

Nov. 25, 1941.

J. E. J. TONER

2,264,226

DOMESTIC BOILER

Filed July 27, 1940

3 Sheets-Sheet 1

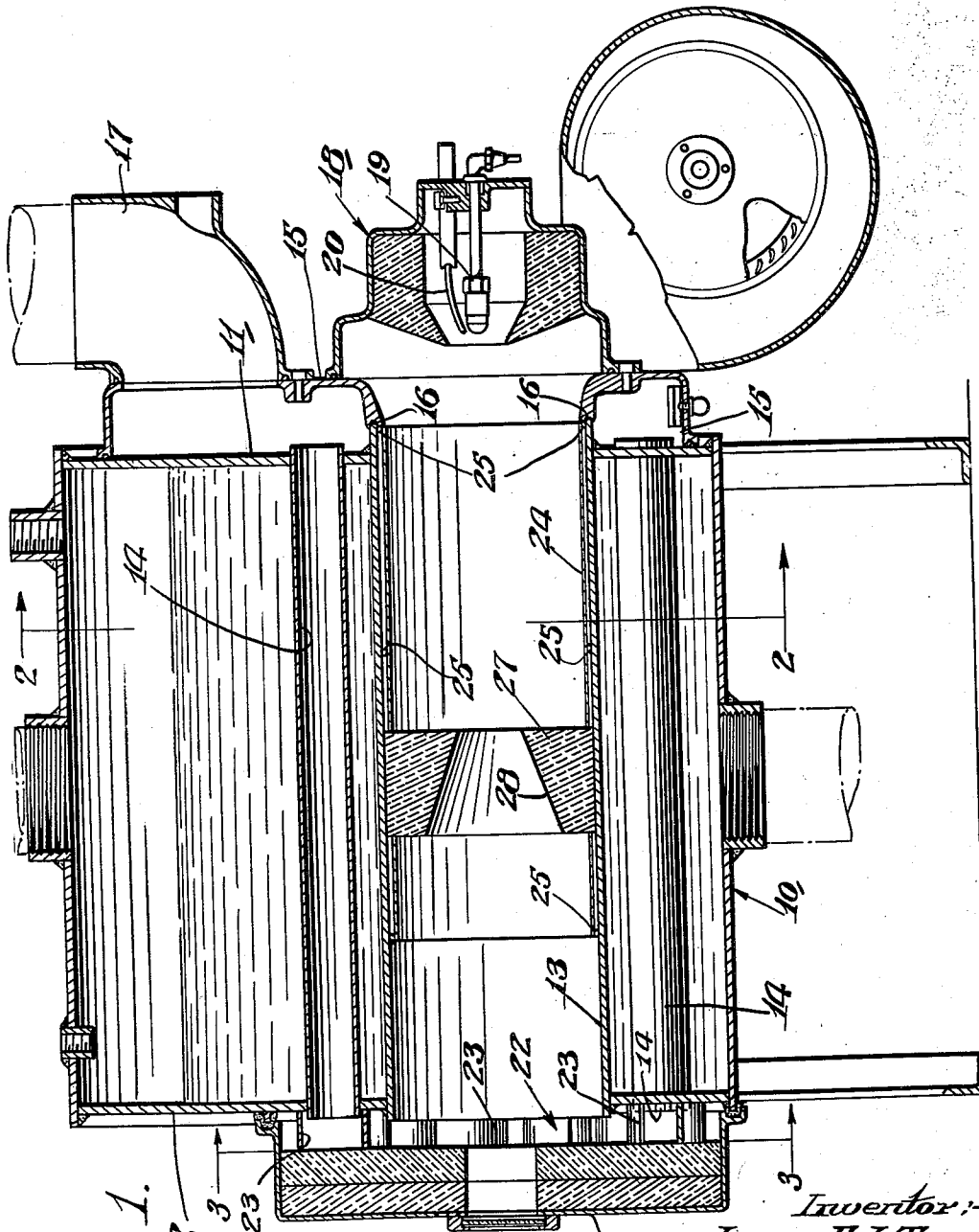


Fig. 1.

Inventor:-
James E. J. Toner
by his Attorneys
Hewson & Hewson

Nov. 25, 1941.

J. E. J. TONER

2,264,226

DOMESTIC BOILER

Filed July 27, 1940

3 Sheets-Sheet 2

Fig. 2.

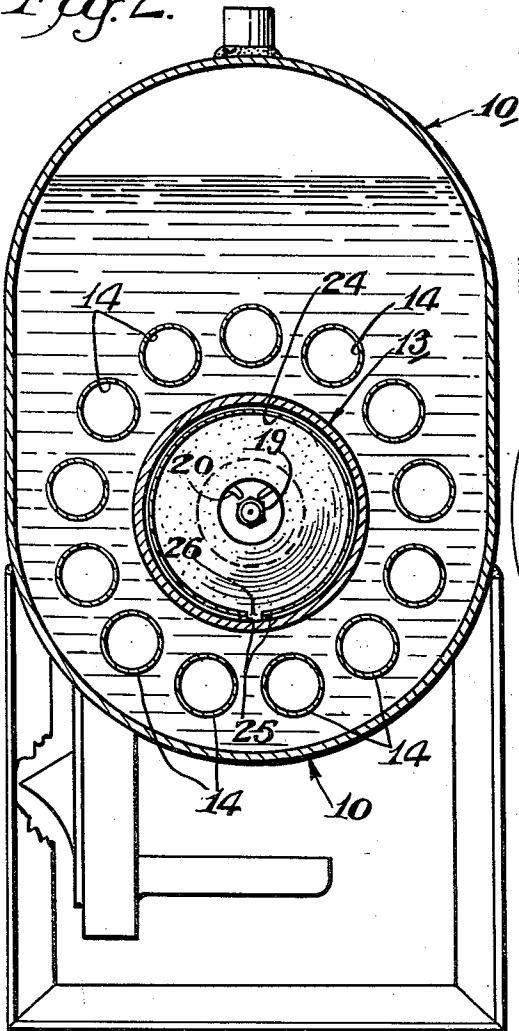
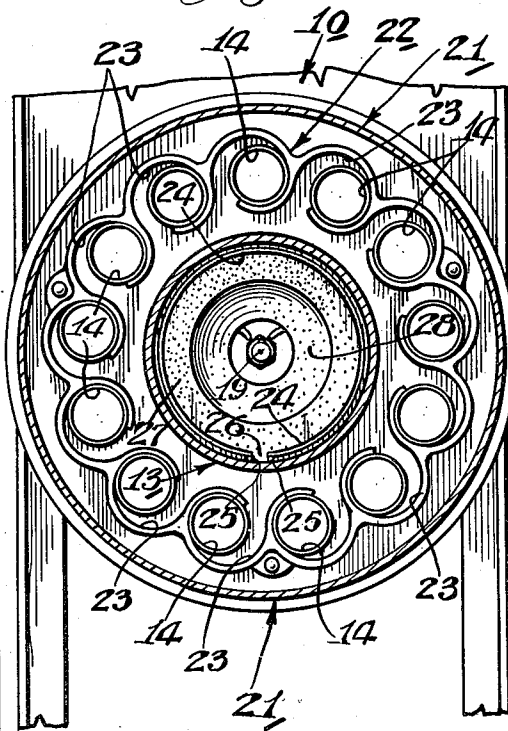


Fig. 3.



Inventor:—
James E. J. Toner
by his Attorneys
Hewson & Hewson

Nov. 25, 1941.

J. E. J. TONER

2,264,226

DOMESTIC BOILER

Filed July 27, 1940

3 Sheets-Sheet 3

Fig. 6.

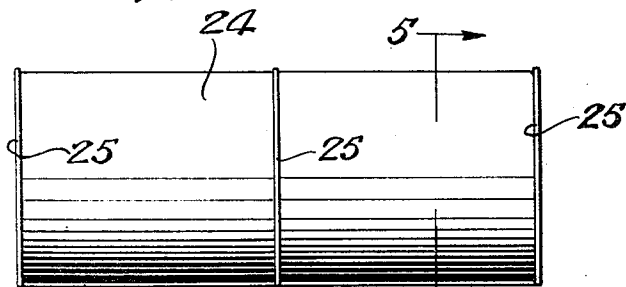
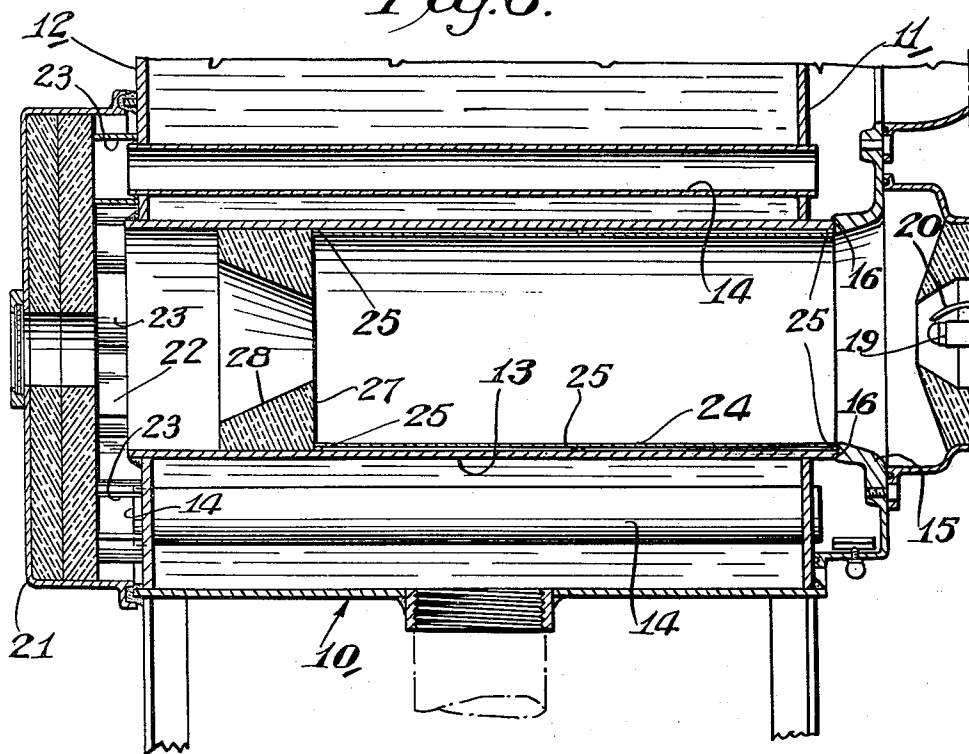
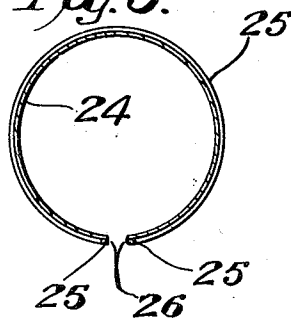


Fig. 4.

Fig. 5.



Inventor:—
James E. J. Toner
by his Attorneys
Howson & Howson

UNITED STATES PATENT OFFICE

2,264,226

DOMESTIC BOILER

James E. J. Toner, Bethlehem, Pa., assignor to
Bethlehem Foundry & Machine Company,
Bethlehem, Pa., a corporation of Pennsylvania

Application July 27, 1940, Serial No. 348,035

3 Claims. (Cl. 122—149)

This invention relates to furnaces and, more particularly, to structures of the type illustrated in the patent to Saha, No. 2,097,255, granted October 26, 1937, for "Method of and apparatus for burning fluid fuel." In such a furnace, air is introduced to a tubular combustion chamber in such fashion that it forms a free spiral vortex therein as it passes therethrough and fuel is admitted substantially at the core of this vortex, combustion thus taking place at the inner periphery of the tube.

In commercial production of a furnace of the character shown in said patent, it has been found that maximum efficiency may only be obtained through certain modifications of the structure enabling all of the fuel to be burned within the combustion chamber. It has also been found, since the wall of the combustion chamber is water cooled and the burning of the fuel takes place immediately against this wall, that it is necessary to partially insulate the flame from the wall until the combustion has been completed, and an important object of the invention is the modification of the structure of the patent to provide for complete combustion and to attain such complete combustion within a relatively short space.

Difficulty has been met with in providing such a baffle due to the fact that the baffle must be maintained in such slightly spaced relation to the wall of the tube that it will be in heat exchange therewith and at the same time must be supported so that it will not warp or buckle in operation since such buckling will place portions of the liner in positions where they will not be protected by the heat transfer to the wall of the tube and will, accordingly, be rapidly destroyed. A further object of the invention is the production of a baffle so constructed that it will constantly maintain proper spacing with relation to the wall of the tube.

In the commercial type of construction, the combustion tube is surrounded by an annular series of fire tubes through which the combustion gases are returned to the stack and it has been found that the efficiency of the boiler may be further increased if the swirling action which takes place in the combustion tube is extended to the fire tubes themselves. Accordingly, an important object of the invention is the provision of a simple and efficient means for providing a swirling action in the fire tubes.

These and other objects I attain by the construction shown in the accompanying drawings wherein, for the purpose of illustration, I have

shown a preferred embodiment of my invention and wherein:

Fig. 1 is a longitudinal sectional view through a boiler constructed in accordance with my invention;

Fig. 2 is a section on line 2—2 of Fig. 1;

Fig. 3 is a section on line 3—3 of Fig. 1;

Fig. 4 is a side elevation of the liner employed;

Fig. 5 is a sectional view therethrough taken on line 5—5 of Fig. 4; and

Fig. 6 is a fragmentary sectional view showing a slightly modified construction of the boiler.

Referring now more particularly to the drawings, the boiler casing 10 comprises end heads 11 and 12 supporting an open-ended combustion tube 13 and a surrounding annular series of open-ended fire tubes 14. To one end of head 11 a flue connection 15 is secured, this flue connection having sealing engagement with the projecting end of the combustion tube as at 16 and receiving the gases discharged from the fire tubes 14 and directing them to the stack outlet 17. This flue connection mounts a burner head 18 including the usual burner nozzle 19 and igniter mechanism 20 and means for introducing air adjacent said burner nozzle in a swirling fashion as described in the Patent No. 2,097,255 above identified.

The opposite end head 12 detachably mounts a cleanout cover 21 which is interiorly lined with fire brick and has its inner face in slightly spaced confronting relation to the ends of the combustion tube 13 and fire tubes 14. Clamped between this cover and the head is an annulus 22 encompassing the annular series of fire tubes 14 and composed of a plurality of connected open cycloidal coils 23, the openings of the coils occurring at the inner surface of the annulus and the smaller curvatures of the coils approximating the diameter of the tubes 14 the projecting ends of which they encompass. It will be obvious that swirling products of combustion leaving tube 13 and entering the space between the end of this tube and cover 21 will be centrifugally delivered to the cycloidal coils 23 and by these coils broken up into a series of smaller vortices which are delivered to the tubes 14. These products of combustion, after passing from the forward ends of tube 14, enter flue connection 15 and thus pass to the stack.

Arranged within the forward end of the combustion tube and extending from such forward end rearwardly for a substantial portion of the length of the tube is a liner 24 which serves to prevent the burning fuel mixture from coming

into contact with the relatively cold walls of the combustion tube and thus cooling the flame tips thereof. This liner should be of relatively thin metal which may become incandescent without affecting its internal structure as, for example, a thin sheet approximately 22 gauge sheet steel of good quality. I have found Allegheny metal satisfactory for this purpose. This sheet is formed to a split cylinder the edges of which are spaced from one another and the outer periphery of the cylinder has secured thereto gauge rods or wires 25 preferably of the same metal and approximately $\frac{1}{8}$ inch diameter. These wires may be so distributed as to provide adequate support for the sheet and upon installation of the liner directly contact with the walls of the tube. Such a liner may expand in the tube without buckling due to the space provided between the edges of the sheet at 26 and will at all times maintain the proper spacing between its surface and that of the tube to insure sufficient heat exchange to prevent destructive heating of the sheet. By use of this liner, combustion within the tube may be completed before the products of combustion come into direct engagement with the walls of the tube.

It has also been found advantageous to employ a means for preventing the walls of the vortex, particularly adjacent the inlet end of the combustion tube, from becoming too thin; thus, incidentally preventing too rapid movement of the burning fuel toward the fire tubes 14. I, accordingly, provide within the combustion tube a baffle 27 comprising a refractory ring fitting within tube 13 and having a tapered interior bore 28 the smaller end of which is arranged adjacent the fuel inlet end of the tube 13. The best position for such a baffle varies with different lengths of combustion tube and different volumes of air delivered thereto but at all times should be well spaced from the fuel inlet end of the tube. In some instances, it is desirable to place this baffle between the ends of the tube liner 24, in which event the liner is formed in two sections and in other instances the baffle may be placed against the rear end of the liner, as suggested in Fig. 6. The smaller diameter of the inner opening of the baffle is considerably less than the internal diameter of the liner and the baffle here acts as a dam increasing the effective depth of the vortex of burning fuel within the combustion tube in advance of the baffle. Being formed of refractory material, the baffle becomes incandescent and serves both to promote rapid combustion of the fuel and to transfer heat to the walls of the combustion tube and thus to the contents of the boiler casing.

By use of these features it has been found that the efficiency of the boiler as originally proposed can be very materially increased and a very compact household unit results. While use of any of the three features above outlined increases the

efficiency of the boiler, their combined use is essential if optimum efficiency is to be obtained.

Since the construction is capable of considerable modification without departing from the spirit of the invention, I do not wish to be understood as limiting myself thereto except as hereinafter claimed.

I claim:

1. A boiler of the type wherein air is moved through a cylindrical tube in a free spiral vortex and fluid fuel is introduced into the core of the vortex, said boiler comprising a boiler casing, a cylindrical combustion tube directed through the casing, means at one end of the tube to introduce fuel and air, an annular series of fire tubes extending through the casing and surrounding the combustion tube in spaced relation thereto, an annulus arranged against the casing comprising a series of connected inwardly-open cycloidal loops each of which surrounds the rear end of one of the fire tubes, and a closure member abutting the rear face of said annulus.

2. A boiler of the type wherein air is moved through a cylindrical tube in a free spiral vortex and fluid fuel is introduced into the core of the vortex, said boiler comprising a boiler casing, a cylindrical combustion tube directed through the casing, means at one end of the tube to introduce fuel and air, and a liner for the tube extending from said end thereof for a considerable distance through the tube, said liner comprising a slotted cylinder of thin sheet metal, means maintaining said liner slightly spaced from the wall of the tube but in good heat-exchange relation thereto, an annular series of fire tubes extending through the casing and surrounding the combustion tube in spaced relation thereto, an annulus arranged against the casing comprising a series of connected inwardly-open cycloidal loops each of which surrounds the rear end of one of the fire tubes, and a closure member abutting the rear face of said annulus.

3. A boiler of the type wherein air is moved through a cylindrical tube in a free spiral vortex and fluid fuel is introduced into the core of the vortex, said boiler comprising a boiler casing, a cylindrical combustion tube directed through the casing, means at one end of the tube to introduce fuel and air, a baffle disposed in said tube in spaced relation to said end thereof, said baffle comprising a ring of refractory material fitting within the tube, the internal opening of said ring being tapered and the smaller end thereof being disposed adjacent said end of the tube, an annular series of fire tubes extending through the casing and surrounding the combustion tube in spaced relation thereto, an annulus arranged against the casing comprising a series of connected inwardly-open cycloidal loops each of which surrounds the rear end of one of the fire tubes, and a closure member abutting the rear face of said annulus.

JAMES E. J. TONER.