No. 690,443. Patented Jan. 7, 1902.

A. L. KULL.

SPEED REGULATOR FOR EXPLOSIVE ENGINES.

(Application filed Mar. 28, 1901.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

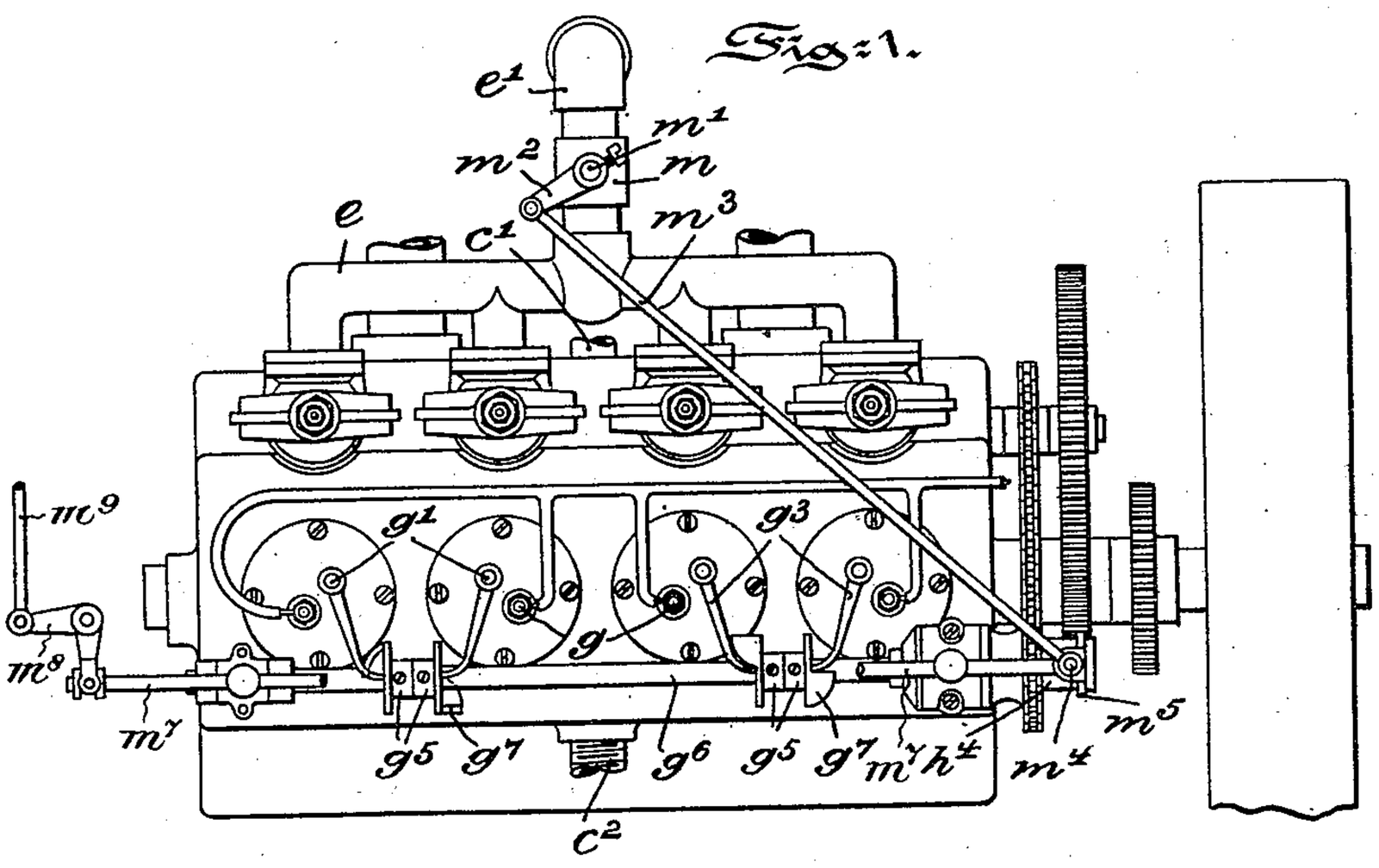
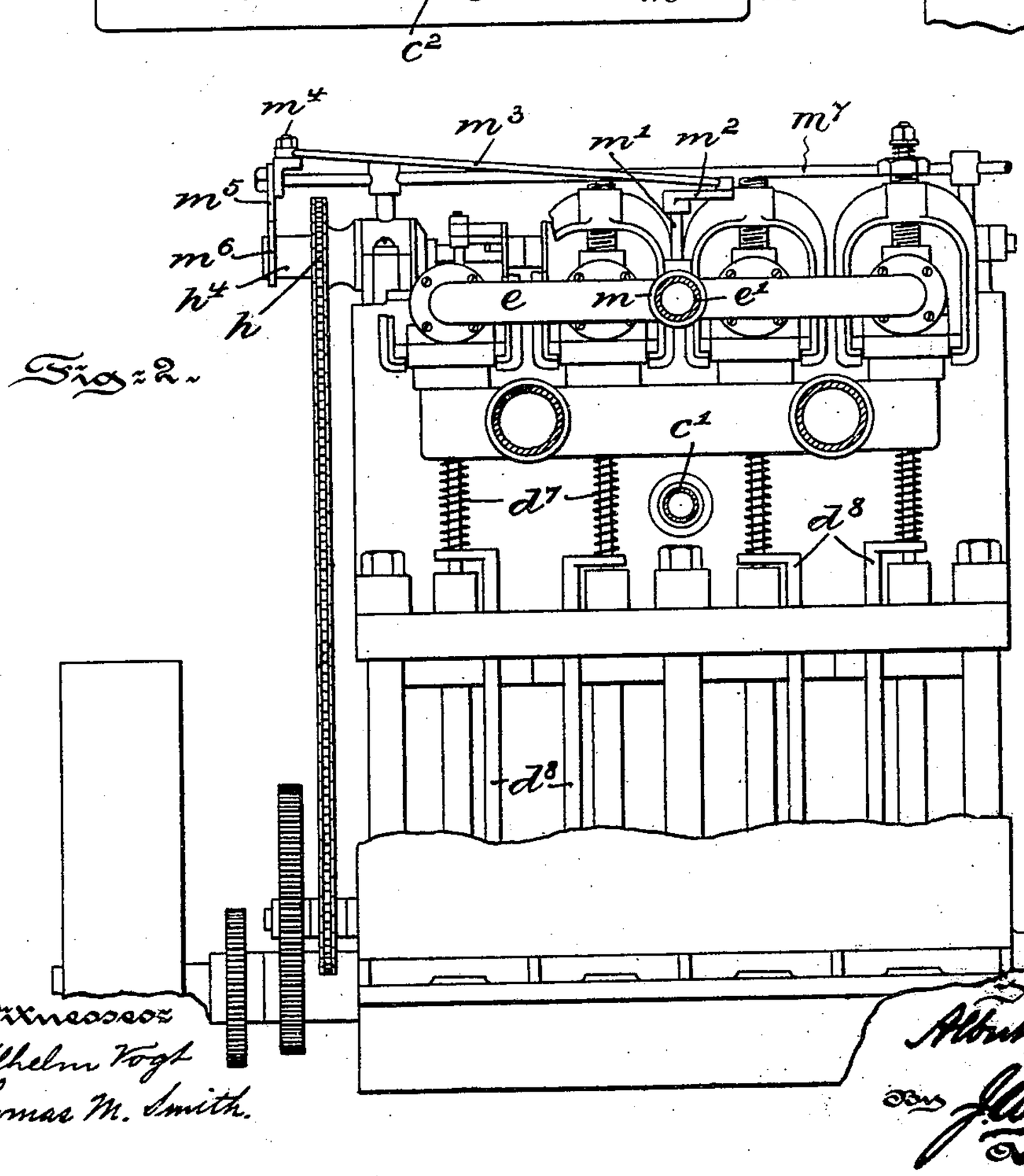


Fig. 2.



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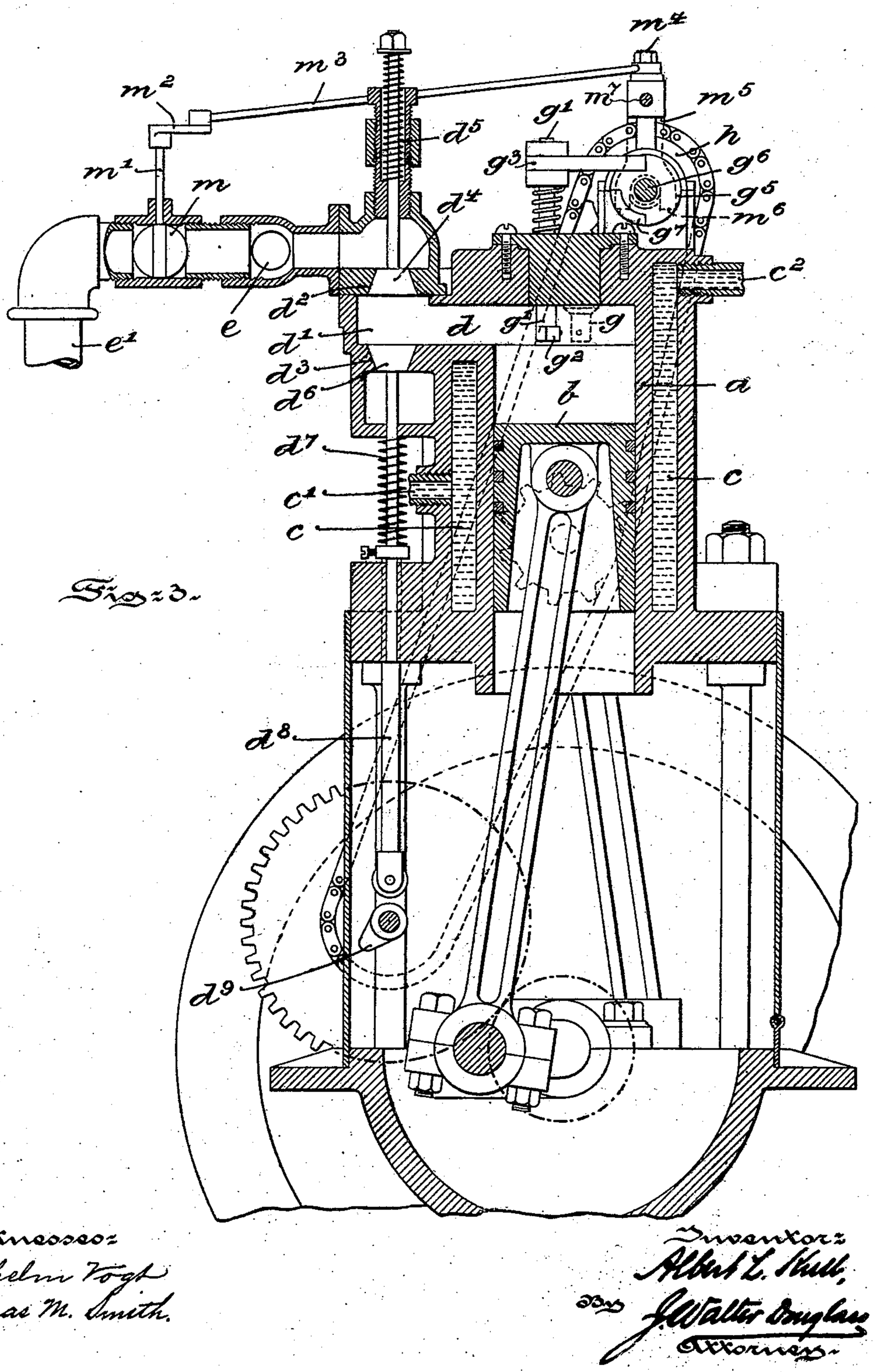

Fig. 3.

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(No Model.) 3 Sheets—Sheet 3.

Fig. 1.

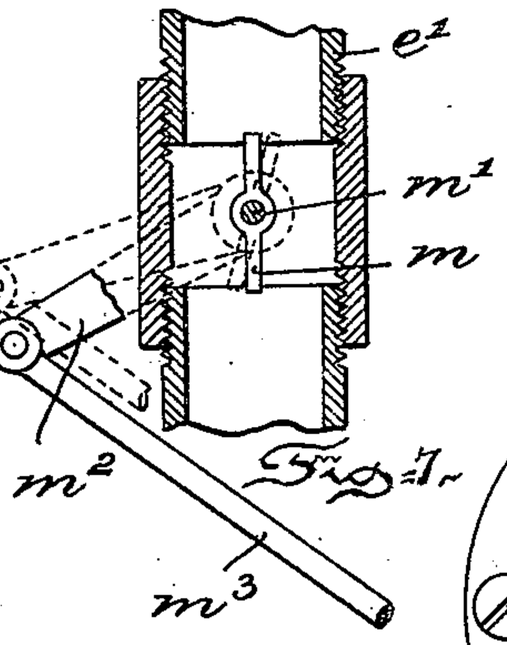


Fig. 4.

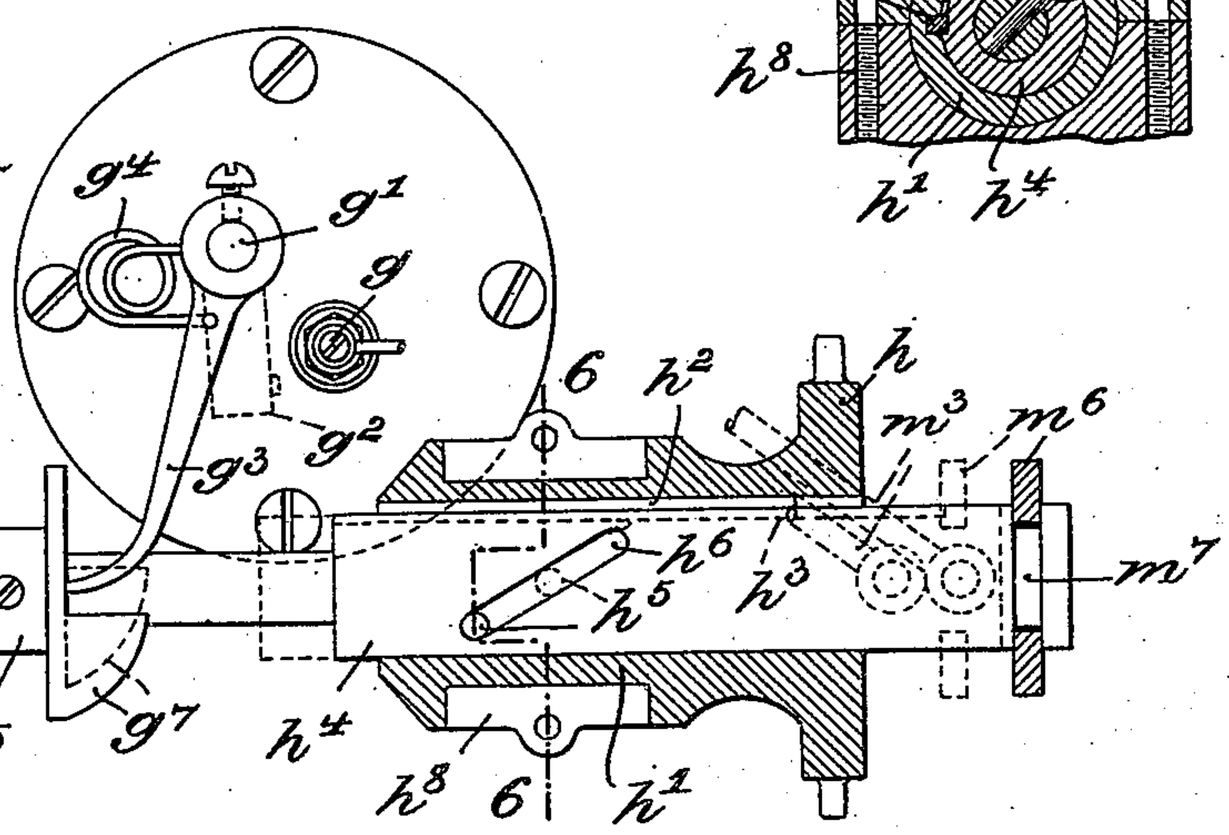


Fig. 6.

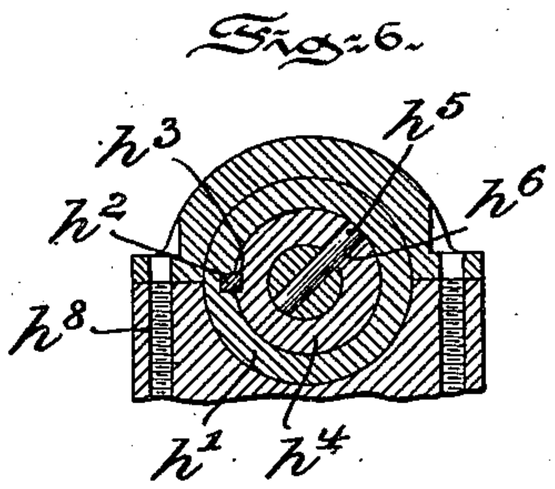
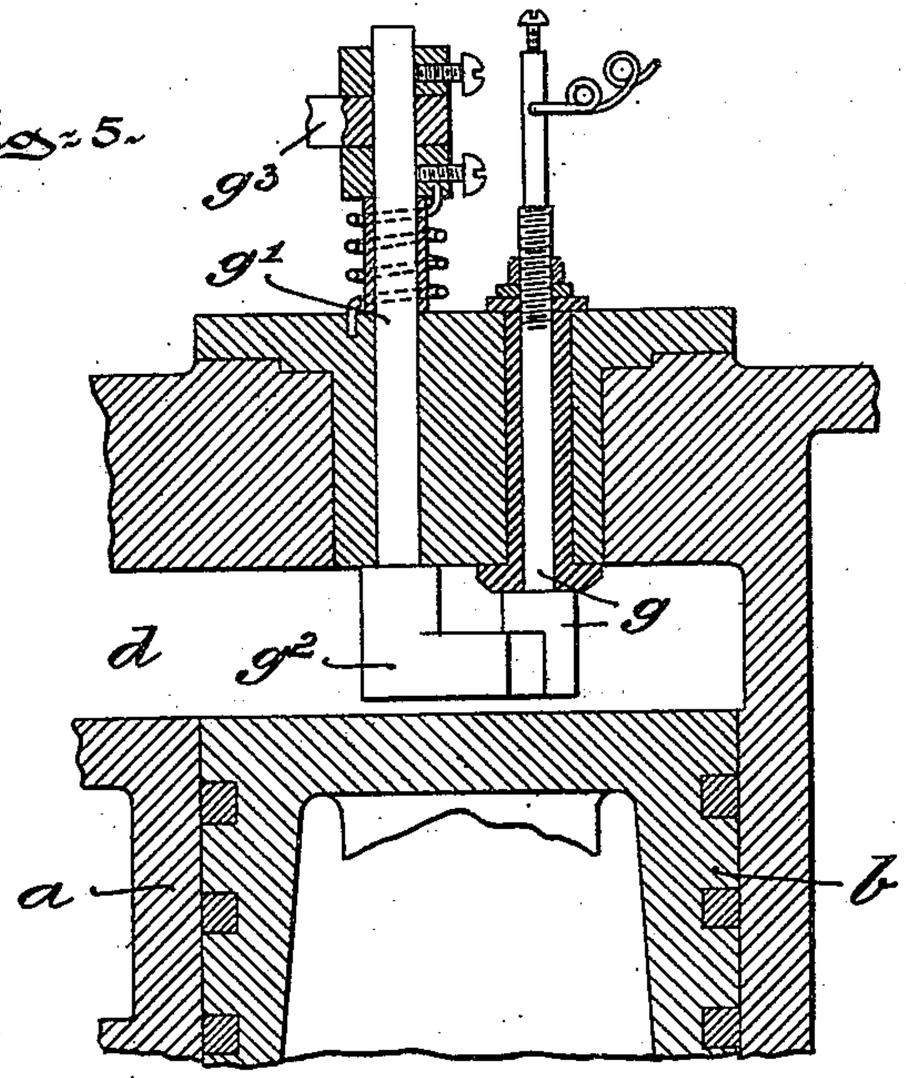


Fig. 5.



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UNITED STATES PATENT OFFICE.

ALBERT L. KULL, OF CAMDEN, NEW JERSEY.

SPEED-REGULATOR FOR EXPLOSIVE-ENGINES.

SPECIFICATION forming part of Letters Patent No. 690,443, dated January 7, 1902.

Application filed March 28, 1901. Serial No. 53,178. (No model.)

To all whom it may concern:

Be it known that I, ALBERT L. KULL, a citizen of the United States, residing at Camden, in the county of Camden and State of New Jersey, have invented certain new and useful Improvements in Hydrocarbon or Explosive Engines, of which the following is a specification.

My invention has relation to a hydrocarbon or explosive engine, and in such connection it relates to the construction and arrangement of the parts of such an engine.

The principal object of my present invention is to so adjust the sparking device or igniter and to so regulate the feeding of the charge to the explosion-chamber that when a low speed is required the charge is diminished in volume and also ignited after the completion of the compression by the piston and upon the power or return stroke of said piston. The means for adjusting the sparking device controls the mechanism for regulating the charge, and as a result there can be no burning of the mixture in the explosion-chamber, and consequently no choking or caking up of the engine.

The nature and scope of my invention will be more fully understood from the following description, taken in connection with the accompanying drawings, forming part hereof, in which—

Figure 1 is a top or plan view of a hydrocarbon or explosive engine embodying main features of my invention. Fig. 2 is a front elevational view of the same. Fig. 3 is a vertical sectional view taken through one of the cylinders of the engine. Fig. 4 is an enlarged top or plan view, partly sectioned, of the means for adjusting the sparking device and the mechanism for regulating the charge, intermediate parts being removed. Fig. 5 is an enlarged detail view, in vertical section, of the two electrodes comprising the sparking device; and Fig. 6 is a cross-sectional view on the line 6 6 of Fig. 4.

Referring to the drawings, the engine illustrated is of the multiple-cylinder type and is therefore provided with four cylinders a, in each of which reciprocates a piston b. The cylinders a are separate and distinct from each other, and all the cylinders a are inclosed in a water-jacket c, having an inlet c' at one side and an outlet c^2 at the opposite side, so as to permit of a constant circulation of water around the walls of all the cylinders, as clearly shown in Figs. 1, 2, and 3. The top of each cylinder opens directly into an explosion-chamber d, and the explosion-chambers d of the cylinders are separated from each other by transverse partitions d'. Each explosion-chamber d has an inlet-opening d^2 and an outlet opening or port d^3, as illustrated in Fig. 3. The inlet-openings d^2 all communicate with a common pipe e, which in turn is fed by a pipe e', leading from the mixing-chamber or carbureter. (Not shown.) Each inlet-opening d^2 is controlled by a valve d^4, normally closed on its seat by a spring d^5, the tension of which, however, is sufficient to permit the valve d^4 to open only during the suction or down stroke of the piston b. When the valve d^4 opens, the charge is drawn into the cylinder a and is compressed on the upstroke of the piston b in the explosion-chamber d. When so compressed, the charge is exploded by a suitable igniter or sparking device. The outlet-port from the explosion-chamber d is controlled by a valve d^6, held closed under tension of the spring d^7 and provided with a rod or stem d^8, extending downward and adapted to be shifted upward to open the valve d^6 when a cam d^9, controlled by the running-gear of the engine, impinges upon the end of the rod d^8. The impingement of the cam d^9 is so timed that immediately after the explosion of the charge in the chamber d and the transmission of the force thus generated to the piston b the valve d^6 will be opened to permit the exhaust or spent gases to be forced out by the upstroke of the piston b. The pistons b in the four cylinders are arranged to operate successively, so that the four cycles of the engine are continuous.

The sparking device or igniter for each cylinder a consists of a stationary pin or electrode g, forming one terminal of an electric circuit, and an oscillating or movable shaft g', carrying an arm or extension g^2, forming the other terminal of the circuit. The rod g and shaft g' are properly insulated from each

other. The shaft g' projects upward through the head of the cylinder and is attached to a curved arm or finger g^3. The free end of the arm or finger g^3 rests under tension of a spring g^4 against the periphery of a cam-sleeve g^5, secured to and rotating with a shaft g^6, as illustrated in Fig. 4. The finger g^3, as the shaft g^6 turns, rides up the cam g^7 of the sleeve g^5 and turns the electrode g' and its extension g^2 so that said extension approaches and contacts with the fixed electrode g. The further turning of the shaft g^6 and the cam-sleeve g^5 causes the finger g^3 to suddenly drop off under tension of its spring g^4 from the highest to the lowest point of the cam-sleeve, and the extension g^2 is thereby suddenly snapped backward away from the fixed electrode g to cause sparking between the electrodes. The spark thus produced will explode the compressed charge in the explosion-chamber d. When the engine is to be run at full speed, the snapping back of the movable electrode, and hence the production of a spark, takes place at the moment when the charge has been fully compressed by the upstroke of the piston b. The cam-sleeve g^5 and its shaft g^6 are adjusted initially, so that the sparking takes place at the proper time. The shaft g^6 is uniformly driven by the gear of the engine, and hence when once properly adjusted the rotation of the cam-sleeve g^5 and the consequent recurrence of the sparks cannot be varied. When the engine is to be slowed up, it is manifest that the time of the explosion in the combustion-chamber ought also to be varied, so that the piston b will not be subjected to as great a shock as when the engine is working at full speed. The adjustment of the electrodes to compensate for the slowing up of the engine may be accomplished in the following manner:

The sprocket h for rotating the shaft g^6 is secured to or preferably formed on one end of a sleeve h', having an internal spline h^2 fitting in the slot or way h^3 of an internal sleeve h^4, which is thus adapted to turn with the sprocket-sleeve h', as well as to be shifted in and out of the same. The shaft g^6 is surrounded by the internal sleeve h^4 and is provided with a pin h^5, engaging or traveling in an inclined slot h^6, formed in the wall of said sleeve h^4. This pin h^5 forms the connection between the shaft g^6 and the sleeve h^4, whereby when the sleeve h^4 rotates the shaft g^6 revolves. When the sleeve h^4 is shifted within the sprocket-sleeve h', the shaft g^6 will turn in the sleeve h^4 independently of the sleeve h^4, as indicated in full and dotted lines in Fig. 4, and the cam-sleeves g^5, carried by the shaft g^6, will be turned more or less to vary the time when the finger g^3 will slip off of the highest to the lowest portion of the cam-surface of the sleeve g^5. By adjusting the internal sleeve h^4 it necessarily follows that the sparking between the electrodes g and g' may be adjusted so as to take place after the charge has been completely compressed by the piston b. The means for so adjusting the sparking device also control the volume of the charge entering the explosion-chamber d through the following preferred mechanism: In the pipe e', leading from the mixing-chamber or carbureter to the pipe e, discharging to the combustion-chambers d, is located a valve m, of preferably the butterfly type. The stem m' of this valve is provided with an arm m^2, pivotally connected to one end of a link m^3. The other end of this link m^3 is pivotally connected, as at m^4, to a bracket m^5, having a forked extension m^6, fitting in a groove m^7, formed on the outer end of the sleeve h^4. The sleeve h^4 can rotate freely in the fork m^6, but when shifted back or forth causes said fork to shift in the same direction. The movement of the fork m^6 and bracket m^5 through the link m^3 causes the arm m^2 of the valve m to be shifted to either shut off a portion of the supply of vapor passing through the pipe e' or to permit the full charge to pass through said pipe e'. The sprocket-sleeve h' is supported in a two-part bearing h^8, which snugly fits a depressed or grooved portion of the exterior of the sleeve h', as clearly illustrated in Figs. 4 and 6. The sleeve h^4 is shifted back and forth by the fork m^6, which for this purpose is secured to a slide m^7, operated by a bell-crank lever m^8, which in turn is controlled in its movement by an arm m^9 under the control of the operator of the engine.

Having thus described the nature and object of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an explosive-engine of the multiple-cylinder type, a series of cylinders, a series of explosion-chambers arranged to communicate directly with the cylinders, each chamber separated from the other chambers, a supply-pipe leading to all the explosion-chambers, a valve controlling the inlet from the supply-pipe to each chamber and operated by the suction in each cylinder, a feed-pipe leading from the mixing-chamber to the supply-pipe, a valve controlling the feed-pipe, a sparking device for each explosion-chamber, means for adjusting all the sparking devices simultaneously so as to vary the time when the spark may be formed, and mechanism for operating the valve in the feed-pipe, said mechanism controlled by the means for adjusting the sparking devices, substantially as and for the purposes described.

2. In an explosive-engine, a sparking device, a finger controlling said sparking device, a sleeve having a cam-surface over which the finger is adapted to ride, a shaft carrying said sleeve, a sprocket-sleeve adapted to be rotated directly by the engine, an interior sleeve to which the sprocket-sleeve is splined, said interior sleeve turning with and adapted to be shifted in the sprocket-sleeve, and a pin projecting from the shaft and adapted to en-

ter an inclined slot in the walls of the interior sleeve, all arranged so that when the interior sleeve is shifted in the sprocket-sleeve, the shaft and cam-sleeve may be turned with respect to the sprocket-sleeve, whereby the relative position of the cam-surface with respect to the curved finger may be varied, substantially as and for the purposes described.

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

ALBERT L. KULL.

Witnesses:
J. WALTER DOUGLASS,
THOMAS M. SMITH.