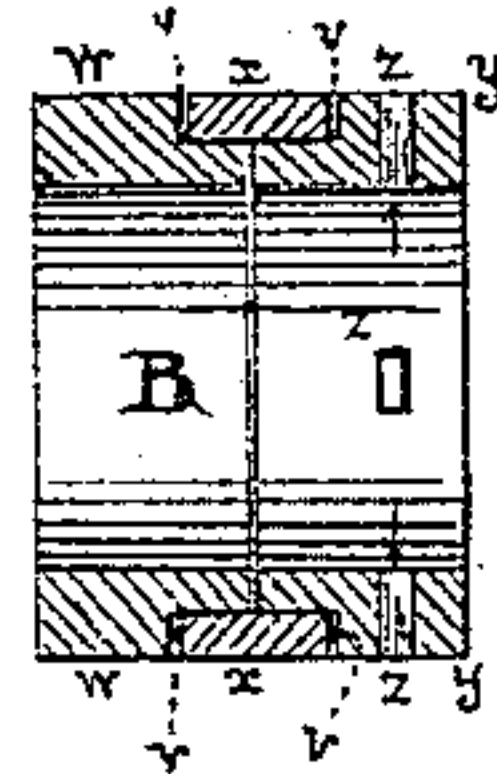
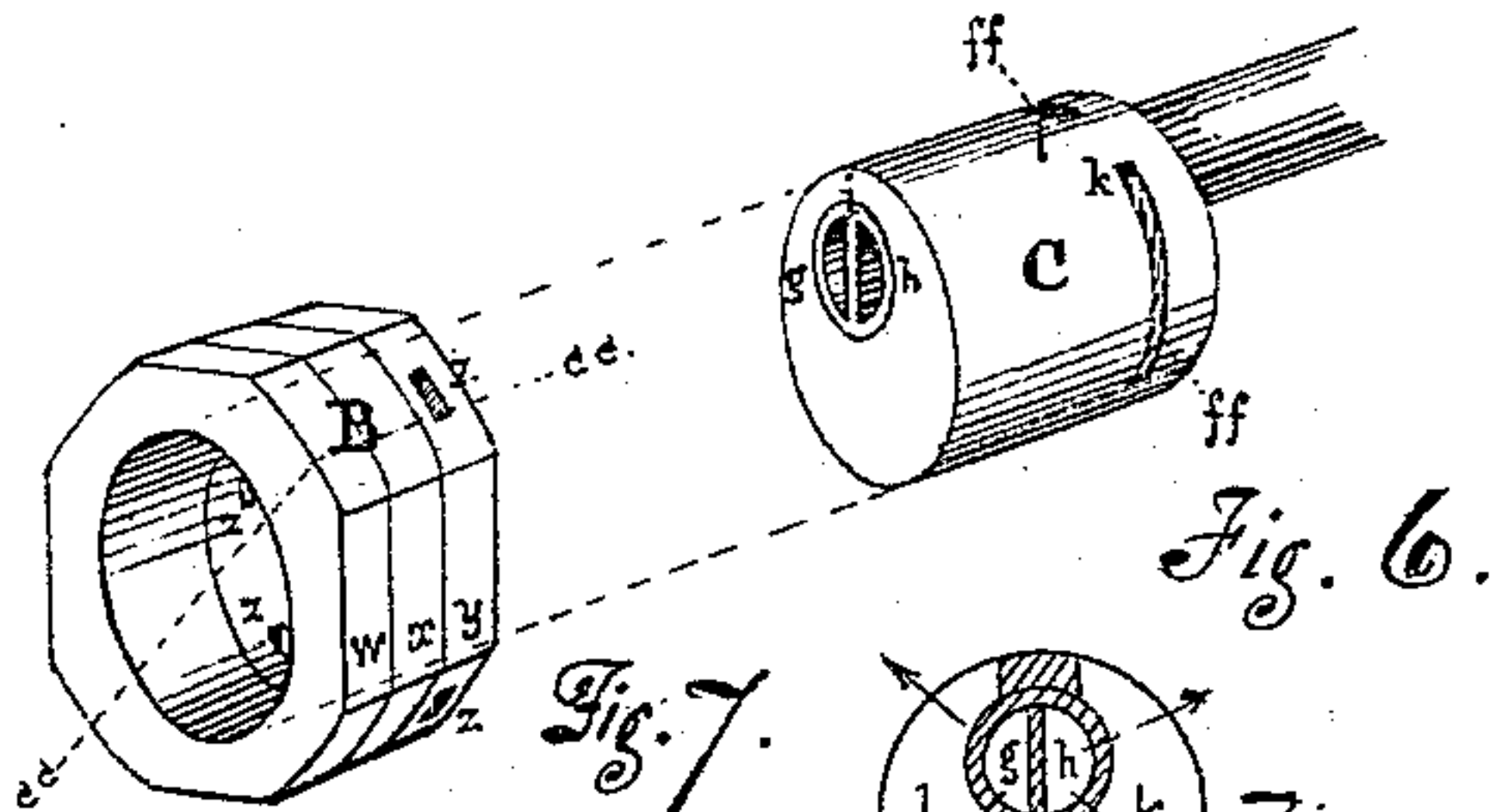
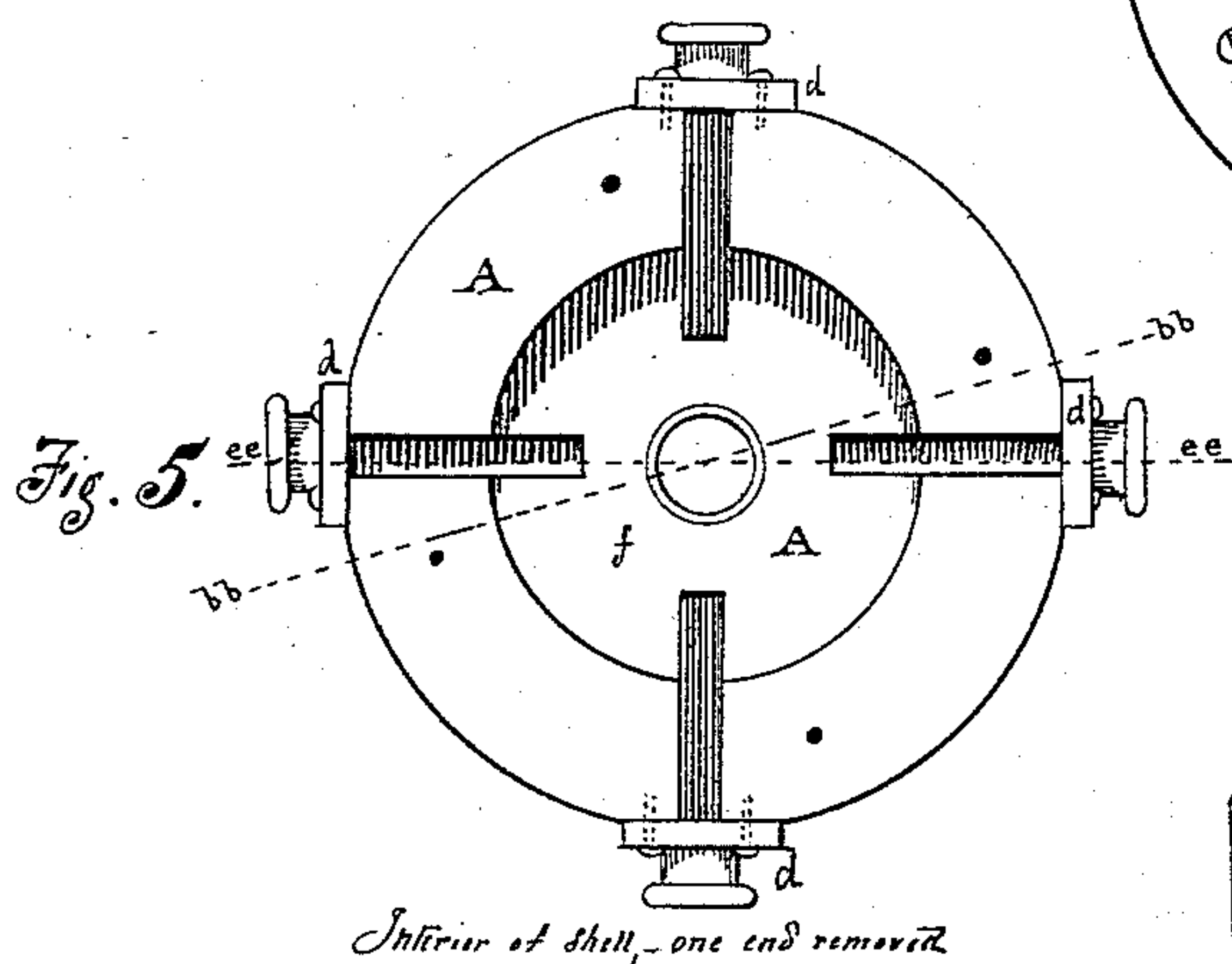
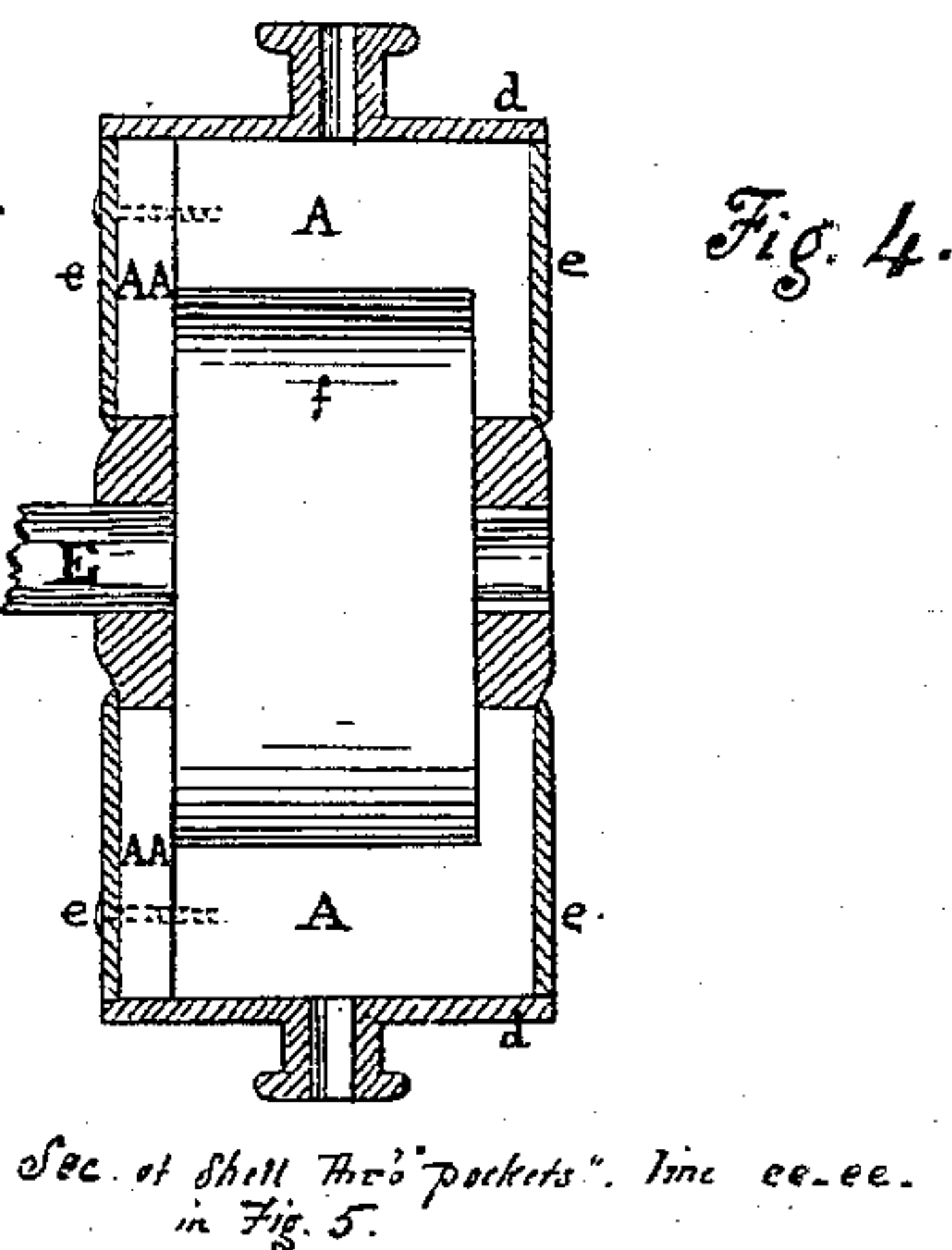
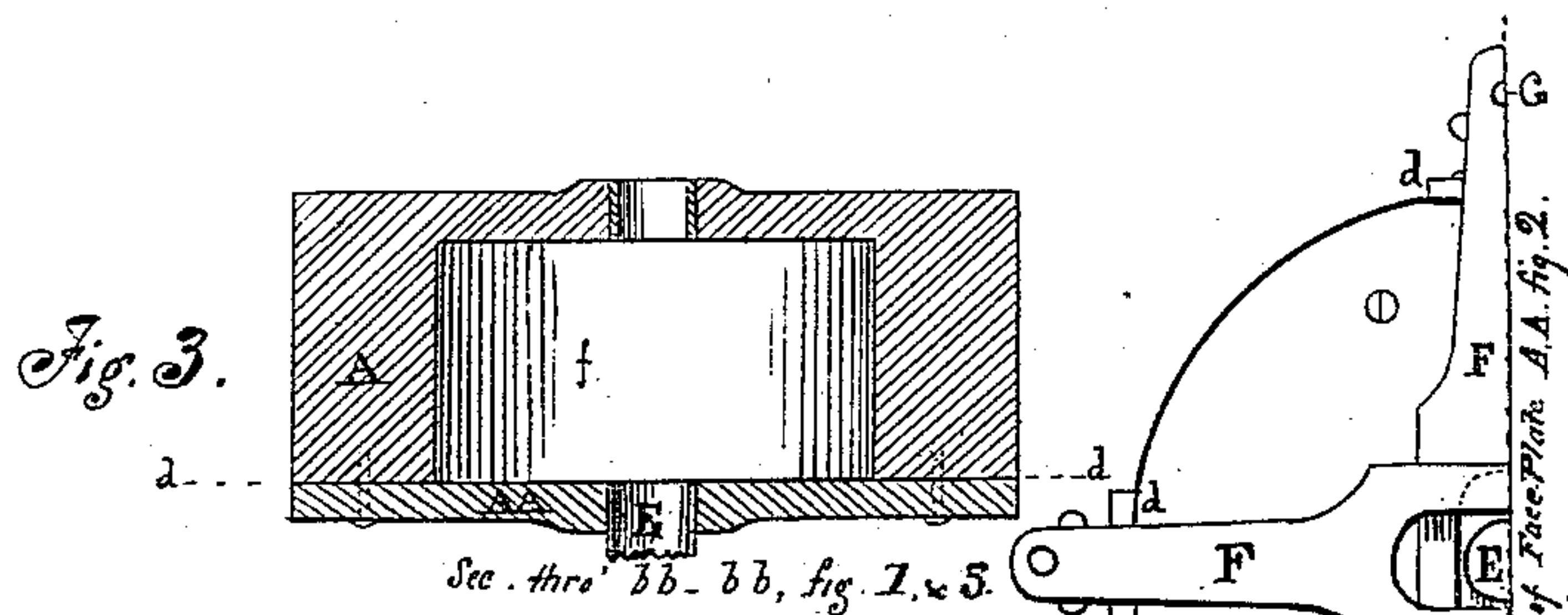
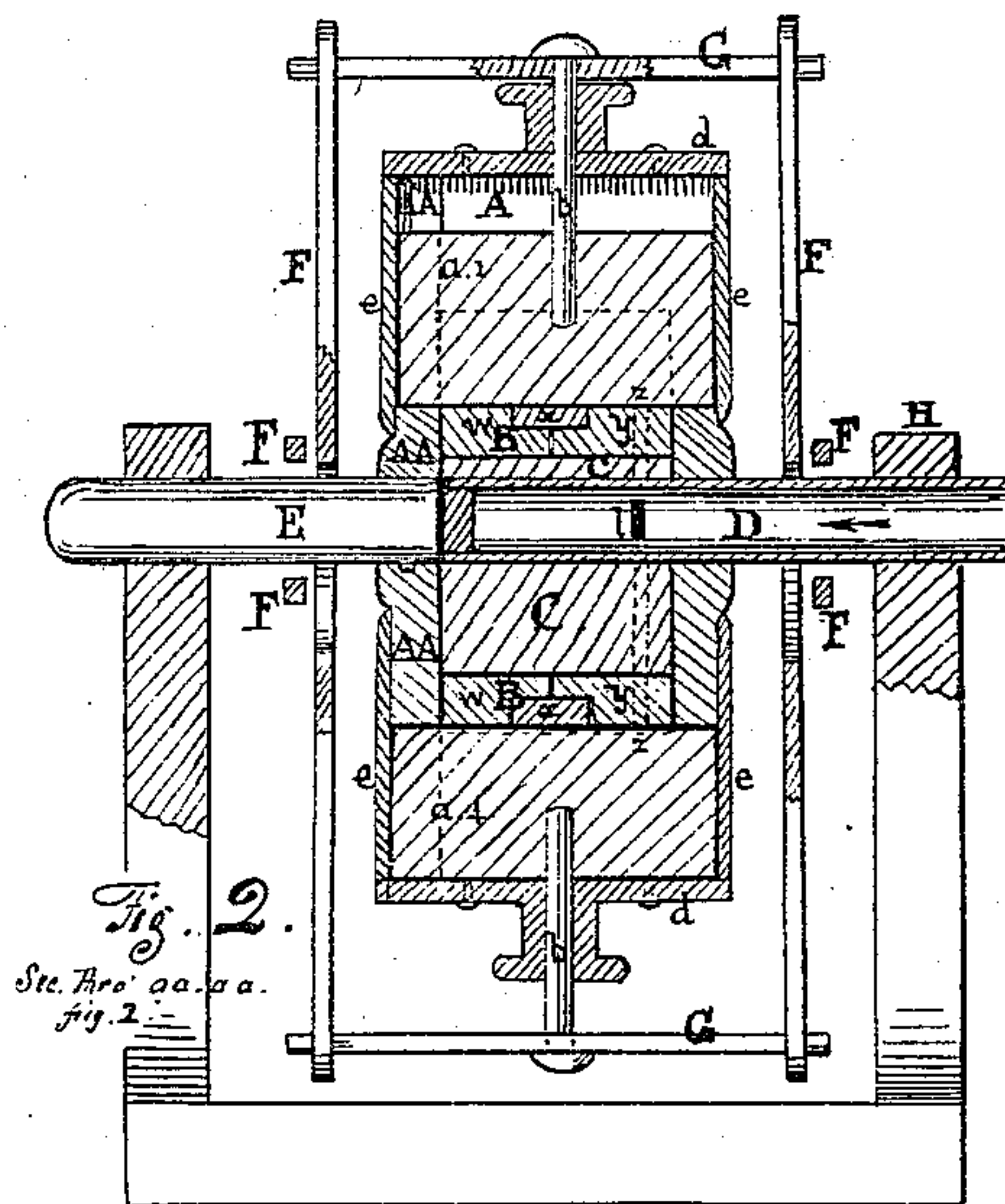
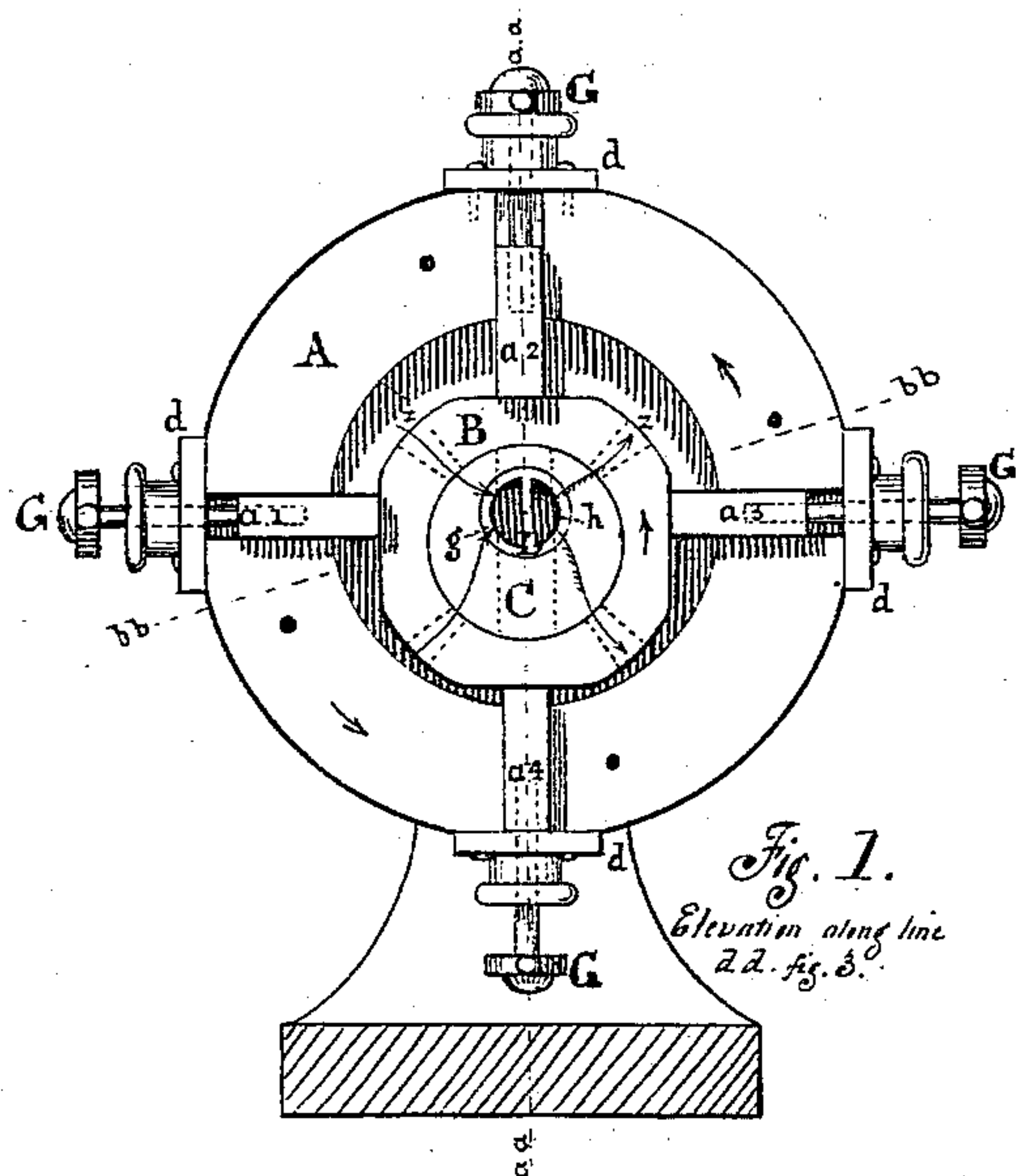


D. D. HARDY & A. C. WEST.
Improvement in Rotary-Engines.
No. 126,203. Patented April 30, 1872.



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Witnesses—
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UNITED STATES PATENT OFFICE.

DEXTER D. HARDY AND AUGUSTINE C. WEST, OF DELAVAN, ILLINOIS.

IMPROVEMENT IN ROTARY ENGINES.

Specification forming part of Letters Patent No. 126,203, dated April 30, 1872.

To all whom it may concern:

Be it known that we, DEXTER D. HARDY and AUGUSTINE C. WEST, both of the town of Delavan, in the county of Tazewell and the State of Illinois, have invented a Rotary Steam-Engine; and do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the annexed drawing making a part of this specification, in which like letters of reference refer to like parts, and in which—

Figure 1 represents an elevation, the cylinder-head removed; Fig. 2, a vertical cross-section through *a a a a*, Fig. 1; Fig. 3, a section of exterior cylinder through *b b b b*, Figs. 1 and 5; Fig. 4, a section of the same through "pockets" on line *e e e e*, Fig. 5; Fig. 5, view or elevation of exterior cylinder, the interior cylinder removed; Fig. 6, perspective view of "eccentric;" Fig. 7, perspective view of interior cylinder; Fig. 8, cross-section of latter through lines *c c c c*, Fig. 7; Fig. 9, transverse section of eccentric through line *f f* in Fig. 6.

Respecting the scale of drawing, the engine can be made of any size.

This invention consists in so arranging and constructing the several parts of a rotary steam-engine as to obtain a uniformity of wear throughout the machine. This we accomplish by placing within the exterior cylinder a cylinder eccentric to the exterior one, thereby leaving a crescent-shaped space for steam surrounding the periphery of the interior cylinder, which space is divided into four compartments by piston-blades, radial from the latter, and held against its flat surfaces. The space thus divided is constantly enlarged on one side, and decreased on the other side of a line passing through the throw of the "eccentric," and so arranged as to admit and cut off and work steam expansively by ports passing from a double steam-duct through the eccentric, and from thence through alternate ports in the interior cylinder into the steam-space.

A represents the exterior cylinder, closed at either end, and hung concentrically on a horizontal shaft, E, which revolves with it. It has an interior cylindrical space concentric with the shaft E and steam-duct D, and four equidistant radiating pockets for the piston-blades *a¹ a² a³ a⁴* in the solid periphery, and

opening into the interior, the ends of said pockets passing laterally beyond the interior surface of each cylinder-head, and the ends closed by plates *e e*, &c. (See Figs. 4 and 5.) The piston-blades *a¹ a² a³ a⁴* are each in a plane passing through the axis of the cylinder. Those piston-blades opposite to each other are respectively united and made to move together by connecting-bars, F, on the exterior of the engine, crossing each other at right angles, and respectively attached to the cross-heads G, terminating the stems *b b b b* of the respective pistons. The stems pass from the blades and pocket through a stuffing-box and plate, *d*, &c., one of which covers each pocket. The piston-blades fit their pockets, and are thick oblong plates, which extend beyond the ends of the two cylinders A B, and are kept continually in contact with their respective planes or flats of the cylinder B by the rods G G. This exterior cylinder is closed by the head A A, a section being seen in Figs. 1, 2, and 4. B is the interior cylinder, which extends horizontally between the exterior cylinder-heads, and in width occupying about three-fourths of the diameter of the interior of the exterior cylinder A, so adjusted with "eccentric" C as to nearly touch one side of the curved interior of cylinder A, (see Fig. 1,) leaving the rest as a steam-space. It is made in two divisions or rings, *w y*, separated by springs *v*, or other elastic means, as steam, &c., to press each half against its respective cylinder-head. A ring or hoop, *x*, lying in a groove at the junction of the two divisions *w y*, makes the joint steam-tight, and also preserves the integrity of the whole cylinder. The latter is flattened longitudinally, with four equal and equidistant planes along its length, as seen in Figs. 1 and 7; and four equidistant radial steam-ports, *z z z z*, are pierced through each of the curved surfaces down to the ports in the included eccentric cylinder C. C, a solid, cylindrical, stationary eccentric cylinder, terminating and fastened to the end of the steam-duct D; it entirely fills the interior of the cylinder B, which revolves upon it. Two steam-ports (induction and eduction, at pleasure of the engineer) communicate with the pipe D and the respective passages in the same, each port having an opening wide enough to supply two of the ports in the cylinder B at

once with steam, the others at such time serving as "exhausts." D is a stationary steam-duct and shaft, divided by a partition, *i*, throughout its length, but closed at the end next to the shaft E, and having openings *l k* through its inclosing eccentric C. It is supported on the outside of the engine in bearings H, in which may be passages, and a valve to supply steam and reverse the engine. The partition *i* lies in the same plane as that of the throw of the eccentric; one of the passages thus formed constitutes the induction and the other the eduction ways, and vice versa in reversing the engine.

The operation of this rotary-engine is as follows: The steam enters through port *k*, (see Fig. 9,) from duct D, or at one or the other passages of the same through the eccentric C, which ports, *k* and *l*, have openings wide enough to supply two adjacent ports, *z z*, of the cylinder B at one time; from thence, *z z*, the steam passes into the steam-space between piston-blade *a⁴* and *a³*, and also between *a³* and *a²*, exerting its force upon the pistons *a³* and *a²* simultaneously, carrying them before it, and, consequently, the exterior cylinder and the interior one, B, the latter moving with the former. It will be seen that the steam acts thus, by its constant effort in expanding, to arrive at the largest part of the steam-space along the continually opening curves of the steam-space, until the ports arrive over the exhaust-port on the other side of the eccentric C. There are thus always two ports open to receive steam, and two open to exhaust the same through the interior cylinder B, which plan obtains in the model and drawing, but can be modified, and with, possibly, some advantage. The two ports to the left of those mentioned above as induction-ports are the exhaust-ports, and in their turn will become

induction-ports in reversing the engine. In the mean time the interior cylinder B rotates on the eccentric cylinder C, its fixed axis, simultaneously with and in the same direction as the exterior cylinder A, which rotates on a different center, (*i. e.*, on shaft E or D,) which center is in the line of the "throw" of the eccentric C. The pistons *a¹ a² a³ a⁴* move upon or slide on their respective cylinder-planes B in making the circuit. Each pair of pistons being connected by the exterior rods G G, &c., keeps them in close contact with the interior cylinder B, and their contact surfaces (with the planes of said cylinder) traverse a space on said planes identical with the throw of the eccentric C, and this contact of the pistons with the planes on the cylinder B is the means by which the latter is rotated in unison with the exterior cylinder.

What we claim as our invention is—

1. In a rotary steam-engine we claim the cylinder B, composed of two or more rings provided with steam-ducts, in combination with elastic springs V, substantially as set forth.
2. The eccentric C, or axis of the cylinder B, fixed eccentrically on the steam-duct D, and stationary with the same, substantially as and for the purpose set forth.
3. The combination of cylinder B, eccentric C, and steam-duct D with the exterior revolving-cylinder A provided with piston-blades *a*, all constructed to operate substantially as set forth.

In testimony that we claim the foregoing rotary steam-engine we have hereunto set our hands this 24th day of November, 1871.

DEXTER D. HARDY.
AUGUSTINE C. WEST.

Witnesses:

EDMUND THURLOW,
M. D. BEECHER.