H. J. PODLESAK.

EXPLOSIVE ENGINE.

APPLICATION FILED DEC. 7, 1910.

1,037,526. Patented Sept. 3, 1912.

FIG. 1

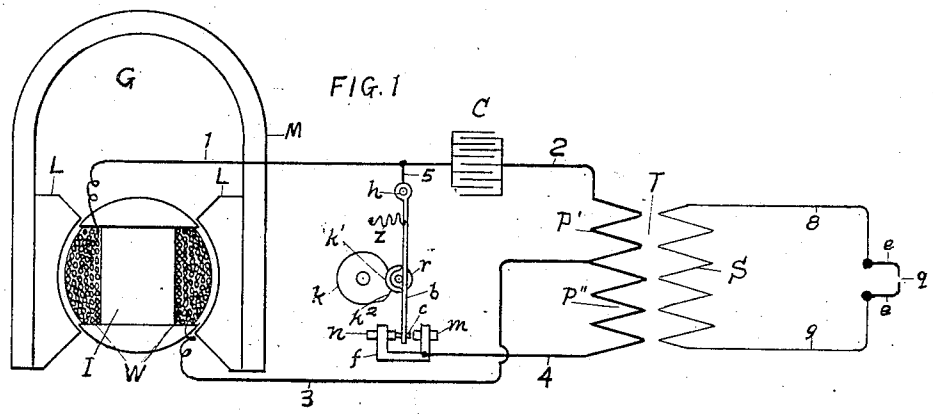


FIG. 2.

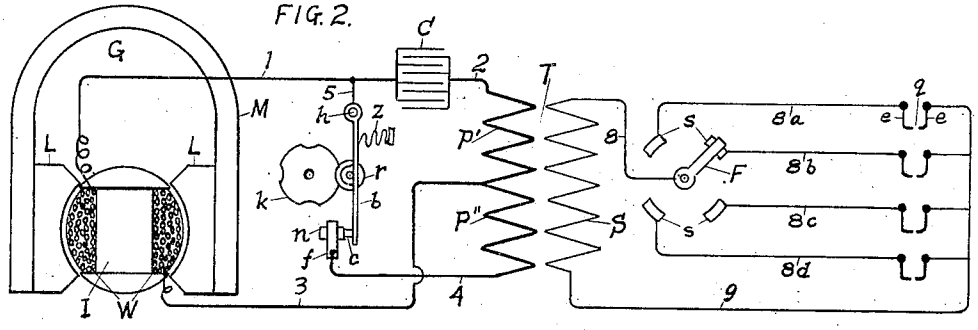


FIG. 3.

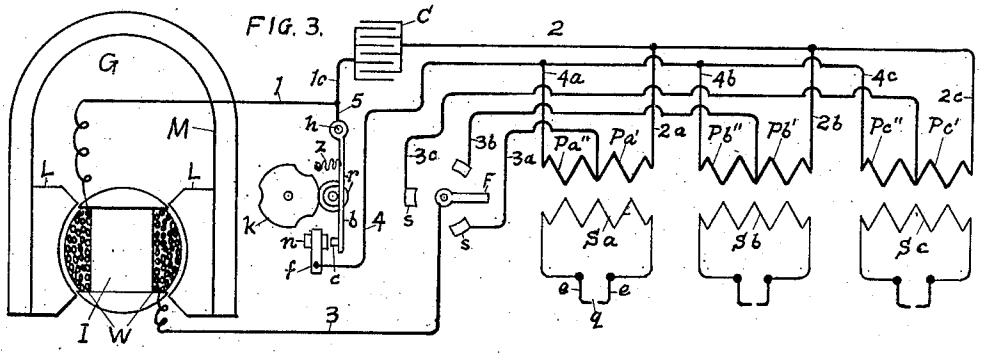
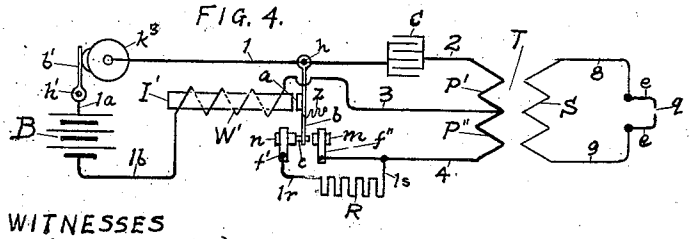


FIG. 4.



WITNESSES

J. R. Tollar

C. L. Bentz

INVENTOR

Henry J. Podlesak

By Chatten Bradway

ATTORNEY.

UNITED STATES PATENT OFFICE.

HENRY J. PODLEŠÁK, OF CHICAGO, ILLINOIS.

EXPLOSIVE-ENGINE.

1,037,526. Specification of Letters Patent. Patented Sept. 3, 1912.

Application filed December 7, 1910. Serial No. 596,062.

To all whom it may concern:

Be it known that I, HENRY J. PODLEŠÁK, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification.

This invention relates to high tension ignition systems for internal combustion engines.

The invention has for its principal object to provide a novel ignition apparatus so designed that efficient sparking can be obtained from a magneto generator in which its rotor turns at a comparatively low speed, such as in starting the engine by hand or such as is used in low speed engines, the rotor of the generator being driven synchronously with the crank shaft, either at the same or a different speed, according to the type of the engine with which the ignition apparatus is used.

Another object of the invention is the provision of a novel combination of transformer, condenser, inductance device and switch, whereby an energizing current traverses a part of the primary winding of the transformer and is then interrupted so that an inductive charge will pass into the condenser through the remaining part of the primary winding and produce a transformation of energy resulting in a spark jumping across the electrodes of the spark plug in the secondary circuit, the condenser being then discharged through the whole of the primary winding of the transformer to produce a second spark at the spark plug by the transformation of energy in the transformer.

With these objects in view and others, as will appear as the description proceeds, the invention comprises the various novel features of construction and arrangement of parts which will be more fully described hereinafter and set forth with particularity in the claims appended hereto.

In the accompanying drawing, which illustrates certain embodiments of the invention, Figure 1 is a diagrammatic view of the ignition system complete for a single cylinder engine. Fig. 2 is a diagrammatic view showing the system adapted for a four cylinder engine or one having four spark plugs, the circuits of the various spark plugs being made and broken at the proper periods by a distributer in the secondary circuit. Fig. 3 is a diagrammatic view of an ignition system adapted for a three-cylinder engine in which an individual transformer is used for each spark plug, the distributer for establishing the successive circuit connections being located in the primary circuit. Fig. 4 is a diagrammatic view of a single spark plug system in which the current is derived from the battery or other source of continuous current.

Similar reference characters are employed to designate corresponding parts throughout the views.

Referring particularly to Fig. 1 of the drawing, G designates a generator of the magneto type, the same including a permanent magnet M having pole pieces L between which rotates or oscillates an armature I having a winding W, the winding being so designed as to introduce considerable inductance in the supply circuit of the system. The transformer T includes a primary winding consisting of sections P′ and P″ connected in series relation, and inductively related to the secondary winding S. One terminal of the armature winding is connected, by wires 1 and 2, with one terminal of the primary winding, there being a condenser C in series with the wires 1 and 2, and the other terminal of the armature winding is connected by a wire 3 with the primary winding at the juncture of the sections P′ and P″ thereof. The other terminal of the primary winding is connected with a wire 4 which leads to a make and break device that controls the various circuits. The make and break device comprises a movable contact or blade *b* which is pivoted at *h* and carries a contact point *c* that is adapted to engage a contact *m* or a contact *n* when the blade is in either extreme position, the said contacts *m* and *n* being fixed on a metal support or conductor *f* to which the wire 4 is electrically connected. The movable contact *b* is connected by a wire 5 with the wire 1 between the armature winding and condenser. The contact *b* is vibrated by the co-action of a spring *z* and a rotating cam *k*, the latter being operatively connected with the armature of the magneto so as to rotate simultaneously therewith and also synchronously in case the generator generates alternating current of comparatively low frequency. On the movable contact *b* is a roller *r* which rides on the cam *k*, and this cam is provided with a depres-

sion k' and a contiguous elevation k^2 for the purpose of causing vibration of the movable element b, first into engagement with the contact n and then into engagement with the contact m. The closing and opening of the circuits in this manner is properly timed with relation to the compression of the charge in the engine so that sparking will occur at the proper time to ignite the compressed charge. The major portion of the cam k is circular and is of such a radius that it will maintain the blade or element b, with the contact c, in mid-position between the contacts m and n, and it will be noted that the spring z maintains the roller r in engagement with the cam. The secondary circuit consists of wires 8 and 9 that are connected with the terminals of the secondary winding S and with the electrodes e of the spark plug, these electrodes being spaced apart to form an air gap at q.

In operation, the armature of the magneto turns as soon as the engine is cranked, and in turning, an electrical pressure is generated in the winding W and at the same time the cam k turns in order to include the armature winding in circuit with the transformer. Assuming that the parts are in the position shown in Fig. 1, it will be observed that the make and break device has established a circuit whereby current flows from the armature winding through the section P″ of the transformer. This circuit consists of the winding W, wires 1 and 5, element b, contacts c and n, wire 4, transformer section P″, wire 3, and winding W. A comparatively heavy flow of current traverses this path and since the generating winding possesses inductance, electrical energy will be stored in the circuit. This circuit is immediately broken by the roller r passing out of the depression k' and riding on the high portion k^2, and as soon as the circuit is broken, an inductive charge will flow into the condenser, accompanied by a flow of high potential through the section P′ of the primary winding. The circuit through which the inductive impulse flows consists of the winding W, wire 1, condenser C, wire 2, primary winding section P′, wire 3 and winding W. The flow through the section P′ of the primary winding is such as to create a magnetic flux which opposes the magnetic flux due to the energizing current previously passed through the section P″.

The condenser discharges instantaneously by the contact c of the make and break device engaging the contact m, whereby a circuit is completed which includes the whole primary winding in series with the condenser. The condenser discharging impulse traverses a path consisting of the condenser C, wires 1 and 5, blade b, contact m, wire 4, sections P and P′ of the transformer, wire 2, and condenser C. It will be observed that the flow through the double sections of the primary winding, incident to the discharge of the condenser, is in such a direction as to create a magnetic flux which is the reverse of that created during the charging of the condenser. These rapid flux variations, incident to the charging and discharging of the condenser, induce high electrical pressures in the secondary circuit, so that hot sparks will jump across the gap of the spark plug and effectively ignite the compressed gas charge in the engine cylinder.

In the system shown in Fig. 2, the primary circuit differs in two respects from the primary circuit shown in Fig. 1, in that the make and break device has only a single fixed contact and the cam k has four sets of depressions and elevations so as to make and break the circuit four times in each revolution, there being four spark plugs in the secondary circuit. At low speeds, the electrical impulses through the section P′ of the primary winding, due to the inductance in the supply circuit, will be sufficient to produce an electrical effect in the transformer to cause the explosive charges to be ignited by the spark plugs, but at high speeds, the circuit is made and broken so quickly at the points c and n that the condenser will discharge through the whole of the primary winding or sections P′ and P″ before the condenser charge has a chance to leak away. The result is, therefore, that with only a fixed contact in the make and break device, the two electrical effects described in connection with Fig. 1, incident to the charging and discharging of the condenser, obtain in the arrangement shown in Fig. 2. In low speed engines, however, the double fixed contact circuit make and break device is more reliable. The secondary circuit consists of a secondary winding S which has one terminal connected with the wire 8 of the leads, to the blade F, which rotates simultaneously with the cam k, and is adapted to successively engage the segments s that are, respectively, connected by wires 8^b, 8^a, 8^c, 8^d, to the separate spark plugs. The other terminal of the secondary winding S is connected by a common return wire 9 with the several spark plugs. The making and breaking of the primary circuit is properly timed with respect to the successive engagements of the distributer blade F with the segments, so that the secondary circuit will be completed through the appropriate spark plug at the time of the maximum fluxes in the transformer.

The system shown in Fig. 3 is to be distinguished from that shown in Fig. 2 by its having the distributer blade F and segments s in the primary circuit and pro-

viding an individual transformer for each spark plug so that long high tension leads will be eliminated. The wire 2 leads from the condenser C and has branches 2^a, 2^b, 2^c, that connect, respectively, with the outer terminals of the sections $P^{a''}$, $P^{b''}$, $P^{c''}$. The wire 4 that leads from the make and break device has branches 4^a, 4^b, 4^c, that connect, respectively, with the outer terminals of the primary winding sections $P^{a'}$, $P^{b'}$, $P^{c'}$. The inner terminals of the primary winding sections are connected, respectively, by wires 3^a, 3^b and 3^c, with the segments s of the primary current distributer. The windings S^a, S^b, S^c, are, respectively, inductively related to the primary windings of the transformer, and each secondary winding is connected with a pair of electrodes e forming a spark plug. As the armature I, disk k, and distributer blade F, move together, the circuits through each transformer will be made and broken in proper sequence to produce electrical effects similar to those described in connection with Fig. 2. For instance, when the blade F is in engagement with the segment s connected with the wire 3^a, current will flow through the path consisting of the winding W, wires 1 and 5, element b, contacts c and n, wires 4 and 4^a, primary winding section $P^{a'}$, wire 3^a, distributer blade F, wire 3, and winding W. As soon as the circuit is opened by the contact c moving away from the contact n while the distributer F is still in engagement with the same segment, an inductive impulse will flow through the circuit including the condenser C and primary section $P^{a''}$, the circuit consisting of the winding W, wire 1, condenser C, wires 2 and 2^a, primary winding section $P^{a''}$, wire 3^a, distributer blade F, wire 3, and winding W. This flow through the part of the primary winding, incident to the charging of the condenser, will produce an electrical effect resulting in a spark jumping across the gap at the spark plug and igniting the compressed gas. If the engine is operating at a high speed, another electrical effect will be obtained by the condenser discharging through the whole of the primary winding comprising the sections $P^{a'}$, $P^{a''}$, as soon as the contacts c and n again engage. The path for this condenser discharging impulse consists of the condenser C, wires 1^c and 5, element b, contacts c and n, wires 4 and 4^a, primary winding sections $P^{a''}$ and $P^{a'}$, wires 2^a and 2, and condenser C.

When a battery is employed for supplying the current, a system is designed as shown in Fig. 4. The battery B has one terminal connected by the wire 1^b with an inductive winding W′ wound around an iron core I′, and this winding and core constitute an electro-magnet for controlling the make and break device. The other terminal of the battery is connected by a wire 1^a with contact b' that is pivoted at h' and coöperates with a cam disk k^3 to form a timer. This cam disk rotates with the crank shaft of the engine and is so positioned that it will close the primary circuit at the proper time for effecting the ignition of the compressed charge in the engine cylinder. The cam disk of the timer is connected by a wire 1 with the condenser C, the latter being in turn connected by a wire 2 with the outer terminal of the primary winding section P′. The inner terminal of this section is connected by a wire 3 with the winding W′. The make and break device includes a movable blade b which has an armature a disposed opposite one end of the core I′, so that when a magnetic flux is produced in the core, the blade will move in opposition to the spring z so as to separate the contact c from the contact m with which an engagement is normally maintained, and this separation is immediately followed by the contact c engaging the contact n, the blade being pivoted at h to swing. The contact m is mounted in a metal support f^2 which is connected by a wire 4 with the outer terminal of the primary winding section P″. A non-inductive resistance R is connected by a wire 1^s with the wire 4 by a wire 1^r to the metal support f' with the contact n. The secondary circuit is similar to the secondary circuit shown in Fig. 1, but it is obvious that a plurality of spark plugs may be employed, as shown in Fig. 2, or a plurality of transformers, as shown in Fig. 3.

The operation of the system shown in Fig. 4 is such that the transformation of energy takes place according to the method hereinbefore described. The energizing current flows through the section P″ of the primary winding as soon as the cam disk of the timer engages the blade b', it being understood that the blade b will be at this time engaged with the contact m. Current flows through the path consisting of the battery B, wire 1^a, the timer, wire 1, blade b, contact m, wire 4, winding section P″, wire 3, winding W′, wire 1^b, and battery B. This current energizes the winding W′ so as to store up energy in the circuit and at the same time cause the armature a to be attracted so that the contact c will open the circuit by disengaging the contact n. At this time, an inductive discharge will take place through a circuit including the section P′ of the transformer and the condenser C, the circuit consisting of the winding W′, wire 1^b, battery B, wire 1^a, the timer, wire 1, condenser C, wire 2, winding section P′, wire 3 and winding W′. The magnetic attraction of the core I′ will be such that the blade 1 will be moved far enough to engage the contact c with the con-

tact n and thereby bring the non-inductive resistance R into circuit to provide a path through which just sufficient current will flow to maintain the attractive flux in the core I'. At the time the circuit is completed by the contacts c and n engaging, the condenser will discharge through both sections P and P' of the transformer to produce a transformation of energy in the latter, whereby another spark will be made. The path through which the condenser discharges consists of the condenser C, wire 1, blade b, contacts c and n, non-inductive resistance wire 4, windings P'' and P', wire 2, and condenser C. The system shown in Fig. 4 can be readily combined with a magneto and make and break device, as shown in Fig. 1, so that current can be derived from two separate sources merely by the manipulation of a switch.

From the foregoing description, taken in connection with the accompanying drawing, the advantages of the construction and of the method of operation will be readily apparent to those skilled in the art to which the invention appertains, and while I have described the principle of operation of the invention, together with the apparatus which I now consider to be the best embodiment thereof, I desire to have it understood that the apparatus shown is merely illustrative, and that such changes may be made when desired as are within the scope of the claims appended hereto.

Having thus described the invention, what I claim as new, is:—

1. In an ignition system, the combination of a primary winding, a condenser in series relation to said winding, means including a circuit connecting a source of current to one terminal of the winding and to a point in said winding intermediate the terminals for producing an impulse through a part of said winding to charge the condenser, means for causing the condenser to discharge through all of the primary winding, and a secondary winding inductively related to the primary winding.

2. In an ignition system, the combination of a primary winding, a secondary winding inductively related thereto, a condenser in series relation to the primary winding, means for charging the condenser through only a part of the primary winding and means for discharging the condenser through the whole of the primary winding.

3. In an ignition system, the combination of a primary winding, a secondary winding inductively related thereto, a sparking device connected with the latter winding, a condenser in series relation to the primary winding, means for charging the condenser through only a part of the primary winding to create a magnetic flux, and means for discharging the condenser through the whole of the primary winding and in such a direction as to create a flux in opposition to the first flux.

4. In an ignition system, the combination of a primary winding, a secondary winding in inductive relation to the primary winding, a current supply circuit possessing inductance and connected with the primary winding at one of its terminals and at a point intermediate its terminals, means for closing and opening said circuit, and a condenser arranged to receive the inductive discharge from said circuit, when the same is opened by the said means, through a part of the primary winding other than that included in the said circuit.

5. In an ignition system, the combination of a primary winding, a current supply circuit possessing inductance and connected with the primary winding at one terminal at a point intermediate its terminals, means for closing and opening said circuit, a condenser arranged to receive the inductive discharge from said circuit through a part of the primary winding other than that included in the said circuit when the latter is opened by the said means, a spark gap device, and a secondary winding connected with the said device and inductively related to the primary winding.

6. In an ignition system, the combination of a primary winding, a secondary winding inductively related to the primary winding, a current supply circuit possessing inductance and including a part of the primary winding in series relation, means for closing and opening said circuit, a condenser arranged to receive the inductive discharge of said circuit, when the latter is opened, through a part of the primary other than that included in the said circuit when closed, and means for discharging the condenser through the whole of the primary winding.

7. In an ignition system, the combination of a primary winding, a circuit including a source of current and inductance connected at one terminal of and at an intermediate point in the primary winding in series relation thereto, a condenser in the circuit, a make and break device including a movable contact connected between the said source and condenser, and spaced contacts cooperating with the movable contact and connected with the other terminal of the other portion, and means for vibrating the movable contact.

8. In an ignition system, the combination of a primary winding, a generator including an armature, a conductor connecting one terminal of the armature winding with one terminal of the winding, a condenser in the said conductor, a conductor connecting the other terminal of the armature winding with the primary winding at an intermedi-

ate point, and a make and break device connected with the other terminal of the primary winding and with the first conductor between the armature and condenser, said make and break device comprising a vibrating element, spaced contacts with which the element alternately engages, and means for vibrating the element.

9. In an ignition system, the combination of a primary winding, a generator including an armature, a conductor connecting one terminal of the armature winding with one terminal of the winding, a condenser in the said conductor, a conductor connecting the other terminal of the armature winding with the primary winding at an intermediate point, and a make and break device connected with the other terminal of the primary winding and with the first conductor between the armature and condenser, said make and break device comprising a vibrating element, spaced contacts with which the element alternately engages, a cam for moving the element in quick succession into and out of engagement with the said spaced contacts during the firing period and for holding the element out of engagement with the contacts during the rest of the cycle of the engine.

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

HENRY J. PODLESAK.

Witnesses:
H. W. Cook,
Elmer McCormick.