E. S. LINCOLN.

UNISPARK IGNITION SYSTEM.

APPLICATION FILED SEPT. 3, 1910. RENEWED FEB. 27, 1912.

1,039,973. **Patented Oct. 1, 1912.**

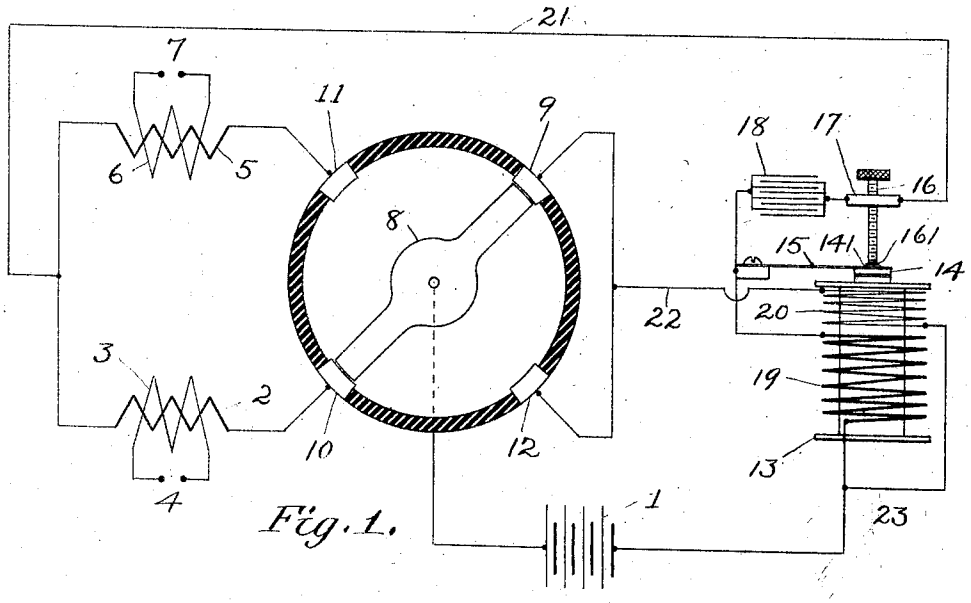

Fig. 1.

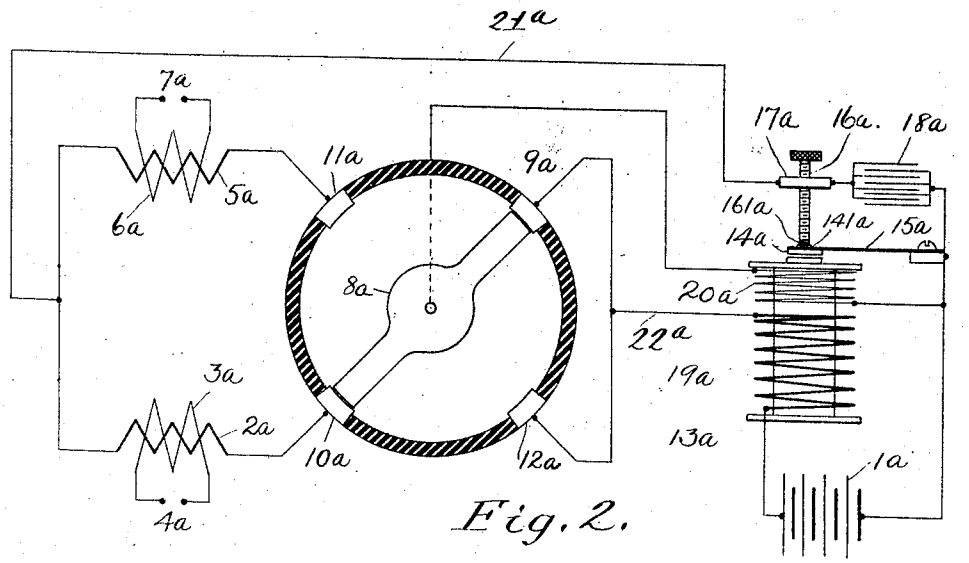

Fig. 2.

Witnesses:
Oscar F. Hill
Glen O. Spring

Inventor:
Edwin S. Lincoln,
by Nathan B. Day,
Attorney.

UNITED STATES PATENT OFFICE.

EDWIN S. LINCOLN, OF BROOKLINE, MASSACHUSETTS, ASSIGNOR TO ELECTRIC GOODS MANUFACTURING COMPANY, A CORPORATION OF MAINE.

UNISPARK IGNITION SYSTEM.

1,039,973. Specification of Letters Patent. Patented Oct. 1, 1912.

Application filed September 3, 1910, Serial No. 580,397. Renewed February 27, 1912. Serial No. 680,164.

To all whom it may concern:

Be it known that I, EDWIN S. LINCOLN, citizen of the United States, residing at Brookline, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Unispark Ignition Systems, of which the following is a specification.

My invention in general relates to electric systems designed to induce a high tension electric current adapted to cause an electric discharge between electrically separated electrodes, and more especially has reference to ignition systems in which are included a battery, or similar source of electrical energy, an induction coil having a primary circuit energized by said battery, and a circuit interrupter or circuit breaker embodying separable contacts intercalated in the energizing circuit, and an electro-magnet for causing the separation of said contacts and for thereby interrupting the energizing circuit.

For the purpose of securing economy in the consumption of electric current in ignition systems of the above type, a contact maker or distributer is employed for intermittently placing the battery in energizing relation with the desired primary winding, for the brief period during which the system is designed to become operative as an igniting agency. In order to secure still further economy in current consumption, arrangements which serve to modify the action of the circuit interrupter, intercalated in the energizing-circuit of the ignition system, have been adopted so that the system operates to produce but a single spark during the period when the distributer operates to connect the battery in energizing relation with the induction coil.

My invention applies more especially to ignition systems in which the modification of the action of the circuit interrupter for the purpose of securing but a single action of the ignition system is secured by the use of an electro-magnet for operating or actuating the circuit interrupter or breaker, in which are provided two magnetizing windings, one winding being of coarse wire and embodying a low resistance, and the other winding being of fine wire with a high resistance; the function of the coarse winding being to initiate a discharge producing movement of the moving element of the circuit breaker into its open circuit position, and the function of the fine winding being to retain said moving element in such position as long as desired.

In systems of the type just described, said coarse winding has been commonly connected in series with the primary winding of the induction coil, so that when the energizing circuit is established by the operation of a distributer or timer, the flow of current energizing the primary winding through the coarse magnetizing winding will cause the disengagement of the separable contacts of the circuit breaker, and interrupt the flow of the energizing current in a manner familiar to those conversant in the art. When such disengagement of the separable contacts occurs, the interruption to the flow of current through the coarse magnetizing winding would result in the demagnetization of the electro-magnet and the separable contacts of the circuit breaker would again reëngage, restoring the circuit breaker to its original closed-circuit condition were it not for the flow of current in the fine magnetizing winding which, being ordinarily connected in parallel with the coarse magnetizing winding, and arranged as a shunt circuit around the separable contacts of the circuit interrupter, offers an alternative path for the flow of current adapted to magnetize said magnet. Owing to the high resistance of the fine magnetizing winding the flow of such current is small, but it is so calculated as to produce a sufficient magnetization in the magnet to retain the movable circuit of the circuit interrupter in its open-circuit condition and thereby to interrupt the flow of the main or energizing current until the system is electrically disconnected from the source of energy by the action of the distributer or timer.

Ignition systems embodying an electro-magnet having plural windings arranged and operating as above set forth have hitherto presented disadvantages which are due to the fact that the fine magnetizing winding is arranged as a shunt only to that portion of the energizing circuit in which is included the coarse magnetizing winding and the separable contacts of the circuit inter-

rupter, so as to establish a permanently closed circuit around such portion of the energizing circuit among which disadvantages may be mentioned the following. After the circuit breaker has operated to interrupt the flow of current which passes through the coarse magnetizing winding and energize the induction coil, a current of small volume still continues to flow through the primary winding of the induction coil by way of the fine winding of the magnet. In consequence, after the interruption of the flow of energizing current through its primary winding of the induction coil by the operation of the circuit interrupter, the coil is not completely deënergized, and the efficiency of the coil as an inductive agency is less than it would be were the said coil completely deënergized at each interruption of the primary circuit by the action of the circuit interrupter. In addition, owing to the fact that the condenser, which is preferably included as a part of the ignition system, is electrically connected in shunt around the separable contacts of the circuit interrupter, said condenser, in the separated position of the circuit interrupter contacts, is itself short-circuited through the fine magnetizing winding, which shunt circuits the said separable contacts. By reason of the short circuiting of the condenser as aforesaid through the fine magnetizing winding, the action of the condenser is retarded and the efficiency of the ignition system as a whole is, in consequence, impaired. Furthermore since in the ignition systems employing an electromagnet having plural windings as above described, the fine magnetizing winding has been connected in parallel with and as a shunt directly around the terminals of the coarse magnetizing winding, and around the separable contacts of the circuit breaker, such coarse winding being included in the energizing circuit, it will result, because of the relatively high resistance of the fine magnetizing winding as compared with the substantially resistance-free circuit, through the coarse winding and the separable contacts, that little or no current will pass through the fine winding until after the interruption of the energizing circuit by reason of the actuation of the circuit breaker. Because of these considerations it will follow that the coarse winding will become energized first, and a flow of magnetizing current through the fine winding of the electro-magnet will not occur until, by reason of the interruption of the main energizing circuit through the coarse winding by the action of the circuit breaker, the fine winding alone is left available as a path for the flow of current from the source of energy. In other words the coarse winding and the fine winding become energized in succession, and not contemporaneously, the fine winding remaining inactive until the interruption of the energizing circuit through the coarse winding by the operation of the circuit breaker.

It is the object of my invention to obviate the objections heretofore pointed out as incident to the use of a circuit interrupter magnet having plural windings arranged and connected substantially as hereinbefore described.

My invention, therefore, consists in a combination of electrical apparatus adapted for use in a high tension discharge producing system, and including a circuit breaker having an electro-magnet provided with high and low resistance magnetizing windings, so arranged and electrically interconnected in such manner as to secure the electrical separation of the high resistance magnet winding from the primary circuit of the induction coil, to avoid the short circuiting of the condenser by the fine magnetizing winding, and further to secure such an arrangement of the said apparatus that both high resistance and low resistance magnetizing windings are energized contemporaneously, so that the combined magnetic attraction due to the energization of both windings is simultaneously exerted upon the circuit breaker armature, and thereby produces a more rapid acceleration of the armature and a quicker action of the said circuit breaker than can be secured in a circuit breaker having two magnetizing windings which act successively.

My invention is shown in two of its preferred forms in the accompanying drawings in which,

Figure 1 is a diagrammatic view showing my invention in its preferred form. Fig. 2 is a diagrammatic view presenting a slightly modified form of my invention.

Referring to Fig. 1 of the drawings, which shows an ignition system embodying my invention as preferably applied to a two-cylindered motor, 1 represents a battery or other source of electric energy. At 2 is indicated the primary winding of an induction coil; the secondary winding, 3, of the same, being adapted to energize spark points, 4, located in usual manner in one of the motor cylinders. Similarly at 5 is shown the primary winding of a second induction coil, whose secondary winding, 6, is adapted to energize spark points, 7, located in another cylinder of the motor. At 8 is represented the rotating arm of a circuit controlling device hereinafter termed a distributer-timer, said arm being adapted to make contact at both ends contemporaneously, in one operative position with the coil contact block 9 and the magnet contact block 10, and in a second operative position with the coil contact block 11 and the magnet contact block 12, said contact blocks

9 and 10 being considered as one set of contact blocks and contact blocks 11 and 12 as a second set.

At 13 is represented an electro-magnet forming the actuating instrumentality of the circuit interrupter, said magnet being adapted when magnetized, to cause a movement of a movable armature 14 carried on a resilient strip 15. Said armature carries a contact 141 which is normally held by the resiliency of said strip 15 in engagement with a contact 161 located upon the tip of a contact screw 16 preferably adjustably mounted in a rigid support 17. The contact 161 carried upon the said adjustable contact screw and the contact 141 carried upon the armature 14 are hereinafter termed the separable contacts of the circuit interrupter. At 18 is a condenser which is connected in shunt around separable contacts just hereinbefore mentioned. The magnet 13 is provided with two independent windings 19 and 20. The winding 19 is of coarse wire with low resistance, while the winding 20 is of fine wire having a relatively high resistance.

The elements hereinbefore described are interconnected preferably in the following manner. One terminal of the primary winding 2 is connected to coil contact block 10, and similarly, one terminal of the primary winding 5 is connected to coil contact block 11. The other terminals of both primary windings 2 and 5 are electrically connected by a single conductor 21 with the screw support 17 and thence through screw 16, and the separable contacts of the circuit interrupter and strip 15 with one terminal of the low resistance winding 19. The other terminal of said winding 19 is connected to one pole of the battery 1 the other pole being connected with the rotating arm 8 of the distributer-timer. The main or energizing circuit, that is the circuit from the battery 1 through one of the primary windings 2 or 5 and through the coarse magnetizing winding is therefore completed when the rotating arm 8 is in engagement either with contact block 10 or with contact block 11 respectively.

The magnet contact blocks 9 and 12 are connected by a common conductor 22 with one terminal of the fine winding 20 of the electro-magnet, the other terminal of the said winding being connected into the main circuit as at 23. It will therefore be evident that, when the rotating arm 8 is in engagement either with contact block 9 or 12, current from the battery 1 will flow through the primary winding 20.

My invention operates in the following manner: As the rotating arm 8 of the distributer-timer arrives into the position wherein it is shown in Fig. 1, so as to be in contemporaneous electrical engagement with coil contact block 10 and the magnet contact block 9 forming one set, current from one pole of the battery 1, passing into the rotating arm 8, will flow through the main circuit, that is, by way of coil contact 10 and the primary winding 2 of one induction coil, through the separable contacts of the circuit breaker and through the coarse winding 19 of the electro-magnet back to the other battery pole. At the same time said current will flow by a separate circuit from arm 8 through the magnet contact 9, and conductor 22, and will traverse the fine winding of the electro-magnet. The magnetization produced by the flow of current through the electro-magnet will attract the movable armature 14 and cause the separation of the contact 141 carried thereon from the contact 161 located on the adjustable screw 16. The resulting disengagement of said separable contacts will serve to suddenly interrupt the energizing circuit which traverses the coarse winding of the electro-magnet and energizes the primary winding of the induction coil; such interruption rendering the induction coil operative to produce a high tension discharge at the spark points 4, in the usual manner. It is evident, however, that the flow of current through the fine winding of the electro-magnet is not interrupted by the operation of the circuit breaker but that current will continue to flow through said fine winding 20 so long as rotating arm of the distributer-timer is in contact with contact member 9. The magnetism so produced in the electro-magnet in consequence of such flow is sufficient to retain the movable armature 14 attracted to the magnet, and the main circuit is consequently interrupted throughout the continuance of the engagement between the arm 8 and the contact block 9. Assuming that the contact blocks comprising each set are located diametrically opposite to each other, and that the members of the second set of contact blocks are located at an angle of 90° from those of the first set, it will be apparent that after the distributer-timer arm has rotated one quarter of one revolution, the arm 8 will contemporaneously engage the contact blocks 11 and 12, comprising the second set of contact blocks, and the ignition system will thereupon again operate as hereinabove set forth to produce a spark. In this instance, however, the primary winding of coil 5 will be energized, and a spark will be produced at spark points 7. A further rotation of 90° will bring the distributer-timer arm 8 into contemporaneous engagement with the members of the first set of the contact blocks, the said arm however, being now advanced 180° so as to occupy a position diametrically opposite to that in which it was hereinabove first described. Similarly

a further rotation of the distributer-timer arm through 90° will again bring the same into contemporaneous engagement with the members of the second set of contact-blocks, the said arm, however, occupying a diametrically opposite position to that just hereinabove described. Thus it will be apparent that the embodiment of the ignition system as described will operate to produce two sparks at each pair of spark points alternately during a single rotation of the distributer-timer arm.

In Fig. 2 is presented a somewhat modified arrangement of my invention. As before 8^a is the rotating arm of a timer adapted to contemporaneously contact in one of its operative positions with the magnet contact block 9^a and the coil contact block 10^a forming one set, and in another of its positions with the coil contact block 11^a and the magnet contact block 12^a forming a second set. Said coil contact block 10^a is connected with one terminal of the primary winding 2^a of an induction coil having a secondary winding 3^a adapted to energize spark points 4^a. The coil contact block 11^a is similarly connected to one terminal of the primary winding 5^a of another induction coil having a secondary winding adapted to energize a second set of spark points 7^a. The other terminals of both said primary windings 2^a and 5^a are connected, by a conductor 21^a through the separable contacts 161^a and 141^a of a circuit interrupter and carried respectively upon the adjustable contact screw 16^a and upon the movable armature 14^a, to one pole of battery 1^a. The other pole of said battery is connected through a low resistance winding 19^a of coarse wire adapted to magnetize an electro-magnet 13^a by which said circuit interrupter is actuated. The other terminal of said coarse winding is connected through a conductor 22^a both to said contact block 9^a and said contact block 12^a. Said electro-magnet is also provided with a fine winding of high resistance; one terminal of the same being electrically connected with the rotating arm 8 of the timer in any approved manner and its other terminal being connected with one pole of the battery 1^a.

The embodiment of my invention just described operates as follows: When the distributer-timer arm 8^a is in the position shown in Fig. 2, so as to be in contact contemporaneously both with magnet contact block 9^a and coil contact block 10^a, a circuit is established which leads from the battery 1^a through the coarse winding 19^a of the electro-magnet 13^a to the magnet contact block 9^a. Passing thence through the distributer-timer arm 8^a into the coil contact block 10^a the circuit continues through the primary winding 2^a and through the separable contacts of the circuit breaker back to the battery 1^a again. At the same time current will flow from battery 1^a through the fine winding 20^a of the magnet into the distributer-timer arm 8^a and back to the battery through the relay contact 9^a and the coarse magnetizing winding 19^a. On the establishment of the circuits just mentioned the resulting magnetization of the electro-magnet 13^a will attract the movable armature 14^a, and will thereby cause the disengagement of the separable contacts 141^a and 161^a of the circuit interrupter. In consequence the circuit through the induction coil 2^a will be interrupted and a high tension discharge will be produced at the spark points 4^a. After the interruption of the main circuit by the operation of the circuit breaker current will continue to flow through the fine winding 20^a of the magnet, such current although being of small volume, operating to magnetize said magnet after the cessation of the flow of current through the coarse winding sufficiently to retain the circuit breaker in its open circuit condition during the continuance of the contact between the distributer-timer arm and the magnet contact block.

As above pointed out in connection with Fig. 1, the operation above described will be repeated at each quarter rotation of the distributer-timer arm, and a spark produced at each pair of spark points alternately. In either embodiment of the invention just described this disengagement of the distributer-timer arm from the contact blocks will interrupt the current through the fine winding, whereupon the circuit interrupter will resume its normal or closed circuit condition and which will remain in such condition until the distributer-timer again comes into one of its operative positions.

It will be evident in my ignition system the advantages incident to the use of the electro-magnet having plural windings are secured, while at the same time the arrangement of the apparatus employed in such system, in accordance with my invention results in increased advantages over similar systems as known in the prior art. This will become evident from the consideration that in my invention, after the interruption of the main or energizing circuit through the primary winding by the action of the circuit interrupter, no current whatever will flow through the primary winding of the induction coil. Consequently the complete deënergization of the said coil will render the same more effective as an inductive means than would be the case were the current which energizes the fine winding of the electro-magnet permitted to flow through the energizing circuit after the operation of the circuit interrupter.

It will furthermore be noted that in my invention the condenser is not short cir-

cuited through the fine magnetizing winding as is the case in similar devices as is heretofore known in the prior art, and the electrical efficiency of the inductive system as a whole is thereby considerably increased.

In addition it will be noted that by the use of my invention are secured the advantages which result from a contemporaneous action of both coarse and fine magnetizing windings which, exerting their combined magnetic attraction upon the circuit breaker armature attracts the said armature more quickly and thereby produces a quicker action of the circuit interrupter than can be secured in apparatus of a similar nature where the coarse and the fine windings act in succession and not contemporaneously, such increased rapidity in the action of the circuit breaker resulting in an increased efficiency in the inductive capacity of the inductive means with which said circuit interrupter is combined.

It is evident that my invention may be applied without substantial change to an ignition system having but a single induction coil, in which case only a single set of two cooperating coil and magnet contact blocks will be required. In such case the distributer-timer may be more properly regarded as merely a timing device. However, as hereinbefore appears, when a plurality of induction coils are employed, the distributer-timer combines in itself the functions both of connecting the battery in energizing relation with a selected induction coil, and of timing the moment of energizing the system. Hence I employ the term "distributer-timer" in connection with a circuit controlling device adapted for use in an ignition system embodying a plurality of induction coils.

Having described my invention, I claim,

1. In an ignition system, in combination with a source of electric energy, an induction coil, circuit interrupting means embodying separable contacts and having a low resistance magnetizing winding for separating said contacts and a high resistance magnetizing winding for retaining said contacts in their separated position when said low resistance magnetizing winding is inoperative, a timer having a plurality of contact elements and a moving member adapted to contemporaneously engage two of said elements in the operative positions of the timer, said source of energy in such operative timer positions being electrically connected through said moving member and one of said contact elements and through the separable contacts, in energizing relation with the induction coil and with said low resistance winding, and being also, in such operative timer positions, electrically connected through said moving member and through another contact element in energizing relation with the high resistance winding.

2. In an ignition system, in combination with a source of electric energy, an induction coil, a circuit interrupter embodying separable contacts and having an electro-magnet for separating said contacts provided with a high resistance winding and a low resistance winding; a timer having a coil contact member and a magnet contact member and a moving member adapted to contemporaneously engage both said coil contact and said magnet contact member in the operative positions of the timer, said source of energy in such operative timer positions being electrically connected through said moving member and said coil contact member and through the separable contacts, in energizing relation with said coil and with said low resistance winding, and being also in such operative timer positions electrically connected through said moving member and said magnet contact member in energizing relation with said high resistance winding.

3. In an ignition system, in combination with a source of electric energy, an induction coil having a primary winding, a circuit interrupter embodying separable contacts and having an electro-magnet provided with a high-resistance winding and a low-resistance winding for separating said contacts; a timer having a coil contact member and a magnet contact member and a moving member in contemporaneous electrical engagement with both said coil contact member and said magnet contact member in the operative positions of the timer, said source of energy in such operative timer positions being electrically connected through said moving member and said coil contact member and through said separable contacts, in energizing relation with said primary winding and with said low-resistance magnetizing winding, and being also in such operative timer positions electrically connected through said moving member and said magnet contact member in energizing relation with said high-resistance winding.

4. In an ignition system, in combination, a source of electric energy, an induction coil having a primary winding, a circuit interrupter embodying separable contacts and having an electro-magnet provided with a high-resistance magnetizing winding and a low-resistance magnetizing winding for separating said contacts, a timer having a stationary element carrying a coil contact member and a magnet contact member and a rotating element electrically engaging said coil contact member and said magnet contact member contemporaneously in the operative positions of the timer, means electrically connecting said source of energy

in such operative positions of the timer through said moving element and the coil contact member and through the low-resistance magnetizing winding and said separable contacts in series with the primary winding, and means contemporaneously electrically connecting said source of energy, in such operative timer position through the moving member and the magnet contact member in series with the high-resistance magnetizing winding of the electro-magnet.

5. In an ignition system, in combination with a source of electric energy, a plurality of induction coils each having a primary winding, a circuit interrupter embodying separable contacts and having an electro-magnet provided with a low-resistance magnetizing winding and a high-resistance magnetizing winding for separating said contacts, a distributer-timer having a stationary element carrying a plurality of coil contact members and a plurality of magnet contact members, and a rotating element engaging said coil contact members successively in the course of its rotation and contemporaneously with each such engagement contacting with a magnet contact member, a plurality of coil energizing circuits, each circuit including a coil contact member, a selected primary winding, said separable contacts and the low-resistance magnetizing winding, and a second circuit electrically exclusive of said primary windings and including said source of energy and said high-resistance winding, each of said energizing circuits being closed in succession through the moving element of the distributer-timer as it engages with a corresponding coil contact member, and said second circuit being closed contemporaneously with the closing of each energizing circuit by the engagement of said moving element with a magnet contact member.

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

EDWIN S. LINCOLN.

Witnesses:
NATHAN B. DAY,
CHAS. F. RANDALL.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."