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H. E. WALLIS

BOILER FURNACE AND GARBAGE INCINERATOR

Filed April 15, 1926

2 Sheets-Sheet 1

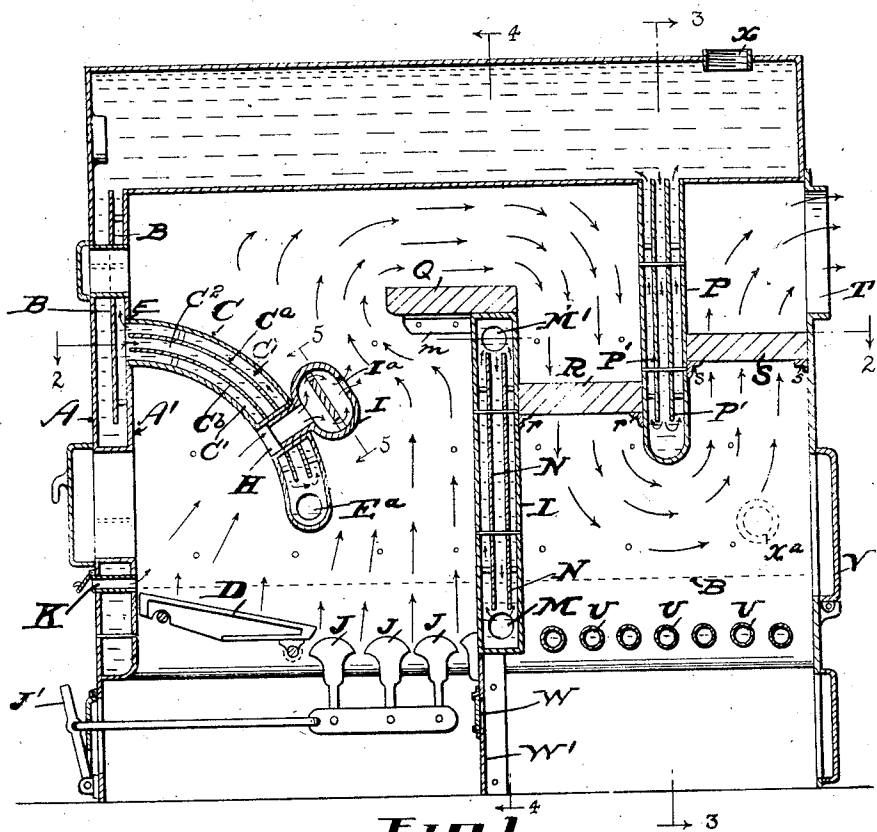


Fig. 1.

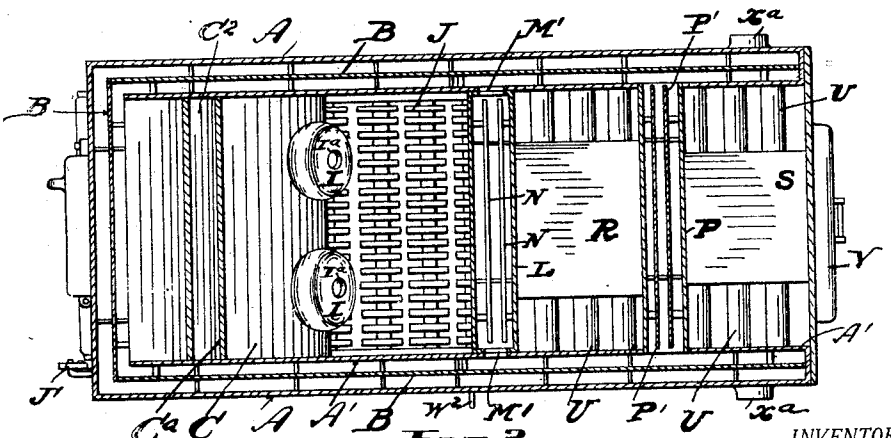


Fig. 2.

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2 Sheets-Sheet 2

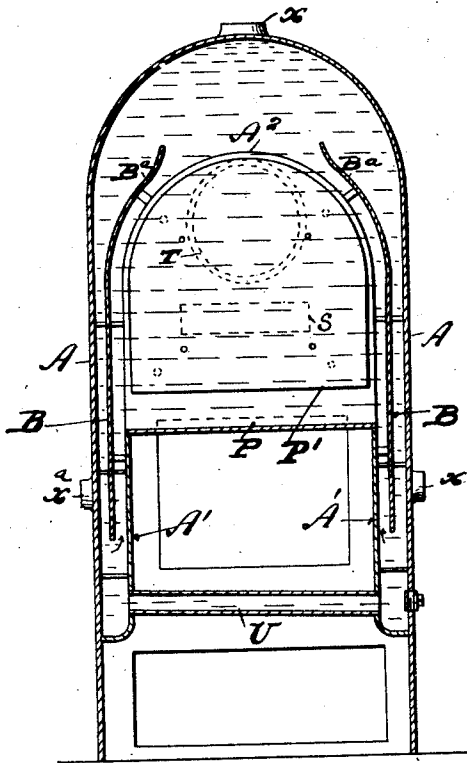


Fig. 3.

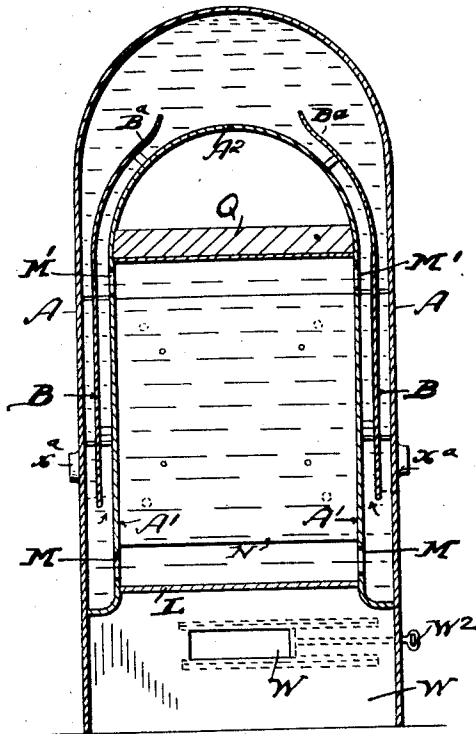


Fig. 4.

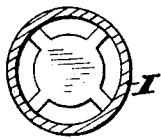


Fig. 5.

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UNITED STATES PATENT OFFICE.

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BOILER FURNACE AND GARBAGE INCINERATOR.

Application filed April 15, 1926. Serial No. 102,115.

My invention relates to a boiler furnace and garbage incinerator shown in the accompanying drawings and more particularly described in the following specification and claims.

5 The primary object of my invention is to construct a boiler furnace for hot water or low pressure system of sheet metal preferably welded together, to reduce manufacturing costs, and so constructed as to secure maximum efficiency by mixing the volatile gases arising from the coal with air in proper portions upon passing the products through a carburetor where they thoroughly co-mingle and become preheated so that when discharged into the furnace proper they have become a highly combustible fuel.

A further object of the invention is to construct a furnace in which low grade bituminous coal may be used and which will insure the elimination of smoke and operate at a high efficiency.

In a heating furnace it should be borne in mind that fully 75% of the time the furnace is operated the dampers are closed and under these conditions there is not sufficient oxygen to effect combustion nor is there sufficient power in the flues to draw the gases through the multitude of small tubes commonly employed in heating units. The draft—in most cases—necessary to accomplish this will be from 25/100 to 30/100 inches as measured by a column of water. It will be apparent from this that when operating with the draft closed the gases released cannot carry through the tubes and under such conditions the tubes are ineffective for they cannot function as heat absorbing members, but soon fill up with soot and ash which are non-conductors of heat. This deposit must be scraped out or otherwise removed from the tubes before they are again effective.

When combustion is imperfect the deposit in the tubes and heating surfaces is very rapid and after a fresh charge of coal the accumulation of soot and ash is sufficient to greatly impair the efficiency of any furnace.

Theoretically 200 cubic feet of air is required to consume one pound of coal. With loss of draft by closed dampers the coal is consumed as if placed in a retort by a baking process and not by a proper mixture that will effect complete combustion.

Modern practice demands that at least 15% of the necessary air must be admitted to the furnace above the fuel bed. This is accomplished in my furnace by passing air through

a carburetor and discharging it immediately above the incandescent coke fire back of the smoke arch.

With the foregoing and other objects in view which will appear as the description proceeds the invention further resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed it being understood that changes may be made in the precise embodiment of the invention herein disclosed without departing from the spirit of the same.

In the drawings accompanying this specification:

Figure 1 is a vertical longitudinal sectional view of the boiler furnace.

Figure 2 is a horizontal sectional view taken on or about line 2—2 of Figure 1 looking down upon the grate bars.

Figure 3 is a vertical cross-sectional view taken on or about line 3—3 of Figure 1.

Figure 4 is a vertical cross-sectional view taken on or about line 4—4 of Figure 1.

Figure 5 is a detail view of one of the carburetors in cross-section taken on or about line 5—5 of Figure 1.

Referring now to the letters of reference placed upon the drawings:

A denotes an outer shell, A¹ an inner shell spaced from the outer shell with a flange at the bottom welded to the outer shell forming a chamber in which water is carried, entirely surrounding the fire and the hot gases of combustion. Between the members A—A¹ on each side of the fire box and extending the full length of the furnace are baffle plates B—B. These baffle plates separate the water into two bodies the outer being the colder water which flows downwardly while the inner space directs the hotter water upwardly following the arch of the crown sheet A² to a point near or on a plane with the top of the crown sheet where the baffle plates are given a reverse curve B^a, the purpose of which is to prevent violent agitation or "priming."

There are three or more cross members bridging the furnace through which water circulates. The first one marked C is located above the grate bars D and arched, extending rearwardly from the front of the furnace about one-third the length of the unit,—it is hollow and is constructed of sheet metal divided by two baffle plates C^a C^b and is welded to the sheets forming the side walls of the fire box and to the front wall of the furnace as at E. This water box is curved—the bot-

tom reaching across the furnace—and has port openings E^a cut through the fire sheet near its bottom end to admit water freely, while the upper end cuts shell A^1 connecting into the inner space formed by the baffles $B-B$ where the water is in high velocity. The baffle plates C^a C^b placed inside the arched leg C divide the water. The smoke arch C is so formed that the portion at the lower side of the arch is the crown under which the coal is coked, and consequently the under-surface is not subjected to a high temperature. The coal lying under this arch is under the process of coking, and the gas from the coal is carried through the carburetor I forward into the furnace proper, where the gas is consumed. There being no heat against the under side of this arch C , the water circulates freely under the lower edge of the baffle C^b , supplying both channels C^1 and C^2 with an ample supply of water at all times.

Passing through this arch-shaped box are short boiler tubes H welded thereto which serve to support the necks of the carburetors $I-I$ which function as follows:

Fresh fuel having been placed in the furnace in front of the arch C —the previous charge having been reduced to coke—it is pushed back under the bottom of the arch into the rear section of the fire box and onto the transverse rocking grate bars J —actuated by the lever J^1 —where it is further consumed. The volatile gas from the fresh charge soon starts to exude from the coal and is carried upwardly mixing with fresh air admitted through airducts K into the fuel bed through which it finds its way to the carburetor where the mixture is perfected and on reaching the inner chamber of the carburetor is heated, becoming a highly combustible gas when discharged through the port I^a from the carburetor,—it is ignited by the flame arising from the coke at the rear of the grates.

At the rear of the transverse grate bars is placed a hollow bridge wall or water leg L . This like the arched front leg is welded to the side fire sheets with ports cut through as at $M-M^1$ to permit water to flow into it from the sides,—it also is provided with two baffles $N-N$. A third box or water leg P is spaced from this one midway to the rear. This leg differs from the others in that it is opened at the sides into the side water legs, and also is provided with double baffle plates P^1-P^1 , for the same purpose as the baffle plates in the front and center water legs.

By dividing the water in this way the friction caused by water passing upwardly and downwardly in the same passage is minimized permitting unrestricted flow, without danger of the water carrying over or "priming."

Q indicates a tile slab resting upon the

top of the bridge wall L and on angle irons $m-m$ secured to the walls of the inner shell. The tile Q extends in a forward direction about one-third the length of the fire box and the flames lapping under the tile pass in front and then back over the top of the tile and in a downward direction in front of the water leg P ,—dividing upon reaching the tile R , resting upon angle irons $r-r$ made fast to the bridge wall and water leg P . The tile R causes the gases to separate, half passing on each side and under the bottom of the water leg P , the gas being then directed upwardly on the opposite side of the leg P encounters the tile S , supported on angle irons $s-s$ secured to the water leg and rear wall of the furnace,—here it again divides before making its exit through opening T to the stack,—not shown. In this manner the gases are forced out against the walls of the furnace where heat is taken up through the plates by the water between the walls of the furnace.

Located near the bottom of the rear chamber are a plurality of water tubes U , spaced apart and projecting through the inner shell A^1 of the side walls. These tubes serve as grate bars upon which garbage or other waste may be deposited through the door V , at the rear of the furnace.

It will be seen that the hot gases from the furnace pass over the garbage—no air being admitted from below—drying the waste material and destroying all odors. When thoroughly dry, it is in condition to take fire and upon opening the sliding gate W in the curtain wall W^1 operated by a handle W^2 extending through the side walls of the furnace air is admitted from the pit below the water tubes U , causing the refuse to burn quickly until all is consumed,—while the heat units contained in the refuse are conserved and carried along with the main volume of gas from the main fuel bed.

X denotes the outlet connection for the water or steam pipes (not shown) leading to radiators and X^a X^a are return connections respectively located on opposite sides of the furnace for convenience in making a suitable return connection from the heating system.

In this construction—there being no small tubes—the draft resistance through the furnace is practically nil, nor is there any place for lodgment of soot or ash,—the heating surface remaining clean at all times and in the best possible condition to absorb the heat. It will also be noticed that nearly the entire heating surface is subjected to radiant heat from the surface on which the rays of heat may shine and are transmitted by convection, which start on or before the gases reach the tile Q .

The combustible gases are in extremely long contact with the heating surface and by following the course of travel, it will be noted

that they pass fully twice the entire length of the furnace before passing out through the flue or chimney.

Having thus described my invention what

5 I claim is:

1. A boiler-furnace including an inner and an outer shell, spaced apart to form a water chamber surrounding the combustion chamber formed by the inner shell; baffle plates
10 dividing the water chamber between the inner and outer shells, whereby the water between the outer wall and the baffle plates may flow downwardly and thence upwardly between the baffle plates and the inner shell to the
15 space above the combustion chamber; a hollow rearwardly and downwardly curved smoke arch located in the combustion chamber and extending from side wall to side wall and from front wall rearwardly, the inner
20 shell of the front wall of the furnace having an opening to establish communication between the water chamber and the smoke arch, the latter having ports leading through the inner shell of the side walls, connecting the
25 arch with the space between the inner shell and the baffle plates; and a plurality of baffle plates in said smoke arch running parallel with the walls of the latter.

2. A boiler-furnace including an inner
30 and an outer shell, spaced apart to form a water chamber, the inner shell forming also the wall of the combustion chamber; a hollow smoke arch bridging the space between the side walls of said chamber and extending
35 rearwardly from the front wall with communicating ports between the side walls and the smoke arch and between the front wall and the smoke arch for the circulation of water through the latter; and a carburetor
40 consisting of a neck open at one end extending through the walls of the smoke arch with an enlarged chamber fitted to the other end of the neck having a contracted discharge opening communicating with the combustion
45 chamber above the smoke arch and a perforated partition wall dividing the enlarged chamber of the carburetor through which the gases pass, and are thereby caused to comingle before being discharged into the combustion chamber above the smoke arch.

3. A boiler-furnace including an inner and an outer shell extending the full length of the furnace, said inner shell forming also the combustion space of the furnace; baffle plates
55 located between the inner and outer shells dividing the water into two bodies, the upper marginal edges of the baffle plates being inclined away from the inner shell at or about the plane of the upper wall of the combustion chamber, providing relatively wide discharge
60 throats for the water circulating upwardly between the inner walls and the baffle plates into the space above the combustion chamber, whereby surface ebullition may be overcome;
65 a hollow smoke arch located above the grates

bridging the space between the side walls of the furnace and extending rearwardly from the front wall with an opening through the inner shell between the front wall and smoke arch and also ports through the side walls
70 into the arch for the circulation of water through the arch; and a carburetor comprising a throat extending through the walls of the smoke arch open to the combustion chamber below the arch and connected with an
75 enlarged chamber located above the smoke arch, having a contracted discharge opening for the passage of furnace gases through said carburetor; and a foraminated partition wall dividing the enlarged chamber of the car-
80 buretor, whereby the furnace gases are thoroughly mixed as they pass through the chamber.

4. A boiler-furnace including an inner and an outer shell, spaced apart to form a water
85 chamber, the inner shell forming the wall of the combustion chamber; a hollow bridge wall communicating with the water chamber between said inner and outer shells; a rear water leg spaced from the bridge wall and
90 from the rear wall of the furnace; a baffle extending from the bridge wall to the rear water leg but spaced from the side walls of the furnace; a second baffle extending from the water leg to the rear wall of the furnace
95 also spaced from the side walls, whereby the products of combustion passing over the bridge wall are divided between the bridge wall and rear water leg and directed toward the respective side walls of the furnace, and
100 upon passing under the water leg are again divided by the second baffle and directed toward the side walls between the water leg and the rear wall of the furnace before passing to an uptake flue.

5. A boiler-furnace of the character described consisting of an inner and outer shell spaced apart to provide a water chamber surrounding the combustion chamber; a bridge wall dividing the fire box from the rear end of
105 the furnace; a depending water-leg spaced from the bridge wall and the rear end of the furnace and communicating with the water chamber between the side walls of the furnace; a plurality of water pipes below the
115 water leg bridging the space between the side walls of the furnace to form a grate; a curtain wall below the bridge wall dividing the ash pit from the space below the water tubes, and a damper in said curtain wall to permit
120 draft to pass from the ash pit up between the water tubes.

6. A boiler-furnace including an inner and an outer shell, spaced apart to form a water
125 chamber, the inner shell forming also the wall of the combustion chamber, a hollow smoke arch bridging the side walls of said chamber and extending rearwardly from the front wall and having communication with said
130 water chamber and provided with a trans-

verse opening extending therethrough, and a carburetor having a hollow chamber and a reduced tubular portion mounted in said transverse opening to support the carburetor above the smoke arch, said chamber being provided with an opening leading into the combustion chamber above the smoke arch.

7. A boiler-furnace including an inner and an outer shell, spaced apart to form a water chamber, the inner shell forming also the wall of the combustion chamber, a hollow smoke arch bridging the side walls of said chamber and extending rearwardly from the front wall and having communication with said water chamber, and a carburetor including a chamber and a neck portion, the neck portion extending through the smoke arch and being open to convey the products of combustion from the underside of the smoke arch into the carburetor chamber, the carburetor chamber having a discharge opening communicating with the combustion chamber above the smoke arch.

8. A boiler-furnace including an inner and an outer shell, spaced apart to form a water chamber, the inner shell forming also the wall of the combustion chamber, a hollow smoke arch bridging the side walls of said chamber and extending rearwardly from the front wall and having communication with said water chamber, a carburetor including a chamber and a neck portion, the neck portion extending through the smoke arch and being open to convey the products of combustion from the underside of the smoke arch into the carburetor chamber, the carburetor chamber having a discharge opening communicating with the combustion chamber above the smoke arch, and a perforated partition wall dividing the chamber of the carburetor through which the gases pass and are caused to co-mingle before being discharged into the combustion chamber above the smoke arch.

9. A boiler furnace having an ash pit and including an inner and an outer shell, spaced apart to form a water chamber, the inner shell forming also the wall of the combustion chamber, a hollow smoke arch bridging the side walls of said chamber and extending rearwardly from the front wall and communicating with the chamber, a bridge wall dividing the fire box from the rear end of the furnace, a depending water leg spaced from the bridge wall and the rear end of the furnace and communicating with the water chamber, a plurality of water pipes below the water leg bridging the space between the side walls of the furnace to form a grate, a curtain wall below the bridge wall dividing the ash pit from the space below the water tubes, and a damper in said curtain wall to permit draft to pass from the ash pit up between the water tubes.

10. A boiler-furnace including an inner and an outer shell, spaced apart to form a

water chamber, the inner shell also forming the wall of the combustion chamber, baffle plates in said water chamber, a rearwardly and downwardly curved hollow smoke arch bridging the side walls of said chamber and having communication with the water chamber, curved baffle plates arranged in said smoke arch in parallelism with each other and with the upper and lower walls of the smoke arch, a hollow bridge wall spaced from the smoke arch and dividing the fire box from the rear end of the furnace and terminating short of the top of the combustion chamber, spaced parallel baffles in the bridge wall arranged in parallelism with the front and rear walls of the bridge wall, the latter having communication with the aforesaid water chamber, a tile roof extending forwardly from the top of the bridge wall and adapted to direct the hot gases from the fire box forwardly from the bridge wall upwardly and over the tile roof, a depending water leg spaced from the bridge wall and the rear end of the furnace and communicating with the water chamber, spaced baffles in the water leg arranged in parallelism with each other and with the front and rear walls of the water leg, a baffle extending from the bridge wall to said water leg and at its sides spaced from the side walls of the furnace, and a second baffle extending from the water leg to the rear wall of the furnace and at its sides spaced from the side walls of the furnace whereby the products of combustion passing over the bridge wall are divided between the bridge wall and the rear water leg and directed toward the respective side walls of the furnace and upon passing under the water leg are again divided by said second baffle and directed toward the side walls of the furnace before passing out of the furnace.

11. A boiler furnace including an inner and an outer shell spaced apart to form a water chamber, the inner shell forming also the wall of the combustion chamber, a rearwardly and downwardly curved hollow smoke arch bridging the side walls of said chamber and having communication with the latter for circulation of water through said arch, baffles arranged in the smoke arch and running parallel with each other and with the upper and lower walls of the curved arch, a hollow bridge wall spaced from the smoke arch and communicating with the water chamber, baffle plates arranged within the bridge wall in spaced relation to each other and parallel with relation to each other and with the front and rear walls of the bridge wall, and a depending water leg spaced from the bridge wall and the rear of the furnace and having communication with the aforesaid water chamber, spaced baffles in the water leg arranged in parallelism with each other and with the front and rear walls of

the water leg, a baffle between the bridge wall and the water leg, and a baffle between the water leg and the rear end of the furnace.

12. A boiler-furnace of the character described, having an ash pit and comprising an inner and an outer shell spaced apart to provide a water chamber surrounding the combustion chamber, a hollow smoke arch in the combustion chamber having communication with said water chamber, a hollow bridge wall dividing the fire box from the rear end of the furnace, a depending water leg spaced from the bridge wall and the rear end of the

furnace and having communication with the water chamber, said bridge wall also having communication with the water chamber, a plurality of water pipes below the water leg to form a grate, a curtain wall below the bridge wall dividing the ash pit from the space below the water tubes, and means for cutting off or establishing communication between the ash pit and the space under the water tubes.

In testimony whereof, I sign this specification.

HENRY E. WALLIS.