A control system for a vehicle, which can be used for controlling an ignition system, a petrol injection system or an engine overspeed control, has an electrically powered radiation source and a radiation receiver which is exposed to the source from time to time through the intermediary of means driven by the engine. When the receiver is exposed to the source, the current flowing through the source is increased rapidly by regenerative action, and moreover there is a constant current flowing through the source which is just sufficient to cause it to radiate.

4 Claims, 3 Drawing Figures
CONTROL SYSTEMS FOR VEHICLES

This invention relates to control systems for vehicles, particularly, road vehicles. The invention is particularly concerned with ignition systems, but can be applied to petrol injection systems or engine overspeed control systems.

A system according to the invention comprising an electrically powered radiation source, a radiation receiver, means driven by the engine for exposing the receiver to the source at predetermined intervals, means operable when the receiver is exposed to the source for increasing the current flow through said source rapidly by regenerative action, and means operable when the receiver is not exposed to the source for passing through said source a constant current which is just sufficient to energise said source so that the source is radiating, said receiver serving to operate switching means effecting the required control.

In the accompanying drawings, FIGS. 1 and 3 are diagrams illustrating three examples of the invention as applied to a vehicle ignition system, an engine overspeed control and a fuel injection system respectively.

Referring to FIG. 1, there is provided a positive supply line 11 connected to the positive terminal of a vehicle battery 10, and a negative supply line 12 which is earthed. A further positive supply line 13 is coupled to the line 11 through a resistor 14 and the lines 13,12 are bridged by parallel circuits one of which contains a capacitor 15, and the other of which contains a resistor 16 and Zener diode 17 in series. The resistor 14 and capacitor 15 prevent transients from substantially altering the potential of the supply line 13. The junction of the resistor 14 and the Zener diode 17 is coupled to the base of an n-p-n transistor 18, the emitter of which is connected to the line 12 through a resistor 19 and the collector of which is connected to the line 13 through a light-emitting diode 21, and to the collector of a transistor 22 through a resistor 23. The base of the transistor 22 is connected to the line 12 through a resistor 24, and is further connected through a resistor 25 to the emitter of an n-p-n photo-sensitive transistor 26, the collector of which is connected to the line 13. The emitter of the transistor 22 is connected to the base of an n-p-n transistor 27, the emitter of which is connected to the line 12, and the collectors of the transistors 22 and 27 are connected through a resistor 28 to the base of an n-p-n transistor 29 having its emitter connected through a resistor 31 to the line 12 and its collector connected through a resistor 32 to the line 11. The emitter of the transistor 29 is further connected to the base of an n-p-n transistor 33, the emitter of which is connected to the line 12, and the collector of which is connected to the line 11 through a series circuit including the primary winding 34 of an ignition coil 35 and a resistor 36. The secondary winding 37 of the ignition coil 35 is connected to the spark plugs 38 of the engine to turn through a conventional distributor 39, and the collector emitter path of the transistor 33 is bridged by a voltage dependent resistor 41.

The light-emitting diode 21 is positioned so that it can illuminate the transistor 26, and thereby cause the transistor 26 to become conductive. Positioned between the diode 21 and the transistor 26 is a shutter 42 which is driven by the engine, the shutter 42 having slots so that at predetermined angular positions of the shutter the transistor 26 becomes illuminated by the diode 21. Assuming for the moment that the transistor 26 is not illuminated, current flows through the diode 21 and the resistors 23 and 28 to turn on the transistor 29, the transistors 22 and 27 being off at this stage. The transistor 29 provides base current for the transistor 33, so that current flows in the primary winding 34. Current also flows through the diode 21 and the transistor 18 and resistor 19, the Zener diode 17 providing a constant bias on the base of the transistor 18 so that the current flow through the transistor 18 is constant. The constant current is chosen to be just sufficient to energise the diode 21 so that it is radiating light.

When a slot in the shutter is positioned between the diode 21 and the transistor 26, then since the diode 21 is illuminated, the transistor 26 will start to conduct and will partially turn on the transistors 22 and 27, which in turn will provide additional current through the diode 21 so that the illumination increases, which in turn increases the conduction of the transistor 26. This regenerative action causes the circuit to switch rapidly between its original state with the diode 21 only just energised and radiating and the transistors 22 and 27 off, and a second state with the diode 21 strongly energised and radiating, and the transistors 22 and 27 fully conductive. Conduction of the transistors 22 and 27 removes the base current from the transistor 29 which turns off and so turns off the transistor 33, so that the flux in the core of the transformer 35 collapses to cause a spark to be produced.

As soon as the slot in the shutter 42 has passed, the path between the diode 21 and transistor 26 is blocked and light no longer falls on the transistor 26, so that the circuit reverts quickly to its original state with the transistors 22 and 27 off, and the transistors 29 and 33 on. The predetermined constant current still flows through the diode 21 so that it is just energised and radiating.

The purpose of the resistor 24 is to prevent the transistor 22 being turned on by leakage current through the transistor 26. The resistor 25 limits the current through the transistor 26 to a safe level.

Although a light-emitting diode is used in the example shown, other radiation sources could of course be used, for example normal filament bulbs, gallium arsenide sources or phosphide diodes. Moreover, the transistor 26 could be replaced by other forms of radiation detector, for example photo-darlington pairs, photodiodes or other similar components.

It will be appreciated of course that numerous modifications of the arrangement shown in FIG. 1 are possible, provided that the required constant current flows through the diode 21 or other light source so that the light source is energised just sufficiently to radiate light, and then has the current through it increased rapidly by regenerative action. Moreover, the type of spark ignition circuit is not important, and the arrangement can control other forms of spark ignition circuit, or other forms of control system altogether. In FIG. 2, for example, there is shown an arrangement for limiting the maximum speed of an engine. The arrangement for controlling the transistor 22 and 27 is the same as in FIG. 1, and so similar components have been designated with the same reference numeral. In this example, however, the shutter 42 has a large number of slots around its periphery and so the transistors 22 and 27 will be switched on and off far more rapidly than in
FIG. 1, so that an a.c. output is produced at a frequency representing engine speed. This a.c. signal is fed to a diode pump circuit 51 of conventional form the circuit 51 producing a d.c. voltage which is proportional to said frequency, and so is proportional to engine speed, this output voltage, the diode pump circuit being coupled to a switching device, for example a schmitt trigger circuit which is connected between the lines 13 and 12, and which changes state when the voltage and therefore the engine speed reaches a predetermined value. When the predetermined value is reached the trigger circuit changes state and as a result, a relay winding 53 is energised to close a normally open relay contact 53a which is connected across the contact breaker 54 of the engine, the contact breaker 54 being connected between the lines 11, 12 in series with the primary winding 55 of the ignition coil and a secondary winding 56 of the ignition coil being connected to the plugs in turn in the usual way. Thus, when the predetermined engine speed is reached, the contact breaker 54 is short-circuited and no further sparks are produced until the engine speed is reduced to a level such that the relay winding 53 is no longer energised. Once again, it will be understood that numerous modifications of the arrangement shown are possible.

In FIG. 3, there is shown an arrangement suitable for controlling fuel injection by a road vehicle. The arrangement is similar to FIG. 1 except that the transistor 33 and the various components controlled by the transistor 33 are now omitted. There is now provided an n-p-n transistor 61 having its base connected to the collector of the transistor 29, its emitter connected to the line 12 and its collector connected to the line 11 through a fuel injector 62. The slots in the shutter 42 are now chosen such that a slot occurs at the instant at which injection is to start. When no slot appears between the diode 21 and transistor 26, the transistor 29 is on, so that the transistor 61 is off, but when a slot appears, the transistors 22 and 27 turn on quickly as previously explained, turning off the transistor 29, so that current now flows through the resistor 32 to turn on the transistor 61 and energise the injector 62 to commence injection of fuel. The arcuate lengths of the slots are chosen such that injection is terminated at the required moment as a result of the slot passing the transistor 26 and diode 21, so that the transistor 29 turns on again to turn off the transistor 61.

All the examples described have the advantage that the diode 21 or its equivalent is only energised at full power when it is exposed to the transistor 26 or its equivalent, so that there is a substantial saving in power. This of course is achieved by passing a small current through the diode 21 at all times, so that it is just radiating light. Without the Zener diode 17 or some other means for ensuring that this small current is constant, it would be possible for the diode 21 to cease to produce light as a result, for example, of a reduction in battery voltage, but as will be appreciated, the invention overcomes this possible difficulty. It will be noted that the constant current is in fact increased in the case of FIGS. 1 and 3 by the current flowing through the resistor 28, but this increase in the constant current is very small and for practical purposes can be ignored.

I claim:

1. A vehicle control system comprising in combination a pair of d.c. supply lines, an electrically powered radiation source, a current regulator means coupling said source to said supply line, said current regulator means passing through said radiation source a constant current just sufficient to cause said source to radiate, a radiation receiver means having a speed of operation dependent on the intensity of exposing radiation, means coupling said radiation receiver means to said supply lines, a switching circuit coupled to said radiation receiver means, said receiver means upon operation thereof when initially illuminated causing sufficient conduction to switch said switching circuit, engine driven means positioned between said radiation source and said receiver means and exposing said receiver to said radiation source at predetermined intervals, and a regenerative feedback circuit means coupling said switching circuit to said radiation source, said regenerative feedback circuit means increasing current flow through said radiation source after initial conduction of said receiver, increasing the intensity of illuminating radiation, thereby increasing the speed of operation of said receiver means and the switching speed of said switching circuit.

2. A system as claimed in claim 1 controlling the spark ignition system of a road vehicle, comprising in combination an ignition coil having a primary winding and a secondary winding to spark plugs of the engine in turn, and a transistor connected in series with said primary winding between said supply lines, said transistor forming part of said switching circuit and being turned off to produce a spark when said radiation receiver is illuminated.

3. A system as claimed in claim 2 for limiting the maximum rotational speed of the engine of said vehicle, comprising an ignition coil having a primary winding and a secondary winding, means coupling said secondary winding to spark plugs of the engine in turn, means whereby said switching circuit when switched prevents production of further sparks by said ignition coil, a slotted disc driven by the engine and constituting said engine driven means, the slots in said disc resulting in the production of an a.c. signal by said receiver, and a frequency to voltage converter coupled to said receiver, said frequency to voltage converter producing a d.c. output proportional to the rotational speed of the engine, and means coupling said converter to said switching circuit to switch said switching circuit at a predetermined engine speed.

4. A control system as claimed in claim 1 including fuel injection means for injecting fuel into said engine, and means coupling said fuel injection means to said switching circuit to control injection of fuel.

* * * * *