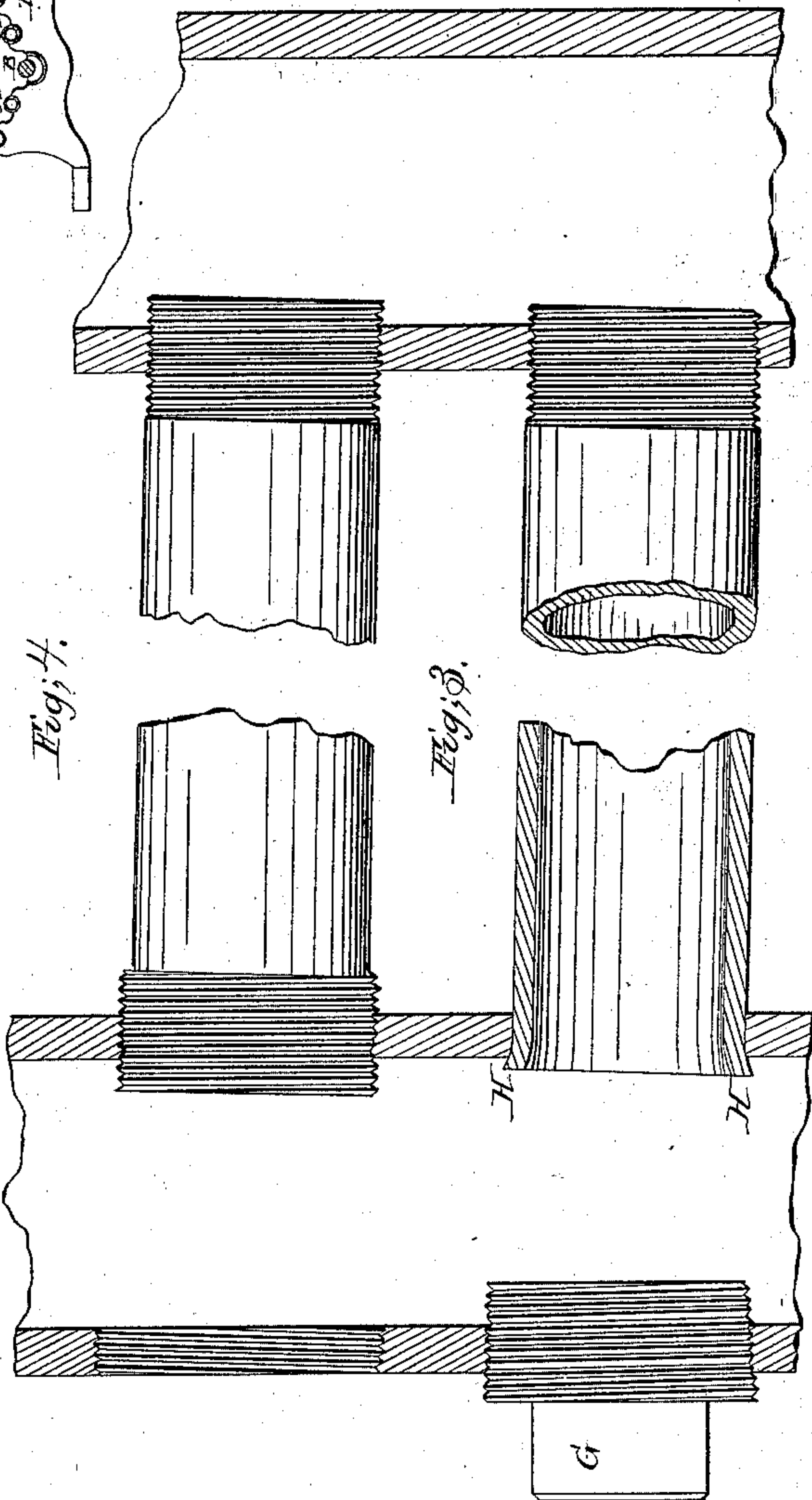
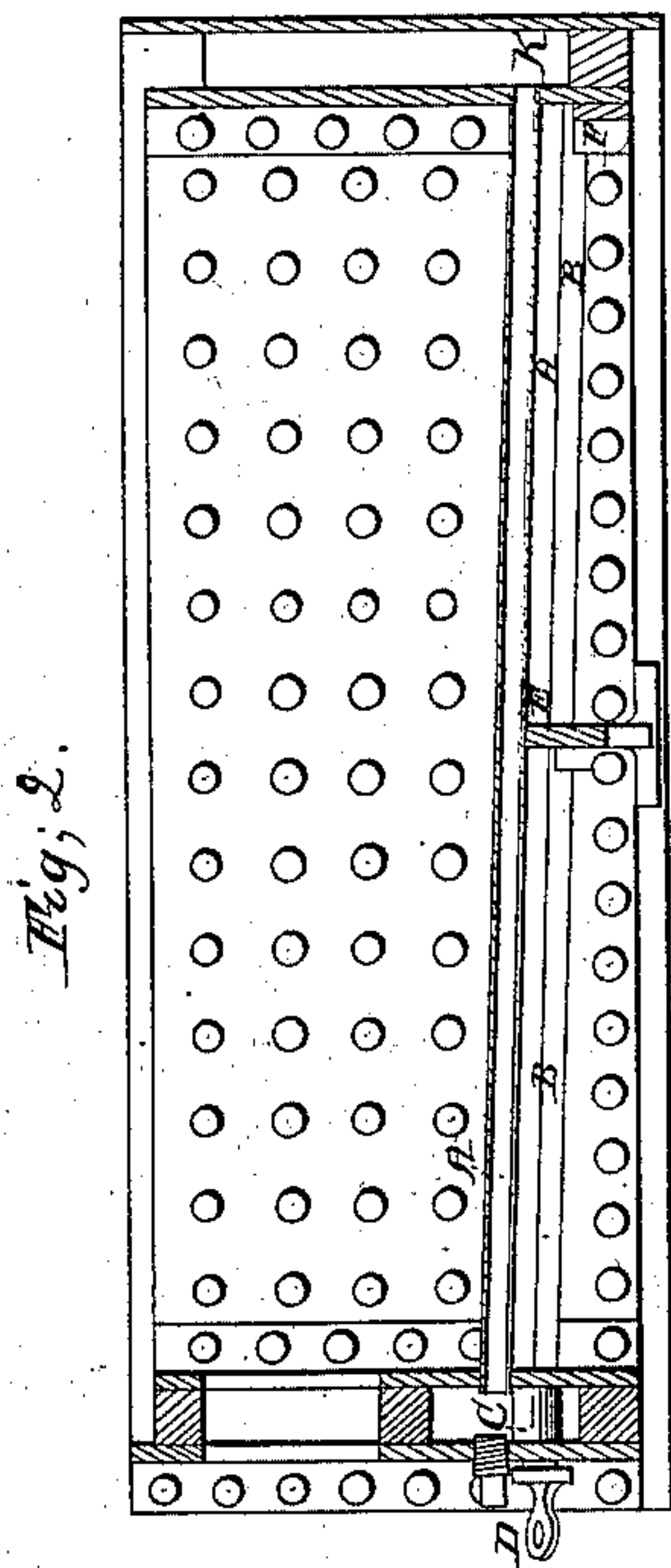
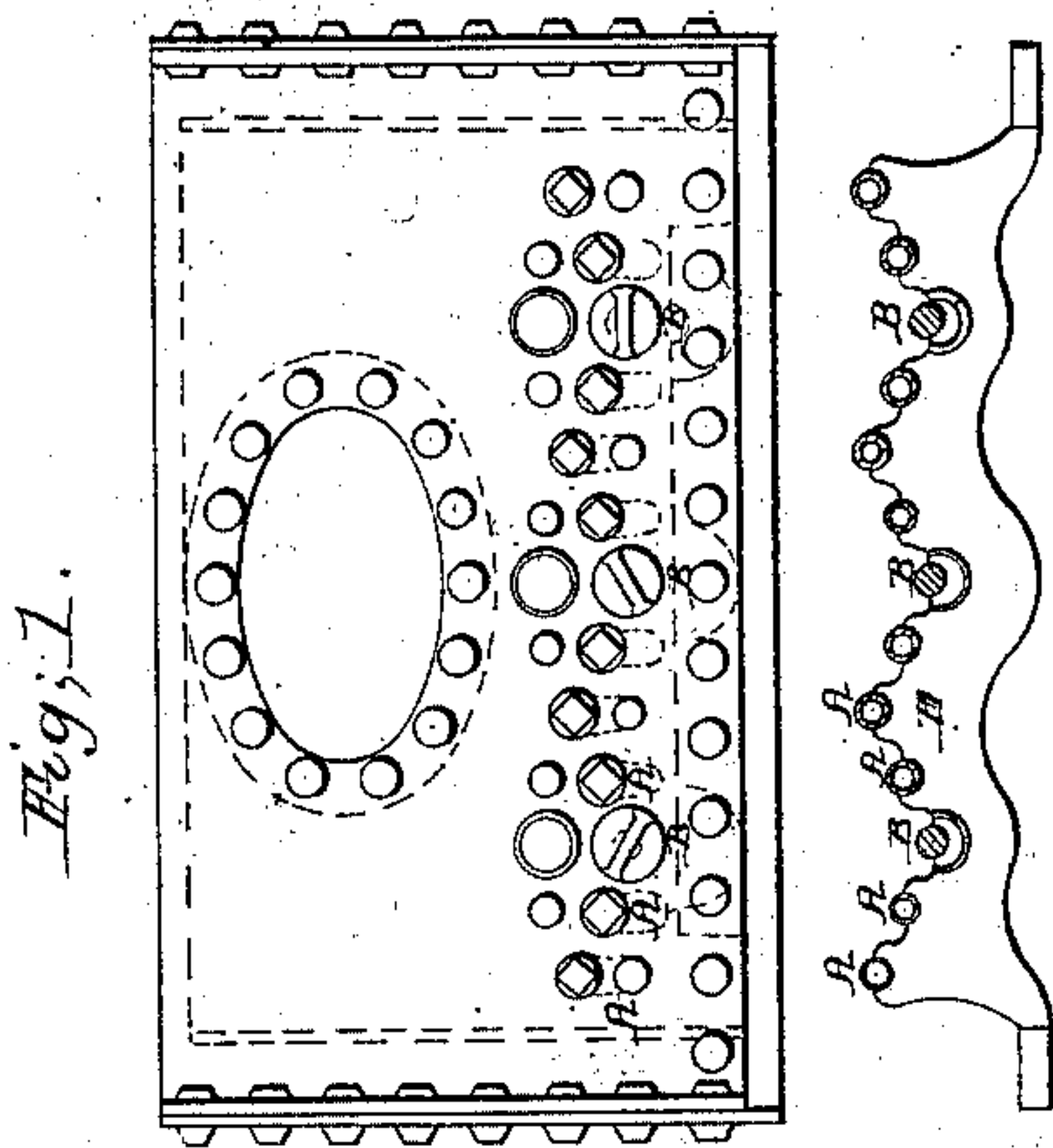


*J. Millholland,*

*Steam-Boiler Furnace,*

*No 32,076.*

*Patented Apr. 16. 1861.*



*Witnesses;*  
*Wm. Cameron,*  
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# UNITED STATES PATENT OFFICE.

JAMES MILLHOLLAND, OF READING, PENNSYLVANIA.

## IMPROVEMENT IN FURNACES OF STEAM-BOILERS.

Specification forming part of Letters Patent No. 32,076, dated April 16, 1861.

*To all whom it may concern:*

Be it known that I, JAMES MILLHOLLAND, of the city of Reading, in the county of Berks and State of Pennsylvania, have invented a new and useful Improvement in the Construction of Water-Grates for Steam-Boilers, and particularly applicable to the furnaces of locomotive-boilers; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The nature of my invention consists in the constructing of a water-tube grate for steam-boiler furnaces by placing the tubes which constitute the grate-bars in such a position with reference to each other as to bring them into lateral contact with the fuel, so as to receive thereby a greater amount of heat from the fuel resting upon them than would be possible if the tubes were placed in a level or curved bed, as heretofore; also, by inclining them to one end, so as to cause a circulation of the water through them.

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

In the accompanying drawings, Figure 1 is a front elevation of a locomotive-boiler, exhibiting the arrangement of my water-tube grate. Fig. 2 is a vertical longitudinal section of the same, and Figs. 3 and 4 are details.

The grate-bars in common use, as is well known, are composed of cast-iron and rest upon sleepers at the ends or sides of the furnace; but solid bars of this kind, especially in the burning of coal as fuel, are liable to various objections, one of which is the formation of "clinker" upon the bars, owing to the great heat they acquire. To obviate this difficulty, as well as to increase the generative capacity of the boiler, are among the objects sought to be obtained by the mode of constructing the water-tube grate hereinafter described.

First, then, for the better bearing and working of the fuel upon the grate, as well as for the better transmission of the heat of the fire to the water-tubes by lateral contact, I arrange and dispose the tubes which con-

stitute the grate-bars in the zigzag order shown in Fig. 1. The lower bars, B B B, Fig. 1, and B B, Fig. 2, are solid rods of wrought-iron, and are supported by the thimbles or short tubes C C, Fig. 2, in the front and back water spaces or legs of the fire-box, through which they are passed. These solid bars are made with an eye on their outer ends, (shown at D, Fig. 2), by which they may be turned about or rotated on their axes, and thereby prevent the caking of the fuel upon them, for it will not cake or form clinker upon the water tubes or bars. These eyes also serve for drawing out these bars when it is necessary to discharge the fuel from the furnace, and they are pointed at the opposite end to permit of being readily replaced in the front bearings. To prevent sinking or springing of the water tubes and bars, I place in the central part of the furnace the bearers E and F, Fig. 2.

Secondly, for the purpose of producing or causing a free circulation of the water through the tubes which form the grate-bars, as well as to give ready exit to the steam which may be formed in them, I place them in the inclined position shown at A A, Fig. 2. The water-tubes being thus higher at the one end than at the other, the current of the water will be upwards, or to the highest end.

Thirdly, the manner in which I introduce the water-tubes to form the grate and fasten them in position is in this wise: I make a circular opening through the exterior plate of the fire-box and in line with the intended position of the tube in the grate, but of a somewhat larger diameter than that of the tubes, so that they may easily pass through it, which opening I tap and fit with a screwed plug. (Shown at G, Fig. 3.) Opposite this opening I make another one, through the interior plate of the fire-box, of the proper size of the tube, which opening I chamfer or bevel to receive the flare of the tube as made by the expanding-tool, in a manner which is well known to boiler-makers, as shown at H, Fig. 3. Then in the opposite end of the furnace I make an opening in the interior plate of the fire-box to receive the other end of the tube, and into this opening the tube is fastened by screwing, as shown at K, Fig. 2. In



practice the tube is first screwed into its place in the front end of the furnace, and then secured at the back end by the expanding-tool; but sometimes I secure both ends of the tubes by screwing, in which case I enlarge one end of the tube sufficiently to cause the thread of the screw to be completely above the body of the tube, as shown at Fig. 4, thus by either method accomplishing the object in an expeditious and thoroughly efficient manner, and which is particularly important, from the facility it affords for making repairs.

I am well aware that tubular grate-bars have been used; but in no case have they been arranged in the manner which I have described, so as to be acted upon laterally by direct heat transmitted by the immediate contact of the incandescent fuel—an arrangement which experience has shown to be very important. I am also well aware that solid grate-bars have been placed in an inclined position, or higher at one end than at the other; but that was to facilitate the passage of the fuel over the grate from the front to the rear part of the furnace, which is a matter of no consequence in a locomotive-boiler, and is a purpose totally different to that which I have in view, for my zigzag arrangement of the tubes gives them so great a generative capacity

that they would be immediately destroyed if a constant circulation of the water was not maintained through them by having one end something higher than the other. Tubular grates heretofore were merely intended to form level beds for the fuel, which would be more durable than solid bars, and upon which the coal would not clinker or cake.

Having thus described the arrangement, construction, and method of placing and securing the tubes into the furnace of a steam-boiler so as to form a water-grate, what I claim therein as my invention, and desire to secure by Letters Patent, is—

1. The zigzag order of placing the tubes for the purpose of receiving by lateral contact with the fuel a more perfect transmission of the heat to the water within them, substantially as described.

2. The zigzag order of the tubes, in combination with their inclined position, for the joint purpose of procuring a more perfect transmission of the heat to the water within the tubes and the circulation of the water through the tubes, substantially as described.

JAMES MILLHOLLAND.

Witnesses:

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