C. F. KETTERING.

CURRENT INTERRUPTER.

APPLICATION FILED JULY 14, 1910.

1,192,906. Patented Aug. 1, 1916.

Fig. 1.

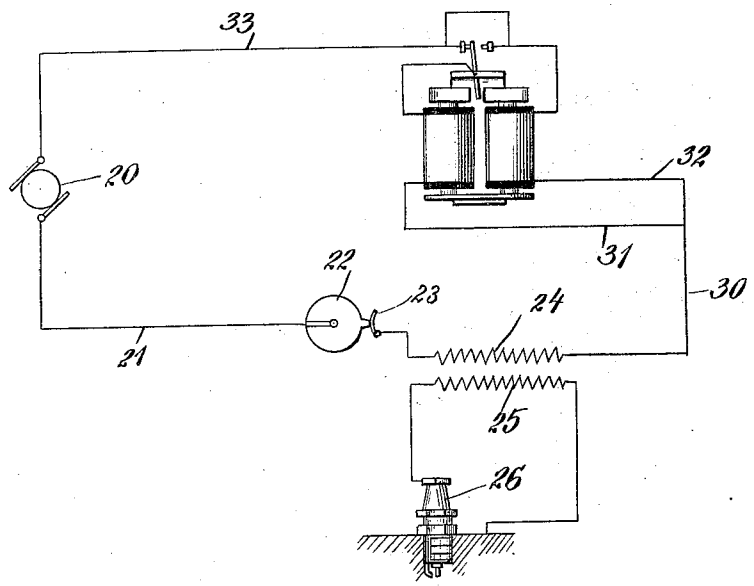


Fig. 2.

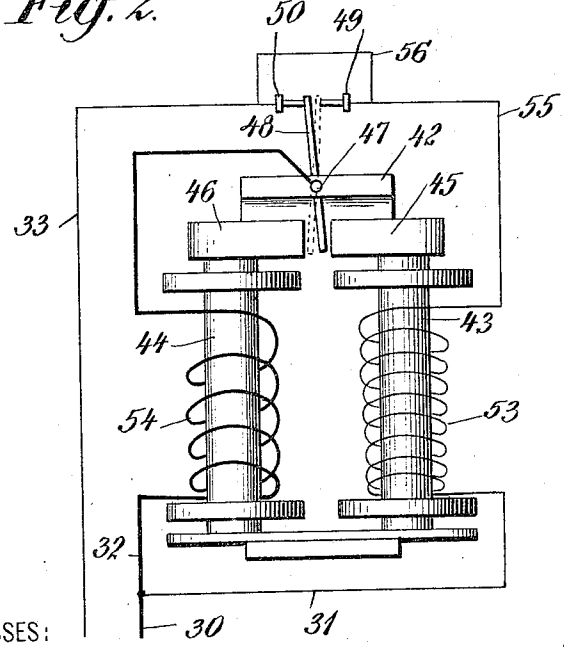
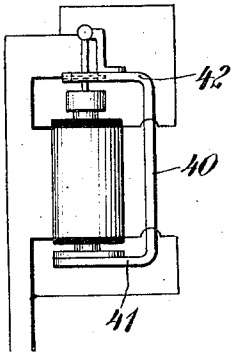


Fig. 3.



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UNITED STATES PATENT OFFICE.

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CURRENT-INTERRUPTER.

1,192,906. Specification of Letters Patent. Patented Aug. 1, 1916.

Application filed July 14, 1910. Serial No. 571,892.

To all whom it may concern:

Be it known that I, CHARLES F. KETTERING, a citizen of the United States, residing at Dayton, county of Montgomery, and State of Ohio, have invented certain new and useful Improvements in Current-Interrupters, of which the following is a full, clear, and exact description.

This invention relates to improvements in current interrupters and is particularly adapted to ignition devices for explosive engines.

It has among its objects to provide a form of construction which will produce a single igniting spark for each contact of the timer or interrupter which controls the sparking in the cylinders of the engine; and also to provide such form of spark controlling device as will be as free as possible from difficulties arising from the rapid oscillations of the make and break device for the circuit, that is, to eliminate as far as possible the detrimental effects of any mechanical periodicity of the contact breaker itself. It is to be understood that these improvements partly relate to current interrupters, but I refer to them above and hereinafter, as more particularly applied to ignition systems, wherein their practical adaptability can readily be pointed out. The advantages of these improvements, in their various uses, to which they may be applied, will be observed by those familiar with the characteristics of these devices.

These improvements are particularly applied to a form of apparatus in which the main source of current for the primary or induction coil is an alternating current such as would be supplied by magneto, and it is one of the purposes of this invention to insure correspondence between the vibrations of the current interrupter and the changes of the direction of alternating current.

With these and incidental objects in view, the invention consists in the combination of mechanisms hereinafter described with reference to the accompanying drawings, forming part of this specification.

In said drawings, Figure 1 represents a diagrammatic vew of my improvements: Fig. 2 is a detailed view of the current interrupter: and Fig. 3 is a smaller side view of the parts shown in Fig. 2.

It may be stated that although the invention as herein shown is applied to one sparking coil and one cylinder, it is equally applicable to be used in any number of cylinders with corresponding number of spark coils or with a distributer system for various cylinders, the timer and distributer being arranged accordingly.

The current from the magneto 20 is led through a wire 21 to the timer 22 which makes contact with the point 23 to close the circuit through a primary coil 24 of the induction coil. This induction coil has a secondary 25 connected with the spark plug 26 in a well-known and usual manner.

The primary coil 24 is connected to a wire 30 which leads to the current interrupter through divided circuits 31 and 32, as will presently be explained; and the wire 33 leads from the interrupter back to the magneto to complete the circuit.

The interrupter comprises a permanent magnet 40 which is bent at right angles to form two arms 41 and 42. Mounted between these two arms are two soft iron cores 43 and 44 connected at their lower ends to the permanent magnet arm 41 and surmounted at their upper ends by the pole pieces 45 and 46.

Pivoted at 47 to the upper magnet arm 42 is a switch arm 48, the lower end of which extends between the pole pieces 45 and 46, and the upper end of which extends between two contact pins 49 and 50.

The core 43 is surrounded by a high resistance coil 53 connected at one end with the wire 31 and at the other end with the contact pin 49 by means of a wire 55. Surrounding the core 44 is a low resistance coil 54 which is connected to the switch arm 48. A wire 56 connects across from the wire 55 to the wire 33.

The operation of these parts is as follows:—The device in reality, forms parts of two magnetic circuits, the first of which is composed of the permanent magnet 40 and the soft iron cores 43 and 44, with their pole pieces 45 and 46; and the second magnetic circuit is an electro-magnetic circuit, composed of the cores 43 and 44 and receiving its magnetic flux, by the energizing of the coils 53 and 54, so that the magnetic flow is through said coils and through the pole pieces 45 and 46, and across the gap which separates said pole pieces. Now when no current is flowing in the electric circuit, the first of these above mentioned magnetic cir-

cuits, controls the switch lever 48. That is said switch lever, being of magnetic material, forms part of the first magnetic circuit, of which the permanent magnet 42 is a part. Therefore with the electric circuit open, the switch arm 48 will be held by this magnetic circuit, either in the full line position of Fig. 2, or in the dotted line position, according to whichever position it was last in.

It is the second magnetic circuit, or the electro-magnetic circuit, which causes the switch lever 48 to oscillate from one side to the other. For example, assume that the said lever has been left in the full line position of Fig. 2, and that the current then is started from the magneto, to go through the coils 54 and 53. These coils, that is, the low resistance coil 54 and the high resistance coil 53, are so wound that when the current is established by the magneto 20 and the timer 22, through the primary 24, of the induction coil, this establishes the electro-magnetic circuit through the cores 43 and 44, and their pole pieces 45 and 46. If the polarity of the pole piece 45, is then the same as the polarity of the permanent magnetic arm 42, the lower end of the switch lever 48 will be repelled so that the lever will move to dotted line position. That is, assuming that the permanent magneto 40 has its north pole at 42, and that the initial direction of the magnetic current is such as to make the electro-magnetic circuit produce a north pole at the pole piece 45, then the switch lever 48, will be swung from its dotted line position. Thus, whereas just previously the lines of magnetic force in the permanent magnet system, were running from the north pole arm 42, through the switch lever 48, to the soft iron pole piece 45, these magnetic lines are now running through the switch arm 48, to the pole piece 46, of the electro-magnetic system, and likewise, the lines of magnetic force of the electro-magnetic system, are running across the air gap, from the north pole 45, to said pole 46. The result of this movement of the lever 48, is to break the current through the low resistance coil 54, during the time that the lever 48 is swinging from the contact pin 50 to the contact pin 49. That is, when the current first started to flow, it was established through the wire 30 where it divided into two branches, one branch through the low resistance coil 54, switch 48, to contact pin 50, and the other branch through the high resistance coil 53, wire 55, wire 56, thus joining the first branch and thus proceeding back to the magneto through the wire 33.

The breaking of the current by the shifting of the lever 48, as just above described, creates such a sudden change in the intensity of the current through the primary 24 of the induction coil as to cause the necessary spark produced by the secondary coil 25. The auxiliary or shunt coil 53 serves to continue the movement of the switch lever 48 to shift its position after the current through the low resistance coil had been broken. As soon as the lever 48 has shifted to its dotted line position making contact with the contact pin 49, the current through the low resistance coil 54 is again established through the contact pin 49, wire 56, back to the magneto so that the divided circuit conditions are again established. The parts are held in this position so long as the current from the magneto flows in this direction. As soon as the alternating current from the magneto reverses its direction, the polarity of the pole pieces 45 and 46 is again reversed with the obvious result that the switch lever 48 is then shifted back to the full line position shown in Fig. 2. This again results in breaking the circuit through the low resistance coil 54 so as to produce another spark by the sudden change in the intensity of the current through the primary 24. To follow out the example given above, this shifting back of the lever 48 to its full line position, takes place when the direction of current through said coils makes a north pole out of the pole piece 46, so that the magnetic flux in the electro-magnetic circuit is now from pole piece 46, across the air gap, to pole piece 45. This change in the current through the coils is, of course, the change in direction of the current as produced by the magneto or other source of alternating current. Therefore, if the pole piece 46 is north, this will repel the switch lever 48, and the said pole piece 45 will attract the same so that the lever remains in its full line position, so long as the current is flowing in that particular direction. This is what produces the successive oscillations of the switch lever 48, from one position to the other, solely by the changes in direction of the alternating current and synchronously therewith. Thus both the breaking of the current and the making of it again, are brought about by this same device and under the control of the circuit itself, without the use of extraneous springs, which have a periodicity of their own, or other mechanical means which offer the same objection. Therefore the switch lever 48 may be termed a polarized armature. It normally partakes of the polarity of the arm 42, of the permanent magnet, and forms a part of that magnetic system, at the same time it acts in cooperation with this second or electro-magnetic circuit, which is produced by the alternating current, through the pole pieces 45 and 46, and which reverses itself in direction. This makes it possible for the electro-magnetic circuits, in its reversals of magnetic flux, to oscillate this polarized armature 48, from one pole piece to the other, according to the direction of the magnetic flow in this

electro-magnetic circuit. This successive oscillation of the switch lever 48 continues with the successive alternations of current from the magneto. It will thus be apparent that the switch lever 48 is under the control of the alternating current from the magneto and will accurately follow the rapid changes of direction of the alternating current, being non-synchronous itself, that is, having no period of vibration of its own independent of the periodicity of the alternating current.

By having the timer and the magneto connected together so that the timer makes contact for the primary 24 only during one change of direction of the magneto alternating current, a single spark may be produced for each contact of the timer, and where the timer is used to distribute the current through a plurality of primaries or induction coils, this single spark is produced successively in the different induction circuits, following accurately the corresponding alternations of the magneto current.

While the form of mechanism herein shown is one which is particularly well suited to accomplish the objects sought, I desire it to be understood that other forms of construction might be utilized without departing from the spirit of this invention as set forth in the claims below.

What is claimed is as follows:—

1. A current interrupter, comprising a source of alternating current, a main circuit therefor and means controlled by said current for making and breaking the main circuit synchronously with the successive changes in the direction of flow of the current.

2. A current interrupter, comprising a source of alternating current, and means controlled by said current for breaking the circuit synchronously with the successive changes of direction of flow and automatically reëstablishing the alternating current circuit after each break and prior to the succeeding break.

3. A current interrupter, comprising a source of alternating current; a make-and-break device in circuit therewith: and an electro-magnet also in circuit therewith and coöperating with said make-and-break device to make and break the circuit synchronously with the alternations of said current.

4. A current interrupter comprising a source of alternating current; a make and break device in circuit therewith, having two positions of adjustment in which said circuit is made, and in the intermediate position of which said circuit is broken; an electromagnet also in circuit with said make and break device, and acting upon the latter, to make and break the circuit, synchronously with the alternations of said current by shifting said device from one position of adjustment to the other; said electro-magnetic device including an auxiliary coil, shunted around said make and break device and also around the main coil of the electro-magnet.

5. A current interrupter, comprising a main source of alternating current; a vibratory switch lever in circuit therewith; two contact points located on opposite sides of said switch lever and each connected in series in said circuit; and an electro-magnetic coil in series with said circuit for vibrating the switch lever between its two contact points.

6. A current interrupter, comprising a main source of alternating current; a vibratory switch lever in circuit therewith; two contact points located on opposite sides of said switch lever and each connected in series in said circuit; an electro-magnetic coil in series with said circuit, for vibrating the switch lever between its two contact points; and an auxiliary electro-magnetic coil shunted around the main coil and switch and connected to said two contact points.

7. In an ignition device for explosive engines, the combination with a source of alternating current, an induction coil and sparking device, and a timer for making contact through the primary of said induction coil; of an interrupter comprising a polarized armature and a low resistance coil in series with the primary coil, and duplex contact points also in series with the primary coil, with which contact points said polarized armature successively makes contact to make and break the main circuit synchronously with the successive alternations of said current.

8. In an ignition device for explosive engines, the combination with a source of alternating current, an induction coil and sparking device, and a timer for making contact through the primary of said induction coil; of an interrupter comprising a polarized armature and a low resistance coil in series with the primary coil, and duplex contact points also in series with the primary coil, with which contact points said polarized armature successively makes contact to make and break the main current synchronously with the successive alternations of said current, and a high resistance coil shunted around said low resistance coil and armature and connected to said duplex contact points, said coils being wound to operate simultaneously upon said armature to vibrate the same from one contact point to the other and break and make the main circuit with each change of direction of the current through said coils.

9. In a current interrupter, the combination with a source of alternating current, an electro-magnetic circuit connected therewith; of means for synchronously breaking

the electro-magnetic circuit with the successive alternations of the current, therein, and a permanent magnet for normally controlling said means when the electro-magnetic circuit is open.

10. In a current interrupter, comprising a source of alternating current, the combination with an electro-magnetic circuit; and means actuated by said electro-magnetic circuit for breaking said circuit synchronously with the alternations of current therein; of a permanent magnetic circuit included in said electro-magnetic circuit for maintaining the position of said electrically actuated means when the electro-magnetic circuit is open.

11. A current interrupter, comprising a source of alternating current, an electro-magnetic circuit connected therewith; a polarized armature electrically controlled to effect the breaking of the electro-magnetic circuit synchronously with the alternations in the flow of current therein; and a permanent magnetic circuit coöperating with said electro-magnetic circuit to actuate said polarized armature to break the electro-magnetic circuit; whereby said permanent magnetic circuit will assist in controlling the position of the polarized armature, until the direction of the flow of current is changed, and will maintain the position of the polarized armature when said electro-magnetic circuit is open.

12. In a current interrupter, the combination with a source of alternating current having a circuit connection; a make and break device for said connection; an electro-magnetic device including an armature also in said connection, and adapted to make and break the circuit connection synchronously with the alternations of direction of said current; and permanent magnetic means for maintaining the armature in the position determined by the direction of current flow through the electromagnetic device.

13. In a device of the class described, a permanent magnet having a polarized armature, and having a pair of soft iron pole pieces normally of like polarity, electro-magnetic windings adapted when energized to reverse the polarity of one of said pole pieces, a source of alternating current supply, a contact maker operating in timed relation with said alternating current source to cause the energization of said coils alternately in reverse direction during the successive current reversals in said circuit, and connections controlled by said armature for abruptly reducing the current in said circuit during each alternation.

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

CHARLES F. KETTERING.

Witnesses:
J. B. HAYWARD,
CHAS. D. BRONSON.