J. E. SEELEY.

HIGH TENSION SPARKING MEANS FOR EXPLOSION ENGINES.

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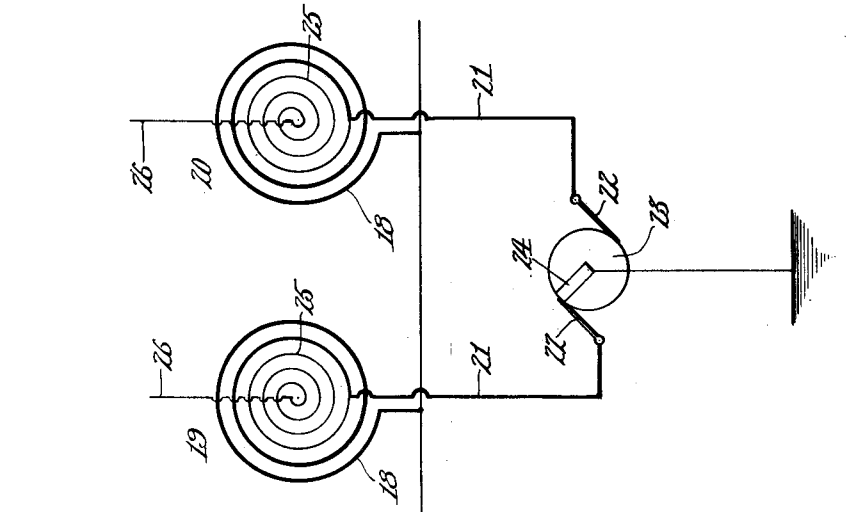
1,051,642. Patented Jan. 28, 1913.



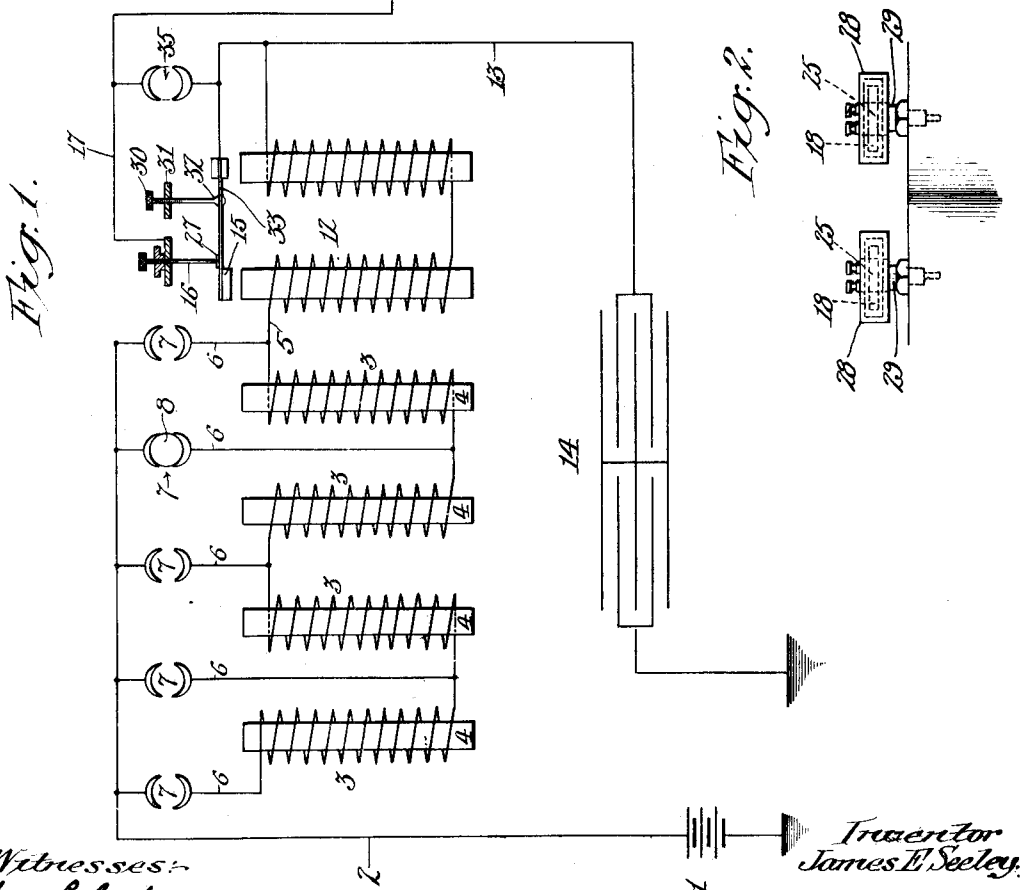


Fig. 1.

Fig. 2.

Witnesses:-
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UNITED STATES PATENT OFFICE.

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HIGH-TENSION SPARKING MEANS FOR EXPLOSION-ENGINES.

1,051,642. Specification of Letters Patent. Patented Jan. 28, 1913.

Application filed April 29, 1907. Serial No. 370,978.

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 High-Tension Sparking Means for Explosion-Engines, of which the following is a specification.

The main object of the present invention is to provide means for developing in an explosion engine, sparks of high potential and frequency. The advantage of such sparks is that they give a sharper, quicker ignition and greater igniting power for a given strength of battery and that they keep the terminals clean, owing to the disruptive effects of the discharge.

Another object of the invention is to protect the circuit controller which distributes the current to the several cylinders of an engine, so that corrosion or burning of the contacts thereof is avoided.

Another object of the invention is to provide a high tension sparking means for explosion engines which can be extended to any desired number of cylinders with but slight increase in the cost. Where the ordinary spark coils are used for each cylinder, the cost runs up more or less in proportion to the number of cylinders, and the object of my invention is to provide a single means for producing induced discharges for all the cylinders and separate high tension induction means for the several cylinders, said induction means being relatively small and of low cost on account of the high tension and high frequency involved.

In the accompanying drawings:—Figure 1 is a diagram showing the apparatus for generating the induced discharges, as applied to two cylinder ignition. Fig. 2 is an elevation of the end portion of a two cylinder engine, showing the application of the high tension induction devices thereto.

1 designates the battery or source of electromotive force connected at one end to ground and at the other end by line 2 to a variable inductance. Said variable inductance preferably comprises a series of coils 3 with cores 4, each coil being of relatively small self-induction, the said coils being connected in series in a circuit 5 and connections 6 being taken from various points of the said circuit through plug switches 7 to line 2, a removable plug 8 being provided for insertion in any one of said switches to include in circuit as many as may be desired of these inductance devices. The line or connection 5 is connected through the coil of a magnet 12 with a wire 13 leading to one side of a condenser 14, whose other side is grounded, said condenser being preferably a series condenser. The magnet 12 operates an armature 15 connected to wire 13 and having a back contact 16 connected by wire 17 to one side of the primary 18 for the high tension induction devices 19, 20. Said high tension induction device is adapted to produce high frequency oscillating discharges, the said device being without iron cores, as indicated in Fig. 1, so that its magnetic circuit is of low permeability and hysteresis, as compared with the ordinary iron-containing magnetic circuit so as to present maximum frequency. The said device consists of a flat spiral having a primary coil of a few turns on the outside and a secondary coil of a greater number of turns on the inside. This high tension device, which I hereafter refer to as a resonator, works best when there is proper tuning between the primary and secondary and when properly tuned the high frequency oscillatory discharge through the primary of the resonator induces correspondingly high frequency currents in the secondary of the resonator, the amount of current induced being greater the nearer each turn of the secondary is to the primary. This produces a maximum of high frequency potential at the inner terminal of the secondary of the resonator and the maximum of current at the outer terminal of the secondary of the resonator. It therefore is immaterial whether the outer terminal of the secondary of the resonator is metallically connected with the primary circuit or insulated from it. The high frequency oscillatory currents developed by such a device cannot be transmitted any considerable distance through the conductor, the energy being dissipated by radiation in electric magnetic waves, and the feature of my invention which consists in applying the resonator directly adjacent to the sparking electrodes, as shown in Fig. 2, is therefore of special advantage. The contacting parts of the armature and its back contact are preferably of platinum, the armature

having a platinum contact 27. The other end of the primaries of said devices are connected by wires 21 to respective contacts 22, coöperating with a circuit controller 23 having a contact 24 which successively engages the aforesaid contacts 22 to distribute or connect the current successively to the respective cylinders corresponding to the induction devices 19, 20. The secondaries 25 of said induction devices are connected at one end to the primaries thereof, the other ends extending to electrodes 26 which extend within the explosion chambers of the engine cylinders. On account of the high tension of the spark and small quantity thereof, these induction devices can be of relatively small size so that they are conveniently applied directly to the spark plugs as shown in Fig. 2, each induction device being formed with a case 28 screwing onto the spark plug 29. The production of a high frequency discharge requires the induction coil or device 18, 25, to be coreless, or without iron core, as shown in Fig. 1, and the utilization of such a discharge requires discharge terminals of this device to be directly in proximity to the point of utilization, namely, the spark gap, as shown in Fig. 2, the spark plug being directly connected thereto, for the reason that an oscillatory current of high frequency becomes lost by induction, in passing through any considerable length of wire. The term high frequency induction device as herein used refers to an induction device of this nature, that is, without iron core. The circuit controller 23 is driven by the engine in usual manner.

The armature 15 of the magnet 12 acts as a circuit breaker for the charging circuit and as a spark gap for the discharge circuit, but it will be noted that the charging circuit is also controlled by the circuit controller so that the charging circuit is not energized unless the circuit controller is closed, and the function of the said armature is to break the circuit subsequently to the closure by the circuit closer. This breaking of the circuit by the armature is preferably effected before the circuit controller has time to break the circuit, but the armature is preferably so timed in its operation that it does not again close the circuit until the circuit controller has again broken the circuit. To insure this, adjusting means are provided, for example, a screw 30 working through a fixed support 31 and having a swivel connection 32 with a leaf spring 33 carrying the armature 15, so that by adjusting said screw the operation of the armature can be prevented until the current has attained full strength, the armature being of sufficient weight so that when it is operated the time required for its return under the elasticity of the spring is such that the circuit controller will meanwhile have broken circuit. A short-circuiting connection may be provided between the wires 17 and 13 and closed, when desired, by a plug 35, leaving the apparatus under the control of the circuit controller, without the operation of the protective circuit breaker above described.

The operation is as follows:—Assuming that the engine is running and the circuit controller 23 is in rotation, it will close circuit alternately to the respective contacts 22, causing current to flow as follows: from battery 1 through wire 2, plug 8, one or more of the inductance devices 3, magnet 12, wire 13, armature 15, back contact 16, wire 17, and the primary of one or the other of the induction coils 19 or 20, wire 21, contacts 22, 24 to ground, and back to battery. This current energizes said induction devices and also energizes the magnet 12, so that said magnet as soon as it is fully energized draws the armature 15 thereof to break connection of the back contact 16. The inductance means 3, or as much of same as may be included in circuit, discharges, on the one hand, through line 2 and battery to ground and on the other hand through line 13 to the condenser. The condenser will thus be charged and will discharge through the spark gap between the armature and the back contact 16, the discharge passing from one side of the condenser through wire 13, armature 15, back contact 16, wire 17, primary of the induction device 19 and the circuit controller to ground, and from the other side of the condenser directly to ground. This gives a high frequency oscillating discharge through the spark gap formed by the armature and its back contact, and this discharge acts on the secondary of the included induction device, say device 19, to generate therein a high tension, high frequency discharge which jumps across the gap in the engine cylinder. I have found that a discharge of this nature has peculiar qualities, fitting it for use for this purpose. First, in that it is sharp and quick in action, giving a much more sudden development of explosion than with a slow or low temperature spark. Second, a spark of this nature, by reason of its high tension and high frequency, has a peculiar mechanical action in cleaning or throwing off from the surfaces, with which it comes in contact, any adhered deposit, so that the surfaces are kept clean and effective.

It will be noted that in the above operation the spark is drawn at the armature contacts 27, 16, and not at the circuit controller contacts 22, 24, so that the high frequency discharge from the condenser expends its energy, as far as regards the spark gap, at this point and the volatilizing or corrosive effect of such a discharge is avoided at the circuit controller. This is of im-

portance for the reason that the circuit controller contacts must be adjusted to certain position for definite operation, and any corrosion thereof leads to defective operation being, in fact, a frequent source of trouble in engines of this class, and this trouble would be aggravated with a high tension and frequency discharge. The contacts 15, 16 are subjected to this corrosive action, but being smaller they can be made of platinum, or other non-corrosive material, and in any case the damage thereto is not so serious as damage to the circuit controller would be either in its effect or running of the engine, or in the cost of repair.

What I claim is:—

1. An ignition means for internal combustion engines comprising a spark plug in the engine cylinder, a resonator directly attached to the spark plug, and electrically connected to the electrode in the spark plug to deliver high tension high frequency oscillatory discharge therethrough without loss, a condenser, a discharge circuit therefor, said resonator having its primary included in the said discharge circuit, a charging circuit for the condenser, including an electromotive source, a self-induction coil, and a circuit controlling means, said discharge circuit of the condenser being independent of the electromotive source, said circuit controlling means being connected to be operated by the engine to close the circuit to energize the self-induction coil and immediately thereafter to open the circuit to cause the discharge from the self-induction coil to charge the condenser and to permit the condenser to then immediately discharge through the said discharge circuit therefor.

2. An ignition means for internal combustion engines comprising a spark gap means in the engine cylinder, a high frequency high tension induction coil having its magnetic circuit of material of low permeability and hysteresis, said induction coil having its high tension side connected to said spark gap means and being located directly adjacent to said spark gap means to deliver the oscillatory discharge from the induction coil to the spark gap means without loss, means for producing in the induction coil an oscillatory current, said means comprising a charging circuit, a condenser connected thereto, a self-induction coil in the charging circuit, said self-induction coil having an inductance greatly in excess of the aforesaid induction coil, a source of electromotive force connected to the self-induction coil, a discharge circuit for the condenser connecting the condenser to the high frequency induction coil independently of the charging circuit through the self-induction coil and a circuit controlling means operably connected to the engine and arranged to close the circuit to energize the induction coil and immediately thereafter to open the circuit to cause the discharge from the self-induction coil to charge the condenser and to permit the condenser to then immediately discharge through its discharge circuit.

3. Means for generating high tension discharges in explosion engines, comprising a self-induction means, a charging circuit therefor, a discharge circuit for the self-induction means including a condenser and a discharge circuit for the condenser including a circuit controller and the primary coil of an induction device, a secondary coil energized by said primary coil, a spark plug directly adjacent to the induction device and directly connected thereto, and a circuit breaker operated by the energization of the charging circuit to open said circuit on closure at the circuit controller and to form a spark gap in the condenser discharge circuit before the circuit controller breaks connection.

4. An apparatus for the purpose described comprising a variable inductance consisting of a plurality of self-induction coils, each of relatively small self-induction, means for including a variable number of said coils in series, an energizing circuit therefor, a discharge circuit for the self-induction coils, a condenser in said discharge circuit, an electromagnet in the charging circuit, an armature operated thereby, a circuit breaker operated by said armature, a mechanically operated circuit controller, a condenser discharge circuit comprising said armature-operated contacts and said circuit controller, an induction coil having its primary included in said discharge circuit, and a sparking terminal connected to the secondary of said induction device.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 13th day of April 1907.

JAMES E. SEELEY.

In presence of—

ARTHUR P. KNIGHT,
FRANK L. A. GRAHAM.