No. 610,084. Patented Aug. 30, 1898.

# F. M. RICHARDS & H. M. FORBES.

## ROTARY ENGINE.

(Application filed July 16, 1897.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

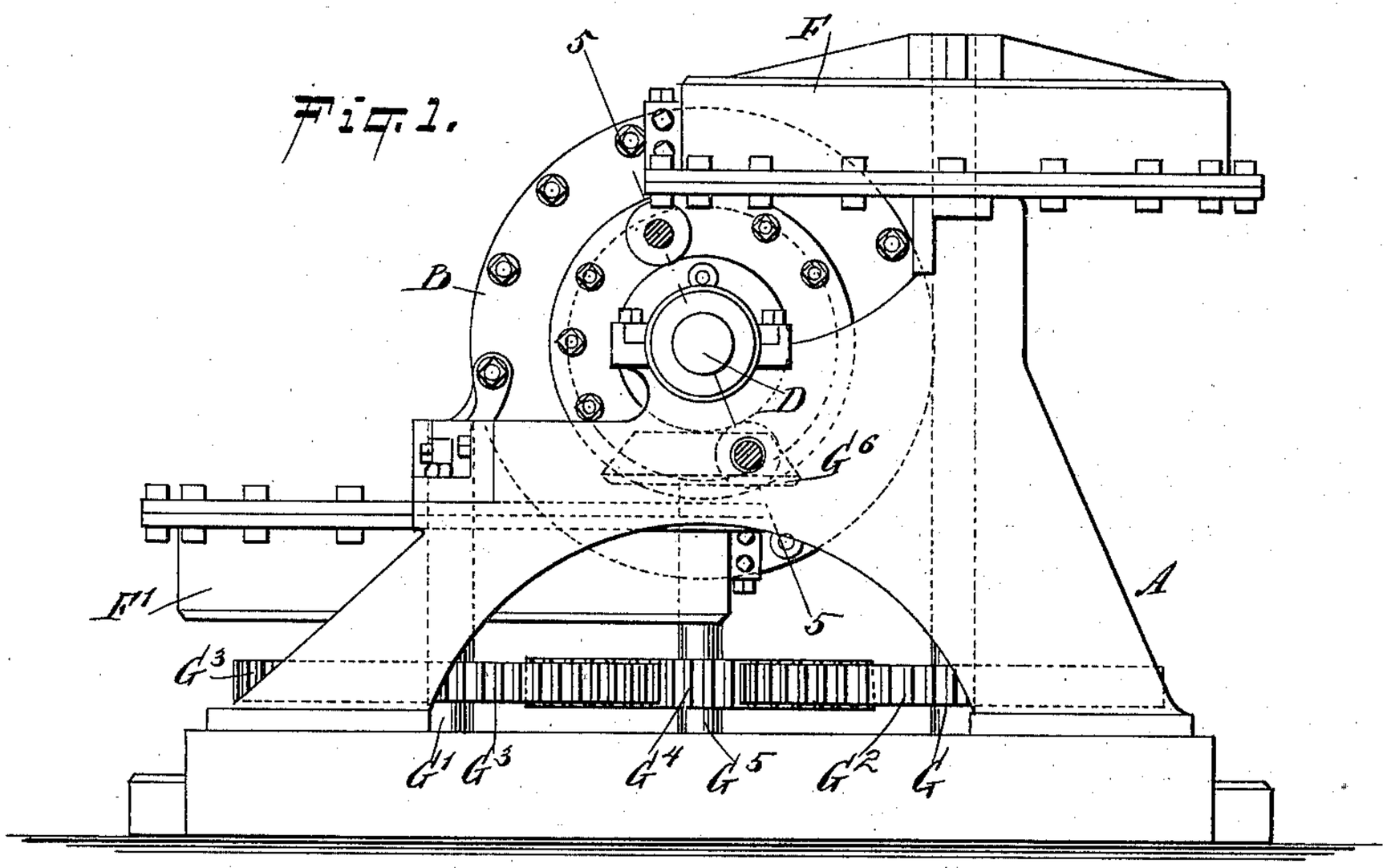
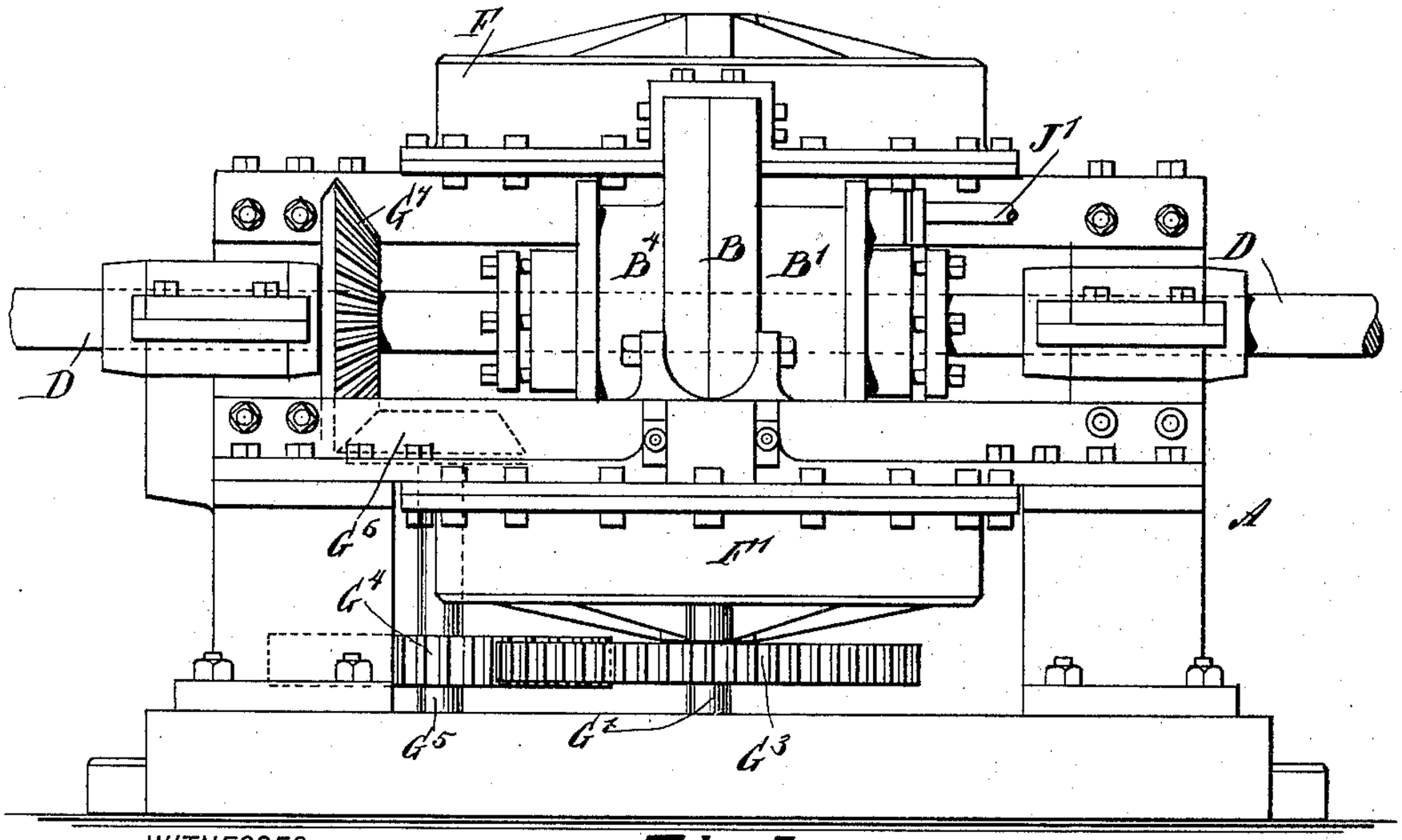



Fig. 2.

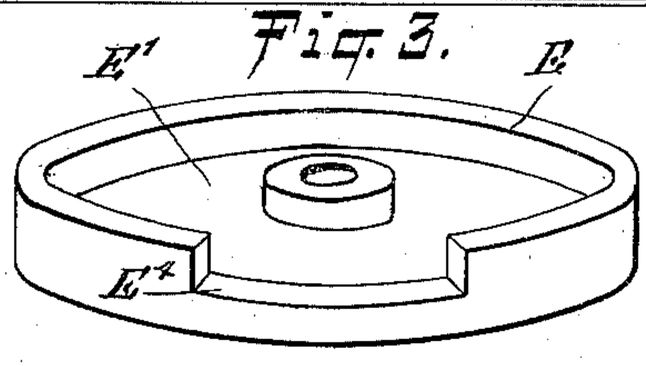



WITNESSES:

William P. Goebel.

Rev. J. Hoosey

Fig. 3.




INVENTORS

F. M. Richards

H. M. Forbes.

BY

Munn & Co.

ATTORNEYS.

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(No Model.) 2 Sheets—Sheet 2.

Fig. 4.

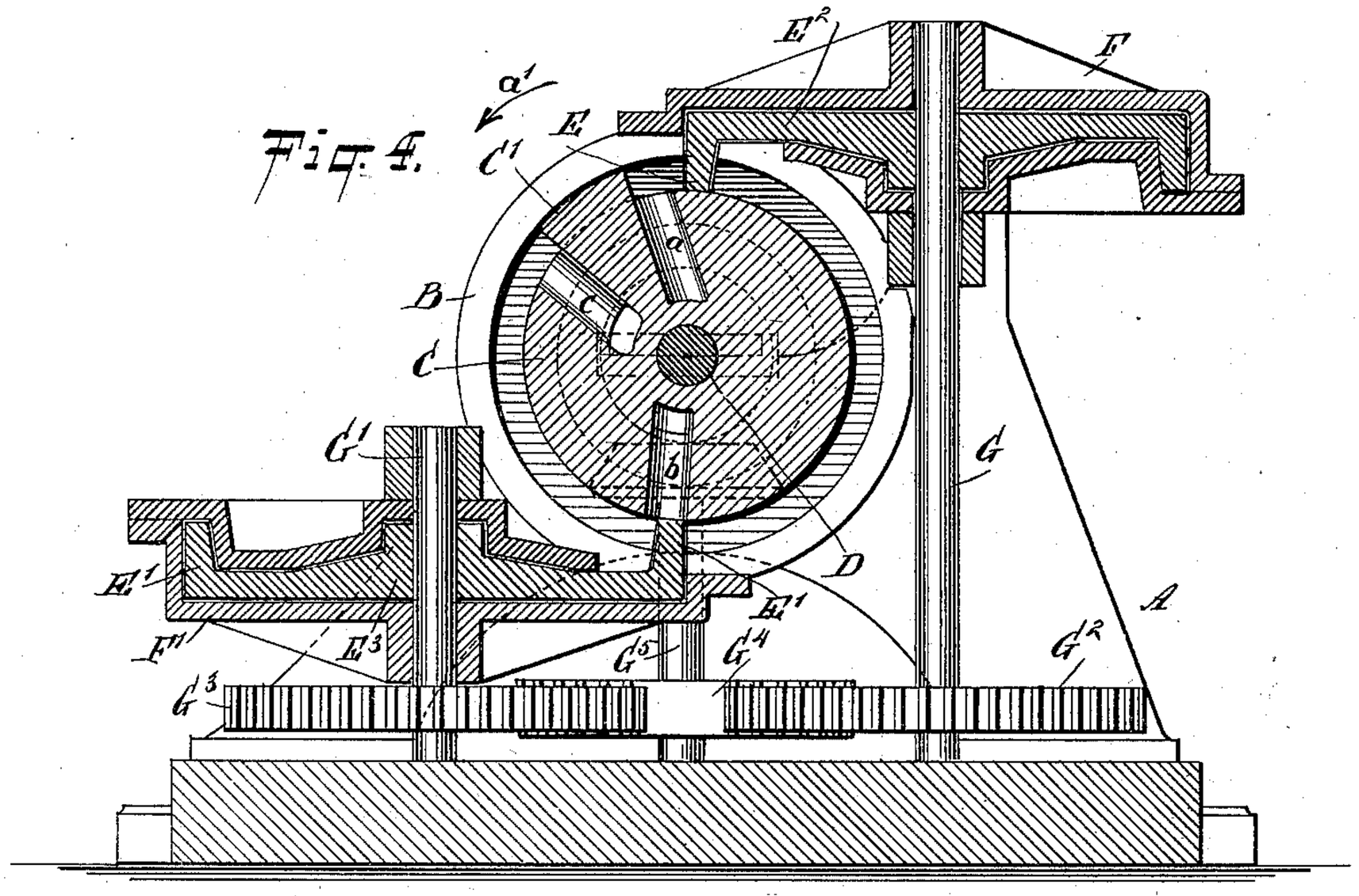



Fig. 5.

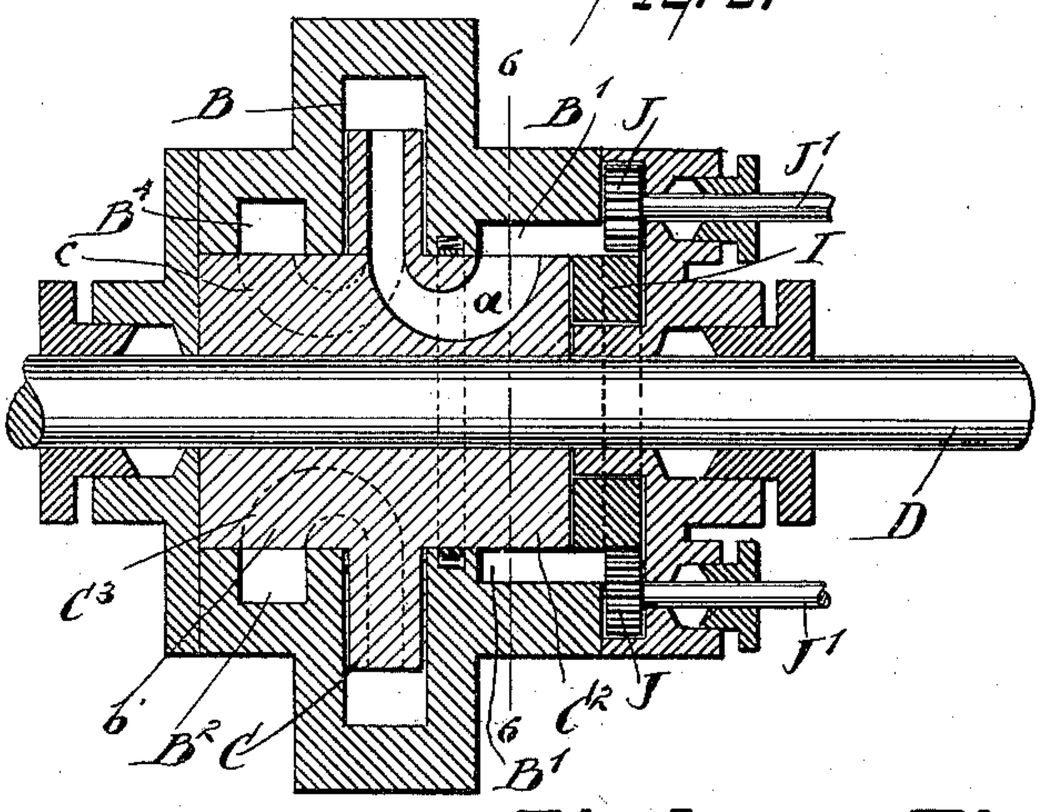



Fig. 6.

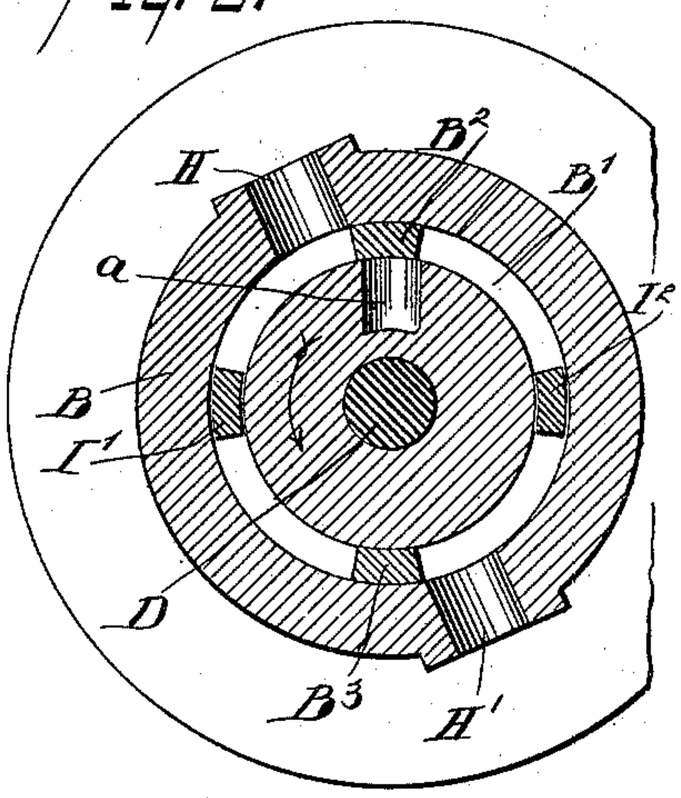



Fig. 7.

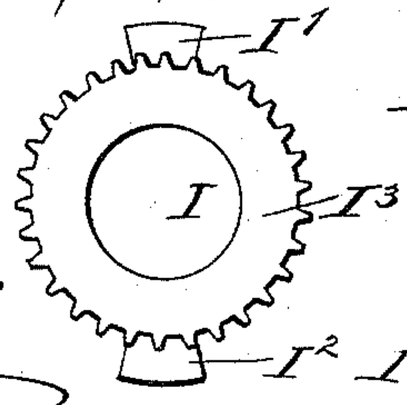
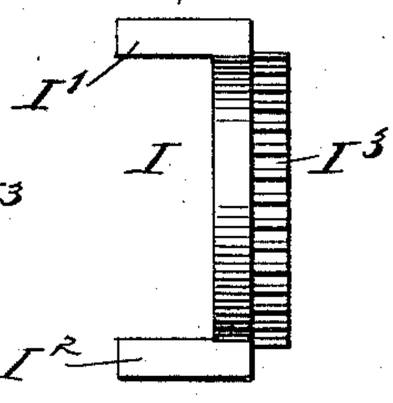



Fig. 8.




WITNESSES:
William P. Goebel.
Rev. J. Hoster.

INVENTORS
F. M. Richards
H. M. Forbes.
BY
Munn & Co.
ATTORNEYS.

# UNITED STATES PATENT OFFICE.

FRED M. RICHARDS AND HENRY M. FORBES, OF PORTAGE, WISCONSIN, ASSIGNORS OF ONE-THIRD TO GEORGE E. YORK, OF SAME PLACE.

## ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 610,084, dated August 30, 1898.

Application filed July 16, 1897. Serial No. 644,748. (No model.)

*To all whom it may concern:*

Be it known that we, FRED M. RICHARDS and HENRY M. FORBES, both of Portage, in the county of Columbia and State of Wisconsin, have invented a new and Improved Rotary Engine, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved rotary engine arranged to utilize the motive agent to the fullest advantage and to reduce the working parts of the engine to a minimum.

The invention consists of certain parts and details and combinations of the same, as will be fully described hereinafter and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is an end elevation of the improvement. Fig. 2 is a side elevation of the same. Fig. 3 is a perspective view of one of the abutments. Fig. 4 is a cross-section of the improvement. Fig. 5 is a sectional side elevation of the cylinder on the line 5 5 of Fig. 1. Fig. 6 is a cross-section of the same on the line 6 6 of Fig. 5. Fig. 7 is a face view of the valve, and Fig. 8 is a side elevation of the same.

The improved rotary engine is mounted on a suitably-constructed frame A, supporting a cylinder B, in which revolves a piston C, having a piston-head C′ and secured on the main driving-shaft D, journaled in suitable bearings arranged on the main frame A.

Into the working chamber of the cylinder B extend one or more abutments E E′, preferably arranged diametrically opposite each other, as is plainly indicated in Fig. 4, each abutment being mounted to revolve through a suitable cut-out portion or slot formed in the cylinder B, suitable packings being provided to render the joint between the abutments and the cylinder steam-tight. The abutments E E′ are in the form of annular flanges on disks $E^2$ $E^3$, respectively, mounted to revolve within suitable casings F F′, respectively, carried by the main frame A.

The disks $E^2$ $E^3$ are secured on vertically-disposed shafts G G′, respectively, journaled in suitable bearings in the main frame A and the said casings F F′, and on the said shafts are secured gear-wheels $G^2$ $G^3$, in mesh with a gear-wheel $G^4$, fastened on a vertically-disposed shaft $G^5$, journaled in suitable bearings in the frame A and connected at its upper end by a beveled gear-wheel $G^6$ with a beveled gear-wheel $G^7$, attached to the main driving-shaft D. Thus when the main shaft D is rotated a rotary motion is transmitted by the gear-wheels $G^7$ $G^6$ to the shaft $G^5$, which by the gear-wheel $G^4$ and gear-wheels $G^3$ $G^2$ imparts a simultaneous rotary motion to the shafts G G′, so that the disks $E^2$ $E^3$ and the abutments E E′, carried by the said disks, are rotated.

In order to let the piston-head C′ pass the abutment at the proper time, we form each of the said abutments with a recess $E^4$, as is plainly indicated in Fig. 3, it being understood that the said recesses of the two abutments are located approximately diametrically opposite each other. When the piston-head C′ approaches one of the abutments, the corresponding recess $E^4$ is at that time in the working part of the cylinder to allow the said piston to pass through the abutment at the recess.

On one side of the cylinder B is formed an annular steam-chest B′, connected at diametrically opposite points with steam-inlets H H′, deriving their supply of motive agent from a boiler or other source. In the steam-chest B′ is mounted to oscillate a valve I, formed with arms I′ $I^2$, located diametrically opposite each other and extending into the said steam-chest B′, as is plainly indicated in Fig. 6. Fixed abutments $B^2$ $B^3$ likewise extend into the said steam-chest B′ at points at right angles to the arms I′ $I^2$, the said abutments being located adjacent to the inlets H H′, as plainly indicated in Fig. 6.

The interior of the steam-chest B′ is connected by an inlet-port *a* in the piston C with the interior or working chamber of the cylinder B, (see Fig. 5,) so that live steam from the said steam-chest can pass into the cylinder whenever the said port is uncovered by the abutments $B^2$ $B^3$ and arms I′ $I^2$. Exhaust-ports *b c* are likewise formed in the piston C and serve to connect the interior or working chamber of the piston B with an exhaust-

chest $B^4$, formed on the side of the cylinder B directly opposite to that on which the inlet-chest B′ is located. The exhaust $B^4$ connects with an exhaust-pipe leading to the outer air.

Now in order to shift the valve I said valve is provided with a gear-wheel $I^3$, in mesh with pinions J, secured on stems J′, passing through suitable stuffing-boxes held on the cylinder B at the outside thereof, so as to be under the control of the operator. By the arrangement described a rotary motion can be given to the valve I, so as to move the arms $I'$ $I^2$ into different positions relatively to the abutments $B^2$ $B^3$ to cut off the steam sooner or later, as the case may be.

The operation is as follows: The steam entering the steam-chest B′ passes through the port *a* into the cylinder between the piston-head C′ and the corresponding abutment E or E′ to press on the said piston, so as to rotate the same in the direction of the arrow *a*′. (Shown in Fig. 4.) The steam in front of the piston-head C′ passes through the exhaust-port *c* or *b* into the exhaust-chest $B^4$ and from the said exhaust-chest to the open air. As the piston C revolves in the cylinder a rotary motion is given to the main driving-shaft D, which transmits the motion to other machinery and at the same time rotates the abutments E E′ by the means above described, so that the said abutments bring their cut-out portions or recesses $E^4$ into the working chamber of the cylinder at the time the piston C′ has to pass the corresponding abutment.

Having thus fully described our invention, we claim as new and desire to secure by Letters Patent—

1. In a rotary engine, the combination with a cylinder, and a piston mounted to turn in the cylinder and provided with a piston-head, of a revoluble disk mounted with its axis at right angles to the axis of the piston and having an annular flange projecting at an angle from the disk and extending into the working chamber of the cylinder to form an abutment, said flange being cut away to permit the passage of the piston, substantially as described.

2. In a rotary engine, the combination with a cylinder, and a piston mounted on a horizontal axis to turn in the cylinder and provided with a piston-head, of a revoluble disk mounted on a vertical axis and having an annular flange projecting at an angle from the disk and extending into the working chamber of the cylinder to form an abutment, said flange being cut away for the passage of the piston, substantially as described.

3. In a rotary engine, the combination with a cylinder, and a piston mounted on horizontal pivots to turn in the cylinder, of two disks mounted at opposite sides of the cylinder on vertical pivots and having annular flanges projecting at angles from the disks and extending into the working chamber of the cylinder to form abutments, said flanges being cut away for the passage of the piston, and means for operating the said disks from the piston, substantially as described.

4. In a rotary engine, the combination with a cylinder provided with a steam-chest, and a piston mounted on horizontal pivots and provided with a piston-head, of disks mounted at opposite sides of the cylinder on vertical pivots and having annular flanges projecting at angles from the disks and extending into the working chamber of the cylinder to form abutments, said flanges being cut away for the passage of the piston, means for operating the disks from the piston, and an oscillating valve in the steam-chest of the cylinder, substantially as described.

5. In a rotary engine, the combination with a cylinder provided with a steam-chest on one side and an exhaust-chest on the other side, and a piston mounted on horizontal pivots in the cylinder, and provided with a piston-head and with ports leading from said chests to the working cylinder, of disks mounted on vertical shafts at opposite sides of the cylinder, and having annular flanges projecting at angles from the disks, the flanges extending into the working chamber of the cylinder, and cut away for the passage of the piston, gearing between the shafts of the disks and the piston, and an oscillating valve in the steam-chest of the cylinder, substantially as described.

6. In a rotary engine, the combination of a cylinder provided with an annular steam-chest having steam-inlets at diametrically opposite sides and provided with fixed and oppositely-arranged abutments, a piston in the cylinder and having a port connecting the steam-chest with the cylinder and an oscillating valve in the steam-chest and provided with diametrically opposite arms extending between the fixed abutments, substantially as described.

7. In a rotary engine, the combination of a cylinder provided with an annular steam-chest having steam-inlets at diametrically opposite sides and provided with fixed and oppositely-arranged abutments, a piston in the cylinder and provided with a port connecting the steam-chest with the cylinder, a valve arranged in the steam-chest and provided with diametrical arms extending between the fixed abutments and with a gear-wheel, and a pinion meshing with the gear-wheel of the valve and a stem secured to the pinion under the control of the operator, substantially as described.

8. A rotary engine, comprising a cylinder having a central working chamber, a steam-chest on one side and an exhaust-chest on the other, the steam-chest being provided with fixed abutments, a piston mounted in the cylinder on a horizontal axis and provided with a piston-head and with ports leading from the chests into the working chamber, two disks mounted on vertical shafts and arranged at

opposite sides of the cylinder and having annular flanges projecting at angles from the disks, the flanges extending into the working chamber of the cylinder to form abutments, and cut away for the passage of the piston, gearing for operating the disks from the piston, and an oscillating valve provided with arms projecting into the steam-chest, substantially as herein shown and described.

FRED M. RICHARDS.
HENRY M. FORBES.

Witnesses:
GEORGE E. YORK,
W. S. STROUD.