No. 863,809. PATENTED AUG. 20, 1907.

# P. SCHULLER.

## ROTARY ENGINE.

APPLICATION FILED JAN. 17, 1907.

5 SHEETS—SHEET 1.

FIG. 2

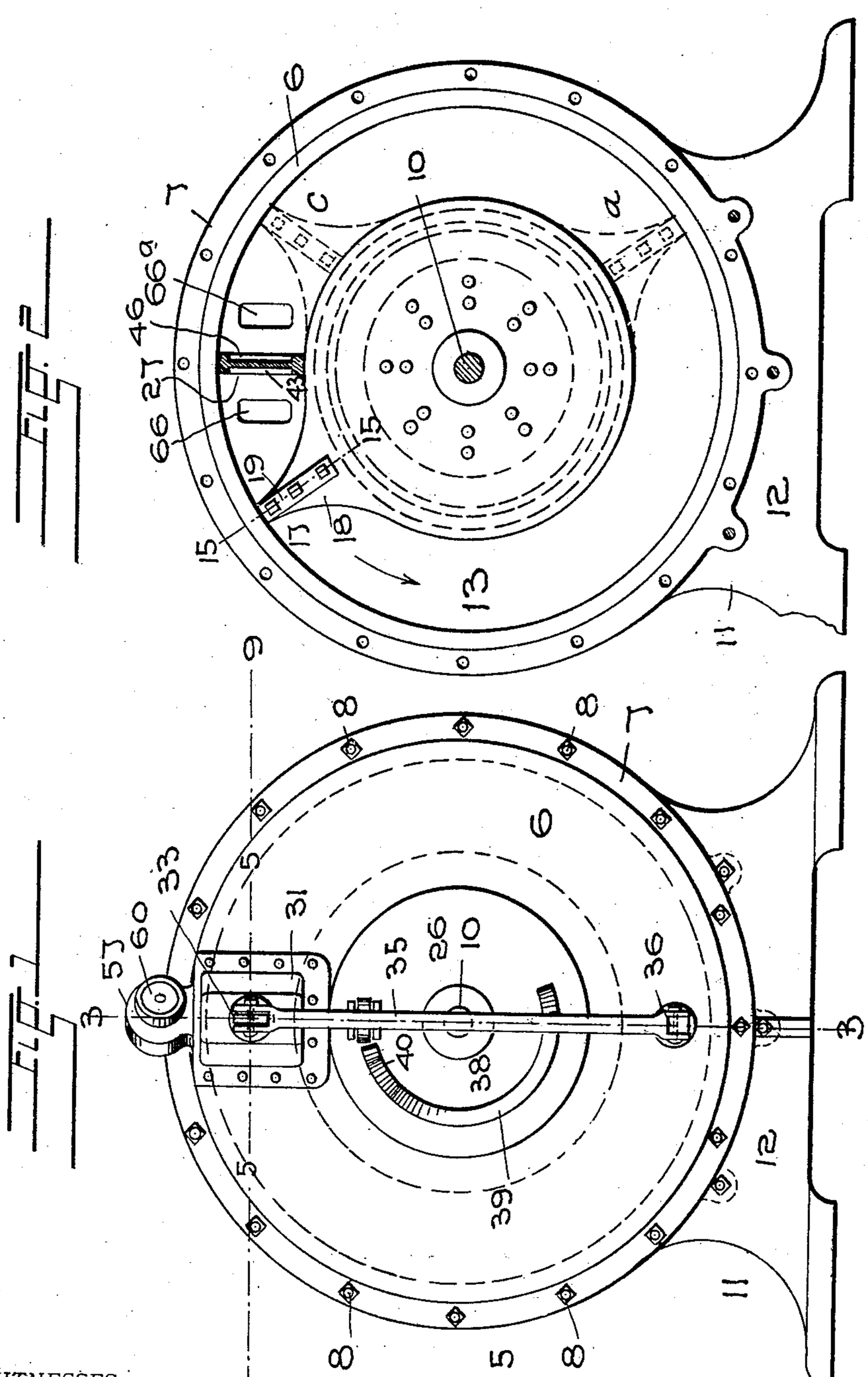


FIG. 7

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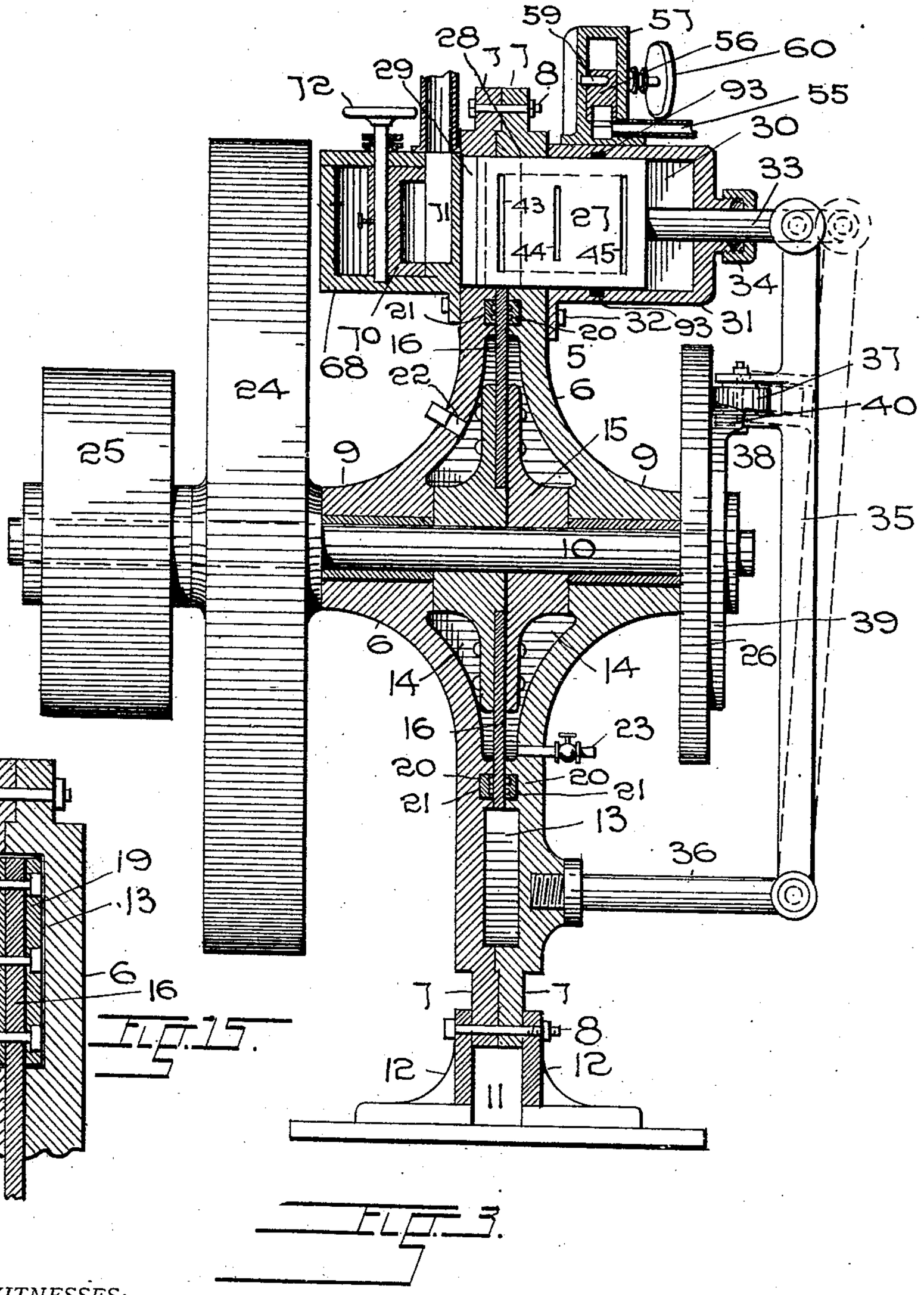


FIG. 1.

FIG. 3.

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5 SHEETS—SHEET 3.

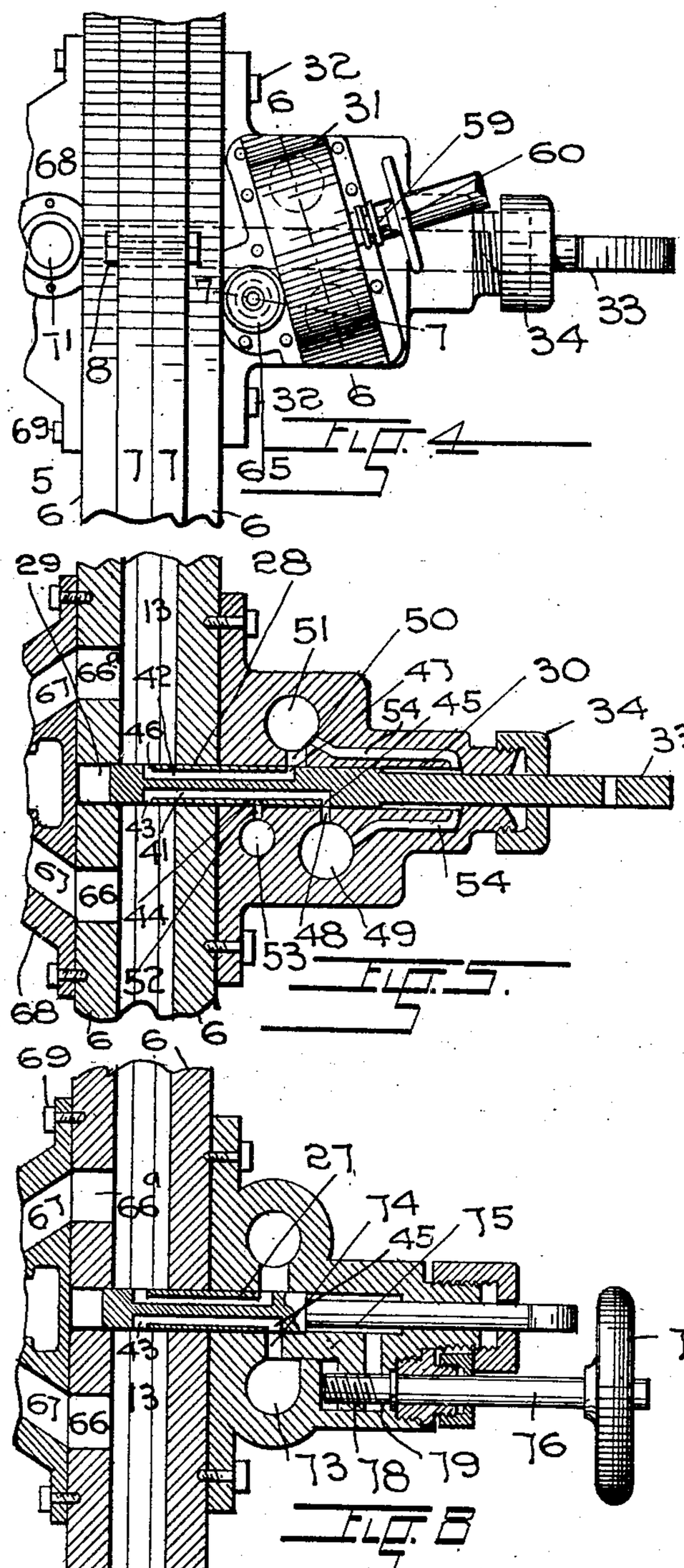


FIG. 4.

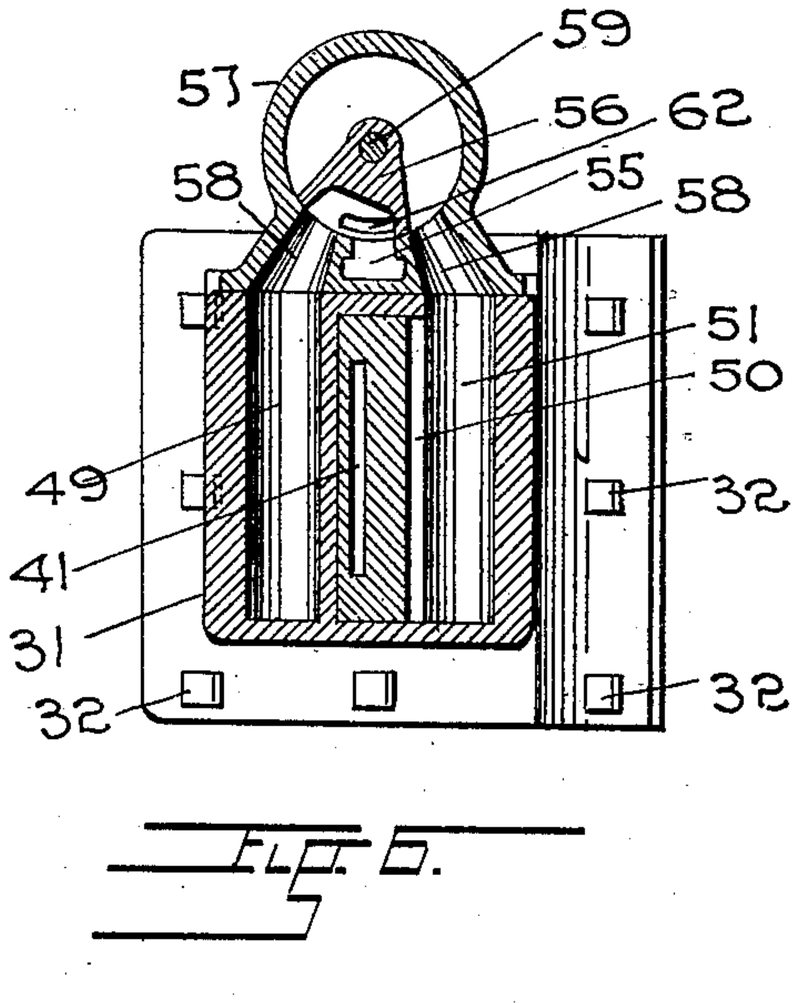


FIG. 6.




FIG. 5.




FIG. 7.




FIG. 8

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## ROTARY ENGINE.

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5 SHEETS—SHEET 4.

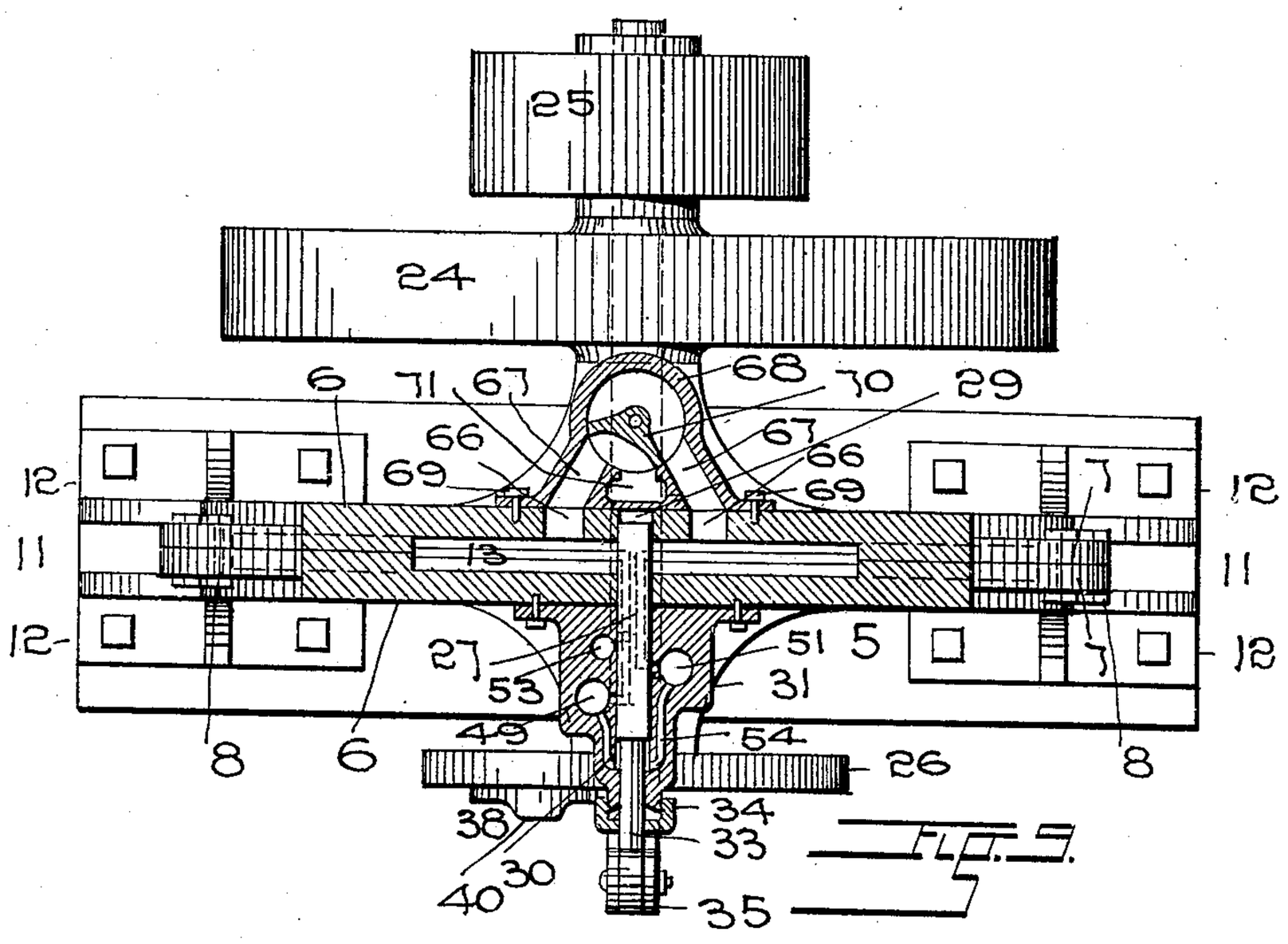


FIG. 9.

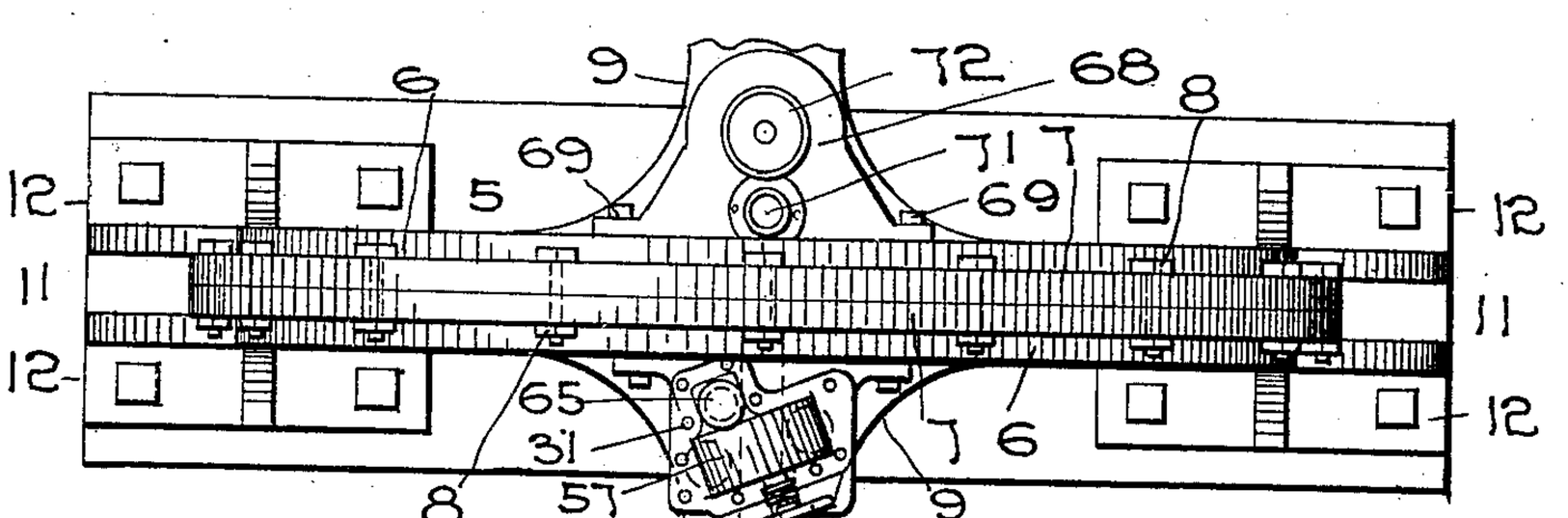


FIG. 10.

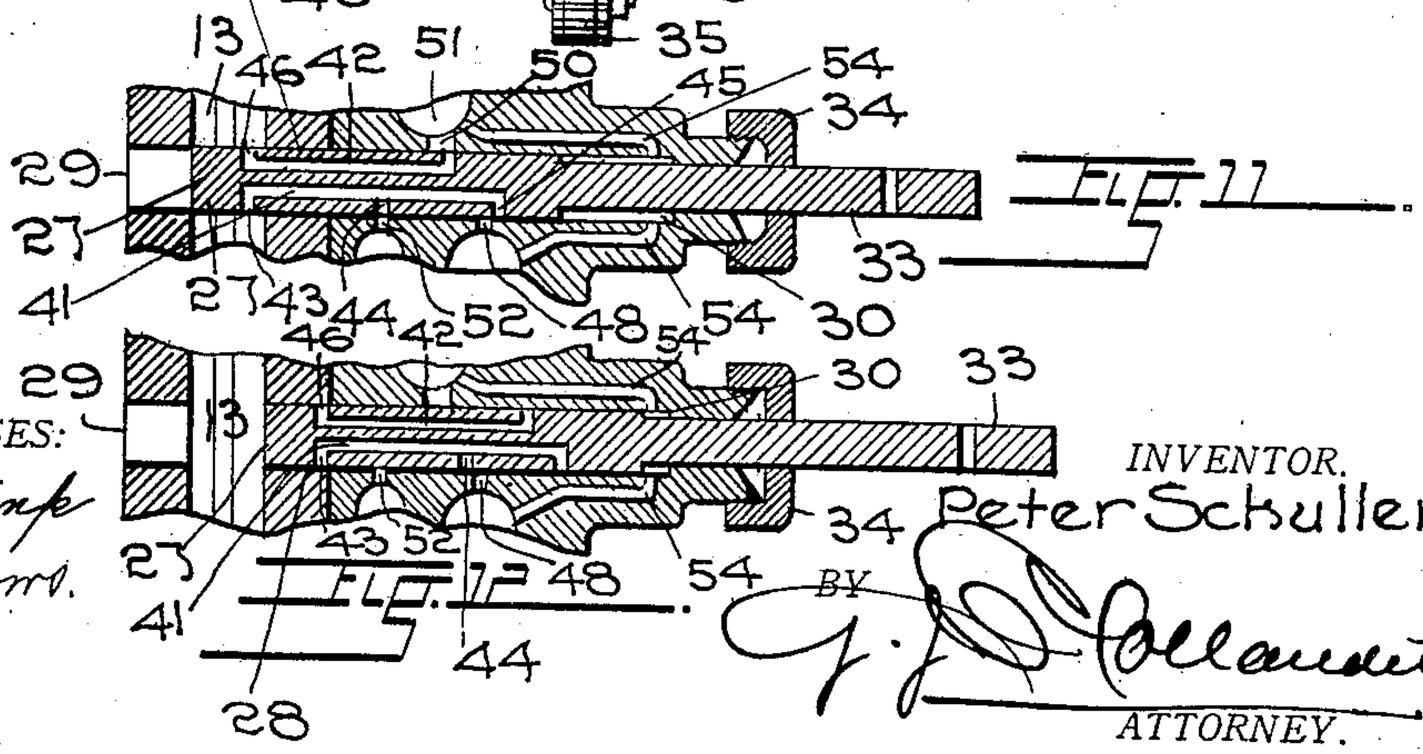


FIG. 11.

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5 SHEETS—SHEET 5.

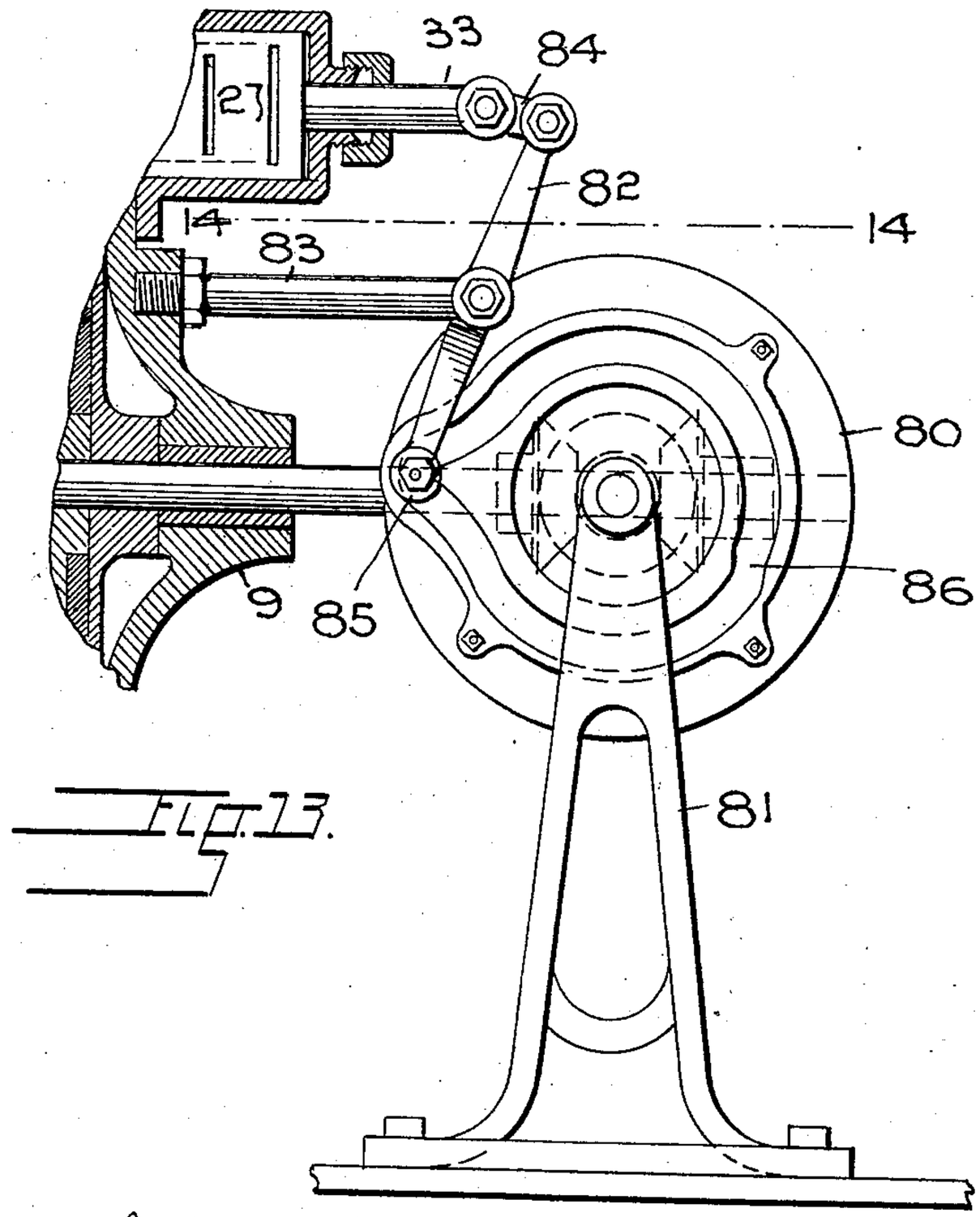


Fig. 13.

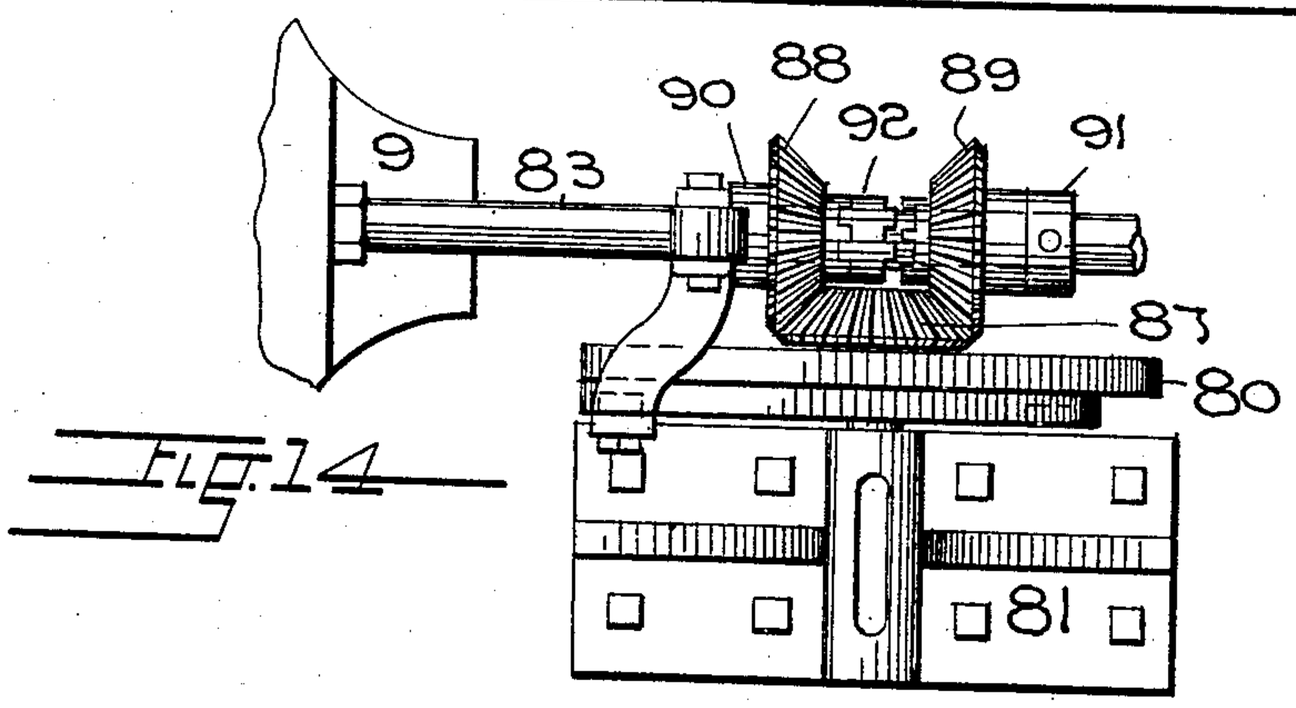


Fig. 14.

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# UNITED STATES PATENT OFFICE.

PETER SCHULLER, OF DENVER, COLORADO, ASSIGNOR TO SCHULLER ENGINEERING COMPANY.

## ROTARY ENGINE.

No. 863,809. Specification of Letters Patent. Patented Aug. 20, 1907.

Application filed January 17, 1907. Serial No. 352,818.

*To all whom it may concern:*

Be it known that I, PETER SCHULLER, a subject of William II, Emperor of Germany, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

My invention relates to improvements in rotary engines and more especially to the class of engines in which one or more pistons extend revolubly within a continuous, annular steam chamber.

The objects of my invention are to provide an engine of the class named in which the maximum of simplicity and economy of construction shall be combined with durability, thorough practicability in use and great efficiency.

In the accompanying drawings, in the several views of which like parts are similarly designated Figure 1—represents an elevation of the engine, Fig. 2—a vertical section therethrough, Fig. 3—an enlarged vertical section taken along a line 3—3, Fig. 1, Fig. 4—an enlarged fragmentary plan view of the engine and valve chest, Fig. 5—a fragmentary cross section taken along the line 5—5, Fig. 1, Fig. 6—a section taken along a line 6—6, Fig. 4, Fig. 7—a fragmentary section taken along a line 7—7, Fig. 4, Fig. 8—a section similar to Fig. 5, showing a modified manner of regulating the inlet of steam. Fig. 9—an enlarged section taken along a line 9—9, Fig. 1, Fig. 10—a plan view of the engine, Figs. 11 and 12—fragmentary sections, similar to that illustrated in Fig. 5, the resistance slide being shown in different positions. Fig. 13—a fragmentary, sectional view of the engine showing modified manner of actuating the resistance slide, Fig. 14—a section taken along a line 14—14, Fig. 13, and Fig. 15—a section along line 15—15, Fig. 2.

The engine, as illustrated in the drawings, consists of a casing 5 which is composed of two substantially identical sections 6 having peripheral flanges 7, the faces of which are in practice contiguous and which are secured together by means of bolts 8.

The two halves of the casing are each provided with an integral central outwardly extending journal bearing 9 through which extends the horizontal shaft 10 and the whole is rigidly secured to and supported by a base 11 which is preferably composed of two identical, oppositely disposed members 12.

The sections 6 of the engine casing are provided on their inner faces, in adjacency to the surrounding flanges 7, with concentric circular channels which when the two halves are bolted together, form the annular, steam chamber or piston way 13. The two sections are furthermore provided with central recesses which together form a chamber 14 adapted to contain a hub 15 which being mounted upon the shaft 10 to rotate therewith, is composed of two sections between which is secured the annular piston-carrying plate 16.

The piston 17 (see Fig. 2) is formed by a projection 18 integral with the plate 16 and extending within the steam chamber, and two plates 19 bolted thereto on opposite sides, the combined widths of the three members of which the piston is thus composed, being equal to the width of the piston way 13.

Packing rings 20, disposed in annular concentric grooves 21, in the contracted portion of the casing, intermediate the central chamber 14 and the steam way 13, engage the opposite faces of the plate 16 to prevent leakage of steam.

The central chamber 14 is, in practice, filled with a lubricating medium such as oil, and the casing is, to this end, provided with a feed opening 22, normally closed by a screw plug or analogous means and with a valve controlled drain pipe 23.

Mounted upon one extremity of the shaft 10, extending outside the casing, is a momentum wheel 24 and a driving pulley 25, through instrumentality of which the movement imparted to the shaft may be conveyed to actuate various appliances. The opposite extremity of the shaft is provided with a surface cam wheel 26, the construction and operation of which will hereinafter be described.

Positioned preferably in the uppermost portion of the engine casing, is a retractible combined resistance or abutment plate and slide valve 27 which projecting through a groove 28 in one of the sections 6 and into an oppositely located, similar opening 29 in the other half of the casing, extends transversely of the piston way 13 and normally divides it into two compartments.

The outer portion of the slide 27 extends in a correspondingly shaped recess 30 in a casting 31 which is secured upon the casing 5 by means of bolts 32. A stem 33 forming part of the slide, extends outside the casting 29, through a thereto applied packing box 34 and is pivotally connected at its outer extremity with the uppermost end of a rocker arm 35 which is mounted at its opposite extremity, upon a stud 36 secured upon the casing. Lever 35 is provided intermediate its extremities, with an anti-friction roller 37 arranged to engage a cam 38 on the before mentioned cam wheel 26. Cam 38 is designed to impart, by rotation of the shaft 10, a varying movement to the valve 27 and has to this end two adjoining portions 39 and 40 of different height and respectively adapted to move the plate 27 out of the slot 29 and to clear the piston way 13. The valve 27 is provided with two longitudinally extending steam passages 41 and 42, the former of which opens into one of its sides at three separate places by means of parallel ports 43, 44 and 45, while the latter opens into the opposite side by means of similar ports 46 and 47.

When the slide valve 27 is in its normal or innermost position, the oppositely located ports 43 and 46 open into the steam chamber 13 while the port 45 communicating with port 43, registers with a port 48 which connects the valve way 30 with a steam chamber 49 in the casting 31, which may be termed the steam chest of the engine.

The port 47 which communicates by means of conduit 42 with the port 46, is synchronously in register with a port 50 opening into the opposite side of the valve way 30 and leading into a second steam chamber 51 which in practice is employed to admit steam when it is desired to reverse the movement of the psiton. The port 50 is in width, equal to the width of the port 47 and the length of the partial stroke imparted to the valve by the portion 39 of the cam, for the purpose of retaining the steam chamber in communication with the steam inlet 51 until the valve 27 is entirely withdrawn during the reversed movement of the piston when the engine is operated without expansion.

When by action of the portion 39 of cam 38 the slide valve is moved out of the seat 29 as illustrated in Fig. 11, the port 44 which, opening into the conduit 41, also communicates with port 43, is brought in register with a port 52 opening into the side of the valve way 27 and leading into a third steam chamber 53 in the steam chest, which may be termed the auxiliary steam chamber. Channels 54 in the casting 31 connect the steam chambers 49 and 51 with the foremost portion of the valve way 30 for the purpose of conveying steam into the latter to impel the slide valve to reassume its normal or innermost position when disengaged by the cam 38. Chambers 49 and 51 which open into the upper surface of the steam chest, may be brought separately in communication with the steam inlet 55 by means of an oscillatory valve 56 which is seated in a housing 57 secured upon the casting 31 and provided with openings 58 which connect with the said chambers. The valve stem 59 projecting through the side of the housing, has a hand wheel 60 by means of which the valve may be positioned in accordance with the desired direction of travel of the piston. An auxiliary compartment 61 in the valve housing 57 is by means of an opening 62, in constant connection with the steam inlet 55 and being situated over the auxiliary chamber 53 is provided with a valve 63 arranged to close the orifice of the latter. The threaded stem 64 of the valve extending through a correspondingly tapped box on the housing, is provided with a hand wheel 65 by manipulation of which the valve may be raised or lowered.

The reference characters 66 and 66ª designate the steam exhaust openings which being situated at equal distances from the opening 29 in the casing, communicate with conduits 67 in a valve housing 68 which is secured to the side of the casing by bolts 69. An oscillatory valve 70, seated in the housing, is arranged to connect either of the exhaust openings 66 with the steam outlet 71 and is provided with a hand wheel 72 to facilitate manipulation.

Fig. 8 represents a modified construction of the steam chest of the engine, in which one of the steam chambers and the auxiliary chamber of the construction shown in Fig. 5 are combined into one chamber 73. The intermediate port 44 of the slide valve is omitted and a vertically extending slide 75 is arranged to vary the width of the opening 74 which connects the chamber 73 with the valve way. The position of the slide 75 is controlled by means of a rod 76 having a hand wheel 77 at its outer extremity while its inner, threaded end extends into a correspondingly tapped opening 78 in the slide. A collar 79 on the rod 76 holds the latter against longitudinal displacement with the result that, by rotation of the wheel 77, a lateral movement is imparted to the slide 75. When it is desired to operate the engine with expanded steam, the port 74 is adjusted to a width equal to that of the corresponding port in the slide valve, so that, when by action of the cam 38, the valve has moved out of the opening 29 the live steam is shut off. To propel the piston by action of live steam during the entire extent of its travel, the opening 74 is by means of the slide 75, widened so that after the slide valve is partly withdrawn, its port will remain in communication with the steam chamber 73 to supply live steam into the piston way. The arrangement of the steam chamber in the opposite side of the steam chest illustrated in Fig. 8, is identical with that of the one previously described.

In Figs. 13 and 14 are illustrated a modified means to actuate the slide valve 27. In this instance the cam wheel 80 is rotatably mounted upon an independent standard 81 with its axis extending at right angles to the axis of the engine shaft 10. A lever 82 fulcrumed upon the extremity of a stud 83 secured to the engine casing, connects at its upper extremity with the slide-valve rod 33 by means of a link 84, while its opposite end carries an anti-friction roller 85 which projects into the pear-shaped cam groove 86 on the wheel 80. A bevel gear wheel 87 mounted concentrically upon the cam wheel, meshes with two diametrically equal beveled gears 88 and 89 which are loosely mounted upon shaft 10 and are held against displacement respectively by collars 90 and 91. A clutch 92 slidably mounted upon the shaft intermediate the gears 88 and 89, is adapted to be brought in operative engagement with one or the other and by these means the direction of rotation of the cam wheel will remain unchanged when the direction of travel of the piston is reversed.

The numeral 93 indicates a packing strip placed in a recess of the piston way to prevent leakage of steam, and I wish it understood that although not shown in the drawings, similar packing means may be applied wherever it is found to be desirable.

Having thus described the mechanical construction of my improved engine, its operation will be readily understood.

Referring to Fig. 2 of the drawings, it is assumed that the piston travels in the direction of the arrow and is in the position drawn in full lines. The valve 27 is now in its closed position as shown in Figs. 3, 9 and 5, and its port 45 being in register with the opening 48 leading to the steam chamber 49, live steam is continually introduced in the piston way between the piston head and the abutment 27. The roller 37 on the rocker arm 35 is synchronously in engagement with the plain surface of the cam wheel 26 and the valve is retained in the closed position by action of the steam introduced into the valve way through one of the channels 54, until the piston head has reached

the position indicated by broken lines at *a* in Fig. 2 when the portion 39 of the cam ridge 38 is brought in contact with the roller 37 causing the slide valve to be retracted a distance sufficient to bring its inner end substantially in alinement with the corresponding surface of the piston way as shown in Fig. 11. The connection between the ports 45 and 48 being broken and the valve 63 being in the closed position upon the orifice of the auxiliary chamber 53, no steam is further admitted into the piston way and the piston to complete its revolution, is impelled by the expansion of the steam occupying the portion of the steam chamber 13, between the abutment plate 27 and the piston. The roller 37 on the rocker arm remains in engagement with the portion 39 of the cam ridge until the piston head has reached a position in proximity to the abutment, as shown in broken lines at *c*, Fig. 2, when the engagement of the part 40 of the cam with the roller will cause the resistance plate to be withdrawn entirely out of the piston way to permit the piston head to pass, (see Fig. 12). When the piston head has reached the point of beginning the slide valve has resumed its original position by action of the steam in the valve way, and during the next revolution the steam in front of the piston is exhausted through port 66ª which is constantly open. When it is desired to operate the engine without resort to the expansive properties of the steam, the valve 63 in the auxiliary compartment 61 of the valve housing 57 is opened, which brings the chambers 53 and 49 in connection by means of the opening 62. Now, when by action of the part 39 of the cam, the abutment plate assumes the position illustrated in Fig. 11 the portion of the piston way between the latter and the piston head will remain in communication with the steam chamber 49 until the resistance plate is entirely withdrawn by reason of the intermediate port 44 in the slide valve being in register with the opening 52 leading to the chamber 53. To reverse the movement of the piston head, the oscillatory valve 56 is turned to bring the steam chamber 51 in communication with the inlet 55, at the same time closing the connection between the latter and chamber 49 and the position of the valve 70 which controls the exhaust ports, is reversed. The increased width of the opening 50 leading into the steam chamber 51, assures constant communication of the latter and the piston way until by engagement of the part 40 of the cam with the roller 37 on the arm 35, the abutment plate is withdrawn and the live steam temporarily cut off.

It will be understood that by placing two or three diametrically differing casings in conjunction with each other around a common shaft, a compound or triple expansion steam engine may be formed in which the steam exhausted from the first or high pressure piston way is made to do further service in the succeeding larger ones.

Having thus described my invention what I claim and desire to secure by Letters Patent of the United States is:—

1. In a rotary engine, the combination of a casing having an annular piston way, transverse abutment ways in opposite sides thereof, an exhaust port in proximity to one of the said abutment ways and an admission port opening within the other, a rotary piston having a head within the piston way, a reciprocating abutment within the abutment ways, having two interconnected ports normally, respectively in communication with the piston way and in register with the admission port, and suitable means to periodically withdraw the said abutment from the piston way.

2. In a rotary engine, the combination of a casing having an annular piston way, transverse abutment ways in opposite sides thereof, an exhaust port in proximity to one of the said abutment ways and two interconnected admission ports opening within the other, a valve arranged to control the said connection, a reciprocating abutment within the abutment ways having three interconnected ports, two of which are normally, respectively in communication with the piston way and in register with one of the admission ports, and suitable means to periodically retract the abutment successively a distance to bring its third port in register with the second admission port and a distance to withdraw it from the piston way.

3. In a rotary engine, the combination of a casing having an annular piston way, transverse abutment ways in opposite sides thereof, exhaust ports on opposite sides of one of the said abutment ways and admission ports opening in opposite sides of the other, a rotary piston having a head within the piston way, a reciprocating abutment within the abutment ways, having two pairs of interconnected ports, one port of each pair being normally in communication with the piston way while the others register with the admission ports, a valve arranged to connect either of the admission ports with the steam supply, and suitable means to periodically withdraw the abutment from the piston way.

4. In a rotary engine, the combination of a casing having an annular piston way, transverse abutment ways in opposite sides thereof, exhaust ports in opposite sides of one of the said abutment ways, the opposite way having two connected admission ports opening in one of its sides and a third admission port in its opposite side, a valve arranged to control the said connection, a valve controlled connection between the third admission port and one of the opposite ones, a rotary piston having a head within the piston way, a reciprocating abutment within the abutment ways having in one of its sides, three interconnected ports two of which are normally, respectively in communication with the piston way and with one of the connected admission ports and on its other side two connected ports normally, respectively in communication with the piston way and with the third admission port, and suitable means to periodically retract the abutment successively a distance to bring the third port on its three port side in register with the other connected admission port and a distance to withdraw it from the piston way.

5. In a rotary engine, the combination of a casing having an annular piston way, transverse abutment seats in opposite sides thereof, exhaust ports on opposite sides of one of the said seats and steam admission ports opening into the other, a combined abutment and slide valve within the seats, arranged to normally connect the steam admission port or ports with the piston way and to shut off the steam supply when retracted, and a rotary piston having a head within the piston way.

6. In a rotary engine, the combination of a casing having an annular piston way, an abutment seat, admission ports opening within the latter and exhaust ports in proximity thereto, a combined abutment and slide valve within the seat transversely of the piston way and adapted to normally connect the steam admission port or ports with the piston way and to shut off the steam supply when retracted, and a rotary piston having a head within the piston way.

7. In a rotary engine, the combination of a casing having an annular piston way and an abutment seat, a reciprocating abutment within the latter transversely of the piston way, means to supply and exhaust steam to and from the piston way, a rotary shaft concentric with the piston way, a disk upon the shaft having an extension projecting within the piston way, plates upon the sides of the said projection in close proximity to the sides of the piston way, and means arranged to retract the abutment as the piston approaches.

8. In a rotary engine, the combination of a casing

having an annular piston way, an abutment seat and a central reservoir, means to supply and exhaust a lubricating medium to and from the latter, a reciprocating abutment within the seat transversely of the piston way, means to supply and exhaust steam to and from the piston way, a rotary shaft concentric with the piston way, a hub upon the shaft, within the reservoir, a disk secured to the hub and having an extension projecting within the piston way, plates upon the sides of the said projection in close proximity to the sides of the piston way, and means arranged to retract the abutment as the piston approaches.

9. In a rotary engine, the combination of a casing having an annular piston way, an abutment seat, an expansible admission port opening within the latter and an exhaust port in proximity thereto, a combined abutment and slide valve within the seat, transversely of the piston way and adapted to normally connect the steam admission port with the piston way and to shut off the steam supply when retracted, a rotary piston having a head within the piston way, and means to periodically impart a varying movement to the abutment.

10. In a rotary engine, the combination of a casing having an annular piston way, an abutment seat, an admission port opening within the latter and an exhaust port in proximity thereto, a combined abutment and slide valve within the seat, transversely of the piston way and adapted to normally connect the steam admission port with the piston way and to shut off the steam supply when retracted, means to augment the area of the admission port, a shaft concentric with the piston way, a piston upon the shaft having a head extending in the piston way, a cam wheel operatively connected with the shaft, a connection on the abutment, engaging therewith, the cam of the said wheel being adapted to periodically impart a varying motion to the abutment.

11. In a rotary engine, the combination of a casing having an annular piston way, an abutment seat, valve-controlled admission ports opening within the latter and exhaust ports in proximity thereto, a combined abutment and slide valve within the seat, transversely of the piston way and adapted to normally connect the steam admission ports with the piston way and to shut off the steam supply when retracted, means to augment the area of one of the admission ports, a shaft concentric with the piston way, a piston upon the shaft having a head extending in the piston way, a cam wheel operatively connected with the shaft, a connection on the abutment, engaging therewith, the cam on the said wheel being adapted to periodically impart a varying motion to the abutment, and means to reverse the movement of the shaft in relation to that of the cam wheel.

In testimony whereof I have affixed my signature in presence of two witnesses.

PETER SCHULLER.

Witnesses:
G. J. ROLLANDET.
S. P. KELSO.