

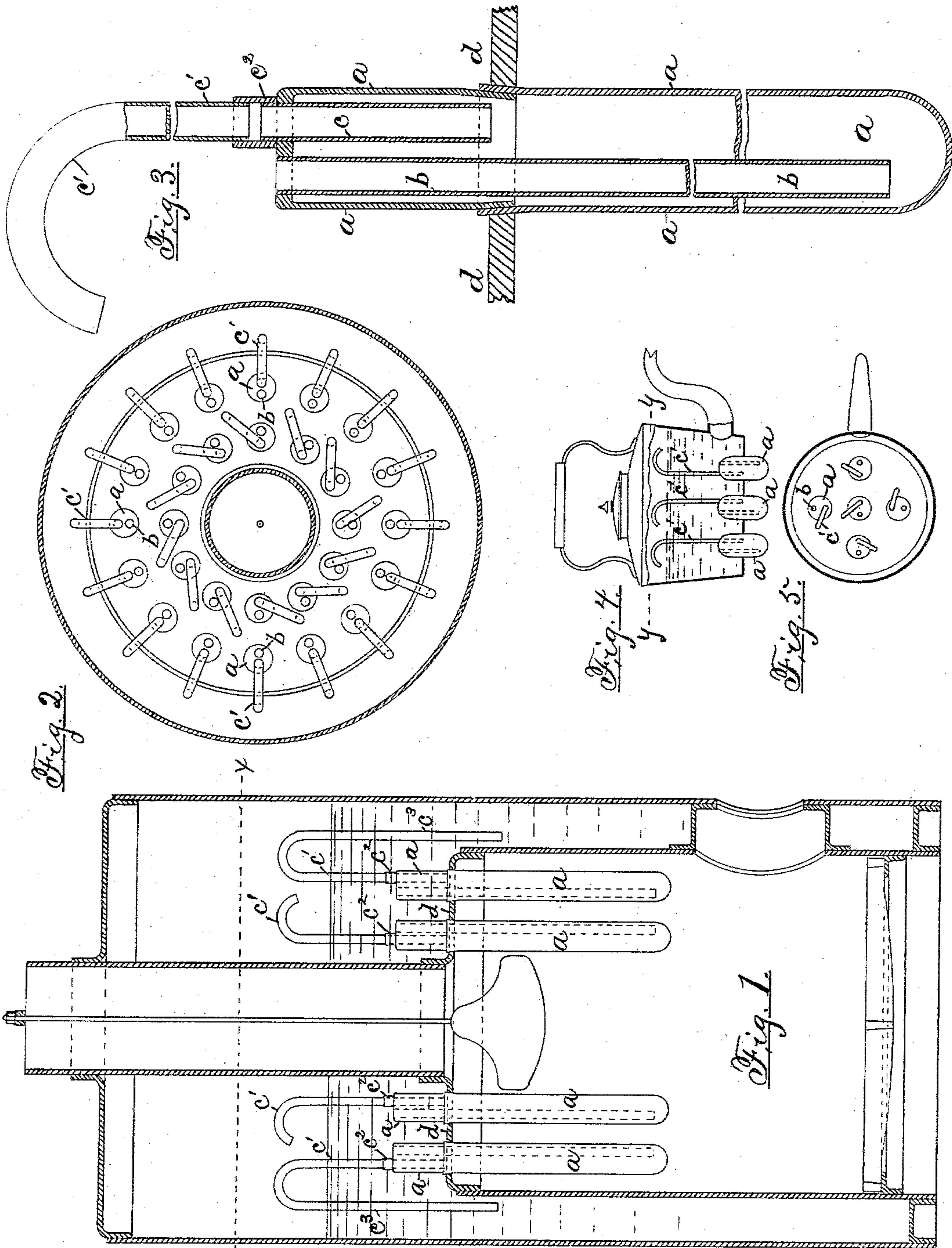
(No Model.)

J. GAMGEE.

STEAM BOILER.

No. 369,402.

Patented Sept. 6, 1887.



Witnesses:  
William Reinhart.  
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# UNITED STATES PATENT OFFICE.

JOHN GAMGEE, OF LONDON, COUNTY OF MIDDLESEX, ENGLAND.

## STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 369,402, dated September 6, 1887.

Application filed January 21, 1887. Serial No. 225,000. (No model.) Patented in England August 16, 1886, No. 10,494; in France October 12, 1886, No. 179,000, and in Belgium October 14, 1886, No. 74,844.

*To all whom it may concern:*

Be it known that I, JOHN GAMGEE, of London, county of Middlesex, England, have invented certain new and useful Improvements in Steam-Boilers and other Apparatus in which Ebullition of Liquids has to be Effected, of which the following is a specification.

This invention relates to generating steam in boilers and to facilitating ebullition in liquids generally by apparatus which causes very active circulation with slight differences of temperature.

Many methods have been employed for extending heating-surface and piercing the body of water by hot tubes; but convection in boilers is still so imperfect, especially when incrustation is present, that pumps have been used to agitate the water and even to aerate it.

My invention consists in fitting steam-boilers or other apparatus in which the ebullition of a liquid has to be effected with what may truly be described as "automatic pumps," whereby the water or liquid is broken up and a very active circulation maintained. The number and size of these pumps is regulated by the size of boiler and the volume of steam to be produced according to well-known rules followed by boiler-makers in relation to grate and heating surface.

Each pump may be described as a triple tube consisting of, first, an outer tube or vertical chamber hermetically closed at both ends (except for the passage at top of the two other tubes) and which preferably projects by its lower end into the flame or furnace; second, a tube fixed into the top of the outer tube and extending to very nearly the bottom of the latter, which is the lowest part of the boiler, or practically so, and cannot be without water; third, another tube fixed or welded into the top of the outer tube and extending downward to some distance therein and extending upward to a level at or above the normal water-level of the boiler. It is best bent at the top to eject water and steam downward. When water is admitted into a boiler fitted with these tubes, it can only partially fill each of the outer tubes. A layer of air is occluded at the upper part and a free steaming surface thereby obtained in each and all of them close to the fiercest heat. On heat being applied the air expands and water

is at once ejected by the upper or discharge tube, and as steam forms a cushion of steam at the upper part of the outer tube operates like the air in the pump of an air-vessel in maintaining an uninterrupted current of the greatest possible activity, the mingled steam and water continually passing from the outer tube up through the upper or discharge tube, and being regularly replaced by water from the main water-space flowing down the tube, which extends to very nearly the bottom of the outer tube. The triple tubes thus act as automatic pumping apparatus, producing forced convection or forced currents in the boiling liquid by the action and reaction of steam and water, (or vapor and liquid.) A scouring action keeps the tubes and the boiler free from fixed scale, and by blowing off the apparatus is kept from any prejudicial deposit.

The annexed drawings serve to illustrate my invention.

Figure 1 is a vertical section, and Fig. 2 a horizontal section, showing it applied to a vertical boiler. Fig. 3 is a vertical section, on a larger scale, of one of my triple tubes. Each of these triple tubes is composed of three tubes, *a b c*. The outer tube, *a*, is shown as formed of two pieces united at the plate *d*; but it may be in one piece, if preferred. It is hermetically closed at its lower end and also at its upper end, except to give passage to the tubes *b* and *c*. The tube *b* is fixed at top into the top of the outer tube, *a*, and extends to very nearly the bottom thereof. The tube *c* is fixed into the top of the tube *a*, and extends downward some distance therein. It also extends upward by means of a tube, *c'*, united thereto by a collar, *c<sup>2</sup>*, to a level above or at the normal water-level of the boiler, and it is preferably bent at top, as shown. It is preferred to extend the bend of a few of the tubes *c'* (say, four of them, more or less) down into the body of the water, as seen at *c<sup>3</sup>*, so that the steam and water ejected therefrom may agitate the water at the lowest part between the inner and outer walls of the boiler, and thereby prevent incrustation thereon. The tubes *c* and *c'* may be made in one piece; but, for convenience, it is preferable to make them in separate pieces, as shown, and to unite them by a collar, as shown, or otherwise.



It will readily be understood that when water is admitted into the boiler it will descend down each of the tubes *b* into the tubes *a*, and rise in these up to or a little above the level of the lower ends of the tubes *c*, and that a layer of air will be occluded in the upper part of the tubes *a*. A free steaming-surface is thus obtained at the upper part of each tube *a*, which thus constitutes a kind of supplementary boiler in the hottest part of the furnace. As the occluded air expands under the action of the boiler-heat, it ejects water from the top of the tubes *c*, and, as steam forms in the top of the tubes *a*, its pressure keeps up a flow of water, or water and steam, through the tubes *c*, this water being continuously replaced by water flowing down the tubes *b*. These triple tubes, or "convection-fountains," as they may be called, may be fixed advantageously erect inside any boiler, and will be quite operative even if they do not project into the flame, though they will then be less active. They may be made removable and capable of being thoroughly examined at pleasure. In any position they accelerate the production of steam and effect a great economy of coal. That portion of each discharge-tube *c'* which is within the water-space of the boiler serves as a secondary heating-surface. It conveys the boiling liquid and its vapor of high specific heat and has a far larger heating capacity than an equal length of tube that conveys hot gases through the water or liquid. In order to extend this secondary heating-surface, the pipes *c'* can be extended horizontally or in any available direction, so as to distribute the heat more uniformly throughout the whole body of the water. They must not, however, be coiled upward in a helix because of the frictional retardation of a gas and a liquid when forced

up a spiral. The invention is not limited to steam-boilers; but, as has been already stated, is applicable to other apparatus in which ebullition of liquids has to be effected. As an example of its numerous applications, I show in vertical section in Fig. 4 and in plan in Fig. 5 a kettle fitted with my triple tubes.

What I claim, and desire to secure by Letters Patent, is—

1. In a boiler or other apparatus in which ebullition of a liquid has to be effected, a closed tube or vessel having at top two openings which receive, respectively, two tubes, one of which projects inward to nearly the bottom and the other projects inward some distance and extends upward to or above the water-level of the boiler, substantially as and for the purpose set forth.

2. In a boiler or other apparatus in which ebullition of a liquid has to be effected, triple tubes arranged, substantially as shown, to act as automatic pumping apparatus, and thereby to produce forced convection or forced currents in the boiling liquid by the action and reaction of steam and water, (or vapor and liquid,) substantially as set forth.

3. In a boiler or other apparatus in which ebullition of a liquid has to be effected, one or more supplementary steaming-surfaces, the steam or vapor from which flows, together with hot water or liquid, through tubes in the water or liquid space and is ejected into the main steam-space, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JOHN GAMGEE.

Witnesses:

GEORGE C. BACON,

JOHN W. WILLIAMS, Jr.