April 4, 1961 H. C. BIERWIRTH ET AL 2,977,870

AIR DISTRIBUTION SYSTEM FOR HEATING, COOLING AND VENTILATING

Filed April 21, 1958 4 Sheets-Sheet 1

Fig. 1

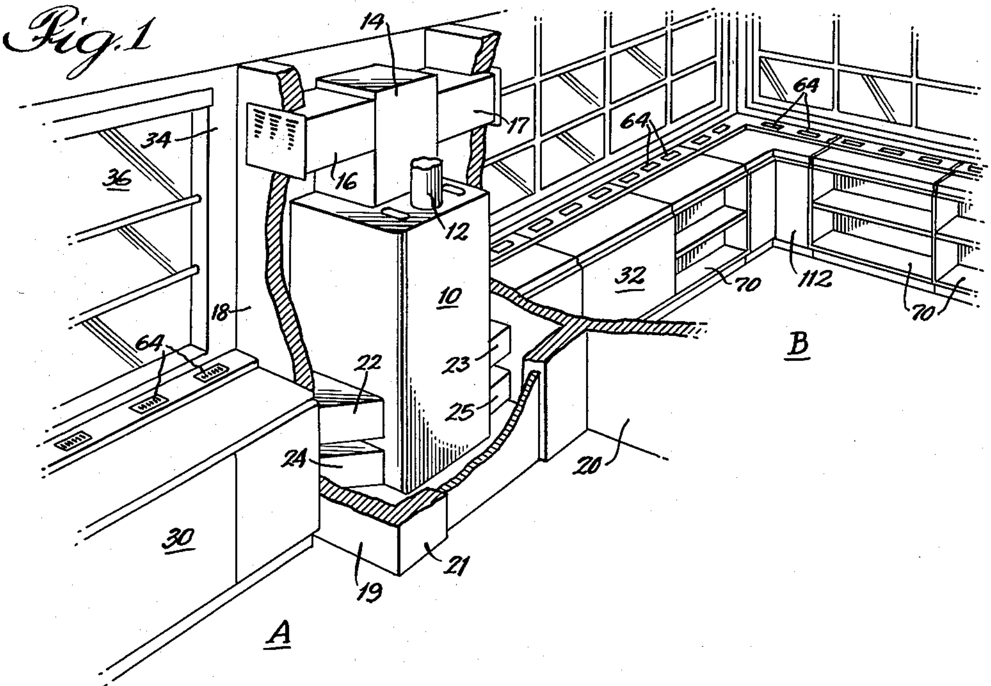
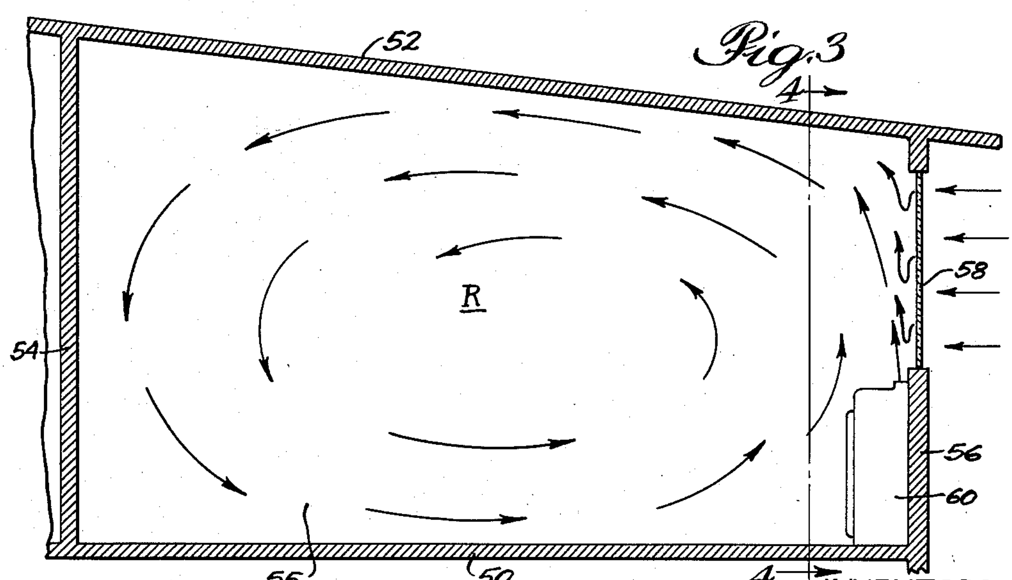


Fig. 3



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AIR DISTRIBUTION SYSTEM FOR HEATING, COOLING AND VENTILATING

Filed April 21, 1958 4 Sheets-Sheet 2

Fig. 4

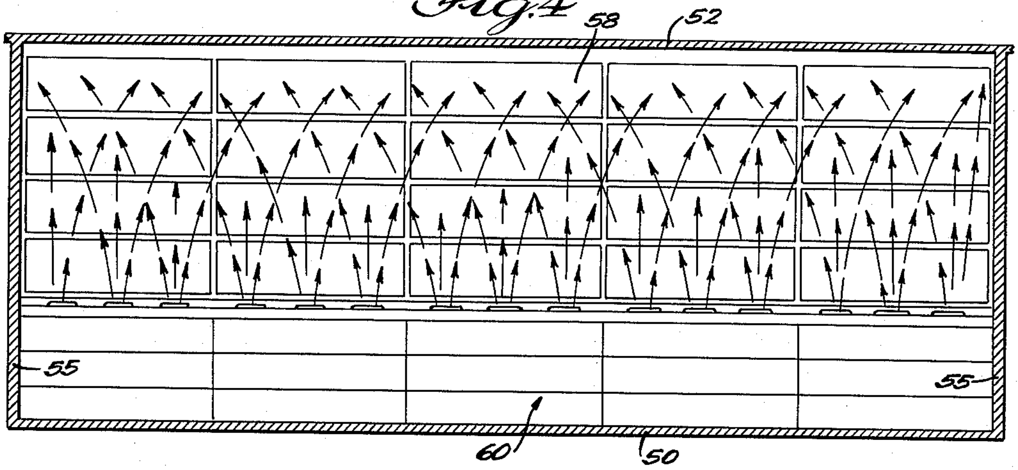
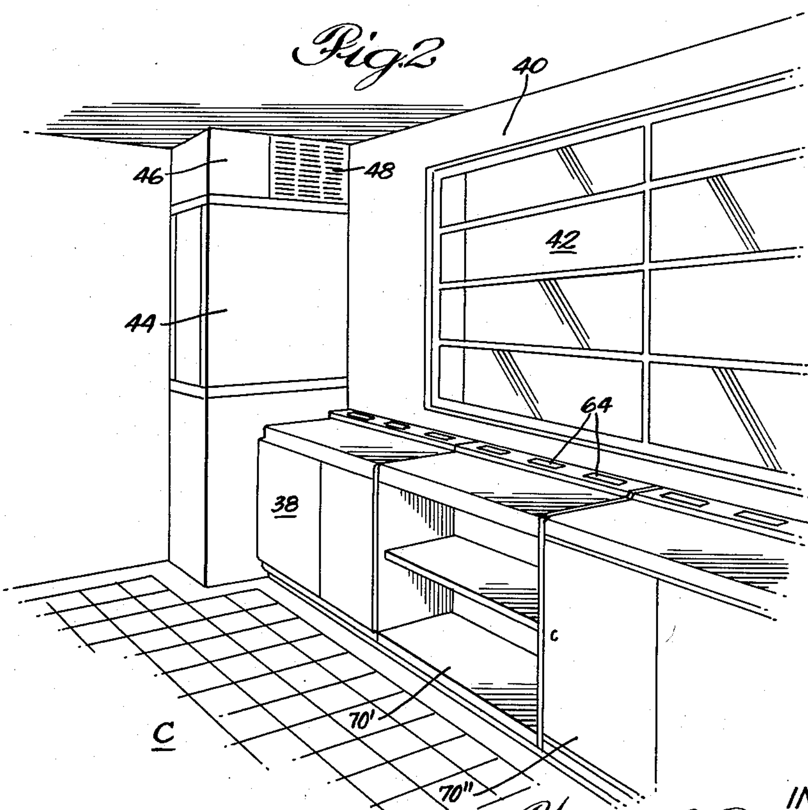


Fig. 2



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AIR DISTRIBUTION SYSTEM FOR HEATING, COOLING AND VENTILATING

Filed April 21, 1958 4 Sheets-Sheet 3

Fig. 5

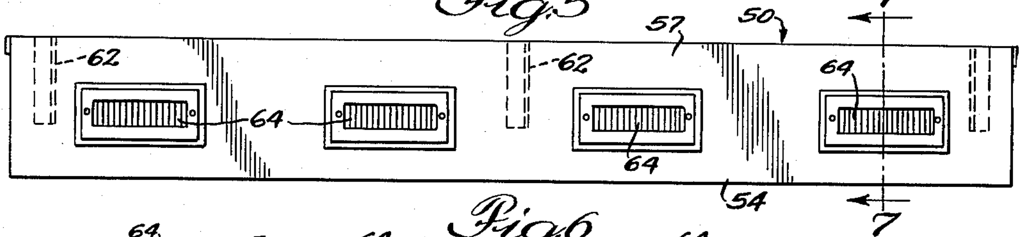


Fig. 6

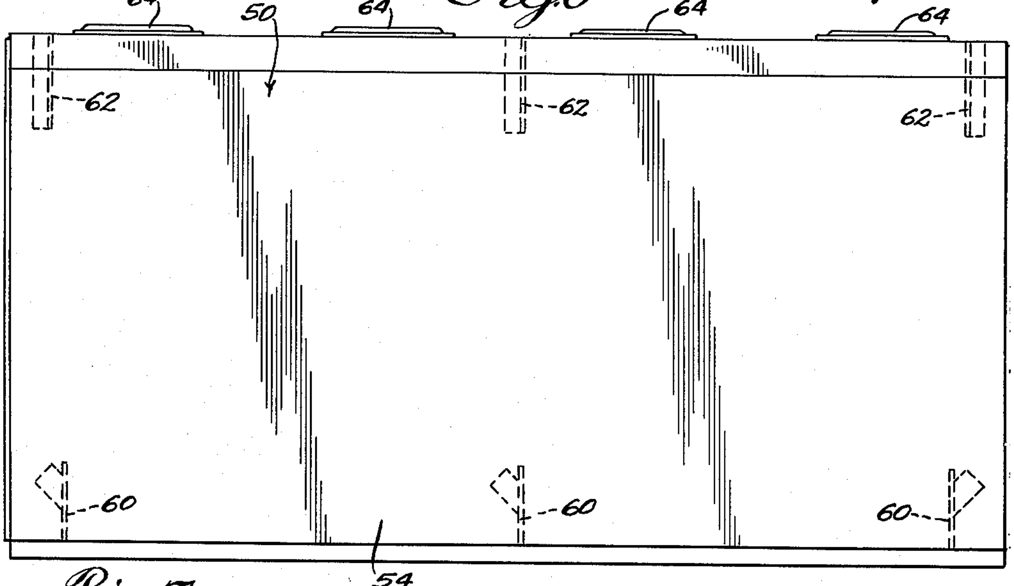


Fig. 7

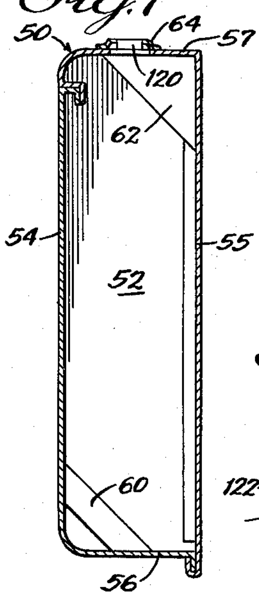


Fig. 11

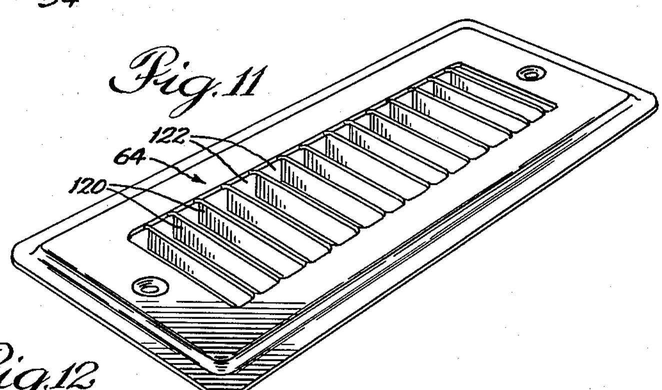
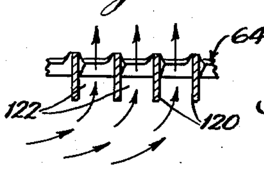


Fig. 12



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Filed April 21, 1958 4 Sheets-Sheet 4

Fig. 8

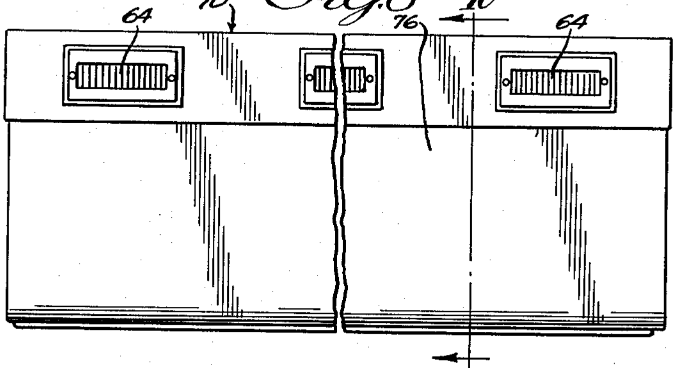


Fig. 10

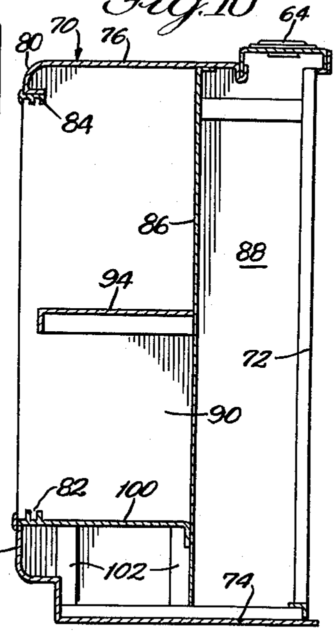
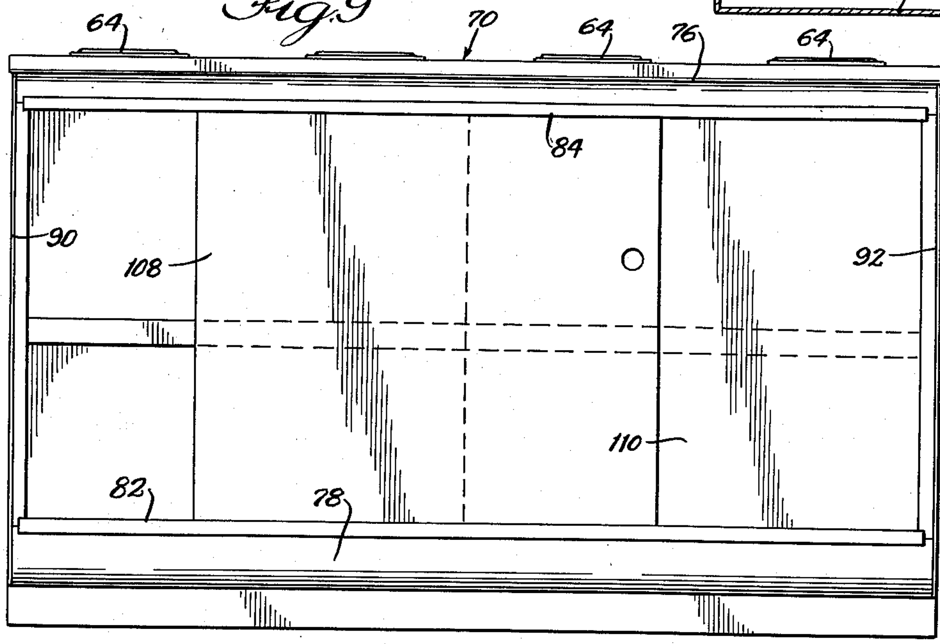


Fig. 9



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United States Patent Office

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1

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AIR DISTRIBUTION SYSTEM FOR HEATING, COOLING AND VENTILATING

Henry C. Bierwirth and Norman L. Rutgers, Marshalltown, Iowa, assignors to Lennox Industries, Inc.

Filed Apr. 21, 1958, Ser. No. 729,872

2 Claims. (Cl. 98—40)

This invention relates generally to an air distribution system for heating, cooling and ventilating. More particularly, this invention relates to a novel apparatus and method for introducing a "curtain" of conditioned air into an enclosed space and effecting a particular pattern of air circulation and temperature regulation therein.

The conditioning of the atmosphere within school rooms, and similar enclosures which present complex and highly variable requirements for heating, cooling and ventilating represents a difficult problem for which presently known air systems fail to provide an adequate solution. The particular difficulties encountered in schoolhouse heating, cooling and ventilating will be discussed in detail so as to present a full background for the typical requirements which are efficiently fulfilled for the first time by the present invention. It will be understood, however, that the present invention is not limited in any way solely to schoolhouse structures, but is fully adapted for use in the air heating, cooling and ventilating of any enclosed zone which presents a variety of complex and changing conditions affecting the demands for conditioned air within that zone.

Architects, contractors and air treatment engineers recognize that classrooms frequently require cooling even when the outdoor weather is extremely cold. The cooling of such rooms frequently presents a far more challenging problem than does their heating. Body heat from the students and other persons present in the classroom, lighting fixtures, and radiant heat from the sun as it strikes the walls, windows and roof, frequently produce "heat gains" within the room which exceed the normal transmission or "heat losses" from the room to the cold outdoor weather. The number of occupants in classrooms, their physical size, their bodily activities, and their lighting requirements vary greatly from room to room within a schoolhouse and within each room during the course of a day. For example, small children of the lower class grades transmit relatively lower total quantities of heat to the room atmosphere than do the older and larger children of the upper class grades. There are also variations from class to class in the amount of lighting required, dependent upon the reading activities of the various grade levels. Such factors as recess and lengths of class periods also result in a variety of different and changing conditions of heat load within various classrooms. Substantial heat is often needed in order to effect initial warming of a classroom during the early morning hours prior to the arrival of the students at the beginning of a school day. After the arrival of the students, the body heat load within the room is often supplemented by direct sunlight striking against the building as the daylight hours progress. In some instances, one or several of a large number of total classrooms may be subjected to use during the evening hours for adult community activities and the like, requiring the maintenance of proper temperature conditions within only one or a few of a large number of classrooms within a given schoolhouse. It will be apparent, therefore, that conditions within any given classroom may change in a matter of minutes from no heat being required, to heat being required, to cooling being required, and such varying conditions within one room may be entirely different from the varying conditions and requirements of an immediately adjacent room. The maintenance of comfortable temperatures within every room is a matter of great importance, and it is necessary to effect the controlled distribution of conditioned air regardless of the outside weather conditions.

2

Although the utilization of upwardly moving patterns of air flow has been known in the past in connection with steam radiators and perimeter or baseboard heating systems, such air patterns are comprised of air which is relatively warmer than the room air. Such warm air has a tendency to rise by natural convection, and little or no direction need be imparted to such air as it is introduced into the room. When, however, the air to be introduced into the room is cold outside air or refrigerated air, or even a relatively cool mixture of such air with heated or recirculated room air, the problems encountered by the natural weight and circulation characteristics of such air is entirely different from that encountered with the convection circulation of relatively warm air. In the case of the relatively cold air, its inherently greater weight or density causes it to effect a natural falling toward the floor. The most common type of prior combination heating and ventilating system has been the "unit ventilator" type of installation. The unit ventilator usually is located at the center of the most exposed wall of the room, and contains heating coils, fans and filters. Such units discharge air upwardly over those immediately adjacent wall surfaces which the impelled air is capable of reaching. Such central positioning along the length of relatively large outside walls, however, has resulted in only a minor central portion of cold outside wall surfaces being properly covered by the flow of incoming air. Room air chilled by the cold outside wall drops downwardly off the the un-reached wall surfaces, creating drafts, cold floors, and general discomfort for the students or occupants near those portions of the wall that are not blanketed by the centrally located unit ventilator. In order to correct such shortcomings of the unit ventilator type of system, the obvious solution suggested by the prior art has been to add "wings" or air duct extensions at each side of the centrally located unit ventilator. Such wings permit an upward moving flow of air to be discharged along a greater length of the outside wall. Even though wing extension ducts have permitted some increase in the area of air distribution along the outside wall, the overhelming major portion of the discharge air moves directly upwardly from the unit ventilator itself, and only substantially smaller amounts of air are actually discharged from the wing units. Air velocities are not even and uniform along the full length of such distribution systems, and there is not sufficient "throw power" to permit the use of very cool air to be discharged for cooling purposes in the room.

It is critical and essential, therefore, that air, whether relatively warmer or colder than the room air, be introduced into the room in a carefully predetermined directional pattern and with a proper "throw power" or motive force so that it will move from a perimeter opening in a desired circulating pattern. The introduction of air through the duct systems of previously known combination heating, cooling and ventilating systems would necessarily result either in mere natural convection of relatively warm air, and consequent "hot layers" in the upper heights of the room, causing "hot zone" discomfort of the heads of occupants, or rapid falling of relatively cold air immediately adjacent the perimeter openings, and consequent excessive cooling of the floor areas immediately adjacent the outside wall without adequate cooling and circulation of the entire room, again causing isolated temperature extreme zones and occupant discomfort.

In order to achieve the desired results which characterize the contributions of the present invention over prior known systems, it is essential that vent openings be particularly located along the full length of the most exposed classroom outside wall or walls. Such openings must be particularly sized, shaped, and oriented so as to achieve equal and uniform velocity at every vent opening along its entire length. At the same time a sufficient velocity pressure must be maintained so as to develop an adequate static pressure at the remote end of the duct system, while insuring that such velocity pressure is not so high as to reduce the discharge velocity through the vent openings at the inlet end of the duct system or risk the aspiration of room air into the vent openings at that end of the duct system.

Outdoor air provides an economical source of relatively cool air for effecting room cooling during all weather conditions in which the outside air temperature is lower than a comfortable air temperature desired inside the room. The proper heating, cooling and ventilating system for a schoolhouse classroom is one which can very quickly bring in enough outdoor air, when needed, to offset the internal heat gains within the room and keep the room temperatures from overunning a thermostat or other control setting. Such a proper distribution system, therefore, must be one that is capable of handling either heated air or cool air in a manner that will provide absolutely even and uniform distribution of air velocity throughout the room. Such a system must achieve this uniformity of air distribution without allowing cool air to drop downwardly over occupants of the room located near the air supply openings.

It is the primary object of this invention, therefore, to provide a distribution system for mixing conditioned air with room air and effecting a novel pattern of air circulation within the room so as to maintain a pleasant and refreshing movement of air at the correct temperature without drafts and without localized cold or hot areas.

It is another object of this invention to provide a novel duct system for effecting the introduction of an upwardly moving "curtain" of air over the interior surfaces of the outside wall and windows of a room, so as to counteract any adverse drift of extreme temperature air along these surfaces and to thereby maintain a predetermined even circulation of conditioned air in a uniform pattern throughout the room.

It is a further object of this invention to provide a novel method of air control, distribution, and circulation within a room by means of an upwardly moving curtain of conditioned air.

Further objects and advantages of this invention will become apparent as the following description proceeds, and the features of novelty which characterize this invention will be pointed out with particularly in the claims annexed to and forming part of this specification.

A preferred embodiment of the invention is shown in the accompanying drawing, in which:

Figure 1 is a perspective view of a typical two-classroom "remote" installation of the air distribution ducts of the present invention.

Figure 2 is a perspective view of a typical single-classroom "in-the-room" installation of the air distribution ducts of the present invention.

Figure 3 is a diagrammatic vertical cross-section of a typical classroom, illustrating the pattern of air circulation within the room in accordance with the air "curtain" principles of the present invention.

Figure 4 is another diagrammatic vertical cross-section, taken substantially as indicated along the line 4—4 on Figure 3.

Figure 5 is a top plan view of an air distribution "wall duct" unit constructed in accordance with the present invention.

Figure 6 is a front elevational view of the unit of Figure 5.

Figure 7 is a vertical cross-sectional view taken substantially as indicated along the line **7—7** on Figure 5.

Figure 8 is a top plan view, partly broken away, of an air distribution "shelf duct" unit constructed in accordance with the present invention.

Figure 9 is a front elevational view of the unit of Figure 8.

Figure 10 is a vertical cross-sectional view taken substantially as indicated along the line **10—10** on Figure 8.

Figure 11 is a perspective view of a single louver plate as employed by the duct units of the present invention.

Figure 12 is a fragmentary vertical cross-section view showing the air-directing surfaces of the individual louver elements of the plate of Figure 11.

The average classroom invariably has at least one wall which contains a relatively large glass or window area. In cold weather, the outside wall and the windows become quite cold on their inside surfaces. As room air circulates into contact with such a wall and its windows, the cold inside surfaces effect a cooling action resulting in a substantial lowering of the temperature of that air. As the air is cooled, it becomes relatively more dense than the adjacent warmer air and tends to "fall" downwardly toward the floor. This natural heat transfer phenomenon creates a relatively large zone along the outside wall which is too cool for comfortable occupancy, and which causes persons located in this area to experience a sensation comparable to a cold downward draft upon their heads. Any change in thermostat settings to render such areas of the room more comfortable obviously results in the major room areas receiving excessive amounts of heated air. This results in an increase in circulation velocity and a further air imbalance with increased discomfort for the occupants.

We have devised a novel and effective means for counteracting the natural drop of cool air downwardly along the relatively cold outside wall surfaces. It is the essential and novel feature of the present invention to forcefully direct a uniform "curtain" of particularly temperature conditioned air upwardly over the entire extent of the cold wall and its window surfaces. This curtain of air comprises cool outside air or refrigerated air mixed with recirculated room air. The room air may also be subjected to contact with a heat exchanger for further raising its temperature to a proper level for balanced mixing with the desired quantity of cool outside air. By particularly controlling the directional pattern and velocity of the upwardly moving curtain of air, we have found that it is possible to completely counteract all of the natural drift of cold air down the outside wall and window surfaces. Occupants immediately adjacent the outside wall, say two feet distant from it, will experience the same comfortable air temperatures as those sitting against the farthest inside walls. The floors will be comfortably warm, and all drafts will be eliminated from the room. A pleasant and refreshing circulation of air at the correct temperature will be effected throughout the entire room volume.

The air distribution system of the present invention may be employed with various furnace and heat exchanger installations. For purposes of illustration, we have shown in Figure 1 a typical "remote" installation for servicing two adjacent classrooms with the same schoolhouse building. In Figure 2 of the drawing, we have illustrated a typical "in-the-room" installation for servicing a single classroom. Referring now more particularly to Figure 1 of the drawing, there is shown a heater unit **10**, comprising a conventional furnace and heat exchanger assembly within a closed housing. Where oil is the fuel to be used, or where codes require that the heater unit be completely outside the classroom, a small "heater room" may be advantageously provided between two adjacent classrooms. A discharge flue for waste combustion products is indicated at **12**, and a return air plenum chamber **14** communicates with the upper end of the heater **10** and with a pair of return air ducts **16** and **17**. The ducts **16** and **17** extend through corresponding inside walls **18** and **20** of adjacent classrooms A and B. The common wall **20** separates the two classrooms, and the entire heater unit **10** is shown for purposes of illustration as being mounted within a suitable heater room defined wholly within the classroom A by walls **19** and **21**. A by-pass air duct **22** and a warm air duct **24** extend from the heater unit **10**, through the wall **18** to an air processing unit **30** located within the classroom A. Corresponding by-pass and warm air ducts **23** and **25** communicate through the wall **20** with another air processing unit **32** located within the classroom B. The air processing units **30** and **32** are identical in structure and function, and are of the type described in detail in our co-pending application, Serial No. 742,393, filed June 16, 1958. The air processing units **30** and **32** are mounted within the respective classrooms A and B on the floor and against an outside wall **34** entirely below windows **36** thereof.

Return air from the two classrooms A and B may be brought back into the top of this remote unit installation through the return air ducts **16** and **17** to the same heater unit **10**, into the return air plenum chamber **14**, past the heat exchanger means fired by the furnace within the heater unit **10**, and outwardly through the warm air ducts **24** and **25** into the corresponding air processing units **30** and **32**. Alternatively, the same return air flow from each classroom may be by-passed within the heater unit **10** so as to pass directly outwardly through the by-pass air ducts **22** and **23**, and without heating, into the air processing units **30** and **32**. Room air, therefore, may be circulated from either or both of the classrooms A and B through the heater unit **10** and into the air processing units **30** or **32** either heated or unheated. In this way, the single isolated heating unit **10** serves to provide heat for the air flow into the air processing units of the two separate adjacent classrooms. Each of the classrooms is then, in turn, serviced by its own independent air distribution system.

Referring now more particularly to Figure 2 of the drawing, we have illustrated a typical "in-the-room" installation. Where gas fuel is available, and where existing building codes will allow it, a gas fired heater may be disposed directly within the classroom to be serviced, and operates to provide heat for the air system of just that single room. We have designated at C a classroom having an air processing unit **38** mounted on the floor and against an outside wall **40** entirely below windows **42** thereof, in the same manner as was described with respect to classrooms A and B of Figure 1. A gas-fired heater unit **44** is installed like a pilaster from floor to roof in the corner of the classroom C.

The heater unit **44** comprises a closed housing having a gas-fired furnace and heat exchanger means therein. A suitable flue extends upwardly within the housing at the top of the unit **44**, and may be directed through the roof for discharge. A return air grille **46** provides means for recirculation of room air into the heater unit **44** at the top thereof. All combustion air, and air to supply a suitable back-draft diverter, are admitted to the enclosed heating unit **44** through suitable openings communicating directly with the outside through the wall **40**. The inlet end of the air processing unit **38** abuts directly against the lower housing portion of the unit **44** to directly receive recirculated room air which may be supplemented with heat as required. For such "in-the-room" applications, by-pass and warm air dampers of the type employed in the air processing unit of our said co-pending application, Serial No. 742,393, filed June 16, 1958, may be omitted. In all other respects, however, the air processing unit **38** is identical with the air processing units **30** and **32**. The outlet end or discharge end of the air processing unit **38** communicates with an independent air distribution system for the classroom **C**.

It is the air distribution system which particularly embodies the inventive features of the present invention. In order to more fully clarify the purposes and advantages of the air distribution structure to be hereinafter described, the pattern of room air flow provided thereby will now be set forth. Referring more particularly to Figure 3 of the drawing, a typical schoolhouse classroom has been illustrated in a more or less diagrammatic vertical cross section. It will be understood that the classroom of Figure 3 may represent any of the classrooms A, B or C of the "remote" and "in-the-room" system installations of Figures 1 and 2. The enclosed volume of ambient air or the "room space" is indicated generally in Figure 3 at R. This volume is defined by a floor **50**, roof **52**, for inside wall **54**, side wall **55**, and an outside wall **56** having windows **58** in the upper portion thereof.

An air distribution duct **60** is mounted upon the floor **50**, against the outside wall **56**, and below the windows **58**. The introduction of air into the room from the duct **60**, and its subsequent pattern of circulation within the room is indicated within Figure 3 by curved-line flow arrows. The impingement of cold outside air against the outer surfaces of the windows **58** has been indicated by horizontal straight-line flow arrows, and it will be understood that such air causes a substantial chilling of the inner surface of the windows **58** within the room space R. Room air passing against the inner surfaces of windows **58** is chilled by such relatively cold surfaces, and inherently tends to fall downwardly along the outside wall **56**. The duct system of the present invention, however, effects the introduction of a "curtain" of upwardly moving air from the duct means **60**, which directly opposes the tendency of chilled air to drop down from the cold outside wall surfaces. In this way, the natural tendency of this downward drift of cold air is completely counteracted, and such air is carried upwardly toward the roof **52**, as indicated by the irregular flow arrows, and continues across the room space R to the far inside wall **54**. In this way, such chilled air is fully assimilated with the temperature conditioned air being introduced into the room by the duct means **60**. A closed-loop pattern of uniform air circulation results, thereby eliminating drafts, temperature extremes, and layering within the room space R.

As illustrated diagrammatically in Figure 4 of the drawing, it is a highly important feature of this invention that the duct means **60** be extended across the full length of the most exposed or outside classroom wall. An equal outlet velocity of air must exist at all vent openings along the full length of the duct means **60** at its wall. The upward pattern of air flow from each vent opening must effect a vertically upward continuity of direction relative to the air of adjacent vent openings, while effecting an intermingling therewith so as to achieve a homogeneity or uniformity of air flow which constitutes the unitary and upwardly moving "curtain" pattern of the present invention.

The novel duct structure for achieving this entirely unique method of air introduction and circulation within a room will now be described. In Figures 5 to 7 of the drawing, a basic air distribution "wall duct" unit **50** has been illustrated. The unit **50** is intended primarily for the secondary school grades where shelf space within the room for use by the students is not required. The unit **50**, therefore, is proportioned as compactly as possible for hugging the outside wall against which it is mounted in an inconspicuous manner. The unit **50** defines a generally tubular open-ended duct **52** having a front wall **54**, a back wall **55**, a bottom wall **56** and a top wall **57**, all integrally interconnected as a unitary structure. The forward edge of the top wall 57 is downwardly curved at 58 for flanged juncture with the top edge of the front wall 54. Suitable lower and upper reinforcing brackets 60 and 62 are provided for insuring structural rigidity.

The top wall 57 provides a plurality of vent openings having overlying louver plates 64 of particular form and design. It is important that the louvered vent openings be equidistantly and uniformly spaced along the full length of each wall unit 50, and along any consecutive series of such ducts or related duct units. In practice, the louver plates 64 are disposed along one-foot centers, and it is important that each unit 50 be dimensioned so as to have a total length constituting an equal multiple of the center-lengths of the louver plates thereof. For example, four plates 64 are provided by the wall unit 50, and its total length for one-foot center spacing of the louver plates would be four feet. A half-spacing is provided between the end-located plates and the open ends of the duct 52 so that the same uniformity of spacing will be maintained when adjacent wall units are combined in cooperation with the single unit 50.

In Figures 8 to 10 of the drawing an alternative "shelf duct" type of unit 70 has been illustrated. The shelf duct type of structure is intended for use by primary and elementary grades where shelf space is desired. The use of such shelf ducts is illustrated in Figures 1 and 2 of the drawing. The shelf duct 70 differs from the wall duct 50 in the supplemental forward projection of a forwardly accessible storage and shelf enclosure. The structure comprises a closed back wall 72, a bottom wall 74, and a top wall 76. The forward end of the bottom wall 74 projects upwardly at 78 to provide a lower front panel portion. The top wall 76 is similarly projected downwardly at its forward end 80 to provide an upper front panel portion. Lower and upper frame brackets 82 and 84 are secured to the edges of the panels 78 and 80 to define an enlarged opening therebetween. A partition wall 86 extends across the full length of the unit 70 in forwardly spaced relation to the back wall 72. The ends of the unit 70 are fully open intermediate the walls 72 and 86 to define a tubular open-ended duct 88. Side panels 90 and 92 provide side closures for the unit forwardly of the partition wall 86. An adjustably positionable shelf 94 is supported by the side panels 90 and 92. A bottom panel 100 is supported on brackets 102 upon the bottom wall 74. In this way, a fully enclosed open shelf space is defined forwardly of the air flow duct 88. The frame brackets 82 and 84 define slide channels adapted to receive overlappingly slidable panel doors 108 and 110. It will be understood that the doors may be employed or removed in an optional manner, as desired. In Figure 2, for example, a unit 70′ has been shown with the doors removed and a unit 70″ shown with the doors in position.

The unit 70 employs a series of louver plates 64 in the identical manner of the wall duct 50.

Although not illustrated in detail, it is contemplated that the duct distribution units of the present invention may include a "corner duct" unit 112, which is shown in Figure 1 of the drawing in a typical installation where the air processing unit 32 must be located along one of two right angular outside walls, both of which must be serviced by the "curtain" of incoming air. It will be apparent that the corner unit 112 provides a right angular air flow duct for communication at its opposite ends with the adjacent shelf duct units 70. Forwardly projecting top and bottom walls, and right angular front closure panels are provided by such a unit for purposes of continuous line appearance and symmetry with the adjacent duct units. Again, louver plates 64 for direct air discharge are provided by the corner unit 112.

The louver plates 64 are of particular structure for insuring proper introduction and formation of the "curtain" of incoming air. As best seen in Figures 11 and 12, each plate 64 provides a plurality of parallel louvers 120 integrally struck and bent into vertical orientation at right angles of the general plane of plate 64. In this way, a plurality of narrow rectangular openings 122 are defined along the length of the plate 64, and are oriented at right angles to the general direction of air flow within the duct units from the air processing unit to the remote end of the distribution system. It is of particular importance thta the louvers 120 be of flat form so as to define straight and vertical pathways for the flow of air within the duct units directly outwardly therebetween in vertically upward paths. This pattern of air flow is best shown in Figure 12 by means of flow arrows.

The critical design and operating factors for insuring the proper introduction of the "curtain" of incoming air in accordance with the principles of the present invention will now be set forth. First, a relatively high static pressure must be maintained within the duct distribution system. In the past, static pressures of about 0.03 to 0.04 inch of water have been common in most domestic air circulation systems. It is contemplated that a static pressure about three times greater than conventional pressures be provided in the distribution system of the present invention. Static pressures of the order of 0.11 to 0.12 inch of water are required.

Second, the air within the ducts is discharged directly upwardly through restricted openings defined by vertical louvers. This manner of air discharge from the ducts serves three important purposes. The restricted size of the outlets is such as to insure a substantial air discharge velocity. At the same time, the louver blades themselves operate in the manner of "straighteners" rather than as diffusers. In this way, adjacent and separately defined "jets" of upwardly moving air are discharged from the duct system to effect a cooperative combination into a uniformly homogeneous curtain-like flow of air at a height of about 18 inches above the sill or level of the louver plates. Still further, the louver blades minimize the noise or recirculation "gurgling" which normally characterizes the operation of conventional diffusers under the high discharge velocities required by the present invention.

Third, the discharge air velocity must provide a sufficient "mass strength" or "force-height" or "throw power" so as to insure aspiration and carrying of the room air into a pattern of even and uniform distribution at a substantial height above the sill or louver plate level. We have found that the length-to-width proportions of the louver plates, and the number and flat vertical form of the vanes, serves to insure the proper air discharge velocity while maintaining the required static pressure within the ducts. In practice, louver plates of sheet metal having a length of 4½ inches and a width of 1½ inches, with 14 adjacent louver elements, satisfy these requirements. The introduction of air in a "curtain" form, and at substantial velocity and consequent substantial throw power, results in an efficient induced recirculation of the room air. We have found that an entrainment ratio of incoming air and surrounding room air of about 4 to 1 is achieved.

Fourth, the cross sectional area of the duct units through which the air flows from the air processing unit to the remote end of the duct system has a material effect upon velocity pressure within the ducts. The duct velocity pressure, in turn, determines the static pressure at the far or remote end of the duct system. As best seen in Figures 7 and 10, the particular discharge opening dimensions of the louver plates are coordinated with a suitable duct cross section for insuring the maintenance of the required static pressure within the ducts. The velocity pressure is used to develop the static pressure at the far or remote end of the duct system, but this velocity pressure must not be so high as to reduce the discharge velocity through the louver plates at the near end of the duct system adjacent its air supply from the air processing unit, or risk aspiration of room air into the ducts through the louver plates at the near end of the system.

We have found that compliance with the above prerequisites of design results in the maintenance of a louver discharge velocity of the order of 1000 cubic feet per minute from the inlet end of the duct system to its remote end within a uniformity variance of less than 5%.

While there has been shown and described a particular embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and, therefore, it is intended in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An air distribution system for an elongated wall of a room, comprising tubular duct means adapted to extend along substantially the full length of the wall and having an air supply inlet at its one end and being closed at its remote other end, air supply means operative to introduce treated air under a velocity pressure into said duct at its inlet end only, whereby said air is confined within the full length of said duct to establish a predetermined static pressure therein, said duct having a plurality of vent openings disposed at spaced points along the full upper surface thereof, said vent openings being equidistantly spaced from each other and of equal area size, and air directing means comprising identical louver plates mounted in said vent openings and each providing a plurality of parallel vertical louvers disposed at right angles to the longitudinal axis of said duct and thereby to the general direction of air flow within said duct, said air directing means being operative to direct all of the air discharge therethrough in straight and parallel upward paths, wherein the combined, spaced flow areas of said vent openings are restricted relative to the static air pressure within said duct to effect substantially uniform and equal air discharge from each of said louver plates at a combined velocity and mass strength operative to effect as aspiration of surrounding ambient room air and collectively cooperate to form a uniform and upwardly moving curtain of air along the full length of the room wall and independently of natural convection flow of air within the room.

2. An air distribution system for an elongated wall of a room, comprising tubular duct means adapted to extend along substantially the full length of the wall and having an air supply inlet at its one end and being closed at its remote other end, air supply means operative to introduce treated air characterized by a lower temperature and greater weight than the ambient room air under a velocity pressure into said duct at its inlet only, whereby said air is confined within the full length of said duct to establish a predetermined static pressure therein, said duct having a plurality of vent openings disposed at spaced points along the full upper surface thereof, said vent openings being equidistantly spaced from each other and of equal area size, and air directing means comprising identical louver plates mounted in said vent openings and each providing a plurality of parallel vertical louvers disposed at right angles to the longitudinal axis of said duct and thereby to the general direction of air flow within said duct, said air directing means being operative to direct all of the air discharge therethrough in straight and parallel upward paths, wherein the combined, spaced flow areas of said vent openings are restricted relative to the static air pressure within said duct to effect substantially uniform and equal air discharge from each of said louver plates at a combined velocity and mass strength operative to effect an aspiration of surrounding ambient room air and collectively cooperate to form a uniform and upwardly moving curtain of air along the full length of the room wall and independently of natural convection flow of air within the room.

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