May 29, 1951

R. B. MILLS

2,554,868

HUMIDIFIER

Filed May 26, 1948

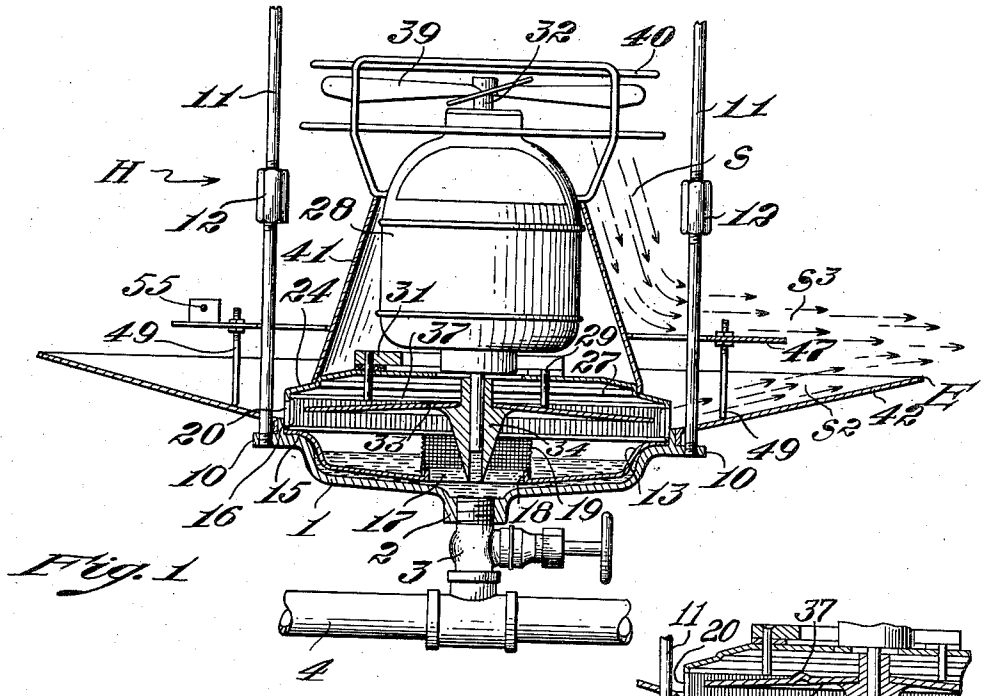

Fig. 1

Fig. 5.

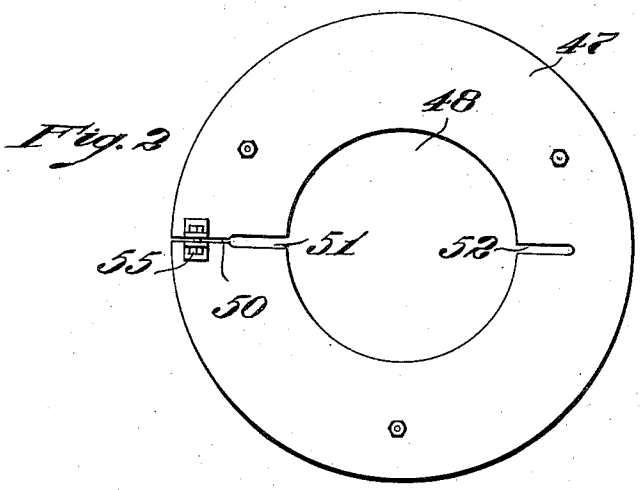

Fig. 2

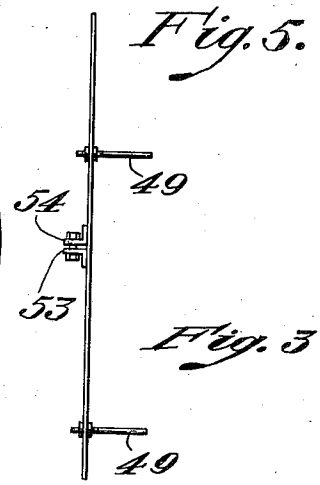

Fig. 3

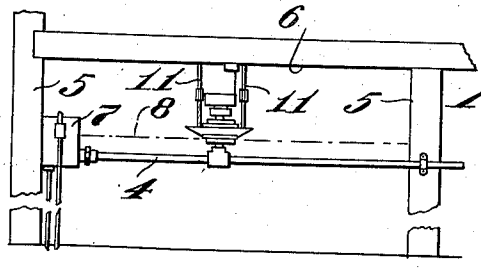

Fig. 4

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HUMIDIFIER

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4 Claims. (Cl. 261—30)

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This invention relates to humidifiers or air moisteners of the general type in which water or other liquid is atomized or reduced to the form of vapor by mechanical means. Such humidifiers are widely used in textile and other manufacturing establishments to provide an atmosphere of the proper moisture content to insure optimum working conditions with reference to the particular process or material involved.

The present invention constitutes an improvement upon the device disclosed in the patent to B. M. Mills, No. 1,812,356, dated June 30, 1931. The device disclosed in said patent has proven highly satisfactory and effective for the vaporization of water by mechanical action, and under most working conditions provides very efficient distribution of the vapor particles throughout the adjacent space without observable "wetting down." The patented apparatus comprises a fan so arranged as to deliver a powerful current of air downwardly into the region in which the water vapor is evolved. The apparatus also includes a shallow deflector pan having an upwardly and outwardly inclined bottom wall upon which the air from the fan impinges. The air current is thereby deflected just at the point at which the water vapor is evolved and carries the water vapor along with it in an upwardly and outwardly divergent annular stream. So long as the apparatus is employed in a high-ceilinged room and at a substantial distance from ceiling or walls, wetting down does not occur. However, it has been observed that if the apparatus be used where it must be close to the ceiling or to a vertical wall or the like some wetting down may occur. Apparently this is due to the fact that when so located, the moisture-laden air which is delivered in an upward direction strikes the ceiling or adjacent vertical surface and is thereby deflected back to the intake of the fan, which picks it up and returns it to the vapor evolving zone where it receives further moisture and eventually becomes so overcharged that the moisture particles coalesce and form droplets which gravitate out of the air and cause wetting.

The principal object of the present invention is to provide a humidifier of the above type, useful in low-ceilinged rooms or restricted spaces and which, when so located, shows no tendency to cause wetting down of adjacent areas. A further

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object is to provide means of simple and inexpensive type whereby an existing humidifier, substantially like that disclosed in the aforesaid patent, may readily be modified for use in a low-ceilinged room or any restricted space so that it will not cause any wetting down. Other and further objects and advantages of the invention will be pointed out in the following more detailed description and by reference to the accompanying drawings, wherein

Fig. 1 is a vertical section showing a humidifier of the type disclosed in Patent No. 1,812,356, modified in accordance with the present invention;

Fig. 2 is a plan view of a baffle constituting a part of the humidifier in accordance with the present invention;

Fig. 3 is an edge elevation of the baffle of Fig. 2 viewed from the left-hand side of the latter figure;

Fig. 4 is a diagrammatic elevation illustrating one desirable embodiment of the improved humidifier in a workroom; and

Fig. 5 is a fragmentary section, illustrating a modified form of atomizing disk.

Referring to the drawings, the letter H designates the humidifier as a whole. This humidifier, except for the particular improvements forming the immediate subject matter of the present invention, may be identical with that shown in the aforesaid patent to Mills, 1,812,356, although it is to be understood that the principal of the present invention is applicable to humidifiers of other specific constructions.

As here illustrated, the humidifier comprises a base 1 which may conveniently be made of brass, bronze, stainless steel, plastic or other material not readily corroded by moisture or by salts or chemicals dissolved in the water used. This base member is preferably basin-like in shape and is adapted to hold a supply of water or such other liquid as is to be vaporized. This basin or base 1 is furnished with a downwardly projecting hollow boss 2 preferably at its center. This boss is internally screw-threaded and adapted to receive the upper end of a water-supply pipe 3. As shown, this pipe is part of a controlling valve by means of which the water supply for the humidifier unit may be controlled. However, this valve is not essential and may be dispensed with. The pipe 3 forms a branch of a supply main 4 which, as illus-

trated in Fig. 4, may be supported in any suitable way, for example upon the columns which carry the ceiling 6 of the millroom. This supply main 4 is disposed at such height as to support the humidifier at the proper elevation, the pipe, as illustrated in Fig. 4, constituting the main support for the humidifier. Preferably the supply main 4 receives water from a tank 7 provided with a valve (not shown) automatically controlled to maintain a constant water level in the tank. This level is indicated in Fig. 4 by the broken line 8 and would be common to all humidifier units mounted upon the main 4. Preferably this water level is so adjusted as to lie about midway of the depth of the base 1 of the humidifier. While the weight of the humidifying unit is mostly carried by the pipe 4, it may be desirable to provide steadying means to prevent the unit from vibrating or swaying. To this end the base 1 is furnished with a plurality of outstanding ears 10 which receive the lower ends of brace rods 11 extending upwardly to the ceiling. These brace rods may be provided with turn-buckles 12 for adjustment.

To facilitate cleaning the humidifier basin, a shallow dish-like lining member 13 made of sheet brass, stainless steel or other non-corrosive material is arranged to fit loosely within the basin or base member 1. This lining 13 is provided with a marginal, substantially horizontal rim which rests upon a substantially horizontal seat surface 15 at the upper edge of the base member 1. The rim of the basin 1 is preferably provided with an upstanding centering flange 16 and the lining member 13 fits within this flange.

The lining member 13 has a central opening 17 at its bottom defined by an upwardly directed flange 18. This flange 18 constitutes centering means for a cylindrical wall member 19 whose lower edge engages the bottom of the member 13 and which projects up substantially to the level of the rim of the lining member. This wall 19 is perforated or preferably made of wire netting and defines a central well wherein the water is kept free of lint and other dirt by the surrounding wall 19. If lint or dirt collects in the annular space surrounding the strainer or well 19, the lining member 13 may be removed and replaced by a clean lining in a few minutes' time.

An annular grid member 20 fits inside of the flange 16 of the basin 1. If the lining 13 is employed, the lower edge of this grid seats upon the rim of the lining member. If the latter is not used, the lower edge of the grid rests directly upon the surface 15. The grid 20 is preferably cylindrical and of corrosion-resistant material, for example sheet brass or stainless steel. This grid comprises a series of substantially vertical spaced bars, vanes or louvres which are inclined with respect to radial planes. Preferably these bars or vanes are integral with the sheet material forming the body of the grid and merge at their upper and lower ends with continuous ring-like portions of the grid structure. The grid thus devised may be made from sheet metal by a stamping or similar operation and as the vanes are securely anchored at top and bottom the grid structure is very rigid and the predetermined angle of the vanes is accurately maintained.

The grid 20 supports a cover member 24 which is preferably integral with or at least permanently united to the upper part of the grid. This cover comprises downwardly and outwardly inclined annular faces united at a substantially vertical shoulder 27. The cover is substantially

imperforate (except for such openings as are necessary for the reception of certain parts hereinafter described), and the space between the cover and the bottom of the basin 1 is substantially closed except for the openings provided between the vanes of the grid. The cover 24 constitutes a support for the motor and other moving parts of the apparatus.

As shown, the electric motor 28 has a base 31 provided with a plurality, usually three, of pins 29 which project downwardly therefrom and through correspondinng openings in the cover 24. The pins fit loosely in these openings and are encircled by resilient washers interposed between the base 31 and the cover 24. This arrangement allows the motor to nutate freely so that its shaft and the parts carried thereby are free to move and to assume a position for any given speed at which all of the forces acting at an angle to the axis of rotation are substantially balanced. The motor and other rotating parts may thus be run at high speed without producing excessive vibration or noise.

The motor shaft 32 projects downwardly through the base 1 and the cover 24 and at its lower end carries the atomizing disk 33. This disk may be of any suitable material capable of rotating at high speed, for example, sheet brass or stainless steel. This disk is furnished with a downwardly directed conical member 34. This conical member 34 projects down into the well defined by the screen 19 and, as the disk 33 rotates, picks up water by centrifugal action and draws it upwardly to the undersurface of the disk 33. Preferably the disk 33 is so placed on the shaft that its outer edge is in a plane substantially midway between the upper and lower edges of the grid 20. While a disk 33a such as shown in Fig. 5 may be used (the disk being like that illustrated in Fig. 1 of the above patent to Mills 1,812,356) it is preferred, as a practical matter, to use the plain disk 33 (like that shown in Fig. 6 of the above patent). When the disk is rotated, water from the well is drawn upwardly to the under surface of the disk and delivered centrifugally with great force against the vanes 21 where the major part of it is broken up into exceedingly fine particles forming a fog or mist. A fan 39 is arranged at the upper end of the motor shaft, above the motor, and is designed to direct a current of air downwardly. Preferably this fan is enclosed within a wire guard 40 to prevent accidental contact of the fan blades with outside objects. As the motor 28 is coaxial with the fan 39 and in the path of the air current, the latter is constrained to assume the form of a hollow annular stream. For guiding this stream there is preferably provided a deflector shell 41 extending from a point near the upper part of the motor casing downwardly to the cover 24 and preferably fitting snugly against the shoulder 27 of the latter. This shell 41 is of sheet metal, for example brass or stainless steel, and increases or flares in diameter from its upper toward its lower end so that the annular air stream increases in diameter as it descends. This descending air-stream is unconfined circumferentially so that it is free to move outwardly.

There is also provided an annular deflector 42 of appropriate material, for example, stainless steel or a plastic, having an inner marginal flange which fits against the flange 16 of the basin 1 to which it is secured in any desired manner. This deflector 42 flares outwardly and upwardly, its inner edge being adjacent to, al-

though slightly spaced from, the outer surface of the grid **20**, said lower or inner edge of the deflector being in a plane slightly below the plane of the atomizer disk. However, the upper or outer edge E of the deflector **42** lies in a plane above that of the atomizing disk. As illustrated, the slope of this deflector is approximately 15° to the horizontal.

As above described the water, centrifugally expelled by the disk, is broken up by impact with the vanes into the fog or mist which passes through the vanes and enters the space at the lower part of the deflector **41**. Under some conditions of temperature or atmospheric humidity some of this fog or mist will condense and form droplets of substantial size upon the upper surface of the deflector. Moreover, the atomizing action is not perfect so that some water particles of appreciable size are expelled outwardly between the vanes and deposited upon the upper surface of the deflector. When, as described in the above patent to Mills, the downwardly directed air current from the fan impinges upon the upper surface of the deflector, it tends to sweep away any droplets of water from the upper surface of the deflector and to eject them from the apparatus as particles of such size that they are not absorbed by the air but fall like rain and wet the surroundings.

In accordance with the present invention, there is provided a baffle **47** arranged to divert the downwardly flowing air stream S delivered by the fan so as to cause said stream to flow horizontally outwardly before it can impinge upon the upper surface of the deflector **42**. This baffle **47** is here shown as a flat ring or annulus having a large central opening **48** (Fig. 2) which receives the deflector shell **41**. This annulus **47** is preferably of sheet metal, for example brass, stainless steel or the like, although it is contemplated that it may be of other material, for example a plastic. However, this annulus should be resilient and capable of being warped out of its normal plane and of resuming its original shape when released. To permit such warping or flexing the annulus is split radially as shown at **50** in Fig. 2, and preferably provided with slots **51** and **52** of substantial width, for example $\frac{5}{16}$ inch, extending from the central aperture **48** outwardly, for example, two-fifths of the distance, from the inner to the outer edge of the annulus and on the same diameter as the split **50**. Brackets **53** and **54** (Fig. 3) are secured to the upper surface of this annulus at opposite sides of the split **50** and these brackets are provided with apertures for the reception of a bolt **55** by means of which the margins of the annulus at opposite sides of the split **50** may be drawn together and relatively fixed.

The annular baffle **47** is provided with legs **49**, three such legs here being shown. The lower ends of these legs rest upon the upper surface of the deflector **42**. These legs are preferably of adjustable length and are usually so adjusted that the annulus does not actually contact the shell **41**.

When the direction of the air current from the fan is suddenly changed by contact with the baffle a zone of negative pressure or suction is created just below the outer edge of the baffle and the suction thus produced affects the rate of evolution of vapor. Were the air volume delivered by the fan the same for all conditions of use, it would be possible for the manufacturer of the humidifier to fix the baffle once for all in

the most advantageous position. However the volume of air delivered by the fan is affected by the distance between the fan and the ceiling—close proximity substantially reducing the amount of air delivered. Thus it is desirable to provide for vertical adjustment of the baffle relatively to the deflector **42** in order to coordinate variations in fan output, atomizing pressures and the suction effect. As here shown, the legs **40** are capable of effective variations in length of approximately one inch, and the baffle is located approximately one inch above the plane of the outer edge of the deflector **47** and approximately seven inches below the fan hub, which is a desirable arrangement in a humidifier of the size and atomizing capacity illustrated, but these dimensions are to be regarded as examples of good practice and not as restrictive. As deflectors **42** may be of different diameters in different installations according to the size of the humidifier, the baffles **47** should correspondingly vary in diameter. A diameter ratio of approximately 17 to 26 is found effective and is here illustrated.

The slots **51** and **52** are of a width such as to accommodate the brace rods **11** above described. In applying the annular baffle **47** to an existing humidifier, the bolt **55** is removed and those portions of the baffle which lie at opposite sides of the slit **50** are moved in opposite diretions so as to flex or twist the annulus out of its normal plane, thus greatly increasing the distance between the parts of the annulus at opposite sides of the split **50**. Sufficient space may thus be provided to permit the annulus to be slipped over one of the brace rods **11** then over the deflector shell **41**, and then over the other brace rod, the annulus then being released so that it resiliently resumes its normal flat shape. The bolt **55** is then introduced and tightened, thus holding the baffle in a plane. The legs **49** are seated upon the deflector **42**, thus supporting the baffle substantially in the position shown in Fig. 1. In this position the plane of the baffle **47** is below that of the fan but above that of the outer edge E of the deflector **42**. The air current S from the fan, passing downwardly over the shell **41**, engages the upper surface of the baffle **47** and is diverted so as to flow outwardly in a strong horizontal expanding annular stream S^3. The fog or mist, indicated at S^2 (Fig. 1), which emerges from between the vanes of the grid slowly moves up along the upper surface of the deflector **42** where it fills the space immediately below the baffle **47**. This fog or mist is eventually caught up by the horizontally flowing deflected stream S^3 from the fan. The moisture-bearing air stream which is thus delivered horizontally, will not impinge upon a low ceiling and, even if it strike an adjacent vertical wall, has little inherent tendency to curl backwardly so as to circulate toward the intake of the fan. Thus there is no chance for the air to become overcharged with moisture and wetting down of surroundings is avoided. Moreover, since the air stream from the fan does not strike the deflector it can not sweep away water drops resting upon the upper surface of the deflector and thus these drops are not ejected in the form of rain onto the surroundings.

While it has heretofore been attempted to attain the effects resultant from the use of the simple and inexpensive baffle herein described, said prior suggestions have been by way of relatively expensive and complicated apparatus. One prior proposal has been to use a fan having

blades of variable pitch, but when such a fan is adjusted for use with a low ceiling, the air volume delivered is reduced, with a corresponding reduction in the efficiency of humidification. Moreover, such an arrangement does not help in reducing air turbulence in the region of humidification, whereas, the present device substantially eliminates turbulence by discharging the body of air in a substantially horizontal direction and in a smooth annular stream.

By the use of the present simple baffle, the air from the fan is caused to exert an aspirating action at the point of fog formation, increasing the rate of evolution of fog or mist. While the baffle here disclosed is a simple horizontal flat plate, spaced a substantial distance below the fan, it is obvious that baffles of specifically different forms and differently located may be employed provided they accomplish the desired result, to wit, the delivery of the moisture carrying air current in a direction such that it does not tend to return to the fan intake, even when the humidifier is arranged close to the ceiling.

The baffle **47** as herein described is highly useful in connection with the humidifier of the general type described in the Mills Patent 1,812,356, but it is obvious that it may be employed in combination with humidifiers using specifically different vaporizing means but wherein there is an upwardly and outwardly inclined deflector, corresponding to the deflector **42** herein described, and in combination therewith means for delivering a strong current of air downwardly so that it would normally impinge upon the inclined surface of such deflector.

While one desirable embodiment of the invention has herein been illustrated and described by way of example, it is to be understood that the invention is broadly inclusive of any and all modifications falling within the scope of the appended claims.

I claim:

1. In combination in a humidifier of the kind which comprises a substantially vertical shaft, a fan secured to the shaft, the fan being constructed to deliver air downwardly, a motor below the fan, a deflecting shell concentric with the shaft and substantially enclosing the motor, said shell causing the air from the fan to flow in an annular unconfined stream, a disk on the shaft below the motor, an imperforate cover member between the disk and motor, the lower edge of the shell fitting snugly against the upper surface of the cover member, means for supplying water to the disk, means cooperating with the disk to evolve water vapor at a point adjacent to the lower end of the shell, and an annular upwardly flaring deflector concentric with the shaft, said deflector having its inner edge disposed adjacent to but below the point at which the water vapor is evolved, a flat, horizontal, annular baffle coaxial with the shell and arranged in a plane above the plane of the outer edge of the deflector, said baffle being operative to divert the air stream and to cause it to move horizontally outwardly across the outer edge of the deflector, the baffle being located in a plane which is approximately one-eighth of the distance between the plane of the outer edge of the deflector and the mean plane of the fan blades.

2. In combination in a humidifier of the kind which comprises a substantially vertical shaft, a fan secured to the shaft, the fan being constructed to deliver air downwardly, a motor below the fan, a deflecting shell concentric with the shaft and substantially enclosing the motor, said shell causing the air from the fan to flow in an annular unconfined stream, a disk on the shaft below the motor, an imperforate cover member between the disk and motor, the lower edge of the shell fitting snugly against the upper surface of the cover member, means for supplying water to the disk, means cooperating with the disk to evolve water vapor at a point adjacent to the lower end of the shell, and an annular upwardly flaring deflector concentric with the shaft, said deflector having its inner edge disposed adjacent to but below the point at which the water vapor is evolved, a flat, horizontal, annular baffle coaxial with the shell and arranged in a plane above the plane of the outer edge of the deflector, said baffle being operative to divert the air stream and to cause it to move horizontally outwardly across the outer edge of the deflector, and adjustable means operative to support the annular baffle.

3. In combination in a humidifier of the kind which comprises a substantially vertical shaft, a fan secured to the shaft, the fan being constructed to deliver air downwardly, a motor below the fan, a deflecting shell concentric with the shaft and substantially enclosing the motor, said shell causing the air from the fan to flow in an annular unconfined stream, a disk on the shaft below the motor, an imperforate cover member between the disk and motor, the lower edge of the shell fitting snugly against the upper surface of the cover member, means for supplying water to the disk, means cooperating with the disk to evolve water vapor at a point adjacent to the lower end of the shell, and an annular upwardly flaring deflector concentric with the shaft, said deflector having its inner edge disposed adjacent to but below the point at which the water vapor is evolved, a flat, horizontal, annular baffle coaxial with the shell and arranged in a plane above the plane of the outer edge of the deflector, said baffle being operative to divert the air stream and to cause it to move horizontally outwardly across the outer edge of the deflector, the baffle being of resilient sheet metal and having a central aperture of a size to receive the shell, the baffle being radially split to enable it to be assembled with the other parts of the humidifier, and means for uniting the opposite margins of the baffle at the split.

4. In combination in a humidifier of the kind which comprises a substantially vertical, rotary shaft, a fan operative to deliver air downwardly, a motor for driving the fan, a deflecting shell concentric with the shaft, said shell housing the motor and causing the air from the fan to flow in an annular stream, a pair of substantially parallel diametrically spaced brace rods substantially parallel with the shaft, a disk on the shaft below the shell, an imperforate cover of a diameter greater than that of the disk interposed between the disk and the motor and which forms the roof of a substantially air-tight chamber within the shell, means for supplying water to the disk, means cooperating with the disk to evolve water vapor at a point adjacent to the lower end of the shell, an annular upwardly flaring deflector concentric with the shaft and in the normal path of said air stream, said deflector having its inner edge disposed adjacent to but below the point at which water is evolved, and a baffle comprising a substantially flat annular plate of resilient sheet material normally

coaxial with the fan shaft and located below the fan and above the plane of the outer edge of the deflector, the central aperture in said baffle plate being of a size to receive the motor housing shell, the baffle plate being disposed in the path of the air stream delivered by the fan and being so located as to divert the air stream from the fan and cause it to move horizontally across the outer edge of the deflector, the baffle having radial slots for the reception of the brace rods, and being radially split to permit it to be warped out of its normal plane in applying it to the humidifier.

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