No. 719,624. PATENTED FEB. 3, 1903.

E. E. TAYLOR.

STEAM GENERATOR.

APPLICATION FILED FEB. 17, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

FIG. 2.

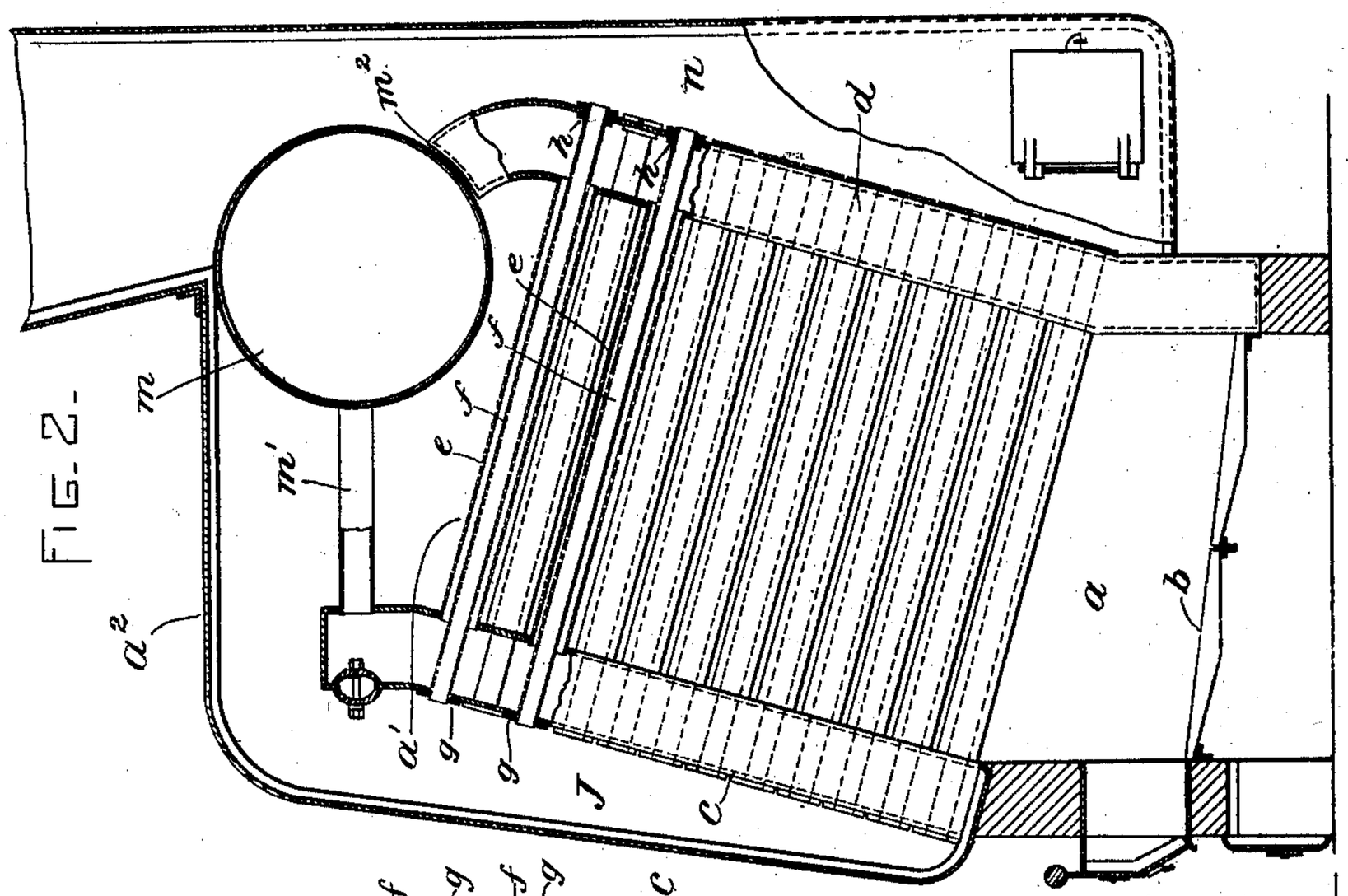
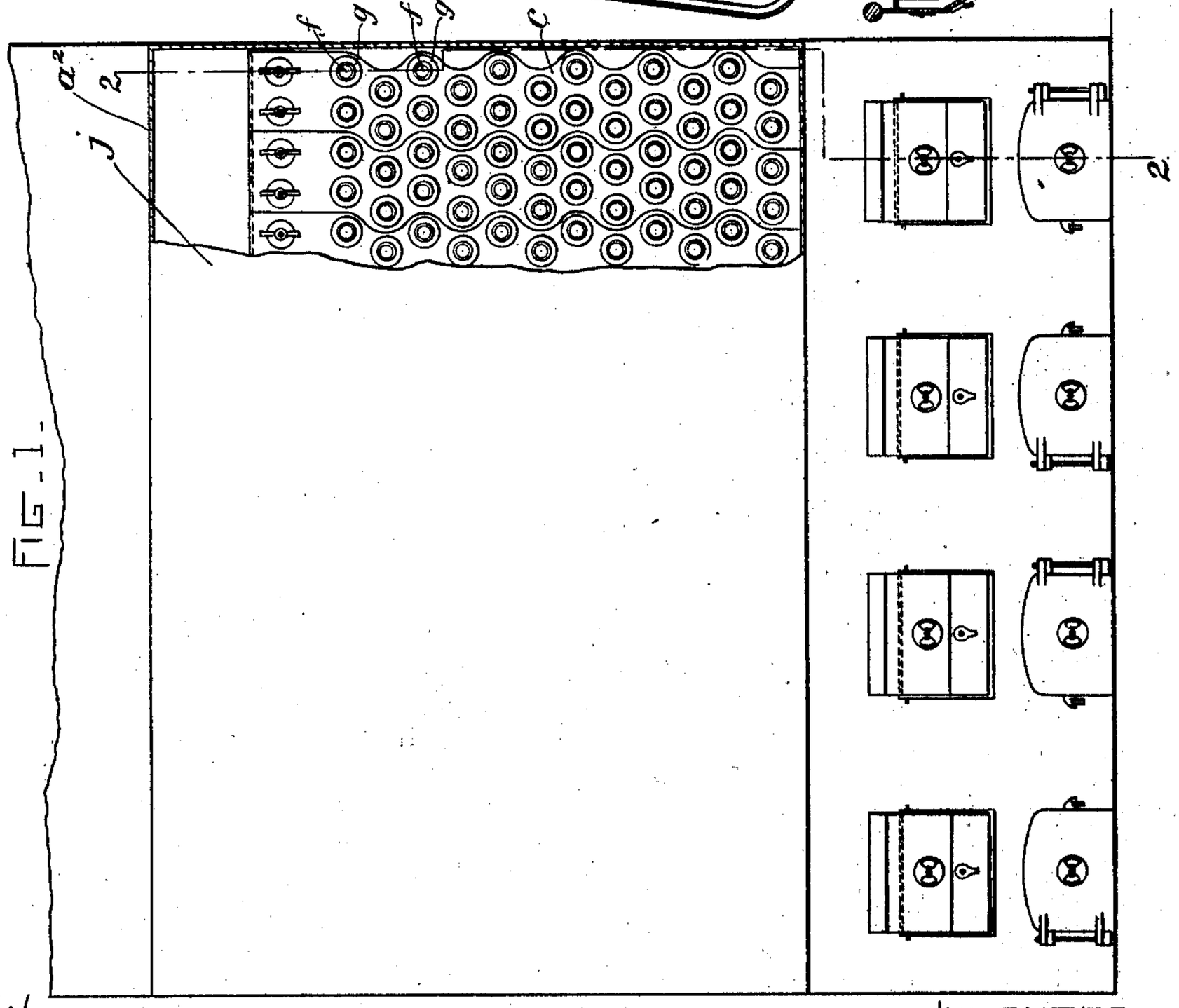


FIG. 1.



WITNESSES:
A. D. Harrison
P. W. Pezzetti

INVENTOR:
E. E. Taylor,
by Wright Brown Quinby & Ormsby
Attys.

No. 719,624. PATENTED FEB. 3, 1903.

E. E. TAYLOR.

STEAM GENERATOR.

APPLICATION FILED FEB. 17, 1902.

NO MODEL. 2 SHEETS—SHEET 2.

FIG. 3.

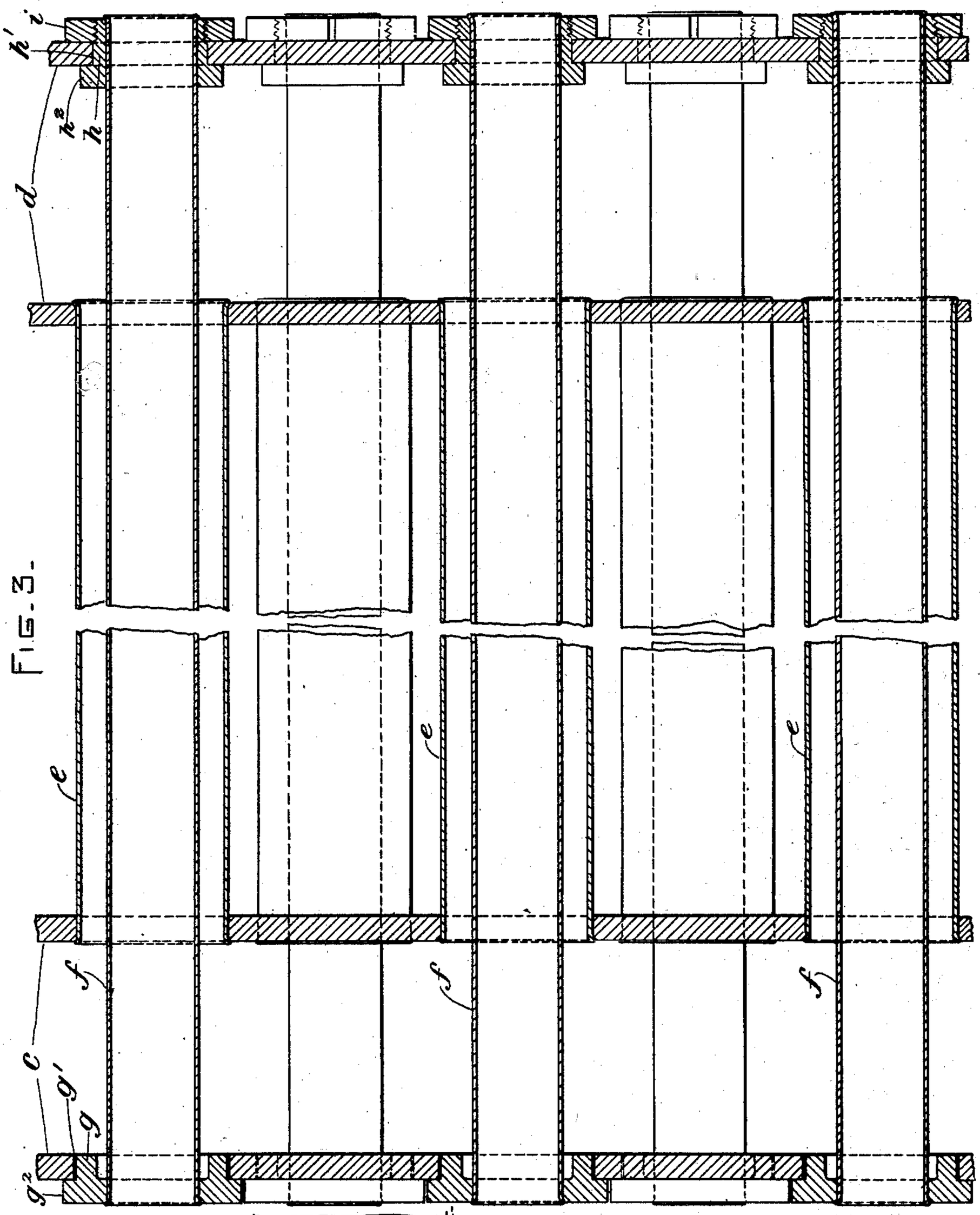


FIG. 4.

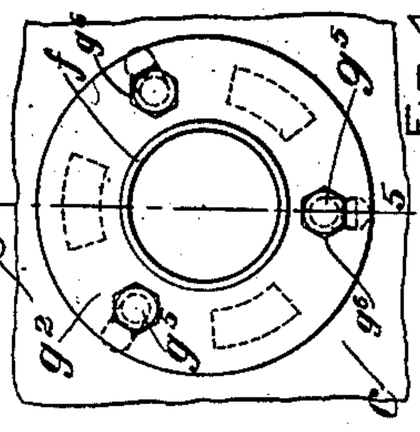
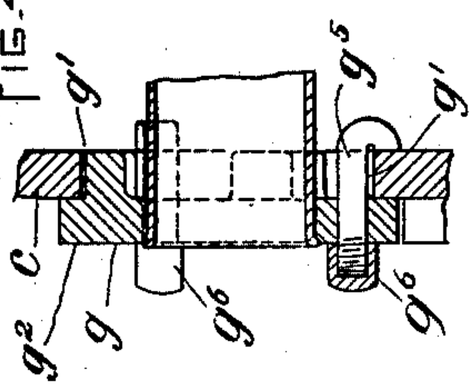


FIG. 5.



WITNESSES

A. D. Harrison

P. W. Pezzetti.

INVENTOR:

E. E. Taylor

by Wright Brown Quinby & Otto

Attys.

UNITED STATES PATENT OFFICE.

ELWOOD E. TAYLOR, OF BOSTON, MASSACHUSETTS.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 719,624, dated February 3, 1903.

Application filed February 17, 1902. Serial No. 94,364. (No model.)

To all whom it may concern:

Be it known that I, ELWOOD E. TAYLOR, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Steam-Generators, of which the following is a specification.

This invention relates chiefly to steam-generators of the type in which front and rear headers are employed, said headers being connected by water-tubes engaged with the inner walls of the headers and passing through an intermediate fire-space, fire-tubes located within said water-tubes and engaged with the outer walls of the headers, so that annular water-passages are formed between the headers, the water in said passages being heated both from the external surfaces of the water-tubes and from the surfaces of the fire-tubes.

This invention has for its object, first, an improved construction of a steam-generator of this type, whereby uniform distribution of heat may be obtained and maximum efficiency secured, and, second, to provide improved means for detachably securing the end portions of fire-tubes to the outer walls of a boiler or steam-generator.

The invention consists of the above-mentioned improvements, which I will now proceed to describe and claim.

Of the accompanying drawings, forming a part of this specification, Figure 1 represents a front elevation of a steam-generator embodying my invention, certain parts being broken away. Fig. 2 represents a section on line 2 2 of Fig. 1. Fig. 3 represents an enlarged sectional view of portions of the headers and portions of water-tubes and fire-tubes engaged therewith. Fig. 4 represents a side view of a portion of one of the headers. Fig. 5 represents a section on line 5 5, Fig. 5.

The same letters of reference indicate the same parts in all the figures.

In the drawings, *a* represents a fire-box located over a suitable grate *b*.

c represents a front header forming the front wall of the ascending fire-space *a'* over the fire-box, and *d* represents a rear header forming the rear wall of said fire-space.

e e represent a series of water-tubes which are engaged with the inner walls of the headers *c* and *d* and extend through the fire-space, said tubes being preferably inclined, as shown in Fig. 2, and forming passages adapted to conduct water from one header to the other.

f f represent fire-tubes which pass through the water-tubes *e* and are detachably secured at their ends to the outer walls of the headers *c* and *d*. The means for detachably securing the fire-tubes are preferably those shown in Figs. 3, 4, and 5 and comprise composition or steel bushings *g h*, engaged with orifices *g' h'*, formed for their reception in the outer walls of the headers, the bushing *g* having a flange g^2 bearing on the outer surface of the outer wall of the header *c*, while the bushing *h* has a flange h^2 bearing against the inner surface of the outer wall of the header *d*. The bushings *g* may be detachably secured to the header *c* by bolts g^5, as shown in Figs. 4 and 5. Said bolts may have curved inner ends bearing on the inner surface of the outer wall of header *c*, the bolts passing through the orifice *g'* and through the flange of the bushing and having threaded outer ends, which are engaged with nuts g^6. The portion of the bushing *g* within the orifice *g'* may be cut away to leave openings for the bolts g^5. The ends of the tube *f* are expanded in the said bushings, and thus securely united thereto. The orifice *g'* is of sufficient diameter to permit the bushing *h* and its flange to pass through it, so that the fire-tube *f* and the bushings attached to it may be inserted and removed through the said orifice *g'*, the water-tube *e* being of greater diameter internally than the diameter of the flange h^2. The bushing *h* may be formed to project through and outside of the outer wall of the header *d* and its projecting portion screw-threaded and provided with a nut *i*, adapted to be seated on the outer surface of the outer wall of the header *d*, or the bushing *h* may be detachably secured to the rear header by means of bolts or nuts. The surfaces of the bushings which bear on the headers and the corresponding surfaces of the headers on which the bushings bear are preferably ground. In practice the bushings *g* and *h* are secured to the headers before the fire-tubes are expanded into the bushings.

It will be seen that when the bushings *g* and *h* have been secured in position and the fire-tubes have been expanded in place steam-tight joints are formed by the contact of the

ground surfaces on the bushings and the corresponding ground surfaces on the headers, said surfaces forming ground joints. It will also be seen that by removing the nuts *i* and the bolts g^5 the fire-tubes and the bushings can be removed as a unit for the purpose of cleaning the water-surfaces of the water-tubes and the fire-tubes or for renewing the water-tubes and can be replaced in position and the ground joints made tight by replacing the nuts *i* and the bolts g^5 and tightening the nuts g^6.

j represents a downtake which is formed as an extension of the top a^2 of the fire-space a' and extends downwardly therefrom over the outer surface of the front header, said downtake connecting the upper portion of the fire-space with the receiving ends of the fire-tubes *f*. The fire-space a' is entirely closed at its upper portion excepting where it communicates with the downtake *j*, so that the fire-space has no outlet excepting the said downtake. Hence the products of combustion ascending in the fire-space between the water-tubes are compelled to pass over the upper end of the front header and downwardly to the ends of the fire-tubes which communicate with the downtake *j*. A steam-drum *m* is located at the upper portion of the fire-space and is connected by connections m' and m^2 with the headers, said steam-drum forming a part of a barrier between the fire-space and the uptake *n*, through which the products of combustion escape. The uptake *n* is extended downwardly along the outer side of the rear header and forms a hood or chamber which communicates with the delivering ends of the fire-tubes *f f*.

It will be seen that the products of combustion pass upwardly from the fire-box between and around the water-tubes to the upper portion of the fire-space a', and from thence downwardly through the downtake *j* to the fire-tubes, and from the latter upwardly through the uptake *n* to the stack.

The described apparatus involves what I term a "methodic principle of heating," high-temperature gases coming in contact with high-temperature steam and water, while low-temperature or exhaust gases come in contact with water of lower temperature entering the tubes *e* from the rear header *d*. There is a uniform distribution of heat throughout the tubes—that is to say, as the gases leave the fire-box and pass upwardly through the fire-space they first come in contact with the lower tubes *e* and give up more heat to the water inside these lower tubes than to the water inside the tubes *e* farther from the fire. As the gases leave the upper tubes *e* they pass between and around the circulating-tubes m', which conduct the mixed water and steam from the front header to the steam and water drum *m*, then downwardly into the downtake or hood in front of the front header, then through the inner or fire tubes *f*, and finally through the uptake to the stack. During this circulation the velocity of the gases passing through the upper fire-tubes will be greater than that of the gases passing through the lower fire-tubes and will of necessity give up more heat to the water outside the upper fire-tubes than to the water outside the lower fire-tubes. This will effect an equal distribution of heat throughout the water contained in the space between the fire and water tubes and will give practically the same speed of circulation to the water contained in the space between the upper fire and water tubes as that imparted to the water contained in the space between the lower fire and water tubes. This will greatly increase the efficiency and capacity of the boiler as compared with the marine horizontal water-tube boilers in general use at the present time, which boilers receive the greatest amount of heat through their lower tubes, and consequently obtain a greater amount of work from the lower tubes than from the upper tubes, which are exposed to gases of much lower temperature.

My improved boiler provides a larger amount of heating-surface in proportion to the number of parts than any other marine horizontal boiler known to me.

The improved means for detachably connecting the tubes *f* with the headers may be used in any structure in which it is desirable to detachably connect a tube with two walls and are not limited to the particular structure here shown.

I claim—

1. A steam-generator comprising a fire-box, front and rear headers forming the front and rear walls of an ascending fire-space above the fire-box, water-tubes secured to the inner walls of the headers and extending through said space, fire-tubes secured to the outer walls of the headers and extending through the headers and through the water-tubes, a downtake connecting the upper portion of said fire-space with the receiving ends of the fire-tubes, said fire-space having no outlet excepting through the said downtake, while the downtake has no outlet excepting through the fire-tubes, and an uptake communicating with the delivering ends of the fire-tubes and with a stack or outlet, the construction being such that the entire products of combustion pass first upward, outside of the water-tubes, and then in a downwardly-inclined direction, through the inner or fire tubes, while the water passes in the opposite direction through the annular spaces between the inner and outer tubes.

2. A steam-generator comprising a fire-box, front and rear headers forming the front and rear walls of a fire-space above the fire-box, the outer walls of said headers having orifices which are larger in one wall than in the other, water-tubes secured to the inner walls of the headers and extending through said fire-space, said tubes being internally of greater diameter than the smaller orifices, fire-tubes

extending through said water-tubes, bushings engaged with the end portions of the fire-tubes and formed to bear on portions of the header-walls surrounding said orifices, the bushing at one end of each fire-tube being smaller than the opposite bushing, so that the fire-tubes and bushings may be inserted and removed endwise, and means for detachably securing the bushings to the header-walls.

3. A boiler or steam-generator having orifices in its opposite walls, the orifices in one wall being larger than the orifices in the other wall, fire-tubes having bushings secured to their end portions and formed to bear on portions of the header-walls surrounding the said orifices, the bushing at one end of each tube being larger than the opposite bushing, and means for detachably securing the bushings to the said walls.

In testimony whereof I have affixed my signature in presence of two witnesses.

ELWOOD E. TAYLOR.

Witnesses:
SAML. A. BURNS,
PHILO WENTWORTH.