No. 774,832. PATENTED NOV. 15, 1904.

E. T. COPELAND.

BOILER.

APPLICATION FILED JAN. 6, 1904.

NO MODEL.

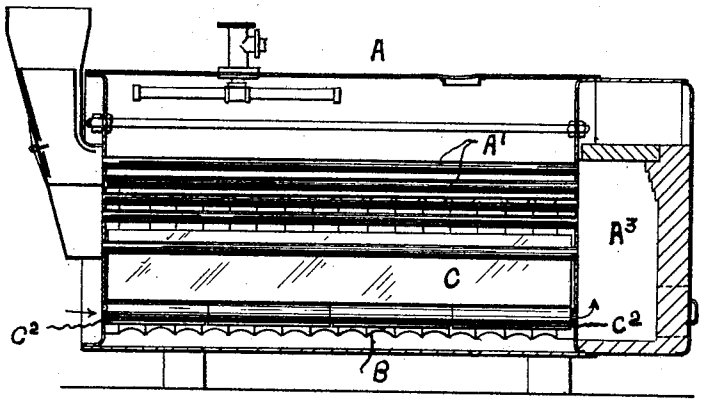


Fig. 1

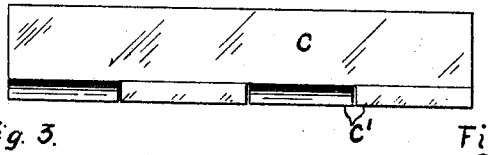


Fig. 3.

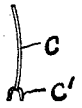


Fig. 4.

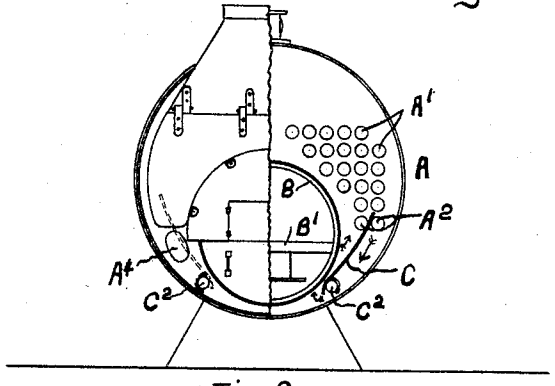


Fig. 2.

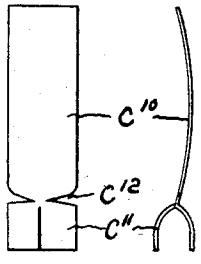


Fig. 5.

Fig. 6.

Witnesses
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No. 774,832. Patented November 15, 1904.

# UNITED STATES PATENT OFFICE.

EDWIN TURNER COPELAND, OF NEWTON, MASSACHUSETTS.

## BOILER.

SPECIFICATION forming part of Letters Patent No. 774,832, dated November 15, 1904.

Application filed January 6, 1904. Serial No. 187,883. (No model.)

*To all whom it may concern:*

Be it known that I, EDWIN TURNER COPELAND, a citizen of the United States, residing at Newton, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in 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 make and use the same.

The present invention relates to improvements in steam-boilers, and more particularly to means for securing an effective circulation of water in boilers of the internal-furnace type. In boilers of this character a tubular furnace is located eccentrically of the boiler-shell and near the bottom thereof, the products of combustion passing from the rear of the furnace through flues arranged within the boiler above the upper half of the furnace. This construction leaves a large body of water beneath the flues and surrounding the lower part of the furnace-shell which does not come into contact, strictly speaking, with the heating-surfaces, since that portion of the furnace-shell below the grate-line is not subjected to the action of the fire and is ordinarily relatively cool as compared with the upper portion of the shell and the flues. As a result the lower portion of the boiler contains a large useless body of inactive and stagnant water of a low temperature. The cause for the existence of this inertness in the water within the lower portion of the boiler is that the water which is in contact with the heating-surfaces being of a higher temperature than that in the lower part of the boiler is also of less density, and therefore the heavy water at the bottom cannot rise and the lighter water at the top cannot descend. On account of this relative difference in the densities between the upper and lower portions of the water in the boiler the only circulation possible is confined to lines located wholly above the grate-line. Since the circulation is defective, all of the water is not brought properly into contact with the heating-surfaces so as to take up the heat most effectively, and incrustation of the heating-surfaces is permitted, thereby further lessening the efficiency. A further defect due to this imperfect circulation is that the parts of the boiler being at different temperatures are subjected to unequal stresses, thereby straining the boiler and detracting not only from the durability but from the safety thereof.

Heretofore in endeavoring to secure a circulation of the water in the lower part of the boiler it has been customary to inject the feed-water into the boiler at a point near its bottom; but this expedient has proven to be of little value in accomplishing the result sought, since a small stream of water introduced at one point can have but little effect in establishing the proper currents.

The object of the present invention is to provide means whereby the water in an internal furnace is caused to circulate in such a manner that the top portion intermingles with the bottom portion to produce a homogeneous mass of water in the boiler having a temperature substantially uniform.

Further objects of the present invention will appear in connection with the following description thereof.

To the above ends the present invention consists in the devices and combinations of devices to be hereinafter described, and particularly pointed out in the claims.

The present invention is illustrated in the accompanying drawings, in which—

Figure 1 represents in longitudinal section an internal-furnace boiler of a common type to which my improvements are applied. Fig. 2 illustrates the boiler partly in end elevation and partly in section. Figs. 3 and 4 show in side and end elevations, respectively, the circulation-plate detached from the boiler. Figs. 5 and 6 show in side and end elevations, respectively, and upon a somewhat larger scale a sectional form of plate adapted to be inserted in boilers which have already been constructed.

Similar reference characters will be used to denote like parts throughout the specification and drawings.

A represents a common form of cylindrical

boiler having an internal tubular furnace B, provided with a grate B'. Flues A' of the usual number and kind serve to carry away the products of combustion and to form heating-surfaces for the water.

The present invention consists in arranging at each side of the furnace-shell and at some distance therefrom a circulation-plate C, which extends the entire length of the boiler and projects above and below the grate-line. A convenient way of mounting these circulation-plates is to slit the lower portion thereof and bend the slitted parts so as to form forks C', which are adapted to straddle rods or tubes $C^2$, secured to the boiler-heads near the bottom of the boiler, the tops of the plates projecting up between the lower rows of flues $A^2$. The circulation-plates are preferably curved slightly, so as to subdivide the water between the shell of the boiler and the shell of the furnace in the proper proportion. The object of these plates is as follows: The water in contact with the heating-surfaces is at the temperature of the steam in the boiler, while the water adjacent the shell of the boiler is somewhat cooler. Consequently as particles of water are progressively heated they become lighter than other particles located above them, but adjacent the shell of the boiler, and because of this variation in density the light particles of water rise and the heavy particles fall to displace the lighter ones. The circulating-plates are situated so as to subdivide these ascending and descending currents, so that the heavier and cooler water must pass entirely around the outside of the plates and below them before it replaces the heated particles on the inner sides of the plates. This natural circulation of the water having once been established continues, thereby causing each particle of water to move in a definite cycle until it is converted into steam and producing a uniform temperature throughout the boiler. This uniform temperature throughout the boiler obviates the common objection of unequal stresses, and consequent strain, in the component parts of the boiler, while the circulation of the water exerts a cleansing effect on the heating-surfaces, brings into use a large body of water ordinarily inert in boilers of the type described, and insures to each particle of water its proper place and function, the whole operating to effect a greater efficiency. Good results may be obtained by supporting the circulating-plates upon the ordinary stay-rods, which are commonly employed in boilers of this type and which extend beneath the furnace and are secured to the heads of the boiler. While the employment of the ordinary stay-bolts or even special stay-bolts to support the circulating-plates is satisfactory, yet by using a tube instead of a rod additional functions are obtained, namely: The tube may open into the external atmosphere at the front of the boiler, while at the rear it passes through the rear head of the boiler and opens into the combustion-chamber $A^3$. A draft is thereby created whereby the air is drawn through the tube and into the combustion-chamber, where it mixes with the furnace-gases and causes the unconsumed combustibles contained in such gases to combine with its oxygen. The air in passing through the tubes is heated by the hot water in the bottom of the boiler, so that as it emerges from the rear end of the tube it is of a temperature substantially equal to that of the steam, whereby it is enabled to commingle with the furnace-gases at a high temperature, causing its oxygen to combine chemically with the unconsumed combustibles in the furnace-gases. By properly designing these tubes and providing them with registers or other suitable regulating means the combustibles which would otherwise pass through the chimney unconsumed may be entirely utilized in the combustion-chamber and the flues.

In order that circulation-plates may be applied to old boilers now in use without necessitating the dismantling thereof, the plates may be made sectional, as shown in Fig. 4. In this figure there is illustrated a narrow plate $C^{10}$, split at its sides at points $C^{12}$ just above the fork. The proportions of the plates $C^{10}$ are such that these plates may be inserted into the boiler through the usual hand-holes $A^4$, the notches $C^{12}$ facilitating the insertion of the fork. The plates are positioned upon the stay-rods and pushed along toward the rear of the boiler until a sufficient number to extend from end to end in the boiler have been applied.

It is thought that the operation of the present invention has been sufficiently set forth in the above description of the construction and mode of operation thereof and that further description thereof is unnecessary.

Having described my invention, I claim as new and desire to protect by Letters Patent of the United States—

1. An internal-furnace, return-flue boiler having in combination, a bar extending longitudinally of the boiler near the bottom thereof and a circulation-plate supported upon said bar and extending upward between a pair of the lowermost flues, substantially as described.

2. An internal-furnace, return-flue boiler having in combination, a circulation-plate extending longitudinally of the boiler together with supporting means adjacent the bottom of the boiler, said circulation-plate resting upon the supporting means and extending upwardly between a pair of the lowermost flues, substantially as described.

3. An internal-furnace, return-flue boiler having in combination, a bar extending longitudinally of the boiler near the bottom thereof and a circulation-plate supported upon

said bar and extending upward between a pair of the lowermost flues, said circulation-plate consisting of a series of plates sufficiently narrow to permit their insertion through the boiler hand-holes and each having a fork at its lower end for engaging said bar, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

EDWIN TURNER COPELAND.

Witnesses:
WILLIAM F. FREUDENREICH,
MAY A. KENNEY.