged along the windowed wall of an enclosure;

Figure 2 is a plan view looking down on top of the unit of Figure 1;

Figure 3 is a view like Figure 1 but showing the unit with the front covers removed from the blower unit portion and from the convector unit portion;

Figure 4 is a view looking down on top of the unit of Figure 3 and with the covers removed;

Figure 5 is a vertical sectional view indicated on line 5—5 of Figure 1 and showing in general the air currents which obtain from the operation of the blower unit and convector unit and the manner in which the heated air from the convector unit blankets the windows;

Figure 6 is a vertical sectional view indicated by line 6—6 on Figure 1 and is taken through the convector unit;

Figures 7 and 8 are fragmentary views showing de-

tails of construction in connection with the convector unit;

Figure 9 is a perspective view partly broken away of the blower unit of the system showing the arrangement therein of the heating coils, blower, filter, inside and outside air inlets, and damper;

Figure 10 is a sectional perspective view showing the convector unit on one side of the blower unit;

Figure 11 is a diagrammatic view showing the arrangement of the blower and convector units together with the control system for controlling the supplying of heating medium to the units and for controlling the position of the damper that regulates the proportions of inside and outside air delivered by the blower unit;

Figure 12 is a sectional view showing details in connection with the room thermostat that exercises general control over the system;

Figure 13 is a view similar to Figure 12 but showing the thermostat that is positioned in the air stream from the blower unit of the system and which exercises secondary control over the system, particularly in connection with the motor that regulates the position on the damper of the blower unit;

Figure 14 is a fragmentary perspective view illustrating the manner in which the convector units can be embodied in a cabinet or bookshelf arrangement; and

Figure 15 is a sectional view indicated by line 15—15—15 on Figure 14.

Referring to the drawings somewhat more in detail, and in particular to Figures 1 through 8, there is illustrated an enclosure to be conditioned comprising an outer wall 10 having windows 12 therein. Arranged along the windowed wall 10 in accordance with this invention, is one or more principal blower type conditioning units, as at 14. Also provided in association with the unit or units 14 are the auxiliary convector units 16, extending along the wall 10 beneath the windows 12.

As will be seen in Figures 1 through 5, the principal unit 12 rests on the floor 18 of the enclosure, and the convector units 16 are suspended from the wall of the enclosure immediately beneath the lower edges of the windows.

The units 14 comprise the grill arrangements, as at 20, along their lower inside walls for the supply thereto of the air from within the enclosure that is to be recirculated through the unit. Each of the units 14 also comprises grill-like openings, as at 22, in the upper surface thereof through which the treated air is discharged.

As will best be seen in Figure 9, each of the units 14 likewise comprises an opening 24 through which air from the outside of the building is drawn into the unit. The openings 20 and 24 are separated by a partition 26, and immediately above partition 26 is disposed a filter means 28 in the usual manner for filtering the air passing through the unit. A damper 30 is pivotally mounted immediately above the filter and cooperates with partition 26 which extends through the filter to the periphery of the damper so that swinging movements of the damper will control the proportions of inside and outside air drawn into the unit 14.

Immediately above damper 30 is positioned the blower 32 of the unit, and which may comprise a single rotary blower element or a plurality thereof, comprising inlets 34 that receive the air to be blown through the unit. The blower, or blowers, discharges through outlet 36 upwardly through the finned heating element arrangement 38, and the air that passes through the heating element then issues through the discharge openings 22 at the top of conditioning unit 14.

Turning now to the convector unit arrangement 16, this will be seen in Figures 3, 4, 10, and 11 to comprise interconnected upper and lower reaches of conduit, as at 42 and 44, respectively. The upper reach 44 has a high point at 46 to which a supply conduit 48 is connected, whereas the lower reach 44 has a low point at 50 to which the discharge conduit 52 is connected.

The described arrangement assures that steam will be admitted to the convector unit only at the higest point thereof and will move therefrom toward the lowest point of the convector, meanwhile condensing to water, and all of the water condensed in the convector unit will flow therefrom at the lowest point. Furthermore, the portions of the lower reach of the convector unit 16 lying outside of the blower conditioning unit 14 are finned, as indicated at 54. This finned arrangement insures that all of the steam in the lower reach of the convector unit will be condensed into water, because the coolest air engages the fins and also insures a relatively uniform dissipation of heat along the entire lower reach of the convector.

The upper unfinned reach of the convector supplies additional heat to the air and serves also to enhance the speed at which the air passes through the convector.

As will best be seen in Figures 5 and 6, the convector conduit is mounted within an enclosure 56 adapted for being secured against wall 10, as by mounting screws 58. Enclosure 56 has openings 60 in the bottom thereof and grill-like openings 62 in the top thereof. Spaced bracket means 64 support the upper reach 42 of the convector at the proper elevation and are arranged to give the desired fall to the said upper reach, whereas other bracket means, as at 66, similarly support the lower reach 44 of the convector.

For convenience in installing and servicing the convector unit, a cover 56 may advantageously be arranged, as illustrated in Figures 6 through 8, wherein it will be seen that a groove 68 is formed on the back wall of the convector unit for receiving the turned-down edge or tongue 70 extending along the rear edge of the upper wall of the housing or cover 56. The rear edge of the lower wall of the cover or housing is detachably connected as by screw and nut 72 to the forwardly turned lower edge of the back supporting plate of the convector.

Referring now to Figure 11, the blower conditioning unit and the convector unit are shown more or less diagrammatically in association with the control system which controls their operation. In Figure 11 the control system comprises a conduit 80 which is supplied with fluid at a predetermined pressure from a source not illustrated. Ordinarily, the fluid employed is air, but it will be understood that the control system could be operated hydraulically or electrically, or in other manners well-known in the art, if desired.

Conduit 80 leads to a room thermostat, generally indicated at 82, and which comprises a bleed port 84, as is better illustrated in Figure 12. Port 84 is adapted for being variably restricted by baffle 86 that is adjustably connected, as by screw 88, with the movable end of a bimetallic strip 90. Strip 90 is so arranged that it will move due to increasing temperatures in the room in a direction to restrict bleed port 84, and will move in the opposite direction when the temperature decreases.

Conduit 80 on the downstream side of thermostat 82 is connected with the valve operator 92 associated with control valve 94 in conduit 48 that regulates the supply of heating medium to the convector unit.

Conduit 80 also leads through a restrictor valve 96 to the operator 98 associated with control valve 100 in supply conduit 102 leading to the heating unit 38 of the blower conditioning unit 14.

On the downstream side of operator 98, conduit 80 is connected with the air stream thermostat 104, which is better illustrated in Figure 13. This thermostat also comprises a bleed port 106 adapted for being variably restricted by baffle 108. Baffle 108 bears on the end of a rod 110 within hollow sleeve 112 and a spring 114 continuously holds the baffle plate and rod in engagement. The arrangement is such that sleeve 112 will expand when the temperature to which it is exposed increases, whereas rod 110 is substantially insensitive to temperature changes, whereby the said increasing temperature brings about greater restriction of bleed port 106.

Similarly, reduction in the temperature to which the thermostat is exposed will cause construction of sleeve **112** leading to reduction in the restriction of bleed port **106**.

Conduit **80** from its connection with thermostat **104** leads to damper motor **116** connected by means of linkage **118** with damper **30**, whereby the position assumed by the damper is determined by the pressure in conduit **80**, as brought about by the thermostats **82** and **104**.

In operation, starting with a cold room, steam, or other heating medium, is supplied to the blower unit **14** and the convector unit through their open supply valves **94** and **100**. Damper motor **30** at this time is positioned to introduce the minimum amount of outside air, and the drive motor **120** associated with the blowers in unit **14** is energized.

As the room commences to warm up, thermostats **82** and **104** will respond by moving their respective baffles toward their respective bleed ports, thereby to throttle the discharge of air from conduit **80** and to cause a build-up of pressure therein. When the pressure in conduit **80** upstream of restrictor **96** reaches a value of, say, eight pounds per square inch, the valve **100** associated with heater element **38** of conditioning unit **14** is closed by operator **98**. At this time, the damper remains in position to admit minimum outside air, and valve **94** for the convector unit remains open.

As the room temperature increases further, the room thermostat gradually closes still further, and when the pressure in conduit **80** reaches about twelve pounds per square inch, valve **94** in supply conduit **48** leading to the convector unit is closed by its operator **92**.

At this time the damper still remains in its original position, wherein a minimum of outside air is introduced into unit **14**.

A still further increase in room temperature will bring about further restricting of the bleed port of thermostat **104**, thereby increasing the pressure to damper motor **116**, whereupon the damper motor will actuate the damper to admit more outside air into the enclosure.

From the foregoing, it will be observed that the air conditioning unit according to my invention is so arranged and controlled that the convector unit or units, as the case may be, is operative throughout the time that the main blower unit or units operate to supply heat to the enclosure, and this prevents the condition arising that was referred to previously, where the heating load for the enclosure was carried by the blower unit, with the convector units running idle.

The net result is to provide for more uniform temperatures throughout the enclosure, while the portion of the enclosure adjacent the cold wall is blanketed and insulated from the effects of loss of heat through the wall.

A graphic indication of the manner in which the combination of the convector unit and the blower unit cooperate in warming an enclosure is illustrated in Figure 5. Figure 5 shows, by means of arrows **122**, the general path that the air takes that is circulated by the convector unit, whereas the arrows **124** generally indicate the path taken by the air that is blown through the main unit **14**. It will be understood that the diagram of Figure 5 is necessarily oversimplified, but it does serve to indicate in general the cooperation between the two units.

In Figures 14 and 15 there is shown a somewhat modified arrangement for the convector unit, wherein the said unit, generally indicated at **130**, is mounted on some suitable sort of back plate arrangement **132** adapted for being retained in position on a wall by screws **134**. Arranged imediately in front of the convector is a vertical wall panel **136** terminating above the level of floor **138**. Panel **136** serves as a back for a cabinet arrangement including a plurality of shelves **140**, the upper of which may be substantially coplanar with the grilled cover plate **142** immediately above the convector, and the lower of which may be formed downwardly, as indicated at **144** to the floor and may comprise apertures **146** for admitting the air that is to be warmed by the convector. The Figures 14 and 15 arrangement presents the advantage that the convector is completely concealed, and also establishes a relatively elongated flue for guiding the air to the convector from immediately above the floor and for distributing the air along the convector.

The controls to be associated with the Figures 14 and 15 convector can be identical with the controls described in connection with the previous modification.

It is to be understood that in either of the convector arrangements illustrated, the results obtain that there is a uniform discharge of uniformly warmed air along the entire length of the convector whenever there is a supply of said medium to the convector. I have found in carrying out my invention that a supply of heating medium to the convector sufficient to produce an output of four hundred and fifty B. t. u. per foot is adequate to create an effective heat blanket to counteract even severe conditions.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions, and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. In combination, a blower-type air-conditioning unit adapted for positioning along a wall of a room, said unit comprising a casing having top, bottom, front and end walls, an air inlet adjacent the bottom of said front wall and air outlet means in said top wall and a first heating element therebetween and a blower to blow air from said inlet to said outlet, an elongated convector unit longer than said blower-type unit casing extending laterally outwardly from one of said end walls of the blower-type unit casing and positioned on the face of the wall, said convector unit comprising a housing with a smaller cross-sectional area than said blower-type unit casing with the bottom face spaced above the floor of the room and having openings in the top and bottom faces thereof, a second heating element comprising a closed loop with the upper reach thereof positioned between said first heating element and said air outlet with a portion of said loop extending through said one of said end walls of said casing into said convector unit and spaced from the interior of said convector housing, and common supply and common discharge conduits in said blower-type unit casing for circulating a heating medium to both of said heating elements.

2. In the combination as claimed in claim 1, with an elongated convector unit extending laterally outwardly from each of said end walls of the blower-type unit casing.

3. In the combination as claimed in claim 1, with said air outlet means comprising apertures directing the air flow from the casing inwardly toward the wall against which the unit is positioned.

4. In the combination as claimed in claim 1, with the lower reach only of said second loop heating element being finned within the convector unit and the upper reach being unfinned to increase the speed of air passing through the convector unit.

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