

No. 717,494.

Patented Dec. 30, 1902.

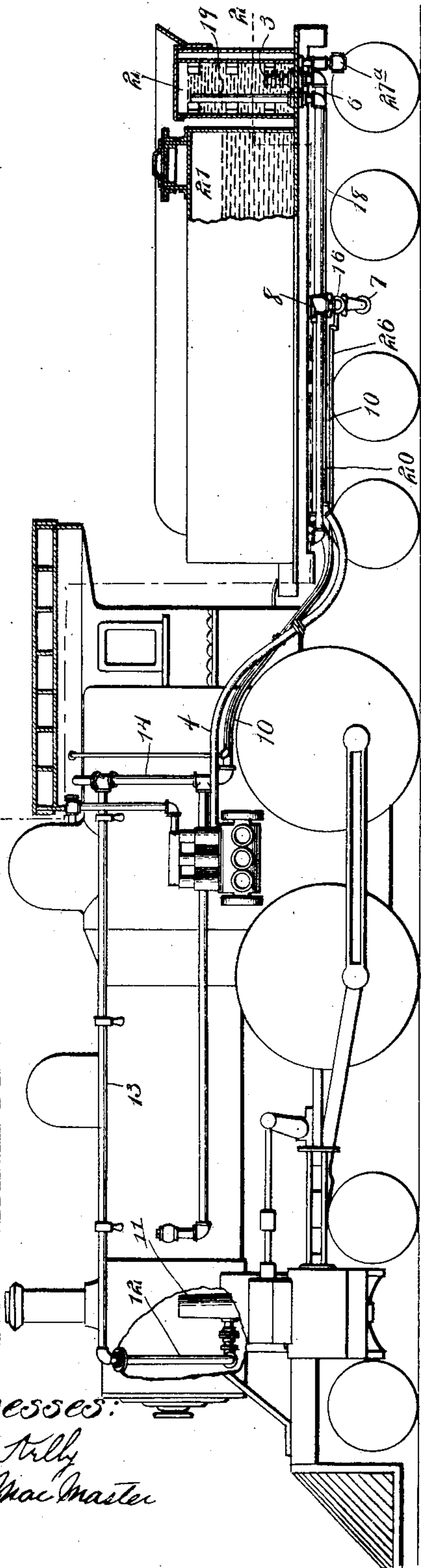
C. H. ATKINS.  
FEED WATER HEATER.

(Application filed Nov. 22, 1901.)

(No Model.)

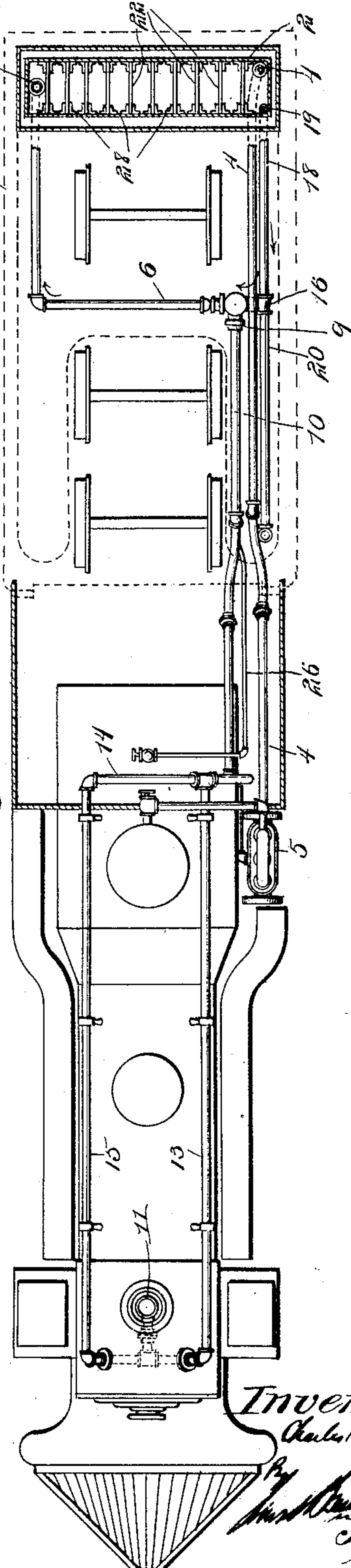
4 Sheets—Sheet 1.

Fig. 1.



Witnesses:  
R. M. Kelly  
John MacMaster

Fig. 2.



Inventor  
C. H. Atkins  
By [Signature] Atty

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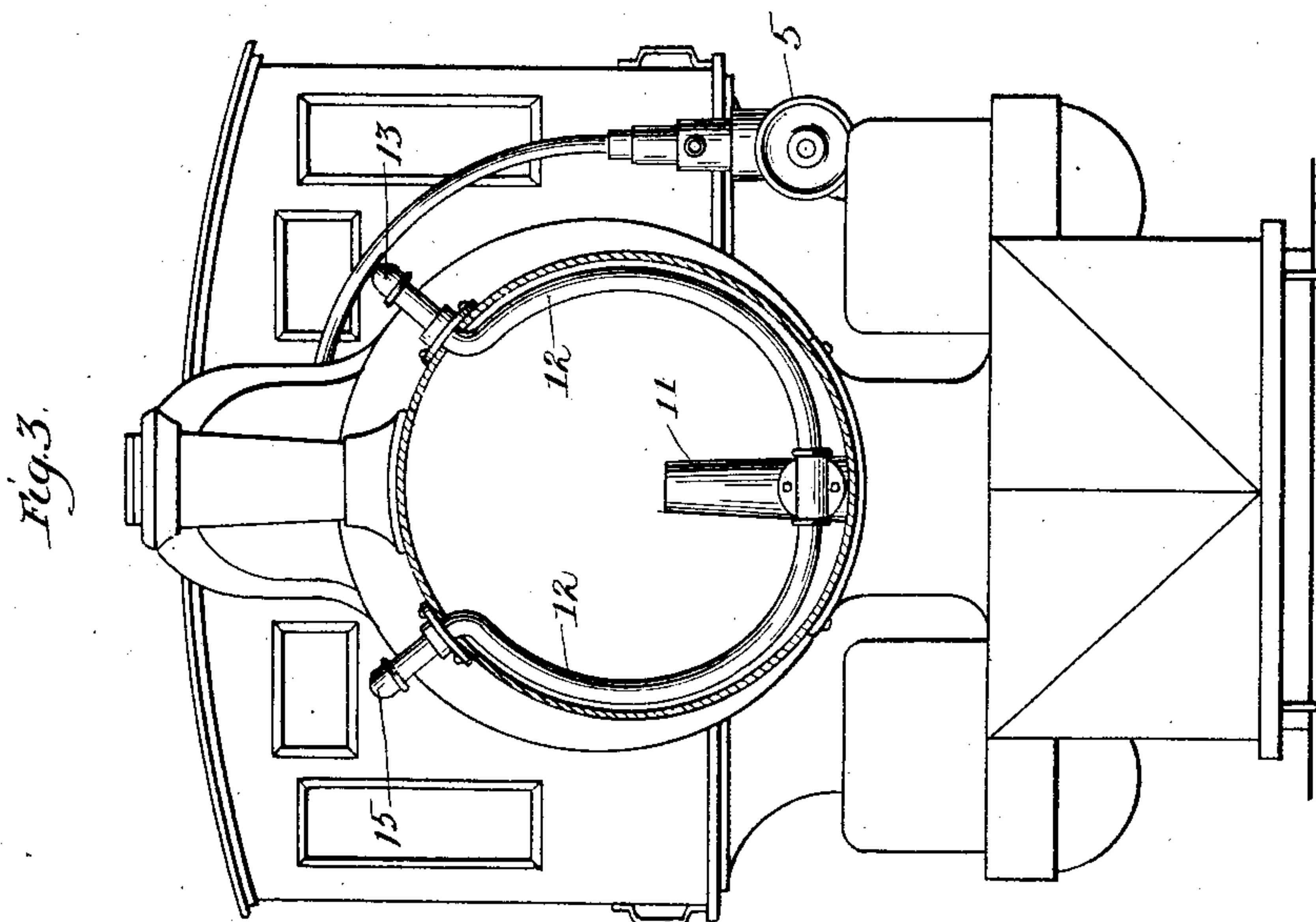
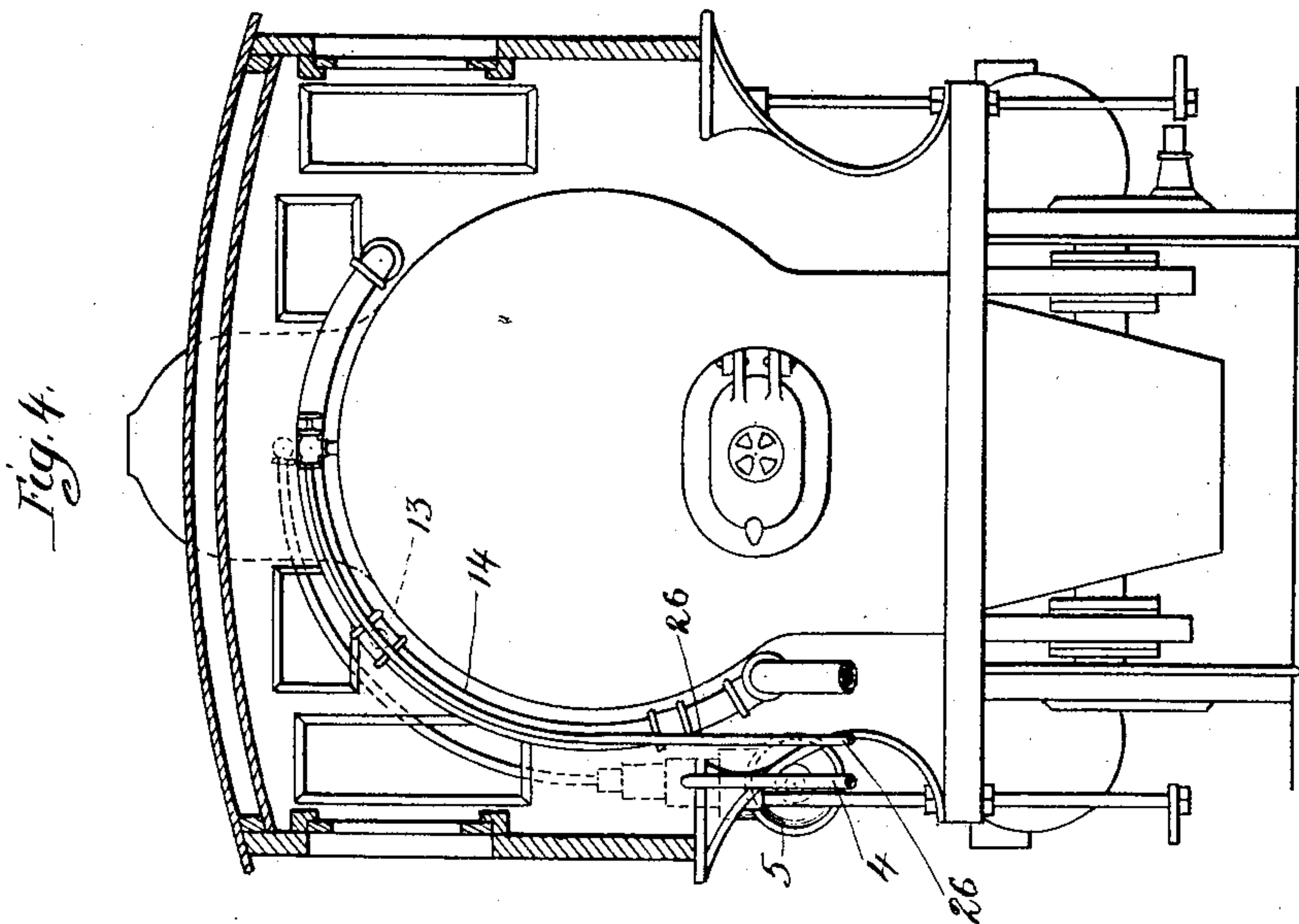
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Witnesses:  
P. M. Kelly  
John Mac Master

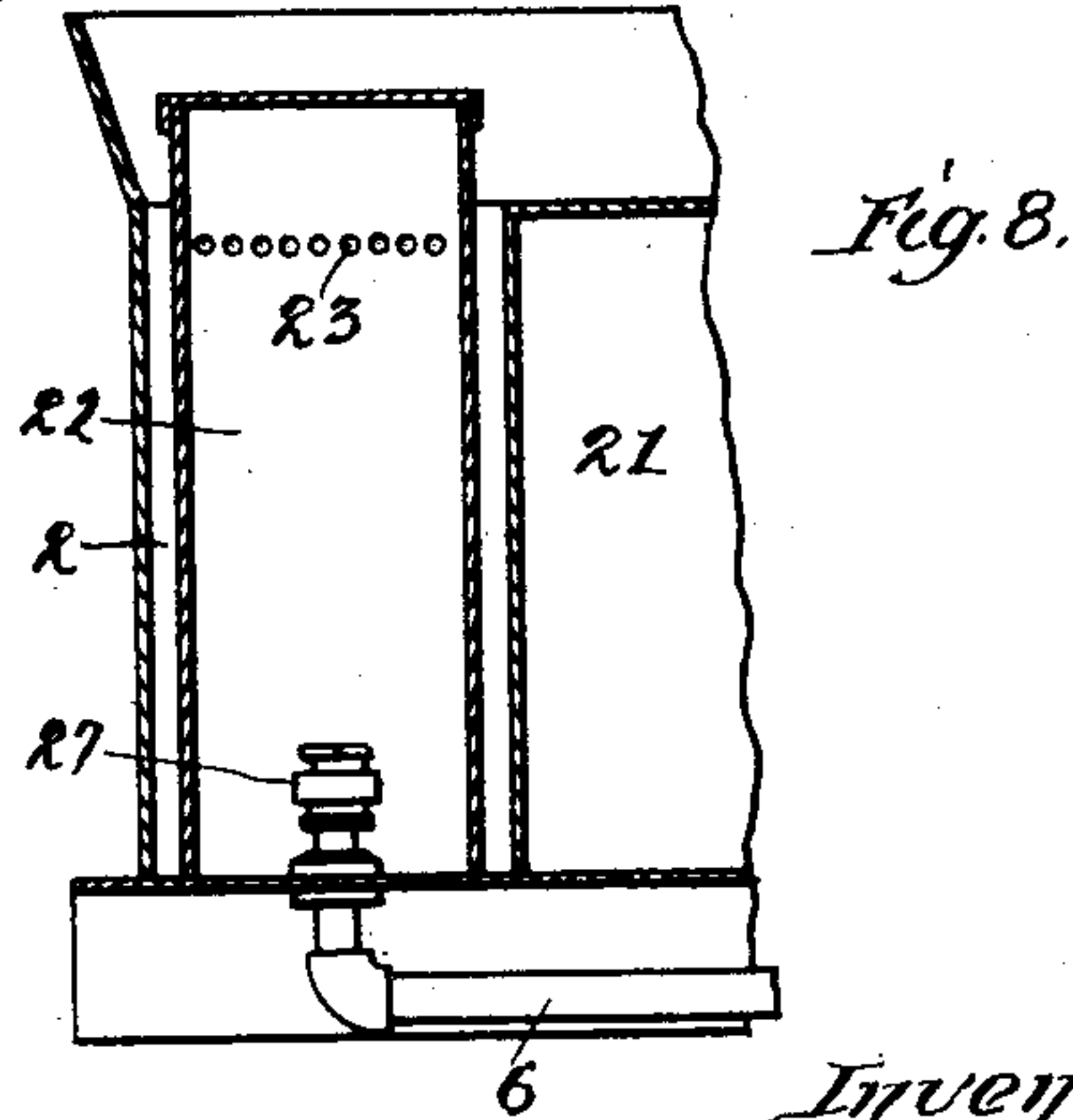
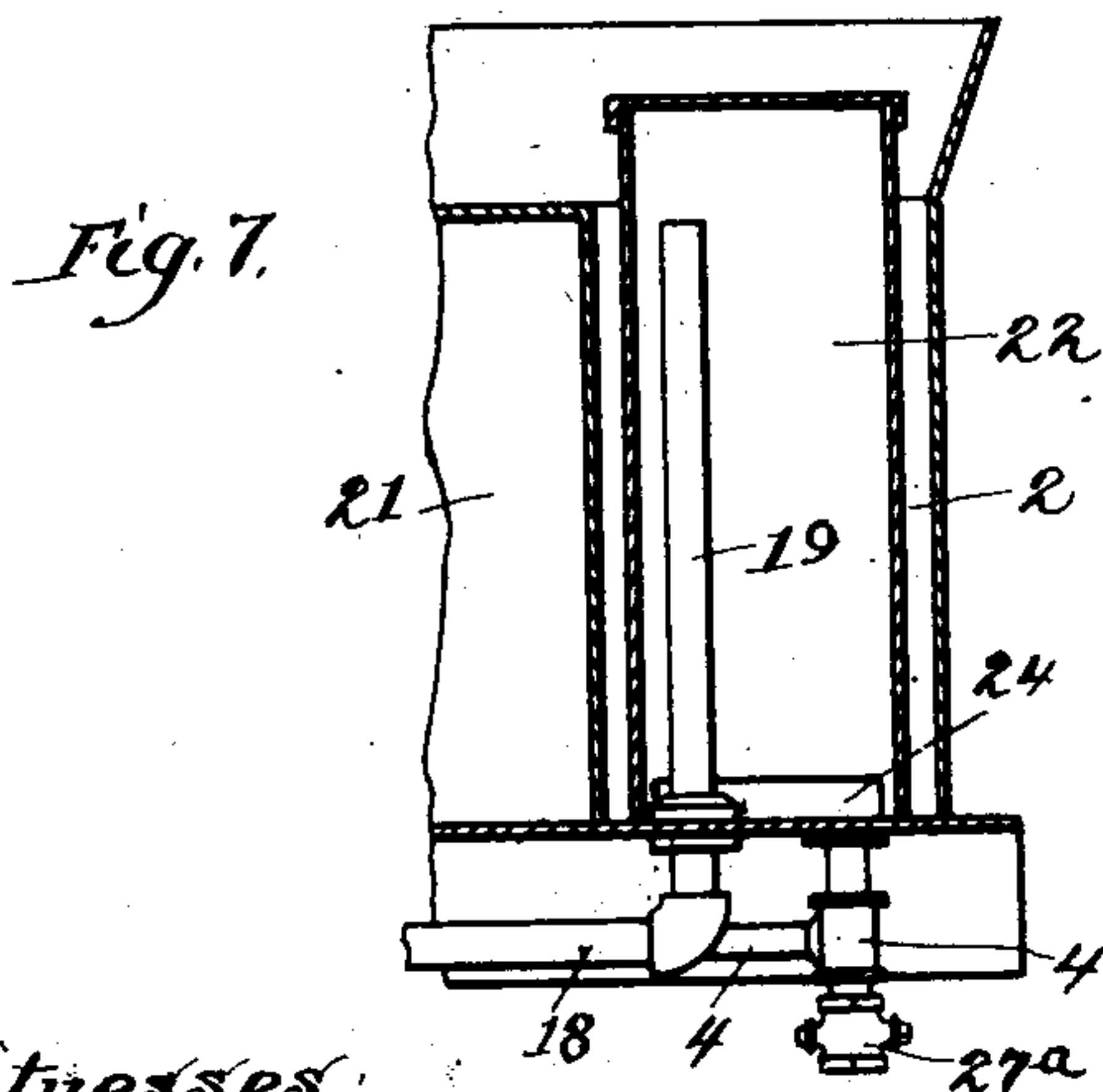
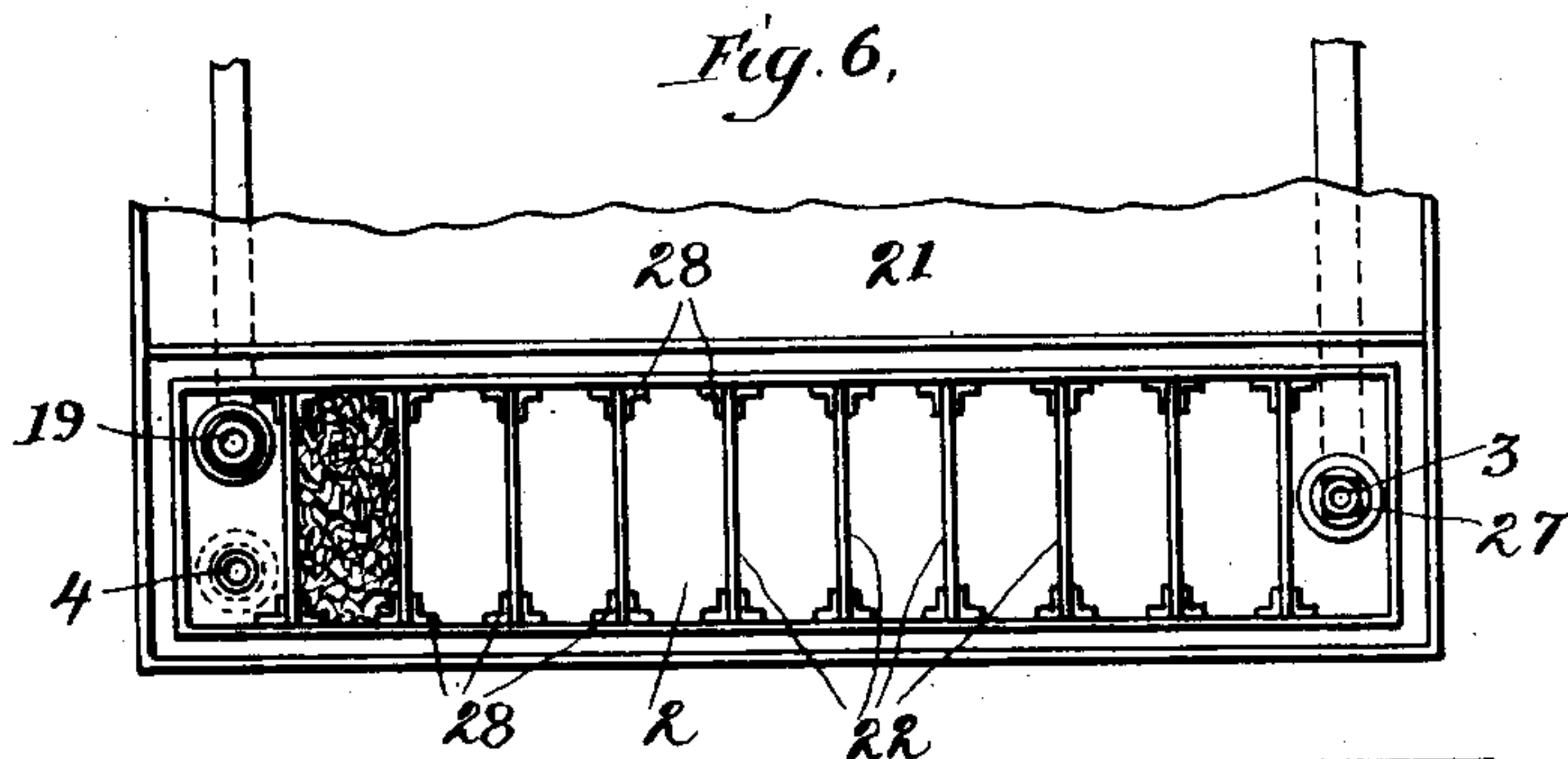
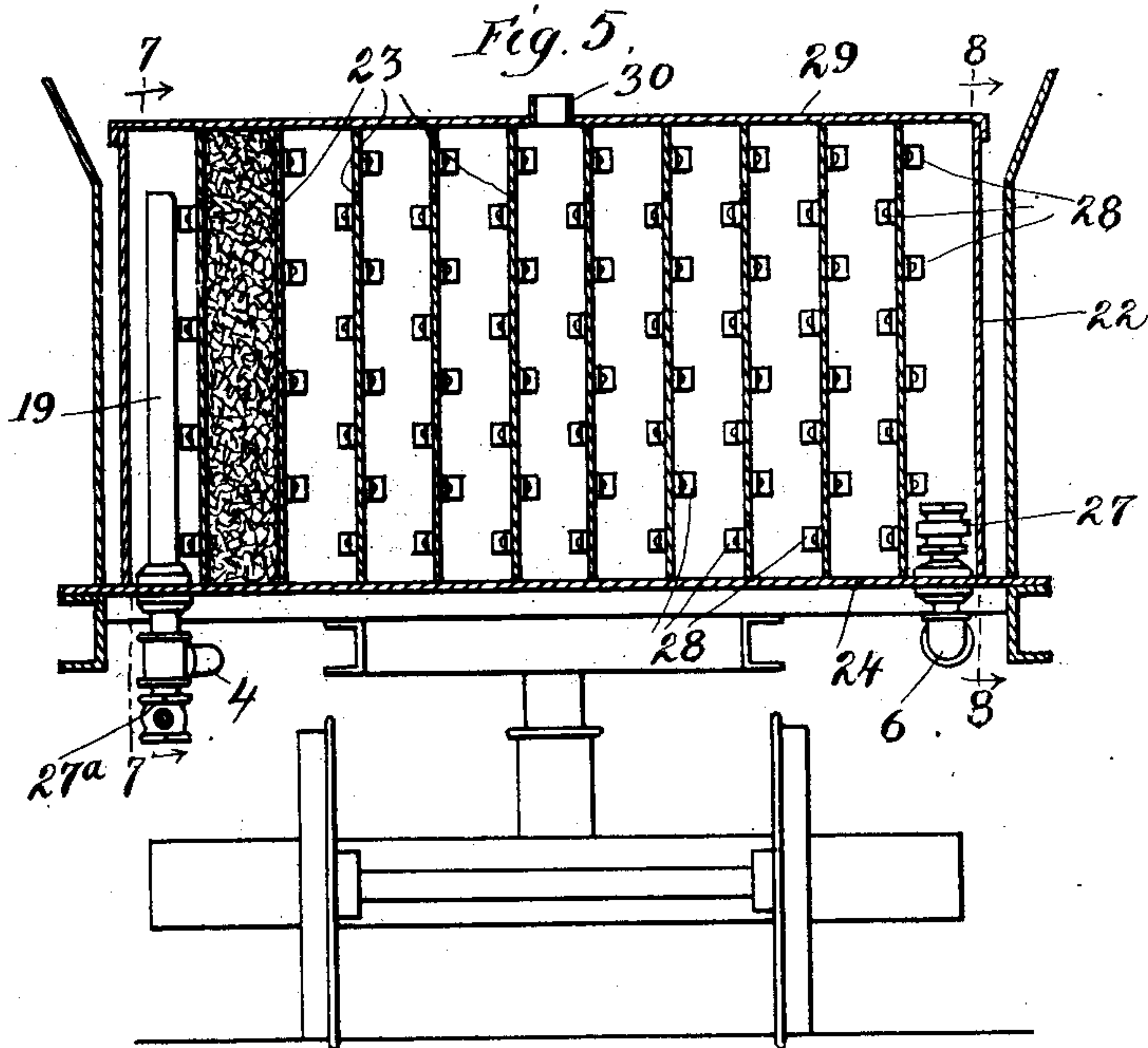
Inventor,  
Charles H. Atkins  
By *Wm. M. Smith*  
Atty.

C. H. ATKINS.  
FEED WATER HEATER.

(Application filed Nov. 22, 1901.)

(No Model.)

4 Sheets—Sheet 3.



Witnesses:  
R. M. Kelly  
John Mac Chester.

Inventor  
Charles H. Atkins  
By *[Signature]*  
his atty.



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(No Model.)

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Fig. 9.

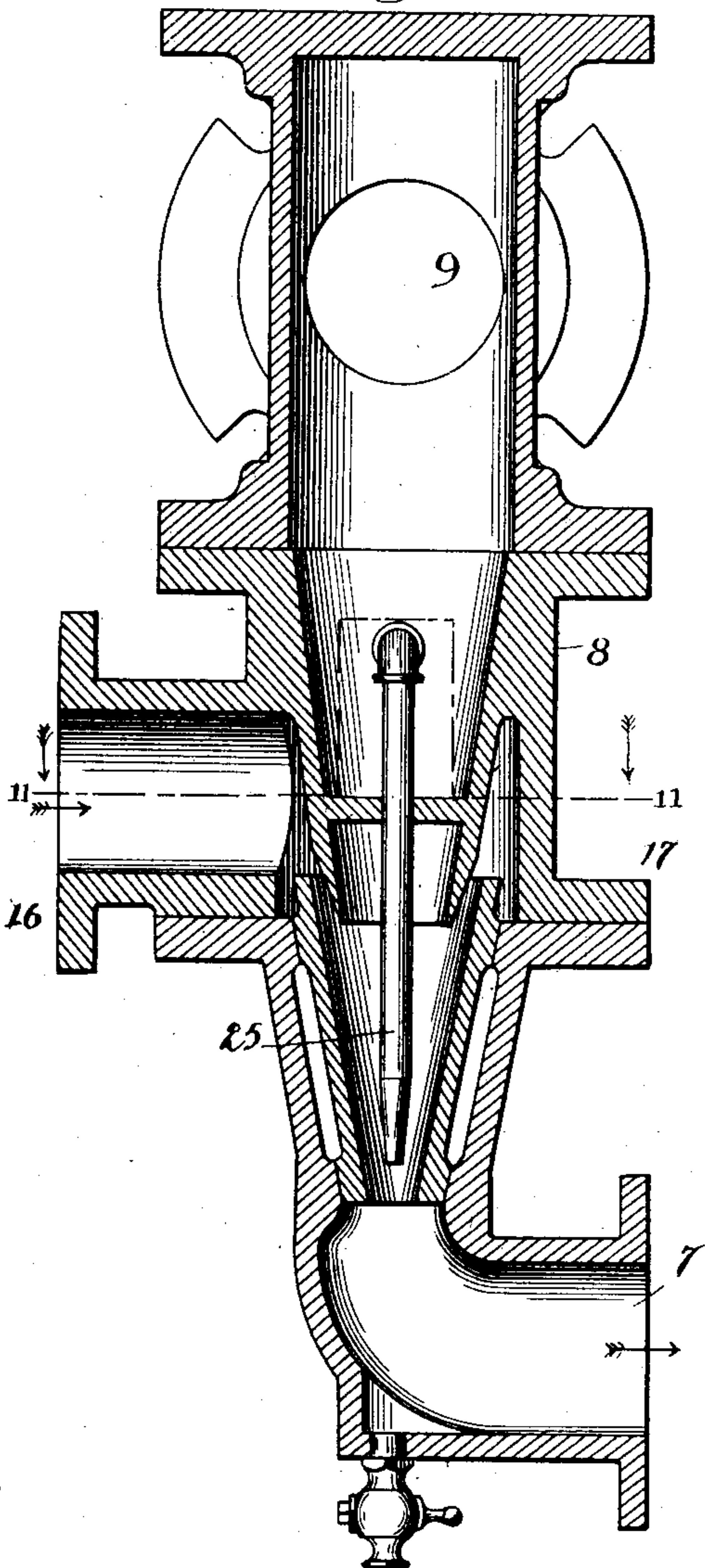


Fig. 10.

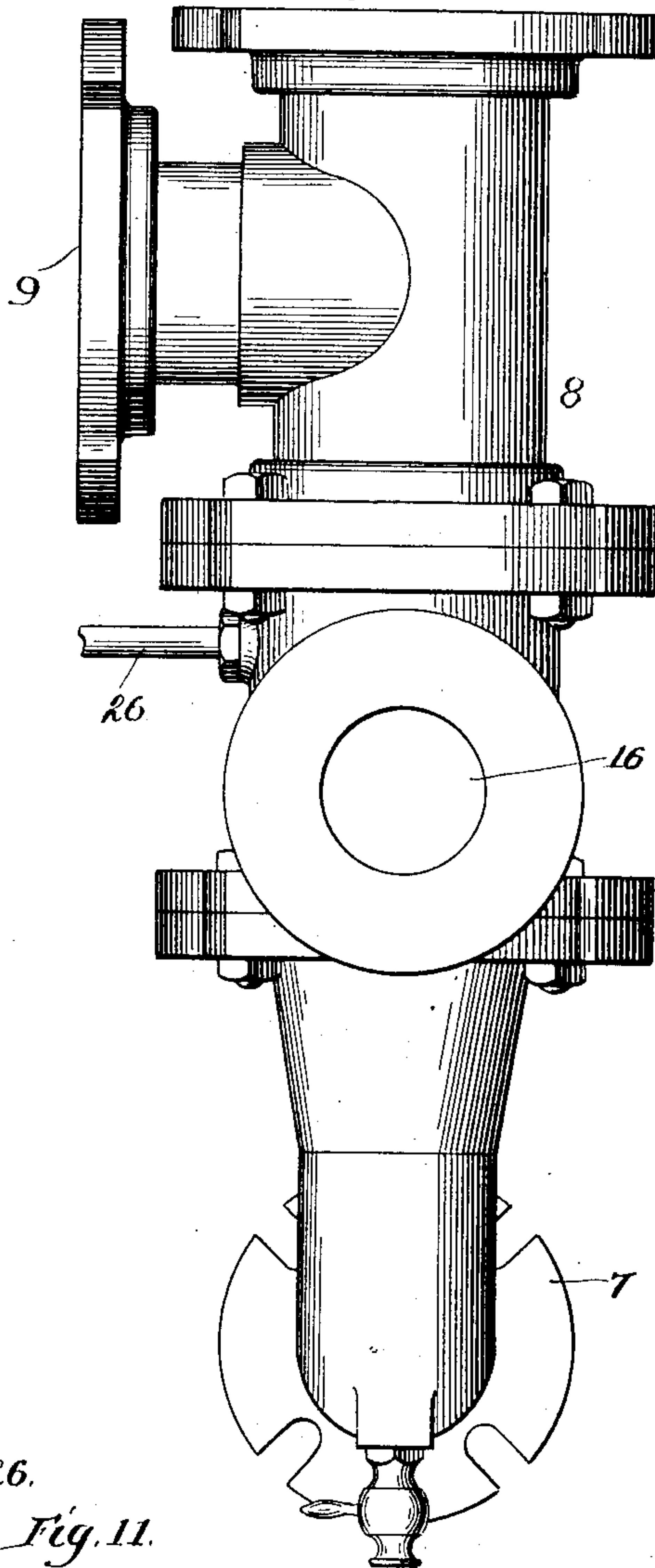
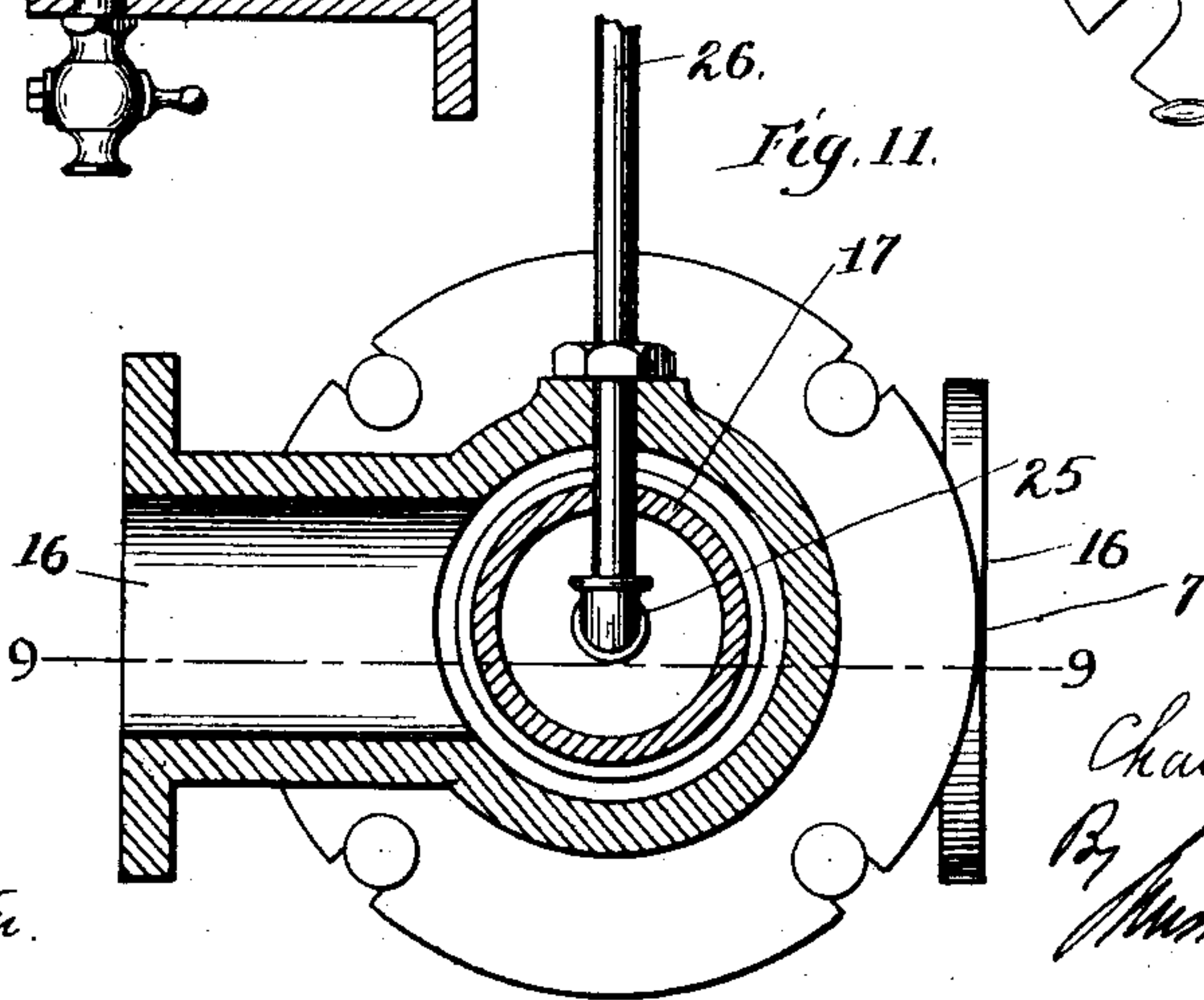


Fig. 11.



Witnesses:  
A. M. Kelly  
John MacMaster.

Inventor:  
Charles H. Atkins  
By *[Signature]*  
his Atty.



# UNITED STATES PATENT OFFICE.

CHARLES H. ATKINS, OF SPRINGFIELD, MASSACHUSETTS.

## FEED-WATER HEATER.

SPECIFICATION forming part of Letters Patent No. 717,494, dated December 30, 1902.

Application filed November 22, 1901. Serial No. 83,240. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES H. ATKINS, of Springfield, county of Hampden, State of Massachusetts, have invented an Improvement  
5 in Feed-Water Heaters, of which the following is a specification.

My invention relates to feed-water heaters for general purposes, but more particularly to feed-water heaters and purifiers for use in  
10 connection with steam-boilers of locomotives; and the invention has for its primary object to subject the feed-water to the heating fluid or steam repeatedly, so that the steam and water will be intimately commingled and all  
15 of the heat units transferred to the water.

A further object of the invention is to inject the exhaust-steam into the water-inlet of the feed-water heater and carry the current from the heater back to said inlet, so that the  
20 same will be circulated by and in contact with the steam a number of times before passing out to the boiler.

A further object of my invention is to replenish the feed-water chamber from the tank  
25 or other source automatically without the aid of a float when the level therein falls below a certain point.

A further object of my invention is to connect the water-supply passage with a circulation-passage, into which the water is entrained by the exhaust-steam or other heating fluid in such a way that the water coming from the feed-water chamber in said circulating-passage will prevent a fresh supply  
30 entering from the main tank or other source of supply; but when the level in the feed-water chamber decreases to an extent incapable of holding such supply back the latter will be automatically entrained into the said circulating-passage, and consequently injected  
40 into the feed-water chamber until the water returning in said circulating-passage again becomes sufficient to hold back the fresh supply.

A further object is to provide the feed-water chamber with removable surfaces for catching and holding the deposit, so that such chamber may be readily cleaned by the removal of said plates.

50 With these ends in view my invention consists in certain features of novelty in the construction, combination, and arrangement of

parts by which the said objects and certain other objects hereinafter appearing are attained, all as fully described with reference  
55 to the accompanying drawings, and more particularly pointed out in the claims.

In the said drawings, Figure 1 is a side elevation, partly in vertical section, of a locomotive and tender having my improved feed-  
60 water heater applied thereto. Fig. 2 is a plan section thereof, taken on the line 2 2 of Fig. 1. Fig. 3 is a transverse section taken on the line 3 3 of Fig. 1. Fig. 4 is a transverse section taken through the cab just back of the  
65 boiler. Fig. 5 is an enlarged transverse vertical section of the rear end of the tender, taken through the feed-water chamber. Fig. 6 is a plan view looking into the feed-water chamber with the cover removed. Fig. 7 is  
70 a cross-section of the feed-water chamber, taken on the line 7 7 of Fig. 5. Fig. 8 is a cross-section of the feed-water chamber, taken on the line 8 8 of Fig. 5. Fig. 9 is an enlarged detail sectional view of the injector or device  
75 for imparting the heat to the feed-water and entraining the water into the feed-water chamber, the section being taken on the line 9 9 of Fig. 11. Fig. 10 is a side elevation thereof looking from the left as viewed in Fig. 9; 80  
and Fig. 11 is a plan section thereof, taken on the line 11 11 of Fig. 9.

In illustrating my invention I have elected to show it in connection with a steam-boiler and tender of a locomotive, because this is  
85 one of the most difficult types of boilers to heat the feed-water, owing to the necessity on the one hand of utilizing every available heat unit in the exhaust-steam for heating the water and on the other hand for utilizing the force of the exhaust to produce the requisite draft for the furnace, thus making it incumbent upon any feed-water-heating device depending upon exhaust-steam and employed in connection with a steam-boiler  
95 of a locomotive, to accomplish the object with but a fraction of the entire exhaust and to that end making it necessary to intimately commingle the steam and water in order to transfer to the water substantially all of the  
100 heat units contained in that fraction. This cannot be done by ordinary means and methods in the very limited space available on locomotives.



1 represents a tank, which may be of the usual or any suitable construction, excepting that in the rear end thereof or at some other suitable point is situated a feed-water-purifying chamber or reservoir 2, which preferably extends transversely of the rear end of the tender and which has a water-inlet 3 at the bottom of one end, while the other end is connected by valved pipe 4 with a suitable steam-pump 5, which supplies the water through suitable connections to the boiler as needed. The inlet 3 is connected by a pipe or passage 6 with the outlet 7 of an injector 8, (best shown in Figs. 9 to 11,) which is provided with a steam-inlet 9, connected by pipe or passage 10 with the exhaust of the engine, the exhaust-nozzle 11 being connected by pipe 12 with a horizontal pipe 13, which extends along the outside of the boiler and is connected to pipe 14, extending downwardly in the cab and having suitable connection to the pipe 10. For the sake of symmetry the pipe 13 is duplicated on the other side of the boiler, as shown at 15, so that the pipes 13 15 may, if desired, be utilized as the hand-rails for the running-boards. The steam-injector 8 is also provided with a water-inlet 16, arranged at a point between the steam-inlet 9 and the outlet 7 and adjacent to the conical nozzle 17, as usual in steam-injectors, and this water-inlet 16 is connected by pipe or passage 18 to the end of the feed-water chamber 2 opposite that in which the inlet 3 is situated, and the pipe 18 is preferably carried upwardly within the feed-water chamber 2 in the form of a stand-pipe or overflow, so that the water cannot discharge into the pipe 18 until it has risen to a point near the top of the feed-water chamber. The water-inlet 16 is also connected by pipe or passage 20 with the tank 21 of the tender 1, so that the water in the tender-tank will when not restrained gravitate into the water-inlet 16 of the injector.

With an apparatus thus constructed it will be seen that when exhaust-steam is admitted to the inlet 9 of the injector the water from the tank 21 will be entrained into the inlet 16 and will be driven through the outlet 7 and the pipe 6 into the bottom of the chamber 2 through the inlet 3 and will rise in the chamber 2, successively traversing vertical cells formed by removable plates or partitions 22, perforated at top, as shown at 23, and cut away at the bottom, as shown at 24, until the level reaches the top of the stand-pipe 19, whereupon it will run down such stand-pipe and be drawn by the force of the steam through the pipe 18 back into the inlet 16 of the injector and again sent on its course or circuit through the pipe 6 and the vertical passages of the chamber 2, thus repeatedly subjecting the same water to the steam, and by thus compelling it to pass in a continuous circuit or current through its circulating-passage constituted by the pipes 6, 18, and 19 and the chamber 2 intimately com-

mingles the steam therewith and extracts from the steam all of its heat units and fully condenses the steam into water at a temperature most suitable for injection into the boiler, and all this in a very limited space. It will also be seen that inasmuch as the supply pipe or passage 20 from the tender-tank is connected to the returning side of the circulating-passage, or, in other words, is connected to the same inlet of the injector as that to which the return-pipe 18 is connected, the swiftly-moving current returning through the pipe 18 will hold back the water from the tank of the tender, and as a consequence the feed-water chamber 2 will not be replenished from the tender-tank until the water in chamber 2 falls below the top of the stand-pipe 19 or until the current returning through the pipe 18 is insufficient to supply the suction produced in the inlet 16 of the injector by the exhaust-steam. Hence it will be seen that the device is perfectly automatic in its ability to keep the supply at a given level in the feed-water tank without depending upon the aid of floats or other valve mechanism liable to be injured or rendered ineffectual by the severe jolting and hard usage to which they would be subjected in uses of this character.

When the injector is flooded, the force of the exhaust-steam alone may be insufficient in some instances to start the circulation through the aforesaid continuous circulating-passage, and in order to provide for this contingency the injector is supplied with a supplemental high-pressure steam-jet 25, which extends downwardly past the water-inlet 16 and is connected by valved pipe 26 with the boiler, thus supplying the injector with sufficient pressure to set up the circulation, which when once induced may be continued by the exhaust-steam.

The inlet 3 is of course provided with downwardly-seating check-valve 27 to prevent back pressure in the injector, and the bottom of chamber 2 may be provided with a drain-cock 27<sup>a</sup> to facilitate cleaning out.

The partitions 22 may be conveniently held in place by brackets 28, arranged opposite sides thereof, so that the partitions may be inserted from the top of the chamber 2, which is closed by any suitable cover 29, having vent 30 for the escape of air and gases liberated from the steam and water, the cover being loose.

The oil rises to the top of the chamber 2 above the perforations 23 and above the top of pipe 19, whence it may be removed from time to time, and the partitions 22 being removable they may be readily cleansed of the scale and other deposit adhering thereto.

In some instances it may be necessary to filter the water before passing it to the boiler, and when such is the case the object may be accomplished by filling one or more of the cells or compartments formed by the plates 22 with some suitable filtrant 22<sup>a</sup>.

Having thus described my invention, what



I claim as new therein, and desire to secure by Letters Patent, is—

1. In a feed-water heater, the combination of a hot-water chamber, independent of the boiler or receptacle to be fed, a water-circulating system embracing said chamber, an injector connected with said circulating system, a steam-pipe for supplying steam to the injector, a water-supply pipe for supplying water to said circulating system, and means to supply hot water from said tank to the boiler or receptacle to be fed.

2. In a feed-water heater, the combination of a hot-water chamber, a circulating-pipe leading to said chamber, means to inject steam into said circulating-pipe, a return-pipe leading from the upper part of said hot-water chamber to the means for injecting steam into the circulating-pipe, and a water-supply pipe communicating with said return-pipe, whereby a constant circulation of water will be effected through said hot-water chamber, circulating-pipe and return-pipe while the level of the water in the chamber is maintained above the inlet to the return-pipe, and water will be drawn from said supply-pipe into said return-pipe and fed to the hot-water chamber whenever the level of the water therein falls below said return-pipe inlet.

3. In a feed-water heater, the combination of a hot-water chamber, a water-circulating system embracing said chamber, means to inject steam into said water-circulating system and to cause the water therein to circulate through the hot-water chamber, whereby a constant circulation and heating of the water in said chamber may be effected and means controlled by the level of the water in said chamber to supply water thereto when the contents fall below a certain level.

4. In a feed-water heater, the combination of a hot-water chamber, a water-circulating system embracing said chamber and having the return connection from said chamber located at a distance from the bottom, means to inject steam into said water-circulating system and to cause the water therein to circulate through the hot-water chamber, whereby a constant circulation and heating of the water in said chamber may be effected while

the water-level is maintained above the level of the outlet from said chamber to the return connection, and means controlled by the level of the water in said chamber to supply water thereto when the contents fall below a certain level.

5. In a feed-water heater the combination of a hot-water chamber having a plurality of removable partitions arranged in said chamber and forming a tortuous passage, a water-circulating system embracing said chamber and an injector for injecting steam into said circulating system to heat the water and cause it to circulate therein.

6. In a feed-water heater the combination of a continuous water-circulating passage comprising a feed-water chamber having an overflow which empties into the return side of said passage, means for injecting a heating fluid into said passage in one direction for continuously circulating the water therein and a source of supply connected with said return side of said passage whereby the returning current will hold back the supply until the water in said chamber falls below said overflow, substantially as set forth.

7. In a feed-water heater the combination of a source of water-supply, a feed-water chamber, an injector having its discharge connected therewith and a return-passage from said chamber and a water-supply from said source both connected with the inlet of said injector whereby the current from said chamber will hold back the supply until such current becomes insufficient to supply the suction of the injector, substantially as set forth.

8. In a feed-water heater the combination of an injector having an exhaust-steam inlet, a water-inlet and an outlet for steam and water, a high-pressure jet discharging into said injector, and a feed-water chamber connected with said outlet and water-inlet, substantially as set forth.

In testimony of which invention I have hereunto set my hand.

CHARLES H. ATKINS.

Witnesses:

RICHARD H. STACY,  
ISABELLA J. ATKINS.