United States Patent [19]

Nozaki

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[54] **VORTEX HUMIDIFIER FOR FORCED FLOW HOT AIR FURNACE**

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[21] Appl. No.: **393,849**

Related U.S. Application Data

[63] Continuation of Ser. No. 218,395, Jan. 17, 1972, abandoned.

[52] **U.S. Cl.**..... **126/113,** 261/79 A, 261/DIG. 15

[51] **Int. Cl.**..... **F24h 3/00**

[58] **Field of Search** ... 126/113; 261/DIG. 15, 79 A, 261/89, 95, 99, 109, 111; 55/238

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[57] **ABSTRACT**

A humidifier for a forced hot air furnace includes a vaporizer which vaporizes water into a hot air flow. The hot air and vapor mixture flows into a conical vortex chamber. There the condensed vapor is drained from the bottom of the chamber and the humidified air is discharged through a duct extending along the spin axis of the vortex chamber.

5 Claims, 8 Drawing Figures

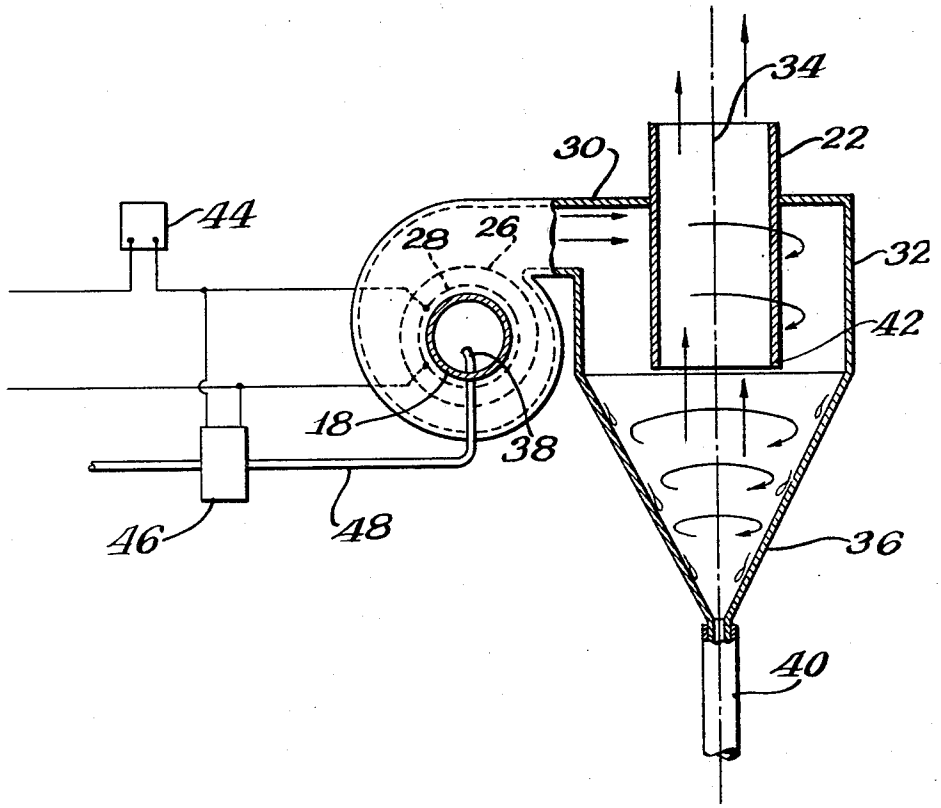


FIG. 2.

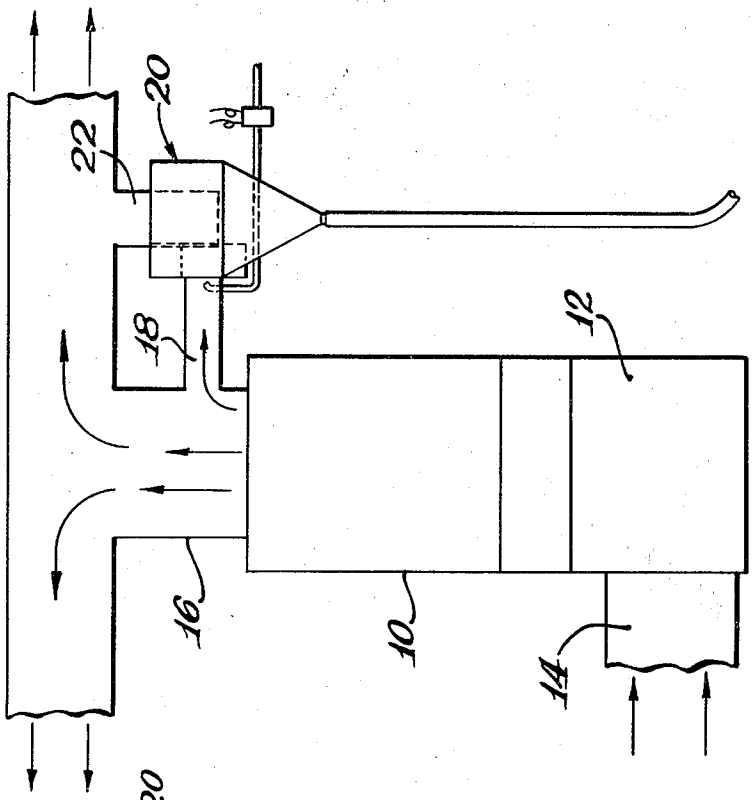


FIG. 1.

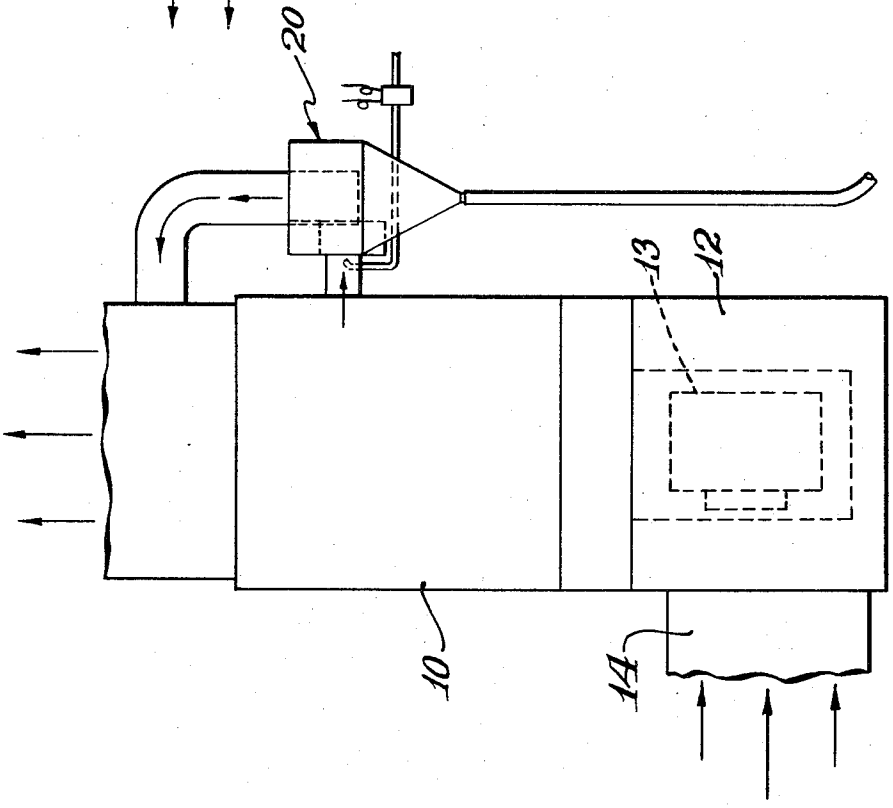


FIG. 3.

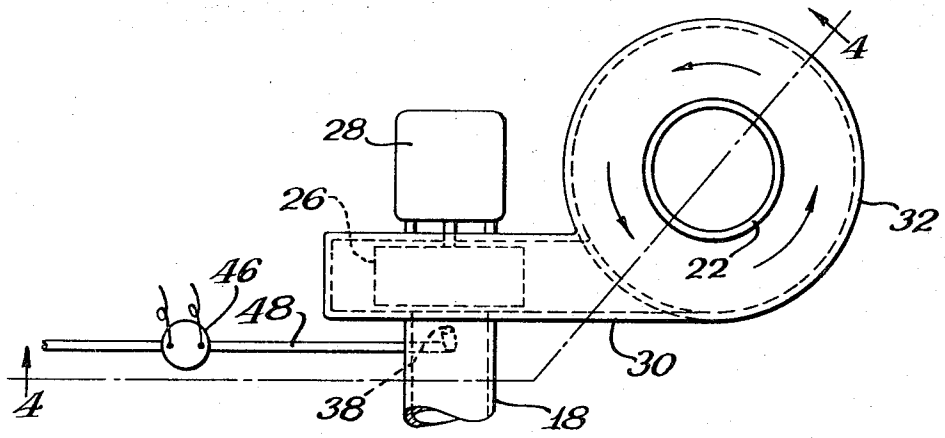


FIG. 4.

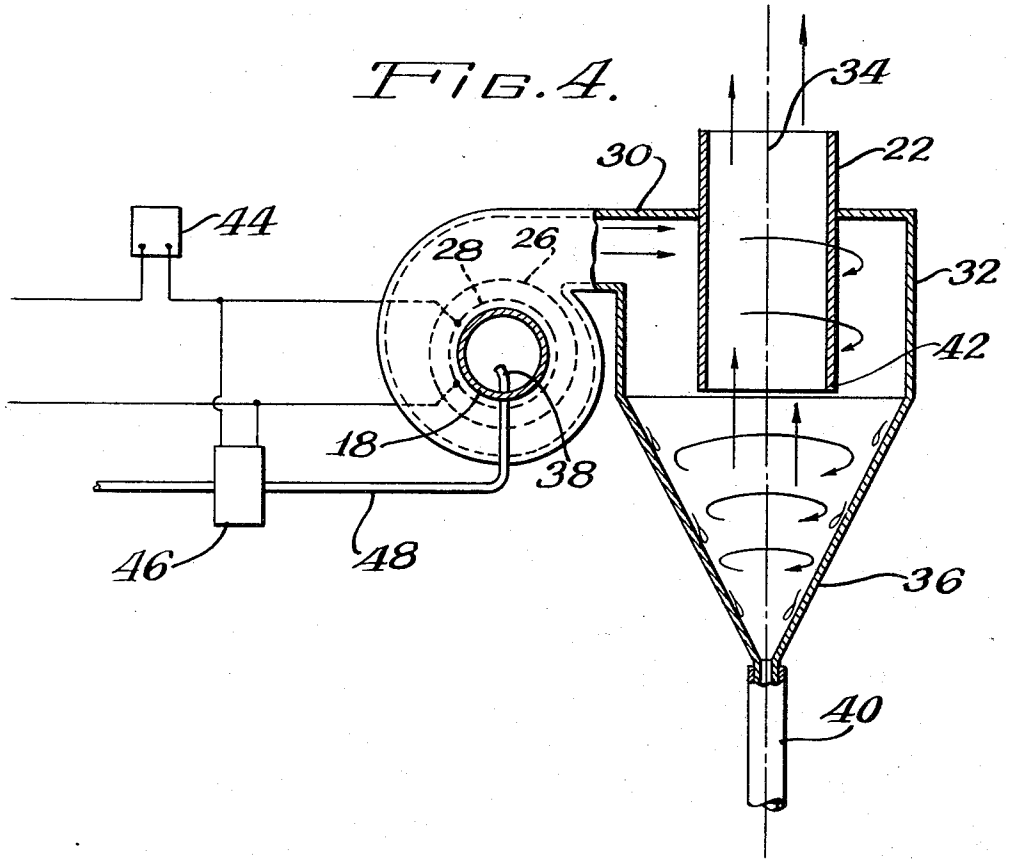


FIG. 5.

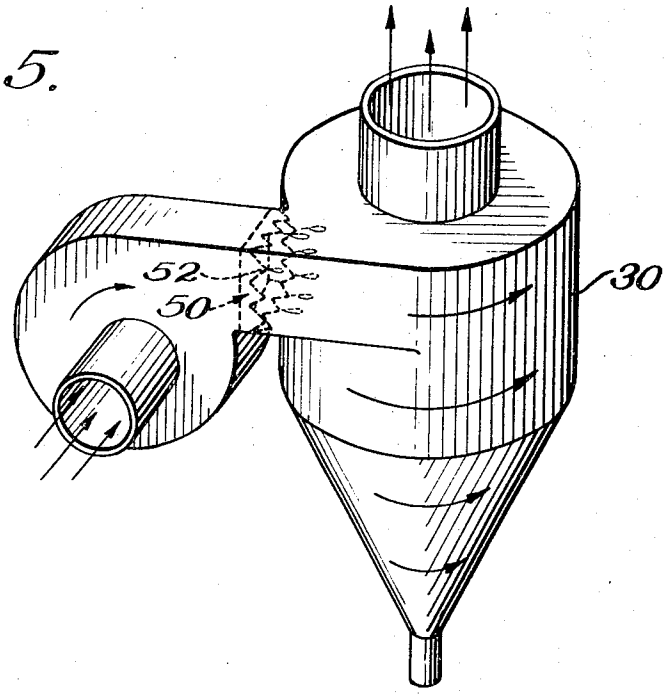


FIG. 6.

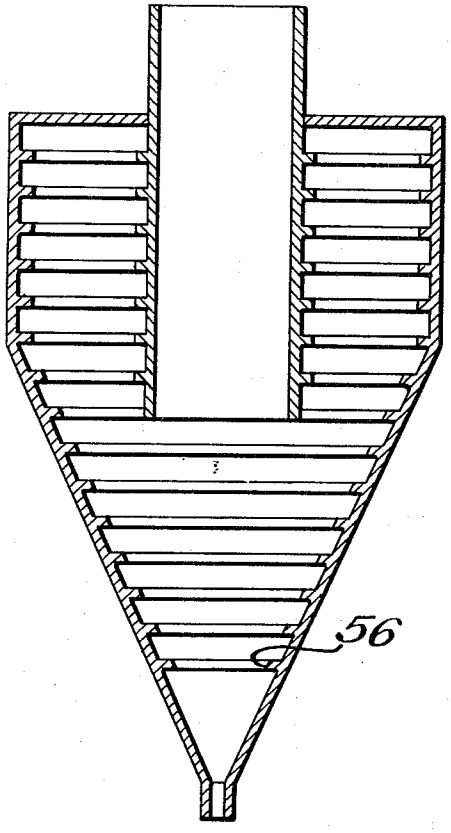


FIG. 7.

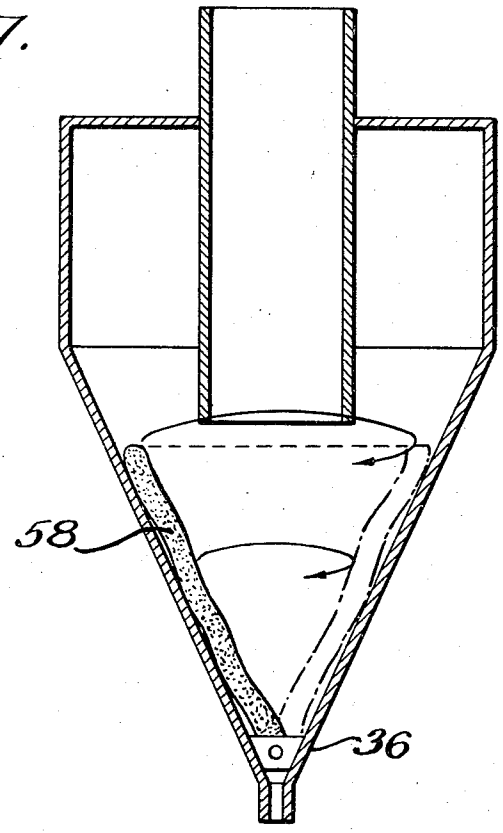
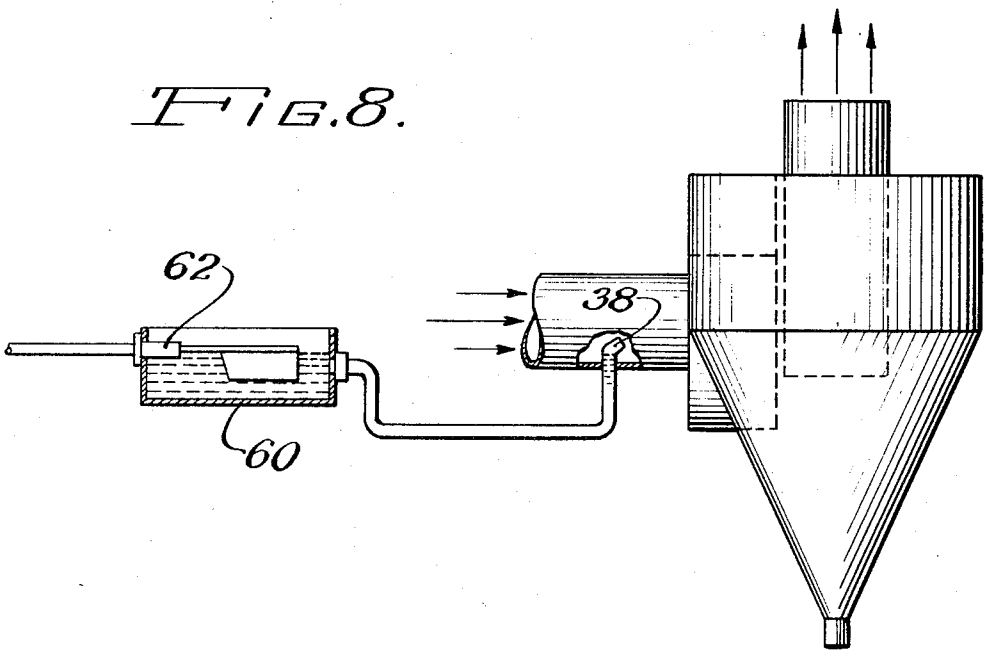


FIG. 8.



VORTEX HUMIDIFIER FOR FORCED FLOW HOT AIR FURNACE

This is a continuation of application Ser. No. 218,395 filed Jan. 17, 1972, now abandoned.

BACKGROUND OF THE INVENTION

In a principal aspect, this invention relates to a humidifier and, more particularly, to a humidifier for a forced hot air furnace.

In homes equipped with forced air furnaces, dryness of the air during the winter months may become a serious problem. Such dryness causes physical discomfort and possibly can aggravate the health of the occupants of a home. In addition, physical damage may occur to the furniture and the house itself due to the drying out of wood.

In a house equipped with an air flow furnace, the air required for combustion of the fuel must be replaced by cold air from outside the house. Of course, the cold air from outside the house, when heated, will have a very low humidity as compared with the humidity of the room temperature air inside the house. This results because the cold air is incapable of retaining a very great amount of evaporated moisture. The operation of the furnace, therefore, merely aggravates the problem of low humidity in a home.

Consequently, it is desirable, if not necessary, to constantly add some moisture into the heated home air so that the humidity will be maintained at a reasonable and comfortable level. Moisture is preferably added to a home at a rate of about 10 to 24 gallons per day depending upon the size of the house.

Many types of humidifiers are available which will add humidity to the air and thus raise the moisture content in a home. These humidifiers, in general, provide or satisfy the need for humidification. However, the mineral content in the water which is added to the air may cause very severe problems. For example, the humidifier itself may become clogged with the minerals in the water, thereby requiring repair or replacement. Atomizer type of humidifiers produce white mineral dust which settles on the interior of the house. Utilizing distilled water which has no mineral content is not economic.

The present invention seeks to overcome these and other problems of prior art humidifiers.

SUMMARY OF THE INVENTION

In a principal aspect, the present invention of a humidifier apparatus includes means for vaporizing fluid in a gas flow and then directing the fluid and gas flow mixture into a vortex chamber where the fluid evaporates into the gas. Any fluid which does not evaporate, condenses in the bottom of the vortex chamber. The humidified gas flow then passes through a discharge passage which is coincident with the rotational axis of the vortex chamber.

It is thus an object of the present invention to provide an improved humidifier apparatus having a minimum number of moving parts.

A further object of the present invention is to provide a humidifying apparatus which utilizes a vortex chamber to effect evaporation of a fluid into a moving gas flow.

Still another object of the present invention is to provide a humidifier apparatus having a reliable and long-life construction.

A further object of the present invention is to provide a humidifier apparatus which may be used to recycle fluid not originally evaporated in the gas flow by the humidifier.

One further object of the present invention is to provide a humidifier apparatus which does not become clogged with minerals and which does not spray mineral dust about a home.

These and other objects, advantages and features of the present invention will be set forth in the detailed description which follows.

BRIEF DESCRIPTION OF THE DRAWING

In the detailed description which follows, reference will be made to the drawing comprised of the following FIGURES:

FIG. **1** is a front plan view of the apparatus of the present invention as incorporated in a forced hot air furnace;

FIG. **2** is a side plan view of the apparatus of the present invention shown in FIG. **1**;

FIG. **3** is a top plan view of the improved humidifier of the present invention;

FIG. **4** is a cross-sectional side view of the humidifier of the present invention taken substantially along the line **4—4** in FIG. **3**;

FIG. **5** is a perspective view of the improved humidifier of the present invention illustrating additional optional features;

FIG. **6** is a cross-sectional view of the vortex cone assembly for the humidifier of the present invention illustrating an alternative construction;

FIG. **7** is another cross-sectional view of the vortex cone of the present invention illustrating still another embodiment; and

FIG. **8** is a diagrammatic view of an alternative water vaporization construction for the humidifier of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGS. **1** and **2** are plan views of a typical furnace installation of the type utilized in the humidifier of the present invention. Thus, a furnace **10** is mounted on a blower housing unit **12.** A blower **13** in the unit **12** circulates unheated air from a cold air duct **14** through the furnace **10** for heating. Heated or hot air is discharged through a hot air outlet duct **16** at the top of the furnace **10.** In the embodiment shown, a portion of the flowing hot air or hot gas is diverted through a humidifier duct **18** and into a humidifying apparatus **20** of the present invention.

The humidifier apparatus **20** controls the relative humidity of the hot air or gas passing therethrough. The humidified air then exits through an exhaust duct **22** into a main hot air duct **24** for mixing with dry heated air and ultimate circulation throughout the building being heated.

FIGS. **3** and **4** illustrate in greater detail the humidifier apparatus of the present invention. A humidifier blower **26** driven by a motor **28** is mounted in the duct **18.** Warm dry air entering through the humidifier duct **18** is forced by the blower **26** into a tangential duct **30** leading into a vortex chamber **32.** The chamber **32** is

substantially cylindrical in shape with a center line axis **34.** Substantially concentric with axis **34** is exhaust duct **22** which extends from within the chamber **32** and connects with the main hot air duct **24.**

The chamber **32** is conically shaped at its lower end **36.** Water vapor or fluid is introduced into the heated air by means of a vaporizer nozzle **38** in duct **18** which sprays a mist of water into the air drawn through the duct **18.** If this water properly evaporates, it will ultimately pass out the exhaust duct **22** into the main hot air duct **24.** That portion of the water which does not evaporate and become appropriately entrained or evaporated in the hot air falls to the sides of the conically shaped lower chamber end **36** to be collected in a drain pipe **40.** The drained water may be recirculated through the nozzle **38** or just drained.

Preferably, the entire structure is built from a non-corrosive material such as a non-corrosive metal or a plastic. Importantly, the duct **39** is tangential to the cylindrical chamber **32.** Additionally, the exhaust duct **22** preferably extends to a position or level below the gas inlet level of duct **30.** Thus, the humidified hot air must pass downward about a lower edge or lip **42** of duct **22** before it can enter the main air flow in duct **24.** The rapidly circulating gases within the chamber **32** including its lower end **36** will expose a maximum amount of hot air to any fluid which does not become evaporated, thereby quickly raising the relative humidity of the hot air to the maximum level permissible. The humidification of the hot air or gas is thus accentuated by the vortex whirling action within the chamber **32.**

Control of the relative humidity in the building area is effected through a humidistat **44** connected in series with the control circuit for the water vapor solenoid valve **46** and the blower motor **28.** Thus, closing the control circuit in the humidistat **44** will cause the blower motor **28** to begin operation. Additionally, the solenoid valve **46** will be actuated so that water may be fed through a water conduit **48** for discharge by the nozzle **38** into the warm or hot air stream in duct **18.**

FIG. **5** illustrates a perspective cut-away view of the improved humidifier of the present invention with the components of the humidifier labeled as in the previous FIGURES. Also illustrated in the embodiment shown in FIG. **5** is a serrated ring **50** positioned in the duct **30.** Teeth or serrations **52** on the ring **50** extend in the direction of air and fluid travel into the chamber **30.** Moisture will collect on the points of the serrations **52** and will thusly become more easily entrained and evaporated in the moving hot air in duct **30.** This configuration accentuates the addition of evaporated fluid to the warm or hot air flow.

FIGS. **6** and **7** illustrate additional configurations for the interior of chamber **30.** In FIG. **6,** the interior of the chamber **30** includes a series of spaced webs **56.** The webs **56** are parallel to each other and arranged in planes substantially parallel to the circular gas flow within the chamber **30.** The webs **56** function to provide a greater surface area within the chamber **30** and thus expose a greater amount of humidity or moisture to the flowing gases through the chamber **30.** In this manner, the hot air is more completely and easily saturated to its dew point. Thus, the velocity of the gases through the humidifier may be increased with the assurance that the air passing through the humidifier will be saturated.

Humidifying capacity may be also increased by otherwise altering the interior surface of the chamber **30.** That is, the interior surface of chamber **32** can be finished quite roughly by sand blasting or the like to sustain separated droplets of moisture for additional evaporation. Insulation of the entire apparatus will also increase the evaporation capacity of the humidifier.

FIG. **7** illustrates another variation in the construction of chamber **30.** A flexible plastic wick **58** is fastened to the interior of the lower end **36.** The wick **58** is preferably fashioned from a sponge-like material. The wick will be caused to rotate about the lower end **36** by vortex gas flow thereby depositing moisture on the walls of the lower end **36.** Thus, any fluid which does condense or does not properly evaporate will be uniformly and evenly deposited or spread for exposure to the whirling gases within the chamber **30.** Again, this construction accentuates evaporation of fluid into the moving flow of gas.

In operation, the rapid evaporation of water into the heated air tends to cool the heated air. For this reason, the humidified air will be at a lower temperature when it is discharged through the exhaust duct **22** into main duct **24.** However, upon mixing with the main stream of heated air the humidified air will tend to increase in temperature. Moreover, the volume of air is increased to thereby effectively decrease relative humidity of the entire volume. Thus, the hot air in duct **22** retains all of the humidity which has been added to it through the flow from duct **22.**

One of the benefits provided by the apparatus is removal of mineral content from vaporized water. By utilizing the apparatus of the present invention, minerals do not become entrained in the vaporized water and air mixture, rather they remain with the condensed water which collects in the drain. For this reason, dust problems posed by prior art humidifiers are eliminated. In addition, although the interior of the humidifier may collect some scale, it can be easily cleaned. In many instances, the scale will be removed through the drain.

Only two moving parts are required for the apparatus of the present invention; namely, the blower and the solenoid valve. The blower actually is the only moving part which operates in the flowing gas and fluid environment required for humidification.

It should be noted that this humidifier can be operated in combination with a conventional mist type humidifier in place of the vaporizer. Condensed water particles and minerals will be trapped by the vortex action of the chamber **32** and drained from the gas flow. Only the humidified air is then circulated.

The blower **26** described above is a typical squirrel cage blower wherein the vaporized fluid is combined with the hot air flow through the inlet and driven into the chamber **32.** To provide for a better water particle size distribution and to improve mixing of the vaporized particles with the hot air, a plastic or stainless steel screen may be inserted within the wheel of the blower **26.** Alternatively, a screen type blower wheel can economically replace the conventional wheel of blower **26** to facilitate intermixing of the fluid and gas.

In the embodiment depicted, the blower motor **28** is simply an on-off type of motor which is made to operate whenever the humidistat closes the control circuit and the furnace blower is also on. However, it is possible to control the humidification rate by providing a shaded pole motor or a permanent split capacity motor

to drive the blower at various desired speeds according to the demands of humidification in the house.

Referring to FIG. **8,** an advantageous water supply to use with a proportional spread motor arrangement would utilize a water reservoir **60** with a float valve **62** associated therewith. The water would then be supplied as demanded through the nozzle **38.** The amount of water thus used would be a function of the negative pressure of the blower inlet which, in turn, is controlled by the blower speed that is modulated in accordance with demand.

What is claimed is:

1. Humidifier apparatus for evaporating water in a heated air flow comprising, in combination:

a water supply conduit;

a flow passage for heated air;

fan means in said passage for moving hot air therethrough;

water vaporization means in said passage connected with said conduit for vaporizing water in the flow of hot air;

a vortex chamber connected with said passage down stream from the water vaporization means, said chamber including a frusto conical portion with a wide upper end, a narrow lower end and an axis of revolution, said passage being tangentially connected with said chamber adjacent the upper end to induce a circular flow of hot air and water vapor in said chamber, said chamber also including an outlet tube extending axially from the interior of said chamber to provide a humidified hot air outlet;

a drain at the lower end for collecting unevaporated water; and

means on the interior surface in said frusto conical portion for effectively increasing the surface area of said interior surface to move effectively promote evaporation of water.

2. The apparatus of claim **1** wherein said inlet passage includes means for increasing vaporization of fluid into said gas flow.

3. The apparatus of claim **1** wherein said means on the interior surface comprise a wiper means for spreading water over said surface.

4. The apparatus of claim **1** wherein said means on the interior surface comprise integral surface irregularities to effectively increase the total interior surface of said chamber.

5. Humidifier apparatus for evaporating water in a heated air flow comprising, in combination:

a water supply conduit;

a flow passage for heated air;

fan means in said passage for moving hot air therethrough;

water vaporization means in said passage connected with said conduit for vaporizing water in the flow of hot air;

a vortex chamber connected with said passage downstream from the water vaporization means, said chamber including a frustoconical portion with a wide upper end, a narrow lower end and an axis of revolution, said passage being tangentially connected with said chamber adjacent the upper end to induce a circular flow of hot air and water vapor in said chamber, said chamber also including an outlet tube extending axially from the interior of said chamber to provide a humidified hot air outlet;

a drain at the lower end for collecting unevaporated water; and

wiper means on the interior surface in said frusto conical portion for effectively increasing the surface area of said interior surface by spreading water over said surface to more effectively promote evaporation of water.

* * * * *