(No Model.) 2 Sheets—Sheet 1.

G. H. ELLIS & J. F. STEWARD.

EXPLOSIVE ENGINE.

No. 580,387. Patented Apr. 13, 1897.

Fig. 1.

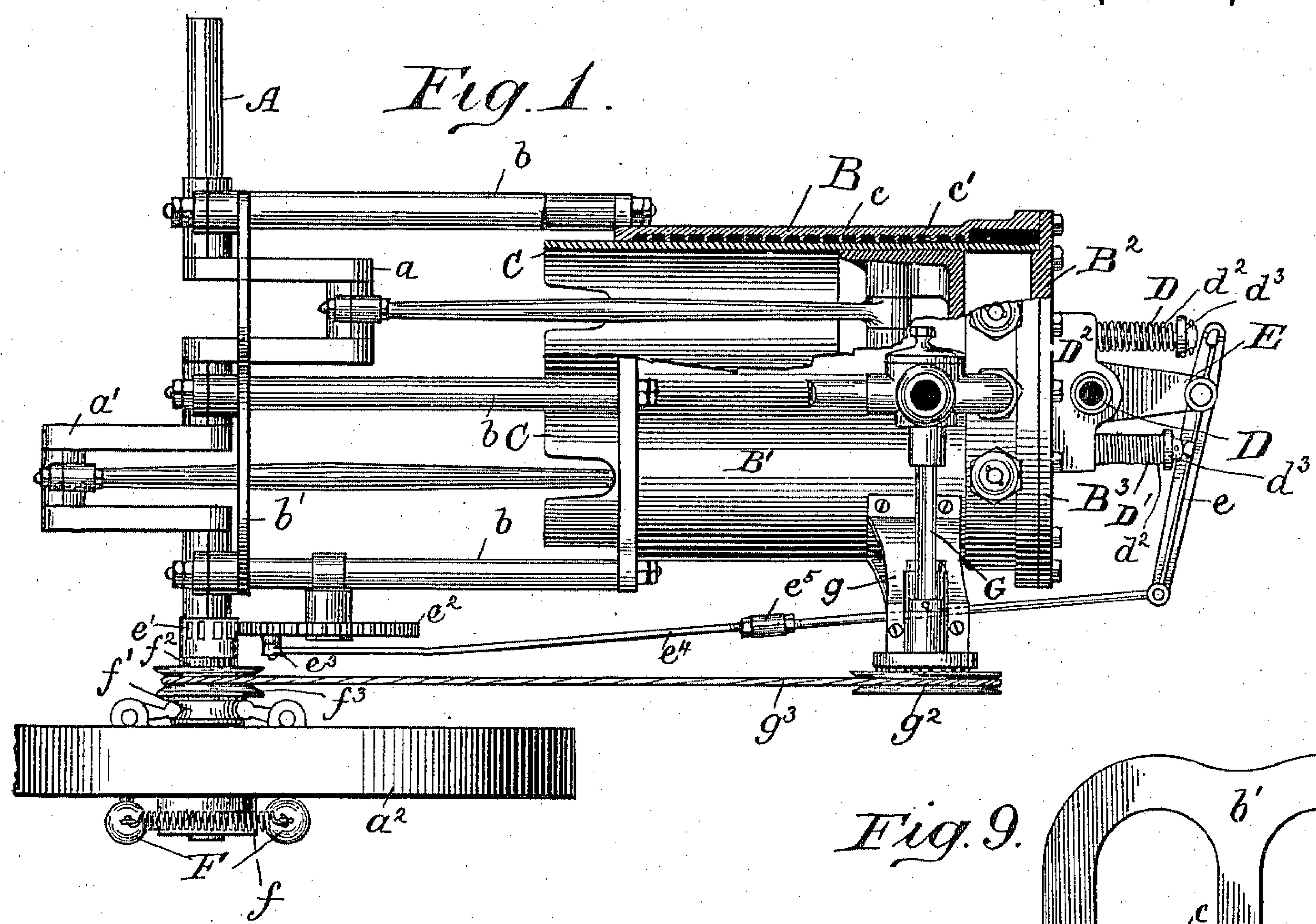


Fig. 9.

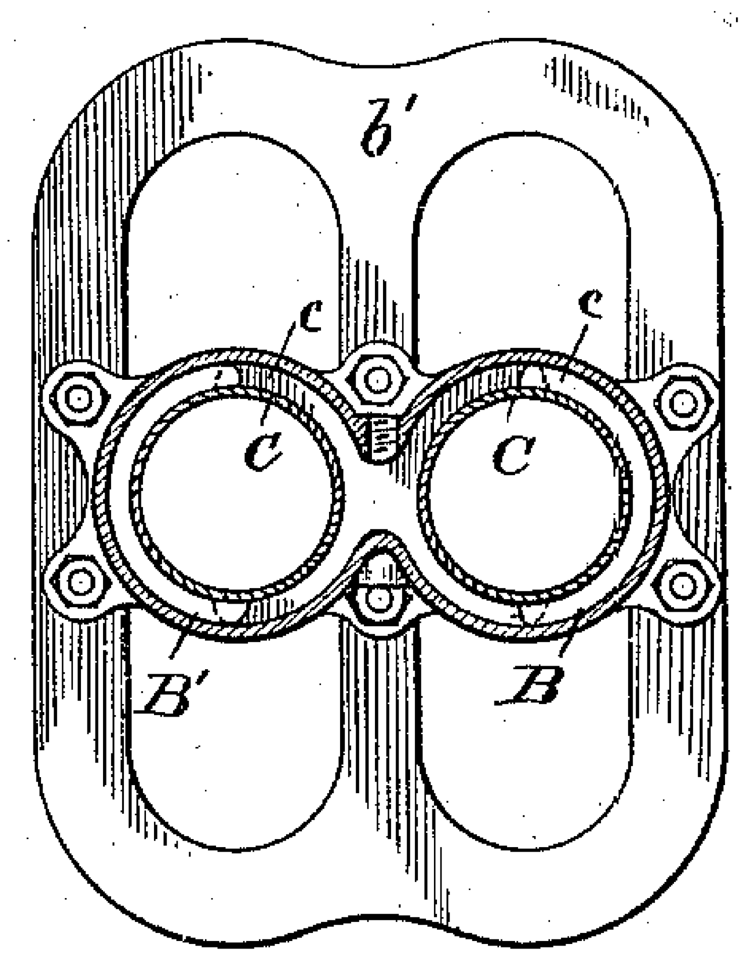
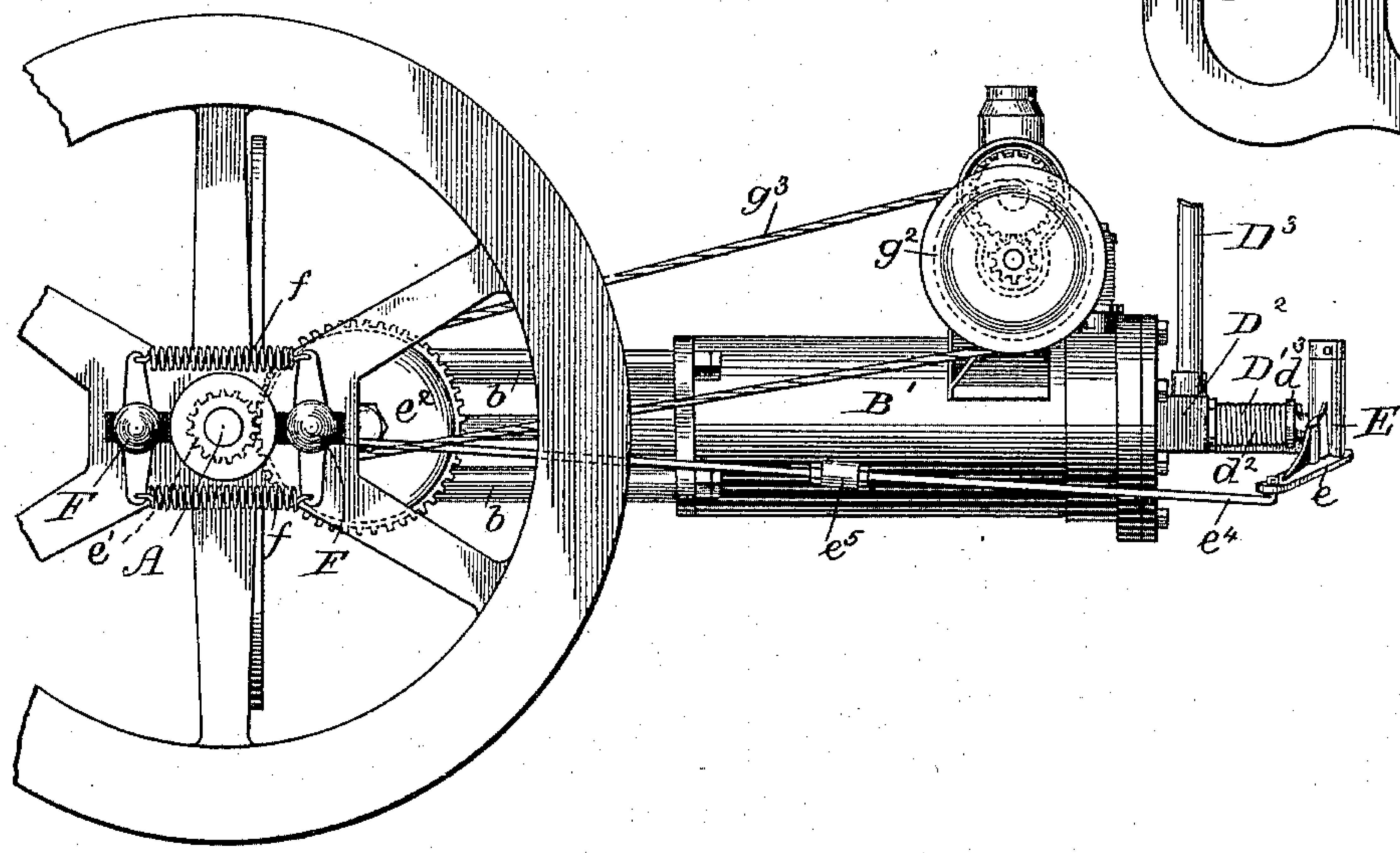


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

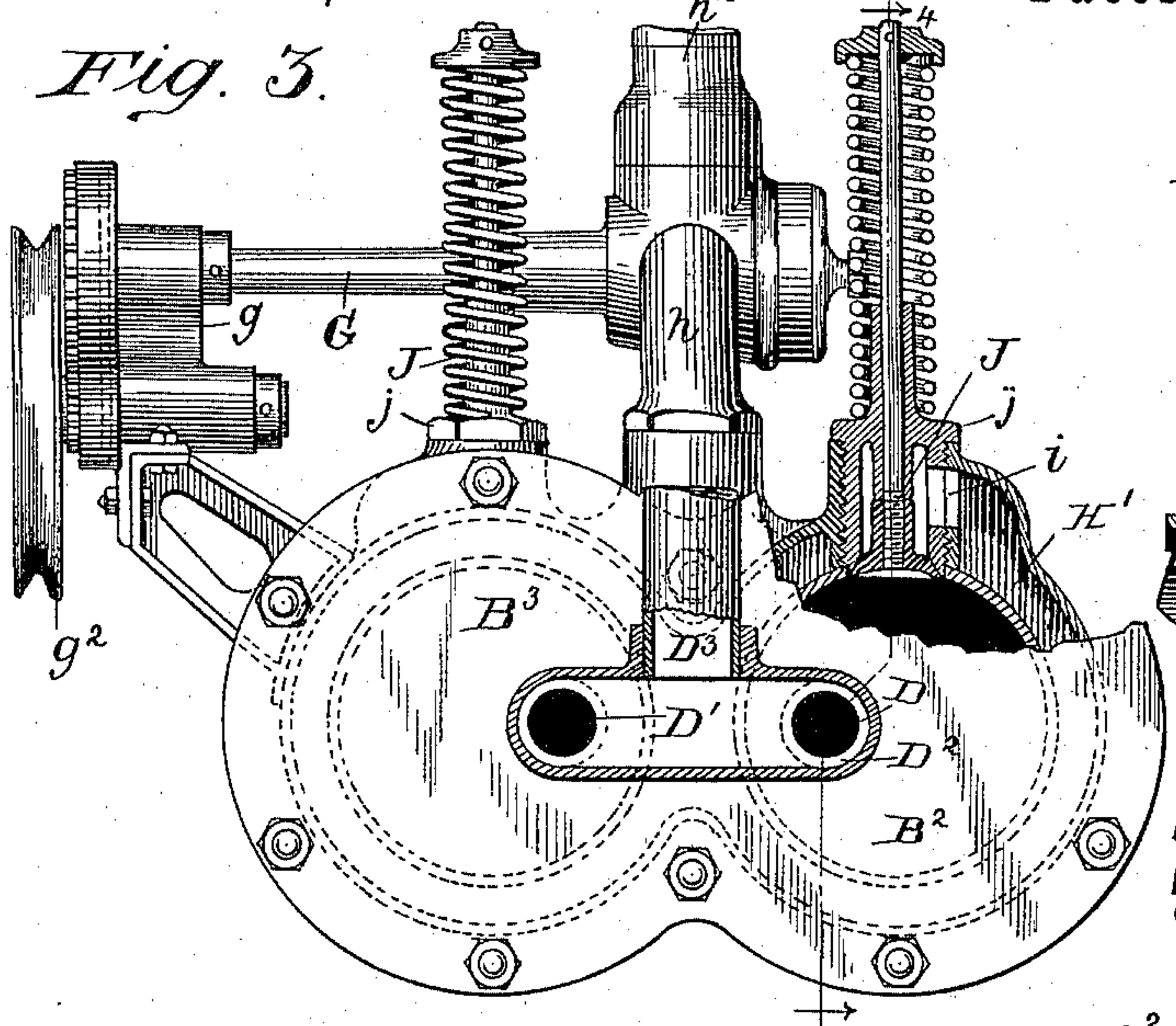


Fig. 4.

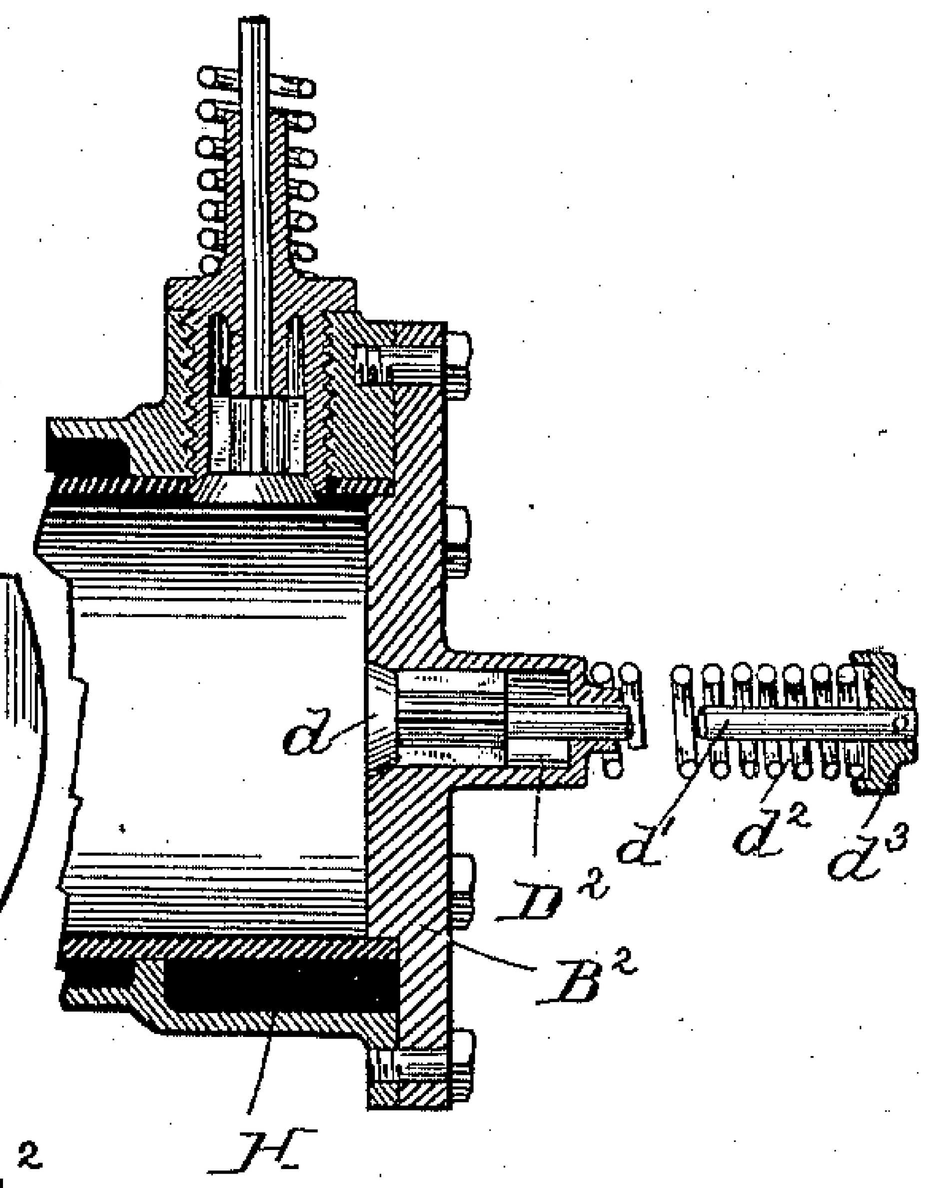


Fig 5.

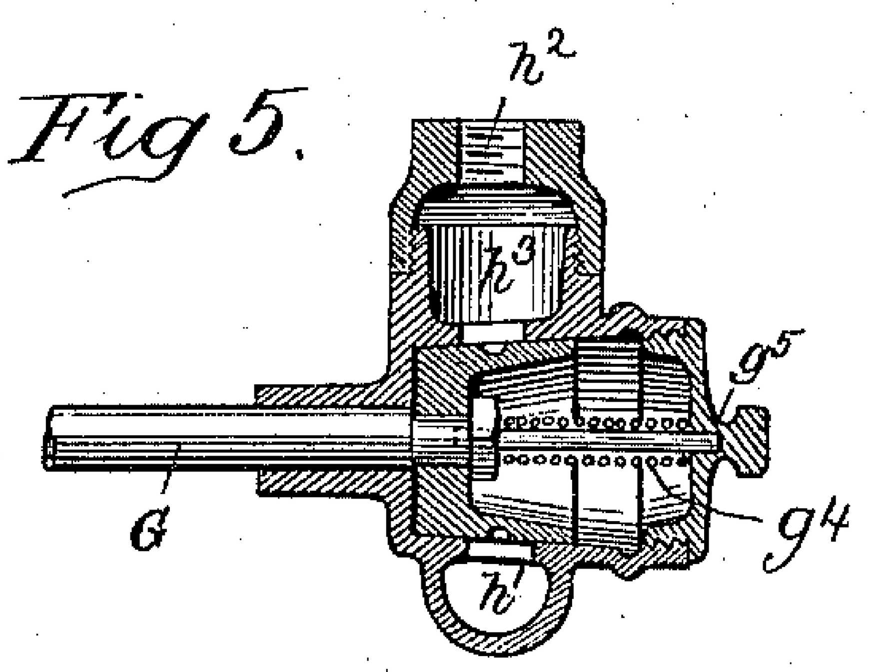


Fig. 6.

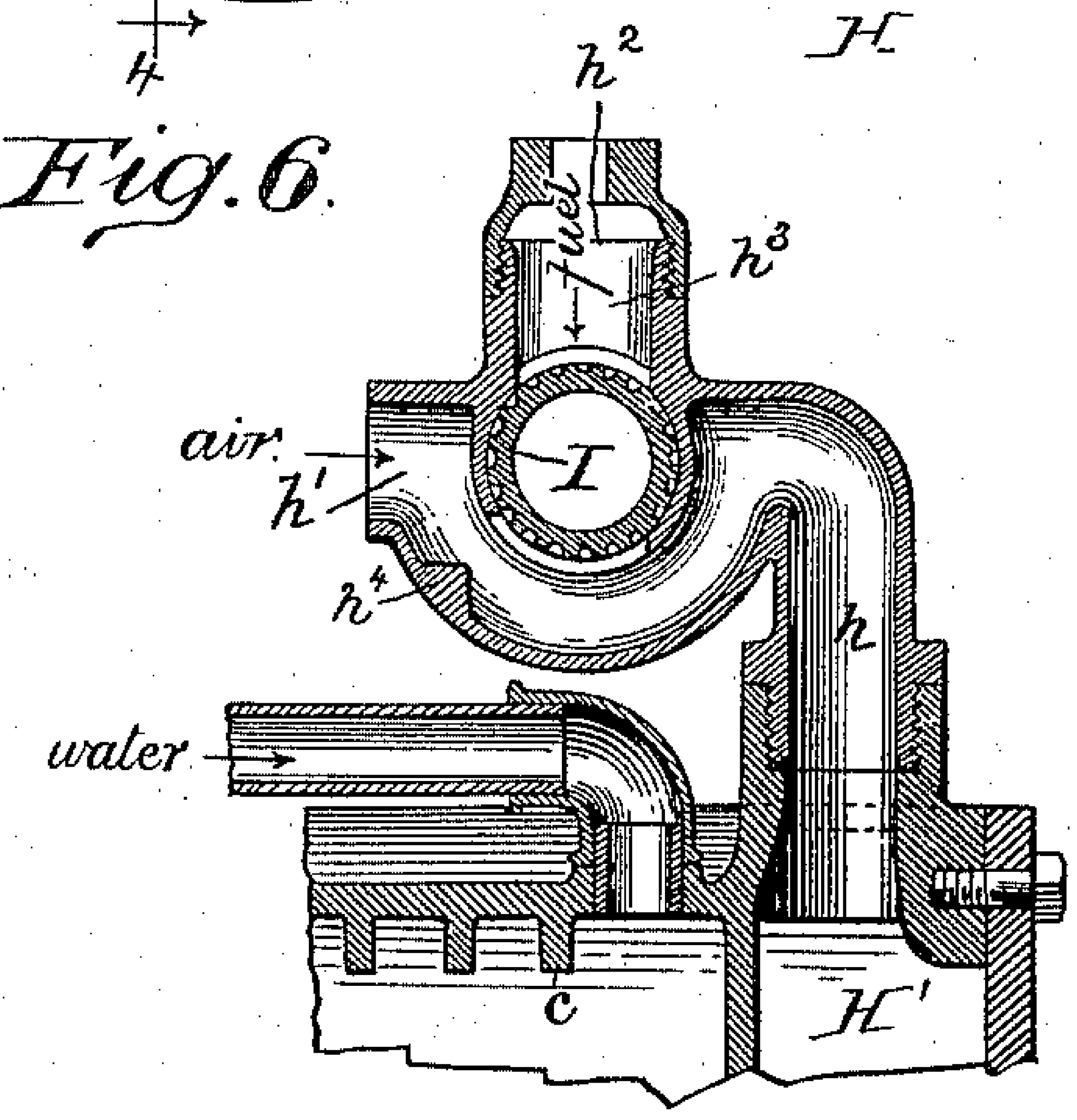


Fig. 7.

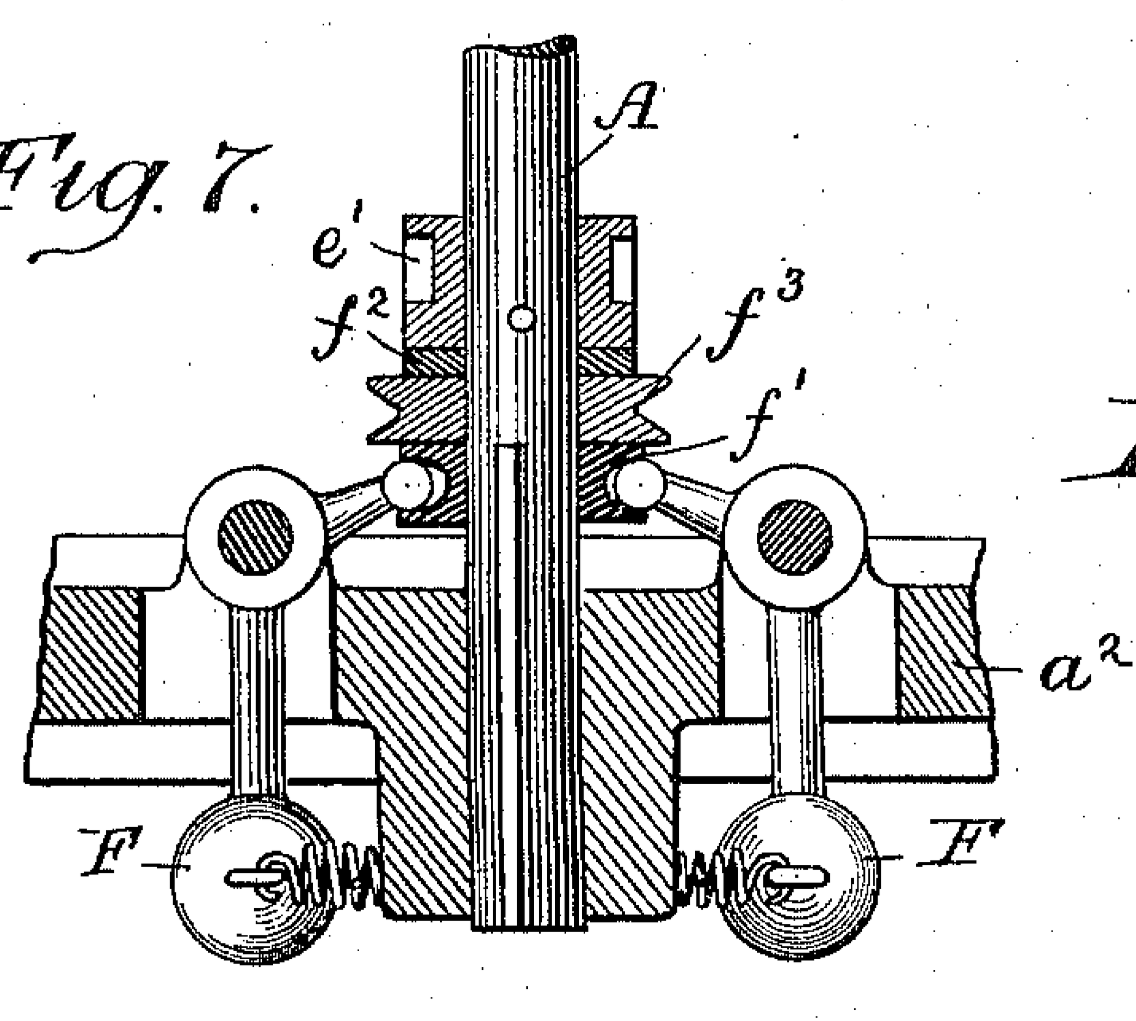
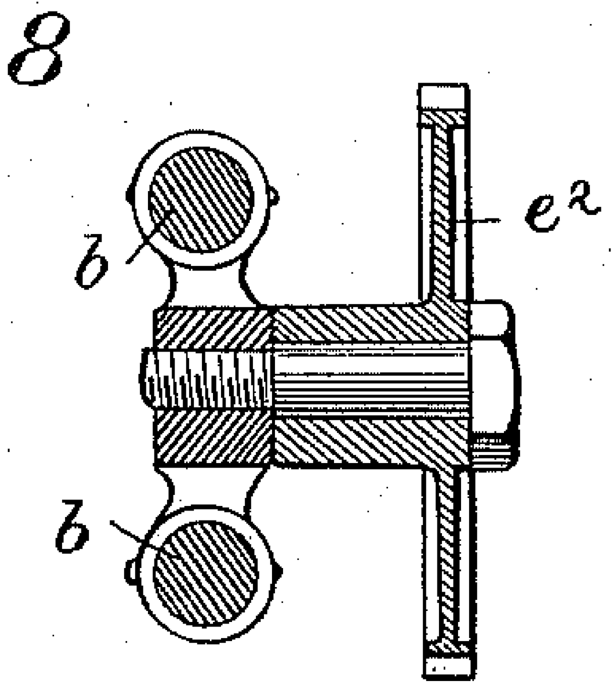


Fig. 8



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United States Patent Office.

GEORGE H. ELLIS AND JOHN F. STEWARD, OF CHICAGO, ILLINOIS.

EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 580,387, dated April 13, 1897.

Application filed December 26, 1895. Serial No. 573,312. (No model.)

To all whom it may concern:

Be it known that we, GEORGE H. ELLIS and JOHN F. STEWARD, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a full description, reference being had to the accompanying drawings, in which—

Figure 1 is a sectional plan view of our engine; Fig. 2, a side elevation of same; Fig. 3, a cylinder end view; Fig. 4, a section of one of the cylinder ends; Figs. 5 and 6, details of the oil-feeding devices; Fig. 7, a detail of the governor; Fig. 8, a detail showing the means of supporting the exhaust-moving gear, and Fig. 9 a sectional view designed to show the cylinder structure.

We construct our cylinder-shell in two parts, making the outer portion of cast metal and the inner portion of drawn-steel tubing, leaving space between the cast portion and the steel tubing for use as a water-jacket.

Our engine, as shown, is provided with two motor-cylinders, and in order that the momentum of the pistons, pitman, and crank may not have too much of a shaking effect we place the cranks oppositely upon their shaft, so that while the reciprocating parts of one cylinder are moving in one direction they are counterbalanced by the like parts moving in the opposite direction.

In the drawings, A is the crank-shaft, having the cranks a and a' and the balance-wheel a^2.

B and B′ are the cylinders. These we make of cast metal, so as to provide lugs and bosses to which to secure the various parts and so as to easily form a water-jacket and mixing-chamber. Extending from suitable lugs on the cylinders are the bars b, which connect the bearings for the crank-shaft thereto. To suitably connect all of these supports for the bearings of the crank-shaft, we provide the plate b', having openings through which the cranks and pitmen may play.

The inner wall of the outer shell of the cylinder is formed with ribs c. These extend so far inwardly as to meet and fit closely to the outer surface of the inner shell C of each cylinder. It is preferable, we have found, after the parts are properly machined to enlarge the outer casing by heating it and force the inner casing in and then bore the latter carefully.

In Fig. 1 the spaces c' between the ribs c are shown. These spaces may be of any form as long as they are connected together, so that the water may circulate from one to the other. The main purpose of the ribs, however, is to strengthen the inner cylinder C, so that very thin material may be employed therein and yet be sufficiently strong to resist the pressure in the cylinder due to explosion.

B^2 and B^3 are the cylinder-heads, the two formed in one piece and secured to the ends of the cylinder by means of bolts in the usual manner.

D and D′ are the exhaust-ports, formed in a chamber D^2, that projects from the cylinder-head. Extending up from this chamber is the exhaust-pipe D^3 for leading away the spent gases that pass out through the exhausts. The exhaust-valves, alike in each cylinder, are shown in Fig. 4, where d is the valve proper, d' the valve-stem, d^2 a spring for keeping the valve closed, and d^3 a flange secured to the end of the valve-stem, between which and the shell of the chamber D^2 the springs rest.

Extending from the end of the cylinder is the lug E, and pivoted thereto the lever e, adapted to engage the ends of the valve-stems and force the valves open when the lever is moved sufficiently. The mechanism for moving the lever may be best understood by reference to Fig. 1, where e' is a pinion upon the crank-shaft and e^2 a gear of twice the diameter of the pinion mounted upon a stud supported upon the bars b. Upon this gear is the crank e^3, and extending from the said crank to the lever e the connecting-rod e^4, having, for purposes of adjustment merely, the turn-buckle e^5. In the figure the crank a' is shown in the position it occupies when the piston in the cylinder B has been carried to the outer end of its stroke. In this position the exhaust D′ should be open, and is so indicated by the fact that the lever e is in engagement with its stem and in position to have forced it open. The exhaust-valve for the cylinder B is constructed the same as that for the cylinder B′ and operated by the same lever, as will be readily understood from the drawings. Within the balance-wheel are pivoted the governor-balls F, suitably supported upon arms extending from the said pivots. The balls are connected together by the spring f. The balance-wheel is of course permanently secured to the shaft, and upon the same shaft is the disk f', having notches upon opposite sides. This disk is secured to the shaft by means of a spline which causes it to rotate with the balance-wheel and governor-balls, but permits it to slide upon the shaft A. The face of the pinion e' is formed to act as a friction-pad. Its surface may consist of the leather pad f^2, if desired.

f^3 is a sheave freely placed upon the crank-shaft between the disk f' and the pad f^2. The tension of the spring f exerted upon the governor-ball, tending, as it does, to drive the latter together, forces the pad f' against the sheave f^3 and the latter in turn against the friction-pad f^2. The effect of this pressure is finally to force the sheave f^3 to rotate, by friction, as the crank-shaft rotates, when at rest or with the engine running slowly, but when the speed of rotation becomes sufficient to throw the governor-balls F F outward the pressure upon the sheave f^3 is reduced and it is allowed to rotate slower or stop altogether. This sheave f^3 is provided for the purpose of giving motion to the oil-feeding device, which is located upon the shaft G in suitable bearings upon the pillow-block g and secured to the cylinder. Upon this shaft is the sheave g^2, and connecting the latter with the sheave f^3 is the band g^3.

The feeding device may be most easily understood by referring to Figs. 3, 5, and 6, where the parts are shown in section. Secured to the head end of the companion cylinders is the air and fuel feeding mechanism, consisting of a flue opening into the explosion-chamber of the cylinder and having an air-supply pipe and a fuel-pipe that is to be supplied from a suitable reservoir.

h is the passage through which the mixture of air and vapor passes. h' is the air-flue, and h^2 the opening through which the fuel enters. The part h^3 may be considered as any kind of oil-reservoir.

I is the rotary oil-feeder. It is a truncated cone in form, secured to the shaft G and adapted to revolve in a recess that exactly fits it. The recess in which it revolves opens above in the reservoir h^3 and below into the air passage-way h'. (See Fig. 5.) The peripheral surface of this truncated cone is provided with a large number of depressions. (Shown in Figs. 5 and 6.) It will be readily seen that while these cells or depressions are in position to open into the reservoir the oil will fill them, the bubbles of air rising to permit the same. As the feeding device rotates, the oil contained in the cells is carried downward until the opening into the air-passage h' is reached, when it is free to fall away or be blown out by the air drawn therethrough by the action of the pistons. It is considered best to direct the air well into the cells of this measuring device, so as to bring it in better contact with the oil therein contained, so as to blow out the oil therefrom. For this better purpose we deflect the air in that direction by the ledge h^4. (Shown in Fig. 6.) The feeding device is operated, as before stated, from the crank-shaft by means of what may be considered a "friction-clutch," adapted to be unshipped as the speed of the engine becomes great. While the engine is standing, no fuel-oil can escape, but as soon as it is put in motion the feeding device rotates and carries the oil to the air-flue and continues to do so as long as the engine moves unless a high rate of speed is attained, when it is permitted to stop. In order that the conical feeding device may always fit the space in which it is moved well, it is held therein by the spring g^4 upon a suitable stem, having a collar against which the spring may press, and passing into the end of the shaft G, the spring resting between the collar and the support for the said stem g^5, that is screwed into the casing of the feeding-cell.

Cold water is led to the water-jacket through the pipe (shown in Fig. 6) and out of the cylinders at any desired point. The water-jackets of the two cylinders are connected so as to avoid the necessity of more than one inlet and outlet pipe. In order to give the air and vapor a good opportunity to mix, we so make the outer case of the cylinder as to have a space that can serve as a mixing-chamber, which space surrounding the explosion-chamber is always kept warm. The vapor thus warmed is found to mix with the air drawn in with it better than if left cold. The water-jacket proper terminates some distance from the head of the cylinder, and between this and the cylinder-head is the circumferential space H' referred to. In Fig. 6 it is seen that the mixture passes into this circumferential chamber H'. The two mixing-chambers are so connected in fact as to be but one, as shown by dotted lines in Fig. 3, and the mixture descends directly therein and passes downward beneath the inner casing and up through the opening i, (see Fig. 3,) thence downward through the valves J. The valves J are spring-held in precisely the same manner as the exhaust-valves. The valve-stems, however, are guided in the glands j. The latter is recessed so as to provide a free passage of the mixture through the opening i and beyond the valve when the latter is opened. The action of the induction-valves depends wholly upon atmospheric pressure of the mixture. As the pistons move to draw in a new supply a partial vacuum is produced and the pressure of the mixture forces the valves open.

Our oil-feeder may be considered as a device that by its movements carries a succession of drops of oil from the supply-chamber to the air-flue or such other place for mixing the air and oil vapor constantly, unless abnormal speed of the engine makes such a disconnection as to permit it to stop when the succession of drops ceases, until by the action of the governor the flow is again permitted.

We are aware that oil-supplying devices adapted to inject a quantity of oil into the air-chamber at each desired stroke of the engine have been used, and the quantity of oil thus injected regulated by a governor, but we do not claim, broadly, circulating the supply of oil by means of a governor.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In an explosion-engine, a cylinder consisting of a strong outer casing having inwardly-projecting supports and a thin inner casing, the water-jacket and circumferential mixing-chamber formed between the two said parts of the cylinder, substantially as described.

2. In an oil-engine, an air-flue, a fuel-feeding pipe adapted to enter the same, and interposed between said air-flue and fuel-feeding pipe, an oil-feeder having measuring-cells that may be filled by the fuel-oil and, by the movement of the said feeding device, delivered from the fuel-pipe to a tangential air-blast forced through the said air-flue, substantially as described.

3. In an oil-engine, the air-flue, the fuel-supply pipe, the conical spring-held rotary feeder located in an oil-tight chamber between the said fuel-pipe and the said air-flue, substantially as described.

4. In an explosion-engine, an air-flue, an oil-supply pipe, a feeder adapted to convey the oil from the said oil-pipe to the said air-flue by means of measuring-cups formed in it, an oil-feeder-actuating mechanism located upon a constantly-running shaft of the engine, and there held and caused to be rotated by friction-pads, said oil-feeder-actuating mechanism suitably connected to the said oil-feeder, and the latter thus operated, a governor adapted to be influenced by the velocity of rotation of the said shaft and thus to release the friction of the said friction-actuated driving devices upon the said shaft, all combined, substantially as described.

5. In an oil-engine, an oil-feeder, a governor and friction-actuated mechanism upon the constantly-running shaft suitably connected to the said oil-feeding device, the said governor so connected to the said friction-actuating mechanism as to release the pressure upon the latter as the governor-balls are thrown outward by increased momentum due to increase of velocity, whereby the said feeding mechanism is moved intermittently and its intermittent movements regulated by the speed of the engine, all combined, substantially as described.

6. In an oil-engine, an air-flue, an oil-supplying reservoir, a feeder located between said air-flue and oil-supply pipe, said feeder adapted to convey the oil from the supply-reservoir to the said air-flue by a continuous movement when the engine is running at a normal speed, mechanism for transmitting movement to the said feeding device connected therewith and with a constantly-moving part of the engine by friction connections, a governor adapted to be influenced by the velocity of the engine and adapted to release the friction of the said friction-acting devices, all combined, substantially as described.

7. In an oil-engine, an air-flue, an oil-supplying pipe, a feeder adapted to convey the oil from the said oil-pipe to the said air-flue by means of measuring-cups formed in its surface, friction-impelled connecting mechanism between the engine-shaft and the said oil-feeder, and a governor so connected to the friction-acting actuating device as to reduce the intensity of the friction-giving motion to the said feeding device, all combined, substantially as described.

8. In an oil-engine, an air-flue, an oil-supplying pipe, a feeder adapted to convey the oil from the said oil-pipe to the said air-flue by means of measuring-cups formed in its surface, friction-impelled connecting mechanism between the engine-shaft and the said oil-feeder, a feeder-actuating wheel located on the said shaft and there held and moved by friction-pads, a governor so connected to said friction-pads as to release the pressure upon the said wheel whenever the speed of the engine exceeds its normal rate, and suitable connecting mechanism from the said wheel to the said oil-feeding device, substantially as described.

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