B. H. ALLEN.

ROTARY STEAM ENGINE.

APPLICATION FILED APR. 5, 1918.

1,309,871.

Patented July 15, 1919.

3 SHEETS—SHEET 1.

Fig. 1.

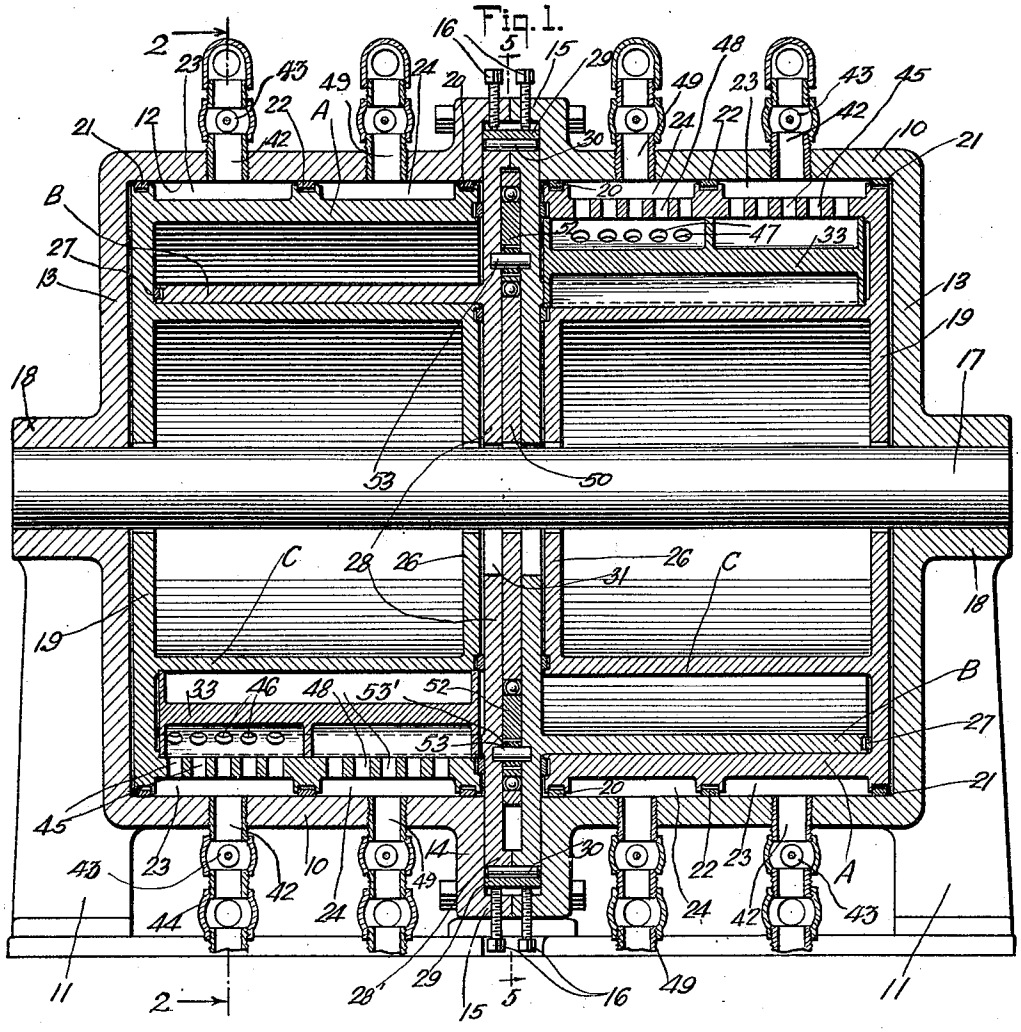
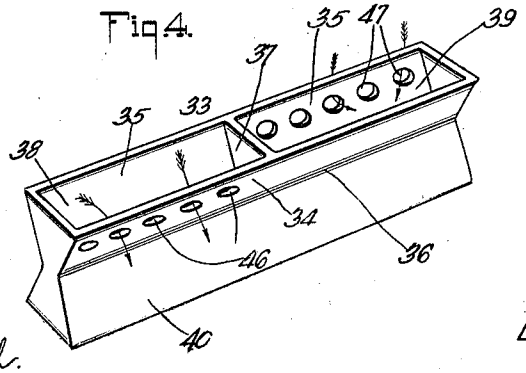


Fig. 4.



WITNESSES

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3 SHEETS—SHEET 2.

Fig. 2.

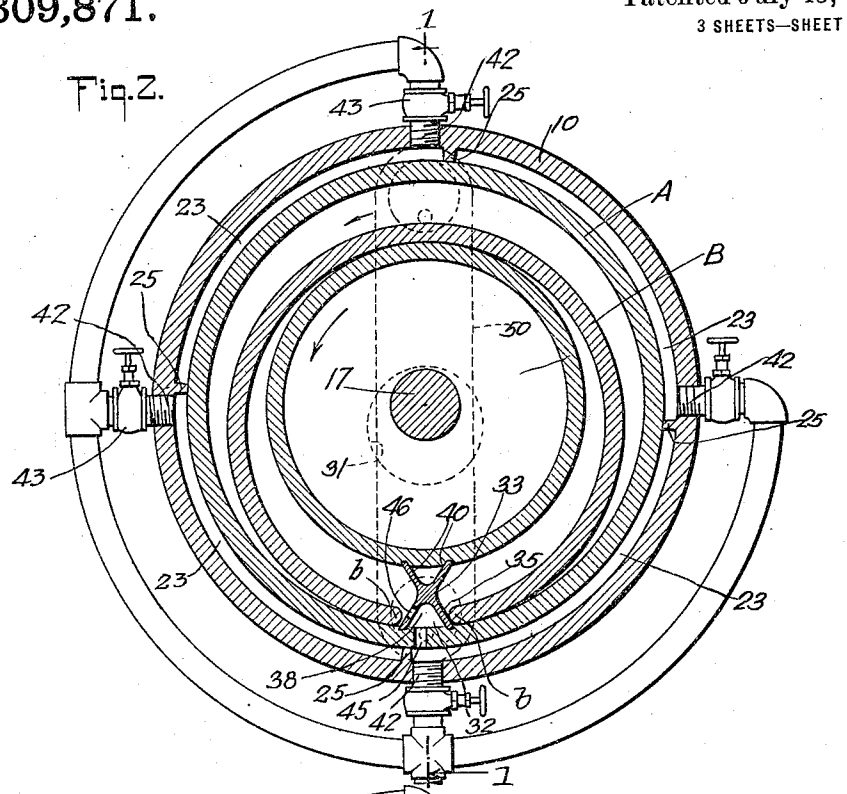
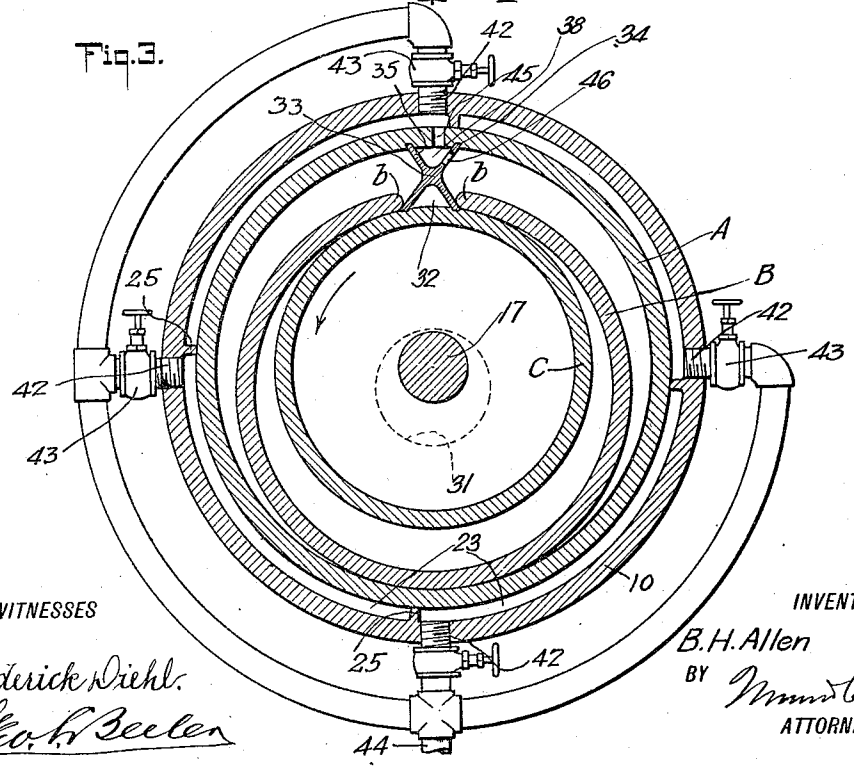


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 5.

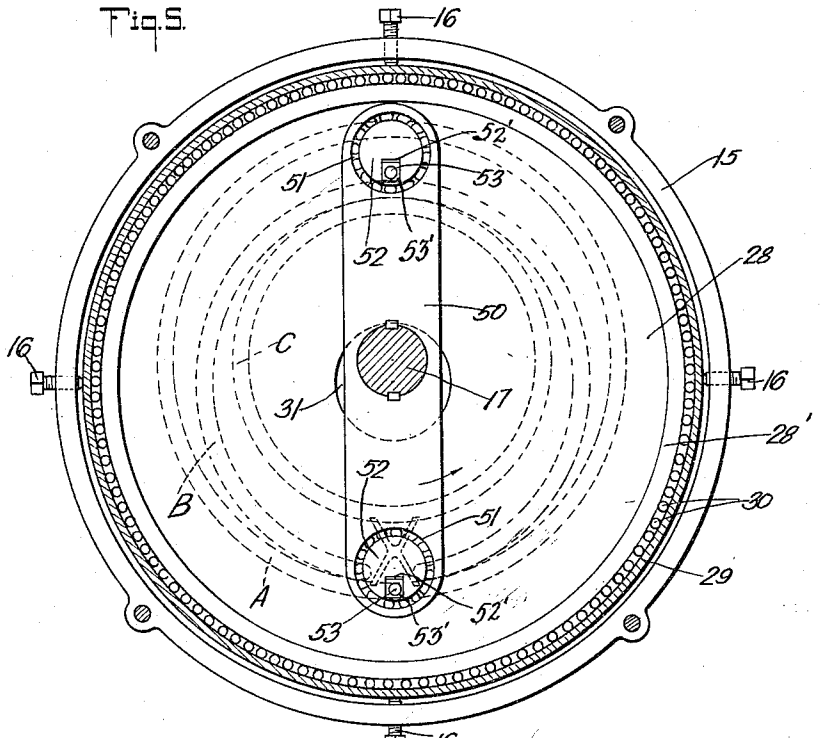
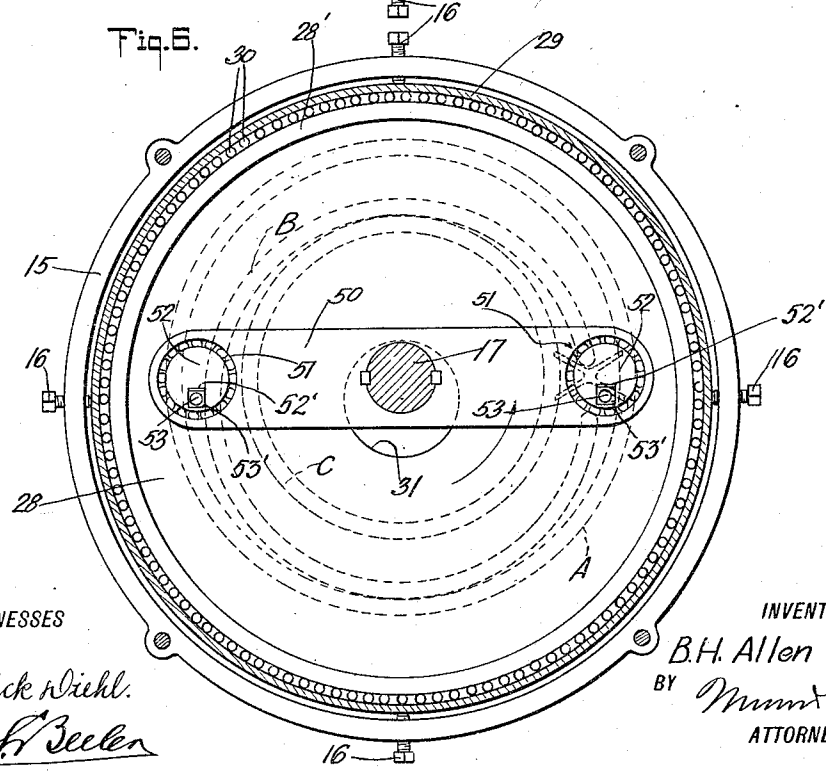


Fig. 6.



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UNITED STATES PATENT OFFICE.

BURNET HENRY ALLEN, OF ABERDEEN, WASHINGTON.

ROTARY STEAM-ENGINE.

1,309,871. Specification of Letters Patent. **Patented July 15, 1919.**

Application filed April 5, 1918. Serial No. 226,919.

To all whom it may concern:

Be it known that I, BURNET H. ALLEN, a citizen of the United States, and a resident of Aberdeen, in the county of Grays Harbor and State of Washington, have invented a new and Improved Rotary Steam-Engine, of which the following is a full, clear, and exact description.

This invention relates to prime movers and has particular reference to rotary steam engines or engines in which the expansive fluid acts directly upon a rotating baffle plate driving it around the engine shaft, as distinguished from a reciprocating piston. By the term "engine" as used in this specification I intend to cover any analogous mechanical contrivance, employing the word in its broad sense, and the improvement hereinafter set forth may be availed of in whole or in part in the construction of not only rotary engines in which any medium under pressure is employed to actuate the pistons, but also machines to which power is applied to drive the shaft and baffle plates so that they may be used as pumps, water meters, and devices for other similar or analogous purposes.

In this engine I employ a new and basic principle of a "double center," and have designated it a "double center rotary engine." The principle of the double center is that the main engine runs on two centers as will hereinafter more particularly appear. In accomplishing this my engine runs on three principal points of bearing, one at each end of the double engine, and one between the two units of the double-engine. I accomplish in this engine an automatic multiple intake and an automatic multiple exhaust without complicated intricate machinery, the exhaust being continuous, and the intake continuous or interrupted as desired. I employ a baffle-plate in place of a piston, which baffle plate has but one motion, that of rotation about the driven shaft. I employ a suitable mechanism to properly and conveniently adjust the parts operating about one center to the parts operating about the other center. For the purpose of operating the moving parts about one center in unison with the moving parts about the other I employ a new and improved mechanism consisting of a bar connected to and driven by and in rotation with the engine shaft, all as hereinafter more particularly explained.

Among the objects of the invention, therefore, is to provide a rotary engine so designed and constructed that the steam or analogous pressure medium will act automatically and directly upon or against the baffle plate, no mechanical cut-offs, sliding valves or other friction producing devices being employed or relied upon to control the admission and exhaust of the steam, except as hereinafter set forth. In the following description I shall assume that the device is being employed as a steam engine, although it is capable of use as a pump, water motor, or the like.

Another object of the invention is to provide an engine in which there are provided a plurality of cylinders at least two of which are hollow and one of them is located between the other two, the innermost and outermost cylinders being concentric and operated to rotate simultaneously around their common center while the interposed cylinder is rotated around a different center but in the some direction once for each rotation of the concentric cylinders, thus providing and accomplishing in the engine the principle of the double center.

A further object of the invention is to provide a rotary steam engine having a multiplicity of inlet ports extending circumferentially therearound, any one or more of which may be functional while the remainder may be idle for varying the operation of the engine.

Another object of the invention is to provide an engine having a plurality of exhaust ports arranged circumferentially of the rotating parts which are all preferably open continually but which may be converted into admission ports while the previously mentioned admission ports become the exhaust ports, the single movement baffle plate being so designed as to accommodate its functions for such reversal.

A still further object is to provide for a rotary steam engine comprising a plurality of nested cylinders each adapted to rotate freely around its own center one cylinder being external to the other and having a different center but both cylinders being in

constant contact with each other along a certain line, means to delicately adjust one of the cylinders radially with respect to the other to maintain such contact and to provide suitable bearings for the several cylinders irrespective of the adjustment thereof.

A still further object of the invention is to provide a rotary steam engine in which there are provided three coöperating cylinders two of which are concentric and rigidly connected to and for the rotation of a central driven shaft having its own bearings, while the third cylinder is eccentric to the other two cylinders and operates between them having constant contact along one line or position with one of the first two cylinders and having constant contact along a diametrically opposite line or position with the other of the first two cylinders, the third cylinder being provided with its own concentric bearings and having means for rotating it from said shaft and hence substantially in unison with the two cylinders connected to and concentric with said shaft.

A still further object is to provide a rotary steam engine comprising a double and reversible engine in which is provided a flange or disk separating and connecting the two units of the engine, on either side of which is rigidly attached a cylinder, one of such cylinders operating in each unit of the double engine, and which disk or flange rotates about a center eccentric to the engine shaft, upon bearings adapted to be delicately adjusted to prevent undue friction of rotating members where they come in contact in forming abutments.

A further object is to provide a rotary steam engine having a bar rotating with and keyed to the engine shaft within and operating a disk or flange connecting and separating the two units of the double engine, said bar being the mechanism operating the working parts of the engine which rotate about one center, but being itself operated by the working parts rotating about a different center.

A still further object of my invention is to provide a rotary steam engine having mechanism simple and substantial to operate within the engine which is constructed on a double-center principle, the moving parts about one center,—while itself being operated about the other center, such mechanism consisting principally of a bar in either end of which is a large bearing opening in which is mounted for anti-friction rotation a disk, said disks being adapted to rotate about their own centers and being equidistant from the one center of the engine being that center about which said bar rotates, while in each disk there is a slot of rectangle form in which is inserted a block so arranged that it may be moved in the slot slightly from center to circumference of the disk or the reverse. Through the block passes a pin fitted into a large disk operating about the other center of the engine, and the center of said pins being equidistant from the center of said disk, thus permitting of a delicate adjustment of the moving parts of one center to the moving parts of the other.

With the foregoing and other objects in view the invention consists in the arrangement and combination of parts hereinafter described and claimed, and while the invention is not restricted to the exact details of construction disclosed or suggested herein, still for the purpose of illustrating a practical embodiment thereof reference is had to the accompanying drawings, in which like reference characters designate the same parts in the several views, and in which—

Figure 1 is a vertical longitudinal section of that embodiment of my improvement that I regard at this time as the most advantageous, the structure illustrated constituting in effect a double engine, the section being on the line 1—1 of Fig. 2;

Fig. 2 is a vertical transverse section on the line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 2, but showing the parts as having made a half rotation from the position of Fig. 2;

Fig. 4 is a detail perspective view of one of the baffle plates as they will hereinafter be termed, the upper portion of the baffle-plate indicated in Fig. 4 being that part that is uppermost in Fig. 3;

Fig. 5 is a vertical tranverse section midway between the two engine parts or substantially on the line 5—5 of Fig. 1 and with the rotating cylinders indicated in dotted lines in the position of Fig. 2; and

Fig. 6 is a view similar to Fig. 5 indicating the relative position of the parts after having made a quarter rotation from the position of Fig. 5.

As above premised Fig. 1 indicates a double engine or a construction in which substantially two complete engines are arranged end to end. In the preferred arrangement of this type of engine one of the baffle plates should always be diametrically opposite the other for the best results. Throughout the following detail description, however, attention will be given primarily to a single engine it being understood that the construction and operation of both engine units are practically identical.

Referring now more particularly to the drawings for a specific embodiment of mechanism, I show at 10 a cylindrical casing supported by any suitable means such as a bracket 11 for the purpose of being held in fixed position. The main portion of the casing constitutes a hollow cylinder having a smooth inner surface 12 while the end wall 13 thereof is flat or disk like. The other end of the cylindrical part of the cas-

ing is provided with an outwardly projecting flange 14 of circular form, but eccentric to the main casing. This flange terminates in a laterally projecting annular flange 15 the axis of which is parallel to the axis of the main casing. This annular flange 15 constitutes a seat for a plurality of adjustable screws 16, or their equivalent, acting radially therethrough.

17 indicates the shaft which represents the driven member. The shaft is journaled for rotation in any suitable bearings such as 18 and is coaxial with the casing 10.

The three cylinders above referred to are indicated by the letters A, B, and C. A is a hollow cylinder having one end open and the other connected by means of a solid disk 19 to the shaft 17. The outer surface of the cylinder A is provided with any suitable steam rings 20 and 21 at its opposite ends and preferably midway between them with a third steam ring 22, all of said rings bearing against the surface 12 of the casing and forming between the outer surface of the cylinder A and said inner surface of the casing two parallel circular series of arc shaped steam chambers 23 and 24, which for the purpose of the present discussion will be regarded as inlet and exhaust chambers respectively. As indicated in Figs. 2 and 3 each series of chambers consists of four members, the divisions between adjacent members being formed by cut-offs 25 constituting extensions leading inward from the casing 10. The steam ring 22 prevents direct communication between any chamber 23 and any chamber 24.

The cylinder C may or may not be hollow but is provided with a smooth unbroken outer surface of true cylindrical form coaxial with the cylinder A. The inner end of this cylinder consists of a disk 26 constituting a means to fix the same to the shaft 17, while the outer end of the cylinder is rigidly connected to the disk 19.

The cylinder B is hollow and consists of a true cylindrical shell of uniform thickness located within but not filling the space between the inner surface of cylinder A and the outer surface of cylinder C, but always in contact with both and along the same lines, namely, the top of cylinder C and the bottom of cylinder A. The outer end of cylinder B is provided with a steam ring 27 making tight joint with the inner surface of the disk 19 between the cylinders B and C. The inner end of cylinder B is rigidly secured to or made as a part of a disk 28 whose periphery 28′ constitutes an annular bearing member concentric with and spaced slightly inward from the annular flange 15. 29 indicates an annular bearing race loosely surrounding the bearing 28′ and adapted to be delicately adjusted by means of the set screws 16 above described, the annular series of antifriction rollers 30 being interposed between the ring 29 and the bearing 28′. These bearing features constitute the primary support for the cylinder B. The disk 28 is provided with a large central opening 31 to accommodate the rotation of the disk around the shaft 17 which extends through the opening but eccentric thereto. From the drawings it will be apparent that the eccentricity of the cylinder B with respect to the other two is substantially equal to the maximum clearance between the inner surface of cylinder B and the outer surface of cylinder C and likewise between the outer surface of cylinder B and the inner surface of cylinder A. I wish to observe at this time, however, once for all that each cylinder rotates around its own axis without any throw, movement or revolution as distinguished from rotation, or change of position with respect to the center of the casing. The cylinder B, however, is provided with a longitudinal slot 32, which at one instance as in Fig. 2 is proximate to the cylinder A while at the next half rotation is proximate to the cylinder C shown in Fig. 3, otherwise the cylinder B is imperforate and so far as now described, is free to rotate around its own axis in the space between the cylinders A and C.

Attention is now called to the baffle plate indicated in detail in Fig. 4 and represented as a whole by the numeral 33. This consists of what may be termed a block of generally rectangular form, but comprising a body substantially X-shaped in cross section. This body therefore comprises outer flanges 34 and 35 arranged divergent from each other from the solid center 36 of the baffle plate forming between them a sort of trough bisected by means of a wall or partition 37 into inlet and exhaust chambers 38 and 39 respectively. The body comprises also inner divergent walls 40. Each baffle plate is substantially coextensive in length with the several cylinders and the walls 34 and 35 are fitted or fixed in any suitable manner in the inner surface of the cylinder A while the otherwise free edges of the walls 40 are fixed or fitted in the outer surface of the innermost cylinder C. Thus the baffle plate constitutes a fixed or rigid connection between the cylinders A and C and so revolves around the axis of the cylinders A and C coincidentally with the rotation of the cylinders around the same axis. Furthermore the baffle plate lies in or projects through the slot 32 formed in the cylinder B, the width of the slot being substantially equal to the wider, inner and outer portions of the baffle plate, while the points or free edges b of the cylinder are adapted to wipe more or less closely along the front and rear walls of the piston while such edges of the cylin-

der B are brought in succession from one extreme position as in Fig. 2 to the other extreme position as in Fig. 3.

For each inlet steam chamber 23 I provide an inlet port or pipe 42 each located close to a cut-off 25. These inlet ports or pipes may be controlled by any suitable valves 43 whereby any portion of them may be rendered idle while the remaining portion may be functional. All four of the inlets, however, may be supplied with live steam from the boiler through the same steam pipe 44. 45 indicates any suitable holes or ports formed through the wall of cylinder A through which steam may pass from any one of the chambers 23 into and through the piston chamber 38 through a series of ports, or their equivalent, 46, leading to the rear of the baffle plate. These ports 45 in the wall of the cylinder A are in open communication with each steam chamber 23 throughout the circumferential extent thereof or from one cut-off 25 to the next and so the chamber 38 and the space at the rear of the baffle plate and between the cylinders A and C is always in direct communication with the live steam and boiler pressure, assuming that all of the ports 42 are open.

On the opposite side of the wall 37 the baffle plate wall 35 is provided with a series of exhaust ports 47 bringing the exhaust chamber 39 of the baffle plate into communication with a series of exhaust ports 48 formed in the cylinder A adjacent to the several steam chambers 24 in succession from each of which leads an exhaust port 49 open to the atmosphere. I wish to observe at this time that while I show four inlet steam chambers 23 and four exhaust chambers 24 for each engine and a pipe connection 42 or 49 for each of these chambers this number is subject to such variation as may be determined in practice according to the purpose to which the machine may be put.

The reader's attention is now called to the means I provide for mechanically connecting the cylinders that are mounted eccentric to each other so that they shall all be caused to rotate substantially in unison around their several axes but without any one of them changing its position bodily. 50 represents what I may call a key bar fixed centrally upon the shaft 17 whereby it is positively rotated by and with the shaft 17. In each end of the bar is formed a large bearing opening 51 in which is mounted in any suitable manner for antifriction rotation a disk 52. In each disk 52 is a slot 52′ into which is inserted a block 53′ through which passes a pivot pin 53 fitted into the disk 28 of the cylinder B. These pivot pins 53 are mounted in the disk 28 equidistant from the center of the cylinder B and diametrically opposite to each other from said center and so they are both eccentric to the bar disks 52 to correspond to the eccentricity of the two cylinder axes. It follows, therefore, that during the rotation of the shaft 17 and bar 50 fixed thereto the bar disks 52 are given a relative rotation with respect to the bearing openings 51 for each bodily revolution of the bar disks 52 around the axis of the shaft 17. In other words, the ends of the bar 50 carry the disks 52 bodily in a revolution thereof around the axis of the shaft 17 while the pivot pins 53 actually hold said disks 52 from rotation around the centers of the disks 52. In other words, since the pivots 53 are located at equal distances from the center of one diameter of the disk 28 and the center of this diameter is always below the center of the shaft 17 it follows that the centers of the pins 53 are always similarly directly below the centers of the disks 52.

It will be observed that the abutments are formed by contact of cylinders A and B, and B and C, and such contact must be adjustable. This is accomplished by adjusting the disk 28 by means of set screws 16. In the adjusting operation it is necessary that a corresponding adjustment be made of the blocks 53′ in the slots 52′, so that the slots 52′ must be of sufficient length extending between center and circumference of disk 52 to permit of such adjustment. The adjustment last mentioned becomes automatic with the adjustment of disk 28.

Having thus set forth the description of the mechanism the operation of the engine may be briefly set forth as follows: Starting with the baffle plate in the position of Fig. 2 steam is admitted at boiler pressure through the pipe 44, port 42, arc shaped chamber 23, through the ports 45 of cylinder A into and through the chamber 38 and through the ports 46 into the space behind or at the left of the baffle plate and between the outer surface of the left half of cylinder C and the inner surface of the left half of cylinder B. From this space there is no escape for the steam because the cylinders B and C are always in direct contact along the upper line. Since these two cylinders B and C each occupy fixed positions or rotate about their own fixed centers, said opposed surfaces constitute in effect a fixed abutment against which the expanding steam reacts and drives the baffle plate and parts connected thereto in the general direction of the arrows on the several figures. This action of the cylinders B and C as a fixed abutment obtains irrespective of the fact that they are rotating each about its own center. While the baffle plate is passing thus to the right in Fig. 2 the ports remain in communication with the steam chamber 23 until the first cut-off 25 is reached, but before the baffle plate reaches the first cut-off a new

abutment will have been formed as will be indicated in Fig. 6 between the outer surface of cylinder B and the inner surface of cylinder A at the back of the baffle plate and so steam admitted into such space will expand in a like manner and drive the baffle plate forward. If only the lowest port 42 is open the full expansion of the steam will be relied upon, but if more than one be open then a fresh charge of live steam will be admitted from each of the chambers 23 in succession. The steam first admitted will begin to exhaust as the baffle plate passes the point represented by the position shown in Fig. 3. In other words, notwithstanding the fact that the top of the cylinder B is always in contact with the top of cylinder C yet the slot 32 has a shifting movement in the nature of an oscillation between the outer surface of cylinder C and the inner surface of cylinder A so that when the edge *b* ahead of the baffle plate leaves the position of Fig. 3 it begins to approach the outer cylinder insuring that all of the steam chamber ahead of the baffle plate will be in open communication with the exhaust ports 47, 48, chamber 24 and exhaust port 49. In brief, the space back of the baffle plate is always closed, the walls bounding such space constituting a fixed abutment, while the space ahead of the baffle plate is always open for free exhaust. The friction incident to the rotation of the cylinder B is very slight, the power required being only enough to rotate such cylinder around its own axis. Thus I provide a rotary engine which may be regarded as valveless unless the cylinder B may be considered in the nature of a valve. Furthermore, since practically every movable element of the engine either rotates or revolves around a fixed center and there is, therefore, no throw nor eccentric movement of any part with respect to the other parts, I have no problems of vibration or the like to combat. As will be noted from Fig. 6 during the first quarter of rotation from the starting point the rotation of the cylinder B appears to be retarded slightly, as an incident of the eccentricities of the cylinder B with respect to the shaft 17 and bar 50 secured thereto. The edge *b* of the cylinder ahead of the baffle plate during this part of the rotation will wipe more or less closely along the outer surface of the wall 35 of the baffle plate. During the second quarter rotation there will be a corresponding acceleration until the same edge *b* comes in contact with the upper portion of cylinder C, Fig. 3. It will thus be seen that the slot 32 and the cross sectional form of the baffle plate will be designed or proportioned according to these movements.

During the third quarter rotation there is a continued apparent acceleration, and in the fourth an apparent retarding, so that in the lower half of the engine there is an apparent retarding and in the upper half an apparent acceleration. It must be borne in mind, however, that cylinder B is rigidly attached to disk 28 driven as hereinbefore described and has a uniform speed equivalent to the speed of an imaginary cylinder located midway between cylinders A and C on their center. The apparent acceleration and retarding of cylinder B is due to the difference of centers.

I claim:

1. In a rotary steam engine, the combination of a shaft, a stationary cylindrical casing in the longitudinal center of which said shaft is journaled, said casing having an annular raceway eccentric to the shaft, pairs of cylinders fixed to the shaft and rotating within the cylindrical casing and concentric with the shaft, means to admit and exhaust steam through the stationary casings and to and from the interior of the cylinders aforesaid, and rotating abutment means within the cylinders against which the admitted steam reacts to rotate the cylinders, said abutment means including members having a pair of closely related parallel disks extending radially outward from the shaft but free thereof and between the rotating cylinders, said disks being eccentric to the shaft and having free bearing rotation in said raceway around a fixed axis.

2. In a rotary steam engine, a stationary cylindrical casing provided with an annular recess eccentric to the axis of the casings and providing a raceway, a shaft journaled in the axis of the casing, a pair of cylinders fixed to the shaft and rotating within the casings respectively, means to admit and exhaust steam to and from the interiors of said cylinders, rotating abutment means within the cylinders against which the admitted steam reacts, said abutment means including a pair of cylinders whose adjacent ends are provided with a pair of disks coaxial with the abutment cylinders and extending radially outward beyond and between the first mentioned cylinders and having their peripheries coöperating with said raceway, and driving connections between the shaft and said abutment cylinder disks and arranged between said disks to cause the rotation of the abutment means simultaneously with the rotation of the first mentioned cylinders and shaft.

3. In an engine of the type indicated, the combination with a shaft, inner and outer coaxial cylinders fixed to said shaft and an abutment cylinder between the inner and outer cylinders, said abutment cylinder having an end supporting disk extending radially beyond the outer cylinder and eccentric thereto, of means to cause rotation of the eccentric abutment cylinder simultaneously

with the concentric cylinders, said means comprising a key bar fixed to the shaft and lying against the outer face of the disk from the cylinders, said bar having adjacent to its opposite ends a pair of circular openings, a pair of pivot disks journaled for free rotation in said openings, and a pair of pivot pins located eccentrically of and in said pivot disks and extending into the eccentric cylinder disk, substantially as set forth.

4. In an engine of the type set forth, the combination with a shaft, a pair of inner and outer spaced cylinders fixed to and concentric with said shaft, an eccentric cylinder located between the inner and outer cylinders and having constant contact with both of them at diametrically opposite points, and means to admit and exhaust motive fluid to and from the space between the inner and outer cylinders, of means to cause rotation of the abutment cylinder simultaneously with the concentric cylinders, said means comprising a key bar fixed to the shaft, said bar having on opposite sides of the shaft a plurality of circular openings, pivot disks journaled antifrictionally in said openings for free rotation therein, and a plurality of pivots extending between the end of the eccentric cylinder and said pivot disks and arranged eccentrically in said disks.

5. In a rotary steam engine, the combination of a stationary casing having an annular recess eccentric to the casing, a shaft journaled in the axis of the casing, a rotating cylinder fixed to the shaft concentric with the casing, means to admit and exhaust steam to and from the interior of said cylinder, rotating abutment means within the cylinder against which the admitted steam reacts, said abutment means including a cylinder eccentric to the rotating cylinder and having an end disk concentric with the eccentric cylinder and said recess and in which the periphery of the disk has bearing support, and means to drive the eccentric cylinder from the concentric cylinder, said means including a member fixed for rotation with the concentric cylinder and having a plurality of circular openings on opposite sides of the shaft, a plurality of pivot disks journaled for free rotation in said openings, and pivot connections between the pivot disks and the eccentric cylinder disk, said pivot connections being eccentric to the pivot disks to correspond with the eccentricity of the eccentric cylinder.

6. In a rotary steam engine, the combination of a stationary casing, a shaft journaled centrally therein, said casing having an annular recess eccentric to the shaft, an annular raceway within said recess, means extending through the wall of the recess to adjust the raceway with respect to the axis of the shaft, a concentric cylinder fixed to the shaft and rotating within the casing, means to admit and exhaust steam to and from the cylinder, rotating abutment means within the cylinder against which the admitted steam reacts, said abutment means including a cylinder eccentric to the shaft and having an end disk concentric with the casing recess aforesaid and coöperating at its periphery with said adjustable raceway, and means to cause the rotation of the abutment means simultaneously with the cylinder, said last mentioned means including a member fixed for rotation with the first mentioned cylinder and having a plurality of circular openings therein remote from the shaft, a plurality of pivot disks journaled for free rotation in said openings, and a plurality of pivot pins mounted eccentrically in said pivot disks and projecting into said eccentric cylinder disk.

7. In an engine of the type set forth, the combination of a cylindrical casing having an annular recess eccentric to the casing, an annular raceway within said recess, means to adjust the raceway toward or from the axis of the casing, a shaft journaled for rotation in the axis of the casing, pairs of main cylinders fixed to the shaft and concentric therewith and rotatable in the casing, said cylinders having their adjacent ends spaced from each other, means to admit and exhaust steam to and from the interiors of the cylinders, rotating abutment means within the cylinders against which the admitted steam reacts, said abutment means including a pair of cylinders eccentric to the shaft and having closely disposed parallel end disks extending radially outward from the shaft in and beyond said space between the cylinders, the peripheries of said disks being circular and having bearing support in said adjustable raceway, a key bar between said disks and fixed to the shaft, said bar having adjacent to its opposite ends circular openings, a pivot disk journaled for free rotation in each circular opening, a pivot pin carried by each pivot disk and eccentric thereto and having its ends projecting into both of the eccentric cylindrical disks, and means providing for variation in eccentricity of the pivot pins in the pivot disks to accommodate the aforesaid adjustment of the annular raceway.

8. In a rotary steam engine, the combination of a stationary cylindrical casing, a shaft journaled in the axis thereof, a cylinder fixed to the shaft and rotatable therewith concentrically of the cylinder, said casing being provided with inwardly projecting cut-offs providing an annular series of steam chambers, means to admit live steam direct from the boiler into any or all of said steam chambers, said cylinder having an inlet port adapted to communicate in succession with the several chambers, a baffle plate within and fixed to said cylinder

and comprising a block of generally rectangular form, but comprising a body substantially X-shaped in cross section straddling said inlet port, and abutment means within the cylinder and rotatable therewith against which the admitted steam reacts to rotate the movable parts, said baffle plate having a live steam port through its rear wall to allow steam to pass toward said abutment means.

9. In a steam engine, the combination with inner and outer spaced concentric cylinders, an eccentric abutment cylinder arranged in the space between the concentric cylinders and having constant contact with both of them along diametrically opposite lines and means to admit and exhaust steam, of a baffle plate spanning the space between the concentric cylinders and fixed thereto for rotation therewith, said baffle plate comprising a body substantially X-shaped in cross section and having admission and exhaust ports through its rear and front walls and near its ends, said eccentric cylinder having a longitudinal slot through which the piston projects, and means to cause rotation of the eccentric cylinder simultaneously with the concentric cylinders, the edges of the eccentric cylinder slot being caused to wipe along the respective front and rear faces of the baffle plate at each rotation of all of the cylinders.

10. In a rotary steam engine, the combination of a cylindrical casing, a cylinder journaled for rotation concentrically therein, said cylinder being spaced from the inner surface of the casing, the casing being provided with inwardly extending projections contacting with the outer surface of the cylinder and thereby forming a plurality of circumferentially arranged steam chambers, means to bring all of said chambers into direct communication with the boiler at boiler pressure, said cylinder being provided with inlet means whereby steam from one of said chambers after the other is admitted to the interior of the cylinder, a baffle plate fixed to the inner surface of the cylinder, and abutment means within the cylinder occupying a fixed position against which the admitted steam reacts back of the baffle plate to cause the rotation of the cylinder.

11. In a rotary steam engine, the combination of a cylindrical casing, a cylinder journaled for concentric rotation therein, a series of inlet ports to admit steam to the interior of the cylinder, a baffle plate connected to the interior of the cylinder, abutment means within the cylinder between which and the baffle plate the admitted steam reacts to rotate the cylinder, and a circumferential series of spaced exhaust ports formed in the casing, the cylinder being provided with an exhaust port through which the expanded steam is adapted to pass outward in succession through said exhaust ports, said inlet and exhaust ports being interchangeable for operation of the engine in either direction.

12. In a rotary steam engine, the combination of a casing, a cylinder journaled within the casing, a circumferentially arranged series of inlet ports formed through the casing, the cylinder having an inlet port through which steam will be admitted from the several inlet ports in succession, the cylinder being provided with an exhaust port, a circumferentially arranged series of exhaust ports in the casing adapted to communicate in succession with the exhaust port of the cylinder, a baffle plate fixed to the cylinder, and abutment means designed and arranged as to coöperate with the baffle plate to cause the rotation of the baffle plate and cylinder in one direction or the other according to the direction of the flow of steam inwardly through the inlet ports and outwardly through the exhaust ports or the reverse.

13. In a rotary steam engine, the combination of a shaft, a cylinder fixed thereto for concentric rotation therewith, an abutment cylinder within the first mentioned cylinder, means to support the abutment cylinder for free rotation around its own axis in fixed position and eccentric to the first mentioned cylinder and shaft, a baffle plate connected to the interior surface of the first mentioned cylinder and between which and the abutment cylinder steam is adapted to react circumferentially, a cylindrical member concentric with the shaft but coöperating with the abutment cylinder and the baffle plate to confine the steam for said expansion, and a key bar fixed to the shaft and acting between the shaft and the abutment cylinder to cause the rotation thereof coincidentally with the rotation of the shaft and first mentioned cylinder and in the same direction.

14. In a rotary steam engine, the combination of a plurality of cylinders, one cylinder being located within the other, eccentric bearing supports for the several cylinders, said bearing supports including a shaft, and means to drive one cylinder from the other at uniform speed but around different centers, said driving means including a bar arranged diametrically of the shaft and fixed to and rotated by one of said parts and having operative connection with another of said parts.

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."