

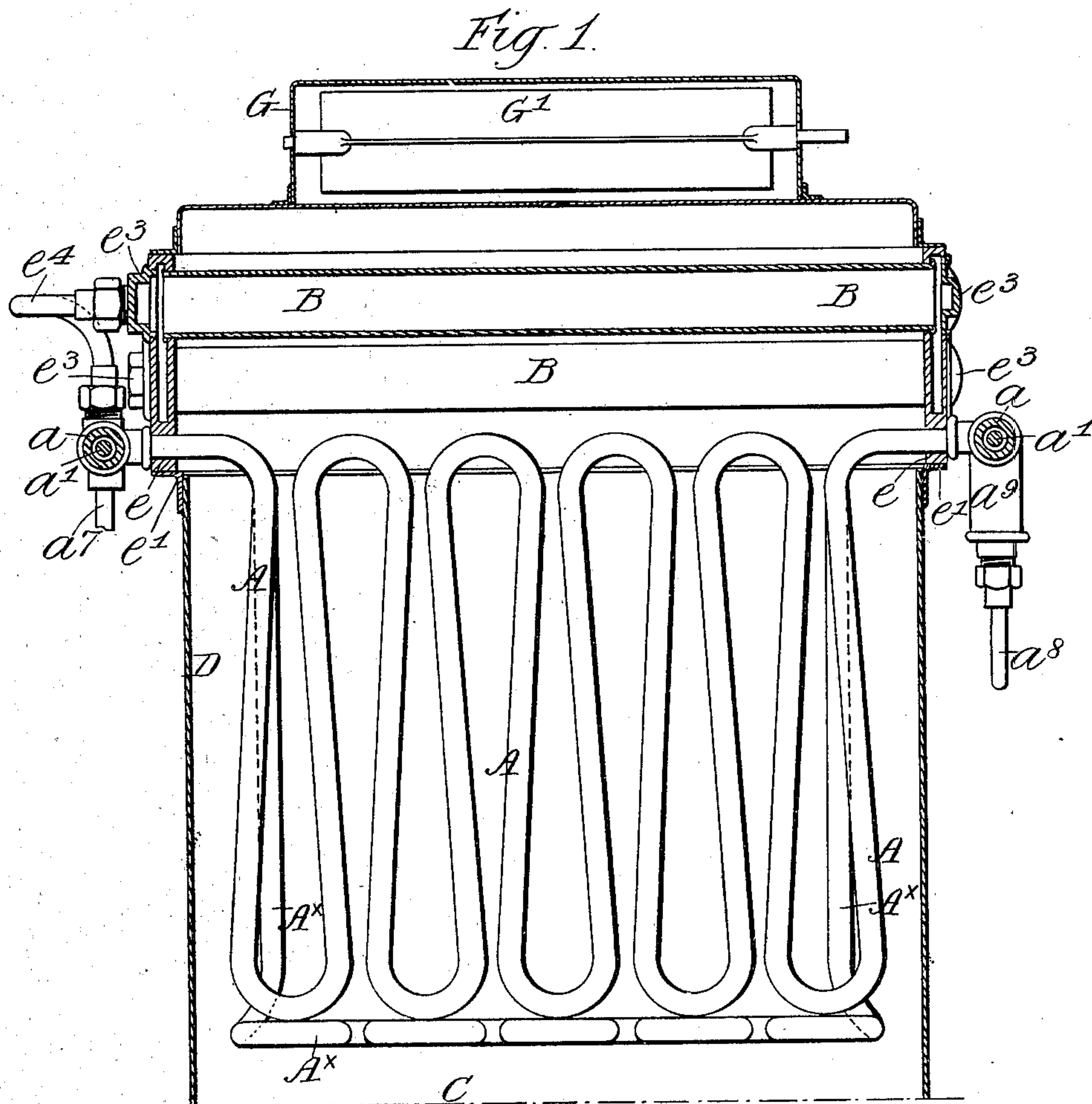
No. 735,275.

PATENTED AUG. 4, 1903.

F. LAMPLOUGH.  
STEAM GENERATOR.  
APPLICATION FILED DEC. 14, 1901.

NO MODEL.

4 SHEETS—SHEET 1.



WITNESSES

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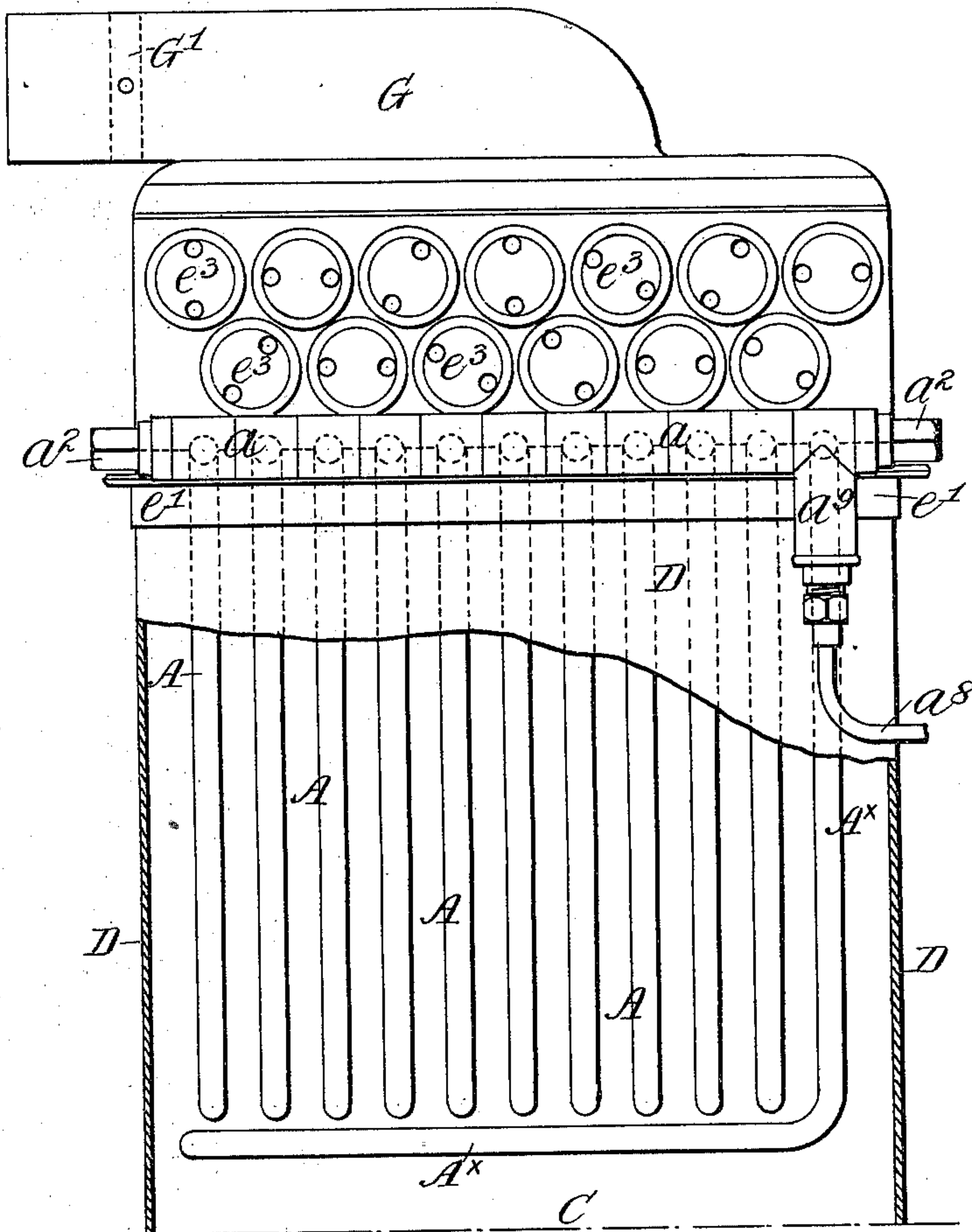
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4 SHEETS—SHEET 2.

Fig. 2.



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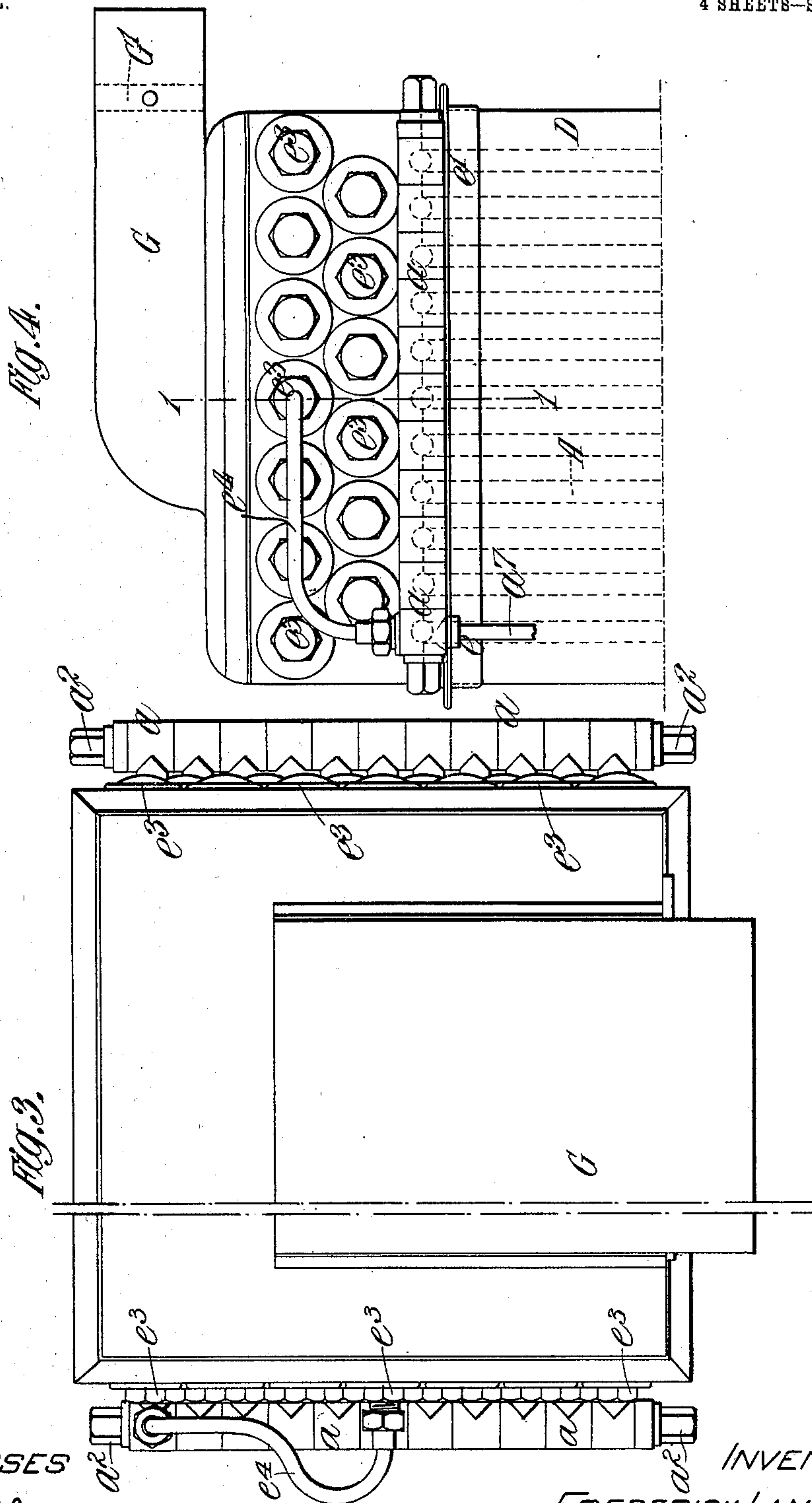
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4 SHEETS—SHEET 4.

Fig. 5.

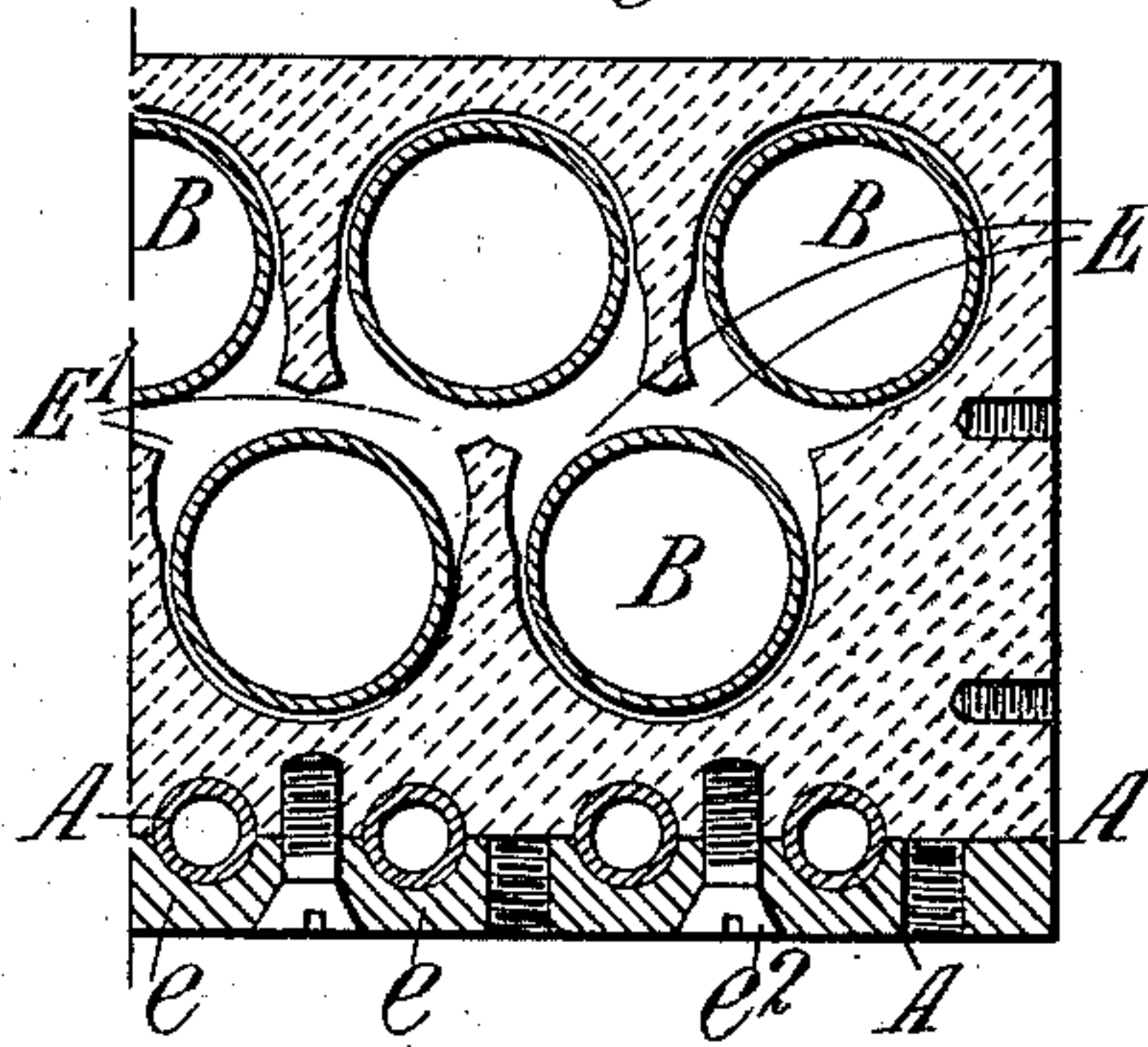


Fig. 6.

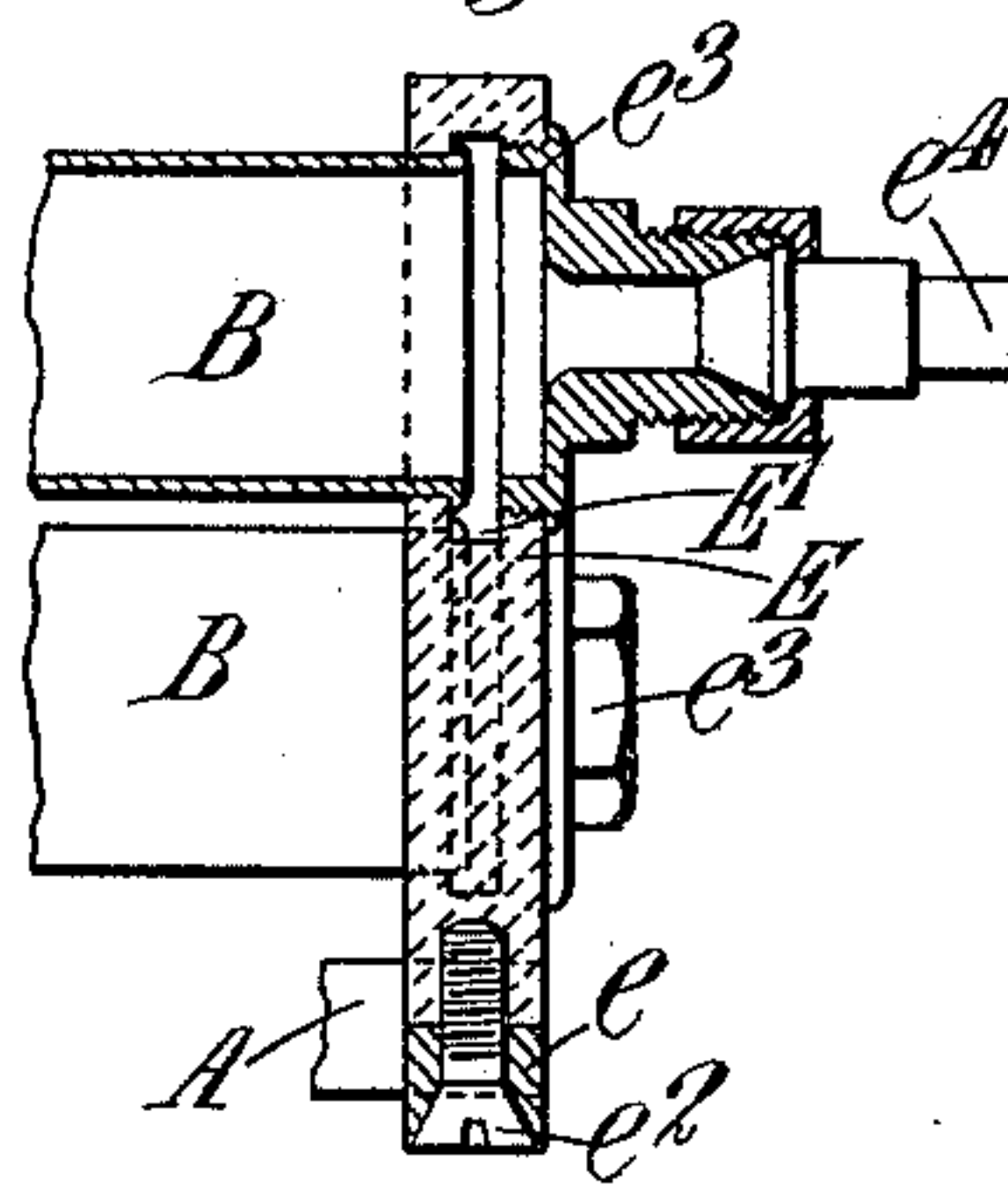


Fig. 7.

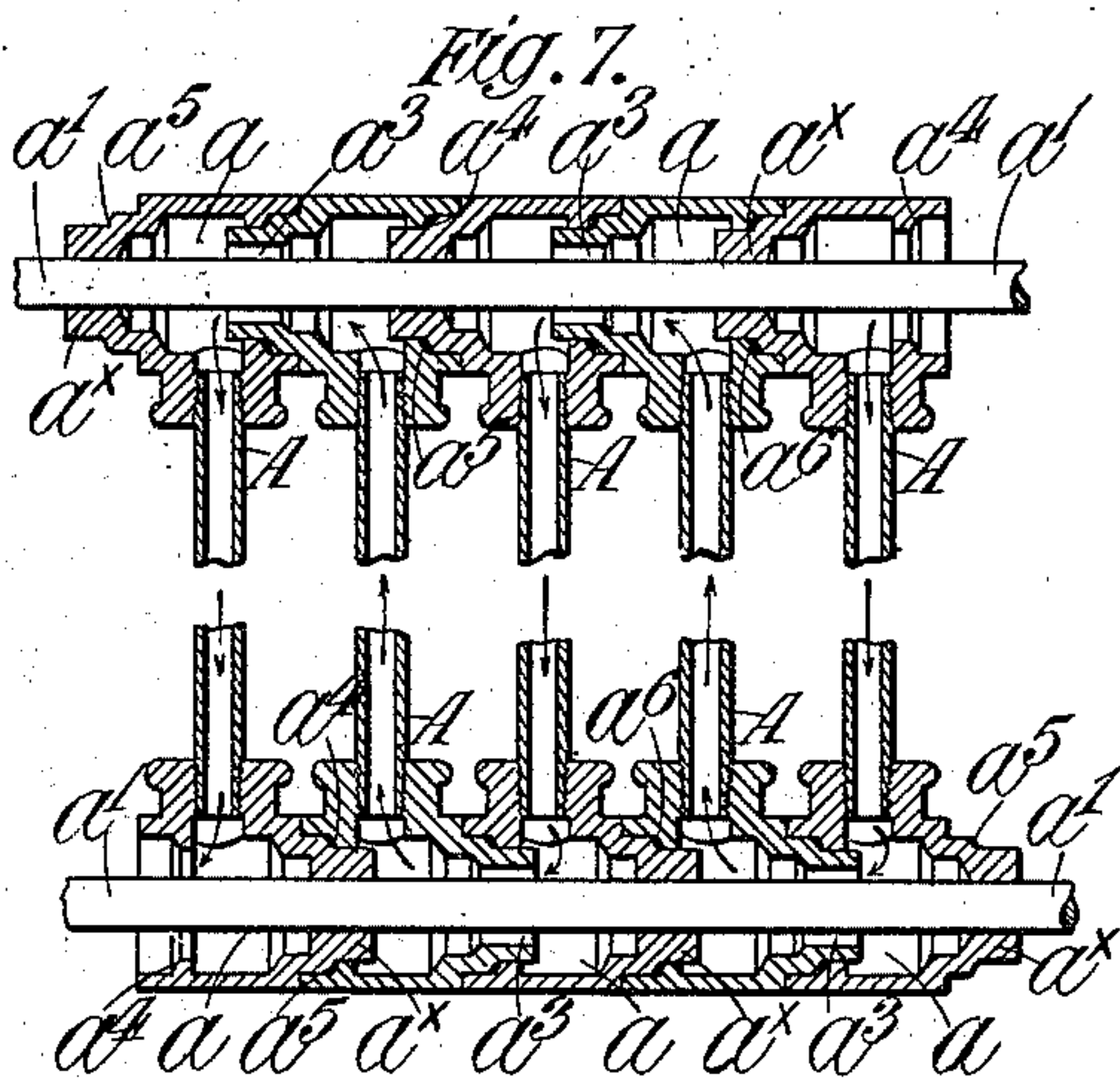


Fig. 8.

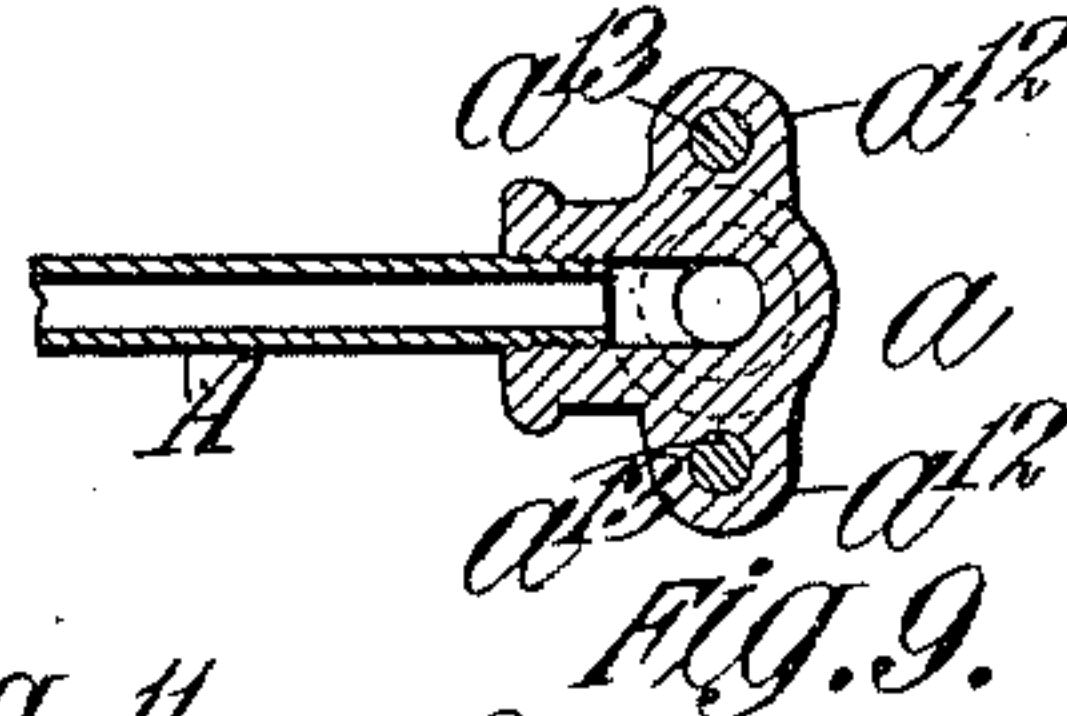
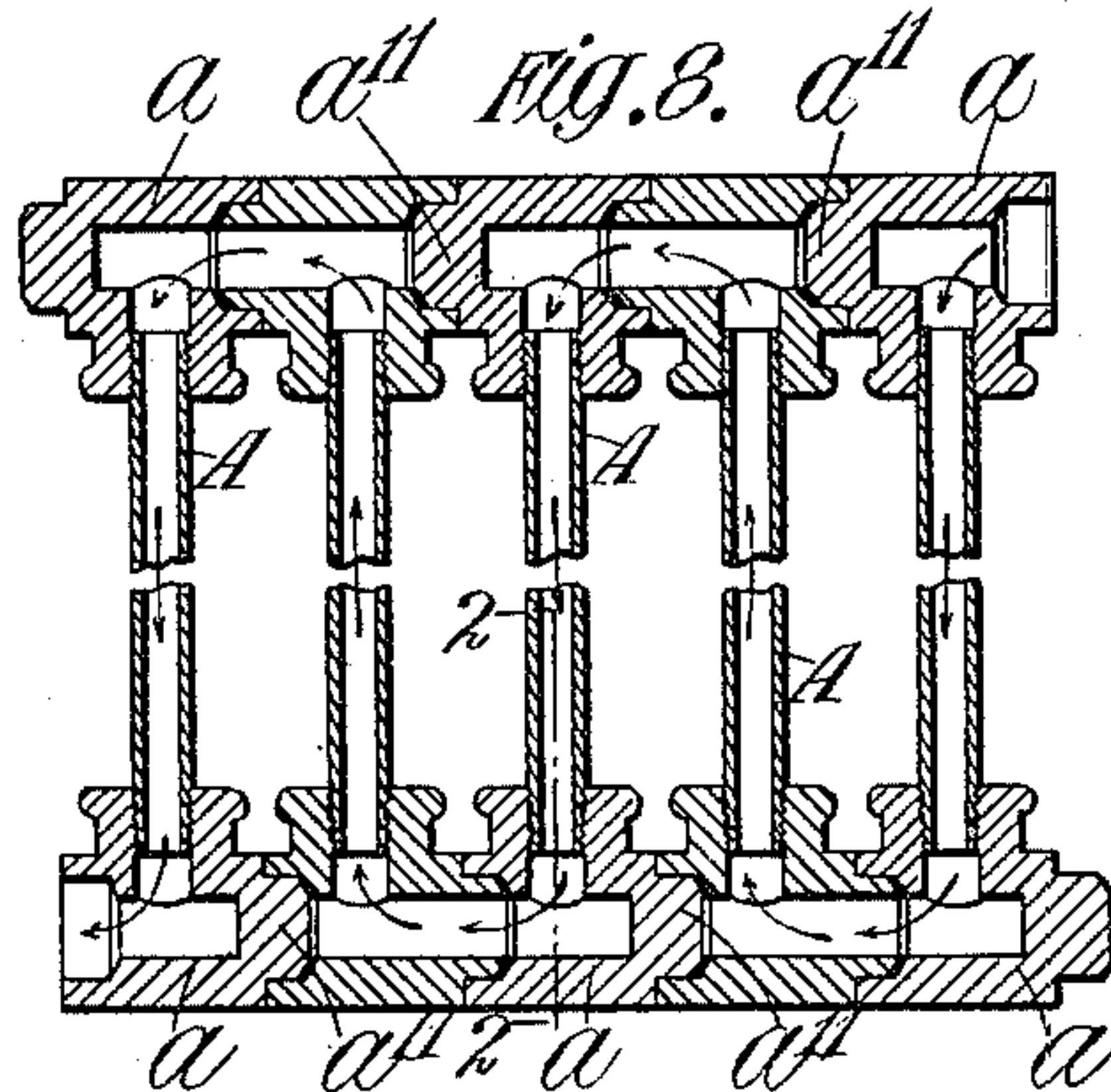


Fig. 10.

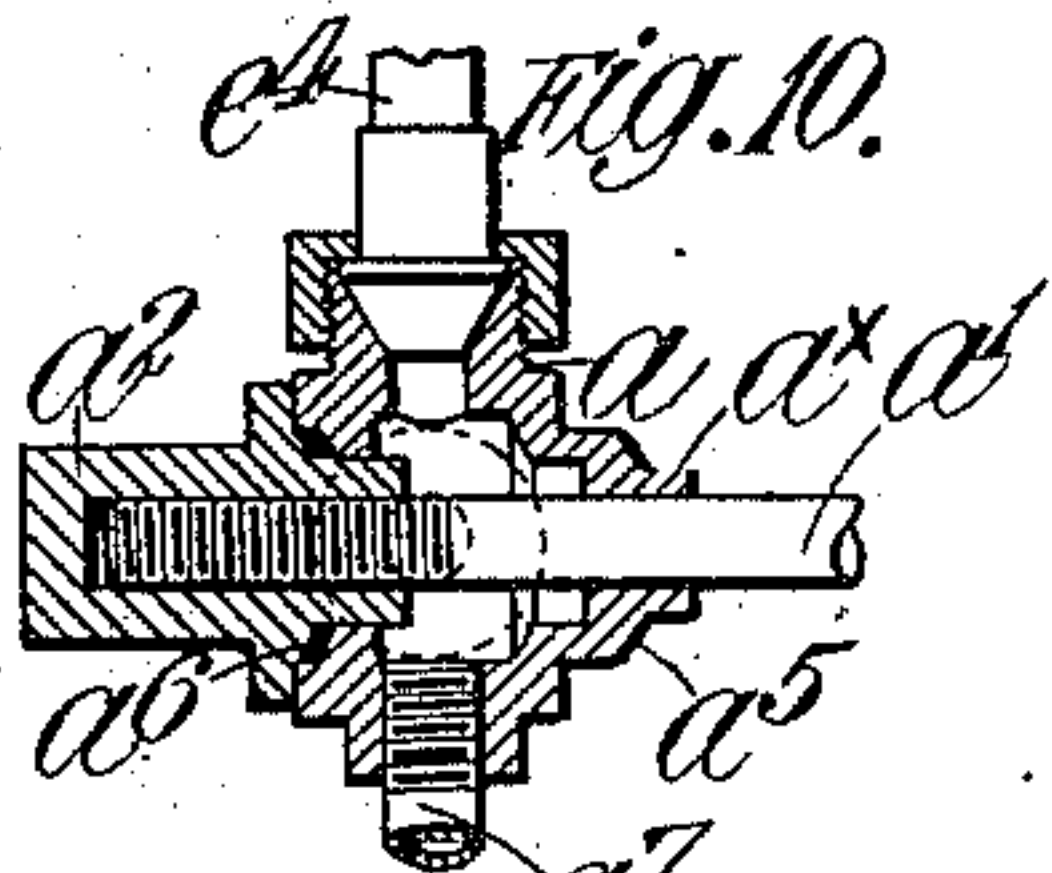


Fig. 11.

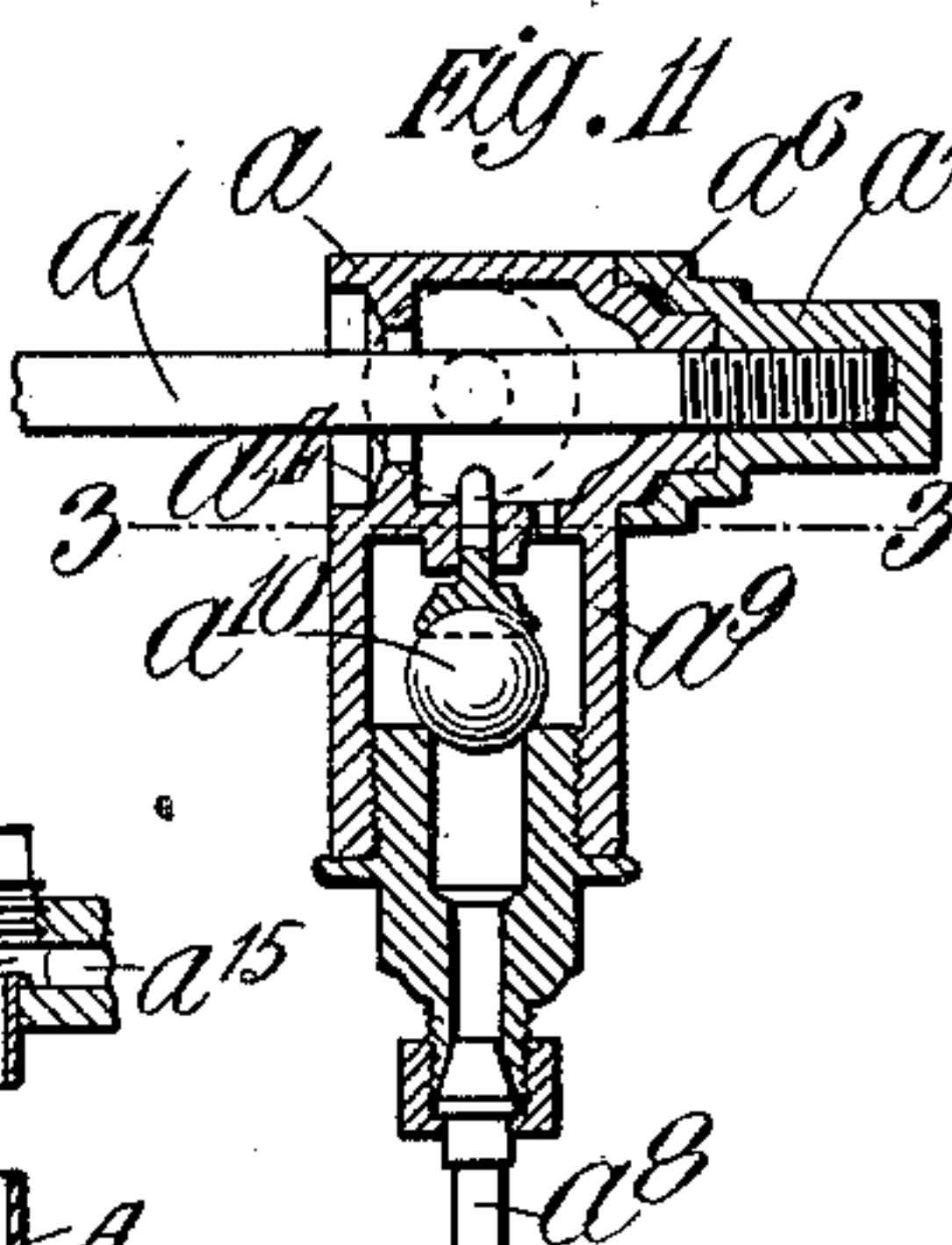


Fig. 14.

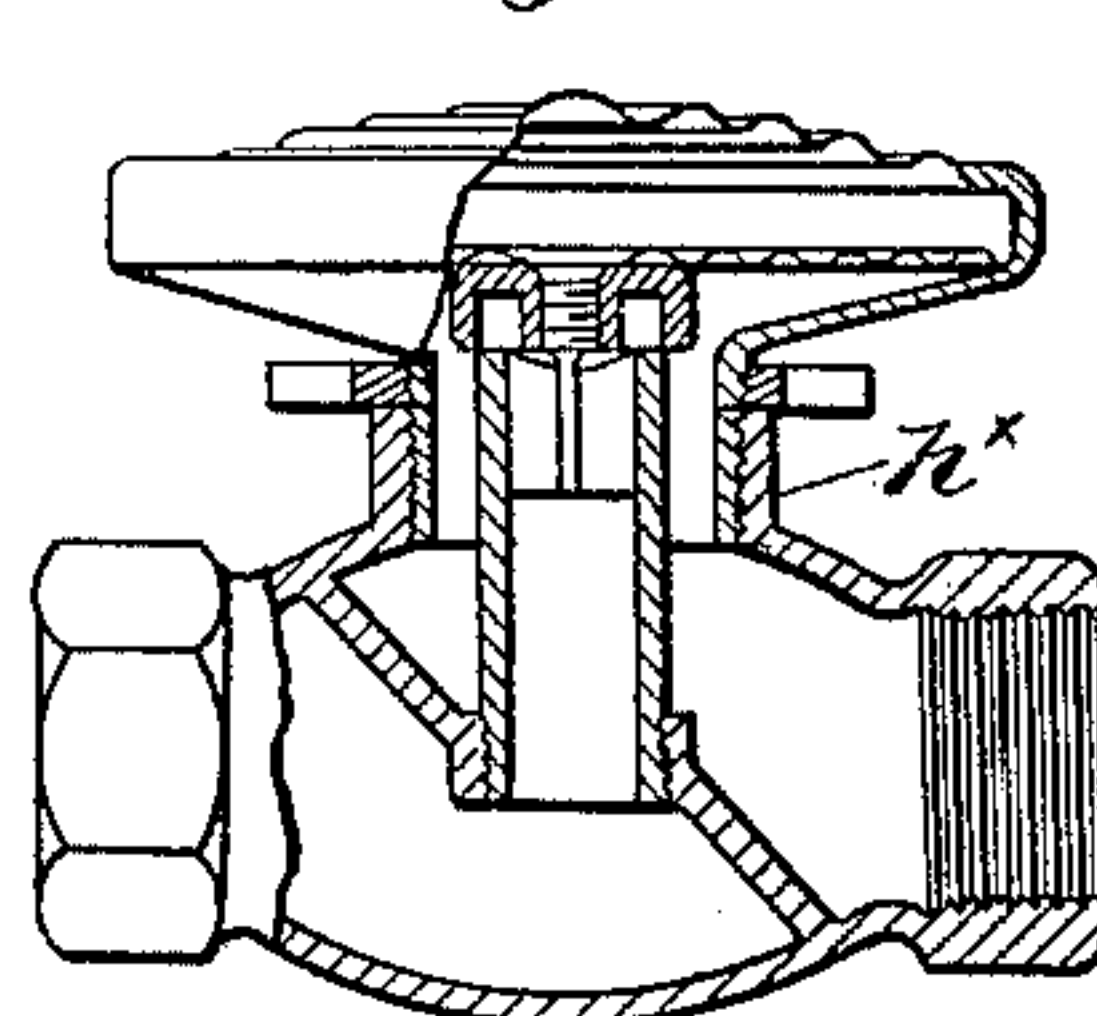


Fig. 13.

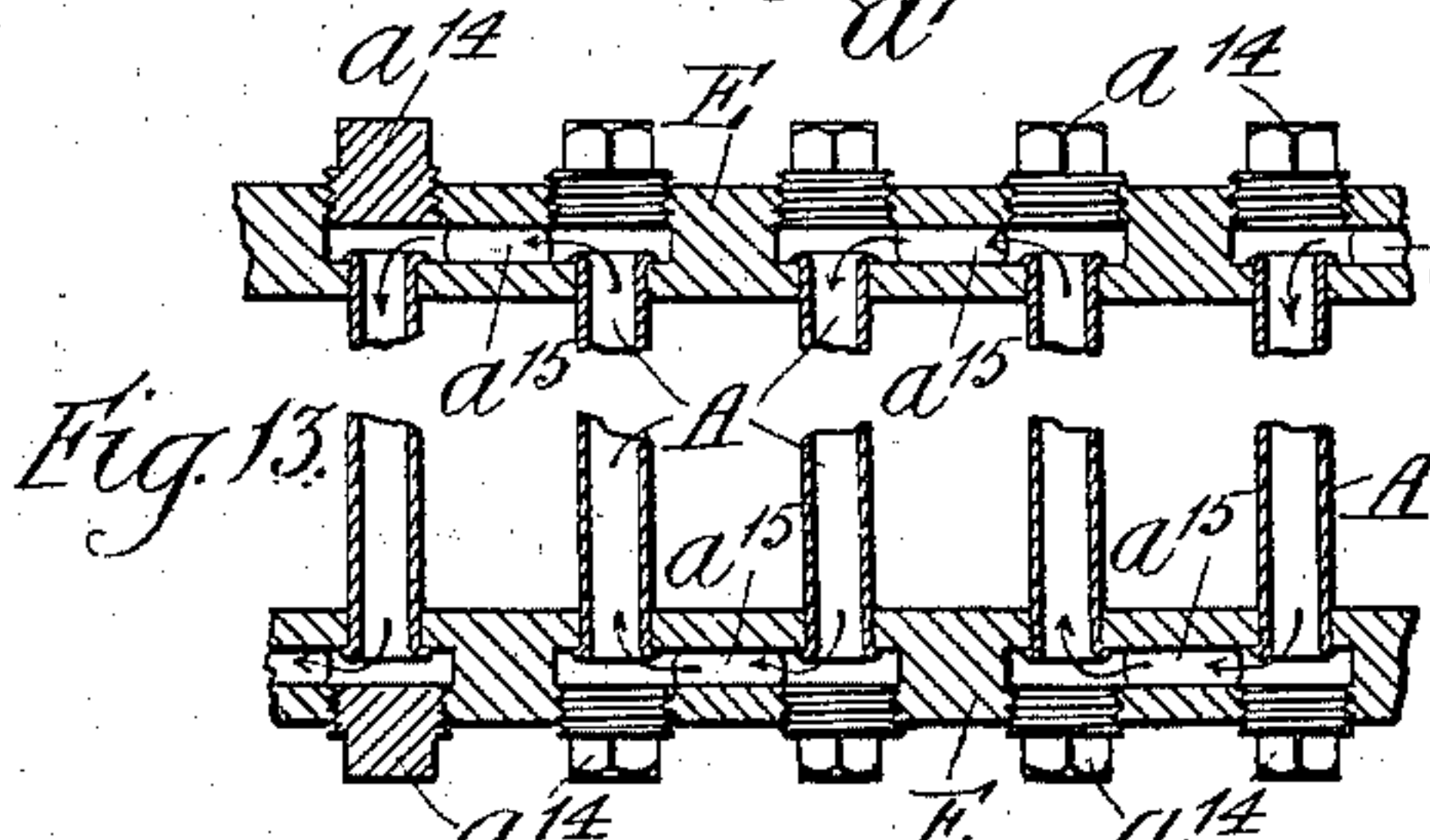


Fig. 12.



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# UNITED STATES PATENT OFFICE.

FREDERICK LAMPLOUGH, OF WILLESSEN, LONDON, ENGLAND.

## STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 735,275, dated August 4, 1903.

Application filed December 14, 1901. Serial No. 85,862. (No model.)

*To all whom it may concern:*

Be it known that I, FREDERICK LAMPLOUGH, engineer, a subject of the King of Great Britain, residing at 6 Scrubbs Lane, Cumberland Park, Willesden, London, in the county of London, England, have invented certain new and useful Improvements Relating to Steam-Generators, of which the following is a specification.

This invention has reference to steam-generators, and more particularly to those intended for use with road-vehicles, steam-launches, and the like, in which lightness and simplicity of construction and the rapid generation of steam are of much importance.

The chief object of my invention is to construct the generator on the water-tube principle and to so arrange the water-tubes that they provide circuitous courses for the water and lie in substantially vertical planes, so that the products of combustion arising from a hydrocarbon-oil burner or other source of heat will be able to act upon the entire external surface of the tubes, which would not be the case if said tubes occupied a horizontal or inclined position. The said water-tubes are so connected one with another through suitable boxes or nipples or through passages in the tube-plates that the water will circulate through said tubes in succession as though they comprised one continuous tube. At or near the upper part of the generator I provide a steam-collector comprising a series of horizontal or slightly-inclined tubes, into which the steam generated in the water-tubes can enter and be stored ready for use in the motor. An important feature in connection with these steam-storage tubes is the manner in which they are mounted in tube-plates and communicate with one another without the use of riveted joints.

In the accompanying drawings I have illustrated a steam-generator constructed in accordance with my invention and provided with the aforesaid improvements.

Figure 1 is a vertical section of the said steam-generator. Fig. 2 is a side elevation of the same as seen from the right with a portion of the casing that surrounds the water-tubes broken away. Fig. 3 is a plan of the generator. Fig. 4 is a side elevation of the upper part of the generator as seen from the

left. Fig. 5 is a vertical longitudinal section, and Fig. 6 is a vertical transverse section, on the line 1 1 of Fig. 4, showing a portion of one of the storage-tube plates. Fig. 7 is a horizontal section of a portion of the series of boxes or nipples by and through which the various water-tubes successively communicate. Fig. 8 is a horizontal section similar to Fig. 7, showing a modified form of the series of boxes or nipples; and Fig. 9 is a transverse section of the same on the line 2 2 of Fig. 8. Fig. 10 is a vertical section of the left-hand member of the series of boxes or nipples shown in Fig. 4, and Fig. 11 a vertical section of the right-hand member of the series of boxes or nipples shown in Fig. 2. Fig. 12 is a cross-section on the line 3 3 of Fig. 11. Fig. 13 is a horizontal section similar to Figs. 7 and 8, showing a modified manner of connecting the water-tubes together; and Fig. 14 is a side elevation, partly in sectional view, of a suitable form of steam-trap.

Like letters of reference indicate similar parts in all the figures.

A A are the water-tubes; B B, the steam-storage tubes. C is the chamber inclosing the burner or other source of heat, and D the casing inclosing the water-tubes. The said water-tubes are arranged in a series side by side in vertical rows above the burner or furnace in the chamber C, each tube being bent into a sinuous form for providing a circuitous course for the water as it circulates through them. The form of these tubes may be circular or otherwise in cross-section. One of the said tubes—viz., the one A<sup>x</sup>, through which the water enters the series—is advantageously bent so as to lie in a horizontal plane beneath the lower portions of the other tubes, and thus act as a baffle for causing the products of combustion from said burner or furnace to be more evenly distributed among the tubes than would otherwise be the case. The ends of the aforesaid water-tubes are connected by screwing or otherwise to the boxes or nipples *a a*, of which there is a horizontal series at each side of the generator. These boxes or nipples are adapted to fit one into the other, as best seen in Fig. 7, and are all connected firmly together in a steam and water tight manner by a bolt *a'*, extending longitudinally through them and secured at



its ends by nuts  $a^2 a^2$ . Every alternate nipple is so made as to leave an annular space  $a^3$  around the said bolt for the passage of the water or water and steam from one tube to the next contiguous tube, and so on through the entire series of tubes in succession. The other alternate nipples are provided with bosses  $a^x$ , that tightly fit around the bolts  $a'$  and act as partitions for dividing each pair of nipples from the contiguous pair. Each box or nipple is preferably formed with shoulders  $a^4 a^5$ , between which suitable packing  $a^6$  is placed for forming a water and steam tight joint between the various nipples when the nuts  $a^2$  are tightened up. All of the water-tubes, the two series of boxes or nipples, and their bolts are thus effectually connected together to form a single composite piece, of which any of the component parts can be readily detached for repair, cleansing, or other purpose. Instead of making the said boxes or nipples  $a$  with bosses adapted to alternately fit the said bolt  $a'$  extending through them I sometimes make them with alternate solid bosses  $a^{11}$ , as shown in Figs. 8 and 9, constituting partitions for separating one pair of boxes or nipples from the contiguous pair, and in such cases I provide lugs  $a^{12}$ , Fig. 9, on the exterior of the said boxes or nipples for bolts  $a^{13}$  to be passed through for securing the series of boxes or nipples together from the exterior by nuts screwed onto the ends of said bolts. In order to support the water-tubes in position within the casing D, I provide metal strips  $e e$ , Figs. 5 and 6, which are connected by screws or otherwise to angle-irons  $e' e'$ , riveted or otherwise fastened to the generator-casing. These metal strips are formed with semicircular recesses corresponding in number to that of the water-tubes which rest in said recesses and are secured therein by the tube-plates E E, which are also formed at their lower edge with corresponding semicircular recesses and are connected to the said metal strips by screws  $e^2$  or otherwise. The water-tubes are thus gripped between the edges of the tube-plates and the said metal strips.

Instead of connecting the various water-tubes together by nipples, as explained above, I may in some cases dispense with the nipples, as represented in Fig. 13. Each of the tube-plates E is in this case formed with a series of holes for the reception of the ends of the water-tubes, each of the said holes being made of two diameters, so as to provide a shoulder against which the end of the water-tube is expanded in any convenient manner. The portions of the holes of larger diameter are closed by screw-plugs  $a^{14}$ , and said holes communicate alternately through lateral passages  $a^{15}$ , formed in the said tube-plates, so that all the water-tubes are in communication one with another for the water to circulate through them. The aforesaid tube-plates E are, as before stated, adapted to carry the storage-tubes B B, which are con-

nected at opposite ends to said plates, each tube communicating with the other through the hollow interior of said plates. In constructing these plates I prefer to first make therein the perforations or holes for the reception of the storage-tubes D, said perforations or holes extending completely through the plates. Then by means of a circular milling-tool I cut passages E' laterally and diagonally through the middle of the plates, through which passages one tube communicates with the other. The perforations or holes in the exterior surface of the plates are closed by screw-caps or plugs  $e^3$ . It will thus be seen that by this construction of the tube-plates I am able to dispense entirely with riveted joints, which greatly adds to the simplicity of the construction. The aforesaid storage-tubes are connected to one of the nipples  $a$  by means of a pipe  $e^4$ , through which the steam generated can reach said storage-tubes. The steam may be supplied from the generator to the motor through the outlet  $a^7$  on one of the nipples.

$a^8$  is the inlet-pipe for the feed-water supplied by a suitable feed-pump to the generator through the nipple to which the first of the series of water-tubes is coupled. This nipple is preferably formed with a chamber  $a^9$  to receive a non-return valve  $a^{10}$ , as represented in Fig. 11.

G is a chimney or exit for the products of combustion leaving the generator, and G' is a damper for regulating the draft.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In a steam-generator, the combination of a series of sinuous water-tubes arranged in vertical rows within a suitable casing, of a horizontal series of nipples by and through which the tubes communicate one with another so that the water can circulate through them in succession, of a chamber below said series of tubes for inclosing the source of heat for heating said tubes, and of a steam-collector situated above said tubes and communicating therewith substantially as described.

2. In a steam-generator, the combination of a series of sinuous water-tubes arranged in vertical rows within a suitable casing, of two series of horizontal nipples by and through which the tubes communicate one with another, of means for connecting together the nipples of each series in a water-tight and steam-tight manner, of means for establishing communication between each pair of nipples alternately at opposite ends of the water-tubes, of a chamber below said series of tubes for inclosing the source of heat for heating said tubes, and of a steam-collector situated above said tubes and communicating therewith substantially as described.

3. In a steam-generator, the combination of a series of sinuous water-tubes arranged in vertical rows within a suitable casing, of two series of detachable nipples located horizontally on opposite sides of the said tubes



and fitting one into the other, of packing between the abutting portions of said nipples, of a bolt extending longitudinally through each series of nipples for securing them together, of an internal boss on alternate nipples for fitting tightly around said bolt and dividing the nipples into pairs communicating through an annular passage between the bolt and the other alternate nipples, of tube-plates through which the ends of the water-tubes extend to reach the said series of nipples, of a chamber below said water-tubes for inclosing the source of heat for heating said tubes, and of a steam-collector situated above said tubes and communicating therewith substantially as described.

4. In a steam-generator, the combination with the series of sinuous water-tubes, their surrounding casing, and the chamber inclosing the source of heat, of a series of steam-storage tubes located substantially horizontally above the water-tubes, of tube-plates perforated for the reception of the ends of said storage-tubes, and hollowed at parts between the said perforations to form lateral passages for establishing communication between the storage-tubes, of plugs for closing

the perforations on the outer faces of the tube-plates, and of means for connecting said storage-tubes with the water-tubes substantially as and for the purpose specified.

5. In a steam-generator, the combination of a series of sinuous water-tubes arranged in vertical rows within a suitable casing, of two horizontal series of nipples by and through which the tubes communicate one with another, of an inlet-valve for admitting water to said series of nipples, of a chamber below said series of water-tubes for inclosing the source of heat for heating said tubes, of a series of steam-storage tubes arranged horizontally above said water-tubes and communicating with each other, of an external conduit for connecting said storage-tubes with the series of nipples, and of an outlet for the steam to be withdrawn from the storage-tubes, substantially as described.

In testimony whereof I have hereunto set my hand, in presence of two subscribing witnesses, this 21st day of November, 1901.

FREDERICK LAMPLOUGH.

Witnesses:

THOS. P. WARDLE,  
WALTER J. SKERTEN.