

Aug. 20, 1940.

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2,212,404

IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES

Filed Nov. 12, 1938

2 Sheets-Sheet 1

Fig. 1.

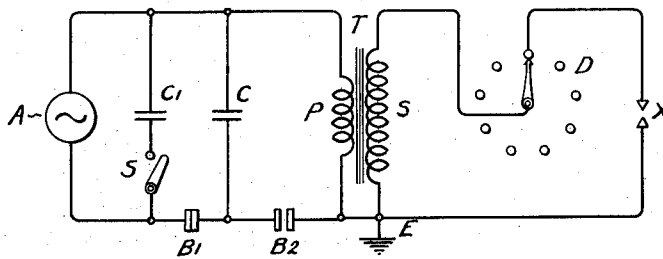


Fig. 2.

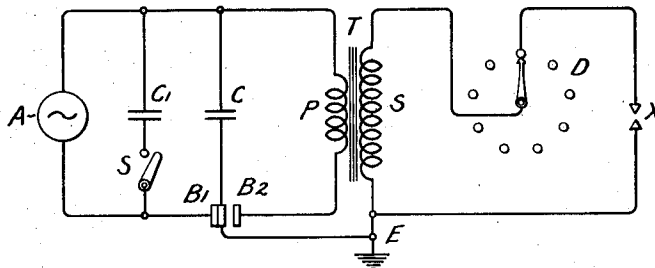


Fig. 3.

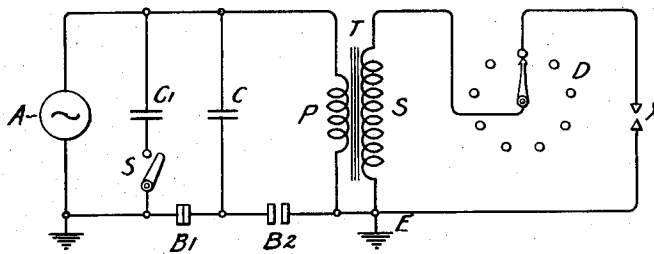
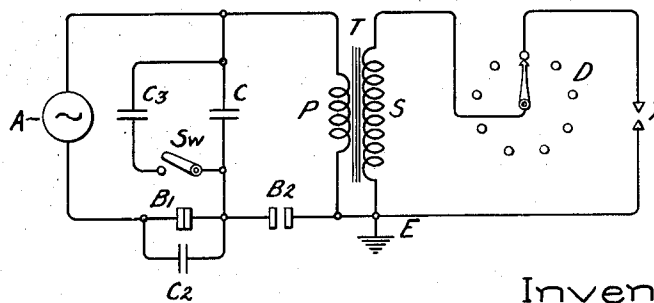


Fig. 6.



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Fig. 4.

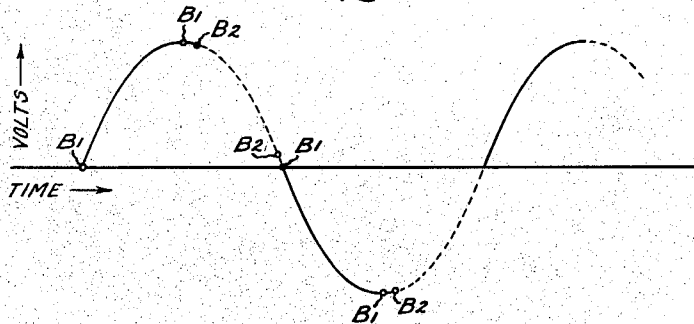
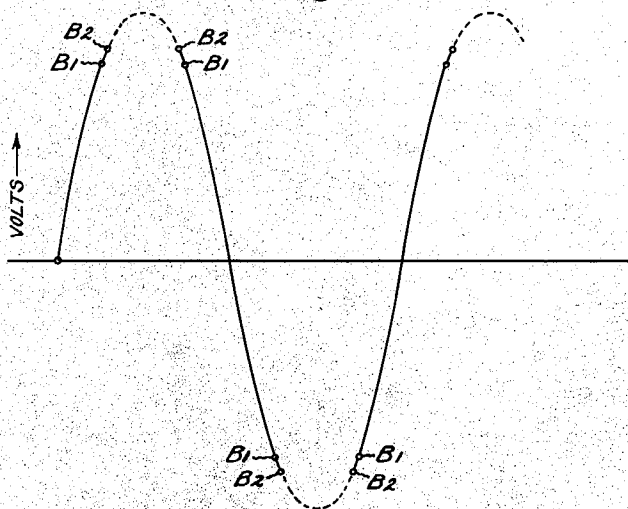


Fig. 5.



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UNITED STATES PATENT OFFICE

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IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES

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 In Great Britain November 11, 1937

5 Claims. (Cl. 123-148)

(Granted under the provisions of sec. 14, act of
 March 2, 1927; 357 O. G. 5)

This invention relates to ignition apparatus for internal combustion engines. The usual type of magneto-electric machine commonly used for ignition purposes does not give satisfactory performance at high speeds due partly to the short time available for building up the flux in the armature core and partly to poor contact breaker operation which is the result of a large open period cam design necessitated by the time of the flux building up just referred to.

The object of the present invention is to provide an improved system of ignition particularly suitable for high speed operation.

According to the present invention we provide an alternator as a source of electromotive force which charges a condenser on each successive half voltage wave by means of a contact breaker such as a mechanical rectifier and subsequently discharge the condenser through the primary of an ignition coil by means of a contact maker in order to produce a high tension electromotive force in the ignition coil secondary. With such an arrangement the time necessary for flux building-up does not arise and the cam required for the operation of the contact mechanisms can be designed for nearly equal periods thus reducing the contact flinging which takes place with an unequal period cam due to rapid acceleration imparted to the lever.

The accompanying drawings illustrate this invention. Figs. 1, 2 and 3 show diagrammatic ignition circuits, Figs. 4 and 5 are curves showing the points of ignition, and Fig. 6 is a modified form of the circuit shown in Fig. 1.

Referring to Fig. 1, A is a source of alternating current electric power supply, such as a small alternator driven from the internal combustion engine and connected to the condenser C through a contact breaker B1 operated by a cam so arranged on the alternator shaft that the contacts break the circuit on the rising portion of the alternator voltage wave so charging the condenser to the instantaneous voltage value v of the wave at the moment of breaking the circuit. The electrostatic energy available in the condenser at this instant is equal to $\frac{1}{2} Cv^2$ joules. The condenser is then discharged by means of contact breaker B2 through the primary P of an induction coil or an ignition transformer T, the resultant high tension voltage which is developed in the secondary S being distributed by the usual type of distributor D to the appropriate plugs X in the engine cylinders. This system operates on both the positive and the negative half cycles of the alternator voltage wave giving in effect two

sparks per pair of poles per revolution of the alternator. In the circuit arrangement shown in Fig. 1 the contact points of both contact mechanisms are at the instant of "break" in the case of B1 and "make" in the case of B2 at a potential relative to earth and require to be insulated. From a design point of view this is in some cases not convenient or desirable and the arrangements shown in Figs. 2 or 3 may be adopted as an alternative. In Fig. 2 one of the contacts of contact breaker B1 is connected to earth at E. In this figure it will be noted that the contact breakers B1 and B2 are combined so that they can be manufactured as a single unit the contact lever carrying two contacts one for "break" at B1 and the other for "make" at B2.

In Fig. 3 the circuit is connected to earth between the alternator and the contact breaker B1.

As an engine requires an ignition system which will operate over a considerable timing range this is obtained by the present invention as follows:

For a retarded contact timing, which is usually required at low speeds for starting purposes, the contacts would be arranged to operate on the crest of the voltage wave, as shown in Fig. 4, as at low speeds the voltage of the alternator will be low and the peak voltage must be utilised to obtain the best results. As the alternator speed increases the voltage increases and as an advanced timing position is only required at medium and high speeds, this timing advance can only be obtained without loss of the requisite condenser voltage by operating the contacts at a position on the voltage wave prior to the peak position as shown in Fig. 5.

As the high tension requirements of an engine are more or less constant over the whole speed range, it is unnecessary for the alternator to develop a greater voltage than that required for the establishment of sufficient electrostatic energy in the condenser C for the production of the requisite high tension voltage from the secondary of the ignition transformer. If it is desired to limit the output, a second condenser C1, shown in Figs. 1, 2 and 3 may be connected across the alternator terminals to limit its output voltage at high speeds. It is also desirable to limit the alternator voltage at medium and high speeds as immediately contacts B1 open a considerable potential difference exists between them. This is due firstly to the removal of the condenser load thereby causing an immediate rise in the alternator voltage, and secondly, with the system

operating in the advance timing position as shown in Fig. 4 to the natural progression of the voltage wave from its instantaneous value at B1 when the contacts open to a higher value at a very short time interval later.

In order to limit this voltage rise across the contacts B1 as well as to limit the voltage of the alternator, a condenser C2 is connected as shown in Fig. 6 across these contacts. Other voltage limiting means may be provided for obtaining the requisite speed-voltage characteristics of the alternator.

At very low speeds the alternator may be insufficient to provide the necessary energy in the condenser C for the production of the requisite high tension voltage. The required energy can be provided by connecting in parallel with the condenser C an additional condenser C3 (Fig. 6) of suitable value. As this additional condenser will impair the performance at high speeds its use is confined to engine starting and low speed running purposes. A switch Sw is provided, which may be manually or centrifugally operated, so that the condenser C3 may be cut out of circuit when the speed of the alternator increases above a predetermined value. The provision of this additional condenser for slow speed running renders the system capable of producing satisfactory ignition over a very wide range.

It will be understood that the condenser C2 and condenser C3 with its controlling switch may be added to the modifications illustrated in Figs. 2 and 3 of the drawings when condenser C1 is omitted.

I claim:

1. The method of providing ignition sparks in the cylinders of internal combustion engines which consists in the employment of an alternator as a source of current and causing each half of the voltage wave to charge a condenser which is discharged through a primary winding of an ignition coil thereby producing a high tension electromotive force in a secondary winding of the coil which is distributed through a distributor to an appropriate plug in the engine cylinders.

2. An ignition system including a source of alternating current electric power supply, a condenser, an induction coil having a primary winding and a secondary winding, and means for connecting said condenser alternately across said source of alternating current electrical power supply for at least a part of each half wave of voltage to charge said condenser and across said primary winding to discharge said condenser therethrough and induce an electrical potential in said secondary winding.

3. An ignition system including a source of

alternating current electric power supply, a condenser, an induction coil having a primary winding and a secondary winding, means for connecting and disconnecting said condenser across said source of alternating current electric power supply and for providing said connection for at least a part of each half wave of voltage to charge said condenser, and means for connecting and disconnecting said condenser across said primary winding and for providing said connection for at least a part of the time said condenser is not connected across said alternating current source of electrical power supply to discharge said condenser through said primary winding.

4. An ignition system including a source of alternating current electric power supply, a condenser, an induction coil having a primary winding and a secondary winding, means including a circuit breaker for connecting and disconnecting said condenser across said source of alternating current electric power supply and for providing said connection for at least a part of each half wave of voltage to charge said condenser, means including a second circuit breaker for connecting and disconnecting said condenser across said primary winding and for providing said connection for at least a part of the time said condenser is not connected across said alternating current source of electrical power supply to discharge said condenser through said primary winding, and a second condenser connected in parallel with said first-mentioned circuit breaker to limit the voltage of the alternating current source of electrical power supply thereacross.

5. An ignition system including an alternator providing a source of alternating current electric power supply, a condenser, an induction coil having a primary winding and a secondary winding means for connecting and disconnecting said condenser across said source of alternating current electric power supply and for providing said connection for at least a part of each half wave of voltage to charge said condenser, means for connecting and disconnecting said condenser across said primary winding and for providing said connection for at least a part of the time said condenser is not connected across said alternating current source of electrical power supply to discharge said condenser through said primary winding, a second condenser, means for connecting said second condenser in parallel circuit with said first-mentioned condenser to increase the condenser energy capacity at low speeds of said alternator and means for disconnecting said second condenser from said parallel circuit above a predetermined speed of said alternator.

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