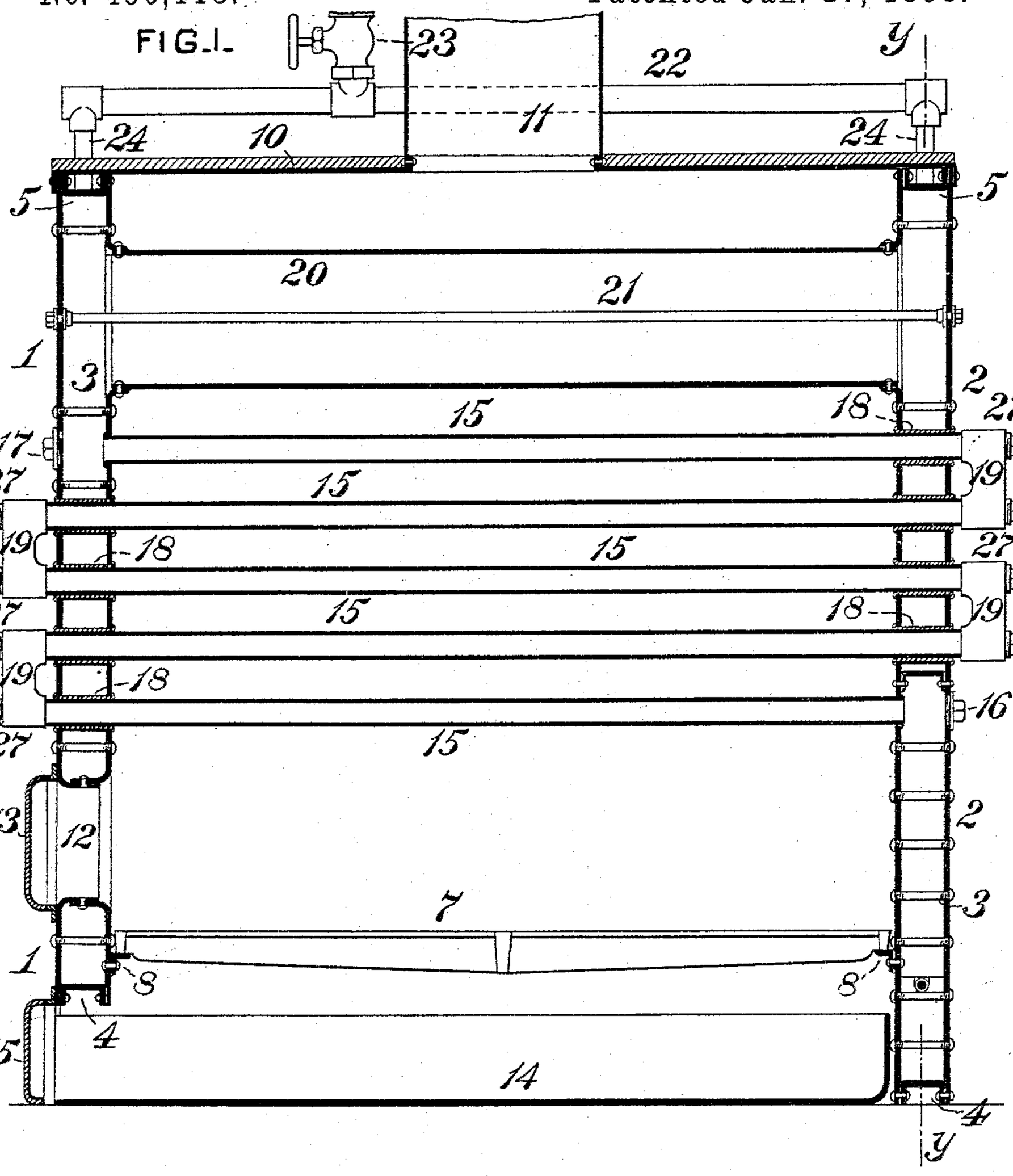
(No Model.) 3 Sheets—Sheet 1.

H. A. LAUGHLIN.

STEAM BOILER.

No. 490,118. Patented Jan. 17, 1893.

FIG. 1.



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(No Model.) 3 Sheets—Sheet 2.

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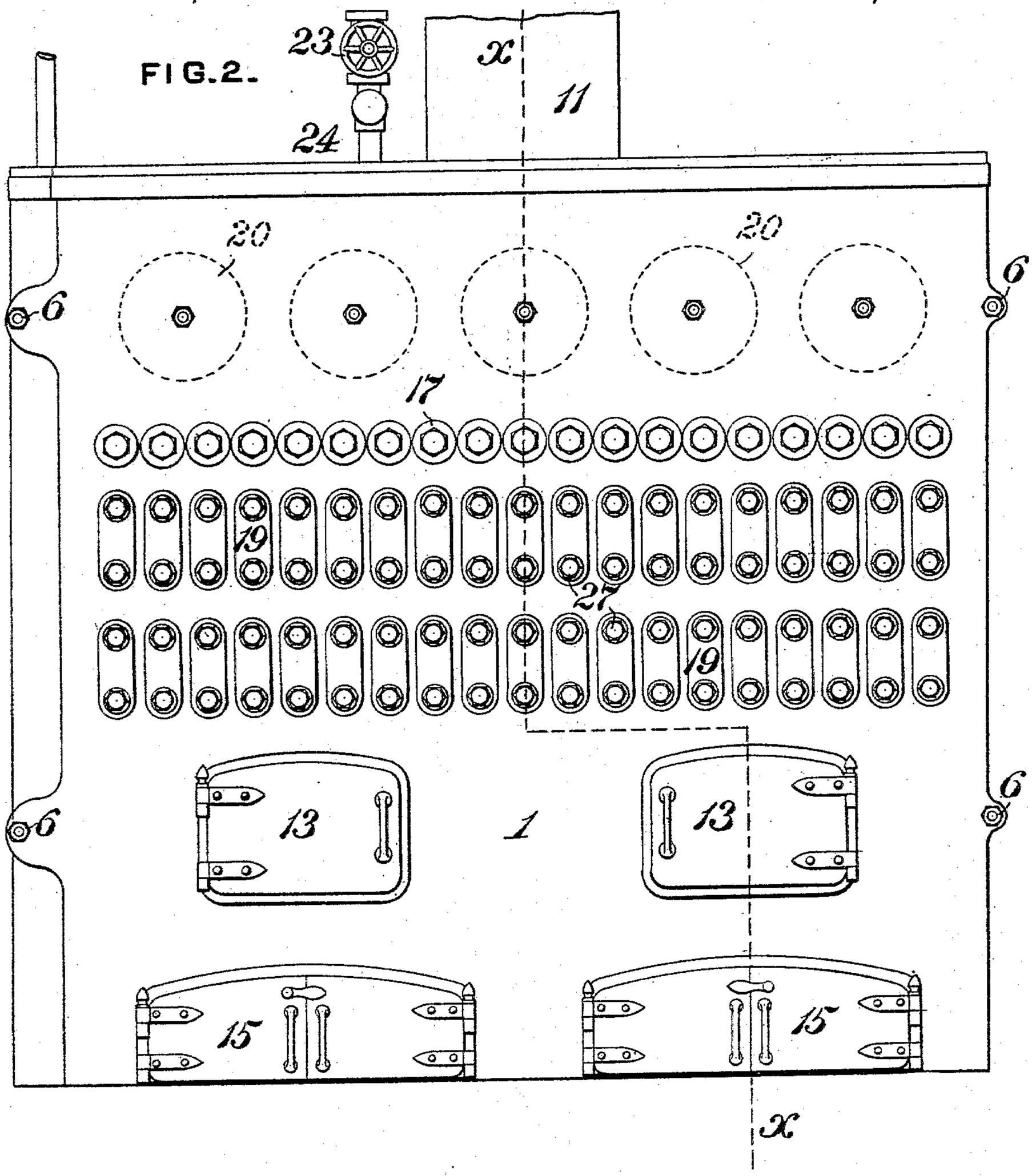
FIG. 2.



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(No Model.) 3 Sheets—Sheet 3.

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STEAM BOILER.

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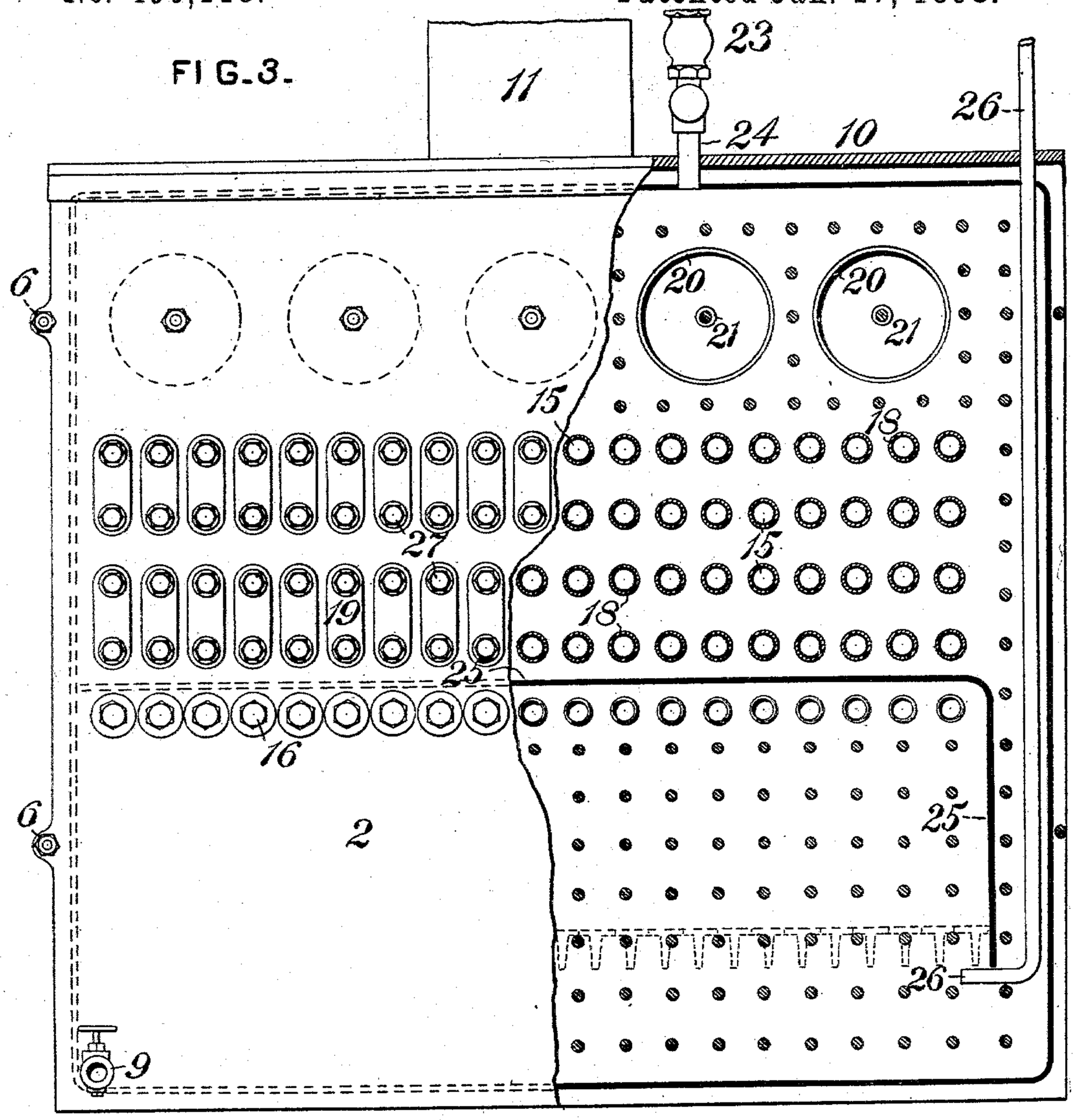
FIG. 3.



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UNITED STATES PATENT OFFICE.

HENRY A. LAUGHLIN, OF PITTSBURG, PENNSYLVANIA.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 490,118, dated January 17, 1893.

Application filed May 6, 1892. Serial No. 432,033. (No model.)

To all whom it may concern:

Be it known that I, HENRY A. LAUGHLIN, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Steam-Boilers, of which improvement the following is a specification.

My invention relates to steam boilers of the class or type known in the art as "tubulous" or "water tube," and its object is to attain, as far as practicable, in a boiler of such type, the structural advantages of simplicity, strength to carry high steam pressure, lightness, and comparatively low cost of erection and maintenance, together with the provision of ample area of grate and heating surface and the protection of all tube joints from the direct action of the fire, as well as to afford a free, rapid, and continuous circulation of water, and to admit of the delivery of dry steam from a large area of liberating surface.

To this end, my invention, generally stated, consists in the combination of two end casings or legs, a steam receptacle connected thereto adjacent to their upper ends, water tubes connecting the end casings at different levels and passing intermediately freely through said casings, and joints connecting the water tubes exterior to the casings. Also, in the combination, with a steam boiler as above constituted, of a diaphragm or circulating plate located in one of the end casings above the ends of the lower rows of water tubes, and a feed water pipe opening into the casing below the diaphragm.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings: Figure 1 is a vertical longitudinal section, at the line x, x, of Fig. 2, through a steam boiler illustrating a form of embodiment of my invention; Fig. 2, a front view of the same, and; Fig. 3, a rear view, partly in section at the line y, y, of Fig. 1.

In the practice of my invention I provide a front and a rear end casing or leg, 1, 2, each of which is of substantially rectangular form, and is constructed similarly to the water legs of ordinary tubular boilers, that is to say, formed of sheets set at a proper distance apart to provide an intermediate water and steam space, and connected and braced as against internal pressure, by socket bolts, or by screw stays 3 as shown, the casings being closed at bottom by mud rings, or, as shown by channel plates 4, and being closed at top by similar plates 5, and also closed at their sides. The casings 1 and 2 are set at such distance apart as to admit between them a fire chamber of the length desired, and are connected by longitudinal tie rods 6. A fire grate 7, which, in this instance, is composed of grate bars of the ordinary form, extending longitudinally from one casing to the other, but which may, if desired, be a water grate, is supported on bearers 8, near the lower ends of the casings, the rear casing 2 extending downwardly to a lower level than the front casing 1, in order to provide a space removed from the direct heat of the fire, for the deposition of separated impurities, which may be discharged, as from time to time required, by a suitable blow off cock 9.

The space between the end casings is closed, at its sides, by walls which may, in stationary boilers, be of brick, or in the case of marine or portable boilers, be formed of light sheet metal, lined with fire brick or tile, and cased with wood or any suitable and preferred non-conducting covering. The fire chamber formed by the space between the casings above the grate 7, is closed at top by a cap plate 10, provided with an exit flue or stack 11, and access to the fire chamber is had through openings 12 in the front casing, located above the grate and provided with the usual fire doors 13. An ashpan 14 is located below the grate, and ashpan doors 15, at the front thereof, are provided for the regulation of draft and the removal of ashes.

The end casings 1 and 2 are connected, at lower and higher levels respectively, by water tubes 15, which are connected, one to another, so as to form a series of vertical flat coils or return bends. In the instance shown, nineteen coils, each formed of five lengths or sections of tube, are employed, but it will be obvious that the number may be varied in the discretion of the constructer, in accordance with the proportions of width and height of the boiler which may be adopted in different cases. The lowest tube of each coil is connected to and expanded in the inner sheet of

the rear casing 2, and opens at this, its receiving end, into the water space thereof, and the highest tube of each coil is similarly connected, at a higher level, to the inner sheet of the front casing 1, into the water space of which it opens at its delivery end. Removable plugs 16, 17, are inserted in the outer sheets of the rear casing 2, and front casing 1, in line with the lowest and highest tubes, respectively, of each coil, said plugs closing openings in the sheets for the insertion of an expanding tool, in securing the tubes in position in the sheets, and for admitting access to the tubes when desired.

The highest and lowest water tubes 15, of each coil, adjacent to their free ends, or those unconnected with the casings 1 and 2 respectively, pass freely through and are supported in tubular sockets 18, the ends of which are secured to and expanded in the inner and outer sheets of the adjacent casings 2 and 1 respectively, and the intermediate tubes of each coil, adjacent to each of their ends, pass freely through and are supported in similar and similarly connected sockets. The several tubes of each coil are connected one to another, by headers or couplings 19, which are located outside of and adjacent to the end casings 1 and 2, and are provided with removable plugs 27, to enable access to be had to the interior of the tubes.

In order to provide proper and ample steam liberating surface and steam chamber volume, the casings 1 and 2 are, near their upper ends, connected to and communicate with a steam drum or drums, in which the normal water level is maintained. In the instance shown, a series of cylindrical drums 20 is employed, thereby affording a material increase of liberating surface as compared with a single one, without involving the weakness due to the necessarily larger diameter of the latter. The drums 20 are preferably riveted to flanges turned on the inner sheets of the casings 1 and 2, and the screw stays applied in other portions of the casings not being admissible opposite the openings of the drums, the casings are stayed at these points by braces 21, extending through the drums, from the outer sheet of one casing to that of the other. The steam supply pipe 22, leading to the engine, is provided with the usual stop valve 23, and may be connected to either of the end casings, but, to equalize the delivery of steam, it is preferably connected to both by short pipes 24.

A diaphragm or circulating plate 25, which may be, as shown, a channel plate, is fitted between the inner and outer sheets of the rear casing 2, and extends horizontally across the same, from one side thereof to a point between the opposite side and the lowest tube 15, of the coil nearest said opposite side. From this point it extends downwardly to a level adjacent to and preferably below that of the grate, a vertical water passage being thus provided between its downwardly extending portion and the adjacent side of the casing. A feed water pipe 26, provided with an ordinary check valve, and adapted to be connected to a feed pump or injector is led into the rear casing 2, with its discharge end opening thereinto below the diaphragm 25, and in order to impart heat to the entering feed water, the feed pipe 26 may, as shown, enter the casing 2 at its top and extend downwardly through the same to a point below the end of the downward portion of the diaphragm, and then be extended horizontally toward the center line of the casing. The blow off cock is located at or near the side of the casing opposite that at which the feed water is supplied.

It will be obvious that as an alternative and equivalent construction, the diaphragm 25 may, if desired, be extended entirely across the casing 2, and communication be established for the passage of water from its upper to its lower side by an outside pipe, connected to the casing above and below the diaphragm, into which connecting pipe the feed water pipe may be led. The construction shown is, however, deemed preferable, in the particulars of being within the requirements of a self contained boiler and of affording ample space for the downward passage of water in the normal and desired circulation thereof during steam generation.

While, in the construction herein shown, the fire chamber is provided with a lower fire grate for the combustion of solid fuel, such fire grate is not an essential of my invention, and is not employed in cases where waste gases from furnaces, or other gaseous fuel, are desired to be utilized in the generation of steam.

In the operation of a boiler in which the essential elements of the construction above described are embodied, the radiant heat of the ignited fuel upon the grate, and the heat of the products of combustion thereof which pass upwardly to the stack 11, is exerted directly upon the inner walls of the end casings 1 and 2, and the surfaces of the intermediate portions of the water tubes 15 which form the several coils. The water in the tubes, as it becomes heated, ascends through the coils, and is delivered to the upper portion of the front casing 1, and thence to the drums 20, its place being supplied by colder water which descends in the rear casing 2, through the passage between the downward projection of the diaphragm 25 and the adjacent wall of the casing, this passage being preferably formed, as indicated in the drawings, by an extension of the rear casing beyond the side wall of the firechamber, so that it is not exposed to the direct heat of the fire. As the cooler water passes under and enters the space on the left hand side of the downward projection of the diaphragm 25, it is heated, and ascending through said space, enters the receiving ends of the lower tubes of the several coils, being prevented from passing above them by the horizontal portion of the dia-

phragm. The active circulation thus instituted is promoted by the heat imparted to the rising currents of water in their passage through the tubes, and is insured by the delivery of the feed water into a portion of the boiler from which its natural and unopposed tendency is to ascend and pass into the receiving ends of the coils of water tubes.

My improvement is particularly adaptable to marine service, and to conditions where the rapid and safe generation of steam of high pressure is required to be effected within comparatively limited space. It will seen that under the construction as above described, a rapid and constant natural circulation of water may be effected, with a corresponding evaporative efficiency, and that any desired amount of grate and heating surface permitted by determined circumscribing limits may be provided. The support of the portions of the water tube coils, intermediate between their receiving and delivery ends, freely in the tubular sockets of the end casings, relieves the latter from strains of expansion and contraction acting on the tubes, and the connection of the water tubes by headers located outside the end casings and therefore entirely removed from the direct action of the fire, enables the joints to be made tight and durable, and affords ready access for renewal and repair. The large area of liberating surface afforded by the drums and the direct connection of the same with the end casings is, further, of material advantage in the prevention of priming by promoting the delivery of dry steam.

I claim as my invention and desire to secure by Letters Patent:

1. The combination, in a steam boiler, of two end casings or legs, an upper steam receptacle connected to said casings, a fire chamber interposed between said casings, and a series of water tubes connected to the inner sheets of said casings at different receiving and delivery levels and passing intermediately freely through said casings and across the fire chamber, substantially as set forth.

2. The combination, in a steam boiler, of two end casings or legs, an upper steam receptacle connected to said casings, a fire chamber interposed between said casings, a series of coils or return bends of water tubes connected to the inner sheets of said casings at different receiving and delivery levels and passing intermediately freely through said casings and across the fire chamber, and headers or couplings connecting the tubes of each coil at alternately opposite ends externally to the end casings, substantially as set forth.

3. The combination, in a steam boiler, of two end casings or legs, an upper steam receptacle connected to said casings, a fire chamber interposed between said casings, tubular sockets connecting the inner and outer walls of each casing, and a series of water tubes connected at a receiving level to the inner sheet of one of the casings and at a higher delivery level to the inner sheet of the opposite casing, and passing intermediately freely through the tubular sockets of both sections and across the fire chamber, substantially as set forth.

4. The combination, in a steam boiler of two end casings or legs, an upper water connection between said casings, a fire chamber interposed between said casings, a series of water tubes connecting said casings at different receiving and delivery levels and passing across the fire chamber, a diaphragm or circulating plate extending across one of said casings above the receiving ends of the water tubes, a water passage connecting the space above and below the diaphragm, and a feed water pipe leading into the space below the diaphragm, substantially as set forth.

5. The combination, in a steam boiler, of two end casings or legs, one or more drums connected to and communicating with each of said casings at a point below the normal water level therein, a fire chamber interposed between said casings, and a series of water tubes connecting said casings at different receiving and delivery levels and passing intermediately freely through said casings and across the fire chamber, substantially as set forth.

In testimony whereof I have hereunto set my hand.

HENRY A. LAUGHLIN.

Witnesses:

J. SNOWDEN BELL,

R. H. WHITTLESEY.