No. 657,783. Patented Sept. 11, 1900.

C. D. MOSHER.

STEAM BOILER.

(Application filed Apr. 25, 1894.)

(No Model.) 3 Sheets—Sheet 1.

FIG. 1b.

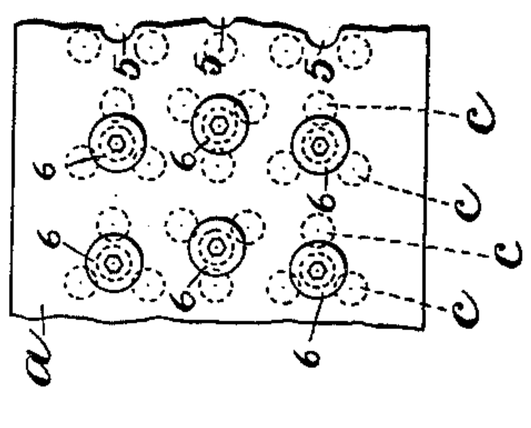


FIG. 1a.

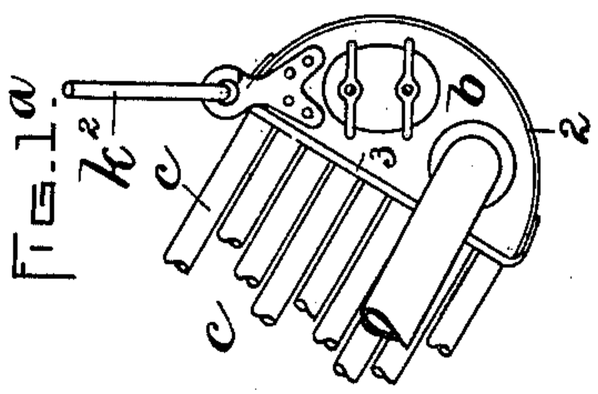
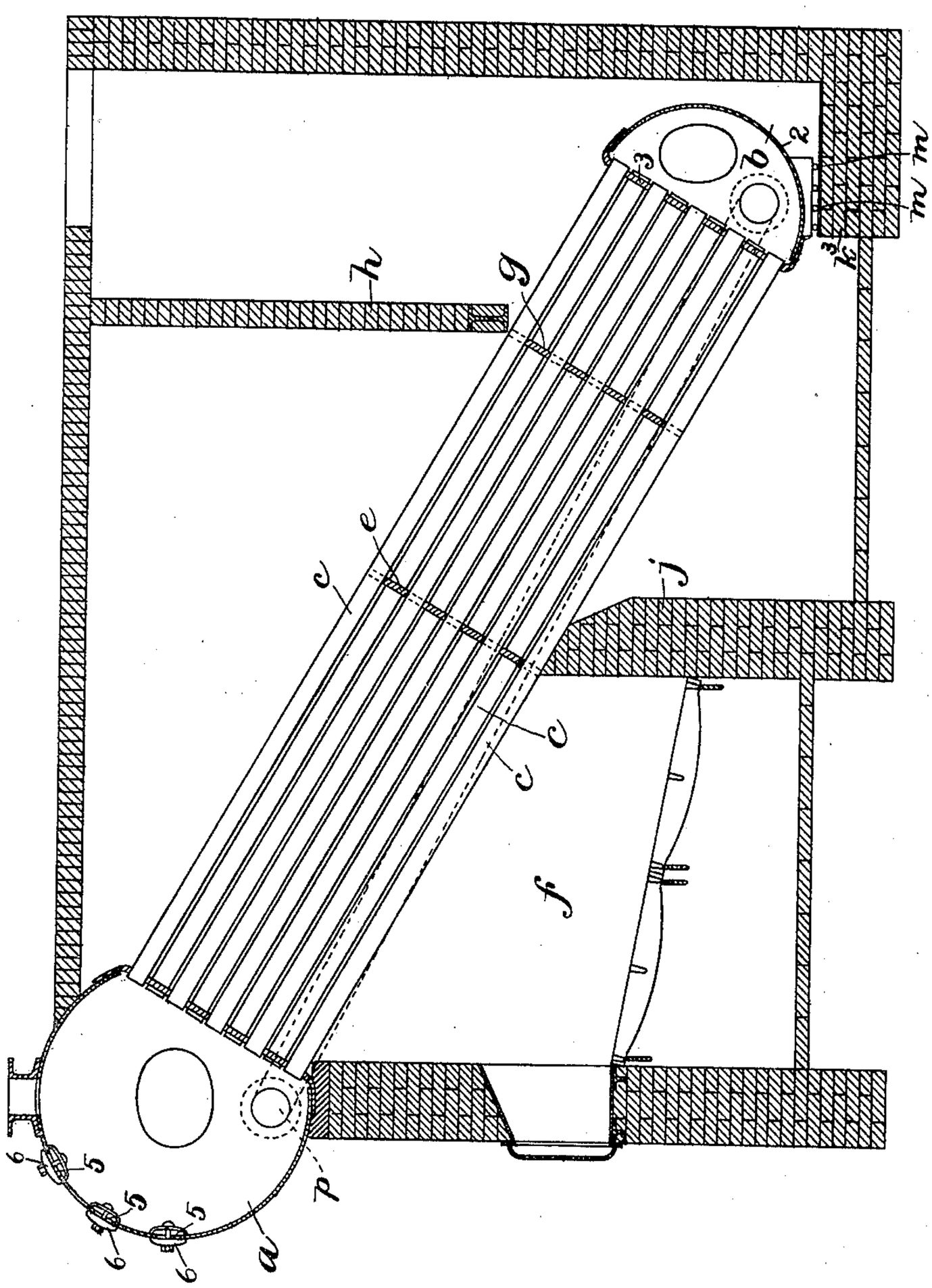


FIG. 1.



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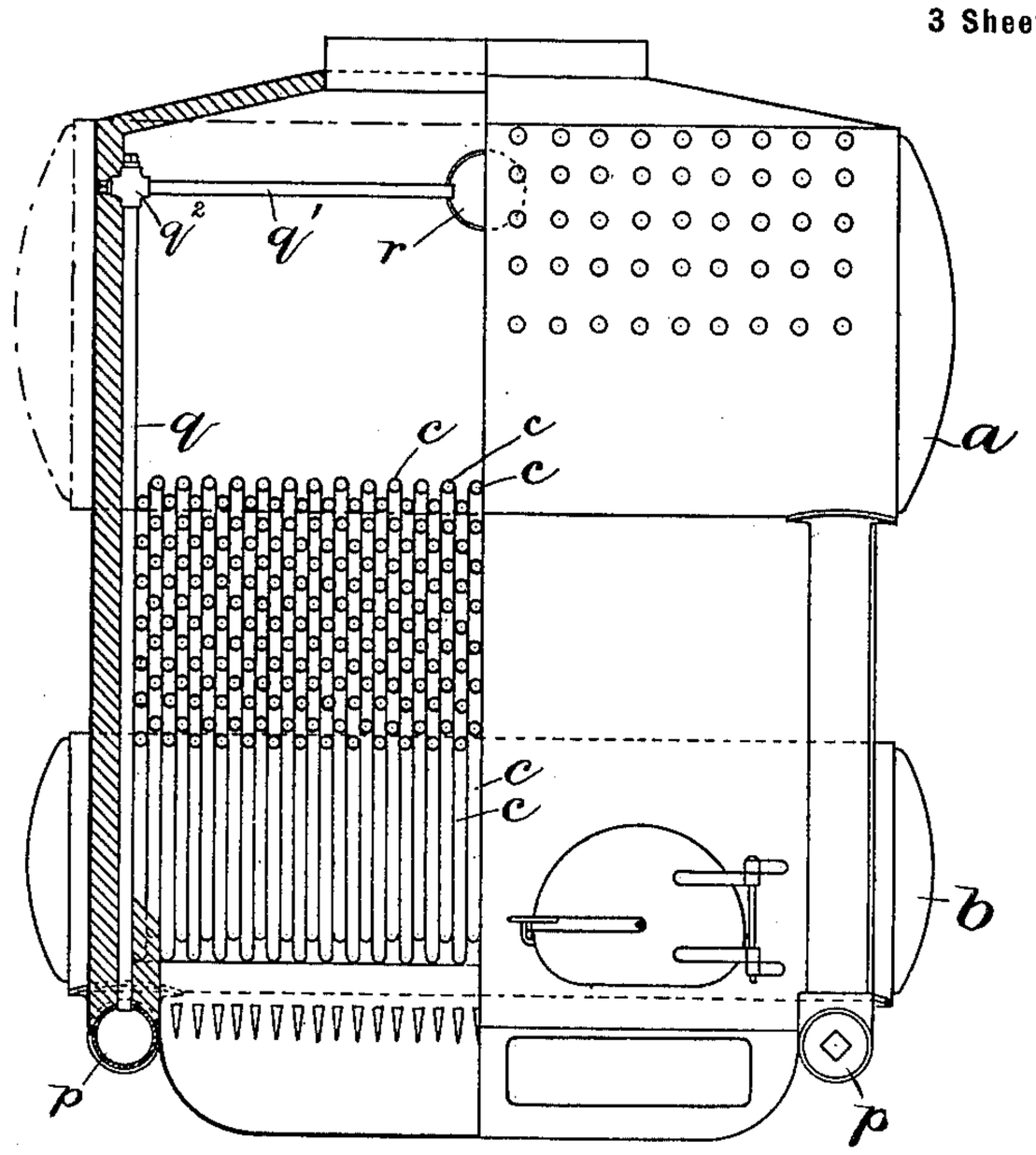
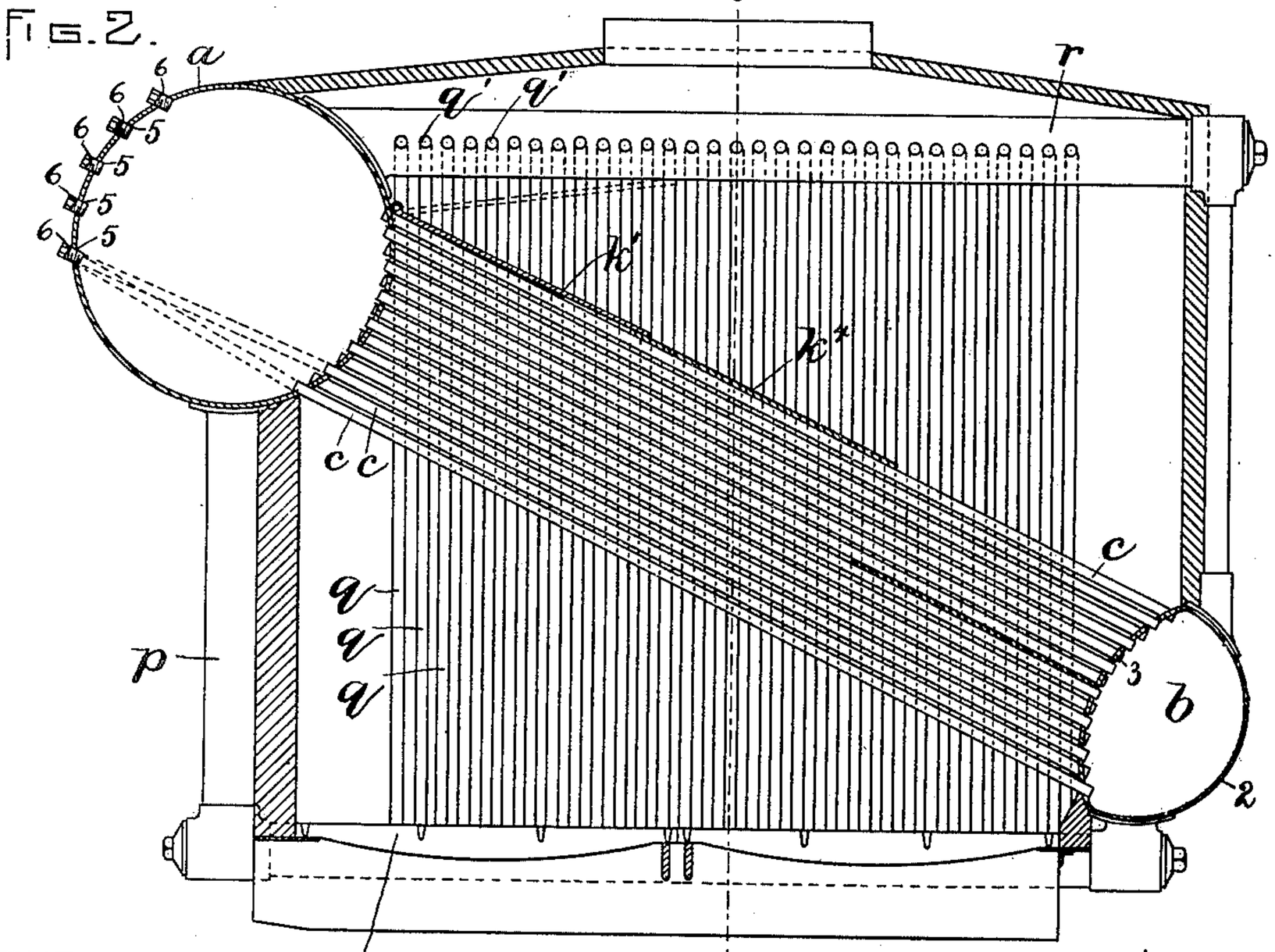
(No Model.) 3 Sheets—Sheet 2.

FIG. 3.



3

FIG. 2.



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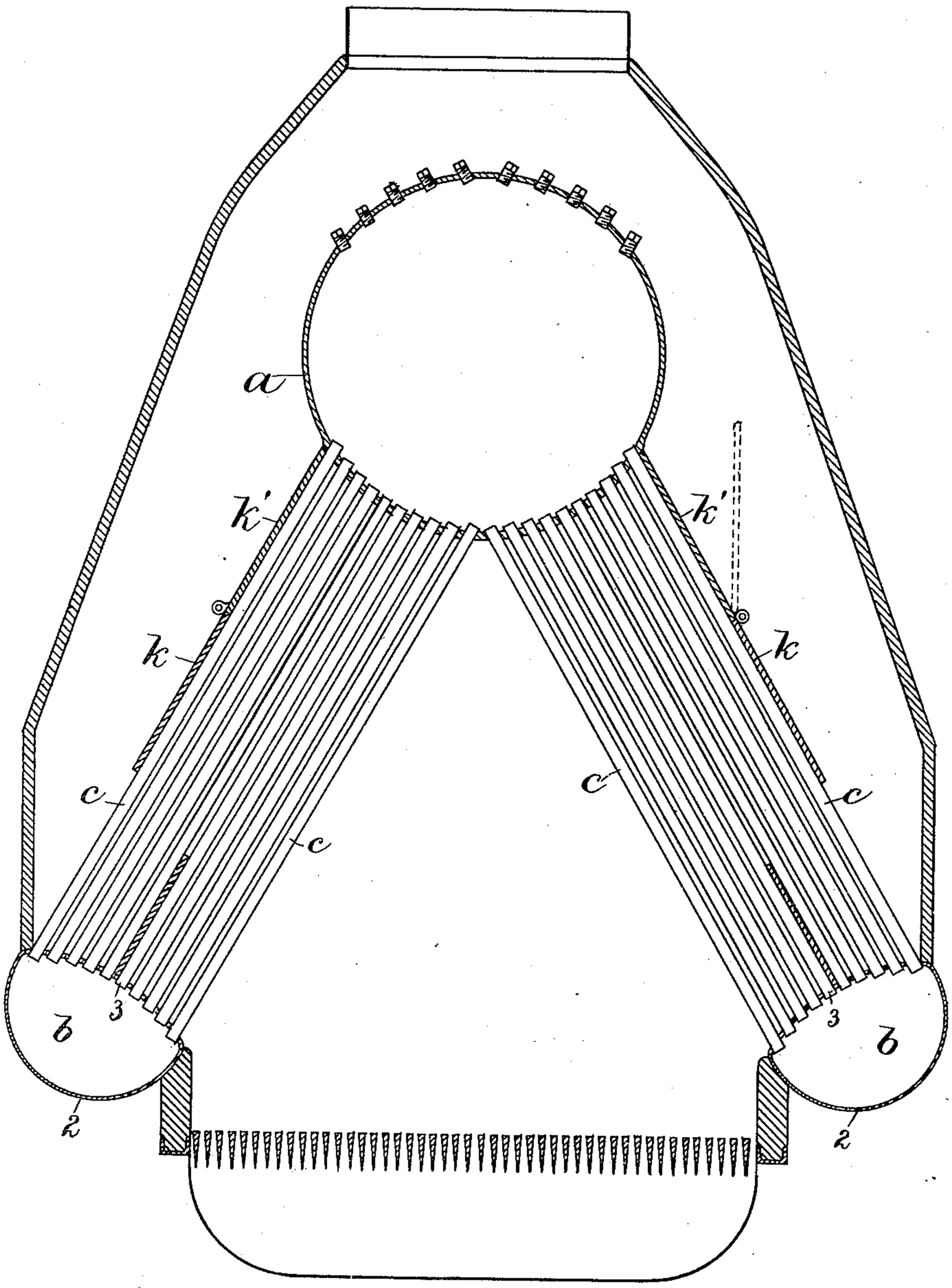
(No Model.) 3 Sheets—Sheet 3.

FIG. 4.



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UNITED STATES PATENT OFFICE.

CHARLES D. MOSHER, OF NEW YORK, N. Y.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 657,783, dated September 11, 1900.

Application filed April 25, 1894. Serial No. 508,970. (No model.)

To all whom it may concern:

Be it known that I, CHARLES D. MOSHER, of the city, county, and State of New York, have invented certain new and useful Improvements in Boilers or Steam-Generators, of which the following is a specification.

This invention relates to boilers or steam-generators which comprise a steam-drum, one or more water-drums located below the steam-drum, and a plurality of tubes connecting said drums, the said tubes being exposed to the action of the products of combustion from the fire, so that steam is generated therein and is delivered by the tubes to the steam-drum.

The invention has for its object to provide a steam-generator of compact and simple form adapted to be economically constructed and having all its parts so arranged that they can be readily inspected and cleaned and having its tubes so arranged that they can be readily replaced in case of accident and will deliver steam freely to the steam-drum.

The invention also has for its object to enable the products of combustion to be applied to the tubes in such manner as that the heat may be more fully absorbed and utilized than heretofore.

To these ends the invention consists in the improvements which I will now proceed to describe and claim.

Of the accompanying drawings, forming part of this specification, Figure 1 represents a longitudinal section showing the preferred construction, a generator having my improvements, when used with a brick casing or setting. Figs. 1^a and 1^b represent details hereinafter referred to. Fig. 2 represents a similar section showing certain additions. Fig. 3 represents a partial section on line 3 3 of Fig. 2. Fig. 4 represents a transverse section showing my improvements applied to a marine boiler or generator.

In the drawings, *a* represents the steam-drum, which is located at an elevated point. *b* represents a water-drum located below the steam-drum and parallel therewith, the two drums being connected by a plurality of tubes *c*.

In Fig. 1 I show but one water-drum, while in Fig. 4 I show two water-drums arranged equidistant from the steam-drum, the latter form being preferable for marine use.

A larger number of water-drums may be employed for marine use, if desired, each being connected with the steam-drum by a plurality of tubes *c*. It is very desirable that the tubes be straight, so that they can be readily inspected and cleaned. It is also desirable for the sake of compactness that the water-drums be reduced to as small a cross-sectional area as possible without unduly reducing the number of tubes that can be connected to the water-drums. I have therefore adopted a form of water-drum which will make practically the whole diameter or width of the drum available for the reception of the tubes, so that the group of tubes may be of practically the same width as the diameter of the water-drum, and have provided the steam-drum with openings in its upper portion, each opening coinciding with one tube, or, as I prefer, with a group of tubes, so that straight tubes of any desired length can be put in place and secured to the drums, each tube being introduced to place by passing it through an opening in the upper portion of the steam-drum and inserting it in the openings prepared for its reception in the lower portion of the steam-drum and in the upper portion of the water-drum.

In making the water-drum I retain the cylindrical form for the sake of compactness and strength so far as possible, the lower portion 2 of the drum being practically a half-cylinder, its upper portion 3 being reduced or given a flat or approximately-flat form, so that it constitutes a face or tube-sheet presenting a tube-receiving surface of practically the entire width or diameter of the water-drum.

The water-drum may be made in two sections, as shown in Fig. 1, the tube-sheet portion 3 being permanently attached by rivets to the main portion, or the said tube-sheet portion may be formed by reducing or flattening one side of a seamless lapwelded tube, the water-drum being thus given the form shown in Fig. 2.

In making the steam-drum I form a plurality of orifices 5, Fig. 1^b, in the upper portion of the drum, each of sufficient size to receive a tube and each provided with a plug 6 or other closing device whereby it may be closed steam-tight. I prefer to make each orifice 5 of such size that a group of three or more tubes may be inserted to place through

one orifice, this arrangement reducing to the minimum the weakening of the drum by the formation of the orifices 5 therein. By so arranging the tube-receiving orifices in the lower portion of the steam-drum relatively to the tube-admitting orifices 5 that each orifice 5 will coincide with the center of a group of three or more tube-receiving orifices three or more tubes can be admitted singly through an orifice 5 but slightly larger than the diameter of one of the tubes, the lower orifices in the steam-drum being of such size that the tubes fit them somewhat loosely, so that the tubes can be inclined, as indicated in dotted lines in Fig. 2, while they are being admitted or moved to place.

It will be seen that by the described improvements I secure the following advantages, namely: first, compactness, due to the reduction or flattening of the upper portions of the water-drums, their form enabling much smaller water-drums to be used with a given number of tubes than would be possible if the drums were entirely cylindrical; second, convenience of application of the straight tubes to the drums without regard to their length, and, third, convenience of removal of a worn or defective tube without disturbing the adjacent tubes, this being a point of great importance.

A furnace or fire-box is arranged in suitable proximity to the tubes, so that they will be advantageously heated. I prefer to so arrange the tubes relatively to the fire-box and the outlet-passage conducting the products of combustion to the stack that the heated gases coming directly from the fire will first sweep through the spaces between the upper portions of the tubes and will then be deflected and pass between cooler lower portions of the tubes, so that a considerable portion of the heat which was not absorbed by the water and steam in the upper portions of the tubes will be absorbed by the cooler water in the lower portions of the tubes, thus utilizing to a high degree the thermal efficiency of the fuel. In the construction shown in Fig. 1 this result is produced by means of a baffle-plate *e*, extending upwardly from the bridge-wall *j* at the rear of the fire-box *f*, said baffle-plate extending across the spaces between the tubes, a downwardly-projecting wall or partition *h* in the chamber or space above the tubes, and a baffle-plate *g*, extending downwardly from the partition *h* across the spaces between the tubes. Said baffle-plates and partitions cause the gases, &c., to sweep first through the spaces between the upper portions of the tubes, where the heat of the contents of the tubes is greatest, and then pass downwardly and again upwardly between lower portions of the tubes, where the water is at a lower temperature.

In the construction shown in Fig. 4, two water-drums being employed, the fire-box is located between the water-drums and between the two series of tubes. The gases, &c., pass upwardly from the fire-box and laterally between the hotter upper portions of the tubes and are then deflected downwardly by baffle-plates *k k*, which extend from the steam-drum downwardly along the outer sides of the groups of tubes nearly to the lower ends of the latter, as shown in Fig. 4, so that the heat-absorbing surfaces last encountered by the partially-cooled gases are the cooler portions of the tubes.

When the water-drum is elevated, so that it is subjected to lateral strains by the expansion and contraction of the tubes, as in the arrangement shown in Fig. 1, I prefer to provide for the lateral movement of said water-drum to compensate for such expansion and contraction. This may be effected by means of an expansion-joint between the drum and its support, the latter being here shown in Fig. 1 as a brick wall k^3, so that the drum may yield to said strains without detriment to its connection with its support. To this end I show the water-drum in Fig. 1 provided with rollers *m m*, resting on a flat surface on the support *k*, so that the drum may move laterally, as required by expansion and contraction of the tubes.

In Fig. 1ª I show the water-drum supported by slings k^2, composed of vertical rods attached at their upper ends to fixed supports on the casing and at their lower ends to the water-drum.

The steam-drum is connected with the water-drum in Fig. 2 by return water-pipes or conduits *p*, which are preferably constructed to extend downwardly from the end portions of the steam-drum to points below the grate and then horizontally to points under the end portions of the water-drums to which said return-pipes are connected. This arrangement is particularly convenient when a series of boilers are grouped together in a battery, the steam-drums being placed end to end, so that there is not room between their ends for the return-pipes. The arrangement of return-pipes shown in Figs. 2 and 3 enables me to obtain increased heating-surface and protect the sides of the casing by the employment of tubes *q*, rising from the horizontal portions of the return-pipes and connected at their upper portions with a horizontal tube or header *r*, extending rearwardly from the steam-drum and communicating therewith. The tubes *q* are separated by spaces through which the products of combustion pass. Their upper ends may be bent inwardly and connected with the header *r;* but I prefer to provide each tube with a cross q^2 at its upper end and connect each cross by a short horizontal tube q' with the header *r*. The crosses q^2 enable access to be conveniently had to the ends of the tubes *q q'* for the purpose of expanding or cleaning the same, the branches of the crosses in line with the branches attached to the said tubes being provided with removable caps or plugs, which when removed permit the insertion of expanding or clean-

ing tools into the tubes q q'. In a single boiler of this construction the return-pipes may enter the ends or heads of the steam and water drums and pass directly from one drum to the other, as shown in dotted lines in Fig. 1.

The drums are provided with suitable manholes and hand-holes and covers therefor, and the steam-drum will have the usual fittings, such as gage-glasses, testing-cocks, &c.

When the return-pipes extend in an inclined direction from the steam-drum to the water-drum, as shown in Fig. 1, their construction is made sufficiently elastic to permit the movements of the water-drum caused by expansion and contraction of the tubes by elbows or curved portions at the ends of the main portions of the return-pipes, said elbows being sufficiently flexible to give the water-drum the necessary freedom of movement.

In Fig. 2 I show a baffle-plate k^4, corresponding to the baffle-plates k in Fig. 4. Each of said baffle-plates k and k^4 has a damper k', which may be opened to promote the draft when first starting the fire, after which said damper may be closed.

I claim—

1. In combination an upper chamber, a pair of lower chambers, groups of tubes connecting the upper with the lower chambers, plug-holes in the upper chamber through which the tubes are adapted to pass, and plugs for closing the holes.

2. In combination an upper chamber, a pair of lower chambers, groups of tubes connecting the upper with the lower chambers, a row of plug-holes in the upper chamber opposite to each group of tubes, through which the tubes are adapted to pass, and plugs for closing the holes.

3. A boiler or steam-generator comprising in its construction a cylindrical water-drum, flattened or reduced at its upper portion to form a tube-sheet which is flat or approximately flat, a series of straight tubes extending upwardly from said tube-sheet substantially at right angles with the water-drum, and a cylindrical steam-drum to the lower part of the cylindrical portion of which the upper ends of said tubes are attached, said tubes being inserted substantially the entire length of said drums, said steam-drum being parallel with the water-drum and having in the upper part of its cylindrical portion a plurality of holes provided with detachable plugs or covers, each hole being opposite a tube or group of tubes, so that the tubes can be introduced by passing them through the said openings and the steam-drum.

4. A boiler or steam-generator comprising in its construction an elevated steam-drum, a plurality of water-drums located below and parallel with the steam-drum, each water-drum being connected with the steam-drum by a series of straight tubes, a furnace or fire-box between the water-drums and between the series of tubes, and a baffle-plate extending downwardly from the steam-drum at the outer side of each series of tubes, whereby the products of combustion after rising and passing between the inner tubes are diverted downwardly and caused to pass between the cooler or outer tubes, said cooler tubes absorbing heat from the products of combustion just before said products escape to the stack, as set forth.

5. A boiler or steam-generator comprising in its construction a water-drum, a steam-drum located higher than the water-drum, a plurality of tubes connecting said drums, a furnace or fire-box at one side of the series of tubes, an outlet for the products of combustion at the opposite side of said series, a baffle-plate extending downwardly from the steam-drum at the opposite side of the series of tubes from the fire-box whereby the products of combustion are caused to first pass upwardly along and between the inner tubes of the series and are then guided downwardly along and between the outer tubes of the series, and extensions hinged to said baffle-plates and adapted to be raised and lowered, as set forth.

6. A boiler or steam-generator comprising a steam-drum, a water-drum located at a lower point than the steam-drum, a series of straight tubes connecting said drums and exposed to the heat from the fire-box, return-pipes connecting the end portions of said drums, a part of each return-pipe being substantially horizontal, and vertical tubes extending upwardly from the horizontal portions of the return-pipes, and connected at their upper ends with a horizontal header communicating with the steam-drum.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 17th day of April, A. D. 1894.

CHARLES D. MOSHER.

Witnesses:

C. F. BROWN,

A. D. HARRISON.