

Feb. 11, 1930.

J. J. CAIN

1,746,240

BOILER CONSTRUCTION

Filed Sept. 1, 1926

2 Sheets-Sheet 1

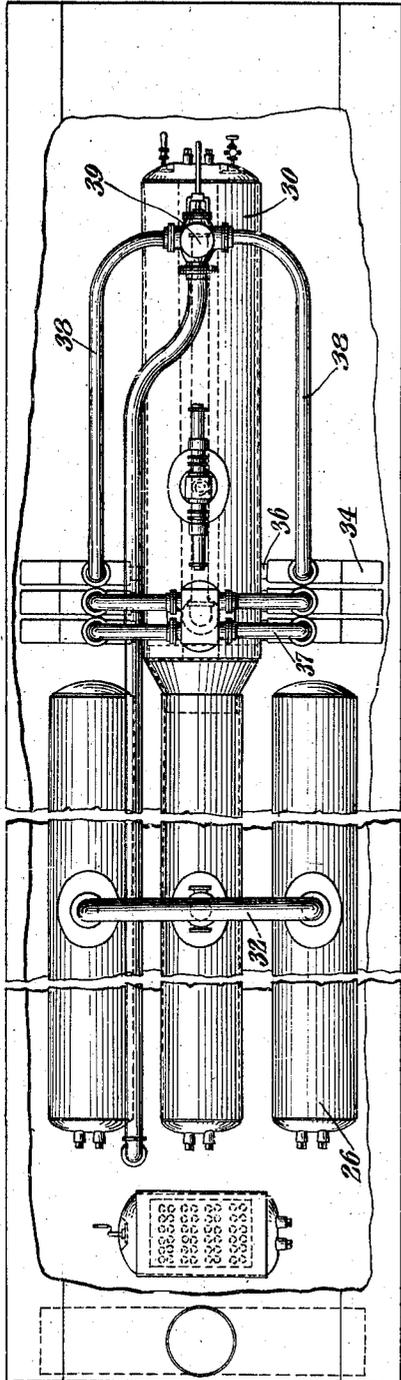


Fig. 2.

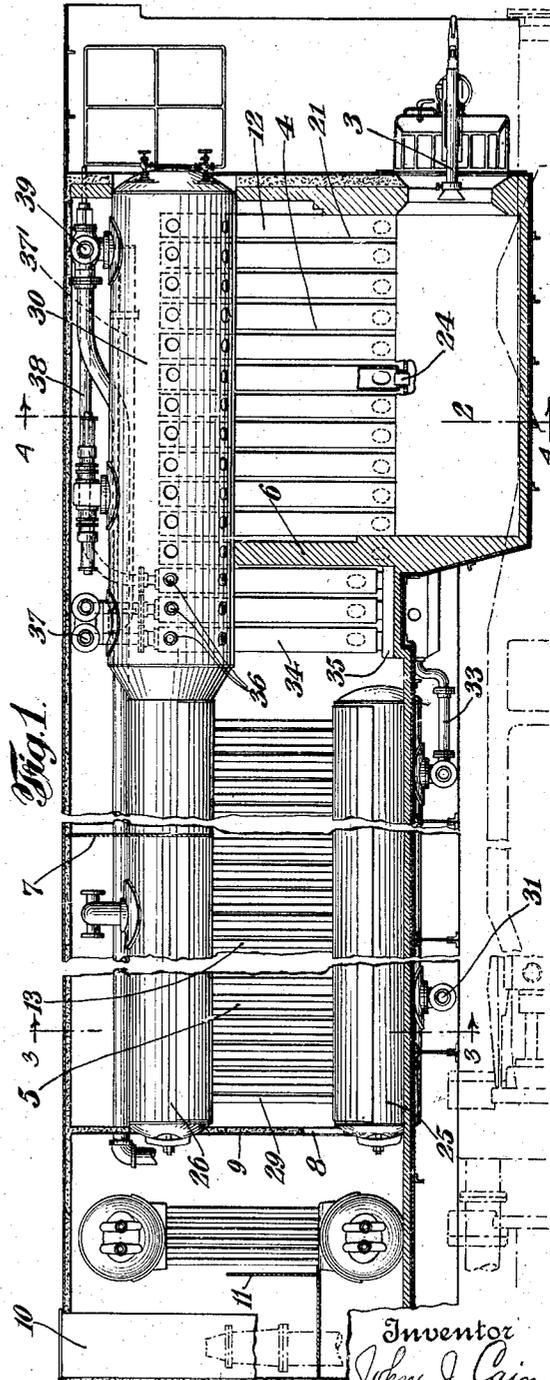


Fig. 1.

Inventor
John J. Cain
By his Attorneys
Prindle Wright Neal & Bean

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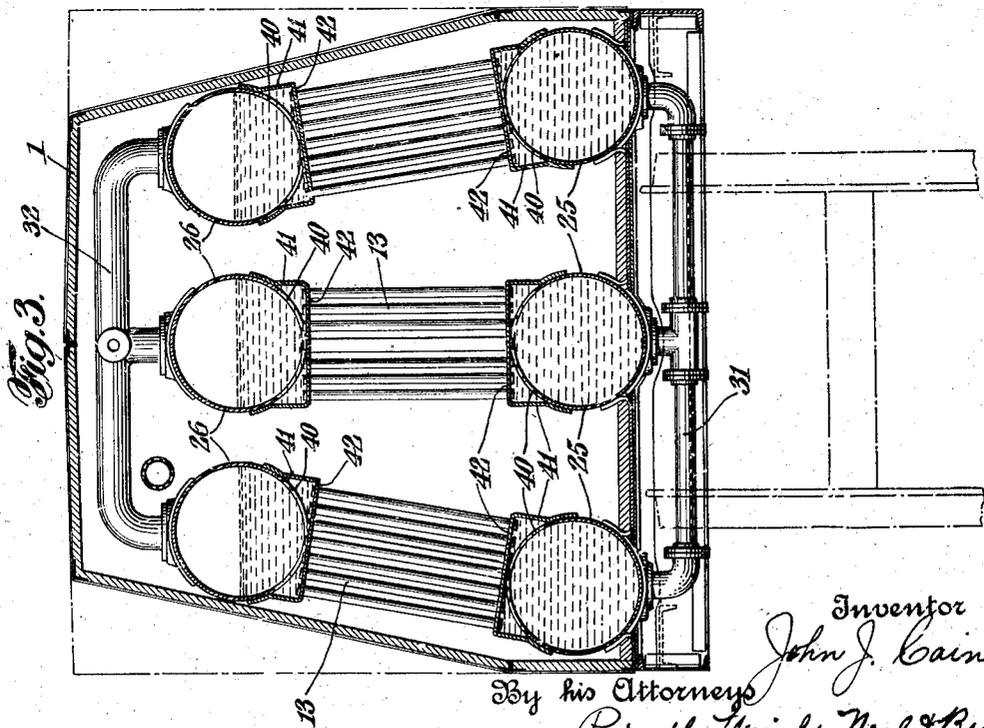
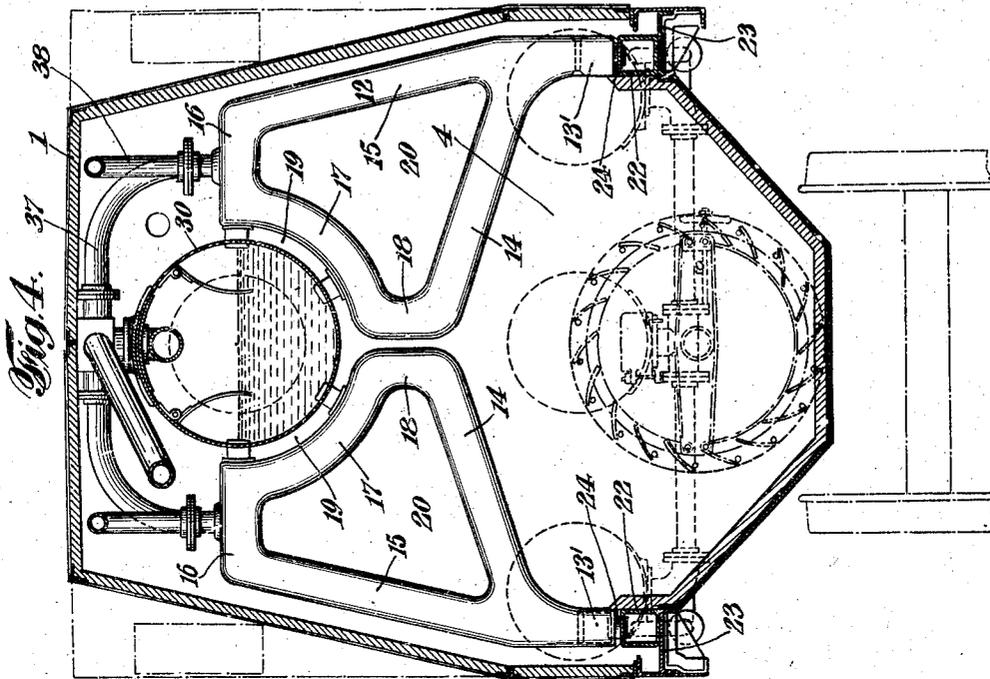
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BOILER CONSTRUCTION

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2 Sheets-Sheet 2



Inventor
John J. Cain
By his Attorneys
Prindle Wright Neal & Bean

UNITED STATES PATENT OFFICE

JOHN J. CAIN, OF BAYONNE, NEW JERSEY

BOILER CONSTRUCTION

Application filed September 1, 1926. Serial No. 132,933.

This invention relates to steam boilers and more particularly to locomotive boilers, but certain features of the same are applicable to steam boiler constructions of general utility as will hereinafter appear with greater particularity.

The principal object of this invention is the provision of a boiler construction which will give maximum heating efficiency with a minimum fuel consumption and with a minimum cost of manufacture and upkeep, and which is strong in construction and capable of withstanding maximum operating pressures with a wide factor of safety.

A further object of the invention is the improvement of that type of boiler construction which is disclosed in my co-pending application, Serial No. 110,330, filed May 20, 1926.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, this invention consists in the construction, combination and arrangement of parts hereinafter described and then sought to be defined in the appended claims, reference being had to the accompanying drawings forming a part hereof and which show, merely for the purpose of illustrative disclosure a preferred embodiment of my invention, it being expressly understood, however, that various changes may be made in practice within the scope of the claims without digressing from my inventive idea.

In the drawings—

Figure 1 represents a vertical longitudinal cross section through a locomotive boiler constructed to embody my invention, parts being shown in elevation and other parts being shown in dotted line diagram to facilitate disclosure.

Figure 2 is a top plan view of the construction shown in Figure 1, the casing of the boiler being broken away to facilitate the disclosure.

Figure 3 is a vertical transverse cross section taken substantially on line 3—3 of Figure 1.

Figure 4 is a vertical transverse cross section taken substantially on line 4—4 of Figure 1.

The construction of the frame and running gear of this locomotive is indicated diagrammatically in dotted lines as it forms no part of this invention, it being understood, of course, that sufficient structural parts are provided to properly support the boiler construction. This boiler construction includes a suitable casing 1 formed so as to provide a main fire box 2 which is indicated as of oil burner construction as at 3. It may be stated in passing that this design of construction is similar in that respect to the disclosure in my United States Letters Patent No. 1,496,521, issued June 3, 1924. However, this invention is applicable to any form of boiler and is not limited to oil burners.

The boiler construction is divided into what I term a fire box portion 4 and the combustion chamber and heating passage portion 5, which latter portion constitutes all of the structure extending forward from the fire box. These portions 4 and 5 are separated by the baffle wall construction 6 over which the hot gases and products of combustion pass. A suitable vertical baffle plate 7 is arranged in the upper part of the combustion chamber and heating passage portion 5 and other baffle plates, not shown, may be used if desired to cause the hot gases and products of combustion to take a retarded zig-zag path through the boiler construction and through the opening 8 in the end partition 9 until they reach the stack 10, being further retarded by the vertical partition 11 in the feed water heater compartment.

The water containing elements in this construction are provided in two different forms for the two different portions of the boiler, those in the fire box portion being in the form of water sections 12 and those in the combustion chamber and heating passage portion of the boiler being in the form of water tubes 13. The water sections 12 are best shown in Figure 4 and are in the form of open hollow castings having the supporting foot or leg 13' from which each section branches to provide the arms 14 and 15. The arm 14 extends at an incline over the fire box and complemented by the arm 14 of the opposed section forms the crown for the fire box, it being

understood that these sections are arranged in pairs transversely of the boiler structure. The arm 15 extends upwardly and then horizontally as at 16 until it reaches the curved or arc-shaped portion 17, which extends down to and curves into the upper end of the arm 14, as at 18. The curved or arc-shaped portion 17 is complementary to the similar portion 17 of the opposed one of the pair of sections and forms a semi-circular space 19, the purpose of which will be described later. The curved portions 18 of the opposed sections of each pair approach each other but do not touch, leaving a space therein. This formation of the sections results in the provision of the large opening or space 20 therethrough. It is also to be noted on referring to the length of the boiler that the pairs of sections are spaced apart as at 21 (see Figure 1) whereby the hot gases and products of combustion have access to the entire exposed surface of each of the sections. These sections are supported upon a mud ring or chamber 22 which rests upon a suitable frame part 23 of the structure, communication being provided by means of the nipple construction 24, such as disclosed in my previous United States Letters Patent No. 1,514,685, issued November 11, 1924.

As before stated, water tubes 13 are utilized in the combustion chamber and heating passage portion of the boiler and these are arranged as illustrated particularly in Figures 1 and 3 of the drawings. It is to be noted that I have illustrated three sets of boiler elements composed of the water tube construction and each set includes the bottom water drum or head 25 supported on the bottom of the casing and extending longitudinally thereof and terminating short of the fire box portion and at or about the line of the partition 9. There is a combined steam and water drum 26 arranged in the upper part of the boiler construction corresponding to each of the lower water drums or heads 25 and these are of substantially the same extent as the lower steam and water drums and extend longitudinally in the boiler construction. The water tubes 13 are arranged in a plurality of sets or series 29 between the combined water and steam drums 26 and the lower water drums or heads 25, sufficient space being provided between each of the sets or series to permit the removal of any one of the tubes from without, without the necessity of removing any of the other tubes or structure. These tubes are arranged in a vertical plane transversely of the boiler, the tubes of the central set extending approximately vertically and the tubes of the outside sets extending in an inclined direction, see particularly Figure 3. The tubes are suitably supported and connected to the drums by means of a construction to be hereinafter described.

The rear end of the intermediate combined water and steam drum 26 connects to another combined water and steam drum 30 which extends into the fire box portion of the boiler and fits within semi-circular spaces 19 provided between the pairs of water sections 12. It is somewhat larger in diameter than the diameter of the drum 26 but is located in alignment therewith longitudinally of the boiler structure. It is suitably connected to the water sections 12 below its water level and at its water level by suitable nipples or other connecting means as shown, so that as it is connected to the intermediate drum 26 it serves as an equalizing drum for all of the water units of the boiler construction for the full length of the steam generating portion of the boiler, as all of the water containing elements have connection with either one or the other of the two drums.

The lower drums 25 are suitably connected by means of pipes or conduits 31 and the upper drums 26 are suitably connected by the pipes or conduits 32, this latter pipe or conduit being arranged to provide steam for operating various auxiliaries. For blowing out purposes the lower conduit or pipe 31 has a connection 33 with the mud drum or chamber of the superheater construction to be presently described which communicates with the mud drum or chamber 22 of the main boiler.

The superheater construction is mounted between the water section portion of the boiler and the water tube portion of the boiler and in fact is positioned just beyond the vertical baffle wall 6 and forward of the fire box portion of the boiler. This construction preferably includes a plurality of sections 34 which are like the sections 12 previously described and are suitably mounted upon and connected to a mud drum or chamber 35 at their bottom and have a blind nipple connection 36 with the combined water and steam drum 30. Certain of these sections 34 have pipes or conduits 37 communicating with the upper portion thereof, these pipes or conduits being connected to the perforated dry pipe 37' mounted in the upper portion of the combined water and steam drum 30. These sections 34 are connected together at their bottoms by means of the small drum or chamber 35 to receive the superheated steam. One of the other sections has the pipe or conduit 38 leading back to the throttle 39 whereby the supply of steam to the cylinders is controlled.

It is to be noted that in connection with this construction the water tubes 13 are all of the same size and length and this is accomplished by providing the drums 25 and 26 with openings or passages 40 leading thereto and mounting on the outside of the drums tube sheet or plate 41 having a straight or flat portion 42, which is provided with a plu-

5 rality of holes or apertures corresponding to
 the tubes. Due to this construction tubes
 may be used which are all of the same length
 and are straight, thereby dispensing with the
 use of bent tubes and tubes of different sizes
 with their numerous and manifest disadvan-
 10 tages. It is to be noted in this construction
 that all the water and steam carrying ele-
 ments are exposed at all times and for their
 entire exposed surfaces to the action of the
 hot gases and products of combustion pass-
 ing through the boiler. The individual units
 are spaced apart so as to permit this action
 and the course of the hot gases and products
 15 of combustion is directed with that idea in
 mind. Furthermore, the various water and
 steam heating units are of maximum size and
 have maximum heating surfaces for the units
 of dimension of the boiler construction as a
 whole resulting in maximum efficiency in heat
 20 absorption per unit of fuel consumption.

It is to be understood that while I have de-
 scribed and specified three sets of water tube
 constructions including top and bottom
 25 drums in the forward portion of the boiler
 construction, this number may be varied as
 my idea is to provide a maximum number of
 such sections so as to accomplish efficient
 generation of steam per consumption of fuel.

30 What I claim is:—

1. A locomotive boiler including, in com-
 bination, a plurality of water sections ar-
 ranged in the fire box portion of the boiler,
 a plurality of sets of water tube sections ar-
 35 ranged longitudinally in the combustion
 chamber portion of the boiler, said sets of
 water tube sections each having a top and
 bottom drum, a water and steam drum ex-
 tending longitudinally of the boiler and con-
 40 nected to said water sections and also having
 a connection with one of said first-mentioned
 drums, the said bottom drums being con-
 nected together and said top drums being
 connected together.

2. A locomotive boiler including, in com-
 bination, a plurality of water sections ar-
 ranged in the fire box portion of the boiler,
 a plurality of sets of water tube sections ar-
 50 ranged longitudinally in the combustion
 chamber portion of the boiler, said sets of
 water tube sections each having a top and
 bottom drum, a water and steam drum ex-
 tending longitudinally of the boiler and con-
 nected to said water sections and also having
 55 a connection with one of said first-mentioned
 drums, and a superheater construction inter-
 posed between said water sections and said
 water tube sections and having a connection
 with said water and steam drum.

3. A locomotive boiler including, in com-
 bination, a plurality of water sections ar-
 ranged in the fire box portion of the boiler,
 a plurality of sets of water tube sections ar-
 60 ranged longitudinally in the combustion
 chamber portion of the boiler, said sets of

water tube sections each having a top and
 bottom drum, said drums being connected to-
 gether, a water and steam drum extending
 longitudinally of the boiler and connected to
 said water sections and also having a con-
 70 nection with one of said first-mentioned
 drums, and a superheater construction inter-
 posed between said water sections and said
 water tube sections and having a connection
 with said water and steam drum, said super-
 75 heater construction including a plurality of
 sections all connected together, certain only
 of the sections having connection with the
 water and steam drum and other sections
 having connection with a throttle or other
 80 controlled outlet.

4. A locomotive boiler including, in com-
 bination, a plurality of water sections ar-
 ranged in the fire box portion of the boiler,
 a plurality of sets of water tube sections ar-
 85 ranged in the combustion chamber portion of
 the boiler, one set being arranged inter-
 mediate of the other two sets, all the sets ex-
 tending longitudinally and each set having
 top and bottom drums, said drums being con-
 90 nected together, a water and steam drum con-
 nected to said water sections and the inter-
 mediate one of said top drums being con-
 nected to said water and steam drum.

5. A locomotive boiler including, in com-
 95 bination, a plurality of water sections ar-
 ranged in the fire box portion of the boiler,
 a plurality of sets of water tube sections ar-
 ranged in the combustion chamber portion
 of the boiler, one set being arranged inter-
 100 mediate of the other two sets, all the sets ex-
 tending longitudinally and each set having
 top and bottom drums, said drums being con-
 nected together, a water and steam drum con-
 nected to said water sections and the inter-
 105 mediate one of said top drums being con-
 nected to said water and steam drum, said inter-
 mediate set of water tubes being arranged ver-
 tically and said outer sets of water tubes
 being arranged at an angle.

6. A locomotive boiler including, in com-
 bination, a plurality of water sections ar-
 110 ranged in the fire box portion of the boiler,
 a plurality of sets of water tube sections ar-
 ranged longitudinally in the combustion
 chamber portion of the boiler, said sets of
 water tube sections each having a top and
 bottom drum, said top drums being con-
 115 nected together and said bottom drums being
 connected together, a water and steam drum
 extending longitudinally of the boiler and
 connected to said water sections and also
 120 having a connection with one of said first-
 mentioned drums, said tubes of said sections
 all being of the same length.

7. A locomotive boiler including, in com-
 bination, a fire box portion and a combustion
 chamber and heating passage portion, a plu-
 125 rality of water sections transversely arranged
 in said fire box portion and a steam and water

drum arranged in the upper portion of said fire box portion and communicating with said water sections, a mud ring or chamber with which the lower portions of said water sections communicate, a plurality of sets of water tube sections arranged in said combustion chamber and heating passage portion and having drums at the top and bottom of each set having communication with said water and steam drum, a separate superheater construction interposed between said water sections and said sets of water tube sections, said superheater being composed of a plurality of sections, certain of said superheater sections communicating with said water and steam drum and a super-heater section communicating with a throttle or other controlled outlet, a mud ring or chamber upon which said super-heater sections are supported and with which they communicate.

8. A locomotive boiler including, in combination, a fire box portion and a combustion chamber and heating passage portion, a plurality of water sections transversely arranged in said fire box portion and a steam and water drum arranged in the upper portion of said fire box portion and communicating with said water sections, a mud ring or chamber with which the lower portions of said water sections communicate, a plurality of sets of water tube sections arranged in said combustion chamber and heating passage portion and having drums at the top and bottom of each set having communication with said water and steam drum, a separate superheater construction interposed between said water sections and said sets of water tube sections, said superheater being composed of a plurality of sections, certain of said superheater sections communicating with said water and steam drum and a super-heater section communicating with a throttle or other controlled outlet, a mud ring or chamber upon which said superheater sections are supported and with which they communicate, said superheater sections being arranged in pairs on opposite sides of the boiler construction.

9. A locomotive boiler including, in combination, a plurality of water sections arranged in the fire box portion of the boiler, said water sections being formed to provide the crown part of the fire box and being formed in their upper portions to provide a semi-circular space, a combined water and steam drum positioned in said semi-circular space and extending longitudinally of said boiler, three sets of water tube sections arranged longitudinally in the combustion chamber portion of the boiler, each set including a top drum and a bottom drum and a plurality of water tubes connecting the top and bottom drum of each set, said water tubes being straight and of the same length,

said top drums and said bottom drums being connected together and said combined water and steam drum having a connection with the intermediate top drum of said water tube sections.

10. A locomotive boiler including, in combination, a plurality of water sections arranged in the fire box portion of the boiler, said water sections being formed to provide the crown part of the fire box and being formed in their upper portions to provide a semi-circular space, a combined water and steam drum positioned in said semi-circular space and extending longitudinally of said boiler, three sets of water tube sections arranged longitudinally in the combustion chamber portion of the boiler, each set including a top drum and a bottom drum and a plurality of water tubes connecting the top and bottom drum of each set, said water tubes being straight and of the same length, said top drums and said bottom drums being connected together and said combined water and steam drum having a connection with the intermediate top drum of said water tube sections, a plurality of separate sections located in the combustion chamber portion of the boiler to form a superheater construction, certain of said separate superheater sections having connection with said combined water and steam drum and another of said separate superheated sections having connection with the throttle.

11. A locomotive boiler, including in combination, a plurality of water sections arranged in the fire-box portion of the boiler, a plurality of sets of water-tube sections arranged longitudinally in the combustion chamber portion of the boiler, said sets of water-tube sections each having a top and bottom drum, one set of said water-tube sections and said top and bottom drums being arranged intermediate the other sets, said drums being connected together, a water and steam drum extending longitudinally of the boiler and connected to said water sections, and also having a connection with one of said first-mentioned drums.

12. A locomotive boiler, including in combination, a plurality of water sections arranged in the fire-box portion of the boiler, a plurality of sets of water-tube sections arranged longitudinally in the combustion chamber portion of the boiler, said sets of water-tube sections each having a top and bottom drum, one set of said water-tube sections and said top and bottom drums being arranged intermediate the other sets, said drums being connected together to a water and steam drum located centrally of the boiler and extending longitudinally thereof, and having communication with said water sections and also having a connection with said intermediate set of water-tube sections and drums.

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13. A locomotive boiler, including in combination, a plurality of water sections arranged in the fire-box portion of the boiler, a combined water and steam drum having communication with said water sections, 5 three sets of water-tube sections arranged longitudinally in the combustion chamber portion of the boiler, each set of said water-tube sections including a top drum and a 10 bottom drum, and a plurality of water-tube sections connecting the top and bottom drum of each set, said water-tube sections being straight and of the same length, said top 15 drums being connected together, and said bottom drums being connected together, and said combined water and steam drum having a connection with one of said top drums.

14. A locomotive boiler, including in combination, a plurality of water sections in the 20 fire-box portion of the boiler, three sets of water-tube sections arranged longitudinally in the combustion chamber portion of the boiler, each set of the water-tube sections including a top drum and a bottom drum and 25 a plurality of water tubes connecting the top and bottom drum of each set, said water tubes being straight and of the same length, said top drums being connected together, said bottom drums being connected together, and a 30 combined water and steam drum having a connection with one of the top drums and also with said water sections in the fire-box portion of the boiler.

In testimony that I claim the foregoing, I 35 have hereunto set my hand this 5th day of August, 1926.

JOHN J. CAIN.

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