July 9, 1940. E. W. SIMONS 2,207,272

COOLING TOWER CONSTRUCTION

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FIG. 3.

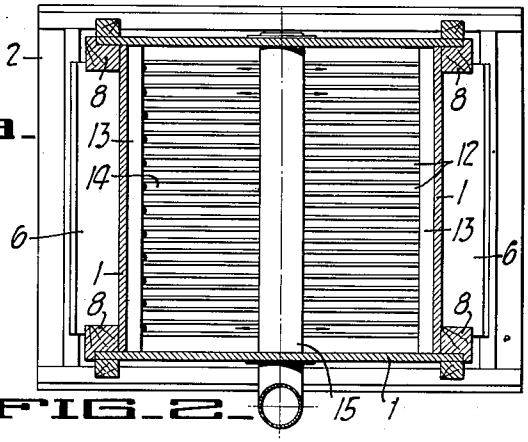
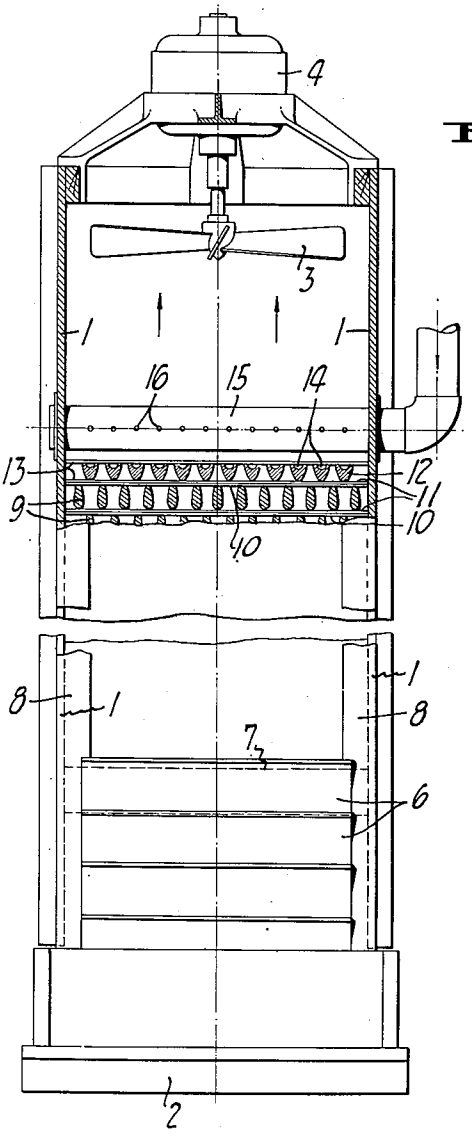
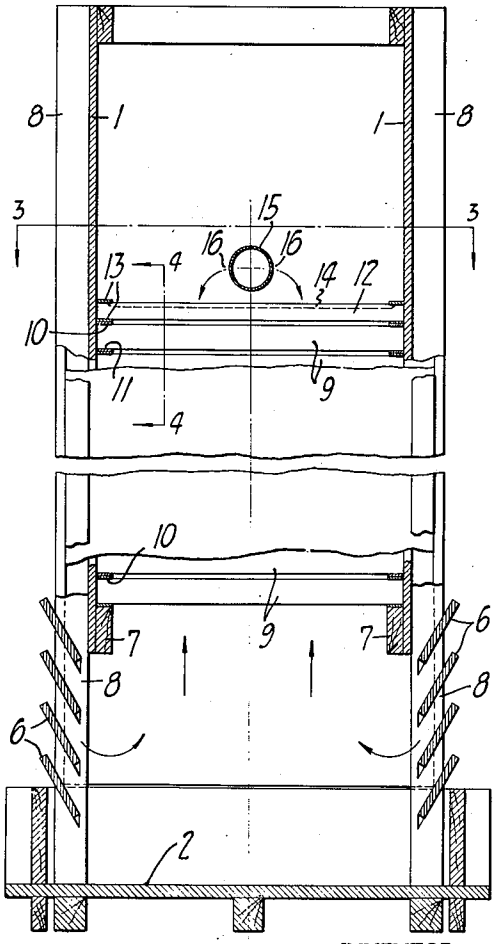


FIG. 2.

FIG. 1.





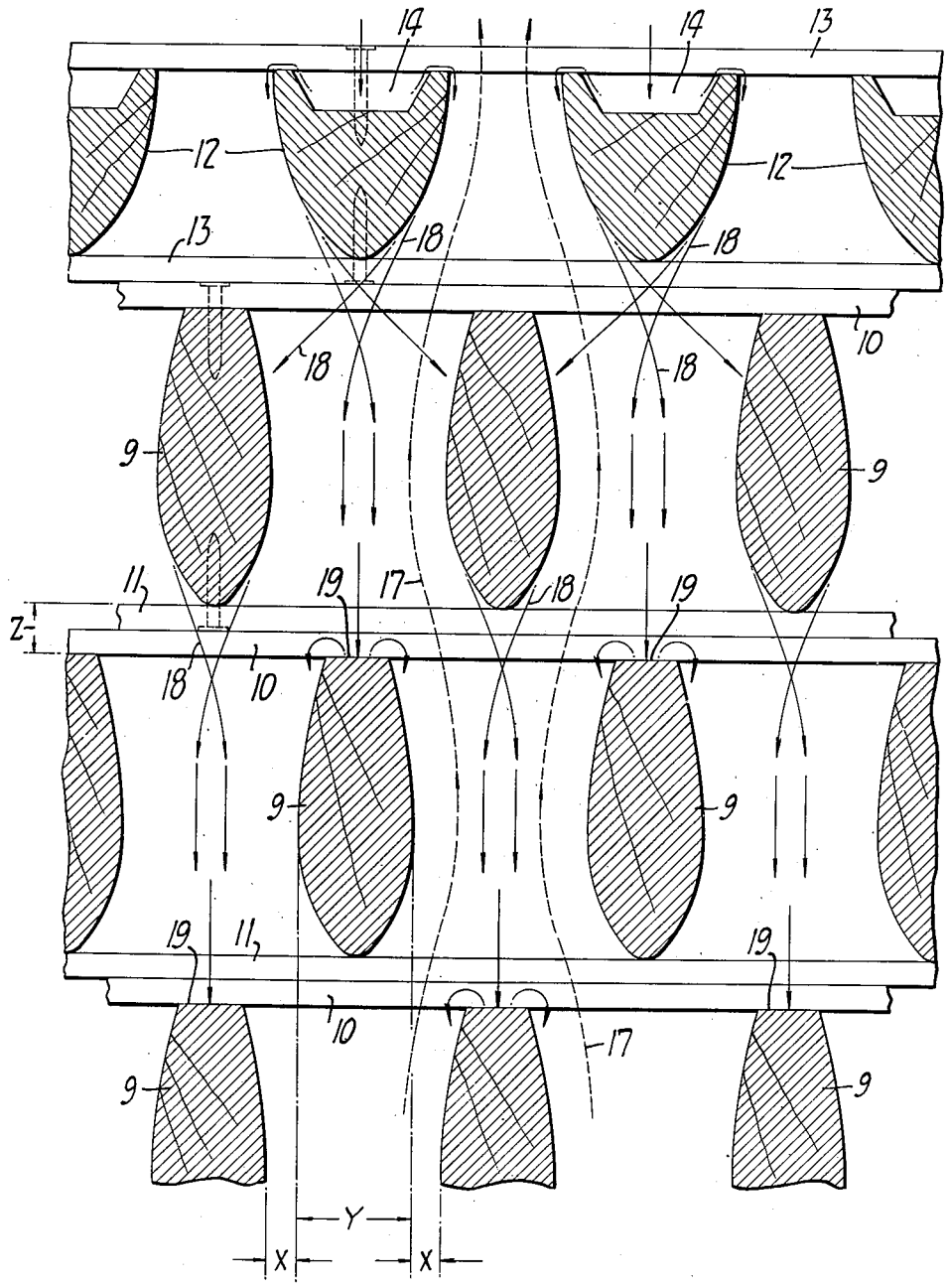
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FIG. 4.



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2,207,272

COOLING TOWER CONSTRUCTION

Edward W. Simons, San Francisco, Calif., assignor to Redwood Manufacturers Co., Pittsburg, Calif., a corporation of Nevada

Application March 7, 1938, Serial No. 194,397

8 Claims. (Cl. 261—111)

This invention relates to cooling towers and has for its objects improved mat construction therein in which the liquid, such as water, is more efficiently distributed during falling thereof in a tower with a reduction in the resistance to the flow of air in the tower thereby increasing the efficiency of the tower for its intended purpose. Other objects and advantages will appear in the specification and drawings annexed hereto.

In the drawings,

Figure 1 illustrates a side view of a cooling tower, partly broken away and partly in section, to show construction.

Figure 2 is a side view of the tower of Figure 1 taken at right angles to the view illustrated in Figure 1, partly broken away and in section.

Figure 3 is a sectional view along the line 3—3 of Figure 2.

Figure 4 is an enlarged fragmentary view of a plurality of mats taken along the line 4—4 of Figure 2.

In detail, the tower illustrated in the drawings comprises vertical sides 1 supported upright on a base 2 which sides thus define the sides of a vertical passageway through the tower, and in this case the tower is substantially square in cross-section as seen in Figure 3, although the shape may obviously be varied, as desired.

The upper end of the tower is open and a horizontally disposed propeller 3 therein is actuated by a motor 4 supported on the tower in any suitable manner, to draw the air in the tower upward thereon and out of the tunnel, or in some instances a conventional suction blower may be used or a forced draft may be used with a propeller or blower at the bottom of the tower. However, the form shown is the preferred means for creating an upward draft of air in said tower.

The two opposite sides of the tower at its lower end are open and fitted with a vertical row of spaced shutters 6 extending divergently upwardly at the opposite sides of the tower, but with the shutters on either side parallel to each other, whereby air is drawn into the tower between said shutters in a generally downward direction at the lower end thereof of said tower. In some instances similar shutters are at all four sides of the tower and in other instances, they are only on one side, but the construction shown in Figure 2 is found to be most generally desirable.

Horizontal parallel beams 7 extend across opposite sides of the tower at about the level of the upper shutters, which beams are bolted or otherwise secured to the corner posts 8 of the tower and against the inner opposite sides of said tower. The beams 7 support the mats which will now be described.

Each of said mats comprises a horizontal row of vertically disposed strips 9 of generally ovate-lanceolate shape in cross section with the curved edge portion lowermost and the upper pointed ends cut off to form substantially horizontal upper sides on the strips all disposed in a single horizontal plane. Extending across the upper sides of the strips at their ends are flat boards or slats 10 to which the strips are secured, as by nailing or in any other suitable manner. Below the strips at said opposite ends are boards or slats 11 similar to boards 10 and similarly nailed to the strips. The boards 10, 11 and strips 9 as described, comprise each of the mats, and the boards and strips forming each mat are adapted to slidably fit in said tower with the lowermost mat supported adjacent opposite side edges on beams 7.

The spacing between adjacent pairs of strips 9 of each mat is substantially equal and the strips of each mat are substantially parallel to each other and to the strips of the other mats; however, the strips of one of the adjacent mats of each pair are horizontally offset to be substantially in vertical planes about midway between the vertical planes in which the strips of the other mat of the pair are disposed, whereby the strips of adjacent mats are in staggered relation as best indicated in Figures 1 and 4. Also, the degree of horizontal spacing of the strips in each mat is slightly greater than the greatest thickness horizontally of the strips. Thus the pair of vertical planes defining the lateral limits of thickness of each of the strips of one of the adjacent mats of each pair of mats will be spaced from similar pairs of vertical planes defining the lateral limits of thickness of the other mat of the pair of mats the distances X, (Fig. 4) which distances respectively are preferably appreciably less than the thickness Y of each strip, and the distance Z, which is the vertical spacing between the adjacent strips of each adjacent pair, is preferably less than one-half of the greatest vertical thickness of the respective strips. These distances, substantially as given, appear to be preferable for greatest cooling efficiency without objectionable resistance to the flow of air through the tower.

Over the spaces between the adjacent strips of the uppermost mat in the tower, I provide elongated liquid distributing elements 12, which elements are held together by slats 13 secured against the under sides of said elements at their

ends. Said elements are parallel with the strips 9 and in cross section are respectively of generally the same shape as strips 9, but are horizontally cut off across their vertical width at the thickest part. The greatest horizontal thickness of said elements is slightly greater than the greatest thickness of the strips, but this can be varied to meet conditions. These elements 12 are centrally grooved longitudinally thereof on their upper sides to form a groove 14 in each element with upwardly divergently extending sides to the grooves, and the ends of the grooves are closed so that when the grooves are filled with liquid the liquid will flow out of the grooves and downwardly over the opposite lateral sides of the elements.

Extending transversely across the upper sides of the elements 12 is a relatively large diameter pipe 15 having relatively small holes 16 formed in its opposite sides, which holes open laterally outwardly directly over the grooves 14 in the elements 12. One end of the pipe 15 is closed and the opposite end connects with a relatively low pressure line conducting the liquid under pressure to the pipe, the volume of flow into said pipe relative to the total capacity of the holes 16 and the pressure being such as to keep the pipe sufficiently filled at all times to cause the liquid ejected through said holes to spurt outwardly from the sdes of the pipe a short distance rather than to dribble down the sides of said pipe, whereby substantially all of the liquid ejected from said pipe will go into the grooves 14.

In operation, the air drawn upwardly through the tower will contact substantially the full lateral and under surfaces of the strips with a rapid movement due to the cross sectional shape of the strips without creating objectionable eddies in the air stream, and without objectionable resistance, thus greatly increasing the rate of evaporation of the water or liquid covering said strips. This freedom from objectional resistance to the air flow also reduces the power required to cause effective movement of said air. In Figure 4 the general directional flow of the air is indicated by the dotted line and arrows 17.

The water flowing over the sides of elements 12 will closely adhere to said sides and tend to be directed divergently outwardly from the under sides of the elements, as indicated in Figure 4, to distribute over the sides of the strips at either side of each of said elements, and some of the water also falls directly downwardly. This water will follow the sides of each of the strips, as indicated by arrows 18, to the lowermost portions thereof where it will drop onto the flat upper sides 19 of the strips 9 of the next mat therebelow to splash outwardly and thereby create a dispersion of the water for facilitating the dispersion of the water which greatly facilitates the direct transfer of heat to the air or vice-versa, according to the character of heat transfer desired, as well as facilitating evaporation of the water.

It is obvious that the advantages of my invention as described are present irrespective of the material used in the construction, although I have used redwood, which is economical and which is durable in the presence of moisture, and which also gives surfaces over which the moisture readily distributes itself.

I claim:

1. In a cooling tower, a pair of superimposed, generally horizontally disposed mats, each mat comprising a row of substantially horizontally extending, horizontally spaced strips, each of which strips is of generally ovate-lanceolate cross-sectional contour, the strips of both mats extending in the same general direction and the strips of one of the mats being horizontally offset relative to the strips of the other mat, the strips of the uppermost mat of the pair being formed with generally horizontal flat upper sides, and means for dropping water onto said flat upper sides whereby the water dropped thereon will be caused to splash, thereby effecting a dispersion of said water for subsequent falling toward the strips of the lowermost mat of the pair.

2. A cooling tower having side walls defining the sides of a vertical passageway through the tower, an opening in one of the sides of said tower at the lower end thereof for admitting air to the lower end of said passageway, means at the upper end of the tower for drawing air through said opening and upwardly through said passageway for ejection at the upper end of the tower, a plurality of pairs of adjacent mats disposed between said opening and said means, said mats each comprising parallel horizontally extending horizontally spaced strips of greater vertical than horizontal thickness, the strips of one of each of said pairs being offset horizontally relative to the strips of the other mat of the pair and the lowermost edge of each of said strips being convexly curved in cross-sectional contour to reduce resistance to the upward flow of air in said passageway, the major portion of the opposite lateral sides of each strip extending generally divergently from the upper edge thereof whereby the major lateral surface area of the strips will directly engage water falling by gravity in the tower and means over the uppermost mat in the tower for supplying water for dropping said water through said passageway and onto said strips, and means vertically spacing the strips of adjacent pairs to position the lower and upper adjacent sides of the strips in horizontal planes a distance less than the vertical thickness of the strips respectively.

3. In a cooling tower, a pair of superimposed, generally horizontally disposed mats, each mat comprising a row of substantially horizontally extending, horizontally spaced strips, each of which strips is of generally lanceolate cross-sectional contour, the strips of both mats extending in the same general direction and the strips of one of the mats being horizontally offset relative to the strips of the other mat, the greatest horizontal thickness of said strips, respectively, being closer to the lower edges thereof than to the upper edges and the spacing between adjacent strips in each mat being greater than the greatest horizontal width of the respective strips.

4. In a cooling tower including a plurality of pairs of superimposed mats respectively comprising a plurality of horizontally spaced strips, the strips of the upper mat each being formed on the upper side thereof with an upwardly opening recess extending longitudinally thereof for receiving water therein for overflowing therefrom over the lateral sides of the strip and said lateral sides extending convexly and divergently upwardly from the lowermost portion of the strip, and the strips in one of the mats of each adjacent pair being offset horizontally relative to the strips of the other mat of said pair, the strips of the mats below said upper mat being of greater vertical than horizontal width with the opposite lateral sides extending divergently downwardly from their upper edges to points at opposite lateral sides of such strips disposed below a

point midway between the upper and lower edges of the strips whereby water overflowing and falling by gravity from the recesses in the strips of the uppermost mat will strike the divergent surfaces of said lateral sides of the strips in the mats below said uppermost mat.

5. In a construction as defined in claim 4, means for supporting water to each of the recesses in each of the strips of said uppermost mat.

6. A mat for cooling towers comprising a horizontally extending row of substantially parallel, spaced strips, each of said strips being of generally ovate cross-sectional contour with convexly curved lower edges and lateral sides, means for supporting the strips of said row in a tower with their longitudinal axes substantially horizontal, said strips having their major cross-sectional axes substantially vertical and with their greatest horizontal thicknesses closer to their lower edges than to their upper edges and water supply means positioned over said strips for dropping water by gravity onto said strips.

7. A cooling tower having side walls defining the sides of a vertical passageway through the tower, an opening in one of the sides of said towers at the lower end thereof for admitting air to the lower end of said passageway, means at the upper end of the tower for drawing air through said opening and upwardly through said passageway for ejection at the upper end of the tower, a plurality of pairs of adjacent mats disposed between said opening and said means, said mats each, comprising parallel, horizontally extending, horizontally spaced strips of greater vertical than horizontal thickness, the strips of one of each of said pairs being offset horizontally relative to the strips of the other mat of the pair and the lowermost edge of each of said strips being convexly curved in cross-sectional contour to reduce resistance to the upward flow of air in said passageway, the major portion of the opposite lateral sides of each strip extending generally divergently from the upper edge thereof whereby the major lateral surface area of the strips will directly engage water falling by gravity in the tower, means over the uppermost mat in the tower for supplying water for dropping through said passageway and onto said strips, the opposite lateral sides of said strips being convexly curved in cross-sectional contour in continuation upwardly from the curved lower edges thereof, and the upper sides of said strips being horizontally flattened for providing a surface onto which the falling water will splash for dispersion thereof over the sides of the strips.

8. A cooling tower mat having horizontally extending, spaced strips of generally lanceolate shape in cross-section disposed with the base portion downward and the lowermost edges of the strips and opposite lateral sides being convex in cross-sectional contour, whereby substantially the entire external surfaces of said strips, when moistened, will be effectively engaged by an up draft of air within which the strips are adapted to be positioned for evaporating said moisture and whereby the resistance offered by said strips to the upward flow of said air therepast will be relatively small, means for moistening the outer surfaces of said strips with water and means for causing an upward movement of air past said strips and over the lower edges and lateral sides thereof.

EDWARD W. SIMONS.