

No. 768,178.

PATENTED AUG. 23, 1904.

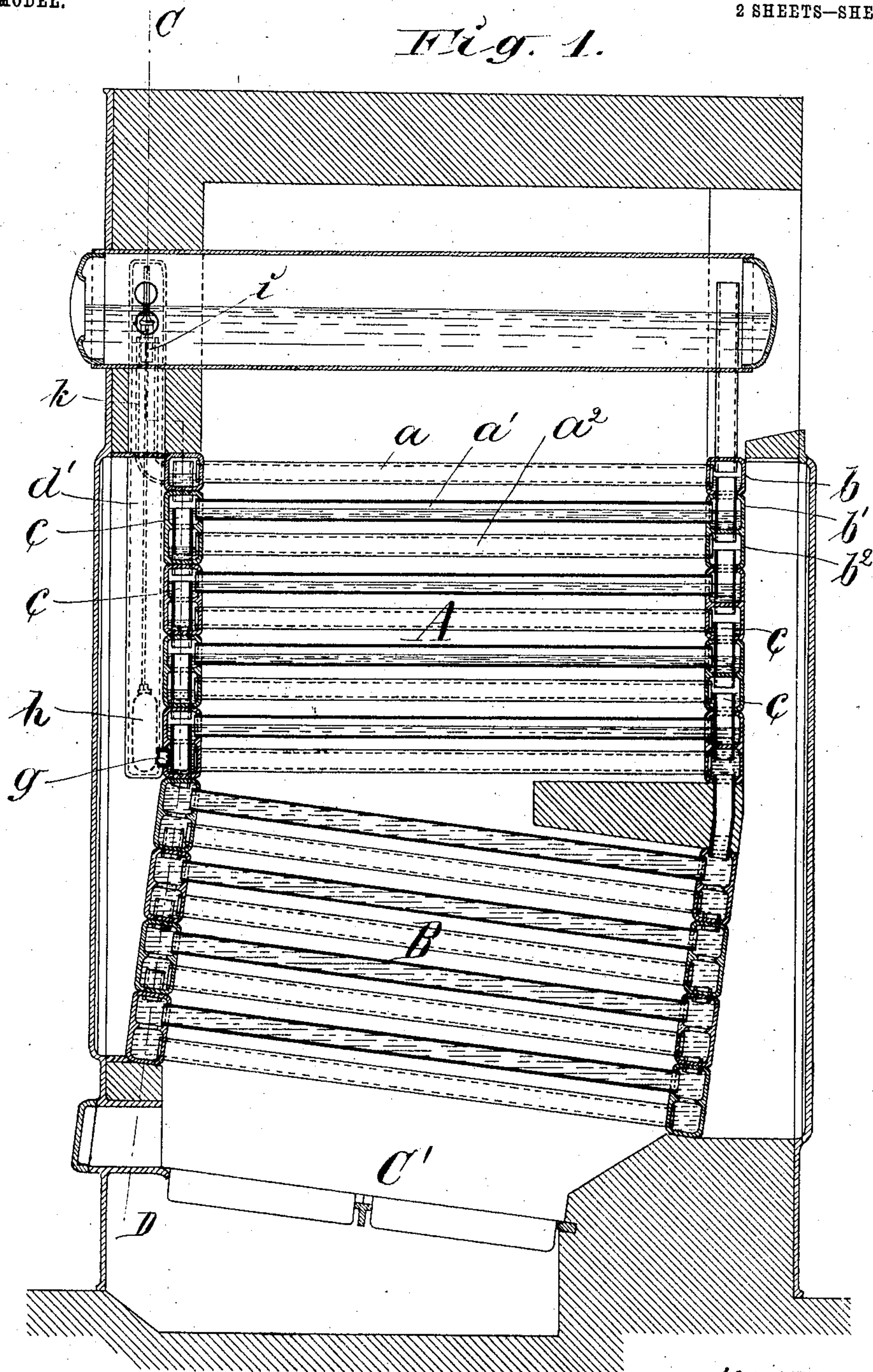
G. HOK.  
STEAM BOILER.

APPLICATION FILED NOV. 17, 1903.

NO MODEL.

2 SHEETS—SHEET 1.

*Fig. 1.*



WITNESSES

Mr. Kuchner  
Helen Grove W. Ellmore

**INVENTOR**

Gustaf Wok

*Richard L.*  
ATTORNEY



No. 768,178.

PATENTED AUG. 23, 1904.

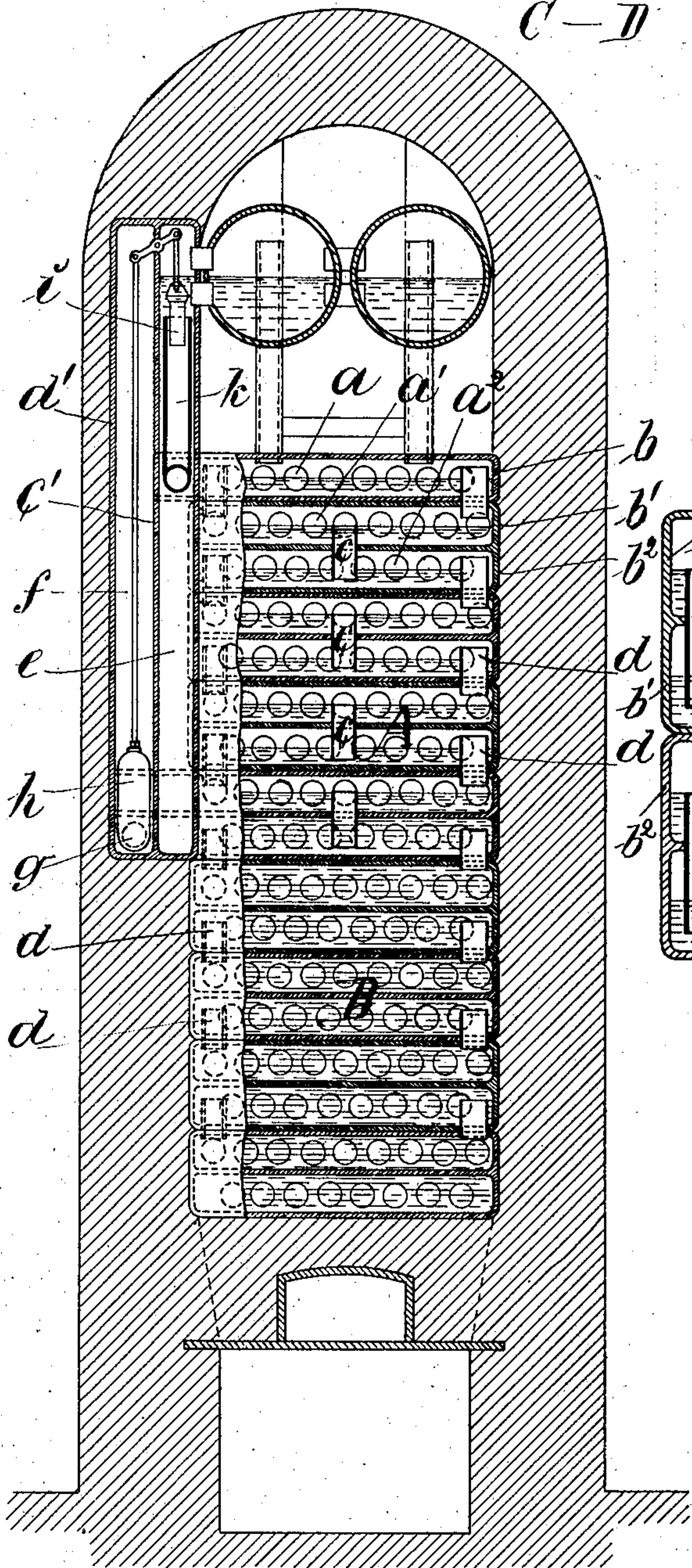
G. HOK.  
STEAM BOILER.

APPLICATION FILED NOV. 17, 1903.

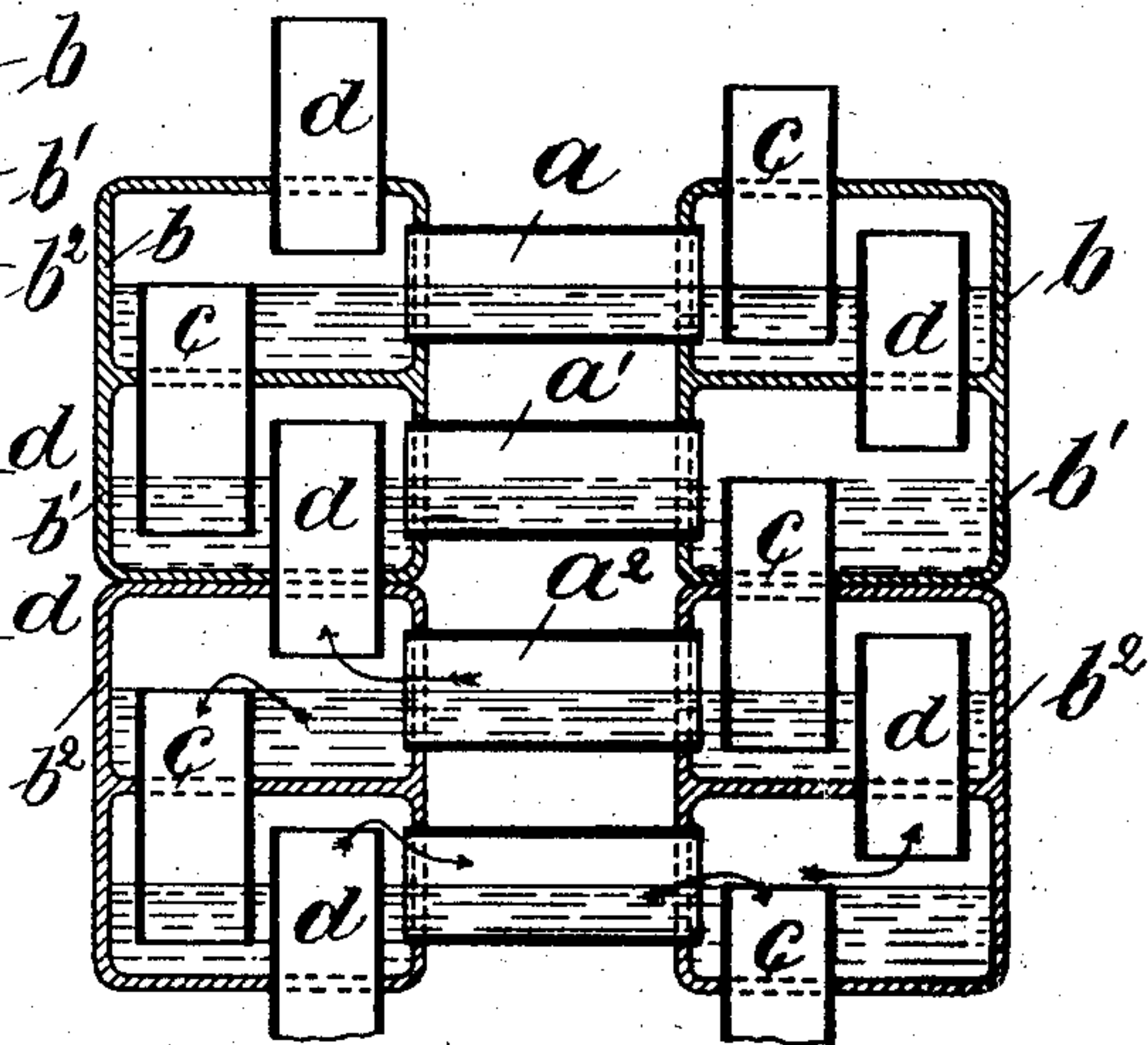
NO MODEL.

2 SHEETS—SHEET 2.

*Fig. 2.*  
*C-D*



*Fig. 3.*



WITNESSES

*Wm. Kuehn*  
*Ben. L. L. L.*

INVENTOR

*Gustaf Hok*

BY *Richard R.*

ATTORNEYS



# UNITED STATES PATENT OFFICE.

GUSTAF HOK, OF ESKILSTUNA, SWEDEN.

## STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 768,178, dated August 23, 1904.

Application filed November 17, 1903. Serial No. 181,541. (No model.)

*To all whom it may concern:*

Be it known that I, GUSTAF HOK, a subject of the King of Sweden and Norway, residing at Eskilstuna, Sweden, have invented certain  
5 new and useful Improvements in and Relating to Steam-Boilers; 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  
10 make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

This invention relates to the construction  
15 and arrangement of that type of steam-boiler wherein groups of water-tubes forming the boiler proper are situated one above the other and wherein the tubes of the same group are placed on one and the same level.

20 The object of the invention is to cause the steam which is generated in the lower group of tubes to be conveyed through the tubes of the groups situated above without having to penetrate the water contained in them. Thus  
25 the steam is conveyed to the steam-collecting drum or chamber in a much drier condition than has hitherto been the case.

The steam-boiler forming the subject-matter of this application is illustrated by the  
30 accompanying drawings, in which—

Figure 1 represents a longitudinal section of the boiler, Fig. 2 being a cross-section thereof along the line C D of the preceding figure; and Fig. 3 is a similar view to Fig. 1,  
35 showing diagrammatically the courses taken by the steam and the water in flowing through the boiler.

$a$   $a'$   $a''$  are various groups of tubes, the latter being provided at their extremities with  
40 transverse headers  $b$   $b'$   $b''$ . Between the various groups of tubes short tubes  $c$  and  $d$  connect alternately both ends and the centers of the groups with two headers—that is to say, as is represented best by Fig. 3, the con-  
45 nection between the ends is effected by the short tubes  $d$ , and the connection between the central parts is obtained by the short tubes  $c$ . Thus, as shown in Figs. 1 and 3, a serpentine-like passage is formed, allowing  
50 the steam to be conveyed from the bottom to

the top. By means of the short tube  $c$  the level of the water within the headers  $b$   $b'$   $b''$  and tubes  $a$   $a'$   $a''$  is regulated, the water reaching to the upper edge of the tubes  $c$ . Since the tubes  $d$  are arranged so as to reach a  
55 higher level than the tubes  $c$ , they connect the steam-spaces of the headers in such a manner that a continuous space is created for the steam, communicating in both directions with the steam-spaces of the headers  $b$   $b'$   $b''$ . The  
60 steam generated in a lower group of tubes, for instance in  $a''$ , is (see Fig. 3) allowed to pass into the header  $b''$ , and then flows from the left-hand side through the tube  $d$  to the header  $b'$ , thence through the adjoining group  
65 of tubes  $a'$  to the right-hand side of the header  $b'$ , whence it passes through the tube  $d$  to the header  $b$ , and so on to the steam-collector. By this arrangement a brisk generation of  
70 steam within each of the groups is promoted and the steam itself is conveyed on as soon as it reaches the surface of the water.

It is quite evident that a boiler of the kind just described must not be exposed to the hottest gases of combustion, because the parts if  
75 containing no water would suffer damage from the intense heat. Such a boiler A must therefore be combined, as illustrated, with another tube-boiler B, entirely filled with water in the  
80 usual manner and placed underneath the improved boiler A and directly above the furnace, so that the lower boiler will absorb a considerable part of heat produced by the  
85 gases of combustion before they come into contact with the improved boiler arranged at the top. The tubes of the lower boiler may be inclined and are of course completely filled  
90 with water. Both the boilers communicate with one another. When two such boilers are combined into one, the feed-water is supplied to the top one, whence it flows to that  
95 below. The difficulty which arises in this case depends on the fact that the ordinary boiler below must always be completely filled, while the horizontally-arranged tubes  
100 of the improved top boiler are only filled partially. If the supply of water becomes excessive, the superfluous water ascends to the top boiler, thereby filling the above-mentioned horizontal tubes, whereas in the event



of the supply not being sufficient the tubes of the lower boiler are not entirely filled with water, and both these possibilities must be considered as disadvantages. The improved  
 5 combined tubular boiler cannot, therefore, be fed with water without a supply-regulating apparatus, and the latter must in consequence be included in the subject-matter of this specification. This water-supply-regulating appa-  
 10 ratus has for its object to prevent the steam-spaces of the tubes of the top boiler from being entirely filled with water in case the supply becomes excessive and must be constructed in accordance with the position and size of  
 15 the short tubes  $d$ . The bottom extremities of these tubes must reach slightly beyond the upper edge of the horizontal tubes  $a$   $a'$   $a''$ . If the surface of the water inside the steam-spaces reaches to the bottom edge of the  
 20 short tube  $d$ , the steam-spaces in the horizontal tubes will be maintained, as the water closes the short tubes  $d$ . This closure hinders the steam from escaping from the horizontal tubes  $a$   $a'$   $a''$ , and so prevents the tubes  
 25 from being entirely filled with water. The steam, however, is in no way prevented from ascending, as the water which effects the said closure allows the steam to pass. Its ascension, however, will not take place more quickly than  
 30 it is generated, and the steam-space will therefore be maintained in the horizontal tubes. This arrangement prevents the horizontal tubes  $a$   $a'$   $a''$  from being entirely filled with water; but it also stops the steam from freely as-  
 35 cending and from becoming dry. This may be attained, however, by the following arrangement: The arrangement consists of a vertical pipe  $d'$ , divided into two parts by a partition  $c'$ , one part,  $e$ , being in communication with the  
 40 water-receptacle, which is filled with water up to a certain level, while the other part,  $f$ , is connected by a short tube  $g$  with the lowest bottom group of tubes belonging to the upper boiler. The part  $f$  is provided with a float  $h$ , connected  
 45 by a lever arrangement with a valve  $i$  in the part  $e$ , the valve being placed in the top of a tube  $k$ , which leads to the uppermost group of tubes of the top boiler. The water in  $e$  assumes a level slightly higher than the top edge  
 50 of the tube  $k$ , and the highest level of the water allowed in the part  $f$  assumes that of the upper edge of the lowest overflow-pipe of the top boiler. Both parts  $e$  and  $f$  of the pipe  $d'$  therefore communicate at the top with the  
 55 steam-collector. If the valve  $i$  is open, the feed-water is allowed to run through the tube  $k$  into the top boiler, whence it flows to the other. Thus both the boilers are supplied with water. Should, however, the supply of water  
 60 become excessive, the water in part  $f$  at once

ascends, raising the float  $h$ , whereby the lever arrangement causes the valve  $i$  to shut, and the water-supply to the boiler is automatically and instantaneously stopped. In the event of  
 65 the supply not being sufficient the float  $h$  descends, thus again opening valve  $i$  and allowing a fresh supply of water to enter into part  $e$  of the pipe  $d'$ . If the float  $h$  does not work properly, the disadvantage is minimized because  
 70 the level of water in the tubes may only reach, as has been explained, the bottom edge of the short tubes  $d$ , while the steam-spaces of the horizontal tubes of the improved boiler are kept free—that is to say, the latter tubes are  
 75 prevented from entirely filling with water. Hence the required proper supply of water for feeding the combined boilers is insured.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I  
 80 declare that what I claim is—

1. In a steam-generator, a lower group of tubes, an upper group of tubes and means for automatically keeping the lower group of tubes full of water and the upper group only  
 85 half full of water, substantially as described.

2. In a steam-generator, a lower group of tubes, an upper group of tubes, means for automatically maintaining the lower group full of water and the upper group only half full,  
 90 whereby a steam-space is formed in said upper group and means for connecting the steam-spaces of the tubes of the group together, substantially as described.

3. In a steam-generator, a series of tubes  
 95 horizontally arranged one above the other, headers connecting the ends of the tubes of each series, tubes  $c$  connecting the water-spaces of the headers and regulating the flow of water so that steam-spaces are formed in the  
 100 tubes and means for connecting said spaces together, substantially as described.

4. In a steam-generator, series of tubes horizontally arranged one above the other, headers connecting the ends of the tubes of each series  
 105 together water-tubes connecting the headers of each series and arranged so as to keep the tubes half full of water and steam-tubes connecting the headers above the water-level therein, said tubes having their bottoms pro-  
 110 jecting under the highest water-level of the horizontal tubes.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

GUSTAF HOK.

Witnesses:

KOUR DAHLQUIST,  
 L. KALLENBERG.