(No Model.)

3 Sheets—Sheet 1.

# S. G. BROSIUS.

## ROTARY ENGINE.

No. 453,612. Patented June 9, 1891.

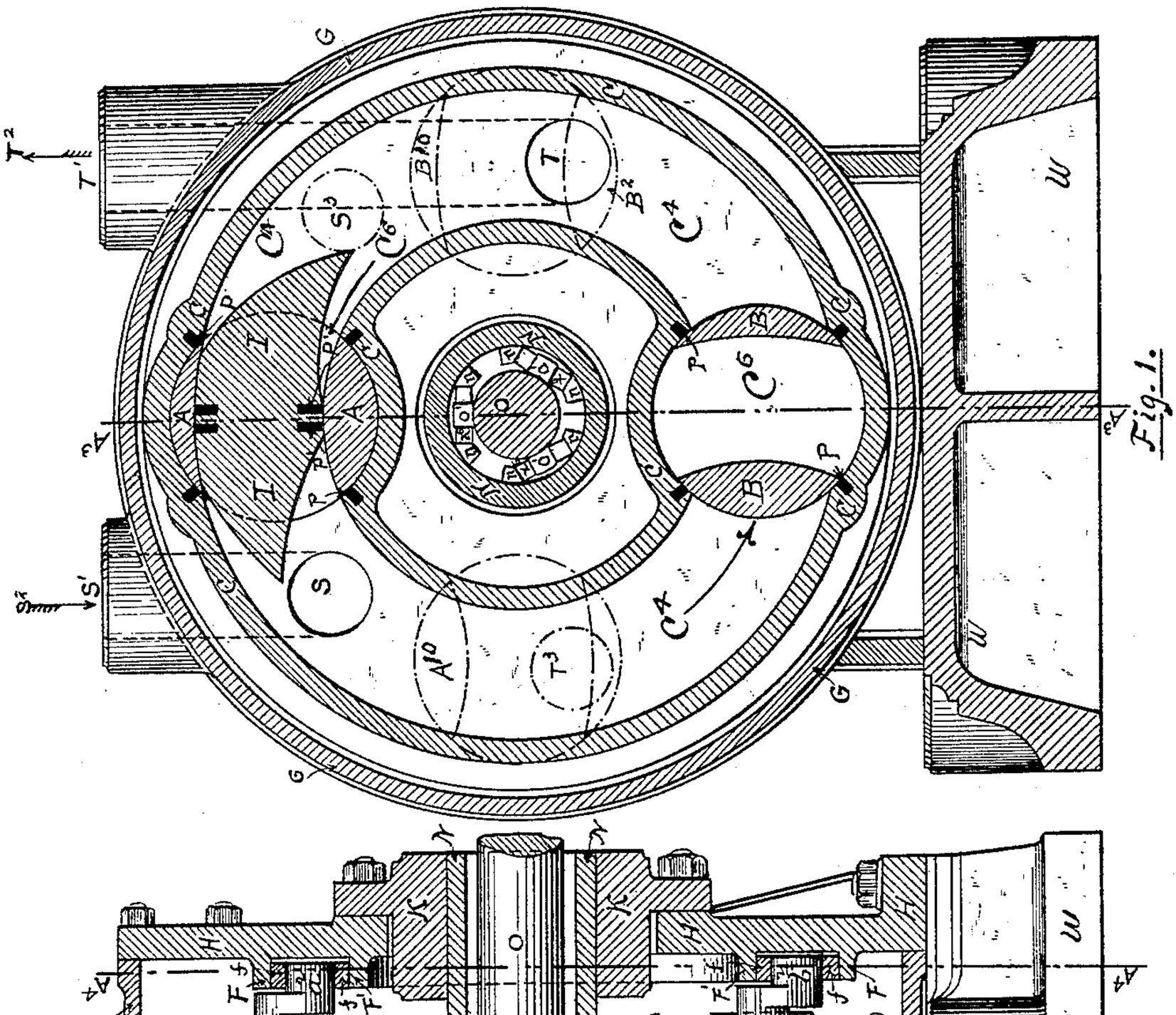


Fig. 1.

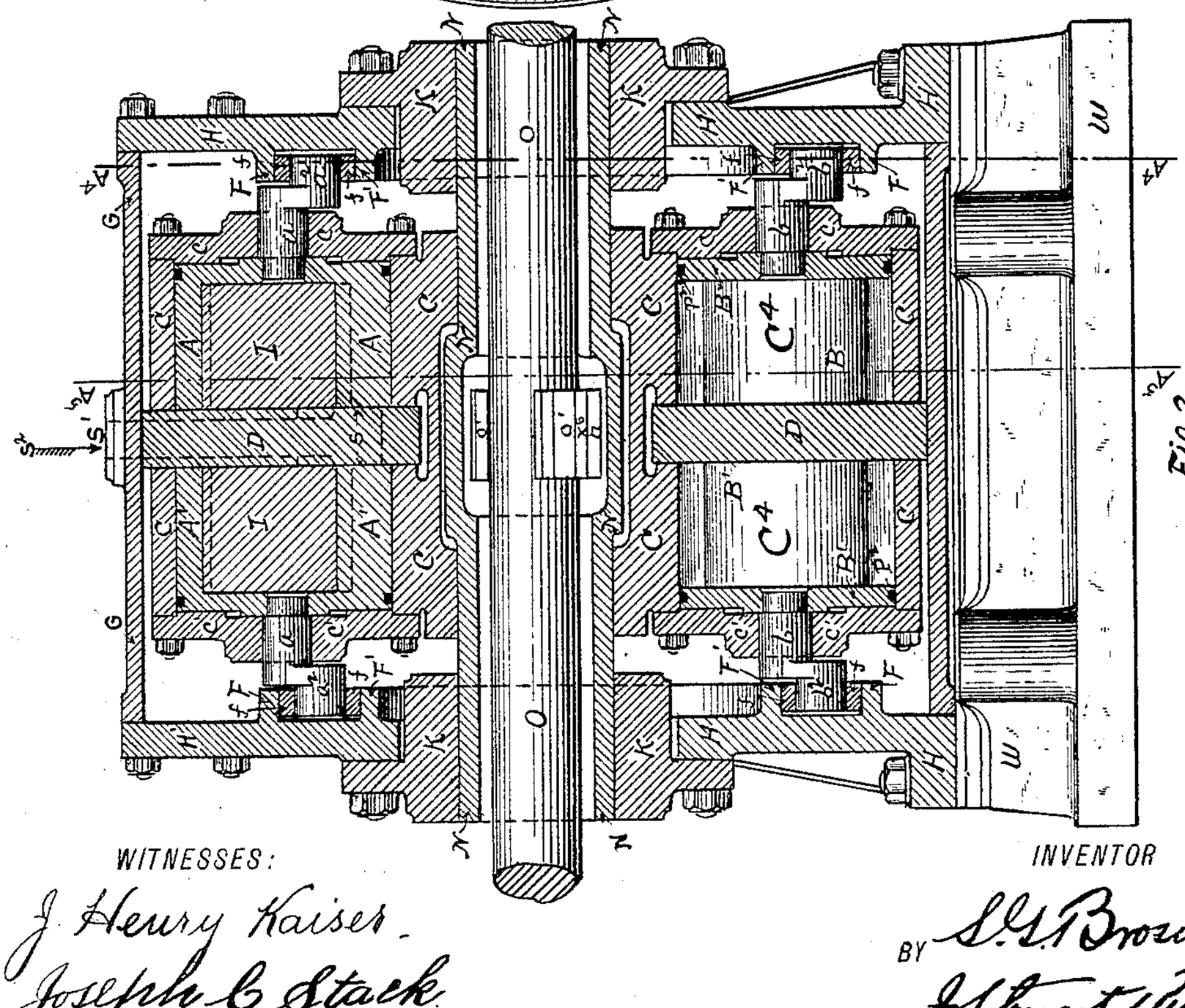


Fig. 2.

WITNESSES:

J. Henry Kaiser.

Joseph C. Stack.

INVENTOR

BY S. G. Brosius

J. Stuart Rusk

ATTORNEY.

(No Model.) 3 Sheets—Sheet 2.

# S. G. BROSIUS.

## ROTARY ENGINE.

No. 453,612. Patented June 9, 1891.

Fig. 3.

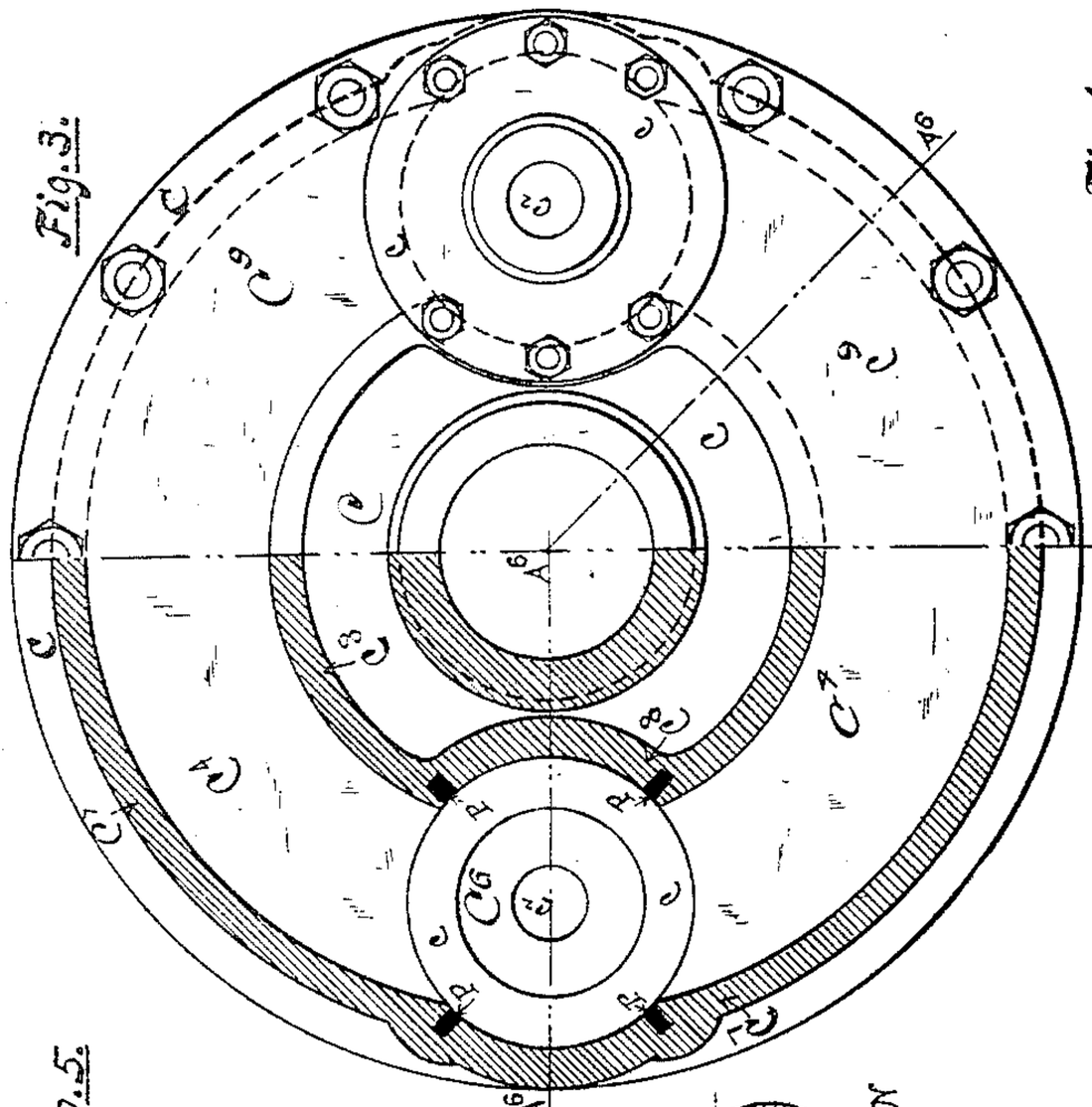


Fig. 4.

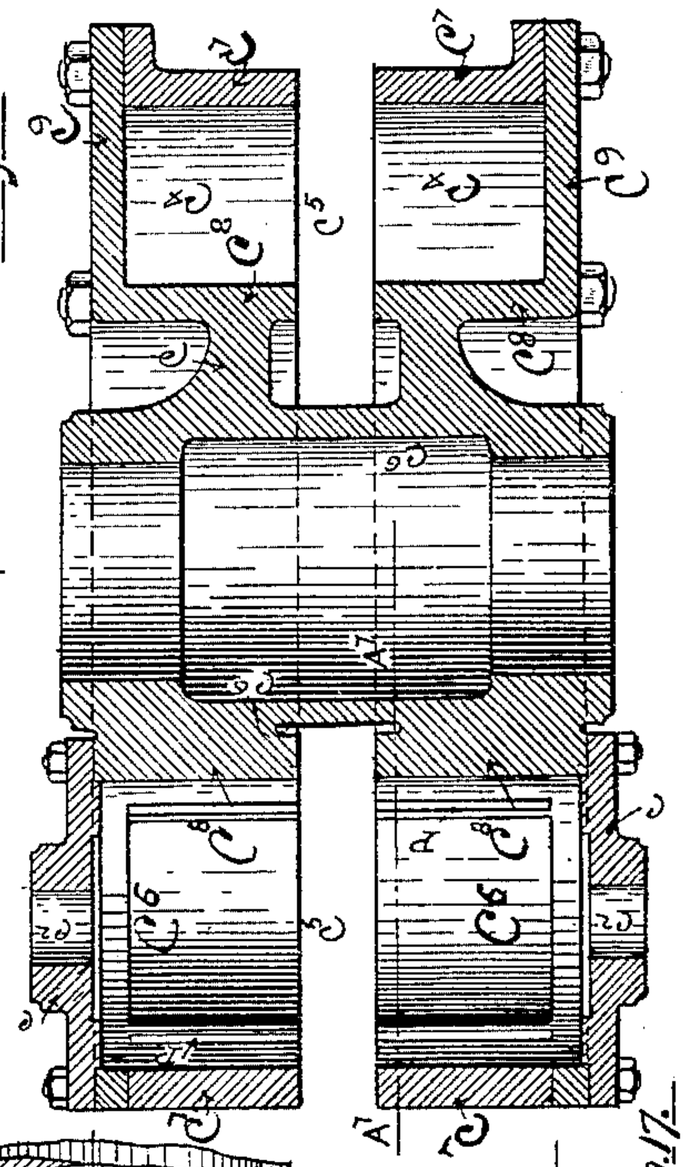


Fig. 5.

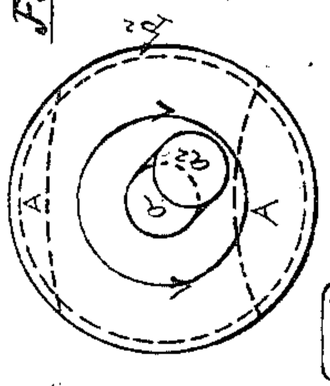


Fig. 8.

Fig. 12.

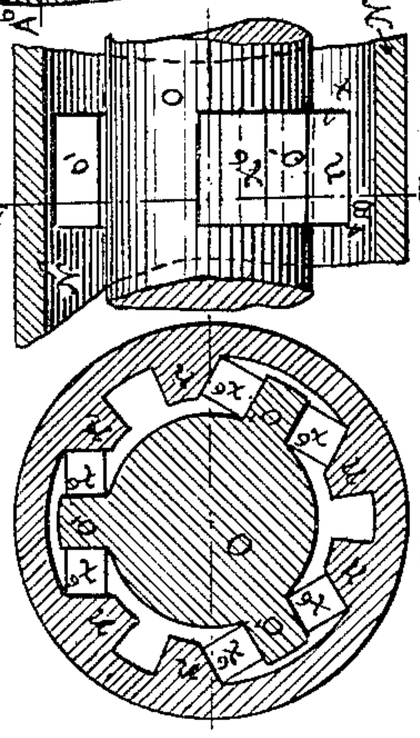


Fig. 14.

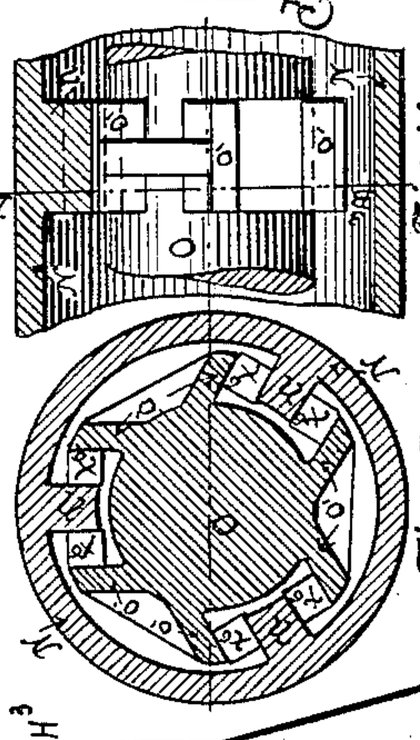


Fig. 17.

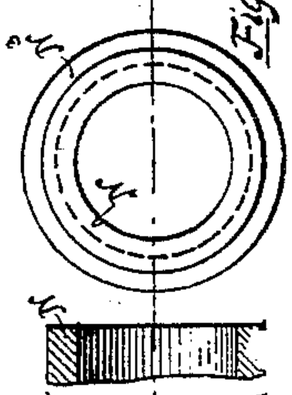


Fig. 6.

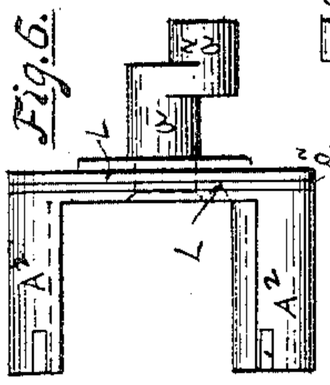


Fig. 9.



Fig. 10.

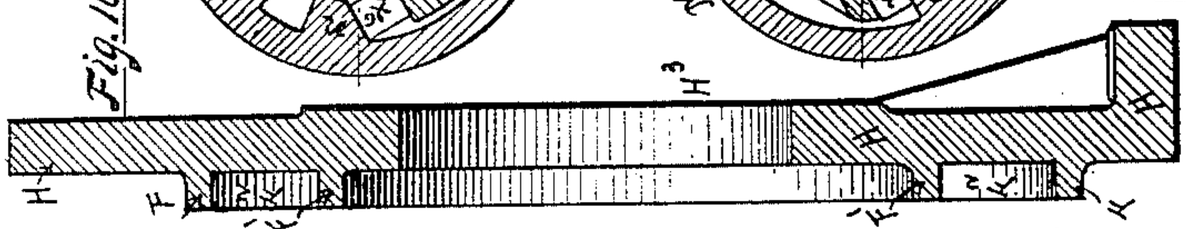


Fig. 13.



Fig. 15.



Fig. 16.

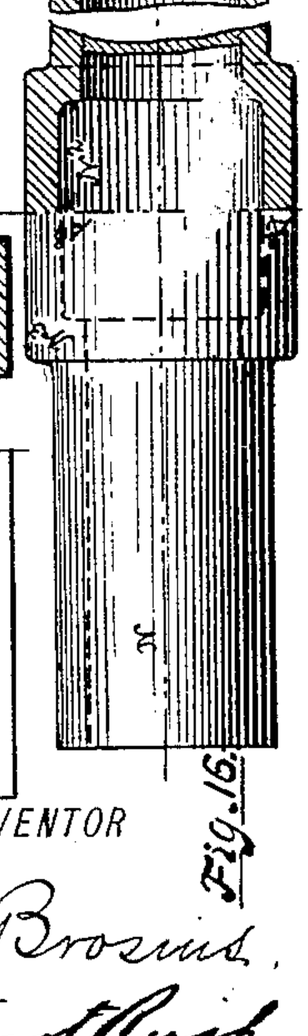


Fig. 7.

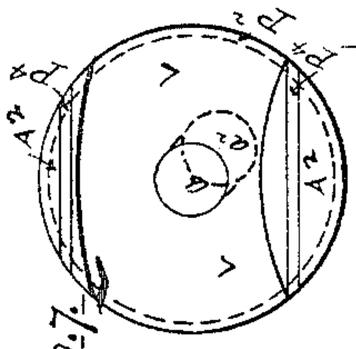
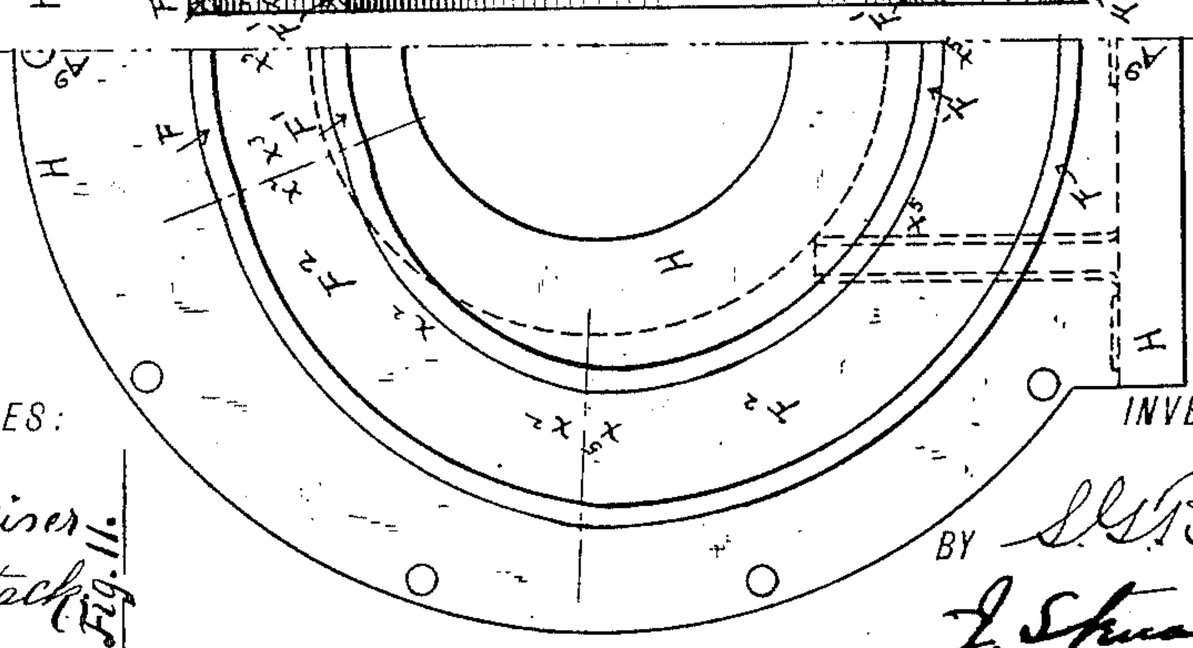


Fig. 11.



WITNESSES:

J. Henry Kaiser

Joseph b. Stack

INVENTOR

BY S. G. Brosius.

J. Stuart Rusk

ATTORNEY.

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## ROTARY ENGINE.

No. 453,612. Patented June 9, 1891.

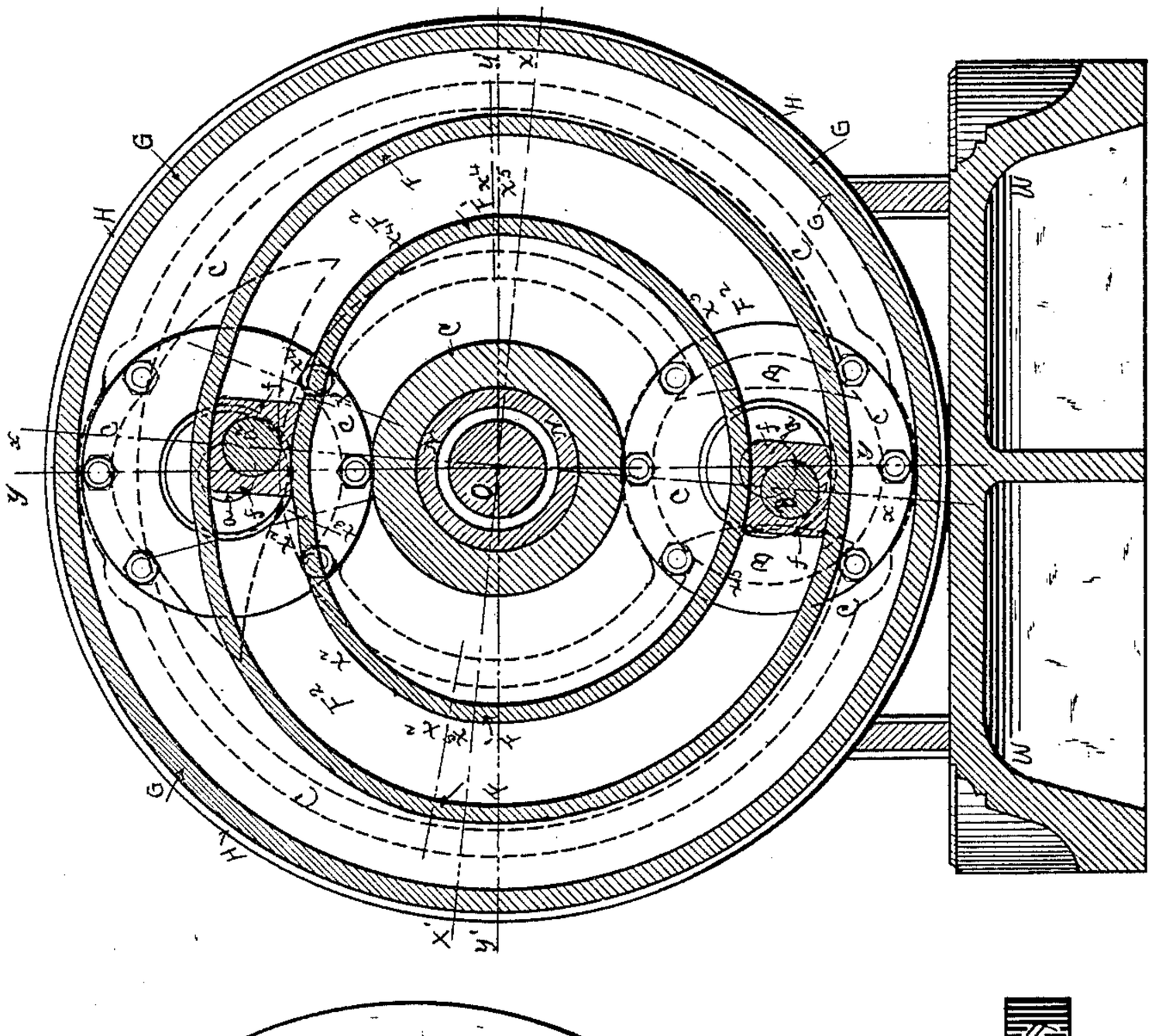

Fig. 18.

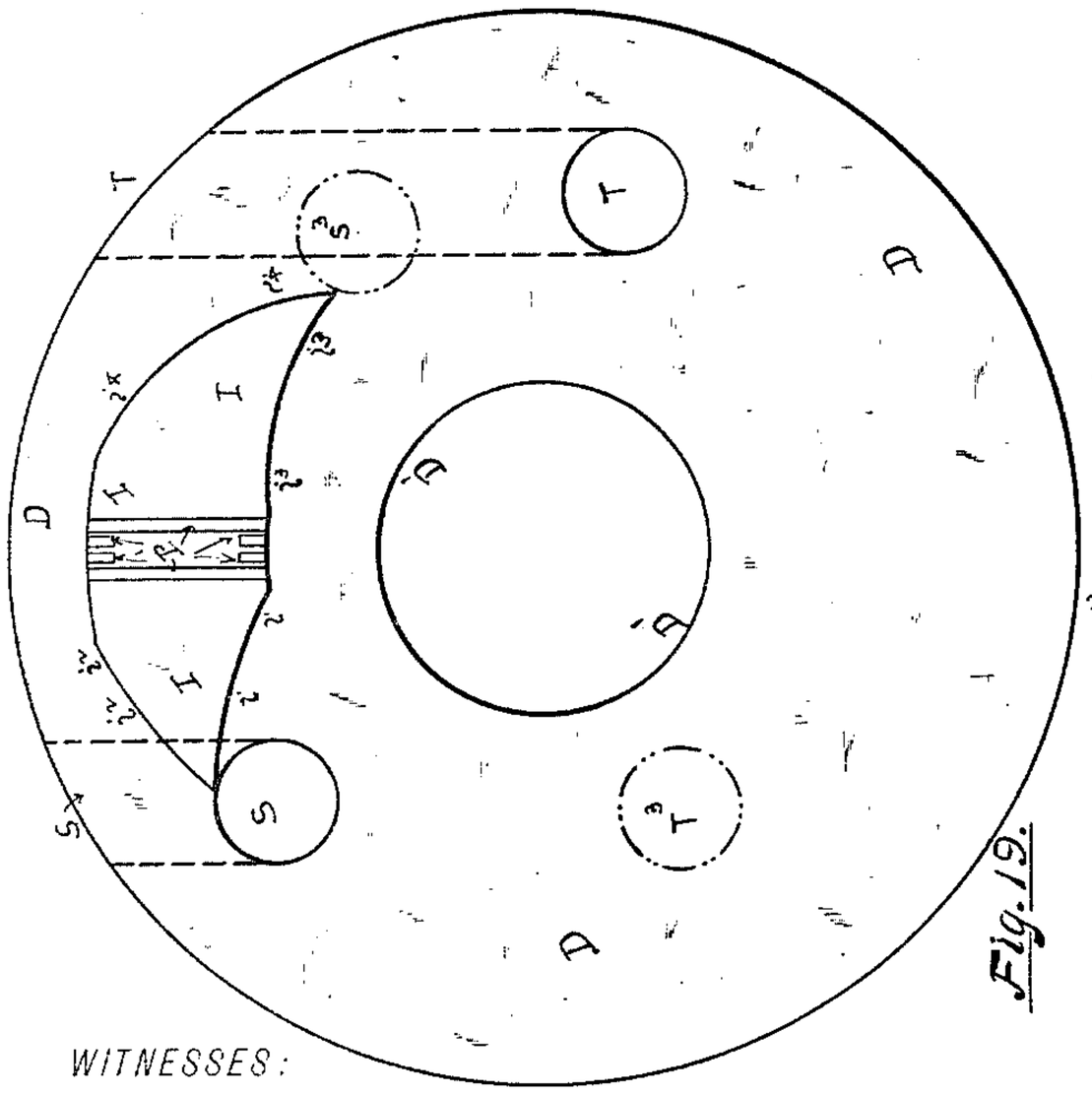

Fig. 19.

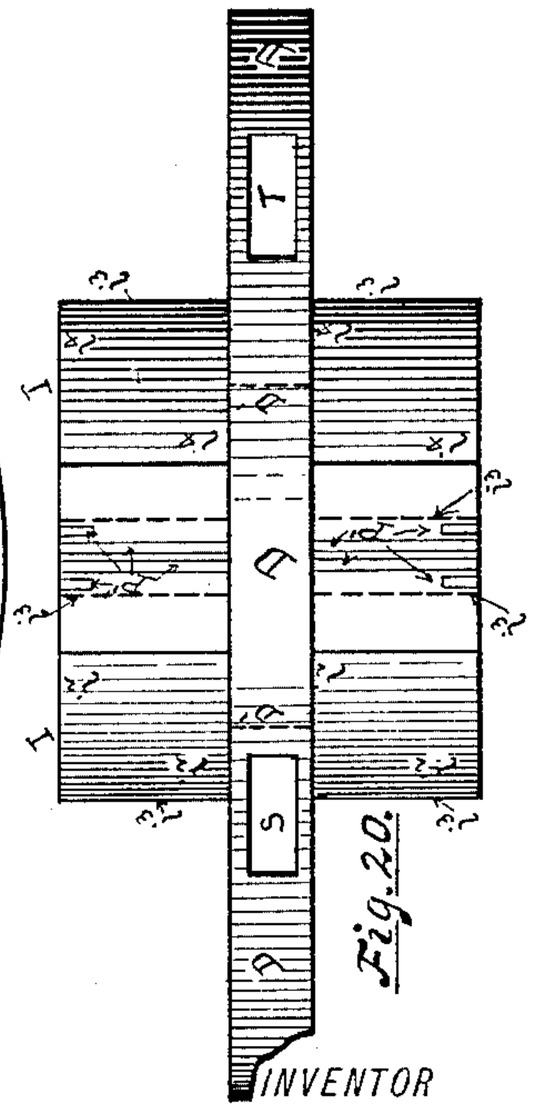

Fig. 20.

WITNESSES:

J. Henry Kaiser

Joseph C. Stack

INVENTOR

BY S. G. Brosius.

J. Stuart Page

ATTORNEY.

# UNITED STATES PATENT OFFICE.

SAMUEL GLENVILLE BROSIUS, OF SAVANNAH, GEORGIA.

## ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 453,612, dated June 9, 1891.

Application filed March 28, 1891. Serial No. 386,871. (No model.)

*To all whom it may concern:*

Be it known that I, SAMUEL GLENVILLE BROSIUS, of Savannah, in the county of Chatham and State of Georgia, have invented a new and useful Improvement in Rotary Engines, of which the following, taken in connection with the accompanying drawings, is a specification.

The invention has the following objects: first, to produce a rotary engine of the least possible friction; second, to produce a rotary engine having a steam-tight packing; third, to construct an engine in such a manner that no part shall bind or cramp and so that the pistons will be at rest with regard to the rotating cylinder when under pressure and to admit steam so as to avoid binding the cylinder or pistons in any position and to avoid all centrifugal and centripetal friction and any packing causing undue friction; fourth, to admit steam simultaneously to the cylinder or cylinders so as to avoid all binding or cramping; fifth, to oscillate or rotate the pistons when the same are not under steam-pressure, thus avoiding friction which would be otherwise encountered; sixth, to construct the cam or cams which oscillate or rotate the pistons with the least possible throw, so as to avoid jar, and also to construct said cam or cams with periods of rest and periods of throw; (during the periods of throw the pistons are balanced and oscillate or rotate, traveling with the rotating cylinder; and during the periods of rest they propel and revolve the rotating cylinder;) seventh, to construct the engine in such a manner that the pistons, after passing the abutments, oscillate, thereby closing the cylinders and acting as piston-abutments, and being at rest with said cylinders during the period they are traveling and rotating said cylinders around the axes of said cylinders to the point of the exhaust, where oscillations of said pistons again occur to pass said abutments, the said oscillations taking place during the time they are not under steam-pressure or after exhaust or when the steam is on both sides of the piston, so that the pistons will be balanced; (while it has been stated that the oscillations are not under pressure, yet they may be, if found desirable;) eighth, to journal the pistons so that the periods of oscillation and periods of rest may be controlled by a cam or some mechanical equivalent; ninth, to construct and connect the pistons so that they will be balanced against centrifugal force under oscillation; tenth, to construct the pistons with the wings, which will balance each other against centrifugal force; eleventh, to propel the shaft by the pressure on the pistons, said power being communicated directly through the cylinder to the shaft, to which it is securely attached; twelfth, to connect the cylinders flexibly to the shaft, so that any jar on said shaft will not be communicated to the engine; thirteenth, to obtain an abutment with curves constructed to avoid the edges of the oscillating piston, and so reduce the waste-steam area to a minimum; fourteenth, to obtain a perfectly-balanced engine in all its parts, which will not be jammed or cramped by steam-pressure, centrifugal or centripetal force, centrifugal packing, and do away with packing around the hub and all sliding friction or any friction caused by any other than ordinary packing, and to obtain a practical and simple construction. These and other objects are accomplished by the engine hereinafter described.

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

In the drawings which illustrate this invention, Figure 1 is a vertical cross-section of the engine, taken on the line $A^5$ $A^5$ of Fig. 2. Fig. 2 is a vertical longitudinal section on the line $A^3$ $A^3$ of Fig. 1. Fig. 3 is a view of the cylinder in elevation and cross-section, the cross-section being taken on the line $A^7$ $A^7$ of Fig. 4. Fig. 4 is a longitudinal section of the cylinder on the line $A^6$ $A^6$ of Fig. 3. Fig. 5 is an end view of the piston, showing the crank. Fig. 6 is an elevation of said piston. Fig. 7 is an end view showing the wings of said piston. Figs. 8 and 9 are respectively end and side elevations of the cam-block. Fig. 10 is a cross-section on the line $A^9$ $A^9$ of Fig. 11, showing the casing-head and cam attached thereto. Fig. 11 is a half-elevation of the casing-head, showing cam. Fig. 12 is

a view, part in cross-section, showing the flexible connection between the cylinder-shaft and driving-shaft. Fig. 13 is a cross-section on line $B^4$ $B^4$ of Fig. 12. Fig. 14 is a view, part in section, showing another flexible connection between the cylinder-shaft and driving-shaft. Fig. 15 is a cross-section on the line $B^3$ $B^3$ of Fig. 14. Fig. 16 is a view, part in elevation and part in cross-section, of the hollow cylinder-shaft. Fig. 17 is an end view of the hollow cylinder-shaft. Fig. 18 is a cross-section of the engine on the line $A^4$ $A^4$ of Fig. 2, showing the general arrangement of the outer casing, the cam, the cam-blocks, the pistons, the cylinder, the hollow shaft, and driving-shaft, the pistons, abutments, and cylinder being shown in broken lines. Fig. 19 is a view in elevation of the abutment-disk, showing abutment in position and steam and exhaust ports. Fig. 20 is a plan view of Fig. 19, and shows the abutments in position on the disk and steam and exhaust ports.

Like letters of reference refer to like parts throughout the several views of the drawings.

Within an outer casing G, to which is attached the heads H H′, secured to the base-plate W, there is arranged a rotating cylinder C, with its pistons A A′ B B′. Said cylinder is attached to the shaft N, which is mounted in journal-boxes K K. The shaft O is connected to shaft N by flexible connections, as hereinafter described. The lugs $n$ of the hollow shaft N are connected to lugs $o'$ of the driving-shaft O by buffers or springs $x^6$, so as to avoid the transmission of any jars on the driving-shaft of the engine, this feature being especially adapted to locomotives or engines of that class. The shaft O in such engines would necessarily be the axle of the driving-wheels.

As shown in Figs. 1, 2, and 12 to 14, inclusive, the revolution of the hollow shaft N causes the driving-shaft O to revolve, the springs or buffers $x^6$ being attached to and placed between lugs $n$ on the inner periphery of the hollow shaft N and lugs $o'$ on the periphery of the shaft O. The power is thus transmitted through said buffers or springs $x^6$, which will modify any jars in shaft O which would otherwise be transmitted to shaft N.

The rotating cylinder C is constructed so as to have annular cavities $C^4$, which are formed by rings $C^7$ $C^8$, disk $C^9$, and piston-seats $C^6$, and an annular groove $C^5$, in which is fitted the stationary abutment-disk D, as shown in Figs. 1 to 4, inclusive. Said cylinder is provided with piston-seat heads $c$, which are placed centrally with said piston-seats and contain the journal-boxes $c^2$, in which the journals of the pistons oscillate. These heads may be made integral with said cylinder C; but it will facilitate construction and repairs to have them separate and securely attached thereto.

The bore of the hub of cylinder C is made so that it may be securely attached to hollow shaft N, which it drives, and may be enlarged at the center $c^6$, as shown in Figs. 4, 16, and 17. Said enlargement is not necessary, as the whole hollow shaft may be enlarged for the purpose of receiving said flexible connections, as above described.

The piston A is constructed with wings $A^2$, which balance against centrifugal force during oscillation, thus reducing the friction and jar on the cam F F′ to a minimum. The disk L of piston A is securely attached to crank-shaft $a$, which has a crank $a^2$. The wings $A^2$ are cut to the curves of the rings $C^7$ and $C^8$, respectively, of cylinder C, as shown in Figs. 1, 5, 6, and 7. The piston is provided with packing-rings $P^2$ in disk L and the packing-strips $P^4$ in the ends of wings $A^2$. Said packing rings and strips respectively pack the piston-disk L in the piston-seat and the wings $A^2$ against the face of the abutment-disk D.

The pistons A′, B, and B′, with their respective cranks $a^2$ and $b^2$ and shafts $a$ and $b$, are identical in construction to piston A, its crank, and shaft. The piston-seat in cylinder C is also provided with packing P, which packs against wings $A^2$ of the piston, as shown in Figs. 3 and 4. The abutment-disk D, which is shown secured to the outer casing, may be, however, attached to the base-plate W, and is provided with abutments I, which protrude into the cavity $C^4$ of cylinder C, and is packed against cylindrical rings $C^7$ $C^8$ and disk $C^9$ of said cylinder C by packing P′. The edges of the rings $C^7$ and $C^8$ of cylinder C pack against said abutment-disk D. This abutment-disk contains the steam and exhaust ports S and T, respectively. Said ports are connected with the pipes S′ and T′ and the casing G. The abutment I is made with the curves $i'$, $i^2$, $i^3$, and $i^4$, which are so constructed as to just avoid the edges and internal faces of the wings $A^2$ of the pistons during the period of oscillation of said pistons, thereby obliterating to a large extent the waste-steam area. The faces of the abutment-disk D may be made to curved form by the "traetrix," known as the "Shields anti-friction curve," or any other suitable curve to avoid unequal wear between it and the packing-strips $P^4$ in the ends of the wings $A^2$ of the pistons. Said unequal wear is caused by the difference in circumferential travel of the inner and outer ends of said packing-strips P in their travel on the abutment-disk. The same curve may be applied to the disk $C^9$ of cylinder C, where the packing-strips P′ in the ends of the abutments I are in contact with said disk, for reasons above described. (Shown in Figs. 1, 2, 19, and 20.)

Referring now to Figs. 10, 11, and 18, it will be seen that the cam is composed of the outer flange F and the inner flange F′, forming between them the cavity $F^2$ in which the cam-block $f$ travels. The said cam-block has the journal-box $f^3$, which receives the crank $a^2$ of the piston-shaft $a$. The oscillations of the pistons are controlled by said cams. It is evident that as the pistons rotate with the cyl-

inder they must necessarily, by means of the crank-shaft $a^2$, carry the cam-blocks $f$. As the said block revolves in the cavities $F^2$, formed as above described, it will be seen that the distance of the cam-blocks $f$ from the center of the cylinder C must be changed, said cams having periods of rest $x^3$ $x^3$ $x^5$ $x^5$ and periods of throw $x^2$ $x^2$ $x^4$ $x^4$, as shown in Figs. 10, 11, and 18. The least possible throw sufficient to oscillate the pistons should be used, so as to avoid jar. During the periods of throw the pistons are balanced and oscillate or rotate so as to pass the abutments I and travel with the rotating cylinder. During the periods of rest $x^3$ $x^3$ the said pistons pass the abutments I, and during the periods of rest $x^5$ $x^5$ they propel and rotate the cylinder C, which in turn propels shaft N, and so drives shaft O. The said cams are respectively attached to heads H and H′, and may be separate or integral therewith, as shown in Figs. 2, 10, and 11. The steam and exhaust ports S $S^3$ and T $T^3$, respectively, may be provided in the abutment-disk D, as shown in Fig. 19, so as to make the engine reversible, one set of the steam and exhaust ports being closed when the other is open. The center lines Y Y and X X, respectively, of the abutments I and of the said cam F F′ should not coincide. The angle of difference between said center lines is such as to allow for the distance of lead or follow of the crank $a^2$ past the center of the piston-shaft $a$, so as to have the center of the rest in said cam coincident with the center of the abutment I. (Shown in Fig. 18.) A suitable cut-off of the usual kind may be used at the steam or exhaust ports or both.

The operation of the engine is as follows: As shown in Fig. 1, the piston A having oscillated from its position around the abutment I into the position as shown at $A^{10}$, the piston B will have taken the position of $B^{10}$. The steam enters at port S and propels piston A in the direction indicated by the arrow. The steam which has just propelled piston B escapes at exhaust-port T. Piston B then oscillates and takes the position formerly occupied by piston A in passing abutment I. The piston A in turn has taken the position formerly occupied by piston B. Continuing the revolution, piston B, after passing the abutment I, again oscillates and takes the position as shown at $A^{10}$, and is acted on by steam from port S. It is evident that piston A has taken the position as shown at $B^{10}$, and the steam which has just propelled it is ready to exhaust at port T. Piston A then oscillates and takes its original position. Piston B also takes its original position, as shown. This constitutes a full stroke. The pistons A′ and B′ necessarily operate in a similar manner.

It is obvious from the above description that all friction in cylinder C which would be otherwise encountered is avoided, as the pressure on the outer rings $C^7$ is neutralized by the pressure on the inner rings $C^8$, and the end pressures on the two disks $C^9$ counteract each other in a like manner, thereby perfectly balancing said cylinder in its revolutions.

While four pistons and two abutments have been shown, I do not limit myself to this number, as any number, with all their corresponding parts, may be used; and, further, I do not confine myself to the exact construction shown, as the same may be varied without departing from the spirit of my invention.

Cross-reference is herein made to my application filed of even date herewith, Serial No. 386,872, as certain features herein shown and described are shown, described, and claimed in that application, especially the rotating cylinders, oscillating pistons, abutments, and the general features of packing.

Having thus ascertained and set forth the construction of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A rotary engine having rotating cylinders and oscillating pistons and a stationary abutment-disk through which the steam is simultaneously admitted to said cylinders, whereby the end pressure resulting in friction is avoided, substantially as described.

2. A rotary engine having rotating cylinders and oscillating pistons and a stationary abutment-disk provided with abutments extending into said cylinders, in which they are packed, said cylinders being packed against said disk, substantially as described.

3. A rotary engine having rotating cylinders, oscillating pistons, and an abutment-disk provided with abutments, said cylinders having a central cavity in which said stationary abutment-disk is adapted to be fitted, substantially as described.

4. A rotary engine having rotating cylinders, oscillating pistons, and stationary abutment-disk having abutments extending into said cylinders, which are formed by outer and inner rings, with the adjacent sides open and abutting against and packed on said abutment-disk, and the outer sides being closed by disks which form the heads of the cylinders, substantially as set forth.

5. A rotary engine having rotating cylinders forming annular cavities by inner and outer rings and outer disks and having a central abutment-disk, said cylinders having seats for oscillating pistons which revolve with said cylinders, said seats being formed by the enlargement of said cylinders, and having heads provided with journals to receive the shafts of the pistons, said heads being in the outer disks, substantially as set forth.

6. A rotary engine having rotating cylinders forming annular cavities by inner and outer rings and outer disks, said cylinders having seats for oscillating pistons which revolve with said cylinders, said seats being formed by the enlargement of said cylinders and having heads provided with journals to

receive the shafts of the pistons, each of which is independently mounted and independently operated, substantially as set forth.

7. A rotary engine having stationary heads, a central abutment-disk, rotating cylinders, and oscillating pistons controlled by cams on the interior surfaces of said heads, substantially as described.

8. A rotary engine having stationary heads provided with cams on the interior surface, rotating cylinders, and oscillating pistons, with crank-shafts which extend into said cams and controlled and oscillated by them, substantially as set forth.

9. A rotary engine having stationary heads provided with cams on the interior surface, rotating cylinders, and oscillating pistons, with crank-shafts whose crank is provided with cam-blocks, said cam-blocks traveling in the groove of said cams, thereby controlling the movements and oscillations of said pistons, substantially as set forth.

10. A rotary engine having oscillating pistons formed of diametrically-opposed wings connected, rotating cylinders, into which cylinders extend stationary abutments having curved projections protruding in opposite directions, to reduce the waste-steam area, said pistons in passing the abutments being packed, and in oscillating clear the said curved projections, which are formed of the curves $i'$, $i^2$, $i^3$, and $i^4$, described by the interior faces and edges of the piston-wings, substantially as shown and described.

11. A rotary engine having oscillating pistons, a rotating cylinder, and stationary heads, said cylinder connected to a hollow shaft which is mounted in journal-boxes attached to said heads, said hollow shaft being flexibly connected to a driving-shaft, substantially as set forth.

12. A rotary engine having oscillating pistons, rotating cylinders, and stationary heads, said cylinders connected to a hollow shaft which is mounted in journal-boxes attached to said heads, said hollow shaft being flexibly connected to a driving-shaft within it, substantially as set forth.

13. A rotary engine having oscillating pistons, rotating cylinders, and stationary heads, said cylinders connected to a hollow shaft which is mounted in journal-boxes attached to said heads, said hollow shaft being flexibly connected to a driving-shaft within it by the means of buffers secured between lugs on the inner periphery of the hollow shaft and lugs on the outer periphery of the driving-shaft, substantially as set forth.

14. A rotary engine having a rotating cylinder connected to a hollow shaft mounted in journals stationary to said cylinder, and a driving-shaft within said hollow shaft, the hollow shaft being flexibly connected to the driving-shaft, substantially as and for the purpose set forth.

15. A rotary engine having oscillating pistons, a rotating cylinder, and stationary heads, said cylinder connected to a hollow shaft which is mounted in journal-boxes, said hollow shaft being flexibly connected to a driving-shaft, substantially as set forth.

In testimony whereof I, SAMUEL GLENVILLE BROSIUS, have signed my name to this specification, in the presence of two subscribing witnesses, on this 21st day of March, A. D. 1891.

SAMUEL GLENVILLE BROSIUS.

Witnesses:
J. HENRY KAISER,
JOSEPH C. STACK.