

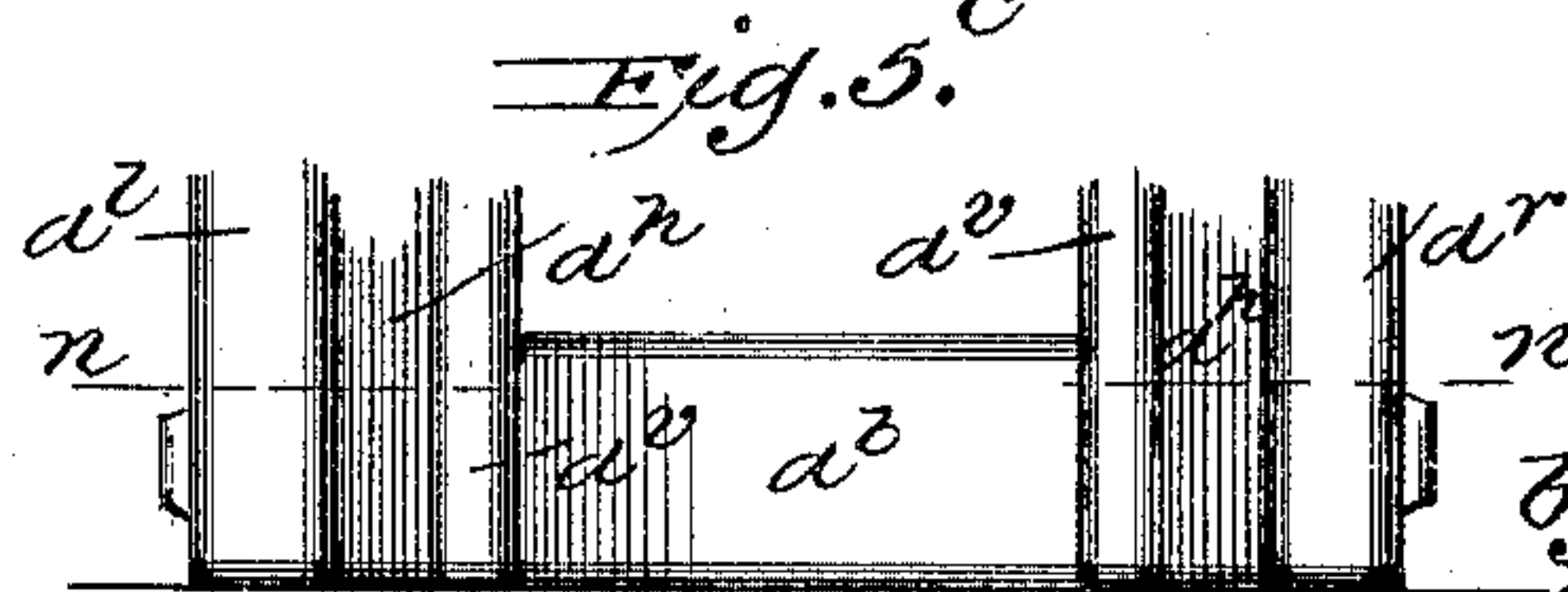
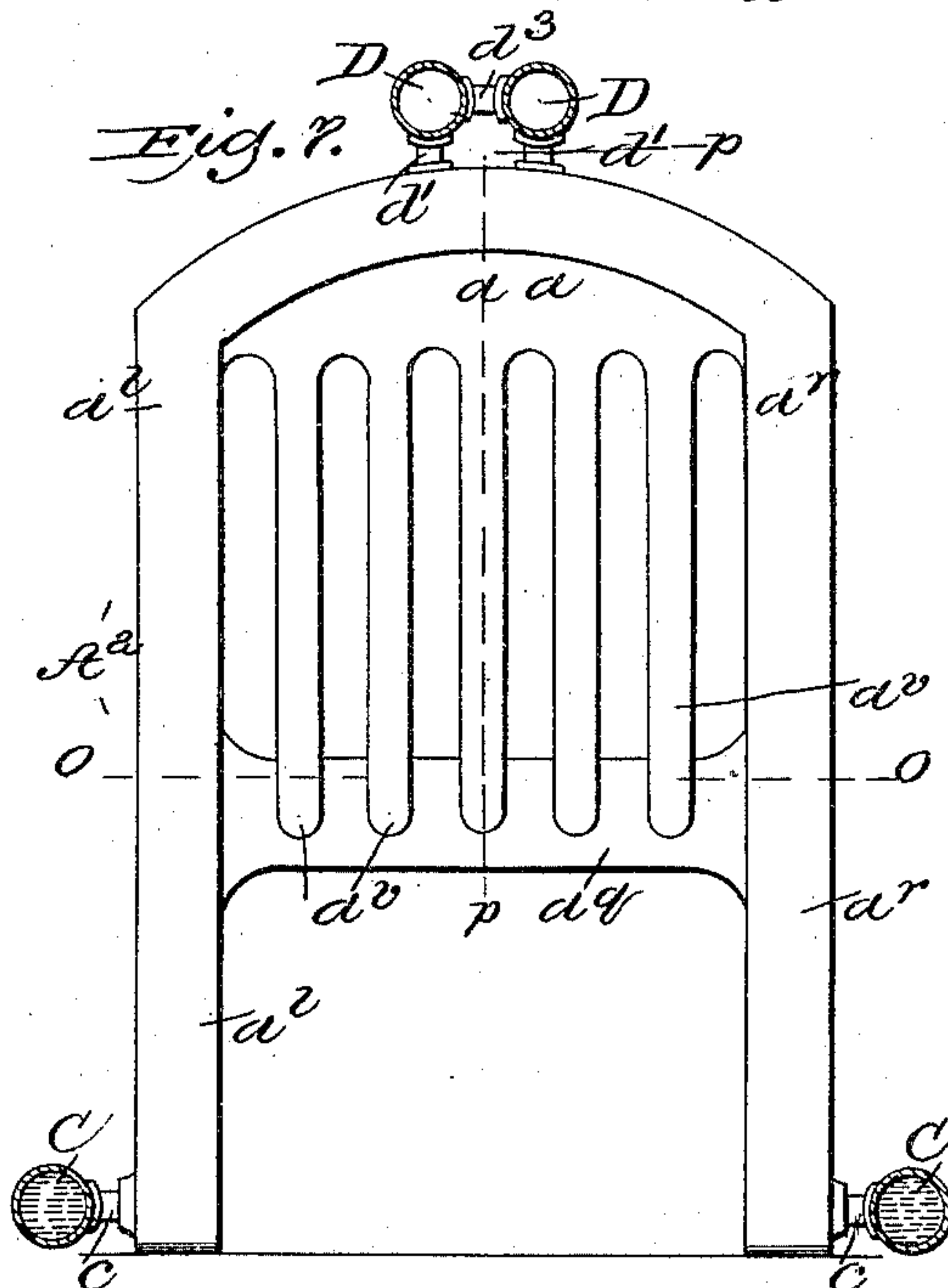
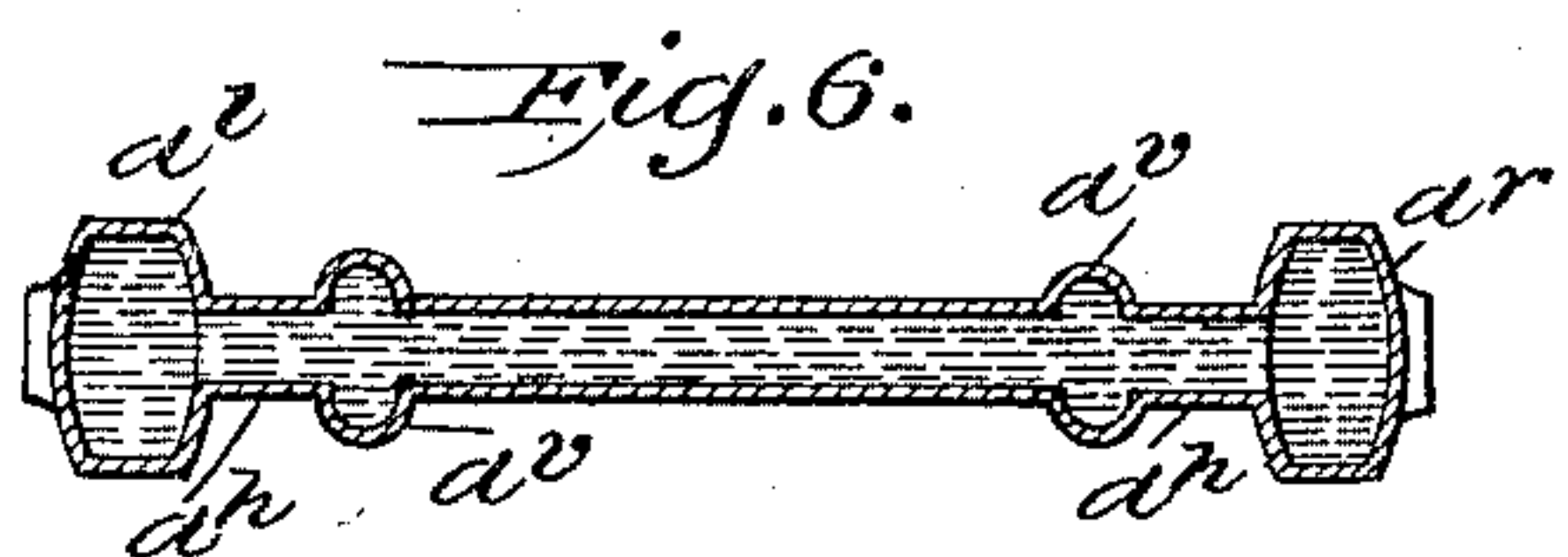
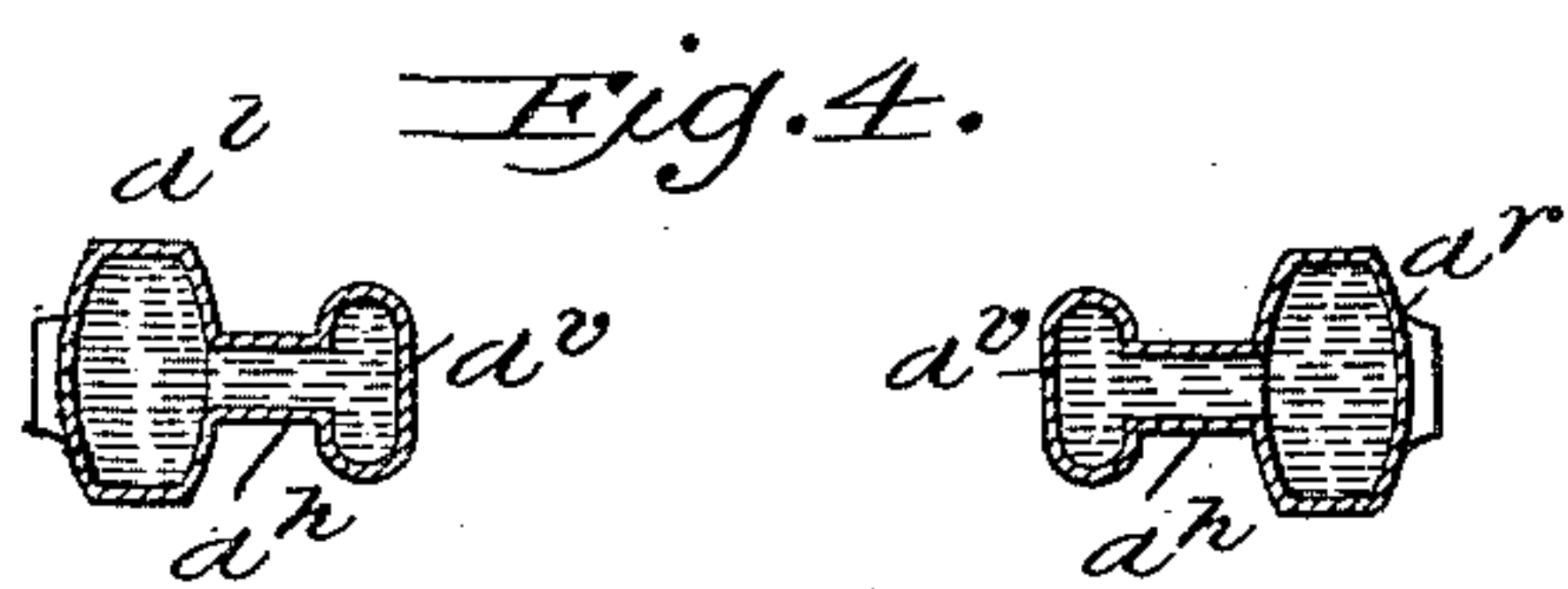
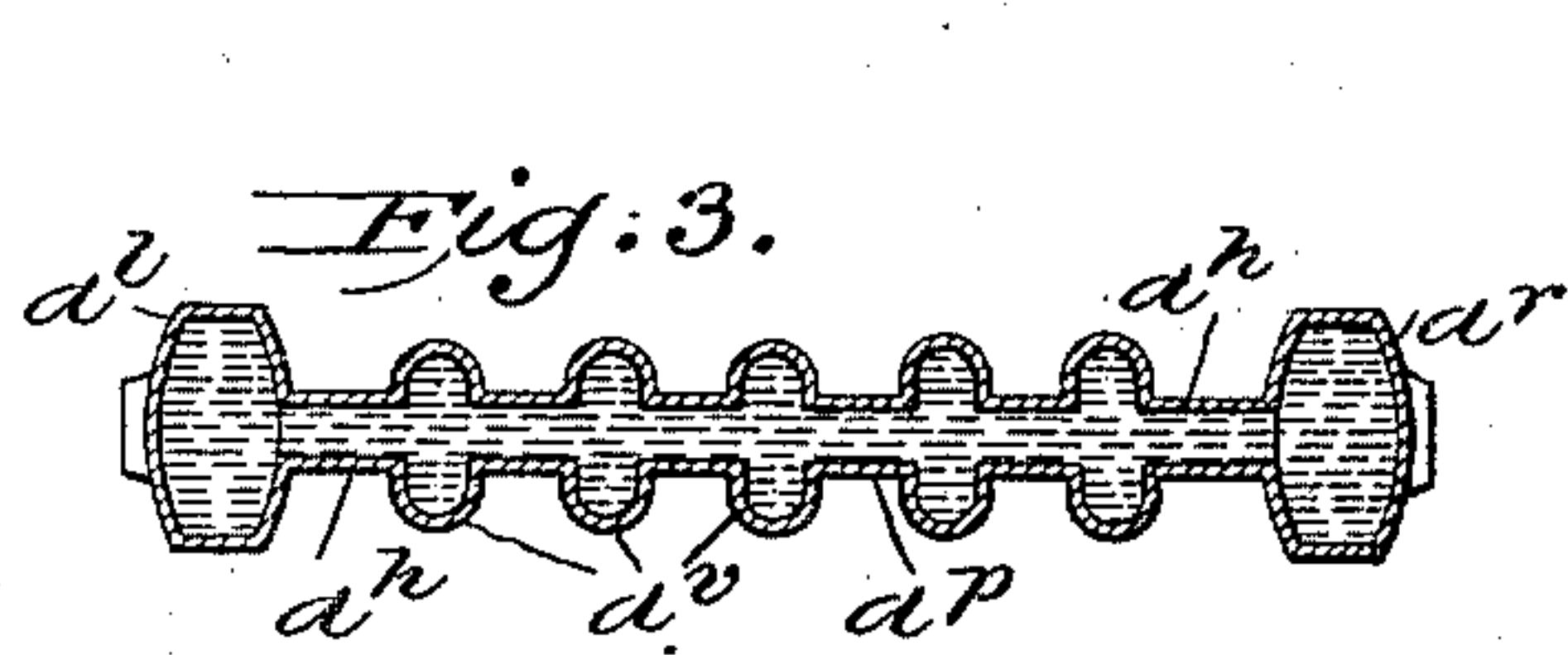
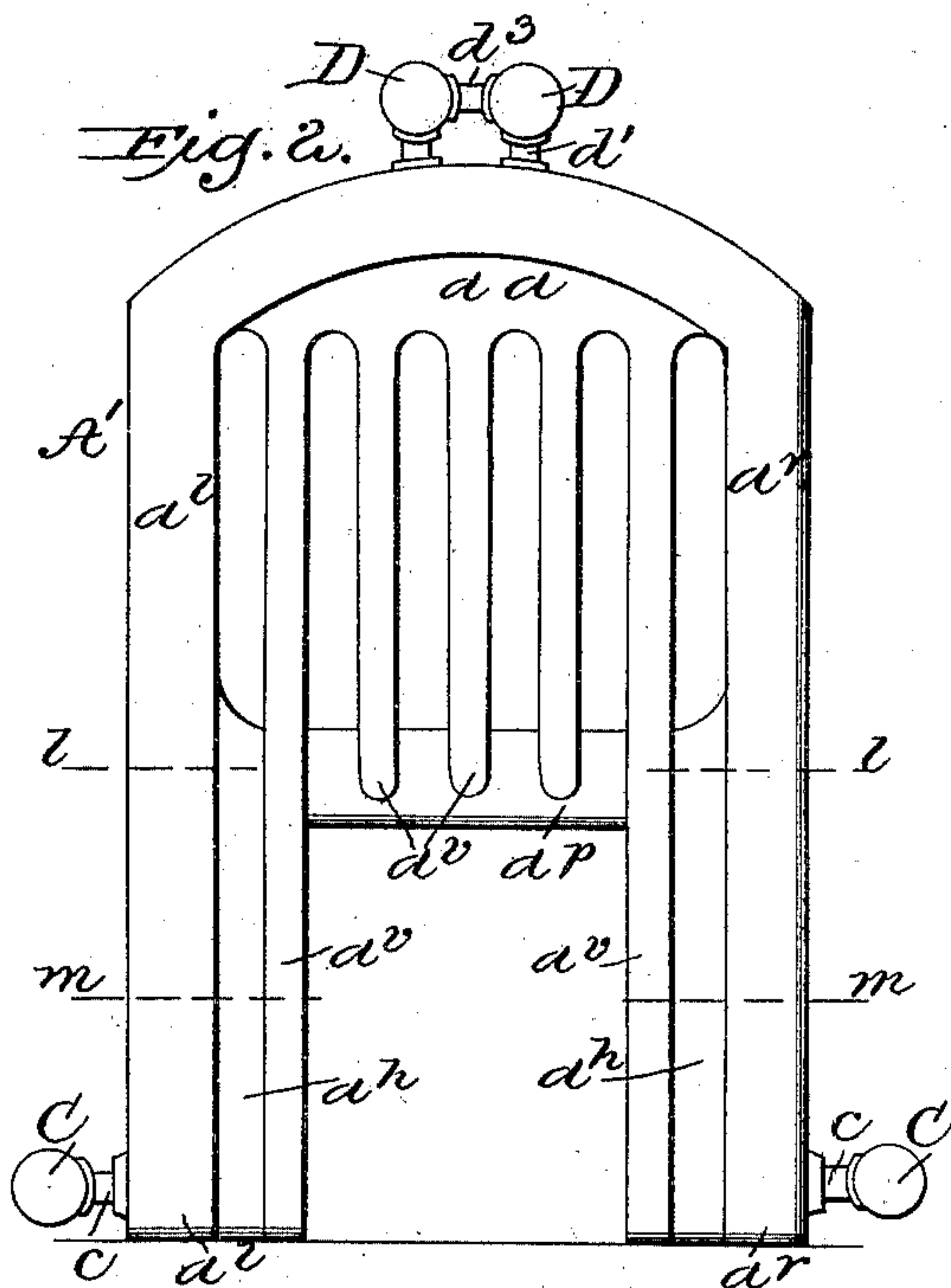
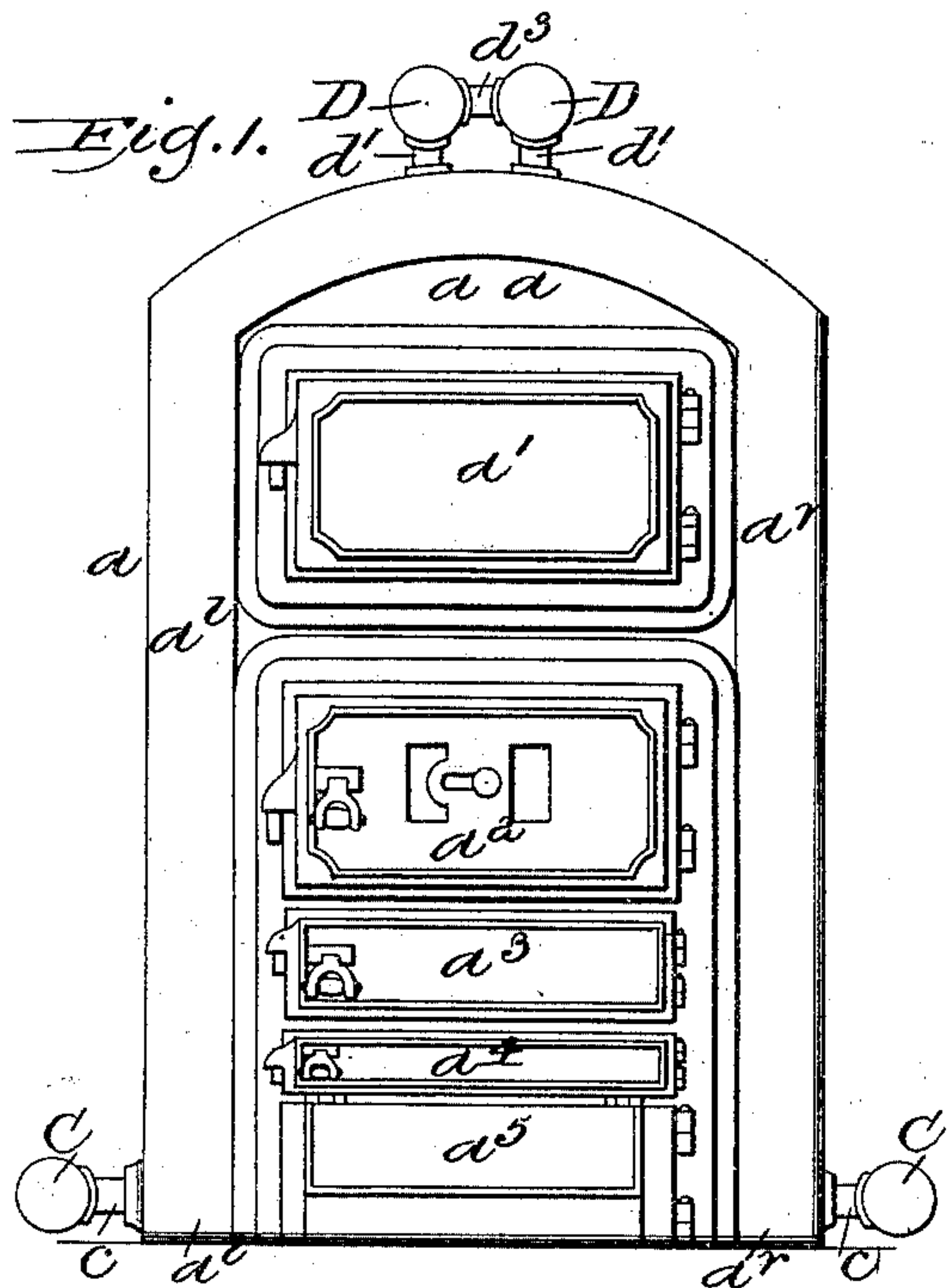
(No Model.)

4 Sheets—Sheet 1.

W. M. MACKAY.  
SECTIONAL STEAM BOILER.

No. 476,804.

Patented June 14, 1892.



Witnesses:  
Arthur Ashley.  
Walter T. Dodge.

Inventor:  
Wm. M. Mackay  
by [Signature]

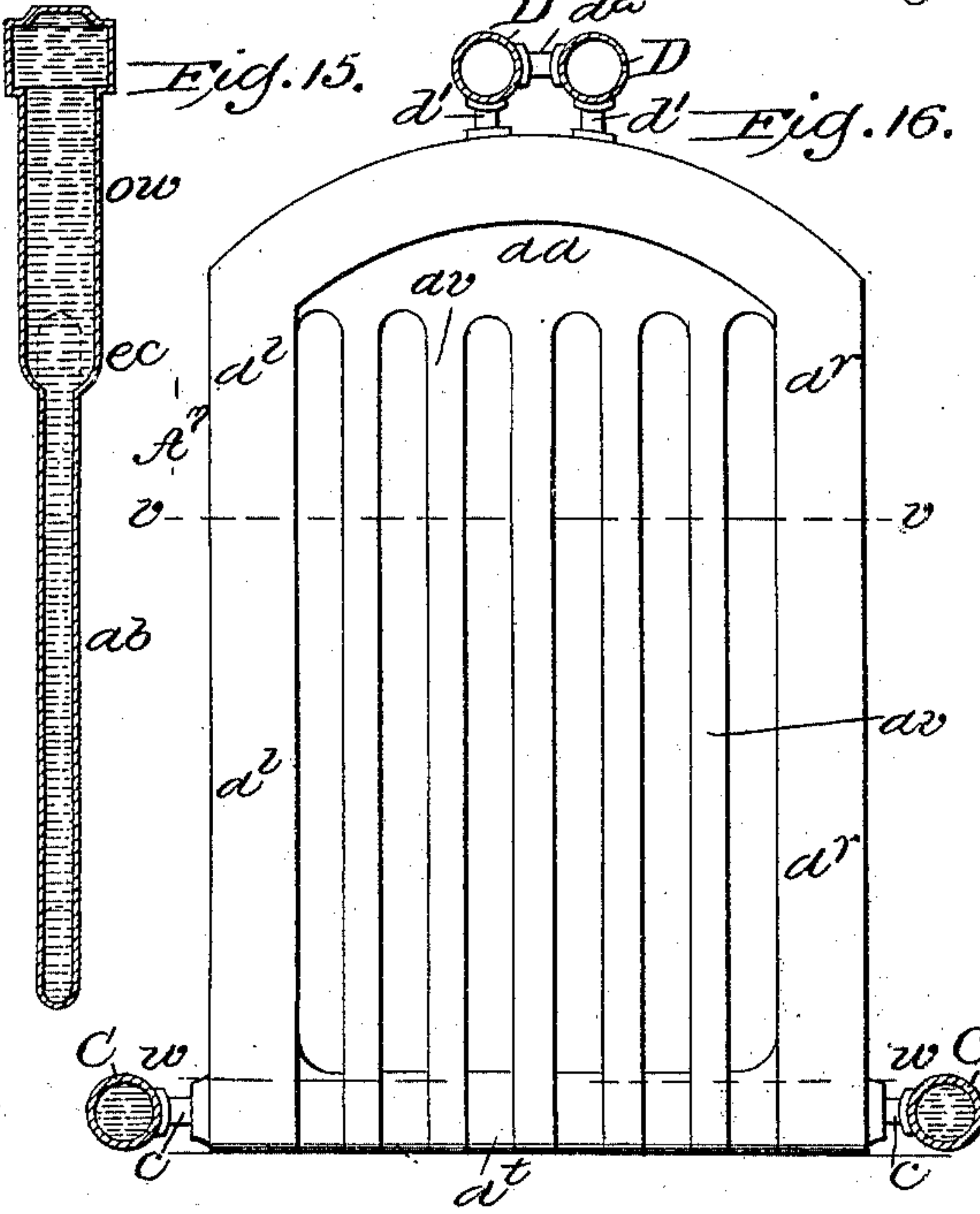
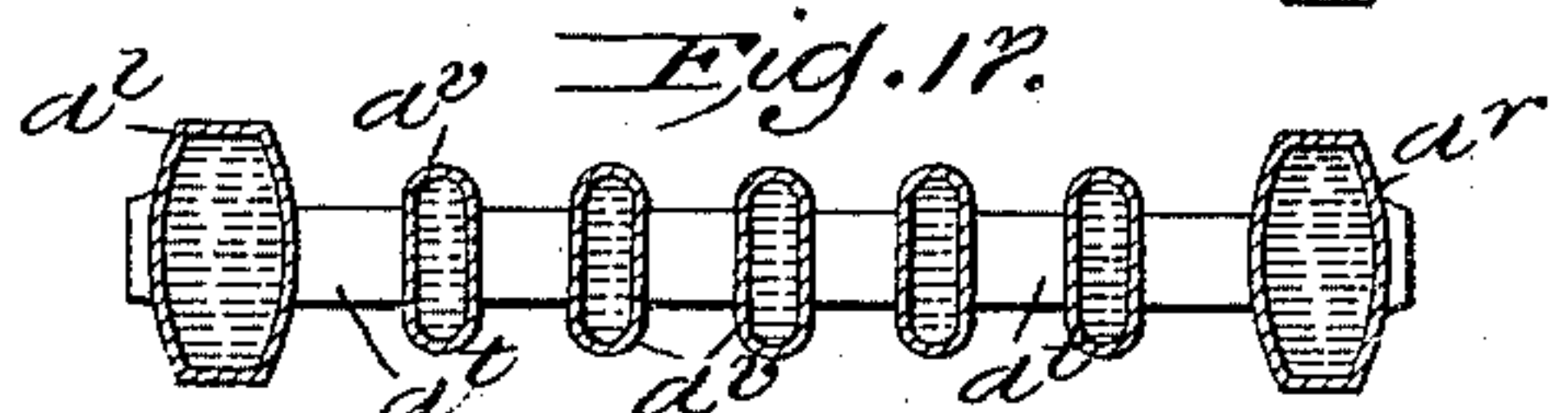
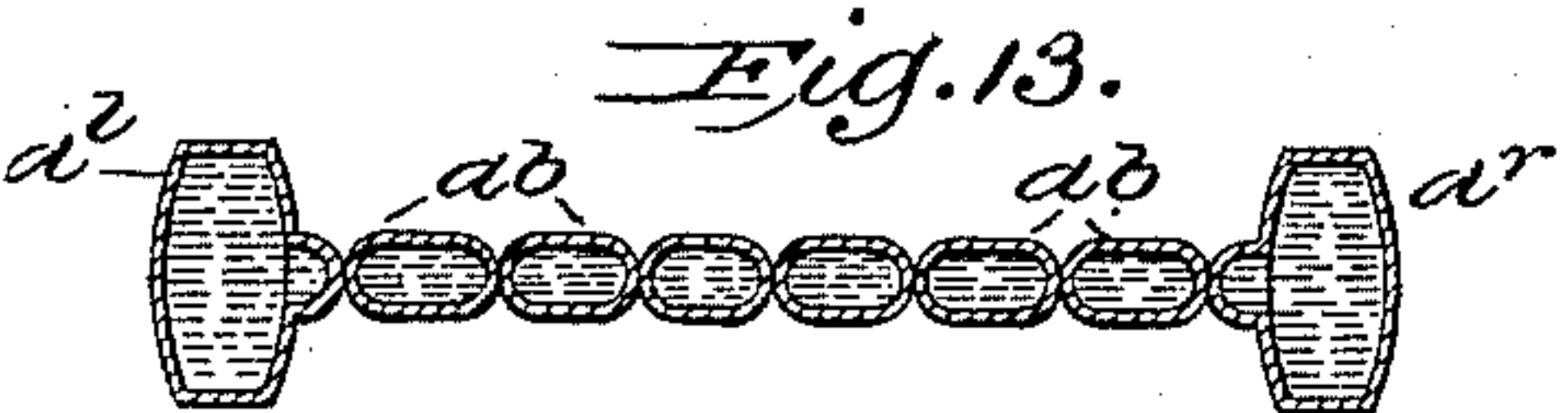
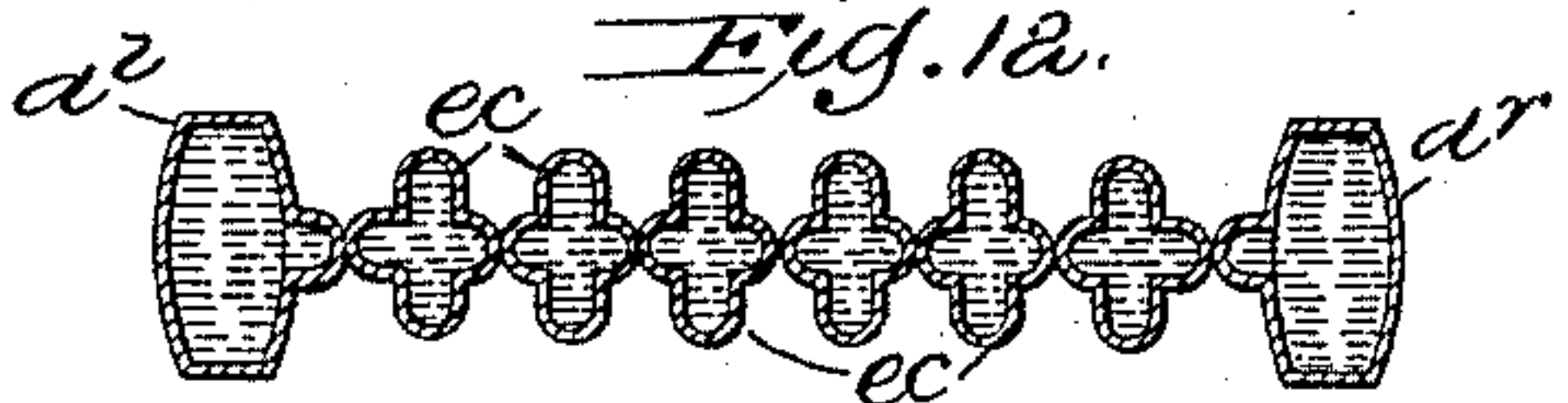
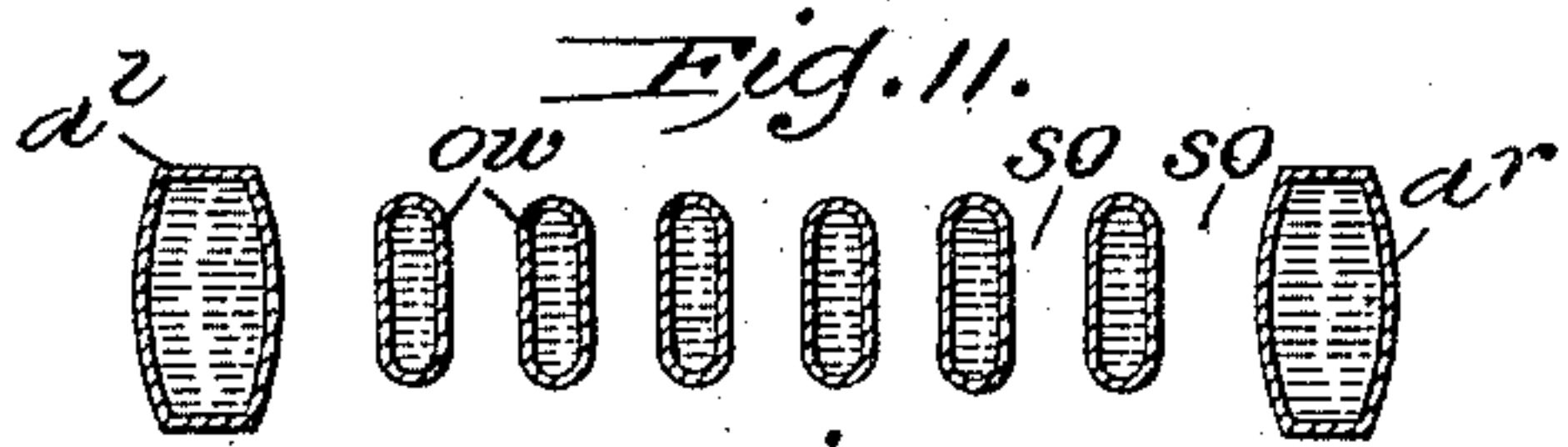
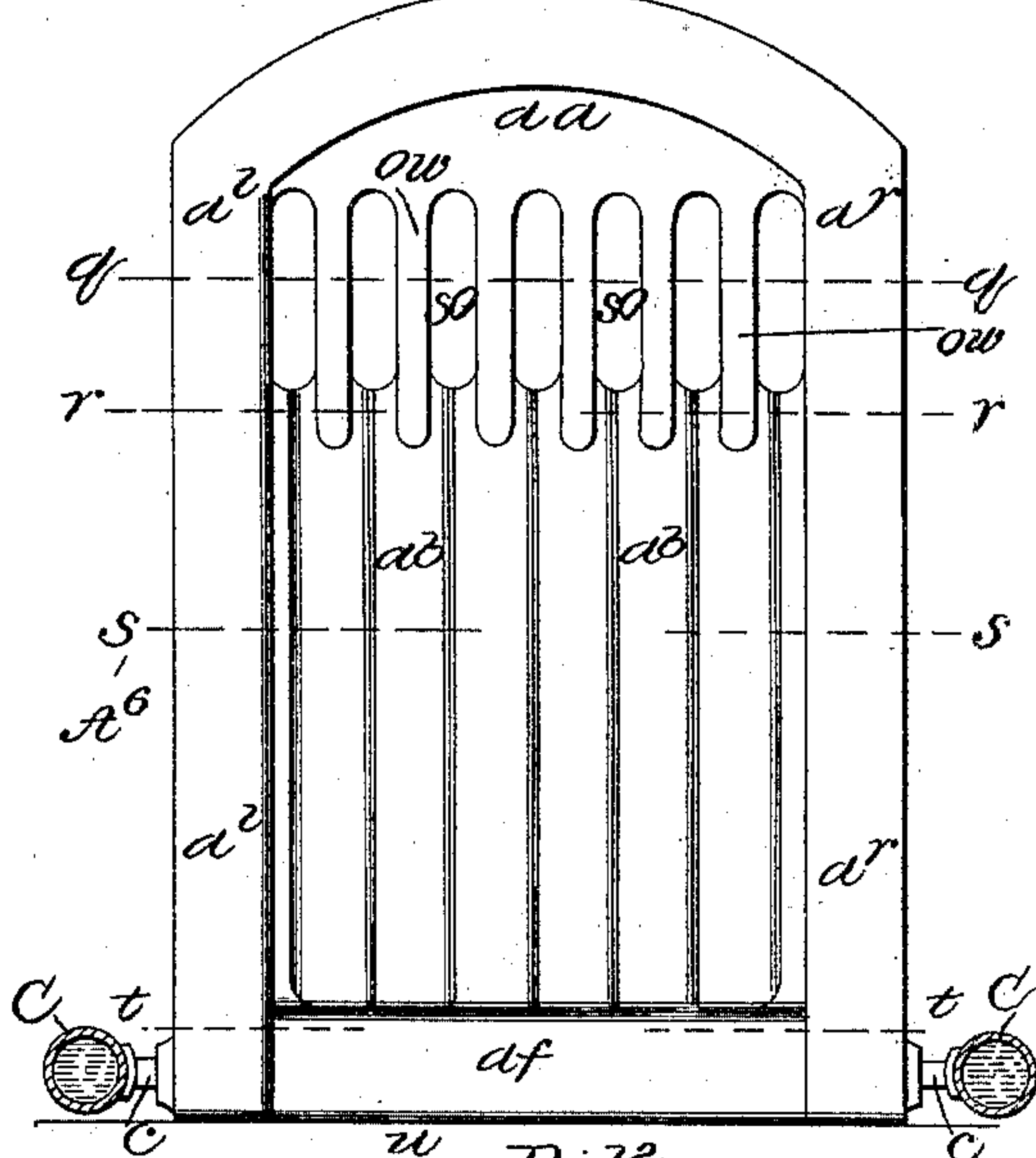
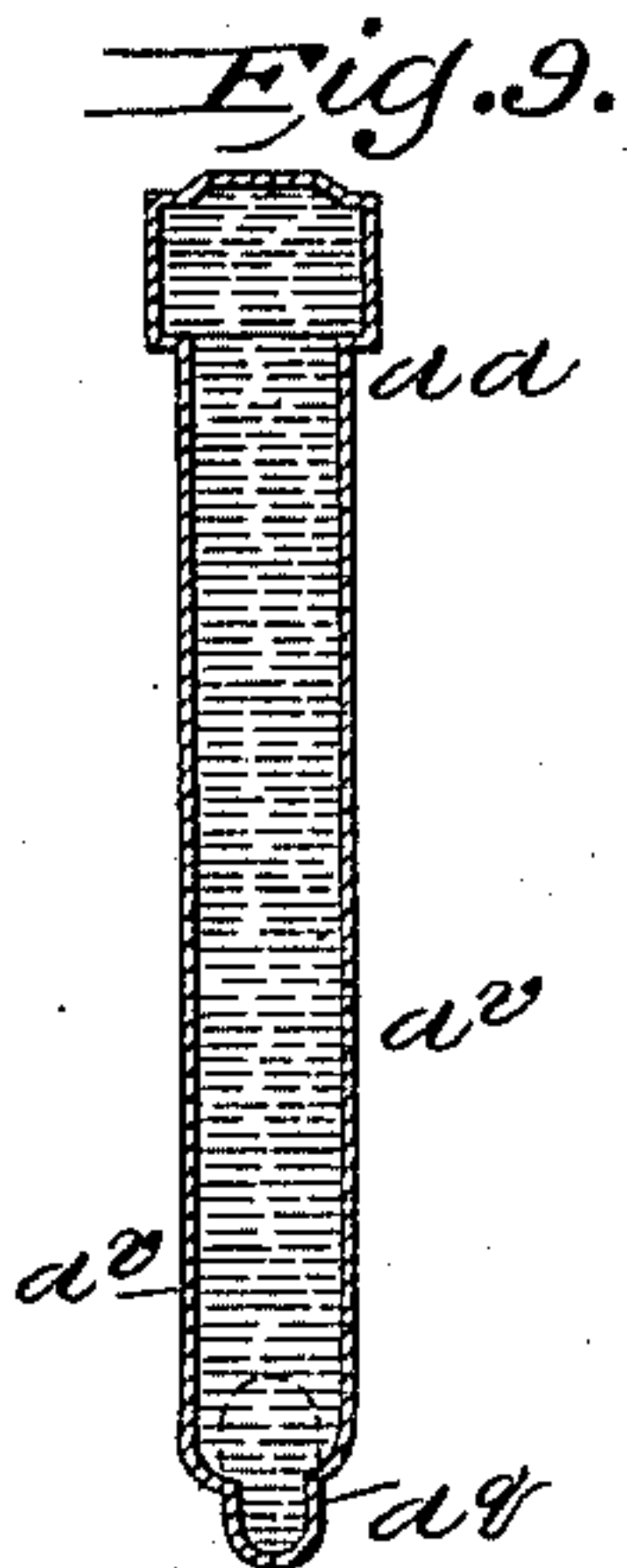
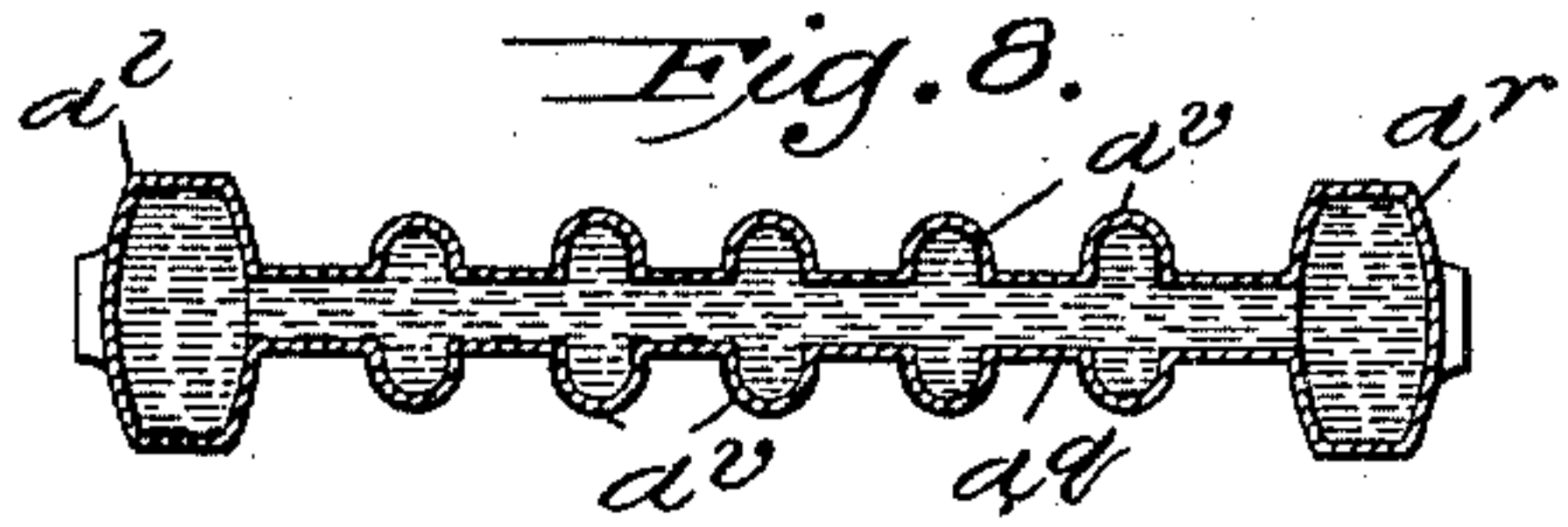
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No. 476,804.

Patented June 14, 1892.



Witnesses:  
Arthur Ashley  
Malter S. Dodge

Inventor:  
Wm. M. Mackay  
by *[Signature]*



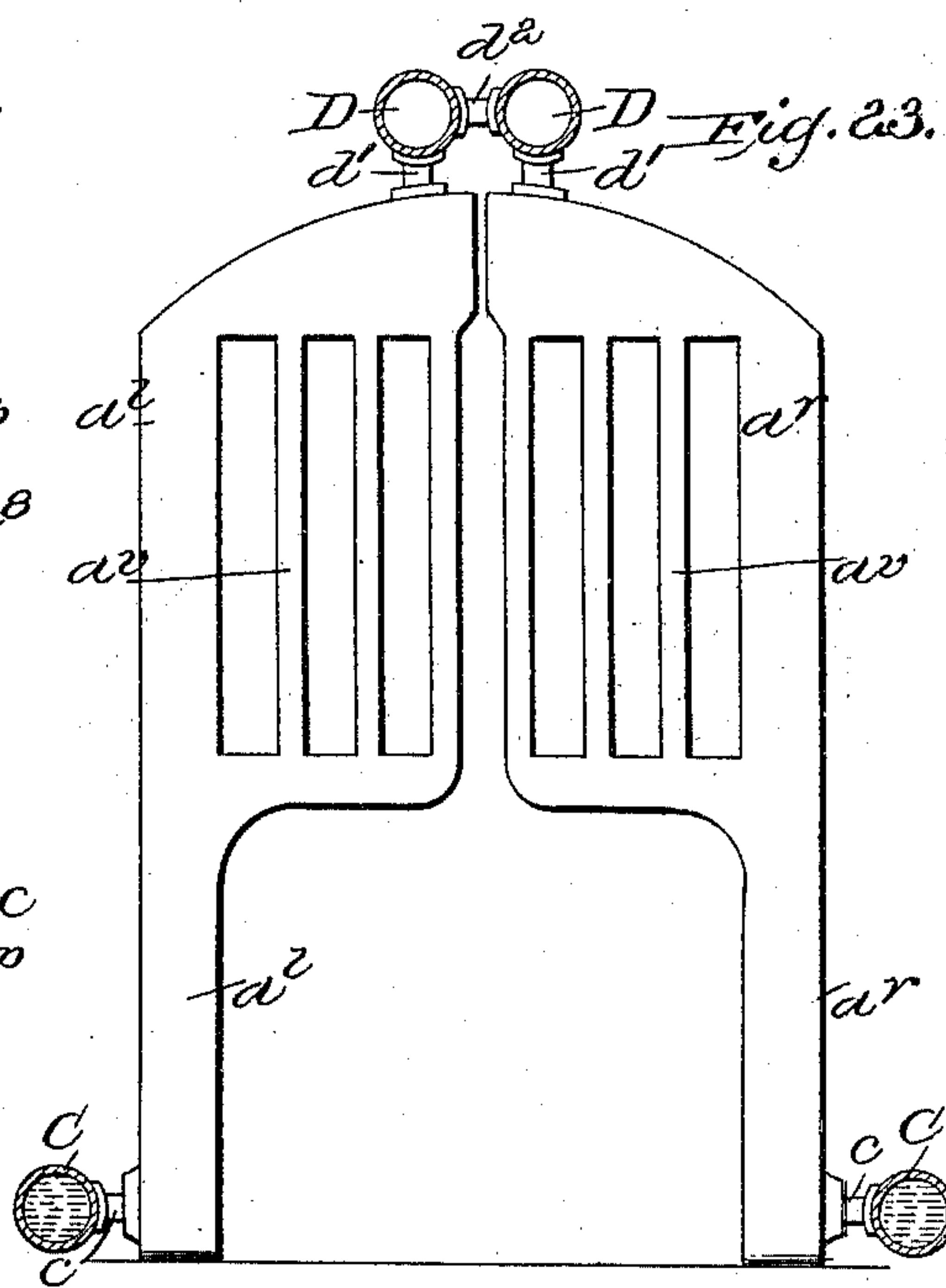
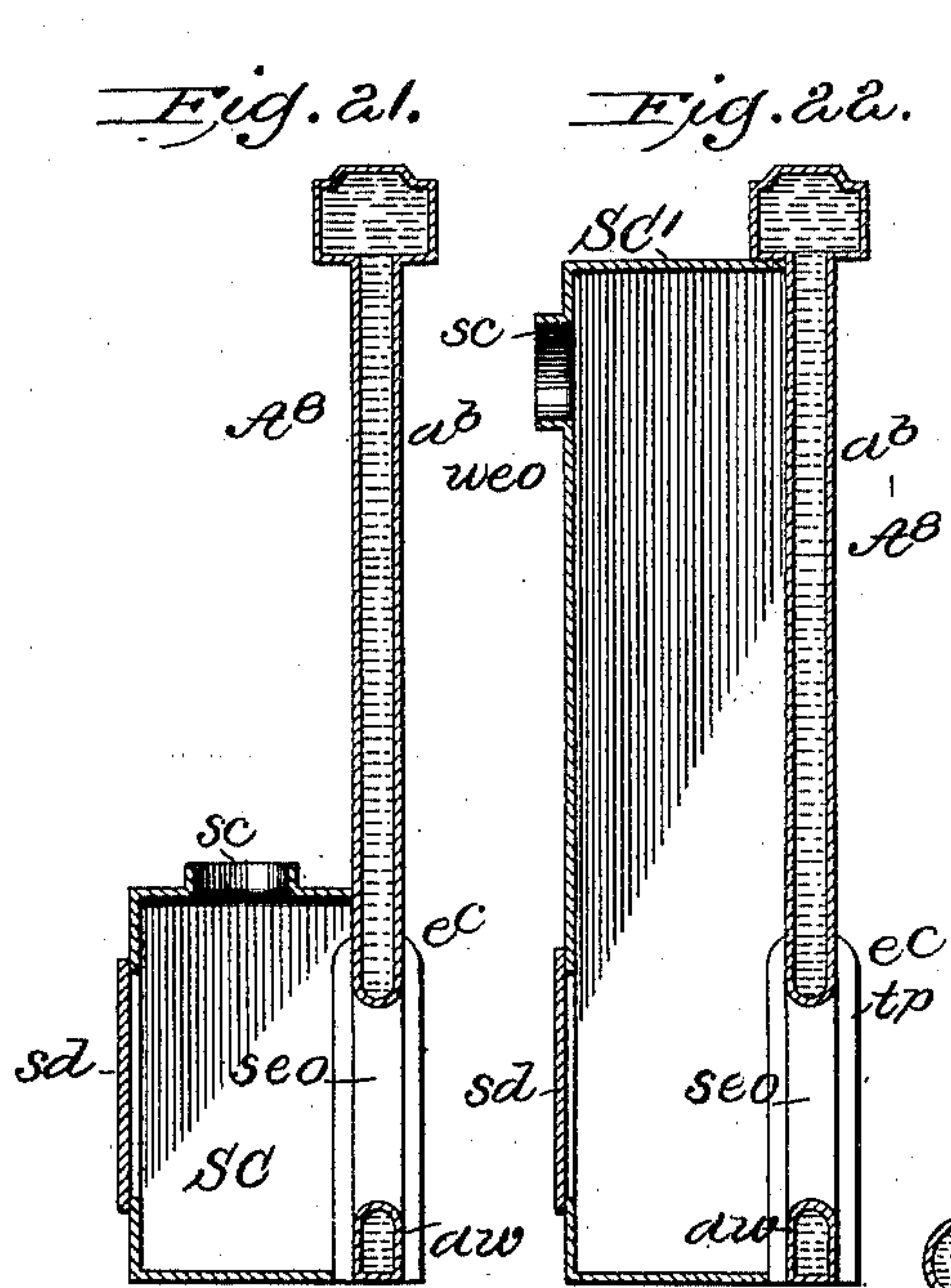
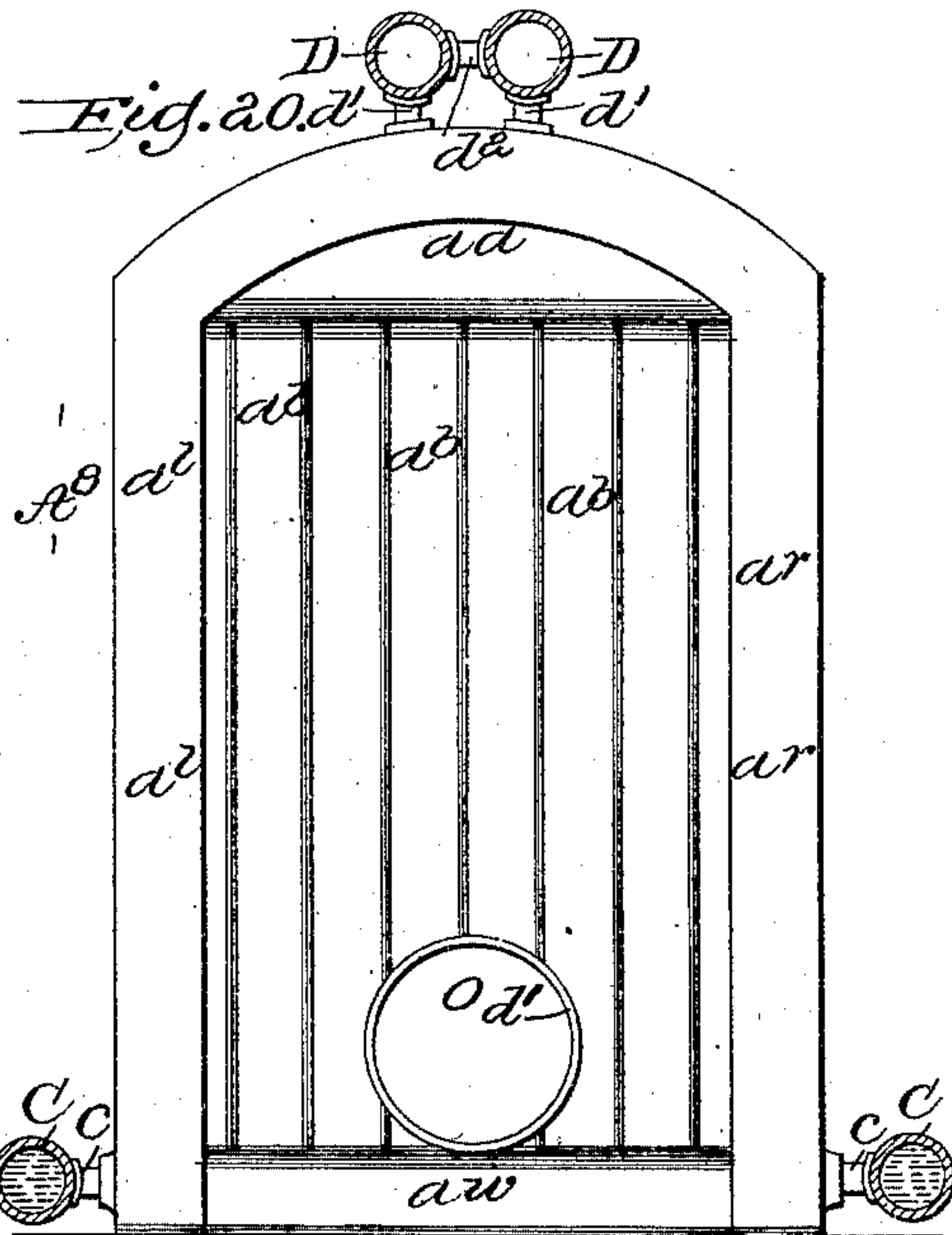
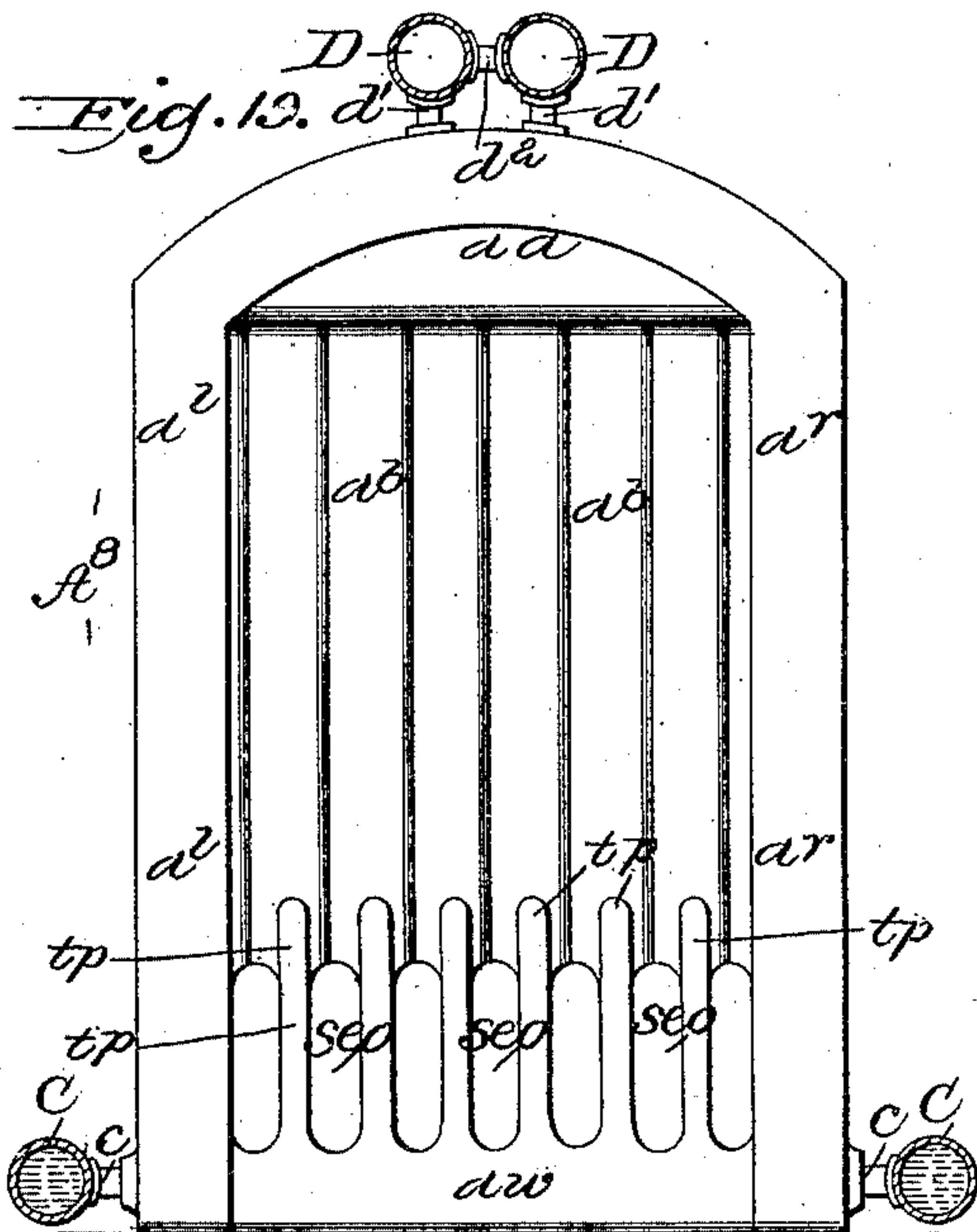
(No Model.)

4 Sheets—Sheet 3.

W. M. MACKAY.  
SECTIONAL STEAM BOILER.

No. 476,804.

Patented June 14, 1892.



Witnesses:

Arthur Ashley  
Mutter & Dodge.

Inventor:

Wm. M. Mackay  
by *[Signature]*

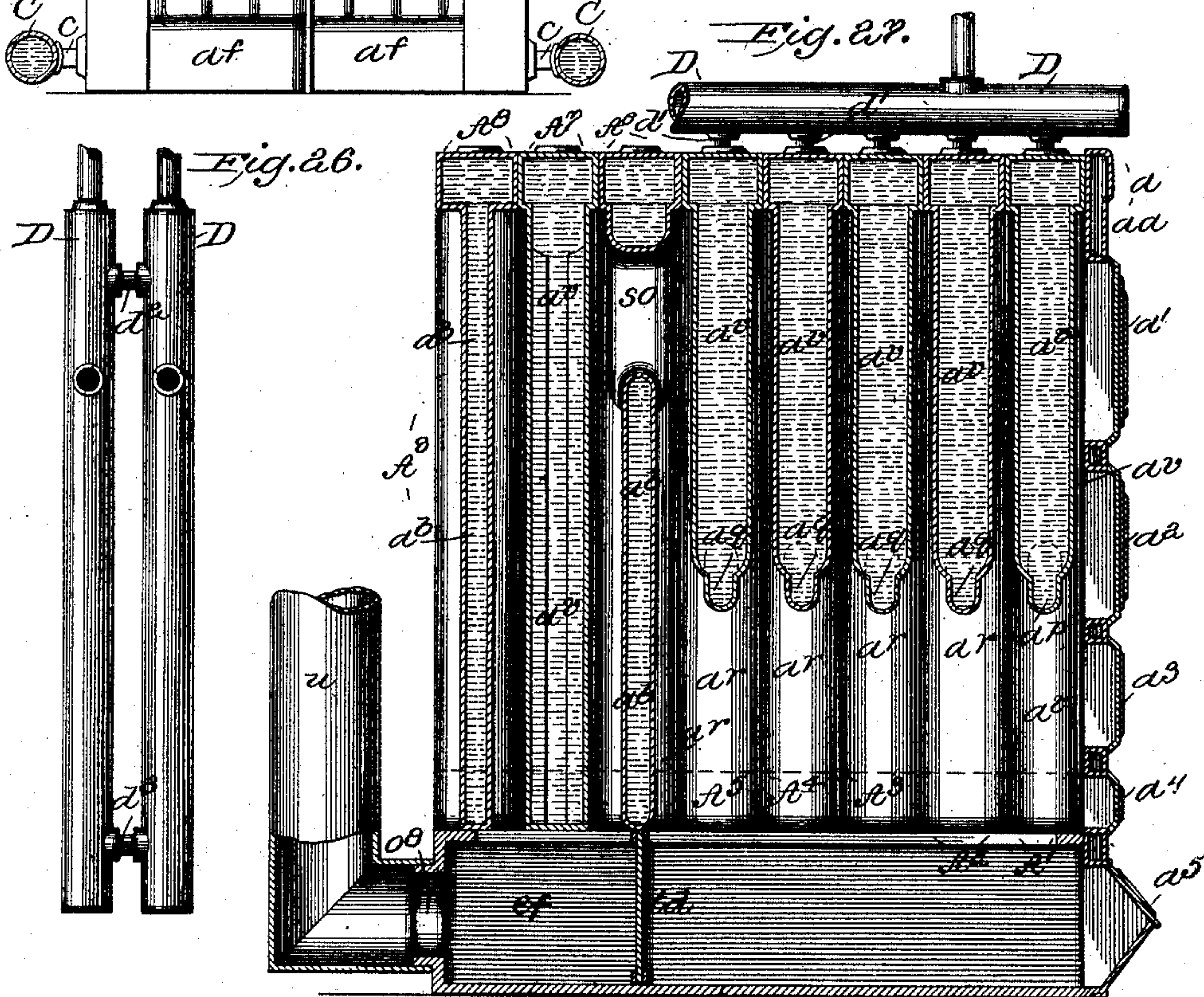
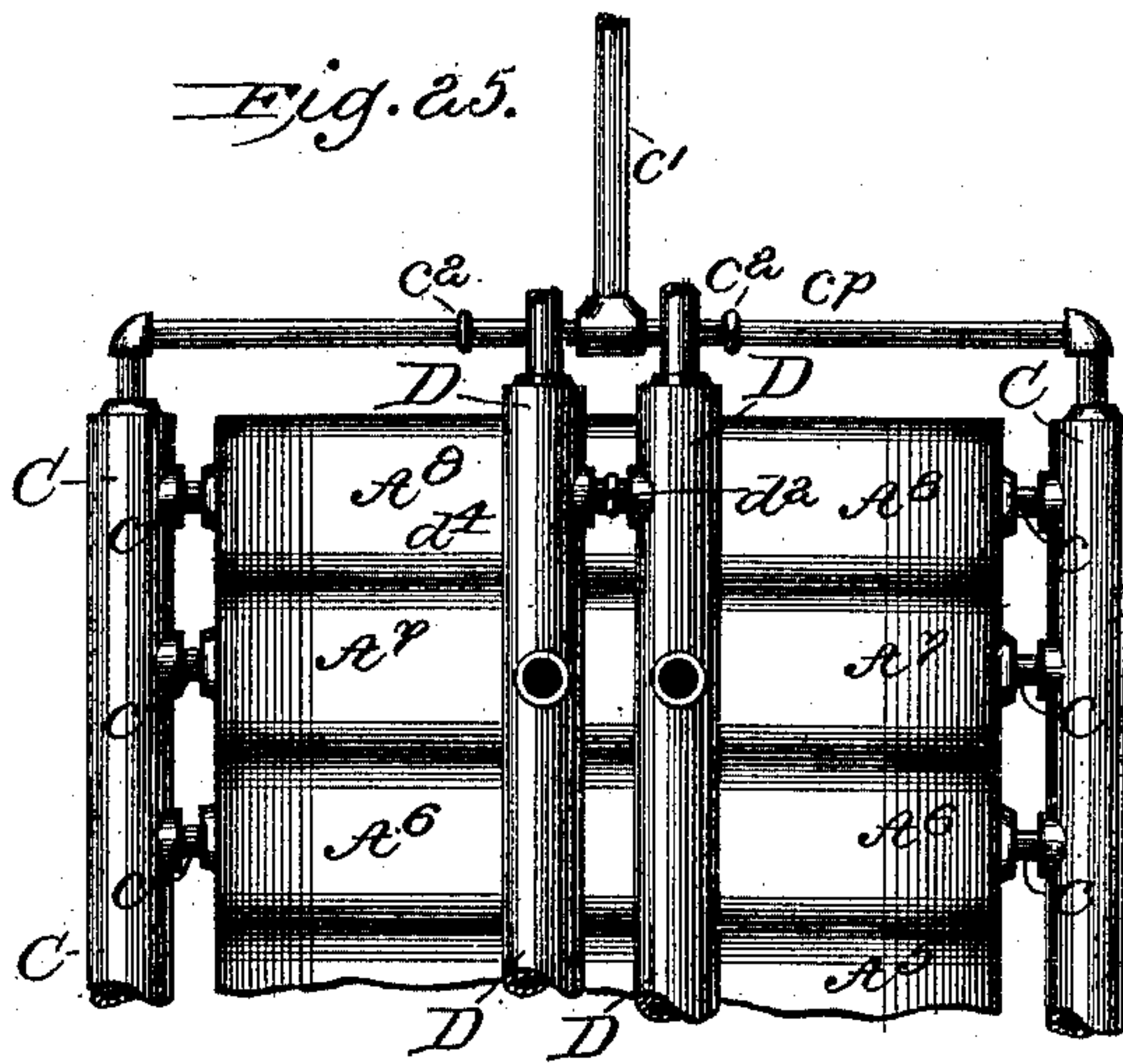
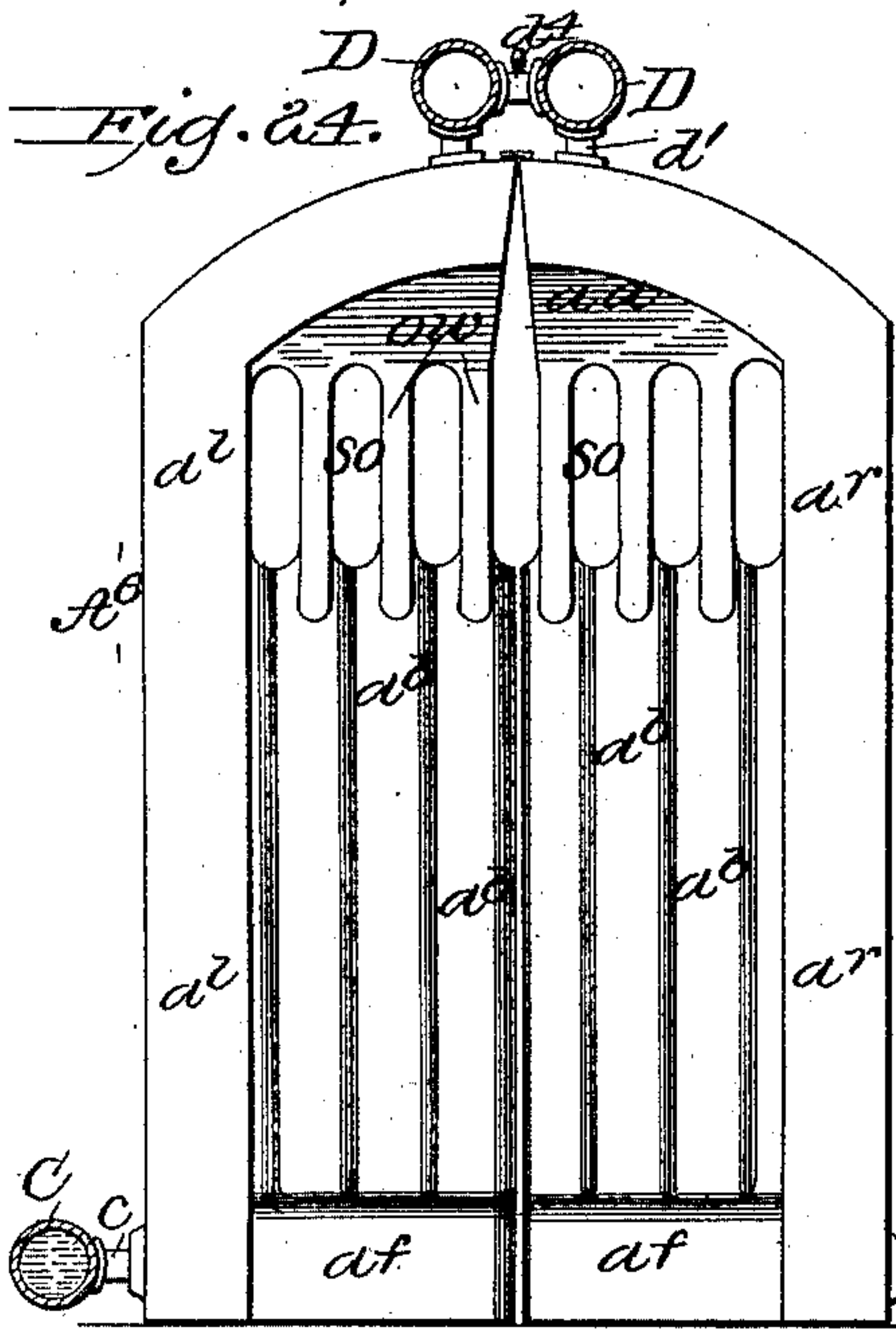
(No Model.)

4 Sheets—Sheet 4.


W. M. MACKAY.  
SECTIONAL STEAM BOILER.

No. 476,804.

Patented June 14, 1892.



Witnesses:  
Arthur Elshley  
Master J. Dodge

Inventor:  
Wm. M. Mackay  
By 



# UNITED STATES PATENT OFFICE.

WILLIAM M. MACKAY, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE  
RICHARDSON & BOYNTON COMPANY, OF NEW YORK, N. Y.

## SECTIONAL STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 476,804, dated June 14, 1892.

Application filed January 25, 1892. Serial No. 419,231. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM M. MACKAY, a citizen of the United States, and a resident of the city of Newark, in the county of Essex, of the State of New Jersey, have invented a new and useful Sectional Steam-Boiler, of which the following is a description.

The invention relates to that class of sectional steam-boilers which may be employed for the production of steam-power, for the production of steam for heating purposes in connection with suitable radiators, or for the circulation of hot water through the various apartments of any structure which it is desired to warm.

The invention consists in the various novel parts and in the various novel combinations of parts in a sectional steam-boiler, as will first be described with particular reference to its details, and then distinctly pointed out in the paragraphs which follow the detailed description and conclude the specification.

In order that my invention may be fully understood, it will first be described with reference to the accompanying drawings, which constitute a part of this specification, and in which—

Figure 1 represents a front elevation of the apparatus. Fig. 2 represents an elevation of the front steam-and-water section, the front closing-plate or door-section having been removed. Fig. 3 represents a horizontal section in the line *l l* in Fig. 2. Fig. 4 represents a horizontal section on the line *m m* in Fig. 2. Fig. 5 represents in elevation a modification of the construction seen in Figs. 2 and 4, the lower portion of the parts seen in those figures being shown as connected by a transverse water-way. Fig. 6 represents a sectional plan in the line *n n* of Fig. 5. Fig. 7 represents a front elevation of one of the fire-box or fuel-chamber sections. Fig. 8 represents a horizontal section of one of the fire-box sections as in the line *o o* in Fig. 7. Fig. 9 represents a longitudinal vertical section as in the line *p p* of Fig. 7. Fig. 10 represents a front elevation of the bridge-wall section. Fig. 11 represents a horizontal section of the bridge-wall section as in the line *q q* of Fig. 10. Fig. 12 represents a horizontal section as in the line *r r* of Fig. 10. Fig. 13 repre-

sents a horizontal section as in the line *s s* in Fig. 10. Fig. 14 represents a horizontal section as in the line *t t* of Fig. 10. Fig. 15 represents a longitudinal vertical section as in the line *u u* of Fig. 10. Fig. 16 represents a front elevation of the intermediate or smoke-chamber section. Fig. 17 represents a sectional plan view in the line *v v* of Fig. 16. Fig. 18 represents a horizontal section in the line *w w* of Fig. 16. Fig. 19 represents an elevation of the rear steam-and-water or exit-flue section. Fig. 20 is an elevation representing the rear steam-and-water section in a slightly-modified form. Fig. 21 represents a central vertical longitudinal section showing the rear closing or smoke-exit section as discharging into a low-down smoke-chamber. Fig. 22 represents a central vertical longitudinal section showing the rear closing or smoke-exit section as when provided with a smoke-chamber which is of equal height with the section itself. Fig. 23 is an elevation representing one of the combustion-chamber sections as composed of two transverse divisions or edge-to-edge sub-sections. Fig. 24 is an elevation representing the bridge-wall section as composed of two divisions or transversely-extending sub-sections. Fig. 25 represents a detail plan, showing the connection of the primary water-supply pipes and the intermediate water-supply pipes or manifolds as when the several transverse sections of the boiler are composed of two distinct transverse parts or sub-sections and when the steam-and-water apparatus is supported upon a separate base or ash-pit section. Fig. 26 represents a top plan view of the two-part, compound, or twin steam-drum detached from the boiler. Fig. 27 represents a longitudinal vertical central section, in which the rear steam-and-water section is closed or imperforate and in which the steam-and-water sections are supported upon a separate base or ash-chamber section.

As will be seen in Fig. 1, the front plate or front closing-section *a* of the boiler *A* is of such form and dimensions as to adapt it to cover the front steam-and-water section *A'*, and it is provided with flue-door *a'* to afford access to the various flues of the steam-sections and may have fuel-doors *a<sup>2</sup>* and *a<sup>3</sup>*, a sliding door *a<sup>4</sup>*, and an ash-pit door *a<sup>5</sup>*. The



front steam-section  $A'$ , in common with all the other sections of the boiler, is provided with right and left water-columns  $al$   $ar$  and a surmounting intercommunicating arch  $aa$ .  
 5 At about the mid-height of this section a transverse passage  $ap$  connects the two columns, while vertical passages  $av$ , longitudinally oval, as shown, and placed at a suitable distance apart, connect the transverse passage with the  
 10 arch portion  $aa$  of the section. The left and right members of the vertical passages  $av$  extend downward to the floor-line and at foot are connected by a short passage  $ah$  with the exterior columns  $al$   $ar$ .

15 The fuel-box or fire-chamber sections  $A^2$   $A^3$   $A^4$   $A^5$  are, as will be seen in Figs. 7, 8, and 9, like the section  $A'$ , except that none of the intermediate passages extend downwardly below the mid-height transverse connecting-passage  $ap$ , while at their upper extremities they  
 20 discharge into the chamber, which is formed by the walls of the exterior columns and their connecting-arch. At the rear of the series of fire-chamber sections is the coincident bridge-wall section  $A^6$ , which in all its parts is clearly  
 25 represented in Figs. 10, 11, 12, 13, 14, and 15. As will be seen, the exterior vertical steam-and-water columns and the surmounting intercommunicating arch in this section are essentially of like construction with correspond-  
 30 ing parts in the front section and in the combustion-chamber section already described. The intermediate portions or vertical steam-and-water chambers or passages of this section consist of the oval tubes  $ab$   $ab$ , &c., flattened at front and rear, as shown, and con-  
 35 nected at foot with the transverse water-passage  $af$ , while at a point a short distance below the smoke-openings  $so$  they are overlapped at front and rear by the oval water-pas-  
 40 sages  $ow$ , which are of precisely similar form to the passages below, but are arranged at a right angle therewith, thereby forming at their junction a series of star-shaped expansion  
 45 and transfer chambers  $ec$ , (best represented in Fig. 12,) which discharge upwardly through the passages  $ow$  between the smoke-openings into the common steam-and-water space, which has direct and free communication with the  
 50 exterior steam-and-water columns and with their connecting arch-like chambers at the upper extremity of the section.

In rear of the bridge-wall section  $A^6$  is the intermediate or smoke-chamber section  $A^7$ , which  
 55 exteriorly is uniform with the contiguous sections, but which in its main portion is composed of the vertical oval steam-and-water passages  $av$ , which at their lower extremities unite with the transverse passage  $al$ , while at  
 60 their upper extremities they discharge into the chamber which is formed by the walls of the exterior columns  $al$   $ar$  and their connecting-arch  $aa$ .

65 In the rear steam-and-water section  $A^8$  the exterior vertical columns are formed as in the bridge-wall section  $A^6$ , Figs. 10, 11, 12, 13, 14, and 15, and the intermediate steam-and-water

passages above the smoke-openings, like the intermediate steam-and-water passages in that section below the smoke-openings, are com- 70 posed of vertically-extending horizontally-oval tubes or passages  $ab$ , which at a little distance above the smoke-openings are overlapped by the front and rear oval portions of tubular passages  $tb$ , which separate the smoke- 75 exit openings  $eo$ , which at their lower extremities overlap and open into the transverse water-way  $aw$ . In this section, it will be observed, the construction represented in the bridge-wall section is essentially reproduced, 80 the parts being in purpose and effect the same and differing only in their arrangement, the object of the construction in each instance being to permit the provision of the smoke-openings within the area of the vertical steam- 85 and-water passages without in any degree diminishing the capacity of such passages.

In Fig. 21 the smoke-exit openings  $seo$  in the rear steam-and-water section are represented as discharging into a rear low-down 90 smoke-chamber  $SC$ , which is suitably attached at this extremity of the apparatus, a collar  $sc$  being provided upon the top plate of the smoke-chamber to receive the uptake-pipe and a door  $sd$  being provided at the rear to 95 afford access to the interior of the box and through the openings  $seo$  to the interior of the two-part chamber behind the bridge-wall section as well.

Under the construction represented in Fig. 100 22 the smoke-chamber section  $SC'$  at the rear will extend to the top of the rear steam-and-water section and the ultimate exit-opening  $ueo$  and its collar  $sc$  will be provided in the rear plate of the smoke-chamber and near the 105 upper extremity thereof, while a low-down door  $sd$  for the removal of refuse from the several flues and chambers behind the bridge-wall section will be provided, as in Fig. 21.

In some cases a separate rear closing-section or smoke-chamber and exit-opening section, as in Figs. 21 and 22, will be dispensed 110 with, and when it is not employed the rear steam-and-water section  $A^8$  will be modified in construction by substituting for the sev- 115 eral smoke-openings  $so$  the single transversely-central low-down smoke-exit opening  $O$ , as indicated in Fig. 20. Under this modified construction a collar  $d'$  will be provided upon the smoke-exit opening, as seen in that figure, 120 for the attachment of an uptake-pipe.

Steam-drums  $D$  and  $D'$  extend longitudinally of the boiler at a suitable distance above the same and at a short distance apart, the drums communicating with each other 125 through connecting-pipes  $d^2$   $d^3$  in any desired number, while each drum has communication with the steam-and-water sections through short vertical connecting-pipes  $d'$ . The connecting-pipes  $d^2$  and  $d^3$  being provided with 130 valves  $d^4$ , communication between the two drums is readily controlled.

Along the base of the apparatus, at each side thereof, extends a water supply and dis-



tributing pipe or chamber C, the two pipes being connected, preferably at the rear of the apparatus, by an intermediate pipe *cp*, through which, primarily, the pipes C C are supplied from an induction-pipe *c'*, which leads from a street-main or other source. A cut-off valve, as *c*<sup>2</sup>, being provided in the pipe *cp* at either side of the point of inflow, it is made easily practicable to limit and regulate the supply of water to either division of the apparatus. Under this construction one division of the apparatus may, if desired, be fitted with connections for heating by hot-water circulation, while the appliances of the other division may adapt it for heating by steam pipes and radiators, and use of either division may be discontinued altogether should occasion require it through necessity for minor repairs or for any other purpose.

As will be most clearly seen in Figs. 2, 3, 7, 8, and 9, the intermediate or interior vertical steam-and-water passages *av* in the front steam-and-water section A' and in the fuel and combustion chamber section A<sup>2</sup> A<sup>3</sup>, &c., are of greater longitudinal extent than the transverse horizontal portion of such sections and project front and rear beyond the same, the curved or rounded projections serving not only to provide a very large surface for exposure to the action of the volatile products of combustion, but also to constitute partially-closed vertical smoke and flame flues, which operate to give direction to such volatile products in their movement from the fuel or fire chamber to the exit-opening. This construction serves, also, to produce an active circulation within the water-spaces, the vertical passages uniting with the horizontal passages wherever they are placed in contact.

In the bridge-wall section A<sup>6</sup> the main or intermediate portion below the smoke-openings is, as already stated, composed of flattened oval tubes, which are placed edge to edge. To avoid retardation of the flow of the currents through the provision of the smoke-openings at the upper extremity of the bridge-wall, it is necessary that the capacity of these steam-and-water sections be undiminished at this point or elsewhere, and it will be observed upon reference to Fig. 10 and other related figures that through the provision of the double oval or star formation a short distance below the smoke-openings the change from the transversely-oval to the longitudinally-oval formation is effected without at any point diminishing the area or capacity of any of these sections. Under this construction, as will be apparent, a change in the direction of the water-column is effected gradually and without check to the velocity of the current, a semi-spiral motion being imparted thereto through the peculiar relation of the parts to each other.

As already indicated, it will be seen that in the rear steam-and-water section A<sup>8</sup>, Fig. 19, a closely-analogous construction is presented, the difference consisting, essentially, in an

inversion of the part and in a greater relative capacity at the lower extremity of such rear section.

It will be understood that the horizontal transverse passage *ab*, Fig. 5, at the base of the front steam-and-water section A' communicates with the front left and right vertical columns, and through such columns with the exterior longitudinal supply and distributing pipe C, with which also all the other steam-and-water sections are connected for water supply and circulation. This horizontal transverse water-way *ab* will preferably be provided in this front section only when the apparatus is of considerable dimensions and is supported upon an independent base, as represented in Fig. 27.

Although in the drawings and in the foregoing description but four fuel and combustion chamber sections are provided for, it will be apparent that in some instances it will be desirable to provide a much greater number.

The construction represented in the first twenty-two figures of the drawings, excepting only Fig. 6, is that which is by preference employed when the apparatus is to be of small or of medium dimensions and is not to be provided with an independent base or ash-chamber; but when extensive structures are to be warmed or when for any purpose very great steam-producing capacity is required all the transverse steam-and-water sections will ordinarily be composed of two left and right parts, as represented in Figs. 23 and 24, and such two-part section will rest upon an independent substructure or separate ash-chamber section, as in Fig. 27, the volatile products of combustion in such case passing from the end flue *ef* behind the transverse diaphragm *td*, either directly into an uptake *u*, coincident with the opening *o*<sup>8</sup>, or into and through a low-down smoke-chamber like that shown in Fig. 21, in connection with one-part transverse steam-and-water sections.

Under the described two-part construction of the transverse sections the exterior horizontal water-supply pipes C will at the rear of the apparatus be connected, as already stated, by a transverse pipe *cp*, and it will of course be understood that each half-section or sub-section will be connected with one of the steam-drums D or D'.

In some situations it may be desirable to provide a smoke-exit opening both in the rear or closing steam-and-water section and in the base or ash-pit section. Under this construction, which may be advantageously employed in connection with a high-up smoke-box, as represented in Fig. 22, it will be practicable by closing the damper in the exit-opening of the steam-and-water section to direct the smoke through the ash-pit section, or by opening the same to permit the smoke to pass more directly to the opening formed in the upper portion of the rear wall of the smoke-box.

Although the intermediate vertical passages in the bridge-wall section and in the rear



steam-and-water section are shown and described as "oval"—that is, rounded at their contiguous sides or edges—it will be apparent that these passages may, if desired, be beveled or obtusely angular instead of being rounded or oval.

It should be understood that, although the drawings represent but one steam-and-water section in the smoke-chamber behind the bridge-wall section, I by no means limit myself to this number, since it is obvious that in situations which require great steam-power or heating capacity a larger number of sections should be employed. It should also be understood that the term "mid-height" as applied in description and claims to the horizontal transverse water-ways *aq* is a generally-descriptive and not a specifically-restrictive term, since it is manifest that the relative elevation of the part might be either somewhat greater or somewhat less than as shown without affecting the manner of the operation or in any way exceeding the scope of the invention. Furthermore, although two steam-drums are represented in the drawings, one only may be employed when only a restricted capacity in dimensions and in power is required.

The invention having been thus described, what is claimed is—

1. In a sectional steam-boiler, a front steam-and-water section which embraces left and right exterior vertical columns, an upper horizontal connecting-chamber, a lower horizontal continuous connecting chamber or passage between the foot of the two columns, an intermediate or mid-height horizontal chamber or passage connecting the two vertical columns, and a series of vertical passages which are longitudinally oval in their horizontal area and which extend from the intermediate horizontal chamber or passage to the upper horizontal chamber or passage.

2. In a sectional steam-boiler, a front steam-and-water section which embraces left and right exterior vertical columns, an upper horizontal connecting-chamber, a lower horizontal connecting chamber or passage between the foot of the two columns, an intermediate or mid-height horizontal chamber or passage which directly connects the two vertical columns, and a series of vertical passages which extend directly upward from the intermediate horizontal chamber or passage to the upper horizontal chamber or passage.

3. A sectional steam-boiler the fuel and combustion chambers of which are inclosed above and laterally by a series of steam-and-water sections, each of which embraces exterior vertical left and right steam-and-water columns, an upper horizontal chamber or passage which unites the vertical columns at their upper extremities, an intermediate horizontal chamber or passage which directly connects the vertical exterior columns and which longitudinally of the boiler is of an extent about equal to one-third the longitudinal ex-

tent of the exterior columns, and a series of vertically-arranged passages which extend downwardly from the upper horizontal chamber or passage and embrace or overlap and unite with the intermediate chamber or passage.

4. A sectional steam-boiler the fuel and combustion chambers of which are inclosed above and laterally by a series of steam-and-water sections, each of which embraces exterior vertical left and right steam-and-water columns, an upper horizontal chamber or passage which at their upper extremities unite the vertical columns, a horizontal chamber or passage which at about its mid-height directly connects the vertical exterior columns and which longitudinally of the boiler is of an extent about equal to one-third the longitudinal extent of such columns, and a series of vertically-arranged passages which are longitudinally of the boiler oval in their horizontal area, which longitudinally of the boiler are about two-thirds the extent of the vertical columns, and which extend from the upper horizontal chamber or passage to the intermediate horizontal chamber or passage.

5. A sectional steam-boiler the bridge-wall section of which is composed of a left and a right exterior vertical steam-and-water column, a top horizontal chamber or passage which connects the exterior steam-and-water columns, a bottom horizontal chamber or passage which connects the lower extremities of the exterior vertical steam-and-water columns, a series of intermediate edge to edge transversely-oval vertical chambers or passages which are of smaller extent from front to rear than the exterior vertical columns, and a series of smoke-openings above the upper extremities of the transversely-oval chambers or passages and immediately below the top horizontal chamber or passage.

6. A sectional steam-boiler the bridge-wall section of which is composed of a left and a right exterior vertical steam-and-water column, a top horizontal chamber or passage which connects the exterior steam-and-water columns, a bottom horizontal chamber or passage which connects the lower extremities of the exterior vertical steam-and-water columns, a series of intermediate contiguous transversely-oval vertical chambers or passages which together extend across the space between the exterior vertical columns, and a series of steam-and-water passages which extend upwardly from the transversely-oval steam-and-water chambers or passages to the top horizontal chamber or passage, such upwardly-extending steam-and-water passages alternating with smoke-openings formed in the upper extremity of such bridge-wall section immediately below the top horizontal chamber or passage.

7. A sectional steam-boiler the bridge-wall section of which is composed of a left and a right exterior vertical steam-and-water column, a top horizontal chamber or passage



which connects the exterior steam-and-water columns, a bottom horizontal chamber or passage which connects the lower extremities of the exterior vertical steam-and-water columns, a series of intermediate contiguous transversely-oval vertical steam-and-water columns or passages, and a series of non-contiguous longitudinally-oval steam-and-water chambers or passages which in their lower portion overlap each side of the upper extremities of the transversely-oval steam-and-water chambers or passages and which in their main portion separate and are in alternation with the members of a series of smoke-openings in the upper extremity of such bridge-wall section.

8. A sectional steam-boiler the bridge-wall section of which embraces a series of vertical transversely-oval steam-and-water tubes or passages which are placed edge to edge in a plane below the several smoke-openings of such bridge-wall section, and a series of longitudinally-oval steam-and-water chambers or passages which in their lower portion overlap the transversely-oval steam-and-water chambers or passages and which are placed in alternation with the members of the series of smoke-openings in such section, whereby smoke-openings of the necessary capacity are provided without diminishing the capacity of the steam-and-water passages.

9. In a sectional steam-boiler, a smoke-chamber section behind and coincident with the bridge-wall section, which is composed of a left and a right vertical exterior steam-and-water column, a top horizontal chamber or passage which extends transversely of the apparatus and connects the exterior steam-and-water columns, a transversely-extending chamber or passage at the lower extremity of such smoke-chamber section which is of about one-third the extent, longitudinally, of the exterior vertical columns, and a series of vertical tubes or passages which are longitudinally oval in their horizontal area, which are of about two-thirds the dimensions from front to rear of the exterior vertical columns, which are placed at a distance apart about equal to their transverse horizontal diameter, and which extend from the top horizontal chamber or passage to the transversely-extending chamber or passage at the lower extremity of such smoke-chamber section.

10. In a sectional steam-boiler, a rear steam-and-water section which embraces left and right exterior vertical steam-and-water columns, a top horizontal steam-and-water chamber or passage which at each end opens into the upper portion of the exterior vertical steam-and-water columns, a bottom horizontal chamber or passage which connects the lower extremities of the exterior vertical steam-and-water columns, and a series of intermediate vertically-placed steam-and-water passages which extend from the top horizontal steam-and-water chamber or passage to a point above a series of smoke-openings and which

in horizontal area are transversely oval and are of less extent from front to rear than the exterior vertical steam-and-water passages.

11. In a sectional steam-boiler, a rear steam-and-water section which embraces left and right exterior vertical steam-and-water columns, a top horizontal steam-and-water chamber or passage which at each end opens into the upper portion of the exterior vertical steam-and-water columns, a bottom horizontal chamber or passage which connects the lower extremity of the two exterior vertical steam-and-water columns, a series of intermediate contiguous vertically-placed horizontally-oval steam-and-water passages which extend from the top horizontal steam-and-water chamber or passage to a point a short distance above a series of low-down smoke-openings, and a series of longitudinally-oval steam-and-water passages which extend downwardly along and upon the transversely-oval steam-and-water passages from a point in a plane above the upper extremities of the several smoke-openings to the bottom horizontal chamber or passage.

12. In a sectional steam-boiler, a series of transversely-extending steam-and-water sections, each of which is composed of a left half-section and a right half-section, each of the two half-sections being complete in itself, the two being placed edge to edge at the center of the apparatus and each being independently connected with a separate steam-drum and with a water-supply pipe which extends longitudinally along the base of the apparatus at each side thereof, substantially as described.

13. In a sectional steam-boiler, a series of transversely-extending steam-and-water sections, each of which is composed of a left half-section and a right half-section, each of the two half-sections being complete in itself, the two being placed edge to edge at the center of the apparatus and each being independently connected with a separate steam-drum and with a separate water-supply pipe which extends longitudinally along the base of the apparatus at one side thereof, the two longitudinally-extending cold-water pipes being connected together at the rear of the apparatus by an intermediate transversely-extending pipe.

14. In a sectional steam-boiler, a series of transversely-extending steam-and-water sections which in their lower outer portions bestride the fuel-chamber and which in their upper portions embrace top transversely-extending steam-and-water passages, mid-height transversely-extending steam-and-water passages, and a series of vertical steam-and-water passages which directly connect the top and the mid-height transversely-extending steam-and-water passages, the mid-height passages and the vertical connecting-passages being of smaller extent from front to rear than the bestriding and overhanging inclosing portions of the sections, so that all



their parts are exposed to the direct action of the gaseous and other volatile productions of combustion.

15. In a sectional steam-boiler, a combustion-chamber which is formed above the fire-box, which opens into and has direct connection with the fire, which has a series of vertical tubes which are connected at the top with the steam-and-water space, and which are connected at the bottom with a mid-height cross-tube, the communication from the cross-tube to the steam-and-water space being directly upward and all the surface in the combustion-chamber being direct-acting fire-surface, substantially as described.

16. A sectional steam-boiler in which are combined a front steam-and-water section which embraces left and right vertical steam-and-water columns, top and mid-height transverse steam-and-water ways and vertical intermediate steam-and-water ways, a series of steam-and-water sections which bestride the fuel-chamber and each of which embraces left and right vertical steam-and-water columns, top and mid-height horizontal steam-and-water ways, and intermediate vertical steam-and-water tubes which connect the horizontal steam-and-water ways, a bridge-wall section which is provided with smoke-openings and which comprises left and right vertical steam-and-water columns, top and bottom horizontal steam-and-water chambers or passages, intermediate vertical transversely-oval contiguous steam-and-water tubes which extend from the bottom passage upwardly to the smoke-openings, and longitudinally-oval steam-and-water passages which are placed in alternation with the smoke-openings, which in their lower portion overlap the upper extremities of the transversely-oval passages and which at their upper extremity open into the top horizontal passage, a smoke-chamber steam-and-water section which has left and right vertical steam-and-water columns, top and bottom horizontal passages, and intermediate vertical steam-and-water passages or tubes which are separated from top to bottom by smoke-openings, and a rear steam-and-water section which has left and right vertical steam-and-water columns, top and bottom horizontal steam-and-water passages, and intermediate vertical steam-and-water passages.

17. A sectional steam-boiler in which are combined a front steam-and-water section which embraces left and right vertical steam-and-water columns, top and mid-height transverse steam-and-water ways, and vertical intermediate steam-and-water ways, a series of steam-and-water sections which bestride the fuel-chamber and each of which embraces left and right vertical steam-and-water columns, top and mid-height horizontal steam-and-water ways, and intermediate vertical steam-and-water tubes which connect the horizontal steam-and-water ways, a bridge-wall section which is provided with smoke-openings and which comprises left and right vertical steam-

and-water columns, top and bottom horizontal steam-and-water chambers or passages, intermediate vertical transversely-oval contiguous steam-and-water tubes which extend from the bottom passage upwardly to the smoke-openings, and longitudinally-oval steam-and-water passages which are placed in alternation with the smoke-openings, which in their lower portion overlap the upper extremities of the transversely-oval passages and which at their upper extremities open into the top horizontal passage, a smoke-chamber steam-and-water section which has left and right vertical steam-and-water columns, top and bottom horizontal passages, and intermediate vertical steam-and-water passages or tubes which are separated from top to bottom by smoke-openings, and a rear steam-and-water section which has left and right vertical steam-and-water columns, top and bottom horizontal steam-and-water passages, intermediate vertical contiguous transversely-oval steam-and-water passages which extend from the top horizontal steam-and-water passage to a point above the plane of a series of smoke-openings, and a series of longitudinally-oval steam-and-water passages which are placed in alternation with the smoke-openings and which overlap the lower portion of the transversely-oval steam-and-water passages and at their lower extremities discharge into the bottom horizontal steam-and-water passage.

18. In a sectional steam-boiler, a series of transversely-extending steam-and-water sections, each of which is composed of a left half-section which is surmounted by a steam-drum and a right half-section which is surmounted by a steam-drum, valved connections between the two steam-drums, and a controllable water-supply pipe which discharges into each of the two half-sections, whereby the action of either of the two half-sections may be controlled or wholly discontinued independently of the other half-section.

19. A sectional steam-boiler which embraces a series of two-part transversely-extending edge-to-edge water-sections, each part being complete in itself, a branched or two-part water-supply pipe which discharges into each part of the two-part water-sections, a steam-drum which surmounts each part of the two-part water-sections, and controllable intercommunicating pipes which connect the two drums, whereby either half-section may be operated to its full capacity or may be thrown out of action altogether independently of the other half-section.

20. A sectional steam-boiler which embraces a series of two-part transversely-extending steam-and-water sections, and an independent base or ash-pit section which supports the steam-and-water sections and which is provided with a transversely-extending diaphragm which is coincident with the bridge-wall steam-and-water section and which is provided in its rear plate behind the transversely-extending diaphragm with a smoke-exit open-



ing, whereby the gaseous and carbonaceous  
products of combustion generated or produced  
at or above the plane of the upper extremities  
of the ash-pit sections are first caused to cir-  
5 culate through and between the several trans-  
verse steam-and-water sections in front of the  
bridge-wall section and are then caused to  
dive through the smoke-chamber behind the

bridge-wall section into the rear portion of  
the base or ash-pit section and to pass to an 10  
uptake behind the exit-opening in the rear  
plate of such base or section.

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Witnesses:

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