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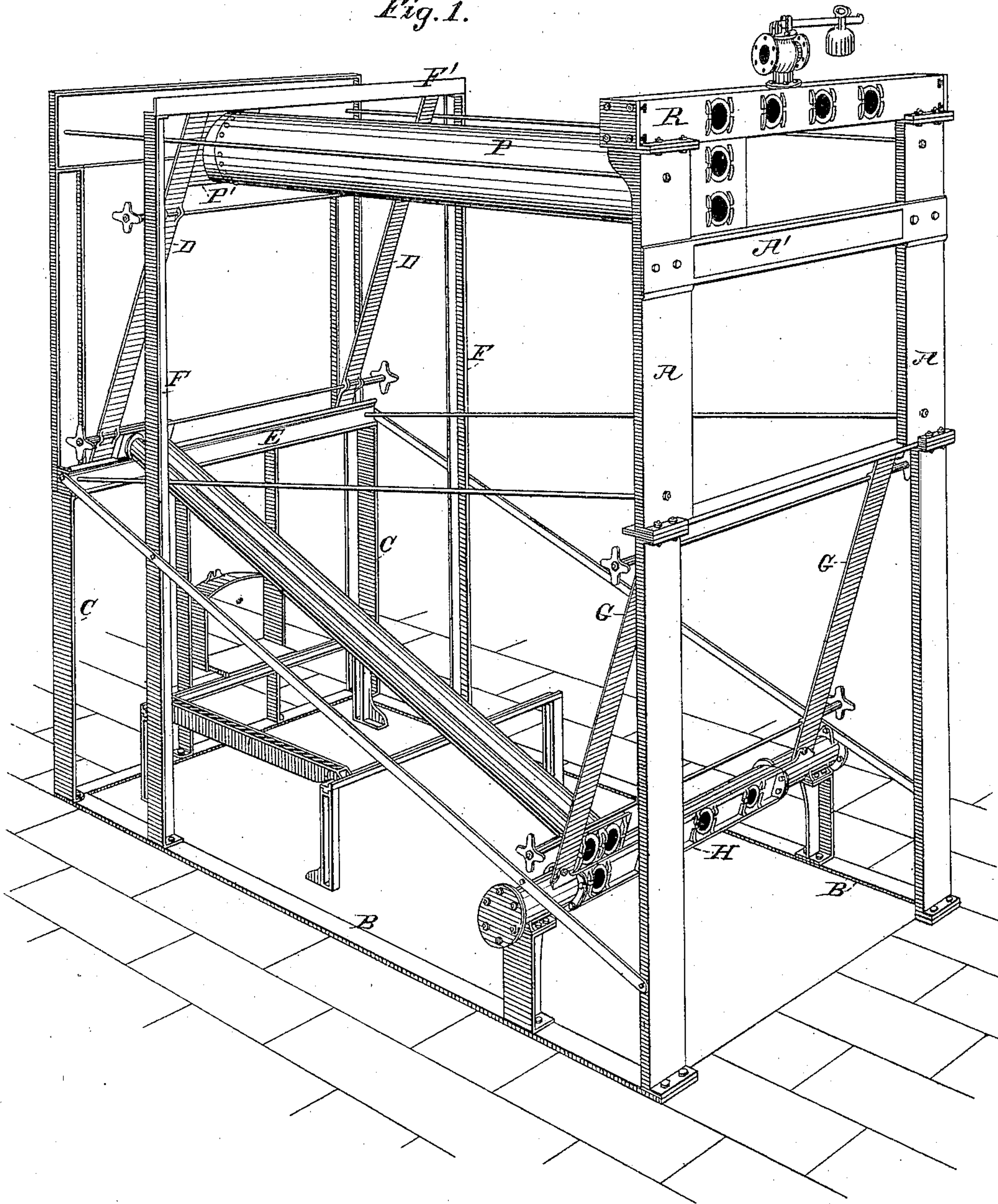
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J. B. ROOT.  
SECTIONAL BOILER.

No. 302,944.

Patented Aug. 5, 1884.

*Fig. 1.*



*Witnesses:*  
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*Att.*



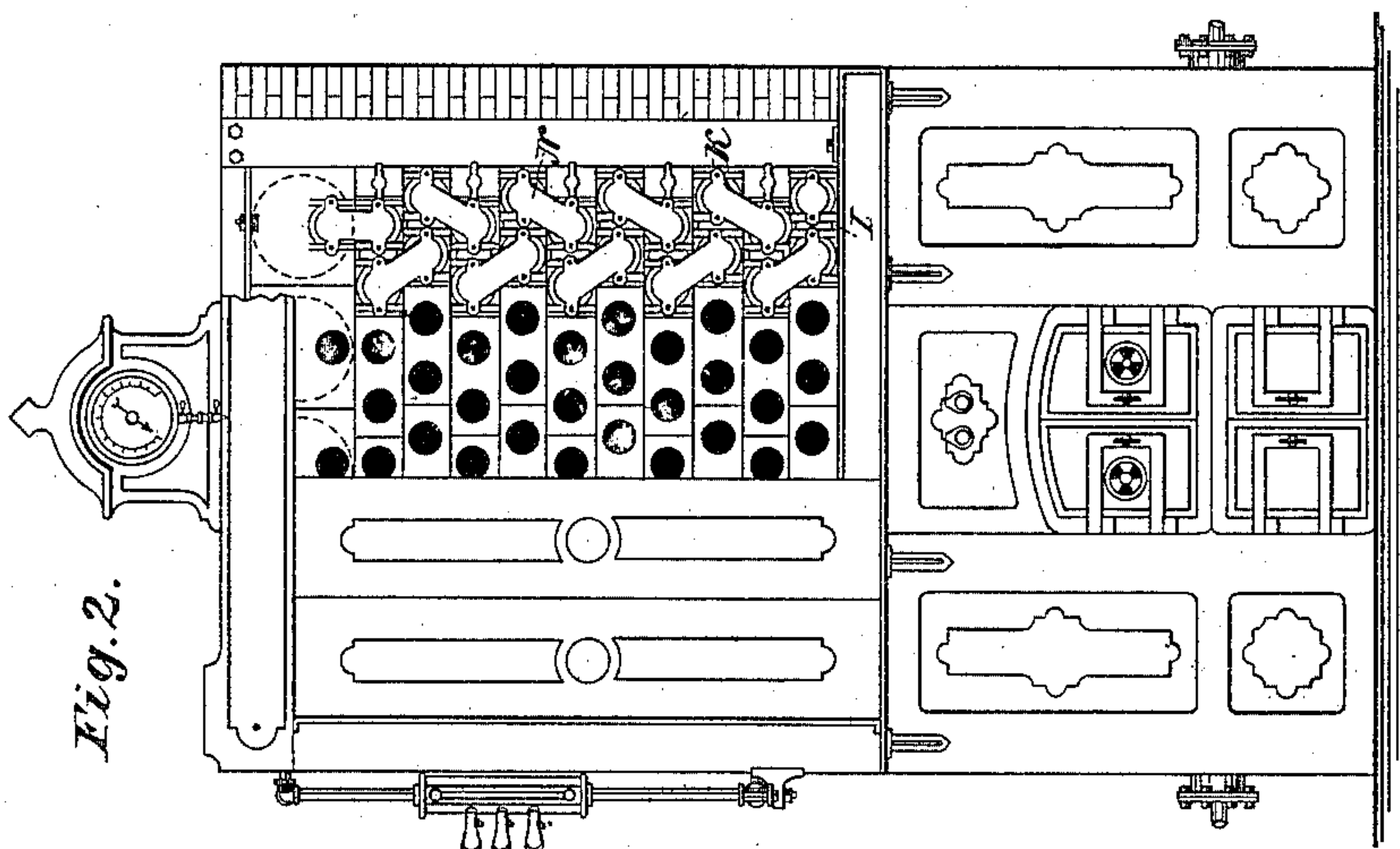
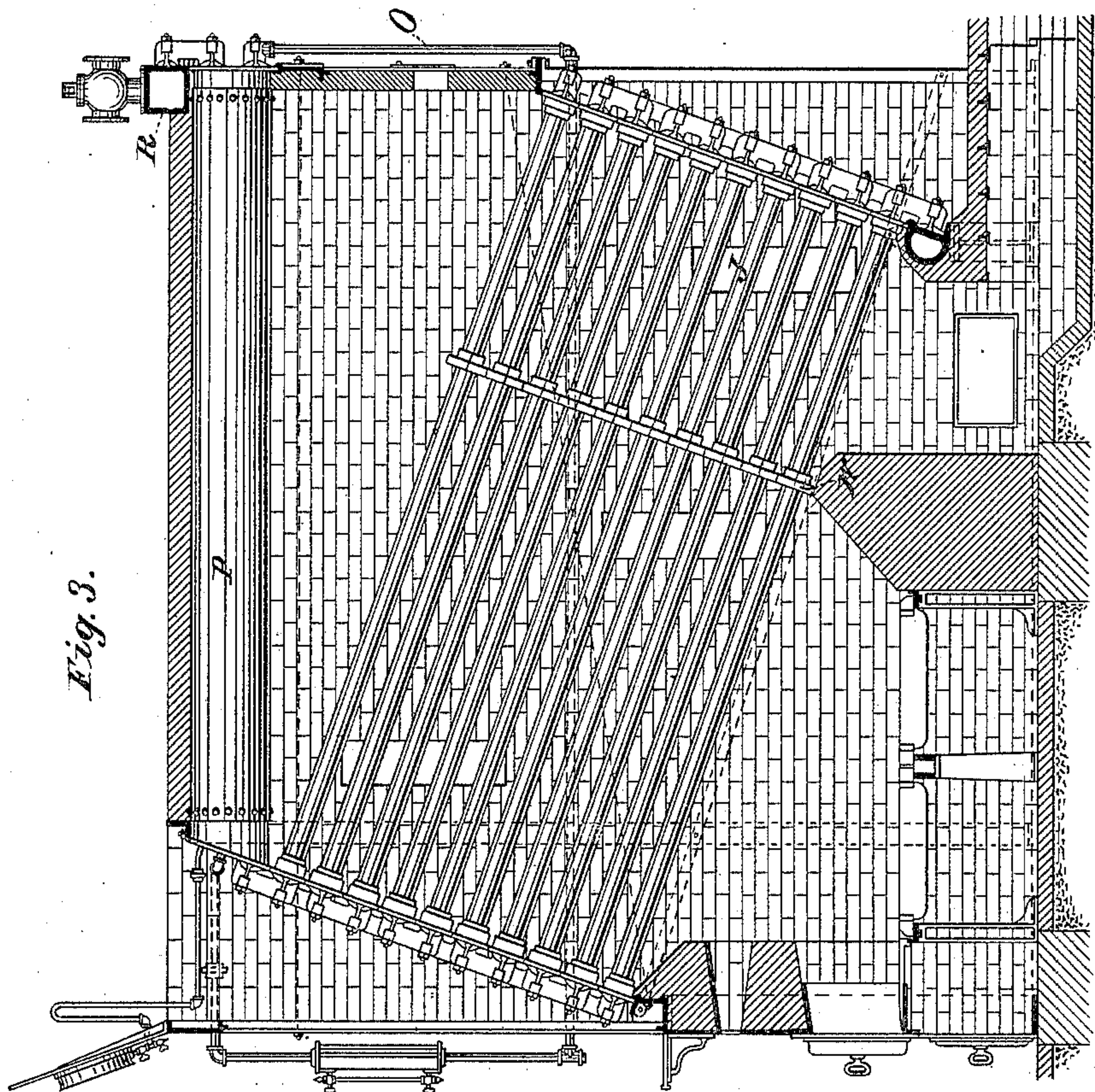
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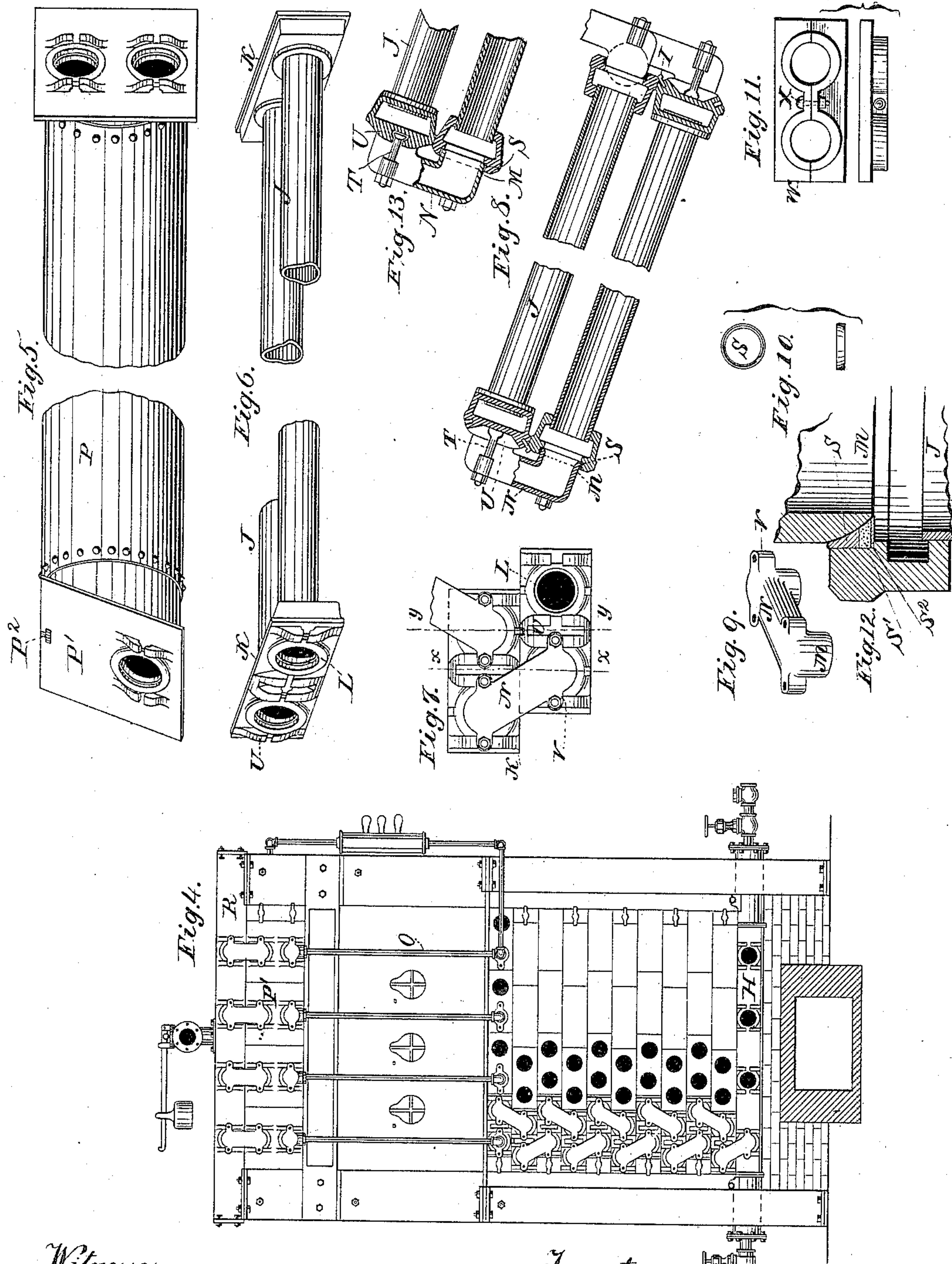
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# UNITED STATES PATENT OFFICE.

JOHN B. ROOT, OF PORT CHESTER, NEW YORK.

## SECTIONAL BOILER.

SPECIFICATION forming part of Letters Patent No. 302,944, dated August 5, 1884.

Application filed October 18, 1883. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN B. ROOT, of Port Chester, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Sectional Boilers; and I hereby declare the following to be a full, clear, and exact description thereof, and will enable those skilled in the art to which they appertain to make and use the same.

10 In the accompanying drawings, Figure 1 shows in perspective the frame-work and supports of the boiler. Fig. 2 is a front view, in partial section, of the completed structure. Fig. 3 is a sectional view thereof. Fig. 4 is a rear view, in partial section, of the same. Fig. 15 5 is a detail view of the ends of one of the steam-drums. Fig. 6 is a like view of one of the units of the system. Fig. 7 is a detail view of the pipe-heads and connecting-bends. Fig. 8 shows sections of the same on planes  $x x$  and  $y y$ . Fig. 9 is a perspective view of a bend. Fig. 10 is a side and sectional view of a soft-metal ring used in the joint between the heads and bends. Fig. 11 shows a front and edge view of a bridge-wall block. Fig. 12 is an enlarged sectional view of the joint between the bends and the heads, and Fig. 13 is a sectional view on a plane through the lugs of one of the pipe-heads.

30 The features of improvement and their various advantages are as follows: first, a frame especially adapted to assist in erecting the boiler and constituting a support therefor, and it is so designed and constructed as to be readily capable of extension for increasing the capacity of the boiler, and to permit the easy removal of such parts as may need repair or duplicating, without deranging the rest of the structure. In the first figure of drawings, which best shows this frame, A A represent front vertical wall-plates, which are fastened at their lower ends to side sills, B B, C C being the corresponding rear vertical wall-plates, which are also secured to the side sills. D D represent front inclined wall-plates, the lower ends of which rest upon the bearing-beam E, which is fastened to the front vertical wall-plates, and the upper ends of which are fastened to and supported by columns F F rising from the side sills; and G G represent rear inclined wall-plates, which are supported at

their lower ends upon a bearing-beam, H, (in this case, the lower cross-pipe of the boiler,) which rests upon short end posts rising from the sills, and at their upper ends upon a cross-bar secured to the rear vertical wall-plates. Upon the front and rear bearing-beams of this frame the boiler is built, (the lower unit of one section being shown in place in the drawings,) the heads of the units being of such size and shape as to accurately fit upon one another and engage with the bearing-beams and inclined plates.

To prevent the units slipping out of place when the boiler is being erected, keys I are employed, which are driven in the upper edges of the rear or lower heads of the units, as seen in Fig. 8, and act as abutments for the units to bear against, and thereby prevent their endwise movement. So, also, in the finished structure, when a unit is to be removed for repair and is disconnected from the other units for this or any other purpose, it will still be held in place until the key against which its lower head bears is withdrawn, and thereby frees it, when it can be removed without disturbing or displacing the other units of the boiler. The top of the structure is braced and bound together by the steam-drums P, which are secured at their front ends to the cross-beam F' of the uprights F by bolts whose heads engage with the sockets P<sup>2</sup> in the end plates, P', of these drums, and at their rear ends these drums are held by the edges of their rear-end plates engaging with the cross-beam R' and cross-pipe R, there being a drum for each section of the boiler. When the boiler is erected, side walls of brick are built between the front and rear vertical wall-plates, proper furnace appliances are put up under the elevated end of the boiler, and the ends of the structure are closed in by means of metallic panel-plates constructed to fit between the vertical wall-plates, and provided with suitable openings and doors, all as seen in Figs. 2, 3, and 4; and when it is desired to extend the boiler to increase its working capacity, this is accomplished by moving the vertical and inclined wall-plates of one side of the structure the required distance from the wall-plates of the other side, lengthening the cross-beams and other cross-connections, and adding such a



number of sections and their drums to the boiler as the case calls for.

The second feature of improvement relates to the devices for flexibly connecting the units of the boiler together in sections, and also to the devices for connecting the sections. These units each consists of two tubes arranged parallel with each other and rigidly united at their ends by hollow heads. The means for connecting such units consist in hollow bends arranged to join one end of the head of a unit with the corresponding end of the adjacent head above, and the other end thereof with the corresponding end of the adjacent head below, the units being disposed with their heads lying horizontally and their pipes in what is known as a "staggered" arrangement, though their arrangement may be such that the tubes of adjacent units shall be directly over each other; and the means for uniting the sections consist of a common cross-pipe located at the bottom of their lower ends, and a dome or cross-pipe common to the drums of all of the sections. These features are illustrated in Figs. 6, 11, where J J indicate the tubes, and K K the hollow heads, into which the ends of the tubes are expanded, and which unite the tubes in rigid pairs or units. These heads are provided with openings L, which are in front of the ends of the tubes, and serve as entrances to the tubes and as seats for the connections or bearings M of the bends N, which couple the heads together, as described. The lower bends of the undermost units of each section connect at the rear with the common cross-pipe H, and the uppermost units connect by their upper bends at the front and by lengthened bends O at the rear with the steam-drums P, which by similar bends open into a common cross-pipe, R, from which the working-steam is taken. The advantages of this arrangement of these parts is that each unit offers a path for the complete circulation of the water therein, and that the paths through which the upward circulation of the water occurs offer practically no opportunity for continuous vertical circulation, because of the changes in direction of the alternate horizontal heads and vertical bends. The end accomplished is the effectual separation of the steam from the water, thereby preventing the flooding of the steam-drums and preserving dry steam therein, for, as all opportunity is given the water to circulate horizontally, or substantially so, through the individual units, and it is obstructed by tortuous passages from circulating vertically, the steam in rising does not take with it the body of water it is found to carry when, as has heretofore been customary, the water has been free to move upward with the steam through straight or unobstructed passages, and if the water be carried to the drums in spite of these precautions it is only the drum of the particular section in which the disturbance causing the flooding occurs that will be flooded, which shows the advantage of providing a drum for each section. So, also, under said circumstances of

flooding, the utility of the connections between the sections and their respective drums becomes particularly apparent, for, being arranged at each end of the drums, they act to drain the drums of water in the quickest manner. By this arrangement of these parts dry steam can always be had from some part of the boiler, and the parts are particularly adapted to readily increasing the size of the boiler by adding more sections.

The third improvement relates to the flexible joints between the bends and the heads, and to the fastenings for holding the bends and heads together; and it consists in making the parts of such joints spherical in shape, so that they may move relatively without separating and causing a leak; and it consists, also, in fastenings for securing each end of the bends to the heads at points along the central line of the heads, so that the parts of the spherical joints may have the freest and amplest relative movement that the construction will permit. The spherical sockets of the joints may be given to either the heads or the bends; but I have preferred to make them in the openings L, and give the bearings M of the bends corresponding exterior spherical shape, so that when the bends are in place the duplicate spherical bearing-surfaces close tightly together.

A preferable mode of making the spherically-shaped sockets is to seat soft-metal spherically-concaved rings S in the openings L, as shown, which rings conform to the shape of the connecting parts M, and constitute the spherical bearing-surfaces of the heads. The use of these rings simplifies the making of tight joints, as they readily conform to the shape of the bends when forcibly inserted, and they also obviate the necessity for accurate fitting, as would be required if the sockets were made in the unyielding metal of the heads. I do not, however, confine myself to the use of such rings, for they may be omitted; so also the mode of using them may vary. Thus, I have found it desirable to seat them upon elastic cushions or packing of asbestos, or any other like material. I also design using flexible rings below the cushions, which shall be supported throughout a part only of their width from the seats which hold the cushions, and which are to give a broader base for the cushioning material, and under the pressure of the steam act to compress such cushions and tighten the joint. In Fig. 12, I show these parts, where S' represents a cushion and S<sup>2</sup> a flexible ring. The ends of the bends are each fastened to their respective heads by bolts T, which have beveled or circular shaped heads that engage with similar shaped lugs U, which are fast upon the faces of the heads, and are so arranged as to hold the bolts to the heads at points on their central lines. By reason of the shape of the bolt-heads and the corresponding shape of the lugs, the outer ends of these bolts may move laterally to either side of said central lines. The outer or shank ends



of these bolts pass through ears V on the ends of the bends, and are threaded and provided with nuts, as shown. These spherical junctions permit all the necessary relative movement of the bends and heads, without separating the parts and causing leakage, that is necessary to compensate for the expansion and contraction of the tubes. This action is particularly facilitated by the arrangement of the movable bolts that hold the bends and heads together, and for this reason the essential effects of expansion and contraction are the moving in and out of the pipe-heads, and hence adjacent heads have a movement in planes practically parallel, and therefore the points of connection between the ends of the bends and their respective heads should be in the planes of said heads to prevent any lever-like action of the bends with said points as fulcras, and thereby strain the fastenings and open the joints. These conditions, it will be seen, are provided for in the described arrangement of the fastening-bolts.

The fourth feature of improvement relates to the bridge-wall of the furnace or that part thereof which extends from the bottom to or near the top of the sections of the boiler and directs the products of combustion up through the front end of the boiler and down through the rear end thereof; and it consists in a wall of blocks which are substantially the same in shape and arrangement as the tube-heads, and which are each made in halves, adapted to be clamped or bolted together upon the tubes of each unit and removed therewith. These blocks are indicated in Figs. 3 and 11 by the letter W, and are each composed of halves, provided with sockets to receive the tubes of a unit, and with means, as the bolts X, for clamping them together and to the boiler-tubes. It will now be understood that these blocks constitute in the erected boiler a continuous and unbroken wall from the bottom to the top thereof, or so far as may be desired, and that in removing any one unit of the boiler that part of this wall belonging to such unit is removed therewith without materially disturbing the rest of the wall.

What is claimed as new is—

1. The combination, with a sectional boiler, of a frame for supporting the same, which consists of front and rear vertical wall-plates and front and rear inclined wall-plates, substantially as and for the purpose set forth.

2. The combination, with a sectional boiler, of a frame consisting of side sills, front and rear vertical wall-plates, front and rear inclined wall-plates, columns for supporting the upper ends of the front inclined wall-plates, and front and rear lower cross beams or pipes, substantially as and for the purpose set forth.

3. In a sectional boiler, removable units composed of two tubes, the heads of which engage with one another by means of keys, substantially as and for the purpose described.

4. In a sectional boiler, the combination,

with the tube-heads, of bends connecting said heads, the uniting parts of said heads and bends being constructed to form spherical joints, and being provided with fastenings attached to the heads at points along their central lines, as and for the purpose set forth.

5. In a sectional boiler, the combination, with the tube-heads, of units composed of two tubes of bends connecting said heads, the uniting parts of said heads and bends being constructed to form spherical joints, and being provided with fastenings attached to the heads at points along their central lines, as and for the purpose set forth.

6. In a sectional boiler, the combination of tube-heads, bends connecting said heads, and bolts for securing the ends of the bends to their respective heads, said bolts having bevel-heads, and said tube-heads having bevel-lugs to receive said bolt-heads, as and for the purpose set forth.

7. In a sectional boiler, the combination, with the tube-heads, of bends connecting said heads, the uniting parts of said heads and bends being constructed to form flexible joints, and being provided with bevel-headed fastening-bolts attached to the heads at points along their central lines by means of bevel-shaped lugs, as and for the purpose set forth.

8. In a sectional boiler, the combination of tube-heads, bends connecting the heads, and fastenings for securing the ends of the bends to their respective heads, the uniting parts of said heads and bends being constructed to form spherical joints with soft-metal rings, as and for the purpose set forth.

9. The combination, in a sectional boiler, of tube-heads and bends connecting said heads by spherical joints constructed with soft-metal rings seated on an asbestos or equivalent cushion or packing, as and for the purpose set forth.

10. The combination, in a sectional boiler, of tube-heads and bends connecting said heads by spherical joints constructed with soft-metal rings seated on asbestos or equivalent cushions or packing which rests upon flexible rings, as and for the purpose set forth.

11. In a sectional boiler, the combination of units composed of pairs of parallel tubes united at their ends by hollow heads with bridge-wall blocks of substantially the same size as said heads, and adapted to be removably attached to the tubes of the units, as and for the purpose set forth.

12. In a sectional boiler, a section composed of units, each consisting of two tubes, J J, and heads K K, connecting the tubes, bends N, connecting the units together, and a drum, P, connected at its front and rear ends with the upper unit of the section, for the purposes set forth.

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