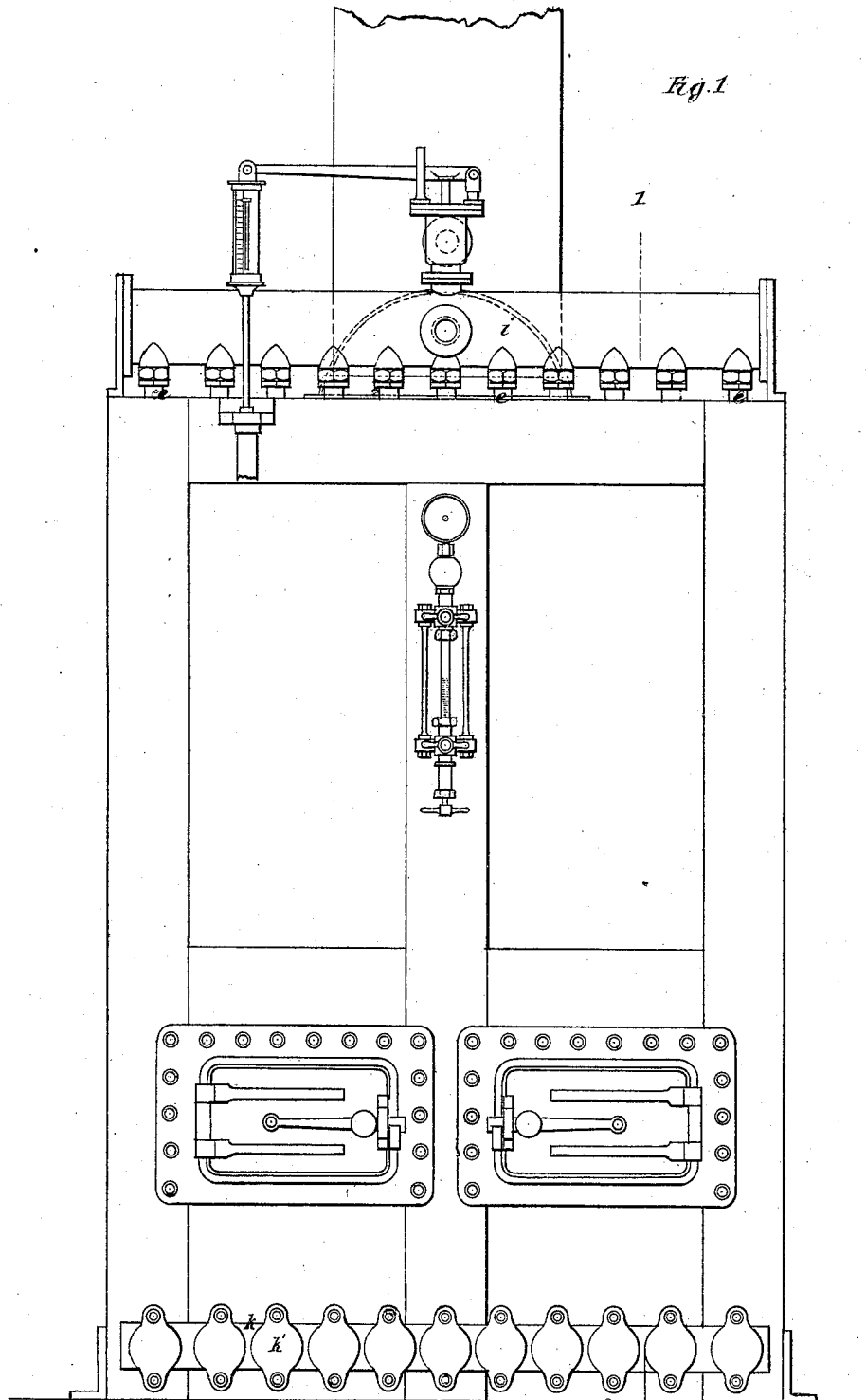


Howard & Bonsfield, 3. Sheets. Sheet 1.

Tubular Steam Boiler.

No. 113298.

Patented Apr. 4. 1871.



Witnesses H. White
65 Chancery Lane

Wm your 24 Aug. Exchange Edward Thorne, Boston

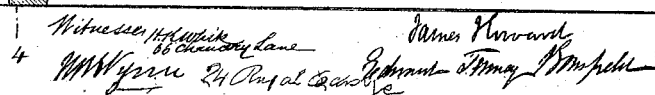
James Howard

Edward Thayer Bonfield

3. Sheets, Sheet 2

No. 113228.

Patented Apr. 4, 1871.



UNITED STATES PATENT OFFICE.

JAMES HOWARD AND EDWARD TENNEY BOUSFIELD, OF BEDFORD,
ENGLAND.

IMPROVEMENT IN TUBULAR STEAM-BOILERS.

Specification forming part of Letters Patent No. **113,298**, dated April 4, 1871.

To all whom it may concern:

Be it known that we, JAMES HOWARD and EDWARD TENNEY BOUSFIELD, of Bedford, in the county of Bedford, in England, have invented a new and useful Improvement in Tubular Steam-Boilers; and we do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to make and use the same, reference being had to the accompanying drawing, forming part of this specification.

The tubular steam-boilers for which we have already obtained Letters Patent have been constructed of groups of tubes consisting of horizontal main tubes and vertical tubes rising from them, the steam being collected from the upper end of each vertical tube by a discharge-pipe common to the whole of the vertical tubes in the group.

Boilers composed of groups of tubes thus arranged, although generally successful, have been found under certain circumstances to possess some disadvantages. Thus, for example, a considerable height or headway is required to allow of the removal of a section or group of tubes or of a single tube from the group, and this in confined situations, as on ship-board, is objectionable, and cannot always be secured.

The short connecting-tubes and the horizontal tubes over them also render the examination and removal of a vertical tube somewhat difficult.

By our present improvements these disadvantages are overcome, and other advantages, to be presently noticed, are also secured, thus rendering the boiler specially suited to marine and locomotive purposes.

We construct our improved boilers of sections or groups of tubes so arranged that the main connecting-tube of each section will be in or approach a vertical position, with smaller tubes projecting from one side of it, say, at right angles thereto, and secured to it by any approved method.

The tubes which stand out at right angles to the main tube we prefer to connect by water and steam ways with each other at both ends.

In the accompanying drawing our improvements are shown as applied to the construction

of a marine boiler provided with two fire-places, set abreast of each other.

Figure 1 is front view of the boiler. Fig. 2 is a vertical section taken in the line 1 2 of Fig. 1. Fig. 3 is a vertical transverse section taken in the line 3 4 of Fig. 2; and Fig. 4 represents a horizontal and transverse section of elastic packing-rings or washers we propose to use in packing the joints.

Similar letters of reference indicate corresponding parts.

By reference to Fig. 2 it will be seen that the improved boiler is canted toward the front, and consequently the main tubes which constitute the back of the boiler, and would otherwise be vertical, have their upper ends slightly inclined forward. It follows, therefore, that the tubes which are connected therewith and stand forward at right angles thereto, are slightly canted out of the horizontal. This is done to facilitate the circulation of water and steam in the boiler.

For the sake of clearness we will, however, in speaking of these tubes, refer to them as the vertical and the horizontal tubes, respectively.

a a a is a series of vertical tubes, formed with flattened sides, and fitting close together, so as to form a closed back for the furnace.

Connected with each of these tubes is a group of horizontal tubes, *b b b*, which are set parallel to and one above the other. These tubes *b* may be screwed directly into the tubes *a*; but we prefer to adopt the screwed coupling-collars *c*, claimed under our patent of 25th May, 1869, No. 90,450.

In forming those sections which are intended to constitute the sides of the border, we place the tubes *b b* close together, as shown at Fig. 3, and they thus form the side walls of the furnace. The front ends of the tubes *b* are closed with a screw-plug, *d*. These screw-plugs are each fitted with a short central tube, which tubes communicate with the vertical tubes *e e*, which extend the whole depth of their several sections. The tubes *e e* are closed at bottom, and severally connect at their upper ends with a transverse steam-pipe, *i*.

This arrangement of the tubes and connections enables us, by simply disconnecting the tubes *b* of either section from the supply-pipe

K and the vertical tube *e*, to withdraw such section horizontally, when desired, for the purposes of inspection or repairs.

The lower rows of tubes of the groups or sections are water-tubes, and, with a part of the vertical tubes, form the water-space of the boiler, and the upper rows of tubes constitute the steam-space.

The several sections of the boiler are connected together at their upper ends, through their tubes *e*, by the transverse steam-pipe *i*, and at their lower ends they are connected by the water-supply pipe *k*.

To give ready access to the lowest row of tubes *b*, which connect with the water-supply pipe, this pipe is fitted with caps *k'*, the removal of which will allow of the cleaning out of the tubes that are in line with the uncovered openings.

In order to insure tight joints for these covers, and for butt joints at other parts of the boiler, we have devised a novel kind of packing-ring, which is shown in place at *y* in Fig. 2, and is drawn on an enlarged scale at Fig. 4. On this packing-ring we shall apply for a separate patent, and in that application particularly point out its merits.

To provide for the rapid circulation of the water, we fit into each horizontal water-tube which is near or adjacent to the fire a modification of the internal tubes described in our former patent. These inner tubes (shown at *f*) are open at both ends, the end near the screw-cap being left free, or supported in a central position merely by struts or spurs *g*. The other end of these tubes projects to about the middle of the tube *a*, and it is cut off at a sharp angle. The object of thus projecting the tubes *f* into the vertical tubes *a*, and of cutting off their ends at a sharp angle, is to provide increased facilities for the circulation of the water in the tubes.

When the heated gases of the furnace impinge on the outside of the water-tubes the steam and heated water will pass along the horizontal tubes *b* and rise in the vertical tube *a*. The said projecting ends of tubes *f* arrest the up-flowing currents in *a* to some extent,

causing them to flow into tubes *b* below tubes *f*, thereby favoring the escape of the water from the latter above the projection.

The horizontal tubes above the water-line are not fitted with internal tubes; but they constitute the steam-space of the boiler and act the part of superheaters, thus insuring the passage of dry, or comparatively dry, steam to the steam-pipe *i*.

Instead of cutting off the projecting ends of the tubes *f* at a sharp angle, as shown at Fig. 2, we propose to fit those ends into a diaphragm, dividing up the vertical back tubes to a short distance below the water-level; or we insert within each of these vertical tubes *a* a smaller vertical tube to receive the ends of the tubes *f*, and thus form a division in the tubes *a*. By this means an upward and downward current will be established within the vertical tubes *a*, and an efficient circulation of the water will be thereby secured throughout the sections.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. The vertical tube *a*, combined with the series of horizontal tubes *b* and their centrally-arranged circulating-tubes *f*, as and for the purpose described.

2. The arrangement of the circulating-tubes *f* upon spurs axially within the horizontal tubes *b*, and projecting therefrom at one end, as and for the purpose specified.

3. The construction of the circulating-tubes *f*, each with projecting end cut obliquely, as and for the purpose specified.

In witness whereof we, the said JAMES HOWARD and EDWARD TENNEY BOUSFIELD, have hereunto set our hands the 5th day of December, in the year of our Lord 1870.

JAMES HOWARD.

EDWARD TENNEY BOUSFIELD.

Witnesses:

H. K. WHITE,

66 *Chancery Lane*.

M. WYNN,

24 *Royal Exchange*.