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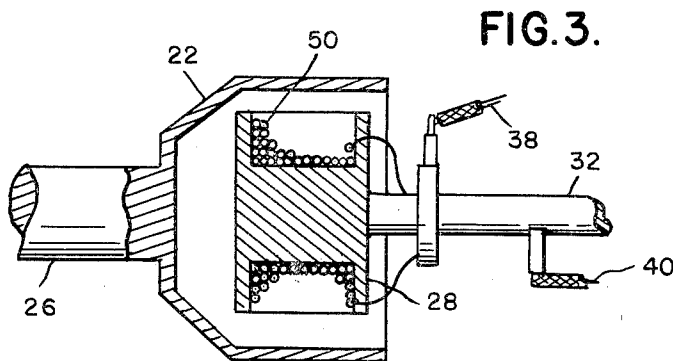
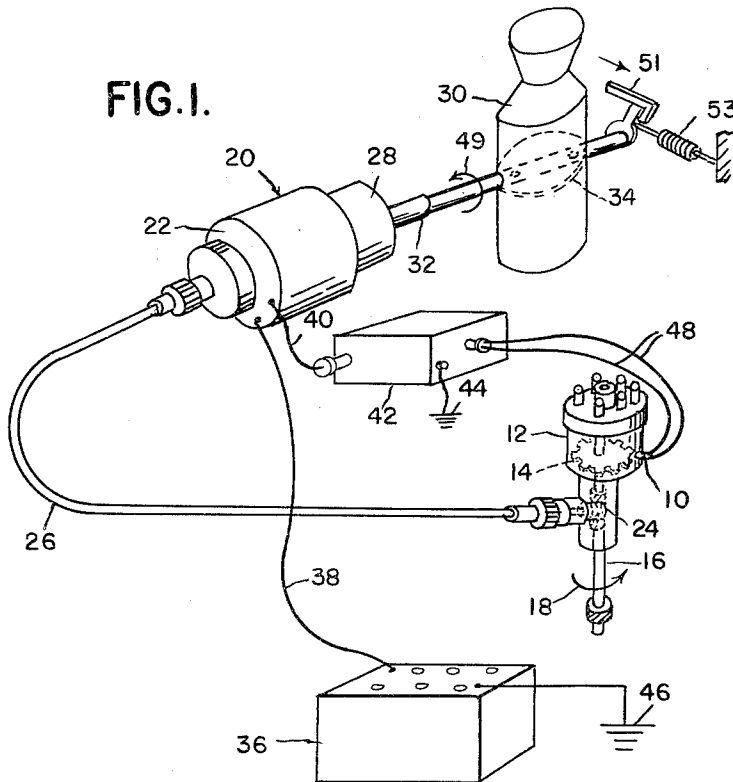
F. S. KERR

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ELECTRIC SPEED GOVERNOR

Filed Sept. 29, 1958

2 Sheets-Sheet 1



INVENTOR.

FRED S. KERR

BY *Whittemore*
Hulbert and Belknap
ATTORNEYS

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F. S. KERR

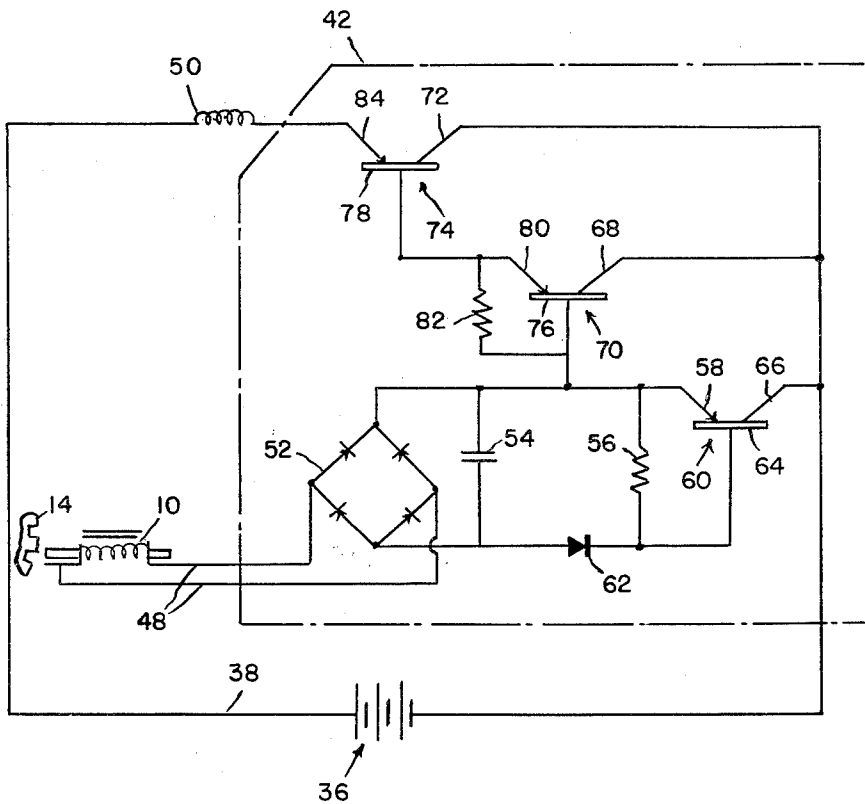
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FIG.2.



INVENTOR.

FRED S. KERR

BY *Whittemore*
Hulbert and Belknap
ATTORNEYS

ATTORNEYS

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ELECTRIC SPEED GOVERNOR

Fred S. Kerr, Oak Park, Mich., assignor to Holley Carburetor Company, Van Dyke, Mich., a corporation of Michigan

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10 Claims. (Cl. 123-102)

The present invention relates to an electronic speed regulation device and refers more particularly to a governor wherein a mechanical throttle valve is adjusted by means of a magnetic clutch actuated by an electrical signal produced after a motor or motor vehicle has reached a desired speed.

In the use of a governor to regulate the speed of an engine it is of importance that the governor operate immediately on the speed of the engine reaching the desired regulation point, leaving little or no time for the engine to overspeed before the regulation is effective. Past governors have often lacked the desired immediate regulation capability at the desired engine speed.

Therefore one of the essential objects of this invention is to provide a governor for an internal combustion engine which reacts immediately to limit the speed of the engine when it reaches a predetermined value.

Another object is to provide means to position the throttle valve of an internal combustion engine after the engine has reached a desired speed to regulate the engine speed.

Another object is to provide means to actuate a magnetic clutch when an internal combustion engine reaches a predetermined speed whereby the throttle valve of said engine is positioned to regulate the speed thereof.

Another object is to provide means responsive to a voltage proportional to the speed of an engine which when said voltage reaches a predetermined value will cause a current to actuate a magnetic clutch which positions a throttle valve associated with the engine to regulate the speed of said engine.

Another object is to provide a device whereby an alternating voltage proportional to the speed of an engine is rectified to produce a direct voltage proportional to engine speed, which device produces a current after the direct voltage has reached a predetermined level and then amplifies the current causing a magnetic clutch to rotate a throttle valve associated with said engine, thereby regulating the speed of said engine.

Another object is to provide an electronic governor for an internal combustion engine which is simple in construction, easy to manufacture and efficient in use.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawing, wherein:

FIGURE 1 is a diagrammatic illustration of the elements necessary for a particular embodiment of the invention and their relation.

FIGURE 2 is a schematic diagram illustrating one form of the control circuit of the invention.

FIGURE 3 is a diagrammatic longitudinal section view of the magnetic clutch illustrated in FIGURE 1 showing the connection of the control circuit of FIGURE 2 thereto.

The device of the invention is a governor which may be used to limit engine speed or vehicle speed. In the embodiment illustrated, engine speed is sensed by a pick-up device which develops an electrical signal proportional to the speed of an engine. This electrical signal increases as engine speed increases and decreases as engine speed decreases. The developed signal voltage can be either A.C. or D.C. In the present form of the invention, the sensing signal is A.C., and is rectified to D.C.

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in a control circuit. While, in this case an electromagnetic pick-up is employed, it is possible to sense engine speed to provide a related electric signal by means of an electric generator driven by the engine, a pulse pick-up from either the primary or secondary winding of the ignition coil, or any other electrical means capable of producing a signal voltage, the magnitude of which is related to engine speed.

Referring to FIGURE 1, magnetic pick-up probe 10 is mounted in a distributor 12 which, in normal use, is mounted on an internal combustion engine (not shown), the distributor 12 also contains wheel 14 and shaft 16 which are positively rotated as indicated at 18 by appropriate gearing to the engine cam shaft (not shown). Magnetic clutch 20 has one rotating member 22 connected to the rotating shaft 16 through flexible coupling 26. The other rotating member 28 of magnetic clutch 20 is connected to the carburetor 30 throttle shaft 32 on which throttle valve 34 is shown attached. Battery 36 is connected to the magnetic clutch 20 through wire 38, and wire 40 connects magnetic clutch 20 to the control circuit 42. Control circuit 42 is connected to chassis ground at 44 as is the negative terminal of battery 36 at 46. Magnetic pick-up probe 10 is connected to the control circuit 42 by wires 48.

Magnetic clutch 20 as illustrated diagrammatically in FIGURE 3 is of the type common in the clutch art in which one side slips relative to the other in normal operation. Side 22 within the housing illustrated in FIGURE 1 is rotated at a speed proportional to engine speed by shaft 16 and flexible coupling 26. On feeding of an electrical current through coil 50 on side 28 of magnetic clutch 20 an electrical field will be set up about coil 50 proportional to the current flow in coil 50 which due to the cutting of flux lines by rotating member 22 causes member 28 to tend to follow the rotation of member 22. A slipping or a drag between members 22 and 28 occurs with such an arrangement and if shaft 32 is held against rotation a torque is applied thereto. The direction in which shaft 32 tends to rotate because of the torque applied thereto through clutch 20 will be determined by the gearing 24 in a manner well known in the art. It is essential to the device as illustrated that shaft 32 tend to rotate in the direction shown at 49 on feeding of current through coil 50.

Under engine running conditions, flexible shaft 26 drives rotating member 22 of clutch 20. Before the speed is attained at which regulation is desired the other member 28 of magnetic clutch 20 is allowed to rotate by means of movement of stop 51. Stop 51 may be attached to the accelerator pedal (not shown). Spring 53 causes shaft 32 and throttle valve 34 to rotate in a manner opposite to that shown at 49 when rotation is allowed in that direction by stop 51. As engine speed increases to a point where governing is desired due to opening of throttle plate 34 by rotation of shaft 32 by spring 53, the electric signal from magnetic pick-up probe 10 activates control circuit 42 which, in turn, causes an electric current to flow in coil 50 (illustrated in FIGURE 3) of clutch 20, causing a torque to be applied to throttle shaft 32 of carburetor 30 in the direction indicated at 49 acting against spring 53 tending to close throttle plate 34. As the throttle shaft 32 and throttle plate 34 are rotated toward a closed position, engine speed is reduced to conform to the desired speed reducing the control current through coil 50 until a balance between control current and engine speed is reached.

Referring to FIGURE 2, magnetic pick-up probe 10 is mounted in a rigid housing where it is in close proximity to a wheel 14 with notched teeth. Wheel 14 is driven by the engine. As wheel 14 rotates, the magnetic coupling between the wheel and magnetic pick-up probe 10 changes

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each time a tooth on the wheel comes into close proximity with the magnetic pick-up probe. This generates an A.C. voltage, the frequency of which, as well as the magnitude, is a function of the rotating speed of the wheel. Therefore, since wheel 14 is positively driven by the engine, the voltage developed from in the coil of the magnetic pick-up probe 10 is a function of engine speed.

Since the output from the coil of the magnetic pick-up probe 10 is an alternating current, and in the embodiment of the invention illustrated a direct current amplifier is employed, the A.C. voltage from the coil of the magnetic pick-up probe 10 is converted to D.C. by a rectifier arrangement as shown at 52. The positive side of the rectified signal is connected to condenser 54, resistor 56, and the emitter 58 of transistor 60. The negative side of the rectified signal is connected to the other end of condenser 54 and to a reference diode 62 (sometimes referred to as a Zener diode). The other end of diode 62 is then connected to the base 64 of transistor 60 as well as to resistor 56.

The collector 66 of transistor 60, the collector 68 of transistor 70 and the collector 72 of transistor 74 are all connected together and in turn are connected to the negative side of battery 36. Battery 36 can be an automobile battery. The base 76 of transistor 70 is connected to the emitter 58 of transistor 60 and the base 78 of transistor 74 is connected to the emitter 80 of transistor 70. Resistor 82 is connected between the emitter 80 and base 76 of transistor 70. The magnetic clutch coil 50 is connected in series between battery 36 and the emitter 84 of transistor 74.

Describing the action of the circuit, an A.C. voltage is developed at the coil of the magnetic pick-up probe 10 as the engine rotates wheel 14. The A.C. voltage is converted to a D.C. voltage in rectifier system 52. Negligible current can flow in the circuit consisting of rectifier 52, emitter 58, base 64 of transistor 60 and reference diode 62 until the developed voltage across reference diode 62 exceeds its zener voltage. As is well known to those versed in the art, any small increase in voltage across a zener diode in excess of its zener voltage results in a relatively large increase of current through the diode. It can readily be seen now, until the developed voltage reaches a value determined by the breakdown or zener voltage, negligible current can flow through transistor 60. As the developed voltage from the magnetic pick-up probe 10 and rectifier arrangement 52 exceeds the zener voltage of diode 62, current will flow through the emitter base circuit of transistor 60. Since, in this circuit, the transistor is basically a current amplifier, a small current flow through the emitter base circuit of transistor 60 results in a larger current flow in the emitter collector circuit of transistor 60.

Current flow in the emitter collector circuit of transistor 60 causes the base voltage of transistor 70 to become more negative whereby a large current is caused to flow in the emitter collector circuit thereof. Current flowing in the emitter collector circuit of transistor 70 causes the base voltage of transistor 74 to become more negative causing a large current to flow in its emitter collector circuit. It can now be seen that, as a small current begins to flow through transistor 60, a large current begins to flow from battery 36 through clutch coil 50 to the transistor circuits.

The result is that no current flows in clutch coil 50 until the engine reaches a speed where the developed voltage from the magnetic pick-up probe 10 is of a value high enough to start the aforementioned action. Any small increase of speed after this condition is reached results in a substantially larger amount of current flow in the clutch coil, and consequently, a greater amount of torque is applied to the throttle shaft. As greater torque is applied to the throttle shaft, the throttle valve closes, reducing the power of the engine, and thereby reducing speed for a given load. As speed is reduced the current flowing in clutch coil 50 will be reduced until a balance between the

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speed of the engine and the current flowing in coil 50 has been reached which will be at the desired regulated speed.

The drawing and the foregoing specification constitute a description of the improved electronic speed governor in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. In combination with an engine having throttle means biased toward the open position, rotatable means operable to bias said throttle means toward a closed position on being coupled to said throttle means, and means for coupling said rotatable means to said throttle means only at a predetermined engine speed with a variable force the initial value of which is substantial and is determined by the particular predetermined engine speed.

2. In combination with an engine having throttle means biased toward the open position, rotatable means operable to bias said throttle means toward a closed position on being coupled to said throttle means, and means for coupling said rotatable means to said throttle means only at a predetermined engine speed with a variable force determined by the particular predetermined engine speed and for thereafter varying the coupling force between the throttle means and rotatable means in response to changes in engine speed above said predetermined engine speed.

3. In combination with an internal combustion engine having a throttle valve, accelerator and resilient means normally opening the throttle valve in response to accelerator movement, a rotating shaft connected to said engine, a magnetic clutch connected between the rotating shaft and the throttle valve, the clutch having a field winding, means associated with said engine for developing a voltage proportional to the speed of the engine including a rectifier having a load resistor in its output circuit, means connected in series with said load resistor and rectifier to produce a current flow when said voltage has reached a predetermined value and means connected in parallel across said load resistor for amplifying said current flow and applying it to said field winding of said magnetic clutch whereby said clutch is caused to rotate said throttle valve in opposition to said resilient means thereby regulating the speed of said engine.

4. Structure as claimed in claim 3 wherein said means for developing a voltage proportional to engine speed also includes a magnetic pick-up probe and a rotating wheel having radial teeth, the wheel attached to said rotating shaft, the magnetic pick-up probe closely associated with the ends of the radial teeth on the rotating wheel whereby an alternating voltage is produced, said rectifier connected across the magnetic pick-up probe whereby said alternating voltage is transformed into a direct voltage.

5. Structure as claimed in claim 4 wherein said means to produce a current flow is a regulating diode connected in series with said load resistor in said rectifier output circuit whereby current flow is limited in the rectifier output circuit until the voltage produced across said rectifier exceeds the zener voltage of said reference diode.

6. Structure as claimed in claim 5 wherein said means to amplify said current flow and apply it to said field winding of the magnetic clutch includes a battery and three transistors, the collector of each transistor connected to one terminal of the battery, the other terminal of the battery connected to the emitter of a first of said transistors through said field winding, the base of the first transistor being connected to the emitter of a second of said transistors, the base of said second transistor connected to the emitter of the third transistor and the emitter base circuit of said third transistor in parallel with the load resistor of the rectifier, said transistors operable in sequence on the conduction of said reference diode to amplify the current in the rectifier output circuit and draw the amplified current through the field winding of said magnetic clutch.

7. In an electronic governor including coil actuating

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means, a control device comprising means to generate a voltage proportional to speed, means preventing current flow through said voltage generating means due to said voltage generated thereby until said voltage reaches a predetermined value and means to amplify said current on occurrence thereof and to feed it through said actuating means.

8. In an electronic governor including coil actuating means, a control device comprising a magnetic pick-up probe for generating an alternating voltage of varying magnitude, a rectifier including a filter capacitor and load resistor in parallel therewith connected to said magnetic pick-up probe whereby said alternating voltage is converted to direct voltage, means in series with said load resistor of the rectifier whereby current is prevented from flowing in the rectifier circuit until the voltage therein reaches a predetermined value, and means to amplify said current on occurrence thereof and feed it through said coil actuating means.

9. In an electronic engine speed governor including coil actuating means, a control device comprising a magnetic pick-up probe for generating an alternating voltage proportional to engine speed, a rectifier including a filter capacitor and load resistor in parallel therewith connected to said magnetic pick-up probe whereby said alternating voltage is converted to direct voltage, a reference diode in series with said load resistor of the rectifier whereby current is prevented from flowing in the rectifier circuit until the voltage therein reaches a predetermined value, and means to amplify said current on occurrence thereof and feed it through said coil actuating means.

10. In an electronic governor including coil actuating means, a control device comprising a battery, a magnetic pick-up probe for generating an alternating voltage proportional to speed, a rectifier including a filter capacitor and load resistor in parallel therewith connected to said magnetic pick-up probe whereby said alternating voltage is converted to direct voltage, a reference diode in series with said load resistor of the rectifier whereby current is prevented from flowing in the rectifier circuit until the

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voltage therein reaches a predetermined value, three transistors for amplifying said current and applying it to the coil actuating means, the collectors of the transistors connected to one terminal of the battery, the other terminal of the battery connected to one end of said coil, the other end of said coil connected to the emitter of a first of said three transistors, a second of the said transistors having its emitter connected between the rectifier and the load resistor and its base connected between the load resistor and reference diode whereby increased conduction in the emitter collector circuit of said second transistor is initiated on conduction of the regulating diode, and the third of said three transistors having its base connected to the emitter of said second transistor and its emitter connected to the base of the first transistor, and a resistor connected between the base and emitter of said third transistor whereby conduction through the emitter collector circuit of said third transistor is increased on increased conduction in said second transistor causing increased conduction in said first transistor increasing the current through said coil actuating means.

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