Sept. 30, 1952 R. F. GIBLER 2,612,153

HEAT EXCHANGER BAFFLE STRUCTURE FOR AIR-HEATING FURNACES

Filed May 9, 1947 2 SHEETS—SHEET 1

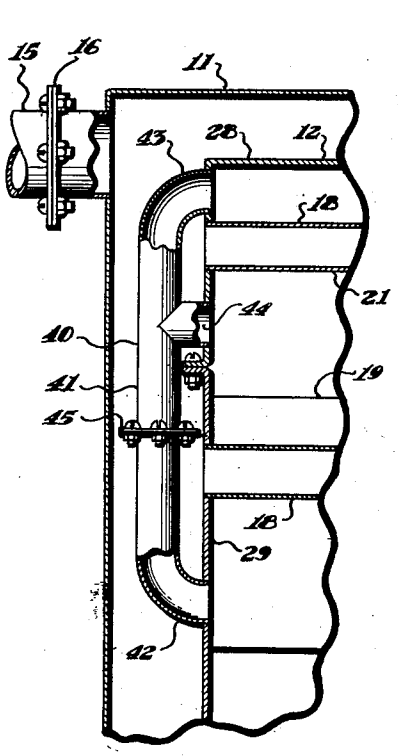


Fig. 3

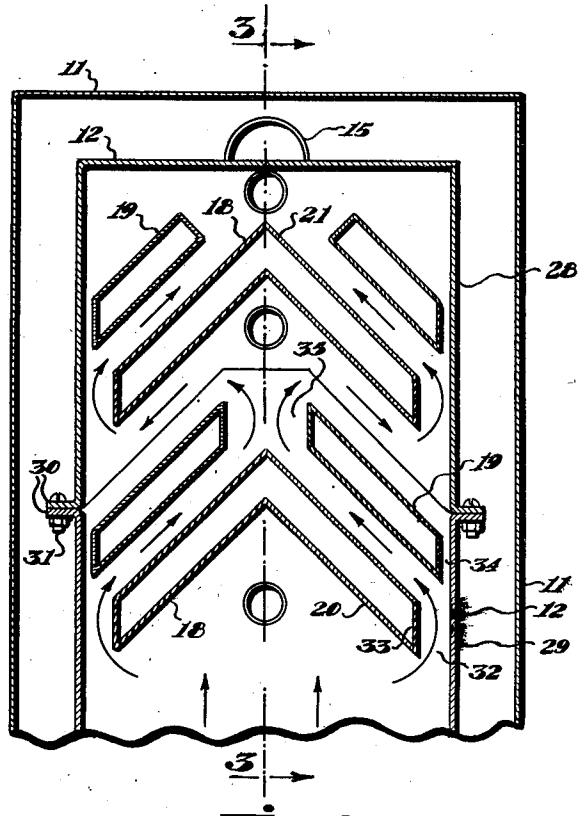


Fig. 2

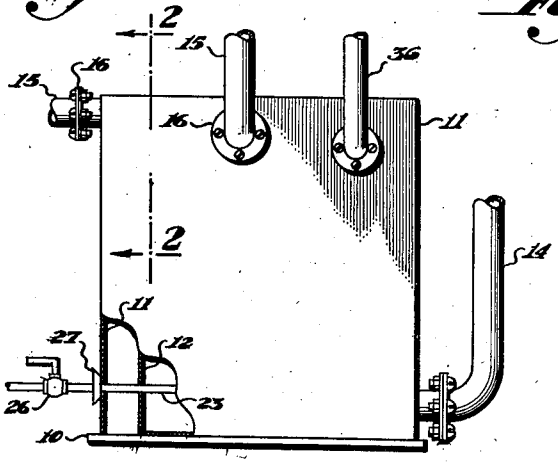


Fig. 1

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HEAT EXCHANGER BAFFLE STRUCTURE FOR AIR-HEATING FURNACES

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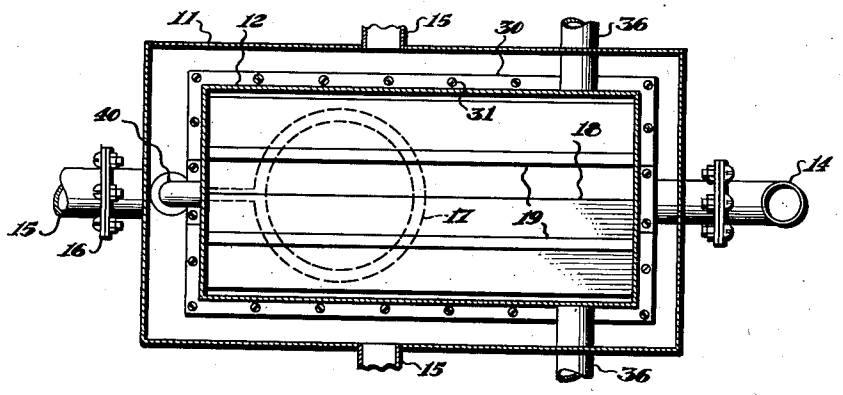


Fig. 5

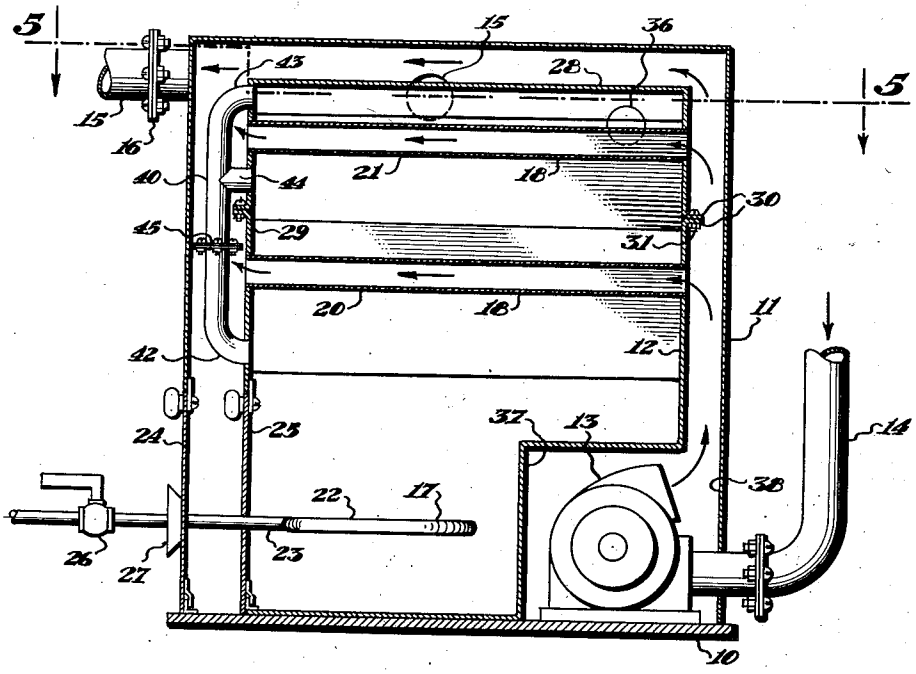


Fig. 4

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HEAT EXCHANGER BAFFLE STRUCTURE FOR AIR-HEATING FURNACES

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7 Claims. (Cl. 126—110)

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This invention relates to furnaces and to heat exchangers for furnaces. More particularly it relates to an improved baffle structure for use within a heating unit to catch and hold combustion gases in contact with heat exchange surfaces until the heat is removed therefrom by means of a fluid heat exchange medium.

One of the major sources of heat loss in furnaces occurs in the release of combustion gases through the stack while still hot. The exiting gases can carry with them a major portion of their heat. A principal objective of this invention has been to provide a construction for the internal portion of a furnace in which substantially all the heat carried by combustion gases is removed therefrom before the gases can leave the furnace.

A further objective of this invention has been to provide baffles within a furnace which are constructed to hold the combustion gases until the heat has been extracted or transferred from them to the medium they are intended to heat.

A principal disadvantage of prior baffle structures for furnaces has been that the baffles have been so designed that they trap and hold dust and fly ash carried in the combustion gases, which collect and build up heat insulating surfaces upon the baffles interfering with the proper flow of the combustion gases past the baffles and insulating heat exchange surfaces of the baffles to limit the amount of heat exchange possible. In accordance with this invention baffles having a self cleansing characteristic are provided in which dust and dirt do not collect upon the heat transfer surfaces. Briefly, this invention provides a plurality of baffles having heat transfer surfaces inclined generally at an angle greater than the angle of repose of dust, ash, or soot contained in the hot gases to permit particles of dust etc, to roll downwardly under the influence of gravity. The lower edges of the baffles are spaced from the sides of a furnace box to provide space through which the particles can fall from the baffles into the bottom of the furnace box.

The baffle structure is arranged to provide a tortuous path through which the hot gases flow and includes a series of peaked, trap baffles of inverted trough shape which may have a cross-section of inverted U-shape or inverted V-shape. Preferably, trap baffles of inverted V-shape are employed having sides inclined at an angle steeper than the angle of repose of dust particles. The baffles are positioned within the furnace above the source of heat. Preferably, a gas or oil burner is employed but the baffles structure of this invention may be used to advantage with other types of heating units as well. Intermediate the trap baffles are directive baffles which cooperate therewith to guide hot gases into the trap baffles. The directive baffles are maintained parallel to and spaced from and between the sides of the peaked trap baffles. The outer edges of the trap baffles are spaced from the sides of an inner furnace box while the outer edges of the straight directive baffles approach quite close to the sides of the furnace box without touching. The trap baffles serve to catch and hold combustion gases while heat is removed from them, and the directive baffles channel the gases into the trap baffles and prevent the gases from rising freely around the edges of the trap baffles. The spaces between the lower edges of the directive baffles and the sides of the furnace box are sufficiently narrow to inhibit the upward flow of hot gases yet sufficiently wide to allow particles of dust to fall freely therethrough.

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As the heated combustion gases rise from the burner, they are caught and held in the peaks of the trap baffles. Only after the gases have cooled sufficiently to displace gases below them do the combustion gases trapped at the apex of each trap baffle settle downwardly and outwardly to be removed from the baffle. When the gases have flowed downwardly inside the bottom-most trap baffle they flow outwardly around the ends and upwardly along its upper surfaces and below the directive baffles to be caught in the apex of the next higher trap baffle where the heat exchange cycle is repeated. Thus, the hot gases are forced to flow down as well as up and are prevented from escaping from the baffles without delivering their heat to the heat exchange fluid.

The baffles are attached to the sides of an inner furnace box and preferably are made of a hollow construction so that the heat exchange medium may be forced through the baffles as well as around the sides of the inner furnace box to pick up all the heat of the combustion gases before the gases can be expelled from the furnace. The baffle structure of this invention may be employed with either a gaseous exchange medium such as air or a liquid heat exchange medium such as water and serves to conserve heat and prevent its dissipation until the heat exchange medium can pick it up.

Other objects and features of the invention will be apparent from the following description of the drawings which represent a preferred embodiment of the invention and in which is shown a furnace having a heat exchange containing

baffles and constructed in accordance with this invention. Gas is the most expensive fuel commonly burned in furnaces and therefore it is necessary with gas to use the most effective heat transfer system. Hence, the invention is shown embodied in a furnace having a gas heating element. In the drawing:

Figure 1 is a side elevational view partly broken away and in section of a furnace constructed in accordance with this invention.

Figure 2 is an enlarged sectional elevational view taken along the line 2—2 in Figure 1.

Figure 3 is an enlarged fragmentary sectional elevational view taken along the line 3—3 in Figure 2.

Figure 4 is a sectional elevational view taken along the same section line as Figure 3.

Figure 5 is a sectional plan view taken along the line 5—5 in Figure 4.

As illustrated in Figures 1 and 4 the furnace rests upon a base 10. The furnace includes an outer shell 11 and an inner shell 12, between which shells air is circulated by means of a blower 13. Air is introduced into the furnace through an intake pipe 14 and is heated by being driven between the shells and through baffles in the inner shell and thereupon forced from the furnace through heating pipes 15. The heating pipes 15 are attached to the outer shell 11 by means of appropriate joints 16.

A heating unit 17 is located near the bottom of the inner shell 12, and heated combustion gases from the heating unit 17 rise and are caught by trap baffles 18 of inverted V-shape, which are attached to and form a part of the inner shell 12.

As shown in Figure 2, the baffles 18 catch and hold the heated combustion gases as they rise from the heating unit 17 until their heat is removed. Then the gases flow downwardly and outwardly around the edges of the baffles 18 as shown by the arrows in Figure 2 and rise around the upper sides of the trap boxes 18. Diagonal directive baffles 19 are provided which parallel the sides of the trap baffles 18 and channel the combustion gases into and along the sides of the V-shaped trap baffles. When the heated combustion gases have risen from a lower trap baffle 20, they rise and are caught by an upper trap baffle 21 where again they are held and trapped until heat is removed therefrom.

In more detail, the outer shell 11 of the furnace is constructed of light sheet metal and, with the inner shell, defines passages through which air may be forced to pick up heat from the inner shell. Various heating pipes 15 of appropriate size are attached to and lead from the outer shell 11.

The heating unit 17 is here shown constructed of a ring 22, which may burn gas as a fuel. However, if desired, an oil burner may be substituted for the gas ring shown without departing from the spirit of this invention. The gas ring 22 is connected to and supported by a gas pipe 23 which passes through the inner and outer shells. Inspection doors 24 and 25 in the outer and inner shells respectively permit inspection and removal of the burner ring 22. A valve 26 on the gas pipe 23 (shown schematically) regulates the height of the gas flame. A mixing valve 27 (shown schematically) adjusts the amount of air directed into the furnace for use in supporting combustion.

The inner shell, which is preferably constructed of suitably heavy gauge sheet metal sections

welded together, includes an upper half 28 and a lower half 29. The halves are equipped with attaching lips 30 and are joined together by a series of bolts 31. The inner shell is preferably constructed as shown in two sections for ease in handling, cleaning, and repair of the baffle structure inside the inner shell.

Each half carries a trap baffle 18 and a pair of directive baffles 19 parallel to and spaced from the upper sides of the trap baffle. All of the baffles are hollow, as clearly shown in Figure 2. A considerable space 32 separates each of the outer edges 33 of the trap baffles from the sides of the inner shell 12 and combustion gases flow about the ends of the trap baffles when rising through the inner shell. On the other hand, the directive baffles are spaced from the sides of the inner shell 12 by only small spaces 34, while the inner edges of the directive baffles 19 are separated by spaces 35 which are much larger than the spaces 34. Accordingly, the gases rising from the V-shaped trap baffles pass between the inner ends of the directive baffles when rising and are directed into the next higher trap baffle. However, any dirt, ash, or foreign matter which may become associated with the combustion gases cannot settle and build up on top of the baffles but rather falls downwardly through the small spaces 34 about the outer edges of the directive baffles. Thus, there is no accumulation of dirt and ash upon the baffles which might impair heat exchange and lower the efficiency of the furnace, and all dirt, ash, and foreign matter settles below the baffles. Dirt, etc. which has settled to the bottom of the inner shell can be removed at intervals through the inspection doors 24 and 25.

The baffles 18 and 19 run lengthwise of the furnace as shown in Figure 4 and are welded to the ends of the inner shell so that each baffle has open ends through which air, which is the heat exchange fluid employed in the unit illustrated, is circulated as shown by the arrows in Figure 4.

Combustion gases, after leaving the upper trap baffle 21 pass out of the inner shell through a pair of smoke pipes 36. The smoke pipes 36 are located near the right hand end of the inner shell as shown in Figure 4, while the heating unit 17 is located near and under the left hand end of the inner shell. Thus, before combustion gases can leave the inner shell they must rise through the inner shell being caught and held by each trap baffle in turn and additionally must flow the length of the shell before being removed from the furnace through the smoke pipes.

The lower right hand corner of the inner shell 12 is cut away, as shown at 37 in Figure 4, to provide a space in which the blower 13 is located. Air to the blower 13 is introduced through an intake pipe 14. The blower 13 is here shown as a centrifugal type blower. It discharges air against the right hand wall 38 of the outer shell 11. The air driven by the blower is forced around all sides of the inner shell 12, over the top thereof and through the hollow baffles 18 and 19. The baffles are all welded in place in the furnace and, because of the good heat conducting properties of the relatively heavy sheet metal of which the inner shell is constructed, heat transferred to the baffles need not all be absorbed by air passing through the baffles. The conduction of heat from the baffles to the outer walls of the inner shell

makes it possible for the air driven around the sides and over the top of the inner shell 12 to pick up heat as well as the air driven through the inside of the hollow baffles.

The furnace illustrated in the drawings is shown equipped with a gas burner as the source of hot gases. As a safety measure a manifold 40 (Figure 2) is provided which by-passes the V-shaped baffles. The manifold 40 is constructed of a pipe 41 having angular ends 42 and 43 which project into the inner shell 12 respectively below and above the trap baffles. A short pipe 44 leads from below the upper trap baffle into the manifold 40. The manifold serves to lead gas around the baffles and into the smoke pipes 36 in case the burner becomes extinguished. A connection 45 is provided in the pipe 41 and makes it possible to remove the upper half of the inner shell from the lower half.

The baffle structure of the present invention permits the maximum economy in the use of fuels which do not require a powerful draft to cause combustion. The combustion gases are caught by the trap baffles and held in the peaks of each until sufficient heat has been removed therefrom that the gases will have cooled until the gases along the lower portions of the baffle can be displaced. Only after the combustion gases have cooled sufficiently to displace the gases which are below can they escape. Then the gases are led and channeled between the upper surfaces of the trap baffles and the directive baffles 19 to be caught and held by the next higher trap baffles. This construction makes it possible to permit the gases rising through the smoke pipe to have a temperature only a small amount above room temperature.

The furnace herein shown utilizes air as its medium for the transfer of heat. However, other heat transfer fluids may be employed. More particularly, liquids such as water may be led or pumped through the baffle structure instead of air, and the invention is not intended to be limited by the foregoing description of a preferred embodiment except as pointed out in the appended claims.

Having described my invention, I claim:

1. A heat exchange unit comprising; an outer shell, an inner shell disposed within the outer shell in spaced relationship therewith, a source of combustion gases located adjacent the bottom of the inner shell, a plurality of hollow baffles of inverted trough shape in cross section extending across said inner shell above the source of combustion gases with the opposite ends of the baffles communicating with the space between the inner and outer shells, a plurality of hollow directive baffles interposed between said inverted trough shaped baffles and spaced vertically with respect to them to delineate a tortuous passageway for rising combustion gases and to direct said rising combustion gases to the undersides of the trough shaped baffles, and means for circulating a heat transfer fluid through the outer shell to exchange heat through said baffles.

2. A heating unit comprising; an outer shell, an inner shell disposed within the outer shell in spaced relationship therewith, a plurality of hollow heat exchange baffles extending across said inner shell, a source of combustion gases located within the lower portion of the inner shell, and a manifold tube having passageways extending through the inner shell below and above the baffles and adapted to bypass a regulated volume of combustion gases around the baffles.

3. A heating unit which comprises an outer shell, an inner shell contained within said outer shell, walls of said inner shell being spaced from walls of said outer shell, a plurality of trap baffles mounted inside said inner shell, said baffles being of peaked shape and mounted in spaced vertical relationship, said baffles being hollow and being attached to front and rear ends of said inner shell, the hollow spaces in said baffles communicating with the space between said shells, a source of combustion gases within said inner shell and below said plurality of baffles, and means for circulating a heat transfer fluid between said shells and through said baffles to recover heat from said combustion gases.

4. A heating unit which comprises an outer shell, an inner shell contained within said outer shell, the walls of said inner shell being spaced from the walls of said outer shell, a plurality of baffles mounted within said inner shell, said baffles being of peaked shape and mounted in spaced vertical relationship, and being attached to front and rear ends of said inner shell, a gas burner within said inner shell and below said peaked baffles, whereby hot combustion gases rise and are caught and held in the peaked baffles until heat is removed therefrom, and a manifold tube having its lower end connected to the inner shell below said baffles and its upper end connected to the shell above the baffles to bypass a controlled volume of combustion gases past the baffles.

5. A heating unit which comprises an outer shell, an inner shell contained within said outer shell, the walls of said inner shell being spaced from the walls of said outer shell, a plurality of heating pipes connected to and leading from said outer shell, a plurality of baffles mounted within said inner shell, said baffles being of inverted V-shape and mounted in spaced vertical relationship, the outer edges of said baffles being spaced from the sides of said inner shell to permit the flow of combustion gases about the ends of said baffles, a plurality of directive baffles parallel to and spaced from the sides of the V-shaped baffles, the inner edges of the directive baffles being spaced to permit the flow of combustion gases, the outer edges of said directive baffles being spaced from the edges of the inner shell to permit finely divided solid matter in the combustion gases to fall through said inner shell, a source of combustion gases within said inner shell and mounted below said baffles, whereby combustion gases rise and are caught and held in the peak of the lowest V-shaped baffle until heat is removed therefrom and thereupon flow downwardly and upwardly to be caught by succeeding higher V-shaped baffles, said baffles being hollow, and means for circulating a heat transfer fluid between said shells and through said hollow baffles into said heating pipes to remove heat from the heating unit.

6. A heating unit which comprises an outer shell, an inner shell contained within said outer shell, the walls of said inner shell being spaced from the walls of said outer shell, a plurality of heating pipes connected to and leading from said outer shell, a plurality of baffles mounted within said inner shell, said baffles being of inverted V-shape and mounted in spaced vertical relationship, the outer edges of said baffles being spaced from the sides of said inner shell to permit the flow of combustion gases about the edges of said baffles, a plurality of directive baffles parallel to and spaced from the sides of the V-shaped baffles, the inner edges of the directive baffles

being spaced to permit the flow of combustion gases, the outer edges of the directive baffles being spaced from the sides of the inner shell to permit finely divided solid matter in the combustion gases to fall through said inner shell, a source of combustion gases within said inner shell and mounted below said baffles, whereby combustion gases rise and are caught and held in the peak of the lowest V-shaped baffle until heat is removed therefrom, and thereupon flow downwardly and upwardly to be caught by succeeding higher V-shaped baffles, said baffles being hollow, and a blower adapted to circulate air between said shells and through said hollow baffles into said heating pipes to remove heat from the heating unit.

7. A heat exchange unit comprising a shell, a source of combustion gases adjacent the bottom of the shell, a plurality of hollow trap baffles of inverted trough shape mounted above said source of combustion gases, a plurality of hollow directive baffles mounted substantially parallel to the sides of said trap baffles, means for circulating a heat transfer fluid through the hollow trap baffles and the hollow directive baffles, the outer edges of the trap baffles being spaced from the walls of the shell, the outer edges of the directive baffles being spaced from the walls of the shell a lesser distance than the edges of said trap baffles, and said trap baffles being disposed vertically between the directive baffles, whereby rising combustion gases are channelled by said directive baffles into said trap baffles and held in said trap baffles until heat is removed therefrom by the heat transfer fluid.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
62,953	Hafer	Mar. 19, 1867
73,886	Gaston	Jan. 28, 1868
100,107	Bellman	Feb. 22, 1870
638,708	Hansen	Dec. 12, 1899
1,076,209	Kent	Oct. 21, 1913
1,689,067	Benner	Oct. 23, 1928

FOREIGN PATENTS

Number	Country	Date
6,272	Great Britain	Mar. 26, 1895