No. 811,613. PATENTED FEB. 6, 1906.

W. H. BATES, R. C. DOUGLASS & W. G. NOURSE.

ROTARY ENGINE.

APPLICATION FILED MAR. 22, 1905.

4 SHEETS—SHEET 1.

Fig. 1.

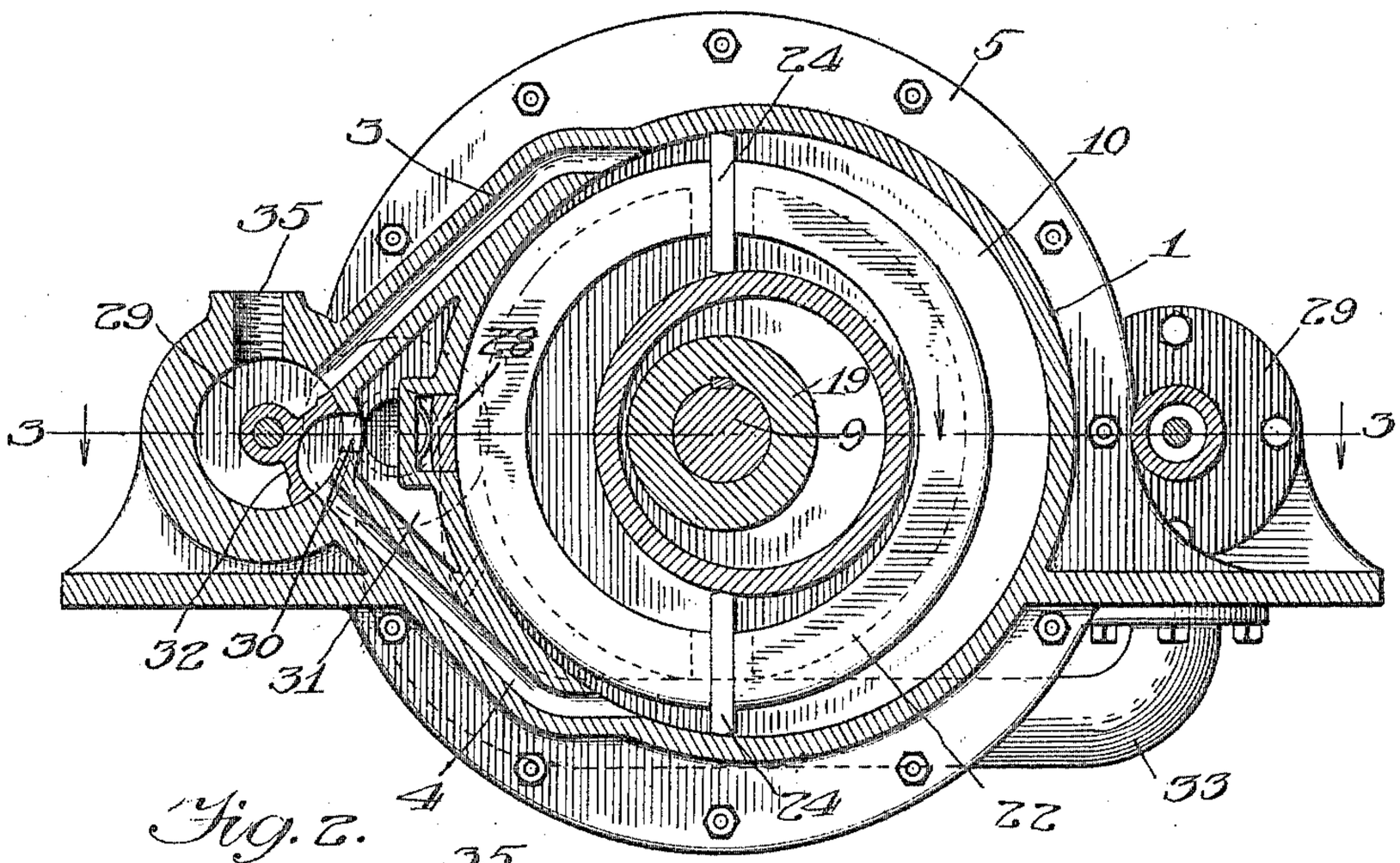
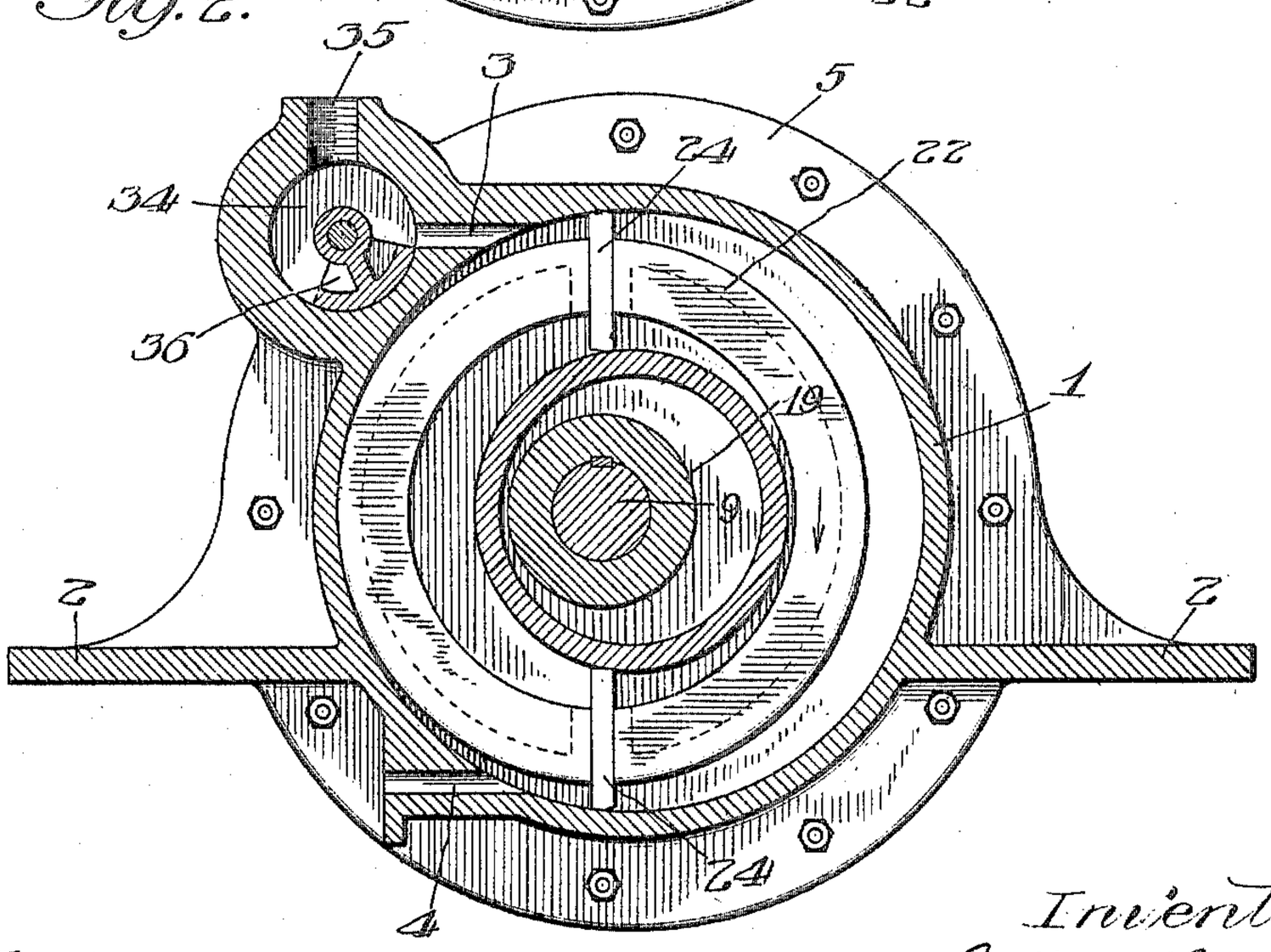


Fig. 2.



Witnesses:

Robert N. Weir

Charles J. Cobb

Inventors:

William H. Bates

Robert C. Douglass

William G. Nourse

By Hill & Hill

Attys.

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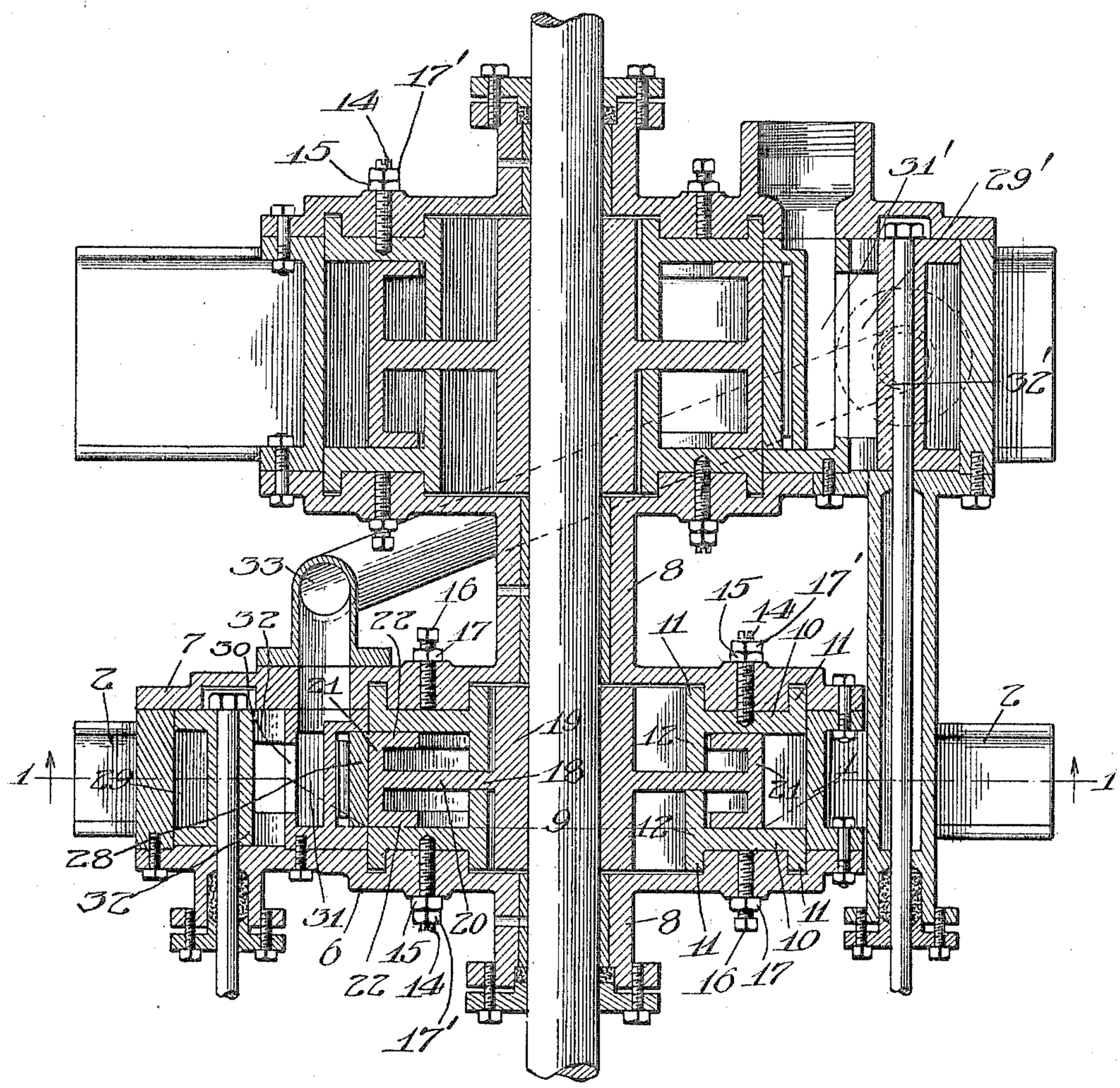
4 SHEETS—SHEET 2.

Fig. 3.



Witnesses:
Robert N. Weir
Charles L. Cobb.

Inventor.
William H. Bates
Robert C. Douglass
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4 SHEETS—SHEET 3.

Fig. 4.

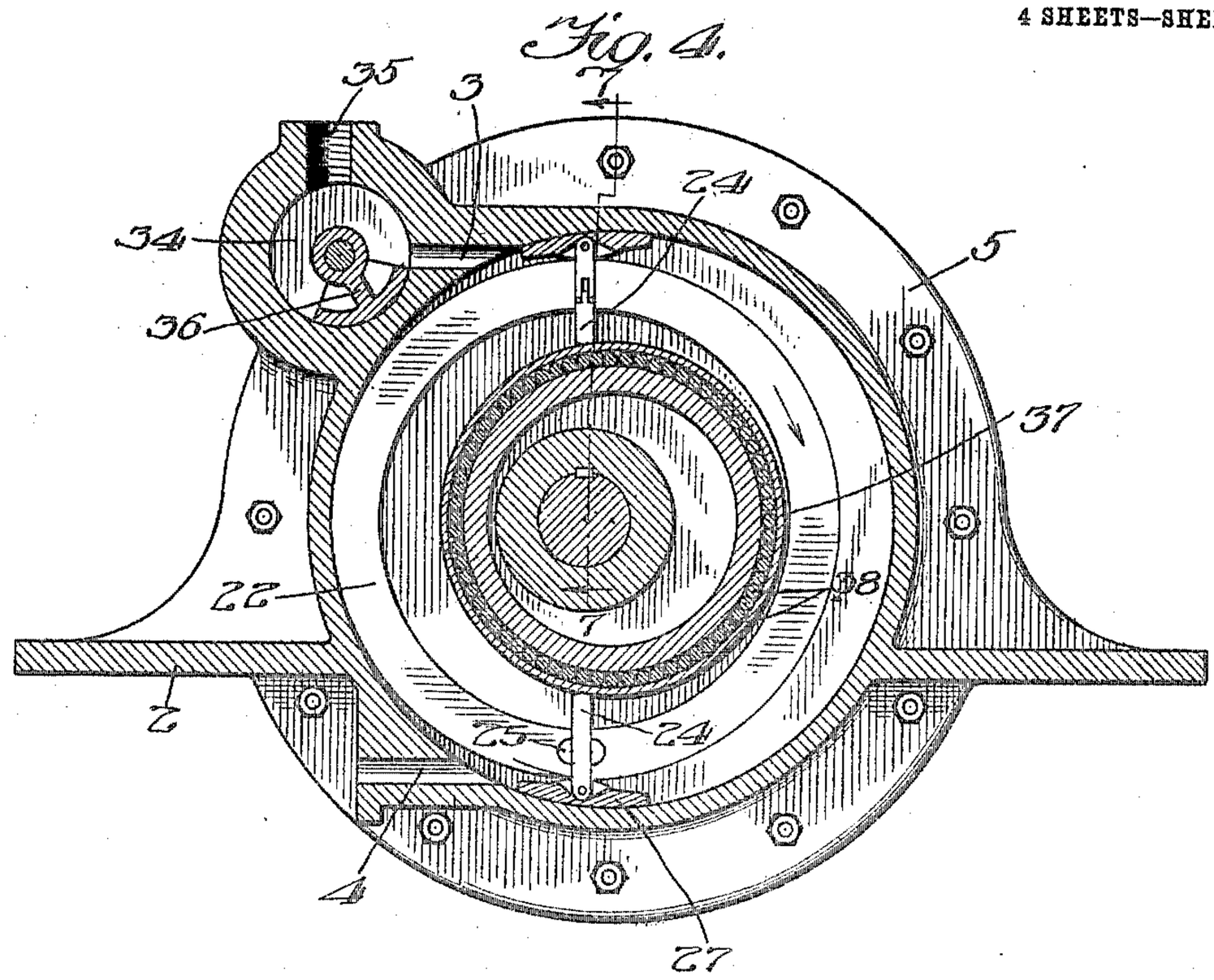


Fig. 5.

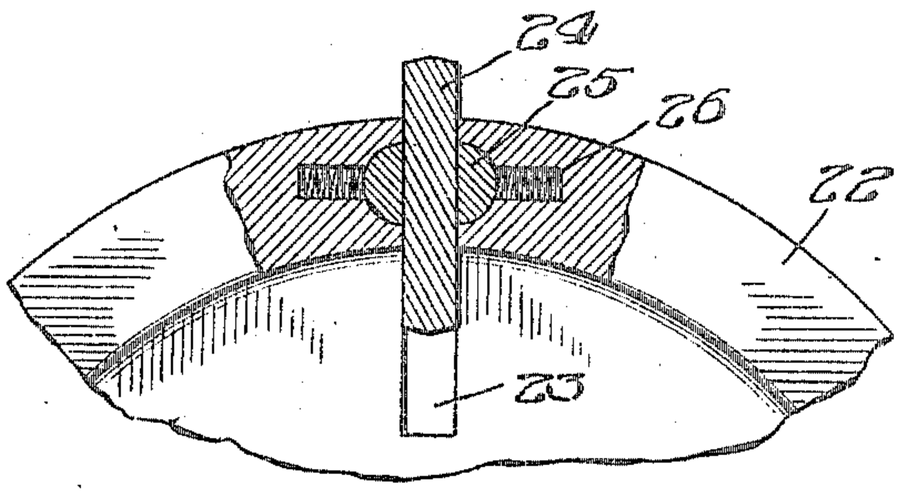


Fig. 6.

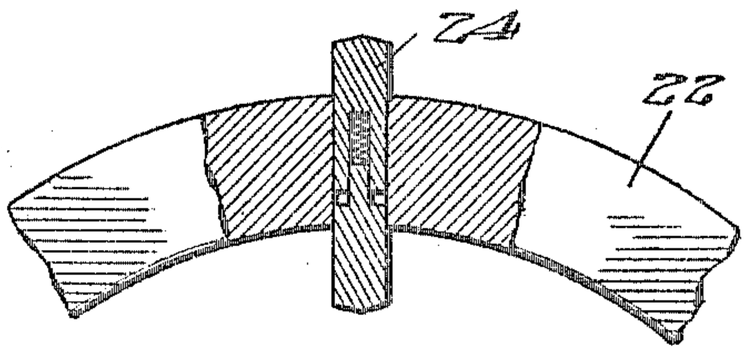
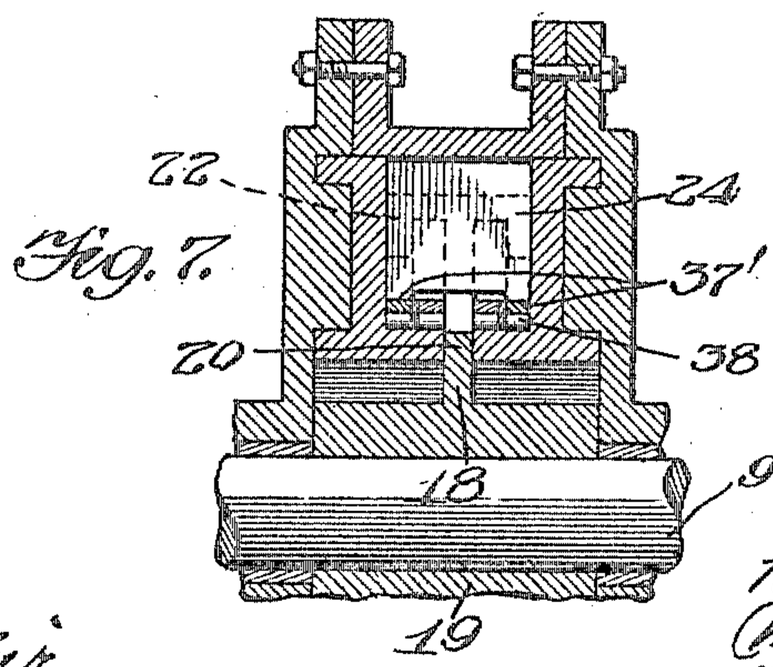


Fig. 7.



Witnesses:

Robert N. Wait

Charles I. Cobb

Inventor:

William H. Bates

Robert C. Douglass

William G. Nourse

By Hill & Hill

Attys.

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ROTARY ENGINE.

APPLICATION FILED MAR. 22, 1905.

4 SHEETS—SHEET 4.

Fig. 8.

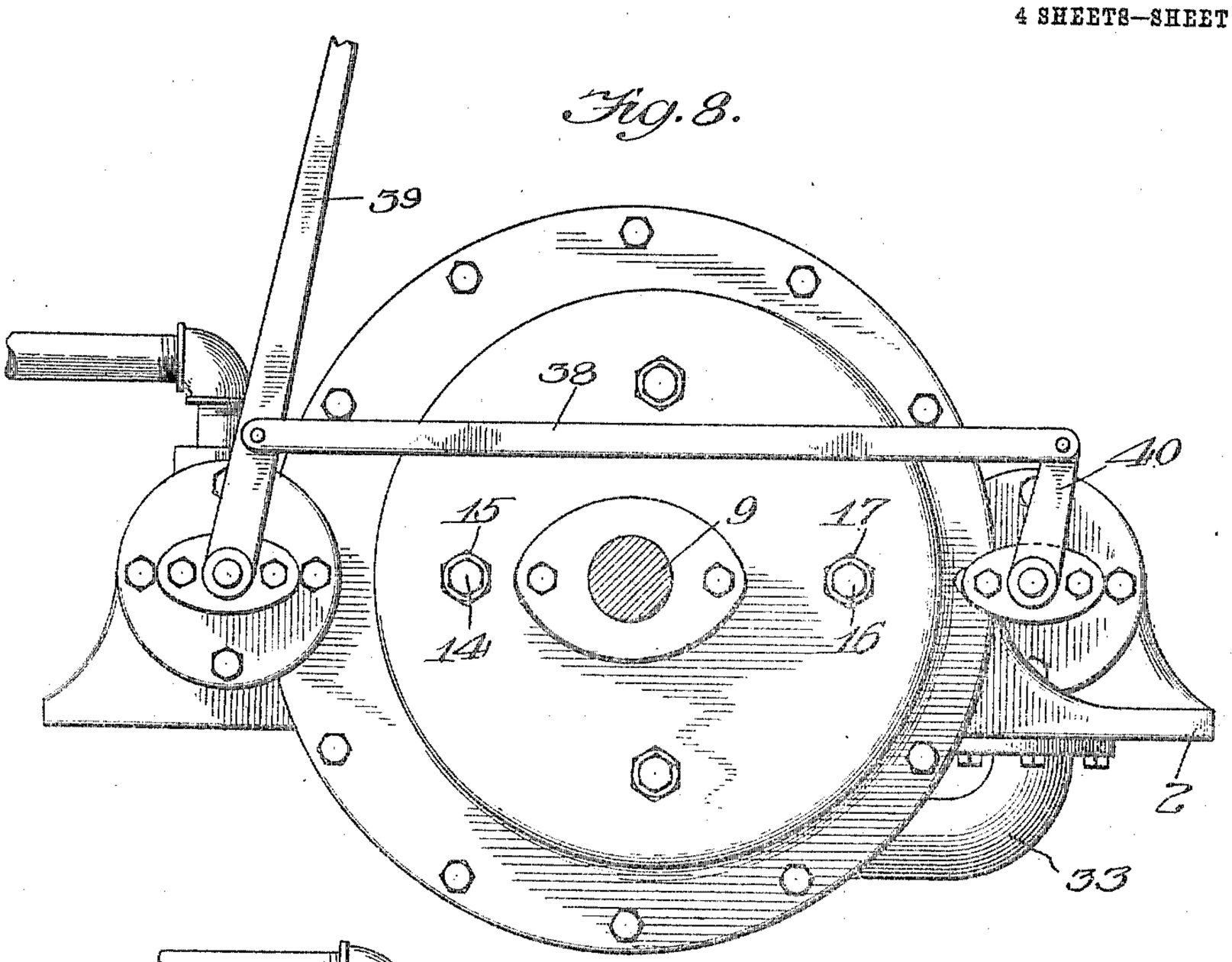
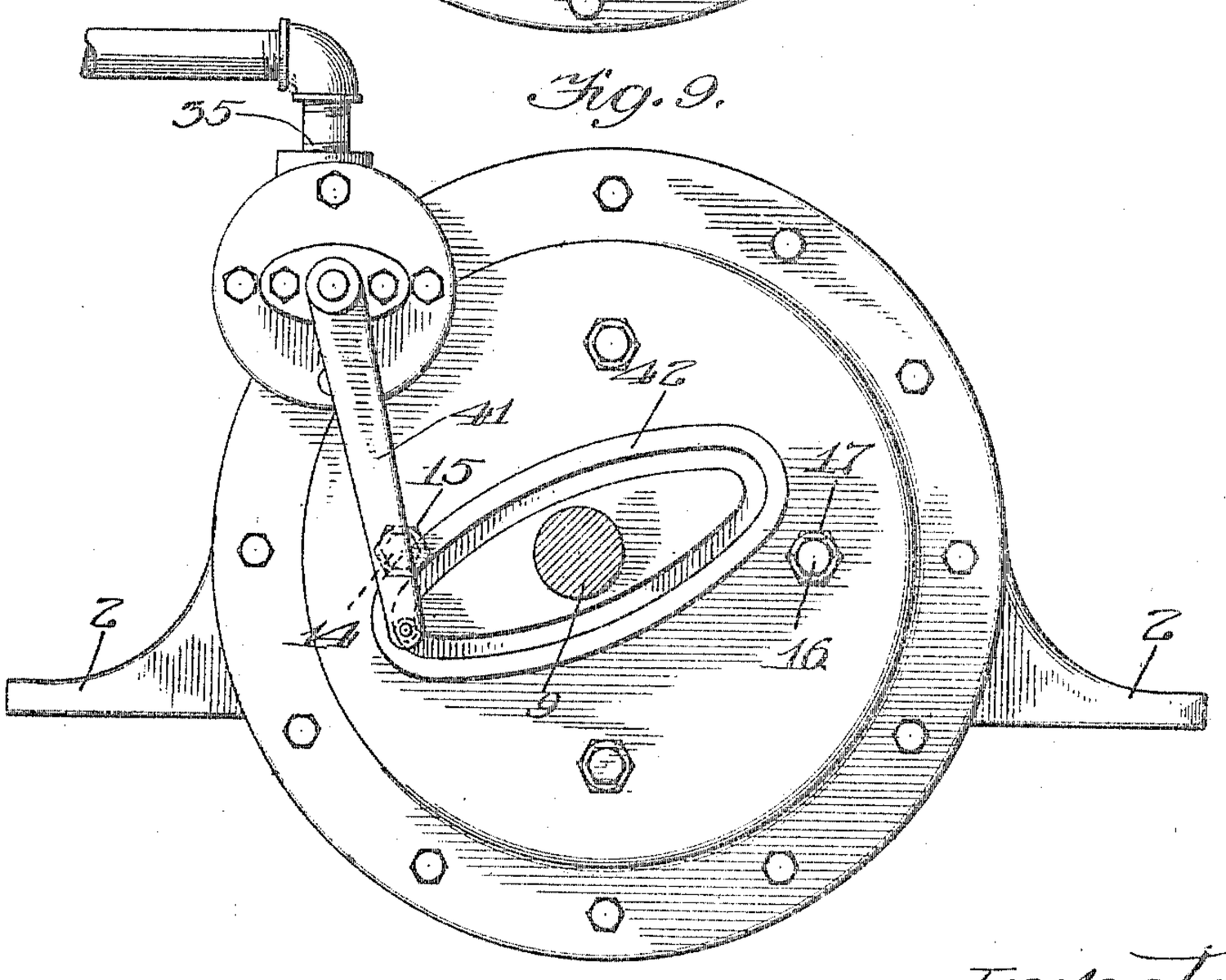


Fig. 9.



Witnesses:
Robert Weir
Charles I. Cobb

Inventor.
William H. Bates
Robert C. Douglass
William G. Nourse
By Hill & Hill
Attys.

UNITED STATES PATENT OFFICE.

WILLIAM H. BATES, ROBERT C. DOUGLASS, AND WILLIAM G. NOURSE, OF CHICAGO, ILLINOIS, ASSIGNORS TO THE MARINE IRON WORKS, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

ROTARY ENGINE.

No. 811,613. Specification of Letters Patent. Patented Feb. 6, 1906.

Application filed March 22, 1905. Serial No. 251,458.

To all whom it may concern:

Be it known that we, WILLIAM H. BATES, ROBERT C. DOUGLASS, and WILLIAM G. NOURSE, citizens of the United States, residing at Chicago, county of Cook, and State of Illinois, have jointly invented certain new and useful Improvements in Rotary Engines, of which the following is a description.

Our invention relates to that class of engines or motors where the motive fluid operates to revolve one or more pistons within a suitable cylinder.

The object of our invention is to produce a simple, efficient, and practical device of the kind described; and to this end it consists in the novel construction, arrangement, and combination of parts herein shown and described, and more particularly pointed out in the claims.

In the accompanying drawings, wherein like or similar reference characters indicate like or corresponding parts, Figure 1 is a section taken substantially on line 1 1 of Fig. 3, showing a compound or two-cylinder reversing-engine. Fig. 2 is a section similar to that shown in Fig. 1, showing a simple non-reversible engine provided with a cut-off valve. Fig. 3 is a section taken substantially on line 3 3 of Fig. 1. Fig. 4 is a section similar to that shown in Fig. 2, showing a modified form of the same type of engine shown in Fig. 2. Figs. 5 and 6 are details. Fig. 7 is a section taken substantially on line 7 7 of Fig. 4, showing a modified form of my device. Fig. 8 is an elevation of the form of my device shown in Fig. 1, and Fig. 9 is an elevation of the form of my device shown in Fig. 2.

In the drawings, 1 is the cylinder of our engine provided with suitable brackets 2 2 for attaching the same to a foundation. The cylinder consists of a plain ring of suitable material finished upon its interior and provided with suitable ports 3 and 4 for the admission and discharge of the motive fluid, Fig. 1. Preferably a flange 5 is formed at each end of the cylinder for attaching the heads 6 and 7 thereto, and thus close the ends of the cylinder. As shown, the heads are each provided with a bearing 8 to support the shaft 9 and accurately retain the same in suitable relation to the coöperating parts of the engine. The heads 6 and 7 are also preferably each provided with an inner facing or liner 10, extending from the inner face of the cylinder toward the shaft a suitable distance, at each edge provided with an annular flange 11 11, each projecting into a suitable recess formed in the head to which it is attached. The liner 10 is also provided with an annular concentric flange 12 near its inner edge, projecting toward the interior of the cylinder, preferably parallel with the inner face of the cylinder 1.

In the preferred form it is desirable that the distance between the liners 10 10 may be adjusted independently of the distance between the heads 6 and 7. Any means may be employed for this purpose, the means shown in the drawings being to provide alternate studs 14, secured to the liners and passing outward through suitable openings in the heads, where each is provided with a nut 15 to draw the liner toward the head, and set-screws 16, arranged in suitable tapped holes in the heads with their points pressing against the liners to force the same away from the head. It is evident that by this means the liners may be securely held in any desired position without regard to the relative positions of the heads and that the space between the inner faces of the liners can be accurately adjusted. If desired, suitable means may be employed upon the studs 14 and set-screws 16 to maintain the liners in their adjusted position, as shown. A lock or jam nut 17 is shown upon the set-screws and a similar jam-nut 17′ upon the studs 14 for this purpose.

The pressure of the motive fluid is transmitted to the shaft 9 by means of suitable pistons 24 and a driver 18 fixed upon the shaft in any suitable manner and positioned within the cylinder. As shown, the driver 18 consists of a hub 19 for attachment to the shaft 9, a radial disk or plate 20, adapted to closely fit between the opposing flanges 12 12, and a cylindrical portion 21 at the periphery of the plate 20 to closely fit between the flat surfaces of the liners 10. Inwardly-projecting flanges 22 22 are preferably provided at the edges of the part 21 to secure a broader bearing-surface between the driver 18 and the liners 10. Any desired number of substantially radial slots 23 are formed in the periphery of the driver 18, extending toward the hub 19 in the plate 20 for the reception of the radially-movable pistons 24. The sides

of the slots, particularly through the parts 21 and 22, are preferably a close or steam-tight fit upon the pistons.

If desired, a slight clearance may be allowed between the walls of the slot and the piston 24 and suitable packing arranged to prevent the passage of steam at this point.

As shown in Fig. 5, a transverse recess is formed across the driver near its periphery upon each side of the piston, and suitable strips of packing material 25, preferably brass or other metal, are fitted in the recesses and resiliently held in contact with the pistons by the springs or equivalent means 26. In the drawings these recesses and packing-strips are shown semicylindrical; but it is obvious that these parts may be rectangular or of any other suitable shape and accomplish the desired object satisfactorily.

The pistons 24 are preferably substantially rectangular blocks of suitable material adapted to be arranged within the slots 23 and of suitable size to fill the space between the periphery of the cylinder 1 and the flanges 12 12 and laterally fitting between the liners 10 10, the opposite sides of the pistons or those in contact with the inner periphery of the cylinder and with flanges 12 12 being so formed that when the pistons in rotating around the shaft depart from a radial position the contact at the interior periphery of the cylinder is maintained. If desired, a shoe 27, Fig. 4, may be pivotally connected to the piston 23, as shown, to form a broader bearing-face against the inner periphery of the cylinder.

The driver 18 is of such a diameter and the shaft 9, upon which it is fixed, is so eccentrically positioned within the cylinder that the periphery of the driver is in contact with and preferably forms a steam-tight joint along one side of the interior periphery of the cylinder while leaving a considerable space between these parts at all other points of their periphery. To assist in maintaining the above-mentioned joint, a spring-actuated packing-strip 28 or equivalent means extending across the face of the driver 18 may be arranged in a suitable recess formed in the cylinder-wall, as shown in Figs. 1 and 3.

Obviously where the shoe 27 is employed a suitable recess may be provided in the periphery of the driver to receive the same when passing the point of contact between the driver and the cylinder.

It is evident that if steam or other motive fluid be admitted into the cylinder by means of the port 3 and discharged by the port 4 the shaft 9 and its associated parts will rotate in one direction, while if the motive fluid be admitted by the port 4 and discharged by the port 3 the shaft will be rotated in the opposite direction. It is also obvious that various cut-off devices may be employed to secure the expansive action of the steam in the cylinder. Hence in the various forms of my device it is desirable to arrange the ports 3 and 4 in different ways. For example, in Figs. 1, 3, and 8 the ports are arranged for a reversible engine. In the form shown in these figures a steam-chest 29 is provided of any desired form connected to the cylinder by means of the ports 3 and 4. An exhaust-port 30 is arranged in the wall of the chest 29 between the openings to the ports 3 and 4 and communicates with a passage 31, to which is connected an exhaust-pipe, condenser, or other suitable means for disposing of the exhaust. A valve 32 is arranged within the chest 29 and so formed that either of the ports 3 or 4 may be connected to the exhaust-port 30 at will, while the other port is simultaneously opened to the chest 29.

In the compound engine shown in Figs. 1, 3, and 8 the exhaust-passage 31 of the high-pressure cylinder is connected, by means of a pipe 33, to the chest 29′ of the low-pressure cylinder, while the exhaust-passage 31′ of the low-pressure cylinder may be connected to a condenser (not shown) or to the outside atmosphere, as preferred, the valves 32 and 32′ being connected in any suitable manner, so that at all times the mechanism in both cylinders will coöperate to rotate the shaft 9 in the desired direction. As shown in Fig. 8, this is accomplished by means of a link 38, attached at one end to a lever 39, mounted upon the projecting stem of the valve 32, and at its opposite end to an arm 40, mounted upon the stem of the valve 32′, the relative position of the lever and arm to their respective valve and the length of the link 38 being such that the valves 32 and 32′ will be simultaneously moved to direct the motive fluid into the proper ports to produce the desired direction of rotation of the shaft 9.

In the form shown in Figs. 2, 4, and 9 a valve-chest 34 is connected to the cylinder 1 by the port 3, the motive fluid, steam, air, or gas being admitted by the opening 35. In this form the valve 36 is operated by means of suitable mechanism from the shaft 9 or other suitable moving parts of the device, so that when a piston 24 is in position to be operated upon by the fluid entering the cylinder through the port 3 the valve 36 is moved to open the port and leave the same open until the piston moves to the desired position, when the port is again closed and the steam within the cylinder acting upon the piston 24 allowed to expand until the piston passes the opening to the port 4, which is connected to an exhaust-pipe, condenser, or the like, when the expanded fluid escapes. Any desired form or class of valve may be employed for this purpose and motion may be imparted to the same by means of an eccentric mounted upon a shaft arranged to rotate at a suitable speed or any other suitable means to produce the desired movement of the valve. A simple and convenient means for producing

these movements is shown in Fig. 9, in which an arm 41 is attached to the projecting stem of the valve 36 and provided with suitable means for engaging a cam 42, fixed upon the shaft 9 in any desired manner, the cam being preferably formed to produce the desired movement of the valve 36.

In the form shown in Fig. 5 a roller-bearing is provided between the pistons 24 and the flanges 12 by providing suitable rings 37 with rollers 38, arranged between each ring and its flange 12, or, if desired, each piston 24 may be provided near each end with an independent ring 37′ and rollers 38 for each ring, as shown in Fig. 7, in which case each piston 24 may be pivotally attached to its own rings 37′, care being taken not to engage the rings of any other piston in the cylinder.

In Fig. 6 a piston is shown formed in two parts united by a tongue 39 and a groove upon their adjacent edges and provided with suitable springs 40 to produce the desired pressure against the periphery of the cylinder and the flanges 12. This form of piston may be employed in my device under some circumstances to advantage.

In the drawings and in our preferred construction two pistons are shown in each cylinder; but it is obvious that one or any number of such pistons may be employed.

Having thus described our improvement, it is obvious that various immaterial modifications may be made without departing from the spirit of our invention. Hence we do not wish to be understood as limiting ourselves to the exact form and construction shown.

What we claim as new, and desire to secure by Letters Patent, is—

1. A device of the kind described, comprising a cylinder provided with suitable ports, a liner adjustably mounted at each end of said cylinder, and a flange concentrically mounted upon each of said liners, in combination with a rotatable driver inclosing said flange and eccentrically mounted to close the cylinder upon one side, and a plurality of unconnected pistons slidably mounted upon the driver and extending from the cylinder to the flange.

2. A device of the kind described, comprising a cylinder provided with injection and ejection ports, in combination with a pair of fixed flanges concentrically mounted within the cylinder, a ring loosely inclosing each flange, friction-reducing means arranged between the flanges and the rings, a rotatable driver inclosing the flanges, and eccentrically mounted to close the cylinder upon one side, and a plurality of unconnected pistons slidably mounted upon the driver and extending from the cylinder to the flanges.

3. A device of the kind described, comprising a cylinder provided with injection and ejection ports, in combination with a pair of fixed flanges concentrically mounted within the cylinder, a ring loosely inclosing each flange, antifriction-rollers arranged between each flange and its ring, a rotatable driver inclosing the flanges, and eccentrically mounted to close the cylinder upon one side, and a plurality of unconnected pistons slidably mounted upon said driver and extending from the cylinder to the flange.

4. A device of the kind described, comprising a cylinder provided with suitable injection and ejection ports, in combination with a pair of fixed flanges concentrically mounted within the cylinder, a ring rotatably inclosing each flange, a rotatable driver inclosing the flanges, and eccentrically mounted to close said cylinder upon one side, and a plurality of unconnected pistons slidably mounted upon said driver and extending from the cylinder to the flanges.

5. A device of the kind described, comprising a cylinder provided with suitable ports, a pair of liners adjustably mounted at the ends of said cylinder, a flange formed upon each liner and concentrically fixed within the cylinder, in combination with a rotatable driver inclosing the flanges and eccentrically mounted to close the cylinder upon one side, a plurality of radial slots formed in the periphery of said driver, and unconnected pistons slidably mounted in said slots each closing the space between the cylinder and said flanges.

6. A device of the kind described, comprising a cylinder provided with suitable ports, a liner adjustably mounted at each end of said cylinder, and a flange provided upon each liner concentrically fixed within the cylinder, in combination with a rotatable driver inclosing said flanges and eccentrically mounted to close the cylinder at one side, a plurality of radial slots formed in the periphery of said driver, unconnected pistons slidably mounted in said slots, each closing the space between the cylinder and said flanges, and means arranged upon said driver at each of said slots to prevent the passage of fluid between said driver and said pistons.

7. A device of the kind described, comprising a cylinder provided with suitable ports, a liner adjustably mounted at each end of said cylinder, and a tubular flange provided upon each liner concentrically fixed within the cylinder, in combination with a rotatable driver inclosing the flanges and eccentrically mounted to close the cylinder upon one side, a plurality of radial slots formed in the periphery of said driver, unconnected pistons slidably mounted in said slots each closing the space between the cylinder and said flanges, one or more grooves formed in the walls of said slots near the periphery of said driver and packing-strips fitted into each of said grooves each adapted to resiliently press against a piston and prevent the passage of fluid radially in said slots.

8. A device of the kind described, compris-

ing a cylinder provided with ports, a pair of flanges concentrically fixed within said cylinder and a plurality of rings rotatably mounted upon each flange, in combination with a rotatable driver inclosing said flanges and eccentrically mounted to close the cylinder upon one side, a plurality of pistons slidably mounted upon said driver, each piston provided with and resting upon a single ring on each flange and substantially filling the space between said rings and said cylinder.

9. A device of the kind described, comprising a cylinder provided with suitable ports having a head securely attached to each end, a liner adjustably supported upon each head and means for adjusting the position of said liner, and a tubular flange formed upon each liner, projecting into, and concentric with said cylinder, in combination with a rotatable driver inclosing said flanges and eccentrically mounted to close the cylinder at one side at a point between said ports, a plurality of unconnected pistons slidably mounted upon said driver and closing the space between said cylinder and said flanges.

10. A device of the kind described, comprising a cylinder an adjustable liner at each end of said cylinder, a plurality of flanges concentrically fixed upon each liner ports communicating with said cylinder and a valve to control said ports, in combination with a rotatable driver inclosing a pair of said flanges and eccentrically mounted to close the cylinder upon one side between said ports, a plurality of pistons slidably and radially mounted upon said driver, each closing the space between said cylinder and said flanges.

11. A device of the kind described, comprising a cylinder provided with suitable ports, a liner adjustably mounted at each end of said cylinder, a flange concentrically mounted upon each of said liners and a ring rotatably mounted upon each flange, in combination with a rotatable driver inclosing said flanges and eccentrically positioned in said cylinder to close the same at one side, and a plurality of unconnected pistons slidably mounted upon said driver and extending from the cylinder to the flanges.

12. A device of the kind described, comprising a cylinder provided with suitable ports, a liner adjustably mounted at each end of said cylinder, a plurality of flanges formed concentrically upon each of said liners, and a ring rotatably mounted upon one flange of each liner, in combination with a rotatable driver inclosing said flange and eccentrically positioned in said cylinder to close the same at one side, and a plurality of unconnected pistons slidably mounted upon said driver and extending from the cylinder to the flanges.

13. A device of the kind described, comprising a cylinder provided with suitable ports, a liner adjustably mounted at each end of said cylinder, a flange concentrically mounted upon each of said liners and a plurality of rings rotatably mounted upon each flange, in combination with a rotatable driver inclosing said flanges and eccentrically positioned in said cylinder to close the same at one side, and a plurality of pistons slidably mounted upon said driver, each piston provided with and resting upon a single ring on each flange and substantially filling the space between said rings and said cylinder.

14. A device of the kind described, comprising a cylinder provided with suitable ports, a liner adjustably mounted at each end of said cylinder, a plurality of flanges formed concentrically upon each liner, and a plurality of rings rotatably mounted upon one flange of each liner, in combination with a rotatable driver inclosing said flanges and eccentrically positioned in said cylinder to close the same at one side, and a plurality of pistons slidably mounted upon said driver, each piston provided with and resting upon a single ring on each flange and substantially filling the space between said rings and said cylinder

15. A device of the kind described, comprising a cylinder provided with suitable ports, a liner adjustably mounted at each end of said cylinder, and means for adjusting the position of said liner, and a tubular member for each liner arranged within the cylinder, in combination with a rotatable driver inclosing said tubular members and eccentrically mounted to close the cylinder at a point between said parts, a plurality of pistons slidably mounted upon said driver and closing the space between said cylinder and said tubular member.

In testimony whereof we have hereunto signed our names in the presence of two subscribing witnesses.

WILLIAM H. BATES.
ROBERT C. DOUGLASS.
WILLIAM G. NOURSE.

Witnesses:
WILLIAM S. BARNES,
MORGAN R. EVANS.