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B. J. HOMKES

3,359,967

HUMIDIFIER

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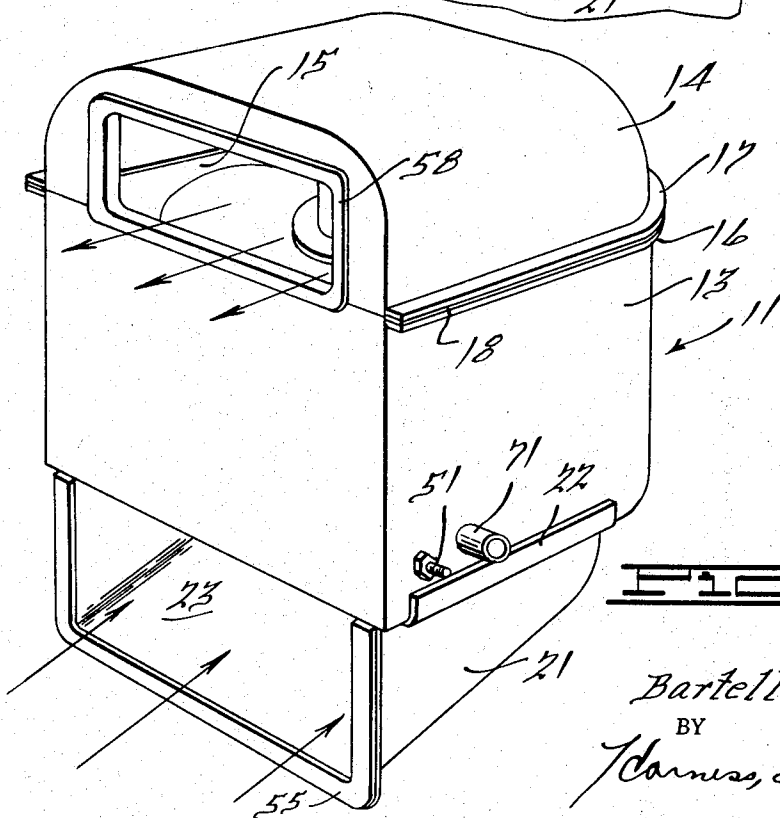
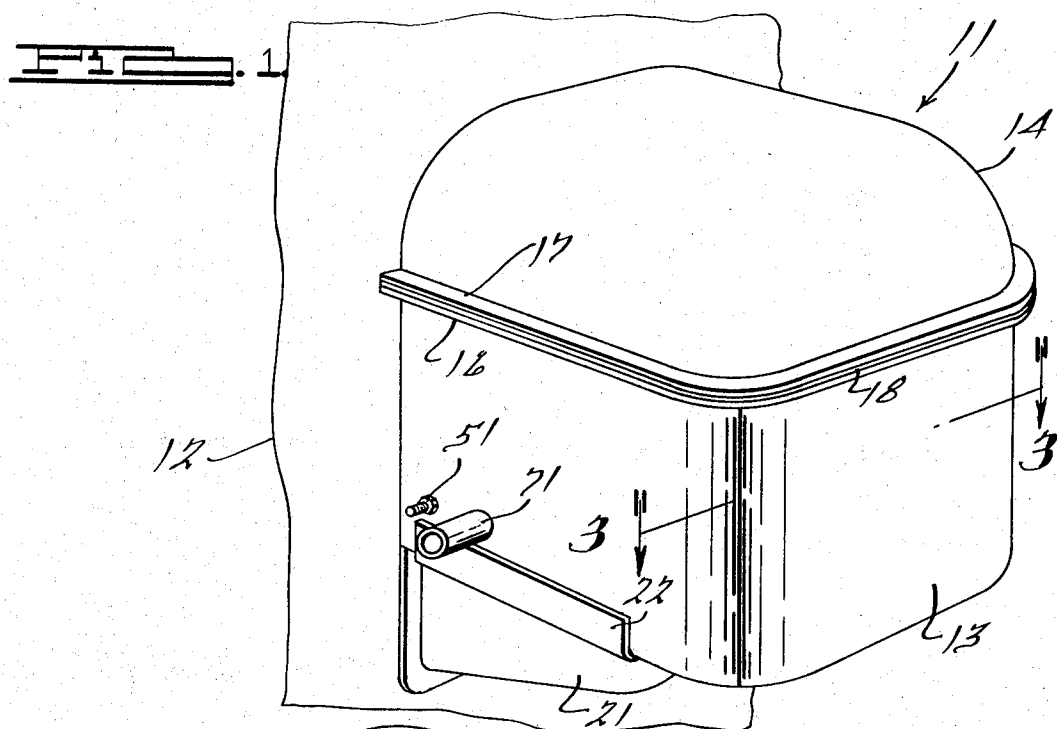


FIG. 2.

INVENTOR.  
Bartell J. Homkes  
BY  
Harness, Dickey & Poirie  
ATTORNEYS.

Dec. 26, 1967

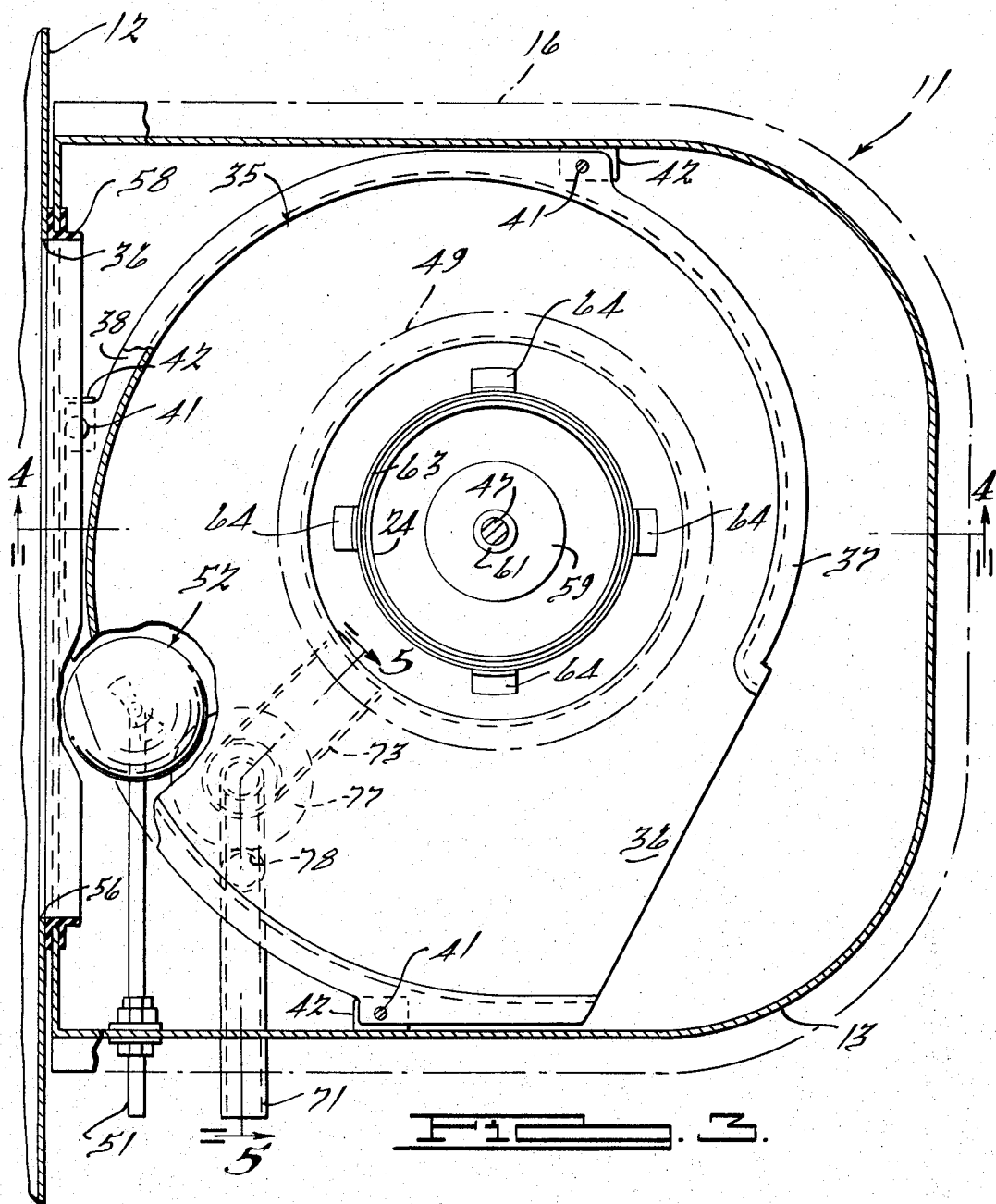
B. J. HOMKES

3,359,967

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4 Sheets-Sheet 2



INVENTOR.  
*Bartell J. Homkes*  
BY  
*Harniss, Dickey & Perie*  
ATTORNEYS.

Dec. 26, 1967

B. J. HOMKES

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HUMIDIFIER

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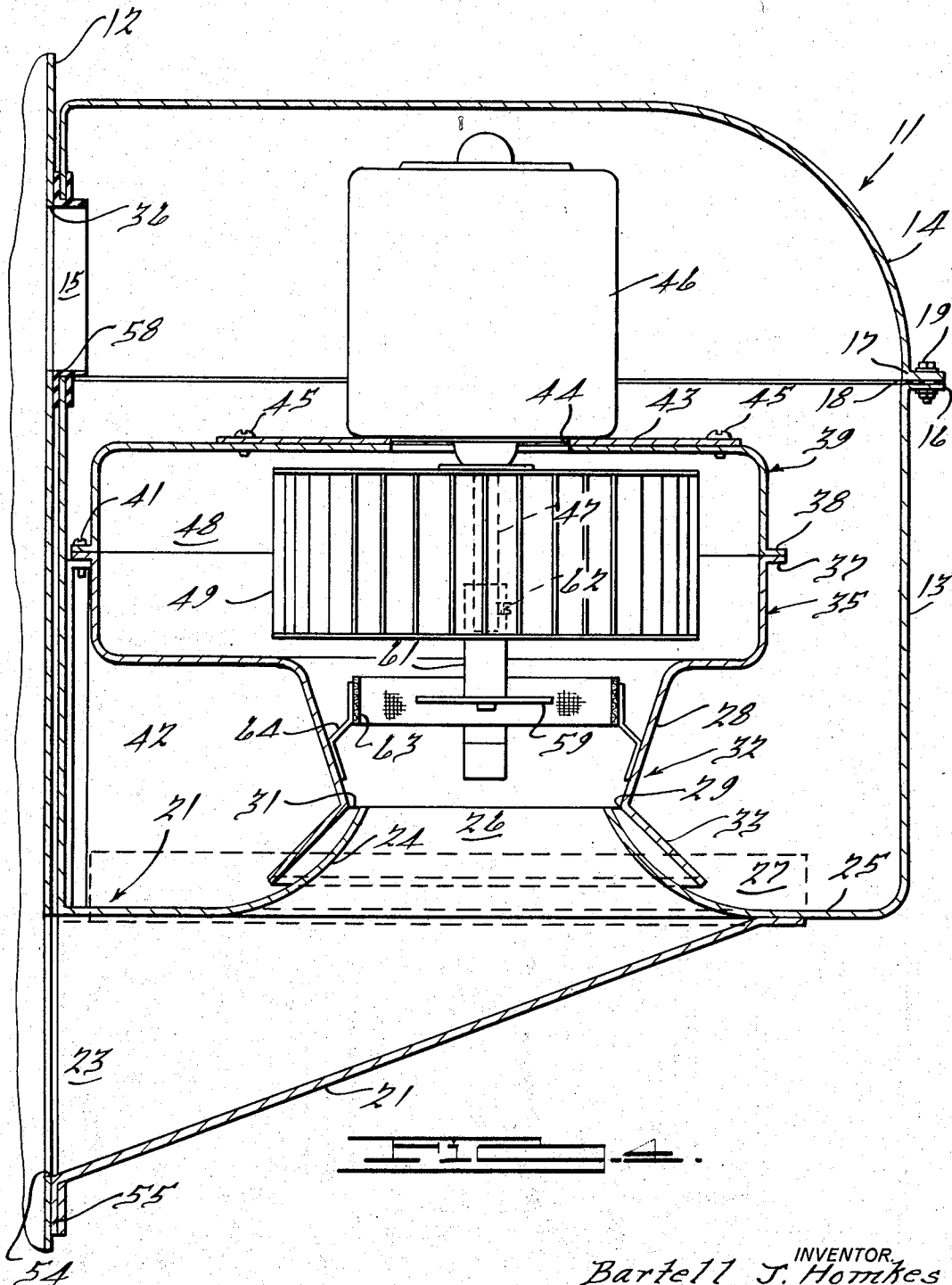


FIG. 4.

INVENTOR  
Bartell J. Homkes  
BY  
Harness, Dickey & Paine  
ATTORNEYS.

Dec. 26, 1967

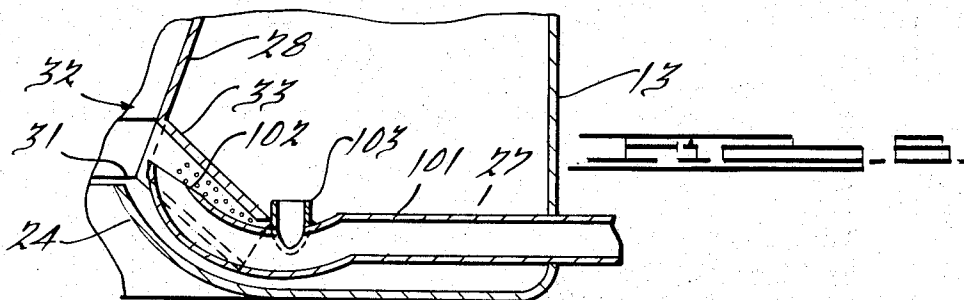
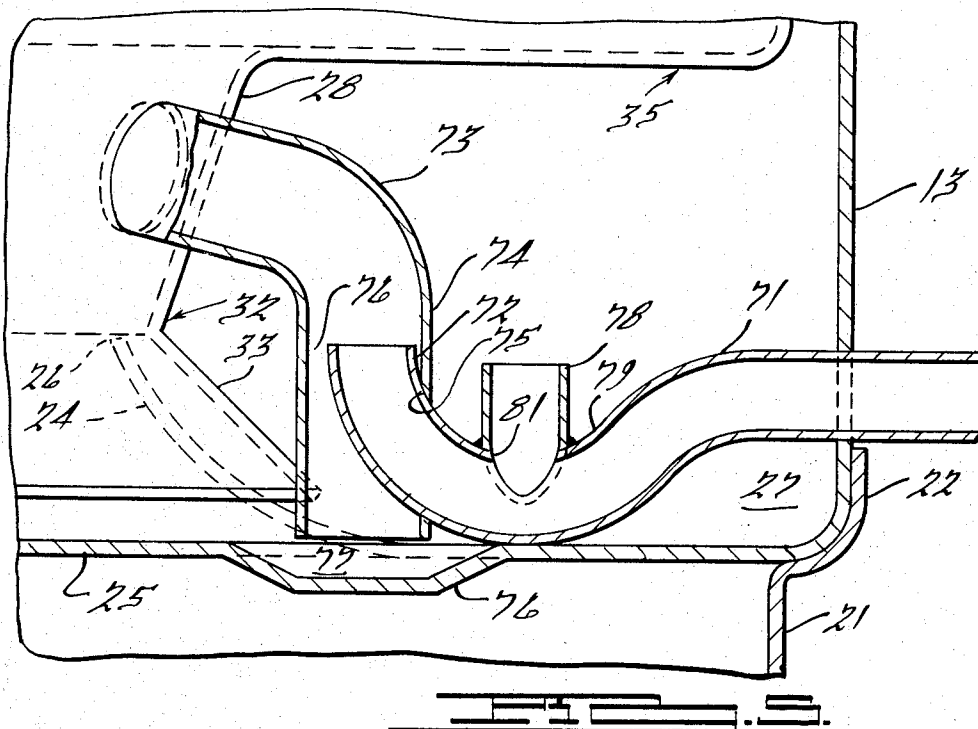
B. J. HOMKES

**3,359,967**

HUMIDIFIER

Filed Dec. 27, 1965

4 Sheets-Sheet 4



INVENTOR,  
*Bartell J. Hornikes*  
BY  
*Warriss, Dickey & Purin*  
ATTORNEYS.

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3,359,967

HUMIDIFIER

Bartell J. Homkes, Ada, Mich., assignor to Evans Products Company, a corporation of Delaware  
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12 Claims. (Cl. 126—113)

This invention relates to a humidifier for adding moisture to the air and for washing the air and more particularly to a duct attached humidifier.

The use of humidifying devices to add moisture to the air and to wash foreign particles from the air is well known. Various types of humidifying devices have been proposed for home use which accomplish the first function but, for the most part, these devices do not provide any significant air washing. The degree of humidification accomplished by the prior art devices also is not completely satisfactory.

The previously proposed devices either do not add sufficient moisture to the air or they depend upon small nozzles or other structure that is prone to loss of efficiency due to mineral deposits which result from the normal water supply, or both. In addition, most of these devices require periodic servicing.

It is, therefore, a principal object of this invention to provide an improved humidifier assembly.

It is another object of this invention to provide a humidifier that will add sufficient moisture to the air and which additionally washes the humidified air.

It is a further object of this invention to provide a humidifier that is self-cleaning so that it will not be adversely affected by mineral deposits.

A humidifier embodying this invention comprises means defining an air inlet, an air outlet and air passage means including a venturi section between the air inlet and the air outlet. Conduit means interconnect a source of water with the air passage means at the throat of the venturi section so that water will be forced from the source into the air passage in response to air flow through the latter. A circulating device is provided to force air through the venturi section.

As a still further feature of the invention, the air is discharged from the venturi section across the source of water in its path to the air outlet so that any excess water as well as foreign particles washed from the air will return to the source. The humidifier also may be provided with a bypass device having an outlet end that opens into the source above the normal liquid level. Means are provided to transmit the pressure at the venturi throat to the bypass device inlet end to draw water from the sump into the bypass when the device is operating. This results in a flushing of the sump to remove mineral deposits from it.

Other objects and advantages of this invention will become more apparent as this description proceeds, particularly when considered in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a perspective view of a humidifying device embodying this invention attached to the plenum of a forced air furnace.

FIGURE 2 is a perspective view of the humidifying device shown in FIGURE 1 taken from the opposite side and indicating the air flow pattern through the humidifying device;

FIGURE 3 is a cross-sectional view taken generally in the direction of the line 3—3 of FIGURE 1;

FIGURE 4 is a cross-sectional view taken along the line 4—4 of FIGURE 3;

FIGURE 5 is an enlarged cross-sectional view taken along the line 5—5 of FIGURE 3; and

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FIGURE 6 is a scale cross-sectional view, in part similar to FIGURE 5, showing another embodiment of the invention.

Referring now in detail to the drawings, a humidifier assembly embodying this invention is identified generally by the reference numeral 11 and is depicted as being attached to a sheet metal side 12 of the plenum of a hot air furnace. Although the humidifier 11 is shown in conjunction with the duct work of the hot air furnace, it is to be understood that the invention may be practiced with a humidifier assembly that is separate from the furnace duct work. In a preferred embodiment of the invention, however, the humidifier 11 is used in conjunction with a furnace.

The humidifier assembly 11 includes a central generally rectangular cross section sheet metal housing member 13 that defines a humidifying chamber. The upper end of the housing 13 is closed by a dome-shaped sheet metal cover 14 in which air outlet opening 15 (FIG. 2) is formed. The housing member 13 and cover 14 have facing outturned flanges 16 and 17, respectively, that are joined together with a gasket 18 interposed therebetween by means of a plurality of bolt and nut assemblies 19 (FIG. 4).

A sheet metal air inlet duct 21 has a pair of upstanding flanges 22 that engage opposite sides of the lower end of the housing 13 and are affixed, as by spot welding, thereto. The air inlet duct 21 forms air inlet opening 23 at the same side of the humidifier assembly 11 as the air outlet opening 15 with the air inlet opening 23 being positioned below the air outlet opening 15.

The air inlet duct 21 directs air from the air inlet opening 23 to a convergent nozzle section 24 formed integrally with a lower wall 25 of the housing 13. The convergent nozzle section 24 is formed centrally within the housing 13 and may be generally circular in shape. The upper end of the nozzle section 24 defines a restricted throat 26. The space around the convergent nozzle section 24 in the housing 13 forms a sump 27 for water for a purpose that will become more apparent as the description proceeds.

Disposed concentrically around the convergent nozzle section 24 is a divergent nozzle section 28 also formed from sheet metal and defining a throat 29. The throat 29 of the divergent nozzle section 28 is aligned with the throat 26 of the convergent nozzle section 24, but is disposed radially outwardly from it to provide an air gap 31 between the respective throats. It should be readily apparent that the convergent and divergent nozzle sections 24 and 28 form a venturi section, indicated generally by the reference numeral 32.

An integral depending flange 33 extends from the divergent nozzle section throat 29 around convergent nozzle section 24 into the sump 27 below the normal liquid level in the sump. The air gap 31 is positioned above the normal liquid level in the sump so that water will not overflow through the air gap 31 into the convergent nozzle section 24. The difference in height between the air gap 31 and the level of the water in the sump 27 is sufficiently low, however, so that the pressure drop created by air flow through the venturi section 32 will draw water from the sump 27 through the passage defined by the depending flange 33 and outer periphery of the convergent nozzle section 24 into the air gap 31 and throat of the venturi section 32, as will become more apparent as this description proceeds.

The divergent nozzle section 28 is formed integrally with a lower fan housing, indicated generally by the reference numeral 35. The lower fan housing 35 is generally scroll shaped (FIGURE 3) and forms an air discharge opening 36 at one side above the sump 27. The

lower fan housing 35 has an outwardly extending flange 37 to which a corresponding outwardly extending flange 38 of an upper fan housing 39 is affixed at three spaced locations, as by threaded fasteners 41. The threaded fasteners 41 are also threaded into vertically extending bosses 42 formed at corresponding locations around the housing 13 so as to support the upper and lower fan housings 39 and 35 and convergent nozzle section 28 with respect to the housing 13. The upper fan housing 39 also has an air outlet opening corresponding to the outlet opening 36 and in registry with it.

A motor supporting plate 43 is affixed to the upper fan housing 39 around a central opening 44 formed in it by means of a plurality of circumferentially spaced threaded fasteners 45. An electric motor 46 is supported by plate 43 by any suitable cushioning means (not shown) with its output shaft 47 depending into a fan cavity 48 formed by the upper and lower fan housings 39 and 35. A squirrel cage type fan 49 is affixed to the motor shaft 47 within the cavity 48 above the venturi section 32.

Water is admitted to the sump 27 by means of a water inlet conduit 51 that extends through the side of the housing 13 and terminates at an outlet end, across which a float valve 52 of any known type is provided. The float valve 52 maintains a constant level of water within the sump 27, which, as has been noted, is below the air gap 31 formed at the throat of the venturi section 32.

In operation the electric motor 46 is preferably coupled into the air circulating fan of the furnace so that the humidifier assembly 11 will only be operative when the furnace is delivering heat. Operation of the motor 46 causes the fan 49 to rotate and draw air from the hot air plenum of the furnace through an air opening 54 formed in the side of the sheet metal 12. The opening 54 registers with the humidifier air inlet 23 with a gasket 55 being positioned around the respective openings to form a seal therebetween. The air passes upwardly through the convergent nozzle section 24 and divergent nozzle section 28 of the venturi 32. The air flow through the throat of the venturi 32 causes a decrease in static pressure at the air gap 31. The air pressure above the water in the sump 27 causes the water to pass upwardly through the channel between the outer surface of the convergent nozzle section 24 and the depending flange 33 and into the venturi section 32. The inspiration of the water will cause mixture with the air flowing through the venturi section 32 which mixture is aided by the turbulence at the throat.

The water forced from the sump 27 into the venturi section 32 impinges upon foreign particles carried by the air as well as mixing with the air. As the air-water mixture passes through the fan housing members 35 and 39 some of the larger water globules will impinge upon the fan 49 and be broken up by its rotation. The humidified air is then forced from the air outlet opening 36 against the adjacent wall of the housing 13 and above the water in the sump 27. The foreign particles which have become saturated with water will be driven against the wall of the housing 13 and will flow along the wall into the sump 27. The moisture laden air must reverse its flow in the housing 13 to flow into the furnace plenum through the humidifier air outlet opening 15. This will also assist in the removal of the foreign particles and larger water globules from the air entering the plenum. From the humidifier air inlet opening 15 the air flows into the furnace plenum through an air passage 56 formed in the sheet metal side 12 above the opening 54. A sealing gasket 58 is supported around the humidifier air outlet 15 to preclude air leakage at this point.

As has been noted, the fan 49 will help to break up larger water globules and any globules which escape past the fan 49 will be returned by gravity to the sump 27. In some instances, however, it may be desired to provide further insurance that larger water particles will be

broken up. For this purpose, a disc 59 having an integral collar 61 is affixed to the motor shaft 47 by means of a set screw 62. Water passing through the venturi section 32 will impinge upon the rotating disc 59 and be thrown radially outwardly. This high velocity radial disposition of the water particles will help to break them up so that they may conveniently enter the air flowing through the venturi section 32.

If further dispersement is desired, a screen 63 may be supported around the periphery of the disc 59 by means of a plurality of supporting pads 64 that are spot welded at one end to the screen 63 and at the other end to the divergent nozzle section 28. Any other type of reticulated member may be used in place of the screen 63 such as an annular comb or the like.

As has been noted, the passage of the humidified air against the housing 13 and across the top of the sump 27 insures the return of foreign particles washed from the air to the water in the sump 27. In addition, a foreign material known in the art as "white dust" composed of minerals from the water will also be returned to the sump 27. It is desirable to remove these particles from the sump 27 so that they will not accumulate therein. This removal may be accomplished automatically by passing excess water through the sump 27 by an overflow device shown in more detail in FIGURE 5.

The overflow device comprises an overflow tube 71 that extends through and is secured to a sidewall of the housing 13 in any suitable manner. The overflow tube 71 has an upstanding inlet end 72 that is positioned above the normal liquid level in the sump 27. The inlet end 72 is exposed to the pressure contiguous to the throat of the venturi section 32 by means of a conduit 73 of generally tubular shape that extends into the venturi section 32 through the divergent nozzle section 28 and is affixed thereto adjacent the venturi throat. A downwardly extending portion 74 of the conduit encircles the inlet end of the overflow tube 72 which extends through an aperture 75 formed in the conduit 73. An air gap 76 exists between the overflow inlet end 72 and the conduit portion 74.

When air is flowing through the venturi section 32, sufficient pressure drop will be created at the overflow inlet end 72 to raise the water through the conduit portion 74 to the level of the inlet end 72. The water will then pass through the overflow tube 71 to a drain (not shown) by means of any suitable conduit (not shown). Thus, water will continuously be circulated through the sump 27 in excess of the amount added to the air passing through the humidifier assembly 11.

The removal of foreign particles may further be aided by forming a depression 76 in the lower housing wall 25 in registry with the lower end of the conduit portion 74. The heavier particles will gravitate to the small sump 77 provided by the depression 76 and will be raised along with some water through the conduit 74 by means of the pressure differential created by the venturi action. The particles will then pass into the overflow inlet end 72 and be passed from the humidifier assembly 11.

Although a float valve assembly 52 is provided to maintain the liquid level in the sump 27, another overflow tube 78 may be provided as insurance in the event that the float valve 52 becomes clogged or otherwise malfunctions. The overflow tube 78 is a short stub tube which is connected to the overflow pipe 71 at an arcuate trap portion 79 by means of a weld. The outlet end at the overflow tube 78 registers with an opening 81 formed in the overflow pipe 71 so that excess water in the sump 27 can pass through the pipe 78 into the overflow pipe 71. It will be noted that the inlet of the overflow pipe 78 lies below the inlet end 72 of overflow pipe 71.

An alternative embodiment of the overflow device shown in FIGURE 5 is depicted in FIGURE 6. In this device, an overflow pipe 101 extends through the housing sidewall 13 and is affixed to it. An inlet end 102 of the

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overflow pipe 103 extends upwardly between the depending flange 33 of the divergent nozzle section 28 and the outer periphery of the convergent nozzle section 24. Thus, the inlet end 102 is subjected to the pressure at the air gap 31 formed at the throat of the venturi section 32. Thus, when air is flowing through the humidifier 11, water will be raised from the sump 27 to the overflow pipe inlet end 102. An additional overflow pipe 103 also may be provided in this embodiment in the same manner as the overflow pipe 78 in the previously described embodiment.

It should thus be readily apparent that the humidifier designs disclosed are highly effective in adding the desired amount of moisture to the air. If desired, a moisture control may be provided by coupling the fan motor 46 to some form of humidistat. The amount of moisture added to the air also may be altered by changing the height of the water within the sump 27. The air will be effectively washed and the particles removed by the washing will be returned to the sump and removed from the sump by means of the unique overflow provided. In addition, no small orifices are present in this device so that periodic cleaning will be relatively unnecessary and there will be no possibility of malfunctioning due to mineral deposits from the water supply.

Although the components of the humidifier housing have been described as being formed from sheet metal, it is to be understood that other materials, such as plastic, may be used. The plastic has the advantage of being rust-proof and permits certain of the components to be adhesively bonded together.

Various other changes and modifications than those suggested above may be made without departing from the spirit and scope of the invention, as defined by the appended claims.

What is claimed is:

1. A humidifying device for adding moisture to air and for washing foreign particles from the air comprising housing means defining a sump for containing a source of water, means defining an air passage from an air inlet to an air outlet through said housing means, means defining a venturi section within said air passage having a throat of restricted area, a fan supported within said air passage and interposed between said throat and said air outlet, said fan being adapted to create a pressure differential upon operation thereof between said air inlet and said air outlet for circulating air through said air passage and for creating a reduced static pressure at said throat, and conduit means extending from a point beneath the normal liquid level in said sump to said throat for delivering water to said throat in response to the air flow therethrough, said fan having a plurality of fan blades supported for rotation within said air passage and positioned adjacent said throat in the path of air flow to be impinged by the water globules discharged into said air passage from said throat upon the creation of a pressure differential thereupon.

2. A humidifying device as set forth in claim 1 wherein a disc is fixed for rotation with the fan adjacent the throat and in the path of air flow for impingement of larger water particles upon said disc for dispersion thereby.

3. A humidifying device as set forth in claim 1 wherein a disc is fixed for rotation with the fan adjacent the throat and in the path of air flow for impingement of larger water particles upon said disc for dispersion thereby and further including a reticulated member encircling said disc and positioned to be impinged by the larger water particles dispersed by said disc for further breaking up of the water particles.

4. In combination, a humidifying device as set forth in claim 1 and a hot air furnace having a plenum, said humidifying device being supported by said furnace and having its air inlet and air outlet registering with said plenum.

5. In combination, a humidifying device as set forth in claim 3 and a hot air furnace having a plenum, said hu-

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midifying device being supported by said furnace and having its air inlet and air outlet registering with said plenum.

6. A humidifying device for adding moisture to air and for washing foreign particles from the air comprising housing means defining a fluid sump for containing a source of water, means defining an air passage within said housing means from an air inlet extending through the bottom of said sump to an air outlet and surrounded at least in part by the liquid in said sump, means defining a venturi section having a reduced area throat in said air passage, said throat being positioned above the normal liquid level in said sump, conduit means extending from a point beneath the normal liquid level in said sump to the throat of said venturi section, and means for circulating air through said air passage from said air inlet to said air outlet and for creating a reduced static pressure at said throat for drawing water from said sump into said air passage means at said throat.

7. A humidifying device as set forth in claim 6 wherein the venturi section is formed by separate convergent and divergent nozzle sections, said nozzle sections being spaced radially from each other at the throat of said venturi section to form an annular air gap, said divergent section having a portion thereof depending from said annular air gap around said convergent section into the sump to form the conduit means for delivering water to the air passage means.

8. A humidifying device as set forth in claim 7 wherein the means for circulating air comprises a fan mounted in the air passage upstream from the venturi section, said fan having a plurality of fan blades supported for rotation within said air passage and positioned adjacent said throat in the path of air flow for impingement of larger water globules on the fan blades and dispersion thereby into the air stream.

9. In combination, a humidifying device as set forth in claim 7 and a hot air furnace having a plenum, said humidifying device being supported by said furnace and having its air inlet and air outlet registering with said plenum.

10. A humidifying device as set forth in claim 7 wherein the air is discharged from the venturi section to the air outlet above the normal liquid level within the sump and in contact with the liquid therein for return of heavier water particles and foreign matter to said pump.

11. A humidifying device as set forth in claim 1 wherein the air is discharged from the venturi section to the air outlet above the normal liquid level within the sump and in contact with the liquid therein for return of heavier water particles and foreign matter to said sump.

12. A humidifying device for adding moisture to air and for washing foreign particles from the air comprising housing means defining a fluid sump for containing a source of water, means defining an air passage within said housing means from an air inlet to an air outlet, means defining a venturi section having a reduced area throat in said air passage, said throat being positioned above the normal liquid level in said sump, conduit means extending from a point beneath the normal liquid level in said sump to the throat of said venturi section, means for circulating air through said air passage from said air inlet to said air outlet and for creating a reduced static pressure at said throat for drawing water from said sump into said air passage means at said throat, means for employing the pressure differential generated by the air flow through said venturi for elevating water from said sump to a higher level, and means for receiving the elevated water at said higher level and delivering said elevated water to a drain.

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JAMES W. WESTHAVER, *Primary Examiner.*