Oct. 27, 1942.

R. D. MOORE

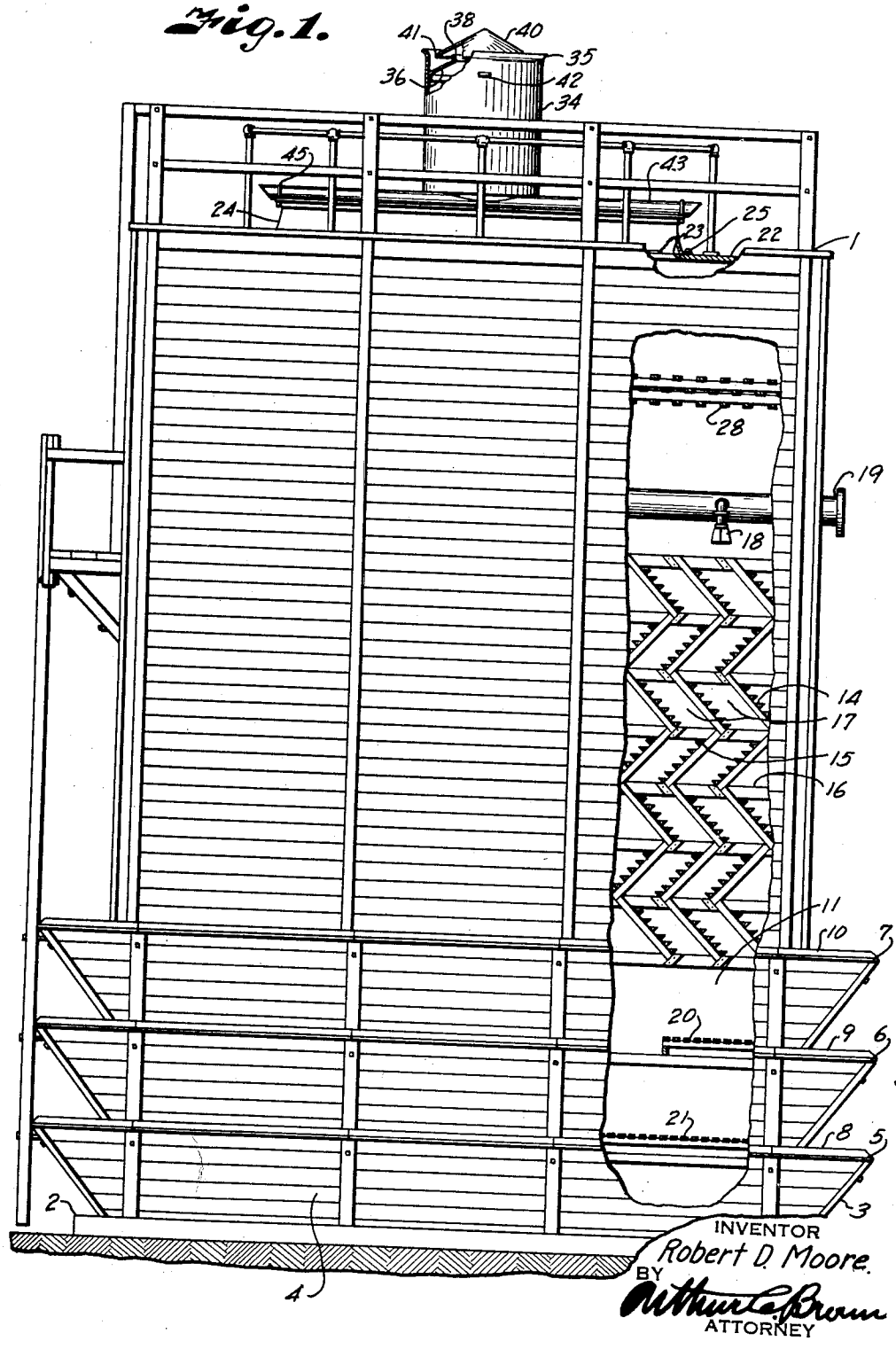
2,299,920

COOLING TOWER

Filed Aug. 22, 1940

3 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

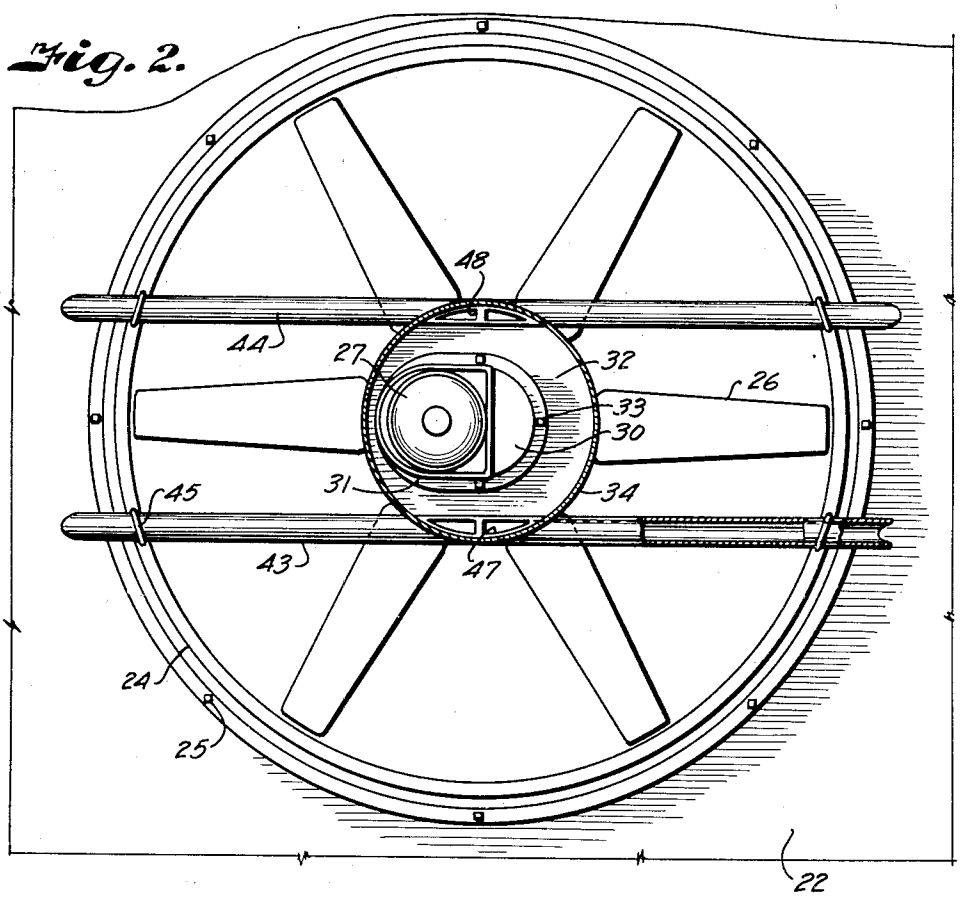
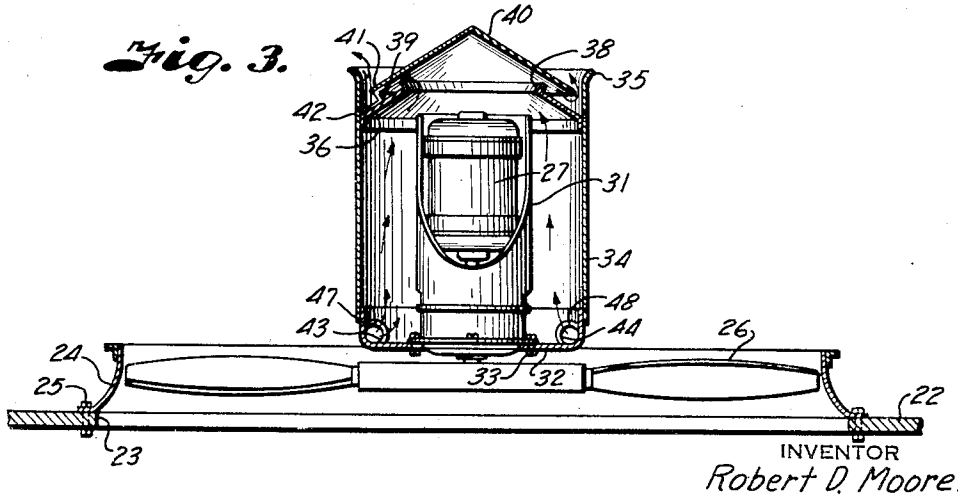


Fig. 3.



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Fig. 4.

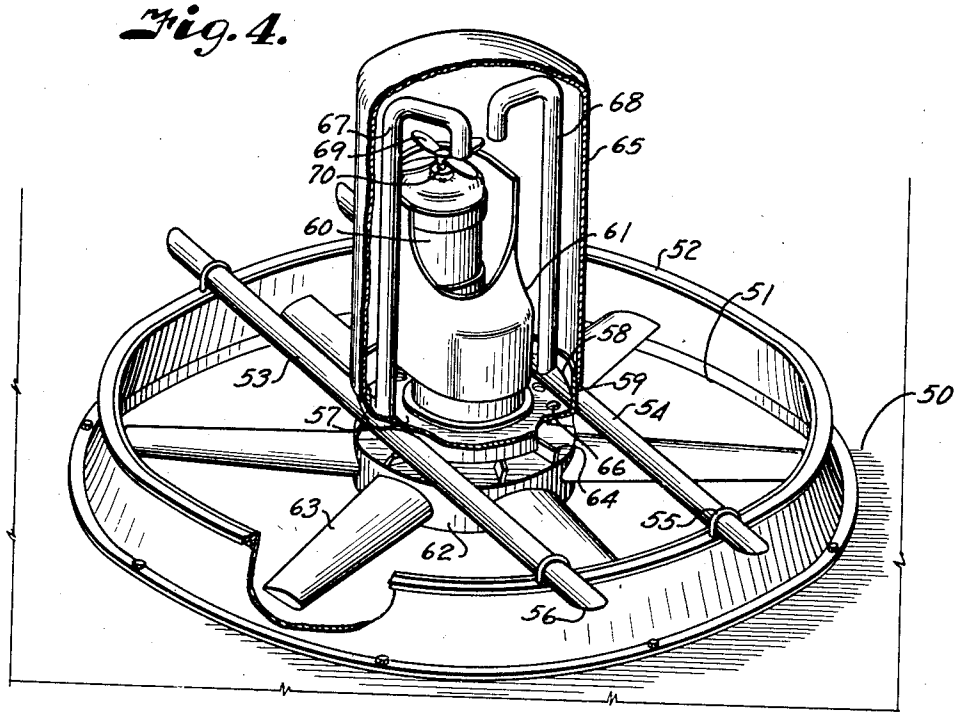
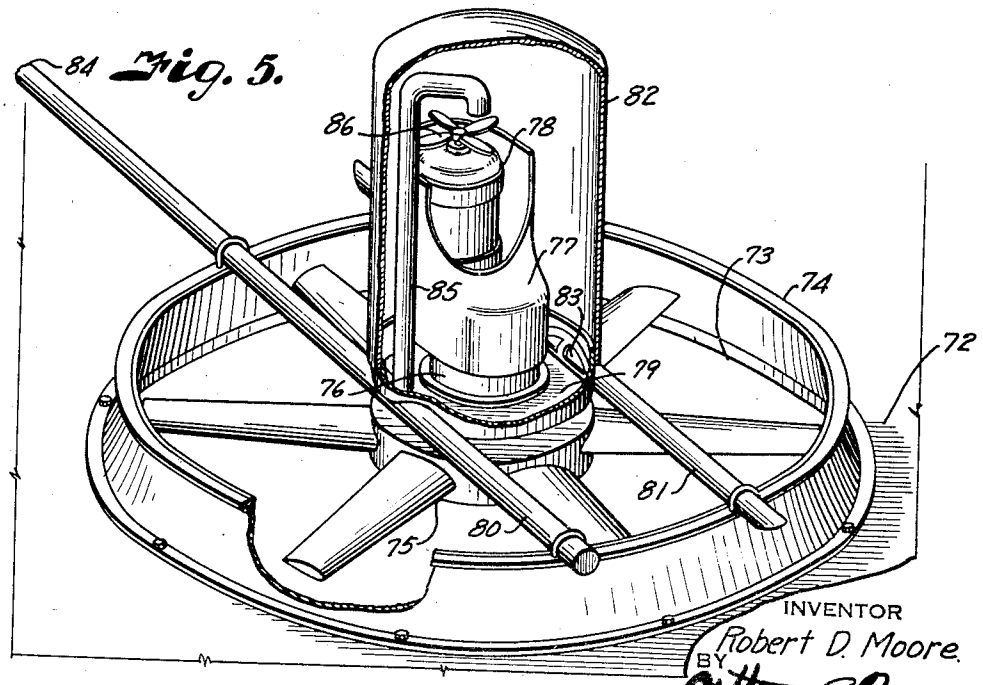


Fig. 5.



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UNITED STATES PATENT OFFICE

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COOLING TOWER

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Application August 22, 1940, Serial No. 353,598

7 Claims. (Cl. 261—30)

This invention relates to cooling towers, and more particularly to induced draft cooling towers, the principal objects of the invention being to provide a convenient, relatively economical and highly efficient cooling tower of the character noted.

In induced draft cooling towers, air of low relative humidity is sometimes passed through sprays of water of relatively high temperature to effect heat transfer from the water to the air and, by evaporation processes, cool the water. The relative humidity of the air is ordinarily consequently increased approximately to the saturation point of the air. The air normally is moved by a fan, which requires power for its energization. When the power is furnished by an electric motor, for example, the motor must be adjacent and subject to the deteriorating influences of the water saturated air stream or, as an alternative, the motor must be placed out of the path of the air stream, thus requiring relatively complex driving connections with the driven fan.

Further objects of the present invention are, therefore, to provide for arranging a motor in convenient relation to a fan driven thereby; to simplify the driving connections between the motor and fan; and to protect the motor from deteriorating influences of water-laden air.

Operation of a fan motor, particularly where the fan is large and is required to perform heavy duties, creates a considerable amount of heat, which should be dissipated in order for the motor to operate efficiently. Where the fan induces an air draft, it is convenient to utilize the draft for cooling the motor, but the deteriorating influences of the water in the air should, if possible, be obviated.

Other objects of the present invention are, therefore, to provide for passing cooling air over the motor taken from sources without the normal path of a saturated air stream drawn from the tower of which the fan forms a part; to provide improved elements for accomplishing the noted objects; and to provide improved arrangements of such elements.

In accomplishing these and other objects of the present invention, I have provided improved details of structure, the preferred forms of which are illustrated in the accompanying drawings, wherein:

Fig. 1 is a side elevational view of a tower embodying the features of the present invention, parts thereof being broken away to more clearly illustrate its construction.

Fig. 2 is a plan view of the tower showing the motor housing in horizontal section, and parts of an air duct being broken away to show the relation of the ducts to the cooling space for the motor.

Fig. 3 is a detail vertical cross-sectional view through the motor housing and tower deck to illustrate the relation of the fan, motor and housings therefor to the tower.

Fig. 4 is a perspective view of a modified form of cooling tower embodying the features of the present invention.

Fig. 5 is a further modified form of cooling tower embodying features of the present invention.

Referring more in detail to the drawings:

1, Figs. 1 and 2, designates an induced draft cooling tower embodying the features of the present invention, and which preferably includes a suitable base having a sump 2 suitably arranged thereon. Upwardly and outwardly diverging side and end walls 3 and 4 project from the sump in superimposed series 5, 6 and 7 to provide air inlets 8, 9 and 10 to the interior 11 of the tower. The tower is provided with preferably substantially vertical side and end walls 12 and 13 comprising suitable boards for closing the tower. Series of baffles 14 and 15 are also preferably supported on suitable rails 16 within the tower to provide tortuous courses 17 for water sprayed from jets 18 issuing from a suitable source 19 normally of heated or hot water to be cooled. As the water gravitates down the baffles in the tortuous courses provided therefor, it drips onto decks or the like 20 and 21 to provide a film through which air passing into the tower from the inlets 8 and 9 passes for admission into the tower.

The upper end of the tower is provided with a deck 22, which closes the upper end of the tower, except for a preferably circular opening 23 in the deck. A ring 24 is mounted on the deck as by fastening devices 25 in encircling relation to the opening 23, and forms a housing for a fan 26, which, upon actuation by a motor 27 induces a draft of air from the inlets 8 and 9 of the tower to the outlet opening 23 from the tower. As air is drawn through the tower, it passes through the decks 20 and 21 and the courses 17 to effect heat transfer from the water to the air, which substantially saturates the air with water. Spaced series of baffles 28 are provided in the tower and suitably supported therein, against which the air impinges to knock what water is left in the air out of the air.

By arranging the motor 27 for driving the fan 26 in the path of water saturated air, a draft of which is induced by the fan, the motor would ordinarily be subjected to deteriorating influences of the water. To overcome or obviate such deteriorating influences, the motor and suitable gear reduction devices 30 therefor, together with a gear reducer jacket 31 that aids in supporting the motor, are mounted on a plate 32, as by fastening devices 33. The plate 32 is preferably provided with an upturned peripheral flange, to which is connected an upwardly extending housing member 34, which preferably has an outwardly flared lip 35 at the upper periphery thereof.

A circular baffle 36 is mounted in the housing member 34 adjacent the upper end thereof, and has an upwardly and inwardly tapered wall, the upper extremity of which is outwardly flared, as shown at 38. Mounted on angle members 39 secured to the upper face of the baffle 36 is a conical hood 40, the lower edges 41 of which overlap the upper edge 38 of the baffle to cause moisture gravitating onto the hood to collect between the upper face of the baffle and the inner face of the housing 34, from which it may be drained through openings 42.

In order to support the motor, fan, motor housings and hoods, hollow duct forming members 43 and 44 are extended through suitable openings in the flange of the plate and suitably secured to the plate, the members 43 and 44 being of a length sufficient to bridge the opening 23 in the tower deck, and are preferably supported as by U clamps 45 on the upper edge of the fan ring 24, as clearly shown in Fig. 2. The members 43 and 44 are preferably cut inwardly and downwardly on their ends to form hoods to prevent collection of moisture in the ducts. Midway between the ends of the duct forming members, openings 47 and 48 are provided, which lead into the interior of the housing 34, as indicated by the arrows in Fig. 3.

The operation of an induced draft cooling tower constructed as described is as follows:

Water to be cooled is ejected from the source 19 through the jets 18 normally in spray form, which water gravitates through the tortuous courses of the baffles onto the decks 20 and 21 to form a film over the screens. The motor, upon being energized in a suitable manner, rotates the fan 26 through the gear reduction mechanism 30 of the motor to induce a draft in the tower from exterior air through the inlets 8 and 9 to the opening 23, the air passing through the water film on the decks and through the mist in the tower and baffle courses to effect heat transfer from the water by evaporation processes and saturate the air.

Continued upward movement of the air causes it to strike the baffles 28 to knock water out of the air, which is thus utilized and further cooled by subsequent evaporation processes.

After passing the baffles 28, the air still has moisture in it, and the fan ejects such air through the opening 23 and fan ring 24 upwardly around the motor housing 34 and beyond the outwardly flared lip at the upper end of the housing 34. Upward movement of such air induces a draft in the interior of the housing 34, which acts through the openings 47 and 48 in the motor supporting plate to induce a draft in the duct forming members 43 and 44 and draw air from points exteriorly of the housing and without the path of travel of the water saturated air. The air entering the ducts and housing follows a tortuous path on the inside of the baffle 36 and underside of the hood 40, from which points it is ejected into the water saturated air stream and aids in drawing following air over the motor housing 27 to air cool the motor.

Any water from the saturated air stream dropping onto the hood 40 does not reach the motor and cannot exert deteriorating influences on the motor for the reason that it collects between the baffle 36 and housing lip 35 and is drawn off through the openings 42 for gravitation back into the tower.

In Fig. 4, a modified form of cooling tower is illustrated, wherein the deck 50 of a suitable tower, such as shown in Fig. 1 of the preferred form of invention, is provided with an air draft outlet opening 51 encircled by a ring 52. Hollow duct forming members 53 and 54 are mounted on the upper periphery of the ring, as by U-clamps 55, and have cut back ends 56 similar to the ends of the members 43 and 44 in the preferred form of invention. The duct members 53 and 54 support a plate 57 as by passing through openings 58 in an upwardly extending peripheral flange 59 of the plate 57. A motor housing 60 is supported on the plate, which motor is provided with gear reduction mechanisms 61, from which depends a rotatable shaft for supporting a fan hub 62. Fan blades 63 radiate from the hub 62 to draw air from the tower through the opening 51, and fins 64 are arranged on the hub between the upper surface thereof and the plate in such a manner as to draw air from the hood 65 on the flange 59 and over the motor 60 to exhaust air from the hood through apertures 66 in the plate 57. As air is exhausted from the hood 65, an induction of outside air is set up, which travels through the open ends of the duct members 53 and 54 through ducts 67 and 68 into the housing preferably to points adjacent the top thereof for passing over the motor to cool the motor.

A fan 69 may also be provided on a stub shaft 70 of the motor 60 to force air downwardly from the top of the hood 65 over the motor and out of the apertures 66 in the motor supporting plate to enhance the induction of air over the motor to air cool the motor.

In Fig. 5, a further modified form of invention is shown, in which the deck 72 of a tower has an outlet opening 73 encircled by a ring 74, in which a fan 75 is rotatably mounted on suitable driving devices 76 supported from a gear reduction mechanism 77 that is engaged with and actuated by a motor 78. A plate 79 supported by duct forming members 80 and 81 supports the motor and fan. A hood 82 cooperates with the plate 79 to enclose the motor and the interior of the hood communicates with the duct member 81 through openings 83.

This form of invention contemplates supplying air to the housing to air cool the motor by supplying air from a suitable source, the source communicating with the open end 84 of the duct member 80, the duct member 80 being provided with an air inlet duct 85 leading into the housing above the motor for forcing air over the motor to cool the same. If desired, a fan 86 mounted integrally with or separately from the drive motor may augment the air cooling effect of the air passing over the motor from the duct 85, the air passing over the motor and out of the housing through the openings 83 and the duct member 81.

It is apparent, therefore, that a convenient, relatively economical and highly efficient cooling tower has been provided by the present invention.

What I claim and desire to secure by Letters Patent is:

1. In an apparatus of the character described, a tower having an inlet and an outlet, ducts mounted on the tower and spanning the outlet, said ducts having openings spaced from said tower outlet, means for spraying fluid to be cooled in said tower, means for inducing a draft of air from the inlet to the outlet through said fluid spray for cooling the same, said means being arranged adjacent the outlet of said tower on the ducts and having communication therewith, and means for drawing air from points without said induced draft through the ducts to dry air cool said draft inducing means.

2. In an apparatus of the character described, a tower having an inlet and an outlet, ducts mounted on the tower and spanning the outlet, said ducts having openings spaced from the tower outlet, means for spraying a fluid to be cooled in said tower, a fan arranged adjacent the outlet of said tower for inducing a draft of air from the inlet to the outlet of the tower and through said fluid spray for cooling the same, a motor for driving said fan, means for cooling said motor including a housing for said motor separating the same from said draft, said housing being mounted on said ducts and having communication therewith, said housing having outlets in the path of said draft leading over said motor housing whereby said draft induces a flow of air from the ducts through the housing for cooling said motor, and a baffle in said housing in the path of the outlet draft from said ducts.

3. In an apparatus of the character described, a tower having an inlet and an outlet, means for spraying a fluid to be cooled in said tower, a fan for inducing a draft of air from the inlet to the outlet of the tower and through said fluid spray for cooling the same, a motor for driving said fan, a housing for said motor separating the same from said draft, ducts having inlets out of the path of said draft and outlets in the path of said draft leading to said motor housing for cooling said motor responsive to draft of dry air induced by the draft of the water saturated air stream, a baffle in the housing path of the outlet draft from said ducts, and a hood over said housing cooperative with said baffle for deflecting moisture laden air from the interior of the housing.

4. In an apparatus of the character described, a tower having an inlet and an outlet, means for spraying a fluid to be cooled in said tower, a fan for inducing a draft of air from the inlet to the outlet of the tower and through said fluid spray for cooling the same, a motor for driving said fan, a housing for said motor separating the same from said draft, ducts having inlets out of the path of said draft and outlets in the path of said draft leading to said motor housing for cooling said motor responsive to draft of dry air induced by the draft of the water saturated air stream, a baffle in the housing path of the outlet draft from said ducts, a hood over said housing cooperative with said baffle for deflecting moisture laden air from the interior of the housing, and means for dissipating moisture deflected from the interior of the housing by said hood and baffle.

5. In an apparatus of the character described a tower having an inlet and an outlet, means for spraying a fluid to be cooled in said tower, a fan arranged adjacent the outlet of said tower for inducing a draft of air from the inlet to the outlet of the tower and through said fluid spray for cooling the same, a motor for driving said fan, means for cooling said motor including a housing for said motor separating the same from said draft and having an outlet opening, and ducts on the tower and spanning the outlet thereof for supporting the motor housing, said ducts having inlets out of the path of said draft and outlets into said housing for cooling said motor in response to a draft of air over said motor.

6. In an apparatus of the character described comprising a tower having an inlet and an outlet, means for spraying fluid to be cooled in said tower, means for drawing air through the inlet, sprayed fluid and outlet for cooling the fluid by evaporation processes, means for actuating said drawing means, means for cooling the air drawing actuating means including a housing over said actuating means having an air outlet therein, and means spanning the tower outlet and having an air passage therein communicating with the housing for supplying said housing with air from sources outside the path of air drawn from said tower to cool said air drawing actuating means.

7. In an apparatus of the character described, a wall having an outlet, a ring surrounding said outlet, a fan for inducing a draft through said outlet, a motor for driving said fan, a housing enclosing said motor having an outlet in the path of the draft from the wall outlet, and a member mounted on the ring and connected to said housing to support said housing, motor and fan over the wall outlet, said member spanning the wall outlet and having a passage therein with an opening at a point without said draft through the wall outlet whereby said draft induces a flow of air separate from that passing through the wall outlet through the supporting member passage and housing to cool the motor.

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