

(No Model.)

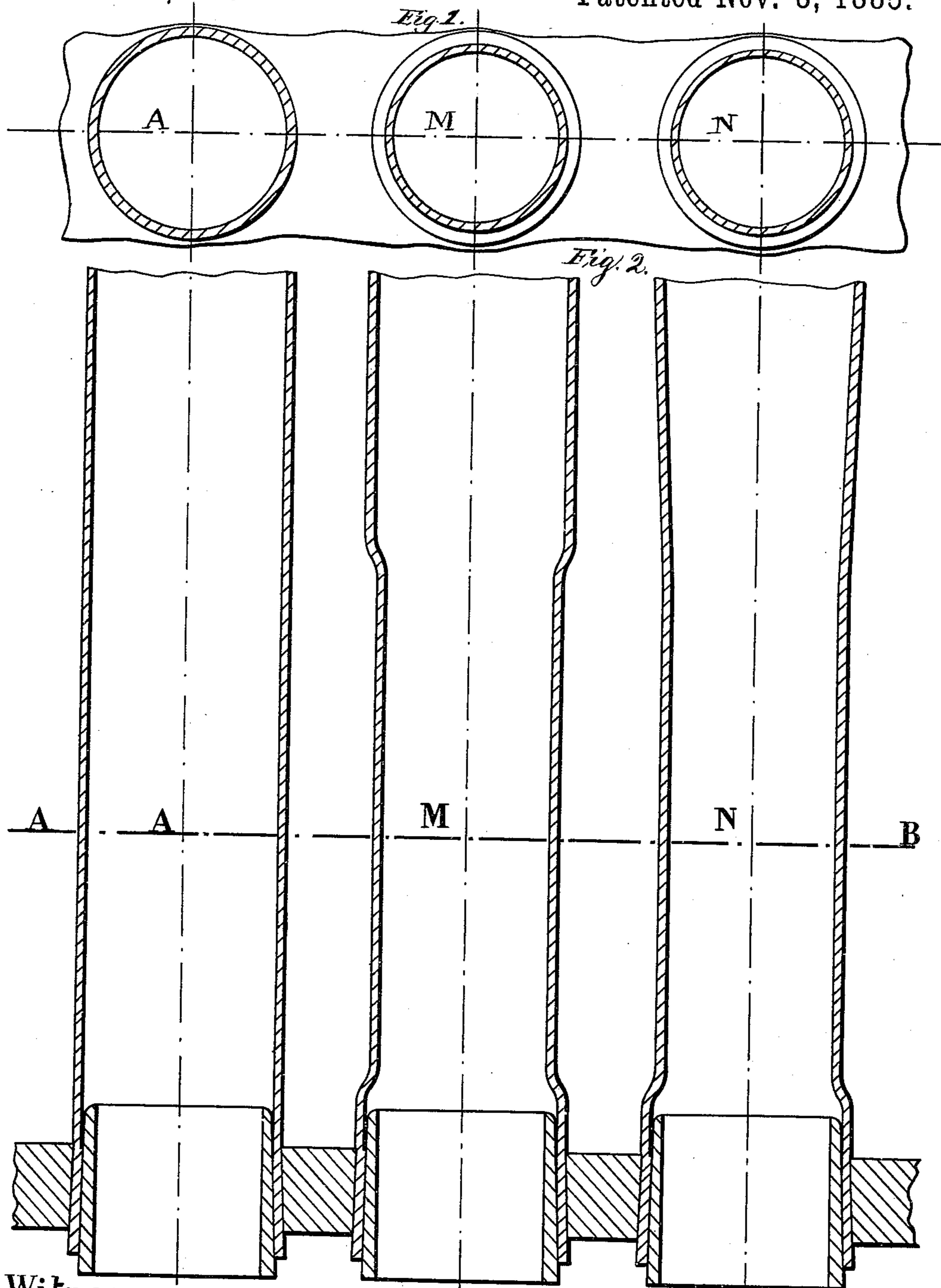
2 Sheets—Sheet 1.

A. NORMAND.

SMOKE TUBE FOR TUBULAR STEAM BOILERS.

No. 329,848.

Patented Nov. 3, 1885.



Witnesses.

*Wm. M. Hooper*  
*Amey. V. Kirk*

Inventor.

*Auguste Normand*

(No Model.)

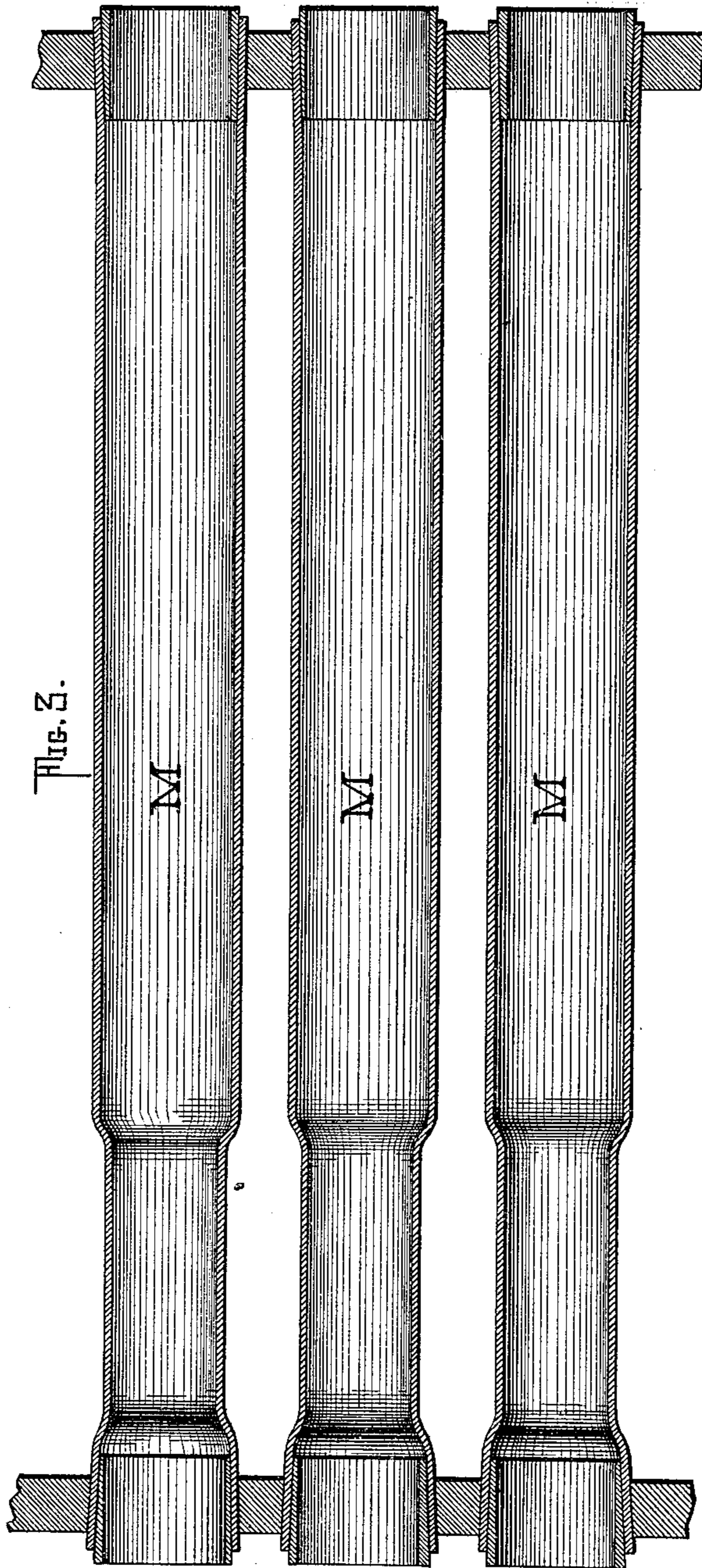
2 Sheets—Sheet 2.

A. NORMAND.

SMOKE TUBE FOR TUBULAR STEAM BOILERS.

No. 329,848.

Patented Nov. 3, 1885.



WITNESSES.  
C. J. Hendrick  
Philip Beauregard

INVENTOR.  
Augustin Normand  
by A. H. L. R.  
his ATTORNEY.

# UNITED STATES PATENT OFFICE.

AUGUSTIN NORMAND, OF HAVRE, SEINE-INFÉRIEURE, FRANCE.

## SMOKE-TUBE FOR TUBULAR STEAM-BOILERS.

SPECIFICATION forming part of Letters Patent No. 329,848, dated November 3, 1885.

Application filed May 11, 1885. Serial No. 165,137. (No model.)

*To all whom it may concern:*

Be it known that I, AUGUSTIN NORMAND, a citizen of France, residing at Havre, in the Department of the Seine-Inférieure, have invented new and useful Improvements in Smoke-Tubes for Tubular Steam-Boilers, of which the following is a specification.

It is known that in the smoke-tubes of tubular steam-boilers the rate of production of steam per unit of length increases in proportion to the nearness of the part under consideration to the fire-box tube-plate. This fact is clearly demonstrated by the experiments of Petret and others. The steam thus produced at the extremities of the tubes, where they are inserted into the tube plate or sheet, acting together with the steam applied by the said tube-sheet itself, diminishes the density of the water in contact with these surfaces, and the refrigerating-power is reduced in proportion as the combustion is more active, the volume of water smaller, and the escape of steam more difficult. The consequence is that these surfaces become overheated and weakened and expand excessively. Possibly the water may even sometimes pass into the spheroidal condition. Leakages consequently often occur at the point of junction of the tubes with the tube-sheet. It would therefore be evidently an advantage to increase the volume of water at this part of the boiler, and to facilitate the escape of steam which is produced therein, provided that the section of the passage for the products of combustion or heating-gases be not contracted in consequence. This may be done. In fact, boiler-tubes are usually provided with iron or steel rings or ferrules in the tube-sheet of the fire-box. The internal diameter of the tubes may consequently be reduced to that of the inside of the rings without contracting the section of the passage for the gases. This reduction of the diameter may be extended for a certain distance—say from about four to twenty inches, for example, or even to three feet and upward—without perceptibly diminishing the evaporation, as the production of steam by a given heating-surface; or, in other words, the quantity of heat transmitted, is proportional, not only to the extent of this surface, but also to the refrigerating-power of the liquid in contact therewith.

In the present instance the heating-surface is slightly diminished at the contracted part of the tubes; but as the density of the mixture of steam and water surrounding it is at the same time increased, there are good reasons for assuming that the quantity of heat transferred is not reduced. On the contrary, if the diameter of the tubes were uniform throughout their length and enlarged at the tube-plates only—an arrangement frequently employed—the heating-surface would be much reduced, and the speed of the heating-gases increased thereby producing a serious diminution in the production of steam.

This invention consists in reducing the diameter of the smoke-tubes in the vicinity of the tube plate or sheet of the fire-box for a fraction of their length, the contraction commencing as near as possible to the internal surface of the tube-plate. The diameter may be so reduced as to render the section of the passage in the contracted part either greater or less than that of the inside of the rings or ferrules, although it appears preferable that the two sections should be equal.

The said invention is applicable to all tubular steam-boilers in which the hot gases pass in the interior of the tubes, and is especially suited for high-pressure boilers having horizontal or nearly horizontal tubes, such as boilers for locomotives, torpedo-boats, and steamers worked with forced draft.

The invention may be applied to tubes made in one piece or otherwise to cylindrical or corrugated tubes arranged horizontally or vertically and irrespective of their dimensions and the nature of the metal of which they are composed.

In the accompanying drawings, Figure 1 is a cross-section, and Fig. 2 a partial longitudinal section, of three smoke-tubes—one, an ordinary tube, lettered A, and two lettered M and N, respectively—constructed in accordance with the invention. Fig. 3 is a longitudinal section showing three of the improved tubes.

The transition from the large to the small diameter of the tubes may be gradual, as in the tube N, or sudden, as in the tubes M. The contracted part of the tube may be either a true cylinder or slightly conical or curved.

The invention is independent of the mode of connecting the tubes to the tube-plate, even when the employment of rings or ferrules is dispensed with.

5 The annexed drawings show one of the arrangements which may be employed. In order to show more clearly the advantages presented by the invention, particularly with respect to the generation of steam, especially when the  
10 tubes are horizontal, or nearly so, the left-hand part of the drawings shows the ordinary arrangement at A, and the right-hand part the improved arrangement at M N. It will be observed that the width of the passage provided  
15 for the steam at the contracted part of the tubes is increased by the difference between the internal diameters of the tubes and of the rings or ferrules. Assuming that the internal diameter of the rings is less by a quarter of an  
20 inch than the normal inside diameter of the tubes, and that the normal thickness of the body of water between the tubes is three-quarters of an inch, the width of the longitudinal passages for the escape of steam is increased  
25 by the improved arrangement by one-quarter of an inch, or about thirty-three per cent., in the vicinity of the tube-sheet or tube-plate of the fire-box where the evaporation is most active, and without diminishing the section of  
30 the passage for the heating-gases.

The contraction must not extend beyond half the length of the tubes, because the effect then is to reduce the heating-surface overmuch, and increase the speed of the heating-gases excessively, so as to produce a serious diminution  
35 in the production of steam.

The object of the present invention is to prevent injurious heating near the tube-sheet without seriously affecting the generation of  
40 steam.

In Fig. 3 the tubes are contracted for about a fourth part of their length.

With regard to the means whereby the local reduction of the diameter of the tubes may be

obtained, it will suffice to mention two—namely, dies and draw-plates. 45

The employment of smoke-tubes of varying section has been patented several times; but these arrangements are entirely distinct from the one forming the object of the present invention. In one of these arrangements the  
50 tubes were made tapering as they receded from the tube-sheet, and were then expanded for the rest of their length, the greatest contraction being at some distance from the tube-sheet, and the diameter in immediate proximity to the tube-sheet being the same as in the enlarged  
55 portion of the tube, whereas it is essential to this invention that the contracted portion, or portion of smaller diameter, should be as close as practicable to the flue-sheet, since it is in immediate proximity to said sheet that over-  
60 heating is liable to occur. The conical tubes referred to would have no effect in preventing this difficulty, which it is the object of this invention to avoid. 65

Having thus described the invention, and reserving the right to vary the materials, proportions, dimensions, and accessory arrangements according to circumstances, what I desire to protect is— 70

In a tubular boiler, the smoke-tubes of reduced diameter at and adjacent to the tube-sheet of the fire-box, the portion of smaller diameter commencing as close as practicable  
75 to the tube-sheet and extending for a fraction of the length of said tube, always less than one-half said length, and the tubes for the remainder of their length being unreduced or of greater diameter than the part at and adjacent  
80 to the tube-sheet, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

AUGUSTIN NORMAND.

Witnesses:

ROBT. M. HOOPER,  
AUG. VINCK.