

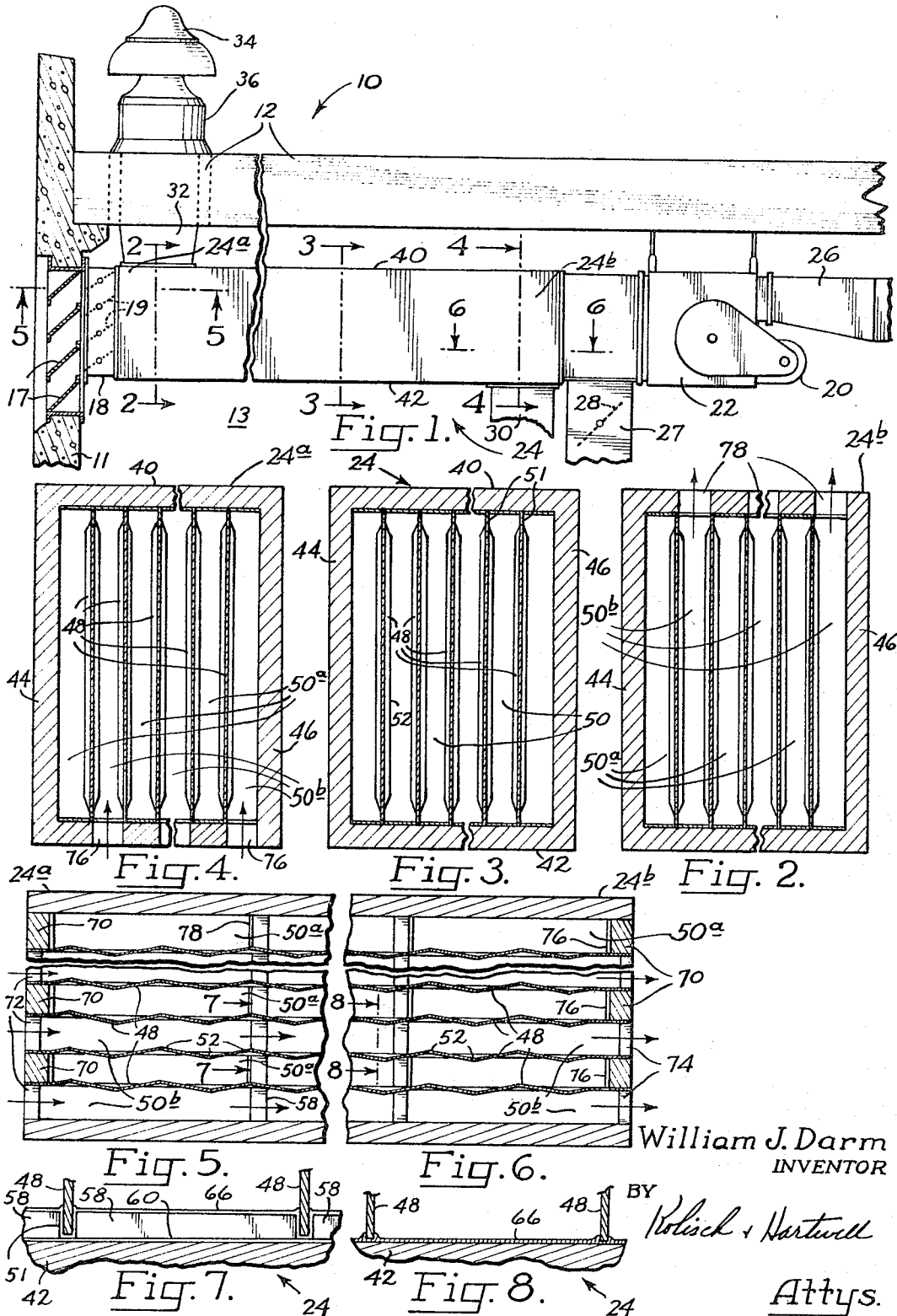
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VENTILATING SYSTEM

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1

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ABSTRACT OF THE DISCLOSURE

Apparatus for recovering heat from air including an elongated housing, substantially parallel metallic sheets within the housing extending between opposed ends and sides of the housing, spacers within the housing adjacent such opposite sides spacing the sheets from each other, a plastic sealant sealing opposed edges of the sheets adjacent said spacers to the interior of the housing, ridges in the sheets extending transversely of the housing sides promoting turbulence, and supply and exhaust port means effective to promote a movement of air in one direction through the housing through a set of channels defined between said metallic sheets and another supply and exhaust port means for effecting the movement of air in the counterflow direction through channels defined between said metallic sheets interspersed with the first-mentioned set of channels.

This invention relates generally to apparatus for recovering heat from air, and more particularly to such apparatus which features a novel heat exchanger, particularly well suited for handling relatively large volumes of air, with an efficient transfer of heat taking place between one moving volume of air at one temperature to another moving volume of air at a lower temperature.

In a specific embodiment of the invention, it is intended that the apparatus be incorporated in the air circulating system of a building, with heat transfer taking place between spent air discharged from the interior of the building and outside or make-up air drawn inside to replace the spent air. In the usual instance heat will travel from the spent air which is relatively warm to the cooler outside air, although under certain climatic conditions the reverse might be true.

A general object of this invention is to provide improved apparatus for effecting a transfer of heat between two moving volumes of air which is capable of handling large volumes in an efficient manner.

A more specific object is to provide such apparatus which, although highly effective, nevertheless is capable of manufacture at relatively low cost.

The apparatus features a heat exchanger having multiple conductive dividers defining relatively thin channels sandwiched side by side within a housing. Alternate ones of these channels provide paths for currents of air moving in one direction through the exchanger, and the remainder of the channels provide paths for currents of air moving in the opposite direction. The dividers separate the various air currents while accommodating efficient conduction of heat from the currents of warmer air to the currents of colder air as these currents flow in interspersed countercurrent streams through the exchanger.

The invention further contemplates, as an object thereof, a novel construction in such an exchanger, for mounting dividers in the desired spaced-apart position within the housing, with edges of the dividers sealed by a plastic composition to inner surfaces of the housing. As a result of the construction contemplated, required rigidity in the unit is obtained. Furthermore, the respective channels in the exchanger are isolated from each other with no leakage permitted from one to the next. This is important in eliminating contamination such as odor contamination

2

between volumes of air traveling through the exchanger.

These and other objects and advantages are attained by the invention, and the same is described hereinbelow in conjunction with the accompanying drawings, wherein:

FIG. 1 is a simplified drawing illustrating portions of a building, and an air-circulating system provided for this building, featuring a heat exchanger as contemplated by the invention;

FIGS. 2, 3, and 4 are transverse cross-sectional views of a heat exchanger in the apparatus, on a slightly larger scale than FIG. 1, taken along the lines 2-2, 3-3, and 4-4, respectively, in FIG. 1;

FIGS. 5 and 6 are cross-sectional views of portions of the exchanger, taken parallel to the longitudinal axis of the exchanger, along the lines 5-5 and 6-6, respectively, in FIG. 1; and

FIGS. 7 and 8 are cross-sectional views, on an even larger scale, taken along the lines 7-7 and 8-8 of FIGS. 5 and 6, of portions of the heat exchanger.

As already indicated generally above, the apparatus of the invention might be incorporated with an air circulation system for a building whereby, for instance, the heat of spent air from inside the building may be employed to heat incoming air from the outside. In this organization, the apparatus has the obvious advantage of reducing heating costs. Thus, and referring to FIG. 1, shown generally at 10 is a building, including walls such as side wall 11 and roof 12, defining an enclosed interior region 13 inside the building.

Introducing fresh air from outside the building into interior 13 is a duct 18 communicating with a ventilating grid 17. Adjustable vanes 19 control the flow of air through duct 18. A power-operated air mover comprising motor 20 and the usual blower within the housing 22 is effective to draw air from duct 18 through a heat exchanger 24 and expel such air into a duct 26. Duct 26 connects with a distributing ductwork for air within the building, which has been eliminated from the drawings for reasons of simplicity. A recirculating duct for air for feeding the blower is shown at 27, which duct is controlled by vane 28.

Spent air inside the building, which is exhausted from the building, travels from interior 13 into the heat exchanger through a duct 30. The air travels through the heat exchanger, and thence upwardly through a duct 32, to be expelled into the atmosphere under a housing cap 34. Shown generally at 36 is a power-operated air mover, more specifically an exhaust fan or blower, which operates to pull air upwardly through duct 32 and to expel the same into the atmosphere.

Heat exchanger unit 24 is shown in more detail in FIGS. 2 through 8. Reference is now made to these figures in explaining the construction of the specific heat exchanger disclosed herein.

The heat exchanger includes a housing which has the shape of an elongated rectangular box. Forming the top and bottom of the housing are panels 40, 42, which may be made of any suitable material, and conveniently may be made of plywood or other such board. Forming opposite sides of the housing are panels 44, 46. These panels are all suitably secured together to form a rigid unit.

Extending along the interior of the housing are multiple elongated dividers of conductive material, more specifically metallic sheets, shown at 48. These sheets are substantially parallel, and parallel opposed sides of the housing. Thus, the sheets function to define multiple elongated relatively thin channels, such as the ones indicated at 50. These channels are side by side, in a sandwich-type of construction.

As contemplated herein, each of the metallic sheets is corrugated in a region located between opposed longitudinal edges. Such corrugations extend transversely of a

sheet, as exemplified by the corrugations shown at 52. Preferably the margins of a sheet along the longitudinal edges thereof are free of corrugation, or flat (as exemplified by margins 51), which facilitates mounting the sheet within the housing.

In mounting the sheets in place, they are inserted from one end of the housing prior to any closing off of the end. Holding the sheets in place, in spaced relationship within the housing, are spacers, such as the ones indicated at 58 and shown enlarged in FIG. 7. These spacers may be secured in a row along an elongated thin strip 60, which strip on being attached to one of the panels in the housing functions also then to anchor the row of spacers in place. A sheet is inserted into its proper position by shifting it endwise between adjacent spacers supported on successive strips distributed along the length of the housing.

In order that the channels be completely isolated from each other, thus to prevent any mixing of air carried by adjacent channels, it is contemplated that a plastic material, for example a liquid resin such as an uncured epoxy resin, be distributed over opposed inner surfaces of panels 40, 42 and the spacers immediately prior to the placement of the sheets in place. Such a layer of resin is best shown in FIGS. 7 and 8 of the drawings at 66. When the sheets are shifted into place, the resin which is still soft at this time, envelopes the flat margins of a sheet and forms an air-tight seal. On curing and hardening the resin layers contribute to the rigidity of the entire unit.

As contemplated herein, alternate channels are employed to carry a moving volume of air in one direction through the exchanger, such as outside air traveling into the interior of the building, and the remaining channels are employed to carry a moving volume of air in the opposite direction, with one volume moving as streams that are interspersed with streams of the other volume of air. Further explaining how such is performed, referring to FIG. 5, shown at 70 are elongated strips (which also may be made of wood) which are secured in place adjacent end 24a of the exchanger in positions closing off alternate channels. Surfaces of these strips may be coated with epoxy resin, which resin enveloping end margins of the strips to form a tight seal therewith. The channels in FIG. 5, which are closed off by these strips, are designated at 50a. The same channels are closed off in a similar manner at the opposite end of the exchanger, or end 24b (see FIG. 6).

Remaining channels 50b interspersed with channels 50a are left open at end 24a, and the openings left for these channels have been given the reference numeral 72. These function as a supply port means for introducing air into the exchanger from duct 18 earlier described. These remaining channels are also left open at the opposite end of the exchanger, and the openings left, shown at 74 in FIG. 6, constitute exhaust port means for exhausting from the exchanger that air which entered through openings 72. Such air exhausted through openings 74 flows into duct 26.

As best seen in FIG. 4, the housing for exchanger 24 along its bottom side is apertured at 76 immediately above where duct 30 joins with the housing. Openings 76 communicate with channels 50b, and constitute supply port means through which spent air may travel into the exchanger and channels 50b from duct 30. Referring to FIG. 2, the top side of the exchanger is apertured at 78 adjacent end 24b, and these openings constituting exhaust port means enable air in channels 50b to travel from the exchanger into duct 32.

Thus, with the construction described, relatively thin channels are provided for passing streams of air in countercurrent flow through the exchanger. These streams are formed on the air entering into the unit, and on being formed, the streams are interspersed with similar streams flowing in the opposite direction through the unit. The construction described, while permitting close intimate as-

sociation of the respective air streams, whereby efficient heat transfer can take place between the streams, at the same time insures that the streams are isolated, thus to prevent contamination of the air making up one set of streams by the air making up the other set. The metallic conductive sheets, which are utilized in defining the channels, are corrugated for the purpose of increasing the turbulence of air flowing in the streams, thereby to promote the transfer of heat from the warmer air streams to the colder air streams.

In operation of the building circulation system disclosed in FIG. 1, air mover 22 is operated to draw fresh air from outside the building into region 13. Assuming winter conditions, this air normally is at a lower temperature than the air inside the building. Spent air leaving the building travels through the exchanger and is exhausted by air mover 36. On passing through the exchanger, the heat contained by the streams of spent air is through conduction transferred to the incoming air with raising of the temperature of this air. Such air on leaving air mover 22 may then be further heated to bring the temperature of the air up to that desired for room conditions inside the building.

From the above it should be apparent that novel apparatus is contemplated which produces efficient transfer of heat between two moving volumes of air. The structure contemplated is relatively simple and is capable of manufacture at relatively low unit cost.

While an embodiment of the invention has been described, it is obvious that changes and variations are possible without departing from the invention. It is intended to cover all embodiments of the invention as would be apparent to one skilled in the art, and that come within the scope of the appended claim.

It is claimed and desired to secure by Letters Patent:

1. Apparatus for recovering heat from air comprising a hollow housing; multiple parallel metallic sheets within said housing having opposed edges adjacent a set of opposed sides of the housing and extending between opposite ends of the housing; spacers inside and adjacent said opposite sides of the housing, spacing the sheets from each other; means sealing said edges of the sheets adjacent said housing sides to the interior of the housing; said sheets, between adjacent ones of the sheets, defining plural channels disposed side by side and extending between said ends of said housing; and first supply and exhaust port means for alternate ones of said channels adjacent opposite ends of the housing for effecting air movement through said channels in one direction through the housing and second supply and exhaust port means for the remaining said channels adjacent opposite ends of the housing for effecting air movement through said remaining channels in the opposite direction through said housing, said sheets have ridges in regions located between their said opposed edges which extend between said opposed set of sides of said housing, said ridges terminating short of said sheet edges to leave flat expanses at said edges, said spacers inside said housing engage said sheets where said edges extend as flat expanses, and wherein the means sealing the edges of the sheets to the interior of the housing comprise a plastic sealing material covering said edges where they extend as flat expanses.

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