This invention relates to improvements in forced air washing and humidifying attachments for hot air heating systems and more particularly to devices of that character built as a unit and adapted to be interposed in the cold air or return air connection of a heating system for humidifying and washing the air admitted to the heating drum of the furnace.

Explanatory to the invention, it will be here stated that means heretofore used for adding moisture to the air used for heating homes, depend on the evaporation of water from a pan or other source. This method, as a general rule, is insufficient unless the evaporators used are formed of some special evaporating surface or material, in which case it would be too expensive for practical use. Moreover, the methods, as heretofore used, do not lend themselves to satisfactory mechanical regulation by thermostats or humidity control devices, nor do they as ordinarily built, provide an efficient means for washing and cleaning the air.

In view of the above, it is the principal object of this invention to provide air washing and humidifying means whereby the inefficiencies and the high cost of operating and installing are avoided, and to produce a construction capable of being operated by thermostatic or other automatic control means to render the spray produced operative or inoperative as is desired.

Another object of the invention is to provide an efficient air washing and humidifying means employing a fan for effecting a forced circulation of the air through the furnace.

Other objects of the invention reside in the various details of construction and combination of parts and in their mode of operation as is hereinafter described.

In accomplishing these objects, we have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawings, wherein—

Figure 1 is a perspective view of a hot air furnace equipped with an air washing and humidifying device embodied by the present invention.

Figure 2 is a vertical section of the device taken in its central longitudinal plane.

Figure 3 is a horizontal section taken on the line 3—3 in Figure 2.

Figure 4 is a detail view of an alternative water distributing means.

Figure 5 is a detail view showing the trough provided with weirs for supplying water to the eliminator plates.

Referring more in detail to the drawings—

1 designates, in its entirety, what may be a hot air furnace of that type generally employed for residence heating and 2 designates a shaft or pipe through which cold air is supplied to the furnace and which connects to the housing 3 of the latter through an opening 4 at its base.

Interposed in the cold air connection between the opening 4 and lower end of pipe 2 is a box like housing 5, preferably of sheet metal, open at the end adjacent the furnace and connected to a laterally extending collar 6 about the opening 4 by means of a flexible sleeve 7 which is used to compensate for any misalignment of the openings.

The housing 5 is divided by a transverse partition wall 8 to provide inner and outer compartments 9 and 10 and the latter is open at the top and is connected with the cold air pipe 2. Centrally of the partition wall 8 is a circular opening 12 and disposed therein is a fan blower 13 fixed at the inner end of a supporting and driving shaft 14 revolvably contained in an elongated bearing 15 that is fixed within an opening in the outer end wall of the housing 5. This shaft is provided at its outer end with belt wheels 16 over which a belt may operate to drive the fan. As illustrated in Figure 1, an electric motor 17 is used to drive the fan and a belt 18 operates over the motor belt wheel 19 and one of the belt wheels 16; a plurality of wheels 16 of various diameters being provided in order to allow the fan to be operated as necessary to increase or decrease the air delivery or to maintain a constant air quantity on different piping systems whose resistance might vary.
Operation of the blower fan by the motor causes fresh outside air or recirculated air to be drawn down through the pipe 2 and this is positively moved, as indicated by the direction of the arrows in Figures 2 and 3, through the housing 5 into the hot air chamber of the furnace where it is heated and is forced thence into the warm air supply ducts 20 leading to various parts of the building served by the furnace.

In this apparatus, the operation of the fan by the driving motor is preferably controlled by an automatic heat controlling means, such as the thermostat 21, to start and stop the motor as the temperature of the air varies in the furnace and this is desirable for two reasons; first, to control the temperature of the rooms supplied with the heated air; second, to operate the fan that excessive humidity due to high temperatures is prevented. In a preferred arrangement, the thermostat controlling the operation of the fan has its sensitive element in the path of the air between the furnace and furnace casing or jacket and the thermostat is so set as to operate to control the supply of electric current to the motor when the temperature of the air of the fan varies from the temperature for which the thermostat is set. In Figure 1, the motor is shown to be connected to an electric circuit by means of wires 22—22; the wire 22 being connected through the thermostat 21.

For the purpose of adding moisture to air entering the furnace, we have mounted a distributing device, preferably a screen, as at 24, across the air entering side of the opening 12 in which the fan is disposed onto which a certain predetermined amount of water is fed from openings 25 in a pipe header 26 that is mounted horizontally in the housing across the top edge of the screen; water being supplied to the header by suitable pipe connections, as at 27, with a supply pipe 28, which may be the city or home cold water service, and its rate of flow is controlled by the adjustment of a needle valve mechanism, designated in its entirety by reference numeral 29, operable under the control of the thermostat 21, or other means not herein illustrated in detail. The water fed to the screen spreads over its surface in a thin film which is broken by the air current, thus adding finely divided particles of moisture to the air.

When the air current carrying these finely divided particles of moisture passes through the fan, the particles are intimately mixed with the air due to impact with the rapidly revolving fan wheel blades.

While it is preferred to have the water distributing means 24 at the air incoming side of the fan, it is readily apparent and in some cases may be desirable to have it located at the opposite side, as indicated at 24a in Figure 2, or it may be desirable to have screens or other water distributing means at both sides of the fan.

In the alternative means, 24a, the humidifying effect is due solely to the passage of air current over or through a thin film of water spread over the screen. This arrangement becomes a preferred form when it is desired to limit the amount of moisture to be added to the air, which condition is desirable in some classes of installations; this resulting from the shortened distance of travel and time of contact between the water distributing means and the water eliminating means located at the outlet of the housing, as will presently be described.

An alternative arrangement of water distributing means that is applicable particularly in cases where the fan wheel has a high peripheral speed, consists of a grooved wheel 35 that is mounted on the fan shaft adjacent the fan and onto which water is fed from a pipe 36 connected with a source of water supply; such a construction being illustrated in Figure 4. In this arrangement the water is thrown outwardly by centrifugal force in a finely divided state and in a plane approximately perpendicular to the shaft and is picked up by the air current in passing through the fan and is further atomized by its impingement against the revolving fan blades.

When extreme conditions are encountered and a maximum cooling is desired, as is the case in summer time, the amount of finely divided water may be increased by the use of a water distributing means in the form of an atomizing spray device, or spray head, 40, that may be used in addition to the screen surfaces or independently thereof and which, preferably, is located within the casing and in the path of the air current. The spray head 40 is supplied with water from the header or pipe 28 and is controlled by automatic mechanism designated at 42.

The cooling of air is effected by the evaporation of water supplied in a finely divided state by the spray 40. During evaporation, latent heat is extracted from the air passing through the spray, thus cooling the air. The same evaporation adds moisture to the air in the form of water vapor, thus increasing its absolute humidity.

In a preferred arrangement, the spray device is located in the chamber on the air leaving side of the fan wheel and is so set as to direct the spray of water against the fan wheel blades. However, we do not wish to be limited to the direction of the water spray against the fan blades as humidification and cooling can be accomplished by spray means not so directed. The purpose of directing the water spray upon the fan blades, or the coincidental passage of air and water through the fan, is to utilize the centrifugal effect
upon the water particles when in contact with the rapidly revolving fan wheel blades. The particles of water are broken up into a fine, mist-like state and are intimately mixed with the air passing through the fan. In addition, the volume of water otherwise required to give the finely divided spray and the pressure of water on the spray device to produce this effect are greatly decreased, resulting in a saving of water and eliminating the requirement of a high pressure head on the spray device.

For the purpose of removing free moisture from the air and for the purpose of washing the air to cleanse it of all dust particles, we have placed a series of eliminators 50 at the outlet side of the housing 5 against which the air impinges as it is driven from the fan. The eliminators consist, preferably, of a plurality of plates of steel of zig-zag form that are fixed vertically in closely spaced relation across the outlet so that the air stream in passing through the outlet is divided into stratas and is forced to follow a tortuous course in passing through the eliminators. The moisture laden air is forced into contact with the surfaces of the zig-zag plates, giving up its free or entrained moisture to the surfaces of impact; the moisture not so given up remaining in the air in the form of water vapor which will not deposit on walls, windows or furnishings unless brought to the dew point temperature by excessive cooling.

Preferably, the zig-zag eliminator plates have lips 51 or gutters facing the air incoming side at each of the vertical bends to aid in removing the entrainment and providing drain channels for its passage to the tank or sump 53 under the eliminators in the base of the housing.

It is well known that in an air conditioning apparatus consisting of a finely divided spray in a casing, and eliminators or washing plates, that the washing or cleaning effect is produced by impact of the air containing the dust and dirt particles on the wet surfaces of the eliminators. Also the cleaning effect is proportional to the amount of wet washing surface in the form of zig-zag plates immersed in the air current. In our invention, a separate means of keeping these plates wet is provided by the placing of a trough 56 above the plates, one side of which parallel to the front of the eliminator, is notched to provide weirs 57 over which the water in the trough may flow to constantly wet the plates independent of the spray formed as previously described. The weir trough is assembled so that one end may be raised or lowered to ensure a level water surface and a constant and equal water flow from each weir. The number and spacing of these weirs is such that each plate may be positively wet.

The amount and flow of water from the weir trough may be controlled by a needle valve or similar device 59 in the water service line 60 to the trough. This flow regulating device to be controlled if desired by a thermostat or automatic humidity control means 61 independent of, or jointly with, a thermostat or automatic humidity control device controlling the water supply to the fan spray device previously described.

Having thus described our invention what we claim as new therein and desire to secure by Letters Patent, is:

In a humidifying unit comprising a housing through which air is circulated, a fan operable in the housing for forcing a circulation of air, a screen interposed in the housing forwardly of the fan through which the air must pass to the fan, means for feeding water over the surface of the screen for delivery to and atomization by the fan, an air washing device at the discharge end of the housing comprising a plurality of eliminator plates of zig-zag arrangement and a trough disposed above the plates with means therein from which water may be fed onto the surface of the plates.

Signed at Seattle, Washington, this 18th day of April, 1927.

WILLIAM LYLE DUDLEY.

EDGAR O. KAUP.