(No Model.) 2 Sheets—Sheet 1.

S. E. ST. O. CHAPLEAU.

ROTARY COMPOUND STEAM ENGINE.

No. 444,087. Patented Jan. 6, 1891.

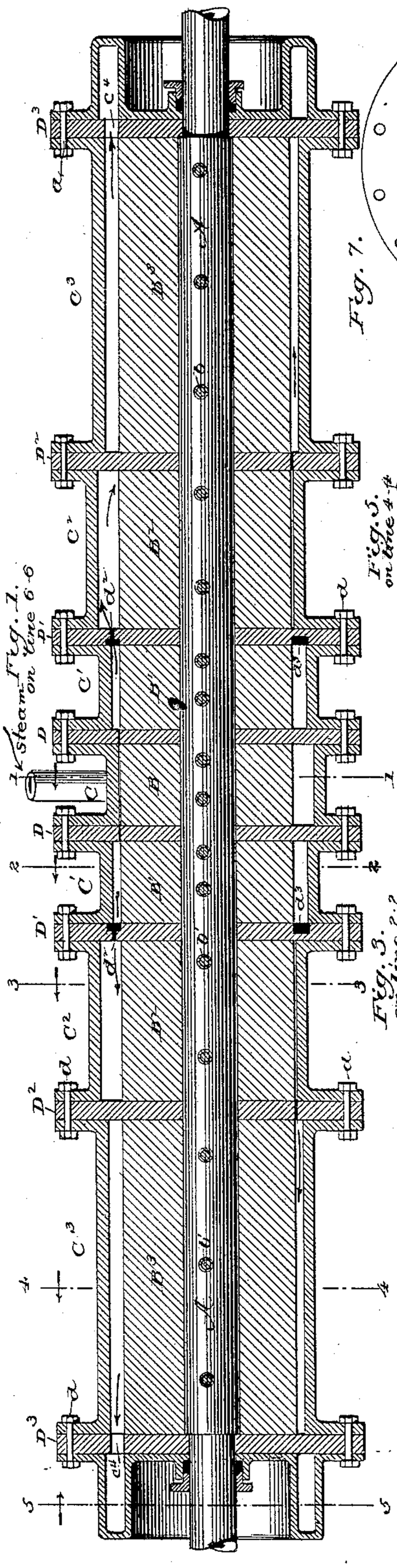


Fig. 1. Steam on line 6-6

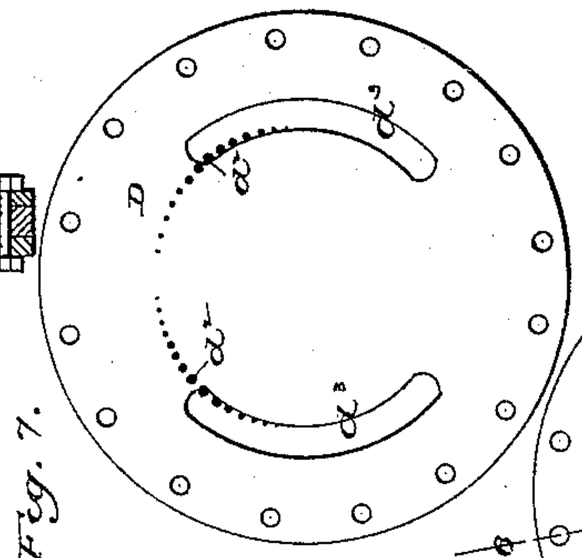


Fig. 7.

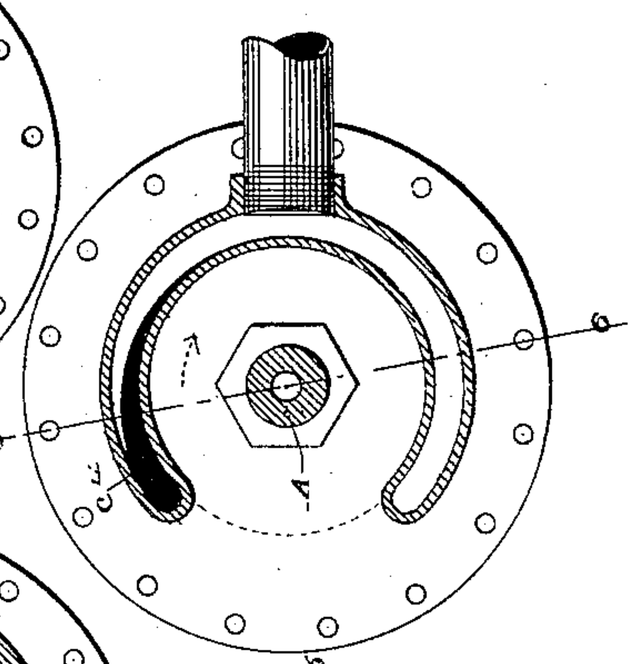


Fig. 6 on line 5-5

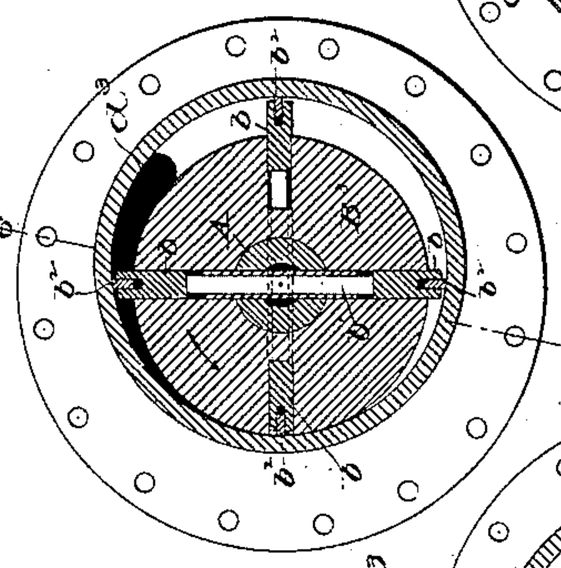


Fig. 5. on line 4-4

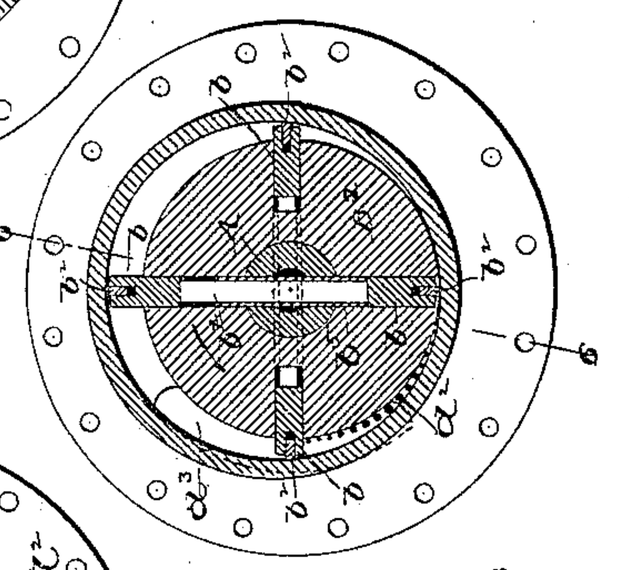


Fig. 4. on line 3-3

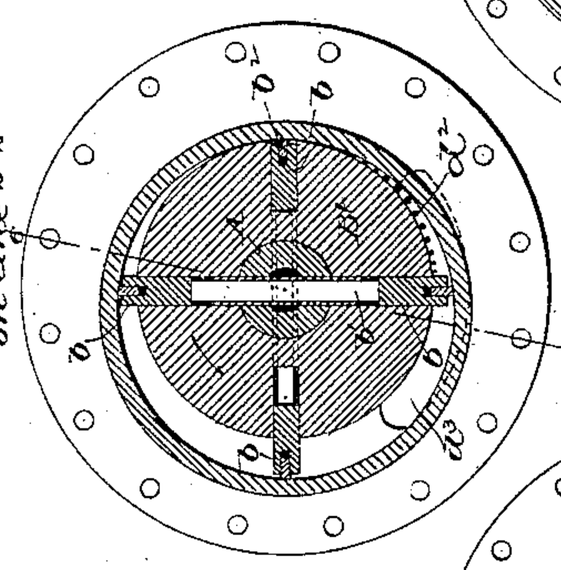
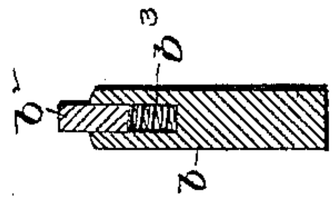


Fig. 3. on line 2-2



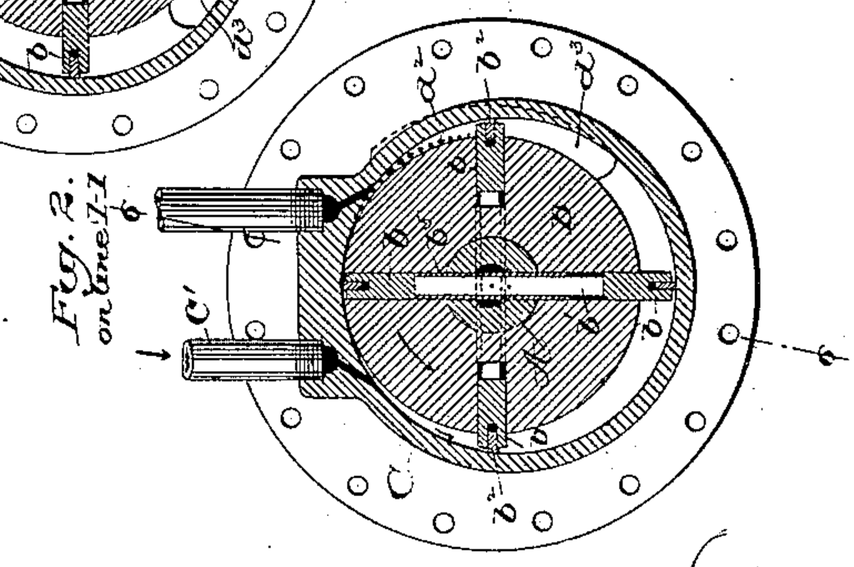


Fig. 2. on line 1-1

Witnesses:
W. W. Mortimer
F. R. Kennedy.

Inventor:
S. E. St. O. Chapleau
By his Attorney
Phil. T. Dodge

(No Model.)

2 Sheets—Sheet 2.

S. E. ST. O. CHAPLEAU.

ROTARY COMPOUND STEAM ENGINE.

No. 444,087. Patented Jan. 6, 1891.

Fig. 8.

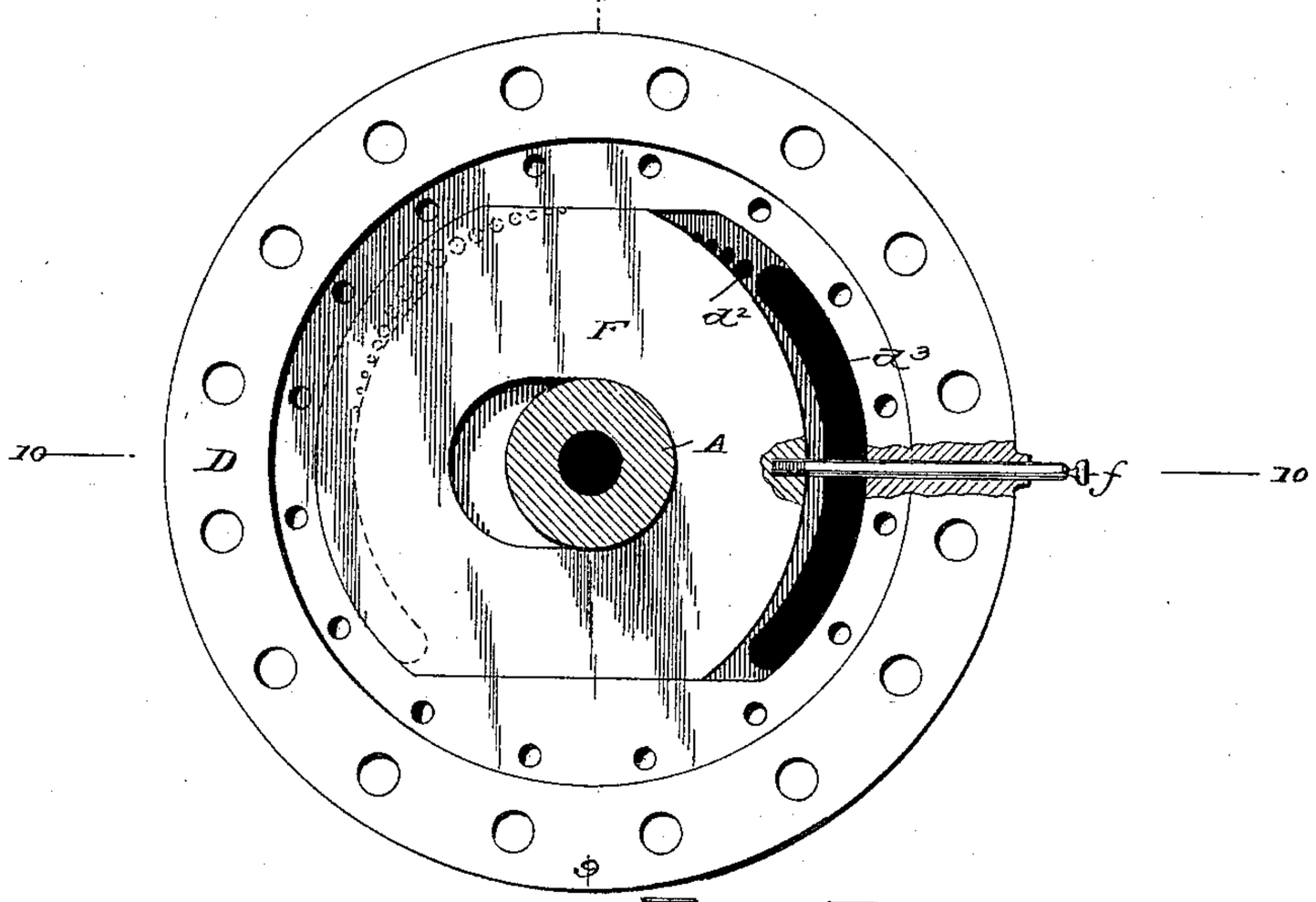


Fig. 9.
on line 9-9

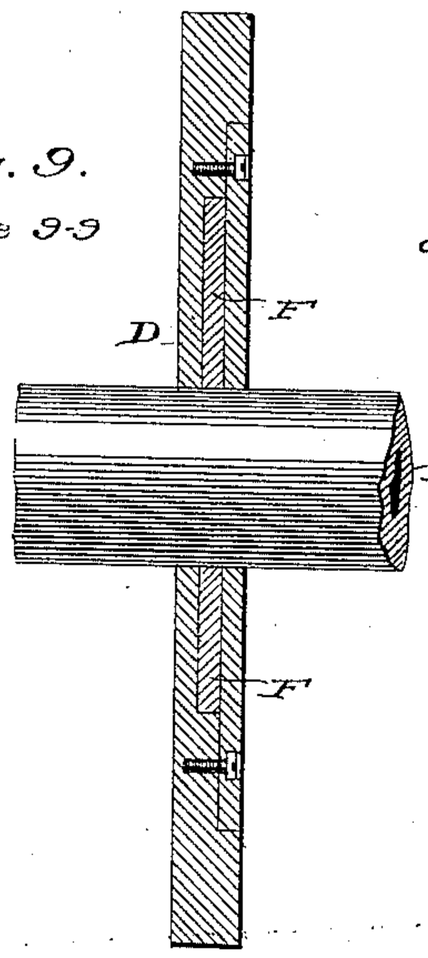
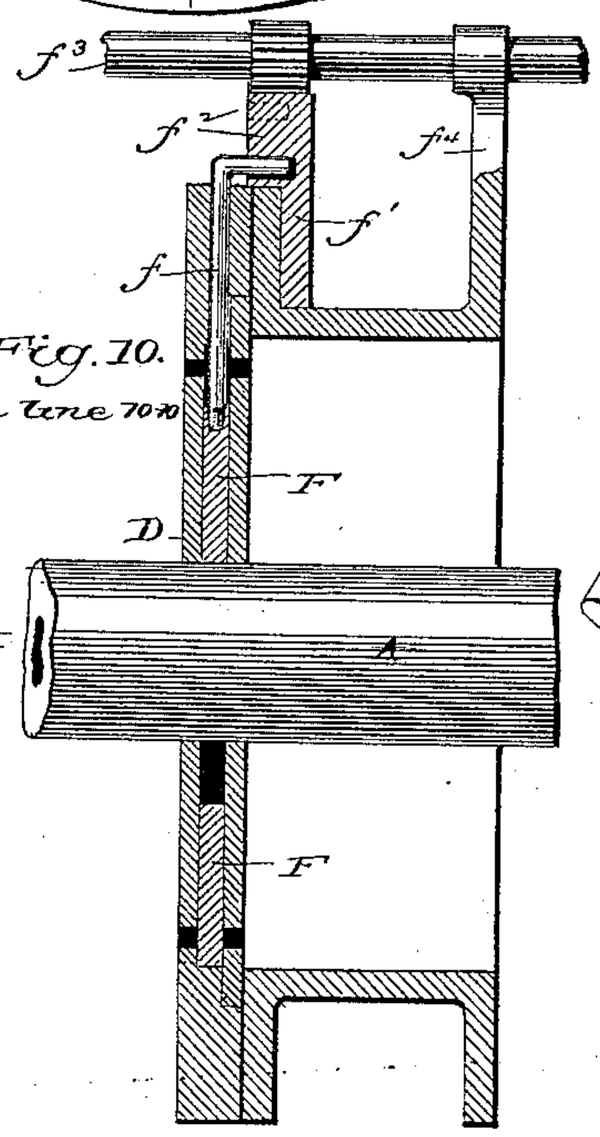


Fig. 10.
on line 10-10



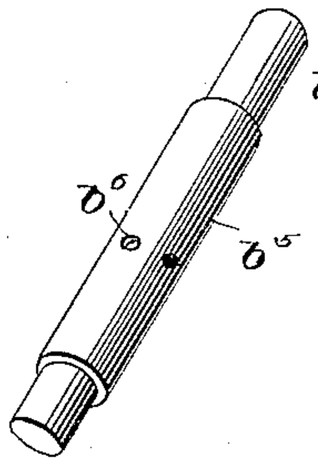


Fig. 11.

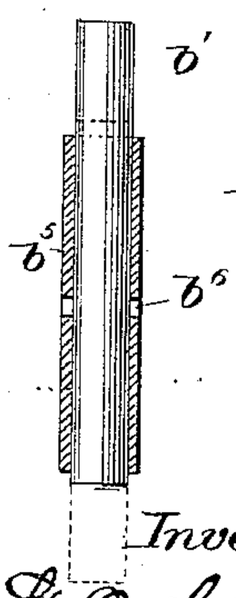


Fig. 12.

Witnesses:
W. W. Mortimer,
H. R. Kennedy.

Inventor:
S. E. St O. Chapleau
By his Atty
P. T. Dodge

UNITED STATES PATENT OFFICE.

SAMUEL E. ST. O. CHAPLEAU, OF OTTAWA, CANADA.

ROTARY COMPOUND STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 444,087, dated January 6, 1891.

Application filed November 29, 1889. Renewed December 3, 1890. Serial No. 373,440. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL E. ST. O. CHAPLEAU, of Ottawa, in the Province of Ontario and Dominion of Canada, have invented certain Improvements in Rotary Compound Steam-Engines, of which the following is a specification.

The aim of my invention is to provide a simple and efficient rotary engine of the compound type—that is to say, of the type in which the steam is used repeatedly and expansively in cylinders of successively increasing capacity. I mount side by side on a common axis a series of concentric pistons, each having a series of radially-movable blades or abutments arranged to travel around the interior of an eccentric cylinder subject to steam-pressure from one side. The cylinders differ in capacity, and are arranged eccentrically to the axis of rotation, and are connected by ports which are alternately covered and uncovered by the revolving pistons in such manner that the steam after being used at high pressure in the smallest cylinder is exhausted, thence into the next larger cylinder, and so on repeatedly throughout the series.

My engine may be constructed to exhaust the entire contents of the high-pressure cylinder into a single low-pressure cylinder; but I prefer, as shown in the drawings, to duplicate all the cylinders except the first and smallest, so that the steam from the latter may be divided between the duplicate cylinders, and this in order to give an increased port area to equalize the strains and permit the running parts to be balanced.

In the accompanying drawings, Figure 1 is a longitudinal central section through an engine constructed on my plan and adapted to secure a quadruple expansion of the steam. Figs. 2, 3, 4, 5, and 6 are vertical cross-sections of the same on the lines therein indicated. Fig. 7 is a face view of one of the division-plates, showing the manner in which the ports are duplicated when an engine is to be adapted for reversal of its motion. Fig. 8 is a view looking into one of the cylinders and showing the reversing-valve. Figs. 9 and 10 are cross-sections on the lines 9 9 and 10 10 of Fig. 8. Figs. 11 and 12 are views of details.

Referring to the drawings, A represents a central shaft; B B′ B^2, &c., a series of cylindrical piston-heads mounted concentrically and rigidly upon the shaft.

C C′, &c., are a series of cylinders inclosing the respective piston-heads and arranged eccentrically to the axis of rotation, each cylinder being turned about one-fourth of a revolution ahead of the next, or, in other words, arranged in an angular relation of ninety degrees to the next, for a purpose which will presently appear.

The cylinders are separated from each other by intervening plates or disks D D′, &c., the several parts being firmly united by the bolts *d*, passing through the plates and through flanges on the ends of the cylinders, or otherwise united in the desired relations.

The central cylinder C is provided with a pipe *c′* for the admission of high-pressure steam from the boiler. The remaining cylinders are constructed in pairs of successively increasing capacity, the first pair C′ C′ to the right and left of the pressure-cylinder being of equal capacity, the next pair C^2 C^2 also of equal capacity, and so on throughout the series. This variation in capacity may be secured either by constructing the cylinders of different lengths or different diameters, or both, the only essential requirements being that the steam in its course through the successive cylinders shall be afforded an opportunity for increased expansion.

Each of the rotary piston-heads is provided at equal distances apart with four radially-sliding abutments or blades *b*, the opposing blades of each piston being connected by an intermediate rod *b′*, passing through the cylinder, so that as the piston-head is rotated the outer edges of the abutments travel in a circular eccentric path, bearing constantly against the inner surface of the cylinder, their construction and operation in this regard being essentially the same as in other rotary engines at present known in the art. The outer edge of each abutment is grooved to receive a packing-strip b^2, which is urged constantly outward by a spring b^3 to maintain a steam-tight joint.

The plates or disks D D′, &c., between the cylinders are each provided with a series of holes or ports d^2 transversely therethrough

for the purpose of permitting the steam which has performed its office in one cylinder to escape through the ports directly into the adjacent and outer cylinder.

The steam entering the high-pressure cylinder C acts in a well-known manner against the abutments therein to effect the rotation of its piston until finally it reaches a point at which it is shut off by the abutments and the piston from communication with the inlet-port, but brought into communication with the exhaust-ports in the plates D D to the right and left into the cylinders C′ C′, where it acts expansively in precisely the same manner as in the first cylinder, and after which it is discharged through the ports in the plates D′ D′ into the cylinders C^2 C^2, and so on repeatedly, until having performed its duty in the cylinders C^3 C^3 it is discharged through ports c^4 in the end plates or heads. The line of ports in each plate is extended, as shown in Fig. 4, in a curved line through an arc of about ninety degrees, so that as the piston revolves its end covers and uncovers the holes or ports successively. On the receiving side the ports of each plate or most of them open into a curved slot or channel d^3, such as shown in Fig. 4. This channel communicates with the cylinder through which the steam is delivered through that portion of the circumference from which the steam is exhausted. As the steam-space between the piston and the cylinder diminishes or is of diminishing area in this part of the cylinder, it is necessary to provide for the free release or clearance of the outgoing steam, in order that it may not be again compressed in the cylinder by the next abutment advancing behind it. The channels d^3 answer this purpose. As soon as an abutment in the course of its revolution reaches a point at which it would tend to compress the steam before it, it passes over one end of the channel d^3, thus uncovering the channel and permitting the steam to escape with freedom into the next cylinder.

It is to be understood that the ports and channels are duplicated between the several cylinders, but that those of each cylinder are about ninety degrees in advance of those from the next cylinder, to correspond with the angular relation of the cylinders before referred to. This arrangement admits of the several cylinders being brought close together and of the exhaust-steam being passed directly and by a very short port from one cylinder into the proper position to perform its duty in the next cylinder.

Another advantage of the arrangement lies in the fact that the effective force of the several pistons is applied to the shaft at different points around its circumference, or, in other words, at different points in the revolution, so that the force is applied in a practically constant manner to rotate the shaft. This results in a uniform speed and in the avoidance of the usual tendency of the shaft and pistons to wear the bearings and cylinders on one side. By the described arrangement of the cylinders I so balance the strain and pressure that the shaft and pistons run with slight pressure and with uniform wear. By duplicating the secondary cylinders to the right and left of the high-pressure cylinder I am enabled to secure a greater area of the ports through which the steam is delivered after leaving the first cylinder, and also to avoid the objections which would be incident to the use of very long cylinders, requiring the steam to travel a long distance in passing therethrough.

The foregoing description is that of an engine adapted to run in one direction only.

When the engine is to be reversed, so as to turn in either direction at will, I provide each of the division-plates with duplicate ports or channels extending, respectively, to the right and the left of an intermediate point, as clearly shown in Figs. 7 and 8.

Within each of the plates I mount a transversely-sliding valve or plate F, provided with a handle f or other connection, by which it may be operated from the exterior, so as to cover the respective channels and ports alternately, the others being rendered for the time being inoperative.

While I prefer to construct these reversing-valves in the form shown in the drawings, it is to be distinctly understood that they may be of any form and construction which will admit of the ports on opposite sides being opened and closed alternately.

In order to facilitate the reversal of the engine, I propose to connect the operating-rods of the various gates with any suitable mechanism which will effect their movement in unison. A simple arrangement for this purpose is represented in Fig. 10, in which the cylinder is encircled by rotary rings f', having eccentric or cam-like portions f^2 engaging respective valve-rods, so that the rotation of the rings will have the effect of shifting valves. This series of rings I propose to operate in unison by means of a rock-shaft f^3, having arms f^4 connected to the rings, as shown. Any other arrangement may, however, be substituted therefor.

For the purpose of insuring constant and proper lubrication of the wearing-surfaces I propose to supply a lubricant from any suitable source to the interior of the tubular shaft, from which it will be carried outward by centrifugal force around the stems or rods which connect the abutments to the sliding faces of the latter. I propose to surround each of these connecting-rods within the piston-head, as shown in Figs. 11 and 12, with a tube or sleeve b^5 of Babbitt metal, brass, or other anti-friction material. When these tubes are used, they will be provided with holes b^6, through which the oil may reach the surfaces of the rods. The reciprocation of the rods will, aside from the centrifugal force, tend to distribute the oil radially.

Having thus described my invention, what I claim is—

1. In a rotary compound engine, a large and a small cylinder arranged end to end, an intermediate division-plate having the holes or ports therethrough and the channel therein, in combination with the rotary piston-heads mounted eccentrically within the respective cylinders and provided with the radially-movable blades or abutments.

2. In a rotary compound engine, a shaft, a series of cylindrical pistons centrally mounted on said shaft and each provided with a series of radially-sliding blades or abutments, a series of circular chambers or cylinders in which the respective pistons are mounted, said cylinders arranged eccentrically and in progressive angular relations to said shaft, and division plates or heads separating the cylinders and each provided with a port leading from the exhaust-point of one cylinder at its inner periphery directly through the plate to the receiving-point of the next cylinder.

3. In a rotary compound engine, two cylindrical chambers or cylinders arranged end to end in eccentric relations, an intervening plate provided with a steam-port directly therethrough from the outer part of one cylinder into the outer part of the other, and rotary pistons mounted eccentrically in the respective cylinders and each provided with a series of radially-moving blades or abutments, whereby the ends of the pistons and the blades are caused to control the steam-port and steam exhausted from one cylinder to the other a number of times during each rotation.

4. In a rotary compound engine, two cylinders arranged eccentrically end to end, and a division-plate having therethrough a steam-port consisting of a series of holes of successively diminishing size arranged in a curved line, as shown, in combination with the rotary pistons provided with radially-sliding blades or abutments.

5. In a reversible rotary compound engine, the central cylinder B, provided with the two steam-inlets C and C′ through its periphery, the cylinders B B′, arranged at opposite ends of the first cylinder and in eccentric relation thereto, the heads or plates arranged between and at the outer ends of the cylinders, each plate with two steam-ports directly therethrough from one cylinder to the next, the cylindrical pistons having a common central axis eccentric to the cylinders, the radially-movable blades or abutments mounted in the pistons, and the sliding reversing-valves applied to the cylinder heads or plates to cover their ports one at a time, whereby the steam is delivered through the successive cylinders directly from one to another in position to cause the backward or forward rotation of the pistons as demanded.

6. In a rotary compound engine, the shaft, the cylindrical pistons centrally mounted thereon, and the radially-moving blades mounted in said pistons, in combination with the series of eccentrically-arranged cylinders, the plates at their ends, each provided with two ports, reversing-valves applied to said plates to close the respective ports alternately, the cam-rings to move said valves, and the rock-shaft connected with the series of rings to operate them in unison.

7. In combination with the cylinder, the rotary pistons mounted eccentrically therein, the tubular piston-shaft, the radially-sliding blades, the reciprocating rods b', located between the opposite blades, and the sleeve b^5, provided with oil-openings b^6, whereby oil may be delivered through the shaft to the rods b' and distributed by the latter to the wearing-surfaces.

In testimony whereof I hereunto set my hand, this 26th day of October, 1889, in the presence of two attesting witnesses.

SAMUEL E. ST. O. CHAPLEAU.

Witnesses:
PHIL. T. DODGE,
W. R. KENNEDY.