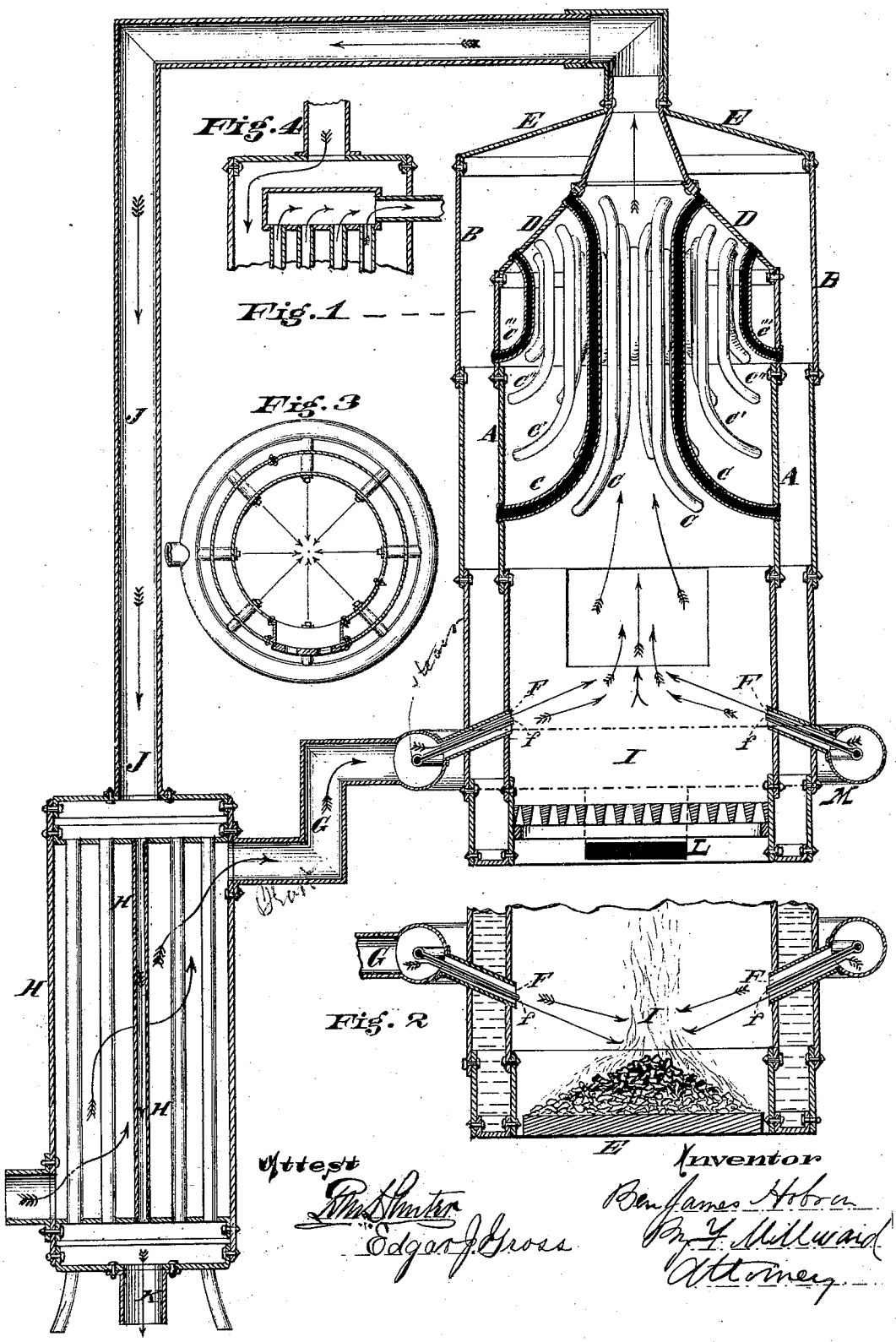
B. J. HOBSON.

STEAM-BOILER FURNACE.

No. 181,440. Patented Aug. 22, 1876.



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IMPROVEMENT IN STEAM-BOILER FURNACES.

Specification forming part of Letters Patent No. **181,440**, dated August 22, 1876; application filed February 28, 1874.

To all whom it may concern:

Be it known that I, BEN JAMES HOBSON, of Hutchinson, Reno county, State of Kansas, have invented certain new and useful Improvements in Steam-Boilers, of which the following is a specification:

My invention has for its objects the form and direction of the tubes of the boiler that will best secure free circulation, and such discharge therefrom as shall facilitate a separation of the steam; the distribution of the tubes in such a manner as to offer least obstruction of the gases; the most favorable inclination or curvature of the tubes for the rapid absorption of heat; such arrangement of different diameters of tubes as shall cause uniform generation of steam; the dispensing with grate-bars where desirable, and the perfect combustion of the gases in the fire-chamber by the utilization of heat generally wasted.

My invention consists, first, in such formation of the tubes and peculiar connection with the boiler that, while they are curved, they enter the tube-sheets at right angles to the sheets at both ends, to provide for a tight joint and free expansion or contraction, and yet extend into the fire-chamber in such a manner as to insure automatic circulation of water and favorable inclination to the current of heated gases, the main length of the tubes being vertically disposed, so as to make the hereinafter more fully described grouping of the tubes practicable, and provide for a more favorable disposition thereof as concerns the number it will be possible to so group; second, in such an arrangement of the tubes in groups as to conform to the natural configuration of flame in a tube, the tubes being made of different sizes and lengths, in such a manner that the largest and longest are exposed to the hottest part of the flame, and the smallest and shortest located where the heat is less intense, for the purpose of preserving a uniform velocity of circulation and a uniform discharge of steam from the tubes in proportion to size; fourth, in the combination and arrangement of the steam-boiler, a draft-blower or forced-air pipes, and an air-heater for this draft, for utilizing the waste heat, inducing perfect combustion in the fire-chamber, and preventing the formation of smoke, the air being introduced into the combustion-chamber at a point or points above the grate and bed of fuel.

Figure 1 is a vertical section of a steam-boiler and apparatus containing the greater part of my invention. Fig. 2 is a view in section, showing the device by which I succeed in dispensing with grate-bars. Fig. 3 is a cross-section of the boiler immediately above the annular air-chamber, and Fig. 4 is a modification in the construction of the heater.

A and B represent, respectively, the inner and outer shells of the boiler. The tubes C are attached at their lower ends to the shell A, and at their upper ends to the conical crown-sheet D. The crown-sheet E, owing to the necessary contracted character of the drawing, is much nearer the sheet D than is desirable in practice. In practice, more steam room than is shown in the drawing is requisite.

The tubes C are bent at both ends, for the purpose of enabling them to enter the sheets at right angles thereto, the presence of the conical sheet D necessitating the bending of the upper ends.

By the provision and arrangement of the conical sheet and bent tubes, therefore, the right-angle joint is not only effected, but the tubes are in such a form as that expansion and contraction will not strain the joint of either end.

The curvature of the upper ends, furthermore, so inclines the discharge of water therefrom (in the generation and the liberation of steam) with relation to the natural direction of the escaping steam that a separation of the steam from the water in these discharges is effected at a point near the crown-sheet D, and the water is prevented from projecting into the steam-space.

The tubes are so grouped, as shown in Fig. 1, that the inner row C, at the bottom, give wide openings between them for the flame to enter, which openings are reduced in width by the spaces between the pipes of the next row, the openings terminating in a point, as it were, against the last row, so that these openings are star-like in cross-section, to con-

form to the natural configuration of flame, and being curved upward and inward, so as to contract in lateral extent, also in conformity to the natural form assumed by flame in a tube or chamber. It is a well-known fact that flame in all cases naturally assumes a tapering pointed form, star-like in cross-section near the apex, as seen in the flame of a burning candle, and that it will not follow the shape of a cylindrical tube for but a short distance; and I have therefore designed that the spaces between the tubes in my boiler shall conform to this natural formation of the flame, rather than be at variance therewith, and by this natural concentration combustion is supported and completed.

The tubes C C′ C″ C‴ are of different sizes and of different lengths; and in order that the water may pass through the outer tubes as rapidly, and liberate as much steam in proportion to area, as the inner ones, I arrange them so that the inner ones are the longest and largest, and from that to the outer ones the length is decreased and the diameter correspondingly decreased.

In some cases I design to dispense with the grate-bars usually employed, and substitute therefor a solid bottom, E, and feed the fire with the necessary gases to support the combustion by the jets F, which are necessarily inclined toward the bottom. These jets may be steam surrounded by annular jets of air; or jets of air alone may be used. I prefer, however, that these jets, whether used with a solid fire-bed, E, or with grate-bars, as shown in Fig. 1, shall be steam surrounded or united with jets F of air, so highly heated as that it shall superheat the steam, and that these jets shall concentrate in a common focus, where the heat, in consequence, will be so intense that the gases arising from the coal will be fully consumed and the formation of smoke prevented, the component parts of the steam and air being in the process separated and utilized.

It will be seen by reference to the drawings that my furnace depends for its supply of air entirely upon that communicated through pipe G, which supplies a forced current of air from a blower, or other apparatus adapted to establish and support a current of air. This current of air passes through a heater, H, of such construction that the air will pass in an opposite direction to the products of combustion, which operate it substantially as shown in the heater for which Letters Patent were granted to myself and William H. Richardson, October 3, 1871, reissued May 28, 1872, so that its temperature is gradually increased, and it leaves the heater at a point where it is hottest. The products of combustion which operate this heater are conveyed from the furnace I by pipe J, and, after passing through the heater, escape at pipe K, the heat so conveyed (which is generally wasted) being utilized in the heating of the air, which is forced in by jets F to support and complete combustion and prevent smoke. In order to maintain below the grate at least as high a pressure as is possible above the fire, a duct, L, is provided, which conducts air under pressure from the circular duct M, which feeds jets F.

In Fig. 4 it is seen, as a modification, that in place of arranging for the air to pass around the tubes of the heater, and the products of combustion through the interior thereof, this may be reversed, the air being then made to pass interiorly, and the gases exteriorly. As in this furnace the products of combustion are under pressure, the door of the furnace should not be opened unnecessarily, and, when open, the escaping gases may be made to ascend a flume or vertical flue over the door, which may be attached to the front of the boiler.

I claim—

1. The shells A B and conical crown-sheet D, in combination with the vertical tubes C, curved at both ends to meet both the shell A and crown-sheet D at right angles, substantially as and for the purpose specified.

2. The circulating-tubes C C′ C″ C‴, increasing in bore toward the center of the combustion-chamber, curved at their lower ends, as shown, and disposed in annularly-arranged groups, inclosing a gradually-contracting stellated space for flame, substantially as and for the purpose specified.

3. The combination of pipe G, supplying forced air, from a blower or other apparatus, to the combustion-chamber of the boiler above the grate or bed of fuel, air-heater H, fuel-furnace I, and pipe J, conveying the products of combustion through the heater H, the parts being combined and operating substantially in the manner and for the purpose specified.

In testimony of which invention I hereunto set my hand.

BEN JAMES HOBSON.

Witnesses:
R. M. HUNTER,
J. L. WARTMANN.