

(No Model.)

G. A. CURTIS & R. CUNNINGHAM.
DROP TUBE STEAM GENERATOR.

No. 560,397.

Patented May 19, 1896.

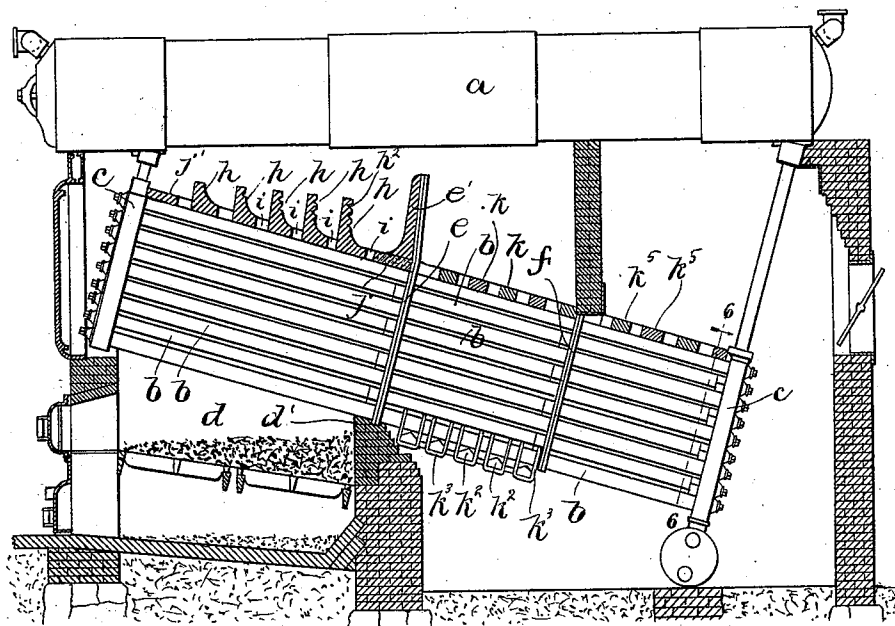


FIG. 1.

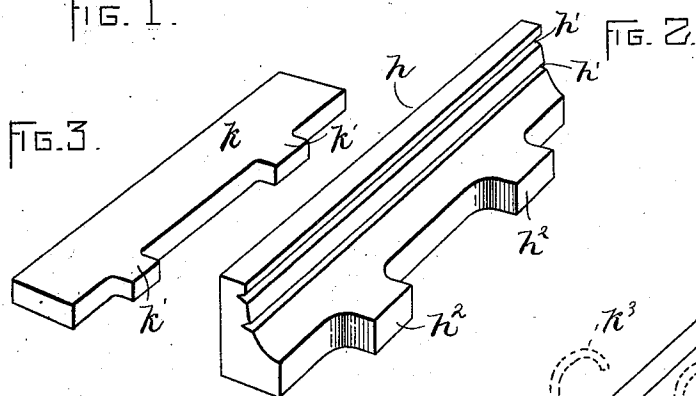


FIG. 3.

FIG. 2.

FIG. 4.

FIG. 5.

FIG. 7.

WITNESSES:
A. S. Harrison.
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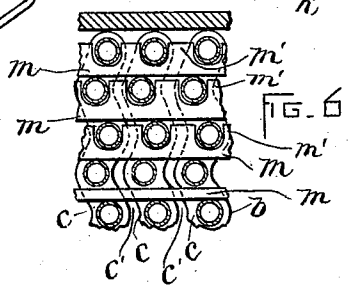


FIG. 6.

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GEORGE A. CURTIS AND RUEL CUNNINGHAM, OF BOSTON, MASSACHUSETTS.

DROP-TUBE STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 560,397, dated May 19, 1896.

Application filed January 25, 1896. Serial No. 576,888. (No model.)

To all whom it may concern:

Be it known that we, GEORGE A. CURTIS and RUEL CUNNINGHAM, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Drop-Tube Steam-Generators, of which the following is a specification.

This invention relates to boilers or steam-generators of the drop-tube type, comprising a substantially horizontal steam-drum, a series of inclined drop-tubes located below the drum and separated therefrom by an intervening space, and a fire-box below said tubes, the arrangement being such that the products of combustion from the fire-box pass upwardly through the spaces between the forward portions of the tubes and into the space between the tubes and the drum, then pass downwardly through spaces between the central portions of the tubes, and finally upwardly through the spaces between the rear portions of the tubes.

Our invention has for its principal object to provide efficient means for at once facilitating the combustion of the unconsumed gases in the space between the forward portions of the tubes and the drum and for causing the impingement of the burning products of combustion against the drum to the end that their thermal efficiency may be thoroughly utilized.

The invention also has for its object to provide means for more thoroughly utilizing those products of combustion that pass between the intermediate and rear portions of the tubes.

The invention consists in the several improvements which we will now proceed to describe and claim.

Of the accompanying drawings, forming a part of this specification, Figure 1 represents a partial side elevation and partial vertical section of a steam-generator embodying our improvements. Fig. 2 represents a perspective view of one of the heat-radiating guides employed over the forward portions of the tubes. Fig. 3 represents a perspective view of one of the heat-retarding bars or plates placed over the intermediate and rear portions of the tubes. Fig. 4 represents a perspective view of one of the heat-retarding bars placed below the intermediate portions

of the tubes. Fig. 5 represents a perspective view of one of the devices used for supporting the bar shown in Fig. 4. Fig. 6 represents a section on line 6 6 of Fig. 1. Fig. 7 represents a perspective view of one of the stoppers.

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

In the drawings, *a* represents the horizontal drum, and *b b* the inclined drop-tubes, of a boiler or steam-generator of the Babcock & Wilcox type, the tubes being connected with each other at their ends by suitable headers *cc*, said headers being connected in the usual manner with the drum *a*.

d represents the fire-box, arranged below the forward portions of the tubes.

e represents the baffle-plate, which extends upwardly from the bridge-wall *d'*, and separates the forward portions of the tubes *b* from the central or intermediate portions, and *f* represents the rear baffle-plate, which separates the intermediate portions of the tubes from the rear portions thereof, all being of a common and well-known construction.

The tubes *b* are separated from the drum by a space which, owing to the inclination of the tubes, increases in height from the front to the rear ends of the tubes, so that the products of combustion which are guided upwardly by the baffle-plate *e* between the forward portions of the tubes naturally tend to pass rearwardly through the wider portion of said space, avoiding the narrower forward portion, the result being that the heat is not utilized upon the portion of the drum directly over the fire-box as fully as is desirable.

In carrying out our invention we provide a series of guides or deflectors *h*, extending across the upper row of tubes and projecting upwardly from the tubes into the space between the tubes and the drum *a*. Said guides, which are made of refractory material, such as fire-brick, are preferably supported by the tubes and are separated from each other by spaces *i*, through which the products of combustion pass, said spaces being made successively narrower from the front to the rear end of the series, as shown in Fig. 1, so that portions of the products of combustion are deflected forward, the products being thus distributed along the entire length of the for-

ward portions of the tubes more thoroughly than would be the case if the openings were all of the same width, in which event the greater volume of the products of combustion would pass through the rear openings. Owing to the inclination of the tubes we make the guides h of varying height, the guides gradually increasing in height from the front to the rear end of the series, as shown in Fig. 1, the increase being such as to make the upper ends of all the guides of practically the same height, so that the products of combustion are guided upwardly to the same extent by each guide. We prefer to make each guide h of the general form shown in Fig. 2, the guide having a relatively broad base adapted to rest upon the series of tubes and being reduced in thickness at its upper portion, so that it can be readily chipped off to reduce its height, it being our intention to make all of the guides of the same height, so that they can be fitted to any drop-tube boiler, whether the inclination of the tubes be greater or less than that shown in Fig. 1. In order that the guides may be readily reduced in height, we provide grooves h' , which are parallel with the upper edges of the guides and guide the workman in chipping off the material. Each guide is provided with spacing lugs or projections h^2 , projecting laterally from one edge of the base of the guide and abutting against the adjacent surface of the next guide. The said lugs are preferably made of uniform length or projection in all the guides and chipped off when the guides are being assembled to give the desired variation in the width of the spaces i . We prefer to interpose a deflecting-plate j of fire-brick between the baffle-plate e and the adjacent guide h , and to interpose a similar plate j' between the upper headers c and the adjacent guide h , as shown in Fig. 1. It will be seen that the guides h , arranged as shown and separated by the intermediate spaces, not only distribute and guide the products of combustion upwardly, causing them to impinge against the drum a , but also become highly heated and radiate heat upon the gases passing between them, thus promoting the combustion of said gases. Although we have described a series of guides h , it is obvious that a single guide arranged to deflect the products of combustion upwardly and to radiate heat for the purpose of promoting combustion would give in part the advantages above set forth, and we therefore do not limit ourselves to the employment of a series of guides.

In Fig. 1 we show the baffle-plate e provided with an extension e' , projecting upwardly into the space between the tubes and the drum, said extension being preferably protected by a facing of fire-brick e^2 and constituting an upwardly-projecting guide, which may be used either with or without the series of guides h . We find that by thus deflecting the products of combustion upwardly and causing them to pass along highly-heated re-

fractory surfaces above those portions of the tubes which are located over the fire-box we effect a material saving of fuel and utilize to a marked degree its thermal efficiency.

Our improvements also include means for retarding the products of combustion in their course from the space between the drum and the tubes through the intermediate and rear portions of the tubes. We have here shown three sets of devices for accomplishing this result, namely:

First, a series of bars or plates k of fire-brick of substantially the form shown in Fig. 3, adapted to rest upon the upper row of the intermediate portions of the tubes, said plates having spacing lugs or projections k' , which form spaces between the plates for the passage of products of combustion.

Second, bars or plates k^2 , suspended from the lower row of the intermediate portions of the tubes, said bars being of the form shown in Fig. 4 and provided with hangers k^3 , formed, as shown in Fig. 5, with hooked ends to engage the tubes and support the bars k^2 below the tubes, said bars having spacing lugs or projections k^4 . We prefer to make the upper sides of the bars k^2 angular, as shown, in order that they may shed the ashes and soot that fall upon them.

Third, a series of bars or plates k^5 , placed upon the upper row of the rear portions of the tubes behind the baffle-plate f , said plates being formed like the plates k and having similar spacing lugs or projections.

We may use either one of the above-described series of retarding-bars, the other two being omitted, or the three series may be used, as shown. The result of these spacing-bars is to retard the products of combustion, first, in the space between the drum and tubes, causing the heat to be more thoroughly utilized upon the drum; secondly, in the spaces between the intermediate portions of the tubes, and, thirdly, in the spaces between the rear portions of the tubes.

The headers c , that connect the tubes b , are of the sinuous form shown in Fig. 6 and are separated from each other by spaces c' , through which a considerable proportion of the products of combustion escape into the space behind the series of tubes without passing upwardly to the space above the rear portions of the tubes. To prevent this loss of heat, we have provided a series of stoppers for the spaces between the sinuous headers, as shown in Figs. 6 and 7, each stopper being a bar m , having projections m' formed on one edge, the bar and projections being adapted to be inserted flatwise between two horizontal rows of tubes, as indicated at the bottom of Fig. 6, and after its insertion the projections m' may be inserted between the tubes by giving the bar a quarter-turn, the projections being formed to partially fill the spaces between the tubes, as indicated in Fig. 6. These stoppers may be made of fire-brick or any other suitable material.

The bars or guides *h* first described may be considered retarding-bars in that they retard the passage of products of combustion upwardly between the forward portions of the tubes, and in this respect they are equivalents of the bars *k* *k*² *k*⁵. We believe that a bar of refractory material adapted to extend across the tubes of a drop-tube boiler and provided with spacing projections which form spaces for the passage of the products of combustion between the bars is new with us, and we therefore desire to cover the same as broadly as possible within legal bounds.

We claim—

1. In a drop-tube steam-generating apparatus, the combination with the drum, drop-tubes, and fire-box, of a series of heat-radiating bars or guides of refractory material supported by the upper row of tubes over the fire-box and projecting above said tubes to guide the products of combustion upwardly toward the drum, said guides being separated by spaces for the passage of the products of combustion.

2. In a drop-tube steam-generating apparatus, the combination with the substantially horizontal drum, the inclined drop-tubes, and the fire-box, of a series of heat-radiating bars or guides of refractory material supported by the upper row of tubes over the fire-box and separated from each other by spaces, said guides increasing in height from the front to the rear end of the series, whereby their upper edges are located at substantially the same height.

3. In a drop-tube steam-generating apparatus, the combination with the drum, drop-tubes, and fire-box, of a series of heat-radiating bars or guides of refractory material supported by the upper row of tubes over the fire-box and projecting above said tubes, said guides being separated from each other by

spaces which decrease in width from the front to the rear end of the series, whereby the products of combustion are partially deflected forward.

4. A retarding bar or guide composed of refractory material and having a broad base adapted to rest on a row of tubes and reduced in thickness above said base, so that its upper edge may be readily reduced or lowered.

5. A retarding bar or guide composed of refractory material and having a broad base adapted to rest on a row of tubes, and a reduced upper portion which is longitudinally grooved to facilitate a reduction of the height of the guide.

6. The combination with the fire-box, the drum, the drop-tubes, and the baffle-plates, of a series of retarding plates or bars of refractory material suspended from the intermediate portions of the lower row of tubes, said bars being separated by spaces.

7. A retarding-bar having spacing projections and hangers whereby it may be suspended from boiler-tubes.

8. A drop-tube boiler comprising the drum, the drop-tubes, the fire-box, the distributing and guiding bars located above the forward portions of the tubes over the fire-box, the retarding-bars located above the intermediate portions of the tubes, the suspended retarding-bars located below the said intermediate portions, and the retarding-bars located above the rear portions of the tubes.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 18th day of January, A. D. 1896.

GEO. A. CURTIS.

RUEL CUNNINGHAM.

Witnesses:

HAZEN CURTIS,
C. F. BROWN.