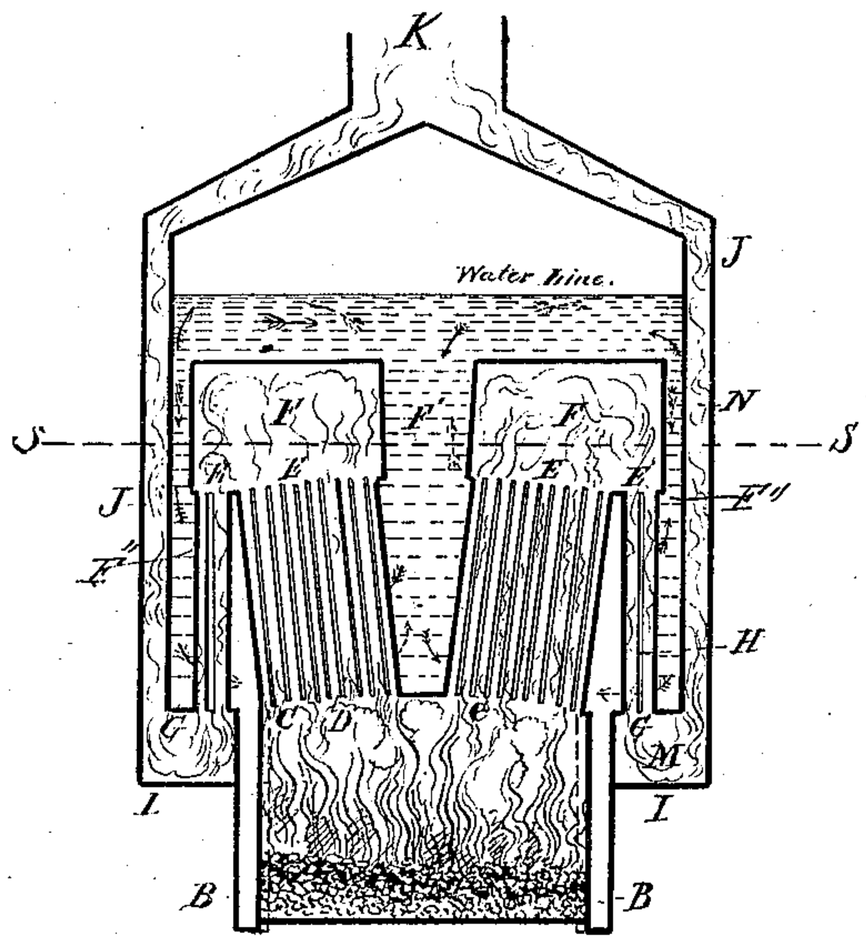
W. Oldman,

Steam-Boiler Fire-Tube.

No. 24,326. Patented June 7, 1859.

Fig. 1



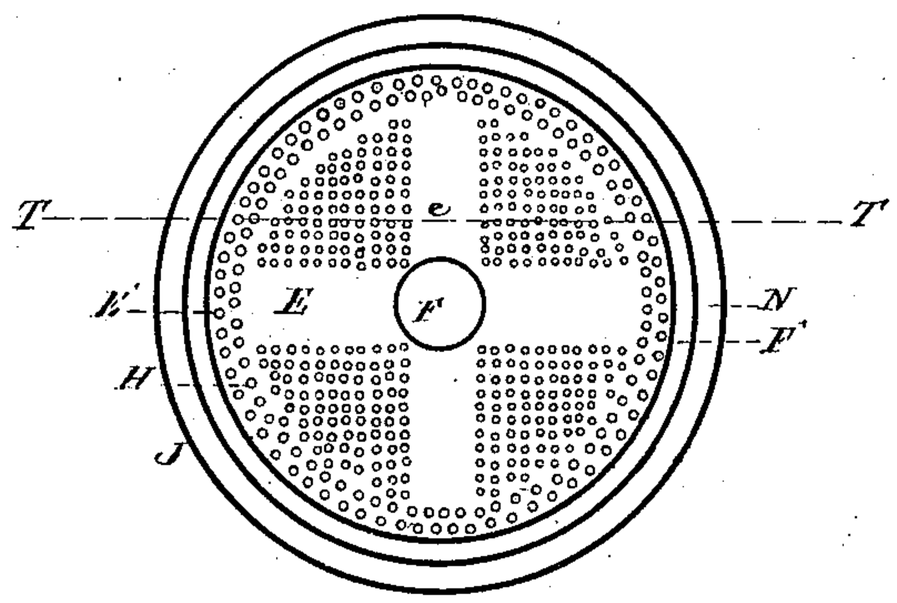


Fig. 2

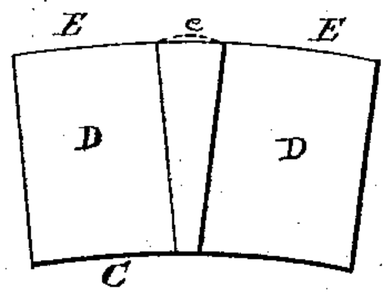


Fig. 3

Witnesses
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UNITED STATES PATENT OFFICE.

WILLIAM OLDMAN, OF BUFFALO, NEW YORK.

IMPROVEMENT IN STEAM-BOILERS.

Specification forming part of Letters Patent No. **24,326**, dated June 7, 1859.

To all whom it may concern:

Be it known that I, WILLIAM OLDMAN, of Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Steam-Boilers; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a vertical section; Fig. 2, a horizontal section, and Fig. 3 an outline diagram to illustrate a portion.

The nature of my invention consists in giving a dishing or partially spherical form to the tube-sheets, which receive and sustain each end of the tubes, the hollow or concave side of one tube-sheet being presented toward the swelled or convex side of the other, in order to allow more expansion and contraction to the tubes than is allowed by the use of plane tube-sheets.

It also consists in a peculiar arrangement of the tubes in reference to each other and to one of the dishing or spherical tube-sheets, whereby the elasticity of the metal is made more available.

It also consists in providing in the within-described relation to an annular water-space on the exterior a liberal water-space extending down the center of the chamber above and communicating with the large central water-space between the tubes, whereby an active current of water is induced to wash the lower tube-sheet.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

My grate A is circular. An annular water-space or water-leg, B, completely encircles the fire, with the exception of an ordinary door on one side. (Not represented.) Across the top of the inside fire-box or furnace extends a crown-sheet or tube-sheet, C, which is not plane, as are all ordinary tube-sheets, but is slightly arched, or, rather, domed, the sheet being convex on its upper face and concave on its lower face, as represented. This sheet C is thickly perforated with holes, in which are secured the ends of the tubes D, through which the products of combustion escape from the furnace. These tubes D are slightly inclined from the perpendicular, diverging as they ascend. I arrange them in three or more sections, as shown in Fig. 2, and dispose the tubes in any one section parallel to the other tubes in the same section. The upper extremities of these tubes are secured in a sheet, E, which is not plane, but, like C, is dishing or spherical, the convex side being presented upward. The sheet E, like the sheet C, is of a circular form. The sheet E is larger than the sheet C. By the divergence of the tubes D a larger sheet is required to secure them at their upper than at their lower extremities, and not only is the area of the curved portion greater, but for obvious reasons the radius of the curvature or "dish" of E is greater than that of C. The sheet E is of so large area that it extends somewhat beyond the limits required to receive the ends of D; but the annular portion E′ exterior to the tubes D, is not dished. It is plane like the ordinary tube-sheets, as represented in Fig. 1. The divergence of the upper ends of the tubes D leaves a considerable space in the center, which, like the smaller interstices between the tubes, is allowed to be filled with water.

Above the annular space in which the upper ends of D are secured is a spacious box or combustion-chamber, F, in an annular form, as represented. In this chamber the unburned gases rising from fresh fuel have a renewed opportunity to mingle with the free oxygen and flame and be burned. This combustion-chamber F is of such diameter that it extends over the plane annular portion E′ of the sheet E. The water-space standing in the center of the combustion-chamber (denoted F′) may be either cylindrical or conical. I have represented it as conical, the larger diameter uppermost. The combustion-chamber F may be of any height consistent with the height of the entire boiler, care being taken to have its top well stayed to the top of the boiler and to be sure that there is always sufficient water on it to avoid danger of its overheating.

The exterior or shell of the boiler is of larger diameter at the middle and top than

at the base. At or near the level of C is an annular sheet, G, which connects the cylindrical portions of the shell of different diameters, as represented. This annular sheet is perforated, as is also the plane portion E′ of the sheet E, and in these perforations are tightly secured the ends of an additional series of tubes, H, as represented. Through these tubes H the hot gases are compelled to descend from the combustion-chamber F. Escaping from the lower ends of H they impinge upon a horizontal plate, I, which surrounds the shell of the boiler at a lower level, as represented, and are then free to ascend in an annular space, N, provided between the shell of the boiler and a suitable jacket, J, and to escape through the stack K in the ordinary manner. This jacket may, if preferred, be double and contain water between its parts, in order to heat such water preparatory to its being forced into the boiler; but I have represented it as a simple jacket of thin metal. The top of the boiler and of the jacket may be of any form consistent with strength, either dome-like or spherical, conical, as represented, or of any other form, according to the height allowable and as the desire to obtain dry steam may dictate.

The steam is taken from the boiler at or near its top, in the usual manner, by a pipe, (not represented,) and there are suitable man-holes and hand-holds (not represented) through the boiler and through the jacket to allow access for repairs.

The hot gases rising from the fire ascend through the tubes D, imparting heat to the water surrounding and between them. Ascending from D slightly cooled, they mingle and complete their combus.ion in the chamber F, and thence descend through the tubes H to the annular smoke-box M, from which they rise in a current completely surrounding the boiler, imparting heat to the contents at every step, and escape comparatively cool into the stack K.

The active circulation of the water in the boiler is represented by either the red or black arrows. As the combustion-chamber F extends very nearly across the whole shell, it is evident that the steam generated between the tubes and about the furnace must rise to the surface of the water through the central water-space, F′, and the narrow annular space F″ between F and the shell, or through one of these alone. As the steam in rising tends to drag up large quantities of water, which must be replaced by water descending at some other point, an active current is invariably established, the water either flowing up through the central water-space, F′, as shown by the red arrows, and down the narrow annular space F″, or down through the central space, F′, and up through F″, as shown by the black arrows. The direction of the current in this respect depends on the proportions of the boiler and the temperature of the gases rising within the jacket on the outside of the shell; but whether it be upward or downward through F′ it must necessarily flow in the reverse direction through F″, and thus the water flows radially either outwardly or inwardly through the spaces between the tubes D, and being by its momentum projected downward it thus continually washes the convex surface of the tube-sheet C, preventing any accumulation of sediment, and consequently preventing the oxidation or burning of this highly-heated and delicate portion of the boiler. The only quiet water is at the bottom of the water-leg B. There the sediment consequently collects and may be removed as often as required by the ordinary means, there being no tubes and few or no stays to diminish the effect of scrapers or of water injected from hose.

Fig. 3 is intended to illustrate the effect of any inequalities in the contraction and expansion of the tubes and tube-sheets. When the tubes expand with heat and demand increased room between the tube-sheets, the irregular transverse strain on each sheet if plane becomes so great at some points as sometimes to destroy them. In my boiler both the sheet C and the sheet E are capable of yielding somewhat, but the lower sheet much the least. The upper sheet, E, is capable of yielding very much, owing to the fact that the tubes are arranged in sections, and that that portion of the sheet between the sections is free to spring. Fig. 3 is a diagram of a cross-section on the line T T. The red line shows the curvature assumed by the free portion of the tube-sheet when the tubes contract, and the blue line close beneath it shows the nearly plane form assumed by this portion when, by reason of the expansion of the tubes, the tube-sheet E is required to rise, and consequently to extend itself. Plane sheets corrugate irregularly when compressed, and are obviously incapable of any yielding to a force of extension; but my dishing or spherical sheets, with the tubes arrangsd in sections, allow a sufficient amount of yielding to obviate the difficulty. By the curvature or dishing form already established in the sheet and by the division of the space into several suitable sections, as represented, a compressive force simply increases the curvature in a slight and harmless degree very much exaggerated by the red line in Fig. 3, while a tensile force simply diminishes the curvature, as represented exaggerated by the blue line in the same figure.

I have ascertained by experience that this boiler is more efficient in generating steam than any others of similar size not tubular, and is much less troublesome to keep tight (and it is presumed will be much more durable) than other forms of tubular boilers.

Having now fully described my invention,

what I claim as new therein, and desire to secure by Letters Patent, is—

The central water-space, F′, in the combustion-chamber F, arranged in relation to the annular water-space F″ and to the tubes D, or their respective equivalents, substantially as within set forth, for the purpose of inducing an active circulation of the water radially among the tubes with the advantages above explained.

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Witnesses:

CHILION M. FARRAR,

W. H. EASTMAN.