No. 609,971. Patented Aug. 30, 1898.

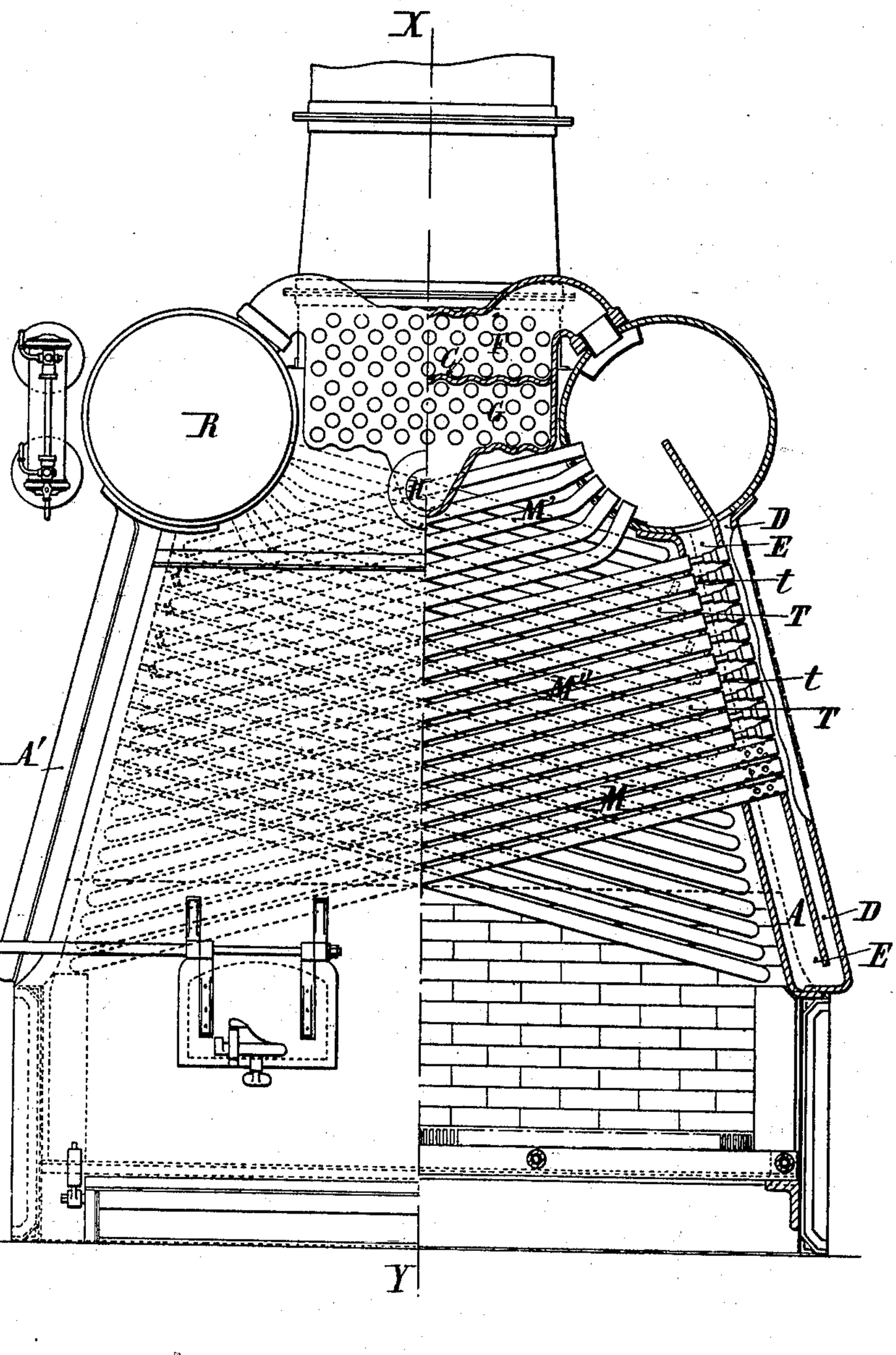
A. MONTUPET.

STEAM GENERATOR.

(Application filed Dec. 20, 1897.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



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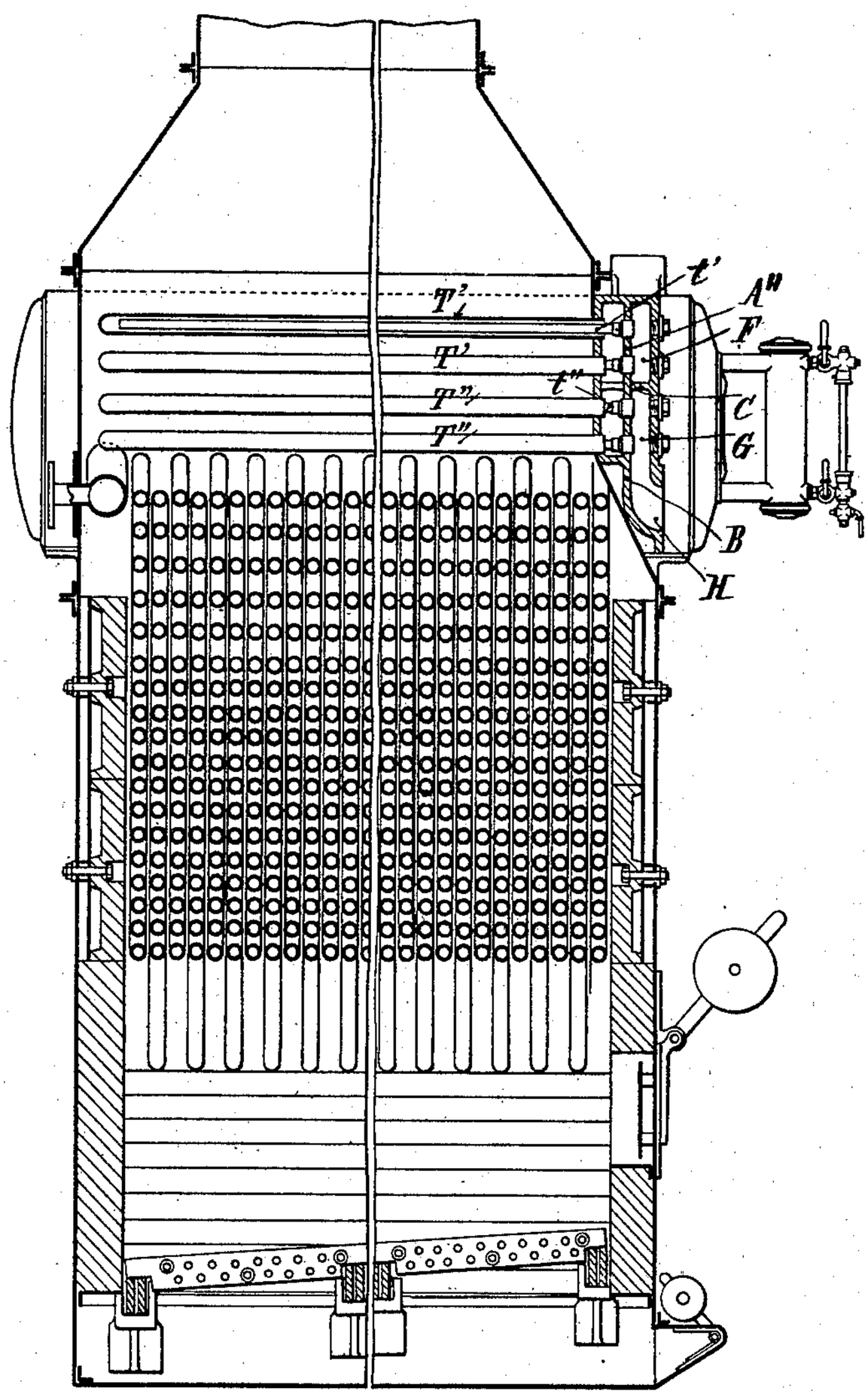
(No Model.) 3 Sheets—Sheet 2.

Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

Fig. 3.

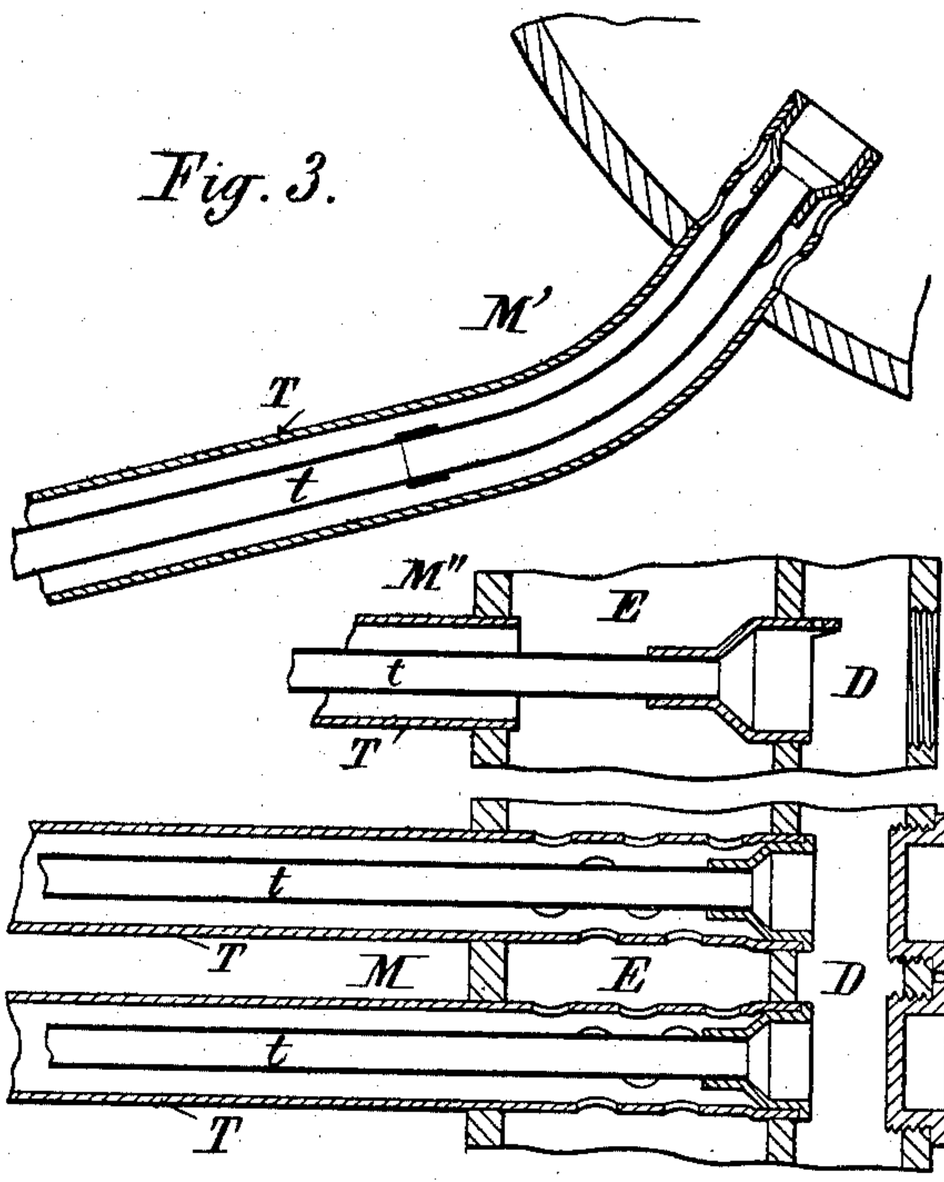


Fig. 5.

Fig. 6.

Fig. 4

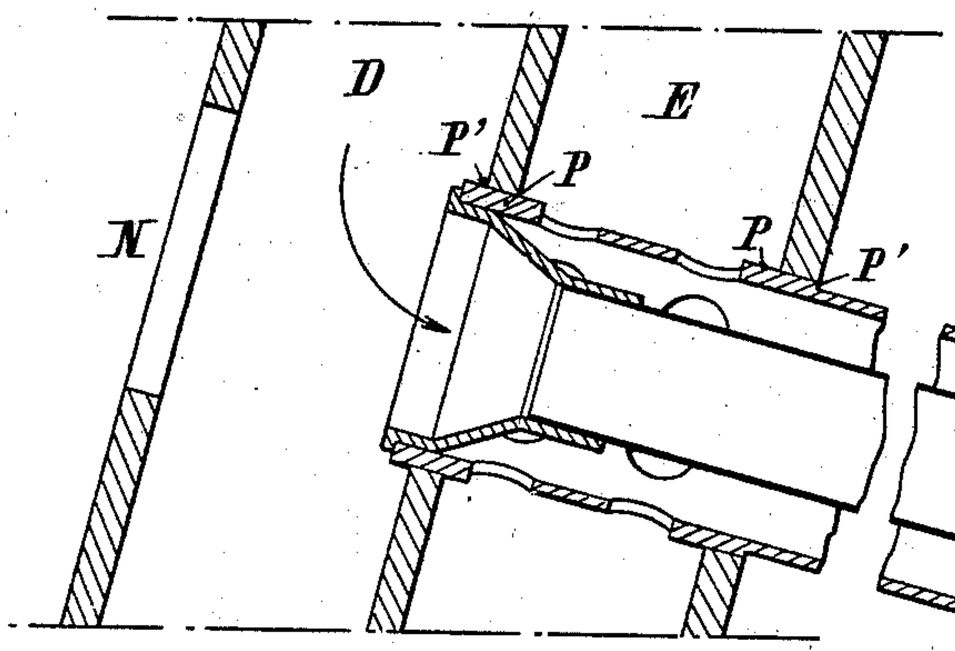
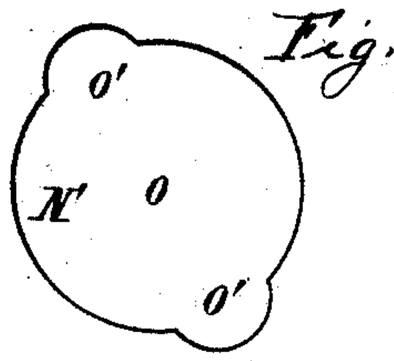
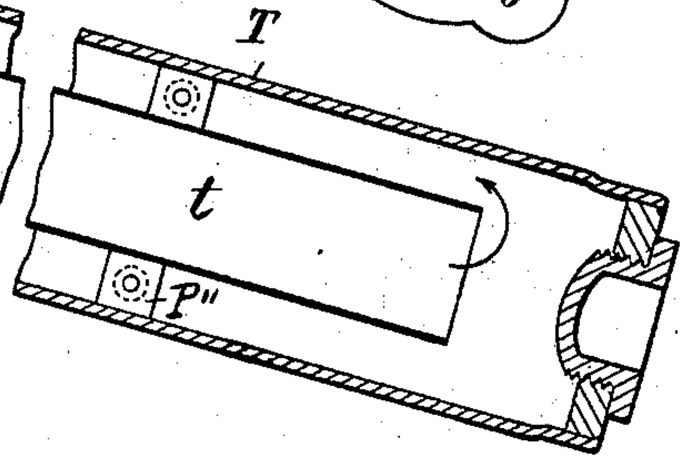


Fig. 7.





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UNITED STATES PATENT OFFICE.

ANTONIN MONTUPET, OF PARIS, FRANCE.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 609,971, dated August 30, 1898.

Application filed December 20, 1897. Serial No. 662,673. (No model.) Patented in France June 2, 1896, No. 256,848.

To all whom it may concern:

Be it known that I, ANTONIN MONTUPET, a citizen of the Republic of France, residing at Paris, France, have invented certain new and useful Improvements in or Relating to Steam-Generators, (for which I have obtained Letters Patent in France, No. 256,848, dated June 2, 1896,) of which the following is a specification.

On board ship and in many other cases it is often necessary to have steam-generators giving a maximum of power—that is to say, of a maximum grate and heating surface in a given space. For this purpose there have been designed numbers of boilers having tubes arranged very close to each other; but the vaporizing-surface in all such boilers has been limited by the necessity of maintaining the tubes (and the stays, if there be any) at a certain distance from each other in order not to impair the strength of the apparatus. The chief difference between my new generator and the generators of other systems hitherto used is that my generator enables the tubes to be brought as close together as desired, even close enough to touch, without any injurious effect on its strength, thus giving the greatest heating-surface obtainable within a given space. It has, moreover, the advantage of being so constructed that its parts are free to expand, in consequence of which the boiler may be forced without any fear of injury.

An example of my new steam-generator is illustrated in the accompanying drawings, in which—

Figure 1 is a front elevation of the whole boiler, one-half being shown in vertical cross-section. Fig. 2 is a longitudinal section on line X Y of Fig. 1. Figs. 3, 4, 5, and 6 are sectional views of details, as hereinafter referred to. Fig. 7 is a diagrammatic view showing the shape of the openings in the outer wall of the steam-chamber.

The generator, according to the present invention, is constituted, as may be seen in Fig. 1, by two steam-chambers consisting of casings A A′, made of sheet metal or cast, and provided with tubes which can freely expand—that is to say, each tube is fixed to only one of the casings. The distance between the tubes is such that, as may be seen in Fig. 2, those of one casing A′ pass between those of the other A, the space left between these tubes being made as small as desired. They may be even made to touch each other when the nature of the fuel allows it. The tubes of one set are arranged in parallel rows, the distance between each two tubes being equal to their diameter plus the clearance which it is desired to leave between the tubes of the two sets when they are all in place. Such arrangement forms an essential and characteristic feature of my system of boiler construction when fitting up a steam-chamber, the stays of the chambers to be placed in the free spaces situated in front of the tubes of the opposite steam-chamber. The tubes of the two sets being very near each other and at an angle to each other, the combustion-gases from the furnace pass into the free spaces between the tubes of the same set, completely surrounding them under much more favorable conditions than in any steam-generators hitherto known. The cross-section of the free passage for the gases is that of the free spaces between parallel tubes of the two sets of tubes.

Each steam-chamber is divided by a partition-wall into two compartments receiving circulating-tubes forming the water-tubes T T T, in the interior of which are placed the water-supply tubes *t t t*. The water descends from a drum forming the top of each steam-chamber through the outer compartment D and through the small tubes *t t t*, and then returns, together with the steam, through the outer tubes T T T and the inner compartment E again into the upper reservoir R.

In order to render the tubes as strong as possible, I fix the lower rows as shown at M in Figs. 1, 3, and 6—that is to say, by fixing them in the inner wall of the steam-chamber and also in the partition-wall. The holes in both plates are a little larger than the diameter of the tubes in order to facilitate their removal, which is still further facilitated if both the holes (in the inner and in the partition walls) are made slightly taper in one cone.

In order to utilize free space between the upper tubes of both steam-chambers and between the two drums R, I arrange circulating-tubes between said drums R, as shown at M′

in Figs. 1 and 3. As may be seen in Fig. 3, the small inner tubes *t t* are in such arrangement preferably made in two parts in order to facilitate their arrangements or fixing in position.

The tubes in the upper rows may be arranged as shown at M″ in Figs. 1 and 5—that is to say, simply fitted into the hole of the inner wall or be secured in any other suitable manner, being provided with screw-threads, conical portions, or with nuts or other means of securing them in place.

For generators which have to stand a considerable amount of forcing all the tubes are secured at two points—*i. e.*, in the rear or inner wall and also in the partition-wall, as shown in Figs. 1, 5, and 6. The tubes are put in place from the inside or from the outside, according to the circumstances of the case and to the space available when putting the apparatus up. As the tubes which are exposed directly to the fire are those generating most steam, they may be made of a larger diameter in order to increase the generation of steam.

According to the use for which they are intended the boilers are made with tubes of a larger or smaller diameter. In boilers for torpedo-boats, for instance, the tubes are preferably made with a diameter of from thirty to fifty millimeters. In those for other small vessels the tubes may have on the average a diameter of from fifty to seventy millimeters, and in those for large ships their diameter is preferably from eighty to one hundred and twenty millimeters. The same applies to the boilers used in workshops, houses, and the like. The tubes, whatever be their diameter, are secured in conical holes bored in two plates—that is to say, in the rear or inner wall and in the partition-wall, as is shown in Fig. 3—but in order to facilitate the dismounting or removal of tubes of large diameter I form the ends P of said tubes in the manner indicated in Fig. 4—that is to say, they are slightly tapered and introduced into openings P′ of the same taper in the plates, Fig. 4. The fitting up, inspection, and cleaning of the tubes is effected through holes N, made in the outer walls of the steam-chamber. In case of tubes of small and medium diameter these holes may be closed by screw-plugs, as indicated at N in Figs. 5 and 6; but with other tubes I prefer to close these holes N with plugs or covers somewhat similar to manhole covers, holes for the passage of which are made in the plates by boring three holes O O′ O″, as shown at N′ in Fig. 7, in order to allow the closing-plate to be introduced and secured in place. All the holes for introducing tubes and for inspection may be dispensed with by providing at the outside a removable part for uncovering said tubes. In all the tubes of my generator the inner pressure tends to expand them and so tends to maintain them in place.

Another advantage of my invention consists in providing the inner tubes with small collars P″, Fig. 4, the tendency of which is to maintain the inner tubes concentric to the outer tubes even should the latter get bent in consequence of being heated when empty. I provide also inlets for air in the front and back plates as well as in the longitudinal sides of the furnace under the refractory lining. These air-inlets serve to complete or assist the combustion of hot gases while working with forced draft.

The accompanying drawings illustrate steam-chambers of short metal suitably stayed or strengthened and extending the whole length of the boiler; but these chambers may also be replaced, as has been mentioned, by chambers or steam-collectors of any shape or cross-section, with or without partition-walls, connected at the top, so as to form always two sets of intersecting tubes. When no partition-wall is employed, the tubes are attached to the inner wall in a similar manner to that shown at M′, Figs. 1 and 3.

The length of the chamber or collectors is determined by the arrangement of the boiler or by the requirements to be met, the lower parts of said chambers taking up all the scale or calcareous deposits, which are easily removed by scraping. Said steam-chambers may also be suitably inclined, if desired, relatively to each other.

In one form of construction of a steam-generator illustrated in the accompanying drawings the front and rear walls of the generator are made removable to enable inspection, cleaning, &c.; but these two walls may be formed as water-containers and may be connected to the other two sides, and even, if desired, to the two upper reservoirs or drums, which latter may be of any shape and cross-section and may be connected in any suitable manner or even be connected to form one longitudinal or transverse body, to the sides of which would be fixed the two sets of vaporizing-tubes.

Multitubular generators have as a rule a great drawback, as the steam produced contains too much water—that is to say, "priming" is very great. My generator would suffer from the same drawback, as it works with a very large vaporizing-surface. I remedy this drawback by the following arrangement: To avoid priming, I use a superheating drying apparatus based on the same principle of circulation as my generator. As may be seen by examining Figs. 1 and 2, this drying apparatus is mainly constituted by a cast or other metallic casing about the tubes and connected in any suitable manner, as by inner joints, to the two drums and provided with partition-walls A″, B, and C and with tubes which can expand freely. The steam is taken from the two drums with the usual precautions and in the usual manner in order to avoid priming and passes into the metallic casing through the upper part of the front compartment F. Then it passes through small tubes *t′ t′* of the

drying apparatus and returns through the large outer tubes T′ T′ into the back compartment, escapes from this compartment through the large tubes T″ T″ at the bottom, and returns through their inner small tubes *t″ t″* into the lower front compartment G. It thus circulates in layers of streams of very small diameter in the direction opposite to that of the hot gases before being led away to the engine, &c., through the branch H. The arrangement of this drying superheater has the great advantage of utilizing a free space, thus obtaining in a very simple and economical manner an important heating-surface, producing a very dry and even superheated steam. This arrangement is at the same time very economical, as it perfectly utilizes the hot gases before they escape into the chimney. Moreover, this apparatus superheats steam under such circumstances that whatever be the intensity of the fire there is no danger of an accident, as the steam passing into the interior prevents the overheating of the metal. This overheating of the metal cannot take place unless the consumption of steam is stopped for a considerable time; but it may be easily avoided by arranging safety-valves at the end of the drying and superheating apparatus, so as to allow the excess of the superheated steam to escape said valves.

The superheating apparatus is placed in the current of hot gases escaping from the vaporizing sets of tubes and before they enter the chimney and is secured to the generator in any suitable manner, and enables the steam to be superheated in a practical manner, which has not been attained hitherto, while its construction affords a large heating-surface in a restricted space.

Changes in the construction, shape, and arrangement of the tubes might be made without departing from the spirit of the invention or sacrificing any of the advantages thereof.

I claim—

1. In a multitubular steam-generator, the combination with two separate steam-chambers, of two intersecting sets of tubes, the tubes of one set being arranged in the spaces between the tubes of the other, and the tubes of each set having connection at one end only with its respective steam-chamber.

2. In a multitubular steam-generator, the combination with two separate steam-chambers each divided into two compartments, of two intersecting sets of tubes, the tubes of one set being arranged in the spaces between the tubes of the other, and each of said tubes being in communication at one end with one of the compartments of the steam-chambers, and tubes arranged within the first-mentioned or outer tubes and in communication at one end with the other compartment of the steam-chambers, and at the opposite end with the other end of the said outer tubes, all substantially as described.

3. In a multitubular steam-generator, the combination with two separate steam-chambers, and a partition arranged in each chamber to divide the same into two compartments, of two intersecting sets of tubes, the tubes of one set being arranged in the spaces between the tubes of the other, one end of each tube being seated within the wall of the chambers, and tubes arranged within the first-mentioned or outer tubes and seated at one end within the partitions of the steam-chambers, the outer tubes being in communication at one end with one of the compartments of the steam-chambers, and the inner tubes being in communication at one end with the other compartment of the steam-chambers and at the opposite end with the other end of the outer tubes, all substantially as described.

4. In a multitubular steam-generator, the combination with two casings forming steam-chambers, of two intersecting sets of tubes, the tubes of one set being arranged in the spaces between the tubes of the other, and the tubes of each set having connection at one end only with its respective casing, reservoirs at the upper ends of the casings, tubes communicating at one end with the interior of the reservoirs, and tubes arranged within the first-named tubes communicating at one end with the interior of the reservoirs and at the opposite end with the other ends of the outer tubes, all as and for the purpose specified.

5. In a multitubular steam-generator, the combination with two casings forming steam-chambers, of two intersecting sets of tubes, the tubes of one set being arranged in the spaces between the tubes of the other, and the tubes of each set having connection at one end only with its respective casing, reservoirs at the upper ends of the casings, tubes communicating at one end with the interior of the reservoirs, and tubes arranged within the first-named tubes and communicating at one end with the interior of the reservoirs and at the opposite end with the other ends of the outer tubes, the said inner tubes being in sections detachably secured together, as and for the purpose specified.

6. In a multitubular steam-generator, the combination with two separate steam-chambers, of two intersecting sets of tubes, the tubes of one set being arranged in the spaces between the tubes of the other, and the tubes of each set having connection at one end only with its respective steam-chamber, and tubes arranged within the first-named tubes and having one end in communication with a steam-chamber and the opposite end in communication with the outer tubes, and collars secured to one end of the inner tubes and to the adjacent ends of the outer tubes, as and for the purpose specified.

7. In a multitubular steam-generator, the combination with casings forming steam-chambers, of two intersecting sets of tubes, the tubes of one set being arranged in the

spaces between the tubes of the other, and the tubes of each set having connection at one end only with its respective casing, the casings being provided with openings formed by intersecting annular openings, as set forth, and plugs removably fitted in the openings so formed.

8. In a multitubular steam-generator, the combination with casings forming steam-chambers, of two intersecting sets of tubes, the tubes of one set being arranged in the spaces between the tubes of the other, and the tubes of each set having connection at one end only with its respective casing, reservoirs at the upper end of the casings, a casing arranged between and communicating with the interior of the reservoirs, partitions dividing said casings into chambers as described, tubes communicating at one end with one of the chambers, and tubes arranged within the other tubes and communicating at one end with the other chamber and at the opposite end with the other end of the outer tubes.

9. In a multitubular steam-generator of the character described, a lower series of inclined tubes T secured to the inner wall and also to the partition-wall of the steam-chamber and perforated at their ends where they enter the steam-chamber, and containing inner water-tubes *t*, in combination with an upper series of inclined tubes secured at their ends to the inner wall of the steam-chamber, and containing water-tubes *t* secured to the partition-wall of the steam-chamber, substantially as set forth.

In testimony whereof I have hereto set my hand in the presence of the two subscribing witnesses.

ANTONIN MONTUPET.

Witnesses:

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EDWARD P. MACLEAN.