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J. SWINBURNE ET AL

2,219,826

HEAT EXCHANGE APPARATUS

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Fig. 1.

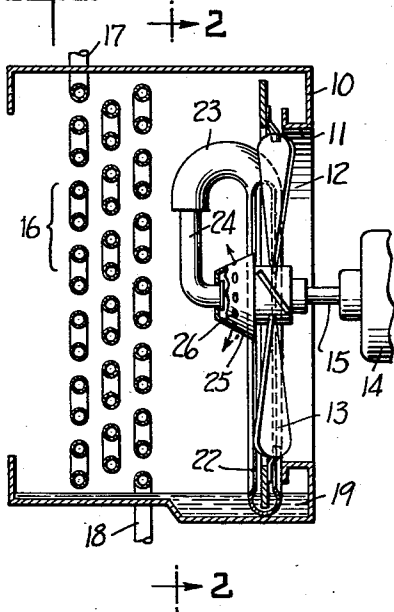


Fig. 2.

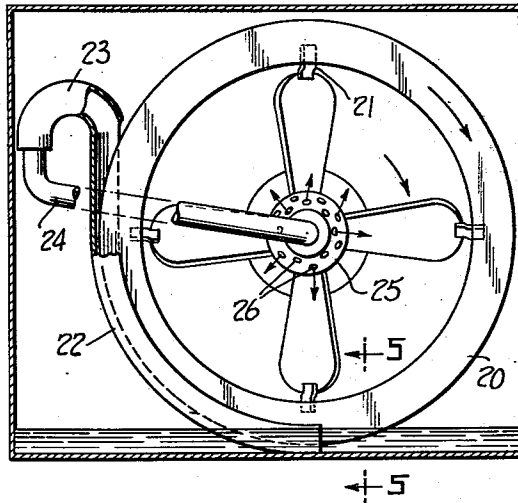


Fig. 3.

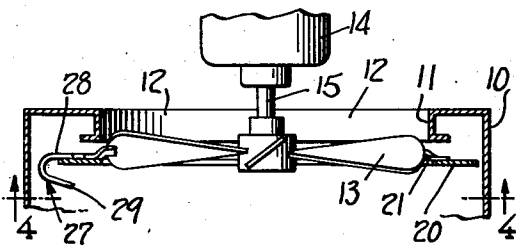


Fig. 4.

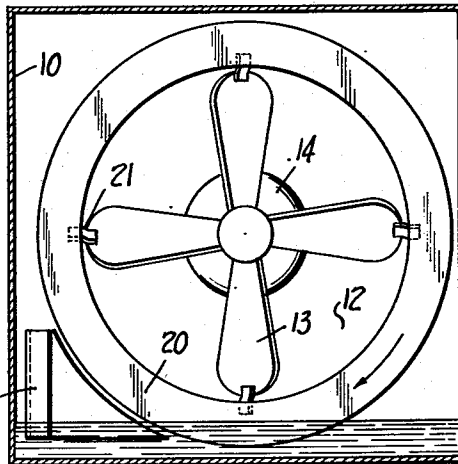
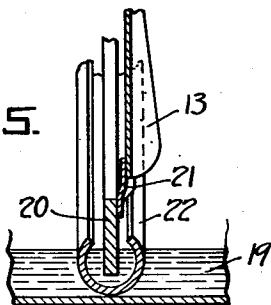


Fig. 5.



INVENTOR
JAMES SWINBURNE &
BLAISE & MOONEY
BY *Herman Seid*
ATTORNEY

UNITED STATES PATENT OFFICE

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HEAT EXCHANGE APPARATUS

James Swinburne and Blaise B. Mooney, Syracuse, N. Y., assignors to Carrier Corporation, Syracuse, N. Y., a corporation of Delaware

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4 Claims. (Cl. 261-9)

This invention relates to heat exchange apparatus, and more particularly to heat exchange apparatus of the type in which heat transfer surface which is to be cooled is contacted by a stream of air and also is wetted by liquid to assist in the dissipation of heat from said surface.

The general object of the present invention is to provide an improved apparatus for supplying liquid to the surfaces of a heat transfer device over which there is circulated a stream of air for the purpose of abstracting heat therefrom.

Another object of the invention is to provide an improved apparatus for wetting the surfaces of a heat transfer device and for circulating air in contact therewith, which is relatively inexpensive, and which is entirely reliable and efficient in operation.

It is another object of the invention to provide an improved apparatus for supplying liquid to the heat exchange surfaces of a heat transfer device and for circulating air thereover, which positively assures the supply of liquid to the heat transfer device without requiring the use of a pump or similar mechanism.

It is another object of the invention to provide for supplying air to the surfaces of a heat exchange device and for supplying liquid thereto from a sump or other container, by means of a relatively simple apparatus which effects the desired liquid distribution with a substantially negligible power consumption.

It is another object of the invention to provide an improved apparatus for wetting the surfaces of a heat exchange device over which air is circulated, which gives assurance that liquid will be distributed throughout all parts of the heat exchange device.

A feature of the invention resides in providing a propeller fan or the like for circulating air over the surfaces of a heat exchange device from which heat is to be abstracted, and providing a splasher device driven by the same means as the fan, for dipping within a sump containing liquid so that the splasher device may set up a spray or splash in a direction normal to that of the axis of rotation of the splasher device. The liquid thus splashed may then be collected within a deflector channel from which it may be conveyed to a distributing cup or the like carried by the fan, and thence distributed by centrifugal force into the air stream circulated by the fan and thus over the surfaces of the heat exchange device.

In a modified form of the invention the deflector channel may be so formed that the liquid

which is delivered therein by the splasher device is thereby deflected back into the air stream circulated by the fan, and thus caused to be impinged upon the heat exchange surfaces of the device to be cooled.

While the invention is not limited thereto, it is of particular utility in air conditioning units of the so-called self-contained type in which the condensate precipitated by the evaporator is to be disposed of without recourse to drain connections or the like. Thus the moisture precipitated by the evaporator may be conveyed to the sump into which the splasher device dips. The resultant supply of this condensate from the sump to the surfaces of the condenser, in accordance with the invention, will result in vaporization of the liquid from the surfaces of the condenser and into the air stream circulated over the condenser. In conventional practice this air stream, after passage over the condenser, is delivered to the outdoor atmosphere, so that the moisture which it contains is completely eliminated from the system without the necessity for providing drain connections or the like.

In addition to providing for the effective disposal of liquid contained within the sump of the apparatus, the supply of this liquid to the surfaces of the heat exchange device substantially increases the rate of heat transfer therefrom, in accordance with principles which are well understood by those skilled in the art.

Other objects, features and advantages of the invention will be more apparent from the following description, to be read in connection with the accompanying drawing in which:

Fig. 1 is a side elevational view, partly in section, diagrammatically illustrating an apparatus embodying the invention;

Fig. 2 is a front elevational view taken on the line 2-2 of Fig. 1;

Fig. 3 is a diagrammatic view in plan, partly in section, illustrating a modified form of the invention;

Fig. 4 is an elevational view taken on the line 4-4 of Fig. 3; and

Fig. 5 is a view of a portion of the apparatus on an enlarged scale, taken on the line 5-5 of Fig. 2.

Referring now to the drawing, similar designations referring to similar parts, numeral 10 designates a casing having a circular turned-in flange portion 11 defining the extremity of an air inlet opening 12 in which fan 13 preferably of the propeller type, is disposed. Fan 13 is driven by motor 14 through shaft 15, it being

understood that the motor and shaft are supported in any desired manner. Within the casing 10 in the path of air circulated through the casing by fan 13, is disposed a heat exchange device 16 of any desired type. As illustrated the heat exchange device comprises a plurality of lengths of tubing, the medium to be treated in the heat transfer device being supplied thereto through line 17 and being relieved therefrom through line 18. It is to be understood that the invention is not limited with respect to the character, type or function of the heat exchange device. Thus, for example, the device may comprise the condenser of a refrigerating system, or may comprise the refrigerant liquid subcooler of a refrigerating system, or both.

The bottom of casing 10 is provided with a liquid sump 19 to which there is delivered, in any desired manner, liquid which is to be supplied to the outer surfaces of the heat exchange device 16. The liquid may be of any nature and may be delivered to the sump 19 from any desired source. If the heat exchange device 16 comprises the condenser of a refrigerating system, however, or the liquid subcooler thereof, or both, it may be desirable to collect the condensate precipitated from air contacting with the evaporator of such system, and to supply this condensate to the sump 19. Such operation broadly is disclosed in pending application Serial No. 83,777, filed June 5, 1936.

There is provided a splasher ring 20 adapted to be rotated by the motor 15 in the vicinity of the fan 13, and to dip within the liquid in the sump 19. While the splasher ring 20 may be mounted in any desired manner to this end, it is preferably mounted by means of lugs 21 to the extremities of the blades of fan 13, so as to rotate therewith. Partially encircling the splasher ring 20 is arcuate trough 22 which is adapted to receive the liquid splashed by the ring 20 in the direction of its rotation. Thus, in Fig. 2, the fan 13 and splasher ring 20 rotate in a clockwise direction, as indicated by the arrows, and the trough 22 is disposed about the lower left hand quadrant of the splasher ring. As will be understood, because of the force with which the splashed particles impinge against the inside of the trough, and because of the direction in which such liquid particles are splashed by the ring 20, the particles delivered within the trough rise to a closed U-bend formation 23 disposed at the top of the trough 22. Liquid delivered to the U-bend 23 drains downwardly therefrom to a pipe 24 which delivers this liquid within a distributor cup 25 mounted coaxially with the fan 13 and rotated therewith by the motor 14. The distributor cup 25 may be mounted in any desired manner to the fan or to the driving shaft 15. The peripheral portions of the distributor cup 25 are provided with apertures 26 and as the cup rotates at relatively high velocity, the water delivered within the cup is discharged by centrifugal force outwardly through the apertures 26 into the path of the air stream generated by fan 13 and passing over the heat exchange device 16. The liquid which is delivered into the path of the air stream is carried thereby to the heat exchange device and serves to wet the surfaces thereof.

The liquid thus delivered to the heat exchange device 16 serves to facilitate the abstraction of heat therefrom both by vaporization from the surfaces thereof, and by increasing the coefficient of heat transfer between the surfaces and the air. As will be understood, of course, a portion of the

liquid sprayed into the air stream will be vaporized therein before contacting the surfaces of the heat exchange device. This action serves to lower the dry bulb temperature of the air stream generated by fan 13 and thus further assists in the abstraction of heat from the heat exchange device 16.

Preferably the distributor cup is conical in shape as illustrated, although it may be cylindrical if desired. The conical arrangement tends to give a better movement of the liquid spray in the direction of air flow so as more completely to cover the surfaces of the heat exchange device 16. Further, the conical construction tends to provide superior air distribution over the surfaces of the heat exchange device and prevents the formation of air eddies at the center of the air stream. Preferably the water outlets 26 are arranged toward the air-leaving side of the distributor cup 25. Any number of openings 26 may be provided and they may be of any size, but it is preferable that the holes be of sufficient size so that there may be little possibility of clogging due to impurities or foreign matter which may be contained in the water delivered to the distributor cup.

In the modification of the invention illustrated in Figs. 3 and 4, the same arrangement of the fan 13 and slinger 20 is employed as in connection with the embodiment illustrated in Figs. 1 and 2 and described above. However, the U-bend 23, conduit 24 and distributor cup 25 of the embodiment of Figs. 1 and 2 are eliminated and instead there is substituted a deflector trough 27 of modified design. The deflector trough 27 is disposed proximate the lower portion of the slinger near the point at which the slinger leaves the liquid in sump 19 after having been immersed therein. The trough 27 is so formed that the sides thereof are disposed at a slight angle to each other, the interior of the trough providing a smooth and continuous surface. The leg 28 of the trough 27 is disposed proximate the splasher 20 and extends to the rear thereof, while the leg 29 of the trough 27 is disposed forwardly of the splasher ring 20 in the direction of air flow and is substantially spaced therefrom. Thus, in operation, water which is thrown from the slinger impinges upon the sloping side 28 of the trough 27 and is deflected by the U-bend of the trough and is then discharged along the interior of the side 29 and thence back into the path of the air circulated by the air stream 13. The air stream then blows this liquid over the surfaces of the heat exchange device.

Since many changes may be made in the invention without departing from the scope thereof, it is intended that all matter set forth in the above description, or shown in the accompanying drawing, be regarded as illustrative only and not in a limiting sense.

We claim:

1. A heat exchange apparatus including in combination a disc type fan, a splasher ring attached to blades of the fan whereby the ring encircles the periphery of the fan and rotates therewith, a sump, a stationary trough positioned with one portion thereof within the sump, said trough being disposed about a portion of the ring, a U-bend formation connected to an extremity of the trough, a distributor cup mounted coaxially with the fan and rotated therewith, means connecting the U-bend formation with the cup, heat exchange surfaces positioned proximate to the fan, and means for rotating the fan, whereby

the ring causes a stream of liquid from the sump to be routed through the trough and U-bend formation to the rotating cup and discharged therefrom into the air stream from the fan, the
5 air stream depositing particles of said liquid upon said surfaces and causing evaporation of liquid from said surfaces.

2. An apparatus according to claim 1 in which said cup is conical and perforated.

10 3. A heat exchange apparatus including in combination a casing, a disc type fan within the casing, a splasher ring attached to and encircling the fan, a shaft for the fan, a liquid distributing cup mounted on the shaft at the air discharge
15 side of the fan, a sump in the casing, a liquid collecting trough positioned within the casing and having a portion thereof dip within the sump, said ring during rotation dipping within the sump
20 rotating the shaft whereby liquid from the sump will be delivered by the ring to the trough and means for routing said liquid from the trough to the distributing cup for discharge into the air stream from the fan, and heat exchange sur-
25 faces positioned proximate the fan and cup for

receiving liquid particles deposited thereon and evaporated therefrom by the air stream.

4. A heat exchange apparatus of the character described including in combination a casing, a disc type fan within the casing, a splasher ring 5 attached to and encircling the fan, a shaft for the fan, a sump in the casing, a liquid collecting trough rigidly positioned within the casing and having a portion thereof dip within the sump, said trough being disposed about one portion 10 of the ring, said ring during rotation dipping within the sump and rotating within the trough, means for rotating the shaft whereby liquid from the sump will be delivered by the ring to the trough, and water distributing means in com- 15 bination with one portion of the trough for discharging said liquid from the trough into the air stream from the fan, said means including an element rotating with the fan, and heat exchange surfaces proximate the discharge side of the fan 20 for receiving liquid particles deposited thereon and evaporated therefrom by the air stream.

JAMES SWINBURNE.

BLAISE B. MOONEY. 25