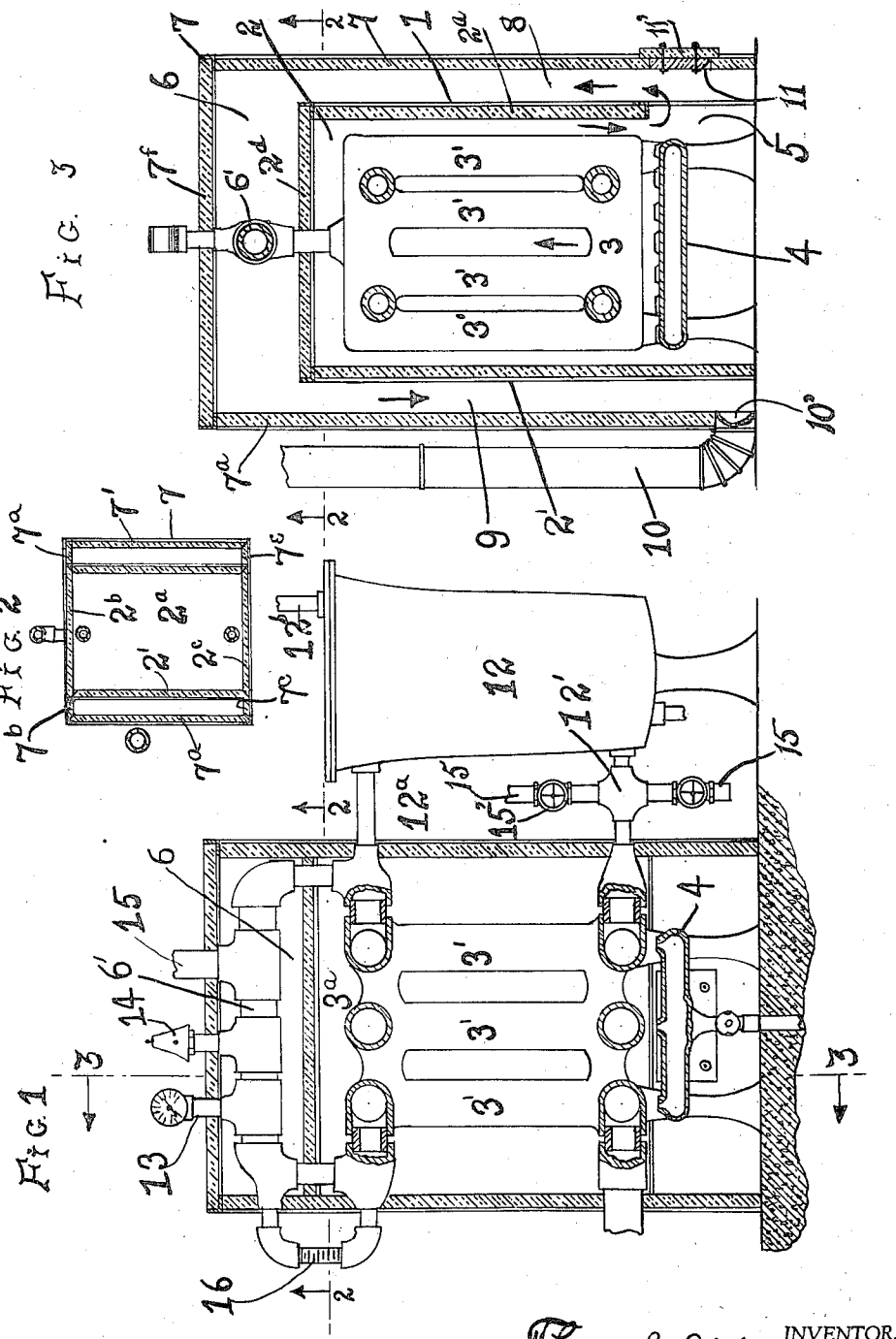
Dec. 22, 1942. T. J. DIGBY 2,305,847

BOILER OR WATER HEATING UNIT

Filed July 27, 1940



INVENTOR.

Thomas J. Digby

BY Joseph L. O'Brien

Patented Dec. 22, 1942

2,305,847

UNITED STATES PATENT OFFICE

2,305,847

BOILER OR WATER-HEATING UNIT

Thomas J. Digby, New York, N. Y.

Application July 27, 1940, Serial No. 347,823

4 Claims. (Cl. 122—333)

This invention relates to improvements in boilers or water-heating units fired with liquid or gaseous fuel.

One of the objects of this invention is to provide a boiler or water-heating unit fired with liquid or gaseous fuel in which the heat-transfer efficiency is greatly increased and the fuel consumption for the heating or converting into steam of a given quantity of water is economized; and a boiler or water-heating unit is produced that will enable the economic absorption, transfer and utilization of heat in a compact, highly efficient and economical unit.

Another object of my invention is to provide a boiler or heater unit which is capable of being fired by the use of liquid and gaseous fuel without the condensation or sweating which conventionally occurs from such flue gases, particularly when the stack or flue temperatures run low and that will so apply heat to the water-heating tubes as to avoid any sweating thereof and will thereafter utilize and transfer to said tubes the maximum amount of heat from the products of fuel combustion.

Another object of my invention is to produce a unit which will provide, for the gases of combustion, an initial trap that will cause the hot gases simultaneously to heat all parts of the entire water container so as to avoid condensation and will enable initially a degree of heat-transfer as to produce steam and will thereafter, in a separate chamber, produce a secondary heat trap and an application therein of the gases of combustion to steam in tubes connected with the container in the primary chamber, and thus in the secondary chamber to provide means for superheating the steam produced in the apparatus within the primary chamber.

Another object of my invention is, in an extremely small and compact unit, to provide a long travel of the hot flue gases.

Another object of my invention is to produce a unit for house-heating systems which will be capable of producing steam for heating with the use of a minimum amount of fuel and which will avoid the use of room air and will thus at all times utilize air for the burner which has been preheated by passage through a flue thus resulting in efficiency.

With these and other objects in view, the invention comprises the combination of members and arrangement of parts so combined as to coact and co-operate with each other in the performance of the functions and the accomplishment of the results herein contemplated, and comprises in one of its adaptations the species or preferred form illustrated in the accompanying drawing, in which:

Fig. 1 is a vertical section of a boiler or water-heating unit embodying my invention;

Fig. 2 is a section on the line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a section on the line 3—3 of Fig. 1, looking in the direction of the arrows.

Referring now to the drawing which illustrates a preferred embodiment of my invention, 1 indicates an inner casing or shell which is preferably cubical in conformation and is provided with a primary combustion and heat-exchange chamber 2 which is enclosed by side walls 2′, 2^a, 2^b and 2^c and top wall 2^d. Mounted within the chamber 2 is a boiler 3 composed of a series of suitably connected pipes 3′ and in the form shown comprising a conventional radiator, supported in raised position fired by a fluid burner 4 which, as shown, is a conventional type of gas burner.

As illustrated, the boiler 3 occupies the major portion of the space within the chamber 3 and said chamber is completely enclosed at its top and provided at one side of its bottom portion with a single outlet opening 5 for the gases of combustion. The combustion and heat-exchange chamber thus formed produces a trap for such gases of combustion which, being unable to escape at the top, quickly fill the said chamber and heat the boiler or water-heating tubes contained therein, and finally escape through the opening 5. As hereinafter more particularly described, the opening 5 is adapted to pass the flue gases to a secondary heat-transfer chamber 6 formed by providing an outer shell or casing 7 to surround, preferably on three sides, the interior shell or casing 1. This outer shell comprises outer side walls 7′, 7^a, 7^b, 7^c, 7^d and 7^e and a top wall 7^f. The sides walls 7′, 7^a and 7^b combined with the outer side wall 2^a provide an updraft conduit 8 leading from said primary opening 5 to the secondary heat-exchange chamber 6 and the walls 7^a, 7^b and 7^c, in cooperation with the wall 2′, form a similar down-draft conduit 9 communicating, at its upper end, with said chamber 6 on the opposite side of the unit and has an outlet opening 10′ at its bottom portion, and connected with said opening 10′, is an external flue pipe 10 leading to the outer atmosphere. The outlet 9′ is disposed below the connecting flue passage 5 and forms a secondary trap for the gases of combustion.

The secondary heat-exchange chamber 6 has mounted therein a steam conduit or pipe 6′

connected with the water-heating container or boiler 3.

The conduit forming members 7', 7a extend completely to the ground which forms the bottom walls thereof and completely enclose the unit and preferably, after ignition, no outside air is permitted to enter the enclosure. An ignition opening in the wall 7' registering with the opening 5 so as to permit ignition through the conduit 8 is provided at 11 to permit the lighting of the burner 4, but after ignition the closure member 11' is preferably inserted in the opening 11 and the unit will thus be completely enclosed and all air is excluded except that coming through the flue 10.

The boiler tubes 3 are partially filled with water, and when the burner is lighted the primary chamber 2 which, as aforesaid, forms a trap almost immediately becomes filled with hot gases of combustion and completely envelop the water in the tubes. These hot gases, of course, first pass upwardly until the chamber is filled and the boiler tubes enveloped, whereupon they pass downwardly and outwardly through the opening 5. It has been found that the trapping of the gases of combustion in this manner completely avoids all the usual condensation or "sweating" of the tubes within the chamber, and enables the absorption of heat from said gases until the flue or stack temperatures register well below 120° F. without any danger of condensation or "sweating."

After passing through the opening 5, the gases of combustion thence pass upwardly through the conduit 8 to the secondary heat-exchange chamber 6 where they bathe the pipe 6' and a secondary heat-exchange occurs. The hot gases of combustion pass from the chamber 6 downwardly through the conduit 9 to the outlet opening 9' and thence through flue 10 to the atmosphere.

Immediately after the burner is ignited, as aforesaid, the closure member 11', which has a tight fit with the ignition opening 11, is applied and all outside air is excluded. When this occurs, it has been found that a circulation through the flue 10 is established so that air passes to the burner 4 through the flue 10, conduit 9, secondary chamber 6, conduit 8 and opening 5 and during such travel, this air becomes thoroughly pre-heated, resulting in economy of fuel. The trapping of the hot gases of combustion in the primary heat-exchange chamber not only simultaneously applies heat to the boiler pipes located therein so as to prevent any condensation or sweating thereof, but the heat exchange will take place all around the said water-heating or boiler tubes located in said primary chamber so that instead of more intensely heating one part of such tubes than another, a more uniform initial heating and constant heat-exchange takes place without the formation of the condensed moisture or sweat.

By providing a secondary heat-exchange chamber and a secondary trapping of the gases of the combustion in this secondary heat-exchange chamber and enclosing therein a section of my heating tubes so as to produce a secondary heating effect upon the steam passing out of the primary chamber, I provide in said secondary chamber for a secondary or superheating of the steam passed from the primary tubes 3'. I have found that when the trapped gases in the secondary chamber 6 are conducted down to the lower end of this chamber through the conduit 9 and are permitted to escape through the outlet 9' to the flue pipe 10, and when this outlet 10' is positioned below the internal flue outlet 5, it is possible, promptly after igniting the burner 4, to insert the closure member 11' and to seal the unit from outside or room air and I have also found that when this is done, the burner 4 will function to draw its supply of air to produce a combustible mixture through the said conduits, chamber and flue opening 10' and pipe 10 and, as aforesaid, the air so sucked in will be heated by its contact with outgoing currents so that a pre-heated air is, as aforesaid, supplied to the burner. I have found that, in the use of a unit of the type hereinabove specified, when the closure member is applied so as to completely enclose the unit, a much higher efficiency is produced and that when outside air is excluded a circulation of air from the flue 10 is at once induced and established by my construction of internal conduits and chambers because, in accordance with my theory, the flue outlet 10' is positioned below the outlet 5 and also below the burner 4, and the secondary chamber permits an expansion of the gases of combustion and a circulation from the primary chamber thus keeping it free from excessive pressure and also draws in cold air from the flue 10.

The casings or shells 1 and 7 are preferably composed of refractory material and may be formed of an asbestos compound.

In the preferred embodiment of my invention, I erect two skeleton frames, one within the other, and apply asbestos sheets to this frame for the purpose of forming the interior and exterior shells disposed as hereinabove specified.

In the embodiment shown, I provide the unit 1 with a suitable source of water supply through the pipe 15 and connect to said unit a conventional hot-water heater or tank 12 which, as illustrated, is connected at its lower end by connection 12' to the lower head of the boiler 3 and is connected at its upper end by connection 12a to the upper head of the boiler 3. The tank 12 has an outlet 12b which may be connected to a storage tank or to a kitchen sink or the like for the purpose of procuring substantially instantaneous hot water. Suitable connections between the unit and a series of radiators may be made in any suitable manner and, as shown, a steam-outlet pipe 15 connected with the unit is used to supply steam to radiators and a steam condensation pipe 15' which extends from the radiators to the unit is also connected with the unit and has a valve 15a. Any suitable water inlet conduit, such as the pipe 16, is provided for supplying fresh water to the unit.

The upper pipe 6' is also preferably provided with a steam gauge 13 and a blow-off valve 14 as well as the steam-outlet 15. A gauge glass 18 also is preferably provided between the heads 3a and the secondary heat-exchange conduit 6'.

Obviously, this unit may be used either to heat water in the tank only or to provide sufficient steam for a series of radiators alone or to serve both the hot water supply and radiators.

Having described my invention, I claim:

1. A boiler or water-heating unit embodying, in combination, a metallic water-heating container, a burner for liquid or gaseous fuel mounted beneath said water-heating container, a casing completely enclosing said water-heating container and burner and providing a primary combustion and heat-exchange chamber having a single primary outlet opening for the products of combustion located at the bottom portion of

one side of the casing, to produce in said combustion chamber a heat-exchange trap for said products of combustion, a secondary casing spaced from the first casing and comprising two unconnected side parts and a communicating top part to provide a secondary heat-exchange chamber enclosing opposite sides and top of said primary casing, said secondary chamber having a single secondary outlet opening for the products of combustion located at the bottom of said secondary heat-exchange chamber at the side of the unit opposite to said primary gas outlet, a flue connected with said last-mentioned outlet, a metallic tube extending horizontally within said secondary heat-exchange chamber and connected with said water-heating container, inlet means for admitting liquid to said water-heating container, and outlet means for steam connected with said water-heating container.

2. A boiler or water-heating unit embodying, in combination, a metallic water-heating container, a burner for liquid or gaseous fuel mounted beneath said water-heating container, a casing completely enclosing said water-heating container and burner and providing a primary combustion and heat-exchange chamber having a single primary outlet opening for the products of combustion located at the bottom portion of one side of the casing, to produce in said combustion chamber a heat-exchange trap for said products of combustion, a secondary casing spaced from the first casing and comprising two unconnected side parts and a communicating top part to provide a secondary heat-exchange chamber enclosing opposite sides and top of said primary casing, said secondary chamber having a single secondary outlet opening for the products of combustion located at the bottom of said secondary heat-exchange chamber at the side of the unit opposite to said primary gas outlet, a flue connected with said last-mentioned outlet, a metallic tube extending horizontally within said secondary heat-exchange chamber and connected with said water-heating container, inlet means for admitting liquid to said water-heating container, outlet means for steam connected with said water-heating container, said primary outlet being located adjacent to the level of said burner and said secondary outlet being located below the level of said primary outlet and of said burner.

3. A boiler or water-heating unit embodying, in combination, a metallic water-heating container comprising a radiator having upper and lower heads and tubes extending between said heads, a burner for liquid or gaseous fuel mounted beneath said water-heating container, a casing completely enclosing said water-heating container and burner and providing a primary combustion and heat-exchange chamber having a single primary outlet opening for the products of combustion located at the bottom portion of one side of the casing, to produce in said combustion chamber a heat-exchange trap for said products of combustion, a secondary casing spaced from the first casing and comprising two unconnected side parts and a communicating top part to provide a secondary heat-exchange chamber enclosing opposite sides and top of said primary casing, said secondary chamber having a single secondary outlet opening for the products of combustion located at the bottom of said secondary heat-exchange chamber at the side of the unit opposite to said primary gas outlet, a flue connected with said last-mentioned outlet, a metallic tube extending horizontally within said secondary heat-exchange chamber and connected with the upper head of said water-heating container, inlet means for admitting liquid to said water-heating container, and outlet means for steam connected with said water-heating container.

4. A boiler or water-heating unit embodying, in combination, a metallic water-heating container, a burner for liquid or gaseous fuel mounted beneath said water-heating container, a casing completely enclosing said water-heating container and burner and providing a primary combustion and heat-exchange chamber having a single primary outlet opening for the products of combustion located at the bottom portion of one side of the casing, to produce in said combustion chamber a heat-exchange trap for said products of combustion, a secondary casing spaced from the first casing and comprising two unconnected side parts and a communicating top part to provide a secondary heat-exchange chamber enclosing opposite sides and top of said primary casing, said secondary chamber having a single secondary outlet opening for the products of combustion located at the bottom of said secondary heat-exchange chamber at the side of the unit opposite to said primary gas outlet, a flue connected with said last-mentioned outlet, a metallic tube within said secondary heat-exchange chamber and connected with said water-heating container, inlet means for admitting liquid to said water-heating container, outlet means for steam connected with said water-heating container, an ignition opening in the outer casing located opposite said primary outlet for combustion gases, and means for completely closing said outlet to exclude room air.

THOMAS J. DIGBY.