(No Model.)

2 Sheets—Sheet 1.

G. F. BROTT.

WATER TUBE CIRCULATING BOILER.

No. 250,642. Patented Dec. 13, 1881.

FIG. I.

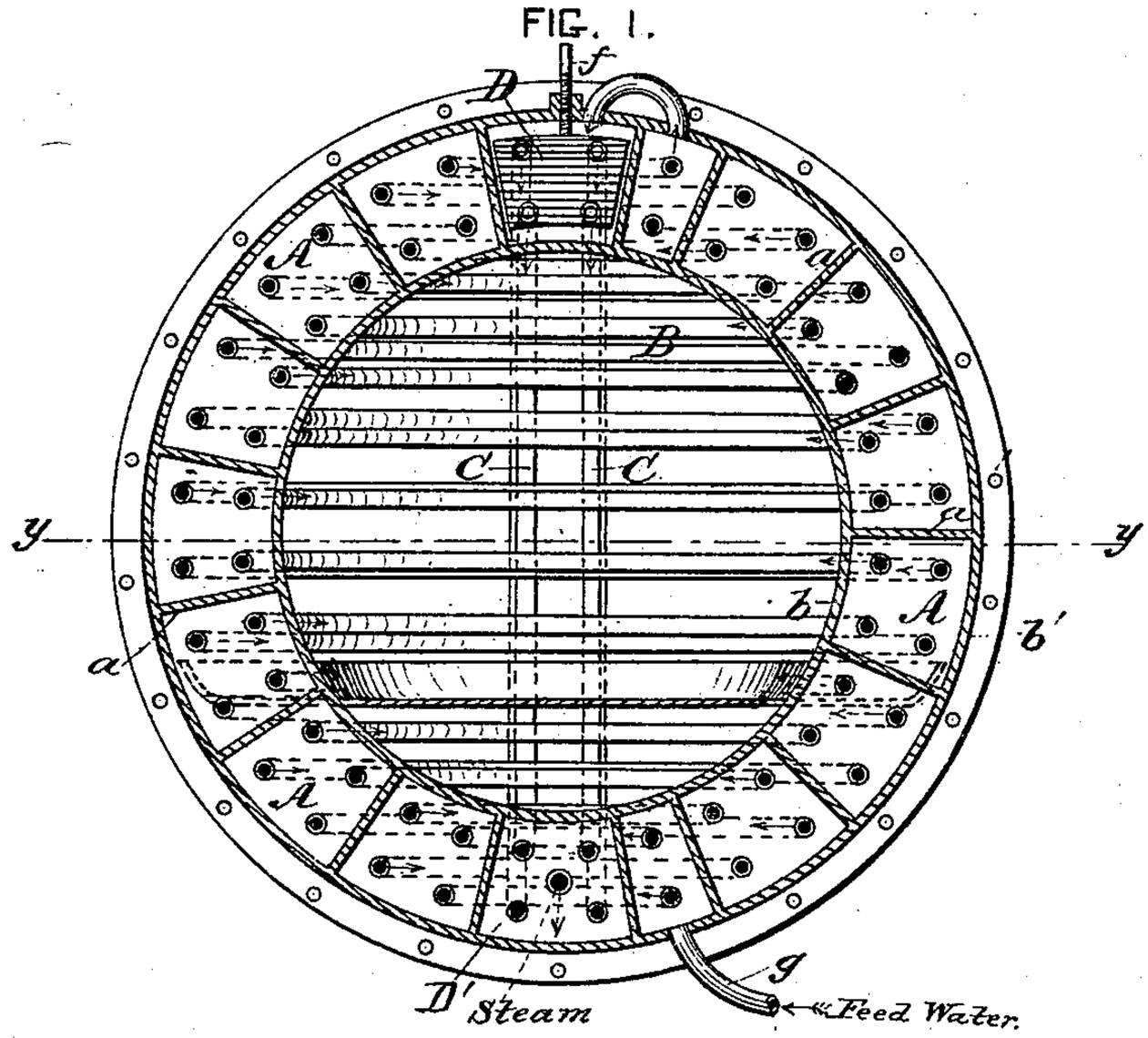
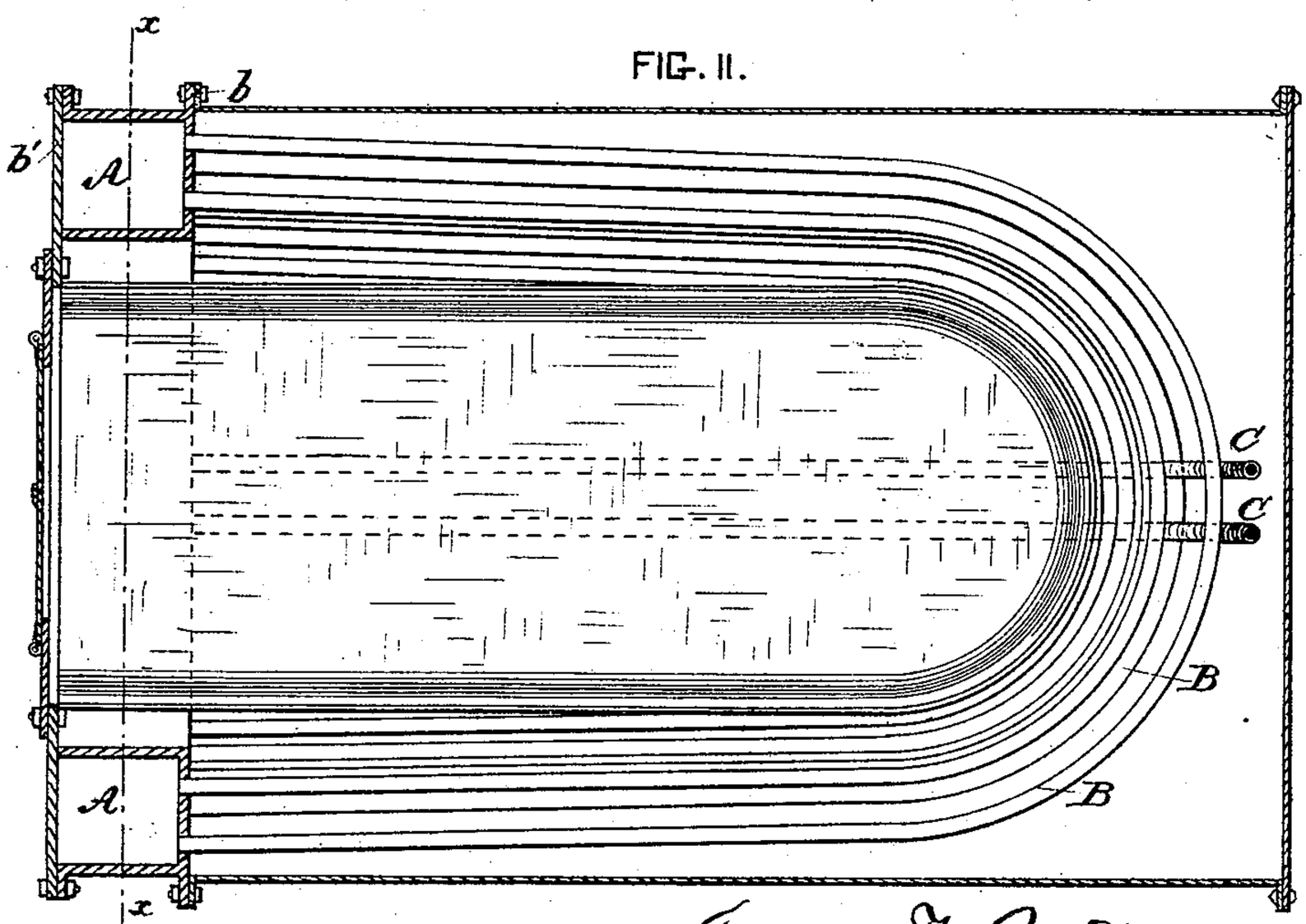


FIG. II.



WITNESSES:

James Richs Callan

M. S. Callan

George F. Brott. INVENTOR

(No Model.) 2 Sheets—Sheet 2.

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FIG. III.

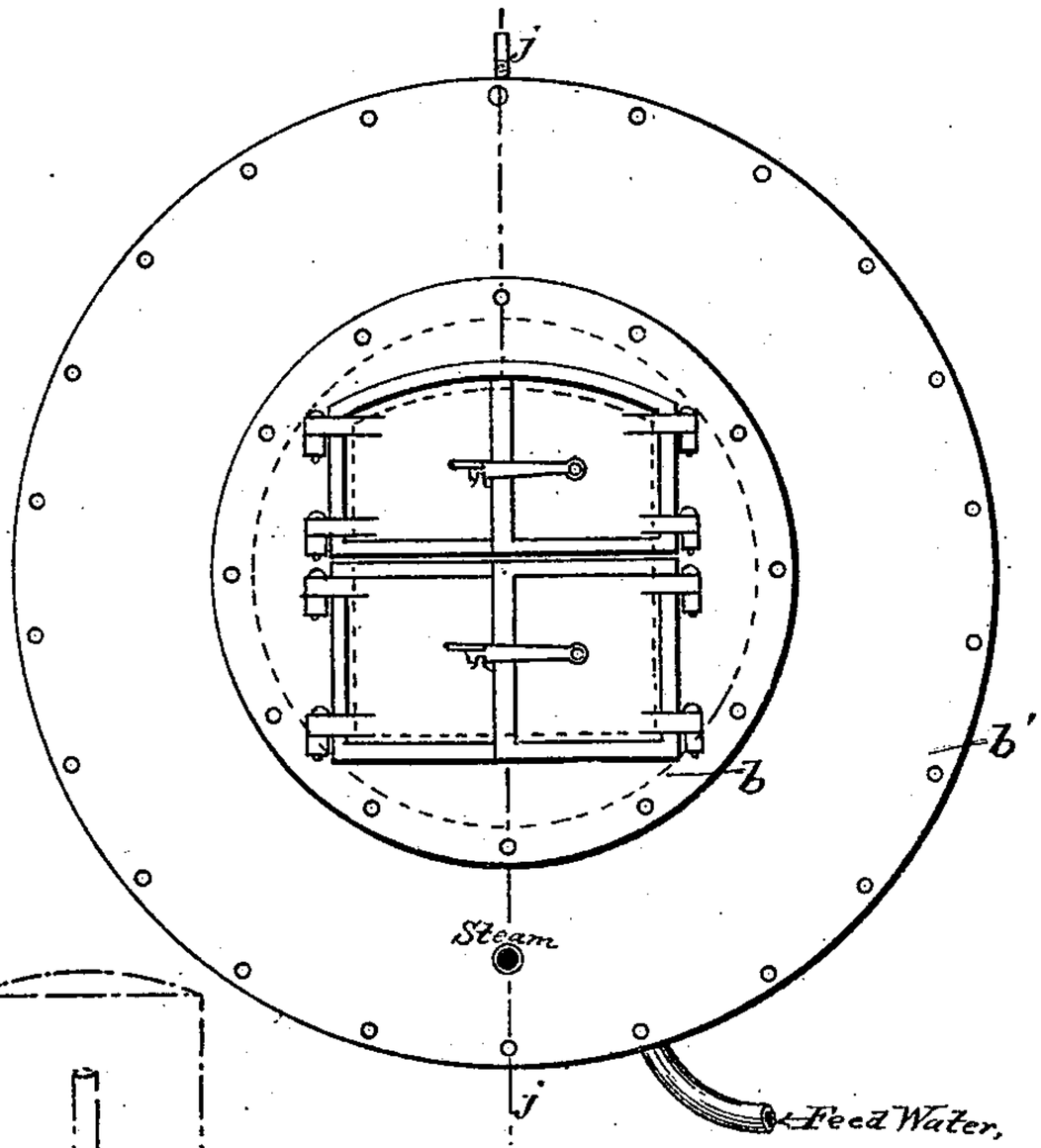
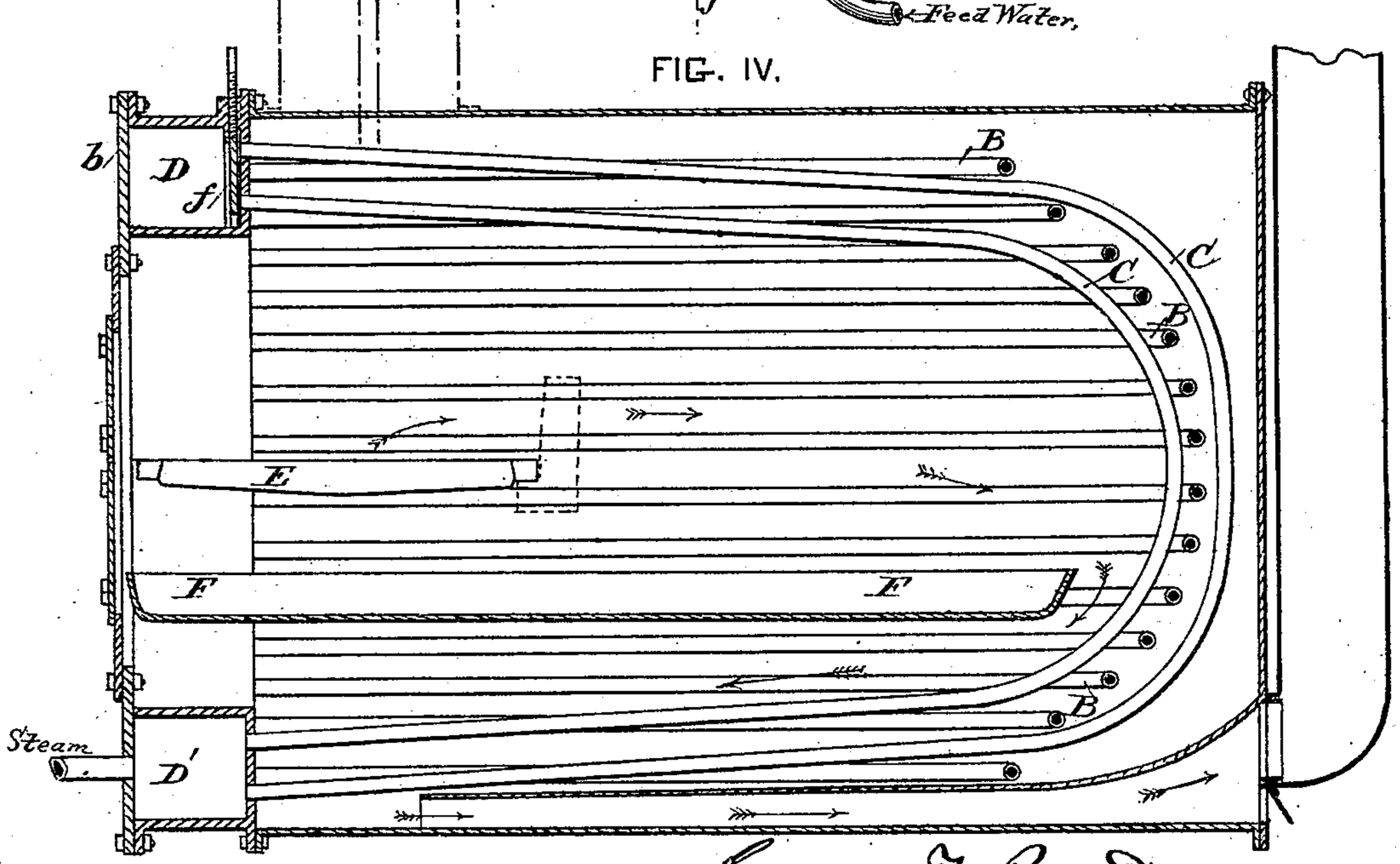


FIG. IV.



WITNESSES:

James Richs Callan

M. S. Callan

George F Brott. INVENTOR:

UNITED STATES PATENT OFFICE.

GEORGE F. BROTT, OF WASHINGTON, DISTRICT OF COLUMBIA.

WATER-TUBE CIRCULATING BOILER.

SPECIFICATION forming part of Letters Patent No. 250,642, dated December 13, 1881.

Application filed January 12, 1881. (No model.)

To all whom it may concern:

Be it known that I, GEORGE F. BROTT, a citizen of the United States, residing at Washington city, in the county of Washington and District of Columbia, have invented certain new and useful Improvements in Water-Tube Circulating Boilers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

This invention has relation to what are known as "water-tube boilers," or to boilers in which a rapid circulation of the water is kept up, and in which the generating-tubes are exposed to a very large heating-surface.

The object of this invention is to obtain the maximum of heat from the least possible minimum of fuel, and also to obtain and retain the greatest maximum of pressure from the least possible minimum of water, so that I combine simplicity of construction, durability, and compactness, and entire safety from explosion—that is to say, while the entire generator is composed of a single structure, should an explosion take place, it would only affect one or two tubes, which would be comparatively harmless, and would not endanger either the structure itself nor any adjacent parts, inasmuch as but little water is contained in the tubes, and can therefore do but little damage. Its further object is to constantly insure a high pressure of steam from a small quantity of water, by which I obtain pressure, and therefrom power, with less weight of water than has been heretofore accomplished. This is essential in yachts, steam-plows, and other machinery where the usual great weight of water entirely destroys the utility of the machinery.

It consists, first, in so arranging the generating-tubes in groups that each set will communicate with certain chambers or pockets located at different horizontal planes in a single head, each of these chambers forming an arc or segment of a circle when it is desired to construct the boiler in a cylindrical shape; second, in arranging the water-tubes in such manner that no one set of tubes are connected to the same chamber by both their ends, all of which are continually kept full of water under pressure—that is to say, the water entering the first group or set of tubes will traverse the entire series continuously before it deposits itself in the steam or reception chamber; third, in so arranging the steam and reception chambers that the steam and water received in the upper chamber is compelled to traverse the flame-chamber, on its passage to the steam-chamber, in opposite direction to the current of water, and thereby converting any water that may enter the reception-chamber into steam, and at the same time superheating the steam generated in the tubes on its passage to the steam-chamber; fourth, combining with the said pockets or chambers and the generating and superheating tubes a combustion-chamber arranged in such manner that the products of combustion are made to take first an ascending and then a descending course on their way to the uptake, all of which will be more fully hereinafter described.

Referring to the accompanying drawings, Figure I represents a vertical cross-section on line *x x*, Fig. II. Fig. II represents a horizontal longitudinal section taken on the line *y y*, Fig. I. Fig. III is a front or end elevation. Fig. IV is a vertical longitudinal section taken on the line *j j*, Fig. III.

A A A show a series of eighteen or twenty chambers or pockets formed by division-plates *a a a* between two concentric cylinders, *b b*, forming a single boiler-head. These chambers may be increased or decreased in number and size as occasion may require.

B B B represent groups or sets of water-tubes, which will correspond in number to the number of chambers, except the induction and eduction chamber D D, in which the tubes begin and end. Preferably I select the top and bottom chambers of the whole series for the steam-chambers—the former for the steam and water and the latter for steam alone. These two chambers are directly connected by an independent series of pipes or tubes, C, through which the saturated steam from the upper chamber is conveyed to the lower or steam chamber proper. The steam is also surcharged while passing through the said tubes C, and any water passing over with the steam from the upper

chamber is converted into steam on its passage, the pipes traversing the hottest portion of the combustion-chamber. These pipes C C are located at right angles to the water-tubes, and are generally arranged outside or beyond the water-tubes in the said combustion-chamber. The upper steam-reception, D, is provided with a sliding or other valve, *f*, for the purpose of controlling the quantity of water or steam and water entering the superheating-tubes, so that when chamber D becomes entirely filled with water only sufficient of it would be allowed to enter the superheating-tubes as could be converted into steam on its passage to the steam-chamber D.

The combustion-chamber is centrally located within the inner cylinder or head, and between the groups of tubes, and is more particularly designed to burn hydrocarbon oils, but may be adapted to burn other kinds of fuel. Any of the well-known kinds of liquid-fuel burners may be used.

I locate the smoke-flue at the bottom of the generator, for the purpose, among others, of compelling the heated products of combustion, after ascending, to descend among all the tubes. By this means I produce a better and more even distribution of the heat, and keep it longer in contact with the generating-tubes than if it passed off direct. It will also be seen that the heat is caused to take an upward, rearward, downward, and a return course to the front, where it passes off through the smoke-flue to the chimney. The smoke-flue may be cleaned from the rear through a man-hole placed there for the purpose.

The front chambered head or section may be cast in one piece or in sections, or may be made of wrought-iron. The front head, which may be bolted on this head, may be made similar to the main head, and be removed and replaced, for the purpose of cleaning, fastening tubes, &c. Of course the tubes are all put in place and fastened before the head is finally put on to stay. The said tubes may be secured by any of the ordinary methods. The smaller head, as will be seen, is also removable, and is secured in the same manner as the larger head—viz., by flanges and rivets or bolts. Before this smaller head is fastened I arrange my furnace, although it can be arranged through the ordinary doors.

It will be seen that I locate a grate, E, and oil-pan F in the furnace. The oil-pan may be utilized for an ash-pan, and at the same time form a deflecting-plate or a horizontal partition, and serves to divide the furnace and direct the flame and heat to the rear of the furnace, although, if desired, when intense heat is found to be necessary and a more rapid generation of steam is required, the ash-pan may be used for an additional burner; but for all ordinary purposes the smaller or upper grate will answer. It would be well, however, to keep a small quantity of oil in the oil-pan, so that it will ignite any unconsumed gases passing off from the upper fire, and thus produce perfect combustion.

Of course it is evident that the steam from the superheaters may be conducted to a steam-dome on the top of the boiler.

It will be noticed that the uptake is at the rear of the boiler. It is evident that it may be placed in any convenient location where it may communicate with the smoke-flue within the combustion-chamber. I have shown the casing around the tubes made of sheet-iron; but it may be constructed of any well-known material. For stationary boilers, as is now presented, safety would demand a non-heat-conducting casing of brick, asbestus, or any other suitable material that would prevent the heat from being carried off.

The operation is as follows: Water being fed at the lower small chamber through pipe *g*, it then passes to its next alternate chamber to its left; from thence back to the chamber on its right; thence to the next above on the left, and again back to the right to the chamber on a higher plane, and so on, from right to left, and vice versa, until it traverses the whole series of pipes and chambers, the pipes beginning in one chamber and terminating in a different one, as may be best seen in Fig. I. Of course these pipes run nearly the entire length of the combustion-chamber, and are made U-shaped, the bend being at the rear, the bend allowing for expansion and contraction of the same. After the hot water and steam is emptied into the upper chamber, D, by means of an elbow-pipe, it is then admitted, by means of a valve, into the superheating-pipes, and, as before stated, is conveyed through the combustion-chamber to the steam-chamber, from whence it may be conveyed through a pipe marked "Steam" to the engine for use, or to the steam-dome above; the U-shaped tubes, each acting independent of the other, through which the water circulates rapidly, receiving and discharging into the chambers, as set forth, where the water forms an eddy, a portion of which remains in a quiescent state, thereby causing any sediment or calcareous matter held in solution in impure water to deposit in the chambers instead of in the tubes, which chambers are but little exposed to the heat of the furnace, and can be readily cleaned by removing the cap or head.

This boiler is an improvement on one patented to me December 7, 1880, and numbered 235,124. Any feature shown or claimed therein I lay no claim to here.

I thus produce a boiler at once simple in construction, cheap in first cost, easily repaired, and requiring but little space for a comparatively powerful boiler, which is readily applicable to portable or stationary purposes, as may be required.

It is evident that this construction may be applied to vertical boilers; and when more than one is required they may be arranged in batteries and connected together in the usual man-

ner; also, that the boiler described may be constructed of any size or dimension required without impairing its safety from explosion.

Having now described my invention, its construction and operation, what I claim as new, and desire to secure by Letters Patent, is—

1. In a water-tube steam-boiler, the combination and arrangement of the generating-tubes in groups or sets, with chambers or pockets located at different horizontal planes in a single head, through which a constant and continuous circulation of the same body of water is produced through all the tubes, in the manner described.

2. The combination, in a water-tube steam-generator, of the chambered head, constructed as described, and the water-tubes, connecting with alternate chambers to the left and right of said head, and at different horizontal planes in the same head, with reception, steam, and water chamber, and the steam-chamber, with their independent superheating-tubes, in the manner shown and described.

3. The combination, in a water-tube circulating steam-generator, of the groups or sets of tubes, with a single boiler-head composed of chambers, the said tubes being arranged in such manner that neither of the sets of tubes will communicate with the same chamber from both of their ends, by which a constant circulation is continuously maintained through each of them and their left and right alternate chambers of the said head, substantially as shown and described.

4. The combination, with the steam-generating, circulating, and superheating system of pipes, the boiler-head composed of segmental chambers, and arranged between two concentric rings or cylinders, by which a central combustion-chamber is formed, said combustion-chamber being so arranged as to force the hot products of combustion to first take an upward, then rearward, downward, and forward course to the smoke-flue, by which a uniform distribution of the heat is imparted to all the tubes, in the manner and for the purposes shown and described.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE F. BROTT.

Witnesses:
JAMES NICHS. CALLAN,
M. S. CALLAN.