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STEAM BOILER.

No. 539,290. Patented May 14, 1895.

FIG. 1

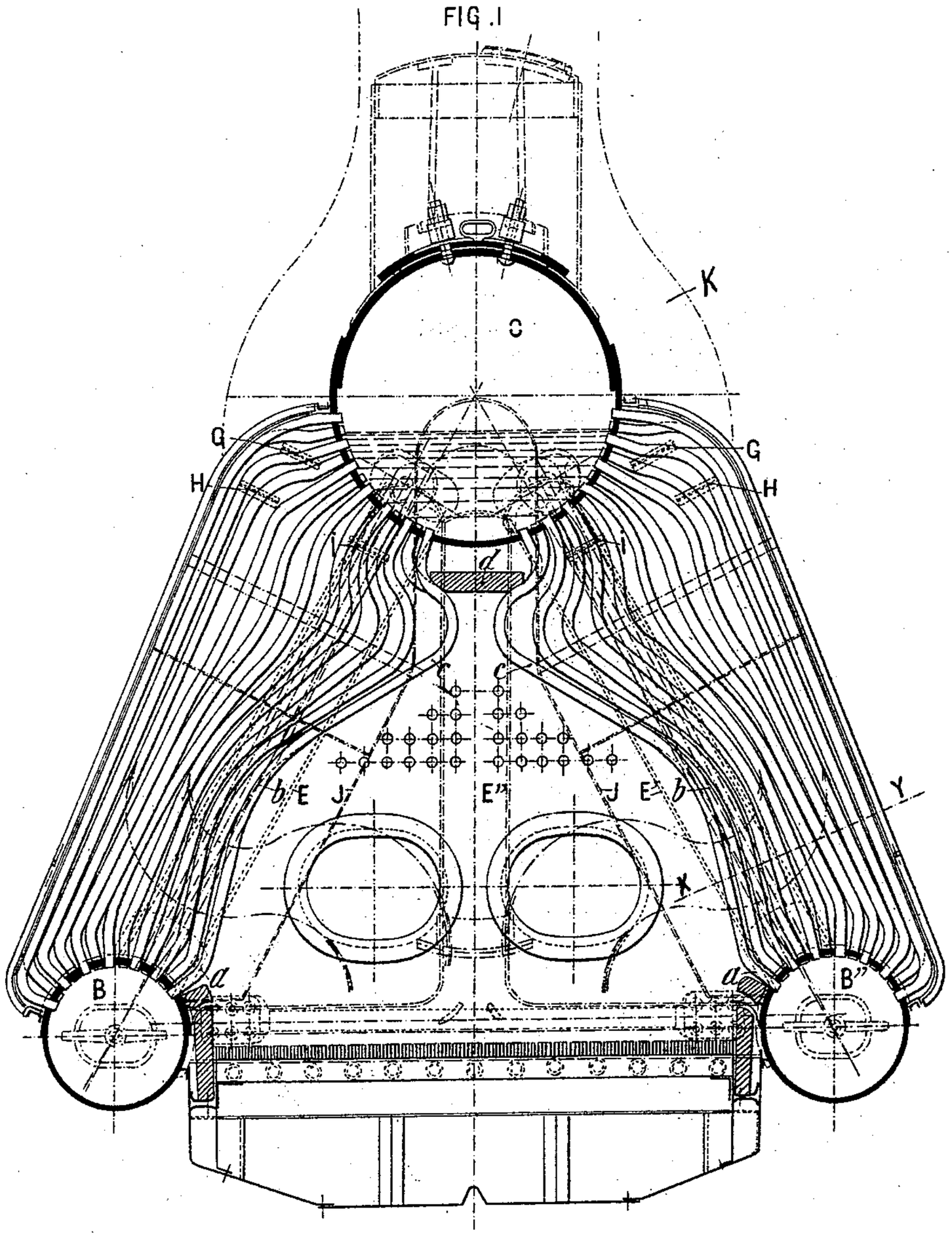

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FIG. 2

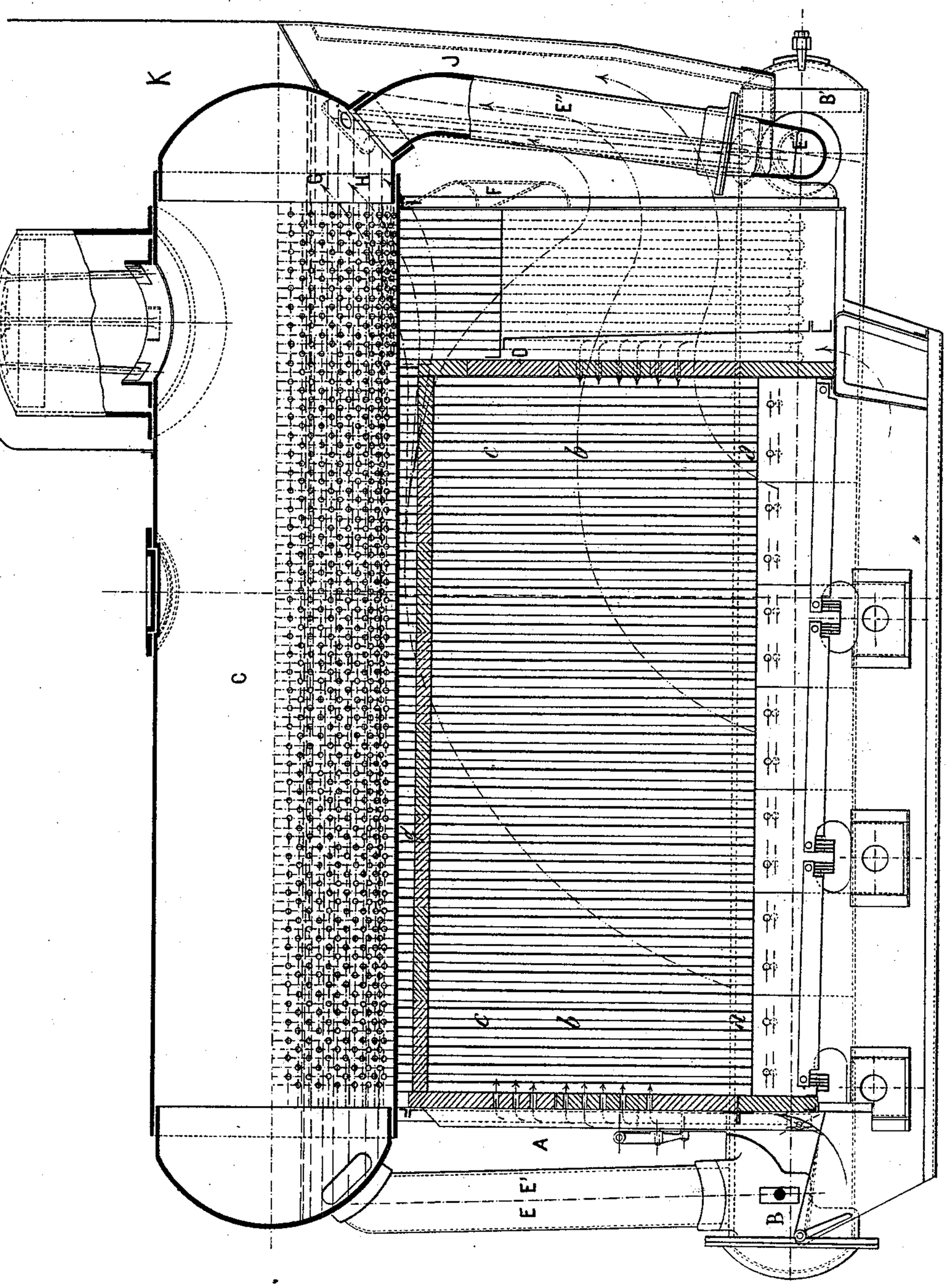

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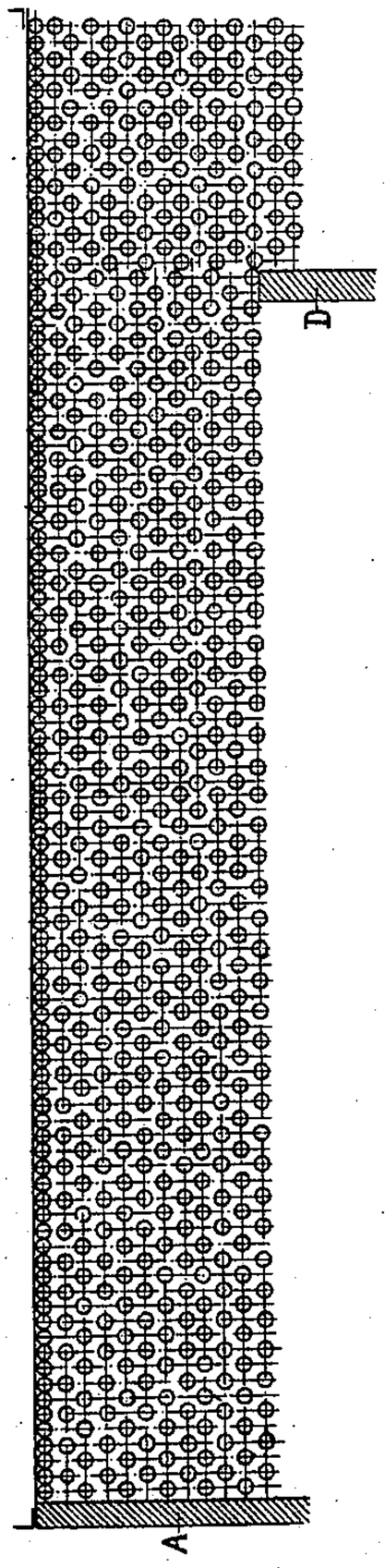
FIG.3



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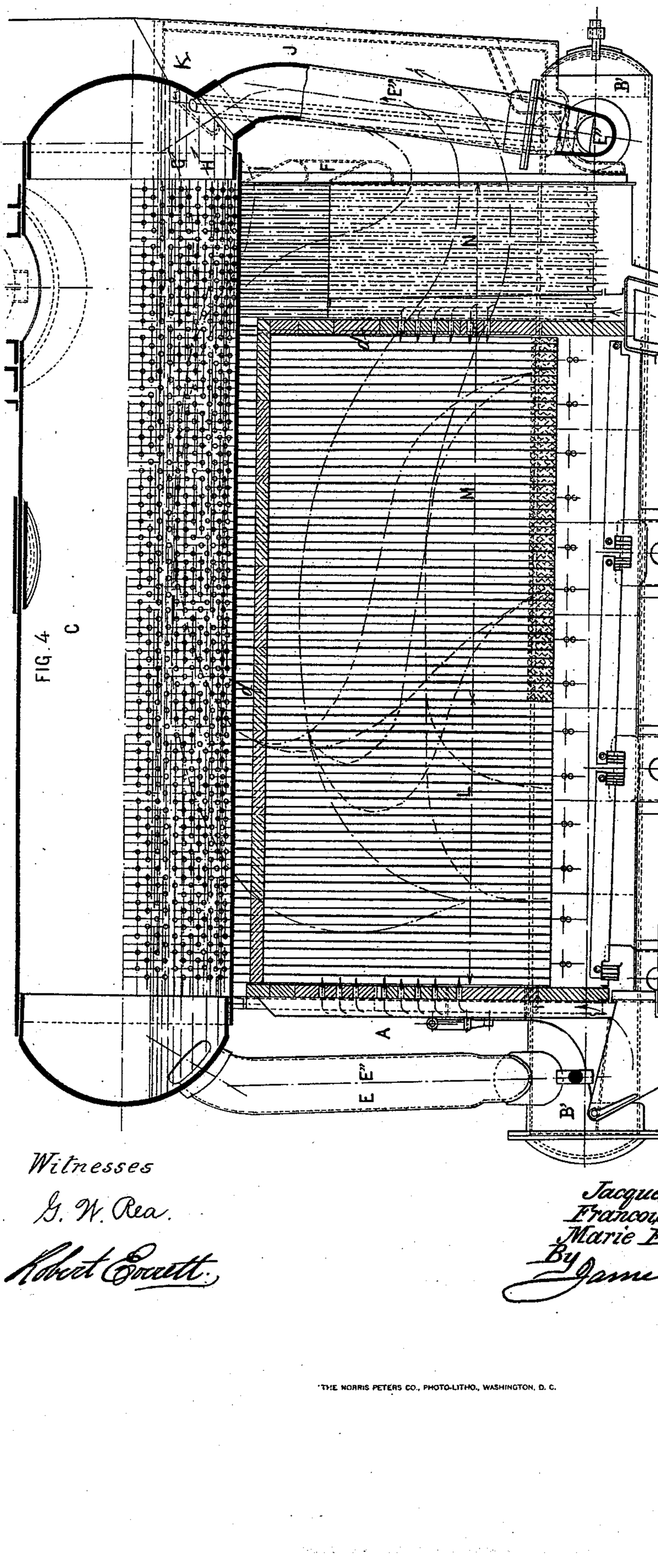

FIG. 4

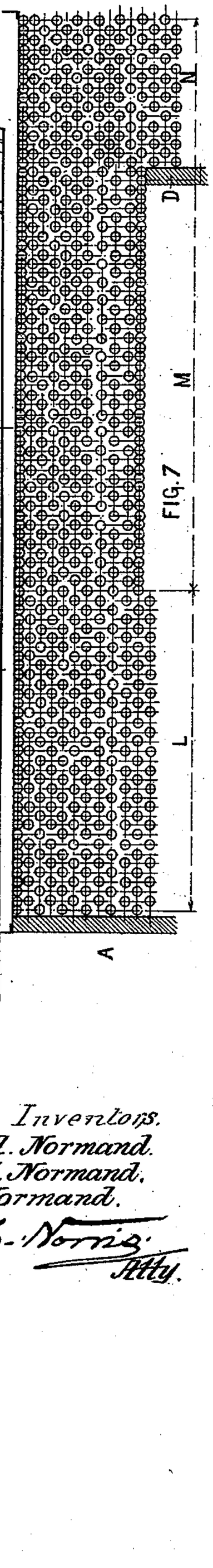

FIG. 7

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STEAM BOILER.

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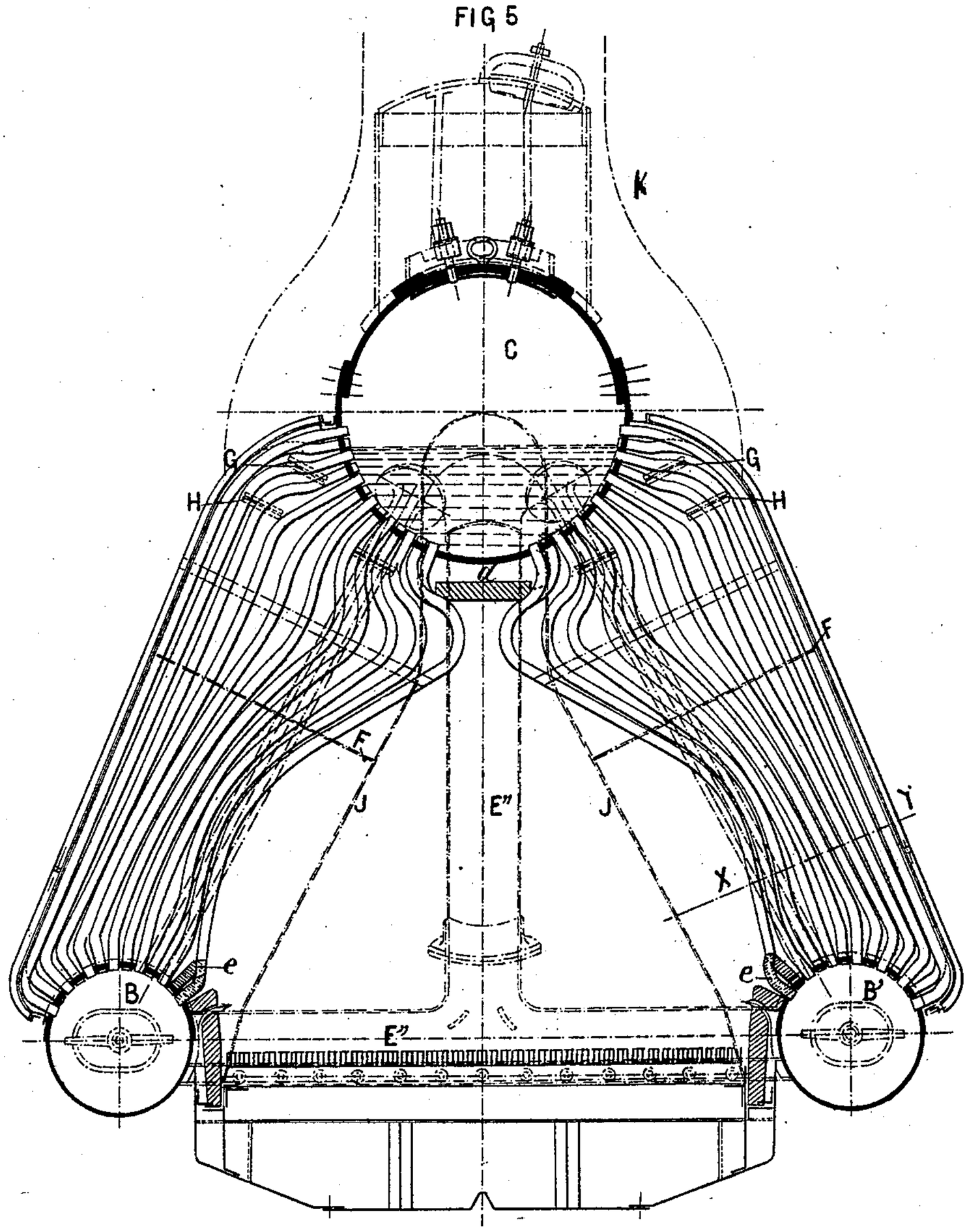
FIG 5



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STEAM BOILER.

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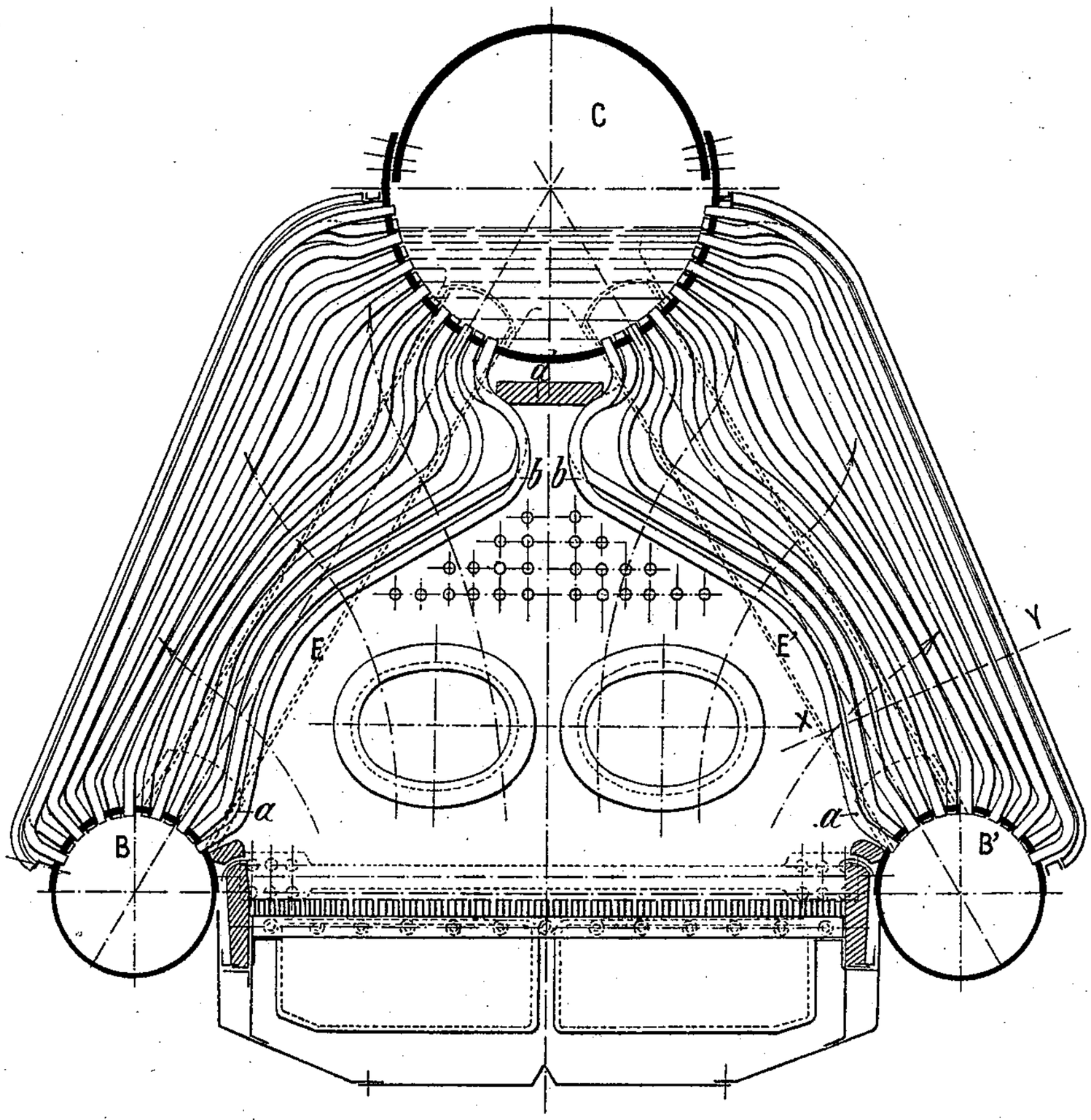
FIG.6



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UNITED STATES PATENT OFFICE.

JACQUES AUGUSTIN NORMAND, FRANCOISE ELISABETH NORMAND, AND MARIE EMILIE NORMAND, OF HAVRE, FRANCE.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 539,290, dated May 14, 1895.

Application filed January 12, 1895. Serial No. 534,716. (No model.) Patented in France October 10, 1894, No. 241,976, and in Italy January 16, 1895, LXXIV, 232.

To all whom it may concern:

Be it known that we, JACQUES AUGUSTIN NORMAND, FRANCOISE ELISABETH NORMAND, and MARIE EMILIE NORMAND, citizens of France, and residents of Havre, in the Department of Seine-Inférieure, France, have invented a new and useful Improvement in Steam-Boilers, (for which we have obtained Letters Patent of France, dated October 10, 1894, No. 241,976, and of Italy, dated January 16, 1895, No. 232, Vol. LXXIV,) of which the following is a specification.

This invention relates to improvements in the construction of steam generators of the class known as multitubular boilers. Boilers of this class comprise heating tubes the greater part of which open or discharge below the level of the water contained in an upper reservoir, and the hot gases in the boilers, after having circulated round the tubes, pass off through the chimney situated at the end opposite to the front of the boiler. Steam generators constructed in this manner should yield more steam, and at a less cost, than the boilers in which the water is made to circulate within the tubes and where the chimney is situated immediately above the grate, inasmuch as the combustion chamber is of greater capacity, the position of the tubes more closely approaches the vertical line, and the sectional area available for the passage of the gases is less and the course of such gases is further extended. These circumstances are calculated to provide thorough combustion, an active circulation of water, as uniform as possible a utilization of the heating surface, and a rapid and energetic displacement of useful gases capable of assisting the transmission of heat. It has however been found that the yield of steam generators of the construction referred to, though slightly greater than that of the older boilers, does not offer over the latter the superiority expected. In order that this may be more clearly understood reference will be made to the accompanying drawings, in which—

Figures 1 and 2 are respectively a transverse and a longitudinal section of a boiler of the type referred to as at present constructed—*i. e.*, one, of which the yield is considered insufficient. Fig. 3 is a section of one of the series of tubes, taken on line X Y, Fig. 1. Fig. 4 is vertical longitudinal section of one form of boiler embodying our present invention. Fig. 5 is a vertical transverse section of the same, taken in that portion of the length of the tubes which is designated by the letter L in Figs. 4 and 7. Fig. 6 is a similar section in that portion or length of the tubes designated by the letter M in Figs. 4 and 7, and Fig. 7 is a longitudinal oblique section on the line X Y of Figs. 5 and 6.

Referring first to the construction shown in Figs. 1, 2 and 3 A is the front of the boiler, immediately connected with the heating chamber.

B B′ are side reservoirs or chambers receiving the lower parts of the heating tubes.

C is the central reservoir or chamber receiving the upper ends of the said tubes.

D is the main bridge situated at the end of the grates.

E E′ E″ are water return tubes situated outside the furnace.

F is an inverted end-bridge under which the hot gases are caused to pass before entering the smoke-box and chimney.

G, H, I are apertures provided in the upper portion of the inverted bridge F.

J is the smoke-box.

K is the chimney.

In boilers of the present construction the hot gases pass among the lateral series of pipes through apertures provided throughout the length of the grates. As a rule these apertures or passages occupy the lower part of the series of tubes only, as from *a* to *b*, Fig. 2. In some cases, however, they have extended farther upward say from *a* to *c* and in any case as before stated, the said apertures extend throughout the length of the grates. Suitable brickwork *d* prevents the flame from circulating among the upper part of the series of tubes.

It will readily be seen from the arrows in Fig. 1 which indicate the most probable course of the hot gases, that, first, the gases circulating among the series of tubes in the vicinity of the bridge D have but a short distance to travel before they reach the chim-

ney, and therefore escape at a very high temperature and may even carry flames into the chimney; second, the upper part of the series of tubes next to the front, is necessarily more or less avoided by the said gases, and third, the gases drawn into the chimney, which they enter upon passing under the inverted bridge F, must needs take the shortest way leading in that direction, and therefore but imperfectly heat the upper portion of the series of tubes. Such is, of necessity, the effect produced in spite of the tendency of the gases to rise, and notwithstanding the provision of the small apertures G H I, the object of which is to cause the gases to follow the upper part of the series of tubes situated next to the chimney.

The object of our invention hereinafter described is to enable the series or bundles of heating tubes to be utilized more fully than has been done hitherto, both in height (or depth) and length, and thereby to provide for a better combustion of the gases by compelling them to remain for a longer space of time in the combustion chamber before passing among the series of heating tubes. For this purpose the gases are admitted to circulate among the series of tubes in the vicinity of the front portion of the boiler only, or in other words at the end which is farthest removed from the chimney, the flow of such gases being, at the same time, spread out over as extensive an area as possible in the upward direction. In this manner the total length and height (or depth) of the series of tubes are traversed by the gases before they escape into the chimney Figs. 4, 5, 6 and 7 of the accompanying drawings represent one form n whiich this purpose may be carried out. In order to enable the invention to be better understood the boiler is supposed to be identical with that already described with the exception of the series of heating tubes, the arrangement of which is modified in accordance with the improvements, which constitute the present invention.

The length or portion of the tubes marked L (Figs. 4 and 7) which is nearest to the heating chamber, is open throughout the maximum area available in the direction of the height of the boiler; that is to say, the curve of the tubes, as indicated in Fig. 5, is such that the gases may pass among the side tubes between *a* and *b*. Throughout the length of tubes marked M, Figs. 4 and 7, which length occupies the remaining part of the furnace, the hot gases are incapable of entering the series of tubes which are so arranged as to form as tight an arch as possible. For this purpose, as shown in Figs. 6 and 7, the two inner rows of tubes on each side are brought into the same plane so as to form an arch or wall. They will then be contiguous if the distance of the two transverse rows be equal, or nearly so, to the external diameter of the tubes. The interstices, if any, are preferably calked with asbestos or other fireproof material, while wider spaces at *d* and *e*, which may exist between them in the vicinity of the upper and lower reservoirs, are filled up with cement, bricks of a particular shape, asbestos or any other suitable material capable of preventing the flame and hot gases from entering in appreciable quantities.

The arrows in Figs. 4 and 5 indicate the course which the hot gases are likely to take.

It will be understood that as the sectional area of the currents of gases through the series of tubes is proportional to the length L and to the height *a b* of the admission sections, the said length L may be so much the smaller as the height of the boiler is greater; and, furthermore, that owing to the arrangement of the tubes, such height may be increased without fear lest the upper portion of the tubes be not fully taken advantage of, in the process of steam-production.

The portion of the tubes occupying the length N, situated between the main bridge D and the inverted bridge F (Fig. 4), has for its object to increase the heating surface. It is not absolutely necessary however and may be dispensed with if preferred.

In order to insure the circulation of gases among the series of tubes at the greatest possible distance from their point of issue, and in order to avoid the flames from being extinguished immediately upon entering, a portion of the tubes may be dispensed with in the length L nearest to the front.

The inner screen or arch of the series of tubes in the length M is formed by bringing together the two innermost longitudinal rows of tubes upon the same plane. In that case it may happen that the heating surface exposed to the direct action of the flame is insufficient. It may however be materially increased by combining, upon the same surface, the third and fourth rows of tubes instead of the first and second. In this case the first and second longitudinal rows would be subjected to the direct action of the fire throughout, and assist, under certain circumstances, the full combustion of the hot gases before they enter the tubes in which they are speedily extinguished.

The improved generator as described consists of an upper reservoir and two lower reservoirs connected by two equal and symmetrical series of tubes. Other arrangements, however, may be adopted if required.

The number of main return tubes, of which there are three in the present instance, may be more or less as may be required; the single tube, for example, which is shown situated in the rear in the vicinity of the chimney, being dispensed with.

What we claim as our invention is—

In multitubular steam generators of the type herein described and having the chimney situated at the end opposite to the boiler front, the combination with the lower cham-

bers B B′, the upper chamber C, the main bridge D situated at the rear end of the grates, the smoke box J and the inverted bridge F intermediate the upper portions of the main bridge and smoke box, of the series of heating tubes L connecting the forward portions of the chambers and spaced apart or open throughout the maximum area available in the height of the boiler, and the heating tubes M connecting rear portions of the chambers and closely arranged to form a tight arch, whereby the hot gases can only pass among the tubes in the vicinity of the boiler front and not throughout the length occupied by the grates, substantially as set forth.

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

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