No. 739,943. PATENTED SEPT. 29, 1903.

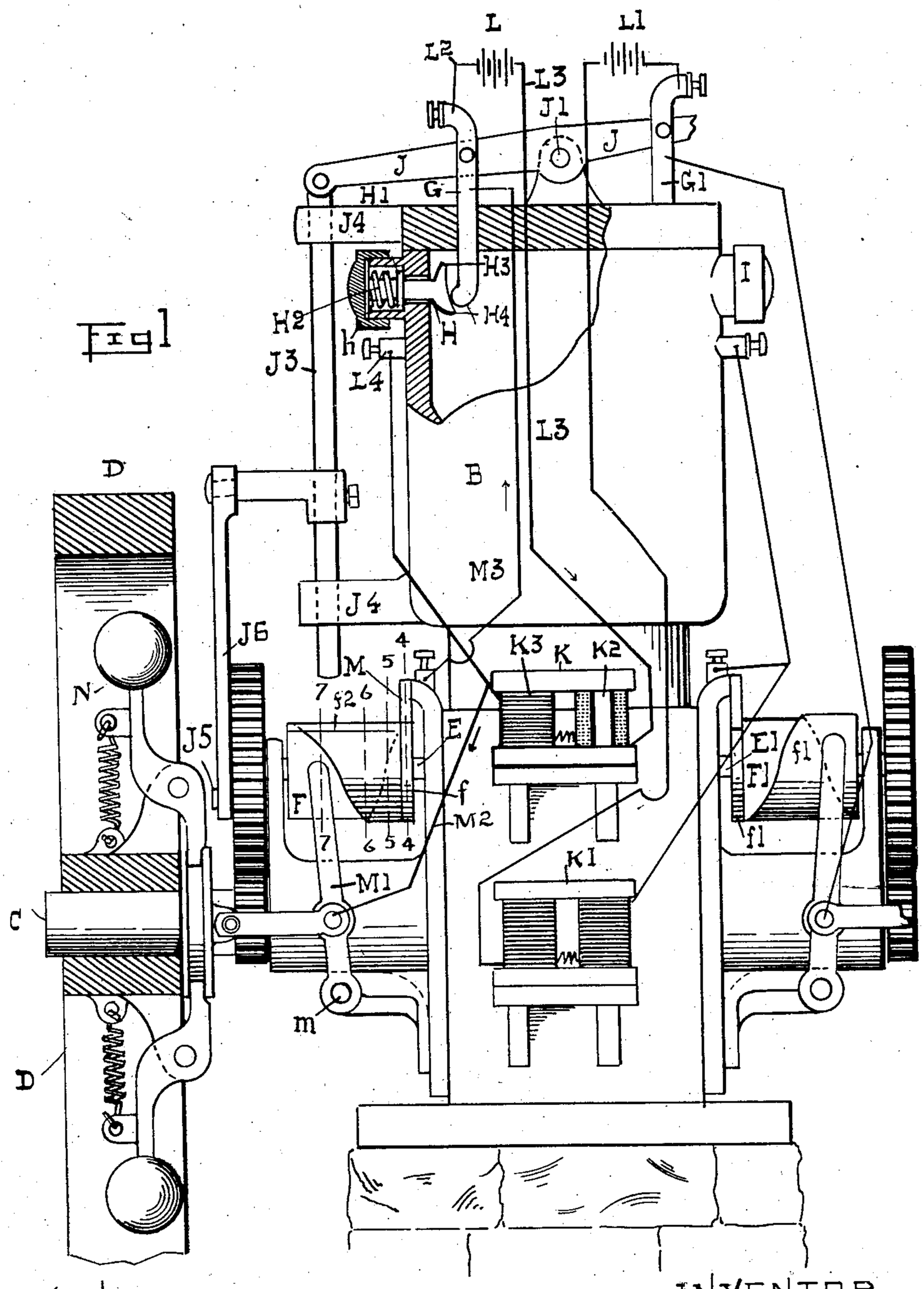
E. J. STODDARD.

ELECTRIC IGNITER.

APPLICATION FILED JUNE 12, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

Fig 1



WITNESSES

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NO MODEL. 2 SHEETS—SHEET 2.

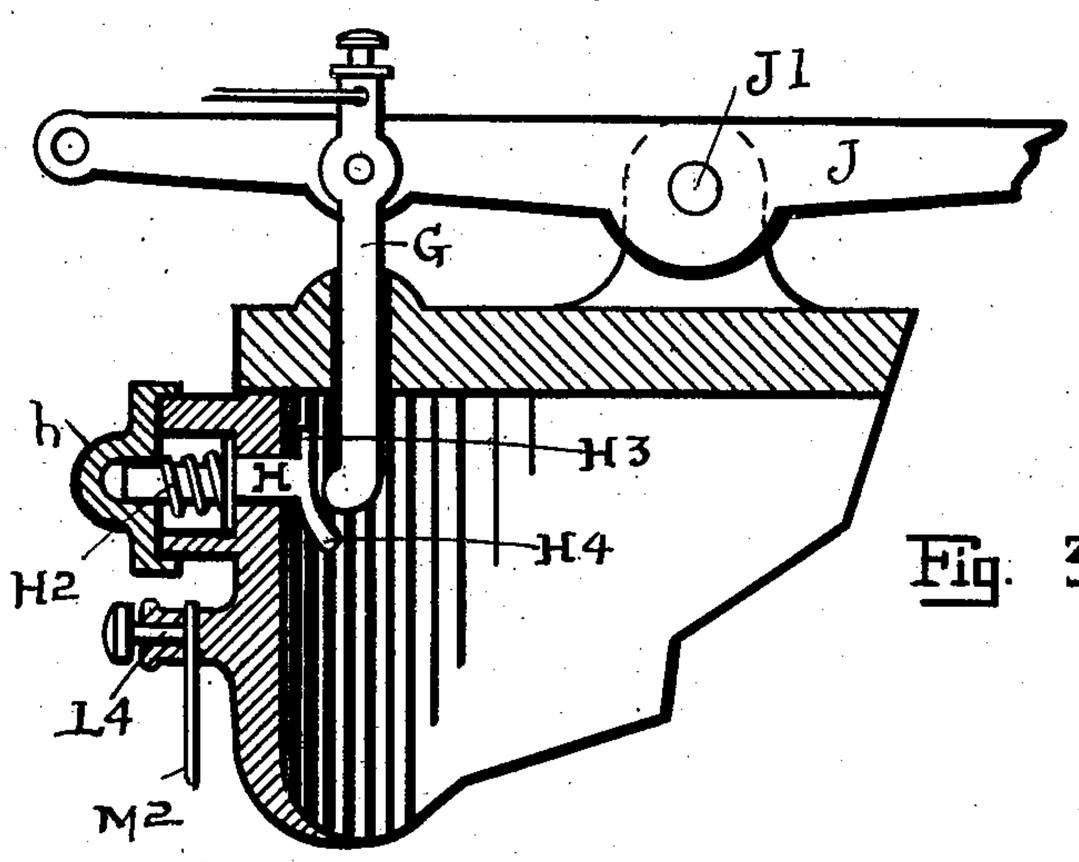

Fig. 3.

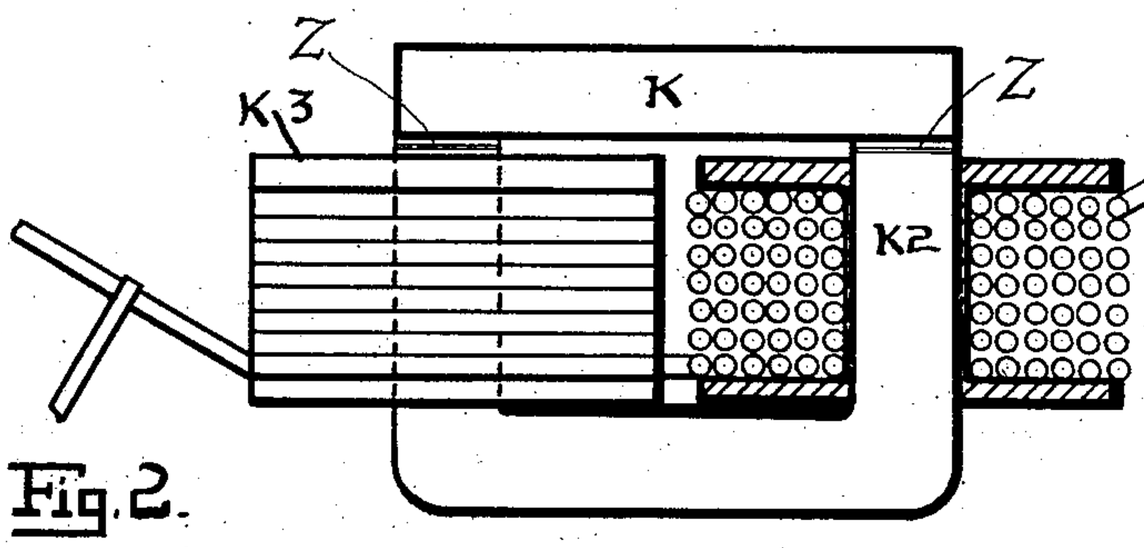

Fig. 2.

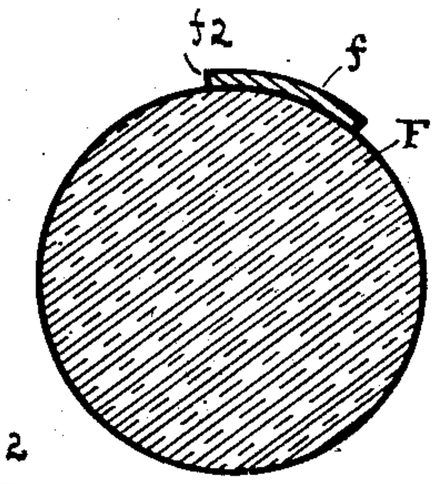

Fig. 7.

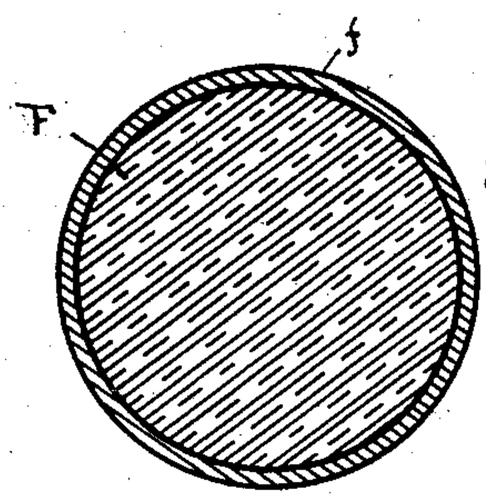

Fig. 4.

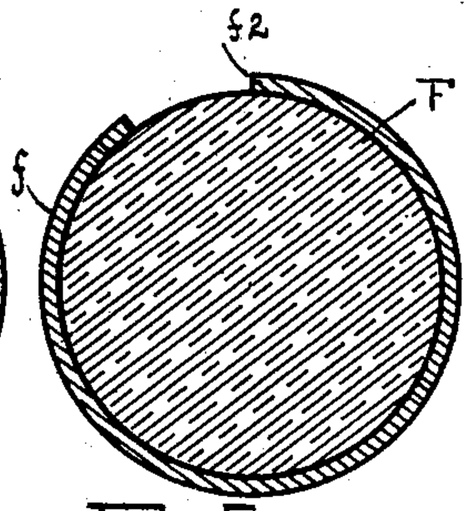

Fig. 5.

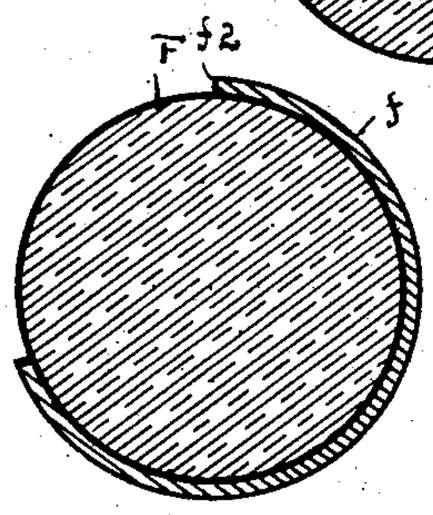

Fig. 6.

WITNESSES

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No. 739,943. Patented September 29, 1903.

UNITED STATES PATENT OFFICE.

ELLIOTT J. STODDARD, OF DETROIT, MICHIGAN, ASSIGNOR TO CHARLES F. BURTON, TRUSTEE, OF DETROIT, MICHIGAN.

ELECTRIC IGNITER.

SPECIFICATION forming part of Letters Patent No. 739,943, dated September 29, 1903.

Application filed June 12, 1901. Serial No. 64,215. (No model.)

To all whom it may concern:

Be it known that I, ELLIOTT J. STODDARD, a citizen of the United States, residing at Detroit, county of Wayne, State of Michigan, have invented a certain new and useful Improvement in Electric Igniters; and I declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to electric igniters for gas-engines; and it consists in the improvements hereinafter described, and pointed out in the claims.

Referring to the accompanying drawings, Figure 1 is an elevation, partly in section, of a gas-engine, with an ignition apparatus attached thereto, embodying my invention. Fig. 2 is an elevation of the self-induction coil used in said apparatus, the wire upon part of the core being shown in section. Fig. 3 is an enlarged elevation of the upper part of the cylinder. Figs. 4, 5, 6, and 7 are sections of the commutators, taken at the respective lines illustrated in Fig. 1.

A is the base, and B the cylinder, of a gas-engine.

C C is the main shaft, and D is the fly-wheel thereon.

E E′ are small shafts parallel to the main shaft C. The shafts E E′ are geared to the main shaft, so that each makes one revolution between alternate ignition-points of the engine motion.

F F′ are cylinders of insulating material secured upon the shafts E E′.

f f′ are strips of metal upon the surface of the cylinders F F′. The strips *f f′* are continuous all around the cylinders F F′ at one end, as indicated in Fig. 4, but leave a continually-increasing surface of the insulating-cylinders exposed toward the other ends, as indicated in the elevations of Fig. 1 and the successive sections of Figs. 5, 6, and 7.

While any suitable make and break for the circuit in the cylinder may be used, I have shown one that is especially adapted to be used with this apparatus.

G is a rod insulated from the cylinder extending through an aperture in the cylinder-head and adapted to be reciprocated longitudinally therein.

H is a rod extending through an aperture in the side of the cylinder and adapted to be reciprocated longitudinally therein.

H′ is a collar upon the rod H. A cap *h* is shown covering the outer end of the rod H.

H^2 is a pressure-spring surrounding the rod H at its outer end, bearing at one end upon the cap *h* and at the other end upon the collar H′. The action of the spring H^2 is to force the rod H inward until stopped by the collar H′ striking against the cylinder-wall. The inner end of the rod H is formed into two surfaces at an angle to each other. The surface H^3 is parallel, or nearly so, to the motion of the rod G, and the surface H^4 is inclined, so that it comes into the line of travel of said rod. There is a second entirely similar make-and-break apparatus I upon the opposite side of the cylinder.

J is a lever pivoted to the cylinder-head at J′ half-way between the rods G and G′.

J^3 is a rod adapted to reciprocate in bearings J^4 J^4 upon the cylinder B.

J^5 is a wrist-pin upon a gear-wheel on the shaft E.

J^6 is a connecting-rod pivoted at one end upon the pin J^5 and at the other end connected to the rod J^3, so that one turn of the shaft E shall raise and lower the rod J^3. The rod J^3 is connected at its upper end to the lever J, so as to oscillate the same. The lever J is connected to the rods G G′ upon opposite sides of the pivot of said lever, so that it shall reciprocate said rods alternately.

The mechanical operation of the above-described make-and-break device is as follows: When the main shaft C of the engine has made two or four revolutions, as the case may be, the shaft E has made one revolution, which has caused the lever J to make one complete oscillation. When the rod G descends, its lower end strikes against the inclined surface H^4, forcing the rod H outward against the action of the spring H^2. When the rod G ascends, it slides along the surface H^4 until the rod H, which is being pressed in by the spring H^2, is arrested by the striking of the collar H′ against the cylinder-wall, when the

contact between the two rods is broken and the lower end of the rod G continues to rise adjacent and parallel to the surface H^3. K K' are coils secured to the engine-base A. Each of these coils consists of a continuous or nearly-continuous soft-iron core K^2, forming a nearly-continuous magnetic circuit wound with a number of turns of insulated copper wire K^3. It is better to interrupt the magnetic circuit for about a thirty-second of an inch or less. I have obtained the best results by placing a single piece of writing-paper between the upper end of each vertical leg and the horizontal cross-piece or from two to four pieces at the upper end of one of said vertical legs. To this end I place pieces of paper Z, Fig. 2, between the armature and the legs of the magnet. I have used a coil of the shape shown, with a one and twenty-five one-hundredth inch by one and twenty-five one-hundredth inch square cross-section of core, legs four inches long, having about seven hundred or eight hundred turns of No. 16 wire upon it, using two or three cells of the Nungesser battery; but in this coil little effort was made to get just the right proportions.

In Fig. 1 L L' are two independent sources of electricity, generally batteries. Each of said batteries forms part of an electric circuit or system, each of which systems is a duplicate of the other, so that it will only be necessary to describe one system. The lead-wire L^2 from one pole of the battery L is connected to the rod G. The lead-wire L^3 from the other pole of the battery leads to and through the coil K and thence to the binding-screw L^4, which communicates through the cylinder with the rod H. When the rods G H are in contact, the electric circuit is complete. When they are separated, the circuit is interrupted, which causes the igniting-spark to pass between the rods.

M is a brush secured to but insulated from the base of the engine. Said brush bears upon the metal *f* of the cylinder F, where said metal is continuous. M' is a second brush pivoted to the engine-frame at *m*, bearing against the cylinder F, so as to be in contact with the metal *f* for a portion of the revolution of the cylinder F, and will rest upon the insulating-surface of the cylinder, and be thereby insulated from the metal F for the remainder of the stroke. The turning of the brush M' about its pivot adjusts its point of contact longitudinally along the cylinder F. At whatever point the brush M' contacts the cylinder F its contact with the metal *f* is broken when the straight edge f^2 of said metal, which is parallel to the axis of the cylinder F, passes from under said brush and the mechanism is so adjusted that this break always occurs just before the contact between the rods G and H is broken. As the other edge of the metal *f* passes spirally around the cylinder the circumferential extent of said metal continually diminishes toward one end, so that the time of contact of the brush M' with the metal continually increases as it moves toward the broader part or the metal *f*.

N is a governor adapted to move the brush toward the broader portion of the metal *f* when the speed of the engine increases and to restore it to the narrower portion of said metal when the speed decreases.

M^2 is a wire connecting the brush M' with the wire leading from the coil K to the binding-post L^4. M^3 is a wire leading from the brush M to the rod G.

The operation of the above-described apparatus will be understood from the following description: In the "contact" or "wipe-spark" system of gas-engine ignition it is the practice to employ a coil having a straight core with the idea that the demagnetizing effect of the ends of this form of core is necessary to produce the required intensity of the induced current, and also to reduce the retarding effect of self-induction on the making of the circuit, and the tendency seems to be to make the coil shorter with reference to its diameter. At the same time special effort is made to so construct the make-and-break apparatus that the sharpest practicable break shall be obtained. With the straight short core a comparatively large current is required to magnetize the same, so that the battery is rapidly used up and but small effect is produced for the current used. The modifications of the make-and-break apparatus designed to produce a sharp break are usually objectionable.

In fast-running engines it is usual to use a large number of cells in series in order to supply sufficient electromotive force to get the current through the coil during the necessarily brief time of contact. If the conditions are such as to require a variable speed, a sufficient number of cells must be supplied to work the apparatus at its maximum speed, so that when running slower a part of the cells do no good and are uselessly wasting their material. A further objection to the contact, and also to a less degree, perhaps, to the wipe-spark system, is that the electromotive force of the battery-current is small, and an indifferent contact of the points within the cylinder where a bad contact is apt to exist stops a large part of the current and prevents the apparatus from working.

It is the object of the above-described apparatus to obviate or mitigate the objections mentioned. To this end a circuit through the coil is established by mechanism outside of the cylinder where it can be kept in order and the time of contact chosen and adjusted, and this outside circuit is broken just before the points are separated inside the cylinder, so that if there is some slight obstruction between the points in the cylinder it will be broken down by the high-tension current, which will in that case be induced on breaking the outside

circuit, and if the contact in the cylinder is satisfactory a high-tension induced current lasting somewhat longer than usual, will produce a spark which will ignite the charge with certainty even when a high degree of compression is used. I also provide for moving the spark along in the explosive mixture, so that it will have a better chance to ignite the same.

The breaking of the circuit outside of the cylinder should be just before the break of the circuit in the cylinder, so that the energy produced in the coil by the current flowing through the outside circuit will not be expended before the break in the cylinder, but will act to induce the current which produces the spark in the cylinder.

I also provide for a longer time of contact than usual, if desired, and means for maintaining the time of contact approximately constant at different speeds of revolution of the engine.

Referring to the drawings, when the engine is started up the brush M′ contacts the metal plate *f*, so that there is a circuit from the battery through the coil K to the brush M′, through the plate *f* to the brush M, thence to the rod G and back to the battery. Just before the rod G separates from the rod H the brush M′ separates from the plate *f*. If there is good contact between the rods G and H, the current continues uninterrupted through said rods. If there is slight obstruction to the current between said rods, a high-tension current will be induced on the breaking of the circuit through the brushes M′ M, which will remove such obstruction. When the rods G H separate, a spark is induced at the point at which they were in contact, and this spark is drawn along on the surface H^3, so that it will come into contact with a larger amount of the mixture and be more apt to ignite a poor mixture. With a nearly complete magnetic circuit the intensity of magnetization with a reasonable magnetizing force is much greater, and with a large number of turns of wire the potential of the induced current with the same rate of decrease of magnetic flux is proportionately greater, so that even if the time taken by the iron to demagnetize on the stopping of the current is greater it is still sufficient to produce the required spark and an induced current of high potential.

It is believed to follow from the above consideration, and the facts are so, that a better spark is formed with a comparatively slow break of the circuit, and the duration of the spark is believed to be longer when the magnetic circuit is nearly complete.

What I claim is—

1. In combination with a gas-engine, a sparking-coil having a core forming a magnetic circuit complete with the exception of a joint in said core forming a gap in said magnetic circuit of sufficient resistance to cause the formation of demagnetizing-poles, a number of energizing-coils wound on said core, and means actuated by the engine for making and breaking a circuit through the coil to produce the spark, substantially as and for the purpose described.

2. In a make-and-break electric-igniting system for gas-engines, a gas-engine, make-and-break electrodes in the cylinder of said engine, a sparking-coil, means for completing the circuit outside of the engine-cylinder through said coil, and means for breaking said outside circuit so proximately before the break between said electrodes that the energy induced in the coil by the current through the outside circuit shall act to produce the spark between said electrodes.

3. In a make-and-break electric-igniting system for gas-engines, a gas-engine, make-and-break electrodes in the cylinder of said engine, a sparking-coil, means for completing the circuit outside of the engine-cylinder through said coil at different points of the engine revolution and breaking said outside circuit while said electrodes are in contact.

4. In a make-and-break electric-igniting system for gas-engines, a gas-engine, a sparking-coil, make-and-break electrodes in the cylinder of said engine, means for completing the circuit through said coil outside of the engine-cylinder at different points of the engine revolution and for breaking said outside circuit while said electrodes are in contact, and means for automatically varying with the speed of the engine the point at which said outside circuit is made.

5. In a make-and-break electric-igniting system for gas-engines, a gas-engine, two complete make-and-break systems so connected to the engine that each system shall produce the spark in the same cylinder at alternate ignition periods, and means for completing the circuit in each system outside of the cylinder, and breaking said outside circuit so proximately before the break between the electrodes in the cylinder that the energy developed in the coil by the current in the outside circuit shall act to produce the spark between said electrodes.

6. In an electric-igniting system for gas-engines, the combination of a sparking-coil, having an energizing-coil thereon, and means for varying the time during which the circuit through said energizing-coil is complete, in proportion to the time necessary to establish the proper energizing-current in said coil.

7. In an electric-igniting system for gas-engines, the combination of a sparking-coil, having an energizing-coil thereon, and means for varying automatically the time during which the circuit through said energizing-coil is complete, in proportion to the time necessary to establish the proper energizing-current in said coil.

8. In a make-and-break electric-igniting system for gas-engines, a gas-engine, make-and-break electrodes in the cylinder of said

engine, a sparking-coil provided with an iron core forming a complete or nearly complete magnetic circuit, means for completing the electric circuit outside of the engine-cylinder through said coil, and means for breaking said outside circuit so proximately before the break between said electrodes that energy induced in the coil by the current through the outside circuit shall act to produce the spark between said electrodes.

In testimony whereof I sign this specification in the presence of two witnesses.

ELLIOTT J. STODDARD.

Witnesses:

CHARLES F. BURTON,

NETTIE V. BELLES.