

May 30, 1939.

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2,160,269

AIR HEATING AND CONDITIONING UNIT

Filed Feb. 1, 1936

3 Sheets-Sheet 1

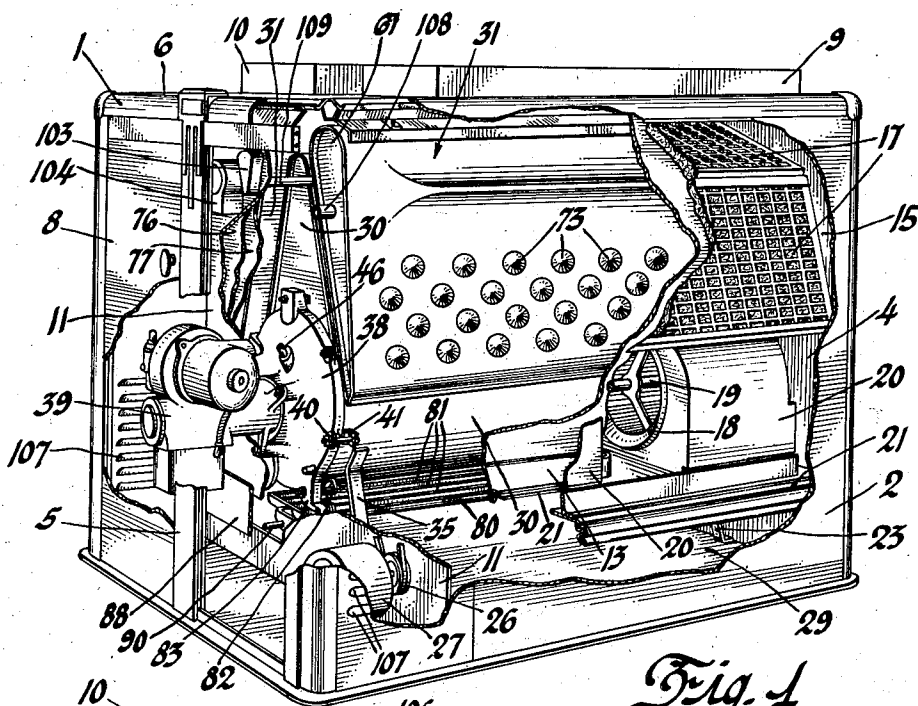


Fig. 1

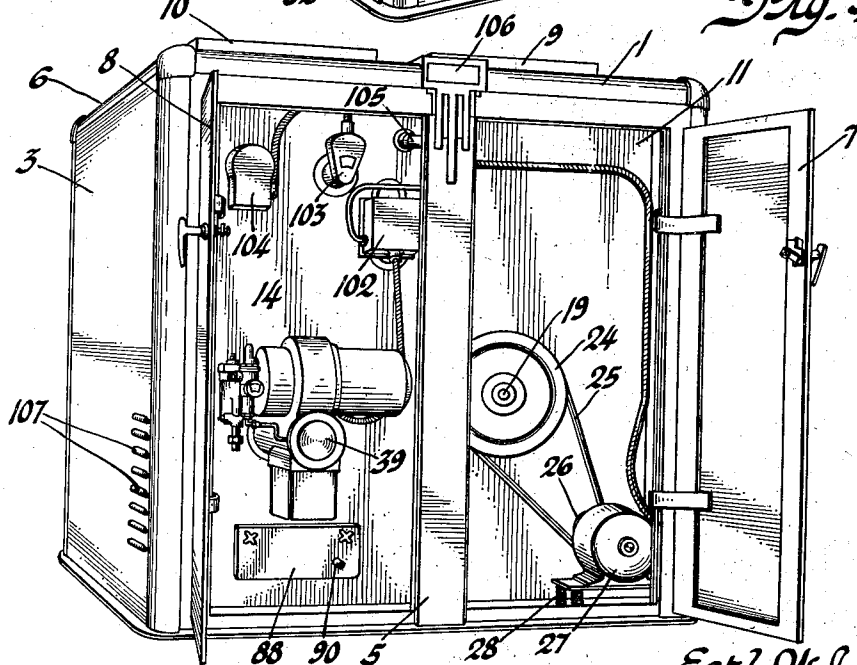


Fig. 2

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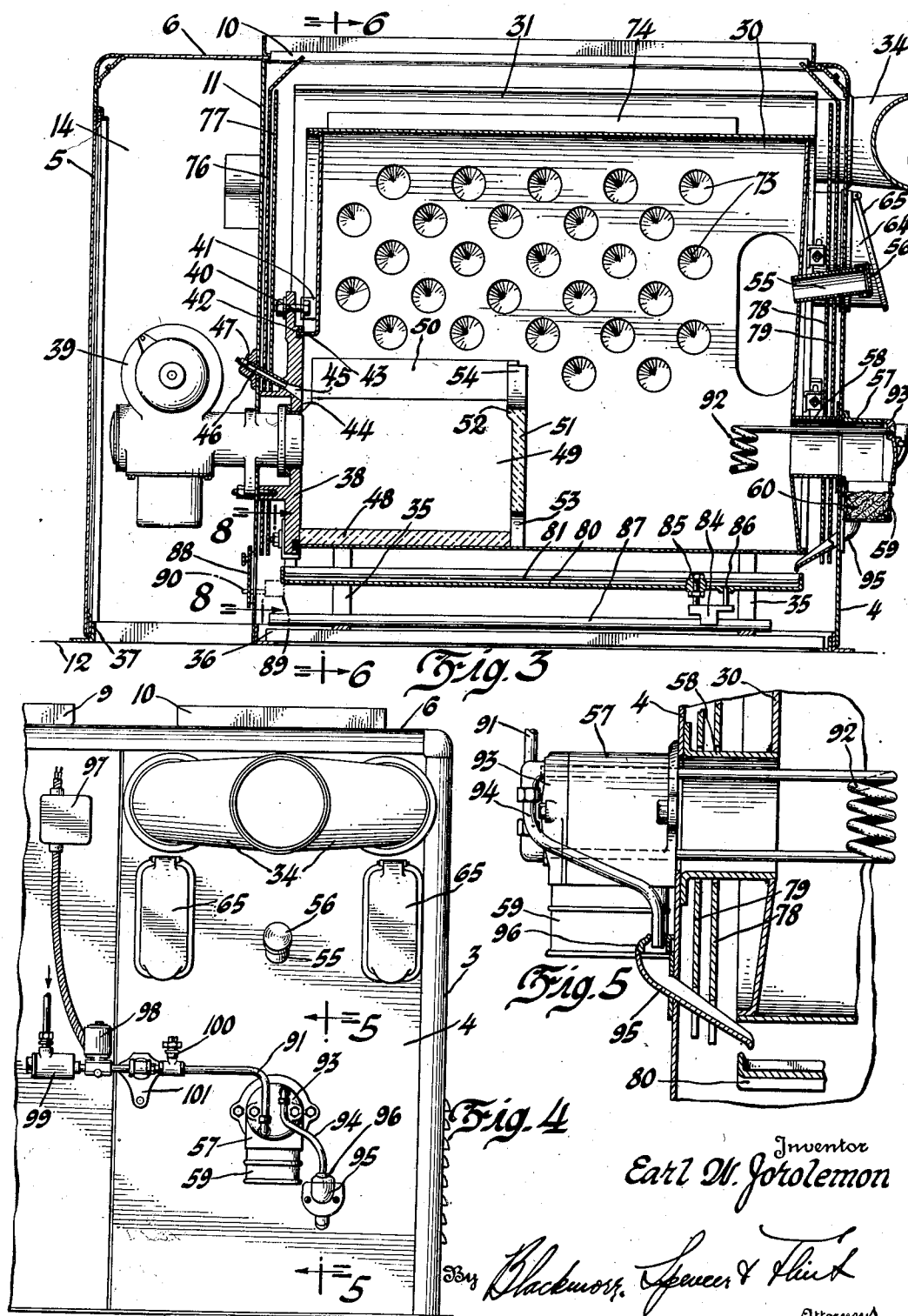
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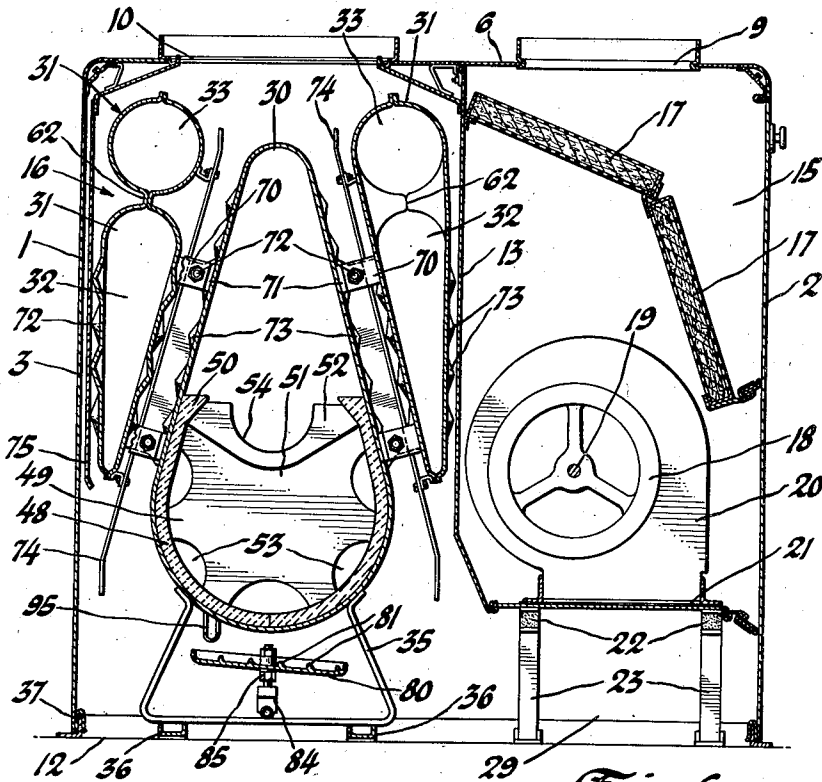


Fig. 6

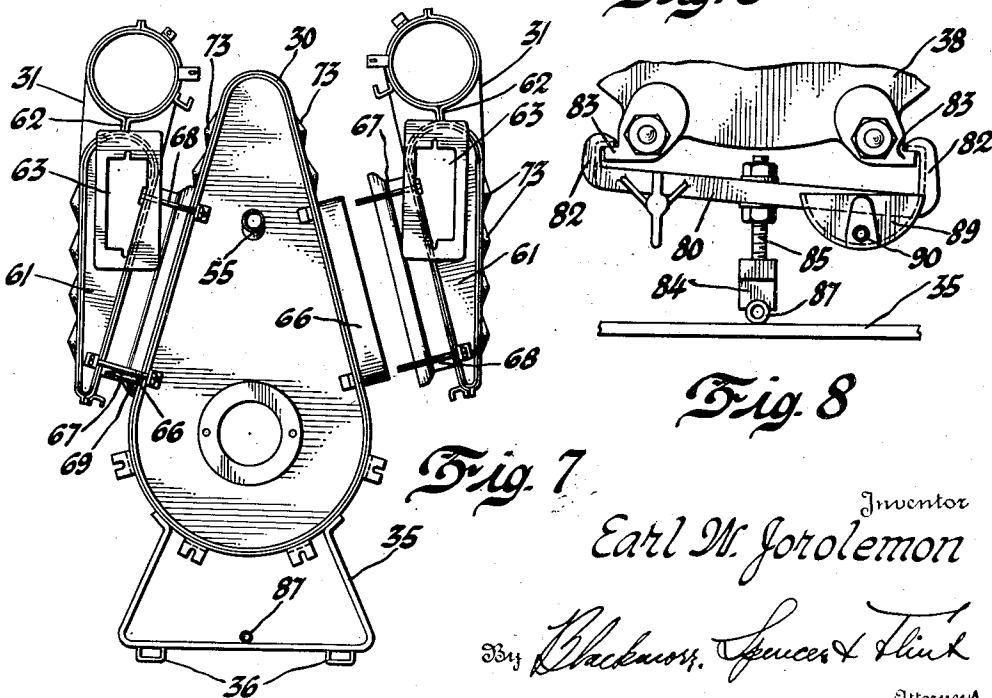


Fig. 7

Fig. 8

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UNITED STATES PATENT OFFICE

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AIR HEATING AND CONDITIONING UNIT

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Application February 1, 1936, Serial No. 61,906

4 Claims. (Cl. 126—116)

This invention relates generally to an air heating and conditioning unit which may be used in the winter for domestic heating purposes and during the summer months for ventilating and cooling.

It is one of the objects of this invention to provide a simple, compact unit which is especially adapted to the use of liquid or gaseous fuels with provisions for automatically purifying or filtering, humidifying, heating and circulating the air for domestic heating purposes.

A further object is the provision in this unit of filters and air circulating means which may be used during the summer months for ventilating and cooling by a positive recirculation of air within the house (if desired, with the addition of basement or outside air), or combined with a standard mechanical cooling apparatus (such as water circulating or refrigerating coils) to obtain a greater degree of cooling.

One of the principal features of this invention is the construction of the heat transfer unit to provide the utmost efficiency in heating the air quickly, thoroughly and economically. The heat transfer unit is not only so designed as to reduce air flow resistance to a minimum while obtaining the maximum transfer of heat to the air which is equally distributed over all of the heating surfaces, but includes a specially designed combustion chamber to obtain the most efficient combustion of liquid or gaseous fuels.

A further feature consists in the provision of a humidifier which is so constructed and arranged as to be readily adjusted to add the desired amount of moisture to the air that is required for comfort and health.

Other objects and features of the invention, such as the novel arrangement, construction and combination of parts together with the advantages thereof, will be apparent from, or specifically pointed out, in the following description and accompanying drawings illustrating one embodiment of the invention, in which:

Fig. 1 is a perspective view of the entire unit with parts broken away to show details of construction.

Fig. 2 is a perspective view of the unit with the doors open to show the front compartment.

Fig. 3 is a longitudinal sectional view, with parts in elevation, taken substantially through the center of the heat transfer unit.

Fig. 4 is a rear elevation of a portion of the unit.

Fig. 5 is an enlarged, fragmentary sectional

view to show parts of the humidifier, taken on line 5—5 of Fig. 4.

Fig. 6 is a cross section of the unit taken substantially on line 6—6 of Fig. 3.

Fig. 7 is a rear elevation of the heat transfer unit with one of the side flues shown as disassembled and spaced from the combustion chamber.

Fig. 8 is an enlarged fragmentary elevation to show the humidifier support taken on line 8—8 of Fig. 3.

Referring to the drawings, the complete unit includes a substantially rectangular cabinet or casing indicated generally at 1 which comprises side walls 2 and 3, a rear wall 4, a front wall 5 and a top wall 6. To facilitate manufacture and assembly, some of these walls are preferably constituted by two panels as shown in the drawings. The front wall 5 includes hinged doors 7 and 8 and the top wall 6 is formed with a flanged air inlet opening 9 and a flanged air outlet opening 10. It should be understood that the air inlet opening 9 is adapted to be connected to return air ducts from suitable locations in the house or to other air inlet ducts as will be noted hereinafter, and the air outlet opening 10 is adapted to be connected to the usual air distributing ducts leading to the outlet registers in the house.

The casing 1 is provided with a vertical transverse partition 11 extending between the side walls from the top wall to the cement base or floor 12 on which the unit is supported, and a vertical longitudinal partition 13 extends between the rear wall and the transverse partition 11. The longitudinal partition 13 extends downwardly from the top wall but terminates in an angular portion above the floor 12 as may be readily seen in Fig. 6.

By this arrangement of walls and partitions the casing is divided into three compartments. The compartment 14 at the front is entirely separate from the rear compartments 15 and 16 which are in communication through the space below the longitudinal partition 13. As will be hereinafter described in detail, the front compartment 14, which is normally closed by doors 7 and 8, houses a burner mechanism, controls and blower motor, the compartment 15 houses air filters and a blower unit, and the compartment 16 houses a humidifier and heat transfer unit.

Proceeding now to a detailed description of the various elements and referring particularly to the showing in Figs. 1 and 6, the compartment 15 is provided below the air inlet opening 9 with longitudinally extending angle brackets 55

which are so positioned as to provide for the support of a plurality of removable filter units 17, which when assembled, extend entirely across the compartment 15 so that all air passing through this compartment must pass through the filters. To provide the maximum filtering area in the space available it should be noted that the filter units 17 are angularly positioned within the compartment 15. The side wall 2, or a portion thereof, is readily removable for inspection of the filter units, and the replacement thereof, whenever required, which is facilitated by the fact that the filter units are not positively connected to the supporting brackets but merely rest thereon. The filter units may be of any suitable character such as commercial viscous type filters with specially treated strands of blown glass to remove all dust, dirt, pollen and bacteria from the air passed therethrough.

Beneath the filter unit 17 in the compartment 15 is the air circulator or blower unit which preferably comprises a plurality of blower wheels 18 which are adapted to circulate a large volume of air at low velocity. As shown in Figs. 1 and 6 the blower wheels are mounted on a single longitudinal shaft 19 and are of the type adapted to draw air axially within the ends and discharge air centrifugally with a housing 20 around each blower wheel to direct the discharged air downwardly through openings in the horizontal plate 21 on which the blower wheels and housings are mounted. The entire circulator or blower unit including the plate 21 is resiliently supported by rubber blocks 22 upon spaced legs 23 with the plate 21 above the base or floor 12 at a level corresponding to the bottom edge of the vertical partition 13. The plate 21 is extended beyond the blower housings on all sides to contact with the walls of the compartment 15 with felt pads to seal the joints with these walls and permit a slight floating movement of the blower unit on the resilient supports to minimize the transmission of vibration to other parts of the entire unit and absorb the noise which might result from any such vibration. As may be seen from Fig. 2, the blower shaft 19 extends through the partition wall 11 into the front compartment 14 where it is provided with a pulley 24 connected by belt 25 to the driving pulley 26 of the blower motor 27 which may be resiliently mounted by means of rubber supports 28. The location of the blower motor and belt drive in the front compartment renders these parts readily accessible for inspection or service.

In the foregoing description, it has been noted that the air circulator or blower unit is supported at some distance above the base or floor. This provides what may be called an equalizing space or chamber 29 into which air is discharged downwardly from the blower wheels. From this chamber the air passes substantially horizontally below the partition 13 into the humidification and heating compartment 16. The function of the equalizing chamber 29 is to allow the air to reduce its velocity before passing into the compartment 16 and thereby create a uniform pressure and a substantially equal distribution over the heating surfaces of the heat transfer unit which will now be described in detail.

The heat transfer unit consists generally of a sheet metal central combustion chamber shell 30 and side flues 31, each of which flues is so constructed as to provide two longitudinally extending flue passageways 32 and 33 with the lower passageways 32 communicating at their

front ends with the respective upper passageways 33. The rear ends of the passageways 33 are connected to pipes 34 which converge and are joined together exteriorly of the rear wall 4 for connection to the usual stack. The construction and arrangement of the combustion chamber shell and side flues is such that the combustion gases pass laterally from adjacent the rear end of the combustion chamber shell into the flue passageways 32, then forwardly to the front ends thereof and upwardly into the flue passageways 33, then rearwardly to the common stack leading to the chimney.

The combustion chamber shell 30 is supported within compartment 16 by spaced brackets 35 which are attached to supporting rails 36. These rails 36 together with the legs 23 which support the circulator or blower unit are adapted to be located correctly by the base frame 37 on which the superstructure is built up during assembly. It is contemplated that in installing the complete unit, this base frame may be first located as desired and levelled and any interstices between the floor and this frame can be filled up with cement to prevent any leakage of air from the compartments 15 or 16 between the base frame 37 and the floor 12.

As shown in Figs. 1 and 3, the front wall of the combustion chamber shell 30 is formed with an opening with a removable cover 38 which provides for ready access to the interior of the shell and is adapted to support the oil burner 39. The cover 38 is attached to the shell 30 by studs or bolts 40 which engage with a series of lugs 41 welded to the shell, and to provide a gas tight joint between the cover 38 and the shell 30, the cover is formed with an annular groove 42 to receive a heat resisting gasket adapted to be engaged by an annular projecting flange 43 around the opening in the front wall of the combustion chamber shell.

The cover 38 is provided with a suitable opening 44 to receive the oil burner and has an opening 45 thereabove in which is received a tube 46 extending to the front side of the partition 11 and normally closed by a plug and cover 47 which may be readily removed for viewing the combustion conditions through the opening 45 when desired to determine if the air and oil supply to the burner are properly adjusted.

Referring to Figs. 3 and 6, the lower portion of the combustion chamber shell 30 is provided with a refractory lining 48 to form the main combustion chamber 49. This lining extends rearwardly from the front wall of the shell in contact therewith with its side portions terminating on each side in an inwardly projecting lip 50. The rear end of the main combustion chamber 49 is constituted by the refractory target wall 51 which is formed with an inwardly projecting lip 52 and provided with openings 53 and a U-shaped channel 54. Both the refractory lining 48 and target wall 51 may be molded as a single part and inserted through the opening in the front wall of the combustion chamber shell, or if desired, may be molded in sections and cemented together after installation within the combustion chamber shell.

This combustion chamber 49 has been so designed as to obtain the most efficient combustion of the liquid fuel with a standard type of pressure atomizing oil burner but may be readily adapted by changes in size and shape to work efficiently with other types of fuel burners. The combustion chamber must be constructed of such predeter-

mined dimensions as will provide the proper space for combustion, and in addition to protecting the sheet metal shell 30 from the intense heat of combustion, the refractory material becomes heated and promotes vaporization and combustion and also continues to liberate stored heat for sometime after the burner has ceased operating.

The inwardly projecting lips 50 and 52 function to turn the flame inwardly to effect more intimate contact with the refractory side walls to assist in proper vaporization and cause a turbulence to promote a more complete combustion mixture within the combustion chamber. The openings 53 in the target wall 51 permit some of the flame or hot gases to pass directly into intimate contact with the lower rear portion of the combustion chamber shell 30 to heat this portion to substantially the same degree as the portion of the shell which is covered by the refractory lining. The remainder of the hot combustion gases pass upwardly and rearwardly over the top of the target wall 51 and all of the combustion gases then enter the side flues 31 near the rear end of the combustion chamber shell. As noted heretofore in the general description of the heat transfer unit, the side flues are so constructed that the gases enter the rear ends of the lower flue passageways 32 and travel forwardly therethrough and then upwardly and rearwardly through the upper flue passageways 33 to the common stack outlet.

The U-shaped channel 54 in the target wall 51 permits the viewing of the combustion conditions, particularly the conditions adjacent the oil burner nozzle, through the inclined inspection tube 55 which extends from the rear wall of the combustion chamber shell 30 through the rear casing wall 4 where it is provided with a removable cover 56.

The rear wall of the combustion chamber shell 30 is also formed with what may be termed an auxiliary air intake passage which leads to a point outside of the rear casing wall 4. In cases where there is a long flue travel with a relatively low draft with oil and primary air proportions so adjusted as to provide a high CO₂ combustion content, it has been found necessary to admit secondary air to mix with any unconsumed or partially consumed fuel to prevent a condition known in the art as "puffing" wherein the combustion will occur as a series of very rapid puffs.

On reference to Figs. 3, 4 and 5, it will be seen that this auxiliary or secondary air intake consists of an elbow 57 secured to the outside of the rear casing wall 4 and a tube 58 connecting this housing to the combustion chamber shell 30. A downwardly directed opening in the elbow 57 is adapted to receive a tube 59 which is filled loosely with metallic wool 60 or some other suitable material to act as a mechanical filter for any gases which pass out of the combustion chamber shell. This arrangement has been found to permit a breathing action between the outside air and the interior of the combustion chamber shell such as prevents the "puffing" action mentioned above.

The side flues 31 may each be constituted by two similar sheet metal parts with each part so shaped as shown in Figs. 1, 6 and 7 that when placed together they may be welded to each other and to end walls 61 and provide a lower flue passageway 32 and upper flue passageway 33 which communicate adjacent the front end of the flue. For almost its entire length each part is formed with an intermediate bend 62 which contacts with the bend of the adjacent part and may be

tack-welded thereto to separate the side flue formed by these parts into the passageways 32 and 33.

Referring to Fig. 6, it should be noted that the flue 31 on the right side of the combustion chamber shell has been shown at a section taken on line 6—6 of Fig. 3 adjacent the front end of the flue where the passageways 32 and 33 are in direct communication, whereas the flue 31 on the left side of the combustion chamber shell has been shown at a section slightly to the rear of the line 6—6 of Fig. 3 where the passageways 32 and 33 are not in communication. The rear end walls 61 of the side flues 31 are provided with openings 63 and tubular members 64 extend from these openings through the rear wall 4 of the casing and are provided with doors 65 to normally close the open ends of the tubular members, but these doors permit ready access to the flues through the tubular members for cleaning.

Referring more particularly to Fig. 7, the side flues 31 are rigidly connected to the combustion chamber shell 30 adjacent the rear end thereof by the connecting means which serves to provide for communication between the shell and the flue passageways 32. This connecting means consists of the telescoping tubular flanges 66 and 67 which are provided, respectively, on the combustion chamber shell and adjacent side flue, and the bolts 68 which engage with threaded bosses on the combustion chamber shell. Each flange 67 is flared, as shown, to provide a space to receive suitable heat resisting material 69 to form an effective sealed joint between the combustion chamber shell and side flue to prevent any leakage of combustion gases.

To provide for the differential expansion of the combustion chamber shell and side flues due to differences in heating of these elements without destroying the anchorage or affecting the sealed joint adjacent the rear ends thereof, the shell and flues are connected together adjacent their front ends by some means which will permit a slight movement of the side flues on the shell. As shown in Fig. 6, this connecting means may consist of the brackets 70 on the side flues 31 extending towards the combustion chamber shell 30 which is provided with cooperating brackets 71, with the brackets 70 and 71 loosely connected by longitudinally extending bolts 72. This connection has been found to permit sufficient relative movement to provide for the differential expansion noted above, but it should be understood that any form of slip joint would be equally effective.

As will be clear from the drawings, the combustion chamber shell 30 is generally teardrop or pear shape in vertical cross section or tapers upwardly with its sides converging from a semicircular bottom portion to a relatively smaller semicircular top portion. The side flues 31 are each of the same general tapered cross section as the combustion chamber shell but are oppositely disposed with their smaller ends at the bottom so that when assembled as shown in Fig. 6, the inner walls of the side flues are substantially parallel to the respective adjacent converging side walls of the shell and the outer walls of the side flues are substantially vertical and parallel to the casing wall 3 and partition 13 of the compartment 16.

To increase the area of the heating surfaces which are exposed to the air to be heated as circulated by the blower wheels, the side walls of the combustion chamber shell 30 and the side

walls of the flues 31 are formed with a multiplicity of conical protrusions or heat projectors 73 which also function as a scrubber on the air to thereby transmit a considerable portion of the heat from these walls directly to the circulated air. It is well known that heat can only be practically transmitted to air by conduction or convection and it is therefore desirable that any heat radiated from the combustion chamber shell and side flues be intercepted and transmitted to the circulated air.

As shown in Fig. 6, longitudinally extending flat sheets 74 are placed in the spaces between the side walls of the combustion chamber shell 30 and the inner side walls of the flues 31. These sheets extend substantially the entire length of the shell and flues and not only serve to intercept and absorb radiant heat and transmit this heat to the circulated air but project downwardly to function as air separators and distribute the circulated air for passage in contact with the several heating surfaces. Since the flat sheets 74 are arranged substantially parallel to the adjacent direct heating surfaces, they offer no appreciable resistance to the air flow but are wiped by the circulated air and give off heat thereto, and may be termed "wipe" sheets or radiation shields. A longitudinally extending flat heat intercepting and absorbing sheet 75 is also provided between the outer casing wall 3 and the adjacent side flue 31.

Referring to Fig. 3, it will be seen that two parallel flat sheets 76 and 77 are provided between the front end of the combustion chamber shell and side flues and the partition 11, and two sheets 78 and 79 are also placed between the rear end of the shell and flues and the rear casing wall 4. These sheets, together with sheet 75, prevent the transmission of any appreciable degree of heat to the casing walls by intercepting and absorbing the radiant heat and giving this heat off to the circulated air which is constantly wiping these sheets when the unit is in operation.

Proceeding now to description of the provisions for humidification and referring first to Figs. 3, 6 and 8, a relatively shallow water evaporating pan 80 is mounted beneath the combustion chamber shell 30 and spaced therefrom. This pan extends longitudinally of the entire length of the combustion chamber shell and is formed with longitudinal ribs 81 to provide a series of troughs.

The front of the pan 80 is supported by means of overhanging lugs 82 which engage over the projections 83 on the cover 38 on the front end of the combustion chamber shell. As may be seen in Fig. 8, one of the lugs 82 is of greater vertical dimension than the other so that the pan will be supported on a slight lateral incline for a purpose to be hereinafter set forth. The pan 80 is supported adjacent its rear end by a base 84 which is provided with an adjustable levelling screw 85 and a guide pin 86. The underside of the base 84 is provided with a groove which engages with a support bar or rod 87 which extends longitudinally beneath the pan 80 and is secured, as by welding, to the brackets 35 which support the combustion chamber shell 30.

By the foregoing arrangement the pan 80 is removably mounted by a three point support and may be readily adjusted or levelled longitudinally by means of the screw 85. Referring to Figs. 2 and 3, an opening with a removable cover 88 is provided on the partition 11 in front of the end of the pan 80 to permit access to or removal of the pan if necessary for repairs or replacement.

As has been stated above, the pan 80 is supported on a slight lateral incline and formed with longitudinal ribs 81 to provide a series of troughs. It will follow that if water is supplied to the uppermost trough it will flow in cascade to the successively lower troughs. A well 89 and overflow drain pipe 90 are provided at the front end of the lowermost trough to drain off any excess of water which is not vaporized. The drain pipe 90 has been shown as extending through the cover 88 and it will be understood that this pipe may be connected to or empty into any suitable means to deliver the excess water to some point of constant drainage or a usual waste pipe.

This construction of the pan 80 provides relatively shallow bodies of water with a large evaporating surface, and the pan is so located that the water surface is exposed directly to air entering the compartment 16 from the blower, which air passes over the water surface transversely to assist the evaporation. Since the pan 80 is located beneath the combustion chamber shell 30, the water will be heated by radiant heat therefrom to materially increase the evaporation.

To provide for still further evaporation, the feed water for the evaporating pan is preheated before reaching the pan. As shown in Figs. 3 to 5, the water flowing through the intake pipe 91 is adapted to flow upwardly through a heating coil 92 which is exposed directly to the heat of combustion in the combustion chamber shell 30. The heating coil 92 may be mounted on a removable plate 93 on the elbow 57 of the auxiliary air intake passage into the combustion chamber shell and extend through the tube 58. The water flows from the coil 92 through the outlet pipe 94 to a feed spout 95 which extends through the rear casing wall 4 and empties into one end of the uppermost trough of the evaporating pan. The spout 95 is shown as enlarged at its upper end which is closed outside of the rear casing wall 4 by a cover 96 which permits an examination of the rate of flow. This enlargement of the spout provides a space for the condensation of any steam which may be formed during passage of water through the heating coil.

To control the supply of water to the evaporating pan 80 through the heating coil 92, a standard humidistat (which is located at some suitable place in the space to be heated) is connected through the junction box 97 to operate a solenoid valve 98 in the water supply pipe to position this valve either open or closed in accordance with the humidity conditions which actuate the humidistat. The water supply pipe 91 is provided with a strainer 99 between the valve 98 and the source of water supply and with a manually adjustable valve 100 between the valve 98 and the connection to the heating coil 92. The pipe 91, together with valves 98 and 100 and strainer 99, may be supported on the rear casing wall 4 by the bracket 101. The function of the valve 100 is to provide a manual control of the rate of flow of the water so that any desired rate of humidification can be obtained. The rate of flow may be readily adjusted so that it will not exceed by any reasonable amount the evaporating capacity of the unit, or it may be cut considerably below this limit if desired. It should be noted that the valves are located between the source of water supply and the heating coil so that there are no moving parts in the water line subject to hot water or steam such as might tend to cause excessive deposits of foreign matter present in the water.

Referring now to Figs. 1 and 2, the controls for the oil burner and air blower motor consist generally of a master control unit 102, an air heat control unit 103, and a blower motor control unit 104. These controls are of standard construction and will therefore be described only to the extent of their location and general function. The controls are contained, for their greater part, within the compartment 14 and may be illuminated by an electric light 105 which may also be used to display a transparent or translucent ornamental name plate 106. The ends of the compartment 14 (parts of casing side walls 2 and 3) are preferably provided with louvers 107 to admit air for ventilation of this compartment and also the primary air for the oil burner 39.

The master control unit 102 constitutes the main control of the oil burner and is adapted to automatically start and stop the oil burner according to the dictates of the usual room thermostat which is located at some suitable place in the space to be heated. This unit 102 embodies a time cut-out mechanism to stop operation of the burner motor after a predetermined time if there is no initial combustion or a failure of combustion when the room thermostat has conditioned the control unit to complete the electrical connections to the burner motor. The cut-out mechanism includes a heat-responsive element which is subject to combustion temperature, and in the present installation this heat-responsive element is extended into one of the side flues 31 through the tube 108 which forms an effective seal to prevent leakage of combustion gases from the side flue.

The air heat control unit 103 also controls the burner motor and constitutes a limit switch to stop the burner motor at some predetermined maximum temperature to prevent damage from overheating. This unit is adapted to be controlled by the temperature of the heated air near the upper portion of the compartment 16 and has a heat-responsive element 109 extending into such compartment.

The blower motor control unit 104 functions to control the operation of the blower motor 27 in accordance with temperature of the heated air in compartment 16 and, like the unit 103, includes a heat-responsive element (not shown) extending into such compartment. This unit is preferably so constructed as to close the circuit to the blower motor when the air temperature in compartment 16 reaches a predetermined point (for instance, 175°) and maintain the blower motor in operation until the air temperature falls below a lower predetermined point (such as, for instance, 100°). It will, therefore, be apparent that there is a positive air circulation through the heat transfer compartment, etc., by the blower only when the air temperature is above that which might cause seemingly cold drafts of air from the house heating registers, and that the differential in the on-and-off settings of this control unit prevents excessive intermittent operation of the blower by a small drop in temperature when the blower is first operated or by a small rise in temperature when the blower is stopped.

In addition to the foregoing controls, it is con-

templated that an entirely separate switch be provided for controlling the blower motor for the circulation of air whenever no heat is desired, and when the unit may be operated for cooling and ventilating. As stated in the objects of this invention, the unit may be used during the summer months for ventilating and cooling by a positive recirculation of air within the house. It will be apparent that ducts may be provided to admit air from the basement or outside the house to the air inlet opening 9 of the unit with valves to control the air admitted from the various sources. Also, it will be apparent that cold water circulating or refrigerating coils, etc., may be provided in an air duct leading to the air inlet opening 9 to obtain a greater degree of cooling.

Whereas there has been described and illustrated a complete unit that has been found to be highly efficient in practical operation, it will be understood that the invention is not to be limited to the specific details but that many changes in details of construction, arrangement and operation may be resorted to without departing from the spirit of the invention.

I claim:

1. A heat transfer unit including a combustion chamber shell, a longitudinally extending flue on each side of said shell and communicating therewith, each of said flues being constituted by two substantially similar halves which are connected together at their edges and which are bent towards one another for a portion of their length intermediate their upper and lower edges to contact and form parallel flue passageways.

2. The construction set forth in claim 1 in which each of said flues is connected adjacent one end to said combustion chamber shell to provide communication between said shell and one of said flue passageways and said flue passageways communicate with each other adjacent the opposite end thereof.

3. An air heating and conditioning unit comprising a casing including vertical front, rear and side walls, a vertical partition wall extending between said side walls and providing a front compartment, a second vertical partition wall extending between said first partition wall and the rear wall to provide two adjacent rear compartments, said second partition wall being of such vertical extent as to provide for communication between said rear compartments through a space below the lower end of said wall, a humidifier and heat transfer unit in one of said rear compartments, air filters and an air circulating blower in said other rear compartment, and a burner mechanism for said heat transfer unit, a motor for said air circulating blower, and controls for said burner mechanism and blower motor in said front compartment.

4. The combination set forth in claim 3 in which the front wall of said casing is provided with a door to permit ready access to said burner mechanism, blower motor and the controls therefor.

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