

No. 662,255.

Patented Nov. 20, 1900.

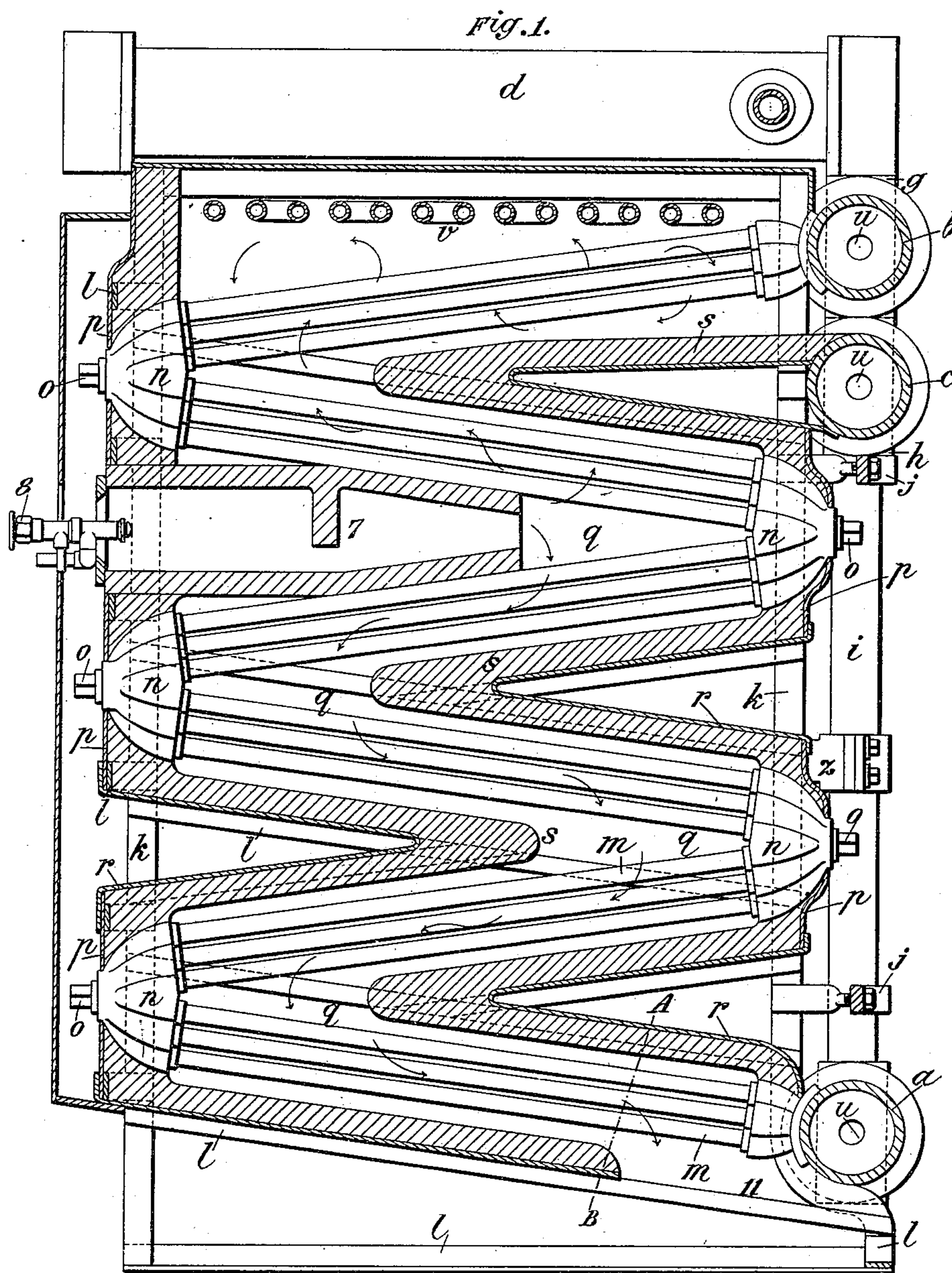
P. DAVIES & A. ROSS.

STEAM GENERATOR.

(Application filed Mar. 19, 1900.)

(No Model.)

3 Sheets—Sheet 1.



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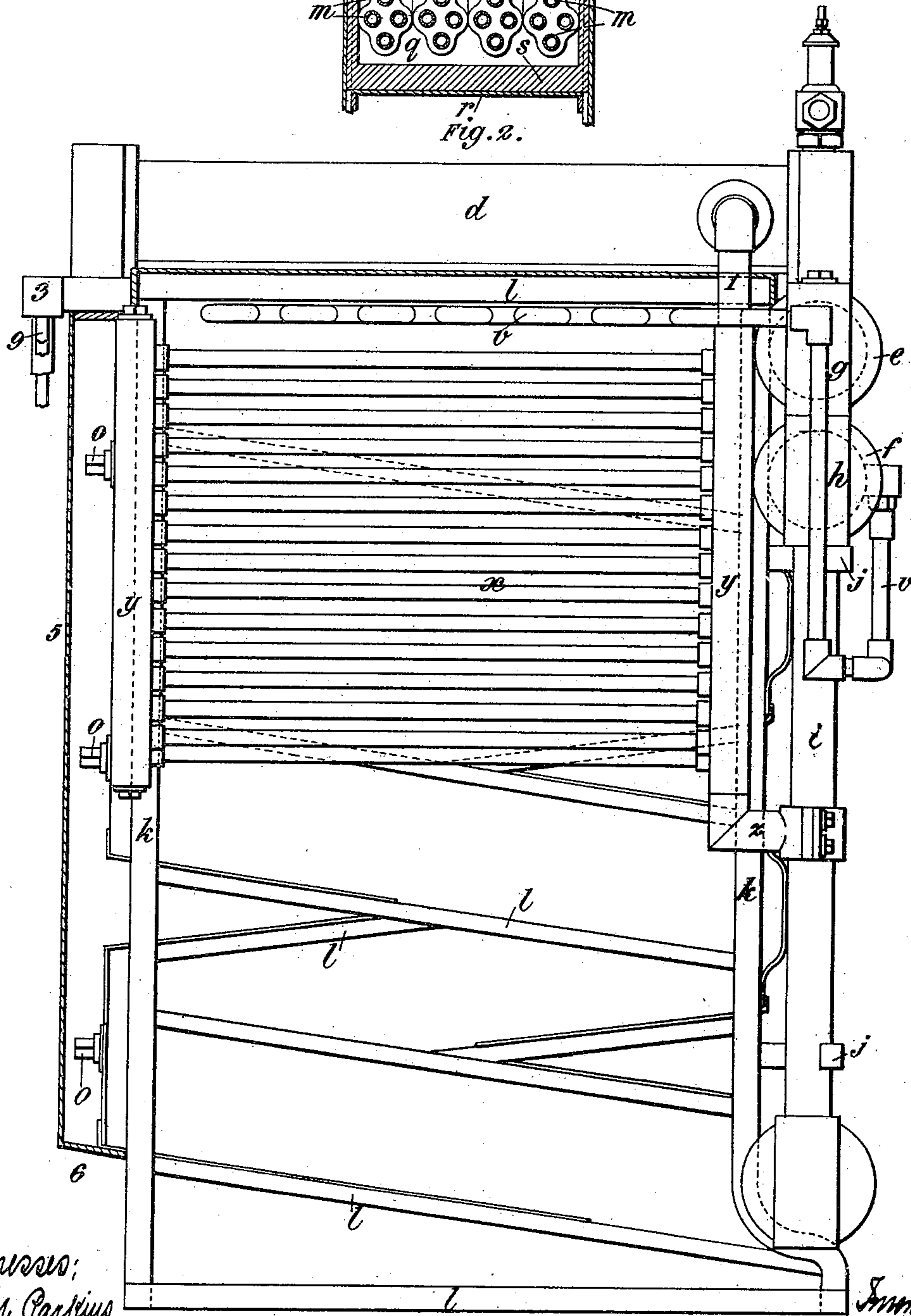
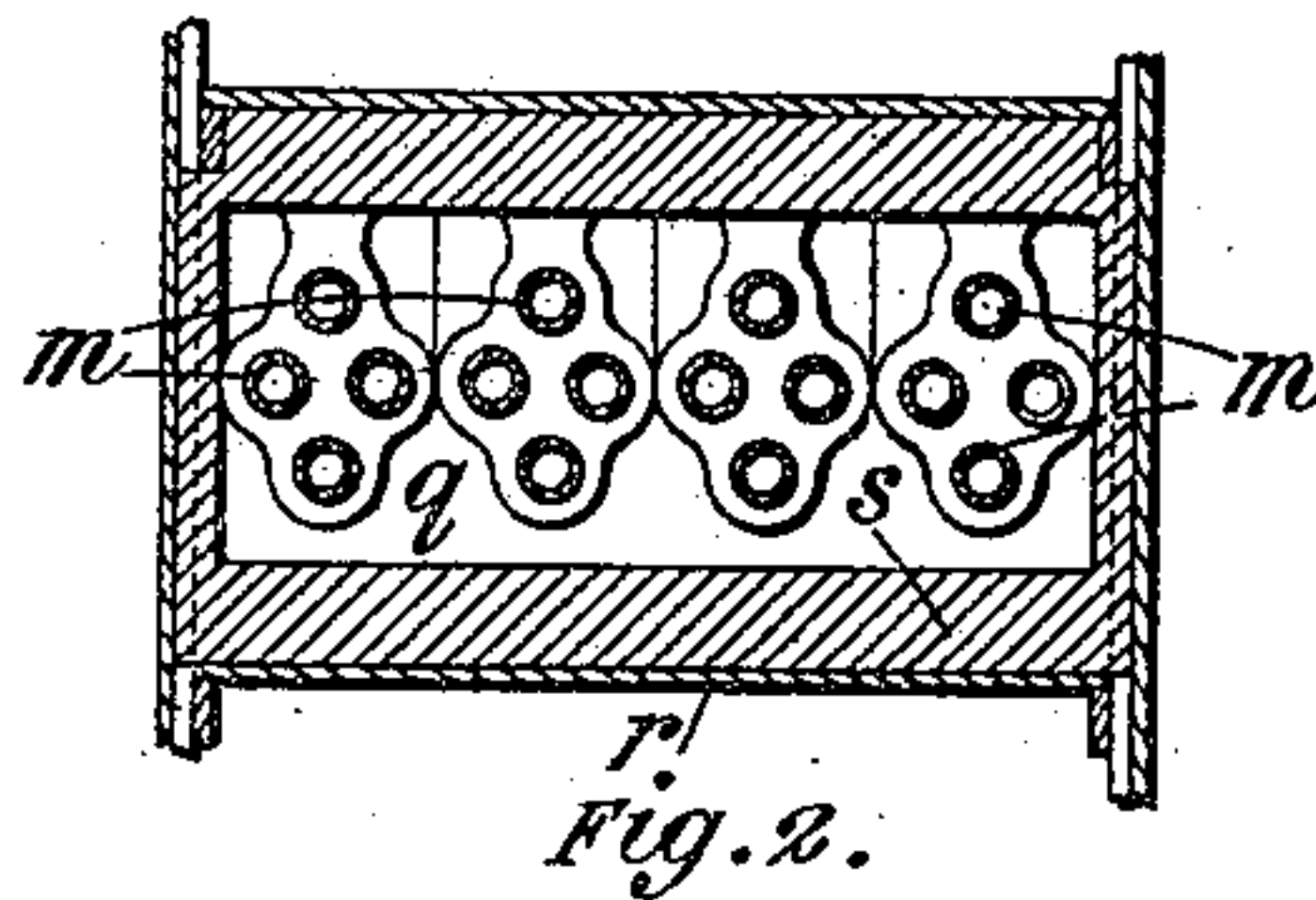
STEAM GENERATOR.

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3 Sheets—Sheet 2.

Fig. 3.



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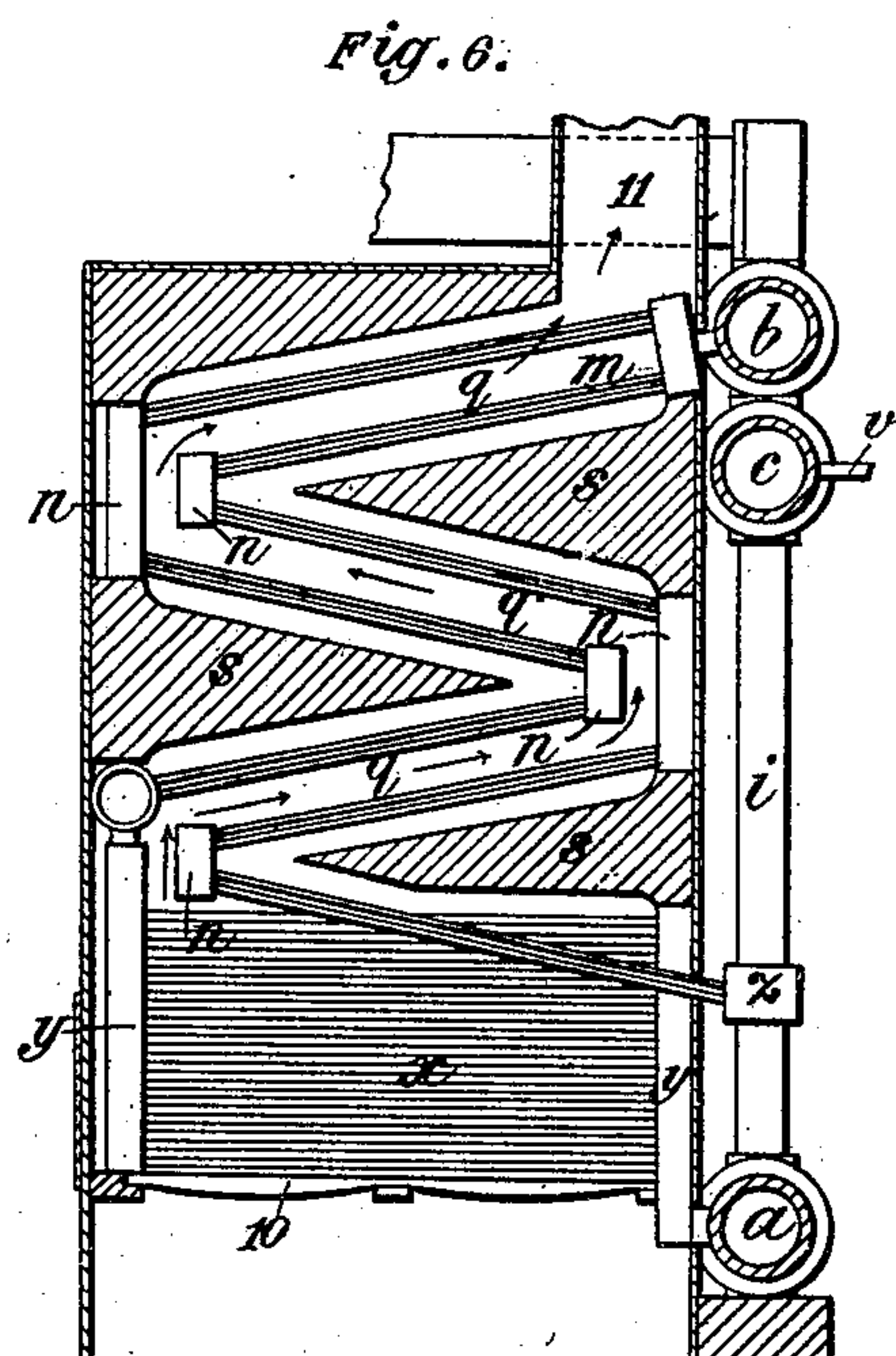
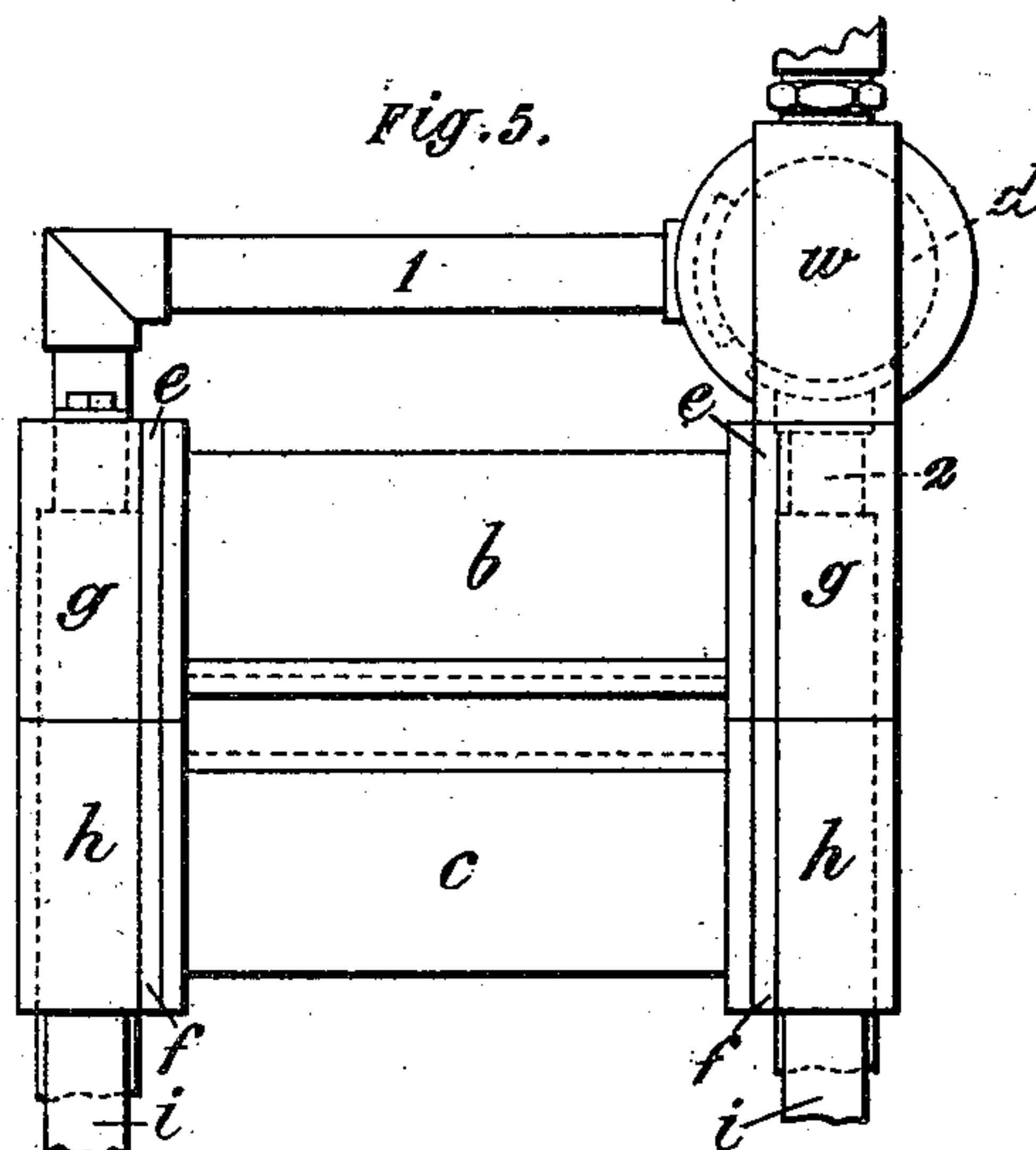
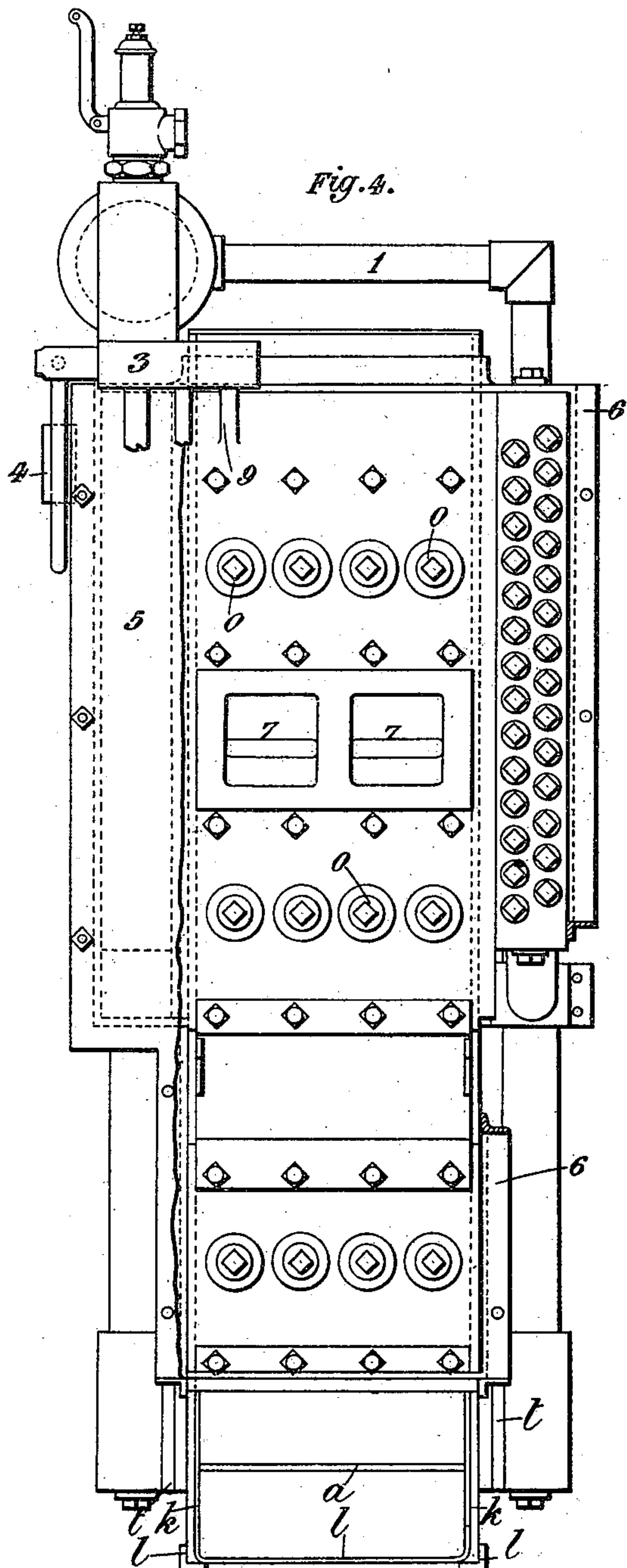
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STEAM GENERATOR.

(Application filed Mar. 19, 1900.)

(No Model.)

3 Sheets—Sheet 3.



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UNITED STATES PATENT OFFICE.

PRESTON DAVIES AND ALEXANDER ROSS, OF LONDON, ENGLAND.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 662,255, dated November 20, 1900.

Application filed March 19, 1900. Serial No. 9,287. (No model.)

To all whom it may concern:

Be it known that we, PRESTON DAVIES, a resident of Southfield, London, in the county of Surrey, and ALEXANDER ROSS, a resident of Fulham, London, in the county of Middlesex, England, subjects of Her Majesty the Queen of Great Britain, have invented new and useful Improvements in and Relating to Steam-Generators, of which the following is a specification.

Our invention, which relates to steam-generators of the water-tube type, has for its object to produce an efficient, economical, inexpensive, compact, and rapidly-steaming generator.

Our invention consists, first, in so constructing the generator that the products of fuel combustion shall be compelled to follow the whole or practically the whole course that the tubes take; secondly, in so constructing the generator that a more uniform difference of temperature between the products of combustion and the water in the generator is obtained, and consequently throughout the system a more uniform interchange of heat is secured, and generally to effect the improvements hereinafter indicated.

The generator is particularly well adapted for use in conjunction with liquid fuel, and the liquid-fuel feeder and arrangements employed may advantageously be such as described in the specification of the prior application for Letters Patent of the United States filed on October 15, 1898, Serial No. 693,684; but it is capable by modifications, if necessary, to be used with ordinary solid or pulverized fuel.

In the accompanying drawings, which are illustrative of our invention, Figure 1 is a vertical longitudinal section of one form of generator, some of the parts being shown in elevation. Fig. 2 is a side elevation thereof with the casing removed. Fig. 3 is a transverse section on the line A B, Fig. 1, of the flue *q* and its contained tubes *m*. Fig. 4 is a front elevation with part of the front plate broken away. Fig. 5 is a partial rear end elevation; and Fig. 6 illustrates, diagrammatically and on a smaller scale, a modified form of generator.

Like reference letters and numerals refer

to corresponding parts throughout the drawings.

a is a mud-drum or bottom water-pocket, and *b*, *c*, and *d* are three top steam and water drums. When three top drums are employed, they are connected to one another. The drawings show the drums *b* and *c* provided, respectively, with end plates or covers *e* and *f*, having vertical cylindrical bosses *g* and *h* formed thereon. These bosses are internally screw-threaded and are coupled together by means of externally-threaded sleeves. Into the drum *c* are screwed hollow pillars *i*, which make connection with the lower drum *a*. The pillars *i* are clamped, as shown at *j*, to a frame consisting of upright members *k*, braced together by ties *l*. Springing from the bottom pocket *a* are the elements, which extend thence preferably in a zigzag manner to one of the upper drums. The drawings show each element consisting of a number of tubes *m*, the uppermost section of each element being connected with the drum *b*. Each section is suitably joined to the next one. The drawings show these connections effected through junction-boxes *n*. These junction-boxes are each provided with openings to receive the tube elements, and steam and water tight connections are made between the sections of tube elements and the junction-boxes in any suitable manner. An opening normally closed by a plug *o* may be conveniently located in each junction-box to facilitate cleansing and the like. The junction-boxes *n* may be conveniently supported in plates *p*, which are in turn attached to the uprights *k* or to some other part of the structure.

According to our invention each tube element or a group of tube elements is or are inclosed in a flue *q* of refractory material, the flue taking the same course (a zigzag one in the illustrations given in the drawings) as the tube elements. By way of illustration we show the flues *q* composed of V-shaped plates *r*, with closed sides and lined with refractory or any suitable non-conducting material *s*. The said flue is supported by the ties *l*, that form part of the main framework.

The covers *e* and *f* of the drums *b* and *c* are provided with ports *u*, through which their contents may pass to the hollow pillars or

down-comers *i*. The bottom drum *a* has similar covers *t*, which likewise have ports *u*.

Water is fed into one of the top drums—say, for instance, the one *c*—preferably through a heating-coil *v*. After admission to the drum *c* it passes through the ports *u* into the down-comers *i*, whence it reaches the bottom drum *a*. Thence it rises through the tube elements *m* and finally reaches the drum *b*. The steam that is generated passes from the drum *b* through its port *u* and rises through an extension *w* of one of the down-comers *i*, (see Fig. 5,) by which it is conveyed to the steam-drum *d*. This drum *d* is similar in construction to those *b* and *c*, but it is shown disposed at right angles to them.

At suitable parts the generator may be provided with water-walls, (see Figs. 2 and 6,) which may be composed of a series of tubes *x*, that extend between headers *y*. These water-walls in the construction shown in Fig. 2 form a kind of by-pass from the main circulation, deriving their supply of water through the pipes *z* from the down-comers *i* and discharging it at a higher temperature into the drum *d* through the connections 1 and 2.

Steam is taken from the drum *d* in any well-known or suitable manner—such, for instance, as is shown at 3, Figs. 2 and 4 to which part a steam-gage 4 may be attached.

5 (see Fig. 4) is a front plate removably attached to a support 6, inclosing the front portion of the apparatus, and which is provided with means of access to the combustion-chamber 7 and with the necessary connections for the particular kind of fuel employed, but the whole of which details are omitted from the drawings.

It will be understood that usual or requisite fittings, such as a safety-valve and water-gage, but which are not shown in the drawings, would be attached to the generator at suitable places.

Figs. 1, 2, and 3 show the generator as deriving heat from the combustion of liquid fuel. The liquid-fuel feeder 8 projects into the combustion-chamber 7, and when the feeder is of the character referred to in the said specification of the prior application for Letters Patent No. 693,684 steam is taken from the generator through one of the pipes 9, but when initially rising steam an initial supply must be derived from an independent source.

Fig. 6 shows the generator adapted for use with an ordinary fire-grate 10. In this form the water is admitted to the system through the pipe *v*, as before, whence it flows through the drum *c* to the down-comers *i*, from which a part flows through the connection 2 and some of the tube elements *m*, while the remainder flows through the drum *a*, tubes of the water-wall *x*, and the remainder of the tube elements *m*, all of which tube elements *m* deliver their contents to the drum *b*. The products of combustion travel in the direc-

tion of the arrows shown in Figs. 1 and 6 and finally escape at the outlet 11. They are thus confined within the flue *q* and conducted from the place of their origin to the point of outlet in such manner that they are kept in close contact throughout with the tube elements, and the length of the flue may be such that the temperature of the issuing products may approximate or be but very little higher than that of the contents of the generator.

It will be obvious that with the combustion-chamber 7 located at the upper part of the flue and the arrangement of flue such that the products of combustion are caused to descend to their point of outlet the most advantageous form of generator is obtained, since the products of combustion when hottest come into contact with those tube elements that contain the water at highest temperature, and that as the temperature of the said products of combustion decreases the said products come into contact with parts of the tube elements that contain water of lower temperature. In this manner a more uniform difference of temperature between the products of combustion and the water in the generator is obtained, and consequently throughout the system a more uniform interchange of heat is secured.

The tube elements may be located in any suitable way within the flue *q*. By way of example, in Figs. 1 and 3 they are shown interspersed within the said flue, while in Fig. 6 they are shown as forming a water-wall within the said flue.

Obviously any number of liquid-fuel feeders may be employed, and either each may have its own flue *q* or the combustion chambers 7 of all of the said feeders may merge into one flue that is common to the whole system.

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

1. In a water-tube steam-generator the combination, with the upper and lower drums, of a structure of refractory material forming a flue, and tube elements located in, extending through the flue in the direction of its length and connected at the top and bottom respectively with said drums.

2. In a water-tube steam-generator, the combination, with the upper and lower drums, of a structure of refractory material forming a flue, tube elements located in, extending through the flue in the direction of its length and connected at top and bottom respectively with said drums, and water-walls forming part of the system.

3. In a water-tube steam-generator, the combination, with the upper and lower drums, of a structure of refractory material forming a flue, tube elements located in and running in the same direction as said flue, and a combustion-chamber located at the upper part of said flue, and an outlet at the lower part

thereof whereby the products of combustion are compelled to follow the course that the tube elements take and also to descend to their point of outlet so that a more uniform difference of temperature between the products of combustion and the water in the generator is obtained.

4. In a water-tube steam-generator, the combination, with the upper and lower drums, of a structure of refractory material forming a flue, tube elements located in and running in the same direction as said flue, a combustion-chamber located at the upper part of said flue, a liquid-fuel feeder projecting into said combustion-chamber, and an outlet at the lower part of said flue whereby the products of combustion are compelled to follow the course that the tube elements take and also to descend to their point of outlet so that a more uniform difference of temperature between the products of combustion and the water in the generator is obtained.

5. In a water-tube steam-generator, the combination with the upper and lower drums, of a structure of refractory material forming a flue, tube elements located in and running in the same direction as said flue, water-walls

forming part of the system, a combustion-chamber located at the upper part of said flue, a liquid-fuel feeder projecting into said combustion-chamber, and an outlet at the lower part of said flue whereby the products of combustion are compelled to follow the course that the tube elements take and also to descend to their point of outlet so that a more uniform difference of temperature between the products of combustion and the water in the generator is obtained.

6. In a water-tube steam-generator a zig-zag structure of refractory material forming a flue, water-tubes located in and extending lengthwise of each section or straight portion of the flue and junction-boxes located at the angles of the flue and connecting the tubes in one section of the flue with those in another, substantially as set forth.

In testimony whereof we have hereunto subscribed our names.

PRESTON DAVIES.
ALEXANDER ROSS.

Witnesses:

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