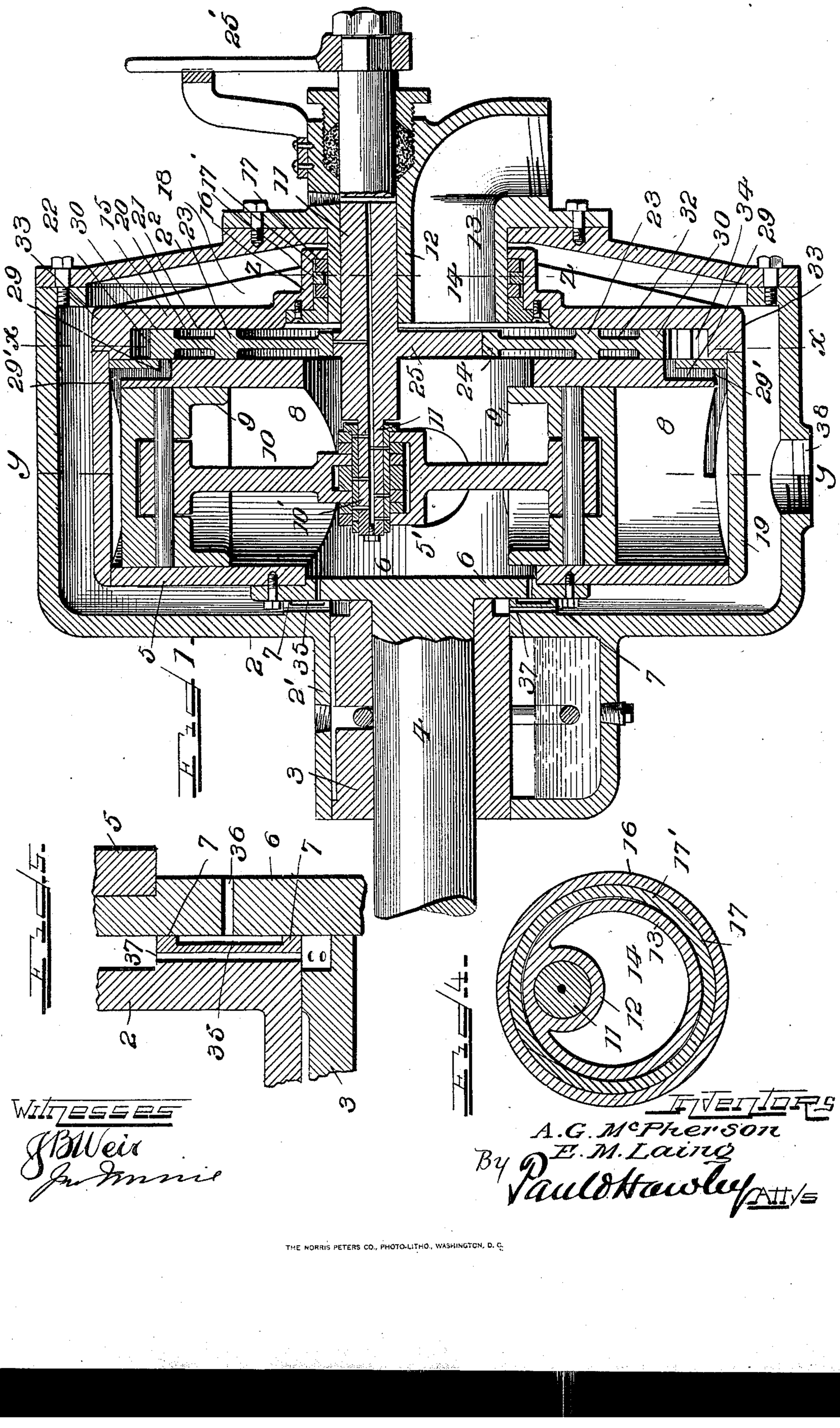
No. 719,359. PATENTED JAN. 27, 1903.

A. G. McPHERSON & E. M. LAING.

ROTARY ENGINE.

APPLICATION FILED JAN. 22, 1901.

NO MODEL. 4 SHEETS—SHEET 1.



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Jno. Dennis

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NO MODEL. 4 SHEETS—SHEET 2.

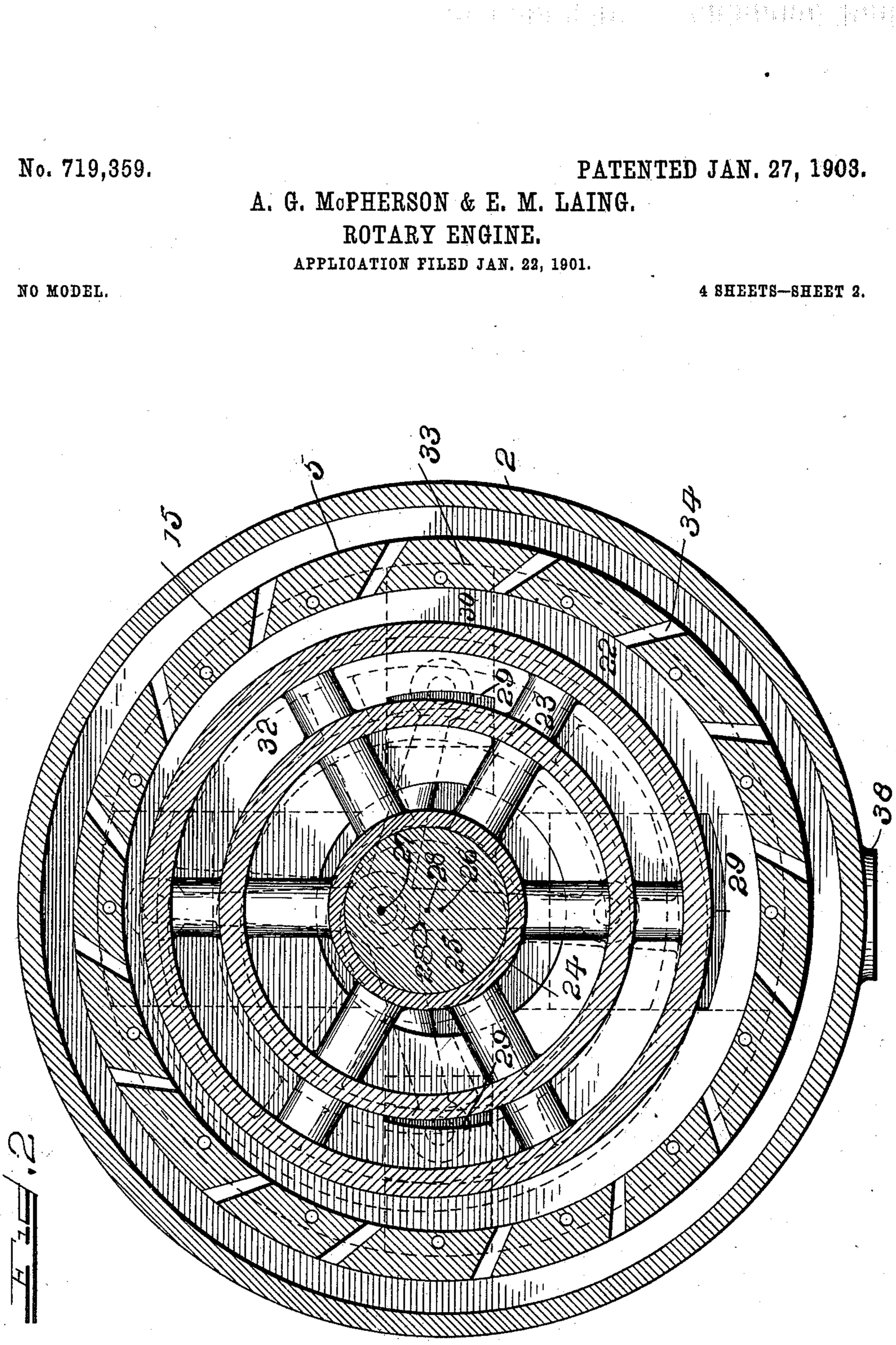

Fig. 2.

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NO MODEL. 4 SHEETS—SHEET 3.

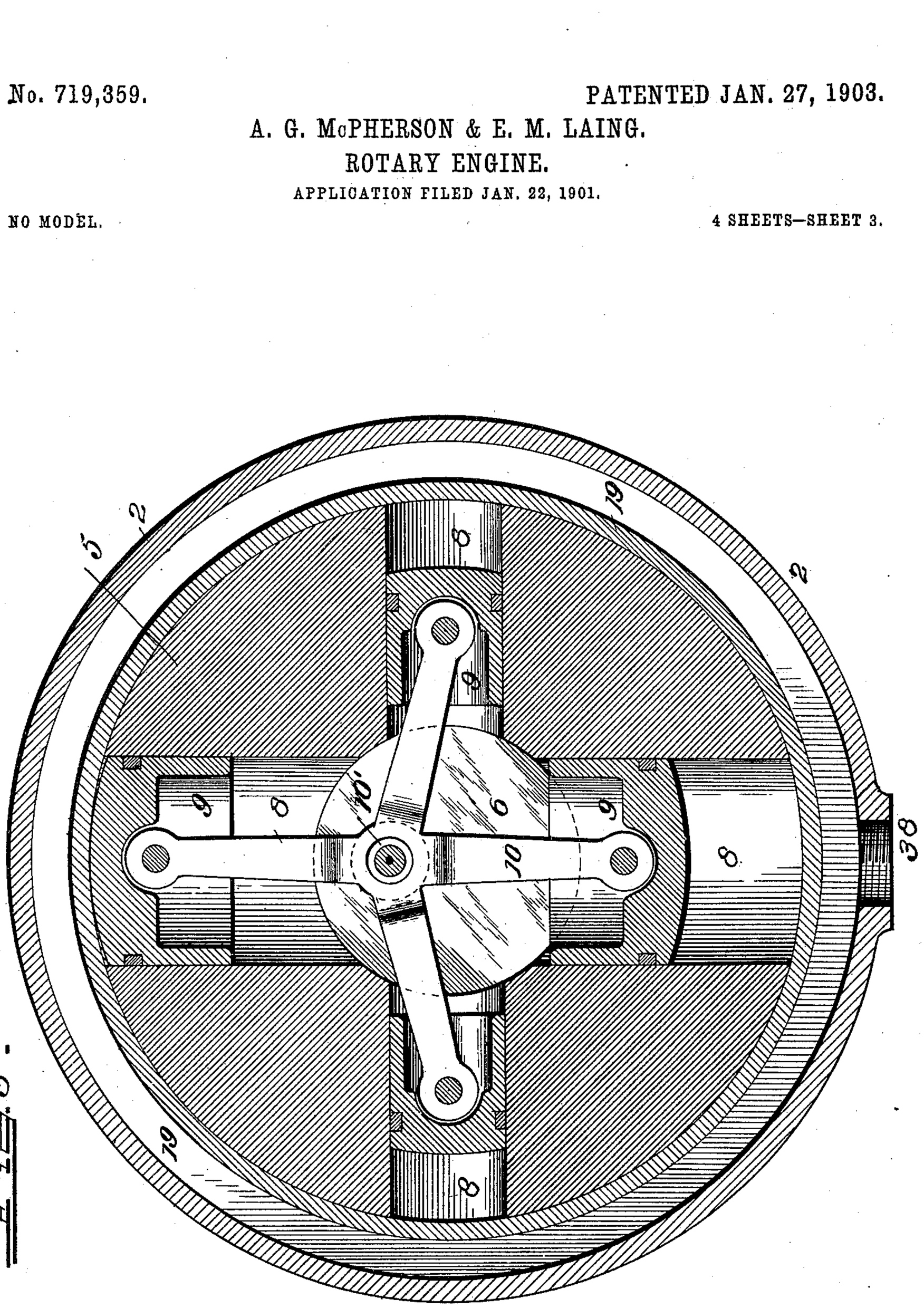

Fig. 3.

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NO MODEL

4 SHEETS—SHEET 4.

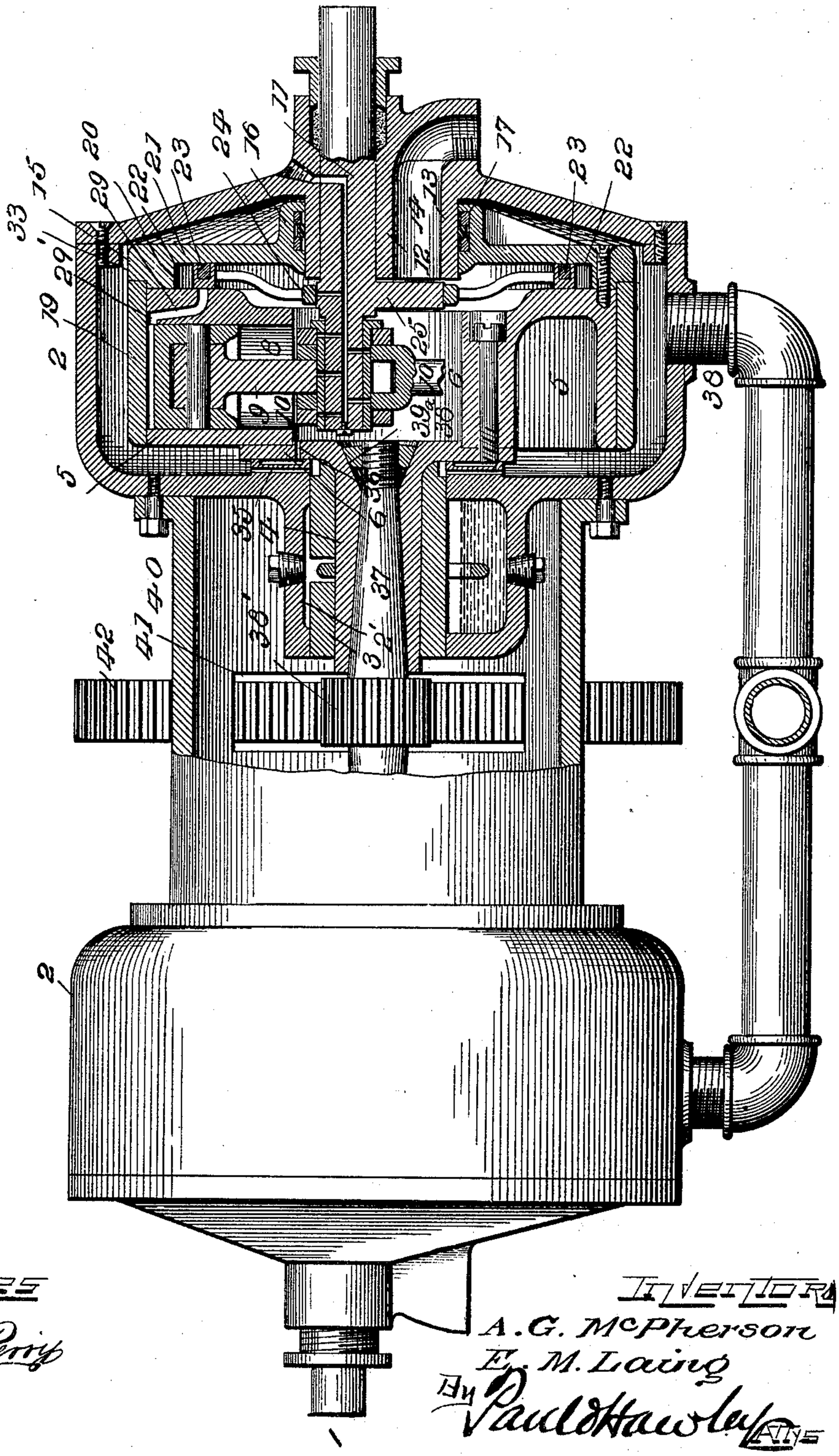

FIG. 6.

Witnesses

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UNITED STATES PATENT OFFICE.

ARTHUR G. McPHERSON AND EDWARD M. LAING, OF HIGHLAND PARK, ILLINOIS, ASSIGNORS OF ONE-HALF TO GEORGE B. FOSTER, OF CHICAGO, ILLINOIS.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 719,359, dated January 27, 1903.

Application filed January 22, 1901. Serial No. 44,278. (No model.)

To all whom it may concern:

Be it known that we, ARTHUR G. McPHERSON and EDWARD M. LAING, of Highland Park, Lake county, State of Illinois, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

Our invention relates to rotary engines, and particularly to rotary steam-engines of that class wherein the rotary movement is developed by the reciprocation of radially-arranged pistons.

The object of our invention is to improve engines of this class; and the particular object of our invention is to improve the construction and arrangement of the steam-valves of rotary engines.

Other objects of our invention will appear hereinafter.

Our invention consists, primarily, in a rotary engine comprising a cylindered body capable of rotation, a relatively stationary crank-pin, pistons provided in said body and joined to said pin, an annular valve-chamber in said body, ports connecting the same with the cylinders of said body, a gyrating ring-valve arranged in said valve-chamber, and an eccentric bearing therefor whereby gyration of the valve is caused by the rotation of said cylindered body; and, further, our invention consists in various constructions and in combinations of parts, all as hereinafter detailed, and particularly pointed out in the claims.

The invention will be more readily understood by reference to the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a longitudinal and vertical section of a rotary engine embodying our invention. Fig. 2 is a transverse vertical section on the line X X of Fig. 1. Fig. 3 is a similar section on the line Y Y of Fig. 1. Fig. 4 is a similar section on the line Z Z of Fig. 1. Fig. 5 is a detail showing the means for balancing steam-pressures upon opposite sides of the cylindered engine-body. Fig. 6 is a side and sectional view illustrating a double engine of our construction.

As shown in the drawings, 2 represents a suitable casing, held stationary by any suitable means. In the casing is a bearing 3 for the engine-shaft 4. The shaft 4 carries the cylindered body 5 of the engine. The bearing 3 is driven into a bored sleeve 2′ of the casing 2. Said body is cylindrical in form and is preferably attached to a flange or disk 6, provided on the inner end of the shaft 4. The disk 6 bears and runs against a balancing-surface 7, concentric with the shaft 4, on the inside of the casing. The body 5 is provided with three or more cylinders 8, each containing a piston 9, and these pistons have connecting-rods 10, by which the same are pivotally joined to an eccentrically-located crank-pin 11, held in the casing 2. This crank-pin 11 projects into the casing and is held in a bearing 12, formed within a steam-inlet sleeve 13 in the end plate 2^2 of the casing 2. The pin is adapted to be partially rotated therein for the purpose of adjusting the hereinafter-described valve. The sleeve 13 preferably contains the steam-inlet duct 14 and has an elbow to which a steam-pipe may be connected. This sleeve 13, like the bearing 3, is preferably made separately from the end of the casing for the purposes of convenience and cheapness of construction, being driven into place or fastened by bolts, as shown. This construction also assists in alining the engine. The sleeve is concentric with the shaft 4 and the cylindered body 5. The body 5 is provided with an end disk 15, having a central boss or sleeve 16, that is concentric with the sleeve 13 and contains a suitable steam-packing 17. The body 5 and said end disk 15, attached thereto, rotate about said sleeve, and it is therefore necessary to observe care in the construction of this steam-packing. We have illustrated a steam-packing which we consider best adapted for the purpose, the same comprising a plurality of packing-rings 17′, which alternately spring upon or against the sleeve 13 and the walls of the boss 16 of said end disk. These rings are ground to fit all surfaces and are held by a suitable follower 18, provided in the inner side of said end disk 15. It will be observed that the cylinders 8 in the body 5 open into a large cavity 5′ at the center thereof and

that the steam is admitted directly to this cavity through the duct in the aforesaid sleeve.

Before proceeding to a description of the leading feature of our invention—the valve—attention is directed to the construction of the cylinder ends. Said cylinders 8 are bored through and through the body 5, high-pressure and low-pressure cylinders being relatively opposite in said body. It is necessary, therefore, to provide outer heads or ends for said cylinder, and for this purpose the body 5 is turned to receive the peripheral ring 19, which is shrunk onto the body, making steam-tight heads for all the cylinders therein and avoiding any special requirement as to balancing the body. The ends of the pistons 9 conform to the curve of the ring 19. The end 20 of the cylindered body and the inner surface 21 of the end disk 15 are faced off so that the same are parallel. The annular space 22 between them is the valve space or chamber of the engine, and the opposite faces 20 and 21 form the valve-seats. Obviously any valve which occupies the entire space between these spaces will be balanced. The valve comprises a simple ring or wheel 23 of less diameter than the body 5, and the hub 24 of which is journaled upon an eccentric 25, that is placed upon the crank-pin 11. The crank-pin, hence the eccentric, is adapted for partial rotation by any suitable means, such as the adjusting-lever 25'.

Referring to Fig. 2, 26 represents the axial center of the engine-body. 27 represents the axial center of the crank-pin 11, and 28 represents the center of the eccentric 25. It will be noted that the center of the eccentric 25 is between the centers 26 27 of the engine-body and the crank-pin—that is, the eccentric or cam 25 is not concentric with the engine-body. This mean eccentricity of the cam 25, and hence of the valve-ring, is not so great but that the valve-ring 23 will cover the valve-ports when in its middle position, and the mean eccentricity referred to furnishes the necessary lead and lap of the valve. In this connection attention is called to the exaggerated showing of the cylinder-ports 29 in Fig. 2. It is obvious that as the eccentric 25 is attached to the crank-pin, which is capable of rotation, said eccentric may be swung from side to side—that is, the center 28 of the eccentric may be swung into or out of a vertical plane including the centers 26 and 27 of the shaft 4 and said crank-pin 11. (See dotted section 28, Fig. 2.) The swing of the eccentric to one side or the other determines the direction of rotation of the cylindered body, and the extent of the swinging adjustment of the eccentric determines the extent to which the cylinder-ports 29 will be opened and the time of the opening and closing thereof. Through this medium any desired cut-off may be obtained.

The ring-valve may be either single or compound—that is, the valve may have either one ring 23 or two rings 23 and 30, according as the engine is a high-pressure or a compound engine. Each cylinder has a single port 29, the ports opening through the face 20. These ports 29 are preferably segmental in form and correspond in radius to corresponding rings of the valve. The valve-faces of the rings 23 30 are of greater width than the ports, so that when the valve is in its central position—that is, when the eccentric most nearly approaches concentricity with the shaft 4—the valve-rings will cover all of the ports and shut off the entrance of steam to any cylinder 8. This relation is altered when the valve-pin 11 is slightly rotated to swing the eccentric 25, whereupon the ring-valve will be thrown to open the ports and admit steam to certain of the cylinders 8 and permit a free exhaust from other cylinders. Thereupon the engine will be set into rotation by the angular thrust between the crank-pin 11 and the cylinder-heads effected through the pistons 9 and the connecting-rods 10. Thereafter the ring-valve will gyrate with relation to the cylinder-body, the relative movements between the body and the eccentric 25 due to the rotation of said body causing a sliding movement between the valve and the body, whereby the valve-ports will be alternately closed and opened upon opposite sides of said ring to supply and exhaust the steam to and from the cylinders. Our valve lends itself admirably to the compounding of rotary engines of the kind shown. This is well illustrated in Figs. 1 and 2 of the drawings, wherein it will be noticed that the two rims or rings 23 30 of the valve are separated by a space 32, proportioned to the relative distance between the high-pressure ports and the low-pressure-cylinder ports with relation to the center of the cylindered body. Furthermore, the space 32 between the two rings 23 30 is proportioned to the capacity of the high-pressure cylinders. When because of the gyration of the valve a high-pressure port is opened to exhaust steam upon the outer periphery of the inner ring of the valve, the port of a low-pressure cylinder will be opened to receive said steam. The space between the rings may be termed and is the "receiver" between the high and low pressure cylinders. The valve and cylinder relations are such that the steam from the high-pressure cylinder is conducted to the low-pressure cylinder in advance thereof, considered with respect to the direction of rotation of the cylindered body. The final exhaust of the engine is from the low-pressure cylinders and occurs when the outer periphery of the valve moves inwardly to uncover a low-pressure port. The exhaust-steam escapes into the annular cavity, or that part of the valve-chest that lies between the periphery of the valve and the annular flange 33 of the end disk 15. This end disk 15 is provided

with a plurality of angularly and obliquely arranged exhaust-ducts 34, through which the steam is projected against the walls of the casing 2, assisting in the rotation of the engine-body 5. These ducts are arranged to assist in the positive rotation of the engine. When the engine is reversed, their effect is to slightly oppose backward rotation.

The perfect lubrication of the engine is accomplished by feeding the lubricant through the crank-pin 11, the same being admitted first to the journals 10′ of the piston-connecting rods and being distributed from thence to every part of the engine, including the valve-seats, and excepting only the bearing for the shaft 4, which is separately oiled.

It is evident that under ordinary conditions there will be a lack of steam balance upon the rotating body of the engine to the extent of the area of the sleeve 13, containing the crank-pin 11 and the steam-inlet duct 14. This would cause a thrust against the end of the bearing containing the shaft 4 or the casing 2. We therefore provide an annular recess 35 in the bearing-surface 7, admitting steam thereto through small holes 36 in the shaft-disk 6 and making the area of said recess 35 equal to the area of said sleeve 13, or substantially so. The back ducts 37 are made to prevent the leakage of steam through the shaft-bearing 3 by permitting the disk 6 to seat against the packing-surface 7.

38 is the exhaust-pipe connection.

Our engine is particularly adapted for coupling in pairs, it being only necessary to connect the two stud-shafts 4 of two engines, arranging the same back to back. The coupling that we prefer to use is shown in Fig. 6, wherein it will be seen that the stud-shaft 4 is provided with a tapered opening to receive the tapered shaft 37, which carries the transmitting-pinion 38. The tapered or coupling shaft 43 may be secured in the stud-shaft 4 by a key, if desired; but the frictional engagement between the shafts is so strong that this is rarely necessary, the only fastening that is required comprising the conical nut 38, screwed upon the end of the shaft 43 and fitting the conical recess 39 in the disk 6 of the engine. This connection is reproduced in the opposite engine. It is obvious that where two engines are connected in this manner the thrust will be equal upon opposite ends of the shaft 43; but even in this case we prefer still to employ the balancing-recesses 37 between the casings and the revolving engine-bodies. The twin engine-casings 2 2 are fastened together by a middle sleeve-casting 40, to which both of the casings are bolted. This casting is provided with a slot 41 to receive the large gear 42, by which the power is transmitted from the engine-pinion 38. We prefer, as shown in Fig. 6, to connect the exhaust-pipes of the two engines.

It is obvious that various modifications of our invention will readily suggest themselves to one skilled in the art, and we therefore do not confine our invention to the specific constructions herein shown and described.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. In a rotary engine, the combination of a suitable casing with a cylindered body, a relatively stationary crank-pin arranged in said casing, a plurality of pistons provided in said body and connected by rods to said pin, said body provided with an annular valve-chamber connected with the cylinders of said body by suitable ports, a gyrating ring-valve arranged in said chamber, and an eccentric bearing for said ring-valve whereby gyration of the valve is caused by the relative rotation of said body and said eccentric bearing, substantially as described.

2. In a rotary engine, the combination with a suitable casing of a cylindered body that is capable of rotation therein, a stationary crank-pin, a plurality of pistons provided in said body and connected by rods with said crank-pin, said crank-pin occupying an eccentric position with relation to said body, suitable means for admitting steam to said casing, a valve-chamber provided in said casing and connected with the cylinders of said body, a ring-valve arranged in said casing, and an eccentric bearing whereon said ring-valve is journaled to rotate with and gyrate upon said body, substantially as described.

3. The combination, in a rotary engine, of a suitable casing, with a cylindered body adapted to rotate therein and provided with an annular steam-chamber having ports communicating with the cylinders of said body, an eccentrically-located stationary crank-pin, a plurality of pistons connected with said crank-pin, a ring-valve arranged in said valve-chamber, and an eccentric upon said crank-pin capable of adjustment thereby and whereon said ring-valve is journaled to gyrate during the rotation of said body, substantially as described.

4. In a rotary engine, the combination with a suitable casing of a cylindered body adapted to rotate therein and provided with a valve-chamber having port connections with the cylinders of said body, a stationary crank-pin, a plurality of pistons connected with said crank-pin, a ring-valve, and an eccentric bearing therefor within said casing, substantially as described.

5. In a rotary engine, the combination with a suitable casing of a cylindered body adapted to rotate therein and provided with a valve-chamber having port connections with the cylinders of said body, a stationary crank-pin, a plurality of pistons connected with said crank-pin, a ring-valve, and an eccentric bearing therefor within said casing, said bearing being normally stationary but capable of adjustment, as and for the purpose specified.

6. In a rotary engine, the combination of a cylindered body capable of rotation with pistons provided in the cylinders of said body, said body being provided with a valve-chamber having port connections with its cylinders, means for introducing steam thereto, a crank-pin eccentrically located with relation to said body and whereto said pistons are connected, an annular valve device, an eccentric bearing for said valve upon said crank-pin, and said crank-pin being adapted for partial rotation to adjust said valve, substantially as described.

7. In a rotary engine, the combination with a rotary body provided with high and low pressure cylinders, pistons provided in said cylinders, an eccentrically-located stationary crank-pin wherewith said pistons are connected, said body being provided with a valve-space having port connections with said cylinders, a double ring-valve provided in said space, and an eccentric bearing for said ring-valve, substantially as described.

8. In a rotary engine, the combination with a suitable casing of a body mounted for rotation therein and containing high and low pressure cylinders, said body also containing an annular valve-chamber having ports communicating with the cylinders of said body, the pistons in said cylinders, an eccentrically-located stationary crank-pin wherewith said pistons are connected, an eccentric arranged on said crank-pin and adapted for partial rotation therewith, and a valve journaled upon said eccentric and comprising the large and small rings suitably connected and arranged in said valve-chamber, said rings being separated by the steam-receiving space described, and means for introducing steam to and exhausting steam from said chamber, substantially as described.

9. In a rotary engine, the combination with a suitable casing of a cylindered body mounted for rotation therein, a rotary packing introduced between said casing and said body, means for introducing steam to said body, pistons in the cylinders of said body, a stationary crank-pin located eccentrically with relation to said body and entering the same, the connecting-rods, an annular valve-chamber provided in said body and having ports communicating with the cylinders thereof, and the ring-valve caused to gyrate in said chamber by the rotation of said body, substantially as described.

10. In a rotary engine, the combination with a suitable casing of a cylindered body and associated parts therein, the shaft 4 of said body, the steam-admission sleeve of said casing, and the recessed balancing-surface 7 of said casing, substantially as described.

11. In a rotary engine, the combination with the casing of the cylindered body having a shaft mounted therein, the sleeve of said casing entering said body, the interposed rotating packing comprising inwardly and outwardly sprung rings 17′, an eccentric crank-pin, pistons connected thereto, an eccentric 25 fixed upon said crank-pin, and a suitable steam-valve mounted upon said eccentric 25, substantially as described.

12. In a rotary engine, the combination with the casing of a cylindered body for rotation therein, a crank-pin and pistons, a suitable valve, steam admission and exhaust means, and the ring 19 upon said body forming the heads for the cylinders thereof, substantially as described.

13. In a rotary engine, the combination with the casing 2 provided with an end plate 2^2 in turn provided with a detachable sleeve 13, a stationary crank-pin eccentrically held in said sleeve, the cylindered body adapted for rotation in said casing and provided with a boss or sleeve 16 containing a packing that bears upon the sleeve 13, pistons provided in said body and connected with said pin, and the gyrating ring-valve revoluble about said pin, substantially as described.

14. In a rotary engine, the combination with a frame 40 of the engine-casings 2 upon the ends thereof, the rotary cylindered bodies and associated parts provided in said casings, said bodies having shafts 4 rotating in suitable bearings, the coupling-shaft 43 having tapered ends fitting said shafts 4, and the tapered nuts for securing said shaft 43 in said shafts 4, substantially as described.

15. In a rotary engine, the combination with a cylindered body provided with radial cylinders, the cylinder-head ring 19 of said body, the pistons provided in the cylinders of said body and having crowned ends conforming to said ring 19, a crank-pin wherewith said pistons are connected, and a suitable steam-valve, substantially as described.

16. In a rotary engine, the combination with a cylindered body adapted to rotate in said casing, pistons provided in the cylinders of said body, a crank-pin wherewith said pistons are connected, said body provided with an annular valve-chamber, a valve therein, steam-admission means, and the oblique exhaust-ducts 34 provided in said body, substantially as described.

17. In a rotary engine, the combination with the casing of the bearing 3 and the sleeve concentrically arranged therein and detachable therefrom, the shaft 4, the cylindered body carried by said shaft and provided with the boss or sleeve having a suitable packing upon the sleeve 13, a crank-pin eccentrically held in the sleeve 13, the pistons connected with said crank-pin, and a suitable ring-valve chamber and valve provided in said body and operated by rotation about said pin, substantially as described.

18. The rotary steam-engine comprising the casing, in combination with the cylindered rotary mass or body, the eccentrically-cen-

tered pistons, the more-nearly-centrally-located valve device adapted to rotate with and to gyrate with relation to said mass, and means for varying the eccentricity and the angle of eccentricity of said valve device during the operation of the engine, substantially as described.

In testimony whereof we have hereunto set our hands this 13th day of December, 1900.

ARTHUR G. McPHERSON.
EDWARD M. LAING.

In presence of—
C. G. HAWLEY,
T. D. BUTLER.