March 17, 1953 H. G. BECK 2,631,580

FUEL BURNING AIR HEATER

Filed Feb. 10, 1949 2 SHEETS—SHEET 1

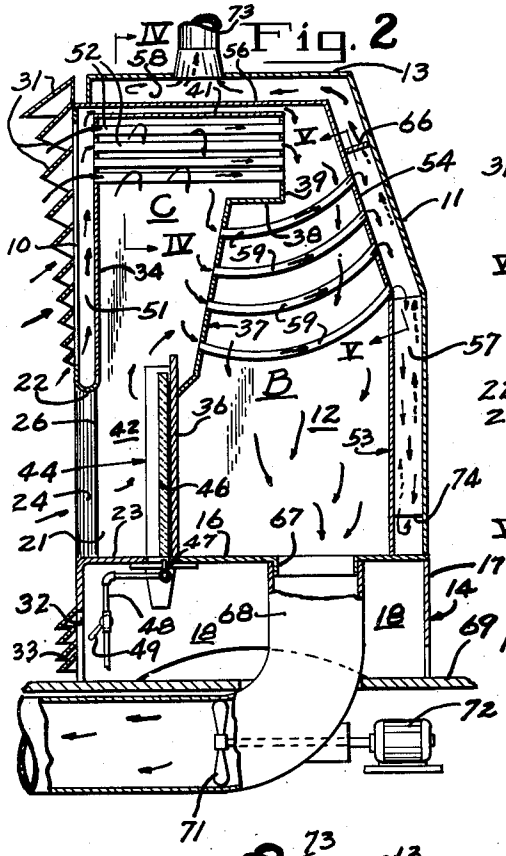


Fig. 2

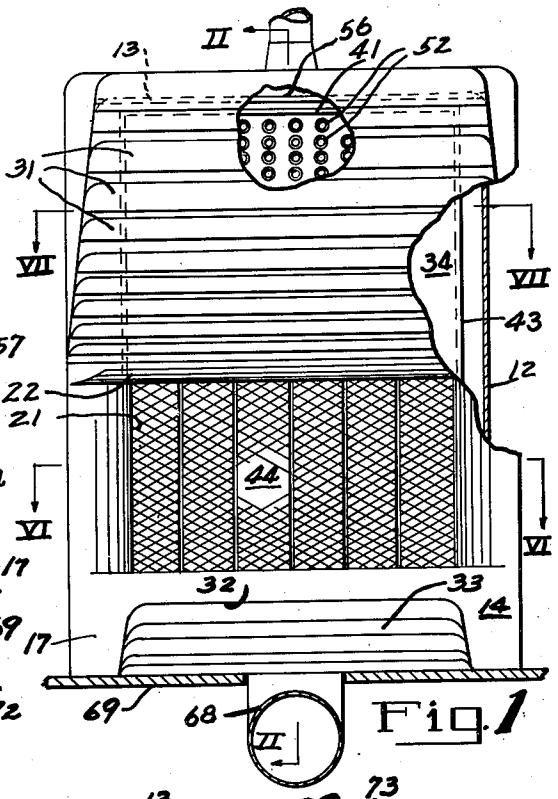


Fig. 1

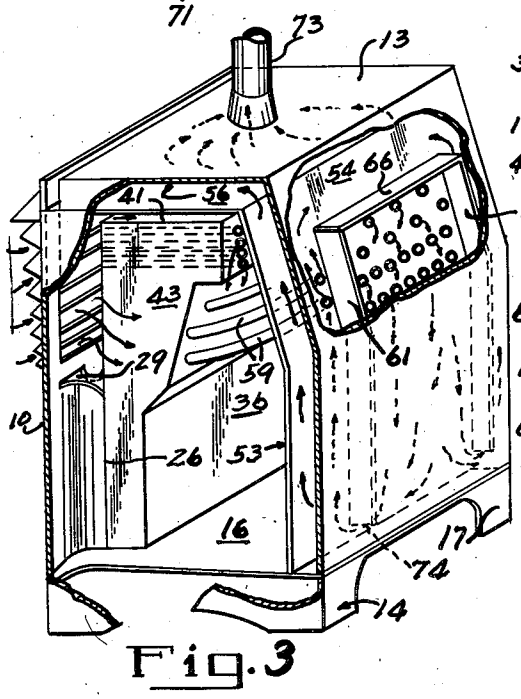


Fig. 3

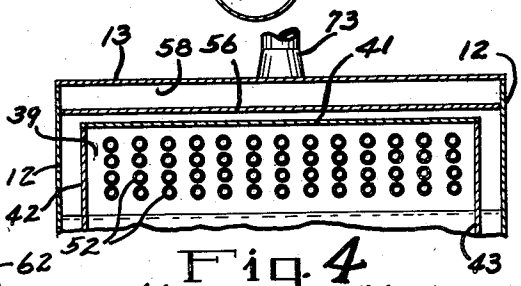


Fig. 4

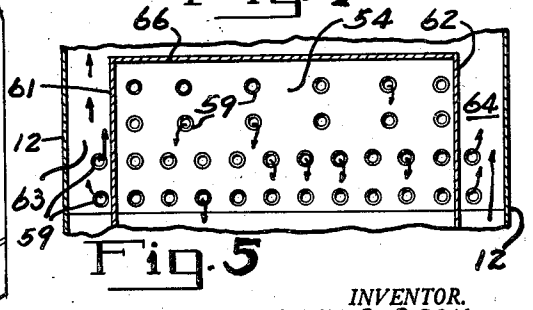


Fig. 5

INVENTOR.
HARRY G. BECK

BY Jennings & Carter

ATTORNEYS

March 17, 1953 H. G. BECK 2,631,580

FUEL BURNING AIR HEATER

Filed Feb. 10, 1949 2 SHEETS--SHEET 2

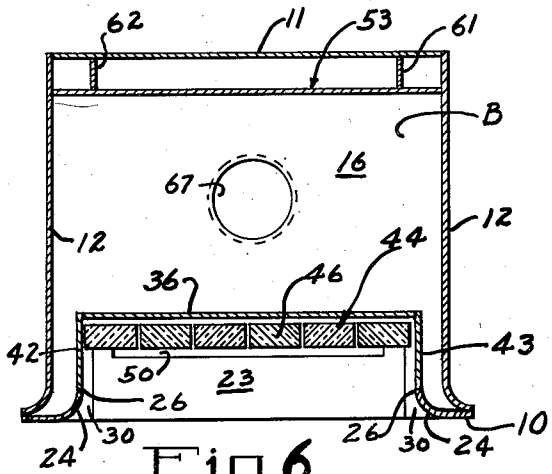


Fig. 6

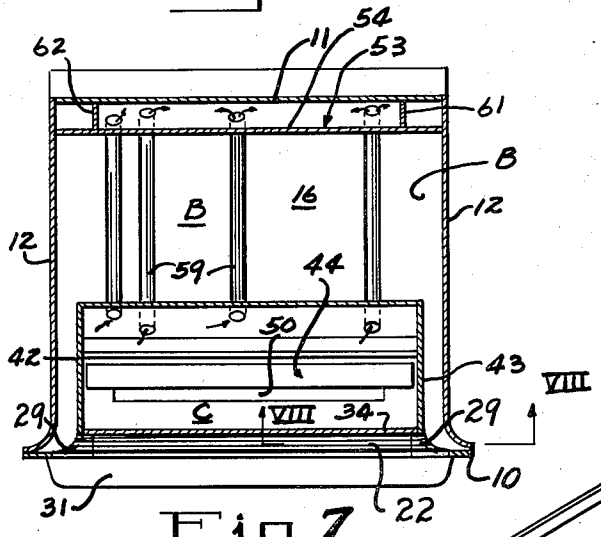


Fig. 7

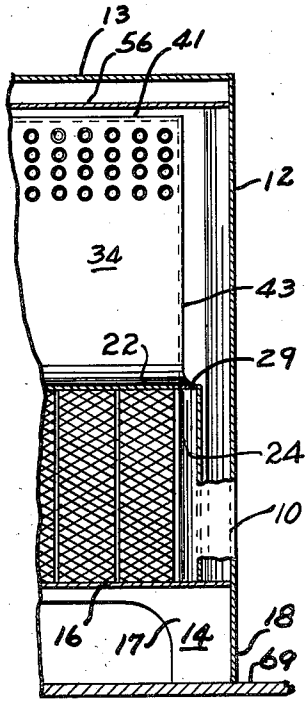


Fig. 8



Fig. 10

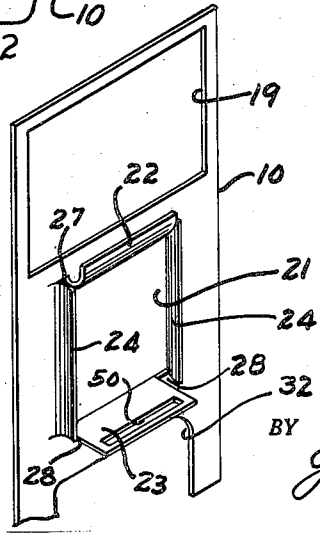


Fig. 9

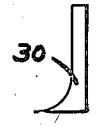


Fig. 11

INVENTOR.
HARRY G. BECK

BY

Jennings & Carter

ATTORNEYS

Patented Mar. 17, 1953 2,631,580

UNITED STATES PATENT OFFICE

2,631,580

FUEL BURNING AIR HEATER

Harry G. Beck, Birmingham, Ala., assignor of one-half to Fred K. Brown, Birmingham, Ala.

Application February 10, 1949, Serial No. 75,653

5 Claims. (Cl. 126—110)

1

My present invention relates to an air heater, and has for an object the provision of a heater which shall have improved heat transfer characteristics so that the maximum amount of heat generated by the burning of fuel is transferred to the air to be heated.

Another object is to provide an air heater embodying a combustion chamber and an air heating chamber, together with sets of flues so constructed and arranged that air to be heated passes through a set of the same disposed in the combustion chamber, and the products of combustion pass through the other set thereof disposed in the air heating chamber, whereby the maximum amount of heat is transferred from the products of combustion to the air to be heated.

My invention further contemplates a heater in which the combustion chamber is disposed in the air heating chamber, the major portion of the air heating chamber lying behind the combustion chamber, the rear wall of the former extending substantially across the latter, said wall also forming respectively the rear flue sheet for the set of flues through which passes the air to be heated, and the front flue sheet for the flues through which pass the products of combustion, thus not only adding to the thermal efficiency of the heater but also resulting in a compact, economical construction.

A further object is to provide a heater embodying the above enumerated features and in which the products of combustion, after passing through the flues therefor are caused to flow downwardly behind the rear wall of the air heating chamber and then upwardly over the top thereof through relatively narrow passages disposed at each corner of the rear wall of the combustion chamber, and thence to a draft stack, whereby the products of combustion are caused to move slowly downward in contact with a large area of the rear wall of the air heating chamber while at the higher temperature, and are then caused to move upwardly at a high velocity and in contact with a small area of the rear wall after a large part of the heat is removed therefrom, thus increasing substantially the thermal efficiency of the heater.

It is another object of my invention to provide an air heater in which the front lower portion of the combustion chamber is open, permitting heat generated by a heat unit placed therein to radiate directly into the room to be heated, while at the same time the products of combustion from the heat unit are all carried from the room in a closed circuit.

Apparatus embodying the features of my invention is illustrated in the accompanying drawings forming a part of this application in which:

2

Fig. 1 is a front elevational view, partly broken away in section;

Fig. 2 is a vertical sectional view taken generally along line II—II of Fig. 1;

Fig. 3 is a somewhat diagrammatic perspective view with certain portions of the outer jacket broken away to disclose some of the interior parts;

Fig. 4 is an enlarged detail sectional view taken generally along line IV—IV of Fig. 2;

Fig. 5 is an enlarged detail sectional view taken generally along line V—V of Fig. 2;

Fig. 6 is a sectional view taken along line VI—VI of Fig. 1;

Fig. 7 is a sectional view taken along line VII—VII of Fig. 1, some of the flues being omitted;

Fig. 8 is a fragmental elevational view, partly broken away and taken along line VIII—VIII of Fig. 7;

Fig. 9 is a perspective view looking at the rear of the front wall of the outer jacket of the heater; and

Figs. 10 and 11 are detail perspective and plan views, respectively, of the odd shaped fill-in plates used at the upper and lower corners of the opening in the front wall of the outer jacket.

Referring now to the drawings for a better understanding of my invention, my improved heater comprises a jacket having a front wall 10, a rear wall 11, and side walls 12, and a top wall 13. In the manner well understood, the walls are joined together at the meeting points by welding or otherwise. The jacket is supported on a base 14 comprising a horizontal plate 16, and vertical rear and end walls 17 and 18. Likewise, the remainder of the structure of the heater is supported principally from the plate 16, as will appear later.

The front wall 10 of the jacket is formed of a plate having an opening 19 at its top and a centrally disposed opening 21 adjacent its bottom. The upper edge of the lower opening carries an upwardly and inwardly curved lip 22, substantially coextensive in length with the width of the opening 21. The lower edge of the opening 21 carries an inwardly turned horizontal flange 23, while the sides of the openings carry inwardly curved lips 24. The vertical rear edges of the lips 24 are welded along the line 26 to the side plates of a combustion chamber as will later appear. The resulting upper and lower open corners 27 and 28 between the lips 22—24 and 23—24 are closed by odd shaped fill-in plates 29 and 30 for

filling respectively the openings 27 and 28, thereby to effectively seal around the opening 21 for a purpose later to appear. A plurality of louvers 31 are disposed across the upper opening 19 through which air to be heated passes, and which serve to ornament the front of the heater. As thus shown in Fig. 9, the lower part of the plate 10 is cut out as indicated at 32, and the space therebetween may likewise be filled with louvers if desired as shown in Fig. 1.

Disposed with its lower edge abutting the upturned edge of the lip 22 is a plate 34. Secured to the plate 16 as by welding along its lower edge, is a vertical plate 36, which as shown in Fig. 2 is spaced rearwardly of the plate 34 behind the lower opening 21 in the plate 10. Welded to the plate 36, and inclined upwardly and rearwardly therefrom is another plate 37, bent to provide a horizontal portion 38, and thence bent to provide a vertical portion 39. The plate 34 and the portion 39 of plate 37 are joined across their tops by means of a plate 41. End plates 42 and 43, cut along their rear edges to conform to the configuration of the rear plate 37 are secured as by welding to the ends of plates 34, 36, 37, and 41, and are welded along their bottom edges to the inturned lip 23. The structure just described defines a combustion chamber C having a relatively shallow lower portion as considered from front to rear of the heater, and a relatively deeper portion at its top.

Resting on the plate 16, just forwardly of the plate 36 to lie within the bottom of the combustion chamber C and behind the opening 21, is a heat unit indicated generally by the numeral 44. While the heat unit employed may burn either solid, liquid or gaseous fuels, I have, for the purpose of illustration, shown the same as comprising a gas heater having the usual refractory backing blocks 46, the burner element 47, the gas supply line 48, and a control valve 49. Air for combustion may if desired be supplied through an elongated opening 50 in the flange 23.

It is to be noted that the plate 34 is placed rearwardly of the plate 10 an amount depending upon the radius of the lip 22, thereby to define a space between these plates indicated by the numeral 51. Within the deep upper portion of the combustion chamber C are a plurality of flues or air pipes 52. The flues extend rearwardly and are fixed at either end in openings in the plate 34 and in the vertical portion 39 of the plate 37, thus to communicate at their forward ends with the space 51 and provide air passages through the chamber C.

Adjacent the rear of the plate 16 and secured as by welding to the upper surface thereof along its lower edge is a vertically extending plate 53. The plate 53 is bent to provide a forwardly inclined portion 54, and thence is bent horizontally and forwardly to provide a portion 56 passing over the upper plate 41 and in spaced relation thereto. The plate 56 overhangs the plate 34 and is welded to the front plate 10. The plate 53, and its portions 54 and 56 are spaced from the rear walls 11 and the top wall 13 of the outer jacket, thereby to provide communicating spaces 57 and 58 respectively. The plate 53, and its portions 54 and 56 extend outwardly to join the end walls 12 of the jacket as indicated more particularly in Figs. 6 and 7. Plate 53 and its portions 54 and 56, together with the end walls 12 of the outer jacket thus define a space B, closed at its bottom by the plate 16, and which I term an air heating chamber. The flues 52 thus communicate with the space 19 and with the chamber B, the plates 34 and vertical portion 39 of plate 37 forming the flue sheets at each end of the flues.

Secured at either end in suitable openings in the rearwardly inclined portion of the plate 37 and the forwardly inclined portion 54 of the plate 53 are a plurality of curved flues 59. The curvature of these flues is such that their rear ends are higher than the forward ends. The flues 59 thus communicate with the combustion chamber C at a point between its top and bottom, and with the space 57 between the rear jacket wall 11 and the plate 53.

Referring particularly to Figs. 3, 4 and 5, secured to the rear of the plate 53 and extending vertically along the inclined portion 54 thereof are spaced baffle plates 61 and 62. The baffles 61 and 62 are spaced relatively far apart with respect to each other, and close to the end walls 12 of the jacket to provide a centrally disposed wide space and a pair of relatively narrow vertically extending spaces 63 and 64. The baffles 61 and 62 are cross connected by means of a baffle 66, disposed above the uppermost ones of the flues 59. The baffle plates 61, 62, and 66 thus inclose the rear ends of all of the tubes 59 except a minor number thereof which emerge through the plate 53 into the spaces 63 and 64. The purpose of these tubes in the functioning of the heater will be described later.

The base plate 16 is provided with an opening 67, and connected to this opening is a conduit 68. The conduit may lead beneath the floor 69 of a room in which the heater is located, the conduit may have therein an induction fan 71, driven by a motor 72. The conduit may lead to hot air registers, not shown, whereby air from the chamber B is delivered from the heater to one or a number of rooms.

The top jacket wall 13 is provided with an opening whereby the space 58 is connected by a suitable pipe 73 to a draft stack, not shown.

From the foregoing the method of constructing and using my improved heater may now be readily explained and understood. With the unit constructed and arranged as shown and explained, it will be apparent that heat generated by the heat unit 44 rises upwardly into the upper part of the combustion chamber C, and in a whirling movement is drawn through the flues 59, from whence it passes into the space 57 between the plates 53 and 11 below the cross baffle 66. In response to the draft from the stack as applied to the flue 59, the gases of combustion are caused to move downwardly in the space 57 between the baffles 61 and 62, and thence to flow under the lower edges 74 thereof, upwardly into the spaces 63 and 64, into the space 58 between the plates 56 and 13, and thence to the stack. With the fan 71 in operation, air to be heated is drawn through the louvers 31, into the space 51, through the flues 52 and into the air heating chamber B, and thence into the conduit 68. Simultaneously, some air in the space 51 is free to pass over the top of the plate 41 of the combustion chamber, and some around the sides thereof and directly into the chamber B without going through the flues 52. It will be apparent that the air is heated in the combustion chamber C while passing through the flues 52, and is further heated after entering chamber B because of the fact that the hot gases of combustion are passing through the flues 59. Further, heat is absorbed by the air to be heated while the products of combustion are moving downwardly in the space 57,

at which time the gases are still at a relatively high temperature. Once the gases reach the lower edges 74 of the baffles 61 and 62, and enter the relatively narrow spaces 63 and 64 their velocity is increased, and they move upwardly and out of the heater at a relatively rapid rate and after most of the heat has been removed therefrom. It is to be noted that spacing the top plate 41 of the combustion chamber C from the plate 56 in effect insulates the hottest part of the system from the coldest part; that is, since some of the air to be heated flows between the plates 41 and 56, this relatively cold air absorbs some of the heat from the gases about to go to the stack. Being relatively cool this air readily takes up heat from the plate 56, thus recovering heat which otherwise would be lost. This arrangement materially increases the thermal efficiency of the unit as a whole. In actual practice I have found my improved heater to be considerably more efficient than those types of heaters in which the air passes only through a set of flues.

The purpose of having a relatively few of the flues 59 exit into the spaces 63 and 64 is to provide a limited amount of draft when first starting the heater, so that any unburned gas has a ready and direct exit to the stack. Since the rear ends of the flues 59 are higher than the forward ends thereof, a natural draft through the flues is provided.

It will also be noted that the heat unit itself is disposed immediately behind the opening 21 in the front plate 10. The same is therefore readily available for servicing, and also the refractory members 46 radiate heat directly into the room to be heated. It will be obvious however that if my improved heater is to be used as central system, the opening 21 may be completely closed, thereby to cause all of the heat to rise to the top of the combustion chamber C, there to be used in heating the air taken in through the louvers 31. Further, it will be apparent to those skilled in the art that instead of the louvers 31 a cold air return conduit could be connected to the opening 19 of the front plate 10, thereby making the unit suitable for use in a closed system in the manner well understood. Likewise, by omitting the fan 71 or reversing the same, cold air may be drawn in through the opening 67 from whence it flows reversely through the flues 52 and out of the opening in plate 10.

From the foregoing it will be apparent that I have devised an improved heater which is simple of construction and manufacture, and which is efficient and compact. Likewise, by completely sealing around the opening 21 by means of the lips 22 and 24 and the fill-in plates 29 and 30, there is no chance for the products of combustion to become mixed with the air to be heated.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. In an air heater a combustion chamber defined by front, rear, top and end plates, there being a centrally disposed opening adjacent the lower end of said front plate, means forming an air inlet passageway adjacent the top of said front plate, a heat unit in the combustion chamber adjacent the opening in said front plate, a plurality of air pipes communicating with said inlet passageway and passing through the front and rear plates adjacent the top of the combustion chamber, rear, top and end walls forming an air heating chamber surrounding the rear, top and end plates of the combustion chamber, a plurality of rows of superposed vertically spaced flues disposed in the air heating chamber connected directly at one end with the combustion chamber at points below the rear ends of said air pipes and opening rearwardly of the rear wall of said air heating chamber, walls disposed rearwardly of the rear wall of the air heating chamber and operatively associated therewith to define a closed space to which said flues communicate, means to vent said space, and means to pass air to be heated through the air pipes and into and out the bottom of said heating chamber.

2. In an air heater, an outer jacket comprising front, rear, top, bottom and end walls, front, rear, top and end plates, spaced inwardly of the respectively corresponding walls of said jacket and defining a combustion chamber, there being a centrally disposed opening adjacent the lower end of the front wall of said jacket and an aligned centrally disposed opening adjacent the lower end of the front plate, there being an inlet passageway in the upper portion of the front wall of said jacket in communication with the space between the front wall of said jacket and the front plate of the combustion chamber, a plurality of air pipes communicating with said inlet passageway and passing through said front and rear plates adjacent the top of the combustion chamber, a partition wall having a portion spaced forwardly of the rear wall of said jacket and another portion spaced beneath the top wall thereof defining a continuous space therebetween, said partition wall and the rear plate of said combustion chamber defining between them an air heating chamber, a plurality of flues disposed in the air heating chamber connected directly at one end with the combustion chamber at points below the rear ends of said air pipes, the other ends of said flues opening rearwardly of said partition wall and communicating with said continuous space, means to vent said continuous space, and means to pass air to be heated through the air pipes and into the heating chamber and out the bottom thereof.

3. In an air heater, an outer jacket having front, rear, top, bottom and end walls, a plate disposed forwardly of the rear wall and having a top portion extending forwardly in spaced relation beneath the top wall of the jacket, said plate being joined along its side edges to the end walls of the jacket thereby defining a closed space extending upwardly along the rear and under the top of the jacket, a draft connection to said space at the top of the jacket, a combustion chamber within said jacket formed of front, rear and end walls joined by a top wall, the top and rear walls of said combustion chamber being spaced from said plate to define therebetween an air heating chamber, the end walls and the upper portion of the front wall of the combustion chamber being spaced from the end walls and the upper portion of the front wall respectively of said jacket, a plurality of air pipes passing through the front and rear walls of said combustion chamber adjacent the top thereof, a heat unit in the combustion chamber, a plurality of flues connected directly at one end with the combustion chamber at points below the rear ends

of said air pipes and opening rearwardly of said plate in direct communication with said closed space between the plate and the outer jacket, there being an inlet passageway in the upper portion of the front wall of said jacket in communication with said air pipes and with the space between the upper portion of the front wall of said jacket and the upper portion of the front wall of the combustion chamber, and means to pass air to be heated through the air pipes and into and out the bottom of said air heating chamber.

4. Apparatus as defined in claim 3 in which said space defined between the plate and the outer jacket is divided by baffles into a relatively wide space flanked on either side by relatively narrow spaces, there being a cross baffle connecting the upper ends of said vertical baffles, and in which the majority of the flues communicate with the space between the vertical baffles and beneath the cross baffle, and a minor number thereof communicate with said narrow spaces.

5. Apparatus as defined in claim 3 in which

the ends of said flues connected to the rear wall of the combustion chamber are at a lower level than the ends thereof connected to the rear plate.

HARRY G. BECK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,547,316	Gehnrich	July 28, 1925
1,666,679	Bridge	Apr. 17, 1928
1,689,067	Benner	Oct. 23, 1928
1,730,298	Rynicker	Oct. 1, 1929
2,234,628	Dunham	Mar. 11, 1941
2,299,901	Johnston	Oct. 27, 1942
2,390,483	Wingert	Dec. 4, 1945

FOREIGN PATENTS

Number	Country	Date
257,202	Great Britain	Aug. 26, 1926
255,342	Switzerland	Jan. 17, 1949