June 4, 1963 J. P. NETT ETAL 3,092,096

FURNACE HUMIDIFIER

Filed May 16, 1961 2 Sheets-Sheet 1

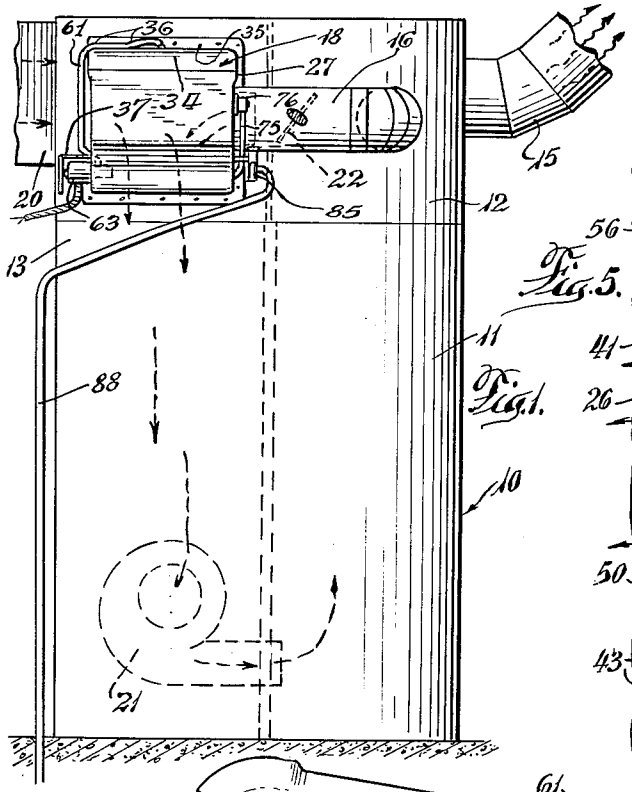


Fig. 1.

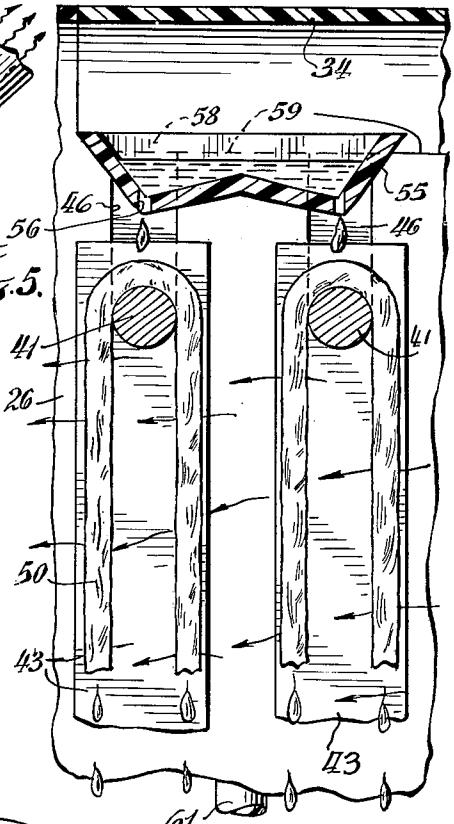


Fig. 5.

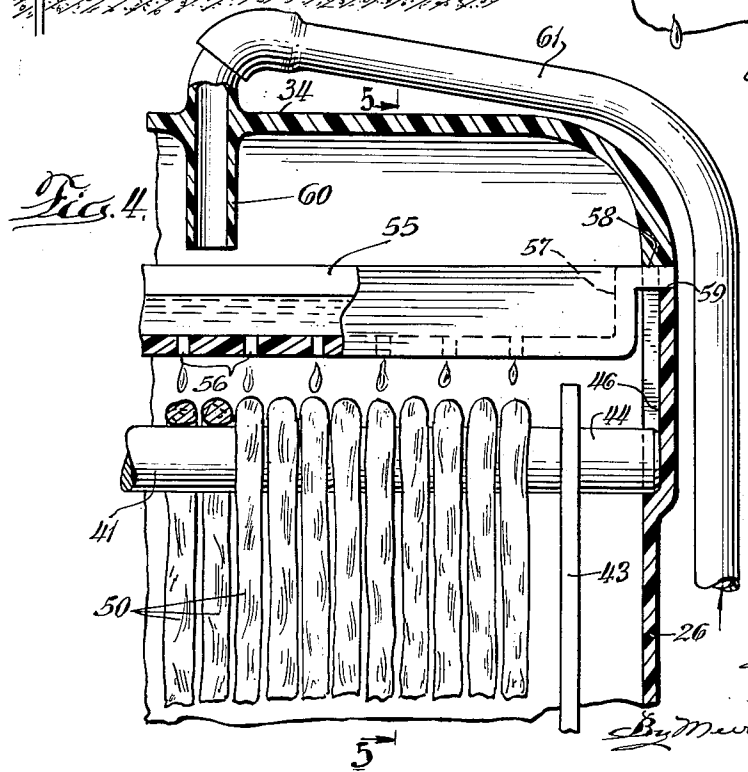


Fig. 4.

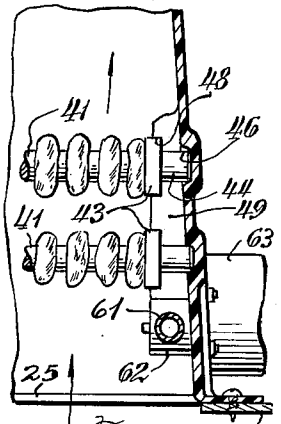


Fig. 6.

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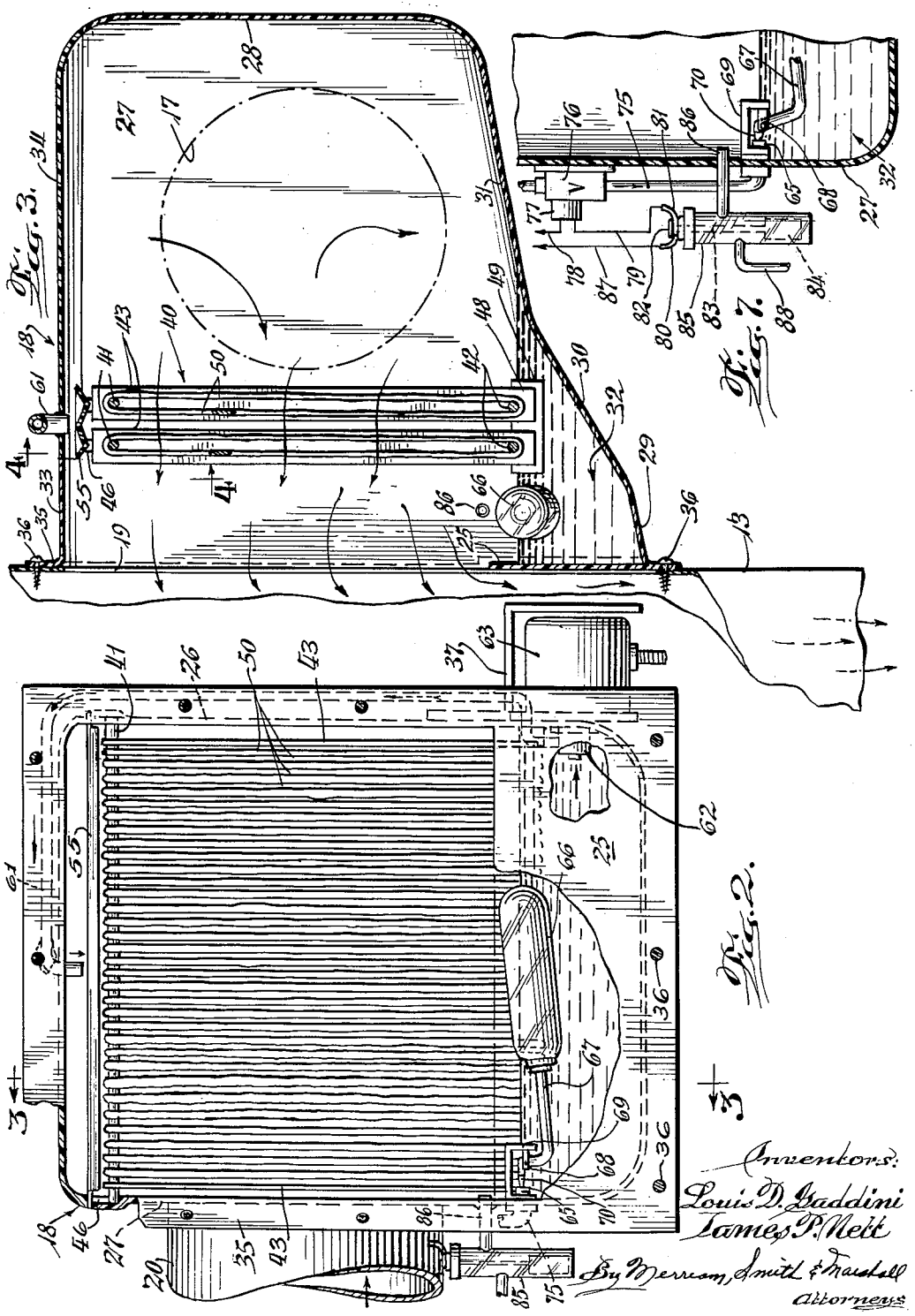


Fig. 3.

Fig. 7.

Fig. 2.

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FURNACE HUMIDIFIER

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The present invention relates generally to air moisteners and more particularly to humidifiers for use with forced air furnaces such as the type employed to heat homes and similar occupied spaces.

There are many deleterious effects resulting from heating occupied spaces or buildings with forced air that has not been humidified. For example, dry, heated air from forced air furnaces absorbs moisture from the mucous linings in the nose and throat of the occupants of the building, resulting in dryness of the nose and throat, stuffed-up nose, and chronic coughing. In addition, dry air evaporates moisture from the bodies of the occupants, causing them to feel cool and chilly, even though the temperature is relatively high. Dry air also causes the skin to lose its smoothness, causes brittleness in hair, and causes nails to crack and break. Since dry air requires higher temperatures for comfort than does humidified air, there is also a substantial increase in expenditures for fuel required to heat comfortably with non-humidified air.

Furthermore, dry air absorbs moisture from plastered walls and wall boards, causing them to dry out and crack; from paint, causing the latter to peel and blister; from wallpaper, causing it to dry out and fade; and from wooden items such as cabinet doors, drawers, stairs and the like, causing warpage to set in. Moreover dry air is a destructive factor to many articles in the home. Without humidity, books and other paper items age faster, house plants wither, carpets and textiles become deleteriously effected, furniture joints dry out and become weak, and window shades, paintings, picture frames and many other aricles suffer deleteriously.

All of these deleterious effects are avoided by the humidifier of the present invention, which comprises a housing having an inlet communicating with the hot air plenum or duct of a forced air furnace, an outlet opening in communication with the cold air duct of the furnace, and a humidifying element situated between the inlet and outlet openings. Heated air from the hot air plenum enters the humidifier housing through the inlet opening, is circulated through the housing where it picks up moisture from the humidifying element, and then passes through the outlet opening into the cold air duct where it mixes with the cold air and is recirculated back through the heating chamber of the furnace and then into the hot air plenum again. Some of this partially humidified air is recirculated back into the humidifier, where it picks up more moisture, said pickup in moisture continuing until an equilibrium condition is achieved.

A feature of the present invention is the construction of the humidifying element which constitutes wick means composed of a plurality of non-intersecting, vertically disposed, spaced-apart, moisture absorbing, cord-like strands that are maintained in a continuously moist condition by dripping water onto the strands from above. This particular arrangement avoids clogging of the humidifying element due to the deposition thereon of insoluble calcium salts normally contained in water provided for domestic consumption, said clogging being a serious drawback in ordinary humidifiers not having the arrangement described above. More specifically, the non-intersecting strands constituting the wick means provide no pockets in which the salts can accumulate. In addition, by maintaining the wicks in a continuously moist condition and

by constantly dripping water thereon from above, salt deposits are not retained on the wicks but are washed downwardly into a sump in the bottom of the humidifier housing.

Water from the sump is continually recirculated back upwardly to the dripping means, thereby reducing the amount of water needed from outside sources and substantially reducing the operating expenses in comparison to an arrangement whereby the dripping means would be provided with water from an outside source entirely.

The sump is replenished with water from an outside source at periodic intervals when the level therein drops below a first predetermined height. As a safety feature, the humidifier contains an automatic shut-off device which stops the entry of water into the sump when the water level therein exceeds a second predetermined height, thereby preventing overflow of water out of the humidifier onto the floor of the furnace room.

The subject humidifier is extremely versatile from an installation standpoint. The inlet opening can be provided in any of the housing side walls not occupied by the outlet opening or in the housing top or bottom wall, thereby adapting the humidifier for use under many installation conditions, as will be subsequently described in greater detail.

The humidifier is also provided with a slidably removable top cover so that if the inlet opening is not in the housing top, the humidifier can be installed close to the ceiling of the furnace room with very little clearance between the housing and the ceiling. Under such conditions of installation, the top is still readily removable because it can be slid off. Furthermore, the humidifying element is detachably mounted in the housing in a manner, to be described, which enables the element to be removed through the housing top for maintenance purposes even if the humidifier is mounted near the ceiling with a minimum of clearance.

Other features and advantages are inherent in the structure claimed and disclosed, as will become apparent to those skilled in the art from the following detailed description in conjunction with the accompanying drawings wherein:

FIGURE 1 is a front elevational view showing a typical embodiment of a humidifier constructed in accordance with the present invention and mounted on a forced air furnace;

FIGURE 2 is a rear elevational view showing the subject humidifier as viewed from within the cold air duct of the furnace;

FIGURE 3 is a sectional view taken along line 3—3 in FIGURE 2;

FIGURE 4 is an enlarged sectional view, partially cut away, taken along line 4—4 in FIGURE 3;

FIGURE 5 is a sectional view taken along line 5—5 in FIGURE 4;

FIGURE 6 is an enlarged, fragmentary plan view of a portion of the interior of the subject apparatus; and

FIGURE 7 is a fragmentary elevational view, partially in section, showing automatic shut-off means for preventing an overflow of water from the humidifier.

Referring initially to FIGURE 1, there is shown a conventional hot air furnace indicated generally at **10** and of the type commonly used for heating occupied spaces such as a residence. Furnace **10** includes a heating chamber **11** containing a conventional heating element (not shown), a hot air plenum or outlet duct **12**, and a return duct or inlet plenum **13** for cold or unheated air. Air from the cold air return system including a conduit **20** and duct **13** is driven by a blower **21** into the heating chamber **11** of the furnace. Heated air from the chamber **11** is forced upwardly into hot air plenum **12**, and a substantial portion of this air is then distributed to the rooms of the

occupied space through distributing ducts such as 15.

Some of the air entering hot air plenum 12 passes through a connecting conduit 16 having a cross-sectional area substantially smaller than that of plenum 12 and leading to an inlet opening 17 (FIGURE 3) in the housing 18 of a humidifier constructed in accordance with the present invention, and in which the hot air absorbs moisture. The humidified hot air then passes through a humidifier outlet opening 19 (FIGURE 3) into the return duct 13 of the furnace, from where it is recirculated by the blower 21 back into the heating chamber and then back out into the hot air plenum 12. Once again some of the hot air (now partially humidified) passes from hot air plenum 12 through the connecting conduit 16 into the humidifier where it picks up additional moisture. The recirculation of the partially humidified hot air continues as long as blower 21 operates, the humidity of the hot air rising until an equilibrium level is reached. Some control over the humidity can be obtained by adjusting damper means 22 located in conduit 16, said damper means regulating the flow of air into the humidifier.

Describing the humidifier now in greater detail, reference is initially made to FIGURES 2 and 3, wherein humidifier housing 18 is shown to comprise a back wall 25 surrounding outlet opening 19, side walls 26, 27 extending forwardly from back wall 25, a front wall 28 integral with the side walls, and integral bottom wall portions 29, 30, 31 extending sequentially between the back wall 25 and front wall 28. Bottom wall portions 29 and 30 and the adjacent portions of back wall 25 and side walls 26, 27 define a sump indicated generally at 32. Extending integrally from back wall 25 around the periphery thereof is a flange 35, through which extend screws 36, for mounting the humidifier onto the cold air return duct 13.

It will be noted that in the embodiment shown in the figures the humidifier inlet opening 17 is in side wall 27, which would be the right side wall as viewed in FIGURE 1. This is because the hot air plenum 12 is to the right of the return plenum 13 as viewed in FIGURE 1. In installations wherein the hot air duct would be located elsewhere (e.g. to the left of the cold air duct), the inlet opening 17 in the humidifier housing can be positioned accordingly (e.g. on the left wall 26 of the housing if the hot air plenum is to the left of the cold air duct). In other installations the opening could be in the bottom wall portion 31, in the back wall 28, or even in the top cover 34. This ability to position the humidifier inlet opening in a wall most convenient to the location of the hot air plenum renders the subject humidifier extremely versatile from an installation standpoint.

Referring now to FIGURES 2 through 6, the humidifying element contained in the subject humidifier is in the form of one or more wick means, embodiments of which are indicated generally at 40, each wick means comprising an upper shaft 41, a lower shaft 42, and a pair of vertically disposed connected members 43 which, together with the upper and lower shafts form a substantially rectangular frame. Upper shaft 41 has a pair of identical opposite end portions or stubs 44 which are removably mounted within recesses or grooves 46 in the top portions of side walls 26, 27 to support the wick frame. The bottom portion of each vertical connecting member 43 is received within a groove 48 in a member 49 connected to one of the side walls 26, 27 near the bottom thereof (FIGURES 3 and 6). Mounting the bottom of the wick frame in the manner just described prevents the entire wick means from pivoting about the axis of upper shaft 41 in response to the impingement against the wick means of air flowing through the humidifier, but still enables the frame to be readily removed, in a manner to be described subsequently, for maintenance purposes or replacement.

Wound around upper and lower shafts 41, 42 are non-intersecting wick strands 50 composed of a sponge-like moisture-absorbent cord having a cotton center and a regenerated cellulose exterior layer. In the embodiment illustrated herein, the cord is wound in substantially vertically extending horizontally advancing convolutions. Strands 50 are spaced apart a distance which permits passage of air therebetween but which does not substantially exceed the thickness of a strand. Accordingly, no less than about one-half of the frontal surface area of the wick means, as viewed from the direction of the approaching air, is composed of moisture-bearing strands, so as to provide a substantial moisture bearing surface to contact and humidify the air passing through the wick means. Other forms of mounting may be utilized so long as the individual strands are in non-intersecting relation as shown in the figures and are disposed in the path of the air flowing from humidifier inlet duct 17 to outlet duct 19. By maintaining these strands in a moist condition, air flowing through the humidifier absorbs water from the strands and is humidified.

Although the illustrated embodiment has two wick frames, this number is not compulsory. Under some conditions one frame may be enough to impart the desired amount of moisture to the air passing through the humidifier. An excessive number of frames tends to retard the passage of air through the humidifier, and under conditions existing in the furnace system in the average residence, four frames would be excessive. Under these same conditions a ten inch or 12 inch square frame would be sufficient for air moistening purposes, with the surrounding housing being of an accommodating size and the inlet opening having about a three inch to eight inch diameter.

The wick strands 50 are maintained in a moist condition by dripping means in the form of a trough 55 having a W-shaped cross-section and positioned above the wick means 40. The trough 55 has a pair of end walls 57 outwardly from which extend a pair of horizontally disposed flanges 58 each of which rests upon a respective top edge portion 59 of one of the side walls 26, 27 to support the trough 55 in the position shown in the figures. In the bottom of the trough are a plurality of openings or perforations 56 through which water from the trough drips down onto the strands 50 to maintain the strands in a moist condition.

Referring to FIGURES 2 and 4, water is introduced into trough 55 through a spout 60 in the top cover 34, said spout being connected to one end of a plastic tube 61, the other end of which is connected to a pump 62 in sump 32 said pump being continuously operated by a continuously running motor 63 mounted on the exterior of side wall 26 beneath a shield 37. Pump 62 transfers water from sump 32 into the trough 55 from where it drips onto the strands 50, moistening said strands. Any excess moisture not absorbed by the strands drips downwardly into sump 32, where it is again transferred by the pump 62 back upwardly into trough 55.

Since there is a continuous transfer of moisture from the interior of the humidifier to the air flowing therethrough, the level of the water in sump 32 will drop as time progresses. This level may be maintained at a predetermined height by introducing water from an external source through an inlet 65 extending through side wall 27. The flow of external water into the humidifier through inlet 65 is controlled by valve means comprising a float 66 connected to an arm 67 having its other end pivotally mounted at 68 to a bracket 69 attached to the interior surface of housing side wall 27. Attached to the arm 67 adjacent its pivotal connection 68 is a closure member or plug 70 which is moved inwardly or outwardly of water inlet 65 in response to changes in the level of float 66. More specifically, when the level of water in sump 32 drops, float 66 drops and arm 67 pivots in a direction causing outward movement of plug 70, thereby opening the inlet 65 and admitting water into sump 32. As the water level rises, float 66 rises and

causes the plug to be pushed back into the inlet 65, thereby stopping the flow of water.

As previously indicated, pump motor 63 operates continuously, independent of blower 21, so that pump 62 continuously transfers water from sump 32 to trough means 55, from where it continuously drips down onto the strands 50. Accordingly, a substantial portion of the insoluble calcium salts which are deposited from the water onto the strands are washed downwardly by said continuous dripping of water and into the sump 32 where they settle. If the strands were not subjected to the continuous dripping of water from above, the insoluble calcium salts would have a tendency to form accumulations on the strands as the latter dried with clogging being a possible result. Another feature of the subject invention which prevents clogging of the humidifying element is the fact that the strands of the wick are not intersecting. Accordingly there are no pockets in which the calcium salts might accumulate, to produce a clogging effect. Clogging of the humidifying element is serious in that over a period of time it builds up a wall or baffle that prevents air from passing through the humidifier. This defect is quite common in humidifiers utilizing humidifying elements not containing the features described above. For example, in humidifiers having ordinary filter-type humidifying elements the build-up of calcium salts becomes quite substantial over a period of time eventually resulting in complete blockage to the flow of air through the humidifier.

After a substantial period of operation it may become necessary to remove wick means 40 and replace the strands 50 thereof. This can be readily accomplished in the instant invention merely by slidably removing the top cover 34, lifting trough means 55 upwardly until the bottom thereof clears the top edges of the humidifier walls and then sliding the trough out, following which wick means 40 can be removed by lifting the wick frame vertically upwardly until the bottom of the connecting members 43 have cleared the tops of the grooves 48, whereupon the frame may be pivoted about the axis of shaft 41 until it is substantially horizontal and then withdrawn from the interior of the housing by sliding the frame frontwardly. Since the wick means 40 can be pivoted to a horizontal position for removal, the entire humidifier can be installed near the ceiling joists of the furnace room with a minimum of clearance between the top cover 34 and the ceiling, and still not impede the removal of the wick means. The only clearance necessary is a slight space between the top cover 34 and the ceiling to enable the wick frame's top shaft 41 to be raised upwardly above the groove 46 in which the shaft's end stubs are mounted.

To offset the possibility of float 66 sticking in a position that prevents plug 70 from closing water inlet 65 as a result of which water will continue to flow into sump 32 and rise to a level at which the water overflows onto the floor of the furnace room, the subject humidifier is provided with an automatic shut-off for stopping the flow of water into sump 32 when the level reaches a predetermined height just above the level at which inlet 65 is normally closed. Describing this structure in more detail, reference is made to FIGURE 7 wherein there is shown a water inlet line or conduit 75 terminating at inlet 65. Across inlet conduit 75 is a valve 76 normally maintained in an open condition by a normally energized solenoid 77 connected to an external source of power (not shown) by lines 78, 79. Line 79 has one end connected to a terminal 81 on a vertically extending tubular float housing 85. Also mounted on float housing 85 is a second terminal 80 spaced from terminal 81 and connected by a line 87 to the external power source.

Bridging the gap between terminals 80, 81 is a switch arm 82 connected by a link member 83 to a float 84 within tubular housing 85. When in the bridging position shown in FIGURE 7, switch arm 82 closes the circuit which energizes solenoid 77. Extending from housing 85 through wall 27 of the humidifier and into the interior of the humidifier at sump 32 is a conduit 86. Conduit 86 extends into the sump 32 at a predetermined level below which the water must be maintained. When the water reaches the level of conduit 86 it flows therethrough in to the interior of float housing 85 until it exceeds the level of the entry to an outlet pipe 88 whereupon the water raises float 84. Because the diameter of conduit 86 exceeds the diameter of outlet pipe 88, the flow of water into unfilled housing 85 exceeds the outflow therefrom when the level in sump 32 exceeds the level of conduit 86. The switch arm 82 connected by link 83 to the float 84 rises with the float thereby breaking the contact between terminals 80 and 81 and opening the circuit from the external power source to solenoid 77. Deenergization of solenoid 77 closes valve 76, thus shutting off the flow of water through line 75 and outlet 65 into sump 32. Water drains out of housing 85 through outlet pipe 88.

Humidifier housing 18, trough 55 and the wick frame are all constructed from a non-corrosive material such as reinforced fibre glass.

There has thus been described a humidifier for use with a forced air furnace, which humidifier is versatile from an installation standpoint, is dependable in operation, has an interior which is readily accessible from a maintenance standpoint, has interior parts which may be readily removed for servicing, contains a moisture-transferring element which is not susceptible to clogging, and includes means for preventing water from overflowing from the humidifier onto the floor of the room containing the furnace.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, as modifications will be obvious to those skilled in the art.

What is claimed is:

1. A humidifier for connection to an air heating system, said humidifier comprising:
   - a housing;
   - said housing having air inlet and outlet openings;
   - wick means located between said inlet and outlet openings;
   - said wick means comprising a plurality of non-intersecting, vertically disposed cord-like strands spaced apart a distance which permits the passage of air therebetween but which does not substantially exceed the thickness of a cord-like strand;
   - each of said strands being composed of a cotton center and a regenerated cellulose exterior;
   - and means for continuously dripping water on said wick means from above.

2. An air heating and humidifying system comprising:
   - an air heating chamber;
   - an outlet duct leading from said chamber;
   - an inlet duct leading into said chamber;
   - a humidifier having an inlet opening and an outlet opening;
   - wick means located between the inlet and outlet openings in said humidifier;
   - said wick means comprising a plurality of non-intersecting, vertically disposed cord-like strands spaced apart a distance which permits the passage of air therebetween but which does not susbtantially exceed the thickness of a core-like strand;
   - each of said strands being composed of a cotton center and a regenerated cellulose exterior;
   - means for continuously dripping water on said wick means from above;
   - means connecting said humidifier inlet opening to one one of said ducts;

and means connecting said humidifier outlet opening to the other of said ducts.

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