No. 701,307. Patented June 3, 1902.

H. T. & H. A. DAWSON.

ELECTRICAL IGNITION APPARATUS.

(Application filed Jan. 25, 1901.)

(No Model.) 2 Sheets—Sheet I.

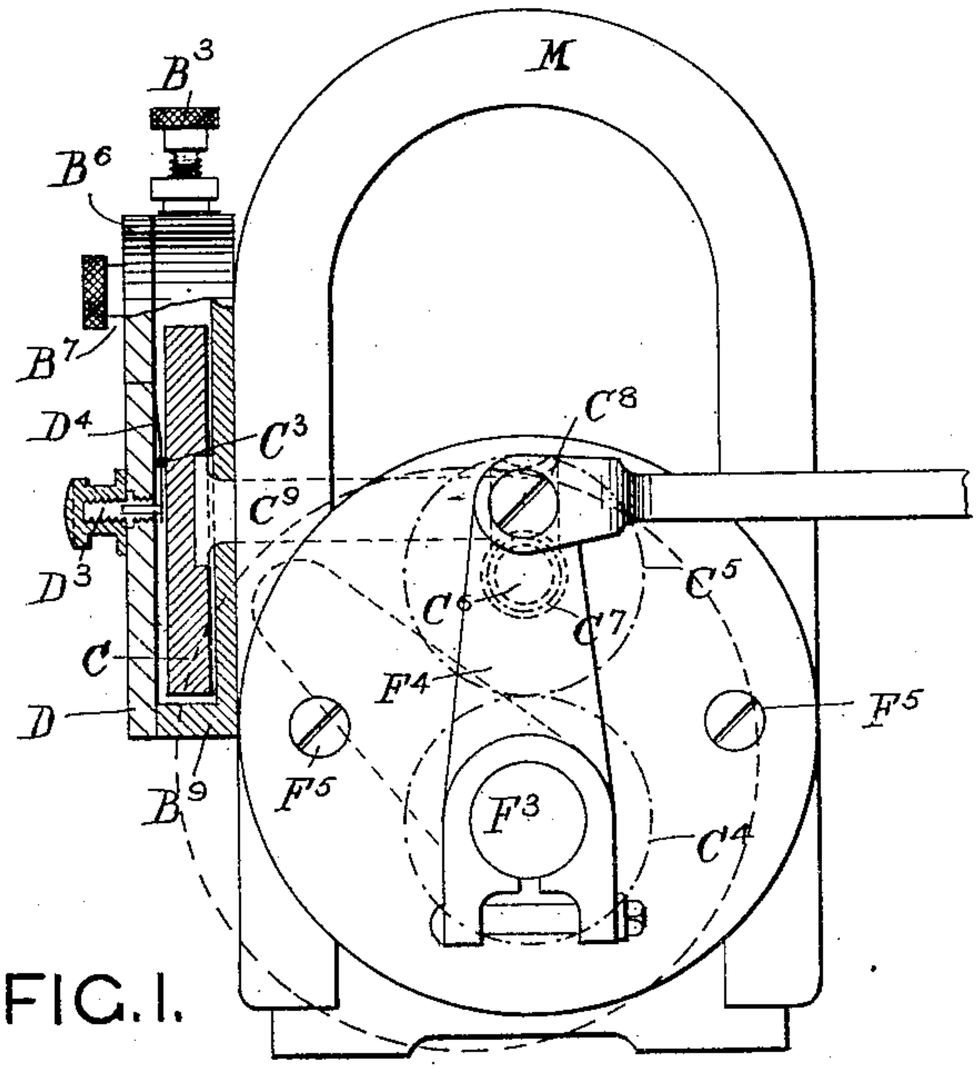

FIG. I.

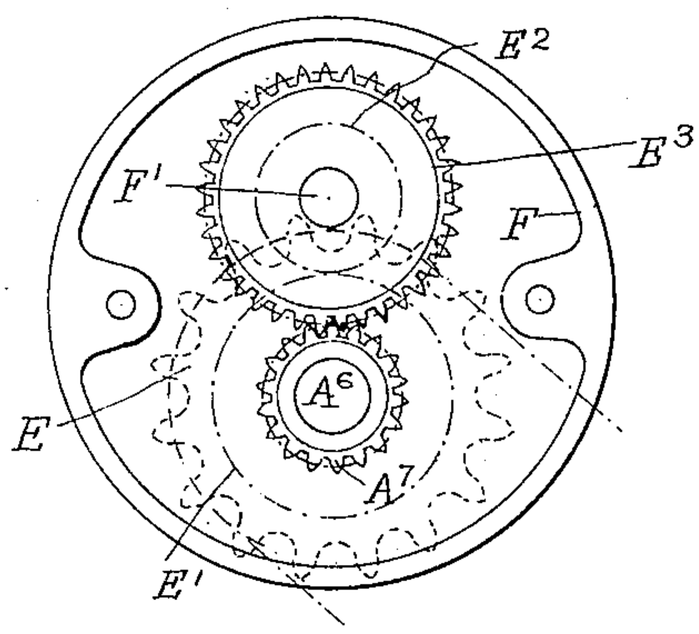

FIG. III.

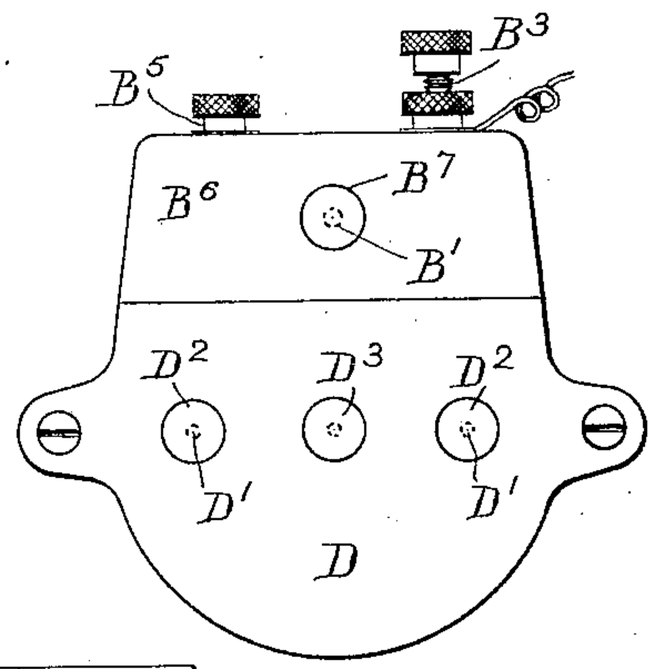

FIG. IV.

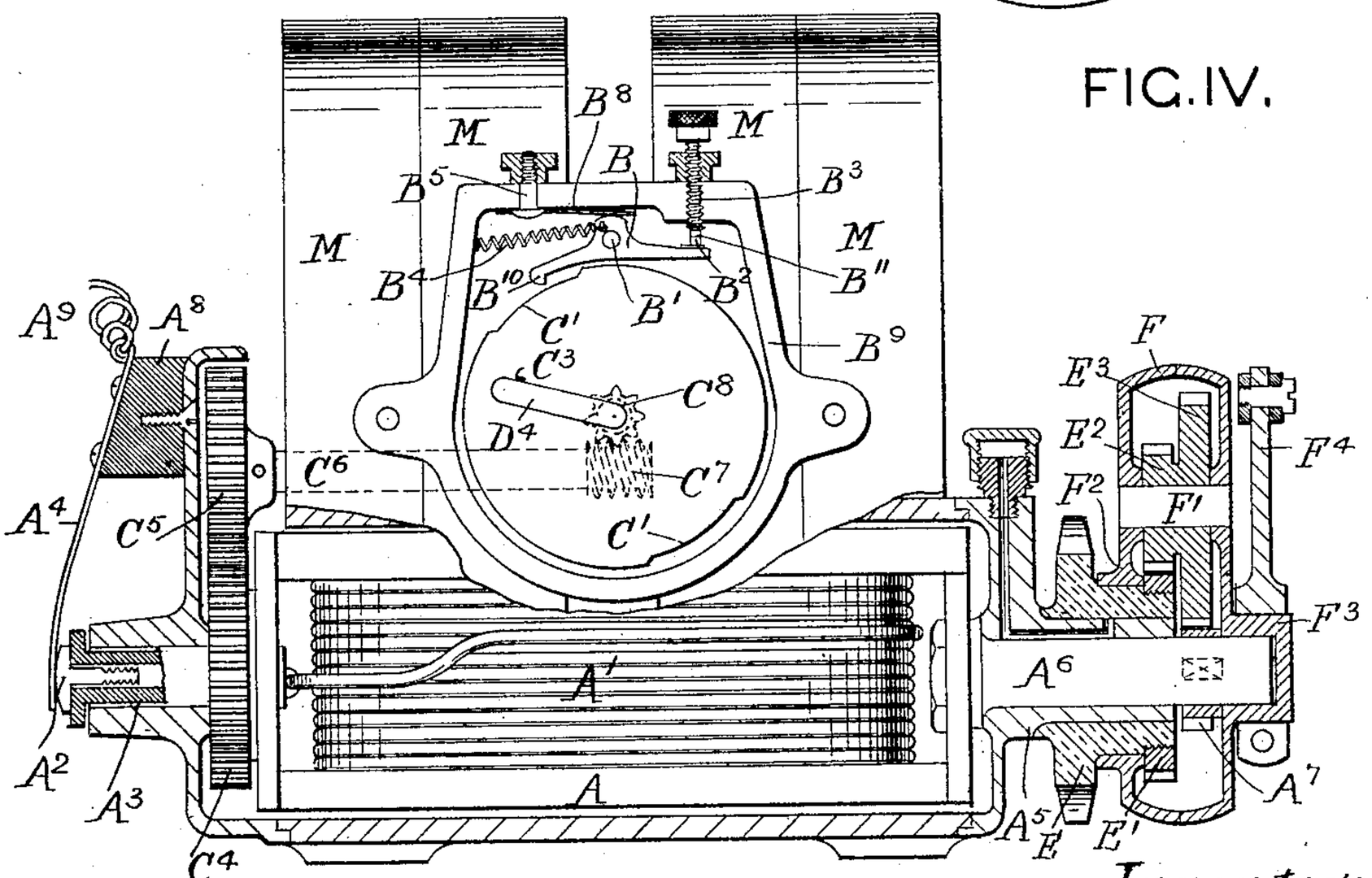

FIG. II.

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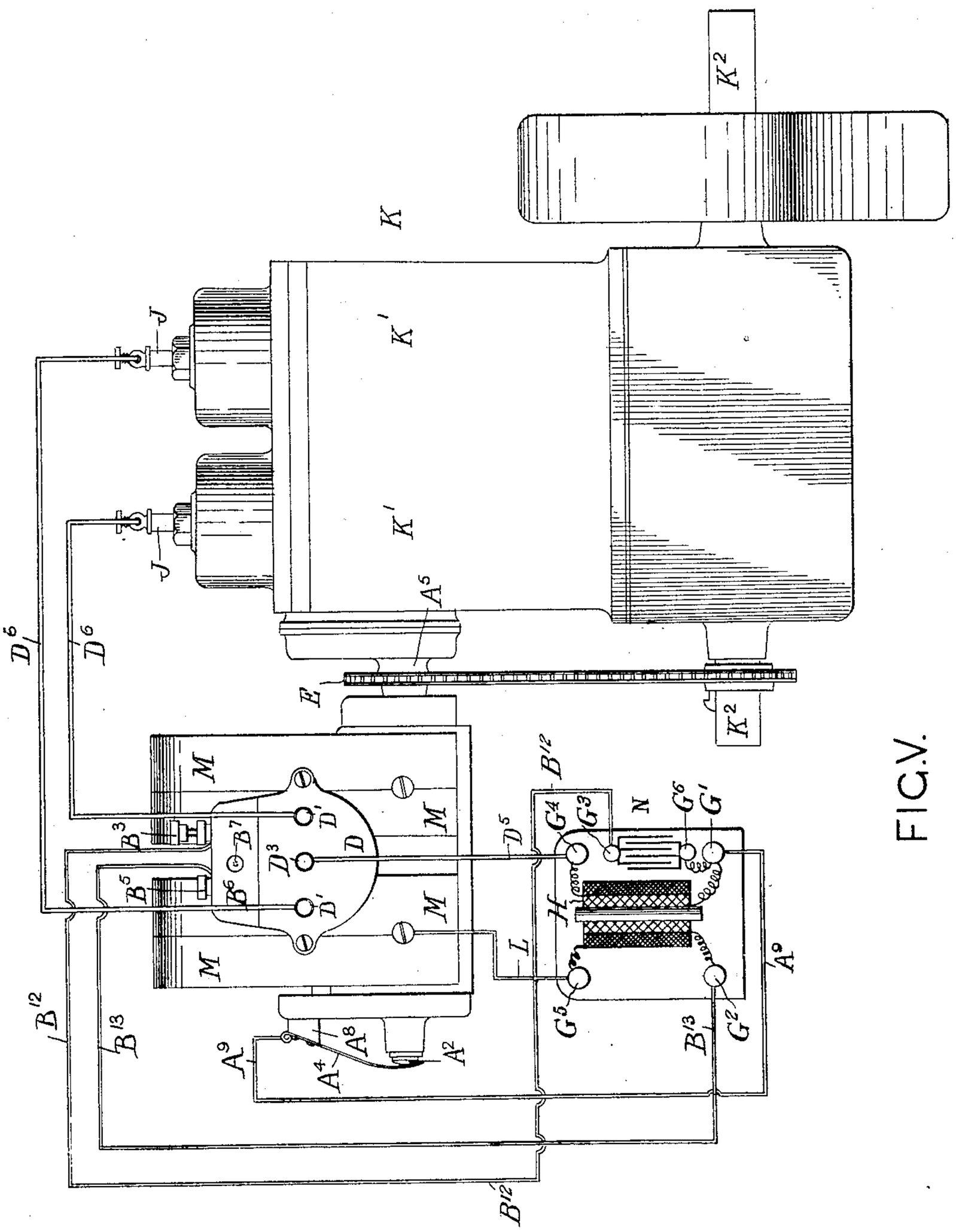

FIG.V.

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UNITED STATES PATENT OFFICE.

HENRY T. DAWSON AND HENRY A. DAWSON, OF CANTERBURY, ENGLAND.

ELECTRICAL IGNITION APPARATUS.

SPECIFICATION forming part of Letters Patent No. 701,307, dated June 3, 1902.

Application filed January 25, 1901. Serial No. 44,643. (No model.)

To all whom it may concern:

Be it known that we, HENRY THOMAS DAWSON and HENRY ALFRED DAWSON, subjects of the Queen of Great Britain, residing at Canterbury, in the county of Kent, England, have invented certain new and useful Electrical Ignition Apparatus, of which the following is a specification.

This invention relates to apparatus for producing electric sparks for the purpose of igniting explosive charges, principally in the case of internal-combustion motors.

The object is to produce a magneto-electric machine which shall be entirely self-contained, which shall merely require driving by chain or other positive gearing at any suitable speed synchronizing with that of the motor, which shall be capable of producing powerful high-tension sparks in any number of cylinders in turn while employing only one induction-coil and avoiding excessive strength of current, and which shall allow of the ignition being advanced or retarded—that is, which shall allow of the said sparks being produced as much sooner or later in the cycle of operations as may be desired; and our invention consists, essentially, in a machine comprising a dynamo in combination with mechanisms, first, for making and breaking the circuit of its current with the primary winding of an induction-coil; second, for distributing the high-tension current thus produced to the sparking-plugs in any desired number of cylinders, so that the sparking may take place in the said cylinders at the proper intervals, and, third, for advancing or retarding the sparkings to any extent required for the control of the motor fitted with the apparatus.

Apparatus constructed according to our invention for a two-cylinder motor is shown in the accompanying drawings; but we wish it to be understood that the details may be modified or replaced by equivalents without departing from the essence of our invention.

Figure I is an end elevation of the apparatus. Fig. II is a broken side elevation, partly in section, of the same, the plate D being omitted. Figs. III and IV are elevations of detail parts. Fig. V is a general view of the apparatus on a smaller scale.

The same characters indicate the same parts in all the figures.

The dynamo is preferably constructed with permanent field-magnets M, to which a shunt-winding may be added, if desired. The armature A is of the H pattern or other interrupted-pole type, so as to produce an undulating current. It is wound so as to produce a suitable electromotive force and current with insulated copper wire A', one end of which is connected to the iron core, and thus grounded to the dynamo, while the other end passes through the hollow spindle A^3 and is connected to the insulated revolving terminal A^2. A continuous rotary motion in either direction is imparted to the armature by the motor K at a definite rate with respect to the crank-shaft K^2, so that the current undulations or certain of them will synchronize with the periods at which ignition should take place by means of positive gearing applied to, say, the chain pinion E, which is mounted loosely on the exterior of the fixed sleeve A^5, which also forms a bearing for the armature-spindle A^6. The pinion E is connected to the spindle A^6 through the train of wheels E' E^2 E^3 A^7. Of these E' is fixed to an extension of the pinion E, E^2 and E^3 rotate as one on a pin F', mounted eccentrically to the spindle in the casing F, and A^7 is fixed directly to the said spindle A^6. By these means the armature A is rotated at a higher rate than the pinion E, such rate being so related to the rate of rotation of the crank-shaft that the number of sparkings required for each cycle of the motor is evenly divisible into twice the number of revolutions made by the armature in one cycle, the quotient being preferably an odd number.

The case F is divided vertically into two parts, each having a journal, of which F^2 bears on the extension of the pinion E and F^3 bears on and preferably forms a dust-cap to the end of the spindle A^6. The two parts may be conveniently connected by two screws F^5, Fig. I. The case as a whole may be turned on the spindle A^6 by any suitable means, such as the arm F^4, secured thereto, for the purpose of advancing or retarding the ignition, as hereinafter mentioned.

We prefer to arrange the collecting mech-

anism as shown in Fig. II, where the metal spring A^4, carried upon an insulated block A^8, collects the armature-current from the revolving but otherwise stationary terminal A^2, upon which its free end bears; but the said current may be collected by any other suitable means, such as by connecting the outer end of the armature-winding to an insulated rotating contact-ring, upon the periphery of which the spring-brush A^4 would then be arranged to bear. In any case the spring A^4 is wired (A^9) to one end G′ of the primary winding of an induction-coil II, the secondary of which is connected in a proper manner to the sparking electrodes.

The disk C, of insulating material, is made to revolve once for each cycle of the motor for the purpose of actuating the contact maker and breaker. The said disk may be arranged in any convenient position and may be rotated by mounting it on a shaft C^9, having a worm-wheel C^8, engaged by the worm C^7. The said worm is fixed to an axle C^6, which is rotated from the armature through the wheels C^4 C^5, or the said disk may be rotated by any other suitable means. A metallic lever B is mounted on an insulated pin B′ in the casing of insulating material B^9. The lever B carries at one end a suitable contact-point B^2, which is impelled by a suitable spring, such as B^4, into contact with the corresponding point B^{11} on the end of an insulated screw or other terminal B^3 in electrical connection (B^{12}) with a condenser N and suitably grounded to the dynamo. The said terminal B^3 is connected to one plate of the said condenser by terminal G^3, the other plate of the condenser being connected to terminal G′. A metal spring B^8, bearing constantly on the lever B, is carried by a bolt B^5, which is in direct connection (B^{13}) with the said end G^2 of the primary winding. The other end B^{10} of the lever B is impelled by the spring B^4 into contact with the periphery of the disk C, and when the said end B^{10} falls into one of the recesses C′, cut in the said periphery, the points B^2 B^{11} make contact, completing the primary circuit just before each sparking is required. As the leaving ends of the recesses lift the end B^{10} of the lever B and separate the points B^2 B^{11} the primary circuit is broken and the secondary current is induced. The number and position of the recesses C′ in the disk C correspond to the number of the cylinders K′ in the motor and the timing of their respective ignitions. The armature A has its rotation so related to that of the disk C that its winding A′ is always cutting magnetic lines of force and producing current at such times as the primary circuit is broken by the parting of B^2 and B^{11} and that the said armature occupies a position differing by half a revolution from its preceding position at each successive contact, so that the direction of the current in the circuit is reversed at each successive sparking, thus preventing pitting of the contact-points and keeping them in good condition. The parts of the apparatus are so proportioned that efficient high-tension sparks are produced at the lowest speeds at which the motor requires to be rotated at starting, while the point at which the circuit is broken is so adjusted relatively to the position of the armature A that the current flowing in the circuit is automatically prevented from rising above a safe value. This automatic regulation is partly due to the distortion of the magnetic field by the rotation of the armature, the distortion increasing as the angular velocity rises, and partly to the time required for the demagnetization of the armature-core. There is thus an increasing tendency for the maximum current to be produced later relatively to the angular position of the armature, and the breaking of the circuit therefore precedes the point of maximum current by an amount increasing with the rise of angular velocity, and as the current wave is increased by an increase of speed the current value at the moment the circuit is broken is maintained practically constant at all speeds, and injury to the contact-points and other parts due to an excess of current is prevented.

We fix a stationary plate D, of insulating material, opposite the disk C and provide it with as many metal studs D′ as there are working cylinders. The said studs D′ are arranged in a circular series concentric with the spindle C^9, and their inner ends lie flush with the surface of the plate D, while their outer ends form terminals and are connected to their respective ignition-plugs by suitable insulated wires. The terminal nuts D^2 are preferably made of insulating material. Another similar stud D^3 is arranged at the center of the plate D and is connected (D^5) to one end G^4 of the secondary winding of the coil. The disk C carries a sufficiently elastic radial metal finger D^4, the inner end of which is pivoted to the stud D^3. The said finger is carried around by a pin C^3, projecting from the face of the disk C, and its outer end is thereby brought into contact with each of the studs D′ in turn at periods when secondary currents are induced in the coil. The said secondary currents are thus led from the coil H to the terminal D^3, along the finger D^4 to one of the studs D′, and thence (D^6) to the corresponding sparking plug J, returning by any suitable path L to the other secondary terminal G^5 of the coil. The make-and-break mechanism may be conveniently provided with a separate cover B^6, of insulating material, the same being held in place by a thumb-nut B^7 screwing onto the end of the pivot-pin B′.

The case F is normally stationary; but it may be moved by turning the arm F^4 or otherwise, when a relative movement will be caused between the pinion E and the wheel A^7. The interrupting and distributing mechanisms are thereby caused to alter their angular positions with regard to the crank-shaft of the motor, and the time of sparking is thus

advanced or retarded, according to the direction in which the case F has been turned about the axis of the spindle A^6. The multiplication produced by the train of wheels $E' E^2 E^3 A^7$ is preferably such that a movement of the case F through a certain angle alters the time of sparking through an approximately equal angle on the crank-shaft of the motor. Suitable means are adopted for retaining the case F in any position to which it may be set until readjusted. After fitting the apparatus to a motor it should be adjusted or "timed" to the mean position of the sparking required by rotating the case F before finally fixing the arm F^4.

Although we have described our invention more particularly as applied to the explosion of the charges in an internal-combustion motor, it will be obvious that it may be applied in whole or in part to other suitable purposes in substantially the same manner.

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

1. In electrical ignition apparatus, the combination with a dynamo having an armature of interrupted-pole type, of a loose pinion, a first wheel fixed to the said loose pinion, a second wheel fixed to the armature, a double wheel gearing with the first and second wheels respectively and means for moving the axis of the said double wheel about the axis of the armature, substantially as and for the purpose set forth.

2. In electrical ignition apparatus, the combination with a dynamo, an induction-coil, a primary circuit, and a motor, of a disk, a number of recesses in the said disk, a fulcrum, a metallic lever movable on the said fulcrum, a blade-spring in electrical connection with the said lever, an insulated terminal, contact-points on the said insulated terminal and on one end of the said lever, a spring adapted to impel both the other end of the said lever into contact with the periphery of the disk and the said points into contact with each other, a sparking plug in each cylinder, metallic studs equaling in number the cylinders of the motor in electrical connection with the respective sparking plugs and arranged in a circular series concentric with the axes of the disk, a central metallic stud in electrical connection with one end of the secondary winding of the induction-coil, a finger carried by the disk and pivoted on the said central stud, and means for rotating the said finger with the said disk once for each cycle of the motor, such means being adapted to bring the outer end of the finger into contact with each of the studs in the circular series in turn, substantially as and for the purpose set forth.

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