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71 Applicant: **EDA Sparkrite Limited**
82 Bath Street
Walsall West Midland WS1 3DE(GB)

72 Inventor: **Gunton, Bruce Stanley**
6 Mulroy Road Sutton Coldfield
West Midlands(GB)

72 Inventor: **Owen, Patrick John**
71 Bodmin Rise Park Hill, Walsall
West Midlands(GB)

74 Representative: **Lewis, Samuel Hewitt et al,**
FORRESTER & BOEHMERT Widenmayerstrasse 4/1
D-8000 München 22(DE)

54 Control of a switching means in an electrical circuit.

57 The invention relates to the control of a switching means in a circuit associated with a spark ignition internal combustion engine. Figure 2 shows a circuit (12) wherein fluctua-

tions in voltage at an input terminal (10) are substantially eliminated by a regulating means which comprises transistor (TR1), transistor (TR2) and zener diode (D1).

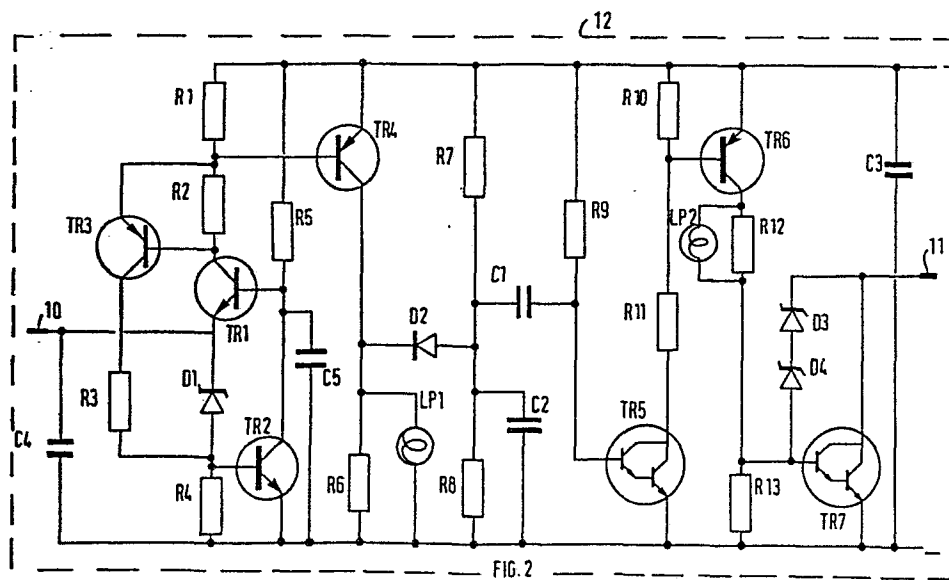


FIG. 2

Title: Control of a switching means in an electrical circuit.

5 The invention relates to a method of controlling a switching means in a circuit associated with a spark ignition internal combustion engine, to a control device for use in the method and to a spark ignition internal combustion engine having an ignition system comprising means for producing an input signal.

10 Known internal combustion engines have an ignition system with switching means which responds to electrical input signals which are produced by signalling means at predetermined stages in the operating cycle of the engine. The switching means controls the discharge of energy at a spark plug of the ignition system. The known switching means responds to an input signal which is a change in voltage, and therefore is susceptible to the
15 influence of electrical components other than the signalling means which produce voltage changes.

According to a first aspect of the invention, there is provided a method of controlling a switching means in a circuit associated with a spark ignition internal
20 combustion engine wherein an input signal is produced at a predetermined stage in the operating cycle of the engine, the input signal is a change in magnitude of an electric input current flow to a point in the circuit and wherein the voltage at said point is maintained
25 substantially constant.

According to a second aspect of the invention there is provided a control device for controlling the flow of an electrical output current in accordance with an input signal wherein the device includes a semi-conductor
30 switching means, a biasing resistor for the switching

means and compensating means, the biasing resistor and compensating means are connected in series with an input terminal at which the input signal is received and the compensating means is arranged to permit an input signal
5 which is a change in current flow to be applied to the biasing resistor without varying substantially the voltage at either the input terminal or a point in the compensating means connected in series with the terminal.

By defining variations in the voltage at the input
10 terminal as not being substantial, we mean that the variations are not sufficient to influence the switching means.

According to a third aspect of the invention there is provided a spark ignition internal combustion engine
15 having an ignition system comprising means for producing at a predetermined stage in the operating cycle of the engine an input signal which is a change in the magnitude of flow of current to a point in the circuit of the ignition system, means for maintaining the voltage at
20 said point substantially constant, and means for changing the condition of a switching means in response to the input signal.

The invention will now be described by way of example with reference to the accompanying drawings
25 wherein:-

FIGURE 1 shows a representation of a spark ignition internal combustion engine having an ignition system which embodies a control device according to the second aspect of the invention;

30 FIGURE 2 shows a diagram of a part of the circuit of the ignition system; and

FIGURE 3 shows a diagram of an alternative circuit which forms a part of the ignition system.

Figure 1 shows an internal combustion engine 16, which is a four stroke engine with four spark plugs 15. An input signal is produced at predetermined stages in the operating cycle of the engine, which signal, in the form of a change in the electric current, the input current, flowing along a single lead 17 via a terminal 10, controls the output from a circuit 12. A battery 14 provides a supply voltage across the circuit. The output from the circuit, via a terminal 11, flows through the primary windings of an ignition coil 13 which stores energy. Energy is discharged to the spark plugs of the engine via a lead 18 and a distributor in accordance with the electrical signal in the single lead 17.

Figure 2 shows the circuit 12 suitable for use in the ignition system of the spark ignition internal combustion engine 16. Typically the current in the single lead 17 is switched between values of 5 milliamps and 35 milliamps according to the stage of operation of the engine. Attendant fluctuations in voltage at the input terminal 10 are substantially eliminated by a regulating means which maintains a substantially constant potential difference, typically having a value of approximately 5 volts, between the terminal 10 and the negative pole of the battery 14.

When the input current increases, the voltage drop across a biasing resistor R1 is sufficient to turn a switching means TR4 on. When this occurs current passes through the switching means and is amplified by the components downstream of TR4 to provide an output at the terminal 11. As current through zener diode D1 and transistor TR2 comprised by the regulating means increases, a compensating means which is in series with the biasing resistor is turned off so that the increase in voltage drop across the biasing resistor is compensated for by a decrease in voltage drop across the compensating means.

A decrease in current to the base of the transistor TR2 turns the switching means TR4 off. A decrease in voltage drop across the biasing resistor is compensated for by an increase in voltage drop across the compensating means. The part of the circuit downstream of the transistor TR4 (to the right of the transistor in Figure 2) is of a known design for amplifying the current through the transistor at the terminal 11.

The regulating means comprises the compensating means (transistor TR1), in addition to transistor TR2 and diode D1 which is in series with the base of transistor TR2.

The characteristics of the zener diode are well known. For a sufficient current (depending on the parameters of the particular diode) break-down is achieved and current may flow through the diode in the reverse mode. The voltage drop across the diode then changes very little for large fluctuations in the current. The diode D1 thus provides a means connected in series with the input terminal 10, which permits a change in current flow through the diode without varying substantially the voltage at the input terminal.

For excessive increases in input current, of the order of 100 milliamps or more, the voltage drop across a biasing resistor R2 of an overload preventing transistor TR3 is sufficient to turn the transistor on and restrict the current flow through the terminal 10. The excess current through TR3 and R3 turns transistor TR2 on and hence turns transistor TR1 off.

The circuit shown in Figure 3 comprises a diode D4' connected in series with the terminal 10' to protect the circuit against an incorrect connection of the terminal to a positive supply. The current flowing at terminal 10'

is governed by a current controlling means comprising resistor R2' diodes D1' and D2' and transistor TR1'. The current at the collector of transistor TR1', which is shunted to the negative earth by zener diode D3', is at all times in the operation of the circuit of a greater magnitude than the current at terminal 10'. The current controlling means ensures that the current at the collector is substantially constant. The zener diode D3' maintains a substantially constant voltage level at the collector of transistor TR1' and base of transistor TR2'.

In operation, an increase in current at input terminal 10' effects an increase in the potential difference across biasing resistor R3'. Switching transistor TR2' is thereby turned on so that transistor TR3' is turned on and a signal is provided at terminal 11'. When the input current and the potential difference across resistor R3' decreases sufficiently, transistor TR2' and transistor TR3' are turned off.

CLAIMS:

1. A method of controlling a switching means in a circuit associated with a spark ignition internal combustion engine wherein an input signal is produced at a predetermined stage in the operating cycle of the engine, the input signal is a change in magnitude of an electric input current flow through a point in the circuit and wherein the voltage at said point is maintained substantially constant.
2. A method according to claim 1 wherein the circuit is an ignition circuit and the switching means controls the discharge of energy to a spark plug of the circuit.
3. A method according to claim 1 or 2 wherein the input signal is applied to a biasing resistor of a semi-conductor device.
4. A method according to any preceding claim wherein electric current flows through said point in the circuit and additionally through a regulating means and the current flow through the regulating means falls when the input current increases.
5. A method according to any preceding claim wherein the input current also flows through a biasing resistor of an overload preventing semi-conductor, and when the potential difference across the biasing resistor of the overload preventing semi-conductor increases, the input current is restricted.
6. A control device for controlling the flow of an electrical output current in accordance with an input signal wherein the device includes a semi-conductor switching means, a biasing resistor for the switching means and compensating means, the biasing resistor and

compensating means are connected in series with a terminal at which the input signal is received and the compensating means is arranged to permit an input signal which is a change in current flow to be applied to the
5 biasing resistor without varying substantially the voltage at either the input terminal or a point in the compensating means connected in series with the input terminal.

10 7. A spark ignition internal combustion engine having an ignition system comprising means for producing at a predetermined stage in the operating cycle of the engine an input signal which is a change in the magnitude of flow of current to a point in a circuit of the ignition system, means for maintaining the voltage at said point
15 substantially constant, and means for changing the condition of a switching means in response to the input signal.

8. Any novel feature or combination of novel features substantially as herein described.

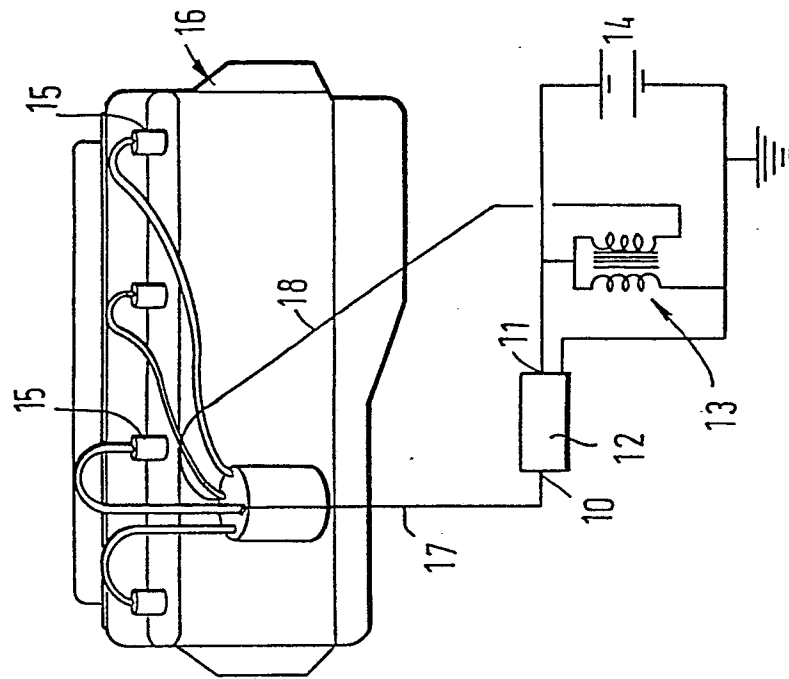
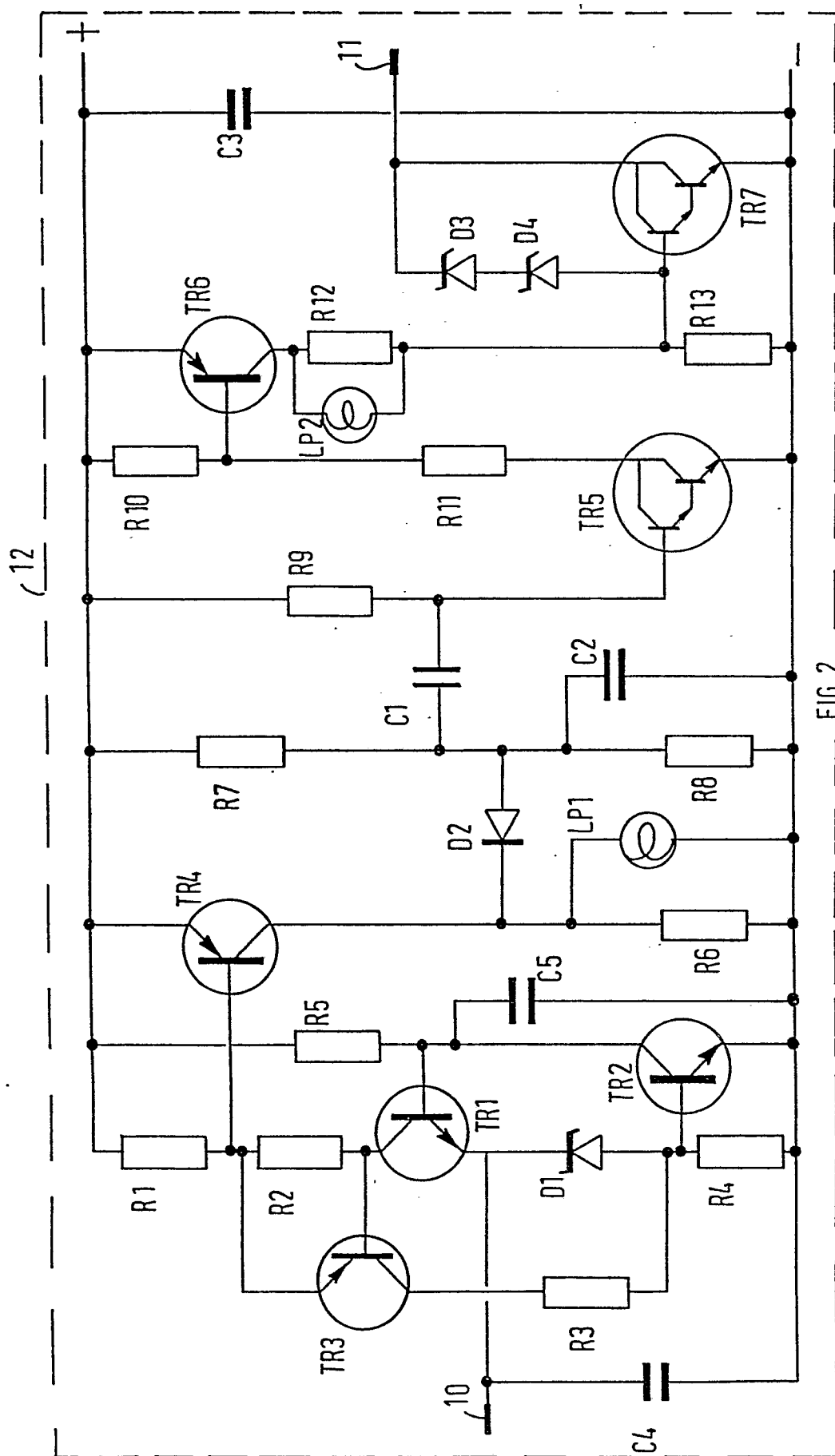


FIG. 1



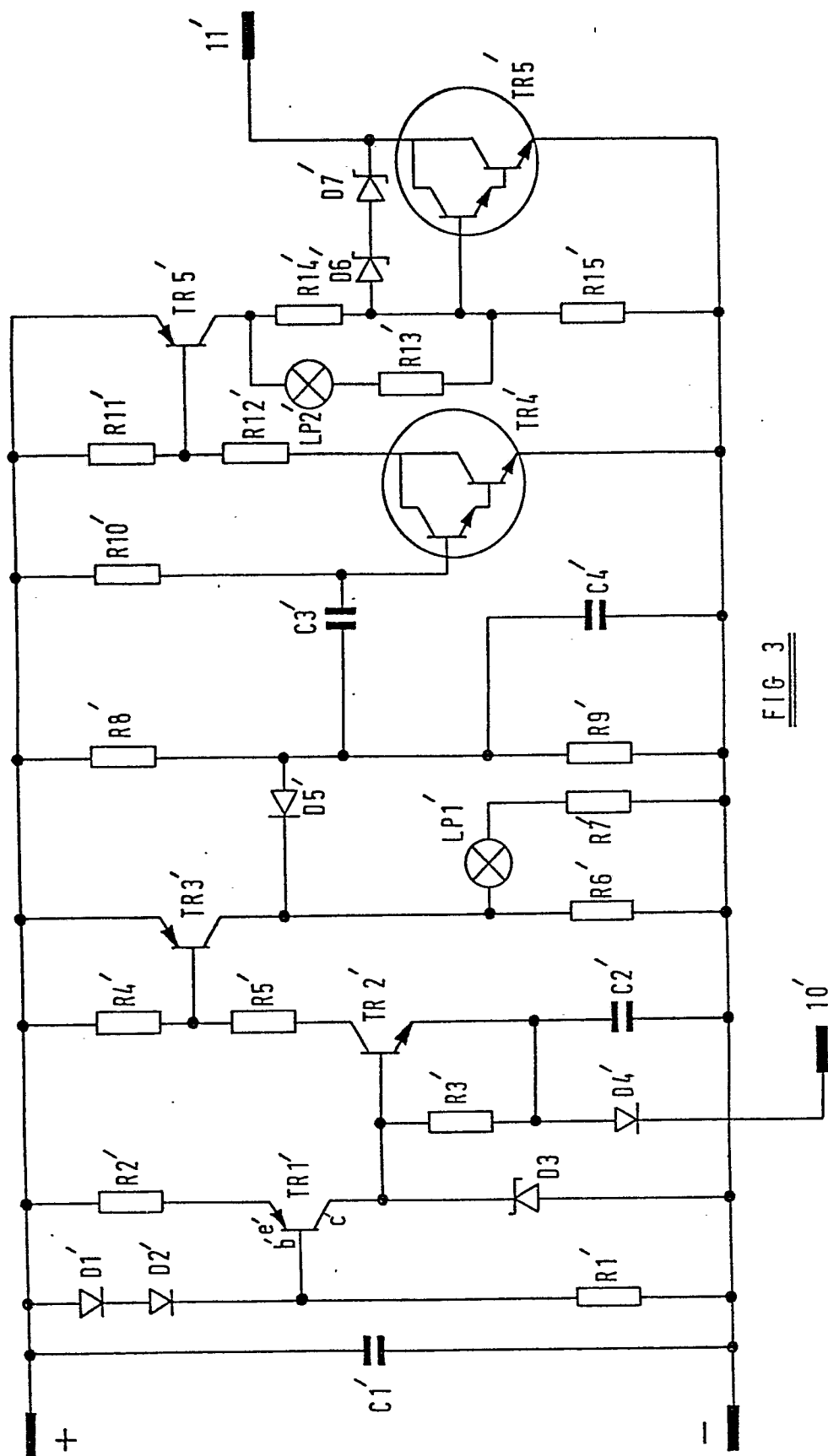


FIG. 3



European Patent
Office

EUROPEAN SEARCH REPORT

0044745

Application number

EP 81 30 3346.1

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	<u>US - A - 4 185 602</u> (F.M. MINKS et al.) * column 1, line 54 to column 5, line 43; fig. 1, 2 *	1,2,7	F 02 P 7/06 F 02 P 3/04
A	<u>US - A - 4 161 693</u> (P.J. CARLSON)	1	
A	<u>FR - A1 - 2 396 176</u> (R. BOSCH) & <u>US - A - 4 202 304</u>	1	
A	<u>FR - A - 2 179 376</u> (FAIRCHILD CAMERA & INSTRUMENT CORP.) & <u>US - A - 3 882 840</u>	1	TECHNICAL FIELDS SEARCHED (Int. Cl. ³) F 02 P 3/04 F 02 P 7/06
			CATEGORY OF CITED DOCUMENTS X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
☒ The present search report has been drawn up for all claims			&: member of the same patent family, corresponding document
Place of search Berlin		Date of completion of the search 15-10-1981	Examiner BORRELLY