No. 866,677. PATENTED SEPT. 24, 1907.

A. H. OLSON & C. E. NYBERG.

ROTARY ENGINE.

APPLICATION FILED JULY 16, 1907.

5 SHEETS—SHEET 1.

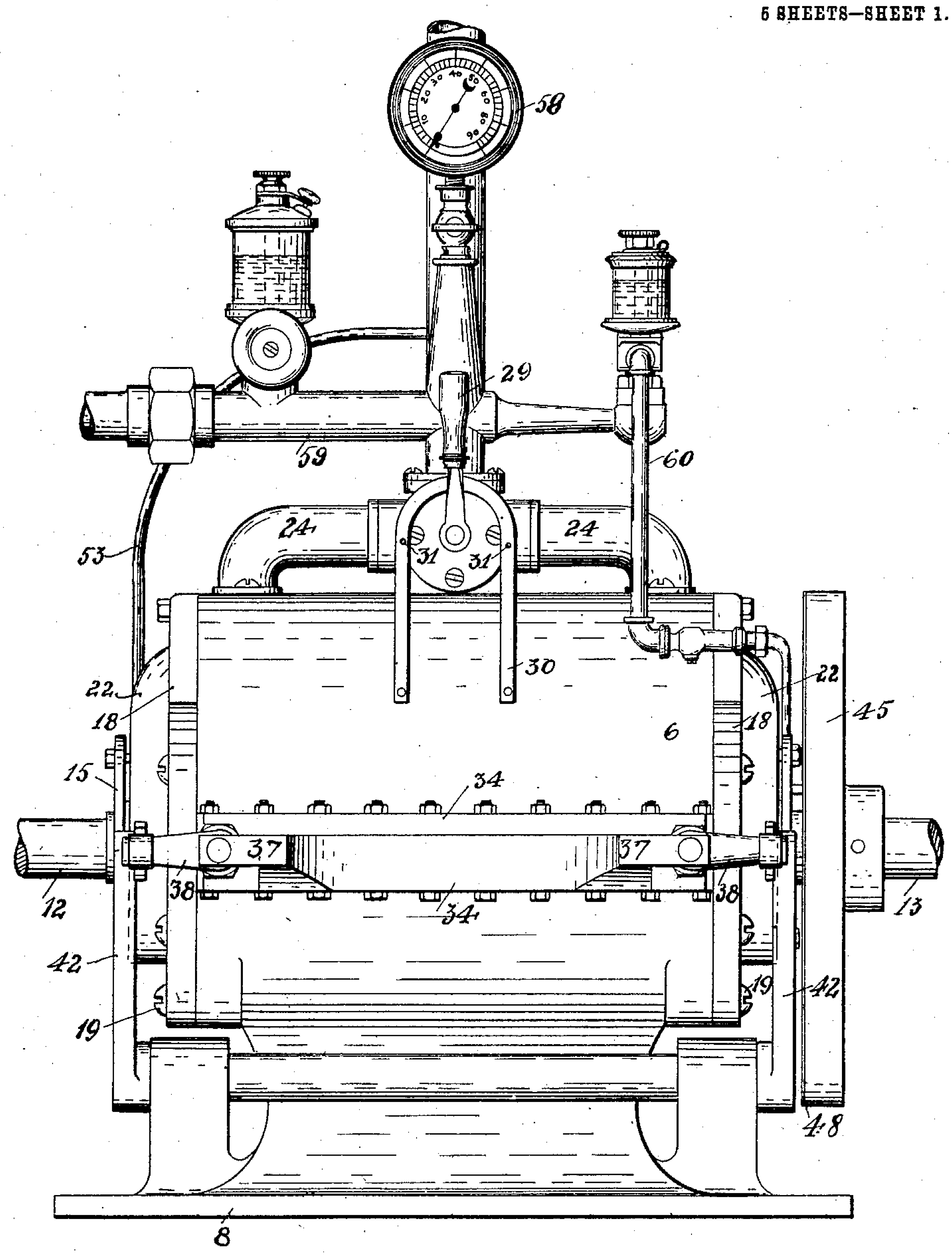

Fig. 1.

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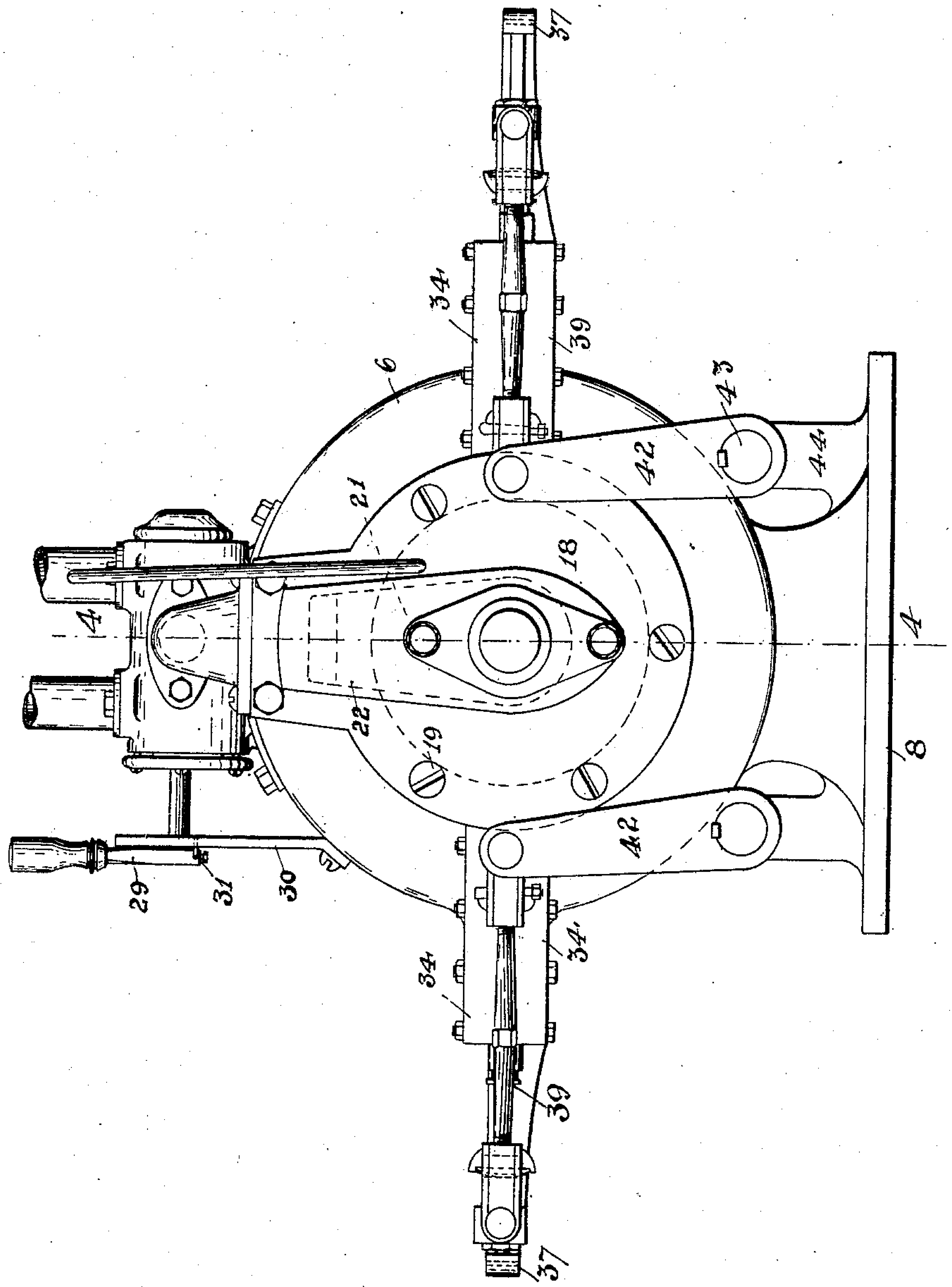
5 SHEETS—SHEET 2.

Fig. 2.



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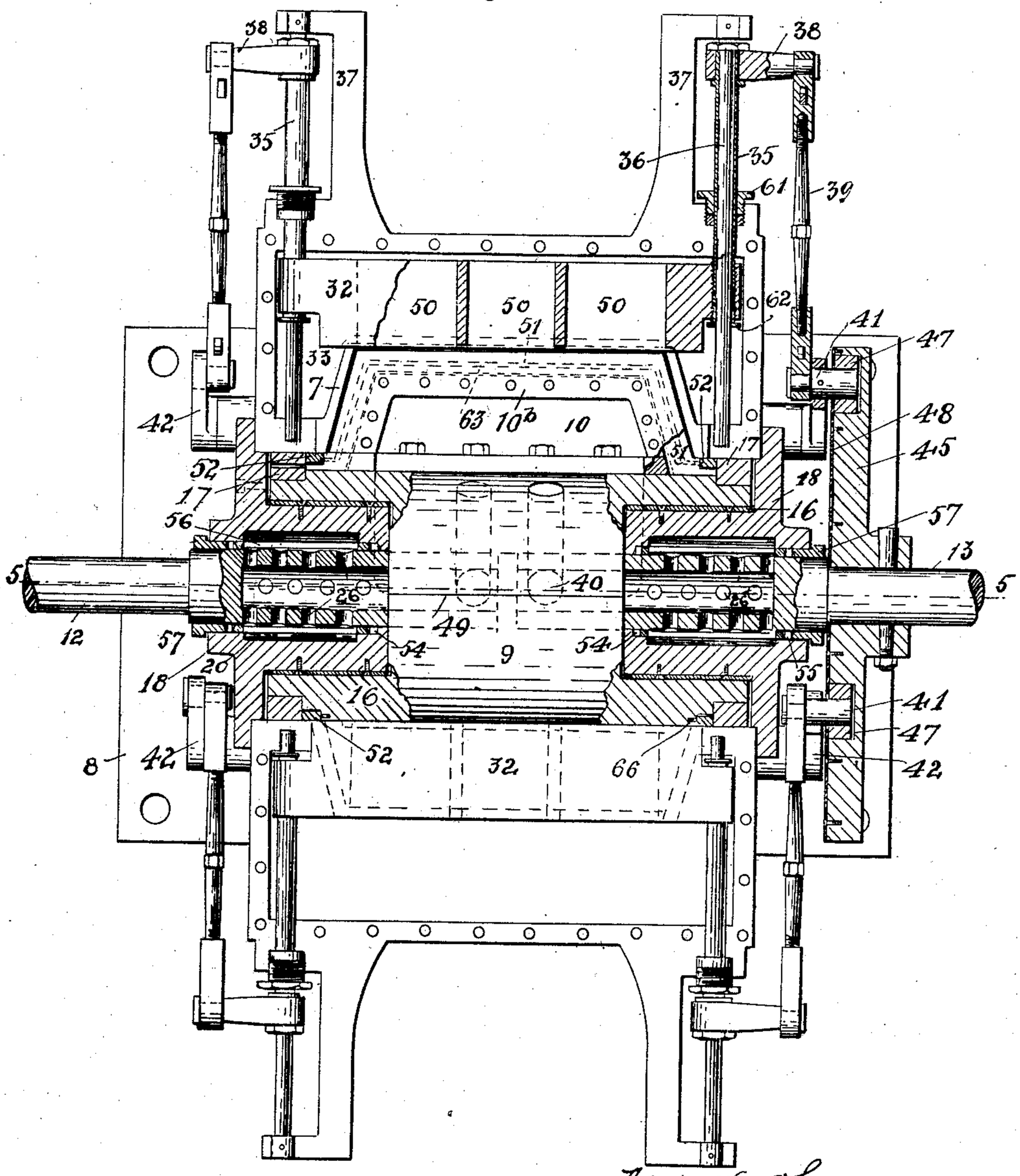
6 SHEETS—SHEET 3.

Fig. 3.



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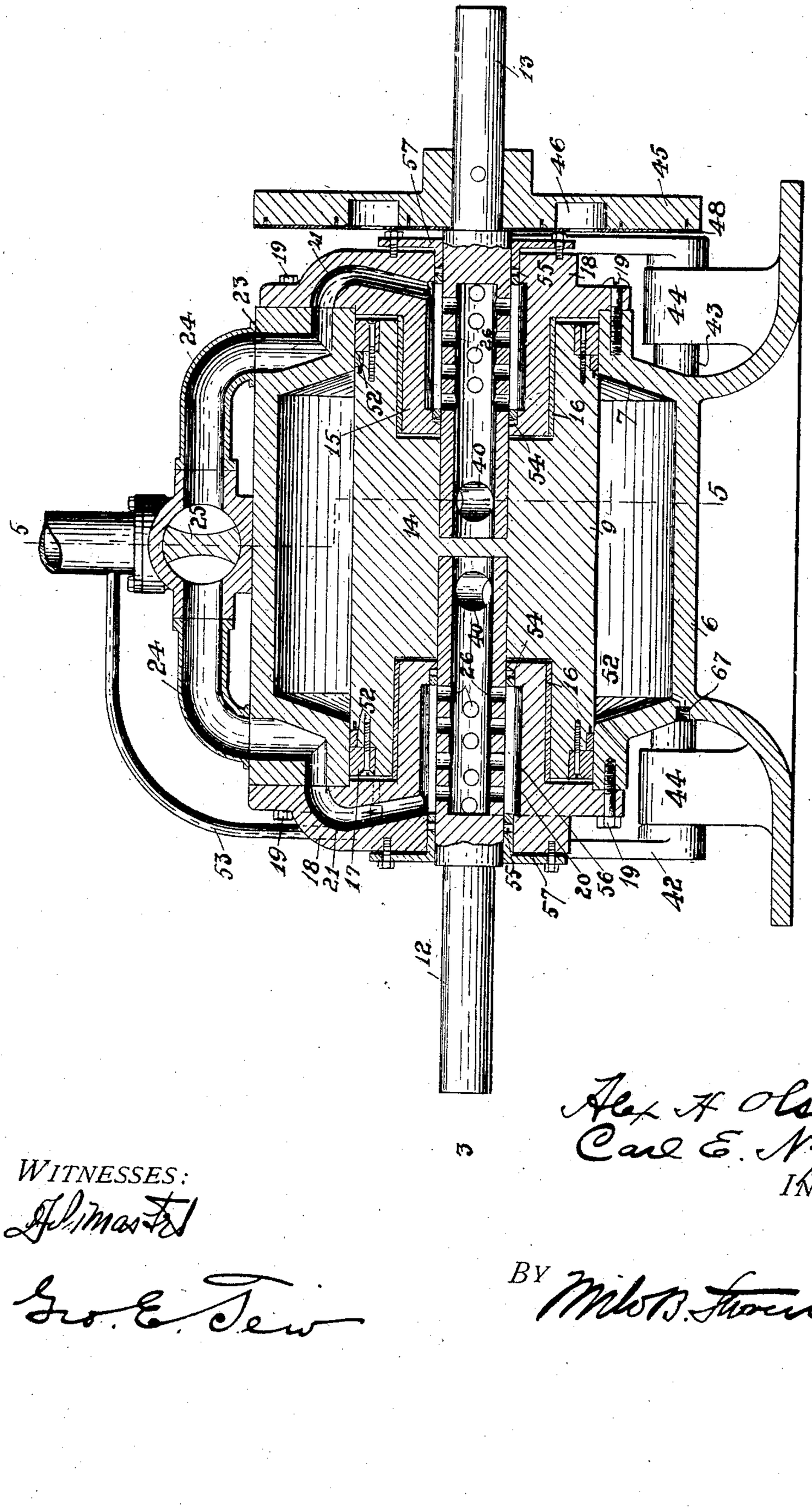

Fig. 4.

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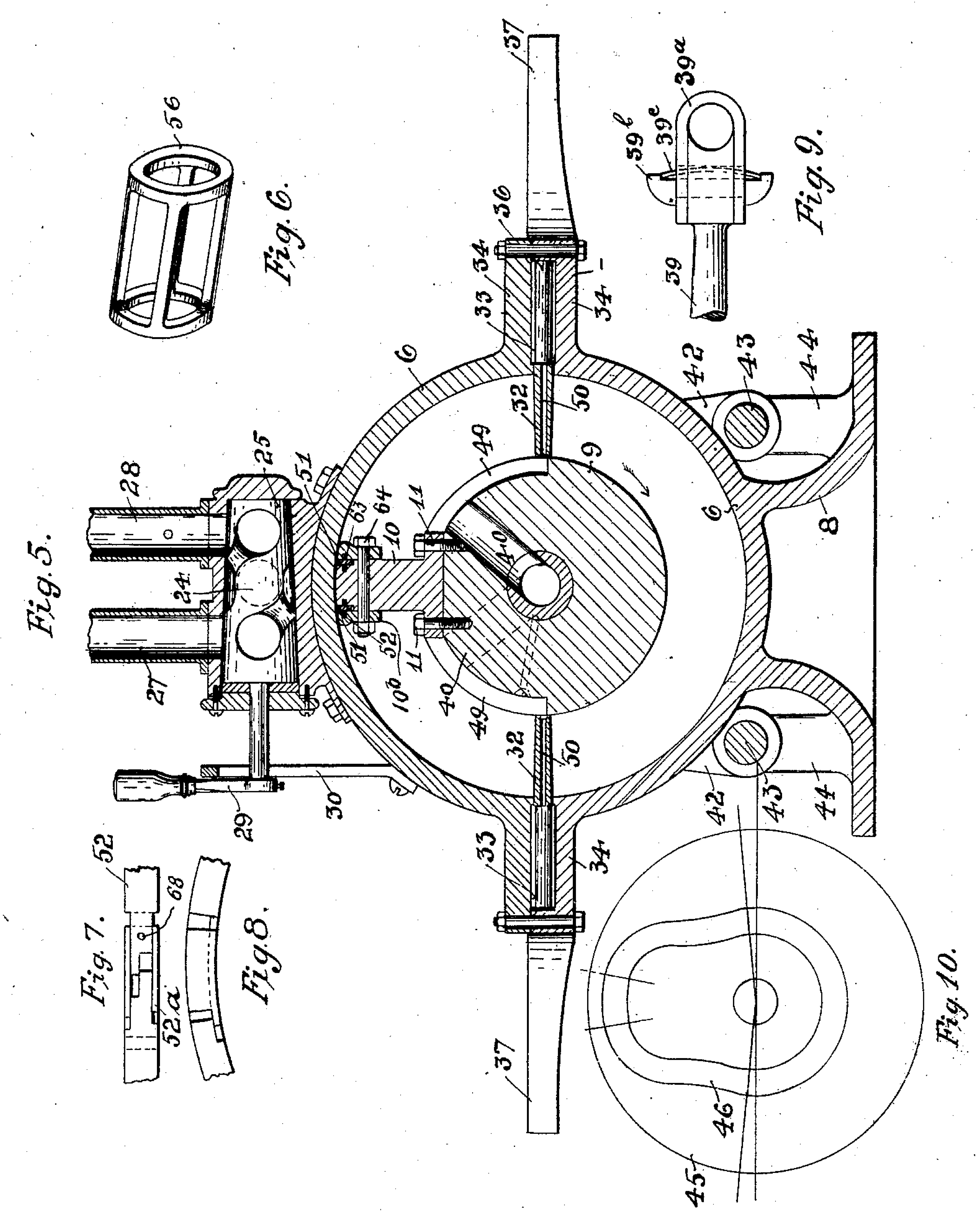
5 SHEETS—SHEET 5.



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UNITED STATES PATENT OFFICE.

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ROTARY ENGINE.

No. 866,677. Specification of Letters Patent. Patented Sept. 24, 1907.

Application filed July 16, 1907. Serial No. 384,086.

To all whom it may concern:

Be it known that we, ALEX H. OLSON and CARL E. NYBERG, subjects of the King of Sweden, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention relates to rotary engines, and particularly to that class thereof having radially slidable abutments which project into or across the steam space in the cylinder, and which are caused to retreat therefrom as the piston passes.

In the present engine the steam is admitted to one side of the piston and exhausted from the other by means of ports leading from a hollow shaft or shaft sections, in communication at opposite ends with the inlet and exhaust passages respectively. The engine will run equally well in either direction and may be readily reversed. It has no dead center and can be started from any position, and an especial feature is that the piston is at all times in receipt of the full pressure of the steam, even as it is passing the abutments. A pair of opposite abutments are used, one of which is always closed, and means are provided to exhaust the steam from both sides of the abutment which is ahead of the piston, or toward which the piston is traveling, so that the abutment will not bind in the recess in which it moves. Means are also provided to balance the abutments by steam pressure, so that they can be easily moved. The abutments are operated by means of a cam, with improved devices for transmitting the motion from the cam thereto. Improved packing means are also provided in connection with the piston and other moving parts of the engine, as well as novel means for admitting and exhausting the steam through the shaft sections.

An embodiment of the invention is illustrated in the accompanying drawing, in which

Figure 1 is a front elevation of the engine. Fig. 2 is an end elevation thereof. Fig. 3 is a horizontal section with the upper half of the cylinder removed. Fig. 4 is a section on the line 4—4 of Fig. 2, the throttle or controlling valve, however, being in open position instead of in closed position, as in Fig. 2. Fig. 5 is a section on the line 5—5 of Fig. 4 with said valve, however, in closed position, and the piston in different position. Fig. 6 is a detail in perspective of a spacing cage or device in the shaft bearings. Figs. 7 and 8 are details of a packing ring. Fig. 9 is a detail of a connection in the abutment operating devices. Fig. 10 is a face view of the cam, much reduced in size.

Referring specifically to the drawings, 6 indicates the cylinder, formed in upper and lower halves bolted together, and the end walls 7 of the cylinder are inclined or converge toward the periphery, as clearly appears in Fig. 4. There is advantage in this with respect to making the piston steam tight, as hereinafter explained. The cylinder is mounted upon a base 8.

Rotatable within the cylinder is a hub 9, carrying a piston 10, fastened to a truncated part of the hub by bolts 11. This hub is fast upon shaft sections 12 and 13, the inner ends or parts of which within the drum are hollow, being separated or closed at said ends by a solid part or partition 14 of the hub. The opposite ends of the hub are counter-bored, to receive the inner annular bearing parts or sleeves 15 on which the hub rotates, a bushing 16 being interposed at the bearing to stand the wear. The inner surface of the casing is also in bearing contact with the outer surface of the drum, or with rings 17 at the end thereof, so that the weight and throw of the drum and piston are not supported by the shaft, but by the cylinder casing or the journal pieces at the end thereof, as referred to. Said journal pieces or parts, indicated at 18, are of comparatively heavy construction, and are firmly fixed to the ends of the cylinder by screws as indicated at 19. Each piece is recessed internally to form an annular steam chamber 20 which extends around the shaft section and which is provided with a steam passage 21 cored in an upwardly extending part 22 thereof and communicating through a passage 23 in the cylinder head with a pipe 24 leading to or from the casing of the controlling valve 25 located on top of the cylinder. Each shaft section has a series of holes 26 opening through between the hollow of the shaft and the steam chamber 20, and these holes are arranged in rows around the shaft so as to give a free and unobstructed way or passage. And said hollow shaft sections also communicate through large passages 40 with the interior or chamber of the cylinder, on opposite sides of the piston 10 and as close as convenient thereto. Said passages 40 extend through the shaft sections and the drum and form respectively inlet and exhaust passages according to the direction of rotation.

The valve 25 is a four-way reversing valve and has the proper ports to open communication between one pipe 24 and the supply pipe 27 from the boiler, and the other pipe 24 and the exhaust pipe 28. This valve is operated by a handle 29 working in front of a bracket 30 which has stops 31 at the limit of movement both ways. In the middle position, as shown in Figs. 1, 2 and 5, the valve is closed, but it may be opened either way by throwing the handle one way or the other, to drive the engine in either direction. The valve is shown open in Fig. 4.

The abutments 32 are arranged horizontally on opposite sides of the cylinder and slide back and forth into and out of the recesses 33 as the piston turns, said recesses being formed between flanges 34 on the cylinder sections. The abutments 32 are tapered, or their upper and lower sides converge so that they are thinner at the edges adjacent the hub than they are at the op-

posite edges, and accordingly they work comparatively loose in their recesses, particularly when they are in retracted position, but when they are advanced their rear or wider edges have a snug fit with the wall of the cylinder at the recess. The abutments are connected to and operated by sleeves 35 which slide on guide rods 36 which are set at their inner ends in the wall of the cylinder and supported at their outer ends by brackets 37 projecting from the lower half of the cylinder casting. At their outer ends the sleeves 35 have arms 38 connected by rods 39 to pins 41 at the upper ends of rockers 42 which are carried by rock shafts 43 supported on bearings 44 on the base of the engine, said rock shafts extending across under the cylinder on opposite sides of the base. Said rods 39 are right and left hand threaded to the end parts, for adjustment, as shown in Fig. 3. The shaft section 13, at one end of the engine, carries a disk 45 which has a cam groove 46 in which travel rollers 47 on the ends of the adjacent pins 41, and the rotation of the cam operates the rockers and produces the reciprocation of the abutments, the parts being properly shaped or timed to retract the abutments to allow the piston to pass, as will be understood. The face of the cam has a shield 48 slotted to agree with the groove, the purpose of the shield being to retain oil in the cam groove.

On opposite sides of the piston 10 the drum 9 is cut away or recessed as indicated at 49, said recesses extending substantially half way round the drum; that is, the ends of the recesses are at diametrically opposite points equidistant from the piston. The abutments 32 have passages 50 extending acrosswise therethrough, and in certain positions these passages communicate with the recesses 49 and also with the recesses 33 behind the abutments. Said recesses 49 also establish communication between the chambers on opposite sides of the abutments 32, at times during the rotation of the piston; and the passages 40 open into the recesses 49. Now by virtue of this construction, the pressure on opposite sides of the abutments 32, particularly during the movement of said abutments, is at all times equal. Take, for example, the exhaust side of the cylinder, as shown in Fig. 5, the piston traveling in the direction of the arrow adjacent thereto, when the end of the recess 49 passes the abutment 32 communication between the space above the abutment and the space below the abutment will be established through the recess 49, thereby equalizing the pressure on both sides of the abutment and allowing the free exhaust from both sides thereof through the exhaust passage 40. At this time, the opposite abutment is closed, remaining closed until after the piston passes the opposite or lower center line. In the inlet side of the cylinder, before the piston has reached the upper central position, a similar action has taken place. That is, steam entering the inlet passage 40 passes through the recess 49 into the chambers on both sides of the abutment 32 at the left hand side of the cylinder as shown in said Fig. 5, and consequently the said abutment 32 is balanced, the abutment 32 on the right hand side being at that time in closed position, so that the live steam fills the lower half of the cylinder between the abutments and also the segmental portion of the cylinder between the left hand abutment and the piston, which is at that time rising through the last quarter of the chamber toward the vertical position, and as soon as the end of the recess 49 on the left hand side passes the abutment 32 the recess 49 on the right hand side of the drum opens into the lower half of the chamber and allows the steam therein to exhaust as heretofore described. In consequence of this construction there is no dead point, because when the piston is passing one abutment it has live steam behind it, confined by the other abutment which is then closed and which remains closed until the opposite abutment becomes completely closed and takes the pressure. There is thus a continuous pressure on the piston in all positions thereof and said pressure remains constant, or identical with the boiler pressure, in all positions of the piston. The flow being continuous there is no necessity for any operating valve, other than the throttle and reversing valve.

In order to compensate for wear and to take up any lost motion in the connection between the abutments and the rockers the connecting rods 39, as shown in Fig. 9, have yokes 39^a at the end, which are loose, or slidable lengthwise with respect to the rod, to a limited extent, as controlled by the keys 39^b which have springs 39^c, said keys and springs extending through mortises in the ends of the rods. This allows a slight yield of the abutments with respect to the operating devices, giving a close contact of the abutments against the hub or drum 9 when the abutments are advanced. The edges of the piston at the ends thereof are inclined to fit the inclination of the end walls 7 of the cylinder, and said piston is packed by means of continuous strips 51 each of which is made in one piece extending along the side and ends of the piston and fastened to the packing rings 52. The absence of any joint in the strip at the corner of the piston effectually prevents leak of the steam past the piston, and the strips being pressed out by the packing rings will close as well against the end walls 7 of the cylinder as against the body walls 6 thereof, in consequence of the inclined position of said walls 7. The hub 9 has a bearing ring 17 at the ends, as heretofore referred to, and is packed by rings 52 adjacent thereto, which in turn are packed by the stuffing 66, in the hub, and on the inside of the packing rings, also communicating with the stuffing 63, thus preventing the leakage of steam around the packing rings. These rings 52, as shown in Figs. 7 and 8, are halved and lapped at the ends and also reduced to receive side pieces 52^a which lap the joint and assist in preventing leak therethrough, one end of the piece being fastened to the rings, as at 68.

In order to dispose of any slight leak which may take place between the cylinder and the drum, or which may escape endwise through the packing of the piston, one of the end pieces of the cylinder is tapped by a pipe 53 which leads from a slight space at the end of the hub to the exhaust pipe 28, and serves to draw away any leak between the parts, thereby removing the pressure under the packing-strips and rings, so as to reduce the friction.

As stated before, the end pieces 18 of the cylinder have inwardly extending cuffs or parts 15 which form the steam spaces around the shaft sections. Each of these cuffs has packing at 54 at the inner end, and at 55 at the outer end, between which is a spacing cage

56 shown in perspective in Fig. 6, and the purpose of which is to transmit the pressure from the gland 57 to both packings, when said gland is tightened. Necessarily the part 56 is in the form of a cage, or with apertures, to let the steam pass through to or from the holes 26.

The piston 10 has two side plates 10^b, and two packing strips 51, set so far apart that one of them passes the recesses 33 before the other has left the cylinder walls, thereby preventing the steam from leaking around the piston as it passes said recesses 33. The middle and the two side plates of the piston are grooved on both sides of the packing-strips to receive stuffing as shown at 63. The object of this is to prevent the leakage of steam around the packing-strips. The two side plates are fastened to the middle part by bolts 64.

The engine may be provided with a steam gage 58, a lubricator 59 delivering to the inflowing steam, for the interior parts of the engine, a lubricator 60 supplying to the cam groove and rollers therein, and a plug 67 to let out the water of condensation. The sleeves 35 are packed at glands 61 and the guide rods 36 are packed at glands 62.

In operation, the steam admitted through either of the pipes 24 will pass through the passage 21, steam chamber 20, holes 26 and passage 40 into the space within the cylinder and will drive the piston accordingly, the exhaust taking place in reverse direction through the opposite shaft section and the passages at the other end of the cylinder. There is no cessation of the pressure during any part of the rotation, and consequently there is no dead point and the engine may be run as slow as desired, much slower than any former engine in which the steam is admitted at different strokes or at intervals.

I claim:

1. In a rotary engine, the combination with a cylinder having end pieces with inwardly projecting circular cuffs, of a shaft extending through said cuffs, a drum on the shaft, bored at the ends to receive said cuffs and bearing on the outer sides thereof, and a piston carried by the drum.

2. In a rotary engine, the combination with a cylinder having bearings at the ends, and end pieces with inwardly projecting circular cuffs, of a shaft extending through said cuffs, a drum on the shaft, bored to receive said cuffs and having rims at the ends projecting between said cuffs and the said end bearings of the cylinder, and a piston carried on the drum.

3. In a rotary engine, the combination of a cylinder the ends of which have cuffs with steam chambers therein, a hollow shaft extending through said cuffs and having openings communicating with said chambers and with the space within the cylinder, packing rings between the cuffs and the shaft at the inner and outer ends of the former, spacing cages surrounding the shaft in said steam chambers and between the rings, and glands bearing against the outer packing rings.

4. In a rotary engine, the combination of a cylinder having opposite radial recesses in its wall, abutments slidable radially in said recesses, a shaft and drum in the cylinder having axial steam passages opening into the cylinder, and a piston carried by the drum, the drum being recessed on opposite sides of the piston to open a passage between the cylinder spaces on opposite sides of the abutments alternately, and the abutments having steam passages extending crosswise therethrough, to connect the recesses in the cylinder walls with the recesses in the drum and balance the abutments.

5. In a rotary engine, the combination of a cylinder having a radial recess in its wall, an abutment slidable in said recess and tapered toward the front edge to admit steam into the recess on both sides thereof, and a shaft and piston rotatable in the cylinder.

6. In a rotary engine, the combination of a cylinder having a radial recess in its wall, an abutment slidable in said recess and having passages extending crosswise therethrough, to admit steam into the recess behind the abutment, and a shaft and piston rotatable in the cylinder.

7. In a rotary engine, the combination of a cylinder, a rotary drum and piston therein, packing rings and strips between the cylinder and said drum and piston, and a pipe for leak, communicating with the spaces behind said rings and strips, and leading to the exhaust pipe of the engine.

8. In a rotary engine, the combination of a cylinder, a rotary drum and piston having bearings therein, and a pipe for leak, communicating with the bearings and leading to the exhaust pipe of the engine.

9. In a rotary engine, the combination of a cylinder having a radial recess in its wall, guide rods projecting through said wall at opposite ends of the recess, an abutment slidable on the guide rods in the recess, sleeves connected to the abutment and slidable on the rods and through the cylinder wall, and means connected to the sleeves to operate the abutments.

10. In a rotary engine, the combination of a cylinder having a radial recess in its wall, guide rods extending across said recess at opposite ends thereof, an abutment slidable on the guide rods in the recess and spaced from the opposite side walls of the recess, and means to operate said abutment.

In testimony whereof we affix our signatures, in presence of two witnesses.

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Witnesses:
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