

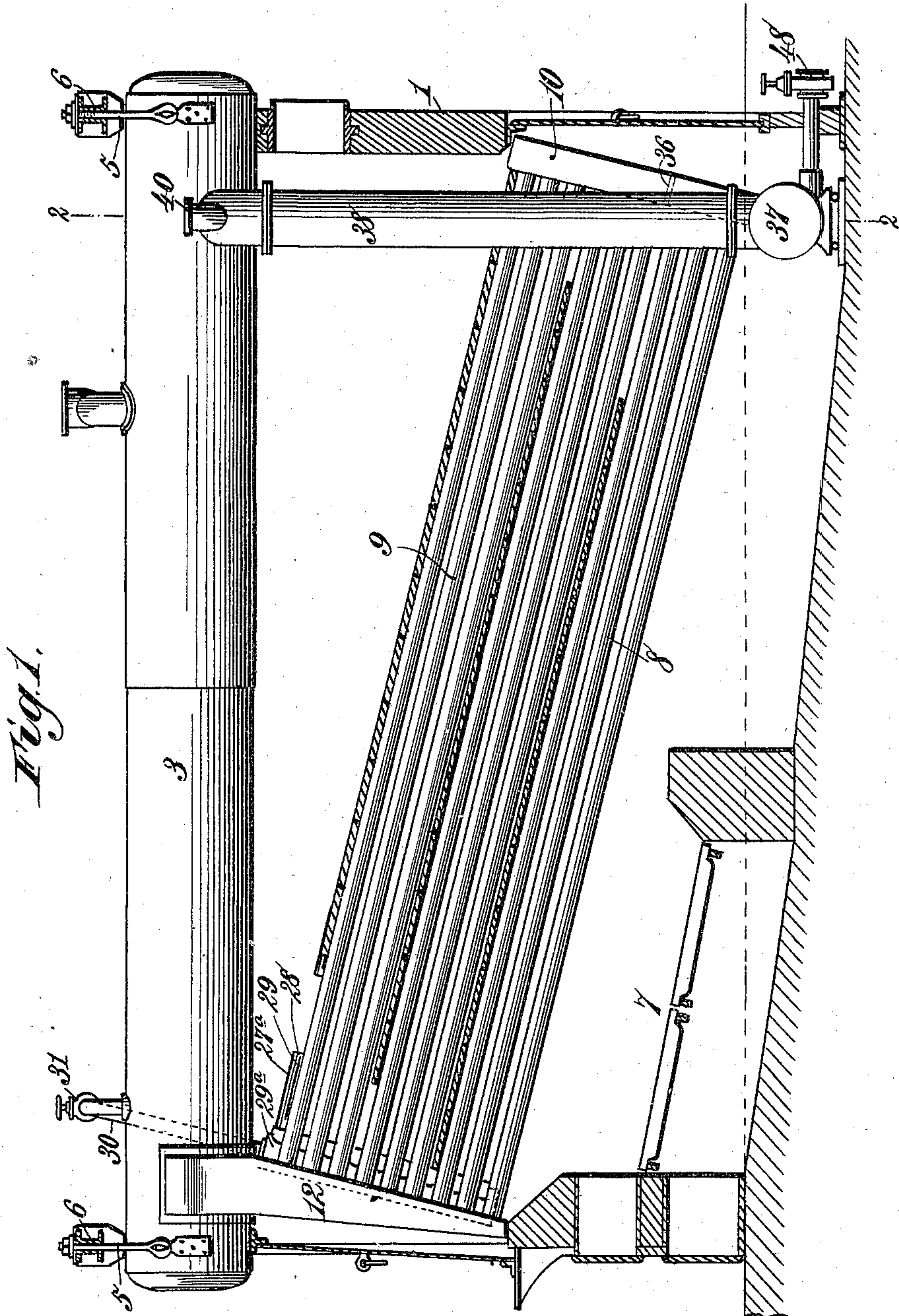
(No Model.)

5 Sheets—Sheet 1.

J. G. COOPER.
STEAM GENERATOR.

No. 558,778.

Patented Apr. 21, 1896.



Witnesses:
Robert Emmett,
J. A. Paul.

Inventor:
James G. Cooper,
By *James L. Norris,*
Atty.

(No Model.)

5 Sheets—Sheet 2.

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Fig. 2.

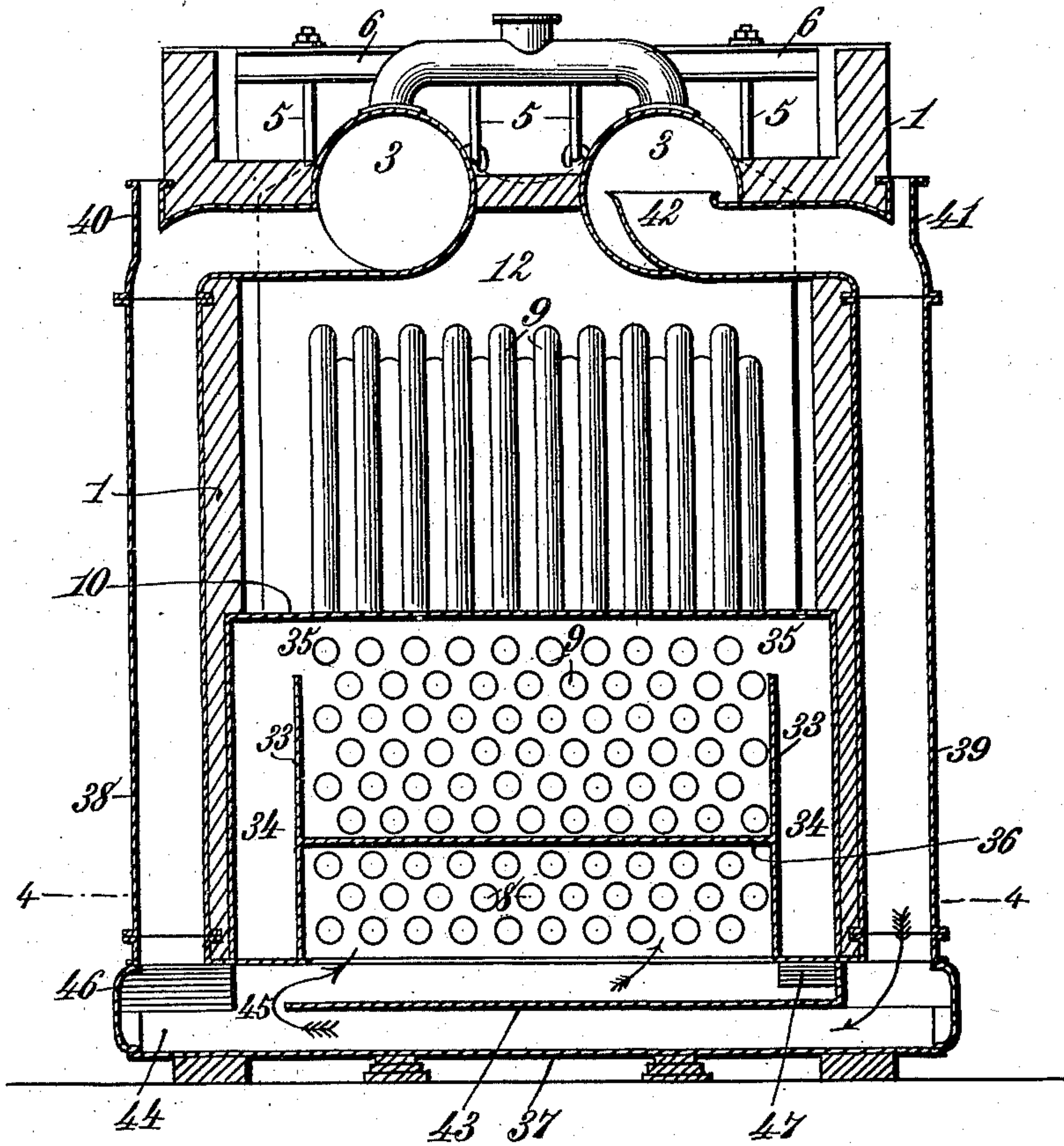


Fig. 3^a

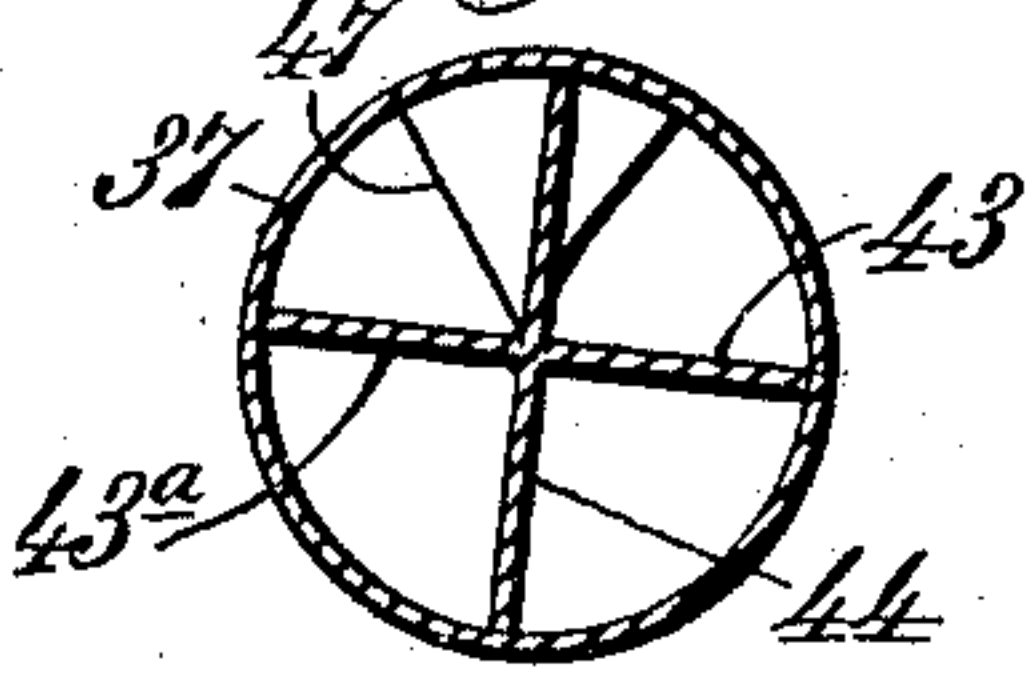


Fig. 3.

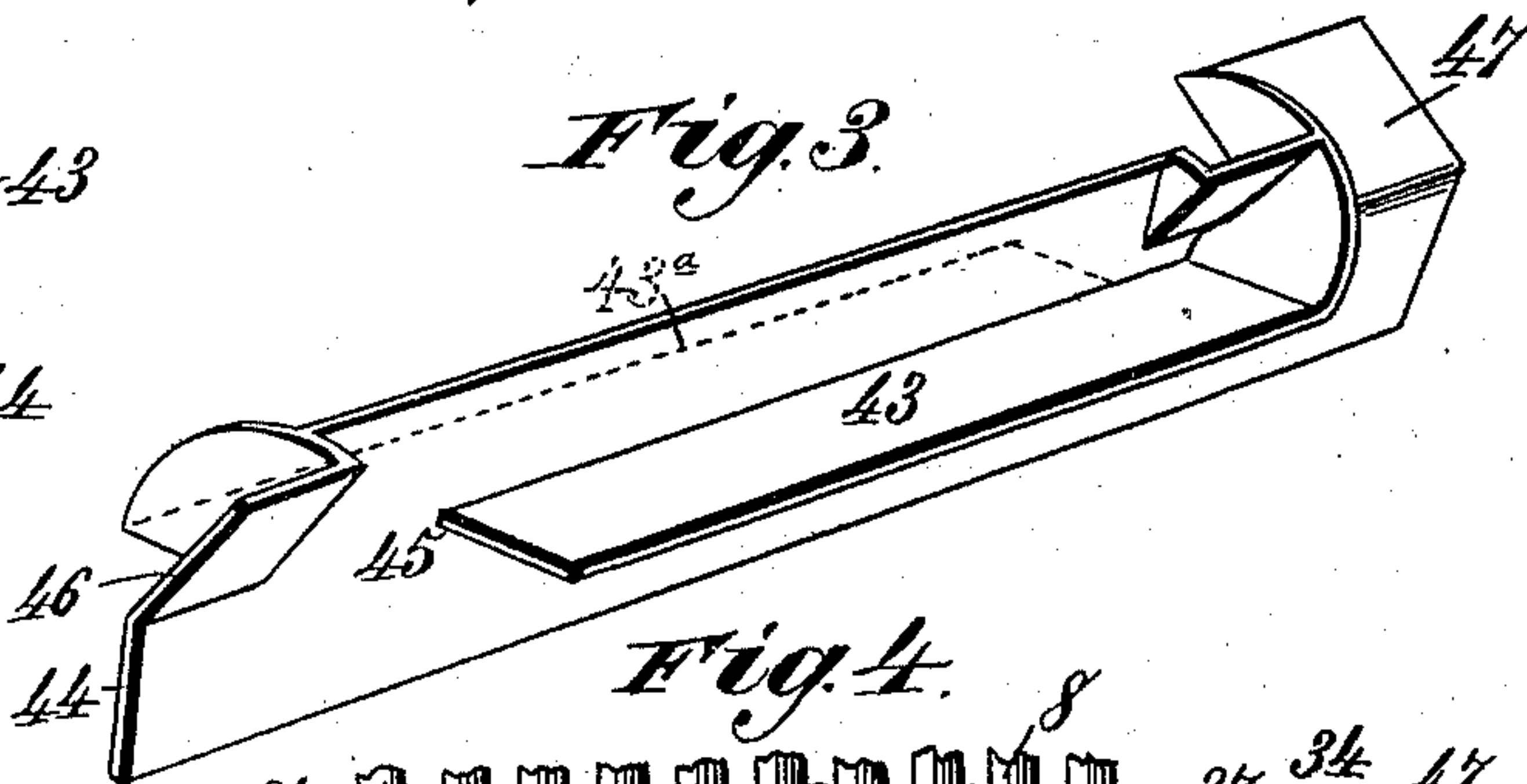
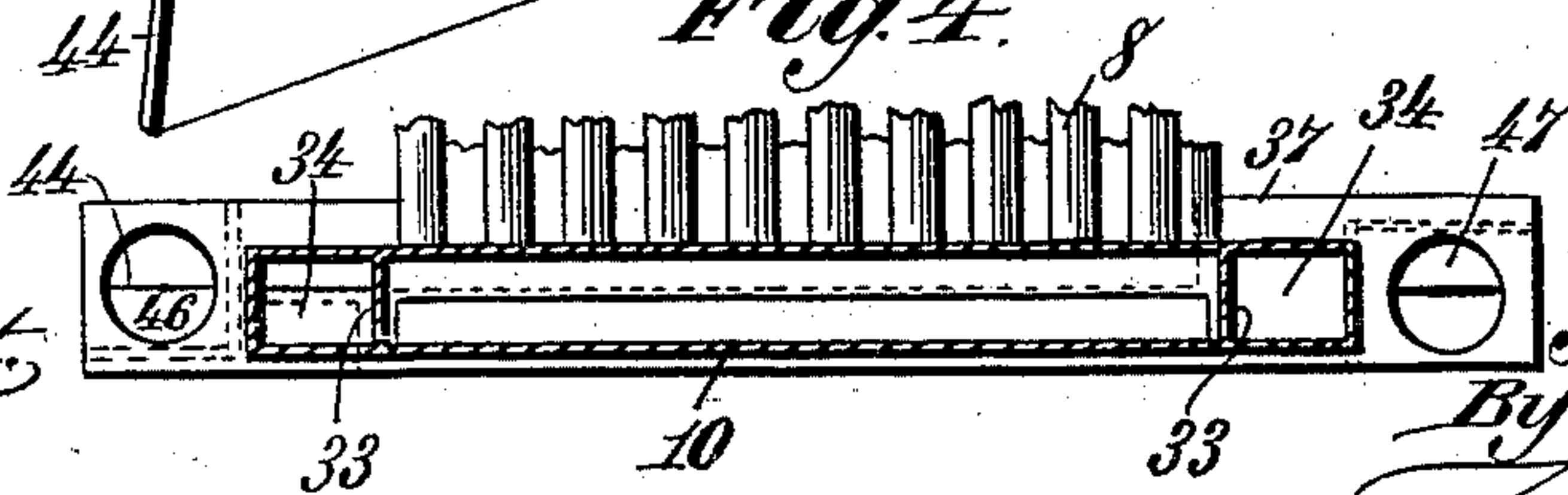


Fig. 4.



Witnesses:
Robert Everett
J. A. Saul

Inventor:
James G. Cooper
By *James L. Norring*
Atty.

(No Model.)

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Fig. 6.

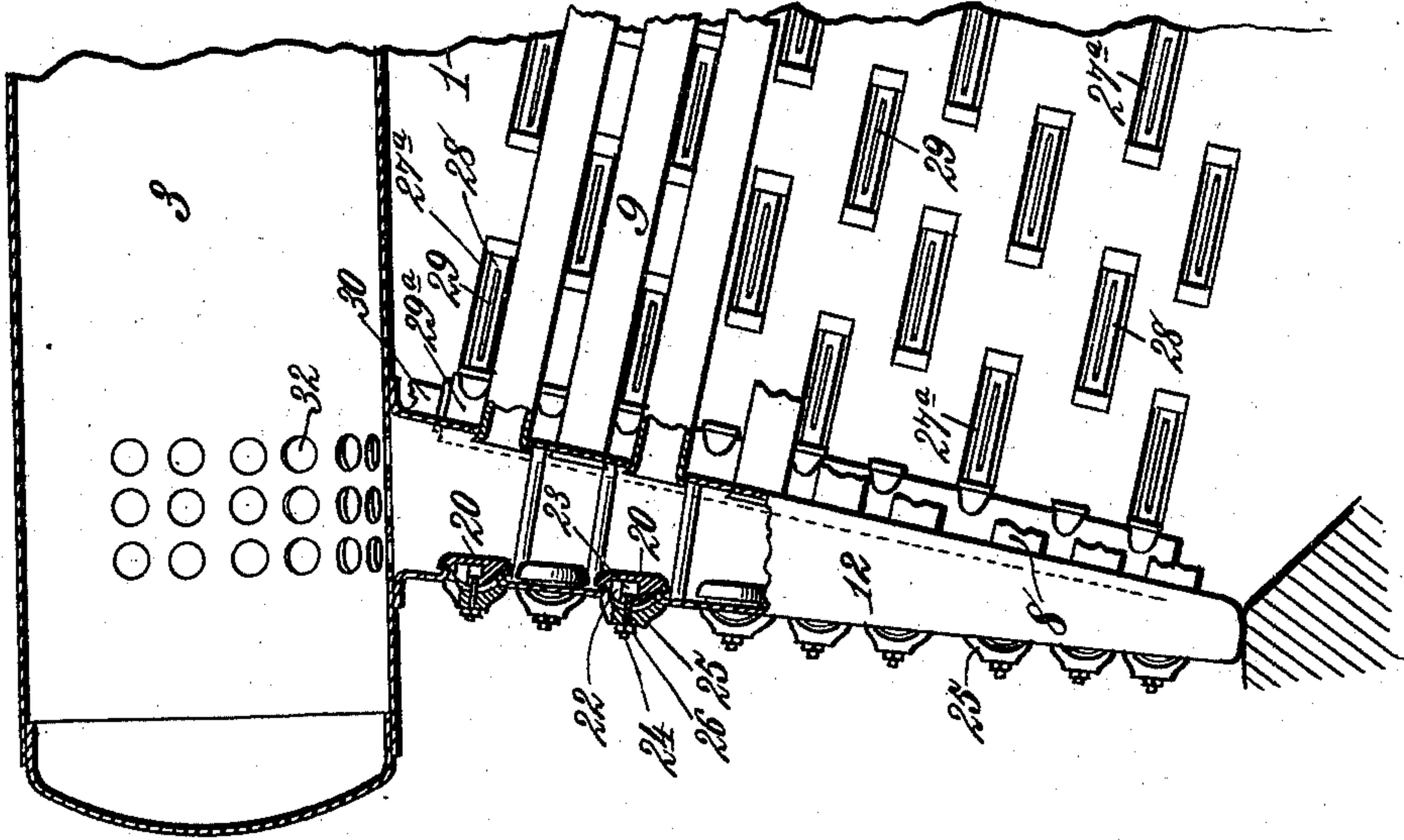
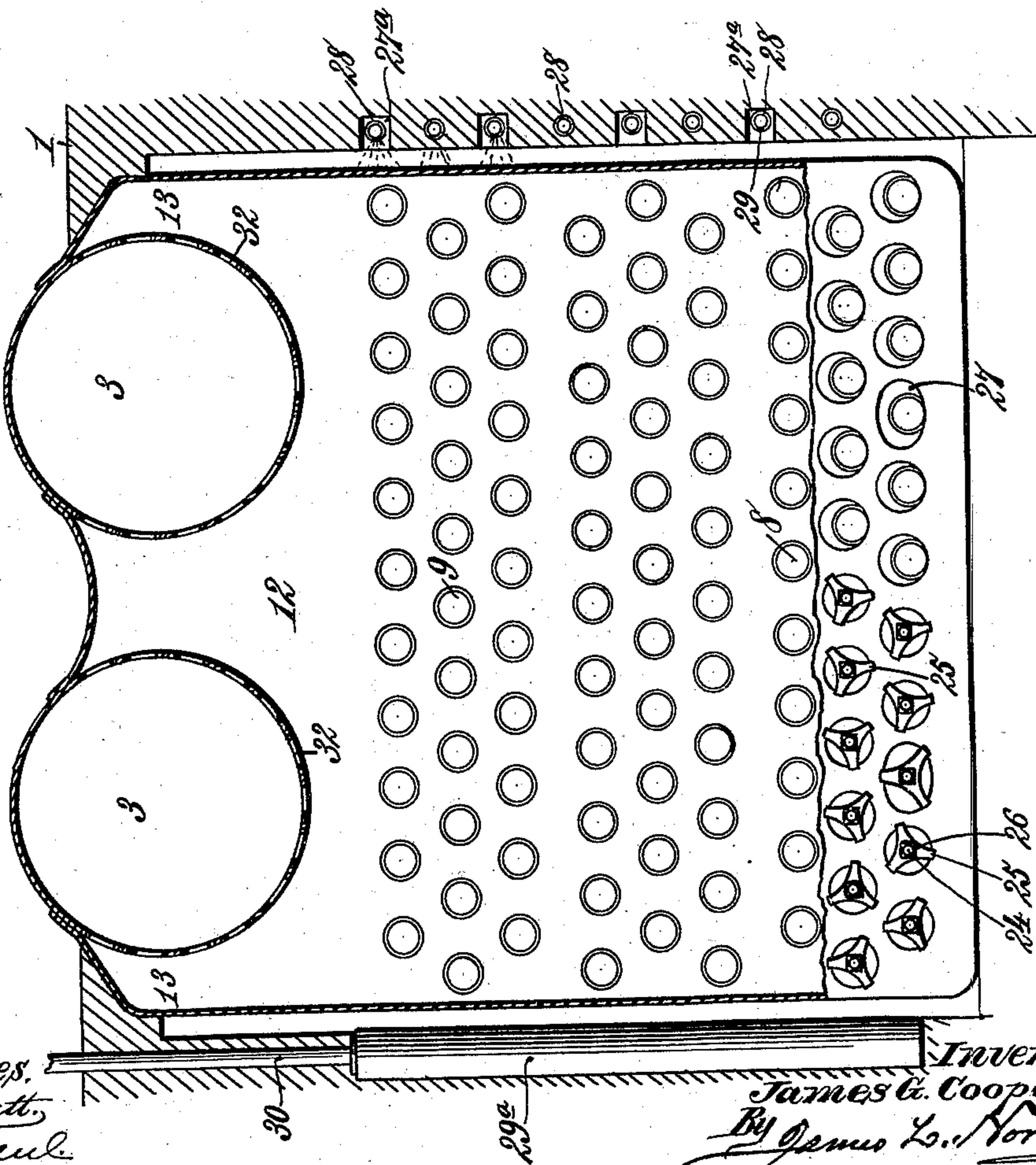


Fig. 5.



Witnesses,
Attest,
J. A. Paul.

Inventor,
James G. Cooper.
By James L. Norris,
Atty.

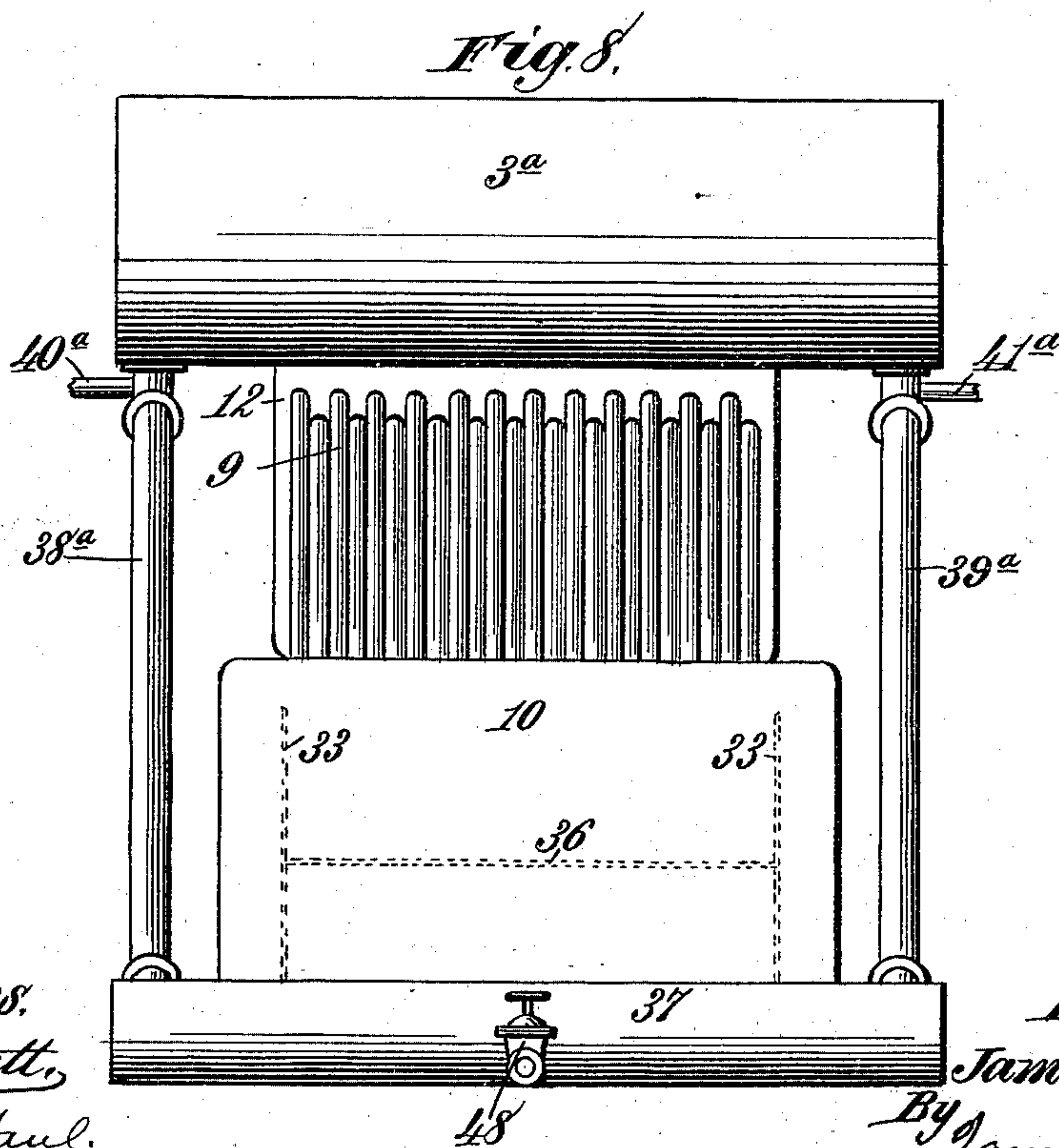
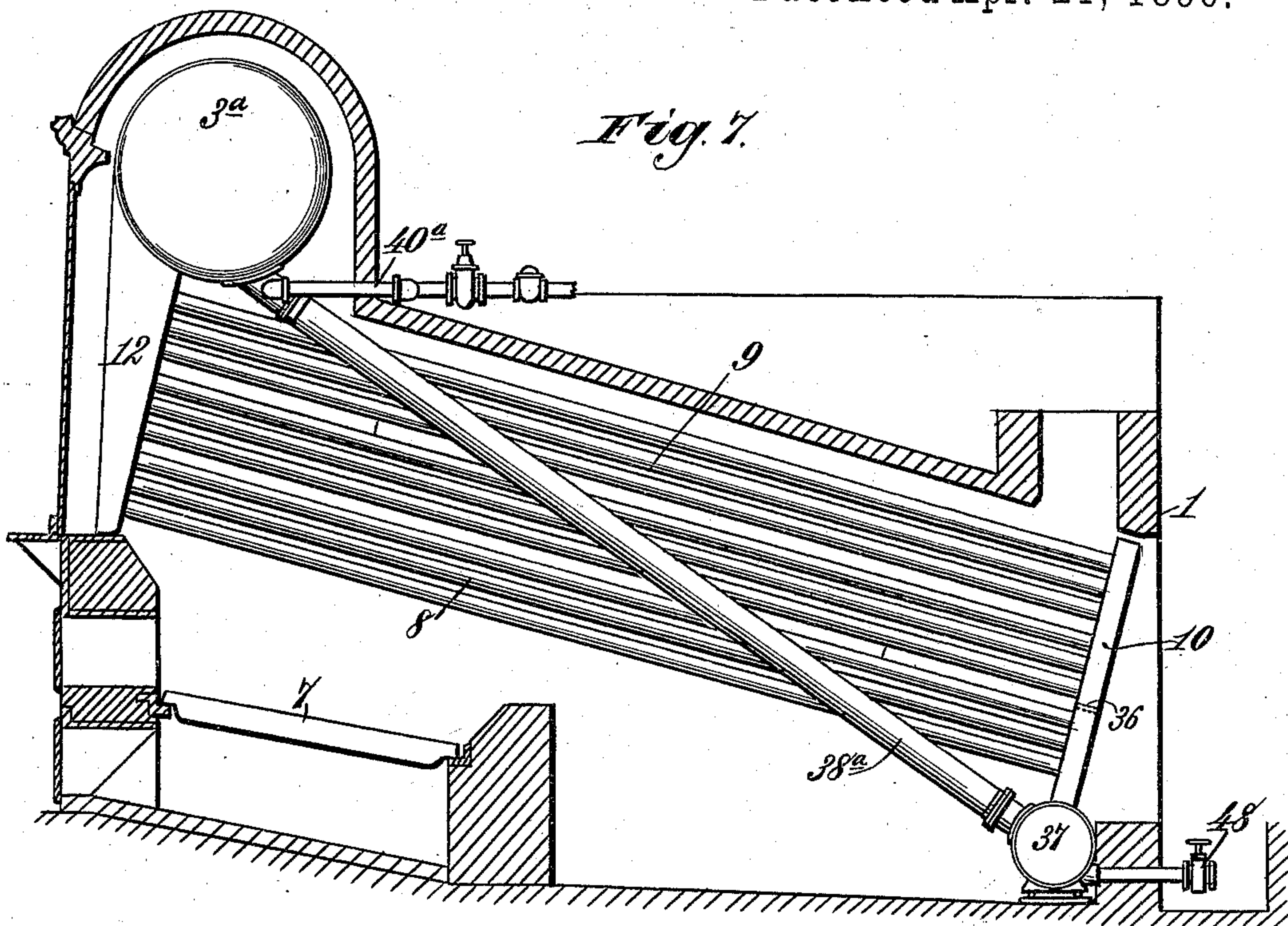
(No Model.)

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J. G. COOPER.
STEAM GENERATOR.

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Patented Apr. 21, 1896.



Witnesses.
Robert Everett,
J. A. Paul.

Inventor,
James G. Cooper.
By James L. Norris,
Atty.

(No Model.)

J. G. COOPER.
STEAM GENERATOR.

5 Sheets—Sheet 5.

No. 558,778.

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Fig. 9.

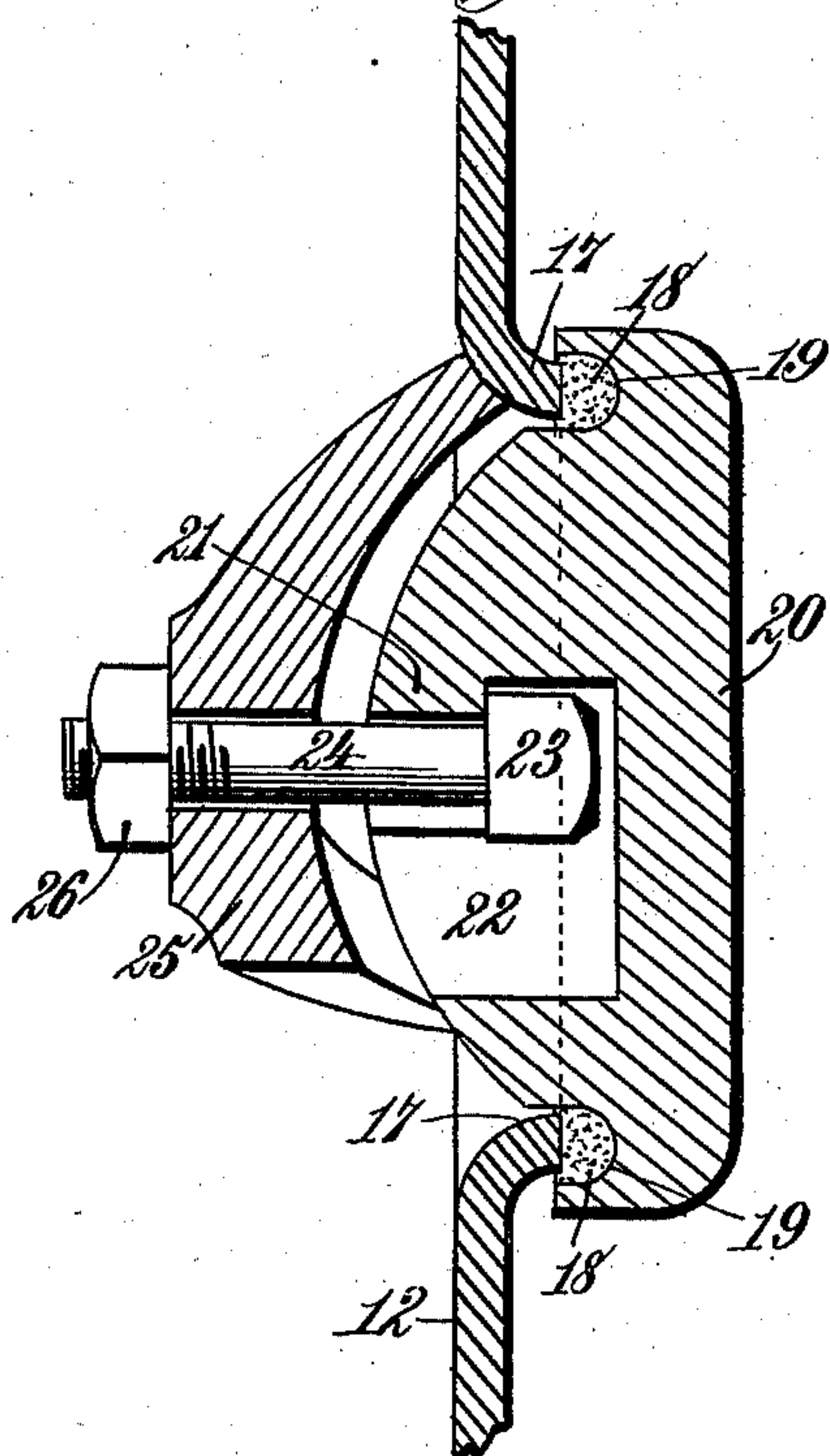


Fig. 10.

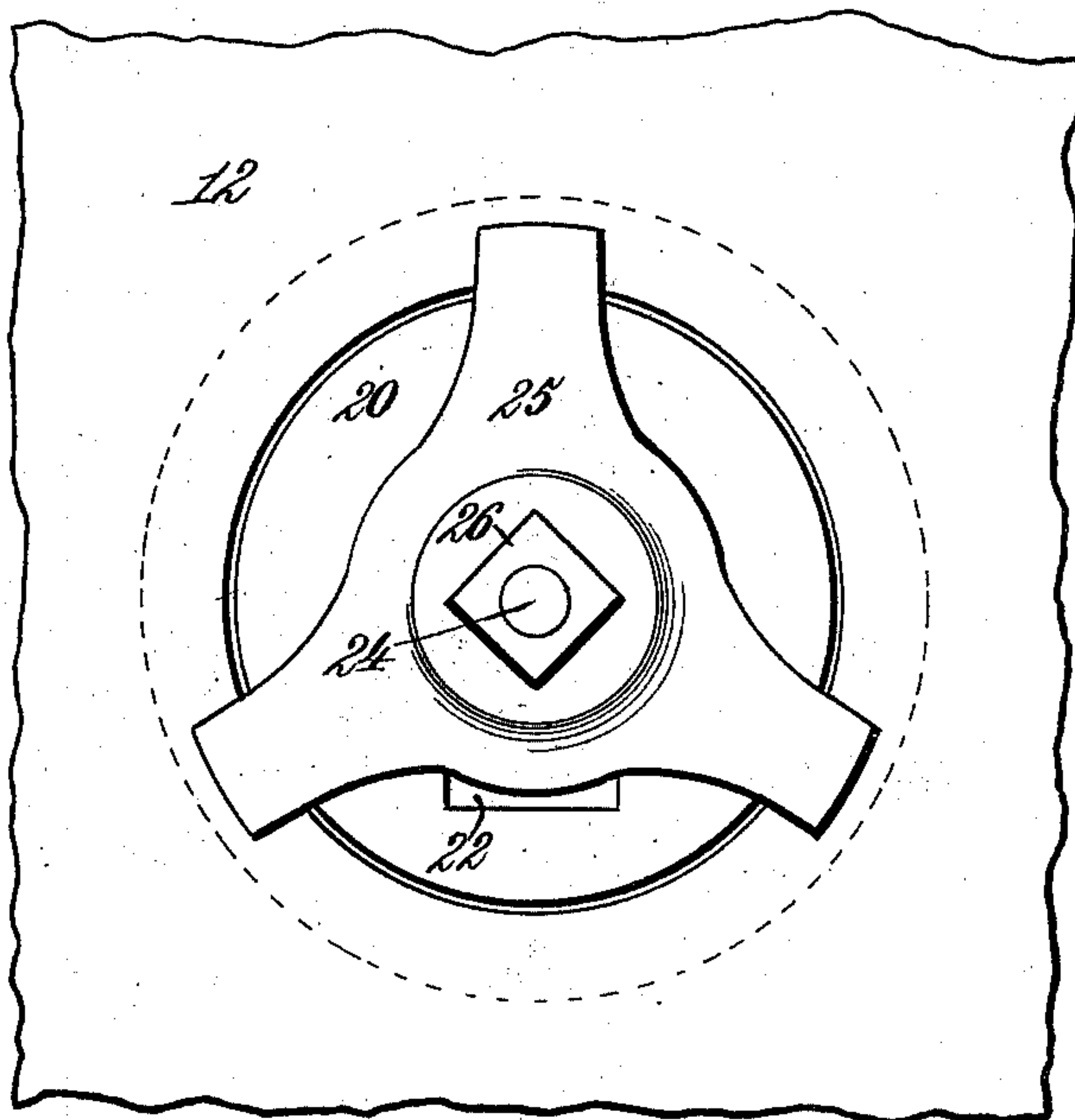


Fig. 11.

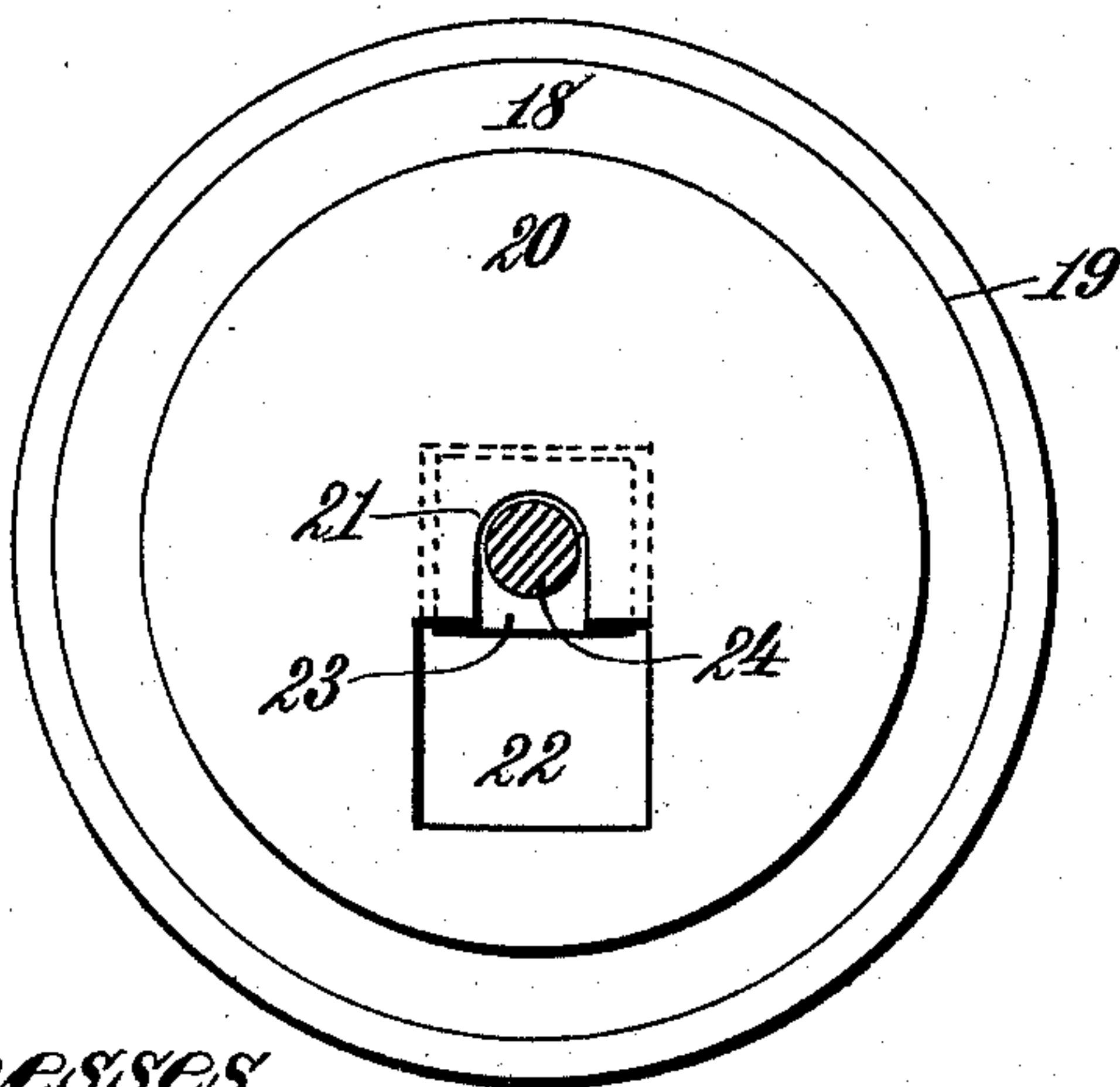
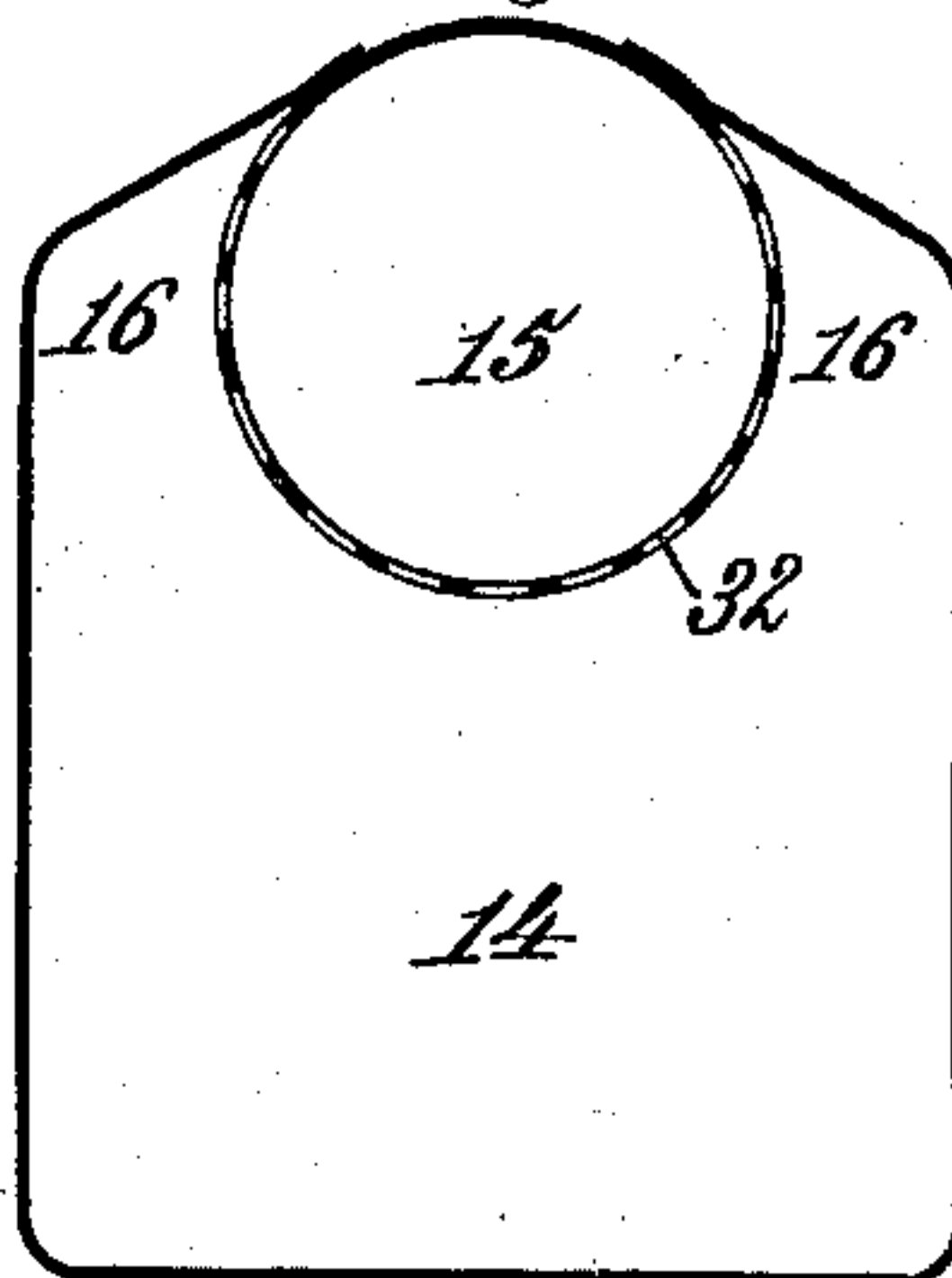


Fig. 12.



Witnesses.
Robert G. Pratt.
J. A. Saul.

Inventor.
James G. Cooper.
By James L. Norris.
Atty.

UNITED STATES PATENT OFFICE.

JAMES G. COOPER, OF CINCINNATI, OHIO.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 558,778, dated April 21, 1896.

Application filed May 3, 1894. Renewed December 31, 1895. Serial No. 573,970. (No model.)

To all whom it may concern:

Be it known that I, JAMES G. COOPER, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented new and useful Improvements in Steam-Generators, of which the following is a specification.

This invention has for its object to provide a new and improved steam-generator of that type wherein the chief or principal surface is composed of a plurality of water-tubes inclined downwardly from front to rear of the furnace structure or brickwork, with the lower ends of the tubes connected to a mud-drum and the upper ends communicating with a vertically-arranged water-leg connected to a drum or cylinder into which the steam is delivered.

The invention also has for its object to provide a new and improved construction of water-leg, whereby it is suited specially to the capacity of the tubes and a better and more efficient release of the steam is secured.

The invention also has for its object to provide new and improved means for obtaining adequate and rapid circulation of the water and a larger or more extended steam-releasing space where the water-leg joins the drum or cylinder for the purpose of making dry steam and delivering it in greater volume into the drum or cylinder above the water-level, so that the steam can pass into the drum or cylinder without interference from water contained therein, by which better results and a superior generator are obtained.

The invention also has for its object to provide new and improved means for introducing the feed-water into circulating stand-pipes and to the mud-drum and causing the water to ascend from the mud-drum, either into the lower gang of water-tubes, which are nearest the fire and connect with a header, or into the upper gang of water-tubes, which are farthest from the fire and connect with the same header, whereby minerals, salts, and sediment in the water will be trapped and deposited in the mud-drum and prevented from entering into the circulation through the water-tubes, and whereby the feed-water in its coldest condition may be directed to the hottest tubes when the boiler is forced to a

point liable to overheat the lower gang of tubes.

The invention also has for its object to provide simple and efficient means for causing scum or impurities on the water-surface in the steam drum or cylinder to descend and deposit in the mud-drum.

The invention also has for its object to provide new and improved means for conveniently and rapidly removing soot, ashes, and other matter from the external surfaces of the water-tubes, whereby the expense, inconvenience, and labor heretofore incident to this operation are avoided, and the numerous steam-hose or pipe-openings ordinarily provided in other furnace structures to keep the water-tubes cleaned exteriorly are unnecessary.

The invention also has for its object to generally improve steam-generators of the character alluded to, whereby they are rendered more efficient and useful and susceptible of being more economically manufactured and assembled into position for practical work.

To accomplish all these objects, my invention consists in the features and the combination or arrangement of parts hereinafter described and claimed, reference being made to the accompanying drawings, in which—

Figure 1 is a longitudinal sectional elevation of a steam-generator embodying my invention. Fig. 2 is a vertical sectional view taken on the line 2 2, Fig. 1. Fig. 3 is a detail perspective view of the diaphragm device detached from the mud-drum to more clearly show its construction. Fig. 3^a is a cross-section through the mud-drum. Fig. 4 is a detail horizontal sectional view taken on the line 4 4, Fig. 2. Fig. 5 is a sectional elevation of the front end portion of the steam-generator. Fig. 6 is a detail sectional side elevation of the same. Fig. 7 is a longitudinal sectional elevation of a steam-generator, showing a modified arrangement of parts. Fig. 8 is a detail rear end elevation of the same. Fig. 9 is a detail vertical sectional view showing one of the stoppers for the holes in the water-leg. Fig. 10 is a front elevation of the same. Fig. 11 is a detail view of the stopper, showing the securing-bolt in section; and Fig. 12 is a diagram of a modified form

of water-leg in connection with a single drum or cylinder.

In order to enable those skilled in the art to make and use my invention, I will now describe the same in detail, referring to the drawings, wherein—

The numeral 1 indicates a furnace structure of any material suitable for the conditions required. The front portion is preferably made of plate iron or steel, to which the door-mounts are attached, and the horizontal drums or cylinders 3 are suspended by means of strap-bolts 5, secured to light horizontal channel-beams 6, supported by suitable vertical channel-beams, the construction being such that considerable weight can be properly supported.

The furnace structure may be provided with any suitable means for heating the generator, but, as here illustrated, an ordinary grate or fireplace 7 is provided, and above the same is arranged the water-tubes, which are divided into a lower gang 8 and an upper gang 9. The water-tubes incline downwardly from the front to the rear, and at the rear they are connected to a header 10, while at their upper ends they connect with the inner plate or wall of an approximately vertical water-leg 12, which gradually widens from its base or lower end to its upper end, where it is joined to and communicates with the drums or cylinders. By gradually enlarging the front water-leg from its base to its upper portion, as described and shown, the circulation is greatly assisted, and the water-leg is well suited to the capacity of the tubes, because the size of the water-leg increases in depth from front to rear and an increasing space for the release of steam is thereby provided.

The width of the water-leg from side to side of the generator is such that its sides or ends inclose the greater portions of the diameters of the drums or cylinders and provide enlarged chambers 13, Fig. 5, which extend above the water-level in the drums or cylinders, and thus secure a large or extended steam-releasing space where the water-leg joins said drums or cylinders, so that dry steam is made and delivered in a larger volume into the drums or cylinders at points above the water-level. By this means I constantly maintain the requisite area or releasing-surface for steam, which greatly promotes circulation and conduces to the production of dry steam. In this connection it is proper to state that this feature of the invention can be utilized in connection with a single drum or cylinder, as indicated by the diagram Fig. 12, where the numeral 14 indicates the water-leg, and the numeral 15 the single drum or cylinder.

It will be obvious from an inspection of the diagram that the width of the water-leg 14 is greater than the diameter of the drum or cylinder, and its sides are approximately vertical from the base to near its top, thereby providing the side chambers 16 to secure the

large or extended steam-releasing space into the drum or cylinder at a point above the water-level therein.

The front and rear sheets or plates of the water-leg may be connected and stayed in the usual manner through the medium of suitable stay-bolts or otherwise.

The front sheet or plate of the water-leg is provided with a series of hand-holes coinciding with the front extremities of the water-tubes, and the edges of the holes are bent inwardly to form annular lips or flanges, as at 17, Fig. 9, each of which is designed to seat against an annular packing 18, composed of lead or an alloy, or other soft metal or material, arranged in an annular groove 19 in the disk-shaped stopper 20, so that when the stopper is clamped in position a perfect steam and water tight joint is provided. The stopper is provided with a shoulder 21 and an enlarged recess 22, adapted to receive the head 23 of a bolt 24 in such manner that the head of the bolt can be readily engaged with the shoulder 21. The bolt extends through a central orifice in a spider or triple-armed clamp-plate 25, and a nut 26 is screwed on the bolt to bear against said spider or clamp-plate, whereby the stopper can be rigidly clamped in position with the lead or similar packing 18 against the lip or flange 17. The stopper is formed with a convex projecting center which approximately fills the hand-hole in the front sheet or plate of the water-leg. The stopper can be introduced, as usual, through proper openings 27, Fig. 5, and is readily detachable when it is desired to internally clean the tubes.

The furnace structure or brickwork is constructed in each side with longitudinal chambers 27^a, Fig. 5, in which are arranged a series of steam-delivery pipes 28, each provided at intervals along its length with a series of slots or jet-orifices 29, Fig. 6, which coincide with openings or recesses formed in the furnace structure or brickwork directly in front of the slots or jet-orifices, in such manner that steam discharged from the slots or jet-orifices 29 will spread and effectually remove all soot, ashes, and other matter from the exterior surface of the water-tubes. The pipes 28, and the recesses containing them, are preferably arranged at the same angle of inclination as the water-tubes, and the slots or jet-orifices in one pipe alternate with those in the two adjacent pipes, whereby the water-tubes are acted on throughout their length, and the best results are attained by very simple means. The pipes 28 connect at one end with an inclined cylindrical header 29, Fig. 5, having a pipe connection 30 with the steam-space of one of the drums or cylinders 3. The steam may, however, be otherwise supplied to the pipes 28. By locating the pipes in the brickwork or setting they are effectually protected from the hot gases, and I entirely avoid the numerous holes ordinarily formed in the furnace-walls for cleaning purposes, and also

avoid introducing steam hose or pipe through the furnace-doors, while the generator can be so conveniently cleaned from soot and ashes by simply opening the valve 31, Fig. 1, that the attendant is not likely to permit soot and ashes to accumulate until compelled to remove the same to generate sufficient steam.

The communication between the large and extended steam-releasing spaces or chambers 13 or 16 and the drums or cylinders, one or more, is preferably effected by providing the shells of the drums or cylinders with a series of perforations 32, Figs. 5 and 6, some of which are located above the water-level in the drums or cylinders.

The header 10 is composed of a rectangular shell having partitions 33 near its sides, which are so arranged as to provide two ascending water-channels 34, one at each side of the shell. The partitions terminate some distance below the top wall of the shell to provide lateral passages 35, Fig. 2, through which the water can flow to the ends of the upper gang 9 of water-tubes. The shells composing the head also contains a horizontal partition 36, which cuts off communication between the lower ends of the gang 9 of water-tubes and the lower ends of the gang 8 of said tubes, and the space below the partition 36 communicates with the transverse horizontal mud-drum 37.

The mud-drum may be of any desired form in cross-section, but is preferably in the form of a cylinder, and its ends extend through the side walls of the furnace structure and connect by circulating stand-pipes 38 and 39 of large capacity with the drums or cylinders 3. The circulating stand-pipes are provided with feed-water-inlet connections 40 and 41, either of which can be utilized for introducing the feed-water. The pipe 39 is extended into one of the drums or cylinders and has its receiving-mouth 42 arranged horizontally at about the water-level in the drum or cylinder, so that scum and other light floating impurities will be drawn down and deposited in the mud-drum beneath a horizontal diaphragm or partition 43 arranged therein and forming part of or attached to an approximately vertical diaphragm or partition 44, which extends substantially the full length of the mud-drum, while the partition or diaphragm 43 is of less length and terminates at such point as to provide a passage 45, so that when the feed-water is introduced through the stand-pipe 39 it will flow down into the mud-drum and horizontally beneath the diaphragm or partition 43, and thence through the passage 45 to the header 10 and into the lower gang 8 of the water-tubes.

The approximately vertical diaphragm or partition 44 is provided at its ends with reversely-inclined wings 46 and 47, so that the feed-water introduced through the pipe 39 will be deflected rearward by the wing 47, while if the feed-water be introduced through the pipe 38 it will be deflected forward by the

wing 46 and pass to the front of the diaphragm or partition 44 beneath a horizontal diaphragm or partition 43^a, similar to the diaphragm or partition 43, which is opposite the same, whereby the water will flow into the ascending channels 34 to the passages 35 into the upper gang 9 of water-tubes.

The mud-drum is provided with a blow-off cock 48, Fig. 1, for cleaning purposes.

The circulating stand-pipes 38 and 39 greatly promote the circulation and also serve for introducing the feed-water, so that the feed-water descends to the mud-drum direct, where it is so baffled by means of the diaphragms or partitions that the minerals, salts, and other impurities are trapped and deposited and do not enter into the circulation through the water-tubes.

The connection of the upper gang 9 of the water-tubes with the mud-drum through the medium of the large ascending water-channels 34 is important in that all sediment is precipitated back to the drum and cannot rise with the slowly-ascending current to the uppermost water-tubes.

The feed-water connections 40 and 41 for the circulating stand-pipes 38 and 39 render it possible to introduce the feed-water into either stand-pipe or into both at the same time at the will of the attendant. This is an important and valuable feature of my invention, in that the coldest water can be directed to the hottest tubes when the generator is forced to a point likely to overheat the lower gang of tubes, which would cause undue expansion and permanently set these tubes, so that they would be imperfect in operation.

In the practical use of the improved generator the flames from the fire are baffled by baffle-plates inserted between the water-tubes for the purpose of securing the best results from the gases of combustion, and causing all the tubes to be completely surrounded by these gases. The baffling-plates more effectually distribute the heat, and therefore the water-tubes are rendered more durable. The parts are all constructed so that they can be readily manufactured and assembled, and it is possible to economically set generators or boilers to secure the best results.

In the generator thus far described the drums or cylinders 3, one or more, extend from front to rear of the furnace, or rather run in the same longitudinal plane as the water-tubes, but in the modification, Figs. 7 and 8, the drum or cylinder 3^a extends transversely or from side to side of the furnace structure. In Figs. 7 and 8 the same reference-numerals indicate parts corresponding to those hereinbefore explained by the same reference-numerals.

The water-leg, the header, and the mud-drum are all constructed substantially the same as described with reference to the other figures; but the circulating and feed-water pipes 38^a and 39^a are inclined from the drum or cylinder 3^a to the mud-drum, and these

pipes are provided with feed-water-pipe connections 40^a and 41^a. The operation is the same as before described, and therefore further explanation of the modification is deemed unnecessary.

In the construction exhibited by Figs. 7 and 8 it is designed to use the steam-pipes with their slots or jet-orifices and connections for the purpose of keeping the water-tubes clean by removing soot, ashes, and other matter from the exterior surface thereof.

In my improved generator the pitch of the water-tubes is largely increased, and is, preferably, about three inches to the foot, which insures good circulation.

The improved construction secures a large releasing-surface for the steam in proportion to the fire-surface, and the result is economy in the consumption of fuel with increased efficiency and capacity, while all back circulation through the upper water-tubes is avoided and large quantities of dry steam can be readily produced.

Having thus described my invention, what I claim is—

1. The combination with a drum or cylinder, and a plurality of water-tubes, of a water-leg having a width greater than the diameter of the drum or cylinder and rising along opposite sides thereof to provide steam-releasing chambers or spaces which extend above the water-level and communicate with the interior of the drum or cylinder above said water-level, substantially as described.

2. The combination with a drum or cylinder, and a plurality of water-tubes, of a water-leg gradually widening in depth from its base to its top and having a width greater than the diameter of the drum or cylinder and rising along opposite sides thereof to provide steam-releasing chambers or spaces which extend above the water-level and communicate with the drum or cylinder above said water-level, substantially as described.

3. The combination with a drum or cylinder, and a plurality of water-tubes, of a water-leg gradually widening in depth in an upward direction and rising along opposite sides of the drum or cylinder to provide steam-releasing chambers or spaces which extend above the water-level and communicate with the drum or cylinder above said water-level, a header at the rear ends of the tubes, a mud-drum connected with the header, and circulating-pipes extending from the drum or cylinder to the mud-drum, substantially as described.

4. The combination with a drum or cylinder, and a plurality of water-tubes, of a water-leg gradually widening in depth in an upward direction and rising along opposite sides of the drum or cylinder to provide steam-releasing chambers or spaces which extend above the water-level and communicate with the drum or cylinder above said water-level, a header at the rear ends of the tubes, a mud-drum connected with the header, and circu-

lating-pipes extending from the drum or cylinder to the mud-drum and each provided with a feed-water-pipe connection for introducing feed-water into either or both of said circulating-pipes, substantially as described.

5. The combination with a drum or cylinder, a water-leg, and a plurality of water-tubes, of a header connected with the rear ends of the water-tubes and provided with internal partitions forming ascending channels and separating the water-tubes into an upper and a lower gang, circulating-pipes each provided with a feed-water-pipe connection, and a mud-drum having its ends connected with the said circulating-pipes and provided internally with diaphragms or partitions, whereby the feed-water can be directed either to the lower gang of tubes or through the ascending channels to the upper gang of tubes, substantially as described.

6. The combination with a drum or cylinder, a water-leg, and a series of water-tubes, of a header connected with the rear ends of the water-tubes and provided with partitions forming ascending water-channels, and a partition which cuts off communication between the rear ends of the upper gang of tubes and the rear ends of the lower gang of tubes, a mud-drum having vertically and horizontally arranged diaphragms or partitions for directing the feed-water either into the lower gang of tubes or into the ascending channels to the upper gang of tubes, and means for introducing feed-water into either end of the mud-drum, substantially as described.

7. The combination with a drum or cylinder, a water-leg suspended therefrom, and a series of water-tubes, of a header connected with the rear ends of the water-tubes and provided with partitions forming ascending water-channels, and a partition which cuts off communication between the rear ends of the upper gang of tubes and the rear ends of the lower gang of tubes, a mud-drum having its ends extended through the side walls of the furnace structure and provided internally with diaphragms or partitions arranged to direct the feed-water either into the lower gang of tubes or into the ascending water-channels, and circulating-pipes connected with the outer ends of the mud-drum and each provided with feed-water-pipe connections, substantially as described.

8. The combination with drums or cylinders, a water-leg connected therewith, and a plurality of water-tubes, of a header connected with the rear ends of the water-tubes and provided with partitions forming ascending water-channels, and a partition which cuts off communication between the rear ends of the upper gang of tubes and the rear ends of the lower gang of tubes, circulating-pipes leading from the drums or cylinders and each provided with a feed-water-pipe connection, and a mud-drum having its ends connected with the circulating-pipes and provided internally with diaphragms or partitions, where-

by the feed-water from one circulating-pipe can be directed into the lower gang of tubes, and the feed-water from the other pipe be directed into the ascending channels to the upper gang of tubes, substantially as described.

9. The combination with a drum or cylinder, a water-leg connected therewith, and a plurality of water-tubes, of a header provided with internal partitions forming ascending water-channels, and a partition which cuts off communication between the rear ends of the upper gang of tubes and the rear ends of the lower gang of tubes, water-circulating pipes each provided with a feed-water-pipe connection, and a mud-drum having its ends connected with the said circulating-pipes and provided internally with an approximately vertical partition having opposite approximately horizontal partitions of less length than said vertical partition for the purpose of enabling the feed-water introduced by one pipe to be directed into the lower gang of tubes, and the feed-water introduced by the other pipe to be directed into the ascending channels to the upper gang of tubes, substantially as described.

10. The combination with a drum or cylinder, a water-leg, and a plurality of water-tubes, of a header connected with the rear ends of the water-tubes and provided with partitions forming ascending water-channels, and a partition which cuts off communication between the rear ends of the upper gang of tubes and the rear ends of the lower gang of tubes, circulating-pipes each provided with a feed-water-pipe connection, and a mud-drum having its ends connected with said circulating-pipes and provided internally with an approximately vertical diaphragm or partition having reversely-inclined wings at its ends and approximately horizontal partitions on its opposite sides, substantially as described.

11. In a steam-generator, the combination with the water-tubes arranged one above another and inclosed by the furnace structure, of a series of chambers formed one above another in the furnace structure, a series of steam-pipes located in said chambers and provided with slots or jet-orifices arranged to deliver steam along the length of the said water-tubes for removing soot and ashes from all the tubes along their entire length, and means for introducing steam into the said pipes, substantially as described.

12. In a steam-generator, the combination with water-tubes arranged one above another and inclosed by the furnace structure, of a series of chambers formed one above another in the furnace structure, a series of steam-pipes located in said chambers and having slots registering with recesses in the inner sides of the furnace structure and arranged to deliver steam along the length of the water-tubes for removing soot and ashes from all the tubes throughout their length, and means for introducing steam into said pipes, substantially as described.

13. The combination with a drum or cylinder, a water-leg, and a plurality of water-tubes, of a header connected with the rear ends of the water-tubes, a mud-drum connected with the header and provided with internal diaphragms for baffling the feed-water, and a circulating water-pipe having its upper end opening into the drum or cylinder at the water-level, and its lower end connected with the mud-drum, substantially as described.

14. The combination with a drum or cylinder, a water-leg, and a plurality of water-tubes, of opposite circulating-pipes each provided with a feed-water-pipe connection, a mud-drum, and a header provided with means whereby the feed-water from one circulating-pipe can be directed into a lower gang of water-tubes, and the feed-water from the other circulating-pipe can be directed into the upper gang of water-tubes, substantially as described.

15. The combination with the water-tubes of a generator, of a header having partitions forming ascending water-channels, and a partition which cuts off communication between the upper gang of tubes and the lower gang of tubes, a mud-drum provided with internal diaphragms or partitions for directing water either into the lower gang of tubes or into the ascending channels to the upper gang of tubes, and means for introducing feed-water into opposite ends of the mud-drum, substantially as described.

In testimony whereof I have hereunto set my hand and affixed my seal in presence of two subscribing witnesses.

JAMES G. COOPER. [L. S.]

Witnesses:

G. W. REA,

THOS. A. GREEN.