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W. E. SUDLOW.

Rotary-Engines.

No. 223,257. Patented Jan. 6, 1880.

Fig 1.

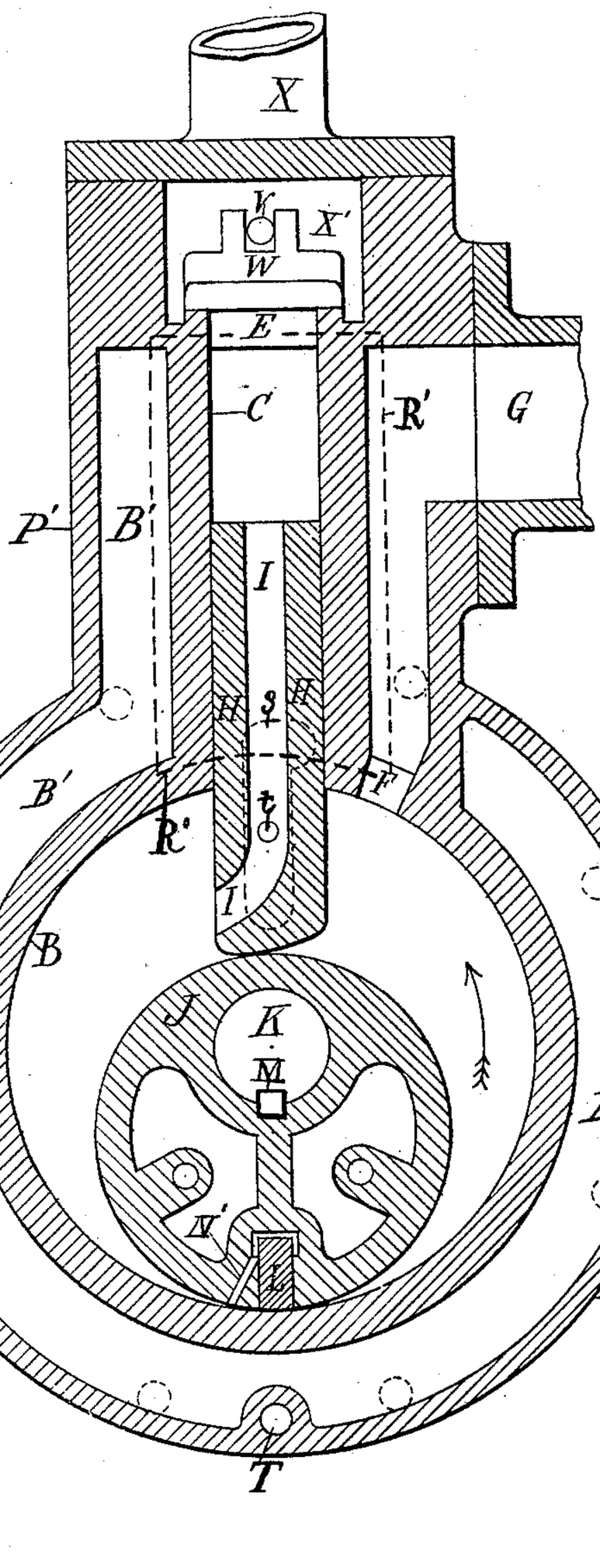

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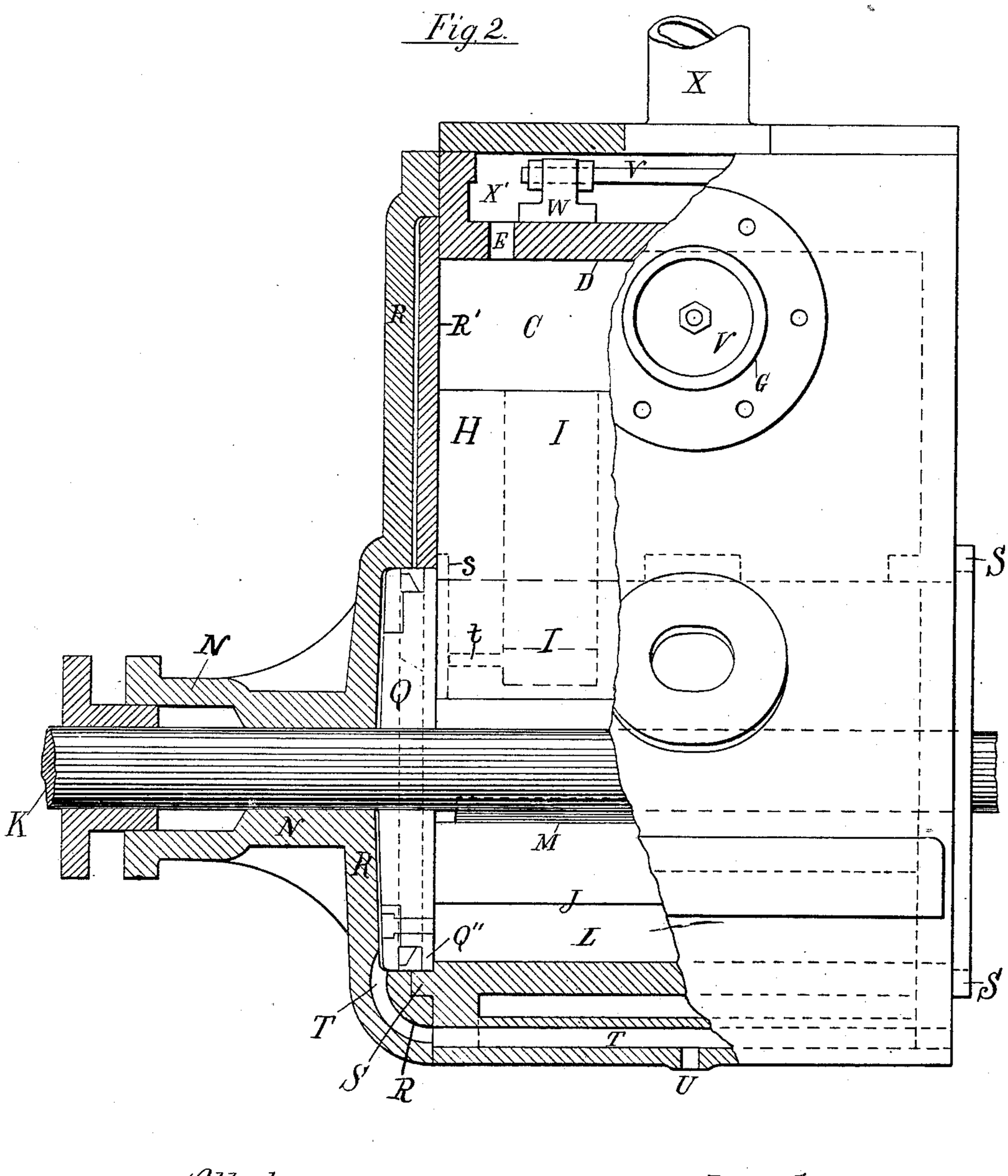
Fig. 2.



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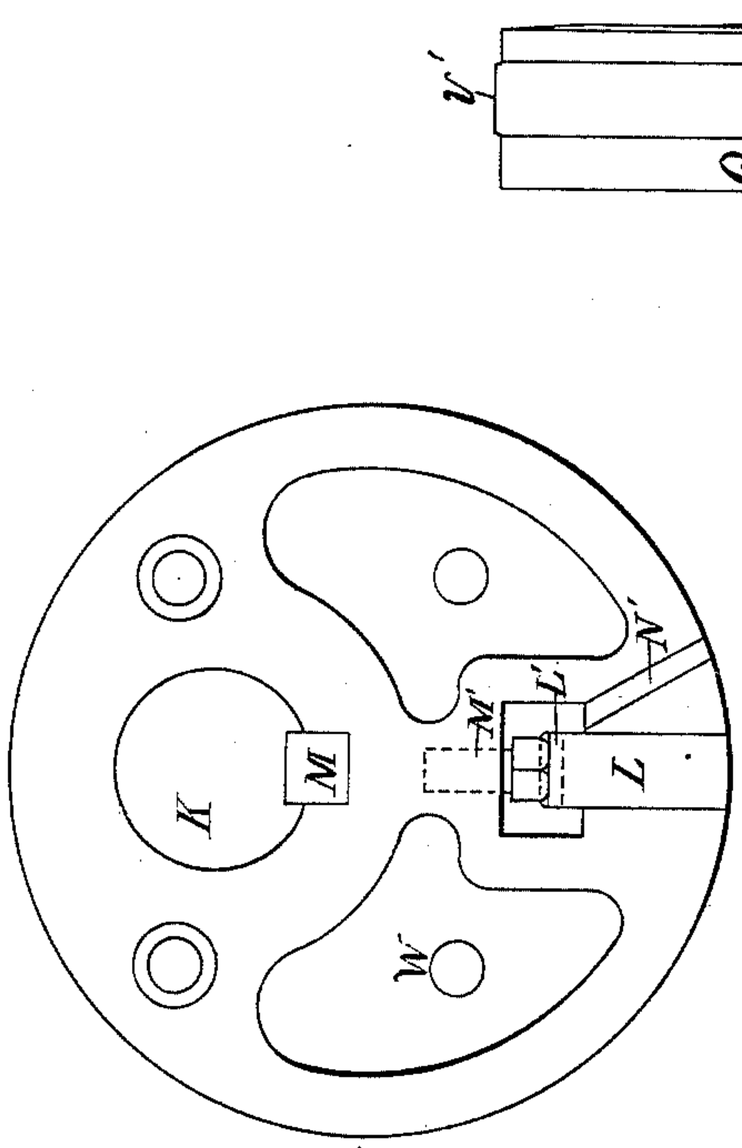

Fig. 4.

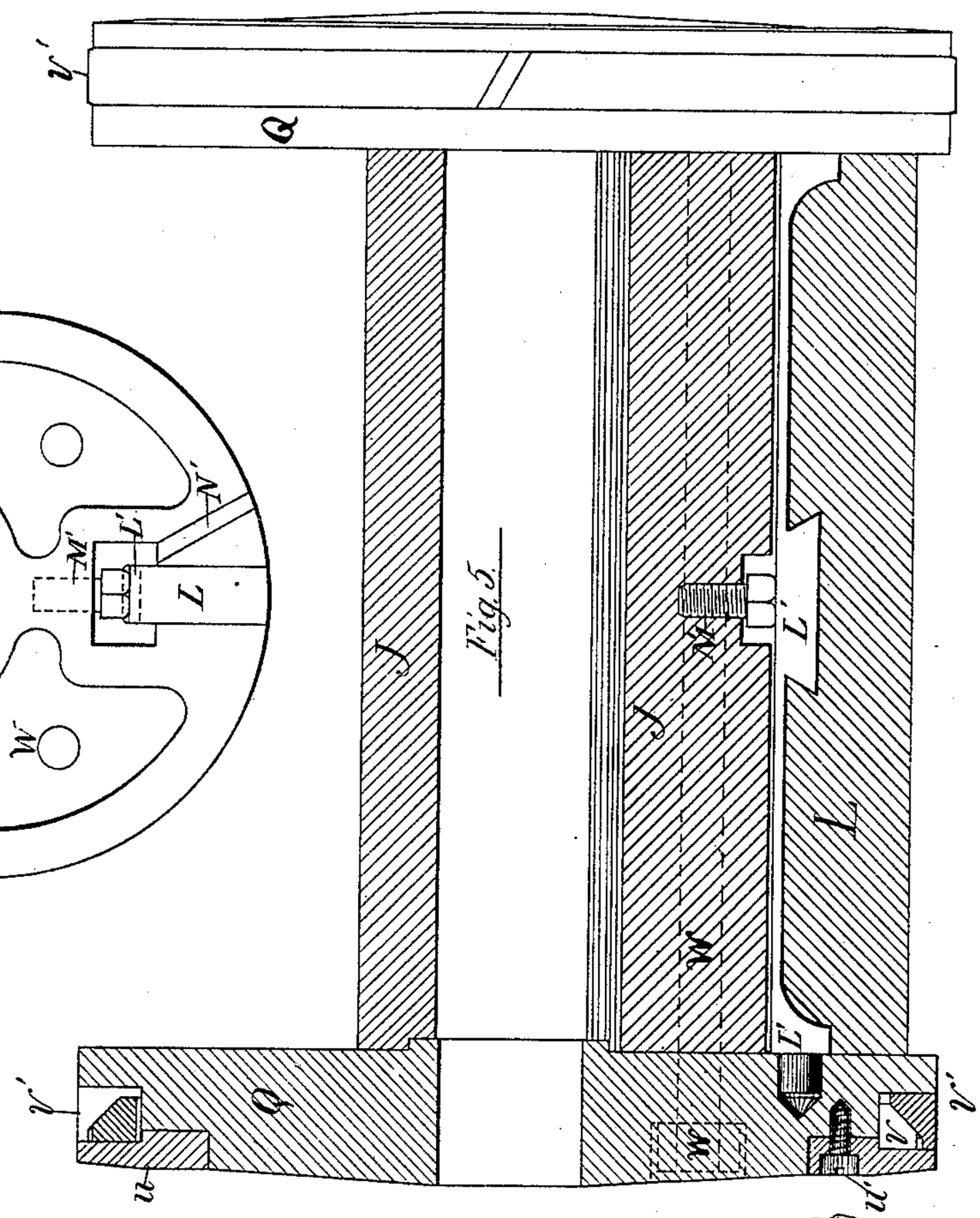

Fig. 5.

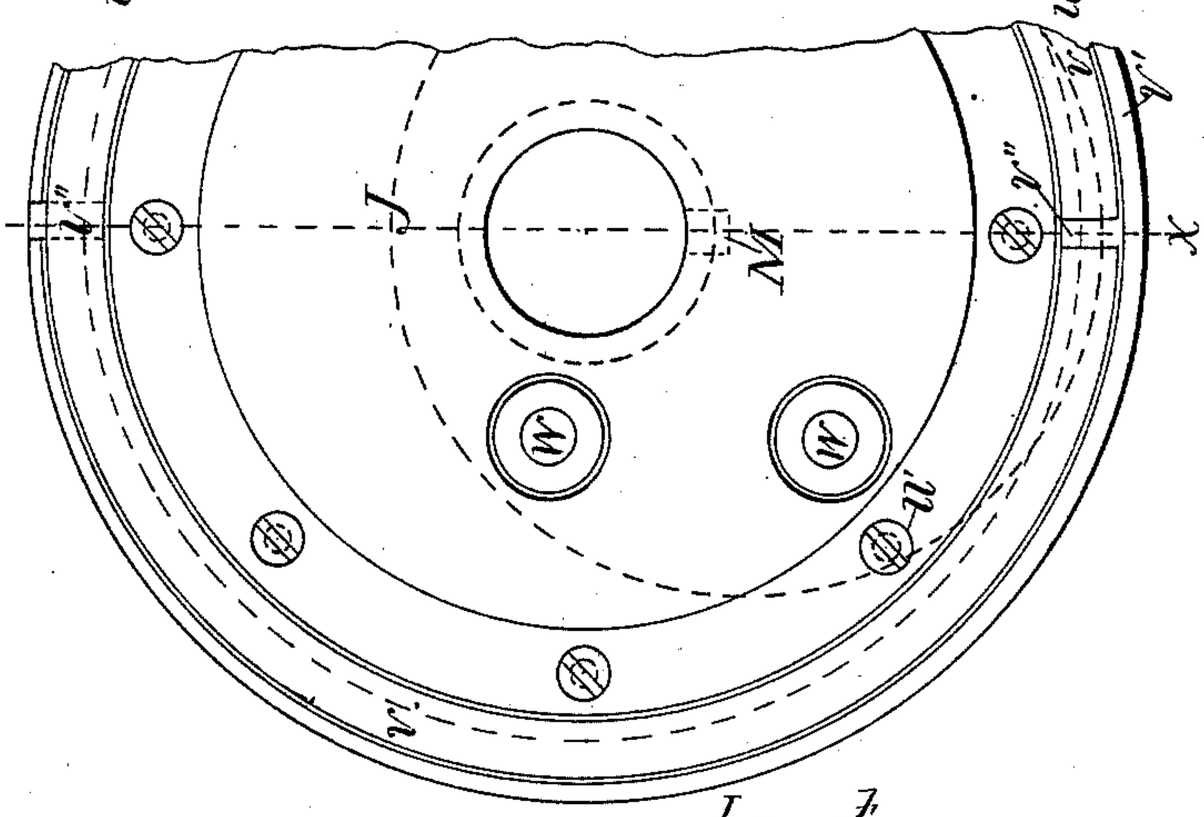

Fig. 3

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Fig. 6.

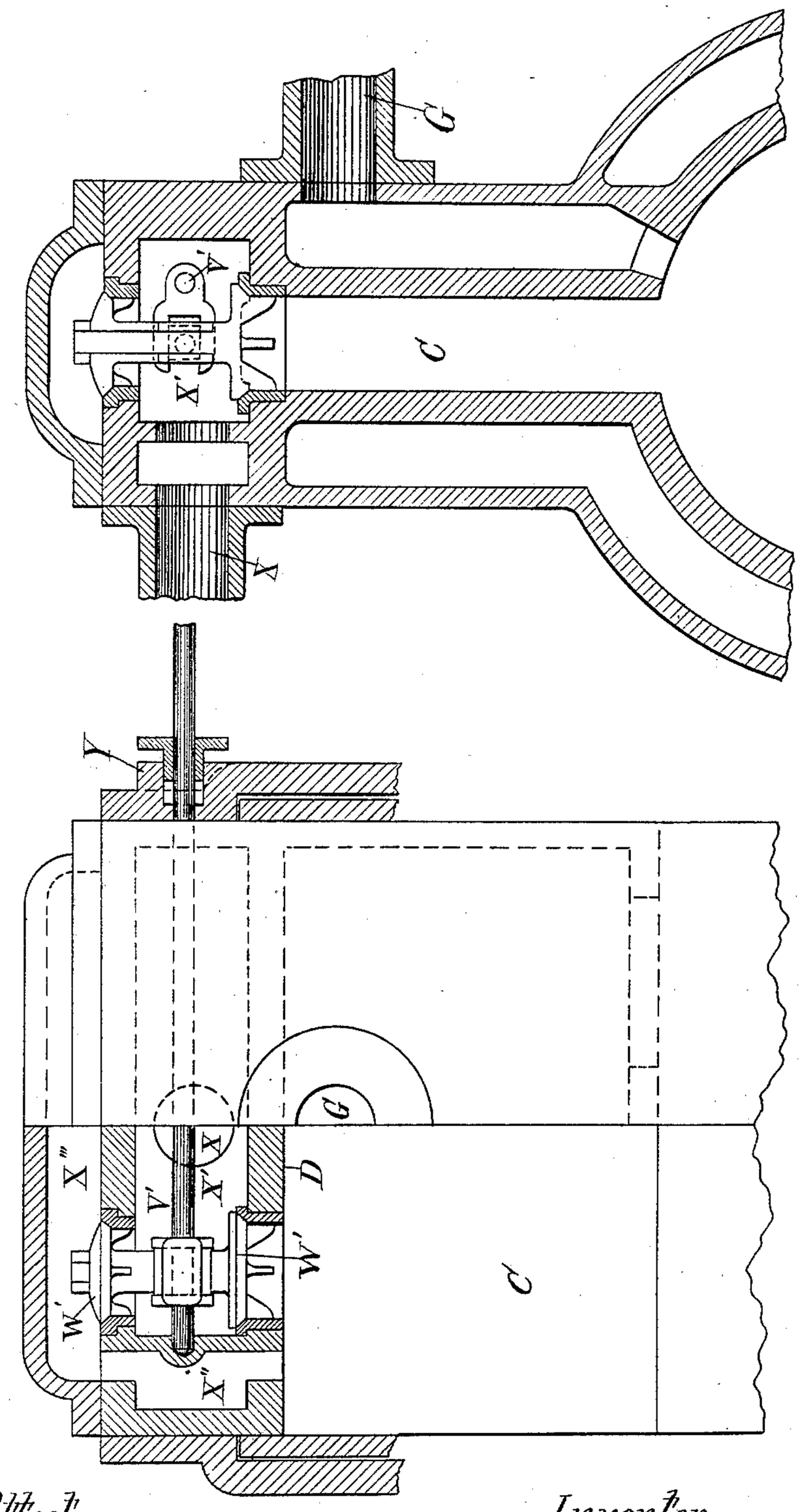

Fig. 7.

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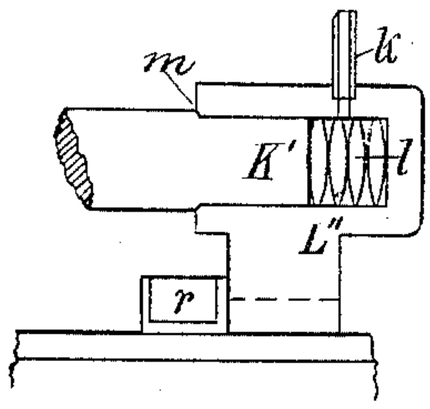
Fig. 10



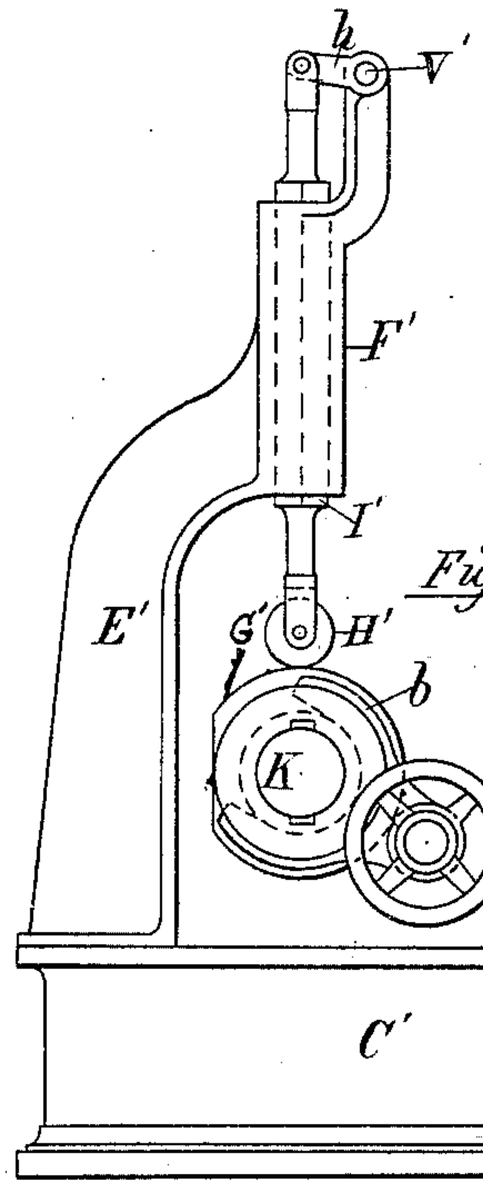


Fig. 9.

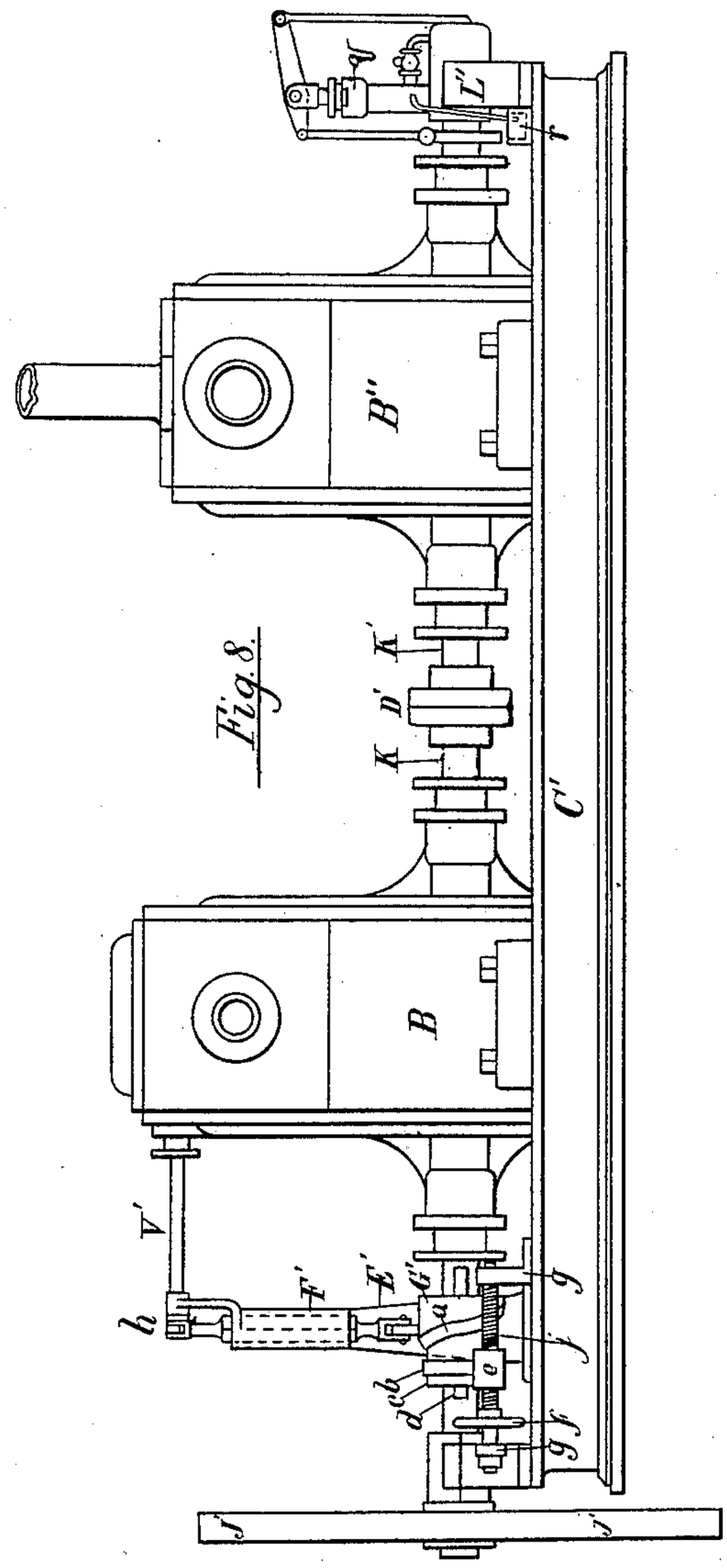


Fig. 8.

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UNITED STATES PATENT OFFICE.

WILLIAM E. SUDLOW, OF JERSEY CITY, NEW JERSEY.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 223,257, dated January 6, 1880.

Application filed November 11, 1878.

To all whom it may concern:

Be it known that I, WILLIAM ELI SUDLOW, of Jersey City, in the State of New Jersey, late of Oldham, in the county of Lancaster, England, have invented a new and useful Improvement in Rotary Engines, which improvement is fully set forth in the following specification and accompanying drawings.

I will first describe the machine as constructed and operated for producing motive power by the use of steam or compressed gases.

Figure 1 of the drawings shows, in section at the central line, an engine-cylinder constructed with my improvements as adapted to a motor. Fig. 2 is a side elevation of the same, partly in section, through the vertical center line. Figs. 3, 4, and 5 are details of the construction of the piston and disks. Figs. 6 and 7 show the arrangement of the balance-valves used with the cut-off mechanism shown in Figs. 8 and 9. Figs. 8 and 9 show the cut-off mechanism. Fig. 10 is a longitudinal section of the thrust-bearing shown at the end of the engine-shaft in Fig. 8.

Referring to Figs. 1 and 2, A A are the feet of the cylinder; B, the bore of the same; and C, a slot extending from the bore to a bridge, D, in which are the inlet-ports E, (only one being shown by drawings,) controlled by a plain slide-valve, W, one or more of which can be secured to and moved with the valve-rod V. The bridge D forms the bottom of the valve-chest X′, to which steam is admitted by the steam-pipe X.

F is an outlet-port, by which the exhaust makes its escape to the waste-pipe G after it passes through the cylinder. H is a sliding abutment fitting nicely in the slot C and furnished with one or more passages, I, which lead from its top end to the interior of the cylinder by openings through its side near the bottom. J is a revolving eccentric or cam of any desired shape, and is secured to a driving-shaft, K, which extends lengthwise through the center of the cylinder. This eccentric, revolving in contact with the interior of the cylinder, forms the piston of the engine, and is packed by a packing-bar, L, kept out against the cylinder-bore, as desired, by the pressure within the cylinder being admitted behind it through a hole, N′.

M is a feather for securing the piston to the shaft K, and is made shorter than the piston, and carefully fitted to the same, so that it shall be tight enough to drive the piston, and yet free to allow expansion longitudinally when the shaft becomes heated.

To obviate friction and leakage I secure to the piston, at each end, a disk or piston-head, Q, which revolves concentric with the shaft in contact with the end of the cylinder at Q″. A projecting ring, S, is cast at the ends or flanges of the cylinders, into which the disks are so fitted as to allow suitable clearance.

The heads or outer covers, R, are fitted over the rings S, and recessed to receive the disks, a small space being left outside of the disks, into which any leakage past the disk is received. A channel, T, is formed at the bottom of each head, and across the bottom of the cylinder or beneath the same, to bring these spaces into communication, and thereby secure an evenness of pressure upon the outsides of the two disks. Any condensation occurring in these spaces may be discharged at U, while the steam remaining in these spaces tends to lubricate the disks as they revolve in their places.

The operation of an engine thus constructed is as follows: Suppose the slide-valve W to be connected with an eccentric or other gearing on the main shaft, and so operated as to begin to open the port E when the packing-bar L in the piston J is directly beneath and in contact with the lower end of the sliding abutment H, which slide will then be up to the farthest attainable point in the slot or recess C. It is evident that the entry of the steam by the valve W and sliding abutment H, when the parts are in these relative positions, will cause the piston to revolve in the direction indicated by the arrow, and the ingress of the steam may be continued, during the revolution, until the packing-bar L passes the exhaust-port F, or its entry may be cut off at any desired point in the revolution by adjustment of the mechanism operating the valve W. As the piston J approaches the completion of the revolution the sliding abutment H will be forced up into the slot C, and the adjustment may be such that the lower apertures, I, will then be closed against the side of the slot C. As soon as the packing-bar passes over the port F the steam will escape out of the cylinder through the exhaust-port F and G, and the revolution of the piston being continued by the momentum of

a fly-wheel or otherwise, the valve W will admit a fresh supply of steam through the sliding abutment H, and so sustain a continuous rotary motion; but where it is desired to vary the point at which the steam shall be cut off I prefer the arrangement shown in Figs. 6, 7, 8, and 9, where a double-beat valve, W′, is placed above the bridge D, the rock-shaft for working these valves being marked V′, and the stuffing-box, by which it enters the valve-chamber, Y.

Fig. 6 shows a section of the valves, and also of the inlet and exhaust pipes X and G, with the slot C below the chest X′.

Fig. 7 shows a side elevation of the upper part of a cylinder, the left side being all in section, except the valve W′, to show a passage, X″, connecting the two valves W′ together, the upper one opening into a chamber, X‴, into which the passage X″ leads.

Fig. 8 shows the mode I adopt to open the valves W′ and close them at any point in the revolution of the piston J.

B is a steam-cylinder, secured to a bed, C′; and B″, a cylinder of somewhat similar construction, fitted for pumping, and its shaft K′ connected by the coupling D′ to the shaft K of the steam-cylinder B. The valve-rod V′ is here shown, and also in Fig. 9, where the connections for operating the same are shown upon a larger scale.

A stand, E′, is mounted upon the bed C′, and supports a vertical guide, F′, over the center of the shaft K. A spiral-faced cam, G′, is placed on the shaft, and a roller, H′, rests upon the cam, being held in the lower end of a rod, I′, which passes through the guide F′, and is connected at the top to a crank or lever arm, *h*, on the rod V′. The cam slides on the shaft, and is driven by feathers *d*, being held at any required part of the shaft by the fork *b*, fitted into a groove formed in the cam G′. This fork is provided with a nut, *e*, fitted to the screw *j*, and operated by the hand-wheel *f*, by which means the cam is moved along the shaft and held at any desired position thereon. This cam is constructed with a raised surface on a concentric hub, the raised surface being arranged spirally to the shaft at one edge, and parallel with the shaft K at the other edge. The length of the time that the raised surface will continue to lift the roller H′ and support it at the highest attained position depends upon the portion of the cam which revolves in contact with the roller. As the roller, acting upon the rod I′ and lever *h*, operates the double-beat valves W′, it is evident that the valves may be dropped at any desired point in the revolution of the piston, and that the straight edge of the raised surface, when once adjusted properly, will cause the valve to open always at the beginning of the revolution.

The engine is shown provided with a fly-wheel, *j′*, and with a special device for oiling a bearing, L″, on the end of the shaft K.

As the shaft passes all the way through the engine described it is especially adapted for use in driving propellers, that the thrust-bearing may be at the extreme end of the shaft. When so employed I arrange a pump, *q*, to be driven by the shaft or otherwise, and provide an oil-tank, *r*, from which the pump constantly draws a supply of oil and forces it into the closed end of the shaft-bearing L.

In Fig. 10 is shown the thrust-bearing L″ on a larger scale, with washers *l* provided to receive the thrust, and an oil-tank, *r*, so located as to catch the oil as it drips, after use, from the open end of the shaft-bearing L.

By the constant operation of the pump the oil entering the pipe *k* exerts a fluid-pressure upon the end of the shaft K′, and virtually prevents all pressure of the shaft upon the washers directly.

The shoulder *m*, formed upon the shaft in contact with the bearing L″, prevents any escape of oil until the pressure exerted by the pump exceeds the thrust of the shaft, when the latter, being thereby forced from its contact with its bearing, affords an outlet for the oil at *m*, and its escape prevents the shaft from being forced out of its bearing to an improper extent.

By the arrangement of the shaft in the piston J, as before described, the shaft can slide endwise in the cylinder without deranging the working of the engine, and therefore no harm can result from applying such pressure as has just been described to the end of the shaft, nor from any end motion arising from the working of a propeller.

Having thus described the larger features of my invention, I will proceed to describe some of the smaller points conducing greatly to the successful operation of the machine.

The sliding abutment H, an end view of which is shown in Fig. 1, is made of the same length as the bore of the cylinder, and the cylinder is constructed with flanges B′ at each end, and may have a steam or water jacket around it, if desired, as at P′. The heads or covers R, Fig. 2, are provided each with an angular groove to fit a corresponding rib, S, at each end of the cylinder, thus forming a support to retain the circular form of the cylinders, and also insuring that the shaft K shall be in the center of the same.

The cylinder-covers are extended over the ends of the slot C, but formed with a rectangular cavity, so that special covers R′ may be first bolted over the ends of the slot, to which the ends of the sliding abutment H can be fitted and scraped with more accuracy than would otherwise be possible, as the heads themselves can be entirely out of the way when the fitting is being done. These special covers are shown at R′ in Figs. 1 and 2, and consist simply of flat plates secured by bolts over the ends of the slot C, and extending from the periphery of the disks Q to and beyond the upper end of the slot.

The rectangular shape of the cover is plainly shown in Fig. 1 by the dotted lines, while in

Fig. 2 is shown the recess in the head R which accommodates the covers R′.

The nose of the sliding abutment H, as shown in Fig. 1, is of a peculiar construction, being rounded off much less toward its front side, where the ports are located, than toward the back, and the pressure upon the upper end of the sliding abutment keeps this nose in close contact with the revolving piston, while the lower end and back side of the sliding abutment being chiefly exposed to atmospheric pressure, a close joint between the exhaust and pressure sides is obtained. In each end of the sliding abutment, where it bears against the disk Q, a packing-piece is inserted, and a hole from the ports I admits pressure behind it.

The disks Q are each packed at the edge by two angular piston-rings, (shown in Figs. 3 and 5,) fitted into a rectangular recess turned in the periphery of each disk and covered on the outer face by a follower, *u*.

Fig. 3 shows one of the disks with the follower removed, while in Fig. 5 is shown a section of the disk and piston through the center line, X, Fig. 3. In this section the rings V V′ are plainly shown, each in section, on the opposite sides of the disks.

At U′ are shown the follower-bolts, and at *w* the bolts for holding the disks Q to the piston J.

The rings V V′ are made of peculiar form to secure a circumferential expansion and lateral pressure of the outer ring, V′. These rings are both made of greater diameter than the recesses provided for them, respectively, and a section is then cut out of each, and they are sprung into their places, and when in place the cut ends should meet, so as to complete the circles.

The recess in ring V′ is turned with an inclined side sloping toward its center, and forming an angular conical cavity, into which the ring V is fitted after being turned of conical shape exteriorly, to fit the interior of the ring V′. These conical surfaces are made at angles of from forty to fifty degrees with the plane of the rings, and thus any pressure exerted by the smaller ring tends to force it into the conical cavity in the ring V′, and to move it laterally.

The packing-bar of the piston (shown enlarged in Figs. 4 and 5) is provided with a spring, L′, that suffices to draw it back into its recess when the pressure communicated to the space behind it from the interior of the cylinder through the hole *n′* is removed.

The spring L is provided with a pin at each end, which fits into a hole in the disks Q, and with a dovetail block at the middle, which fits a notch of the same shape in the back of the packing-bar L.

A screw or screws, M′, are provided to adjust the packing-bar L to the surface of the piston in contiguity to the bore of the cylinder, which may be made concentric for some distance, by first forming a piston a little too large for its place, and then turning off the excess by revolving the piston on its shaft.

Having thus described my invention, I claim as new, and desire to secure by Letters Patent, the following:

1. In a rotary engine or pump, the combination of the cylinder B, constructed with the passages E and F and slot C, the sliding abutment H, provided with ports I, and which moves automatically under the influence of the revolving piston J, and the steam or gas pressure holding it in contact with said piston.

2. In a rotary engine or pump, the combination and arrangement of the shaft K and disks Q, concentric with the cylinder and eccentric to the piston J, and the cylindrically-bored cylinder B, substantially as herein set forth.

3. In a rotary engine or pump, disk Q, of a greater diameter than the bore of the cylinder B, and the sliding abutment H, the end of which does not recede beyond the periphery of the disk, in combination with the eccentric piston J.

4. The combination of the annular rib S, cover R, and packing V and V′ in the periphery of the disks Q, for closing the joint between the cylinders and cover, in the manner set forth.

5. In a rotary engine or pump, a disk, Q, with a following-ring, *u*, to admit the rings V and V′, in combination with the rings V and V′, having beveled sides fitting into each other, and provided with clearance to allow the inner ring to expand.

6. In a rotary engine or pump, the special cover R′, combined and arranged with the slot C and sliding abutment H, in the manner and for the purpose set forth.

7. In a rotary engine or pump, the combination and arrangement of the covers R, disks Q, and covers R′, to form the cavities for containing the fluids that escape from the cylinder B, connected by the channel T, whereby the pressure upon the outsides of the disks Q and covers R′ is equalized, as and for the purposes herein set forth.

8. In a rotary engine or pump, the channel T, connecting in any convenient manner the spaces inside the covers R upon both sides of the cylinder B, for equalizing the pressure upon the outsides of the disks Q and covers R, as specified.

9. In combination with the piston J, the packing-bar L and the reacting spring L′, for withdrawing the packing-bar when the same is relieved from pressure.

10. In a rotary engine or pump, the piston J, in combination with the shaft K and feather M, arranged so that the shaft may expand longitudinally through the piston.

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Witnesses:

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GEO. F. GRAHAM.