

July 10, 1934.

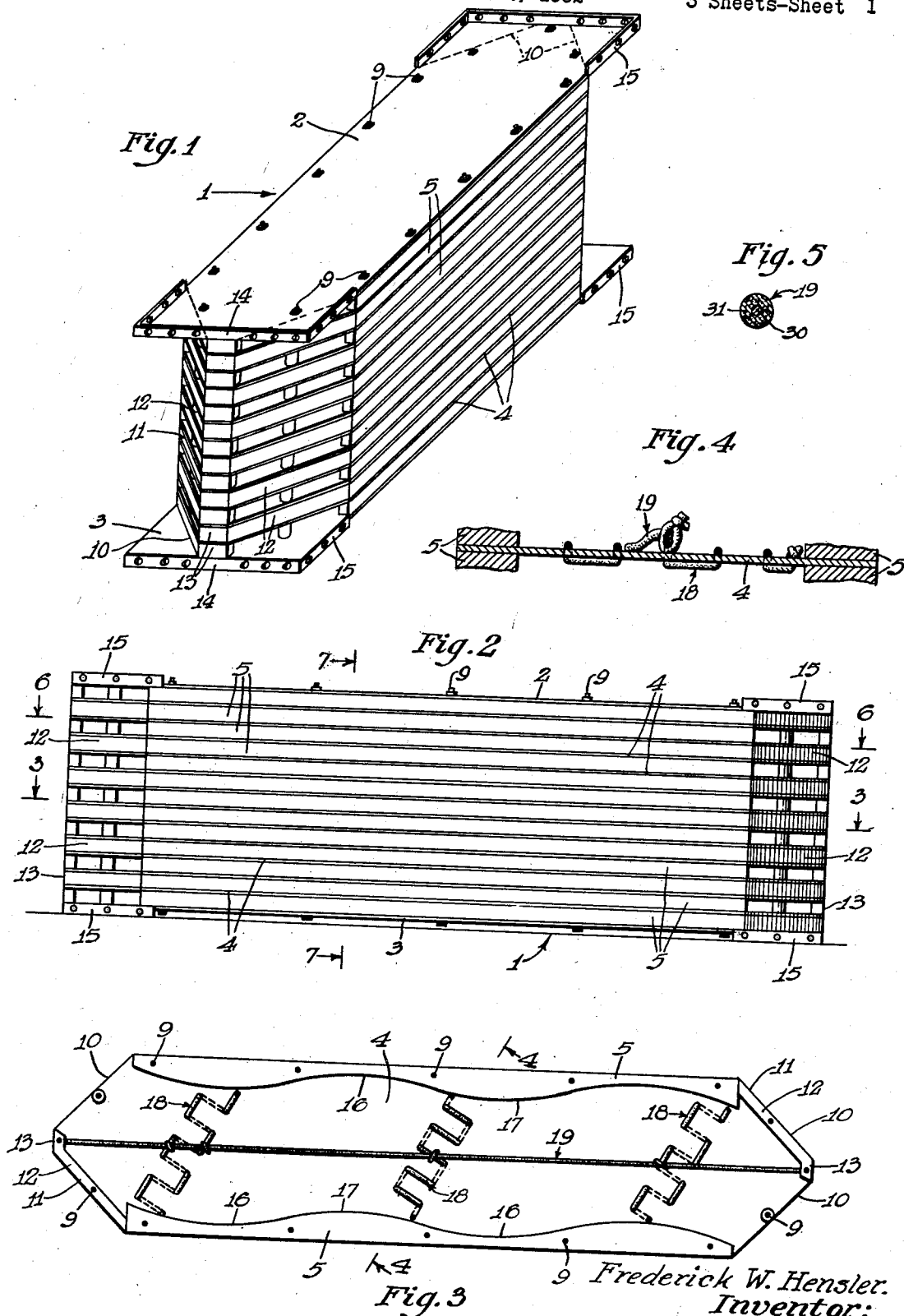
F. W. HENSLER

1,966,034

AIR CONDITIONING APPARATUS

Filed Feb. 3, 1932

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

Fig. 6

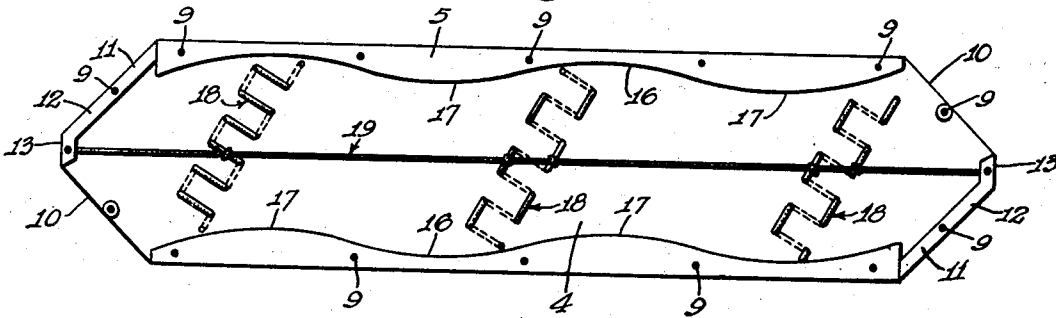


Fig. 7

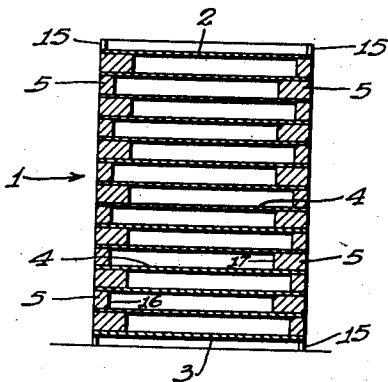


Fig. 8

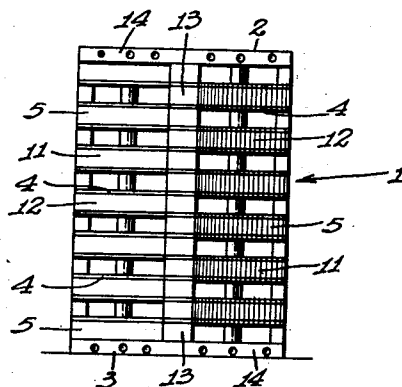
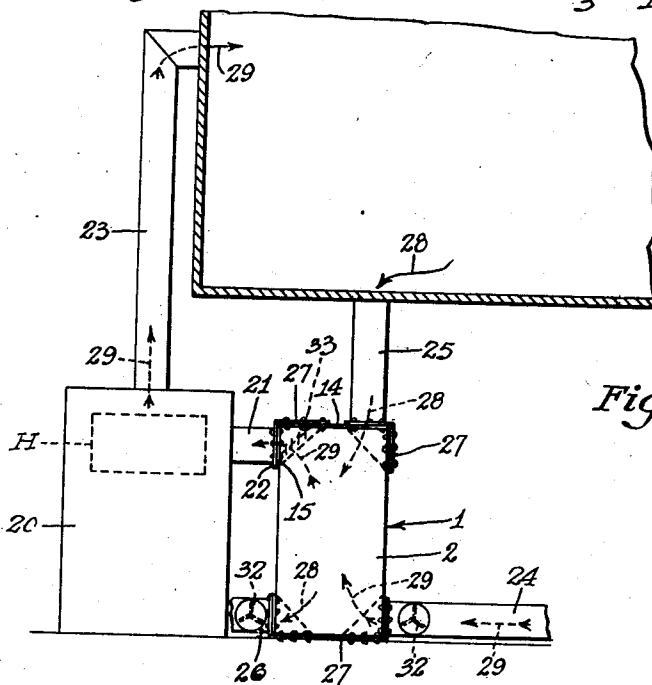


Fig. 9



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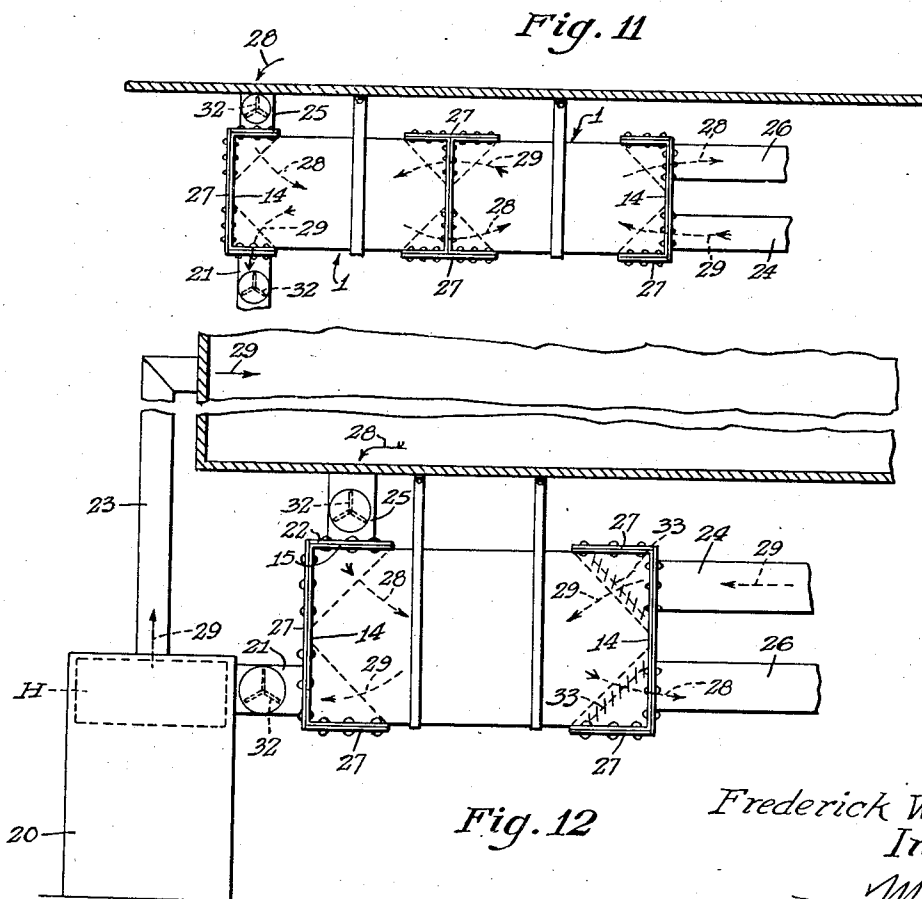
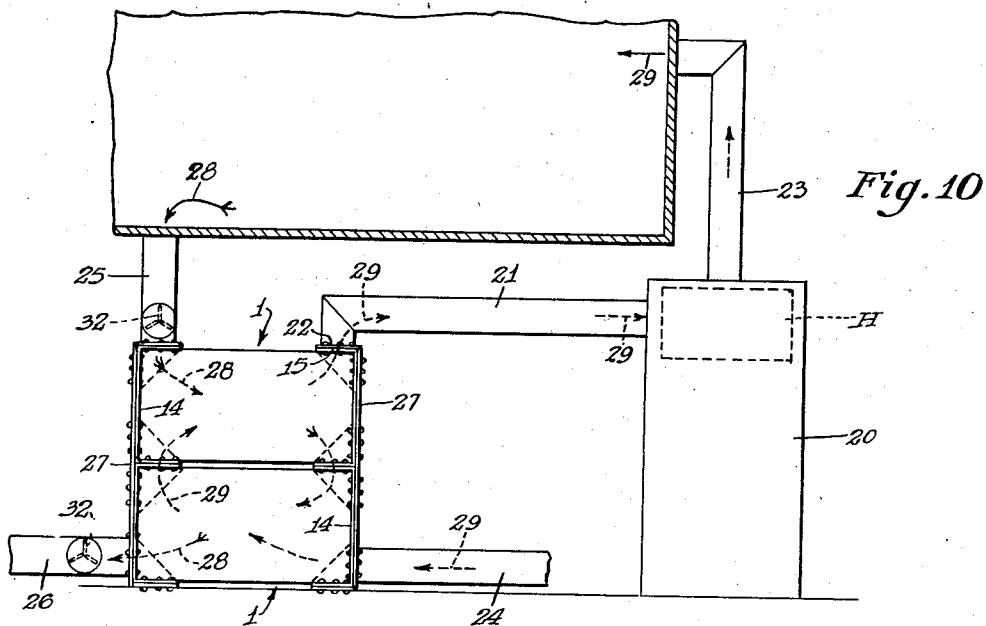
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

1,966,034

AIR CONDITIONING APPARATUS

Frederick W. Hensler, Indianapolis, Ind.

Application February 3, 1932, Serial No. 590,738

3 Claims. (Cl. 257-245)

My invention, herein called an air-conditioning apparatus, relates to the art of conditioning air generally and particularly to regenerative air conditioning.

It is adaptable for use with ventilating systems wherever a difference in temperature occurs between air outgoing from the ventilated space and exterior air incoming toward ventilated space. Its function therewith is to condition the incoming air by transferring properties between the incoming and outgoing air.

An object of my invention is to transfer heat between incoming air and outgoing air. Novel contributory improvements are provided therefor.

A further object is to transfer humidity between incoming and outgoing air. Novel means for conveying moisture precipitated from cooling air to the warming air are provided therefor.

A further object is to transfer heat in form of moisture between incoming and outgoing air. Novel arrangements of moisture transferring means are provided therefor.

A further object is to provide a device wherein the transfer of heat or humidity may take place from the outgoing air to the incoming air under certain temperature conditions and automatically transfer in reverse direction when temperature conditions are reversed, thus being adaptable for use with any ventilating system, heating system or cooling system.

A further object is to provide this invention in units that may be assembled in various combinations according to the capacity and transfer desired.

Other objects and advantages will appear in the following specification, and the novel features of the invention will be particularly pointed out in the appended claims.

My invention is illustrated in the accompanying drawings, forming part of this application, in which

Figure 1 is a perspective view of my device,

Figure 2 is a side elevation of my device,

Figure 3 is a horizontal sectional view taken along the line 3-3 of Figure 2,

Figure 4 is a transverse sectional view taken along the line 4-4 of Figure 3,

Figure 5 is a sectional detail view of the humidity transfer construction in my device,

Figure 6 is a horizontal sectional view taken along the line 6-6 of Figure 2,

Figure 7 is a vertical sectional view of my device,

Figure 8 is an end elevation of my device,

Figure 9 is a view showing my device installed in a heating and ventilating system,

Figure 10 is a view showing the manner in which a pair of my units may be combined in superimposed relationship and installed in a heating and ventilating system,

Figure 11 is a view showing the manner in which a pair of my units may be combined in end-to-end relationship and installed in a heating and ventilating system,

Figure 12 is a view showing another manner in which my device may be installed in a heating and ventilating system.

In carrying out my invention, I provide a unit 1 which comprises a pair of spaced-apart plate members 2 and 3 which are preferably rectangular in shape, as shown in Figure 1. A plurality of spaced-apart partitioning plates 4 are disposed between the plate members 2 and 3 and are held in their spaced-apart positions by means of spacing members 5 disposed therebetween. The spacing members may be constructed of any suitable material, preferably with sound retarding properties, such as a fiber composition. If desired, the spacing members might also be constructed interlocking or otherwise attached to the edge of the plates.

The plate members 2 and 3 and the partitioning plates 4 may be constructed of any suitable heat conducting material, such as galvanized sheet iron. The partitioning plates are of substantially the same length and width as the plate members 2 and 3. The plate members 2 and 3, the partitioning plates 4, and the spacing members 5 are provided with aligned openings there-through for receiving bolts 9 whereby the plate members, the partitioning plates, and the spacing members may be connected together as a unit. It will be noted that each end of the plates 4 is provided with oppositely inclined end portions 10. The spacing members 5 are substantially equal in length to the mean distance between the inclined end portions of the partitioning plates taken along a side of a partitioning plate.

On referring to Figures 3 and 6, it will be noted that the opposed ends of the unit 1 are also provided with spacing members 11 disposed between certain of the partitioning plates. The spacing members connected with each end of the unit are alternately disposed in the spaces in the opposed inclined sides of the unit 1. Each of the spacing members 11 comprises a portion 12 and an end portion 13. If desired the spacing members 5 may be extended to include portions occupied by spacing members 11, 12, and 13.

It will be noted that the end portions 13 of the spacing members are always disposed between the extreme end portions of the partitioning plates 4 for providing closed end portions made up of the partitioning plates 4, the spacing members 11, and the plate members 2 and 3.

In like manner, the plate members 2 and 3, the partitioning plates 4 and the spacing members 5 form closed side walls. The spacing members 11 are so positioned that a stream of air may flow through the unit 1, through alternate passageways between the partitioning plates, and another stream of air may flow through the unit, through the remaining passageways between the partitioning plates. Thus it will be seen that two currents of air may flow through a unit simultaneously and that a transfer of heat may be made from one current of air to the other current of air through the medium of the partitioning plates 4.

The plate members 2 and 3 are provided with flanged end portions 14 and flanged side portions 15 which may be formed integral therewith or may be otherwise provided by means of angle bars connected with the plate members 2 and 3 by any suitable means such as bolts or welding. The flange portions 14 and 15 are for the purpose of connecting a plurality of units together, connecting pipes with the units, or in general for purposes of assembly.

It will be noted on referring to Figures 3 and 6 that the spacing members 5 are each provided with an undulated inner surface comprising alternating concave portions 16 and convex portions 17. In considering a pair of opposed spacing members, it will be noted that the convex portion of one spacing member is opposite to the concave portion of the opposite spacing member, thus forming passageways undulated transversely to general direction of air flow.

It will be noted that the deflecting portion of passage is that of its narrowest dimension and that the deflecting is accomplished without restricting cross sectional area of passageways. The churning or whirling turbulence of air contributory to transfer of heat is thus accomplished with minimum resistance being offered to air flow therein.

Partitioning members 4 are provided with openings therein leading from passageways for outgoing air to passageways for incoming air. The openings are closed to the passage of air humidity transfer members 18 and 19. Portions of the humidity transfer members are in communication with air on each side of the partitioning members 4. Humidity transfer members comprise a moisture conductive portion 31 which may be linen or other suitable material and may also comprise a reinforcing portion 30 to further resist cutting or loosening from position. They are provided in size and shape suitable to the openings in the plate member through which moisture is to be transferred. It will be seen that by means of humidity transfer member, moisture precipitated from currents of air in cooling may be transferred to air warming and there evaporated.

Extensions of the humidity transfer members are provided to present a greater surface area exposed in the passageways to facilitate the attraction and evaporation of moisture. Openings are provided in rows with portions of transfer members 18 disposed in passageways between openings alternately on opposite sides of its respective partitioning plate. The openings are

positioned that the portion of moisture transfer member exposed in passageways is in transverse position to flow of air to thus create additional turbulence of air movement and attracting precipitation to occur upon its deflecting surface in one passage and facilitate its evaporation in opposite passage. One way of arranging the openings is to form them in double rows as shown. These rows are on a bias to the direction of the air passageway. When the wick is threaded through the openings over and under as shown (Fig. 6), its portions exposed on opposite sides will appear overlapped, though spaced, upon being viewed in the longitudinal line of the passageway.

It will be noted that the portion of member exposed in passageways is adjacent to the portions transferring moisture through partitioning plate and that moisture precipitated thereon need be conveyed a very short way to the opposite side of the partitioning plate.

In considering this feature, it should be noted that moisture precipitated from air is at its vapor temperature at the instant of its precipitation. Also that in form of moisture the heat content therein is greatly concentrated. Thus it will become apparent that the arrangement for attracting precipitations to a desired point and conveying it rapidly therefrom will contribute to the transfer of heat by transferring the moisture at or near the temperature of its precipitation.

A moisture transfer member 19 is positioned longitudinally with respect to the partitioning plates. It is in communication with the humidity transfer members 18 at points of their crossings. A portion of the moisture transfer member 19 is in continuous communication with passageways of warmer air. It serves as media for conveying moisture between the humidity transfer members 18. It may be extended to exterior of passageways for removing unevaporated moisture from the unit and dripped to any suitable receptacle or attached to any evaporating element, such as a heater.

Figures 9, 10, 11, and 12 show how one or a plurality of units may be utilized in heating systems. In these views, I provide a heater H having a heating chamber 20. A pipe 21 has an end connected with the heater and the other end connected with a unit 1. The pipe 21 is provided with flanges 22 for being connected with the flange portions 14 or 15 of a unit 1 by any suitable means, such as bolts or rivets.

A pipe 23 has an end connected with the heater and another end is in communication with the ventilated chamber for providing communication between the heating chamber and the ventilated space. A fresh air inlet pipe 24 may be connected with a unit in the same manner as is the pipe 21.

In like manner, pipes 25 and 26 may be connected with a unit. The pipe 25 provides communication between the ventilated space and a unit whereby the exhaust air may flow from the ventilated space to certain passages within the unit and the pipe 26 provides communication between the unit and the exterior thereof whereby the air may flow from the passageways to the exterior.

Plate members 27 may be connected with the flange portions 15 and 16 not connected with pipes, for enclosing the end spaces between the plate members 2 and 3 whereby the air passing through the passageways cannot escape.

The spacing members are so positioned that

pipes 21 and 24 are in communication with the same passageways in a unit and the pipes 25 and 26 are in communication with other passageways.

It will thus be seen that the heated exhaust air passes from the ventilated space in the direction of the arrows 28 through the pipe 25, certain alternate passageways between the partitioning plates in the unit 1, and thence through the pipe 26 to the exterior. At the same time, the fresh air is drawn in the direction of the arrows 29, through the pipes 24, certain alternate passageways between the partitioning plates in the unit 1, and through the pipe 21 to the heating chamber from which it passes through the pipe 23 to the ventilated space. Fans 32, shown diagrammatically in Figures 9, 10, 11, and 12, may be provided for positively forcing the air through the units at a uniform rate of speed. Dampers 33, also shown diagrammatically in Figures 9 and 12, may be provided for controlling the circulation of air through the ventilating system. The dampers 33 and the fans 32 may be positioned between the end portions of the plate members 2 and 3, if desired.

Thus it will be seen that heat from the outgoing air is transmitted to the incoming air through the media of the partitioning plates, thereby conserving heat energy. A portion of the moisture in the outgoing air is also transferred to the ingoing air through the media of the humidity transfer means. The humidity transfer members 18 also provide additional means for turbulating the air passing through the passageways.

It will also be seen that the units may be made of any suitable size and that they may be provided with any suitable number of partitioning plates. Furthermore, any number of the units may be combined in various combinations.

While I have shown ventilating systems in which the units are associated with a heating ele-

ment, it will be understood that cooling elements may be substituted for the heating elements, and that the exhaust air from the ventilated space may be utilized for precooling the incoming air prior to the incoming air coming in contact with the cooling element. It will be apparent under such condition, the transfer of humidity could take place in reversed direction.

I claim:

1. The combination with adjacent air conduits having a partition therebetween, of means for transferring moisture from one conduit to the other comprising a plurality of transverse wicks threaded through openings in said partition to expose alternate portions of each wick to the air current in said conduits, and a longitudinal wick in one of said conduits connecting said transverse wicks.

2. In a ventilating apparatus, at least a pair of plate members to form an air current passageway, at least one of said plate members having openings, a wick threaded through all of the openings from one to another, and spacers to hold the plate members apart and complete the passageway, the confronting surfaces of the spacers being alternately concave and convex to provide an undulating inner surface to oscillate the air current across the wick.

3. In a ventilating apparatus, means to form an air current passageway, said means including a plurality of plate members, one of said members having double rows of openings, the rows being on a bias to the direction of said passageway, and a wick so threaded through the openings as to expose the wick portions on opposite sides of the respective plate members in spaced but overlapping relationship when viewed in the longitudinal line of said passageway.

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