No. 774,773. PATENTED NOV. 15, 1904.

J. M. McCLELLON.

LOCOMOTIVE BOILER.

APPLICATION FILED JULY 11, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

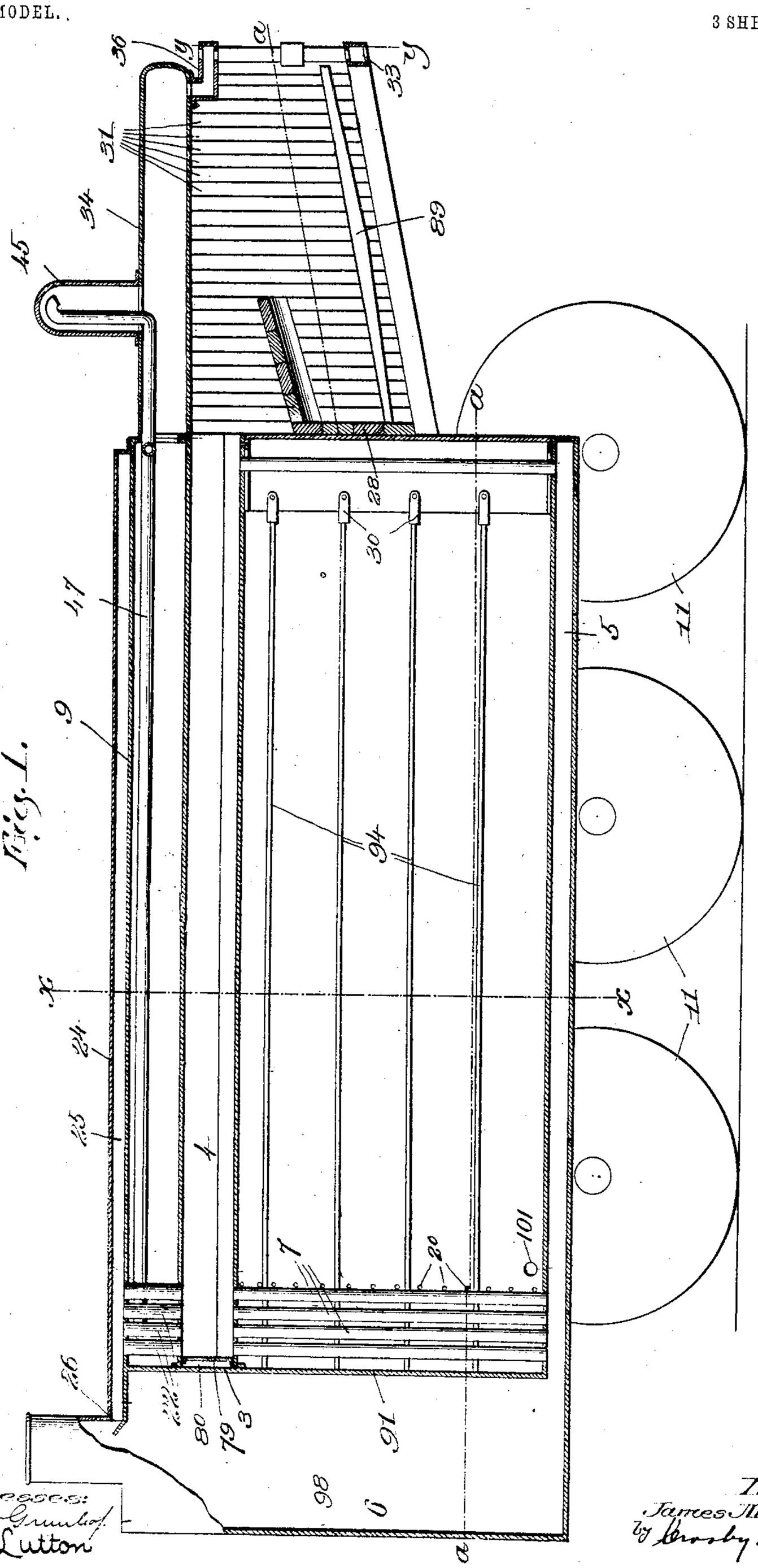
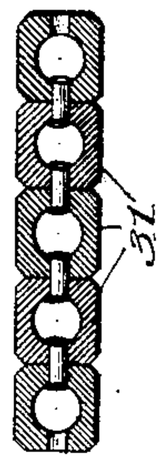


Fig. 10.



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S. W. Lutton

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 3.

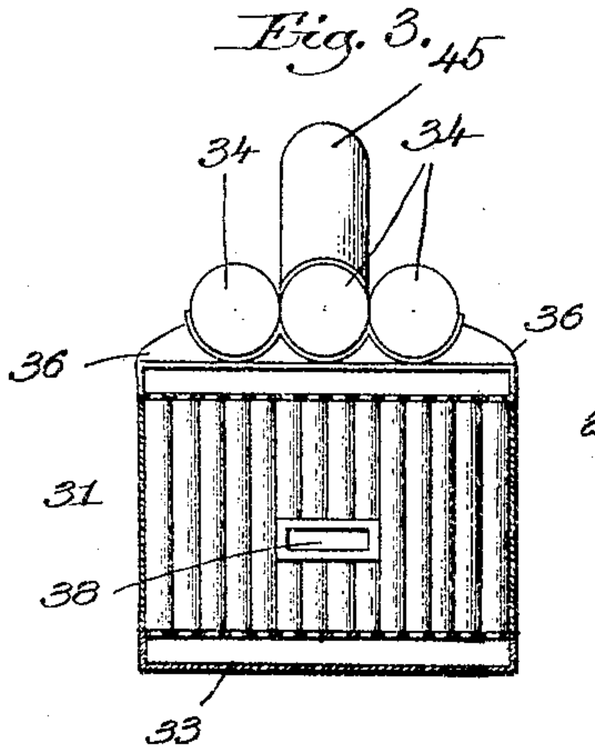


Fig. 2.

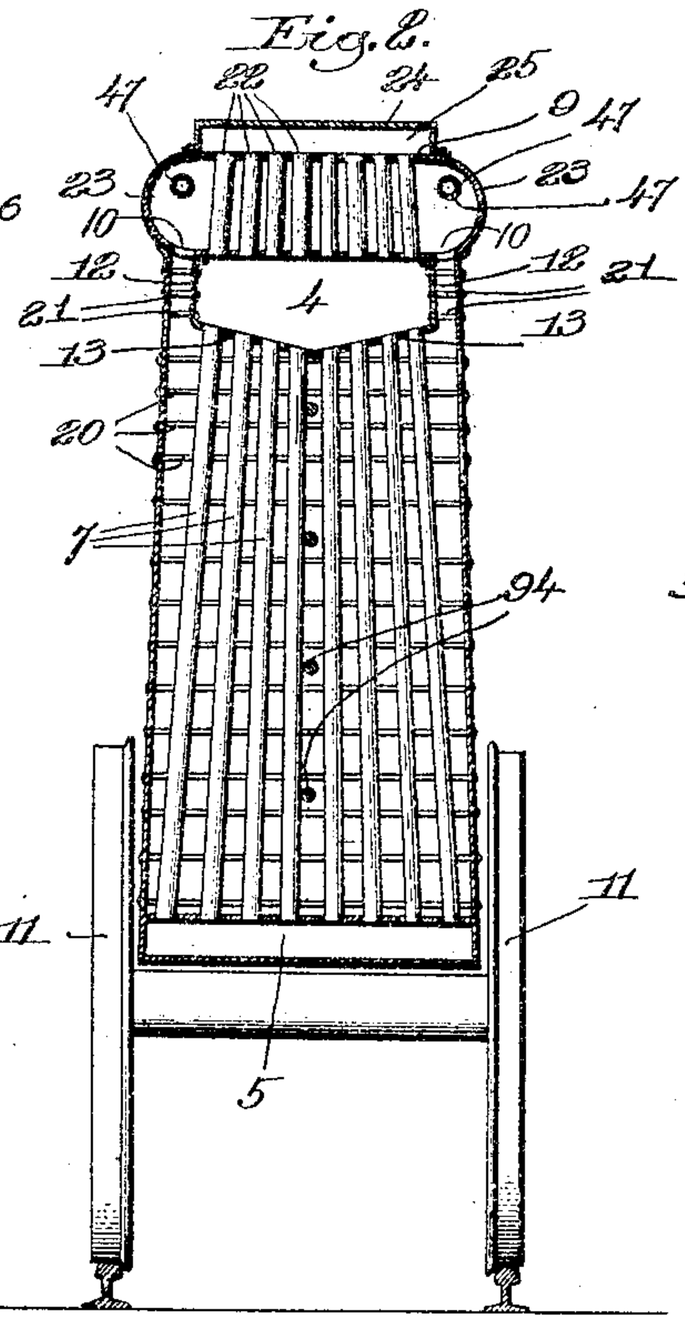


Fig. 4.

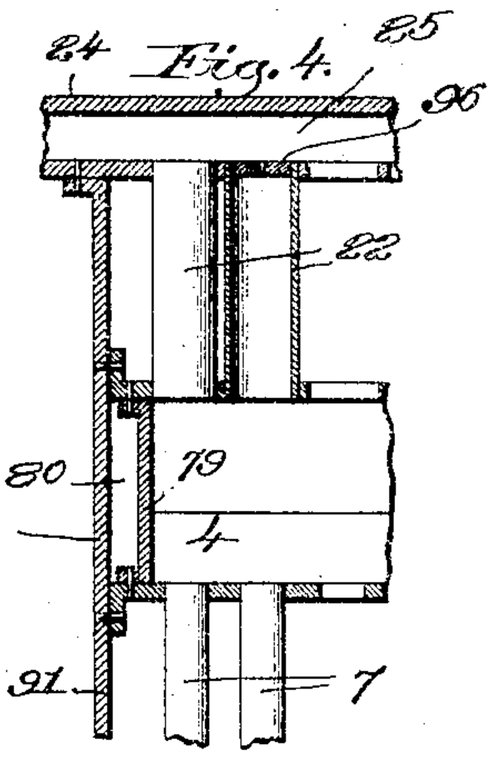
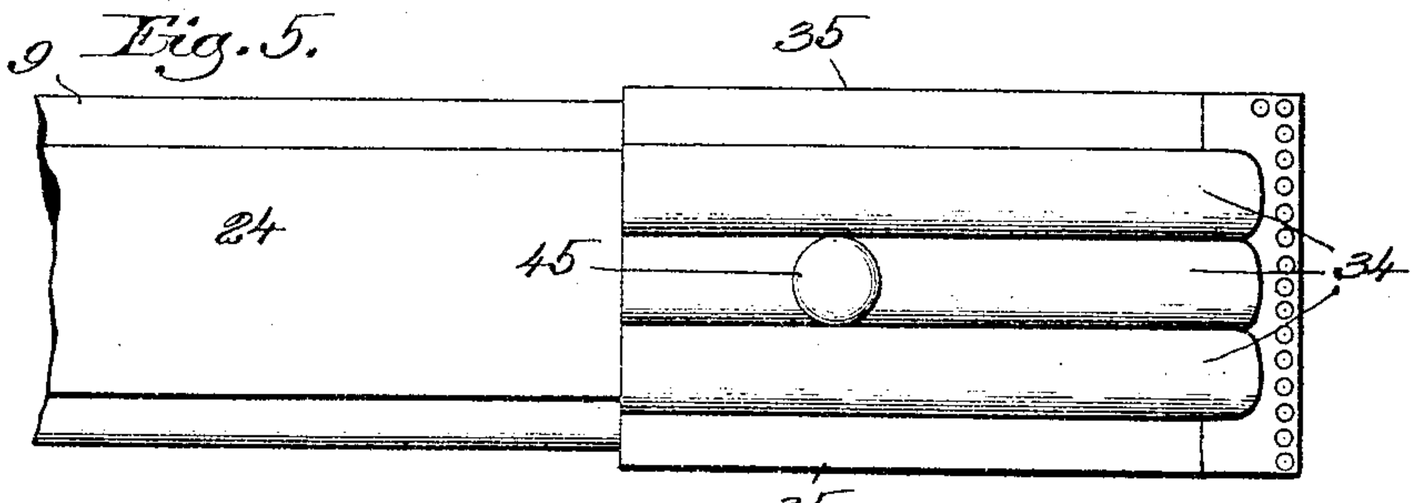


Fig. 5.



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NO MODEL. 3 SHEETS—SHEET 3.

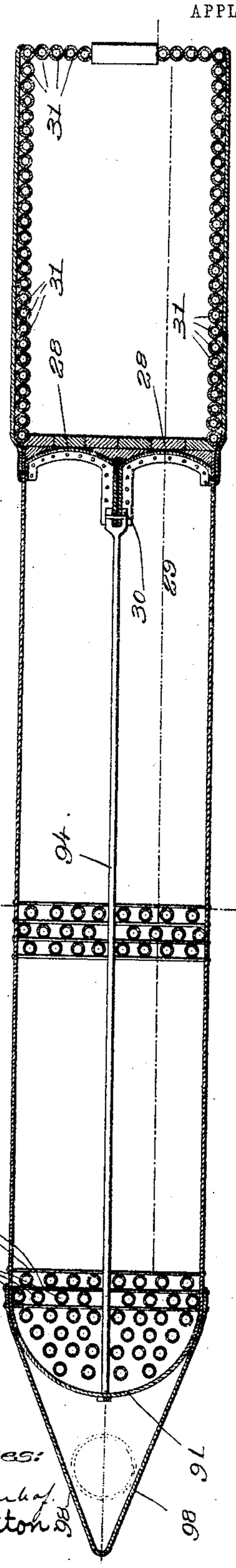

Fig. 6.

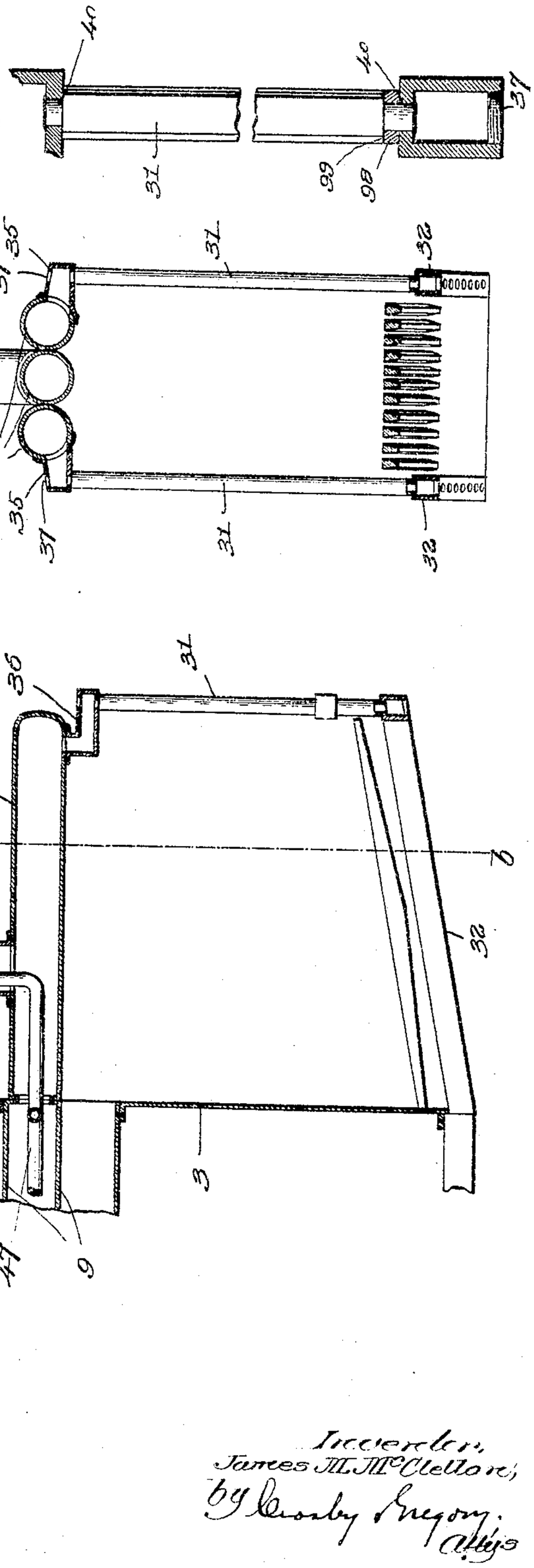

Fig. 7.

Fig. 8.

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No. 774,773. Patented November 15, 1904.

UNITED STATES PATENT OFFICE.

JAMES M. McCLELLON, OF EVERETT, MASSACHUSETTS.

LOCOMOTIVE-BOILER.

SPECIFICATION forming part of Letters Patent No. 774,773, dated November 15, 1904.

Application filed July 11, 1903. Serial No. 165,110. (No model.)

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 Suffolk 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 numerals on the drawings representing like parts.

This invention relates to tubular boilers, and especially to locomotive-boilers; and the object of the invention is to produce a boiler of this class which will be more efficient than locomotive-boilers as now commonly built. I propose to gain this increased efficiency by so constructing the boiler that the displacement of the water in the boiler is in an opposite direction to the displacement of the hot gases as they pass from the combustion-chamber to the smoke-stack.

As I have herein embodied my invention the boiler comprises a shell having substantially vertically disposed flues therethrough and an upper chamber above said shell which communicates with the combustion-chamber and a lower chamber beneath the shell which communicates with the smoke-chamber. The feed-water is admitted to the bottom of the boiler-shell, and as it evaporates there is of course a gradual upward displacement of the water. The hot gases pass from the combustion-chamber directly into the upper chamber and then are taken downwardly through the flues to the lower chamber and thence to the smoke-stack, so that the hottest gases are above and along the upper side of the shell, while the coolest gases are in the lower chamber and in the lower portions of the flues. With this construction the feed-water which is introduced into the boiler is first heated by the coolest gases in the lower chamber and at the lower ends of the flues. As said water is heated and gradually rises or is displaced upwardly it absorbs heat and is still further heated by the hot gases in the central portion of the flue, and when said water reaches the upper end of the shell it comes in contact with portions of the shell and flues which are heated from the hottest gases issuing from the combustion-chamber. The hottest gases, therefore, are utilized in evaporating heated water, and the somewhat cooler gases are used in heating the water to boiling-point. By means of this displacement in opposite directions of the water in the boiler and the gases issuing from the combustion-chamber I produce a boiler having a much greater efficiency than one in which the gases and water travel in substantially the same direction.

Other novel details of construction will be more fully hereinafter described, and then pointed out in the claims.

In the drawings, Figure 1 is a central sectional view of a locomotive-boiler embodying my improvements. Fig. 2 is a section on the line *x x*, Fig. 1. Fig. 3 is a transverse vertical section through the fire-box on the line *y y*, Fig. 1. Fig. 4 is an enlarged section through a portion of the upper part of the boiler. Fig. 5 is a top plan view of the fire-box end of the boiler. Fig. 6 is a horizontal section on substantially the line *a a*, Fig. 1. Fig. 7 is a vertical section showing a modified form of fire-box. Fig. 8 is a section on the line *b b*, Fig. 7. Fig. 9 is an enlarged horizontal section through the fire-box, and Fig. 10 is an enlarged horizontal section through a portion of the side of the fire-box.

In this embodiment of my invention, 3 designates the shell of the boiler, 4 a chamber situated above the shell and communicating with the combustion-chamber, and 5 a chamber beneath the shell and communicating with the smoke-chamber 6.

In order to prevent confusion, I will hereinafter refer to the chamber 4 as the "upper" chamber and the chamber 5 as the "lower" chamber.

Extending through the shell 3 are a plurality of flues 7, which connect the upper and lower chambers and through which the products of combustion pass on their way from the combustion-chamber to the smoke-stack.

Above the upper chamber 4 is a supplemental shell 9, which is secured to the main shell 3 and the interior of which communicates with the interior of shell 3 by means of a series of apertures 10. This supplemental shell forms the top of the upper chamber 4.

In order that the boiler as a whole may set

as low as possible, I make the shell 3 substantially rectangular in cross-section and of a width to be received between the drivers 11 of the engine, as best seen in Fig. 2. The top of the shell 3 is formed by a sheet of metal bent to form substantially three sides of the chamber 4, said sheet having the vertical side portions 12 and the inclined portions 13, which form the bottom of the chamber 4 and the top of the shell 3.

The flues 7 are expanded into the portion 13 in any suitable way. These portions 13 of the shell of the boiler are subjected to an intense heat, and the water coming in contact with said portions is very rapidly evaporated. The object in giving these portions the inclination shown is to allow the steam formed to escape as rapidly as possible, so that its place may be taken by water, thus preventing the top of the shell from being burned out.

The flues 7 on each side of the vertical diameter of the boiler are arranged at a slight inclination, as best seen in Fig. 2, and thus serve to brace the boiler-shell and prevent it from racking. These flues, it will be understood, operate to stay the boiler-shell vertically. To stay the sides of the shell, I will preferably use stay-bolts 20, which extend transversely through the shell from one side to the other. The upper end of the sides of the boilers are stayed to the vertical portions 12 by short stay-bolts 21.

The front of the boiler-shell 3 is curved outwardly, as shown in Fig. 6 at 91, and therefore does not need to be stayed.

I prefer to make the end of the shell 3 toward the fire-box with the two curved portions 28, which are riveted at their outer edges to the sides of the shell and at their inner or adjacent edges are provided with the flanges 29, which are riveted together to make a tight joint. A plate 30 is interposed between the flanges 29 and extends back into the boiler far enough to act as a plate-girder to hold the inner edges of the curved heads 28 in place. Its upper and lower edges will be riveted to the top and bottom sheets. This plate also serves as a calking-plate, so that the joint between the plates 28 may be tightly calked. When the upper and lower edges of these curved portions 28 are riveted to the top and bottom sheets, a boiler-end construction is provided which will stand any ordinary pressure without being stayed longitudinally. By means of this construction I eliminate the necessity of any longitudinal stay-bolts, although, if desired, such stay-bolts 94 may be used, as seen in Fig. 6. Any other suitable way of providing for the proper staying of the front and rear ends of the boiler-shell 3 may be provided without departing from my invention.

The upper shell 9 contains an ample steam-space, as well as sufficient depth of water over the crown-sheet to protect the latter from excessive heating, and said shell may be stayed vertically either by suitable stay-bolts or by hollow stay-bolts or flues 22. To obviate the necessity of staying the supplemental shell horizontally, I will make the sides 23 of the shell rounding, as shown in Fig. 2. Where the stay members 22 are made hollow, I will preferably extend over the supplemental shell a sheet 24, which forms, with the upper portion of said shell, a chamber 25, having communication at one end with the smoke-stack or smoke-chamber, as at 26. With this construction some of the heated gases from the chamber 4 pass through the stay members 22 and into the chamber 25, from which they pass to the smoke-stack and in passing through said stay members and along the top of the shell 9 serve to partially dry out the steam in the steam-chamber 9, whereby the steam is rendered more effective. A very slight circulation of the heated gases through the flues 22 is sufficient for this purpose, while a rapid circulation would withdraw hot gases from the flues 7. In order to cut down the circulation through the flues 22, I make use of the perforated plugs 96, which are dropped into the upper end of said flues. I propose to make these plugs so that they will loosely set into the flues, as it is not necessary that they should be screwed or otherwise rigidly secured to the flues. Other means of cutting down the circulation through these flues may be employed, however, without departing from my invention.

I prefer to make the front walls 98 of the smoke-chamber inclined toward each other, thus making the engine with a V-shaped or pointed front to reduce as much as possible the resistance of the air to the movement of the engine. The usual smoke-stack, spark-arrester, and other devices will be placed in this V-shaped smoke-chamber and in front of the front end 91 of the shell 3.

I have not deemed it necessary to herein illustrate any particular construction of smoke-stack or spark-arrester, as these elements form no part of my present invention.

To facilitate the removal or insertion of any individual flue 7, I propose to place the flues 22 in alinement with the flues 7 and to make each flue 22 large enough in diameter to admit of the alined flue 7 being passed therethrough. This enables me to remove any damaged flue 7 and insert a new flue without disturbing the boiler structure as a whole.

The fire-box which I employ is of novel construction and is of such a design that all flat surfaces and stay-bolts are dispensed with without decreasing in any way the heating-surface. This makes a greatly-improved fire-box construction over any with which I am familiar. The sides and front of the fire-box are formed by water-tubes 31, which are arranged in engagement with each other, and I will preferably plane off or flatten the sides

of the tubes, as best seen in Fig. 10, so that any two adjacent tubes fit each other tightly. The lower ends of the tubes of each row at the sides of the fire-box are expanded into suitable headers 32, and the lower ends of the tubes of the row at the front of the fire-box are expanded into a cross-header 33, which is connected to the headers 32. The top of the fire-box is formed by a plurality of longitudinally-extending drums 34, which are suitably connected together, each of which communicates with the interior of the supplemental shell 9. The outside drums have secured to their outer sides the headers 35, into which the upper ends of the tubes of the rows at the sides of the fire-box are expanded. A suitable header 36 extends across the ends of the drums, and the upper ends of the tubes of the front of the fire-box are expanded into said header. Both of the side headers 35 and the cross-header 36 have communication with the drums 34 in some suitable way—as, for instance, by providing said drums with a plurality of holes. I prefer to provide each of the headers with hand-holes opposite the ends of each tube, so that proper tools may be inserted through any hand-hole and the corresponding tube cut for removal or expanded into the header after it has been put in place without disturbing other tubes. These hand-holes are closed by suitable plugs 37.

Certain of the tubes across the front of the fire-box are cut away to form an opening 38 for a furnace-door. These tubes in alinement with the door may be either ordinary drop-tubes or short headers may be placed across the top and bottom of the door into which said tubes are expanded.

In order to permit the tubes to be expanded into the headers, as above described, and yet enable the former to come in contact with each other, it is necessary to employ tubes having a considerable thickness of metal. Fig. 9 shows one way in which these tubes may be expanded into the headers without unduly weakening said headers. From said figure it will be seen that the ends of the tubes are reduced or necked, as at 40, and said reduced ends or necks inserted into the apertures in the header and expanded therein in any suitable way. This construction leaves sufficient metal between the reduced ends of adjacent tubes to give the necessary strength to the headers.

To provide for the insertion or removal of any of the tubes 31, I have illustrated one end of each of said tubes as having a longer necked portion 40 than the other end, so that said longer necked portion may be first inserted through its aperture and the tube moved longitudinally sufficiently to admit of its other end being brought into line with the corresponding aperture in said header. The tube may then be brought into place and then expanded into the headers. 98 designates a filling-piece which is adapted to be inserted between the header and the shoulder 99 of the tube after the tube is in place. By reason of the continuity of the metal around the tubes heat will be transmitted to the water on all sides, and in case a film of steam forms on the side next the fire the water will still be able to absorb heat and prevent the tube from becoming overheated.

The steam-dome 45 may be of any suitable construction and will preferably be mounted on and connected to the center drum 34. This dome will of course contain the usual throttle-valve, (not shown,) and I propose to take the steam-pipe 46 from said dome through the central drum 34 and then branch said pipe and take the two branches 47 through the supplemental casing 9 at the sides thereof, as shown in Fig. 2, into the smoke-chamber, one branch leading into one cylinder and the other branch leading to the other cylinder, as usual.

In Fig. 1 I have illustrated a fire-box of ordinary depth which is formed by placing the headers 32 and 33 and the grates 89 some distance above the lower chamber 5. This construction has the advantage that a considerable space is provided beneath the fire-box for placing apparatus of any description which forms part of the regular equipment of a locomotive.

In Figs. 7 and 8 I have illustrated another form of fire-box, which has a depth equal to the full height of the boiler. This is made by placing the lower headers 32 and 33 substantially on the level with the bottom of the boiler. This form of fire-box will be used where a large combustion-chamber is desired.

In order to strengthen the water-tubes which form the sides of the fire-box, I may rivet the adjacent tubes together, as shown in Fig. 10. To accomplish this, the tubes are riveted together as they are put in place, each rivet being headed through the aperture in the opposite side of the tube.

In order to prevent the smoke-stack end of the chamber 4 from burning out, I provide the false front 79, which is spaced from the curved portion 91 of the shell sufficiently so as to leave a water-chamber 80 between these parts. This chamber, it will be understood, is connected with the shells 9 and 3 by any suitable means.

Although I have herein described one form which my invention may assume, I do not wish to be limited to the exact construction shown, as various changes may be made in the construction of the parts without departing from the spirit of the invention.

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

1. In a locomotive-boiler a main shell and a supplemental shell forming between them a chamber which communicates with the combustion-chamber, and flues extending through said main shell, and communicating at one

end with said chamber and at the other end with the smoke-chamber, said main shell having substantially vertical sides and being of a width to set between the drivers.

2. In a locomotive-boiler a shell having substantially vertical sides and of a width to set between the drivers, a fire-box at one end of said shell, the sides of said fire-box being formed by parallel water-tubes arranged in engagement with each other, headers communicating with said shell into which said tubes are expanded, and vertical flues extending through the shell and connecting at their upper ends with the combustion-chamber of the fire-box, and at their lower ends with the smoke-chamber.

3. In a locomotive-boiler, a shell having at one end a smoke-chamber, and at the other a fire-box comprising longitudinally-extending drums forming the top of said fire-box, vertical engaging water-tubes forming the sides and end thereof, and headers into which said tubes are expanded, combined with flues extending through said shell and communicating at one end with the smoke-chamber and at the other with the fire-box.

4. In a tubular locomotive-boiler, a main shell and a supplemental shell forming between them an upper chamber which connects with the combustion-chamber, a second or lower chamber beneath the main shell and connected with the smoke-chamber, flues extending through the main shell and connecting said upper and lower chambers, and other flues extending through the supplemental chamber.

5. In a tubular locomotive-boiler, a main shell and a supplemental shell forming between them an upper chamber, which connects with the combustion-chamber, a second or lower chamber beneath the main shell and connected with the smoke-chamber, flues extending through the main shell and connecting said upper and lower chambers and other flues extending through the supplemental chamber, and means to conduct the gases which escape through the latter flues to the smoke-chamber.

6. In a tubular locomotive-boiler, a main shell and a supplemental shell forming between them an upper chamber, which connects with the combustion-chamber, a second or lower chamber beneath the main shell and connected with the smoke-chamber, flues extending through the main shell and connecting said upper and lower chambers, and other flues extending through the supplemental chamber, and means to maintain a circulation through the latter flues.

7. In a tubular locomotive-boiler, a main shell and a supplemental shell forming between them an upper chamber, which connects with the combustion-chamber, a second or lower chamber beneath the main shell and connected with the smoke-chamber, flues extending through the main shell and connecting said upper and lower chambers, and other flues extending through the supplemental chamber, said latter flues being larger than the first-named flues and situated in line therewith.

8. In a tubular locomotive-boiler, a main shell and a supplemental shell forming between them an upper chamber, which communicates with the combustion-chamber, and flues extending through said main shell and connecting the upper chamber with the smoke-chamber, the top of the main shell being sloping so as to permit the free escape of the steam generated thereby.

9. In a tubular locomotive-boiler, a boiler-shell, a chamber above the shell connected with the combustion-chamber, and flues extending through the shell and connecting said combustion-chamber with the smoke-chamber, the top of the main shell being inclined so as to permit the free escape of the steam as it is generated.

10. A tubular locomotive-boiler comprising a shell to contain water, a fire-box at one end of the shell, a smoke-chamber at the other end thereof, vertical flues extending through the shell, closely-arranged water-tubes forming the sides of the fire-box, and headers to which said water-tubes are directly connected both at the top and bottom.

11. In a tubular locomotive-boiler, a water-containing shell having flues extending therethrough, a plurality of longitudinal drums forming the top of the fire-box, rows of closely-arranged water-tubes forming the sides of said fire-box, and headers communicating with the shell and to which said tubes are connected.

12. In a tubular boiler, a water-receiving shell having flues extending therethrough, a fire-box the top of which is formed by drums which communicate with the shell, and the sides of which are inclosed by straight vertical parallel water-tubes in contact with each other, and headers into which the ends of said tubes are expanded, said headers having communication with the drums.

13. In a tubular locomotive-boiler, a shell, a fire-box, vertical flues extending through the shell and connected to the interior of the fire-box, the sides of the fire-box being formed by vertical water-tubes in engagement with each other, and headers into which said tubes are expanded, said headers being connected to the shell.

14. In a tubular locomotive-boiler, a shell, a fire-box, and flues extending through the shell, the top of the fire-box being formed by longitudinally-extending drums, and the sides of the fire-box being formed by vertically-arranged water-tubes in contact with each other.

15. In a tubular locomotive-boiler, a main shell, and a supplemental shell communicating with each other and forming between them an upper chamber, a combustion-chamber at one end of said shell communicating with said

upper chamber, a smoke-chamber at the other end of said shell, and flues extending through the main shell, and establishing a communication between the combustion and the smoke chambers.

16. In a locomotive-boiler a horizontal shell having parallel sides, and rounded or bumped ends, and means to stay the parallel sides.

17. A locomotive-boiler having parallel sides and a rounded or bumped front end, the rear end being formed by two outwardly-curved vertical plates which have their adjacent edges extending inwardly and riveted together.

18. A locomotive-boiler comprising a shell, a fire-box at one end of the boiler, a longitudinal chamber within the shell to communicate with the fire-box, flues extending from one side of said chamber through the shell and communicating with the smoke-chamber, and other flues extending from the other side of said chamber through the shell in an opposite direction to the former flues, said latter flues being larger than the former flues and in line therewith.

19. In a tubular locomotive-boiler, a main shell and a supplemental shell forming between them a chamber which connects with the combustion-chamber, flues extending through the main shell, and means whereby any individual flue may be removed from the exterior of the boiler.

20. In a tubular locomotive-boiler, a shell to receive water, a chamber within the shell and extending longitudinally thereof, said chamber communicating with the fire-box, and flues extending downwardly from said chamber to the shell and communicating with the smoke-chamber, each flue being capable of removal from the exterior of the boiler without disturbing any other flue.

21. In a tubular locomotive-boiler a shell to receive water, a longitudinally-extending chamber within the shell, said chamber communicating with the fire-box, vertically-extending flues passing through the shell and forming a communication between said chamber and the smoke chamber, and stay-rods extending across said shell and staying its sides, each flue being capable of removal from the boiler without disturbing any other flue.

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

JAMES M. McCLELLON.

Witnesses:

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LOUIS C. SMITH.