

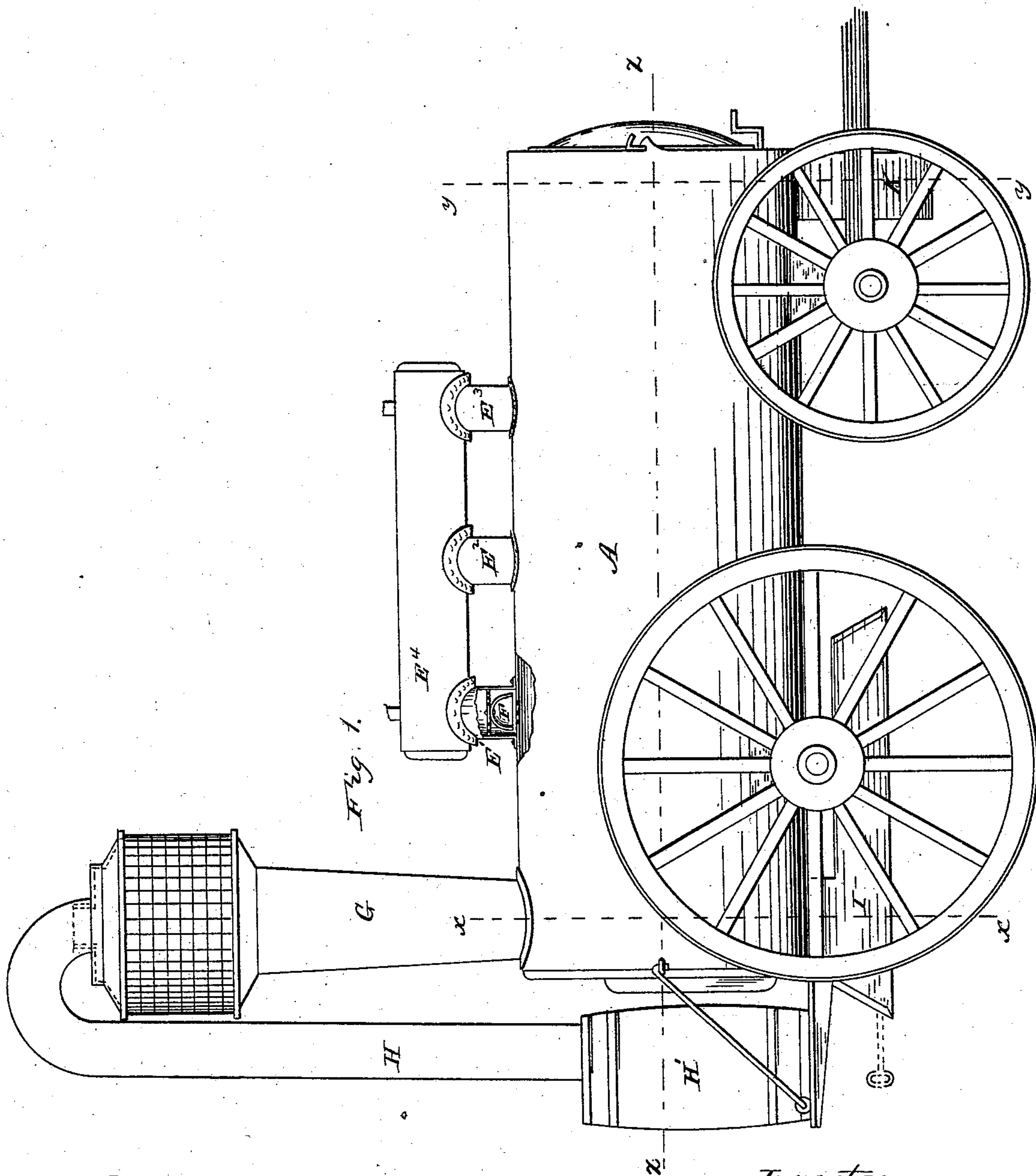
(No Model.)

2 Sheets—Sheet 1.

J. H. ELWARD.  
Steam Boiler.

No. 236,011.

Patented Dec. 28, 1880.



Witnesses:

A. M. Low

J. B. Barker

Inventor:

John H. Edward  
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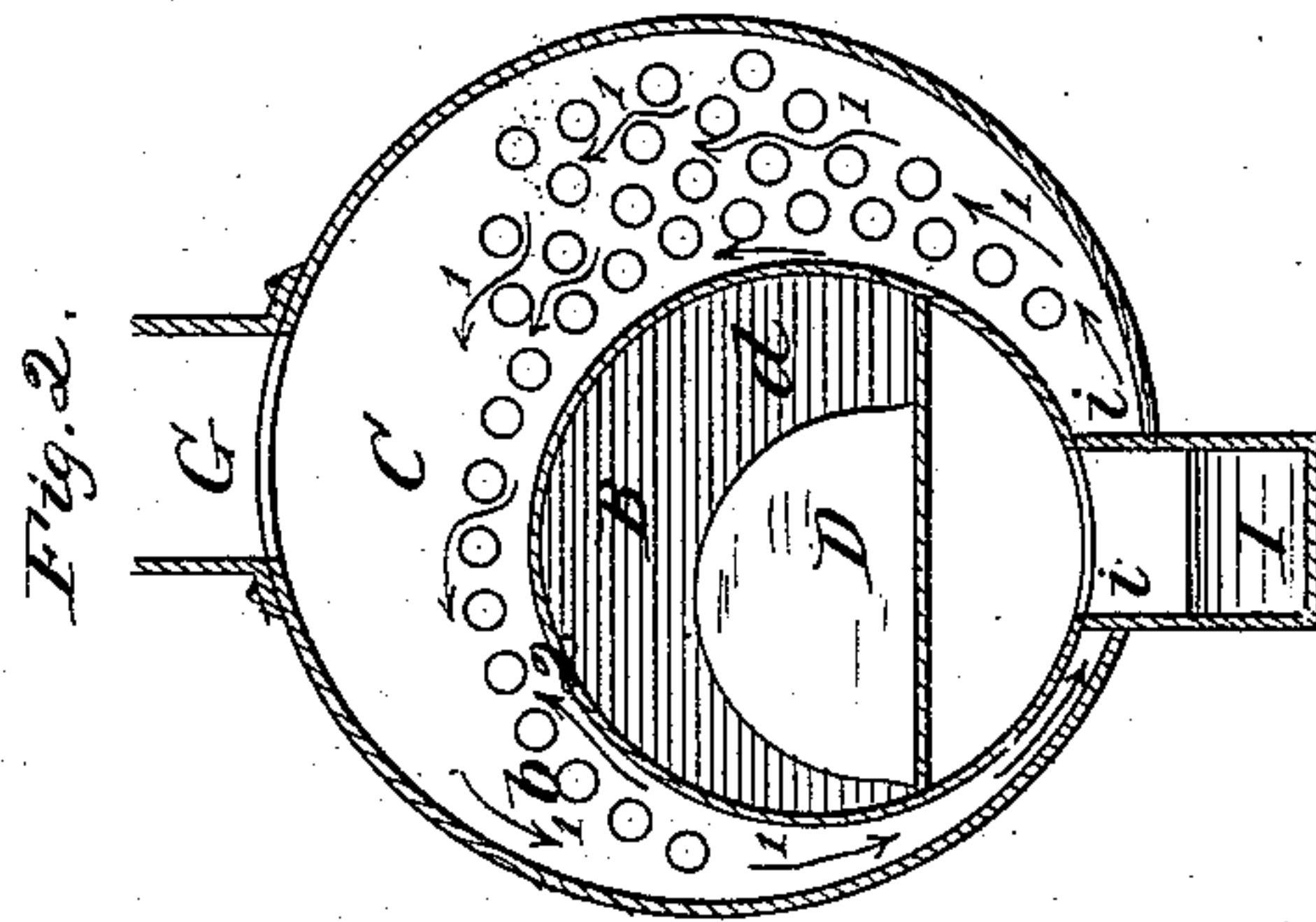
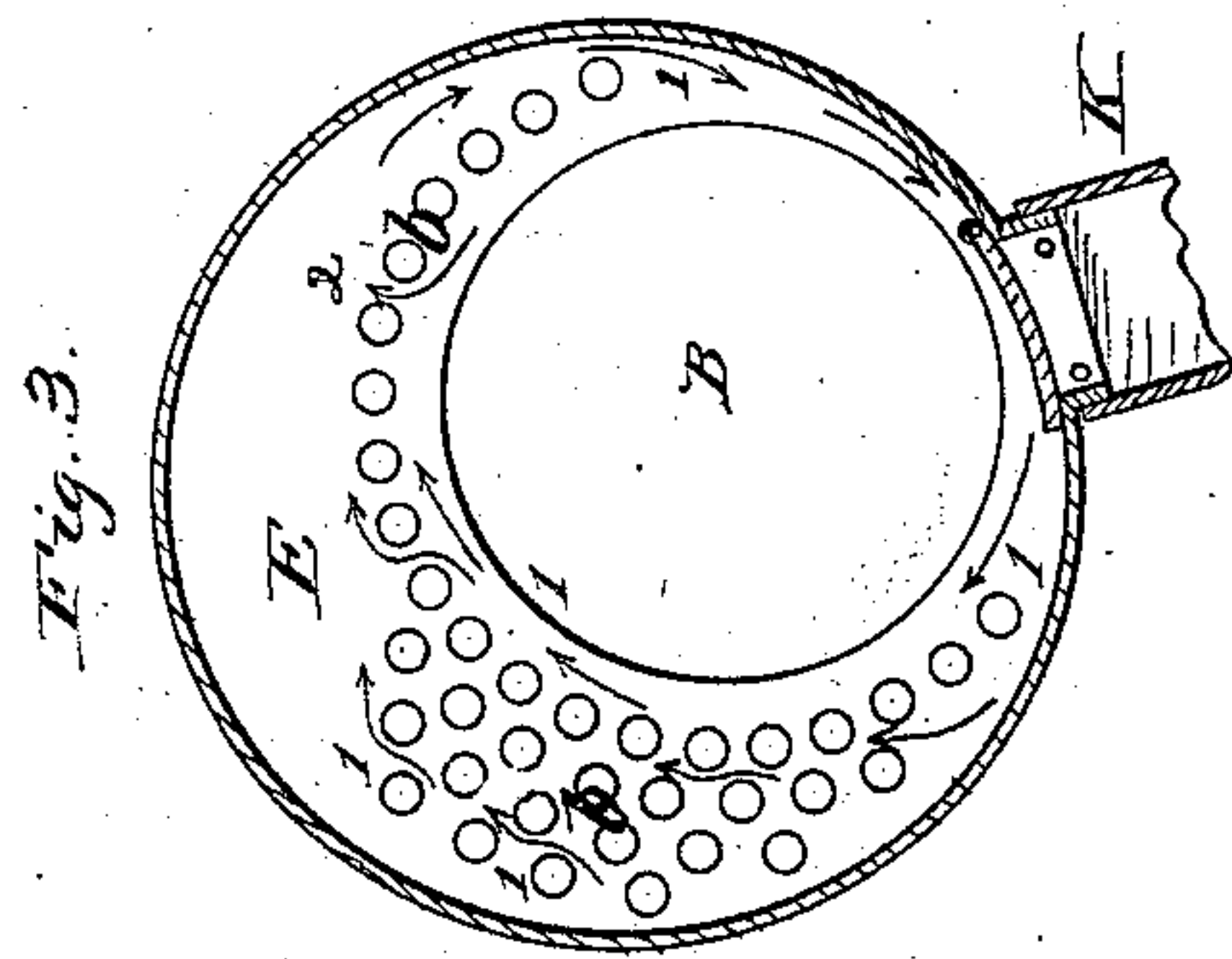
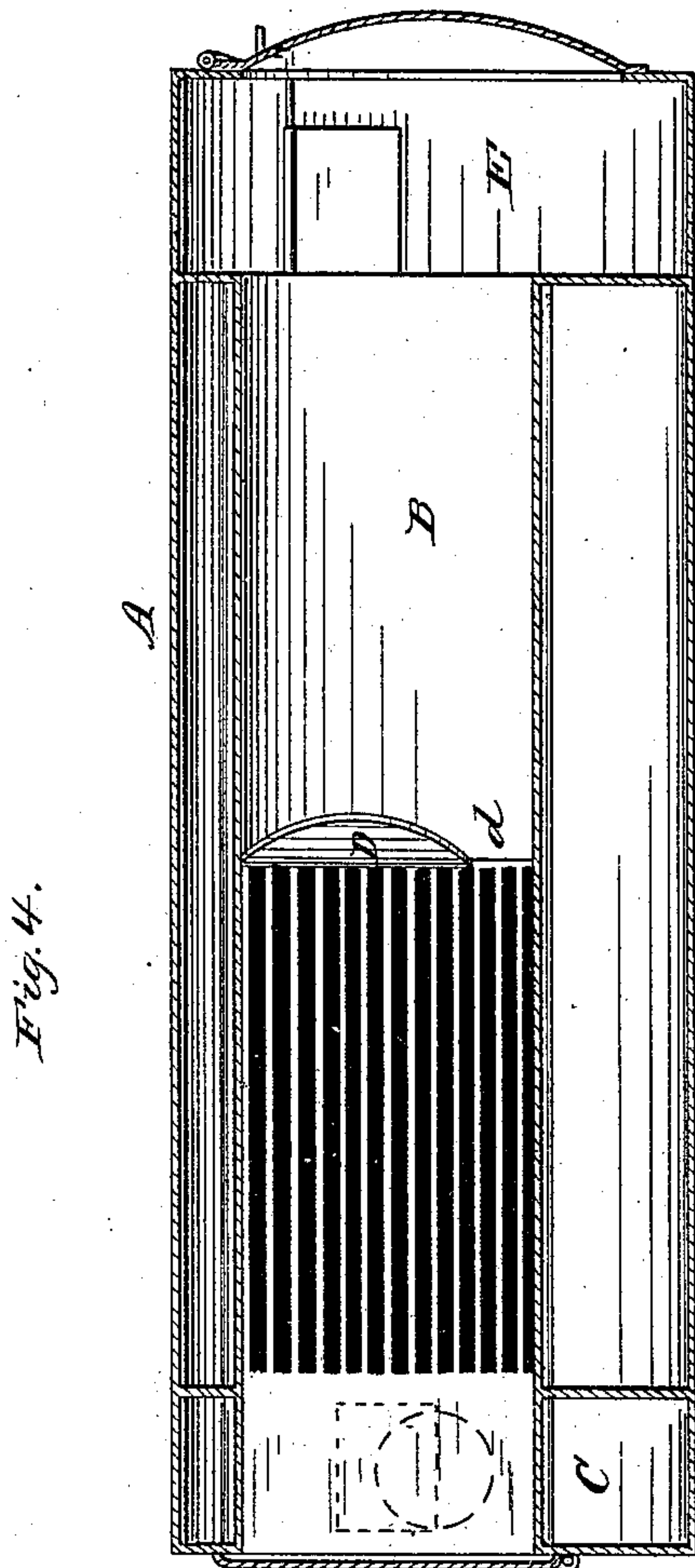
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2 Sheets—Sheet 2.

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Patented Dec. 28, 1880.



Witnesses:

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# UNITED STATES PATENT OFFICE.

JOHN H. ELWARD, OF STILLWATER, MINNESOTA.

## STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 236,011, dated December 28, 1880.

Application filed October 6, 1880. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN H. ELWARD, a citizen of the United States, residing at Stillwater, in the county of Washington and State of Minnesota, have invented certain new and useful Improvements in Steam-Boilers for Portable Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

Figure 1 is a side elevation of a portable engine-boiler embodying my improvements. Fig. 2 is a vertical transverse section taken on the line *x x*, Fig. 1. Fig. 3 is a vertical transverse section taken on line *y y*, Fig. 1. Fig. 4 is a longitudinal horizontal section on line *z z*, Fig. 1.

The boiler may be mounted for transportation upon any of the ordinary devices, and may be combined with an engine of any preferred character.

The boiler is represented by A, and within it the fire-flue B is placed. The fire-box or furnace proper is arranged at the rear end of the fire-flue, there being a smoke-chamber, C, surrounding said fire-box at its rear end, and arranged to carry the products of combustion from the return-flues to the smoke-stack. The fire-flue B is situated so as to have its center at one side of the central vertical line of the boiler, and the return-flues *b b* are situated around the fire-flues on curved lines concentric with said fire-flue B, and it will be seen by examining the drawings that said return-flues are so arranged that there shall be flues above and upon each side of the fire-flue B, the greater number of the flues being on the side of the boiler opposite to the one in which the fire-flue is situated. The result of this arrangement of flues is, that a current is established in the water within the boiler, owing to the fact that the water is hotter upon that side of the boiler to which the fire-flue B is nearest than it is on the opposite side.

I am aware that boilers have been constructed with a somewhat similar arrangement of flues; but in the construction heretofore employed

there has been so much more heating-surface upon one side of the boiler than upon the other that the boiler has been warped in consequence of the unequal heating of the shell upon opposite sides. The boilers straighten themselves again upon cooling off, and the warping and straightening result in their rapid destruction.

I have found that by placing the fire-flue B about as much to one side as is shown in the drawings, and also arranging some of the return-flues between the fire-flue B and the nearest adjacent part of the shell of the boiler, I am enabled to produce the circulation of the water in planes transverse to the longitudinal axis of the boiler, and at the same time avoid the injurious warping above referred to. Arranging the return-flues in curved lines which are concentric to the fire-flue facilitates the passage of the water-currents, and therefore equalizes the temperature, so that there is less difference between the temperature at the water-line and the water in the lower part of the boiler than is customary with the ordinary constructions.

I have found that there are two or more currents induced by this arrangement of flues, which still further facilitate the generation of steam.

When the fire-flue is arranged at one side of the central vertical line of the boiler, with the return-flues arranged upon both sides of the fire-flue, but with a much larger number of return-flues upon one side than upon the other side, the circulation of water is entirely different from that which occurs when the fire-flue is situated directly upon the said central vertical line, or when the fire-flue is arranged in close proximity to one side of the boiler and without any return-flues arranged in the narrow space thus formed. When it is upon the vertical central line of the boiler there are two currents of substantially uniform strength and volume, one upon each side of the fire-flue, the water rising in close contiguity with the flue and descending near the shell of the boiler. These two currents leave, as will be readily seen, a body of substantially motionless water underneath the fire-flue and between the above-mentioned currents, which motionless water remains at a much lower temperature than



that of the water in the other parts of the boiler.

Having discovered the objectionable operations and results above referred to, I instituted a series of experiments with a view to overcoming them and to inventing a construction of boiler which should not only obviate these difficulties, but should also produce a much greater quantity of steam with a given amount of fuel than could be generated in boilers of previous construction; and as the result of such experiments I have demonstrated that when the fire-flue is arranged as I have shown the return-flues, constituting a much greater aggregated heating-surface upon one side of the central line of the boiler than there is upon the opposite side, produce a strong current, which passes entirely around the boiler and in close proximity to its outer shell, as indicated by arrows 1, Figs. 2 and 3. There is also another weaker supplemental current (indicated by arrows 2) passing up between the fire-flue and the small group of return-flues which occupy the narrowest space between the fire-flue and the shell of the boiler. By means of these currents the efficiency is largely increased, and the objections which have heretofore existed in boilers of this class, growing out of the unequal expansion upon opposite sides of the boiler, and which is occasioned by the presence of a substantially motionless body of water of low temperature below the fire-flue, is obviated, and the warping of the boiler is thus prevented. The arrangement of the return-flues upon lines which are substantially concentric to the fire-flue also facilitates the movements of the currents which I have described above.

D represents the bridge-wall at the rear end of the fire-box proper, over and around which the products of combustion pass from said box through the fire-flue to the front smoke-chamber, E. This bridge-wall, so far as its construction is concerned, may be of the well-known character; but by placing it in a peculiar situation I have succeeded in imparting to the wall of the fire-flue a much greater heat than can be obtained when the bridge-wall is situated in the ordinary manner.

By an examination of Figs. 1 and 2 it will be seen that the central vertical line of the bridge-wall does not coincide with the central vertical line of the fire-flue B, but is situated considerably to one side thereof. When the currents of hot air leave the fire-box the greater part of said air naturally tends to pass through the larger open space *d* on an eccentric line. This guides the currents against the wall of

the flue near the bridge-wall D, and from that point they are deflected and induced to take a spiral path as they move longitudinally along the flue. When the hot air takes a path of this character it is retained within the fire-flue longer than when it passes through it on straight lines, and, moreover, is carried through it in close proximity to the walls of the fire-flue, so as to impart to it much more of its heat than when moving in straight lines.

These improvements may be used with a portable engine of any suitable construction.

In Fig. 1 I have shown, in side elevation, the essential parts of the boiler and furnace which I prefer to use.

G represents the smoke-stack, which receives the products of combustion from the smoke-chamber C. H H' represent a spark-arresting apparatus. E<sup>4</sup> is a steam-drum, communicating with the boiler through separate pipes E' E<sup>2</sup> E<sup>3</sup>. Within each of these latter pipes there is placed an inverted cone and a horizontal diaphragm, for the purpose of removing the water of condensation from the steam, as shown at F.

I and K are ash-boxes, respectively situated beneath the rear smoke-chamber, C, and the front chamber, E.

I do not, however, in this application claim any features of construction shown in connection with any of these last said devices—that is to say, in the ash-receptacles I and K, the steam-drum E<sup>4</sup>, the pipes E' E<sup>2</sup> E<sup>3</sup>, the drying apparatus at F, and the spark-arresting mechanism—as I prefer to make these the subjects-matter of another application which I have filed.

What I claim is—

1. In a portable engine, the combination of the boiler, the fire-flue B, situated within the boiler, and the bridge-wall D, when arranged, substantially as described, to have its central vertical line at one side of the central vertical line of the fire-flue B, as and for the purposes set forth.

2. In a portable engine, the combination, with the boiler, of the fire-flue situated at one side of the central vertical line of the boiler, and the return-flues arranged above and on both sides of the fire-flues, substantially as and for the purposes set forth.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN H. ELWARD.

Witnesses:

GEO. H. GOODHUE,  
EDWARD J. HETFIELD.