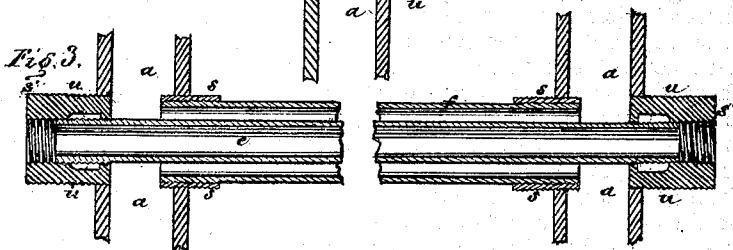
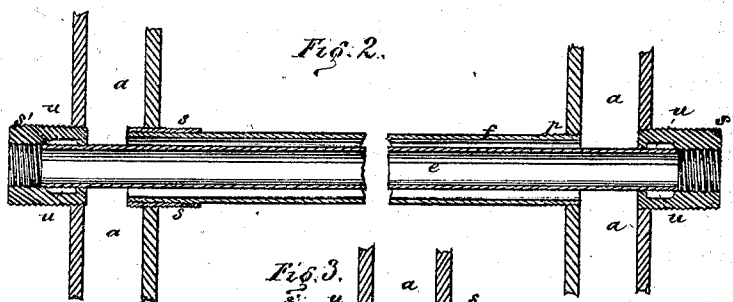
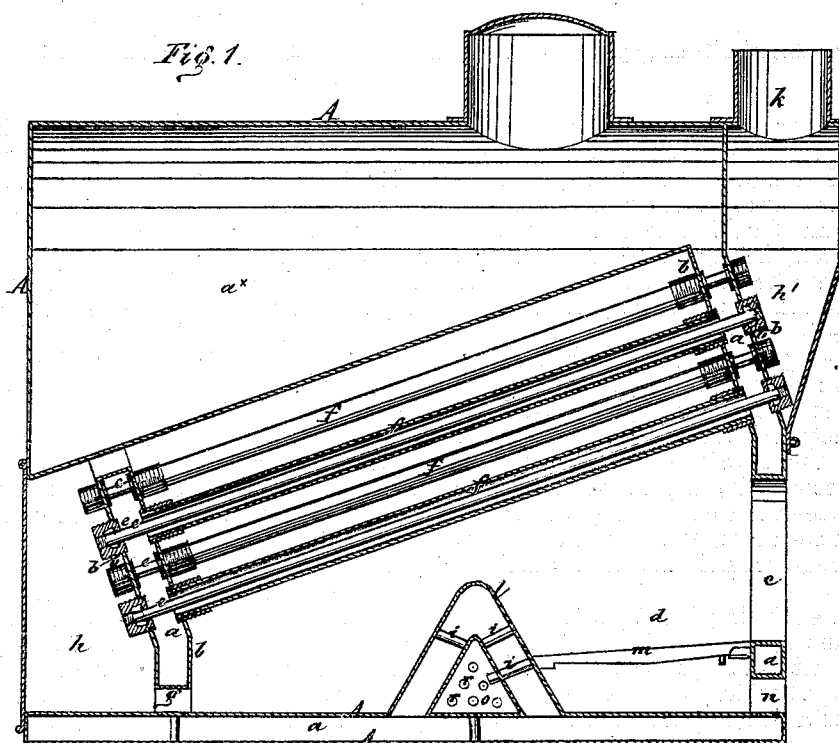


F. R. Hulbert.

Steam-Boiler.

No. 122,252.

Patented Dec. 26, 1871.



Witnesses:

L. J. Hertz
Thos D D Conrad

Inventor:

F. R. Hilbert.

PER

Attorneys.

UNITED STATES PATENT OFFICE.

FRANCIS R. HULBERT, OF GRAND RAPIDS, MICHIGAN.

IMPROVEMENT IN STEAM-BOILER TUBE-BUSHINGS.

Specification forming part of Letters Patent No. 122,252, dated December 26, 1871.

To all whom it may concern:

Be it known that I, FRANCIS R. HULBERT, of Grand Rapids, in the county of Kent and State of Michigan, have invented a new and Improved Steam-Boiler; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawing making a part of this specification, in which—

Figure 1 is a longitudinal vertical section, and Figs. 2 and 3 are longitudinal sections of one of the double tubes; showing, also, in section, the double-tube sheets and bushings.

The object of this invention is to so construct a steam-boiler, comprising a proper combination of tubes and tube-sheets as to better secure the tubes in the tube-sheets, and provide an easy means for their removal and insertion for the purpose of repair.

Referring to the drawing, Fig. 1 is a boiler made with a double inclosing-shell, A, throughout its whole extent. *a* are water-spaces formed between the double shell. *ax* is the water and steam space. *b b* are double tube-sheets, with water-spaces between, continuous with and forming a part of the double inclosing-shell. *c* is the opening through the front water-space for the introduction of fuel to the fire-chamber *d*. *e* are inclined tubes, which are secured to the outer walls of the double tube-sheets. *f* are tubes inclosing the tubes *e*, and secured to the inner walls of the double tube-sheets, thereby forming annular water-spaces continuous with the water-spaces *a*. The products of combustion pass from the fire-chamber *d*, circulate among the larger tubes *f*, communicating heat through them to the water inclosed between the inner and outer tubes, and also communicating heat through the inner walls of the double tube-sheets *b* to the water inclosed in the spaces *a*. *g* is an orifice, of which, however, there may be more than one, made through the rear double tube-sheet, for the products of combustion to pass through into the rear smoke-jacket *h*, whence said products flow into the inner tubes *e*, and thereby are conducted to the front smoke-jacket *h'*, from which they escape through the smoke-pipe *k*. On their passage through the tubes *e* the smoke and gases communicate additional heat to the water inclosed between the tubes *e f*. The opening *g* may be made either between the tubes through

the double tube-sheets, or through the continuations of the double tube-sheets. The bridge-wall *l*, Fig. 1, is also made double, and incloses a water-space that communicates with the other water-spaces. The grate-bars *m* are tubular, and receiving air from the lower side that enters through the ash-pit door *n*, they conduct it to tubes *i* that pass through the water-space of the bridge-wall *l*, and open into an air-chamber, *o*, that is inclosed within the bridge-wall, and also may receive air through perforations *r* opening directly into it through the boiler-wall. Tubes *i* on the other side of the chamber *o* discharge air among the currents of smoke and gases that flow downward toward the opening *g*, thereby effecting a more perfect consumption of the products of combustion, owing to the fact that at the point of contact of the latter with the air-jets said products are highly heated, and therefore more inflammable. The tubes *f* may be enlarged externally at one end, as shown at *p*, Fig. 2, and secured into the tube-sheet by means of a thread cut in such enlargement, or said tubes may be provided with independent bushings *s* at each end to secure the tubes to the tube-sheets. The tubes *e* screw at their ends into bushings *s'*, which are screwed into the outer tube-sheets. The bushings *s'* are cast hollow, as shown in Figs. 2 and 3, the spaces *u* within them opening into the adjacent water-spaces *a*, by which arrangement said spaces receive water, and consequently prevent the bushings from becoming burned out. The outer ends of the bushings *s'* are made with facets, in order that a wrench may be fitted thereto for the purpose of unscrewing them, and the diameter of the bushings *s'* is such that when removed from their tube-sheets the tubes *f* may be withdrawn through the orifices where the bushings were. This arrangement enables each tube *f* to be removed for repair without disturbing any of the others, or taking out the tube-sheets or either of them. The ends of the tubes and bushings may be plated with nickel or other suitable metal to prevent corrosion.

It will be noticed that every part of the inclosing double shell may be effectually braced, while in the ordinary multi-tubular boiler that part of the shell surrounding the tubes has to depend upon the strength of the shell alone. The ends of the tubes *f* and of the independent bushings

project into the water-spaces *a*, as shown in Figs. 2 and 3, and are adapted to receive a wrench for unscrewing the tubes and bushings.

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

1. The inner and outer tubes *e* and *f*, in combination with the double tube-sheets *b*, the outer tube-sheets being provided with orifices for receiving the bushing of the inner tubes, and made large enough to allow the removal of the larger

tubes through them when the bushings are removed, as herein shown and described.

2. The hollow bushing *s'*, as specified.

3. The outer tube *f*, inner tube *e*, hollow bushings *s'*, and double tube-sheets *b*, all arranged together, as explained.

FRANCIS R. HULBERT.

Witnesses:

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