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G. BURKHARDT

1,743,112

BOILER

Filed March 11, 1926

Fig. 1.

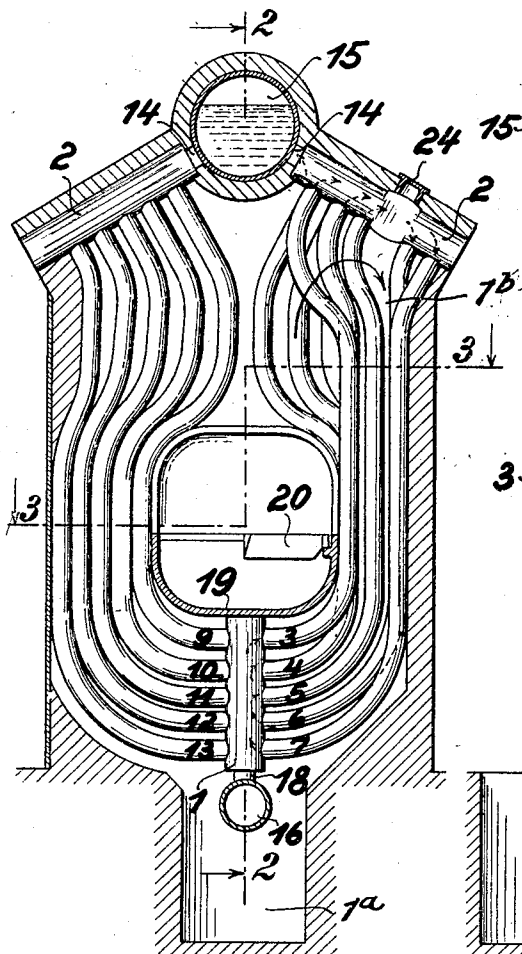


Fig. 2.

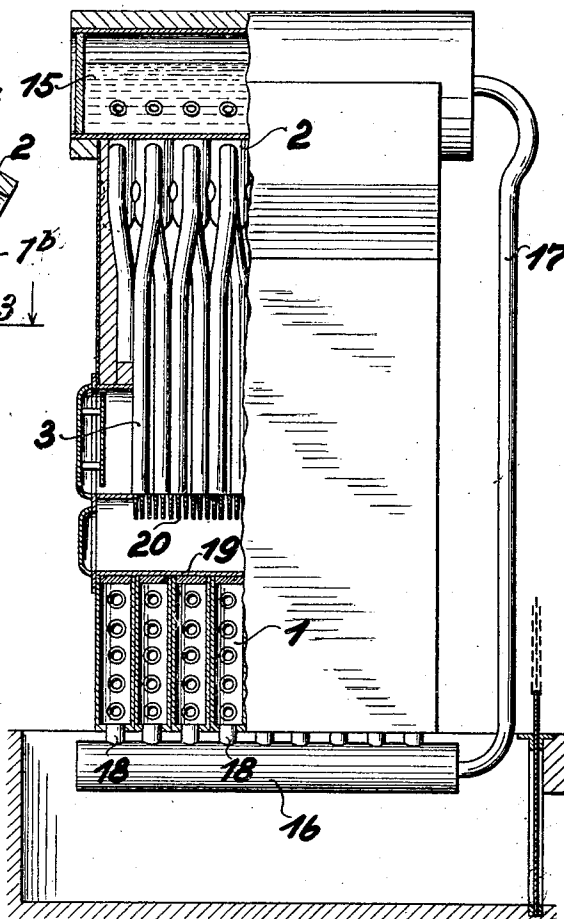


Fig. 3.

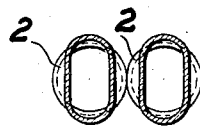
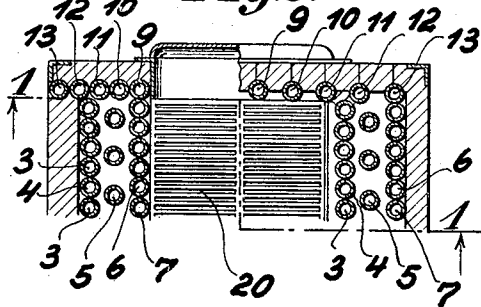


Fig. 4.

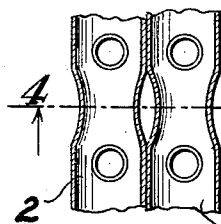


Fig. 5.

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UNITED STATES PATENT OFFICE

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BOILER

Application filed March 11, 1926, Serial No. 93,884, and in Germany December 12, 1925.

This invention has reference to water tube boilers, and it comprises in particular a boiler of the kind referred to which may be manufactured to a large extent from wrought iron pipes in a comparatively easy and inexpensive manner, and which combines the advantages of the usual cast iron sectional boilers, particularly the easy assembling of the several sections into a complete boiler, by merely serial connection, closed fire-box, the walling-in of the flues by heating surfaces, a minimum of space and other advantages with the advantages derived from the use of wrought iron as a material for the construction of boilers of which may be mentioned in particular high resistibility combined with but moderate thickness of shell, most favorable convection of heat, the possibility of welding defective portions and other important points of advantage. It is a further object of my invention to improve the water circulation in the boiler, and to improve the construction and manipulation of the same. The boiler constructed in accordance with this invention among other uses is particularly adaptable for use as a small boiler for central heating plants with low steam pressures, though, of course, it should be understood that it is not restricted thereto, but may be used as well for high pressures likewise.

The invention will be further described with reference to the accompanying drawings, showing by way of example certain embodiments of the principles of my invention. Figure 1 is a vertical longitudinal section of one of the preferred forms of construction. Figure 2 is a side elevation with parts in section corresponding thereto, while Figure 3 shows this exemplification in horizontal section, and Figure 4 is a transverse section through the upper intermediate sectional chamber at its point of constriction and Figure 5 is a longitudinal section at the same point.

Referring particularly to the drawings, the new boiler according to this invention comprises the lower series of headers 1 which are vertically disposed side by side of each other and in such a manner that their axes will be situated in the vertical central plane of the

boiler, and it also comprises the upper opposite sets or series of headers 2, 2 symmetrically disposed with relation to the central plane and angularly (at acute angles) thereto. The lower and upper headers are connected to each other by curved boiler tubes 3, 4, 5, 6, 7 of which the pipes 3, 4 on the one hand and respectively 6, 7 on the other hand are curved in such a manner that the lower ends are situated with their axes in planes passing through the axes of the lower headers, while the upper ends of the pipes are disposed in planes passed through the axes of the upper headers, while the intermediate portions of the pipes are disposed with their axes parallel to each other and in planes in parallel relation to the axis of the boiler.

It will be observed that the construction and arrangement of the tubes 3 to 7, inclusive, is such as to provide two banks of tubes lying opposite each other and on opposite sides of the central vertical plane of the boiler and symmetrically with respect to each other and to said plane, and that each bank of tubes comprises three parallel rows of tubes extending longitudinally of the boiler, the tubes 3 and 4 forming an inner row, the tubes 5 an intermediate row, and the tubes 6 and 7 an outer row. As shown, the middle portions of all the tubes are straight and vertical, and such portions of the tubes 3 and 4 of the inner row and the tubes 6 and 7 of the outer row are in contact, and form the inner and outer side walls of a downdraft flue 1^b for passage of the gases of combustion to the exhaust outlet 1^a centrally positioned at the base of the boiler structure, while the intermediate tube row 5 divides this flue 1^b into two longitudinal channels and the tubes of the row 5 are spaced to provide lateral passages between the channels. As shown also, the tubes 3 and 4 of each bank form the adjacent side wall of the fire-box 1 and the upper ends of the tubes 3, 4, 5, 7, which are curved laterally for connection with the inclined headers 2, are relatively offset in such manner as to form lateral passages for the flow of the products of combustion from the combustion chamber lying above the fire-box to the upper end of the flue 1^b, while the lower ends of the tubes 3, 4, 5, 7, which are bent or

curved inwardly beneath the fire-box for connection with the headers 1, are relatively offset or spaced in such manner as to provide between them passages for the flow of the gases of combustion from the lower end of the flue 1^b between and about the lower ends of the tubes to the outlet 1^a. By this arrangement of the tubes of the banks, which form the side walls of the fire-box and combustion chamber, as well as the gas-flues, the heat of the burning fuel and of the products of combustion is utilized in a most effective manner, while at the same time, as the tubes 3, 4 and the tubes 5 are, by the arrangement described, heated to a higher degree than the tubes 6 and 7, the effect is to cause an upflow action through the tubes 3, 4 and 5, and a downflow action through the tubes 6 and 7, so that a highly efficient circulation of the water and steam is obtained for the rapid generation of the water into steam and raising of the temperature of the latter to a predetermined degree without waste of heat and at a low fuel cost. The transverse bank of tubes 9 to 13, inclusive, which are shown arranged across the boiler at the front, similarly have straight intermediate portions, inwardly curved lower ends connected to the lower headers and outwardly and upwardly curved upper ends connected to the upper headers, said tubes being so arranged as to form the front wall of the fire place.

The tubes or pipes 3, 4, 5, 6, 7 are moreover bent in such a manner that with the tubes arranged symmetrically thereto they will constitute a cluster or group of tubes of substantially U-shape.

The upper headers 2, 2, are connected to a common upper drum 15 the horizontal axis of which is situated in the plane of symmetry of the boiler by comparatively broad connecting tubes 14; the lower headers 1 are connected by the passages or tubes 18 to a collecting pipe 16 by means of which the several lower headers may be emptied together.

The space produced by the arrangement of the interior pipes or tubes 3, 4 or by the walls constituted thereby serves as a fire box which is closed at its bottom by the ash-box 19 of the fire place 20. From said fire place or grate 20 the fire gases ascend in this space and enter below the upper headers into the smoke flues formed by the tubes 3, 4 and 6, 7 respectively and symmetrically disposed with relation to the central plane. The smoke and gases flow downwards in said flues or passages, thereby surrounding the tubes 5, and are discharged below from the clusters of tubes and enter into the smoke channel disposed below the boiler and provided in practice with a regulatable smoke slide or the like. Inasmuch as the tubes 3, 4 and 5 are heated to a considerably higher temperature than the tubes 6 and 7, a very lively circulation is set up, the circulating current rising in the tubes 3, 4, 5 and descending in the pipes or tubes 6, 7, as indi-

cated by the arrows in Figure 1 of the drawing. The steam bubbles issuing from the ascending tubes rise through the ports 14 and into the steam collector 15, while the feed water supply is admitted into the circulating current in any suitable way.

The (front and rear) headers of the upper and lower sets are distinguished from the intermediate headers of the sets hereinbefore described by a different arrangement of the tubes 9, 10, 11, 12, 13 the axes of which are disposed in a plane at right angle with relation to the central plane of the boiler. Only their ends are bent into another plane parallel to said intermediate headers, but situated farther to the outside, so that the terminal tubes will be disposed close to the tubes 3, 7 of the intermediate headers which are situated farthest to the outside, as appears from Figures 2 and 3 of the drawing. By this arrangement the tubes of these terminal headers constitute front and rear walls for the fire box and for the smoke channels, as shown in Figure 3. By using only a limited amount of fire-proof masonry these walls are closed against the escape of smoke and gases. In order to provide for the cleaning of the smoke escape passages between the tubes 3, 4 and 6, 7 the upper headers between the connections of the ascending and descending tubes are constricted, as shown in Figures 4 and 5. Through the apertures thereby produced which are covered up by lids or covers 24 cleaning devices, such as scrapers, brushes and the like may be introduced into the smoke escape passages between the wall-forming tubes or boiler pipes, thereby causing the soot to drop down into the smoke gas channel.

While I have described and shown the invention in the present instance as exemplified by a preferred embodiment, giving satisfactory results, it is to be understood that the principles of the invention may find expression in other embodiments likewise without deviating from the spirit and scope of the invention as expressed in the appended claims.

I claim:—

1. An upright water tube boiler having an outlet at or near its bottom for the discharge of exhaust gases, a centrally disposed firebox, banks of curved water tubes disposed opposite each other and on opposite sides of and symmetrically with respect to the central vertical plane of the boiler, each bank of tubes extending above and below the firebox and comprising an inner row of tubes and an outer row of tubes arranged longitudinally of the boiler, said rows being spaced to form a flue for the passage of the gases from above the smoke box outward laterally between the upper ends of the tubes of the inner row and thence downwardly between the tubes of the rows and finally to the exhaust outlet, whereby the inner and outer rows will be heated to

different degrees of intensity for the upflow of fluid through the inner row of tubes and a downflow of fluid through the outer row of tubes, vertically arranged lower headers disposed below the horizontal plane of the firebox and with which the lower ends of the tubes of the banks connect, and upper headers with which the upper ends of the tubes of the banks connect.

2. An upright water tube boiler having an outlet at or near its bottom for the discharge of exhaust gases, a centrally disposed firebox, banks of curved water tubes disposed opposite each other and on opposite sides of and symmetrically with respect to the central vertical plane of the boiler, each bank of tubes extending above and below the firebox and comprising an inner row of tubes and an outer row of tubes arranged longitudinally of the boiler, said rows being spaced to form a flue for the passage of the gases from above the smoke box outward laterally between the upper ends of the tubes of the inner row and thence downwardly between the tubes of the rows and finally to the exhaust outlet, whereby the inner and outer rows will be heated to different degrees of intensity for the upflow of fluid through the inner row of tubes and downflow of fluid through the outer row of tubes, a single central row of vertically arranged headers extending longitudinally of the boiler and directly connecting the lower ends of the tubes of the banks, and upper headers on opposite sides of the central vertical plane of the boiler with which the upper ends of the tubes of the respective banks connect.

3. An upright water tube boiler having an outlet at or near its bottom for the discharge of exhaust gases, a centrally disposed firebox, banks of curved water tubes disposed opposite each other and on opposite sides of and symmetrically with respect to the central vertical plane of the boiler, each bank of tubes extending above and below the firebox and comprising inner, outer and intermediate vertical longitudinal rows of tubes, said rows being spaced from each other to form flue channels and the tubes of the intermediate row being spaced from each other to form passages laterally connecting the flue channels for the flow of the gases from above the smoke box outward laterally between the upper ends of the tubes of the inner row to and downwardly through said flue channels and thence to the exhaust outlet, whereby the tubes of the inner and intermediate rows will be heated to a single degree of intensity for the upflow of fluid therethrough and the tubes of the outer row will be heated to a lesser degree of intensity for the downflow of fluid therethrough, vertically arranged lower headers below the firebox and directly connecting the lower ends of the tubes of the banks, and upper headers on opposite sides of

the central vertical plane of the boiler with which the upper ends of the tubes of the respective banks connect.

4. An upright water tube boiler having an outlet at or near its bottom for the discharge of exhaust gases, a centrally disposed firebox, banks of curved water tubes disposed opposite each other and on opposite sides of and symmetrically with respect to the central vertical plane of the boiler, each bank of tubes extending above and below the firebox and comprising an inner row of tubes and an outer row of tubes arranged longitudinally of the boiler, said rows being spaced to form a flue for the passage of the gases from above the smoke box outward laterally between the upper ends of the tubes of the inner row and thence downwardly between the tubes of the rows and finally to the exhaust outlet, whereby the inner and outer rows will be heated to different degrees of intensity for the upflow of fluid through the inner row of tubes and a downflow of fluid through the outer row of tubes, a single central row of vertically disposed headers to which the lower ends of both banks of tubes are connected, and rows of upper headers inclined to the central vertical plane of the boiler and to which the upper ends of the tubes of the respective banks are connected.

5. An upright water tube boiler having a centrally disposed fire-place and a bottom exhaust gas outlet, a longitudinal series of vertical lower headers arranged beneath the fire-place in the vertical center line of the boiler, a series of upper headers arranged above the level of the fire-place and on opposite sides of the vertical center of the boiler, banks of tubes on each side of the boiler, each comprising inner and outer rows of tubes spaced at different distances from the vertical center of the boiler and from each other to form downdraft flues, the intermediate portions of the tubes of the inner rows of the banks being straight and forming the side walls of the fire-place, the lower ends of all the tubes of the banks being curved inwardly beneath the fire-place and spaced to form passages connecting the lower ends of the flues with the exhaust gas outlet and connected to the lower headers, and the upper ends of the tubes of each bank being connected to the associated upper headers and curved and offset with relation to each other to form passages for the flow of the gases from the fire-place to and about said ends of the tubes and to the upper end of the flue formed thereby.

6. An upright water tube boiler having a centrally disposed fire-place and a bottom exhaust gas outlet, a longitudinal series of vertical lower headers arranged beneath the fire-place in the vertical center line of the boiler, a series of upper headers arranged above the level of the fire-place and on opposite sides of the vertical center of the boiler, banks of

tubes on each side of the boiler, each comprising inner and outer rows of tubes spaced at different distances from the vertical center of the boiler and from each other to form down-draft flues, the intermediate portions of the tubes of the inner rows of the banks being straight and forming the side walls of the fire-place, and a transverse bank of vertical tubes between the banks of tubes at one end of the boiler and forming an end wall of the fire-place, the lower ends of the tubes of all the banks being curved inwardly beneath the fire-place and connected to the lower headers and spaced to form passages connecting the flues with the exhaust gas outlet and the upper ends of all the tubes of the banks being curved toward and connected to the upper headers, the upper ends of the tubes of the side banks being spaced and offset with relation to each other to form passages for the flow of the gases from the fire-place to and about said ends of the tubes and to the upper ends of the flues formed thereby.

7. In an upright water tube boiler, heating means, a longitudinal series of lower headers arranged in the central vertical plane of the boiler, two longitudinal series of upper headers arranged respectively on opposite sides of and inclining upwardly and inwardly at oblique angles converging toward said plane, and banks of curved vertical water tubes arranged on opposite sides of said plane, the tubes of both banks communicating at their lower ends with the lower series of headers and the tubes of the opposite banks respectively communicating at their upper ends with the oppositely disposed upper series of headers, and the tubes of each bank being disposed in groups so arranged with respect to each other and to the heating means and course of travel of the products of combustion therefrom that a certain group will be heated more intensely than another group to provide for a fluid upflow circulation through one group and a fluid downflow circulation through the other group.

In testimony whereof I affix my signature.

GOTTLOB BURKHARDT.

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