May 14, 1963 T. C. BRANDT 3,089,315

CONVERTIBLE SELF-CONTAINED COOLING UNIT FOR AIR CONDITIONING

Filed Sept. 25, 1961

FIG. 3

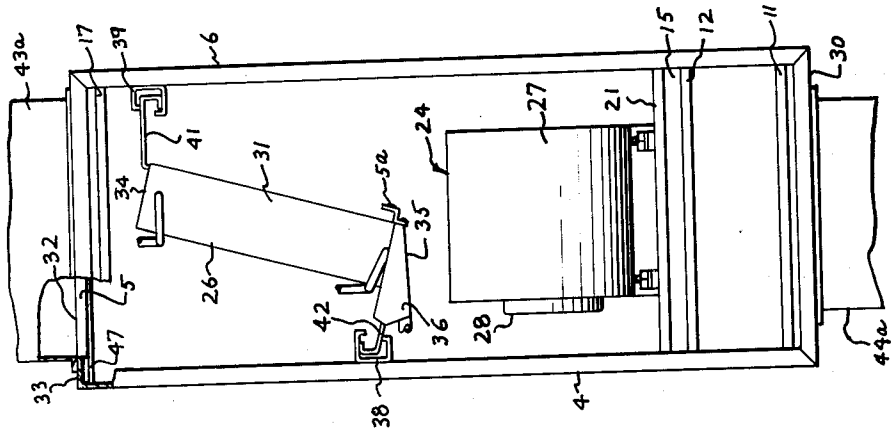


FIG. 2

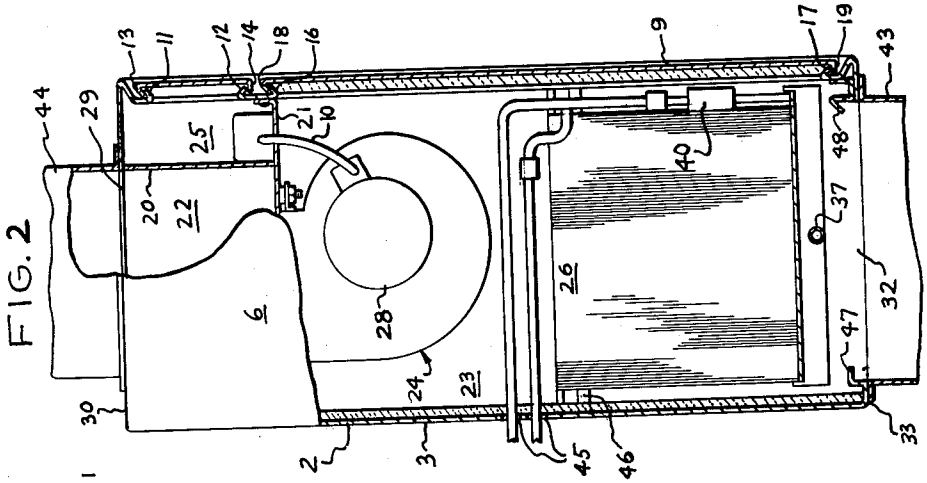
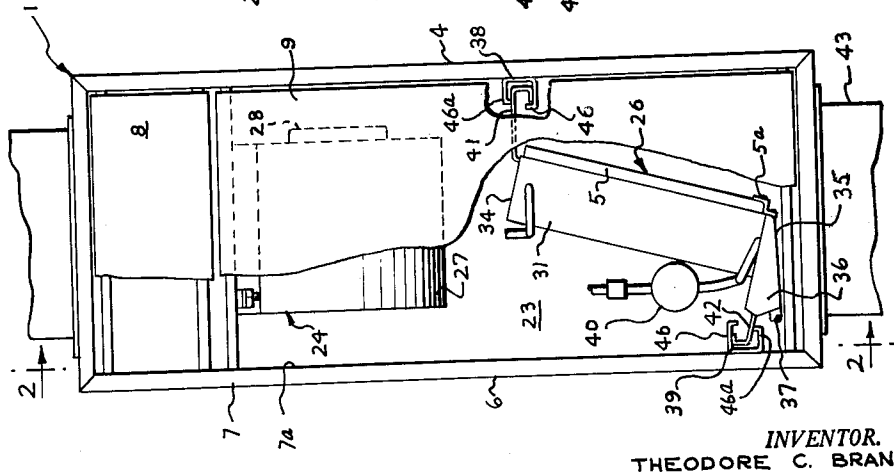


FIG. 1



INVENTOR.
THEODORE C. BRANDT

BY Herbert L. Mellhoff

HIS ATTORNEY

United States Patent Office 3,089,315 Patented May 14, 1963

3,089,315

CONVERTIBLE SELF-CONTAINED COOLING UNIT FOR AIR CONDITIONING

Theodore C. Brandt, Whitehouse, Tex., assignor to General Electric Company, a corporation of New York

Filed Sept. 25, 1961, Ser. No. 140,522
4 Claims. (Cl. 62—326)

The present invention relates to air conditioning apparatus and more particularly to an improved arrangement for a self-contained cooling unit which may be quickly and easily converted at the site of installation to provide air discharge from the unit either from the upper portions or the lower portions thereof.

Because of the various types of house construction used today, it is necessary to provide air conditioning and heating apparatus that may be mounted or installed in a variety of different ways in order to handle the various heating and cooling problems presented by the particular type of house construction. For example, some houses are built without basements and utilize air flow to the various rooms of the enclosure through ducts located in the attic of the structure. In such as case it is necessary to mount the conditioning unit above the floor level of the house and to circulate the air from the unit upwardly into the duct work while receiving the recirculated air in the lower portions of the unit. This is commonly known in the industry as an upflow unit. Other structures without basements sometimes arrange the duct work under the floor of the structure and, in such a case, it is necessary to mount the conditioning unit above the floor level in a manner so that the air is circulated downwardly into the duct work. Units of this type are commonly called downflow units in the industry. Other structures having basements and using conventional duct work located in the ceiling of the basement, usually require that the air be discharged upwardly from a unit mounted in the basement or below the floor level of the structure.

Air conditioning apparatus of the type utilized for central air conditioning, i.e. designed to discharge its conditioned air into a plurality of ducts leading to the various rooms of the structure, normally includes a cooling unit, which cools the air discharged into the duct work, and a condensing unit which dissipates the heat derived from the structure into a source of cooling medium such as outdoor air or a suitable water supply. The condensing unit usually includes a suitable refrigerant compresor, a refrigerant condenser, and means for circulating a cooling medium over the condenser. The cooling unit usually includes an air circulating device for blowing air through the duct work and a cooling unit in the form of a refrigerant evaporator and refrigerant expansion controls. The cooling unit and condenser unit are connected by lengths of refrigerant tubing leading from the cooling unit to the condensing unit. In order to accommodate the needs of the building industry many manufacturers have made two different types of units for each of the particular models they manufacture, one designed for upflow of air and the other designed for downflow of air. Manufacturing costs, of course, go up as the number of different models required by the industry go up. It has been found desirable, therefore, to manufacture but one type of unit which may be easily converted in the field to provide the necessary air flow requirements dictated by the particular housing structure.

Accordingly, it is an object of the present invention to provide a cooling unit which may be quickly and easily converted from an air upflow type unit to an air downflow type unit in the field.

Further objects and advantages of the invention will become apparent as the following description proceeds

and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In carrying out the objects of the present invention, there is provided a cooling unit comprising a case including a back, opposite side walls, and a front wall having front opening therein. A partition means disposed across the case forms a plenum chamber in one end of the case. Mounted within the case is a blower unit which is arranged to discharge into the plenum chamber air withdrawn from the remaining portions of the case. An evaporator unit having upper and lower ends is adapted for mounting in the opposite end of the case for conditioning air drawn into the case through an air inlet aperture located in the case adjacent the evaporator unit. In order to permit air to discharge from the plenum chamber into the duct work of the building, located either above or below the cooling unit, the case is adapted for mounting in one position with the plenum chamber in the upper end thereof or in the inverted position with the plenum chamber in the lower end thereof. Means including an outlet aperture leading from the plenum chamber is provided for connecting the case to the duct work of a building. In order to support the evaporator unit so that it is always properly oriented within the case there are provided a pair of support members ararnged on the opposite side walls of the case with one support member being arranged substantially above the other. The evaporator unit is provided with upper and lower brackets extending in opposite directions from the upper and lower ends of the evaporator and adapted to engage with either of the aforementioned support members to support the evaporator unit so that the evaporator unit may be removed through the front opening in the case and reinstalled in the case in its proper orientation regardless of the orientation of the case with respect to the building.

For a better understanding of the invention reference may be made to the accompanying drawing, in which:

FIGURE 1 is a front elevation view of the cooling unit of the present invention with portions of the front panels removed;

FIGURE 2 is a side elevation view of the cooling unit taken along line 2—2 of FIGURE 1; and

FIGURE 3 is a front elevation view of the cooling unit arranged in a position inverted from that of FIGURE 1 to provide flow of air in the downward direction through the unit.

Referring now to FIGURE 1 of the drawing, there is shown a cooling unit 1 of an air conditioning system which is normally mounted within a house or building structure and connected to the duct work of the house or building for circulating conditioned or cooled air into the various rooms of the structure. As is well known in the art, the cooling unit comprises only one portion of the total air conditioning system. The other major portion being the condensing unit which is sometimes mounted outside the house and exposed to outdoor air, or other cooling medium such as water, for cooling the refrigerant condenser of the system. It should be understood, however, that it is not always necessary to mount the condensing unit outside of the house or building. It could very easily be mounted within the structure in the same general location as the cooling unit or in some desirable location to which air from the outdoors can be easily circulated. It will also be understood that the condensing unit and the cooling unit are connected by suitable refrigerant tubing for carrying refrigerant between the components of the refrigeration system.

The cooling unit 1 comprises an upright case 2 generally having a greater height than width or depth. The case is normally metallic and comprises a rear wall 3,

side walls 4 and 6 and a front wall 7, which is usually provided with one or more panels which may be removed in order to gain access to the components within the unit through a large front opening 7*a* in the case. In order to prevent sweating of the case, it is usually provided with insulating material which covers the inner surfaces of the case and prevents heat transfer from the air within the case to the metal side walls and top thereof. As may be seen in FIGURE 2, an upper panel 8 is held in place by a flange 11 in the upper end of the case 2 and flange 12 on the crosspiece 15 extending vertically across the front side 7 of the case 2. More specifically a pair of flanges 13 and 14 on the front panel 8 mate respectively with the flanges 11 and 12 and secure the front panel into place. A certain amount of spring tension is provided in the flanges so that the front panel 8 is solidly retained in place by spring action when positioned on the front of the case so that it does not rattle or vibrate during operation of the unit. Similarly, the large lower panel 9 is retained in place by lower flange 16 of the crosspiece 15 and the flange 17 on the bottom front of the case (as seen in FIGURE 1) which mate with flanges 18 and 19 respectively of the lower panel. It may be desirable to attach the panel members 8 and 9 by means of spring latches of the type well known in the art to retain the panels in place without undue vibration.

As may be seen in FIGURE 2, the case 2 is divided by means including a horizontal barrier or partition 21, into a plenum chamber 22 in one end of the case and a cooling or machinery compartment 23 in the remaining portions of the case. The partition 21 is secured at the front of the case to the crosspiece 15. Part of the region above the partition 21, as seen in FIGURE 2, is separated from the plenum chamber 22 by a vertical panel 20 and thereby forms a small electrical control compartment 25 adjacent the plenum chamber. The electrical control compartment 25 and the machinery or lower compartment 23 are accessible from the front of the unit by removing the upper and lower front panels 8 and 9 respectively.

Within the compartment 23 of the case there is mounted a blower unit 24 and an evaporator unit 26 substantially one above the other. More specifically, the blower unit 24 comprises the scroll 27 which is bolted to the partition 21 with the outlet of the scroll arranged to direct air into the plenum chamber through an opening in the partition 21 adapted to fit the outlet of the scroll. Air is withdrawn by the blower unit 24 from the remaining portions of the case 2. Mounted on the scroll 27 for driving the blower wheel (not shown) within the scroll is a motor 28, which in the embodiment of the invention shown is mounted so that most of the motor extends into the scroll and only a small portion thereof extends outwardly from the scroll. The blower may also be mounted in a manner well known in the art on suitable slides to permit easy removal of the blower through the front opening in the case for servicing operations. This is a well known manner for mounting a motor on the blower scroll and further description thereof is not deemed necessary for a full understanding of the invention. As may be seen in FIGURE 2, the motor 28 is connected by power supply line 10 to its power supply in the electrical control compartment 25.

In order to discharge air from the plenum chamber 22 into the duct work of a building, means, including the outlet aperture 29, leading from the plenum chamber, are provided for connecting the plenum chamber to the duct work 44 of the building. The outlet aperture 29, in the illustrated embodiment, is shown in the end 30 of the case 3. However, it will be understood that the outlet aperture 29 may be provided at any position in the case leading into the plenum chamber 22 and the building duct work connected thereto. In practice it has been found desirable to merely outline a number of outlet apertures on the case 3 in various positions around the plenum chamber 22 so that the outlet aperture may be cut into the case at the site of installation. During operation, air is drawn from the compartment 23 into the blower scroll as indicated by the arrows in FIGURE 1. This air is first cooled as it passes through the evaporator unit 26 arranged in the end of the case opposite from the plenum chamber or, as seen in FIGURES 1 and 2, in the lower end of the case. In the illustrated embodiment of the invention, air enters the compartment 23 of the case through an air inlet aperture 32 which is formed on the side 4 of the case adjacent the evaporator unit 26. The building return air duct 43 is shown in FIGURE 1 connected to the case for directing recirculated air back into the case. Obviously, the inlet aperture 32 does not necessarily have to be formed in the side 4 of the case but it is necessary, however, that the aperture 32 be so arranged with respect to the disposition of the evaporator unit within the case that air flows through the evaporator unit before entering the blower unit 24.

The evaporator unit 26 includes a refrigerant evaporator or air cooling coil 31 and is usually provided with an expansion valve 40 for expanding liquid refrigerant from condenser pressure to evaporator pressure as well as various other apparatus for controlling the flow of refrigerant through the system. A filter 5 is shown attached to the evaporator unit 26 when the unit is mounted so that air flows upwardly through the evaporator unit toward the blower 24. A bracket 5*a* attached to the lower portion of the evaporator unit supports the filter adjacent the cooling coil 31 so that air entering the case first flows through the filter 5 before passing through the coil 31. As will be explained later on in the specification, the filter is removable so that it may be repositioned when the cooling unit is converted to a downflow unit so that air always flows first through the filter 5 prior to entering the coil 31. The filter 5 removes much of the dirt and lint from the air stream and prevents clogging of the evaporator coil 31.

Since the details of the refrigeration system and the controls may be varied, these will not be described in detail in the present invention inasmuch as a full understanding of the operation of these control components is not essential to a full understanding of the invention. However, it will be understood that, during operation of the refrigeration system, it is necessary to have the upper end 34 of the evaporator 31 oriented as shown in FIGURE 1 and the lower end 35 of the evaporator unit disposed in the downward direction. The lower end 35 of the evaporator unit is provided with a condensate water collector means or tray 36 for collecting moisture which condenses out of the air flowing through the evaporator 31. Water flows down the coil 31 into the tray 36 disposed on the lower end 35 of the unit and this water is carried from the drip tray 36 into suitable drain conduits leading from the unit. More specifically water is carried from the drip tray 36 by means of a conduit 37 which may be connected to suitable drain means disposed on the outside of the unit. Conduit 37 passes through the case 21 through any suitable opening or hole made in the case below the level of the drip tray 36.

As was mentioned previously, the evaporator 31 is connected to the condensing unit by means of suitable tubing which is inserted into the case 2 of the unit through suitable openings, in the sides or top and bottom of the case such as the openings 45 (shown only in FIGURE 2) provided in the rear side 3 of the case. After the tubing from the condensing unit is inserted into the case, the openings 45 are sealed by suitable means or collars so that air may not escape from the case through these openings.

It will be seen upon reference to FIGURE 1, that the

evaporator unit 26 is mounted within the case 2 for easy removal therefrom. Most specifically, the evaporator unit is slidably mounted within the case on a pair of support members or channel-shaped brackets, one each being arranged respectively on opposite sides 4 and 6 of the case 2. One of the support members is arranged substantially above the other on opposite sides of the case 2. More specifically the support member 38 is arranged on the side 4 toward the central portion of the case, or adjacent the blower. More specifically the other or second support member 39 is positioned toward the end 33 of the case opposite from the plenum chamber 22 or adjacent the lower end of the case as seen in FIGURES 1 and 2. Obviously the relative position of the support members could be rearranged so that they are attached to opposite sides of the case, i.e., support member 38 could be attached in its same relative position on the opposite side 6 while the support member 39 is attached in its same relative position on the side 4. In this way it is possible to permit quick adjustment of the relative position of the evaporator unit 26 so that air may be directed into the case through the side 6 if such an arrangement is desirable.

The support members 38 and 39 are disposed a vertical distance apart approximately equal to the height of the avaporator unit 31 so that they mate with support arms or brackets 41 and 42 projecting respectively in opposite directions from the upper end 34 and the lower end 35 of the evaporator unit. In the preferred embodiment of the invention brackets 41 and 42 are designed to slide into the support members 38 and 39 and to securely hold the evaporator unit 26 in the upright position. As may be seen in FIGURE 1, the support members 38 and 39 are of a generally U-shape or channel-shaped construction with inwardly directed tips 46 and 46*a* which are designed to receive the substantially square or channel-shaped end sections of the support brackets 41 and 42. The support brackets 41 and 42 are inserted into the opening at the end of the support channels 38 and 39 adjacent the front opening and the entire cooling coil is slid transversely into the case 2 from the front opening 7*a* of the case. It is a simple matter to remove the avaporator unit 26 merely by reaching through the opening 7*a* in the front of the case and sliding the evaporator unit out of the case 2 after all of the couplings on the ends of the respective tubes have been released. It will be seen that the above-described arrangement for supporting the evaporator unit makes the entire cooling unit convertible in the field from an upflow unit as seen in FIGURES 1 and 2 to a downflow unit as illustrated in FIGURE 3.

It should be mentioned that hanging brackets 41 and 42 extend continuously between the upper and lower ends of the evaporator unit and close the space between the ends of the evaporator unit and the sides of the case. This prevents air from flowing around the evaporator into the blower unit 24 and assures that all of the air will be cooled in the evaporator 31 as it is circulated through the case toward the blower.

The unit is usually shipped as an upflow unit, which will be considered the normal position of the unit. When one of these units is received in the field and is delivered to the construction site it is merely necessary to mount the unit in the first position, such as shown in FIGURE 1, or in the position shown in FIGURE 3 to provide either upflow or downflow air through the unit. That is, at the site of installation, when the return air duct 43*a* is to connect with the upper portion of the case and the conditioned air duct 44*a* of the house is to connect at the bottom portion of the case, all that is required to convert the unit from an upflow unit to a downflow unit is to slide the evaporator unit out of the case and remove the filter 5 therefrom, invert the case, as may be seen by the arrangement in FIGURE 3, and then slide the evaporator unit 26 back into place with the upper support bracket 41 arranged in the support channel 39 and the lower support bracket 42 arranged in the support channel 38. The filter 5 is then inserted above the evaporator unit (as seen in FIGURE 3) into support means provided in the end 30 of the case or in the duct work of the building. In the preferred embodiment of the invention, the filter 5 is supported by a bracket 47 and a spring clip 48 which permits the filter to be easily inserted across the opening 32 when the case is in the inverted position, as shown in FIGURE 3. By reversing the case, the support channel 39 is moved to the uppermost position in the case while the channel 38 is disposed below the support channel 39. The hanging brackets 41 and 42 of the evaporator unit 26, however, are then arranged in their normal orientation with bracket 41 above bracket 42 so that the evaporator unit is always disposed to permit water to drain downwardly into the drip tray 36 regardless of the general orientation of the case 2 within building. Thus the evaporator is always arranged in a position which will permit it to function in the normal manner. It should be noted that the filter 5 is repositioned during the conversion of the unit from an upflow to a downflow unit so that the air entering the case is first filtered prior to flowing over the cooling coil 31.

When the evaporator unit 26 and the filter 5 have been placed back into the unit then the front panels are replaced onto the front of the unit. It should be noted that the front panels 8 and 9 are positioned in their same relative position on the case so that, when the case is inverted, the front panel 8 is below the front panel 9.

As mentioned previously, the unit does not necessarily have to be provided with inlet and outlet apertures 29 and 32 in the ends 30 and 33 of the case as shown in the drawings. These sometimes are cut into the case 2 of the unit at the construction site in order to more easily adapt the unit to the particular arrangement of the duct work within the building construction. This is commonly done in all types of air conditioning installations. However, by using the cooling unit of the present invention it is only necessary to cut the openings in the proper location in the case after the unit has once been mounted with the plenum chamber 22 arranged in the upper or lower end of the case depending upon the desired direction of air flow. The only components of the unit that require any adjustment are the evaporator unit 26 and the filter 5 which merely need to be removed and reinserted into the case in their proper orientation before connecting the tubes leading to the condenser unit and to the water drain.

While in accordance with the patent statutes, there has been described what at present is considered to be the preferred embodiment of the 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 it is, therefore, the aim of the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. A cooling unit adapted for mounting above or below the air handling duct work of a building for discharging cooled air into the duct work comprising a case including a rear wall, side walls, and a front wall having a front opening therein, partition means in said case forming a plenum chamber in one end thereof, a blower unit mounted in said case and so arranged and constructed as to discharge air into said plenum chamber and to withdraw air from the remaining portions of said case, means including an outlet aperture in said plenum chamber for discharging air into said duct work of said building, an evaporator unit in said case having an upper end and a lower end, an air inlet aperture in said end of said case adjacent said evaporator unit, a pair of support members for supporting said evaporator unit in said end of said case opposite from said plenum chamber, one each of said support members attached to opposite sides of said case

in said end thereof opposite from said plenum chamber, one of said support members being arranged substantially above said other support member, upper and lower brackets extending in opposite directions from said upper and lower ends of said evaporator unit, each of said brackets adapted to engage with either of said support members to removably support said evaporator unit within said case so that said evaporator unit may be removed from said case through said front opening therein and be reinstalled into said case with said ends of said evaporator properly oriented regardless of the orientation of said case.

2. A cooling unit adapted for mounting above or below the air handling duct work of a building for discharging cooled air into the duct work comprising a case including a rear wall, side walls and a front wall having a front opening therein, partition means in said case forming a plenum chamber in one end thereof, a blower unit mounted in said case and so arranged and constructed as to discharge air into said plenum chamber and to withdraw air from the remaining portions of said case, means including an outlet aperture in said plenum chamber for discharging air into said duct work of said building, an evaporator unit having an upper end and a lower end and being removably mounted within said case in vertical alignment with said blower unit, an air inlet aperture in said case adjacent said evaporator unit, a pair of support members for supporting said evaporator unit in said end of said case opposite from said plenum chamber, each of said support members being attached to opposite sides of said case, one of said support members being arranged substantially above said other support member a distance approximately equal to the height of said evaporator unit, upper and lower brackets extending in opposite directions from said upper and lower ends of said evaporator unit, each of said brackets adapted to engage with either of said support members to removably support said evaporator unit within said case so that said evaporator unit may be removed from said case through said opening therein and after inverting said case be reinstalled into said case with said ends of said evaporator unit properly oriented for operation of said evaporator unit.

3. A cooling unit adapted for mounting above or below the air handling duct work of a building for discharging cooled air into the duct work comprising a case including a rear wall, side walls, and a front wall having a front opening therein, partition means in said case forming a plenum chamber in one end thereof, a blower unit mounted in said case and so arranged and constructed as to discharge air into said plenum chamber and to withdraw air from the remaining portions of said case, means including an outlet aperture in said plenum chamber for discharging air into said duct work of said building, an evaporator unit removably mounted in said end of said case opposite from said plenum chamber, an air inlet aperture in said end of said case adjacent said evaporator unit, a pair of channel shaped support members for supporting said evaporator unit in said case, each of said support members being attached to opposite sides of said case with one of said support members being arranged above said other support member a distance approximately equal to the height of said evaporator unit, upper and lower support brackets extending in opposite directions from said upper and lower ends of said evaporator unit, said brackets having square shaped ends thereon

adapted to mate with and slide into either of said channel-shaped support members through said front opening in said case so that said evaporator unit may be removed from said case through said front opening therein and be reinstalled into said case with said upper and lower ends of said evaporator properly oriented regardless of the orientation of said case.

4. A cooling unit adapted for mounting above or below the air handling duct work of a building for discharging cooled air into the duct work comprising a case including a rear wall, side walls, and a front wall having a front opening therein, partition means in said case forming a plenum chamber in one end thereof and a machinery compartment in the other end thereof, said case being adapted for mounting in a normal position with said plenum chamber disposed above said machinery compartment and mounted in the inverted position with said plenum chamber disposed below said machinery compartment, a blower unit mounted in said machinery compartment and so arranged and constructed as to circulate a stream of air from said machinery compartment into said plenum chamber, means including an outlet aperture in said plenum chamber adapted to discharge air into the duct work of said building, an evaporator unit removably mounted in said machinery compartment and having an upper end and a lower end, said evaporator unit including a first filter support means for supporting a filter across said evaporator unit on the downstream side thereof when said case is disposed in said normal position, an air inlet aperture in said machinery compartment adapted for connection to the duct work of said building for the circulation of air to be cooled into the said machinery compartment, said air inlet being so arranged within said compartment that air flowing into said compartment first flows through said evaporator unit before entering said blower unit, second filter support means adjacent said air inlet opening for supporting a filter across said inlet opening, a pair of channel-shaped support members for supporting said evaporator unit in said case, each of said support members being attached to an opposite side of said case with one of said support members being arranged above said other support member a distance approximately equal to the height of said evaporator unit, upper and lower support brackets extending in opposite directions from said upper and lower ends of said evaporator unit, said brackets having square-shaped ends thereon adapted to mate with and slide into either of said channel-shaped support members through said front opening in said case so that said evaporator unit may be removed from said case through said front opening therein and be reinstalled into said case with said upper and lower ends of said evaporator properly oriented regardless of the orientation of said case, and a filter adapted for mounting in said first support means on the upstream side of said evaporator when said case is in said normal position and adapted for mounting in said second filter support means on the upstream side of said evaporation unit when said case is in said inverted position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,529,203	Turpin	Nov. 7, 1950
3,012,762	Norris	Dec. 12, 1961