Sept. 20, 1960 M. R. GUIOT 2,953,719

ELECTRONIC IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES

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Fig. 1.

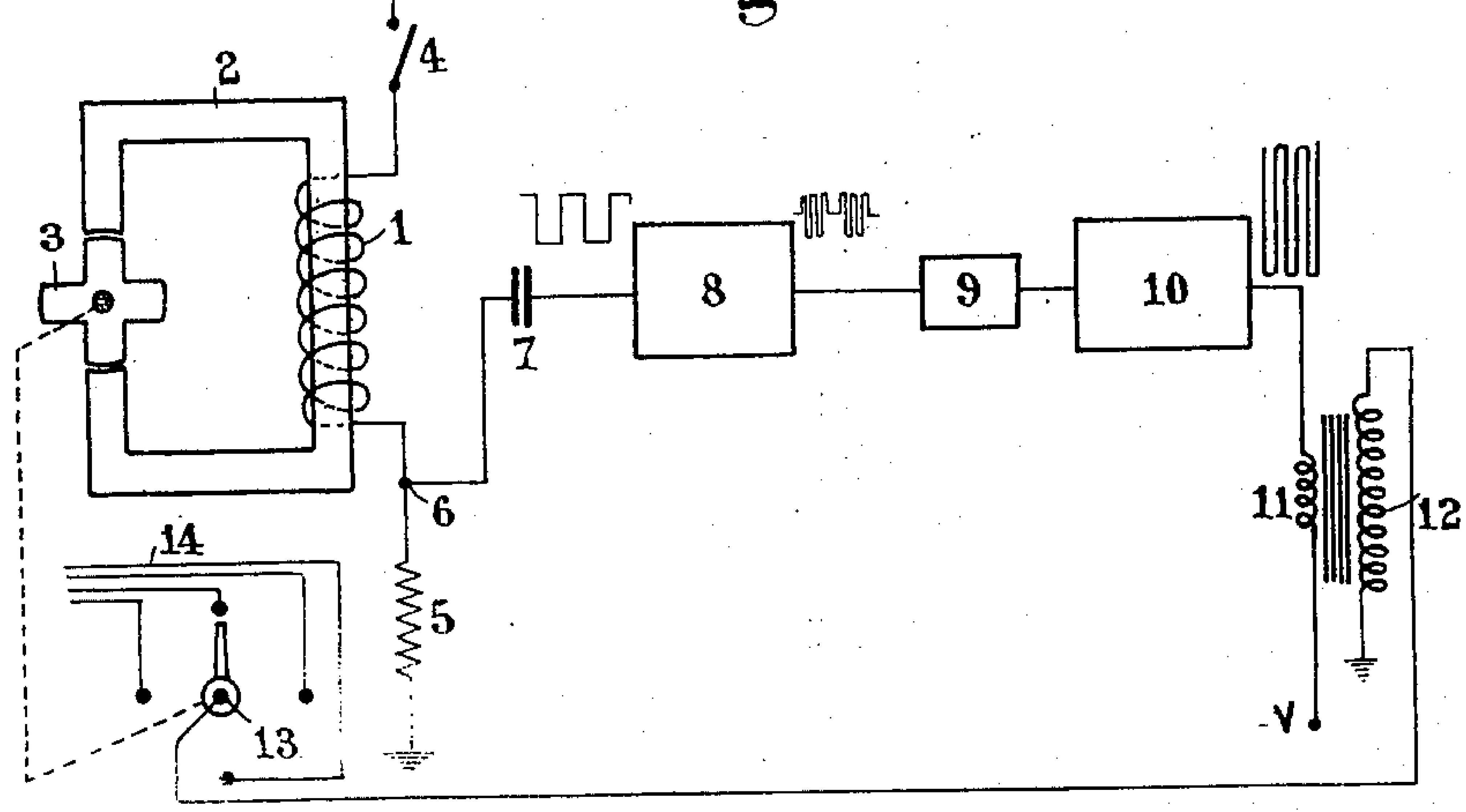

Fig. 2.

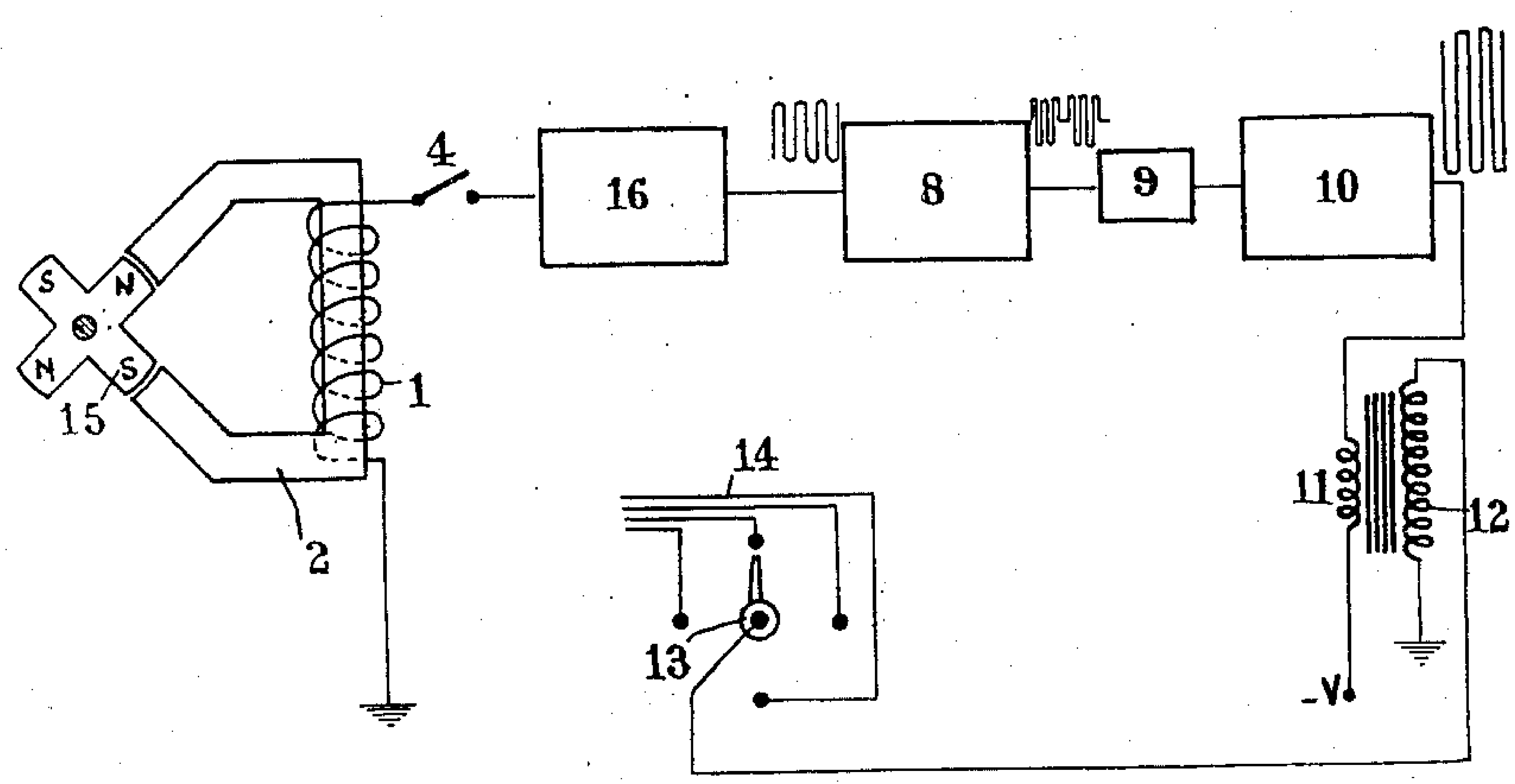

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Fig.3

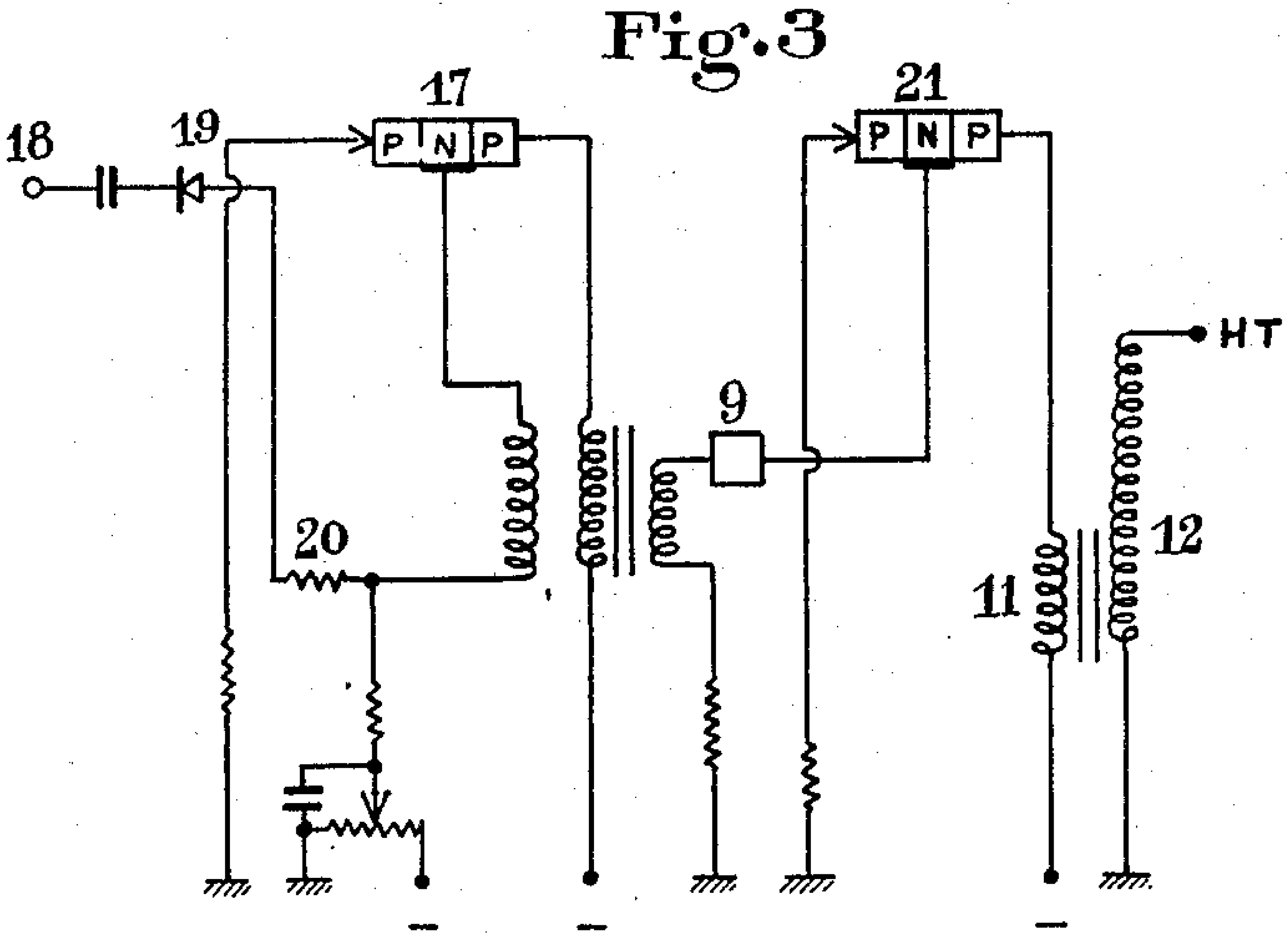


Fig.4

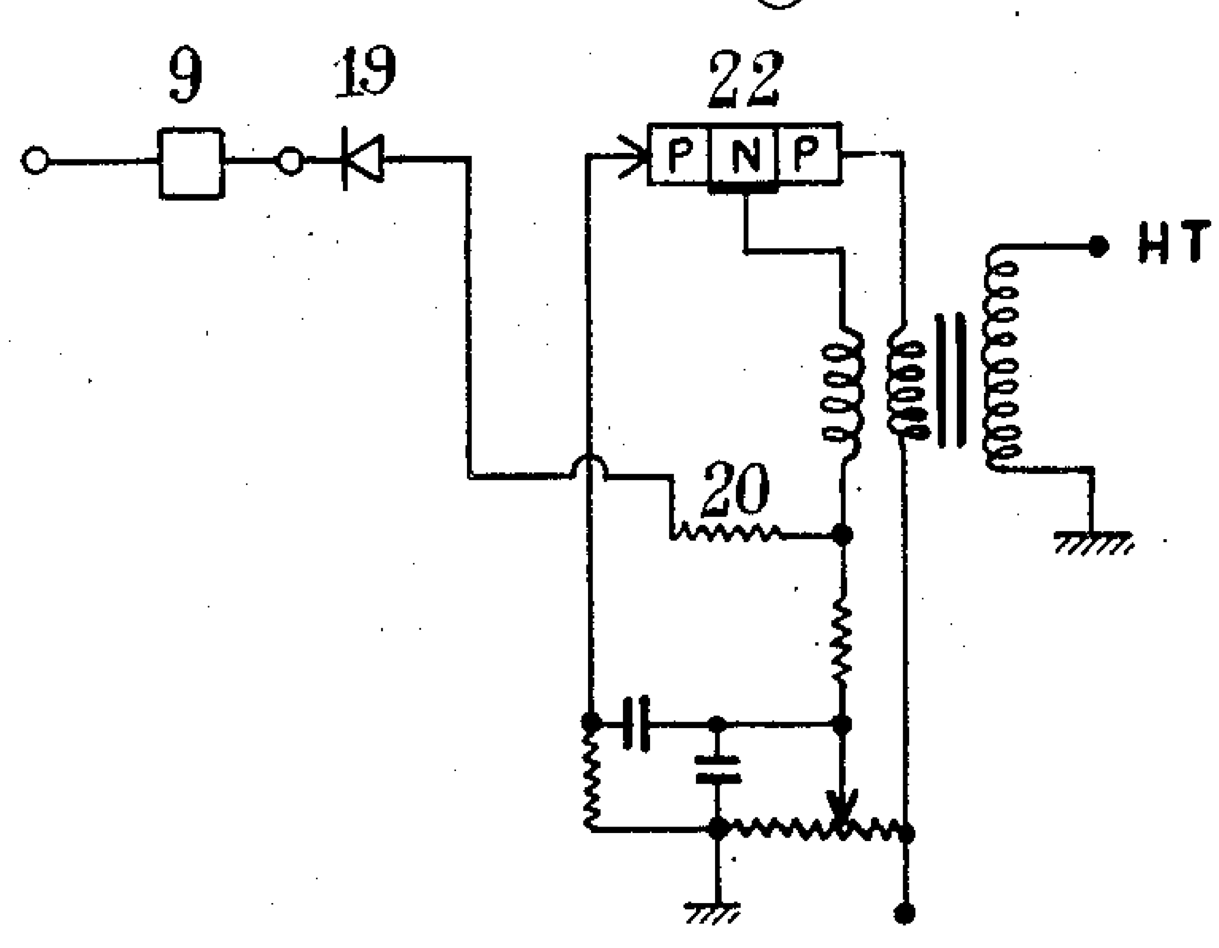
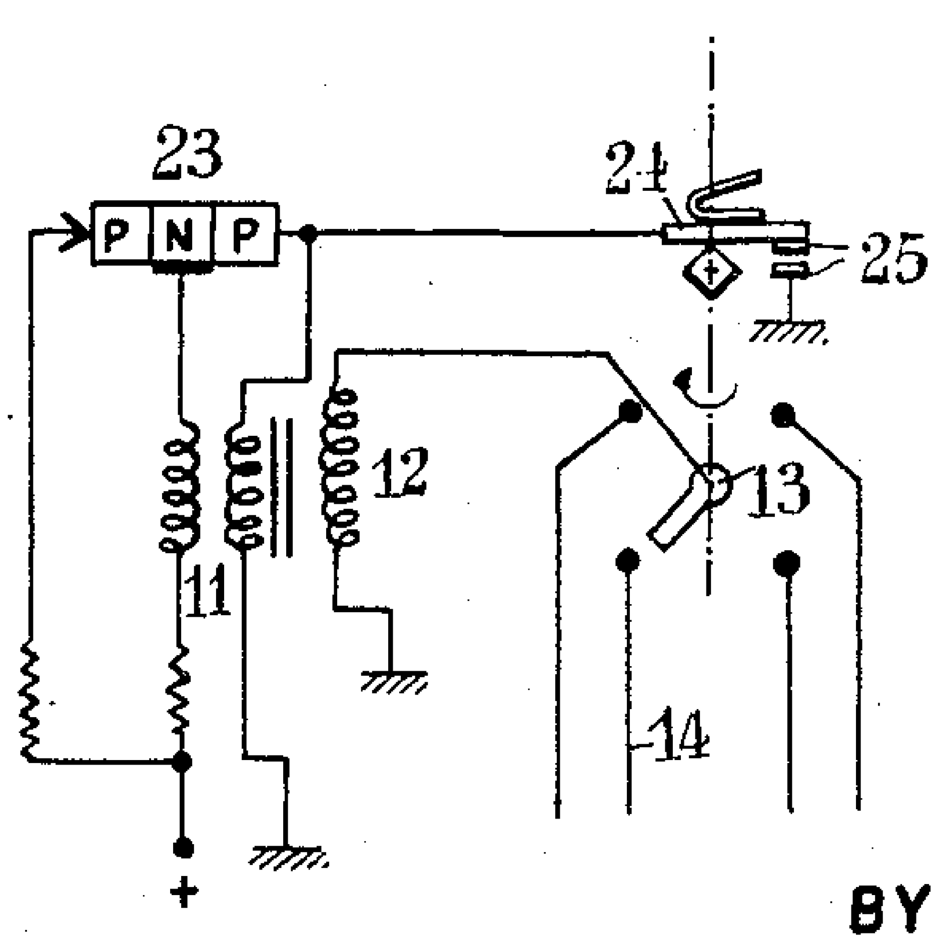


Fig.5



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ELECTRONIC IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES

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4 Claims. (Cl. 315—171)

This invention relates to high-frequency, low-tension electronic ignition systems for internal combustion engines.

In known ignition systems of the make-and-break type, that is, comprising a distributor, the use of an induction coil and the breaking of the primary circuit by means of tungsten contacts or like points are attended by serious inconveniences. On the one hand the efficiency of the ignition coil is reduced owing to iron losses, and on the other hand rebounds may occur in the tungsten contacts, thereby making the ignition defective.

It has already been proposed to overcome these drawbacks by substituting an electronic device, in which the use of tungsten or like contacts may be dispensed with, for the usual electromechanical system.

Now it is the essential object of this invention to provide and improved and simplified electronic ignition system which may easily be adapted to known distributors.

This invention therefore consists of a high-tension generator adapted for use notably with internal combustion engines, this generator comprising essentially a rotary member adapted to generate electric control pulses, and a high-frequency release electron oscillator incorporating one or more transistors.

The invention relates more particularly to a device of the type broadly set forth hereinabove, wherein the oscillator is periodically released by control pulses of a given polarity which are generated by a suitable rotary member which may easily be fitted on the distributor-carrying shaft.

My invention is also concerned with a device of the aforesaid character wherein the electric control pulses of a predetermined polarity are applied after clipping at the base or at the emitter of one or more oscillator-mounted transistors.

The control pulses creating rotary member may consist if desired of a rotary magnet, an alternator or the tungsten or like contacts of a conventional-type distributor.

The advantages offered by transistor circuits are well known to anybody conversant with the art. They are sturdy, have a high efficiency and their feed voltage is within the limits of conventional storage batteries; moreover, it was found quite surprisingly that with transistor mountings groups of sparks were obtained across the electrodes of spark plugs. These sparks are obtained independently of the speed of operation of the engine and take place not only between two electrodes of the spark plug but also between the central electrode and the screwed end of the plug.

In order to afford a better understanding of the invention and of the manner in which the same may be carried out in the practice, reference will now be made to the attached drawings forming part of this specification and illustrating diagrammatically by way of example a few embodiments of the invention. In the drawings:

Figure 1 is a diagram showing a first embodiment of the electronic ignition system of this invention.

Figure 2 is a modified embodiment thereof.

Figure 3 is a wiring diagram of an oscillator-amplifier unit adapted for use in the embodiments of Figs. 1 and 2.

Figure 4 is another wiring diagram illustrating another oscillator adapted for use in the embodiments of Figs. 1 and 2, and

Figure 5 is a modified embodiment adapted to be associated with an existing distributor.

In the Figure 1 the device comprises an electromagnetic circuit consisting of a coil **1** wound on an open magnetic circuit **2** adapted to be alternately interrupted by a four-armed core **3** (for example in the case of a four-stroke, four-cylindered engine).

This core **3** may be driven from the distributor-carrying shaft of a conventional ignition system.

One side of the coil **1** is connected through a switch **4** to the voltage source —V (V being the potential of the battery having a grounded positive terminal and thus providing a substantially constant voltage) and on the other side is grounded through a resistor **5**.

A condenser **7** is connected across the junction **6** between the coil **1** and resistor **5**, and the input side of a release oscillator **8** illustrated in block form.

The output of this oscillator **8** is connected to a phase-shifting network **9** connected in turn to a power amplifier **10**.

The output of this power amplifier **10** is connected to a winding **11** having its other side connected to the potential —V.

This winding **11** is iron-coupled to a step-up winding **12** having one side grounded and the other side connected to the distributor **13** mounted on the same shaft as the aforesaid core **3**.

The above-described device operates as follows:

Under normal operating conditions the switch **4** is closed and the core **3** rotates to alternately vary the reluctance of the magnetic circuit **2** and consequently the reactance of the coil **1**.

As a result, a series of pulses of constant voltage are produced at **6** which are of same frequency as the engine firing frequency.

These pulses transmitted through the coupling condenser **7** are fed to the input of the release oscillator **8**.

This release oscillator **8** comprises a junction-type transistor.

The arrangement of an oscillator of this type is already known per se; two typical embodiments thereof are shown by way of example in Figs. 3 and 4, but it will be readily understood that other oscillator arrangements may be used without departing from the spirit and scope of the invention.

The biasing voltages of the different component elements of the transistor are so selected that the input pulses transmitted through the condenser **7** will release the oscillator during a time period subordinate to the duration of these control pulses.

As a result, a series of trains of oscillations are produced at the output of this oscillator **8** which are subsequently fed to an appropriate phase-shifting network **9** adapted to determine the phase-shifting of these trains of oscillations as a function of the break frequency.

Thus, an ignition lead which is a function of the velocity of rotation of the engine will be obtained.

The trains of phase-shifted oscillations are fed to a power amplifying stage **10** also shown in block form.

This amplifier comprises a power transistor which may be mounted as shown in Fig. 3.

The trains of oscillations thus obtained at the output (collector) side of amplifier **10** are fed to the primary winding **11**.

As a result, a series of high-tension pulses are obtained at the ends of the high-tension step-up winding **12** and fed to the rotor arm **13** of the distributor and hence to the different spark plug wires **14**.

Figure 2 illustrates a modified embodiment of the invention.

In this figure the same reference characters are used to designate the same elements as in Fig. 1.

A four-armed permanent magnet **15** is substituted for the core of Fig. 1 and driven from the distributor-carrying shaft **14**.

This permanent magnet **15** generates in the coil **1** a train of oscillations which are transmitted via the closed interrupter **4** to a compensator filter **16**.

This compensator filter is adapted to compensate any variations of E.M.F. induced as a function of the rotational velocity of the magnet **15**, i.e. of the engine.

This train of oscillations of a frequency depending on the velocity of rotation of the magnet **15** and therefore of the engine is fed in a similar manner to the release oscillator **8**.

The remaining portion of the electric system is the same as in the diagram of Fig. 1.

Figures 3 and 4 illustrate wiring diagrams of known transistor oscillators adapted for use in the practical embodiments of the invention. Only the essential features of these mountings will be described hereinafter.

In Fig. 3 of the drawings the release oscillator comprises a p-n-p junction-type transistor **17**. This transistor is normally blocked by suitably selecting the biasing voltages of its emitter and base. The release pulses fed to the terminal **18** are transmitted through a diode **19** and a resistor (or thermistance) **20** to the base of transistor **17**. By suitably selecting the value of resistor **20** it is possible once and for all to determine the value at which the oscillator will be released. At low engine speeds the control pulses thus obtained are characterized by extremely elongated edges. If no clipping device were provided the release of the oscillator and, therefore, the ignition proper, would have a strong forward shift, which would be in opposition with the principle of internal-combustion engine ignition. The provision of a suitably selected pulse threshold makes it possible to reduce the active portion of the pulse to the crest zone, in which any form variations that may result from variations in the engine speed are not very appreciable. Thus, the oscillator **8** will emit trains of oscillations which are subsequently phase-displaced by the phase-shifting network **9** before they are fed to the power amplifier **10**. The latter comprises a p-n-p junction-type transistor **21** having the coupling coil **11** connected to its collector.

Figure 4 illustrates another embodiment of the device of this invention comprising a known transistor oscillator. In this device the oscillation and amplification functions are carried out by a single transistor **22** of the p-n-p type. The release pulses are phase-shifted in the network **9** and fed to the terminal **18**.

Figure 5 shows another modification of the device of this invention including a known transistor oscillator. The collector of transistor **23** is connected on the one hand to the coupling coil **11** and on the other hand to the movable contact-support **24** of a conventional tungsten-contact device **25**. Thus, the oscillator may readily be fitted on existing distributors. To this end, it will be sufficient to dispense with the condenser connected in parallel with the tungsten contacts and to reduce the gap between these contacts. When the points **25** are moved apart from each other the transistor is released; as a result a high-frequency oscillation is produced in the coupling coil **11**. When the points engage each other the collector of transistor **23** is grounded, the coil **11** short-circuited, and the oscillations are discontinued.

In this specific embodiment when contacts **25** open they interrupt the very moderate current flowing through the transistor **23** in its blocked condition; consequently, no sparks can develop and this accounts for the removal of the now useless condenser from this arrangement; at the same time, the contact points **25** will have a considerably longer useful life. Besides, these contact points do not act anymore like breaker contacts and therefore the maximum gap therebetween may be reduced to a substantial extent while suppressing any risk of rebound at high engine speeds.

Other transistors, such as tetrodes, etc. may be substituted for the conventional triode-type junction transistors shown in the drawings and mentioned hereabove; besides, a push-pull oscillator or amplifier system may also be substituted for these transistors.

Finally, n-p-n transistors may be substituted for the p-n-p transistors, provided, of course, that the biasing of the different electrodes be reversed and the control pulse polarity modified accordingly.

What I claim is:

1. Electronic high-tension ignition device for internal combustion engine, comprising a transistor circuit device, means for coupling an output circuit to an input circuit of said device, whereby said device is adapted to produce high frequency oscillations, means for inhibiting the production of said oscillations, an electromagnetic circuit connected across a substantially constant voltage, means for varying the reluctance of said electromagnetic circuit by opening and closing it in synchronism with said engine, means for converting these reluctance variations to electric impulses, means for periodically applying impulses to a set input of said transistor circuit device and thus rendering said device effective to produce said oscillations, and means for feeding said oscillations at high voltage to a spark plug for said engine.

2. Electronic high tension ignition device for internal combustion engine, according to claim 1 comprising means for clipping said impulses.

3. Electronic high-tension ignition device according to claim 1 in which said means for varying the reluctance of said electromagnetic circuit by opening and closing it comprise a magnetic core having as many arms as there are spark plugs and rotatably driven in a gap in said electromagnetic circuit.

4. Electronic high-tension ignition device according to claim 1 in which said means for converting the reluctance variations to electric impulses comprise a battery, a magnetic circuit, a winding wound upon said magnetic circuit, one extremity thereof being connected to the battery, and a bias resistance connected to the other extremity of said winding, one extremity of said winding being connected to the set input of said transistor circuit device.

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