No. 627,332. Patented June 20, 1899.

W. G. FLORENCE & A. B. TREMBLEY.

REVERSIBLE ROTARY ENGINE.

(No Model.) (Application filed June 23, 1898.) 3 Sheets—Sheet 1.

Fig. 1.

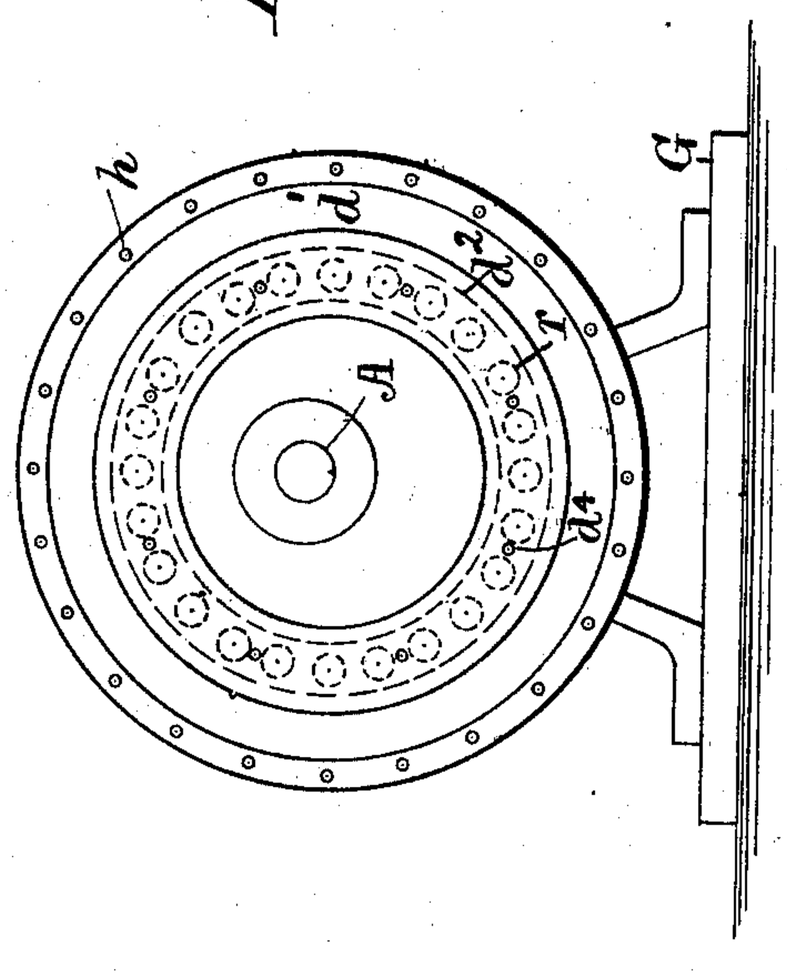

Fig. 2.

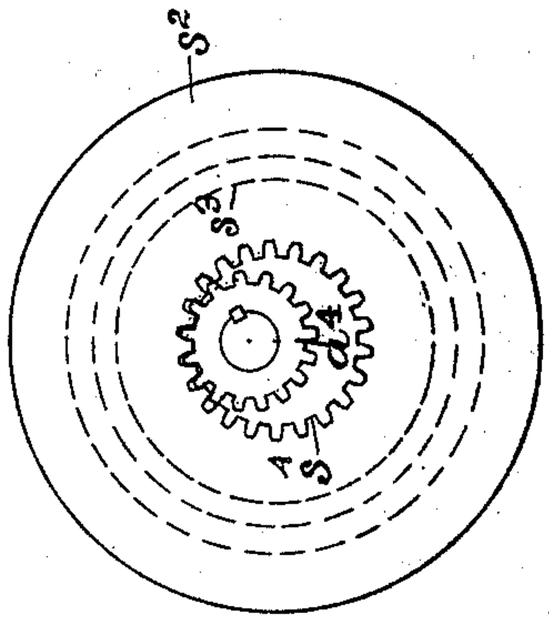

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Fig. 4.

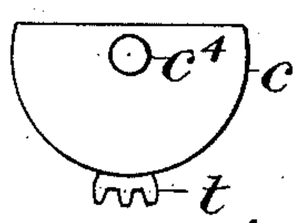

Fig. 5.

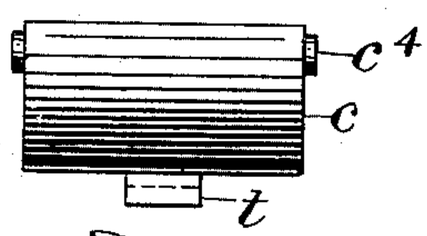

Fig. 3.

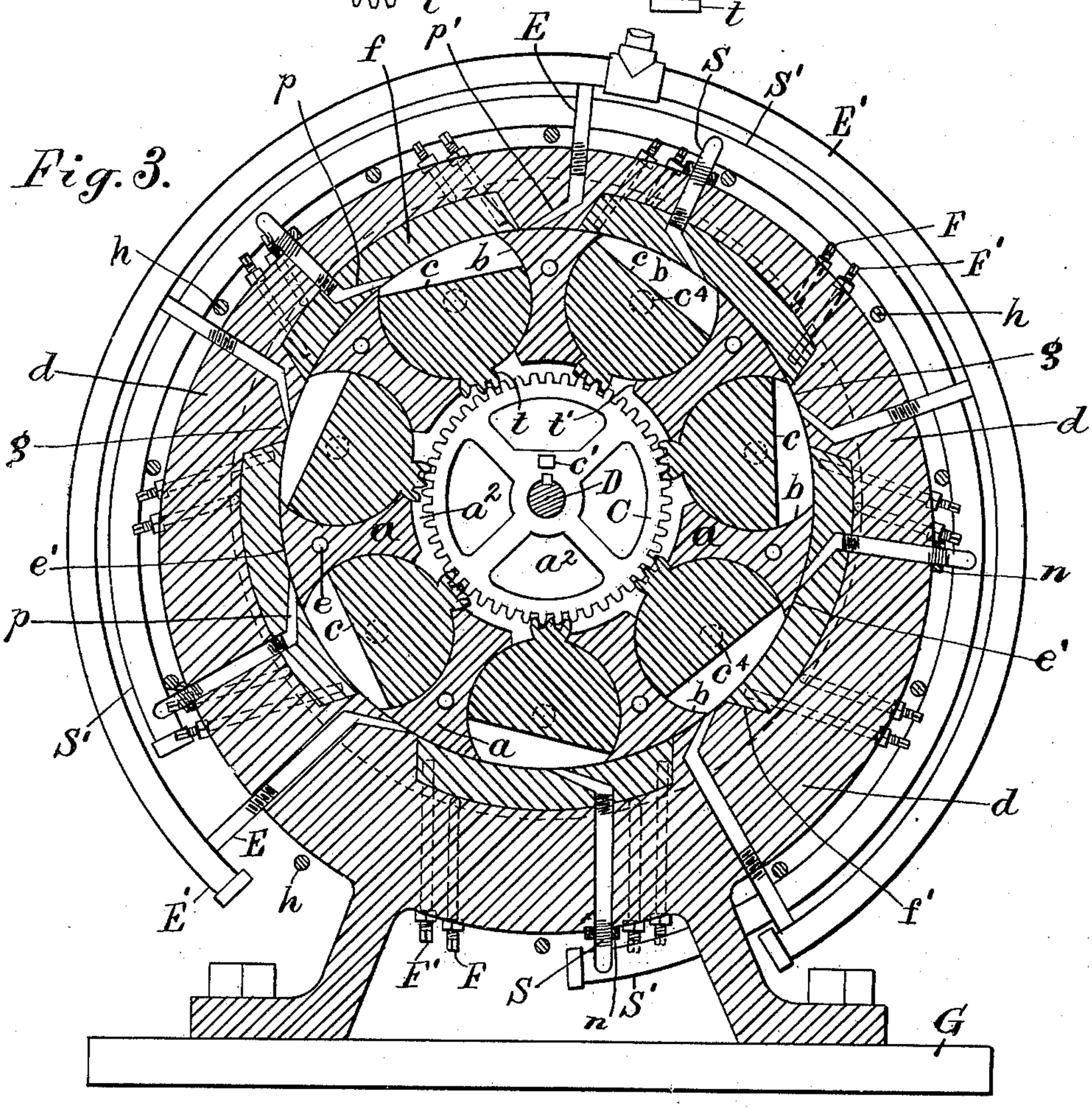

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Fig. 7.

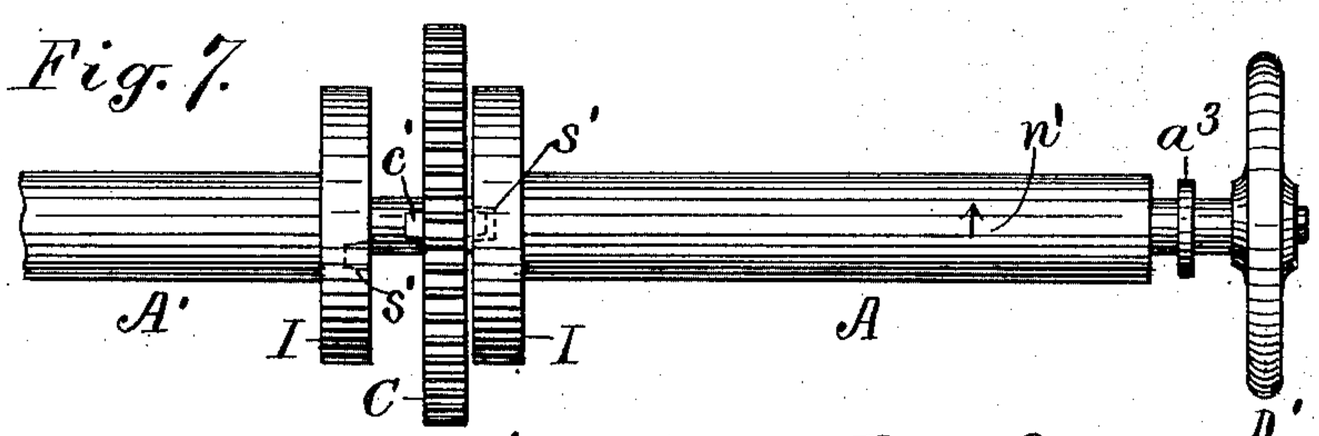

Fig. 6.

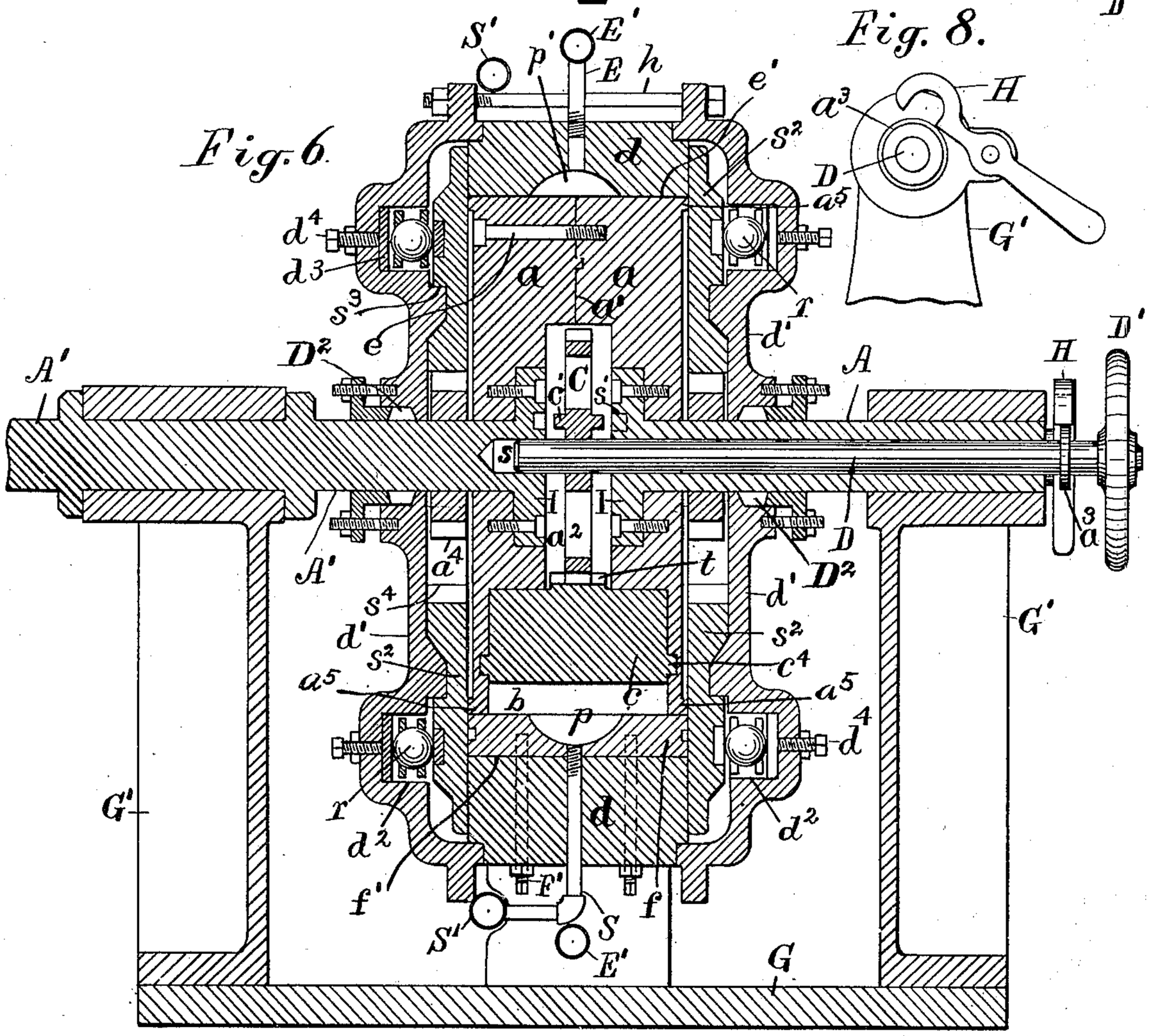

Fig. 8.

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UNITED STATES PATENT OFFICE.

WILLIAM G. FLORENCE AND ARTHUR B. TREMBLEY, OF NEWARK, NEW JERSEY.

REVERSIBLE ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 627,332, dated June 20, 1899.

Application filed June 23, 1898. Serial No. 684,298. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM G. FLORENCE and ARTHUR B. TREMBLEY, citizens of the United States, residing at Newark, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Reversible Rotary Engines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

The present invention relates to that class of rotary engines in which a drum provided with pockets in its periphery is mounted within a cylinder having tangential or inclined jets; and the object of the present invention is to improve the means of packing the sides and periphery of the drum, and especially to furnish a construction adapted to readily and efficiently reverse the rotations of the drum-shaft. To effect such reversal, the cylinder is formed with two sets of ports inclined in opposite directions and arranged alternately and connected with suitable pipes to use at pleasure for either steam or exhaust. The drum is provided with a series of transverse cylindrical pockets having segmental blocks adjustable therein at opposite inclinations, so that the pockets may be made the deepest upon the forward side, in whichever direction the steam-jets are operated. To facilitate the reversal of the engine when in motion, a spindle is inserted through the drum-shaft and connected by a cog-wheel with the segmental blocks, so as to tip the blocks in the required direction without stopping the engine. The engine may thus be used for hoisting and driving steamboat-propellers and for other purposes where frequent and quick reversal is required.

The invention will be understood by reference to the annexed drawings, in which—

Figure 1 is an end elevation of the engine. Fig. 2 is an inside view of one of the packing-rings. Fig. 3 is a cross-section of the engine. Fig. 4 is an end view of one of the segmental blocks, and Fig. 5 a side view of the same. Fig. 6 is a longitudinal vertical section of the engine, and Fig. 7 is a plan of the drum-shaft and the adjustable gear removed from the interior of the drum. Fig. 8 is an end elevation of the standard, with the latch H.

a designates the body of the drum, having in its periphery pockets *b*, which are formed in cylindrical spaces, having the segmental blocks *c* pivoted therein upon pivots c^4. The outer ends of the drum are continuous, and in order to introduce the segmental blocks into the cylindrical pockets the drum is divided at the middle line *a'* and the halves secured together by bolts *e*. The drum is formed internally at the center with a cylindrical chamber a^2, and the drum-shaft is divided into two parts A A', which are provided at their inner ends with flanges I, secured within such chamber.

The shell of the cylinder *d* is formed with a series of concentric recesses *f'*, separated by cross-bars *g*, and concentric packing-blocks *f* are fitted to the recesses and to that part of the periphery of the drum which forms joint ridges *e'* between the cylindrical pockets. The packing-blocks are adjusted by set-screws F and retained in position by bolts F'. Ports *p* and *p'*, inclined in reverse directions, are formed in each of the blocks and its adjacent cross-bar, and pipes S and E are connected with such ports and extended outwardly through the shell of the cylinder *d*. The pipes in the blocks *f'* pass loosely through the shell, and their joint upon its exterior is closed by a suitable packing beneath a nut *n*. The pipes S are joined to a common supply-pipe S' and the pipes E to a common pipe E', and in practice suitable valves are supplied to deliver steam into either of the pipes S' or E' at pleasure.

When the steam is turned into the pipes S and ports *p*, the blocks *c* in the pockets are inclined forwardly, as shown in Fig. 1, and the jet of steam entering each port then impinges against the sharp corner of the deeper side of the pocket. The packing-blocks *f'* are made about twice the length of the pocket, so as to cover the adjacent joint-ridge *e'*, and the port *p* opens at the middle of its length. The distance between the ports *p* and *p'* is greater than the width of the pocket, so that when steam is supplied to the port *p* the joint-ridge *e'* effectively closes such steam-port as the pocket moves past the same before the front edge of the pocket reaches the succeeding port *p'*, which operates to exhaust

the contents of the pocket. When the steam is supplied to the ports p' and the ports p are used for exhaust, the same effect is produced by the rotation in the opposite direction; but the blocks C are then tipped to a reverse position to that shown in Fig. 1 by gearing located within the center of the drum. To operate such gearing, an arbor D is extended through the drum-shaft and the chamber a^2, within which it is provided with a toothed wheel C, and each of the segmental blocks c is provided with a toothed arm t, which is extended through a slot t' into the chamber to mesh with such wheel. The arbor D projects beyond the end of the shaft A, and a hand-wheel D′ is attached to the outer end of the arbor to turn the toothed wheel slightly to oscillate the segments c when their reversal is required. The slots t' regulate the movements of the arms and the inclinations of the segmental blocks in the pockets b. The inner end of the arbor is fitted movably in a socket s in the shaft A′, and the opposite sides of the toothed wheel C are provided with pins c', adapted to fit recesses s' in the faces of the flanges I when the wheel is turned in opposite positions in adjusting the blocks c. One of the pins c' is shown in Fig. 7 in one of the recesses s' in the adjacent flange I, thus locking the wheel C and all of the segmental blocks in the position shown in Fig. 3. An arrow n' is shown in Fig. 7 upon the shaft A′, indicating the direction of rotation when the blocks c are thus adjusted, and the shifting of the hand-wheel endwise, with the wheel C in an intermediate position, as shown in Fig. 6, permits the retarding of the hand-wheel by a slight pressure, so as to shift the wheel C and throw the blocks c in an opposite position to prepare the drum for reversal, which is then effected by turning the steam into such opposite ports. The hand-wheel is then pushed endwise, so that the opposite pin c' may engage the corresponding hole s', which is arranged, as shown in Fig. 7, to coincide with the pin when the wheel C is thus oscillated. The cylinder is bolted by a foot-piece to a bed-plate G, upon which standards G′ are mounted, with bearings to carry the shafts A and A′, the outer end of which may project outside such bearings to any suitable distance, as shown at the outer end of the shaft A′, to apply a driving-wheel. The arbor D is provided with a collar a^3 near the hand-wheel D′, and a latch H is pivoted upon the standard G′, as shown in Fig. 8, to fit upon the shaft at either side of the collar when the toothed wheel C is clutched, respectively, to each of the flanges I. The latch is lifted when it is necessary to shift the toothed wheel by moving the hand-wheel D′, and the dropping of the latch by the side of the collar then indicates to the operator that the toothed wheel has been fully shifted and clutched to the adjacent flange. The cylinder d is formed with eccentric body or flange, and the heads d' are fitted steam-tight to the outer margin of such body, with flanges projected beyond the edge of the cylinder to receive bolts h for securing the heads d'. Each head is formed between its inner side and the end of the cylinder with a space which is eccentric to the bore of the cylinder, and a packing-ring s^2 is fitted to such space and guided eccentrically to such bore by an annular shoulder s^3 upon the head. The heads have stuffing-boxes D^2. An annular recess d^2 is formed in each head and provided with a series of balls r to press upon the outer side of the ring s^2, which is fitted into steam-tight contact with the ends of the cylinder and the cross-bars g and against annular flanges a^5 at the outer edges of the drum a.

Steel wearing-rings d^3 to contact with the balls r are let into the recesses d^2 and furnished with set-screws d^4 to adjust them, and similar rings are sunk in the faces of the packing-rings s^2. Internal gear-teeth s^4 are formed within a central opening in each of the rings s^2, and a pinion a^4 is keyed upon each of the shafts A and A′ to mesh with such teeth. Such pinions drive the rings at about one-half the velocity of the drum a, and as the packing-ring moves eccentrically over the parts against which it is fitted it is obvious that it is constantly changing its wearing contact with such parts, and thus maintains a perfect joint therewith.

Seven of the pockets b are shown upon the drum and five of the blocks f, containing the inlet-port p, and such ports do not, therefore, operate simultaneously upon the pockets, but successively as the drum rotates, so as to maintain a continuous effect upon the revolving shaft A A′.

The packing-blocks f are long enough between the port p and the end of the block to cover the pocket in whichever direction it revolves, and as the pocket reaches the exhaust-port p immediately afterward it will be understood that the steam is retained in the pocket until it reaches such exhaust-port. As the port p is at the middle of the packing-block f, the same effect is produced in whichever direction the drum revolves; but it is intended that the port in the packing-block shall be used as a steam-inlet where the engine is continuously or chiefly rotated in one direction.

Having thus set forth the nature of the invention, what is claimed herein is—

1. In a reversible rotary engine, the combination, with heads d' having stuffing-boxes with drum-shaft therein, of the cylinder d having series of inlet and outlet ports arranged alternately and inclined in opposite directions, and adapted, at pleasure, for use as steam or exhaust ports, and a drum having a series of peripheral pockets with bottoms adjustable at opposite inclinations to receive the steam-jets in opposite directions, substantially as herein set forth.

2. In a reversible rotary engine, the combination, with heads d' having bearings with

drum-shaft therein, of the cylinder *d* having series of inlet and outlet ports arranged alternately and inclined in opposite directions, a drum having a series of transverse cylindrical pockets with segmental blocks rotatable therein, and means operating through the drum-shaft for adjusting the blocks in opposite positions, substantially as herein set forth.

3. In a reversible rotary engine, the combination, with heads *d'* having bearings with drum-shaft therein, of the cylinder *d* having series of inlet and outlet ports arranged alternately and inclined in opposite directions, of a drum having a series of peripheral pockets less in number than the series of inlet-ports with bottoms adjustable at opposite inclinations, and the steam-jets thus operating successively upon the various pockets and maintaining a uniform action therein, substantially as herein set forth.

4. In a rotary engine, the combination, with a drum-shaft, of a drum having a series of joint-ridges *e'* with intermediate pockets having inclined bottoms, heads supporting a drum-shaft, and a cylinder having a series of recesses with intervening cross-bars *g*, having inclined ports, packing-blocks fitted to such recesses and to the ridges upon the cylinder with screws to adjust such blocks, each block being adapted to cover one of the pockets and the adjacent ridges, and having an inclined port with a pipe projecting therefrom through the shell of the cylinder, as and for the purpose set forth.

5. In a rotary engine, the combination, with a drum-shaft, of a drum having a series of joint-ridges *e'* with intermediate pockets having inclined bottoms, a cylinder having a series of recesses with intervening cross-bars *g* having inclined ports, packing-blocks fitted to such recesses and to the ridges upon the drum with screws to adjust such blocks, each block having an inclined port with pipe extended outwardly therefrom, a head fitted to each end of the cylinder and drum-shaft and having an eccentric raceway with balls therein, and a packing-ring pressed by such balls against the end of the drum and cylinder, and against the packing-blocks in the same, substantially as herein set forth.

6. In a rotary engine, the combination, with a drum-shaft, of a drum having a series of joint-ridges *e'*, with intermediate pockets having inclined bottoms, a cylinder having a series of recesses with intervening cross-bars *g* having inclined ports, packing-blocks fitted to such recesses and to the ridges upon the drum with screws to adjust such blocks, each block having an inclined port with pipe extended outwardly therefrom, a head fitted to each end of the cylinder and drum-shaft and having an eccentric raceway with balls therein, a packing-ring fitted against the end of the drum and cylinder, and against the packing-blocks in the same, a set of balls guided in the raceway, and an adjustable collar with set-screws in the head to press the balls against the packing-ring substantially as herein set forth.

7. In a rotary engine, the combination, with a drum-shaft, of a drum having a series of concentric joint-ridges with intermediate pockets having inclined bottoms, a cylinder having a series of recesses with intervening cross-bars *g* having inclined ports, packing-blocks fitted to such recesses and to the ridges upon the drum, with screws to adjust such blocks, each block having an inclined port with pipe extended outwardly therefrom, a head fitted to each end of the cylinder and drum-shaft and having an eccentric raceway with balls therein, a packing-ring pressed by such balls against the end of the drum and cylinder, and against the packing-blocks in the same, teeth inside the ring and a pinion upon the drum-shaft to rotate the ring eccentrically to the drum, as and for the purpose set forth.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

WILLIAM G. FLORENCE.
ARTHUR B. TREMBLEY.

Witnesses:
JOHN C. CORY,
THOMAS S. CRANE.