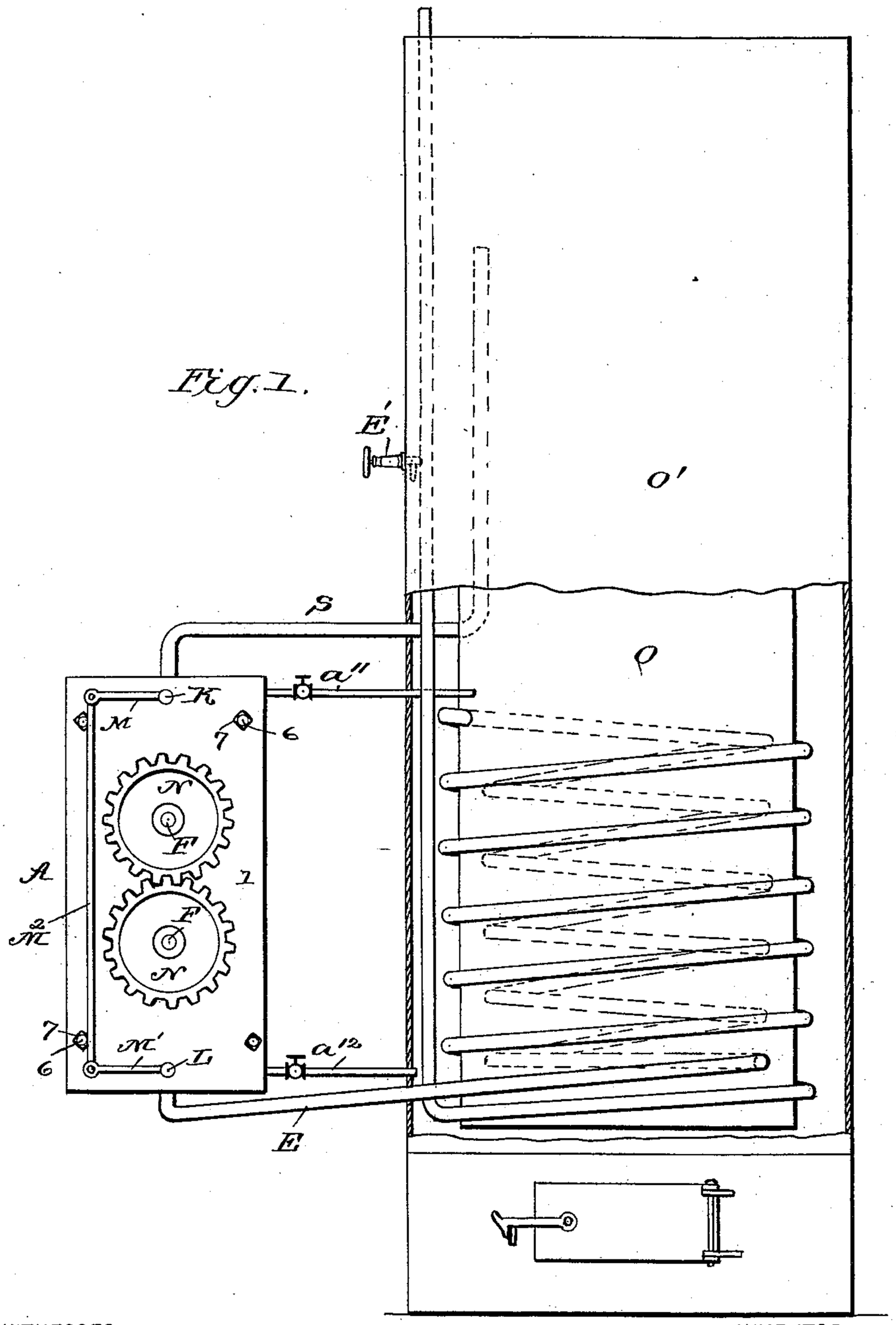
(No Model.) 2 Sheets—Sheet 1.

E. H. McDONALD.

ROTARY STEAM ENGINE.

No. 465,194. Patented Dec. 15, 1891.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

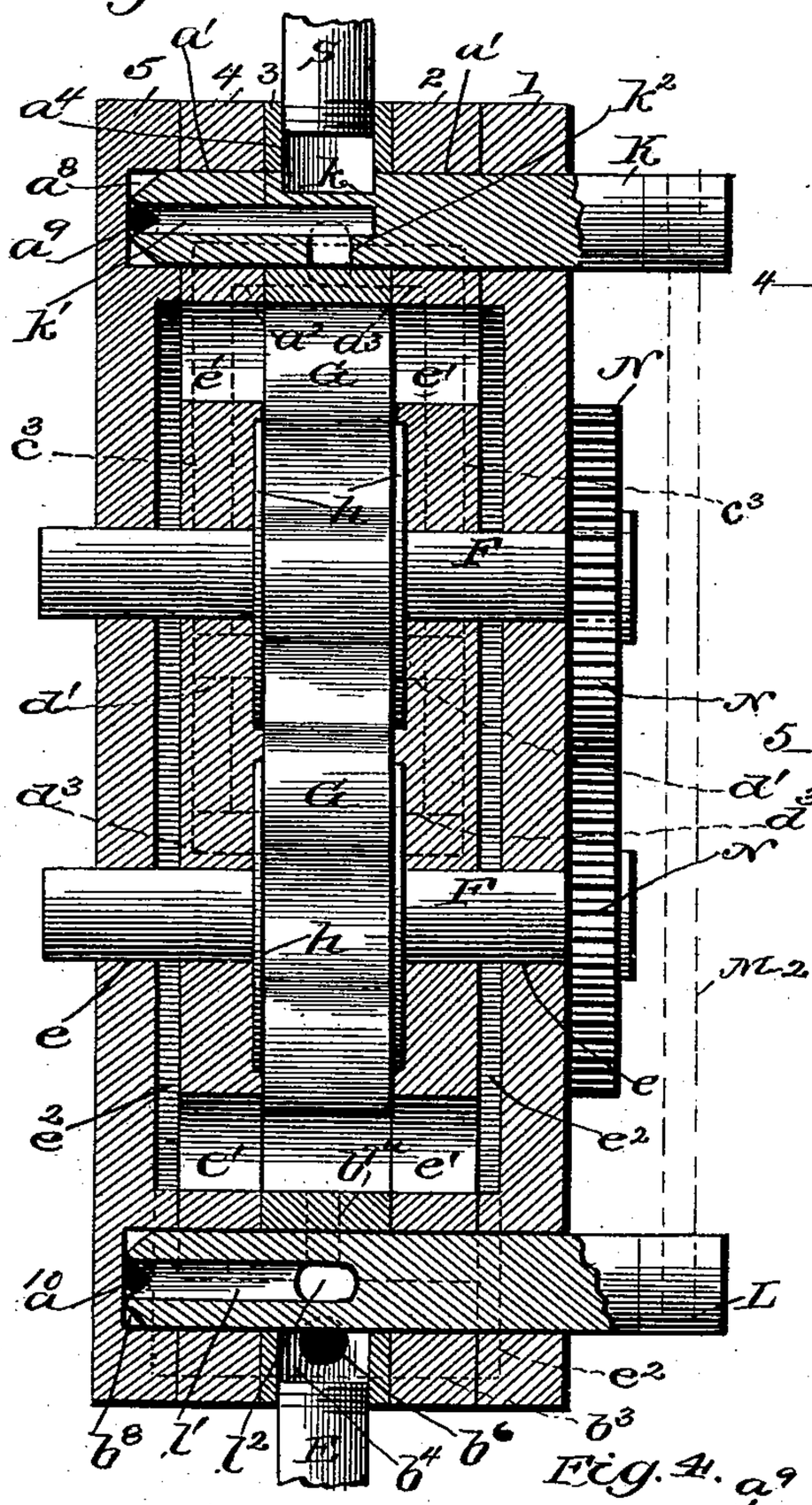


Fig. 3.

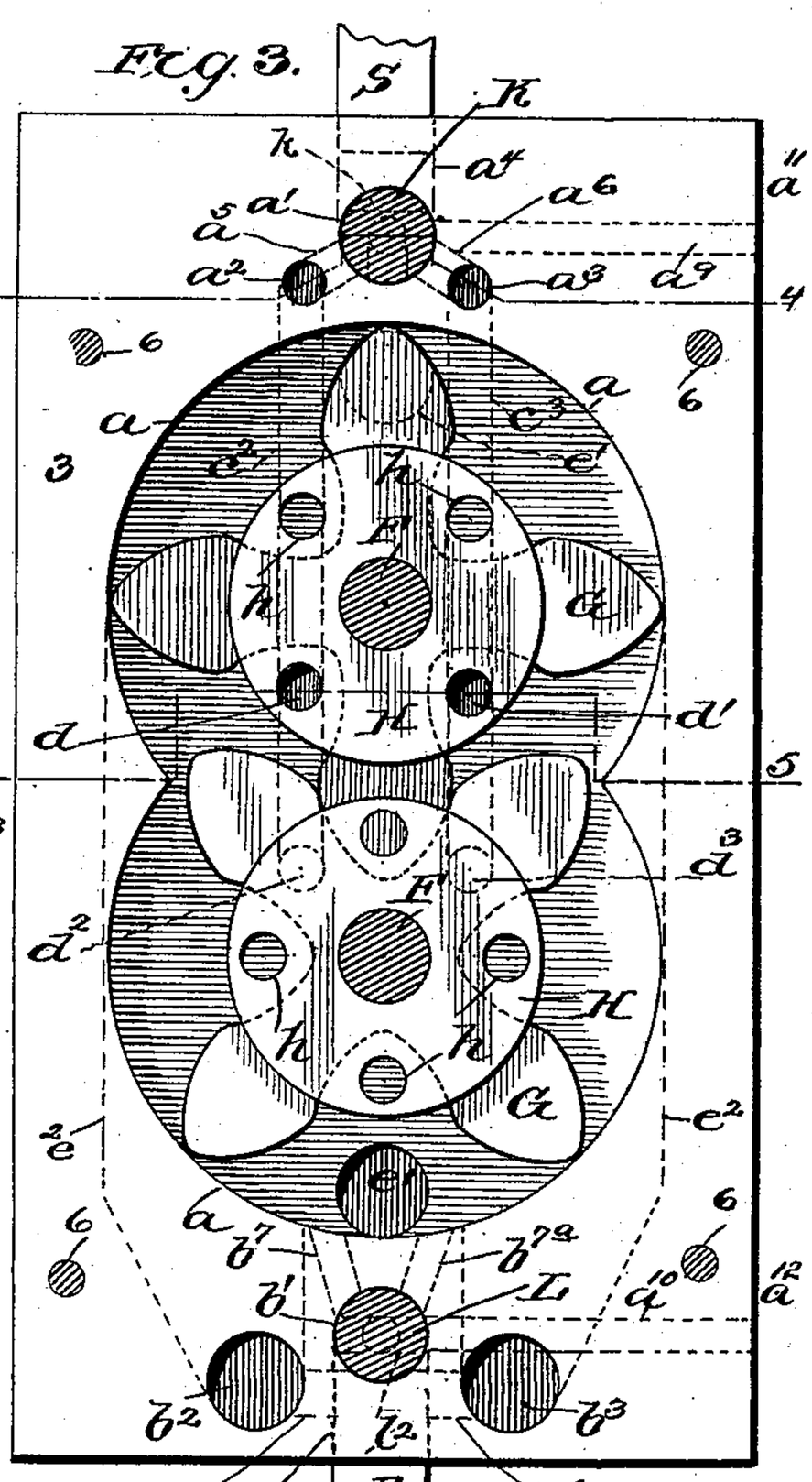


Fig. 4.

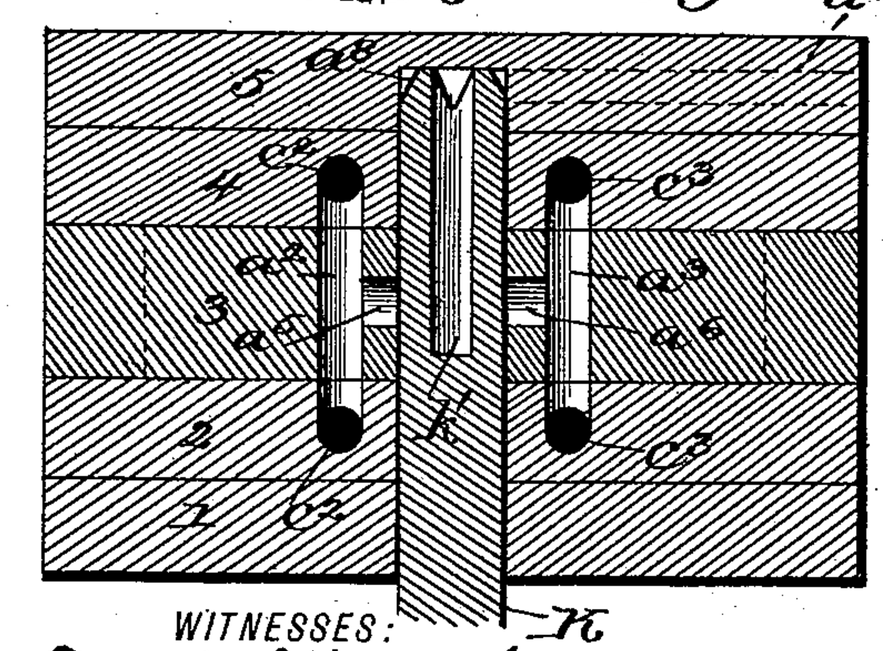
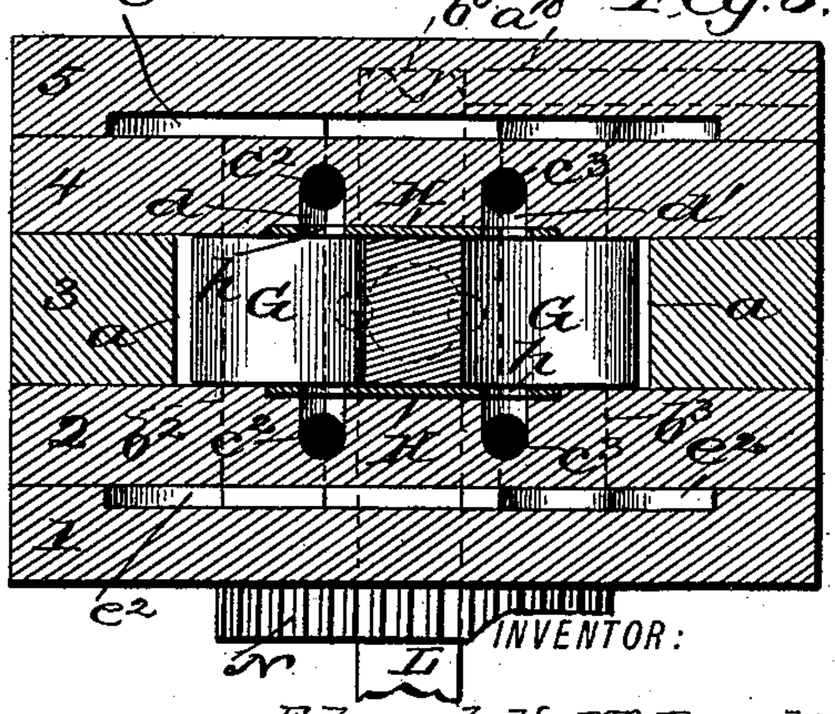


Fig. 5.



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UNITED STATES PATENT OFFICE.

EDWARD H. McDONALD, OF WYTHEVILLE, VIRGINIA.

ROTARY STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 465,194, dated December 15, 1891.

Application filed February 13, 1891. Serial No. 381,369. (No model.)

To all whom it may concern:

Be it known that I, EDWARD H. McDONALD, of Wytheville, in the county of Wythe and State of Virginia, have invented a new and useful Improvement in Rotary Steam-Engines, of which the following is a specification.

This invention relates, generally, to steam-engines, and more particularly to an improved rotary engine of the double-piston pattern.

The object of my invention is to provide an engine of the character described which shall be simple, compact, and efficient and one in which the several parts can be easily constructed to form perfect joints and connections.

A further object of my invention is to so construct the parts of the engine that it may also be used as a pump for forcing feed-water to the boiler; and a still further object is to provide a construction whereby the exhaust-steam may be employed to heat water in the boiler and also the feed-water.

With these various objects in view my invention consists in the peculiar construction of the various parts and their novel combination or arrangement, all of which will be more fully hereinafter described, and pointed out in the claims.

In the drawings forming a part of this specification, Figure 1 is a view of my improved engine arranged in connection with a boiler, the outer shell of boiler being broken away. Fig. 2 is a longitudinal section, the pistons being shown in elevation. Fig. 3 is a face view showing the steam cavity and pistons arranged therein. Fig. 4 is a section on line 4 4, Fig. 3; and Fig. 5 is a section on line 5 5, Fig. 3.

The same letters and figures of reference in all the figures indicate the same parts.

In the practical embodiment of my invention I employ a casing A, essentially cubical in shape, said casing being preferably formed of a series of thick plates 1, 2, 3, 4, and 5, all of which are securely united by means of the bolts 6 and nuts 7, forming steam-tight joints, and in practice plates 1 and 2 and 4 and 5 may be made integral. The plates 1 and 5 constitute the outer or face plates of the casing, while the plate 3 is cut out to receive the pistons, the plates 2 and 4 forming, in connection with the cut-out plate 3, the steam-chamber, within which the pistons revolve. The plate 3 has an opening a produced therein, said opening being formed by the intersection of two circular openings, the shape of the opening a forming an important feature of my invention, as will appear hereinafter. Near one end of the plate 3 and on the longitudinal diameter of the same is produced a transverse aperture a', and on each side of the aperture a' and adjacent to the opening a are produced the transverse apertures or passages a^2 and a^3, of less diameter than the aperture a'. A longitudinal bore or passage a^4 extends from the aperture a' to the end of the plate, the steam-pipe S being inserted in the outer end of said bore a^4, and passages a^5 and a^6 are made to extend, respectively, from the transverse aperture a' to the passages a^2 and a^3. Near the opposite end of the plate a transverse aperture b', similar to a', is made, and upon each side of the same, adjacent to the end of the plate, are produced the passages b^2 and b^3. A longitudinal bore or passage b^4 extends from the aperture b' to the end of plate, the exhaust-pipe E being inserted in the outer end of said bore b^4. Passages b^5 and b^6 extend from the longitudinal bore b^4 and communicate, respectively, with the passages b^2 and b^3. Oblique passages b^7 and b^{7a} communicate with the opening a and aperture b' upon opposite sides of the diameter of the opening a. The sides of the opening a form the sides of the steam-chamber, and the inner faces of the plates 2 and 4 form the faces of the said chamber. Both plates 2 and 4 have an aperture a' formed near the ends, said aperture registering with the aperture a' of plate 3 when the said plates are properly arranged. The opposite ends of the plates 2 and 4 are also constructed with the apertures b' and the passages b^2 and b^3, all of which register, respectively, when the plates are properly arranged. Passages a^2 and a^3 are produced in the inner faces of the plates 2 and 4, said passages registering with the similar apertures in plate 3. The passages a^2 and a^3 in the plates 2 and 4 do not extend entirely through said plates, but communicate, respectively, with the longitudinal passages c^2 and c^3, which are arranged on opposite sides of the longitudinal center and extend from the passages

a^2 and a^3 beyond the transverse center of the plate, where they communicate with the parts d^2 and d^3, respectively, which open into the steam-cavity. Ports d and d' are also arranged to communicate, respectively, with the passages c^2 and c^3 at opposite points nearer the passages a^2 and a^3. At the center of each intersecting circle which forms the opening a is produced an aperture e, through which is passed the shafts F, upon which the pistons are mounted. Exhaust-ports e' are produced in the plates 2 and 4 at opposite ends of the opening a, said ports passing entirely through said plates, as clearly shown.

Plates 1 and 5, constituting the face-plates of the casing, are very much alike, each having aperture e for the passage of the piston-shafts, and each having recesses e^2, into which the steam exhausts through the ports e', and it will also be observed that recesses e^2 communicate with the passages b^2 and b^3, the purpose of which will be presently explained. Plate 1 has the apertures a' and b' at its opposite ends, registering with the similar apertures in the plates 2, 3, and 4. Plate 5, however, has circular cavities a^8 and b^8 at the opposite ends, which register with the openings a' and b', respectively, of the plates 1, 2, 3, and 4, the cavities a^8 and b^8 being made in the inner faces of the plates and extending only a short distance into the same, said cavities being separated from the recess e^2, and leading from said cavities are the passages a^9 and a^{10}, respectively, the feed-pipe a^{11} and inlet-pipes a^{12} being inserted in the outer ends, respectively, of the passages a^9 and a^{10}, whereby water is fed to the boiler and flows from the heater, as will appear farther on.

A piston G is mounted upon each shaft F within the steam-cavity, each piston being in the form of an epicycloid and of a size to fit snugly within the steam-cavity. By having the pistons in the form of epicycloids they mesh perfectly with each other, and as the opening in the plate 3 is formed by the intersection of two circles, and also as each piston is pivoted at the center of its respective circle, the tips of the piston-arms form tight joints with the sides of the opening, thereby forming steam-tight subcavities within the steam-chamber proper. Circular disks H, of the same diameter as the pitch-circles of the piston, are secured to the opposite faces of each piston, said disks having openings h formed therein, which register with the steam-ports admitting the steam into the cavity, the disk proper acting as a cut-off to prevent the continuous flow of steam into the chamber.

A plug K is inserted in the aperture a', one end of said plug resting in the circular cavity a^8 in plate 5, the opposite end of said plug projecting a short distance beyond the face-plate 1. The plug is cut away or reduced at k opposite the steam entrance or passage, whereby the steam may be guided to either the passage a^5 or a^6, according to the direction the plug be turned, or it may be shut off entirely. A longitudinal bore k' is produced in the end of the plug within the casing, the said bore extending into the plug to a point opposite the reduced portion k, where it opens out on the side, as at k^2, directly opposite the said reduced portion. The end of the plug resting in the cavity a^8 is grooved or serrated, whereby the pipe a^{11} may communicate with the bore in the plug k.

A plug L is inserted in the aperture b', one end resting in the cavity b^8. This end is also grooved or serrated and communicating with said grooves in the longitudinal bore l', which in turn communicates with the transverse bore l^2, which is adapted to register alternately with the passages b^7 and b^{7a}. A lever M is secured to the plug k, whereby the said plug is turned to reverse or stop the engine, and a similar lever M' is secured to the plug L, the said levers being connected by means of a pitman M^2, whereby they move in unison. Driving-gears N N are mounted upon the projecting ends of the piston-shafts.

In connection with my improved engine I employ a boiler O, surrounded by a water-jacket O', the steam-supply pipe extending from near the top of boiler to the engine. The exhaust-pipe of the engine, passing through the water-jacket and boiler-shell, is coiled upwardly around the water-tubes in the fire-box. It is then brought out through the boiler-shell into the water-jacket, where it is coiled around the boiler to the bottom of the jacket, and is then carried upward the full height of the boiler, and about midway its height is provided with a blow-off cock E', whereby the steam may be discharged into the water-jacket or into the smoke-stack. The water-feed-supply pipe communicates with the boiler near its center, the water-suction pipe leading from the water-jacket, as clearly shown.

All the parts being arranged as described, the plug k is turned to admit steam into the passage a^5, through which it passes into the passage a^2, thence through the passages c^2, and out through the ports d and d^2 and the opening h in the disks H, thus driving the pistons in opposite directions, as shown. The steam after spending its force upon the pistons exhausts through the ports e', passing into the recesses e^2, thence into the passages b^2 and b^3, where it passes by means of the passages b^5 and b^6 into the bore b^4 and out through the exhaust-pipe E, where it is carried through the fire-box and water-jacket to heat the water in the boiler. It will be observed that the disks act as cut-off valves to prevent a continuous flow of steam, and it will also be observed that by the peculiar arrangement of the ports it is impossible to so arrange the pistons and disks as to entirely close all the ports. From this it follows that there is always one port open ready to start. Consequently no turning of the pistons by hand preparatory to starting is necessary.

In serving the purpose of a pump the water

flows by gravity into the inlet-pipe from the water-jacket, and when the plug K is turned to let steam into the passage a^5 the opening k^2 will communicate with the passage a^6, and as the plug L is turned in unison with the plug K the transverse bore is brought into communication with the oblique passage b^{7a}. The water passes through the inlet-pipe a^{12} into the passage a^{10} and the cavity b^8. Here it enters the longitudinal bore of the plug L and passes through the transverse bore of the same and the passage b^{7a} into the steam-cavity upon the side of the piston opposite to that on which steam is acting. The water then enters the ports d' and d^3, thence into the passages c^3, and it is then conducted through the passages a^3 and a^6 into the longitudinal bore of the plug K, where it is guided into the cavity a^8 and then out through the passage a^9 into the feed-pipe a^{11} and to the boiler.

Having thus described my invention, what I claim is—

1. In a rotary engine, the combination, with a casing having a chamber constructed as described and the inlet and exhaust ports, of the epicycloidal-shaped pistons journaled in the chamber, and the disks having apertures formed therein, said disks being arranged upon the opposite faces of the pistons, substantially as shown and described.

2. In a rotary engine, the combination, with a casing having a steam-chamber constructed as described, inlet and outlet ports, and passages leading to and from the same, of the pistons, cut-off disks, and the turning-plugs arranged at each end of the casing, whereby steam is introduced and exhausted, substantially as shown and described.

3. In a rotary engine, the combination, with a casing provided with a steam-chamber, inlet and exhaust ports and passages communicating therewith, and the water-passages, of the turning-plugs arranged at each end of the casing communicating with the inlet and outlet passages and the water-passages, and the pistons arranged in the steam-chamber, substantially as shown and described.

4. In a rotary steam-engine, the combination of a casing composed of a series of sections and having a steam-chamber constructed as described, the inlet and outlet steam ports and passages communicating therewith, the water-passages independent of the steam-passages, but communicating with the steam-chamber, the pistons arranged in the chamber, and the turning-plugs, all arranged substantially as shown and described.

5. The combination, with the casing, of the pistons arranged therein, inlet and exhaust plugs, inlet and exhaust steam-pipes, the inlet-water pipes, the feed-water pipes, the steam-boiler, and water-jacket, all arranged substantially as shown and described.

6. In a rotary engine, the combination of a casing composed of a series of sections and provided with a steam-chamber, the inlet and outlet steam ports and passages communicating therewith, the inlet and outlet water-passages independent of the steam-passage and communicating with the steam-chamber, the inlet and feed-water pipes, the inlet and exhaust steam-pipes, the inlet and exhaust plugs communicating with the steam and water passages, the levers attached to said plugs, and the pitman connecting the levers, the epicycloidal pistons arranged in the chamber, and the cut-off disks, all arranged and adapted to operate substantially as shown and described.

EDWARD H. McDONALD.

Witnesses:
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C. P. McWANE.