

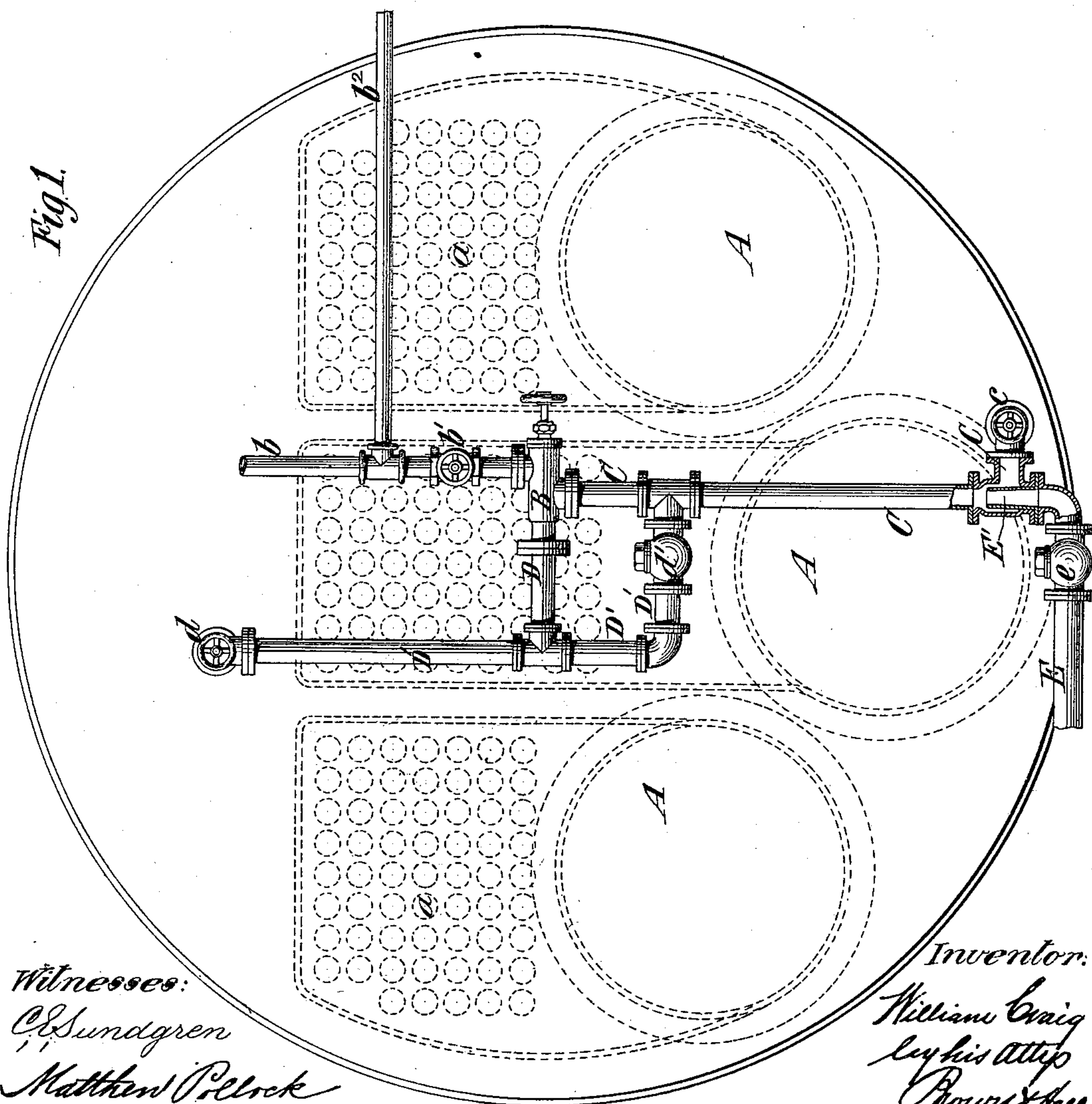
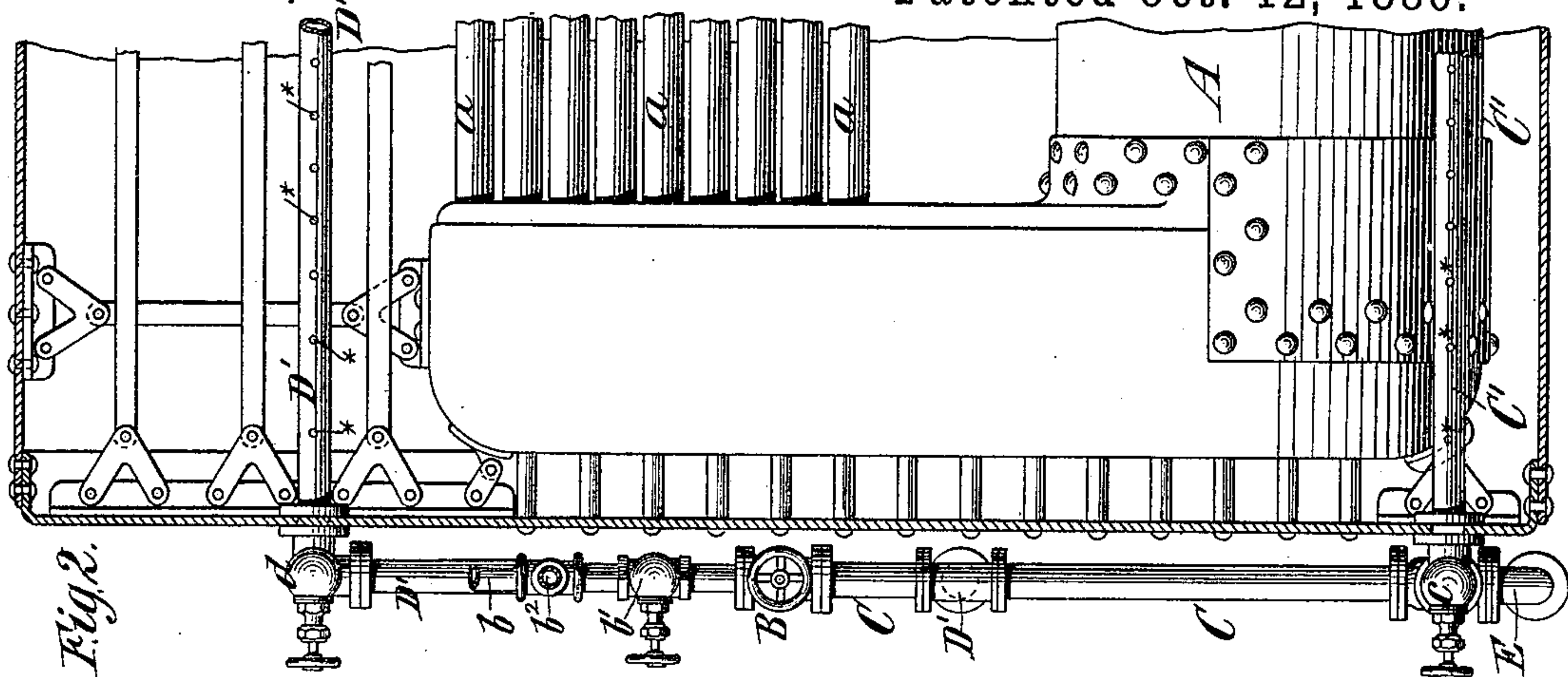
(No Model.)

W. CRAIG.

METHOD OF CIRCULATING WATER IN BOILERS.

No. 350,722.

Patented Oct. 12, 1886.



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# UNITED STATES PATENT OFFICE.

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## METHOD OF CIRCULATING WATER IN BOILERS.

SPECIFICATION forming part of Letters Patent No. 350,722, dated October 12, 1886.

Application filed March 24, 1885. Serial No. 159,927. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM CRAIG, of the city of Brooklyn and county of Kings, in the State of New York, have invented a new and useful Improvement in the Methods of Circulating Water in Steam-Boilers, of which the following is a specification.

My invention relates to the method of circulating water in marine and other steam-boilers which are heated by internal furnaces.

In my United States Letters Patent No. 294,118, dated February 26, 1884, I have shown, in connection with a steam-boiler, an injecting apparatus capable of operation by steam from the main boiler or from a supplemental boiler, whereby water will be taken from the bottom or one part of the boiler, heated, and discharged into another part thereof, thus producing an outside circulation of the water in the boiler in order to bring it to a more uniformly-heated condition throughout and prevent unequal expansion of the plates of the boiler. Where steam alone is employed for the injecting-current, it is found that difficulty is experienced in continuing such circulation after the water becomes heated to a very high degree, and the object of my present invention is to provide for continuing the circulation of the water in the steam-boiler after it becomes so highly heated that a single injector, if operated by steam, would cease to work.

My present invention includes an improvement in the method of producing the circulation of water in steam-boilers having internal furnaces, consisting in withdrawing water from the bottom of the boiler by means of an injecting-current of feed-water, in mingling together the feed-water and the water so taken from the bottom of the boiler, and in then discharging the mingled feed-water and the water taken from the bottom of the boiler, without further subjecting them to the heat of the fire in the furnaces, into the upper part of the boiler.

The invention consists in an improved method of producing the circulation of water in a steam-boiler, which consists in the employment of the feed-water as an injecting-current, whereby is induced a flow of water from one part of the boiler outward to the exterior of

the boiler, in mingling the feed-water with the water so taken from the boiler, and in the employment of an injecting-current of steam for inducing the flow of the mingled feed-water and water taken from the boiler, and heating and discharging them together into another part of the boiler.

In the accompanying drawings, Figure 1 represents an end view of a marine-boiler having my invention applied thereto, and Fig. 2 is a longitudinal section of the end portion of the boiler and an elevation of the apparatus whereby my method is carried out.

Similar letters of reference designate corresponding parts in both figures.

As here represented, the apparatus is applied to the rear end of the boiler; but it may be at the front thereof, or in any other convenient position.

My invention in no way relates to the construction of the boiler, and I have shown only such parts thereof as are necessary to illustrate the attachment of the apparatus whereby my method is carried out.

A designates the furnace-flues of the boiler, (shown by dotted lines in Fig. 1,) and *a* designates the return-tubes through which the heated products of combustion pass.

B designates a steam-injecting apparatus, which may be of any approved construction, and which is supplied with an injecting-current of steam by a pipe, *b*, in which is a stop-valve, *b'*. The pipe *b* is here shown as broken off, but may be attached to the steam-space of the boiler at any suitable point. Communicating therewith is a pipe, *b''*, by which steam may be supplied from a supplementary or donkey boiler for operating the injecting apparatus B, as described in my patent above referred to.

C designates a pipe through which the injecting apparatus B is supplied with water, and D designates a pipe through which the water is delivered by the injecting apparatus B, and which communicates with a pipe, *D'*, entering the upper portion of the boiler, and provided with a stop-valve, *d*, whereby the discharge of water from it into the boiler may be controlled. As here shown, the pipe *D'* is prolonged horizontally beyond the valve *d*



and for a considerable distance within the boiler, and such extension or prolongation of the pipe within the boiler is perforated with numerous holes or openings, \*, for the distribution of the water discharged into the boiler from the pipe D'. As here shown, the pipe D' is prolonged downward beyond the point of its communication with the pipe D, and is connected with the supply-pipe C below the steam-injecting apparatus B, the pipe D' being provided with a check-valve, *d'*, which will permit the flow of water from the pipe C through the pipe D', but will prevent the discharge of water from the pipe D' into the pipe C.

The pipe C has at its lower end a horizontally-extending branch, C', which is prolonged within the boiler, as shown in Fig. 2, and is provided at its point of attachment with the boiler with a stop-valve, *c*, whereby the flow of water thereto may be controlled. The pipe-extension C' within the boiler is provided with numerous holes or perforations, \*, like the pipe D' above described, so that the pipe C' will draw its supply from different points in the boiler.

E designates a pipe through which the feed-water passes to the boiler from the usual feed-pumps. In the pipe E is the ordinary feed-check-valve *e*, and the pipe E beyond this check-valve is provided with a nozzle, E', which is concentric with the lower end of the pipe C, and through which the feed-water is discharged into said pipe C.

It will be readily understood that the feed-water discharged through the nozzle E' forms an injecting-current, whereby the flow of water is induced through the pipe C' from the lower part of the boiler, and the feed-water and the water taken from the lower part of the boiler are mingled together and pass upward through the pipe C to the steam-injecting apparatus B. By the operation of the steam-injecting apparatus B the mingled feed-water and the water taken from the lower part of the boiler are heated and discharged together through the pipes D and D', and delivered into the boiler through the perforated extension of the pipe D'. The mingled feed-water and the water taken from the bottom of the boiler are not subjected to the heat of the furnaces after they leave the injector E' until they are discharged into the upper part of the boiler. It will therefore be seen that the feed-water produces an injecting-current to induce the flow of water from the boiler upward to the steam-injecting apparatus, and that both the feed-water-injecting apparatus and the steam-injecting apparatus combine to produce a forced and positive circulation of the water in the boiler from the pipe C' outside the boiler to and through the pipe D' into the same.

When it is desired to circulate the water in the boiler before steam is raised therein, and hence while no feed-water is being introduced

through the pipe E, the steam-injecting apparatus will be operated alone through steam supplied by the pipe *b*<sup>2</sup> from a supplemental or donkey boiler, and by the action of this steam-injecting apparatus water will be drawn from the boiler through the pipes C' and C and delivered into the boiler through the pipes D and D', as described in my patent above referred to.

When the water in the boiler becomes so highly heated that the steam-injecting current of the apparatus B will not be effective in promoting a circulation of water, the injecting apparatus E' alone will act, and the mingled current of feed-water and water taken from the lower part of the boiler may pass upward through the pipe C, check-valve *d'*, and pipe D' into the upper part of the boiler, thus passing around the steam-injecting apparatus B, and not through the same.

Where the steam-injecting apparatus is used alone to produce the circulation of the water from one part to another of the boiler, as in my patent above referred to, the operation of circulating ceases when the water in the boiler has become heated to such a high temperature that the steam-injecting apparatus will not work or condense the steam; but when the feed-water, which is discharged into the boiler during the whole time that the main engines or auxiliary engines or pumps are running, is employed as an injecting-current for producing the circulation of water from one part to another of the boiler, such circulation may be continued during any time desired, or during all the time that the engines or pumps are running.

It will be observed that in the operation of the two injectors the current of water induced from the boiler by the injected stream of feed-water becomes mingled with the feed-water, and by the colder feed-water has its temperature so modified that the steam-injector will operate successfully to deliver it into the boiler, even though the water taken from the boiler be so hot that the steam-injector could not deliver it alone into the boiler.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The improvement in the method of producing the circulation of water in a steam-boiler having internal furnaces, consisting in withdrawing water from the bottom of the boiler by an injecting-current of feed-water, in mingling together the feed-water and the water so taken from the bottom of the boiler, and in discharging the mingled feed-water and the water taken from the bottom of the boiler, without further subjecting them to the heat of the fire in the furnaces, into the upper part of the boiler, substantially as and for the purpose herein described.

2. The improvement in the method of producing the circulation of water in a steam-boiler, consisting in the employment of the feed-water as an injecting-current, whereby a

flow of water is induced from one part of the boiler outward to the exterior of the boiler, in mingling the feed-water with the water so taken from the boiler, and in the employment  
5 of an injecting-current of steam, whereby the mingled feed-water and the water from the boiler are heated and discharged together into

another part of the boiler, substantially as and for the purpose herein described.

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