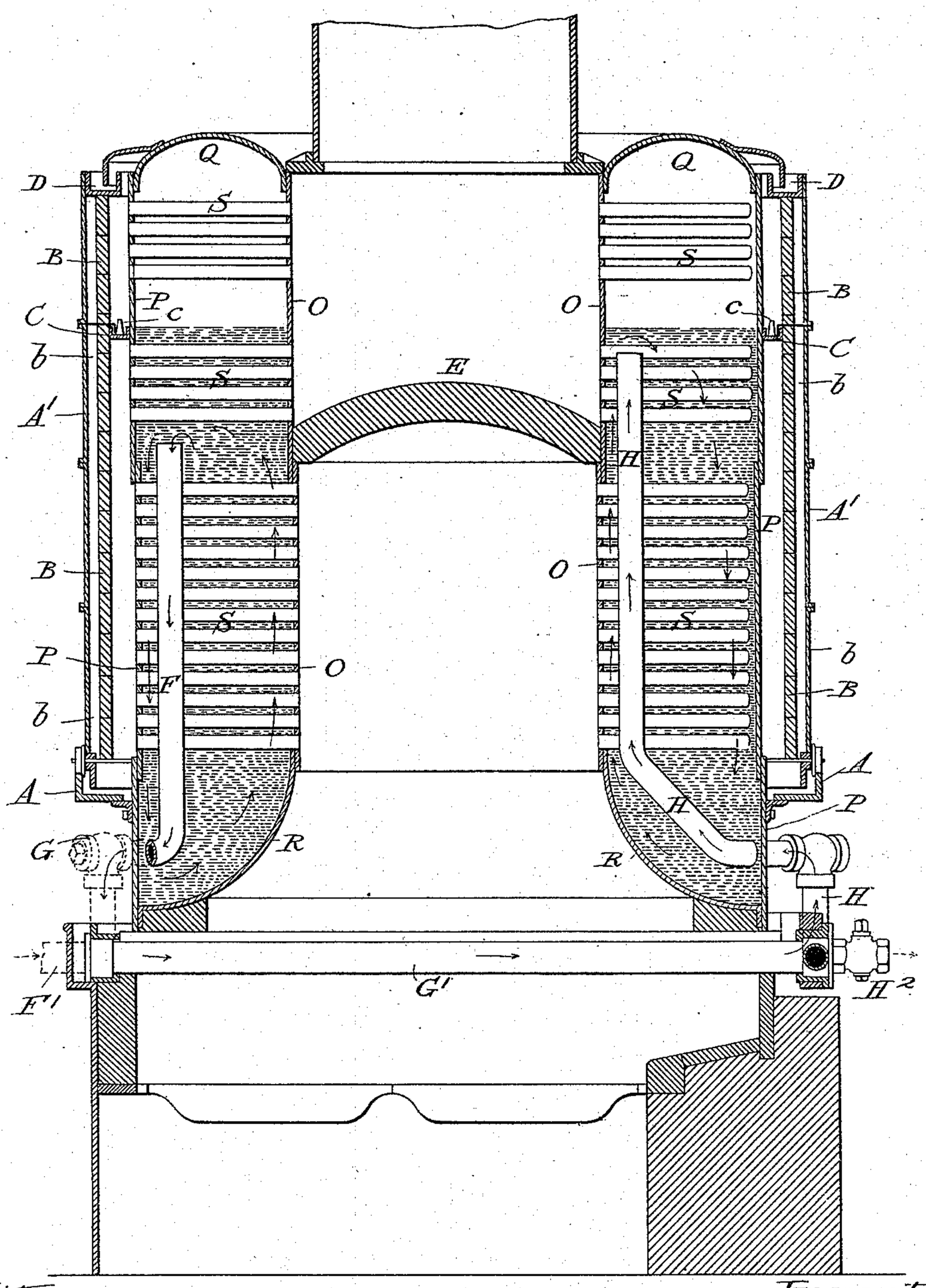
(No Model.) 2 Sheets—Sheet 1.

W. H. BERRY.

STEAM BOILER.

No. 573,256. Patented Dec. 15, 1896.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

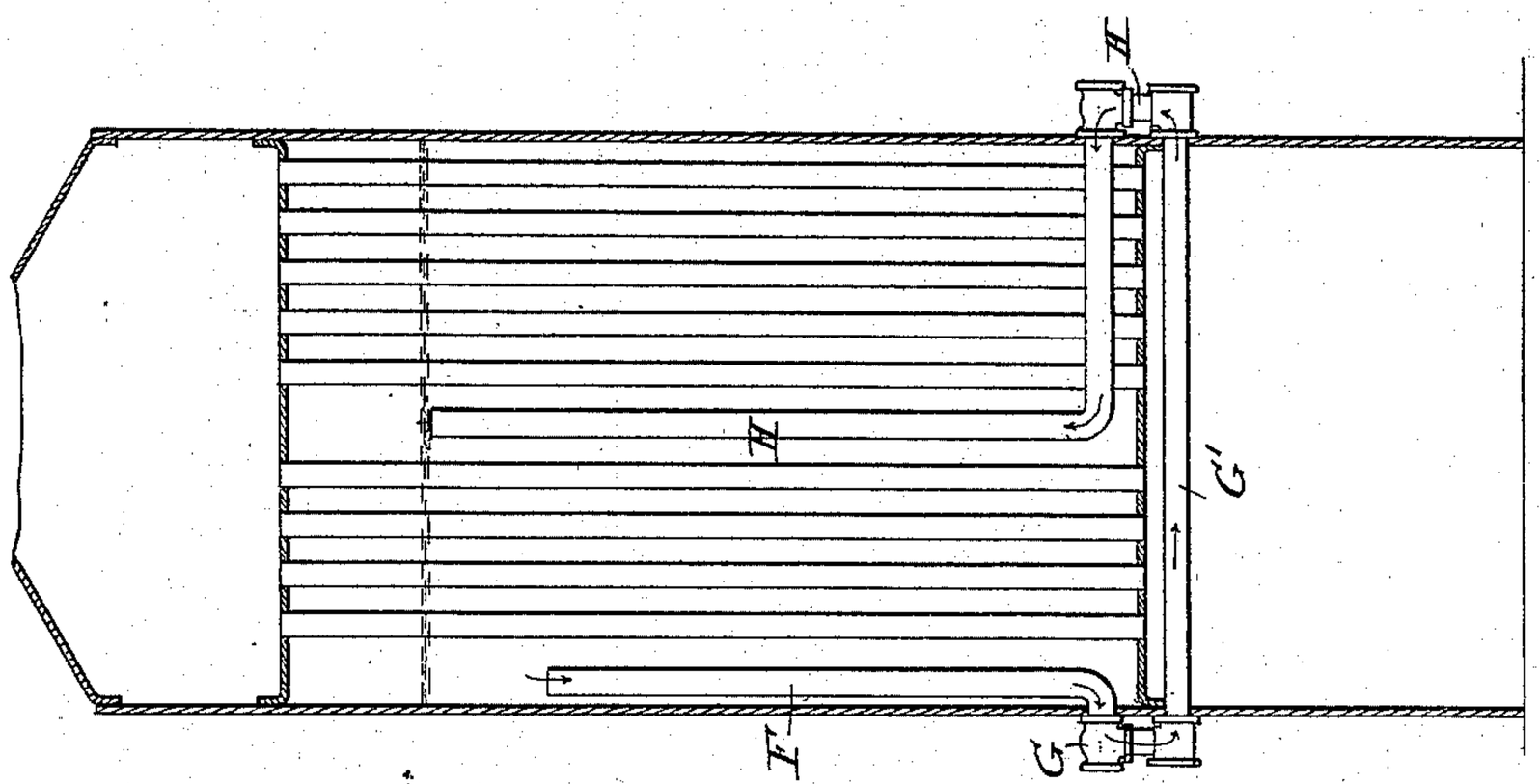
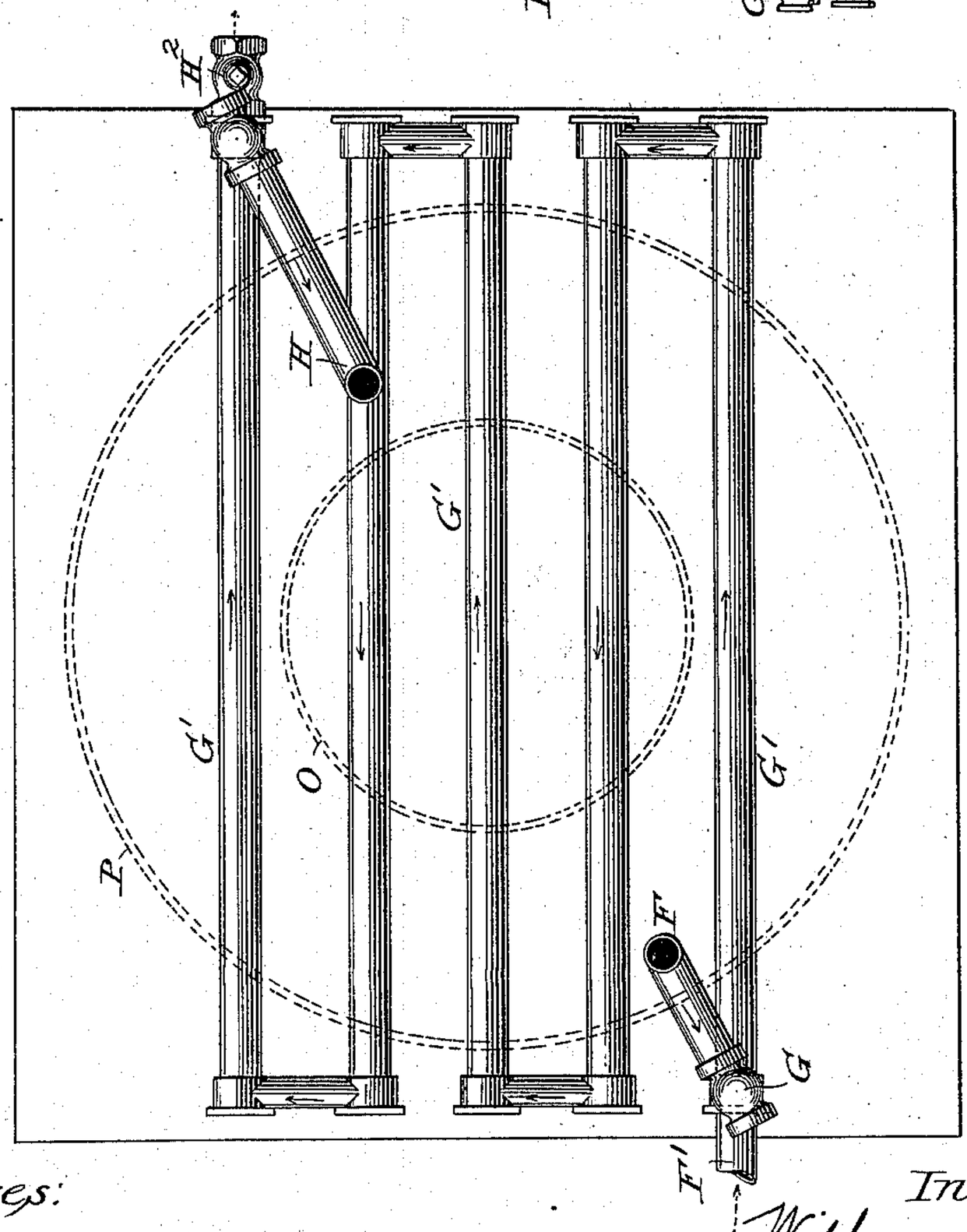


Fig. 2.



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UNITED STATES PATENT OFFICE.

WILLIAM H. BERRY, OF CHESTER, PENNSYLVANIA, ASSIGNOR TO THE BERRY ENGINEERING COMPANY, OF SAME PLACE.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 573,256, dated December 15, 1896.

Application filed March 24, 1896. Serial No. 584,658. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. BERRY, of Chester, in the county of Delaware and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Boilers, of which the following is a specification, reference being had to the accompanying drawings and to the letters of reference marked thereon.

The nature and objects of my invention will be fully set forth in the specification and claims.

In the drawings, Figure 1 is a vertical section of a boiler substantially such as is described in my Patent No. 542,674, dated July 16, 1895, to which my present invention is applicable. Fig. 2 is a plan view of the same, showing the water-circulating coils. Fig. 3 is a vertical section of a more ordinary form of boiler having my invention applied thereto.

Similar letters of reference indicate similar parts in the respective figures.

The boiler, as seen in Figs. 1 and 2, consists of two vertical cylindrical shells O and P, one within the other, united at the top by a crowned ring Q and at the bottom by a cone-shaped ring or crown-sheet R. Tubes S S of small diameter, through which the products of combustion pass, radiate from the inner to the outer shell, thereby forming braces for each. By this arrangement the circulation of the water and steam is upward near the inner shell and downward near the outer shell. The lower end of the outer shell P is of sufficiently heavy material to carry the weight of the boiler without bracing and forms a rigid base for the boiler, while a roomy and entirely unobstructed space is provided under the tubes for cleaning and inspection. A manhole is employed for entrance to this space.

Secured to the heavy base-sheet of the boiler is a circular ring or trough A, Figs. 1 and 2, adapted to be partly filled with sand, and the outer rim of which ring or trough forms a track upon which a casing or smoke-jacket A′ is supported, so that it may be revolved around the boiler. The lower edge of the casing A′ projects into the sand and prevents the passage of air, while it allows the casing to be freely revolved. This casing is lined throughout with fire-clay tile B in such manner as to form an insulated air-space *b* inside the casing.

At or a little below the water-line a draft-check C is provided similar in construction to the one below. Through this check a limited number of openings *c* are provided, the area of which may be controlled. The object of these openings *c* is to permit a portion of the products of combustion to pass above the draft-check C and through the tubes S, extending across the steam-space for the purpose of drying the steam. A third check D of the same construction is placed at the top of the casing. At a point covering about three-fourths of the submerged tubes an arch or dome of fire-brick E is inserted in the inner shell O, and from the top of this shell the stack or flue connection rises.

The furnace is preferably of the simplest possible construction, square in form, and lined throughout with fire-brick and having ample and efficient grate area.

Doors of convenient height and arranged to the best advantage for hand-firing or any of the shaking-grates or automatic stokers may be employed.

To avoid arches and other unsatisfactory brickwork in the furnace, I use a continuous coil of four-inch tubing G′ to carry the furnace-covering. Through this coil all the feed-water passes, as well as all the blow-off water, in addition to which a rapid continuous circulation of the water in the boiler is maintained by the following means: A down-take-pipe F, connected to one end of the coil G′, enters the boiler through the outer shell P, near its base, and extending upwardly therefrom close to the outer shell to a point above the level of the fire-chamber opens into the boiler. A check-valve G, opening outwardly, is placed between the coil G′ and the pipe F, outside the boiler, to insure the passage of the water at all times in one direction. At this end of the coil the feed-wa-

ter is also introduced through the pipe F′ below the check-valve G. The coil extends back and forth under the boiler and over the fire, and at its other end connects with an uptake-pipe H, which passes through the outside shell into the boiler and across the water-space in close proximity to the inner shell, where it is extended up to a point near the water-line. A check-valve, opening inwardly, is placed in the uptake-pipe near its connection with the coil. At or near this end of the coil is placed the blow-cock H^2.

In operation, and assuming the boiler to contain the proper quantity of cold water and the fire to have been started, the products of combustion will pass through the tubes below the arch E into the space between the shell P and the outer casing A. The check C will cause the greater portion of the products of combustion to pass back into the shell O through the tubes between said check C and the arch E. A certain proportion of the products of combustion will, however, pass through the openings *c* in the check C and be deflected by the check D through the tubes above the water-line into the shell O, whence they will pass to the smoke-stack. It is obvious that the products of combustion expend the greater part of their heat upon the coil G′, the inner shell O below the dome E, and the fire-tubes located in this portion of the boiler. The water near the inner shell O will therefore be hotter than that near the outer shell P, and there will consequently be a tendency of the former to ascend and of the latter to descend. The pipe F, being near the outer shell P of the boiler, is of course in the relatively cooler descending current of water, while the pipe H, rising near the inner shell O, is in the warmer ascending current. As soon as heat is applied to the coil G′ the water rises in the vertical internal extension of the pipe H, and, being lighter than the water near the outer shell of the boiler, the circulation will begin, and when steam is generated in the coil the resistance in the vertical extension of the pipe H will be so slight that a rapid circulation will be kept up.

The check-valve G, which, as before stated, opens outwardly, prevents the heated water in the coil from passing up the pipe F, but as the heated water rises in the pipe H cooler water flows down the pipe F into the coil and thus keeps up the circulation.

The feed-water is introduced into the end of the coil G′, which receives the water from the boiler, and is in consequence mingled with many times its volume of hot water which is moving rapidly through the coil. Therefore in its passage through the coil the feed-water becomes highly heated and any floating sediment or mineral substance held in solution is made ready for precipitation. No precipitation occurs, however, in the coil or pipe H, owing to the rapid movement of the water therein. When the water is delivered from the pipe H at the water-line, it passes outward to the slowly-descending column at the outer shell and the settlement then occurs. The sediment is thus deposited in a portion of the boiler protected from the fire and whence it may be readily removed, and the water while in contact with the heating-surfaces will deposit no sediment, thus preventing scale.

The pipe F, which forms the main feature of the present invention, has its mouth about twenty or twenty-four inches below the plane in which is the mouth of the pipe H and a few inches above the highest row of fire-tubes S, which connect directly with the fire-chamber. If through carelessness or otherwise feed-water is not supplied to the boiler, the circulation through the pipes F G and the coil G′ continues until the level of the water in the boiler falls to the level of the mouth of the pipe F, when the circulation will stop, for obviously no more water can enter the said pipe. The water remaining in the coil G′ and the pipe F will be driven by the influence of the heat through the pipe H into the boiler, thus leaving the coil dry and causing it to become, in consequence, the weakest part of the boiler, and it being in the hottest part of the fire will burn out before the water falls low enough to expose the top row of fire-tubes S. The coil burning out, steam will pass down through the pipe F into the ruptured or destroyed coil G′ and put out the fire, thus preventing an explosion of the boiler.

Fig. 3 shows an ordinary vertical tubular boiler having a coil exposed to the heat of the furnace and the pipe F communicating with one end thereof and extending above the lowest safe water-level.

It is apparent that my invention is applicable to all forms of boilers in which a coil is employed exposed to the heat of the furnace and through which the boiler-water circulates.

Having described my invention, I claim—

1. The combination, with a boiler, of a coil exposed to the heat of the furnace and through which the water in the boiler circulates, the coil being supplied with water from a point near the outer shell of the boiler, above the lowest safety water-level, and discharged at a point at or slightly below the normal water-level, and means, such as described, to cause the water to flow always in one direction, substantially as set forth.

2. The combination, with a boiler, of a coil exposed to the heat of the furnace and through which the water in the boiler circulates, an uptake-pipe connected with the coil and placed within the boiler near the heated inner shell, and a downtake-pipe connected with the opposite end of the coil and rising within the boiler near the cooler outer shell to a point above the lowest safety water-level, substantially as set forth.

3. The combination, with a boiler, of a coil exposed to the heat of the furnace, and through

which the water in the boiler circulates, an uptake-pipe and a downtake-pipe, within the boiler connected to the opposite ends of the coil, and placed near the inner and outer shells, respectively, and means, such as described, to cause the water to flow always in one direction, substantially as set forth.

In testimony whereof I have hereto set my hand and affixed my seal.

WILLIAM H. BERRY. [L. S.]

Witnesses:
CHARLES PALMER,
W. HINKSON.