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J. HEATON.

Process of Converting Cast Iron into Bar Iron and Steel.

No. 67,762. Patented Aug. 13, 1867.

Fig. 1

Sectional Elevation on the Line A.B. Figs. 2. 4

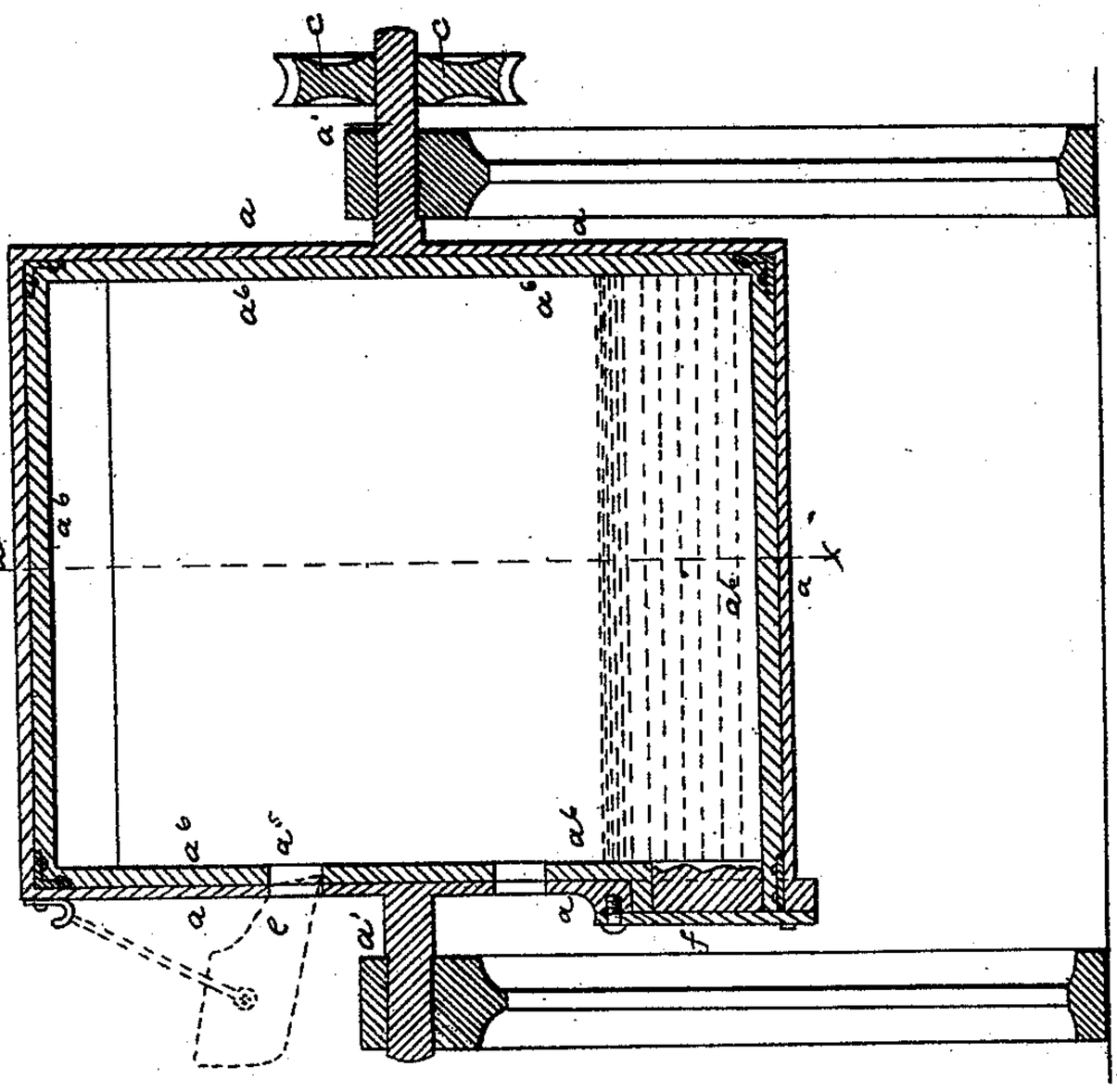


Fig. 2

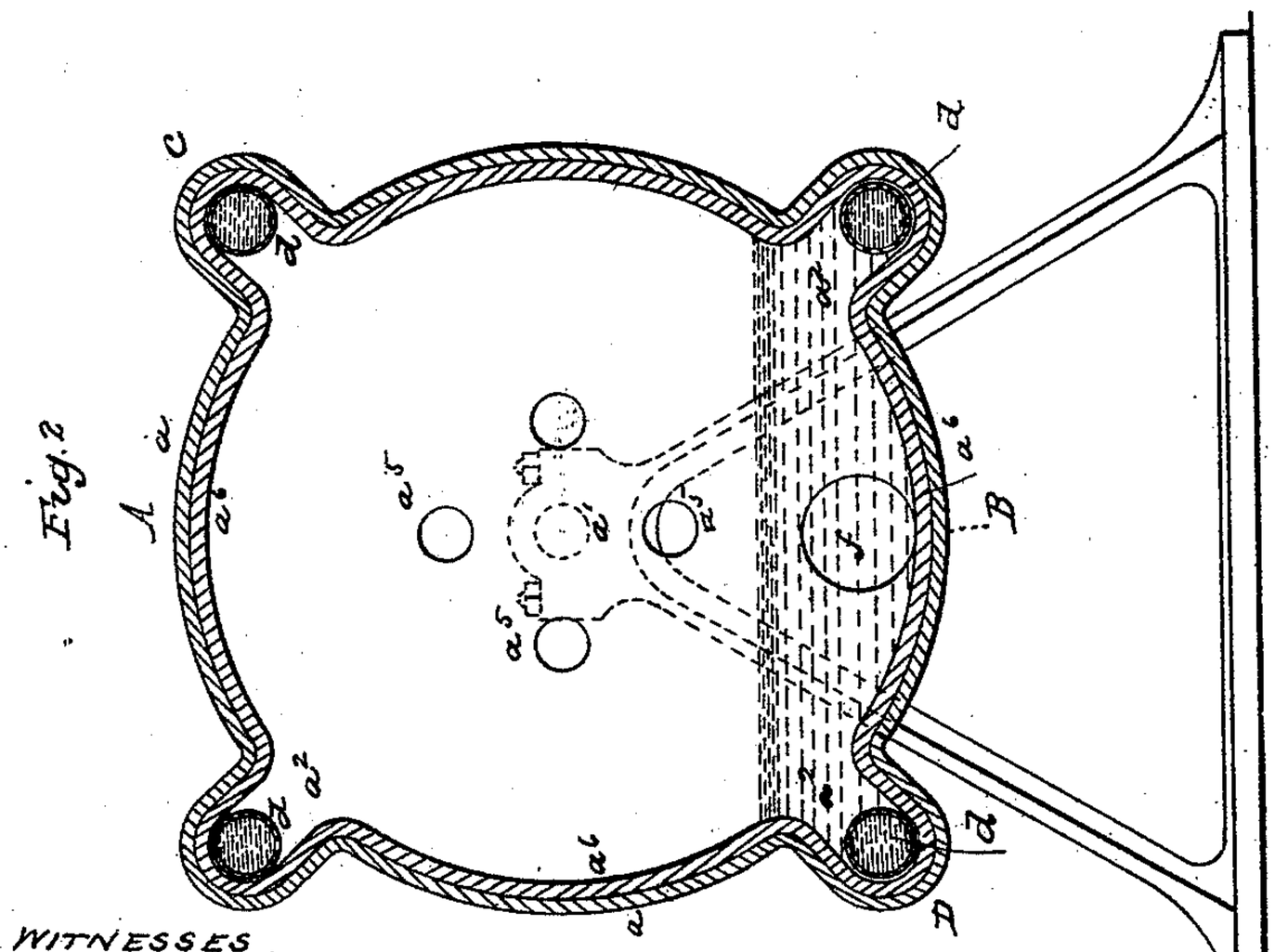


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Fig. 3

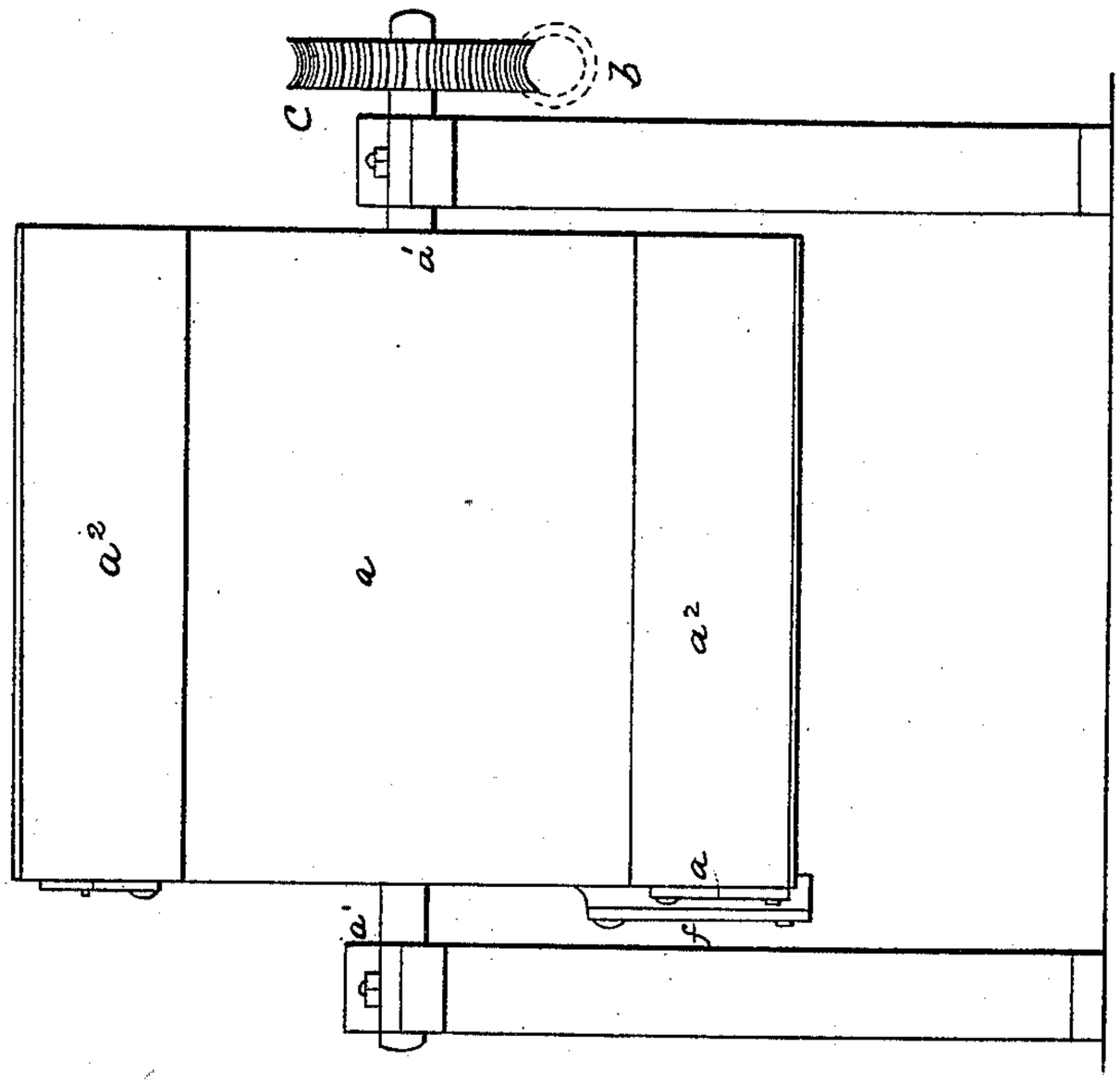


Fig. 4

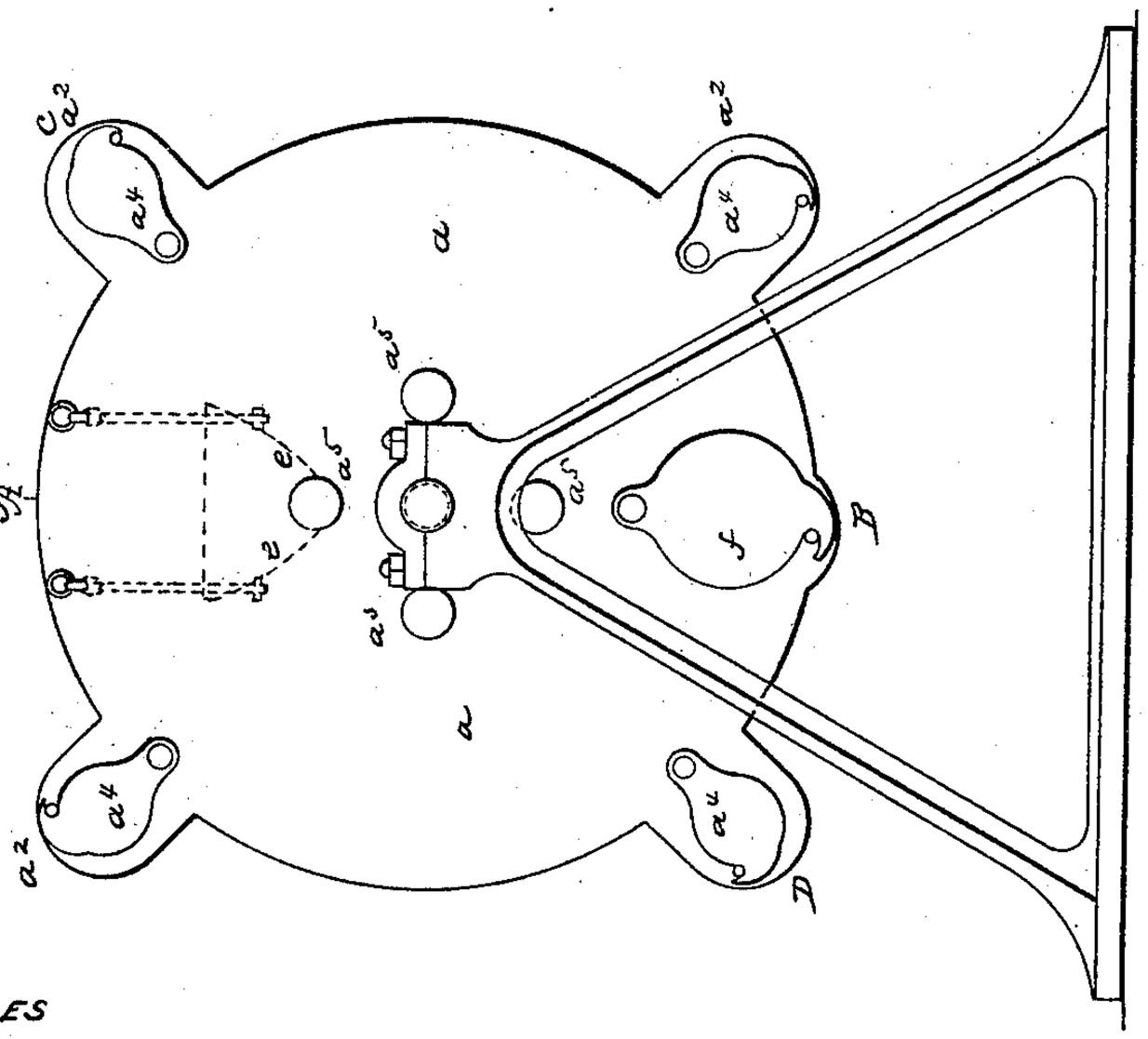


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Fig. 5
Section thro C.D. figs. 2 & 4

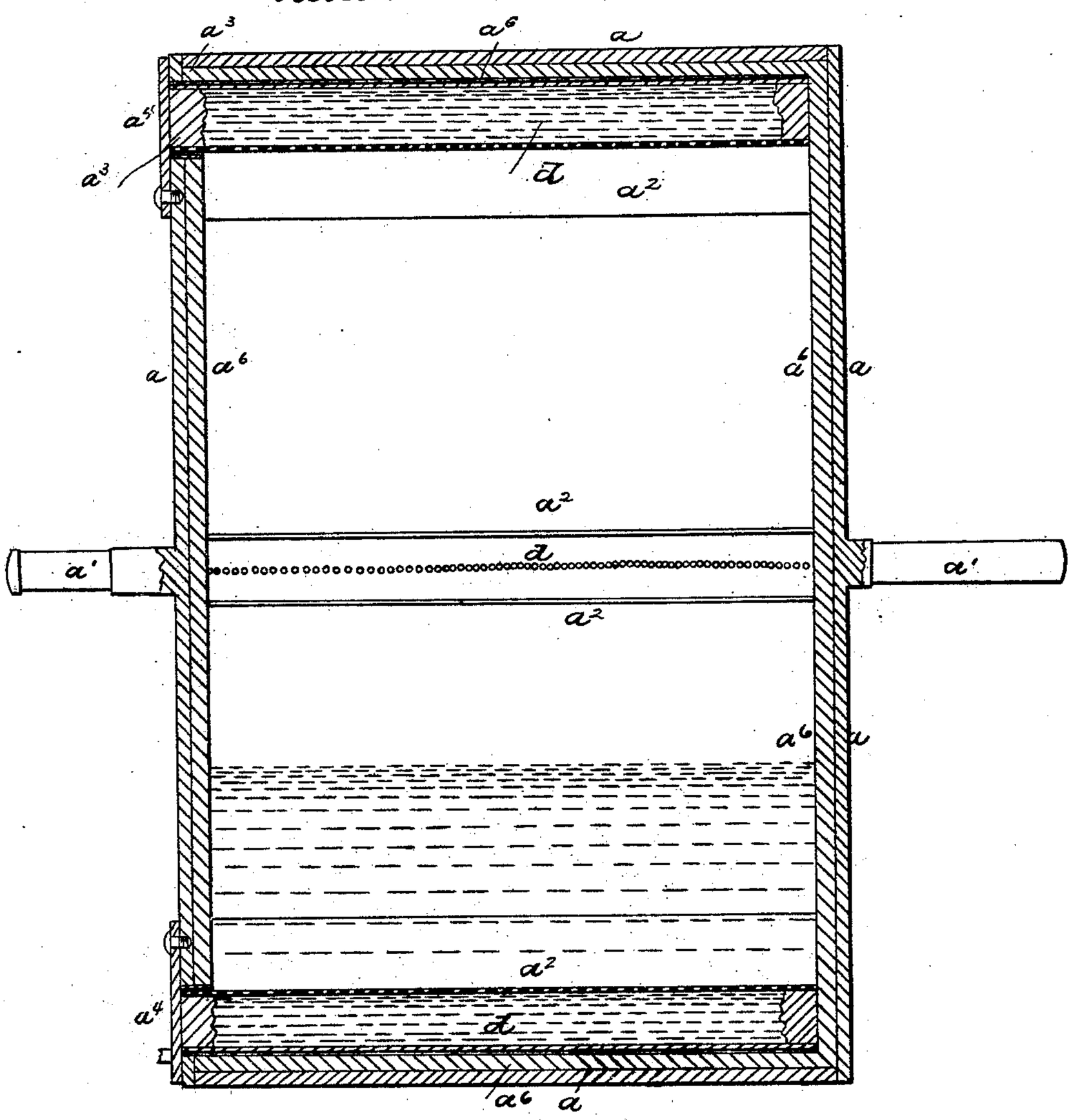


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Fig. 6

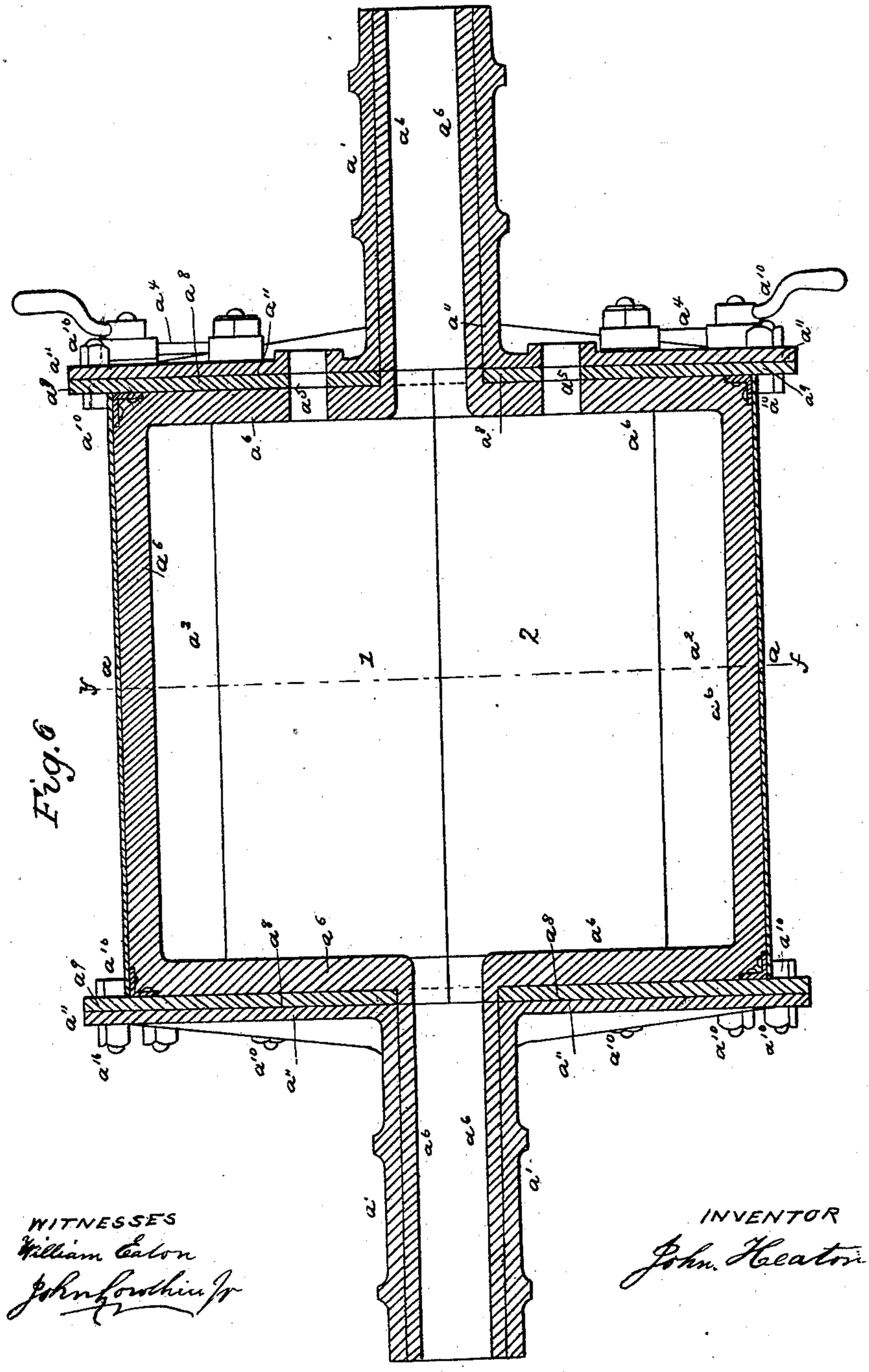

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Fig. 7

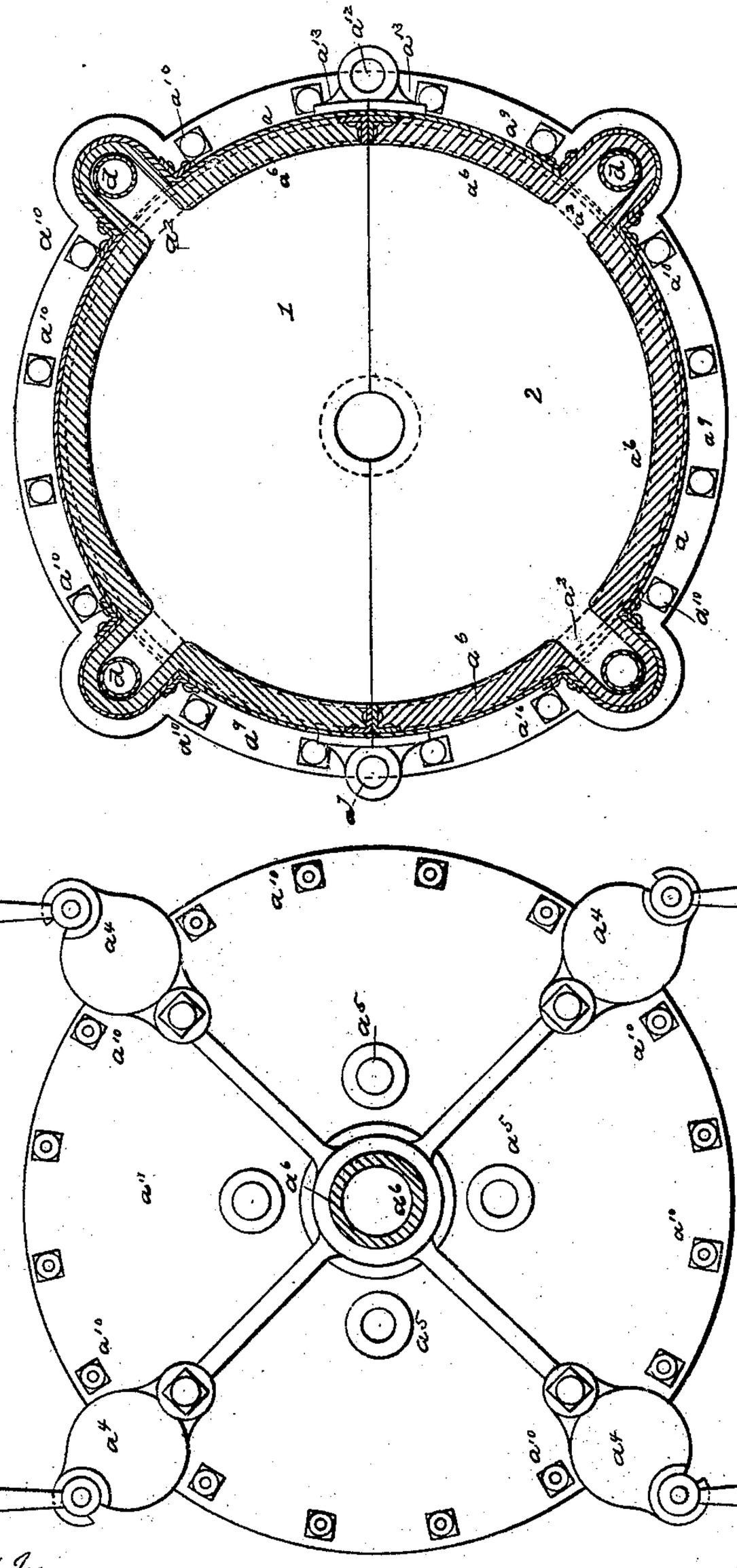

Fig. 9



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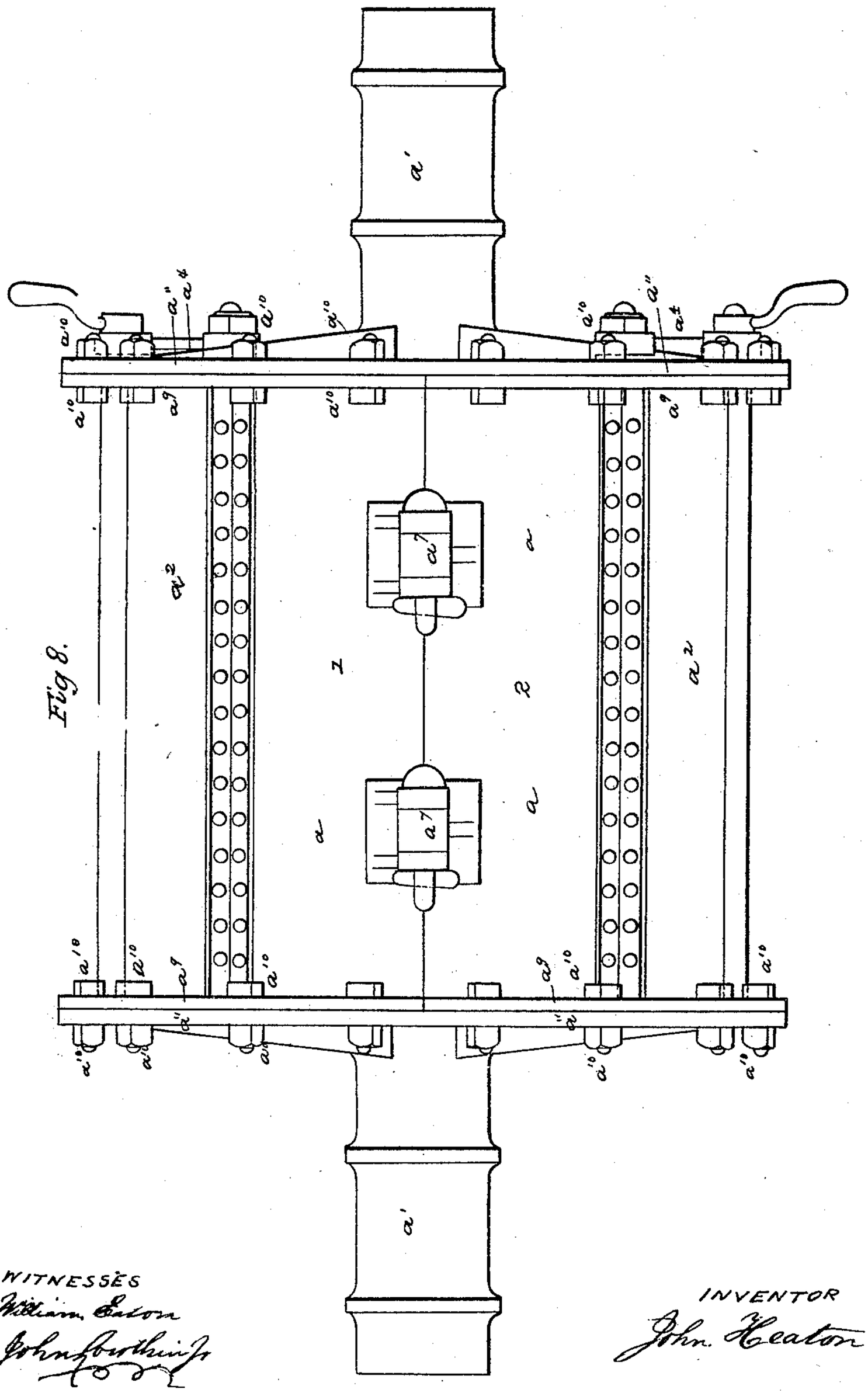

Fig 8.

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Fig. 11

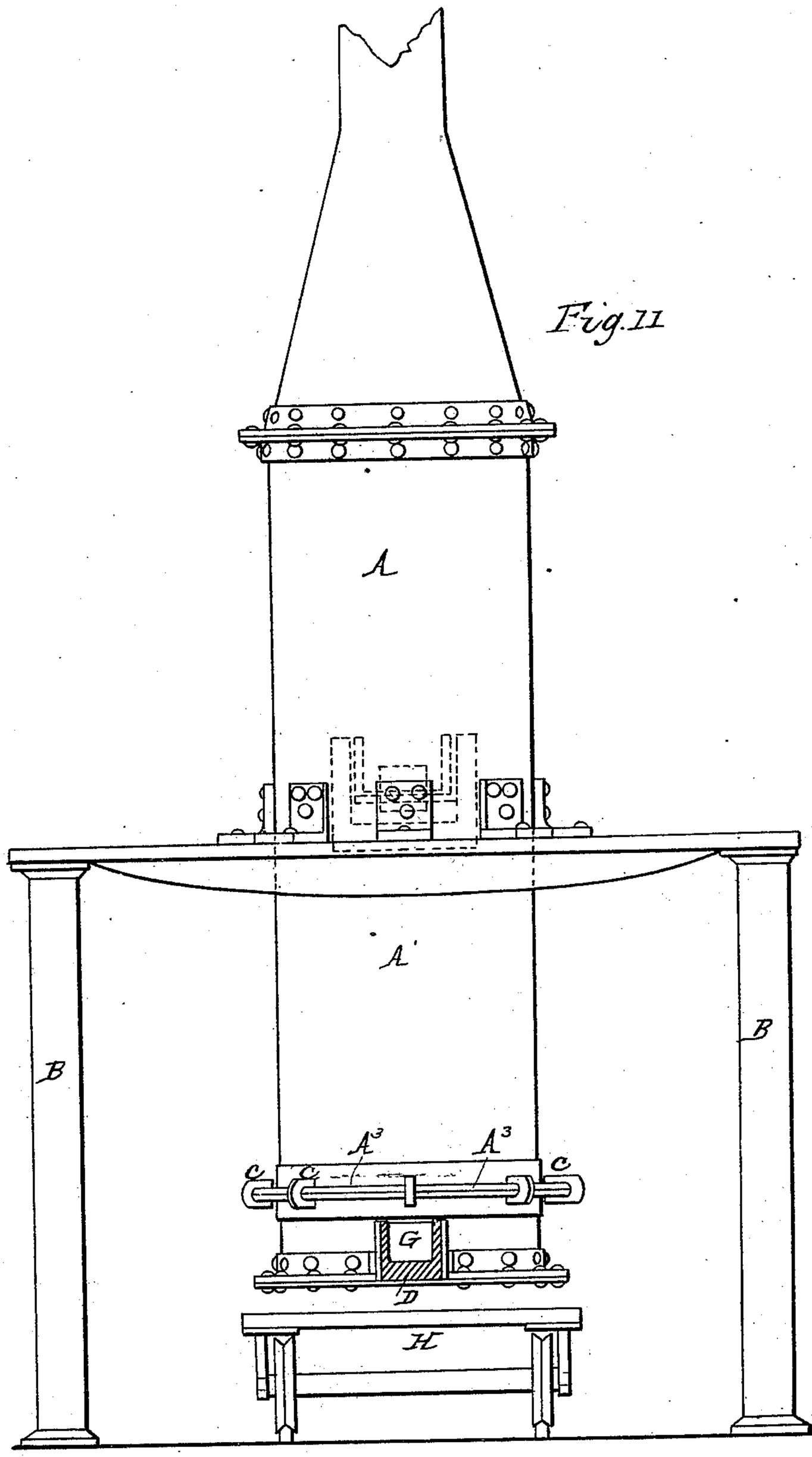


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Fig. 10

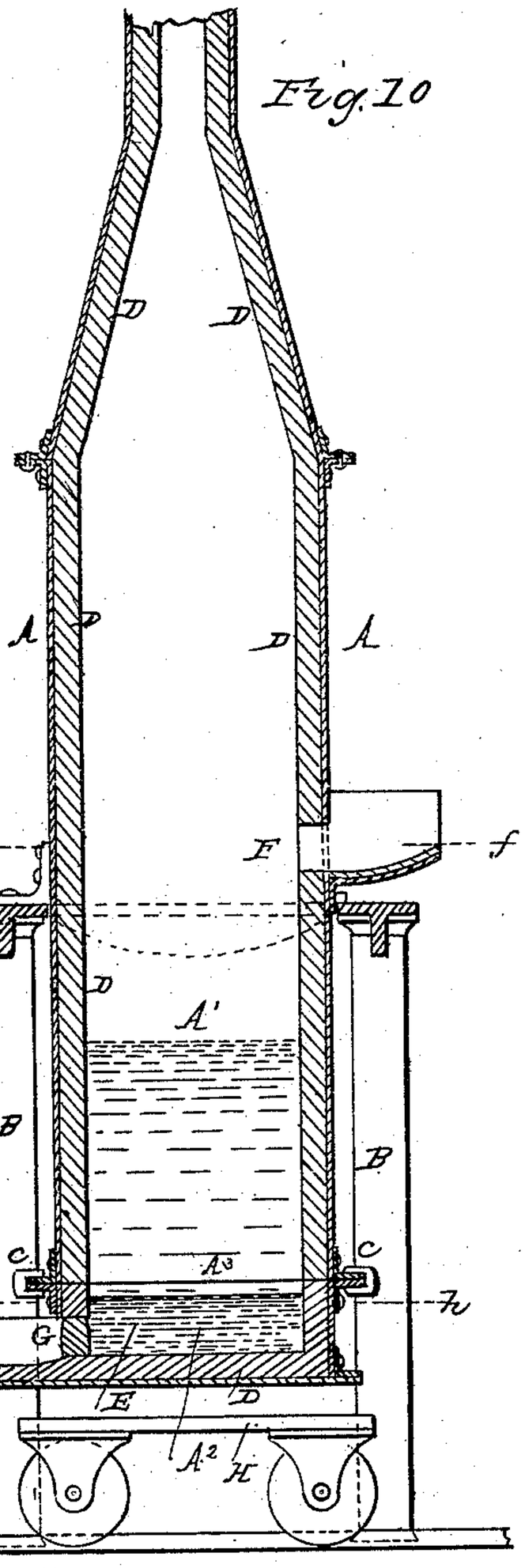



Fig. 12

Line e.f. of Fig. 10

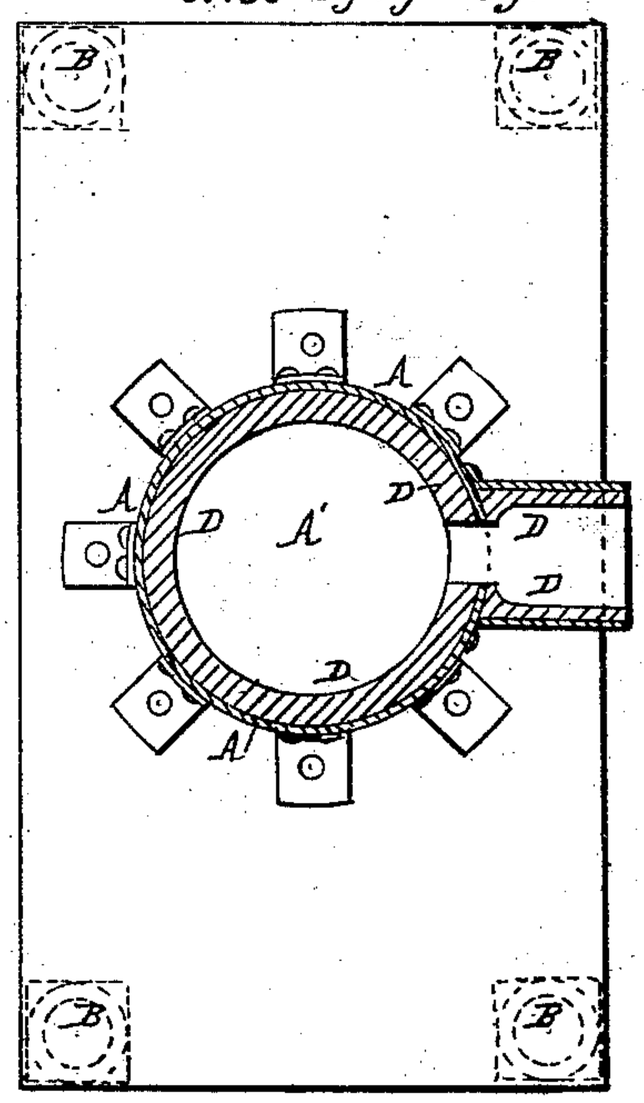
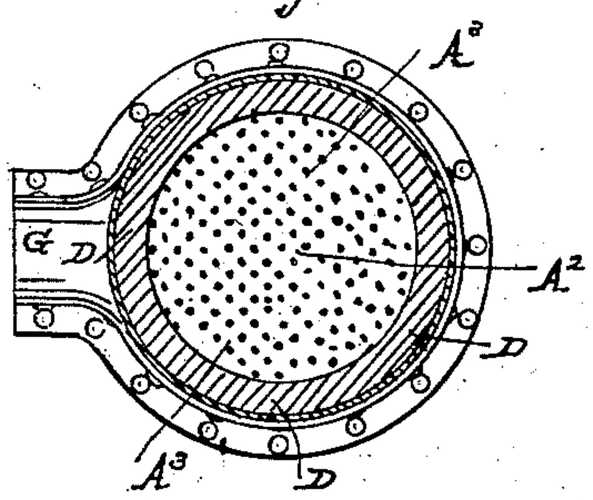



Fig. 13

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# United States Patent Office.

JOHN HEATON, OF LANGLEY MILL, ENGLAND.

*Letters Patent No.* 67,762, *dated August* 13, 1867.

## IMPROVED PROCESS OF CONVERTING CAST IRON INTO BAR IRON AND STEEL.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, JOHN HEATON, of Langley Mill, in the county of Derby, England, have invented certain new and useful Improvements in the Conversion of Cast Iron into Steel and into Wrought or Soft Iron, and in the means employed therein; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to which my invention appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a longitudinal central section in the line A B, fig. 2, of the apparatus which I have found to answer in carrying out my invention.

Figure 2 is a transverse section taken in the line *x x*, fig. 1.

Figures 3 and 4 are corresponding external views, the former being a side and the latter an end elevation.

Figure 5 represents a section through the line C D of fig. 2.

Figure 6 is a longitudinal central section of a slightly modified form of the apparatus.

Figure 7 is a transverse section of the same through the line *y y*, fig. 6.

Figures 8 and 9 side and end elevations, respectively, of this modification.

Figure 10 represents a vertical central section of a modification of the converter more particularly adapted to the conversion of large quantities of metal.

Figure 11 is a side elevation of the same, partly in section, to show the construction of the discharge opening.

Figures 12 and 13 are transverse sections taken respectively in the lines *e f* and *g h* of fig. 10.

Similar letters of reference indicate corresponding parts in the drawings.

This invention relates to obtaining steel, and also wrought iron, direct from cast or pig iron, and consists in acting upon such iron while in a molten state by means of nitrate of soda or nitrate of potash, or chlorate of soda or chlorate of potash, in chambers or receptacles within the receiver of the molten metal, or in position to act upward upon such metal, and in the apparatus employed for the purpose.

In the production of cast steel, supposing the cast iron under operation to contain about five per cent. of carbon, then the proportion of nitrate I employ is about one hundredweight to twenty hundredweight of the cast iron; but such proportion will be varied to the proportion of carbon consumed in the cast iron under operation, as well as to the kind of steel to be obtained, and to other circumstances, as will be readily understood by persons familiar with the manufacture of steel or wrought iron.

To produce wrought iron I employ an additional quantity of nitrate, say about fifteen per cent. more than would be used with the particular iron for the time under operation for the production of cast steel.

In most cases the desired conversion of the molten iron will be obtained in about three (3) minutes from the time of its introduction to the nitrate. When chlorate is employed the time of action will be less.

*a a* are a cylinder or vessel formed with axes, $a^1$, which are supported on suitable framing, so that the cylinder may be capable of a rotary motion. This rotary motion I prefer to be a slow one, and it is obtained, according to the arrangement shown, by a worm-wheel, *b*, driven by a steam engine or other suitable power acting upon the screw-wheel *c*, affixed on one end of the axes $a^1$. The vessel or cylinder *a* contains a series of small chambers, *d*, each of which is received into a recess, $a^2$, formed for it in the cylinder *a*. The chambers *d* are each formed by tubes of sheet iron, closed at one end by a lump of fire-clay, and perforated with numerous holes in order to admit of the free action of the contained nitrate or chlorate on the molten iron. The chambers *d* are introduced into or removed from the recesses $a^2$ through the apertures $a^3$ in the vessel *a*, which apertures are closed by covers $a^4$. The one end of each chamber *d* is closed by the application thereto of fire-clay before that chamber with its nitrate or chlorate is introduced into its recess $a^2$, and that fire-clay, projecting and sticking to the end of its recess, $a^2$, aids in holding the chamber *d* in position. When the chamber with the nitrate or chlorate therein has been applied to a recess, $a^2$, the other end of that chamber is then stopped up with fire-clay, so as to prevent the escape of the gas or molten metal therefrom, or the action of them on the covers $a^4$. This change of chamber *d* may be readily effected whilst in the slow motion of the vessel, as a recess, $a^2$, is for the time uppermost. $a^5$ $a^5$ are openings in the vessel or cylinder *a* for the supply of the molten metal by the aid of a trough or funnel, *e*, represented by dotted lines, and also for the escape of the gases generated. *f* is a door

for the discharge of the molten metal when it has passed over and been acted upon by the nitrate or the chlorate. The opening within this door is also, in use, plugged up by the application of fire-clay. The cylinder or vessel *a* is formed of metal, lined with fire-brick or fire-clay, $a^6$. It should be sufficiently large to be capable of holding the quantity of iron and of nitrate or chlorate under operation, and it is caused to revolve in order, by such revolution, to cause a more intimate mixture or combination of the nitrate or chlorate with the iron when in a molten state. The cylinder *a* may be formed in two parts, 1 and 2, as represented in figs. 7, 8, and 9, connected together by hinges $a^7$, in order that the apparatus may be more readily lined with fire-brick or fire-clay. The ends of the cylinder *a* are each formed of semicircular plates of metal $a^8$, the outer circumferences of which project beyond the surface of the cylinder *a* and form flanges $a^9$, through which bolts $a^{10}$ are passed, thereby connecting the chamber *a* to the outer plates $a^{11}$, to which the axes $a^1$ are attached. $a^{12}$ is a bolt passed through the flanges $a^{13}$ $a^{13}$, in order more securely to hold the parts 1 and 2 together. By removing the bolts $a^{12}$ and the bolts $a^{10}$ of one half of the cylinder *a*, that half may be turned back, thereby allowing free access to the inside for repairs or otherwise. The axes $a^1$ may be made hollow, as shown, for the purpose of conducting away the noxious vapors which arise, in which case the openings $a^5$ may be plugged up. In this modification the door *f* is dispensed with, the metal being discharged through one of the apertures $a^3$.

In the modification shown in figs. 10, 11, 12, and 13, the chamber A is divided into two parts, $A^1$ and $A^2$. The upper part, $A^1$, is stationary, and supported upon columns B. The lower part, $A^2$, is removable from the part $A^1$, and is connected to it by clamps C, passing over the flanges $A^3$ or otherwise. The side surface and bottom of the chamber A are lined with fire-brick or fire-clay D, and the joint between the parts $A^1$ and $A^2$ is luted. The nitrate or chlorate to be used is placed, as represented at E, in the lower part $A^2$. A perforated plate of iron is then laid on it, as represented at $A^3$. This plate may conveniently be of from five-sixteenths of an inch to five-eighths of an inch thick, and the perforations in it may be about three-eighths of an inch in diameter and about one and a half inch apart, but these relations may be varied. The molten iron is poured in at the opening F, and it is drawn off at the opening G. The metal may be directly taken from the converter while in a molten state, and put into a receiving furnace of the form of a puddling-furnace, with the bottom a little deeper, (to suit the quantity of metal in the converter or other convenience,) with a tap-hole in it to run the metal out when required for manufacturing. The metal while in this furnace may be covered by the cinder from the converter, or any substance of that kind, to keep it from the action of the atmosphere, or it may be run into the puddling-furnace direct when some kinds of iron are to be made with steel qualities, such as armor plating. The forms of these furnaces are sufficiently known, and therefore require no description here. For convenience of carriage away and replacing fresh portions $A^2$, I apply under the chamber A a rail or tramway for truck H, upon which the parts $A^2$ are received.

I wish it understood that I do not confine myself to the exact proportions or method of working herein stated, as the same may be varied without departing from the peculiar character of the invention, and the nitrates or chlorates may be applied to the under side of a vessel similar to a crane ladle, except that I prefer it to be of a square in place of a circular form, and to have a flat bottom, such vessel being used as a receiver for conveying the molten metal from the melting-furnace to the moulds.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The use of nitrate of soda or nitrate of potash, or chlorate of soda or chlorate of potash, to act from the under side upwards upon cast or pig iron when such iron is in a molten state, for the purpose of converting the same into steel and into wrought iron, substantially as described for the purpose specified.

2. The removable chamber, containing nitrate of soda or potash, or chlorate of soda or potash, inserted in recesses of a revolving cylinder containing molten cast or pig iron, for the purpose of forming steel, or wrought or soft iron, substantially as described for the purpose specified.

3. The revolving cylinder *a*, with a solid or hollow axis, $a^1$, and with or without the semicircular end plates, made in one piece or two parts, 1 and 2, and adapted to receive the removable perforated chambers *d*, substantially as described for the purpose specified.

4. The converter A constructed as described, having a lower chamber, $A^2$, containing nitrate of soda and nitrate of potash, or chlorate of soda and chlorate of potash, covered by a perforated plate, upon which molten cast or pig iron is placed, substantially as described for the purpose specified.

5. A receiver for conveying molten cast or pig iron from the melting-furnace to the moulds, containing nitrate of soda and nitrate of potash, or chlorate of soda and chlorate of potash, acting from the under side of such molten metal upwards, substantially as described for the purpose specified.

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