No. 776,530. PATENTED DEC. 6, 1904.

A. MONTUPET.

STEAM GENERATOR.

APPLICATION FILED APR. 2, 1900.

NO MODEL. 3 SHEETS—SHEET 1.

FIG. 1.

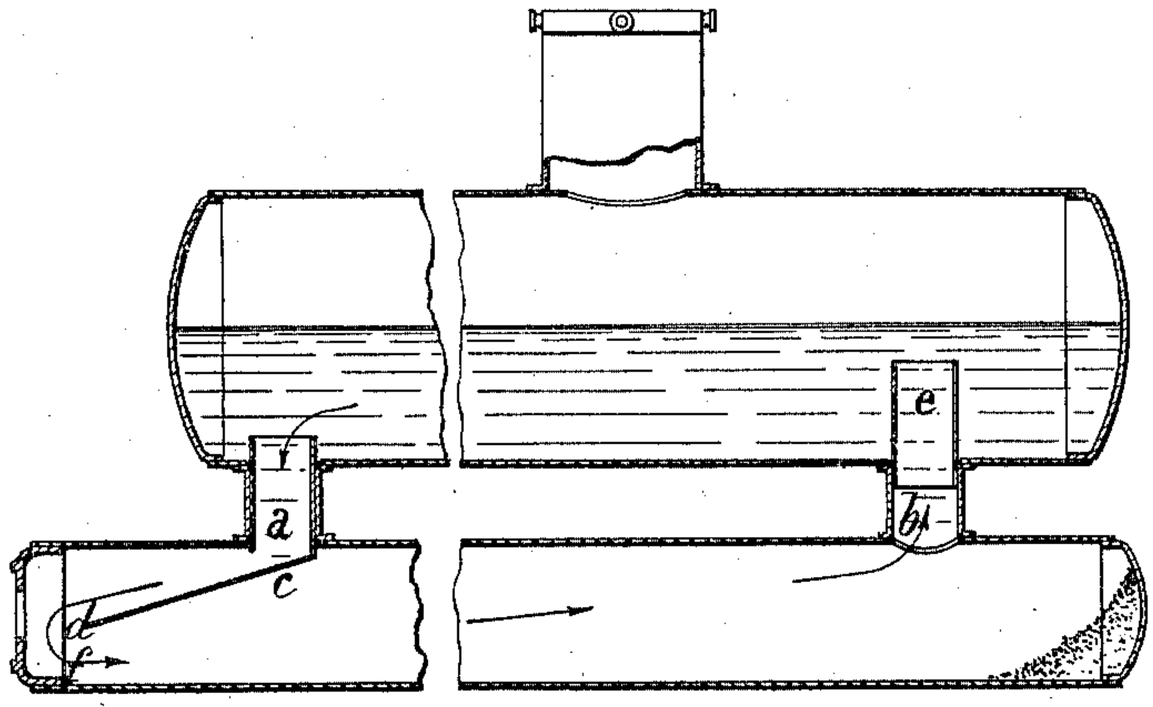


Fig. 1a

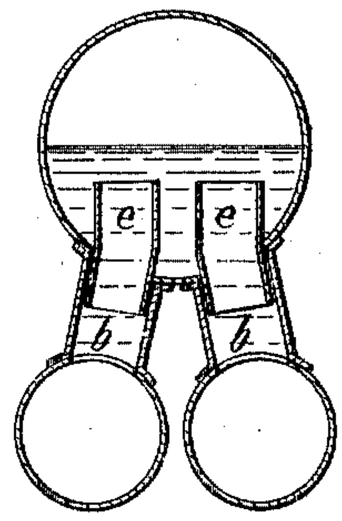


FIG. 2.

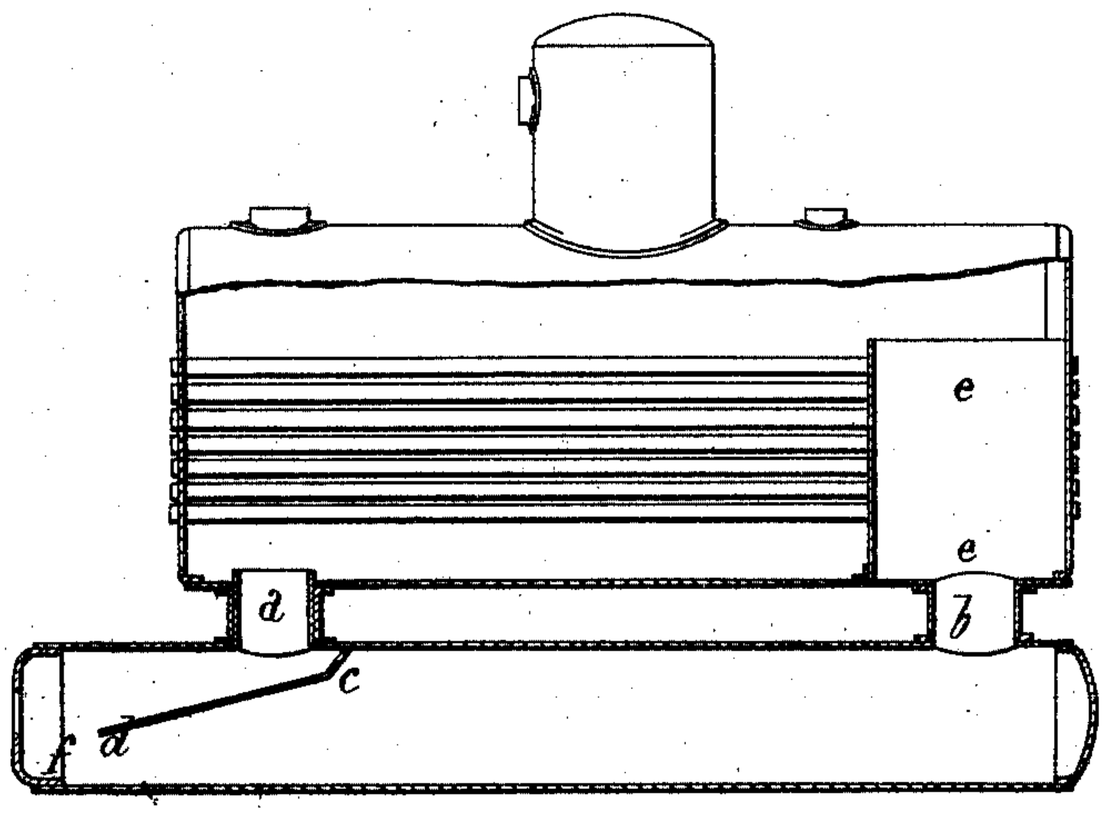
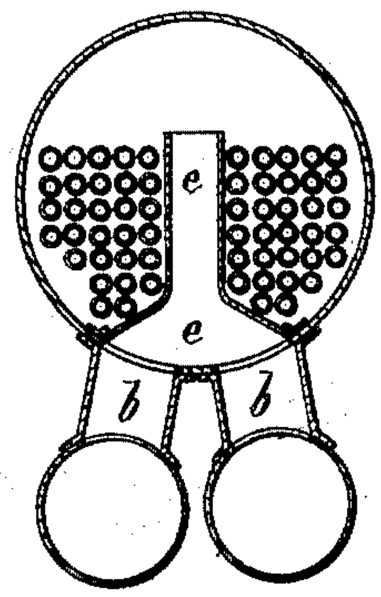


Fig. 2a



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STEAM GENERATOR.

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NO MODEL. 3 SHEETS—SHEET 2.

FIG. 3.

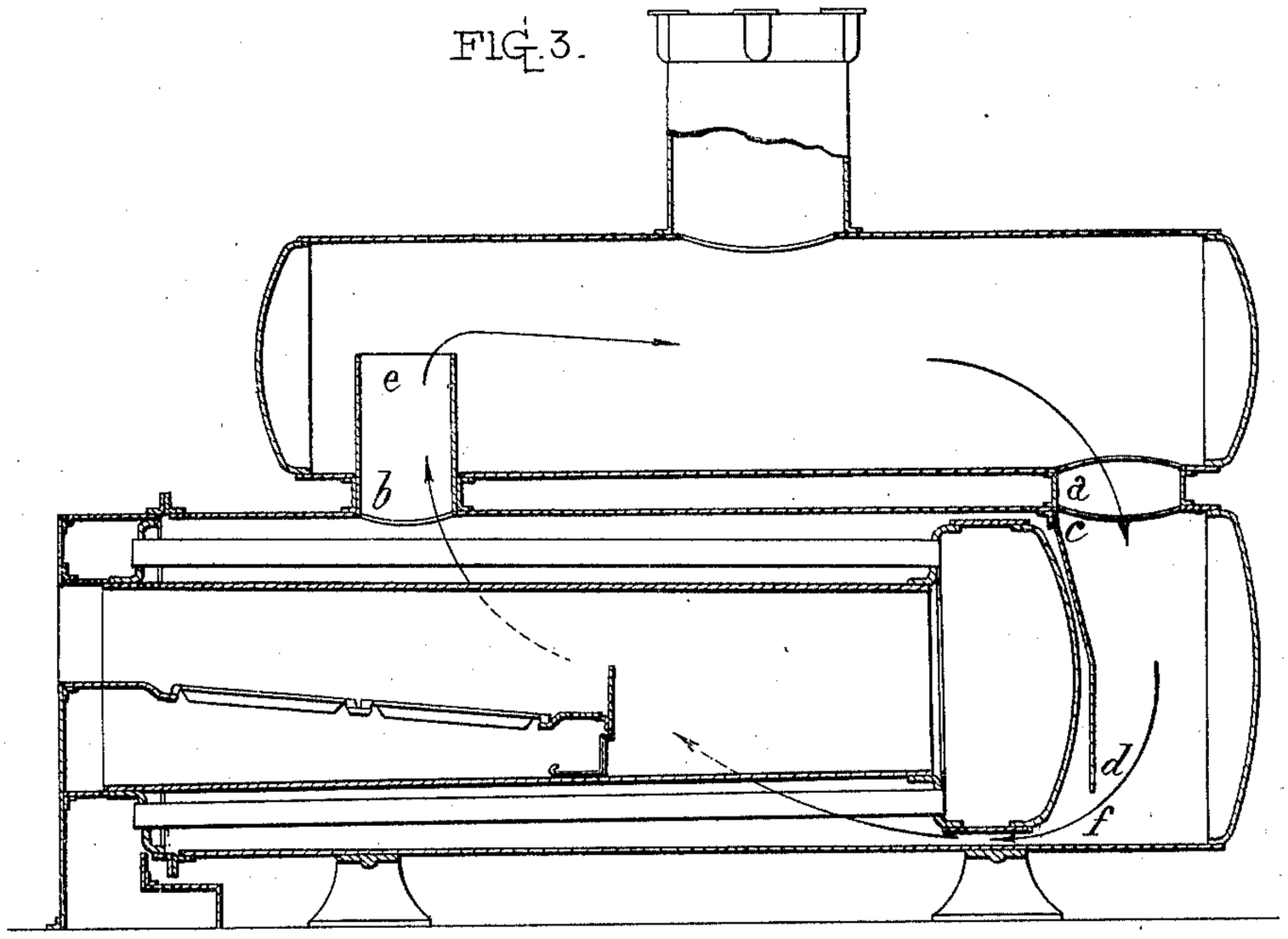


FIG. 4.

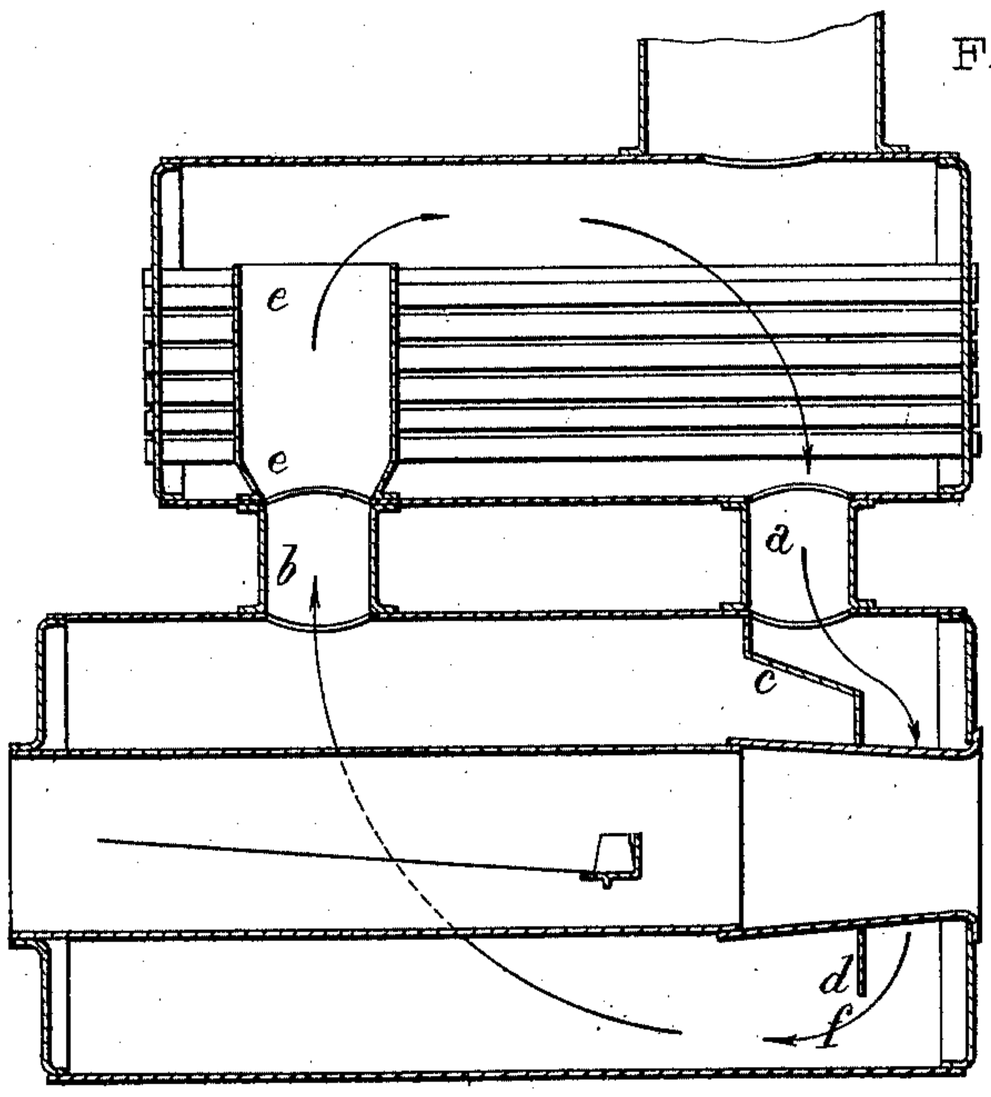
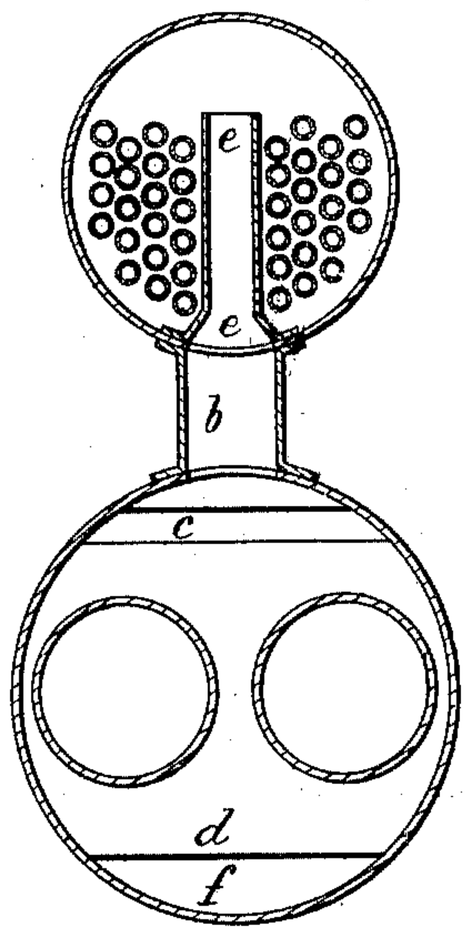


Fig. 4a



Witnesses

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No. 776,530. PATENTED DEC. 6, 1904.

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STEAM GENERATOR.

APPLICATION FILED APR. 2, 1900.

NO MODEL. 3 SHEETS—SHEET 3.

FIG. 5.

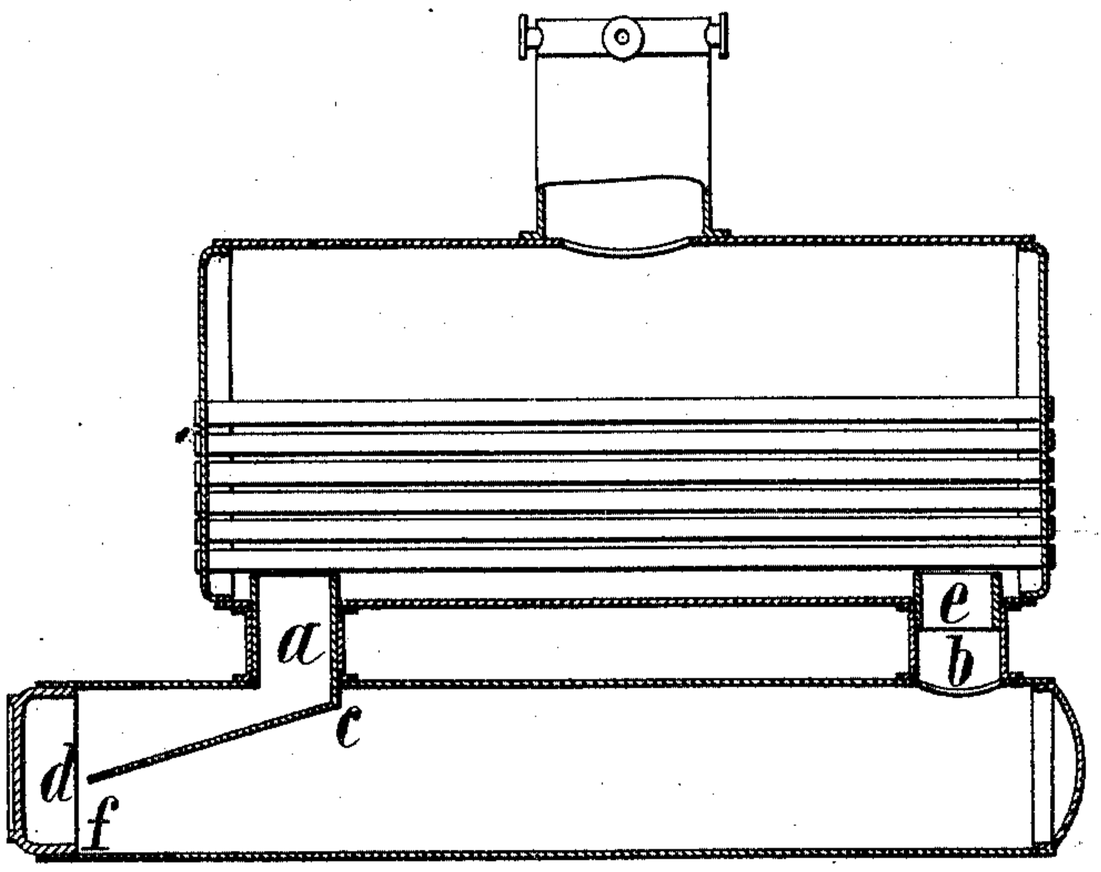
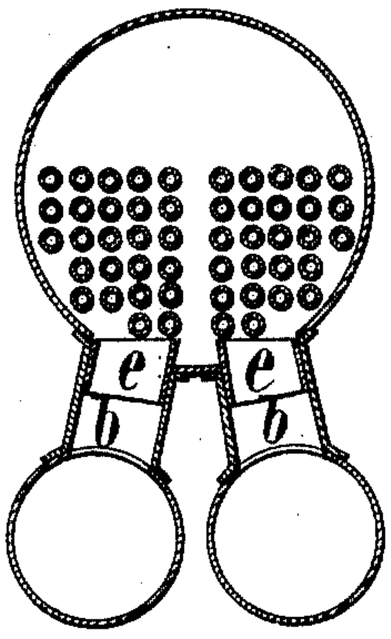


FIG. 5a



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No. 776,530. Patented December 6, 1904.

UNITED STATES PATENT OFFICE.

ANTONIN MONTUPET, OF PARIS, FRANCE.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 776,530, dated December 6, 1904.

Application filed April 2, 1900. Serial No. 11,224. (No model.)

To all whom it may concern:

Be it known that I, ANTONIN MONTUPET, a citizen of the Republic of France, residing at Paris, in the Republic of France, have invented certain new and useful Improvements in or Relating to Steam-Generators, (for which application has been made in France, under No. 292,362, dated September 7, 1899; in Great Britain, under No. 4,600, dated March 10, 1900; in Italy, under No. 183, dated March 11, 1900, and in Belgium, dated March 8, 1900,) of which the following is a specification.

Since multitubular boilers have been introduced into the navies, the importance of the water circulation has been recognized in its bearing upon the question of vaporization or steam production, and inventors and engineers have exerted themselves to the utmost to find the most effective means of obtaining a perfect system of water circulation.

There are types of marine boilers in which a very considerable degree of evaporization is obtained; but the boilers employed for industrial purposes may be said to have been quite overlooked and neglected in this respect.

The object of the present invention is to provide steam-generators of the latter class with a water-circulating system equal to that of the navy boiler by means of a judicious arrangement of tubular vaporizing elements; and such system consists, broadly, in producing a current of water in the generator which carries off the steam-bubbles as quickly as they are formed.

When a bubble of steam is formed on the wall of a boiler in which there is no water circulation, the bubble will isolate the metal from contact with the water and will only separate from the metal and rise when its elastic force is sufficient to drive it through the mass of water above it. It therefore remains in contact with the metal and is heated during the whole time necessary for increasing its volume and its elastic force, and since steam is a bad conductor of heat it opposes the transmission of heat from the furnace or from the metal to the water. When detached, this bubble, superheated and expanded and having no adhesion to the water, will unite with other bubbles and form a greater or lesser volume of steam, which in passing through the water produces only a lateral displacement of the water and no appreciable forward movement. The vaporization is therefore effected by a process of replacement. In boilers, however, characterized by a quick circulation of water the steam-bubbles are carried away in their vesicular state the moment they are formed and are replaced in a continuous manner by others, which follow in the same current of water along the metal as long as the latter is sufficiently heated. The water, which is a good conductor of heat, thus comes in contact with the heated wall, while at the same time carrying off the steam-bubbles as they are formed, thereby producing a much more steady and rapid transmission of heat from the furnace to the water intended to be converted into steam without any risk of overheating either the metal or the steam, since the production of the steam-bubbles proceeds more or less rapidly in proportion as the heat is raised or lowered in the furnace. The steam-bubbles produced under such conditions are intimately mixed with the water as they are formed. Thus a fluid is created the density of which is sensibly lower than that of the mass of the water in the boiler, a fluid which moves more rapidly as its density decreases—*i. e.*, when steam-bubbles are held in suspension or when the vaporization is greater. It will therefore suffice to give to these fluids of lower density suitable directions to obtain an efficient circulation within the boiler. This principle is applied to various types of boilers by establishing in the interior of the boiler steam-generating columns—*i. e.*, columns of lower density—and thereby most satisfactory results have been obtained.

Figure 1 is a vertical longitudinal sectional view of a steam-boiler having my invention applied thereto. Fig. 1ª is a vertical sectional view taken through the rear tubes *b*. Fig. 2 is a view similar to Fig. 1, showing another type of boiler having my invention applied. Fig. 2ª is a vertical sectional view taken through the rear tubes *b*. Fig. 3 is a view similar to Fig. 1 of a further type of boiler having my invention applied thereto. Fig.

4 is a like view of a further type of boiler with my invention applied. Fig. 4ª is a vertical sectional view taken through the rear tubes *b*. Fig. 5 is a view similar to Fig. 1, showing a further type of boiler with my invention applied. Fig. 5ª is a vertical sectional view taken through the tubes *b*.

If we examine a boiler of the type represented in Fig. 1, in which the upper body of the boiler or reservoir is united to the steam-generating part by tubes *a b* at the front and back, the steam will be produced and pass together with the water through the rear tubes *b* if its passage through the front tubes is prevented or impeded by a partition *c d*. By prolonging the tubes *b* by means of tubes or extensions *e* extending upward toward the water-level, for instance, columns of lesser density will be formed, which will establish a rapid circulation of water between the communications *a* and *b*. By guiding the water toward the front of the boiler and by forcing it to descend as low as possible the water descending through the tubes *a* is caused to pass through practically the whole length of the boiler, while the height of the fluid columns of lower density is increased, which begin at the lower part where the steam-bubbles are produced on the walls of the generator and which are prolonged into the upper reservoir, and at the same time the speed of circulation is also increased; but the circulation produced in the steam-generator and upper body of the boiler not only causes an increased amount of vaporization, but also keeps in suspension and in motion the particles of mud or deposit precipitated from the evaporating water and prevents it from settling down in the form of a hard calcareous crust on the parts of the boiler exposed to the action of the fire. Such deposits can only be formed in those parts of the boiler where the water is not agitated, and consequently never above the parts exposed to the direct action of the fire or those strongly heated. In such system of water circulation the precipitate will collect in the upper part of the boiler only, and to prevent any of it from descending again through the front communications or tubes the latter are made to slightly project into the upper body of the boiler, as shown in Fig. 1. During the stoppages of the boiler the precipitate will of course also collect in the steam-generating or lower parts in proportion as the circulation of the water ceases; but it will not adhere to the walls, and on resuming the heating it will be again carried off by the rising circulating water and will be deposited only in places where the effects of the current do not reach. The tubes *e* may be prolonged more or less, and the conduits *a* may be of any shape or form. They may be cylindrical or of other cross-section and may conduct the water to any suitable part of the steam-generators.

The improved arrangement may be applied to any kind of boiler consisting of two parts arranged one above the other, as represented in Figs. 1, 2, 3, and 4, and others of a similar type, and the same principle of circulation may be obtained by arranging the tubes or conduits for the water and steam currents connecting the two parts and which in the examples represented are between these parts at the side of them or outside the masonry supporting the boilers.

In the boiler represented in Fig. 1 the water circulates from the front to the back of the steam-generators; but the direction can easily be reversed by reversing the order of the conduit arrangement.

Fig. 2 illustrates the application of the invention to a semitubular boiler in which the two rear communications through which the steam-laden water passes upward are united in one conduit passing upward between the heating-tubes.

Fig. 3 shows a boiler with the furnace within the steam-generator, over which is arranged the upper part or water and steam reservoir, and in which the water is caused to descend to the bottom of the steam-generator behind a metal sheet partition *c d*, leaving a free part *f* at the bottom.

Fig. 4 represents the application of this principle to a boiler with two steam-generators with a furnace in each, over which is arranged the water and steam reservoir, provided with smoke-tubes, in which boiler the partition for causing the water to descend is arranged at the back at *c d*, the water passing through the lower opening *f*.

The examples described above show how the invention can be applied in the construction of various boiler types consisting of two parts; but it can also be applied to similar steam-generators already constructed or in use, an example of which is illustrated in Fig. 5. In this case the series of tubes in the upper part does not allow of the tube *e*, through which the steam-laden water rises, being carried as high as in the former cases, owing to which the speed of the circulation is less in proportion; but even under such circumstances the results are very satisfactory.

The position of the metal tube *c d* is limited, first, at its lower end at a point corresponding to the level of the charge of fuel in the furnace, so that the steam formed in the lower portion of the furnace is carried off by the ascending water column, but it also may descend to the level of the grate; second, at the upper end it must reach to the lowest level of the water possible in the boiler, so as to sufficiently cover the parts over the furnace in order that the steam carried up by the ascending column and formed above the furnace may not become mixed with the feed-water which descends on the outside. The tube may also reach higher, according to the special applications. This tube should have no break

in its continuity and should be nearly at the same distance from the furnace on all sides, so as to insure as far as possible the same degree of density in the ascending column and the same speed along the whole circumference.

This system may be applied to all boilers with one or more inside furnaces provided with tubes placed in continuation of the furnace or above it or with Galloway or other tubes, as well as to steam-generators with inside furnaces only.

The circulation created in steam-generators by the use of columns of fluid of lower density insures the following advantages: first, the prevention of calcareous matter becoming hard and adhering to the boilers or the localization of such deposits in those parts of the boiler in which water is not greatly heated and agitated; second, water is not carried off with the steam; third, a more rapid, and consequently more economical, vaporization; fourth, the possibility of increasing to great extent the production of steam in a boiler without risk of overheating it or strain on the heated parts; fifth, finally, the indication of risks of accidents in case the water runs short. These results are attained by the circulation of water according to this system in any boiler, and it is easy to explain the first four, while the last becomes evident on considering that the circulation stops almost instantly as soon as the orifice through which the steam-laden water issues is uncovered. The vaporization in the boiler becomes less at the same time, and the parts worked by the steam coming from the boiler show at the same time a decrease of speed or in yield, thereby forcibly indicating the abnormal condition of the boiler. Under such conditions vaporization continues by replacement, as in the case of ordinary boilers, and without any risk or danger.

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

The combination with a steam-generator, comprising an upper and a lower section, upright tubes providing communication between the said sections, said tubes being arranged at opposite ends of the generator, one of said tubes being extended upwardly in the upper section above the bottom thereof, of a plate arranged within the lower section, the upper end of the plate joining the upper wall of the lower section at a point intermediate the upright tubes and the lower end of the plate lying above the bottom of the lower section of the generator, the said plate being so arranged that practically all the steam generated in the lower section is forced to pass up through one of the tubes thereby causing water to pass down the other, all arranged for coöperation as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ANTONIN MONTUPET.

Witnesses:

LOUIS SULLIGER,

EDWARD P. MACLEAN.