

(No Model.)

J. B. McCORMICK.  
MOLDING APPARATUS.

No. 381,156.

Patented Apr. 17, 1888.

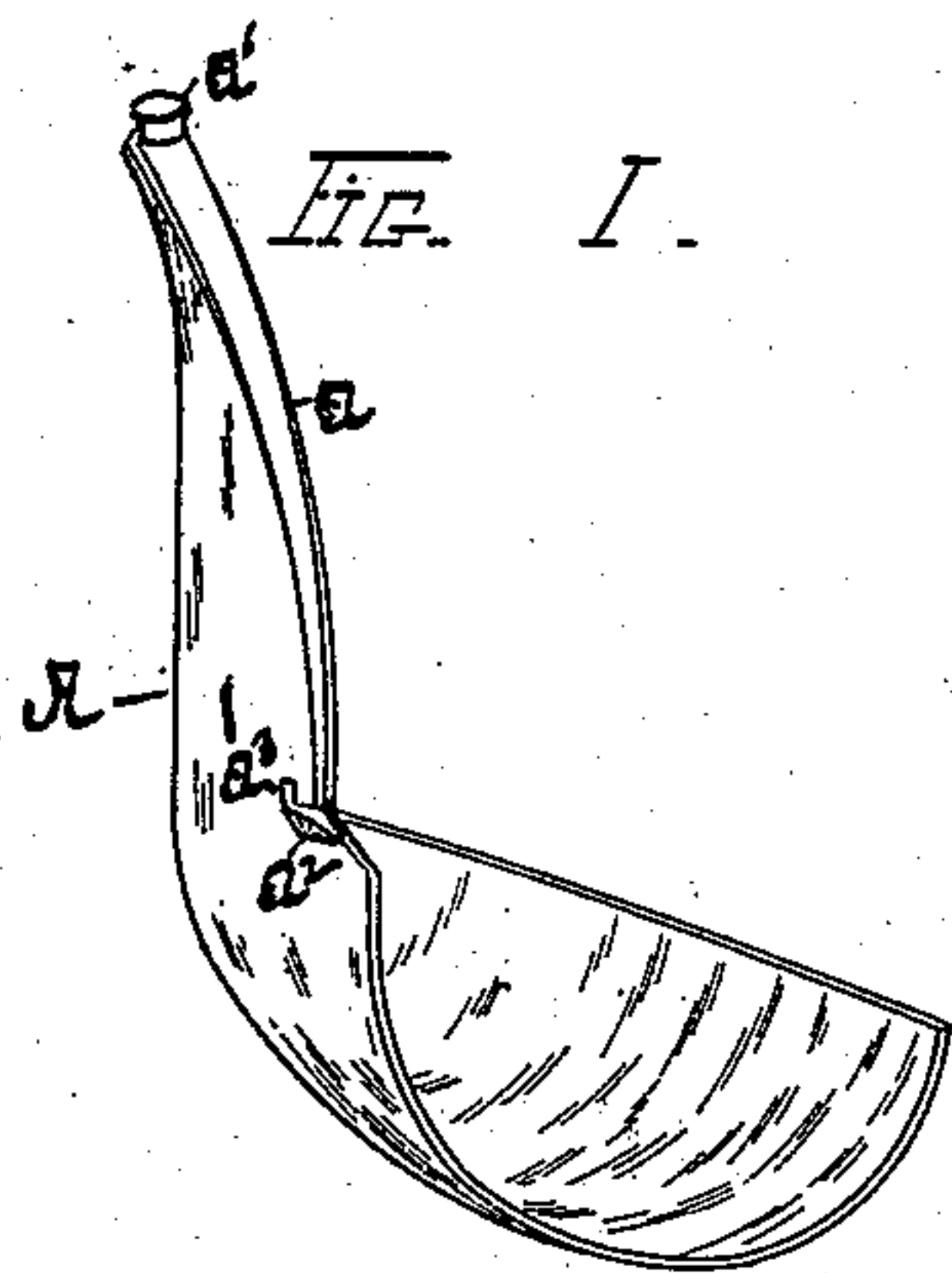


FIG. 1.



FIG. 6.

FIG. 2.

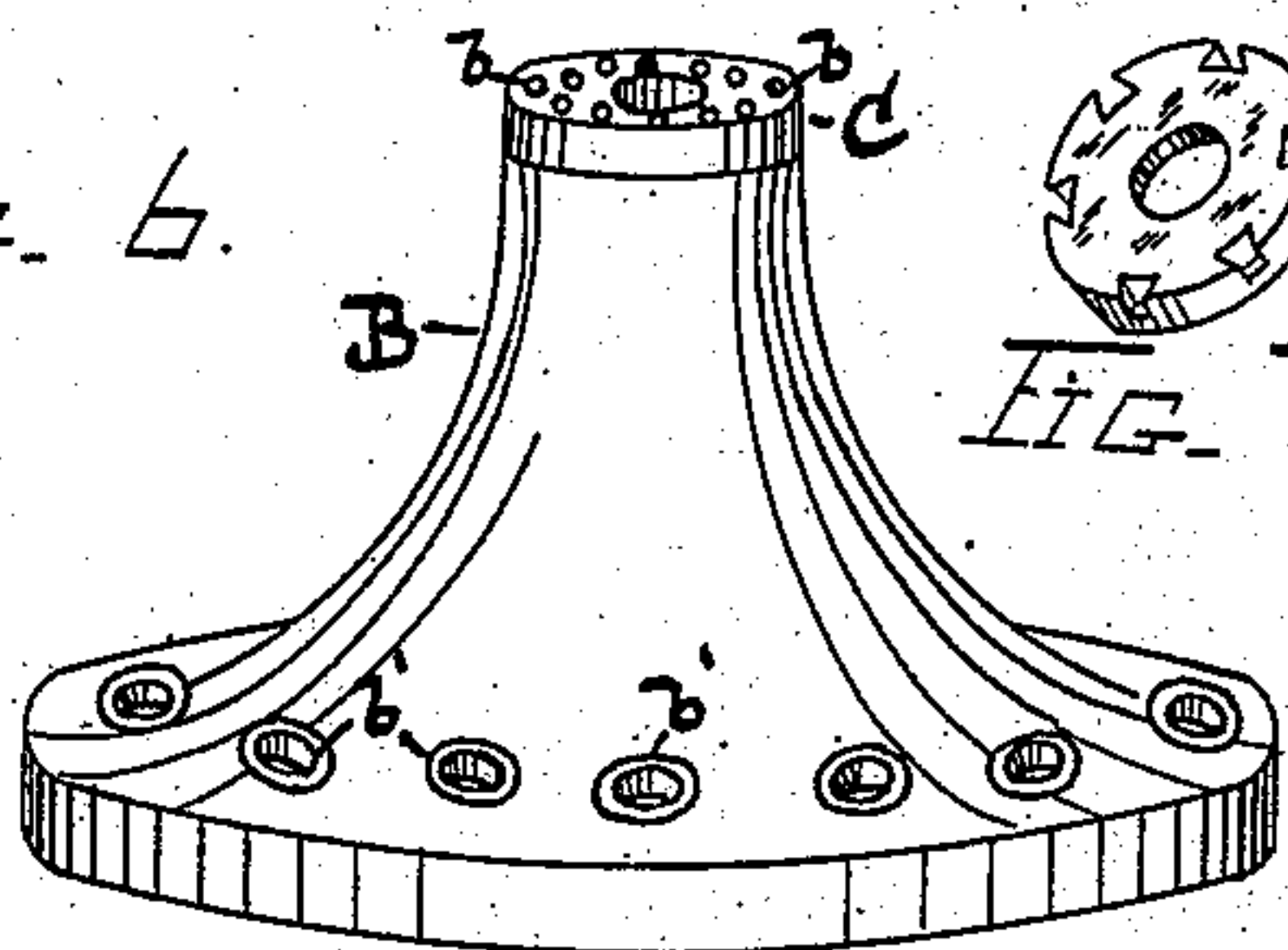


FIG. 7.

FIG. 3.

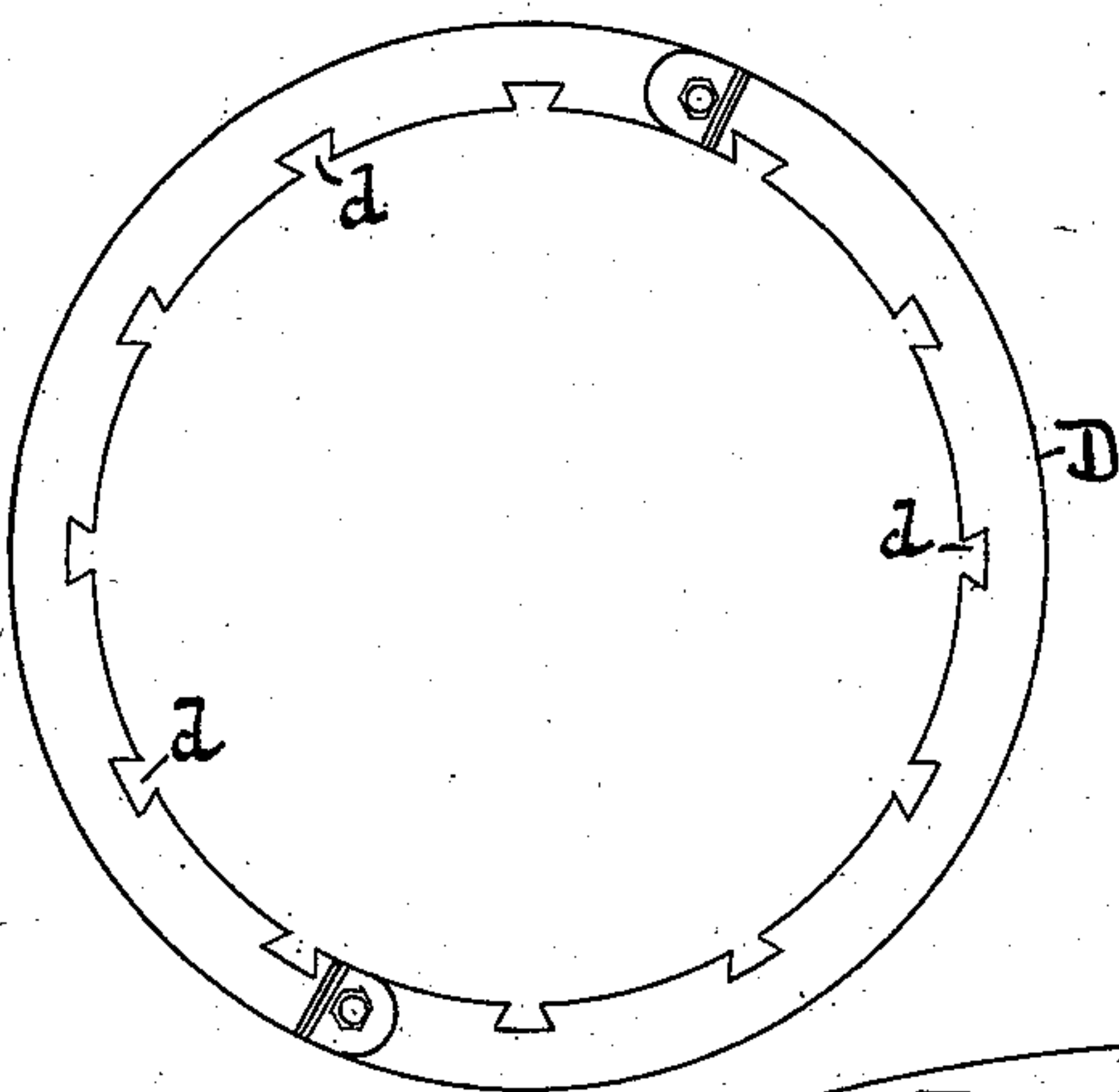


FIG. 4.

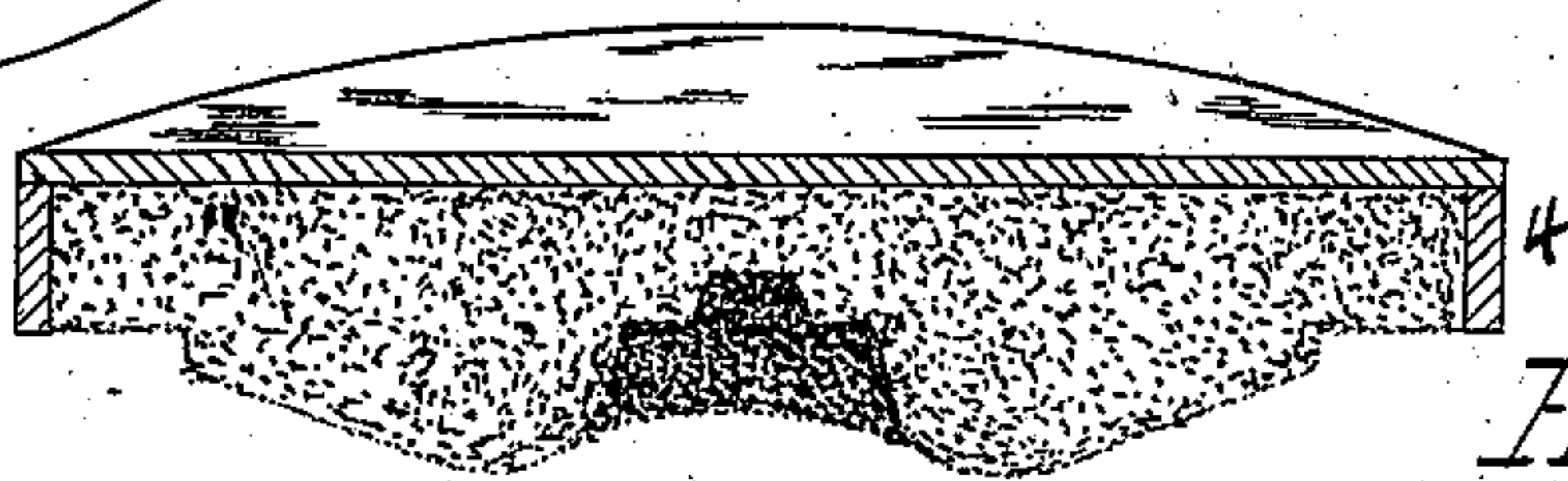
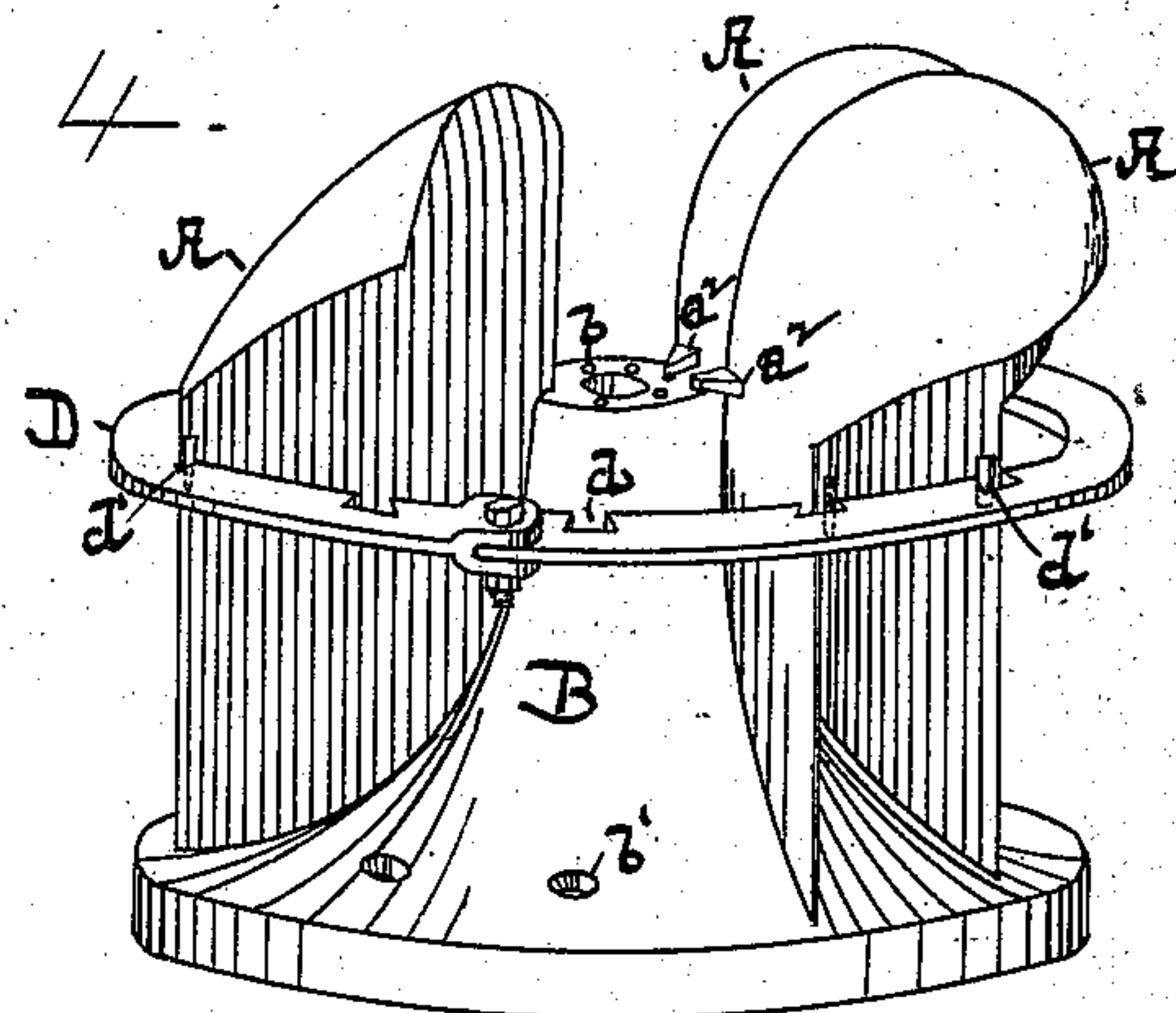
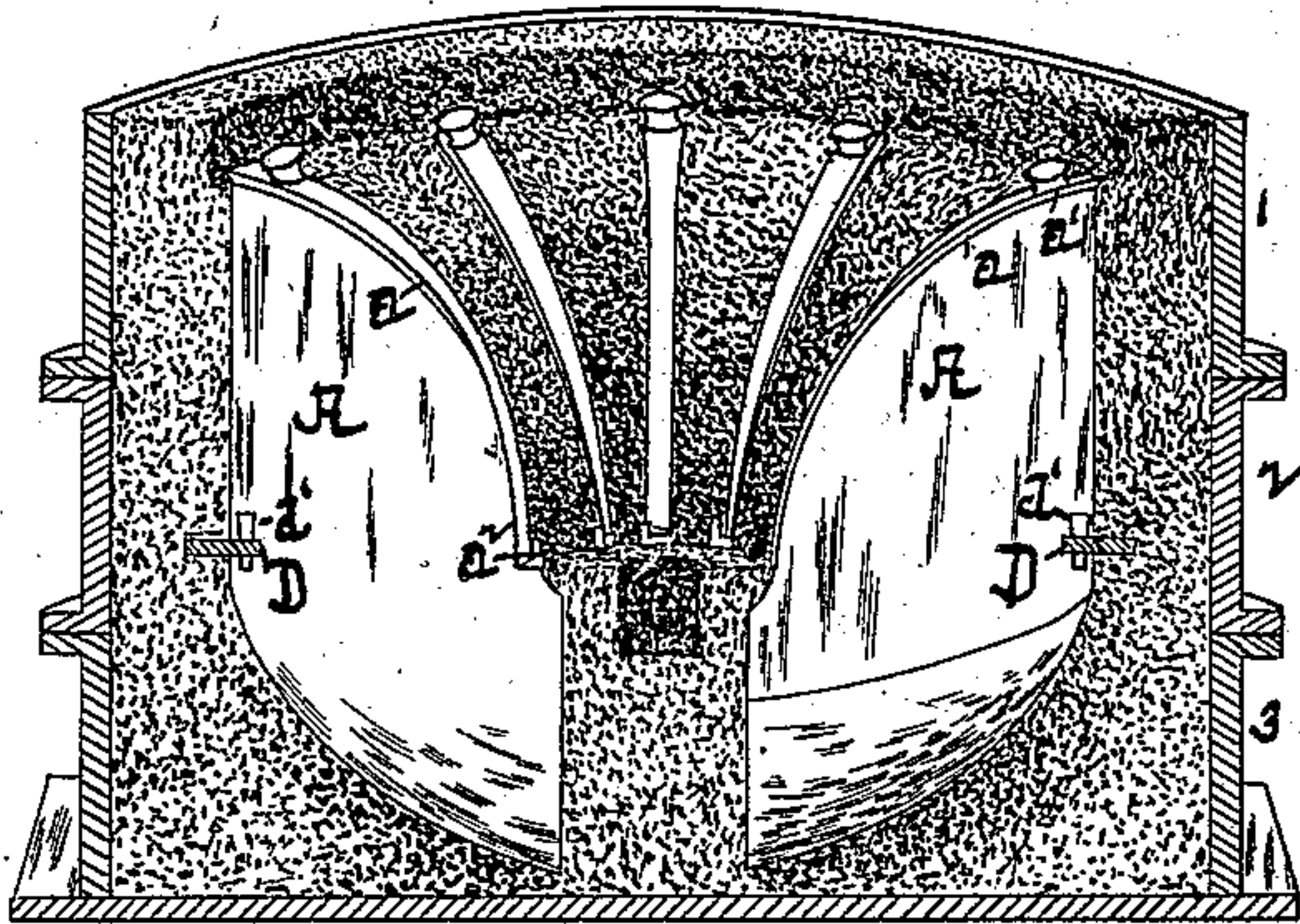


FIG. 5.



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# UNITED STATES PATENT OFFICE.

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## MOLDING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 381,156, dated April 17, 1888.

Application filed December 12, 1887. Serial No. 257,727. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN B. McCORMICK, of Holyoke, in the county of Hampden and Commonwealth of Massachusetts, have invented a new and useful Improvement in Apparatus for Use in Molding Turbine Wheels, of which the following is a specification, reference being had to the accompanying drawings, forming part thereof.

My invention relates to the art of casting turbine water-wheels, and has for its object to provide means for accurately adjusting and holding the buckets of such a wheel within the mold in such manner that the operation of casting the hub thereto may be greatly expedited, and that when so cast the hub will form with the buckets a compact wheel of great strength and durability.

To this end my invention consists in the apparatus hereinafter fully described, and particularly pointed out in the claims.

Referring to the drawings, in which like letters designate like parts in the several figures, Figure 1 is a view in perspective of one of the buckets. Fig. 2 is a view of the pattern for the wheel-hub. Fig. 3 is a plan view of the adjusting and holding ring. Fig. 4 illustrates the manner in which the buckets are held by the hub-pattern and ring previous to the introduction of sand to the mold. Fig. 5 is a vertical central section of the mold after being rammed with sand, the hub-pattern being omitted in order to more clearly show the arrangement of the buckets. Figs. 6 and 7 show slight modifications, hereinafter described.

The letters A A A designate a portion of the buckets of a turbine wheel, which are cast in the usual manner, each bucket being provided with the tapering tenon  $a$  upon the edge which is to be united to the hub, and having a teat-like projection,  $a'$ , at one end of said tenon and a lug,  $a^2$ , having pin  $a^3$  at the opposite end thereof, as clearly shown in Fig. 1. The projection  $a'$  is of less diameter at its center than at its ends, and therefore when the metal composing the hub is cast around it and the tenon  $a$ , which is of dovetail shape in cross-section, a very strong connection between the hub and buckets is secured. It is to facilitate the operation of casting the hub to the buckets in such manner that the distance between

the latter can be accurately predetermined that the apparatus now to be described has been devised by me.

The letter B designates the pattern for the hub, which pattern may be made from wood or metal, and which is provided at its small end with a series of orifices,  $b$ , to receive the pins  $a^3$  on the buckets, and near its large end with a series of orifices,  $b'$ , to receive the projections  $a'$  on the buckets, the orifices of each series being arranged at regular intervals about the axis of the pattern and extending in a direction parallel with said axis, as shown. When the body of the pattern B is made of wood, I prefer to fit a metallic cap, C, upon its small end, as shown in Fig. 2, said cap containing the orifices  $b$ , and to insert metallic bushings in the orifices  $b'$ , as represented in said figure, whereby the durability of the pattern is greatly enhanced.

The buckets A, when applied to said pattern with pins  $a^3$  in orifices  $b$  and projections  $a'$  in orifices  $b'$ , as shown in Fig. 4, are supported in such manner that their outer edges are free to move toward and away from each other; and as it is essential to the formation of a perfect wheel that the distance between said outer edges, especially at the point where the discharge occurs when the wheel is in operation, shall be exactly uniform with respect to all the buckets, I have furthermore devised the adjusting and holding ring D (shown in Fig. 3) to accomplish this result. The inner diameter of this ring is less than the diameter of the circle described about the outer edges of the buckets when the latter are applied to pattern B, as just described, and therefore said ring is made in two semicircular sections, pivoted together at one end and detachably connected together at their opposite ends by means of a bolt, as shown, or in any convenient manner, so that the ring can be opened for the purpose of applying it to and removing it from the buckets. A series of recesses,  $d$ , of slightly greater width than the thickness of buckets A at their outer edge, are formed within the inner surface of ring D at uniform distances apart and corresponding in number with the number of buckets with which the wheel is to be provided. The ring is applied to the buckets, as shown in Fig. 4, with the outer edge of each bucket located within one



of the recesses  $d$ , and wedges or keys  $d'$  are then inserted in said recesses upon one or both sides of the bucket therein, by means of which the buckets are adjusted laterally relatively to each other to the desired position and are securely locked in such position. To facilitate the action of said wedges or keys against the sides of the buckets, I prefer to make the recesses  $d$  in the ring with tapering sides, as shown; but such shape is not essential. I have shown the wedges or keys  $d'$  as the means for securing the adjustment of the buckets within the recesses of the ring, for the reason that they form a simple and effective means for such purpose; but it will be obvious to persons skilled in the art that other well-known devices could be employed in lieu of said wedges or keys without the exercise of invention.

The operation of the apparatus in the formation of the mold is as follows: The pattern B being placed upon the "bottom board" in the position shown in Fig. 2, the buckets A, which have been previously cast, are applied to said pattern, as shown in Fig. 4. The ring D is then opened to permit it to pass the upper ends of the buckets, and then closed about the buckets, with the outer edge of each of the latter resting within one of the recesses  $d$ , and is supported in about the position shown in Fig. 4 by wooden blocks (not shown) placed beneath it and resting upon the bottom board, or in any other convenient manner. The wedges or keys  $d'$  are then applied to one or both sides of each bucket within recesses  $d$ , in such manner that the spaces between the discharging edges of the buckets are uniform throughout. The flasks 1, 2, and 3 (see Fig. 5) are then placed in position upon the bottom board and are rammed with sand in the usual manner. The mold is then inverted upon the bottom board, as shown in Fig. 5, the flasks 1 and 2 removed, and the sand removed around the outer edges of the buckets until ring D is reached, when said ring is opened and removed, the undisturbed sand between the buckets holding them securely in position. The cores for forming the usual rim about the buckets are then inserted, flasks 1 and 2 replaced, and the same again rammed with sand. The pattern B is then withdrawn, the sand between tenons  $a$  on the buckets removed so as to expose said tenons, the usual central core—the position occupied by which is indicated by the recesses shown in Fig. 5—is placed in position, cope 4 is applied, and the casting of the hub proceeded with in the usual manner.

It will be observed that by the use of this

simple and inexpensive apparatus the operation of preparing the mold for casting the hub to the buckets can be very quickly performed, and that the relative positions of the buckets can be accurately predetermined.

The pattern B will be made to correspond to buckets of various shapes and sizes, and its orifices can be shaped to correspond with the projections on the buckets. In Fig. 6, for example, I have shown a portion of a bucket having a dovetail-shaped lug instead of the lug  $a^2$  and pin  $a^3$ , and for such a bucket the cap on the pattern B would be provided with a series of recesses of similar shape, as shown in Fig. 7, in lieu of the orifices  $b$ .

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

1. The apparatus for use in molding turbine wheels herein described, consisting of hub-pattern B, having the series of orifices  $b$  at its small end and the series of orifices  $b'$  near its large end, arranged substantially as shown, whereby it is adapted to pivotally support the wheel-buckets, a ring having within its inner surface a series of recesses to receive the outer edges of the buckets, and devices, substantially as described, for adjusting and securing the buckets within said recesses, substantially as and for the purpose set forth.

2. The apparatus herein described, consisting of the hub-pattern having the series of orifices  $b$  at one end and the series of orifices  $b'$  near its opposite end, ring D, having the series of recesses  $d$ , and wedges or keys  $d'$ , substantially as described.

3. The combination, with a series of buckets A, having lugs  $a^2$ , provided with pins  $a^3$  and projections  $a'$ , of hub-pattern B, having a series of orifices at one end to receive said pins  $a^3$ , and a series of orifices near its opposite end to receive said projections  $a'$ , ring D, composed of two semicircular sections pivoted together at one end and having within its inner surface a series of recesses,  $d$ , and wedges or keys  $d'$ , substantially as set forth.

4. The ring D, composed of two semicircular sections pivoted together at one end and secured together at their opposite ends by a bolt or other similar device, said ring having within its inner surface a series of recesses,  $d$ , arranged at regular intervals about said inner surface, substantially as and for the purpose described.

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Witnesses:

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