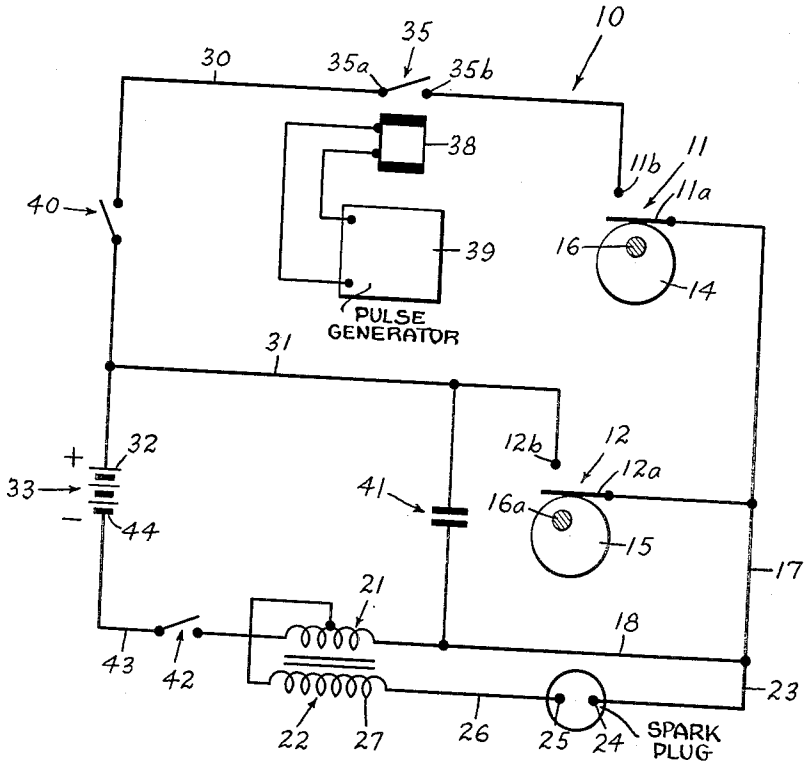
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SPEED CONTROL FOR INTERNAL COMBUSTION ENGINES

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SPEED CONTROL FOR INTERNAL COMBUSTION ENGINES

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This invention relates to a control system for internal combustion engines and more particularly it relates to an ignition system arrangement whereby the speed of operation of an internal combustion engine may be conveniently controlled.

In the field of radio-controlled aircraft and guided missiles, for example, dependable, compact and lightweight remote-control devices are required for controlling the engine speed. Also, these control devices must be designed so that in the event of a mechanical failure, the engine will still be able to function independently thereof.

Numerous control devices have been devised for this general purpose. However, none have proved entirely satisfactory in all respects, under actual operating conditions. In addition, the conventional control devices are generally of relatively complicated design and their installation necessitates substantial modification of the standard ignition parts.

These and other difficulties are overcome by the applicant's new control system whereby the speed of the engine is regulated by controlling the firing frequency of the spark plugs. To this end, a set of variable-speed relay points are included in the primary circuit of the ignition system. The relay points, which are independently controlled, may be opened and closed at different frequencies than the conventional, non-variable breaker points also included in the primary circuit, and, as a result, the speed of the engine may be controlled.

It will be noted that the following description of this invention is described in conjunction with an ignition system for a two-cycle one-cylinder gasoline engine. It will be understood, of course, that this new device may be used in conjunction with many other types of internal combustion engines.

With reference to the accompanying drawing, it will be seen that an ignition system 10 for a one-cylinder, two-cycle, internal combustion engine, is diagrammatically disclosed therein. The ignition system 10 has two sets of conventional type breaker points, indicated at 11 and 12, which are opened and closed by eccentric cams 14 and 15, respectively. The cams 14 and 15 are rotated by cam shafts 16 and 16*a*. The cam designs as well as the degree of rotative displacement of the cams in respect to the cam shafts, is such that points 11 may be utilized for low-speed engine operation, and points 12 for high-speed engine operation. It will be understood, of course, that the cams 14 and 15 may be mounted on the same cam shaft.

The cam actuated electrodes 11*a* and 12*a* of the breaker points 11 and 12 respectively, are connected by conductors 17 and 18 to the primary 21 of an induction coil indicated at 22. Conductors 17 and 18 are also connected by conductor 23 with a stationary electrode 24 of a spark plug. Another electrode 25 of the spark plug is connected by conductor 26 to the secondary 27 of the coil 22. The coil 22 is utilized in the conventional manner, to generate the required high voltage in the secondary 27 to cause a spark momentarily to jump the gap between the spark plug electrodes 24 and 25, whenever either the breaker points 11 or 12 are opened.

The stationary electrodes 11*b* and 12*b* of the breaker points 11 and 12 respectively, are connected by conductors 30 and 31 to the positive terminal 32 of an electrical power source 33, such as, for example, a battery. Thus, it will be seen that the breaker points 11 and 12 are connected in a parallel arrangement between the positive side of the battery 33 and the coil 22.

A set of electrical relay points 35 are connected in series with conductor 30 between the low-speed breaker points 11 and the battery 33. The relay points 35 have a movable electrode 35*a* which is vibrated in and out of engagement with a stationary electrode 35*b* by means of a solenoid 38 disposed adjacent thereto. The solenoid 38 in turn may be activated by suitable means, such as, for example, electrical impulses received by a radio receiver 39. It will be appreciated that under certain circumstances, the relay points 35 may be utilized to break the primary circuit, and, as a result, cause a spark to be fired between the spark plug electrodes 24 and 25.

An electrical switch indicated at 40, is connected in series with conductor 30 between the relay points 35 and the battery 33. It will be seen that when the switch 40 is opened, the low-speed breaker points 11 and the relay points 35 are rendered inoperative. A condenser indicated at 41, is connected between conductors 31 and 18, and is thereby paralleled across the breaker points 12 and across the breaker points 11 and 35 in series. The condenser 41 is utilized in the conventional manner to prevent arcing of these points when they are opened. Also, a main ignition switch 42 is connected in series with conductor 43 which in turn connects the negative terminal 44 of the battery 33 with the primary 21 of the coil 22. When the ignition switch 42 is opened, the entire ignition system is disconnected from the battery 33.

To understand the operation of this new control system, it must first be understood that the engine operating speed automatically synchronizes with the sparking frequency between the electrodes 24 and 25. Further, it will be seen that when the switch 40 is opened, the frequency of the spark is controlled by the high-speed breaker points 12, and, as a result, the engine operates at high speed. When the switch 40 is closed, the spark frequency is controlled by the low-speed breaker points 11 (disregarding for the moment, the relay points 35), because the primary 21 of the coil 22 can only induce the required high voltage in the secondary 27, when the primary circuit is broken. This in turn, cannot occur until the last set of points (the low-speed breaker points 11) are opened.

The operating speed of the engine may be controlled, between the low and high-speed ranges, by varying the breaking frequency of the relay points 35*a* and 35*b* between the limits of the breaking frequencies of the low and high-speed breaker points 11 and 12. In this connection, it will be noted that by breaking the relay points 35*a* and 35*b* within these limits, the relay points 35 are always opened after the high-speed points are already opened, and always before the low-speed points are opened. Therefore, the relay points 35 are the last set of points to break the primary circuit, and, as a result, they control the firing of the spark.

It will be appreciated that this new control device may be utilized in an ignition system having only one set of conventional non-variable breaker points in the primary circuit. The advantage of having two sets of non-variable breaker points, as in the system described above, is that the low and high-speed points may be pre-adjusted so as to provide the desired minimum low and maximum

high speed engine operation, and the relay points are only able to control the engine speed within this range.

One of the important features of this invention is that the mechanical failure of this new control device will not cause the failure of the entire ignition system. In this event, the spark is controlled by either the low or high-speed breaker points depending on whether or not the switch **40** is open or closed. Also, in this connection, the relay points **35** may be arranged so that they automatically close or remain open when the solenoid **38** or receiver **39** are not working.

Another important feature of this control device is that it is of extremely compact and light-weight design. Furthermore, this device may be conveniently installed in nearly any conventional ignition system without necessitating substantial modification of the standard ignition parts.

It is to be understood that the form of the invention disclosed herein is subject to considerable modification. For example, other means may be utilized to open and close the relay points **35** at the desired frequency, such as independent mechanical means or manually operated means apparent to those skilled in the art. Furthermore, it will be appreciated that the solenoid **38** may be made responsive to thermostatic controls, photosensitive relays, pressure-sensitive relays and the like. Therefore, the form of the invention disclosed herein should be considered as illustrative and not as limiting the scope of the following claims.

I claim:

1. In an ignition system for combustion engines having a primary circuit which when opened causes a high voltage current to pass through a secondary circuit, a control device comprising at least two sets of non-variable contact means connected in parallel in said primary circuit, variable contact means connected in series with at least one of said non-variable contact means, and means to open and close said variable contact means in in a frequency range defined by the breaking frequencies of at least two of said non-variable contact means.

2. In an ignition system for combustion engines having a primary circuit connecting between a voltage source and an induction coil, which when broken causes a high voltage current to pass through a secondary circuit, a control device comprising a high-speed contact means in said primary circuit, a low-speed contact means in said primary circuit which is connected in parallel with said high-speed contact means, variable contact means connected in series with said low-speed contact means and in parallel with said high-speed contact means, and means for opening and closing said variable contact means in a frequency range defined by the breaking frequencies of the low and high-speed contact means.

3. A control device as described in claim 2 including means for inactivating said low-speed and variable contact means.

4. A control device as described in claim 2 wherein said means for opening and closing said variable contact means includes an actuatable solenoid means which when actuated opens and closes said variable contact means, and a radio receiver for receiving electrical impulses and to thereby actuate said solenoid means.

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