J. F. HOPPER.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JULY 26, 1911.

1,026,317. Patented May 14, 1912.

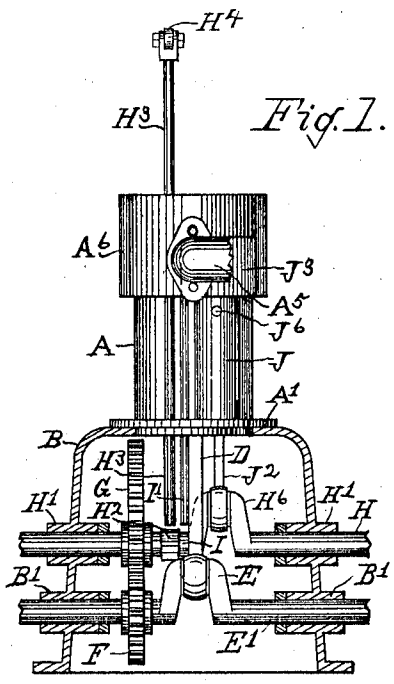

Fig. 1.

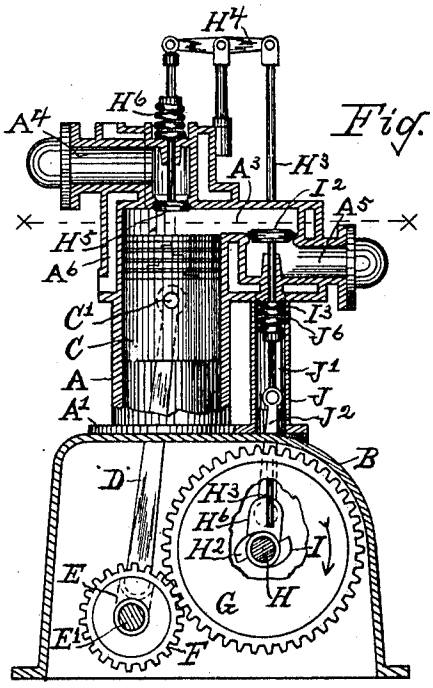

Fig. 2.

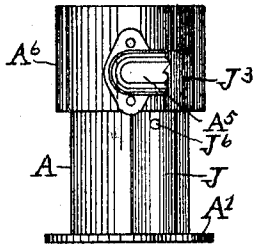

Fig. 3.

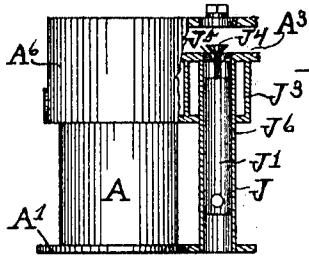

Fig. 4.

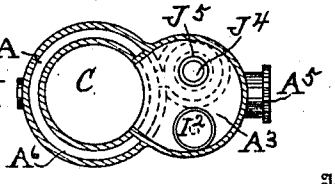

Fig. 5.

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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

1,026,317. Specification of Letters Patent. Patented May 14, 1912.

Application filed July 26, 1911. Serial No. 640,714.

To all whom it may concern:

Be it known that I, JAMES F. HOPPER, a citizen of the United States, residing at Sherman, in the county of Grayson and State of Texas, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal combustion engines, and more particularly to the ignition system of said engines.

The state of perfection of the present-day internal combustion engine has not been reached without deep study and investigation, in the course of which it has been realized that ignition has vastly more to do with efficiency than was at first believed. The early conception of ignition was the production of a spark sometime toward the end of the compression stroke, and if this spark was successful in igniting the mixture, that was all that was desired. The character of the spark, the accuracy of its production, or the exactness of its timing were points that were disregarded by the designer, because he did not understand that these had any bearing on the power output or on the fuel consumption of the engine.

The charge of mixture represents a certain heat value and has a certain maximum pressure. To exert the greatest possible proportion of this pressure against the piston, each particle of mixture should be made to give up its heat at the instant when the piston is at the end of the compression stroke and ready to move outward on the power stroke. To gain this result, it would be necessary to ignite each particle of the mixture at the same instant, and thus to have ignition and combustion occur at top dead center. The mixture would thus be compressed into minimum space before ignition and the rise in pressure due to combustion would then be most abrupt, the piston being driven out with maximum force. No existing ignition system will ignite all of the particles of mixture at the same instant. The system in use ignites the mixture at one or two points from which the flame is expected to communicate itself to the remaining mixture particles.

The object of this invention is the production of an igniting device in the nature of a mass of flame, by effective and simple means, dispensing entirely with a magneto or battery and coil system for the purpose and insuring a more highly efficient operation of the engine. This and other objects I attain in a gasolene engine embodying the features herein described and illustrated.

In the accompanying drawings, forming a part of this application and in which similar reference characters indicate corresponding parts on the several views; Figures 1 and 2 are partial vertical sections of an engine embodying my invention; Fig. 3 is a detail outer view of a portion of the engine cylinder and of a smaller cylinder formed integral, which cylinder comprises a portion of my igniting device; Fig. 4 is a partial view of the engine cylinder with my igniting device shown in section; and Fig. 5 is a partial section along the line X-X of Fig. 2.

Referring to the drawings, the engine cylinder is denoted by A, and it has a widened base, A^1 adapted to rest upon and be secured to a bed B. Within the cylinder A is fitted the primary piston head C to which at C^1 is pivoted a connecting rod D that is connected in the usual manner to crank E of main shaft E^1, which shaft is supported by bearings B^1 formed integrally with the engine base B. On the shaft E^1 is secured a pinion F that drives a gear G on the cam shaft H that has bearings H^1 formed on the bed B. At regular intervals the cam H^2 raises the push rod H^3 pivoted to the walking beam H^4, opening valve H^5 permitting the escape of the burned gases from the combustion chamber A^2, and therefrom to the exhaust conduit A^4. The cam I likewise raises the valve stem I^1, opening intake valve I^2 admitting mixture to the chamber A^3. The valves are closed respectively by springs H^6 and I^3. A^6 represents the usual water jacket employed with such engines.

Having thus outlined the principal features of all ordinary internal combustion engines I will now proceed to describe in detail, in connection with the same, my improved igniting device.

An auxiliary cylinder J is preferably cast with the engine cylinder A, it is of smaller bore and fitted with a solid secondary piston J^1 that is driven by the crank H^7, on cam shaft H, through connecting rod J^2, J^3 being a water jacket of ordinary construction. The upper end of this cylinder opens into the combustion chamber A^3 where it is pro-

vided with a valve J^4 and a valve seat J^5. The top face of valve J^4 is relatively much greater in area than the bottom face, so that the compression or compressed gases in the primary cylinder and firing chamber may overcome in this manner the denser compression or compressed air in the auxiliary or secondary cylinder and hold said valve firmly on its seat, until it be engaged by the upper end of the plunger J^1. On the downward stroke of the piston or plunger J^1 it passes below an opening J^6 in the cylinder J, allowing the portion of the cylinder above the piston or plunger to fill with air, which on the upward stroke of the piston or plunger is compressed to a density sufficient to fire the charge of mixture in the chamber A^3. This compressed air of high density is admitted to the chamber at the proper time by the piston or plunger J^1 which on its upward stroke contacts the stem of valve J^4. The point in the temperature scale at which ignition takes place in the chamber A^3 depends upon the fuel used. That is, the higher the heating value of the fuel the less heat required to bring it to the point of ignition. So we will consider the use of the hydrocarbon, gasolene, as the fuel for an illustration, and the maximum compression in the chamber A^3 that would be permissible with safety would be 80 to 90 pounds gage, as a compression of 125 pounds per square inch would bring it to the ignition point. With the mixture at the above safe density, a jet of air from the cylinder J at a density of 150 pounds per square inch contacting the mixture causes instant explosion, and the jet being of considerable volume ignites a large percentage of the mixture, greatly increasing the maximum power output of the engine. Should kerosene or crude oil be the fuel used the point in the temperature scale at which ignition would take place would be higher, requiring a proportionately higher compression of air for ignition.

I have illustrated and described preferred and satisfactory constructions, but changes could be made within the spirit and scope of my invention.

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

1. In an internal combustion engine, a primary cylinder having a firing space, a piston working in said primary cylinder and an auxiliary cylinder having communication with said primary cylinder, in combination with a valve opening and closing the communication between said cylinders and held on its seat by the compressed gases in said primary cylinder except at predetermined intervals, means working in said auxiliary cylinder to compress air therein and means for actuating the same, said air compressing means engaging and unseating said valve at predetermined intervals to allow the compressed air in said auxiliary cylinder to escape into the firing space of said primary cylinder and thereby ignite the charge therein.

2. In an internal combustion engine, the combination with a combustion chamber having intake and exhaust ports, of an air compressor cylinder, air compressing means working therein, said air compressor cylinder opening into the combustion chamber, a valve controlling said opening, said air compressing means engaging and unseating said valve at predetermined intervals to allow the escape of compressed air into the combustion chamber to fire the charge therein.

In testimony whereof I affix my signature in presence of two witnesses.

JAMES F. HOPPER.

Witnesses:
HAMLET C. SMITH,
THOS. P. HOPPER.