No. 789,818. PATENTED MAY 16, 1905.

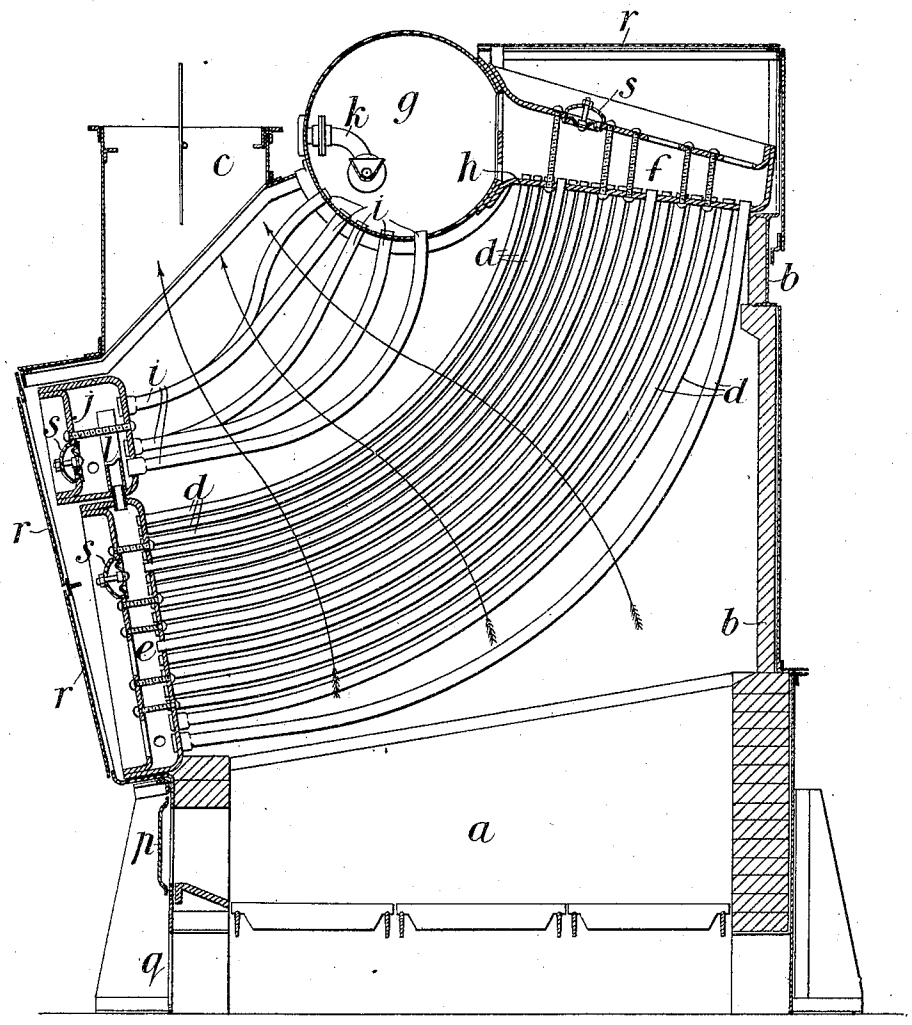
D. ROBERTS.

WATER TUBE BOILER.

APPLICATION FILED OCT. 29, 1904.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses.

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Inventor.

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PHOTO-LITHOGRAPHED BY SACHETT & WILHELMS LITHO & PTG. CO. NEW YORK

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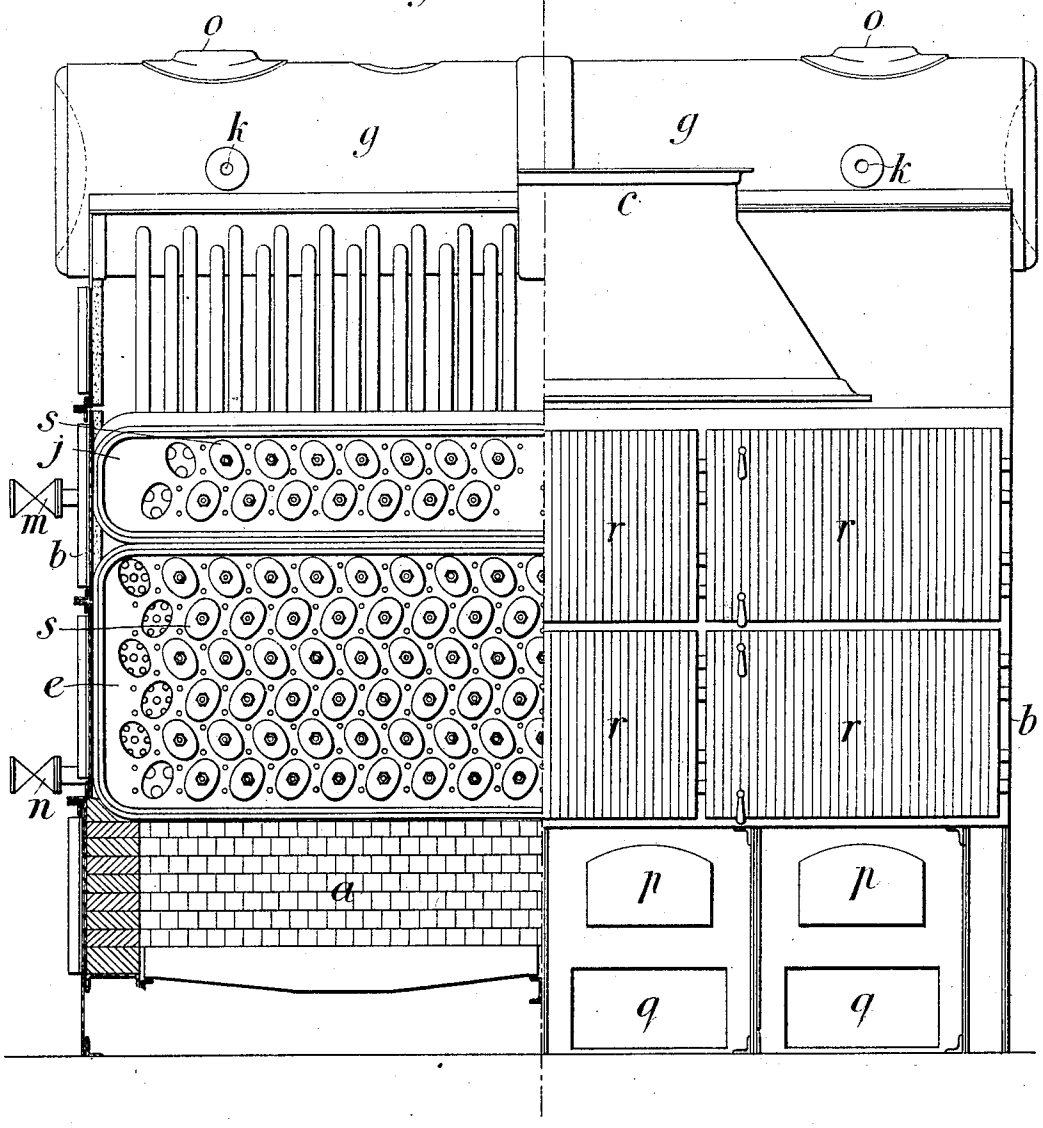
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3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 5.

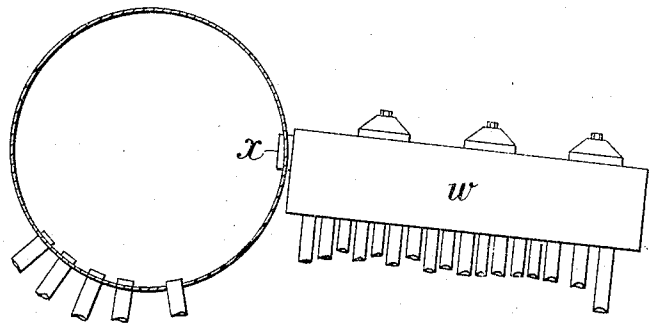


Fig. 3.

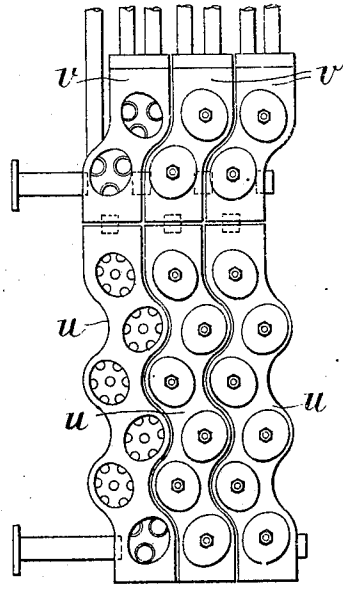
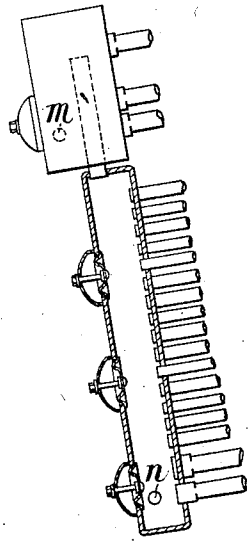


Fig. 4.



Witnesses.

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No. 789,818. Patented May 16, 1905.

UNITED STATES PATENT OFFICE.

DAVID ROBERTS, OF GRANTHAM, ENGLAND.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 789,818, dated May 16, 1905.

Application filed October 29, 1904. Serial No. 230,526.

To all whom it may concern:

Be it known that I, DAVID ROBERTS, a subject of the King of Great Britain, residing at Spittlegate Iron Works, Grantham, in the county of Lincoln, England, have invented new and useful Improvements in Water-Tube Boilers or Steam-Generators, of which the following is a specification.

This invention relates to improvements in water-tube boilers or steam-generators of the type wherein the tubes are connected at the lower ends to headers and at the upper ends partly to a header or headers and partly to the steam and water drum, the object being to provide greater freedom of expansion for the tubes, the arrangement of the heating-surface in the minimum of space, the better circulation of water, greater water-surface, greater freedom for liberation of the steam, and also to effect the deposit of foreign substances in a section or sections of the headers farthest from the fire and before the water has reached the tubes subject to the greatest heat.

These improvements, although suitable for boilers using all classes of water, are more particularly applicable to those using water free from salts that deposit on the heating-surfaces, such as boilers for generating steam for the propulsion of ships.

According to the invention the tubes are curved forwardly and downwardly over the furnace with any desired curvature and are fixed at the front lower ends in flat sectional headers of round, hexagonal, rectangular, or zigzag shape following the course of the tubes. The top header or headers of this set is or are preferably made deeper and larger than the others to receive any deposit from the feed-water. All the headers at the lower ends of the tubes are connected to one another by tubes or nipples to allow of free circulation of the water. At the top end the tubes nearest the fire are fixed in a flat header or headers, either rectangular or zigzag in shape, and coupled either direct or by nipples to the steam and water drum. The groups of tubes farthest from the fire are secured at their lower ends to the top headers of the front lower set, their upper ends being fixed into the steam and water drum below the normal water-level therein. The feed-water is delivered into the steam and water drum and passes down the tubes farthest from the fire leading into the top front headers and there deposits any foreign substances before mingling with the general circulation of the boiler. The front lower headers are inclined forwardly slightly from the vertical over the stoke-hole, but not sufficiently to interfere with the firing of the furnaces and the ventilation. The headers into which the top ends of the tubes are fixed are nearly horizontal, but by preference inclined slightly upwardly to the steam and water drum to enable the steam and water to more readily separate and also to provide a weir to partially separate the feed-water in the drum from the water in circulation in the tubes nearest the furnace. The upper ends of these tubes are connected to the top headers below the normal water-level. Access to the tubes at the bottom end for their cleaning and replacement is given by doors approximately the full size of the section and at the top end by small hand-hole doors, either one to each tube or one to a group of tubes. Small hand-hole doors may be used in the bottom headers or large doors in the top headers, however, if preferred. Although the stoke-hole is advantageously arranged at the side of the boiler next the lower headers, the furnaces may be fired from any one of the sides that may be found convenient.

In the accompanying drawings, Figure 1 is a sectional elevation of a boiler made according to my invention. Fig. 2 is an end view thereof with the furnace fronts and casing over the headers removed on the left-hand side. Fig. 3 is a part end view showing zigzag or sinuous headers which may replace the plain headers in Fig. 2. Fig. 4 is a side view of the headers shown in Fig. 3. Fig. 5 is a side view of a sinuous header which may replace the header shown in Fig. 1 joining the steam and water drum.

Referring to Figs. 1 and 2, *a* is the furnace, *b* the casing or walls round the boiler forming the chamber, and *c* the base of the chimney. The direction of the flow of the prod-

ucts of combustion is indicated by the arrows. *d d* are the tubes curved downwardly and forwardly over the furnace and fixed at the front lower end to the header *e* and at the top end to the header *f* below the normal water-level in the drum and header. The header *f* is attached to the steam and water drum *g*, and there is free communication between the header *f* and the steam and water drum *g*. The tube-plate *h* slopes upwardly to the steam-drum to form a weir, as clearly shown. *i i* are the tubes fixed at the front to the header *j* and at the top to the steam and water drum *g* below the normal water-level in the drum. The feed-water enters the steam-drum through the pipe *k* and passing down through the tubes *i i* deposits any sediment or salts it may contain in the header *j*, which is made deeper to receive such deposit. From the header *j* the water passes through the nipples *l* to the header *e* and thence to the evaporating-tubes *d d*. The nipples *l* are carried well into the header *j* to intercept deposit. This deposit is blown off at intervals through the cock *m*. *n* is a blow-off cock for the header *e*. *o o*, Fig. 2, are seatings for the steam stop-valve and safety-valve. *p p* are the furnace-doors; *q q*, the ash-pit doors. *r r* are the removable covers over the headers. *s s* are the hand-hole doors in the headers for giving access to the tubes. In lieu of these doors, however, the whole or part of the side of the header opposite the tubes may be made removable for access. Headers the full width of the boiler have been shown in Figs. 1 and 2; but these may be subdivided into suitable sections, if preferred.

Figs. 3, 4, and 5 show an alternative construction of header. In these figures, *u u* represent zigzag or sinuous headers taking the place of the header *e* in Figs. 1 and 2. *v v* represent zigzag or sinuous headers taking the place of the header *j*. *w* is a sinuous header taking the place of the header *f*. The headers *w* are preferably connected to the steam and water drum *g* by nipples *x*.

In cases where the water is practically pure the enlarged top front header *j*, Figs. 1 and 2, or top headers *v v*, Figs. 3 and 4, may be made, if desired, in one with the lower headers *e*, Figs. 1 and 2, or lower headers *u*, Figs. 3 and 4, and the top blow-off cock *m* dispensed with.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a water-tube boiler, the combination with the steam-drum, of a top header extending rearwardly therefrom and connected thereto, the front headers located below the level of the drum, a series of tubes connected to the lower part of said front headers and connected to the top header below the normal water-level, and extending nearest to the fire, a separate series of tubes connected to the upper part of the front headers, and connected to the steam-drum below the water-level therein, and arranged farther from the fire than said first-mentioned tubes, and means for admitting feed-water to the steam-drum adjacent to the tubes connected with the upper part of the front headers, to cause any sediment to deposit in said front headers, substantially as described.

2. In a water-tube boiler, the combination with the steam-drum, of a top header extending rearwardly therefrom and connected thereto, the front headers located below the level of the drum, a series of tubes connected to the lower part of said front headers and connected to the top header below the normal water-level, and extending nearest to the fire, a separate series of tubes connected to the upper part of the front headers, and connected to the steam-drum below the water-level therein, and arranged farther from the fire than said first-mentioned tubes, means for admitting feed-water to the steam-drum adjacent to its connection with the tubes connected with the upper part of the front headers, and means for removing sediment from the front headers, substantially as described.

3. In a water-tube boiler, the combination with the steam-drum, of a horizontally-disposed top header, connected to the drum above the level of the bottom of the drum, but below the normal water-level therein, and extending in rear of the drum, front vertically-disposed headers located below the level of the drum, a series of tubes connecting the lower portion of the front headers with the upper header, and arranged close to the fire, a series of tubes farther from the fire connecting the upper parts of the front headers with the steam-drum below the water-level therein and means for admitting feed-water to the steam-drum, adjacent to the said water-tubes, whereby the deposit of sediment takes place in said front headers, and a weir is formed by the connection of the top header with said drum, substantially as described.

4. In a water-tube boiler, the combination with the steam-drum, of a top header connected therewith and extending rearwardly therefrom, a lower front header, tubes connected to said header, and connected to the top header below the normal water-level therein, an upper front header, a nipple connecting said front headers and extending a considerable distance up into said upper front header to facilitate the deposit of sediment therein, tubes connecting said upper front header with the drum below the water-level therein and means for admitting feed-water to said drum adjacent to said tubes connected with the upper front header, substantially as described.

5. In a water-tube boiler, the combination with the steam-drum, of a top header con-

nected therewith and extending rearwardly therefrom, a lower front header below the level of the drum, tubes connected to said lower front header and connected to said top header below the normal water-level therein, an upper front header of greater depth than the lower front header, located above and connected with the lower front header, tubes connecting the upper front header with the drum below the water-level therein and means for admitting feed-water to the drum, substantially as described.

6. In a water-tube boiler, the combination with the steam-drum, of a top header extending rearwardly therefrom and connected to the drum below the water-level therein, a series of lower front headers, connected together, curved tubes connected to said front headers and connected to the top header below the water-level, a series of upper front headers connected together and to the lower front headers, tubes connecting said upper front headers and the lower part of said drum below the water-level therein, a blow-off for the upper front headers, a separate blow-off for the lower front headers, and means for admitting feed-water to the drum, whereby a weir is formed by the connection of the top header with said drum, substantially as described.

7. In a water-tube boiler, the combination with the steam-drum, of a top header extending rearwardly therefrom and connected thereto, the front headers located below the level of the drum, a series of tubes connected to the lower part of said front headers and connected to the top header below the normal water-level, and extending nearest to the fire, a separate series of tubes connected to the upper part of the front headers, and connected to the steam-drum below the water-level therein, and arranged farther from the fire than said first-mentioned tubes, means for admitting feed-water to the said drum, adjacent to the tubes leading to the upper front headers, said front headers and top headers being provided with removable hand-hole doors, opposite the ends of the tubes connected therewith, substantially as described.

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