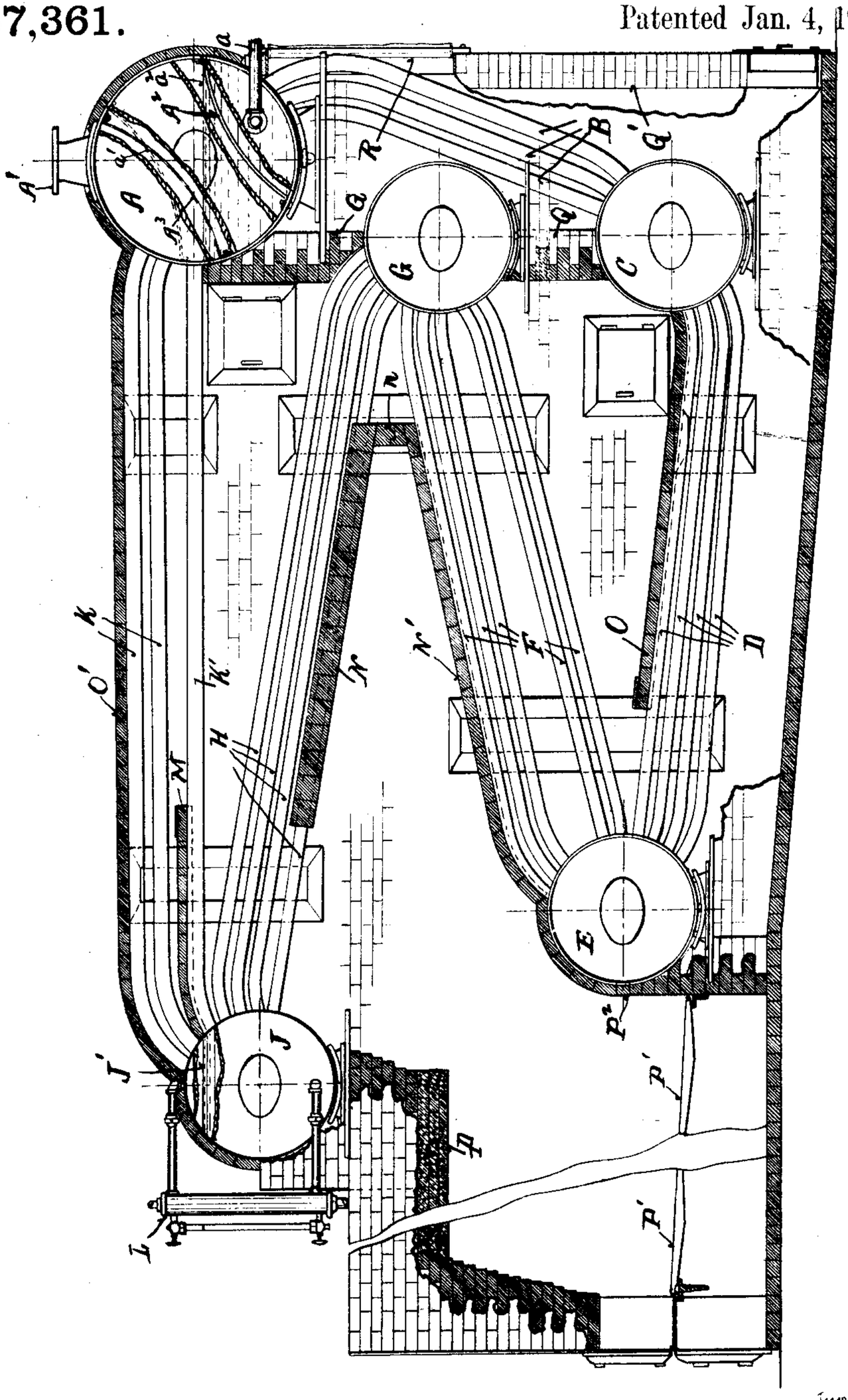
W. A. MOFFAT.

WATER TUBE STEAM BOILER.

APPLICATION FILED JUNE 16, 1915.

1,167,361. Patented Jan. 4, 1916.



Inventor

Walter A. Moffat

By J. A. H. McGregor

Attorneys

UNITED STATES PATENT OFFICE.

WALTER A. MOFFAT, OF ERIE, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO ERIE CITY IRON WORKS, OF ERIE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

WATER-TUBE STEAM-BOILER.

1,167,361. Specification of Letters Patent. Patented Jan. 4, 1916.

Application filed June 16, 1915. Serial No. 34,500.

To all whom it may concern:

Be it known that I, WALTER A. MOFFAT, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented certain new and useful Improvements in Water-Tube 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 make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked therein, forming part of this specification.

My invention relates to water-tube steam generators, and the object of my invention is to arrange the water-tubes in such positions that the tubes and portions of tubes containing the hottest water will be exposed to the hottest fire-gas, and that those tubes which contain the coolest water are exposed only to the coolest fire-gas.

The features of my invention are hereinafter fully set forth and pointed out, and are illustrated in the accompanying drawings, in which:—the figure is a side elevation of a water-tube boiler, embodying my invention, with portions of the heads of two drums broken away; with portions of the side wall of the boiler-setting broken away, so as to expose the boiler in place therein.

In the drawing, A, indicates a water and steam receiving drum, located at the highest portion of the boiler so as to receive the steam generated in the boiler. Communicating with the lower portion of the drum A, is a feed-water pipe a, and at the upper side of the drum A, is a steam discharge pipe A′. Within the drum A, is a longitudinal division wall A^2, which forms a cold water chamber in the lower portion of the drum A, into which the feed-water from the pipe a enters. The division wall A^2, does not longitudinally extend entirely from end to end of the drum A, there being a space between each end of the wall A^2, and each end head of the drum A. Within the drum A I also place another longitudinal division wall A^3, which is secured in the upper portion of said drum, which forms a chamber therein from which steam passes outward through the pipe A′. This division wall A^3, is provided with perforations a', so that there is easy communication for steam and water through said division wall A^3. From the lower portion of the drum A, a series of water-tubes B extend downwardly to the upper portion of a header-drum C, which is located at the lowest portion of the boiler. From the lower portion of the drum C, a series of water-tubes D, leads forward to the lower portion of a header-drum E, which drum E, is placed at a slightly higher elevation than the header-drum C. From the upper portion of the header-drum E, a series of water-tubes F, leads rearwardly to the lower and middle portion of a header-drum G, which is located about the header-drum C. From the drum G, a series of water-tubes H, leads forwardly to the middle portion of a drum J, which drum J, is located at a higher elevation than the header-drum G and in advance of the drum E, and from the upper portion of the drum J a series of steam conveying tubes K, lead horizontally rearwardly to the upper portion of the drum A, and a series of horizontal water-tubes K′, also leads rearwardly to the drum A. Communicating with the drum J, is a water-gage L, of ordinary construction, adapted to show the water-level in the drum J. The tubes B, D, F and H, and the header-drums C, E and G, are completely filled with water, and the drum A, should be filled until the water-level a^2, therein is substantially up to the exit end of the tubes K′, while the water-level J′, in the drum J, should be slightly above the intake end of the tube K′. The circulation of water through the drums and tubes is in the order in which they are hereinbefore described.

Upon the forward portion of the tubes K′, and abutting against the drum J, I place a baffle-plate M, which extends rearwardly about one quarter of the length of the tubes K′. Underneath the intermediate portion of the series of tubes H, I place a baffle-plate N. Above the series of tubes F, I place a baffle-plate N′, which extends from the drum E, backward to the rear end of the baffle-plate N, the space between the rear ends of said baffle-plates N and N′, being closed as shown at n, and above the series of tubes D, I place a baffle-plate O, which extends forwardly from the drum C, about two-thirds of the length of said tubes D. The fire-box arch P, extends rearwardly far enough to shield the drum J, from the fire on the grate-

bars P′; and the fire-wall P², extends over the drum E, to the baffle-plate N′. Above the series of tubes K, I construct the top-wall O′, which covers the drum J, tubes K, and drum A. Adjacent to the rear end of the boiler-setting, I place a wall Q, which closes the spaces between the drums A, G, and C, and in spaced relation to the wall Q, there is a rear wall Q′, through which there is a smoke exit opening R, through which the smoke may flow to the stack (not shown). The flow of fire-gas is therefore from the fire-box upwardly, behind the drum J, and between the water-tubes H, and between the ends of the baffle-plates M and N, from hence it flows rearwardly under the covering O′, to the wall Q, and thence downwardly between the tubes H, and F, and between the rear ends of the baffle-plates N and N′, and drum G, and thence forwardly and around the front end of the baffle-plate O, and thence rearwardly under the baffle-plate O, and drum C, into the space between the walls Q and Q′, and thence upwardly therein around and about the tubes B, located between said walls, and outwardly through the opening R.

It will be observed that the water in the tubes B, is cooler than at any other point in the boiler, and that the fire-gas in contact with the tubes B, is also cooler than at any other point in the boiler setting; also it will be observed that the water in the tubes H, will have a higher degree of temperature than will the water in the tubes D and F, and that the fire-gas flowing over the front end of the baffle-plate N, should have their maximum temperature at that point.

The operation of my improved boiler is therefore as follows, viz:—The water in the tubes B, being of comparatively low temperature, readily absorbs the maximum amount of heat units from the fire-gas in the chamber between the walls Q and Q′, because the gas at that point has a relatively higher temperature than the water in the tubes B. As the water flows from the drum C, through the tubes D, F and H, and their connecting drums, it gradually increases in temperature, in proportion as the tubes D, F and H, are in progressively hotter portions of the stream of fire-gas, so that as the water becomes more nearly equal in temperature with the fire-gas at one point in the boiler-setting, it flows to a point therein where there is an excess of heat units in the fire-gas over what is contained in the water, so that the same can be readily absorbed by the water. The steam liberated from the water in the drum J, flows through the tubes K, in which, being located at the top of the setting where the heat is highest, it is superheated during its flow to the drum A. It will thus be seen that at all points in my improved boiler there will be present a sufficiently greater number of heat units in the fire-gas contacting with the water-tubes, than is contained in the water therein, so that at all points throughout the circulation of the water, I am enabled to obtain the maximum amount of absorption of heat by the water. The water in the drum J, which has not transformed into steam, flows backward through the tubes K′, into the drum A, and flows around the ends of the wall a^2, therein and again into the tubes B.

The lowermost tubes of the series H, I preferably make straight at the ends thereof where they are secured in the drum J, for the reason that they are in the path of the hottest fire-gas, and that I have found that straight tubes withstand the effect of heat longer than tubes which have been subjected to a bending operation.

Having thus shown and described the preferred construction of my improved steam generator and the operation thereof so as to enable others to utilize the same, I do not desire to limit myself to the exact arrangement shown and described, as it is obvious to those skilled in the art, that many modifications can be made therein, without departing from the spirit of my invention.

Therefore what I claim as new and desire to secure by Letters Patent, is:

1. The combination of a box-like boiler setting, a fire-box at the front thereof having a discharge thereinto, a fire-wall at the rear of said fire-box, a steam and water receiving drum at the rear end of said setting, a drum below the upper edge of said fire-wall, water-tubes secured to said drum, said tubes being in communication with the steam and water receiving drum, a drum located above said fire-box, water-tubes secured therein, said tubes being in communication with the drum behind said fire-wall, steam and water conveying tubes connecting said steam and water receiving drum, and the drum above said fire-box, and a series of baffle-plates adapted to cause the fire-gas to flow along the exterior of said water-tubes in a direction opposite to the flow of water in said tubes, and in the direction of the flow of steam in the steam conveying tubes, substantially as shown and described.

2. In a water-tube steam boiler the combination of a water and steam receiving drum, a pair of tube-header drums therebelow, water-tubes connecting said upper drum and the lowermost drum, a rear boiler-setting wall, a transverse wall in spaced relation to said rear wall and closing the spaces between said drums and leaving a fire-gas passage under the lowermost drum, a smoke exit in said rear wall, a fire-wall at the rear of the grate-bars, a header-drum partially inclosed in said fire-wall, a series of water-tubes connecting said lowermost

drum and the drum in said fire-wall, a series of water-tubes connecting the drum in said fire-wall and the intermediate header drum at the rear of said boiler, a steam liberating drum above the fire-box of the boiler setting, a series of water tubes connecting said rear intermediate drum and said steam liberating drum, a series of steam conveying tubes connecting said steam liberating drum and said steam and water receiving drum, a series of water conveying tubes connecting said last mentioned drums at substantially water level, and a series of baffle-plates adapted to guide the fire-gas directly to the top of the boiler-setting, thence rearwardly and downward in front of said rear intermediate drum, thence forward and downward behind the drum in said fire-wall and rearwardly under the lowermost drum and into the chamber under the steam and water receiving drum, substantially as set forth.

3. In a steam generator, a boiler setting comprising side walls, a rear wall, a covering therefor, a fire-box having a fire-wall at the rear thereof, and an arch wall thereon, a steam and water receiving drum mounted upon the rear of said setting, a lowermost drum in spaced relation to the bottom and rear wall of said setting, a series of down-flow water-tubes connecting said drums, a drum mounted behind said fire-wall, a series of up-flow water-tubes connecting said lowermost drum and the drum at the rear of said fire-wall, a baffle-plate above said water-tubes and extending forwardly from said lowermost drum a portion of the length of said tubes, an intermediate drum above said lowermost drum and in spaced relation thereto, a vertical wall inclosing the spaces between said rear-drums, a series of up-flow water-tubes connecting the drum behind the fire-wall and said intermediate drum, a baffle-plate above said water-tubes extending backwardly from the drum behind said fire-wall a portion of the length of said tubes, a steam liberating drum above the fire-box arch, up-flow water-tubes connecting said intermediate drum and said steam liberating drum, a baffle-plate under said tubes and extending forwardly from the rear end of the last previously mentioned baffle-plate a portion of the length of said tubes, a series of water-tubes connecting said steam liberating drum and said steam and water receiving drum, a baffle-plate thereon extending from said steam liberating drum rearwardly a portion of the length of said tubes, and a series of steam conveying tubes above said water conveying tubes and connecting said steam liberating drum and said steam and water receiving drum above the water level therein, substantially as set forth.

In testimony whereof I affix my signature.

WALTER A. MOFFAT.