(No Model.) 4 Sheets—Sheet 1.

S. G. BROSIUS.

ROTARY STEAM ENGINE.

No. 463,267. Patented Nov. 17, 1891.

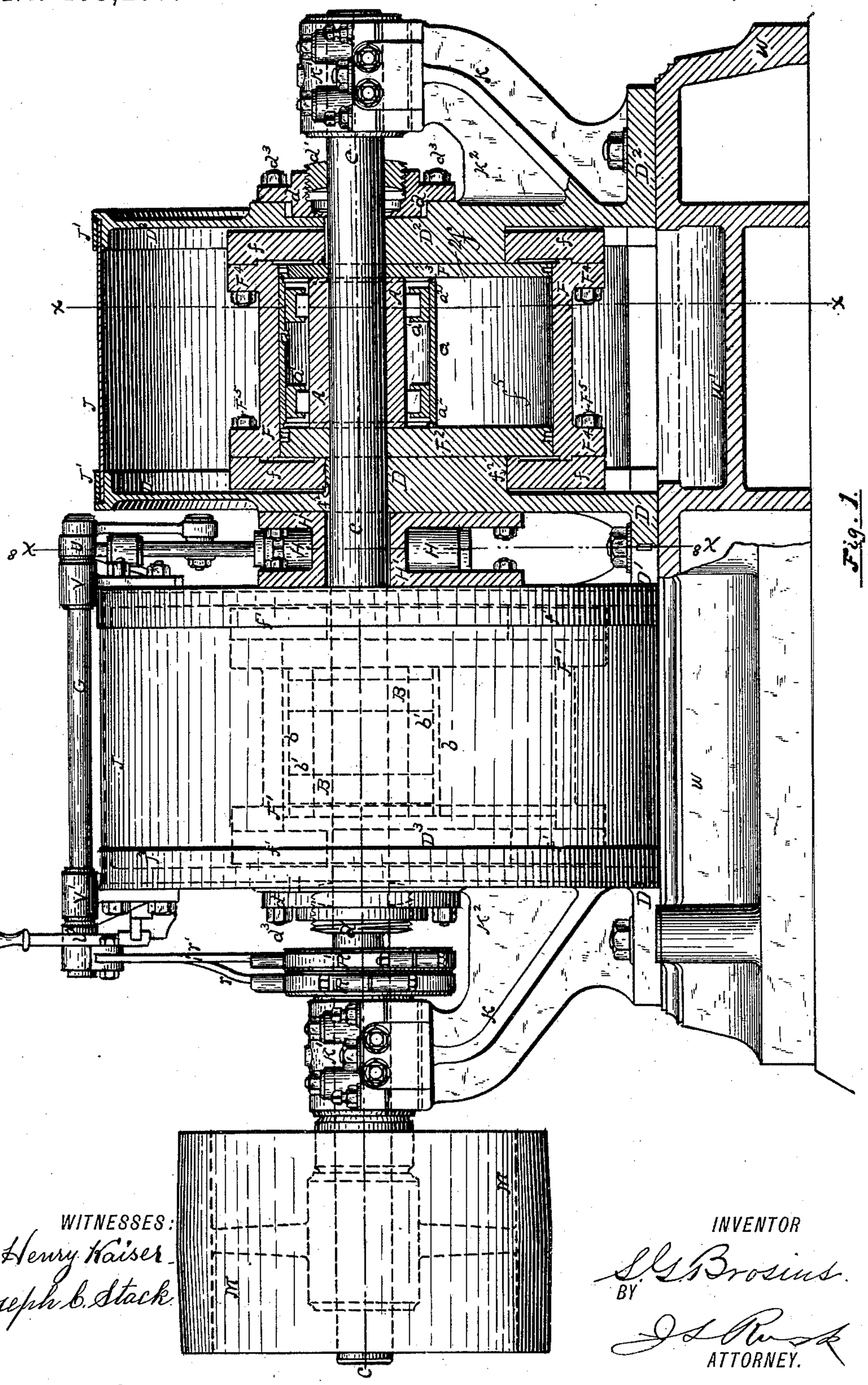

Fig. 1.

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ROTARY STEAM ENGINE.

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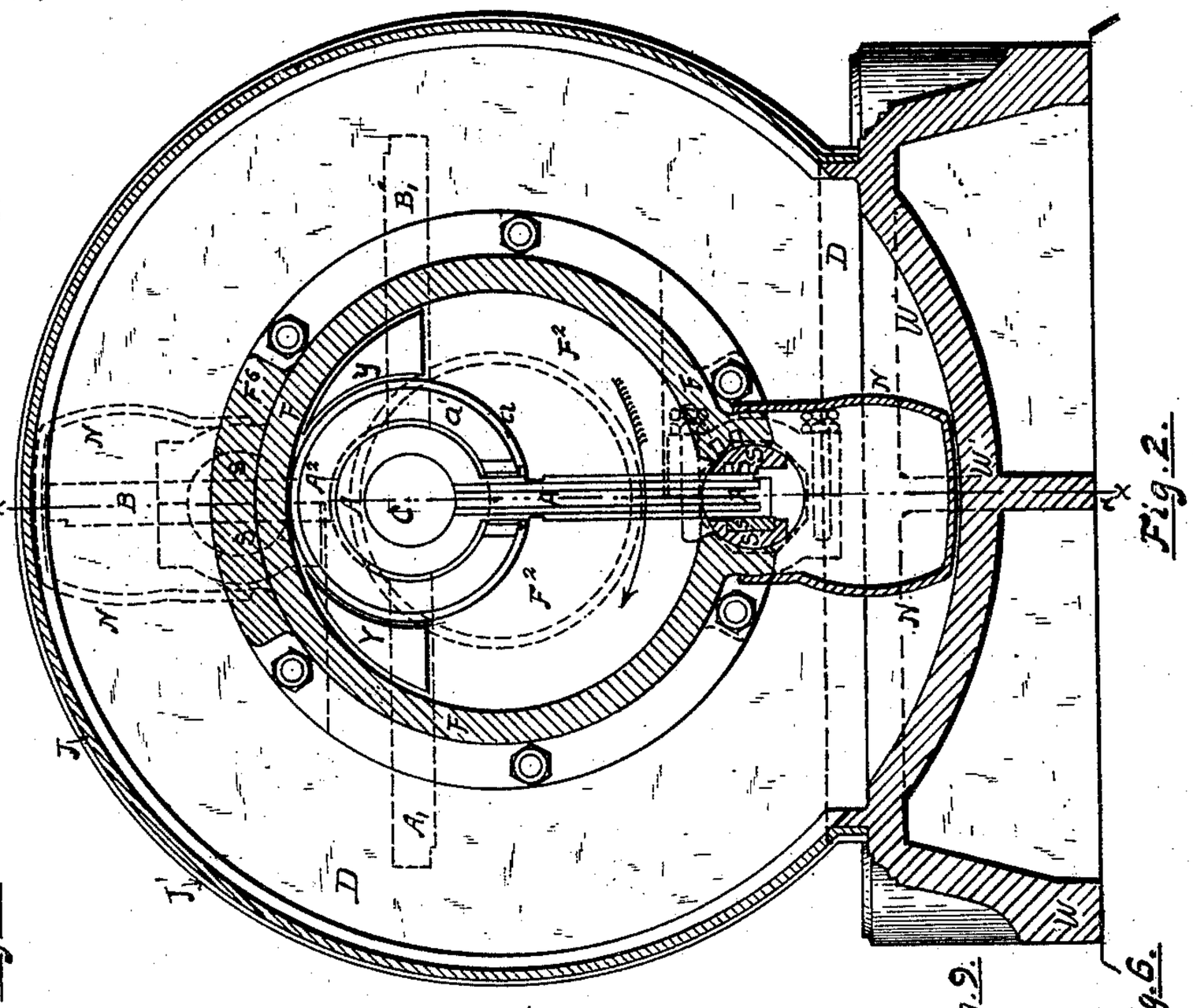

Fig. 1.

Fig. 13.

Fig. 12.

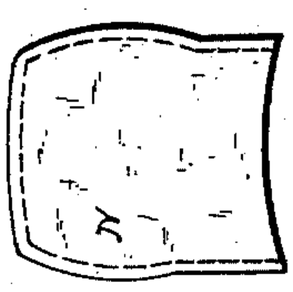

Fig. 11.

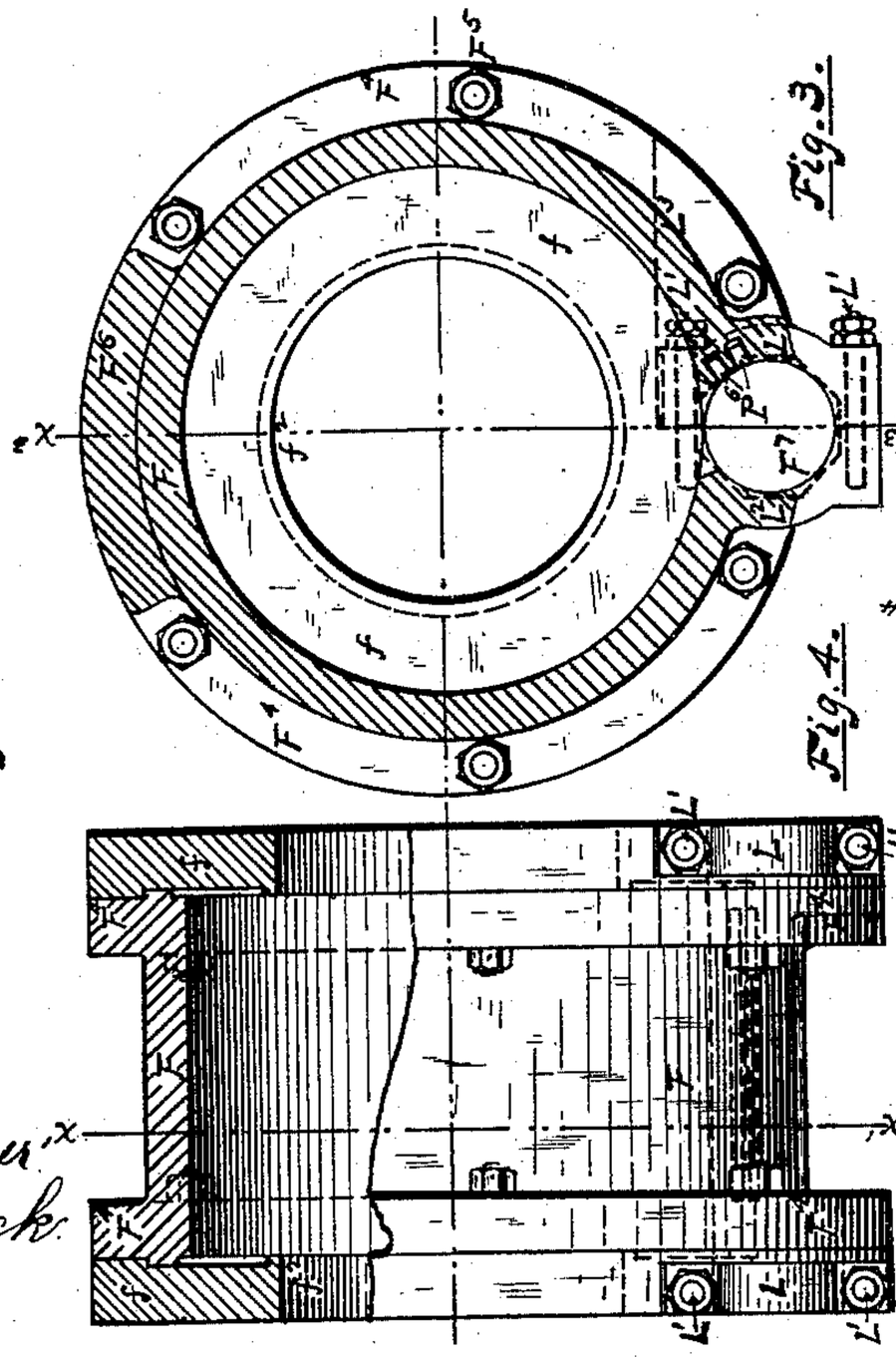

Fig. 4.

Fig. 3.

Fig. 6.

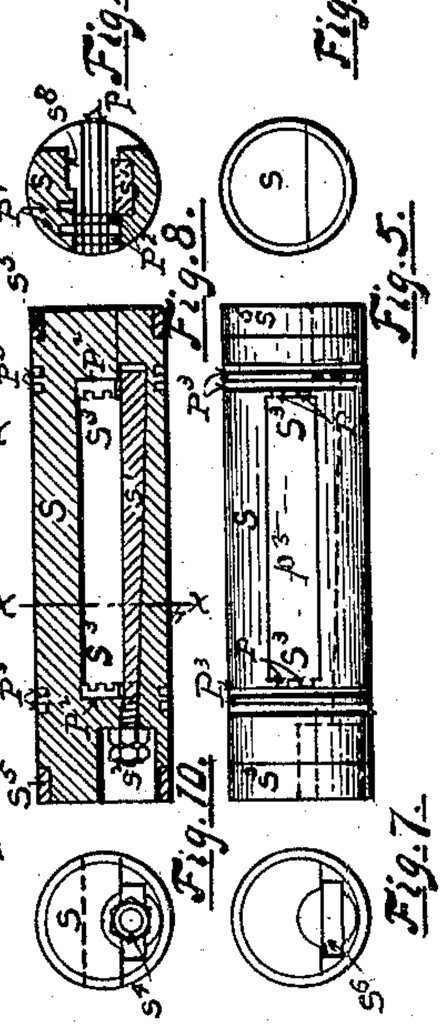

Fig. 10.

Fig. 9.

Fig. 8.

Fig. 5.

Fig. 7.

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S. G. BROSIUS.

ROTARY STEAM ENGINE.

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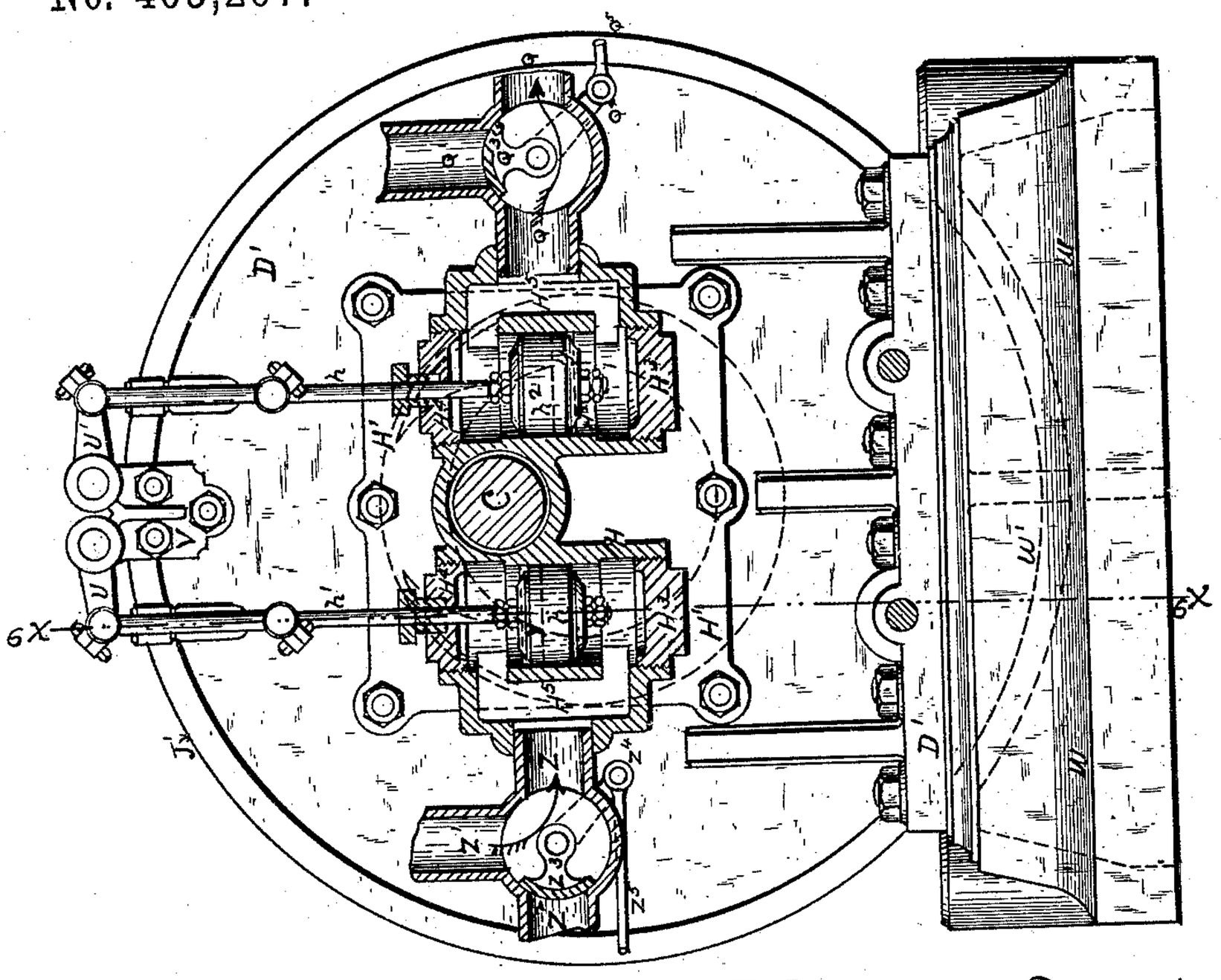

Fig. 15.

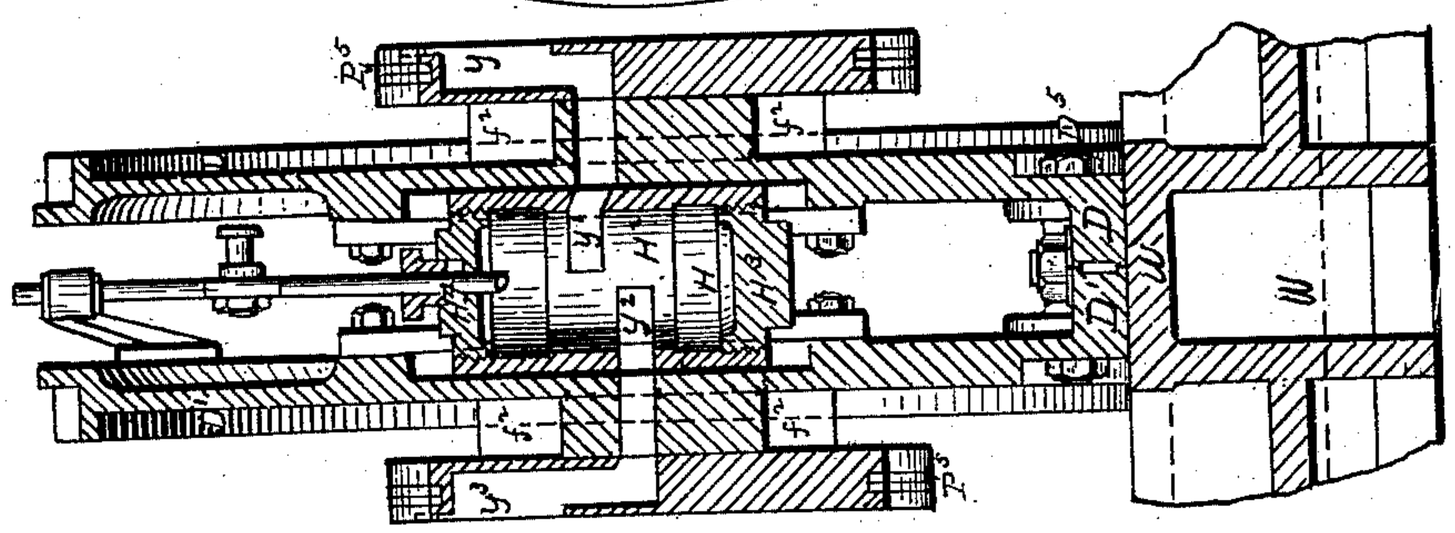

Fig. 16.

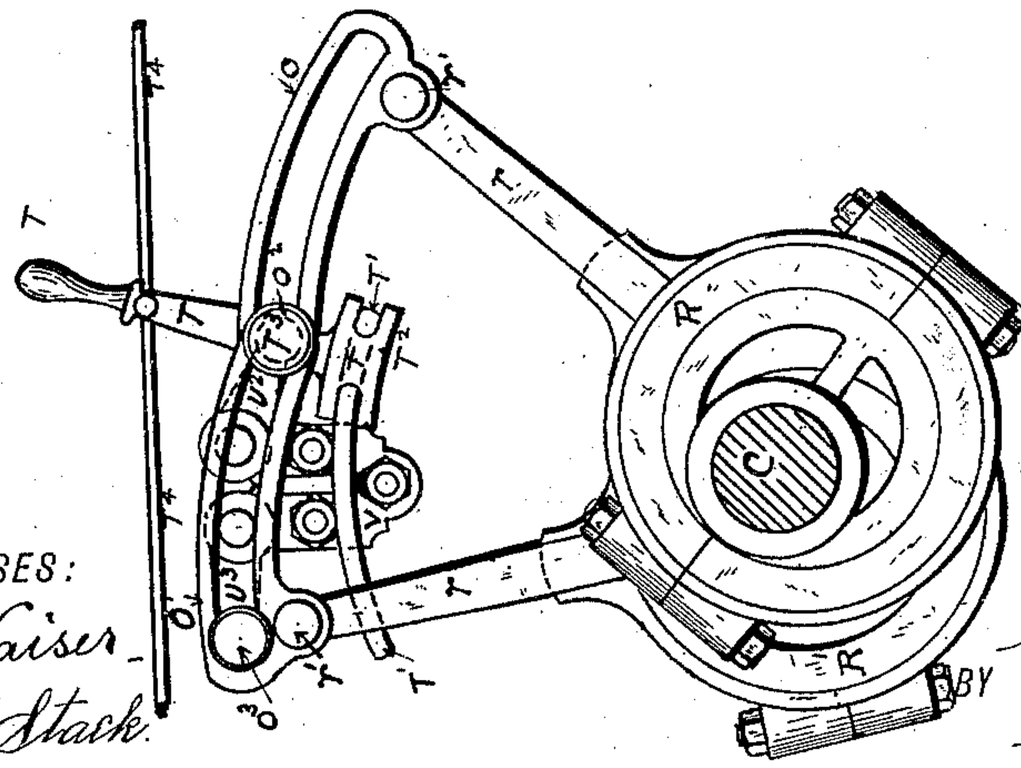

Fig. 17.

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ROTARY STEAM ENGINE.

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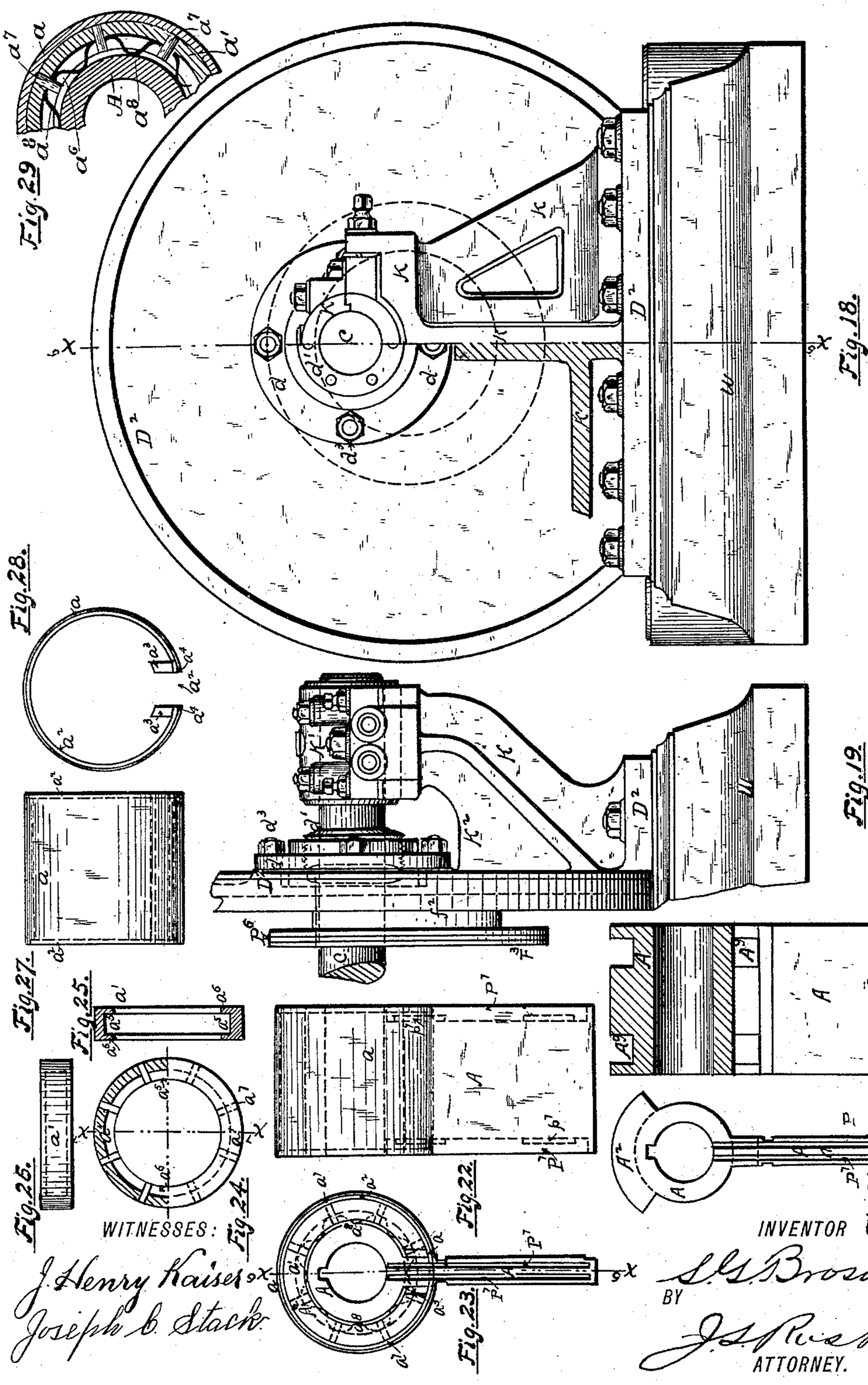

Fig. 29.

Fig. 18.

Fig. 28.

Fig. 27.

Fig. 19.

Fig. 25.

Fig. 20.

Fig. 26.

Fig. 24.

Fig. 22.

Fig. 21.

Fig. 23.

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UNITED STATES PATENT OFFICE.

SAMUEL GLENVILLE BROSIUS, OF SAVANNAH, GEORGIA.

ROTARY STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 463,267, dated November 17, 1891.

Application filed January 17, 1891. Serial No. 378,063. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL GLENVILLE BROSIUS, of the city of Savannah, county of Chatham, State of Georgia, have invented certain new and useful Improvements in Rotary Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of the specification, in explaining its nature and construction.

This invention relates to improvements upon the rotary engines shown in my patents, Nos. 445,038 and 445,039, dated January 20, 1891.

The cylinders in the engine set forth in this application rotate on their axes, and the pistons, one being used in each cylinder, pass through the circumference of their respective cylinders, each being held in position by cylindrical guides, which are journaled in the sides of said cylinders. The pistons are keyed or attached to and revolve with the shaft whose center is eccentric to the axes of the said cylinders. The distance between the axes of the said pistons and the said rotating cylinders is such as to allow the hubs of the pistons to be packed steam-tight against the inner periphery of the said cylinders by automatic packing. Said automatic packing is held out against the inner periphery of the said cylinders, as will be set forth in this specification. This packing is composed of a packing-ring and two expansion-rings around the hub of each piston. Each cylinder has one piston, whose hub extends over that portion of the shaft which passes through its respective cylinder. Said expansion-ring is so constructed as to allow it to adjust itself to any inequality of the inner periphery of said rotating cylinder or to any wear in the journals of the shaft whereby the axes of either shaft or cylinder is thrown out of line.

In engines of this class as heretofore constructed, except in the engines described in my applications above referred to, the steam is admitted between the outer casing and the periphery of the inner rotating cylinder. This cylinder performs, ordinarily, the function of abutment or packing. Such a construction brings about great loss of steam due to the condensation caused by the action of cold air upon the greater external surface without a casing, and also the greater area contained between the rotating cylinder and outer casing as compared with the area of the rotating cylinder itself, and also necessitates packing the pistons against the inner periphery of the outer casing, thereby causing great friction due to the centrifugal force of the packing against the said outer casing. This friction and loss due to the condensation above described is overcome in these engines in a similar manner to that used in my previous construction. The friction is further reduced by eliminating all internal journals and causing the cylinders to revolve upon and between two fixed heads in such a manner that the cylinder is used simply as a casing in which the steam operates, said pistons operating upon or driving the shaft by a direct action.

Among the several objects of this invention is to overcome the friction caused by the travel of the pistons through the cylindrical guides when the shaft is driven by the rotating cylinder, as are the constructions in the above application referred to.

A second object is to overcome the friction caused by the thrust brought to bear upon the rotating shaft by the tendency of the heads (one rotating and the other stationary) to separate when under steam-pressure, as will be seen by reference to the above-mentioned application. This I overcome by making both heads stationary and revolving the cylinders on and between them.

A third object is to obtain a steam-tight packing simple in construction around the respective hubs of the pistons.

A fourth object is to so arrange the cut-off that the engine may be readily reversed.

A fifth object is to take up the wear in said cylindrical guides and also in the journal of said guides in the rotating cylinder, as shown in the accompanying drawings.

These and other objects are accomplished by the construction shown in the drawings, hereinafter described, and pointed out in the claims.

Figure 1 is a side elevation of a rotary engine, part being in section taken through one of the cylinders. The section is taken on line

x^2 x^2 of Fig. 2. The pistons in Fig. 1 are placed in a horizontal position, but in Fig. 2 they are shown perpendicular. Fig. 2 is a cross-section of the right-hand cylinder through line x x, the piston and guide in the left-hand cylinder being shown in broken lines. Fig. 3 is a cross-section of the rotating cylinder upon the line x' x' of Fig. 4. Fig. 4 is a side elevation of the rotary cylinder, part in section on line x^3 x^3 of Fig. 3. Fig. 5 is a side view of the cylindrical guides. Figs. 6 and 7 are end views of the cylindrical guides. Fig. 4 is a section of said cylindrical guide along its longitudinal center line. Fig. 9 is a cross-section of the cylindrical guide at x^4 x^4 of Fig. 8. Fig. 10 is an end view of cylindrical guide, showing the wedging-place. Figs. 11 and 12 show the steam-tight cap which is placed over the cylindrical guide on the rotating cylinder. Figs. 13 and 14 show the packing-strips which are used to pack the piston on the face and side within the cylindrical guide. Fig. 15 is a cross-section of the rotary engine, on line x^8 x^8 of Fig. 1, showing the arrangements of the steam-chest with the valves and cut-off for the reverse motion. Fig. 16 is a cross-section of the steam-chest and cut-off, showing the steam-chest and cut-off on line x^9 x^9 of Fig. 15. Fig. 17 shows the arrangement of the eccentric and the compound link and throwing-bar. Fig. 18 shows an end view of the right-hand cylinder, the pillow-block and the journal-box being removed from the left-hand side of figure. Fig. 19 is an elevation of Fig. 18, showing the pillow-block and journal-box. Fig. 20 is a front elevation of one of the pistons. Fig. 21 is an end view of one of the pistons. Fig. 22 is a front view of one of the pistons, showing packing in position around the hub. Fig. 23 is an end view of Fig. 22. Fig. 24 shows the expansion-ring. Fig. 25 shows a cross-section of Fig. 24 on line x^7 x^7. Fig. 26 shows an elevation of the expansion-ring. Fig. 27 shows an elevation of the packing-ring. Fig. 28 shows an end view of the packing-ring, and Fig. 29 is a cross-section showing springs in expansion-ring.

Like letters of reference indicate like parts in all the figures, and the same scale has been kept throughout the drawings, except in Figs. 13, 14, and 29.

In Fig. 1 the shaft C is journaled in the boxes k' k', said boxes being held in pillow-blocks K. The outer stationary heads D^2 D^2 may be made solid with the pillow-blocks, as shown. The inner stationary heads D D′ are secured to each other by the bracket H′. This bracket is also used to hold the steam-chest in position, and forms the casing around the shaft C, Fig. 15. The revolving cylinders (two being used in this illustration) are journaled on and between their respective stationary heads. Said stationary heads have journal-disks f^2, which extend inwardly and form journals upon which the cylinders revolve.

F F′ are rotating cylinders provided at their ends with the annular plates f f, which are fastened by bolts F^5 to flange F^4 of the cylinder. The inner periphery of the annular plates support the cylinder upon the journal-disks upon which the cylinder revolves.

C is the shaft upon which the pistons are keyed or securely attached. Said pistons may be set opposite to each other, as shown in Fig. 2. Said shaft is packed steam-tight in the outer stationary heads by the stuffing-boxes c and glands d', and provisions have been made to adjust the journal-boxes K′, so that the shaft C may be raised or lowered, thereby bringing the respective packing-rings around the hubs of said pistons in proper contact with the inner periphery of the rotating cylinders. This adjustment is made by the set-screws and clamp-nuts shown in said pillow-blocks and journal-boxes K′ K′. The stuffing-boxes are so constructed that they may be adjusted to the shaft C.

F^2 F^3 are the packing-disks, and are securely fastened to their respective stationary heads. These packing-disks in their peripheries are provided with packing-rings P^5, which pack said disks steam-tight against the inner periphery of said rotating cylinders. The chief purpose of these disks is to give an unbroken surface against which to pack the edges of the said pistons. The cylinders are not journaled on these disks, but, as pointed out, merely pack them at their ends. The journals of said cylinders, as above described, have the annular plates f f, said plates revolving on the journal-disk f^2 f^2 of their respective stationary heads to the said rotating cylinders. These journals are made as small as feasible, so that the leverage of friction caused by the rotating cylinder may be reduced to a minimum. This reduction is effected, as will be readily seen, by the decreasing leverage of the journal as compared with the diameter of the rotating cylinder.

The cylindrical piston guide S, Figs. 5 to 10, inclusive, is provided with the taper key S′, which bears against one side of the piston, the other side of the piston bearing against the guide. Any wear of the piston or guide is taken up by adjusting the key by means of the thread on the end of the key and the nuts S^2. The said key is placed in the cavity S^6, as shown in Figs. 7. The ends of the slot through which the pistons pass are provided with grooves, which contain the packing P^2 P^2. This packing is provided with grooves p^2 p^2, through which the packing P^7 of the pistons passes. These cavities p^2 p^2 are for the purpose of allowing the packing P^7 P^7 of the piston to pack against the said packing-disk f^2 f^3 without being interfered with by said packing-strips. The said cylindrical guides have the cavity P P for the same purpose. The packing P^2 also contains the cavity p to hold the spring in position, which sets it out against its respective edge of the said piston. Said packing-strip is shown in Fig. 13. The packing-strips P′ are placed within grooves provided in the faces of the slot S^3 S^3, as shown

in Fig. 9, and pack against the respective face of the pistons P′, as shown in Fig. 13. Packing-strip P′ is also provided with cavities, in which are placed the springs which hold it out against said face of the pistons. The packing-strips P^2 P′, as shown in Fig. 9, are located near the inner edge of the slot S^3 S^3—that is to say, the edge nearest to the center of said rotating cylinder—so as to cut off all unnecessary steam-pressure, which would otherwise cause friction. As will be seen, S^8 is a cavity along the inner edge of said slot for the same purpose. P^3 P^3 are packing-rings in the ends of the said cylindrical guide S. As shown in Figs. 2 and 3, the cylindrical guide is placed in the side of the said cylinder, and is journaled at each end in the journal-box L^2 and L.

The cap L is held in position by the bolts L′. The cavities L^3 are made in the journal-flange *f f* of the rotating cylinders F and F′ to facilitate the placing of caps L in position.

P^6 is packing placed along the cylindrical guide and extends between the packing-rings P^3 and P^3, and is in the inside journal in which said cylindrical guide oscillates to pack it steam-tight in the said rotating cylinder on that side against which the live steam is admitted. Packing should not be used on the exhaust side of said guide. This is to reduce the friction which would be caused by steam getting between the guide and its journal.

The cap N is placed so that it will act as a cover and retain any steam which may escape through the packing of either of the cylindrical guides or around said guides. This cap is secured to the cylinder, as shown in Fig. 2.

The piston is composed of a wing and a hub, which may be made sclid, as shown. This wing has the cavity A^9 and A^9, through which the expansion-wings *a′* and *a′* pass. This expansion-ring is held out from the hub and in position by the springs a^8. The pins a^7 prevent the springs from moving endwise. The packing-ring *a* is securely attached to the said expansion-rings. The springs a^8 allow for automatic adjustment whether due to inequalities in the inner periphery of the rotating cylinders or the disalignment of the axis of either of the rotating cylinders or rotating shaft. The packing-wing *a* is cut or split at a^2, and is provided with the wing-strips a^3, which bear against the faces of the piston-wings. Ring *a′* may also be split, if found advisable. The packing-ring *a* has at both ends packing a^2, which packs it steam-tight against the packing-disk. Said packing-ring also has cavities to contain the packing a^4 a^4 to pack the longitudinal edges of said packing-ring against the faces of the wings of said pistons. As will be seen in Figs. 3, 20, and 21, the said rotating cylinder and said piston are provided with counter-balances, respectively, F^6 and A^2.

As shown in Figs. 15 and 16, two steam-chests H and H are so located that steam may be admitted to either the exhaust or steam ports. This arrangement makes the engines reversible. When the steam is admitted at port *y*, the engines revolve, as indicated by the arrow in Fig. 2. When admitted at Y, it revolves in an opposite direction, the steam escaping from that port that is not used as a live-steam port. Each steam-chest has its port so located, as shown in Fig. 16 at *y′* y^2, that one stroke of the valve makes the cut-off and admission. This will be readily seen by reference to Figs. 15 and 16. The steam enters at *y*, first passes through the port and escapes at *y*, acting within the said right-hand rotating cylinder and on its piston. That port is then closed by the valve and steam is admitted at y^2 and passes through port y^3, acting within the left-hand rotating cylinder and on its piston, the steam in both cylinders escaping at their respective exhaust-ports. The steam-pipes *z′* *q′* admit steam into their respective steam-chests through the channels *z* and *q*. These pipes may be closed or opened into said channels by the oscillating valve z^3 and q^3. When closed, the said channels become the passage for the exhaust which passes out at z^2 or q^2, respectively. These valves z^3 q^3 are operated by levers z^5 q^5 to throw the bar T by rods T^4. The levers z^4 and q^4 are so connected and arranged that one steam-passage with its respective exhaust-passage is open at the same time—that is, the steam-passage *z′* is open while the steam-passage *q* is closed and the exhaust-passage z^2 is closed while the exhaust-passage q^2 is open—so that the steam may pass through the port on one side, acting on a piston within the rotating cylinder and escapes at the other. The valves *h* and h^2 are operated by eccentrics R′ R. The throwing-bar T is so arranged that the link *o* is held stationary and its respective valve is thrown down and out of the way, so as to leave the ports open when the ports of that steam-chest are exhausting. The other steam-chest, which is then the inlet steam-chest, has its valve in operation by being connected with its eccentric through its link *o′*. It will be seen that by reversing this throw-bar the action is reversed—that is, the link and valve which was acting as the exhaust is thrown into action, while that which was acting as a cut-off is thrown down, leaving its port open—so that it may be used as the exhaust, which of course reverses the engine.

R and R′ are the eccentrics.

r and *r′* are the eccentric-rods.

T is the throw-bar.

U′ U^2 U^3 are the cranks and are provided with the wrists o^2 and o^3, respectively, which operate the cut-off through the action of the link *o o′*.

h^3 h^4 are the connecting-links which operate the valve-stems *h h′*.

h h^2 are the valves.

H^3 H^4 are the stationary heads of the steam-chest.

H H are the steam-chests. Brackets H′ H′

hold the steam-chest in place, also acting as braces to the inner stationary head of the rotating cylinders and form the covering around the rotating shaft C.

J J′ are the outer casings and hands, which protect the said rotating cylinders from the cold air, thereby reducing condensation.

I do not confine myself to this identical construction, as it is obvious that slight changes may be made in the details, and while two cylinders with their respective operating parts have been shown, any number—one or more—may be used without departing from the spirit of my invention.

What I do claim as my invention, and desire to secure by Letters Patent, is—

1. In a rotary steam-engine, the combination, with the revolving cylinder journaled on stationary heads at each end, of a piston mounted eccentrically on the shaft whose hub is packed steam-tight against the inner periphery of said rotating cylinder, substantially as shown and described.

2. In a rotary steam-engine, the combination of a rotating cylinder with the stationary heads and the packing-disks equal in diameter and provided with packing-rings and placed in the ends of the cylinder, substantially as shown and described.

3. In a rotary engine, the combination of a rotary cylinder with stationary heads which are reduced on their inner sides to form bearings for the cylinder, with packing-disks provided with packing-rings placed in the ends of the cylinder, substantially as shown and described.

4. In a rotary engine, the combination of a rotating cylinder with stationary heads, which are reduced on their inner faces to form journals for the cylinder, and a shaft passing eccentrically through the said cylinder and reduced portion of the heads, substantially as shown and described.

5. In a rotary engine, the combination of a rotating cylinder with a shaft whose axis is eccentric to said cylinder which rotates on the stationary cylinder-heads, and the adjustable stuffing-box around the shaft, substantially as shown and described.

6. In a rotary engine, the combination of a rotating cylinder with pistons passing through said cylinder and provided with packing around the hub, the shaft attached to the piston, and the adjustable pillow-block for said shaft, whereby the piston may be adjusted to keep the packing in contact with the cylinder, substantially as shown and described.

7. In a rotary engine, the combination of a rotating cylinder revolving on stationary heads with a piston passing through its side mounted upon the shaft, and a packing around the hub of the piston consisting of two expansion-rings and a packing-ring.

8. In a rotary engine, the combination of a rotating cylinder revolving on stationary heads with a piston passing through its side mounted upon a shaft whose center is eccentric to the center of the cylinder, said piston having packing around its hub consisting of two expansion-rings provided with annular cavities in their inner periphery for the reception of springs, and a packing-ring, substantially as shown and described.

9. In a rotary engine, a rotating cylinder revolving on stationary heads, in combination with a piston which passes through its sides and mounted upon a shaft which is eccentric to the cylinder, packing-rings around the hub consisting of two expansion-rings having recesses on their inner periphery for the reception of springs, and a packing-ring and the strips for packing the sides of the piston, substantially as shown and described.

10. In a rotary engine, the combination of a rotating cylinder with piston mounted upon a shaft eccentric to said cylinder, the cylindrical guides through which the piston passes, and the key in the guide for taking up wear, substantially as shown and described.

11. In a rotary engine, the combination of a rotating cylinder with a piston mounted upon a shaft eccentric to said cylinder, said piston passing through a cylindrical guide, which is provided with a tapering key on the side and packing-strips on its ends, said strip having cavities through which the packing-strips in the face of the piston pass, substantially as shown and described.

12. In a rotary engine, the combination of the valve with its seat having two ports, with means for cutting off twice at each stroke of the valve.

13. In a rotary engine, the combination of the two steam-chests and their cut-off valves with the reversing exhaust-valves z^3 and q^3, whereby the engine can be reversed, substantially as shown and described.

14. In a rotary engine, the combination of the two rotating cylinders journaled on stationary heads, two pistons mounted and fixed upon a shaft eccentric to said cylinders, the brackets for holding the inner heads in position and forming the steam-chest and casing around the shaft, substantially as shown and described.

15. In a rotary engine, the combination of the two valves and their chests with the double links and their eccentrics, whereby one valve is held in position to control the exhaust while the other is acting to admit and cut off the steam, substantially as shown and described.

16. In a rotary engine, the combination of a revolving cylinder with a piston mounted on the shaft which is eccentric to said cylinder, of a packing for the hub consisting of the packing-ring, the expansion-rings provided with recesses for the reception of the springs, the pins for spacing the springs, and the springs, substantially as shown and described.

17. In a rotary engine, the combination of a revolving cylinder with a piston mounted on a shaft which is eccentric to said cylinder,

of packing around the hub, provided with spacing-pins which hold the packing-springs in position, substantially as shown and described.

18. In a rotary engine having a rotating cylinder, pistons passing through guides located in the side of said cylinder, and packing-strips provided with projections for holding the springs in place, substantially as set forth.

19. In a rotary engine having a rotating cylinder, pistons passing through guides located in the side of the cylinder, and packing-strips held in cavities and provided with projections for holding the springs in place, substantially as set forth.

20. In a rotary engine, the combination of two steam-chests with their valves and double links pivoted stationary to a lever traveling on an arc and operated by eccentrics at the ends, whereby one valve is held in position to control the exhaust while the other is acting to admit and cut off the steam, for the purpose set forth.

21. In a rotary engine, the combination of steam chests and valves and double links pivoted at the center and operated by eccentrics at the ends, whereby one valve is held in position to control the exhaust while the other is acting to admit and cut off the steam, for the purpose set forth.

22. In a rotary engine, a rotating cylinder in which are journaled guides and a cap attached to said cylinder, so as to confine the steam escaping around and through said guides, for the purpose set forth.

23. In a rotary engine, a rotating cylinder in which are journaled guides and a cap in which the pistons play, said cap clearing said pistons and confining the steam, for the purpose set forth.

24. The combination, in a rotary engine, of cylinders revolving on inner and outer stationary heads, the inner stationary heads being connected by a bracket, substantially as set forth.

25. The combination, in a rotary engine, of cylinders revolving on inner and outer stationary heads, the inner stationary heads being connected by a bracket which is adapted to hold the steam-chest in position between said cylinders, said bracket also acting as a brace to stiffen the said inner heads, substantially as set forth.

26. In a rotary engine, the combination, with a revolving cylinder, of pistons mounted on a driving-shaft and passing through the side of the cylinder, the said pistons being mounted diametrically opposite on said driving shaft, so as to avoid dead-center, substantially as set forth.

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

SAMUEL GLENVILLE BROSIUS.

Witnesses:
J. HENRY KAISER,
M. D. CONVERSE.