

[54] **LIQUID COOLING APPARATUS**

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[51] Int. Cl. **B01d 47/00**

[58] Field of Search **261/112, DIG. 11; 55/240, 55/241; 210/150**

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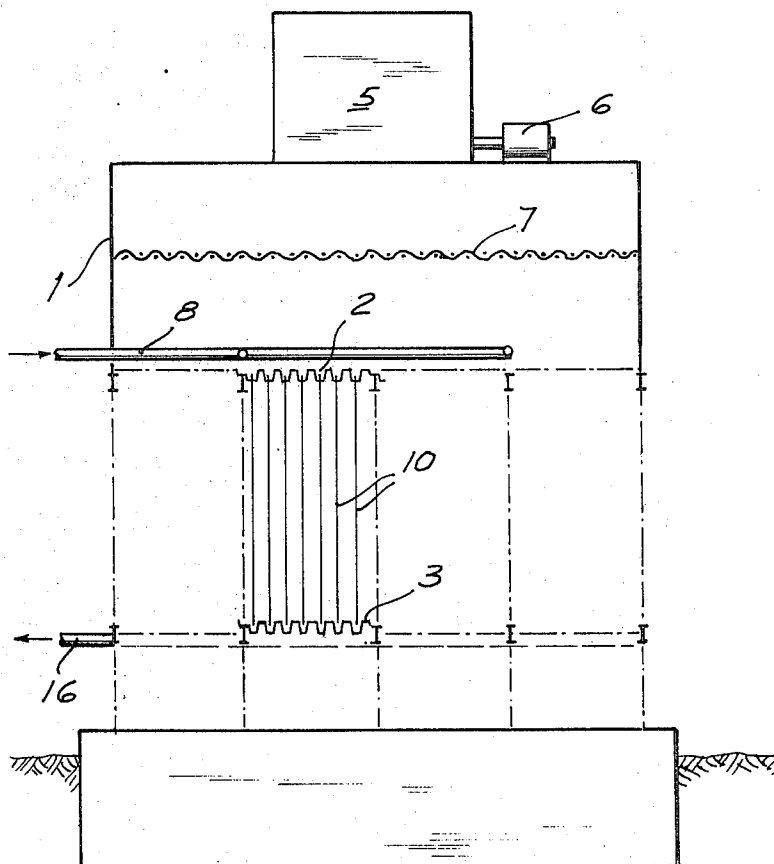
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[57] **ABSTRACT**

Apparatus in the form of a cooling tower having an air outlet and drift eliminator at the inner top area and

above the point of entrance of the liquid flow to be cooled, together with fluid distributor means leading flow to a plurality of top panels lying in a horizontal plane and which, as to each, have two series of apertures, one series being air orifices and the second series having means for holding depending flow-receiving elements in register therewith, there being a plurality of bottom panels of form similar to the said top panels but which have only air orifices at the tops of upwardly directed areas intermediate channel formations, the bottom ends of the flow-receiving elements lying below the said air orifices and in the channel formations. The said bottom panels provide cool-fluid reception means and they discharge into a network of flow means which preferably is adapted to concentrate the flow to one or several points for removal through the cooling tower. At the base of the cooling tower is an air inlet opening below which the structure is adapted, as desired in some cases, to incorporate one or more liquid reservoirs. At the top of the cooling tower, or at one or more upper side areas, suitable fan means for upward movement of cooling air, may be provided.

1 Claim, 9 Drawing Figures



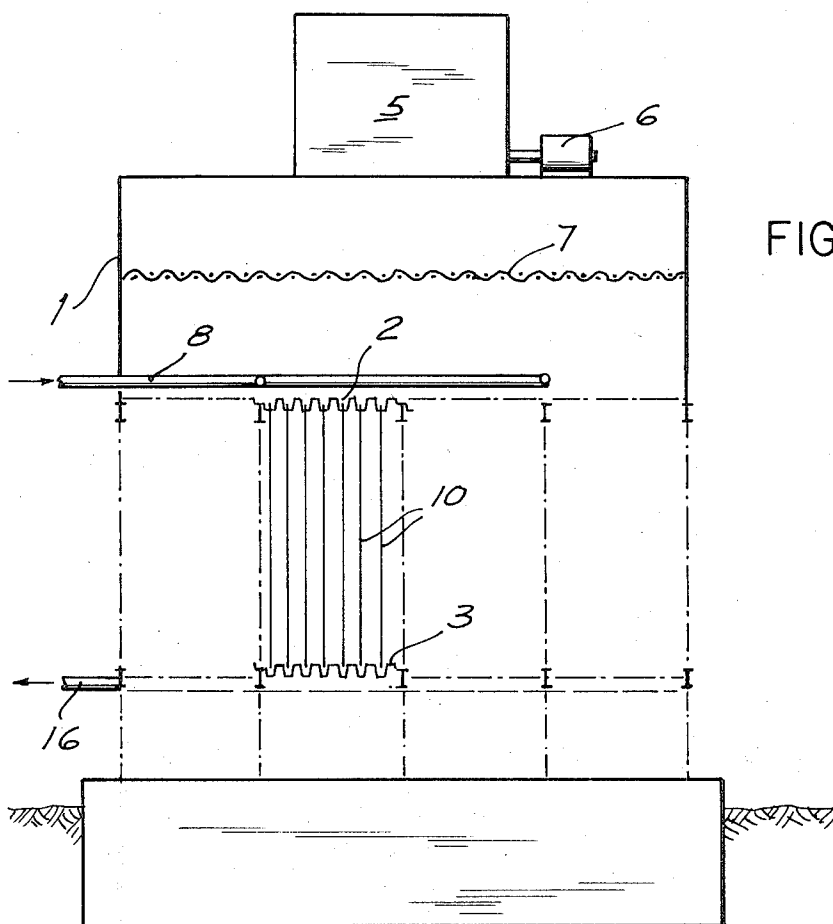


FIG. 1

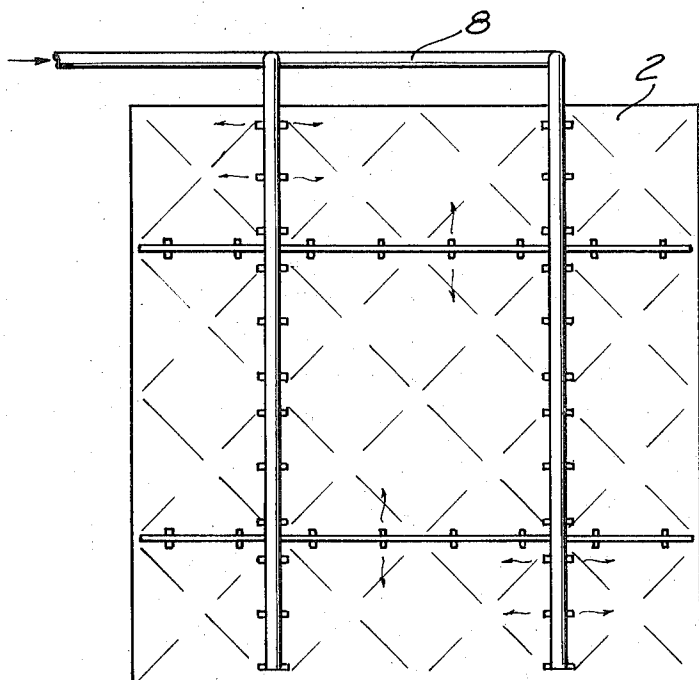
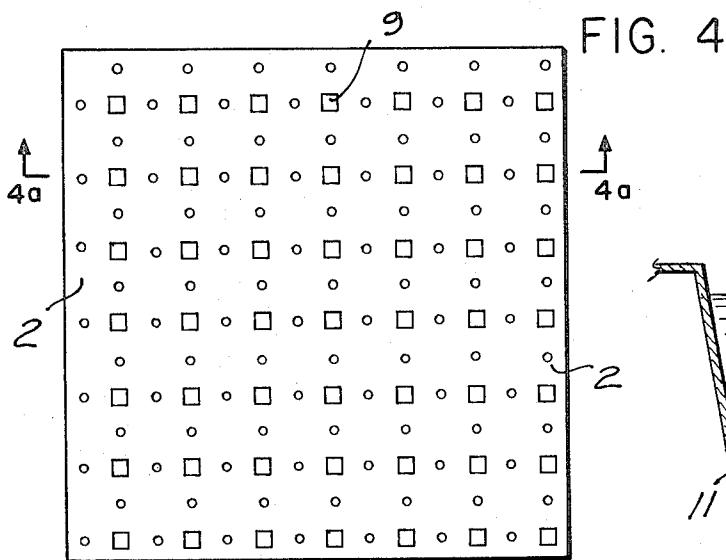
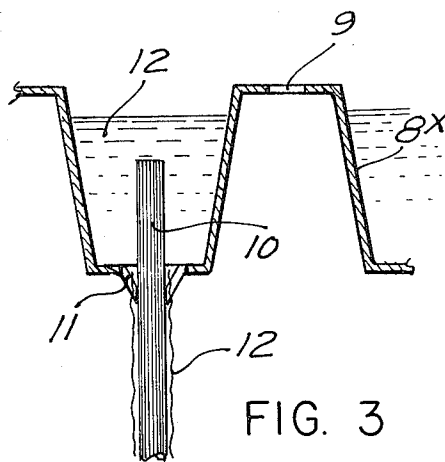
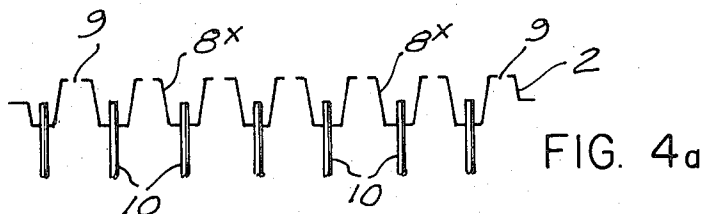
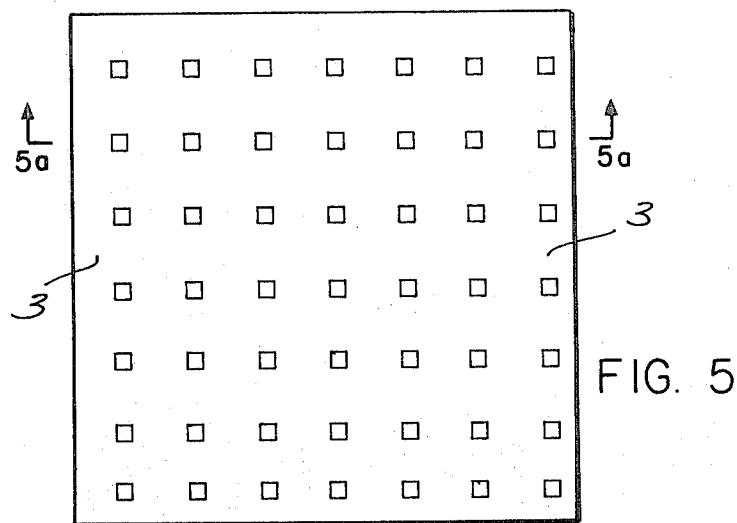
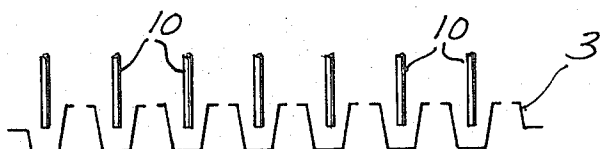


FIG. 2

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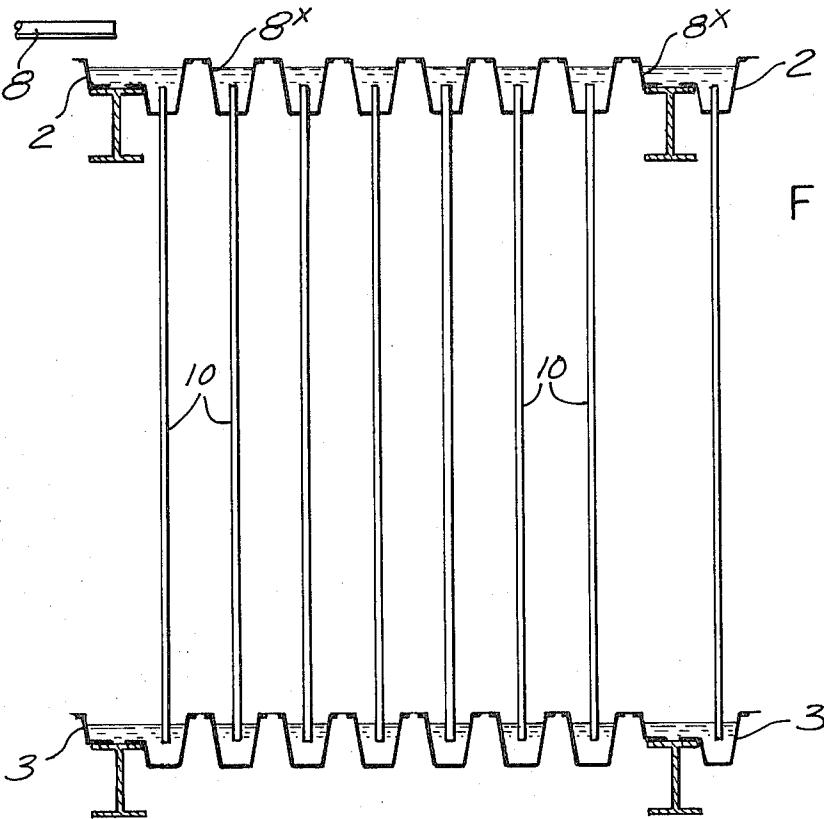


FIG. 6

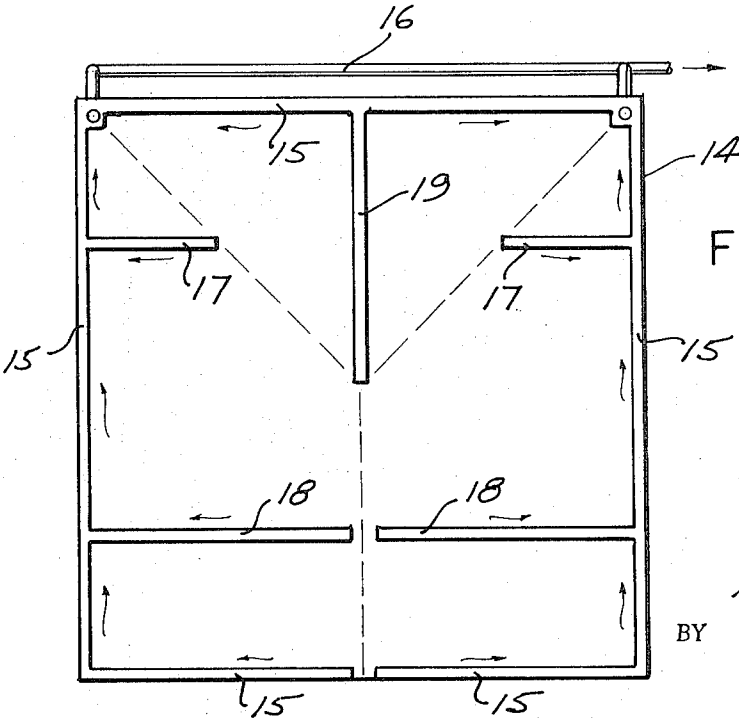


FIG. 7

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LIQUID COOLING APPARATUS

The invention will be described with reference to the accompanying drawings, in which:

FIG. 1 is a schematic vertical section through an embodiment of the invention and indicating the position of one of the flexible flow receiving elements.

FIG. 2 is a schematic plan view illustrating a suitable arrangement of the top distributor panels.

FIG. 3 is a vertical section through an area of one top panel, showing two flow receiving elements held thereby in apertures providing liquid flow around the flow receiving elements.

FIG. 4 is a plan view of one top distributor panel.

FIG. 4a is a schematic transverse section taken on the line 4a-4a, FIG. 4.

FIG. 5 is a plan view of one lower panel and thus as indicated, as to position, in FIG. 1.

FIG. 5a is a schematic transverse section taken on the line 5a-5a, FIG. 5 to show the position of the lower ends of the flow receiving elements relatively to the lower panel.

FIG. 6 is a schematic section taken transversely of spaced upper and lower panels with flow receiving elements suspended from the upper panel and lying in collection channels of the lower panel below air-passage apertures.

FIG. 7 is a plan view of a suitable cooled fluid collection arrangement for the plurality of associated distributor panels above it.

Referring to FIG. 1 of the drawings it will be seen that it shows an area of the tower casing 1 containing an upper distributor panel 2 and a lower distributor panel 3. Schematically shown at 10 is a flow receiving element. At the top of the casing is indicated a fan stack 5, with 6 a drive motor for fan-means (not shown). At 7 is indicated a drift eliminator and which in practice may be a wide mesh screen or of lattice formation.

Referring to FIG. 2 it will be noted that a plurality of side-by-side upper distributor panels are employed in the illustrated embodiment of the invention, and the said Figure shows at 8 the liquid inlet pipe and its branches so arranged that the liquid to be cooled will be equally distributed over the said group of upper distributor panels. Reference to FIG. 3 will best show the form of each of the upper distributor panels 2 and that the said panel is formed with spaced troughs separated by upwardly projecting hollow peaks, and each peak is provided with an orifice for the upward passage of air, one of the peaks being designated 8^x, and one of the orifices being designated 9. Also it will be seen that each trough will be provided at its base with a plurality of spaced orifices each to receive flow receiving element 10. Each orifice will be of greater diameter or thickness of the flow receiving element, so as to permit flow of fluid down and over the septa, and suitable means, such as pronged wedges in said orifices, will hold the flow receiving elements suspended. Such wedges are indicated at 11. In said FIG. 3 flowing liquid is indicated at 12 as it passes down the flow receiving elements, two being shown.

With reference to the "peaks" 8^x they may be conical or rectangular in form, and the troughs run at right angles exterior the peaks and as to any of the top distributor panels the troughs are in mutual communication.

As to the spacing and relation of the top and bottom panels, this is best shown in FIG. 6, which while schematic, shows that the suspended flow receiving elements 10 are led at their bottom ends into the troughs of the lower panel 3 and hence below the air orifices of the peaks in said panel 3. The said lower panel 3, which may be termed a "collector panel" of the group of said panels corresponding to the group of upper panels, is similar to upper panel 3 but without orifices for the flow receiving elements.

The plurality of flow receiving elements may be of one or a combination of natural or manufactured materials, including dacron, nylon, synthetic resins, manila, sisal, fiberglass and paper; and if an inflexible flow receiving element is incorporated it may be of ceramic, metal, wood, etc. The flow receiving element material may be of monofilament or multifilament character and fabricated in straight, twist or braided form. The sizes are variable as desired. The flow receiving elements are attached only the top panel in general practice.

Referring to the top panel and the troughs thereof, the upwardly protruding ends of the flow receiving elements may be immersed in a liquid preferably from one to two inches deep in the troughs and, as stated, below the level of the orifices in the peaks 8^x of said top panel. Thus sufficient waterway is provided in said troughs or channels to convey the fluid to each flow receiving element in equal rate to the others of the depending flow-receiving elements, and the latter may be of such character that the liquid saturates them and partially flows through open interstices therein, and, of course, flows along their exterior surfaces, while air rises alongside and the cooling process is performed. Liquid reaching the bottom panel leaves the flow receiving elements, which are immersed in the troughs or channels of the bottom panel 1 to 2 inches, for example, and below the orifices, and passes to the cooled collection system and outwardly of the casing.

The panels above described may be fabricated from reinforced plastic material, reinforced fiberglass, steel, aluminum or other satisfactory relatively rigid material of sufficient strength; and they may be of any suitable shape or size depending on the function of the cooling system, but preferably are in rectangular form such as squares measuring 2 to 5 feet in width. The depth of the panels may vary, with 4 inches depth being suitable.

Referring to FIG. 7 which shows the collection member below the lower panels 3, and acting for all of the latter, it will be seen that the said collection member 14 is bordered with communicating channels 15 which effect flow of cooled liquid to a final channel or pipe 16, the latter communicating with any form of suitable outlet means. Also in said FIG. 6 it is shown that branch channels may be employed, branch channels 17 and 18 extending transversely of channel 19, so that the directions of flow may be controlled as indicated in part by the dotted lines. The said collection member 14 may have sufficient rearward tilt toward pipe 16 to stimulate liquid flow thereto, and the margins may have upwardly directed flanges extending above the marginal channels, as will be understood without further explanation.

Summarizing the invention, the cooling of water and other liquids is achieved by effecting the flow of such liquid downwardly in many thin layers, as by a plurality of flow receiving element groups, while air is intro-

duced through a bottom (lower) panel. Air is exhausted through a plurality of orifices in the top panels. Each flow receiving element passes through an appropriate top panel via an orifice larger than the thickness of the flow receiving element and projects several inches above the lower surface of said panel, and the flow receiving element is suspended at said orifice, as by a pronged or channeled wedge engaging the flow receiving element at two or more points and held by the edge of said orifice to allow open area between the flow receiving element and said edge.

In operation, the assembly of top panels act as distributor means for the liquid to be cooled, and the groups of flow receiving elements act as conductors for the liquid. Thus the liquid is conducted downward through a prescribed length of the flow receiving elements, groups and then collected by the lower panel. The up-flowing cooling air may be of natural or induced draft.

The lowering of the temperature of the water or other liquid may be controlled by several features of the invention. The factors affecting temperature loss in the liquid include the size or diameter of the flow receiving elements, its length as to the individual flow receiving element, the material and structure of the flow receiving element, the number of flow receiving elements per unit of area, the size of the air orifices and their number per unit of area. The degree to which water or other liquid may be cooled is limited only by the air or cooling gas temperature and its relative humidity relative to the treated liquid and its distribution. For example, every square inch or multiple thereof may be furnished with a flow receiving element and an orifice, providing 144 flow receiving elements and orifices, for example, per square foot.

It will be understood that the form of the elements illustrated in the drawings, and their mutual relation, may be modified within the spirit of the following claims.

Having described my invention, what I claim and desire to secure by Letters Patent is as follows:

1. A liquid cooling apparatus in the form of a cooling tower having an air outlet, means below said outlet for entrance of the liquid flow to be cooled, at least one top panel lying in substantially a horizontal plane below said outlet for the liquid flow and having two series of apertures, one series being air orifices and the second series below said air orifices having means for holding depending flow receiving elements with fluid flow space around them, at least one bottom panel having air orifices at the tops of upwardly directed areas intermediate channel formations, a plurality of flow receiving elements held by said top panel and depending therefrom and having their bottom ends lying below the air orifices of the bottom panel, and means for collecting and discharging cooled liquid received from said bottom panel, the top panel being formed with a plurality of spaced upwardly directed peaks apertured at their tops to form air orifices, the top panel at the base areas being formed with a plurality of apertures each associated with grip means holding a depending flow receiving element in such manner that liquid may flow along the said element from said top panel, the bottom panel being in combination with a collection trough member, having a plurality of flow-guiding members for the liquid received from said bottom panel, said flow guiding members being adapted to direct flow of said liquid in a plurality of directions and thence to a point of discharge of said collection trough member.

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