April 24, 1962 A. L. KOHL ET AL 3,031,173

CROSS-FLOW COOLING TOWER PACKING

Filed Feb. 18, 1960 2 Sheets-Sheet 1

Fig. 1

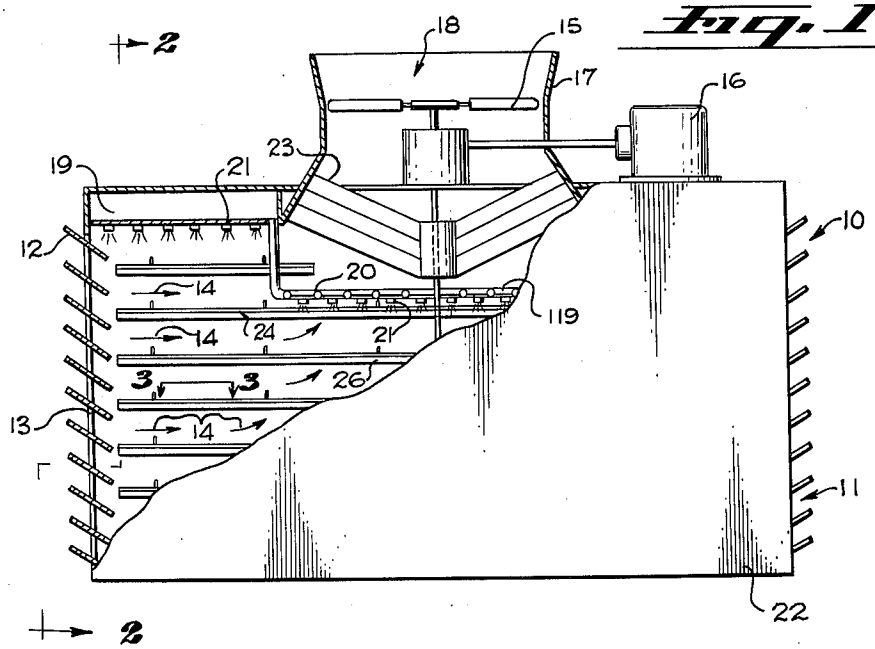
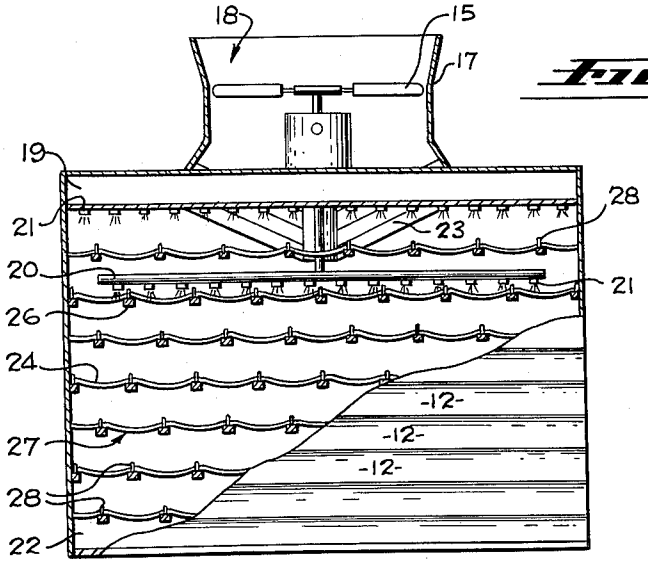


Fig. 2



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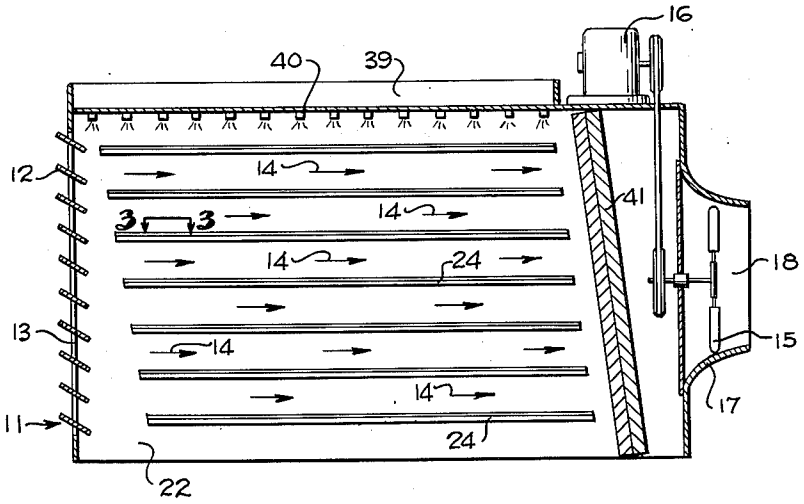


Fig. 6

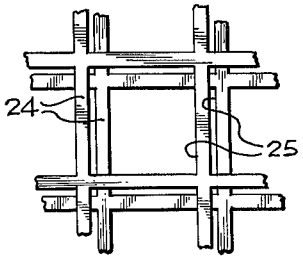


Fig. 4

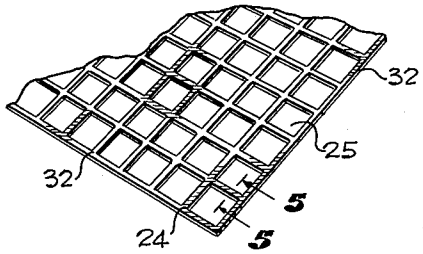


Fig. 3

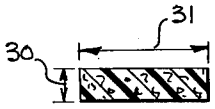


Fig. 5

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CROSS-FLOW COOLING TOWER PACKING

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This invention relates generally to packing for cross-flow cooling towers, and to improvements in such towers themselves brought about at least in part by the combination therein of novel packing, resulting in improved cooling performance of crossflow towers.

Broadly speaking, the invention contemplates the provision in a crossflow cooling tower of novel packing which is easily and readily installable and replaceable, which is simple to fabricate, not subject to rapid deterioration as is conventional wooden decking, and finally which functions to improve the over all cooling performance of cross-flow towers. The latter generally comprise an upright tower chamber having air inlet and outlet openings at the side and top, together with means for distributing liquid in particles into the upper interior of the tower chamber for heat transfer with air flowing transversely into the tower chamber through the inlet openings and transversely or upwardly within the chamber toward the outlet. While the invention is discussed in relation to crossflow towers, it will be understood that it is applicable also to counterflow cooling towers.

According to the invention, the tower chamber contains vertically spaced relatively highly flexible sheets, preferably plastic, having freely hanging transverse extent within the chamber, air being freely flowable transversely between the vertically separated sheets as it enters the chamber through the side inlet. More specifically, each sheet has gridwork form containing vertically open perforations through which air and liquid particles are free to pass vertically, the gridwork sheets each having upwardly presented flat surface extent for splash interception and filming of liquid falling within the chamber.

The thin sheets of plastic packing material are each supported at transversely spaced intervals so that the unsupported sections of the sheets have freely hanging transverse extent, the sheets being subject to rapid and ready installation merely by hanging them over the transverse supports to which they may be retained as by upward projections on the supports interfitting perforations in the sheets. As will be brought out, the plastic sheets are preferably reinforced as by glass or other fibers to minimize fatigue stretching of the gridwork typically forming rectangular perforations. The latter are sized to provide openings greater than ½ inch but less than about 2 inches in cross dimension. For maximum cooling performance associated with effective splashing and filming of water droplets on the gridwork, the width dimension of the latter for best results lies between ⅛ inch and ¾ inch. If less than ⅛ inch, the gridwork width between perforations is insufficient to assure splashing of impinging drips which would merely break and not splash. On the other hand, if the gridwork strips are too wide, i.e., greater than ¾ inch, splashing is reduced as a result of the formation of a thick water film on the grid.

These and other objects and advantages of the invention, as well as the details of an illustrative embodiment will be more fully understood from the following detailed description of the drawings, in which:

FIG. 1 is a side elevation of the crossflow cooling tower assembly containing the improved novel packing;

FIG. 2 is a view taken on line 2—2 of FIG. 1;

FIG. 3 is a perspective view showing the gridwork form of one embodiment of the packing sheet;

FIG. 4 is an enlarged plan view showing overlapping of the vertically spaced plastic sheets in the tower assembly;

FIG. 5 is an enlarged cross section through a reinforced strip of the gridwork sheet packing; and

FIG. 6 is a side elevation of another arrangement of cross-flow cooling tower assembly containing the improved packing.

Referring first to FIGS. 1 and 2, the cooling tower generally indicated at 10, has opposite ends 11 at which vertically spaced and inclined louvers 12 form air inlets 13 through which air enters the tower chamber to flow transversely and then upwardly as shown by the arrows 14. Such air flow is typically induced by a fan 15 driven by motor 16 to rotate within the stack 17 forming an air outlet 18 at the top of the tower chamber. Water distributing means in the form of distribution basin 19 and header 119 and spaced apart laterals 20 is shown within the upper interior of the chamber, nozzles 21 receiving water from the distribution basin and the laterals and distributing it in drops or particles within the upper interior of the tower so that the water falls downwardly in heat transfer relation with air flowing transversely and upwardly within the chamber. Accordingly, the water is cooled by such heat transfer and is collected at the bottom 22 for further use. Drift eliminator means such as vanes or baffles 23 are located within the tower in such manner as to remove air entrained water particles from the air flowing upwardly toward the fan.

As shown in FIGS. 1 and 2, vertically spaced packing sheets 24 are supported within the chamber for promoting cooling of the water particles. These sheets, which are made of thin plastic material, are relatively flexible due to the fact that they are thin and contain perforations 25 as better shown in FIGS. 3 and 4. The gridwork form sheets are supported in the chamber at transversely spaced intervals by horizontally elongated members 26 typically extending across the tower chamber in parallel relation, at the elevations indicated. Accordingly, each of the sheets is supported by the members 26 so that unsupported sections 27 of the sheet have freely and loosely hanging transverse extent, whereby air is freely flowable transversely between the sheets after entering the chamber through the opposite side inlet. In this connection, it will be noted that the members 26 extend in directions generally parallel to the entering air flow instead of transversely thereto so that the sheet extents 27 and the members 26 present minimum resistance or obstruction to entering air flow.

The gridwork sheets have upwardly presented flat surface extent for splash interception and filming of water falling within the chamber. The sheets present downwardly facing convex surfaces and upwardly facing concave surfaces, as is clear from the drawings. Also, the length and width dimensions of the sheets are great as compared with the maximum transverse dimensions of the perforations 25. Generally speaking, vertically successive sheet gridworks will overlap, as typically illustrated in FIG. 4, so that water particles falling off the sheet gridwork will splash impinge upon lower sheet gridworks after falling through one or more of the perforations 25 associated with intervening sheets. These perforations are typically adapted to receive projections extending upwardly from the cross members 26 as shown at 28 so as to retain the sheets in position against sideward shifting in the tower chamber, thereby to maintain the freely hanging extents 27 of the sheets approximately in the configuration as seen in FIG. 2.

Preferably, the plastic sheet 24 should be less than about 3/16 inch thick and is desirably reinforced with glass or other fibers as indicated in FIG. 5 to minimize fatigue stretching. In FIG. 5, the sheet thickness is shown at 30

whereas the width of the gridwork between rectangular perforations **25** is indicated at **31**. Such width should be over ⅛ inch but less than ¾ inch for the reasons discussed in the introduction. Also, the perforations should be sized to provide openings greater than ½ inch but less than about 2 inches across. These gridwork width and perforation cross dimensions are such as to maintain the top surface area of each sheet between 25 and 65 percent of the total area within the upwardly projected periphery of the sheet, the latter being indicated at **32** in FIG. 3, in order best to promote the cooling performance of the packing. Finally, the vertical spacing between adjacent sheets may vary between about 2 inches and 20 inches depending upon the application. However, for any given application, the vertical spacing between vertically adjacent sheets should be approximately uniform throughout the vertical extent of the packing in the tower chamber.

In FIG. 6 which is a somewhat different arrangement of crossflow tower from that shown in FIGS. 1 and 2, the entering air **14** flows transversely through air inlets **13** formed by louvers **12**, thence, transversely through the tower. Such air is typically induced by a fan **15** driven by a motor **16** to rotate in a stack **17** forming an air outlet typically at the side of the tower chamber. Water distributing means in the form of a distribution basin **39** is shown at the upper portion of the chamber, nozzles **40** receiving water from the distribution basin and distributing it in drops or particles within the upper interior of the tower so that the water falls downwardly in heat transfer relation with air flowing transversely within the chamber. Accordingly, the water is cooled by such heat transfer and is collected at the bottom **22** for further use. Drift eliminator means such as baffles **41** in an inclined stack are located within the tower at the outlet side of the packing **24** and in such manner as to remove air entrained water particles from the transversely flowing air. The gridwork sheet packing **24** is typically installed in the manner already described in connection with FIGS. 1 and 2. Descriptions of the novel packing itself and arrangements and supports shown in and described in connection with FIGS. 1 through 5 apply to the packing embodied in FIG. 6.

From the foregoing it will be understood that the packing minimizes obstruction to the transverse or upward air flow within the tower thereby to minimize the horsepower required to draw air at any given volumetric rate through the tower. At the same time the packing promotes cooling of water falling within the tower, to best economic advantage, and it is easily installable and replaceable, easy to fabricate in the first instance, and is not subject to rapid deterioration as is conventional wooden decking. The plastic packing sheets may typically comprise high impact polystyrene film or glass fiber reinforced polyester compositions of appropriate thickness as previously discussed. Fatigue stretching of the plastic sheets is minimized by integral reinforcement with the glass fibers or other fibers.

It is also an important feature of the supported packing that the supports **26** are vertically staggered as for example is shown in FIG. 2. This construction assures that the water filming on the sheets and tending to flow transversely and downward to the lowermost hanging portions thereof will drop not upon the lowermost hanging portions of sheets therebelow, but will fall upon sheet surface portions at higher elevations and thereafter flow transversely and downward along such surface portions. Accordingly, the water is gravity filmed transversely whenever it strikes or impinges upon a sheet, to promote maximum cooling performance.

We claim:

1. An improved cooling tower assembly, comprising an upright tower chamber having air inlet and outlet openings, means for distributing liquid in particles into the upper interior of said chamber to fall downwardly therein, and vertically spaced relatively flexible sheets having freely hanging transverse extent within said chamber and between which air is freely flowable after entering the chamber, the spaces between said sheets being open in all directions transversely through the chamber interior, said air inlet openings being at the side of the chamber and at the general levels of said sheets and the spaces therebetween so that air may be drawn generally transversely through said inlet openings and into the spaces between vertically successive sheets, each sheet having gridwork mesh form containing a large number of like vertically open perforations through which air and liquid particles are free to pass vertically, the interconnected strips of the gridwork mesh having upwardly presented flat surfaces, with said mesh being draped over supporting members in such a manner that material between said members presents upwardly facing concave surfaces and downwardly facing convex surfaces.

2. An improved crossflow cooling tower assembly, comprising an upright tower chamber having air inlet and outlet openings, means for distributing water in particles into the upper interior of said chamber to fall downwardly therein, a plurality of vertically spaced highly flexible sheets and members supporting said sheets in the chamber at transversely spaced intervals so that the unsupported sections of the sheets have freely hanging transverse extent whereby air is freely flowable transversely between the sheets after entering the chamber through said side inlet, the spaces between said sheets being open in all directions transversely through the chamber interior, said air inlet openings being at the side of the chamber and at the general levels of said sheets and the spaces therebetween so that air may be drawn generally transversely through said inlet openings and into the spaces between vertically successive sheets, each sheet having gridwork mesh form containing a large number of like vertically open perforations through which air and water particles are free to pass vertically, the transverse dimensions of said perforations being substantially greater than the transverse dimensions of the strips of the gridwork mesh between adjacent perforations, the length and width dimensions of the sheets being great as compared with the maximum transverse dimensions of said perforations, the interconnected strips of the gridwork mesh having upwardly presented flat surfaces, with said mesh being draped over supporting members in such a manner that material between said members presents upwardly facing concave surfaces and downwardly facing convex surfaces.

3. The invention as defined in claim 2 in which each sheet comprises plastic material sufficiently thin that the sheet hangs freely from the support members.

4. The invention as defined in claim 3 in which said support members have transversely spaced apart and horizontally elongated extent.

5. The invention as defined in claim 4 in which the top surface area of each sheet is between 25 to 65 percent of the total area within the upwardly projected periphery of the sheet.

6. The invention as defined in claim 4 in which said support members are vertically staggered.

7. The invention as defined in claim 2 in which the tower chamber outlet opening is at the top of the chamber.

8. The invention as defined in claim 2 in which the tower chamber outlet opening is at the side of the chamber opposite said inlet opening.

9. Improved packing installable in a crossflow cooling tower chamber having air inlet and outlet openings and means for distributing water in particles into the upper interior of the chamber to fall downwardly therein, said packing comprising highly flexible sheets adapted to be spaced vertically in said chamber and supported so as to have freely hanging transverse extent whereby air is then freely flowable transversely between the sheets after entering the chamber, the spaces between said sheets being open in all directions transversely through the chamber

interior, each sheet having gridwork mesh form containing a large number of like vertically open perforations through which air and water particles are free to pass vertically, the transverse dimensions of said perforations being substantially greater than the transverse dimensions of the sheet extents between adjacent perforations, the length and width dimensions of said sheets being great as compared with the maximum transverse dimensions of said perforations, the interconnected strips of the gridwork mesh having upwardly presented flat surfaces, with said mesh being draped over supporting members in such a manner that material between said members presents upwardly facing concave surfaces and downwardly facing convex surfaces.

10. The invention as defined in claim 9 in which each sheet comprises thin plastic material.

11. The invention as defined in claim 10 in which said sheets contain glass or other fiber reinforcement.

12. The invention as defined in claim 10 in which said perforations are rectangular and have cross dimensions greater than the sheet thickness and within the range ½ inch to 2 inches.

13. The invention as defined in claim 12 in which the dimensions of the strips of the gridwork mesh between perforations lie in the range ⅛ inch to ¾ inch.

14. The invention as defined in claim 10 in which the top surface area of each sheet is between 25 to 65 percent of the total area within the upwardly projected periphery of the sheet.

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