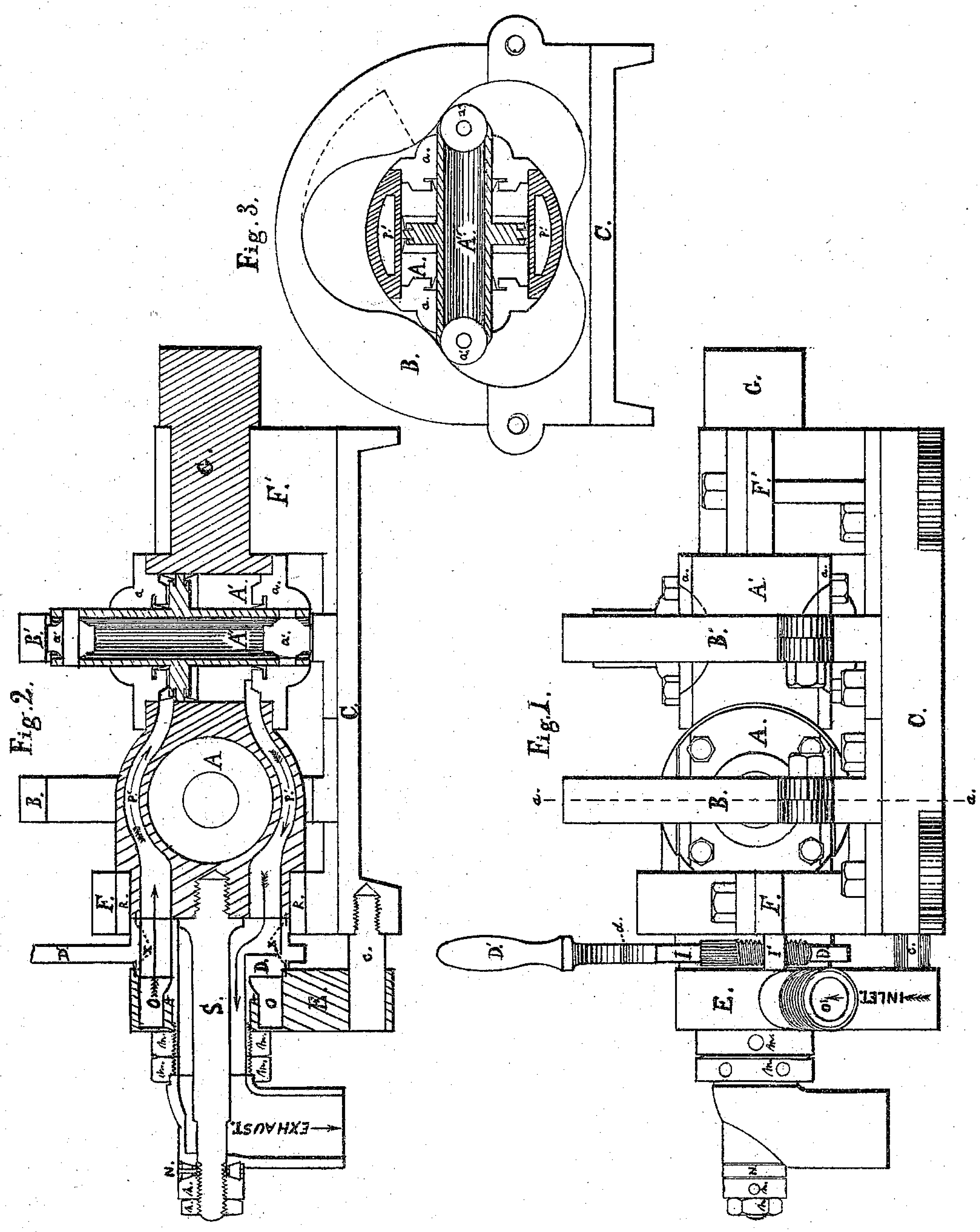
2 Sheets--Sheet 1.

# J. E. CRISP.

## Rotary Engines.

No. 142,559. Patented September 9, 1873.

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Att'ys.

2 Sheets--Sheet 2.

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## Rotary Engines.

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Fig. 4.

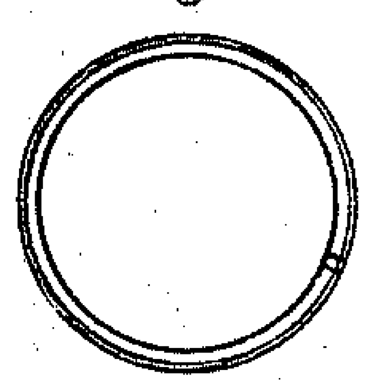


Fig. 7.

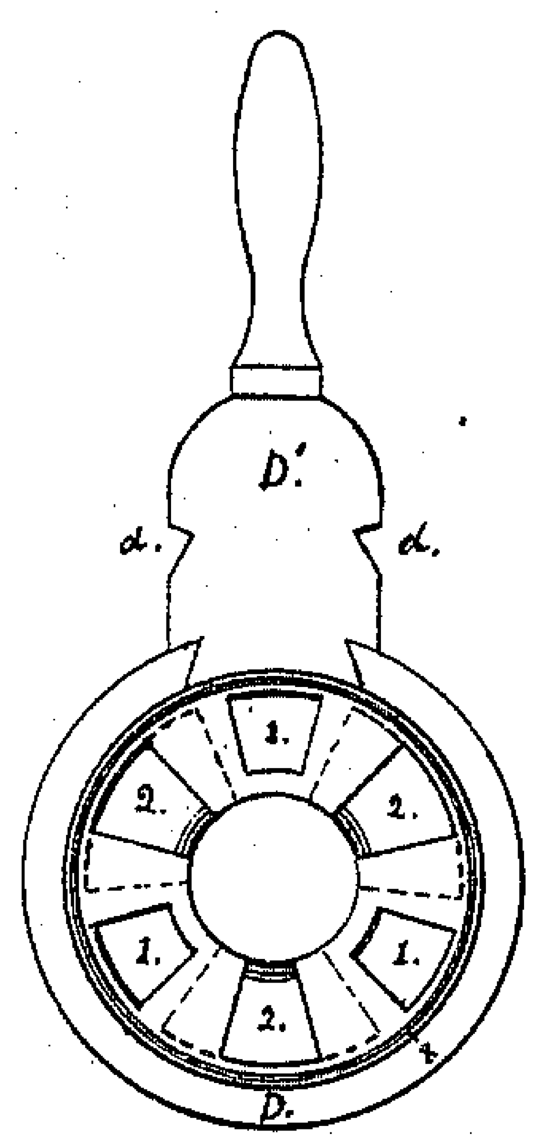



Fig. 5.

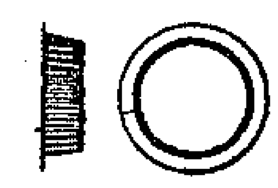


Fig. 6.

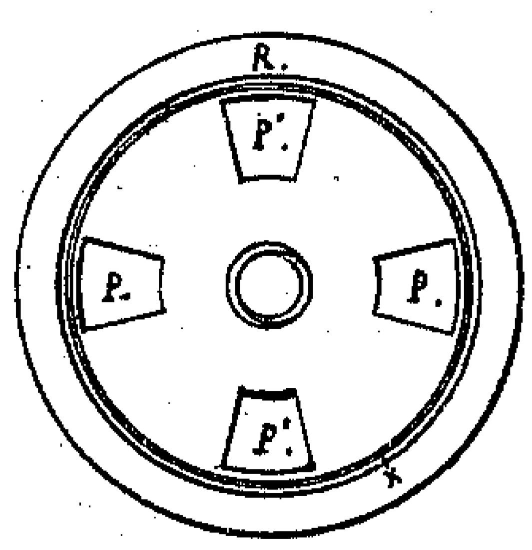



Fig. 9.

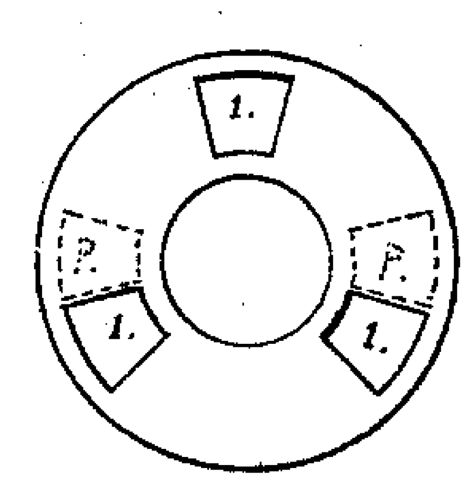


Fig. 10.

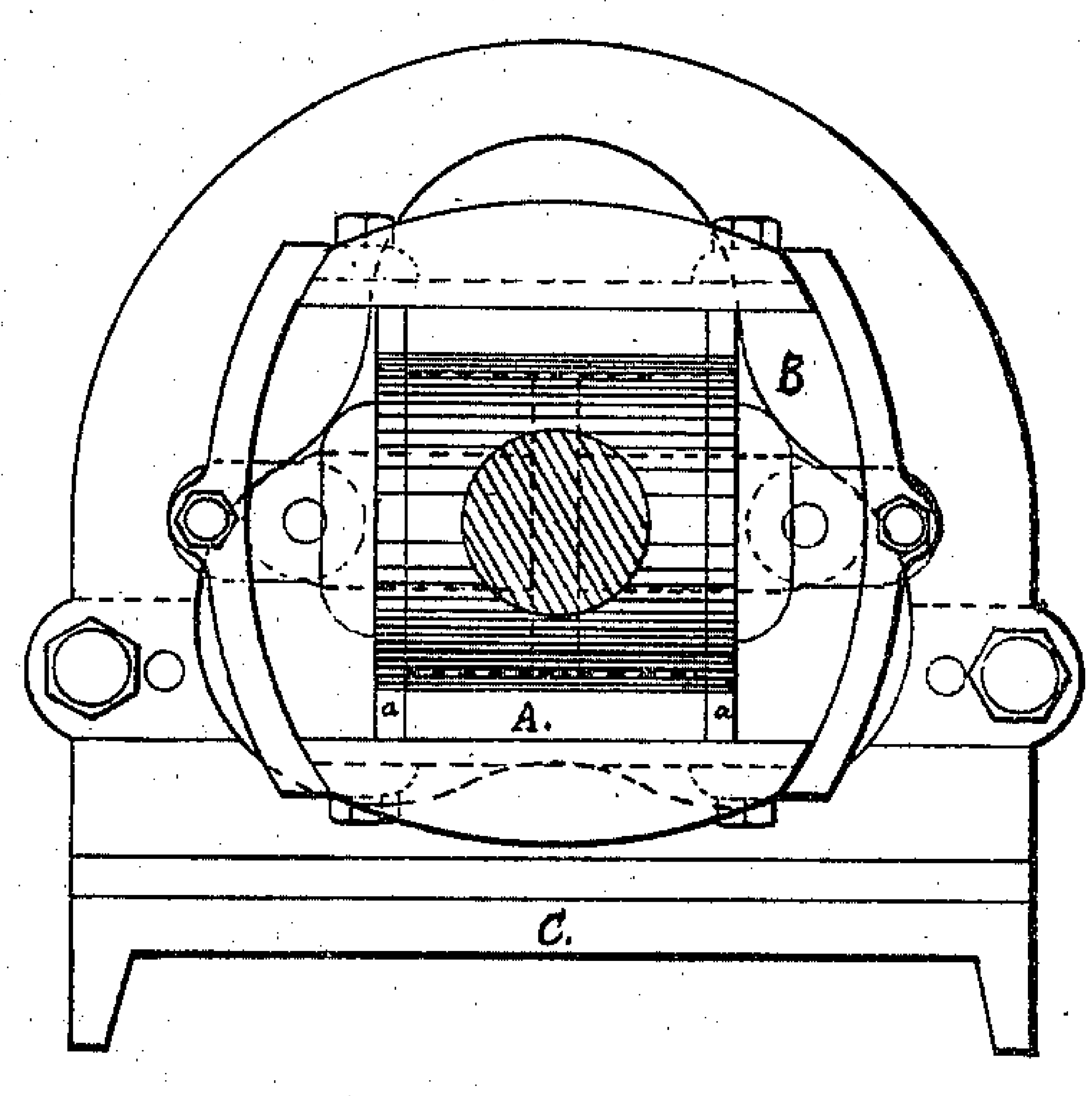



Fig. 11.

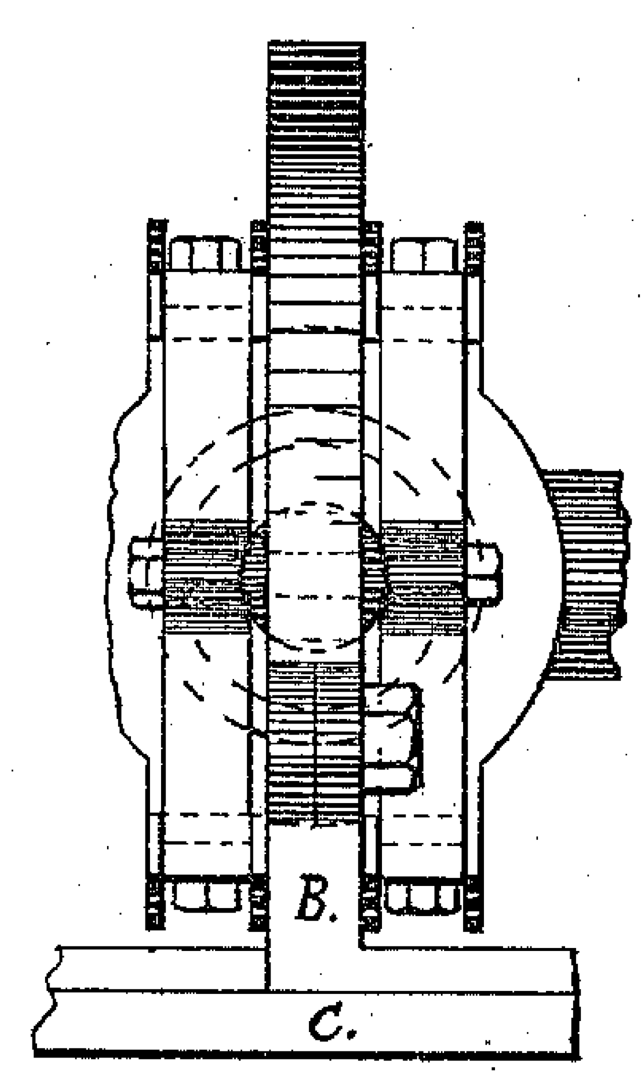
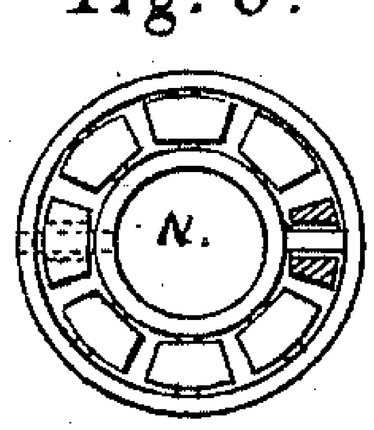



Fig. 8.

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# UNITED STATES PATENT OFFICE.

JOSEPH E. CRISP, OF CHARLESTOWN, MASSACHUSETTS.

## IMPROVEMENT IN ROTARY ENGINES.

Specification forming part of Letters Patent No. **142,559**, dated September 9, 1873; application filed May 28, 1873.

*To all whom it may concern:*

Be it known that I, JOSEPH E. CRISP, of Charlestown, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Rotary Engines; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

The nature of my invention consists in the construction and arrangement of a reciprocating engine, to be run by steam or water, as will be hereinafter more fully set forth.

In order to enable others skilled in the art to which my invention appertains to make and use the same, I will now proceed to describe its construction and operation, referring to the annexed drawings, in which—

Figure 1 is a side elevation of my engine. Fig. 2 is a longitudinal vertical section, and Fig. 3 a cross-section through line *a a*, Fig. 1, of the same. Figs. 4, 5, 6, 7, 8, and 9 are views of detached parts of the engine; and Figs. 10 and 11 show modification of the same.

C represents the base or bed-plate. F and F′ are the bearings for the main shaft G, which bearings are secured to the base in any suitable manner. A and A′ represent two reciprocating cylinders, placed at right angles with each other and forming part of the main shaft G, the ends of the cylinders A A′ being at equal distance from the center of rotation of the shaft G, and the center line of the cylinders being in the plane of its rotation. The cylinders A A′ are provided with ports under the bearing F, which is made large to accommodate the valve-seat, the face of which is shown in Fig. 6, the ports for each cylinder being placed opposite the ends of that cylinder. The ports P′ P′ lead around the cylinder A to the cylinder A′, while the ports P P lead directly into the cylinder A. Inside the cylinders work the reciprocating pistons A″ A″, the heads of which are made thin with a groove around them, and formed solid with the rods, a rod projecting from each side of the piston and through the cylinder-heads *a a*, the center being hollow. In the ends of the rods are the friction-rollers *a′ a′*, secured to the outside shell by pins passing loose through them and fitting tight in the shell. These rods are long enough, so that when the piston is at either extremity of the stroke there will be a part of the rollers still protruding beyond the cylinder-heads. Outside and in the center of the cylinders A A′ are placed the stationary cams B B′ made fast to the base C. These cams are of irregular formation—that is, the highest part on one side of the cam being diametrically opposite the lowest part on the other—thus forming a cam with an uneven number of points. The number shown in Fig. 3 is three, although one point will answer if a quick-running machine is desired. The difference of distance from the center of rotation of the shaft G to the highest and lowest points of the cams B B′ must be equal to the stroke of the cylinders A A′, and the distance across the cams diametrically with the center of the shaft the extreme length of the pistons and rods. These cams are made in two parts to facilitate the removal of the cylinder-heads, if desired. Around the valve-seat is placed the ring R, the outside of which forms the journal that runs in the bearing F, and also the support for the stationary valve D. The ring R also answers another purpose, for, when removed, the heads in the cylinder A can be turned, and thus ground to a joint.

The pistons are made to run tight in the cylinders by a packing formed by bending sheet brass or other sheet metal in the form shown in Fig. 4, and then inserting the flange in a groove shown in the piston-heads, a packing-ring being placed in each side of the piston. The piston-rods are also secured from leakage by a packing made the reverse shown by Fig. 5, placed, as shown, in a recess formed in the cylinder-heads *a a*. The ends of this packing, before being turned, are neatly scarfed to an edge; and it will be seen that the packing exerts no pressure on the rods or insides of the cylinders without there is a steam or other pressure in the cylinder next to the packing.

The valve D, the face of which is shown in Fig. 7, is formed in two parts—the valve proper, with the inlet and exhaust ports, the inlets 1 1 1 passing through the valve, and the exhaust-ports 2 2 2 passing back from the face of the valve, and merging into one central passage, and connecting with the quarter-turn, by which the exhaust can be led in any required direction. The second part of the valve, E, passes over the elongated part of the valve D, and is secured to it by the jam-nuts *m m*, they being so adjusted that the valve can be moved around in the part E by the lever and handle $D^1$. Between the parts E and D there is formed a passage, O, leading around the back of the part D, the inlet-ports 1 1 1 opening into it. To the outside is attached the steam or water pipes to supply the motive power.

It will be seen that if pressure were admitted to the passage O, with the part E in its proper place, and the face of the valve D lying on any plane surface, the effect would be to repel the valve from that surface by the pressure passing through the ports 1 1 1; and, consequently, the valve has to be secured to its seat by the stud S and the jam-nuts *n n* placed outside of the quarter-turn, the jam-nuts being adjusted so that the valve will run tight with the valve-seat. The valve D, passing away from the seat at all times with a force equal to the area of the three ports 1 1 1, by the pressure per square inch in the passage O, a packing is introduced in a groove, formed part in the valve-seat and part in the valve D, made from a thin ring of metal scarfed at the ends, and the outside nicely turned to fit the groove, the pressure on the inside forcing the ring out in case the valve leaks. The part E of the valve is prevented from turning by a prolongation at the bottom, which engages with the stud C′ in the base C.

The outside end of the quarter-turn forms a bearing for the friction-bar N, which is placed between it and the jam-nuts *n n*. The bar N, a plan of which is shown in Fig. 8, receives all the back pressure of the valve D, and converts the friction between the faces of the jam-nuts and quarter-turn into rolling friction.

It will be seen that the rolls in the bar N are not allowed to press out to the ring surrounding them, but are held by a recess formed in the quarter-turn and nut next to it, the ring being only to hold the rolls in the bar N in their proper position, the holes in the rolls being far larger than the pins through them. There are also two studs, I I, that work in projections I′ I′, made fast, one on each side of the bearing F, the ends of which engage with the notches *d d* in the valve-lever D′. The movement of these studs up or down adjusts the bed of the valve D.

To the outer end of the main shaft G can be attached a pulley or coupling, as may be desired, and it will be seen that a propeller can be run direct from the shaft by reversing the cams B B, so that the base would form into the sides of the boat or vessel. The valve D, it will be seen by Fig. 7, has three inlet and three exhaust ports, placed on the face of the valve, equal distances apart and diametrically opposite each other, the number coinciding with the points in the cams B B; and in all cases that must be true. Therefore, in order to make one complete revolution of the shaft G, the pistons A″ must make six half-strokes, the effect being the same as if the engine was geared three to one. Another and very peculiar effect from this arrangement of valves, valve-seat, and cam can be seen by reference to Figs. 3, 6, 7, and diagram Fig. 9, showing the position of the direct ports in the valve D when on the center, the dotted lines showing the ports in the valve-seat leading to the cylinder A shown in position in Fig. 3, the other cylinder being on the center or non-acting point. This effect is the absolute impossibility to move the shaft G in either direction, so long as the valve D is on the center, without moving against the whole pressure that can be placed in the cylinders, thus forming a perfect stop, making a very effective engine for hoisting purposes.

In practice it requires nearly three times the amount the engine will raise to run it back.

It will also be seen from Fig. 3, that the dead point is smaller than in a crank-engine; and it has been found almost impossible to set a single cylinder-engine of this form so nicely that it could not be started by the valve in one direction or the other.

It will also be seen, by reference to Fig. 3, that, as now designed, the slides are formed by the piston-rods A″ taking a bearing in the cylinder-heads *a*, and that these rods are prevented from turning by the rolls *a′* pressing against the inside of the cams B. This will work very well for small engines, or where something very cheap was wanted to run but little time—for instance, torpedo-boats, where they would most likely get destroyed. But large and durable engines would require slides placed outside of the cylinders, as shown in Figs. 10 and 11, which make slides with more bearing than usual, and do not increase the size of the machine; and, even with these slides, there is but little weight out of balance.

These engines can be made to cut off at any part of the stroke desired by contracting the width of the inlet-ports 1 1 1 in the valve D, and compounded by making two passages in the part E of the valve, one for the exhaust from the first cylinder to pass into, and two sets of ports in the valve D.

It will be seen, in Fig. 2, that the part of the main shaft G running in the bearing F′ is necked into a close fit endwise, and the part running in the bearing F is without a shoulder, and as the shaft expands by the effect of the heat, that end of the shaft and all connected with it can pass freely out, and thus prevent all trouble.

In large engines there should be an outside bearing placed at the end of the stud S, to prevent the possibility of its not running true and thus cause the valve D to rock on its rest and leak.

Supposing the various parts are put together and properly packed for a single cylinder-engine with a fly-wheel, with the piston on one of the dead-points of the cam or inclined planes B—say, the vertical one—ready to start down with the rolled end of the lower piston end resting on the highest part of the incline next to the base C, the highest part of the cams are supposed to be those nearest the center of the shaft G.

By the use of the studs I I and the lever D′ the valve D is set so that the port next to the lever will just open the upper port in the cylinder A when resting at either side on the studs I I, as the lever D′ may be changed. Then placing the cylinder in the position shown by Fig. 3, and setting the valve on the center—that is, with the handle vertically—admit the pressure into the passage O, no motion will ensue; but electing the direction that it is desired for the shaft G to revolve, the lever is moved down to the stud I on that side, which will cause the pressure to enter the cylinder at the opposite end, and act on the piston and force the rollered end of the rod next to the lever against the incline in the cam B, and cause the shaft G to turn until the end of the rod has reached the lowest part of the cam B, and the fly-wheel will pass it by the dead-point. Then it will be seen that the moment that one end of the rod has reached the very lowest point in the cam B that the opposite end of the rod has arrived at the highest on the other side, and that the ports in the valve and valve-seat are in position to cause that end to run down in the same manner; and so it will act as long as there is pressure in the passage O or the lever D′ remains untouched, the effect being one roller continually running down an inclined plane, and the remainder of the momentum not exerted against the plane converted into rotary motion by the shaft G.

It will also be seen that the motor converts rectilinear motion into rotary by the motion of perfect reciprocating cylinders that can be kept tight by the same means used to prevent leakage in such cylinders.

With two cylinders, as shown, no fly-wheel is necessary, and one cylinder will, with only one point on the cam, make as perfect a motor as any single-cylinder machine; and it will be seen that it makes a self-supporting machine in all of its parts without the usual vibration common to reciprocating engines in passing the centers. It also can be run at a very high speed of piston; and for water it makes a very effective engine, running with great steadiness.

A well-proportioned engine of this plan should not much exceed seven times the length of the stroke in height and width, and the weight of the cylinders, revolving as they do, supply nearly all need of a fly-wheel.

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

1. The combination of the cylinders A A′, arranged at right angles with each other and forming part of the main shaft G, the bearings F F′ with valve-seat, pistons A″ A″, cams B, cylinder-head *a*, and valves D E, all substantially as and for the purposes herein set forth.

2. The valve D E made in two parts, united as described, and provided with an annular passage, O, between them, and with an uneven number of inlet and exhaust passages, all as and for the purposes herein set forth.

3. The combination of the valves D E, jam-nuts *m m*, lever and handle D′, studs I I, and projections I′ I′ with the cylinder and its ports, substantially as and for the purposes herein set forth.

4. The combination of the valve-seat, the stud S, valve D, valve E, friction-bar N, and the jam-nuts *n n*, substantially as shown, and for the purposes set forth.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

JOSEPH E. CRISP.

Witnesses:
A. J. BAILEY,
GEO. H. LONG.