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T. F. MORRIN & W. W. SCOTT.

STEAM GENERATOR.

No. 309,727. Patented Dec. 23, 1884.

Fig. 1.

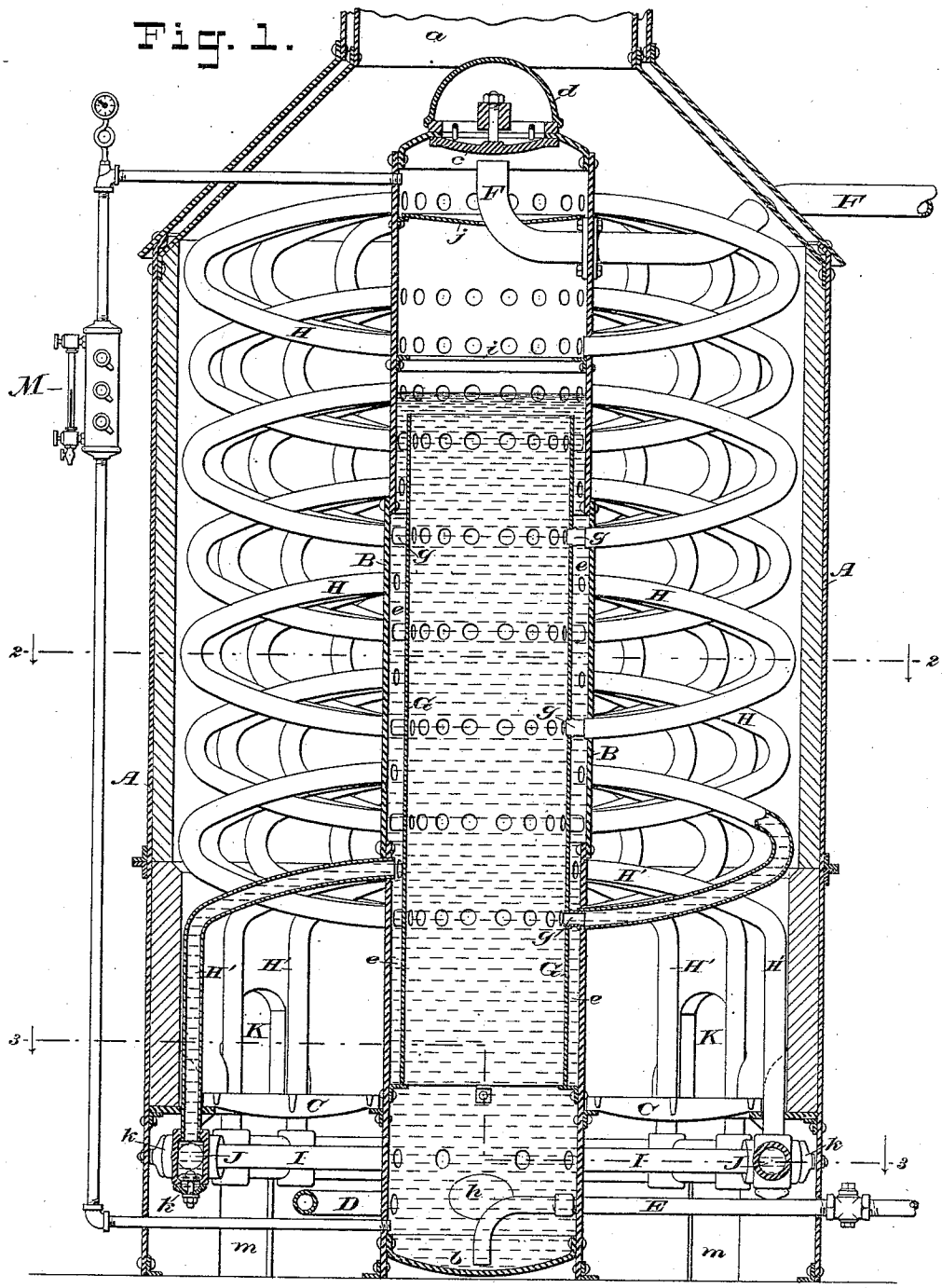

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Fig. 2.

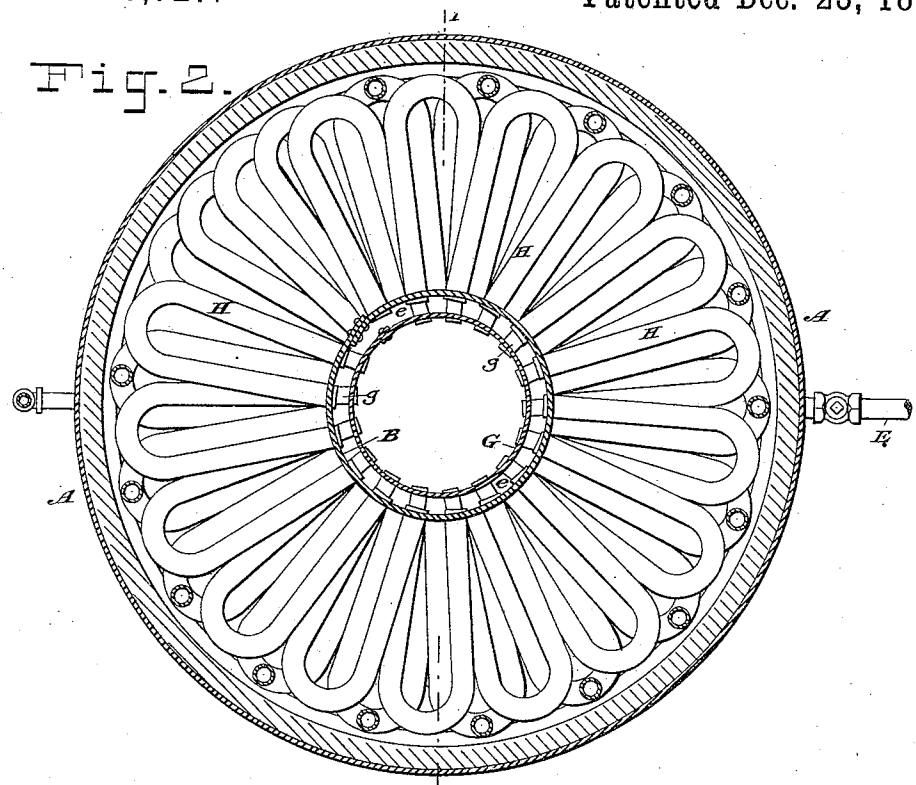

Fig. 3.

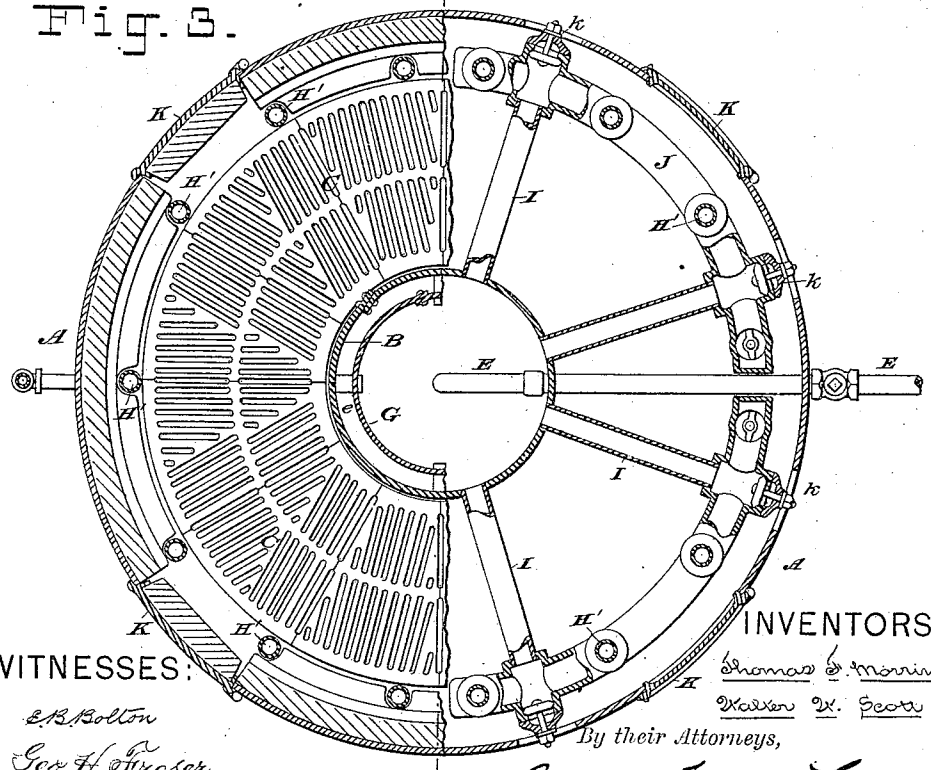

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Fig. 4.

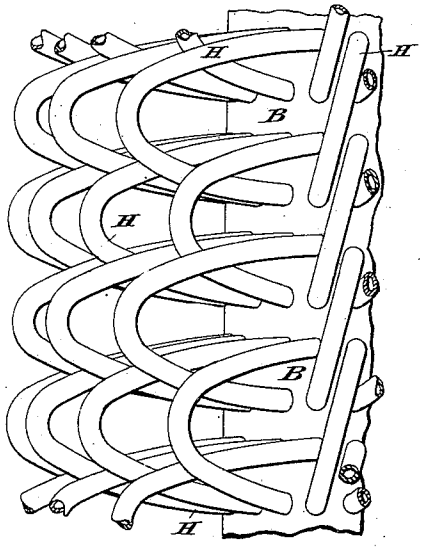


Fig. 5.

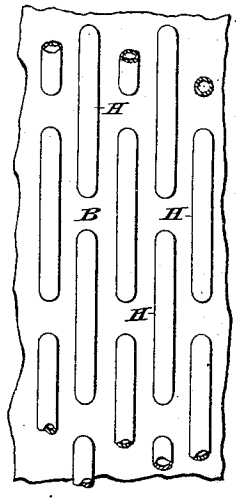


Fig. 8.

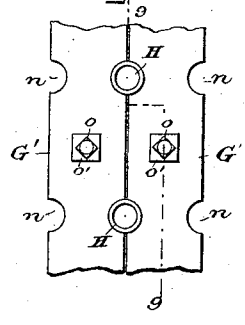


Fig. 6.

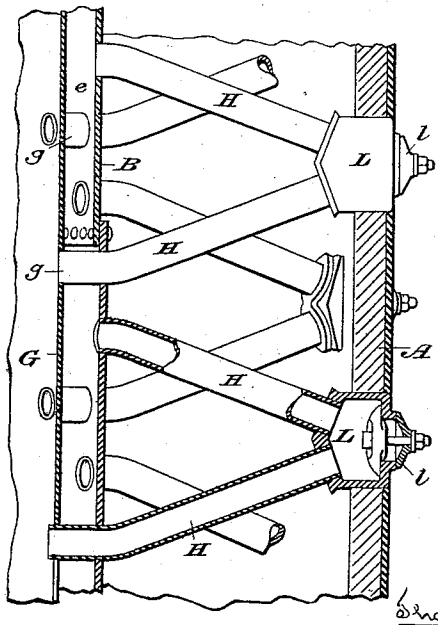


Fig. 7.

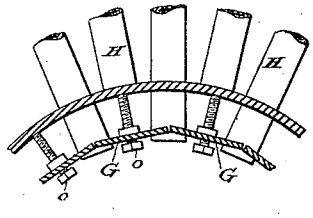
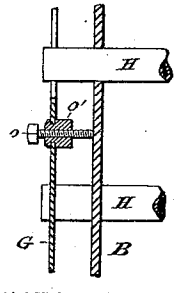


Fig. 9.



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UNITED STATES PATENT OFFICE.

THOMAS F. MORRIN AND WALTER W. SCOTT, OF JERSEY CITY, NEW JERSEY.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 309,727, dated December 23, 1884.

Application filed July 8, 1884. (No model.)

To all whom it may concern:

Be it known that we, THOMAS F. MORRIN, a citizen of the United States, and WALTER W. SCOTT, a British subject, both residents of Jersey City, Hudson county, New Jersey, have invented certain Improvements in Steam-Generators, of which the following is a specification.

Our invention relates to that class of steam-generators wherein a vertical (generally cylindrical) generator-shell provided with lateral tubular branches is arranged within a furnace-shell provided with an annular grate or fire-bed. A type of this class of generator has a vertically-arranged generator-cylinder placed in the axis of the furnace shell, and provided with exterior radial bent tubes arranged in nearly vertical planes, their lower ends entering the generator-cylinder below the water-line, and their upper ends entering it above the water-line. Another type has an inner cylindrical diaphragm provided with radially-arranged open-ended tubes, which project outward through the generator-shell into larger closed tubes, which extend radially from the generator-shell. The object of this arrangement is to increase the circulation in the tubes. The products of combustion must pass upward among these tubular branches on their way to the outlet above.

In our improved generator we seek, first, to insure the free circulation of the water through the numerous tubular branches, without which economical results cannot be attained; second, an extended and efficient heating-surface, so placed as to secure the maximum heating effect from the flames and products of combustion; third, economy in the first cost of the generator, in repairs, and in attention required in its operation; and, fourth, an extended grate-surface.

In the drawings which serve to illustrate our invention, Figure 1 is a vertical mid-section of our generator, taken on lines 1 1 in Figs. 2 and 3. Fig. 2 is a horizontal section taken on line 2 2 in Fig. 1. Fig. 3 is a horizontal section taken as to the left half just above the grate, and as to the right half just below the grate, substantially on line 3 3 in Fig. 1. Fig. 4 is a fragmentary elevation designed to illustrate the oblique arrangement of the semi-elliptical tubes. Fig. 5 is a fragmentary elevation designed to illustrate a modified arrangement of the tubes. Fig. 6 is a sectional fragmentary view illustrating a modification in the construction of the tubes themselves. Figs. 7, 8, and 9 represent modifications that will be hereinafter described.

Referring particularly to the first four figures, A is an outer cylindrical shell, which incloses the furnace and generator. This may be of sheet-iron of suitable thickness, and lined with tiles of refractory material. We have shown the coned top of this shell as double, and provided with an uptake or stack, *a*.

Arranged in the axis of the shell A is the generator cylinder or vessel B, which is made from iron or steel of the proper thickness to stand the steam-pressure, and provided with a bottom, *b*, and a man-hole and cover, *c*, at its top. To prevent ashes and débris from collecting on this cover a cap, *d*, may be arranged over it.

C is the grate, which is annular, part of the lower end of the cylinder B being below the grate.

D is the water-supply pipe.

E is the blow-off pipe.

F is the steam-supply pipe, which leads out from the upper part of B, and M is the water-gage.

G is a cylinder of sheet metal, open at both ends and set in cylinder B so as to leave an annular space, *e*, between the two. This tube is supported on brackets, arranged at about the level of the fore-bed, by preference, and it extends up nearly to the water-level.

H H are double-branched bent tubes, arranged in approximately radial series or tiers, both ends of the same being secured in the wall of the cylinder B. These tubes extend out nearly to the lining of the shell A, and are arranged to overlap, as shown—that is, the upper branches of one tier of tubes overlap and enter the cylinder B above the lower branches of the next tier above—and the two ends of the tube are arranged in different ver-

tical planes. This so "staggers" the tubes that the uprising heated gases must impinge upon and impart the maximum of their heat to the tubes. This "staggering" of the tubes is well illustrated in Fig. 4.

The angle at which the tubes H stand with reference to a horizontal plane may be varied. In some cases it may be best to arrange them more nearly horizontal than as in Fig. 4. By overlapping the tiers of tubes as shown we are enabled to get within a practicable compass an unusually large amount of heating-surface and to fill up the gas-passage of the furnace with a net-work of tubes.

In order to effect and insure a constant circulation of water in the tubes H when the generator is in operation, we extend the lower ends of the tube across the annular space *e* and into the inner cylinder, G, by means of extension-thimbles *g g*, the outer ends of which fit more or less tightly into the lower ends of the bent tubes, and the inner ends of which are or may be secured in the wall of the cylinder G by slightly expanding them.

So far as described, the operation is as follows: The generator-cylinder B being heated by the flames and gases, an upward current will be established in the annular space *e* and a downward current in cylinder G. The tubes H being also heated, a current upward will be established in them, the water entering their lower branches from G through thimbles *g*, and discharging through their upper branches into the annular space *e*. This constant circulation will insure even heating, will bring all the particles of the water successively into contact with the heated surfaces, and will in a great measure prevent the formation of scale and sediment in the tubes. In that portion of the cylinder B below the grate the water will be almost in a state of rest, especially at the bottom, which forms a still-water chamber, and here the sediment will collect. It may be blown off at the pipe E, and access may be had at a hand-hole, *h*. The upper series of tubes H—that is, those in which both branches enter B above the water-line—form superheaters, and these are, of course, unprovided with thimbles *g*, as they are wholly above the inner cylinder, G. In order to prevent the water in its flow upward from the annular space *e* and in its surface ebullition from entering the lower ends of these superheating-tubes, we prefer to provide an annular flange, *i*, which is secured to the inner wall of B just below the point where the lower branches of said tubes enter cylinder B. The pipe F is arranged to take steam from the extreme upper part of the cylinder B, in order to insure that the steam shall be dry, and to further assure this, and to insure a circulation of steam in the superheater, we prefer to arrange within the cylinder B, just below the point where the upper branches of the superheating-tubes enter it, a diaphragm, *j*, which nearly closes the cylinder B. This diaphragm is preferably a little coned or hopper-shaped to permit any water of condensation to drip back into the chamber below. We may or may not employ this diaphragm.

In order to further utilize the heat from the furnace, as well as to insure some circulation at the lower part of the boiler, we employ the arrangement of tubes best seen in Figs. 1 and 3.

I I are tubes which project radially from the cylinder B below the grate, the outer ends of which enter segmental headers J, of cast-iron, which lie close to the furnace-shell A. In the tops of these segmental headers are secured the lower ends of tubes H′, which extend upward above the fire-bed, arch over it, and enter cylinder B above the point where the lower branches of the first tier of semi-elliptical tubes H enter said cylinder B. We usually employ four segmental headers J, each of which has two radial tubes I and four upright tubes H′; but this arrangement may be varied. Caps *k* may be provided on the segmental headers J opposite the ends of tubes I, and the lower ends of tubes H′, whereby the latter may be readily cleaned out.

The furnace has doors *k k*, of which there should be several, in order to enable the fire to be got at from the several sides. The doors *m* to the ash-pit may be arranged below these in any manner desired.

We have shown the upright tubes H′ as partly surrounded by the refractory lining of the furnace-chamber just above the grate. This serves to protect the lining from the intense heat at this point.

In Fig. 5 we have shown both ends of the semi-elliptical tube H as entering the cylinder B in the same vertical plane. This arrangement will not serve so well as that wherein the tubes stand oblique, and the same area of heating-surface cannot be obtained; but it serves to illustrate our mode of constructing the tiers of tubes to intersect or overlap.

In Fig. 6 we have shown a modification in the construction of the tubes H. In this construction the upper and lower branches of the tube are formed separately and connected at their outer ends by a header, L, which has a cap, *l*, whereby access may be had to both branches of the tube for cleansing them. These headers may be embedded in the walls of the outer shell, A, as shown.

We have shown the elements A, B, and G as cylindrical, as this is the form preferred for strength and simplicity of construction; but they might, one or all, be elliptical, polygonal, square, or of other shapes in cross-section.

In order to be able to insert it with ease we prefer to make the cylinder G in three segments, to be bolted together after they are placed; but this is not essential.

In lieu of the use of thimbles *g*, it might also be possible to extend the lower branches of the tubes H across the space *e* and into cylinder G. The construction described is, however, preferable.

In Fig 6 the lower branch of the tube H is

shown as extending through cylinder B into G, and the thimbles are dispensed with.

The object in constructing the lower branches of the tubes H to extend farther into the interior of the generator-cylinder than their upper ends is to increase the heating capacity of the generator in the main. The shell of the generator-cylinder being directly exposed to the heat, and the contained water being a poor conductor, it follows that the water next the shell will be heated to a higher temperature than that nearer the axis of the generator-cylinder. The lower ends of the tubes pass through the hotter stratum of water and receive from the cooler body nearer the axis. The heating of the tubes generates an upward current in them, and they discharge into the hotter stratum next the shell. There is an upward current next the shell, and the tubes take the water from the central part of the generator and discharge it into this current, thus effecting a circulation from center to circumference. The upper ends of the tubes merely pass through the shell of the generator-cylinder. They are not designed to project into it.

As the cylinder B has numerous perforations to receive the tubes, care must be taken to make it thick enough to stand the required pressure despite this weakening.

In Figs. 7, 8, and 9 we have shown a modification in the construction of the cylinder G, Fig. 7 being a fragmentary horizontal section, Fig. 8 a front view, and Fig. 9 a vertical sectional view (on line 9 9 of Fig. 8) of one of the segments of which cylinder G is formed. In this construction we form the cylinder G of staves or segments G′ of thin iron plate, and form in the edges of these half-round notches *n* to receive the ends of the tubes H, these latter being embraced between the edges of adjacent segments, G′. As these tube ends converge, (see Fig. 7,) the segments are made to clamp them tightly, and to fit together snugly edgewise by being pressed inward radially by set-screws *o*, which screw through the segments from the inside, and impinge upon the inner wall of the generating-cylinder. As the segments are of thin metal, we prefer to provide the nuts *o′* for the set-screws of malleable iron with square end, and secure these in place in the segments by burring or riveting, as shown in Fig. 8. This construction is adapted to that mode of setting the tubes H where the thimbles *g* are dispensed with, and it enables the inner cylinder, G, to be readily built up within the generator from narrow staves, and to be as readily removed. In placing the staves they may be entered between the tube ends edgewise, and then turned and drawn inward until they wedge snugly between the tubes.

We are aware that it has been proposed to employ an inner cylinder or diaphragm in connection with the tubes of a generator, in order to effect an increase in the circulation, and we do not broadly claim this. One of the principal features of our generator is the obliquely-arranged tubes, the upper ends of which merely pass through the generator-shell, while the lower ends pass some distance into the body of water contained therein. This we prefer to effect by the thimble-extensions, as by using them a considerable economy is effected in cleaning and repairing the generator. The construction of the tiers of tubes to overlap or intersect is another important feature.

We are also aware that it has been proposed to construct a steam-boiler comprising a stand-pipe and spiral coils arranged to encircle said stand-pipe, and connected with the latter at both ends of said coils. The connection of the upper and lower ends of the coils to the stand-pipe is made by means of a hooded bushing which screws into the stand-pipe, the coned elbow on the end of the coil being drawn into said bushing by a bolt. The hood on the bushing projects into the stand-pipe above the open end of the coil, and supplies a bearing for the inner end of the securing-bolt. These spiral coils have been arranged in two sets, one nearer the stand-pipe than the other, and the attached ends of the outer set constructed to extend beyond the attached ends of the inner set, both above and below. This construction differs materially from ours, and we make no claim to it.

Having thus described our invention, we claim—

1. A steam-generator provided with one or more tiers or horizontal series of double-branched radial obliquely-arranged tubes, H, both ends of which tubes enter the generator-cylinder, and the lower ends of which are constructed to extend farther into the interior of the said cylinder than the upper ends, substantially as and for the purposes set forth.

2. A steam-generator provided with tiers or horizontal series of radial double-branched tubes H, both branches of which enter the generator-cylinder, one above the other, and the upper branches of one series constructed to enter said generator-cylinder above the point or line where the lower branches of the next tier above enter it, substantially at set forth.

3. The combination, in a steam-generator, of the upright generator-cylinder, the inner open-ended cylinder, G, arranged within the generator-cylinder so as to leave an annular space between them, and the double-branched tubes H, the upper branches of which enter the generator-cylinder and the lower branches of which connect with the cylinder G, substantially as shown and described, and for the purposes set forth.

4. The combination, in a steam-generator, of the generator-cylinder, the cylinder G, arranged within the generator-cylinder substantially as shown, the double-branched radial tubes H, connected with the cylinder at both ends, and the thimbles *g*, arranged to connect the lower branches of the tubes with the inner cylinder, G, substantially as set forth.

5. The combination, in a steam-generator, of the upright generator-cylinder, the inner

open-ended cylinder, G, arranged to extend up to a point below the water-line, the lower series of tiers of double-branched radial tubes H, the lower branches of which connect with cylinder G and the upper branches of which connect with the generator-cylinder, and the upper tiers of tubes H, both ends or branches of which connect with the generator-cylinder above the water-level to form superheaters, substantially as set forth.

6. In a steam-generator, the combination, with the generator-cylinder, of the inner cylinder, G, the double-branched radial tubes H, arranged substantially as set forth, one series or tier above the water-level to serve as superheaters, and the annular flange *i*, arranged within the generator-cylinder between the water-level and the point where the lower branches of the superheater-tubes enter the same, substantially as and for the purposes set forth.

7. In a steam-generator, the combination, with the upright generator-cylinder, of the inner cylinder, G, arranged as shown, the double-branched radial tubes H, arranged in tiers, the upper or superheating tier being above the water-line, the steam-pipe F, and the diaphragm *j*, arranged in the generator-cylinder just below the point where the upper branches of the superheater-tubes enter said cylinder to form a partition to partially separate the lower portion of the cylinder from the upper portion, substantially as and for the purposes set forth.

8. In a steam-generator, the combination, with the shell A and the annular grate, of the upright generator-cylinder B, the lower end of which extends below the grate to form a still-water and sediment chamber, the inner cylinder, G, and the radial double-branched tubes H, arranged in tiers, substantially as shown, and the lower branches of the same arranged to connect with said inner cylinder, G, all substantially as and for the purposes set forth.

9. In a steam-generator, the combination, with the exterior shell, A, and the grate, of the generator-cylinder set upright with its lower end extending below the grate, the tubes I and segmental headers J, arranged below the grate, and the tubes H′, arranged to extend, substantially as shown, from the headers J to and to connect with the generator-cylinder above the fire-bed, substantially as shown, and for the purposes set forth.

10. In a steam-generator, the combination, with the exterior shell, A, and the annular grate, of the generator-cylinder B, arranged in an upright position, as shown, the inner cylinder, G, the tubes I and H′, and headers J, arranged substantially as shown, and the double-branched radial tubes H, arranged in tiers with their lower branches connected with the inner cylinder, G, and their upper branches connected with the generator-cylinder B, all substantially as and for the purposes set forth.

In witness whereof we have hereunto signed our names in the presence of two subscribing witnesses.

THOMAS F. MORRIN.
WALTER W. SCOTT.

Witnesses:
HENRY CONNETT,
ARTHUR C. FRASER.