(No Model.) 3 Sheets—Sheet 1.

J. T. HALSEY.

ENGINE.

No. 544,299. Patented Aug. 13, 1895.

Fig. 1.

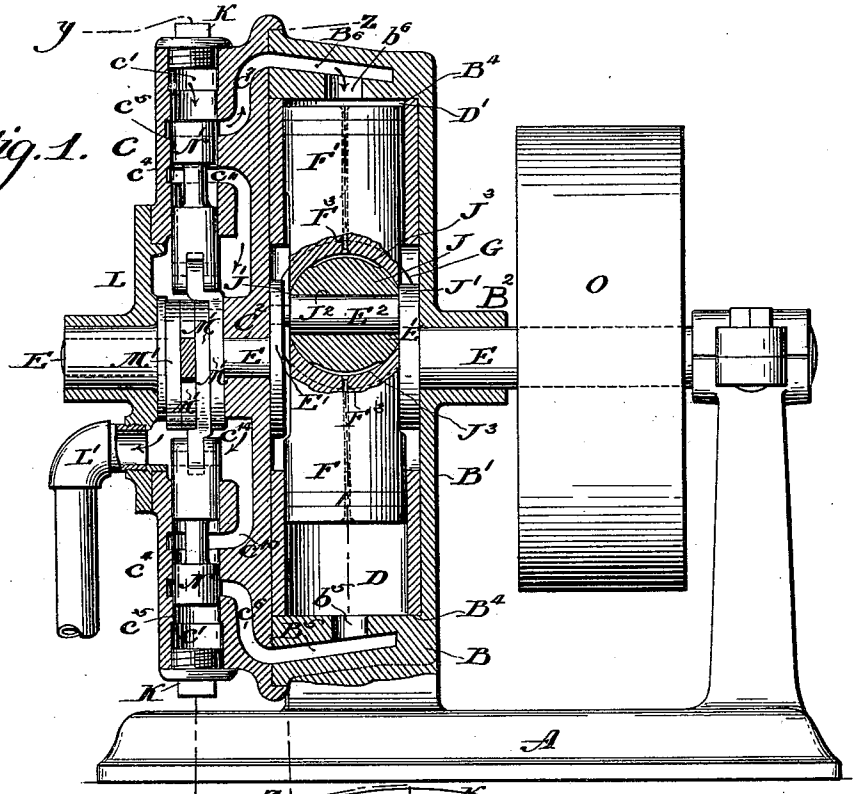
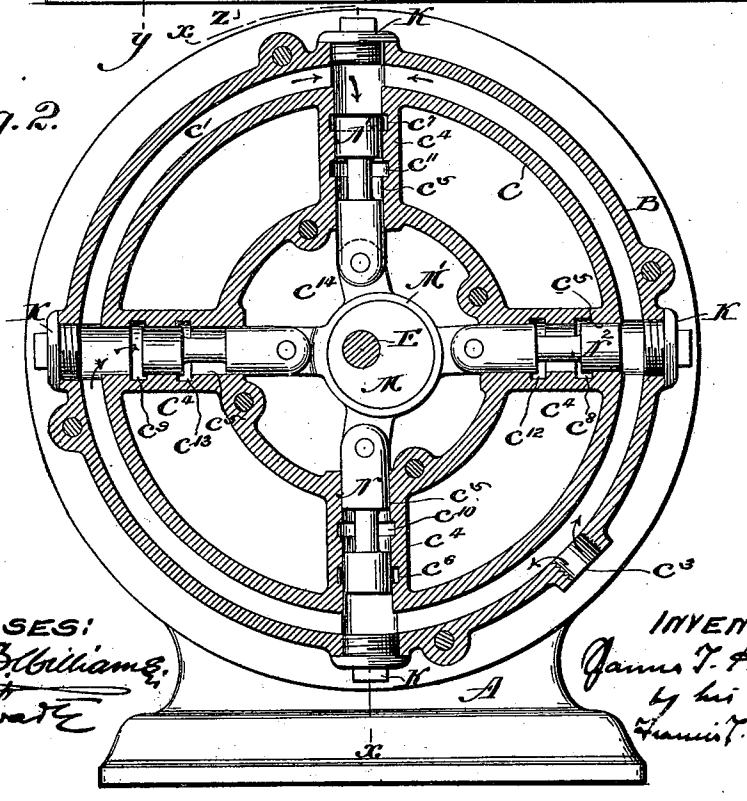


Fig. 2.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 3.

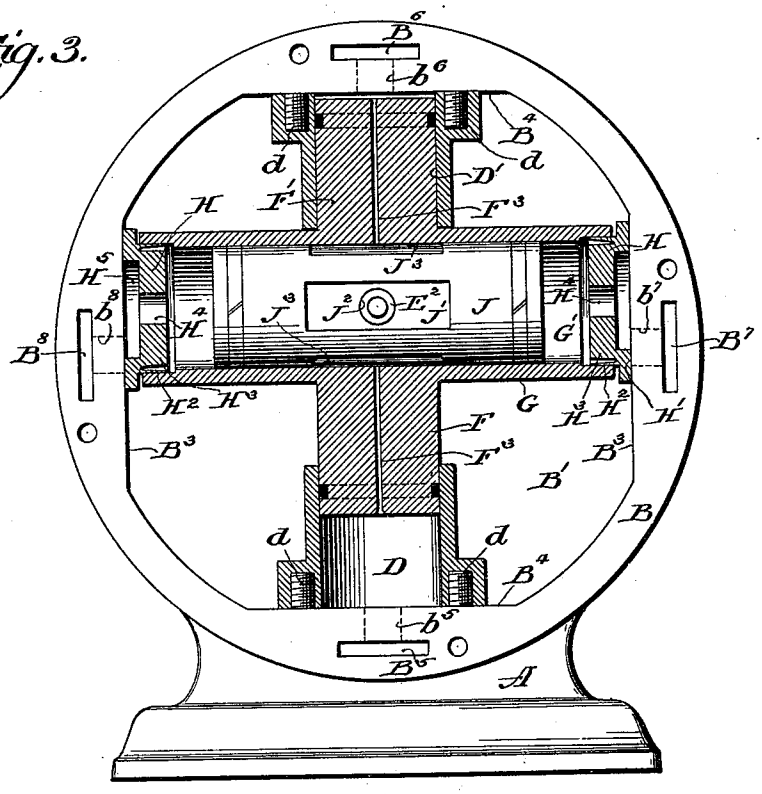


Fig. 4.

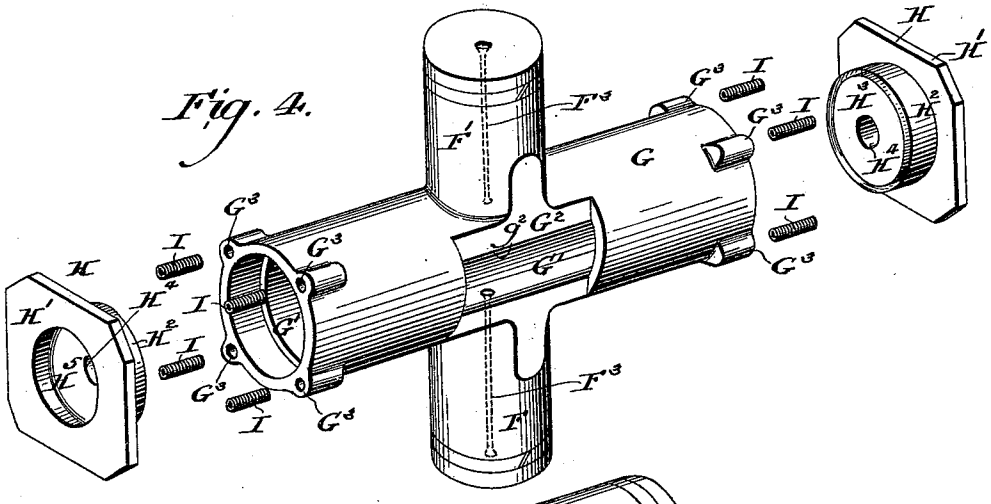
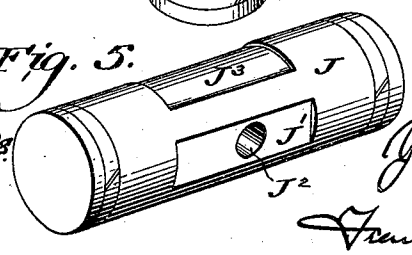


Fig. 5.



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ENGINE.

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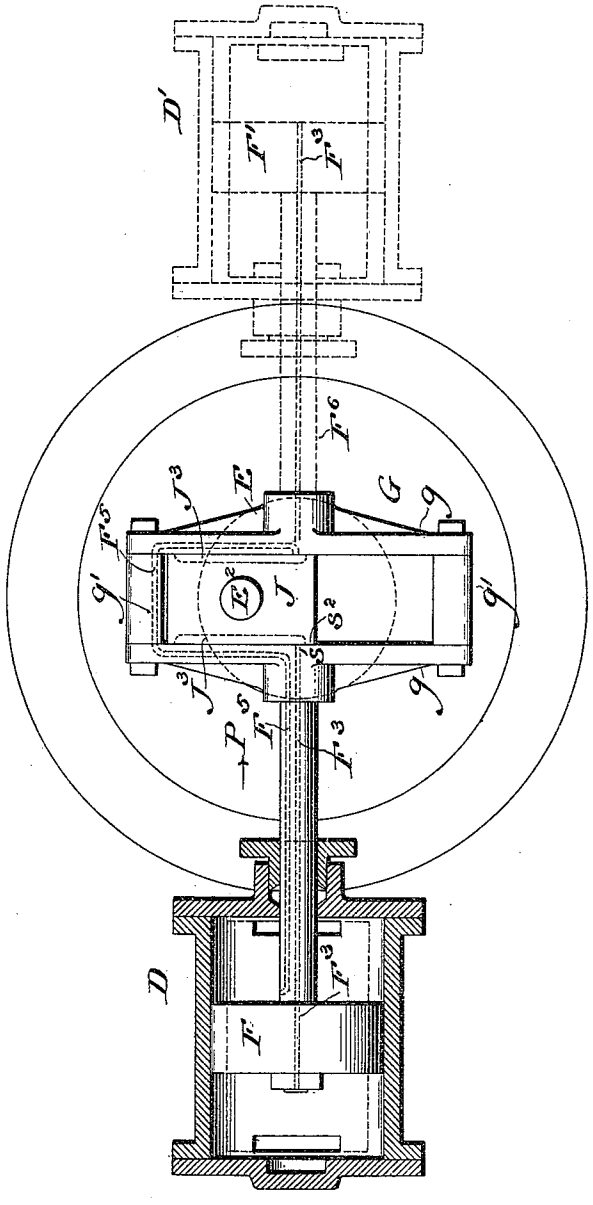

Fig. 6.

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UNITED STATES PATENT OFFICE.

JAMES T. HALSEY, OF PHILADELPHIA, PENNSYLVANIA.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 544,299, dated August 13, 1895.

Application filed March 23, 1893. Renewed January 16, 1895. Serial No. 535,165. (No model.)

To all whom it may concern:

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

My invention relates to the construction of engines, and in its leading features is applicable to engines actuated by fluid-pressure or used to compress or force fluids.

Particularly my invention relates to engines in which one or more cylinders are arranged to operate a crank through a device of the general character known as a "Scotch yoke," and my object is to counteract and balance the pressure acting through the yoke upon the crank so as to diminish the friction, which is the well-recognized drawback of this means of communicating motion.

To this end my invention consists in the introduction of fluid under pressure into a recess of suitable area between the reciprocating and sliding parts of the yoke.

The nature of my invention will be best understood as described in connection with the drawings, which illustrate a steam or air engine embodying my improvements, and in which—

Figure 1 is a side elevation showing the engine-casing as sectioned on a vertical plane through the center of the shaft, and also showing a portion of the movable cylinder cut away to illustrate the connection of the crank with the piston or slide moving in said cylinder. Fig. 2 is a cross-section on the line *y y* of Fig. 1; Fig. 3, a cross-section on the line *z z* of Fig. 1. Fig. 4 is a perspective view of the pistons and the movable cylinder to which they are connected; Fig. 5, a perspective view of the piston or slide moving in the movable cylinder; and Fig. 6 is a side elevation, partly in section, of a modified form of engine connected to a shaft by a Scotch yoke balanced according to my invention.

As best shown in Figs. 3 and 6, D D′ are cylinders in which reciprocate pistons F F′, respectively. Connected to the pistons either immediately, as shown in Fig. 3, or through the medium of piston-rods, as F^5 F^6, as seen in Fig. 6, is the yoke G. In Fig. 3 this yoke is formed as a hollow cylinder for a purpose hereinafter to be explained, while, as shown in Fig. 6, the yoke may be built up of side pieces *g g* and connecting-bars *g′ g′*. Arranged so as to slide in the yoke G is a journal or slide J, which is connected to a shaft E by means of a pin E^2. This slide J fits neatly in the yoke G, and serves as the yoke is reciprocated by means of the pistons to communicate the motion of the pistons to the shaft. The drawback to the use of the Scotch yoke in this connection has been that the pressure of the yoke proper on the slide or journal developed excessive friction between the faces, as *s′* s^2, Fig. 6, of the yoke and journal which are in contact with each other, as the journal slides in the yoke. To overcome this objection I form recesses J^3, preferably of substantially the same area as the pistons F F′ between the adjacent surfaces of the yoke and journal, and connect said recess to some source of fluid under pressure. The most convenient source is the steam in the cylinder, and, as shown, I have connected this with the recesses by means of passages F^3, leading through the pistons F F′. This permits the steam to exert upon the side of the slide J a pressure substantially equal to that exerted upon the slide J by the yoke G actuated by the pistons, whereby practically all pressure is relieved between the slide and yoke.

In order to make the engine compact and also to give a positive movement to the slide J, I prefer to arrange it as shown in Figs. 1 to 5. In this arrangement A indicates the base of the engine, which, as shown, is represented as a stationary engine, but which, when applied to light work, such as operating a drill, can be made without a base-plate and of dimensions and weight adapting it to be held in the hand.

B is the engine-casing, which, as shown, is of substantially cylindrical form, having one end B′ formed integral with the rim and provided with a bearing B^2 for the main shaft E. The other end of the casing B is open and provided with a removable end plate C, in which are formed valve chambers and ports, &c., connecting with ports in the casing B. As shown, the casing is formed at top and

bottom with flat surfaces B^4 B^4, upon which the stationary cylinders D and D′ are seated and to which they are secured, as by studs *d*. On each side the casing is formed with flat surfaces B^3 B^3, which serve as slides, over which move the ends of the yoke G, here formed as a cylinder.

B^5 and B^6 indicate steam-passages formed in the casing and connecting with the cylinders D and D′ through ports b^5 and b^6. B^7 and B^8 indicate similar steam-passages formed in the casing; b^7 and b^8 ports leading to the face of the slides B^3.

The plunger-pistons F F′, fitting and moving in the stationary cylinders D and D′, are connected with or formed integral with the yoke or cylinder G, which extends at right angles to the line of the pistons F and F′ and is formed with a passage G′, preferably of cylindrical form, extending entirely through it. On each side the portion G^2 of the cylinder G is cut away to form a flat surface and slot, as indicated at g^2, and preferably each end of the cylinder G is formed with a series of sockets G^3 to receive springs, such as are indicated at I I, &c., in Fig. 4. The slide or journal J is formed as a piston, which fits and works in the cylindrical passage G′ of the yoke or cylinder G, and is formed with a perforation J^2 to receive and form a bearing for the crank-pin. At each end of the perforation J^2 the cylinder is cut away to form a flat surface J^2, which comes flush with the flat surface G^2 of the cylinder G. The piston or slide J is also provided with recesses J^3 J^3, arranged to come opposite to the cylinders D and D′ and of an effective area substantially equal to the face of the pistons F and F′, which recesses are connected to the cylinders D D′ by passages F^3 F^3, as has been described, and these recesses J^3 J^3 are preferably made of such a length that they will always be in communication with the said perforations irrespective of the position of the piston or slide J in the cylinder.

E′ E′ indicate the crank-arms of the shaft E, and E^2 the crank-pin, which fits in the perforation J^2 of the piston or slide J and extends through the slot g^2 in the cylinder G.

Referring to Fig. 3 it will be noticed that the ends of the cylinder G in the construction shown do not come directly in contact with the slides D^3. A cylinder-head H, having a flat face H′, which rests against the slide, is connected with each end of the cylinder G, as shown, the elastic flange H^2 fitting in the end of the cylinder. The construction of this elastic flange is shown in Figs 3 and 4, and this construction is advisable, because it is proper to give a slight freedom of motion to the head. A recess H^5 is formed on the outer portion of the head and made of sufficient length to insure its always registering with the port b^7 or b^8 in the head, and from the opening H^5 of port H^4 leads to the interior of the cylinder G. The area of the opening or recess H^5 should be such as will counterbalance to a certain extent the pressure of the steam or other fluid upon the inner face of the head H. By properly proportioning these areas all undue friction of the head H in sliding upward and downward can be overcome. The springs I I, &c., exert a pressure of properly-regulated amount, thrusting the heads H against the slides and insuring a tight fit at all times.

It will, of course, be understood that steam is admitted alternately to the two ends of the cylinder G, acting upon the piston J seated thereon to move it backward and forward, and the admission of steam to said cylinder being of course regulated in proper admission to the cylinders D and D′. A convenient valve system for this apparatus is illustrated in Figs. 1 and 2. The slide C is formed with an annular steam-passage C′, communicating with a supply-pipe, through an orifice C^3, through webs C^4 C^4, &c. Valve-chambers C^5 C^5, &c., are formed most conveniently by drilling a passage from the outside, as indicated, and closing the outer orifice by a screw-cap, as K. From the valve-chambers C^5 passages C^6, C^7, C^8, and C^9 communicate, respectively, with the passages B^5, B^6, B^7, and B^8, while other passages C^{10}, C^{11}, C^{12}, and C^{13} communicate with a common steam-space C^{14}, which in turn communicates with the exhaust-pipe L′, formed, as shown, in a plate L, which is secured on the outside of the plate C and forms one wall of the chambers C^{14}.

N N′ N^2 N^3 indicate the four valves working in the cylindrical valve-chambers already described, and these valves, as shown, are actuated by a cam M secured to the shaft E, and having cam-straps connected, as shown, with the stems of the respective valves. This valve system is a simple and effective one for controlling the admission and exhaust, but forms no part of my invention and can be modified or changed at will.

In practice, steam or other fluid is admitted alternately to the cylinders D D′, causing a reciprocating action of the pistons F F′, which reciprocates the yoke G, and this effects the rotation of the crank-shaft E.

In the engine shown in Figs. 1 to 5 steam is also admitted at proper intervals into the ends of the yoke-cylinder G, causing the journal J to move positively in a direction substantially at right angles to the movement of the pistons F F′, and because of the balancing effect of the steam in the recesses J^3 there is substantially no friction between the sides of the yoke and the journal.

It is obvious that the cylinder D can be a power-cylinder and D′ a pump, or power may be applied to the shaft E, and both D and D′ can be used as pumps. Moreover, in the engine shown in Fig. 6 it is evident that the engine operating in the cylinder D can be made double-acting, and if the cylinder D′ be left off, by leading steam from both sides of the piston-head to the two recesses J^3 J^3 by ducts F^3 F^3, as shown, the journal will be entirely

balanced, and so the device may be used to advantage in a single-cylinder engine.

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 a cylinder and piston relatively movable, a yoke connected to the piston and adapted to be moved thereby, a journal sliding in said yoke, a recess arranged between the adjacent faces of the yoke and journal and a conduit for conveying fluid under pressure to said recess whereby the pressure of the yoke on the sliding journal is balanced substantially as and for the purpose specified.

2. In a fluid pressure engine the combination with a cylinder and piston relatively movable, a yoke connected to the piston and adapted to be moved thereby and having an interior area greater than that of the piston, a journal sliding in said yoke substantially at right angles to the movement of the yoke, a recess arranged between the adjacent faces of the yoke and journal and a conduit for conveying fluid under pressure to said recess whereby the pressure of the yoke on the sliding journal is balanced substantially as and for the purpose specified.

3. The combination in a fluid pressure engine of a cylinder and piston relatively movable, a yoke connected to the piston and adapted to be moved thereby, a journal sliding in said yoke substantially at right angles to the movement of the yoke, a recess of substantially the same area as the area of the piston arranged between the adjacent faces of the yoke and journal and a conduit for conveying the motive fluid to said recess whereby the pressure of the yoke on the sliding journal is balanced substantially as and for the reason described.

4. In an engine the combination of a movable cylinder as G, a piston J working in said cylinder, and having recesses J^3 formed in its sides as described, cylinders D D′ arranged on each side of cylinder G, pistons F F′ moving in said cylinders D D′ and connected to cylinder G, steam connections to cylinders D D′ and to the recesses J^3 arranged as described and so that steam will be simultaneously admitted to and exhausted from a cylinder and corresponding recess J^3 and a crank pin having a bearing in piston J and moving in a slot in cylinder G.

5. In an engine the combination of its oppositely arranged cylinders D D′, the cylinder G, the pistons F F′ attached to cylinder G and working cylinders D D′ said cylinders having perforations F^3 extending through them to the inside of cylinder G, the piston J fitting in cylinder G and having recesses J^3 arranged as described to communicate with perforations F^3 and a crank pin turning in a suitable bearing in piston J and moving in slots in cylinder G.

6. In an engine the combination with a frame having bearing faces B^3 B^4 and steam ports b^5 b^6 b^7 b^8 of cylinders D D′ connected with ports b^5 b^6, a movable cylinder G connected at its end with ports b^7 b^8, pistons F F′ connected to cylinder G and moving in cylinders D D′ said pistons having perforations F^3 leading through them to the inside of cylinder G, a piston J fitting in cylinder G and having recesses J^3 arranged to connect with perforations F as described and a crank pin journaled in piston J and moving in slots in cylinder G.

7. In an engine the combination with a frame having bearing faces B^3 B^4 and steam ports b^5 b^6 b^7 b^8 of cylinders D D′ connected with ports b^5 b^6, a cylinder G, sliding cylinder heads H H fitted to the ends of cylinder G and having recesses H^5 adapted to maintain connection with ports b^7 b^8 and to counterbalance the pressure on the inside of said heads, pistons F F′ connected to cylinder G and moving cylinders D D′ said pistons having perforations F leading through them to the inside of cylinder G, a piston J fitting in cylinder G and having recesses J^3 arranged to connect with perforations F^3 as described and a crank pin journaled in piston J and moving in slots in cylinder G.

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