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54 **Engine control device.**

57 A device for controlling an internal combustion engine in which the supply of fuel is controlled by a movable throttle member (12), comprises a sensor (4) mounted to generate an electrical signal characteristic of the engine speed, detector means (3) adapted to receive the electrical signal from the sensor and to identify the proximity of the engine speed to a predetermined value, and throttle control means (solenoid 5) to engage the throttle member (12) in response to an instruction from the detector means (3). The device allows the fuel supply to drop to a low value or zero when the engine is in an over-run condition and prevents the engine from stalling when that condition no longer exists.

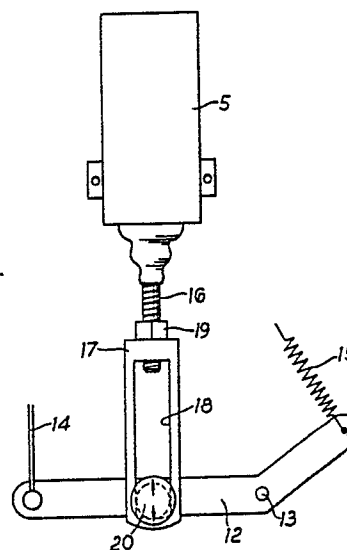


Fig. 2

EP 0 363 010 A1

Engine Control Device.

The present invention is a control device for use with an internal combustion engine and is devised to assist in limiting the consumption of fuel by such an engine.

It has already been recognised that, when an internal combustion engine is in an over-run condition, that is, when the engine speed is being maintained by rotation of the road wheels of a vehicle rather than the wheels being driven by the engine, then fuel may be being supplied to the engine unnecessarily or at an unnecessarily high rate. With this in view, fuel-saving systems and devices have been developed which are intended to limit the supply of fuel when an over-run condition exists. Such systems are usually quite complicated and correspondingly expensive and are usually designed with a particular engine model in mind; often they are a fundamental part of the engine construction and cannot readily be fitted after the engine has been built into the vehicle.

A further difficulty arises in that over-run conditions may appear to exist when in fact there is no over-run. For example, the engine speed may be unduly high for a given throttle setting, not because the engine is over-running but because some operating variable is at an incorrect level, for example the engine may be running at too high a temperature. In order to distinguish between true over-run and such other conditions producing similar symptoms, detectors such as that described in UK Patent Specification No. 2153553A have been proposed. Detectors of this type add further to the cost of a fuel-economy system.

It is an object of the present invention to provide a device which assists economical operation of an internal combustion engine in over-run conditions, but which avoids or reduces at least some of the disadvantages of many prior such devices.

The device according to the present invention, for use to control an internal combustion engine in which the supply of fuel to the engine is controlled by a movable throttle member, comprises a sensor mounted to generate an electrical signal characteristic of the speed of rotation of the engine, detector means adapted to receive a said electrical signal and to identify the proximity of said engine speed to a predetermined value, and throttle control means adapted to engage said movable throttle member in response to an instruction from said detector means.

The device according to the invention operates via the throttle member and, unlike the operation of a conventional internal combustion engine throttle, allows the fuel supply to fall towards zero when the driver takes his foot from the accelerator pedal. If,

however, the engine speed approaches a value at which it would normally stall, then the throttle control means automatically engages the throttle member and restores the fuel supply to a level at which stalling is avoided. Thus, when over-run conditions obtain, the fuel supply is reduced or preferably cut off but when those conditions no longer exist and the engine approaches stalling speed, the necessary fuel supply is restored.

The device is suitable for use with an internal combustion engine of any sort, provided that it is one in which the fuel supply is controlled by a movable throttle member. Thus it may be used with piston and rotary engines and with engines driven by petrol, diesel, low pressure gas and similar fuels, for example. The throttle member may be a rigid straight linkage which moves linearly in the direction of its length, or may be a pivoted lever.

The speed of rotation of the engine is observed by means of a sensor, mounted within the region of any of the moving parts of the engine so as to generate an electrical signal in response to the rotation, which signal is characteristic of the engine speed. The sensor may monitor the engine speed by electrical means, for example by monitoring the signal in the circuit of an electrical revolution counter, but it is much preferred to use a magnetic sensor, since such a sensor may be installed without direct intrusion into the mechanical or electrical operation of the engine. With an electrical sensor, the signal may vary in level or frequency in response to variations in the engine speed; using a magnetic sensor, the signal may take the form of pulses of induced voltage at intervals directly related to the speed of rotation of the engine.

The detector means monitors the signal generated in the sensor and identifies the approach of the engine speed to a predetermined value, which in practice is a value within the region of the speed at which the engine tends to stall. It is at approximately this speed that the throttle control means is caused to operate. That is, as the engine speed increases to a value above the stalling speed, then the throttle control means is taken out of active operation, while as the engine speed falls to a value near to the stalling speed, then the throttle control means is brought into operation. In general, the predetermined value of the engine speed at which the detector causes the throttle control means to be brought into and out of operation is normally slightly greater than the minimum acceptable tick-over speed of the engine, at which stalling is avoided. The detector means may comprise a control unit which includes an electrical circuit hav-

ing an electrical filter by means of which signals of different frequency generated by the sensor are distinguished from each other.

In the device according to the invention, the throttle control means engages the movable throttle member under instruction from the detector means. In doing so, it may, as required by the circumstances, prevent the throttle member from moving to the position corresponding to zero fuel supply or positively move the throttle member so as to increase the supply of fuel. In a greatly preferred form of the invention, the throttle control means comprises a solenoid, the armature of which directly or indirectly engages the throttle member when an electrical signal is received by the solenoid from the detector means. Movement of the armature out of its operating position, that is out of engagement with the throttle member or at least into a position in which the throttle member cuts off the fuel supply, may be achieved by the receipt of a reverse signal from the detector means but is preferably effected by a spring bearing upon the armature. Separate spring means will normally urge the throttle towards its zero position.

Conveniently, a visual indicator, for example an indicator lamp, is provided in the vehicle within sight of the driver so that he may be aware of the operating condition of the device. For example, when the device is brought into operation by means of a signal from the detector unit, an associated signal from the same source may illuminate an indicator lamp on the vehicle dashboard. The indicator lamp also acts as a fault indicator in that it will remain illuminated if a fault occurs in the system.

Preferably, a manual override means is provided whereby, if the device fails through failure of the sensor or the detector means, the throttle control means may be brought into constant engagement with the throttle member.

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

Fig. 1 is a schematic representation of the interconnection between the components of one preferred embodiment of the control device according to the invention; and

Fig. 2 illustrates the functioning of the throttle control solenoid of Fig. 1.

Referring firstly to Fig. 1, the device is operated by a solid state electronic control module 3, electrically linked as shown to a sensor 4, a solenoid 5 and a combined light and switch unit 6. A 24-volt control supply is fed to the device via line 7, which incorporates a 5-amp fuse 8. Line 9 feeds a 24-volt power supply to the device via a 15-amp fuse 10. The reference numeral 11 designates the common negative line.

The sensor 4 is a magnetic sensor which monitors the movement of the teeth on the starter ring gear of a vehicle, giving rise to approximately 95,000 pulses per 600 revs and thereby giving a highly sensitive and stable indication of vehicle speed. Alternative forms of sensor may be used and the sensor employed may monitor the movement of another moving part of the vehicle engine, for example-the coupling by which the drive is transmitted to the vehicle injector pump in the case of a diesel engine.

The signal from the sensor 4 is monitored in the control module 3 and when the signal frequency indicative of the engine speed falls below a predetermined value corresponding to an engine speed close to that at which the engine would normally stall, the module operates the solenoid 5 as described below. At the same time the indicator lamp of the unit 6 is illuminated to advise the vehicle driver that the engine control device is in operation.

The unit 6 also incorporates an override switch to enable the driver to take over manual control from the control device.

Fig. 2 shows the manner of operation of the solenoid 5. The throttle arm 12 is pivoted at 13 and is normally operated by the throttle cable 14, being returned to the position of minimum or zero fuel supply by the throttle return spring 15. Upon the threaded armature 16 of the solenoid 5, a bracket 17 having an elongated slot 18 is secured by means of a lock nut 19, which also allows the position of the bracket 17 on the armature 16 to be adjusted. A stud 20 on the throttle arm 12 is free to move within the length of the slot 18.

During normal operation of the vehicle engine, the armature 16 is extended from the solenoid 5 and as the throttle arm 12 moves the stud 20 traverses the slot 18, the bracket 17 meanwhile remaining stationary. However when the solenoid is energised, the armature 16 is retracted and the bracket 17 either operates the throttle arm 12 or, if the throttle arm is already in operation, prevents it returning to its full rest position.

Thus, when the ignition of the vehicle is first switched on, the solenoid 5 is energised to cause the bracket 17 to operate the throttle arm 12 and the indicator lamp is illuminated. When the engine is started and its speed of rotation exceeds the desired tick-over speed, say 700 - 800 r.p.m., then this speed is observed by sensor 4 and the control unit 3 instructs the solenoid to allow the bracket 17 to move to its rest position. In this way, the operation of the throttle becomes independent of the solenoid and, if an over-run condition arises, then the fuel supply to the engine may fall to zero. However, the supply to fuel of the injector pump (in the case of a diesel engine) or the carburettor (in

the case of a petrol engine) is maintained as usual. When the bracket 17 is in its rest position, the indicator lamp is no longer illuminated.

When the over-run condition no longer obtains, then the engine speed falls towards a value at which the engine would stall but, before that speed is reached, the sensor 4 observes this situation and again, under instruction from the control unit 3, the bracket 17 is caused to operate the throttle arm 12. Again the indicator lamp is illuminated to advise the driver that the solenoid is activated.

The illustrated device is designed to be used with an engine in which the throttle arm is operated by a cable. However, the device can readily be modified for use with throttles operated by means of rod linkages. In the latter case, the throttle control means may comprise a solenoid of which the armature moves into and out of direct engagement with one of the throttle linkages, in order to operate that linkage or prevent it moving to a minimum-fuel position.

Experimental operation of a control device according to the invention upon fuel delivery tankers has shown that significant fuel savings can be achieved by its use. For example, the device was fitted to a fuel delivery tanker driven by a Rolls-Royce 300 LI diesel engine and the operation of the tanker with and without the control device on comparable runs each exceeding 1500 miles was observed. It was found that a fuel saving of at least 12.5% was achieved by the use of the device. Since the tanker relied upon its engine in off-loading its contents at delivery points, the observed fuel saving would no doubt be greater in the absence of such use.

On subsequent comparable runs of approximately 300 miles each, savings in excess of 15% were achieved by the use of the device.

Thus the device according to the invention is effective in saving fuel. Because it is fully adjustable in both its sensing and its control, it can readily be fitted to any internal combustion engine.

Claims

1. An engine control device for controlling an internal combustion engine in which the supply of fuel to the engine is controlled by a movable throttle member (12), characterised in that it comprises a sensor (4) mounted to generate an electrical signal characteristic of the speed of rotation of the engine, detector means (3) adapted to receive a said electrical signal and to identify the proximity of said engine speed to a predetermined value, and throttle control means (5) adapted to engage said movable throttle member in response to an instruction from said detector means.

2. A device according to claim 1, characterised in that the sensor (4) monitors the engine speed electrically.

3. A device according to claim 1, characterised in that the sensor (4) is a magnetic sensor, mounted to monitor movement of a moving engine part.

4. A device according to any of the preceding claims, characterised in that said predetermined value of said electrical signal corresponds to an engine speed near to the stalling speed.

5. A device according to any of the preceding claims, characterised in that the throttle control means comprises a solenoid (5), the armature (16) of which directly or indirectly engages the throttle member (12) in response to an electrical signal from the detector means (3).

6. A device according to claim 5, characterised in that disengagement of said armature (16) from said throttle member (12) is effected by a spring.

7. A device according to any of the preceding claims, characterised by a visual indicator to signal operation of the device.

8. A device according to any of the preceding claims, characterised by a manual override means to override operation of the device.

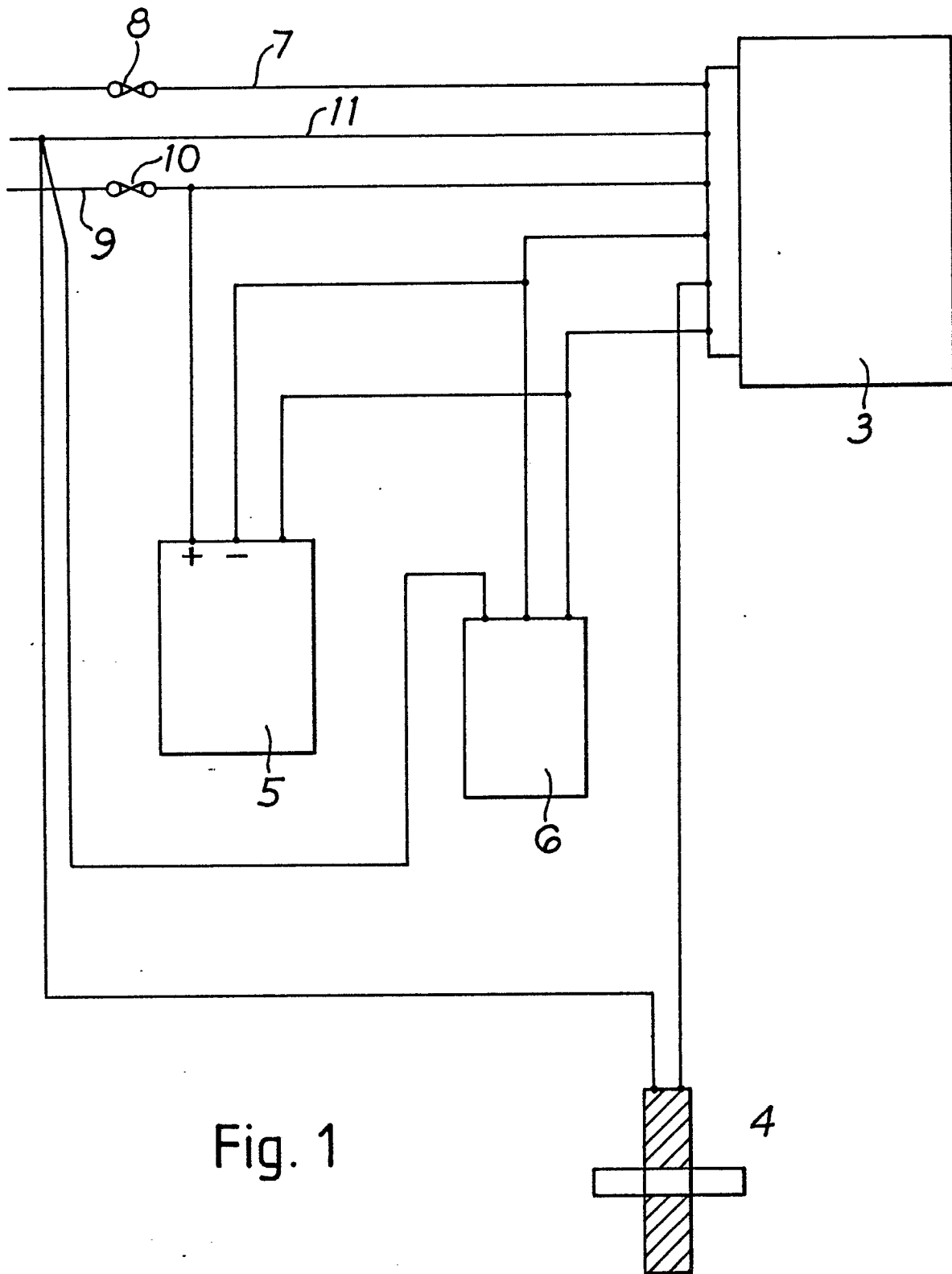


Fig. 1



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	GB-A-1 357 540 (A.J. CARTER) * Page 1, lines 9-58,72-76; figure *	1,2,5,6	F 02 M 3/04
Y	---	3,7,8	F 02 D 41/12
X	FR-A-2 327 406 (L. BARTHELEMY et al.) * Page 1, lines 10-33; page 3, line 32 - page 4, line 16 *	1,2,4-6	
Y	---		
Y	FR-A-2 480 353 (H. HERRMANN) * Page 2, lines 10-17 *	7	
Y	---		
Y	US-A-4 146 006 (GARABEDIAN) * Column 2, lines 12-15; column 3, lines 43-53; column 12, lines 15-18; column 12, lines 26-30 *	8	
Y	---		
Y	US-A-4 489 685 (KINOSHITA et al.) * Figures 2,3; column 2, lines 52-56 *	3	
A	---		
A	GB-A-2 043 772 (E.S.I. HARRIS)		
A	---		
A	FR-A- 893 588 (CHANGY)		
A	---		
A	FR-A-2 562 952 (DUROT)		

The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 10-11-1989	Examiner MOUALED R.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			