(No Model.) 5 Sheets—Sheet 1.

L. DE NAEYER.

HEATING FEED WATER.

No. 370,010. Patented Sept. 13, 1887.

Fig. 1.

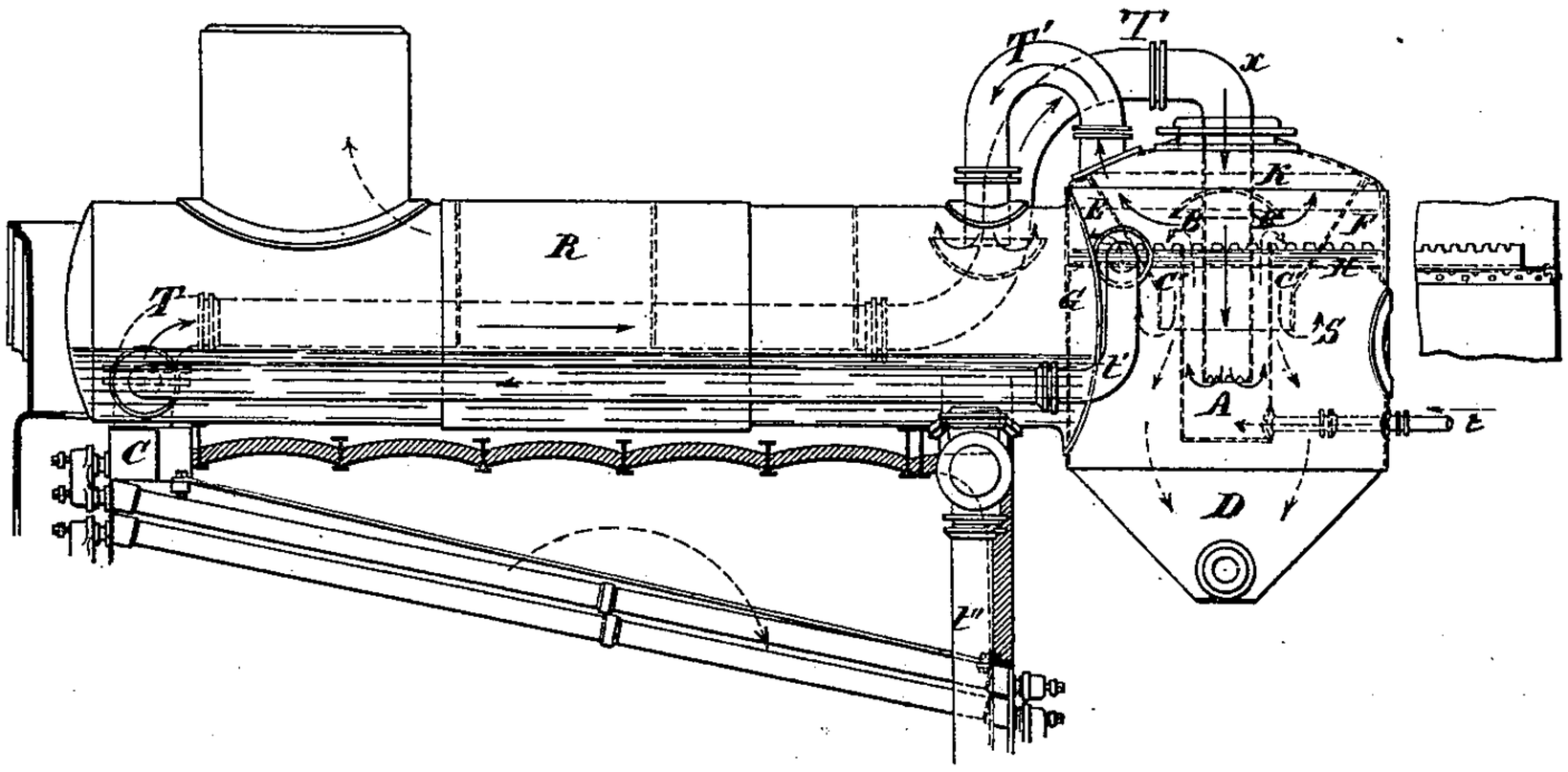
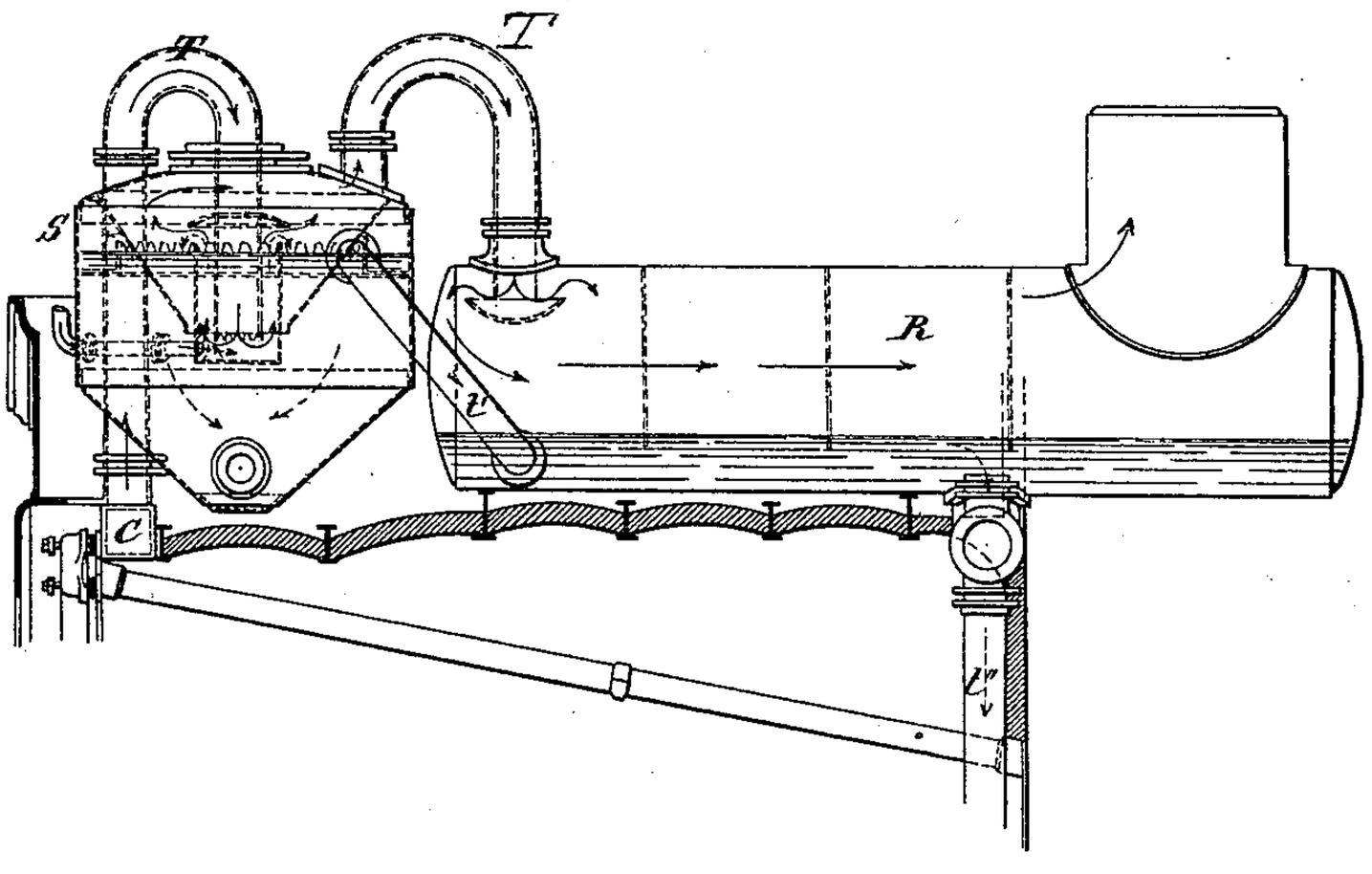


Fig. 2.



Witnesses,
Percy B. Hills,
Robert Everett.

Inventor
Louis De Naeyer,
By James L. Norris.
Atty.

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L. DE NAEYER.

HEATING FEED WATER.

No. 370,010. Patented Sept. 13, 1887.

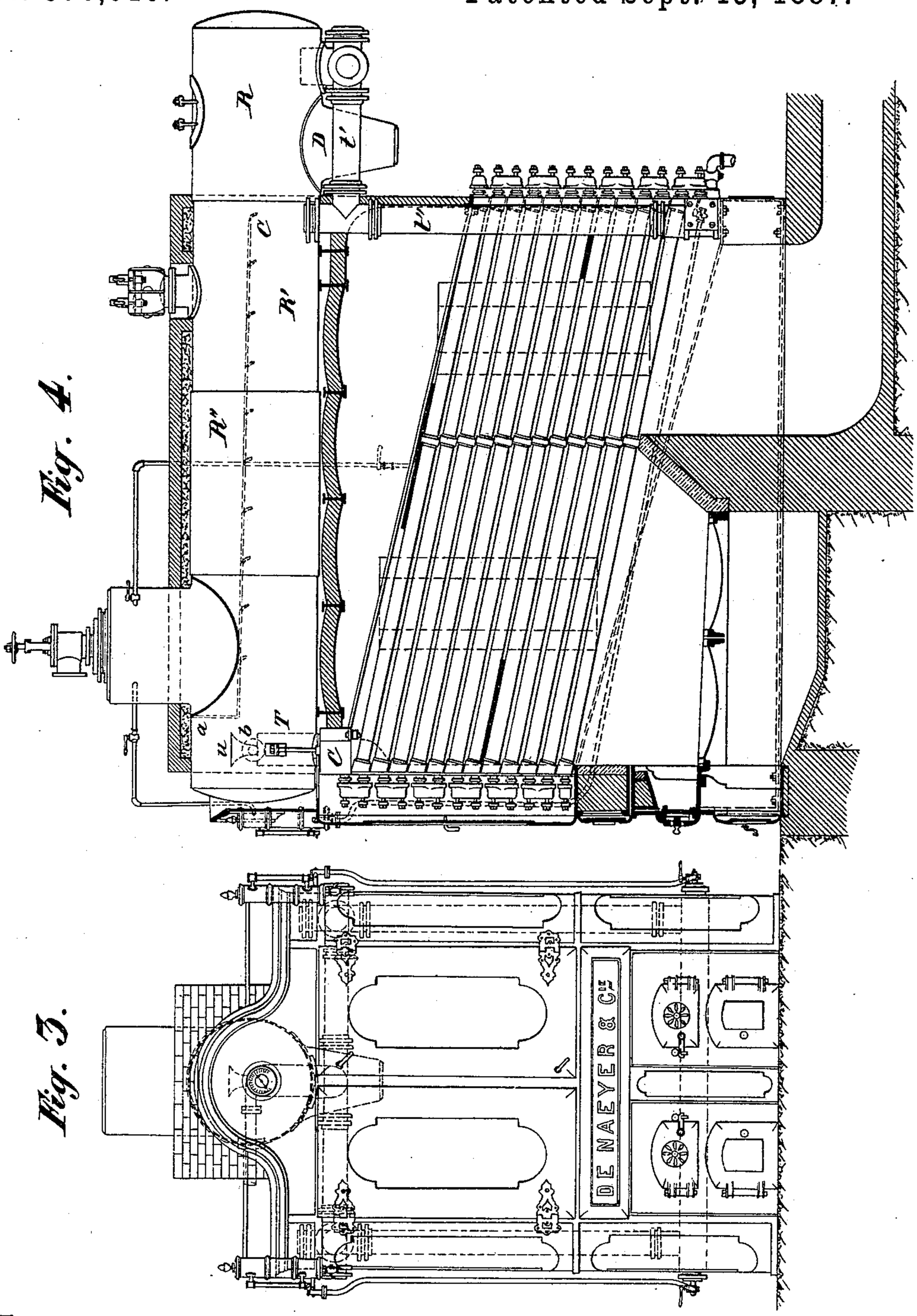

Fig. 4.

Fig. 3.

Witnesses.
Geo. B. Steele
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5 Sheets—Sheet 3.

L. DE NAEYER.

HEATING FEED WATER.

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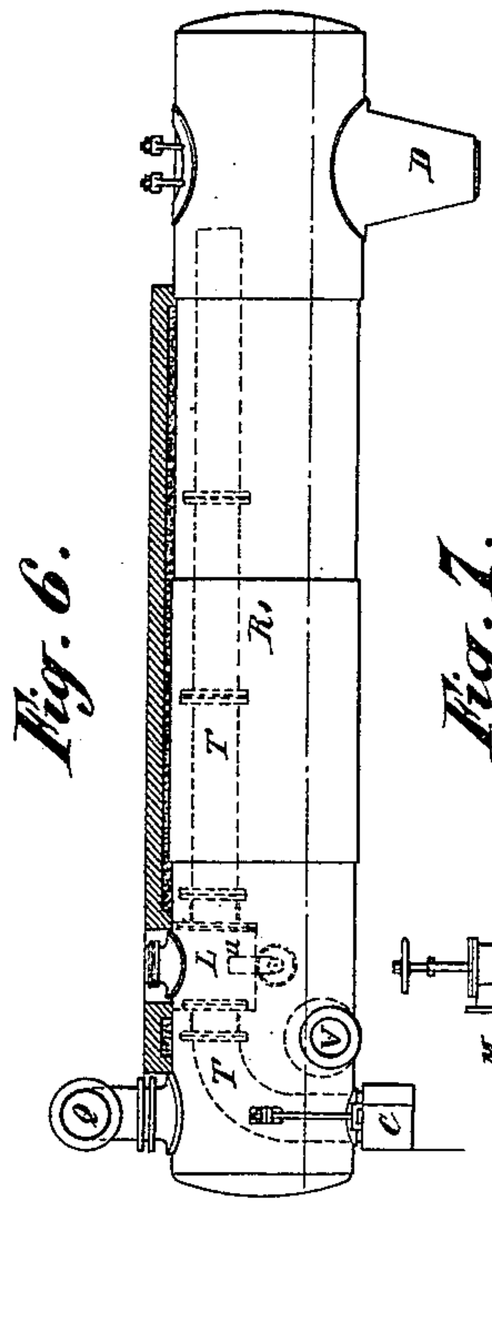

Fig. 6.

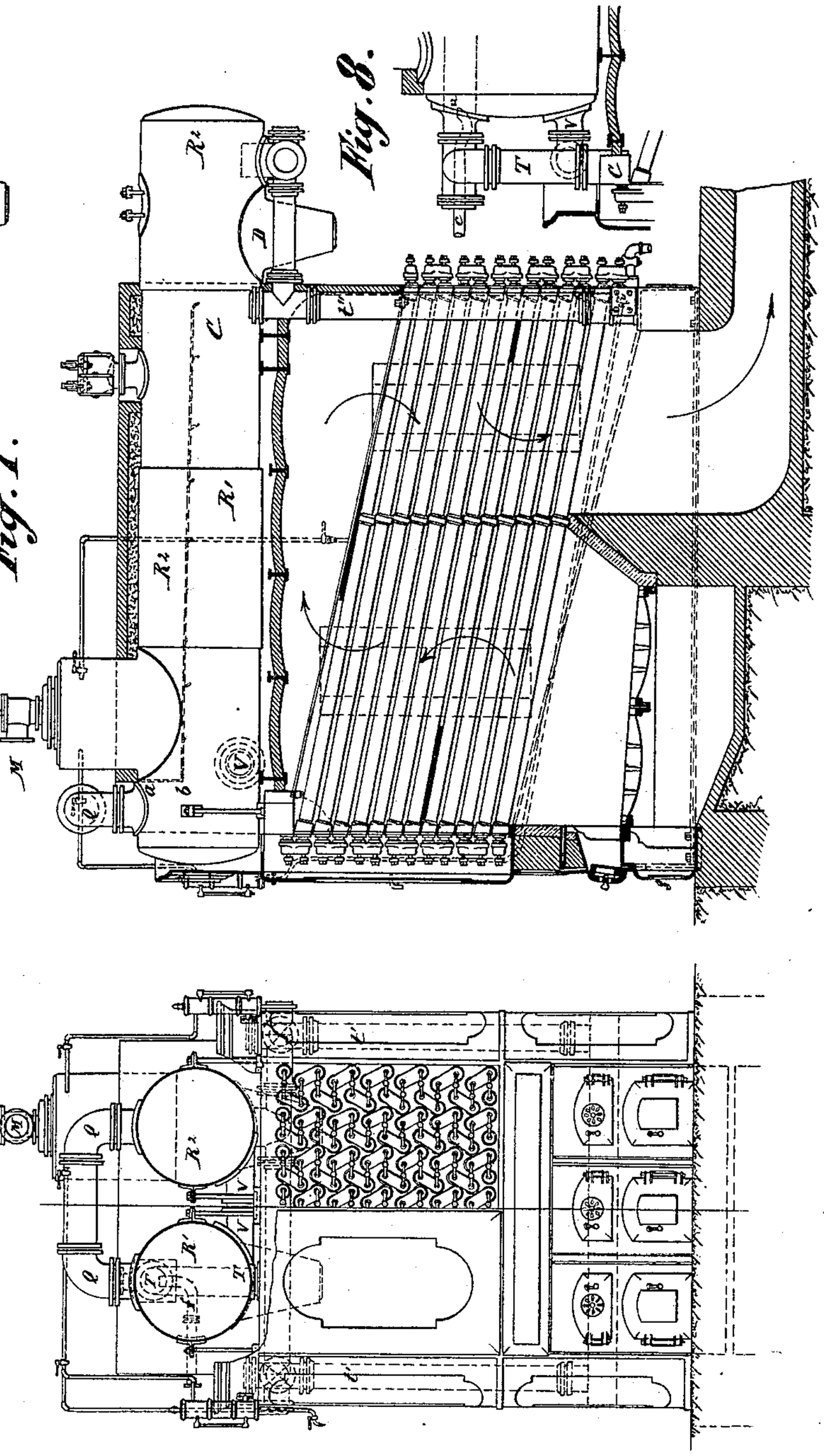

Fig. 7.

Fig. 5.

Witnesses.

Percy B. Hills.

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(No Model.) 5 Sheets—Sheet 4.

L. DE NAEYER.

HEATING FEED WATER.

No. 370,010. Patented Sept. 13, 1887.

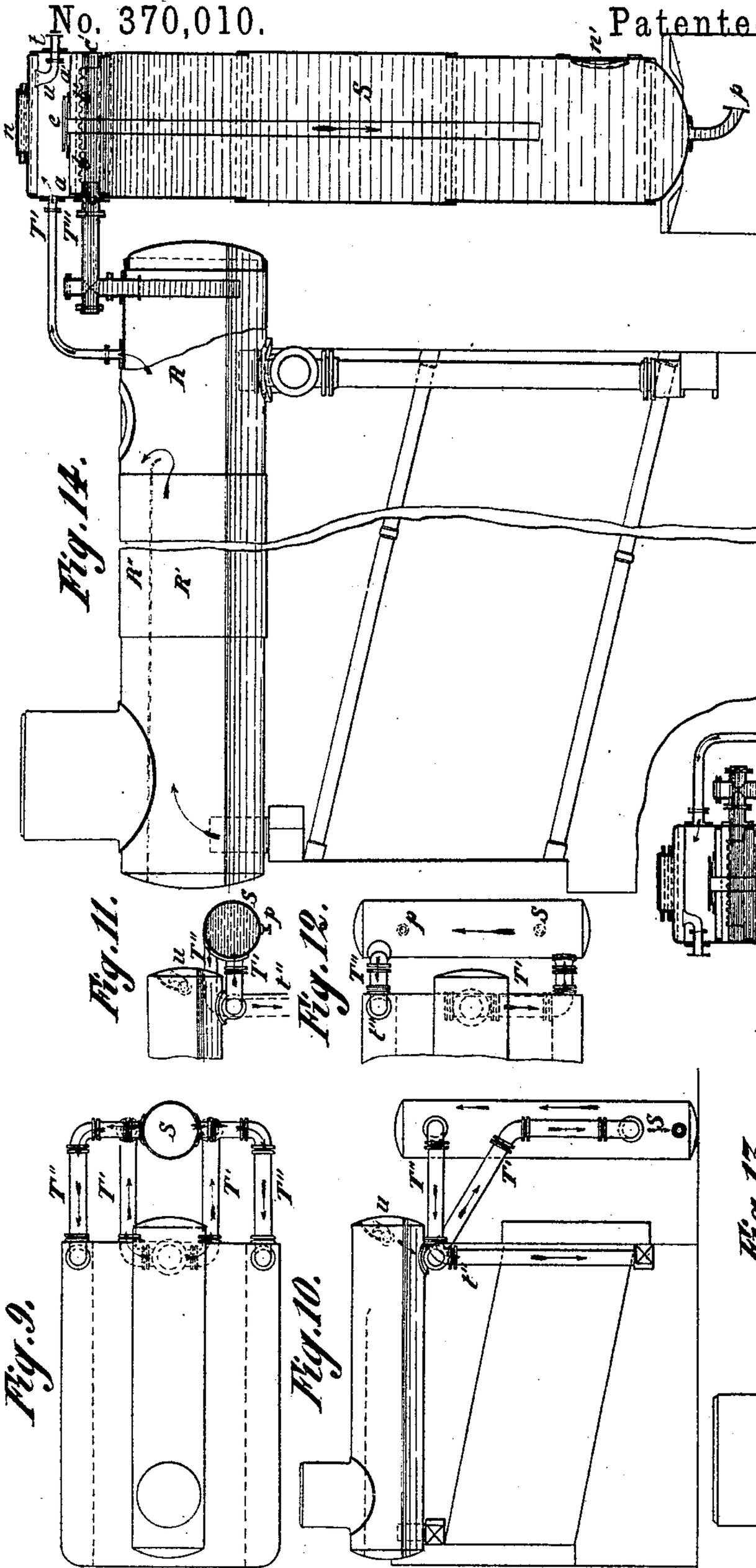

Fig. 14.

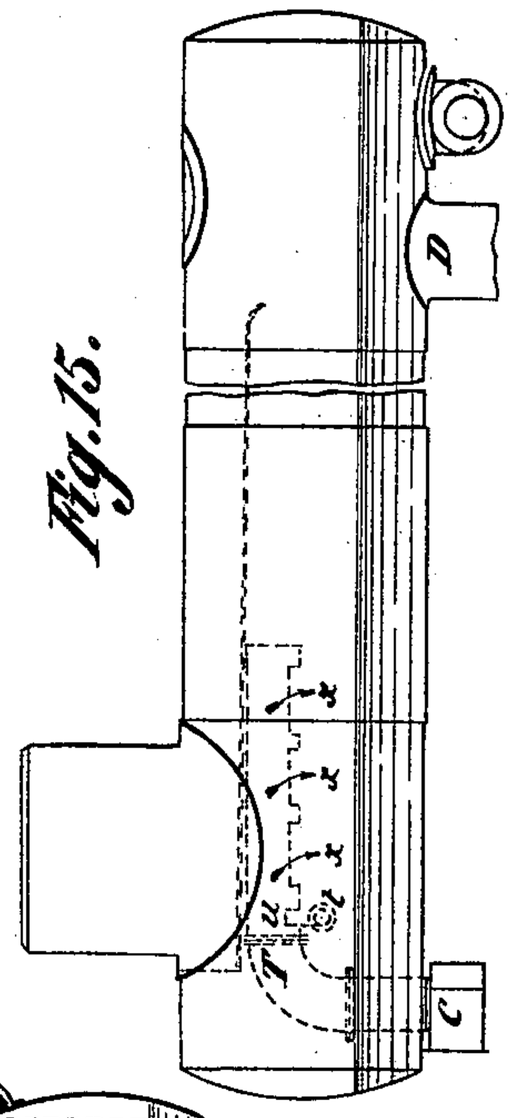

Fig. 15.

Fig. 11.

Fig. 12.

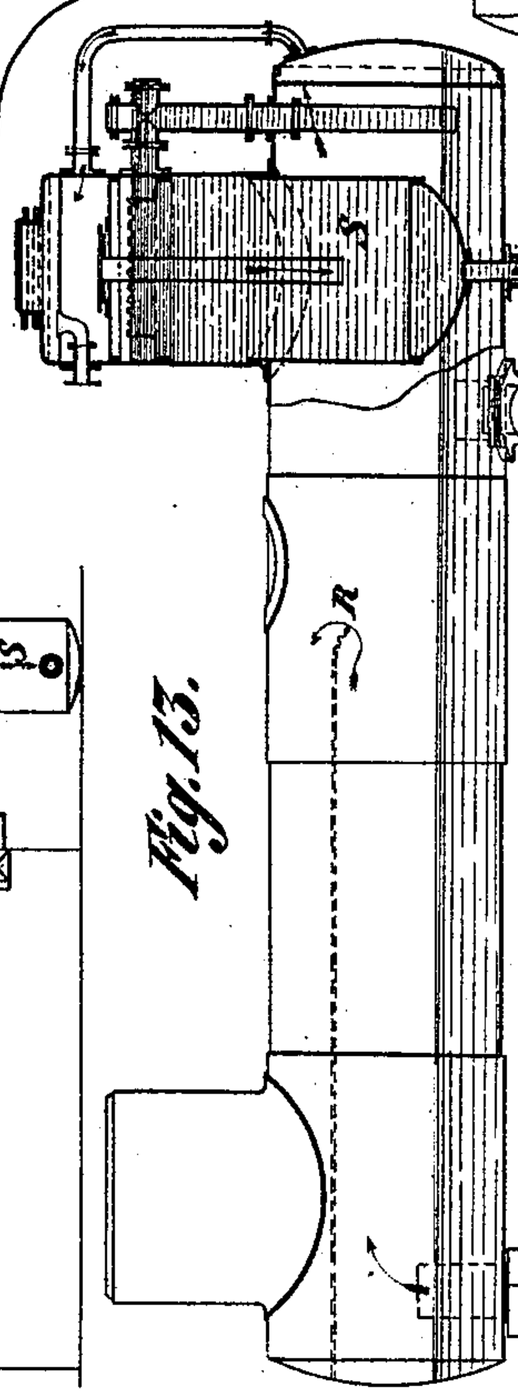

Fig. 13.

Fig. 9.

Fig. 10.

Witnesses.
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L. DE NAEYER.

HEATING FEED WATER.

No. 370,010. Patented Sept. 13, 1887.

Fig. 15.

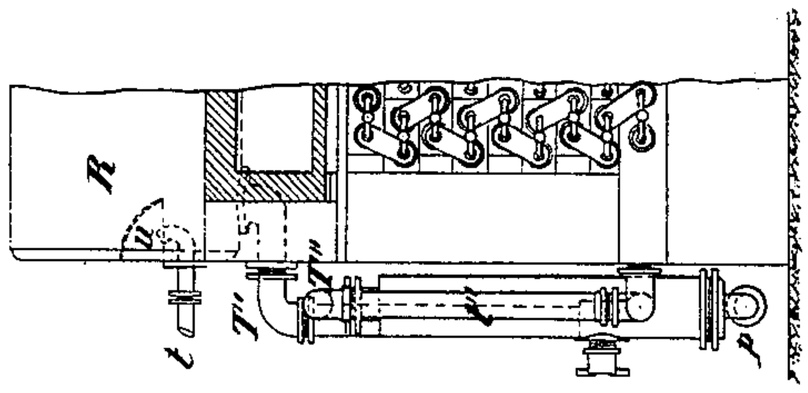


Fig. 18.

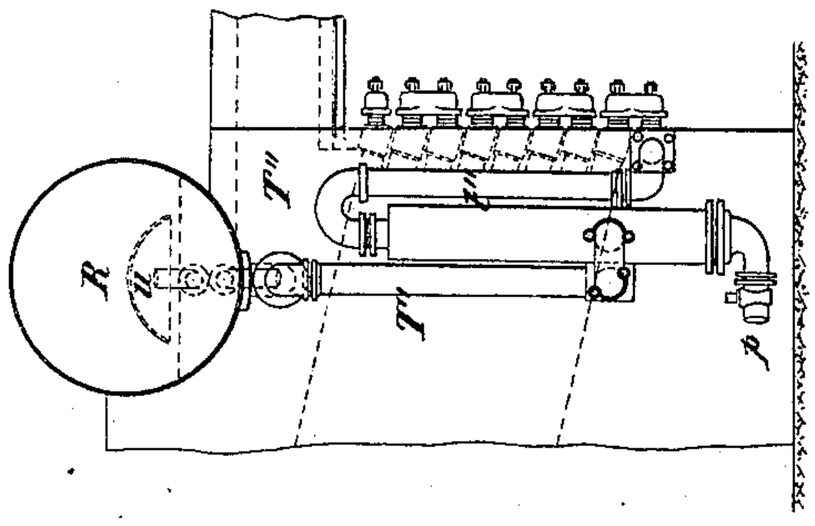


Fig. 17.

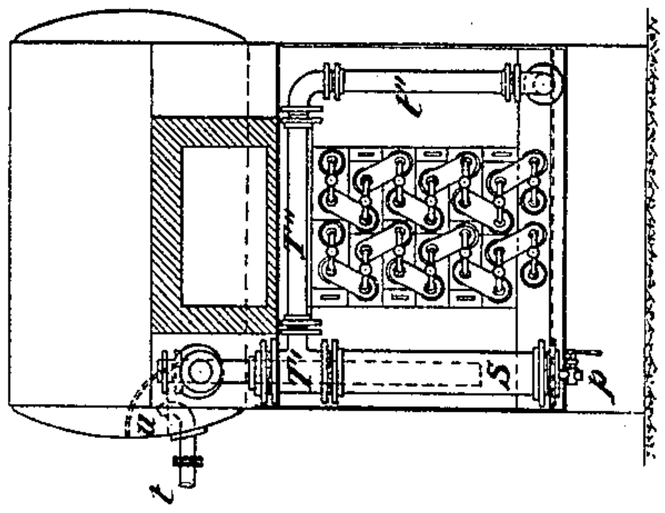
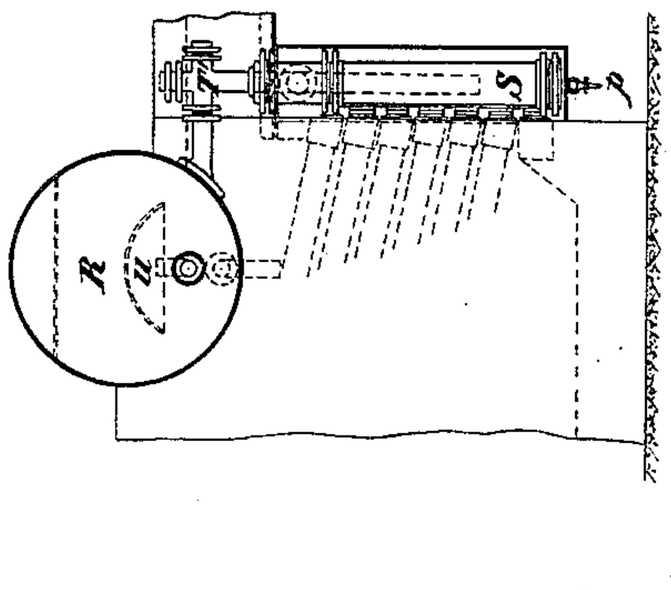


Fig. 16.



Witnesses
Percy B. Hills.
Robert Everett.

Inventor:
Louis De Naeyer.
By James L. Norris.
Atty

UNITED STATES PATENT OFFICE.

LOUIS DE NAEYER, OF WILLEBROEK, BELGIUM, ASSIGNOR TO DE NAEYER & CO., OF SAME PLACE.

HEATING FEED-WATER.

SPECIFICATION forming part of Letters Patent No. 370,010, dated September 13, 1887.

Application filed November 9, 1886. Serial No. 218,409. (No model.) Patented in Belgium December 2, 1885, No. 71,069; in England February 25, 1886, No. 2,769; in France April 20, 1886, No. 175,642; in Italy June 30, 1886, No. 452, and in Spain August 27, 1886, No. 6,054.

To all whom it may concern:

Be it known that I, LOUIS DE NAEYER, a subject of the King of the Belgians, and a resident of Willebroek, Belgium, have invented new and useful Improvements in Heating Feed-Water for Steam-Boilers, of which the following is a specification, reference being had to the accompanying drawings.

My improvements are applicable to all kinds of steam-boilers, and have for their object to provide for the introduction of the feed-water and the discharge of steam in such a manner as to separate, on the one hand, the steam from the water which it tends to carry away, and, on the other hand, the water from the incrusting substances which it contains, and which it should deposit in parts of the boiler which can be easily cleaned and are not subjected to the direct action of the flame. To obtain these two results, I commence by intimately mixing the water and steam. I then cause them to circulate in such a manner that these two fluids must separate from each other, and the calcareous substances which have become insoluble will be compelled to settle down in very accessible parts of the water-chambers.

In the annexed drawings, Figure 1 is a side elevation of a steam-boiler and connections embodying my invention. Fig. 2 is a similar view illustrating a modification in the arrangement and location of parts. Fig. 3 is an end elevation of a steam-boiler and furnace, and Fig. 4 is a longitudinal section of the same, illustrating further modifications of my invention. Figs. 5, 6, and 7 illustrate other modifications, hereinafter described, and which are especially adapted for boilers of great power. Fig. 8 shows a modification in the arrangement of the pipes which establish communication between the collectors, the reservoirs, and the feed. Figs. 9 to 12 illustrate an arrangement of devices for application to existing boilers to facilitate the deposition of calcareous substances without requiring any change in the feed. Figs. 13, 14, and 15 show other additions to existing boilers for feeding water into the current of steam and separating calcareous substances. Figs. 16 to 19 show my invention applied to boilers of small power.

Fig. 1 shows a chief arrangement applied to one of my multitubular boilers, and in which, as in the following arrangements, my conic joints are used throughout. The steam, passing from the collector C, enters the pipe T, which may be either at the exterior or in the interior of the steam-reservoir R, and which conducts the steam to the top of the separator S, into which the pipe T extends nearly to the bottom of the sheet-metal vessel A. The feed-water is here introduced through the pipe *t*, and rises to the crown B B′, over which it flows into the funnel C′ C′, conveying it into the depositing-chamber D, where it rises to the crown E F, placed at the same height as the crown B B′. Around this crown E F is arranged an annular channel, G H, from the exterior of which the pipe *t′* extends into the steam-chamber R, whence the water descends through the pipe *t″* to the lower collector of the series of tubes. The flow of the water from the feed-pipe *t* to this collector is clearly indicated by dotted arrows. The flow of the steam is indicated by full arrows. After having traversed the whole quantity of water contained in the vessel A the steam passes through the annular section, which remains free, between the crown B B′ and the cap K, and thence passes into the steam-chamber R through the pipe T′, which extends vertically downward into the interior of this chamber in such a manner that the water carried away by the steam is projected downward by virtue of its inertia, and will mix with the water which fills the bottom of the reservoir, while the steam passing toward the dome is compelled to change its direction. It will be readily understood that the water in the vessel A, being continually traversed by the whole quantity of steam which the boiler generates, must attain the temperature of this steam when it enters the chamber D, where, being in almost a complete state of repose, it must permit its incrusting substances to deposit at the bottom of this chamber, whence they can be removed as often as desired by the blow-off valve P.

Fig. 2 represents a modification of the preceding arrangement. The depositing-chamber D is placed in front of the boiler and the steam-dome at the rear thereof. The pipes T and *t'* are thus considerably shortened and the feeding takes place at the forward part of the boiler. The steam leaving the collector C passes into the separator S before it arrives in the reservoir R.

Figs. 3 and 4 represent another arrangement, likewise applicable to one of my inexplosive boilers. The steam-chamber R is divided into two parts, R' R'', by the partition *a b c*. The steam passes into the chamber R', coming from the steam-collector C, through the pipe T, which opens under the funnel *u* at the end of the feed-pipe *t*. The steam thus encounters the thin sheet of water which flows over from this funnel, mixes intimately with it, and carries away the particles of water through the entire length of the chamber R'. The inertia of the water carries these particles beyond the extremity *c* of the partition *b c*, while the steam, to reach the dome and the orifice M in the latter, must pass back through the chamber R''. Immediately behind this extremity *c* is a depositing-vessel, D, where the water in a state of rest deposits the greater portion of its incrusting substances (which are removed through a blow-off valve) before entering the pipe *t'*, which is connected with its branches to the pipes *t''*, leading to the lower collector of the series of tubes. The particles of water which have not been carried away to the vessel D deposit their incrusting substances at the bottom of the reservoir R', where they remain in the state of mud, and are carried away into D by the movement of the water when this vessel is cleaned.

Figs. 5 and 6 represent a more complete arrangement than the preceding, especially applicable to boilers of very great power. There are two steam-reservoirs. The first, R, receives the steam directly from the collector C through the pipe T, which extends internally or externally to near the rear extremity of the reservoir. In this pipe T is a chamber, L, into which opens the extremity *u* of the feed-pipe *t*. The water which flows over from this extremity is carried away by the steam to the end of the reservoir above the depositing-vessel D, where the water, whose temperature has necessarily been raised to that of the steam when mixing with it, deposits a large portion of the substances which have become insoluble. At the opposite extremity—that is to say, at the forward part of the boiler—the two steam-reservoirs communicate through the pipe V in such a manner that the feed-water, in order to enter the reservoirs R' R'', must pass through nearly the entire length of the reservoir R', and continue to deposit in the latter the substances which are not retained in the vessel D. The water must afterward move to the rear, passing above the second depositing-vessel, D', to reach the pipe *t'*, branched from the pipes *t''*, which descend to the lower collector of the series of tubes. It will therefore deposit in this vessel D' and all along the chamber R' the substances which are not retained in the reservoir R'. The two chambers R' R'' are separated by the partition *a b c* and the steam which, after having passed through the pipe T, Figs. 5 and 6, and returned to the forward part in the reservoir R', and having next traversed the pipe Q, in order to enter the part R' of the reservoir R^2, has yet to pass along this partition *a b c* to reach the chamber R'', and thence the steam-port M. The steam cannot therefore fail to separate in this passage from the particles of water which it might otherwise carry away.

Fig. 8 represents a modification of the arrangement of the pipes which serve to establish communication between the collectors and the reservoirs, as well as with the feed. The pipe V, which unites the reservoirs, is at the front of the latter. The steam-pipe T extends from one extremity of the steam-collector and receives in a branch fixed upon the reservoir R' a horizontal feed-pipe, which is bent at its extremity, so as to have its orifice vertical. I have, in fact, recognized that it is indispensable, in order to obviate the shocks or jars resulting from the injection of water into the steam, that the water shall leave through a nearly horizontal orifice and in an upward direction. It is in accord with reason and experience that, whatever may be the activity of the evaporation and feed, the arrangements which I have described completely separate, on the one hand, from the water any insoluble substances which it contains, and, on the other hand, the steam from the water which it would otherwise carry away. The same object can be attained by simple additions to existing boilers, such as those represented in Figs. 9, 10, 11, 12, 13, 14, and 15.

Fig. 15 shows a simple application of the mode of feeding water into the current of steam through the opening of the feed-pipe *t* in the interior of the steam-pipe T, in which are provided openings *x*, to permit the water carried away to fall immediately into the lower part of the reservoir R if the steam does not carry it farther. A depositing-chamber, D, has also been added.

Fig. 14 shows the addition of a receptacle, S, placed outside the boiler and connected with the steam-reservoir R through a steam-pipe, T', and with the water-pipe T''. A partition, *a a'*, traversed by the pipe *t'*, forms in the upper part of the reservoir S a small steam-chamber, into which opens the funnel *u* of the feed-pipe *t*. The water, heated to a temperature nearly equal to that of the steam, descends through the opening *e* of the pipe *t'* to near the bottom of the reservoir S, in which it deposits the substances that have become insoluble or are held in suspension. It can pass into the reservoir R only by flowing over the crowns *b b'*, to fall into the circular chan-

nel *c c'*, which extends around this crown, and into which opens the pipe T''. Two manholes, *n n'*, permit the reservoir S to be easily cleaned, and the blowing-off valve *p* enables the deposited substances to be removed as often as desired.

In Fig. 13 the reservoir S is placed in the reservoir R, no other change being made.

Figs. 9, 10, 11, 12 show a general arrangement designed to facilitate the deposition of calcareous substances without changing anything in the feed. In the arrangement shown in Figs. 8 and 9 the water introduced into the reservoir R can pass to the pipe *t''*, which conducts it to the lower collector of the generator only after having traversed the pipe T, which conducts it to near the bottom of the reservoir S, whence it must rise again to the pipe T'' to enter the pipe *t''*. A blow-off valve, *p*, permits the removal of deposits from the reservoir S. The feeding can be effected as shown in Fig. 14, or directly into the reservoir R through a pipe opening into the funnel *u*, Fig. 10.

In Figs. 11 and 12 the separator S is horizontal. The water passes through the pipe T', traverses the reservoir S, and enters at *t''* through the pipe T''. The blow-off valve is at *p*.

In Figs. 16, 17, 18, and 19 are shown similar arrangements to the preceding, and specially applicable to boilers of small power.

In the arrangements shown in Figs. 16 and 17 the pipe T' extends into the interior and to near the bottom of the separator S, while the pipe T'' leaves from the top of this receptacle to convey the water to the pipe *t''*, which extends downward to the lower collector. A blow-off valve, *p*, is applied to the separator. The feeding is effected directly into the steam-reservoir R through the extremity *u* of the pipe *t* opening into full steam.

In the arrangement shown in Figs. 18 and 19 the pipe T' is at the exterior of the separator S, from the top of which the pipe T'' *t''* extends directly to the lower collector of the generator. For these small boilers the steam-reservoir has been placed transversely to gain height while having a large diameter.

I am aware of the patent to Brazelle, August 16, 1881, No. 245,776, and Butman, July 10, 1883, No. 281,013, and do not claim the construction shown therein.

What I claim is—

The combination of a boiler, a steam-reservoir, a feed-water pipe, a series of chambers or pipes for collecting a mixture of steam and feed-water, chambers or pipes for circulating a mixture of steam and feed-water, and a depositing-chamber communicating with the feed-water pipe, with the steam-collecting chambers or pipes, and with the mixed feed-water and steam-circulating chambers or pipes, whereby the feed-water is mixed with the steam without shocks, and the mixture of feed-water and steam circulated to effect their separation before entering the boiler, and to deposit incrusting substances at accessible points, substantially as shown and described.

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

LOUIS DE NAEYER.

Witnesses:
GEORGE BEDE,
M. WASSON.