

(No Model.)

G. C. HICKS.  
TUBE CLOSER FOR STEAM BOILERS.

No. 504,582.

Patented Sept. 5, 1893.

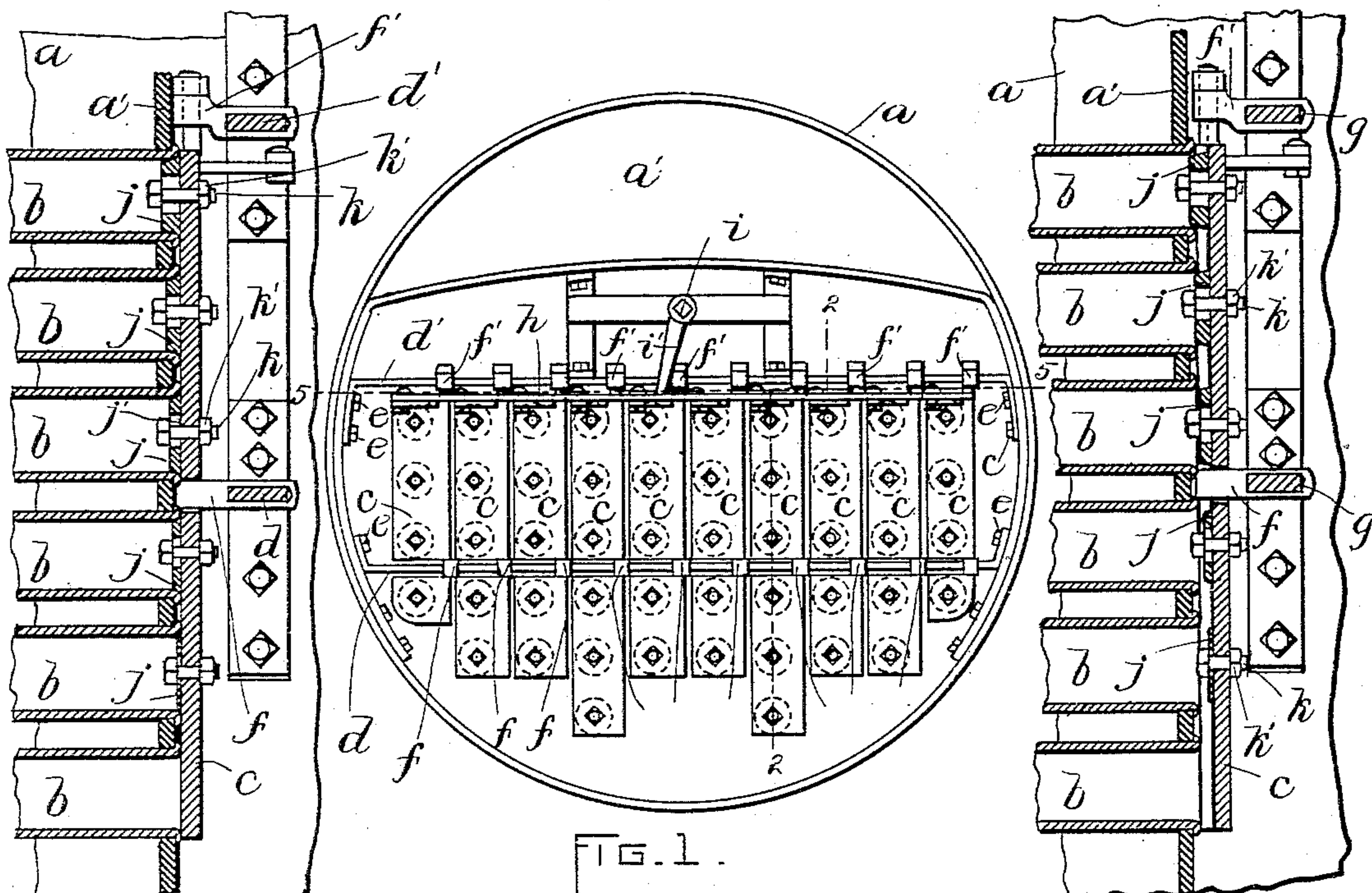


FIG. 1.

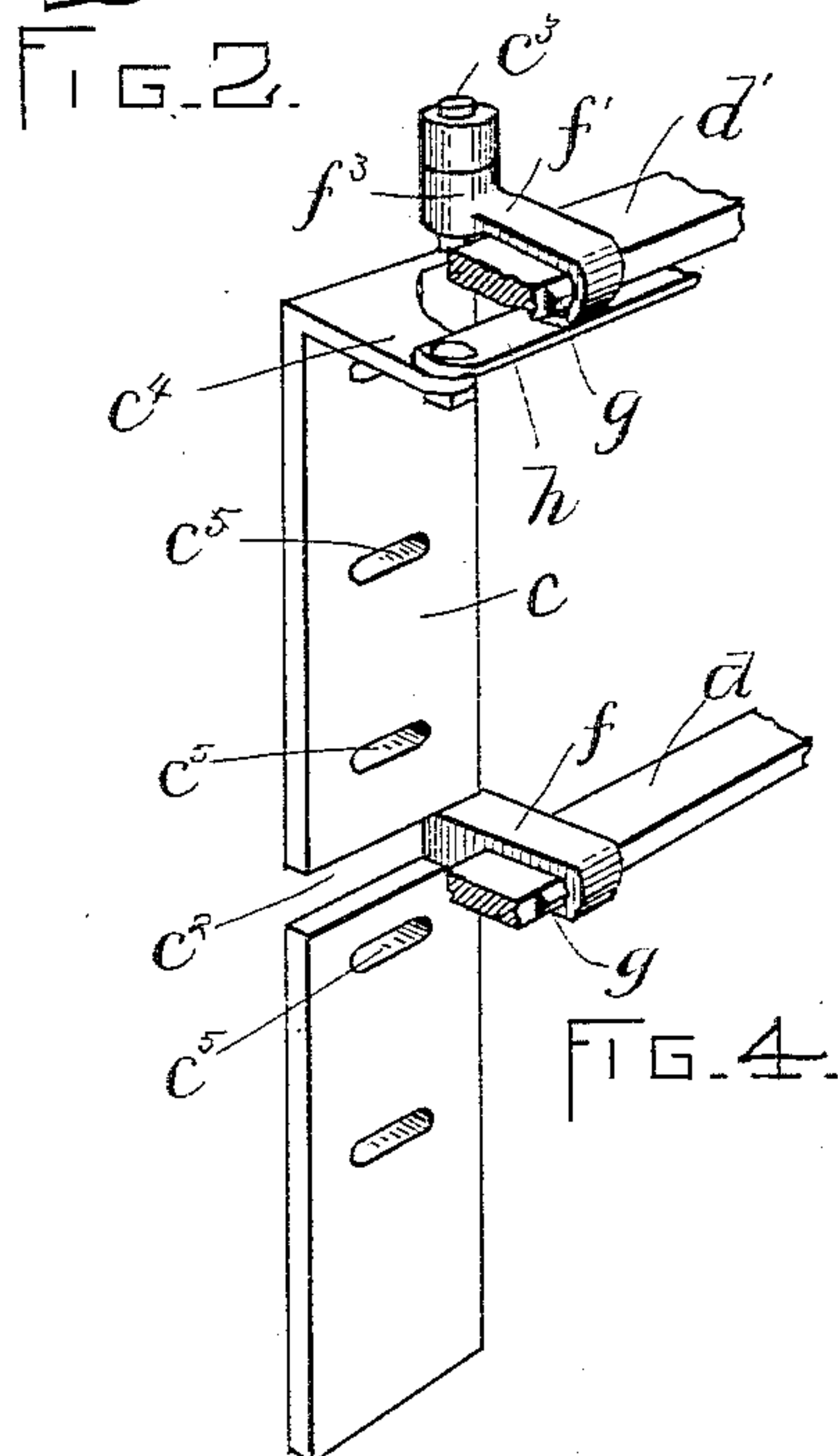


FIG. 4.

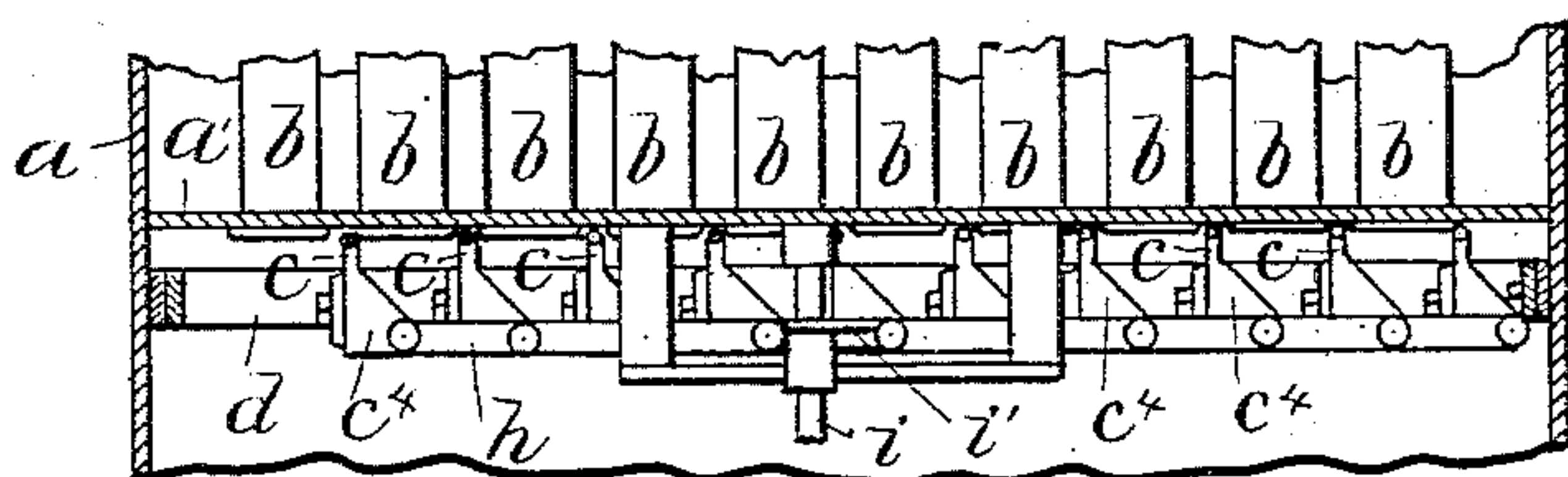


FIG. 5.

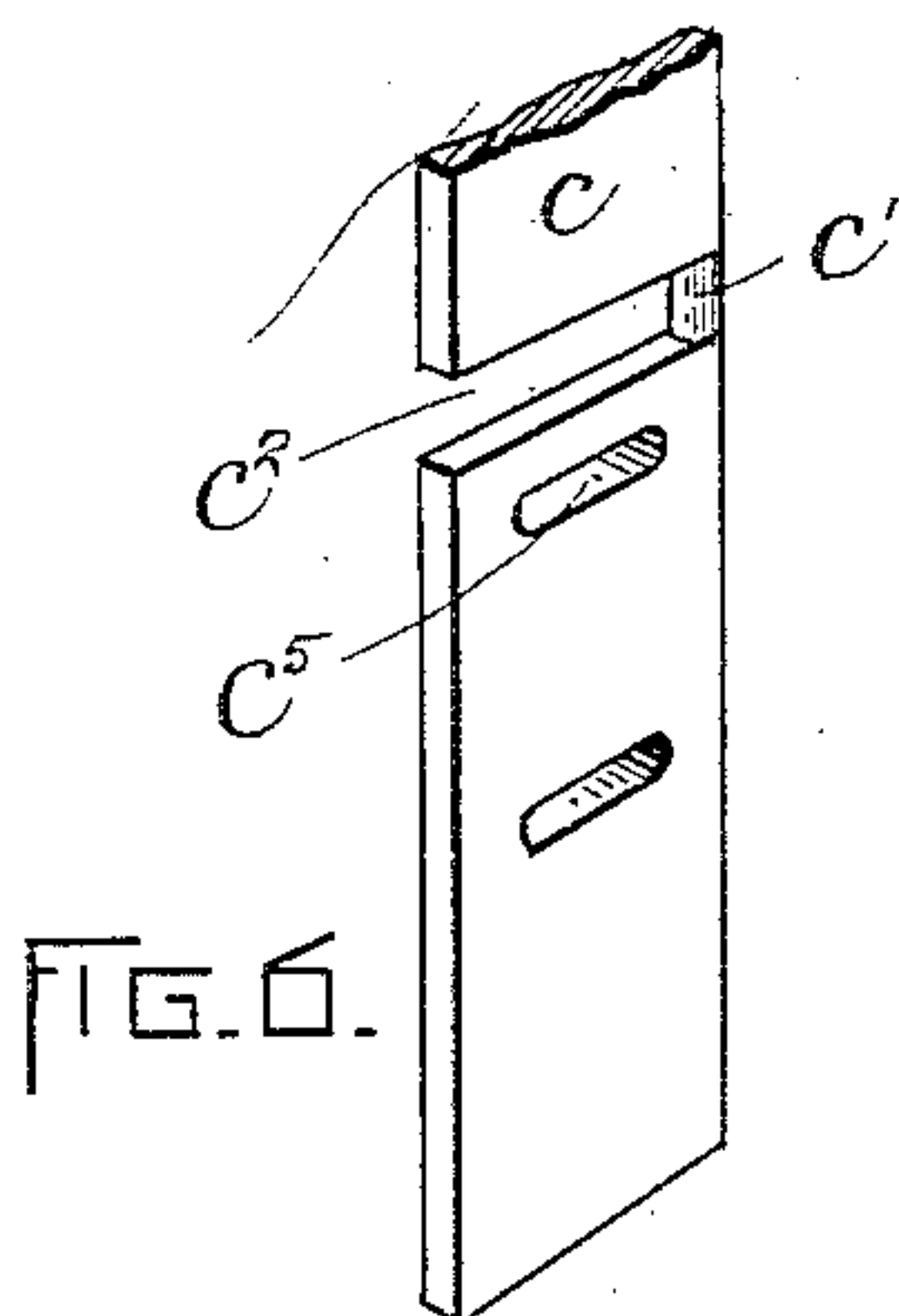


FIG. 6.

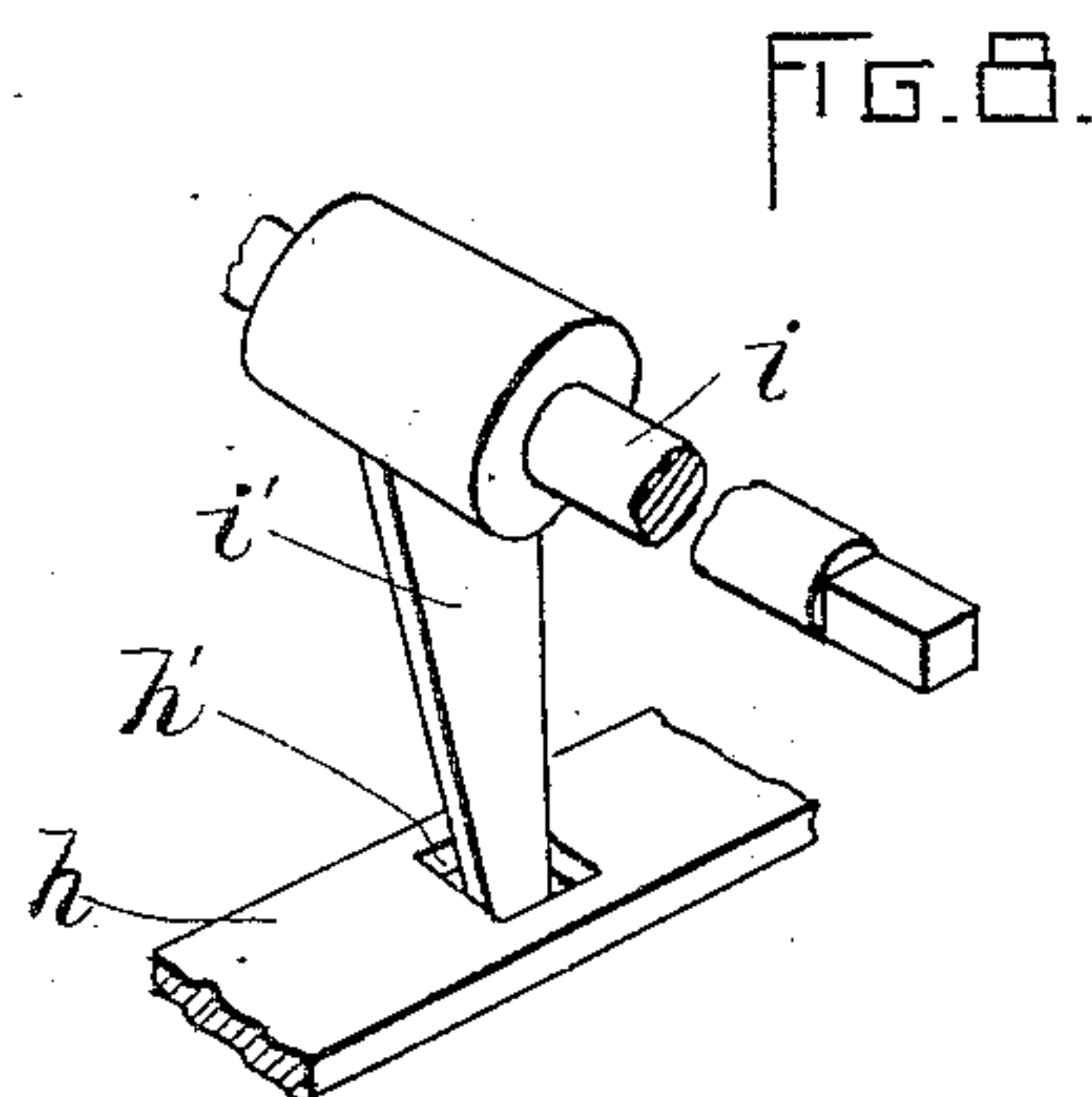


FIG. 3.

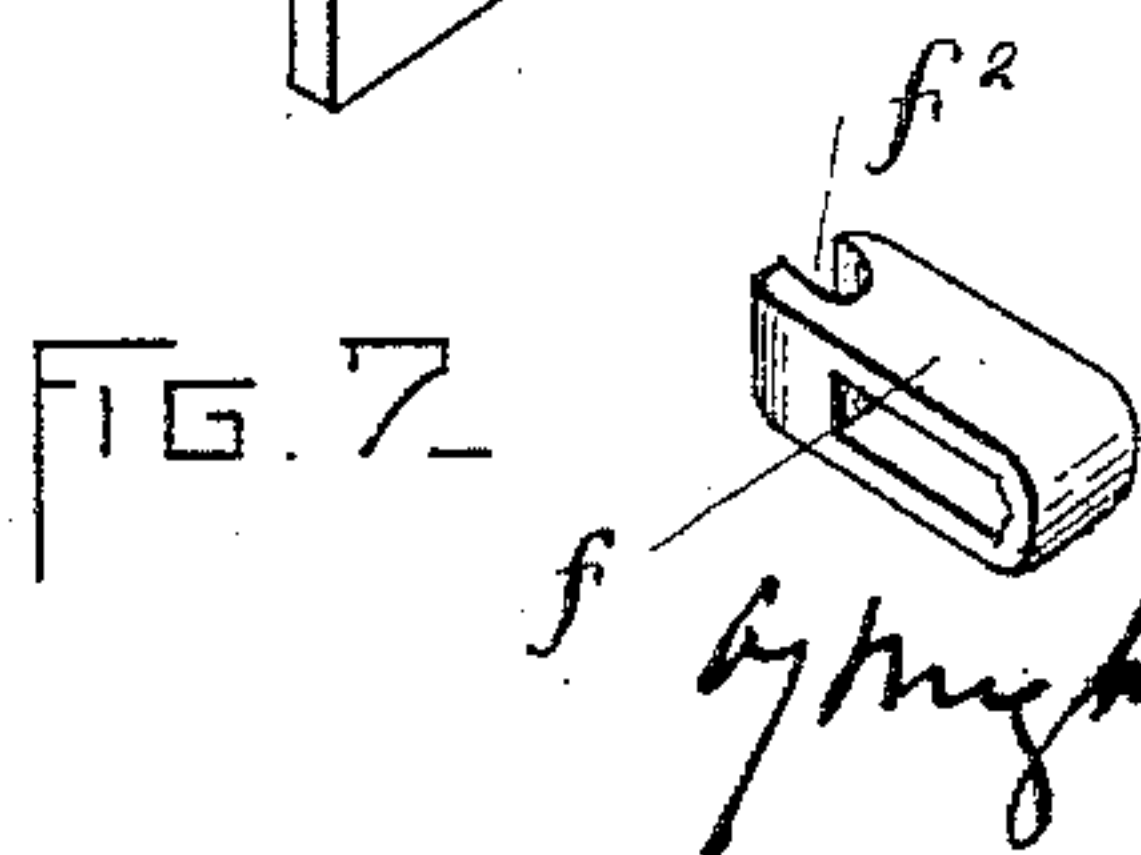


FIG. 7.

WITNESSES:

W. C. Jackson  
J. S. M. Lead

INVENTOR.

Geo C. Hicks

By Night/ Anne Rossley

attys



# UNITED STATES PATENT OFFICE.

GEORGE CLEVELAND HICKS, OF BOSTON, MASSACHUSETTS.

## TUBE-CLOSER FOR STEAM-BOILERS.

SPECIFICATION forming part of Letters Patent No. 504,582, dated September 5, 1893.

Application filed December 27, 1892, Serial No. 456,316. (No model.)

*To all whom it may concern:*

Be it known that I, GEORGE CLEVELAND HICKS, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Tube-Closers for Steam-Boilers, of which the following is a specification.

This invention relates, in general, to the class of devices shown in Letters Patent of the United States Nos. 287,829 and 287,931, both granted to me November 6, 1883; and more particularly to the improved construction shown in my application for Letters Patent of the United States, filed June 15, 1892, Serial No. 436,756. The said patents show and describe a method of and means for retaining the heat of steam boilers when in temporary disuse, said method consisting in suppressing the circulation of local gaseous currents between the boiler tubes or flues and the cooler escape passages or chimney-stack during periods of temporary disuse. In my above-mentioned application, I show an improved form of tube-closing devices, comprising a series of independent pivoted shutters, adapted to open or close the exit ports of the boiler tubes, said shutters being arranged to bear, when closed, on the ends of the tubes, the pivots on which they rotate being located between the rows of tubes, so that, when the shutters are turned outwardly from the tube-sheet, the tubes are entirely unobstructed; and, when the shutters are turned inwardly toward the tube-sheet, the tubes are closed, wholly or partially as the case may be.

The present invention has for its object more particularly to provide tube closing devices adapted to control and cause a uniform distribution of the gaseous currents through the flues by a graduated or partial obstruction of the flues which obstruction increases from the lower flues upwardly and prevents the natural tendency of the gases to pass through only the higher flues, and thereby causes a uniform action of the heating surfaces of the tubes, and a uniform heating of the boiler.

The invention also has for its object to simplify and improve the construction and mode of application of the tube closing devices, and to these ends, my present invention consists, first, in the combination with a boiler, of

graduated tube closers or valves, connected for simultaneous operation and formed to unequally close or contract the outlet ports of the tubes, the contraction gradually increasing from the lower tubes upward, so that the outlet capacity of the highest tubes may be reduced to the minimum, the outlet capacity of the tubes below being successively greater so that the lowest tubes have the maximum outlet capacity, the variation in the outlet capacity of the tubes being proportioned to the variation in the specific gravity of the heated gases, so that said gases are compelled to be more nearly equalized in their passage through the flues than would be the case if the outlet capacity of all the flues were equal.

The invention also consists in the hereinafter described improvements, relating to the construction and adjustability of the tube-plugs or valves, and to the means for supporting the shutters in place adjacent to the tube-sheets.

Of the accompanying drawings, forming part of this specification: Figure 1 represents an end elevation of a boiler provided with tube-closing devices embodying my invention. Fig. 2 represents a section on line 2 2, Fig. 1, all the tubes shown in said view being closed. Fig. 3 represents a similar section, illustrating the successive opening of the flues, beginning with the lower flues. Fig. 4 represents a perspective view, showing one of the shutters, and the means for pivotally supporting the same. Fig. 5 represents a section on line 5 5, Fig. 1, looking downwardly. Figs. 6, 7 and 8 represent perspective views of details hereinafter referred to.

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

In the drawings: *a* represents the shell of an ordinary tubular steam boiler.

*a'* represents the tube-sheet, which receives the delivering ends of the tubes *b b b*, said tubes being secured to the tube-sheet at their delivering ends in the usual or any suitable way.

*c c c* represent a series of vertically-arranged shutters, which are pivotally connected to fixed supports attached to the boiler, each shutter being mounted to swing on vertical pivots which are arranged between the vertical rows of tubes, the arrangement being



such, that, when the shutters are swung outwardly, substantially at right angles with the tube-sheet, as shown in Fig. 5, the delivering ends of the tubes will be entirely unobstructed, as shown in my above-mentioned application. Each shutter is here shown as composed of a plate, which should be of metal or some other suitably fire-proof material.

The means here shown for pivotally supporting the shutters are, first, fixed horizontal cross-bars  $d d'$ , extending across the boiler parallel with the tube-sheet, the ends of said bar being affixed to the shell of the boiler in any suitable way, as by bolts  $e e$ , passing through flanges formed on the ends of the bars  $d d'$ , as shown in Fig. 1; and, secondly, short arms  $f f'$ , adjustably mounted on the bars  $d d'$  and projecting from said bars toward the tube-sheet. The arms  $f$  on the lower cross-bar  $d$  are provided at their outer ends with sockets  $f^2$ , which receive a neck  $c'$  connecting two parts of the shutter  $c$ , each shutter being here shown as slotted at  $c^2$ , the neck  $c'$  being at one end of the slot and formed to turn as a pivot or trunnion in the socket  $f^2$ . The arms  $f'$ , affixed to the upper cross-bar  $d'$ , are provided at their inner ends with tubular sockets or bearings  $f^3$ , which receive trunnions or studs  $c^3$ , formed on and projecting upwardly from the upper ends of the shutters  $c$ , the trunnions or studs  $c^3$  being in line with the necks  $c'$ . The arms  $f f'$  therefore constitute bearings for the shutters, and permit them to swing freely toward and from the tube-sheet.

The arms  $f f'$  are provided with slots, which receive the cross-bars  $d d'$ , said arms being horizontally adjustable upon the cross-bars, so that the shutters can be accurately adjusted to the vertical rows of tubes, suitable means, such as keys  $g g$  (Figs. 3 and 4), being employed to secure the arms  $f f'$  at any position to which they may be adjusted. The upper ends of the shutters  $c$  are provided with outwardly projecting ears  $c^4$ , the ears of all the shutters being connected by a horizontal rod or bar  $h$ , so that the shutters are moved simultaneously on their pivots.

Any suitable means may be employed to swing or move the shutters, the means here shown being a shaft  $i$ , journaled in bearings in a fixed support, suitably attached to the boiler and provided with an arm  $i'$ , entering a slot  $h'$  in the connecting-bar  $h$  (Fig. 8). The outer end of the shaft  $i$  may be provided with a crank or handle, or otherwise adapted to be rotated in either direction.

Each of the shutters  $c$  is provided on its inner face with a vertical row or series of tube-plugs or valves  $j$ , formed to enter and close the exit ports of the tubes  $b$ . Said plugs are made of successively-increasing thickness, as shown in Figs. 2 and 3, the lower plug of the series being thinner than the next plug above, and so on throughout the entire series, the upper plug being the thickest. That portion of

each shutter coming opposite the lower tube in the row covered by the shutter is preferably left bare or not provided with a plug, as shown in Figs. 1 and 2, the body of the shutter closing upon the end of the lower tube, as in my above-mentioned application. When the boiler is in use the above described graduated tube closing devices are partially opened or moved away from the tube-sheet, as shown in Fig. 3, so that the upper tubes are but slightly opened, the thick plugs at the upper ends remaining in said tubes. The lowest tubes are opened, however, to a much greater extent, and the intermediate tubes are opened to varying degrees in proportion to their height, so that the tendency is to compel the gases to pass through the lower tubes before they pass through the upper tubes so that the passage of the gases through the flues is equalized, the outlet capacity of each flue being proportioned to its height, so that the tendency of the gases to pass through the higher flues and avoid the lower flues is prevented and a uniform distribution of the gaseous currents through all the flues is insured. When the boiler is in temporary disuse the shutters are closed as shown in Fig. 2, so that all the tubes are wholly closed.

It will be observed that my improved tube closing or graduating devices differ from my former inventions above mentioned, in that they are adapted for operation when the boiler is in use, as above described their usefulness not being limited to the periods when the boiler is in temporary disuse.

By the above described construction, I am enabled to do away with the necessity of employing two or more independent sets of shutters, one set to close the tubes at the lower portion of the boiler, and another set to close the upper tubes, as shown in my above-mentioned application, the graduated series of plugs enabling practically the same result to be accomplished that was accomplished by the said independent sets of shutters. A moderate amount of fire may be carried by opening the lower tubes and keeping the upper tubes closed and preventing the gases from making a short cut through the upper tubes to the stack. At the same time, the heating surfaces of all the tubes are brought into active use through the local currents in and out of the tubes at the end of the boiler nearest the fire. When the shutters are swung outwardly, substantially at right angles with the tube-sheet, all the tubes are of course wholly opened. I prefer to secure the plugs  $j$  to the shutters  $c$  adjustably, so that the plugs can be accurately adjusted to the ends of the tubes. To this end, I provide each plug with a slot  $j'$ , which receives the bolt  $k$  whereby the plug is attached to the shutter, the shutter being provided with a series of slots  $c^5$  to receive the bolts  $k$ , said slots permitting any desired range of adjustment of the plugs on the shutters. The bolts are provided with



nuts  $k'$ , whereby the plugs may be positively secured at any positions to which they may be adjusted.

I do not limit myself to the described means for adjustably securing the plugs to the shutters, and may use any other suitable means without departing from the spirit of my invention.

It is obvious that various changes may be made in the details of construction hereinbefore described, my invention not being limited to the particular details here represented.

Each shutter and the plugs  $j$  thereon constitute a graduated tube closer mounted on a substantially vertical axis, and adapted to unequally close or contract a vertical row of tubes, the connections between the shutters enabling the series of graduated tube closers to be operated simultaneously.

I claim—

1. The combination with a boiler, of a series of shutters having pivots arranged between the rows of tubes and provided with tube-plugs or valves formed to enter the ends of the tubes, said plugs varying in thickness, as described, so that the tubes are opened or uncovered successively by the opening movement of the shutters, the lower tubes being opened before the upper tubes, substantially as and for the purpose specified.

2. The combination with a boiler, of a series of vertically-arranged shutters connected with fixed supports by pivots arranged between the rows of tubes, each shutter having a vertical row or series of tube-plugs or valves formed to enter the ends of a row of tubes, said plugs being of successively-increasing thickness from the lower to the upper end of the series, whereby, when the shutter is moved from its closed position, the tubes will be opened successively from the bottom upwardly, as set forth.

3. The combination of a boiler, a series of vertically-arranged shutters connected with fixed supports on the boiler by pivots arranged between the rows of tubes, rows of

tube-plugs or valves on said shutters, and means for adjusting said plugs on the shutters and positively securing them at any positions to which they may be adjusted, as set forth.

4. The combination of a boiler, fixed cross-bars extending horizontally across the boiler parallel with the tube-sheet and at the outer side thereof, arms or bearings adjustably secured to said cross-bars and projecting therefrom toward the tube-sheet, and vertically-arranged shutters pivotally engaged with said arms and adapted to be seated on the exit ports of the boiler-tubes, as set forth.

5. The combination with a boiler, of a series of graduated tube closers or valves independently mounted on substantially vertical axes and connected for simultaneous operation, each tube closer being formed to unequally close or contract the outlet ports of a vertical row of tubes, the contraction gradually decreasing from the highest tubes downward, as set forth.

6. The combination with a boiler, of a series of graduated tube closers or valves pivotally connected to fixed supports at points between the vertical rows of tubes, said tube closers being movable toward and from the outlet ports of the tubes and so arranged that when fully opened they do not obstruct the tubes, and connections between said tube closers whereby they may be moved in unison, the highest tube closers being formed to reduce the outlet capacity of the corresponding tubes to the minimum while the tube closers below are formed to successively increase the outlet capacity of the tubes from the top to the bottom of the series, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 22d day of December, A. D. 1892.

GEORGE CLEVELAND HICKS.

Witnesses:

C. F. BROWN,

ARTHUR W. CROSSLEY.