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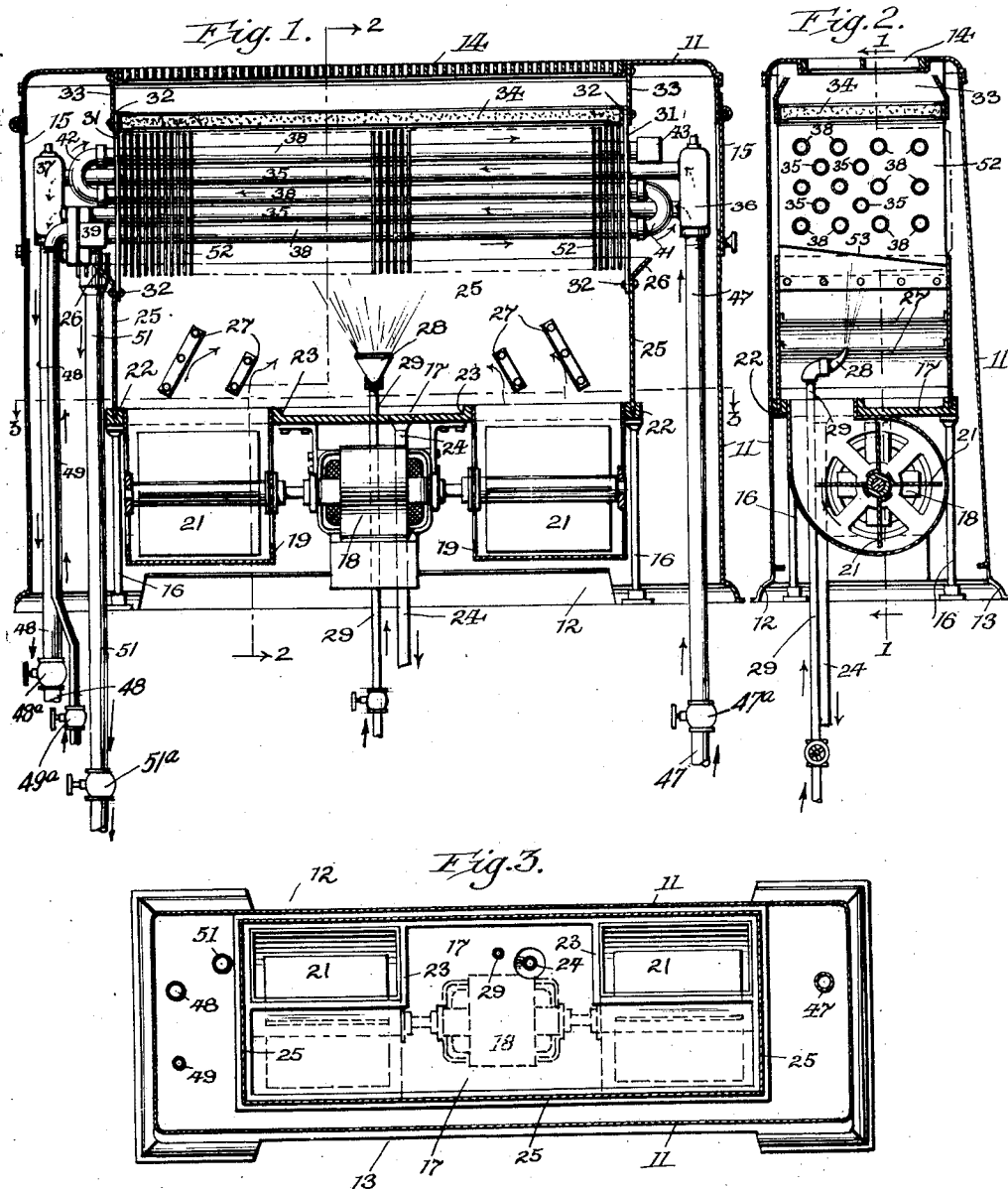
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2,065,873

HEATING AND VENTILATION

Filed March 17, 1933

2 Sheets-Sheet 1



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Fig. 7.

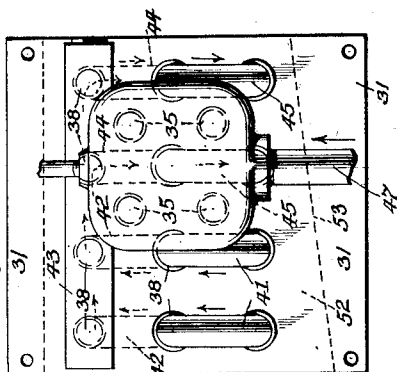


Fig. 9.

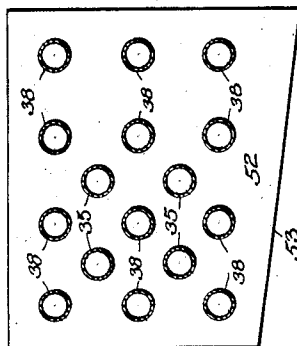


Fig. 4.

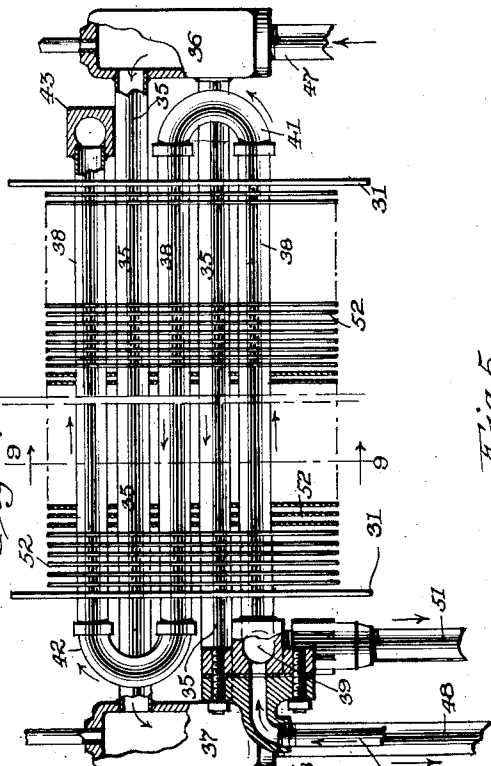


Fig. 5.

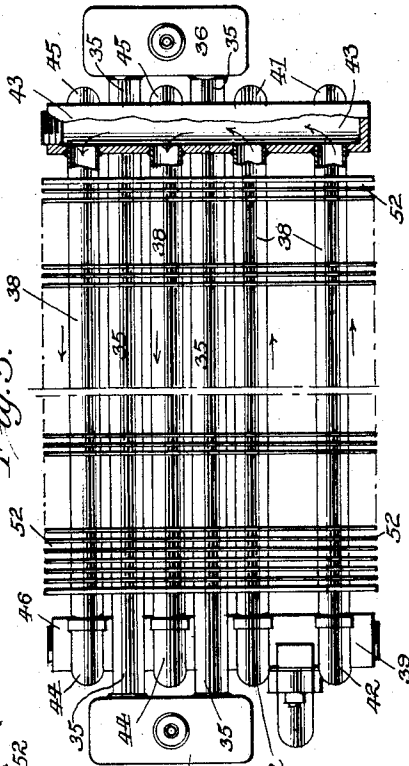


Fig. 6.

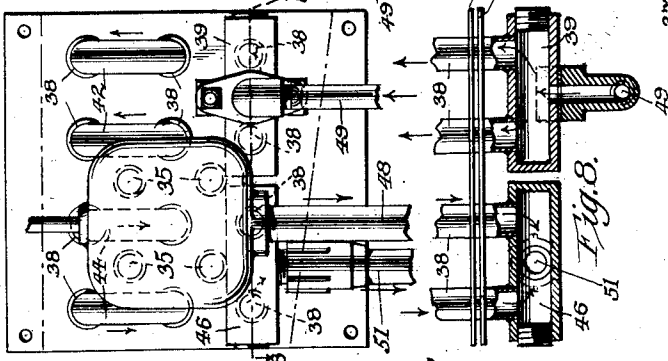


Fig. 8.

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## UNITED STATES PATENT OFFICE

2,065,873

## HEATING AND VENTILATION

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Application March 17, 1933, Serial No. 661,408

16 Claims. (Cl. 257—9)

This invention relates to heating and ventilation and particularly to devices of the so-called unit type intended to be installed in the room whose air is to be treated.

5 The purpose of the invention is to provide a single compact unit which will heat and humidify air in winter and cool and dehumidify air in summer. The air so treated may be drawn from any source, for example from the room, or partly from the room and partly from out of doors. Both practices are common in the arts of heating and cooling.

For simplicity I shall omit fresh air connections and dampers and shall describe the invention as applied to a unit in which the air is drawn from the room, treated and returned to the room, but it is to be understood that the use of fresh air connections is not excluded from the scope of the invention, and is regarded as conventional practice with devices of this general class.

One feature of the invention is the use of two tubular heat exchangers, one for a heating medium and the other for a cooling medium, in conjunction with a single set of heat transfer fins or plates, such fins being in heat conducting relation with both tubular heat exchangers.

Another feature of the invention is the construction of the fins or plates in such a manner as to deliver moisture deposited thereon out of the path of circulating air and into a drain or sump. This moisture is deposited on the plates chiefly under summer conditions, by condensation; but may be deposited under winter conditions if the humidifying spray is operated at an excessive rate.

The device is characterized by the fact that a single set of fins acts to increase the heat transfer surface for both heating and cooling, although separate paths for the heating and cooling media are provided. Furthermore, the fins serve the functions of eliminators and act as a muffler to absorb the noise of the fan and its driving motor.

A preferred embodiment of the invention is illustrated in the accompanying drawings, in which:—

Fig. 1 is a vertical section through the complete unit on the line 1—1 of Fig. 2.

Fig. 2 is a vertical section through the unit on the line 2—2 of Fig. 1.

Fig. 3 is a horizontal section through the unit on the line 3—3 of Fig. 1.

Fig. 4 is an elevation of the combined heating and cooling element looking from the front (right side in Fig. 2). Parts are shown in section.

Fig. 5 is a plan view of the same. Parts are shown in section.

Fig. 6 is an elevation of the left end of the element shown in Fig. 4.

Fig. 7 is an elevation of the right end of the element shown in Fig. 4.

Fig. 8 is a fragmentary section on the line 8—8 of Fig. 6.

Fig. 9 is a section on the line 9—9 of Fig. 4.

The present invention is not concerned with controlling means for the heating and cooling media or for the fans, but any preferred automatic controls may be used.

The mechanism is enclosed and partly supported by a substantially rectangular metal case or housing 11, closed on its sides except for air inlet slots 12, 13, near the floor. One of these slots 12 at the back might be connected with a fresh air duct if preferred, but as shown both slots 12 and 13 serve as inlets for recirculated air. The major portion of the top is open, forming an air discharge passage protected by a grille 14. Access doors are indicated at 15 and may be located wherever desired.

Supported on legs 16 is a horizontal plate 17 beneath which are suspended the fan motor 18 and the housings 19 of two fans 21 driven by said motor. The housings are of the "snail shell" type and their discharge connections fit into apertures formed in plate 17 to receive them.

An upstanding slotted flange 22 encircles the plate 17 and flanges 23 encircle the discharge ports, so the plate 17 serves as a sump or basin to collect moisture which is drained away through drain pipe 24.

A rectangular enclosure 25 is seated in the slot in the flange 22, and has a flared upper portion 26 at its ends. Inclined baffles 27, overlying the fan discharges are used to secure even distribution of the discharging air over the heat exchange unit above. A humidifying spray 28 fed with water by pipe 29 is used to deliver atomized water to this unit under winter conditions. This spray head may be omitted altogether.

The heat exchange unit is carried by two end plates 31 which are connected at 32 to the ends of the enclosure 25 and are also connected by suspender plates 33 with the top of housing 11. A filter 34 also carried by the suspender plates 33 overlies the heat exchange unit.

The heat exchange unit is made up of two sets of pipes or tubes. In the example illustrated there are four heating pipes 35 connected in parallel between a supply manifold 36 and a return manifold 37, and twelve cooling pipes 38. The

cooling pipes make six passes in series, two pipes being in parallel with each other in each pass. The supply manifold 39 (Figs. 6 and 8) supplies the first pass (two pipes), the return bends 41 connect the first and second passes, the return bends 42 the second and third. The manifold 43 (Figs. 4, 5 and 7) connects the third and fourth passes. The return bends 44 and 45 form connections between the fourth and fifth, and the fifth and sixth passes respectively. The discharge manifold appears at 46.

The heating medium supply pipe is shown at 47 and the return at 48. The heating medium may be steam or other suitable fluid. The heating medium may be shut off under summer conditions by closing the stop valves 47<sup>a</sup> and 48<sup>a</sup> (see Fig. 1).

The supply and return pipes for the refrigerating medium are shown at 49 and 51, and may be shut off under winter conditions by closing the stop valves 49<sup>a</sup>, 51<sup>a</sup>. The refrigerant will commonly be merely a heat convector such as refrigerated brine, but it may be a volatile refrigerant in which case the tubes 38 act as an evaporator in an ordinary compressor, condenser, evaporator refrigerating circuit.

The tubes 35 and 38 extend through apertures in, and are supported by the end plates 31. These end plates form a part of the extended heat exchange surface. Any condensed moisture draining from these plates will be intercepted by the flaring portions 26 and delivered to the top of plate 17.

Between the plates 31 the tubes 35 and 38 have a plurality of closely spaced fins 52 of sheet copper or other metal characterized by high heat conductivity. These fins are common to all the tubes, and act both as extended heat transfer surfaces and as eliminators. So far as the invention is concerned they may be wholly independent or interconnected, both types of fin being known.

The lower edges of these plate fins are inclined as indicated at 53, so that condensate, adhering by capillary attraction will flow to the low corner and there drip to plate 17 and not into the fan housings (see Fig. 2). This takes the drip out of the air path and prevents the droplets from being picked up by the air current.

The invention provides a peculiarly simple and compact structure available for heating (with or without humidification) and for cooling (which will commonly entail dehumidification). The spray can be used under summer conditions as a washer, but this is not ordinarily desired. Separate flow paths are afforded the two heat exchange media, and the maximum available surface is secured in the available space.

Since the heating and cooling elements are brought into heat conducting relation with one another and are used selectively, each functions with the aggregate surface of the two; and since the two are at substantially the same temperature, stresses incidental to differential expansion are avoided. This last permits the two units to be carried by a single support without the provision of any special means to permit differential expansion and contraction of the two units.

Modifications within the scope of the invention are contemplated.

What is claimed is,—

1. The combination of two tubular heat exchangers; connections for circulating a heating medium through one of said exchangers; connections for circulating a cooling medium

through the other of said exchangers; means controlling said connections to provide circulation of said media selectively; a plurality of substantially vertical heat conducting plates through which the tubes of said heat exchangers pass and with which the tubes of both exchangers are in heat conducting relation, said plates having inclined lower edges arranged to deflect moisture deposited on the plates and cause it to flow therefrom adjacent one side of the exchanger; and means for spraying moisture on said plates.

2. The combination of means forming a substantially vertical duct; a heat exchanger; a plurality of substantially vertical heat conducting plates in heat conducting relation with said exchanger and extending across said duct, said plates having inclined lower edges serving to deflect to one side of the duct, moisture deposited on said plates; means for collecting such moisture as it flows from the plates; and means for causing a circulation in said duct.

3. The combination of means forming a duct; two tubular heat exchangers, each made up of a plurality of tubes extending transversely across said duct and distributed over the flow path therethrough, the tubes of one exchanger being interspersed among the tubes of the other exchanger; connections for circulating a heating medium through the tubes of one exchanger; connections for circulating a cooling medium through the tubes of the other exchanger; means controlling said connections to provide circulation of said media selectively; a plurality of heat conducting plates extending transversely to said tubes, through all of which the tubes of both exchangers pass and with all of which the tubes of both exchangers are in heat conducting relation; supporting means connected with certain of said plates and serving to support both exchangers and the plates as a unit; and means for causing a circulation through said duct.

4. Apparatus for conditioning the air in a room by selectively heating or cooling air delivered thereto, comprising a housing; means for forcing air through said housing into such room; a convertible heating and cooling heat exchanger mounted in said housing in the path of such air, said exchanger comprising means forming separate flow paths, one for a heating and the other for a cooling medium, and a fin structure of extended heat transfer surface in heat conducting relation with both said path forming means; and means for supplying heating and cooling media selectively to said flow paths.

5. Apparatus for conditioning the air in a room by selectively heating or cooling air delivered thereto, comprising a housing; means for forcing air through said housing into such room; a convertible heating and cooling heat exchanger mounted in said housing in the path of such air, said exchanger comprising means forming separate flow paths, one for a heating and the other for a cooling medium, and a fin structure of extended heat transfer surface in heat conducting relation with both said path forming means; means for supplying heating and cooling media selectively to said flow paths; moisture collecting means in said housing out of the path of air therethrough; and means associated with said fins for delivering moisture deposited on said exchanger to said collecting means.

6. Apparatus for conditioning the air in a room by selectively heating or cooling air delivered thereto, comprising a housing; means for forcing air through said housing into such room;

a convertible heating and cooling heat exchanger mounted in said housing in the path of such air, said exchanger comprising means forming separate flow paths, one for a heating and the other  
 5 for a cooling medium, and a fin structure of extended heat transfer surface in heat conducting relation with both said path forming means; means for supplying heating and cooling media selectively to said flow paths; and supporting  
 10 means for said exchanger, connected with the extremities of fins forming part of said fin structure.

7. Apparatus for conditioning the air in a room by selectively heating or cooling air delivered thereto, comprising a housing; means for forcing air through said housing into such room; a convertible heating and cooling heat exchanger mounted in said housing in the path of such air, said exchanger comprising means forming separate flow paths, one for a heating and the other  
 15 for a cooling medium, and a fin structure of extended heat transfer surface in heat conducting relation with both said path forming means; means for supplying heating and cooling media selectively to said flow paths; moisture collecting means in said housing out of the path of air therethrough; means associated with said fins for delivering moisture deposited on said exchanger to said collecting means; and supporting means  
 20 for said exchanger, connected with the extremities of fins forming part of said fin structure.

8. The combination of means forming a duct; two tubular heat exchangers, each made up of a plurality of tubes extending transversely across  
 35 said duct and distributed over the flow path therethrough; connections for circulating a heating medium through the tubes of one exchanger; connections for circulating a cooling medium through the tubes of the other exchanger; means controlling said connections to provide circulation of said media selectively; a plurality of heat conducting plates extending transversely to said tubes, through which the tubes of both exchangers pass and with which the tubes  
 40 of both exchangers are in heat conducting relation; and means for causing a circulation of air through said duct.

9. The combination of means forming a duct; two tubular heat exchangers, each made up of a plurality of tubes extending transversely across  
 50 said duct and distributed over the flow path therethrough, the tubes of one exchanger being interspersed among the tubes of the other exchanger; connections for circulating a heating medium through the tubes of one exchanger; connections for circulating a cooling medium through the tubes of the other exchanger; means controlling said connections to provide circulation of said media selectively; a plurality of heat  
 55 conducting plates extending transversely to said tubes, through which the tubes of both exchangers pass and with which the tubes of both exchangers are in heat conducting relation; and means for causing a circulation of air through  
 60 said duct.

10. In a heat exchanger, a heating conduit, a cooling conduit, said conduits having independent inlet and outlet connections whereby heating and cooling mediums are circulated independently through said conduits, a plurality of  
 70 fins engaged with said conduits whereby the heating conduit and fins constitute an extension of the surface of the cooling conduit to assist the cooling conduit in cooling fluid passed through the exchanger when a cooling medium is circulated through the cooling conduit, and the cooling conduit and fins constitute an extension of the surface of the heating conduit to assist the heating conduit in heating a fluid passed through the exchanger when a heating medium is circulated through the heating conduit.

11. In a heat exchanger, a series of pipes disposed to extend similarly and interconnected at their ends to provide a conduit through which a heating medium may be circulated to afford a heating conduit, another series of pipes disposed  
 15 to extend similarly to each other and the first series of pipes and interconnected at their ends to provide a conduit through which a cooling medium may be circulated to afford a cooling conduit, and a series of plates forming fins and engaged with the pipes of both of said conduits whereby the heating conduit and fins constitute an extension of the surface of the cooling conduit to assist the cooling conduit in cooling a fluid passed through the exchanger when a cooling medium is circulated through the cooling conduit, and the cooling conduit and fins constitute an extension of the surface of the heating conduit to assist the heating conduit in heating a fluid passed through the exchanger when a heating medium is circulated through the heating conduit.

12. In a heat exchanger, a heating conduit comprising a plurality of pipes interconnected at corresponding ends and having inlet and outlet  
 35 connections at opposite ends of the conduit, a cooling conduit comprising a plurality of pipes interconnected at corresponding ends and having inlet and outlet connections at opposite ends of the conduit, said pipes being arranged in substantially parallel relation, a plurality of fins engaged with said conduits and extending in substantial parallelism at an angle to the conduits whereby the heating conduit and fins constitute an extension of the surface of the cooling conduit to assist the cooling conduit in cooling a fluid passed through the exchanger when a cooling medium is circulated through the cooling conduit, and the cooling conduit and fins constitute an extension of the surface of the heating conduit to assist the heating conduit in heating a fluid passed through the exchanger when a heating medium is circulated through the heating conduit.

13. In ventilating and air treating apparatus, 55 the combination with a temperature modifying element comprising a set of side pipe sections, spaced apart fin plates through which said pipe sections extend and on which they are secured, a second set of pipe sections each of which is adjacent a corresponding one of the first mentioned pipe sections and extends through and is secured to the corresponding fin plate, said fin plates collectively defining a multiplicity of air passages transverse to said pipe sections, of  
 60 means for passing an air heating fluid through the pipe sections of one set, means for passing an air cooling fluid through the pipe sections of the other set, and means for directing a flow of air through said fin passages.

14. In ventilating and air treating unit, the combination with a casing having two spaced apart sets of ports through which the interior of said casing communicates with the room in which the unit is located, of an element mounted in  
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said casing and comprising a set of side by side pipe sections and spaced apart fin plates through which said pipe sections extend and to which they are secured, a second set of pipe sections each of which is adjacent a corresponding one of the first mentioned pipe sections and extends through and is secured to the corresponding fin plates, the latter collectively defining a multiplicity of air passages transverse to the pipe sections and interposed between the ports of one set and the ports of the other set, means for passing an air heating fluid through the pipe sections of one set, means for passing an air cooling refrigerant fluid through the pipe sections of the other set, and a fan in said casing for moving room air into the casing through the ports of one set and thence through said passages and back into the room through the ports of the other set.

15. The combination of means forming a substantially vertical duct; two tubular heat exchangers, each made up of a plurality of tubes extending transversely across said duct and distributed over the flow path therethrough; connections for circulating a heating medium through the tubes of one exchanger; connections for circulating a cooling medium through the

tubes of the other exchanger; means controlling said connections to provide circulation of said media selectively; a plurality of heat conducting plates extending transversely to said tubes, through which the tubes of both exchangers pass and with which the tubes of both exchangers are in heat conducting relation, said plates being arranged to deliver to one side of said duct, moisture deposited upon them; means for collecting moisture so delivered; and means for causing a circulation of air through said duct.

16. Air conditioning apparatus for heating or cooling air for an enclosure comprising a heat exchange element including a group of heat conducting plates, a plurality of heating tubes arranged in heat conducting contact with said plates, and a plurality of cooling tubes arranged in heat conducting contact with said plates and interspersed among said heating tubes; means for conveying heating fluid through said heating tubes; means for conveying cooling fluid through said cooling tubes; and means for conveying air in contact with said heat conducting plates and into the enclosure.

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