(No Model.) 4 Sheets—Sheet 1.

E. E. WOODWARD.

ADJUSTABLE NOZZLE.

No. 497,903. Patented May 23, 1893.

Fig. 1.

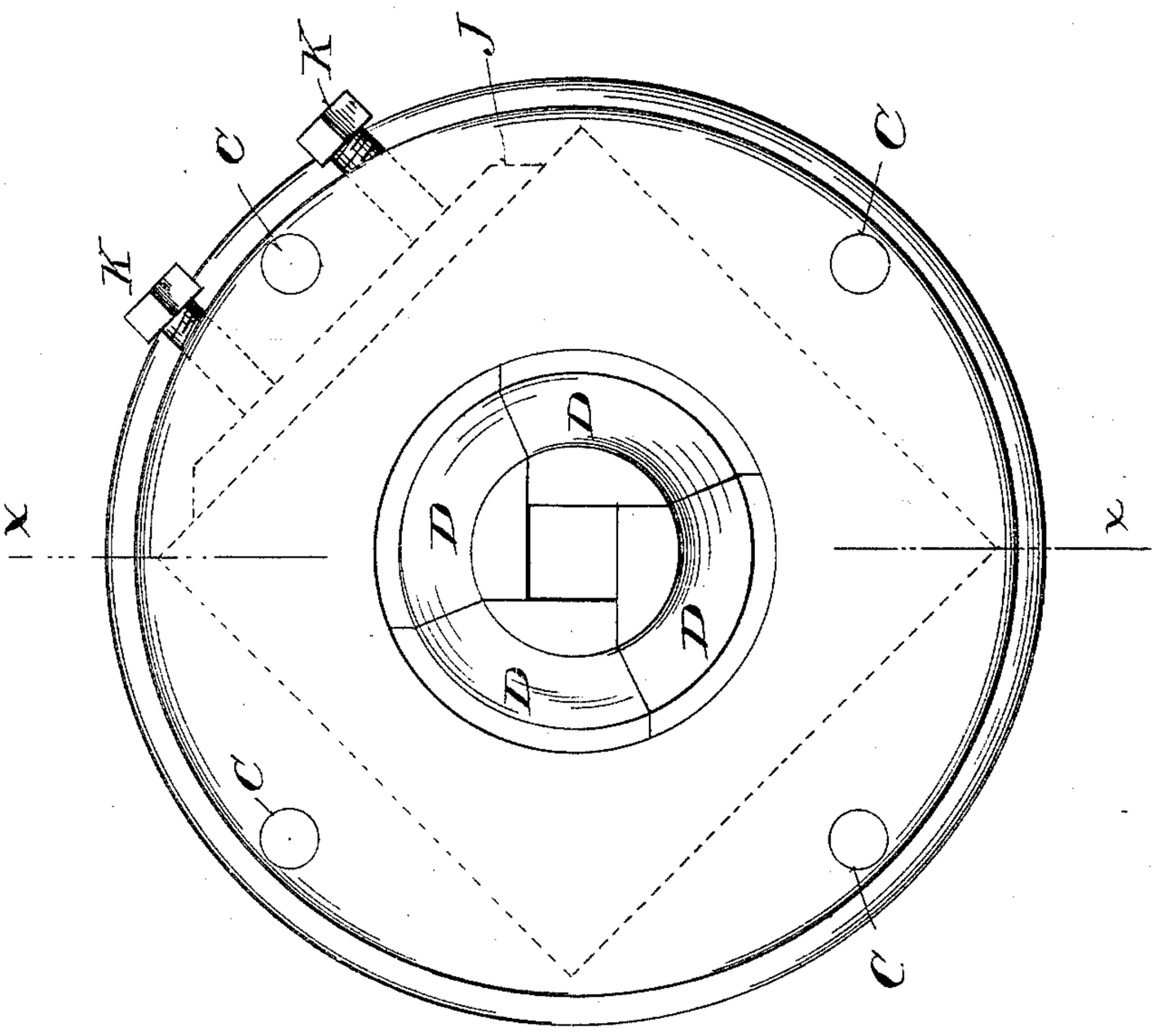
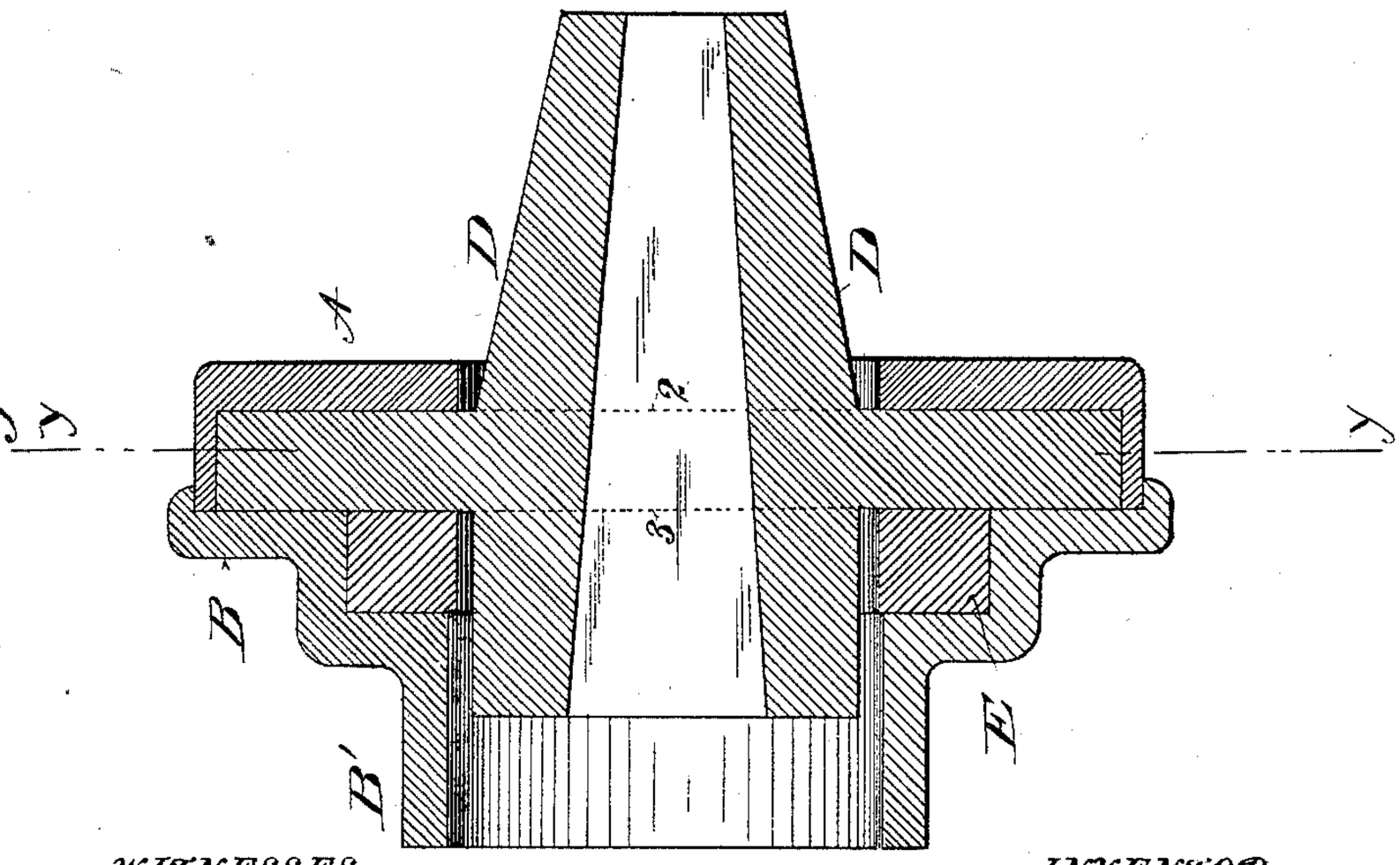


Fig. 2.



WITNESSES

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Fig. 3.

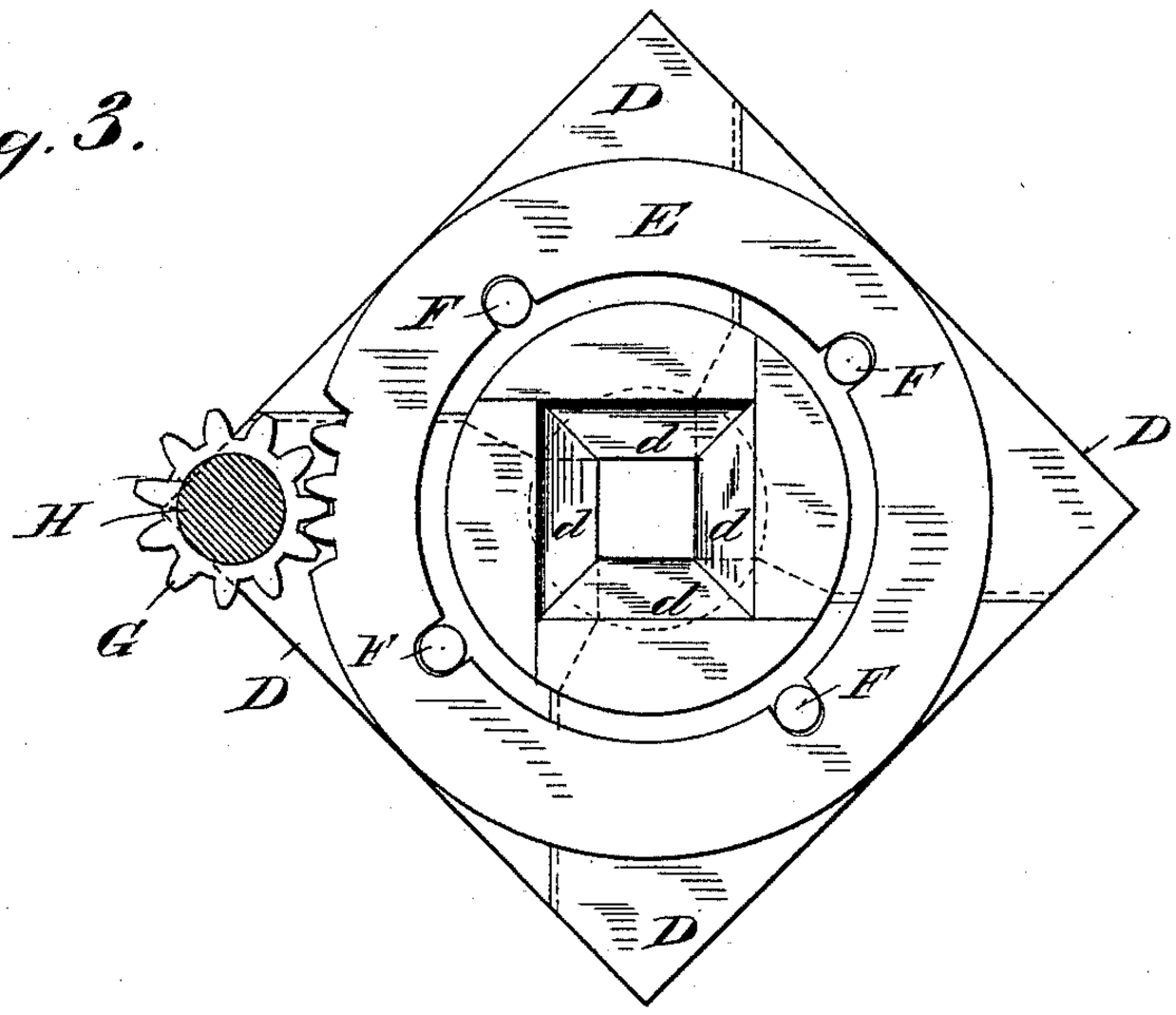
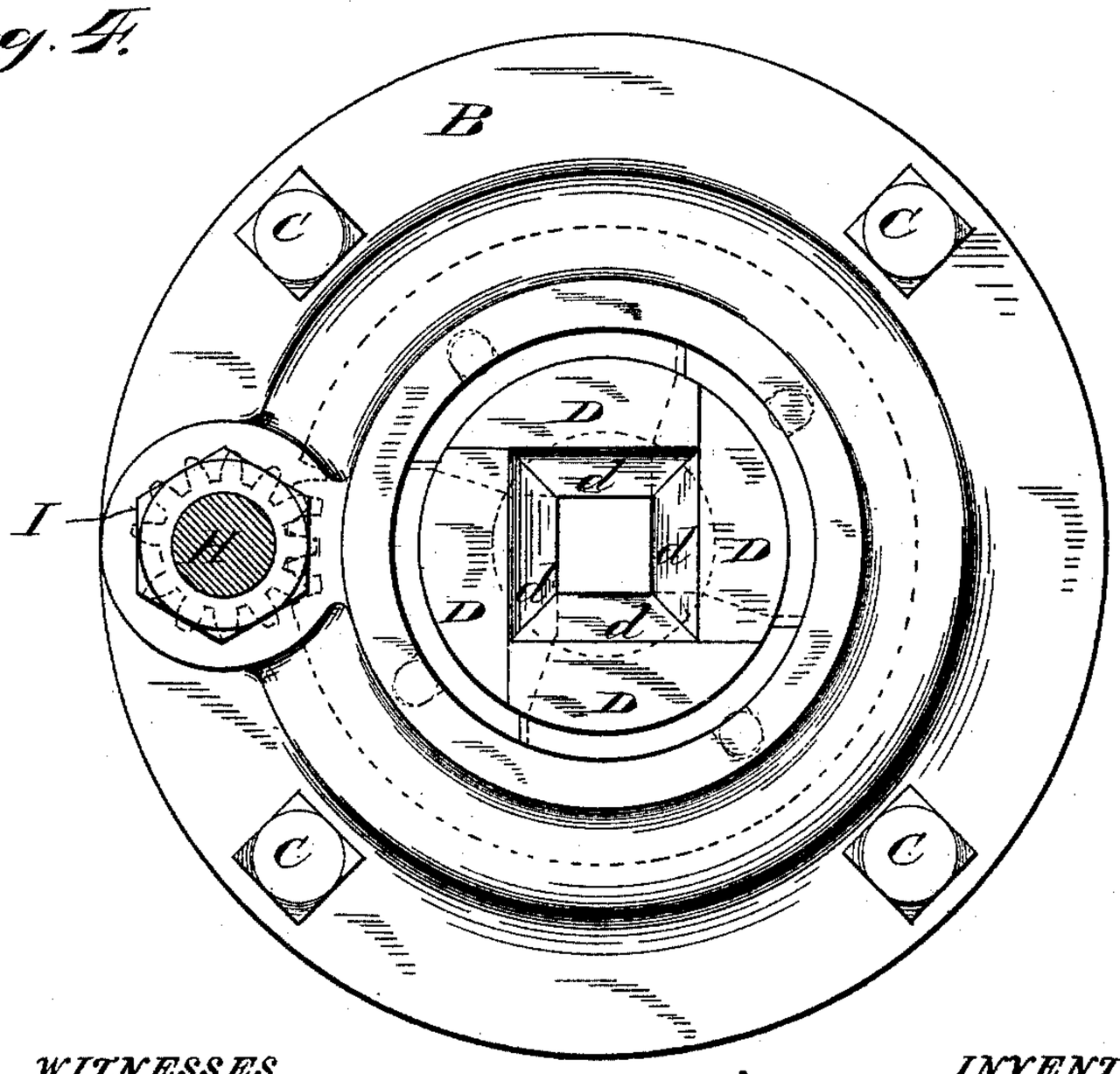


Fig. 4.



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4 Sheets—Sheet 3.

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ADJUSTABLE NOZZLE.

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Fig. 6.

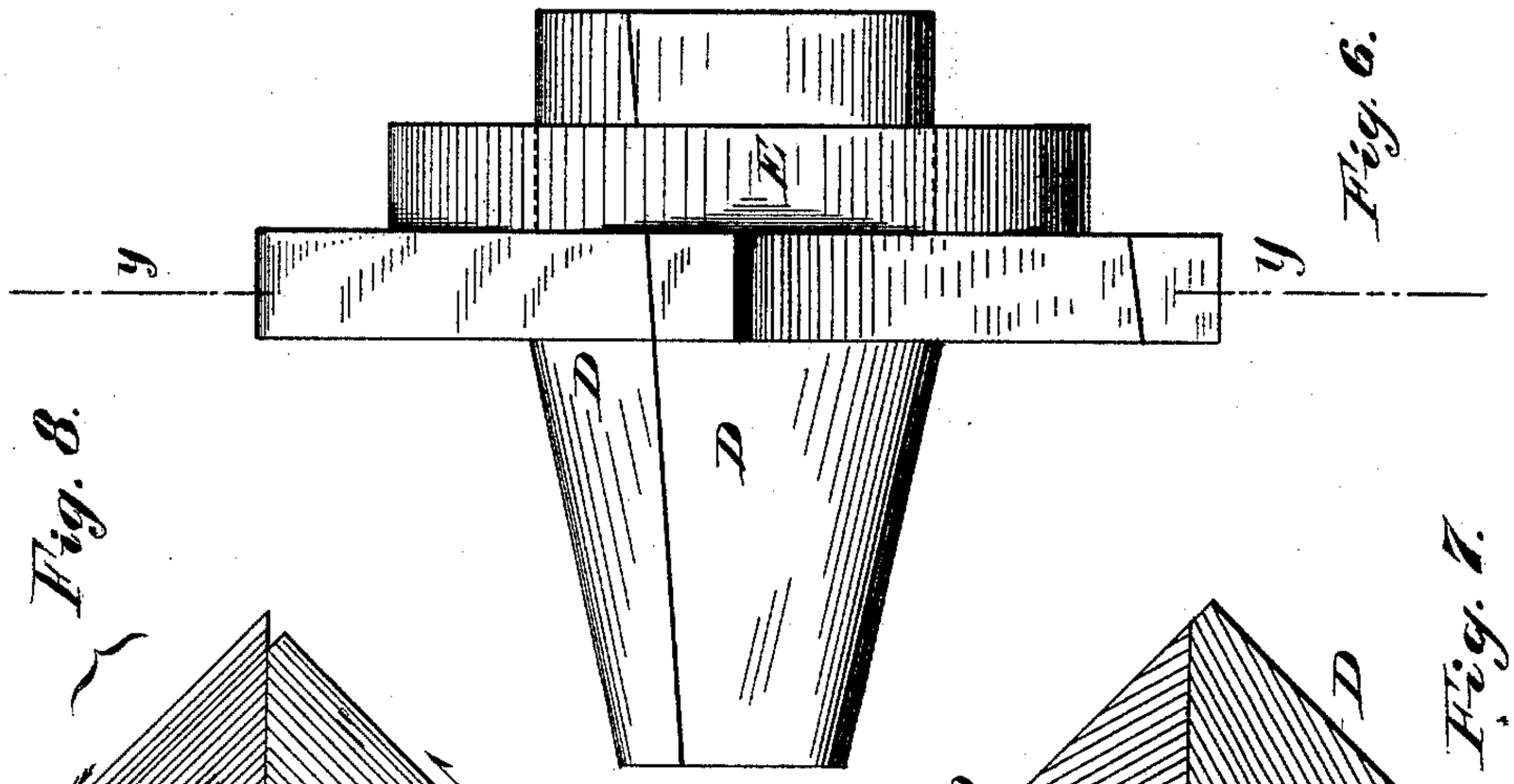


Fig. 8.

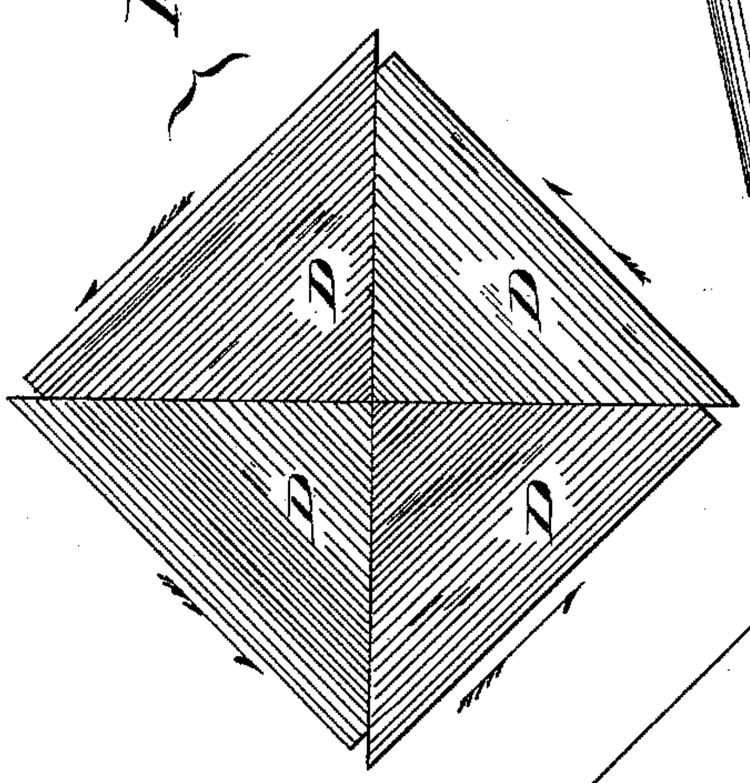


Fig. 7.

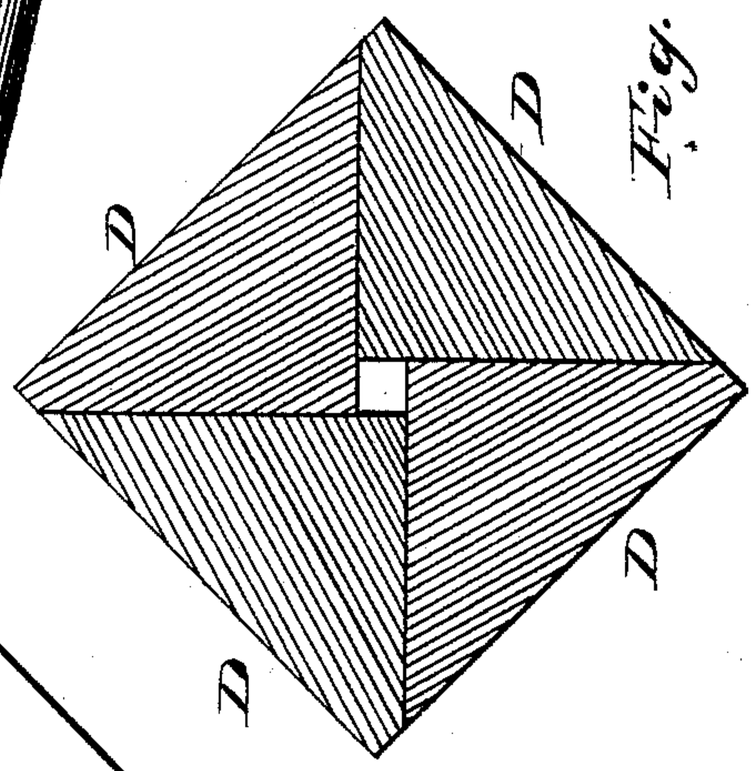
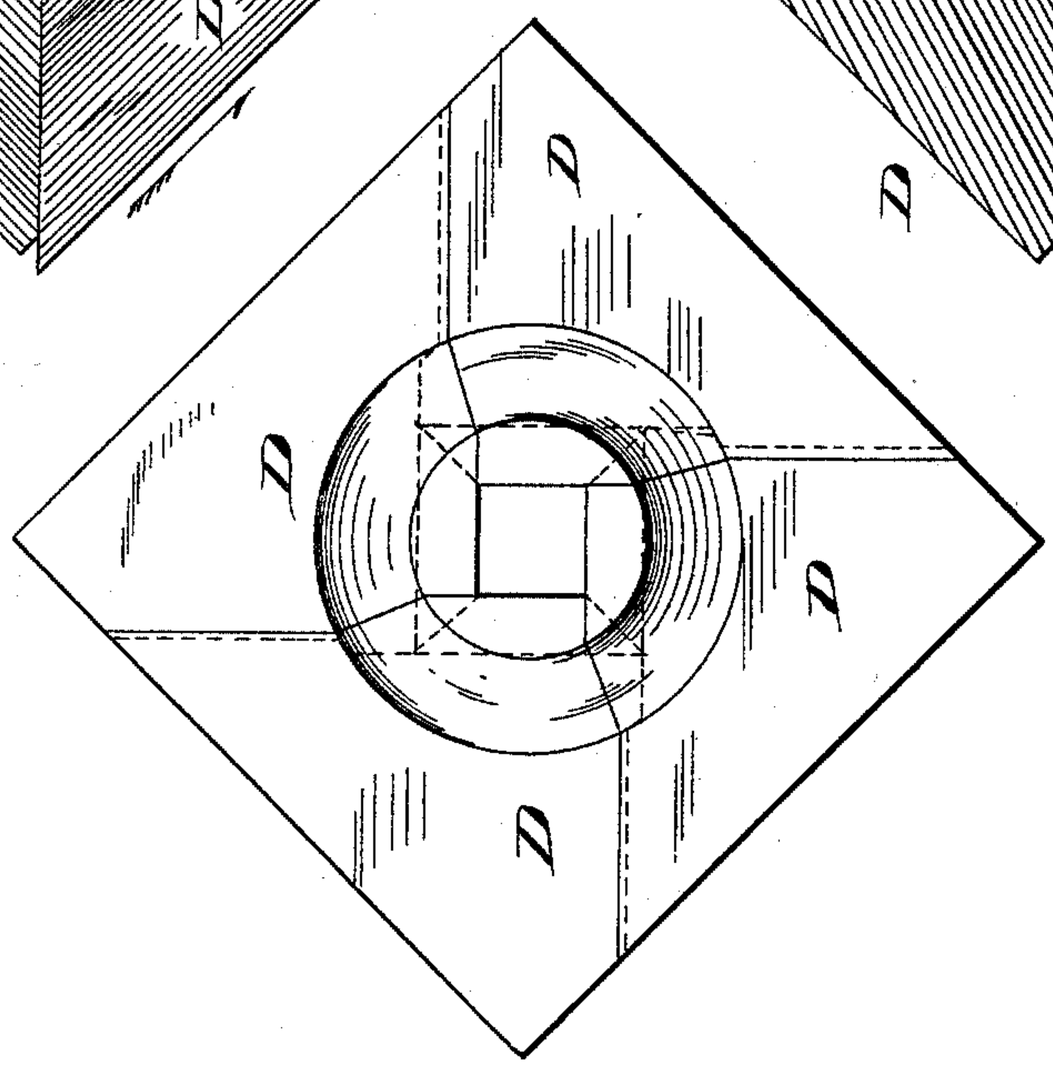


Fig. 5.



WITNESSES

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(No Model.) 4 Sheets—Sheet 4.

E. E. WOODWARD.

ADJUSTABLE NOZZLE.

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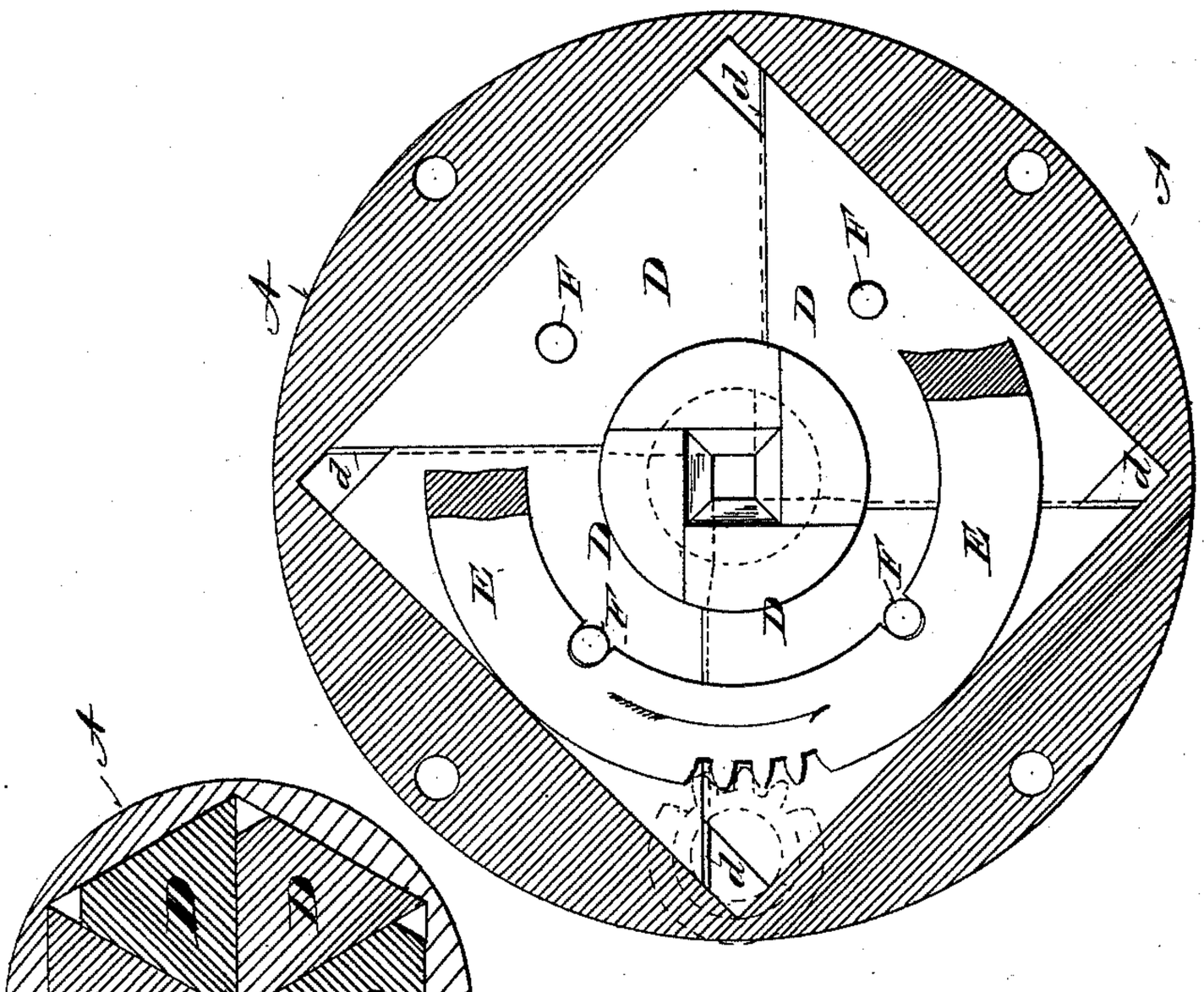

Fig. 9.

Fig. 11.

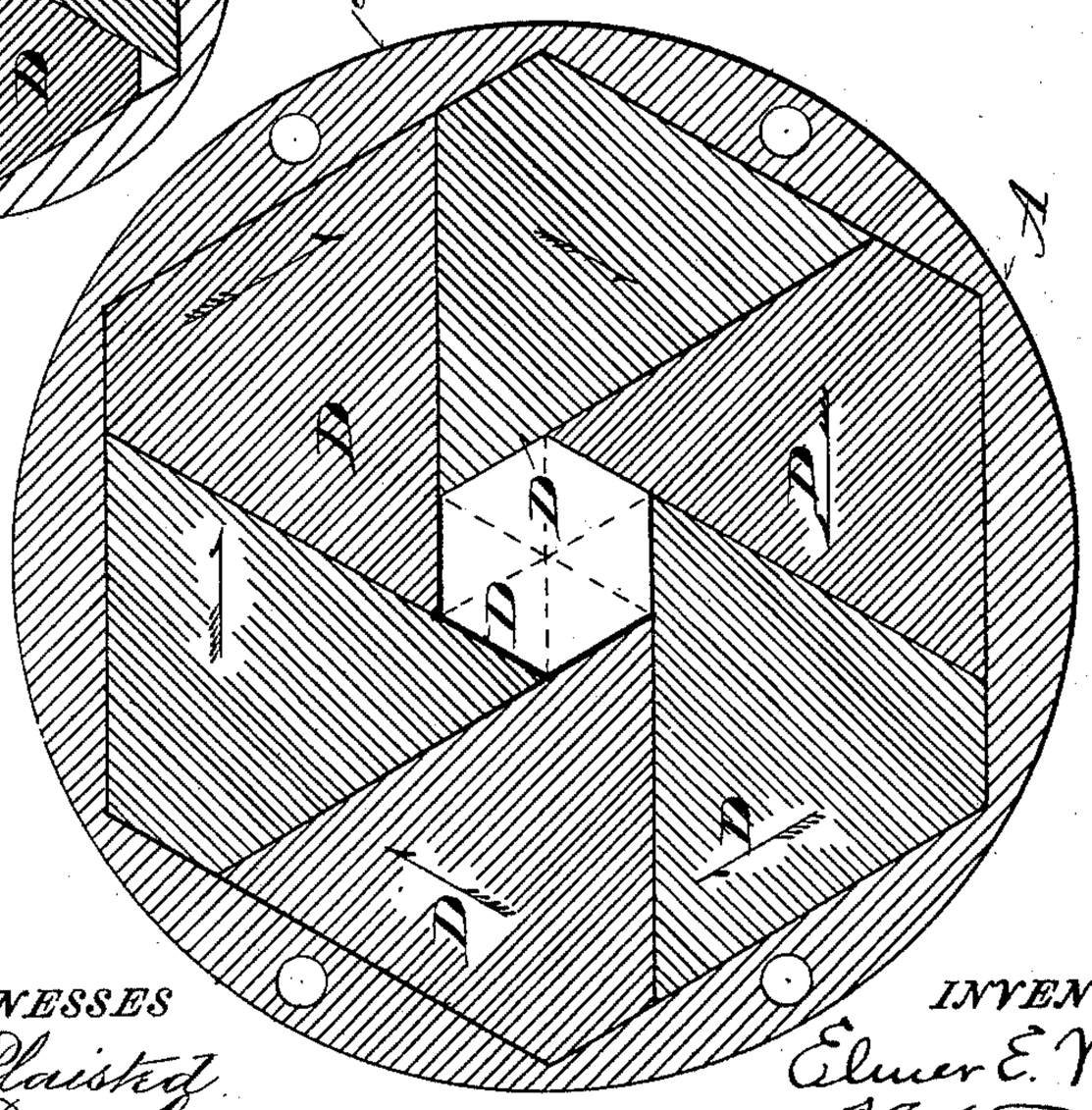

Fig. 10.

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UNITED STATES PATENT OFFICE.

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ADJUSTABLE NOZZLE.

SPECIFICATION forming part of Letters Patent No. 497,903, dated May 23, 1893.

Application filed April 9, 1892. Serial No. 428,474. (No model.)

To all whom it may concern:

Be it known that I, ELMER E. WOODWARD, a citizen of the United States, residing at Rockford, in the county of Winnebago and State of Illinois, have invented certain new and useful Improvements in Adjustable Nozzles, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to certain new and useful improvements in adjustable nozzles, being especially adapted for use with impact or hurdy gurdy wheels.

The object of my improvements is to provide means for varying the size of the stream or streams delivered to the buckets of the water wheel, without corresponding loss of efficiency by the change of opening for the delivery of the water; and to regulate the delivery of water to the wheel by discharge openings substantially of similar cross section, but differing in area or size without corresponding difference of shape.

To this end my improvements have reference to guiding jaws for delivering water through a variable sized opening; have reference to a special form of said jaws provided with bearing wings, and a case for said jaws; the sum of the area of said jaws, being less than the inclosing chamber of the casing, whereby a space will be left at the center of the jaws when fully open, will be distributed at the sides of said jaws when fully closed, and be located partly at the center and partly at the sides when the jaws are adjusted to intermediate positions; and have reference to adjusting mechanism for said jaws adapted to effect simultaneous action thereof, the movement of the jaws taking place transversely to the axis; and have reference to the means for taking up the wear of said jaws; and have reference to other points hereinafter described and claimed.

In the accompanying drawings on which like reference letters indicate corresponding parts: Figure 1, represents a face view of an adjustable nozzle exemplifying my improvements; Fig. 2, a cross section on the line *x x* Fig. 1, the nozzle being fully open; Fig. 3, a rear view of the adjustable jaws of the nozzle, and operating ring and pinion, without the casing; Fig. 4, a rear view of the nozzle showing the casing, and the adjustable jaws mounted therein; Fig. 5, a front view of the adjustable jaws alone, in their matching position for full opening of the nozzle; Fig. 6, an edge view of the same with the operating ring mounted thereon; Fig. 7, a cross sectional view of the adjustable jaws in smaller size, the view being taken on line *y y* of Figs. 2 and 6; Fig. 8, a view of the jaws in their closed position; Fig. 9, a back view of the jaws in an intermediate position, the inclosing case being shown in section and a portion of the adjusting mechanism; Fig. 10, a sectional view of a nozzle formed by six jaws and inclosing casing, the nozzle being fully opened; and Fig. 11, a similar view in smaller size of Fig. 10, the nozzle being fully closed.

The letter A designates the front of the casing, the letter B the back thereof, secured to the front by bolts C, and having a rearward extension B′ whereby the nozzle is secured to the pipe or chamber from which the water is delivered to the nozzle. Between the front and the back of the casing is a polygonal opening, square as shown in Fig. 9, hexagonal as in Fig. 10, or otherwise, according to the number of jaws D, having flanges mounted in said casing and preferably extending to the front and rear, as shown in Fig. 2. A taper is formed on the inside of said jaws preferably, to constitute the tuyere or discharge opening of the nozzle. This inclination is shown alike on all the jaws and is carried lengthwise through the same as shown in Fig. 6. The jaws are all alike, the angles and sides of one jaw corresponding with the angles and sides of the other jaws, and substantially triangular in cross section, whatever the number of jaws composing the nozzle.

Referring to Figs. 7 and 8 illustrating the principle of the device, it will be seen that the jaws when fully open as in Fig. 7, and fully closed as in Fig. 8, constitute a square, and fill the inclosing chamber except for a certain space or spaces, which constitute the full discharge opening when located at the center Fig. 7, and is divided into a number of spaces and located at the sides of the jaws, when the latter are fully closed, as in Fig. 8. By sliding the jaws simultaneously in the direction

of their respective arrows, Fig. 8, the spaces at the sides or corners are diminished, and a corresponding opening formed at the center of the jaws. The jaws move all together, the one ahead of any particular jaw moving out of the way as that jaw slides forward, and the one in the rear of any particular jaw backing up the same to occupy the space left vacant. A reverse movement of the jaws diminishes the central opening or space, and correspondingly increases the area of the spaces at the outside of the jaws.

Fig. 9, shows the jaws in an intermediate position, the operating space or clearance being distributed partly at the outside of the jaws at the corners of the case, and partly at the center, where it constitutes the discharge opening of the nozzle. The inclination or slant of the meeting surfaces of the jaws, is indicated by the full and dotted lines in the figures, and designated by *d*.

The cut-off portion from each triangular prism is preferably removed so as to present a surface parallel to the opposing side of the case or inclosing chamber, whereby this heel portion will butt against the said wall when fully open at the center. While it is preferable to form the jaws with inclined matching surfaces *d*, they may be formed without the said incline, or otherwise than shown, according to the shape of the discharge opening desired.

Any convenient means may be used to effect the adjustment of the jaws, but I have illustrated an adjusting mechanism consisting of a ring E engaged by slots, or otherwise, with projecting pins F from the flanges of the jaws, Figs. 3 and 9, and provided with a toothed portion meshing with a pinion or segment G, mounted on an operating shaft H, provided with a stuffing box I, Fig. 4. The back wall of the case, in front of which the ring is preferably mounted, is recessed to receive the same, as shown in Figs. 2 and 4. The pins F have sufficient clearance in their engagement with the ring E, to allow the motion of the jaws parallel to the sides of the inclosing case, while the ring moves in a circle.

In order to illustrate the adaptability of this device to nozzles having a larger number of jaws, I have shown one having six jaws, by the sectional views Figs. 10 and 11. Each jaw, it will be seen, is substantially triangular, the cut-away portion forming the clearance or operating space, being shown similar to Figs. 7 and 8. In both forms or constructions, the sum of the angles of the jaws meeting at the center is three hundred and sixty degrees, and the angle between each inner side of a jaw and the outer side, must be equal, whether there be four, six or other number of jaws. I lay claim broadly to these adjustable jaws adapted to move so as to open and close a central opening forming the discharge opening of the nozzle. I also claim broadly these adjustable jaws provided with slanting or inclined surfaces adapted to constitute the taper of the nozzle for the proper delivery of the stream. The sides forming the angle at the center of each jaw, match with the adjacent side of the next jaw and slide thereon, the back or outer side of each jaw operating against the respective side of the case. In order to take up the wear, one or more set-plates J Fig. 1, may be provided, and operated by set screws K, as may be found necessary. Furthermore, I claim broadly these jaws sliding on each other, and provided with extensions, to constitute sufficient length of discharge opening, from the operating wings by which said jaws are adjusted.

Referring to Figs. 10 and 11 for example, it will be observed that since the movement of the jaws is guided by the sides of the inclosing chamber, all points in each jaw move in tangents to circles whose radii are the distances from the center to the respective points on a normal to the guiding surface. It therefore follows that the inner angle of each jaw meeting at the common center, will travel in a line drawn through that center or a diameter. The dotted lines in Fig. 10 represent the traces of the respective inner points of the jaws which meet as shown in Fig. 11 to close the opening. Attention is also called to the dotted lines 2 and 3, in Fig. 2. The extensions or projections may be eliminated at the points indicated by these lines, and the jaws made without such extensions.

My invention includes the jaws both with and without such extensions or either of them.

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

1. In an adjustable nozzle, a series of sliding pieces abutting on each other and lying in the same plane, substantially as described, and each sliding on the edge of the adjacent piece toward and away from a common center, to constitute a variable sized opening, and means to operate said pieces.

2. In an adjustable nozzle, a series of uniform symmetrical pieces, the said pieces being arranged so that each two adjacent pieces are in sliding contact, and an inclosing casing forming a chamber in which said pieces are mounted, the adjustment of said pieces simultaneously to and from a common center forming an opening of variable size.

3. In an adjustable nozzle, the combination with a casing forming an equilateral and equiangular chamber to constitute guiding surfaces, of a corresponding number of uniform sliding pieces forming jaws bearing on each other and each on its matching guiding wall of said chamber, and provided with similarly matching extended portions beyond said chamber to constitute a nozzle, and means to adjust said pieces or jaws toward and away from a common center by sliding them on each other and on the said guide walls.

4. In an adjustable nozzle, the combination with an inclosing casing provided with a symmetrical polygonal chamber, of laterally extending jaws equal in number to the sides of the chamber, and having wings mounted in said chamber, and each jaw sliding on the adjacent jaw at its inner portion, and on the chamber wall as a guide on an outer portion of the jaw, a toothed ring embracing said jaws, slots in one member and pins in the other member to allow a sliding adjustment of the jaws toward and away from the central axis, and an operating pinion meshing with said ring to effect a rotation of the latter and thus slide the jaws on each other and the guide walls of the chamber, to regulate the size of the nozzle opening.

5. In an adjustable nozzle, a series of simultaneously sliding pieces, all of said pieces having the same angle at their inner ends, the said angles forming a polygonal opening when separated, and adapted to meet at a common center to close said opening, and guides for said pieces, substantially as shown.

6. In an adjustable nozzle the combination with a casing having guiding surfaces, of jaws mounted in said casing and adapted to slide on said guides and on each other, whereby the size of the central discharge opening is varied and a gib or bearing plate constituting one of said guiding surfaces and adapted to be set up against said jaws to take up the wear thereon.

In testimony whereof I affix my signature in presence of two witnesses.

ELMER E. WOODWARD.

Witnesses:
L. L. MORRISON,
E. F. DOWLING.