(No Model.) 2 Sheets—Sheet 1.

P. & H. BLOOMSBURG.

WATER CIRCULATOR.

No. 472,915. Patented Apr. 12, 1892.

Fig. 1.

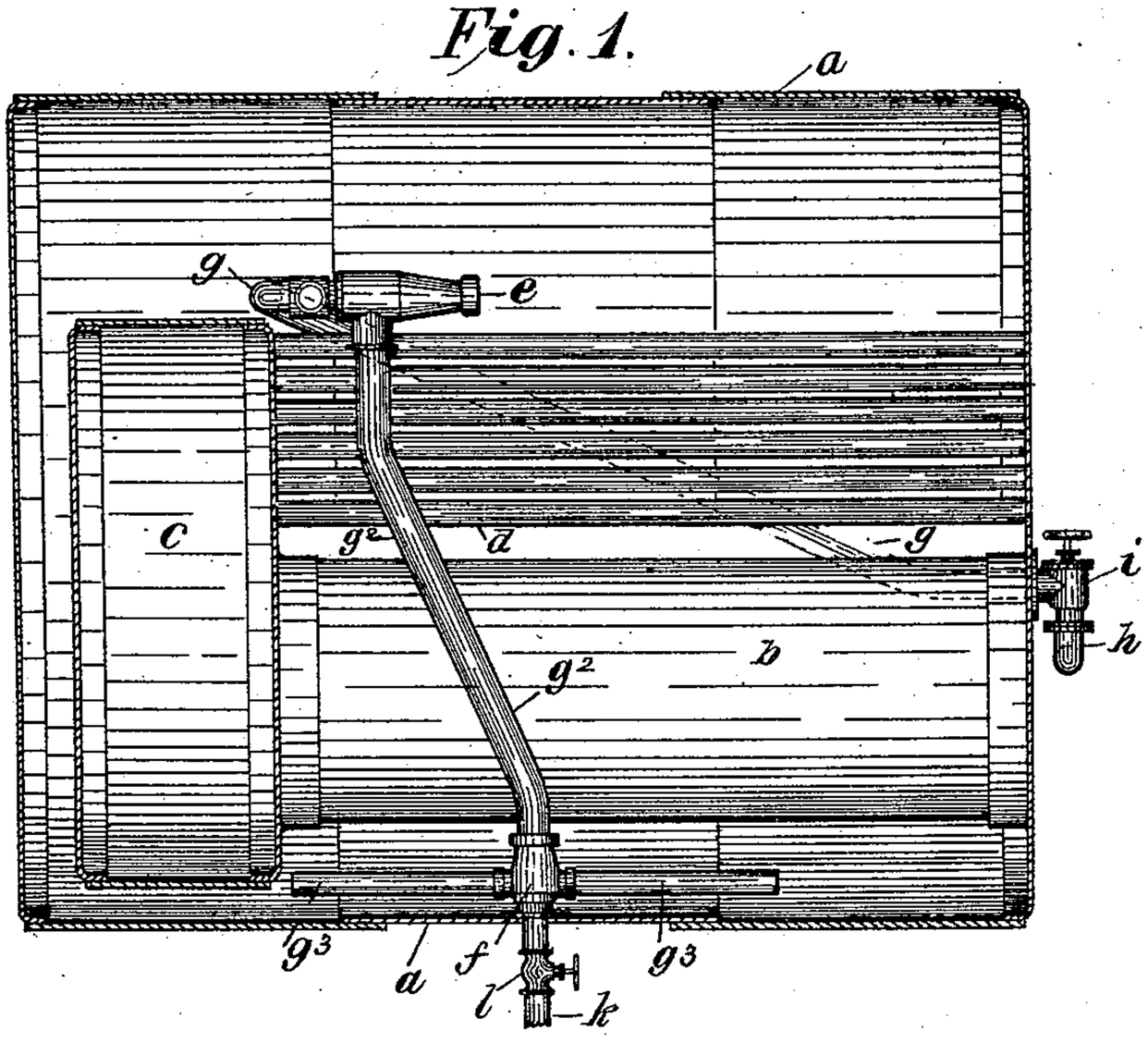
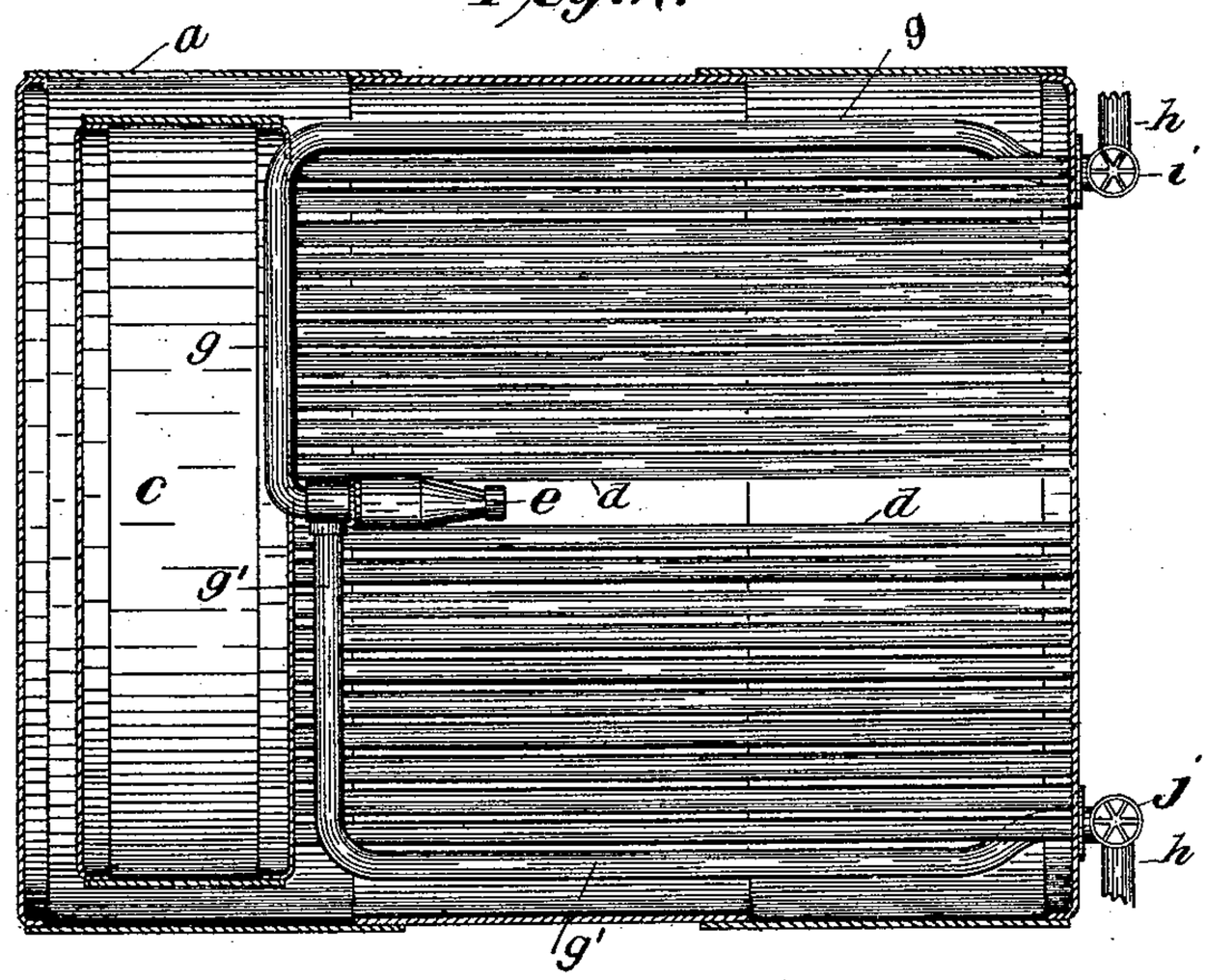


Fig. 2.



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Inventors
Peter Bloomsburg
Harry Bloomsburg

(No Model.) 2 Sheets—Sheet 2.

P. & H. BLOOMSBURG.

WATER CIRCULATOR.

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Fig. 3.

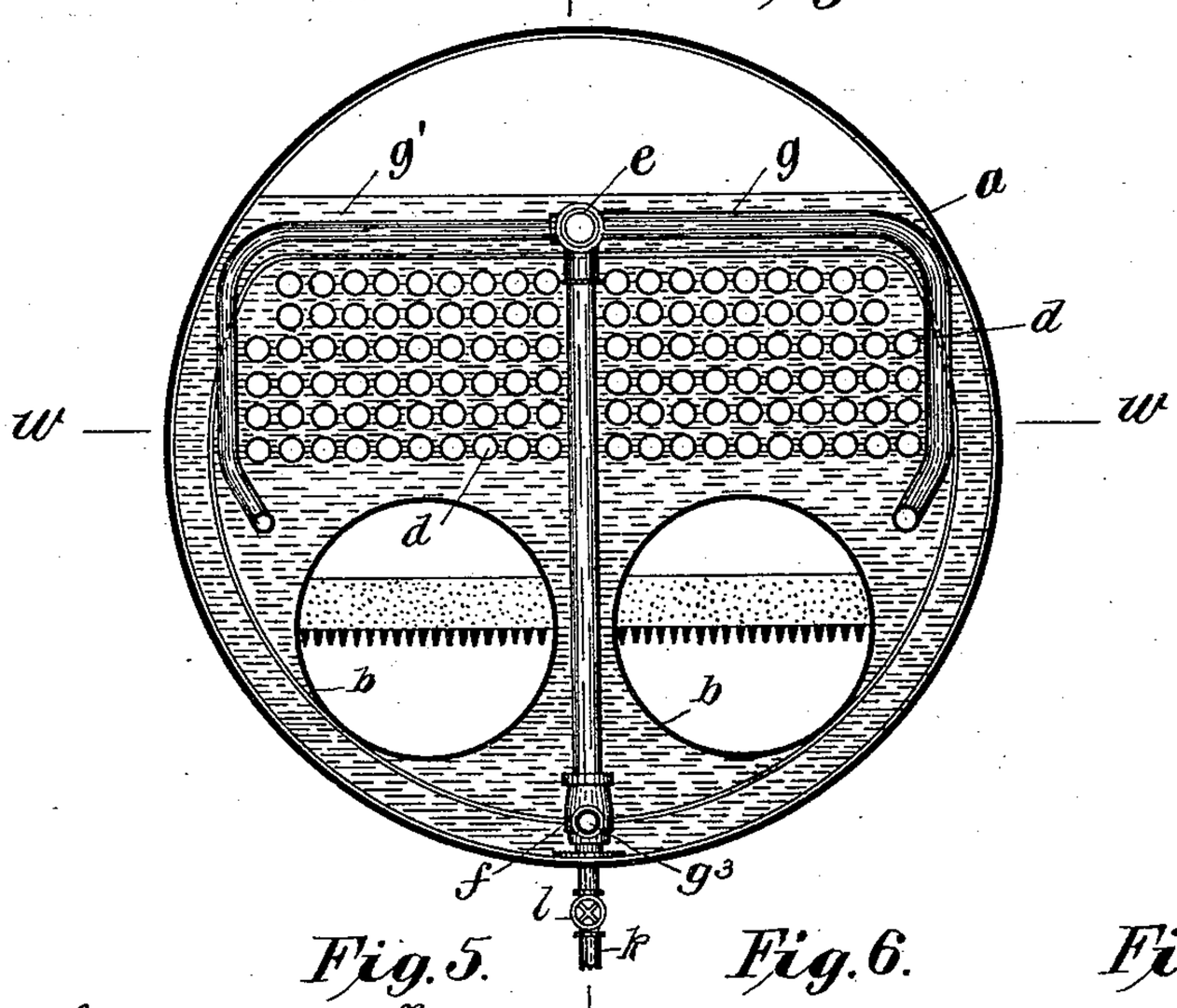


Fig. 5.

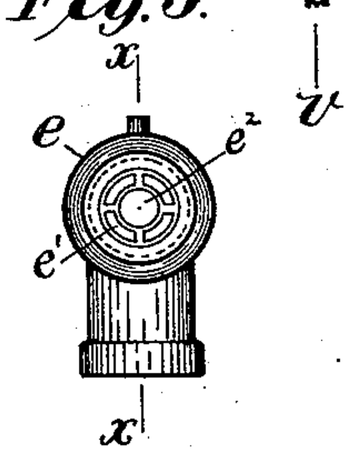


Fig. 6.

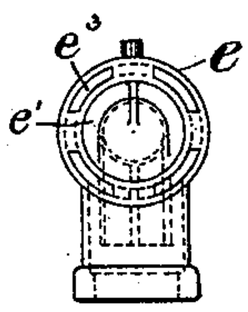


Fig. 7.

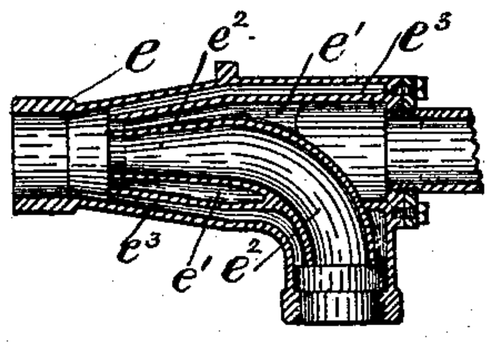


Fig. 4.

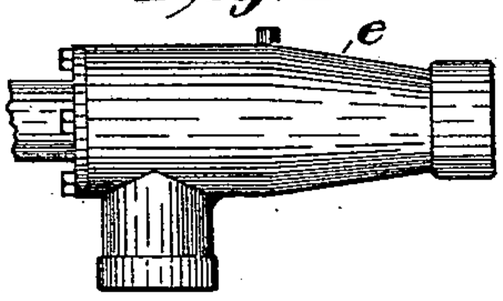


Fig. 8.

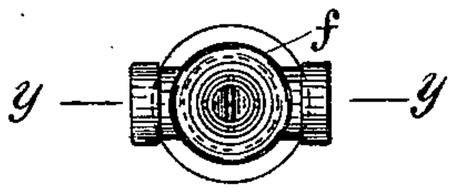


Fig. 9.

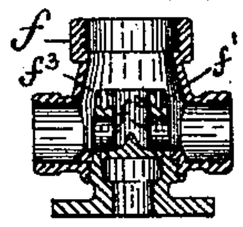


Fig. 10.

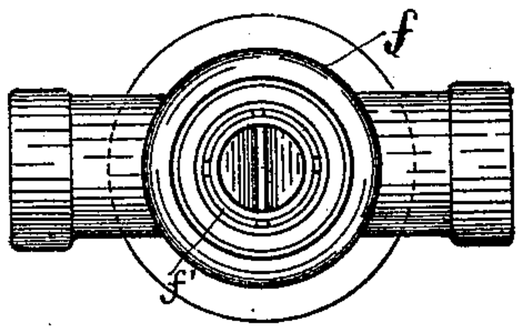


Fig. 12.

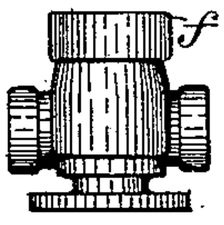


Fig. 13.

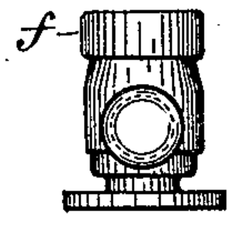


Fig. 11.

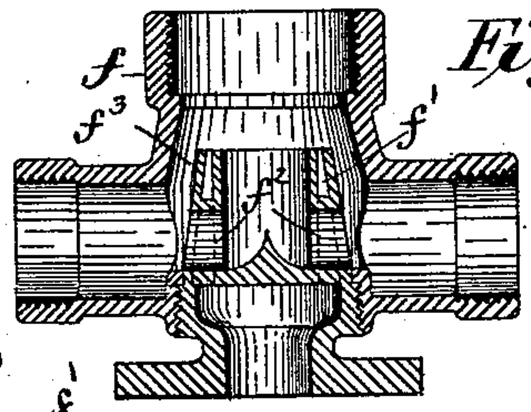
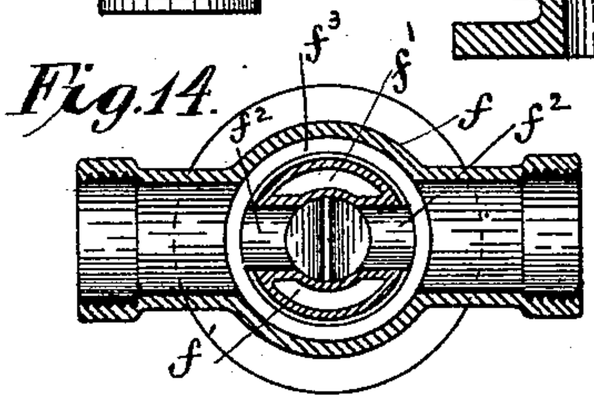


Fig. 14.



Witnesses:

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UNITED STATES PATENT OFFICE.

PETER BLOOMSBURG AND HARRY BLOOMSBURG, OF WILMINGTON, DELAWARE.

WATER-CIRCULATOR.

SPECIFICATION forming part of Letters Patent No. 472,915, dated April 12, 1892.

Application filed October 8, 1891. Serial No. 408,202. (No model.)

To all whom it may concern:

Be it known that we, PETER BLOOMSBURG and HARRY BLOOMSBURG, both citizens of the United States, residing in the city of Wilmington, State of Delaware, have invented a new and useful Improvement in Water-Circulators, of which invention the following is a specification.

This invention relates to apparatus for producing a circulation of the water in marine and other steam boilers.

The objects in view in our invention are, first, to save space, which is material, especially in the case of marine boilers. This object we effect by arranging the apparatus wholly within the boiler.

Second. Another object is to reduce the cost of apparatus. This we effect by reducing the number and simplifying the form of the parts thereof.

Third. Another object is to produce a quicker and more thorough circulation of the water. This we effect by the use of an injector-nozzle of novel construction, as well as by locating the apparatus wholly within the boiler, where it works in an equilibrium of pressure.

In the annexed drawings, Figure 1 is a longitudinal section on the line *v v* in Fig. 3 of the shell and smoke-box or combustion-chamber of a marine boiler, showing our circulator and one of the usual furnace-flues with its return-tubes in side elevation. Fig. 2 is a longitudinal section of the same on the line *w w* in Fig. 3, showing our circulator and the return-tubes in plan. Fig. 3 is a front end elevation of the same, the head of the boiler being removed. Fig. 4 is a side elevation, and Fig. 5 a front end elevation, of the injector-nozzle *e*. Fig. 6 is a rear end elevation of said nozzle with cap removed, and Fig. 7 is a longitudinal section of the same on line *x x* in Fig. 5. Fig. 8 is a plan of the injector ⊥, (marked *f*,) arranged at the bottom of the boiler; and Fig. 9 is a section of the same on line *y y* in Fig. 8. Fig. 10 is a plan, and Fig. 11 a section, both on an enlarged scale, but similar in all other respects to Figs. 8 and 9, respectively. Fig. 12 is a side elevation, and Fig. 13 an end elevation, of the same. Fig. 14 is a sectional plan of the ⊥-injector *f* on the line *z z* in Fig. 11.

Similar letters denote similar parts in the several figures.

a represents the shell of the boiler; *b*, the furnace-flues; *c*, the smoke-box or gas-combustion chamber; and *d*, return-tubes leading from the chamber *c* to the chimney or stack. (Not shown.)

e represents an injector-nozzle, consisting of an annular passage *e'* for feed-water, the cylindrical passage e^2, and the annular exterior passage e^3. The injector-nozzle *e* is located below and near the surface of the water.

f represents an injector ⊥, arranged at or near the bottom of the boiler and provided with an annular steam-passage *f'*, the interior water-passage f^2, and the annular water-passage f^3 exterior to the steam-passage *f'*.

g g' g² g³ represent the pipes of the circulator, all arranged within the boiler below the usual water-line. The pipe *g* extends from its connection with the nozzle *e* through the boiler-shell, outside of which it is joined to the ordinary feed-water pipe *h*, which is supplied in this case, as usual, by a pump. (Not shown.)

i' represents the ordinary check-valve in pipe *h*.

The pipe *g'* branches from pipe *g* and extends through the boiler-shell, outside of which it is joined to the ordinary injector feed-water pipe, the latter being provided with the usual check-valve *j*. The pipe g^2 connects the nozzle *e* with the ⊥, (marked *f*.) The pipes g^3 extend from their connection with the ⊥ (marked *f*) a greater or less distance along the bottom of the boiler and have open ends for the admission of water.

k is a pipe extending from a donkey-boiler through the shell *a* of the main boiler and connected with the annular steam-opening in the ⊥, (marked *f*.)

l is a stop-valve in pipe *k*.

A slow fire having been started in the furnaces, steam from the donkey-boiler is at the same time admitted by pipe *k* through the stop-valve *l* into the injector ⊥, (marked *f*,) from which it passes through the annular steam-passage *f'*, inducing a current of water from the bottom of the boiler into the ends of the pipes g^3, and through the interior water-passage f^2 and the exterior annular water-

passage f^3 into the vertical pipe g^2, from which the induced water passes through the injector-nozzle e, and is discharged near the surface of the body of water, the induced water being heated on its way by the steam that mixes with it and imparting its heat to the body of water at the surface thereof by discharging into the latter and at the same time rapidly circulating the water in the boiler, this action being kept up until all the water in the main boiler a has become heated and steam has begun to form in this boiler, when steam from the donkey-boiler is shut off by closing valve l. The injector, referring now to the ordinary feed-water injector, (not shown,) is then started with steam from the donkey-boiler, and the main boiler a is filled to its proper level. The feed-water from the last-named injector, as well as that from the feed-water pump, referring to the ordinary feed-water pump, (not shown,) is discharged through the annular passage e' of the injector-nozzle e and induces a current of water from the bottom of boiler a into the suction-pipes g^3 up the pipe g^2 out through the interior water-passage e^2 and annular exterior passage e^3, thus raising the colder water from the bottom and discharging it at the surface, while the hotter water settles down to take the place of the water raised. By this means a rapid, constant, and thorough circulation of the water is maintained.

The suction-pipes g^3 may be perforated along their lengths and they may have closed instead of open ends, if desired.

One of the suction-pipes g^3 may be omitted; but such omission would in some cases injure the efficiency of the apparatus.

Instead of constructing the injector-nozzle e and the injector ⊥ (marked f) in the manner described, they may be made in the usual form of injector-nozzles; but when they are made each with an annular discharge-passage which surrounds an interior suction-passage, and is surrounded by an exterior suction-passage, as first described, a frictional surface, which is enormous as compared with the volume of the discharge, is obtained for transmitting the momentum of the feed-water and steam, respectively, to the water to be acted upon.

The injector-nozzle or device employing the above-described annular column as the inducing factor can be used for moving gases or powdered solids as well as liquids.

We claim—

1. The combination, with a main steam-boiler, of these appliances when contained within the boiler—namely, a discharge-injector nozzle arranged at or below the water-line, one or more pipes connecting said nozzle with the feed-water pipe or pipes, and a suction-pipe connecting said nozzle with an injector ⊥ or device arranged at or near the bottom of the boiler and provided with one or more water-suction pipes and also with an orifice for the admission thereto of steam by pipe connection from a donkey-boiler, forming a device for starting and maintaining a constant and rapid circulation of the water in the main boiler, substantially as set forth.

2. The combination of nozzle e, provided with an annular feed-water discharge-passage and internal and external suction-passages, pipes g' and g for respectively connecting said nozzle with the usual feed-water pipes located outside the main boiler a, suction-pipe g^2, and an injector ⊥, (marked f,) provided with the annular steam-passage and internal and external suction-passages and with an aperture adapted for pipe connection to the donkey-boiler located outside said main boiler and also provided with one or more suction-pipes g^3, all contained within said main boiler and arranged therein, substantially as and for the purposes set forth.

PETER BLOOMSBURG.
HARRY BLOOMSBURG.

Witnesses:
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A. P. WILLITS.