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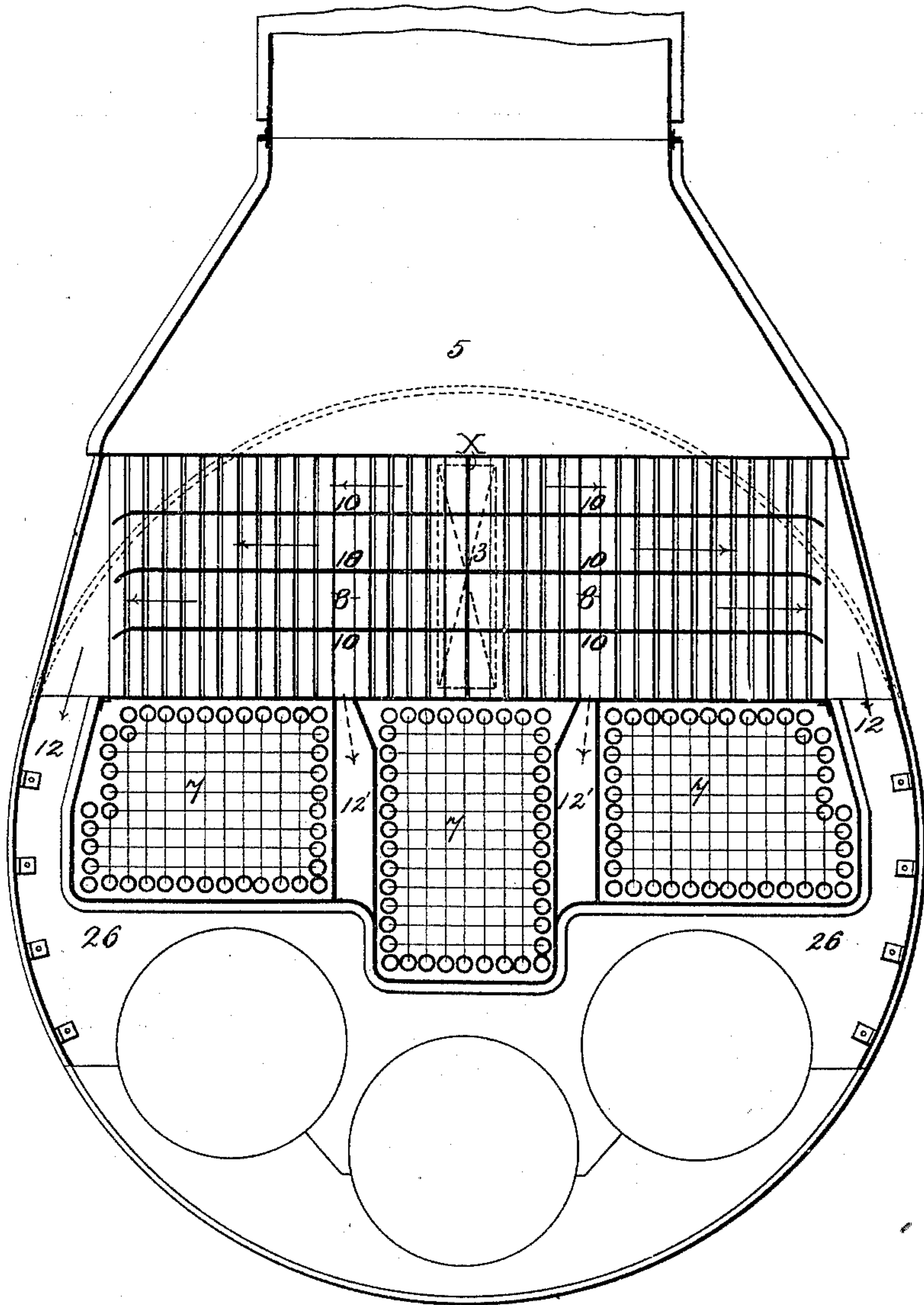
4 Sheets—Sheet 1.

J. HOWDEN.  
APPARATUS FOR HEATING AIR.

No. 518,455.

Patented Apr. 17, 1894.

FIG. 1.



WITNESSES:

*George Baumann*  
*Edith J. Griewold*

INVENTOR

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BY  
*Howden and Howden*  
his ATTORNEYS.

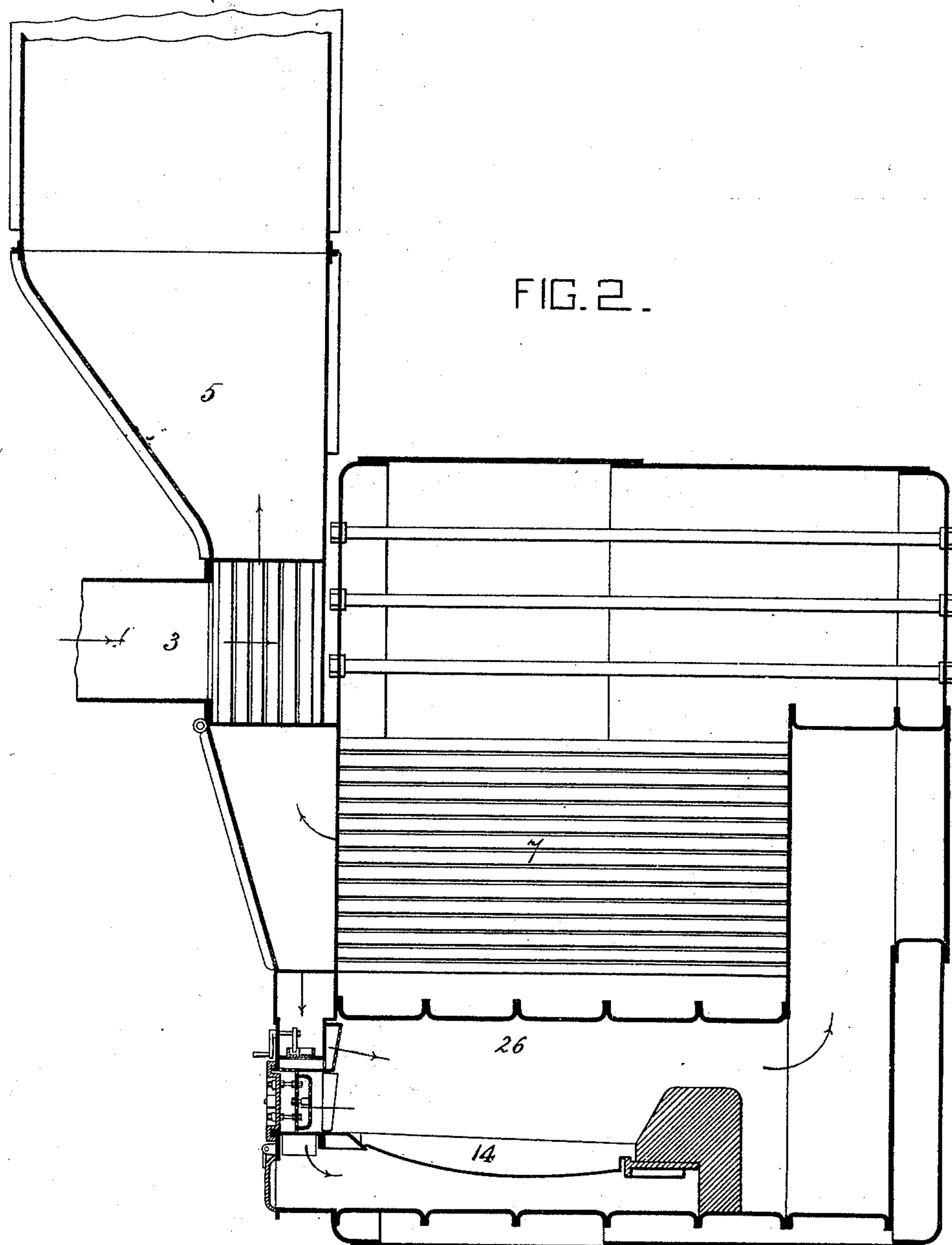
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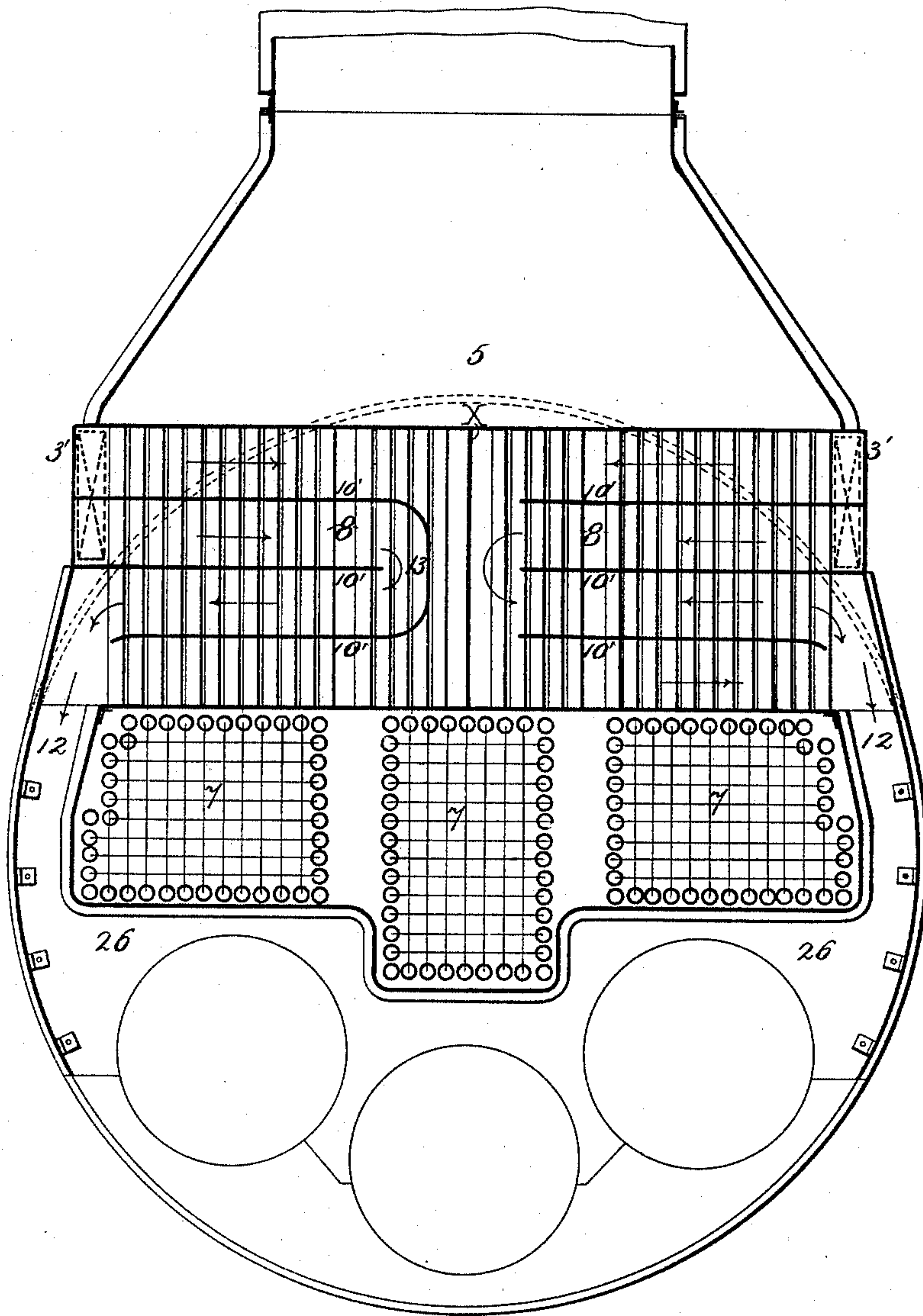
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FIG. 3.



WITNESSES:

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(No Model.)

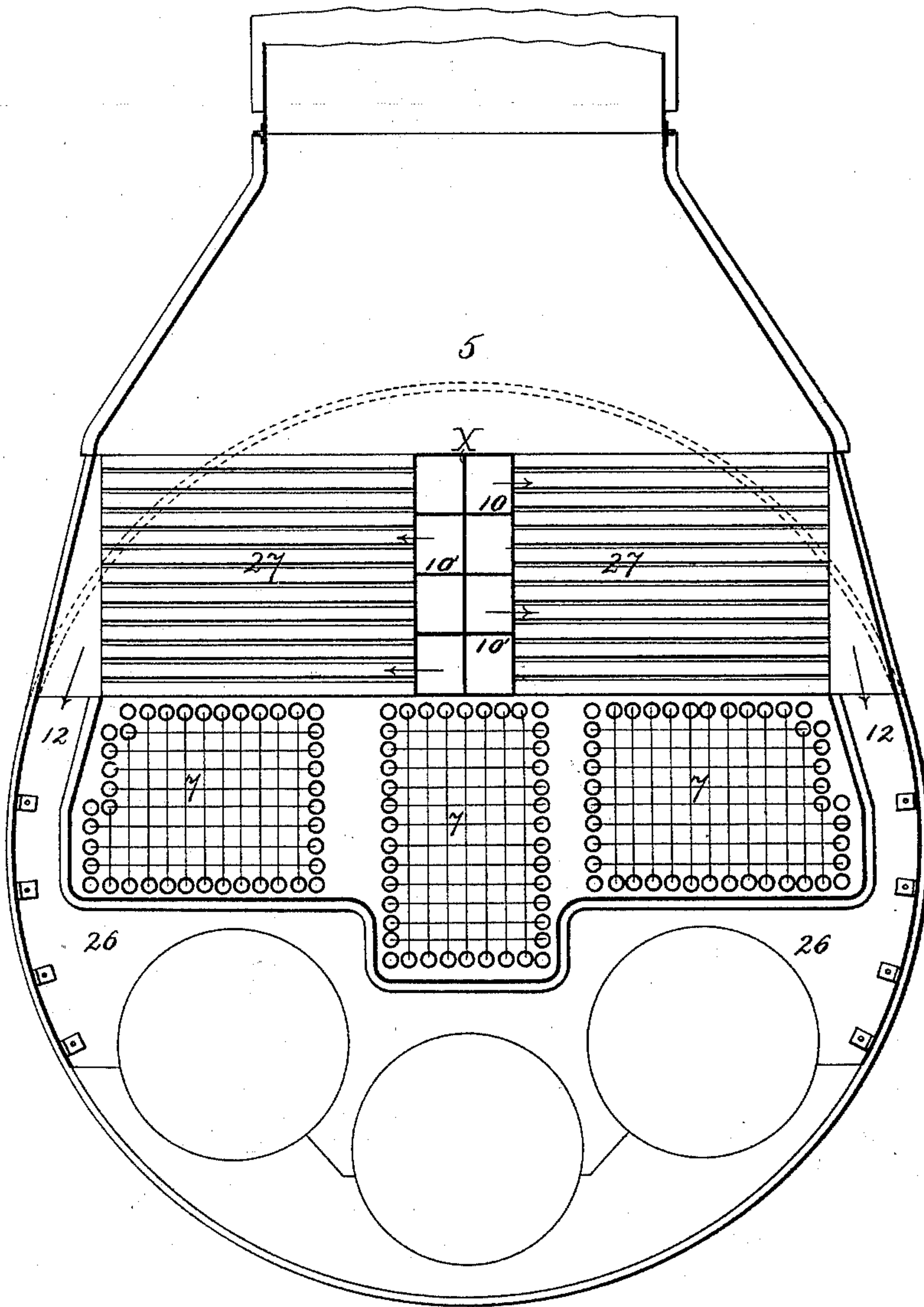
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FIG. 4.



WITNESSES:

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# UNITED STATES PATENT OFFICE.

JAMES HOWDEN, OF GLASGOW, SCOTLAND.

## APPARATUS FOR HEATING AIR.

SPECIFICATION forming part of Letters Patent No. 518,455, dated April 17, 1894.

Application filed August 21, 1893. Serial No. 483,687. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES HOWDEN, a subject of the Queen of Great Britain and Ireland, and a resident of Glasgow, Scotland, have invented Improvements in Apparatus for Heating Air in Steam-Boiler Furnaces, of which the following is a specification.

My invention relates to steam boilers, the furnaces of which are supplied with air heated by heat remaining in the fire gases after they have acted on the heating surfaces of the boiler, and is more particularly intended as an improvement upon the invention, for which I obtained Letters Patent November 13, 1883, No. 288,437.

According to my former invention, the fire gases pass through horizontal tubes in the boiler to a smoke box or boxes, and thence, in one form of heating apparatus, through vertical tubes to the up-take, these vertical tubes being in a casing through which the air was caused to pass by fans or other blowing apparatus on its way to the furnaces.

The object of my present invention is to render the heating action of the fire gas tubes more efficient and uniform, and to make the passage of the air through the casing easier and more economical in propelling power.

In order to utilize a substantial amount of the heat of the fire gases the tubes through or over which the gases pass should be as long as the space available will allow. In arrangements of air-heating casings heretofore, the air is not uniformly distributed over or through the tubes, but passes irregularly to the outlets or flues from the casing. It is this defective action which I propose to remedy.

In the accompanying drawings, Figure 1 is a sectional elevation of the smoke box end of a marine boiler, constructed in accordance with my invention. Fig. 2 is a longitudinal section of the same. Fig. 3 is a view, corresponding with Fig. 1, but of a modification: and Fig. 4 is a sectional view of another modification.

The air supply comes into the air heating chamber in the smoke box either at or near the center or at opposite sides. In most cases I prefer to provide a central vertical division plate X, separating the air heating chamber into right and left compartments, but this central division plate is not necessary in all cases.

In the construction shown in Figs. 1 and 2, the inlet 3 for the air under either pressure or suction is arranged to deliver the air close to the middle plate, equally on each side of it, and from the top to the bottom of it or nearly so. Each compartment through which pass the vertical air-heating tubes 8 for the products of combustion, is divided by three horizontal partitions 10 into four horizontal spaces which may be of equal or varied depths. The horizontal partitions extend close to the middle vertical division plate so that altogether the entering air is subdivided into eight streams. At the outer ends of the horizontal partitions the four streams of air of each set unite and pass down the side flues 12 past the smoke box compartments 7, 7 to the casing or chamber 26 from which the air is distributed above and below the grates 14 of the furnace. Each of the subdivided streams of air is compelled to pass in contact with the tubes 8 in the space it passes through, in an effective manner, and as the aggregate cross sectional area of the air passages is comparatively large the rate of flow is comparatively slow, the air thus having more time to take up heat, and requiring less power to propel it, owing to diminished resistance. If found desirable in boilers with three or four furnaces, a part of the stream of air from the lower or hottest zone in the air heater may be allowed to pass down passages or flues 12' between the central and the side smoke-box compartments, as indicated by the dotted arrows, as well as through the side down flues 12.

In some cases in which the air-heating tubes are comparatively short there may be in each compartment only two or even only one instead of three horizontal partitions 10; and on the other hand there may be more than three horizontal partitions if found advantageous.

In the modifications shown in Fig. 3 in which the air-heating casing is divided by a middle vertical division plate X, as before, each compartment receives an equal supply of air at its outer upper corner at 3' and each supply is divided by horizontal partitions 10' into two streams which first proceed toward the middle and then return through lower spaces to delivery outlets at the sides. The several spaces may communicate with each other at the middle as shown at the right, but



preferably they are kept separate by partitions 13, as shown at the left.

In the modification, Fig. 4, the products of combustion from the smoke boxes pass over  
5 horizontal tubes 27 to the up-take 5, while the air in this case passes from a central air inlet through these horizontal tubes to the down flues 12. In this case also there is preferably  
10 a central vertical division plate X at the point where the air comes in, and the central space between the two sets of tubes 27 is divided by horizontal partitions 10' which secure a uniform distribution of air to the heating tubes, as in the constructions already described.

15 I claim as my invention—

1. A steam-boiler having an air-heating chamber in connection with the smoke box and through which pass the products of combustion, an air inlet or inlets to the chamber,  
20 flues for the passage of heated air from said chamber and a partition or partitions in the latter to give divided streams of air through the chamber, substantially as described.

2. A steam boiler having an air-heating chamber in connection with the smoke box, 25 with vertical tubes therethrough for the passage of the products of combustion, an air inlet or inlets to the chamber, flues for the passage of the heated air from said chamber, and horizontal partitions in the chamber, substan- 30 tially as and for the purpose set forth.

3. A steam boiler having an air-heating chamber in connection with a smoke box with a central vertical division plate and horizontal partitions for the distribution of the air, 35 a central air inlet at the said division plate and side flues for the passage of the heated air from the chamber to the furnace, all substantially as described.

In testimony whereof I have signed my 40 name to this specification in the presence of two subscribing witnesses.

JAMES HOWDEN.

Witnesses:

S. C. CONNOR,  
HUBERT HOWSON.