No. 641,138. Patented Jan. 9, 1900.

P. F. ODDIE.

STEAM MOTOR.

(Application filed July 15, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

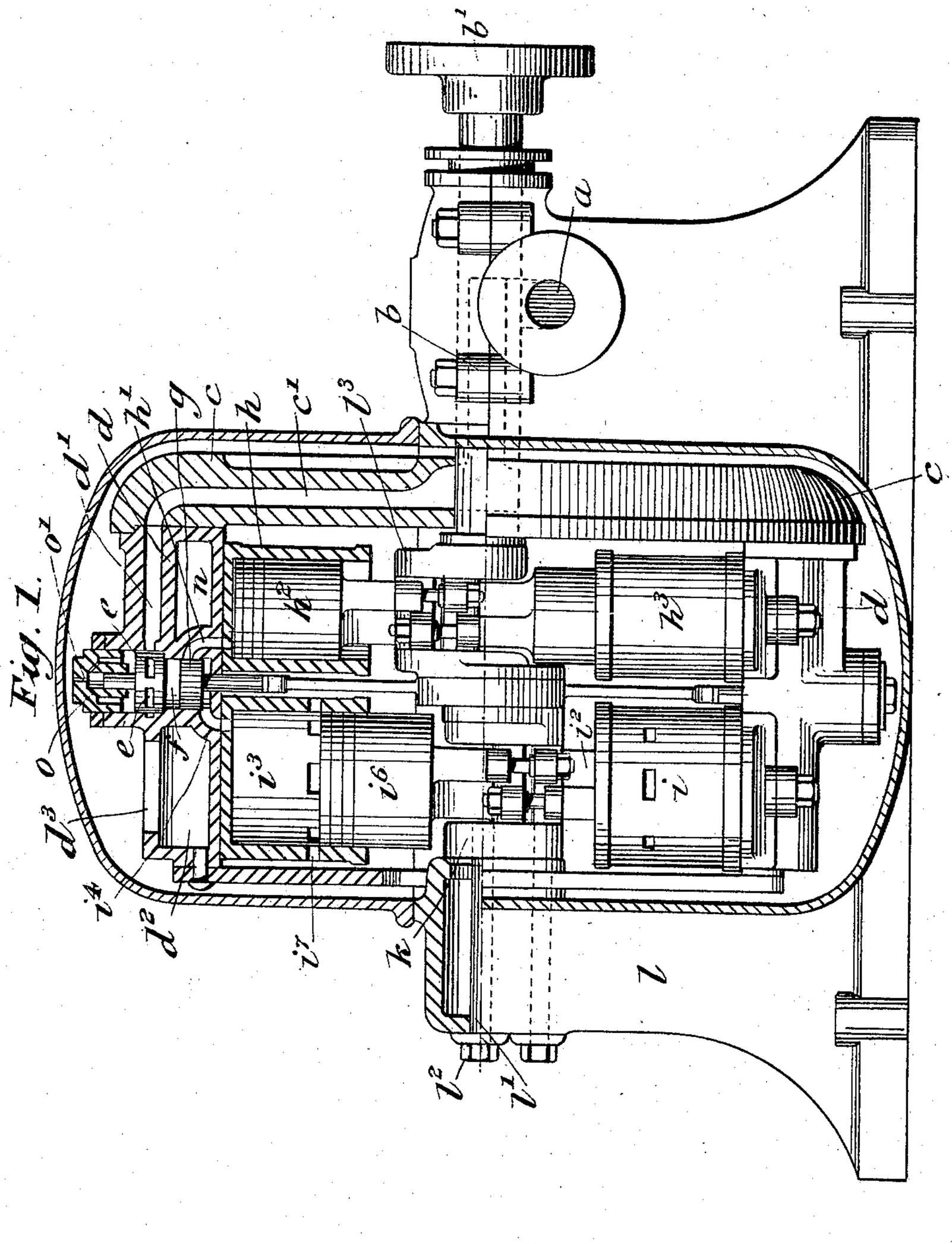

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Fig. 2.

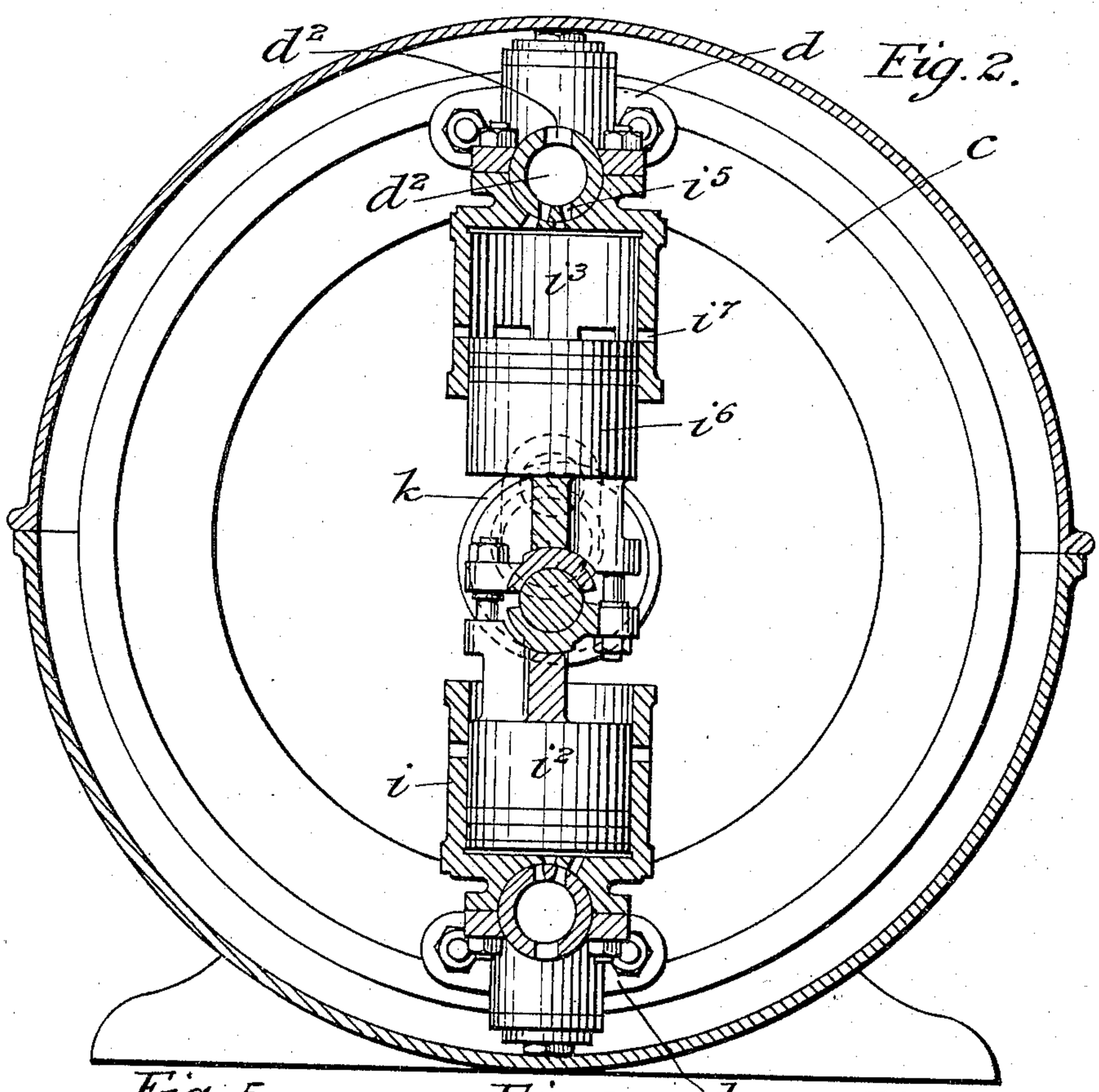


Fig. 5.

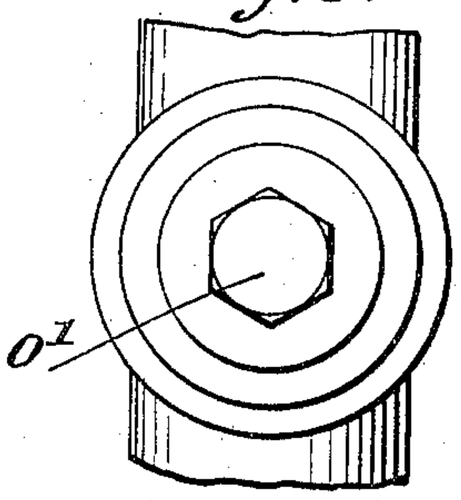


Fig. 3.

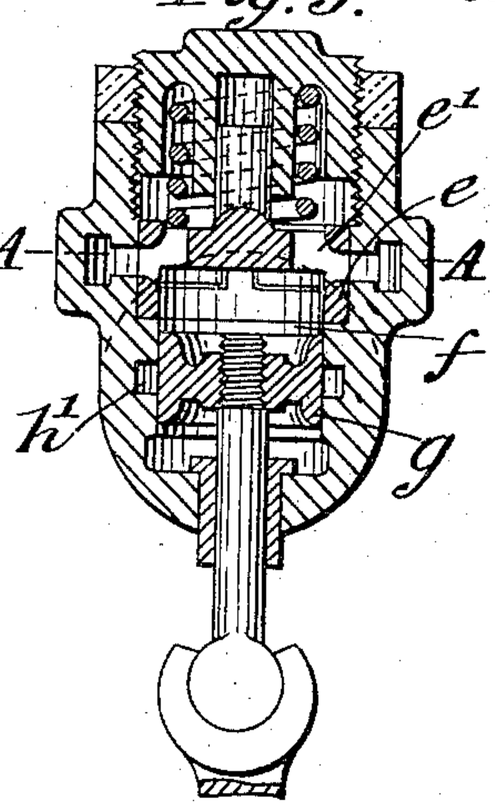
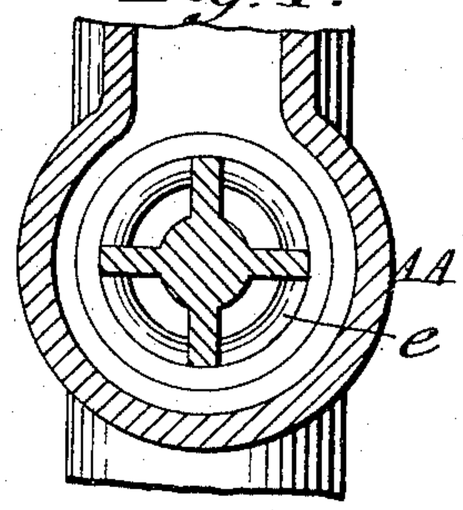


Fig. 4.



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UNITED STATES PATENT OFFICE.

PHILIP FRANCIS ODDIE, OF LONDON, ENGLAND.

STEAM-MOTOR.

SPECIFICATION forming part of Letters Patent No. 641,138, dated January 9, 1900.

Application filed July 15, 1899. Serial No. 723,988. (No model.)

To all whom it may concern:

Be it known that I, PHILIP FRANCIS ODDIE, engineer, a subject of the Queen of Great Britain, residing at 9 Mansel road, Wimbledon, London, in the county of Surrey, England, have invented certain new and useful Improvements in Steam-Motors, (for which application has been made in Great Britain, dated January 7, 1899, No. 378, and in Germany in February, 1899,) of which the following is a specification.

This invention relates to improvements in steam or other fluid-pressure engines and refers to that class known as the "revolving-cylinder" type.

I have designed my invention with the object of increasing the working economy and reducing to a minimum the vibrations set up when revolving at a high number of revolutions in a given time.

My invention is embodied in an improved motor consisting of a disk or fly-wheel mounted on a shaft which revolves in suitable bearings. On one side of this disk, approximately near the periphery, I fix lateral hollow studs or arms in pairs, one member of each pair opposite to its fellow, which project at right angles to the line of the face of the disk. On each of these lateral studs or arms I mount a cylinder or cylinders either singly—that is to say, one cylinder to each lateral stud or arm—or, as herein shown, in pairs, one pair mounted on each stud or arm. The under side of each lateral stud or arm is formed with a circular edge, which corresponds with a circular groove formed in the outer heads or covers of each cylinder, forming a kind of socket-joint to allow the cylinders to oscillate slightly on the projecting studs or arms.

My improved construction of motor embodies a plurality of cylinders, each provided with a piston, each piston having its inner end connected each respectively to the opposite pin of a double-throw crank by means of suitable brasses or bearings. As in an ordinary engine, where the crank revolves, the stroke is determined by the amount of eccentricity of the crank-pins, so in my invention the travel of the pistons in and out of their respective cylinders when the disk and cylinders revolve is determined by the eccentricity of the fixed crank-pins. In order to keep the piston end brasses or bearings in constant contact with the crank-pins and to avoid the shock caused by any change of direction of pressure, I make the pistons sufficiently heavy for the centrifugal force generated by their rotation to become slightly greater than the total initial pressure acting on the pistons.

The steam or the operating fluid enters the engine through suitable orifices formed in the shaft on which the disk is mounted. It passes into the disk and from thence by suitable ports or channels to a steam-chest formed in each lateral stud or arm and which communicates with a cylinder back of the piston therein. These steam-chests are provided with valve-faces and suitable ports communicating with their respective cylinders.

My invention also embodies a new construction of governing or regulating valve, which I have shown in each hollow arm located as nearly as possible to the valve-chamber comprising a throttle-valve which is kept open by being pressed upon by an adjustable spring. The weight of this throttle-valve is proportioned to the controlling force of the spring, so that when the normal speed of the engine is exceeded the centrifugal force causes the spring to be compressed by the valve, which, moving outward, reduces the opening for steam or motive fluid, and consequently constricts the supply thereof. I use a valve, one to each projecting stud, herein shown as piston-valves, although another form of valve may be used, and I expose the outer face or area of each valve constantly to the initial pressure of the steam. These valves are actuated by means of an eccentric or other equivalent device. When an expanding fluid, herein referred to as "steam," forms the working medium, I arrange the engine to work in what is known technically as the "compound" way; but it is within the scope of my invention to work with the expansive or other fluid according to the simple expansive mode.

In the embodiment of the invention shown I have mounted the cylinders on the hollow studs in pairs, two to each projecting stud, and make them single-acting. The diameter of one of each of the pairs of cylinders is made

considerably larger than its fellow cylinder. The steam enters the smaller cylinders of each pair first, afterward being further expanded in the larger cylinders.

Herein I have shown the high-pressure cylinders arranged next to the disk; but this arrangement is not essential, as these positions may be reversed. The high-pressure pistons are connected to one crank-pin, while the pistons of the low-pressure cylinders are connected to the opposite crank-pin of the double-throw crank.

I have shown the distributing-valves as located between the two cylinders in the projecting stud and as what are known as "piston-valves," one valve acting for each pair of cylinders; but the form of valves so employed is essentially capable of variation.

In operation with the described motor the steam entering the steam-chest is distributed to the cylinders by the piston-valves and presses on the pistons. This pressure reacts on the covers or ends of the cylinders, and through them the pressure is transmitted to the projecting studs, causing the disk and shaft to revolve. This revolution results from the angular direction of the thrust arising from the eccentricity of the double-throw crank to which the pistons are connected. Each pair of pistons are so connected to opposite cranks that they reciprocate in opposite directions—that is to say, one piston is in its extreme inward position when the other is in its extreme outward position. Thus in a compound engine arranged as described the high-pressure piston of one pair of cylinders is coöperating or acting with the low-pressure piston of the other pair, and the low-pressure piston of the opposite pair is coöperating with the corresponding high-pressure piston. This arrangement is designed to relieve the bearings of the shaft on which the disk is mounted of all undue strain, the outward thrust of one high-pressure cylinder being approximately balanced by the outward thrust of the opposite low-pressure cylinder. This results in the development of two forces operating tangentially to cause the engine to revolve.

Owing to the construction of the outer heads or covers of the cylinders, I am enabled to utilize the oscillatory movement of each cylinder end relatively to the lateral hollow stud or arm to cover and uncover the exhaust-passages formed in said heads which correspond on the exhaust-stroke with similar ports formed in the under circular part of the lateral hollow studs. In the case of a compound engine these ports in the high-pressure cylinders communicate with intermediate receivers formed in the projecting studs, which are made hollow for the purpose, the steam passing from the receiver to the low-pressure cylinder on its next working stroke.

The disk and cylinders are herein shown as being surrounded with a casing, into which the steam is exhausted after it has done its work in the cylinders, and I prefer such construction; but the casing may be modified or dispensed with, especially in tunnel-work, when employing air as the motive fluid.

In the drawings, Figure 1 is a partial vertical section taken in the line of the main shaft. Fig. 2 is a transverse vertical section taken through the low-pressure cylinders. Fig. 3 is a vertical section of the distributing-valve, valve-chest, and adjacent parts, taken transversely to the same parts in Fig. 1 and drawn to a larger scale. Fig. 4 is a horizontal section taken on the line A A of Fig. 3. Fig. 5 is a plan view of the covering parts of Fig. 3.

a is the entrant-passage for the motive fluid, which passes thence by the hollow perforated shaft b to the passages in the disk c, one only of such passages at c' being shown, the lower part of the disk being similarly provided. The said passages are extended into and through lateral hollow studs or arms d, projecting from and communicating with the passages formed in the interior of the disk c, one such extension being shown at d', where it gives access of the fluid to the passages e' of the throttle-valve e, whence it passes to the chamber f and from there to the passage h', leading to the cylinder h, when the distributing-valve g in its movement uncovers the entrance to said passage h'. The fluid-pressure from the passage h' acts on the high-pressure piston h^2 to force it outwardly as soon as the parts are moved from the dead-point, and in like manner the fluid that has been led to and has operated the other high-pressure cylinder h^3 now passes to the opposite lower-pressure cylinder i, forcing its piston i^2 out at the same time that the coacting piston h^2 is forced out and by their combined pressure causing the moving parts to revolve about the fixed double-throw-crank shaft k, which shaft is bolted to the framing l by rods l' and nuts l^2. The opposite end l^3 is formed recessed to inclose the adjacent end of the revolving shaft b, and thereby to be steadied. The fluid having performed its work in the cylinder h now returns by the passage h' and passes on the under side of the upraised distributing-valve g into the low-pressure cylinder i^3 by the passage i^4 until by the return stroke of the valve g said passage h' becomes closed, when the surplus fluid passes into the receiver n by passages (not shown) correspondingly placed to the like passages i^5 in the upper part of cylinder i^3, (see Fig. 2,) said passages corresponding with passages into the receiver during the whole of the exhaust movement of the piston, and the parts obstruct each other's passages during the active stroke of the piston under the fluid-pressure, the steam in the receiver n being imprisoned during such active stroke, and upon the next return stroke of the piston h^2 into the cylinder h the passages between h and n are reopened, allowing the fluid from n to mix with the fluid now being exhausted from h into i^3. Having forced out the low-pressure piston i^6 to

the point where the passage i^7 in the side of the cylinder i^3 becomes uncovered, the fluid is then at liberty to be discharged thereby into the space between the casing and the engine, and in the case of steam it is led away as required. Fluid remaining in the cylinder i^3 on the return inward stroke of the piston i after the passages i^7 become closed passes away to the outer space through the passages i^5 and the hollow part d^2 of the stud d and out by opening d^3. At the same time corresponding operations have been taking place with the fluid between the corresponding cylinders h^3 and i' through like passages and cooperating parts.

The machine to be driven is either coupled up directly to the shaft b, as by connections to the coupling indicated at b', or the driving-power may be transmitted by the intervention of any usual means of transmission, either positive or frictional.

Owing to the fact that every moving part of my improved motor participates in the centrifugal force developed by the high rate of revolution every particle of the motive fluid is more or less subject to the influence of that force, and consequently if any watery particles are or become present by condensation such heavier particles become separated from the more fluid parts and are delivered by the passages to the outermost or peripheral portion, and thence they are discharged by openings, as o o and o', into the surrounding space. Like openings o o and o' are provided adjacent to the opposite valve parts; also, these openings o' may be free or they may be fitted with any well-known devices by which they are only opened upon the higher pressure developed by escaping water; but normally they remain closed to the passage of dry steam or fluid. This constant leakage of condensed liquid from the motor when in operation and which leakage is the greater the higher the speed of revolution developed enables the working parts to be kept in the highest state of efficiency, reducing to a minimum any initial condensation, owing to no condensed water being left in the cylinders or passages after exhaust to set up active further condensation.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a motor, the combination with a revolving shaft from which the power developed is transmitted, of a motive-fluid-supply passage, a disk c provided with fluid-distributing passages, hollow projecting studs, each hollow arm having fluid-passages and carrying a distributing-valve, a high-pressure cylinder and a low-pressure oscillatory cylinder, each cylinder being provided with fluid-passages and with a piston and connections between said piston and the fixed centrally-located cranked shaft and a supporting-framing therefor, substantially as set forth.

2. In a motor, the combination of the cranked shaft, the fly-wheel disk mounted on the shaft and constructed in its interior with radial passages for distributing the working fluid, the hollow studs projecting laterally from the disk and communicating with the internal passages thereof, and having exhaust-ports, throttle-valves mounted in said lateral, hollow studs, cylinders having their ends seated upon and oscillating about said studs to control the exhaust-ports in the latter, and pistons connected with the cranked shaft, substantially as described.

3. In a motor the combination of the hollow cranked shaft, the balance-wheel disk formed internally with radial fluid-distributing passages communicating with the interior of said shaft, the hollow studs projecting laterally from one side of the disk and communicating with the said internal passages thereof, the cylinders journaled upon and oscillating about said lateral, hollow studs, the throttle-valves slidable transversely of and mounted within said studs, the pistons in the cylinders, and connections between the pistons and throttle-valves and the cranked shaft, substantially as described.

4. In a motor, the combination of the cranked shaft, the disk mounted on the shaft and having radial fluid-passages in its interior, the lateral, hollow studs projecting from the disk and communicating with the internal passages thereof, the cylinders oscillating upon the lateral, hollow studs and communicating with the interiors of said studs, pistons in the cylinders, connected with the cranked shaft, sliding throttle-valves mounted in and moving transversely of said hollow studs, and springs arranged to act against the outer ends of the throttle-valves and resist the centrifugal force thereof, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

PHILIP FRANCIS ODDIE.

Witnesses:
ALFRED GEORGE BROOKES,
JOHN GOODE SCOTT.