(No Model.)

J. B. GRANJON.

STEAM GENERATOR.

No. 572,750. Patented Dec. 8, 1896.

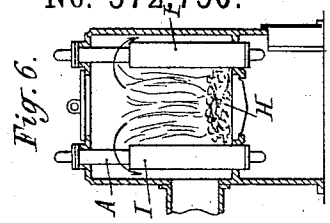

Fig. 6.

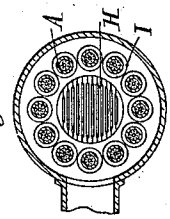

Fig. 7.

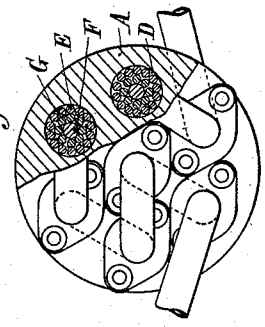

Fig. 5.

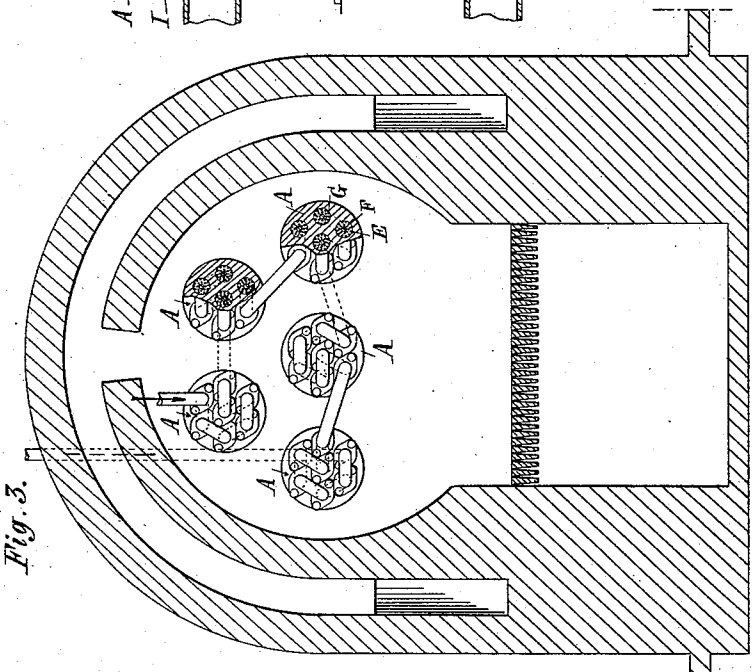

Fig. 3.

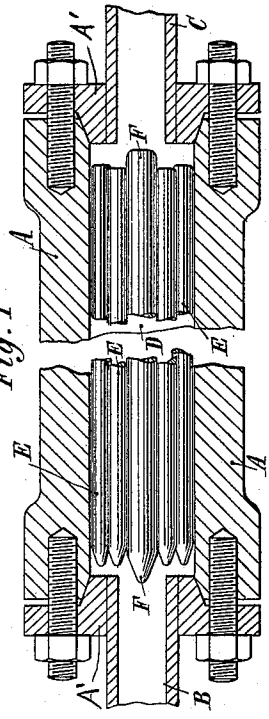

Fig. 1.

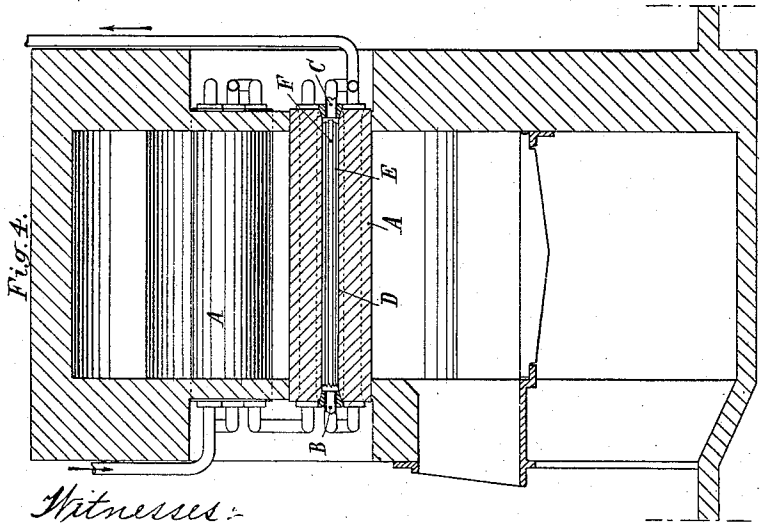

Fig. 4.

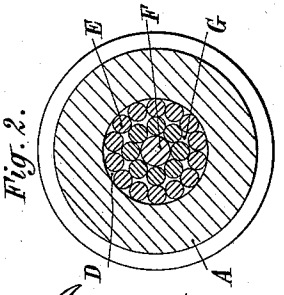

Fig. 2.

Witnesses:
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UNITED STATES PATENT OFFICE.

JEAN BENOIT GRANJON, OF CHATONNAY, FRANCE.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 572,750, dated December 8, 1896.

Application filed February 18, 1896. Serial No. 579,728. (No model.) Patented in France August 17, 1895, No. 249,615.

To all whom it may concern:

Be it known that I, JEAN BENOIT GRANJON, a citizen of the Republic of France, residing at Chatonnay, Republic of France, have invented certain new and useful Improvements in or Relating to Steam-Generators, (for which I have obtained Letters Patent in France, No. 249,615, dated August 17, 1895,) of which the following is a specification.

The steam-generator which forms the subject of the present invention comprises the combination and application of a special arrangement of a vaporizing tube or tubes. (Shown by way of example in the accompanying drawings.)

The realization of very rapid vaporization is based in principle on obtaining great heating-surface corresponding to a small volume of the liquid to be vaporized, and this realization can be practical only on condition that the scale or sediments, which are liable to obstruct the circulation of the liquid to be vaporized, may be easily, rapidly, and thoroughly removed.

In the accompanying drawings, Figures 1 and 2 show by longitudinal and transverse sections, respectively, a vaporizing-tube constructed in accordance with this invention. Figs. 3 and 4 are longitudinal and transverse sections, respectively, of a generator, showing one arrangement of the vaporizing-tubes. Fig. 5 is an end view, partly in section, of one of the tubes seen in Figs. 3 and 4. Figs. 6 and 7 are vertical and horizontal sections, respectively, of a steam-boiler, showing another arrangement of vaporizing-tubes.

The arrangement of the vaporizing-tube according to this invention (shown by way of example in Figs. 1 and 2 of the accompanying drawings in longitudinal and transverse section) comprises, as an examination of these figures will show, a metallic tube A, which may vary in length, diameter, and thickness, the ends of which receive, so as to form a tight joint, heads A', through which extend short pipes B and C as an inlet and outlet for the liquid. The heads are removably secured to the tube A by suitable means, as clamping bolts and nuts, as shown.

The hollow interior D of each tube A is provided with metallic rods E, of suitable shapes, sections, and dimensions, which rods may, if desired, be hollow, with their ends closed when it may be important to decrease the weight. These rods E are maintained tight in the interior D of each tube by means of other rods, F, forming keys, which may vary in number and in position, according to the shape and section of D.

In the examples herein described and illustrated the tubes A, both externally and internally, are of circular cross-section, as also the rods E and keys F for these rods, which are placed within the said tubes, but it is evident that both the cross-section of these parts and also their other dimensions may vary considerably without altering the substance of the invention.

In all cases the section of the rods E and their keys F will be such and in such way combined with the section of the hollow interior D of the tubes A that between the rods and keys themselves, as well as between them and the walls of the tube, there will be formed spaces G of very small even capillary section. The application and the combination of these rods result chiefly in a great division of the section of the liquid which has been injected into the tubes A in any suitable manner, the evaporation of which liquid is effected the more rapidly, being of small section and in close contact with the rods E, which are heated and maintained at a high temperature by the fact of their contact with each other and with the inner wall of the tubes A, the contact being secured by tightening produced by the rods F forming the keys.

It is clear that by the arrangement of the vaporizing-tube, which has been just described, the problem of very rapid vaporization has been resolved in a practical manner by realizing a very great heating-surface corresponding to the spaces of small section for circulation of the liquid to be vaporized. It is evident that in consequence of this arrangement the liquid injected into the vaporizing-tube, and which must be subjected to a very great heat, will be immediately vaporized by the fact of the wall of the tube A transmitting, by reason of its conductibility, its intense heat to the rods E and keys F and so to the injected liquid, very rapid vaporization of which will be thus produced.

Concerning the cleaning of the vaporizing-tube, it is very simple and easy. It is sufficient in fact, the heads A′ and short inlet and outlet pipes being removed, to take out the bunch of rods E from the interior of the tube A, which removal will be made possible and easy by removing in the first instance the keys F tightening the rods E.

This arrangement of tubes for rapid vaporization may be modified without altering the spirit of the invention, as shown, for example, in Figs. 3, 4, and 5. In this modification the tubes A may be made of a greater diameter and may have several hollow spaces D in them, each of which is provided with rods E and keys F, as previously described and shown in Figs. 1 and 2; that is to say, that in this arrangement the vaporizing-tubes consist of several elements, connected with each other by the pipe-pieces connecting the inlets and outlets of every two elements, so that a continuous circulation is obtained in opposite directions, if two elements are considered as connected by the same pipe-piece.

In accordance with the importance of the steam-generators to be erected the tubes A with multiple vaporizing elements may be combined in different numbers successively connected to each other, two and two, so as to get the liquid to be vaporized circulated through the whole.

As an example a generator, as shown in Figs. 3 and 4, may have five vaporizing-tubes, each tube having seven combined vaporizing elements. In this case the injection of the liquid is effected through one of the elements of the upper tube A on the left of Fig. 3, the liquid passing through each of the elements of each of the tubes A and coming out as steam under high pressure through one of the elements of the lower tube A on the left of the drawing.

In a further modification (shown in vertical and horizontal section in Figs. 6 and 7) a vertical boiler is arranged with tubes which are in this case supposed to be composed of only one element. Similar to those shown in Figs. 1 and 2 the vaporizing-tubes A, which are respectively connected with each other by inlet and outlet pieces, are placed vertically round the furnace H. These tubes are not thick and may be strengthened by a cast-iron envelop or jacket I at that part which is subjected to the greatest heat from the furnace H.

In the case of vaporizing-tubes A with either multiple elements or with a single element, as illustrated in the accompanying drawings, passages may be made in the walls of the tubes, so as to allow the hot gases to pass and, if desired, to heat the tubes inside as well as outside.

It is evident that the above are only examples of the modifications and applications of which the present invention is capable.

I claim—

1. In a steam-generator, the combination with a furnace, of a tube, rods arranged in the interior of the tube and adapted to be removed endwise from the latter, means for temporarily holding the rods firmly in position, liquid inlet and outlet pipes, adapted to communicate with the interior of the tube, and means removably secured to the tube and temporarily closing the ends of the latter, for the purpose specified.

2. In a steam-generator, the combination with a furnace, of a tube, rods arranged in the interior of the tube and adapted to be removed endwise from the latter, a key adapted to temporarily hold the rods firmly in position, heads removably secured to the ends of the tube and temporarily closing the latter, and liquid inlet and outlet pipes extending through the heads and communicating with the interior of the tube.

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

JEAN BENOIT GRANJON.

Witnesses:
LOUIS SULLIGES,
CLYDE SHROPSHIRE.