J. S. BARDEN. 2 Sheets--Sheet 1.

Improvement in Sectional Steam-Boilers.

No. 129,513. Patented July 16, 1872.

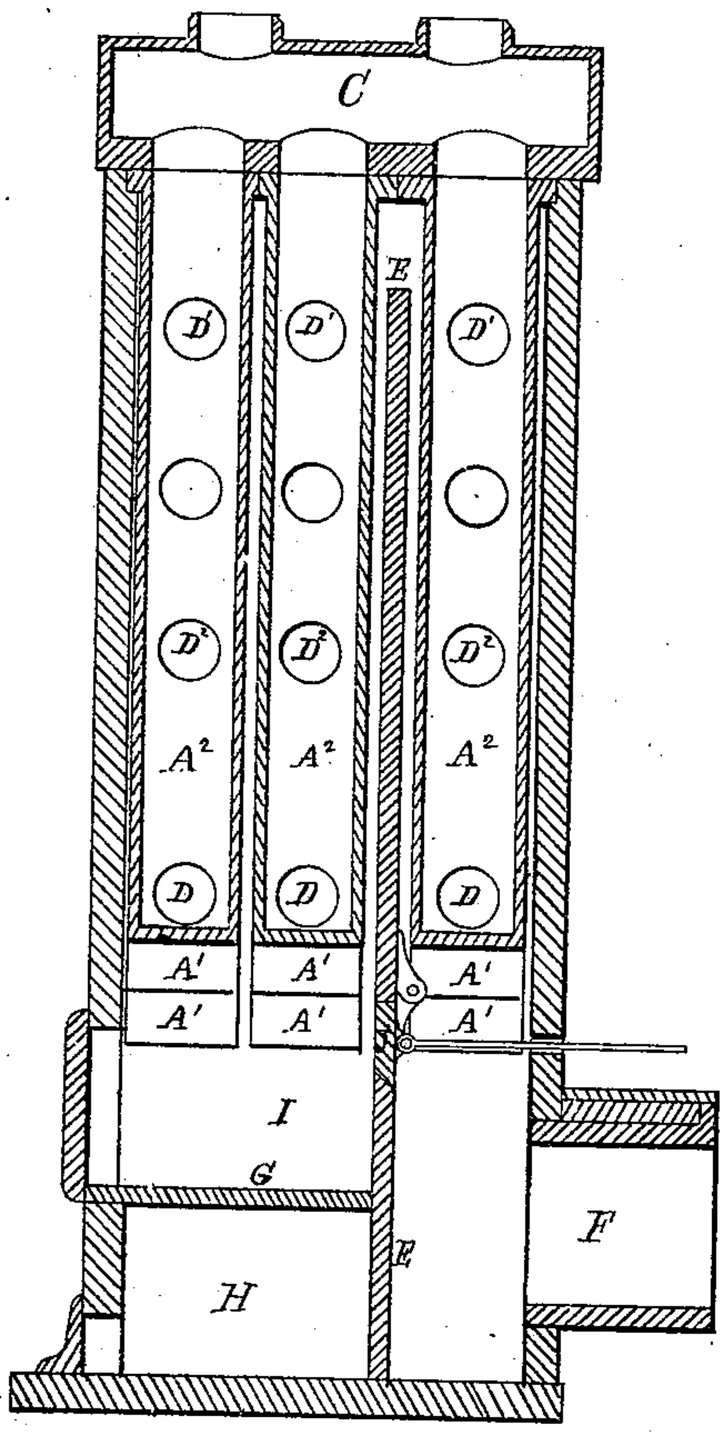

FIG. 2.

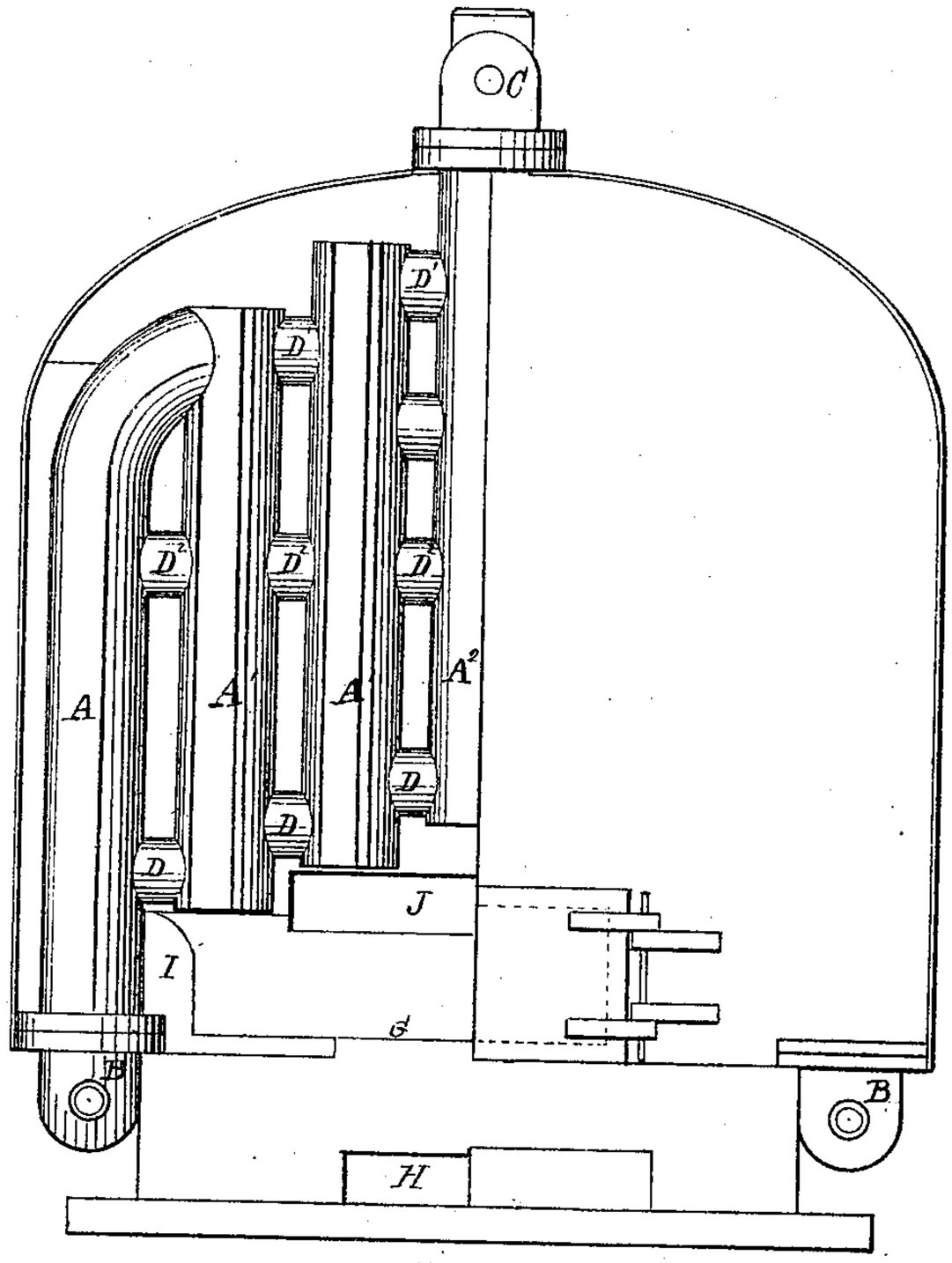

FIG. 1

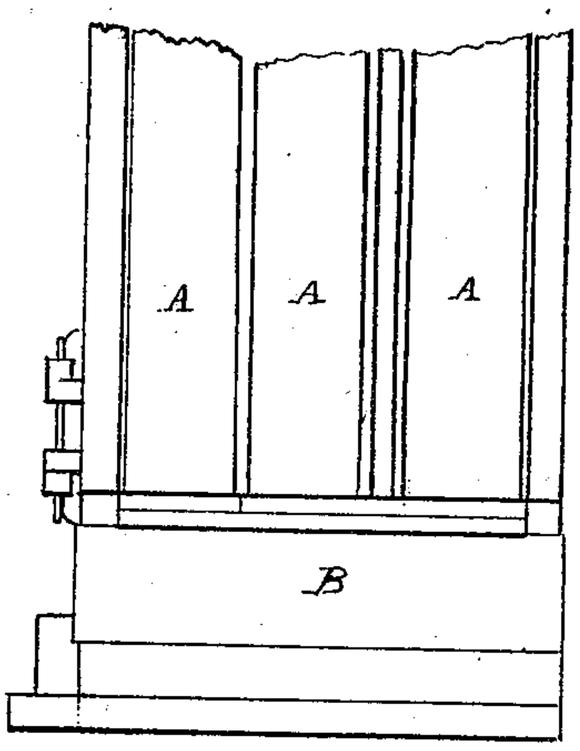

FIG. 4.

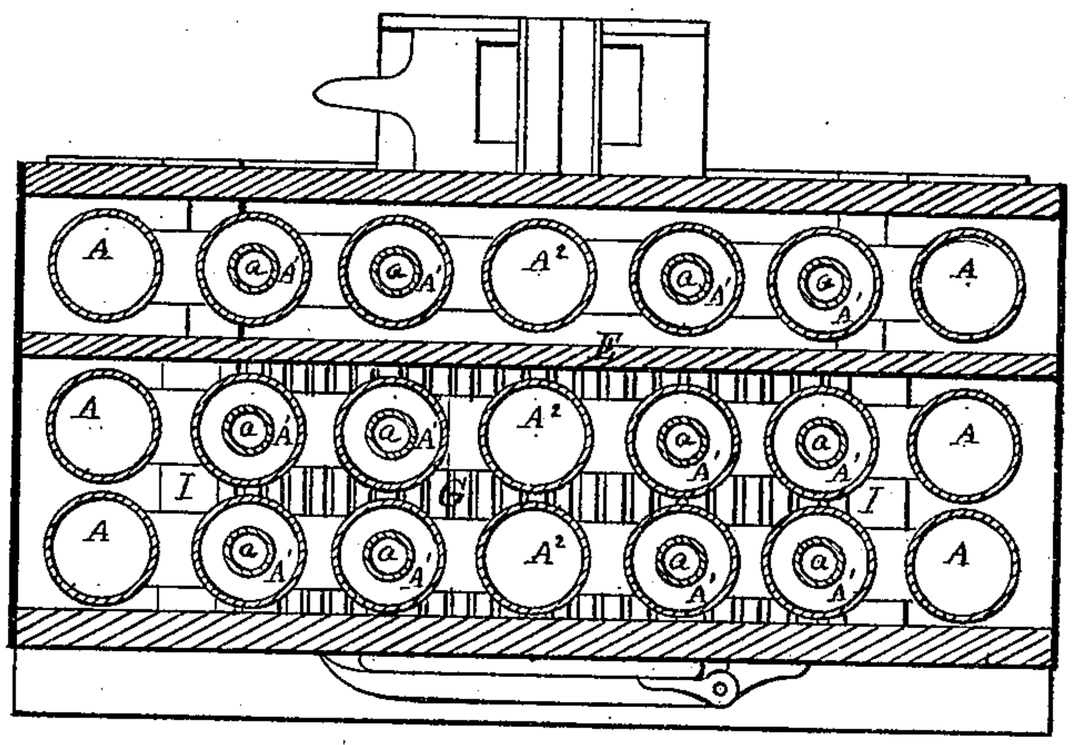

FIG. 3.

0 1 2 3 4 5 6 7 8 9 10 11 12 in.

WITNESSES.

David T. Pray.

Frank K. Rogers.

INVENTOR.

John S. Barden

by his attorney-

N. C. Lombard,

J. S. BARDEN. 2 Sheets--Sheet 2.

Improvement in Sectional Steam-Boilers.

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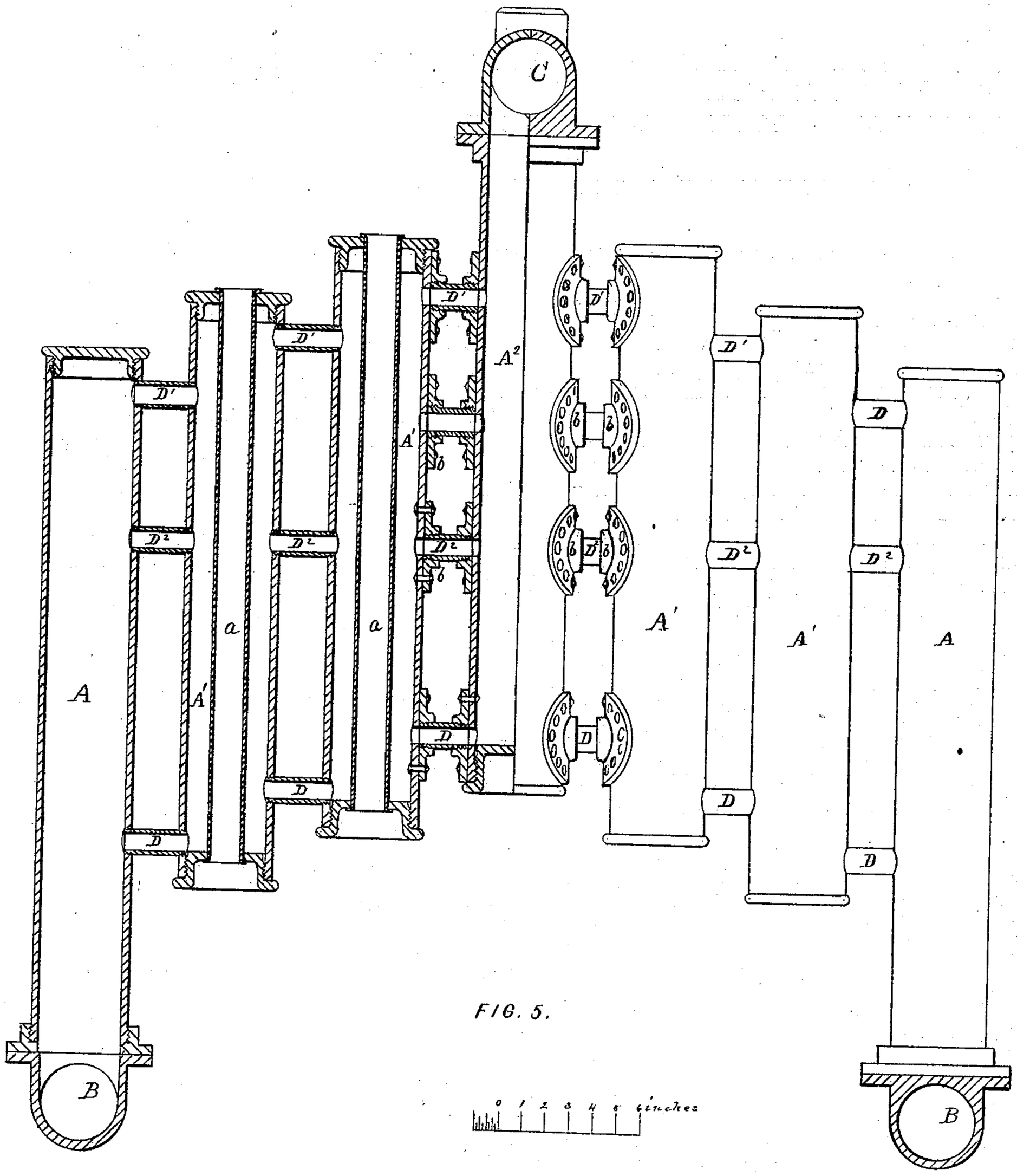

FIG. 5.

0 1 2 3 4 5 6 inches

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UNITED STATES PATENT OFFICE.

JOHN S. BARDEN, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR OF TWO-THIRDS OF HIS RIGHT TO JAMES A. WOODBURY AND CHARLES W. UNDERHILL, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN SECTIONAL STEAM-BOILERS.

Specification forming part of Letters Patent No. 129,513, dated July 16, 1872.

Specification describing certain new and useful Improvements in Steam-Boilers, invented by JOHN S. BARDEN, of Providence, in the county of Providence and State of Rhode Island.

My invention relates to that class of steam-boilers called "sectional," which are made up of a series of independent steam-generators, all of which communicate with a common steam-drum or chamber; and it consists, first, in constructing each section or independent generator of a series of straight, vertical, or nearly vertical tubes, arranged in a row across the boiler, and parallel, or nearly so, to each other, the two outside tubes of each section extending below the line of the grate and communicating with a horizontal water-pipe on each side of the ash-pit, while the other pipes of the section have their lower ends located sufficiently far above the grate to form a suitable combustion chamber, side pipes being connected together at either end by short horizontal pipes, those at their upper ends being for the passage of steam from the side pipes to the center of each section, which opens into a steam-pipe or drum arranged at the top of the boiler in a horizontal position and common to all the sections, and the horizontal pipes connecting the vertical pipes at their lower ends being for the passage of water from the horizontal pipe at the side of the ash-pit to the tubes above the fire. It also consists in the employment, in a sectional tubular boiler, of a horizontal connecting-pipe located at or just below the water-line, and connecting all the tubes of a section for the purpose of allowing the water that is carried upward by the steam in its attempt to escape to circulate across the boiler, and, descending in the outside tubes keep up a constant circulation of the water in the tubes, as will be more fully described.

The vertical tubes are arranged at such a distance apart, and the different sections at such a distance from each other and from the inclosing casing, as to allow the flame and hot gases to completely envelop said tubes.

My invention further consists in the use of one or more fire-tubes passing through the center of a water-tube on either side of the center-tube, in combination with a center and two outside water-tubes without a fire-tube, as will be described.

In the drawing, Figure 1 is a front elevation of my improved steam-boiler with one half of the front casing removed. Fig. 2 is a vertical section on line *x x* on Fig. 1. Fig. 3 is a horizontal section on line *z z* on Fig. 1. Fig. 4 is a side elevation of the lower portion of the boiler with the casing removed; and Fig. 5 is a sectional elevation of one of the sections, showing two modifications in the mode of construction.

The sections, as represented in Figs. 1, 2, 3, and 4, are designed to be made of cast-iron in one piece, with openings from the two outside pipes and flanges for securing the same to the horizontal sediment-pipes below the grate, and also an outlet from the central tube and a flange for securing it to the horizontal steam-pipe or drum.

In Fig. 5 is shown different modes of construction to be employed in constructing the sections from wrought-iron lap-welded tubes. A A^1 A^2 are the vertical water-tubes, the two outside ones A being open at their lower ends and provided with flanges by which they are bolted to the horizontal sediment-pipes B B, located on either side of the ash-pit and below the line of the grate. The tubes A^1 A^1 are made of about equal lengths, and are so located with reference to the grate and the pipes A A as to give sufficient height for combustion, and are each provided with the fire-tube *a*, which passes through the center of the same, and is open at both ends for the passage of the products of combustion. The tube A^2 is closed at the bottom, and opens into the steam-pipe or drum C, to which it is secured by suitable flanges and bolts. D, D^1, and D^2, are short horizontal pipes connecting the vertical tubes A A^1 and A^2 together, the pipes D being located at or near the lower ends of the pipes A^1 and A^2, and the pipes D^1 being located at or near the upper ends of the pipes or tubes A and A^1. The pipes D^2 are located in a line across the section at or just below the water-line, and are designed to work in conjunction with the pipes D to effect a complete circulation of the water in the tubes, the water rising in the central tubes, passing outward through the pipes

D^2, and descending in the tubes A, and flowing through the tubes D to the central tubes A^1 and A^2. It will be seen that the main pipes are vertical and the branches connecting all the tubes of a section are horizontal, which, though perhaps not absolutely necessary in order to produce steam, I consider a very essential feature in the invention, for the following reasons: First, it disposes the material immediately over the fire so as to obtain the fullest advantage therefrom in the production of steam, in that the fire completely surrounds the lower ends of all of said vertical pipes that are over the fire; and the cross-pipes being somewhat smaller than the vertical pipes gives a freer passage for the products of combustion in an upward direction than would be the case if the horizontal pipes were as large as the vertical ones. Secondly, the section so made is better adapted to resist the strain of unequal expansion to which they are subject than would be the case if the horizontal pipes were the trunk pipes and the vertical ones the branches; and, thirdly, this construction is much more convenient for inserting the fire-tubes than it would be if the trunk-pipes were horizontal; and it also enables me to better support the core in casting the sections.

In small portable boilers the tubes *a* may be dispensed with. E is a partition-wall, which may be made of iron or of masonry, extending across the boiler from side to side, from the ash-pit floor nearly to the tops of the tubes A and A^1, dividing the boiler into two nearly equal compartments, the one at the front end of the boiler forming the ash-pit combustion-chamber and an ascending flue, in which are placed a suitable number of sections of water-pipes, or in other words, a suitable number of steam-generators, and the other compartment forming a diving-flue, also containing a suitable number of the steam-generators, said rear compartment having the uptake or flue F leading to the chimney opening at or near its bottom, so that the flame and gases from the fire on the grate G are compelled to rise among the cluster of tubes in the front compartment completely surrounding the same, and giving out a large portion of their heat to said pipes or tubes, and the water contained therein and passing over the wall E descend among the tubes in the rear compartment, and giving out the heat remaining therein to said tubes, and escaping into the chimney through the flue F. H is the ash-pit, and I is the fire-brick lining of the combustion-chamber.

The inclosing-casing may be made of masonry or of plate iron, and covered with a suitable non-conductor to prevent radiation of heat therefrom. The sediment pipes B B may be provided with caps at either end, by removing which said pipes may be readily cleaned. The feed-pipes which supply the boiler with water should open into the pipes B B on either side of the boiler.

The sections, as above described, are made of cast-iron; but I design to make these sectional boilers of boiler-iron or of wrought-iron lap-welded tubes, which was one of the main objects had in view in devising this arrangement of tubes, two modes of uniting which are shown in elevation and in section in Fig. 5.

When made of lap-welded tubes the horizontal pipes D, D^1, and D^2 may be screwed directly into the vertical tubes, said pipes having a right-hand thread cut on one end thereof, and a left-hand thread on the other end, as shown, between the tubes A and A^1 in Fig. 5, or when larger tubes are used flanged bosses *b b* may be riveted to the vertical tubes, and the pipes D, D^1, and D^2 may be screwed into said bosses, as above described.

In large marine-boilers the vertical tubes would be from eight to twelve inches in diameter, and would preferably be made of boiler-plate iron, the joints being riveted and caulked in the usual manner, and the horizontal pipes D, D^1, and D^2 might be made in the same way, and be riveted to the vertical tubes in a well-known manner; or flanged bosses may be riveted to said vertical tubes, and the horizontal pipes be screwed therein, as above described.

J is a damper placed in an opening formed in the wall E, by the opening of which a direct draught will be obtained from the fire to the chimney without passing over the wall E for the purpose of increasing the draught when starting a fire.

In small boilers the wall E may be dispensed with, all the tubes being placed over the fire, and the products of combustion pass out of the top of the boiler, or a plain diving-flue may be used without tubes therein, and the smoke and gases pass to the chimney from near the bottom of the boiler, as above described.

In constructing a sectional boiler of the kind herein described, the horizontal connecting-pipes need be only so large as will allow the necessary circulation of water—say of a diameter about one-fourth of that of the vertical tubes; and when the boiler is made of wrought-iron tubes it is quite desirable that these pipes should be as small as is allowable in order to admit of their being screwed directly into the vertical tubes, and also to diminish the pressure tending to tear the section asunder, said pressure being equal to the area of the three connecting-pipes multiplied by the pressure per square inch.

What I claim as new, and desire to secure by Letters Patent of the United States, is as follows:

1. A steam-generator made up of any suitable number of straight vertical or nearly vertical tubes, arranged in a row, and connected together at three or more points by short horizontal pipes, substantially as described.

2. In a steam-generator made up of a series of vertical or nearly vertical tubes, and provided with steam connections at or near their upper ends, and corresponding water connec-

tions at or near their lower ends, I claim a horizontal tubular connection of said tubes at or just below the water-line, substantially as described.

3. In a steam-generator consisting of vertical or nearly vertical water-tubes, connected by three horizontal pipes, I claim a fire-tube passing through the center of one or more of said water-tubes on either side of the center tube, substantially as described.

4. A sectional steam-generator, consisting of a series of tubes or chambers, having three connections so arranged that the fire or hot gases may have free access to all sides of said connections, and so that two of said connections can maintain a free circulation of the water while the third will allow the steam to pass freely to the steam-pipe or drum, substantially as described.

Executed at Boston this 5th day of January, 1872.

JOHN S. BARDEN.

Witnesses:
N. C. LOMBARD,
FRANK K. ROGERS.