

J. B. PEARSE.

Improvement in Apparatus for the Manufacture Bessemer Steel.

No. 133,249.

Patented Nov. 19, 1872.

FIG. 1.

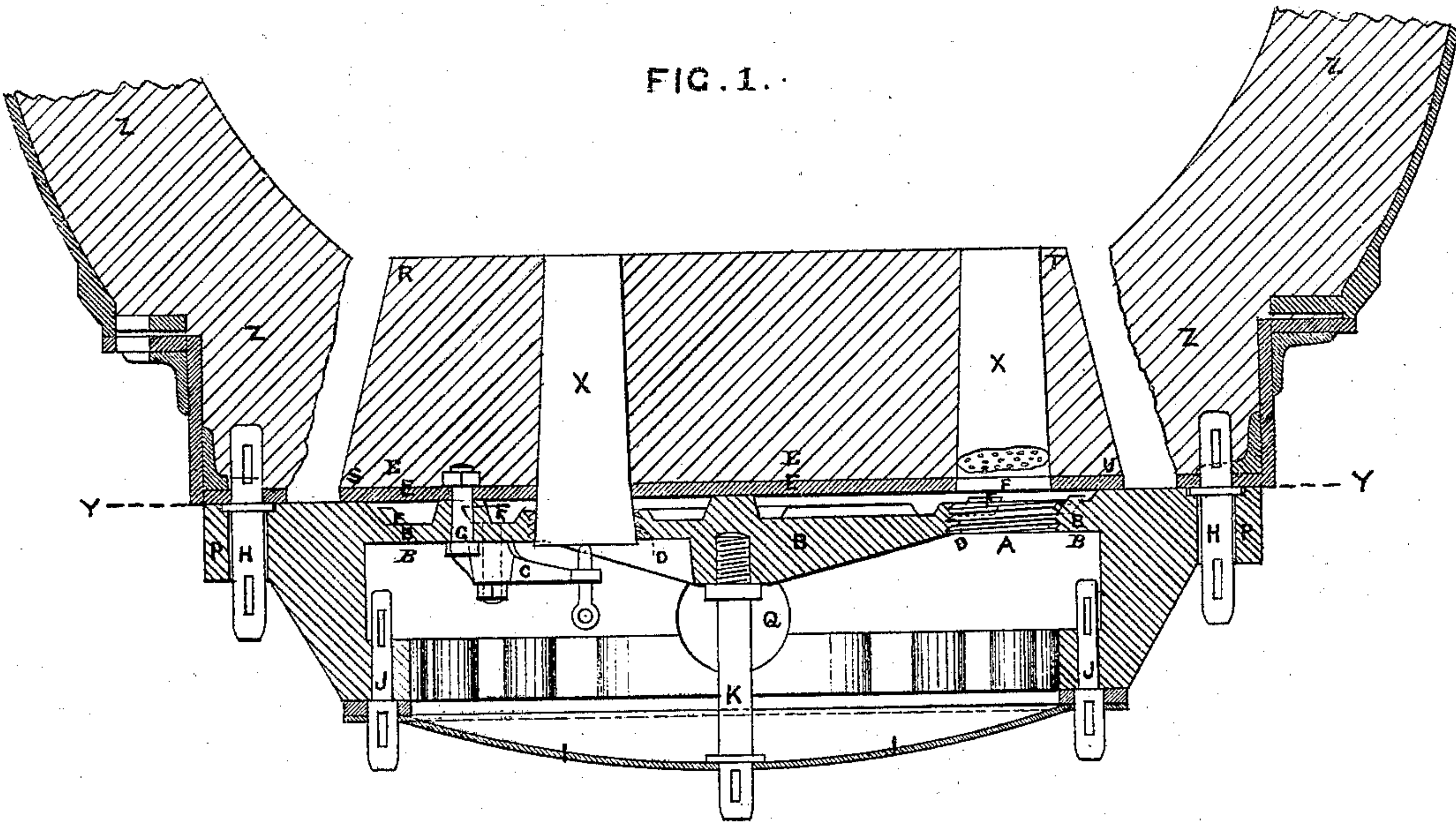
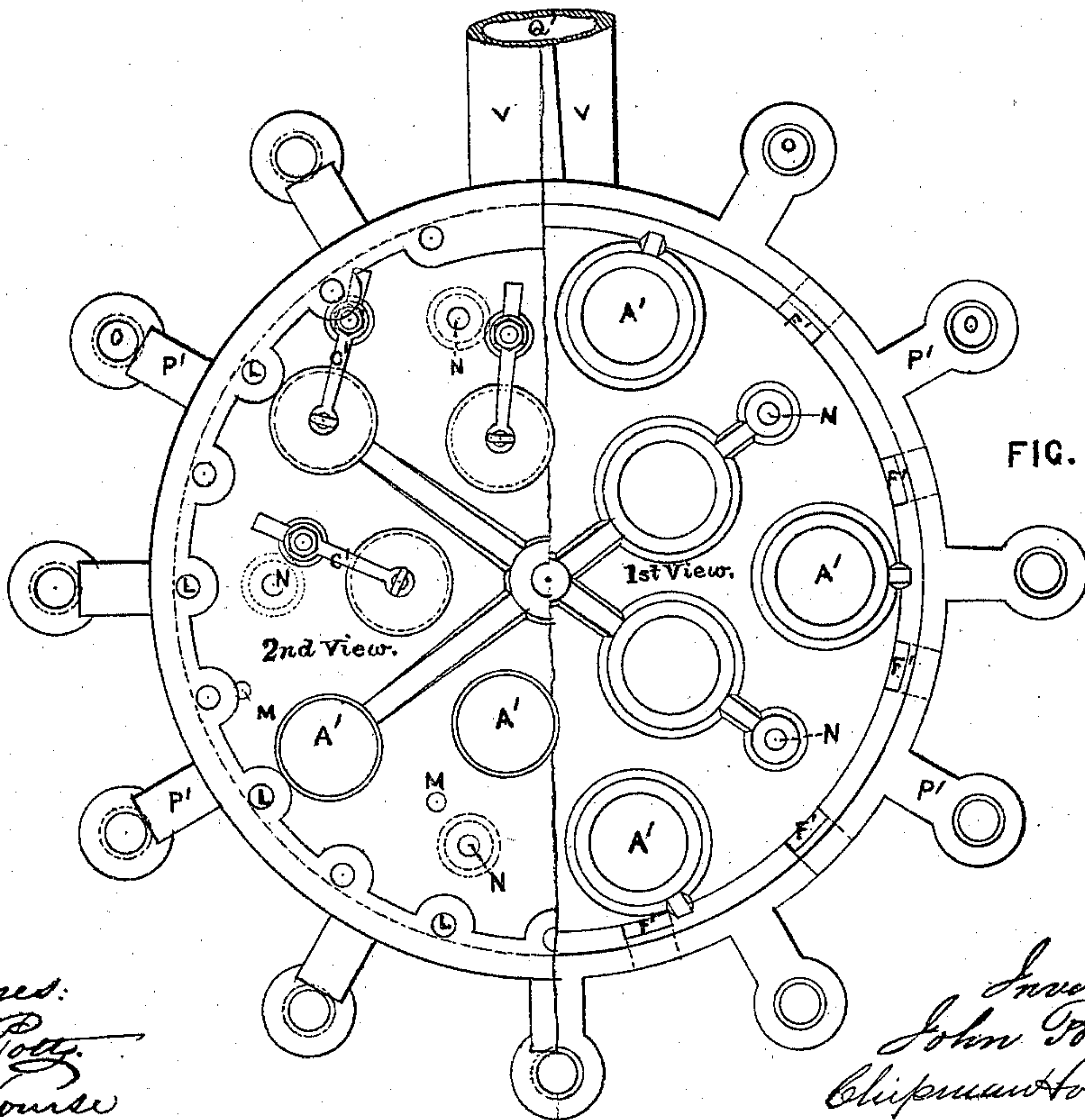


FIG. 2.



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Inventor.  
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Chipman & Son & Co  
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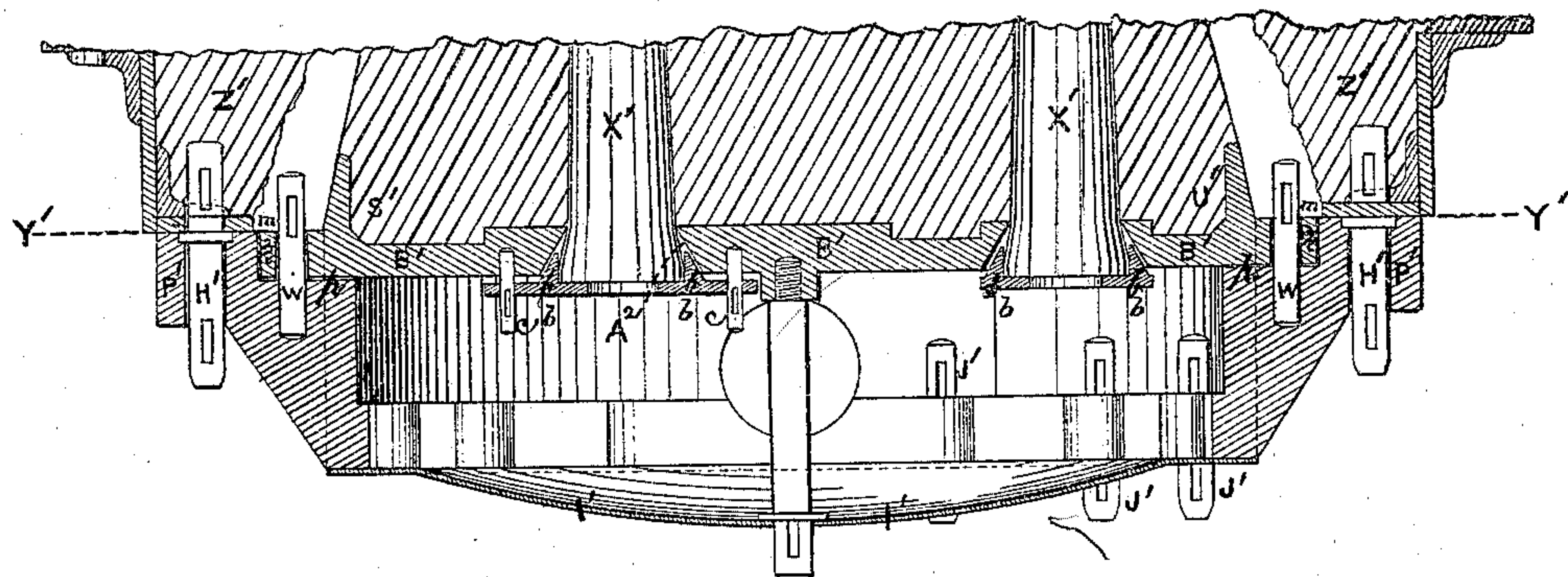


FIG. 3.

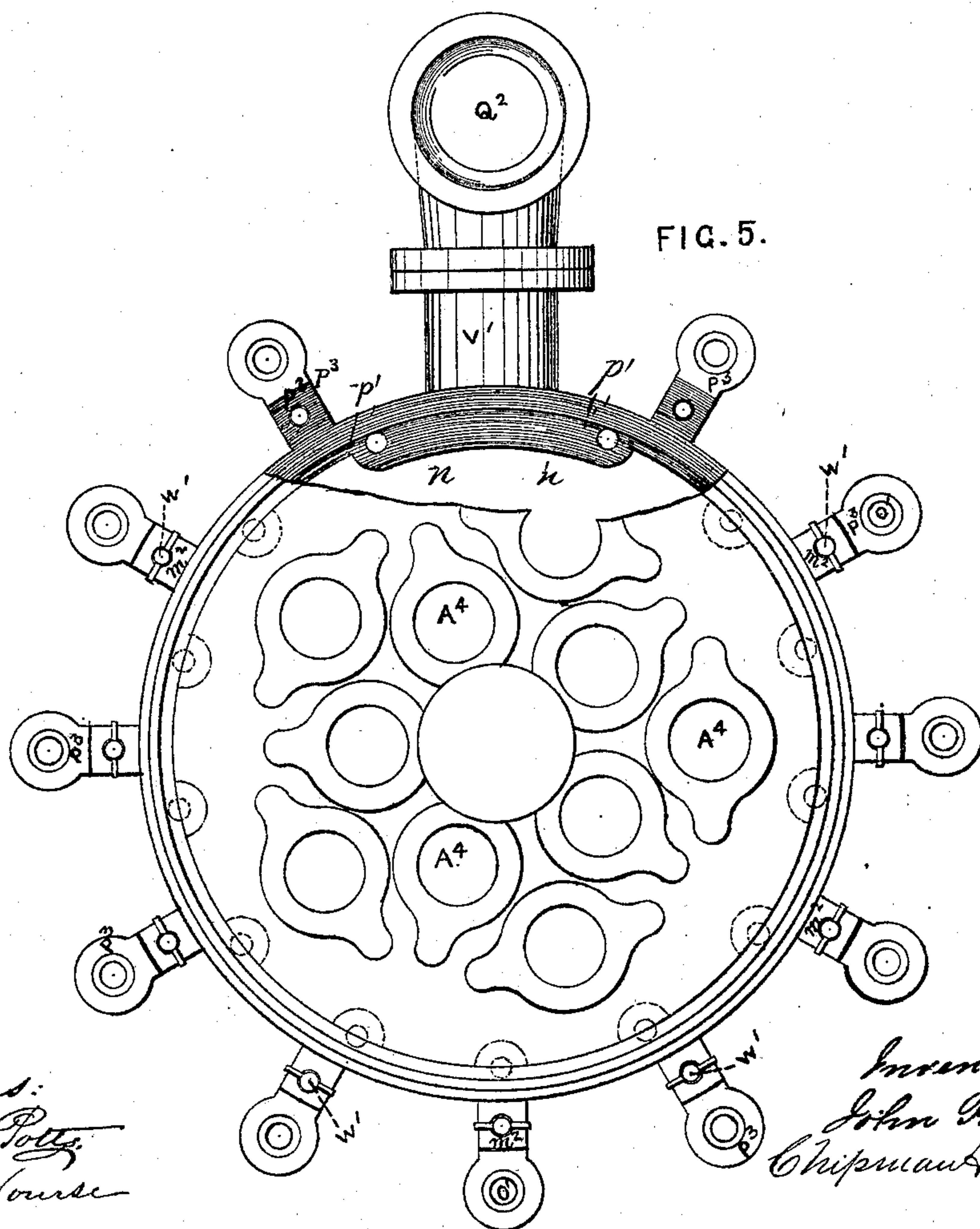


FIG. 5.

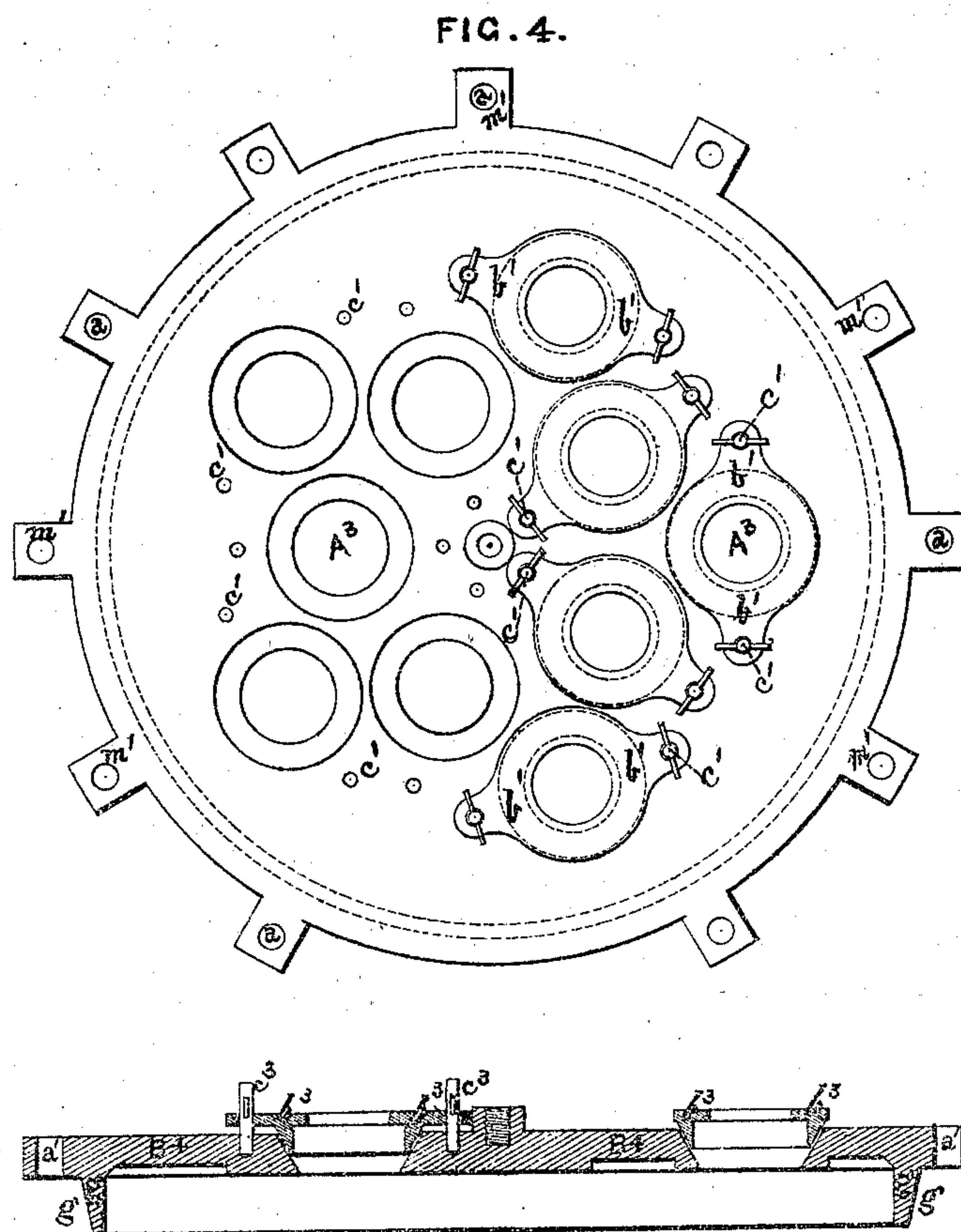
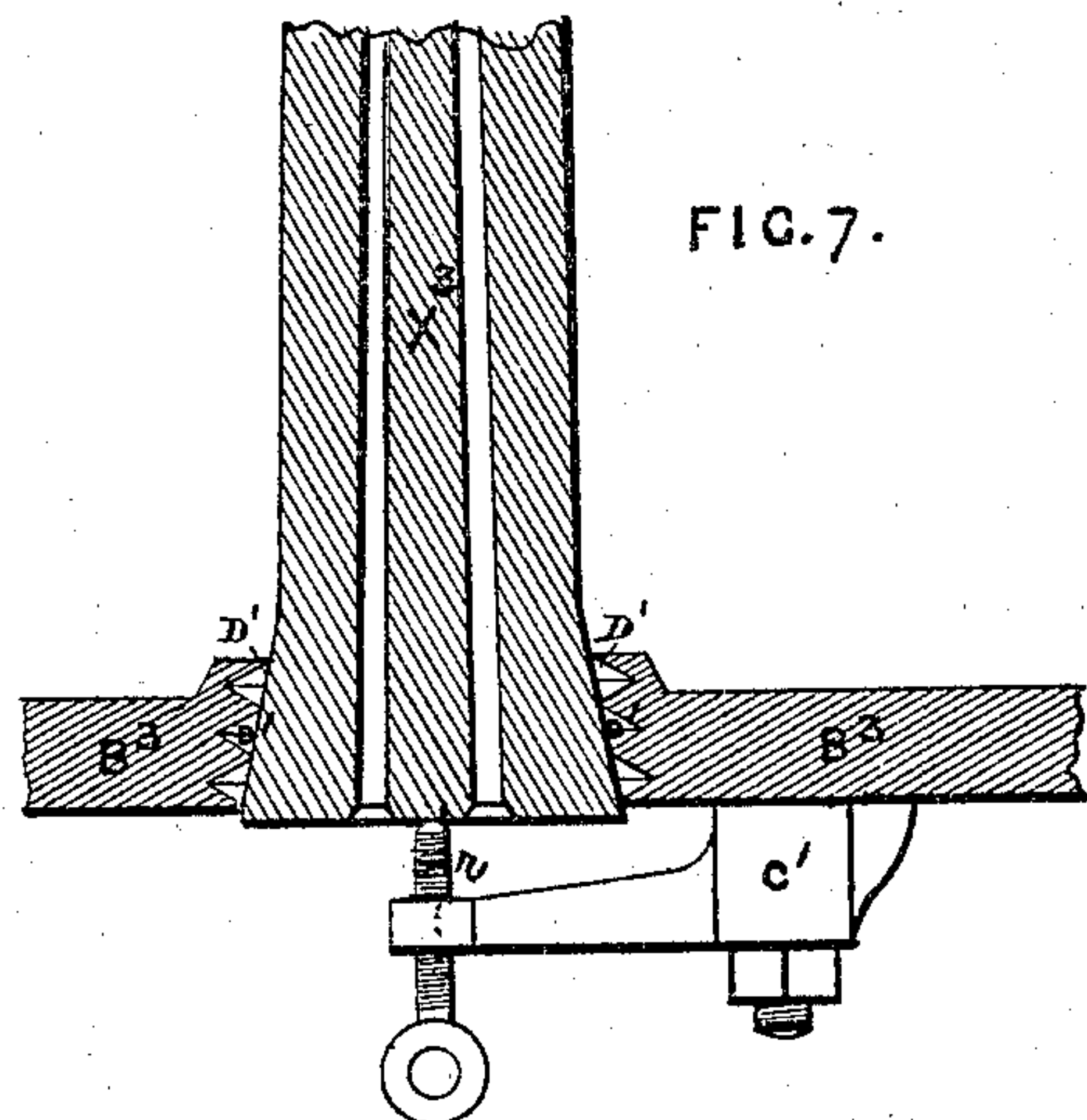
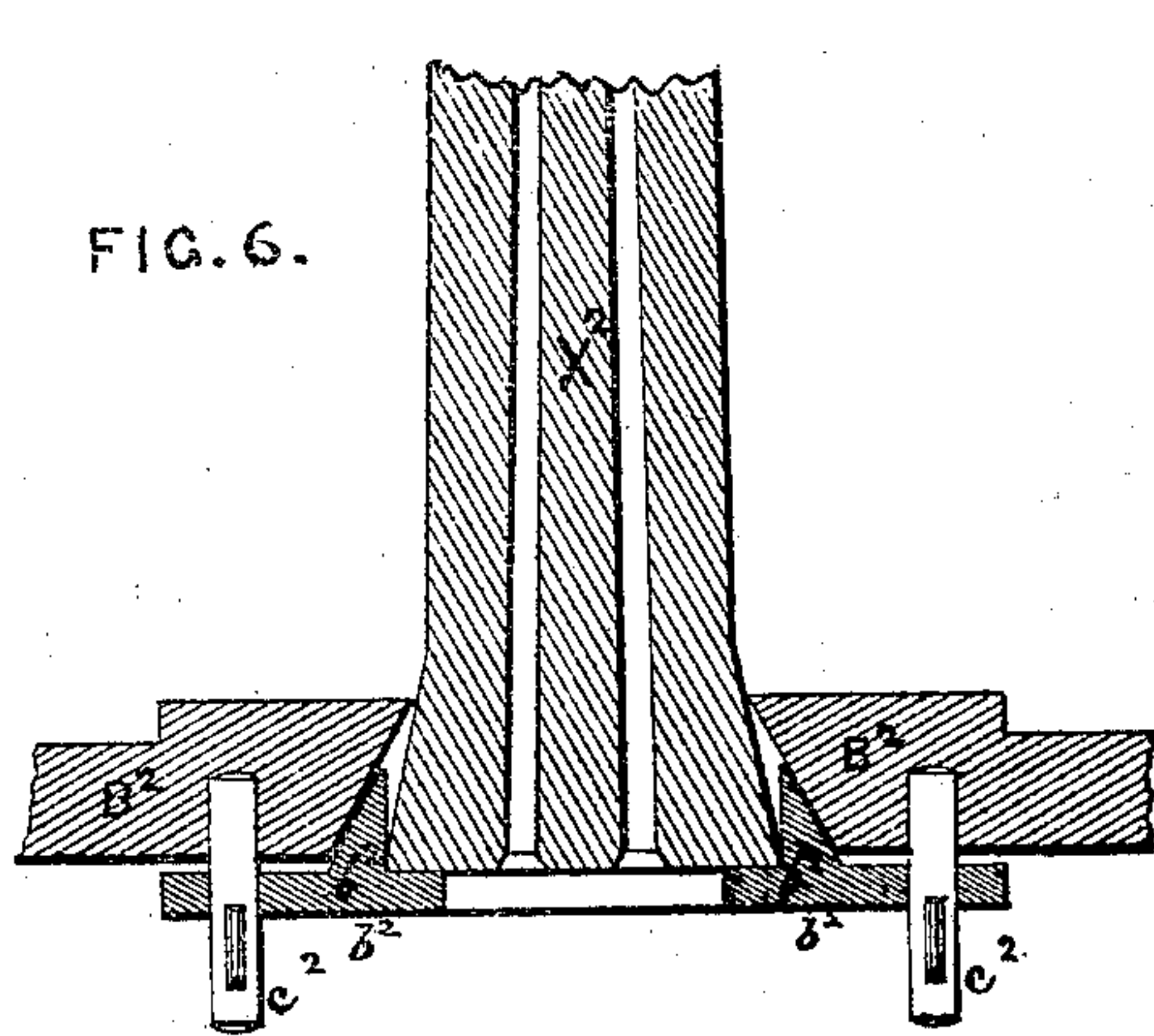
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FIG. 8.

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# UNITED STATES PATENT OFFICE.

JOHN B. PEARSE, OF SWATARA TOWNSHIP, DAUPHIN COUNTY, PA.

## IMPROVEMENT IN APPARATUS FOR THE MANUFACTURE OF BESSEMER STEEL.

Specification forming part of Letters Patent No. **133,249**, dated November 19, 1872.

*To all whom it may concern:*

Be it known that I, JOHN B. PEARSE, of Swatara township, in the county of Dauphin and State of Pennsylvania, have invented a certain new and valuable Improvement in the Apparatus for the Manufacture of Iron and Steel; and I hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawing making a part of this specification, and to the letters and figures of reference marked thereon.

This invention relates to the apparatus for the manufacture of steel by the Bessemer or pneumatic process; and consists in an improved method of making the tuyere-box of the converting-vessel and of inserting the tuyeres into the said tuyere-box. The tuyere-box is that part of the vessel furthest from the mouth or "nose" of the vessel. The blast, after passing through one of the trunnions of the vessel, goes into the tuyere-box and thence finds its way upward through the tuyeres into the melted iron in the body of the vessel. The tuyeres are usually inserted into holes in the top of the tuyere-box, and are held in place by screw-brackets; any space remaining around their base when in the holes is packed with hemp forced into said remaining space and into grooves left for the purpose. The tuyeres usually pass through a second plate, which is so fixed upon the top of the tuyere-box as to leave some space through which the air can get away in case any escapes through the packing around the tuyere. This plate is held firmly and permanently in position by a sufficient number of screw-bolts, and the tuyeres simply pass through it loosely. The so-called "bottom" is the ganister (a mixture of quartz and fire-clay in various proportions) which is rammed in a conical shape upon the tuyere-box, or, as the case may be, upon the second plate. With all previous arrangements of the tuyere-box and methods of ramming the ganister-bottom upon the same, except that patented by Holley and Pearse in patent No. 86,304, the tuyere-box has been cast in one piece, as a whole, and, therefore, much unnecessary weight has to be handled in the operations subsequent to the taking of the tuyere-box off the vessel for the purpose of renewing the bottom. In some cases even

a part of the lower section of the vessel is taken off along with the tuyere-box and is retained in connection with the latter. Both these methods are very cumbersome, and, in addition to the unnecessary handling of very heavy and unwieldy weights, the large size of the parts thus required to be taken off makes it necessary to take up a great deal of otherwise useful space in the drying-ovens, and also on the floor of the converting-room. In Holley and Pearse's patent the separate plate holding the tuyeres and forming the top of the tuyere-box is inserted upward and inside the tuyere-box; but this joint between the separate plate and the flange round the top of the tuyere-box has been found to be very imperfect owing to the difficulty of making it tight against the blast without using such contrivances as greatly hinder, if not prevent, the removal of the separate plate after the bottom has been worn out. The old method of packing the joints round the tuyeres with hemp (or hemp smeared with fire-clay) forced into grooves is unreliable, because the packing can never be firmly forced into the grooves left for the purpose. The leakage of the blast up around the tuyeres has heretofore been, and is still, where the old method is used, a source of great trouble and expense.

My invention consists in so arranging a separate top plate of the tuyere-box that it can be keyed on the top of the body of the tuyere-box from without instead of from within whenever a fresh bottom is to be inserted into the vessel, and so that it can be quickly removed from the tuyere-box and lifted off whenever a bottom has been used up. My invention also consists in the combination, with this removable top plate, of an improved method of packing the tuyeres in the same so as to secure a perfectly air-tight joint.

To enable others to carry out my invention I have shown the details of it in the annexed drawing, of which Figs. 1, 2, and 7 show the old methods, and 3, 4, 5, 6, and 8 show the details of my improved methods.

Figure 1 is a representation of the usual form of tuyere-box, the top of which is cast solid in one piece with the rest of it. The lower section of the vessel proper comes down to the line Y Y, and upon this lower section the tuyere-box is keyed by means of keys



driven through both ends of the studs or pins H H, which run through the lugs or arms P P of the tuyere-box, and also through the flange of the lower section of the vessel. The cone, at the four corners of which (as apparent, the cone being shown in section) the letters R S T U stand, is the so-called bottom, which is commonly rammed upon the plate E E, and through which the tuyeres X X run up. The plate E E is permanently held upon the tuyere-box by means of several bolts similar to the one marked G. The tuyeres X X are inserted in the holes A, (one of which is fully shown in Fig. 1, the tuyere being broken off to show it,) and are held in place by the screw-clamp C, and packed with hemp or other fibrous material jammed into any space remaining in A and into the grooves D D. The space shown between the plate E E and top of tuyere-box B B is left for the escape of any air (that may leak up round the tuyeres) into the holes F F, and through them into the outside air. The plate B B is the solid top of the tuyere-box cast in one piece with the latter. The wind enters the tuyere-box through the hole Q in a pipe at the side, (not shown in Fig. 1,) and the whole box is closed by means of the wrought-iron plate I I firmly held upon the box by means of keys driven through each end of the studs or pins J J and K.

Fig. 2 gives two views of the old tuyere-box. The first view of Fig. 2 represents the top of the tuyere-box as seen when looking upon it from above, after the plate E E has been removed for the purpose of a better view. The holes A<sup>1</sup> A<sup>1</sup> are those through which the tuyeres X X pass up. The holes to receive the bolts G are denoted by the letters N N. The lugs or arms of the tuyere-box are marked P<sup>1</sup> P<sup>1</sup>. The holes F' F' are those through which any air escapes that has leaked out of the tuyere-box. The pipe V is that through which the blast enters the tuyere-box. The letters O O show the holes through which the studs or pins H H pass through the lugs P. The second view shows the tuyere-box as seen when looking up into it from below when the wrought-iron plate I I is not in place. A<sup>1</sup> A<sup>1</sup> designate the under side of the holes to receive the tuyeres. C' C' are the screw-clamps to fasten the tuyeres in place. M M represent the holes to receive the bolts which fasten these clamps to the tuyere-box. The under side of the holes for the bolts G to fasten the plate E E is shown by the letters N N. The under side of the lugs or arms of the tuyere-box is shown at P<sup>1</sup> P<sup>1</sup>, and the under side of the holes in said lugs is shown at the letters O' O'. The holes L L are those through which the studs J J, Fig. 1, pass.

Fig. 3 is a representation of my improved form of tuyere-box as attached to the vessel. The lower section of the vessel comes down to the line Y' Y'. The removable separate plate which I key upon the body of the tuyere-box is represented by the letters B<sup>1</sup> B<sup>1</sup>. Through this removable plate the tuyeres X<sup>1</sup>

X<sup>1</sup> run, being placed and packed in the holes A<sup>2</sup>, (shown as partly filled by the tuyeres X<sup>1</sup>.) This removable top plate is turned up smooth and true for a space of about three to four inches wide on the outer part of its lower side, and is held firmly down against the part p of the body of the tuyere-box, which is turned off smooth to receive it, in order that no wind may escape there. Keys driven through the holes in the pins W W, which pass through the small lugs m m of the removable plate or top, hold the latter firmly down in its place against the pressure of the wind inside. The under side of the small lugs m m is also faced off smooth and true. The tuyeres X<sup>1</sup> X<sup>1</sup> are shown in the holes A<sup>2</sup> in the removable top plate, and the method of packing the tuyeres in the holes is clearly shown. The gland or circular wedge, in the form of a ring tapering to an edge, is marked b b, and keys driven through the studs c c drive the glands firmly up into their places.

Fig. 4 on Sheet C is a representation of the under side of the removable top plate when removed from the tuyere-box. The lugs m<sup>1</sup> m<sup>1</sup> are those through which the studs W, Fig. 3, pass, by means of the holes a a. The holes A<sup>3</sup> A<sup>3</sup> receive the tuyeres as before. The studs to hold the glands around the tuyeres are shown by c<sup>1</sup> c<sup>1</sup>, and the glands themselves are denoted by b<sup>1</sup> b<sup>1</sup>.

Fig. 5 is a representation of the tuyere-box with the removable plate in position. Part of the latter is broken away in order to show the method of making the joint between the body of the tuyere-box and the removable plate. The lugs on the body of the tuyere-box are shown by the letters P<sup>3</sup>. The studs H' H', Fig. 3, which hold the tuyere-box on the vessel, pass through the holes O' O'. The lugs of the removable top plate are denoted by the letters m<sup>2</sup> m<sup>2</sup>, and the studs which pass through them are marked W' W'. The holes for the tuyeres are marked A<sup>4</sup> A<sup>4</sup>. The joint or faced part of the body of the tuyere-box, onto which the faced part of the removable top plate fits, is shown by the moderately-darkened surface marked p' p'. The very dark part n n is at the bottom of the tuyere-box, and is a part of the flange through which the studs J J, Fig. 1, and J' J', Fig. 3, (which hold the wrought-iron plate I I, Fig. 1, and I' I', Fig. 3,) pass, by means of the holes L' L'. V' represents the blast-pipe leading to the tuyere-box, and Q<sup>2</sup> the bell-mouthed opening of said pipe.

Fig. 6 is a representation, on a larger scale, of my improved method of setting and packing the tuyeres. B<sup>2</sup> B<sup>2</sup> is a part of the removable top plate. X<sup>2</sup> is the tuyere, set in its hole. The gland around the tuyere is marked b<sup>2</sup> b<sup>2</sup>, and the studs to hold the gland in place are marked c<sup>2</sup> c<sup>2</sup>. It will be noticed that the gland fits the bottom of the tuyere in such a manner that when the tuyere is pushed up into its place it is held there firmly by the gland and prevented from shaking from side to side.

Fig. 7 is a representation, on a large scale,



of the old method of setting the tuyeres.  $B^3$   $B^3$  is a part of the solid top of the old form of tuyere-box.  $D'$   $D'$  represent the grooves, one above the other, to receive the hemp or other fibrous material which is packed around the tuyere. The screw-clamp to hold the tuyere in position is marked  $C'$ , and the screw of the clamp is marked  $r$ .

Fig. 8 is a section of the removable top plate, in which  $B^4$  represents the plate itself, and  $g$   $g$  the flange around the circumference of the plate. This flange has two purposes to serve—viz., to prevent the plate from warping when over a hot fire, and to prevent the ganister-bottom from slipping off when the plate is inclined, as it always is in the operation of fixing a fresh bottom in the vessel. The glands  $b^3$   $b^3$  and studs  $c^3$   $c^3$  are the same as shown in preceding figures. The flange  $g$   $g$  is cast solid in one piece with the removable top plate. The latter is put over a hot fire whenever a "bottom" is rammed up upon it, in order to dry said bottom before inserting it into the vessel.

After the ganister-bottom has, in the course of using the vessel, been worn down so as to be too thin to stand the heat and wear of another conversion, it must be removed and another and fresh bottom substituted. In doing this I proceed as follows: When the tuyere-box is to be removed from the vessel I take the keys out of the pins  $H'$   $H'$ , Fig. 3; let the whole tuyere-box, with its top plate  $B^1$   $B^1$ , Fig. 3, together with what is left of the tuyeres and ganister-bottom, down upon a car placed under it. I then shove the car into such a position that it can be conveniently got at with a crane, and remove the keys from the studs  $W$ , Fig. 3, or  $W'$ , Fig. 5. This leaves the top plate entirely free from the body of the tuyere-box, and it is then lifted off from the latter, which is left on the car. I then put a fresh bottom, which has been previously rammed and dried on another removable top plate,  $B^1$   $B^1$ , Fig. 3, upon the body of the tuyere-box which has remained on the car. I then key the removable top plate fast to the tuyere-box by means of keys driven through the studs  $W$   $W$ , Fig. 3. I have found this to make a perfectly tight joint against any blast used in the tuyere-box. The bottom and tuyere-box are then ready for use, and the car is shoved back again under the vessel. The tuyere-box and bottom are then raised into position on the vessel, as shown in Fig. 3, and the whole is keyed fast by means of keys driven through the pins  $H'$   $H'$ . The bottom is then ready for use as soon as the lining of the vessel  $Z'$   $Z'$ , Fig. 3, has been repaired at the joint between it and the bottom.

My method of inserting the tuyeres into the removable top-plate of the tuyere-box is as follows: First, I put the tuyere  $X^2$  on and into a gland such as described above, and then insert the tuyere into the proper hole (which is that shown at  $A^3$ , Fig. 4, and  $A^4$ , Fig. 5,) in the removable top plate  $B^2$   $B^2$ , Fig.

6, which is the same as that shown at  $B'$   $B'$ , Fig. 3. Then, as the tuyere goes up, the gland comes into contact with one of the sides of the hole, and instantly centers itself and the tuyere, holding the latter firmly, when the gland is keyed up. I then ram the ganister-bottom around the tuyeres and dry it in an oven.

After the bottom is dried and taken out of oven, I pack the tuyeres as follows: I first remove the glands, as the friction of the ganister against the tuyere retains the latter in its place. Then I fill all the space between the tuyere and the walls of the hole with any clayey mixture that will set hard, but preferably with a mixture of brick-clay and anthracite-coal dust, mixed to the consistency of putty. I then drive the gland  $b^2$   $b^2$ , Fig. 6, forcibly upon and into this clay putty, so that the latter is forced into every crack between the tuyere and the walls of the hole, and between the removable top plate  $B^2$   $B^2$  and the gland. When this clay putty has been warmed by the heat of the vessel it does not shrink, but sets as hard as a brick, thus forming a perfectly air-tight joint (which is indestructible by heat) between the tuyere and the removable top plate.

My improvement facilitates handling by reducing the weight and size of the parts to be handled, and by putting the parts into better shape facilitates all operations performed on the bottom. It renders the repair of the tuyere-box perfectly easy, and makes the expense of such repair merely nominal. In drying the ganister-bottom in an oven on the old plan, the whole tuyere-box, blast-pipe, &c., must be lifted and handled with the bottom. I only take the bottom itself, thus making handling easy and giving the bottom a much better chance to dry. If the blast leaks up around a tuyere in the old tuyere-box, and the steel, in consequence, burns the top plate, the whole expensive tuyere-box is often made useless. If this accident occurred with my improvement, the necessary repair would merely be to put a fresh top plate on the tuyere-box. The cost of the removable top plate is merely nominal. Further, the top plate is scarcely liable to be burned, where my improvement would be used, because my method of packing the tuyeres makes a reliable joint.

I do not limit the method of making the removable top plate to the method shown in Fig. 3. The removable top plate can be made in any suitable way, and may be made either with or without the addition of the second plate. Nor do I limit the position of the studs which hold the removable top plate to the body of the tuyere-box to the position shown in Fig. 3. These studs may be placed, if so desired, entirely inside the tuyere-box or in any other convenient position.

What I claim, and desire to secure by Letters Patent, is—

1. The combination, with a tuyere-box as ordinarily constructed, of a removable top



plate, intended to be taken off whenever the ganister-bottom has been worn out by use, and so constructed as to be laid upon the tuyere-box from above, as specified.

2. The combination, with a tuyere-box as ordinarily constructed, of a removable top plate, intended to be taken off whenever the ganister-bottom has been worn out by use.

3. The combination, with a removable top plate, of a circular flange, either cast in one piece with it or cast on the second plate, which is sometimes used with the removable top plate.

4. The combination, with the removable top

plate, of a number of glands, each formed by a sharp-edged annular ring and a flange, substantially as and for the purposes described.

5. The glands of the shape as described, so that they will hold the tuyeres firmly in place while the ganister-bottom is being rammed around them, substantially as described.

In testimony whereof I have hereunto affixed my hand and seal.

JOHN B. PEARSE. [L. S.]

Witnesses:

JOSEPH POTTS,  
H. S. NOURSE.