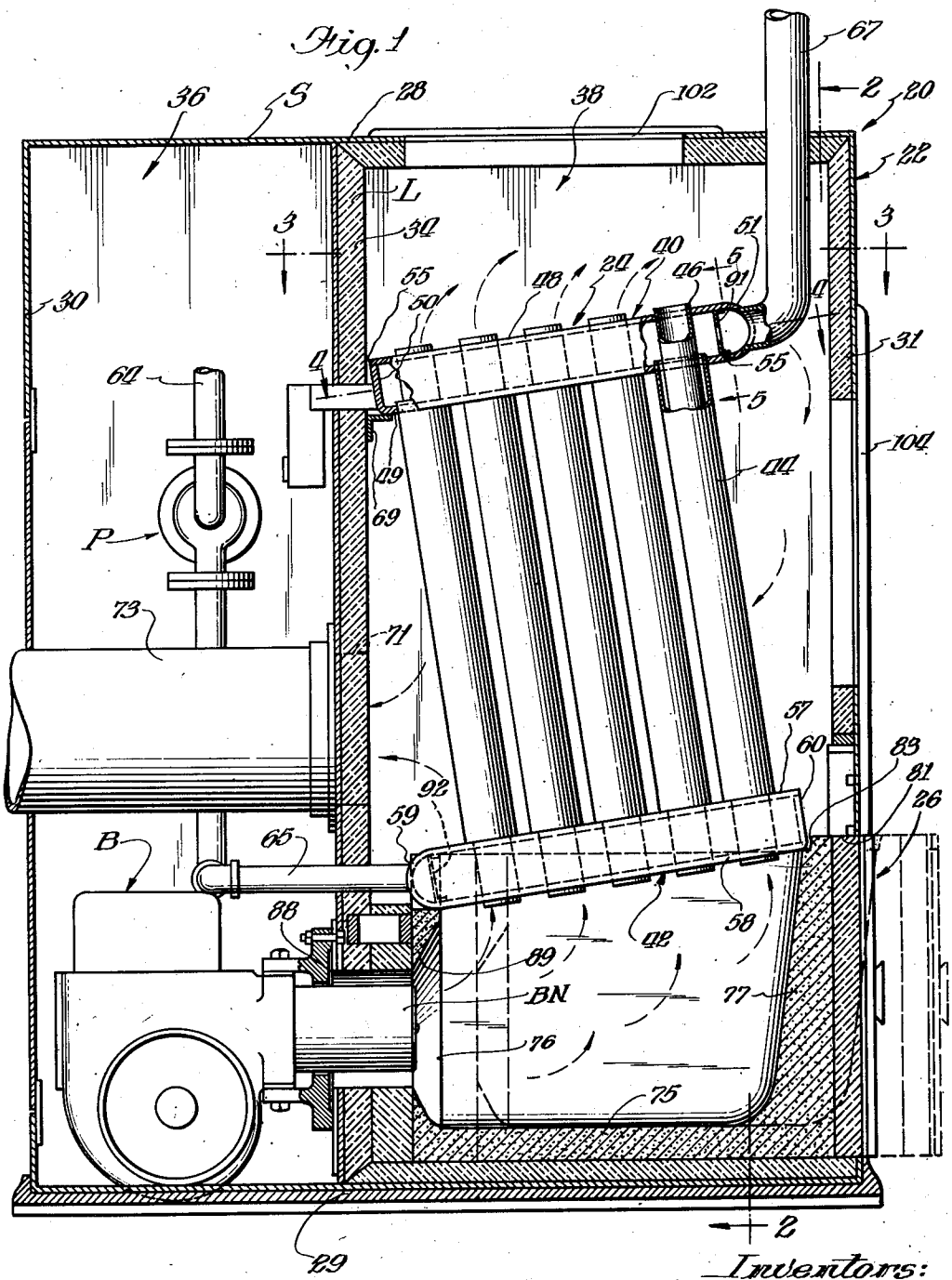
Aug. 19, 1952 C. T. DENKER ET AL 2,607,325

VERTICAL WATER TUBE BOILER WITH REMOVABLE COMBUSTION CHAMBER

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Fig. 1



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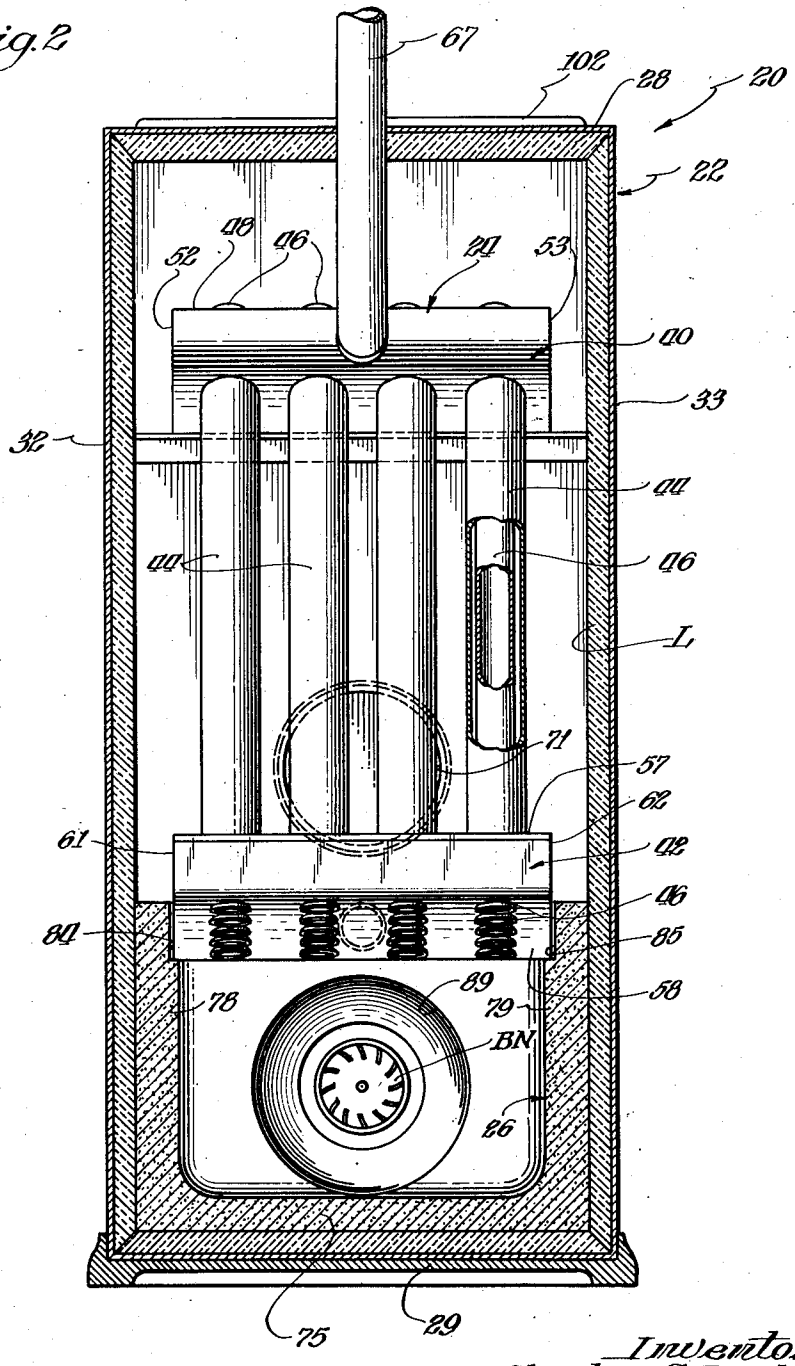
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Fig. 2



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Fig. 3

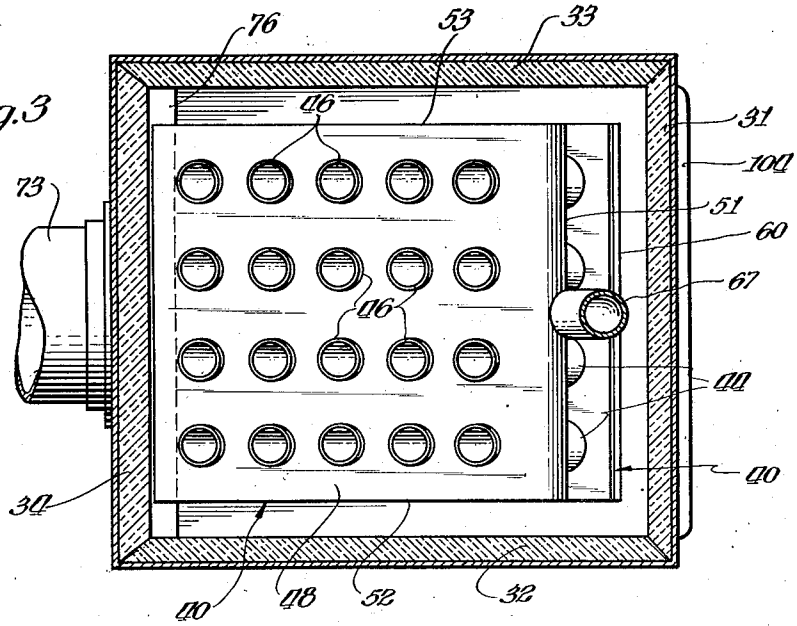


Fig. 4

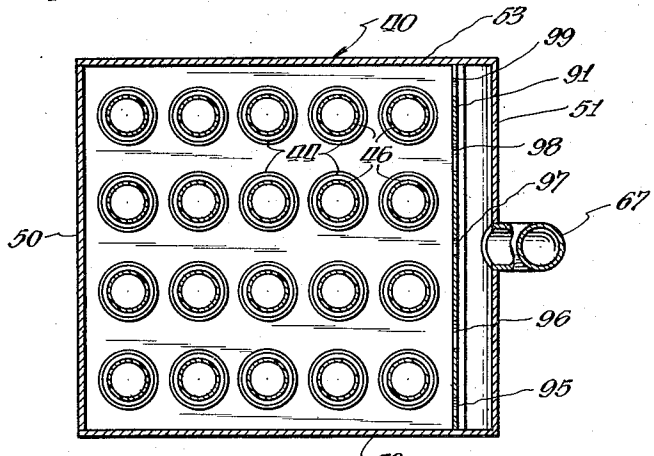
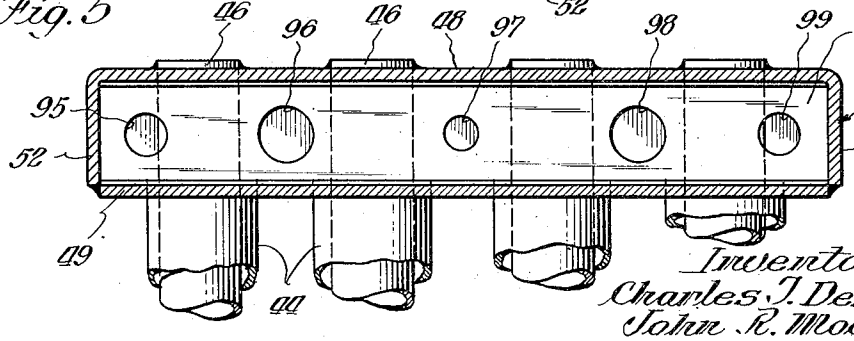


Fig. 5



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UNITED STATES PATENT OFFICE

2,607,325

VERTICAL WATER-TUBE BOILER WITH REMOVABLE COMBUSTION CHAMBER

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5 Claims. (Cl. 122—271)

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This invention relates to boilers and more particularly to boilers of the water tube-fire tube type.

Boilers of the water tube-fire tube type have heretofore been known in the art. However, boilers of this general type which have been heretofore known have had several inherent disadvantages such as, for example, being relatively expensive or difficult to produce commercially; being difficult to clean or repair; or having a tendency to "sweat," that is, having a tendency to form condensation on the outer surface of certain water tubes and like parts through which water passes during an operation of the boiler, especially when the boiler is being operated at high capacity.

It is a primary object of our invention to overcome these disadvantages and to afford a novel boiler which may be economically constructed in a novel and expeditious manner, and which is efficient in operation and embodies improved operational characteristics.

We have found that one of the principal causes of what is commonly known in the art as "sweating" during operation of a boiler of the aforementioned type, is that the distribution of the water or other liquid passing through the boiler is uneven so that certain parts thereof receive more than their proper share of the relatively cool liquid being fed into the boiler so that in some instances, and especially when the boiler is being operated at high capacity, the chilling effect of the relatively large amount of liquid passing through these parts is sufficient to cause condensation on the outside of the same.

An important object of our invention is to construct a boiler of the aforementioned type in such a manner that proper, substantially even distribution of the flow of water or other liquid therethrough is assured in a novel and expeditious manner.

An object ancillary to the foregoing is to enable a novel fire tube-water tube boiler, embodying an inlet header and an outlet header to be constructed in such a manner that the flow of water through the inlet header into the water tubes of the boiler, and the flow of water from the water tubes of the boiler through the outlet header, is controlled and distributed in such a manner that substantially equal flow is afforded through all of the water tubes.

A further object of our invention is to construct a novel boiler of the aforementioned type embodying metering, or control, plates in the headers thereof which plates are effective to control or distribute the flow of water through the

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headers and through water tubes connected thereto, in a novel and expeditious manner.

Yet another object of our invention is to provide a boiler of the aforementioned type having a novel removable firebox embodied therein.

In addition, it is an object of our invention to enable a boiler of the aforementioned type to be constructed in such a manner that the firebox of the boiler may be removed or inserted therein and when inserted in operative position in the boiler, may be disposed in sealing engagement with a header mounted in the boiler in such a manner that the header affords a top wall for the firebox so that combustion products passed from the firebox into other portions of the boiler housing are required to pass through the header.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show a preferred embodiment and the principles thereof and what we now consider to be the best mode in which we have contemplated applying those principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a longitudinal sectional view of a boiler embodying the principles of our invention;

Fig. 2 is a sectional view taken substantially along the line 2—2 in Fig. 1;

Fig. 3 is a detail sectional view taken substantially along the line 3—3 in Fig. 1;

Fig. 4 is a detail sectional view taken substantially along the line 4—4 in Fig. 1; and

Fig. 5 is a detail sectional view taken substantially along the line 5—5 in Fig. 1.

In the drawings, a boiler 20, embodying the principles of our invention, and comprising, in general, a housing 22 in which a heat-exchange unit 24 is mounted over a removable firebox 26.

The housing 22 comprises a top wall 28, a bottom wall 29, a rear wall 30, a front wall 31, Fig. 1, and two side walls 32 and 33, Fig. 2, a partition wall 34 being disposed in upright position between the rear wall 30 and the front wall 31 to thereby divide the housing 22 vertically into an accessory section 36 at the rear thereof and a chamber 38 at the front thereof. The aforementioned walls of the housing 22 may be constructed of any suitable material such as, for example, sheet metal S, and the partition wall 34, the front

wall 31, and the forward end portions of the top wall 28, the bottom wall 29 and the side walls 32 and 33 preferably have a suitable refractory material such as fire clay, fire brick, or the like, disposed thereon to afford a lining L for the chamber 38.

The heat-exchange unit 24 comprises an upper header 40 and a lower header 42 interconnected by a plurality of water tubes 44, the water tubes affording passageways through which a liquid such as water to be heated in the boiler 20, may pass from one to the other of the headers 40 and 42. Individual fire tubes 46 are mounted in each of the water tubes 44 in spaced relation to the side walls thereof, and the fire tubes 46 extend upwardly and downwardly through the headers 40 and 42, respectively.

The header 40 is substantially rectangular in form and relatively flat, comprising a top wall 48, a bottom wall 49, a rear wall 50, a front wall 51, and two side walls 52 and 53. In the construction of the header 40 we prefer to form the top wall 48, the front wall 51, and the side walls 52 and 53, from a single sheet of suitable material such as, for example, sheet metal, and to form the rear wall 50 and the bottom wall 49 of a single sheet of suitable material such as, for example, sheet metal, and to thereafter secure the two units together by suitable means such as welding 55.

The header 42 comprises a top wall 57, a bottom wall 58, a rear wall 59, a front wall 60 and two side walls 61 and 62 and, as a matter of fact, is substantially the same as the header 40 with the exception that the rear wall 59, instead of the front wall 60 is arcuately-shaped. In fact, in the commercial production of our novel boiler 20, the upper header 40 and the lower header 42 are preferably interchangeable, the lower header 42 merely comprising a header constructed in the same manner as the upper header 40 but being turned end over end and disposed in inverted position so that what comprise the top wall 48, bottom wall 49, front wall 51, and rear wall 50 of the upper header 40 are disposed to afford the bottom wall 58, the top wall 57, the rear wall 59 and the front wall 60 of the lower header 42.

The water tubes 44, Fig. 1, extend through the bottom wall 49 of the header 40 and the top wall 57 of the header 42 and are preferably connected thereto in sealing relation therewith by suitable means such as welding. Similarly, the fire tubes 46, which extend through the water tubes 44, extend through the top wall 48 and the bottom wall 49 of the upper header 40 and through the top wall 57 and the bottom wall 58 of the lower header 42, and are connected to the walls 48, 49, 57 and 58 in sealed relation thereto by suitable means such as by welding.

Suitable means, such as, for example, a circulation pump P, which is adapted to be connected to a source of supply, not shown, by a pipe or conduit 64, is connected to the longitudinal central portion of the rear wall 59 of the lower header 42 by a pipe or conduit 65, is afforded for feeding water or other liquid to be heated in the boiler 20 into the headers 42 and 40 and the water tubes 44, the pipe 65 extending through the partition wall 34.

An outlet pipe 67 may be mounted in the upper wall 28 of the housing 22 and may be connected to the central longitudinal portion of the end wall 51 of the upper header 40 to afford means for feeding water from the headers 40 and 42 and the water tubes 44 to work units, not shown, to which water heated in the boiler 20 is to be fed.

The heat-exchange unit 24 is preferably mounted in the chamber 38 of the housing 22 in such a manner that the headers 40 and 42 are disposed at a slight, acute angle to the horizontal therein, with the front end portions of the headers 40 and 42 disposed above the rear end portions thereof, and with the water tubes 44 rearwardly inclined at a relatively small, acute angle to the vertical. Support of the heat-exchange unit 24 in this position may be effected by a bracket 69 mounted on the partition wall 34, and on which the rear end portion of the header 40 is disposed, and by the outlet pipe 67 and the inlet pipe 65 which extend through the top wall 28 and the partition wall 34, respectively, of the housing 22.

An opening 71, Figs. 1 and 2, is formed in the central portion of the partition wall 34, and an exhaust duct 73 is connected thereto and projects rearwardly therefrom out through the rear wall 30 of the housing 22 and affords means whereby combustion products may be fed from the combustion chamber 38 outwardly of the housing 22, as will be discussed in greater detail presently.

The removable firebox 26 is substantially drawer-like in form, comprising a bottom wall 75, a rear wall 76, a front wall 77, Fig. 1, and two side walls 78 and 79, Fig. 2, and is mounted in the lower end portion of the chamber 38 and rests on the bottom wall 29 of the housing 22, the walls 75–79 being formed of suitable refractory material such as fire clay, fire brick, or the like. The firebox 26 is of such size that it may be slid inwardly and outwardly through an opening 81 formed in the front wall 31 of the housing 22, and the walls of the firebox 26 are so constituted and arranged that when the firebox 26 is disposed in normal operating position within the housing 22, the rear wall 76, the bottom wall 75 and the side walls 78 and 79, thereof, are disposed in juxtaposition to the partition wall 34, the bottom wall 29, and the side walls 32 and 33, respectively, of the housing 22, and the front wall 77 of the firebox 26 is disposed in alignment with the upper portion of the front wall 31 of the housing 22. As is best seen in Figs. 1 and 2, the rear wall 76, the front wall 77 and the side walls 78 and 79 of the firebox 26 are so constituted and arranged that when the firebox 26 is disposed in the aforementioned normal operating position in the housing 22, the upper surface of these walls affords a ledge or shelf projecting inwardly from the adjacent corresponding walls of the housing 22. As is best seen in Fig. 1, the rear wall 76 is somewhat shorter than the front wall 77 of the firebox 26 and the upper surfaces of the side walls 78 and 79 thereof slope downwardly from the upper surface of the front wall 77 to the upper surface of the rear wall 76. Notches 83, 84 and 85 are formed in the inner upper edge portion of the front wall 77 and the side walls 78 and 79, respectively, of the firebox 26 and afford ledges which are disposed in sealing engagement with the adjacent edge portions of the header 42 when the firebox 26 is disposed in the aforementioned normal operating position. The rear wall 76 of the firebox 26 is of such a height that when the firebox 26 is disposed in the aforesaid normal operating position, the upper surface

thereof is in sealing engagement with the rear edge portion of the header 42.

Suitable means such as, for example, an oil burner B, of a type well known to those skilled in the art, may be mounted in the accessory section 36 of the housing 22 for feeding fuel and air into the firebox 26 during an operation of our device.

Aligned openings 88 and 89 are afforded in the partition wall 34 of the housing 22 and the rear wall 76 of the firebox 26, respectively, to afford means through which fuel and air may be fed from the burner B into the firebox 26, the oil burner B shown in the accompanying drawings embodying a nozzle BN, which is shown extending through the openings 88 and 89, Fig. 1, into the firebox 26, in position to feed fuel and air into the firebox 26 in a manner well known to those skilled in the art.

Two metering plates or control plates 91 and 92, Figs. 1 and 5, are mounted in the headers 40 and 42, respectively, in parallel relation to the end walls 51 and 59. Each of the plates 91 and 92 extends entirely across the header 40 or 42 in which it is mounted to afford a partition wall therein which is in engagement with the top wall, bottom wall and two side walls of the header within which it is mounted. The metering plate 91 is disposed between the outlet pipe 67 and the closest adjacent water tubes 44, and, likewise, the plate 92 is disposed between the inlet pipe 65 and the closest adjacent water tubes 44.

Each of the metering plates 91 and 92 has five openings 95, 96, 97, 98 and 99, Fig. 5, formed therein which are of such predetermined diameter, and are so constituted and arranged, that effective control of the passage of the water from the pipe 65 into the water tubes 44, and from the tubes 44 into the outlet pipe 67, is afforded in such a manner that water passing through the heat-exchange unit 24 is substantially evenly distributed among the water tubes 44.

With the boiler constructed in the manner shown in the accompanying drawings, and wherein the inlet pipe 65 and the outlet pipe 67 are connected to the central portion of the rear wall 59 and the front wall 51 of the headers 42 and 44, respectively, we have found that to effect the aforesaid even distribution of the water flow through the water tubes 44, it is desirable that the central opening 97 in the control plates 92 and 91 be of a predetermined diameter which is considerably less than the diameter of the inlet pipe 65 and outlet pipe 67, respectively. The openings 95 and 99 which are disposed most closely adjacent to the ends of the plates 91 and 92 of the five openings disposed therein, preferably have a diameter somewhat larger than the opening 97 but still considerably smaller than the diameter of the pipes 65 and 67. Likewise, the intermediate openings 96 and 98, between the central opening 97 and the end openings 95 and 99, respectively, are preferably of a diameter somewhat larger than that of the openings 95 and 99, but still considerably less than the diameter of the pipes 65 and 67.

As a specific example of the approximate preferred size of the openings through the plates 91 and 92, we have found that when using headers having a depth of substantially 3", a width of substantially 14⅜" and a length of substantially 17⅜", and when using water tubes having an internal diameter of substantially 2", and fire tubes having an internal diameter of substantially 1¼", and when using inlet and outlet pipes having an internal diameter of substantially 2", the opening 97 preferably has a diameter of substantially ⅝", the two openings 95 and 99 preferably have diameters of substantially 1⅜", and the two openings 96 and 98 preferably have diameters of substantially 1¼".

With the boiler 20 constructed in the aforementioned manner, it has been found that the flow of water through the water tubes 44 is substantially equally distributed thereamong and with a minimum of resistance to the flow of water through the heat-exchange unit 24.

Thus, it will be seen that in the operation of our novel boiler, water may be fed by the pump P through the inlet pipe 65 and the end wall 59 into the header 42, whence it flows through the openings 95–99 in the metering plate 92, the water tubes 44 and into the header 48. The water in the header 48 may flow outwardly through the openings 95–99 in the metering plate 91 into the outlet pipe 67 to the work units to which the boiler may be attached. During this passage of water through the heat-exchange unit 24, fuel and air are fed by the burner unit B into the firebox 26 which is disposed in normal operating position, shown in solid lines in Fig. 1. The fuel and air thus fed into the firebox 26 enter into combustion therein and the hot gases resulting therefrom pass upwardly through the fire tubes 46, and swirl upwardly from the top of the header 40 down past the front end portion thereof, across the outside of the water tubes 44 and outwardly through the opening 71 and the exhaust duct 73 whence it may be fed to the atmosphere through suitable means such as a smoke stack, not shown. Thus it will be seen that the water in the headers 40 and 42 and the fire tubes 44 are heated by hot gases passing upwardly therethrough and passing transversely across the outside thereof in an efficient manner.

Removable panels 102 and 104 may be mounted on the top wall 28 and the front wall 31 of the housing 22, if desired, to thereby facilitate cleaning of the upper portion of the chamber 38 and permitting ready access to the heat-exchange unit 24.

Also, it will be seen that the removable firebox 26 affords ready access to the lower portion of the chamber 38 and to the lower end portion of the heat-exchange unit 24 to thereby permit ready cleaning and repair of the heat-exchange unit 24 and the lower interior portion of the housing 22.

From the foregoing it will be seen that we have afforded a novel boiler which may be readily and economically constructed and wherein the flow of water through the water tubes thereof is evenly distributed to thereby prevent localized sweating of certain of the tubes as has been heretofore experienced in boilers known in the art.

Also, it will be seen that we have afforded a novel boiler embodying a novel firebox which may be quickly and readily removed or replaced in the housing of the boiler and wherein ready access is afforded to the interior of the boiler for the purpose of repairing or cleaning the boiler housing or units such as the heat-exchange unit mounted therein.

Thus, while we have illustrated and described the preferred embodiment of our invention, it is to be understood that this is capable of variation and modification and we therefore do not wish to be limited to the precise details set forth, but desire to avail ourselves of such changes and

alterations as fall within the purview of the following claims.

We claim:

1. A boiler comprising a housing, a drawer slidably mounted in said housing and movable into and out of a predetermined position in the latter, a heat-exchange unit mounted in said housing, said heat-exchange unit including a header mounted in said housing in position to engage said drawer when said drawer is disposed in said predetermined position and to afford a top wall therefor, means mounted on said housing for feeding fuel and air into said drawer for combustion therein, means connected to said heat-exchange unit for feeding water thereinto, and means including said heat-exchange unit for feeding combustion products from said drawer to the atmosphere.

2. A boiler comprising a housing having side walls, a top wall, and a bottom wall defining a combustion area therebetween, a drawer comprising a bottom wall, and side walls projecting upwardly therefrom, said drawer being slidably mounted in said housing with said bottom wall of said drawer engaged with said bottom wall of said housing, said drawer being operable to be disposed in a predetermined position in said housing wherein said side walls of said drawer are disposed in engagement with corresponding side walls of said housing and to be moved on said bottom wall outwardly from said position relative to said housing, corresponding side walls on one side of said housing and said drawer having aligned openings formed therein, means mounted in said opening when said drawer is disposed in said predetermined position for feeding fuel into said drawer for combustion therein, and a heat-exchange unit for passing water through said combustion area in heat-exchange relation to combustion products from said drawer.

3. A boiler comprising a housing having walls defining a combustion area therein, a drawer slidably mounted in the lower end portion of said housing and having a normal predetermined position in said housing wherein said drawer affords an inwardly projecting ledge extending around said combustion area, said drawer being movable outwardly from said housing away from said predetermined position, a water header mounted in said housing in position to engage said ledge when said drawer is in said predetermined position in said housing, another water header mounted in said housing in spaced relation to said first mentioned header, means for feeding water into and out of said headers, means for feeding fuel into said drawer for combustion in said housing, and means including fire tubes mounted in and extending through said headers for feeding combustion products from said drawer through said headers and to the atmosphere.

4. A boiler comprising a housing having side walls, a front wall, a rear wall, a top wall and a bottom wall, said walls defining a chamber therebetween, means including an upper and a lower header for passing water through said chamber, a drawer affording a removable firebox mounted in said housing below said lower header, said drawer comprising a bottom wall and a front wall, rear wall and two side walls projecting upwardly from said last mentioned bottom wall, said drawer being operable to be disposed in a predetermined position in said housing with said side walls, rear wall and front wall of said drawer disposed in sealing engagement with the peripheral edge portion of said lower header and to be moved outwardly therefrom into outwardly projecting relation to said housing, means mounted on said housing for feeding fuel into said drawer for combustion in said chamber when said drawer is disposed in said predetermined position, and means including conduits in said lower header for feeding combustion products from said drawer through said chamber to the atmosphere.

5. A boiler comprising a housing having wall means defining an upper and lower chamber, one portion of said housing being slidable inwardly and outwardly relative to the other portion of said housing, said lower chamber being defined in said one portion, means including a heat-exchange unit mounted in said upper chamber for feeding hot gases from said lower chamber to the atmosphere, said heat-exchange unit being operable to engage said first mentioned portion of said housing when said first mentioned portion of said housing is in said inwardly disposed position to thereby afford a partition wall between said upper and lower chambers, and means for feeding liquid into said heat-exchange unit into heat-exchange relationship with such hot gases.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
311,450	Stead	Jan. 27, 1885
358,423	Babbitt et al.	Mar. 1, 1887
555,754	Benton	Mar. 3, 1896
622,352	Hanson	Apr. 4, 1899
662,882	Shaw	Nov. 27, 1900
1,796,713	Jacobus	Mar. 17, 1931
2,096,586	Johnson	Oct. 19, 1937
2,228,757	Drummond	Jan. 14, 1941
2,277,974	Heagle	Mar. 31, 1942
2,385,065	Du Brie	Sept. 18, 1945
2,429,916	Belgau	Oct. 28, 1947