(No Model.) 3 Sheets—Sheet 1.

W. WEBSTER.

ROTARY ENGINE.

No. 415,337. Patented Nov. 19, 1889.

Fig. 1.

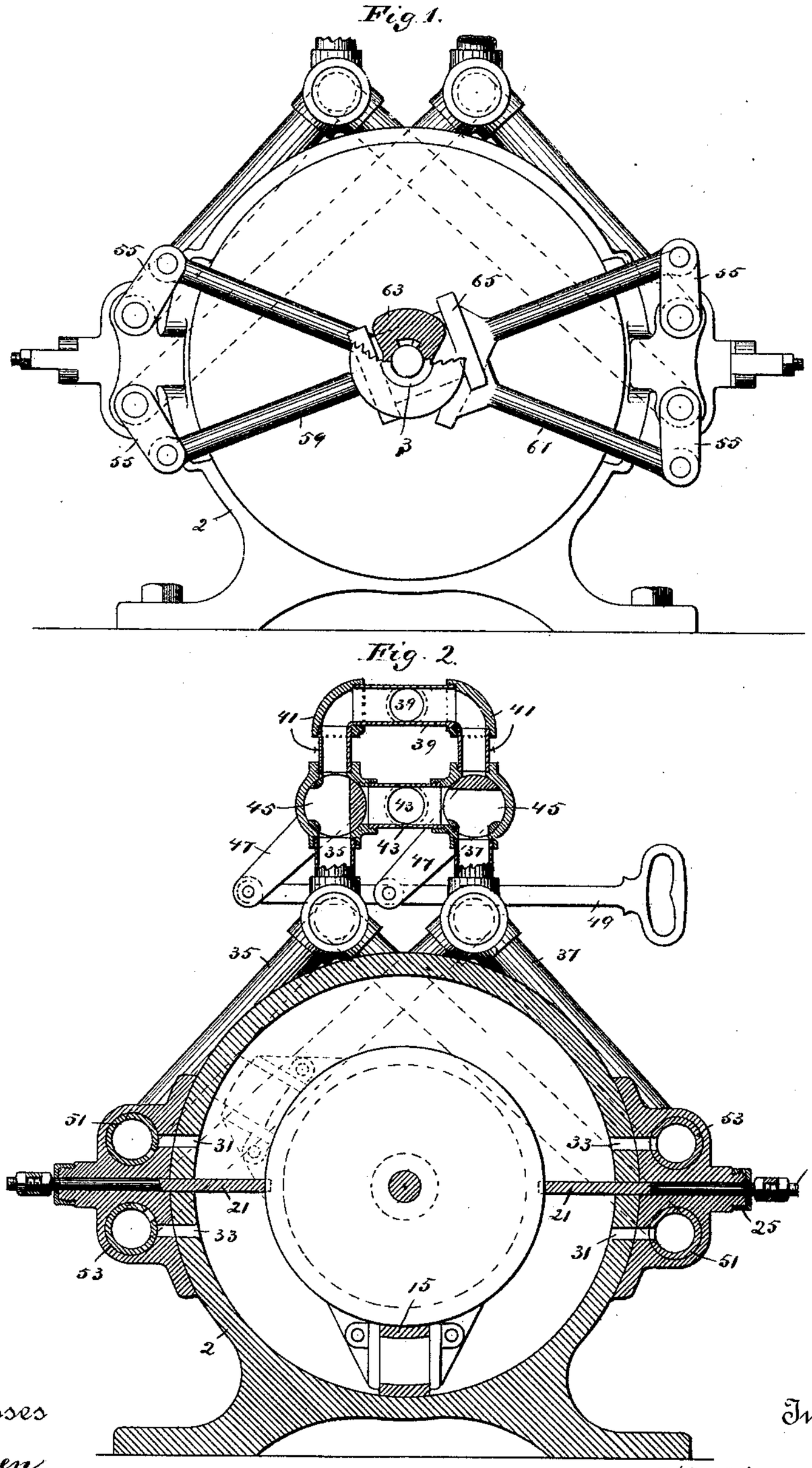

Fig. 2.

Witnesses

J. Jessen.

Hector Baxter

Inventor

William Webster

By his Attorneys

Paul Sanford & Merwin

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Fig. 3.

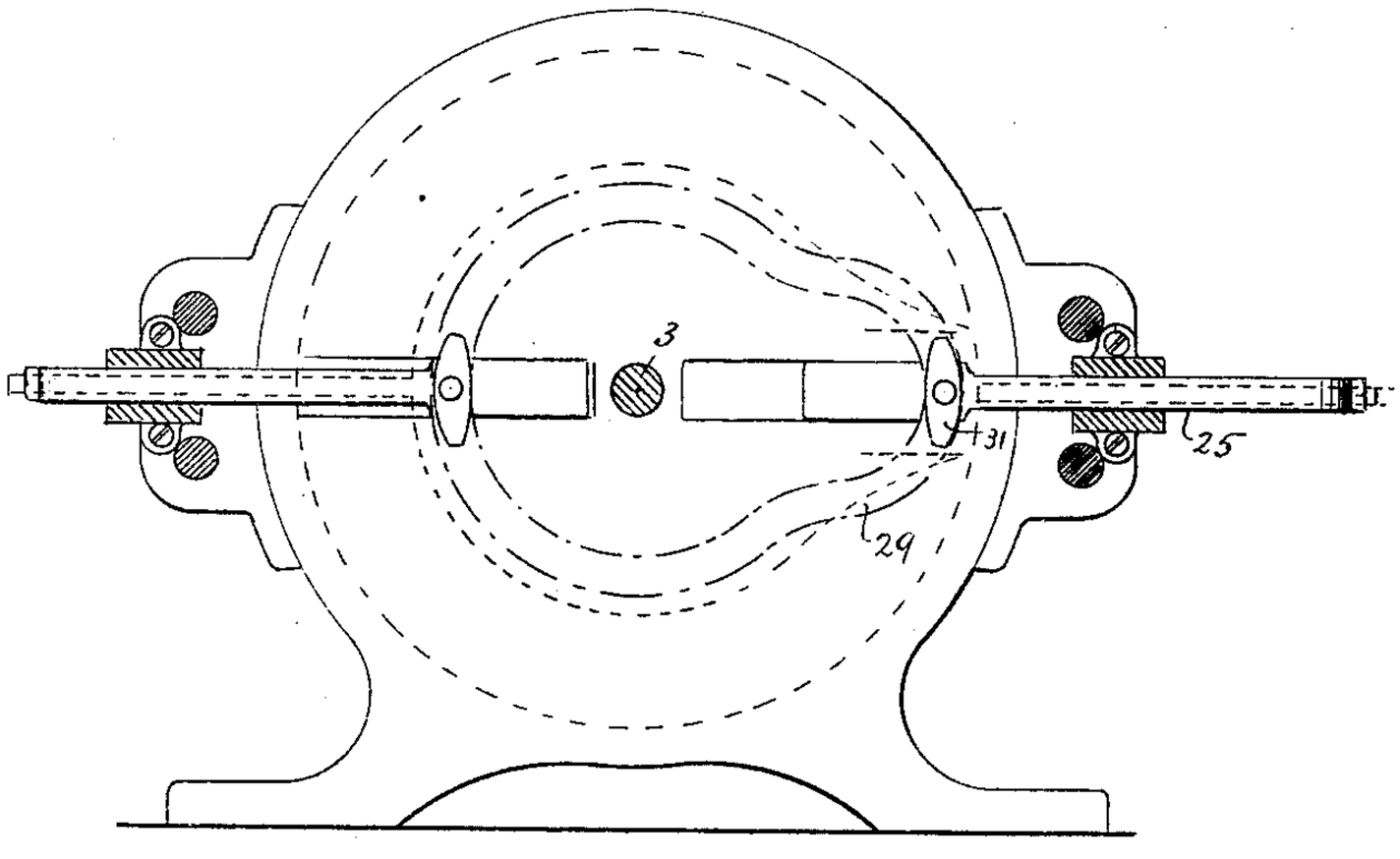

Fig. 5.

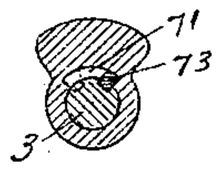

Fig. 4.

Witnesses

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Fig. 6

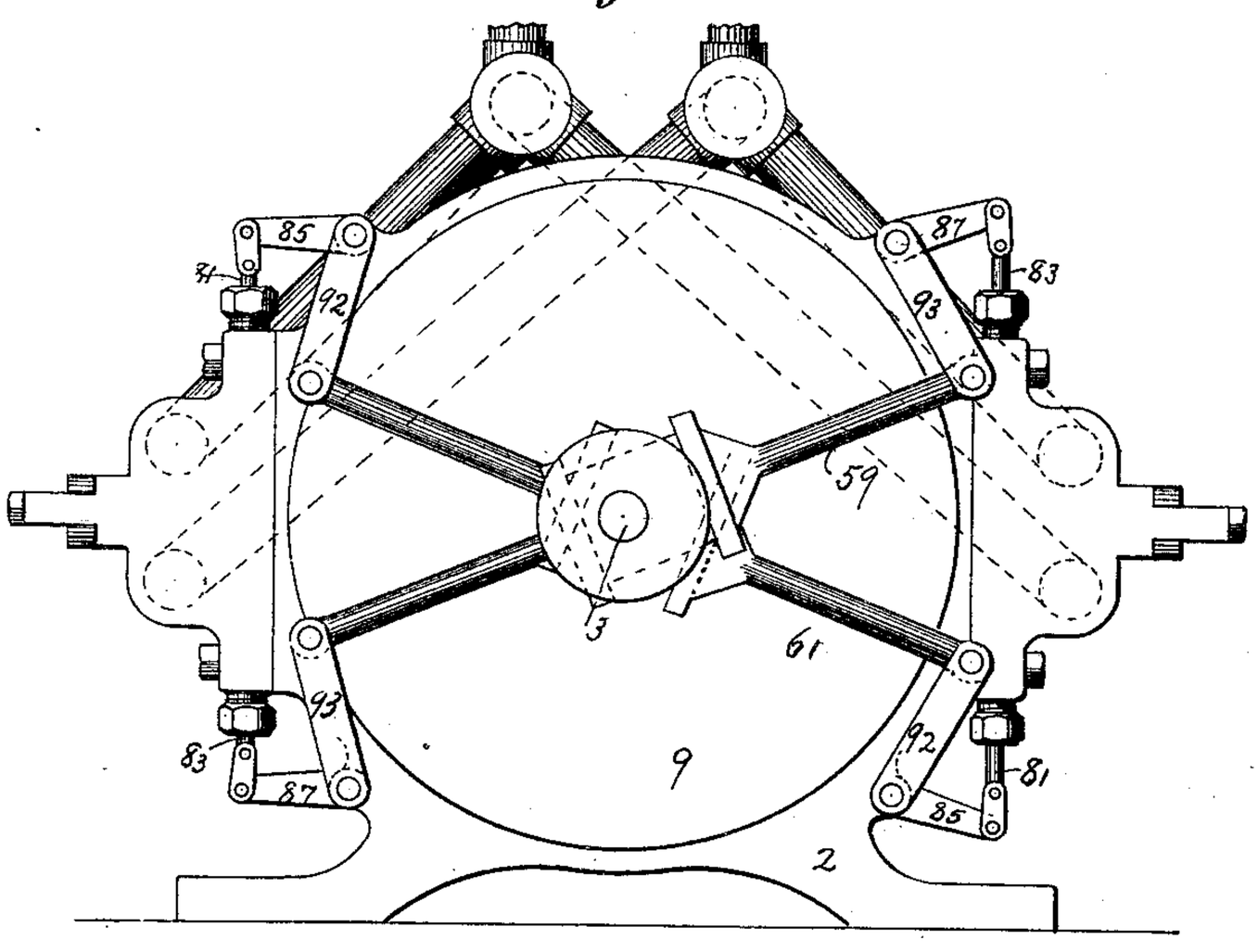
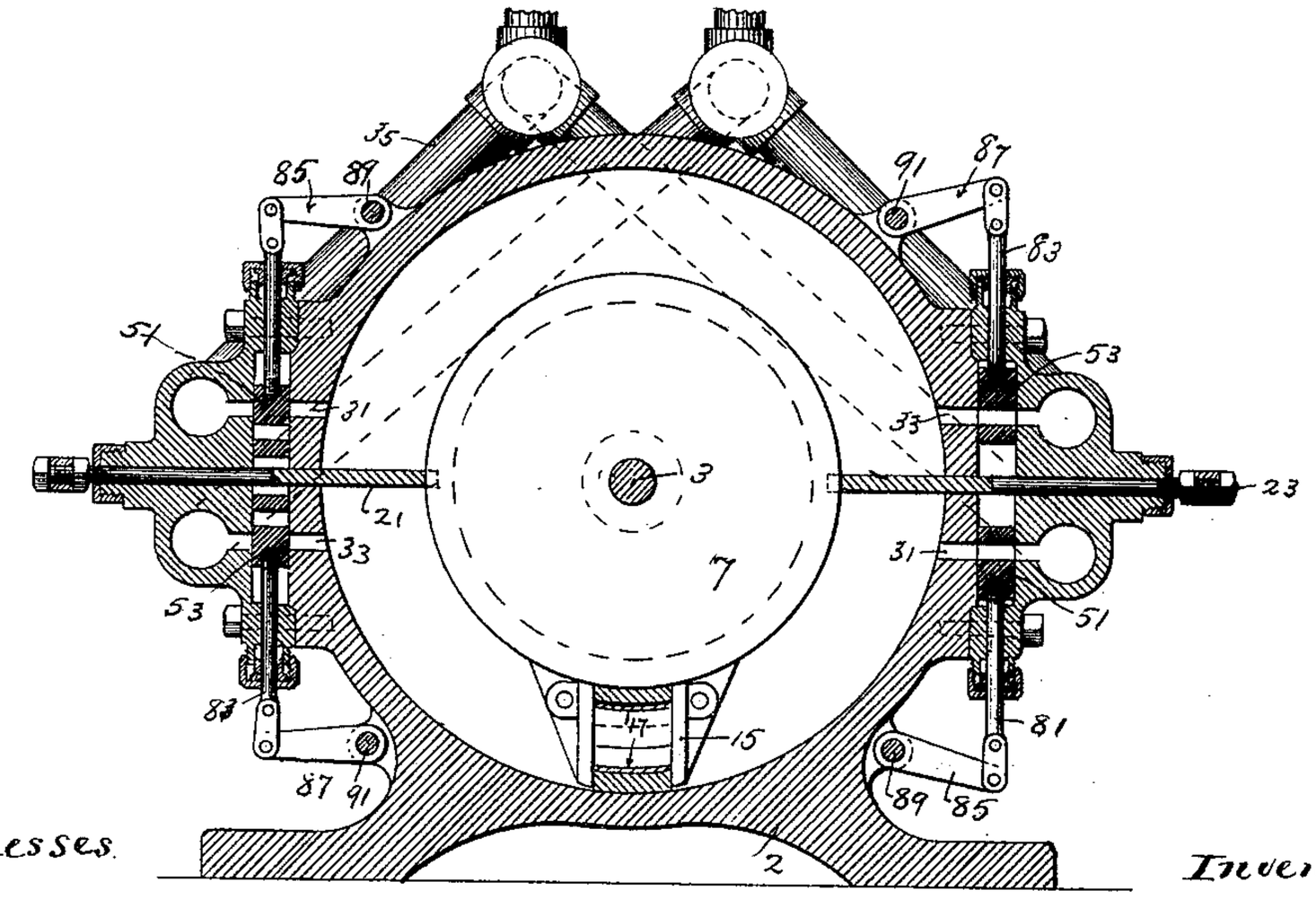


Fig. 7.



Witnesses.
J. Jessen.
Hector Baxter

Inventor
William Webster.
By Paul, Sanford & Merwin Att'ys

UNITED STATES PATENT OFFICE.

WILLIAM WEBSTER, OF SEVERANCE, MINNESOTA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 415,337, dated November 19, 1889.

Application filed May 14, 1888. Serial No. 273,844. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM WEBSTER, of Severance, in the county of Sibley, State of Minnesota, have invented certain Improvements in Rotary Engines, of which the following is a specification.

The objects of my invention are to provide a light-running high-speed rotary engine which does not have any dead-center, and to avoid any back-pressure from the exhaust.

The invention consists in the construction and combination of parts hereinafter particularly described and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a side elevation of my improved engine. Fig. 2 is a transverse vertical section of the same. Fig. 3 is a similar section showing the arrangement of the cam which operates the sliding abutments. Fig. 4 is a horizontal section through the center of the engine. Fig. 5 is a detail. Fig. 6 is a side elevation, and Fig. 7 is a vertical section showing a modification in the valve motion.

In the drawings, 2 represents the cylinder or casing, which may be of any suitable size and arranged to be mounted on any suitable support. Mounted in suitable bearings in this cylinder is the shaft 3, which forms the main shaft of the engine, and from which power may be applied through any desired means to any machinery which it is desired to operate. Secured to the shaft 3 is a piston, which fits within the cylinder, and is caused by the pressure of the steam to travel therein.

The construction of the piston which I prefer to use is as follows: A sleeve 5 is keyed to the shaft 3 so as to rotate therewith. A disk 7 is secured to or formed integrally with the sleeve 5 and projects toward the circumference of the cylinder. The cylinder is formed with heads 9, to which are secured the inwardly-projecting portions 11, which are arranged centrally within the cylinder with a sufficient space between them for the disk 7. A packing 13 may be provided between each of the heads 11 and the disk 7, thereby forming a steam-tight joint. An annular chamber is thus formed between the outer circumference of the heads 11 and the inner circumference of the cylinder. A piston-head 15 is secured to the disk 7, and is arranged within this annular chamber and is adapted to travel in either direction therein. This piston-head may be of any preferred construction. The construction which I prefer, and which I have shown in the drawings, consists of a substantially rectangular box formed in parts and fitted together by a sliding joint. A series of plates 17 are arranged within this piston-head and cover joints therein. Suitable springs 19 may be arranged within the piston-head, so that they are adapted to force the sections thereof apart. By this means if there is any wear upon the sections of the piston-head it will be taken up by springs and a steam-tight joint maintained between the piston and cylinder.

Arranged at opposite sides of the cylinder are the sliding abutments 21, which are adapted to be held against the edges of the cylindrical heads 11 and the disk 7, and thereby to divide the annular chamber into two separate compartments, as shown in Fig. 2. Each of these abutments 21 is connected by a rod 23 with a sliding-arm 25, which is mounted in a groove in the cylinder-head and radiates from the center of the cylinder. A disk 27, provided with a cam-groove 29, is keyed upon the shaft 3 and revolves therewith. A projection $31\frac{1}{2}$, pivotally secured upon the arm 25, engages the groove 29 in the disk 27. This groove is so constructed that as the shaft revolves and the piston-head 15 is brought nearly to the abutment 21 the abutment is withdrawn from the annular chamber, permitting the piston-head to pass and is immediately moved back into the chamber as soon as the piston-head passes. The cylinder is provided, also, with the inlet-ports 31 and the exhaust-ports 33, which are preferably arranged upon opposite sides of the abutments 21, as shown in Fig. 2.

A branched pipe 35 is connected with both of the inlet-ports 31, and a similar pipe 37 is connected with both of the ports 33. A steam-pipe 39 is connected by branch pipes 41 with the pipes 35 and 37. Both of the pipes 41 are also preferably connected with the exhaust 43. Each of the pipes 41 is provided with a three-way cock or valve 45, each of which is preferably provided with an arm 47, both connected to an operative rod 49. The three-way valves 45 are so arranged with

reference to each other that when the steam-pipe 39 communicates with the pipes 35 the pipes 37 communicate with the exhaust 43, as shown in Fig. 2. When these valves are given a quarter-turn from this division by means of the operating-rod 49, the steam-pipe 39 will communicate with the pipes 37 and the pipes 35 will communicate with the exhaust 43. By this means the engine may be reversed and driven in the opposite direction, the ports which had previously been used as the inlet-ports becoming now the exhaust-ports, and vice versa. Each of the ports 33 and 31 is provided with a suitable valve, by means of which the steam is let on or cut off from the cylinder at pleasure. These valves are all preferably similar in construction and operation. They are formed, preferably, as short tubes mounted in bearings in the casings, and each of them provided with an opening adapted to register with the steam-ports, as shown in Fig. 2. The steam-pipes 35 and 37 communicate with the interior of the said valves 51 and 53. Each of the valves is provided with a crank-arm 55, by means of which the valve may be turned in its bearing, so as to cause its opening to register with the port or to be moved away from it.

A connecting-rod 59 joins the two crank-arms of the valve 53, and a similar rod 61 joins the two arms of the valves 51. Each of these connecting-rods is provided with a yoke 65, and a cam 63 on the shaft 3 is arranged to engage both of these yokes, so that as the shaft is rotated the valves 51 and 53 are oscillated so as to open or close the ports 31 and 33. When one of the ports 31 is open, the other is closed, and when one of the ports 33 is open the other is closed, as shown in Fig. 2.

The cams 63 may be arranged so as to allow for a slight movement of the shaft independent of the said cams. This is for the purpose of giving the necessary lead for the steam as the inlet is changed from one set of valves to the other in reversing the motion, and is accomplished by providing the hub of each cam with a circumferential recess or slot 71, which engages a key 73 fixed in the shaft and extending into the said recess, as shown in Fig. 5. This recess is made of a width sufficiently greater than the width of the key to allow for the proper variation. The lead for the forward motion is ascertained and the cam set with the key in contact at the forward end of the slot, as shown in full lines in Fig. 2. A similar lead is allowed for the backward motion, with the key in contact at the back of the slot, as shown in dotted lines in Fig. 5, and as the engine is reversed the cams will remain stationary until the shaft has revolved sufficiently to carry the key from one end of the slot to the other and thus work off the lead.

When it is only required to run the engine in one direction, the three-way valves 45 may be dispensed with. The pipes 35 will then become the permanent inlet or steam pipes, and the pipes 37 will be used only as outlet or exhaust pipes.

The operation of the engine is as follows: The sliding abutments divide the annular chamber into two compartments, and the valves are so set that the steam is being admitted to one of these compartments and exhausted from the other. The steam is admitted through the three-way valve 45 to the pipe 35 and passes to the valves 51, and is admitted to the cylinder by one of these valves through the port 31, and exerts its pressure between the abutment 21 and the piston 15, causing the piston to travel in the annular chamber and revolve the shaft 3, to which it is attached. The steam follows the piston until it has reached the opposite sliding abutment 21, which is withdrawn by the action of the cam-groove 29 in the disk 27, and the piston allowed to pass this abutment. The steam still follows the piston after this operation until the said piston has passed the opposite inlet-port 31. By this time the sliding abutment has been moved back to its original position. The piston which we will say was first acted upon in the lower compartment has now passed out of this compartment and is inclosed within the upper compartment in the position denoted by dotted lines in Fig. 2. The lower compartment and the space between the abutment and the piston are still under pressure. The valves 51 and 53 are now changed by the action of the cam 63 closing the two already used for admission and exhaust. Steam is now admitted through the port 31 back of the piston in the upper compartment, and the steam confined in the lower compartment is allowed to exhaust through the port 33. While the steam is acting upon the piston in the opposite compartment a continuous action of the steam is maintained and the back-pressure is avoided.

It will be seen that the sliding operation of the abutments 21 takes place with equal pressure upon their two sides, for when they are thrown out before the piston reaches these steam is exhausted from both sides, and when they are forced back after the piston passed it is through the steam under equal pressure upon both sides. This avoids any unequal wear upon the slides on the grooves in which they operate. These sliding abutments are preferably supported at the two sides by suitable grooves in the cylinder-heads and the inner ends are supported by projecting into a recess in the inwardly-projecting portions 11 of the said heads. Other construction, however, may be used for this sliding abutment without departing from my invention.

In some instances I may prefer to substitute slide-valves for the rotary valves already described, and in Figs. 6 and 7 I have shown the machine constructed with this modification. The valves 51 and 53 slide in suitable

ways formed between the steam inlet and exit pipes and the cylinder and control the ports 31 and 33. These valves are operated by suitable valve-rods 81 and 83, which are preferably connected to rocker-arms 85 and 87 on the shafts 89 and 91. Arms 92 and 93 are preferably secured to the said shafts and are attached to the connecting-rods 59 and 61, and are operated in a manner substantially similar to the oscillating or rotary valves. The cams 63 on the main shaft force the connecting-rods 59 and 61 outward, carrying the arms 92 and 93 and partially revolving the shafts to which they are attached. This motion throws the arms 85 and 87 outward and causes the openings in the valves 51 and 53 to register with the ports to admit steam upon one side of the sliding abutment and to exhaust it from the other side.

The set of valves controlling the ports in the opposite side of the cylinder are similarly constructed and operated by the connecting-rods 59 and 61, so that when one set of valves is open the other set is closed.

I claim as my invention—

1. In a rotary engine, the combination, with a cylinder having an annular chamber, of a piston revolving in said annular chamber, the sliding abutments dividing said annular chamber into two or more separate compartments, inlet and outlet ports for each compartment, and the valves controlling said ports to open one port and close the other on one side of said abutments for admission of steam to act on the piston and close one and open the other port on the opposite side of the abutments to cut off and exhaust steam therefrom before the piston enters therein, substantially as and for the purposes set forth.

2. In a rotary engine, the combination, with the casing 2, of the inwardly-projecting heads 11, forming an annular space between said heads and the inner circumferential face of the casing in which the piston travels, the sliding abutments 21, dividing said space into compartments, the arm 25, sliding in the casing, the disk 27, provided with a cam-groove 29, engaging a projection 31½ on the said arm, by which the said sliding abutment is withdrawn from the chamber while the piston passes, and the shaft 3 actuating the said disk, substantially as described.

3. In a rotary engine, the combination, with the casing 2, provided with an annular chamber, of the piston revolving in said chamber, the shaft 3, driven by said piston, the sliding abutment 21, dividing the annular chamber into compartments, the valves 51 and 53, respectively arranged on opposite sides of said abutments for admitting and exhausting the steam from each compartment, the cams 63, secured to the shaft, and the rods 59 and 67, operated by the cams and connected with said valves, opening one of said valves 51 on one side of the abutments and the valve 53 on the other side, while the other valves are closed, substantially as described.

4. The combination, in a rotary engine having an annular chamber in which the piston travels, of the sliding abutments dividing said annular space into compartments, the branch pipe 35, connecting with each of said compartments through the ports 31, a branch pipe 37, connected with each compartment through the ports 33, said ports 31 and 33 being arranged on opposite sides of the abutments, as described, a steam-pipe 39, connected to both pipes 35 and 37, an exhaust-pipe 43, also connected to both pipes 35 and 37, and the three-way valves 45, placed at the confluence of the said exhaust-steam and branch pipes, and so arranged that either branch pipe may be open to the steam and the opposite pipe to the exhaust, in order to drive the engine in either direction, substantially as described.

In testimony whereof I have hereunto set my hand this 31st day of March, 1888.

WILLIAM WEBSTER.

In presence of—

A. C. PAUL,

A. M. GASKELL.