

June 10, 1958

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2,838,294

HUMIDIFIER

Filed Sept. 30, 1954

2 Sheets-Sheet 1

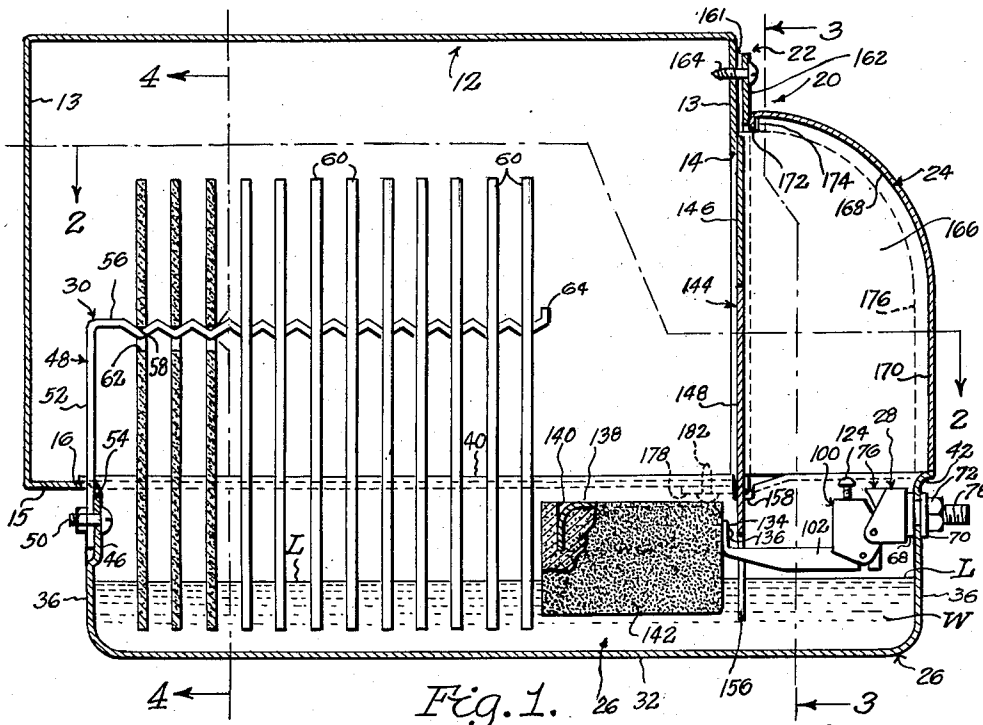


Fig. 1.

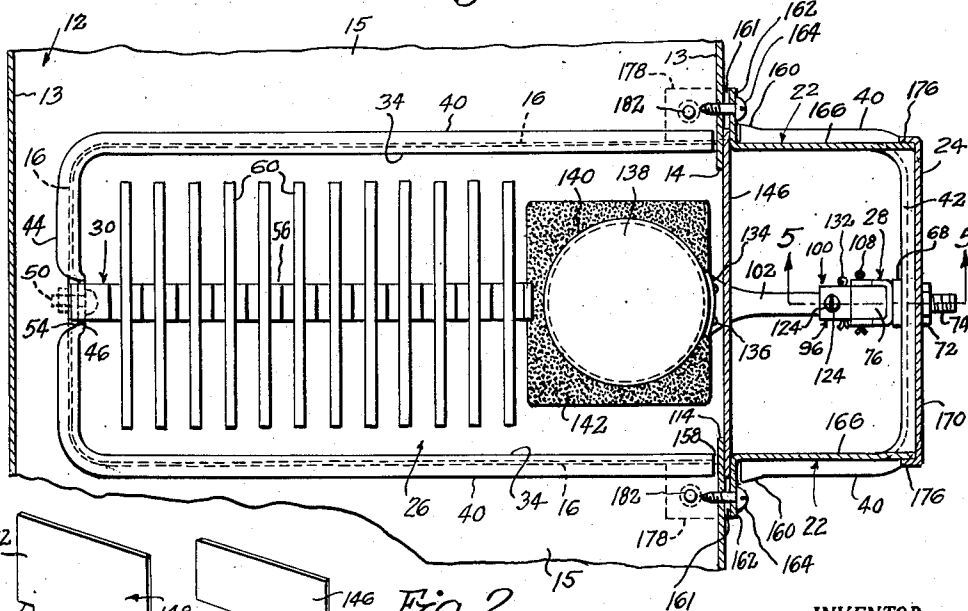


Fig. 2.

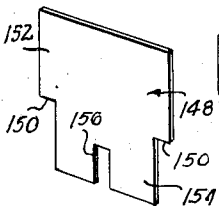


Fig. 9.

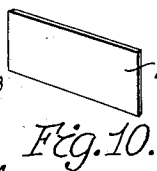


Fig. 10.

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2 Sheets-Sheet 2

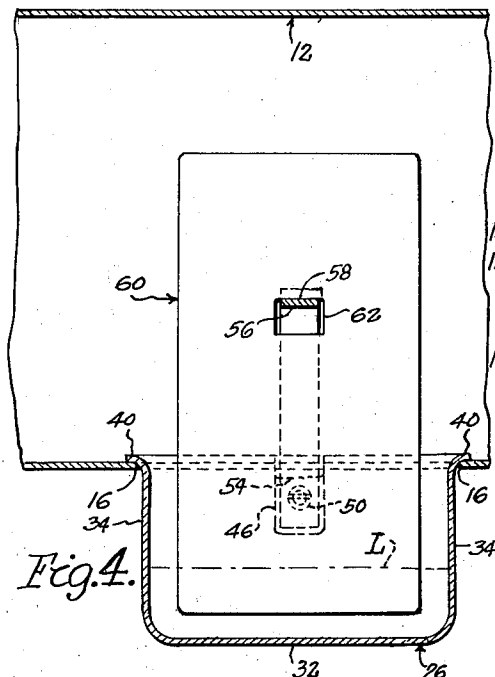


Fig. 4.

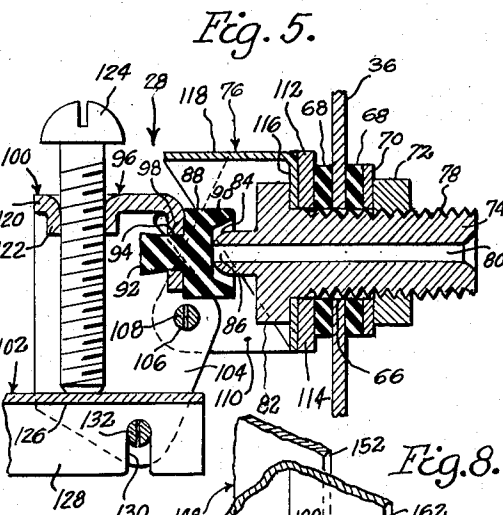


Fig. 5.

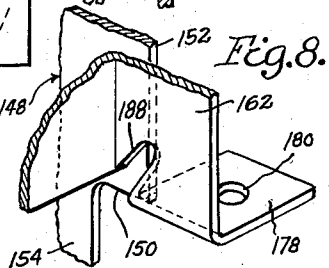


Fig. 8.

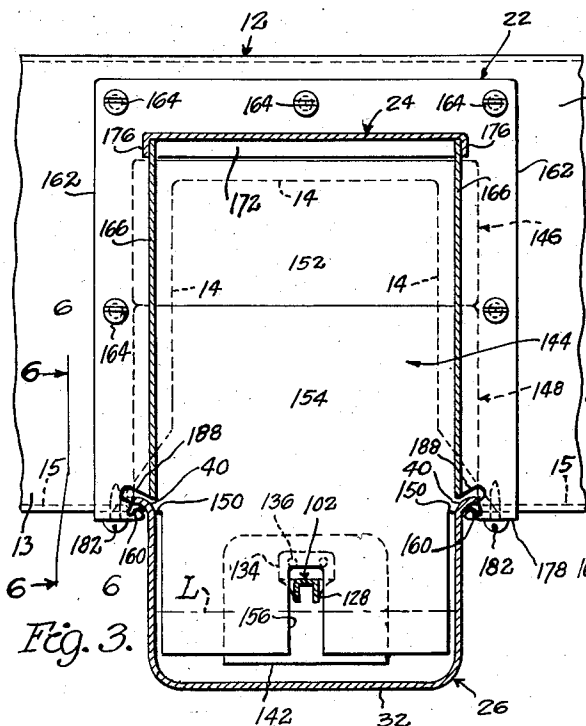


Fig. 3.

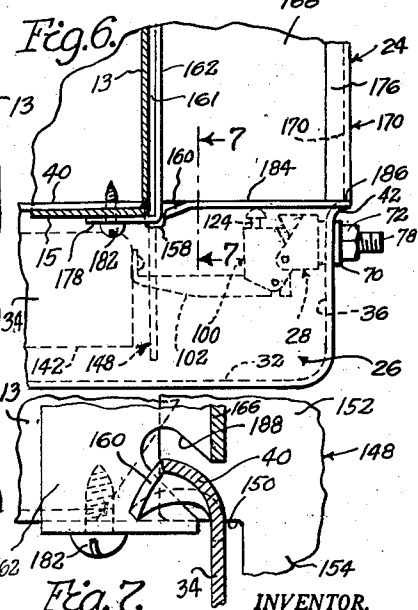


Fig. 6.

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2,838,294

HUMIDIFIER

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1 Claim. (Cl. 261—104)

This invention relates to humidifiers and, in particular, to humidifiers installed in connection with heat exchangers.

One object of this invention is to provide a humidifier which is adapted to be installed in a heating duct connected to a heating system in order to amplify the humidification where insufficient humidification is provided by the humidifier installed in the heater itself.

Another object is to provide a humidifier having an improved mounting for the evaporator plates of such a character that the plates are more easily installed and removed than the evaporator plates of prior humidifiers, do not overhang the edges of the humidifier pan and therefore do not cause dripping and dissipation of the humidifier liquid outside the pan.

Another object is to provide a humidifier having an improved float construction for operating the flow valve of the humidifier wherein no metal is directly immersed in the hot water in the humidifier pan but wherein the water-contacting float is of foam glass so that no electrolysis can occur by action of the metal of the float mechanism in contact with the hot water.

Another object is to provide a humidifier having an improved water flow valve which prevents spray from being emitted from the valve, as in prior humidifier flow valves.

Another object is to provide a humidifier wherein the humidifier pan is mounted and supported in an improved manner and wherein the flow valve and the adjacent metal parts are protected by an improved partition construction from the heat of the furnace and consequently from becoming clogged by lime deposited from the water as the result of such heat, and damage from electrolysis or galvanic action being prevented by forming the lower partition plate immersed in the water of the pan from a sacrificial metal such as aluminum which gradually dissolves and is easily replaced.

Another object is to provide a humidifier with an improved partition plate construction, as set forth in the object immediately preceding, wherein the partition plate is mounted in an improved manner in the front bracket of the humidifier and has outwardly-extending arms which engage notches in the humidifier pan, so that the partition plate also locks the evaporator pan in position and prevents it from coming out.

Another object is to provide a humidifier with an improved float-operated water flow control valve mechanism of such a construction that the float and its supporting arm may quickly and easily be detached from the remainder of the valve-operating mechanism so as to enable the valve member to be swung widely away from its valve seat for the purpose of inspection, cleaning or replacement of these parts which have been subject to rapid deterioration yet relatively inaccessible in prior humidifier float valve mechanisms.

Another object is to provide a humidifier with an improved float-operated water flow control valve mechanism

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nism which is free from the defects of prior humidifiers resulting from vibration of the humidifier float and float arm due to vibration transmitted thereto from the motor-driven blower of the heating plant, which vibration causes chattering and scoring of the valve seat in the water flow control valve as well as continuous minute water flow producing increased lime deposition on the valve parts.

Another object is to provide a humidifier with an improved float-operated water flow control valve mechanism which imparts a self-flushing action to the valve seat and valve member, thereby further reducing the deposition of lime thereon and maintaining the valve seat and valve member in a clean condition.

Other objects and advantages of the invention will become apparent during the course of the following description of the accompanying drawings, wherein:

Figure 1 is a central vertical section through a humidifier constructed according to one form of the invention and mounted transversely in a heating system duct;

Figure 2 is a horizontal section taken along the line 2—2 in Figure 1;

Figure 3 is a vertical cross-section taken along the line 3—3 in Figure 1, showing the improved partition plate construction of the humidifier of Figure 1;

Figure 4 is a vertical cross-section taken along the line 4—4 in Figure 1, showing the improved evaporator plate and mounting construction;

Figure 5 is an enlarged vertical longitudinal section through the water flow control valve and the adjacent portion of the float arm, taken along the line 5—5 in Figure 2;

Figure 6 is a fragmentary vertical longitudinal section taken along the line 6—6 in Figure 3, showing the manner of securing the humidifier front bracket to the bottom of the heating duct in which it is installed;

Figure 7 is a cross-section taken along the line 7—7 in Figure 6, showing the manner in which the humidifier pan and lower partition plate are supported in the humidifier mounting bracket;

Figure 8 is a fragmentary perspective view of the adjacent portions of the humidifier front bracket and lower partition plate at the location where the bracket is secured to the bottom wall of the heating duct;

Figure 9 is a perspective view, in reduced size, of the lower partition plate of the humidifier shown in Figures 1 to 8 inclusive; and

Figure 10 is a perspective view of the upper humidifier plate thereof.

Hitherto, in large heating installations for large houses or commercial buildings, it has been found that the humidifiers ordinarily provided in domestic heating installations are inadequate and that there is insufficient room in which to mount large evaporator pans required for adequate humidification. In prior humidifiers, moreover, the evaporator plates which have been customarily installed to accelerate the evaporation of the water from the evaporator pan have been unsatisfactory because they have ordinarily been made of T-shaped form with overhanging opposite side arms which engage notches in racks or in the top edges of the humidifier pan itself. These prior evaporator plates, because of their odd shapes, have been expensive to cut out of sheets because of the wastage of the surplus material required to be discharged in forming the side arms. Moreover, such T-shaped plates have been unsatisfactory because their side arms have caused the water to drip from them outside the humidifier pan, and the mounting of the plates in notches received by such side arms has caused frequent breakage of such plates because of the faulty mechanical distribution of forces and

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the leverage exerted at the points of engagement of the arms with the supporting notches resulting from the great separation of the highly-located center of gravity of the tall plate from the supporting arms located at a considerable distance below this center of gravity. Such T-shaped prior plates, moreover, have been awkward to install or replace because of the limited visibility and because the hands of the workman obscure his vision.

Prior humidifiers have also been defective for the further reason that the metal floats customarily used therein have been subject to electrolysis or galvanic action by reason of their direct contact with the hot water in the humidifier pan, and the erosion resulting therefrom has greatly shortened the working life of the parts of the float and of the water flow control valve connected thereto. The heat emitted from the furnace and coming into contact with the float arm and flow control valve in such prior humidifiers has aggravated this defect by causing increased deposition of lime upon these parts, from the water flowing out of the valve. Finally, the prior water flow control valves have been faulty because of the water spray which they have set up in the vicinity of the valve, increasing the deposit of lime and the galvanic action in the vicinity of the valve.

The humidifier of the present invention eliminates all of these defects of prior humidifiers by providing a humidifier which can quickly and easily be installed in a heating duct in addition to the humidifier installed in the heater itself and wherein the evaporator plates do not overhang the edges of the humidifier pan but are supported by a bracket secured to the rearward end of the pan and having a longitudinal arm extending forward from the rearward end of the pan and passing through an aperture in each evaporator plate, so that the plates are easily installed and removed, are not easily broken since their point of support is close to the center of gravity of the plate, and do not dissipate water by dripping because they do not overhang the edges of the humidifier pan.

The float of the humidifier of the present invention has no metal parts which are directly immersed in the water in the humidified pan, but instead are seated from above in a recess in a foam glass float which is inert to galvanic action or electrolysis. An improved partition construction consisting of upper and lower partition plates mounted in an improved manner protects the float arm and water flow control valve from direct heat from the furnace, and the lower partition plate is made of a sacrificial metal, such as aluminum, which by its gradual dissolution prevents the working parts of the humidifier from attack by electrolysis or galvanic action, as well as reducing the deposit of lime upon these parts previously occurring in unprotected or poorly protected humidifier float arms and valves. The partition plates are also mounted in an improved manner in the humidifier front bracket, and the latter is adapted to be easily secured to the side and bottom of a heating duct after an aperture has been cut in the duct at any convenient location.

Referring to the drawings in detail, Figure 1 shows in cross-section a heating system duct 12 having side and bottom walls 13 and 15 containing side and bottom openings 14 and 16 respectively in which is mounted a humidifier, generally designated 20, constructed and arranged according to one form of the present invention. The openings 14 and 16 are rectangular and at right angles to one another, and the humidifier 20 is provided at the front with a front bracket, generally designated 22, having a cover 24 closing the front thereof including the opening 14. The humidifier 20 is also provided with a humidifier pan or evaporator pan, generally designated 26, having mounted thereon at opposite ends thereof a valve and float assembly, generally designated 28, and an evaporator plate and support assembly, generally designated 30.

The humidifier pan 26 is provided with bottom and side walls 32 and 34 respectively and front and rear end

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walls 36 and 38 respectively, the upper edges of these walls being bent outwardly to provide side flanges 40 and front and rear flanges 42 and 44 respectively (Figure 2). The side flanges 40 and the rear flange 44 overlap the side and rear edges of the bottom opening 16 in the duct 12 so as to rest upon and be supported by the adjacent portions of the bottom wall 15. The mid-portion of the rear wall 36 of the pan 26 is indented as at 46 (Figures 1 and 2) in order to provide a seat of elongated rectangular shape for an inverted L-shaped evaporator plate bracket 48. The bracket 48 and the adjacent portion of the indentation 46 are drilled to receive a fastener 50, such as a bolt, by which the vertical portion 52 of the bracket 48 is secured to the end wall 36 of the pan 26. A gap or notch 54 is provided in the rear flange 44 (Figure 2) for passage of the vertical arm portion 52.

The bracket 48 is also provided with a corrugated or undulating portion 56 having notches 58 spaced at intervals along the length thereof for receiving and spacing evaporator plates 60 of suitable capillary material, such as pressed glass fiber, ceramic material, or the like, capable of exerting capillary force to draw water upward out of the pan 26 and disperse it through the heating system by evaporation. The evaporator plates 60 are of approximately rectangular shape elongated in a vertical direction (Figures 1 and 4) and have apertures 62 therein for the passage of the horizontal arm 56 of the L-shaped bracket 48 so as to support the plates 60 in positions with their lower edges spaced above the bottom wall 32 of the pan 26. The horizontal portion 56 of the bracket 48 at its free end has an upwardly-projecting end 64 serving as a hook to prevent accidental dropping off of any of the evaporator plates 60.

The valve and float assembly 28 (Figures 1, 2 and 5) is mounted on the front wall 36 of the humidifier pan 26, which has a hole 66 in it for that purpose. Seated in the hole 66 and held therein by resilient washers 68, a solid washer 70 and an internally-threaded nut 72 is the threaded stem 74 of a flow control valve, generally designated 76. The nut 72 engages external threads 78 on the stem 74, leaving enough of the threads 78 for the attachment of the pipe coupling (not shown) of the water supply pipe. The stem 74 is provided with a fluid passageway 80 leading through a flanged portion 82 and a valve seat 84 to an outlet port 86. The latter is closed and opened intermittently by the engagement of a resilient valve member 88 of rubber, synthetic rubber or other elastic deformable material having a cupshaped portion 90 engageable with the valve seat 84 and a stem 92 of reduced diameter passing through a hole 94 in a float arm base 96. The valve member stem 92 is made sufficiently larger than the hole 94 in which it is mounted so as to expand after being forced through the hole, and thus be held in position on the downwardly-extending central portion 98 of the float arm base 96.

The float arm base 96 is the upper part of a two-piece float arm, generally designated 100, the lower part 102 thereof (Figure 5) being of U-shaped cross-section and separably connected to the upper part 96. The upper float arm part or base 96 is also of approximately U-shaped cross-section with spaced parallel side wings 104 which are drilled with aligned holes 106 to receive a pivot pin 108 (Figure 5) which in turn passes through the suitably drilled spaced parallel side arms or wings 110 of a float arm bracket 112, the central portion 114 of which is bored to receive the threaded stem 74. Also mounted upon the threaded stem 74 immediately adjacent the flange or enlargement 82 thereof is the central portion 116 of a hood or spray guard 118 which, as its name signifies, prevents spray from the valve port 86 from being thrown upward and deflects all such spray downward into the pan 26.

The central or bridge portion 120 of the float arm base 96 is provided with a centrally-disposed tubular internally-threaded portion 122 through which a vertical

screw 124 is threaded. The lower end of the screw 124 engages the central or bridge portion 126 (Figure 5) of the lower part 102 of the float arm 100, the spaced parallel sides 128 of which are notched as at 130 near the rearward end of the lower float arm portion 102 to enable the latter to be hooked over a horizontal pin 132 extending between and passing through the suitably drilled side arms 104 of the upper float arm portion or base 96. The pins 108 and 132 are shown as cotter pins but other types of pins or fasteners may be used for the same purpose. Thus, the screw 124 serves as an adjustment screw to regulate the position of the lower float arm portion 102 relatively to the float arm upper portion or base 96 so as to regulate the water level at which the cup-shaped valve member 88 closes the valve port 86.

The forward end of the lower float arm portion 102 is provided with a widened upstanding arcuate flange 134 (Figures 2 and 3) by which it is secured as by the fasteners 136 to an inverted cup-shaped float attachment member 138 which is seated in an annular depression 140 in the top of a cellular float 142 of foam glass. The cup-shaped float attachment portion 138 is seated in the foam glass block 142 constituting the float and is then cemented in position in the annular groove 140 by any suitable conventional waterproof cement, such as that widely known commercially as Permatex. The foam glass of which the float 142 is constructed is, as its name signifies, composed of myriads of minute glass bubbles containing the gas which renders the mass light and capable of floating upon water. The foam glass float 142 is immune from attack by any chemicals in the water or by galvanic or electrolytic action.

The flow control valve 28 and its adjacent parts are prevented from being exposed to direct heat by a partition plate construction, generally designated 144, consisting of upper and lower partition plates 146 and 148 respectively placed one above the other and overlapping the opening 14 in the side 13 of the heating system duct 12 (Figures 1 and 3). The upper partition plate 146 is rectangular and the lower partition plate 148 is approximately rectangular but with cutaway portions or shoulders 150 on its opposite sides which connect a wider upper part 152 to a narrower lower part 154. The lower part 154 extends downward into the humidifier pan 26 to a location slightly above the bottom wall 32 thereof so as to extend slightly below the level L of the water W (Figure 1), and has an upwardly-extending notch or slot 156 (Figure 3) for the passage of the lower float arm portion 102.

The horizontal shoulders formed by the cutaway portions 150 extend into notches 158 (Figures 1 and 2) in the upper side edges of the humidifier pan 26 so as to lock the latter in position and prevent it from being moved outward or inward until the partition plate 148 is moved upward. The forward portions of the side flanges 40 are bent downward and outward at 160 (Figure 7) to form stops. The partition plate construction 144 is made in two pieces in order to facilitate insertion and removal of its component plates 146 and 148 which are flexed into arcuate shape during such insertion or removal. The lower plate 148 is preferably made of a sacrificial metal, such as aluminum, so as to protect the other metal parts from erosion or corrosion due to electrolysis.

The upper and lower partition plates 146 and 148 are held in position against the portions of the side wall 13 of the heating duct 12 adjacent the side wall openings 14 in a space 161 between the side wall 13 and the approximately U-shaped mounting flange 162 of the front bracket 22. The flange 162 is secured in position by fasteners 164, sheet metal screws being useful for that purpose. The flange 162 surrounds three sides of the side wall opening 14 and has spaced parallel side wings 166 of plane flat shape extending forward to the forward end flange 42 of the humidifier pan 26 so as to close the

sides of the space above the forward end of the pan 26. The remainder of this space is closed by the cover 24, the latter being of arcuately-bent sheet metal (Figure 1) fitting the arcuate upper edges 168 of the wings 166, the lower edge portions 170 being straight and vertical. The cover 24 has a downwardly-bent flange 172 at its upper end adapted to hook into notches 174 in the upper inner ends of the side wings 166. The cover 24 is also provided with side flanges 176 (Figure 3) which extend over the edge portions 168 and 170 thereof. The lower ends of the U-shaped flange 162 have perpendicularly-bent tabs 178 (Figures 6 and 8) which are provided with holes 180 for the reception of sheet metal screws or other fasteners 182 by which these tabs 178 are secured to the bottom wall 15 of the heating duct 12. The lower edges 184 and 186 of the side wings 166 and cover 24 respectively rest upon the side and end flanges 40 and 42 of the humidifier pan 26. The edge flange 162 adjacent the lower end tabs 178 (Figures 3, 7 and 8) is provided with inclined notches or slots 188 for the reception of the edge flanges 40 of the humidifier pan 26.

In the operation of the invention, let it be assumed that the humidifier 20 has been installed in the heating duct 12 of the furnace by cutting the side and bottom openings 14 and 16 as described above and by sliding in the pan 26 with the evaporator plates 60 either already in position on the bracket 48 or inserted after the pan 26 has been slid into its position with its side flanges 40 overlapping the edges of the bottom opening 16. Let it also be assumed that the valve stem 78 has been connected to a water supply pipe and that the partition plates 146 and 148 have been sprung into position in the gap 161 between the front bracket flange 162 and the side wall 13 of the heating duct 12, and finally that the cover 24 has been placed in position by dropping it over the top edges 168 of the side wings 166 with its end flange 172 in the notches 174 (Figure 1).

Assuming the pan 26 to be empty and the float 142 resting upon the bottom wall 32 thereof, water supplied under the usual pressure to the pipe connection 78 flows through the passageway 80 therein (Figure 5) and pushes the valve member 88 away from its valve seat 84, uncovering the port 86 so as to permit water to spurt outward therefrom. Any water spurting upward is deflected by the hood or spray gauge 118 so as to fall downward into the pan 26 and prevent the deposit of lime on parts of the humidifier behind the hood 118. The float 142 rises with the water level so that the float arm 102 swings upward, transmitting this motion through the screw 124 to the base 96 and swings the cup-shaped valve member 88 into closing engagement with the valve seat 84, temporarily cutting off the flow of water.

As the water in the humidifier pan 26 evaporates and the level L thereof drops, the float 142 and its arm 102 swing downward around the pivot pin 132 away from the bottom of the screw 124 independently of the float arm base 96, so that the water pressure in the passageway 80 is again free to push the valve member 88 away from the valve seat 84 and again permit water to spurt out from the port 86 to refill the pan 26, whereupon the float 142 again rises and the mechanism operates in the foregoing manner to again temporarily shut off the flow of water.

The additional pivotal connection 132 of the float arm 102 to the float arm base 96, and the pivotal connection 108 of the latter to the bracket 112 have been found to eliminate the vibration hitherto transmitted to the float and float arm from the motor-driven blower of the heating plant, and to avoid the consequent chattering and scoring of the valve seat as well as the excessive deposition of lime thereon occurring in prior humidifiers lacking this construction. Moreover, the present humidifier valve, apparently as a result of the elimination of this vibration, does not permit the minute opening of the valve and the tiny flow of minute streams of water for

long periods of time, as in prior valves lacking the present construction, the present valve permitting only a substantial flow which gives a self-flushing action. Furthermore, the float arm 102 and float 142 can be quickly and easily detached from the base 96 merely by unscrewing the screw 124 a few turns so as to permit the slot 130 of the float arm 102 to be unhooked from the pin 132 and pulled out. This construction enables the float arm base 96 and valve member 88 to be then swung downward away from the valve seat 84 so as to completely expose both the port 96 and the cup-shaped portion 90 of the valve member 88 for inspection, cleaning or replacement.

During the operation of the humidifier 20, the partition plates 146 and 148 prevent heat from reaching the valve 28 and consequently reduce the depositing of lime on the parts thereof and the adjacent float mechanism which would otherwise be accelerated by the heat. Since the foam glass of the float 142 is an electrical insulator, there is no electrical conduction path from the water W to the metal parts of the float and valve, thereby eliminating any opportunity for electrolysis or galvanic action. Inasmuch as the lower partition plate 148 is preferably made of a sacrificial metal, such as aluminum, this metal dissolves when electrolysis occurs, protecting the other portions of the humidifier from erosion or corrosion due to this influence.

When it becomes necessary to clean or replace the evaporator plate 60, this is also easily done by removing the cover 124 and partition plates 146 and 148. The operator can then reach his hand into the interior and unhook the plates 60 from their positions in the notches 58 on the horizontal portion 56 of the bracket 48. Since there is no overhang of the plates 60, there is no dripping of water from them to points outside the boundaries of the humidifier pan 26. Breakage of evaporator plates 60 is also minimized since the plates are supported near or above their centers of gravity, rather than by racks near their lower portions, as in prior devices, and consequently the leverages existing in prior evaporator plate holders and causing such breakage do not exist in the case of the present invention.

Furthermore, the humidifier 20 of the present invention is quickly and easily installed in the heating ducts themselves, thereby amplifying the humidification effected by the furnace humidifier whenever the latter is inadequate to the installation or situation.

What I claim is:

A humidifier for mounting in a hole in a heating apparatus, said humidifier comprising a generally-vertical mounting structure having an opening therethrough and adapted to be secured to the heating apparatus in alignment with the hole thereof, an elongated water-evaporating pan extending through said opening and mounted on and secured to said mounting structure in supported relationship therewith, said pan having front and rear end portions disposed respectively in front of and behind said mounting structure with the major part of the length of said pan disposed behind said mounting structure, an inverted L-shaped evaporator plate bracket having a vertical arm and a horizontal arm, said vertical arm being secured to the rear end portion of said pan and extending upwardly therefrom and providing the entire support for said bracket, said horizontal arm extending from said vertical arm forwardly over said pan toward said mounting structure with its forward end free, and perforated evaporator plates of capillary material threaded upon said horizontal arm rearwardly of the free end thereof and depending from said horizontal arm into said pan whereby said mounting structure and pan can be fully preassembled and inserted through the hole in the heating apparatus and secured to the heating apparatus, after which the evaporator plates can be inserted through said opening in the mounting structure and threaded upon said horizontal bracket arm over the free end thereof in full view of the operator looking through said opening.

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