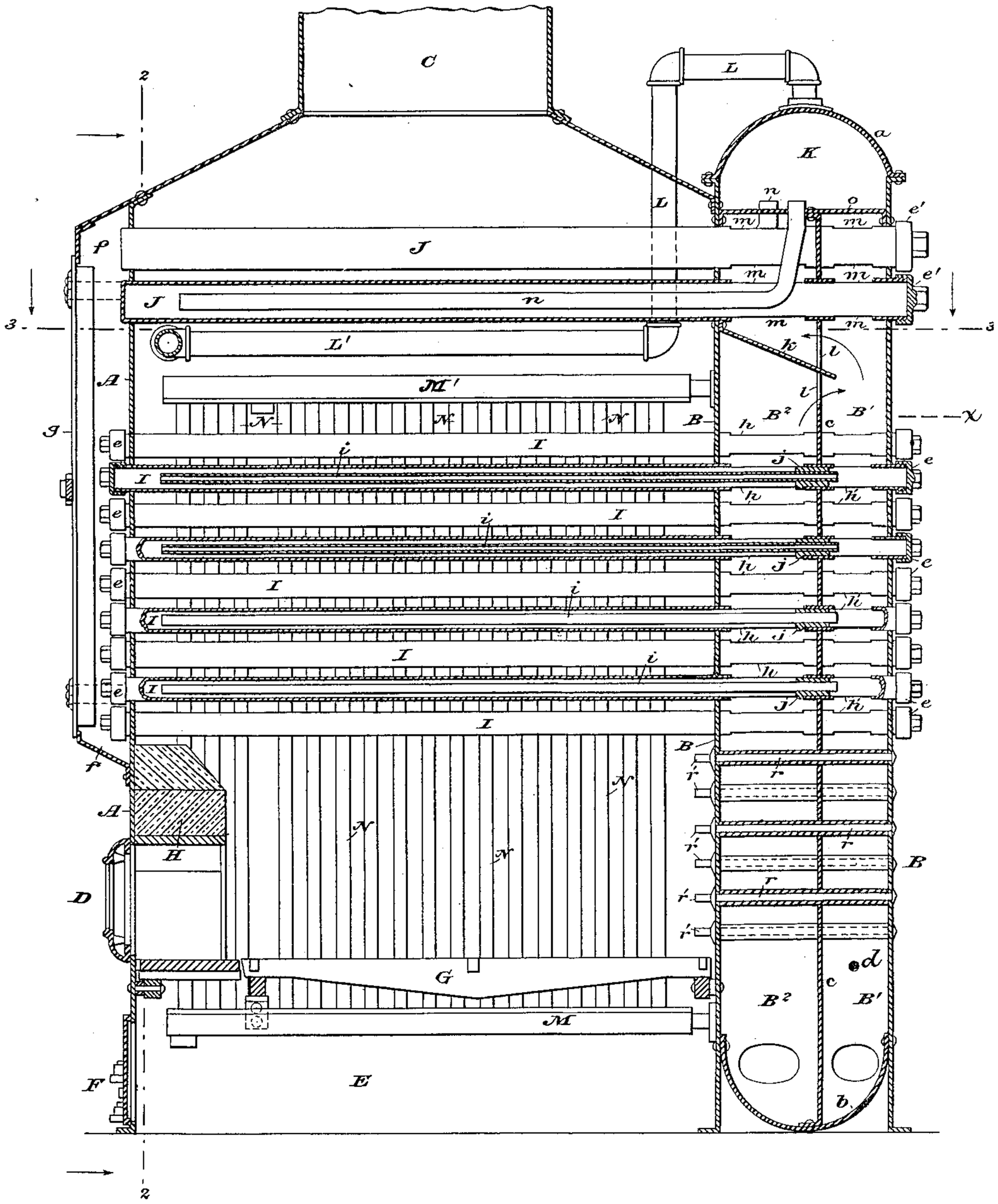
(No Model.) 3 Sheets—Sheet 1.

# T. F. MORRIN.

## STEAM GENERATOR.

No. 377,324. Patented Jan. 31, 1888.

Fig. 1.

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*By his Attorney,*

Henry Connett

(No Model.)

3 Sheets—Sheet 2.

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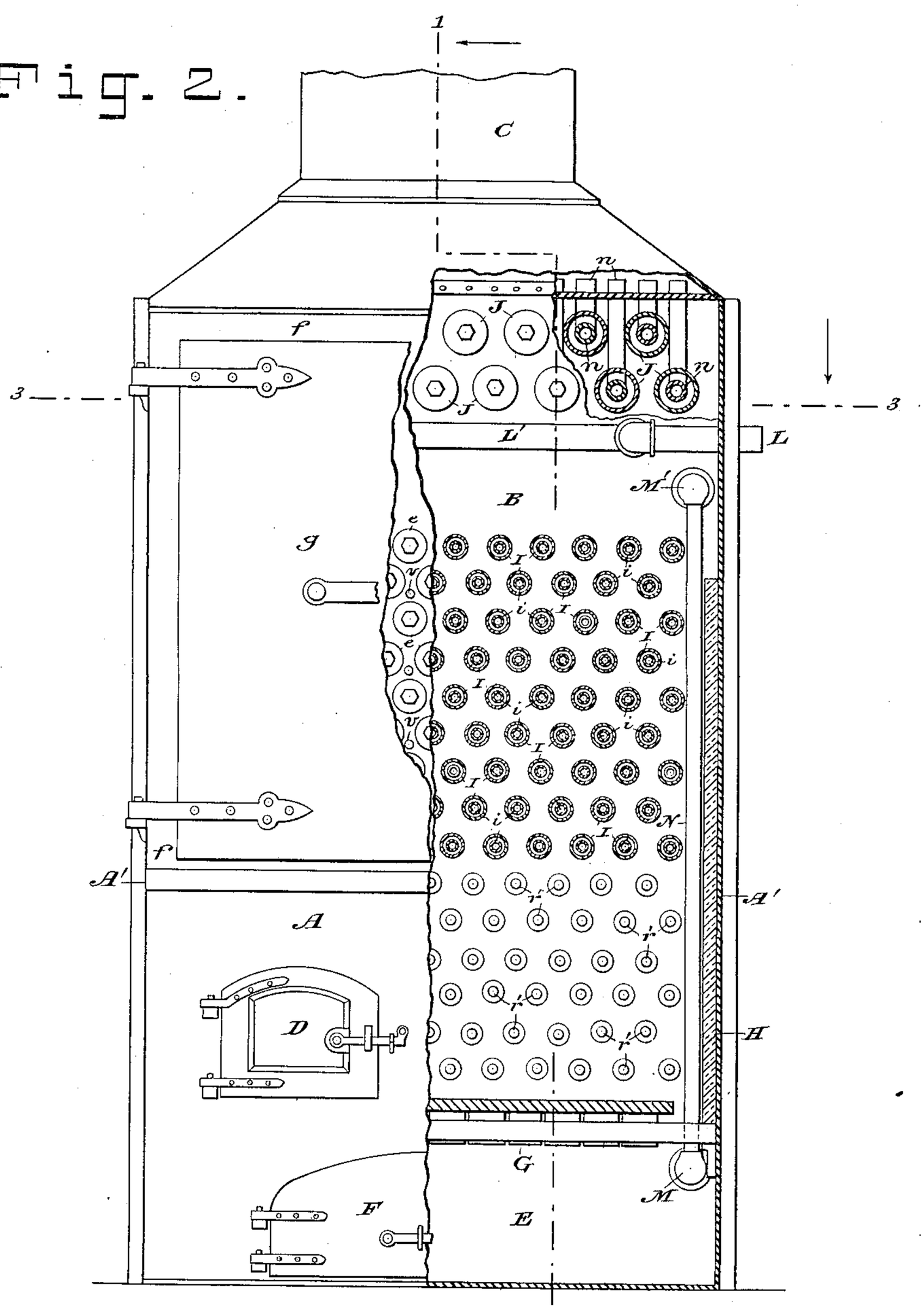
## STEAM GENERATOR.

No. 377,324. Patented Jan. 31, 1888.

Fig. 2.

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3 Sheets—Sheet 3.

# T. F. MORRIN.

## STEAM GENERATOR.

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Fig. 6.

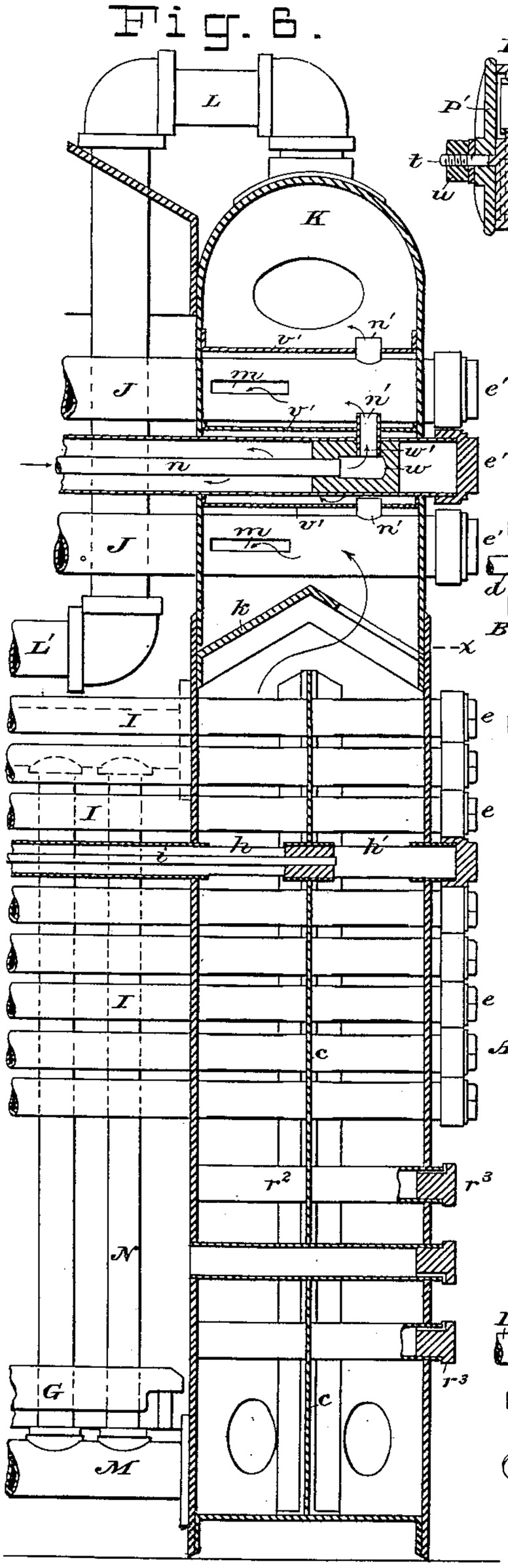



Fig. 4.

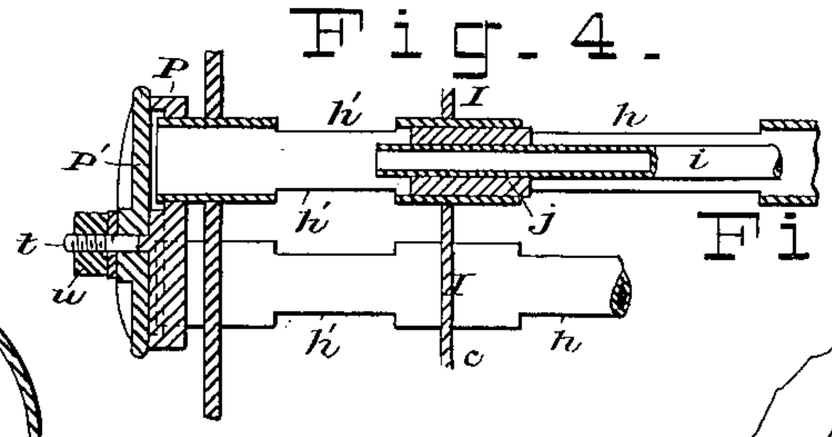



Fig. 5.

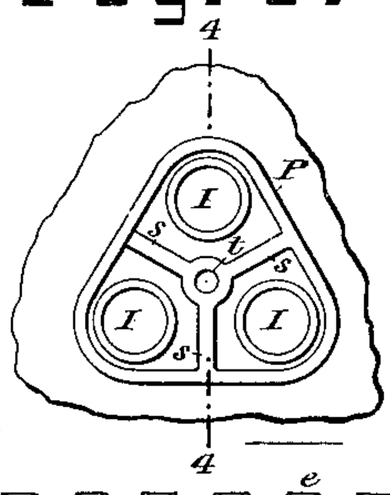
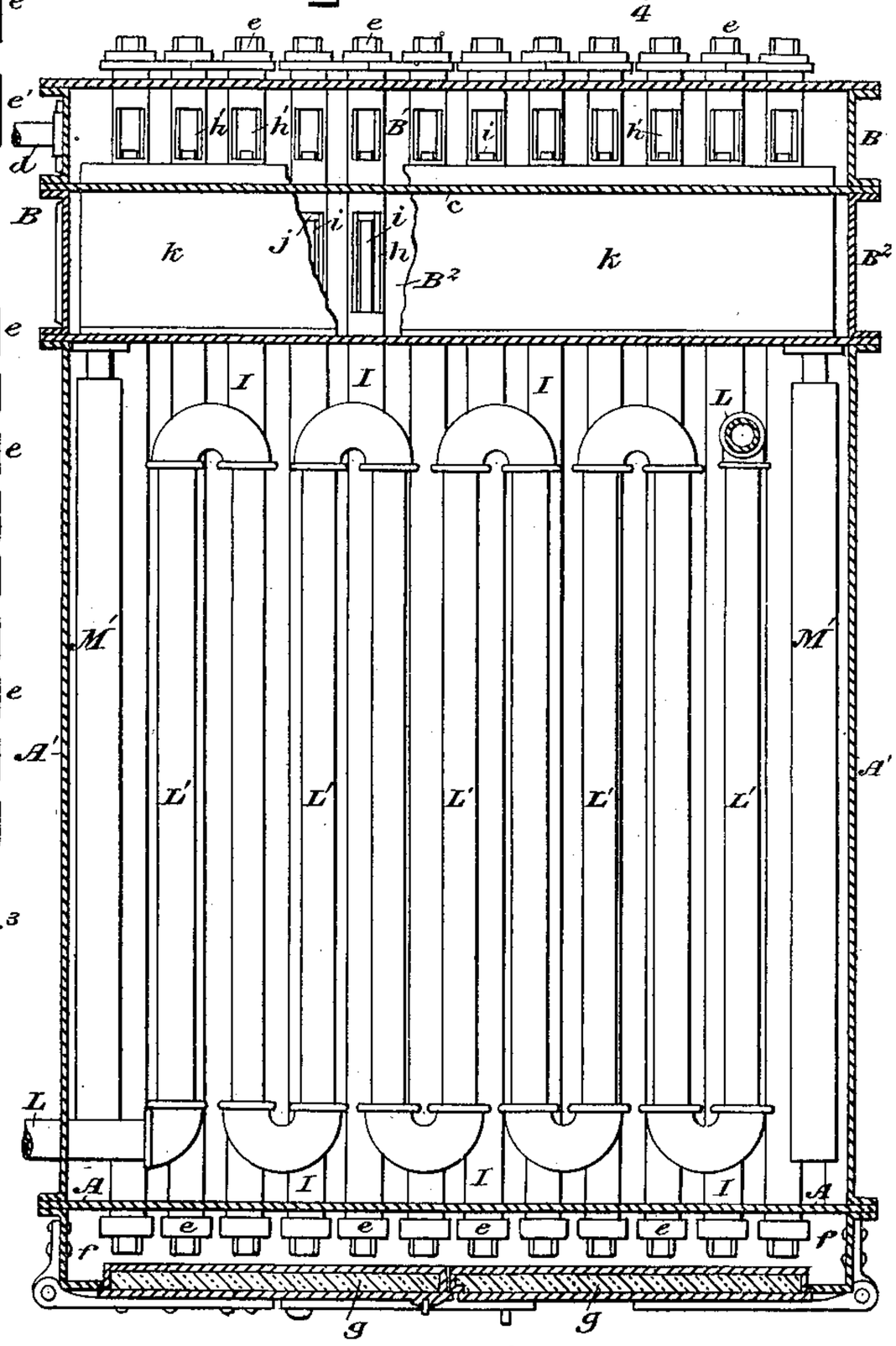



Fig. 3.

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# UNITED STATES PATENT OFFICE.

THOMAS F. MORRIN, OF JERSEY CITY, NEW JERSEY.

## STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 377,324, dated January 31 1888.

Application filed July 14, 1887. Serial No. 244,257. (No model.)

*To all whom it may concern:*

Be it known that I, THOMAS F. MORRIN, a citizen of the United States, and a resident of Jersey City, Hudson county, New Jersey, have invented certain Improvements in Steam-Generators, of which the following is a specification.

My invention relates to that class of steam-generators wherein the steam is generated in tubes which project from the generator chamber or shell into the combustion-chamber over the fire-bed, and the flames and heated gases pass upward among the said generating-tubes.

The object of my invention is to provide a steam-generator of the class above named with an extended heating-surface and free and abundant circulation in the generating-tubes and to provide perfectly dry and superheated steam. My construction also enables me to obtain a very large extent of heating-surface in a generator of compact form, thereby adapting the generator to steam-yachts and other vessels having limited boiler-room.

My invention will be fully described hereinafter, and its novel features carefully defined in the claims.

In the drawings, which serve to illustrate my invention, Figure 1 is a sectional side elevation of my improved generator, the plane of the section taken substantially on line 1 1 in Fig. 2. Fig. 2 is a sectional front elevation, the left half being substantially in front elevation and the right half being mainly in section on line 2 2 in Fig. 1. Fig. 3 is a sectional plan, the plane of the section being indicated by line 3 3 in Figs. 1 and 2. Figs. 4 and 5 illustrate a modified form of the header for the generating-tubes. Fig. 4 is a sectional view of the header and tubes on line 4 4 in Fig. 5, and Fig. 5 is a front view of the header with the cap removed. Fig. 6 is a sectional elevation of the back part of the generator only, (similar to Fig. 1,) which illustrates some minor variations of construction.

Referring first to Figs. 1, 2, and 3, A represents the front plates of the generator, and A′ A′ the side plates of the same. These plates, together with the generator-chamber, designated as a whole by B, inclose the rectangular combustion-chamber, fire-box, and ash-box. This shell is surmounted by a chimney or uptake, C.

D is the furnace-door; E, the ash-box; F, the ash-box door; G, the grate-bars, and H the refractory lining of the fire-box at the front and sides of the same.

I will now describe the generator-chamber B, which forms the back wall of the fire-box and combustion-chamber opposite to the charging-doors. This chamber is in the form of an oblong rectangle, as seen in plan, Fig. 3, and is made of boiler-plate and stayed in the usual manner, so as to stand the internal pressure. I prefer to make the top and bottom plates, *a* and *b*, of the semicircular or convex form seen in Fig. 1. This generator-chamber is divided by a transversely-arranged vertical partition, *c*, into two chambers, $B'$ and $B^2$, the former of which I call the "water-chamber," and the latter the "steam-chamber," although both will contain water. The water-chamber B′ is provided with a feed-water inlet, *d*, and both chambers may be provided with sediment-blow-off pipes and suitable hand-holes for access in cleaning out.

I will now describe the construction and arrangement of the generating-tubes and the means whereby the proper circulation is maintained therein.

I I are straight generating-tubes, which extend entirely through the combustion and generator chambers from front to rear, the front ends being supported in the front plate, A, and the rear ends being expanded in and supported by the front and back plates of the generator-chamber B. These tubes are provided with suitable screw caps or headers, *e e*, whereby they may be inspected internally and cleaned out. At the front the projecting ends of the tubes are protected by a housing, *f*, provided with large doors *g*, whereby they may be inspected conveniently, and yet be protected against currents of cold air. Where the tubes I cross the steam-chamber $B^2$, they are provided with apertures or slots *h* for the escape of steam therefrom into the chamber, and where they cross the water-chamber B′ they are provided with similar apertures or slots, *h′*, for the admission of water thereto.

In each generating-tube I is arranged a smaller tube, *i*, on which is fitted a sleeve, *j*, (see Fig. 4,) which fits snugly in the tube I between slots *h* and *h′*, at the point where tube I passes through partitions *c*. The tube *i* does

not extend back beyond slot *h'*, and it does not extend forward quite to the end of tube I. At its forward end I usually support the inner tube, *i*, on a stud or "chaplet," so as to keep it substantially in the axis of tube I; but this is not absolutely essential. This extremity of tube *i* might be allowed to rest on the bottom of tube I at this point.

The line *x* indicates about the proposed water-level in the generator-chamber B—that is, the water should cover the upper series or tier of tubes, I—when the said tubes will stand normally full of water. The products of combustion, heated gases, and flames pass upward among the generating-tubes, and the water therein is set in motion and steam generated. The colder water enters the tube I at slots or apertures *h'* from chamber B' and passes through the inner tube, *i*, toward the front, flows from the front end of tube *i* into the tube I, and passes back along the annular space in tube I, (exterior to tube *i*,) and escapes at slots or apertures *h* into chamber $B^2$. In its rearward flow it is exposed in the form of an annular film or sheet to the intense heat, and is in part converted into steam, which rises in the "steam-chamber" $B^2$, carrying with it considerable watery vapor. As it rises above the water-level it encounters a deflecting-plate, *k*, which is secured to the front plate of the chamber B, extends across the same from side to side, and back through an aperture, *l*, here formed in partition *c*. In passing around the free edge of plate *k* the steam discharges its load of watery vapor into chamber B', and then rises and enters the superheater, which I will now describe.

At the upper part of the generator are arranged the superheating-tubes J J—one or more tiers—extending like the tubes I from front to rear and supported in the front plate, A, and the plates of the generator-chamber B. They may have removable caps *e'* at one end only, as seen in Fig. 1, or at both ends, as in the case of tubes I.

Each tube J is open to the chamber B, through the medium of slots or apertures *m m* in the tubes, where they pass through said chamber, and in each tube J is arranged a smaller tube, *n*, which extends forward therein nearly to the front end of same. At their rear ends the ends of tubes *n* are bent or turned upward, pass out through the aperture *m*, and up through the crown-sheet *o* of chamber B into the steam dome or receiver K. Thus the saturated steam from the steam-space in chamber B is compelled to flow out through the annular space in the tube J, across the combustion-chamber toward the front, and then back through the inner tube, *n*, to the steam-dome. During its passage through tubes J and *n* it is thoroughly dried and to some extent superheated. As the aperture *l* in the partition *c* practically throws the two chambers B' and $B^2$ into one above the water-level, the extension of the tubes J across the chamber B and the extension of the partition *c* up to the crown-sheet *o* are mainly for convenience of construction and operation. The pipes J might be stopped at the inner plate of chamber B and expanded therein; but when allowed to extend through, as shown, they serve as stays to the chamber B and afford better access for cleaning from the back. I prefer, also, to extend the partition *c* up to the crown-sheet, as shown.

In order to further superheat the steam I prefer to arrange the steam-supply pipe, as shown. This pipe L taps the steam-dome K, and is then carried down into the combustion-chamber, where it connects with or forms coils L' in the combustion-chamber below the tubes J, passing out at the termination of said coil through the wall or shell of the combustion-chamber, as clearly shown in Figs. 2 and 3. In order to further utilize the heat of the furnace and provide for the thorough circulation of the water in the generator, I provide headers M, arranged in the ash-box E, one near each side wall thereof and extending from front to rear, and I also provide two similar headers, M', arranged at the sides of the combustion-chamber and above the water-line *x* of the generator. These headers are in the nature of pipes or tubes and connect at their back or inner ends with the chamber $B^2$, the lower pair tapping said chamber below the fire-bed, as shown. These headers—that is to say, the upper and lower headers on each side—are connected by numerous vertically-arranged tubes N N, which, of course, stand full of water normally and serve as generating-tubes. The tier or set of vertical tubes N may be arranged very close together, and they serve to protect the lining or side plates of the combustion-chamber from the intense heat, which will be in the main absorbed by the water in the tubes.

The front plate of chamber B', between the lower tier of the tubes I and the grate G, is exposed directly to the heat of the furnace; and in order that the heat may be transmitted back to the water in the generator-chamber B, I prefer to provide the stays *r* of this portion of said chamber with projecting studs *r'*, which project out into the furnace, as shown in Fig. 1, where they will be heated to a high temperature. The lower part of chamber B, below the grate, serves as a sediment-chamber and may be provided with the usual blow-off, as before stated. The two tiers of tubes J are merely duplicates, and only as many of said tubes need be employed as will be required to carry off the steam as fast as it is generated.

Where the tubes I are made of sufficiently thick metal to bear a screw-thread, the headers or caps *e* (seen in Figs. 1 and 3) will serve, but in case quite thin metal is employed I prefer to use a header similar to that illustrated in Figs. 5 and 6, which I will describe.

I represents the generating-tube, and *i* the inner tube, before described. P represents the header, which is of the character of a shallow triangular box with three apertures to receive

the ends of the three tubes I I, and in which they are secured by expanding them. The recess in the box-like header is divided by partitions *s s* and a screw, *t*, which passes through the cap P′, receives a securing-nut, *u*, on its outer end, which serves to clamp the cover down firmly. With this construction the header not only serves to close the ends of the tubes I, but to separate them and prevent the water from passing from one to the other at the header.

Instead of constructing the header to embrace three tubes, it may as well be made to embrace two or four.

In order that a jet of steam may be conveniently employed for cleaning soot and other substances which collect thereon from the exterior surfaces of tubes I, I provide holes *v v* in the front plate or fire-front A of the generator for the insertion of a nozzle or jet-tube. There may be any desired number of these holes, and they will be provided with plugs or stoppers when not in use.

I will now describe the construction illustrated in Fig. 6, merely indicating the points which differ from the construction already described.

In lieu of the stays *r* with projecting heads *r′*, as seen in Fig. 1, I employ large tubular stays $r^2$, which are expanded in the plates and in the partition *c*. These project through the back plate and are stopped by plugs $r^3$. These plugs are provided each with a groove along its side to admit a little air to the furnace. The partition *c* only extends up about to the water-line, and the deflector *k* extends entirely across the chamber and has an aperture in it for the passage of steam. There are horizontal partitions *v′ v′* across the chamber between the several tiers of drying-tubes J, and these latter are provided with plugs *w w*, in which the inner tubes, *n*, find bearings or sockets. From the bore in each plug *w* there is a lateral passage, *w′*, at the upper side, and a short tube, *n′*, is here connected with the bore in the plug and extends out through the shell of tube J and up into the chamber above, the upper one opening into dome K. This construction compels the steam to flow through each tier of tubes in succession before it reaches the dome K.

Having thus described my invention, I claim—

1. In a steam-generator, the generator-chamber constructed with plane front and back plates and with a tight partition, *c*, extending up to the water-line with communication above between the two parts of said chamber, and the compound generating-tubes mounted in the plates and partition of said chamber and extending across the combustion-chamber over the fire-bed, substantially as set forth.

2. In a steam-generator, the combination, with the front plate and side plates of the combustion-chamber, of the generator-chamber B, forming one wall of said chamber, and the compound generating-tubes mounted at their one ends in the generator-chamber and at their other ends in the opposite plate of the combustion-chamber, said generating-tubes having suitable apertures within the generator-chamber for the ingress and egress of water, substantially as set forth.

3. In a steam generator, the combination of a generator-chamber, B, of substantially the form shown, and provided with a partition, *c*, of the generating-tubes mounted therein and comprising each an exterior tube, I, with openings *h* and *h′*, arranged on opposite sides of said partition in the chamber B, and the inner tube, *i* mounted in tube I, substantially as set forth, whereby a proper circulation is effected in said tubes.

4. In a steam-generator, the combination, with the generator-chamber, forming one wall of the combustion-chamber and fire-box, and the plates A A′ A′, forming the other sides of the same, of the header M, arranged below the grate and connected at its one end with the generator-chamber, the header M′, arranged above the water-level in the combustion-chamber and also connected with the generator-chamber, and the tubes N N, connecting said headers, said tubes and headers being arranged near the wall of the combustion-chamber, substantially as set forth.

5. In a steam-generator, the combination, with the generator-chamber B, having a partition, *c*, which divides said chamber below the water-line into chambers B′ and $B^2$, and having also a deflecting-plate, *k*, over chamber $B^2$, of the compound generating-tubes mounted in said generating-chamber, substantially as set forth.

6. In a steam-generator, the combination, with the generator-chamber B and the generating-tubes mounted therein, of the compound superheating or drying tubes mounted in said generator-chamber above said generating-tubes, said superheating-tubes comprising each an exterior tube, J, open to the chamber B and extending across the combustion-chamber, and an inner tube, *n*, opening into the steam-dome, substantially as set forth.

7. The generator-chamber B, provided with a partition, *c*, and with tubular stays $r^2$, extending across said generator and opening into the fire-box at their inner ends, said stays being each provided at its outer end with a grooved plug or stopper, $r^3$, substantially as set forth.

8. The combination, with the generator-chamber, of the partitions *v′ v′*, across the same below the steam-dome K, forming chambers, the drying-tubes J, arranged in tiers and secured in the walls of said generator-chamber, said tubes J provided with apertures *m m*, the chambered stoppers *w*, and the tubes *n* and *n′*, arranged substantially as set forth.

9. The header P for the generating-tubes, constructed in the form of a shallow box, provided with holes to receive two or more of said tubes, with partitions *s s*, separating each of said tubes from the others, and with a cap and screw fastening therefor, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

THOMAS F. MORRIN.

Witnesses:

HENRY CONNETT,

J. Q. CAPLINGER.