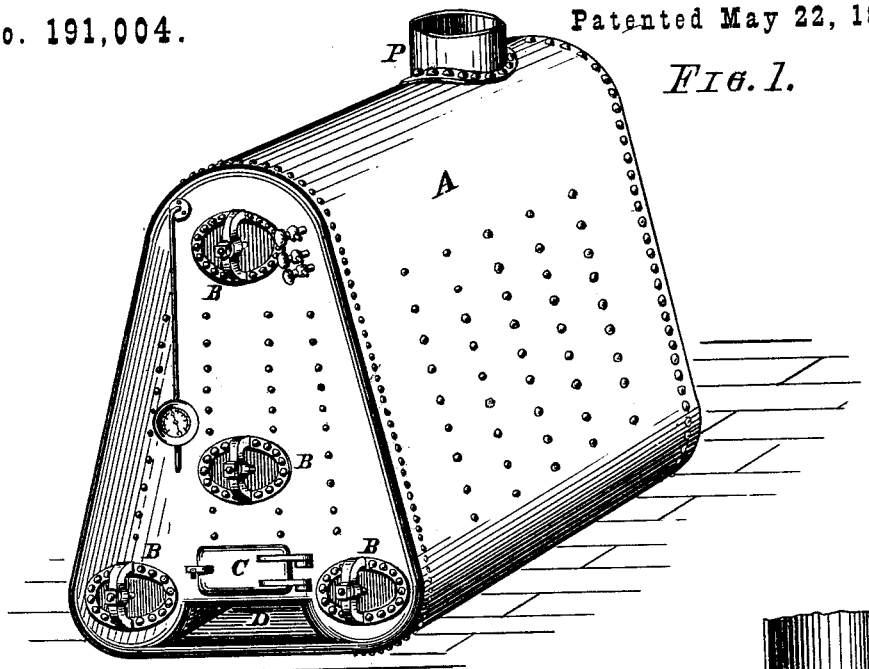
2 Sheets—Sheet 1.

J. & G. FIRMENICH.

STEAM-GENERATOR.

No. 191,004. Patented May 22, 1877.

FIG. 1.



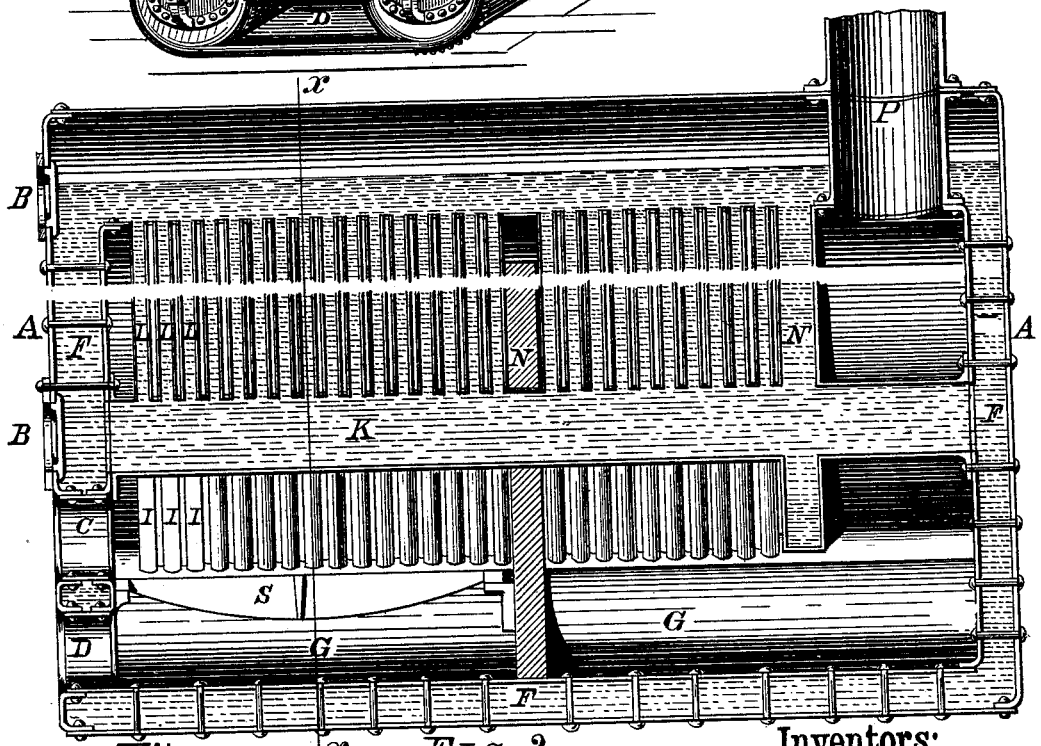


FIG. 2.

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Phal. Bevsart

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by Michael J. Stark

their attorney

2 Sheets—Sheet 2.

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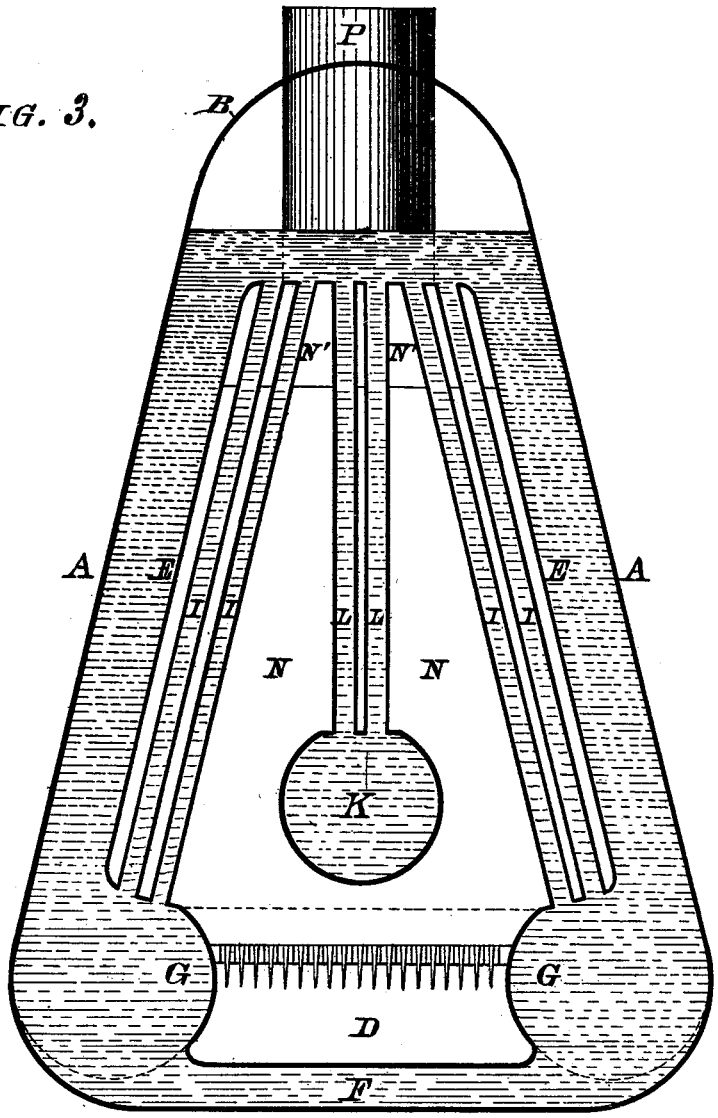
STEAM-GENERATOR.

No. 191,004. Patented May 22, 1877.

FIG. 3.



Witnesses:

Frank Hirsch

Chas. Brosart

Inventors:

Joseph & Geo. Firmenich

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their attorney.

UNITED STATES PATENT OFFICE.

JOSEPH FIRMENICH AND GEORGE FIRMENICH, OF BUFFALO, NEW YORK, ASSIGNORS OF ONE-THIRD THEIR RIGHT TO FRANK FIRMENICH, OF SAME PLACE.

IMPROVEMENT IN STEAM-GENERATORS.

Specification forming part of Letters Patent No. **191,004**, dated May 22, 1877; application filed April 4, 1877.

To all whom it may concern:

Be it known that we, JOSEPH FIRMENICH and GEORGE FIRMENICH, both of Buffalo, in the county of Erie and State of New York, have jointly invented certain new and useful Improvements in a Steam-Generator; and we do hereby declare that the following description of our said invention, taken in connection with the accompanying sheets of drawings, forms a full, clear, and exact specification, which will enable others skilled in the art to which it appertains to make and use the same.

Our present invention has special reference to improvements on steam-generators; and it consists in the peculiar arrangement, with an exterior closed shell, of an interior chamber having two longitudinal inwardly-projecting swells, whose upper surface is flattened, and provided with apertures wherein are inserted a series of obliquely-arranged heating-tubes, connecting the said swells with the crown-sheet of said interior chamber. This interior chamber is longitudinally traversed by a heating-drum, having a series of vertically-arranged heating-tubes terminating in the center of the said crown-sheet. The interior of the inner compartment is divided into combustion-chambers by means of a bridge wall or walls, the rear chamber of which is in communication with the exterior of the generator by means of a vertical flue connecting the inner and outer shells, all as hereinafter more fully set forth and described, and pointed out in the claims.

In the drawings hereinbefore mentioned, Figure 1 is an elevation in perspective of a boiler embodying our improvements. Fig. 2 is a longitudinal vertical section. Fig. 3 is a transverse sectional elevation in line *x x* of Fig. 2, like parts being indicated by corresponding letters of reference in all the figures.

A is the exterior shell of our improved steam-generator, made of boiler-iron of the proper grade and thickness, and provided in the front head with suitable man-holes B, stoke-port C, and ash-pit opening D, as clearly indicated in Fig. 1. Within this shell A is placed a similar shell, E, of sufficiently smaller size to produce water-spaces F between said shells. The inclined side walls of the interior shell E have two longitudinal inwardly-bulged parts, G, the upper surface of which is flattened, and has a series of apertures within which are expanded a corresponding number of heating-tubes, I, extending obliquely upward to the crown-sheet of the interior shell, within which the said heating-tubes are likewise expanded. The front and back heads of the interior shell are connected by a horizontal heating-tube, K, riveted with its ends to the said heads, which are provided with openings of a size in accord with that of said heating-tube K. This heating-tube is connected with the crown-sheet aforesaid by means of a series of vertically-arranged heating-flues, L, expanded within said crown-sheet and tube K in the same manner as the heating-tubes I. The interior of the shell E is divided into combustion-chambers by means of the bridge-walls N N′, the former reaching to within a suitable distance of the crown, and the latter to within a like distance of the bottom sheets of said interior shell. These bridge-walls may be either made of fire-bricks, or they may form a part of the heating-surface of the boiler, by being properly made of sheet-iron in such manner that the water within the boiler can enter the space between the walls of said bridge, as shown in Fig. 2, in which the front wall is indicated as being made of fire-brick, and the rear wall as being a part of the boiler proper. The rear combustion-chamber is in communication with the exterior of the boiler by means of a flue, P, connecting the inner and outer shells, either in the top or heads thereof, to form a passage for the gases of combustion from the boiler to the smoke-pipe or chimney. The front combustion-chamber is provided with the usual fire-grate S, placed either between or upon the longitudinally-protuberating parts G, as shown in Fig. 2.

It is evident that the spaces G and the tube K, and the steam-space R above the crown-sheet, should preferably be made of such diametrical dimensions as to admit of the entrance of a person within, to properly expand the heating-tubes I and L, and also that the

plane parallel surfaces of the two shells must be properly stayed to prevent displacement when under pressure.

A steam-generator constructed as hereinbefore described has the advantage of being portable, and of having an exceedingly large heating-surface as compared with its external dimensions, the entire interior shell and the exterior of the heating-tubes I, K, and L being available heating-surface. For this reason our boiler is comparatively small and light, for a given size, as compared with others of a similar capacity, and therefore eminently suitable for marine purposes, where lightness and the occupancy of but little space are two of the main requisites in a boiler of this kind. Furthermore, there are in our boiler no exposed surfaces whatever which are directly heated by the fire within, thus precluding the possibility of igniting surrounding combustible matter, wherefor our boiler is especially adapted for use in planing-mills, furniture and box factories, &c., where readily-combustible matters are always more or less in close proximity to the steam-generator.

In the drawings we have illustrated the interior as being partitioned off into three combustion chambers. This arrangement we prefer, because it allows of the most complete utilization of the combustible used. It may, however, be varied by dispensing with the middle chamber. In this case the gases of combustion should enter the escape-flue on the bottom of the rear chamber. So may both middle and rear chambers be dispensed with, and the gases of combustion lead directly from the top of the fire box to the exterior, thus converting our boiler into one of the kind usually styled "upright" boilers. Our boiler may be further modified by dispensing with the water-bottom under the fire-grate and in the rear chambers, as shown in Fig. 3, which will considerably cheapen its cost without curtailing its usefulness or steaming capacity.

In operation, the boiler is filled with water to a height covering the crown-sheet of the interior chamber for a proper distance. The gases of combustion, obtained from the burning of the fuel upon the grate S, pass from the front fire-box, over the fire-bridge, down the middle chamber, through the rear bridge, up the rear chamber, through the flue P, into the chimney. In their passage these gases strike the entire inner shell, as well as the exterior of the heating-tubes I K L, whereby they depart with so much of their heat as to enter the uptake at a temperature but little above that of the steam within the boiler.

There are in our boiler no small flues and passages for the gases of combustion. This, in connection with the arrangement of the upright and horizontal heating-tubes within, results in a considerable saving of fuel, because the gases of combustion are kept in one bulk, and thereby capable of producing more perfect combustion and departing with a larger quantity of heat atoms to the exposed surfaces than any other boiler can accomplish.

Having thus fully described our invention, we claim—

1. A steam-generator consisting of an exterior shell, A, having inwardly-protuberating parts, G, and a double series of straight heating-tubes, I, arranged obliquely, and connecting the parts G with the crown-sheet of the interior shell E, as set forth and described.

2. A generator in which the interior shell E is provided with an auxiliary heating-tube, K, attached to the front and back heads of the interior shell, and connected with the crown-sheet thereof by a series of heating-tubes, L, as described, for the object stated.

3. A steam-generator consisting of an exterior shell, A, an interior shell, E, having longitudinal inwardly-protruding parts G, connected with the crown-sheet by a double series of heating-tubes, I, and a heating-tube, K, also provided with heating-tubes L, the whole arranged as described, for the use and purpose stated.

4. A steam-generator consisting of an exterior shell, A, an interior shell, E, having longitudinal inwardly-projecting parts G, connected with the crown-sheet by a double series of heating-tubes, I, a heating-tube, K, provided with heating-tubes L, as described, said interior shell being divided by the wall or walls N N′ into combustion-chambers, the rear one of which is in communication with the exterior through the flue P, the whole constructed and arranged as described, for the use and purpose set forth.

In testimony that we claim the foregoing as our invention we have hereto set our hands and affixed our seals in the presence of two subscribing witnesses.

JOSEPH FIRMENICH. [L. S.]
GEORGE FIRMENICH. [L. S.]

Attest:
MICHAEL J. STARK,
FRANK HIRSCH.