No. 662,631. Patented Nov. 27, 1900.

H. B. STEELE.

COUNTERBALANCE FOR EXPLOSION ENGINES.

(Application filed July 12, 1897.)

(No Model.) 2 Sheets—Sheet 1.

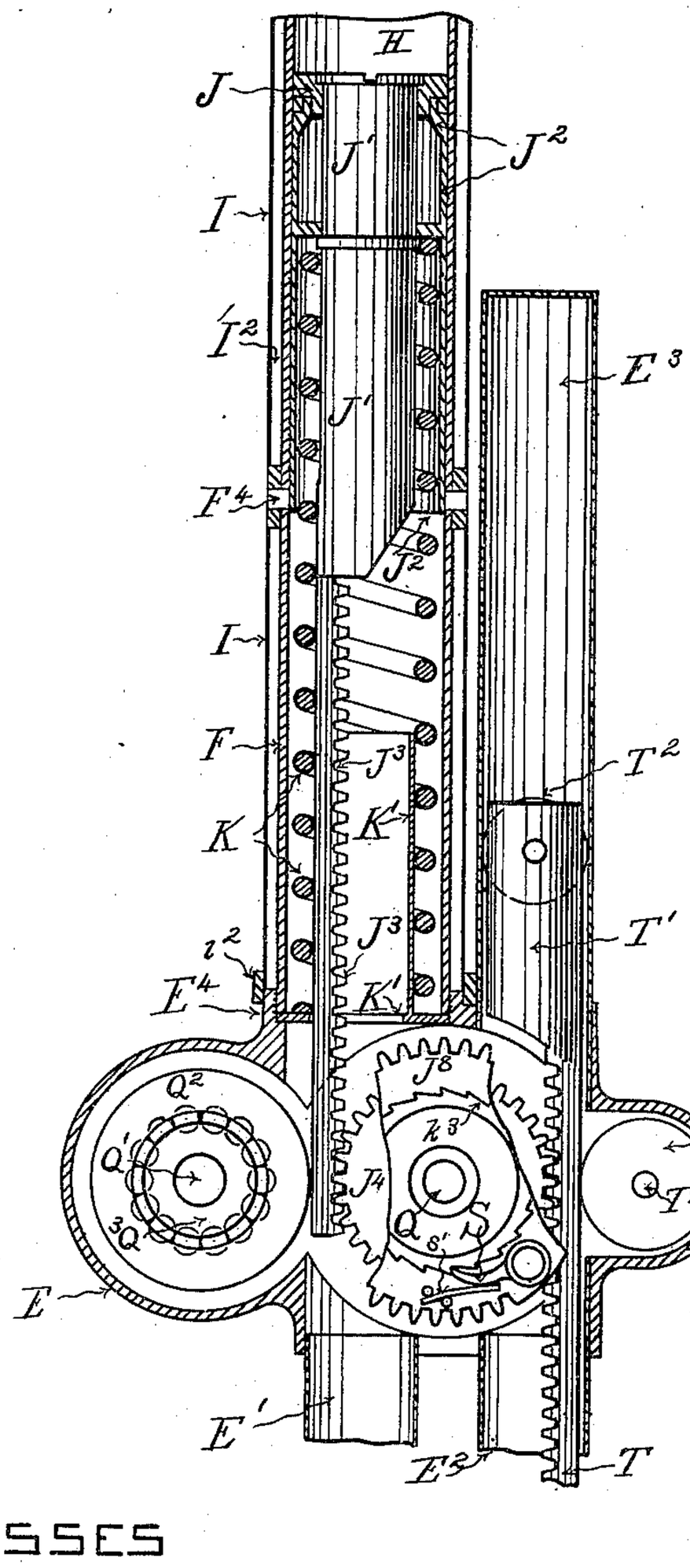

Fig. 1.

WITNESSES

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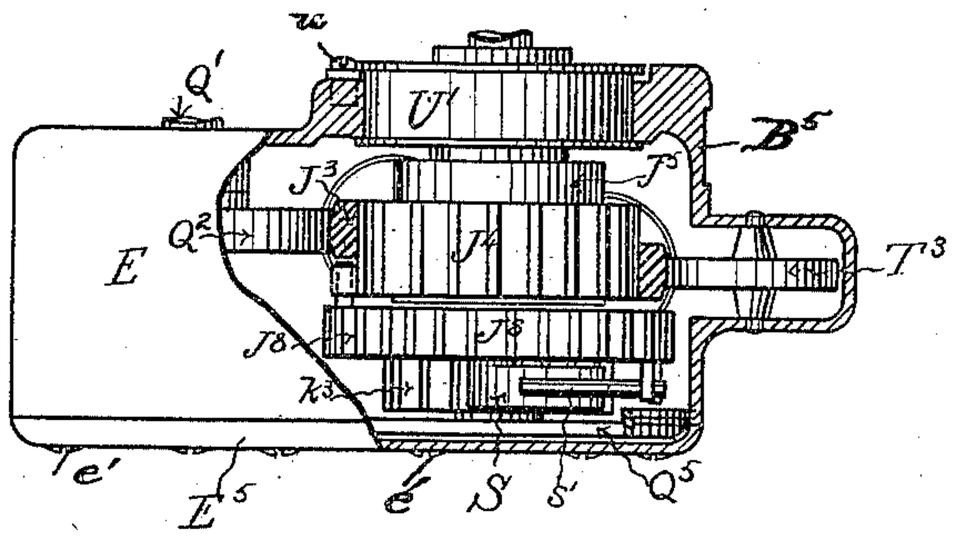

Fig. 2.

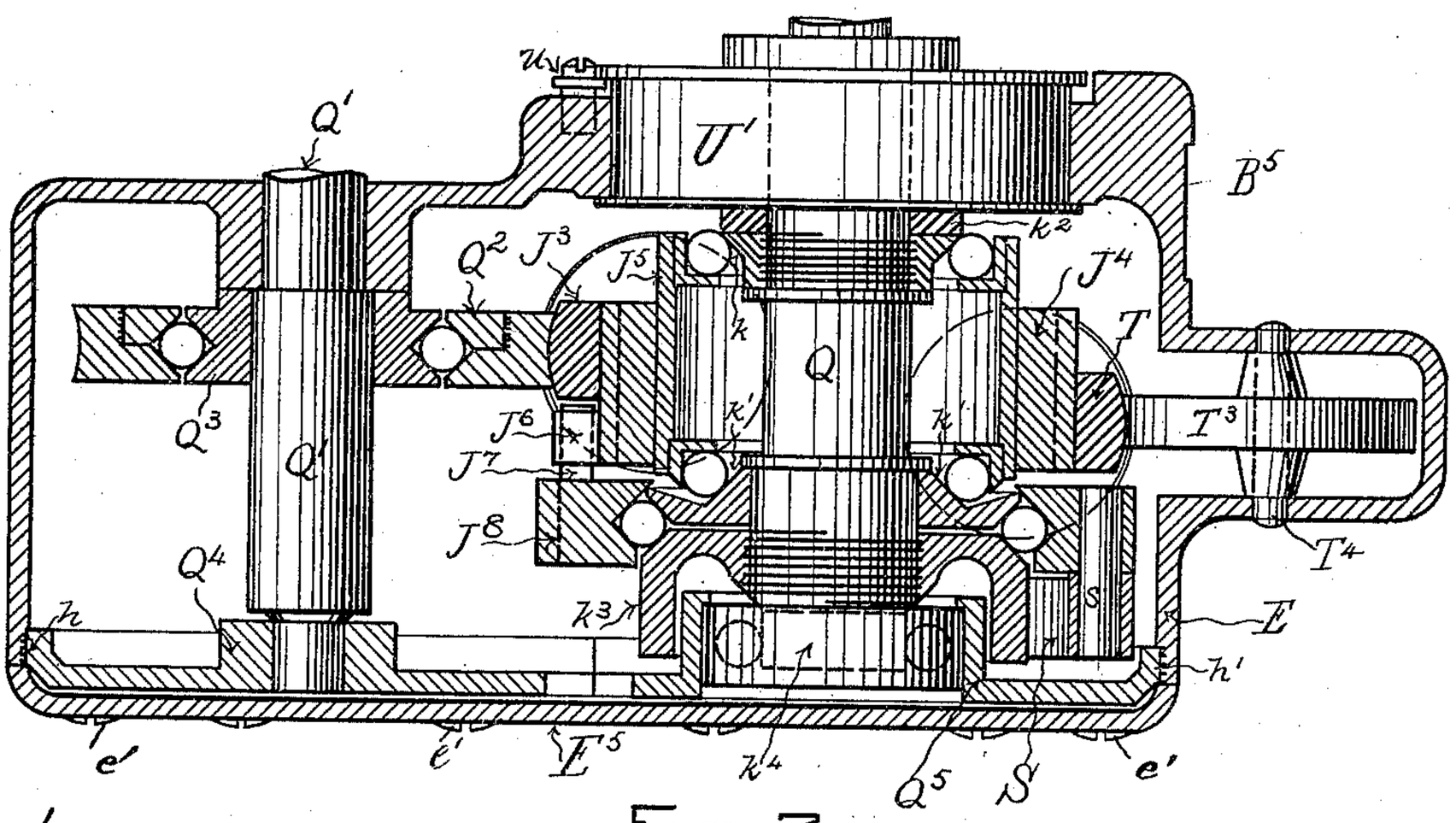

Fig. 3.

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UNITED STATES PATENT OFFICE.

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COUNTERBALANCE FOR EXPLOSION-ENGINES.

SPECIFICATION forming part of Letters Patent No. 662,631, dated November 27, 1900.

Original application filed January 18, 1897, Serial No. 619,545. Divided and this application filed July 12, 1897. Serial No. 644,177. (No model.)

To all whom it may concern:

Be it known that I, HERBERT B. STEELE, a citizen of the United States, residing at Malden, in the county of Middlesex and State of Massachusetts, have invented a new and useful Counterbalance for Explosion-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification, in explaining its nature.

In the following description my invention is shown as applied to an engine of the free-piston type and such as is fully described in my application Serial No. 619,545, now on file in the Patent Office; but I do not limit myself to its use with such engine.

In the drawings, Figure 1 is a vertical section of the engine, portions of the rack-covering tubes E′ and E² and also of the rack T having been broken off and portions being broken from the gear J⁸ to reveal the mechanism beneath. Fig. 2 is a horizontal section just above the large case E, from which a portion is broken to show the mechanism within. Fig. 3 is a horizontal section, enlarged, on the plane of the shaft.

In a general way the construction and mode of operation of the engine is the same as that of the engine described in my before-mentioned application.

E is the case, corresponding to the crank-case in certain styles of engines and to the bed-plate in others, and it surrounds and contains the lower portions of the mechanism. In it is borne the main shaft Q, sufficiently moved laterally from the axis of the cylinder to permit its main gear J⁴ to properly engage the rack of the piston. In the case also and parallel with the main shaft is carried the auxiliary shaft Q′. Rising from the boss E⁴ of the said case (see Fig. 1) is the cylinder F, which is provided with a combustion-chamber H and a piston composed of the head J, the barrel J², and the central core J′, which is prolonged into a rack J³, suitable for engaging with the gear J⁴, previously referred to. The cylinder is also provided with exhaust-ports, as F⁴, and with a casing I, forming the space L² between itself and the cylinder for the circulation of the cooling medium. The particular mode of supplying and exploding the gaseous charge and of expanding and discharging it may be that previously set forth in my said application or any other. Likewise a spring, as K, may be used for accomplishing the non-motive stroke, or any other well-known means. The rack J³ extends downward from the central portion of the piston in length somewhat greater than the movement thereof and engages a gear J⁴, carried free on the shaft Q, so that it can be rotated back and forth on the shaft by the rack as it is reciprocated back and forth by the piston. On the opposite side the rack J³ is supported by a bearing-roll Q², mounted by ball-bearing upon the flange Q³ of the shaft Q′. Upon the opposite side the gear J⁴ engages a rack T, similar to the rack J³. The rack T is also supported by a friction-roll T³, bearing on the side of the rack opposite to the gear and which roll is carried freely on a shaft T⁴, revoluble in the case E.

Upon the upper end of the rack T and fast thereto is a weight T′, of any convenient shape, and this weight is guided by a friction-roll T², carried near the upper end thereof and revolving unrestrained by the weight. Throughout its reciprocation the roll T² bears and runs upon the interior of the tube E³, which surrounds the counterweight and which tube is fast at its lower end in a raised boss of the case E. It is obvious that as the piston reciprocates the gear J⁴ turns back and forth with it and also that the counterweight has an equal and opposite motion imparted to it by the said gear. This being so, the engine is balanced from shaking when the counterweight is made equal to the weight of the piston and one-half the weight of the spring K added. I find in practice this construction gives a sufficiently-perfect balance for all ordinary uses. Should a still more perfect result be desired, the counterweight may be located on the bottom end of the rack T and offset therefrom, so that it moves back and forth in the axis of the cylinder, or two counterweights, one on each side of the cylinder and each of one-half the normal weight, may be used, each offset from its rack, so that the cylinder F is brought on a straight line between them.

Now as a matter of improved construction the gear J^4 is carried on the shaft Q by ball-bearings which revolve on the cones k and k', fast on the shaft at the ends of the gear, and the outside "cups" are fast in the sleeve J^5, upon and structurally a part of which the gear J^4 is. I communicate rotary motion to the shaft Q by means of a ratchet-wheel k^3, screwed fast thereon, and a pawl S, carried by a pawl-carrier J^8, oscillated back and forth by and with the gear J^4. This pawl-carrier is borne upon ball-bearings formed upon the exteriors of the cone-piece k' and the ratchet k^3, screwed firmly against the same, and the cup is formed by a groove made in the interior of the pawl-carrier J^8. Motion is given to the pawl-carrier J^8 by pins J^6 and J^7, extending from the said pawl-carrier and the gear J^4 (see Fig. 3) and engaging each other. For its present purpose the pawl S might just as well be carried directly by the gear J^4, as the carrier J^8 has no motion distinct therefrom. The pawl is made to engage the teeth of the ratchet by a spring s' on one motion and slide over them on the reverse. The shaft Q is carried at one end in ball-bearings in a case k^4, carried by the spider Q^5, which is screwed into the case E by the thread h', and at the other end within the bearing-case U', which is strained into the case E by screws, as u. The shaft Q' is carried at one end in a spider Q^4, screwing by threads at h into and at the other in a boss raised from the case E. Over the spiders I place a cap-plate E^5, held by screws e'.

Other means than the ratchet and pawl may be used to rotate the shaft—as, for instance, the common crank and connecting-rod—and other means than the gear J^4 may be used to connect the piston and counterweight—as, for instance, a lever pivoted in the center and having a connecting-rod at one end reaching to the piston and another at the other end reaching to the counterweight—and other means of guiding the rack-stems of the piston and counterweight may be used—as, for instance, a plain block bearing against them where now are the friction-rolls Q^2 and T^3.

If so desired, the case E may be provided with the usual flanged base for resting upon a foundation; but I have shown it with a seat at B^5, by which also it may be attached to a pedestal or other support if it is desired so to do.

I disclaim any and all matter herein shown and described, but claimed in my application of January 18, 1897, Serial No. 619,545, and of which this application is a division.

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States—

1. The combination in an explosion-engine of the gear J^4 engaged by the piston as specified, and the counterbalance T' having an antifriction-roll T^2 and connected with the said gear J^4 by a rack.

2. The combination of the gear J^4 engaged by the piston as specified, the counterbalance T', and its rack T and a roll bearing against the back of the rack to keep it in engagement with the said gear.

3. The combination in an explosion-engine of the piston J', the spring K, the rack J^3, the gear J^4 and the rack T bearing a counterbalance, as and for the purposes described.

4. In an explosive-engine, the combination with an explosion-cylinder, of a free flying piston therein, an equilibrating weight or counterbalance having a free rectilinear movement parallel with and opposite to that of said piston, a main shaft operatively connected with and intermittently rotated by said piston, and a freely-rotatable gear-wheel mounted on said main shaft and interconnecting said piston and weight; whereby movement of said piston will impart a reverse movement to said weight.

5. In an explosive-engine, the combination with an explosion-cylinder, of a free flying piston therein, an equilibrating weight or counterbalance having a free rectilinear movement parallel with and opposite to that of said piston, a main shaft operatively connected with and intermittently rotated by said piston, a freely-rotatable gear-wheel mounted on said main shaft and interconnecting said piston and weight; whereby movement of said piston will impart a reverse movement to said weight, and a spring to resist the flight of said piston and coact with said counterbalance.

6. The combination in an explosion-engine of the piston, the spring K, the rack J^3, the gear J^4 and the rack T bearing a counterbalance, and means of converting the reciprocating motion of the piston to rotary motion.

7. The combination in an explosion-engine of the piston, the spring K, the rack J^3, the gear J^4, the rack T bearing the counterbalance T' and a ratchet k^3 connected to a shaft as Q, and a pawl as S engaging with said ratchet.

8. In an explosive-engine, the combination with an explosion-cylinder, of a free flying piston therein, an equilibrating weight or counterbalance mounted in parallelism with said piston and having reverse rectilinear movements relative thereto, a rotary shaft between said piston and counterbalance, a gear-wheel loosely mounted on said shaft and connecting said piston and counterbalance so as to impart the movements of the one to the other in opposite directions, and a clutch fixed on said shaft and so connected with said gear-wheel and piston as that intermittent impulses are imparted to the said rotary shaft.

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Witnesses:
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