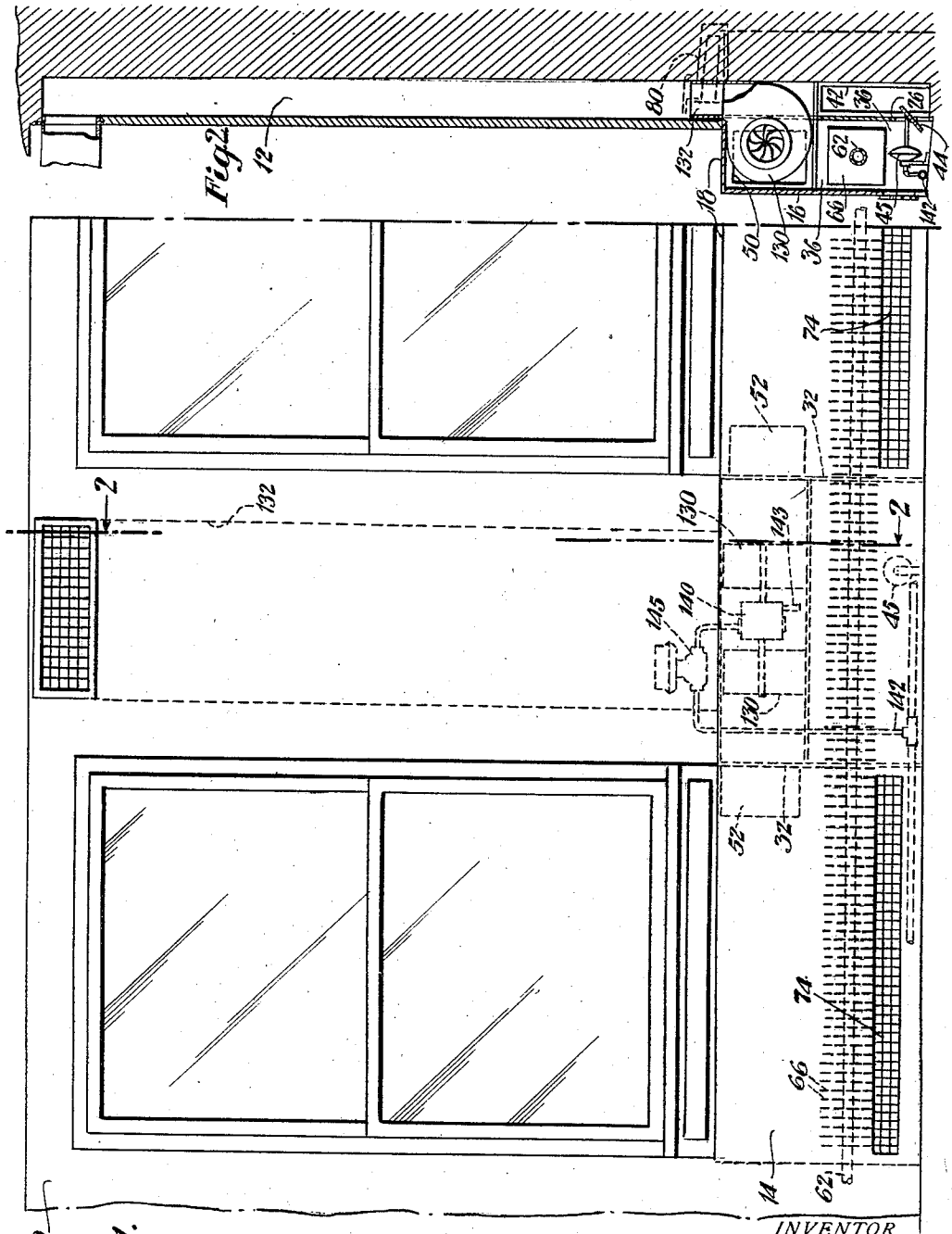
Oct. 16, 1934. J. A. SPACE 1,977,248

AIR CONDITIONING SYSTEM

Original Filed April 14, 1931 3 Sheets-Sheet 1



INVENTOR
JAMES A. SPACE

BY Edmund G. Borden ATTORNEY

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Fig. 4.

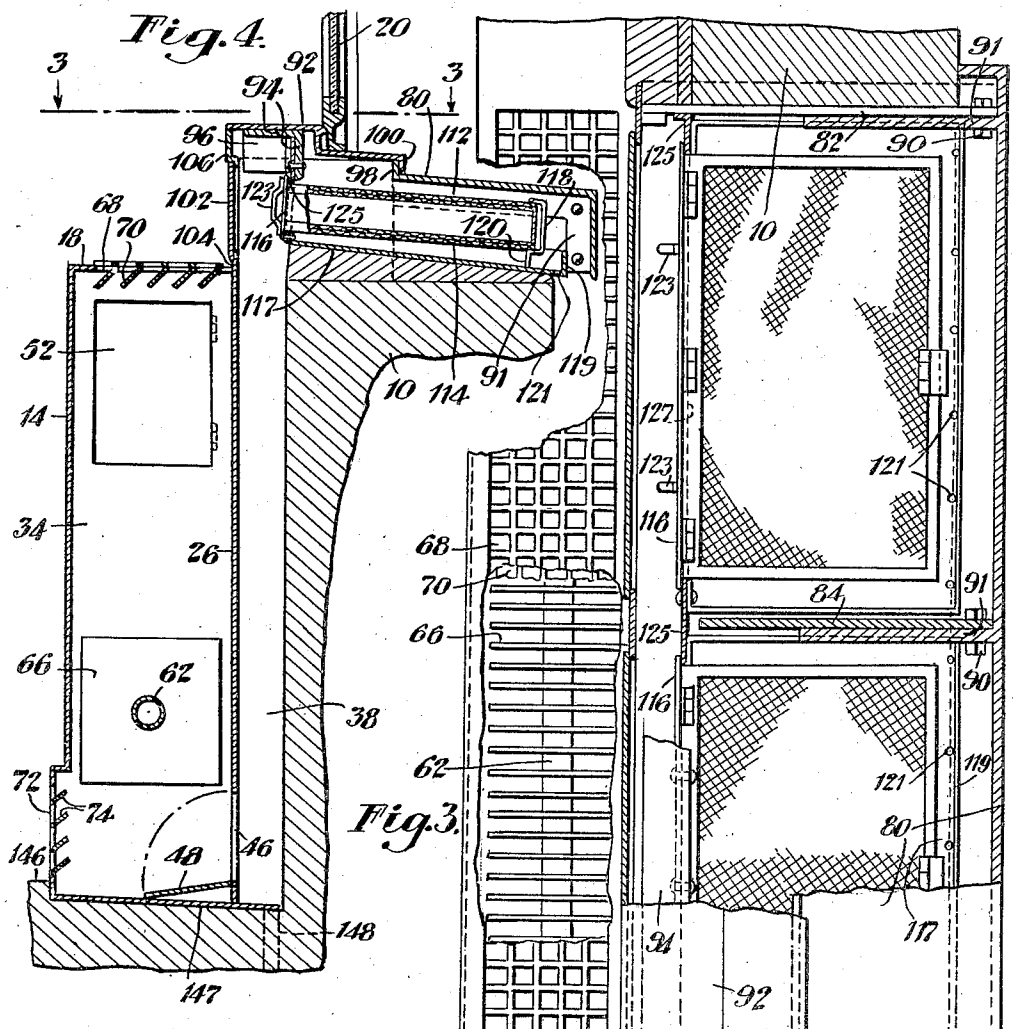
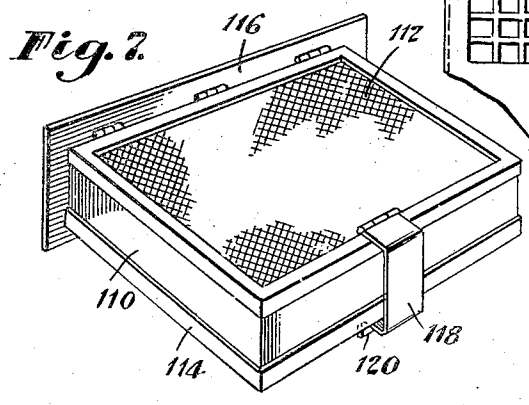


Fig. 3.

Fig. 7.



INVENTOR
JAMES A. SPACE

BY Edmund G. Rader ATTORNEY

Oct. 16, 1934. J. A. SPACE 1,977,248

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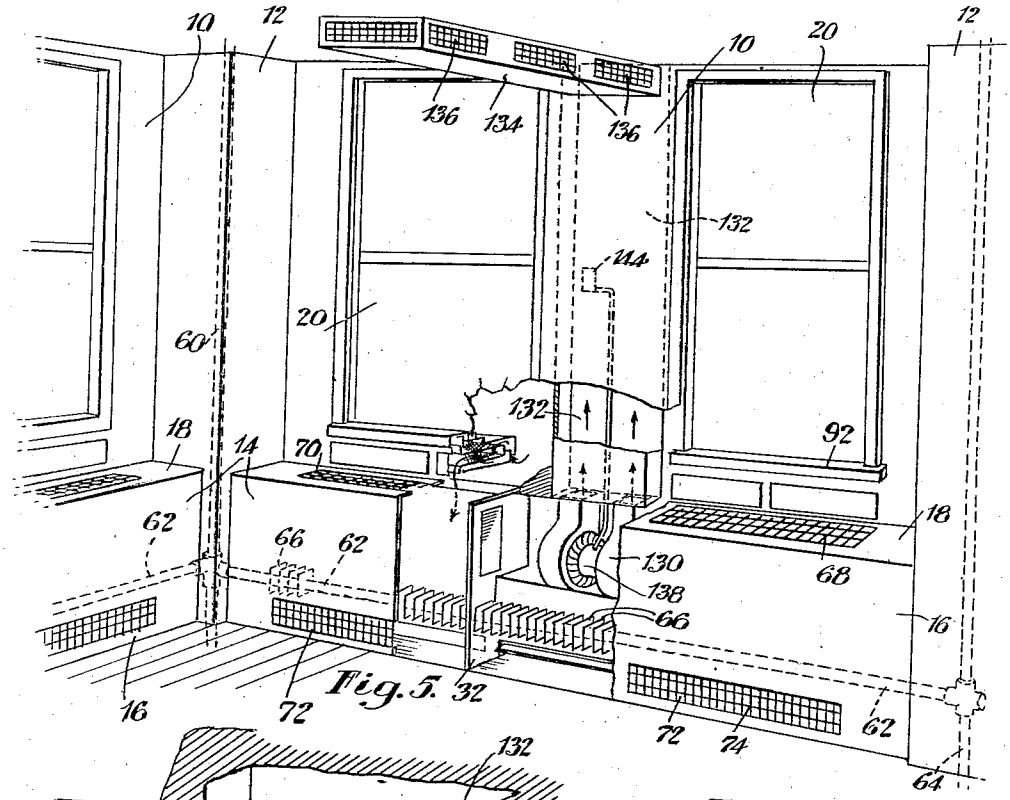


Fig. 5.

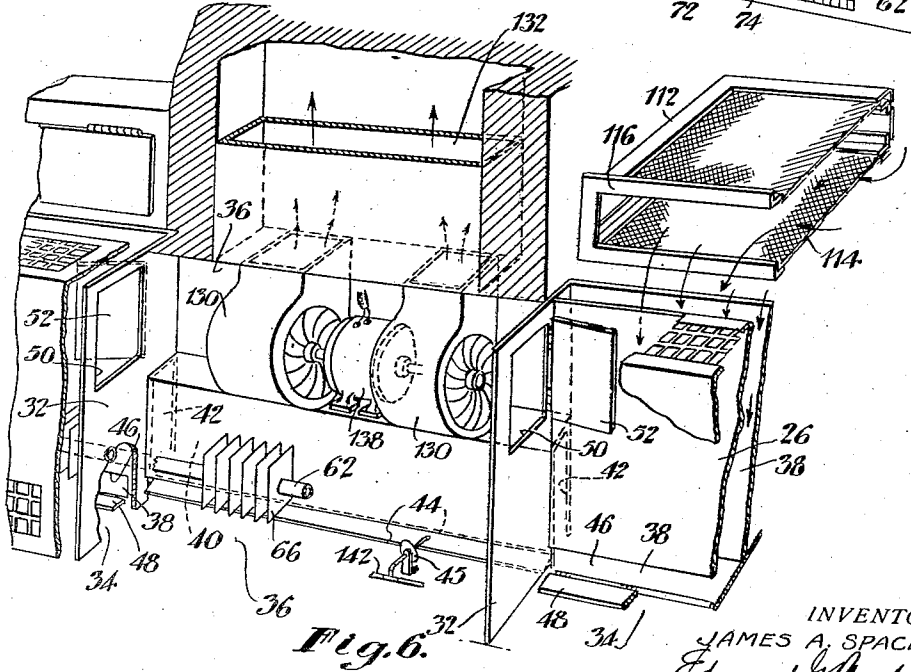


Fig. 6.

INVENTOR
JAMES A. SPACE
BY Edmund J. Berdeau
ATTORNEY

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AIR CONDITIONING SYSTEM

James A. Space, East Orange, N. J., assignor to Doherty Research Company, New York, N. Y., a corporation of Delaware

Original application April 14, 1931, Serial No. 529,911. Divided and this application April 4, 1933, Serial No. 664,324

6 Claims. (Cl. 257—8)

This invention relates to air conditioning, heating and cooling; and more particularly it concerns air conditioning and ventilating apparatus of the unit type adapted for use in ventilating and cooling or heating a room or other unit space in an office building, hotel, or similar structure. The subject matter of the present invention was originally described in my copending application Serial No. 529,911, filed April 14, 1931, of which this is a division.

In the more recent practice in building construction, in view of the rapidly mounting value of floor space, efforts continually are being made to limit the demands upon such space for ordinary building operating purposes. Central ventilation systems utilize much valuable space within modern office buildings, often amounting to as much as 600 sq. ft. or more of floor space. To productively utilize the maximum amount of floor space, a unit system is here employed in which the individual unit or units used for ventilating each room or floor occupies a small amount of floor space at and immediately adjacent the space normally occupied by the radiators normally employed.

The commercial development of heating and ventilating apparatus of the unit type has, prior to the present invention, been restricted due to certain objectionable features limiting the effectiveness of such apparatus where large spaces are to be ventilated. Where such heating units were placed directly in front of windows, the conditioned air flowing upwardly from the housing moved closely adjacent the side of the room in front of the window, at a point where normally an appreciable amount of fresh air will, through normal leakage, enter the room. At the same time the portions of the room remote from the windows were not provided with sufficient fresh air at a suitable temperature such as that to which the fresh air was heated before it entered the room from the ventilating unit.

The present invention has been developed in recognition of the present need for a ventilating system comprising a compact unit having high heating and cooling efficiency, adapted for heating and ventilating buildings in winter and for cooling and ventilating buildings in summer, under conditions whereby fresh conditioned air is introduced into the room,—after removal of extraneous matter, dust and the like,—at points remote from the walls of the room, while at the same time providing for recirculation and reheating of room air under conditions adapted to permit to the greatest possible extent dilution of the recirculated air with any fresh air independently entering the room around or through the windows.

Among the more important objects of the present invention may be noted the following:

To provide in a novel manner for uniformly supplying fresh, filtered and conditioned air to the room to be ventilated; to provide a novel air conditioning unit adapted for ventilating a room with heated air in cold weather and for ventilating the same with cool air in warm weather; and to provide in an air conditioning system for a novel hollow window sill construction adapted to provide within the sill a hidden inlet for fresh air and to provide for the cleansing of air within the sill.

In its broadest scope, the invention involves the use of a novel air conditioning system, convertible so as to be adapted either for cooling or heating air prior to introduction of the latter into the room to be ventilated. Fresh air is introduced into the room, at points remote from the windows and from the walls of the room, under forced draft, preferably automatically controlled under the influence of the temperature of the room or of that at any suitable point in the ventilating system. The fresh air is drawn by an induced draft through a hollow window-sill, preferably of light-weight cast metal construction and provided with an air filtering medium, the latter of which is in the form of a replaceable or removable filter cartridge.

In cold weather the filtered fresh air is drawn or flows over heating elements, and the resultant heated air is conducted through wall conduits and is discharged into the room near the ceiling at one or more selected points remote from the walls and windows.

A more complete statement of the objects of the air conditioning system of which the present invention forms a part is set forth in my aforementioned parent copending application Serial No. 529,911.

In the accompanying drawings illustrating certain preferred forms of the invention, Fig. 1 shows a portion of a room interior in elevation and includes certain elements of the invention;

Fig. 2 is a section taken on the line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a plan view taken along the line 3—3 of Fig. 4, parts being broken away to show the inner construction of the hollow window-sill; and adjacent parts;

Fig. 4 is a vertical section through a hollow window-sill and ventilator housing;

Fig. 5 is a perspective view of a room having a wall casing with parts broken away to show the air conditioning equipment, the arrangement of parts being that adapted for air heating;

Fig. 6 is a perspective view of a portion of the air conditioning apparatus on a somewhat larger scale than Fig. 5, parts being broken away, the arrangement being that adapted for air cooling; and

Fig. 7 is a perspective view of a filter supporting box.

In the drawings, 10 designates a portion of a building wall extending between two adjacent pilasters 12, viewed from the interior of the building. A sheet-metal housing or casing 14, having front and top members 16, 18, which may be of ornamental design if desired, is disposed along the wall of the room between pilasters. The casing may be constructed of other material than metal,—such as wood, or other well known material of construction.

One or more windows, 20, are located in the wall between the pilasters. In the form shown in Figs. 1 and 5, two windows are thus disposed; and the height of casing 14 is such that its top 18 is positioned a substantial distance below the level of the window sill.

A longitudinal partition 26 divides the space within the casing 14 into a front passageway and a rear passageway extending the length of the casing.

Transverse partitions 32, 32 are vertically disposed within the casing adjacent the respective side margins of each of the windows, the said partitions 32, 32 serving to reinforce the casing,—to divide the front passageway longitudinally into the heat transfer chambers 34 and 36; and to divide the rear passageway into air inlet chambers 38, and 40.

The chambers 34 and 38 are located directly in front of each window 20; and the chambers 36 and 40 are located between adjacent windows (see Fig. 6). The rear passageway has an interior portion of reduced height, extending between adjacent windows and adjacent partitions 32, so that chamber 40 is of less height than chamber 38.

An opening 42 in each partition 32 permits free communication between the chambers 38 and 40 at all times. Likewise an opening in the lower portion of partition 26 automatically controlled by a pneumatically operated damper 44 or its equivalent, permits communication between chambers 36 and 40, under certain desired conditions hereinafter designated.

An opening 46 in the partition 26 controlled by a door 48 permits controlled communication between chambers 34 and 38; and an opening 50 in each partition 32 and controlled by a door 52 permits controlled communication between chambers 34 and 36. Access to doors 48 and 52 may be obtained through suitable openings in the casing adjacent thereto or by any other common means for the purpose.

For supplying heat-transfer fluid for conditioning air flowing through compartments 34 and 36, a riser pipe 60, adapted to convey an air conditioning fluid is mounted in the wall and is provided with lateral extensions 62 disposed within the series of chambers 34 and 36, the opposite end of each lateral extension 62 being suitably connected with a fluid-return conduit 64 in well known manner. Each extension 62 may be in the form of one or a plurality of tubular heat-transfer elements such as finned pipes, pipe coils or the like. In the form shown, the radiator element consists of a conduit having mounted thereon a plurality of flat metal heat-radiating fins or plates 66 arranged in parallel and extending throughout the length of the casing 14.

An opening 68, adapted to be closed when desired by a louver member 70 is provided in that portion of the member 18 forming the top of each chamber 34. Likewise in the lower portion of the casing member 16 that forms the front of each compartment 34 there is provided an opening 72 adapted to be closed when desired by the louver 74.

For conducting fresh air into the building from outside the latter, there is provided a hollow metal window ledge member 80 preferably of metal or alloy and in the form of a thin-walled casting. A light weight but tough, durable metal such as aluminum or an aluminum alloy having a thickness of from ⅛ to ⅜ inch or more has been found in practice to be highly satisfactory, the metal thickness varying according to the stresses to which the window ledge is to be subjected in ordinary use.

The sill construction comprises metal supporting end members 82, 82 and an intermediate supporting member 84 of steel or the like, each having its lower flanged margin grouted or otherwise secured in the building wall 10. The window ledge or plate 80 is supported on the members 82, 84 with its outer end extending beyond these members and depending beyond the wall. The member 80 is secured to each of the said supporting members by bolts 90, connecting the latter with internal flanges 91 on the former.

A sill member 92 is supported by a transverse member 94 of angle iron, the latter being mounted at its ends upon supporting members 96 secured to supporting member 82. A lug or shoulder 98 on the member 80 cooperates with a shoulder 100 on the sill member 92 to assist in maintaining the ledge 80 in the desired position, the space between the shoulders 98 and 100 preferably being caulked with a suitable plastic packing material for preventing passage of air, dust and the like at this point.

A removable closure member 102 cooperates with a flange 104 on the casing top 18 and with a flange 106 on the inner margin of sill 92 for preventing direct communication between the interior of the hollow window sill and the room excepting when desired. The sill member 92 extends inwardly beyond the inner surface of the wall 10 a distance corresponding to the width of compartments 38 and 40.

One or more air-filtering units are supported within each hollow window sill. According to a preferred form of the invention, one such filtering unit is provided within the sill on each side of the intermediate supporting member 84. Each filtering unit comprises, in the form shown in Figs. 3, 4, and 7, a box-like member 110 having solid side walls and outer wall, and having a hinged lid 112 and a hinged bottom 114, both of the latter being made of a foraminous material such as metal screening or metal lath and adapted to permit free flow of air therethrough.

The inner side wall of the box 110 is open and is provided with a flanged collar portion 116 to which both the top and bottom are hinged, and which is adapted to cooperate with the adjacent margins of a sealing plate 125, the latter of which is secured to members 94 and to the inner flanged margin of metal drain pans 117 supported on the wall 10 below the metal window ledge 80.

Each said drain pan slopes outwardly and downwardly and has an upturned outer margin 119 provided with openings 121 near its outermost portion. Plate 125 extends the width of the window and has its sides secured to members 82. Openings 127 are provided in plate 125, the margins around which cooperate with the collar 116 to establish relatively fluid-tight seals respectively around the collars 116 of a pair of the boxes 110. The interior of each box is in permanent communication through the opening in the inner side wall with the rear passageway of the casing 14, as clearly shown in Fig. 4.

A hinged U-shape member 118 of resilient metal such as steel, is adapted normally to secure the lid and bottom member of each box in closed position, as illustrated in Fig. 7. A depending end portion thereof 120 serves for supporting the forward end of the boxes 110 when the latter are in position within the hollow window-sill. The boxes are adapted to be introduced into and withdrawn from the hollow window-sill through the opening normally closed by the member 102. Handles 123 are secured to the collars 116 for facilitating ready removal of the boxes 110 and the filtering elements carried thereby from the hollow window sill upon removal of the closure 102.

A suitable filtering medium such as cloth, felt or coarse sheets of fibrous material such as wood pulp is secured upon the foraminous top and bottom members 112 and 114, these members being open for the purpose. The sheets of filtering material thereafter are maintained in position by the flanges on the top and bottom members after the latter are closed and are secured together in place by the clamping member 118. A single sheet of filtering material long enough to cover both members 112 and 114 may be employed,—or these members may be covered by separate sheets. Other modified forms of replaceable or removable filter elements may be substituted for those shown.

For drawing air into the casing through the filter in the hollow window ledge and for distributing the same within a room to be ventilated, there is provided a fan or blower 130 mounted in the upper portion of each compartment 36 and so arranged as to draw air from the latter, and discharge it upwardly into a conduit 132 within the outer building wall. The upper end of the conduit 132 may be connected with a horizontal air distributing manifold 134, preferably located near the ceiling and having louver-controlled openings 136 located at spaced points longitudinally thereof and in its end for conducting the fresh air to points remote from the building walls before its introduction into the room to be ventilated. Air may be discharged at any desired point of conduit 132 by the introduction of a register therein.

One or more fans 130 may be mounted upon the rotor shaft of a variable speed electric motor 138. Preferably a pair of such fans are thus mounted at the respective sides of the motor in well-known manner. In many instances it is preferred to substitute for the electric motor a compressed air motor 140, such as shown in Fig. 1. This is especially desirable where the air conditioning system is under thermostatic control and where it is desired intermittently to vary the speed of the fan in accordance with temperature conditions within the system. A compressed air conduit 142 and an air discharge conduit 143 are connected with the air motor 140 for obvious purposes.

For controlling the amount of fresh air drawn into the room by the fan 130, in accordance with the temperature conditions existing within the room or at a selected point in the ventilation system, a thermostat 144 of suitable type is placed at the point in the system to be employed in connection with such regulation. The said thermostat is arranged in an electric circuit which also includes the variable speed motor 138; or, in case an air motor is used, the thermostat preferably is connected with a thermostatically-operated valve 145 in the compressed air line leading to the air motor as shown in Fig. 1. In any event the construction of the thermostat and the arrangement of the associated elements of the circuit controlling operation of the motor is such that the speed of the motor varies with changes in the temperature of the air around the thermostat, thereby changing the rate of flow of fresh air to the room from outside in accordance with temperature variations within the room or other space being ventilated, or elsewhere in the system.

In practice the thermostat 144 conveniently is placed in the air conduit 132 into which air from the fan 130 discharges. Obviously however the thermostat can be located either in the room being ventilated or wherever it may be serviceable for the purpose indicated.

As more clearly shown in Fig. 4, the floor 147 within the casing 14 is at a lower elevation than the room floor 146, and the former slopes downward slightly in the direction away from the room and toward one or more drain conduits 148, thus providing drainage for any moisture condensing in the casing 14 or flowing thereto through the louvers 74 during cleaning of the room.

Instead of employing heat transfer elements of the type illustrated, other well-known heat-transfer means may be utilized. In certain instances individual separately-controlled radiator elements may be used in the respective chambers 34, 36; or the heat-transfer elements in the various chambers 34 may be directly connected with one header pipe, carrying steam, cold brine or other heat transfer fluid,—and those in a plurality of compartments 36 within the same or adjacent casings may be connected with a second header pipe carrying steam, cold brine, or other heat-transfer fluid at a higher or lower temperature than that carried by the first-named header.

The practice of the invention will be described in connection with the ventilation of a single room. However, obviously the invention can be applied to any number of rooms; and a single room may contain a number of units such as here described, each adapted to work in conjunction with or indepndently of the other.

In the preferred practice of the invention in connection with the heating and ventilating of a room,—steam or other suitable heating fluid is passed through the conduit 62 and radiates heat to the air flowing within the respective chambers 34 and 36. The louvers 70 and 74 in the respective top and front of the casing 14 are open, and the heat communicated to the air passing the conduit 62 induces natural convection currents, thereby drawing air from the lower portion of the room and projecting it upwardly past the radiating surfaces 66 and thence through the openings 68 into the room at points directly in front of the windows. This heated air rising in front of each window is cooled and diluted by any air drawn into the building around the window.

Simultaneously fresh air is drawn from outside

the building through the hollow window-sill by action of the motor-driven fan 130. Such air passes through the top or bottom of the box 110 and the filter element carried thereby,—after which the air flows downwardly to chambers 38 and 40, and thence uninterruptedly flows to chamber 36. Here it is drawn upwardly around the heating elements 66 and thence is projected through conduit 132 to the manifold 134 adjacent the ceiling of the room through which it flows, gradually escaping into the room through the louvered openings 136 which are adjusted to effect air distribution into the room in any desired manner.

During this operation the doors 48 and 52 are closed so that communication between the chamber 34 and the other chambers within the casing 14 is cut off. This insures that all of the filtered fresh air, after suitable heating thereof, is conducted directly to points remote from the windows and walls of the room. The thermostat 144 located in the wall conduit 132 is adjusted to control the flow of air past the elements 66 and thus to maintain the air flowing through the conduit 132 at the desired temperature.

Preferably the thermostat is adjusted to introduce conditioned air into the mid portion of the room at a temperature substantially lower than that of the recirculated air in order to allow for the subsequent heating effect of the lights and other heating agencies in the room.

The thermostat may be made responsive in some degree to the heated recirculated air flowing through the chamber 34 by mounting the former at a strategic position within the room being ventilated where the thermostat is subject to the effect of the conditioned, recirculated air as well as of the fresh air.

The pneumatic device 45 for controlling the damper 44 may be operatively connected with the compressed air conduit to the air motor where the latter is employed; or the device 45 may be connected through a compressed air line to any point adapted for remote control of the damper 44. The damper-operating device 45 is connected with the compressed air line to the motor in such manner that the damper is maintained in open position at all times when air under pressure is present in the air line. When this pressure is released,—for instance at night when the heat to the heat exchange apparatus is cut off and the air compressor is stopped,—the device functions in well known manner,—as by means of a valve controlled by a spring-pressed diaphragm,—to cut off the flow of fresh air into the building. Other devices adapted to so function and to provide automatic control of the fresh air flowing through the hollow window sill may be substituted for that mentioned; and such devices may be operated electrically or in any other manner, from either a proximate or a remote point of control.

In the practice of the invention for cooling and ventilating a room, a cooling medium such as cold water, brine or the like is flowed through the lateral pipe 62,—the doors 48 and 52 being open, and the louvers 70 and 74 being closed. Air from the outside is drawn through the hollow window-sill construction and the filter element therein in the manner previously described. A portion of the air flows directly to chamber 40 and thence into chamber 36 where it is drawn upwardly around the cooling elements 66 by action of the fan 130, and is directed into the mid-portion of the room adjacent the ceiling through conduits 132 and 134.

A portion of the fresh air flowing into the building through the hollow window-sill construction passes into chamber 34 through the opening 46, and is thereafter drawn upwardly around the cooling plates 66 and thence through open doorway 52 to the chamber 36 under action of the fan 130, where the cooled air mixes with that flowing upwardly therein.

During this cooling operation it will be noted that there is no recirculation of room air in front of the windows. In warm weather the latter ordinarily will be at least partly open, thus providing ample ventilation and cooling at such points. All of the air being conditioned is distributed in the room at suitable points near the ceiling and at distances remote from the walls thereof.

In operations for heating and ventilating a room or building, where cold fresh air must rapidly be heated over a fairly wide temperature range,—in some cases from 0° F. to 70° F.,—a very high velocity flow of the air over a limited heat transfer member maintained at a suitable temperature serves most efficiently for the heating of the room. On the other hand, in cooling and ventilating operations where it is necessary to cool the fresh air through a narrow temperature range, often in the neighborhood of but 8° or 10°,—the cooling of the fresh air requires passing the air over a much larger heat-exchange surface than is employed in heating fresh air, especially since the heat exchange surface used for cooling is maintained at a more moderate temperature, than that used for heating purposes—the increased heat-exchange surface being used to compensate for the slower rate of heat exchange where heat-transfer members having a more moderate temperature are used. The temperature of the cooling medium may be conveniently so selected that the temperature of the air will be reduced in the neighborhood of 5° to 30° F. during its period of contact with the cooling medium.

Any moisture condensed around the cooling coils during circulation of air around the same in the warm summer months is drained away from the floor 145 through the outlets 148.

By the practice of the present invention the above objects have been attained, and it is possible to employ the same air conditioning system and apparatus effectively and economically both for cooling and ventilating a room or building in warm weather and for heating and ventilating a room or building in winter.

The invention is susceptible of modification within the scope of the appended claims.

I claim:

1. A hollow window-sill for use in connection with the ventilation system of a building, which comprises a reinforced sill member, means for supporting the sill member upon and in spaced relation with respect to an underlying portion of the building wall, an outwardly sloping base member carried by the building wall and spaced below the sill member so as to define with the latter and with side members at least one hollow chamber open at the front and rear, a filter-supporting foraminous member removably mounted within the said chamber, a replaceable filter cartridge carried by the said foraminous member, and means connecting the interior of the filter-supporting member with a fresh air conduit having therein means for inducing a flow of fresh air from without the building through the filter cartridge and to the upper portion of a room to be ventilated.

2. The hollow window sill defined in claim 1 in which the sloping base member is provided at its outer margins with openings for permitting drainage therefrom to points outside the building.

3. The hollow window-sill set out in claim 1 in which the filter-supporting member comprises a shallow box-like structure having top and bottom members of foraminous material, one side of the box having an opening therein, a collar surrounding the said opening, and the side opposite the opening being provided with a member adapted to secure the bottom and top members in closed position and to support the box with the bottom thereof spaced from contact with any solid surface.

4. Air conditioning and ventilating system for buildings, comprising a hollow window-sill a box removably mounted within the hollow sill, and having a foraminous cover support for a filter element, a thin replaceable filter body carried by the said support a conduit connecting the interior of the box with the upper part of a room to be ventilated at points remote from the building wall and window, means for inducing a controlled flow of fresh air through the said conduit, heat-exchange means associated with the conduit, and means operatively associated with the said air-flow inducing means and adapted to close the said conduit when the last-named means is inoperative.

5. Air conditioning and ventilating system for buildings which comprises a hollow window sill member having one side open to the air outside of the building, means separating the interior of the hollow sill member into two communicating compartments respectively, the last-named means including a filter-supporting member open at one end into the interior of the building and having respective hinged foraminous top and bottom members and means for supporting the said filter-supporting member in spaced relation to the building wall and to the sill member, and means for introducing the filter-supporting member within the sill member and for removing the same therefrom.

6. In an air conditioning and ventilating system for buildings, a hollow window sill in the form of a chamber open at the front and rear, a filter-supporting box having a foraminous cover removably mounted within the said chamber and having an opening in one side thereof, a collar surrounding the said opening and adapted to form a closure for the rear of said chamber, a conduit connecting the interior of said box with a room to be ventilated, heat exchange means associated with the conduit, and means for inducing a controlled flow of fresh air through the said sill, box, and over the heat exchange means.

JAMES A. SPACE.