(No Model.) 4 Sheets—Sheet 1.

J. E. STUDLEY & R. C. BERRY.

ROTARY ENGINE.

No. 410,043. Patented Aug. 27, 1889.

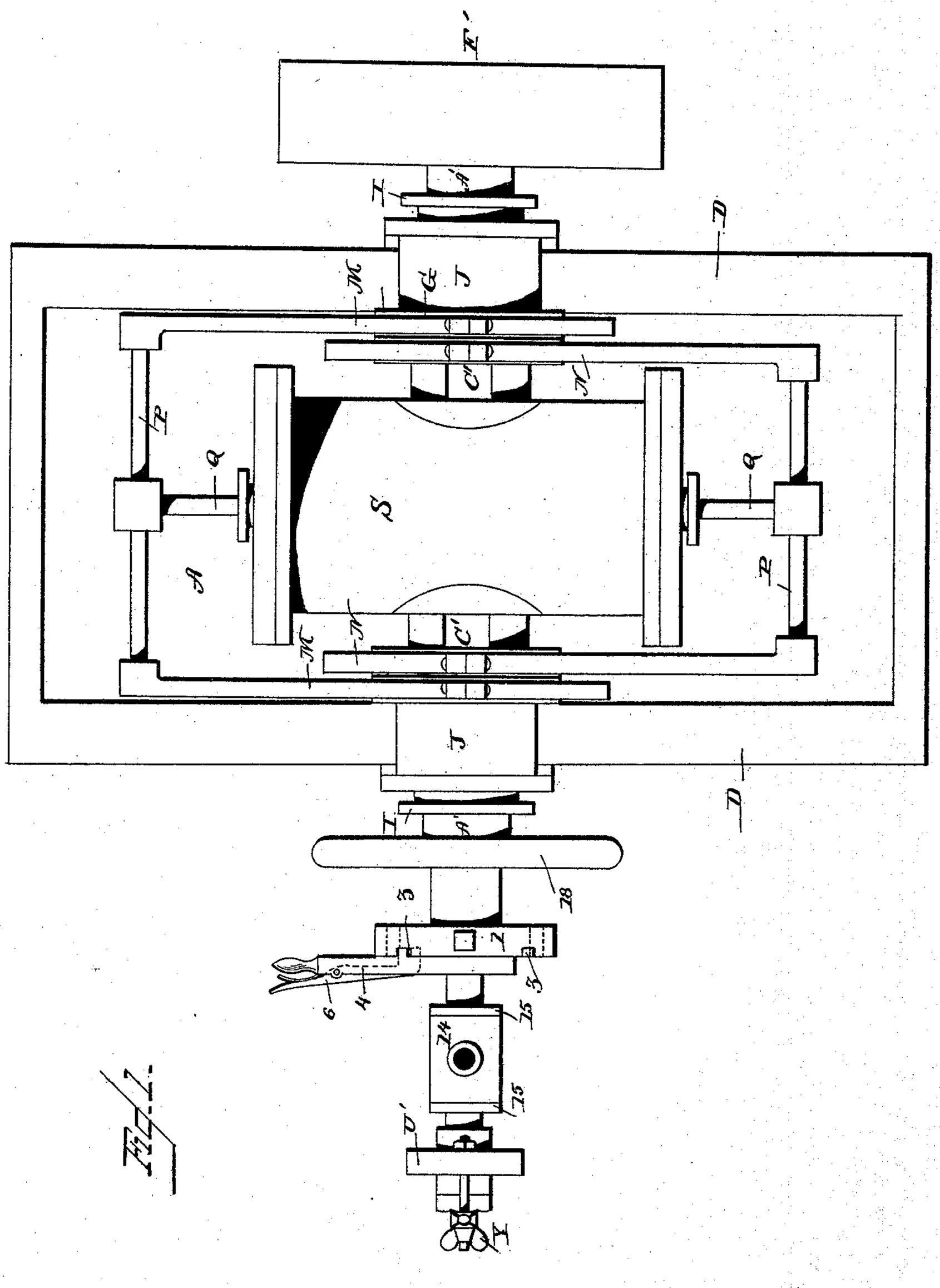

Fig. 1.

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ROTARY ENGINE.

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Fig. 2.

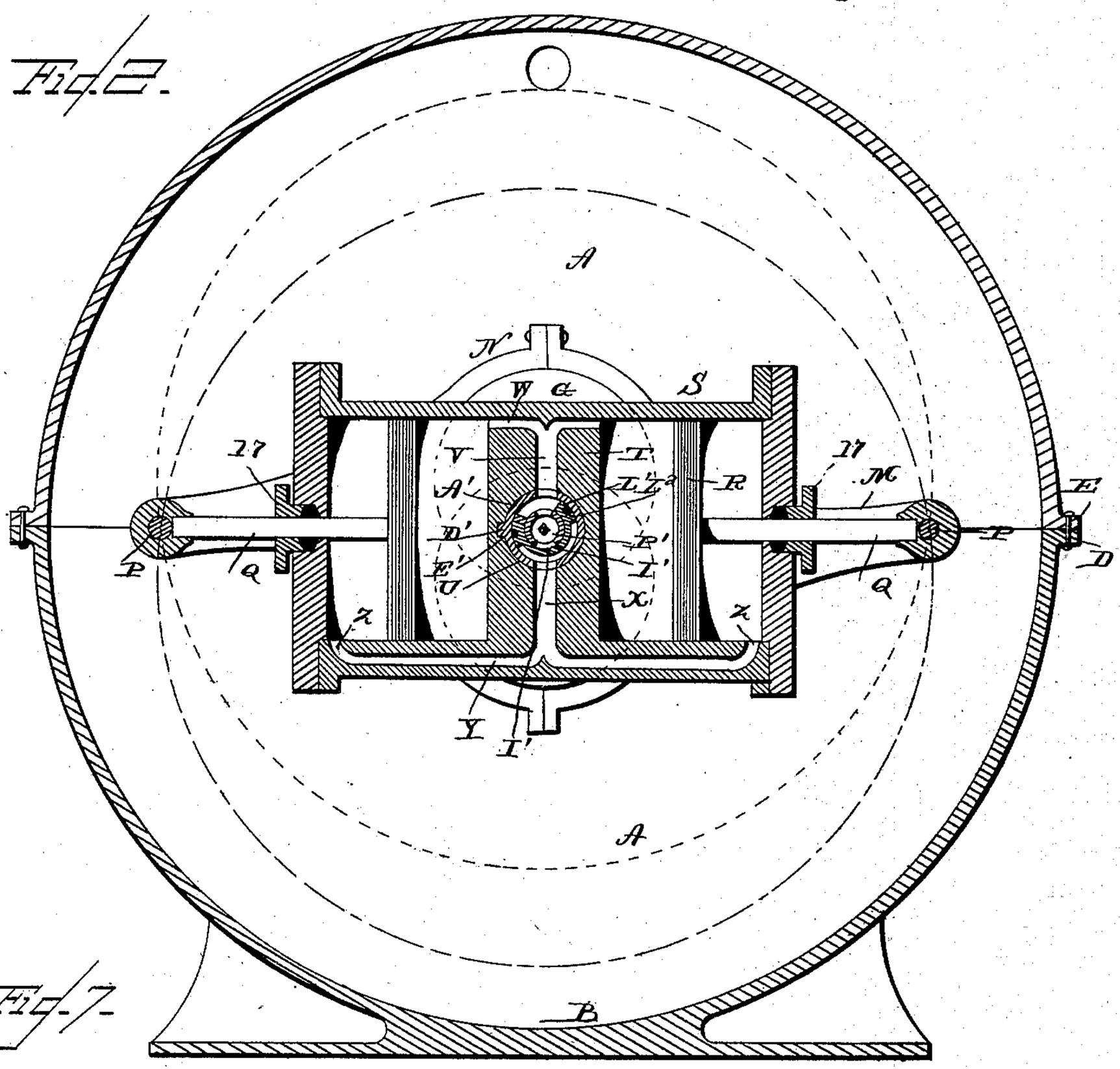


Fig. 7.

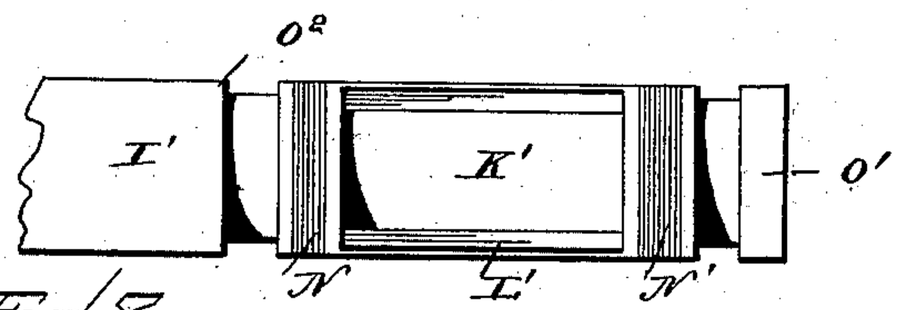


Fig. 8.

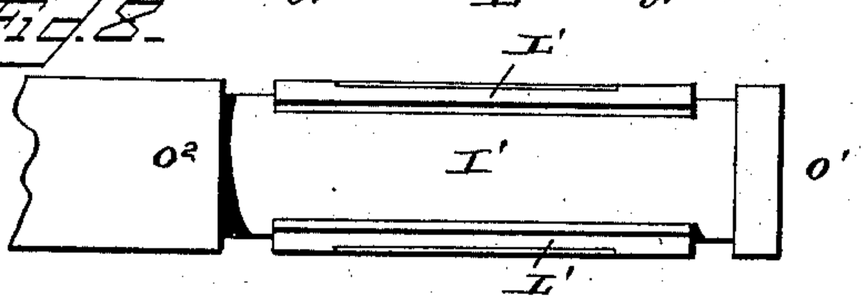


Fig. 6.

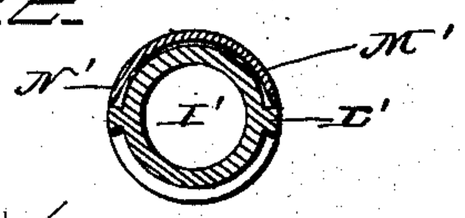
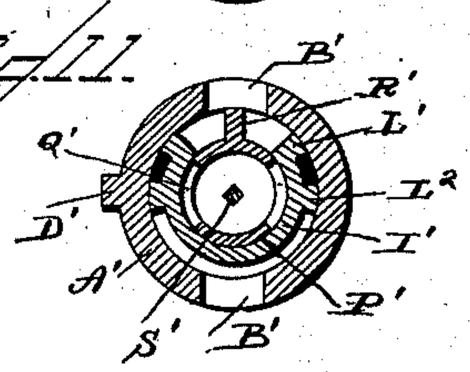


Fig. 11.



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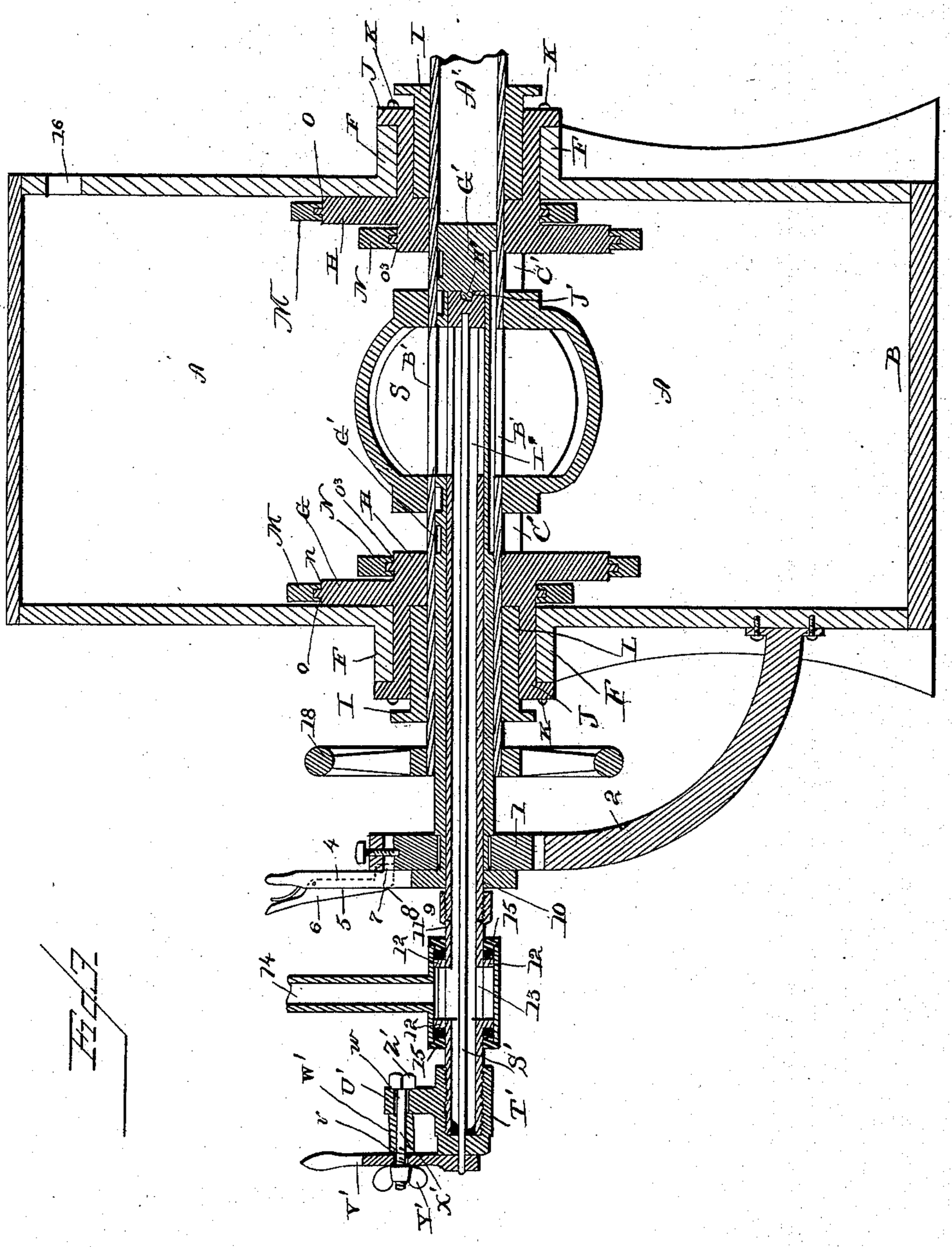
ROTARY ENGINE.

No. 410,043. Patented Aug. 27, 1889.



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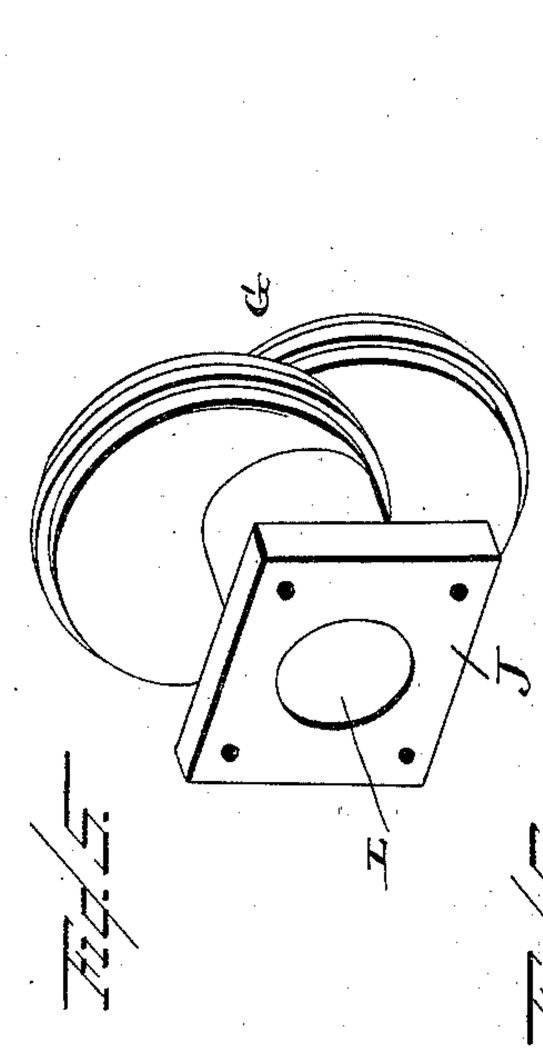
No Model.)

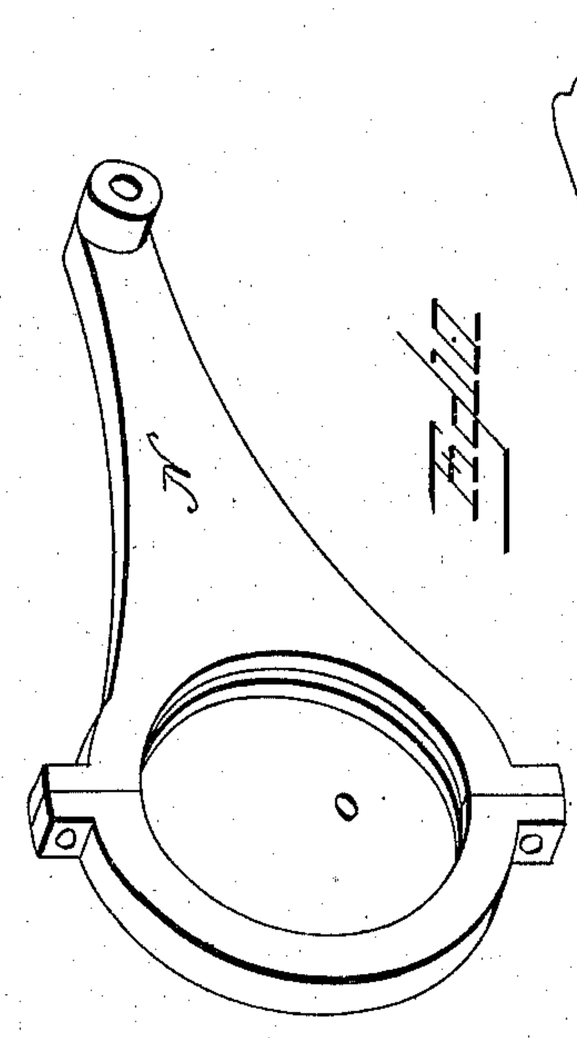
4 Sheets—Sheet 4.

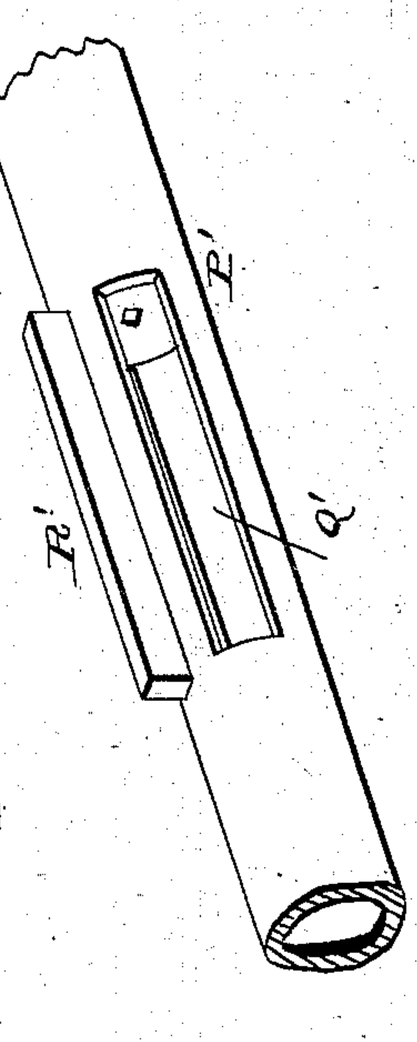
J. E. STUDLEY & R. C. BERRY.

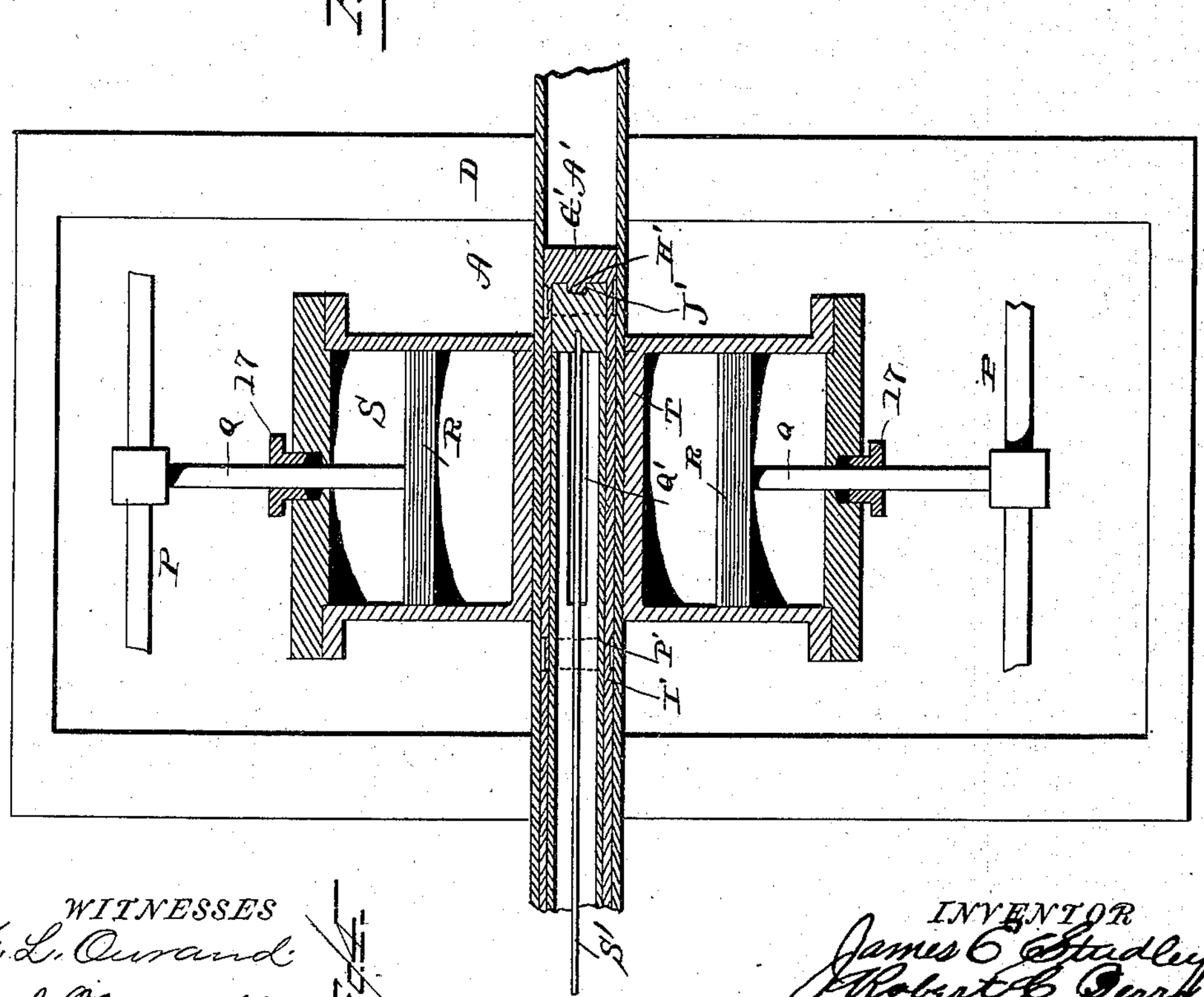
ROTARY ENGINE.

No. 410,043. Patented Aug. 27, 1889.









WITNESSES

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UNITED STATES PATENT OFFICE.

JAMES E. STUDLEY AND ROBERT C. BERRY, OF OSHKOSH, WISCONSIN, ASSIGNORS OF ONE-THIRD TO JOHN M. McDONALD, OF LAFAYETTE, INDIANA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 410,043, dated August 27, 1889.

Application filed [illegible]ry 23, 1889. Serial No. 300,894. (No model.)

To all whom it may concern:

Be it known that we, JAMES E. STUDLEY and ROBERT C. BERRY, citizens of the United States, and residents of Oshkosh, in the county of Winnebago and State of Wisconsin, have invented certain new and useful Improvements in Rotary Piston Engines; and we do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification, and in which—

Figure 1 is a top plan view of our improved rotary engine, showing the upper section of the casing removed. Fig. 2 is a transverse vertical sectional view taken through the center of the engine, showing the ports or slots registering upon the upper side of the machine. Fig. 3 is a longitudinal section taken through the hollow shaft, showing the ports or slots registering upon the upper side of the cylinder. Fig. 4 is a horizontal section with these ports registering. Fig. 5 is a detail view of the eccentrics, hub, and flange. Fig. 6 is a detail view of the connecting side pieces. Fig. 7 is a top plan view of the valve. Fig. 8 is a similar view of the opposite side of the valve. Fig. 9 is a cross-section of the valve taken through the packing and curved spring in one of the semi-cylindrical recesses. Fig. 10 is a detail view of the cut-off valve, and Fig. 11 is a cross-section through the valve proper and cut-off valve when said cut-off valve is adjusted so as to stop the flow of steam into the hollow shaft.

Like letters of reference denote corresponding parts throughout the several figures.

Our invention relates to certain new and useful improvements in reversible double or single acting engines, and relates more especially to the class of rotary cylinder engines; and it consists in providing a double or single acting rotary engine so constructed that the piston-heads will receive and exhaust steam or other motive power alternately upon their front and rear faces; further, in providing suitable valve mechanism whereby the steam is admitted into the cylinders and exhausted therefrom on each half-revolution of the cylinder; further, in providing suitable eccentrics, in combination with the side connections, whereby said connections are made to control the inward and outward movement of the piston-heads; furthermore, in providing suitable means whereby the engine may be reversed when necessary with but the slightest difficulty; furthermore, in providing a suitable cut-off valve of the construction herein shown and described, by means of which the engine may be stopped at any point of its revolution, and, furthermore, in various other details of construction, as will be hereinafter more fully set forth and described.

In the accompanying drawings, the letters A A represent the lower and upper sections of the casing of our improved steam-engine. The lower half of the cylindrical casing is provided at its bottom with a base-piece B and its upper edge with a rectangular flange D, upon which the lower rectangular flange E of the upper half of the casing rests, and the two are bolted or secured together in any desirable manner. The upper and lower halves of the casing are furthermore provided each with central semi-cylindrical bearings F F, which, when the two are secured together, form circular bearings.

G G are the eccentrics, having the hubs H H extending laterally therefrom and resting upon metallic bush-boxes I I, formed within the circular bearings of the cylindrical casing. The outer ends of the hubs extend beyond the outer side of the casing, and are provided with square flanges J J, which enable the same to be secured, by means of bolts K K, to the casing. These bolts pass through the flange formed upon the hub, through the sides of the casing, and through the eccentrics, and thus hold the latter in a rigid position. The hub and eccentrics have the circular opening or hole L passing through the same, in which the stuffing-boxes I I are disposed.

M M represent the outer connections, and N N the inner connections. The inner ends of these connections are considerably larger than the outer ends, and provided with circu-

lar openings O O and O^3 O^3, respectively, which fit around the eccentrics and permit of the easy revolution thereof. The outer and inner connections are provided at their ends with cross-pieces P P, said cross-pieces carrying the piston-rods Q Q, which are provided on their inner ends with the usual piston-heads R R, reciprocating within the cylinder S. This cylinder is provided with a partition T, having a central transverse hole U to permit of the hollow shaft passing through the same. This central hole communicates at one point with a vertically-extending channel V, which terminates at the top in two oppositely-directed laterally-extending channels W W, which communicate directly with the respective sections of the cylinder. From the opposite point of this central hole extends downward a similar channel X, which likewise communicates with lateral channels Y Y, the extension of the channels, after leaving the central partition, being formed upon the inner side of the cylinder, (designated by the letters Z Z,) and communicate at their extreme ends directly with the cylinder, the inner side being somewhat thicker than the opposite side of the cylinder to permit of these channels being constructed therein. By this construction it will be seen that as steam is admitted into either of these opposite channels it will pass between the space formed between the piston-heads and the partition or outer end of the cylinder, as the case may be, pressing the piston-heads either outward or inward, according to which channels or ports the steam passes through. For instance, if the steam passes through the channels which lead to the rear of the piston-heads, said piston-heads are forced outward, and as the cylinder, partition, and outer hollow shaft connected to said partition are revolved in unison, as hereinafter more fully described, steam will be next admitted to the channels leading to the front of the piston-heads, forcing them inward, and at the same time forcing the steam to the rear thereof through the channels by which it was admitted into the hollow cylinder, and thence out of the appropriate exhaust-ports into the casing of the engine. The same may be said in regard to the steam in front of the piston-heads, for, as they are forced outward by the pressure of the steam from the rear, the steam in front is returned through the same channels in which it entered into the hollow shaft, and thence into the casing of the engine through the appropriate exhaust-ports.

Having thus described how the steam is transferred through the central partition and back and forward of the piston-heads, and the alternate exhaust of the same back through the channels, we will now proceed to describe the interior mechanism of the hollow transverse shaft referred to, and which is designated in the drawings by the letter A′. This shaft runs transversely through the machine and through the central partition, as before described, and is provided upon opposite points of its surface, respectively, with longitudinal ports B′ B′, and near each end with oppositely-arranged exhaust ducts or openings C′ C′. It is also provided with a locking shoulder or key D′, which fits into a corresponding recess E′ in the central partition, and thus secures the same thereto. A balance-wheel F′ is secured upon one of the extreme ends of the shaft, and within the shaft at this end is arranged a cylindrical block G′, provided with an inwardly-projecting pintle or bearing-point H′.

An inner valve I′ is inserted within the hollow shaft, and is provided on its ends with a recess J′, into which the pintle H′ fits and revolves. This valve is provided upon its upper surface with an elongated semi-cylindrical opening or port K′, which, when the hollow shaft is not in motion, registers with one of the longitudinal openings within said shaft. Around this opening K′ is a raised rim L′, and surrounding this rim is a second rim L^2, the space between these rims forming a recess, in which are disposed suitable curved springs M′, and upon these springs are placed suitable packings N′, which, when the sleeve is inserted within the hollow shaft, will bear firmly against the inner surface of said shaft. Arranged upon the valve are annular collars O′ O^2, collar O′ being upon the extreme end, while the opposite collar is somewhat removed from the extremity. A cut-off valve P′ is arranged within this valve I′, and is provided with two longitudinal slots or ports Q′ Q′, and has located thereon a stop R′, adapted to bear against the raised rim upon each side of the longitudinal port in the valve I′, and permitting only a partial revolution of said cut-off valve. This cut-off valve is regulated by a valve-rod S′, secured to the head thereof, said rod passing outward, and provided near the end thereof with a cap T′, said cap being formed or provided on its upper surface with a slotted quadrant U′. Upon the extreme end of this rod is a lever V′, provided with a perforation *v*. A block W′ is disposed between this lever and the outer side of the quadrant, and is provided with a tongue or extension *w*, passing into the curved slot of the quadrant. A screw-bolt X′ passes entirely through this block, and also through the lever, the end passing through the lever being provided with a winged nut Y′ and the opposite end with a locking-nut Z′. It will be seen that by this construction the lever is secured adjustably to the cap, so as to be secured firmly thereto at any angle.

Fitting around the end of the valve, and bearing against the annular collar O^2 thereof and upon the outside of the casing, is a ring 1, having secured thereto a supporting-bracket 2, the lower end of said bracket being secured to the lower half of the casing of the machine. The circular portion of this bracket is provided upon its outer side with notches 3 3.

To the extreme end of the valve is rigidly

secured a reverse lever 4, said lever being provided therein with a recess 5, in which is secured a spring-actuated pawl 6, having an inward extension 7, which works through the lower slot 8 of the lever, and when said spring-actuated pawl engages either of the notches of the circular portion of the bracket the lever is locked, and it is impossible to turn or revolve the valve. When it is desired to reverse the same, however, all that is necessary to be done is simply to release the pawl from engagement by pressing upon the upper end and the lever is free to turn the valve at pleasure.

The end of the valve is provided with male screw-threads 9, adapted to register with female threads 10 upon the end of a joint or connection 11, said joint or connection being provided with inner collars 12 12, the latter being connected by longitudinal strips 13, thus forming a series of open spaces. Fitting around the open space formed between the collars 12 12 is a T-shaped steam-pipe 14, the lower circular portion thereof extending laterally from the collars of the joint or connection. Suitable stuffing-boxes 15 15 fit between the circular portion of the steam-pipe and the upper surface of the joint or connection and bear against the collars thereof.

Having thus described the construction of our improved rotary engine, we will now proceed to point out the operation of the same.

To illustrate: In the first place, the longitudinal port in the cut-off valve and valve proper are made to register. The hollow shaft is then adjusted so that one of the longitudinal ports therein registers with these slots, and also with either of the oppositely-arranged channels in the partition-block. When the several ports are thus registering, it will be observed that two of the exhaust-ports which communicate with the casing of the engine will be closed by the outer semi-cylindrical rim surrounding the port in the valve proper, while the opposite exhaust-ports will be open, as said semi-cylindrical rim does not extend far enough around to shut off communication between the exhausts and the depressed side of the valve. In this position all of the several ports communicate, and a free passage is gained through the series of pipes and valves running transversely through the cylinder and the partition thereof, affording means for the passage of the steam to the cylinder. In case the longer channels in the partition-block register with the several ports, of course the steam will be conveyed to the front faces of the piston-heads. Steam is now introduced through the steam-pipe. The moment it passes through the registering slots into the channels of the partition, where, as above stated, the longer channels are employed, the steam passes forward of the piston-heads and forces them inward, at the same time giving a rotary movement to the cylinder, said cylinder carrying with it the hollow shaft which is keyed or secured to the partition-block, said partition in turn being rigidly secured to the cylinder. By the time the piston-heads have reached their limit on the instroke the cylinder, partition, and hollow shaft will have made a half-revolution, so that the shorter channels in the partition, as well as the opposite port of the hollow shaft, will register with the ports in the valve and cut-off valve, which always remain stationary, and permit steam to pass to the rear of the piston-heads, and the pressure of the steam on the rear of the piston-heads will force the steam to the front thereof, back through the longer channels in the partition-block into the hollow cylinder, through the port thereof which is not taking steam, filling the space between said hollow shaft and the depressed side of the valve formed by the raised rim surrounding the longitudinal port therein, and as this rim does not entirely surround the valve two of the exhaust-ports are necessarily left open, so that the steam may be free to pass into the casing of the machine, and thence out of the same through an eduction-opening 16 in the same.

The operation is the same when the shorter channels in the partition-block are not taking steam, but are in position to receive the exhaust, for in this case the steam to the rear of the piston-heads is forced through the shorter channels into the hollow shaft and between the inner surface of the same and the depressed side of the valve, as in the former case, and thence out of the exhaust-ports in the hollow shaft opposite to the two which exhausted the steam when the piston-heads were forced inward.

In the drawings I have shown the holes in the cylinder, and through which the piston-rods pass, provided with suitable stuffing-boxes, (designated by the numerals 17 17,) so as to prevent the escape of steam from the two divisions of the cylinder.

It will also be seen that by releasing the spring-actuated pawl from engagement with the notches upon the circular portion of the supporting-bracket the valve I′ may be turned at will, thereby enabling the reversing of the engine with but the slightest difficulty. If the revolutions be from right to left, all that is necessary to be done is simply to turn said valve by means of the lever in an opposite direction, whereby the rotation of the engine will be changed so as to revolve from left to right. When this lever is operated, it will also have the effect of turning the joint or connection 11, the same being secured to the end of the valve by registering screw-threads.

The cut-off valve P′ is controlled by the rod S′, so that if for any reason it is desired to suddenly stop the revolutions of the cylinder the cut-off valve is turned by means of this rod, so that the slot therein is prevented from registering with the ports in the valve and

hollow shaft. This necessarily cuts off all communication between these different ports and prevents the steam entering the cylinder. The lever upon the end of the valve-rod is made adjustable within the quadrant, so as to suit the convenience of the person operating.

From the above description it will be seen that our rotary engine possesses many advantages.

The motive power need not be confined to steam, as water or air may be used with equal advantage. It will also be noted that as the pistons take and exhaust steam alternately upon their front and rear faces the engine will be caused to rotate in a running balance when in labor, also equalizing the pressure on the journals of the shaft.

A further advantage consists in providing eccentrics and suitable side connections, whereby the cross-pieces which connect the side connections are not made to bear all the strain of the piston-rods, but the strain is transferred to the eccentrics and the inner circular ends of these connections. This is illustrated clearly when the piston-heads are forced inward, for in that case the cylinder and side connections begin to revolve, and gradually the distance from the periphery of the eccentrics to the axis of rotation becomes less, allowing, of course, a greater in-play of said piston-rods. Again, when the piston-heads are forced outward, the side connections revolve upon the eccentric, and gradually approach the point where the distance from the periphery of the eccentrics and the axis of rotation is greater, thus diminishing the play of the piston-rods.

It will be seen from the drawings that we have further provided our improved engine with a hand-wheel 18, located upon the end of a hollow shaft A′, for the purpose of throwing it off a dead-center, if found necessary.

Having thus described our invention, what we claim, and desire to secure by Letters Patent of the United States, is—

1. The combination, with a subdivided cylinder, of a hollow shaft passing through the partition or dividing block and turning with the cylinder, and a stationary valve incased within said hollow shaft, the dividing-block, hollow shaft, and valve being provided with suitable ports, whereby steam is alternately admitted to the front and rear faces of the piston and exhausted alternately from said front and rear faces on each half-revolution of the cylinder, substantially as set forth.

2. In a rotary engine, the combination of a casing and cylinder, pistons, a partition-block dividing said cylinder into two apartments, said block provided with oppositely-arranged channels, one of said channels communicating with lateral extensions for conveying the steam to the inner faces of the pistons and the other channel communicating with lateral extensions for conveying the steam to the outer faces of the pistons, said channels alternately admitting and exhausting the steam from the cylinder on each half-revolution of the cylinder, a hollow shaft secured to the partition-block and provided with opposite longitudinal ports registering with the channels of the partition-block, and also provided with oppositely-arranged exhaust ports or ducts, and a valve provided with a longitudinal port, substantially as set forth.

3. In a rotary engine, the combination of the casing, the cylinder, the partition-block provided with oppositely-arranged channels, the hollow shaft secured to the partition-block and provided with oppositely-arranged ports adapted to act alternately as inlet and outlet ports, and also provided with oppositely-arranged exhaust ports or ducts, and the valve provided with the longitudinal port, with which the oppositely-arranged ports in the hollow shaft alternately register, and also having the annular collars and the rims or raised portions, the springs arranged within the spaces formed by said rims, and the packing above said springs, substantially as set forth.

4. In a steam-engine, the combination, with the valve provided with a longitudinal semi-cylindrical port, of the cut-off valve provided with the diametrically-opposite ports, and also having a radially-extending stop interposed between said ports adapted to bear against the sides of the longitudinal semi-cylindrical slot in the valve proper, substantially as set forth.

5. In a rotary engine, the combination of the valve provided with a longitudinal semi-cylindrical port, the cut-off valve provided with the diametrically-opposite ports, and also having a radially-extending stop interposed between said ports, and the valve-rod provided with an adjustable lever, substantially as set forth.

6. In a rotary engine, the combination of the valve provided with a longitudinal semi-cylindrical port, the cut-off valve, the valve-rod provided with a cap upon the outer end thereof, said cap provided with a slotted quadrant, the lever upon the end of said rod, the centrally-apertured block having an inward extension or tongue, the screw-bolt, and the nuts, substantially as set forth.

7. In a rotary engine, the combination of the casing, cylinder, and pistons thereof, the hollow shaft and interior valve mechanism provided with registering ports adapted to permit free passage of steam alternately to the front and rear faces of the pistons, and the exhaustion of the steam alternately from said front and rear faces, the bracket arranged upon the end of the valve and provided with notches upon its outer side, and the lever for reversing the valve, substantially as set forth.

8. In a rotary engine, the combination of the valve having one end extending laterally from the casing of the engine and provided with male screw-threads, the joint or connection provided on one end with female threads

adapted to engage the male threads of the valve, and provided with inner collars and strips extending between said collars, the stuffing-boxes, and the T-shaped steam-pipe, substantially as set forth.

9. In a rotary engine, the combination of the casing consisting of two parts provided with meeting flanges, each of said flanges provided with central semi-cylindrical bearings, the cylinder and pistons, the side connections, the eccentrics provided with laterally-extending hubs, said hubs being provided with suitable flanges, and the bolts for securing said flanges to the casing of the engine, substantially as set forth.

10. In a rotary engine, the combination of the casing, the cylinder, the partition-block provided with oppositely-arranged channels, the hollow shaft secured to the partition-block, and provided with oppositely-arranged ports adapted to act alternately as inlet and outlet ports, and also provided with oppositely-arranged exhaust ports or ducts, and the valve provided with the longitudinal port, with which the oppositely-arranged ports in the hollow shaft alternately register, and also provided with the raised portion around the longitudinal port, substantially as set forth.

11. In a rotary engine, the combination of a cylinder, a hollow shaft passing transversely therethrough and turning therewith, stationary eccentrics located upon opposite ends of the shaft on each side of said cylinder, connections having inner circular openings surrounding the eccentrics, and cross-pieces connecting the outer ends of said connections and carrying piston-rods, substantially as set forth.

12. The combination of the casing, the cylinder provided with central partition having oppositely-arranged channels, the eccentrics provided with laterally-extending hubs, said hubs provided with suitable flanges, the side connections having their inner ends surrounding said eccentrics, the hollow shaft provided on one end with a balance-wheel, and having arranged therein at this end a cylindrical block provided with an inwardly-extending pintle or bearing-point, said hollow shaft also being provided with oppositely-arranged ports adapted to act alternately as inlet and outlet ports, and having oppositely-arranged exhaust ports or ducts, the valve provided with the longitudinal port, with which the oppositely-arranged ports in the hollow shaft alternately register, and also having the annular collars and the raised portion around the longitudinal port, the cut-off valve, the valve-rod provided on its outer end with a cap, said cap being provided with a slotted quadrant, the lever upon the end of said valve-rod, the centrally-apertured block having an inward extension or tongue, the screw-bolt, the nuts for securing the valve-rod lever in its adjustable position, the supporting-bracket, the lever for adjusting the valve, the connection or joint provided with inner collars and strips extending between said collars, the stuffing-boxes for said valve, the T-shaped steam-pipe, and the hand-wheel upon the end of the hollow shaft, substantially as set forth.

In testimony that we claim the foregoing as our own we have hereunto affixed our signatures in presence of two witnesses.

JAMES E. STUDLEY.
ROBERT C. BERRY.

Witnesses as to James E. Studley:
CHAS. B. W. RYCKMAN,
HELLEN A. RYCKMAN.
Witnesses as to signature of Robert C. Berry:
W. C. MITCHELL,
J. M. DRESSER.