No. 789,586. PATENTED MAY 9, 1905.

H. L. BICKERTON.

ROTARY ENGINE.

APPLICATION FILED DEC. 20, 1904.

3 SHEETS—SHEET 1.

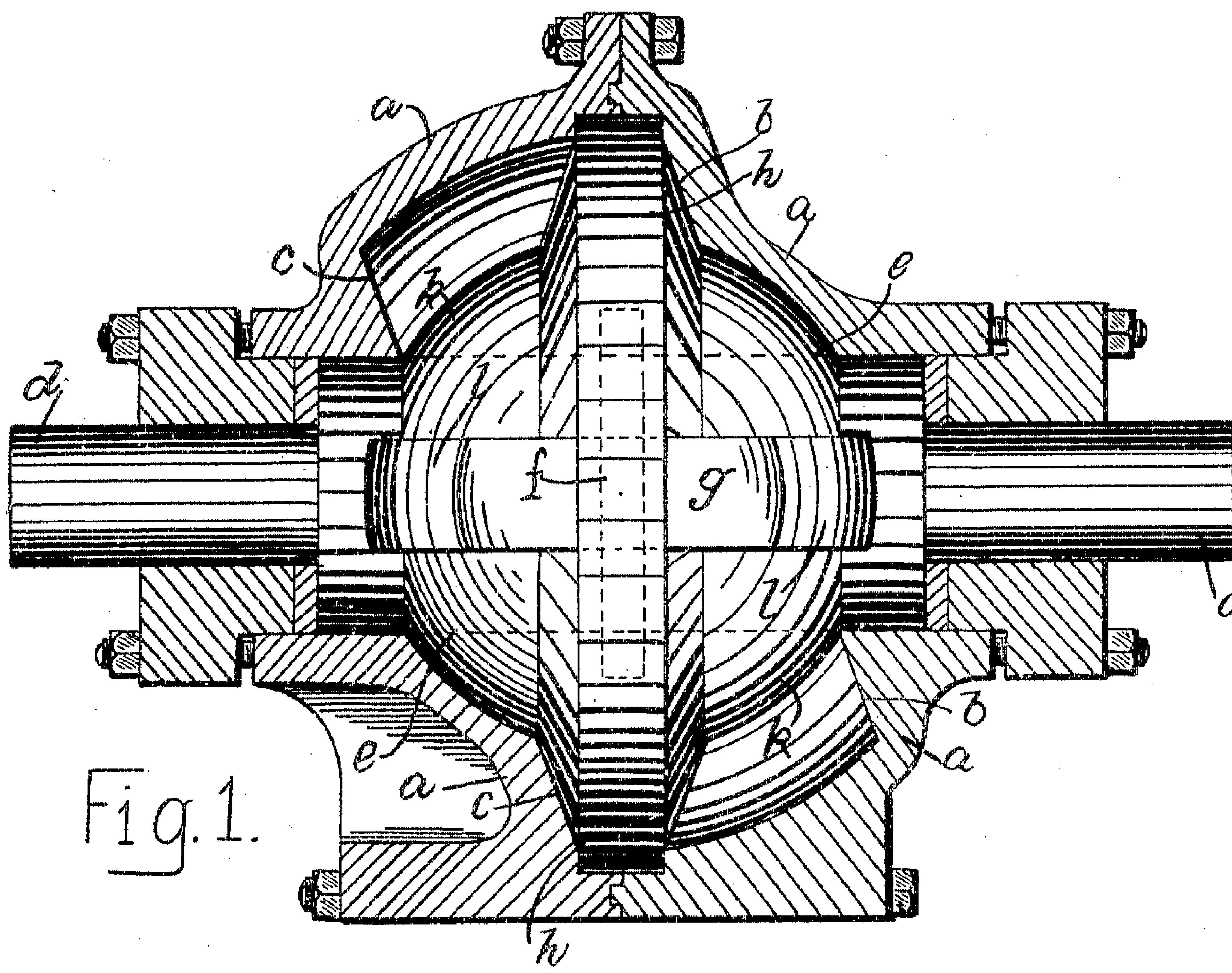

Fig. 1.

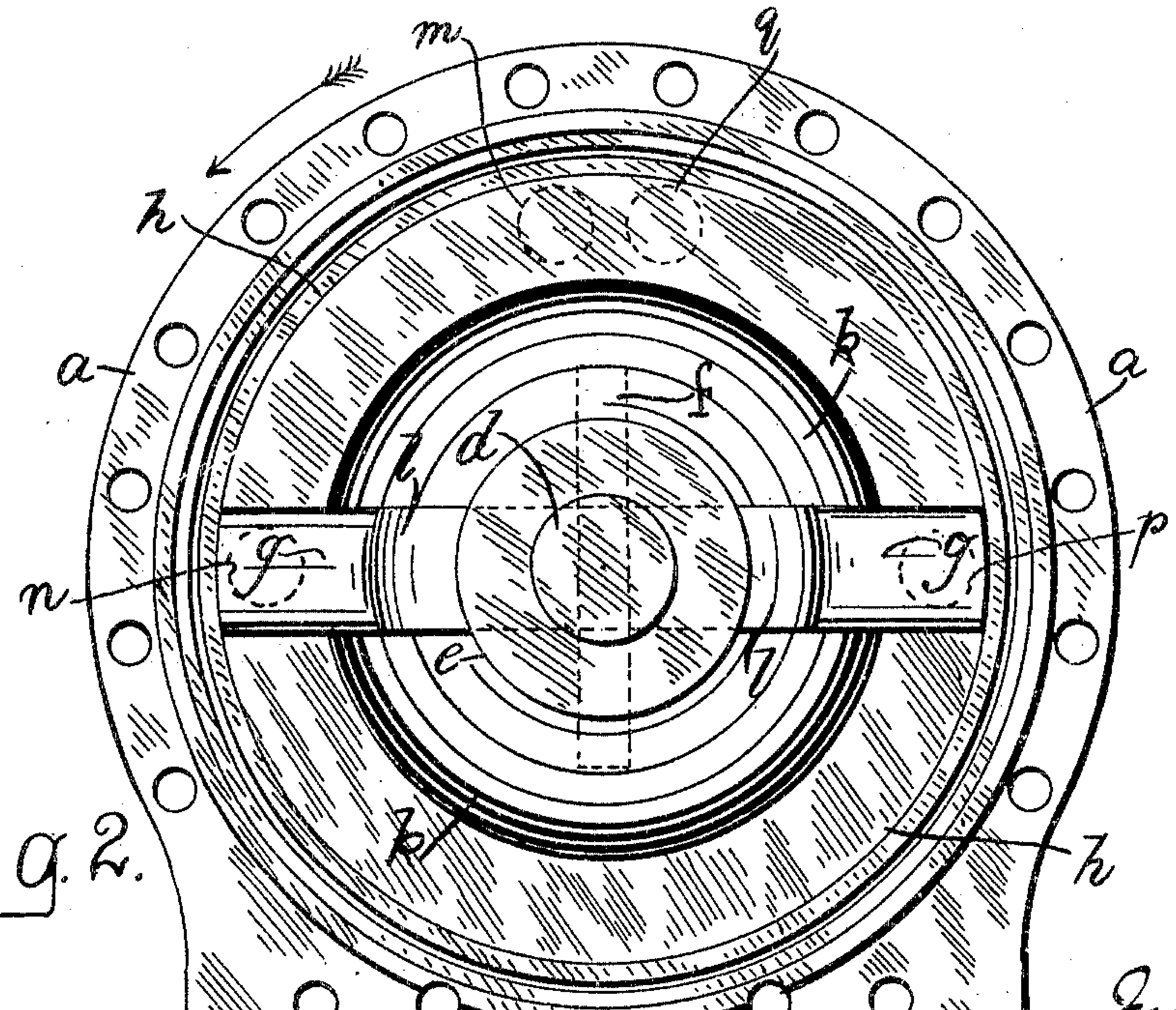

Fig. 2.

Witnesses:
J. Stephen Giusta,
W. Max. Duvall.

Inventor:
H. L. Bickerton
by Wilkinson & Fisher
his Attorneys

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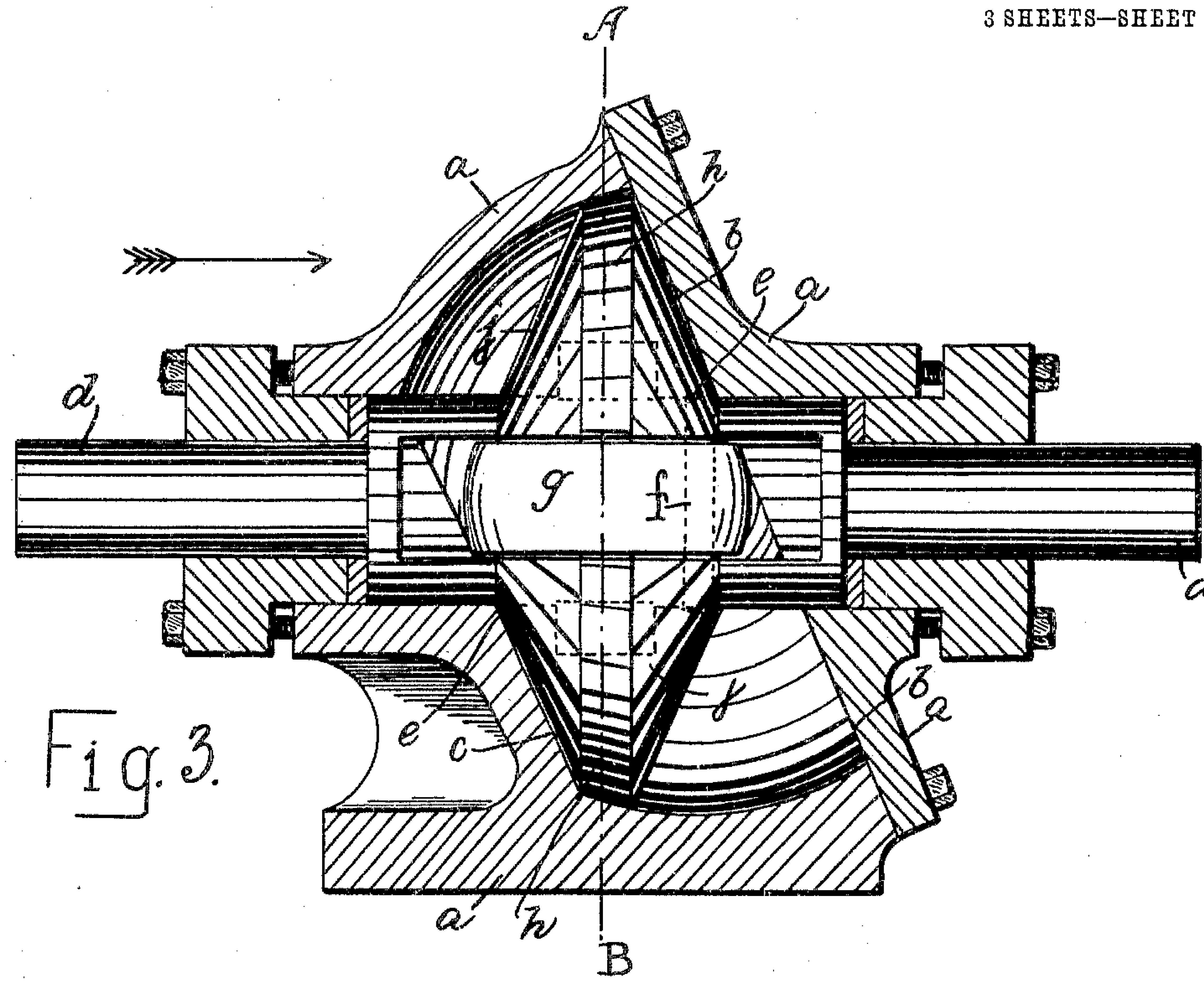

Fig. 3.

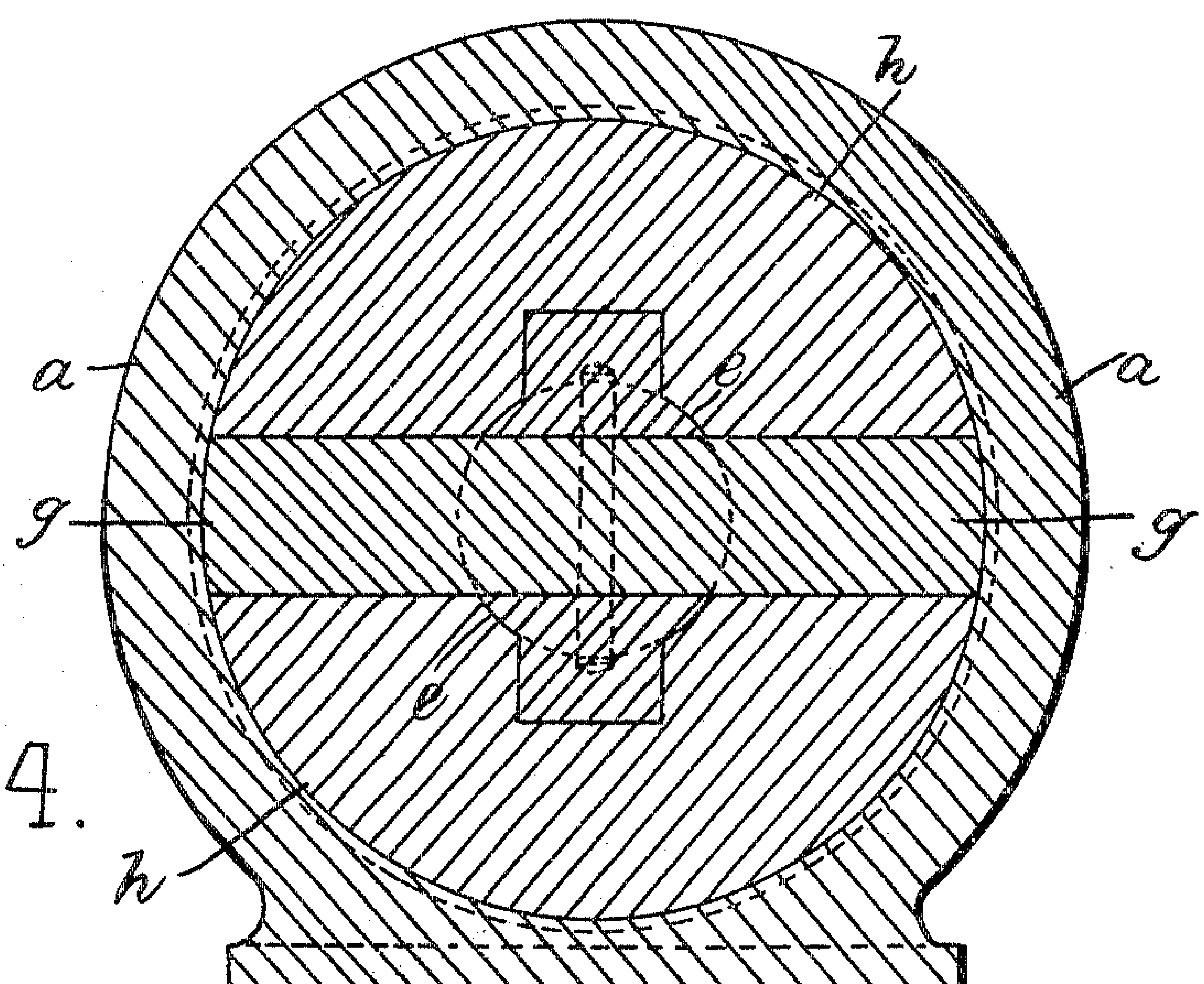

Fig. 4.

Witnesses:- Stephen Kinsta. Wm. Max. Duvall.

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3 SHEETS—SHEET 3.

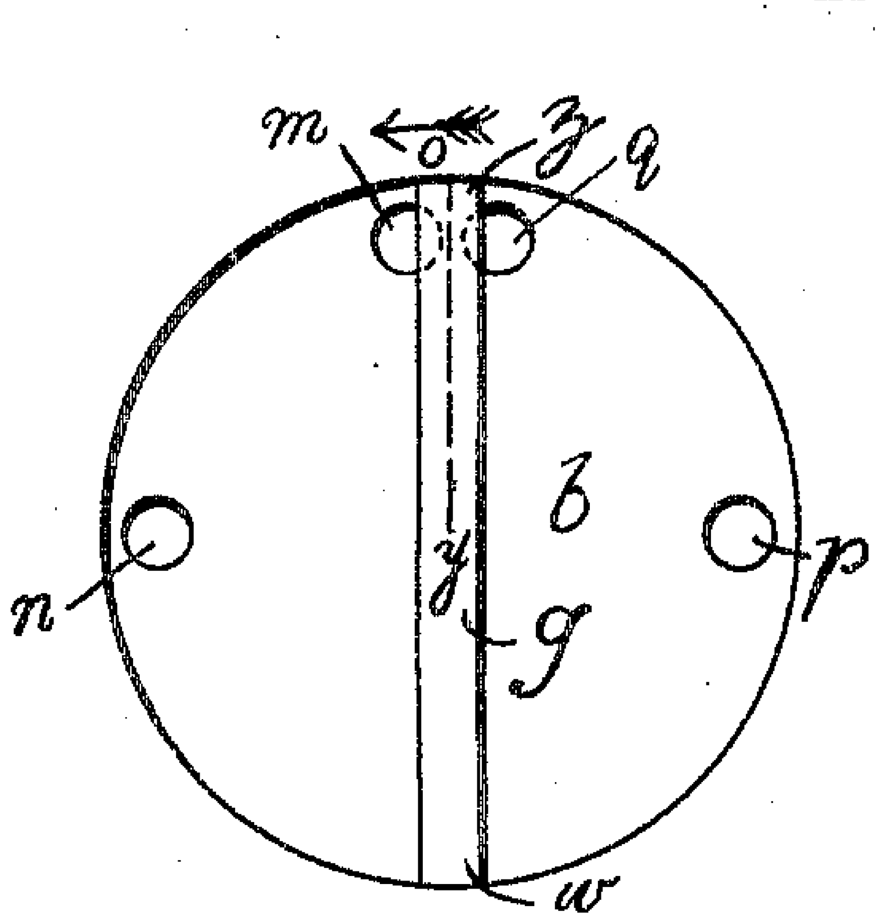

Fig. 5.

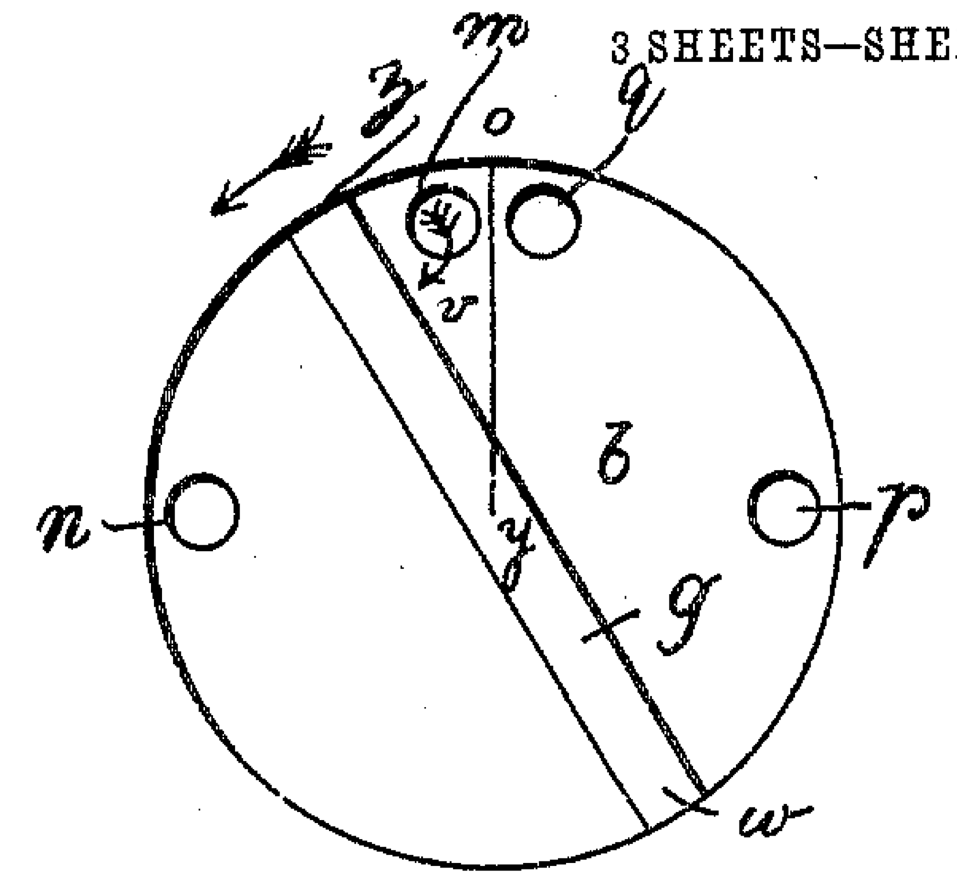

Fig. 6.

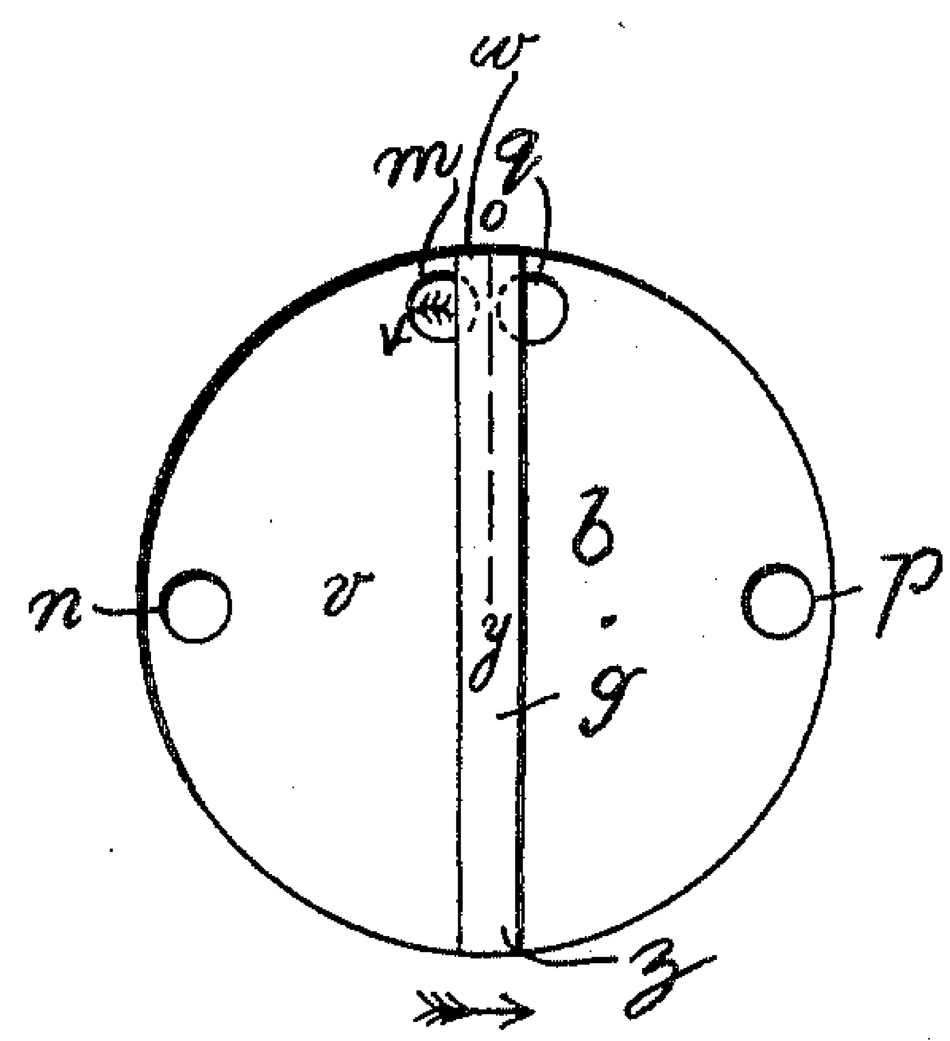

Fig. 7.

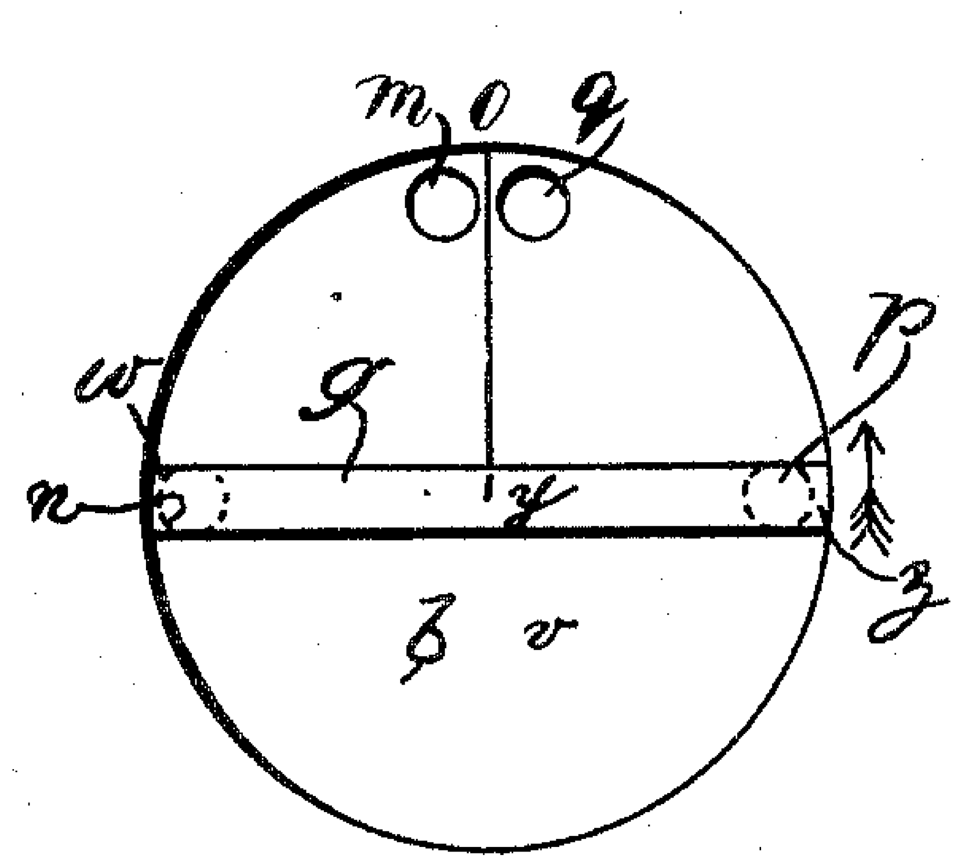

Fig. 8.

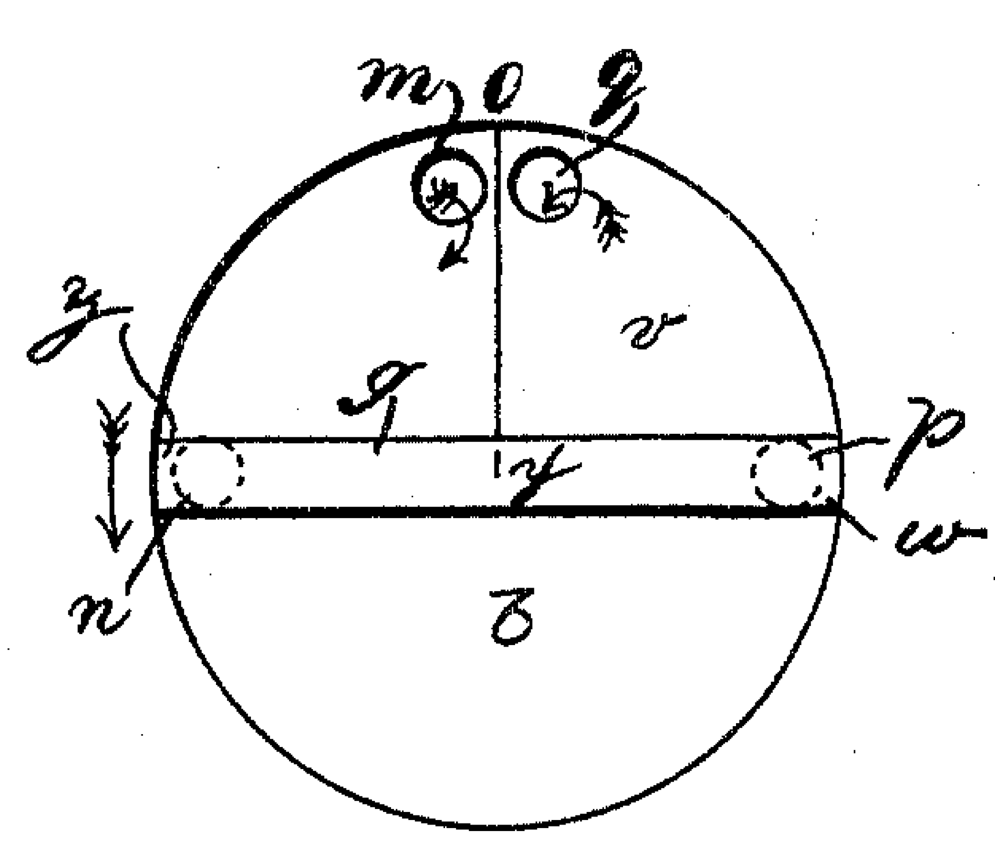

Fig. 9.

Witnesses:-
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H. May Duvall.

Inventor:-
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No. 789,586. Patented May 9, 1905.

UNITED STATES PATENT OFFICE.

HERBERT LAWRENCE BICKERTON, OF CROSS PATH, RADLETT, ENGLAND.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 789,586, dated May 9, 1905.

Application filed December 20, 1904. Serial No. 237,672.

To all whom it may concern:

Be it known that I, HERBERT LAWRENCE BICKERTON, a subject of the King of England, residing at Cross Path, Radlett, in the county of Hertford, England, 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 form of rotary engine which may be driven by steam-hydraulic, internal-explosion, compressed-air, or other motive power or may be driven by external means and used as a pump, exhauster, compressor, or for any other purposes whatsoever.

In order to explain the principle of the invention, I will first describe the same in its simplest form and then proceed to give simple examples illustrated by drawings, it being of course understood that the form may be modified according to requirements and to the use to which the engine is to be put.

The body of the engine has a casing the inside of which is so shaped as to form a portion of a sphere bounded by two parallel planes placed diagonally to the shaft, the internal chamber thus forming in the normal form a portion of a sphere bounded by two circular plane surfaces. In the chamber is a disk, (which I call the "rotor,") mounted vertically between the two faces upon a horizontal shaft, with which it rotates. The opposite faces of the rotor may be of conical shape, the angles of the cone corresponding to one another and to that made by the planes with the shaft, so that when the rotor is mounted in position there is a permanent line of contact between one portion of the conical or other shaped surfaces and the plane on each side of the disk. The rotor is provided with a long slot extending across same in the direction of a diameter and placed centrally, or the rotor may consist of two separate halves so mounted or formed as to leave a slot or space between them. The axle on which the rotor is mounted is also so formed or fitted that a slot is made corresponding in position with the slot in the rotor and in the same plane therewith. In this slot in the rotor at some convenient point at or near the middle I pivot a flat piece of metal, which is free to swing on its pivot and is so shaped that its edges are always in contact with some portion of the inclined surfaces and with some portion of the spherical surfaces of the interior chamber in order to divide each of the chambers formed between the rotor and the plane and the interior of the chamber into steam-tight chambers at constantly-varying capacity as the shaft rotates. Suitable inlet and outlet ports are provided for admission and egress of steam.

Referring to the drawings accompanying this specification, Figure 1 shows a sectional elevation of an engine constructed according to my invention. Fig. 2 is an end view with one side of the casing removed. Fig. 3 shows a sectional elevation of a second form of engine. Fig. 4 is a section of Fig. 3, taken through the line A B looking in the direction of the arrow. Figs. 5 to 9 show details hereinafter referred to. In Figs. 1 and 3 the whole of the parts connected with the casing are shown in section and the parts connected with the shaft, rotor, and piston are shown in elevation.

The same letters of reference are employed to denote the same parts in all the views.

a shows the casing, which is preferably cast in two pieces and bolted together. The interior of the casing *a* is of spherical formation, the surface of the sphere having its center at a point on the axis of the shaft *d*, which point is also the point of intersection of the axis of the pivot *f*, (where a pivot is employed,) upon which the piston is mounted with the axis of the shaft *d*.

b and *c* are two plane surfaces, which, in conjunction with the spherical surface, bound the chamber of the motor. It will be seen that these surfaces are so disposed that they are parallel to one another and are consequently inclined at the same angle to the axis of the shaft *d*. The shaft *d* is mounted in suitable bearings. The portion *e* of the shaft *d* is formed into a kind of frame, through which the pivot f, carrying the plate or piston g, passes. In Fig. 1 the pivot f is shown mounted centrally and in Fig. 3 to one side of the frame, the position being determined, as before described, so that its axis and that of the shaft d intersect at the center of the spherical surface a. h is the rotor. This is formed in one (as at Fig. 1) or mounted upon (as at Fig. 3) the frame portion e of the shaft d, each side of the rotor having a face j, forming a truncated cone, the apex of each cone being coincident with the points of intersection of the corresponding diagonal plane b or c with the axis of the shaft d. It is essential that the angles of inclination of the conical surfaces j of the rotor h be similar to each other and to that made by the planes b c with the axis of the shaft d.

In the form of engine shown at Fig. 1 there is mounted upon or formed with the faces of the rotor h and the frame e a spherical surface or boss k, which fills up a portion of the chambers left between the spherical surface a, the surfaces of the rotor h, and the surfaces b c, while in the form shown at Fig. 3 the conical surfaces j extend as far as the frame e. The frame e forms, as before stated, a slot in which the piston g is mounted on its pivot, or in some cases the pivot may be dispensed with. Corresponding to the slot in this frame is a slot extending across the diameter of the rotor h, or the rotor h is so made up as to leave a space corresponding with the slot in the frame e. In the case of the machine shown at Fig. 1 the slot does not extend entirely across the rotor, as will be seen on reference to Fig. 2, while in the case of that shown at Fig. 3 the slot divides the rotor h into two halves, as seen at Fig. 4. In the case of the machine shown at Figs. 1 and 2 a corresponding groove is cut circumferentially around the inner surface of the chamber, into which the edge of the rotor fits. In the case of the machine shown at Fig. 1 the piston g has a spherical portion l formed therewith corresponding to the spherical portion k, formed or attached to the rotor h. It will be seen that the edge of the piston g all round is constantly in contact with some portion of the spherical and inclined surfaces and that consequently each of the chambers on either side of the rotor h is divided into portions of constantly-varying capacity during the rotation of the shaft d. Packings may be provided at all necessary points of contact.

The inlet and outlet ports have been omitted from Figs. 1 and 3 for the sake of clearness; but their arrangement can be readily understood from reference to Fig. 2, which shows the arrangement which I find answers well in practice, it being understood that similar ports in corresponding positions are arranged in each of the plane surfaces. In the case of the engine shown at Fig. 1 for rotation in the direction of the arrow, Fig. 2, m is an inlet-port; n, an additional inlet-port for the purpose hereinafter described. p is an exhaust-port, and q another exhaust-port.

To understand the action of the machine, it is necessary to consider the formation of the chamber to contain the steam, its increase to a maximum volume, its decrease and final disappearance. This will be readily understood from consideration of Figs. 5 to 9, where the position of the piston g is shown diagrammatically at various portions of its travel in relation to the ports. In each of these figures an arrow showing the direction of rotation is kept opposite the same end z of the piston g. oy shows the permanent line of contact of the surface of the cone with the plane surface b. It will be seen when the piston g is in the position oy the space between the rotor h, the spherical casing, and the plane on each side of the rotor is divided into two equal chambers. As the shaft d rotates the piston g travels round and rocking into the space between the rotor and the plane on each side forms a chamber v. This chamber is bounded by the line of permanent contact oy, the spherical surface a, the piston g, and the plane b, and as the rotor turns it (the chamber v) increases steadily in volume. At the position shown in Fig. 7, when the end z has passed through one hundred and eighty degrees, the chamber v and the chamber on the other side of the piston on the same side of the rotor are equal. The chamber v increases further in volume until the piston reaches the position shown at Fig. 8, when the end z has passed through two hundred and seventy degrees, the lower chamber v then having a maximum volume. After this it steadily decreases. When the end z has passed through three hundred and sixty degrees, it (the chamber v) is again equal in volume to the chamber on the other side of the piston on the same side of the rotor. When the position is that shown at Fig. 9 and the end z has passed through four hundred and fifty degrees, the chamber v is decreased greatly in volume, and when the end z has passed through five hundred and forty degrees the chamber v vanishes entirely. Now considering the action of the steam when the piston g is in the position shown at Fig. 6 steam is entering through the port m and, forcing its way into the steadily-expanding chamber v, drives the engine round until the position shown at Fig. 7 is reached, when the piston g crossing the port m the supply of steam is cut off. The steam continues to expand until the piston is in the position shown at Fig. 8. As from this moment the chamber v containing the steam begins to diminish in volume, an exhaust-port p is provided and the steam begins to escape, it being of course understood that steam is being fed through the port m into a new chamber being formed on the other side of the piston. The exhaust continues to take place until the end w of the piston g crosses the port p. (See Fig. 9.) There is then a small volume left in the chamber v, and an exhaust-port q is provided through which this is discharged in order to prevent any possibility of compression taking place. The cycle of operations continues in exactly the same order on each side of the rotor.

The object of the additional inlet-port n is to enable the engine to start in the event of it being in a position with the piston g over the port m, in which case the steam would be shut off from the chambers. Should this be the case, the port n is temporarily opened by means of a suitable cock and the engine started, after which the port n may be closed, if required.

For reversing the engine it is simply necessary to convert the inlet into outlet ports and the outlet into inlet ports, and various methods may be devised for switching the steam into either set of ports, as required.

What I claim, and desire to secure by Letters Patent of the United States of America, is—

1. A rotary engine, provided with a chamber bounded by a zone and two plane surfaces parallel to each other and disposed diagonally to the axis of the shaft of the engine, the said chamber containing a disk or rotor mounted perpendicularly to the shaft and extending from one to the other of the plane surfaces, the faces of the said disk or rotor being preferably conical in form, the conical surfaces being of such angle that a continuous line of contact is formed on each side between the plane surface and the surface of the cone, the said disk or rotor being provided with a plate or piston so mounted as to rock backward and forward with its edges constantly in contact with some portion of the aforesaid chamber, the steam being admitted by suitable inlet and outlet ports all substantially as set forth.

2. A rotary engine comprising a casing provided with a chamber bounded by a zone and two parallel planes having suitable inlet and exhaust ports, a shaft passing through said chamber angularly disposed with relation to said planes, a rotor mounted to revolve with said shaft, and an oscillating piston mounted in said rotor, substantially as described.

3. A rotary engine comprising a casing provided with a chamber bounded by a zone and two parallel planes having suitable inlet and exhaust ports, a longitudinally-slotted shaft passing through said chamber angularly disposed with relation to said planes, a rotor mounted to revolve with said shaft, and a piston mounted in said rotor to oscillate through said slot, substantially as described.

4. A rotary engine comprising a casing provided with a chamber bounded by a zone and two parallel planes having suitable inlet and exhaust ports, a shaft passing through said chamber angularly disposed with relation to said planes, a rotor mounted to revolve with said shaft and constructed so as to form a continuous line of contact with said planes, and an oscillating piston mounted in said rotor, substantially as described.

5. A rotary engine comprising a casing provided with a chamber bounded by a zone and two parallel planes having suitable inlet and exhaust ports, a shaft passing through said chamber angularly disposed with relation to said planes, a rotor mounted to revolve with said shaft each side of said rotor being in the form of a truncated cone, the apex of which would coincide with the intersection of the axis of said shaft and the adjacent bounding plane of said chamber, and an oscillating piston mounted in said rotor, substantially as described.

6. A rotary engine comprising a casing provided with a chamber bounded by a zone and two parallel planes having suitable inlet and exhaust ports, a longitudinally-slotted shaft passing through said chamber angularly disposed with relation to said planes, a rotor mounted to revolve with said shaft, a piston passing through said slot and rotor symmetrically with respect to the latter, and a pivot-pin passing through said shaft and piston at the point of intersection of the axis thereof and the center of the sphere formed by completing said bounding zone, substantially as described.

7. A rotary engine comprising a casing provided with a chamber bounded by a zone and two parallel planes, having suitable inlet and exhaust ports, a shaft passing through said chamber angularly disposed with relation to said planes, a rotor dividing said chamber into two compartments mounted to revolve with said shaft, and an oscillating piston constructed to maintain its edges constantly in contact with some portion of said chamber mounted in said rotor, substantially as described.

8. A rotary engine comprising a casing provided with a chamber bounded by a zone and two parallel planes equidistant from the center of the sphere formed by completing said zone, a longitudinally-slotted shaft passing through said chamber angularly disposed with relation to said planes, a rotor mounted to revolve with said shaft, its center being coincident with the center of the sphere formed as aforesaid, a pivot-pin passing through said shaft and the center of said rotor, a piston mounted in said slot and rotor and on said pin, and suitable inlet and exhaust ports in said casing, substantially as described.

9. A rotary engine comprising a casing provided with a chamber bounded by a zone and two parallel planes equidistant from the center of the sphere formed by completing said zone, a shaft passing through said chamber angularly disposed with relation to said planes, a sphere of less diameter than the sphere

formed as aforesaid and having its center coinciding therewith mounted on said shaft, a rotor mounted within said sphere, an oscillating piston mounted within said rotor, and suitable inlet and exhaust ports in said casing, substantially as described.

10. A rotary engine comprising a casing provided with a chamber bounded by a zone and two parallel planes, a shaft passing through said chamber angularly disposed with relation to said planes, an oscillating piston mounted in said rotor, main inlet and exhaust ports in the casing substantially two hundred and seventy degrees apart, an auxiliary inlet-port substantially ninety degrees from the main inlet-port, and an auxiliary exhaust-port adjacent the main inlet-port, substantially as described.

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

HERBERT LAWRENCE BICKERTON.

Witnesses:

A. BROWNE,

A. E. VIDAL.