Feb. 5, 1957 A. B. RIMBACH 2,780,445

HEAT EXCHANGE APPARATUS

Filed Aug. 25, 1954 2 Sheets-Sheet 1

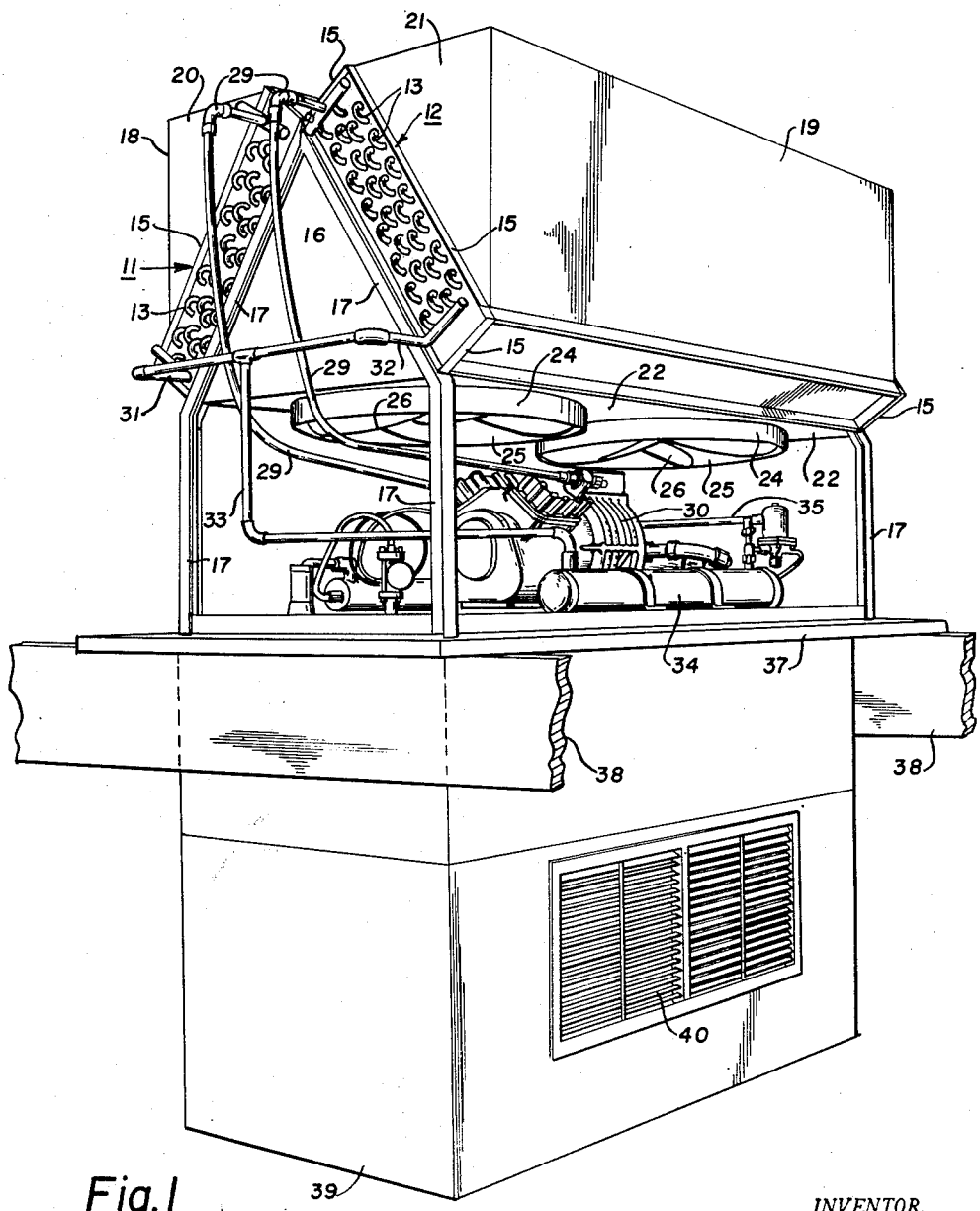


Fig. 1

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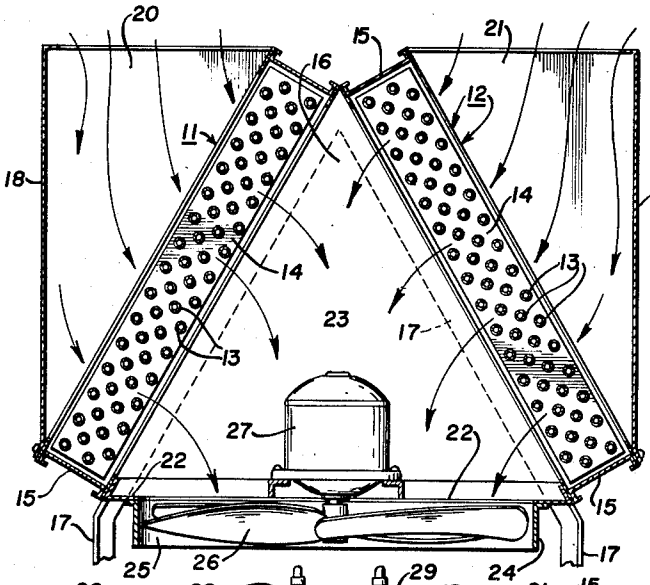
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Filed Aug. 25, 1954 2 Sheets-Sheet 2

Fig.3



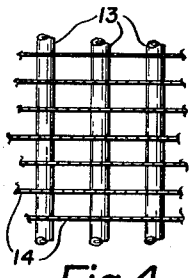


Fig.4

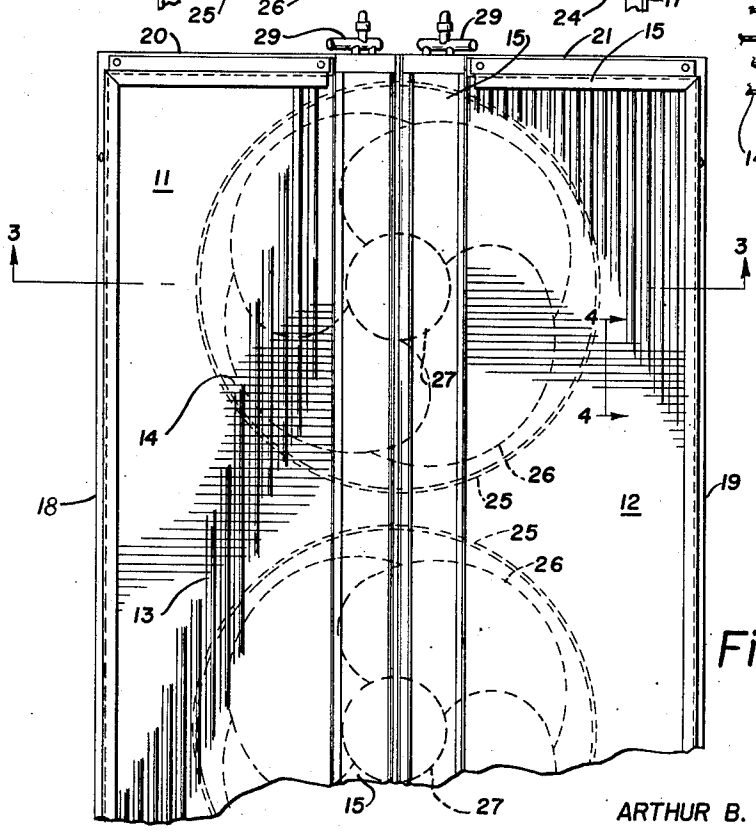


Fig.2

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2,780,445

HEAT EXCHANGE APPARATUS

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Application August 25, 1954, Serial No. 452,040

7 Claims. (Cl. 257—137)

My invention relates to heat exchange apparatus and particularly of the type wherein there is heat exchange between fluid contained in the tubes or chamber of a heat exchanger and the air of the surrounding atmosphere.

An object of my invention is the provision of an improved construction of a device arranged to obtain efficient heat exchange between the fluid moving through tubular heat exchangers and the atmosphere.

Another object is the provision for maintaining equilibrium or balance of heat exchange through a plurality of heat exchangers positioned for efficient heat exchange with air.

Another object is the provision of a construction arranged to prevent lateral winds in the atmosphere from upsetting the normal balance of movement through a plurality of heat exchangers.

Another object is the provision for obtaining compactness, as well as efficiency, in a device in which heat exchange is made between fluid and atmosphere.

Another object is the provision of an arrangement for maintaining all of the heat exchangers of a plurality of exchangers at maximum efficiency.

Another object is the provision for obtaining a greater heat exchange area within a given lateral space.

Another object is the provision for obtaining results not heretofore readily obtainable and in a manner not heretofore known.

Other objects and a fuller understanding of my invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a perspective view of apparatus embodying my invention;

Figure 2 is a partial plan view looking down upon the apparatus shown in Figure 1;

Figure 3 is a cross-sectional view taken through the line 3—3 of Figure 2; and

Figure 4 is an enlarged sectional view through a heat exchanger and taken through the line 4—4 of Figure 2.

In the usual use of my apparatus, the heat exchanger is mounted so as to be positioned over and above the roof of a building and is supported, for example, upon roof beams 38 shown in Figure 1. The roof of the building is carried on beams 38 and the base 37 of my apparatus is substantially flush with the flat roof.

An air conditioning unit in the compartment 39 is suspended down within the room or open space in a building. Air from the room moving through the opening 40 of the unit 39, and through other openings of the unit, is cooled by refrigerant cooling coils within the unit 39. My apparatus is directed to the dissipation of heat absorbed by the cooling coils within the unit 39 by a heat exchange apparatus mounted in atmosphere above the roof.

Framing members 17 of angle irons are formed, as shown in the drawings, to provide support for heat exchangers spaced above the level of the base 37. At their upper ends the two pairs of the members 17 are inclined

toward each other and are joined together to provide a rigid support.

A pair of identical heat exchangers denoted generally by the reference characters 11 and 12 are mounted on the inclined sides of the framing members 17. Thus, the exchange units 11 and 12 are inclined at an angle to each other and are also inclined at an angle to the horizontal and to the vertical. The two units may be considered as a heat exchanger folded upon itself to define a triangle therebetween.

Each of the heat exchanger units is made up of a bank of tubes 13 passing recurrently back and forth and joined by fins 14 through which the tubes pass. The construction of the units 11 and 12 is such that air passing down through the units between the tubes is in heat exchange relationship with refrigerant fluid contained within the tubes. As fluid is pumped through the tubes 13 of the heat exchangers, heat in the fluid is dissipated to the air passing between the plurality of tubes. Each of the units has confining or framing walls 15 in rectangular form so as to box in or frame the tubes and fins within the unit.

At the opposite ends of the apparatus are end walls 16 of triangular form extending between the units 11 and 12. There is a bottom wall 22 joining the bottom edges of the units 11 and 12 and joining the opposite end walls 16 to form a triangular chamber 23. Air passing through the heat exchanger units 11 and 12 enters this triangular chamber 23.

Extending vertically upright on one side is a side wall 18 and extending vertically upright on the other side is a side wall 19. The upright walls 18 and 19 are parallel to each other and are secured to the lower edges of the respective units 11 and 12. At the opposite ends of the apparatus are pairs of upright walls 20 and 21 extending between the respective ends of side walls 18 and 19 and the inclined sides of the units 11 and 12.

The several walls 16, 18, 19, 20 and 21 form a rectangular box which is open on its upper side. Thus, the units 11 and 12 are open to atmosphere only from above by air moving downwardly between the enclosing sides of this box-like structure. Laterally moving air, that is, wind, cannot directly impinge upon the units 11 and 12 by reason of the side walls interfering with and barring entrance of such lateral winds.

In the bottom wall 22 there are two openings 25 surrounded by cylindrical walls 24, respectively. A fan or air propellor 26 is mounted within each opening 25 in a manner to force air downwardly through the respective opening 25 and hence to draw air from the chamber 23 and to force it downwardly toward the building roof. A suitable electric motor 27 drives each of the fans or air moving means 26. It is thus seen that action of the motor-driven fans 26 causes air to be drawn downwardly through the box-like structure and generally following the direction of air shown diagrammatically by the arrows in Figure 3. This causes movement of air through the heat exchange units 11 and 12 and thus provides for heat exchange with the fluid in the tubes.

The movement of air through the two openings 25 is at a relatively constant rate of delivery. With the motors 27 operating at a fixed speed, there is a relatively fixed rate of movement downwardly through the apparatus. Generally, air cannot move faster through the openings 25 than is permitted and provided by the constant rated movement of the fans 26. Thus, any excessive movement of air above the normal operating rate of the fans cannot be accommodated by the apparatus.

Fluid from the refrigerant coil within the unit 39 comes up through pipes not shown to a compressor 30. The refrigerant fluid under pressure by the compressor is carried up by twin supply pipes 29 to the tops of the units

11 and 12 to supply fluid to the tubes 13 at the upper level of the units. The fluid moves downwardly in the units 11 and 12 as it passes back and forth in the units. The fluid is withdrawn from the units through return pipes 31 and 32 from the respective units, and these return pipes come together to a common return pipe 33, which in turn carries the fluid back to a return tank 34. From here, the fluid moves through the cooling coils within the unit 39 and through other devices not important to this invention, and ultimately back to the compressor 30 by a return pipe 35. In brief, there is a movement of fluid bearing heat upwardly to the tops of the units 11 and 12 and the fluid, after passing through the units 11 and 12, is withdrawn to be again circulated through the cooling coils of the air conditioning unit in the compartment 39, and again compressed and circulated.

By reason of the relatively constant rate of delivery of air through the openings 25 by the fans 26, any excess of air above normal moving through one of the units 11 and 12 would cause a deficiency or decrease of air moving through the other of the units. Such an upsetting of the balance or equilibrium of the two units can be caused by a laterally moving wind against one of the units. For example, if a wind moving from right to left in Figure 3 would be able to impinge directly upon the unit 12 (in the absence of the wall 19) so as to increase the amount of air which would normally move downwardly through the openings 25 by reason of the constant rate of speed of the fans 26, then there would not be the normal or usual amount of air moving through the other unit 11. In effect, this would be a stopping up or clogging of the air passages through the unit 11 because the lateral wind against the unit 12 would be so increasing the amount of air moving through the unit 12 that the capacity of the fans 26 in openings 25 would be taken up by this excess air caused by the lateral wind against the unit 12. This upsetting or disturbing the balance of the air moving through the two units causes a decrease in the over-all efficiency of the two units, as the unit 11 would not be doing the heat exchange work required of it.

Therefore, by having the confining upright walls around the inclined units 11 and 12, all of the movement of air is downward from the open top and through the units 11 and 12 and hence out through the openings 25. This provides for maintaining the balance of air movement through the plurality of equal heat exchange units and, thus, for maintaining the equality of efficiency throughout the plurality of units.

This disclosure includes that contained in the appended claims as well as that in the foregoing description.

Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. Apparatus for heat exchange between atmosphere and fluid bearing heat to be dissipated to the atmosphere, comprising in combination a pair of rectangular banks of coils adapted to contain said fluid, said banks being inclined at an angle to each other, the apex of said angle being disposed uppermost, air-displacement means for moving air downwardly through said banks of coils for heat exchange therewith, the air moved through the respective banks by said air-displacement means being in a fixed proportion, and spaced walls extending upwardly from substantially adjacent the plane passing through the lower edges of the respective banks to substantially a parallel plane passing through the upper edges of the respective banks, said walls providing baffles to bar horizontally moving winds in said atmosphere from direct access to said banks of coils, the baffling of said winds maintaining the said proportion of air moved through the respective banks, each of said banks comprising tubes passing recurrently back and forth in horizontally disposed sections from top to bottom and having a fluid inlet connected to the said tubes of each bank adjacent the top of the bank and having a fluid outlet connected to the said tubes of each bank adjacent the bottom of the bank, whereby downwardly moving fluid in said tubes in heat exchange relationship with downwardly moving air becomes progressively cooled as the fluid progressively moves from section to section of said tubes in its travel from said inlet to said outlet.

2. Apparatus for heat exchange between atmosphere and fluid, comprising in combination coil means adapted to contain said fluid, said coil means being divided into a portion disposed in a first plane and a portion disposed in a second plane, said planes being inclined at an angle to each other with the apex of the angle uppermost and the sides of the angle disposed on opposite sides of a vertical plane passing through said apex, air displacement means for moving atmospheric air downwardly through said coil means, part of said atmospheric air being moved through the portion in the first plane and part of said atmospheric air being moved through the portion in the second plane, said parts of atmospheric air being in a fixed proportion, and baffle means for barring horizontally moving atmospheric air from direct access to the said coil means to maintain the balance of said proportion, each of said portions of the coil means comprising tubes passing recurrently back and forth in horizontally disposed sections from top to bottom and having a fluid inlet connected to the said tubes of each portion adjacent the top of the portion and having a fluid outlet connected to the said tubes of each portion adjacent the bottom of the portion, whereby downwardly moving fluid in said tubes in heat exchange relationship with downwardly moving air becomes progressively cooled as the fluid progressively moves from section to section of said tubes in its travel from said inlet to said outlet.

3. Apparatus for dissipating heat to the atmosphere wherein substantially horizontally moving winds occur comprising a pair of banks of heat exchange coils adapted to contain fluid from which heat is to be dissipated, said coil banks being inclined toward each other on opposite sides of a vertical plane, fan means in communication with both said coil banks for moving atmospheric air downwardly through both said coil banks to provide heat exchange through the coils between said fluid and said atmospheric air, the air movable by said fan means through each of the coil banks being in a fixed proportion relative to the air movable by said fan means through the other of the coil banks, said fan means having such limits on air movement that relative increase in air movement through one of said coil banks causes relative decrease in air movement through the other of said coil banks, and baffle means positioned on opposite sides of said pair of coil banks and spaced horizontally from the upper sides of said coil banks to meet horizontally moving winds while permitting vertically moving air to move through said coil banks, said baffle means barring horizontally moving winds from access to the coil bank on the side of the wind direction and substantially maintaining the said proportion of air movable through the respective coil banks, each of said banks comprising tubes passing recurrently back and forth in horizontally disposed sections from top to bottom and having a fluid inlet connected to the said tubes of each bank adjacent the top of the bank and having a fluid outlet connected to the said tubes of each bank adjacent the bottom of the bank, whereby downwardly moving fluid is said tubes in heat exchange relationship with downwardly moving air becomes progressively cooled as the fluid progressively moves from section to section of said tubes in its travel from said inlet to said outlet.

4. The combination of a pair of rectangular heat ex-

changers through which air is moved downwardly to provide for heat exchange between fluid moving through the exchangers and the air moving through the exchangers, said exchangers being inclined at an angle to each other, the air movable vertically through the respective exchangers being substantially fixedly proportioned in the absence of substantially horizontal movement of air against one of the exchangers, and spaced upwardly extending walls positioned alongside said exchangers in the path of any horizontally moving air directed toward the side of a said heat exchanger, said walls providing baffles to hinder horizontal movement of air against a said exchanger to substantially maintain said proportion, each of said exchangers comprising tubes passing recurrently back and forth in horizontally disposed sections from top to bottom and having a fluid inlet connected to the said tubes of each exchanger adjacent the top of the exchanger and having a fluid outlet connected to the said tubes of each exchanger adjacent the bottom of the exchanger, whereby downwardly moving fluid in said tubes in heat exchange relationship with downwardly moving air becomes progressively cooled as the fluid progressively moves from section to section of said tubes in its travel from said inlet to said outlet.

5. The combination of heat exchanging means adapted to contain fluid holding heat and to permit air to move through the exchanging means for providing heat exchange therebetween, said heat exchanging means having portions facing in opposite directions and in the path of horizontally moving air, air moving means positioned below said heat exchanging means to move air through said heat exchanging means substantially vertically downward, the air moved through said portions being in a predetermined ratio to maintain uniform heat exchange efficiency of all said portons, and baffle means positioned laterally outward from, and on opposite sides of said heat exchanging means, to meet said horizontally moving air and to bar its direct flow against said heat exchange means whereby the balance of said ratio is maintained, each of said portons of said heat exchanging means comprising tubes passing recurrently back and forth in horizontally disposed sections from top to bottom and having a fluid inlet connected to the said tubes of each portion adjacent the top of the portion and having a fluid outlet connected to the said tubes of each portion adjacent the bottom of the portion, whereby downwardly moving fluid in said tubes in heat exchange relationship with downwardly moving air becomes progressively cooled as the fluid progressively moves from section to section in its travel from said inlet to said outlet.

6. In apparatus for exchanging heat in fluid moving through the coils of a heat exchanger with the open air subject to lateral winds, the combination of heat exchange means arranged in planes inclined to the vertical and the horizontal, fan means for moving air downwardly through said heat exchange means and in a

vertical direction, the dimensions and arrangement of the heat exchanger in said planes being such that air is moved substantially similarly through the heat exchanger at all said planes by said fan means, and wall means positioned adjacent and on opposite sides of the heat exchanger, said wall means extending upwardly and athwart horizontal planes passing through said heat exchanger to meet and baffle lateral winds blowing toward the heat exchanger, the baffling of said winds providing for substantially maintaining the said similarity of air movement through the heat exchanger at all said planes, the heat exchange means in each of said planes comprising tubes passing recurrently back and forth in horizontally disposed sections from top to bottom and having a fluid inlet connected to the said tubes of the heat exchange means in each said plane adjacent the top of the heat exchange means in said plane and having a fluid outlet connected to the said tubes of the heat exchange means in each said plane adjacent the bottom of the heat exchange means in said plane, whereby downwardly moving fluid in said tubes in heat exchange relationship with downwardly moving air becomes progressively cooled as the fluid progressively moves from section to section in its travel from said inlet to said outlet.

7. The combination of a heat exchanger folded into a plurality of portions disposed in flat planes inclined at an angle to each other and to the vertical and the horizontal, air-displacement means for moving air downwardly through a common chamber and through the heat exchanger portions at all said planes in a fixed ratio as between the respective heat exchanger portons at each said plane, and baffle means for hindering lateral movement of air in the horizontal planes passing through the heat exchanger, whereby the said ratio of air moving through the heat exchanger portions at each said plane is maintained, the heat exchanger in each of said planes comprising tubes passing recurrently back and forth in horizontally disposed sections from top to bottom and having a fluid inlet connected to the said tubes of the heat exchanger in each said plane adjacent the top of the heat exchanger in said plane and having a fluid outlet connected to the said tubes of the heat exchanger in each said plane adjacent the bottom of the heat exchanger in said plane, whereby downwardly moving fluid in said tubes in heat exchange relationship with downwardly moving fluid in said tubes in heat exchange relationship with downwardly moving air becomes progressively cooled as the fluid progressively moves from section to section in its travel from said inlet to said outlet.

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