(No Model.) 2 Sheets—Sheet 1.

G. J. PERKINS.

LOCOMOTIVE OR OTHER WATER TUBE BOILER.

No. 534,002. Patented Feb. 12, 1895.

Fig. 1.

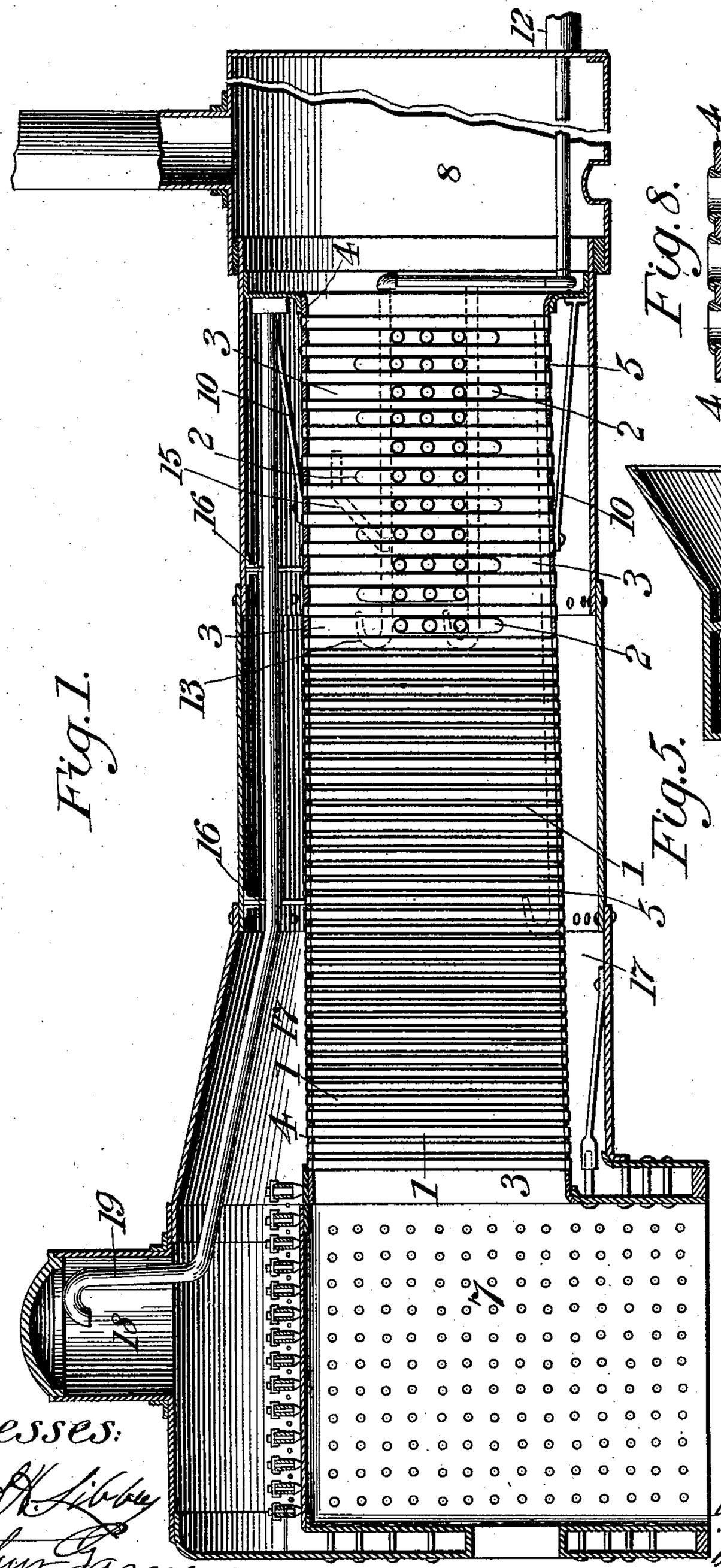

Fig. 4.

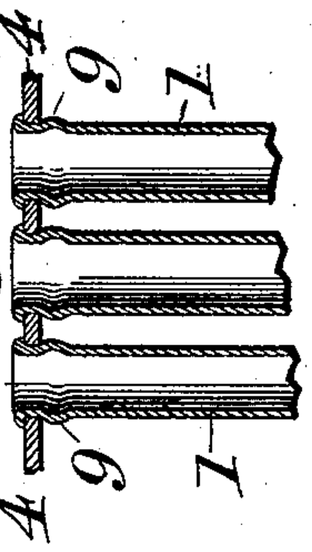

Fig. 5.

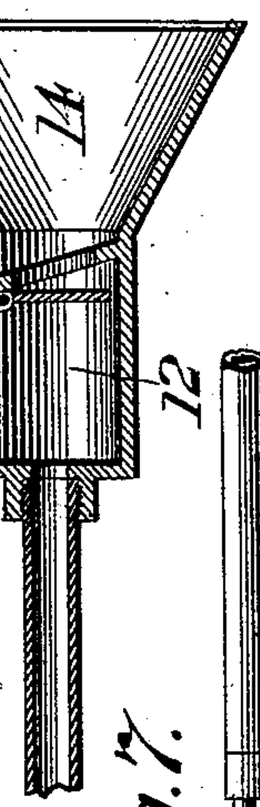

Fig. 7.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

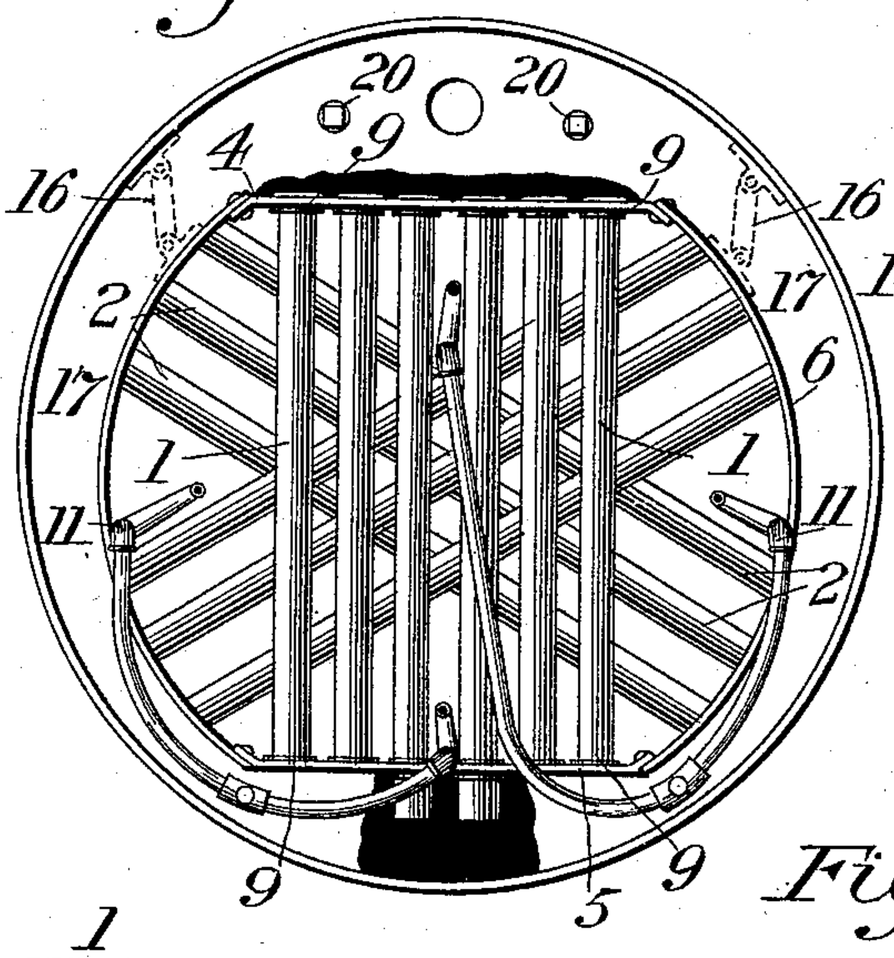


Fig. 4.

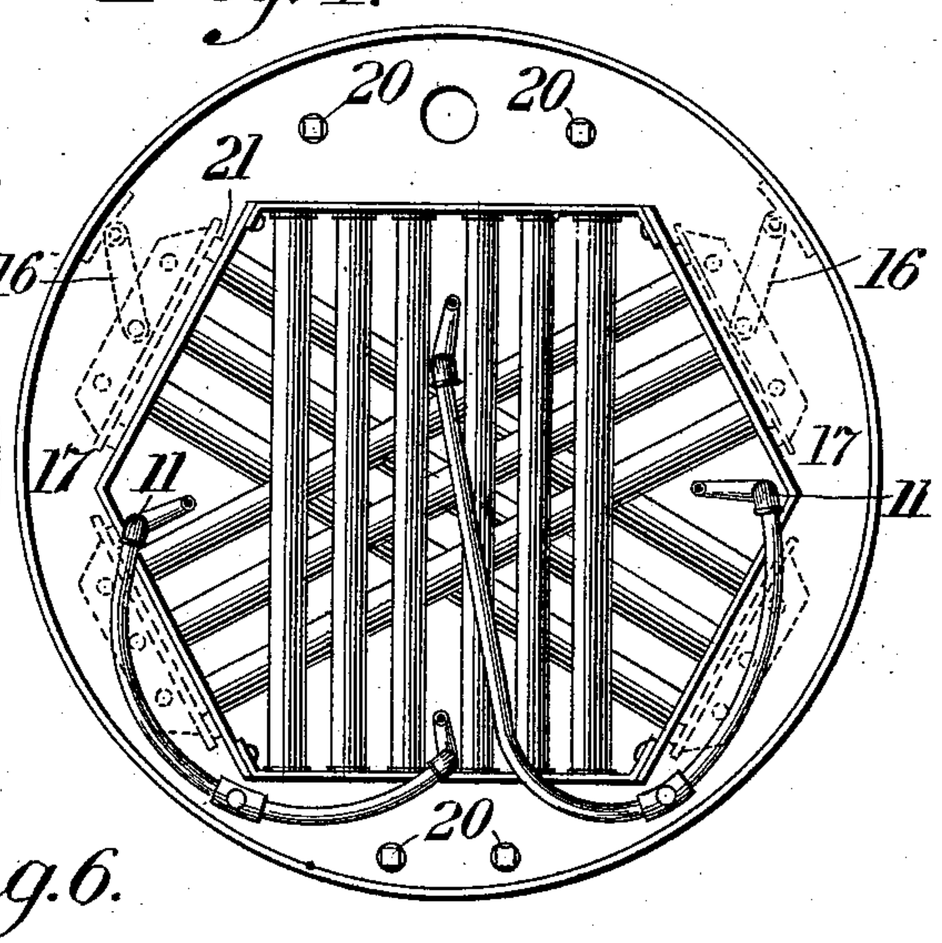


Fig. 6.

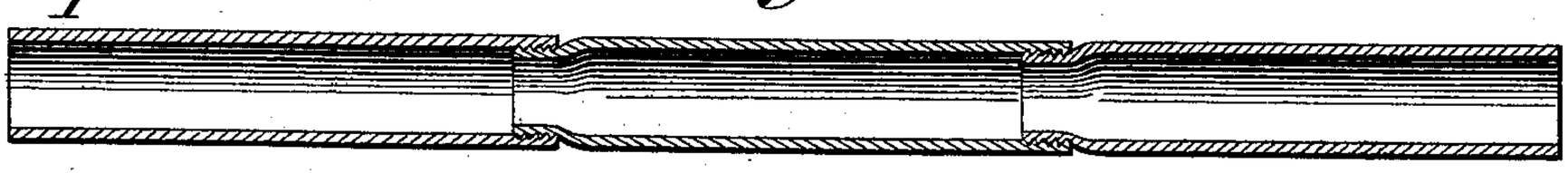
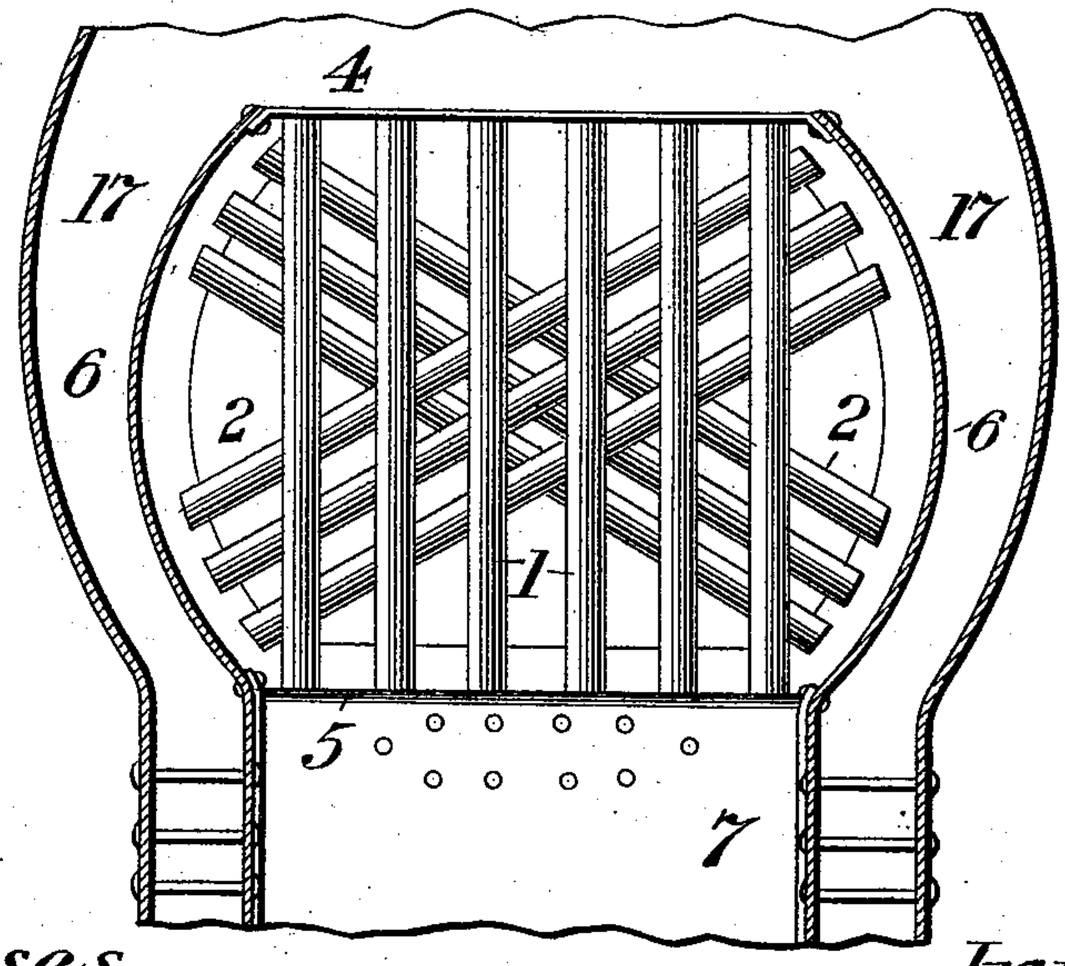


Fig. 3.



Witnesses:
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Arthur Garner

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UNITED STATES PATENT OFFICE.

GEORGE J. PERKINS, OF TRUCKEE, CALIFORNIA.

LOCOMOTIVE OR OTHER WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 534,002, dated February 12, 1895.

Application filed February 19, 1894. Serial No. 500,789. (No model.)

To all whom it may concern:

Be it known that I, GEORGE J. PERKINS, a citizen of the United States, residing at Truckee, in the county of Nevada and State of California, have invented certain new and useful Improvements in Locomotive or other Water-Tube Boilers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to steam boilers for locomotive engines, or any other internally fired boiler, and its object is to provide a steam boiler which shall contain a relatively large amount of heating surface economically disposed for the absorption of heat, with such details of construction as will enable the flame to pass a sufficient distance to consume all gases before being extinguished by the too rapid reduction of temperature, thereby preventing the escape of smoke and obtaining perfect combustion; and also to obtain a positive circulation of water to prevent or reduce to a minimum, the deposition of sediment, increase facilities for the removal of such sediment, reduce the expansion and contraction of the parts due to changes of temperature, thereby lengthening its life, materially increasing the efficiency of the engine by reducing the back pressure on the cylinders by an enlargement of the exhaust nozzle, obtain a more nearly uniform degree of heat throughout the length of the boiler, to thereby obviate the use of an extreme degree of heat, as is now required, in the fire box of the present type of locomotive boiler, by means of a softer action on the fire, and by the same means prevent the throwing of sparks out of the stack and avoiding the possibility of setting fires along the track, as is frequently now the case, increase the weight of engine and thereby add to its tractive power, and effect a material reduction in the consumption of fuel over the present type of locomotive boilers by means of an increased quantity and superior quality of heating surface.

With these and other objects and advantages in view, the invention consists of the construction and arrangement of the several parts which will be more fully hereinafter described and claimed.

In the drawings—Figure 1 is a longitudinal vertical section of a locomotive boiler embodying the invention and shown broken away in its length. Fig. 2 is an end elevation of the front end of the tube chamber, the outer shell being also shown. Fig. 3 is a cross sectional view of the back end of the tube chamber and the outer shell. Fig. 4 is a view similar to Fig. 2, showing a modified form of construction. Fig. 5 is a longitudnal view of the outer end or portion of the combustion pipe showing the hinged valve therein. Fig. 6 is a detail view of one of the tubes, showing a modified form of construction. Fig. 7 is a detail elevation of the inner end of one of the combustion pipes. Fig. 8 is a sectional detail on an enlarged scale, of portions of the tubes and one of the sheets showing the beads or shoulders.

Similar numerals of reference are employed to indicate corresponding parts in the several views.

Referring to the drawings, the numeral 1 designates a series of vertical water tubes having arranged in alternation therewith at a certain point a series of transversely extending, diagonal or angularly arranged tubes 2 which terminate in an inner shell or tube chamber 3 having parallel flat top and bottom sheets 4 and 5, and circular side sheets 6, to resist the collapse in pressure or strain brought to bear thereon. If desired, the said diagonal or angular tubes may be used through the side sheets to partially close the space between the outer rows of the vertical tubes and said sheets in order to prevent the escape of heat. The said tube chamber 3, as shown in Fig. 2, is preferably made of four sheets of metal with longitudinal seams and extends from the fire box 7 to the smoke box 8, being practically a continuation of the fire box and crown sheet, which, together with the transverse water tubes, form a very efficient heating surface.

The water tubes are formed near their extremities with beads 9 by means of a roller tube expander, which beads acts as shoulders to support the sheets of the tube chamber, and resist the collapse of the same due to the steam

and water pressure between the inner and outer shells. The said vertical tubes 1 may be used exclusively from the back or fire box end as far forward as is desired and set in parallel rows which are spaced longitudinally at suitable distances, and at the back end are spaced diametrically at suitable distances, conforming to the tube chamber and closing in toward the forward end, the tube chamber being smaller at the forward end to increase the draft and the water space and also to obtain sufficient space between the inner and outer shells to allow the movement of the forward head or tube sheet, and accommodate expansion and contraction of the tube chamber, caused by the fire contact with the same and thereby relieve strain on the seams in the fire box. The forward head may be stayed to the inner shell by means of longitudinal braces 10. The middle rows of vertical tubes may be extended below the bottom sheet of the tube chamber as far as desired to pick up a lower strata of water and increase the circulation of the same. From the point where the angular tubes are desired they will alternate with the vertical tubes, that is, a row of vertical tubes is first arranged, a succeeding row of diagonal or angular tubes, another row of vertical tubes, and a further row of diagonal or angular tubes extending across in a direction opposite to the first named diagonal or angular tubes, and so on in succession. The spaces between parallel rows of the diagonal or angular tubes in the side sheets may be stayed by the employment of any suitable brace or reinforcing device.

By means of pipes 11 from the forward end of the smoke arch, as shown in Fig. 1, which are supplied near their forward extremities with automatic valves 12, hot air or steam may be admitted to form blowers to elongate the flame and continue the combustion of the gases. The said pipes are carried back toward the fire box as far as desired, and fitted with a return bend 13 with a small opening therein for the passage therethrough of air or steam; whichever may be used to promote combustion of the gases. When running at a high rate of speed a sufficient amount of air will pass in through the said pipes to give the required amount of draft by the discharge of hot air, which is materially facilitated by forming or providing the outer or front ends of the said pipes with funnel shaped openings, as at 14.

A pipe 15, as shown in dotted lines in Fig. 1, may be used from inside of outer shell to direct the feed water after passing through the check valve, throwing it upward, and either forward or back and away from the inner shell to catch the downward circulation, thereby avoiding the precipitation of sediment on the inner shell at the feed point.

As is plainly seen, this device can be adapted to any ordinary locomotive boiler by removing the tubes and tube sheets, and supplying the tube chamber filled with transverse tubes and heads flanged to conform to said tube chamber, except in case where a new fire box or crown sheet is put in, or radial stay fire box is used, in which case the forward end of the fire box may be made to conform to the back end of the tube chamber and thereby avoid the necessity of using the back head, except from the bottom tube chamber down to form water leg in front of the fire box. The tube chamber or inner shell 13 carrying the water tubes is supported to avoid vibration, by means of braces 16 connected to the outer shell by rivets which can be readily put in after the inner shell is in position.

Any vertical tube back of where the diagonal or angular tubes begin can be renewed through the top or inside of chamber by bending the same slightly and passing through the top hole, then straightening and rolling from the top end by means of a sectional pin for the expander.

Any of the tubes in advance of the diagonal or angular tubes, that is, in advance of the point where the latter are located, may be renewed by a sectional tube formed with threads attachably or detachably arranged, whereby the parts thereof may be separated or connected at will for convenience in positioning the same properly within the tube chamber.

One of the said tubes is fully shown in Fig. 6 and is adapted to be placed in position from the outer part of the inner shell by successively attaching the series of sections of which it is composed and working it through in its proper position, and may be rolled from either end.

Water and steam spaces 17 surround the tube chamber and fire box, and 18 designates a steam dome having a dry pipe 19 leading therefrom.

By means of washout plugs 20 placed in the forward head, or outer shell, the tube chamber and every tube can be readily reached by hose to be washed out. The upper part of the tube chamber is readily accessible for repairs and purposes of cleaning through the dome when the cap thereof is removed, which can be effected in any of the usual ways.

It will be seen by the arrangement of transverse, vertical and diagonal or angular water tubes, as set forth, that a much larger extent of available heating surface is had than has hitherto been obtained in locomotive engines, or in boilers of that character, allowing material increase in the size of the steam exhaust, and thereby reducing the back pressure and increasing the efficiency of the engine.

The action of the fire in the improved form of boiler in passing through between the tubes and coming in contact with and passing around each one separately enables a thorough utilization of the fire and consumption of the gas before it reaches the forward end of the boiler, whereas in the ordinary boiler

the gas passes directly through the flues and a large percentage escapes unconsumed through the stack.

The tubes employed in the form of boiler set forth being short in comparison with the longitudinal tubes hitherto used, the expansion and contraction of the same, due to changes of temperature, is proportionately reduced, and the fire contact being the same on the tube chamber as on the tubes, the expansion and contraction on the chamber should be the same as on the tubes. Hence, there is nothing to loosen the tubes in the holes in the sheets, and the pressure being on the inside of the tubes, instead of on the outside, as in the ordinary type of boiler, will have a tendency to keep them tight rather than to make them leak, consequently, they should run longer without repairs and the life of the boiler be proportionately lengthened.

As shown in Fig. 4, a slight modification in the construction of the tube chamber is shown, and in this form the side sheets at the point from which the diagonal or angular tubes are located are flattened to an octagon shape. In this instance the suspending stays are also employed and fully shown.

If desired, the side sheets of the tube chamber may be strengthened by means of angle or T-irons 22, riveted to the outside of the same, with washers 21 between to allow the circulation of water, or the said sheets may be corrugated.

The device can be applied to any boiler at about the same cost as a new set of tubes, the tube ends being all submerged. No safety fire ends or special grade of tubes is required. This device is applicable to either locomotive, marine, or stationary service.

This invention also constitutes an improvement on Patent No. 483,473, granted to me September 27, 1892.

It has been demonstrated by experiment that the best results are obtained by extending the water tubes throughout the entire length of the tube chamber in the vertical and diagonal disposition shown in the forward end thereof, and in practice such construction will be carried out, but if preferred, the diagonal tubes may be omitted at any desired point, as shown in the rear portion of the tube chamber in Fig. 1. In this construction the side sheets of the inner shell must be braced to prevent their collapse. No such provision is necessary where the tubes extend throughout the length of the tube chamber alternately in vertical and diagonal relation as previously intimated.

Having thus described the invention, what is claimed as new is—

1. In a locomotive steam engine or other boiler, the combination with a fire box, of a tube chamber, a series of vertical and diagonal water tubes, the latter disposed in alternation with the said vertical tubes, the successive series of diagonal tubes being arranged in reverse directions substantially as and for the purpose specified.

2. In a locomotive steam engine or other boiler, the combination with a fire box, of a tube chamber having flat top and bottom sheets, and outwardly deflected sides, of a vertical series of water tubes bracingly attached at their ends to the said top and bottom sheets, and a series of diagonal water tubes attached bracingly at their ends to the outwardly deflected sides, the diagonal tubes being reversely disposed in succeeding order and having a vertical series of tubes arranged between them, substantially as described.

3. In a locomotive steam engine or other boiler, the combination with a fire box, of a tube chamber composed of two or more overlapping sheets of metal, said tube chamber being flat at the top and bottom and deflected outward at opposite sides, and having its upper surface a continuation of the crown sheet of said fire box and nearly on an elevation with the same and communicating at one end with the fire box and at the other end with the smoke arch, and a series of vertical and diagonal water tubes, the diagonal tubes being reversely disposed and interspersed with the vertical tubes, which latter are bracingly attached at their ends to the said flat top and bottom, substantially as specified.

4. In a locomotive steam engine or other boiler, the combination with a fire box, of a tube chamber, a series of water tubes arranged therein in vertical and transverse angular positions, of pipes entering the said tube chamber for the admission of air or steam to aid combustion and automatic valves in the outer portions of said pipes, substantially as and for the purposes specified.

5. In a locomotive steam engine, or other boiler, the combination with a tube chamber, of pipes entering the same and having automatic valves in their outer portions and return bends at their inner portions, the said return bends having openings therein for the admission of smoke consuming jets into the tube chamber, substantially as and for the purposes specified.

6. In a locomotive steam engine or other boiler, the combination of a fire box, a tube chamber having its surface a continuation of the crown sheet of said fire box and substantially on a level with the same and communicating at one end with the fire box and at the other end with the smoke arch, water tubes arranged vertically and diagonally or angularly in transverse directions, and an end head or sheet at each end of the tube chamber to connect the same with the fire box and outer shell, the forward end being provided with wash-out holes for the removal of sediment, and the said water tubes being provided near their extremities with beads or shoulders, substantially as and for the purposes specified.

7. In a locomotive steam engine or other boiler, the combination with a fire box, and a tube chamber having its bottom side flattened, of a vertical series of water tubes bracingly attached at their lower ends to the flattened bottom of the tube chamber, the end tubes terminating about flush with the said flattened bottom, and the intermediate tubes projecting a short distance beyond the flattened bottom into the water space, substantially as described, for the purpose set forth.

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

GEORGE J. PERKINS.

Witnesses:
CHAS. S. HYER,
AUGUSTUS P. SCHELL.