No. 751,694. PATENTED FEB. 9, 1904.

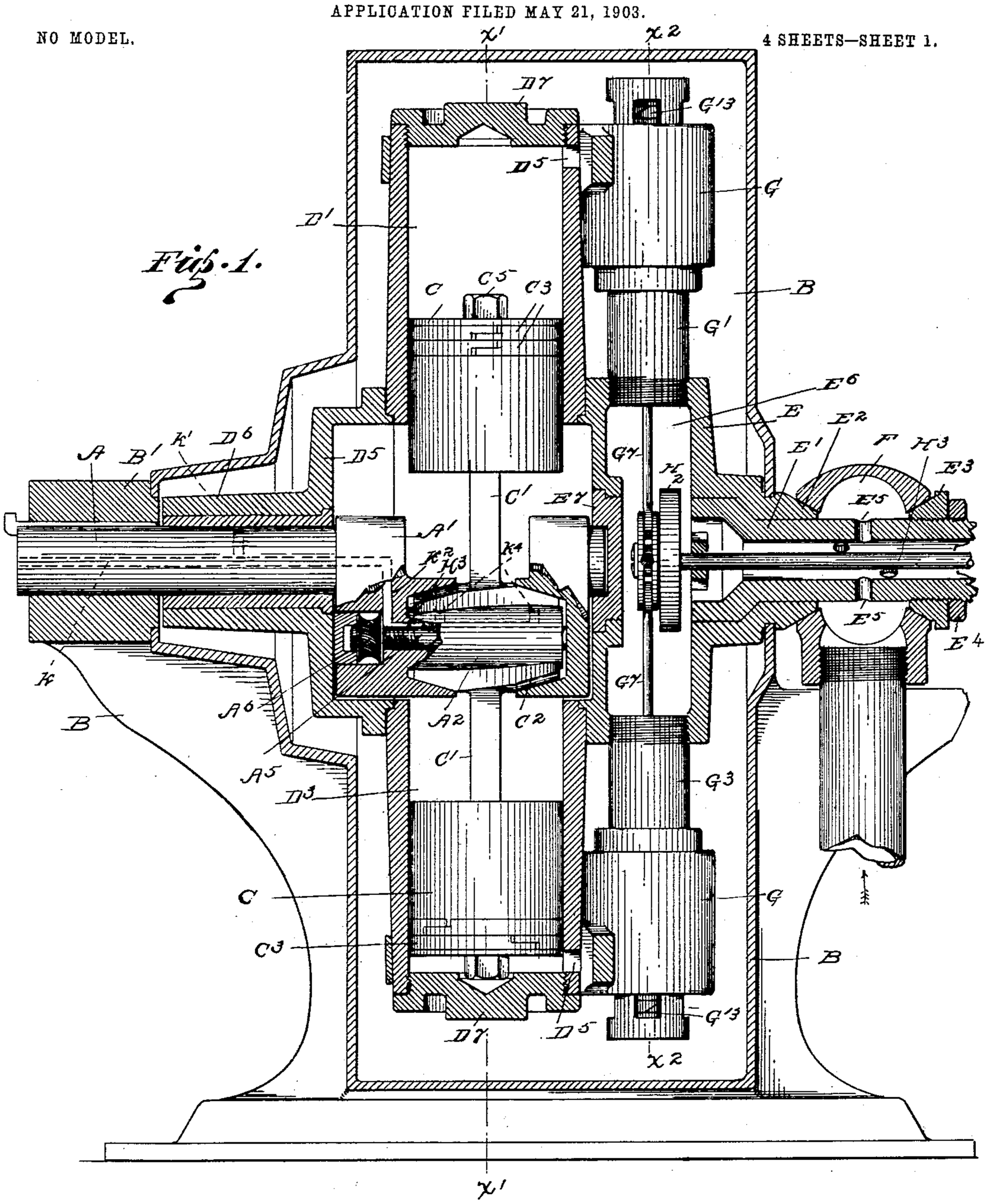
J. E. SHEARER.

ROTARY ENGINE.

APPLICATION FILED MAY 21, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

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BY Jos. E. Shearer

Baldwin Vale

ATTORNEY.

No. 751,694. PATENTED FEB. 9, 1904.

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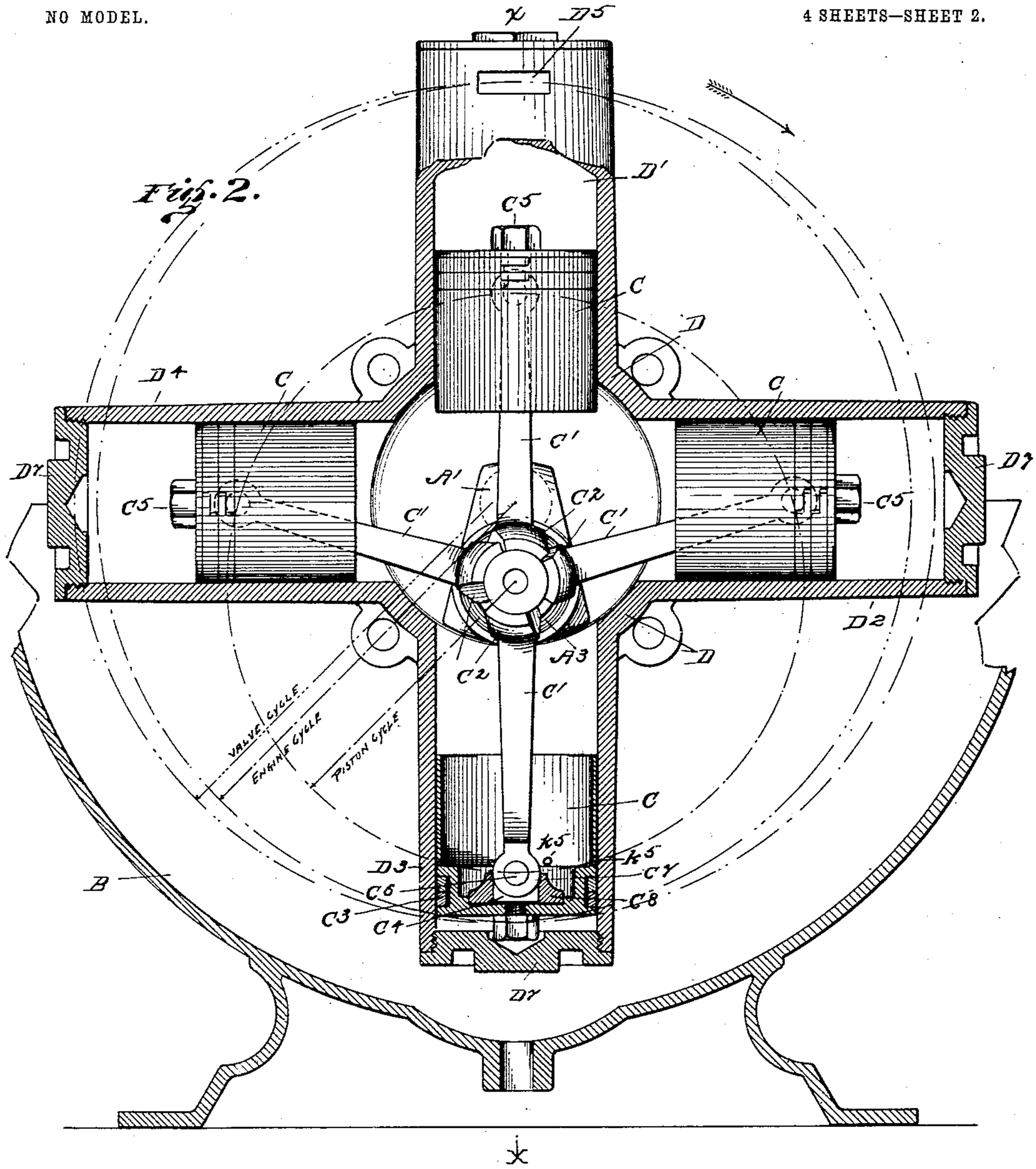
NO MODEL. 4 SHEETS—SHEET 2.

Fig. 2.



WITNESSES:

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NO MODEL. 4 SHEETS—SHEET 3.

Fig. 3.

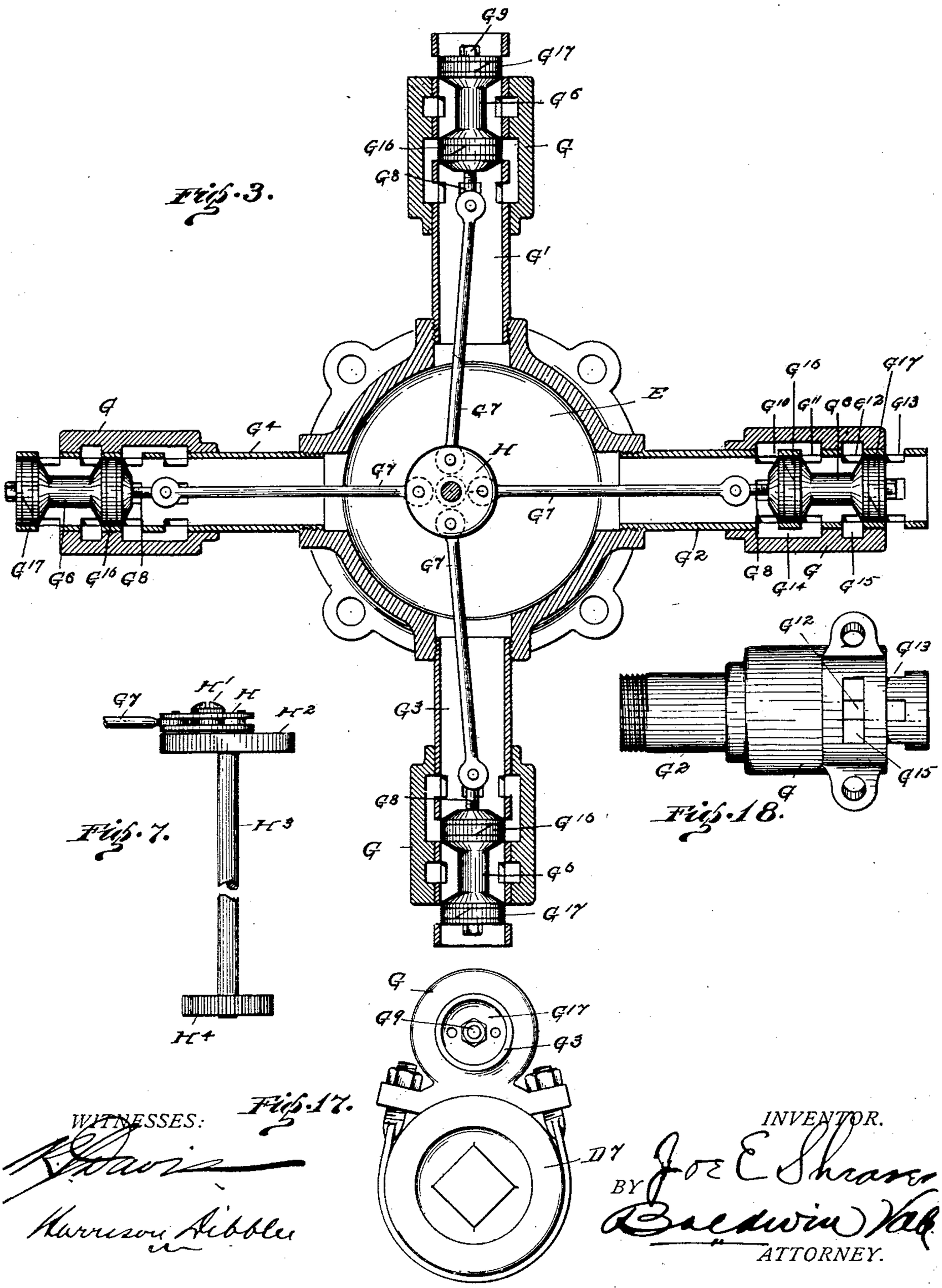

Fig. 18.

Fig. 7.

Fig. 17.

WITNESSES:

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No. 751,694. PATENTED FEB. 9, 1904.

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NO MODEL. 4 SHEETS—SHEET 4.

Fig. 8.

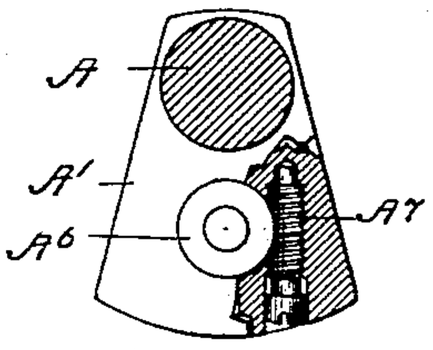


Fig. 9.

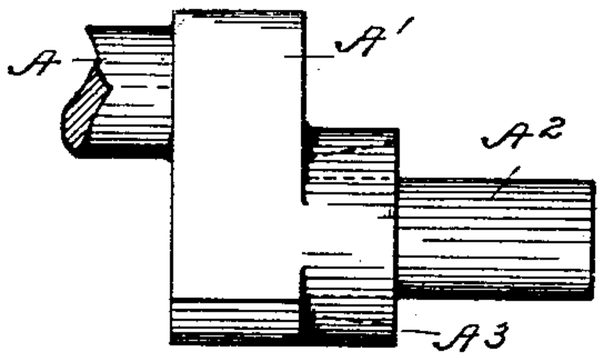


Fig. 10.

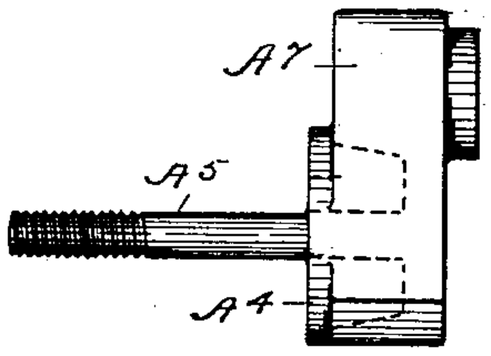


Fig. 11.

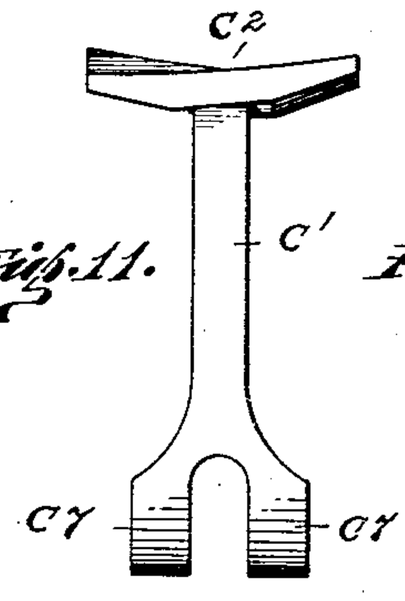


Fig. 12.

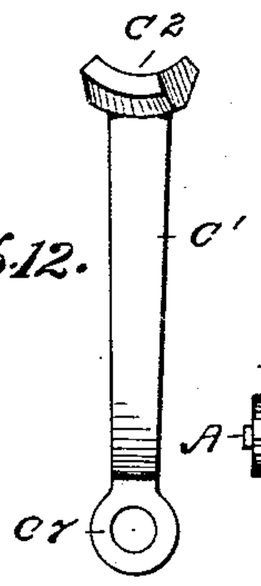


Fig. 19.

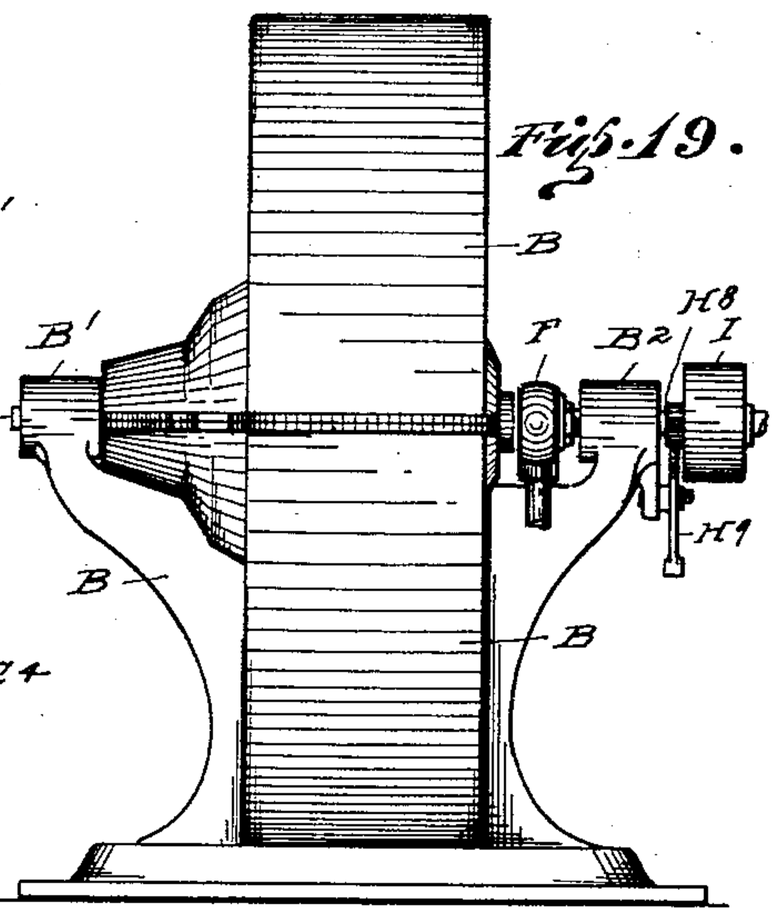


Fig. 13.

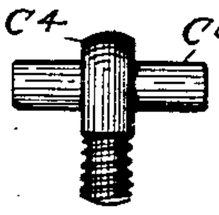


Fig. 14.

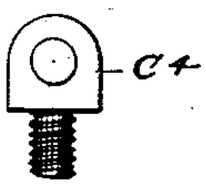


Fig. 15.

Fig. 16.

Fig. 4.

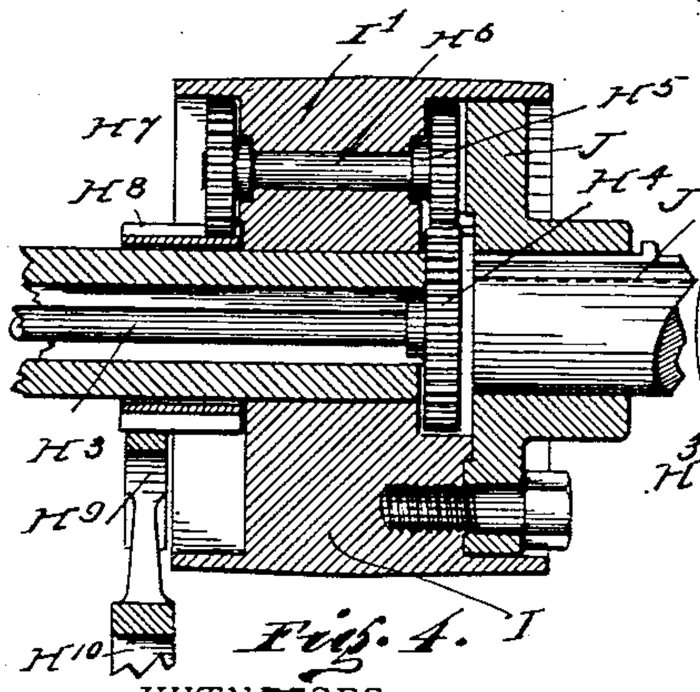


Fig. 5.

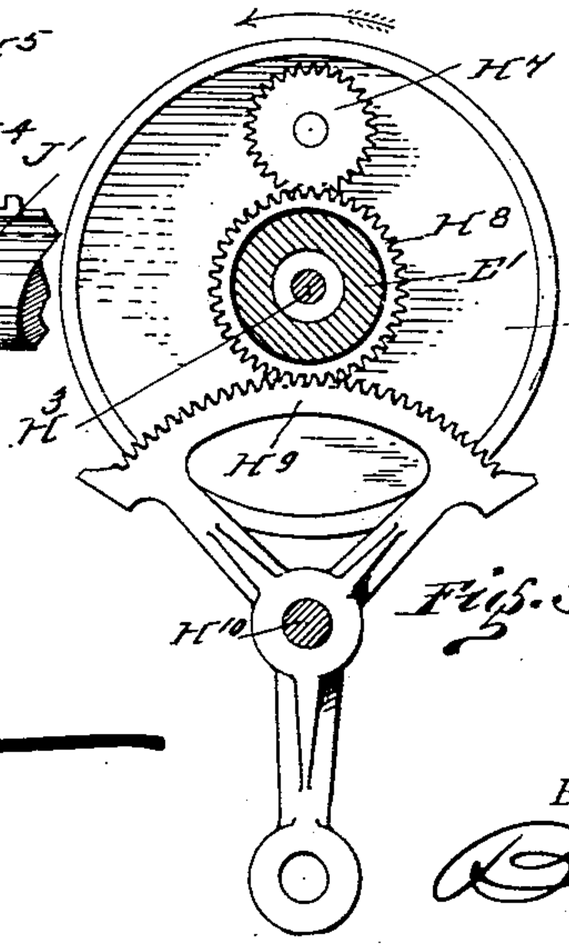
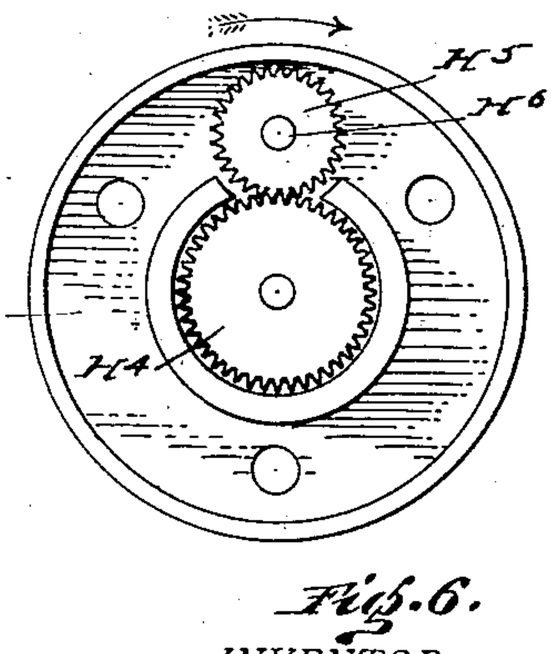


Fig. 6.



WITNESSES:

Harrison Hobbs

INVENTOR.

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ATTORNEY.

No. 751,694. Patented February 9, 1904.

UNITED STATES PATENT OFFICE.

JOE E. SHEARER, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR TO ROBERT J. DAVIS, OF ROSS STATION, CALIFORNIA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 751,694, dated February 9, 1904.

Application filed May 21, 1903. Serial No. 158,152. (No model.)

To all whom it may concern:

Be it known that I, JOE E. SHEARER, a citizen of the United States, residing in the city of San Francisco, county of San Francisco, and State of California, 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 said invention, such as will enable others skilled in the art to which it most nearly appertains to make, use, and practice the same.

This invention relates to improvements in rotary engines of the multicylinder type, and particularly to the novel construction and arrangement of the parts.

The objects sought to be accomplished are to utilize the expansive force of steam or other fluids under pressure without incidental vibrations, to attain the maximum of power within the minimum of weight and space, to reduce the number of parts and so place them as to be readily accessible, to provide a direct and generous cut-off portage to allow for quick expansion and exhaust of the cylinders.

Broadly, the invention consists of a plurality of single-acting cylinders (preferably four) radiating from and adapted to revolve concentrically with the working axis of the engine; pistons in the cylinders revolving about a fixed crank-pin eccentric to the working axis of the engine; a hollow axle, steam-chamber, and valve-chests fixed to the revolving cylinders; slide-valves operating within the valve-chests and revolving about a pin adapted to swing in an orbit about the working center of the engine, whereby the steam is cut off with regard to the piston-stroke to control the speed and reversal of the engine travel; an exterior control of the throttle-valves consisting of a reacting gear operating through the hollow shaft of the engine, whereby the revolution of the engine-shaft is offset with regard to the throttle mechanism; means for introducing steam to the valve-chests through the hollow shaft of the engine, and a suitable journal-mounting for the engine, including an inclosing casing, to lead off the exhaust.

In the drawings, Figure 1 is a vertical cross-section of a engine constructed in accordance with this invention, certain of the parts being shown in full lines on line X X, Fig. 2. Fig. 2 is a similar view across the axis of the engine, portions of the casing being omitted, on line X′ X′, Fig. 1. Fig. 3 is a similar view confined to the valve mechanisms on line X^2 X^2, Fig. 1. Fig. 4 is a vertical cross-section of the reacting gear controlling the cut-off of the valves. Fig. 5 is an end elevation of the same from the engine side. Fig. 6 is a similar view from the outside. Fig. 7 is plan view from above of the main shaft in the reacting gear with the mechanisms directly fixed thereto to be read in association with Fig. 3. Fig. 8 is an end elevation from the outside of the fixed crank, broken away to show the means for taking up wear in the crank-pin connections. Fig. 9 is a side elevation of the same. Fig. 10 is a side elevation of the external wearing-cone forming part of the crank-pin connection. Fig. 11 is a side elevation of one of the connecting-arms between the piston and crank-pin. Fig. 12 is a front elevation of the same. Fig. 13 is a side elevation of the pivot-pin connecting the connecting-arms with the piston. Fig. 14 is an end elevation of the same. Fig. 15 is a side elevation of the bearing-block interposed between the connecting-arm and the piston. Fig. 16 is an end elevation of the same. Fig. 17 is an end elevation of a cylinder and valve-chest, showing the means of connecting the same. Fig. 18 is a side elevation from the cylinder side of a valve-chest and nipple connecting same to the steam-chamber, showing the port leading to the cylinder. Fig. 19 is a diminutive side elevation of the complete engine to show particularly the journal-mountings and the relation of the external to the internal mechanisms of the engine.

In the description with reference to the drawings the invention will be divided into major groups distinguished by a reference-letter, the minor mechanisms of these groups being designated by group letter strengthened by the addition of a numeral thereto.

In detail the construction consists of the fixed crank-shaft A, keyed rigidly in the pillow B′ of the frame B. The crank-shaft A,

crank A′, and crank-pin A^2 are an integral forging to insure rigidity at this point of resistance, upon which the piston-power is centered. For additional rigidity of the crank-shaft the block A^7, in which the cup A^4 is cut, is stepped in the plug E^7 in the wall of the steam-chamber on the crank-shaft center, forming, in effect, a double crank.

The connecting-arms C′ are connected to the trunk-pistons C by a knuckle-joint (see Figs. 11 to 16, inclusive, and cylinder D^3 in Fig. 2) composed of stud C^4, screwed through the head of the piston and locked by the nut C^5 and having the cross-pin C^6 engaging the lugs C^7 on the connecting-arms. The thrust of the piston is taken directly by the bearing-block C^8, countersunk in the head of the piston and shaped to conform to the lugs C^7 on the connecting-arms. This construction compensates for the changing angle of the connecting-arms in their travel about the crank-pin, provides a wide bearing-surface and means for taking up wear at this point. The pistons are connected to the crank-pin by the arms C′, having the lateral extension C^2, forming the bearing-surface of the connecting-arms with the crank-pin. The extension C^2 of the respective connecting-arms are nested helixically around the crank-pin. Their combined outer surfaces, tapered from the ends toward the arms, form cones upon either side of the arms which are inclosed within the cone-cups A^3 A^4, the former being an integral part of the crank A′ and the latter being independently advanced upon the extensions C^2 by the pin A^5, extending through the crank-pin and threaded in the nut A^6, recess in the crank, and rotated by a worm A^7, meshed with its toothed periphery. Forcing the cone-cups upon the extensions C^2 takes up any lost motion incidental to wear upon the crank-pin. The slight twist of the bearing-surface C^2 gives a lead across the vertical center of the crank-pin, which counteracts any disposition of the connecting-arms to bind thereat.

The above construction respecting the connection of the pistons to the crank-pin has a wide range of application to other types of engines, pumps, &c., involving a plurality of cylinders.

The cylinder member D is an integral casting, in which the cylinders D′ D^2 D^3 D^4 are bored to receive the pistons. The cylinder member revolves concentrically with the line center of the engine and is supported (see Fig. 3) on the left by the cap D^5, hermetically bolted over the crank-chamber, forming the center of the cylinder member, and in which the journal D^6, riding on the crank-shaft, is formed, and on the right by the similar cap E, into which the hollow shaft E′ is forced, becoming a fixed part thereof and revolving in the journal-box B^2 on the engine-frame. The outer ends of the cylinders are closed by the screw-plugs D^7, between which and the trunk-pistons C, packed by the expansion-rings C^3, the fluid is permitted to expand. Thus assembled the cylinder member D, supported upon lubricated journals, the pistons engaging the crank-pin and moving freely in the cylinders, render the mechanical derivatives ready for the application of the fluid power, (in this instance steam.) The steam is led to the cylinders from the source of supply through the annular pocket F, "floating" between the cone E^2 on the cap E and cone E^3, threaded on the shaft E′ and locked by the running nut E^4, which allows for take-up in maintaining steam-tight the joints of the cones with the pocket. From the pocket F the steam enters through the perforations E^5 the hollow shaft E′, connecting with the steam-chamber E^6. From the steam-chamber the steam enters the tubes G′ G^2 G^3 G^4, Fig. 3, over which the jackets G are forced or shrunk to form valve-chests, clamped to the cylinders adjacent the ports G^5 in the respective cylinders. The flow is cut off in the valve-chests by the balanced pistons G^6, sliding within the same. These pistons are operated by the connecting-rods G^7, pivoted to the valve-stems G^8, upon which the pistons are screwed and locked by the nuts G^9. The tubes G′ G^2 G^3 G^4 have four sets of ports G^{10} G^{11} G^{12} G^{13}, cut through the walls of the tubes at regular intervals. The steam is liberated from the tube through the ports G^{10} to the annular space G^{14} of the jackets G, (see valves associated with tube G^2,) thence through ports G^{11} reënters the tube between the heads G^{16} G^{17} of the piston G^6 into the annular space G^{15}, which is open to the port G^5 of the cylinder D^2, within which the steam expands until position of cylinder D^4 is reached, when the piston will have slid forward, closing space G^{14} and opening the cylinder to the atmosphere-exhaust through the ports G^{13}. Obviously the positions of the valve mechanisms as shown and described are approached gradually, taking full advantage of the resiliency of the steam. The valve-pistons are at all times balanced by the steam-pressure acting thereon from the center outward, inertia being the only resistance to be overcome in shifting them. The inner ends of the rods G^7 meet and are pivoted in the block H, revolving on the pin H′, fixed eccentrically in the plate H^2, which controls the throw of the valve-pistons. The range of speed and the reversal of the engine is accomplished wholly by the cut-off of the steam-inlets to the cylinders through an external control operating through the hollow shaft E′. In ordinary cases the shaft H^3 can project beyond the end of the hollow shaft and be provided with a simple crank to throw the pin H′, controlling the cut-off. In many instances it is desirable to make direct connection with dynamos, water-wheels, &c., to the end of the engine-shaft. This is accomplished by the flange J, bolted to the web of the coupling I

and keyed to the shaft J′ of the dynamo or other machine. To permit lateral connection with the shaft H^3 and counteract the rotary action of the engine-shaft, a reacting gear is necessary. This reacting gear consists of the pinion H^4, fixed on the end of the shaft H^3 and meshed with the pinion H^5, fixed on the counter-shaft H^6, extending idly through the web I′ of the coupling I, fixed on the extreme end of the hollow shaft outside of the journal-box thereof. Obviously the pinion H^5, revolving upon its own axis and swinging in an orbit about and meshed with the pinion H^4 on the axial center of the engine, will counteract the revolution of the engine with respect to the pinion H^4, holding it inactive. This reaction is duplicated on the opposite side of the web I′ by the pinion H^7, fixed on the counter-shaft H^6 and meshed with the pinion H^8, loose on the engine-shaft.

The valve cut-off is manipulated by the segmental gear H^9, pivoted at H^{10} to the engine journal-box B^2 and meshed with the idle pinion H^8. Granted that the engine is running full speed to the right, (as illustrated,) the speed would be reduced by swinging the segmental gear H^9 to the left, which will swing the pin H′ to the right, gradually reducing the cut-off until forty-five degrees of the circle have been traversed, which results in a complete reverse direction of the revolution of the engine, capable of the same range of speed until the cut-off is returned to the normal.

Referring to the drawings, Figs. 2 and 3, the cylinders revolving concentrically with the engine-center and the pistons therein revolving on the crank-pin eccentric to the engine-center and the valve-pistons revolving in a changeable orbit about the engine-center give three cycles of action, the first two cycles being in fixed relation, and the third at the will of the engineer controls the speed of the engine cycle. As illustrated, the cut-off is set on the quarter. The cylinder D′ has reached its maximum expansion and is approaching its exhaust. The cylinder D^2 has reached its median exhaust and is approaching its intake. The cylinder D^3 has reached its full intake and begun its expansion against the crank-pin, giving impetus to the cylinder member in its cycle. The cylinder D^4 is at its median expansion and is approaching its maximum. The expansion condition of the various cylinders are subject to control through the valve mechanisms. The engine under full head is capable of accomplishing any speed up to, say, three thousand revolutions per minute. This high speed necessitates a large portage area, which has been one of the prime considerations in the present construction.

Oiling of the working parts is accomplished by leading the oil through the perforation K in the engine-shaft, through the by-pass K′ to the journal D^6, through the by-pass K^2 in the crank-shaft to the channel K^3 in the crank-pin, thence through the by-passes K^4 to the surface of the crank-pin, from whence it is carried by centrifugal force out the crank-arms to the head of the pistons, lubricating the knuckle-joint thereat, thence escaping through the perforations K^5 to the wall of the cylinder. The cylinder-walls and the block A^7, stepped in the plug E^7, will be always well lubricated by the free oil in the crank-chamber. A small quantity of oil occasionally introduced with the steam will keep all working parts within the steam-chamber well lubricated, as the action therein is slight. The lubrication of exposed working parts is accomplished in the usual manner.

Attention is drawn to the centralizing of all working parts—that is, the line of action is made as direct as practicable—offsets being avoided as much as possible—the crank-pin and piston connections and slide-valves, for instance.

In an engine constructed in accordance with this invention and carefully balanced there is an entire absence of vibration under all speeds, which renders it particularly desirable for automobiles, small pleasure-boats, motor-cycles, and wherever vibration is a serious consideration. The constant and positive torque makes this a perfect engine for direct connection to dynamos, centrifugal pumps, automatic machinery, and the like. The absence of dead-centers makes it possible to start a full load with the whole expansive force of the steam in any position of the engine.

Having thus described this invention, what is claimed, and desired to be secured by Letters Patent, is—

1. In a rotary engine, a cylinder member comprising a plurality of cylinders, radiating from and adapted to revolve concentrically with the working axis of the engine; pistons in the cylinders revolving about a fixed crank-pin eccentric to the working axis of the engine; a hollow axle, steam-chamber, and valve-chests fixed to the revolving cylinder member; slide-valves operating within the valve-chests, and revolving about a pin adapted to swing in an orbit about the working center of the engine; an exterior control of the throttle-valves consisting of a reacting gear operating through the said hollow shaft; means for introducing steam to the cylinders through the throttle-valves, and the said hollow axle; and suitable journal-mountings for the engine including an inclosing casing.

2. In a rotary engine, a cylinder member comprising a plurality of cylinders radiating from and adapted to revolve concentrically with the working axis of the engine, pistons in the cylinders revolving about a fixed crank-pin eccentric to the working axis of the engine, slide-valves controlling admission of steam to said cylinder, rods pivoted to said valves, a

plate concentric with the working axis of the engine, a block eccentrically mounted thereon and adapted to revolve in an orbit about the engine-center, said rods being pivoted to said block, and means for varying the orbit in which said block revolves.

3. In a rotary engine, a cylinder member comprising a plurality of cylinders radiating from and adapted to revolve concentrically with the working axis of the engine, pistons in the cylinders revolving about a fixed crank-pin eccentric to the working axis of the engine, a steam-chamber fixed to the revolving cylinder member, means for introducing steam to said steam-chamber, slide-valves controlling the admission of steam from said chamber to said cylinder, a block mounted in said steam-chamber and adapted to revolve in an orbit about the engine-center, rods pivoted to said block and said valves, and means for varying the orbit in which said block revolves.

4. In a rotary engine, a cylinder member comprising a plurality of cylinders radiating from and adapted to revolve concentrically with the working axis of the engine, pistons in the cylinders revolving about a fixed crank-pin eccentric to the working axis of the engine, a steam-chamber fixed to the revolving cylinder member, tubes leading from said steam-chamber and having lateral ports cut through their walls at regular intervals, slide-valves working in said tubes across said ports and adapted to revolve in a changeable orbit about the engine-center, jackets inclosing said tubes and forming annular spaces about said ports, and means for introducing steam to the steam-chamber.

5. In a rotary engine, comprising a plurality of single-acting cylinders with ports adjacent their closed outer ends; valve-chests fixed to said cylinders having annular spaces communicating with said ports; tubes extending through said valve-chests, and communicating with the steam-supply, and having lateral ports cut through their walls at regular distances communicating with the annular chests; slide-pistons operating in said tubes across the ports, to alternately fill and exhaust the said cylinders through the said valves; and connecting-links from said slide-pistons, to a pin adapted to swing in an arc about the working axis of the engine.

6. In an engine comprising a plurality of opposed cylinders, pistons in said cylinders operating on a crank-pin eccentric to the working center of the engine, connecting-arms connected to the pistons by a stud screwed through the piston-head and jammed with a lock-nut, and having a lateral pin loosely engaging the end of the connecting-arms, which seat in a bearing-block interposed between the head of the piston and the connecting-arms; a crank-pin connection for the said arms consisting of a lateral extension on either side of the arm center, nesting helixically about the crank-pin, the combined outer ends of said lateral extensions forming cones inclosed by cone-cups formed respectively in the reaches of the cranks, which are adapted to be drawn upon the said cones by a threaded pin extending through the crank-pin, and engaging a take-up nut rotatable in the crank.

7. In an engine comprising a plurality of opposed cylinders, pistons in said cylinders operating on a crank-pin eccentric to the working center of the engine; connecting-arms pivoted to the pistons; a crank-pin connection for the said arms consisting of a lateral extension on either side of the arm center, nesting helixically about the crank-pin, the combined outer ends of said lateral extensions forming cones inclosed by cone-cups formed respectively in the reaches of the cranks, which are adapted to be drawn upon the said cones by a threaded pin extending through the crank-pin and engaging a take-up nut rotatable in the crank.

8. In an engine comprising a plurality of opposed cylinders, pistons in said cylinders operating on a crank-pin eccentric to the working center of the engine; connecting-arms connected to the pistons by a stud screwed through the piston-head, and having a lateral pin loosely engaging the end of the connecting-arms which seat in a bearing-block interposed between the head of the piston and the said arms, which are suitably connected to the said crank-pin.

9. In a rotary engine comprising a plurality of cylinders rotating concentrically with the working center of the engine, and having pistons therein rotating about a crank-pin eccentric to the working center of the engine; a hollow axle, steam-chamber, and slide-valves fixed to the revolving cylinders; means for introducing steam to the cylinders through the hollow axle consisting of lateral perforations through the hollow axle communicating with an annular pocket "floating" between a cone fixed on the hollow axle, and a cone adjustable on the hollow axle, and suitable steam-supply to the said pocket.

10. In a rotary engine comprising a plurality of cylinders revolving about the working center of the engine, and having slide-valves fixed to each cylinder; connecting-links from the valve-slides to a pin adapted to swing in an arc about the working center of the engine; means for swinging said pin consisting of a shaft extending through the hollow shaft of the engine and engaging the pin, a pinion on the outer end of said shaft meshed with a pinion fixed on a counter-shaft journaled in a coupling fixed on the said hollow shaft; a second pinion on said counter-shaft meshed with a pinion loose on said hollow shaft; a segmental gear pivoted to the engine-frame, and meshed with said idle pinion.

11. In an engine, a crank member compris-

ing a straight shaft, a main crank, and a hollow crank-pin; and a supplemental crank connected to said main crank through the hollow crank-pin.

12. In an engine, a crank member comprising a straight shaft, a main crank having a hollow crank-pin extending therefrom, a supplemental crank having a pin extending through said hollow crank-pin, and means for relatively adjusting said cranks.

In testimony whereof I have hereunto set my hand this 27th day of April, 1903.

JOE E. SHEARER.

Witnesses:
R. J. DAVIS,
HARRISON DIBBLER.