No. 791,428. PATENTED MAY 30, 1905.

S. J. LAWRENCE.

ROTARY ENGINE.

APPLICATION FILED NOV. 8, 1904.

2 SHEETS—SHEET 1.

Fig. 1.

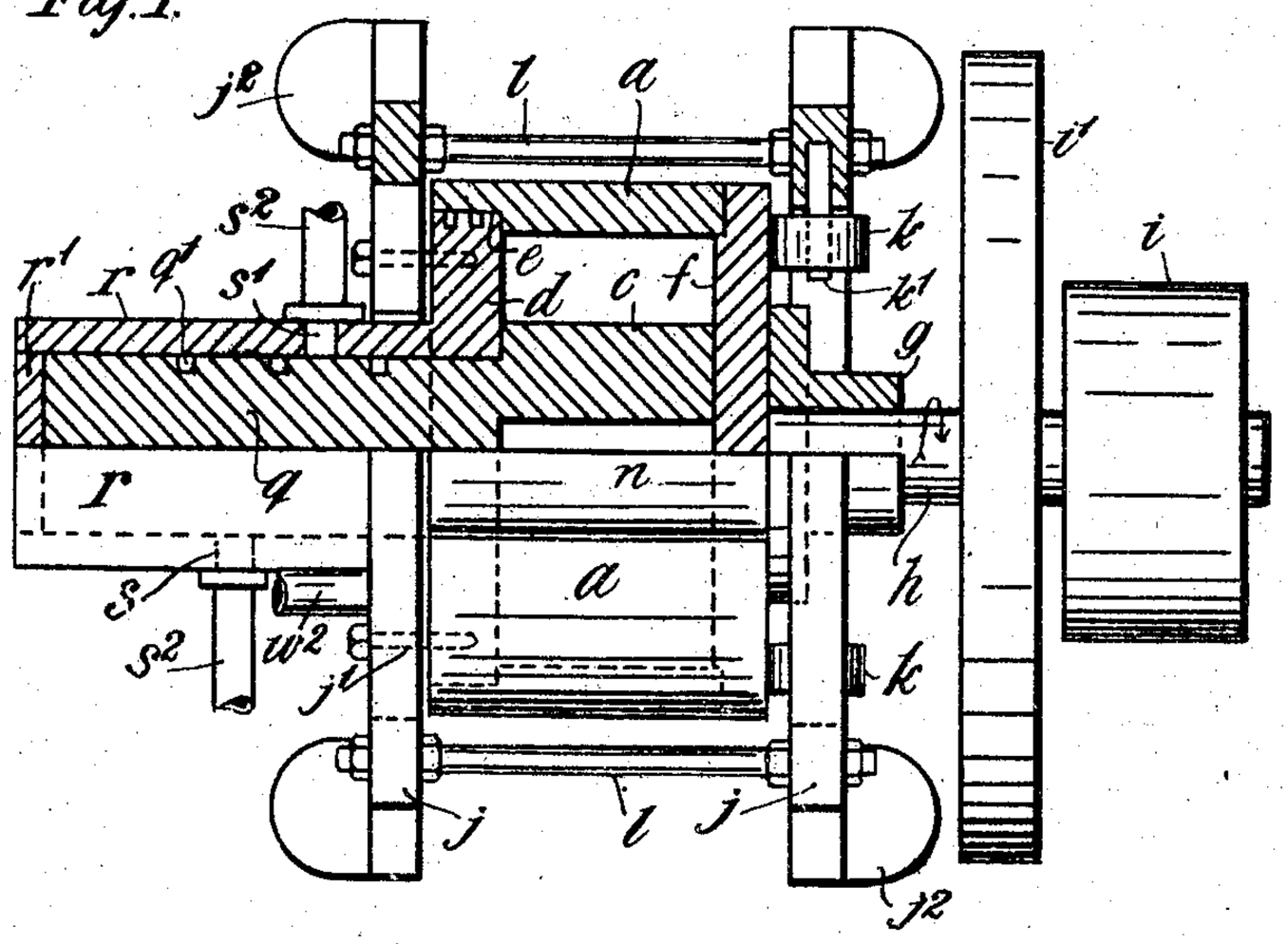
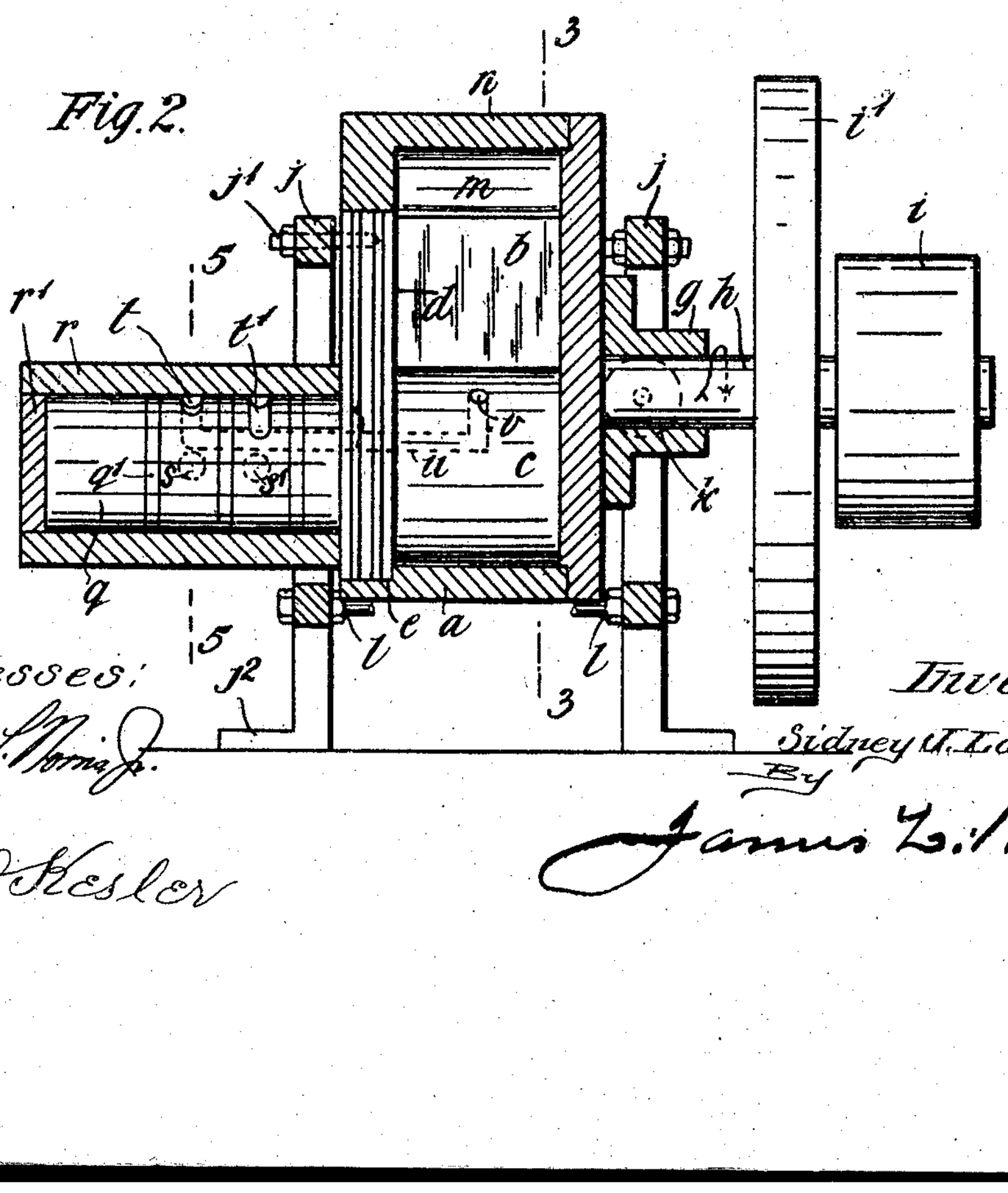


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 4.

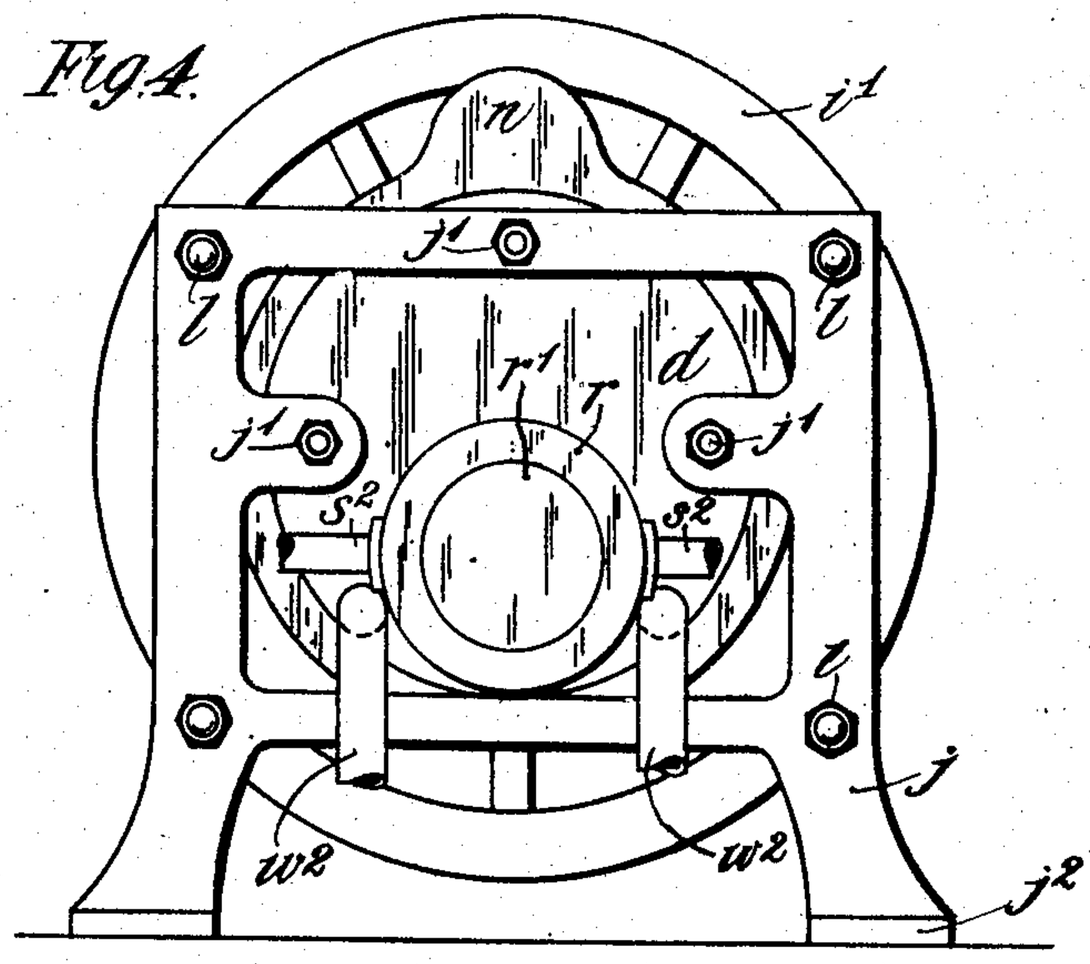


Fig. 6.

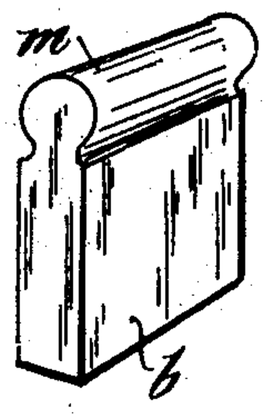


Fig. 3.

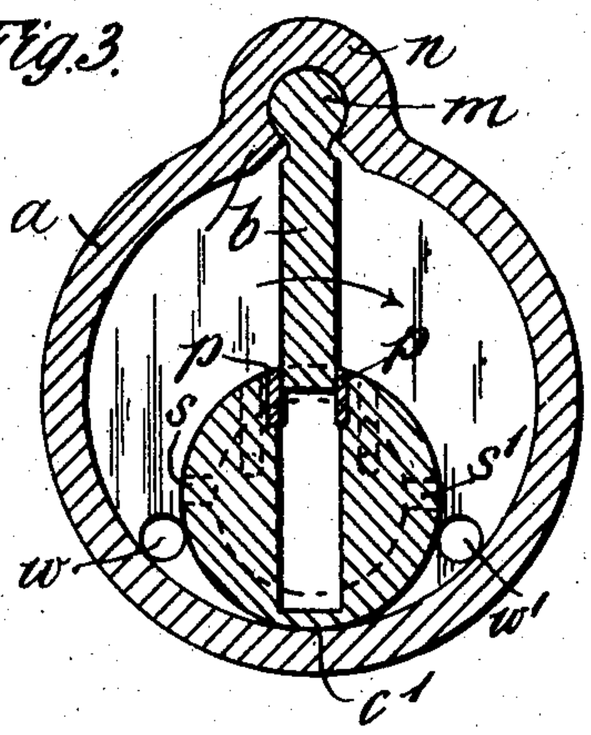


Fig. 7.

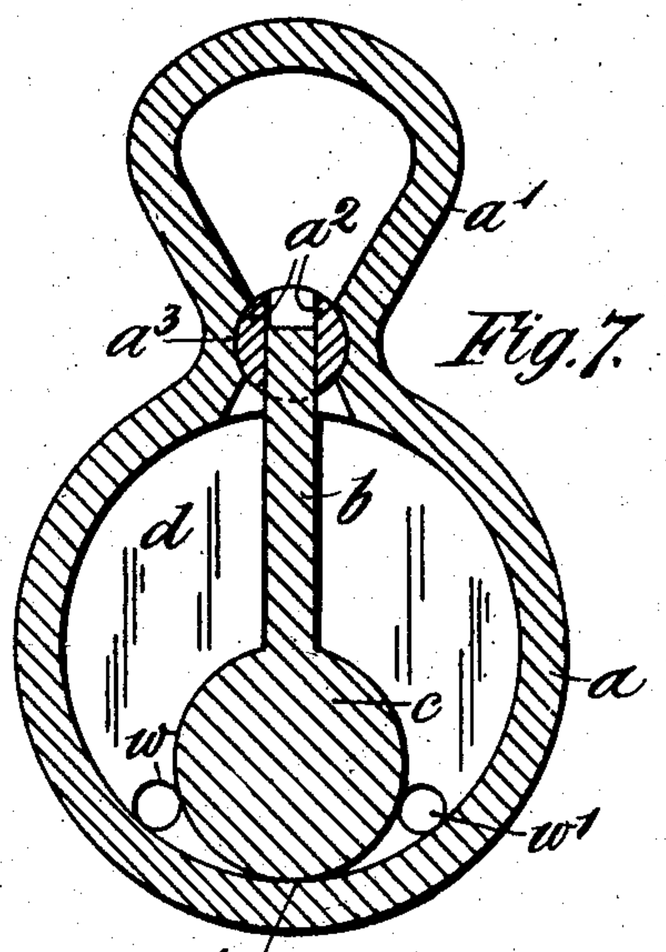
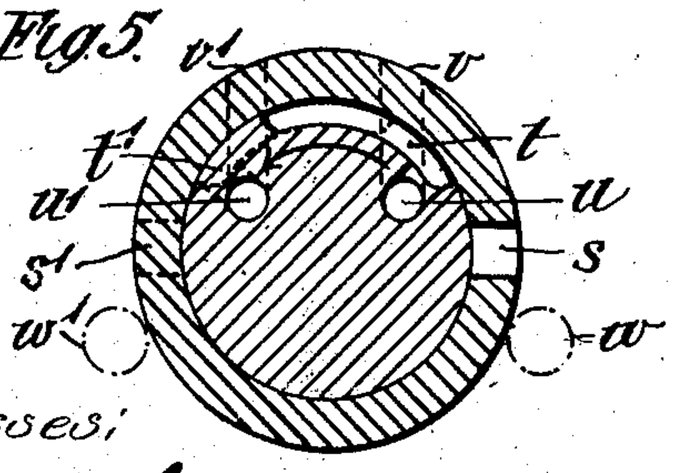


Fig. 5.



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UNITED STATES PATENT OFFICE.

SIDNEY JOHN LAWRENCE, OF RICHMOND, ENGLAND.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 791,428, dated May 30, 1905.

Original application filed September 6, 1904, Serial No. 223,484. Divided and this application filed November 8, 1904. Serial No. 231,903.

To all whom it may concern:

Be it known that I, SIDNEY JOHN LAWRENCE, engineer, a subject of the King of Great Britain, residing at 19 Darrell road, Richmond, in the county of Surrey, England, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention has reference to rotary engines or rotary pumps, and is designed to simplify the construction of the same and to render them more efficient and economical than heretofore.

According to the said invention the engine or pump is constructed with a rotary cylinder in which revolves a radial piston or vane extending between the circumference of the said cylinder and an eccentrically-arranged boss or abutment-block, so that during a revolution the effective length of the piston is continually altering. It is a feature of the invention that the said piston or vane has a positive connection both with the wall of the revolving cylinder and also with the hub, and that all these three parts revolve together in the same direction, and that it is from the cylinder that the main shaft is driven. To permit of the revolution of the cylinder, one of the covers thereof is formed by a stationary disk and is fitted into the cylinder, so that its edge or circumference forms a bearing, as it were, for the rest of the cylinder and is suitably packed to render it steam-tight, while permitting of the cylinder revolving thereon.

A further feature of the invention is that the valve is formed by a rotary spindle or plug extending axially from the aforesaid eccentric boss and fitting in a projecting sleeve or casing on the stationary end cover, the arrangement being such that efficient expansion of the steam or motive fluid is allowed for.

In order that the invention may be more readily understood, reference will now be had to the annexed drawings, in which—

Figure 1 is a plan, partly in horizontal central section, of a rotary engine or pump constructed according to the present improvements. Fig. 2 is a vertical central section through the cylinder, showing the internal arrangement of the main parts. Fig. 3 is a transverse section on the line 3 3 of Fig. 2 looking to the left. Fig. 4 is an end view looking toward the right, Fig. 1. Fig. 5 is an enlarged section on the line 5 5 of Fig. 2 looking toward the right. Fig. 6 is a perspective detail view of the piston. Fig. 7 is a vertical section analogous to Fig. 3, showing a modification of construction. These figures are merely shown by way of example and are not to scale.

As it is well known that most rotary engines can be used interchangeably as pumps, the apparatus will be hereinafter referred to only as a "rotary steam-engine," this being its main purpose, though it will be understood that it is not limited in its applicability and that it may be used with any other convenient motive fluid besides steam.

Referring more particularly to Figs. 1 to 5, *a* is the revolving cylinder, *b* is the piston or vane, and *c* is the eccentrically-arranged boss or abutment-block, which at its bottom part forms a practically steam-tight joint at the point *c'* with the wall of the cylinder. At one end the cylinder is, as stated, closed by a fixed disk *d*, which instead of being bolted to it like an ordinary cover is let into it, as shown, and has packing-rings *e* to prevent escape of steam, the said cover being stationary and the cylinder revolving round it. At its other end the cylinder has a cover *f* bolted to it and revolving with it, and centrally on this cover is a flanged socket *g*, in which is secured the shaft *h*, carrying the belt-pulley *i* and fly-wheel *i'*, this shaft *h* being further supported by a separate bearing or journal, if desired. The parts are supported by a frame *j*, to one side of which the stationary disk *d* is secured by bolts *j'*, while the other side carries suitable friction-rollers *k*, mounted on studs *k'*, which rollers are pressed against the cover *f* of the cylinder, the degree of pressure being regulated by the tie-bolts *l* at the end of the frame, said tie-bolts being so arranged as not to interfere with the rotation of the cylinder *a* and its projection *n*. In this way the disk *d* and the cylinder *a* are prevented from coming apart. The frame

itself rests on suitable feet j^2. The piston b extends radially from the boss c and is connected at its outer end to the cylinder by any suitable means. In the example shown a knuckle-joint is employed, formed by a cylindrical head or beading m on the piston fitting into a corresponding socket or seating n on the cylinder. At its inner end the said piston fits into a diametrical recess or cavity o in the boss c. This recess extends almost through the boss, and its mouth is provided with a pair of lining brasses or strips p to form a practically steam-tight fit against the piston. The opposite end of the recess o is closed by a thin wall of metal, as shown. The effective length of the piston depends on the amount of which is drawn out of the recess o, being greatest in the position shown in Fig. 3 and practically *nil* at the opposite half of its revolution. The valve arrangement comprises, as stated, a spindle or plug q, extending axially from and revolving with the boss c. This plug q fits in a fixed tubular sleeve or casing r, extending from the end plate d, and forms, in effect, an axle or shaft for the boss to revolve on, the sleeve or casing constituting the bearing for said axle or spindle. In addition, however, the spindle also serves as a rotary valve-plug for controlling the steam admission. For the latter purpose there are formed in the casing r two steam-ports s s', the supply to one or other of which can be shut off as desired, according to the direction the engine is working in. Corresponding ports t t' are cut in the surface of the rotary plug q and form segmental grooves therein, as shown, their length depending on the duration desired for the steam admission. From these grooves suitable passages u u' extend through the plug and the boss and open at v v' on each side of the piston b. q' represents packing-rings to prevent steam escaping along the surface of the plug q, and r' is an end cover to keep the tubular casing r closed steam-tight. s^2 represents the two steam-supply pipes leading to the ports s s'. The exhaust-passages, which are also in duplicate like the inlet-ports s s', are formed in the disk d, as shown at w w', and each communicates with its own exhaust-pipe w^2. It will be readily understood that when the engine is to run one way the pipes r^2 and w^2, leading to the steam-port s at one side and the exhaust-port w' at the other side, are only in use, the other two ports, s' and w, being shut off. The pipes of this latter pair are opened and those of the first pair shut off when the engine is reversed.

In some cases the fly-wheel i' may be mounted directly upon the rotary cylinder itself and be secured thereto by suitable arms or spokes, and the belt-pulley might be fixed in the same position, thus dispensing with the extended part of the shaft h, and so economizing space.

The various arrows indicate the direction in which the parts they are applied to are moving.

The action is as follows: When the piston has reached the vertical position, Fig. 3, the space on the left will have already received its charge of steam from the port s and passage v, and this steam will have been shut off and expansion will be going on. It will be seen that the pressure will be acting laterally both on the piston b and on the boss c. The area being much greater above than below the center of the boss, the piston will continue to be forced round and will drive both the cylinder and the boss in the same direction. Owing, however, to the eccentricity, it will be gradually pushed home into the recess o and will be nearly home when it passes the (in this instance) open exhaust-port w'. The exhaust will then take place; but the piston and cylinder will continue to travel round under the impetus, the parts m and n passing under the boss at the dead-point c', where it makes contact with the cylinder. Almost immediately after passing this joint the groove t will begin to open the steam-port s, and live steam will be admitted, say, for a third of a revolution. The port s will then be closed, and expansion of the steam will commence. The piston and cylinder continuing to travel round, the former will be gradually drawn out until the vertical piston is again reached, after which the piston begins to be pushed inward again, and so on.

It will be readily understood that the variation in the effective length of the piston may be obtained by forming the cavity o in the cylinder instead of in the boss c, the piston being then rigidly connected to the boss c. Such an arrangement is shown in Fig. 7, wherein the cylinder a has a hollow enlargement or chamber a' of V shape to receive the piston, the interior of such chamber constituting the cavity in question. The mouth of this chamber is provided with a pair of swiveling brasses or jointing-pieces a^2, which fit into seats or bearings a^3, and thus accommodate themselves to the different angular positions of the piston b. The shape of the chamber a' is also determined by the same consideration, and hence it has inclined sides, as shown. In other respects the arrangement and action are substantially the same as in Figs. 1 to 6. The advantage of this modification, however, is that it enables the size of the boss c to be somewhat reduced. In the first-mentioned arrangement the employment of the cavity o to take the piston necessitates the boss c being more than half the diameter of the cylinder; but in the arrangement shown in Fig. 5 this requirement does not apply, and hence the space saved in the size of the boss can be utilized in increasing the effective length of the piston, and therefore the power of the engine.

The lubrication may conveniently be effected by a permeator—that is to say, an arrange-

ment for feeding oil into the steam-supply—so that the steam itself carries the oil to the parts required.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In a rotary engine, the combination of a rotary cylinder, a rotary boss within and eccentric to said cylinder, a piston movably connected to said cylinder and operable with said boss, a chamber on said cylinder to accommodate the movements of the piston and means movable with the boss and forming a valve, substantially as described.

2. In a rotary engine, the combination of a rotary cylinder, a rotary boss within and eccentric to said cylinder, a piston projecting from said boss and rigidly connected therewith a chamber on said cylinder to accommodate the movements of the piston, and a rotary spindle extending from said boss and forming a valve, substantially as described.

3. In a rotary engine the combination of a rotary cylinder, means movable with said piston and forming a valve a piston engaging said cylinder, a chamber on the cylinder to receive and accommodate the piston to different periods of its revolution, and a fixed end cover for said rotary cylinder forming also a bearing therefor.

4. In a rotary engine the combination of a rotary cylinder, a revolving piston engaging said cylinder, a chamber to accommodate the motions of said piston, an eccentric rotary boss to which said piston is rigidly secured, a fixed end cover let into said cylinder and forming also a bearing therefor, and packing between the circumferential edge of said fixed end cover and the inner wall of the cylinder, substantially as described.

5. In a rotary engine, the combination of a rotary cylinder, a rotary boss inside same eccentric thereto, a piston rigidly connected therewith and radial thereto, a fixed end cover on which said cylinder rotates, a framework carrying said end cover, and a rotary spindle or plug extending through said fixed cover from the eccentric boss and forming a rotary valve, substantially as described.

6. In a rotary engine, the combination of a rotary cylinder, a rotary eccentric boss inside same, a radial piston rigidly secured to said boss, a fixed end cover at one side of said cylinder, and a driving-shaft projecting centrally from and secured rigidly to the opposite end cover of the cylinder, substantially as described.

7. In a rotary engine, the combination of a rotary cylinder, a rotary eccentric boss therein, a fixed end cover forming a bearing for said cylinder a tubular sleeve projecting from said cover and forming a valve-casing a rotary valve-plug mounted in said tubular sleeve, and a rotary valve-spindle projecting axially from said boss, substantially as described.

8. In a rotary engine, the combination of a rotary cylinder, a rotary eccentric boss therein, a fixed end cover forming a bearing for said cylinder a tubular sleeve projecting from said cover and forming a valve-casing a rotary valve-plug mounted in said tubular sleeve, a rotary valve-spindle projecting from said boss, and a driving-shaft fixed centrally to the revolving cover of said cylinder substantially as described.

9. In a rotary engine the combination of a rotary cylinder, a rotary boss therein of less than half the diameter of the cylinder, a piston projecting from said boss radially and extending through the cylinder, a chamber outside said cylinder to accommodate the motion of said piston, means for transmitting driving motion from said cylinder, and means for rotatably supporting said cylinder and boss, substantially as described.

10. In a rotary engine, the combination of a rotary cylinder, a rotary boss therein of less than half the diameter of the cylinder, a piston extending from said boss through the wall of the cylinder, a chamber outside said cylinder to receive said piston, a rotary spindle extending axially from said boss on one side thereof and forming an axle therefor as well as a valve, substantially as described.

11. In a rotary engine, the combination of a rotary cylinder, a fixed end cover let into the same and forming a bearing therefor, an eccentric rotary boss inside said cylinder, a spindle extending axially therefrom through said fixed end cover, a tubular projection from said cover fitting said spindle and forming both a valve-casing and a bearing for the spindle, substantially as described.

12. In a rotary engine, the combination of a rotary cylinder, a fixed end cover let into the same and forming a bearing therefor, an eccentric rotary boss inside said cylinder, a spindle extending axially therefrom through said fixed end cover, a tubular projection from said cover fitting said spindle and forming both a valve-casing and a bearing for the spindle, and a driving-axle extending centrally from the rotary cylinder on the side opposite the fixed end cover, substantially as described.

In testimony whereof I have hereunto set my hand, in presence of two subscribing witnesses, this 28th day of October, 1904.

SIDNEY JOHN LAWRENCE.

Witnesses:
C. BARNARD BURDON,
FRANCIS W. FRIGOUT.