(No Model.)

2 Sheets—Sheet 1.

P. J. BORIS.
ROTARY ENGINE.

No. 604,960.

Patented May 31, 1898.

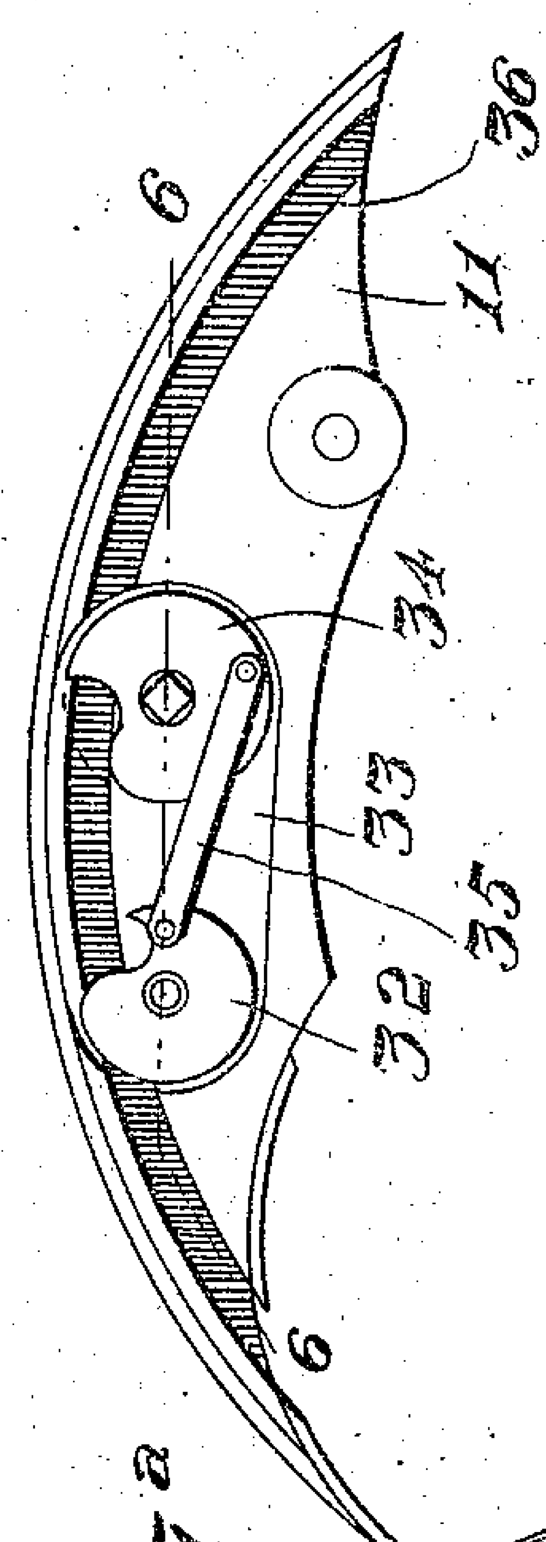

Fig. 5.

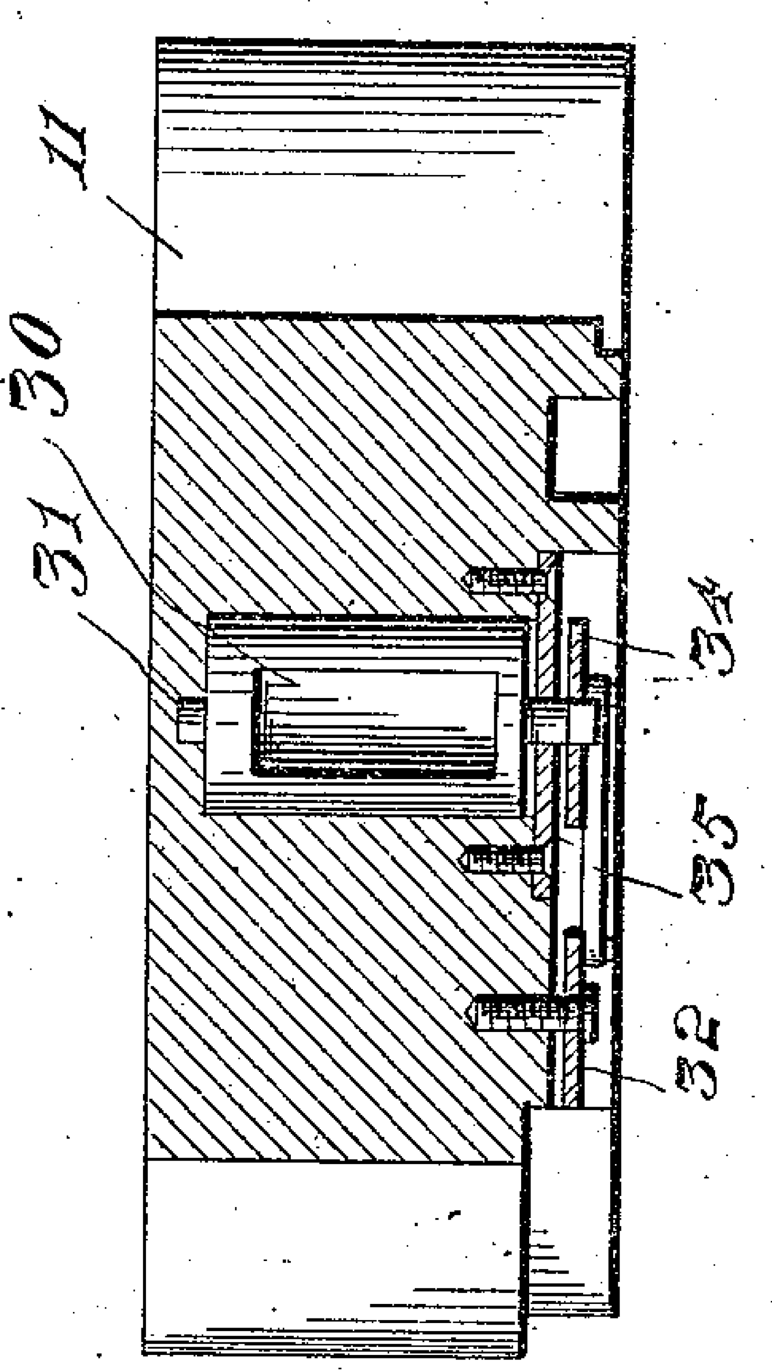

Fig. 6.

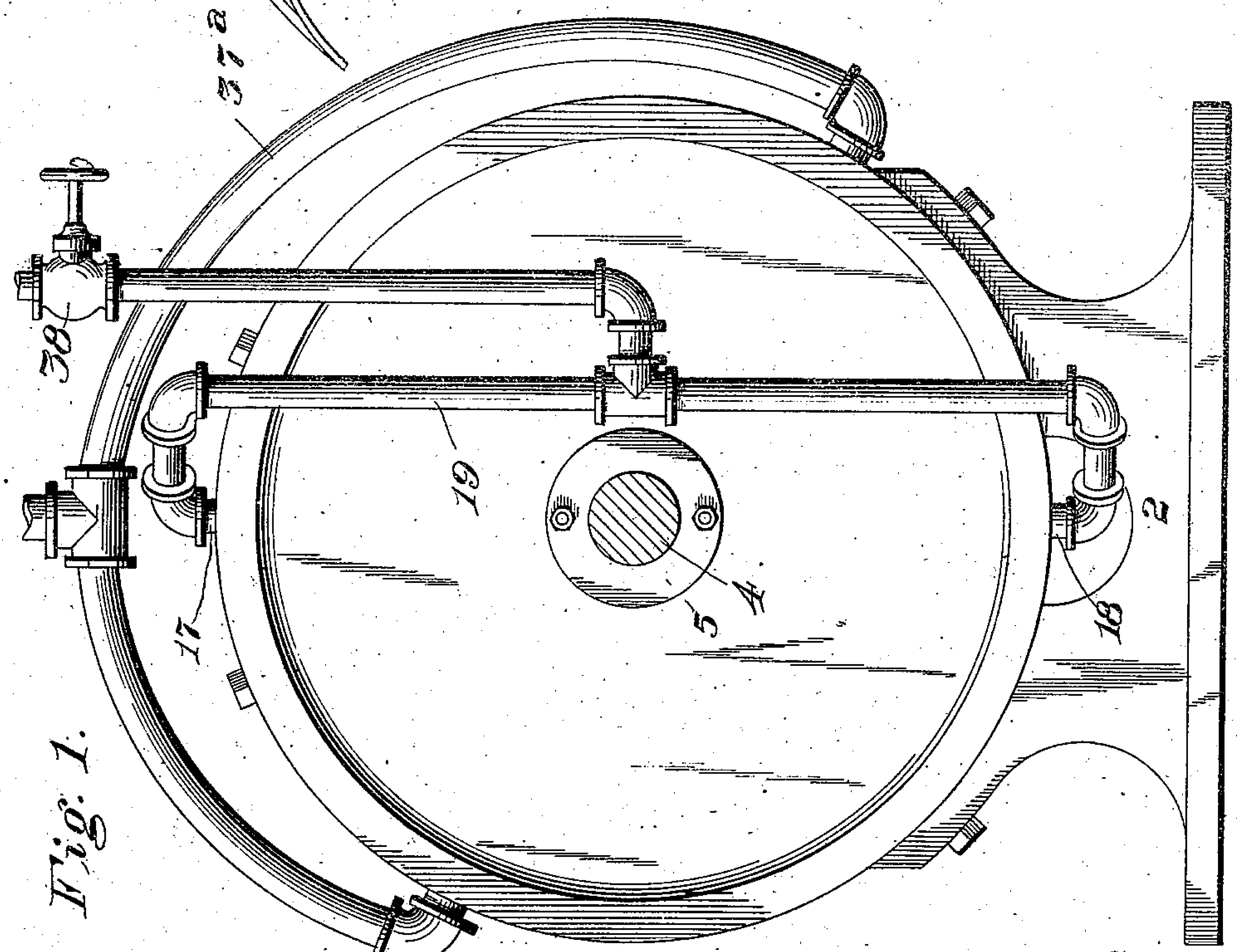

Fig. 1.

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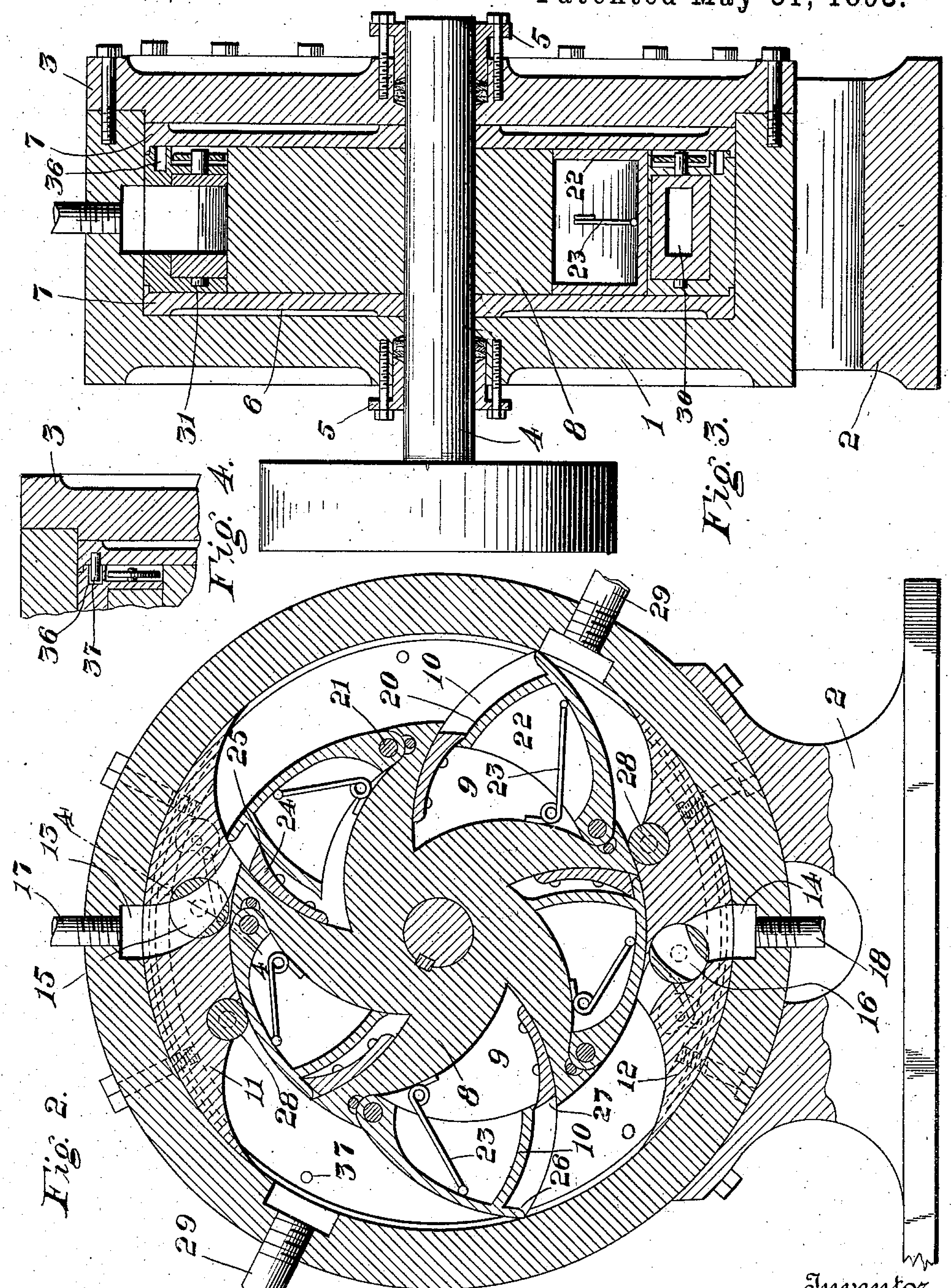

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UNITED STATES PATENT OFFICE.

PIERRE JULIEN BORIS, OF BOSTON, MASSACHUSETTS.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 604,960, dated May 31, 1898.

Application filed September 17, 1897. Serial No. 652,048. (No model.)

To all whom it may concern:

Be it known that I, PIERRE JULIEN BORIS, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Rotary Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a novel rotary engine, and has for its object the production of a simple, durable, and efficient motor of this class in which both the force of the impact and compression of the live steam and the expansion of the steam after it has been cut off are utilized, in which the cut-off is automatically effected, and in which the details of construction are such that leakage or waste of steam is prevented and the thorough lubrication of the parts is effected.

To the accomplishment of the above and other objects subordinate thereto the invention consists in providing a cylindrical casing with an axially-located shaft, upon which is keyed within the casing or cylinder a rotary head provided with a series of pivoted heads, against which live steam is directed over diametrically opposite sides of the cylinder in alternative succession, and in providing automatic valve mechanism located at the steam-inlets and designed to be actuated alternately to permit ingress of the steam and to cut off the steam-supply to permit utilization of the expansion during a portion of the movement of the head as it passes from the inlet to the exhaust, the relation of the parts being such that while the steam is being admitted through one inlet the valve in the other inlet will be closed to permit the utilization of the expansive energy upon one side of the piston, while the corresponding head upon the diametrically opposite side is being acted on by the live steam.

Referring to the drawings, Figure 1 is a side elevation of my engine proper. Fig. 2 is a central vertical section therethrough. Fig. 3 is a central vertical section taken at right angles to the section of Fig. 2. Fig. 4 is a detail sectional view on a line 4 4 of Fig. 2. Fig. 5 is a detail view of the valve and cut-off cams, and Fig. 6 is a sectional view on a line 6 6 of Fig. 6.

Referring to the numerals of the drawings, the numeral 1 indicates an open-sided cylindrical casing mounted upon a suitable stand 2 and provided with a cover or head 3, bolted or otherwise secured to the open side of the casing to complete what may be termed the "cylinder" of the engine.

4 indicates a power-shaft comprising the cylinder-axle and surrounded by packing-glands 5, located in the heads of the piston.

6 indicates the piston of the engine, which is composed of a pair of circular plates 7, fitting closely within the cylinder and located against the inner faces of the cylinder-heads and between which is secured, in a manner to identify the latter as a single structure, a cylindrical head-carrier 8 of somewhat less diameter than the interior diameter of the cylinder and provided with a circumferential series of head-sockets 9, in which are mounted piston-heads 10, constructed and designed to be actuated in a manner to be described.

11 and 12 indicate a pair of abutments secured to the inner periphery of the cylinder diametrically opposite each other by bolts or the like and designed to partly fill the space between the plates 7 and the periphery of the head-carrier and the inner periphery of the cylinder and through which extend forwardly-curved steam-inlets 13 and 14, controlled by rotary valves 15 and 16, the branches 17 and 18 of a steam-pipe 19 comprising a cylinder communicating with the inlets, as illustrated. The effectiveness of these abutments will be well understood, since it is obvious that in order to rotate the piston under steam-pressure the steam must be confined between fixed and movable elements, the abutments in the present constituting the former and the head-carrier and heads constituting the latter, as will presently appear.

It will be observed that in order to cause the expansive force of the steam to be exerted upon the piston it is necessary that obstructions be placed within the passages extending from between the abutments upon the opposite sides of the head-carrier, and it is for the purpose of providing such obstructions and in a manner which will permit of their retractions into the plan of the periphery of the head-carrier that I have provided the heads 10, that I have constructed as illustrated. These heads are disposed in the same direction and are formed with a curved impact-plate 20 at their free ends and pivoted, as by pintles 21, located at their forward ends, side plates 22 being provided, extending endwise and of an extent corresponding to the dimensions of the impact-plate and the head proper to form the heads into substantially cup or receptacle shape, and pivoted members designed to be forced outwardly by springs 23, of any suitable form, located intermediate of the abutments of the sockets 9 and the heads 10. The impact-plates 20 are curved concentric with the pintles 21, and a steam-tight joint is formed between the impact-plate and the contiguous face of the socket by a packing-plate 24 eccentrically with respect to the pintle and having a sharp edge 25, which bears against the impact-plate and permits the same to move under the impulse of the spring without allowing the escape of the steam around the head into the socket.

26 indicates a limiting-flange upon the free end of the head, designed to seat in recesses 27, formed by the outer edge of the plate 26 and the contiguous portion of the socket 9. This organization of elements permits the several heads which are curved in a degree corresponding to the degree of curvature of the head-carriers to lie concentric with the head-carriers and to permit heads to constitute portions of a continuous unbroken cylindrical surface. It will now be observed that as the piston rotates the heads will be successively forced into the sockets by passing under the inner faces of the abutments, antifrictional rollers 28 being provided to reduce the frictional contact to a minimum, and that as soon as the heads have passed from under the abutments upon the opposite side they will swing outwardly upon the impulse of the springs 23, and the edge of the flange 26 will contact with the inner periphery of the casing, the side plates of the head being in steam-tight contact with the inner faces of the plates 7.

In order that the steam as it escapes from the inlets into the steam-space in contact with the heads may not pass around the latter during the outward movements of the heads when released by the abutments, the end faces of the abutments 11 and 12 are curved in a degree corresponding to the curve described by the heads as they swing outwardly upon their pivots when being carried forward by the piston. Thus, supposing the engine to be in the position indicated in Fig. 2, the steam will be admitted from the steam-pipe 17 into the inlet-port 13 and will pass thence, the valve 15 being open, to the interior of the cylinder, where its energy will be exerted upon the impact plate or face 20 of the adjacent head, which has just been released by the abutments and is swinging to its outward position. By referring to the opposite side of the engine, however, it will be seen that the head which has just passed the abutment 12 is being propelled under the expansion of the steam which has previously been admitted through the inlet 14 and that the valve 16 is now closed. Thus while the head adjacent to the inlet 13 is propelled under the impulse of live steam the diametrically opposite head is being subjected to the expansive energy of the steam that its adjacent inlet-valve closed or cut off. This relation of the parts is maintained continuously but alternately, each head receiving live steam through, say, for instance, one-third of its movement toward the exhaust-port, and being driven the remainder of its travel under expansion until it passes either of the exhaust-ports 29, located diametrically opposite each other and adjacent to the rear ends of each of the abutments. It is a fact, however, that in order to partly open and close the valves 15 and 16 to effect this alternative feed and cut-off of the steam at the opposite sides of the engine diametrically-revolving actuating mechanism must be employed, and its connection must depend upon the movement of the piston, for the reason that the latter determines the position of the heads with respect to the abutments at all times. The controlling-valves 15 and 16 are of cylindrical form and are journaled in any suitable manner, all the abutments being provided with transverse steam-ports 30 and shafts 31, upon the outer extremities of which are located valve-cams 32, located within slightly-elongated recesses 33 in the face of the abutment contiguous to one of the plates 7. Within the recesses 33, a suitable distance in advance of the valve-cam, are pivotally mounted cut-off cams 34, one being provided in its relation to each of the valve-cams and linked thereto, as by links 35. One of the abutments is likewise provided with a longitudinally-extending linked recess 36, designed for the reception of horizontally-extending pins or rollers 37, carried by one of the plates 7 and designed at the proper time to actuate the valve-cam to open the valve and thereby permit the ingress of live steam to the interior of the cylinder, as illustrated in the upper view of Fig. 2. As the pin passes the cam 32 the adjacent head is receiving the impact of live steam and tends to do so until the pin or roller 37 contacts with the cam 34, when, as will be obvious, the latter will be rotated and through the link 35 will cause the rotation of the cam 32 in the direction to close the valve, and the cut-off of the steam will thereby be effected at a time determined by the distance between the valve and cut-off cams, and if it is desired that the head shall receive live steam during more than one-third of its travel between the ingress and egress ports it is simply necessary to change the distance between the valve-cam and the cut-off cam in order that the cut-off may be effected and will operate. The exhaust-ports 29 are connected with a suitable exhaust-pipe 37^a, the steam-pipe 19' is provided with a throttle-valve 38, and the engine is complete.

In conclusion it may be stated that the valves and valve-actuating mechanism are so arranged relatively that whenever one valve is open the other is closed, that whenever one head is being driven under the impulse of live steam the diametrically-opposed head is being subjected to the expansion of the steam after the cut-off has been effected, and that the exhaust from the opposite sides of the engine alternates and is not effected until the entire potential energy of the steam has been converted into kinetic power by this initial expansion and by this continued expansion after the cut-off is effected; but while the present embodiment of my invention appears at this time to be preferable I do not desire to limit myself to the structural details illustrated and described, but reserve the right to change, modify, or vary them at will within the scope of my invention.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a rotary engine, the combination with a cylinder, a shaft, a rotary piston on the latter, of a series of pivoted heads carried by the said piston, diametrically-disposed abutments within the cylinder having curved steam-passages therein running in reverse directions, valves controlling the said steam-passages, cams for operating the said valves, means carried by the said piston for actuating the valves and cams, and diametrically-opposed exhausts situated intermediate the said abutments.

2. The combination with a cylinder provided with ingress and exhaust ports, of a shaft, a rotary piston on said shaft provided with a series of pivoted piston-heads, valves controlling the ingress-ports, valve-cams connected to said valves, independently-pivoted cut-off cams connected to said valve-cams, and means carried by the said piston for actuating the valves and valve-cams automatically in alternation, substantially as specified.

3. The combination with a cylinder provided with diametrically-opposed abutments having steam-passages therein running in reverse directions therethrough and adapted to be alternately opened and closed, antifrictional rollers carried by the said abutments, and valves controlling the said steam-passages, of a rotary piston consisting of circular plates movable upon the opposite sides of the abutments, a cylindrical head-carrier intermediate the plates, a series of spring-actuated pivoted heads on the said head-carrier adapted to be automatically forced outwardly and moved inwardly by the said abutments, and pins or rollers on the said plates for operating the said valves, substantially as specified.

4. The combination with a cylinder provided with ingress-ports and exhaust-ports, of rotary controlling-valves in the ingress-ports, valve-cams connected thereto, independently-pivoted cut-off cams in advance of the valve-cams, links intermediate of the cut-off valve-cams, a rotary piston and means carried thereby for successively actuating the valve and cut-off cams, substantially as specified.

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