Oct. 14, 1941. H. S. MURPHY 2,258,790

AIR TEMPERING DEVICE

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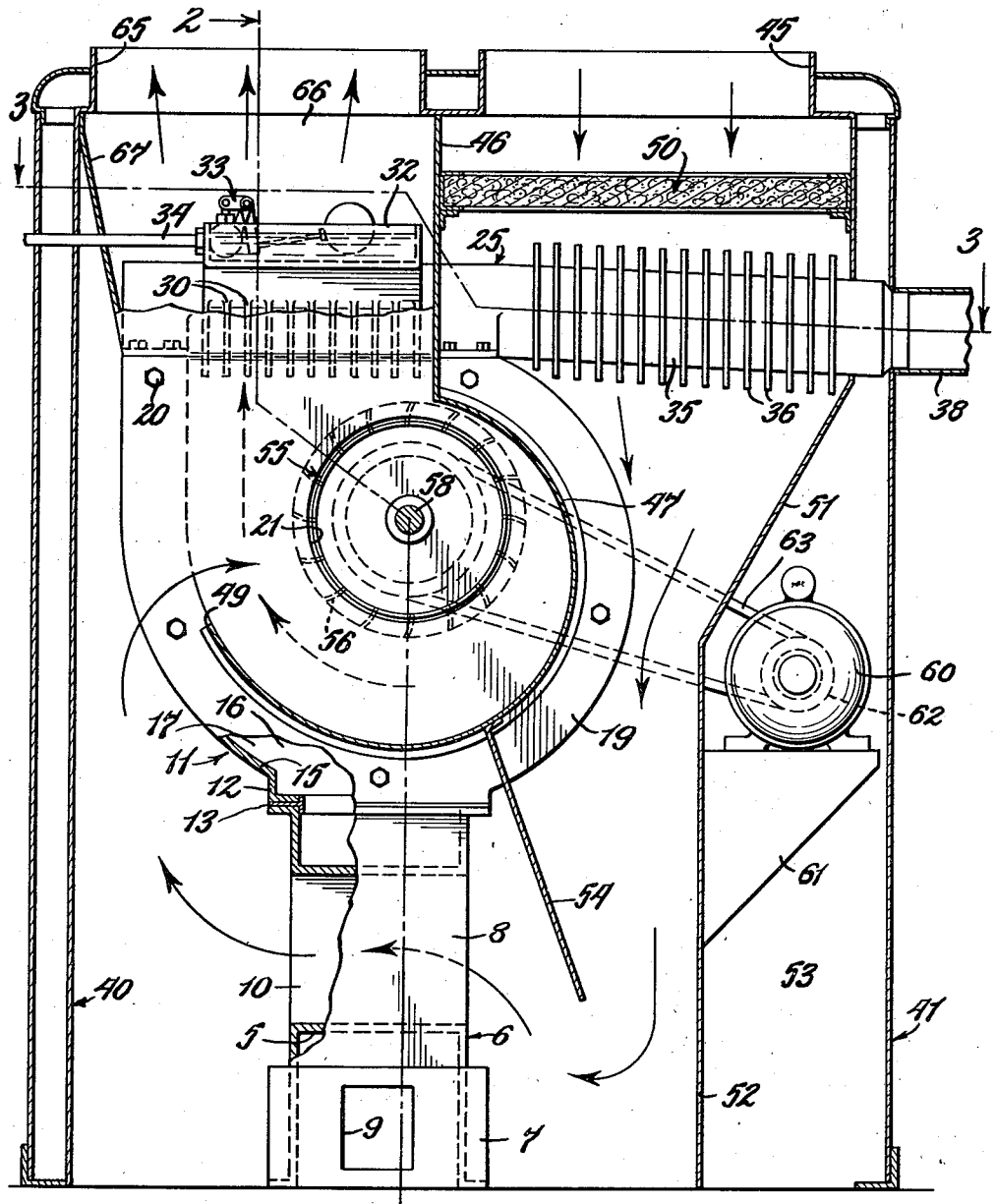

Fig. 1.

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Fig. 2.

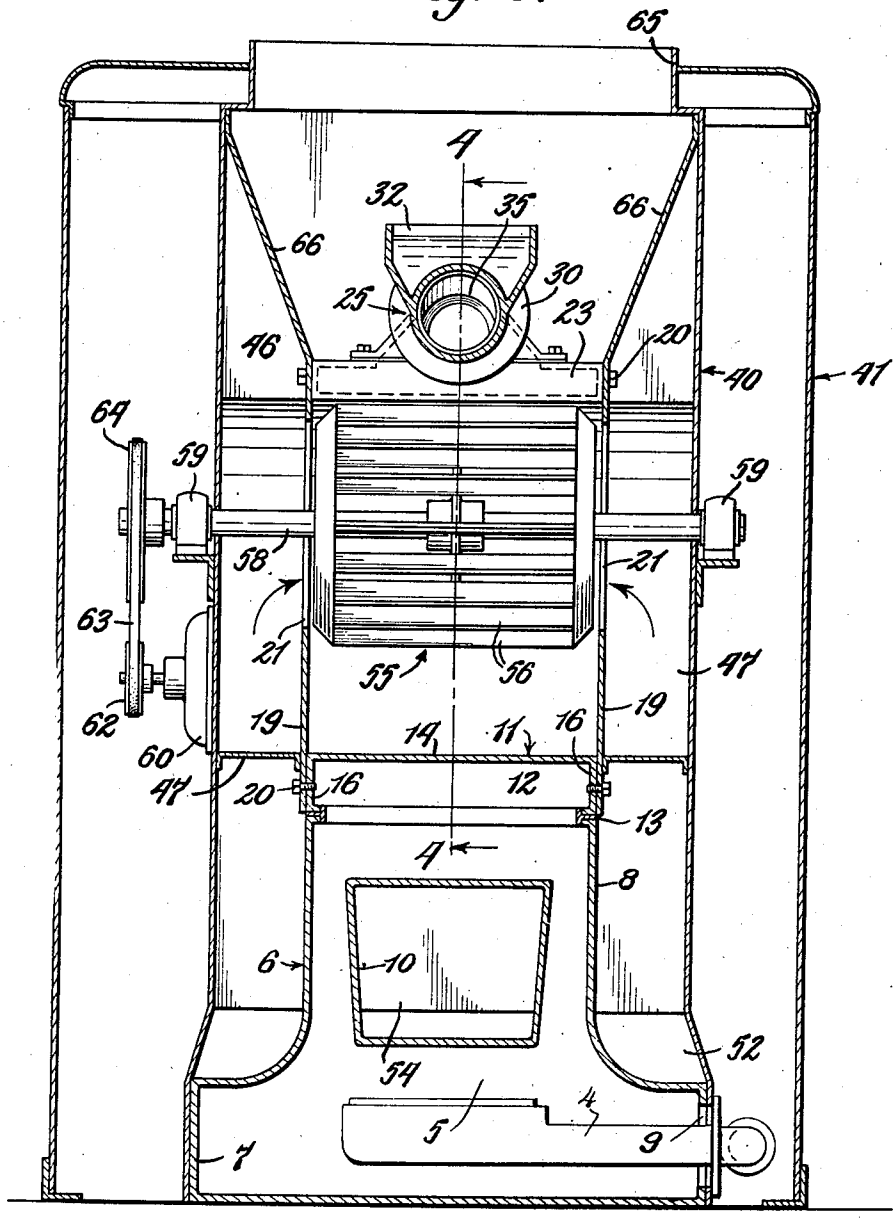

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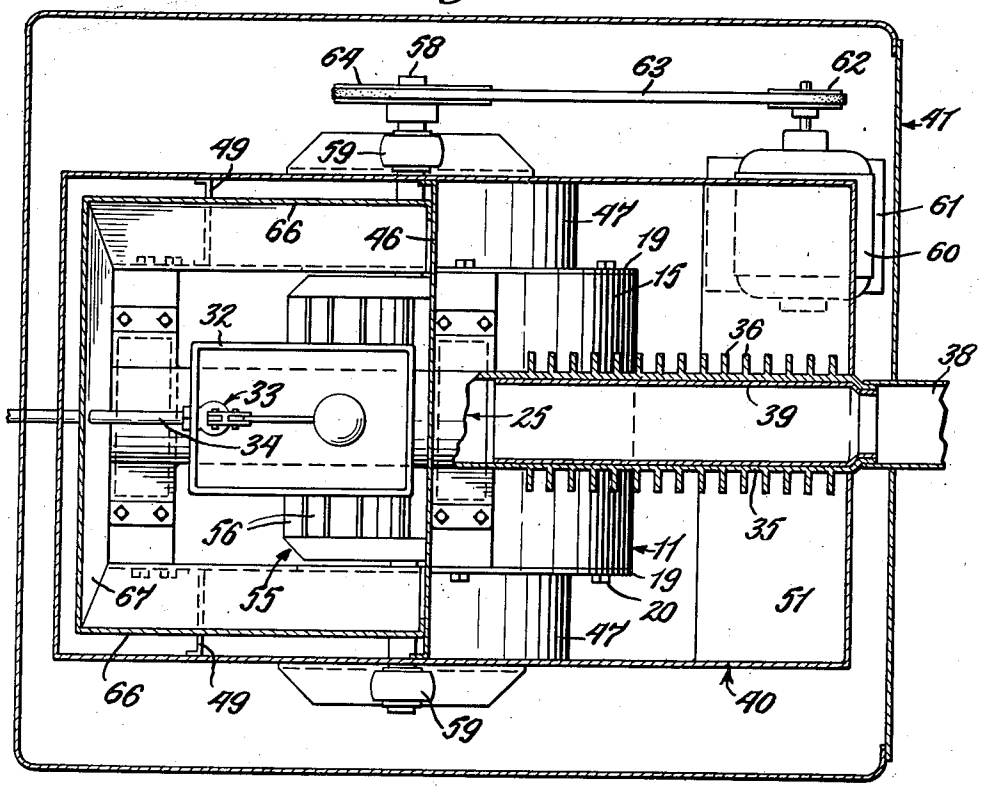
Fig. 3.



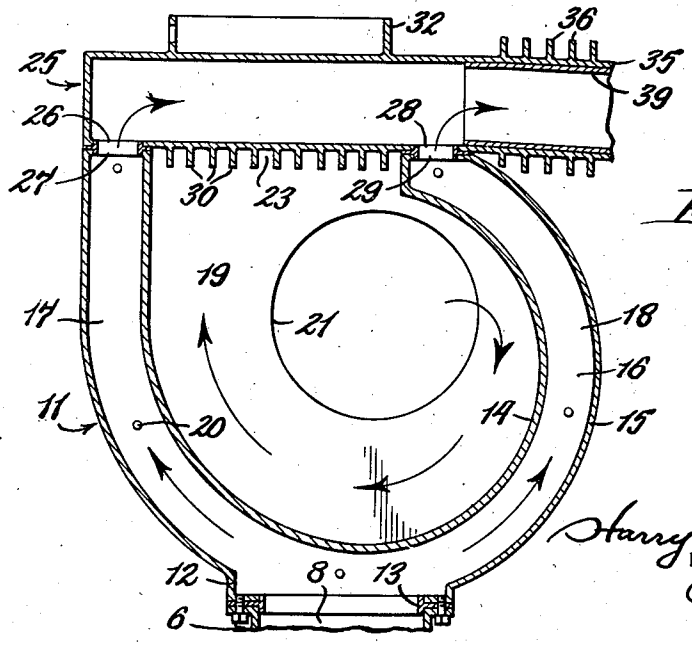


Fig. 4.

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UNITED STATES PATENT OFFICE

2,258,790

AIR TEMPERING DEVICE

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Application July 25, 1939, Serial No. 286,390

9 Claims. (Cl. 126—110)

This invention relates to an air tempering device and is more particularly shown as embodied in a direct fired house heating unit having a blower for drawing air through the unit and forcing the heated air through distributing ducts.

In such direct fired heating units as now generally constructed the unit comprises a casing containing a combustion chamber from which the products of combustion pass through a heat exchanger and thence out through a flue. The blower is usually arranged in this casing, drawing air past the heat exchanger and forcing it out through an outlet duct. Other equipment, such as filters and humidifying devices, have also been provided.

The principal object of the present invention is to provide an air tempering device including a fan wheel arranged in a fan housing which cooperates with the blades of the fan wheel to provide the desired air movement and the fan housing being constructed to also provide the principal heat exchanging surfaces. By this dual use of the fan housing as the housing and as the principal heat exchanger, an air tempering unit made in accordance with the invention can be produced at substantially less cost and is very compact and light in weight and at the same time improved efficiency in heat transfer results since the air being tempered is swept around the fan housing by the fan wheel and agitated to violently wash the fan housing so as to secure the rapid transfer of heat between the air and fan housing before the air is delivered from the fan housing.

Another object of the invention is to provide such an air tempering device which can be used with any kind of heating medium, such as direct fire heat, as illustrated in the accompanying drawings, steam, or hot water and can also be used with a cooling medium, such as brine or direct expanded refrigerant, to provide cooled or dehumidified air.

Further objects of the invention are to provide such an air tempering device in which the fan housing can be made in the form of a simple double walled casting around the exterior of which the air is drawn to be preheated and having a flue extending across the outlet of the fan housing and also extending across the path of the incoming air thereby to obtain high fuel economy.

Another object of the invention is to provide a direct fired heat exchanger in which the air is preheated by passing around the combustion chamber and which is of compact form and in which the combustion chamber, fan housing and flue can be conveniently made of small cast iron sections.

Other objects of the invention are to provide such a compact direct fired heating unit in which the flow of the air is so directed as to obtain the maximum efficiency in heat transfer; which will stand up under continuous use for a long period of time without requiring repairs or adjustment; and in which the usual filter and humidifying arrangements can be included in the casing to insure the delivery of dust free, humidified air.

In the accompanying drawings:

Fig. 1 is a vertical section, through a direct fired heating unit embodying my invention, showing parts broken away.

Fig. 2 is a vertical transverse section, taken on line 2—2, Fig. 1.

Fig. 3 is a horizontal section, taken on line 3—3, Fig. 1.

Fig. 4 is a fragmentary vertical section, taken on line 4—4, Fig. 2 and showing the fan housing or scroll in section, the fan not being illustrated.

The drawings illustrate a direct fired heating unit such as would be used for heating a home, although as previously indicated the invention, in its broader aspect, is directed to a heat exchanger which can be used for heating or for cooling or dehumidifying air.

In the form of the invention illustrated, the fuel, such as gas supplied through a gas burner 4, is burned within the combustion chamber 5 of a cast iron combustion chamber section 6, this combustion chamber section 6 preferably having an elongated base 7 and a central column 8 rising from this base. The fuel and air can be admitted through an opening 9 in the base 7 of the combustion chamber section. The column 8 of the combustion chamber section is open at its upper end and is provided with a relatively large central duct 10 extending horizontally therethrough.

To the upper end of the column 8 of the combustion chamber is secured a double walled fan housing or scroll 11 of a blower, this fan housing or scroll being preferably also made of cast iron and its open base 12 being formed to fit over the open upper end of the column 8 of the combustion chamber section 6. Preferably a gasket 13 is interposed between the base 12 of the fan housing or scroll and the upper end of the column 8 of the combustion chamber section so as to insure against the leakage of any products of combustion into the air drawn over the ex-

terior of the combustion chamber section and the fan housing or scroll.

The double walled fan housing includes a scroll shaped inner wall 14; a similarly shaped outer wall 15 rising from the base 12 and end walls 16 connecting these inner and outer walls so as to provide two passages 17 and 18 through the fan housing for the products of combustion. The upper ends of the passages 17 and 18 are partly closed by horizontal top walls and the opposite sides of the fan housing are shown as enclosed by sheet metal plates 19, each of which is bolted to the corresponding wall 16 of the fan housing by bolts 20 or in any other suitable manner and each of these plates 19 being formed to provide the circular inlet or eye 21 of the blower. The cast iron fan housing with its side plates 19 provide a blower outlet 23.

The products of combustion from the two passages 17 and 18 are relieved through a horizontal cast iron flue indicated generally at 25. This flue is preferably of tubular form in cross section and its extreme end is suitably formed to be bolted or otherwise secured to the horizontal wall of the cast iron fan housing above the passage 17, this extreme end of the flue being also provided with an opening 26 registering with an opening 27 in the fan housing so that the products of combustion passing upwardly through the passage 17 are relieved into the flue 25. Near its center the cast iron flue 25 is also formed to be bolted or otherwise secured to the horizontal wall of the cast iron fan housing above the passage 18 and this portion of the flue being also provided with an opening 28 registering with an opening 29 leading from the passage 18 so that the products of combustion passing upwardly through the passage 18 are relieved into the flue 25.

In order to obtain increased efficiency it is desirable that a greater proportion of the products of combustion travel through the passage 17 than through the passage 18. To this end the base 12 of the fan housing is offset laterally toward the direction of the passage 17. It will be understood that any desirable balance in the flow of the products of combustion through the two passages 17 and 18 can be obtained either by proper arrangement of the base 12 of the fan housing or by the proper adjustment of the size of these passages or the opening leading from each of these passages into the flue section 25.

In order to secure improved heat transfer, the flue is preferably provided with an extended surface in the form of fins 30 in its part which extends across the blower outlet 23. This part of the flue 25 is also shown as having cast integrally therewith a trough 32 which is shown as containing a float valve 33 controlling the supply of water from a supply line 34 to this trough. It will be seen that this trough therefore acts to humidify the air leaving the lower outlet, a proper amount of water being maintained in the trough 32 by the float valve 33.

The flue 25 extends horizontally beyond the blower outlet, this horizontal extension 35 of the flue being preferably provided with integral fins 36. The end of this extension 35 of the flue 25 is connected with an outlet 38 which can lead to the usual chimney (not shown) and this extension 35 preferably slants downwardly from the fan housing and is lead lined, as indicated at 39. By this means condensate forming in the extension 35 of the flue 25 is drained outwardly into the outlet 38 from which it can be conveniently drained to the sewer by any means (not shown) and the lead lining 39 prevents the extension 35 from being corroded by this condensate.

The cast iron sections previously described are housed within an inner casing 40 which is preferably made of sheet metal and this inner casing is in turn housed within an exterior shell or housing 41 which likewise can be made of sheet metal and may be ornamented in any suitable manner to render the heating unit attractive in appearance. The inner casing 40 is provided in its upper wall and at one side with an air inlet duct 45 which extends through a suitable opening provided in the outer shell 41 and can be connected to the return air duct (not shown) of the house heating system in the usual and well known manner.

The inner casing 40 is also provided with a central partition 46 which leads down from the upper wall of the inner casing 40 to the fan housing 11 and at its lower end is bifurcated to extend along the opposite sides of the fan housing in the form of scroll-shaped baffle extensions 47. These baffle extensions terminate, as indicated at 49, in a plane below the fan inlets 21 and at the left hand side of the fan housing, as viewed in Fig. 1. The outer edges of this partition 46 and its scroll-shaped extensions 47 are connected with the adjacent side walls of the inner casing 40 and the scroll-shaped extensions 47 and be secured to the side plates 19 of the fan housing in any suitable manner.

The air drawn in through the inlet duct 45 is shown as first passing through a filter 50 which can be mounted, preferably removably, in any suitable manner, and extends across one side of the inner casing 40 to the partition 46, as best shown in Fig. 1. The air so drawn through the filter is prevented from passing directly to the inlets 21 of the fan housing by the partition 46 and its extensions 47 and hence this air passes downwardly past the extended surface 36 of the flue 25, this air being thereby preheated. In order to deflect the air against the exterior of the heated fan housing 11 the inner casing 40 is formed to provide a baffle 51, this baffle extending the full width of the inner casing and being extended downwardly, as indicated at 52, to provide a relatively cool chamber 53. The air, after passing the fins 36, is deflected against the fan housing so as to be preheated to a greater degree and then encounters a baffle 54 which is secured to the fan housing and extends downwardly and laterally toward the wall 52. The air is thereby deflected to the base of the unit and against the lower end of the combustion chamber section 6. This air then flows upwardly under the baffle 54 and passes through the passages provided on opposite sides of the central column 8 of the combustion chamber section 6 and also through the opening 10 in this combustion chamber section. The air is thereby further preheated through contact with the exterior walls of the combustion chamber section 6.

After leaving the exterior of the combustion chamber section 6 the air passes upwardly and over the ends 49 of the pair of scroll-shaped baffles 47 and into the inlets 21 of the fan housing. A fan 55 of the centrifugal blower type is arranged in this fan housing, this fan having the usual blades 56 which throw the air centrifugally outward as the fan is rotated and the fan being

mounted on a fan shaft 58 which is journaled in bearings 59 mounted on the exterior of the inner casing 40. The fan is driven by a motor 60 which is arranged in the chamber 53 between the baffle 51 and wall 52 of the inner casing 40 and the exterior casing 41. This motor is shown as mounted on a bracket 61 carried by the wall 52 of the inner casing 40 and drives a pulley 62, this pulley being connected by a belt 63 with a pulley 64 on the fan shaft 58. The pulleys 62 and 64 and the belt 63 are thereby located externally of the inner casing 40 and hence are maintained in a cool condition.

The outlet 23 of the blower discharges into a discharge duct 65 extending upwardly from the inner casing 40 on the left hand side of the unit as viewed in Fig. 1. In order to insure free discharge of the heated air into the hot air duct 65 the discharge 23 of the blower is connected with the hot air duct 65 by inclined side plates 66 and an inclined end plate 67, these plates insuring against noise in the discharge of the heated air. The heated air from the duct 65 can be conducted to the ductwork of the house heating system (not shown) in any suitable manner.

In operation as long as fuel is supplied to the combustion chamber 5, the motor 60 is operating to drive the fan 55, this drive being effected through the pulley 62 on the motor shaft, belt 63 and pulley 64 on the fan shaft 58. The products of combustion from the fuel burning in the combustion chamber 5 rise through the column 8 of the cast iron combustion chamber section 6 and into the bottom of the double walled cast iron fan housing 11. The hot products of combustion thereupon divide, passing up the two passages 17 and 18 in the cast iron fan housing section 11, a greater proportion of the products of combustion passing through the passage 17 by reason of the offset relation of the base 12 of the cast iron fan housing section 11, this being offset to the left, as viewed in Fig. 1. The walls of the cast iron fan housing 11 are thereby heated and the products of combustion pass through the openings 26—29 into the horizontal cast iron figure 25. The products of combustion thereupon pass horizontally through the extension 35 of this flue section, this extension sloping downwardly and also being lined with lead 39 so that the condensate flows into the outlet 38 and does not corrode the interior of this flue extension 35.

Since the fan 55 is in operation, cold air is drawn in through the duct 45 and through the filter 50, and past the finned surface of the horizontal extension 35 of the flue 25. The air is preheated on passing these fins, and passes downwardly, this air being deflected against the exterior of the cast iron fan housing section 11 by the inclined baffle 51. The air is prevented from passing directly to the inlets 21 of the blower by the central partition 46 and its pair of scroll-shaped extensions 47. This air is also prevented from flowing directly under the fan housing by the baffle 54 which forces the air to flow to the base of the unit casing and against the lower part of the combustion chamber section 6. The air thereupon passes through the central opening 10 of the column 8 of this combustion chamber section 6 and also on opposite sides of this column. The air is then drawn upwardly around the extremities 49 of the scroll-shaped baffles 47 and into the two inlets 21 in the side plates of the fan housing. The fan 55 thereupon forces the air centrifugally outward at high velocity in contact with the interior wall 14 of the double walled cast iron fan housing section 11. This air is thereby brought into contact with the interior of the heated fan housing at high velocity and with a high degree of turbulence, this air violently washing the interior surface of the fan housing so that a high rate of heat transfer between the heated fan housing and the air obtains.

The air is thereupon forced through the outlet 23 of the blower and past the trough 32 which is maintained full of water by the float valve 33. The air thereby absorbs moisture from this water and is humidified, the filtered, heated and humidified air being discharged through the discharge duct 65.

From the foregoing it will be seen that the present invention provides an air tempering device which is highly efficient in its rate of heat transfer inasmuch as the use of the fan housing itself as the principal heat transfer surface takes advantage of the high air velocity and turbulence created by the fan against the interior of the fan housing. At the same time the air tempering unit is compact inasmuch as the fan housing serves the dual function of a fan housing and the principal heat transfer apparatus. This dual use of the fan housing also results in a low cost of the unit and it will be particularly noted that the unit as a whole is very inexpensive, including only three cast iron castings as the heat generating and transfer means. Further, it will be noticed that the heating unit shown is extremely economical in fuel consumption inasmuch as a low flue gas temperature can be obtained and the air is adequately heated, first by contact with the flue and the exterior of the fan housing and thereafter by contact with the combustion chamber section and the other exterior side of the fan housing before being admitted to the interior of the fan housing where the principal heat transfer takes place. It will also be seen that the motor and other drive parts for the fan are located in relatively cool air spaces and at the same time are adequately protected by the exterior shell which forms an ornamental enclosure for the entire apparatus.

I claim as my invention:

1. An air tempering device, comprising a rotary fan wheel carrying blades to discharge air centrifugally outward, a double walled cast iron scroll forming an enclosed chamber and surrounding said fan wheel and cooperating with the blades of said fan wheel to discharge air through an outlet at the enlarged part of said scroll, separate side plates secured to the sides of said cast iron scroll at least one of which is formed to provide an air inlet adjacent the axis of the fan wheel and means for passing a tempering medium through the enclosed chamber provided by the double walls of said scroll to maintain the inner wall of said scroll at a temperature substantially different from the air drawn in said inlet to temper this air before being discharged from said outlet.

2. An air tempering device, comprising a rotary fan wheel carrying blades to discharge air centrifugally outward, a scroll shaped fan housing having an air inlet adjacent the axis of said fan wheel and an air outlet at the enlarged part of said scroll shaped fan housing, the blades of said fan wheel cooperating with said scroll shaped fan housing to draw air in said air inlet and discharge

air through said air outlet, the outer wall of said scroll shaped fan housing being provided with an inlet for a tempering medium to the space provided by the double walls of the fan housing, a tempering medium outlet pipe secured directly to said fan housing and extending across said air outlet and through the path of the air discharged therefrom, said tempering medium outlet pipe being in independent communication with said space on opposite sides of said air outlet and means for introducing a tempering medium through said tempering medium inlet and the space between the double walls of said fan housing and withdrawing said tempering medium through said pipe, said tempering medium maintaining the inner wall of said fan housing at a temperature substantially different from the air drawn in said air inlet to temper the air before being discharged from said air outlet.

3. An air tempering device, comprising a rotary fan wheel carrying blades to discharge air centrifugally outward, a scroll shaped fan housing having an air inlet adjacent the axis of said fan wheel and an air outlet at the enlarged part of said scroll shaped fan housing, the blades of said fan wheel cooperating with said scroll shaped fan housing to draw air in said air inlet and discharge air through said air outlet, the outer wall of said scroll shaped fan housing being provided with an inlet for a tempering medium to the space provided by the double walls of the fan housing, a tempering medium outlet pipe secured directly to said fan housing and extending across said air outlet and through the path of the air discharged therefrom, said tempering medium outlet pipe being in independent communication with said space on opposite sides of said air outlet, said pipe being provided with an extended fin surface in that part extending across said air outlet and means for introducing a tempering medium through said tempering medium inlet and the space between the double walls of said fan housing and withdrawing said tempering medium through said pipe, said tempering medium maintaining the inner wall of said fan housing at a temperature substantially different from the air drawn in said air inlet to temper the air before being discharged from said air outlet.

4. An air tempering device, comprising a casing having an air inlet and an air outlet, a rotary fan wheel arranged in that side of said casing adjacent said air outlet and carrying blades to discharge air centrifugally outward, a double walled scroll shaped fan housing having an air inlet adjacent the axis of said fan wheel and an air outlet at the enlarged part of its scroll communicating with the air outlet of said casing, said fan housing air inlet being in communication with the interior of said casing and the blades of said fan wheel cooperating with the inner wall of said double walled fan housing to draw air from said casing through said fan housing air inlet and discharge said air through said fan housing air outlet, means for introducing a tempering medium through the outer wall of said fan housing on the side opposite its air outlet, an outlet pipe for said tempering medium extending across the outlet of said fan housing and through the path of the air discharged therefrom and also across the inlet of said casing and through the path of the air admitted therethrough and communicating with the space between the double walls of said fan housing and means for maintaining said tempering medium at a substantially different temperature from the air drawn in said fan housing inlet to temper the air before being discharged from said fan housing air outlet.

5. An air tempering device, comprising a casing having an air inlet and an air outlet, a rotary fan wheel arranged in that side of said casing adjacent said air outlet and carrying blades to discharge air centrifugally outward, a double walled scroll shaped fan housing having an air inlet adjacent the axis of said fan wheel and an air outlet at the enlarged part of its scroll communicating with the air outlet of said casing, said fan housing air inlet being in communication with the interior of said casing and the blades of said fan wheel cooperating with the inner wall of said double walled fan housing to draw air from said casing through said fan housing air inlet and discharge said air through said fan housing air outlet, means for introducing a tempering medium through the outer wall of said fan housing on the side opposite its air outlet, an outlet pipe for said tempering medium extending across the outlet of said fan housing and through the path of the air discharged therefrom and also across the inlet of said casing and through the path of the air admitted therethrough and communicating with the space between the double walls of said fan housing, those portions of said outlet pipe extending across said fan housing air outlet and said casing air inlet being provided with an extended fin surface, and means for maintaining said tempering medium at a substantially different temperature from the air drawn in said fan housing inlet to temper the air before being discharged from said fan housing air outlet.

6. An air tempering device, comprising a casing having an air inlet and an air outlet in its top and arranged side by side, a rotary fan wheel arranged in the upper part of said casing under said air outlet and carrying blades to discharge air centrifugally outward, a double walled scroll shaped fan housing having an air inlet adjacent the axis of said fan wheel and an upwardly directed air outlet at the enlarged part of its scroll communicating with the air outlet of said casing, said air inlet being in communication with the interior of said casing and the blades of said fan wheel cooperating with the inner wall of said double walled fan housing to draw air from said casing through said fan housing inlet and discharge said air through said fan housing outlet, a combustion chamber section secured to the underside of said fan housing and discharging the products of combustion into the space between the double walls of said fan housing, and a generally horizontal flue extending across the air outlet of said fan housing and through the path of the air discharged therefrom and the air inlet of said casing and through the path of the air admitted therethrough and relieving the products of combustion from said space between the double walls of said fan housing.

7. An air tempering device, comprising a casing having an air inlet and an air outlet, a rotary fan wheel arranged in the upper part of said casing and carrying blades to discharge air centrifugally outward, a double walled scroll shaped fan housing having an air inlet adjacent the axis of said fan wheel and an air outlet at the enlarged part of its scroll communicating with the air outlet of said casing, said fan housing air inlet being in communication with the interior of said casing and the blades of said fan wheel cooperating with the inner wall of said double walled fan housing to draw air from said casing through said fan housing inlet and discharge

said air through said fan housing outlet, a combustion chamber section arranged in said casing below said fan housing, means providing communication between said combustion chamber and the space between the double walls of said fan housing, a flue at the upper end of said fan housing and communicating with said space, the products of combustion on passing through said fan housing heating the inner wall thereof to provide a heat exchange surface, and baffle means in said casing for directing the air passing through said casing first against the exterior of said flue and then successively against one exterior side of said fan housing, the exterior of said combustion chamber and the opposite side of said fan housing before being admitted to the air inlet of said fan housing.

8. An air tempering device, comprising a casing having an air inlet and an air outlet at one end, a rotary fan wheel arranged in said casing, a fan housing arranged in said casing and surrounding said fan wheel and having an air inlet communicating with the interior of said casing and an air outlet connected with said outlet of said casing, said fan housing cooperating with the blades of said fan wheel to draw air in said fan housing inlet and discharge said air through said fan housing outlet, means for maintaining said fan housing at a temperature substantially different from the air drawn in said fan housing inlet to temper the air before being discharged from said fan housing outlet, a partition in said casing between said casing inlet and outlet and connecting with said fan housing and spaced from the end of said casing opposite said casing inlet and outlet to provide, in combination with said fan housing and said casing, a generally U-shaped air passage through said casing through which the air is compelled to traverse substantially the entire exterior surface of said fan housing before being admitted to said fan housing inlet.

9. An air tempering device, comprising a casing having an air inlet and an air outlet at one end, a rotary fan wheel arranged in said casing and carrying blades to discharge air centrifugally outward, a scroll shaped fan housing having an air inlet adjacent the axis of said fan wheel and an air outlet at the enlarged part of its scroll communicating with the air outlet of said casing, said fan housing air inlet being in communication with the interior of said casing and the blades of said fan wheel cooperating with said scroll shaped fan housing to draw air in said fan housing inlet and discharge said air through said fan housing outlet, means for maintaining said fan housing at a temperature substantially different from the air drawn in said fan housing inlet to temper the air before being discharged from said fan housing, a partition in said casing between said casing inlet and outlet and connecting with said fan housing and spaced from the end of said casing opposite said casing inlet and outlet to provide, in combination with said fan housing and said casing, a generally U-shaped air passage through which the air is compelled to pass substantially the entire exterior surface of said fan housing before being admitted to said fan housing inlet and the walls forming said air passage being irregularly disposed to compel said air to traverse a tortuous path while passing therethrough.

HARRY S. MURPHY.