(No Model.) 2 Sheets—Sheet 1.

V. W. BLANCHARD.

STEAM GENERATOR.

No. 413,908. Patented Oct. 29, 1889.

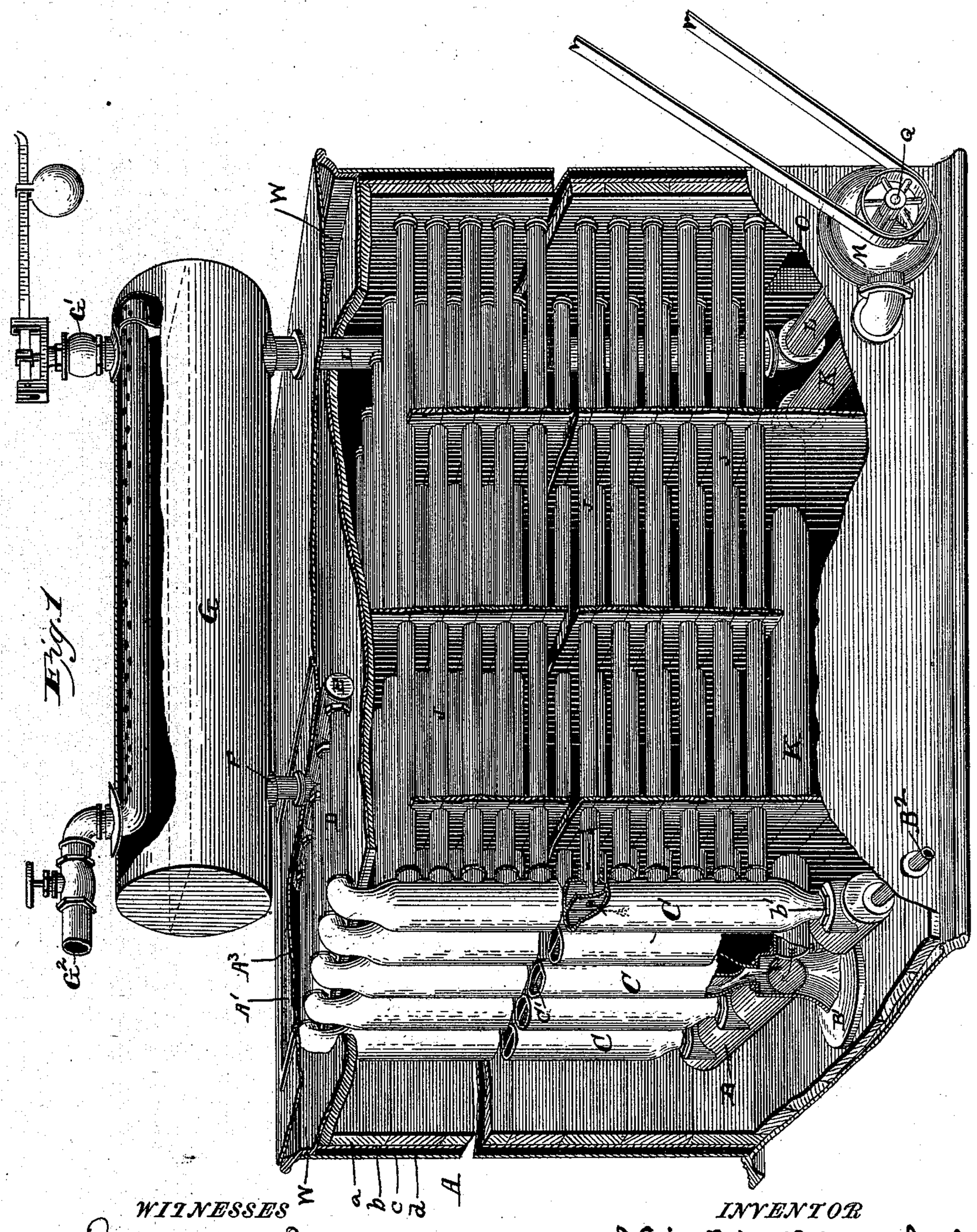

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

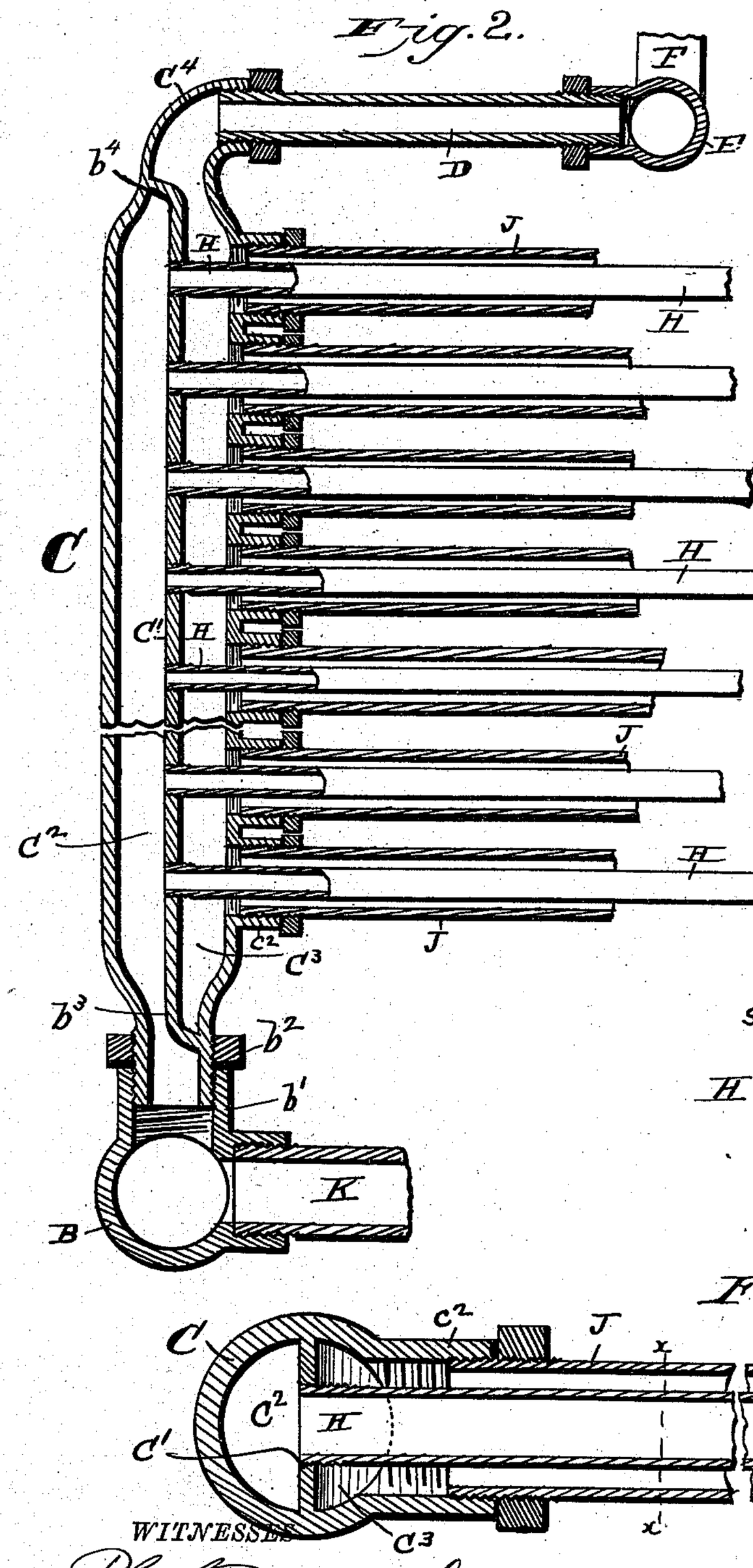

Fig. 5.

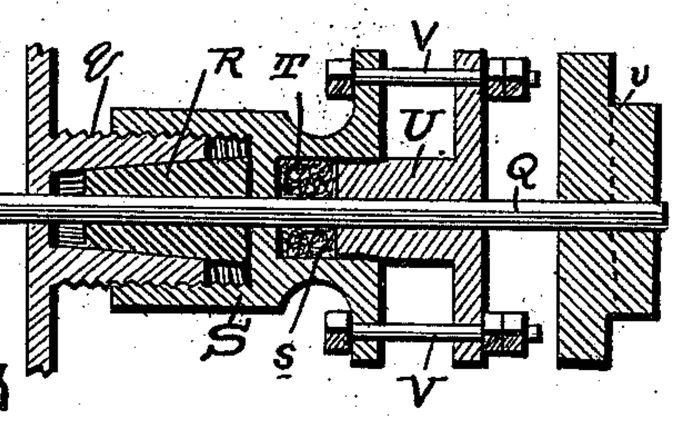

Fig. 4.

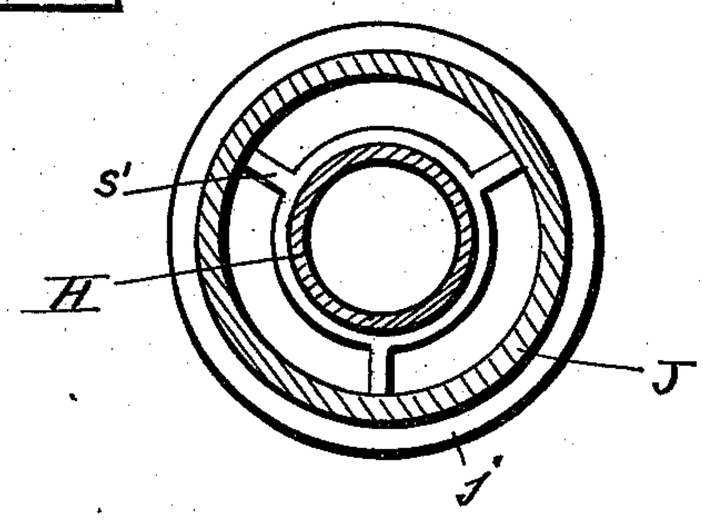

Fig. 3.

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UNITED STATES PATENT OFFICE.

VIRGIL W. BLANCHARD, OF NEW YORK, N. Y., ASSIGNOR TO JOSEPH A. DAVIS, OF SAME PLACE.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 413,908, dated October 29, 1889.

Application filed April 9, 1889. Serial No. 306,537. (No model.)

To all whom it may concern:

Be it known that I, VIRGIL W. BLANCHARD, of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Steam-Generators; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form part of this specification, in which—

Figure 1 is a perspective view of my improved steam-generator. Fig. 2 is a vertical section, enlarged, through one of the vertical subdivided legs, showing portions of the tubes broken away. Fig. 3 is a horizontal diametrical section through a duplex tube and its pipe. Fig. 4 is a cross-section through the duplex tube, taken in the plane indicated by dotted line *x x*, Fig. 3. Fig. 5 is a detail sectional view illustrating the manner of packing the shaft of the pump.

My invention relates to tubular steam-generators, and my object is to improve the construction of such generators by so constructing and connecting the parts thereof that ample allowance is made for unequal expansion and contraction of the parts and each section of the generator and tubes can be independently connected or removed for repairs. This object is effected by the devices which are hereinafter clearly described and claimed.

Referring by letter to the drawings, A designates a casing within which is my improved steam-generator. This casing preferably has its walls composed of an internal lining of fire-brick *a*, a layer *b* of asbestus paper or other refractory material, a layer *c* of porous or pulverized fire-brick, and an external shell *d* of cast plates or boiler-iron. The top of the casing is double, the external shell rising above the wall proper thereof, leaving a space W, and this top has a manhole A^3 in it leading into said chamber and closed by a plate A′. I prefer to fill the space W with mineral wool or other non-conducting material.

B designates a horizontal transverse pipe or drum, which is sustained substantially upon the floor of the casing A within the same by means of a pedestal B′, which is preferably cast hollow to contain water, and may be incased with masonry, if desired, for additional protection from the heat. This pipe is cast with screw-tapped couplings *b′* and it is connected at one end to a feed-pipe B^2, that extends through the wall of casing A to any suitable supply of water.

Into each one of the couplings *b′*, I screw a vertical leg C, and I prefer to use a jam-nut b^2 and suitable packing to hermetically seal the joint. Each one of the legs C is constructed with a vertical diaphragm C′, which forms two chambers C^2 C^3, closed at b^3 and b^4. The leg C is also constructed with couplings c^2, into which are screwed horizontal tubes J, the outer or free ends of which are hermetically closed by caps *j*. These tubes J are supported by means of sectional partitions arranged as shown in Fig. 1, for the purpose of causing the heated products of combustion to take a zigzag course through the case A on their way to the outlet O, and thus circulate through every part of the chamber within said case. Inside of each tube J is a smaller tube H, which is open at both ends and screwed or properly secured to the diaphragm C′ at one end and centered by a spider *s′* at or near the other end, as clearly shown in Fig. 3. The upper terminal portion C^4 of each leg C is at right angles to the longitudinal axis thereof and communicates with a horizontal transverse pipe E in space W by means of a short pipe D. The pipe E by a coupling F communicates with a steam-dome G, provided with a safety-valve G′ and a steam-pipe G^2, leading to an engine. The steam-drum communicates with a water-forcing engine M by means of a pipe L, and this engine communicates with the pipe B by means of a pipe K. The engine is used to give a forced mechanical circulation to the water in the generator, sending the latter through the legs, tubes, and drum; but the engine might in some instances be dispensed with and the natural circulation of the water depended upon.

When the generator is in use, the water and steam pass from the pipe B through the

chambers C^2 into and through the tubes H in the interiors of tubes J, thence back through tubes J outside tubes H into chamber C^3, thence through pipes D and E into the steam-drum G. From this drum the circulation is conducted through pipe L and engine M back into the pipe K. The upper ends of the partitioned leg C may be connected directly to the pipe E; but I prefer to employ the intermediate connections D, as shown and described, and to provide the manhole A^3 for affording convenient access to said pipes and their joints.

The legs C, constructed as described, can be readily cast, and the partition therein affords a brace for the walls thereof, greatly strengthening the latter. It is obvious that each pair of tubes is independent of all the other pairs and can freely lengthen or shorten or otherwise contract or expand independently of the others and of each other, their only rigid connection being to the leg C, and these connections of the inner and outer tubes being independent. The legs C are also independent of each other and only connected at top and bottom, and these connections are such that the expansion of said legs is amply provided for. It should be observed that the legs are placed at the entrance portion of the casing, or at the point where the greatest heat is found, and while they are thus placed the cold water admitted through pipe B^2 is conducted through the portions of the pipe B and the backs of the water-legs exposed to the most intense heat, the cold water being, in fact, conducted into the hottest part of the generator and carried in its circulation through the hottest water, by which it is partly heated in tubes H. I thus provide against burning out of the parts by applying the comparatively-cool water admitted into the generator where the greatest heat is found.

As the generators are intended for use in producing a very high steam-pressure—say from two hundred to five hundred pounds—it is necessary to carefully guard all points against leakage, and the shaft of the pump is usually a weak point, where the greatest difficulty is found in preserving a tight joint without frequent renewals of the packing.

In Fig. 5 I show an improved shaft-packing, which I preferably use to avoid these defects, which packing is clearly described and claimed in my application for piston-rod packing filed April 17, 1889, Serial No. 307,613. In this the shaft Q of the propeller within the engine passes through a stuffing-box *q* on the pump-casing, having a conical bore, and in this bore is placed a conical plug or packing R, of Babbitt metal, which is forced into the stuffing-box by a screw-cap S, through which passes the shaft Q, and this cap in turn is formed with a stuffing-box *s* in its outer face, in which is placed a proper fibrous packing T, and secured therein by a follower-plate U, attached to the cap by bolts and nuts V, as usual. By this means I am able to make a joint between the shaft and the casing which will be absolutely steam-tight without binding or preventing rotation of the shaft. As the Babbitt wears by turning cap S the plug R is compressed between the converging walls of the box and bound around the shaft, and the packing T is compressible by adjusting plate U, as usual. The pulleys *v* of the pump are secured on the shaft outside the cap S, as indicated in Fig. 5.

The steam-drum is preferably constructed as described in my application for Letters Patent filed April 12, 1889, Serial No. 306,974.

Having thus described my invention, I claim—

1. The combination, in a steam-generator, of a series of horizontal tubes jointed to independent vertical legs which are subdivided by partitions into two independent chambers, with return-tubes in said horizontal tubes, and a common horizontal pipe suitably supported and communicating with a steam-drum and with the legs, substantially as described.

2. The combination of a series of vertical legs subdivided by a diaphragm and communicating with a common supply-drum at their lower ends, with a series of horizontal tubes arranged one within the other and communicating, respectively, with the chambers in said legs, substantially as set forth.

3. A series of vertical pipes vertically subdivided into two independent water-circulating chambers, in combination with a lower communicating water-supply drum, pipes leading to a steam-drum from one of the water-chambers in each leg, and horizontal tubes arranged one within the other and communicating, respectively, with the chambers in said legs, substantially as described.

4. A steam-boiler consisting of a series of vertical water-legs C and horizontal tubes closed at their outer ends and opening into one of the chambers of a vertical water-leg, in combination with internal tubes opening into one of the other chambers of the leg, a horizontal transverse base-pipe supporting the legs, and the water-supply thereto, all substantially as set forth.

5. The combination of a series of vertical water-legs C, horizontal tubes closed at their outer ends and opening into one of the chambers of a series of vertical legs, with internal tubes opening into one of the other chambers of the legs, a horizontal transverse base-pipe connected to said legs, a steam-drum, its connections with said legs, and a forcing-engine and its connections with said drum and base-pipe, substantially as set forth.

6. In combination with a series of vertical subdivided pipes C, having bent upper ends, a horizontal base-pipe communicating with the latter and provided with a feed-pipe, the pipe-communications with the steam-drum, and the horizontal internal and external tubes communicating with the said subdivided legs, all constructed and arranged substantially as specified.

7. The herein-described water-legs for tubular boilers, consisting of the metal tubular casting having an internal partition dividing its interior into two non-communicating chambers, openings through the outer wall into one of said chambers and through the partition into the other chamber, and having its upper end bent at right angles, substantially as specified.

8. In a steam-boiler, the combination of one or more vertical pipes subdivided by a vertical diaphragm forming two chambers, one of which is closed at its upper end and the other at its lower end, with a base-pipe, a steam-drum, a series of external tubes closed at their outer ends, a series of internal return-tubes open at both ends, and a series of short pipes connecting the upper ends of the vertical pipes to a horizontal pipe communicating with the steam-drum, substantially as described.

9. The combination, with the water-legs having two compartments, of the external water-tubes communicating with one of said compartments, a water-tube open at both ends and placed within the external tube and communicating with the other compartment of the water-leg, and a series of vertical partitions through which said tubes pass, all substantially as specified.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

VIRGIL W. BLANCHARD.

Witnesses:
W. R. KEYWORTH,
F. O. MCCLEARY.