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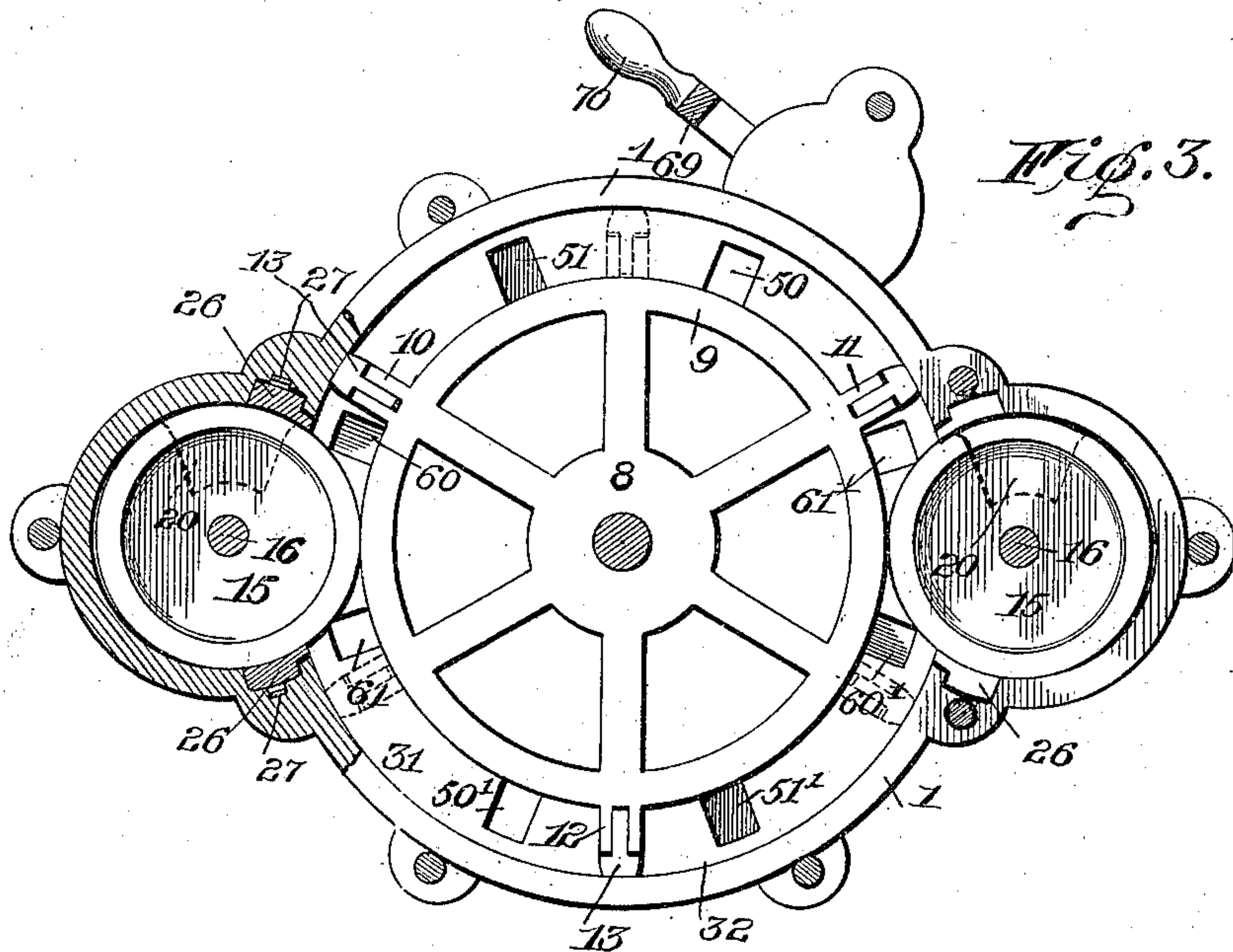
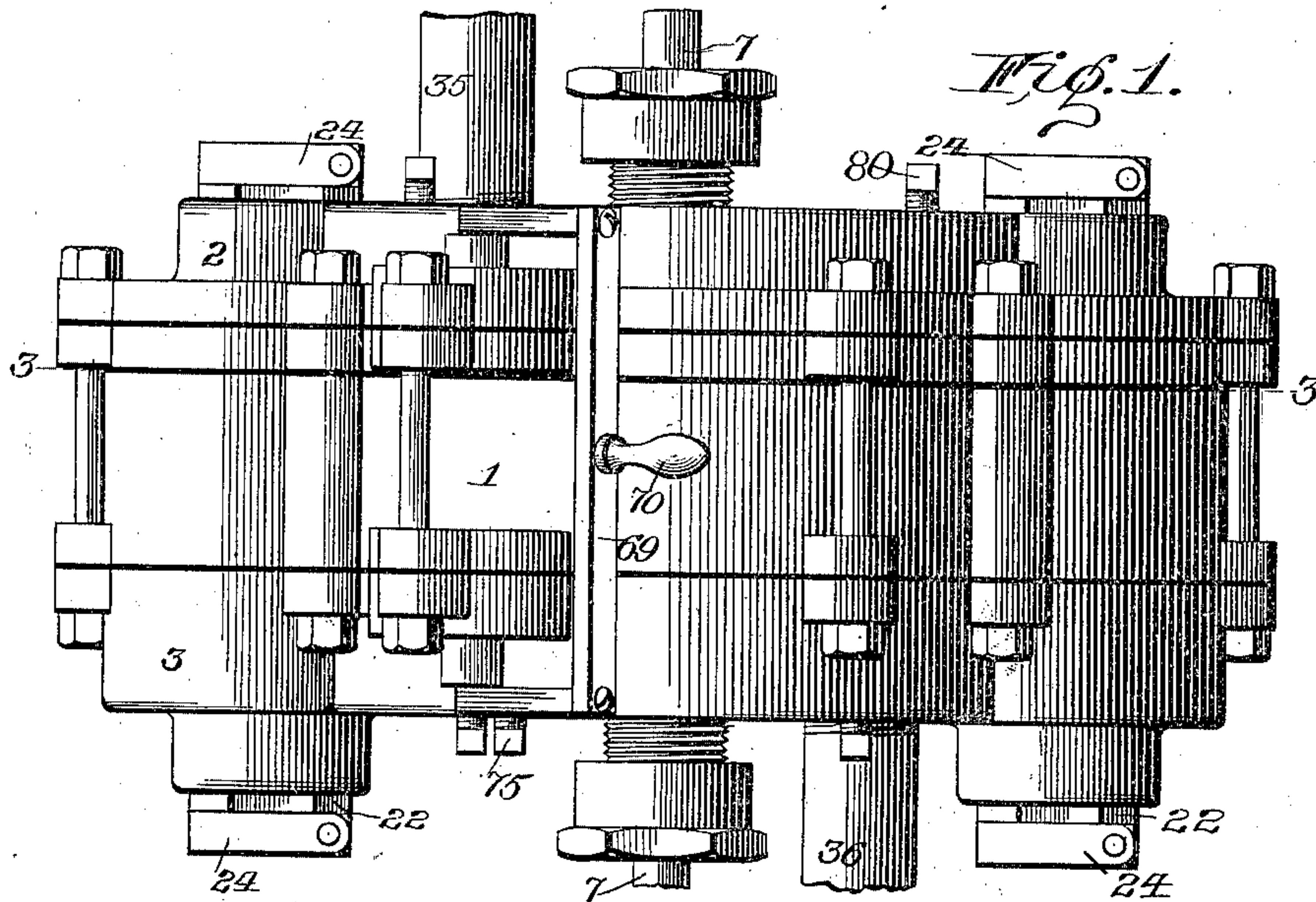
Patented Dec. 3, 1901.

E. H. EATON & T. WRIGHT.  
ROTARY ENGINE.

(Application filed Oct. 13, 1900.)

(No Model.)

4 Sheets—Sheet 1.



Witnesses.

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Inventors:

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their Attorney.*



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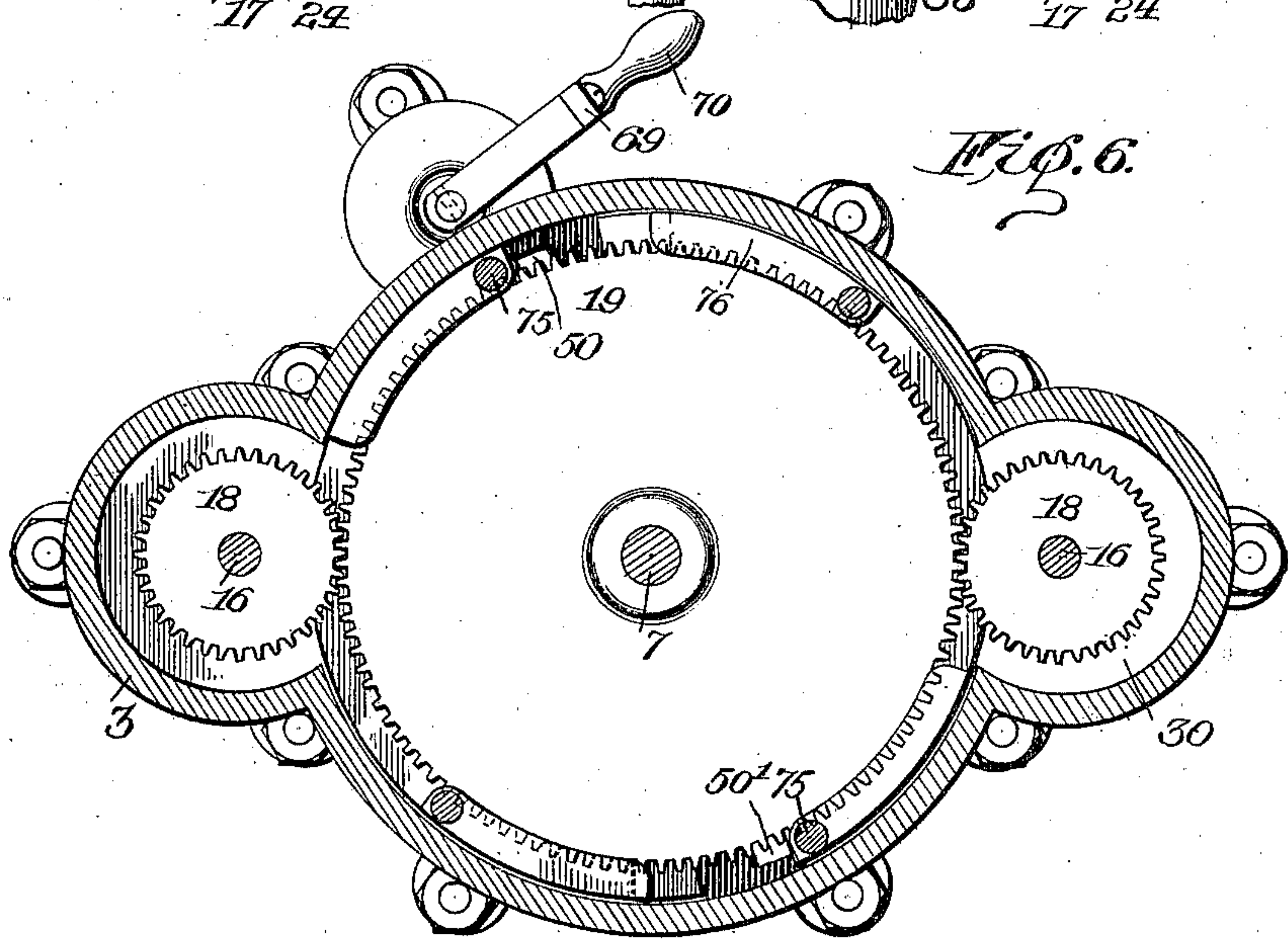
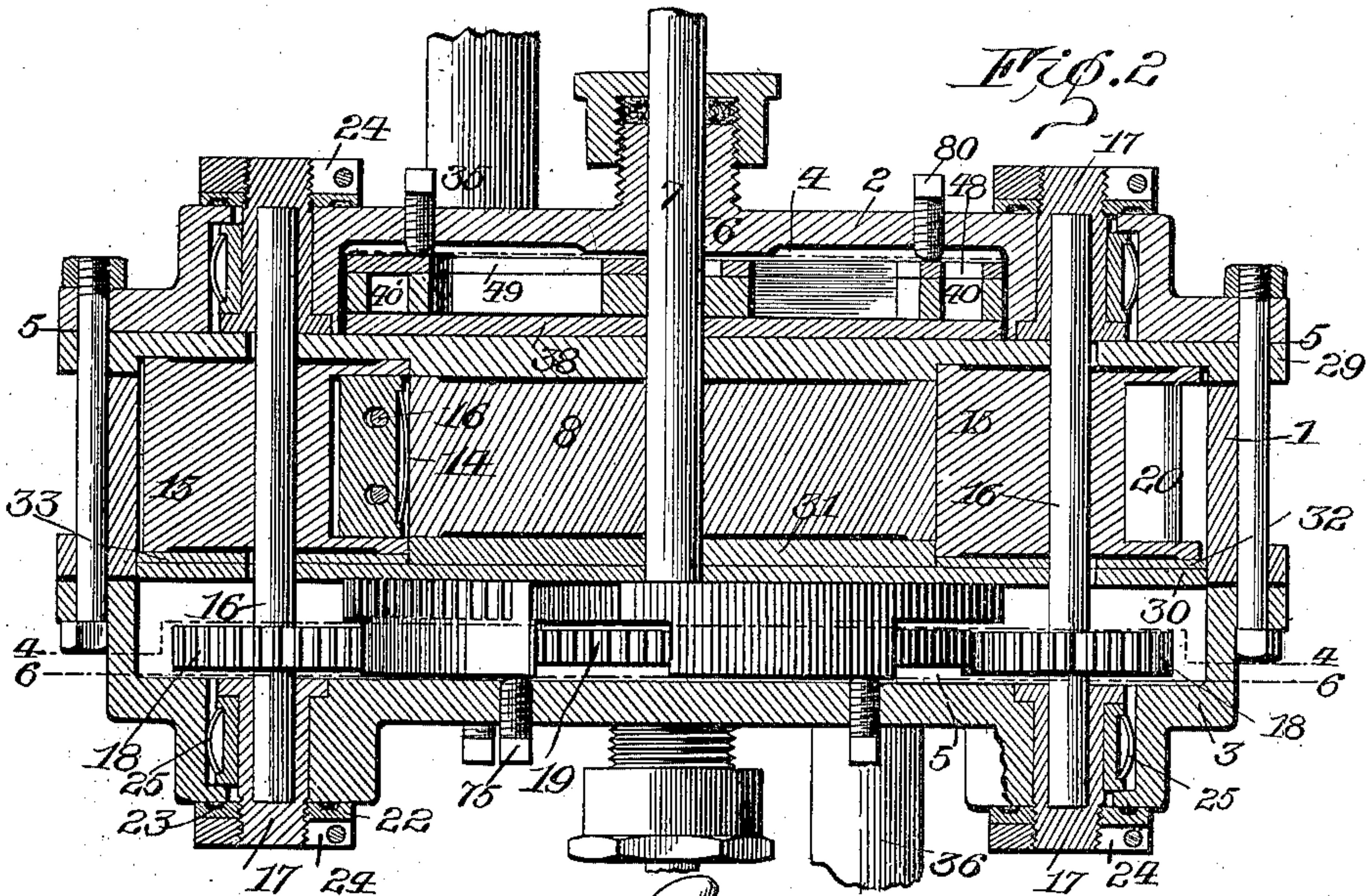
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4 Sheets—Sheet 2.



Witnesses.

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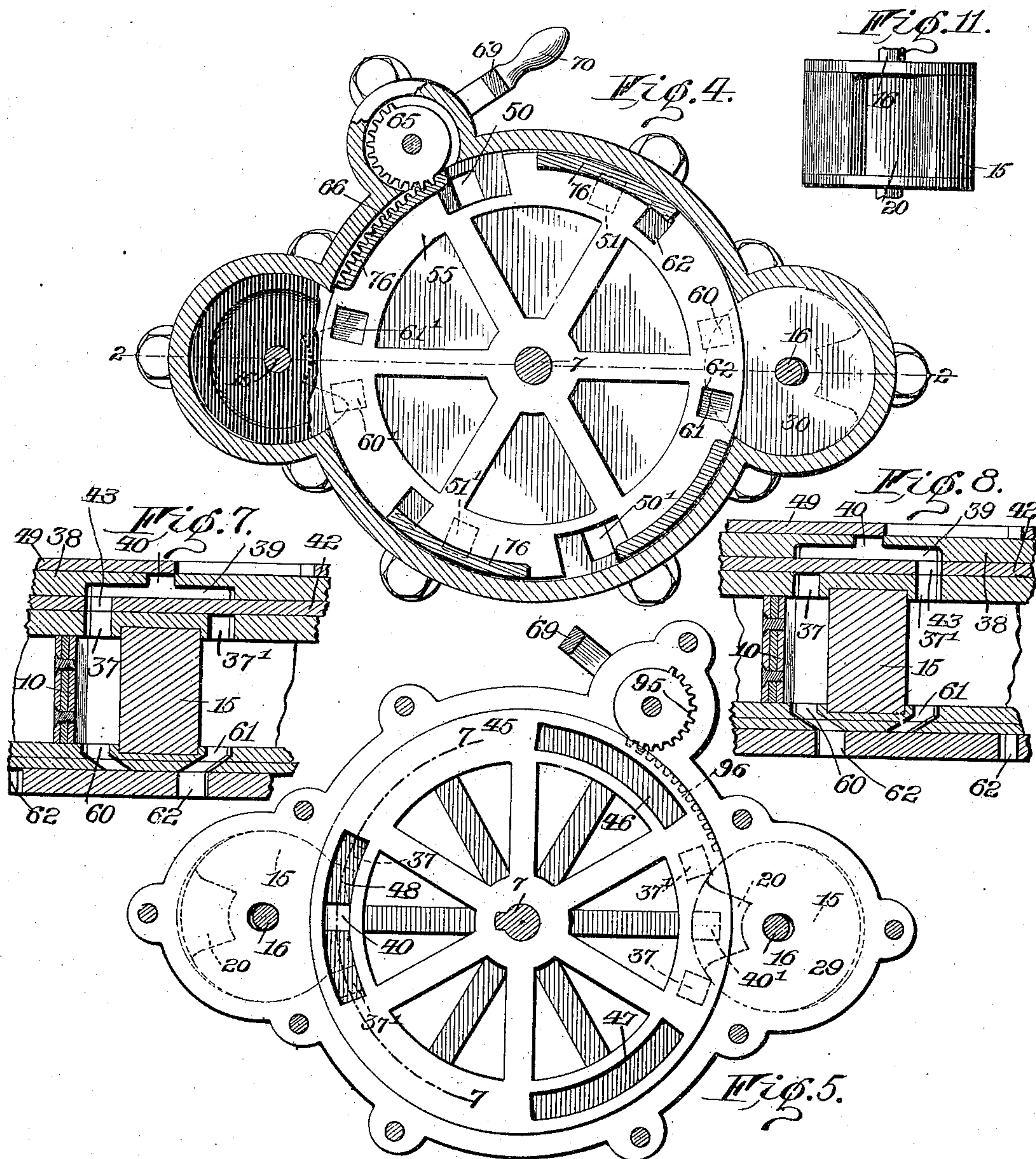
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(No Model.)

4 Sheets—Sheet 3.



Witnesses.

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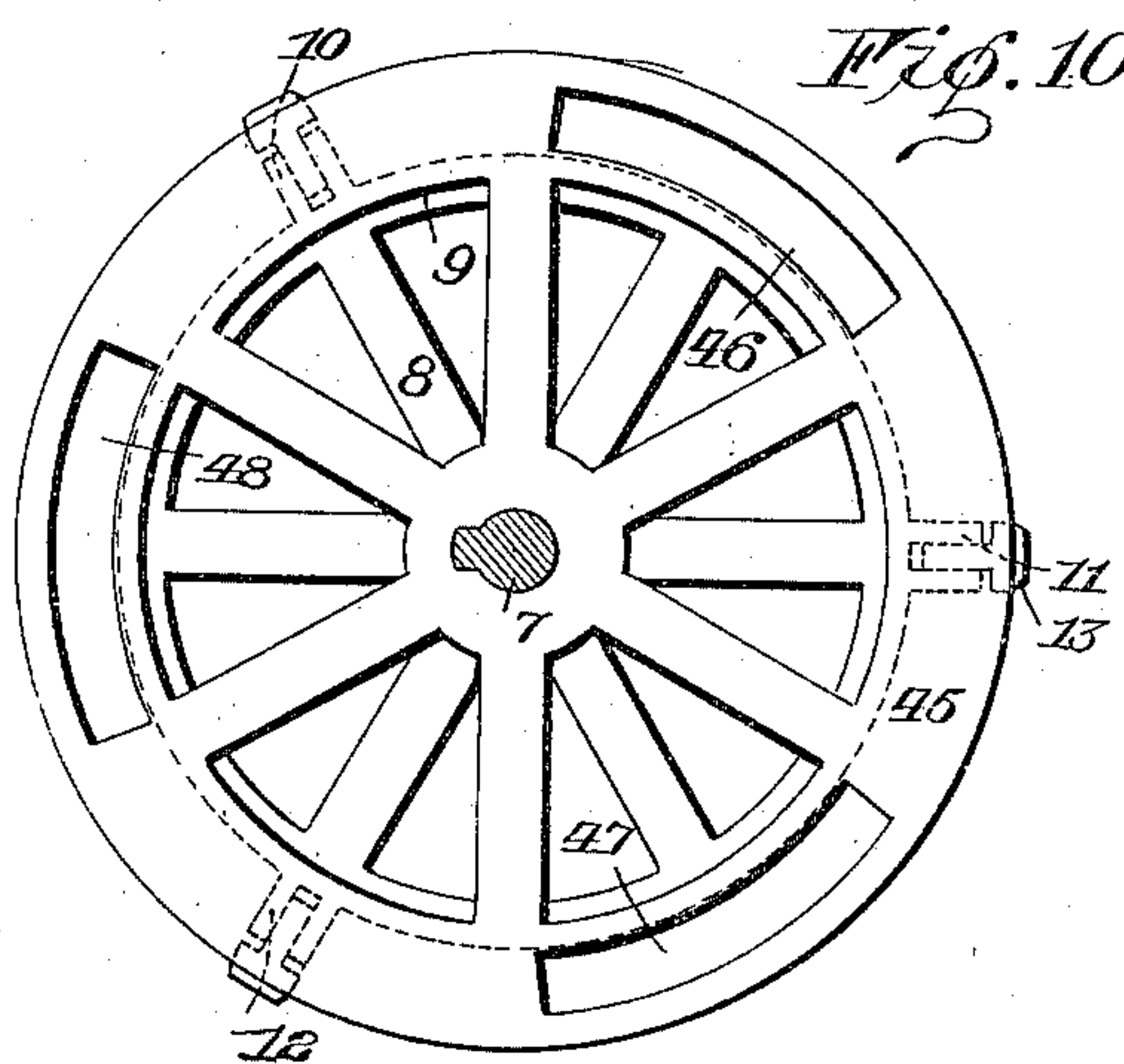
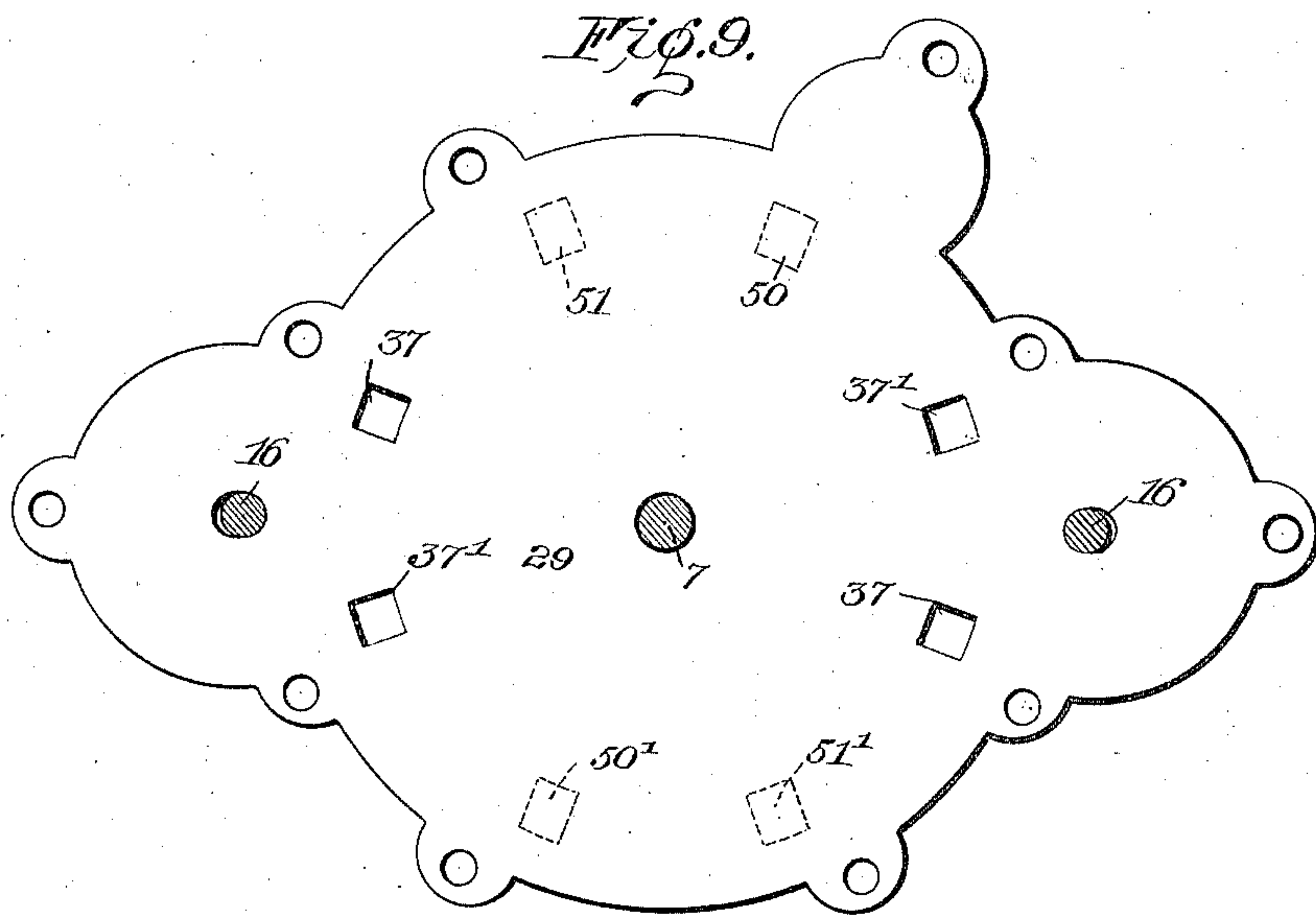
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4 Sheets—Sheet 4.



Witnesses.

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# UNITED STATES PATENT OFFICE.

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OF ONE-HALF TO FRANCIS C. OWEN, OF DANVILLE, NEW YORK.

## ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 687,822, dated December 3, 1901.

Application filed October 13, 1900. Serial No. 32,946. (No model.)

*To all whom it may concern:*

Be it known that we, ELI H. EATON and THOMAS WRIGHT, of Rochester, New York, have invented certain new and useful Improvements in Rotary Engines; and we do hereby declare the following to be a clear, full, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the reference-numerals marked thereon.

Our present invention relates to steam-engines, and particularly to the form known as "rotary" engines, in which the power is applied directly to the driving-shaft by means of a rotary piston; and it has for its object to provide an engine capable of operation in either direction and embodying suitable valve mechanisms whereby the inlet and exhaust ports may be easily adjusted to cause a reversal in the direction of the rotation of the parts of the engine.

To these and other ends our invention further consists in certain improvements in construction and combination of parts, all as will be described and the novel features pointed out in the claims at the end of the specification.

In the drawings, Figure 1 is a top plan view showing the exterior of an engine constructed in accordance with our invention. Fig. 2 is a longitudinal sectional view taken on the line 2 2 of Fig. 4. Fig. 3 is a cross-sectional view on the line 3 3 of Fig. 1. Fig. 4 is a cross-sectional view on the line 4 4 of Fig. 2. Fig. 5 is a cross-sectional view on the line 5 5 of Fig. 2. Fig. 6 is a similar view on the line 6 6 of Fig. 2. Fig. 7 is a sectional view on the line 7 7 of Fig. 5, showing the position of the inlet-port when operating the piston in one direction; and Fig. 8 is a similar view showing the ports reversed to operate the piston in the opposite direction. Fig. 9 is a diagrammatic view illustrating the relative positions of the inlet and exhaust ports, and Fig. 10 is a diagrammatic view illustrating the relative positions of the piston-faces and valve-plate apertures. Fig. 11 is a detail view showing one of the abutment-blocks in elevation.

Similar reference-numerals in the several figures indicate similar parts.

Engines constructed in accordance with our invention embody a shell or casing 1, inclosed upon its opposite sides by heads 2 and 3, forming a steam-chest 4 upon one side and an exhaust-chamber 5 upon the other and provided centrally with bearings 6, supporting a shaft 7, on which is mounted a rotary piston 8. The latter is constructed with a rim or face 9, upon which are arranged a series of projections or piston-faces, in the present instance being three in number and indicated by 10, 11, and 12. Each of said projections is provided with a movable face-plate 13, adapted to be moved outward and held in close contact with the face of the cylinder as the piston 8 is revolved by means of springs 14, arranged in slots in the projections and operating against tongues formed upon the rear sides of the plates 13, and the latter are held in place and their outward movement limited by pins 16, passing through the projection and engaging elongated slots in the tongues.

The expansion-chambers (corresponding to steam-cylinders) proper are formed between the inner face of the casing 1 and the face of the rim 9 and upon one end by one of the pistons 10, 11, or 12, a revoluble abutment-block 15, journaled in the casing, being held in contact with the face of the rim and forming the opposite end of the chamber. These blocks are arranged within the casing upon opposite sides of the rotary piston and are adapted to be held in contact with the face of the rim 9 and to be rotated with it, and for this purpose the blocks are mounted on shafts 16, the ends of which are supported in bearings 17, mounted in the heads 2 and 3 and provided with pinions 18, meshing with a gear-wheel 19, secured to the shaft 7. This arrangement insures the positive operation of the blocks at a speed relative to that of the piston 8, causing the projecting faces on the latter to register with a recessed or cut-away portion 20, formed in the face of the blocks, as the parts are revolved together. A slight lateral movement is permitted the blocks relative the piston 8. The adjacent portions of the casing are extended slightly, as shown, for this purpose, and the bearings 17 are supported in elongated apertures in the heads 2 and 3,



their outer extremities being threaded and provided with rings 22, having packing 23 upon their faces engaging the exterior of the heads and secured in position by locking-nuts 24. Springs 25 are located in the apertures in the outer sides of the bearings and serve to press the blocks 15 into engagement with the rim 9 of the rotary piston and compensate for any expansion or wear of the parts, always securing a steam-tight joint between the constantly-moving surfaces. Small face-blocks 26, lying in recesses in the casing, are adapted to be moved outward by flat springs 27 to engage the opposite side of the blocks 15 to prevent steam from escaping around the latter.

Arranged between one side of the casing and the head 2 is a cover-plate 29, against which one edge of the piston 8 and blocks 15 revolve, and provided upon the opposite side of the piston 8 is a follower-plate 30, movable in the casing 1, having secured upon its inner side three accurately-ground plates 31, 32, and 33, adapted to engage the opposite sides of the said piston and blocks and also form steam-tight joints upon the inner circumference of the several parts of the casing at the side of the said piston and blocks. It is obvious that these three plates might be constructed of a single piece and the plate 30 omitted; but owing to the difficulty of forming accurate fitting throughout on account of the irregular outline it is preferred to make them in the manner described, when each piece may be fitted separately and afterward secured in position on a single plate, as in this way means may be provided, as will be presently described, for adjusting the follower-plate relative the piston and blocks to preserve a tight joint and compensate for lateral expansion or wear between the parts.

The steam is conducted through the pipe 35 to the steam-chest 4, from which it is allowed to pass through suitable inlet-ports, and after acting upon the piston for a portion of its revolution is permitted to pass into the exhaust-chamber 5, being finally exhausted through the pipe 36. The plate 29, forming the inner side of the steam-chest, is provided with four apertures 37 37' and 37' 37', located upon opposite sides of the point of contact of the abutment-blocks with the rim 9 and arranged diametrically opposite each other, as shown in dotted lines in Fig. 5 and in Fig. 9. Located above the plate 29 is a stationary plate 38, having upon its lower side passages 39, extending to both of the passages 37 37', located upon each side of the piston, and at the center of said passages are apertures 40 40', opening upon the upper face of the plate upon opposite sides of its center and in line with the centers of the abutment-blocks. In order, however, that steam may be admitted to but one pair of inlet-ports at the same time, we employ an intermediate adjustable inlet-controlling plate 42, located between the plates 29 and 38 and provided with two apertures

43, adapted to register with and permit the steam to be admitted through one port of each pair, a suitable operating device in the form of a mutilated pinion 95, meshing with gear-teeth 96, provided upon the periphery of the plate 42 and operated from the exterior of the casing, being provided for oscillating the plate about its axis on the shaft 7 to connect either pair of inlet-ports, permitting the engine to be run in the direction desired. In order to regulate the admission and cut off of the steam through the ports just described, we provide a valve-plate 45, keyed to the shaft 7 and resting upon the plate 38, having three elongated apertures 46, 47, and 48 arranged between the piston-faces 10, 11, and 12, as shown in the diagrammatic view in Fig. 10. The valve-plate apertures are elongated, as shown, allowing the steam to enter the expansion-chamber formed between one of the piston-faces and the abutment-block until the preceding face has passed the opposite abutment-block 15 and the port above it opened to admit the steam thereto, at which instant the former port is closed, so that while fresh steam is entering upon one side of the rotary piston 8 the opposite side thereof is acted upon by the expansive force of the steam previously admitted, which operates upon the piston and is not exhausted until the third piston-face, passing one of the abutment-blocks and coming into position, is operated upon by steam admitted through the first port.

The exhaust-ports are provided in the follower-plate 30 intermediate the inlet-ports in the plate 29 and are indicated by 50 50' and 51 51'. Said ports are arranged in pairs and adapted to be opened relative the inlet-ports, a movable plate 55, journaled on the axle 7 in the exhaust-chamber, being adapted to close such of said ports as are not employed. In order to relieve the back pressure of the steam between the piston-faces and the abutment-blocks occasioned by the sudden reversal of the engine, we provide supplementary exhaust-ports 60 60' and 61 61' upon opposite sides of each of the blocks 15 directly beneath each of the inlet-ports 37 37', with which coöperate apertures 62 in the plate 55, opening the expansion-chambers in rear of the piston-faces when it is desired to change the direction of operation of the engine. Only those ports through which the steam is admitted to cause the movement of the piston in the same direction and their corresponding exhaust-ports are opened at any one time, the oppositely-arranged inlet and exhaust apertures being closed by means of the plates 42 and 55, which are adapted for simultaneous operation. A portion of the rim of the plate 55 is provided with gear-teeth 66, and engaging therewith is a mutilated pinion 65, similar to the pinion 45, both of which are mounted on studs 67, journaled in the casing, with their ends projecting through the latter and provided with crank-arms 68. A cross-bar 69 extends between the ends of the latter,



and a handle 70 affords a convenient means for moving the two plates in unison. The follower-plate 30 has been described as movable relative to the piston 8 and abutment-blocks 15 for the purpose of maintaining steam-tight joints or surfaces between it and the said parts and also between the latter and the cover-plate 29, and to carry out this end we provide adjusting-screws 75 in the head 3, bearing at their inner ends upon segmental flanges 76 on the outer side of the plate 55, as shown particularly in Figs. 2 and 6. By means of these screws the parts may be compressed sufficiently to prevent the escape of steam around the piston 8 or the abutment-blocks, and the central portions of the latter parts are cut away, as in Fig. 2, to reduce the friction between the movable and stationary parts, as will be understood. Small adjusting-screws 80, arranged in the head 2, also serve to hold the valve-plate 45 and the plates 38 and 42 in contact upon the cover-plate without the necessity of employing springs or similar devices, and being accessible from the outside of the casing they may be easily adjusted after the parts are assembled.

The operation of the engine will now be readily understood. The movable inlet-controlling plate 42 and exhaust-valve plate 55 being adjusted to the position shown in Figs. 3, 4, and 7, the steam from the chest 4 will enter the expansion-chamber between the piston-face 10 and block 15 through the aperture 48 and inlet-port 37, revolving the rotary piston 8 to the dotted position shown in Fig. 3, moving the piston-face 11 past the other abutment-block 15. Upon the instant the end of the aperture 48 passes the port 40 in the stationary plate 38 the aperture 46 is uncovered the port 40', admitting the steam directly against the piston-face 11, and before the latter port is fairly closed the aperture 47 has opened the first-mentioned port 40, admitting the steam to the piston-face 12. As the apertures 46, 47, and 48 are located centrally between the piston-faces and the inlet-apertures 39 39' are arranged upon a central line between the abutment-blocks, the opening and closing of the ports will be the same in whichever direction the piston 8 is rotated. The exhaust-apertures may be located as desired to permit the steam to be exhausted after the inlet-ports are closed in the rear of each piston-face, and, as shown in the present instance, the two pairs of ports are located a slight distance upon either side of a central point between the inlet-ports, and the plate 55 is arranged to open those farthest away from said ports in the direction of rotation, thereby permitting the steam to expand in each chamber before being released.

Engines constructed according to our invention are compact in structure, and by employing the steam force upon opposite sides of the axis of the rotary piston at the same time the engine is perfectly balanced in its operation.

We claim as our invention—

1. In an engine, the combination with a casing, a rotary member therein having piston-faces, an abutment-block bearing against said member journaled in the casing and having a recess to receive the piston-faces, connections between the rotary member and the block for causing the positive operation of the latter, and an inlet-passage opening upon each side of the abutment-block, of an adjustable part in connection with said passage for opening the latter on one side of the block only, a valve mechanism operated by the rotary member controlling the inlet-port to admit steam thereto as the successive piston-faces pass the abutment-block, and main exhaust-ports upon each side of the abutment-block, operating devices for opening and closing the latter relative the position of the adjustable inlet-port, supplemental exhaust-ports arranged opposite the inlet-ports, means for controlling the latter simultaneously with the adjustable inlet-port to open the exhaust upon the side of the abutment opposite from that upon which the steam is introduced.

2. In a rotary engine, the combination with a casing, a rotary member supported therein having the piston-faces, recessed abutment-blocks arranged upon opposite sides thereof journaled in the casing, driving connections between said member and blocks, of inlet-ports in the casing arranged upon each side of the blocks, adjustable means above said ports for controlling the latter in pairs, and valve devices operated by the rotary member, governing the entrance of steam between the piston-faces and blocks, separate exhaust-ports arranged intermediate the inlet-ports, operating devices for controlling the exhaust-ports in pairs and means for simultaneously adjusting the latter relative to the inlet-ports.

3. In a rotary engine, the combination with a casing having the head upon one side and a cover-plate upon the inner side of the latter forming a steam-chest, the head upon the opposite side of the casing and the movable plate inclosed by the latter forming the exhaust-chamber, of a rotary member inclosed between the cover-plate and the movable plate and having the piston-faces engaging the interior of the casing, the recessed abutment-blocks arranged upon opposite sides of the rotary member bearing against the latter and journaled in the casing, and operating connections between said member and the blocks, inlet-ports arranged in the cover-plate upon opposite sides of a central line through the abutment-blocks, exhaust-ports in the movable plate located between the inlet-ports, a valve-plate arranged in the steam-chest and means for operating the plate to admit and cut off the steam in the inlet-ports relative to the movement of piston-faces.

4. In a rotary engine, the combination with a casing having the head upon one side, a cover-plate between the latter and the casing forming a steam-chest, a head upon the opposite side of the casing and a movable fol-



lower-plate within the latter forming an exhaust-chamber, of the rotary member inclosed between the cover-plate and follower-plate and having piston-faces engaging the interior of the casing, revoluble abutment-blocks, having the recesses and bearing against the face of the rotary member and journaled in the casing, operating connections between the said member and blocks, and a shaft connected to the rotary member extending without the casing, inlet-ports arranged in the cover-plate upon opposite sides of a central line through the abutment-blocks, exhaust-ports in the movable plate located between the inlet-ports, a valve-plate mounted on the shaft in the steam-chest, and having apertures arranged relative the piston-faces adapted to cooperate with the inlet-ports as the piston is revolved.

5. In a rotary engine, the combination with a casing having the head, the cover-plate upon one side forming the steam-chest in one of the heads, the rotary piston operating in the casing and having the piston-faces, and the shaft connected to the piston and supported in bearings in the heads, of revoluble abutment-blocks journaled in the casing upon opposite sides of the rotary piston, connections between the piston and blocks for causing the positive operation of the latter, and means for holding the blocks in contact with the rotary piston, the supply-ports provided in the cover-plate upon opposite sides of the blocks, an adjustable plate adapted to close either pair of said supply-ports arranged upon opposite sides of a central line through the abutment-blocks, and a valve-plate secured to the shaft, provided with valve-apertures arranged relative the piston-faces, two pairs of exhaust-ports, and a plate adapted to open said exhaust-apertures in pairs.

6. In a rotary engine, the combination with a casing having the heads, the cover-plate upon one side forming the steam-chest in one of the heads, the rotary piston operating in the casing having the piston-faces, and the shaft connected to the rotary piston supported in bearings in the heads, of the revoluble abutment-blocks journaled in the casing upon opposite sides of the rotary piston, connections between the piston and blocks for causing the positive operation of the latter and means for holding the blocks in contact with the piston, the supply-ports provided in the cover-plate adapted to operate in pairs, an adjustable plate adapted to close either pair of said ports, and a valve-plate secured to the shaft having apertures arranged relative the piston-faces and controlling said supply-ports, two pairs of exhaust-ports located between the supply-ports and an adjustable plate for closing either pair of exhaust-ports and connections between the supply and exhaust port plates whereby the corresponding pairs of ports controlled thereby may be adjusted simultaneously to permit the operation of the engine in either direction.

7. In a rotary engine, the combination with a casing having the heads, the cover-plate forming the steam-chest in one of the heads, the rotary piston mounted in the casing, and the shafts secured to the piston and supported in bearings on the heads, of the revoluble abutment-blocks journaled in the casing upon opposite sides of the rotary piston, the supply-ports provided in the cover-plate and arranged upon opposite sides of each abutment-block adapted to operate in pairs, an adjustable plate journaled on the shaft adapted to close either pair of said ports, and a valve-plate secured to the shaft, having apertures arranged relative the piston-faces and controlling the passage of steam through the supply-ports, two pairs of exhaust-ports located between the supply-ports, an adjustable plate journaled on the shaft for alternately opening or closing the pairs of ports, and connections between the supply and exhaust port plates, whereby the cooperating pairs of supply and exhaust ports may be simultaneously adjusted.

8. In a rotary engine, the combination with a casing having the heads, the cover-plate forming the steam-chest in one of the heads, and the follower-plate forming the exhaust-chamber in the opposite head, the rotary piston mounted in the casing having the piston-faces, the shaft secured to the piston and supported in bearings on the heads, and the revoluble abutment-blocks journaled in the casing upon opposite sides of the piston, of the supply-ports provided in the cover-plate upon opposite sides of each of the abutment-blocks, an adjustable plate journaled on the shaft in the steam-chest, adapted to close said ports in pairs and a valve-plate secured to the shaft having apertures arranged relative the piston-faces, two pairs of exhaust-ports provided in the follower-plate, an adjustable plate journaled on the shaft in the exhaust-chamber, adapted to close one pair of said ports, and means connecting the supply and exhaust port plates whereby they may be simultaneously adjusted.

9. In a rotary engine, the combination with a casing having the heads, the cover-plate forming the steam-chest in one of the heads, and the follower-plate forming the exhaust-chamber in the opposite head, the rotary piston mounted in the casing between the cover and follower plates and having the piston-faces, the shaft secured to the piston and supported in bearings on the head, and the revoluble abutment-blocks journaled in the casing upon opposite sides of the piston, of the supply-ports provided in the cover-plate upon opposite sides of each abutment-block, an adjustable plate journaled on the shaft in the steam-chest, adapted to close said ports in pairs and provided with gear-teeth, and a valve-plate secured to the shaft above said plate and having apertures arranged relative the piston-faces, two pairs of exhaust-ports located in the follower-plate, an adjustable



plate journaled on the shaft in the exhaust-chamber adapted to close one pair of said ports and provided with gear-teeth, and pinions journaled on the casing and engaging the gear-teeth on the supply and exhaust port plates, for operating the latter to open or close the respective pairs of ports.

10. In a rotary engine, the combination with a casing having the heads, the cover-plate arranged between one of the heads and the casing, and the follower-plate in the opposite head movable relative the cover-plate, the rotary piston mounted in the casing between the plates and having the piston-faces, and the revoluble abutment-blocks arranged upon opposite sides of the piston, of the supply-ports provided in the cover-plate upon opposite sides of each abutment-block, an adjustable plate adapted to close said ports in pairs, and a separate valve-plate located above the latter controlling the entrance of the steam relative the piston-faces, cooperating pairs of exhaust-ports arranged in the follower-plate, between the supply-ports, separate back-pressure steam-passages located in the follower-plate opposite the supply-ports, a movable plate adapted to control the opening of the exhaust-ports in pairs and also the steam-passages in pairs relative the supply-ports and means connecting the movable plates whereby the latter may be adjusted simultaneously to reverse the operation of the engine.

11. In a rotary engine, the combination with a casing having the heads, a cover-plate arranged between one of the latter and the casing, the rotary piston, the shaft secured thereto and supported in bearings in the heads, and the revoluble abutment-blocks journaled in the casing, of the movable follower-plate arranged within the casing, the supply and exhaust valves arranged in the cover and follower plates, a movable plate controlling the exhaust-ports having the flanges, and the screws on the head engaging said flanges to hold the follower-plate against the side of the piston.

12. In a rotary engine, the combination with a casing provided with the heads having the bearings and having the supply and exhaust ports, the rotary piston supported in the casing and the shaft secured in the piston and mounted in the bearings on the heads, of the revoluble abutment-blocks arranged upon opposite sides of the piston, the shafts supporting the latter, the bearings carrying said shafts arranged within the heads and radially movable in the casing relative the rotary piston and means for moving the bearings inwardly to hold the blocks in contact with the face of the piston.

13. In a rotary engine, the combination with a casing provided with the heads having supply and exhaust ports, the rotary piston having the face or rim provided with the projections or piston-faces, of the revoluble abutment-blocks arranged upon opposite sides of

the piston and having the recesses, means connecting the blocks with the piston to cause their positive rotation, and the shafts in the blocks, bearings supporting the latter arranged within the heads on the casing and movable relative the rotary piston, and springs operating against the bearings to hold the blocks in contact with the face of the piston.

14. In a rotary engine, the combination with a casing, a rotary piston operating therein, and abutment-blocks arranged upon opposite sides of the piston and movable in the casing radially of the latter, of movable face-plates in the casing adapted to engage opposite sides of the blocks to close the passages around the latter, and the heads upon opposite sides of the casing inclosing the piston and blocks, provided with supply and exhaust ports.

15. In a rotary engine, the combination with a casing, a rotary piston operating therein having the shaft, and abutment-blocks having the shafts, arranged upon opposite sides of the piston and movable radially of the latter, of the movable face-plates in the casing engaging opposite sides of the blocks to close the passage around the latter, the heads upon opposite sides of the casing having the stationary bearing for the piston-shaft and provided with the movable bearings for supporting the shafts in the abutment-blocks, means engaging the bearings for holding the blocks in contact with the piston, and supply and exhaust ports arranged in the heads.

16. In a rotary engine, the combination with a casing, a rotary piston operating therein having the shaft, abutment-blocks provided with the shafts arranged upon opposite sides of the piston and movable radially of the latter, and the movable face-plates engaging opposite sides of the blocks to close the passage around the latter, of a stationary cover-plate upon one side of the casing having the supply-ports, the movable plate upon the opposite side inclosing the piston and blocks and provided with the exhaust-apertures, and means operated by the rotary piston for controlling the supply of steam admitted through said ports, the heads secured upon opposite sides of the casing having the stationary bearings for the piston-shaft and provided with movable bearings adapted to support the shafts in the abutment-blocks, and means upon one of the heads for adjusting the follower-plate relative the piston.

17. In a rotary engine the combination with a casing, a rotary abutment having a recess and a rotary member having a plurality of piston projections cooperating with the casing and adapted to enter the recess in the abutment, said casing having supply and exhaust ports the former leading upon each side of a line drawn through the centers of rotation of the blocks and rotary member, of a valve-plate carried by the rotary member having a series of apertures, a valve device arranged



between the valve-plate and the casing and  
coöperating with the apertures in said plate  
and the inlet-ports to control the passage of  
steam to one side or the other of the abut-  
5 ment-block, a similar valve device control-  
ling the operation of the exhaust-ports, and  
connections between the two controlling de-

vices whereby the inlet and exhaust passages  
may be operated simultaneously.

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