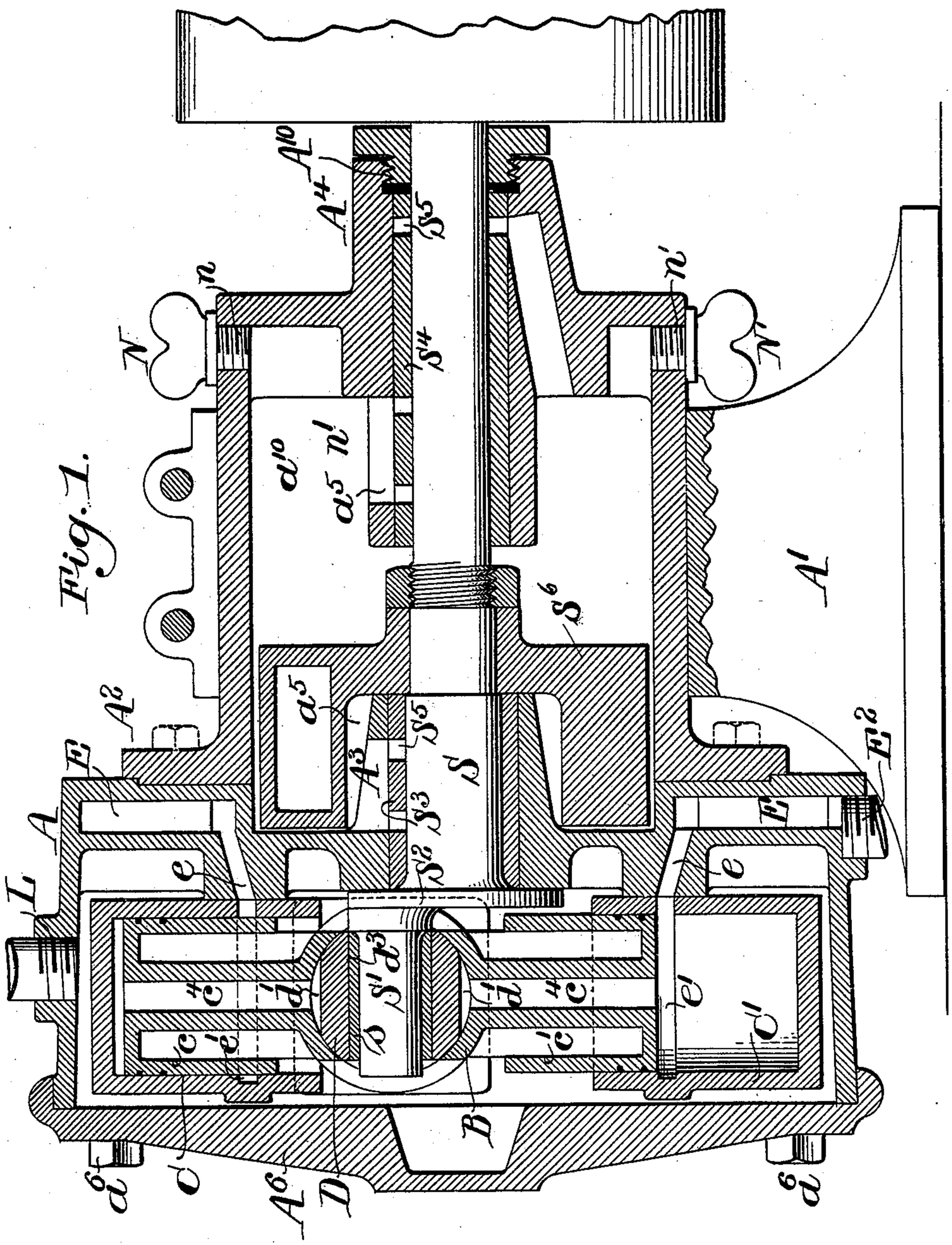
(No Model.) 4 Sheets—Sheet 1.

J. T. HALSEY.

STEAM ENGINE.

No. 594,529. Patented Nov. 30, 1897.

Fig. 1.



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STEAM ENGINE.

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Fig. 2.

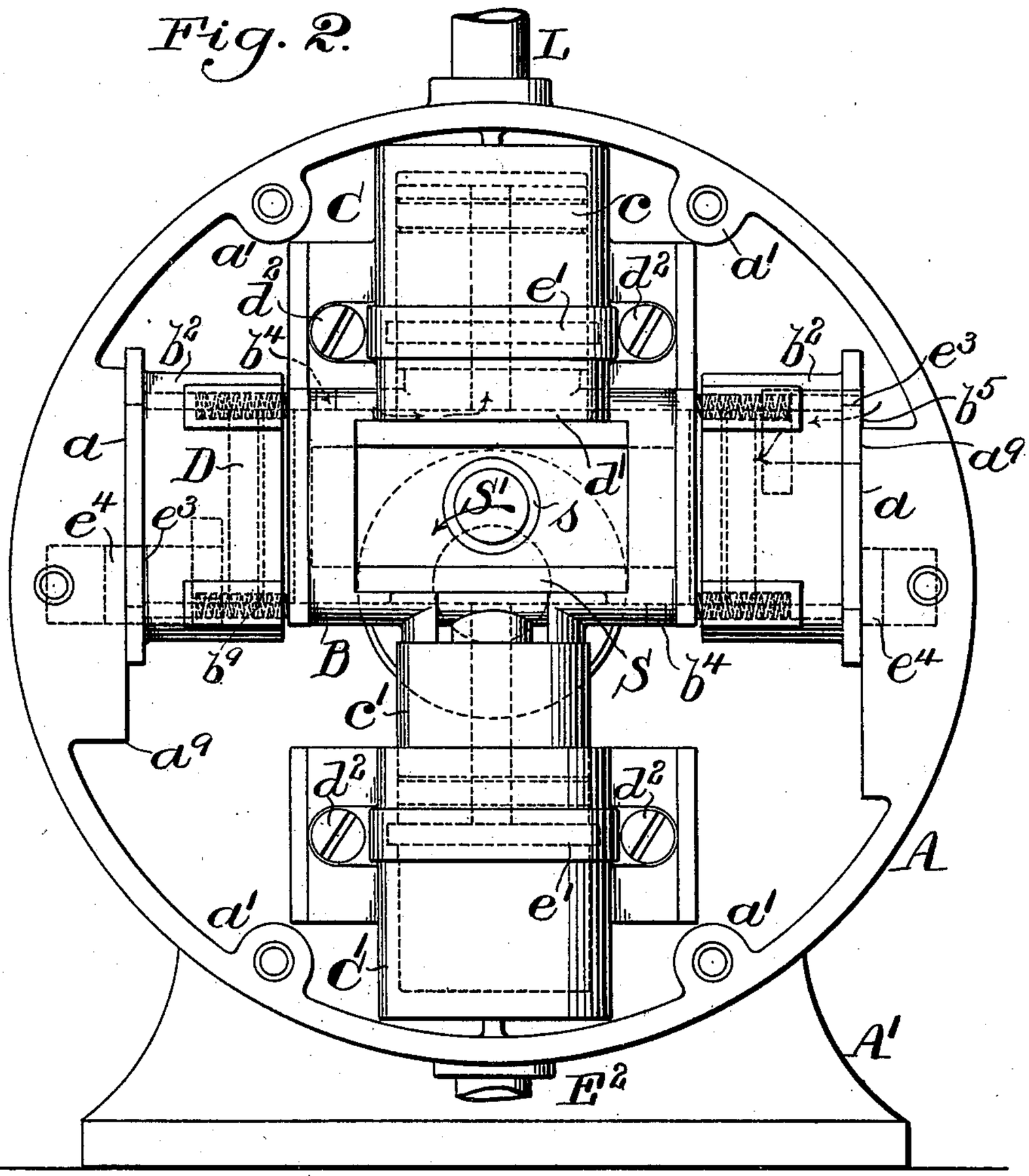


Fig. 3.

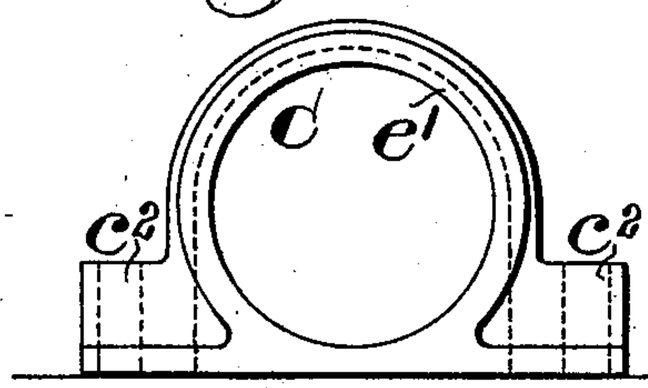
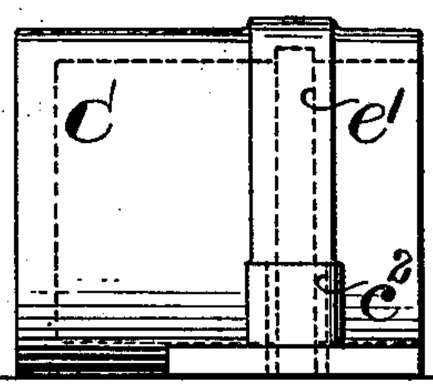


Fig. 4.



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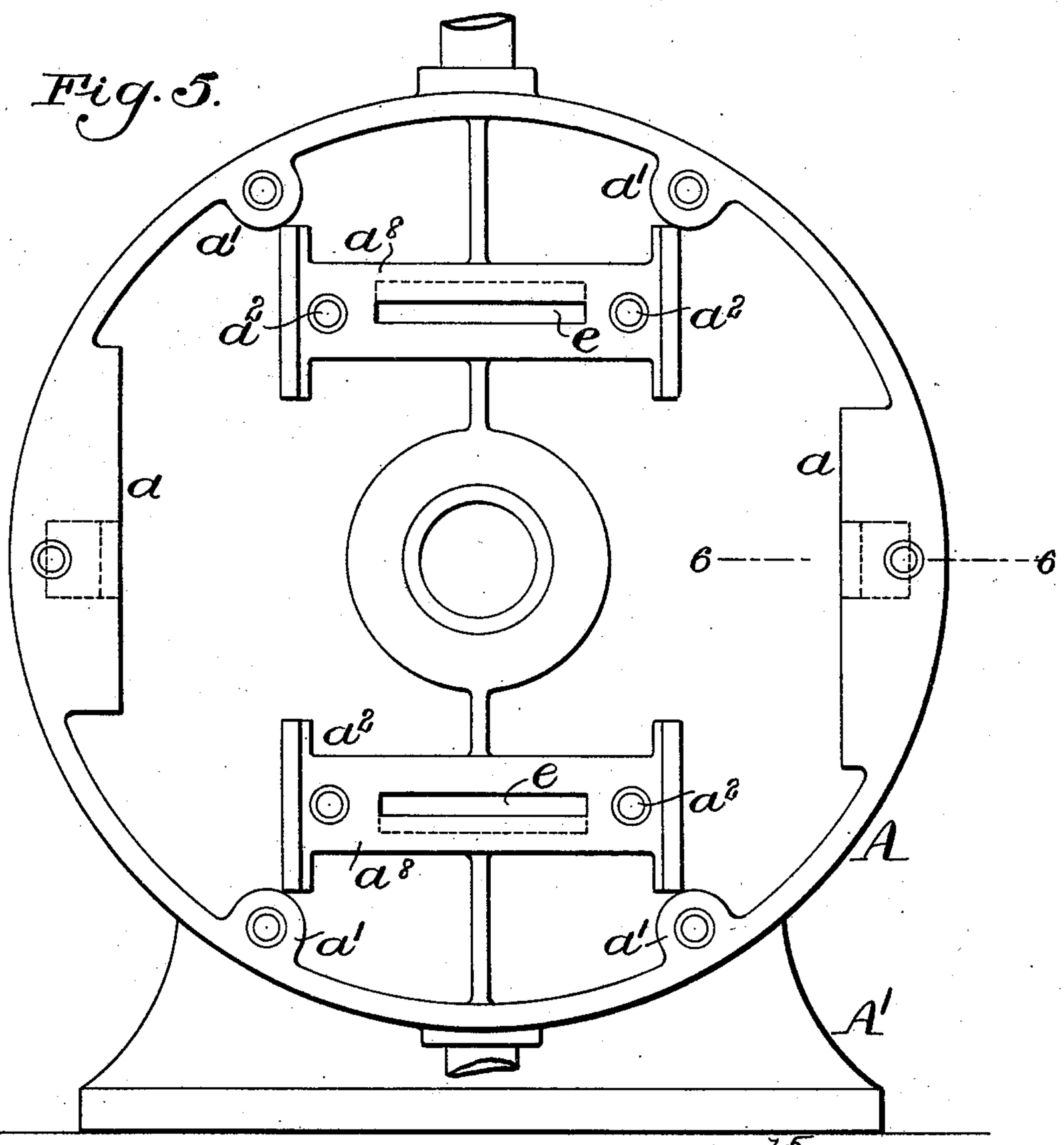
No. 594,529. Patented Nov. 30, 1897.

Fig. 5.



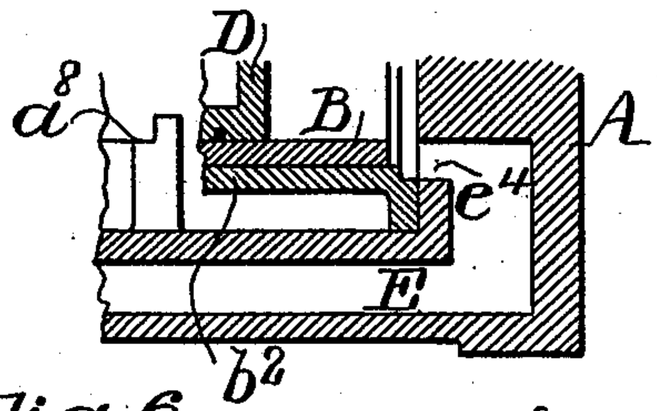


Fig. 6.

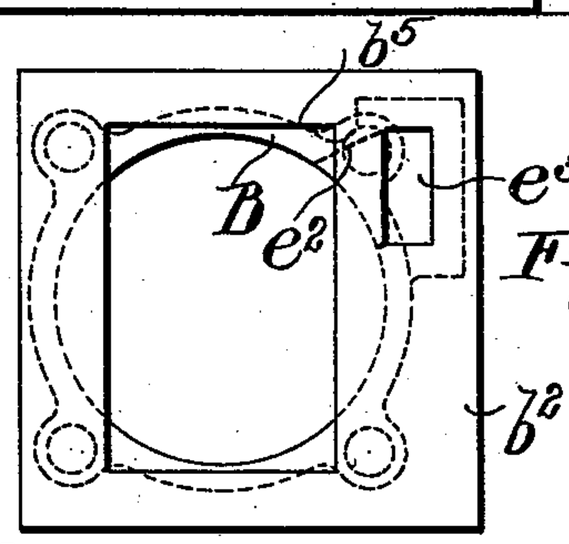


Fig. 7.

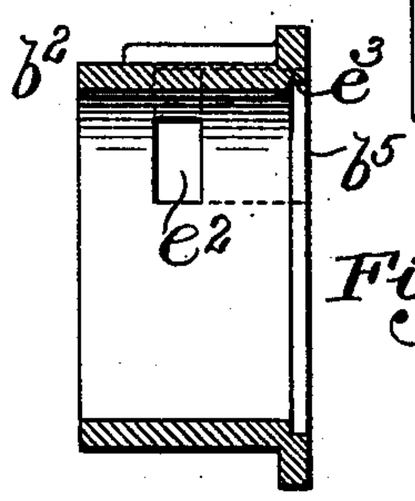


Fig. 8.

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J. T. HALSEY.

STEAM ENGINE.

No. 594,529. Patented Nov. 30, 1897.

Fig. 10.

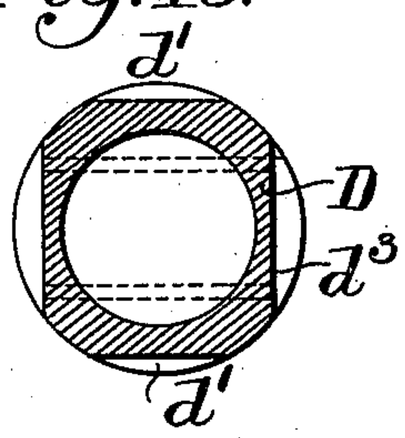


Fig. 9.

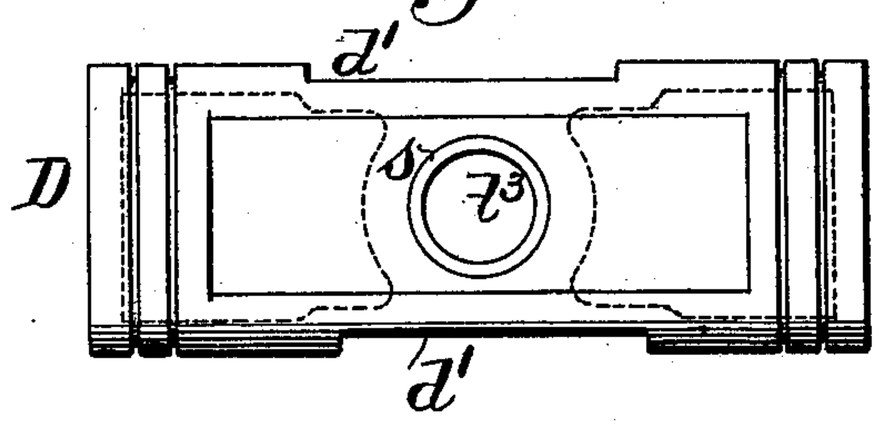


Fig. 11.

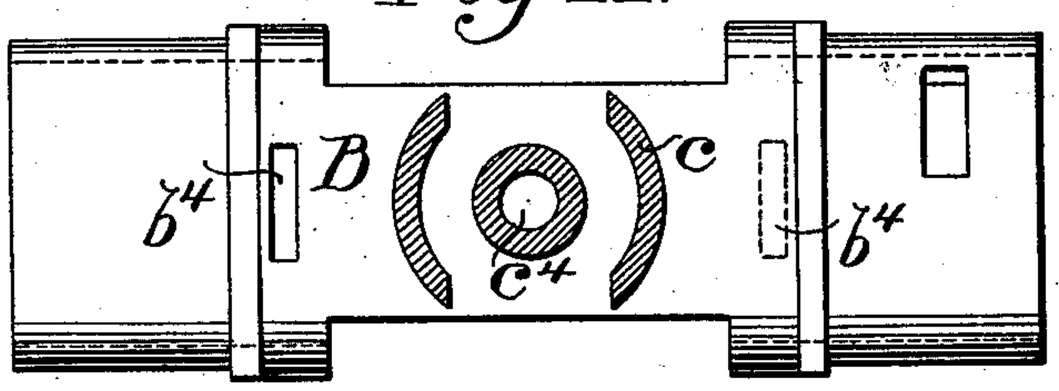


Fig. 12.

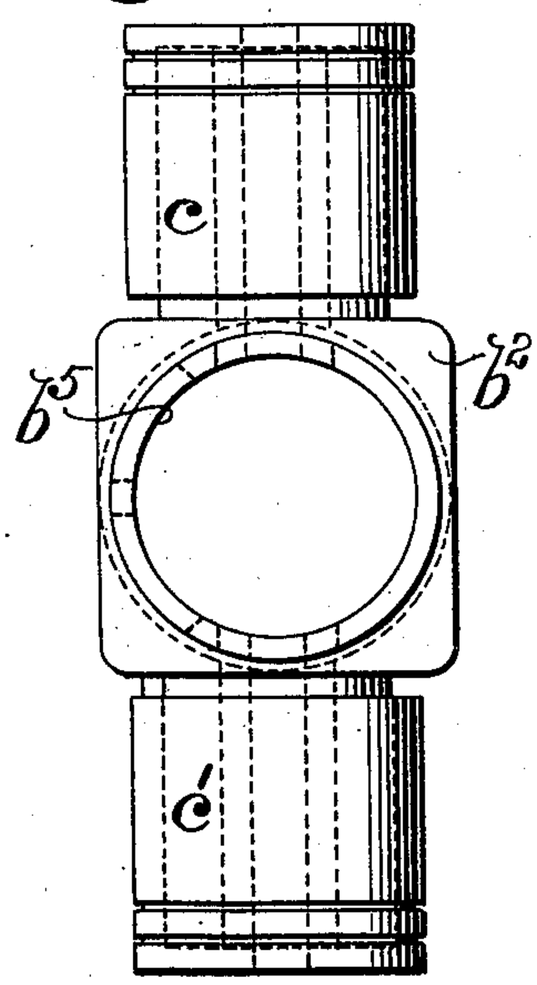
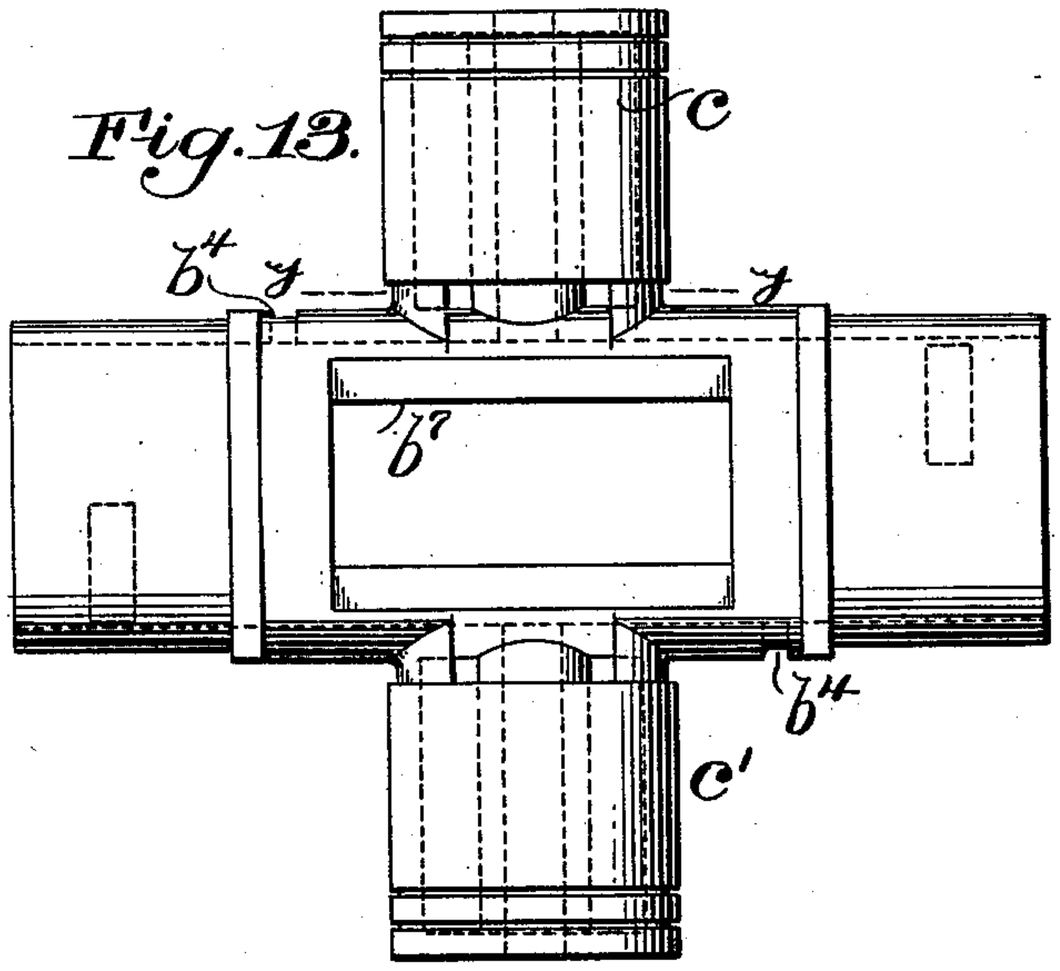


Fig. 13.



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UNITED STATES PATENT OFFICE.

JAMES T. HALSEY, OF PHILADELPHIA, PENNSYLVANIA.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 594,529, dated November 30, 1897.

Application filed January 17, 1895. Renewed May 18, 1897. Serial No. 637,121. (No model.)

To all whom it may concern:

Be it known that I, JAMES T. HALSEY, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a certain new and useful Improvement in Steam-Engines, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My invention relates to fluid-pressure engines, and more particularly to multiple-cylinder engines, and has for its main object to provide an engine which can run smoothly at very high speeds.

In my application, Serial No. 467,311, filed on March 23, 1893, I have shown and described a perfectly-balanced engine wherein what is known as a "Scotch yoke" is employed to transmit motion from the pistons to the crank, this yoke being balanced by steam-pressure. In the engine described in the above-noted application, however, I employed valves operated from an eccentric on the engine-shaft to govern the flow of motive fluid to and from the cylinders. In an engine designed to run at a very high speed, as my engines are, it is very desirable that the number of parts and connections shall be diminished as much as possible, so as to prevent wear and do away with the resultant rattling and jar.

My present invention consists mainly in so arranging the ports through which steam is admitted to or exhausted from the cylinders of my engine that they will be opened and closed at the proper times by the movements of the cylinders or pistons themselves.

Various other improvements will be hereinafter pointed out which tend to make a very smoothly-running and perfectly-balanced machine.

My invention will be best understood as explained in connection with the accompanying drawings, in which—

Figure 1 is a sectional elevation of my improved engine. Fig. 2 is a front view of the engine, the cover of the casing which supports the cylinders being removed. Figs. 3 and 4 are detail views of one of the stationary cylinders shown in Fig. 2. Fig. 5 is a view of the casing with all the operative parts removed. Fig. 6 is a section on the line 6 6 of Fig. 5, showing the arrangement of the exhaust-passage. Fig. 7 is an end view of the head of one of the reciprocating cylinders. Fig. 8 is a sectional view of this cylinder. Fig. 9 is a side view of the piston which operates in the reciprocating cylinder. Fig. 10 is a central cross-section of this piston. Fig. 11 is a plan view, partly in section, on the line $y\ y$ of Fig. 13, showing the reciprocating cylinder. Fig. 12 is an end view of this cylinder, and Fig. 13 is a side view thereof.

A indicates a suitable casing in which are secured the operating parts of the engine. This casing is preferably so formed that when the cylinders and pistons are in position a cap or cover A^6 can be secured to it, as by bolts a^6, so as to form, with the exception of the holes for the steam and exhaust pipes and the shaft-bearing, a tight box.

A′ is a base to which the casing is secured, and A^2 an additional casing having a bearing at A^4 for the shaft.

C C′ are cylinders arranged opposite to each other, as best shown in Fig. 2. These may be bolted to the casing by means of bolts at $d^2\ d^2$, as shown, or secured to it in any other suitable way.

B is a cylinder to which are secured the pistons $c\ c'$, which operate in the cylinder C C′. These pistons $c\ c'$ and the cylinder B are very conveniently cast together, as shown in Figs. 12 and 13.

D is a piston which operates in the cylinder B, and it is provided, as shown in Figs. 2 and 9, with a bearing d^3 for the crank S′, a bushing s being inserted, as shown, to take up the wear.

The piston D and the cylinder B form a Scotch yoke, and to do away with the undue friction which has heretofore prohibited in practical operation the use of the device and rendered it impractical at high speeds I provide between the adjacent surfaces of the cylinder and piston suitable recesses $d'\ d'$, (here shown as formed in the piston,) into which I admit steam or other motive fluid at the same time that it is admitted into the steam-spaces of the cylinders C C′, suitable passages, as $c^4\ c^4$, connecting the recesses with the steam-spaces. These recesses $d\ d'$ have substantially the same area as have the

pistons *c c'*. Therefore there is practically no pressure exerted by the cylinder B on the sides of the piston D, which slides in it.

The parts thus far described are substantially the same in their general arrangement as those shown in my allowed application, Serial No. 467,311, referred to. In the present application, however, I employ no valves proper, but provide suitable ports which are uncovered at proper times by the cylinder B or the piston *c* or *c'* in their movements, so as to admit steam to and permit its exhaust from the steam-spaces of the cylinders.

In the construction shown I admit steam or other motive fluid into the casing A through the live-steam pipe L, and the live-steam ports when open admit the steam from the interior of the casing to the cylinders.

To admit steam to the steam-space of the cylinder C or C', I provide ports b^4 b^4 in the cylinder B, which when the pistons D are in the proper positions connect the steam-space in the casing with the recesses *d' d'*, whereby steam is admitted through the ports b^4, recesses *d'*, and passages c^4 to the steam-spaces in the cylinders C and C'. By varying the position of the ports b^4 the point of cut-off can of course be varied, as can also be the point of admission. The exhaust-ports *e e* (see Figs. 1 and 5) are arranged near the lower limit of the stroke of the pistons *c c'*, and, as shown, serve to connect annular passages *e' e'*, formed in the cylinders C and C', with the exhaust-conduit E, conveniently formed by casting an annular passage in the casing, as shown, E^2 being the exhaust-pipe.

Faces *a a* are formed in the casing, across which slide the ends of the cylinder B, which is preferably provided with heads b^2, which are so constructed as to be nearly, if not entirely, balanced by steam-pressure, but which are held against the faces *a a* by means of suitable springs, as indicated at b^9. The faces *a a* are not arranged symmetrically with regard to a central line, as *z z*, of the travel of the cylinder B, but one face, as the one on the left in Fig. 2, extends farther above than below this center line, and the other, as the one to the right, farther below the line than above. As a result of this construction the open end b^5 of the cylinder B, near the end of its movement in one direction, will, as indicated at the right of Fig. 2, extend beyond the edge a^9 of the face *a*, so that the steam will have free entrance into the cylinder. The left end of the cylinder of course takes steam when at the other end of its travel from that shown in Fig. 2.

The heads b^2 have each formed in them an exhaust-passage e^2, whose mouth e^3 is adapted, when the cylinder is in the position indicated in Fig. 6 and on the left of Fig. 2, to register with the exhaust-port e^4, which is connected, as shown in Fig. 6, to the exhaust-passage E. Therefore, by the movement of the cylinder D and pistons *c c'*, ports will be opened and closed, so as to govern the inflow and egress of steam. This permits the engine to run at the fastest speed, since there are no small ports to be rapidly moved or reciprocated and no multiplicity of connections which will wear and rattle after a little use. Preferably the passages e^2 extend up some distance in the sides of the heads, as shown, and communicate with the cylinder some distance from its outer ends, so that as the piston D moves toward the end of the cylinder it cuts off the exhaust before reaching the end of its stroke and is cushioned on the steam remaining in the end of the cylinder.

The casing A has a boss A^3 formed with it, which serves as a support for the shaft S.

S^3 is a bushing arranged in the boss A^3.

S^2 indicates a plate formed with or secured to the shaft, which bears against the boss on the inside of the casing.

S' is the crank which is journaled in the piston D and which serves to rotate the shaft.

The shaft S projects into the casing A^2 and is preferably supported in a second bearing A^4, in which a bushing S^1 is provided, as shown.

A^{10} is a stuffing-box which serves to prevent the escape of any oil or water which leaks into the chamber a^{10}, formed by the casing A^2. This chamber a^{10} conveniently serves as an oil-chamber, and I provide openings, as *n n'*, through which oil can be poured into and drained from the chamber, N and N' indicating plugs to close these openings. To insure that the oil shall reach the shaft, I form holes, as S^5, in the bushings and openings a^5 in the journals A^3 and A^4, so that the oil can readily reach the shaft. To counterbalance the weight of the crank S', I provide the counterbalance-wheel S^6, which, as shown, is made solid on the side opposite to the crank S' and hollow on the other side, as shown in Fig. 1. This wheel S^6 revolves rapidly with the shaft in the chamber a^{10} and tends to agitate the oil, although the oil will acquire a rapid motion with the shaft.

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

1. In a fluid-pressure engine the combination with the oppositely-arranged cylinders C C' of pistons *c c'* moving therein, a cylinder B secured to and operated by the pistons *c c'* a piston D working in said cylinder and having recesses *d' d'* in its sides substantially as and for the purpose specified, a port connecting each of the recesses *d' d'* with the steam-space in a cylinder C or C' and ports b^4 b^4 in the cylinder B with one of which ports each recess is adapted to register at a portion of the stroke of the piston D whereby there will be a free passage for motive fluid through the ports b^4 to the steam-spaces in the cylinders C C'.

2. In a fluid-pressure engine the combination of a suitable casing having oppositely-arranged faces *a a*, a cylinder B adapted to reciprocate in said cylinder and having heads

bearing against the faces *a a*, said faces *a a* being arranged substantially as specified and so that one face extends farther to one side and the other face extends farther to the other side of the middle line of travel of the cylinder B, all substantially as specified and so that the extreme movement of the cylinder in either direction will bring part of the cylinder-opening beyond the edge of one of the faces so as to admit steam into one end or the other of the cylinder.

3. In a fluid-pressure engine the combination of the casing A cylinders C C′ arranged therein as specified pistons *c c′* operating in said cylinders, a cylinder B operated by the pistons *c c′*, a piston D in said cylinder B having recesses *d′ d′* therein, a port leading from each recess to the steam-space in one of the cylinders C or C′, ports b^4 in the cylinder adapted to register with the recesses *d′* at certain parts of their travel and admit fluid under pressure to the steam-spaces of the cylinders, ports serving on the proper movement of the cylinder B to admit motive fluid thereto and exhaust-ports adapted when uncovered to permit the escape of motive fluid from the cylinders.

4. The combination with the casing A having slide-faces *a a* of the fixed cylinders C C′ situated opposite to each other, exhaust-ports e^4 e^4 leading from the faces *a a*, exhaust-ports *e e* leading from cylinders C C′ at a distance from their outer ends, the pistons *c c′* working in cylinders C C′, the cylinder B firmly secured to pistons *c* and *c′*, the heads b^2 b^2 secured on each side of cylinder B and moving on slides *a a* said heads having passages e^3 e^2 adapted to register with the exhaust-ports e^4 at proper times and communicating with the cylinder B at some distance from the outer ends thereof, and means for admitting steam to each cylinder in turn, all substantially as described, and whereby each outward movement of the pistons is cushioned on steam inclosed in the outer end of its cylinder.

5. In a fluid-pressure engine the combination with a casing A adapted to contain live steam and having an exhaust-passage E formed in its walls, of the oppositely-arranged cylinders C C′ secured to the casing and projecting into the steam-chamber thereof, pistons *c c′* moving in said cylinders, a cylinder B directly secured to the pistons *c c′* and adapted to be moved thereby, steam-ports c^4 formed in each piston *c c′*, steam-ports b^4 b^4 connecting casing A with cylinder B, a piston D working in said cylinder B adapted to engage with a suitable crank-pin and operate a power-shaft, recesses *d′ d′* in piston D adapted to connect ports b^4 and c^4 at proper intervals, exhaust-ports *e* leading from cylinders C′ C′ and opened at proper intervals by the movement of pistons *c c′*, faces *a a* against which the heads of cylinder B slide formed to connect each end of the said cylinder at proper times with the casing A and with the exhaust-passage, and exhaust-passages e^2 e^2 formed in the cylinder-heads and adapted to register with the exhaust-ports at proper times.

6. The combination with the casing A containing a series of cylinders and pistons arranged to act upon a crank contained in said cylinders and to afford a bearing for a crank-shaft passing into said casing, said casing also serving as a receptacle for the fluid by which the pistons are actuated of a casing A^2 secured to the wall of casing A at one end and at its other supporting a second bearing for the shaft, said casings A and A^2 having no channel of communication, and means for supplying oil to said casing A^2 as described and so as to flood both shaft-bearings with oil.

7. The combination with the casing A serving as a receptacle for the actuating fluid and having the fixed cylinders C C′, the movable cylinder B secured to the pistons *c c′* of the cylinders C C′ and the piston D of a crank S′ journaled in piston D, a crank-shaft S passing through casing A, a casing A^2 secured to the wall of casing A and surrounding shaft S, a counterbalance-wheel S^6 secured to shaft S and revolving in casing A^2, and means for supplying oil to casing A^2 to flood both bearings.

JAMES T. HALSEY.

Witnesses:
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BERNHARD THALHEIMER.