(No Model.) 6 Sheets—Sheet 1.

G. LENTZ.

STEAM BOILER.

No. 481,796. Patented Aug. 30, 1892.

FIG. 1.

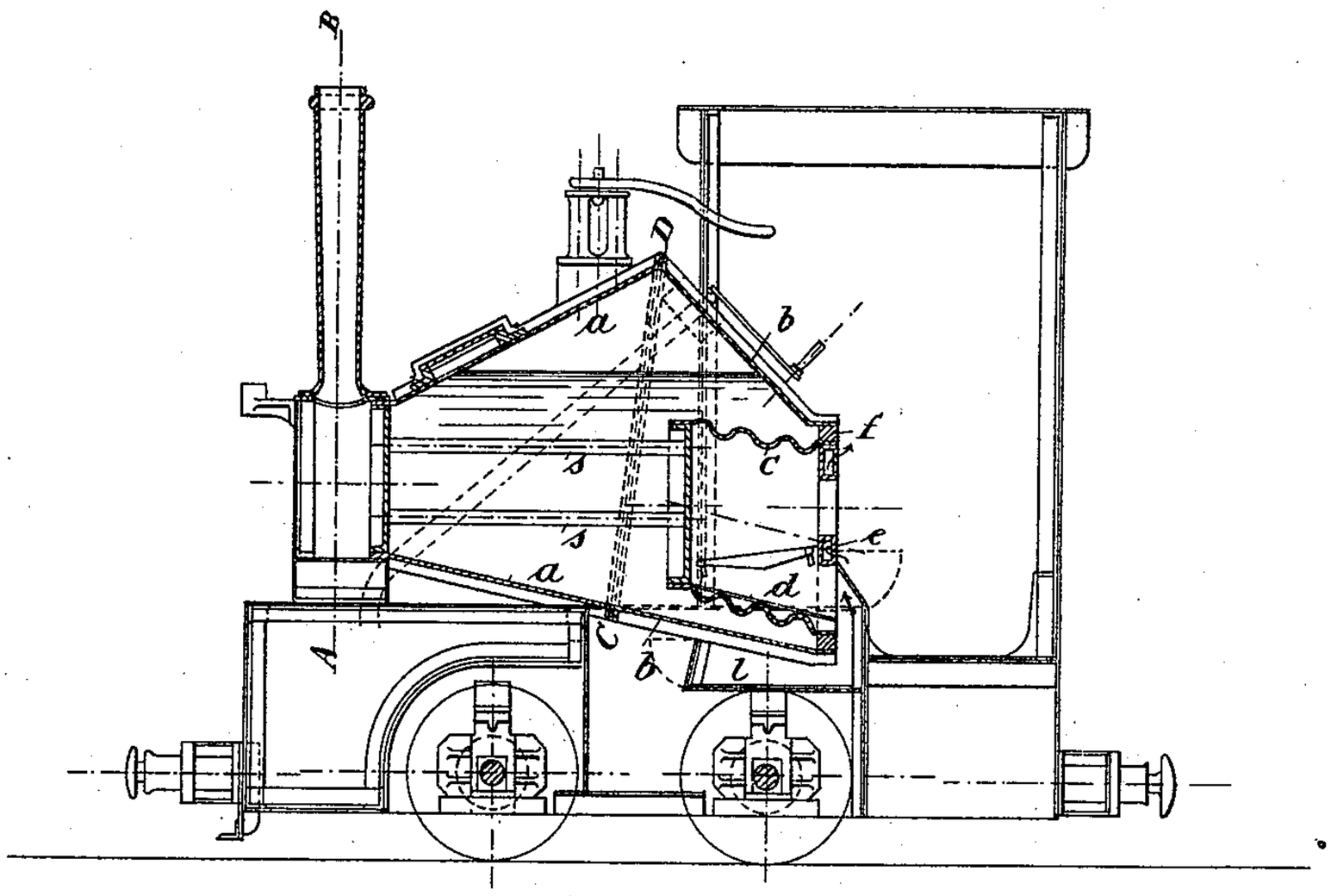
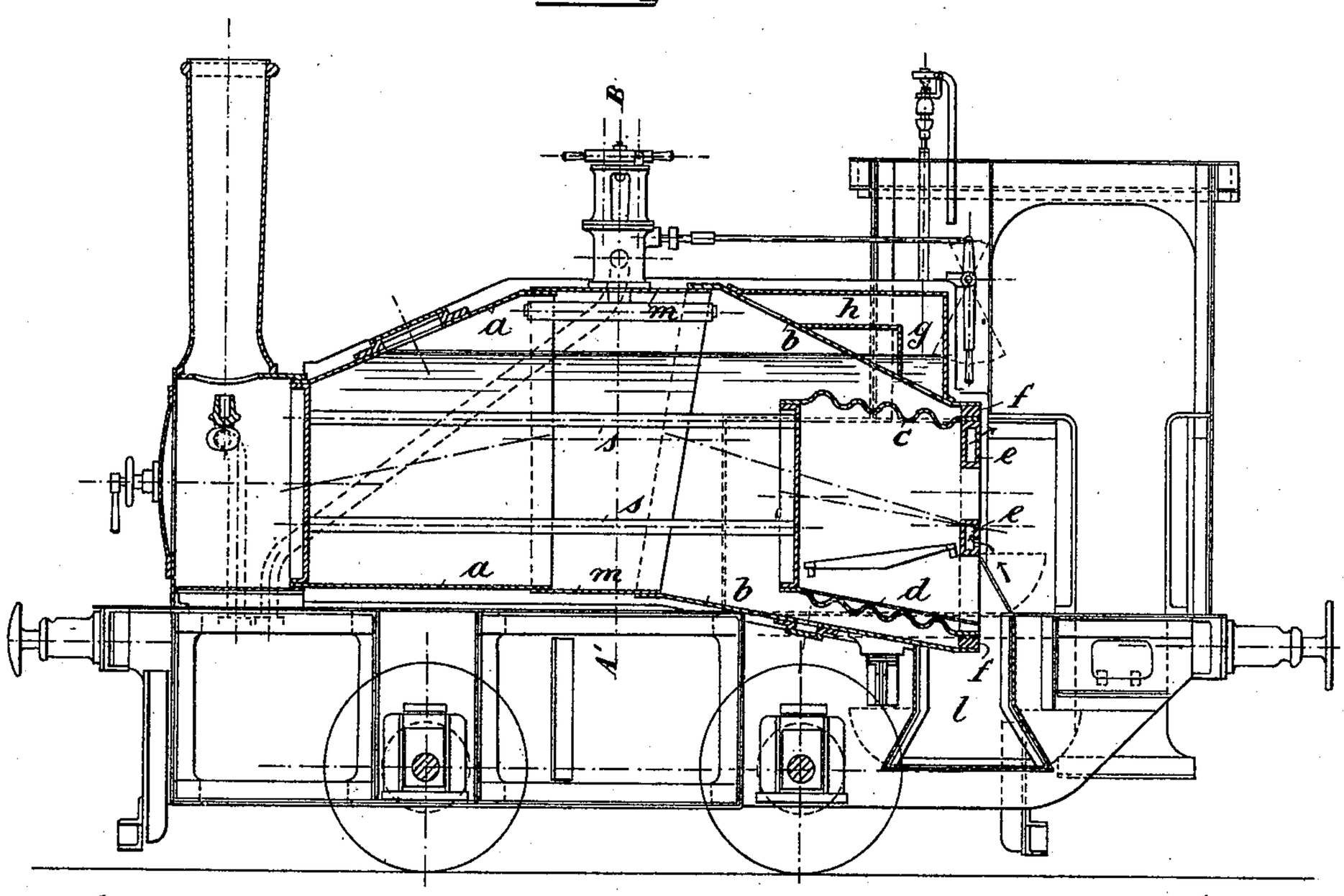


FIG. 4.



Witnesses.
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A. D. Weaver

Inventor.
Gustav Lentz
per Henry A. Wh
Atty

(No Model.) 6 Sheets—Sheet 2.

G. LENTZ.

STEAM BOILER.

No. 481,796. Patented Aug. 30, 1892.

Fig. 2.

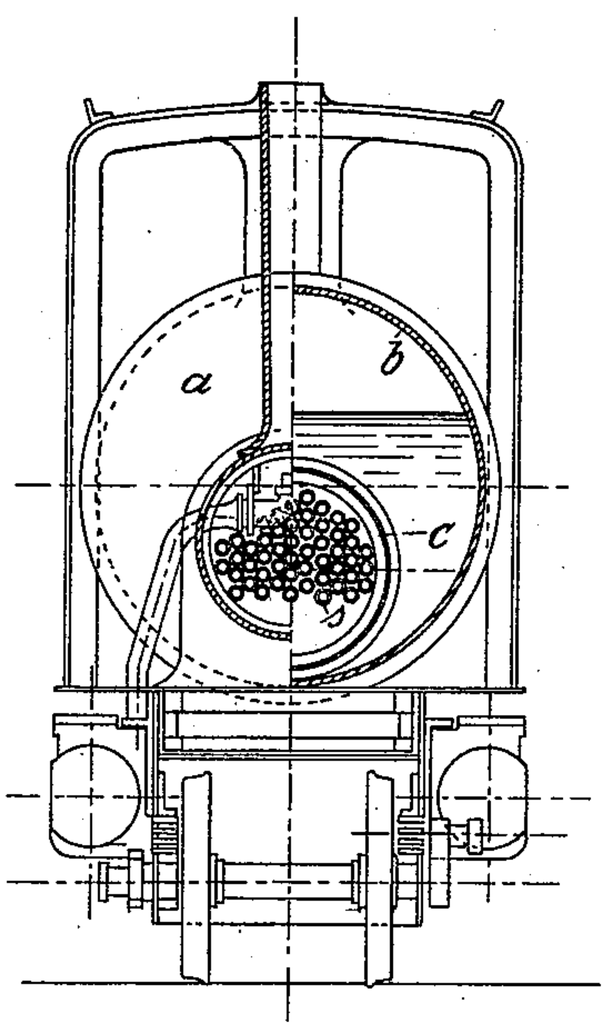


Fig. 3.

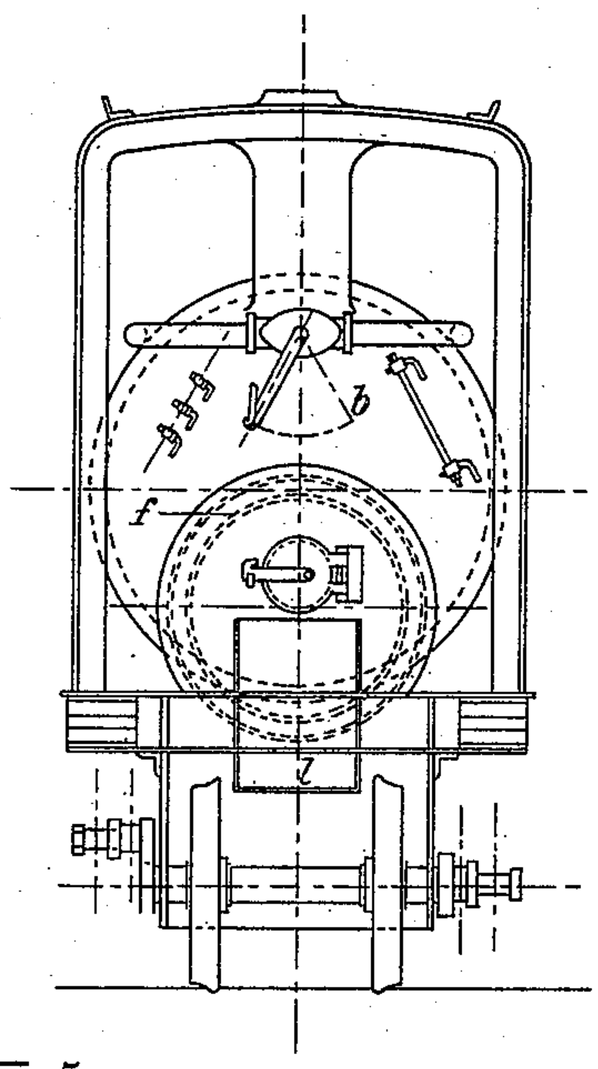
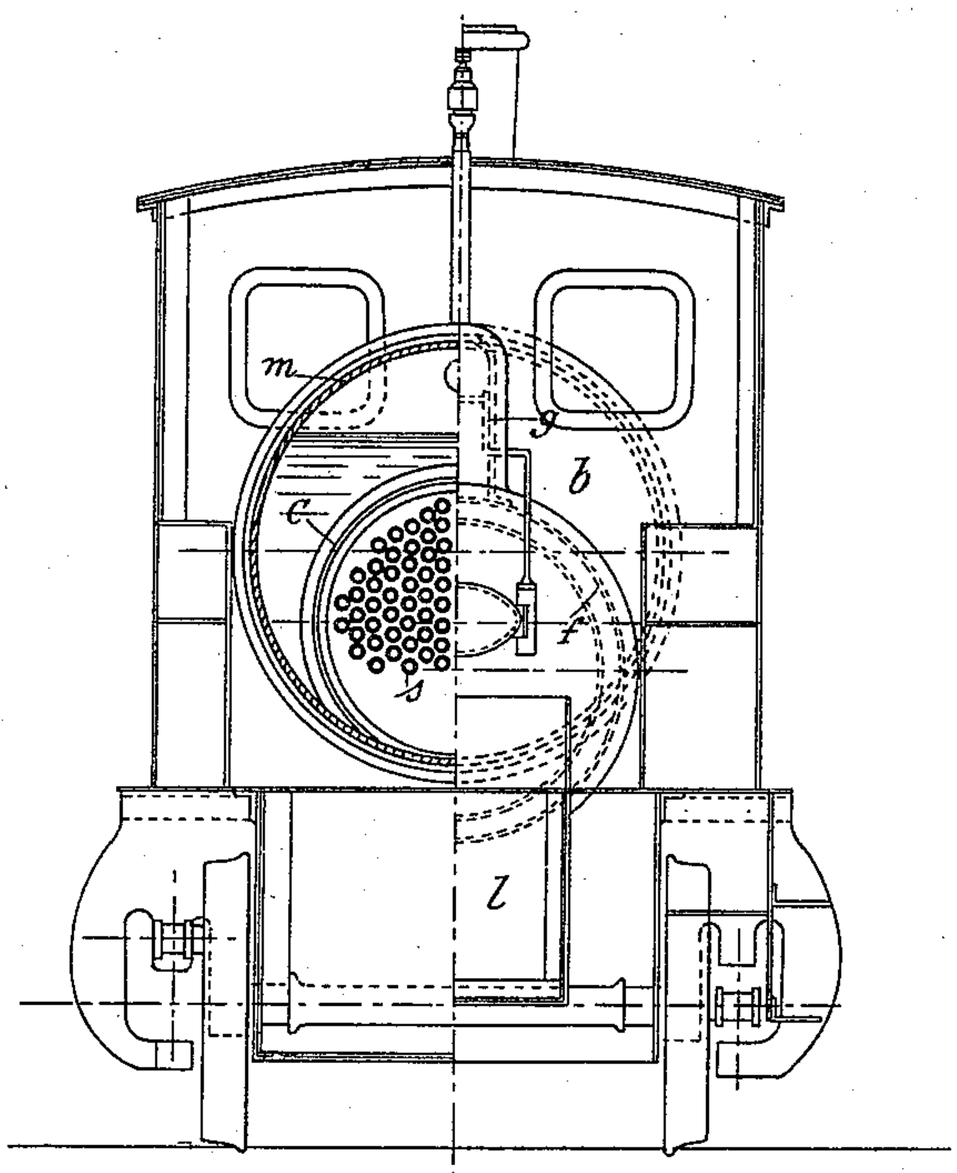


Fig. 5.



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(No Model.) 6 Sheets—Sheet 3.

G. LENTZ.

STEAM BOILER.

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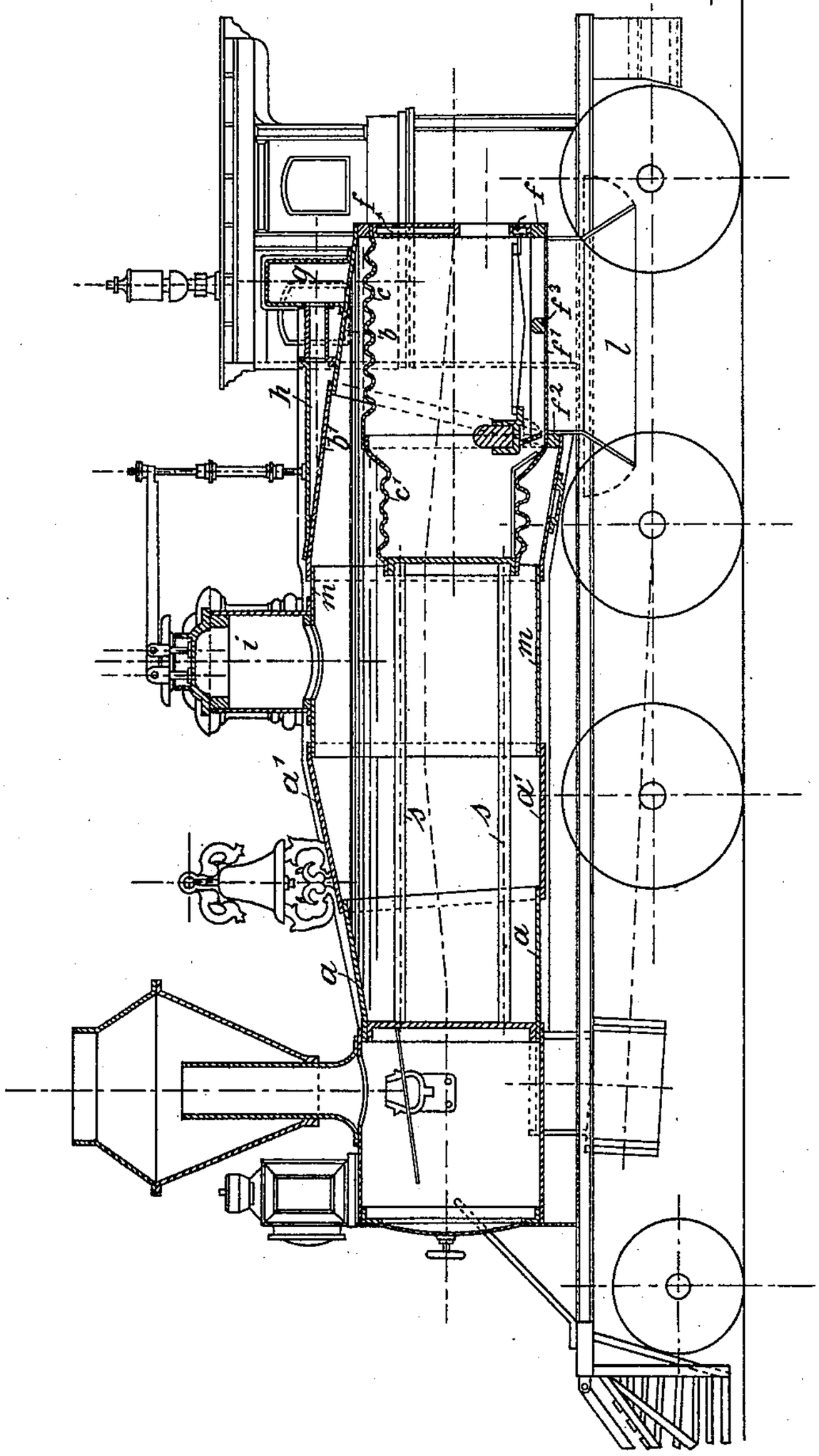
FIG. 6.



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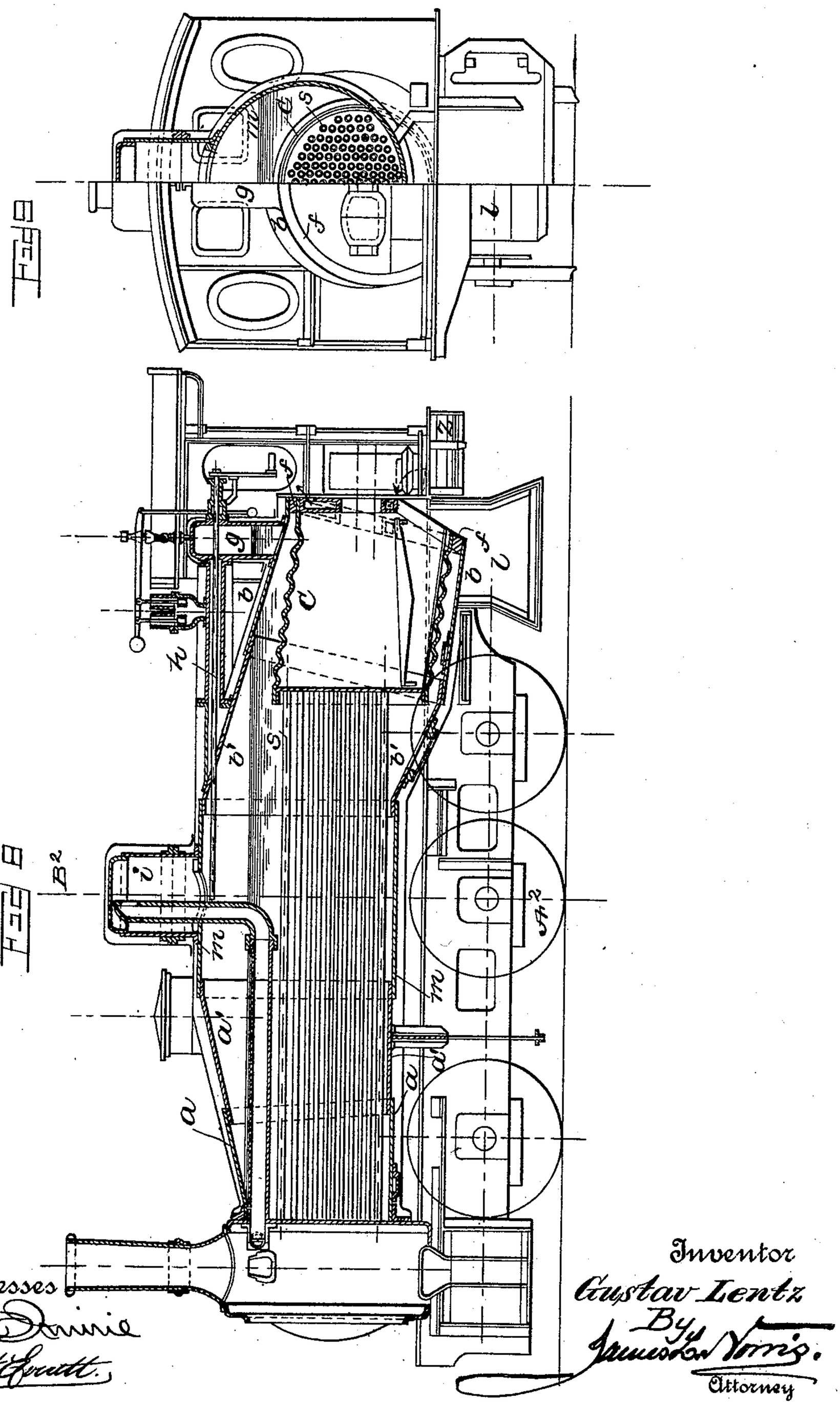
(No Model.) 6 Sheets—Sheet 4.

G. LENTZ.

STEAM BOILER.

No. 481,796. Patented Aug. 30, 1892.



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STEAM BOILER.

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FIG. 10.

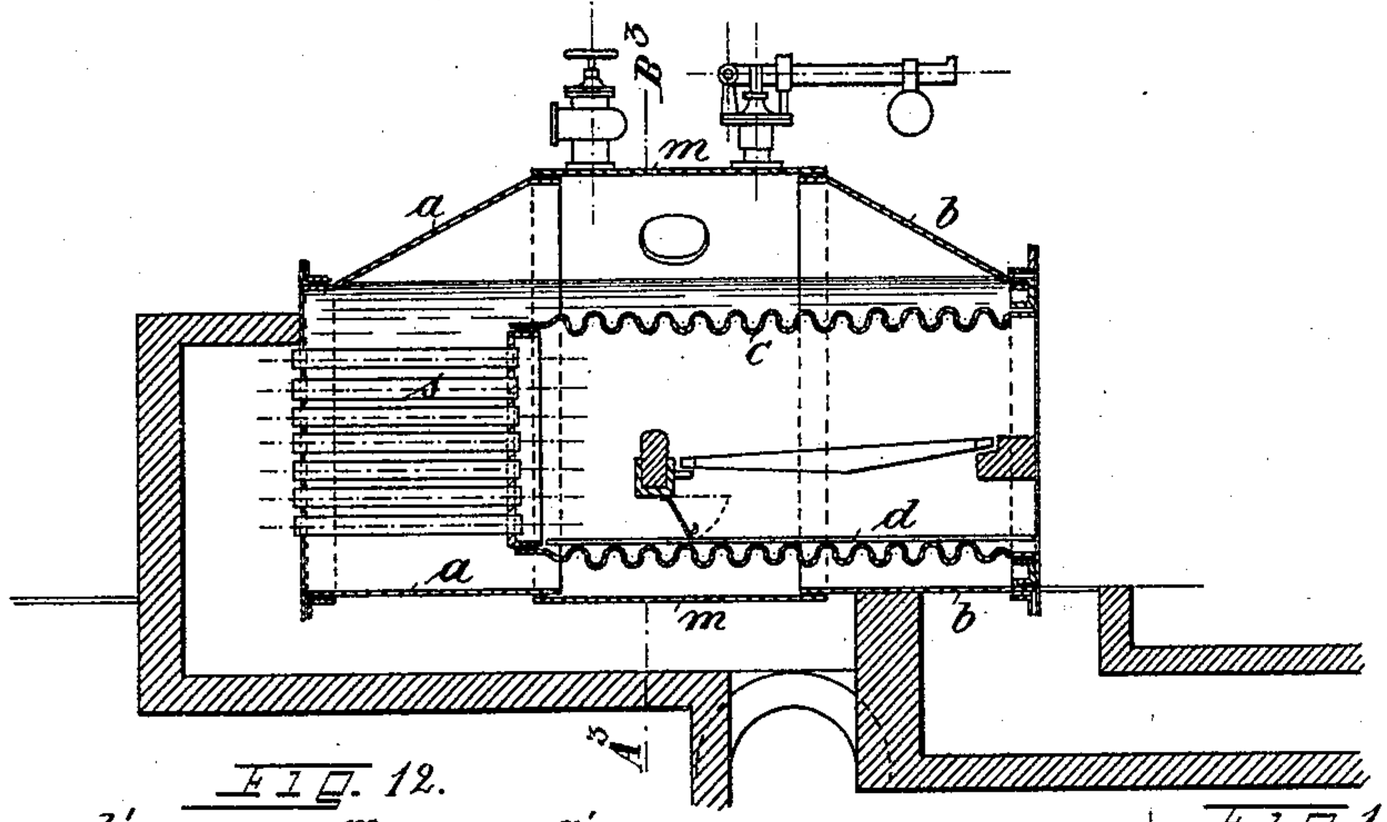


FIG. 12.

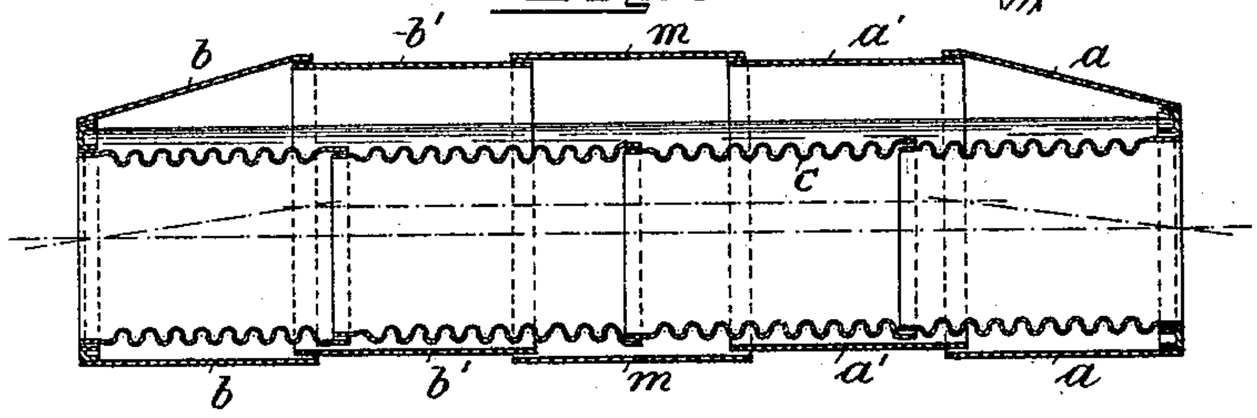


FIG. 13.

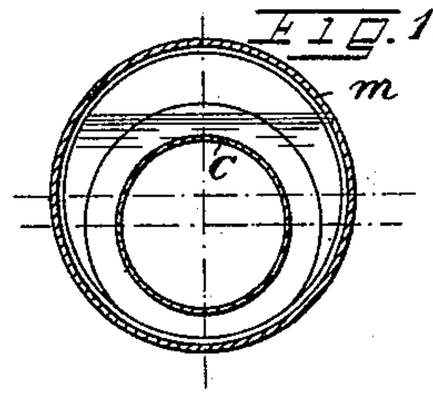


FIG. 14.

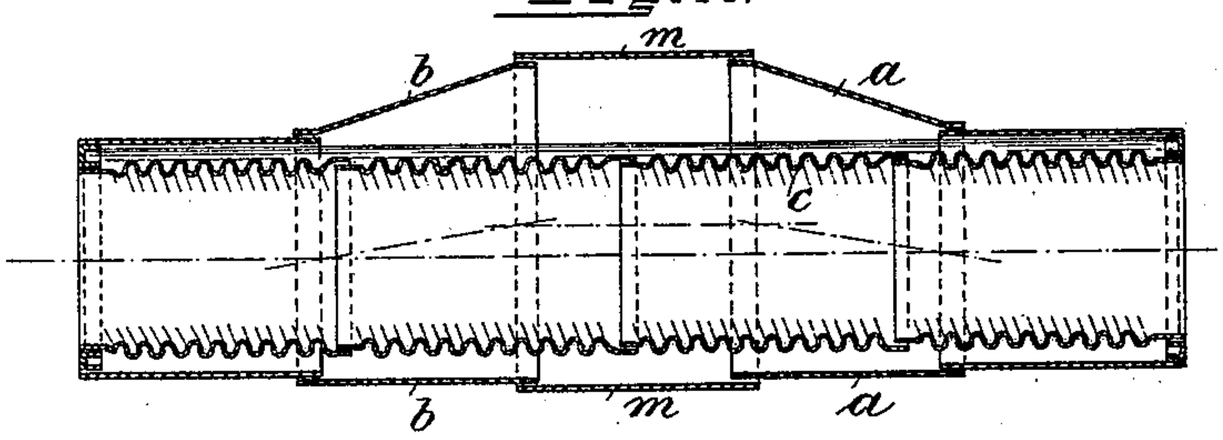


FIG. 15.

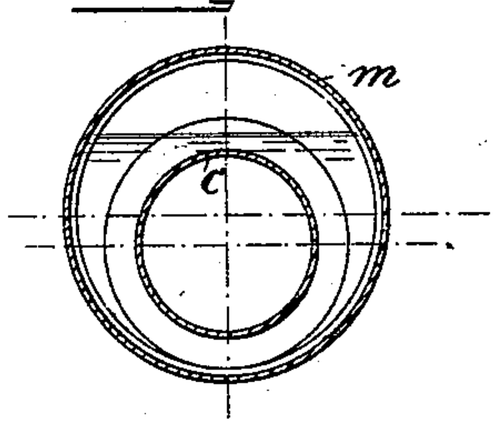


FIG. 16.

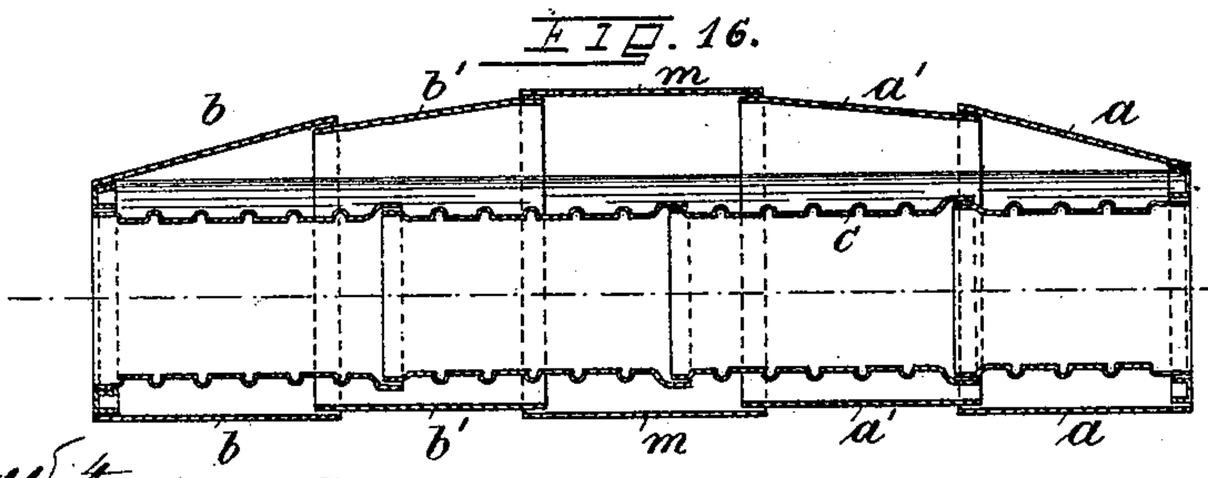
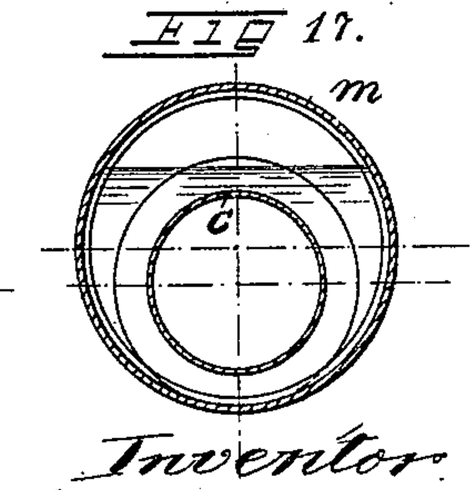


FIG. 17.



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(No Model.) 6 Sheets—Sheet 6.

G. LENTZ.

STEAM BOILER.

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FIG. 11.

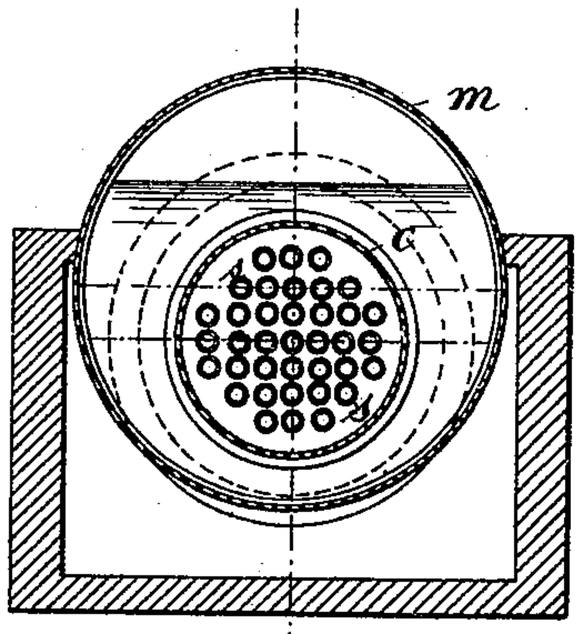


FIG. 18.

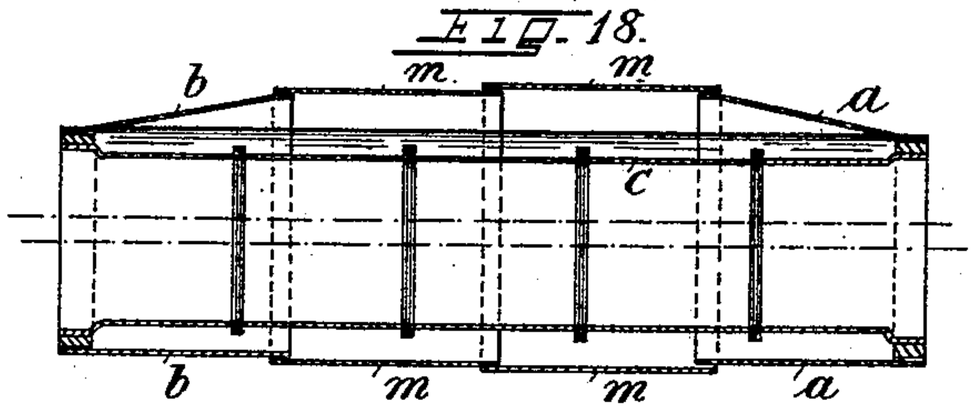


FIG. 19.

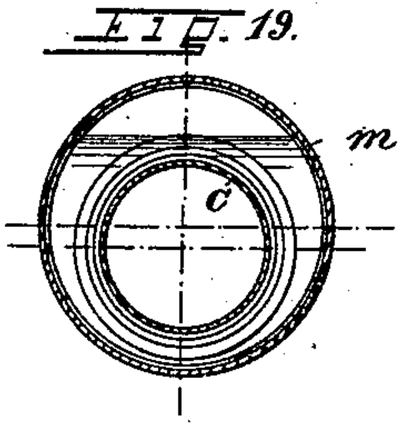


FIG. 20.

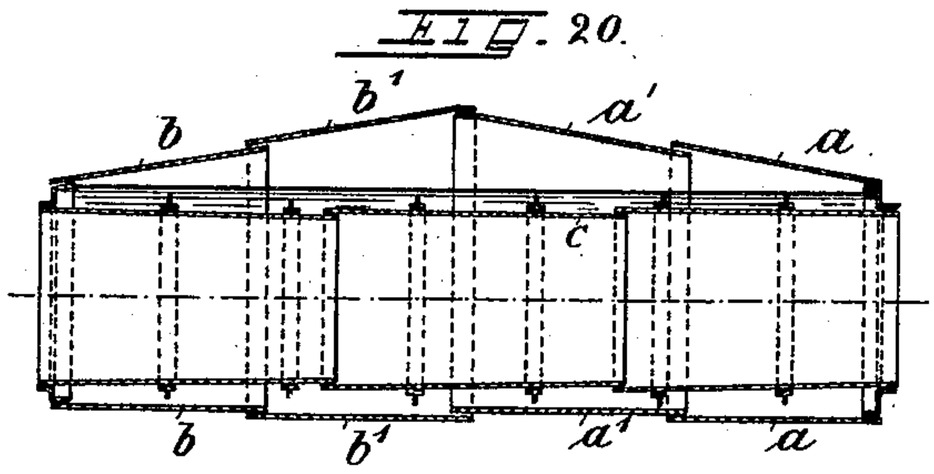


FIG. 21.

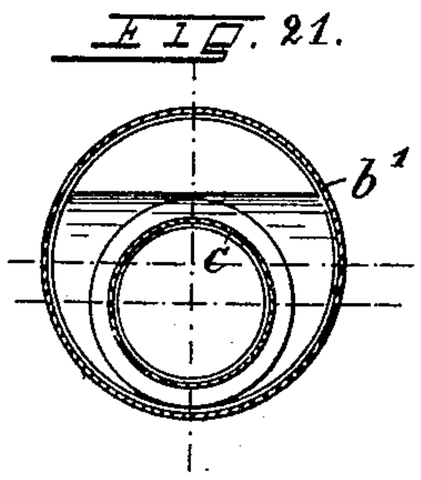


FIG. 22.

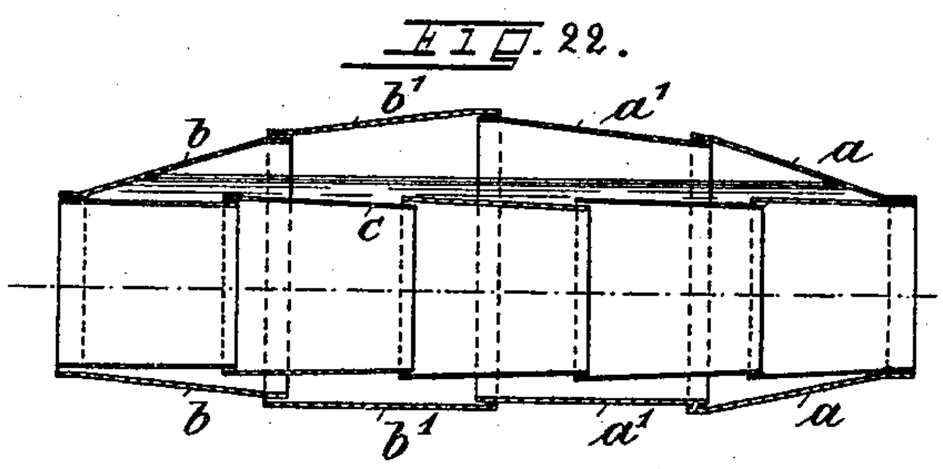
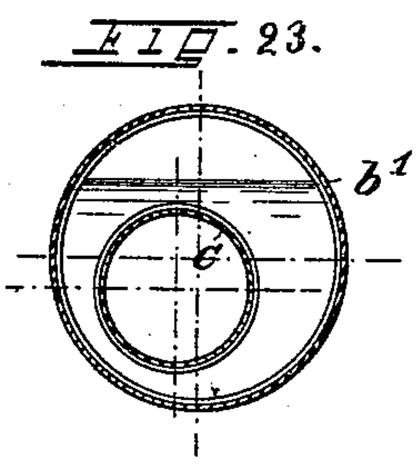


FIG. 23.



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UNITED STATES PATENT OFFICE.

GUSTAV LENTZ, OF DUSSELDORF, GERMANY.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 481,796, dated August 30, 1892.

Application filed October 2, 1889. Serial No. 325,811. (No model.) Patented in England August 20, 1889, No. 13,107; in Sweden August 20, 1889, No. 2,291; in Germany August 20, 1889, No. 51,028; in France August 20, 1889, No. 200,308; in Switzerland August 20, 1889, No. 1,416; in Belgium August 21, 1889, No. 87,453; in Italy September 30, 1889, XXIII, 26,032, LI, 422; in Austria-Hungary December 19, 1889, No. 36,269 and No. 63,628, and in Russia July 12, 1891, No. 7,692.

To all whom it may concern:

Be it known that I, GUSTAV LENTZ, civil engineer, a subject of the King of Prussia, residing at Dusseldorf, Prussia, German Empire, have invented certain new and useful Improvements in Steam-Boilers, (for which I have obtained Letters Patent in England, No. 13,107, dated August 20, 1889; in Sweden, No. 2,291, dated August 20, 1889; in Germany, No. 51,028, dated August 20, 1889; in France, No. 200,308, dated August 20, 1889; in Switzerland, No. 1,416, dated August 20, 1889; in Belgium, No. 87,453, dated August 21, 1889; in Italy, XXIII, 26,032, LI, 422, dated September 30, 1889; in Austria-Hungary, No. 36,269 and No. 63,628, dated December 19, 1889, and in Russia, No. 7,692, dated July 12, 1891;) 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, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

Referring to the drawings, Figure 1 represents a longitudinal section of a locomotive-engine for narrow-gage railways and having a boiler constructed according to my invention. Fig. 2 is a cross-section, partly on line A B and partly on line C D, and Fig. 3 is an end view, of the same. Fig. 4 is a longitudinal section, and Fig. 5 is an end view, half in section, on line A′ B′ of Fig. 4, showing my invention applied to a locomotive-engine for a broader-gage railway. Fig. 6 is a longitudinal section, and Fig. 7 is an end view, of a heavy locomotive-engine, showing my invention applied thereto. Fig. 8 is a longitudinal section, and Fig. 9 is an end view, half in section, on line A^2 B^2 of Fig. 8, of another form of heavy locomotive-engine, illustrating the application of my improvements thereto. Figs. 10, 12, 14, 16, 18, 20, and 22 are longitudinal sections showing the application of my invention to stationary boilers. Figs. 11, 13, 15, 17, 19, 21, and 23 are respectively cross-sections of the same.

The invention relates to that class of locomotive or other steam boilers which are provided with an internal fire-box.

The object of the invention is not only to avoid the use of stay-bolts by means of which the fire-box is usually secured to the waist or barrel, but also to provide a construction of boiler so combined with the tubes or flues and fire-box as to materially increase the strength of the boiler, on the one hand, and to provide a steam-space centrally of the boiler the area of which gradually diminishes toward the ends thereof. To these ends I construct the boiler of sections having substantially the form of a truncated cone and assemble the same so that the bottom or base of the boiler will be substantially horizontal, while the top will form a continuous arch from the longitudinal center or about the longitudinal center of the barrel or shell to the smoke-box and rear end of the boiler, respectively, and I secure the fire-box to the inner flue-sheet and rear end of the boiler and the outer flue-sheet to the front end of said boiler, so that said fire-box and the flues will form a longitudinal truss or brace for the shell, whereby the strength thereof is materially increased and the use of the usual stay-bolts avoided.

In practice I prefer to employ a circumferentially-corrugated fire-box, with a view to compensating contraction and expansion, and construct the said fire-box in the form of a truncated cone or of truncated-cone sections, the base of which may be horizontal or inclined, according to the general arrangement of the grate and ash pit or pan, or said fire-box may be of uniform diameter throughout its length.

In practice I form the rear boiler-head of a hollow ring provided with ports for the circulation of air; but that my invention may be fully understood I will now describe the same in detail, first referring to Figs. 1, 2, and 3.

The boiler consists of two sections or plates *a* and *b* of tension equilibrium, and each having the form of a conoidal or conical tube, the two tubes being connected together at their bases, so that the upper part of the boiler-shell inclines downward from the middle portion toward the ends, while the under

part of the boiler-shell is straight, but having a downward inclination from front to rear. The end plate of the boiler is formed of a flat iron ring *f*, to which one end of the fire-box *c* is secured, the said fire-box having substantially the same inclination as the bottom of the boiler, and below the grate I arrange an inclined plate *d*, from which the ashes will be automatically discharged into the ash-pan *l* when the locomotive is in motion, so as to leave the air-space underneath the grate always clear. The fire-box is provided with a hollow cast-iron plate *e* to assist the passage of air to the grate. The other end of the fire-box is connected with the tube sheet or plate *s*, which, together with the ring *f*, constitutes the only support for the fire-box, which will be found sufficient, and as neither stay-bolts, screws, nor analogous fastenings are required all danger of leakage from this source is avoided.

By connecting the fire-box with the boiler-flues I provide a firm and sufficient longitudinal brace or stay for the boiler-heads.

In Figs. 4 and 5 I have shown a boiler substantially like that described in Figs. 1 and 2, except that the boiler-sections are connected at the base of the conoidal or conical tubes to an intermediate cylindrical section *m* and that said boiler has a steam-dome at its rear end. The steam-dome consists of a pipe *g*, connected with the steam-space of the boiler by a pipe *h*.

In the heavier form of locomotive-engines (illustrated in Figs. 6, 7, 8, and 9) the boiler is composed of four conoidal or conical tubes *a a' b b'*, the cones *a' b'* being connected to the cylindrical central section *m*, which carries the steam-dome *i*. As in the engines shown in Figs. 4 and 5, a small or auxiliary steam-dome *g* is fitted over the fire-box and is connected with the highest part of the steam-space of the boiler. By reason of the inclined form of the upper part of the boiler-shell the steam always rises toward the middle part and into the dome *i* and the regulator, whether the locomotive is running up or down a grade, and the water is entirely prevented from adhering, as the steam-space is large and the water is not near to the dome. The result is that perfectly-dry steam is obtained and a saving in feed-water and fuel thereby effected. The boiler, also, can be kept cleaner than an ordinary boiler, as it is easily accessible from above as well as from below, and for periodical inspections, when the boiler-tubes are taken out, no stay-bolts or the like need be destroyed or taken out, it being only necessary to remove the rivets in the flat iron ring and perhaps in the bottom ring.

In Figs. 6 and 7 the end ring *f* is similar to that in the Belgian locomotives and is connected to a bottom ring *f' f²*, having a cross-bar *f³*, in order to support the ash-pan *l* in its proper place. The rear portion *c* of the fire-box is therefore not cylindrical, but is joined at the lower end to the part *f'* of the bottom ring, and only the fore part of the fire-box is cylindrical.

In Figs. 8 and 9 is shown another form of end ring which can be employed for altering existing boilers where no space is provided for the air-current through the ash-pan. In this case the end ring *f* is of an inclined form, as indicated by dotted lines, so as not to obstruct the air-passage *z*. This would of course cause the fire-grate to be rather smaller; but I can obviate this, if necessary, by using a bent ring, as shown in full lines in section, instead of the straight ring shown in dotted lines, the fire-door then retaining its usual position.

The hereinbefore-described auxiliary steam-dome connected by a pipe with the middle steam-space of the boiler is especially advantageous when applied to locomotive-boilers or boilers for torpedo-boats, steam-road boilers, and other locomotive-engines.

In the stationary boiler shown in Fig. 10, which is a longitudinal section, and in Fig. 11, which is a transverse section on the line $A^3 B^3$ of said Fig. 10, the upper part is formed, as hereinbefore described, inclined downward from the middle toward the ends. The same remark applies to the different types of stationary boilers with inside flues illustrated in Figs. 12 to 23. With regard to the latter type of boilers having outer shells of various forms the flue forms the longitudinal stay for the boilers and all end or corner stays are unnecessary. In all of the boilers the outer shell forms, so to speak, an arch or roof, in which the fire-box, in combination with the boiler-tubes or the flue, serves as a stay, while the corrugated fire-box or flue affords the necessary elasticity.

Instead of the corrugated flues referred to plain fire-boxes or flue-sections can be used, as indicated in the stationary boilers shown in Figs. 18 to 23; but the corrugated form of fire-box is preferable.

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

1. In a steam-boiler having an internal fire-box or flue, an outer shell, the two end portions of which are formed as truncated conical or conoidal tubes coextensive in diameter where they are connected together and the smaller ends of which constitute the ends of the shell, substantially as described.

2. In the outer shell of a steam-boiler having an internal fire-box or flue, the combination of a cylindrical part forming the middle portion of the shell with two truncated conical or conoidal tubes coextensive in diameter where they are connected together and having their larger ends joined to the said cylindrical middle part, while their small ends constitute the ends of the shell which receive the boiler-heads, substantially as described.

3. In a steam-boiler having an internal fire-box or flue, an outer shell consisting of the combination of a cylindrical part forming the

middle portion of the shell with two truncated conical tubes coextensive in diameter at their larger ends, where they are joined to the said cylindrical part, while their small ends are directly toward the ends of the shell, substantially as described.

4. In the outer shell of a steam-boiler having an internal fire-box or flue, the combination of a cylindrical part forming the middle portion of the shell with two truncated conical or conoidal tubes coextensive in diameter at their larger ends, where they are joined to the said cylindrical middle part, while their small ends are connected to other cylindrical parts constituting the ends of the shell, substantially as described.

5. A steam-boiler having its outer shell composed of two end portions formed as conical or conoidal tubes to provide a steam-space which is confined to the middle portion of the shell, combined with an auxiliary steam-dome at the rear end of the boiler, which is connected with the said steam-space by a tubular connection, substantially as and for the purposes set forth.

6. In a boiler of the class described, a fire-box or flue constructed of one or more sections having substantially the form in cross-section of the rear end of the boiler, the rear section of the fire-box having an open bottom, in combination with the inner flue-sheet and rear end of said boiler, from which the opposite ends of the fire-box are supported, an ash-pan connected with the open bottom of said rear section of the fire-box, and a cross brace or bar connected with the opposite sides of the open fire-box section and ash-pan, substantially as and for the purposes specified.

In testimony whereof I affix my signature in presence of two witnesses.

GUSTAV LENTZ.

Witnesses:
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A. WÖHRMANN.