No. 724,994. PATENTED APR. 7, 1903.

J. F. COOLEY.

ROTARY FLUID ENGINE.

APPLICATION FILED OCT. 26, 1900. RENEWED DEC. 13, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

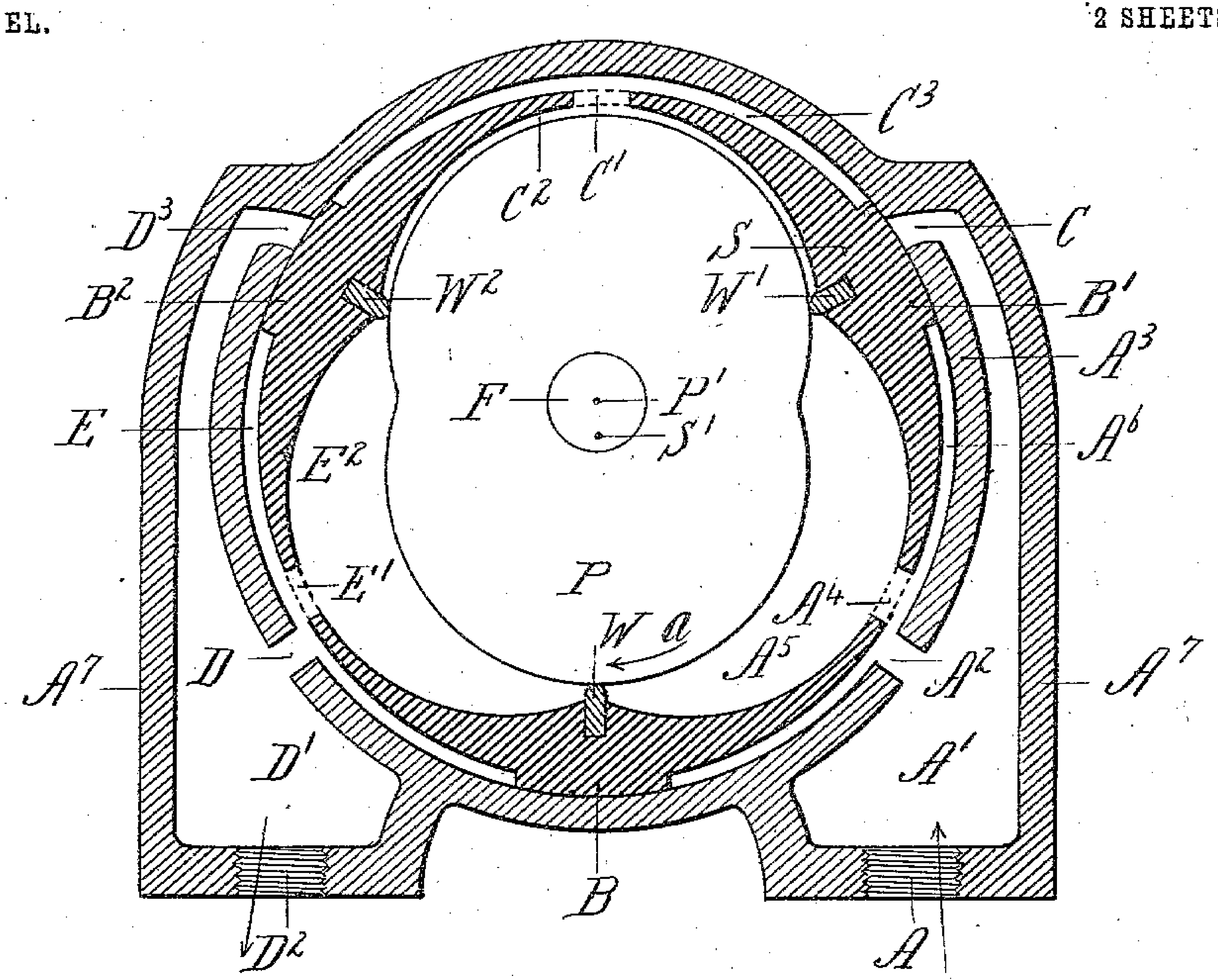

Fig. 1

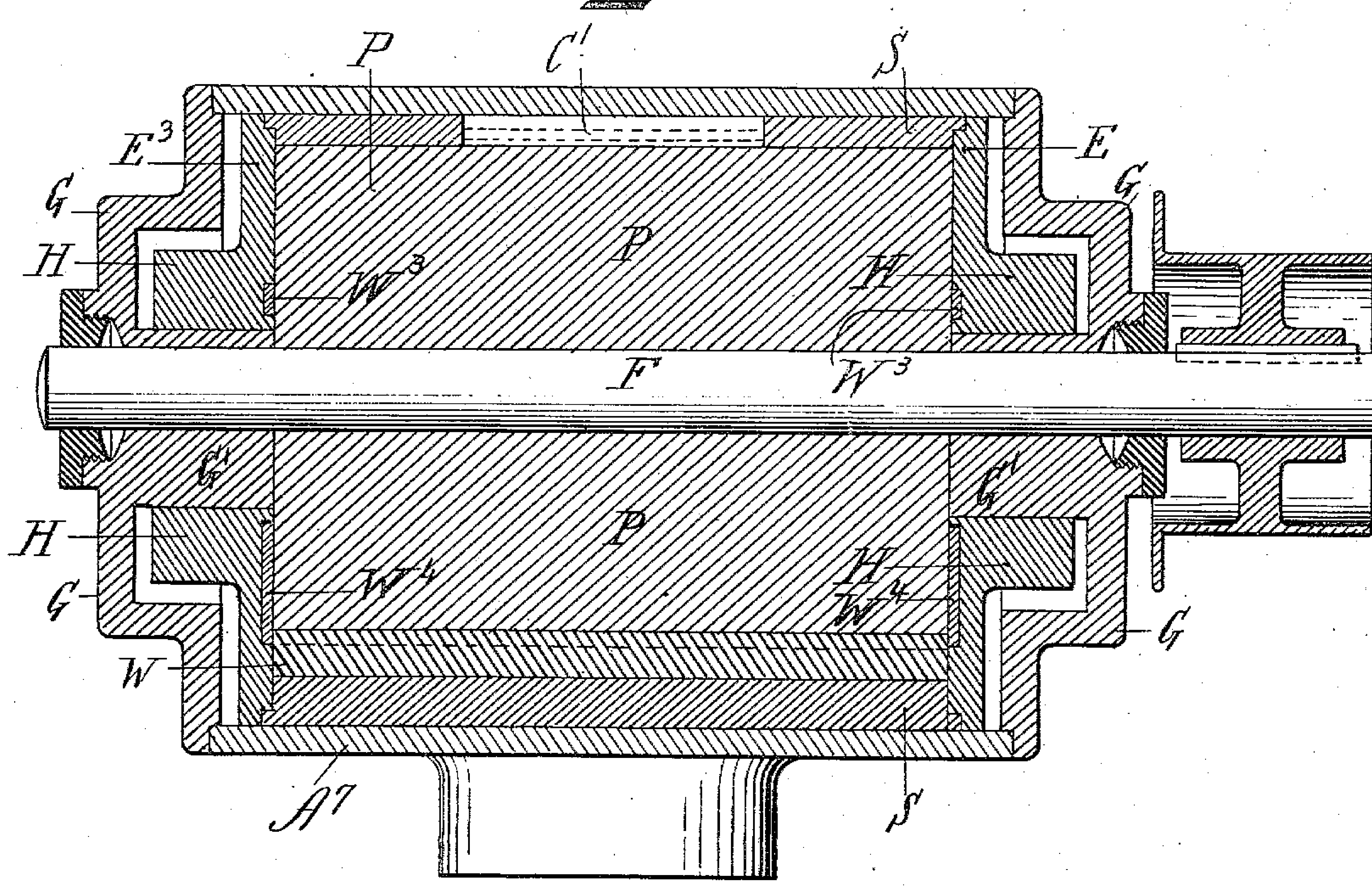

Fig. 2

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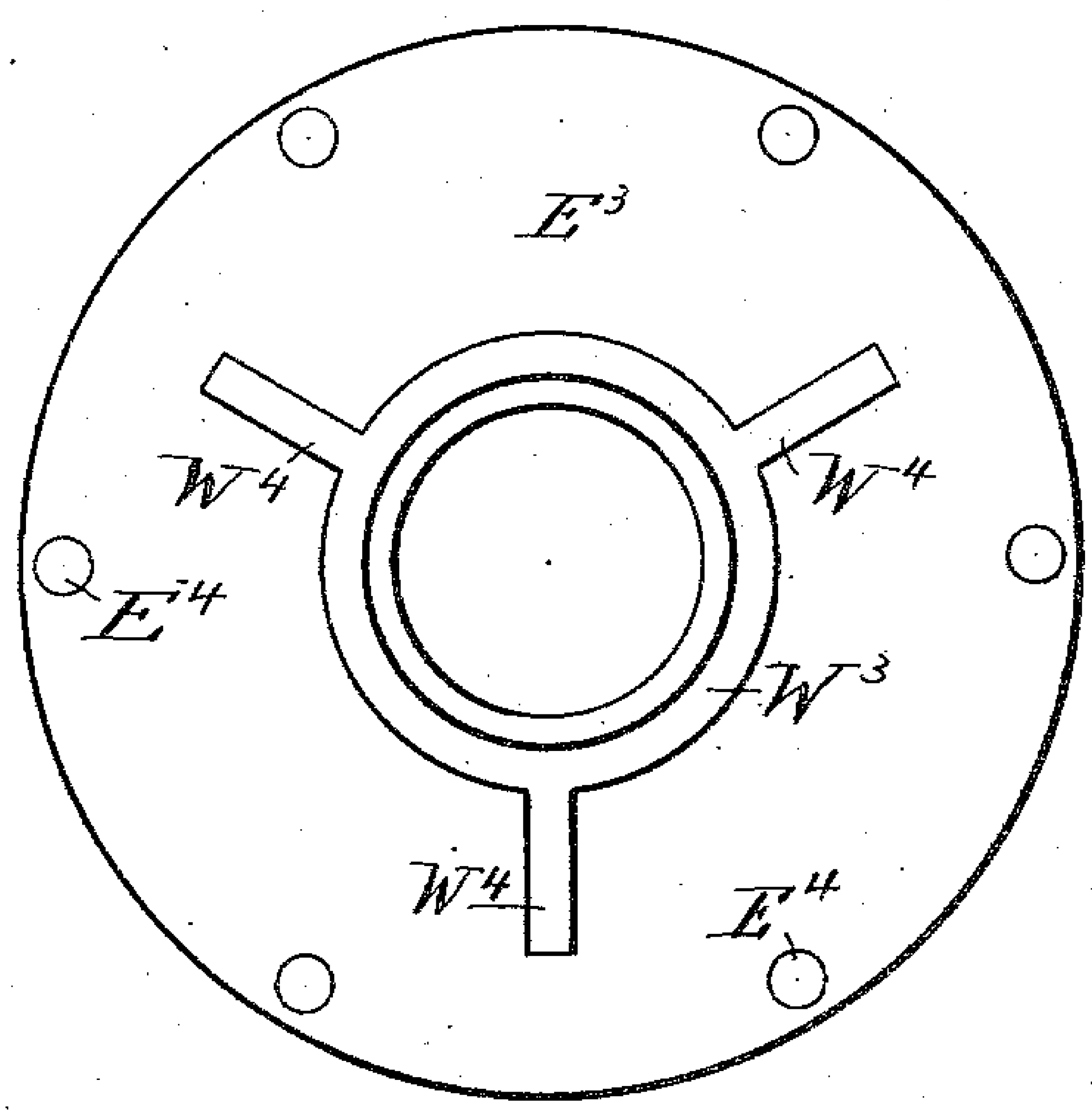

Fig. 3.

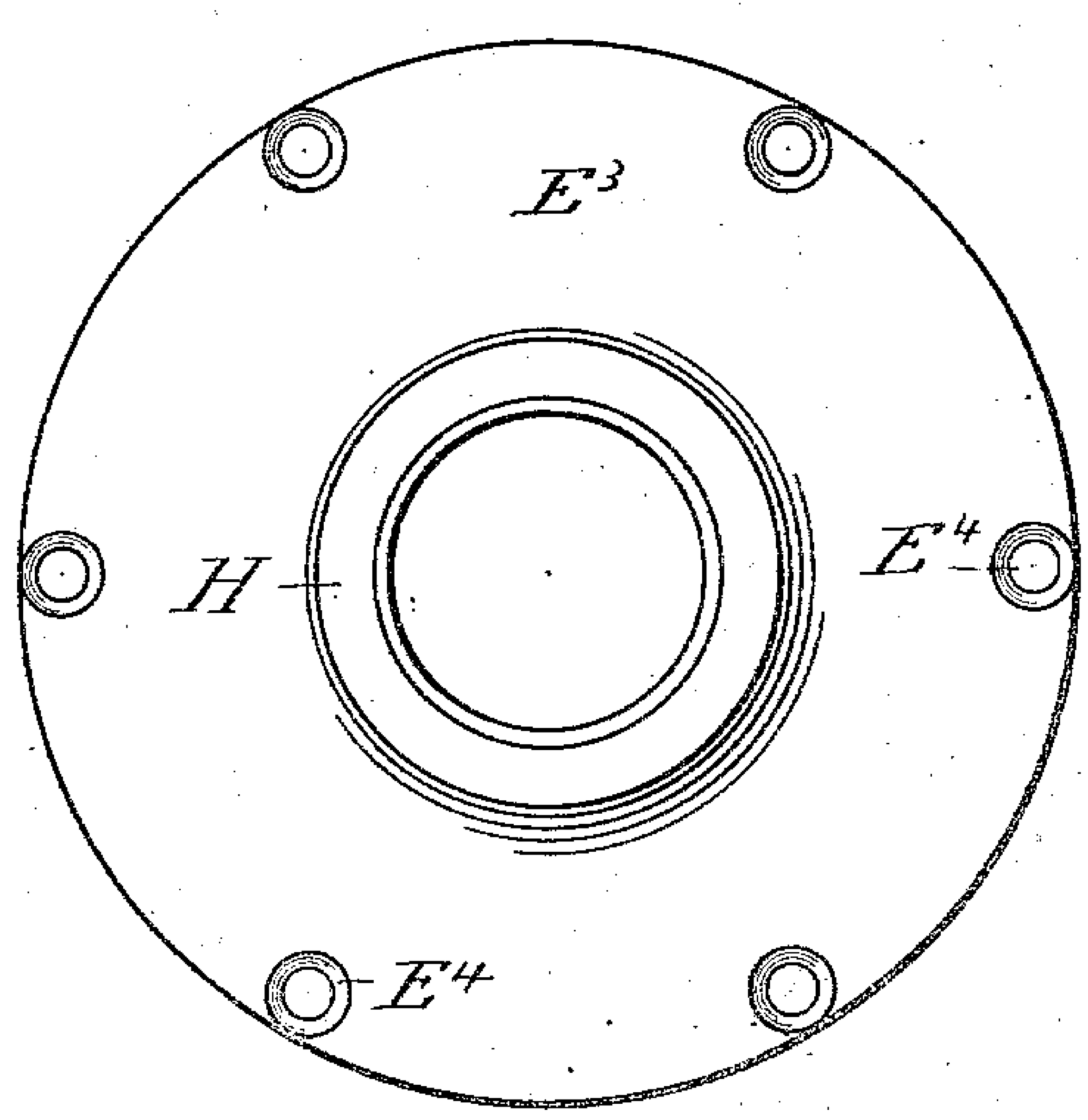

Fig. 4.

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UNITED STATES PATENT OFFICE.

JOHN F. COOLEY, OF BOSTON, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO COOLEY EPICYCLOIDAL ENGINE DEVELOPMENT COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF NEW JERSEY.

ROTARY FLUID-ENGINE.

SPECIFICATION forming part of Letters Patent No. 724,994, dated April 7, 1903.

Application filed October 26, 1900. Renewed December 13, 1902. Serial No. 135,163. (No model.)

To all whom it may concern:

Be it known that I, JOHN F. COOLEY, residing in the city of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Rotary Fluid-Engines, of which the following is a specification.

This my invention in its broad scope relates to the solution of the problem of the construction of rotary fluid-engines for propelling or being propelled by fluids—in other words, a rotary fluid-engine which may be operated by external devices to produce pressure in a fluid medium and, conversely, which operates in consequence of pressure in a fluid medium to give motion to external devices. I found that when a point was revolving around and at a set distance from an axis at a given rate of movement upon a plane which revolved in like direction around an axis slightly offset from the axis of revolution of the point and with a comparative rate of revolution of the plane to the point, as two to one, three to two, four to three, &c., then the point delineated and circumscribed upon the plane epicycloidal or hypocycloidal forms, which might also be produced by the circle and point bearing disk of cyclometry, I noticed that the movement of two to one produced the well-known cardioid, the three to two a nephroid, &c., and I also found that the cardioid had two such points revolving around the same axis, which would describe the same epicycloidal curvilinear form at the same time, and that the described dicuspid form (or nephroid) had three such points, the tricuspid had four, &c., and that if another circumscribed epicycloidal form was described whose cusps corresponded to these points upon these forms then the opposing lines or their axial and longitudinal extensions, forming surfaces which would be a condition of practice, would form partitioned spaces between their opposing surfaces which presented conditions which if inclosing a fluid under pressure on either side of a straight line drawn through the two axes (supposing the ends to be properly closed by suitable end plates preferably identified with one of the moving parts and in close moving contact with the other) then the fluid-pressure would cause a rotary movement of the first epicycloidal form, and the corresponding relative movement of the first epicycloidal form and the corresponding relative movement of the second epicycloidal form would follow, and if the first form was caused to move the second would follow and a pressure be exerted upon the fluid contained between the two forms and between the partitions and the rate of the relative progression of the second form would be in the same ratio as the aforesaid generating-point would bear to the plane in producing the first form, which would be the epicycloidal form of the cardioid, bicuspid, tricuspid, &c., of this engine, and upon this I base my invention.

In practice it substantially consists of the combined correlative construction and functions of two preferably cylindroid parts, a piston-cam, and a spacer-abutment of equal length one within the other, suitably bounded by parallel planes, each part rotating in the same direction, one in moving contact with the other at points having common radial and mutually equal cyclic distances moving at a relatively constant rate of speed differing by unity each upon an axis, which is independent of the other and at a slight predetermined distance or offset therefrom, but parallel therewith and of unchanging location, secured by suitably-attached axles or bearing-surfaces in fixed bearings, wherein the lateral opposing surfaces of one of the parts (the piston) is described by the said points of the other producing circumscribed epicycloidal or hypocycloidal forms or modifications thereof, one piece (the spacer) possessing numerically one more bearing-point than the number of piston-rises and a means for fluid entrance and exit to and from the spaces so formed. The part with the bearing-points would perform the function of a partitioning and spacing device, determining by the distance between its points, which bear and move upon the opposing lateral surfaces of the other part, the peripheral extent over which and by its relative movement the direction from which mutual surface-abutment exists with reference to any therein-inclosed fluid. This piece herein is called a "spacer," because it spaces off the peripheral surfaces of the piston. The other piece, whose lateral surfaces oppose the spacer and support the moving contact of the cusps thereof, is herein called a "piston."

The spacer is preferably cylindroid, but may be otherwise constructed—as, for instance, by radial partitions connected together and moving within the limits of the cusps or bearing-points and performing their functions in contact with cylinders whose centers are concentric with the axis of rotation of the partitions; but the lateral surfaces of the piston upon which the cusps or partitions contiguously move must be of epicycloidal or hypocycloidal generation, and to it or from it power should be transmitted, preferably, through one or two suitable axial extensions. It is also preferable to close the ends of the moving parts by identifying suitable disks with and at each end of one of the moving parts, so that they may revolve therewith in close moving contact with the other moving part, and when the disks are so identified with one of the parts, especially when that part is the spacer, it is preferable to provide bearing-surfaces on the disk for the support of the spacer, making and providing a central opening in the disk large enough to allow the movement of the shaft therein.

My invention consists of certain novel features hereinafter described, and particularly pointed out in the claims.

In the accompanying drawings, which illustrate a construction embodying my invention, Figure 1 is a transverse section through my improved engine. Fig. 2 is a longitudinal section through my improved engine. Fig. 3 is a view of the inside of one of the end disks, showing a wearing-ring with radial wearing projections. Fig. 4 is an external view of the end disk shown in Fig. 3.

When this engine is operated as a motor by fluid under pressure, motive fluid for operating the engine enters through the opening A into the steam or other fluid chest A′, formed within the shell A^7, through the port A^2 in the cylinder A^3, then through the opening A^4 in the spacer S into the space A^5. The motive fluid is now under pressure in the spaces A^5 A^6 and mutually repels the surfaces of the cylinder between the projections B B′ on one side and the piston between the equidistant wearing-strips W W′ in the other direction, the resultant of which pressure passes below the axis of revolution P′ of the piston P and propels the piston in the direction of the arrow *a*. The equidistant wearing-strips W W′ W^2 form bearing-points and are in continuous contact with the piston in all forms and positions of the moving parts of this invention, and the spaces between the strips form separate equal cylinders. At the same time that the movement of the piston takes place in Fig. 1 the spacer also revolves at a rate which, reckoned in complete revolutions of both spacer and piston, may be expressed in integral numbers, as "2" to "3," and the fluid under pressure operating within the space A^5 continues to so propel the piston until its movement, together with the correlative movement of the spacer, brings their line of mutual repulsion to correspond to a line through the centers S′ and P′ of the spacer and piston. In the meantime by the correlative movement of the parts the external spacer projection B′ has passed the port C, allowing the fluid to enter the space C^3, then through the opening C′ into the space C^2, causing the mutual repulsion of the surfaces, which in that position of the parts also causes a rotary tendency of the piston, due to the deflection of the line of mutual repulsion from a line corresponding with the centers of the piston and spacer, due to their relative change of position, and so on in order, thus keeping up the motion of the engine. When the spacer projection B has reached the point in its revolution in which it passes the port D, then the fluid under pressure in the spaces A^5 A^6 has free access to the exhaust-space D′ and exhausts through the opening D^2. D^3 is an additional port to allow free relief from the space as divided by the spacer until the spacer projection has passed the point at which it is desirable to allow the entrance of steam or other motive fluid into the space in consecutive order, as shown in the drawings. In the revolution of the engine when the spacer projection B^2 has passed the port C in the continued revolution the fluid will enter the space E and through the opening E′ into the space E^2, and the operation continues, as previously described. The wearing-rings W^3, provided with radial projections W^4, are located in the two opposite end disks E^3, as shown in Figs. 2 and 3. On the outer ends of the engine are located the cylinder-heads G, through which project the shaft E of the piston P, and which cylinder-heads have also inwardly-projecting hubs G′, which form a bearing for the hub H on the disks E^3, to which are secured the spacer S through the openings E^4, Fig. 4. The axis of rotation of the piston P is parallel to but eccentric with the axis of the bore of the cylinder A^3, which coincides with the axis of rotation of the spacer S.

Having thus described the nature of my invention and set forth a construction embodying the same, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a rotary fluid-engine, a cylinder having an internal bore, a rotary cam-piston therein whose axis is parallel to the axis of said bore, a like directionally-rotating spacer between said piston and said bore in continuous contact at radially coincident and equiangularly-spaced intervals with both bore and piston, and entrance and exit ports for fluids.

2. In a rotary fluid-engine, a cylinder having an internal bore, a rotary cam-piston whose axis is parallel to the axis of said bore, a like directionally-rotating spacer between said piston and said bore in continuous contact at radially coincident and equiangularly-spaced intervals with both bore and piston, and entrance and exit ports for fluids laterally situated in the bore of said cylinder to be opened and closed by said spacer.

3. In a rotary fluid-engine, a cylinder having an internal bore, a rotary cam-piston therein whose axis is parallel to the axis of said bore, a like directionally-rotating spacer between said piston and said bore in continuous contact at radially coincident and equiangularly-spaced intervals with both bore and piston, said piston and spacer rotating in the same direction at relatively constant but different rates of speed, and ports in the cylinder for the admission and exhaust of fluids.

4. In a rotary fluid-engine, a cylinder having an internal bore, a rotary cam-piston therein whose axis is parallel to the axis of said bore, a like directionally-rotating spacer between said piston and said bore in continuous contact at radially coincident and equiangularly-spaced intervals with both piston and bore, disks for supporting and inclosing the piston, said piston and spacer rotating in the same direction at relatively constant but different rates of speed, and ports in the cylinder controlled by said spacer for admitting and exhausting the fluids to and from the piston between said contact-points.

5. In a rotary fluid-engine, a cylinder having an internal bore, a rotary cam-piston therein whose axis is parallel to the axis of said bore, a like directionally-rotating spacer open between said piston and said bore and in continuous contact at radially coincident and equiangularly-spaced intervals with both bore and piston, and ports in the cylinder controlled by said spacer for admitting and exhausting the fluids to and from the piston between said contact-points.

6. In a rotary fluid-engine, a cylinder having an internal bore, a rotary cam-piston therein whose axis is parallel to the axis of said bore and mounted on a shaft eccentric to said bore, cylinder-heads provided with eccentric bearings for said piston-shaft, a like directionally-rotating spacer between said piston and said bore in continuous contact at radially coincident and equiangularly-spaced intervals with both bore and piston, and entrance and exit ports for the fluid-pressure between said contact-points.

7. In a rotary fluid-engine, a cylinder having an internal bore, a rotary cam-piston therein whose axis is parallel to the axis of said bore and mounted on a shaft eccentric to said bore, cylinder-heads provided with eccentric bearings for said piston-shaft, a like directionally-rotating spacer between said piston and said bore in continuous contact at radially coincident and equiangularly-spaced intervals with both bore and piston, concentric bearings for the spacer, disks provided with bearing-surfaces for supporting said spacer upon said concentric bearings, and entrance and exit ports in the cylinder controlled by said spacer for admitting and exhausting fluids to and from the piston between said contact-points.

8. In a rotary fluid-engine, a cylinder having an internal bore, a rotary cam-piston therein whose axis is parallel to the axis of said bore, a like directionally-rotating spacer having ports and between said piston and said bore in continuous contact at radially coincident and equiangularly-spaced intervals with both bore and piston, both piston and spacer rotating in the same direction at relatively constant but different rates of speed, and ports in the cylinder controlled by said spacer for admitting and exhausting the fluids to and from the piston between said contact-points.

9. In a rotary fluid-engine, a cylinder having an internal bore, a rotary cam-piston therein whose axis is parallel to the axis of said bore and mounted on a shaft eccentric to said bore, cylinder-heads provided with eccentric bearings for said piston-shaft, a like directionally-rotating spacer between said piston and said bore in continuous contact at radially coincident and equiangularly-spaced intervals with both bore and piston, both piston and spacer rotating in the same direction at relatively constant but different rates of speed, concentric bearings for the spacer, disks provided with bearing-surfaces for supporting said spacer, and entrance and exit ports for the fluids in said cylinder.

10. In a rotary fluid-engine, a cylinder having an internal bore, a rotary cam-piston therein whose axis is parallel to the axis of said bore and mounted on a shaft eccentric to said bore, cylinder-heads provided with eccentric bearings for said piston-shaft, a like directionally-rotating spacer between said piston and said bore in continuous contact at radially coincident and equiangularly-spaced intervals with both bore and piston, both piston and spacer rotating in the same direction at relatively constant but different rates of speed, concentric bearings for said spacer, disks provided with bearing-surfaces for supporting said spacer upon said concentric bearings, and entrance and exit ports in the cylinder controlled by said spacer for admitting and exhausting fluids to and from the piston between said contact-points.

11. In a rotary fluid-engine, a cylinder having an internal bore, a rotary epicycloidal cam-piston therein out of contact therewith and whose axis is eccentric to but parallel with the axis of said bore, a like directionally-rotating spacer between said piston and said bore composed of two or more equiangularly located and connected radial partitions of equal radial height whose outward edges are in continuous contact with said bore and

whose inner edges are in continuous contact with said piston, and entrance and exit ports for fluids through said bore.

12. In a rotary fluid-engine, a cylinder having an internal circular bore, a rotary epicycloidal cam-piston therein out of contact therewith whose axis is eccentric to but parallel with the axis of said bore, a like directionally-rotating spacer between said piston and said bore composed of two or more equiangularly located and connected radial partitions of equal radial height whose outward edges are in continuous contact with said bore and whose inner edges are in continuous contact with said piston, and entrance and exit ports laterally situated in the bore of said cylinder to be opened and closed by the said spacer.

13. In a rotary fluid-engine, a cylinder having an internal circular bore, a rotary cam-piston therein out of contact therewith having a shaft extending through its axis which is eccentric to but parallel with the axis of said bore, a like directionally-rotating spacer between said piston and said bore composed of two or more equiangularly situated and connected radial partitions of equal radial height whose outward edges are in continuous contact with said bore and whose inner edges are in continuous contact with said piston, said cylinder having end plates provided with bearings to support said shaft, and entrance and exit ports for fluids through said bore.

14. In a rotary fluid-engine, a cylinder having an internal circular bore, a rotary epicycloidal cam-piston therein out of contact therewith whose axis is eccentric to but parallel with the axis of said bore, a like directionally-rotating spacer between said piston and said bore composed of two or more equiangularly located and connected radial partitions of equal radial height whose inner edges are in continuous contact with said piston, said spacer having end plates connected thereto and inclosing said piston in moving contact therewith, openings provided in said plates to allow the extension of the piston-shaft, and entrance and exit ports for fluids through said bore.

15. In a rotary fluid-engine, a cylinder having an internal circular bore, a rotary cam-piston therein out of contact therewith whose axis is eccentric to but parallel with the axis of said bore, a like directionally-rotating spacer between said piston and said bore composed of two or more equi-angularly located and connected radial partitions of equal radial height whose outward edges are in continuous contact with said bore and whose inner edges are in continuous contact with said piston, said spacer provided with end plates connected thereto and inclosing said piston and in moving contact therewith, said end plates being provided with bearing surfaces and openings provided to allow the extension of the piston-shaft, and entrance and exit ports for fluids through said bore.

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

JOHN F. COOLEY.

Witnesses:
RALPH W. BARTLETT,
JAMES A. MORSE.