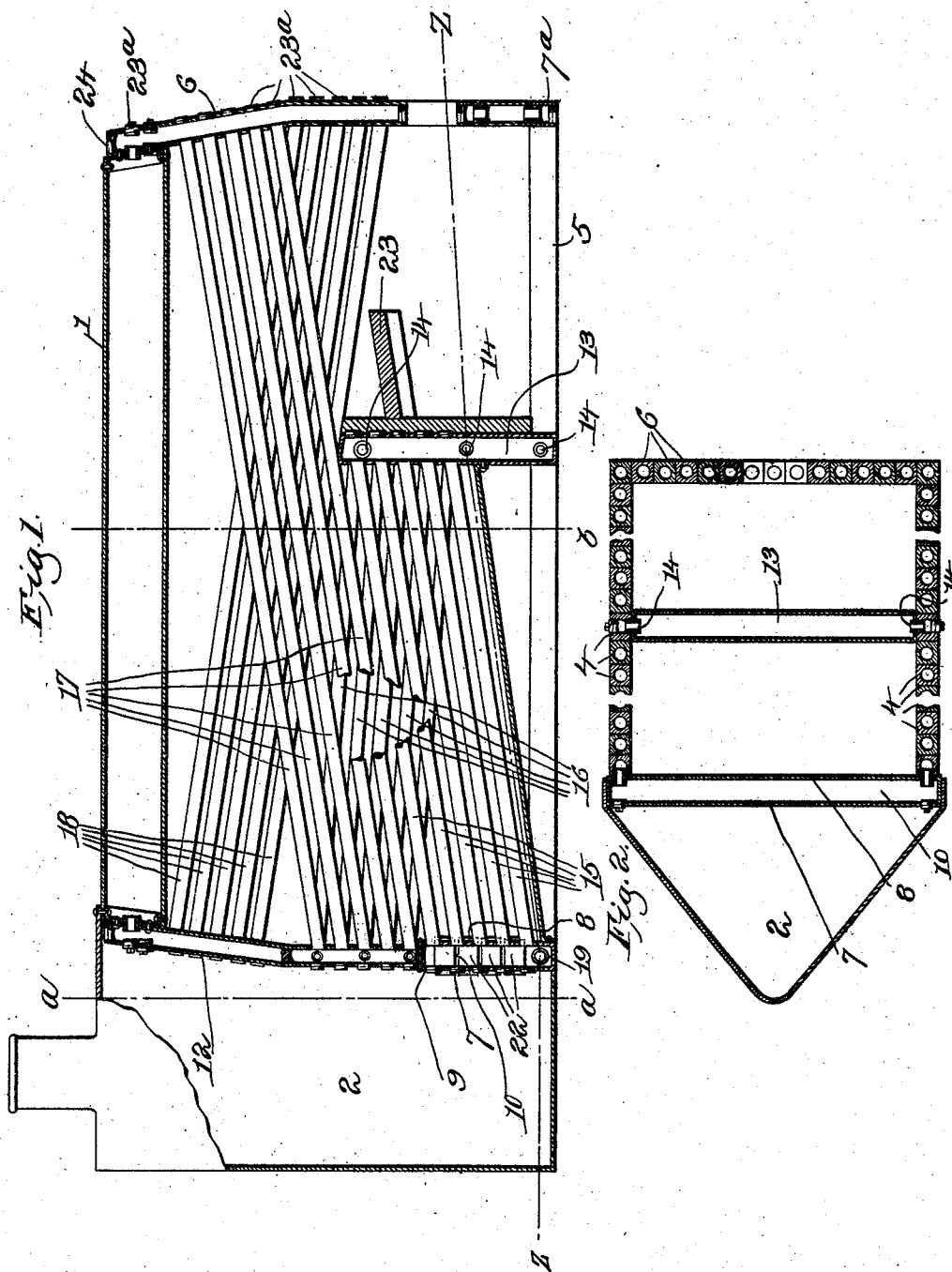


No. 782,352.

PATENTED FEB. 14, 1905.

J. M. McCLELLON.
LOCOMOTIVE BOILER.
APPLICATION FILED MAY 11, 1904.

3 SHEETS—SHEET 1.



Witnesses.
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3 SHEETS—SHEET 2.

Fig. 3

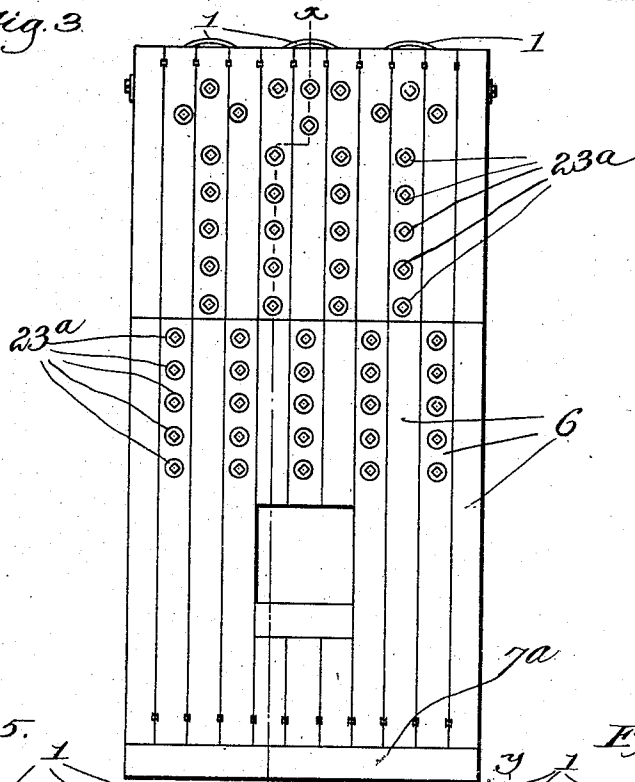
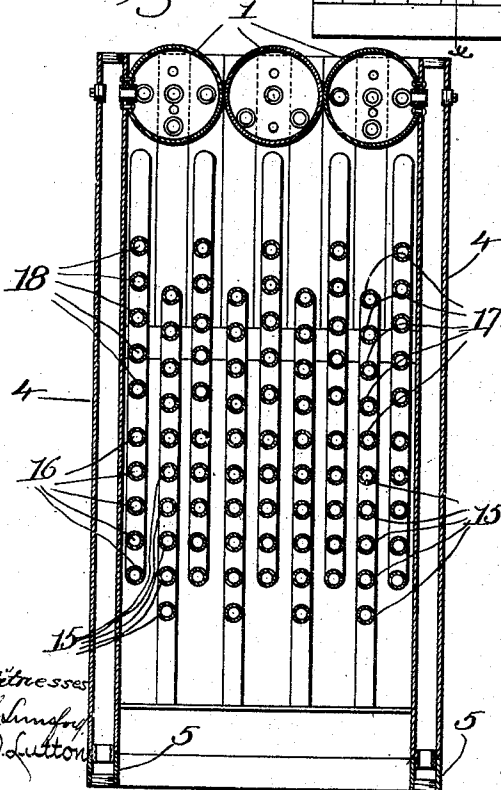
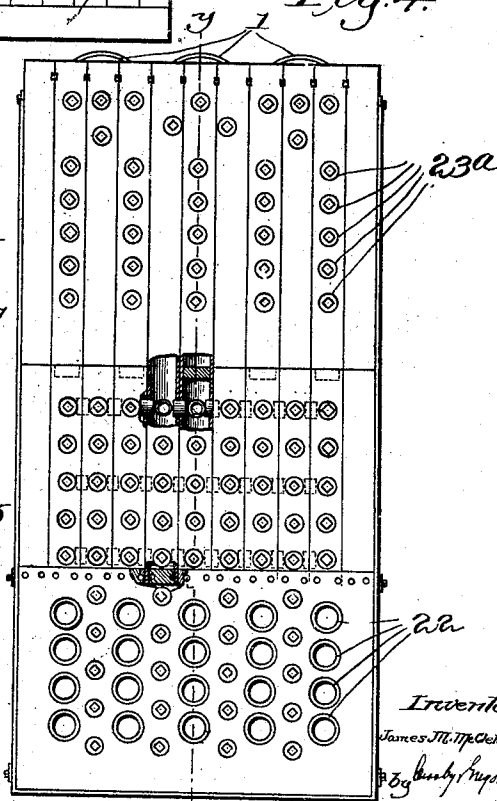


Fig. 5.



Witnesses
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Fig. 4.



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3 SHEETS—SHEET 3.



UNITED STATES PATENT OFFICE.

JAMES M. McCLELLON, OF EVERETT, MASSACHUSETTS.

LOCOMOTIVE-BOILER.

SPECIFICATION forming part of Letters Patent No. 782,352, dated February 14, 1905.

Application filed May 11, 1904. Serial No. 207,439.

To all whom it may concern:

Be it known that I, JAMES M. McCLELLON, a citizen of the United States, residing at Everett, in the county of Middlesex and State of Massachusetts, have invented an Improvement in Locomotive-Boilers, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to water-tube locomotive-boilers, and has for its object to simplify the construction and to provide a boiler in which all stayed surfaces are eliminated as far as possible.

The top of the boiler is formed by longitudinal drums which extend over both the flue and the fire-box, and the sides of the boiler are formed by closely-arranged water-tubes, which are riveted and nipped at their upper ends to the drums, said tubes forming the sides of both the flue and the fire-box. In the flue, which connects the fire-box with the smoke-chamber, are a plurality of banks of inclined water-tubes arranged one above the other and preferably in a zigzag manner, and the ends of the tubes of each bank are connected to headers or water-legs extending across the boiler. The feed-water is admitted to the header to which the lower banks of tubes are connected, and therefore passes upwardly through the banks in succession. The products of combustion pass from the flue to the smoke-chamber at or near the bottom of the former, and therefore they have a downward as well as a forward movement through the flue. The result is that the general movements of the water in the tubes and the products of combustion in the flue are in opposite directions, with the result that the efficiency of the boiler is increased.

Figure 1 is a longitudinal central section of a boiler embodying the present improvements, taken on the lines *xx* and *yy*, Figs. 3 and 4. Fig. 2 is a horizontal view taken on the line *zz*, Fig. 1, part of the boiler being broken out in this view. Fig. 3 is a view of the door end of the fire-box. Fig. 4 is a section on the line *aa*, Fig. 1, looking to the right. Fig. 5 is a section on the line *bb*,

Fig. 1, looking to the left. Fig. 6 shows a modification, and Fig. 7 is a view of a portion of the sheet 41.

The top of the fire-box is formed by the longitudinal drums 1, which extend over both the fire-box and the flue, which connects the fire-box with the usual smoke-chamber 2, and the sides of the flue and also of the fire-box are formed by closely-arranged vertical water-tubes 4, which are connected at their lower ends to headers 5, extending along the sides of the boiler. These water-tubes 4 may have any desired shape or contour; but I prefer to make them flat sided, because tubes of this shape can be more easily secured to the drums. In the drawings I have illustrated tubes which are substantially square in exterior cross-section, and they may be either round or square interiorly, as desired. To make a simple and effective connection between the tubes 4 and the drums 1, the outer sides of the outer drums are flattened, and the sides of the tubes 4 at their upper ends overlie and are secured to such flattened sides of the drums, preferably by riveting and nipping them thereto, as seen in Fig. 5.

In the form of the invention shown in Figs. 1 to 5 the door end of the fire-box is formed by vertical tubes 6, which are secured in some suitable way at their lower ends to the cross-header 7^a and at their upper ends overlie and are nipped and riveted to the flat ends of the drums 1. Extending across the boiler between the smoke-chamber and the flue are sheets 7 and 8, which are connected by the horizontal partitions 9 and which form between them the water legs or chambers 10 and 11. These sheets extend only part way to the top of the boiler, and are secured between them at their upper edges are the lower ends of the water-tubes 12, which overlie the flattened ends of the drums 1 and are riveted and nipped thereto. These sheets 7 and 8 are stayed in any usual way, and the sheet 8 is nipped to the end tubes 4, as shown in Fig. 2. Extending across the boiler back of the bridge-wall is a water chamber or leg 13, which has communication through suitable nipples 14 with the tubes 4 directly opposite. The water-tubes within the flue are inclined

and arranged in banks. In the form of my invention shown in Fig. 1 the banks are situated one above the other in a zigzag manner, while in Fig. 6 they do not have the zigzag arrangement. I will first describe the form of my invention shown in Figs. 1 to 5. In this form the tubes of the lower bank are designated by 15, and these connect at their lower ends with the water-chamber 10 and at their upper ends with the water chamber or leg 13. The next adjacent bank of tubes are designated by 16, and these connect at their lower ends with the water-leg 13 and at their upper ends with the water chamber or leg 11, this latter bank inclining in an opposite direction from the first bank. The tubes of the next higher or third bank are designated by 17, and they connect at their lower ends with the water-leg 11 and at their upper ends with certain of the water-tubes 6. These latter tubes 17 extend substantially parallel to the tubes 15 and at their right-hand ends in Fig. 1 extend through the fire-box. The lower ends of the bank of tubes 16 lie alongside of the upper ends of the tubes 15 and the upper ends of said tubes 16 overlap or lie alongside of the lower ends of the tubes 17. With this construction the tubes 17 stand vertically over the tubes 15 and the tubes 16 stand in a vertical plane just one side of the plane of the tubes 15 and 17. It is proposed to employ as many banks of tubes similar to 15 as the width of the boiler will permit, and hence the tubes 16 will lie between the adjacent banks 15. Situated directly over each bank of tubes 16 is another bank of tubes, 18, which are inclined in the same direction as the tubes 16 and are connected at their lower ends to one of the tubes 12. The tubes 6 are of such size that one bank of tubes 17 will be connected to one tube 6 and the adjacent bank of tubes 18 will be connected to the next tube 6, while the third tube 6 will have another bank of tubes 17 connected thereto. The tubes 17 are therefore connected to the alternate tubes 6 and the tubes 18 to the other tubes 6. The feed-water is admitted to the lower bank of tubes, preferably to the chamber 10, as shown at 19, and from the chamber 10 passes up the tubes 15 to the water-leg 13, from said water-leg through the tubes 16 to the chamber 11, and from the chamber 11 through the tubes 17 to certain of the tubes 6, and thence into the drums 1. The cool water at the right-hand end of the drums passes down the tubes 6 to which the tubes 18 are attached, and thence upwardly through the tubes 18 to certain of the tubes 12 and thence to the drums. The blank water-tubes 12, or those which are not connected to the tubes 18, are connected at their lower ends to a cross header or tube 20, which has connected to its ends the downtakes 21. These downtakes are nipped at their lower ends into the chamber 11. With this construction there is a gradual upward displacement of the wa-

ter through the tubes 15 16 17 and a circulation of the water down certain of the tubes 6, up tubes 18, down the blank tubes 12 and the downtakes 21 to the chamber 11, and up the tubes 17 again. 22 designates small flues which extend through the lower chamber 10 and through which the products of combustion escape from the main flue to the smoke-chamber. The products of combustion are deflected by the deflecting-arch 23 to the upper end of the fire-box and thence pass forwardly and downwardly and through the small flues 22 to the smoke-chamber, this general movement being opposite to that in which the water is displaced in moving from its point of entrance to the boiler to the evaporating-surface. By thus causing the water and the products of combustion to be displaced in opposite directions the efficiency of the boiler is increased. The arrangement of the water-tubes in the flue is such that an extremely large heating-surface is presented, and at the same time the best possible circulation is obtained.

Any tube in the boiler can be removed without disturbing any of the other tubes, this being accomplished by providing each of the tubes 12 and 6 and the sheet 7 with apertures opposite each tube, which apertures are closed by removable plugs 23^a. By simply removing the proper plugs the ends of any tube can be reached for cutting or for expanding. Each of the tubes 4, 6, and 12 is provided with apertures closed by removable plugs opposite the nipples, so that any one of said tubes can be easily removed. The upper ends of the tubes 4 and 12 are closed by suitable plugs 24. All of the tubes 4, 12, and 6 are preferably made flat-sided, so that a tight joint can be made between the tubes and the drums and also between the tubes 12 and the sheets 7 and 8.

In Fig. 6 I have shown a slightly different arrangement of water-tubes within the flue, said water-tubes being arranged in inclined banks, but not with the zigzag arrangement shown in Fig. 1. In this form of my invention I extend across the flue the two sheets 41 42, which form between them the water leg or chamber 43, and also employ back of the bridge-wall the two sheets forming the water chamber or leg 13, as in Figs. 1 and 2. The door end of the fire-box may either be formed by sheets 44 and 45 or by water-tubes, such as tube 6 in Figs. 1 and 2. The lower bank of tubes is designated by 15^a, and these extend from the lower portion of the chamber 43 upwardly into the chamber 13. From the upper end of the chamber 13 extends another inclined bank of tubes, 16^a, which connect said chamber 13 with either the chamber between the sheets 44 and 45 or with the various water-tubes at the front of the boiler. Another bank of the inclined tubes, 17^a, extends from the chamber 43 clear to the front

end of the boiler and communicates with the water-chamber at the door end. I also employ a third bank of tubes, 18^a, which connects with the water-chamber 43 at their lower end and at their upper end with a water leg or chamber 46, which extends clear across the door above the tube 17^a. The sheets 42 and 44 overlie the ends of the drums 1 and are riveted directly to such ends of the drums, and filling-pieces 48 are placed between the edges of the sheets 44 and 45 and 41 and 42, such filling-pieces being riveted to each sheet and tying them together. Any suitable and usual means of staying the sheets 44 and 45 may be employed. For staying the sheets 41 and 42 I prefer to use the hollow stay-bolts 50, as seen in Fig. 7, although any other suitable means of staying these sheets may be employed. I prefer these hollow stay-bolts because they act as flues to prevent the escape of a portion of the products of combustion, and as a result the hot gases adjacent the sheet 42 are uniformly distributed. The products of combustion escape from the flue into the smoke-chamber 2 through flues or outlets 22 at the lower end of the smoke-chamber and through outlets or flues 22^a at the upper end and also through the hollow stay-bolts 50. With this arrangement of water-tubes the water which is admitted to the lower end of the chamber 43 circulates upwardly through the tubes 15 to the chamber 13 and from the latter through tubes 16^a to the chamber at the door end of the fire-box and also through the tubes 17^a directly to said chamber, and from the latter it passes to the drum 1. Water also circulates through the pipes 18^a to the chamber 46, and thus into the drum. In this form of boiler the tubes which are subjected to the highest temperature are the short tubes 16^a, which take their supply of water from the chamber 13. This chamber 13 is supplied with water through the tubes 15^a, and as there are more tubes 15^a than there are tubes 16^a there would always be a sufficient supply of water to the latter tubes to prevent them from being burned out, as often occurs when these tubes extend the full length of the boiler. The longer tubes 17^a, which do extend the full length of the boiler, are not subjected to as great temperature as the tubes 16^a, and the danger of their burning out is very slight. This arrangement of tubes has the advantage that those tubes which are subjected to the highest temperatures are so arranged as to reduce to a minimum the danger of their burning out. This incline arrangement of water-tubes makes a very rigid boiler, which will withstand the racking to which a locomotive is subjected. As in the other form of my invention, all of these tubes are made removable by providing suitable removable plugs opposite the ends of the tubes.

A boiler constructed as above described is

very simple to build, easily repaired, and has a high efficiency.

Although I have illustrated some particular forms of boiler embodying my present invention, I do not wish to be limited to the constructional details shown, as various changes in the shape of the tubes, manner of securing them to the drums, and general arrangement of the tubes may be varied in many ways without departing from the invention. While I prefer to make the water-chambers at the door end of the fire-box and those at the upper end of the front of the flue in the form of tubes, such as 6 and 12, yet this is not essential, as these chambers could be made in other ways without sacrificing any of the advantages of the invention or departing therefrom.

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

1. A locomotive water-tube boiler having a fire-box at one end and a smoke-chamber at the other end, a horizontal flue with flat sides connecting said fire-box and smoke-chamber, and a plurality of banks of inclined water-tubes in said flue arranged one above the other in a zigzag manner, the upper ends of the tubes of one bank having communication with the lower ends of the tubes of the next higher bank.

2. A locomotive water-tube boiler having a fire-box at one end and a smoke-chamber at the other end, a horizontal flue with flat sides connecting said fire-box and smoke-chamber, a plurality of banks of inclined water-tubes in said flue arranged one above the other in a zigzag manner, the upper ends of the tubes of one bank having communication with the lower ends of the tubes of the next higher bank, and means to deliver the feed-water to the lower bank of tubes.

3. A locomotive water-tube boiler having a fire-box at one end and a smoke-chamber at the other end, a horizontal flue connecting said fire-box and smoke-chamber, the sides of the flue being formed by water-tubes in engagement with each other, and a plurality of banks of inclined water-tubes in the flue arranged one above the other in a zigzag manner.

4. In a locomotive water-tube boiler, a combustion-chamber and a smoke-chamber connected by a horizontal flue in which there is a general downward displacement of the products of combustion, a plurality of banks of inclined water-tubes in said flue arranged one above the other in a zigzag manner, the upper ends of the tubes of one bank overlapping and being connected to the lower ends of those of the next higher bank, and means to feed water to the lower bank of tubes.

5. A locomotive water-tube boiler having at one end a fire-box and at the other a smoke-chamber, a flue connecting said fire-box and smoke-chamber, and in which there is a gen-

eral downward displacement of the products of combustion, rows of engaging water-tubes forming the sides of the flue, a plurality of banks of inclined water-tubes in the flue, and means to feed water to the tubes of the lower bank.

6. In a locomotive water-tube boiler, a fire-box and a smoke-chamber connected by a horizontal flue in which there is a general downward displacement of the products of combustion, the sides of the flue and also of the fire-box being formed by rows of engaging water-tubes, a plurality of banks of inclined water-tubes in said flue arranged one above the other in a zigzag manner, the upper ends of the tubes of one bank overlapping and being connected to the lower ends of the tubes of the next higher bank, and means to feed water to the lower bank of tubes.

7. A locomotive water-tube boiler having a fire-box at one end and a smoke-chamber at the other connected by a horizontal flue, the sides of the fire-box being formed of rows of engaging water-tubes, and a plurality of banks of inclined water-tubes in the flue, the tubes of said banks being connected together in series.

8. In a locomotive water-tube boiler, a plurality of drums forming the top of the fire-box, rows of engaging water-tubes forming the sides of said box, said water-tubes communicating with the drums, a smoke-chamber connected with the fire-box by a flue, and a plurality of banks of inclined water-tubes in the flue.

9. In a locomotive water-tube boiler, a combustion-chamber and a smoke-chamber connected by a horizontal flue, longitudinal drums forming the top of said flue and fire-box, and vertical engaging water-tubes forming the sides of said flue and fire-box.

10. In a locomotive water-tube boiler, longitudinal drums forming the top of the flue and fire-box, the outer drums having flattened outer sides, and water-tubes secured to such flattened sides and forming the sides of the flue and fire-box.

11. In a locomotive-boiler, a plurality of longitudinal drums forming the top of the flue and fire-box, the outer sides of the outer drums being flattened, and flat-sided water-tubes secured to such flattened sides of the drums and forming the sides of the flue and fire-box.

12. In a locomotive-boiler, a plurality of longitudinal drums extending over the flue and fire-box and forming the top thereof, the outer sides of the outer drums being flattened and closely-arranged flat-sided water-tubes riveted to the flat sides of the drums, said water-tubes forming the sides of the flue and fire-box.

13. In a locomotive-boiler, a plurality of longitudinal drums extending over the flue and fire-box and forming the top thereof, the outer sides of the outer drums being flattened

and closely-arranged flat-sided water-tubes nipped to the flat sides of the drums, said water-tubes forming the sides of the flue and fire-box.

14. In a locomotive-boiler, a plurality of longitudinal drums extending over the flue and fire-box and forming the top thereof, the outer sides of the outer drums being flattened, and closely-arranged flat-sided water-tubes riveted and nipped to the flat sides of the drums, said water-tubes forming the sides of the flue and fire-box.

15. In a locomotive-boiler, a plurality of longitudinal drums forming the top of the flue and the fire-box, the ends of all the drums and the outer sides of the outer drums being flattened, and closely-arranged flat-sided tubes riveted and nipped to such flattened sides and ends of the drums and forming the sides of the flue and the sides and door end of the fire-box.

16. In a locomotive-boiler, a plurality of longitudinal drums forming the top of the flue and fire-box, the outer sides of the outer drums being flattened, and flat-sided water-tubes having their inner flat sides nipped and riveted to the flat sides of the drums, said tubes forming the sides of the flue and fire-box.

17. In a locomotive water-tube boiler, a combustion-chamber and a smoke-chamber connected by a horizontal flue, longitudinal drums forming the top of said flue and fire-box, vertical engaging water-tubes forming the sides of said flue and fire-box, and a plurality of banks of inclined water-tubes in said flue.

18. In a locomotive-boiler, a combustion-chamber and a smoke-chamber connected by a flue, longitudinal drums forming the top of said flue and combustion-chamber, vertical water-tubes connected to the drums and forming the sides of the flue and fire-box, and a plurality of banks of inclined water-tubes in said flue arranged one above the other in a zigzag manner, the upper ends of the tubes of one bank overlapping and being connected to the lower ends of the tubes of the next higher bank.

19. A locomotive-boiler having a fire-box at one end and a smoke-chamber at the other connected by a flue, two separate water-chambers one above the other extending across the boiler and dividing the smoke-chamber from the flue, a third water-chamber extending across the boiler back of the fire-box, and other water-chambers at the door end of the fire-box, inclined tubes connecting the lower chamber at the front of the boiler to the chamber back of the fire-box, other inclined tubes connecting the latter chamber with the upper chamber at the front of the boiler, and still other inclined tubes connecting the latter chamber with the chambers at the door end of the fire-box.

20. A locomotive-boiler having a fire-box at one end and a smoke-chamber at the other con-

5 nected by a flue, two separate water-chambers one above the other extending across the boiler and dividing the smoke-chamber from the flue, a third water-chamber extending across the boiler back of the fire-box, and other water-chambers at the door end of the fire-box, inclined tubes connecting the lower chamber at the front of the boiler to the chamber back of the fire-box, other inclined tubes connecting the latter chamber with the upper chamber at the front of the boiler, other inclined tubes connecting the latter chamber with the chambers at the door end of the fire-box, and still other water-tubes inclined in an opposite direction from the last-named tubes and connecting the chambers at the door end of the fire-box to vertical tubes, as 12, at the front of the fire-box.

20 21. In a locomotive-boiler, a lower and an upper water-chamber extending across the boiler and dividing the flue from the smoke-chamber, another water chamber or leg back of the bridge-wall, and other water-spaces at the door end of the fire-box, inclined water-tubes connecting the lower chamber with that back of the bridge-wall, other inclined water-tubes connecting the latter chamber to the upper chamber, still other inclined tubes connecting the upper chamber to the water-spaces at the door end of the fire-box, and still other inclined tubes connecting the latter water-spaces to other water-spaces at the front of the boiler, and downtakes connecting the last-named water-spaces with the upper chamber.

35 22. In a locomotive-boiler, a row of closely-arranged water-tubes forming the door end of the fire-box, a steam and water space at the top of the fire-box and flue, a water-leg extending across the boiler at the front end of the flue, a row of closely-arranged water-tubes, as 12, secured to the upper end of said water-leg and communicating with the steam and water space, inclined tubes connecting the water-leg with the alternate water-tubes at the door end of the fire-box, oppositely-inclined water-tubes connecting the other water-tubes at the door end of the fire-box with the alternate water-tubes 12, and means connecting the other water-tubes 12 with the water-leg.

50 23. In a locomotive water-tube boiler, a plurality of drums forming the top of the fire-box and flue, closely-arranged water-tubes nipped and riveted to the ends of drums and forming the door end of the fire-box, other water-tubes as 12 riveted and nipped to the front ends of the drums, a water-leg extending across the boiler below the tubes 12, inclined water-tubes connecting said water-leg with certain of the tubes at the door end of fire-box, other reversely-inclined tubes connecting other of the tubes at the door end of the fire-box with certain of the tubes 12, a cross-header connected to the lower ends of the other tubes 12 and downtakes connecting said cross-header with the water-leg.

24. In a locomotive-boiler, a row of closely-arranged water-tubes forming the door end of the fire-box, a similar row of water-tubes and also a water-leg at the front end of the flue, rows of inclined water-tubes connecting the water-leg with the upper end of certain of the tubes at the front of the fire-box, other rows of reversely-inclined tubes connecting other of said tubes at the door end of the fire-box to certain of the tubes at the front end of the flue, and means establishing a communication between other of the latter tubes with the water-leg.

25. A locomotive water-tube boiler having a fire-box at one end and a smoke-chamber at the other end, a horizontal flue connecting said fire-box and smoke-chamber, said flue having substantially straight vertical sides, and a plurality of banks of inclined water-tubes within said flue, said water-tubes having a zigzag arrangement.

26. A locomotive water-tube boiler having a fire-box at one end and a smoke-chamber at the other end, a horizontal flue connecting said fire-box and smoke-chamber, a bridge-wall at the back of the fire-box, a plurality of inclined water-tubes in said flue, a portion of said water-tubes extending from the front of the flue to the bridge-wall, and other of said water-tubes extending the full length of the flue, and all of said tubes being in the path of the products of combustion.

27. A locomotive water-tube boiler having a fire-box at one end and a smoke-chamber at the other end, a horizontal flue connecting the fire-box and smoke-chamber, a water-space between the front end of the flue and the smoke-chamber, another water space or chamber between the fire-box and the flue, and a plurality of inclined water-tubes within the flue, part of said water-tubes connecting the water-space at the front of the flue adjacent the bridge-wall, and other water-tubes extending the full length of the flue above the bridge-wall, all of said water-tubes being in the path of the products of combustion.

28. A locomotive water-tube boiler having a fire-box at one end and a smoke-chamber at the other end, a horizontal flue connecting said fire-box and smoke-chamber, and a plurality of banks of inclined water-tubes within the flue arranged one above the other in a zigzag manner, the upper ends of the tubes of one bank communicating with the lower ends of the tubes of the next higher bank, each bank of tubes extending clear across the boiler, and all the banks of tubes being in the path of the products of combustion.

29. A locomotive water-tube boiler having a fire-box at one end and a smoke-chamber at the other end, a horizontal flue connecting said fire-box and smoke-chamber, vertical water tubes or headers at the door end of the fire-box, other vertical tubes at the front end of the smoke-chamber, and water-tubes extend-

ing the length of the boiler and connecting
said vertical water-tubes, the alternate vertical
water-tubes at each end of the boiler consti-
tuting uptakes and other water-tubes consti-
5 tuting downtakes.

30. A locomotive water-tube boiler having
a fire-box at one end and a smoke-chamber at
the other end, a horizontal flue connecting said
fire-box and smoke-chamber, vertical tubular
10 headers at the door end of the fire-box, other
vertical tubular headers at the smoke-cham-
ber end of the flue, and oppositely-inclined

water-tubes connecting one set of the tubular
headers to the other, the alternate tubular
headers at each end of the boiler constituting 15
uptakes and the other tubular headers consti-
tuting downtakes.

In testimony whereof I have signed my name
to this specification in the presence of two sub-
scribing witnesses.

JAMES M. McCLELLON.

Witnesses:

LOUIS C. SMITH,
MARGARET A. DUNN.