No. 685,600. Patented Oct. 29, 1901.

D. HALPIN.

THERMAL STORAGE APPARATUS FOR STEAM BOILERS.

(Application filed July 29, 1901.)

(No Model.) 4 Sheets—Sheet 1.

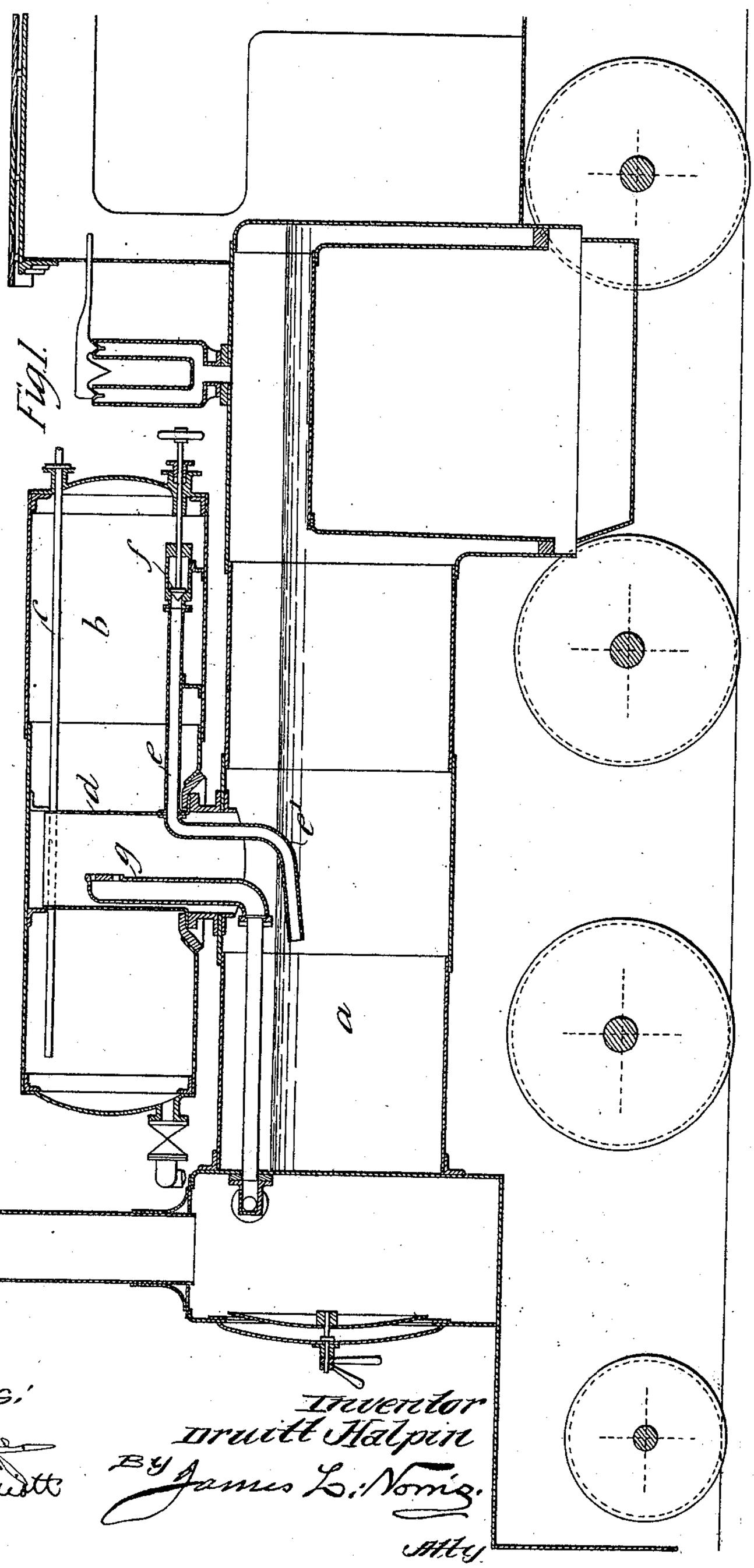

Fig. 1.

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Fig. 6.

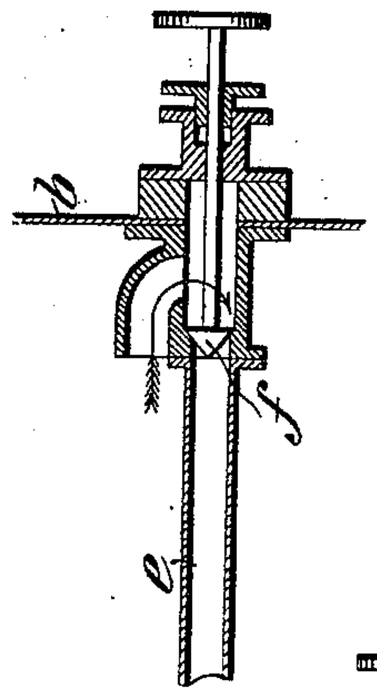

Fig. 5.

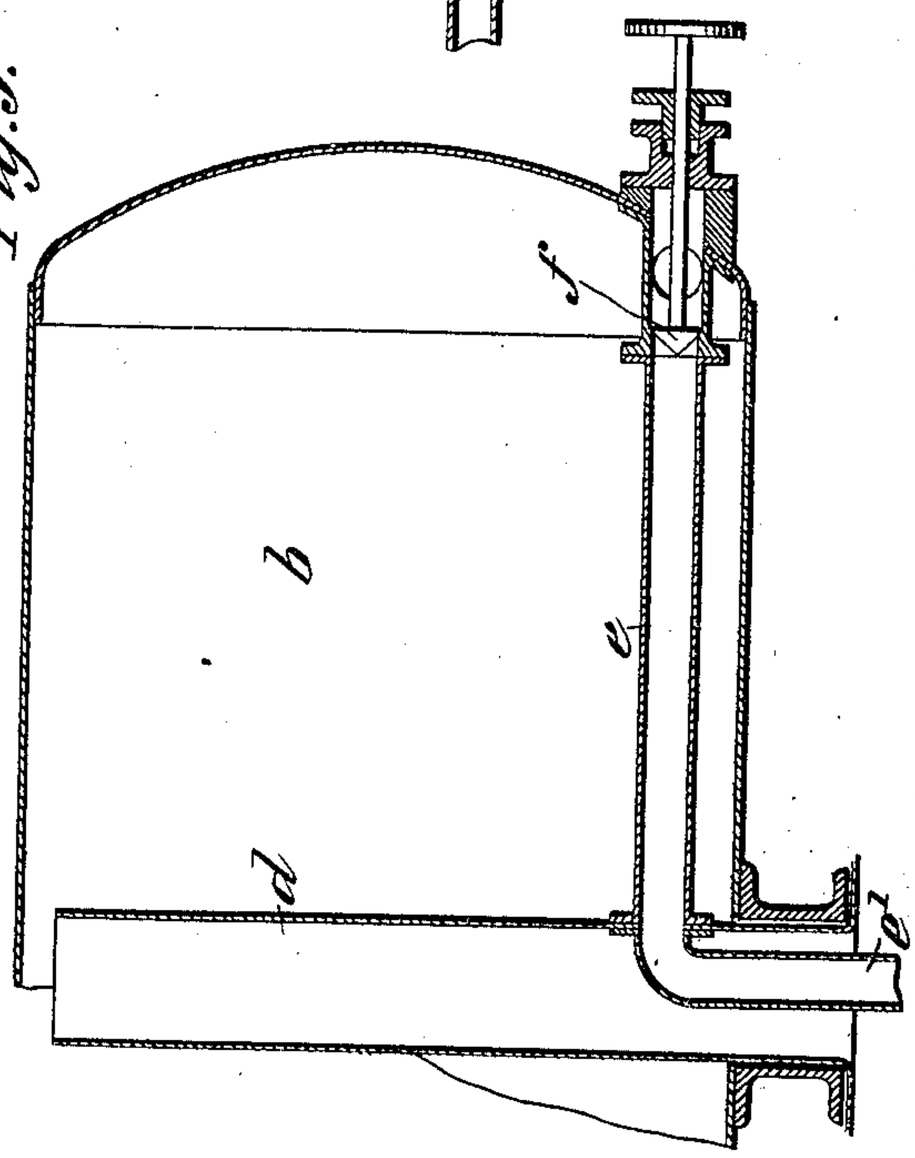

Fig. 4.

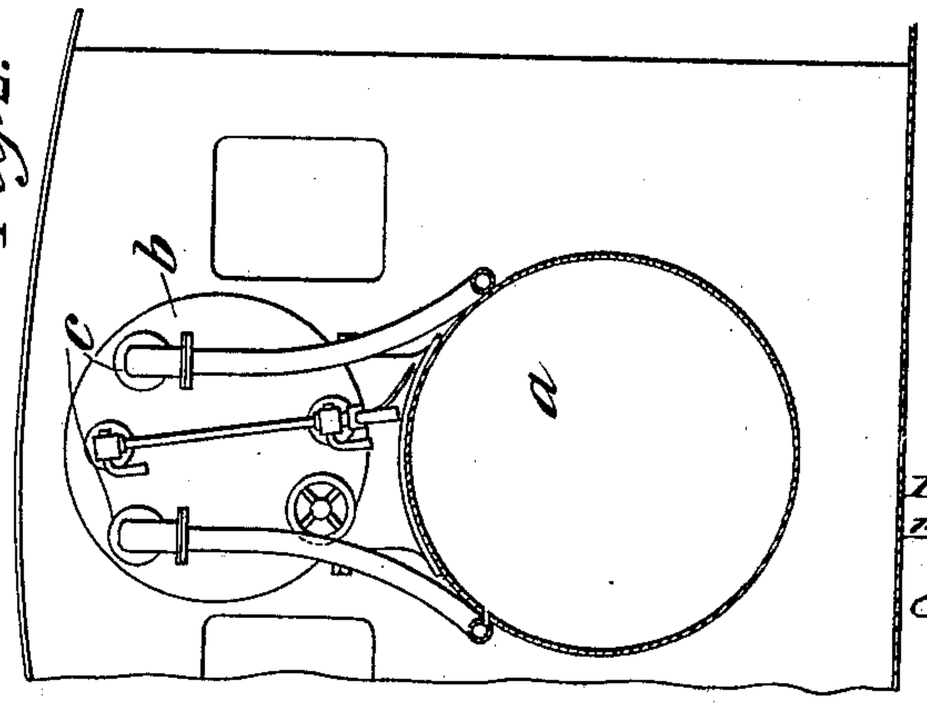

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Fig. 3.

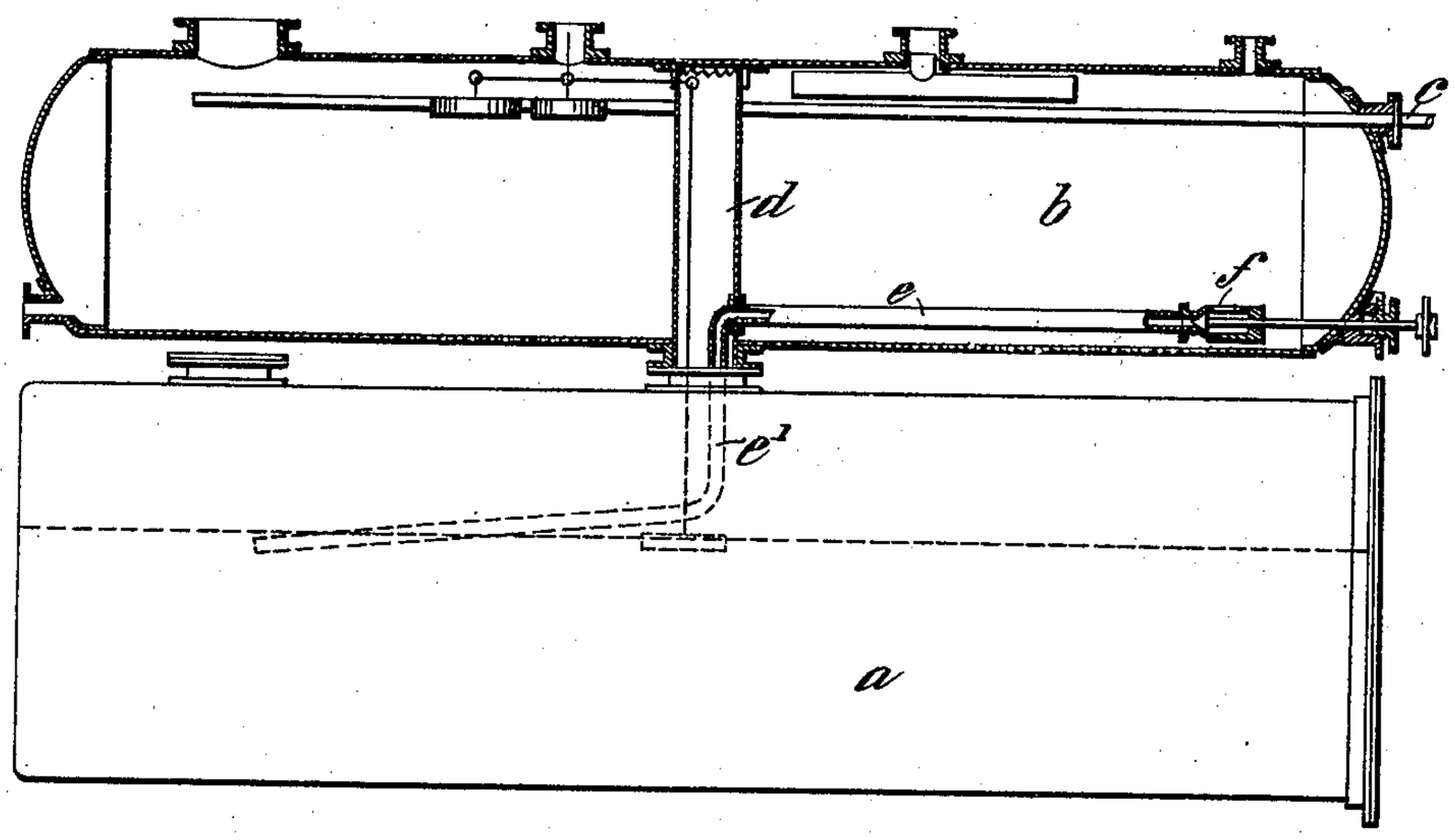
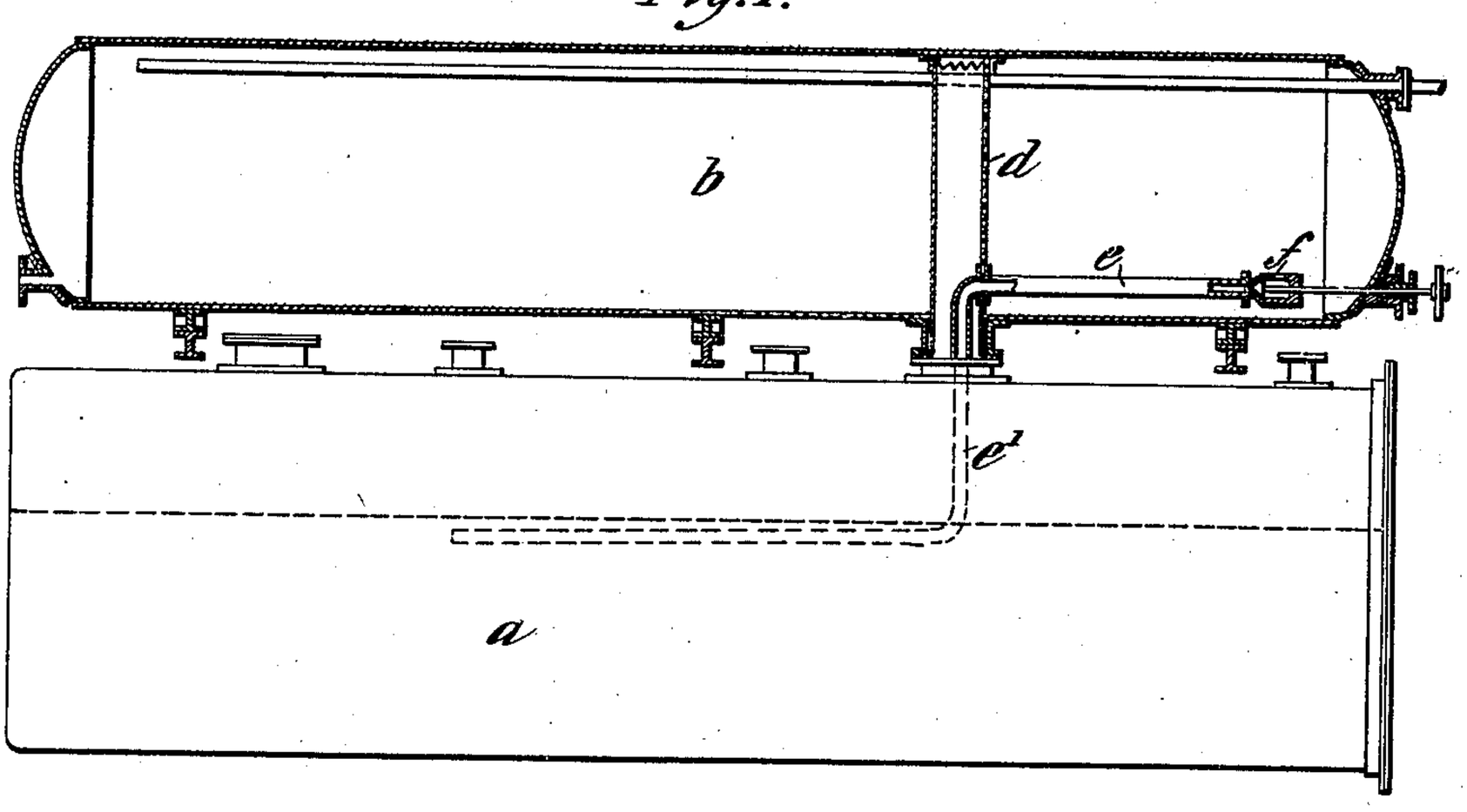


Fig. 1.



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(No Model.) 4 Sheets—Sheet 4.

Fig. 4.

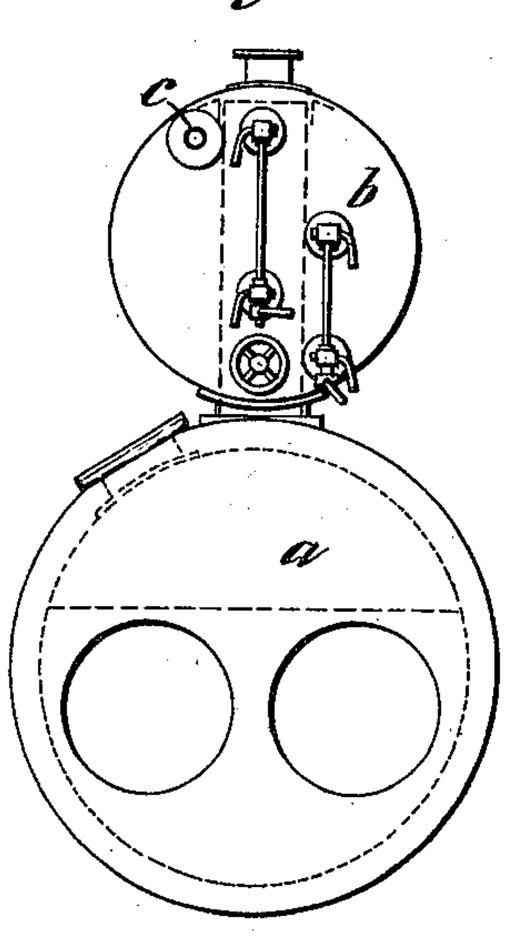


Fig. 9.

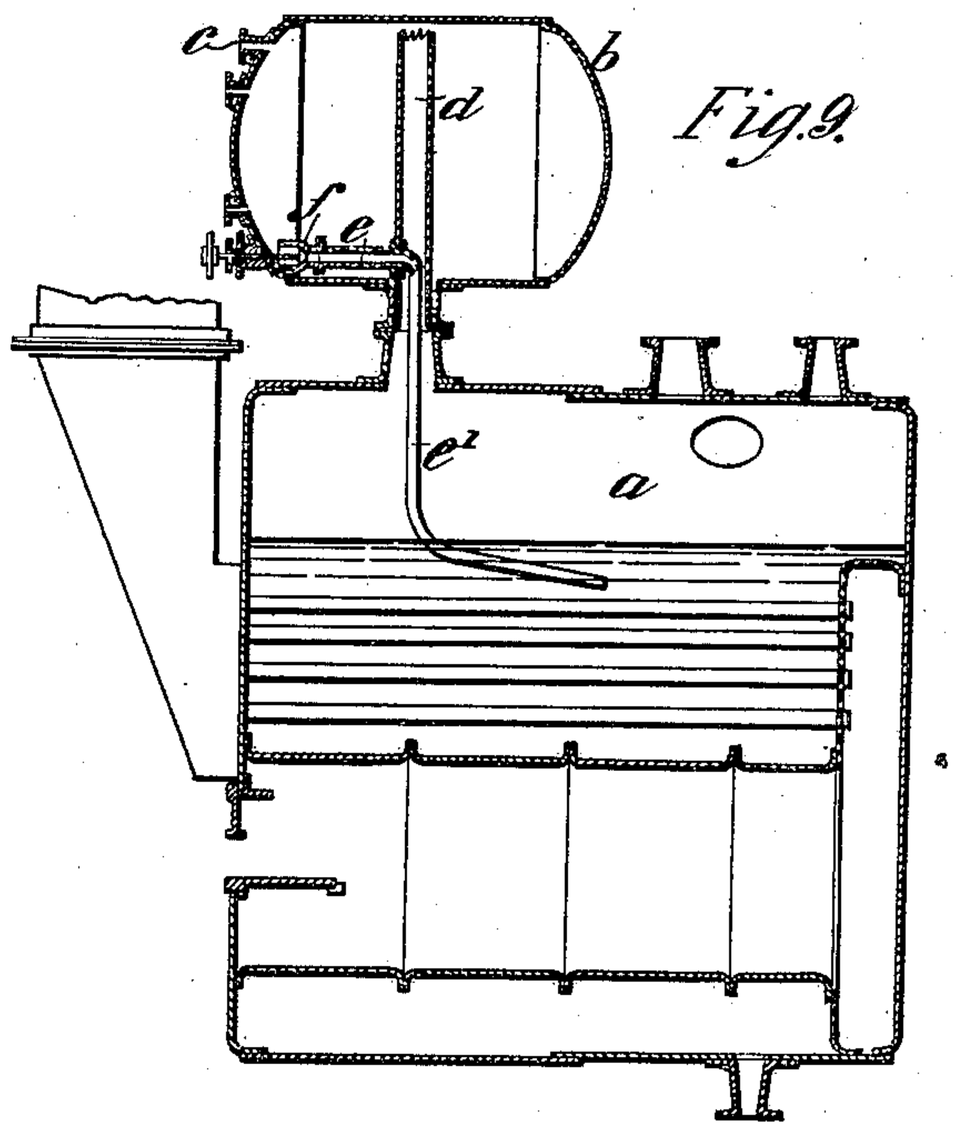


Fig. 8.

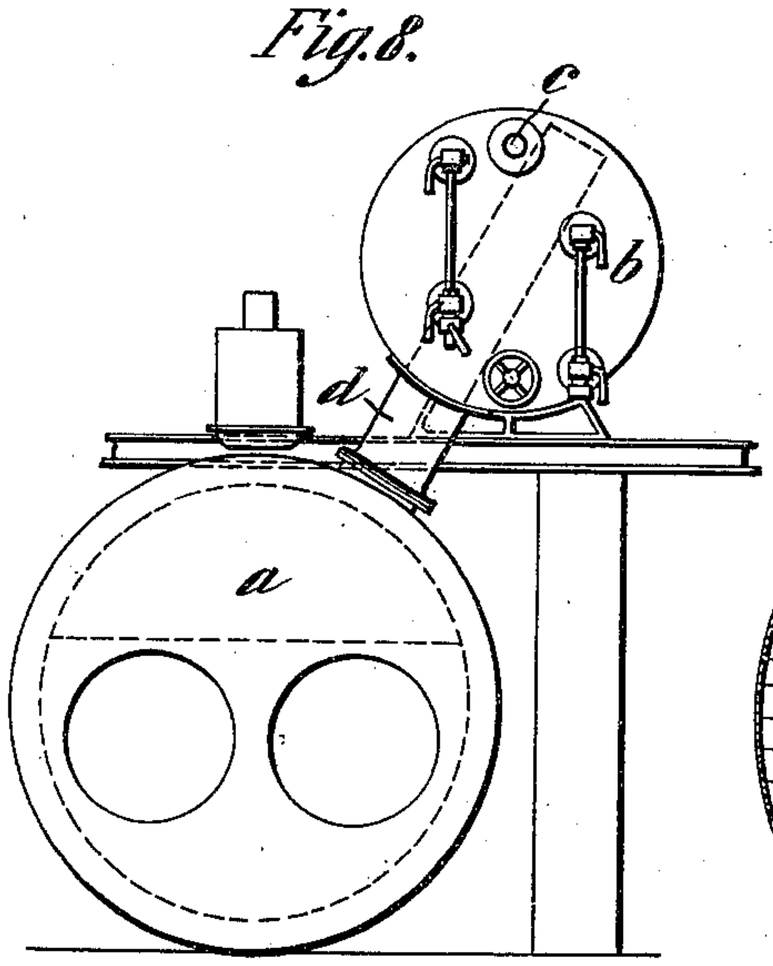
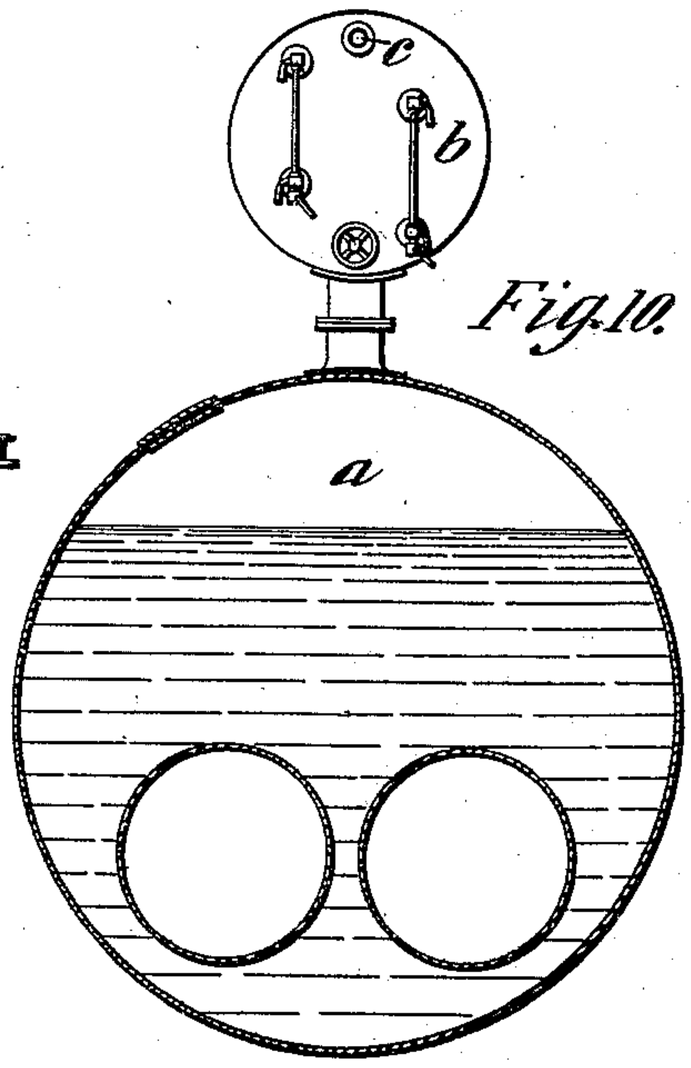


Fig. 10.



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UNITED STATES PATENT OFFICE.

DRUITT HALPIN, OF LONDON, ENGLAND.

THERMAL STORAGE APPARATUS FOR STEAM-BOILERS.

SPECIFICATION forming part of Letters Patent No. 685,600, dated October 29, 1901.

Application filed July 29, 1901. Serial No. 70,125. (No model.)

To all whom it may concern:

Be it known that I, DRUITT HALPIN, a citizen of England, residing at 17 Victoria street, Westminster, London, England, have invented a certain new and useful Thermal Storage Apparatus for Steam-Boilers, of which the following is a specification.

In the specification to my Patents No. 20,203 of 1891 and No. 363 of 1892 I described a method of and apparatus for effecting thermal storage in connection with steam-boilers, the main feature of which consisted in causing any excess of power generated in the boiler beyond that which was required for consumption for the time being to be stored in the form of steam and hot water in a separate chamber or reservoir, so as to be subsequently available when a greater amount of duty was required to be performed by the boiler.

My present invention consists in an improved construction of apparatus for carrying out the method of operating above referred to, whereby on the one hand a considerable simplification and more compact arrangement of the apparatus is effected, while on the other hand the use of a check-valve in the pipe connecting the water-space of the boiler with that of the thermal storage-reservoir and consequently also a forcing device for conveying the water from the latter to the former are dispensed with. The further advantage is also obtained by the new construction that all the pipes or tubular conduits employed therein are so arranged as to be subject to equal internal and external pressures, thus practically avoiding all strain thereon. The main features of the said improved construction whereby the above-mentioned advantages are obtained are as follows: I arrange the thermal storage-reservoir as closely as practicable to and either immediately over or to one side of the top of the boiler. From the steam-space of the boiler a pipe or tubular conduit of large sectional area extends up into the storage-reservoir, to near the top thereof, so that the steam passes freely from the boiler into the reservoir through this pipe, thus maintaining the same pressure in both. The feed-water is introduced by suitable forcing apparatus into the upper part of the storage-reservoir, where it becomes heated to nearly the same temperature as the water in the boiler, and the solid matter suspended or dissolved in such water becomes deposited in the bottom of the reservoir, whence it can be easily removed, as no incrustation is formed, the storage-reservoir not being heated externally. At a suitable height above the bottom of the storage-tank is arranged a water-supply pipe for conveying the water from the storage-tank to the boiler. This pipe is led through the side of the before-mentioned steam-pipe of large size and passes down inside the same into the water-space of the boiler. The upper end of this pipe is more or less closed by means of a throttling plug or valve for regulating the quantity of water passing from the storage-reservoir into the boiler. This plug or valve and its seat are preferably arranged close to one end of the storage-reservoir, in which is formed an opening closed by a bonnet, through which access can be gained to the valve from time to time for clearing it of any deposit. The valve and its seat may be arranged in a box or chamber projecting from the end of the reservoir, so as to be more readily accessible, such box having a passage through which the water from the reservoir passes to the valve-opening. The arrangement might also be such that not only the valve, but also its seat and the pipe leading therefrom to the pipe that passes down into the boiler, can be removed for cleaning.

When applying the above-described construction to the boiler of a locomotive-engine, the before-mentioned steam-pipe of large area connecting the steam-spaces of the boiler and storage-reservoir is preferably made to take the place of the ordinary steam-dome, the steam-supply pipe to the cylinders being led up within such pipe, so as to take the steam from the upper part thereof.

On the accompanying drawings is shown by way of example the application of my above-described invention to various forms of steam-boilers combined with thermal storage-reservoirs.

Figure 1 shows a longitudinal section, and Fig. 2 a cross-section, of a locomotive-boiler and reservoir.

The boiler *a* is connected to the thermal storage-reservoir *b* by means of a pipe or tubular conduit *d*, of comparatively large sectional area, which connects the steam-space of the boiler freely with the steam-space of the reservoir, so that the same steam-pressure is always maintained in both vessels. The lower end of the pipe *d* is here shown formed as a separate strong ring, serving as a support for the reservoir. This may, however, be supported on the boiler in any other suitable manner. The feed-water for the boiler is introduced into the upper part of the storage-reservoir through a pipe *c*, the feed-water, which may be either previously heated or not, being forced in by an injector or pump in the usual way. By means of the steam the feed-water is heated up to near the temperature of that in the boiler before it is let down into the latter, this being effected by a pipe *e e'*, of which the part *e* is arranged at a sufficient height above the bottom of the storage-reservoir to be clear of the deposit from the feed-water therein and is more or less closed at one end by an adjustable plug or valve *f*, while the other end passes through or is fixed against a lateral hole in the large pipe *d*, to which is also attached the other part *e'* of the feed-pipe, situated within the pipe *d* and leading down to below the water-space of the boiler. From this arrangement it will be seen that the pipe *e e'*, as also the pipe *d*, are subject to equal external and internal pressures and are consequently liable to no strain; also, that the only external pipe connection between the boiler and storage-reservoir is that of the pipe *d*, and that consequently a saving of external joints is effected. Furthermore, as the steam-pressure will under all circumstances be the same in the boiler and storage-reservoir the water flowing from the latter into the former through the pipe *e e'* will never be subjected to a greater head of pressure than that due to the distance between the water-levels in the two vessels. As there is with this arrangement no heavy check-valve to be raised in pipe *e'*, the said head of pressure will suffice to cause the requisite flow of water into the boiler. The throttling plug or valve *f* for regulating this supply is preferably arranged at or near the end of the storage-reservoir, as shown in vertical section and sectional plans at Figs. 5 and 6, in order that access may be readily gained to the valve and its seat for clearing them of any deposit that may possibly accumulate there. The valve and its seat might also be arranged in a box or chamber projecting from the end of the reservoir in order still further to facilitate the access thereto, such box being provided with a passage through which the water from the reservoir passes to the valve-opening. The arrangement might be such that not only the valve, but also its seat and the pipe *e*, could be withdrawn for cleansing purposes, the end of the pipe being in that case merely made to fit into the hole of the pipe *d*.

An essential feature of the above-described construction is that the large steam-pipe *d* at the same time serves the purpose of the ordinary steam-dome of a locomotive, the steam-supply pipe to the cylinders being led up it, as shown at *g*, so as to take steam from the upper part thereof.

The above-described locomotive with improved thermal storage apparatus will operate as follows: When the locomotive is running on a level road or on a downgrade, the feed-water is supplied in the ordinary way through pipe *c* into the thermal storage-reservoir *b*, where it becomes heated to a considerable degree by the steam from the boiler *a*, a corresponding quantity of the hot water being allowed to pass through the throttle-valve into the boiler. When the engine is required to develop an increased amount of power, as when going up an incline, the supply of feed-water through pipe *c* to the storage-reservoir is cut off. The water in the latter will then be raised practically to the same temperature as that of the water in the boiler, and in being fed into the latter through pipe *e e'* at this high temperature it will cause a correspondingly greater development of steam at a high temperature to take place.

Figs. 3 and 4 show, respectively, a side view, partly in section, and an end view of a stationary Lancashire boiler combined with a thermal storage-reservoir constructed according to my present invention, in which the storage-reservoir is arranged immediately over the boiler, as with the locomotive. In Figs. 7 and 8 are shown the same views of a similar boiler, in which the storage-reservoir is placed to one side of the boiler, so as to leave the top of this free for the usual fittings, the storage-reservoir being supported independently of the boiler, while the large connecting steam-pipe *d* is arranged in an inclined position. Figs. 9 and 10 show, respectively, a vertical section and a cross-section of a marine boiler with its thermal storage-reservoir arranged immediately over the top thereof. In all these arrangements the parts are substantially the same as described with reference to Figs. 1 and 2, and they are marked with the corresponding letters of reference, *a* being in all cases the boiler; *b*, the thermal storage-reservoir; *d*, the connecting steam-tube, of comparatively large sectional area, through which passes the pipe *e e'* for supplying the boiler with water from the reservoir, and *c* the pipe for supplying the feed-water to the reservoir. The mode of operating with the apparatus is also the same as with the locomotive—that is to say, when the boiler has to perform a normal amount of duty feed-water is admitted to the storage-reservoir and a corresponding quantity, regulated by the throttle-valve *f*, is allowed to

pass thence into the boiler. When a greater development of power is required, the supply of feed-water through pipe *c* is cut off and the boiler is fed with highly-heated water from the storage-reservoir.

Although I have in all cases spoken of the connecting steam-pipe *d* as being of comparatively large sectional area, it is to be understood that except in those cases where the pipe *d* takes the place of the steam-dome it need only be of such a size that while allowing the passage of the water-supply pipe *e e'* through it it shall at the same time allow of the free passage of the steam from the boiler to the storage-reservoir.

Having thus described the nature of this invention and the best means I know of carrying the same into practical effect, I claim—

1. In a combined steam-boiler and thermal storage apparatus, a steam-pipe or tubular conduit extending from the steam-space of the boiler up through the storage-reservoir to the steam-space thereof so as to maintain the same steam-pressure in the boiler and the reservoir, means for supplying the storage-reservoir with feed-water, and a pipe in the storage-reservoir controlled by a plug or valve passing through the side of said steam-pipe and down within the same into the water-space of the boiler for supplying the latter with a regulated quantity of water from the storage-reservoir, said steam-pipe being of sufficient transverse sectional area to allow of the passage of said water-supply pipe through, while at the same time affording free passage for the steam from the boiler to the storage-reservoir, substantially as described,

2. In a combined steam-boiler and thermal storage apparatus, a steam-pipe or tubular conduit extending from the steam-space of the boiler up through the storage-reservoir to the steam-space thereof so as to maintain the same steam-pressure in the boiler and the reservoir, means for supplying the storage-reservoir with feed-water and a pipe in the storage-reservoir controlled by a plug or valve passing through the side of said steam-pipe and down within the same into the water-space of the boiler for supplying the latter with a regulated quantity of water from the storage-reservoir, said steam-pipe being made to serve in lieu of the ordinary steam-dome of a boiler from which steam is taken to supply the engines substantially as described.

3. The combination of a steam-boiler such as *a*, a thermal storage-reservoir such as *b*, a pipe such as *d* extending from the steam-space of the boiler up through the storage-reservoir into the steam-space thereof so as to allow free passage of steam from the boiler to the storage-reservoir a pipe *c* for supplying the storage-reservoir with feed-water, a pipe *e e'* situated above the bottom of the storage-reservoir and passing through the side of the steam-pipe *d* and down inside the same into the boiler, for supplying the latter with water from the storage-reservoir, and a valve or plug *f* to the pipe *e e'* for regulating such supply of water to the boiler, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

DRUITT HALPIN.

Witnesses:
GERALD. L. SMITH,
WALTER J. SKERTEN.