No. 747,894. PATENTED DEC. 22, 1903.

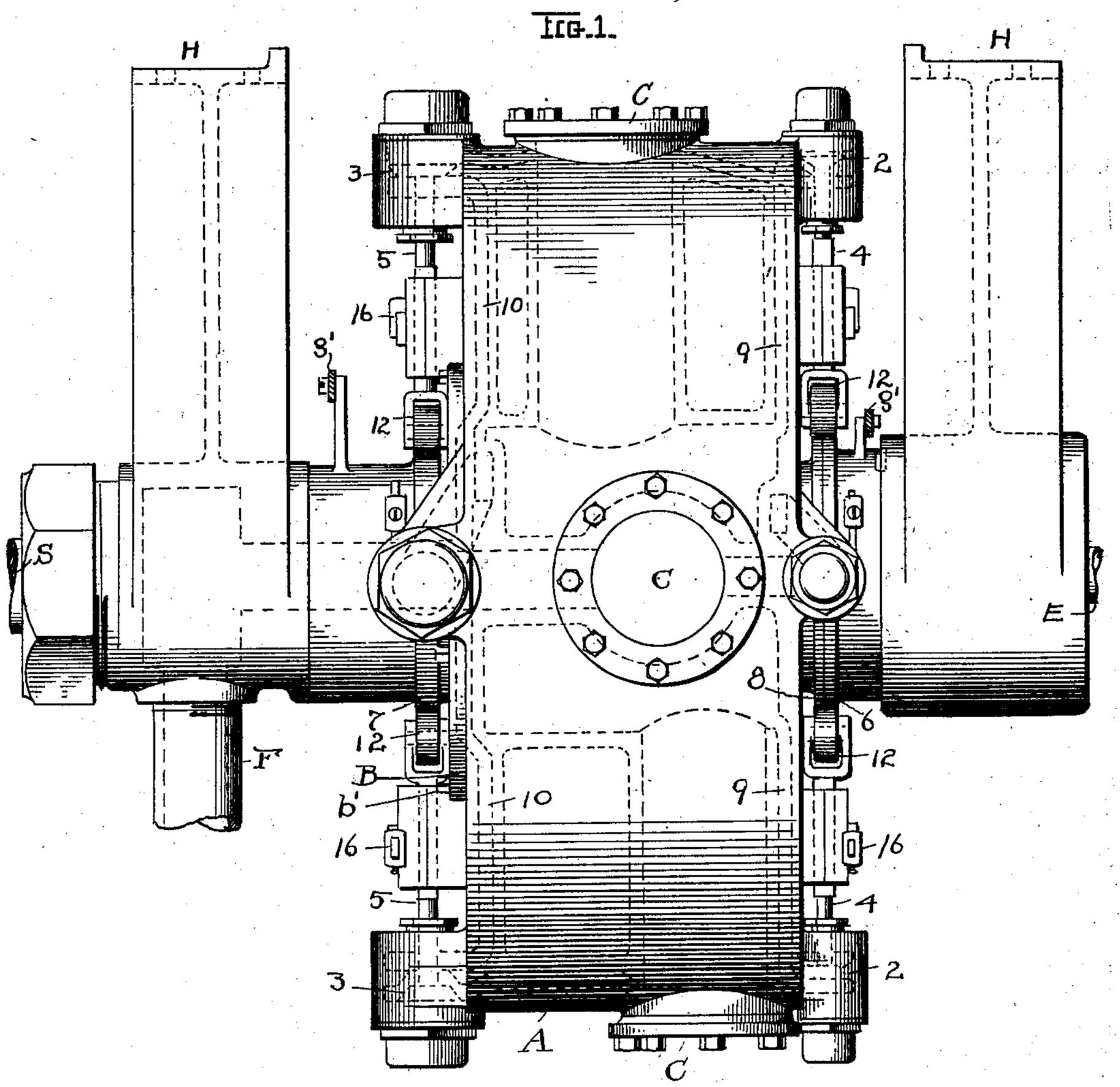
A. P. SCHMUCKER.

ROTARY ENGINE.

APPLICATION FILED AUG. 17, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

FIG. 1.



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NO MODEL. 4 SHEETS—SHEET 2.

FIG. 2.

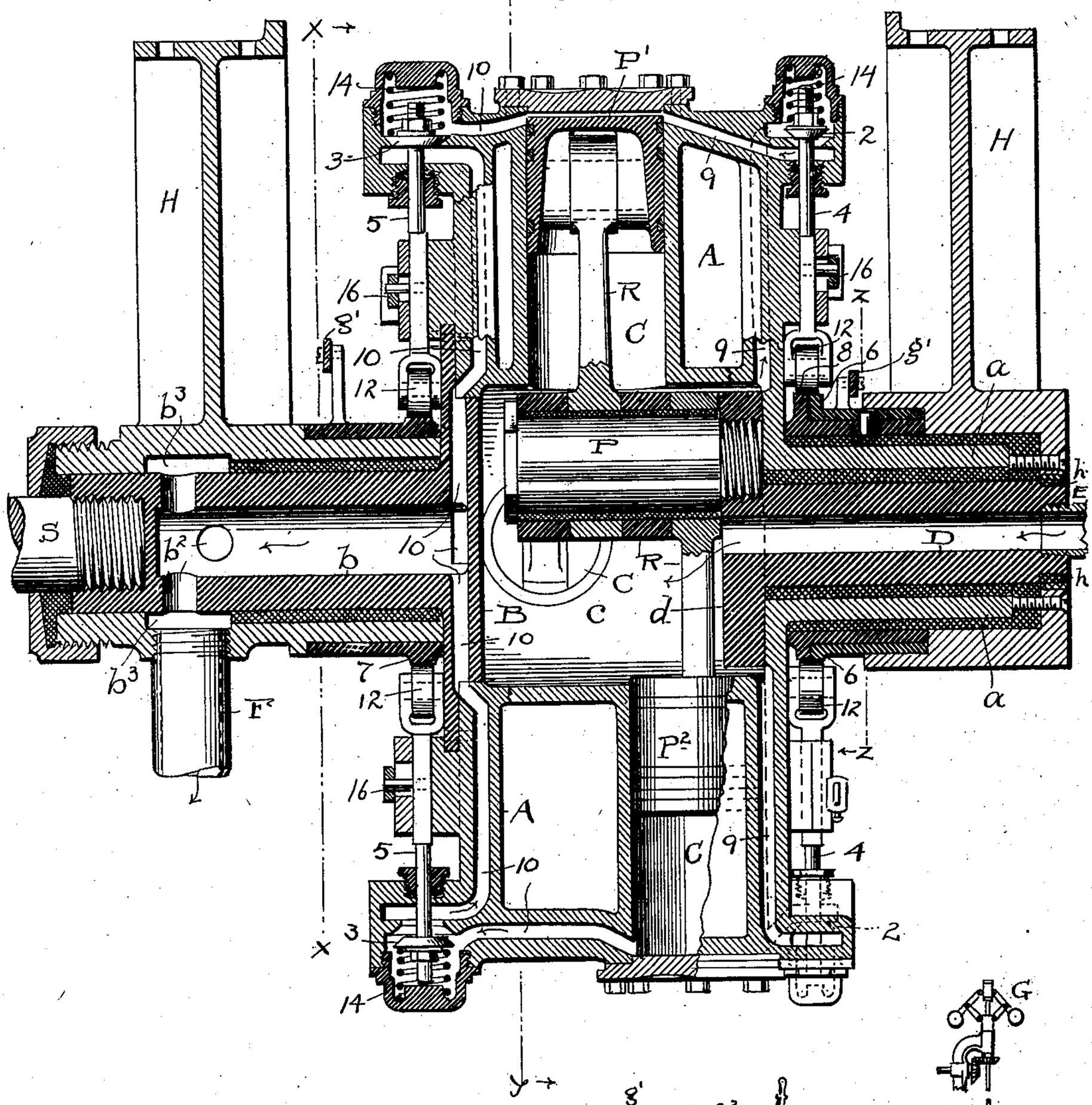
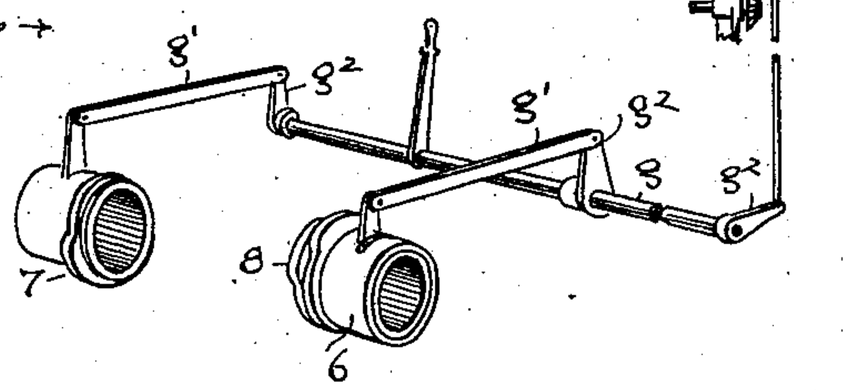


FIG. 3.



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NO MODEL. 4 SHEETS—SHEET 3.

FIG. 4.

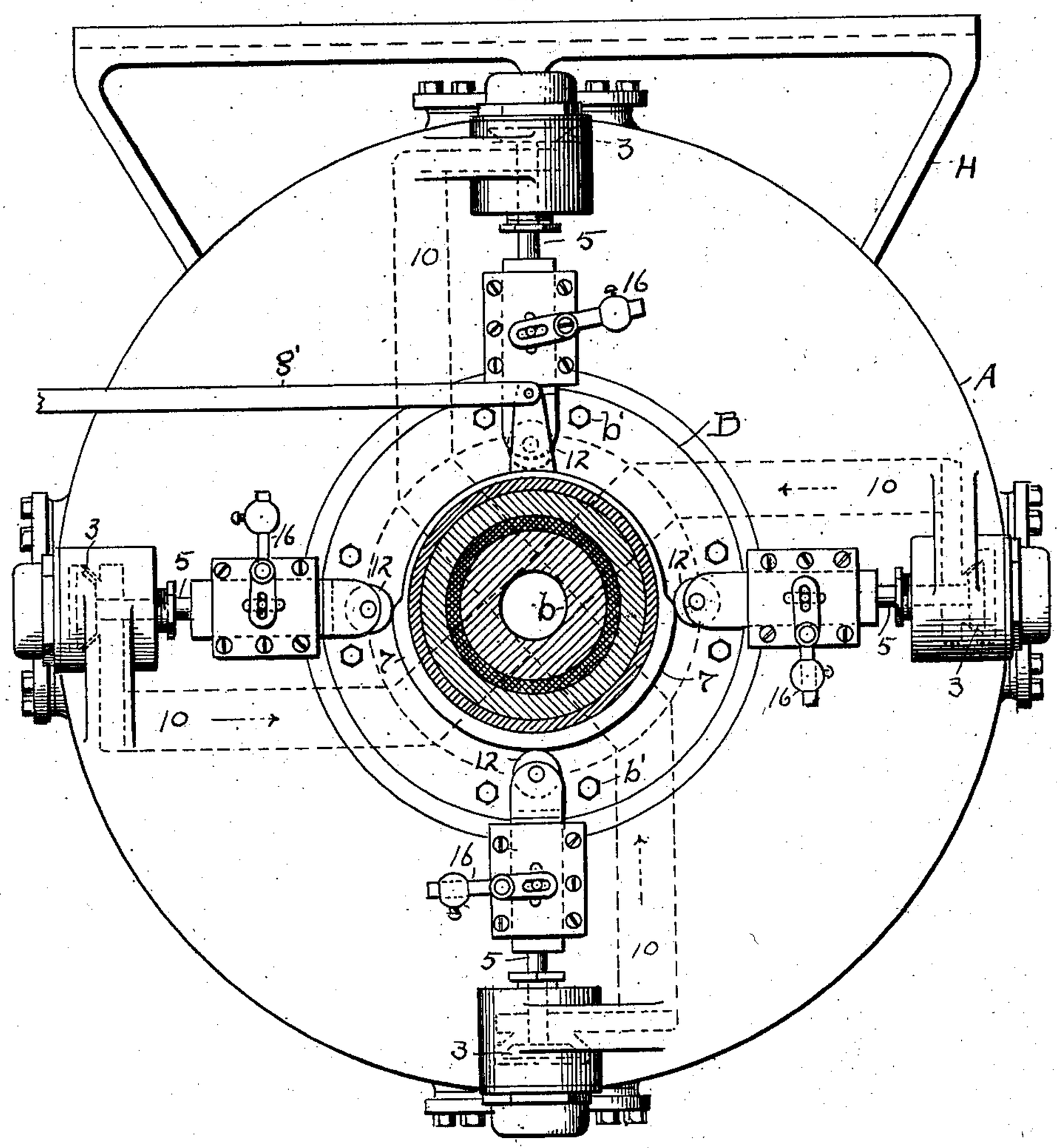
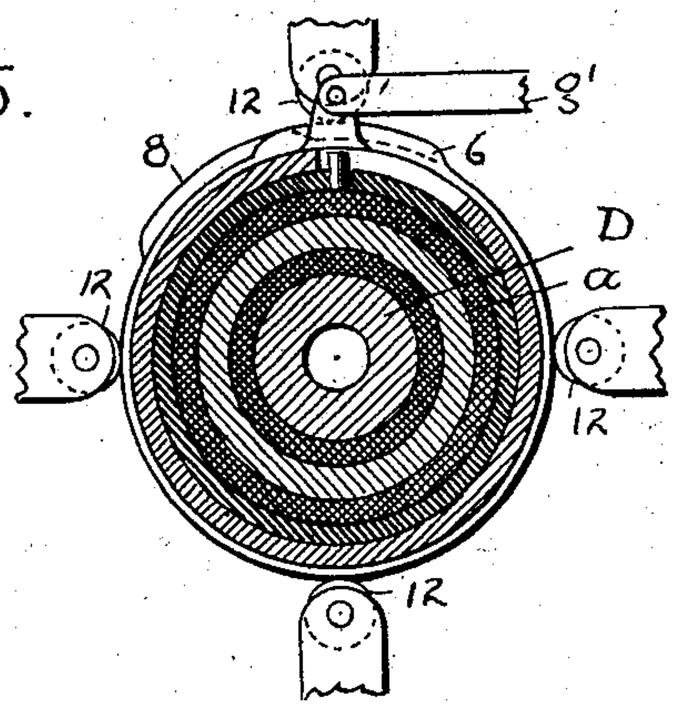


FIG. 5.



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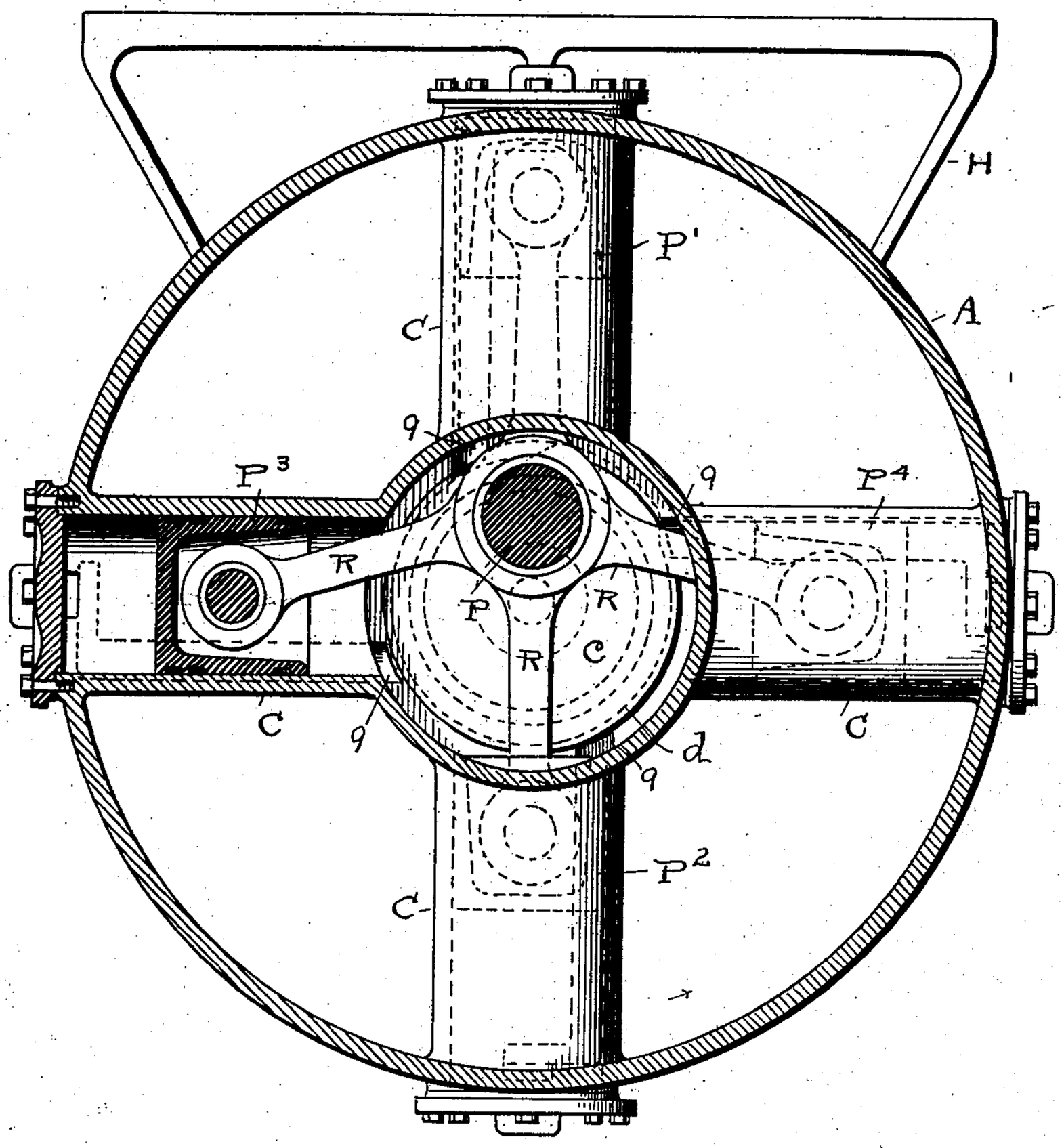
NO MODEL. 4 SHEETS—SHEET 4.

FIG. 6.



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No. 747,894. Patented December 22, 1903.

UNITED STATES PATENT OFFICE.

ALFRED P. SCHMUCKER, OF FRANKLIN, PENNSYLVANIA, ASSIGNOR TO E. M. HELM, OF CLEVELAND, OHIO, AND W. J. HUNKIN, OF RIDGEWAY, PENNSYLVANIA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 747,894, dated December 22, 1903.

Application filed August 17, 1903. Serial No. 169,833. (No model.)

To all whom it may concern:

Be it known that I, ALFRED P. SCHMUCKER, a citizen of the United States, residing at Franklin, in the county of Venango and State of Pennsylvania, have invented certain new and useful Improvements in Rotary Engines; and I do declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to rotary steam-engines; and the invention consists in the construction and combination of parts substantially as shown and described, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a plan elevation of my engine with the means for suspending the same in working position shown at each side. Fig. 2 is a sectional elevation vertically on the axis of the engine. Fig. 3 is a separate and considerably-reduced perspective view of the cams and mechanism for operating the same to control the position of the inlet and exhaust valves, as hereinafter fully described. Fig. 4 is a side elevation of the casing and certain associated parts and a cross-section of certain central parts on line $x\,x$, Fig. 2. Fig. 5 is a cross-section on line $z\,z$, Fig. 2, but omitting the casing behind the same. Fig. 6 is an elevation in section on line $y\,y$, Fig. 2, disclosing especially the position of the piston-governing crank in relation to the axis of the engine and the pistons disposed around the same.

The engine thus shown comprises a suitable casing formed in two parts A and B, as hereinafter fully described, and in which are four several cylinders C radially disposed about a common center within said casing and at equal or quarter distances apart, as seen in Fig. 6. Said cylinders constitute an integral part of the casing in this instance. The said casing also has a central internal steam chamber or chest c, open alike to all said cylinders, and said cylinders are in such staggered relation about said chamber as to afford to each piston P' P^2 P^3 P^4, respectively, a direct or straight rod connection R with the fixed crank P, on which the said piston-rods are supported side by side, Fig. 2.

The plan of operation for the engine contemplates the rotation of both the cylinders and the pistons therein about their own respective axes; but the pistons necessarily travel with the cylinders, and the axial center of casing A is the axis also of cylinders C, while crank P is the axis for the pistons. This arrangement makes the cylinders C eccentric to the pistons or the pistons eccentric to the cylinders, according to the point of view, because crank P, from which the pistons are supported and operated, is considerably off the axial center of casing A and is a fixed or stationary part as to rotation with the other parts. It may, however, be given individual rotation, if desired, for starting the engines or other purpose. As shown here, the said crank is screwed into flange or head d of a centrally-bored short shaft D, which is placed in position from the left through steam-chamber c and projects outward through and beyond journal a of the engine-casing, where steam-inlet pipe E connects with the same and affords a channel for live steam to the engine. The casing comprises also a side portion B, as above stated, and which is provided with a journal b, corresponding to journal a on the opposite side of the casing. Said portion B is secured to the side of the main portion of the casing by means of bolts b' and is of a size to overlap the edge of steam-chamber c all around, thus closing said chamber on this side, as is obvious, and packing can be used in this connection if needed.

Exhaust-pipe F is fixed upon the bottom of hanger H and is in open communication with the exhaust-ducts from the pistons through a bore in journal b and side ports b^2 into the annular space b^3 open to pipe F. It thus occurs that steam enters through journal a and exhausts through journal b, and both pipe connections E and F are fixed or non-rotatable parts.

As herein shown, the engine is designed more especially for automobile service, and brackets or hangers H are provided for supporting it in working position. Power-delivering shaft S is shown as having a fixed connection in the extremity of journal b, and

thus it is manifest that the entire engine is planned to have a rotary movement about its axis in hangers H, while the pistons also rotate therewith in cylinders C, but in addition are given a back-and-forth movement in said cylinders, or the cylinders move back and forth in respect to the pistons, as already explained. Now having cylinders C rotatable and the pistons connected with a fixed non-rotatable crank the net effect of steam-pressure in the cylinder is to bend or flex the pressure into a rotary movement of the cylinders, and thus what is a direct pressure of steam at a dead-center point is converted into a rotary driving force or power the instant the live cylinder comes into action past said center point and up to something like a half-rotation of the engine. Thus, assuming that bottom cylinder C with piston P^2, Fig. 6, to be carried across its dead-point toward P^4. At P^4 it reaches the half-way point of its movement outward, with exhaust-valve open, and when it gets up to P′ it reaches the limit of its stroke. At this point and as the piston retreats in the cylinder live steam is admitted past valve 2, as above described, and said piston and cylinder are for the time neutralized. This continues as long as the piston continues its rearward travel or until it takes position of piston P^2, Fig. 6, and so on as to each piston and cylinder in turn successively.

Each cylinder is provided with its own steam-inlet valve 2 and outlet or exhaust valve 3, and said valves have stems 4 and 5, respectively, supported in suitable brackets and are controlled or operated by cam-rings or cams 6 and 7, respectively, fixed rotarily upon suitable bearings immediately at the outside of casing A at each side thereof, as shown in Fig. 2. Said rings are adapted to be rotated automatically or by hand, as shown in Fig. 3, but the operation is automatic usually through a suitable governor G, whether of the form shown or some other form. Suitable connections by shaft *g*, links *g*′, and levers g^2 on shaft *g* connect governor G with said cam-rings and control their positions rotarily, according to the speed of the engine. If the speed be high, the said cams are turned to limit or shorten the flow of steam past valve 2, and if the speed be low said cams are rotated reversely. Auxiliary cam 8 is used in conjunction with cam 6 to still further prolong or extend the inflow of steam, and is shown as sleeved within cam 6 in this instance and has limited rotation therein. By this special arrangement the working length of cam 6 can be lengthened or shortened at pleasure, so as to prolong or shorten the flow of live steam to the front of the pistons. Such flow is through ducts 9 from steam-chest *c* and the exhaust is by ducts 10. Cams 6 and 7 are stationary except as moved by said governor.

Each valve-stem has a roller or wheel 12 running on the corresponding cam 6 or 7, as the case may be, and at its other end is under pressure of a spring 14 to press the valve to its seat. Hence each valve is open only as it is forced open by the corresponding cam, and as a given inlet-valve is open, Fig. 2, the exhaust-valve for the same piston is closed and steam enters in front of said piston. This occurs at the instant, substantially, that the directly-opposite piston is carried across the dead-center, and thus the piston which is up for the time being, P′ in this instance, is neutralized and is not permitted during its idleness to work against the piston upon which the work is placed. This is so because all the pistons are alike under pressure on their inner sides all the time, and if this pressure were offset or counterbalanced on piston P′ it would simply balance the pressure on piston P^2 and the engine would be blocked. Hence piston P′ must be cut out or neutralized, and this is done by admitting steam to the front thereof also, which equalizes the pressure on both sides thereof.

If the valve-rods 4 and 5 show a centrifugal tendency under the high rate of travel of the engine, notwithstanding springs 14 to keep them in, I may provide a counter-weighted arm 16 for each valve or valve-rod so arranged that its own throw will be inward rather than outward.

By reason of operating all the parts on the rotary principle I am enabled to run this engine at a high rate of speed without damage or detriment to any part, and as all the working parts are incased at or in the center of the engine they are absolutely protected from dust. This also brings the parts together for effective lubrication through the steam.

The material advantage to be gained by the auxiliary cam is twofold. For economy in the use of steam it is necessary that the admission of steam should be cut off at the earliest possible point of the stroke in order that the greatest possible proportion of the power developed by the machine should be derived from the expansive properties of the steam. For example, presuming a given size cylinder with given stroke were made to cut off at one inch of the stroke the diameter of the cylinder being such that we would consume one-twelfth of a cubic foot of steam. With steam at a given pressure we will presume that the mean effective pressure of the piston throughout the entirety of the stroke to be ten pounds. Taking the same cylinder and allowing the steam to be admitted to the cylinder for the total length of the stroke, which we will presume in this case is twelve inches, it would essentially take twelve times the amount of steam, while the power derived would be from a mean effective pressure of your total boiler-pressure. While in this case the power derived is six times as much, yet the consumption of steam is twelve times as much. Thus for economy sake the earlier the cut-off the better. On the other hand, the engine

used for the purposes for which this is designed is called upon frequently to exert an extreme amount of power, possibly only momentarily, as ascending a steep grade. In this case by lengthening the period of admission of steam we are enabled to attain from the engine all the power needed, even though for the time being the economy may not be so great, yet it serves well to help over the requirements for a short period. This arrangement of the auxiliary cam also eliminates the necessity of moving the crank-shaft, as with the admission-cam lengthened out to over one-fourth of the periphery of the circle it allows two valves to be opened at one time in case the position of the engine is such that the one piston on which the cam is operating is at or near dead-center, thus allowing the other valve to propel the engine until such time as the other piston is moved to a point sufficiently far from dead-center to exert its power. Thus in starting a machine we admit steam to the piston for over one-half of its stroke, while after starting the point of cut-off can be made earlier, thereby insuring greater economy.

What I claim is—

1. In rotary engines, a series of radially-disposed cylinders having a common axis and a centrally-arranged live-steam chamber open to the inner end of the cylinder, pistons for said cylinders having a different axis from said cylinders, steam inlet and outlet ports at the outer end of said cylinders, and valve mechanism to open and close said ports, substantially as described.

2. The engine-casing and the cylinders therein adapted to be rotated about a common axis, a central live-steam chamber open to all said cylinders, a crank within said chamber, pistons in said cylinders connected with said crank, inlet and exhaust ports with valves for each cylinder, a cam to control the movement of said valves, and an auxiliary cam to vary the length of time said valves are to remain open, substantially as described.

3. An engine-casing adapted to be rotated about a central axis and radially-disposed cylinders therein, in combination with a crank extending into said casing, pistons in said cylinders with crank connections therefor, inlet and outlet ports with valves for each cylinder, a cam for operating said valves, an auxiliary cam member mounted flush with said first cam, and means to adjust said cam member to vary the peripheral outline of the cam, substantially as described.

4. The rotatable engine-casing and a plurality of cylinders radially disposed therein, a crank centrally within said casing, pistons within said cylinders with crank connections therefor, inlet and outlet ports for each cylinder with valves for each port, and an operating-cam common to all said valves and means to rotate said cam, in combination with an auxiliary cam independently rotatable at the side of said first cam and means to rotate the same in respect to said first cam, substantially as described.

5. An engine-casing adapted to be rotated about a central axis and radially-disposed cylinders therein, inlet and exhaust ports open to said cylinders, pistons and connecting-rods and a fixed crank within said casing, valves for the inlet and exhaust ports, a cam for operating said valves, and means connected therewith to control the time of cut-off, substantially as described.

6. The engine-casing and the cylinders therein radially arranged about a common axis, a crank within said casing, pistons with crank connections, inlet and outlet ports and steam-controlling valves therefor, a rotatable cam for said valves, and an auxiliary cam mounted upon said first-named cam and independently movable thereon to vary the shape of the peripheral track around both cams, and operative means for each cam, substantially as described.

7. The engine-casing having cylinders therein and a central-arranged live-steam chamber open to said cylinders, a fixed crank within said chamber, pistons for said cylinders connected with said crank, inlet and exhaust valves for each of said pistons, and means to open and close said valves, substantially as described.

8. In rotary engines, a series of radially-disposed cylinders having a common axis and a central live-steam chamber open to all said cylinders, pistons for said cylinders, a fixed crank within said chamber, crank connections for the pistons, a steam inlet and outlet port at the outer end of each of said cylinders, a valve for each port, a cam for said valves rotatably mounted at each side of said casing, an auxiliary cam rotatably mounted at the side of one of said cams and having a limited independent movement therewith, and separate means to actuate said cams and auxiliary cam, respectively, substantially as described.

In testimony whereof I sign this specification in the presence of two witnesses.

ALFRED P. SCHMUCKER.

Witnesses:

IRVING W. COLBURN,

PHIL ENGELSKUGER.