(No Model.) 3 Sheets—Sheet 1.

O. S. GARDEEN.

ROTARY ENGINE.

No. 490,648. Patented Jan. 31, 1893.

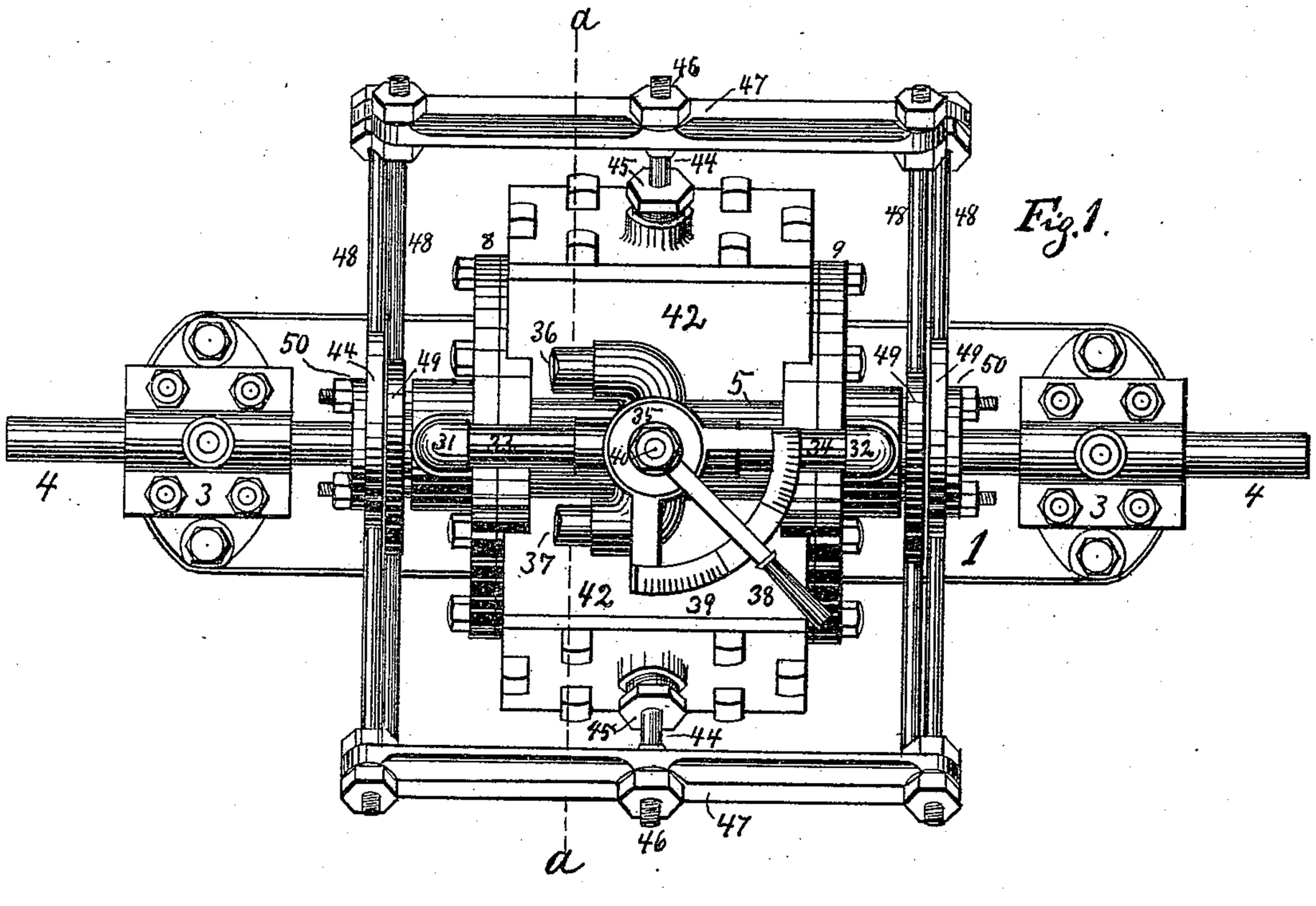

Fig. 1.

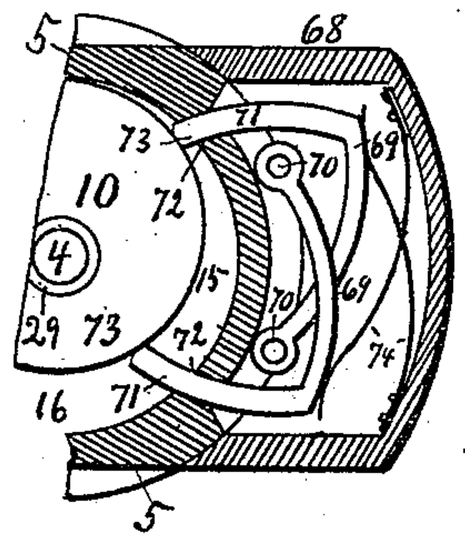

Fig. 10.

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(No Model.) 3 Sheets—Sheet 2.

O. S. GARDEEN.

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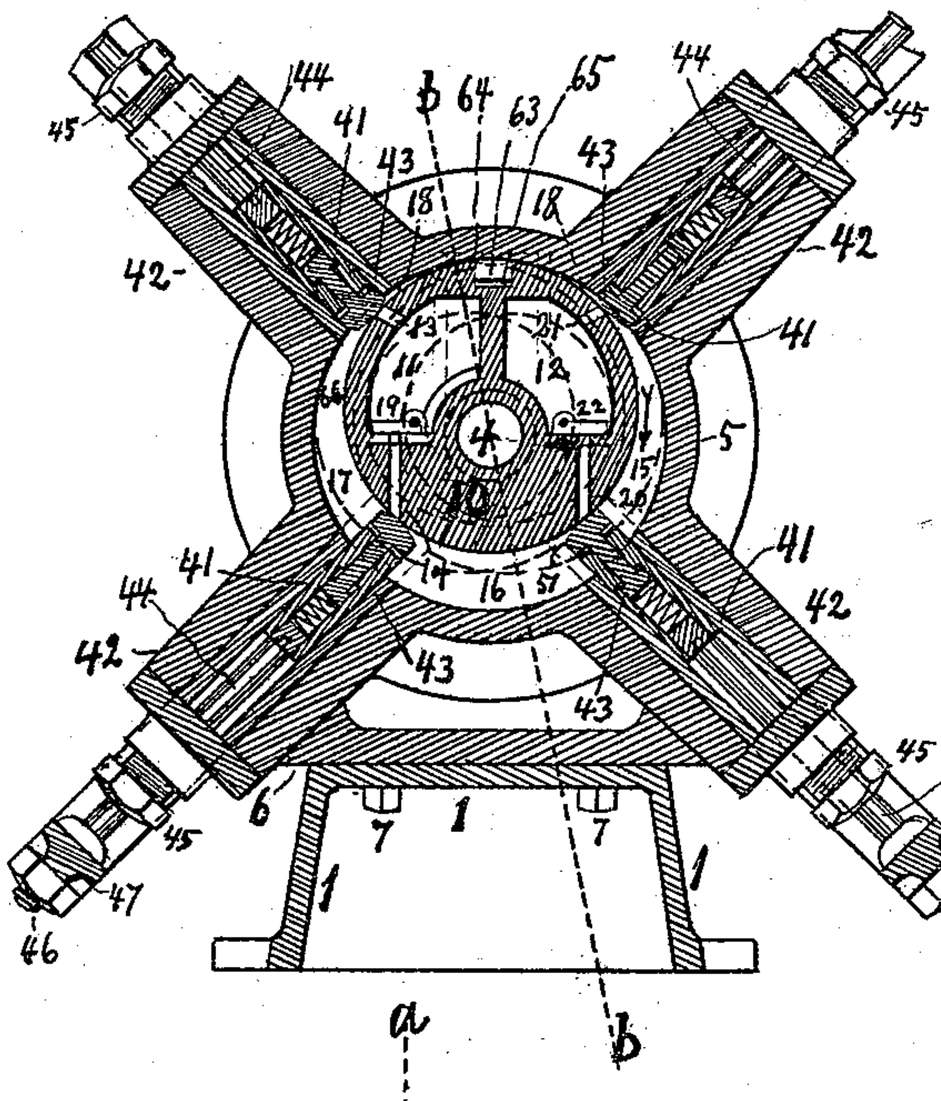

Fig. 2.

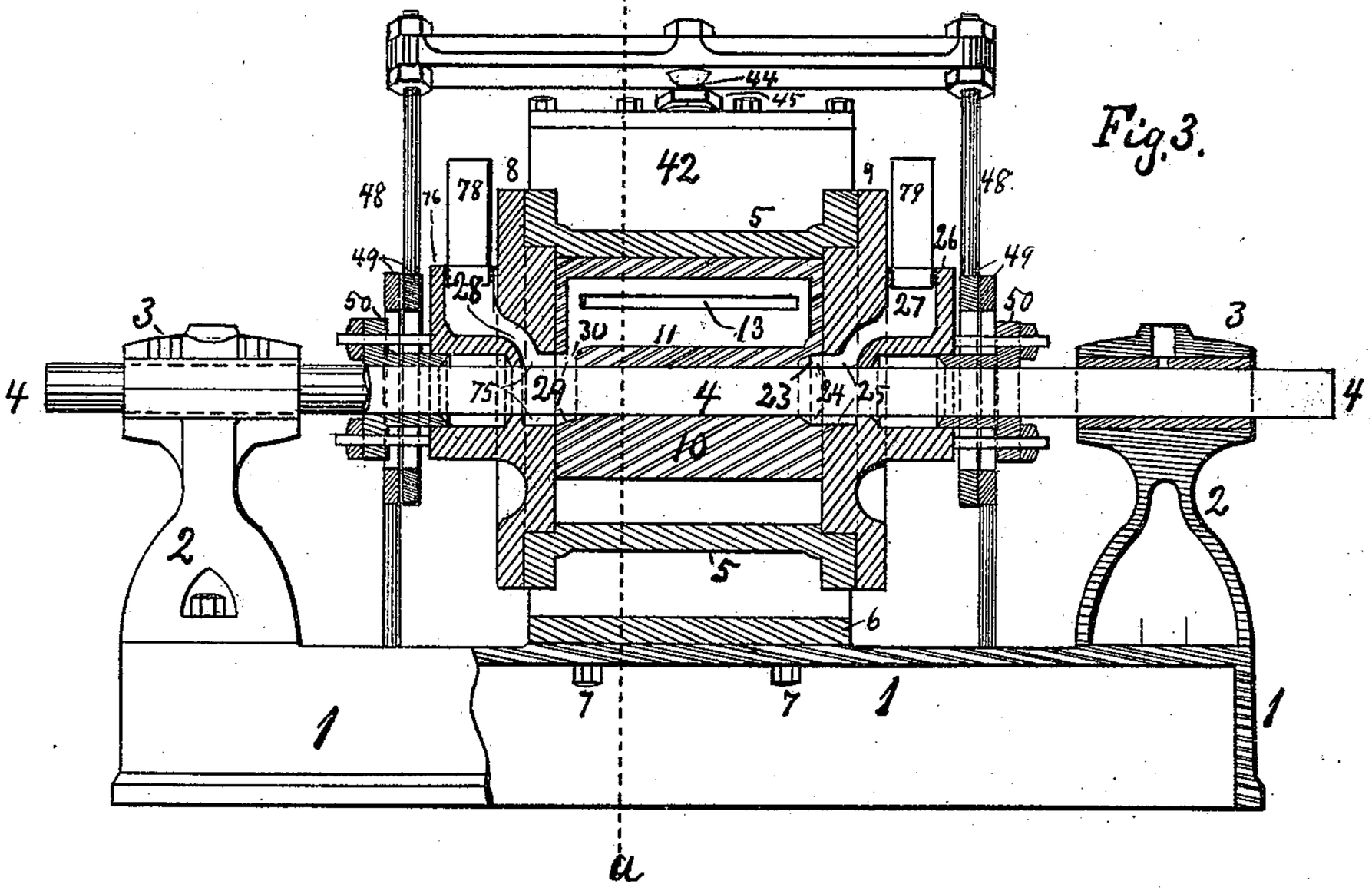

Fig. 3.

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ROTARY ENGINE.

No. 490,648. Patented Jan. 31, 1893.

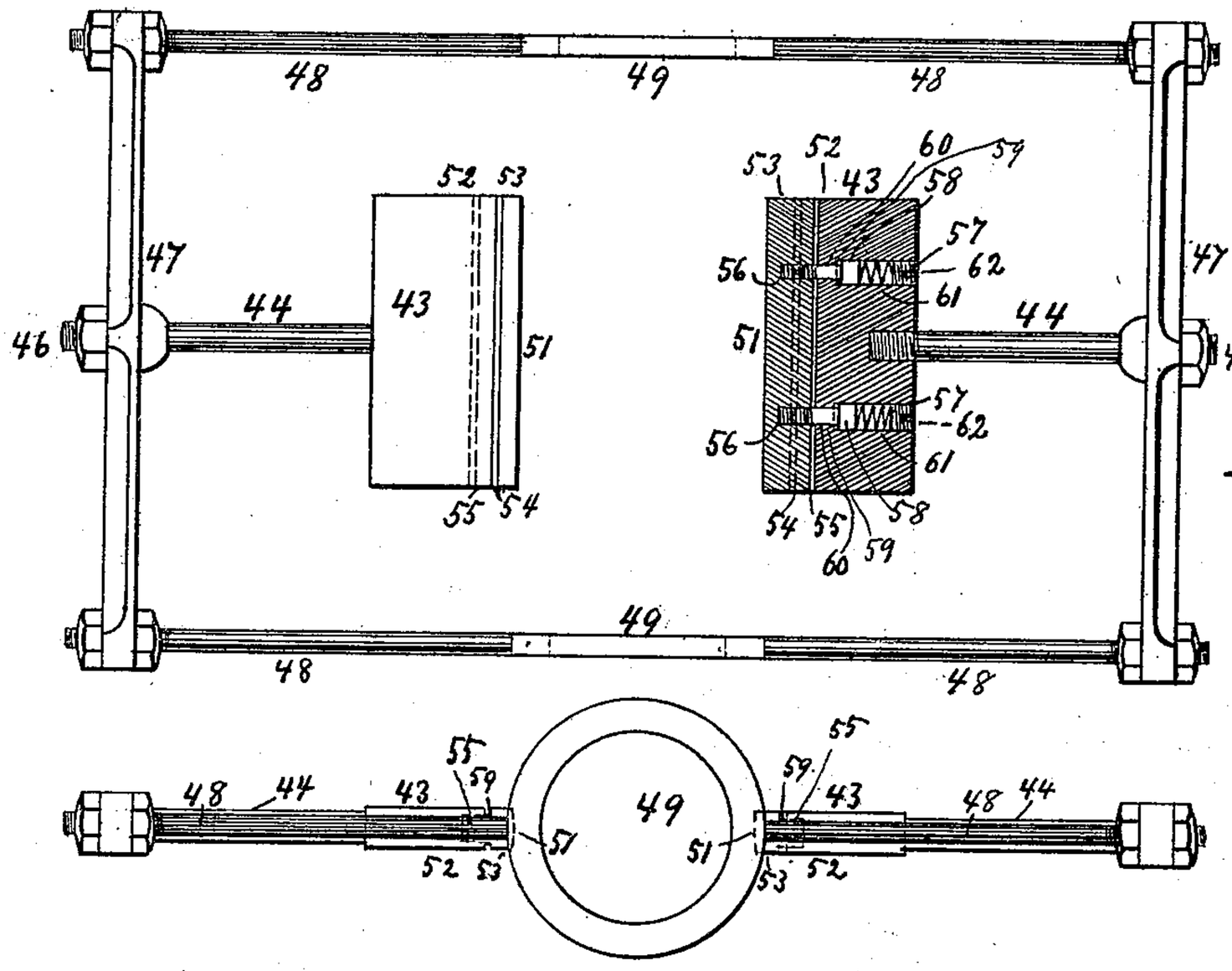

Fig. 8.

Fig. 9.

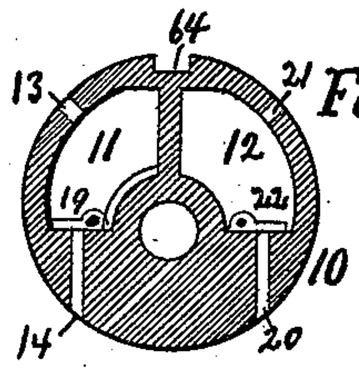

Fig. 4.

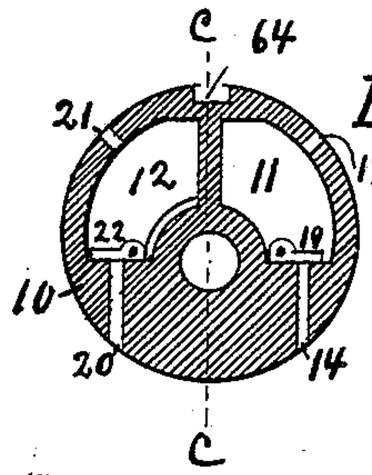

Fig. 5.

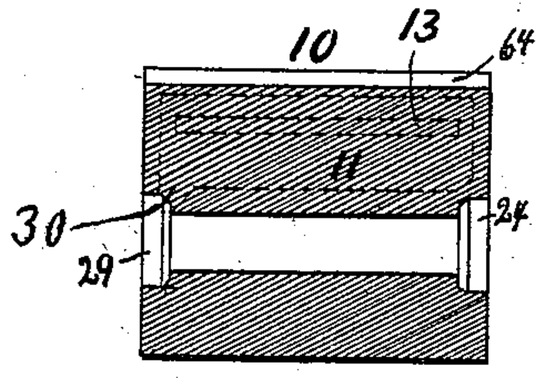

Fig. 6.

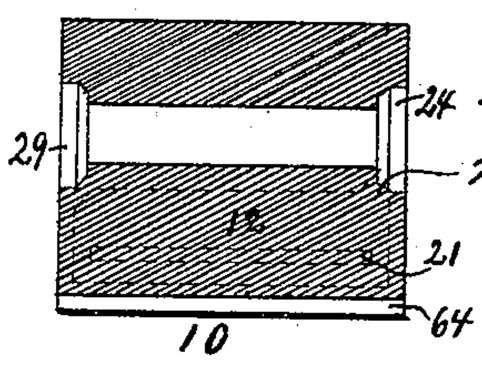

Fig. 7.

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UNITED STATES PATENT OFFICE.

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ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 490,648, dated January 31, 1893.

Application filed April 8, 1892. Serial No. 428,408. (No model.)

To all whom it may concern:

Be it known that I, OSCAR S. GARDEEN, a citizen of the United States, residing at St. Paul, in the county of Ramsey and State of Minnesota, have invented certain new and useful Improvements in Rotary Engines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in rotary steam engines.

One object of my invention is to provide a steam engine that may be run at a very great rate of speed so that it may be connected directly to dynamos and other fast running machinery which has heretofore been run by objectionable belts from slow running steam engines.

Another object of my invention is to provide a rotary engine with a piston that has no slides to wear out, weaken the piston or press with great friction upon the inside of the cylinder on account of their centrifugal force or momentum when the engine is run fast.

I attain these objects by the novel construction and arrangement of parts in illustrated in the accompanying drawings in which

Figure 1, is a top plan view of my complete engine. Fig. 2, is a sectional end view of Fig. 1, on the line *a*, *a*, Fig. 3, is a partial sectional side elevation of Fig. 1, on a line as *b*, *b*, in Fig. 2. Figs. 4, and 5, are vertical sectional views of the piston cut off at or near its middle. Figs. 6, and 7, are longitudinal sectional views of the entire piston cut through at the line *c*, *c*, of Fig. 5. Fig. 8, is a detail side view of a yoke and two slides held by said yoke against opposite sides of the piston. Fig. 9, is an edge view of Fig. 8. Fig. 10, is a modification of the slides that separate the live steam from the exhaust steam.

The main principle of my engine is to cause a shaft to revolve by applying steam pressure directly upon the outer cylindrical surface of an eccentric secured upon the shaft and being exposed to the steam pressure mainly upon one side of the portion of the eccentric having the longest radius upon the center of the shaft.

Referring to the drawings by figures of reference—1, designates the bed-plate of the engine.

2, are stands projecting upward from the bed-plate and provided at their top ends with journal boxes 3, in which is journaled the shaft 4, of the engine.

5, is the cylinder which has a flat bottom side 6, adapted to fit upon the bed-plate 1, and be bolted thereto by the bolts 7.

8, and 9, are the covers or heads of the cylinder.

10, is the piston which is secured upon the shaft 4, and consists of an outwardly cylindrical casting or body with the shaft 4, secured in it, as far from the center of the said body as may be desired to make the eccentricity of the piston. The casting or body of the piston has two large longitudinal chambers 11, and 12, extending nearly from end to end of the piston. The chamber 11, is provided with longitudinal slots or steam ports 13, and 14, best shown in Figs. 4, to 7, communicating with the spaces 15, 16, 17 and 18, in the cylinder. That is, communication is by those two ports 13, and 14, established between the chamber 11, as any part of the space inside the cylinder at various times during a revolution of the piston. The steam can however, not leave the chamber 11, through the port 14, as that is provided with a hinged valve 19, that can open only inward into the chamber 11, in which it is located. The chamber 12, is arranged exactly the same way as already described for chamber 11, by having the ports 20, 21, and the valve 22. The chamber 11, further communicates through a port 30, with an annular groove 29, formed in the very end of the piston near and around the shaft 4. This groove 29, registers with a similar annular groove 75, in the cylinder head 8. From this groove 75, extends through a projection 76, formed upon the cylinder

head 8, the steam port 28, which at its top or outlet is rounded so as to receive a screw-threaded steam pipe 78, carrying at its top end an elbow 31 (shown in Fig. 1.) The chamber 12, likewise communicates through the steam port 23 (see Fig. 7.) Annular grooves 24, and 25, with the outlet 27, into which a pipe 79, is screw-threaded and carries at its upper end the elbow 32 (shown in Fig. 1.) From the elbows 31, and 32, extend the horizontal pipes 33, and 34, which are screw-threaded into opposite sides of a suitable double-gated valve 35, which is further provided with a steam inlet pipe 36, and an exhaust pipe 37.

The construction and arrangement of the gates in the valve check 40, are such that when the valve handle 38, is moved to one side upon the graduated quadrant 39, the live steam will enter the pipe 33, and fill the chamber 11, in the piston, while the exhaust steam is at liberty to escape from the chamber 12, through the port 23, (best shown in Fig. 7.) Grooves 24, 25, conduit 27, upright pipe 79, elbow 32, pipe 34, a suitable gate in the valve check 40, and thence out through the exhaust pipe 37; and if the handle 38, is swung to the other side upon the quadrant 39, the live steam is turned into the pipes 34, 32, 79, 27, port 23, and chamber 12, while the exhaust steam leaves chamber 11, and follows the course 30, 29, 75, 28, 78, 31, 33, and finds its way through a gate in the valve 40, to the exhaust pipe 37. Thus by setting the handle 38, to the middle of the quadrant 39, the steam is shut off and the engine stopped and by turning the handle to either end of the quadrant the engine is started in either direction.

How the steam acts upon the piston will presently be described; we will first consider the construction of the cylinder.

The cylinder 5, is provided with several (in the present instance four) longitudinal slots 41. These slots are of even length with the piston, which fit closely between the cylinder heads. Said slots extend from the inner surface of the cylinder through the cylinder walls and are further prolonged a considerable distance into projections 42, cast upon the sides of the cylinder and forming what may be termed abutment chambers, in which are housed and slide the abutments 43, the inner and rounded ends of which are constantly held against four opposite sides of the piston dividing the space in the cylinder into several smaller spaces 15, 16, 17 and 18. The abutments 43 (best shown in Figs. 8, and 9,) are held against the piston by being secured to rods 44, sliding through stuffing boxes 45, and having their outer ends 46, secured in the cross bars 47, which are united or secured together in pairs by the yoke bars 48, which are at their middle provided with openings 49 (see Fig. 9.) by which to encircle the shaft and stuffing boxes 50, of the engine; said openings 49, are sufficiently large to allow the proper motion of the yokes, which are operated by the throw of the eccentric-shaped piston 10, against the inner ends 51, of the abutments 43, as the piston revolves. The slides 43, are further made automatically adjustable to the different distances between them, caused by the different positions of the piston, by being built of two pieces or parts 52, and 53 (see Figs. 8, and 9.) a portion 54, of the piece 53, is reduced and let into a groove in the front end of the piece 52, and held therein by the sliding screws 56, which are let into the large holes 57, in the piece 52, until their fillister heads 58, stop against the bottom 59, of the hole 57. Through said bottom 59, are smaller holes 60, through which the screws pass and are tightly screwed into screw-threaded holes in the piece 53; springs 61 are then dropped in on the tops of the screw heads 59, where they are compressed by screw-threaded plugs 62, which also retain the said springs in their respective chambers where they act as cushions allowing the piece 53 and the screw heads 58, to slide back and forth in the piece 52, for the purpose already stated.

63, is a metallic strip placed in the slot 64, and by a suitable flat spring 65, placed between the metallic strip and the bottom of the slot, pressed outward toward the inner face of the cylinder, thereby forming a packing or steam-tight line at the highest point of the piston, which is supposed to always follow the inner surface of the cylinder.

In operation the live steam, as already above described, may be turned into either of the piston chambers 11, and 12. We will suppose that it is turned so as to fill the chamber 11. The live steam will then pass from said chamber 11, through the port 13, and fill the space 17, in the cylinder, causing pressure to bear upon the side 66, of the piston which is exposed to said pressure. This will revolve the piston and shaft in the direction of the arrow until the steam port 13, passing the space 18, fills that space with steam, then the spaces 15, and 16, are likewise filled with live steam as fast as the port 13, reaches them; and in all the spaces the side 66, of the eccentric or piston receives the pressure. The valve 19, is kept shut by the steam pressure being always a little higher in the chamber 11, than at the outside of the piston, (where the live steam also has access to the port 14, and might open the lid 19 if the pressure were not higher inside the chamber.); while the piston is thus revolved by a continual pressure upon one side of it, the exhaust steam is let out from each one of the spaces 15, 16, 17 and 18, through the ports 20, and 21, by which it escapes into the piston-chamber 12, and from there out through the conduit 23, 24, 25, 27, 79, 32, 34, 35, 37, as already above described. The different functions of the ports 20 and 21, are as follows: Supposing the piston to have made one revolution and stands in the position shown in Fig. 2, then most of the ex-

haust steam has just left the space 15, through the port 20, and valve 22, but there is some steam left in said space 15, which can no longer reach the mouth of the port 20, this steam escapes through the port 21. Turning the piston a little farther around the port 20, reaches the space 16, in which the steam has expanded about fifty per cent., and as to its position to the piston presses upon the dead center side of it producing no motive power, the steam now rushes from the space 16, out through the port 20, lifting the valve 22,which is otherwise kept down by its momentum and in addition thereto a light spring (not shown) is used where so found necessary. When the port 20, has passed through or crossed the space 16, the latter has assumed the shape shown in space 15, and the port 21, has to receive the balance of the exhaust steam, the same as already described about the space 15, and so on, with all the four spaces in the cylinder. I may have more or less than four spaces by using more or less than four of the abutments 43, and the expansion of the steam will thereby be increased or decreased accordingly. In the present instance I use four slides, and by so doing the live steam is cut off from each of the spaces 15, 16, 17 and 18 when the spaces have reached the size and shape of space 17, as shown in Fig. 2. The rest of the space is filled out by the expansion of the steam till the shape and size of space 16, are obtained when the exhaust commences.

How to reverse the engine has already been partly described, and as the action of the steam upon the piston is simply in every way a reversed direction of what has just been described for rotation in the direction of the arrow, a recitation of the reverse action is considered unnecessary.

In very fast running engines I dispense with the yokes 48, bars 47, stuffing boxes 45 and rods 46, and change the slides and slide houses to the shape illustrated in Fig. 10, in which 4, is the engine shaft, 10, the piston (which is exactly the same as above described), 5, is the cylinder upon opposite sides of which I cast or secure two abutment chambers like 68, in each of which are two broad arms 69, pivoted at 70, to the end walls of the chamber 68. The free ends of said pivoted arms 69, are formed into segmental shaped abutments 71, having their centers in the middle or center of the pivots 70. These abutments 71, fit snugly in slots 72 in the walls of the cylinder through which they pass and bear with their rounded ends 73, against the entire length of the cylindrical face of the piston against which they are held with proper force by suitable springs 74, pressing upon the backs of the arms 69. These springs have stroke enough to chase the abutments 71, into steam tight contact with the piston 10, in whatever its position may be.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is,

1. In a rotary engine the combination of an eccentrical piston secured upon a shaft centrally located in a steam cylinder, said piston having two longitudinal chambers, each of said chambers having two longitudinal steam ports of which one is covered by a hinged valve located inside the chamber, each chamber also having a steam port extending in opposite directions into annular grooves formed into the ends of the piston around the shaft for delivering or receiving steam through annular grooves and conduits in the cylinder heads, with a cylinder having through its walls several longitudinal slots of even length with the piston, abutments moved by the piston outward in said slots, and springs for moving inward and holding said abutments at all times in contact with the cylindrical surface of the piston, for dividing the steam space in the cylinder into several compartments, substantially as shown and described and for the purpose set forth.

2. In a rotary engine the combination of the eccentric piston 10, secured upon the engine shaft 4, centrally located in a steam cylinder, said piston having longitudinal steam chambers, each of said chambers having two longitudinal steam ports of which one is covered by a hinged valve located inside the chamber; each chamber also having a steam port extending in opposite directions into annular grooves formed in the ends of the piston around the shaft, for receiving or delivering steam through registering annular grooves and conduits in the cylinder head, with the cylinder 5, having through its walls several longitudinal slots of even length with the piston, abutments moved by the piston in and out in said slots. The abutment chambers, 42, for guiding and housing the slides, the rods 44, and stuffing boxes 45, the yokes consisting of the bars 47, and 48, connecting together such two and two of the abutments as are located in opposite sides of the cylinder, said abutments being made in two pieces, grooved together so as to partly slide into each other, and having sliding bolts as 56, for holding the pieces together and springs as 61, housed-in holes in the rear part of the abutments for pressing upon the heads of the sliding bolts 56, thereby pressing the front part of the abutment against the face of the piston; the screw-threaded plugs, 62, for retaining in place and compressing the said springs 61, substantially as shown and for the purpose specified.

3. In a rotary engine the combination of the narrow bed-plate 1, stands 2, journals 3, shaft 4, with the cylinder 5, having the flat side or bottom portion 6, abutments 43, having yokes 46, 47, 48, the abutment chambers 42, two of which straddle the bed-plate, the piston 10, having the chambers 11, and 12, conduits 13, 14, 20, 21, valves 19 and 22, steam

ports 23, and 30, the cylinder heads 8 and 9, having annular grooves around the shaft of the engine, the conduits 27, 28, pipes 78, 79, elbows 31, 32, pipes 33, 34, 36, 37, valves 35, 40, graduated quadrant 39, and handle 38, substantially as shown and described and for the purpose set forth.

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

OSCAR S. GARDEEN.

Witnesses:
A. J. CARLSEN,
THOS. P. BRENNAN.