No. 675,658. Patented June 4, 1901.

# H. DE F. HUBBARD.

## WATER TUBE BOILER.

(Application filed Aug. 14, 1900.)

(No Model.) 3 Sheets—Sheet 1.

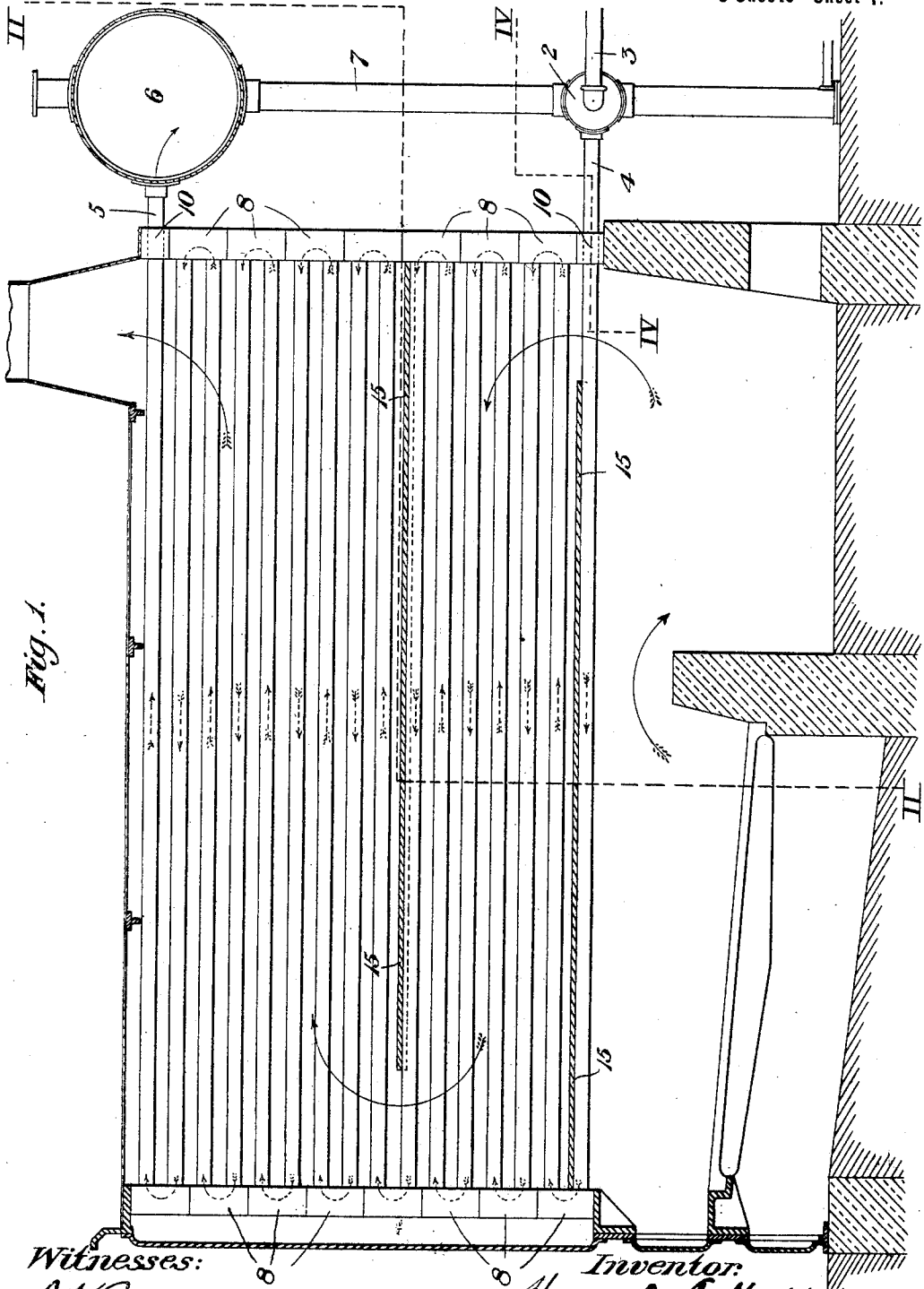



Fig. 1.

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Fig. 2.

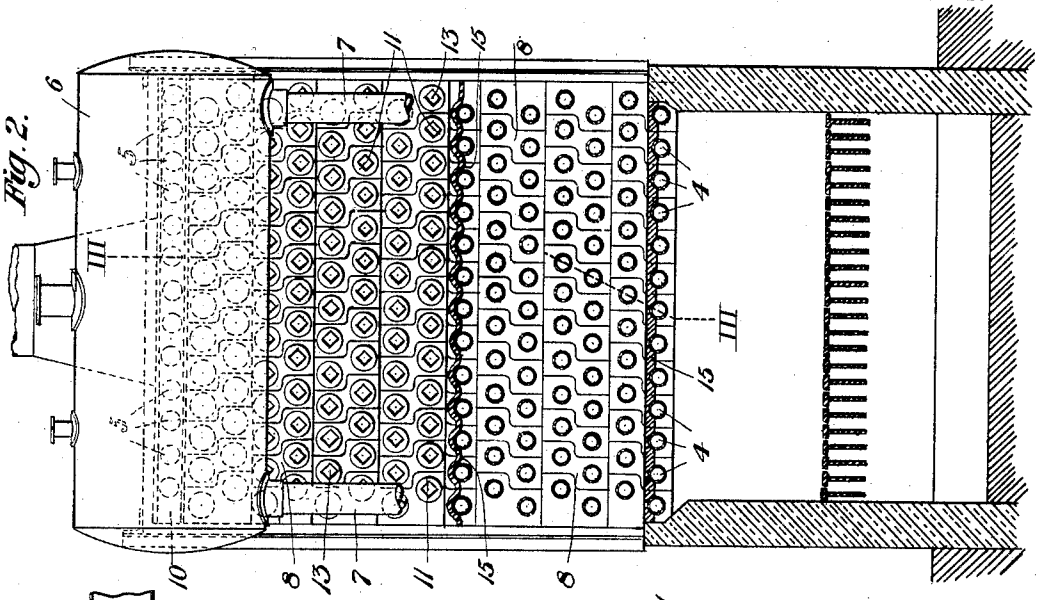
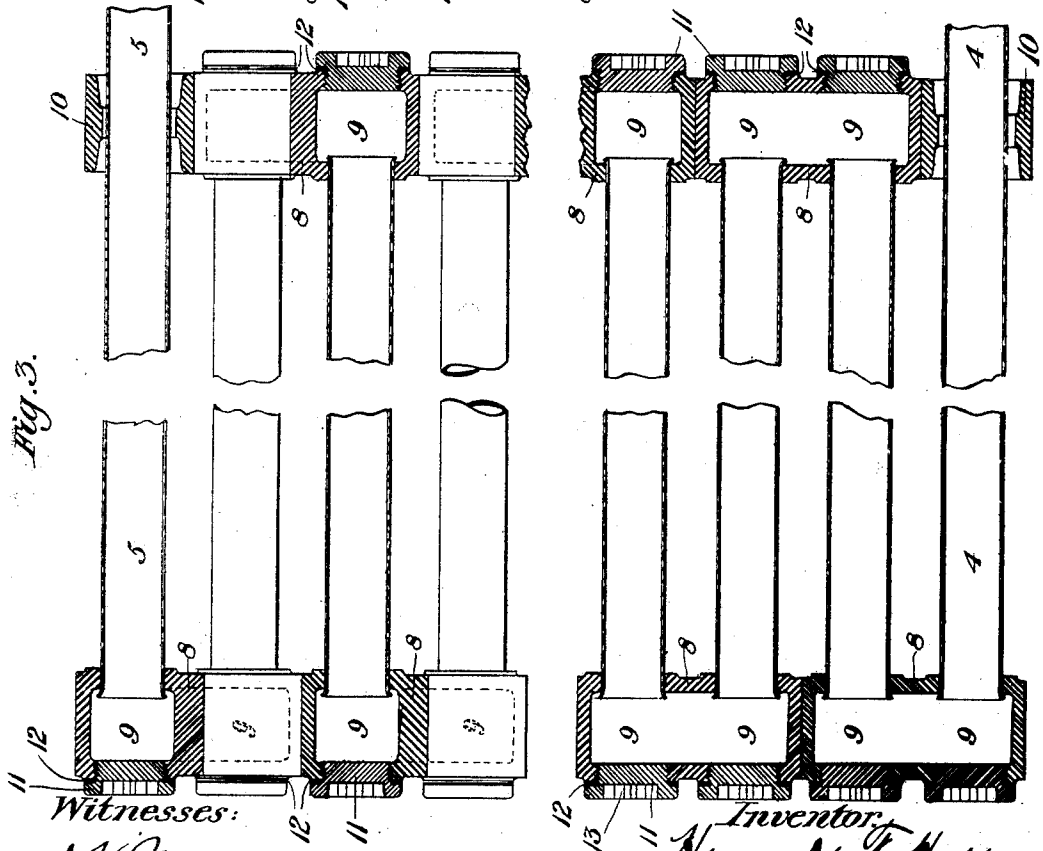


Fig. 3.



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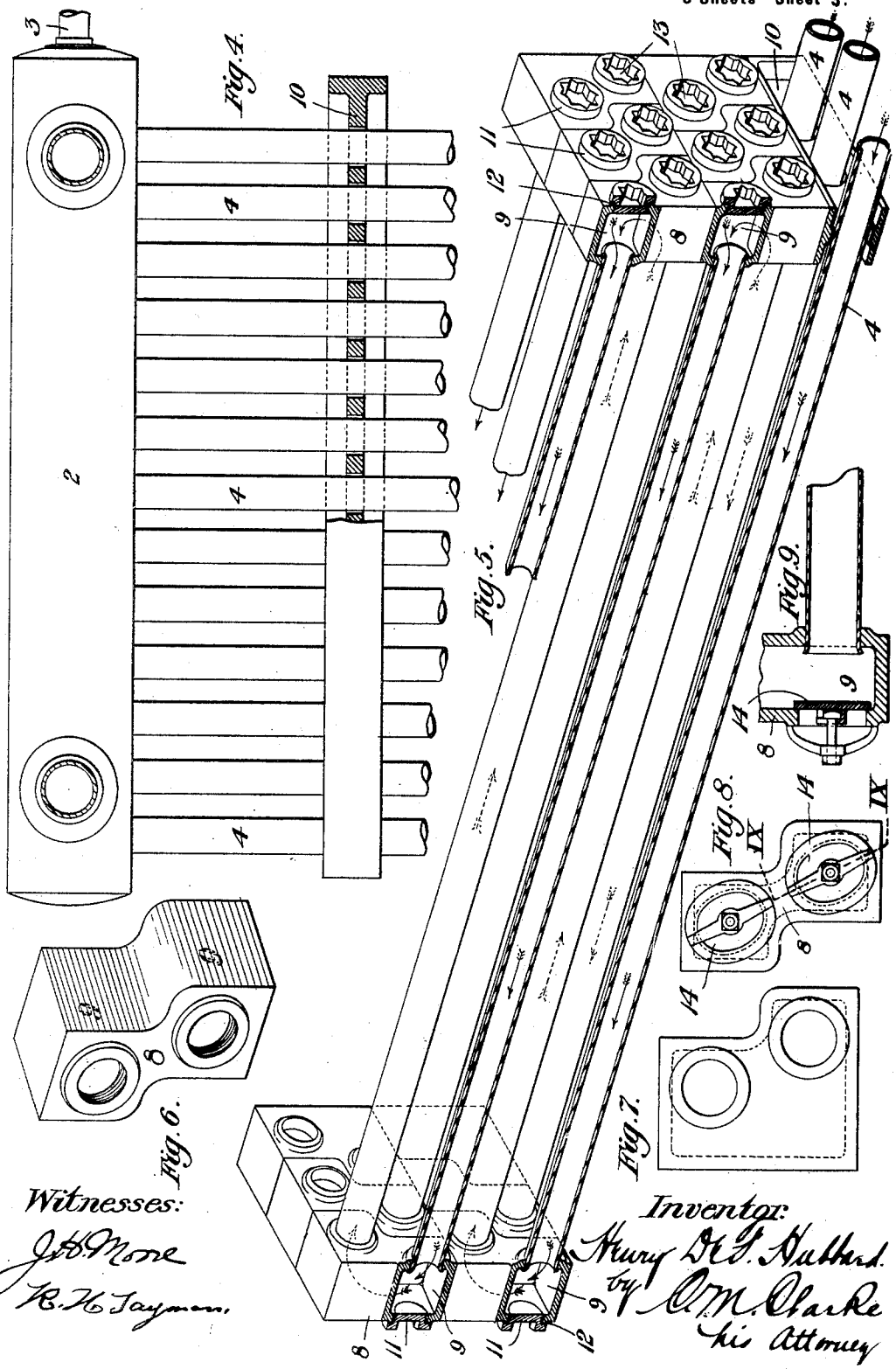
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## WATER TUBE BOILER.

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# UNITED STATES PATENT OFFICE.

HENRY DE F. HUBBARD, OF PITTSBURG, PENNSYLVANIA.

## WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 675,658, dated June 4, 1901.

Application filed August 14, 1900. Serial No. 26,808. (No model.)

*To all whom it may concern:*

Be it known that I, HENRY DE F. HUBBARD, a citizen of the United States, residing at Esplen, Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Water-Tube Boilers, of which the following is a specification, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a longitudinal vertical section of a boiler constructed in accordance with my invention. Fig. 2 is a transverse sectional view, partly in elevation, indicated by the line II II of Fig. 1. Fig. 3 is an enlarged detail view, partly broken away, showing the arrangement and construction of the tubes and headers, the section being indicated by the line III III of Fig. 2. Fig. 4 is a plan view, partly in section, showing the lowermost row of horizontal water-tubes connected with the feed-water drum, the view being indicated by the line IV IV of Fig. 1. Fig. 5 is a perspective view of a number of tubes and headers assembled, with the bottom filling-header, illustrating the water circulation. Fig. 6 is a perspective detail view of one of the intermediate headers. Fig. 7 is a face view of one of the end or corner headers. Fig. 8 is a modified detail view of a header provided with hand-hole closures. Fig. 9 is a sectional view thereof, indicated by the line IX IX of Fig. 8.

My invention relates to water-tube boilers, and relates more particularly to the headers and manner of erecting and assembling the tubes and their connections, whereby all of the space is utilized to the best advantage, thorough circulation is insured, and ample heating-surface provided for the circulating gases of combustion. In the general class of water-tube boilers the tubes are usually inclined, curved, or vertical to insure circulation, and the ends of all of the tubes are secured in heads which constitute the end walls of the boiler.

My invention has in view the construction of a boiler wherein individual headers are used for the various tubes comprising each vertical set or series, the headers being so designed as to provide for the most economical and efficient arrangement of the tubes and to form when assembled compact wall structures.

A further object is to provide a boiler construction which will be elastic in dimensions, so as to be available for any space as to length, width, and height.

Referring now to the drawings, 2 is the water-supply drum, to which water is supplied by pipe 3. The drum is of a length approximating the width of the complete boiler, and connected with it is the first row of tubes 4, each of which constitutes the lowermost of the several sets or series of vertically-arranged horizontal staggered tubes, through which the water circulates forward and back, the several sets or series finally terminating in upper tubes 5, which are connected on a common level with the common steam-drum 6. The steam-drum and water-drum are connected by communicating pipes 7, by which any water of condensation or such as is carried over into the steam-drum is returned to the water-drum.

In water-tube boilers the best results are secured by a staggered arrangement of the tubes, whereby greater area is exposed to the circulating gases and the flame is broken up, and I have therefore adapted my tubes to conform to such arrangement. At each end the two communicating ends of the tubes are expanded in a common header 8, the openings for the tubes being angularly arranged in the headers, as shown, so that the return-tube shall be located above and midway between the lower tube and the next adjacent parallel tube, as clearly shown in Fig. 2. The headers comprise hollow chambers having upper and lower offset cavities 9 9, communicating in the interior, adapted to receive the ends of the tubes, as I have indicated, and are made in rights and lefts for the opposite ends. The opposite inner and outer faces of the headers being substantially the same before tapping the thread for the plug permits all of the intermediate headers for both ends to be cast from the same pattern, thus insuring uniformity and facilitating manufacture. Their upper and lower faces are flat, so that each layer provides a continuous flat surface for the next layer. The sides are offset, as I have stated, the inner upper and inner lower sides extending toward the middle, where they are

turned out laterally for half the width of the cavity and then outwardly to the top and bottom, the corners being rounded, so that the openings for the tubes are midway vertically of each cavity. By this construction the headers are adapted to the arrangement of the tubes and also make a break-joint with the next successive higher and lower row of headers, as is shown in Fig. 2, insuring a bond and facilitating the work of erection. It will be noted that the outgoing horizontal tubes from the upper cavities enter the lower cavities of the opposite wall on the same level, necessitating the location of each successive opposite row on a proportionally higher level equaling half the depth of the header, leaving at the bottom and top a free space not occupied by the headers. At such points I have provided filling-headers 10 10, through which the tubes pass from the water-drum and to the steam-drum, they having no other function than to provide space-filling walls. Each header above and below opposite the tube-hole is provided with a closing-plug 11, tapped into the header with intervening packing 12, and these plugs are preferably provided with a recessed socket 13, adapted to admit a square turning wrench or key.

As shown in Figs. 8 and 9, hand-hole closures 14 may be provided, if preferred, and it will be understood that the openings may be closed in either way. It will be understood that the outer openings are of sufficient size to admit of the tubes, which are expanded by any suitable tool inserted through the hand-hole after the headers are set in position and during the erection of the boiler.

By my improved construction each pair of tubes being connected to the individual headers may freely expand and contract without the restraint due to solid boiler-heads, and inasmuch as the heat varies within wide limits at different zones of the furnace and due to the circulation of water this is a valuable feature of the invention. Expansion and contraction of the tubes may be communicated to the headers to any necessary extent without disturbing the wall structure.

It will be noted that by my construction I avoid the necessity of stay-bolts, sheets, or interior braces of any kind. It will also be noted that the spaces between the tubes horizontally by reason of their arrangement are unobstructed, allowing of the insertion of baffle-plates 15 at any desired level and arrangement. The tubes may be of any length desired, while the height and width of the boiler may be controlled at pleasure, according to the results desired or to predetermined limitations as to space. This last feature makes it particularly available for marine installation.

Surrounding brick, masonry, or metallic wall-settings, as well as any suitable furnace-chamber, may be incorporated with the structure or suitable retaining or binding means to insure stability when erected may be used within the province of the skilled engineer, as such do not specifically form any part of my invention.

Each tube being horizontal, straight, and open at both ends may be easily cleaned, or in case it is desired for any purpose one or more of the tubes may be removed, as may also one or more of the headers, without disturbing or injuring the others.

While I have shown and in practice prefer to use individual headers, it is obvious that continuous horizontal headers provided with cross-partitions and properly-located openings may be substituted, and such are of advantage for the first row of tubes or elsewhere and serve to provide an additional bond for the wall. I have not illustrated such construction, however, and prefer to embody it in the subject-matter of a later application.

The advantages of my invention will be appreciated by those skilled in the art to which it refers, and while the drawings clearly illustrate a standard type of construction I do not desire to be limited to the specific details as shown and described, but to include within the scope of the claims all such changes and variations as would be within the province of the skilled mechanic.

Having described my invention, what I claim is—

1. In water-tube-boiler construction, an ascending series of horizontal tubes located in staggered arrangement above each other, individual hollow headers adapted to connect the adjacent ends of pairs of the tubes, a lowermost inlet connection and an uppermost outlet connection, with intervening connections providing for circulation, substantially as set forth.

2. In water-tube-boiler construction, a plurality of ascending series of horizontal tubes and individual hollow headers adapted to connect the adjacent ends of pairs of the tubes of each series, the headers being adapted to form end walls of the boiler, substantially as set forth.

3. In water-tube-boiler construction, a plurality of ascending series of horizontal tubes and individual hollow headers adapted to connect the adjacent ends of pairs of the tubes of each series, the headers being adapted to form end walls of the boiler, lowermost inlet connections and uppermost outlet connections with intervening connections provided for circulation, substantially as set forth.

4. In a water-tube boiler, the combination of oppositely-disposed horizontal layers of individual hollow headers, a lowermost row of inlet-tubes, an uppermost row of outlet-tubes, and a plurality of intervening ascending series of horizontal tubes located in staggered arrangement above each other, connecting with the individual headers and forming through them a continuous circulation from the inlet-tubes to the outlet-tubes, substantially as set forth.

5. In a water-tube boiler, the combination of an end wall formed of upper and lower filling-headers, intervening individual hollow headers interfitting with each other, an opposite wall consisting of interfitting individual hollow headers, such headers being adapted to form communicating chambers for the ends of adjacent tubes, a plurality of ascending series of horizontal tubes connecting the headers and lowermost and uppermost inlet and outlet tubes passing through the filling-headers and connected with the hollow headers, with intervening outer connections providing for circulation, substantially as set forth.

6. A hollow header for water-tube boilers, consisting of a chamber having upper and lower communicating portions offset from each other, provided on one side with openings in which the tubes are expanded and on the other side with a removable closing device, substantially as set forth.

7. A hollow header for water-tube boilers, consisting of a chamber having upper and lower communicating portions offset from each other, provided on one side with openings in which the tubes are expanded, and on the other side with threaded plugs screwed into the header, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

HENRY DE F. HUBBARD.

Witnesses:

PETER J. EDWARDS,

C. M. CLARKE.