(No Model.) 3 Sheets—Sheet 1.

E. D. MEIER.

WATER TUBE STEAM GENERATOR.

No. 551,680. Patented Dec. 17, 1895.

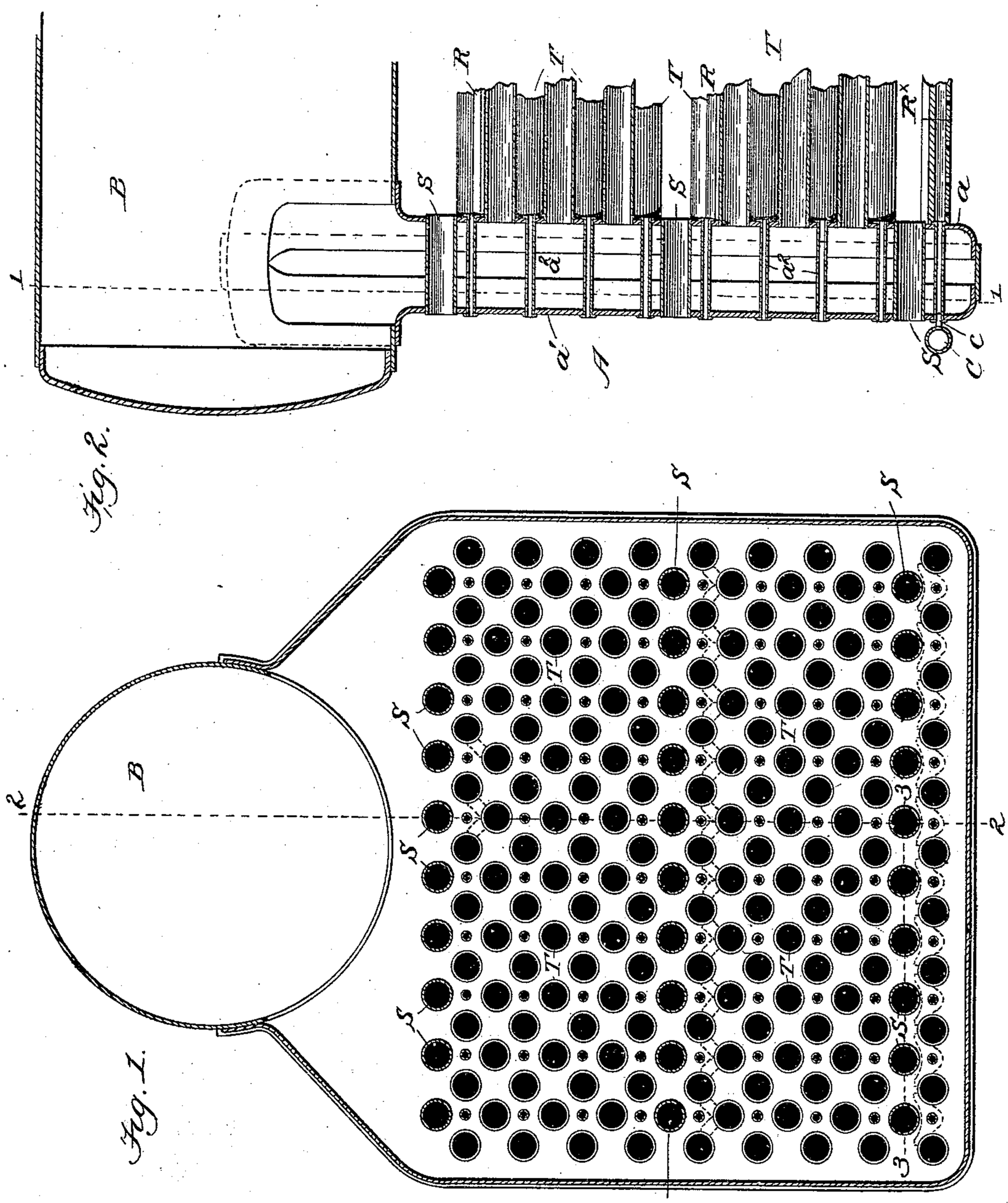

Fig. 2.

Fig. 1.

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(No Model.)

3 Sheets—Sheet 2.

E. D. MEIER.

WATER TUBE STEAM GENERATOR.

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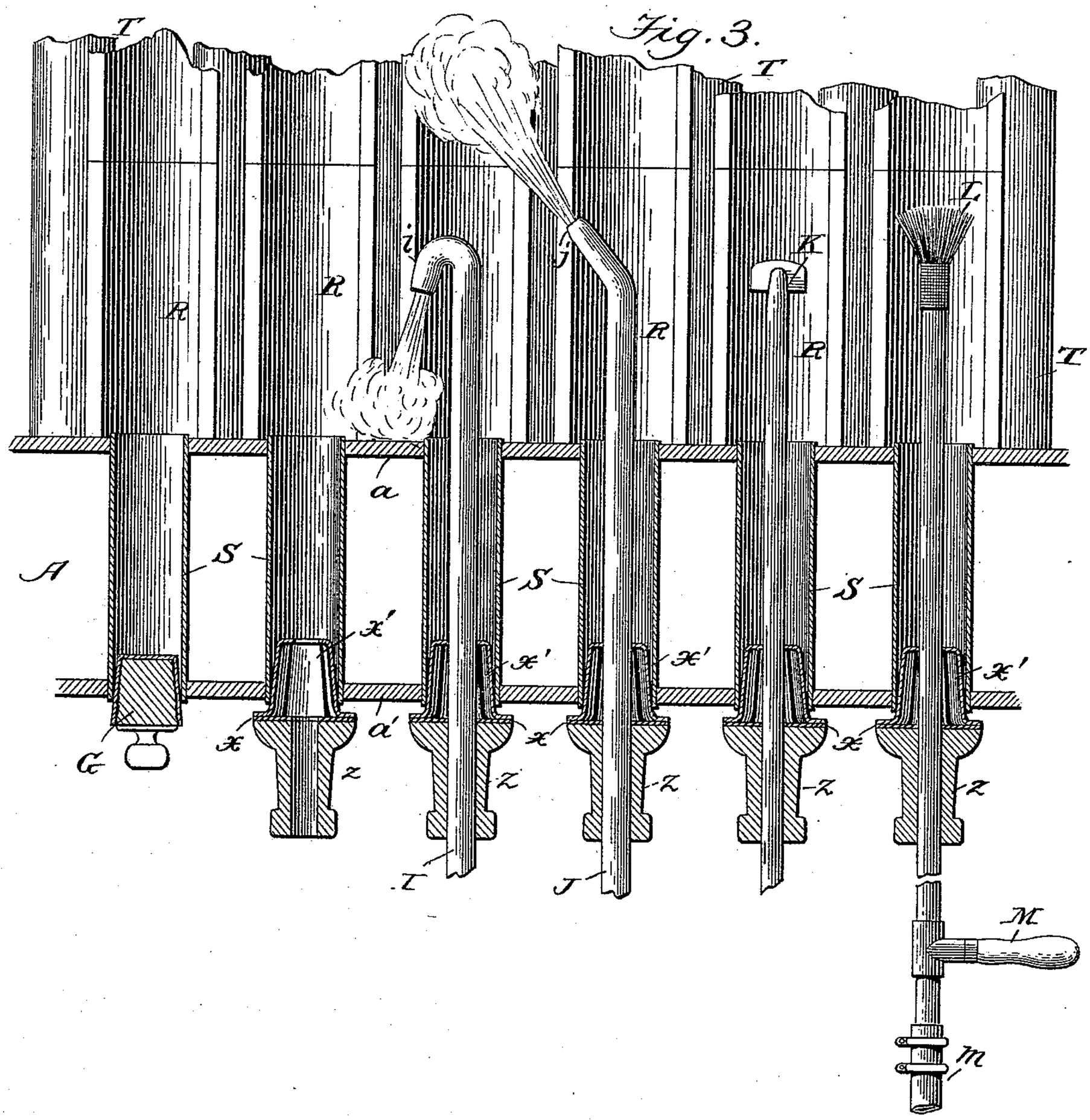
Fig. 3.



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(No Model.) 3 Sheets—Sheet 3.

E. D. MEIER.

WATER TUBE STEAM GENERATOR.

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Fig. 4.

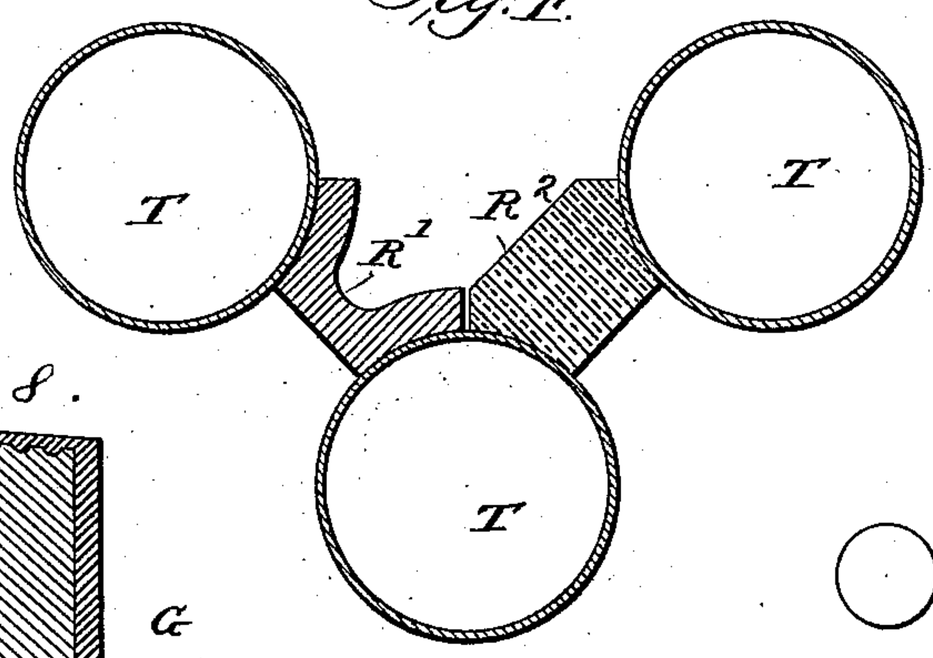


Fig. 8.

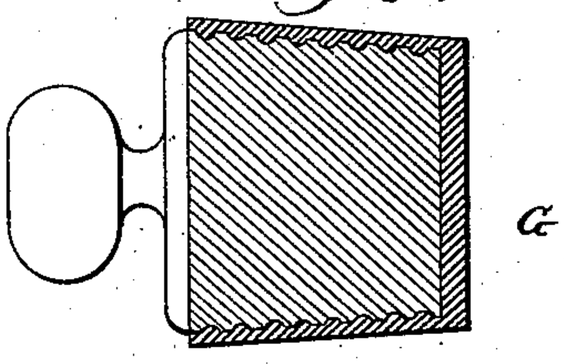


Fig. 9.

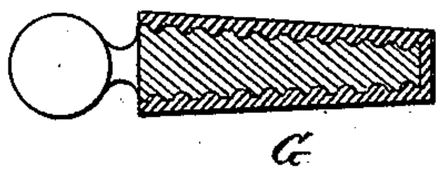


Fig. 5.

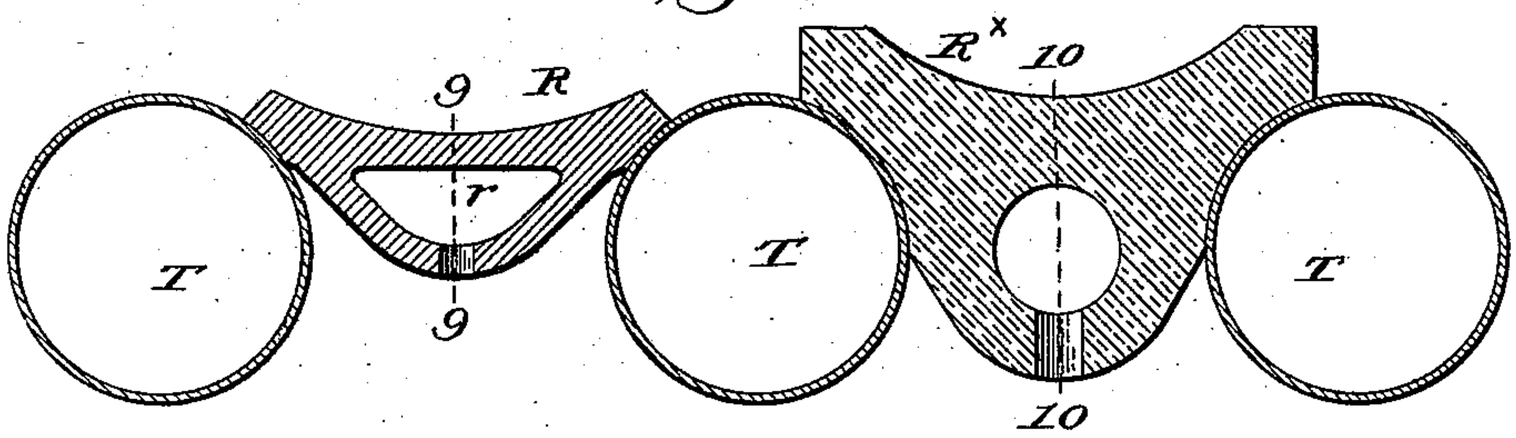


Fig. 6

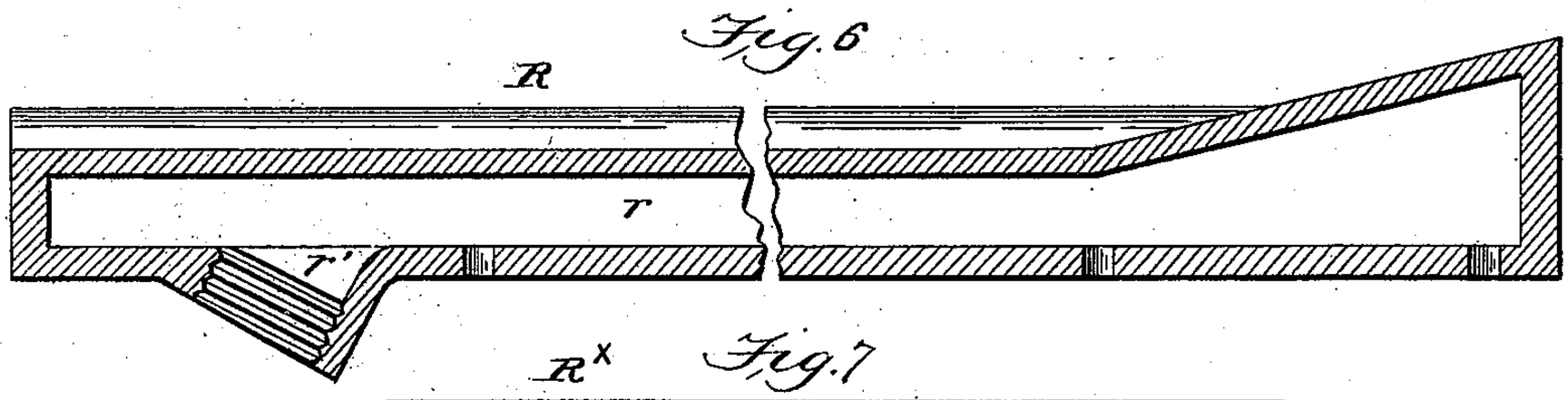
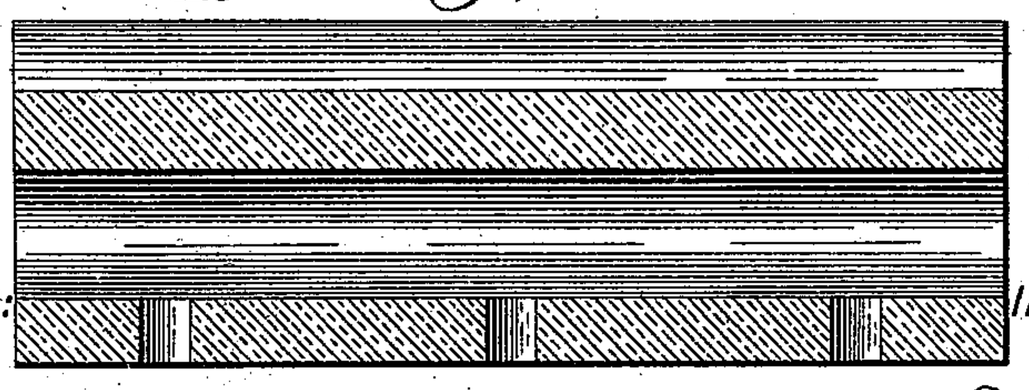


Fig. 7



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UNITED STATES PATENT OFFICE.

EDWARD D. MEIER, OF ST. LOUIS, MISSOURI.

WATER-TUBE STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 551,680, dated December 17, 1895.

Application filed March 25, 1895. Serial No. 543,129. (No model.)

To all whom it may concern:

Be it known that I, EDWARD D. MEIER, a citizen of the United States, residing at St. Louis, in the State of Missouri, have invented certain new and useful Improvements in Water-Tube Steam-Generators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to steam-generators of the type shown and described in United States Letters Patent No. 304,195, granted to Herman Heine on the 26th day of August, 1884, in which two water-legs surmounted by a steam-drum are connected by a series of water-tubes to which the heat of the furnace is applied, and which tubes are separated into groups by means of tiles arranged and disposed between the same to form a sinuous passage for the gases and the products of combustion rising from the furnace below. In operation the boiler-tubes become covered and coated with soot and ashes to such an extent that frequent cleaning is required, and to provide improved means and facilities for effecting this cleaning is one of the objects of my present invention.

Another object is to provide means and facilities for introducing and withdrawing the tiles, above referred to, whereby the boiler-tubes are divided and separated into groups.

Another object is to provide means for introducing air or steam into the ascending gases below or between the groups of boiler-tubes and for heating the same before its introduction, for the purpose of securing complete combustion and thereby preventing the deposition upon the tubes of residual products.

Other minor objects of the invention will be understood from the following description.

In the accompanying drawings, which illustrate my invention and form a part of this specification, Figure 1 is a vertical transverse section through one of the water-legs and through the steam or circulating drum on the line 1 1 in Fig. 2. Fig. 2 is a broken view representing a vertical section in a longitudinal plane through one of the water-legs and through the steam or circulating drum on the line 2 2 in Fig. 1. Fig. 3 is a broken view on an enlarged scale representing a horizontal section through one of the water-legs, as on line 3 3 in Fig. 1, showing various tools and appliances used for cleaning and removing deposits from the boiler-tubes and tiles. Fig. 4 is a view showing the manner of applying the separating-tiles to the boiler-tubes, different forms of tiles being shown. Fig. 5 is a sectional view showing modified forms of hollow tiles or fire-plates adapted to the lower range of boiler-tubes and the manner of applying the same. Fig. 6 is a longitudinal vertical section on the line 9 9 in Fig. 5, and Fig. 7 is a similar section in the line 10 10. Figs. 8 and 9 are sectional views of details hereinafter fully explained.

Referring to the drawings, A designates one of the water-legs of the boiler, and B the steam or circulating drum mounted thereon and communicating therewith, as usual. These water-legs are constructed as usual, except that I propose to make them higher than heretofore in order to accommodate a greater number of boiler-tubes with the view of increasing the steam-generating capacity of the boiler, this being however merely a matter of degree.

T designates the boiler-tubes extending from leg to leg and having their ends expanded into, or otherwise connected with, the tube-plates *a*, as usual. The tubes are arranged in horizontal rows, those of each row alternating with those of adjacent upper and lower rows, as shown in Fig. 1, so that the gases and products of combustion in passing from the furnace upward between and among the same are compelled to take a sinuous or zigzag course, whereby the several tubes are completely enveloped and the heat of the furnace utilized more fully than if the gases were permitted to pass to the flue or stack in a direct course. Even under this arrangement, however, a large percentage of the heat passes to the flue, and therefore with the view of further utilizing the heat and effecting the greatest economy in fuel the tubes are separated into groups by means of tiles or fire-plates R arranged and disposed to form, with the tubes between which they are located and by which they are supported, horizontal partitions extending alternately from opposite ends or sides and overlapping each other after the

manner of "baffle-plates," whereby the hot gases and the products of combustion are caused to travel back and forth between and among the tubes in their passage toward the flue or stack. I find that three of these partitions, located respectively at or near the bottom, at the top, and intermediately between the top and bottom, give excellent results, but a greater or less number may be employed, according to the vertical space occupied by the boiler-tubes, and one or more partial or incomplete partitions may be used as the necessary areas for the passage of gases may require.

Preferably the lower tiles are supported on and by the tubes of the lower row alone and these are therefore made of width and shape to partially overlap two adjacent tubes and to depend between the same, whereby they are supported and held against lateral movement.

For the upper and intermediate partitions the tiles are made of such width and shape as to fit between adjacent tubes of two adjacent horizontal rows, as shown at R′ and R², thus standing in inclined positions and forming, with the tubes of the respective rows between which they are located, zigzag partitions, as clearly shown in Fig. 1. The tiles of the lower row may be arranged and supported in the same way.

It is well known that the more perfect the combustion of fuel and of the gases resulting therefrom the higher will be the degree of heat and the smaller the volume of residual products, and it is therefore common to stimulate combustion by forcing air into the furnace to supply the oxygen required. For this purpose and with the view of delivering air in the most efficient manner and to the best advantage I make my tiles or fire-plates hollow, especially those forming the lower partition, and connect therewith a suitable air-supply to deliver air therethrough, the tiles being perforated at intervals along their under sides to permit the air to escape in jets into the ascending gases.

In Figs. 6 and 7 I show two forms of tiles or plates, the first made of cast-iron and the other made of fire-clay. These tiles (shown in cross-section in Fig. 5 and marked, respectively, R and R×) may be made in single lengths or in short lengths joined together end to end, as may be found most expedient. Preferably they are constructed in separate lengths, whereby they are adapted to be extended or shortened by adding or taking out sections, so as to give more or less lap to the partitions and regulate the sizes of the draft-openings at the ends of the respective partitions.

In the construction shown in Fig. 6, which represents a cast-iron plate, the inner chamber *r* has a branch opening *r*′, with which the air-supply is to be connected, while in the clay tile represented in Fig. 7 the connection is made at the open end which abuts against the tube-plate *a*, or a branch opening similar to that shown on the iron plate can be formed on the tile.

For the attainment of the best results the air should be heated before its introduction in the hollow tiles or fire-plates, a final heating being effected by the heat radiating from the walls of the chamber *r*. For effecting such preliminary heating the supply pipe or flue through which the air is delivered to the tiles or plates may pass through the furnace-chamber or its walls. As a convenient arrangement for effecting such preliminary heating, I show a transverse pipe C connected with the source of supply (not shown) and by branches *c* with the several tiles or plates of the lower partition. These connections may be made at either end of the tile partitions. (Similar connection may be made with each partition if it be found desirable or expedient to introduce air at different points.)

It is usual in the construction of boilers of this class to tie the head-plates *a*′ and the tube-plates *a* together between the boiler-tubes by hollow stay-bolts *a*² screwed or expanded into the respective plates. For convenience as well as for the sake of economy, I propose to alternate a row of these hollow bolts with the boiler-tubes of the lower row and to so construct the tiles that their chambers shall be in line and communicate with the passages through the respective bolts. Then by connecting the branches *c* of the air-supply pipe with the hollow bolts the air will pass through them to the hollow tiles. In the construction of these boilers heretofore the horizontal rows of tubes T have been equally spaced from top to bottom. I now propose to divide them into groups by omitting one or more horizontal rows of the tubes, the lines of separation being immediately above the respective partitions, so that each group shall be covered by an overlapping partition, as indicated in Fig. 2. Opposite each of the open spaces and also immediately above the upper group of tubes, I locate a row of stay-tubes S, which extend through the water-leg and are screwed or expanded into the plates *a a*′ in the same manner as the stay-bolts *a*². These tubes are of larger diameter than the stay-bolts *a*², being approximately of the same diameter as the water-tubes and they are arranged centrally over the respective spaces between the boiler-tubes, as shown. Their purpose is to afford facilities for the insertion of cleaning-tools for removing soot, ashes, &c., deposited on the boiler-tubes and on the surfaces of the tiles or the plates *a*, and for introducing, withdrawing, and adjusting the tiles R forming the central and upper partitions.

As already explained, the upper tiles—that is, those composing the partitions above the lower one—are formed to fit between adjacent tubes of adjacent rows. The width of the spaces thus to be filled being less than the diameter of the stay-tubes S, the tiles are adapted to be inserted, placed in position,

and withdrawn, when required, through the said tubes. The stay-tubes S, by reason of their size, also afford facilities for the insertion and operation of suitable tools for cleaning the water-tubes and partitions by removing the deposits or accumulations of soot, ashes, or other residual products of combustion.

In Fig. 3 I show a variety of cleaning-tools I J, representing pipes or tubes designed to be coupled with a steam-hose *m*, and having nozzles *i j* of different shapes, the pipe with a return-nozzle being designed to clean the tube-sheet *a* by directing against the same a powerful jet of steam, and the pipe J to clean the boiler-tubes and the tiles by directing the steam-jet among and along the same.

K is a hoe designed to scrape the tubes and tiles and to push the soot, ashes and other deposits before it, and L a wire brush or broom for brushing or sweeping off the deposits. These tools are each provided with a handle M, whereby they are adapted to be operated and turned at will.

Each cleaning-tool is provided with a loose sleeve or collar *z*, through and in which it is adapted to slide and turn. These sleeves are adapted to close the stay-tubes S for the purpose of preventing the escape of heat and gases or ingress of cold air during the cleaning operation, and they are therefore constructed to fit into the ends of the tubes, thus serving as both stoppers and guides for the tools. They may be made of any suitable material, preferably of wood, faced at their front ends with asbestos cloth or other non-conducting material *x*, and provided with forwardly-extending metal plates *x'* adapted to fit closely within the tubes S and by their resiliency to hold the sleeves in place.

When the cleaning-tubes are not in use the stay-tubes S will be tightly closed, and for this purpose I provide stoppers or plugs G, also preferably made of wood corrugated circumferentially and covered with suitable fireproof material—such, for example, as asbestos cement or vulcabeston. Similar plugs or stoppers are provided for closing the stay-bolts a^2.

While I show in the drawings entire rows of stay-tubes S extending from side to side of the water-legs and alternating throughout with the boiler-tubes above and below the same, it is to be understood that the objects of the invention in this respect may be partially attained by partial or broken rows in which, for instance, every second or third water-tube is omitted to make room for a stay-tube S; also, that while I have above described the stay-tubes S as being arranged in definite relation to the horizontal partitions above the respective groups of water-tubes, additional rows or partial rows of such tubes may be interspersed between or among the several groups, such additional tubes being advantageous in that they afford additional facilities for cleaning the boiler-tubes.

Having now described my invention, I claim—

1. In a water tube boiler the combination of water legs, a nest of water tubes arranged in horizontal rows, hollow partition tiles or plates extending alternately from the respective legs, the tiles or partitions having downwardly opening passages at intervals, and an air supply connected with the chambers in the tiles, substantially as described.

2. The combination with the tubes of a water tube boiler of a series of hollow tiles or plates arranged and disposed to form a horizontal partition and having downwardly opening passages from their hollow interiors, and an air supply connected with the chambers of said tiles, substantially as described.

3. The combination of horizontally arranged rows of water tubes of a boiler, a series of longitudinally extending hollow tiles or plates, having passages through their under sides, supported by adjacent tubes in the same row, and an air supply connected with the chambers of said tiles, substantially as described.

4. In a water tube boiler the combination of water legs, a nest of water tubes arranged in separate groups, and stay tubes for a boiler head and tube sheet, having an area approximately that of the water tubes opposite the spaces by which the water tubes are divided into groups, substantially as described.

5. In a water tube boiler having its tubes arranged in horizontal staggered rows and having stay tubes for head plate and tube sheet, a series of longitudinally extending tiles or plates constructed to be inserted through the stay tubes and to fit between, and to be sustained by, adjacent tubes of adjacent rows, said tubes and tiles together forming a zig-zag transverse partition or diaphragm across the boiler, substantially as described.

6. In a boiler of the character described the combination of two water legs, a nest of tubes extending from leg to leg and separated at intervals into groups by enlarged spaces, and stay tubes extending through both water legs opposite said enlarged spaces, the tubes approximating in transverse area that of the boiler tubes to afford adequate space for the introduction of tools adequate to clean the tubes and partitions, or of tiles or partition plates, substantially as described.

7. In a boiler embracing water legs and a nest of water tubes, the combination of a series of longitudinally extending hollow tiles, sustained by the water tubes, hollow stay bolts or stay tubes arranged to register with the hollow tiles, and an air supply connected with, and discharging to, said stay bolts and hollow tiles, substantially as described.

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

EDWARD D. MEIER.

Witnesses:
E. R. FISH,
EDW. C. MEIER.