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W. F. MATTES.

STEAM GENERATOR BOILER.

(Application filed Apr. 20, 1898.)

(No Model.)

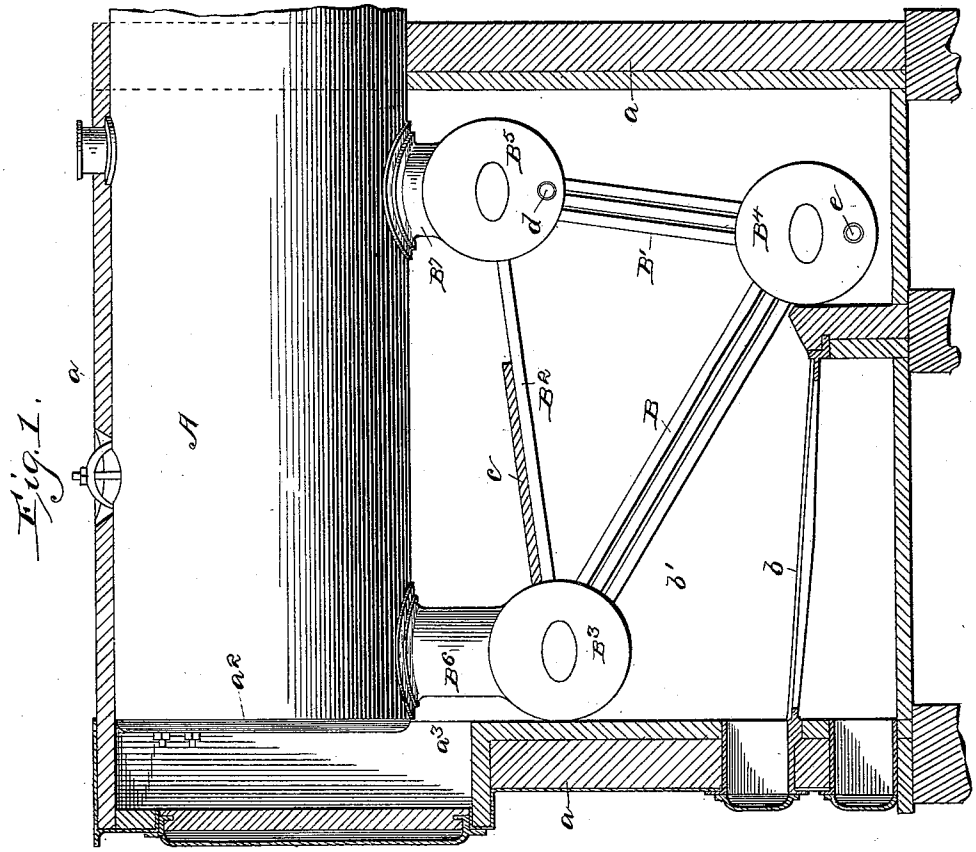

Fig. 1.

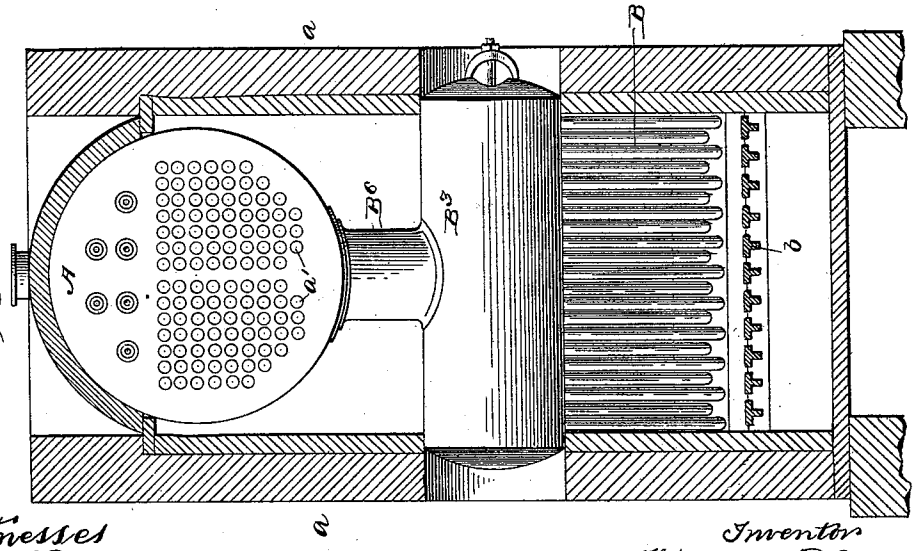

Fig. 2.

Witnesses
Thos. H. Edwards Jr.
J. T. Motherhead.

Inventor
William F. Mattes
By Edson Bros.
Attorneys

UNITED STATES PATENT OFFICE.

WILLIAM F. MATTES, OF SCRANTON, PENNSYLVANIA.

STEAM-GENERATOR BOILER.

SPECIFICATION forming part of Letters Patent No. 615,086, dated November 29, 1898.

Application filed April 20, 1898. Serial No. 678,294. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM F. MATTES, a citizen of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented certain new and useful Improvements in Steam Generators or 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.

My invention relates to improvements in steam generators or boilers.

Among the principal types of steam-generators in general use is the so-called "cylindrical tubular" or "return tubular," the essential features of which are a cylindrical shell with flat heads connected by small tubes passing through said heads. The heated gases from the combustion-chamber play along the shell or cylinder to the back end thereof and then return through the tubes.

The advantages of the return tubular boiler are, first, simplicity and cheapness of construction; second, large water capacity and water surface, providing steadiness of action under fluctuating demands for steam. The disadvantages are, first, the impingement of the flame and radiated heat from the products of combustion upon a comparatively small area of the under side of the shell, resulting in a severe strain by the unequal expansion of opposite sides of the shell and preventing the use of thick plates, which limits this style of boilers to low pressures or to cylinders of small diameters; second, the feed-water is delivered directly into the shell or cylinder, and consequently whatever mud or scale-forming elements may be present in the water are deposited upon the tubes and the lower part of the interior of the shell, and this leads to a great loss of efficiency, to the frequent burning of the shell over the fire, to leaky tubes, and an occasional rupture and explosion; third, deficient circulation, and consequent large area of heating-surface required per actual horse-power; fourth, the area of floor-space occupied per horse-power is large as compared with some other types, and consequently the cost per horse-power for land, foundations, brickwork, piping, and buildings is greater; fifth, the larger number of boilers required increases the cost of attendance.

The advantages of the water-tube boilers consist, substantially, in reversing the disadvantages of the return tubular. In doing this, however, certain disadvantages are encountered, which are, first, insufficiency of water capacity, sensitiveness of the water-line, and wet steam, if forced; second, the closely assembling of numerous water-tubes, which collect soot and dust, renders the same very difficult of cleaning and obstructs the draft; third, difficulty of access to heating-surfaces for examination and cleaning; fourth, difficulty of removal and renewal of a damaged tube, tubes usually being long, and therefore expensive to renew; fifth, the use either of bent tubes or of a very large number of steam-joints for obtaining access to the interior of tubes for inspection and cleaning; sixth, insufficient combustion-space above the fire.

By the combination of the two systems herein disclosed the chief advantages of both are retained, while the disadvantages enumerated are eliminated.

My invention therefore consists of the combination and arrangement of the parts, substantially as hereinafter more fully disclosed, and specifically pointed out in the claims.

Latitude is allowed herein as to details, as the same may be readily changed without departing from the spirit or principles of my invention and the same yet remain intact.

In the accompanying drawings, Figure 1 is a vertical sectional elevation of my invention, taken on the line $x\ x$ of Fig. 2. Fig. 2 is a vertical longitudinal section of the same, taken on the line $y\ y$ of Fig. 1.

In the embodiment of my invention, A refers to the shell or cylinder of the steam generator or boiler of the so-called "cylindrical tubular" type, suitably housed or inclosed in the usual masonry and iron closure a, preferably as shown, said shell or cylinder being secured in the upper part thereof in the well-known way and provided with numerous closely-arranged heating tubes or flues a', extending therethrough from head to head and opening through said heads, as common. The shell or cylinder A has its forward end arranged a short distance from the upper off-

set portion of that end of the closure a, as at a^2, also from the upper or top edge of the lower front portion thereof, as a^3, to provide for the passage of the heated gases from the combustion-chamber to and through the flues a' to aid the heating of the water in said shell, said gases finally escaping through the ordinary smoke, &c., flue or chimney at the back of the shell or closure.

In practice the heating tubes or flues a' are arranged to occupy about five-eighths of the cross-sectional area or water-space of the shell, above that being the steam-space, having the usual steam-exhaust outlet.

B B' B^2 is a triangular arrangement of three series of water-heating tubes arranged below the shell or cylinder A and joining or connected at the corners of the triangle with three transverse drums B^3 B^4 B^5. The series of water-tubes B are disposed or inclined upward and downward immediately above the fire-grates b in the combustion-chamber b' to receive the direct impingement or efficiency of the flame. The series of tubes B', with the mud-drum B^4, are arranged well in rear of the fire-grate to remove said tubes from the maximum or greatest action of the heated gases and said drum to the most distant point from the heat to prevent the baking of the mud or sediment therein, and consequently the incrustation of the interior of said drum, as would otherwise occur. The tubes B^2, ranging above the tubes B, have applied to their upper sides tiling c, extending to within a short distance of the drum B^5, preventing direct action of the greatest efficiency of the flame with the shell or cylinder, yet providing for the upward rearward passage of the heated gases thereunder on their way to the heating tubes or flues in the boiler. Thus while the action of the flame is fully utilized for heating the water in said tubes it will be prevented from directly reaching the shell and unduly expanding the same and licking or impinging the ends of the heating tubes or flues therein and burning them out where they unite with the boiler-heads. To permit of the heated gases passing freely between said water-tubes and to provide for their full utilization, said tubes are spaced well apart for that purpose, said gases passing upward from between the tubes B and forking up between the tubes B' and B^2 and the tiling c and the drum B^5 and around said drum, entering the passage between said tiling and the shell.

The drums B^3 B^5 are connected near their ends by short pipe-sections or necks B^6 B^7 to the shell A, the neck B^6 being somewhat longer than neck B^7, though that is a matter of no particular moment, thus providing for the passage of the heated gases over the drums, while the necks, with the drums, effect communication between the water-tubes B B' B^2 and the shell. The feed-water is admitted to the drum B^5 at d, permitting the sediment or mud in the water to settle in the drum B^4 immediately therebelow, whence it is discharged or removed as becomes necessary by a blow-off cock at e. The water fed into the drum B^5 and passing directly therefrom into the tubes or pipes B' least heated, therefore giving the sediment or mud ample time to settle into the drum B^4 most distantly removed from the heat, preventing liability of the same baking or hardening therein, as would otherwise be the case, circulates or passes through the drum B^4, the pipes B, drum B^3, (more or less backing into the pipes B^2,) through the neck B^6, into the forward end of the shell A, thence passing rearwardly through said shell and entering the neck B^7, the upper part of the drum B^5, and finally the tubes or pipes B^2, whereby a continuous circulation and heating of the whole volume of the water are maintained, with the elimination of all foreign substances or sediment, thus providing for the uniform heating of the water and promoting longevity of the boiler or generator.

Access is given to interior parts by four manholes, one in the head of each drum and one in the top of the shell. The necks connecting the two upper drums with the shell are large enough for a man to pass through to inspect and clean the interior of the shell under the fire-tubes. Access to the exterior of the drums and water-tubes is obtained by small doors through the brickwork, (not shown,) the labor of inspecting and cleaning these parts being greatly facilitated by the large interior spaces designed for that purpose and by the shallow and open grouping of the tubes. This last-named feature is also highly beneficial in preventing an undue accumulation of dust upon and between the tubes. Access to the fire-tubes and to the front boiler-head is given by a large door in the boiler-front in a common manner.

From what has been above disclosed it will be seen that the inclined group of water-tubes over the fire is exposed to the direct radiation of heat and the first impingement of the flame and hot gases. This group of tubes is so open and shallow that with a lively fire some of the flame passes the tubes unquenched and the combustion is completed in the large triangular chamber just beyond. Thus the high efficiency of direct radiation is not utilized at the expense of incomplete combustion. From the triangular chamber mentioned the gases pass in part through the nearly vertical group of water-tubes which connect the upper back drum with the mud-drum and in part between the tubes which connect the front drum with the upper back drum through the opening between the tiles and the upper back drum. The course of both streams of gases after passing the tubes is first upward against the under side of the shell until the chamber at the forward end is reached, and thence backward through the fire-tubes to the chimney-flue. The circulation of the feed-water is downward from the upper back drum through the vertical tubes

to the mud-drum, during which passage the temperature has been raised sufficiently to cause the precipitation of lime sulfate and other scale-forming impurities, and this precipitation is further favored, as above intimated, by the entrance into the mud-drum remote from the fire, within which the velocity of flow is greatly reduced. From the mud-drum the circulation is upward through the tubes leading to the front drum. Within these tubes the generation of steam is extremely lively, the heat being at the maximum and the rapid circulation quickly sweeping the steam-bubbles into the front drum, and thence upward therefrom through the neck connected therewith into the shell. A portion of the water is deflected, as above noted, by the upper water-tubes to the back drum; but the greater part passes through the said neck, then backward through the shell, sweeping off the steam-bubbles forming on the fire-tubes, then downward through the back neck, mingling with fresh feed-water in the upper back drum, and so on around again.

By means of this combination and arrangement of parts the following advantages accrue: first, high efficiency of fuel, due to utilization of radiation without sacrificing the complete combustion of the gases; second, the parts (water-tubes) first exposed to the fire are of a character best adapted to withstand it, and the tubes being short, straight, and accessible can be cheapened and quickly renewed when necessary; third, no flame touches the large shell, nor is there any concentration of hot gases upon a limited area thereof; but the temperature of the gases is so reduced and they are spread over so large a surface simultaneously as to be harmless to even very thick plates; fourth, the reduction of temperature of the gases adds greatly to the life of the fire-tubes, which in ordinary return tubular boilers are prone to burn off and become leaky at the ends where the flame and gases enter them; fifth, the reduction in temperature of the gases before entering the fire-tubes also permits a reduction in the length of the latter, and consequently of the shell, and it follows that the side walls are shorter and the cost of foundations and buildings is less; sixth, the life of the shell and other parts is also prolonged and safety increased by the activity of the water-current and the efficiency of the mud-drum, which combine to keep the inner surfaces free from scale, and the tendency to form hard scale is also abated by the removal of the shell from the direct action of the fire; seventh, a continuous high evaporative efficiency, which is secured by clean surfaces within and without and by the powerful circulation; eighth, the steadiness of action, which is due to large water capacity and large water surface combined with perfect circulation.

Having thus fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a steam-generator, the combination of the multitubular shell or boiler, the triangular arrangement of transverse drums, two connecting with the under side of said boiler, near its forward and rear ends, respectively, and the third connecting by series of tubes with the aforesaid two (drums), substantially as set forth.

2. In a steam-generator, the combination of the multitubular boiler or shell, the triangular arrangement of transverse drums, two connected by necks with said boiler, upon the under side, near its forward and rear ends, and the third drum connected by series of tubes or pipes with the aforesaid drums, substantially as set forth.

3. In a steam-generator, the combination of the multitubular boiler or shell, the triangular arrangement of transverse drums, two connecting by short necks with said boiler, upon the under side, near its forward and rear ends and connected together by a series of tubes or pipes, and the third drum connected by series of tubes or pipes with the aforesaid drums, substantially as set forth.

4. In a steam-generator, the combination of the multitubular boiler, the triangular arrangement of transverse drums connected by short necks with said boiler on the under side, near its forward and rear ends, and together by a series of tubes having a tiling laid thereon a great portion of their lengths, the third drum connected by series of tubes with the aforesaid drums, substantially as set forth.

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

WILLIAM F. MATTES.

Witnesses:

R. LOUIS GRAMBS,

VICTOR E. WENZEL.