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L. T. MART

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FORCED DRAFT FAN-IN-BASE COOLING TOWER

Filed Sept. 10, 1953

3 Sheets-Sheet 1

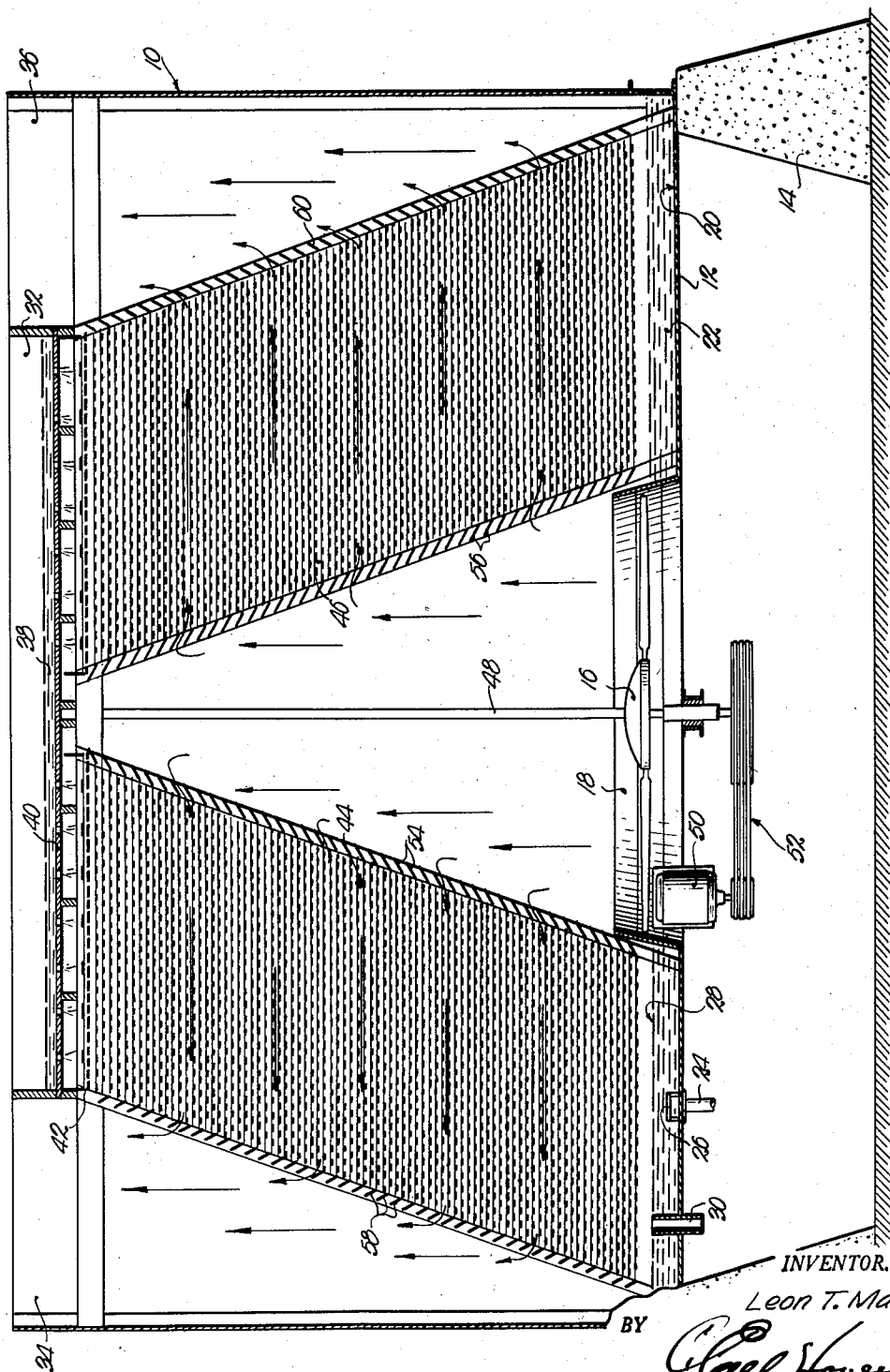


Fig. 1.

INVENTOR.

Leon T. Mart

BY

Carl Hovey
ATTORNEY.

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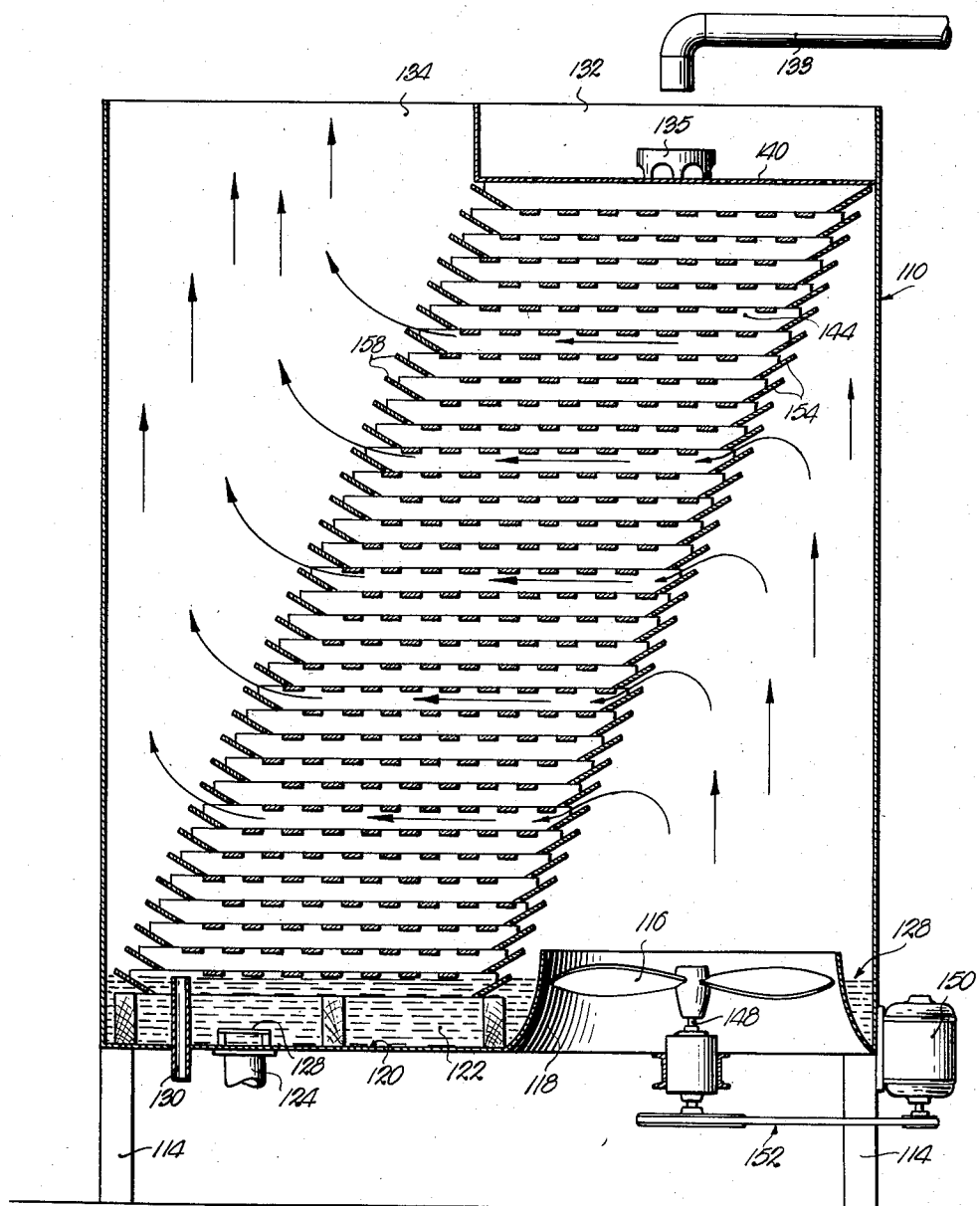


Fig. 2.

INVENTOR.

Leon T. Mart

BY

Carl Hovey
ATTORNEY.

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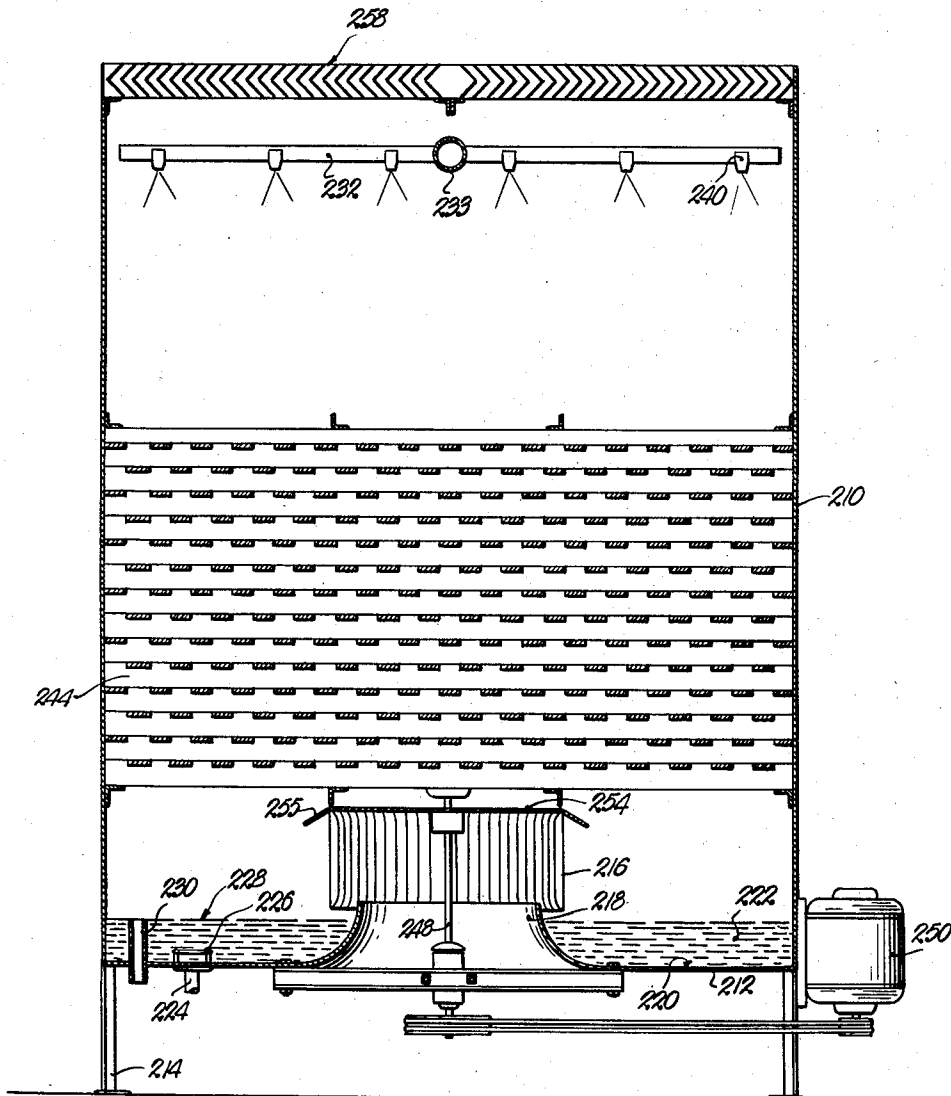


Fig. 3.

INVENTOR.
Leon T. Mart
BY *Carl Hovey*
ATTORNEY.

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FORCED DRAFT FAN-IN-BASE COOLING TOWER

Leon T. Mart, Mission Township, Johnson County, Kans.,
assignor to The Marley Company, Kansas City, Mo.,
a corporation of Delaware

Application September 10, 1953, Serial No. 379,398

1 Claim. (Cl. 261—30)

This invention has to do with improvements in water cooling systems and particularly to cooling towers, the primary object being to provide a tower wherein the means for creating and directing artificial currents of air through the tower and taking the form of a blower fan is located within the bottom of the tower so that the side walls thereof are completely closed and the unsightly component parts of the cooling system thereby hidden from view.

Another important object of the present invention is to provide cooling tower structure so formed and located as to permit disposition of the fan for producing a forced draft at the lowermost end of the tower hidden from view therewithin and disposed for directing currents of air vertically through the air inlet opening and the air outlet opening of the tower.

Another important object hereof is to provide a cooling tower wherein all mechanical equipment, including the fan, the ring guard, air inlet louvers and other parts of the tower are partially hidden from view, and the usual hand rail, fan deck, water piping, external ladders and the like, can be either eliminated or so housed as to present a neat and attractive assembly.

A still further object of this invention is to provide a forced draft water cooling tower of either the counter-flow or cross-flow principle wherein mechanical equipment is conveniently accessible adjacent the supporting surface upon which the tower is located.

An additional object is to provide a cooling tower of such construction that the overall height may be reduced and permitting a construction wherein objectionable noise due to falling water and operation of the fan and the motor are reduced, eliminated or may be muffled to suit the desires of the user.

More minor objects will be made clear as the following specification progresses, reference being had to the accompanying drawings, wherein Figure 1 is a vertical-sectional view of a forced draft fan-in-base cooling tower made pursuant to one embodiment of the present invention. Fig. 2 is a similar sectional view illustrating a second form of the invention, and Fig. 3 is a vertical-sectional view of still another embodiment of the principles of the invention hereof.

The important features of the invention about to be described are incorporated in all three forms illustrated in the drawings, Fig. 1 depicting a double flow type of tower, Fig. 2 showing a single fill assembly operable on the cross-flow principle, and Fig. 3 illustrating a tower wherein the air is forced through the gravitating water counter to its direction of movement through the splash deck fill.

In Fig. 1 of the drawings, there is illustrated a water cooling tower that includes a suitable casing broadly designated by the numeral 10 and which is preferably rectangular in horizontal cross-section and provided with a bottom wall 12. The four side walls of the casing 10 are completely closed and the entire tower is suitably supported in an elevated position such as by use of the

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supporting concrete pillars or the like 14. Such supporting of the casing 10 presents a space below the bottom wall 12 that is open to the atmosphere and, therefore, artificial currents of air may be produced and drawn into the casing 10 from the space below wall 12 by a blower fan or the like 16.

Fan 16 is disposed within a frustro-conical fan ring 18 that extends through the bottom wall 12 centrally thereof to present an air inlet opening and to present a basin 20 for collection of cold water 22. The fan ring 18 is spaced from all of the side walls of the casing 10 so that the basin 20, and therefore the water 22, completely surrounds the ring 18.

Fan ring 18 extends upwardly into the casing 10 above the bottom wall 12 and a suitable cold water drainage system is provided for the catch basin 22 to prevent escape of the cool water 22 from the tower 10 over and through the fan ring 18. To this end there is included a suitable sump or merely a water outlet conduit 24 having an anti-cavitation plate 26 thereabove. A water level 28 below the upper edge of ring 18 is maintained through provision of an overflow pipe 30 extending through the bottom wall 12.

The uppermost end of the casing 10 is entirely open except only for the provision of an open top, hot water distribution basin 32. The basin 32 is within the air outlet opening at the top of the casing 10 thus dividing the opening into a pair of opposed ducts 34 and 36. Hot water 38 is directed into the basin 32 in any suitable manner now shown and the bottom wall 40 of the basin 32 is foraminous throughout for even and continuous draining of hot water 38 therefrom. The water emanating from the distribution means 32 falls upon a distribution deck 42 which further sub-divides the streams of water into smaller particles or globules prior to gravitation of such hot water globules to a pair of splash deck fills 44 and 46.

Shaft 48 for fan 16 extends vertically through the casing 10 between the fills 44 and 46 and is suitably attached to framework that supports the basin 32 and to framework that reinforces the bottom 12. Fan 16 is driven by a prime mover such as an electric motor 50, carried by the casing 10 below or within the ring 18 and a V-belt drive 52 is provided between the motor 50 and the fan shaft 48.

The splash decks 44 and 46 are made up of a plurality of layers of spaced slats which may be alternated throughout the height of the fills 44 and 46 so far as the longitudinal axes of the slats are concerned all to the end that the gravitating hot water is broken up continuously into extremely small particles and so that the hot water films on the slats are thereby subjected to the full action of the air being forced therethrough. By such construction the maximum amount of heat is removed from the water by the air prior to collection of the water in the basin 20 and discharge of the hot air upwardly through ducts 34 and 36.

It is to be noted that the fills 44 and 46 converge as the distribution means 32 is approached and, therefore, each splash deck fill 44 and 46 is inclined upwardly and inwardly from the basin 20 to the distribution means 32 toward the central shaft 48 and into overlying relationship to ring 18 and fan 16. Consequently, the entire uppermost ends of the fills 44 and 46 are beneath the distribution means 32, offset relative to the air outlet ducts 34 and 36. By the same token, the entire lowermost ends of the fills 44 and 46 are above the basin 20 on opposite sides of the fan ring 18.

The fan 16 and, therefore, the air inlet opening being directly below the distribution means 32 and offset relative to both ducts 34 and 36, all incoming air from the space below bottom wall 12 must move vertically through

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the fan ring 18. Such air enters the fills 44 and 46, passes therethrough horizontally in intersecting relationship to the direction of gravitation of the water and is discharged from the casing 10 through vertical paths of travel by way of air outlet ducts 34 and 36.

Means is provided to avoid direct flow of the incoming air into the fills 44 and 46 which would tend to increase the drift of water toward the air outlet ends of the fills 44 and 46 and such means takes the form of stacks of spaced louvers 54 and 56 for fills 44 and 46 respectively. Louvers 54 and 56 disposed at the air inlet ends of the fills 44 and 46 converge as the distribution means 32 is approached and, therefore, overlie the fan ring 16. Each louver 54 and each louver 56 is inclined inwardly toward the corresponding fill 44—46 and downwardly toward the basin 20. Consequently, the fan 16 and motor 50 are protected against moisture since the louvers 54 and 56 tend to prevent any escape of water through the fan ring 18 because any water that tends to collect at the air inlet ends of the fills 44 and 46 is redirected into the fills and toward the basin 20.

It is manifest that the forced draft tends to carry the water films through the fills and through the air outlet ducts 34 and 36. Such tendency is reduced and water is removed from the moisture laden air by deflecting the path of travel of the air from a horizontal path through the fills to a vertical path through the air outlet ducts. Such deflection means takes the form of eliminators 58 and 60 for the fills 44 and 46 respectively and disposed at the air outlet ends of the latter. The eliminators 58 and 60 are likewise in the form of a plurality of spaced, transversely inclined louvers, it being noted that the inclination is such as to tend to redirect water drifting toward the eliminators 58 and 60 back into the fills 44 and 46 respectively and toward the basin 20.

Eliminators 58 and 60 are inclined inwardly from the basin 20 to the distribution means 32 in converging relationship as the latter is approached. Eliminators 58 are preferably parallel with the louvers 54 and similarly the eliminators 60 and the louvers 56 are in parallelism.

The principles of the tower shown in Fig. 1 and above set forth are included substantially in the same manner in a different type of tower such as shown by Fig. 2 of the drawings. A casing 110, having the side walls thereof closed, may be substantially rectangular in horizontal cross-section and supported in a suitable manner such as by use of standards 114 to present a space below bottom wall 112 open to the atmosphere. A fan ring 118 extends through the bottom wall 112, presenting an air inlet opening and terminating within the casing 110 to present a catch basin 120 for cool water 122 that surrounds the ring 118. The cold water outlet conduit 124 and an overflow pipe 130 extend through the bottom wall 112, the pipe 130 establishing a water level 128 and the conduit 124 being provided with an anti-cavitation plate 128. A blower fan 116 within the ring 118 has its shaft 148 coupled with an electric motor 150 through a belt drive 152.

The uppermost end of the casing 110 is open except only for the provision of hot water distribution means in the nature of a basin 132 that directly overlies the fan 116 and the ring 118, presenting therefore an air outlet opening or duct 134. Hot water may be directed into the basin 132 by an inlet pipe 133 disposed above an anti-splash box 135 within the basin 132. Bottom wall 140 for the basin 132 is foraminous throughout and overlies a splash deck fill 144. Fill 144, together with its louvers 154 and its eliminators 158, are disposed substantially the same as the fill 44, the louvers 54 and the eliminators 58 in Fig. 1. It is to be noted, however, that the fill 144 and the louvers 154 extend to partially or wholly overlying relationship to the fan 116 and the air inlet fan ring 118.

The fan 116 draws in air from the atmosphere within the space below bottom wall 112, forces the cool air

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vertically through the fan ring 118, whence it is deflected laterally and horizontally through the fill 144 in intersecting relationship to the hot water globules, droplets and films gravitating through and forming on the slatted splash decks of the fill 144. The hot moisture laden air is deflected upwardly by the eliminators 158 and after moisture is removed therefrom by the eliminators 158 the hot air escapes from the casing 110 along a vertical path of travel through the air outlet opening 134.

Fig. 3 of the drawings illustrates the manner in which the principles of the present invention may be embodied in a counter-flow forced draft water cooling tower. A vertical, upright casing 210 has a bottom wall 212 elevated by standards 214 to present a space therebelow open to the atmosphere. A fan ring 218 extending upwardly into the casing 210 through the wall 212 presents an air inlet opening and a catch basin 220 for cold water 222 that surrounds the ring 218. A level 228 is established by the provision of an overflow pipe 230 and the water is drained from the basin 220 by an outlet conduit 224 provided with an anti-cavitation plate 226. A blower fan 216 within the casing 210 above the fan ring 218 has its shaft 248 coupled with an electric motor 250 by V-belt drive 252.

A splash deck fill 244 within the casing 210 directly overlies the basin 220 and therefore the fan 216 as well as the air inlet opening defined by ring 218. Fan 216 is protected by and cold water emanating from the fill 214 is deflected toward the basin 220 so that it will not escape from the casing 21 by way of the fan ring 218 by means of a plate 254 overlying the fan 218 and provided with a downwardly and outwardly inclined annular skirt 255.

Hot water is directed into the casing 210 by means of an inlet pipe 233 and such water is distributed evenly over the fill 214 by means of one or more manifolds 232 having a plurality of distribution nozzles 240 throughout the length thereof.

The uppermost end of the casing 210 is completely open for discharge of hot air emanating from the fill 244 except only as interrupted by a two-pass eliminator 258 that consists of a plurality of transversely V-shaped louvers as is clearly illustrated in Fig. 3.

In this embodiment of the invention, fan 218 causes air from the space below bottom wall 212 to move vertically through the fan ring 218 and to discharge laterally from the fan 216 whence it rises vertically through the fill 244. Notable is the fact that the rising air emanating from fan 216 moves along a path of travel counter to the direction of gravitation of the hot water through the fill 214 thereby removing heat therefrom prior to discharge from the casing 210. The cold water from fill 244 flows to the catch basin 220 and the hot air is deflected in the air outlet end of the casing 210 by the eliminators 258 to remove moisture therefrom. Any upward drift of water in the fill 244 will be further cooled between the distribution means 232—240 and the fill 244 and, for the most part, will fall to the fill 244 rather than be carried by the air to the eliminators 258. However, further cooling is provided by the air passing through the sprays emanating from nozzles 240 and most of such water that tends to drift toward the eliminators 258 will be removed because of the deflection of the path of travel of the air through eliminators 258. The cold air entering the fan ring 218 is forced against the water collection at the lowermost end of the fill 244 to remove remaining heat therefrom immediately prior to gravitation of such cold water to the basin 220. As the air progresses upwardly through the fill 244 and thence to the spray from the nozzles 240, it becomes progressively warmer and, therefore, the hottest air contacts the hottest water adjacent the nozzles 240 immediately prior to discharge of the hot air from the casing 210. This construction is highly efficient and through such arrangement it is possible to attain all of the aims and objects initially set forth herein.

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Accordingly, while details of construction may be varied, it is desired to be limited only by the spirit of the invention as defined by the scope of the appended claim.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

In a forced draft, cross flow, vertical discharge water cooling tower, a substantially rectangular, open top casing having opposed ends and opposed side walls respectively setting off a space within the casing, a hot water distribution basin closing a portion of the top of the casing and forming, with the end walls thereof, a pair of upwardly facing air outlet openings; a catch basin underlying said set off space at the bottom of the casing and having a central air inlet opening formed therein below and in axial alignment with the distribution basin and having an area less than that of said basin; means supporting the casing in an elevated position to present a substantially unobstructed space below the casing open to the atmosphere; an upwardly discharging fan in said opening and having blades disposed in the plane of the catch basin; and a pair of spaced apart splash deck assemblies within the space of the casing extending from side wall to side wall of the latter, one between each end wall of the casing and the air inlet opening and the fan therein respectively, said assemblies including means for dividing the water falling by gravity from the hot water distribution basin, the combined areas of the upper ends of the pair of splash deck assemblies being substantially the same as that of the hot water distribution basin whereby the hot water distribution basin completely overlies and closes the upper ends of the pair of splash deck assemblies, the lower ends of the splash deck assemblies

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being between respective end walls of the casing and the air inlet opening and the fan therein at the bottom of the casing, the opposed sides of each splash deck assembly being inclined upwardly and inwardly whereby to form a space therebetween and above the said air inlet opening and the fan therein, and further to form a space between each end wall of the casing and the inclined side of the proximal assembly, the cross-sectional areas of the space above the air inlet opening and the fan progressively decreasing as the hot water distribution basin is approached from said air inlet opening, the cross-sectional area of each space between the end walls of the casing and the inclined side of the proximal assembly progressively decreasing as the catch basin is approached from the air outlet opening thereabove.

References Cited in the file of this patent

UNITED STATES PATENTS

753,573	Hettinger	Mar. 1, 1904
1,051,661	Anderson	Jan. 28, 1913
1,564,075	Lakin	Dec. 1, 1925
1,929,410	Coey	Oct. 10, 1933
2,136,003	Coey	Nov. 8, 1938
2,194,711	Meyer et al.	Mar. 26, 1940

FOREIGN PATENTS

16,663	Great Britain	Sept. 30, 1899
16,664	Great Britain	Sept. 30, 1899
16,724	Great Britain	July 30, 1904
231,437	Germany	Feb. 22, 1911
313,200	Germany	July 18, 1919
543,273	Germany	Feb. 3, 1932
571,497	Germany	Mar. 1, 1933