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[54] **ARRANGEMENT FOR PREVENTING EXCESSIVE SPEEDS IN INTERNAL COMBUSTION ENGINES**

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[51] **Int. Cl.** **H02g 3/00**

[58] **Field of Search** ..... 307/10 R, 120; 180/105 E; 123/102, 32 EA

[56] **References Cited**

UNITED STATES PATENTS

3,636,933 1/1972 Ohtani et al. ..... 180/105 E

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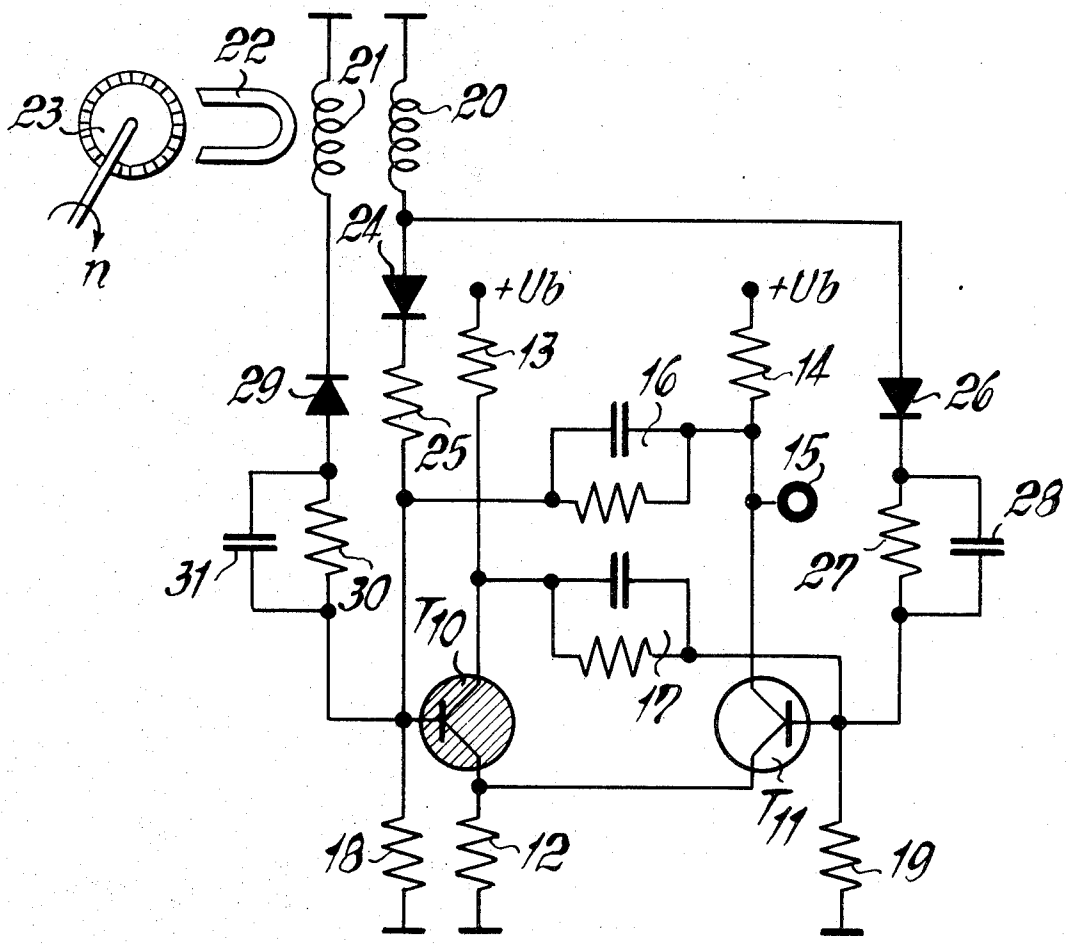
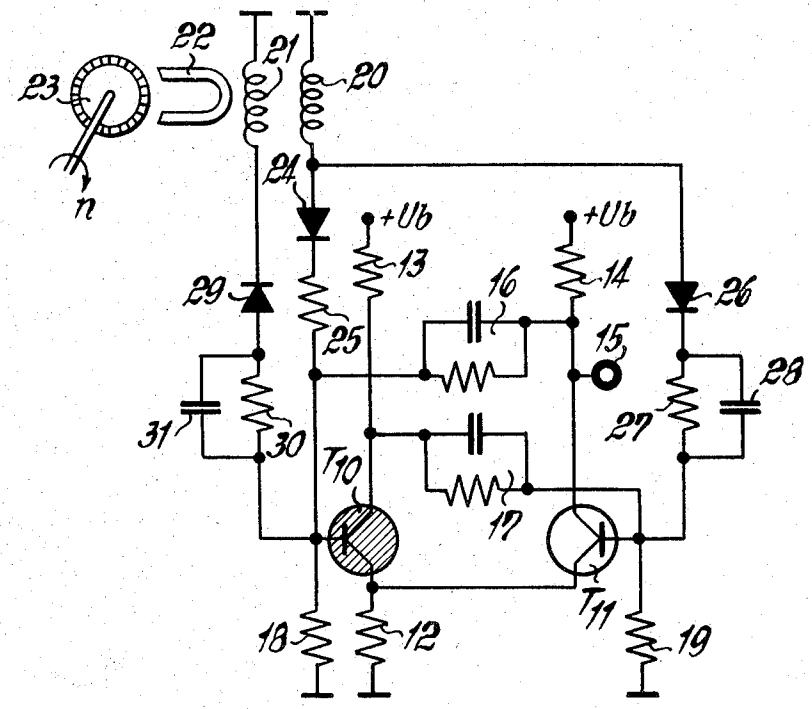
[57] **ABSTRACT**

An AC tachometer has two output windings, each connected to one input of the same bistable circuit. A rectifier and filter circuit or a Zener diode is interconnected between each output winding and bistable circuit input. When the voltage at the bistable inputs exceeds a predetermined magnitude, the bistable input flips to the second stable state. A signal resulting from the change in state can be used to cut off fuel supply to stop the engine.

5 Claims, 1 Drawing Figure





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ARRANGEMENT FOR PREVENTING EXCESSIVE SPEEDS IN INTERNAL COMBUSTION ENGINES

BACKGROUND OF THE INVENTION

This invention relates to a safety arrangement for preventing excessive speeds in internal combustion engines. It is particularly useful in conjunction with internal combustion engines which have an unstable speed characteristic, and particularly for Diesel engines in which fuel is injected by means of electronic regulators. The safety arrangement is energized by a tachometer which is connected to the shaft of the internal combustion engine and furnishes speed signals, signifying the engine speed of said internal combustion engine.

Internal combustion engines should not be driven at a speed substantially exceeding the highest design speed, since otherwise considerable mechanical damage may result. Particular danger of excessive speed exists in internal combustion engines having an unstable speed characteristic, as for example in Diesel motors in which the speed increases steadily even over the maximum permissible speed if the amount of fuel furnished thereto is increased. The known mechanical fuel regulators for internal combustion engines of this category thus require an excess speed prevention arrangement which causes the fuel supply to be stopped when the speed of the motor reaches a predetermined maximum speed. In known Diesel motor arrangements the excursion of the centrifugal regulator may be used to limit the amount of fuel injected by the injection pump thus preventing the motor from being driven over its designed maximum speed. The danger of excessive speeds causing considerable mechanical damage is not as great in internal combustion engines using carburetors since this type of motor has a stable speed characteristic. The resistance of fuel intake in the intake manifold of the carburetor type engines is sufficiently high that the motor speed is automatically limited to some predetermined speed.

It has been shown and has been demonstrated in practice that, for example, Diesel motors, may be driven much more exactly within their operating characteristics if for each operating condition the fuel supply is varied correspondingly. This may be accomplished most readily by an electronic regulating system, since the electronic regulating system, as opposed to mechanical systems, can readily accommodate a plurality of parameters in determining of the amount of fuel for operating the cycle. Because of the previously mentioned unstable speed characteristic of such Diesel motors, it is particularly necessary that a reliable excessive speed control be furnished in conjunction with the electronic regulating circuit, since the electronic and electrical elements are subject to failure during operation.

SUMMARY OF THE INVENTION

It is an object of the present invention to furnish an electronic excess speed control system particularly suitable in conjunction with Diesel motors exhibiting an unstable speed characteristic.

It is a particular object of the present invention to furnish an electronic excess speed control system whose reliability is at least equal to the reliability of a mechanical regulator, while bieng more readily adjustable to different maximum speeds than said mechanical regulators.

The present invention comprises an arrangement for furnishing an output signal when the speed of an internal combustion engine exceeds a predetermined speed. It comprises tachometer means having a first and second output winding, and furnishing a speed signal corresponding to the speed of said internal combustion engine on each of these output windings. Bistable circuit means have a first and second input respectively connected to said first and second output winding. The bistable circuit means have a first stable state when the speed of the engine is less than said predetermined speed and respond to said speed signal on each of said output windings to charge to a second stable state when the speed of said engine exceeds said predetermined speed. Output means furnish an output signal when said bistable circuit means are in said second state.

The output signal can be used to stop the fuel supply to the engine, thereby causing the engine to stop.

It is an advantage of the arrangement of the present invention that first, it can be used in conjunction with all types of motors and can be readily adjusted for any desired value of maximum speed. Further, it is less costly than a corresponding mechanical regulating arrangement.

The arrangement of the present invention is of particular advantage when the regulation of the fuel supply of the internal combustion engine is carried out completely in an electronic fashion so that additional mechanical regulating, control or safety components can be eliminated.

In a particular advantageous embodiment of the present invention, the tachometer means comprise an A.C. generator and diodes are connected between the output windings and the respective inputs to the bistable states. The diodes are connected with such a polarity that the current flowing therethrough causes a voltage to appear at both inputs which tends to cause the bstable circuit means to flip into the second stable state, indicating excessively high speeds. Use of an A.C. tachometer yields the advantage, that no current-carrying mechanical parts are required. For example, brushes and commutators are subject to rather rapid wear and do not offer a constant resistance to current flow.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING:

The single FIGURE shows one embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

The preferred embodiment of the present invention will now be described with reference to the drawing. The single FIGURE shows a circuit diagram of a circuit furnishing an output signal when the engine speed exceeds a predetermined speed. This circuit arrangement is connected to the output of an A.C. tachometer. It comprises bistable circuit means having a transistor 10 and a transistor 11. The emitters of the two transistors

are connected in common to ground through a resistance 12. The collector of transistor 10 and the collector of transistor 11 are connected to the positive supply line +Ub via a load resistance 13 and 14 respectively. An output terminal 15, one embodiment of output means, is connected to the collector of transistor 11. When the speed of the engine exceeds a predetermined speed, of the engine exceeds a predetermined speed, the voltage at this terminal jumps from approximately +Ub volts to approximately 0 volts. An RC coupling circuit 17 is connected between the collector of transistor 11 and the base of transistor 10, while RC coupling circuit 17 is connected between the collector of transistor 10 and the base of transistor 11. Both RC coupling circuits comprise a parallel circuit of a resistance and a capacitance. The capacitor is designed to improve the dynamic operation of the circuit during switching and to smooth the base voltages of transistors 10 and 11 as will be described below. The tachometer comprises an A.C. generator having windings 20 and 21 mounted on a stator 22 (indicated only schematically). The A.C. generator further comprises a multi-pole armature 23. The rotation of armature 23 causes a voltage to be induced in the winding 20 and 21, whose amplitude is proportional to the speed n. Winding 20 has one terminal connected to ground and is connected to the base of transistor 10 via a diode 24 and a resistance 25. Winding 20 is further connected to the base of transistor T11 through a diode 26 and a parallel circuit comprising a resistor 27 and a capacitance 28. Output winding 21 of the tachometer has one terminal connected to ground and the second terminal connected to the base of transistor T10 via a diode 29 connected in series with a parallel circuit comprising a resistance 30 and a capacitance 31. More specifically the anodes of diodes 24 and 26 are connected to the output winding 20, while the cathode of diode 24 is connected through resistance 25 to the base of transistor T10, while the cathode of diode 26 is connected to the base of transistor T11 through resistor 27. The polarity of diode 29 is opposite to that of diodes 21, 26. Specifically, the cathode of diode 29 is connected to output winding 21, while the anode of diode 29 is connected to the base of transistor T10 through resistor 30.

The above-described arrangement operates as follows:

It is assumed that at the start of the operation the engine is standing still. Thus no current flows through windings 20 and 21. Thus resistor T10 is blocked, since its base is at an approximately ground potential because of its connection to ground through resistor 18. Transistor T11 receives a sufficiently high voltage at its base via the voltage divider comprising the resistances 17 and 19, that is transistor is conductive. Thus the signal at terminal 15, herein referred to as the output signal, under these operating conditions corresponds to the same signal as under excessive speed conditions. Thus, it is possible to check for proper operation of the arrangement prior to starting the engine. If, after the engine is started, the shaft of armature 23 which is coupled to the drive shaft of the internal combustion engine rotates at some particular speed, then a corresponding A.C. voltage is induced in windings 20 and 21. Because of the so-induced voltages a positive base voltage is applied through diode 24 and resistance 25 to transistor T10, causing this transistor to be switched to the conductive condition. Transistor T11 then blocks because of the decrease in voltage at its base. This condition, namely the condition in which transistor T10 is conductive and transistor T11 is blocked constitutes the first stable state of the bistable circuit means, namely the state wherein the bistable circuit means indicates normal operation of the internal combustion engine. Even after the end of the first positive half wave, this condition is maintained because the capacitors associated in the coupling circuits 16 and 17 tend to maintain the shift in base voltage of both transistors until discharged. The time constants of circuits 16 and 17 are sufficiently large to prevent a resetting of the circuit between half waves.

If now the speed of the internal combustion increases above a predetermined speed, then the negative D.C. voltage applied to the base of transistor T10 via diode 29 and the parallel circuit comprising resistor 30 and capacitor 31 reaches a value which causes this transistor to block. Simultaneously the positive voltage applied to the base of transistor 11 through diode 26 and the parallel circuit comprising resistance 27 and capacitor 28 increases to a value which tends to cause this transistor to become conductive. Specifically, capacitors 31 and 28 charge during the particular half wave determined by the associated diode (29, 26 respectively) and discharge during the other half wave. The voltages across resistors 30 and 27 are thus a D.C. voltage with relatively little ripple which are applied to the base of transistor 10 and 11 respectively. The bistable circuit means thus change to the second stable state in which transistor T10 is blocked and transistor T11 is conductive. This causes the output signal to appear at terminal 15. This output signal signifies an excessive speed and causes the fuel supply to the internal combustion engine to be shut off in a manner which is not further illustrated here. The particular speed at which the bistable circuit changes state can be determined by the size of resistors 30 and 27.

It is further possible to replace diode 29 and 26 in series with the associated RC circuits by Zener diodes. In this particular case the breakdown voltage of the Zener diodes determines the speed at which the fuel supply is to be blocked.

It is a further advantage of the present invention that the voltage induced in winding 20 serves to supply the base bias for transistor T10. Thus if the circuit connection to coil 20 is broken, transistor T10 remains blocked at all times and the signal at terminal 15 does not disappear even after the engine is started.

When the amplitude of the A.C. voltage appearing on coils 20 and 21 has reached the amplitude corresponding to the predetermined speed which is not to be exceeded, the bistable circuit means, as described, switch to the second stable state. It is possible by suitable design of the circuit to cause the bistable circuit means to remain in the second stable state indicating excessive speed even when the speed decreases again, causing the voltages across coils 20 and 21 to decrease correspondingly. The circuit remains in the second stable state until a subsequent restarting of the engine causes a repetition of the above-described cycle.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art fairly constitute essential characteristics of the generic or specific aspects of this

invention, and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended

1. In an internal combustion engine, an arrangement for furnishing an output signal when the speed of said engine exceeds a predetermined speed, comprising, in combination, tachometer means having a first and second output winding, each of said windings furnishing a speed signal corresponding to the speed of said internal combustion engine; bistable circuit means having a first and second input respectively connected to said first and second output winding of said tachometer means, said bistable circuit means having a first stable state in the presence of speed signals signifying an engine speed less than said predetermined speed, and switching to a second stable state in response to speed signals corresponding to an engine speed exceeding said predetermined speed; and output means connected to said bistable circuit means to furnish said output signal when said bistable circuit means is in said second stable state.

2. An arrangement as set forth in claim 1, wherein said tachometer means comprise A.C. generator means.

3. An arrangement as set forth in claim 2, further comprising first diode means interconnected between said first output winding of said tachometer means and said first input of said bistable circuit means; and second diode means interconnected between said second output winding of said tachometer means and said second input of said bistable circuit means in such a manner that the polarity of each of said diode means permits current flow in a direction for switching said bistable circuit means to said second stable state.

4. An arrangement as set forth in claim 1, wherein said bistable circuit means comprise first transistor means conductive when said bistable circuit means is in said first stable state and second transistor means conductive when said bistable circuit means is in said second stable state; further comprising base bias circuit means connected to said first transistor means and to said first output winding, for furnishing base bias for said first transistor means in dependence on the speed signal furnished by said first output winding.

5. An arrangement as set forth in claim 1, wherein said output means comprise an output terminal furnishing said output signal when said bistable circuit means is in said second state.

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