No. 709,926. Patented Sept. 30, 1902.

E. DE PORTO-RICHE.

STEAM GENERATOR.

(Application filed Feb. 19, 1901.)

(No Model.)

7 Sheets—Sheet 1.

Fig. 1.

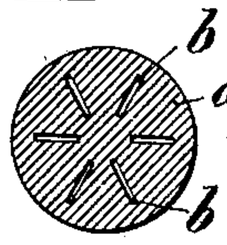

Fig. 3.

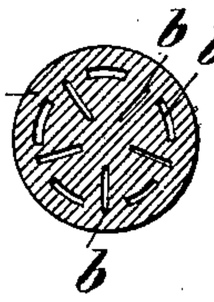

Fig. 4.

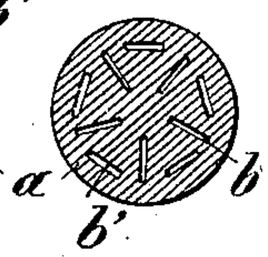

Fig. 2.

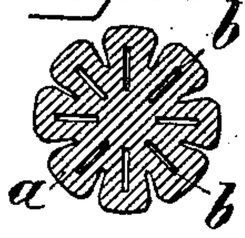

Fig. 5.

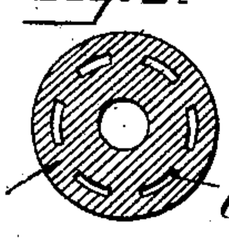

Fig. 6.

Fig. 10.

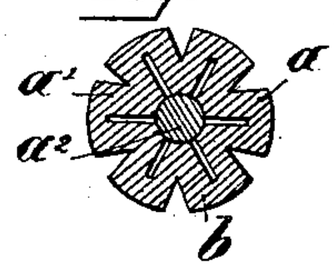

Fig. 7.

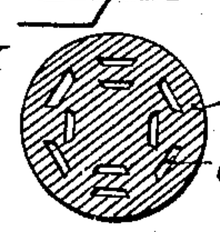

Fig. 8.

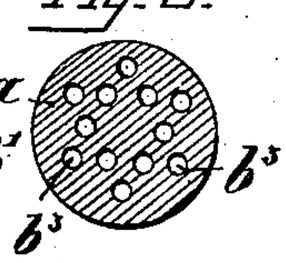

Fig. 9.

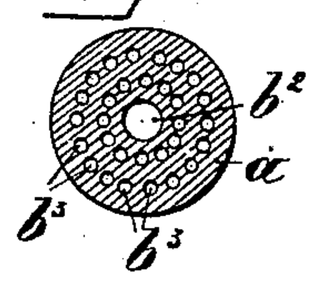

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Fig. 13.

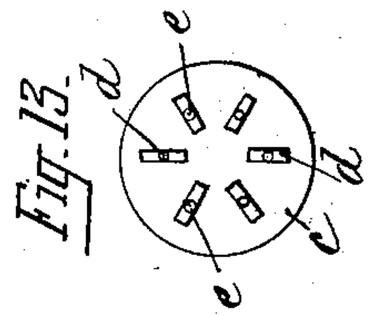


Fig. 12.

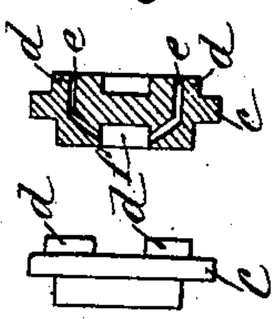


Fig. 11.

Fig. 15.

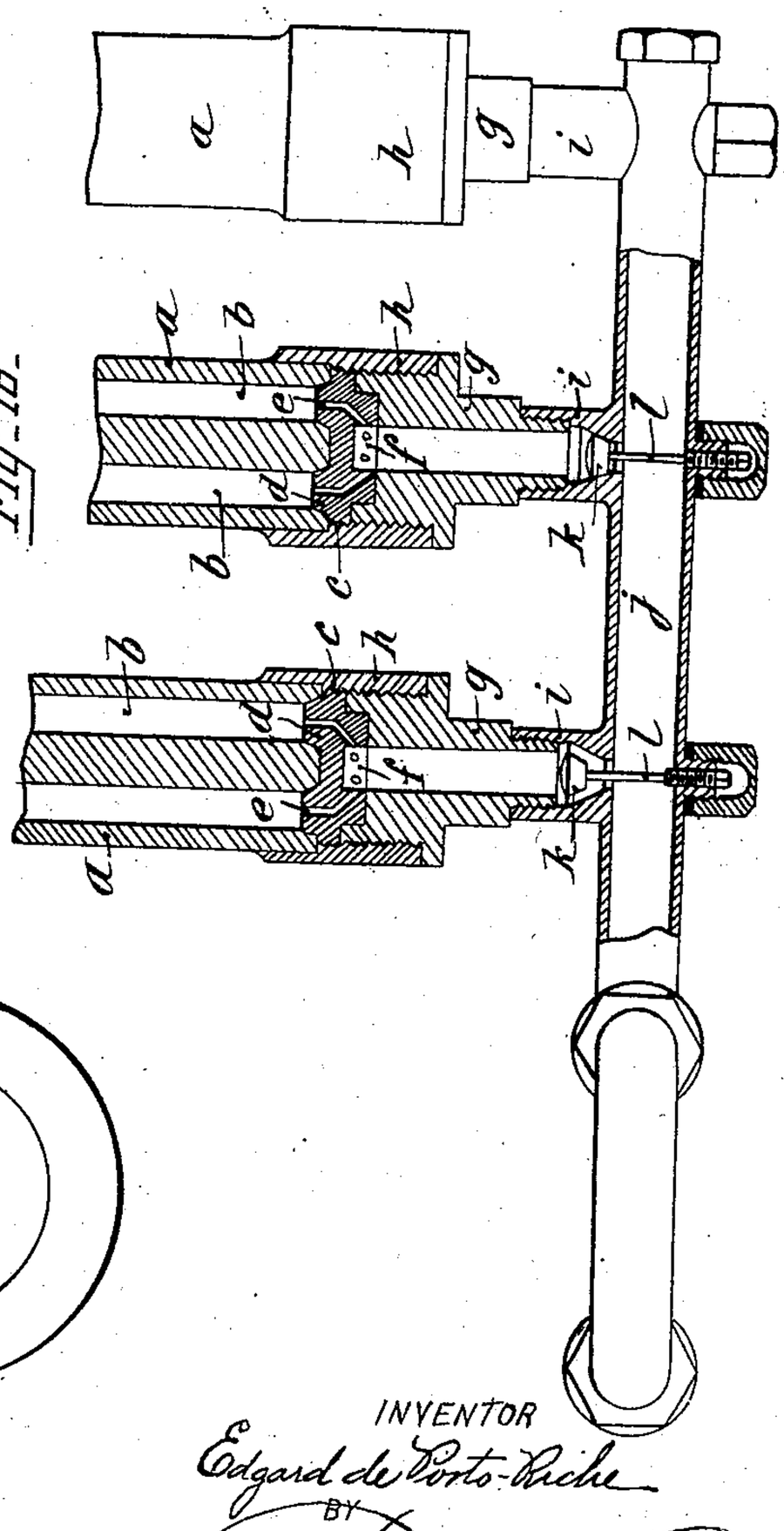
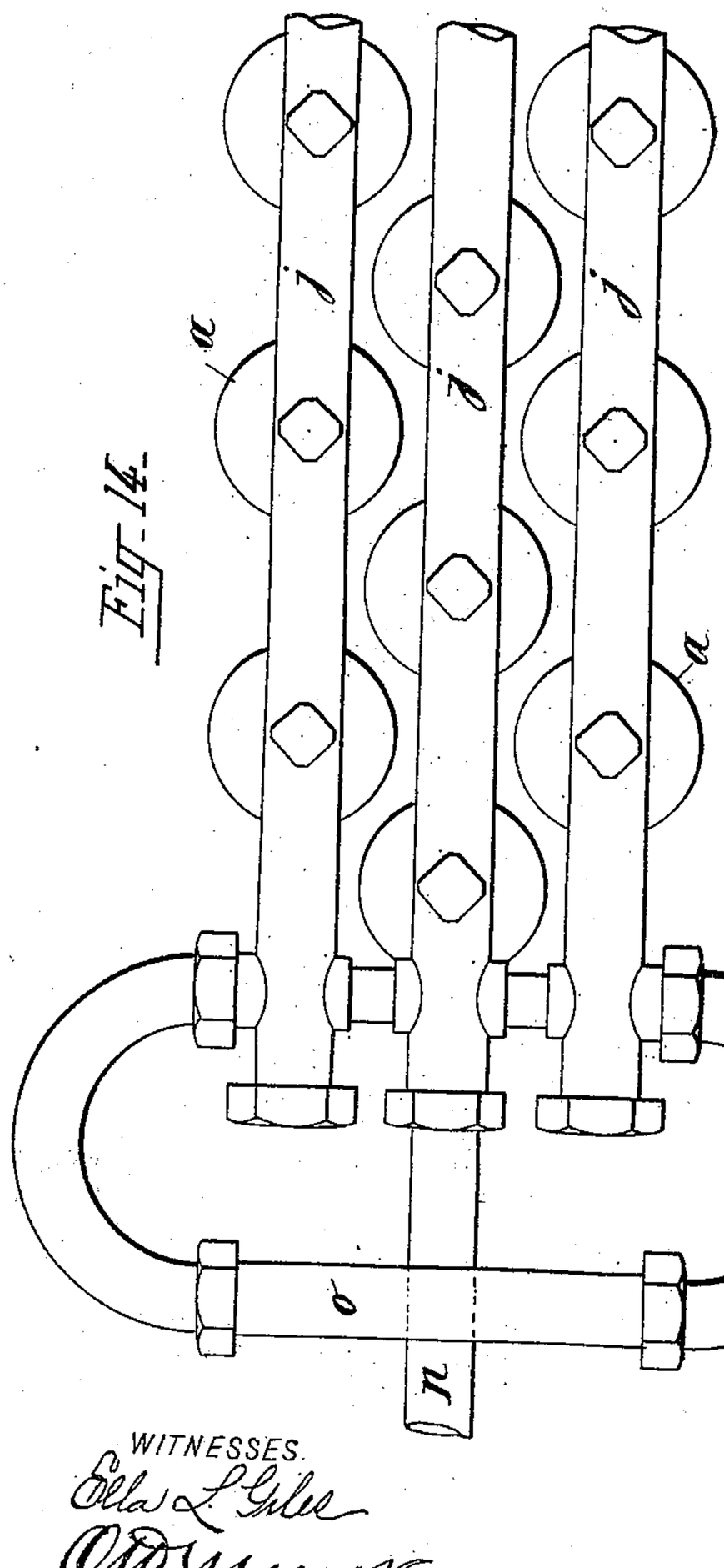


Fig. 14.



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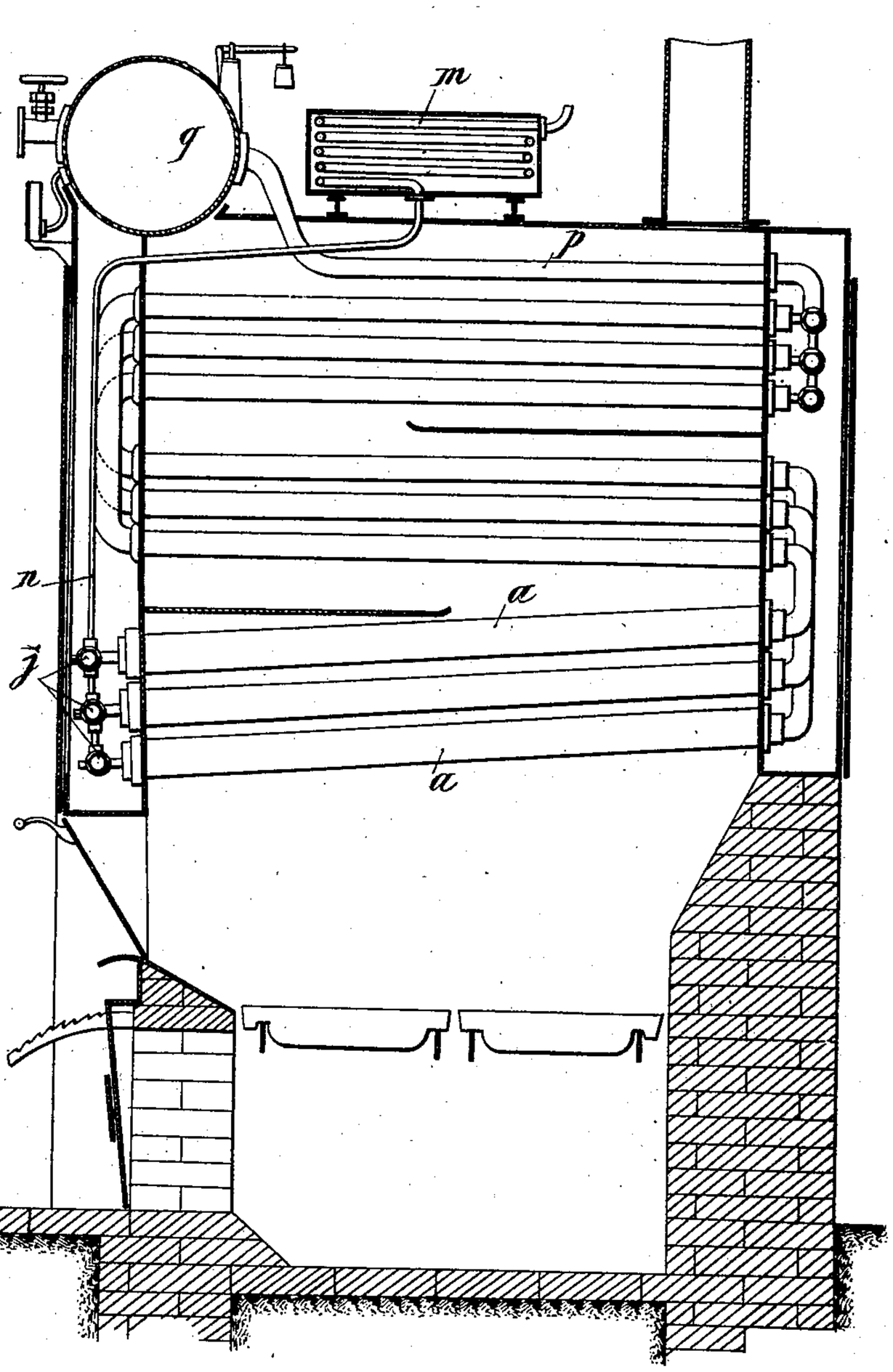
7 Sheets—Sheet 3.

Fig. 17.



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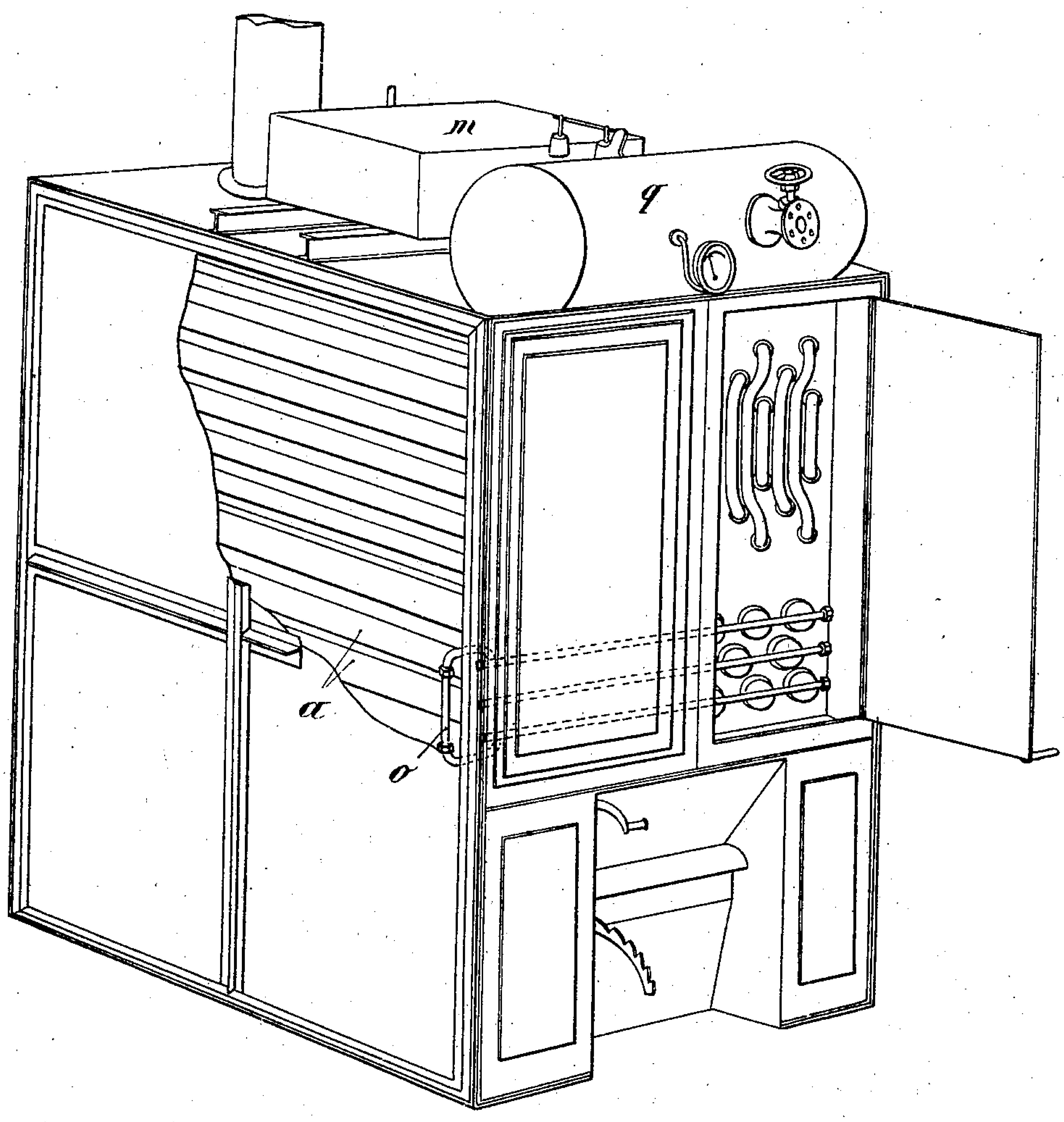
(No Model.)

7 Sheets—Sheet 4.

Fig. 18.



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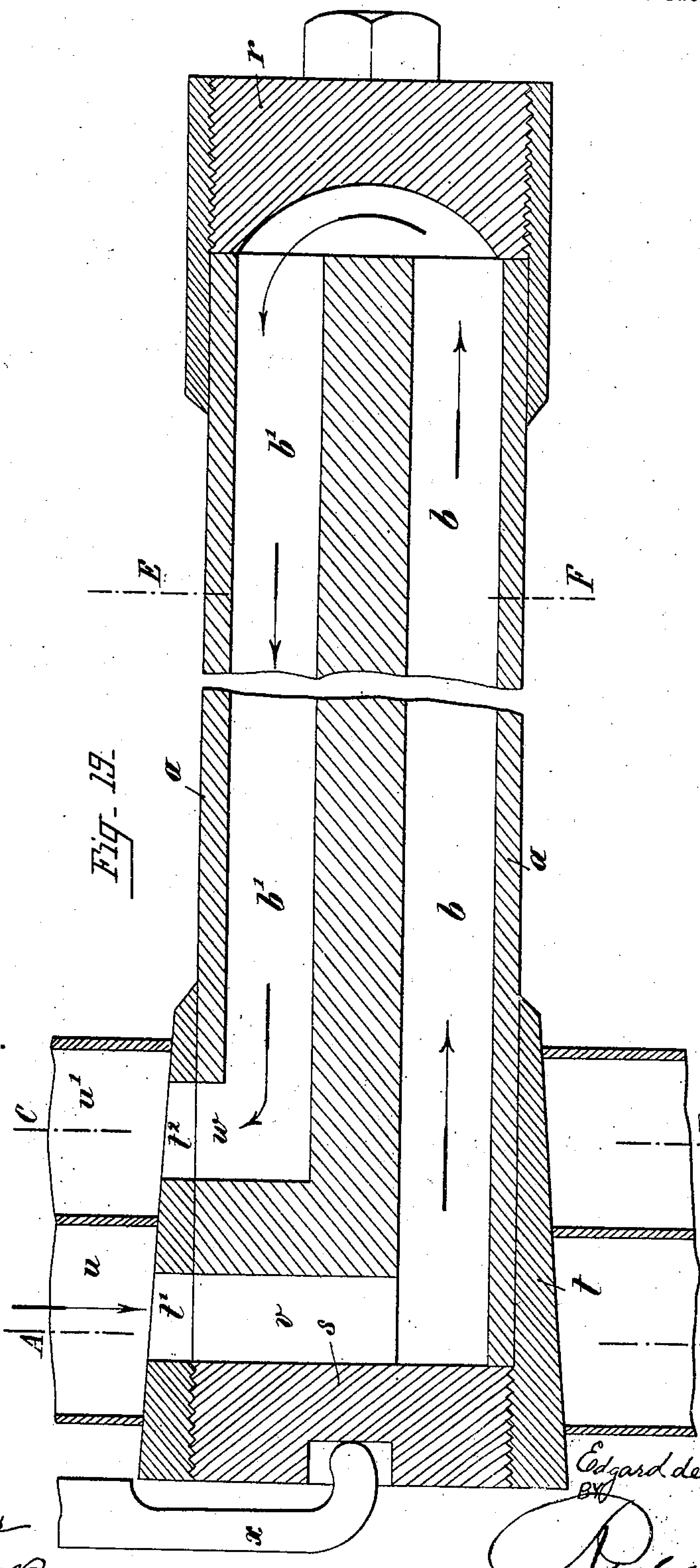
7 Sheets—Sheet 5.



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(No Model.)

7 Sheets—Sheet 6.

Fig. 22.

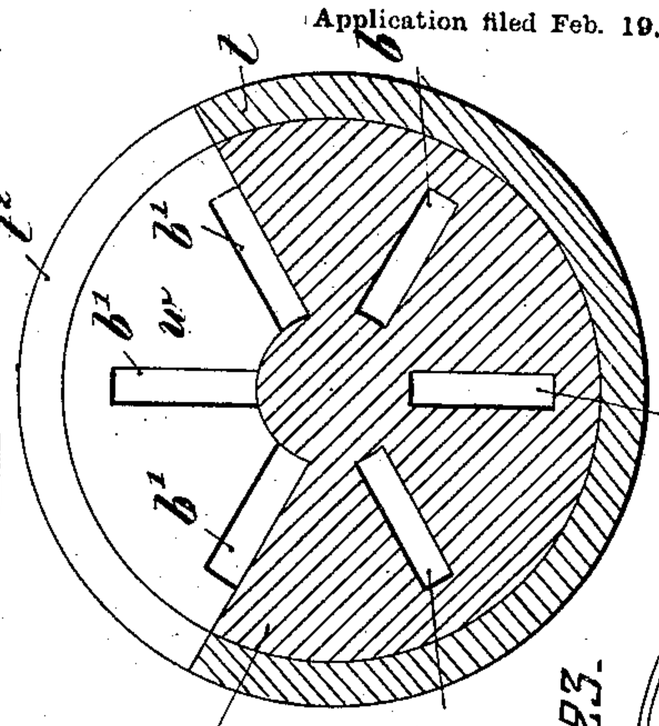


Fig. 23.

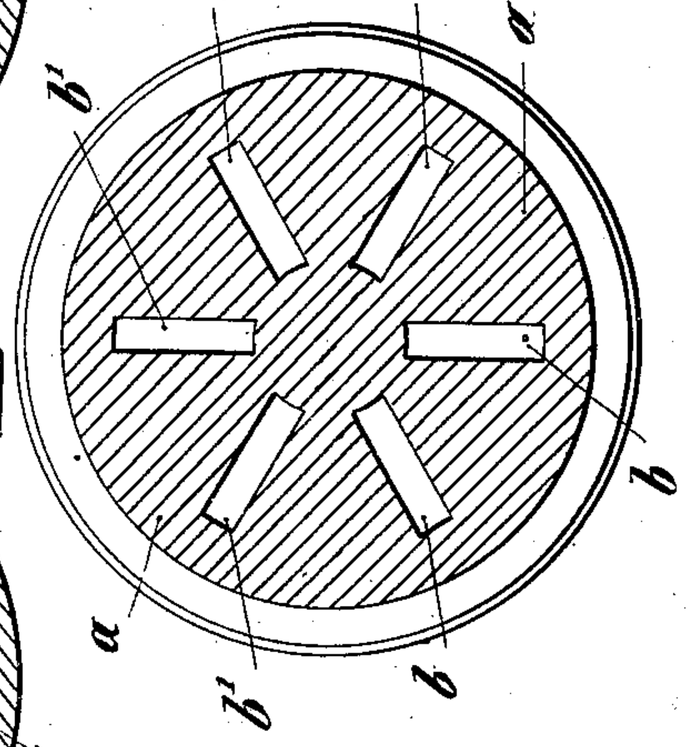


Fig. 21.

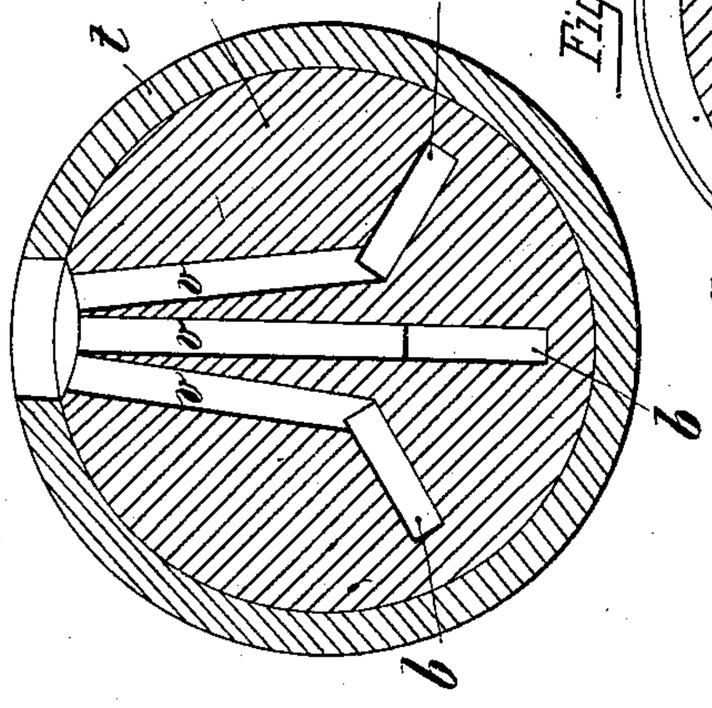
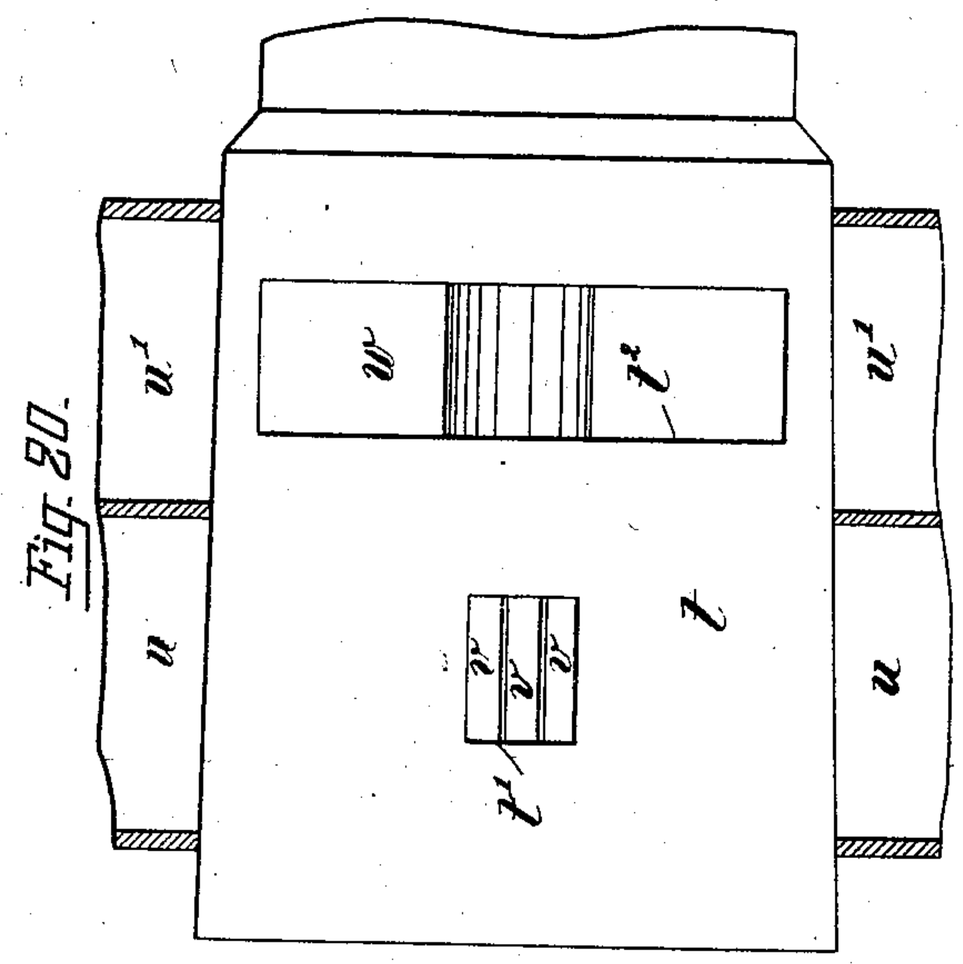


Fig. 20.



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7 Sheets—Sheet 7.

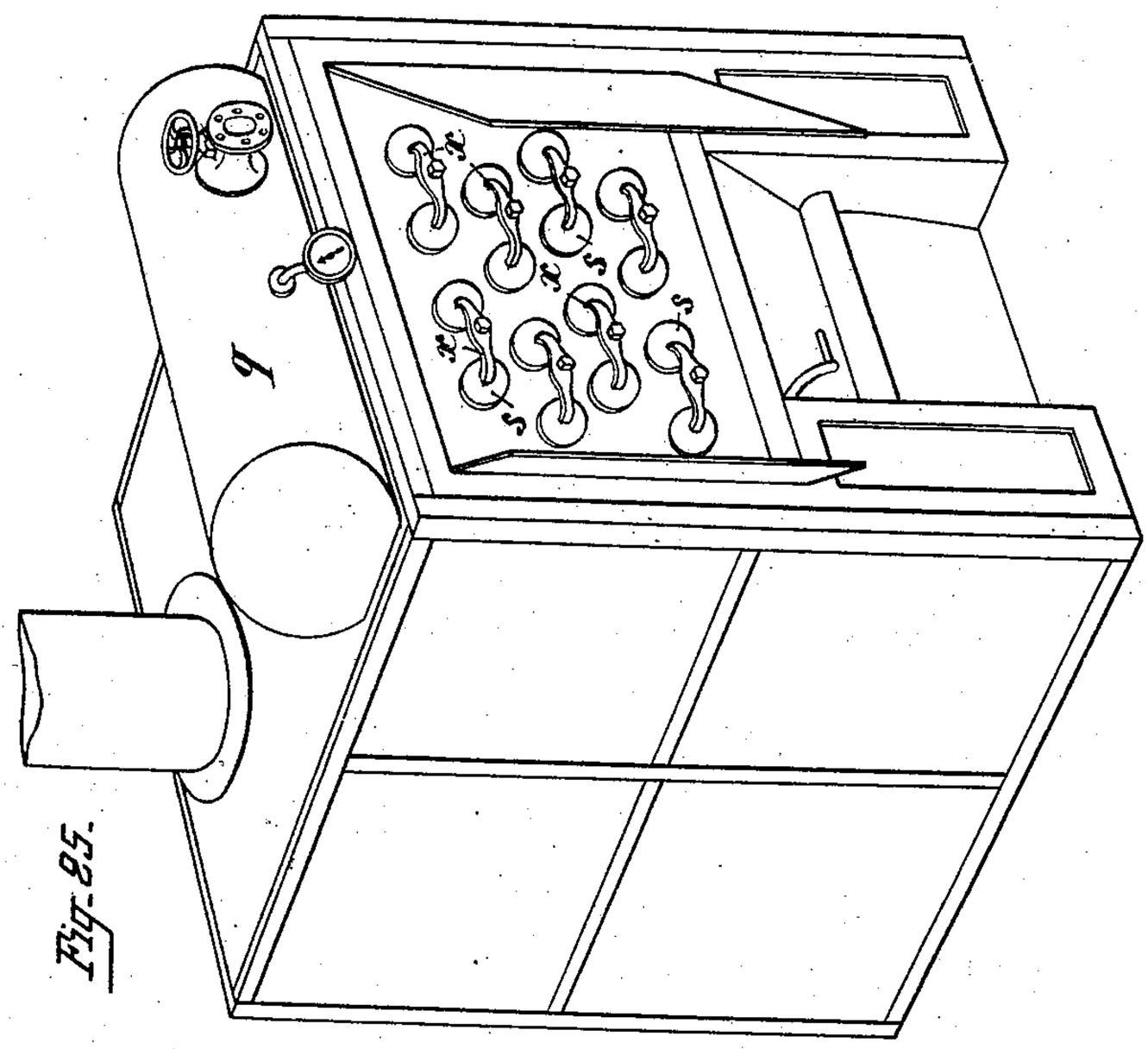

Fig. 25.

Fig. 24.

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UNITED STATES PATENT OFFICE.

EDGARD DE PORTO-RICHE, OF PARIS, FRANCE.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 709,926, dated September 30, 1902.

Application filed February 19, 1901. Serial No. 47,943. (No model.)

To all whom it may concern:

Be it known that I, EDGARD DE PORTO-RICHE, gentleman, of 5 Rue Scribe, in the city of Paris, Republic of France, have invented Improvements in Steam-Generators, of which the following is a full, clear, and exact description.

This invention relates to improvements in steam-generators of the kind in which the evaporation is instantaneous, and a characteristic feature of the said invention is the special arrangement of the elementary evaporators. Each elementary evaporator comprises a metallic bar in the substance of which are provided longitudinal channels of any convenient form and cross-section. The channels are completely independent one from another, and the water to be evaporated is conducted into them by means of an injector mounted at the head of the said bar or by any other suitable means. As a consequence of the complete independence of the different channels each elementary evaporator always gives its maximum yield, since the channels all evaporate under the same conditions. It is very evident that the said conditions would no longer exist if these channels were in communication one with another. The water under the action of gravity would constantly flood the lower channels, and the upper channels would be only partially filled and might even be entirely deprived of water. These upper channels would therefore have no useful effect or only a very feeble yield. Moreover, the lower channels by receiving the water of the upper channels would have their temperature lowered, and the mass of metal of which they are formed could no longer hold a sufficient quantity of heat to instantly evaporate the injected water. In my improved evaporator the channels are quite separate one from another and are submitted equally over the whole of their perimeter and under the same conditions to the action of the heat absorbed by the mass of metal. By means of this special arrangement my improved evaporator stores heat equally well at the center as at other points in its mass. Moreover, each channel receives only the quantity of water which it is designed to evaporate. My arrangement permits the utilization of some of the channels provided in the same bar as "evaporators," properly so called, and other channels as superheaters of the steam formed in the first-mentioned channels. For this purpose the group of evaporating-channels communicates at one end of the metallic bar with the group of superheating channels. At the other end of the metallic bar the evaporating-channels are put in communication with the water-collector, while the superheating-channels open into the steam-collector. The water supplied from the collector to the evaporating-channels is evaporated during circulation in these channels. At the end of the said channels the water is generally converted into steam. The steam thus formed passes into the superheating-channels, where it is superheated during circulation in the opposite direction and finally flows into the steam-collector.

In order to fix the ideas, I have shown in the accompanying drawings, in principle, as an example only, my improved evaporator.

Figures 1 to 10 show in transverse section various modified forms of my improved elementary evaporator. Figs. 11, 12, and 13 show an injector viewed, respectively, in elevation, in section, and from one end. Figs. 14, 15, and 16 show, respectively, front, side, and sectional views of one method of mounting my improved elementary evaporators. Fig. 17 is an elevation, partly in section, showing a boiler having my improvements applied thereto; and Fig. 18 is a perspective view of the same. Fig. 19 shows in longitudinal section my improved elementary evaporator arranged in such a manner as to permit the utilization of the lower channels as evaporators and the upper channels as superheaters. Fig. 20 is a plan view of the front portion. Figs. 21, 22, and 23 are transverse sections taken, respectively, upon the lines A B, C D, and E F, Fig. 19. Fig. 24 is an elevation, partly in section, showing a boiler comprising this form of elementary evaporator. Fig. 25 is a perspective view of the same.

In the figures like letters of reference indicate corresponding parts.

My improved elementary evaporator comprises, essentially, a metallic bar *a*, in which are provided channels *b*, completely independent of each other. This bar *a* can be of any convenient outline. Its exterior surface

may be smooth, Fig. 1, or provided with ribs, Fig. 2. The cross-section of the channels *b* may be of any suitable shape; but this cross-section is preferably of an elongated form. These channels can be of rectangular cross-section and radiate from the center of the metallic bar, or they may be arranged in one, two, or more concentric circles, or, if desired, they can be of circular cross-section. Fig. 3 shows a type of elementary evaporator *a* comprising channels *b*, radiating from the center of the bar, and channels *b'*, interposed between the former and arranged on a common circular center line. The channels *b'* can be of curvilinear cross-section, as shown in Fig. 3, or of rectilinear cross-section, as shown in Fig. 4. The metallic bar *a* may comprise channels *b'*, arranged in a single circle, as shown in Fig. 5, or in two or more concentric circles, as shown in Fig. 6. The channels *b'*, arranged in a single circle or in two or more concentric circles, can be of curvilinear cross-section, Figs. 5 and 6, or of rectilinear cross-section, Fig. 7. The evaporating-channels can, moreover, be of circular cross-section of small diameter, as shown at b^3, Figs. 8 and 9. The metallic bar *a* can, moreover, be provided with a central channel b^2, around which the evaporating-channel can be arranged, whatever the pattern in which these latter are set out, Figs. 5 and 9. This channel b^2 can be employed as a conduit for the return of the steam generated in the evaporating-channels. I can, if desired, construct the evaporating-channels, whatever their arrangement, in the substance of a metallic bar of annular form, the central conduit of which can be traversed by the heated gases from the furnace in such a manner that the elementary evaporator is subject to the heat of the furnace upon its interior and exterior surfaces. These elementary evaporators may be manufactured by any suitable process—by casting, drawing, rolling, electrodeposition, boring, &c. They can be manufactured, for example, by taking a tube *a*, provided with interior ribs *a'*, and joining the interior surfaces thereof by compression to a central core a^2, forming a mandrel, Fig. 10.

Water can be conducted into each of the channels *b* of an elementary evaporator through an injector comprising, as shown in Figs. 11, 12, and 13, a disk *c*, provided with small tenons *d*, corresponding to the channels *b*, formed in the elementary evaporator and obturating the entrance to these channels. Each tenon *d* is pierced by a small conduit *e* in communication with a central cavity *f* in such a manner that the water passing into this central cavity *f* is ejected in a uniform manner through the small conduits *e* into the various channels *b* of the elementary evaporator. The injector is supported against the head of the elementary evaporator by a joint-piece or nipple *g*, screwed at one end into a socket *h*, carried by the elementary evaporator, and at the other end into a pipe *i*, extending from the collector *j*, by which the feed-water is conducted to the boiler, Figs. 14, 15, and 16. In order to regulate the feeding of water into each elementary evaporator and even to cut off the supply of water—for example, in case it may be necessary to remove an element when the boiler is under steam—each pipe *i* incloses a stop-valve *k*, mounted on a screw-threaded rod *l*, as shown in Fig. 16. By turning this rod in one or the other direction the cross-sectional area of the water-admission port is adjusted or can be completely closed to cut off the supply of water. The same arrangement is equally applicable to the steam-exit for the purpose of preventing the escape of steam in case it is desired to remove one of the elementary evaporators. The elementary evaporators can in this manner be rendered completely independent at will.

Figs. 17 and 18 show a type of boiler comprising my improved evaporator. The water first of all enters a heating-coil *m* and is led through a conduit *n* to the lower collectors *j*. This water is introduced by the injectors C into each of the channels of the elementary evaporators. The type of boiler here represented comprises three rows or tiers of evaporators connected together, as shown in Figs. 17 and 18. The water-gage *o* is mounted upon the lower collectors *j*. The steam produced is conducted through the pipe *p* into the steam-dome *q*, which is provided with a steam-valve, a pressure-gage, a safety-valve, &c. As a consequence of the special arrangement of the elementary evaporators my improved steam-generator produces steam instantaneously with very great economy of fuel as compared with existing systems, since each of the channels provided in each elementary evaporator always gives its maximum yield.

In my improved arrangement of elementary evaporators some of the channels formed in one bar—for example, the lower channels *b*, as shown in Fig. 19—can be utilized as "evaporators," properly so called, and others of these channels—the upper channels *b'*—can be employed as superheaters of the steam formed in the first set of channels. The metallic bar *a* is in that case always closed at one of its ends by a plug *r*, bored or cut away in such a manner as to permit communication between the evaporating-channels *b* and the superheating-channels *b'*, Fig. 19. This plug *r* can be secured to the extremity of the bar *a* by any suitable means. The bar *a* is closed also at its other extremity by a plug *s*, attached in any suitable manner. For example, this plug may be provided with a screw-thread engaging corresponding screw-threads on the interior of a socket *t*, serving to attach the elementary evaporator to the collector. Each evaporating-channel *b* is in communication with the water-collector *u* through a small conduit *v*, as shown in Figs. 19, 20, and 21, and the superheating-channels open into the

steam-collector u' through an opening w, Figs. 19, 20, and 22. As shown in Fig. 19, the superheating-channels b' are not extended beyond the point where they enter the steam-collector. The sleeve t has orifices t' t^2 arranged therein for the passage of water and steam. The ends of each elementary evaporator are incased in the collector-walls, and the fluid tightness of the joints is assured in any convenient manner. The plugs s of two adjacent elements are attached to the front plate of the generator by means of a common strap or dog x or by any other suitable arrangement.

Figs. 24 and 25 show a type of boiler comprising my improved elementary evaporator. The water from the feed-reservoir q passes into the collector u and flows through the conduits v into each of the evaporating-channels b of the various elements a. This water circulates in these channels b in the direction indicated by the arrows, Fig. 19, and is converted into steam during this course. The steam thus generated passes at the end of each element into the superheating-channels b', returns through these channels toward the front plate of the boiler, and flows through the apertures w into the collector u', finally passing to the upper part of the feed-reservoir q. The water which is not completely evaporated during its passage through the lower channels b on arriving at the end of the element passes into the upper channels b', where its evaporation is completed. This arrangement permits a boiler to be very easily and quickly dismantled. The removal of an element and its restoration to place can be effected in a very short time. Moreover, all the parts employed for attachment are placed upon the front plate in such a manner that for the upkeep and cleaning of the generator it is only necessary to be able to reach this front plate. The three other walls of the generator are not required to be accessible.

It is well understood that my improved elementary evaporator can be applied to generators of all kinds, and I reserve the right to modify the form, dimensions, and the number of channels provided in each elementary evaporator, as well as the mode of attaching the elements, according to the various applications of my improvements.

I claim—

1. A steam-generating device with instantaneous vaporization wherein each element is composed essentially of longitudinal passages, entirely independent of each other, embedded in the body of a metal bar and provided each one separately with feed-water.

2. A steam-generating device with instantaneous vaporization wherein each element is composed essentially of longitudinal passages, entirely independent of each other, embedded in the body of a metal bar and adapted each one separately to receive feed-water, which feed-water is supplied by means of small conduits discharging into the respective vaporizing-channels and emerging from a small basin, into which the water of the collector flows directly.

The foregoing specification of my improvements in steam-generators signed by me this 5th day of February, 1901.

EDGARD DE PORTO-RICHE.

Witnesses:
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MAURICE H. PIGNET.