United States Patent

[11] **3,626,912**

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[31] **4796/69**

[54] **DEVICE FOR REGULATING THE SUPPLY OF CARBURANT TO AN INTERNAL COMBUSTION ENGINE**
6 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** .... **123/97 B,** 123/102, 123/124 B
[51] **Int. Cl.** **F02d 9/00,** F02d 11/10
[50] **Field of Search** .... 123/97 B, 124 B, 102, 198 DC

[56] **References Cited**

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ABSTRACT: An internal combustion engine is fitted with an electromagnetically operated slow running jet and switch means operated by the accelerator pedal controlling means for interrupting the feed from the slow running jet during deceleration and idle running. A transistorized circuit reestablishes the supply from the slow running jet when the engine drops below a given speed according to the frequency of impulses supplied to the circuit, this frequency depending upon the engine speed.

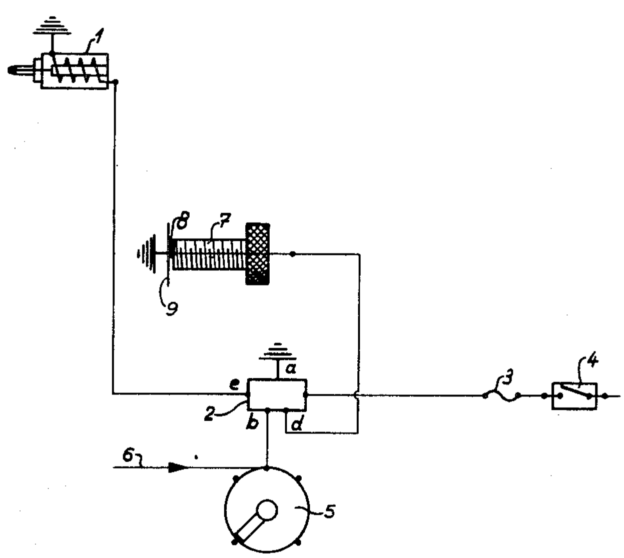


FIG.1

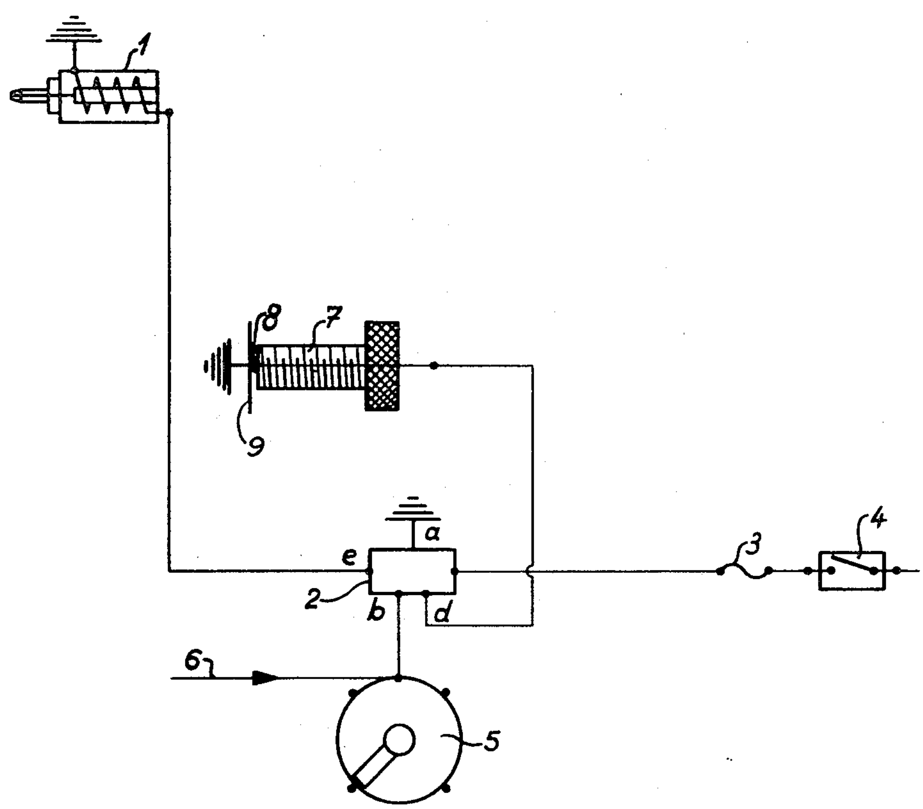
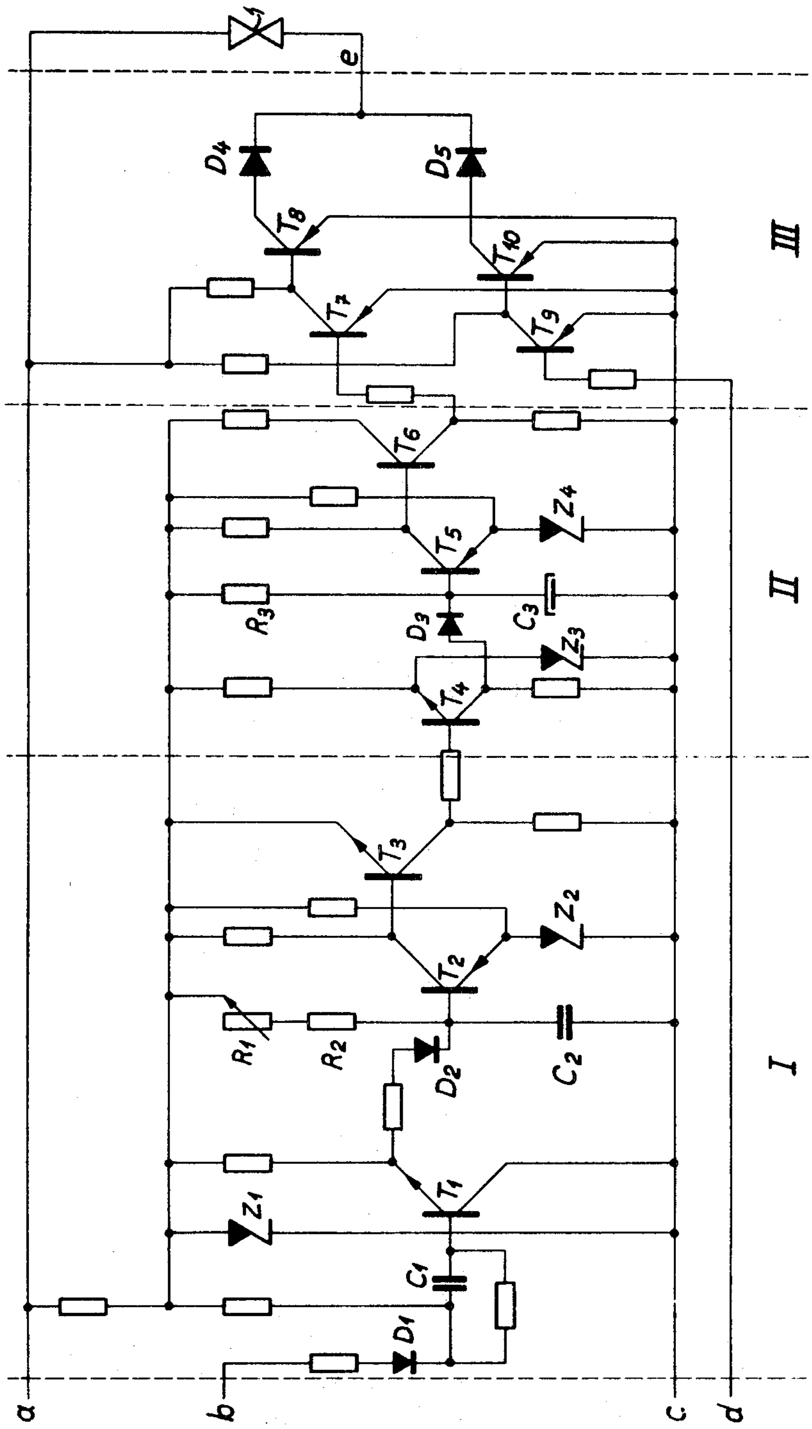


FIG. 2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DEVICE FOR REGULATING THE SUPPLY OF CARBURANT TO AN INTERNAL COMBUSTION ENGINE

It is realized that the contribution made by the automobile to air pollution is considerable, and that numerous measures have been proposed to reduce this pollution. Particularly in the period of deceleration, the rate of pollutent emission is higher than when at a running speed or during acceleration. On examining the behavior of an engine, it is established that it can act as a brake without even consuming carburant, but simply working on air. Therefore, it is possible to totally cut off the supply of carburant to an engine during a period of deceleration whilst ensuring that the feed will be reestablished when the engine drops below its idling speed.

A device has already been proposed which employs an electromagnetic jet controlled by a switch operated by the accelerator pedal, the supply being interrupted when the pedal is released and reestablished when the engine drops below idling speed by a drop in voltage of the dynamo connected to the exciter coil of the jet.

However, modern vehicles are being increasingly equipped with alternators of such a type that this solution is not universally applicable as no useful drop in voltage is produced at the alternator terminals.

The present invention precisely relates to a universal device satisfactorily employable both on vehicles equipped with a dynamo or with an alternator.

The invention proposes a device for adjusting the supply of carburant to an internal combustion engine, comprising an electromagnetic slow-running jet and a switch operated by the accelerator pedal, and means operated by said switch for interrupting the supply from the idle running jet during periods of deceleration and slow-running and independent electronic means for reestablishing the supply when the engine speed drops below a given rate.

The accompanying drawings show by way of example, an embodiment of the invention.

FIG. 1 is a schematic diagram of the device.

FIG. 2 is a circuit diagram of an electronic switching device.

On the diagram in FIG. 1, all elements are represented in the conventional manner.

The device comprises an electromagnetic slow-running needle jet 1, closed at rest, and open when its coil is excited. Such jets exist on the market. This jet is fed through an electronic circuit 2, a fuse 3 and the switch 4 operated by the ignition key. The circuit 2 works as an electronic switch operated on the one hand by the distributor head 5 which sends alternating current 6 supplied, as for the sparking plugs, by the ignition coil of the engine and, on the other, by a switch consisting of the slow-running adjusting screw 7 having a contact 8 at one end. Contact 8 is, of course, insulated from the metallic or other support into which is screwed either by an insulated tube enclosing the screw or by making the screw itself from an insulating material. In the rest position shown in the drawing, the terminal 8 is grounded since the arm of the butterfly comes up against the screw 7.

The device works as follows: the contact 8 is closed until the driver depresses the accelerator pedal; the contact 8 lifts-off its ground connection and the electromagnetic jet 1 is excited by the circuit 2. To slow down, when the driver allows the accelerator pedal to come up, the terminal 8 is grounded, and circuit 2 cuts the supply to the slow-running jet. Whilst the speed of the engine is higher than the idling speed, the supply to the jet through the circuit 2 remains cut off. When the speed of the engine drops below the idling speed, the circuit 2 reopens the circuit between the jet and the contact 8 in such a way that the supply of carburant to the slow-running jet is reconnected. This feed is interrupted as soon as the speed once more becomes higher than the idling speed.

The use of the slow-running adjusting screw as a switch allows the installation to be carried out very simply and only requires, in addition to an electromagnetic slow-running jet, a small case to protect a printed circuit with the elements of circuit 2.

It is, of course, possible to employ two electromagnetic switches instead of power transistors to control the jet supply through circuit 2.

An embodiment of the switching circuit is shown in FIG. 2. This circuit comprises 10 transistors T_1 to T_{10}, 4 Zener diodes, Z_1 to Z_4, 5 diodes D_1 to D_5, three condensers C_1 to C_3, and several resistances marked by rectangular boxes.

This circuit can be divided into three distinct parts: a first timing circuit I, a second timing circuit II, and a switch stage III. This circuit works as described hereafter.

The alternating current coming from the vehicles ignition coil is fed to the circuit at *b*. The impulses of this current, at a frequency proportional to the speed of the engine, are rectified by diode D_1 and applied to the base of amplifying transistor T_1. At rest, the condenser C_2 is charged up to a supply voltage limited to 10 volts by the Zener diode Z_1 and the transistor T_2 conducts. The input of a positive impulse to the base of T_2 abruptly discharges condenser C_2, the base of transistor T_2 becoming more positive than its emitter the potential of which is held at least at 1 volt by the Zener diode Z_2. The transistor T_2 remains blocked during an interval determined by the time constant R. C_2 where $R=R_1+R_2$. A negative square wave appears at the collector of T_2. i.e., at the base of transistor T_4 which is the first transistor of the second timing circuit. The same square wave appears of T_5 but this time it is positive. Transistor T_5 operates in the same way as transistor T_2, namely, it is blocked when a positive voltage appears at its base for the duration of the positive square wave. At the end of the interval, the condenser C_3 is recharged through the resistance R_3 and the transistor T_5 once again conducts at the end of a time interval fixed by the time constant R_3. C_3. If a new square wave arrives at the base of T_5 before the end of this time interval, T_5 does not have the time to operate again and remains blocked. The conduction of T_5 depends on the input impulse frequency, i.e., the speed of the engine. If T_5 is blocked, T_6 as well as T_7 and T_8 are also blocked and the slow-running jet 1 is not supplied with current. On the other hand, if the frequency drops below certain thresholds, adjustable by means of the potentiometer R_1, transistor T_5 has time to periodically become a conductor, deblocking transistors T_6, T_7 and T_8 which feed the electromagnet of the jet.

The transistors T_9 and T_{10}, homologous with transistors T_7 and T_8, are directly operated by the contact 8.

This circuit is perfectly stable, all voltages are stabilized, and its work threshold can be adjusted with precision by means of potentiometer R_1.

What is claimed is:

1. A device for regulating the supply of fuel to the internal combustion engine of an automotive vehicle comprising a throttle valve, an arm for operating said throttle valve, an adjusting screw cooperating with said arm to set the setting position of said throttle valve, an idling jet, electromagnetic valve means for closing said idling jet, and electric circuit means controlling said valve means to close said idling jet during deceleration when the engine is exerting a braking action, said circuit means comprising a timing circuit responsive to engine speed to open said idling jet when the engine speed falls below a selected idling value and contacts on said throttle valve arm and idling adjusting screw which are closed when said throttle valve is in idling position, whereby said idling jet is closed when said contacts are closed and the speed of said engine is above said selected idling speed.

2. A regulating device according to claim 1, in which said timing circuit comprises pulse generating means operated in synchronism with said engine, capacitance means, means responsive to said pulse generating means for periodically charging said capacitance means, means for discharging said capacitance means and switching means controlled by said capacitance means and actuated when the rate of pulses generated by said pulse generating means falls below a selected valve.

3. A device according to claim 1, in which said timing circuit comprises pulse generating means operated in

synchronism with said engine, a first timing stage having an output and an input connected with said pulse generating means, a second timing stage having an output and an input connected to the output of said first timing stage and a switching stage connected to and controlled by the output of said second timing stage and said contacts on throttle arm and idling adjusting screw.

4. The device according to claim **3**, in which said first timing stage comprises a power supply, a first transistor having a base connected through a diode and a capacitor to said pulse generator, a second transistor having a base connected with the emitter of said first transistor, the base circuit of said second transistor comprising a capacitor connecting said second transistor base with a first side of said power supply and a variable resistor connecting said second transistor base with a second side of said power supply, a zener diode connecting, the emitter of said second transistor with said first side of said power supply, and a third transistor having a base connected with the collector of said second transistor.

5. A device according to claim **4**, in which said second timing stage comprises a fourth transistor having a base connected with the collector of said third transistor, a fifth transistor having a base connected with the collector of said fourth transistor, a capacitor connecting said fifth transistor base with said first side of said power supply, a resistor connecting said base with the second side of said power supply, zener diodes connecting the emitters of said fourth and fifth transistors with said first side of the power supply and a sixth transistor having a base connected with the collector of said fifth transistor.

6. A device according to claim **3**, in which said switching stage comprises a first switching transistor controlled by said second timing stage, a second switching transistor controlled by said contacts and circuit means connecting the outputs of both of said switching transistors to said electromagnetic valve means, said connecting circuit means comprising diodes in the outputs of said switching transistors.

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