

May 17, 1932.

J. ARMSTRONG

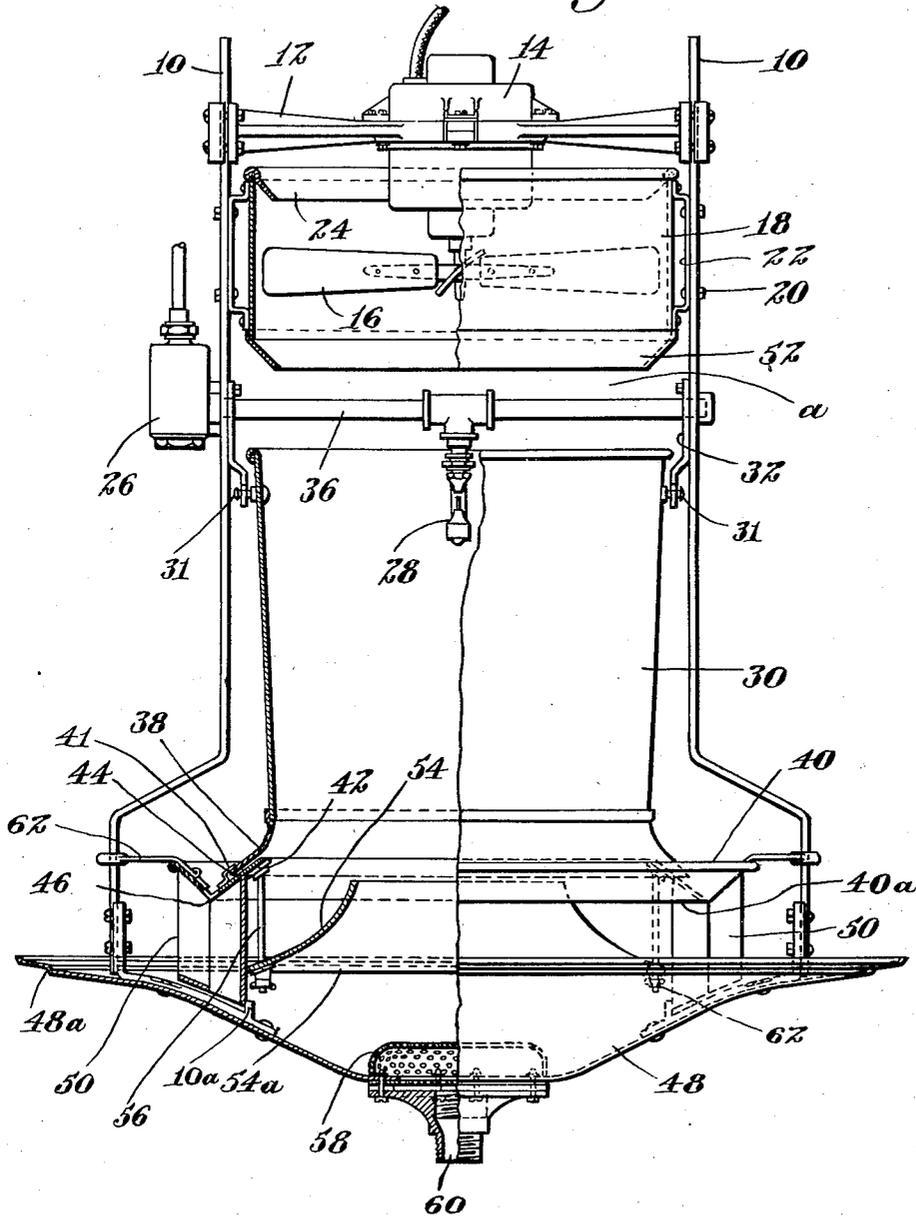
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HUMIDIFIER

Filed May 14, 1926

2 Sheets-Sheet 1

Fig. 1.



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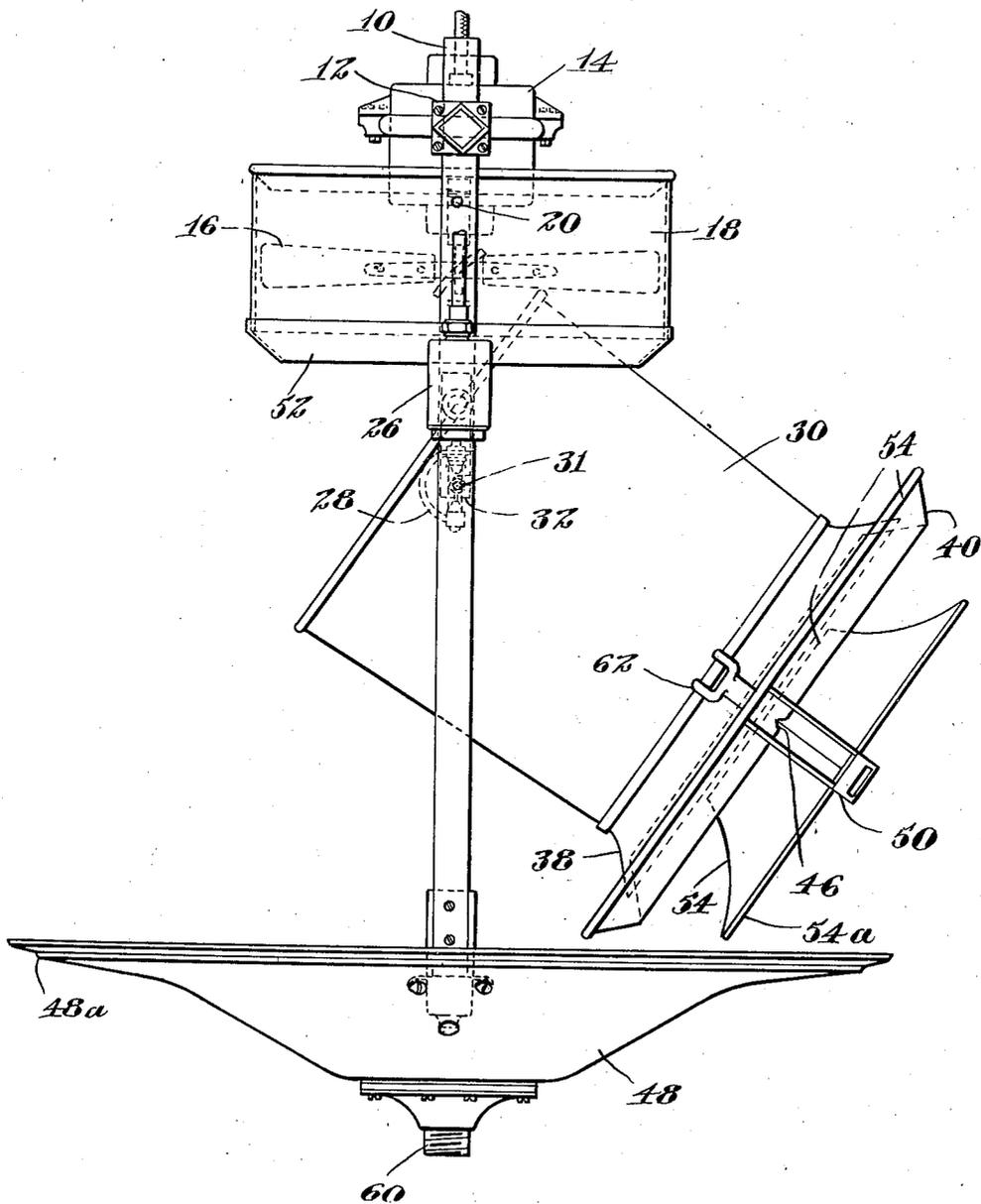
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Fig. 2.



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HUMIDIFIER

Application filed May 14, 1926. Serial No. 109,185.

This invention relates to improvements in humidifiers. More especially it is directed to improved apparatus which is simple and economical in construction, highly efficient in operation, and readily accessible for cleaning.

In apparatus of the general type to which the invention pertains a vertical and approximately cylindrical casing is provided, in which is a very fine spray whose minute particles become entrained or absorbed in air which is fan-driven through the spray and thence distributed about the room. The invention provides a large increase in the absorption and distribution of moisture obtainable with the fan at the top of the casing, and the spray nozzle below on the axis. Analysis of the operation and the causes of the benefits observed in the present invention leads to the conclusion that in the customary construction the air stream is annular and for the most part is located close by the casing wall with but little air movement in the central portion of the casing, so that consequently at the central part of the casing the air is not moving at a sufficient velocity, or perhaps is not sufficiently dense, to pick up the available moisture. The present invention provides means for diverting from the side into the central region that air which was delivered by the fan blades as an annular current, and for supplying additional air to replace that thus directed into the central region, this additional air being drawn in through the periphery of the casing.

The greatly increased volume of air thus passed through the spray necessarily picks up more moisture. Some of this is taken from the regions near the axis where cone spray is denser, and may in consequence be in larger globules; but the invention further makes special provision for automatic elimination of the large liquid globules. This is brought about by a preliminary separation of the moisture laden air stream into two currents which individually are deflected so as to separate globules that are too heavy to continue with the air; and which currents are then reunited in cross directions of flow whereby remaining large particles are either broken up or absorbed, so that the air which is ulti-

mately projected into the room is both heavily laden with moisture, and at the same time has that moisture in such a fine fog that the air is perfectly able to carry it till it is absorbed and disappears in the atmosphere of the room. The features of the invention which make these benefits possible further provide an improvement in casing structure giving easy accessibility for the regular service of cleaning which is so often necessary when the apparatus is used in textile mills.

The invention employs the usual electric motor and fan, set on a vertical axis, and the customary nozzle for making a cone spray of water through which the air current passes to become moistened. The fan is within and close below the entrance end of a short tubular casing, which has an annular flange projecting interiorly to near the edges of the fan blades and thus to prevent upward escape of air driven off from the tips of the blades. The blast from the fan moves downward past another annular flange, also projecting interiorly, which concentrates the current and directs it toward the central region of the casing. At this second flange the casing terminates. There is an interval, and then another casing of equal diameter begins, through which the concentrated blast flows with additional outside air entering through the said interval and entrained between this concentrated blast and the walls of the lower casing. At the entrance of the second casing is the spray nozzle which forms the cone jet of water diverging from the axis to the wall of the lower casing. This wall, converging slightly continues a little way below where the cone strikes it, and then flares abruptly outward and terminates. A wide V shaped trough whose inner edge is set just below, conducts the drainage from the casing to short vertical ducts leading to the drip pan below. The under side of this trough and the upward and outward sloping bottom of the drip pan constitute a circular horizontal discharge nozzle for the expanded and heavily moistened air current which has come down through the spray within the casing. The invention provides separate passages leading to this discharge nozzle

whereby the moistened air current is separated into sections and diversified as to velocity and/or direction of flow. The outer part of this downward current is changed first from its vertical course to a radially outward horizontal course, for distribution in all directions, by the annular top of a hollow frusto-conical deflector located centrally above the bottom of the drip pan; and is then given somewhat of an upward turn by the sloping margin of the drip pan. The remainder of the current passes through the open centre of the conical frustum and follows along under its diverging wall until it rejoins the first part flowing out over the air discharging edge of the drip pan. The fact that the middle part of the downward air current goes through the cone opening enables the main annular body remaining to be discharged at a velocity low enough so that globules of water too heavy to be permanently entrained in the moistened air current beat downward on either the cone plate or the upstanding rim of the drip pan, whence they drain into the usual waste pipe. In consequence the moisture remaining in the air which is discharged is carried along without precipitation in the room. The free course of the air currents with only this single change in direction makes the effective distance of projection great, while the injection of the additional air enables a greater amount of moisture to be disseminated than if only the air passing directly from the fan through the water jet were used.

In the preferred form of apparatus embodying the present invention the upper section of casing is fixed about the fan. The lower section and the cone deflector attached at its bottom can either be swung outward on pivots or be removed entirely. This disassembling, the cleaning and the re-assembling can be done quickly and easily.

It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty exist in the invention disclosed.

In the accompanying drawings, which show an illustrative embodiment of the invention:

Figure 1 is an elevation of a humidifier constructed in accordance with the present invention with the left half of the casing in medial section; and

Figure 2 is an elevation, at right angles to the view of Figure 1, showing how the parts may be disposed for cleaning.

Referring to the drawings, the apparatus is hung from overhead by a pair of hanger straps 10 to which is attached the spider 12 supporting the motor 14 and fan 16. The upper section of open-ended tubular casing 18 is secured to the hangers by suitable means such as binding screws 20 which pass through

brackets 22 riveted to the vertical edges of the casing 18 at the top and bottom.

The fan is disposed so as to drive air downward through this casing 18. Its efficiency is markedly conserved, however, by the provision of an interior flange 24 which projects inward around the casing over the tips of the blades and inclines downward slightly into the region of suction of the fan. The considerably greater downward delivery of air which results shows that in fans used heretofore in such apparatus some air has been driven radially outward by the blades, against the casing, and has divided, part flowing along the casing wall in the direction of the blast and the remainder passing backward and out of the casing, the power applied thereto being wasted. By the present construction, any tendency of the laterally thrown air to flow backward is frustrated by the flange. Any air of the room which flows radially inward past the edge of the flange is immediately sucked downward.

The water supply enters through the usual strainer 26 mounted on one of the hangers and through pipe 36 which reaches across to the other hanger and feeds the spray nozzle 28, located at the axis of the humidifier and about midway of its height. This nozzle forms a cone shaped jet or curtain of spray which impinges upon the wall of the lower section 30 of casing, between which and the first or upper section of casing is a peripheral opening *a* for the admission of air additional to that driven downward by the fan through the upper section. This lower casing section 30 is on the axis of the upper and in the form illustrated is at its top of substantially the same diameter as the upper section. It has a pair of pivot pins 31 that engage slots in brackets 32 attached to the hangers 10, so that the casing normally hangs vertical but can have its lower end swung outward about the pin pivot 31 as shown in Figure 2; or it can be unhooked therefrom and entirely removed if preferred.

This lower casing section continues downward slightly converging until at 38 it flares abruptly outward. The angle of flare should not be so great as to prevent the water from the spray which runs down the inner surface of this casing from continuing on the underside of the diverging flare 38 until it reaches the edge, where it falls into a shallow drain channel or V-shaped trough 40 which is attached to the casing by brackets 41 with its inner edge 42 inside of the bottom edge 44 of the casing's flare. The space between their adjacent edges is only large enough for the water running on the flare to clear the lower surface until it drops thereon. The narrowness of this opening prevents any appreciable escape of the moistened air through this passage, and the convergence of the casing aids in this respect for the air is

thereby shot past the flare with little chance of turning rapidly enough to enter the annular opening. The water flows along the V-shaped trough to holes 46 on each side opposite the hanger straps and there it falls to the drip pan 48 below, being protected from the outgoing air blast by the walls of suitable ducts 50 depending from the lower side of the trough.

The outer part of the air current which starts directly downward from the fan, together with that portion of the air which is initially driven radially outward and which is deflected down the casing wall, are concentrated centrally of the casings by an interiorly projecting annular flange 52 at the lower edge of the upper casing 18. This flange constitutes a nozzle, as it were, so that the air stream as it passes the peripheral opening *a*, creates a suction or injector effect which draws more air into the humidifier through the said opening and enables a much greater volume of air to be passed through the jet than would be the case if no such opening *a* were provided. The increased volume of air flows downward through the jet-spray, picking up and entraining moisture therefrom, and then for the most part is turned into a horizontal direction by a deflector 54 standing centrally in the bottom of the drip pan, to pass out through the circular nozzle defined by the upward-sloping pan bottom and the lower edge 40^a of the drain channel. The said deflector 54 is a plate shaped like the side surface of a frustum of a flaring cone, leaving its top open and set with its bottom edge 54^a spaced from the pan bottom by its supporting legs 56 which are attached to the inner wall of trough 40.

The large volume of air flowing downward in casing 30 is separated by the deflector into two portions, the larger of which flows over the top surface of the deflector and the lesser of which enters its top opening and flows along its under side to the pan, which turns it upward to mix again with the larger portion. This provision of an inner and an outer passage by the cone is important because of the abnormal quantity of air flowing through the casing. It has been observed that if the cone top be closed, and all the air passes down outside the cone, large particles of moisture are carried out which are too heavy to be supported in the outer air. This is believed to result from the very great velocity necessarily imposed upon the air when all of its large volume is forced through the annular passage between the outer cone surface and the under side of the drain channel 40. This velocity being so high that the powerful current sweeps the heavy particles out before they have opportunity to fall on the cone or pan below. By providing the top opening in the cone the air current is divided temporarily, each portion is sep-

arately deflected, and the two come together beyond the cone edge with different velocities and in cross currents of flow. In consequence some large globules of entrained water, which are being carried by the moistened air but are too large to continue with it, are entrapped on the surface of the deflector and the pan bottom, whence they drain away through the strainer 58 and outlet 60; and others, by reason of the intermingling turmoil of the air currents, become smaller, by fracture or partial absorption, so as to be successfully carried away, because of the absorptive capacity of the air. The resulting discharge is a very fine fog of surprisingly even texture, containing a higher percentage of securely floating moisture than the product of any similar apparatus of which I am aware. When it becomes desirable to clean the apparatus, the pivoted arms 62 are disengaged from the hangers 10 and then the lower casing, with the attached deflector 54, is swung upward about the pin pivots 31 as illustrated in Figure 2. Although the deflector 54 can be removed by taking off the thumb nuts 62 this is not necessary because the space between the deflector and the trough 40 is large enough for one's hand to pass through into the casing. After cleaning the casing 30 is permitted to swing back to its vertical position, the ducts 50 assuming positions outside of lugs 10^a on the pan which center the casing, and the forked arms 62 are turned outward into engagement with the hangers to prevent swinging about the pivots 31.

I claim as my invention:

1. A humidifier comprising, in combination, a tubular casing; means for supplying spray in the casing; and means for creating a current of air through said spray, comprising a fan within the casing driving air through said spray; there being an opening in the casing wall between said fan and spray, through which opening air is drawn into said casing by the said driven air.

2. A humidifier comprising, in combination, a tubular casing; a fan therein for moving air through it; an opening in its wall, beyond the fan, through which opening additional air is drawn in by the air passing said opening; and means for supplying a spray in the casing beyond said opening, through which spray all said air passes.

3. A humidifier comprising, in combination, a tubular casing, a fan and means for supplying spray therein; there being an opening in the portion of casing wall lying between said fan and spray; and means whereby air from the fan passes said opening with injector effect, whereby additional air is drawn into said casing through the annular opening and is forced through said spray.

4. A humidifier comprising, in combina-

tion, a tubular casing, a rotary blade fan in the casing; means for supplying a spray therein beyond the fan; and an annular flange extending inward and in the general direction of air propulsion by the fan, located at and overlying the path of rotation of the tips of the blades and leaving an opening over the main parts of the blades; said flange preventing backward escape of air from the fan.

5. A humidifier comprising, in combination, a tubular casing; a fan and means for supplying a spray in said casing; and an annular interiorly projecting flange in said casing between the fan and said spray, deflecting inward and thus concentrating the blast; there being an opening in the casing wall between said flange and said spray through which air is drawn into the casing by the concentrated blast.

6. A humidifier comprising, in combination, a casing having upper and lower sections; a fan within said upper section forcing air toward and through said lower section; and means within said lower section for supplying spray therein; there being an opening between said sections through which air is injected into the casing in addition to the air forced through the upper section.

7. A humidifier comprising, in combination, a casing having upper and lower sections with an opening therebetween; means for propelling air through said upper section and past said opening into the lower section; means within said lower section for supplying spray therein; and means at the bottom of said upper section for concentrating the air passing therethrough whereby additional air is injected into the lower section through the said opening.

8. A humidifier comprising in combination a tubular casing; means for supplying spray within it; means for propelling air through said casing to entrain moisture from said spray; the said casing providing a single passage for all of the propelled air at the place where the spray is; and there being beyond that place means dividing said passage into separated passages; and a discharge opening for said air; said separated passages leading to said discharge opening, and being arranged to separate into sections the current of air with entrained moisture from the single passage and to diversify the directions of and then to re-unite the said sections while their directions are diverse.

9. A humidifier comprising, in combination, a vertical tubular casing; means for supplying spray therein; means for propelling air through said spray to entrain moisture therefrom; a pan underneath, co-acting with the bottom end of the casing wall to form a circular discharge nozzle; and a deflector extending partially across said casing, between it and said pan, arranged to sep-

arate the moistened air current into two portions flowing in different directions to said nozzle whereby the two portions intermingle in said nozzle during discharge therefrom.

10. A humidifier comprising, in combination, a tubular vertical casing; means for supplying spray therein; means for propelling air through said spray to entrain moisture therefrom; a pan underneath, coacting with the bottom end of the casing wall to form a circular discharge nozzle; and a circular deflector having its entrance edge below said spray between the axis and wall of the casing, extending thence outward over the pan and toward the said discharge, and co-operating with the casing to make a passage for the outer portion, and with the pan to make a separate passage outward for the inner portion of the moistened air, the said deflector terminating short of said nozzle whereby the said portions intermingle in the nozzle during discharge therefrom.

11. A humidifier comprising, in combination, a tubular vertical casing; means for supplying spray therein; means for propelling air through said spray to entrain moisture therefrom; a pan underneath, co-acting with the bottom end of the casing wall to form a circular discharge nozzle; and a hollow frusto-conical sheet deflector above the pan, dividing the current of air with entrained moisture into a central portion and a peripheral portion with a passage for moistened air between said pan and the deflector, and a passage between the deflector and the casing; the said passages joining before the nozzle is reached whereby the said portions intermingle in the nozzle during discharge therefrom.

Signed at Boston, Massachusetts, this thirteenth day of May 1926.

JOSEPH ARMSTRONG.