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VOLTAGE-MULTIPLYING, ALTERNATING-PULSE CIRCUITS, NOTABLY
FOR THE IGNITION SYSTEM OF INTERNAL COMBUSTION ENGINES
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Fig. 1

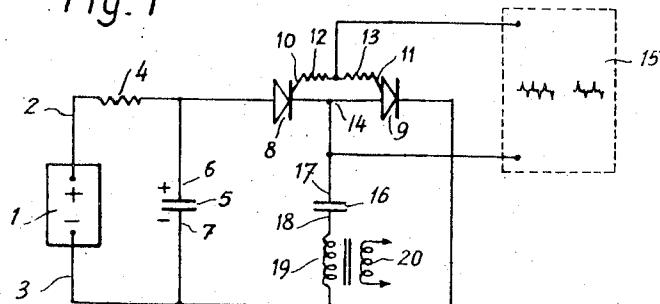


Fig-2

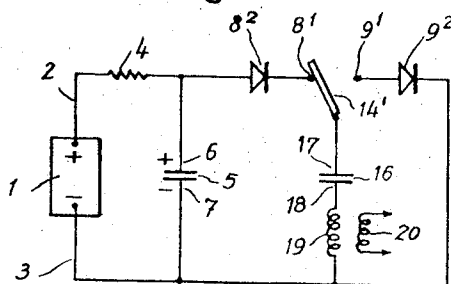


Fig. 3

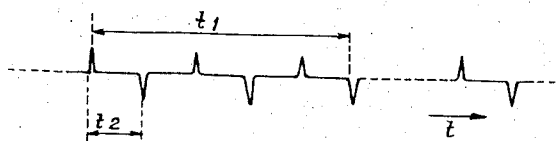
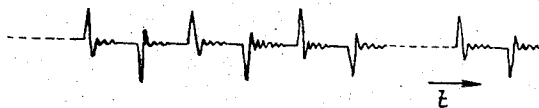


Fig. 4



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VOLTAGE-MULTIPLYING, ALTERNATING-PULSE CIRCUITS, NOTABLY FOR THE IGNITION SYSTEM OF INTERNAL COMBUSTION ENGINES

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30,550

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ABSTRACT OF THE DISCLOSURE

An alternating-current generator having a pair of thyratrons connected in series across a direct current source. A monitoring-pulse generator is connected to the control members of the thyratrons to alternatively render them conductive. A capacitor and the primary of a transformer are series connected between a point common to the thyratrons and to a terminal of the current source to develop and deliver the alternating current produced.

This invention relates to a device capable of generating relatively powerful alternating-current pulses across the terminals of a coil from a direct-current source, a pair of electron relays of the threshold and snap-switching type, such as solid or gas thyratrons, at least one capacitor and a monitoring-pulse generator for controlling said relays.

A pair of threshold snap-switching electron relays are connected in series across the terminals of said direct-current source of the alternating pulse generator according to this invention, said relays being rendered conducting alternately, by means of their relevant control members connected to the monitoring-pulse emitter. Between the circuit point common to said relays and one of the terminals of said D.C. source are disposed in series, a capacitor and the primary winding of a transformer having its secondary winding adapted to deliver said alternating pulses.

The device according to this invention is capable of charging said capacitor at a voltage several times higher than that of the supply source. Under low-charge conditions of said coil it was observed that the voltage increase across the terminals of said capacitor was five to seven times the supply voltage. By using for example two thyratrons, more particularly two solid thyratrons of the silicon type frequently referred to as thyristors, it was observed that this device was capable of generating series of alternating pulses across the terminals of the aforesaid secondary winding without causing any one of said thyratrons to remain energized between successive pulse series, thus affording substantial savings in current, the thyratrons used being adapted to be blocked or unblocked by the control gate.

A circuit of this character is particularly useful for the ignition systems of the controlled-ignition type for internal combustion engines, when it is desired to produce several sparks per plug at each ignition. Thus, for example, a spark may be produced every 20 microseconds during 200 microseconds, it being understood that these figures are given by way of illustration, not in a limiting sense.

In order to afford a clearer understanding of this invention and of the manner in which the same may be carried out in practice, reference will now be made to the accompanying drawing in which:

FIGURE 1 is a wiring diagram of the circuit according to this invention;

FIGURE 2 is an electrically equivalent circuit diagram

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permitting an easier understanding of the voltage-multiplying process;

FIGURE 3 is an oscillogram showing a control signal fed to the control elements, notably in the case of an ignition system of internal combustion engine, and

FIGURE 4 shows under the same conditions the oscillogram of the voltage obtaining across the coil terminals.

In the wiring diagram of FIGURE 1 a direct-current source 1 has its positive and negative output terminals 2 and 3 connected through a limiting resistance 4 to a capacitor 5. In the path extending from the positive plate 6 of capacitor 5 to the negative plate 7 thereof are inserted in series a pair of solid silicon thyratrons 8 and 9, the anode of thyatron 8 being connected to the aforesaid plate 6, and the cathode of thyatron 9 being connected to the negative plate 7. Both thyratrons 8 and 9 are of the inverted type, i.e., the gate control 10 of thyatron 8 acts upon the cathode whereas the gate control of thyatron 9 acts upon the anode. Under these conditions the two gates are electrically in parallel in relation to the circuit point 14 common to both thyratrons and connected by means of limiting resistances 12 and 13 to a known generator 15 of trains of alternating pulses, the first signal of one train of waves fed to the gates being positive, the following one being therefore negative in relation to point 14, as evidenced by FIGURE 3.

The common circuit point 14 is connected to the plate 17 of a capacitor 16 having its other plate 18 connected through a return line to the negative line 3 and to the armature 7 through the primary winding 19 of a high-voltage transformer feeding through its secondary 20 the load (not shown) utilizing said alternating pulses. This secondary winding 20 may thus be connected to the spark plugs of an internal combustion engine through a conventional distributor (not shown). The capacity of capacitor 16 is but one fraction of that of capacitor 5.

The operation of this circuit will now be explained with reference to the electrically equivalent circuit diagram illustrated in FIGURE 2, wherein the thyratrons 8 and 9 are replaced by fixed contacts 8¹ and 9¹, a movable contact blade 14¹ being disposed between these contacts having diodes 8² and 9² mounted in series thereacross. The movement of contact blade 14¹ simulates the energization of the thyratrons by their relevant gates under the influence of the monitoring pulse generator 15.

(1) From a positive voltage of plate 6 in relation to plate 7, this positive voltage being equal to the voltage T of source 1, closing the contact 8¹, 14¹ will bring the voltage of plate 17 of capacitor 16 substantially to the aforesaid voltage value T, this also applying therefore to the winding 19 through which a current i is gradually produced as the voltage across the terminals of said winding decreases and plate 18 is charged in relation to 17. After the voltage across the terminals of winding 19 has attained zero value a reverse voltage appears as i decreases. Under these conditions, plate 18 is charged toward -T and plate 17 remains at +T, the discharge being prevented by the diode 8². Thus, the difference in potential between these plates 17 and 18 is 2T.

(2) As contact 9¹, 14¹ is closed, armature 17 resumes substantially the potential of the negative terminal 3 as a current develops in winding 19, the same process as described in paragraph (1) hereinabove being repeated but with opposite signs. Upon completion of the cycle, the capacitor is charged at a value approximating 2T but reversed, plate 17 being negative in relation to plate 18.

(3) Reclosing contacts 8¹, 14¹ will cause the voltages of capacitors 5 and 16 to add themselves and a voltage value approaching 3T is fed to winding 19. At the end of the cycle, as the plate 17 remains connected to the plate 6 of capacitor 5, the value acquired by the other capacitor 16 approximates 4T.

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(4) In fact, the voltage increase of capacitor 16 is attended by an increment in the coil losses, notably in the spark and a stabilized condition is obtained after a few cycles.

Referring again to the wiring diagram of FIGURE 1, it will be readily understood that each thyatron can be blocked by reversing the voltage produced by the primary winding 19, provided that the control signals have an adequate amplitude and interval between pulses.

As illustrated in FIGURE 3, these control signals will appear in the form of trains of waves having a total duration t_1 , the relative time spacing of the signals being t_2 .

The voltage delivered by the secondary winding 20 and shown in FIGURE 4 will have the rate of the control signals.

In the specific case of the ignition system of internal combustion engines, trains of sparks having the desired duration can be produced with this device by using two conventional-type thyratrons. The alternating control pulses are easily obtained as rectangular signal derivatives. If the source has a low impedance and permits a fast charging of capacitor 16, the storage capacitor 5 and resistance 4 may be dispensed with.

I claim:

1. An alternating-pulse generator comprising a direct current source, a pair of semiconducting thyratrons of opposite polarities serially connected across said source and each having a control member, one said control member being connected to the anode of one thyatron and the other control member being connected to the cathode of the other thyatron, a monitoring-pulse generator having two outputs, said control members being connected to each other and to one of said output terminals with the other output terminal being connected to a common point between said thyratrons, a capacitor connected to said

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common point, and a transformer the primary winding of which is serially connected between said capacitor and one terminal of said source and the secondary winding of which is adapted to deliver said alternating pulses.

2. In a means for feeding alternating pulses to spark plugs of an internal combustion engine, an alternating-pulse generator according to claim 1 wherein said secondary winding delivers said alternating pulses to said spark plugs.

3. A generator according to claim 2 wherein said monitoring-pulse generator as adapted to trigger said thyratrons in such a manner that a series of alternating pulses having a total duration ranging from 20 microseconds to 200 microseconds per ignition is obtained for each ignition.

4. A generator according to claim 1 wherein said monitoring-pulse generator comprises a base timer delivering alternating impulses and a gate circuit limiting the duration of the rate of ignition pulses to a determined duration.

5. An alternating-pulse generator according to claim 1 further comprising a storage capacitor connected across and charged by said source.

References Cited

UNITED STATES PATENTS

3,257,566	6/1966	White	307—88.5
3,211,964	10/1965	Thorne	307—88.5
3,163,782	12/1964	Ross	307—88.5
2,175,900	10/1939	Knight	315—177

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