G. HONOLD.

ELECTRICAL IGNITION DEVICE.

APPLICATION FILED MAR. 21, 1908.

1,165,601.

Patented Dec. 28, 1915.

3 SHEETS—SHEET 1.

Fig. 1.

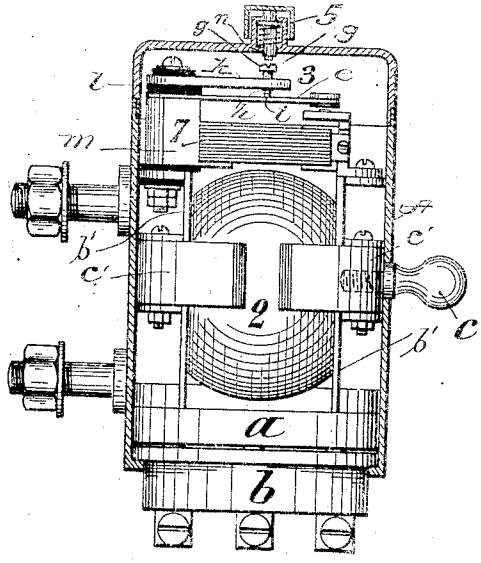



Fig. 2.

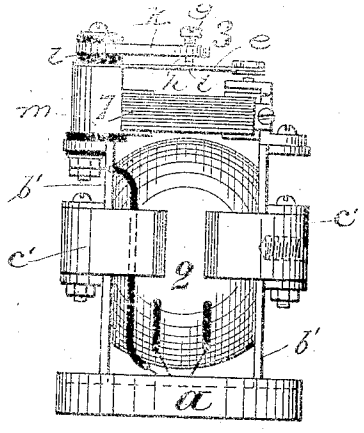



Fig. 3.

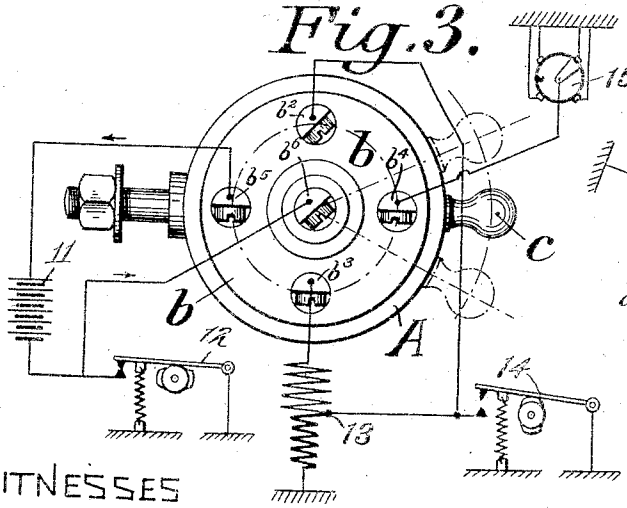
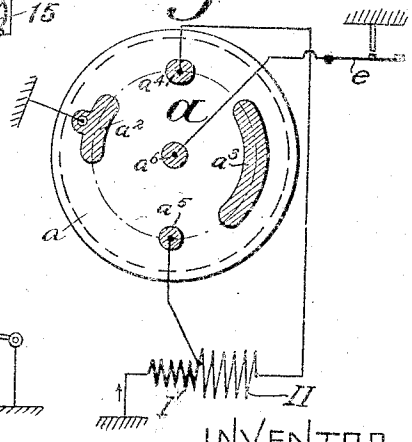



Fig. 4.




WITNESSES

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3 SHEETS—SHEET 2.

Fig. 5.

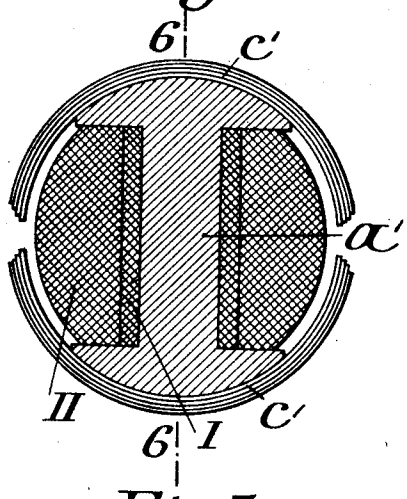



Fig. 6.

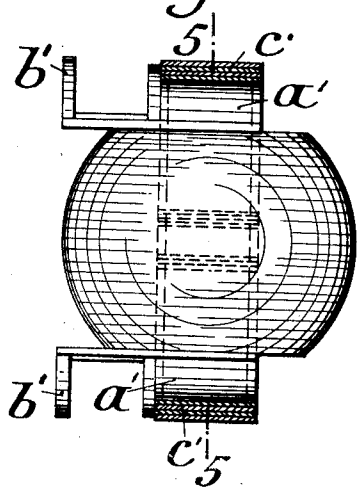
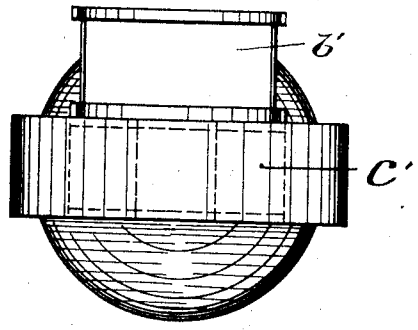



Fig. 7.




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3 SHEETS—SHEET 3.

Fig. 8.

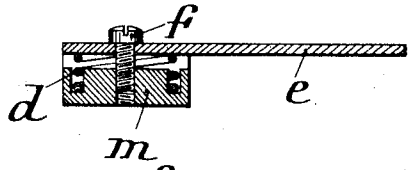



Fig. 9.

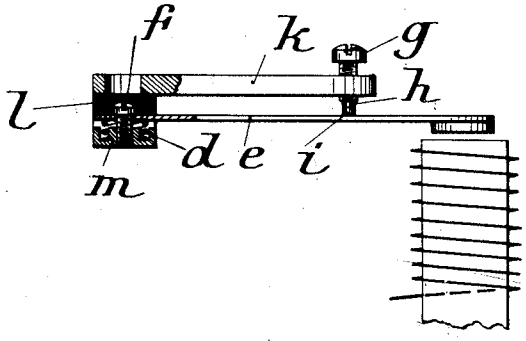



Fig. 10.

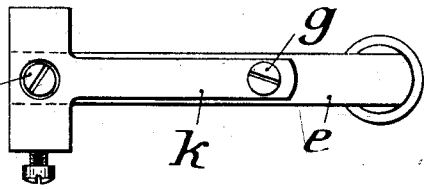



Fig. 11.

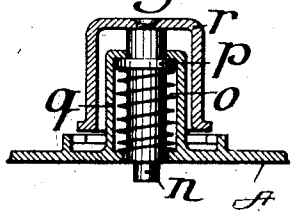



Fig. 12.

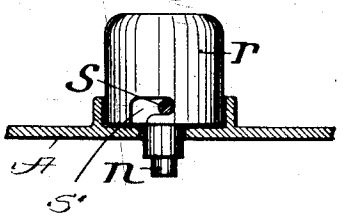



Fig. 13.

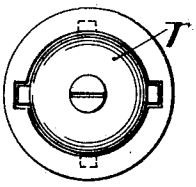
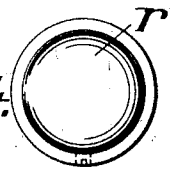



Fig. 14.




WITNESSES

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# UNITED STATES PATENT OFFICE.

GOTTLOB HONOLD, OF STUTTGART, GERMANY.

## ELECTRICAL IGNITION DEVICE.

1,165,601. Specification of Letters Patent. Patented Dec. 28, 1915.

Application filed March 21, 1908. Serial No. 422,417.

*To all whom it may concern:*

Be it known that I, GOTTLOB HONOLD, engineer, a subject of the German Emperor, residing at 11 Hoppenstrasse, Stuttgart, Germany, have invented certain new and useful Improvements in Electrical Ignition Devices; and I do hereby 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 appertains to make and use the same.

This invention relates to apparatus for applying the method of starting multi-cylinder internal combustion engines wherein a battery and coil ignition is used, described in U. S. Patent No. 1,003,743 of September 19, 1911.

In starting multi-cylinder internal combustion engines which after an interruption are set in motion again merely by igniting the charge in one of the cylinders there exist two cylinders wherein at this moment there is a compression equal to half the normal compression, and the cylinder in which ignition ought to occur is that one the ignition plug of which is put into circuit by the distributer. The common experience is, however, that the spark produced by the battery and the coil does not suffice to ignite a mixture the compression of which is low, unless the sparks follow each other repeatedly and rapidly, whereas a single spark suffices to ignite the mixture when the motor has once been started. It is therefore necessary, in starting the engine, to use a trembler such as is commonly employed when the ignition is by means of a battery or accumulator; whereas as soon as the engine is started the trembler may be dispensed with.

The present invention relates to the starting of multi-cylinder internal combustion engines by means of an ignition apparatus supplied with current from a battery or accumulator in which single sparks suffice for the ignition, and consists essentially in effecting the ignition in the first instance with aid of a trembler in known manner, and then effecting the ignition by single sparks when the engine has been started, the trembler being no longer in action.

This method, compared with those commonly used for starting the engine, in which the trembler is in action while the engine is running, presents the advantage that since single sparks are used during the running, the demand on the battery is considerably less and the electrodes of the ignition plug are less used. Moreover, all the defects of the trembler which unfavorably affect the quality of the ignition spark, do not come into play during running, so that the disadvantage inherent in the trembler, namely that it always requires a certain interval of time before it starts vibrating, which delay may retard the ignition at high speeds to an extent close upon an angle of 25° and gives rise to irregular working, is avoided.

The object of the present invention is to assemble all the parts compactly with the push-button and the plate carrying the switch terminals mounted on the casing which incloses the other parts.

In the accompanying drawings Figure 1, is an elevation of the assembled apparatus, the casing being shown in section; Fig. 2 is an elevation of the coil removed from the casing; Fig. 3 is an underside plan of the apparatus showing the electrical connections in a diagrammatic manner; Fig. 4 is an underside plan of the switch plate, displaced 90° relatively to Fig. 3, and showing the electrical connections in a diagrammatic manner; Fig. 5 is a section on line 5—5 of Fig. 6; Fig. 6 is a part section on line 6—6 of Fig. 5; Fig. 7 is an underside plan of Fig. 6; Fig. 8 is a part longitudinal section through the trembler spring; Fig. 9 is a diagrammatic sectional elevation of the whole trembler; Fig. 10 is a plan of the trembler spring; Fig. 11 is a vertical section through the push button in its normal position; Fig. 12 is an elevation thereof partly in section, the button being depressed; and Figs. 13 and 14 are plans of Figs. 11 and 12 respectively; Figs. 8—14 are drawn to an enlarged scale.

The casing A is provided with an annularly disposed slot through which projects a handle *c* extending radially from a frame within the casing which frame carries the vibrator, the coil, and the switch plate. This is for the purpose of bringing the plate into the various switching positions, though it may be equally convenient to arrange for turning the plate *b* carrying the switch terminals, leaving the other parts stationary. In either case, apart from the movable contacts $a^2$, $a^3$, $a^4$, $a^5$ and $a^6$ of the switch and the contact of the push-button, all the connections may be made by perme-

nent assembling devices which need not be taken apart even for inspection and removal of the coil, and even for this the connecting leads need not be disarranged.

The battery 11 and the ignition current generator 13, shown in Fig. 3, are connected by suitable leads or conductors with the contact spring *e*, the condenser 7, the coil 2, and the switch (consisting of the switch plate *a* and the terminal plate *b*) so as to form the several circuits set forth in the aforesaid patent.

To permit compactness I give the iron core of the induction coil 2 a special form which is illustrated in Figs. 5, 6 and 7. The characteristic feature of this form is that the core, constructed as usual of laminated iron has the form of a shuttle armature. In the drawing *a'* is the core, *b' b'* the brackets for fixing it, and *c'* sheet iron segments mounted on the pole pieces and serving to improve the closing of the magnetic circuit.

I and II are the two windings.

The preferred form of trembler or vibrator is shown in Figs. 8, 9 and 10, in Figs. 9 and 10 of which the magnet is shown diagrammatically. In a piece of metal *m* is incased a helical spring *d* which presses the contact spring *e* against the adjusting screw *f*. The latter controls the height of the contact spring, so that by adjusting it the most favorable position of the spring relatively to the magnet core and contact screw *g* is attained. Above the piece *m* and the contact spring *e* is fixed a casting *k* separated from the spring by an insulating piece *l*. In this casting is screwed the contact screw *g* having a platinum contact at its end to bear against the platinum *i* on the contact spring *e*.

The metal block *m* supports the condenser 7, and is secured to but insulated from one of the arms or brackets *b'* to the lower ends of which the switch plate *a*, is secured, and to the central portion of which the coil 2, is secured, the several elements being thus brought compactly together in a single structure which is rotatably supported within the casing A and manipulated by means of the handle *c*. The advantage of this trembler as compared with known vibrators resides in the fact that its manufacture is exceedingly simple and cheap and that the tension and position of the contact spring *e* may be easily adjusted by turning the screw *f*.

The switch, composed of the movable switch plate *a* and the stationary terminal plate *b*, is adapted to cut out the ignition entirely, or to bring the magneto alone, or the battery alone, into circuit as desired, these adjustments being accomplished by shifting the handle *c* into the various positions indicated in Fig. 3. As shown in Fig. 4, the switch *a* carries the contacts $a^2$, $a^3$, $a^4$, $a^5$ and $a^6$. The contact $a^6$ is connected with the contact spring *e* of the vibrator; the contact $a^2$ is grounded as indicated; the contact $a^3$ is unconnected; the contact $a^4$ is connected to the outer end of the secondary winding II; and the contact $a^5$ is connected to the junction between the primary winding I and the secondary winding II of the coil 2. The stationary contact plate *b* is provided with the contacts $b^2$, $b^3$, $b^4$, $b^5$ and $b^6$. The contact $b^6$ is connected to one terminal of the battery 11 and to the stationary contact of the mechanical battery interrupter 12; the contact $b^2$ is connected to the junction between the primary and secondary windings of the magneto or ignition current generator 13, and also to the stationary contact of the mechanical magneto interrupter 14; the contact $b^3$ is connected to the outer end of the secondary winding of the ignition current generator 13; the contact $b^4$ is connected to the rotating brush of the distributer 15; and the contact $b^5$ is connected to the other terminal of the battery. When it is desired to start the ignition, the handle *c* is placed in the starting position shown in Fig. 3 in the bottom position indicated by broken lines and the push button 5 is depressed until its contact terminal *n* engages the contact terminal *g* of the arm *k* to thereby ground the contact spring *e* on the casing A. The current then flows from the battery 11 through the contacts $b^6$, $a^6$ to the contact spring *e*, and through the contacts *i*, *h* and *g*, *n* to the casing A. Inasmuch as the primary winding I is grounded on the casing, the current flows through this winding and back to the other terminal of the battery through the contacts $a^5$, $b^5$. In flowing through the primary winding I, a high tension ignition current is produced in the secondary winding II at each interruption, and the ignition current is conducted through the contacts $a^4$, $b^4$ to the distributer 15 and the spark plugs of the engine. When the engine has been started, the vibrator is cut out of the circuit by releasing the button 5, and the ignition then proceeds in the usual manner, the battery current flowing, during the period of ignition, by way of the engaged contacts of the mechanical interrupter 12 to the grounded end of the primary winding I, instead of through the contacts $b^6$, $a^6$.

By moving the handle *c* to the intermediate position shown in full lines in Fig. 3, the battery 11 and the vibrator *e* (shown with its electrical connections in Fig. 4) are cut out of circuit, and the ignition current generator 13 is cut into circuit by reason of the fact that the contact $a^3$ then connects the contacts $b^3$ and $b^4$ to connect the sec-

ondary winding of the ignition current generator 13 to the distributer 15.

In order to cut out both ignition systems, the handle $e$ is moved to the uppermost position shown in broken lines in Fig. 3, thereby grounding the insulated end of the primary winding of the ignition current generator 13 through the contact $a^2$, and disengaging all the other contacts of the plate $a$ from the contacts of the plate $b$.

Ordinarily, the push button 5, which throws the trembler or vibrator into action will be only momentarily depressed. In practice, however, it may sometimes happen that, the battery ignition being in circuit, it is desirable to keep the trembler in operation so as to utilize for ignition a series of sparks instead of one alone. In this case the control is still through the usual interrupter which is operated by the engine and which suspends the action of the trembler as soon as the contacts of the interrupter come together.

One part of this invention relates to a construction of the button 5 which allows of its being brought into position for making its contact either momentarily or for any length of time as may be desired. For this purpose the button is constructed to be turned as well as to be moved axially; when thus turned it is kept in the position in which it closes the contact. This construction is shown in Figs. 11 to 14. The rod $n$ is urged upward by spring $o$ in such manner that collar $p$ on the rod abuts against the inner surface of the top of the cap $q$, formed or secured on the casing and through a perforation in which the rod extends. To the top of the rod $n$ is fixed a cap $r$ adapted to be retained in its depressed position by a bayonet slot $s'$ engaging a radial pin or lug $s$ on the cap $q$, as shown in Fig. 12.

It is advantageous that the button or rod $n$ should itself form a part of the conducting mass of the apparatus, for in this manner complicated arrangements for insulating the button are avoided, and the latter, which is exposed to the air, may be made of metal.

To connect the button with the mass of the engine, the whole casing may advantageously be made of metal, the most convenient form being that of a hollow cylinder, as shown in Fig. 1. At the same time this arrangement secures high durability and resistance to external influences, as well as economy of space.

Having thus fully described my invention, what I claim is:

1. In an ignition apparatus, the combination, with a casing, an induction coil rotatable therein, a trembler spring carried by said induction coil and in electrical communication with the primary of said coil, and means extending outside the casing for rotating the said induction coil and trembler spring, of a yielding contact device carried by the casing and arranged to be moved into contact with said trembler spring to close an electrical circuit therethrough.

2. In an ignition apparatus, the combination, with a cylindrical casing, an induction coil rotatable therein and a trembler spring mounted on one end of said induction coil, and electrically connected with said coil, of a cap for closing one end of said casing, a push button device, carried by said cap and arranged to contact with said trembler spring to close an electric circuit therethrough, and means extending outside the casing for rotating said induction coil and spring.

3. In an ignition apparatus, the combination, with a casing, an induction coil rotatable therein, a trembler spring, a condenser and a movable switch-plate carried by said induction coil, said switch-plate having a plurality of independent contacts, leads electrically connecting the coil, the condenser and the trembler spring to the respective contacts of the switch-plate, and means extending outside the casing for rotating the induction coil and its connected parts, of a stationary switch-plate in fixed relation to the casing, said stationary switch-plate having contacts arranged to engage the respective contacts of the movable switch-plate and having conductor terminals and a push-button device carried by the casing and arranged to close an electrical circuit through the trembler spring.

4. In an ignition apparatus for multi-cylinder internal combustion engines, the combination, with a casing, an induction coil rotatable therein, a trembler spring, a condenser, and a movable switch-plate carried by said induction coil, said switch-plate having a plurality of independent contacts, leads electrically connecting the coil, the condenser and the trembler spring to the respective contacts of the switch-plate, and means extending outside the casing for rotating the induction coil and connected parts of a stationary switch-plate in fixed relation to the casing, said stationary switch-plate having contacts arranged to engage the respective contacts of the movable switch-plate and having conductor terminals, a push button device carried by the casing and arranged to close an electric circuit through the trembler spring, and means for locking said push button in its closing position.

5. In an ignition apparatus, the combination, with an induction coil comprising a core and a winding having one end grounded on its core, a movable switch-plate in fixed relation with the induction coil and having a plurality of separate contacts, a condenser and a trembler spring in fixed relation to

said induction coil, a lead connecting the trembler spring and one terminal of the condenser to one of the said contacts on the movable switch-plate, leads connecting two points of the winding of the induction coil to two separate contacts of said movable switch-plate, a metallic casing in which the induction coil, condenser, trembler spring and movable switch-plate are rotatably mounted, and means extending outside the casing for rotating said induction coil and its connected parts, of means for grounding the other terminal of the condenser on said casing, manually operated means for grounding the trembler spring on the casing, and a stationary switch-plate in fixed relation to the casing and provided with contacts arranged to engage the respective contacts of the movable switch-plate, the contacts of said stationary switch-plate having cable terminals, substantially as described.

6. In an ignition apparatus for internal combustion engines, the combination, with a casing, an induction coil in said casing, a trembler spring arranged to be actuated by the induction coil, an adjusting screw and a helical spring arranged to press said trembler spring against the said adjusting screw, and yielding means carried by the casing and arranged to close an electrical circuit through the trembler spring.

7. In an ignition apparatus for internal combustion engines, the combination, with an induction coil comprising a shuttle-armature shaped core and windings thereon, one terminal of said windings being grounded on said core, a trembler spring arranged to be actuated by the induction coil, means for electrically connecting one end of said trembler spring with the windings of the induction coil, and means for making an interruptable electrical connection between the trembler spring and the core of the induction coil.

8. In an ignition apparatus for internal combustion engines, the combination, with a cylindrical metallic casing, an induction coil having a shuttle-armature shaped core and windings thereon, one terminal of said windings being grounded on the core, said coil being rotatable in said casing and having its core in electrical communication with the casing, a trembler spring, a condenser and a movable switch-plate carried by said induction coil, said movable switch-plate having a plurality of contacts, leads connecting one terminal of the condenser and the trembler spring to one of the contacts of the movable switch-plate, a lead connecting the same contact to the windings of the induction coil, and a lead connecting another contact of the movable switch-plate to the windings of the induction coil, of a stationary switch-plate having separate contacts, one permanently in contact with that contact of the movable plate to which the trembler spring and condenser are connected and a contact arranged to engage the other contact of the movable plate to which the induction coil winding alone is connected, the contacts of the stationary plate having cable terminals, means for intermittingly making a contact between the trembler spring and the casing, and means outside the casing for rotating the induction coil and its attached parts, whereby one contact of the movable plate is moved out of engagement with the corresponding contacts of the stationary plate.

9. In an ignition apparatus, for internal combustion engines, the combination, with a cylindrical casing, an induction coil rotatable therein, a trembler and a movable switch-plate carried by said induction coil and in fixed relation thereto, and means extending outside the casing and arranged to rotate said coil and its attached parts, of means for connecting the trembler and the windings of the induction coil to contacts of the movable switch-plate in parallel relation, and a stationary contact plate in fixed relation to the casing and provided with contacts arranged to engage the corresponding contacts of the movable switch-plate, said stationary plate having cable terminals in connection with its said contacts.

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

GOTTLOB HONOLD.

Witnesses:
REINHOLD FLWERT,
ERNST ULMER.