United States Patent

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[54] **CONTROLLED FORCED DRAFT ACTION TO THE FLUE OF A GAS FIRED HEAT EXCHANGER**

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[52] **U.S. Cl.** ..... **165/64,** 126/110 R

[51] **Int. Cl.** **F25g 29/00**

[58] **Field of Search**...165/26, 64; 120/110 R; 431/20

[56] **References Cited**

UNITED STATES PATENTS

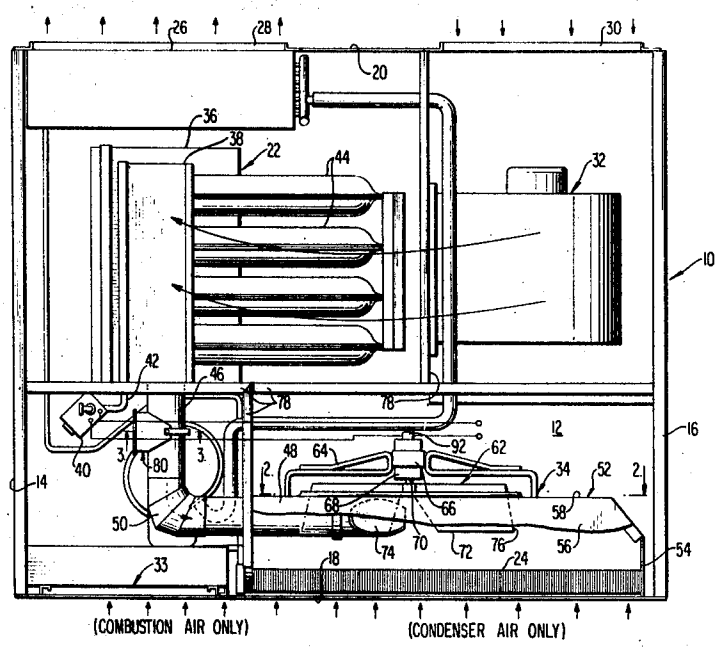
3,277,947	10/1966	Gacioch	126/110 R
3,071,181	1/1963	Wright	126/110 R
2,538,222	1/1951	Wilson	431/20

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[57] **ABSTRACT**

The flue pipe leading from the combustion chamber of a gas fired heat exchanger has its discharge opening aligned with and conforming to the periphery the condenser fan for forcibly discharging the combustion products and maintaining proper draft. A damper valve within the flue pipe, intermediate of the gas fired heat exchanger and the condenser fan insures proper maintenance of the vacuum pressure within the combustion chamber regardless of wind conditions acting on the combined heating and cooling unit.

7 Claims, 3 Drawing Figures



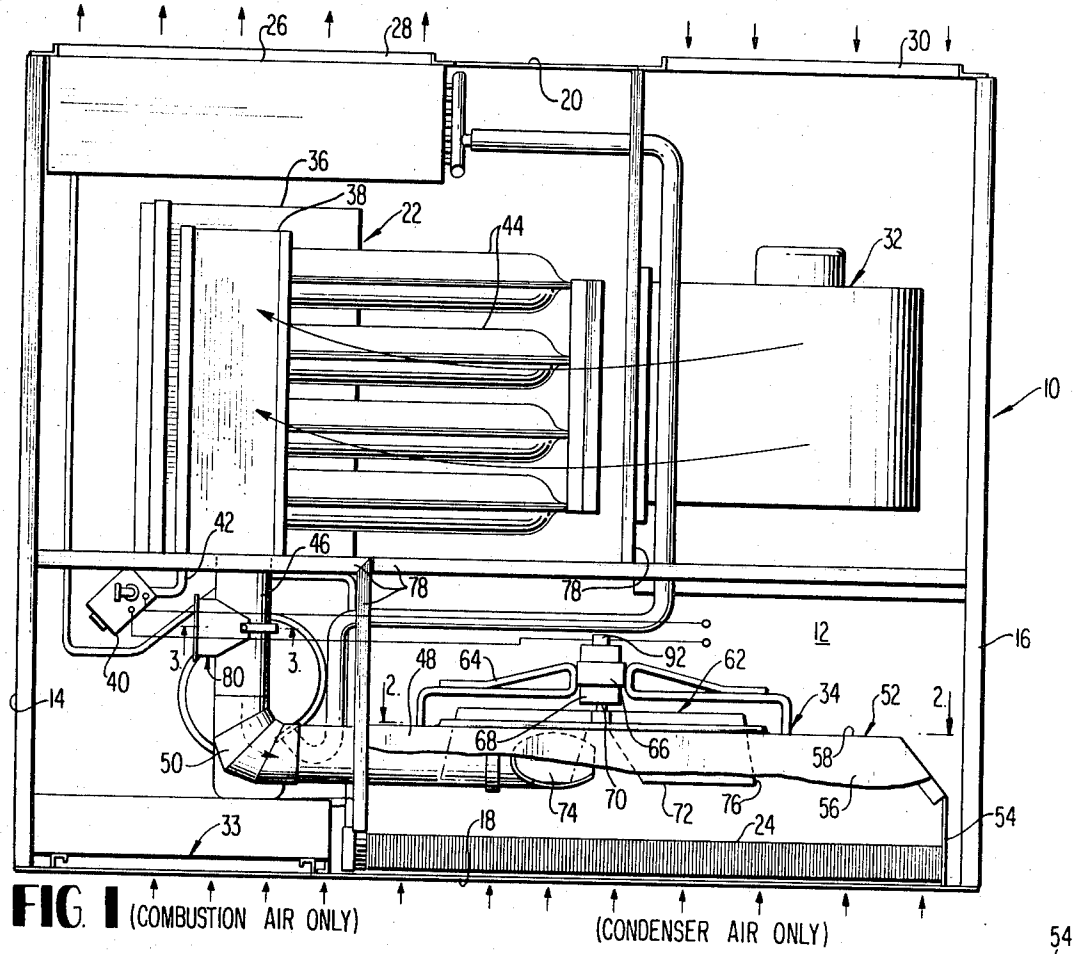


FIG. 1

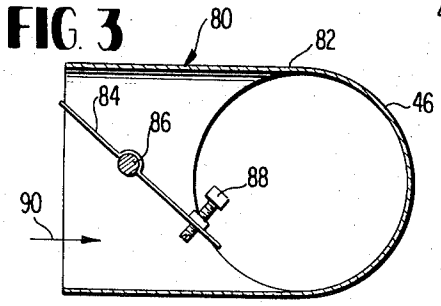


FIG. 3

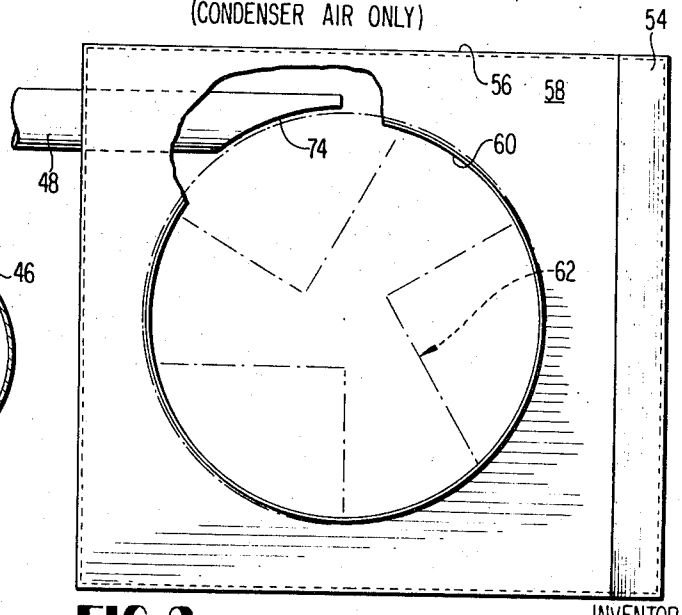


FIG. 2

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CONTROLLED FORCED DRAFT ACTION TO THE FLUE OF A GAS FIRED HEAT EXCHANGER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a combined gas fired heat exchanger and refrigeration air-conditioning unit in which the condenser fan provides forced draft action to the flue, and more particularly to such an arrangement in which the vacuum pressure within the combustion chamber is maintained constant regardless of fluctuation in atmospheric conditions surrounding the unit.

2. Description of the Prior Art

Depending upon the environmental use of relatively large, combined gas fired heat exchangers and air-conditioner units, the efficiency of the gas or other fuel furnace is dependent upon the maintenance of a proper draft within the flue leading from the furnace combustion chamber to the exterior environment. This is especially true where the gas fired heat exchanger and air-conditioner unit is mounted on the roof of the building being serviced or in like position, where the unit is subject to varying wind conditions which materially affect combustion operation. Obviously, the coupling of the furnace to a suitable chimney such as an elongated cylindrical duct to provide a natural flue effect is a universal method of creating sufficient draft to remove the combustion products and maintain a slight vacuum pressure within the furnace combustion chamber. However, such conventional chimneys are highly dependent on the natural environmental conditions and the vacuum within the combustion chamber varies depending upon wind velocity exterior of the unit and its effect on the chimney.

To insure maintenance of a vacuum and a proper draft within the flue, the duct or chimney discharging the product of combustion exteriorly of the unit may have incorporated therein, an auxiliary blower or fan. While this tends to insure some draft depending upon blower speed, the electric motors for such fans and blowers are generally of the small fractional horsepower type on the order of 1/25 of a horsepower to as low as 1/40 horsepower. These motors tend to burn out, require constant maintenance and are readily affected by the heat of the flue product stream. Further, the blower or fan blades which directly contact the products of combustion are adversely affected to the extent that they must be continuously replaced.

In a further attempt to overcome this problem, the flue duct carrying the products of combustion has been allowed to terminate within the chamber carrying the condenser with a suitable condenser fan forcibly discharging the combustion products exteriorly of the unit. This necessarily requires the condenser fan to operate not only during summer cooling, but also during winter heating and while, such condenser fans involve electric motors much greater in size than the auxiliary electric motors previously employed in the flue to effect a forced draft action, the mere discharge of the products to combustion into the chamber behind the condenser fan fails to insure either the creation of an efficient forced draft action to the flue, nor the maintenance of the same regardless of wind conditions.

SUMMARY OF THE INVENTION

The present invention is therefore directed to an improved combined heating and cooling unit of this type in which the flue pipe leading from the gas fired heat exchanger terminates in a configured concave opening adjacent to and spaced slightly from the peripheral path of the condenser fan blades to greatly increase the effectiveness of the condenser fan in creating the desired required forced draft action to the flue. With the opening in the duct conforming to the blade configuration, the blade actually scoops the combustion gasses out of the duct and readily discharges them externally of the unit. A barometric draft control such as those manufactured by Field Control Division of Conco Engineering Company constituting a pivotable disc-like damper carrying an adjustable weight is operatively carried by the flue pipe intermediate of the discharge opening and the gas fired heat exchanger. This allows a constant vacuum pressure to be maintained in the heat exchanger combustion chamber even where, due to wind conditions or an increase in the velocity of the fan, there is an increase in vacuum pressure pulled by the fan at the discharge end of the flue pipe. The damper valve which is always partially open, opens further, allowing atmospheric pressure to modify the vacuum being pulled by the fan to maintain the vacuum pressure constant within the combustion chamber. The fan constitutes an annodized aluminum or 409 stainless steel blade to resist deterioration by the products of combustion. A centrifugal switch within the condenser fan motor is series coupled to a solenoid operated gas value to prevent firing of the furnace prior to the flow of combustion air through the heat exchanger.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a top plan view of the combined gas fired heat exchanger and air-conditioning unit incorporating the improved controlled forced draft flue of the present invention.

FIG. 2 is an elevational view of the condenser fan and the venturi panel assembly of the unit of FIG. 1, taken about lines 2—2.

FIG. 3 is a sectional view of the damper valve incorporated in the flue pipe illustrated in FIG. 1 taken about lines 3—3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, the gas fired heat exchanger and air-conditioning unit **10** of the present invention is illustrated generally in the form of a sheet metal rectangular casing which carries the forced air, gas fired furnace, the refrigeration cooling unit, the necessary ducts and compartments for the controlled passage of the gasses through the unit and the control elements employable in conjunction therewith. The casing or housing, in this case, has the top wall removed but incorporates an imperforate bottom wall **12** imperforate side walls **14** and **16**, a front panel or wall **18** and a rear wall **20**. Appropriate openings are provided within the front, rear and top walls for receiving and discharging the air for combustion within the gas fired heat exchanger assembly **22**, the air for cooling con-

denser 24 as well as, the air to be conditioned which passes over the evaporator 26 adjacent the rear wall after initially entering through opening 30. This conditioned air exits through opening 28 also within rear wall 20 with the air being forcibly moved by a blower assembly 32. During the winter of course, the same air passes over heat exchanger assembly 22 of the gas fired furnace and moves through generally the same path for discharge through opening 28. Of course, suitable supply and return ducts (not shown) are coupled to the inlet opening 30 for the air to be conditioned and the discharge opening 28 for the conditioned air. With respect to the air entering the furnace for mixing with the fuel and for discharge in the form of combustion gasses, the inlet for the same is shown at 33 and the outlet (not shown) lies in the top wall overlying chamber 12. The openings for combustion air and condenser air may be horizontally aligned or may be above or below as desired. It is preferable, however, that the combustion air and condenser air enter the unit on the same side so as to cancel out the effects, as much as possible, of wind velocity acting on the unit especially if the unit is employable in a rooftop installation.

While partitions (not shown) divide the air passage for the conditioned air from that of the combustion air, and also the air forced over and through the condenser 24 by means of the condenser fan assembly indicated generally at 34, the present invention is not at all concerned with the components previously described and such arrangements are conventional. For purposes of understanding the present invention however, it is to be noted that the combustion air enters as indicated (by the arrows to the left) through the front wall 18 and passes to the rectangular fire box 36 which underlies a rectangular flue box 38 positioned immediately above the same. A solenoid operated gas valve 40, controls the delivery of either liquid or gas fuel through delivery pipe 42 to the fire box 36 whereby, the fuel and air mixture is ignited by conventional means all within a confined compartment defined by the fire box 36. The products of combustion pass through heat exchange chambers 44 which readily transfer the thermal energy to the conditioned air moving in a semi-circular path from inlet opening 30 to outlet opening 28 within this end of the unit 10. The products of combustion are of course combined within the individual heat exchange chambers 44 and are collected within the overlying flue collecter box 38. Coupled to one end of the flue box 38, is a damper pipe 46, which, in turn is coupled directly to a flue pipe 48 by elbow 50. The pipes 46, 48 and 50 may be of any size, but in the illustrated embodiment constitute 4 inch metal pipe.

The flue pipe terminates in the proximity of the condenser fan assembly 34 in a manner insuring maximum efficiency in using the condenser fan as a means for proper maintaining of the draft action within the flue and discharging the products of combustion externally of the unit 10. In this respect, the condenser fan assembly comprises a venturi panel assembly or shroud 52 formed of sheet metal and consisting of a side wall 54, an upper wall 56, and a rear wall 58. Wall 58 carries a large circular opening 60 of a diameter slightly in excess of that of the fan blade assembly 62. The condenser fan assembly 34 further includes a series of bent rod supports 64 which are affixed at one end to the rear wall 58 of the venturi panel assembly and at the other end to collar 66 which supports in concentric fashion the blower fan motor 68. The motor shaft 70 has fixed thereto at its outer end, the fan blade assembly 62 comprising a plurality of specially configured fan blades 72 which are preferably formed of annodized aluminum or 409 stainless steel. Blades 72, while being light in weight are extremely resistant to the flue gasses eminating from the discharge opening 74 of the flue pipe 48. In this respect, it is noted that the flue passage defined by flue box 38, the damper pipe 46, the connecting elbow 50 and the flue pipe 48, terminates at the top and to one side of the large opening 60 within the venturi panel assembly 50. The curved opening 74 conforms to periphery of the rotating fan blade assembly 62 such that the tips 76 of the blade tend to scoop the products of combustion from opening 74 mixing them with air pulled through condenser 24 for discharge through the venturi assembly 52. This action operates in a similar manner to the operation of the vanes in a centrifugal pump which pass the intake ports. While the means of supporting the components within the unit 10 are not illustrated, they may include but are not limited to the frame members 78.

A second important aspect of the present invention resides in the damper valve 80 which is incorporated within the damper pipe 46 and thus the flue passage. The damper valve 80 constitutes the commercially available "Fields" barometric draft control which involves a cylindrical housing 82 intersecting the damper pipe 46 at right angles. Housing 82 carries a disc-like damper valve 84 mounted for pivotable movement about a horizontal axis by pivot means 86. An adjustable weight 88 in the form of a threaded screw or the like is coupled to the damper valve disc 84 below the pivot axis in such a manner that the weight tends to move the valve to closed condition while, the application of suction pressure as evidenced by arrow 90, due to the operation of the condenser fan 34, causes the valve to open against the action of weight 88. This allows atmospheric pressure to influence the vacuum pressure within the flue pipe as created by operation of the fan 34, and maintains a constant light vacuum in the furnace.

During the winter months, operation of the furnace is dependent upon rotation of the condenser fan 34. As seen in FIG. 1 a series circuit is completed between centrifugal switch 92 at the end of motor shaft 70 and solenoid fuel control valve 40, preventing the flow of fuel to the furnace in the absence of condenser cooling air.

In the illustrated embodiment, which comprises a 160,000 BTU heat exchanger, the improved flue system was constructed employing a 4 inch flue pipe running from the flue collecter box 38 of the heat exchanger to the condenser fan 34. Positioning of the flue opening over the top of the fan blades reduces the possibility of condensation and freezing of moisture from the combustion products, resulting in a build-up of ice which the fan blade might hit. In the absence of the damper valve, operation of the condenser fan 34 has a varying effect with respect to the negative static pressure created in the flue pipe dependent upon the wind velocity and its direction with respect to the inlet and outlet openings within the front wall 18 of the unit.

The employment of the damper valve serves a twofold purpose. The damper valve insures maintenance of a constant static in the flue pipe under varying wind conditions and further, since the weight **88** is adjustable on the valve, the static may be adjusted to a desirable level for a given fan velocity.

From the above description it is obvious that for the heating cycle the only part of the air-conditioning apparatus which operates is the condenser blower **34**. It is further important to note of course as is conventional in such units that the air entering the furnace and serving to support combustion during the operation of the furnace and the discharge in the form of flue gas, is carried in confined ducts which are sealed from the air to be conditioned entering inlet **30** for discharge through outlet **28** after being heated by contact with the heat transfer chambers **44**. Further, during condenser fan operation air other than the flue gas exiting from flue pipe opening **74** will be drawn through the condenser, this air being the same air that normally cools the condenser during summer cooling operation of the unit. The operation of the condenser fan during the summer months along with the other components of the refrigeration system of course, is completely separate from the operation during the winter as is described in detail above.

The present invention therefore eliminates the use of auxiliary blower or fan motor to effect forced draft action for the flue of the heat exchanger, greatly reducing maintenance and service problems. Efficient and positive operation of the blower fan to achieve the forced draft action results from the position of the flue pipe with respect to the fan blades, the curved opening in the pipe which conforms to the peripheral edge of the rotating fan blades. The employment of annodized aluminum fan blades allows such operation without deleterious effects to the blades. As mentioned previously the barometric damper automatically maintains the desired negative static pressure within the heat exchanger and allows the value of the same to be readily changed and set. In addition, the employment of the centrifugal switch for controlling the solenoid gas valve to insure operation of the condenser fan prior to combustion further enhances the utilization of the present system in a combined gas fired heat exchanger and air-conditioning unit.

While the invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. In a combination heating and cooling unit comprising a housing, a cooling unit within said housing including a condenser and an assembly including a condenser fan and shroud means encompassing said fan, and a fuel burning forced air furnace including a furnace heat exchanger assembly, the improvement comprising: a flue pipe leading from said furnace heat exchanger assembly for discharging products of combustion, said flue pipe having the discharge end extending into said shroud means with the discharge opening of said pipe conforming to the peripheral path of the condenser fan blades and closely overlying the same, whereby the products of combustion are induced to flow from said discharge opening to achieve a proper draft within the flue pipe.

2. The unit as claimed in claim 1 wherein said shroud means comprises panel means positioned downstream of said condenser and carrying a circular opening for partially receiving said fan blade, and said unit further includes means for positioning the discharge end of said flue pipe adjacent to the inlet side of said panel opening.

3. The unit as claimed in claim 2 wherein the end of said flue pipe overlies the axis of rotation of said fan.

4. The unit as claimed in claim 1 further comprising a barometric draft control damper positioned within said flue pipe intermediate of said furnace heat exchanger and the discharge end of said pipe for insuring maintenance of a constant vacuum pressure within said furnace regardless of invironmental wind effects on said unit.

5. The unit as claimed in claim 4 wherein said damper comprises a cylindrical pipe intersecting said flue pipe and extending outwardly therefrom at right angles thereto, a disc valve pivotably mounted for rotation about a horizontal axis within the open end of said damper pipe, and an adjustable weight carried by said valve disc tending to maintain said valve disc in slightly open position in the absence of applied vacuum pressure to said damper pipe internally of said valve disc; whereby, adjusting said weight allows the vacuum pressure within said furnace to be varied for a given fan velocity.

6. The unit as claimed in claim 3 further comprising a barometric draft control damper positioned within said flue pipe intermediate of said furnace heat exchanger and the discharge end of said pipe for insuring maintenance of a constant vacuum pressure within said furnace regardless of environmental wind effects on said unit.

7. The unit as claimed in claim 6 wherein said damper comprises a cylindrical pipe intersecting said flue pipe and extending outwardly therefrom at right angles thereto, a disc valve pivotably mounted for rotation about a horizontal axis within the open end of said damper pipe, and an adjustable weight carried by said valve disc tending to maintain said valve disc in slightly open position in the absence of applied vacuum pressure to said damper pipe internally of said valve disc; whereby, adjusting said weight allows the vacuum pressure within said furnace to be varied for a given fan velocity.

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