

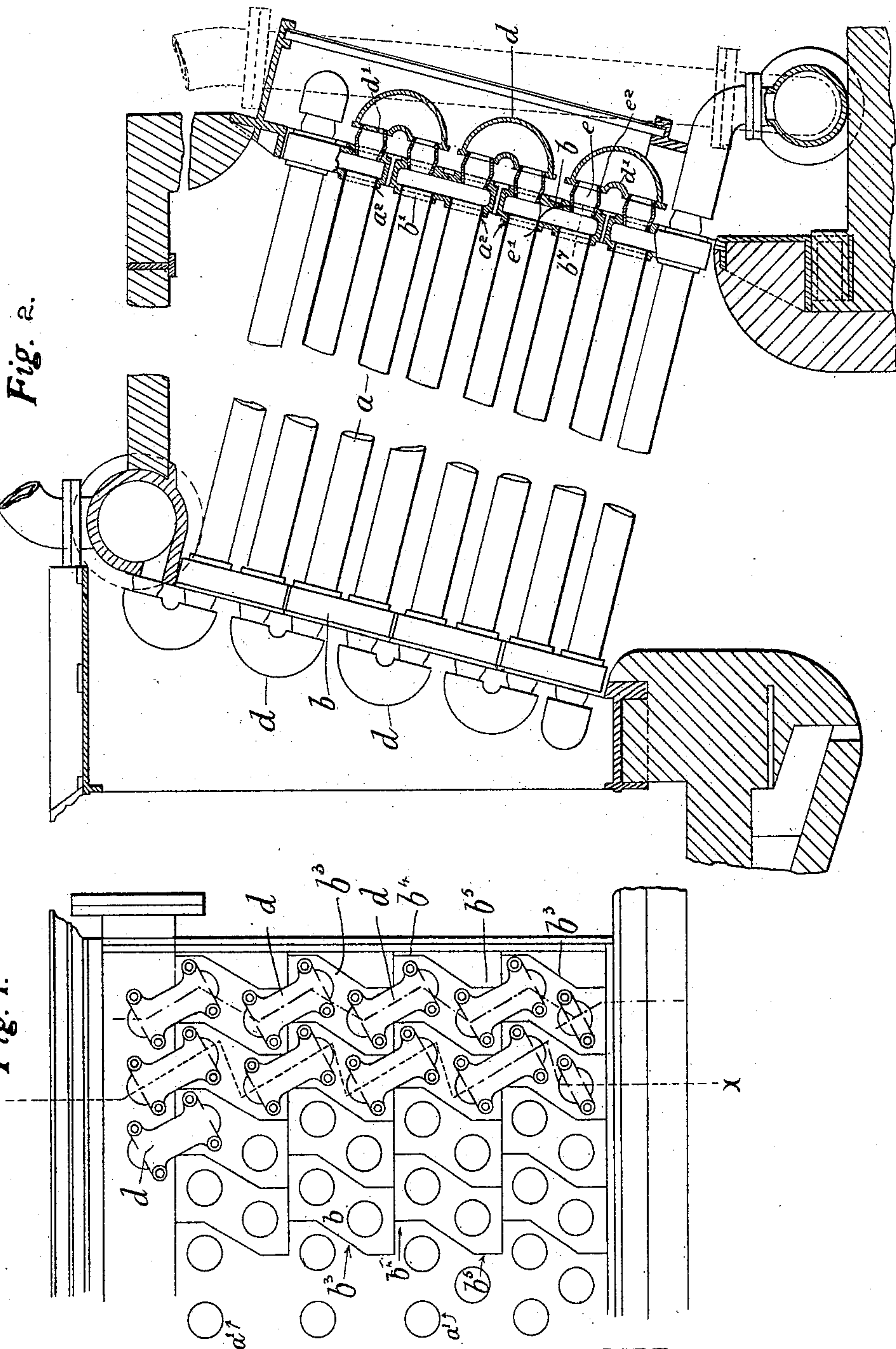
(No Model.)

2 Sheets—Sheet 1.

C. C. S. KNAP.
WATER TUBE BOILER.

No. 606,153.

Patented June 21, 1898.



WITNESSES

J. B. Keefe
U. G. Smith

INVENTOR

Conrad C. S. Knap
By *James L. Norrie*

ATTY

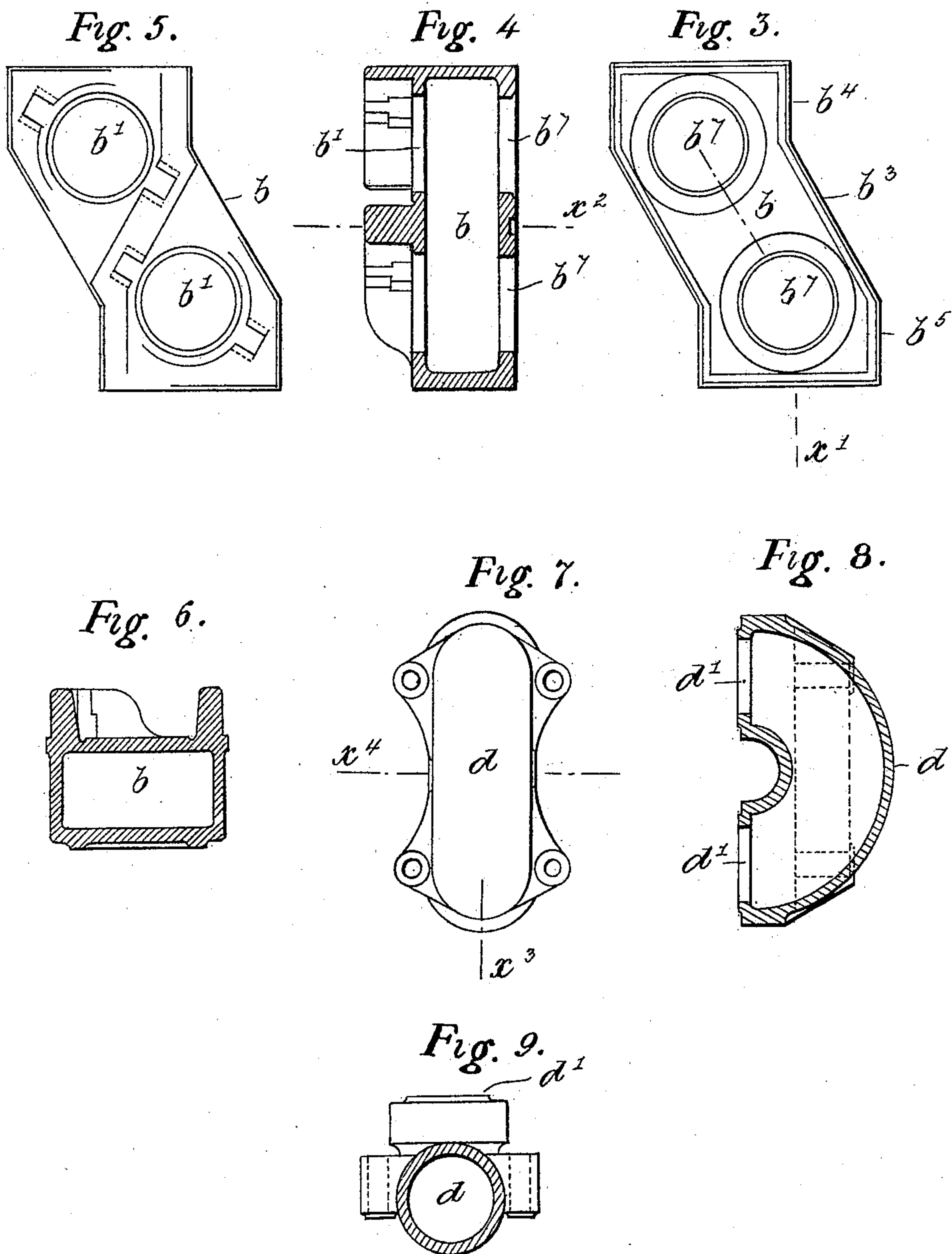
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J. B. Knap
W. C. Knap

INVENTOR

Conrad C. S. Knap
By James L. Norris

ATTY

UNITED STATES PATENT OFFICE.

CONRAD CHRISTIAN SEVERIN KNAP, OF LONDON, ENGLAND.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 606,153, dated June 21, 1898.

Application filed December 15, 1897. Serial No. 662,041. (No model.) Patented in England August 20, 1897, No. 19,251.

To all whom it may concern:

Be it known that I, CONRAD CHRISTIAN SEVERIN KNAP, engineer, a subject of the Queen of Great Britain, residing at 11 Queen Victoria street, in the city of London, England, have invented certain new and useful Improvements in Water-Tube Boilers, of which the following is a specification, and for which invention I have obtained Letters Patent of Great Britain, dated the 20th day of August, 1897, No. 19,251.

This invention relates to water-tube boilers of the "Root" type, in which a number of water-circulating tubes, fitted at their ends with headers and connecting-caps, are arranged in series, one row above another, to any suitable height, and through which said tubes, caps, and headers the water being heated circulates.

In such boilers as usually constructed the headers, into each of which the ends of two side-by-side tubes take, are arranged horizontally or lengthwise in rows, each of which break joint with the rows above and beneath, and in an eight-tube-high boiler connection is made between a vertical series of headers by a number of obliquely-disposed connecting-bends. Thus, for instance, the cap of the bottom header proceeds from the right-hand end and inclines in a right-hand oblique direction to the same end of the header above, from whose left-hand end another cap runs, with a left-hand inclination to the like end of the third header, and so on, inclining first to the right and then to the left throughout the whole series, so that the water in circulating through headers and caps arranged in this way has to travel through a zigzag and circuitous course and pass around a large number of bends, some of which are at a very acute angle, so that considerable friction has to be overcome and the proper circulation is greatly impeded.

The object of my improvements is to so construct and arrange the headers and connecting-caps of the water-tubes that the number of bends to be passed by the water in circulating is lessened, whereby friction or resistance to the flow of the water is reduced and the circulation greatly improved.

Figure 1 of the accompanying drawings represents in elevation a part of one end of an

eight-tube-high water-tube boiler, showing the arrangement of the tube-headers and connecting-caps in accordance with my invention. Two vertical rows of headers have the connecting-caps fitted up, while the other rows are shown without the caps. Fig. 2 is another view of the said boiler, one part of the same representing the tubes, headers, and connecting-caps in elevation, while another part represents them in section upon the dotted line x , Fig. 1. Fig. 3 represents, upon an enlarged scale, a front elevation of one of the headers separately. Fig. 4 is a section of the same upon the dotted line x' , Fig. 3. Fig. 5 is a back elevation of Fig. 3; and Fig. 6, a section upon the dotted line x'' , Fig. 4. Fig. 7 is an elevation of a connecting-cap; and Fig. 8, a vertical section thereof upon the dotted line x^3 , while Fig. 9 is a cross-section upon the dotted line x^4 , Fig. 7.

The same letters of reference indicate corresponding parts in the several figures of the drawings.

a are the water-tubes of the boiler, disposed in rows a' , arranged tierwise one above another to the height (in the form shown in the drawings) of eight tubes and with the tubes of any one row coming opposite the spaces between the tubes of the next row. These tubes preferably are inclined from the back upward toward the front, and their ends a^2 take through openings b' in the backs of erect headers b and are there secured. The said headers each have an inclined or obliquely-directed middle part b^3 and are arranged to fit closely together side by side in rows and with the ends b^4 b^5 of the several headers of each row respectively breaking joint with the two contiguous headers of the rows above and below them, and each header connects together two tubes—that is, the end of one tube in the top horizontal row is connected by the oblique middle part of the header to the end of the nearest tube of the second row, and each obliquely-linable pair of tubes of the third and fourth rows are connected up in like manner, and so on throughout the boiler, so that each two rows of water-tubes have a single row of headers in connection with them, and these headers are in turn coupled together in vertical series by connecting-caps d , disposed between the top end b^4 of

one header and the contiguous end b^5 of the header next above it and running in an oblique direction or at an obtuse angle relative to inclined middle part of the headers, said headers and connecting-caps being united by joints e , whose ends e' e^2 , respectively, take into coned or flared openings b^7 in the outward sides of the headers and the open ends d' of the caps.

10 In my improved boiler having the headers of the tubes and the connecting-caps uniting the said headers arranged as described, with the headers disposed in vertical series and in their longer directions one above another and

15 forming slightly-obliquely-directed passages between the respective pairs of tubes of each double row, while the connecting-caps are set at a similar angle, but are inclined in the reverse direction to the oblique parts or passages of the headers, the water and steam in circulating through the system travels in an easy undulatory or wave-like course, (see the chain-dotted line in Fig. 1,) and in circulating from the top joint of one header to the

25 top joint of the header next above has only to pass around four bends instead of having to pass eight bends, as it would have to do in traveling a like distance through the headers of a Root boiler arranged according to the system now in common vogue and described in the first part of this specification. Internal friction is thereby greatly reduced and the circulation of the boiler correspondingly improved.

35 The tubes may be connected to the headers by expanding the ends of the former into the interior of the latter, while the joints between the headers and their connecting-caps may be double coned, as represented, or of

40 any other approved construction, and instead of connecting the ends of only two tubes to each header I may connect more than two, in which case there would be covers opposite the tubes, except the top and bottom ones, in

45 each header.

Having fully described my invention, what I desire to claim and secure by Letters Patent is—

1. In a water-tube boiler, the combination with a number of vertically-disposed headers having their middle parts directed obliquely or at an angle relative to their ends and arranged in vertical series of connecting-caps connecting up each header with the next adjacent header of its particular series and inclined in opposite directions to the said header middles, substantially as described.

2. In a water-tube boiler, the combination with a number of vertically-disposed headers having their middle parts directed obliquely or at an angle relative to their ends and arranged in vertical series, each header connecting together the ends of two tubes disposed one at a relatively higher plane than the other, of connecting-caps connecting up each header with the next adjacent header of its particular series and inclined in opposite directions to the header middles, substantially as described.

3. In a water-tube boiler, the combination with a number of vertically-disposed headers having their middle parts directed obliquely or at an angle relative to their ends and arranged in vertical series, each header connecting together the ends of two tubes disposed one at a relatively higher plane than the other and having its ends breaking joint with the ends of the headers of the next adjacent series, of connecting-caps connecting up each header with the next adjacent header of its particular series and inclined in opposite directions to the said header middles, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

CONRAD CHRISTIAN SEVERIN KNAP.

Witnesses:

PERCY KNAP,
LEO KNAP.