(No Model.) 2 Sheets—Sheet 1.

H. HEINE.

STEAM GENERATOR.

No. 304,195. Patented Aug. 26, 1884.

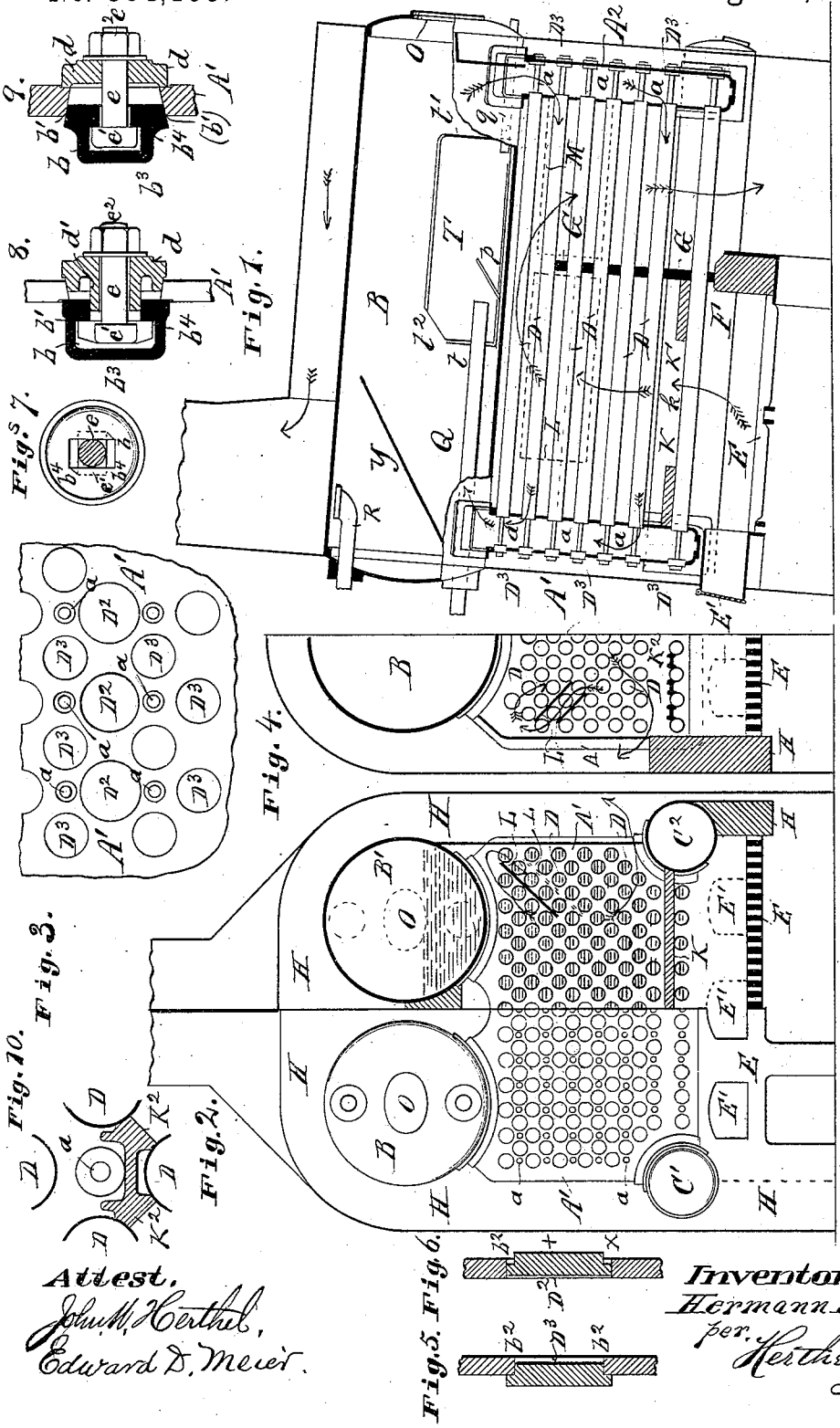

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 10.

Attest.
John M. Herthel,
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Inventor,
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Atty's.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 11.

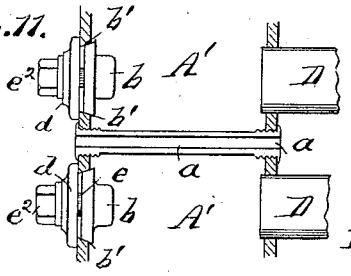


Fig. 13.

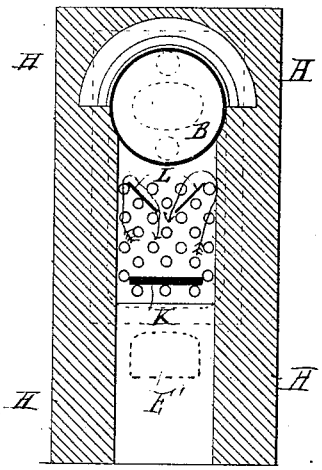


Fig. 12.

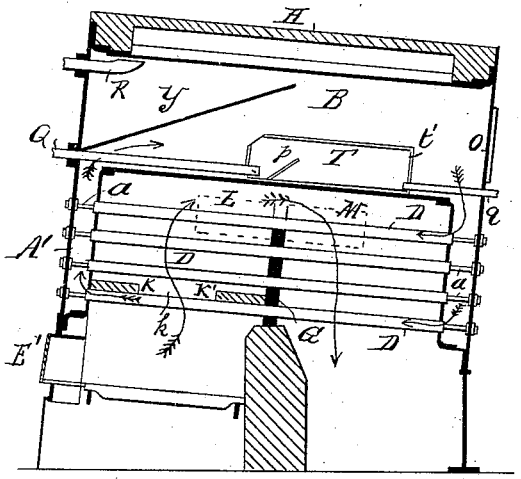


Fig. 15.

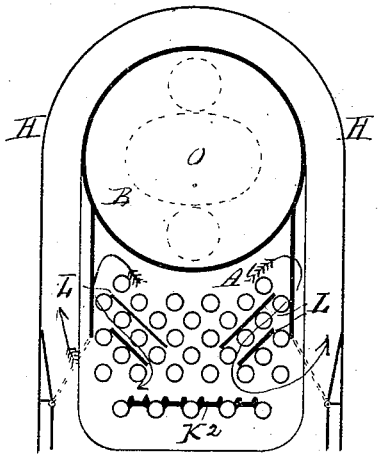
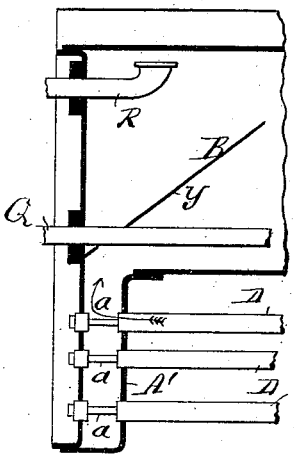


Fig. 14.



Attest;
John W. Berthel.
Edward D. Meier.

Inventor;
Hermann Heine
per, Berthel & Co
Attys

UNITED STATES PATENT OFFICE.

HERMANN HEINE, OF BERLIN, GERMANY, ASSIGNOR TO ADOLPHUS MEIER & CO., OF ST. LOUIS, MISSOURI.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 304,195, dated August 26, 1884.

Application filed October 16, 1882. (No model.) Patented in Germany May 18, 1881, No. 15,983; in England July 21, 1881, No. 3,181, and in Austria-Hungary October 11, 1881, No. 1,398.

To all whom it may concern:

Be it known that I, HERMANN HEINE, of the city of Berlin, Prussia, Germany, have invented a new and useful Steam-Generator, of which the following is a specification, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to the same class of steam-generators designed for stationary, marine, locomotive, and other boilers, and for which Letters Patent of the United States were granted me, No. 200,294, dated February 12, 1878, and No. 233,094, dated October 12, 1880.

My present invention is an improvement and modification in some particulars of the steam-generators which characterize and constitute my said former patents, and, like them, is designed to achieve the prominent objects—such as more economical utilization of the combustibles, a more proper course for the distribution and passage of the hot gases, a constant renewal and more perfect circulation of the water, and consequent better or more perfect generation of steam, &c.—the present devices, however, by which the said objects are accomplished being in many respects essentially different from my said former patents, as will now more fully appear.

The accompanying drawings illustrate my improvements as applied to the particular application or use the boiler is designed for.

Sheet I: Figures 1 and 2 represent the improved stationary boiler, Fig. 1 being a longitudinal sectional elevation, Fig. 2 being a front and transverse sectional elevation. Fig. 3 is an enlarged detail part of one of the head-chambers to better show location of its large and small hand-holes; also the hollow stays. Fig. 4 is a front sectional elevation of one-half of the stationary boiler, but dispensing with the use of the lower waists or boilers. Figs. 5 and 6 are enlarged sectional views to show the two sizes of hand-holes, and further illustrate how, through the larger hand-hole, the proper inner cover is passed to close a smaller hand-hole. Figs. 7, 8, 9 are respective enlarged detail views showing the manner and means to connect the inner and outer covers to the head-plate. Fig. 10 is an enlarged detail section to show the trough-shaped tile and its location between the water-tubes.

Sheet II: Fig. 11 is an enlarged detail of the head-chamber, its hand-holes closed by their double covers, the stay-bolt or hollow stays, and the ends of the water-tubes. Figs. 12 and 13 show the improvements applied to a marine boiler, Fig. 12 being a longitudinal sectional elevation; Fig. 13, a cross-sectional elevation. Figs. 14 and 15 represent a portable boiler, the former figure being but a part sectional elevation, and the latter figure a transverse section.

Similar letters refer to similar parts throughout the several views.

A' A^2 are the front and rear head-chambers or water-legs, made up of tube-sheets and head-plates, are of the same dimensions at both front and rear ends of the generator, and the sheets and plates are directly attached to the steam drum or drums at right angles therewith, and the throats leading from the legs or water-chambers are of a capacity approximating the aggregate capacity or area of the water-tubes, as clearly shown in the drawings. By reason of this construction and combination of water-legs and steam-drum, practically free circulation is obtained through the tubes, legs, and drum, and the corresponding parts of the legs are duplicates of each other, thus affording economy and convenience in fitting, shaping, &c.

B B' represent one or more steam-drums.

D are the series of water-tubes.

All the just-named parts are arranged or set in the inclined position shown, (see Fig. 1,) being highest at the forward end of the furnace. The water-tubes D have their front and rear ends, respectively, communicating with the front and rear head-chambers, and the latter communicate at top near the respective bottom front and bottom rear portions of the boiler B. (See Fig. 1.)

In my patents above referred to, the water-tubes were arranged concentrically with relation to the lower waist or central boiler. In the present case the water-tubes D are "staggered"—that is, the tubes of one row come over

the spaces of the previous row; or the said arrangement can be described as being in horizontal rows with equidistant spaces between, every alternate row being placed midway in said spaces, and as clearly shown in Fig. 2. So arranging and setting the water-tubes insures a rapid circulation of the water, which sweeps every particle of steam, as fast as formed, to the steam-drums, supplying its place with fresh water, thereby absorbing the heat of the fire to the best advantage; also, and more especially owing to said water-tubes being staggered, the hot gases striking said tubes have their currents constantly broken, and a fresh transfer of heat to the heating-surface always takes place.

D^3 and D^2 represent the series of two different sizes of hand-holes to permit access to the water-tubes, head-chambers, &c., for cleaning and other purposes. These hand-holes or openings exist in the outer sheet or "head" plates of the respective front and rear chambers, A' A^2. (See Figs. 1, 3, 5, 6, 8, 9.) Each hand-hole is positioned directly opposite to the open end of each water-tube—that is, has its geometrical axis in line with the like axis of this water-tube; hence, also, the said arrangement of the hand-holes D^3 and D^2 is similar to the horizontal and diagonal rows of the water-tubes themselves. (See Figs. 1, 11.) I also here employ (as in Patent No. 233,094, above referred to) inner and outer cap-plates or covers, *b d*, to close each hand-hole; but according to said last-named patent, to insert or seat the inner covers, *b*, this was chiefly done by passing the same through the man-hole in the lower waist or central boiler, but where the same is used in the present case it is not so located as to permit access to all the hand-holes. Therefore, to render all the hand-holes accessible, to facilitate the proper seating and fastening of each inner cover to close its proper hand-hole, I construct the parts as follows: I make the openings constituting a certain number of the hand-holes larger than the openings constituting the remaining hand-holes; hence it can be here stated that the inner and outer covers will correspond in size to fit said different sizes of hand-holes. Thus, let D^2 represent the enlarged hand-hole; D^3, the smaller hand-hole. By referring to Fig. 6, let b^2+x represent the diameter of the hand-hole D^2, and by referring to Fig. 5, let b^2 represent the larger diameter of the small inner covers; hence, as the diameter b^2+x is greater than the diameter b^2, the small inner cover can be passed through the said larger openings. This done, the further proper seating of said inner covers to proper hand-hole, D^3, is readily accomplished. To seat and secure the inner covers to close the larger hand-holes D^2, this is done by way of the man-hole of the boiler, or through man-hole of the lower waists (larger tubes) in cases where same are used.

The devices to join together and lock the inner and outer covers, *b d*, to close each hand-hole, are illustrated more fully in Figs. 7, 8, 9, 11. *b*, the inner cover, has an annular shoulder at b', internal opening, b^3, with locking-corners b^4. (See Figs. 7, 8, 9, 11.) *d*, the outer cover, is formed with a sleeve projection, d', fitted to partly engage the bore of the opening leading to the opening b^3. (See Fig. 8.) Through the sleeve d' (of cover *d*) the bolt *e* passes, its head e' being fitted so that by a quarter-turn motion it can be locked within the opening b^3 (of inner cover.) (See Figs. 7, 8, 9, 11.)

e^2 is the outside nut to fasten the bolt secure to its place.

In Fig. 8 the outer cover by its conical face can be wedged into the conical face of the hand-hole, while the inner cover, *b*, has simply a square shoulder-face against the sheet or plate.

In Figs. 9, 11 I show the face b' of the inner cover made conical, and the outer cover is simply held firmly against the plate; also, as seen in said Fig. 9, the outer cover, *d*, has no sleeve projection, but is simply a disk-plate with proper opening for the passage of the bolt.

a are the tubular stays. (See Figs. 1, 2, 3, 11.) These stays are identical in construction and manner of fastening, as described and shown in Fig. 8 of my Patent No. 233,094. I however arrange the stays so that they are in the horizontal pitch-line of the one row and the vertical pitch-lines of the next row of hand-holes and their inner and outer covers, thus giving more room for circulation of water and manipulations that may be required in the head-chambers. Every hand-hole and its double covers (with the exception of such of these parts as are positioned at the extreme borders of the head-chambers) derive, therefore, the advantages of strength, security, and joint afforded by a pair of stays. The circulation of the water through the tubes, and front and rear chambers, takes the course indicated by arrows shown in Figs. 1, 12, 14.

Q is the feed-pipe to feed water to the boiler. The feed-pipe extends sufficiently outside the front of the boiler to make suitable connection with the water-supply. The rear portion of feed-pipe enters the mud-catcher T. (See Figs. 1, 12.) The mud-catcher T consists of a cylindrical or box-like vessel, having two heads, t t', the former and part of the top shell of the mud-catcher being cut away to form the opening t^2, by means whereof the feed-water is left free to take part in the circulation in the boiler, and as indicated by arrows in Figs. 1, 12, 14. The rear head, t', of mud-catcher can be left away, and the same arranged so as to have the same rear head as the steam-drum.

q is the blow-off pipe. Its rear end enters the mud-catcher, as shown, (see Fig. 1,) while the outside part of blow-off pipe is provided with a suitable blow-off valve.

p is an inclined plate placed in the mud-catcher (see Figs. 1, 12) to prevent the feed-water from stirring up the deposit of mud,

&c., which collects in the rear portion of the mud-catcher, said sedimentary matter being "blown off" from time to time through the blow-off pipe. In the rear portion of the mud-catcher T the motion of the water will be very slack, at the same time its temperature being above the boiling-point; hence said two conditions insure the deposit of nearly the entire sediment or scale-forming ingredients of the water, which are thus deposited in a convenient receptacle for blowing off, and do not take part in the further circulation of the water. The bottom of the mud-catcher should be placed a short distance above the bottom of the steam-drum, so that the water in same can circulate around and below the mud-catcher, preventing the burning of those sheets upon which the mud is deposited.

Y is an inclined sheet or plate to aid in the circulation, prevent priming, &c.

R is the outlet for the steam.

O is the boiler man-hole.

G is the partition-wall.

F is the fire-bridge.

E is the grate.

E′ is the furnace-doors.

H is the surrounding brick-work or plates or walls, the sides of which being built close against the outermost tubes D, the top wall closing over the boiler. (See Figs. 1, 2.)

K K′ are similar brick coverings or tiles placed between the lowest rows of water-tubes D. (See Figs. 1, 2.) Further, the tile covering K is placed to abut against the front head-chamber, while the opposite tile, K′, abuts against the partition or diaphragm, as shown. Between both the tiles K K′ there is left a passage or throat, *k*, for the passage of the gases, heat, &c. These tiles K K′ cause a more complete combustion of the fuel before escaping from the furnace, and the gases, heat, &c., escaping directly from the furnace are forced to converge in their upward passage through the throat *k*, thence spread in the direction or take the further course among and outside the inclined water-tubes.

K^2 are tiles or castings having a single longitudinal hollow or trough shape on one side, or made trough shape on both its upper and lower sides. (See Figs. 4, 10, 15.) These tiles or castings are so placed between the water-tubes that, with their contiguous tubes, they form troughs to collect soot and ashes, which can be blown off by a steam-jet through the hollow stay-bolt opening just above such tile or casting. (See Figs. 4, 10, 15.) The tiles K′ and tiles or castings K^2 are made in short sections and of substantially the form shown, so that they may be inserted or removed after the boiler is set up.

L M are sets of deflecting plates or tiles placed in an inclined position between the top rows of water-tubes, the one set extending from the partition-wall to the front a certain distance. The remaining set are located in a similar manner to the rear of said partition-wall. (All shown in Figs. 1 and 2.) The said plates L M deflect the currents of hot gases to follow the course indicated by arrows, (see Figs. 1, 2, 4, 13, 15,)—that is to say, said currents, as they strike the under forward portion of the boiler, are compelled to pass along the under surface thereof until they reach the rear bottom portion of the boiler; thence said gases, &c., are forced downward between the water-tubes in the combustion-chamber to the rear of the partition-wall. Finally, said currents pass out of the flue, chimney, or uptake. It will be noted that the currents of hot gases, heat, &c., rising upward to reach the under forward portion of the boiler, are constantly intercepted by some fresh-water tube, and, striking against same, said currents are constantly broken into fresh volumes; also, that the same process takes place when the currents descend at the opposite side of the combustion-chamber and until the currents reach the proper point of final passage and exit. By this means the important result is gained that the outer envelope of the flame or gas which has been cooled by contact with a water-tube does not come in contact with the next water-tube. This tube, by its position over the center of the spaces, divides the current of the gas or flame, so that the central or hottest portion of this gas or flame is made to strike and envelop it.

H represents the outward or surrounding sheets or covering with space between same and the sides and top of the boiler leading to the uptake or stack used for locomotive and marine boilers. (See Figs. 12, 13, 15.)

For marine boilers I employ the lower longitudinal tubes or waists, C′ C^2, to give increased heating-surface, aid the circulation of water, &c. Said waists are located to rest against the side walls of the furnace. The ends of said waists are joined in open communication with the respective head-chambers. (See Fig. 2.)

I claim—

1. In a steam-generator, the water-tubes arranged in horizontal and staggered rows and having head-chambers or water-legs connected with a circulating drum or drums, the combination therewith of stay-bolts, substantially as described—that is to say, one stay-bolt between each pair of hand-holes or water-tubes in the alternate horizontal and vertical rows of holes and tubes—as specified.

2. The combination, with the upper shell or circulating-drum of a water-tube steam-generator, of a mud-drum mounted within said circulating-drum below the normal water-line, the feed and outlet passages being at the same end of the mud-drum, so that the current is opposed to the feed-current and is deflected backward by the upward current in the water-leg.

3. In a water-tube steam-generator, the combination, with the mud-drum T, of the deflector Y, arranged across the head of the water-leg A′, for deflecting the upward current toward the mud-drum, thereby tending to hold the contents of the mud-drum within the same, and

finally deflecting the current from it toward the rear end of the generator, as set forth.

4. A water-tube boiler having water-legs of the same dimensions attached directly to the drum at right angles, so that the head-plates and tube-sheets are duplicates of each other, and whose openings into the drum are of approximately equal area or capacity with the aggregate tube area, whereby unobstructed circulation and convenience and economy in fitting, shaping, &c., are obtained.

5. In a steam-generator, the series of water-tubes D, arranged in horizontal and staggered rows, and communicating with the front and rear chambers, A′ A², as described and shown, the inclined plates L M between the said water-tubes, the former extending from the diaphragm to near the front head-chamber, the latter tiles or plates extending from the diaphragm completely to the rear head-chamber, the diaphragm G, and the furnace and its grate, by means whereof the currents of hot gases, &c., are deflected between the said water-tubes and under the surface of the boiler, in the manner and for the purposes set forth.

6. In a steam-generator having water-tubes D, arranged in horizontal and staggering rows, as described and shown, and communicating with head-chambers A′ A², having hollow stays *a*, the tiles K², each of which is placed below the opening of the hollow stay and longitudinally between three of the said water-tubes, forming, with the latter, a diaphragm or trough for the horizontal circulation of the gases, and means to collect soot, ashes, &c.

7. The combination, in a steam-generator, of the water-tubes D, the head-chambers A′ A², with or without the lower boilers or waists, C′ C², the steam-drum, the diaphragm G, the deflecting-plates L M, the tile coverings K K′, and throat or passage-way *k*, all said parts constructed and arranged to operate in the manner and for the purposes set forth.

8. The improved steam-generator, consisting of the essential parts, viz: the head-chambers A′ A², the water-tubes D, the boiler B, having mud-catcher T, feed-pipe Q, blow-off pipe *q*, diaphragm G, tiles K K′, deflecting-plates L M, furnace-chamber, and chimney-exit, all said parts constructed and arranged to operate substantially in the manner and for the purposes set forth.

9. In a steam-generator, the combination of the series of water-tubes D, head-chambers A′ A², the latter communicating with the boiler at its forward and rear portions, the head-chambers further having the large and smaller hand-holes D² D³, each closed by inner and outer covers, *b d*, fastening-bolt *e*, and the tubular stays *a*, arranged with relation to said hand-holes, all constructed in the manner and for the purposes set forth.

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

HERMANN HEINE.

Witnesses:
BERTHOLD ROI,
CARL NEUER.