

No. 762,893.

PATENTED JUNE 21, 1904.

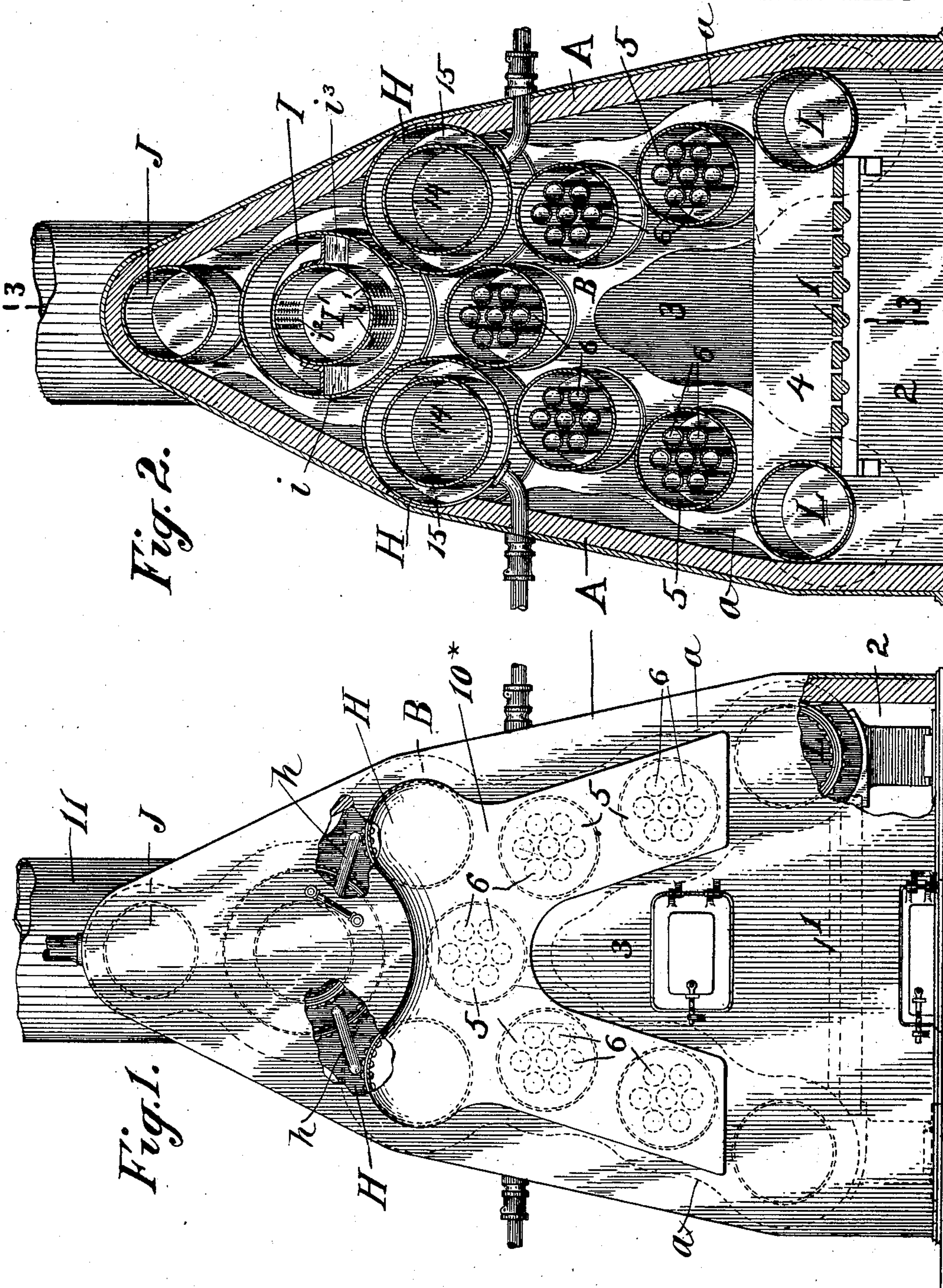
G. FARREL & B. ETCHEGARAY.

STEAM GENERATOR.

APPLICATION FILED MAY 5, 1903.

NO MODEL.

6 SHEETS—SHEET 1.



Witnesses
Geo W Eisenham
Raena H. Yudizky

Inventors:
Guillermo Farrel
Benito Etchegaray.
By their Attorney
Abner duPuy.

No. 762,893.

PATENTED JUNE 21, 1904.

G. FARREL & B. ETCHEGARAY.

STEAM GENERATOR.

APPLICATION FILED MAY 5, 1903.

NO MODEL.

6 SHEETS—SHEET 2.

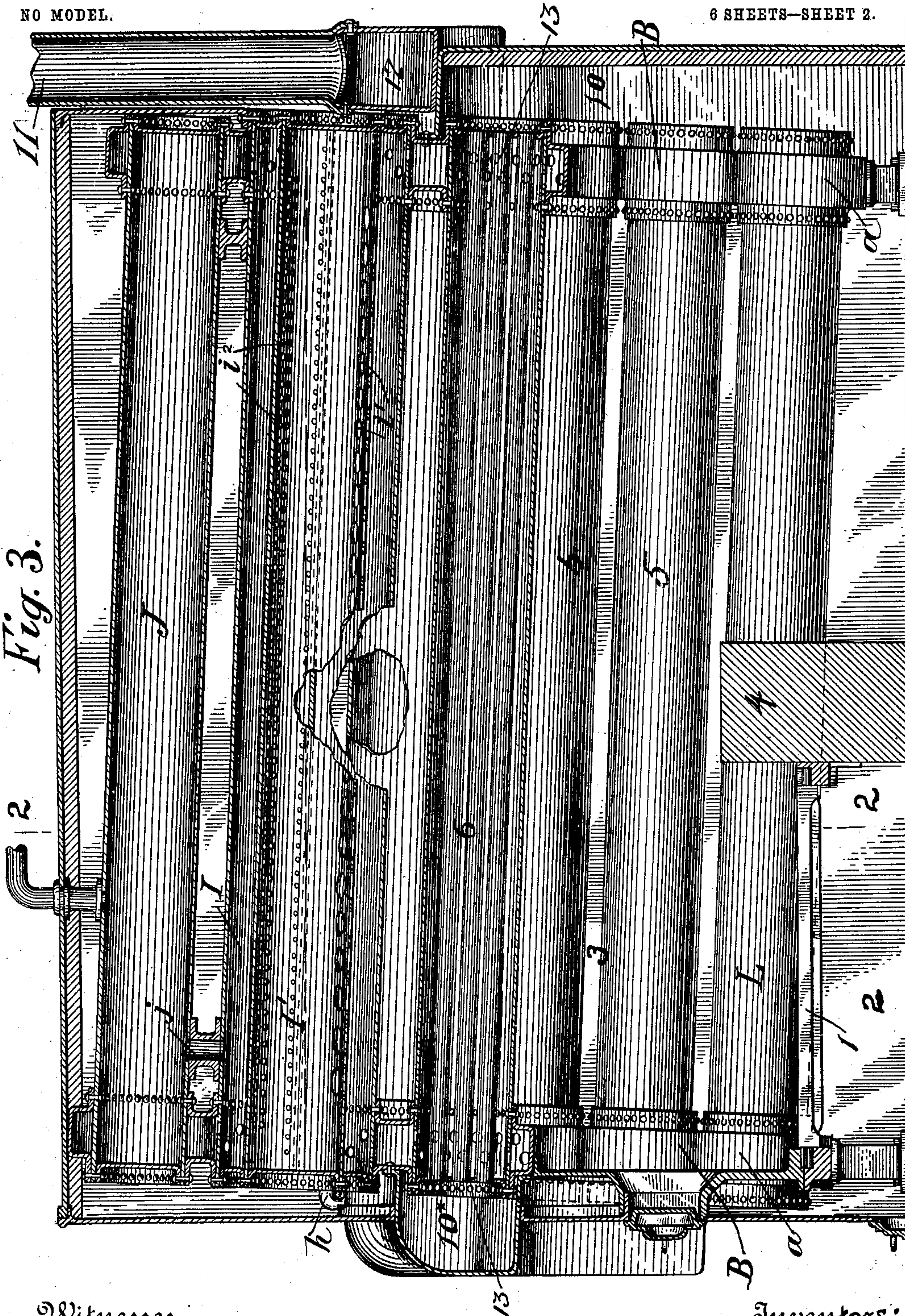


Fig. 3.

Witnesses
Geoff Eisenbaum
Raena H. Yedizky

Inventors:
Guillermo Farrel,
Benito EtcheGARAY.
By their Attorneys
A. J. duBois.

No. 762,893.

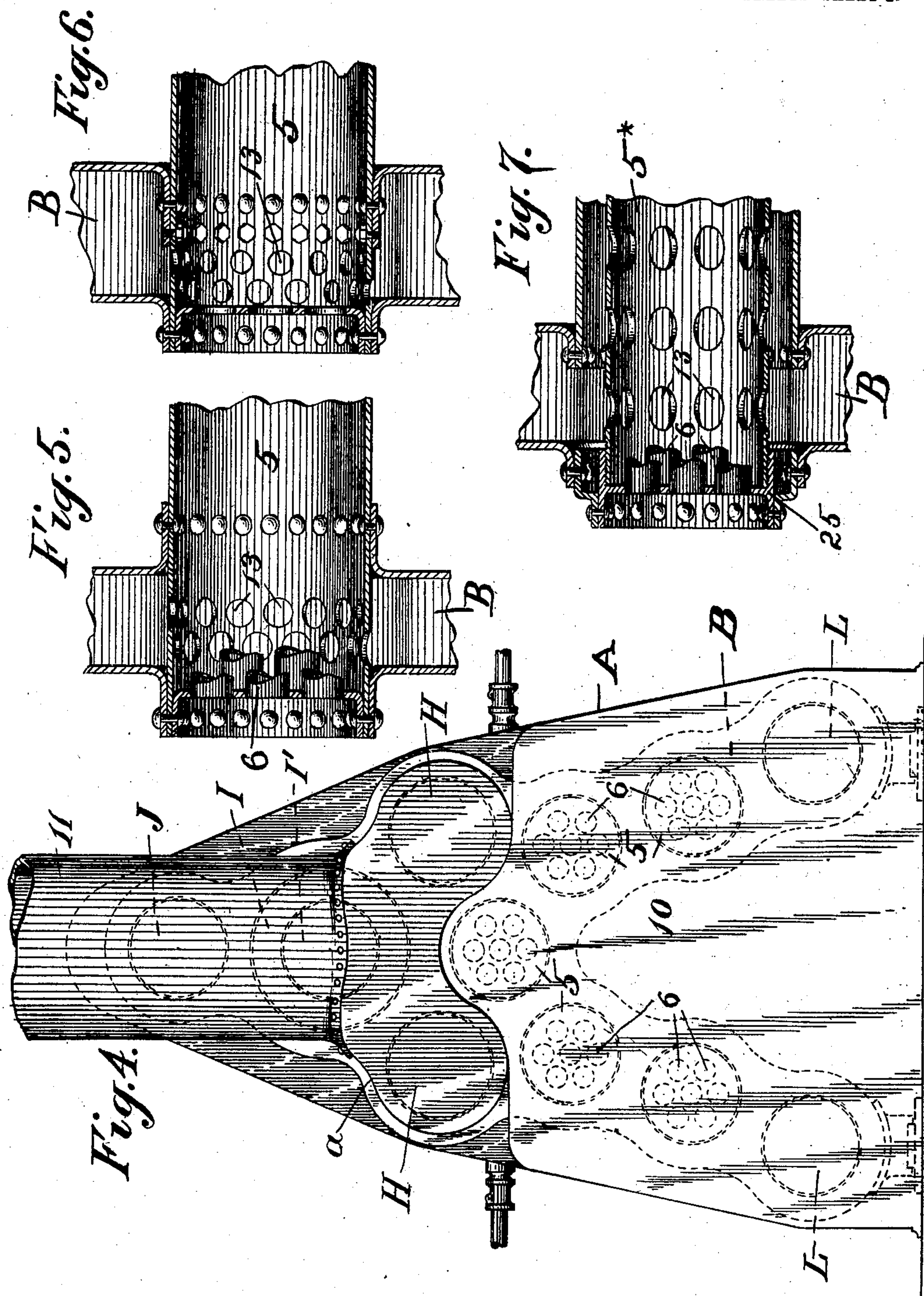
PATENTED JUNE 21, 1904.

G. FARREL & B. ETCHEGARAY.
STEAM GENERATOR.

APPLICATION FILED MAY 5, 1903.

NO MODEL.

6 SHEETS—SHEET 3.



Witnesses
G. W. Eisenbraun
Raena H. Yudigky

Inventors:
Guillermo Farrel
Benito Etchegaray
By this Attorney
A. Faber du Ruyck

No. 762,893.

PATENTED JUNE 21, 1904.

G. FARREL & B. ETCHEGARAY.

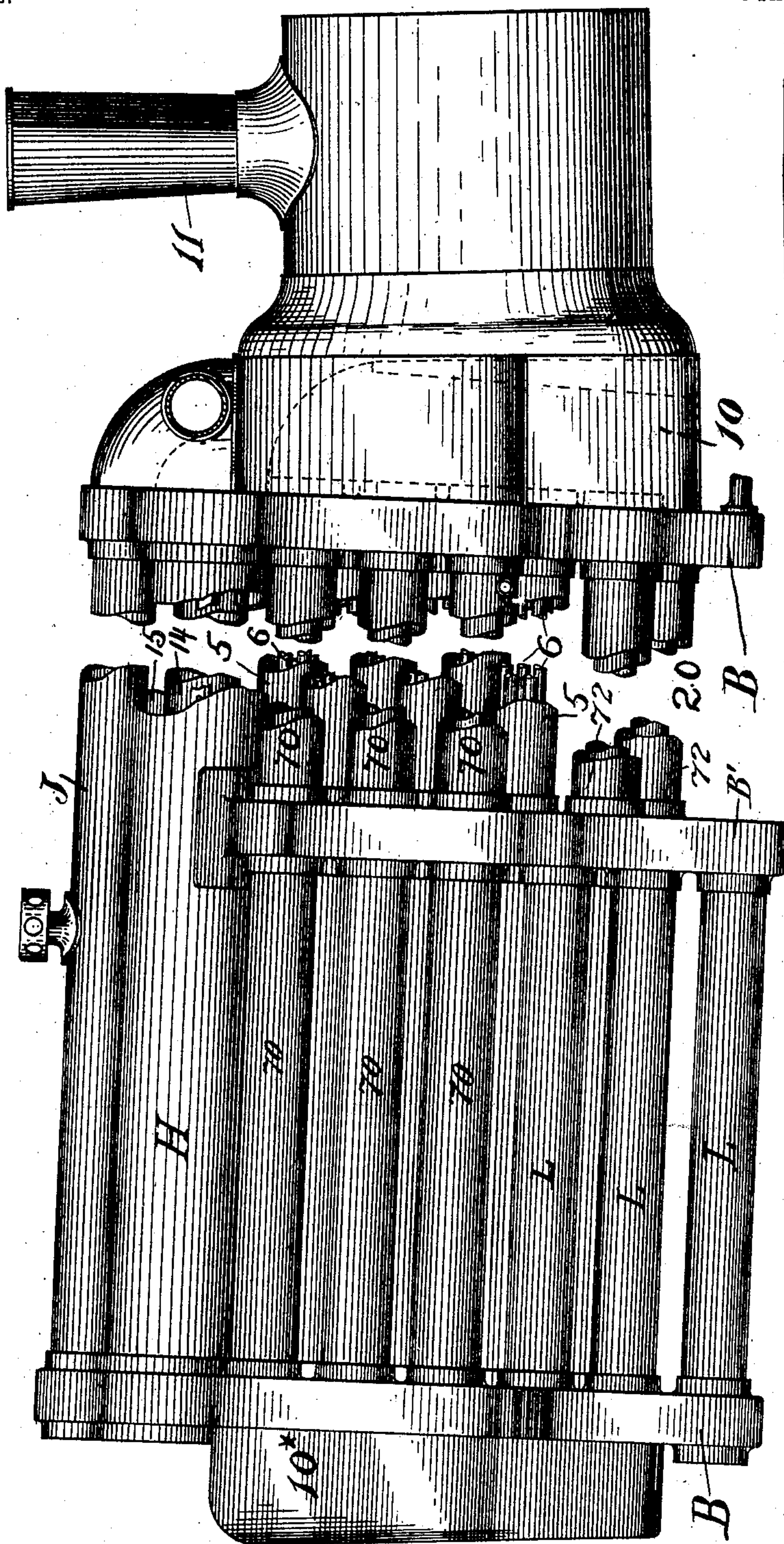
STEAM GENERATOR.

APPLICATION FILED MAY 5, 1903.

NO MODEL.

6 SHEETS—SHEET 4.

Fig. 8.



Witnesses
George Wm. Eisenbaum
Raena H. Yedizky.

By their Attorney

Inventors:
Guillermo Farrel,
Benito EtcheGARAY,
Attest: [Signature]

No. 762,893.

PATENTED JUNE 21, 1904.

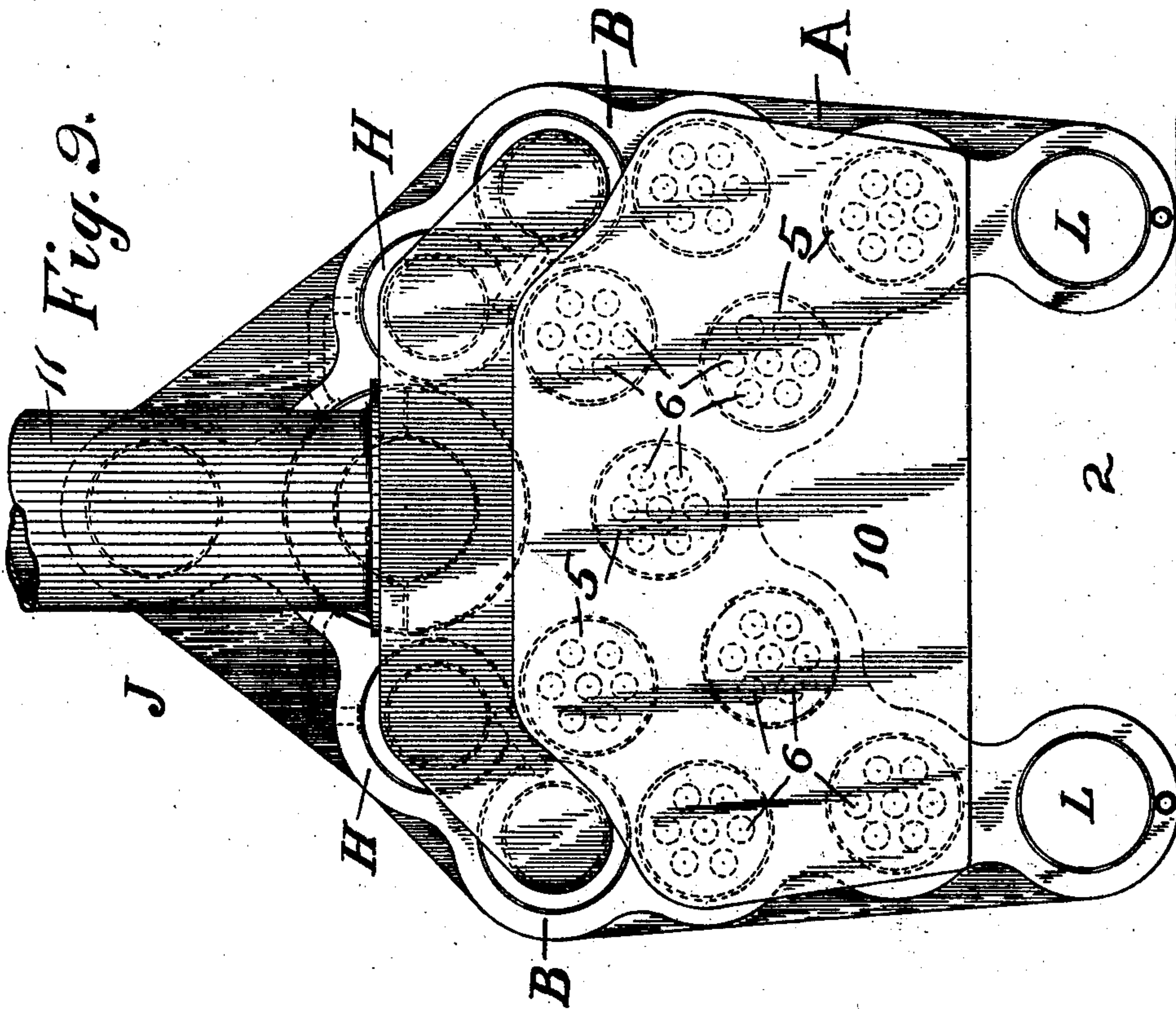
G. FARREL & B. ETCHEGARAY.

STEAM GENERATOR.

APPLICATION FILED MAY 5, 1903.

NO MODEL.

6 SHEETS—SHEET 5.



Witnesses
Geo. W. Esenbrenner
Raena H. Yudizky.

Inventors:
Guillermo Farrel
Benito Etchegaray
By their Attorney
A. Faber du Raux

No. 762,893.

PATENTED JUNE 21, 1904.

G. FARREL & B. ETCHEGARAY.

STEAM GENERATOR.

APPLICATION FILED MAY 6, 1903.

NO MODEL.

6 SHEETS—SHEET 6.

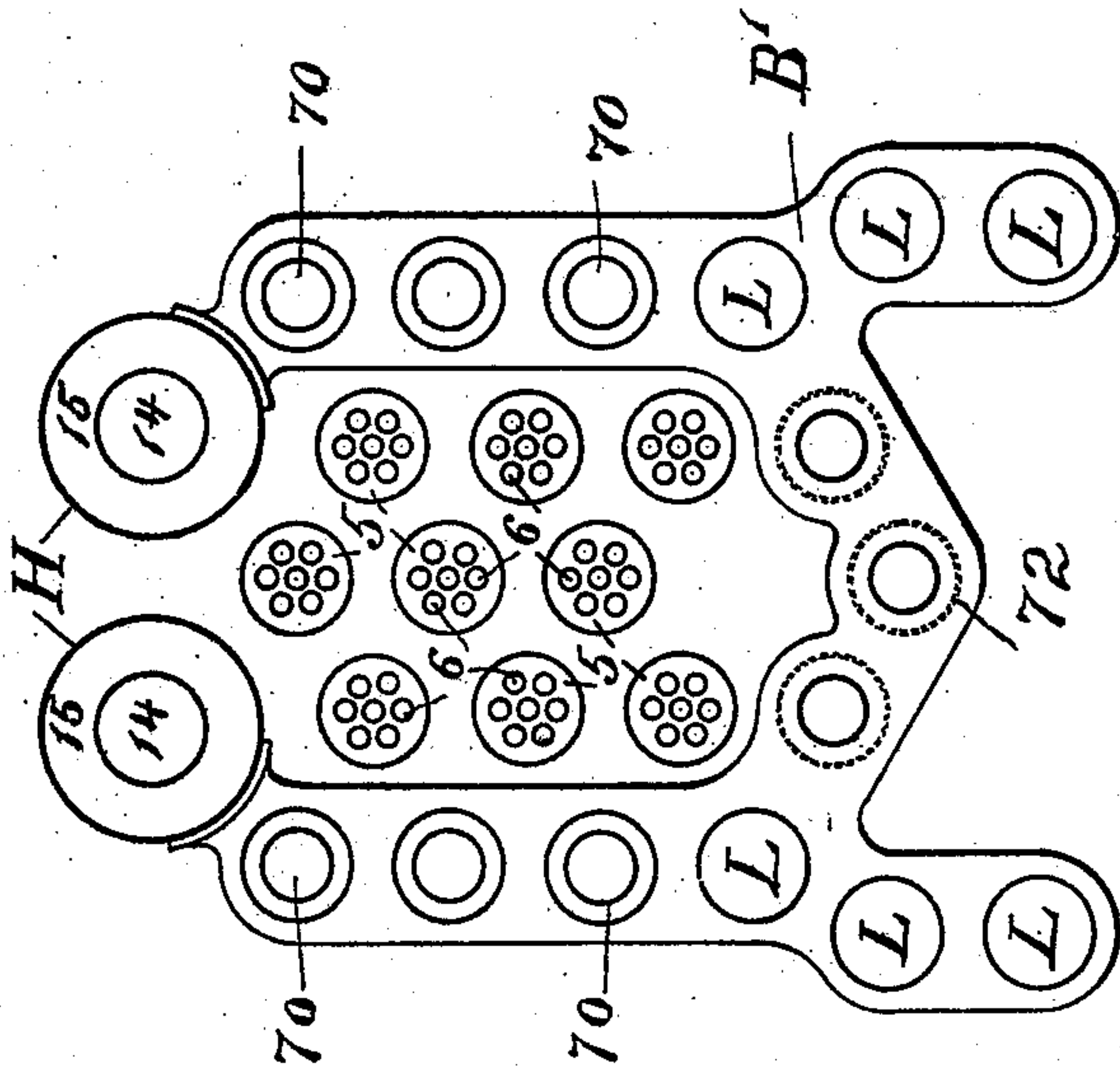


Fig. 10.

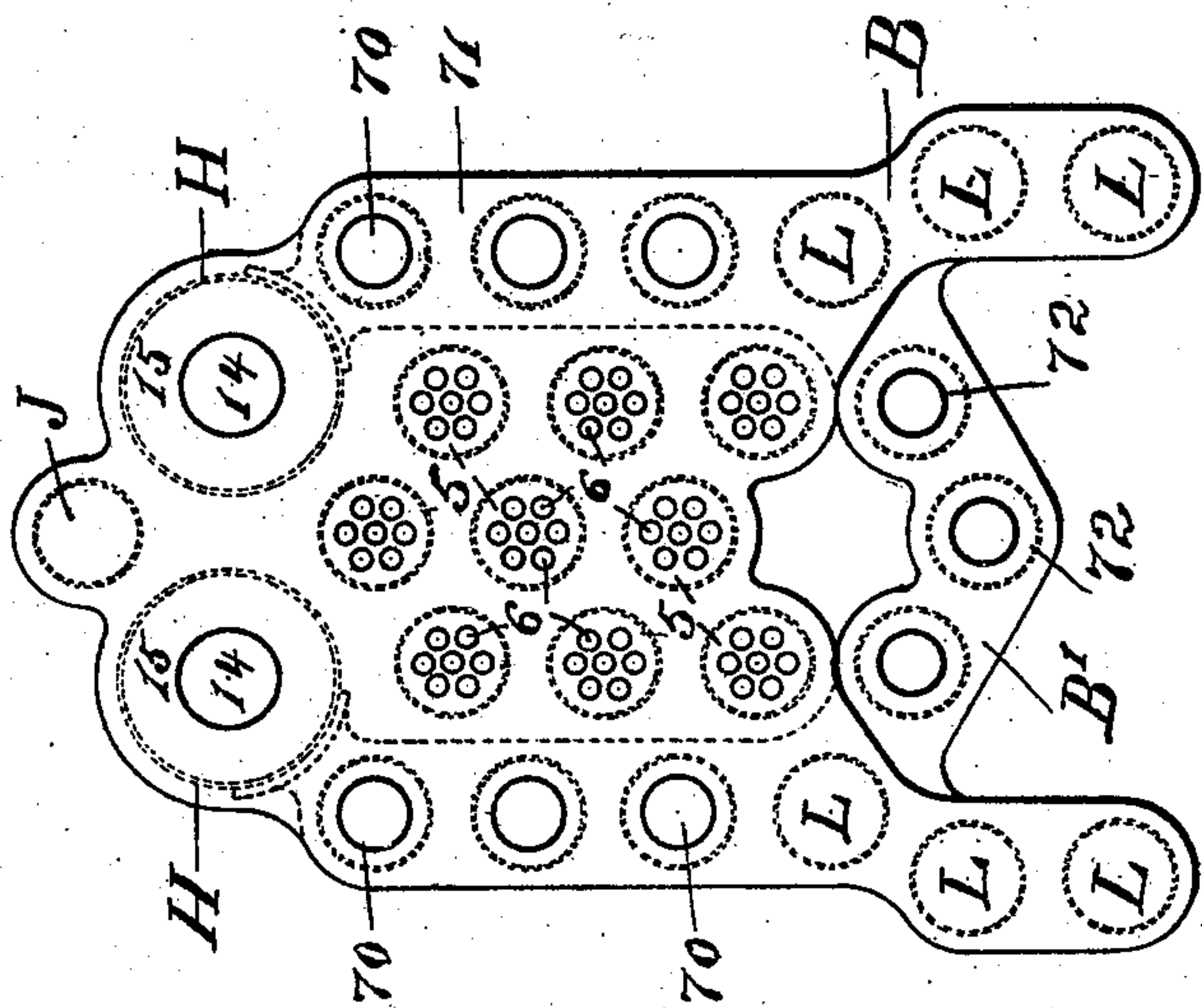


Fig. 11.

WITNESSES:

G. W. Enslin
R. B. Bruns

INVENTORS:

Guillermo Farrel
Benito Etchegaray
BY *A. Faber du Sauf*
ATTORNEY

UNITED STATES PATENT OFFICE.

GUILLERMO FARREL AND BENITO ETCHEGARAY, OF SAN LUIS POTOSI, MEXICO.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 762,893, dated June 21, 1904.

Application filed May 5, 1903. Serial No. 155,785. (No model.)

To all whom it may concern:

Be it known that we, GUILLERMO FARREL, a subject of the King of Spain, and BENITO ETCHEGARAY, a citizen of Mexico, both residing at San Luis Potosi, Estado de San Luis Potosi, Mexico, have invented certain new and useful Improvements in Steam-Generators, of which the following is a specification.

Our invention has reference to improvements in steam-generators, and has for its objects, first, to increase the efficiency of a steam-boiler by more perfectly utilizing the gases of combustion, and consequently increasing the steam-producing capacity according to bulk and weight of the boiler, and, secondly, to produce a sectional boiler at a comparatively low expense adapted for all purposes and readily to be fitted together.

The nature of our invention will best be understood when described in connection with the accompanying drawings, in which—

Figure 1 represents a front elevation of a steam-generator embodying our invention, parts being broken away. Fig. 2 is a vertical section on the line 2 2, Fig. 3. Fig. 3 is a vertical section on the line 3 3, Fig. 2. Fig. 4 is a rear elevation. Figs. 5, 6, and 7 are detail views, on an enlarged scale, illustrating the construction and connections between the water-heads and the generating-tubes. Fig. 8 is a side elevation with part broken away, showing the construction applied to a locomotive-boiler. Fig. 9 is an end elevation of Fig. 8 with parts removed. Fig. 10 is a section on the line 10 10, Fig. 8. Fig. 11 illustrates a modified form for a stationary boiler, the same being a rear elevation.

Similar letters and numerals of reference designate corresponding parts throughout the several views of the drawings.

Referring at present to Figs. 1 to 4, inclusive, of the drawings, wherein we have illustrated our invention as applied to a stationary boiler, numeral 1 designates the grate, which may be of any usual well-known type. 2 is the ash-pit, 3 the combustion-chamber, and 4 a low bridge-wall. In the present instance we have shown the boiler provided with a surrounding casing A, lined with fire brick or

clay and provided at its opposite ends with water-heads B, having diverging limbs *a*, extending to or below the grate-surface and to substantially the top of the boiler. Between said water-heads is arranged a series of water-tubes 5, extending through said water-heads and provided with lateral openings 13, Figs. 3, 5, and 6, within said heads for the purpose of placing the same in communication with the interior of said heads and for establishing a circulation of water through all said tubes and through the heads. The water-tubes 5 are arranged in arch form above the fire—that is to say, within the combustion-chamber which extends throughout the entire length of the furnace—and within each of said tubes is located a number of small fire-tubes 6, open at their ends and communicating at their rear ends with the chamber 10 and at their front ends with the smoke-box 10*. These fire-tubes 6 are fixed to the heads of the tubes 5, as indicated in Figs. 5 and 6, or they may be fixed to the heads of a separate removable and perforated tube 5*, as shown in Fig. 7. Sufficient space for the proper circulation of water through the water-tubes 5 is left between the fire-tubes and the interior walls of the said water-tubes. The method of securing the water-tubes to the water-heads B will vary according to circumstances and accessibility as to riveting, and each tube is preferably provided with a plug for washing out sediment. Above the water-tubes 5 or above the arch of the series of tubes 5 are arranged on opposite sides of the center line feed-water heaters H, each composed of two concentric tubes 14 and 15, placed the one within the other and adapted to form a narrow annular water-space around the interior tubes. The feed-water for the boiler is introduced into said annular space between the tubes at the lowest point near the chimney 11 and is discharged at the highest point of said annular spaces into the distributing-tube I through the connections *h*. The total area of the openings of the annular spaces between the tubes 14 and 15 should be from thirty-three per cent. to fifty per cent. greater than the total area of the openings of the fire-tubes,

the proportion varying according to the length of the boiler. The tubes 14 and 15 are slightly inclined toward the rear end of the boiler, thus permitting the deposition of solid matter contained in the feed-water at the lowest point of the annular space between said tubes, at which said point suitable discharge-cocks or hand-holes are provided, as usual. The furnace-gases pass around the water-tubes 5 and from the fire-chamber to the chamber 10 in the rear, thence through all the fire-tubes 6 to the smoke-box 10* in front, thence through the fire-tubes 14 of the water-heaters H to the smoke-box 12 at the rear; and thence finally to the stack 11. Some of the fire-gases will circulate from the fire-space 3 through the space above, around the distributing-tube I and the dry-steam tube J, and back to the fire-space 3. A tube I, which in connection with an interior tube I' constitutes the main deposit-drum, is secured to the heads B in a similar manner as the tubes 5 and is inclined forwardly and upwardly similarly to the remaining tubes. In the circulation of water through the tubes 5 and the main drum I I' the tendency is to deposit solids at the bottom of the rear head B, where the latter is provided with a suitable discharge cock or cocks and cleaning-plugs for the purpose of removing the accumulated sediment at intervals. In practice I prefer to make the tube I about twice the diameter of the water-tubes 5 and connect the two tubes I and I' by suitable orifices i' and i'' . Above the tubes I and I' is located a tubular steam-drum J, closed at the ends and in communication with the top of the tube I by a short pipe j , and at one or both ends of the drum communication may be established with the interior of the water-heads. The purpose of tube I' is, first, to act as a stay for the main drum or distributing-tube I, it being secured thereto at each end, and also to act as a means for preventing priming or the carrying up of water to the dry tube J. The tube I' is made substantially half the diameter of the tube I and is provided with holes i' at its bottom whose total area should equal the area of the opening of the main tube. The top of the tube I' is also provided with openings i'' , which should equal in total area the area of cross-section of said tube. As before stated, radial flanges i and i' , extending throughout the full length of the tubes and fastened to the tube I', are provided for the purpose, forming baffle-plates in the usual manner. Beneath the tubes 5 and substantially in line with the grate are arranged water-heads L, preferably made tubular in form and of the same diameter as said tubes 5, but not provided with fire-tubes. They are preferably furnished with hand-holes for the purpose of removing sediment.

In Figs. 8 and 9 we have shown a method of applying our invention to locomotive-boilers. As in the stationary boiler above de-

scribed, a series of water-tubes 5, with internal fire-tubes 6, are arranged between two water-heads B B, one at the forward end of the boiler, the other at the rear end, the fire-tubes communicating at their rear ends with the chamber 10 and at their forward ends with the smoke-box 10*. H H are the feed-water heaters formed of the external pipes 15, extending from the forward water-head to the rear water-head, while the internal flues 14 pass through the water-heads B in front and in the rear, so as to communicate at the front with the smoke-box 10* and at the rear with a flue leading to the chimney 11. The annular water-space between the pipes 15 and 14 are closed at the ends. In addition to the two end water-heads we have provided an additional intermediate water-head B'. The forward water-head receives the forward ends of all the tubes with the exception of the three central bottom tubes 72, which latter start from the intermediate head B' and extend to the rear water-head B. The intermediate water-head surrounds the series of water-tubes 5 and is attached at its upper end to the tubes H. It receives on opposite sides the additional tubes 70, on the forward side the tubes 70 and L extending from the front head and on the rear side the corresponding tubes extending from the rear head B and also the three tubes 72 extending from said head. Return fire-flues pass through the tubes 70, all through from the forward end to the rear end, so as to communicate with the smoke-box 10* at the forward end and with the fire-chamber 10 at the rear end. The gases circulate substantially in the manner described in relation to Figs. 1 to 3. They pass around the tubes 5 above the grate and in the space 20 beyond the grate to the chamber 10 in the rear, thence through the fire-tubes 6 to the chamber 10* in front, thence partly through inner tubes 14 of the water-heaters H and partly through the fire-tubes of the several tubes 70 to the rear of the boiler, and finally to the stack 11.

In preference we make the backs of the different pipes illustrated of cast-iron lined with fire-brick and line the sides with fire-clay blocks backed with asbestos secured to light steel plates, the latter being made in sections and bolted to each other, so that their removal may be conveniently effected. In the types illustrated in Figs. 1 to 7 the tubes H are so arranged that they lie close to the main distributing-drums I, so as to prevent the upward escape of gases and require less lagging and also form protection against fire to the main distributing-drums in case of low water.

For calcareous districts it is preferable to insert into the water-tubes 5 a perforated tube—for instance, as 5* in Fig. 7—containing a nest of small tubes 6, made of brass and so arranged that the entire tube and nest of fire-tubes may be removed from the tubes 5 and

immersed in acid-baths for cleaning without disturbing the fire-tube joints. It will be observed that all tubes are so spaced in the heads as to make a strong job without the necessity of stay-bolts for the flat surfaces, or, in other words, each tube is made its own stay added to the additional staying effect of the small tubes. In some cases where there are a great number of tubes in the heads difficult of access for riveting, particularly in instances where it is necessary to remove one tube without disturbing the remainder, one flange of each water-head B is turned inward, as shown in Fig. 7, and riveted to the water-tube 5, and a short piece of tubing 25 of the same diameter as the tube 5 is inserted from the outer side of the water-head and secured to the forward flange by bolts screwed through the corresponding flanges. The tube 5* is closed at the ends by the tube-sheets and provided with suitable openings to permit of circulation.

In Fig. 11 we have shown a modified form of the water-heads and of the arrangement of the several tubes for stationary boilers.

Owing to the methods of construction herein shown and described, all tubes, large and small, are utilized as stays, thus permitting a much higher steam-pressure with the same factor of safety allowed in other types of boilers.

In view of the construction of the boiler herein described there is a more perfect utilization of the products of combustion, and the boiler has for its bulk and weight a greater steam-producing capacity, and consequently an efficiency greater than the well-known types of boilers. Being a combination of a series of small boilers it is practically safe against explosion and is susceptible of many different combinations, so that the form best adapted to local conditions may be obtained.

What we claim as new is—

1. A steam-generator comprising means for consuming fuel, a combustion-chamber, a casing or inclosing walls, water-heads located at opposite ends of the combustion-chamber, water-tubes extending through the combustion-chamber and connected with the water-heads at opposite ends, front and rear fire-chambers, fire-tubes nested within the water-tubes and communicating at opposite ends with the rear and front fire-chambers respectively, one or more sets of concentric tubes, the annular space between the tubes forming a water-space and the inner tube communicating with the front fire-chamber and at its rear with the chimney, a water-supply at or near the lower end of the said water-spaces, and a discharge into the circulation at or near the upper end of the same, substantially as described.

2. A steam-generator comprising means for consuming fuel, a combustion-chamber, a casing or inclosing walls, water-heads located at opposite ends of the combustion-chamber, water-tubes extending through the combustion-

chamber and connected with the water-heads at opposite ends, front and rear fire-chambers, fire-tubes nested within the water-tubes and communicating at opposite ends with the rear and front fire-chambers respectively, one or more sets of concentric tubes, the annular space between the tubes forming a water-space and the inner tube communicating with the front fire-chamber and at its rear with the chimney, a water-supply at or near the lower end of the said water-spaces, a discharge into the circulation at or near the upper end of the same, and a distributor communicating with the said water-space, substantially as described.

3. A steam-generator comprising means for consuming fuel, a combustion-chamber, a casing or inclosing walls, water-heads located at opposite ends of the combustion-chamber, water-tubes extending through the combustion-chamber and connected with the water-heads at opposite ends, front and rear fire-chambers, fire-tubes nested within the water-tubes and communicating at opposite ends with the rear and front fire-chambers respectively, one or more sets of concentric tubes, the annular space between the tubes forming a water-space and the inner tube communicating with the front fire-chamber and at its rear with the chimney, a distributor communicating with the said water-space, and a dry-steam drum located above and communicating with the distributor, substantially as described.

4. A steam-generator comprising means for consuming fuel, a combustion-chamber, a casing or inclosing walls, water-heads located at opposite ends of the boiler, water-tubes extending between the said end water-heads, front and rear fire-chambers, fire-tubes nested within the water-tubes and communicating at opposite ends with the rear and front fire-chambers respectively, an intermediate water-head partially surrounding the said series of fire and water tubes, a series of water-tubes connecting the three heads, fire-flues located within said water-tubes passing from the front header to the rear header and communicating with the front and rear fire-chambers, and a series of bottom tubes and fire-flues connecting the intermediate water-head and the rear water-head, and the fire-flues communicating with the rear fire-chamber and with the combustion-chamber, substantially as described.

5. A steam-generator comprising means for consuming fuel, a combustion-chamber, a casing or inclosing walls; water-heads located at opposite ends of the combustion-chamber, water-tubes extending through the combustion-chamber and connected with the water-heads at opposite ends, front and rear fire-chambers, fire-tubes nested within the water-tubes and communicating at opposite ends with the rear and front fire-chambers respectively, one or more sets of concentric tubes, the annular

space between the tubes forming a water-space and the inner tube communicating with the front fire-chamber and at its rear with the chimney, and a dry-steam tube or drum
5 located above the concentric tubes and communicating with the water-space of the same, substantially as described.

6. A steam-generator comprising means for consuming fuel, a combustion-chamber, a casing or inclosing walls, water-heads located at
10 opposite ends of the boiler, water-tubes extending between the said end water-heads, front and rear fire-chambers, fire-tubes nested within the water-tubes and communicating at
15 opposite ends with the rear and front fire-chambers respectively, an intermediate water-head partially surrounding the said series of fire and water tubes, and permitting the

circulation of flame and gases around and between the combined water and fire tubes, a
20 series of water-tubes connecting the three heads, and fire-flues located within said water-tubes passing from the front header to the rear header and communicating with the front and rear fire-chambers.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

GUILLERMO FARREL.
B. ETCHEGARAY.

Witnesses for Guillermo Farrel:

RAENA H. YUDIZKY,
A. FABER DU FAUR, Jr.

Witnesses for Benito Etchegaray:

C. C. VIRAMONTES,
JOSEFA ZAVALA.