J. E. SEELEY.

MEANS FOR PRODUCING HIGH TENSION DISCHARGES.

APPLICATION FILED APR. 15, 1909.

1,015,088. **Patented Jan. 16, 1912.**

2 SHEETS—SHEET 1.

Fig. 1.

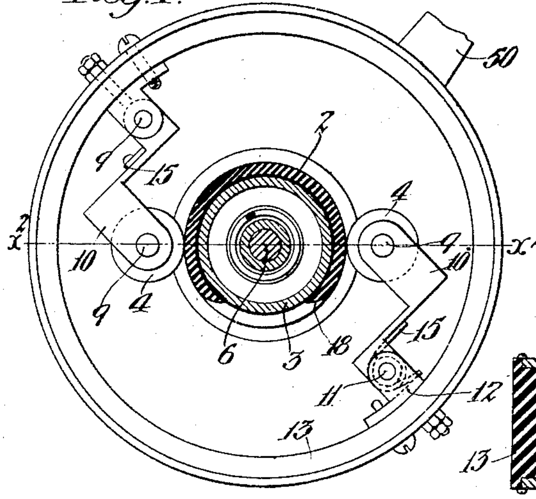


Fig. 2.

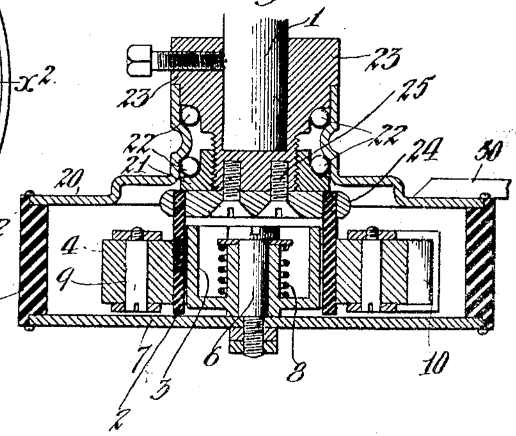


Fig. 3.

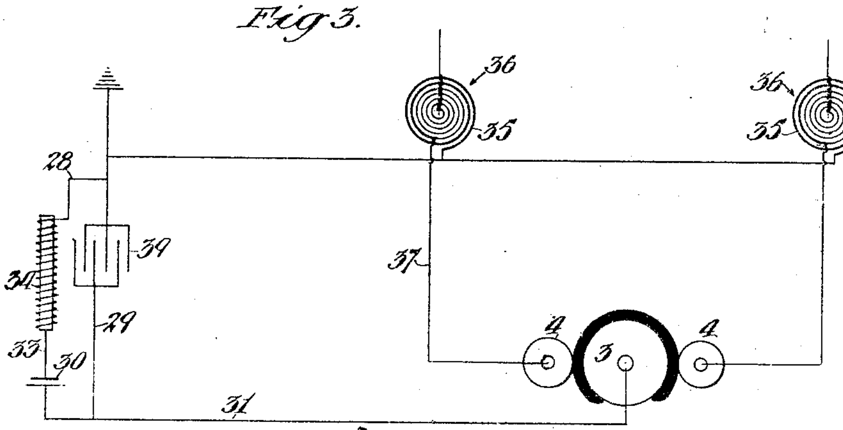


Fig. 4.

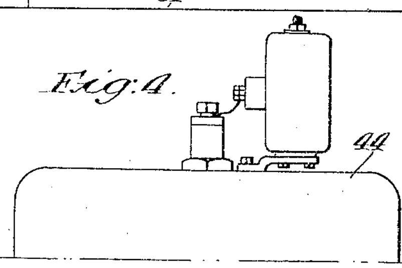
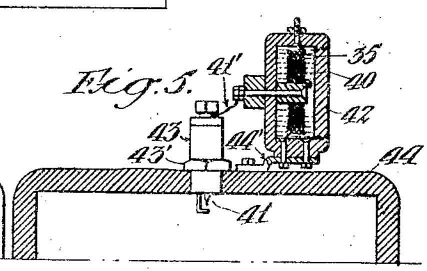


Fig. 5.



Witnesses:
Louis W. Gratz.
Frank C. [illegible]

Inventor
James E. Seeley.
by [illegible] Attys.

J. E. SEELEY.

MEANS FOR PRODUCING HIGH TENSION DISCHARGES.

APPLICATION FILED APR. 15, 1909.

1,015,088.

Patented Jan. 16, 1912.

2 SHEETS—SHEET 2.

Fig. 6.

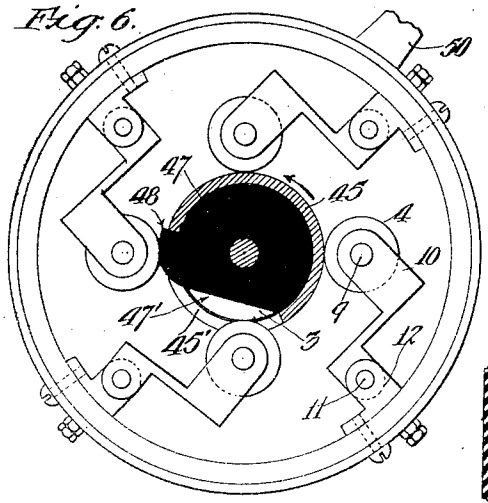


Fig. 7.

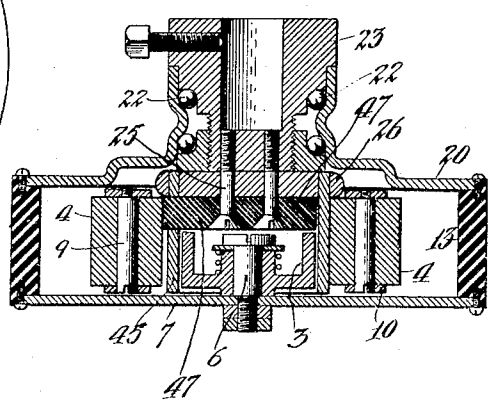
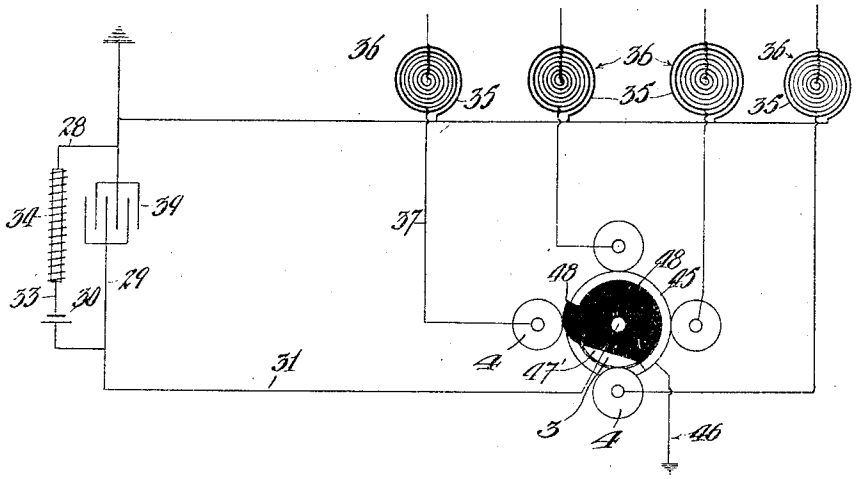


Fig. 8.



Witnesses:-
Louis W. Gratz.
Frank L. Graham.

Inventor.
James E. Seeley.
by Thomond & Lewthwaite
attys.

UNITED STATES PATENT OFFICE.

JAMES E. SEELEY, OF LOS ANGELES, CALIFORNIA, ASSIGNOR TO HIGH FREQUENCY IGNITION COIL COMPANY, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF CALIFORNIA.

MEANS FOR PRODUCING HIGH-TENSION DISCHARGES.

1,015,088. Specification of Letters Patent. Patented Jan. 16, 1912.

Application filed April 15, 1909. Serial No. 490,168.

To all whom it may concern:

Be it known that I, JAMES E. SEELEY, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Means for Producing High-Tension Discharges, of which the following is a specification.

This invention relates to means for producing high tension oscillatory discharges, particularly for use in ignition in internal combustion engines.

The invention has special relation to the production of discharges which involve the disruption of current of considerable energy at the primary break. In such cases the primary circuit breaking device is subject to rapid deterioration by the arcing at the break.

The main object of the present invention is to prevent deterioration of the contacts of the circuit breaker by the arcing at the break.

A further object of the invention is to so continually change the location of the break in relation to the contacts so that the deterioration due to arcs is distributed over the contacts.

Other objects of the invention appear hereinafter.

Referring to the drawings:—Figure 1 is an end elevation of the circuit controller which is adapted particularly for use as the "timer" of an internal combustion engine, showing parts in section. Fig. 2 is a horizontal section thereof on the line x^2—x^2 in Fig. 1. Fig. 3 is a diagram of the circuit connections. Fig. 4 is an elevation of the resonator for producing high frequency discharges. Fig. 5 is a vertical section of the resonator. Fig. 6 is an end elevation of a different form of the invention, showing parts in section. Fig. 7 is an axial section of the form shown in Fig. 6, and Fig. 8 is a diagram of the circuit connections for the form of the invention shown in Fig. 6.

The invention will be described particularly with reference to an ignition device of an internal combustion engine, for example, a two cylinder engine.

1 designates a shaft which may be the valve operating shaft of the engine and 2 designates a rotary circuit breaking member attached to or carried by said shaft and adapted to rotate between the circuit controlling contacts to alternately make and break the circuits thereof. Said circuit controlling contacts comprise an inner contact 3 and outer contacts 4. Contact 3 is preferably formed as a metallic wheel or roller journaled on an arbor or stud 6 secured to the supporting plate or disk 7 of metal, a spring 8 being interposed between the contact wheel 3 and the stud 6 to insure electric connection therebetween. The contacts 4 preferably consist of wheels or rollers, each mounted to rotate upon a journal pin 9 carried by arms 10 which are pivoted at 11 on brackets 12 secured to the insulating circular rim 13. Springs 15 engage the arms 10 and the brackets 12 to press the contact wheels 4 toward the central contact wheel 3. The rotative circuit breaking member consists in the form shown in Figs. 1 to 3 of a shell of insulating material. Said insulating shell 2 is formed as a segment of a cylinder having a portion thereof cut out, as shown at 18, to allow the outer contact rollers 4 to come into contact with the central contact roller 3 alternately, in the rotation of said insulating shell. Insulating support or rim 13 is conveniently supported in axial relation to the operating shaft 1 by a member 20 connected to said rim and turning on collars 21, 23 by ball bearings 22, said collars 21, 23 being secured on said shaft. Said collar 23 has a plate 24 fastened to said collar by screws 25 which plate serves for attachment of the insulating shell 2 to the shaft. The metal disk 7 is secured at its outer edge to the insulating rim 13.

The electrical connections are shown in Fig. 3. One side of the battery or source of energy 30 is connected by wire 31 to the shaft 6 of the central roller 3, the other side of said battery being connected by wire 33 to the self induction coil 34 from which a wire 28 leads to the primary coil 35 of two resonators 36, the other ends of said primary coils being connected by wires 37 to the respective supporting brackets 12 of the two outer contact rollers. A condenser 39 is connected on a circuit 29 between the wires 28, 31. The resonators may be of the construction shown in Figs. 4 and 5, being formed with primary coils 35 preferably in the form of wire or ribbon of few turns and

of low resistance, the secondary coil 40 of the resonator being connected at one end of the primary and consisting of thinner wire wound with a greater number of turns than the primary, the said secondary wire being within the primary winding and being connected at its outer end to the inner end of the primary winding and the inner end of the secondary wire being connected to the sparking electrode 41. This high frequency induction coil or resonator, is without iron core, its magnetic circuit being of material of low permeability so that the time period of the coil is a minimum and it is adapted to produce oscillatory discharges of extremely high frequency. Such a discharge is not capable of transmission for any considerable distance through a conductor, on account of loss by induction, and in order to avoid such loss a resonator is mounted directly adjacent to the sparking electrode, for example, as shown in Figs. 4 and 5. The resonator may be inclosed in a casing 42 adjacent to the spark plug 43, said casing and spark plug being secured by means 44′, 43′, to the cylinder 44 of an internal combustion engine. The spark gap means comprises an outer electrode which is grounded or connected to the cylinder wall and an inner electrode 41 which is connected by wire 41′ to the inner terminal of the secondary coil of the resonator as stated.

The construction of resonator or high frequency induction coil as above described has the property of presenting a greater oscillatory electromotive force at one terminal than at the other, the electromotive force of the terminal connected to the primary being substantially *nil* and the entire oscillatory electromotive force being developed substantially at the terminal farthest from the primary, said terminal being connected to the sparking electrode 41 in the engine cylinder. It has been found that when an oscillatory discharge is communicated to a grounded electrode or to an electrode in contact with the cylinder the energy of the discharge is wasted or dissipated in the ground or in the metallic body of the cylinder, and by providing a resonator whose discharge is substantially at one terminal only and connecting that terminal to the insulating spark electrode in the engine the advantage is secured of delivering substantially the entire energy of discharge to the spark.

The operation is as follows: In rotation of the shaft 1 for example, in the operation of the internal combustion engine, the insulating segmental shell 2 is caused to revolve. In the position shown in Fig. 3 this shell breaks circuit connection between the central contact roller 3 and both of the other contact rollers 4. In the continued revolution of the shell it reaches a position wherein one of the contact rollers will be allowed to come into contact under the pressure of one of its springs 15 of the central contact roller, thereby closing the charging circuit as follows: from the battery 30, by wire 31, central contact roller 3, one of the contact rollers 4, wire 37, primary coil 35 of one of the resonators, wires 28 and 33 through the self induction coil 34 back to the battery. The current so passing energizes the self induction coil 34 and on continued revolution of the insulating shell 2 when it reaches a point at which its advancing edge comes under the outer contact roller 4 aforesaid it will raise said contact roller from the central contact roller 3 and at the same time will interpose an insulating wall between the contact rollers, thereby interrupting the circuit and causing the self induction coil 34 to generate an induced current of high potential to charge the condenser 39. The moment said condenser charge reaches its maximum potential it proceeds to discharge through a circuit independent of said self induction coil, namely through the wire 29, primary coil 35, wire 37, contact roller 4, spark gap between said contact roller and the central contact roller 3 and wires 31, back to the condenser. No appreciable part of this condenser discharge will pass back to the charging circuit on account of the excessive impedance of the latter as compared with that of the circuit through the primary of the resonator just traced. Said primary being of few turns and of resistance, and inductance, the discharge thus passing from the condenser will be high frequency.

The circuit interrupting means above described has the following advantages. At every interruption of the circuit the discharge takes place between a different part of the respective contacts so that no two parts are, in general, exposed to repeated attack by the discharge, the heating and corroding effects of the discharge being thus distributed over the entire discharging surface of each contact. As there is no sharp edge from which the arc is drawn the danger of over-heating or burning by the arc is reduced to a minimum. For both of the above reasons the amount of metallic vapor generated at the point of arcing or discharge between the contacts is reduced to a minimum and the specific resistance of the space between the separating contacts is thereby increased so that the rise of resistance during separation reaches a maximum with a corresponding increase and rapidity of the discharge of the self induction coil and an increase of charging potential on the condenser. This fact is further evident in the discharge from the condenser in giving a short, snappy discharge instead of a lingering one in which the energy of the discharge is wasted by attenuation.

A further advantage of the above described circuit controlling means is that the timing of the spark is not influenced or varied by reason of wearing away of the contacts. In any timer the arc drawn at the contacts wears away the edges of the contacts and, in general, the wear is unequal on the different contacts, so that it is not possible to secure proper adjustment of the timer for more than one cylinder. The breaking of the circuit by an insulating shell, which prevents the same condition at each point of break, obviates this difficulty.

The invention is not limited to the use of a shell of insulating material, as other means may be used for lifting the outer contact roller from the inner contact roller. In the form shown in Figs. 6 to 8 a means for this purpose is shown consisting of an insulating member acting as a cam to lift the outer roller from the inner roller. In this form of the invention the casing, outer and inner contact rollers, driving shaft, etc., are or may be constructed as above described, and are indicated by reference numerals, as above, but the driving shaft in this case carries a metallic shell 45 secured to the shaft by the head plate 26. Said metallic shell is formed as a segment of a circle having a portion thereof cut out as shown at 45′ to allow the outer contact rollers 4 to come into contact with the central contact roller successively. Four of such outer contact rollers are shown in this case, said rollers being connected respectively to the low tension coil of the respective resonators 36. The inner contact roller 3 extends only half the length of the metallic shell and the inner end of the shell is occupied by a block 47 of insulating material which is cut away at 47′ so that it extends to a less radial distance than the periphery of roller 3 and directly at the rear of this portion is provided with an outwardly extending projection or cam portion 48 which extends somewhat beyond the periphery of the metallic shell 45. Shell 45 being carried by the head 23 in shaft 1, is insulated from central roller 3 by the insulating ring 13. The contact rollers 4 are of sufficient length to extend over the inner roller 3 as well as over the insulating block 47. An operating arm 50 is provided for the casing of the device to set or advance the spark in the well known manner. The connections are as above described, with the addition that the metallic segmental shell is grounded, as indicated at 46 in Fig. 8. The operation of this form of the apparatus is as follows: In the rotation of the metallic shell 45, as indicated by the arrow in Fig. 6, the outer contact rollers 4 will drop successively onto the inner contact roller as the open portion of said shell comes beneath said outer rollers the insulating block 47 being cut away, as stated, adjacent to the first portion of this opening in the shell. This contact of an outer roller with the inner roller serves to close energizing connection for self induction coil 34, through wire 37, and the primary coil of one of the resonators, as above described. Then in the further rotation of the shaft 1 the cam portion 48 will come under the said outer roller and will lift it out of contact with the inner roller 3, thereby interrupting the energizing circuit for the self-induction coil and causing discharge of the self-induction means into the condenser with ensuing discharge of the condenser through the spark gap formed at the break between the outer and inner contact rollers as above described. If the device rotates in the opposite direction, for example, if in turning over the machine it turns backward, sufficiently to bring into contact with the inner roller an outer roller connected to the resonator for a spark gap in a cylinder which is on the compression stroke, the lifting of the outer roller from the central roller will be by means of the metallic shell 45 and this shell being grounded it short circuits the corresponding resonator so that the condenser discharge is without effect on the resonator and no explosion occurs. This prevents back firing which is a frequent cause of accident. The shell 45 being insulated from the central contact member 3, it follows that when any contact roller 4 is resting on this shell 45, the connection from the energizing circuit and condenser, through wire 31 is broken, the shell 45 holding the roller off of contact roller 3 and operating as a connection breaking means, or circuit breaker. This opening of the charging circuit by the shell 45, as well as by the projection 48 is necessary, as some of the rollers 4 are always in contact with the shell, and if the shell were not insulated from central roller 3, the operation of projection 48 would be without effect on the circuit.

The shell 45 in Figs. 6 to 8, although it is of conducting material, serves as an insulating shell as regards the inner and outer contact members, and the term insulating shell is intended to cover the construction.

What I claim is:

1. A circuit controlling device for ignition apparatus comprising a central contact means, an outer contact means movable toward and from the central contact means, means for pressing the outer contact means toward the central contact means, a rotary circuit breaking member mounted concentrically with the central contact means and rotatable relatively to both of said contact means, said rotary circuit breaking member being formed as a shell movable between said central and outer contact means, and means for rotating said circuit breaking member.

2. A circuit controlling device for ignition apparatus comprising a central contact means, an outer contact means movable toward and from the central contact means, means for pressing the outer contact means toward the central contact means, a rotary circuit breaking member mounted concentrically with the central contact means and rotatable relatively to both of said contact means and movable between said contact means, said rotary circuit breaking member comprising a shell formed as a segment of a cylinder, and means for rotating said circuit breaking member.

3. In a circuit controlling device for ignition apparatus, a central contact roller, a circuit breaking segmental shell mounted to rotate on an axis concentric with said contact roller, an outer contact roller, means for movably supporting said outer contact roller and permitting movement thereof to and from the central contact roller, and a spring for pressing the outer contact roller upon the central contact roller and enabling separation of the rollers by the circuit breaking shell in the rotation thereof.

4. A circuit controlling device for ignition apparatus comprising a central contact roller, a plurality of outer contact means movable toward and from the central contact roller and provided with means whereby they are pressed toward the central contact roller, a rotary circuit breaking member mounted concentrically with the central contact roller and movable between the outer contact means and the central contact roller to lift the outer contact means successively from contact with the central contact roller, and means for rotating said circuit breaking member.

5. A circuit controlling device for ignition apparatus comprising a central contact means, a plurality of outer contact means provided with supporting devices holding the same yieldingly in contact with the central contact means, and a rotary segmental shell adapted to rotate between the central and outer contact means, said shell being rotatable relatively to the central and to the outer contact means, said shell having an opening to permit the outer contact means to contact with the inner contact means.

6. A circuit controlling device for ignition apparatus comprising a central contact means, a plurality of outer contact means provided with supporting devices for holding the same yieldingly in contact with the inner contact means, a rotary segmental metallic insulated shell adapted to rotate between the inner and outer contact means, said shell having an opening to permit the outer contact means to contact with the inner contact means, a grounded circuit connected to said outer and inner contact means and including self induction means, a source of electromotive force, a condenser connected to receive a charge from the self induction means, a plurality of induction coils having their primaries connected to the respective outer contact means, spark gap means connected to the secondaries of said induction coils, and a ground connection for said metallic insulated shell.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 16th day of February 1909.

JAMES E. SEELEY.

In presence of—
ARTHUR P. KNIGHT,
FRANK L. A. GRAHAM.