United States Patent [19]

Klaiber et al.

[11] **3,800,755**

[45] **Apr. 2, 1974**

[54] **SPEED REGULATING ARRANGEMENT FOR INTERNAL COMBUSTION ENGINES**

[75] Inventors: **Erich Klaiber**, Stuttgart; **Hans Stöckle**, Neckarweihingen; **Helmut Domann**, Leonberg, all of Germany

[73] Assignee: **Robert Bosch GmbH**, Stuttgart, Germany

[22] Filed: **Nov. 11, 1971**

[21] Appl. No.: **197,814**

[30] **Foreign Application Priority Data**

Nov. 13, 1970 Germany 2055874

[52] **U.S. Cl.** **123/102,** 310/279, 335/229, 307/88.5

[51] **Int. Cl.** **F02d 11/10**

[58] **Field of Search** 123/102; 324/166; 317/5; 310/30, 279; 335/229

[56] **References Cited**

UNITED STATES PATENTS

3,249,098	5/1966	Rosenberg	123/102
3,252,022	5/1966	Smith	317/5 X
3,207,950	9/1965	Smith	317/5 X
3,374,374	3/1968	Smith	317/5 X
3,258,094	6/1966	Zechnall et al.	317/5 X
3,264,496	8/1966	Scholl	317/5 X
3,157,807	11/1964	Kimberly, Jr.	317/5 X
3,560,854	2/1971	Moss et al.	123/102 X
3,346,771	10/1967	Sutton	123/102 X
3,613,820	10/1971	Bozoian	317/5
3,058,039	10/1962	Ray	335/279
3,221,191	11/1965	Cuches et al.	335/279
2,364,656	12/1944	Price	335/279

Primary Examiner—Laurence M. Goodridge
Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

A speed regulating arrangement for internal combustion engines in which an electrical pulse generator is coupled to the crankshaft of the engine and is operated in accordance with the engine speed. The pulse generator applies its output to an electronic speed regulating circuit which, in turn, operates an electromagnet having a rotatable armature. The throttle flap of the engine is coupled to the armature and positioned in accordance with the signal output from the electronic speed regulating circuit. The latter has a series circuit of a monostable stage, a low pass filter, a regulating stage and a power amplifier.

15 Claims, 7 Drawing Figures

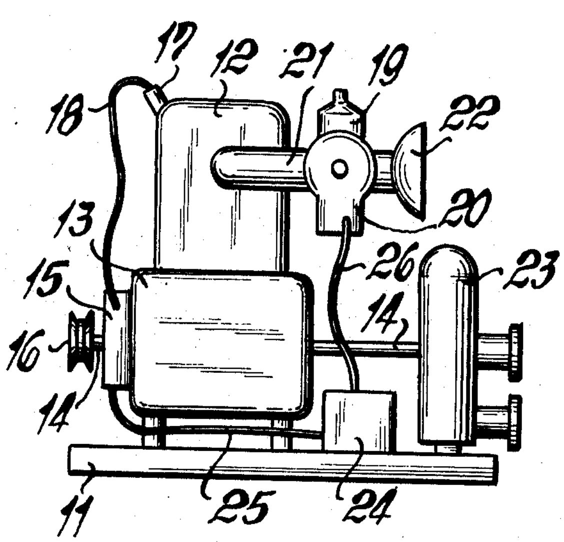


FIG.1

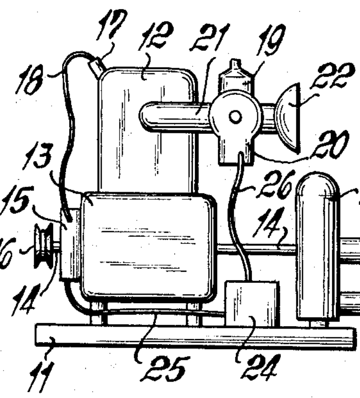


FIG.2

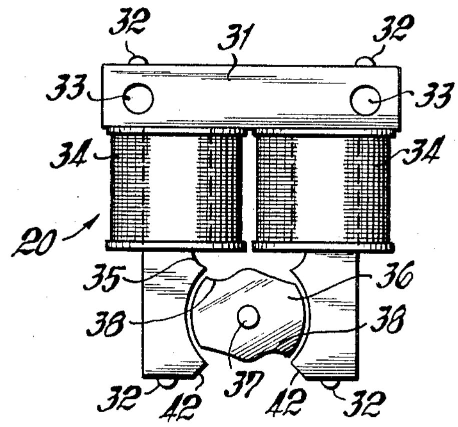
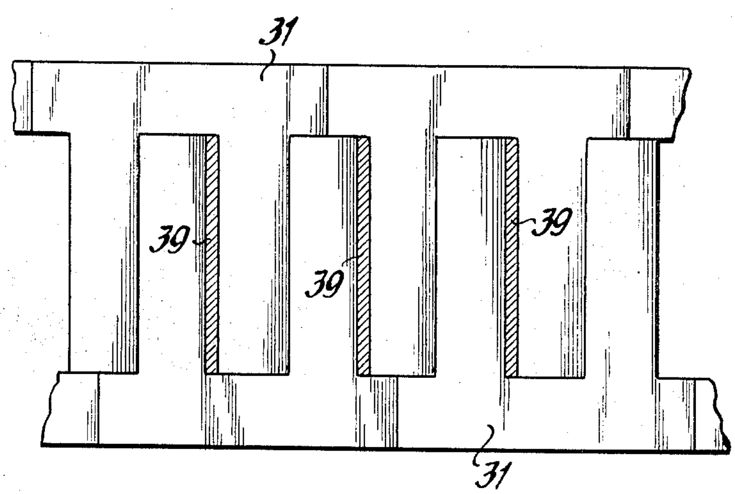


FIG.3



INVENTORS
Erich KLAIBER
Hans STÖCKLE
Helmut DOMANN
BY

their ATTORNEY

FIG. 4

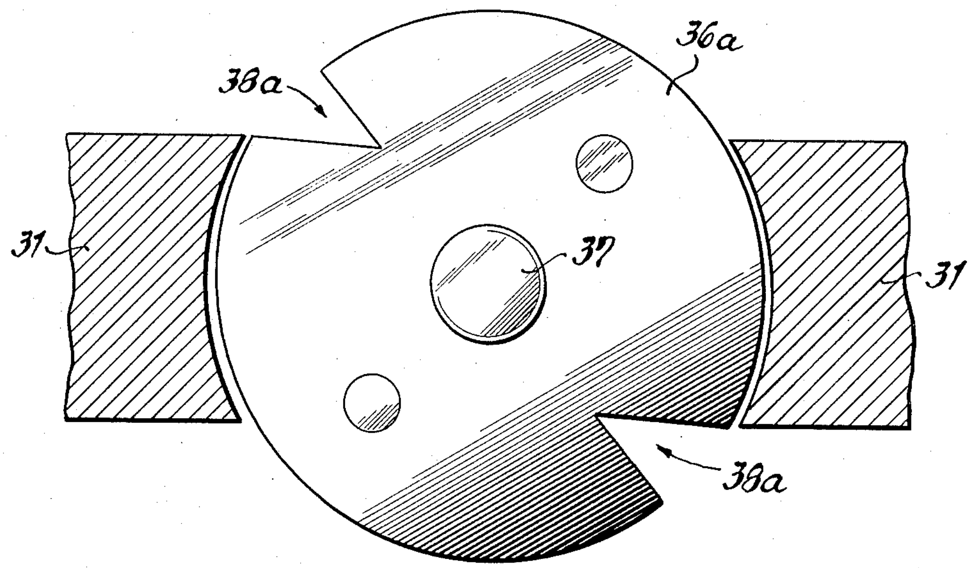
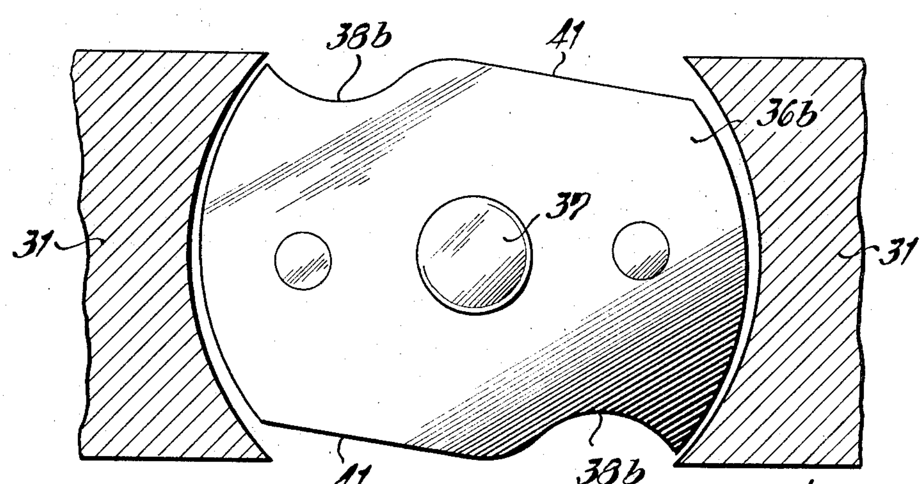


FIG. 5



INVENTORS

Erich KLAIBER
Hans STÖCKLE
Helmut DOMANN

BY

their ATTORNEY

PATENTED APR 2 1974

3,800,755

SHEET 3 OF 3

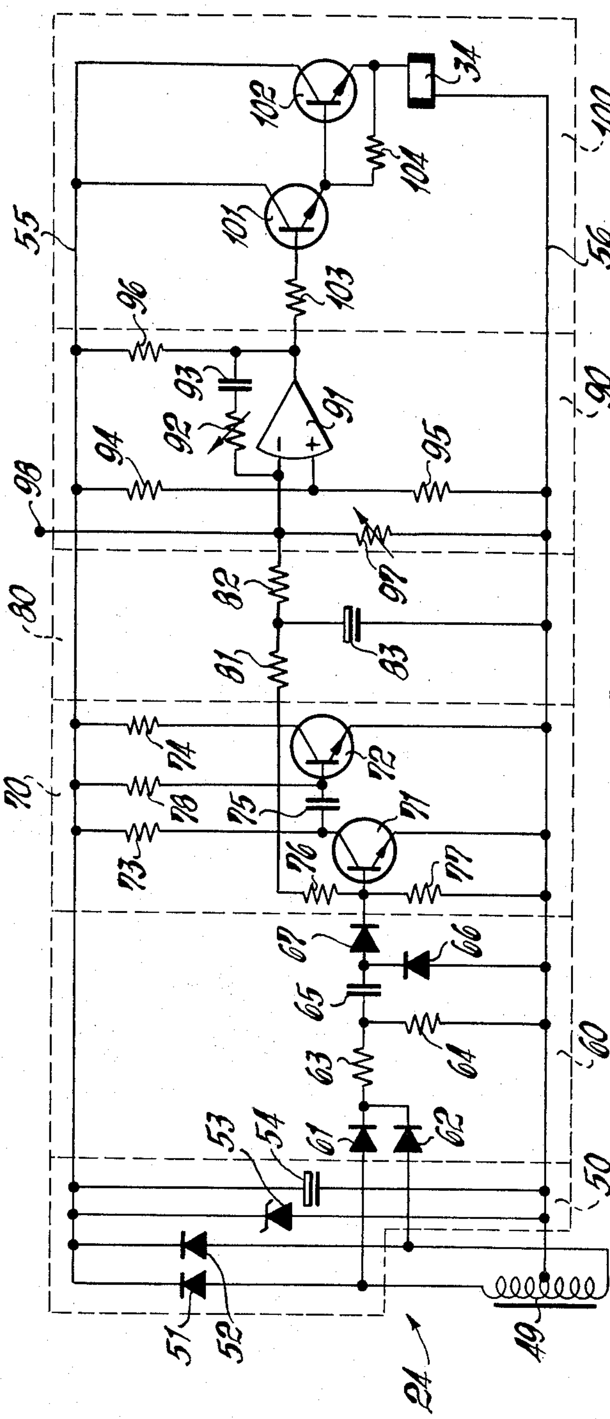


FIG. 6

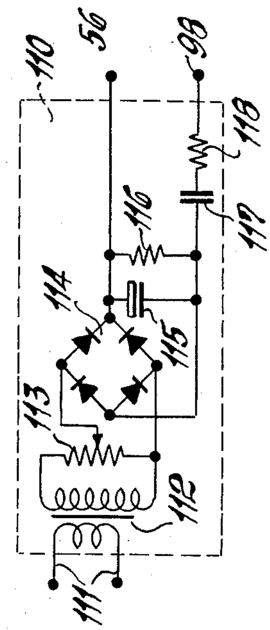


FIG. 7

INVENTORS
Erich KLAIBER
Hans STÖCKLE
Helmut DOMANN
BY

SPEED REGULATING ARRANGEMENT FOR INTERNAL COMBUSTION ENGINES

BACKGROUND OF THE INVENTION

The present invention relates to a speed regulating arrangement for an internal combustion engine used to drive a load. Examples of a load driven by the engine are water pumps, electrical generators, motorized saws for power saws, floor scrapers, etc. With such driven apparatus it is required that the speed of the internal combustion engine remain constant even though the load varies. Thus, the water pressure should be independent of the quantity flow rate of the pump, and should remain constant. At the same time the output voltage of the generator should be independent of the magnitude of the current and the cutting speed of the power saw should be independent of the length of the cut and independent from the applied pressure. The floor scraper or ground digging apparatus should dig uniformly and independent of the depth of operation. Considerable further examples of this type are also possible.

Mechanical centrifugal regulators are known in the art for purposes of speed regulation. These centrifugal regulators are used to actuate the throttle flap of an internal combustion engine. The mechanical centrifugal regulators have three distinct disadvantages: one disadvantage is that they are relatively heavy and are therefore not adapted for portable power saws. The second disadvantage of the centrifugal regulator is that they have a large regulating time constant, and as a result, when the regulators are used in conjunction with electrical generators or water pumps, the electrical voltage or water pressure varies too much when the load varies rapidly. The third disadvantage resides on the basis that upon load variations, a proportional speed change is obtained.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a speed regulating arrangment for internal combustion engines which avoid the foregoing disadvantages of the conventional devices in the form of mechanical centrifugal regulators.

Another object of the present invention is to provide an arrangement which is reliable in operation and may be readily fabricated.

A further object of the present invention is to provide an arrangement of the foregoing character which may be easily installed in internal combustion engines.

The objects of the present invention are achieved by providing a pulse generator connected to the crankshaft of the engine and synchronously driven in accordance with the speed of the engine. The output of the pulse generator is applied to an input of an electronic speed regulator which, in turn, operates an electromagnet with a rotatable armature. The rotatable armature positions the throttle flap of the engine. A particularly advantageous arrangement, in accordance with the present invention, is achieved when the electronic speed regulator has a series circuit consisting of a monostable multivibrator or monostable switching stage, a low pass filter, a regulating stage, and a power amplifier.

Mechanical centrifugal regulators have the characteristic of proportional regulators. As a result, the

speed can be adjusted at constant load, but the speed drops with increasing load. This disadvantage can be avoided through a further embodiment of the present invention by providing that the regulating stage be in the form of a PI regulator. Residual speed variations are not possible when the regulating characteristic has an integrating portion.

When the throttle flap is to be actuated electromechanically, it is necessary to provide a rotatable armature which has a substantially constant torque over a relatively large angle of rotation of approximately 90°. This feature is attained in a further embodiment of the present invention by providing that the rotatable armature is in the form of a segment armature which has rounded recesses for increasing the torque in the initial or end position of the armature.

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 drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic diagram of an internal combustion engine with a speed regulating arrangement;

FIG. 2 is an elevational view of an electromagnet with rotatable armature;

FIG. 3 is a schematic diagram of the arrangement of core laminations for the electromagnet, when being stamped, in accordance with the present invention;

FIG. 4 is an enlarged sectional view of the electromagnet of FIG. 2 when using a circular armature;

FIG. 5 is an enlarged sectional view of a part of the electromagnet of FIG. 2 when using a segment armature;

FIG. 6 is a circuit diagram of the speed regulating arrangement and shows the electronic components and their interconnections; and

FIG. 7 is a circuit diagram of a correction applying stage used in conjunction with the circuitry of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, FIG. 1 shows an internal combustion engine with a cylinder **12** and a crankshaft housing **13.** The internal combustion engine drives a centrifugal pump **23,** with an extension of its crankshaft **14.** The centrifugal pump **23** is secured or mounted fixedly to the chassis **11,** similar to the internal combustion engine. The crankshaft housing **13,** furthermore, carries an ignition generator **15** on the side of the housing **13** which is opposite to that facing the centrifugal pump **23.** The ignition generator **15** supplies power to a spark plug **17,** by way of a cable **18,** and to an electronic regulator **24,** through an interconnecting cable **25.** The ignition generator **15** is penetrated by a second extension of the crankshaft **14.** This extension has, at its end, a pulley **16** which can drive about for the purpose of turning over or starting the engine. Connected to the cylinder **12,** furthermore, is an intake manifold or suction intake **21** a gas applying unit **19,** a throttle flap and an air filter **22.** The throttle flap is not shown in the drawing. This throttle flap becomes actuated through a rotatable armature magnet **20**, which receives voltage from an electronic regulator **24**, through the interconnecting cable **26**.

The rotatable armature electromagnet **20** is shown without a housing, in FIG. **2**. This electromagnet consists essentially of a U-shaped core **31** which carries two coils or windings **34** on the poles or arms of the core. A rotatable armature **36** is rotatable in cooperation with the arms of the core. The core **31**, furthermore, is constructed of individual laminations assembled together and interconnected with each other through soldered joints. A welded joint can also be used for this purpose. Such soldered or welded joint is denoted by the reference numeral **32**. Two mounting holes **33** are provided for mounting the electromagnet to the gas applying housing **19**. The gas applying unit **19** may be in the form of, for example, the conventional carburetor. The arms of the core **31** have circular-shaped recesses on their inner surfaces for the purpose of accommodating the armature **36**. Directly above the circular recesses, the arms of the core **31** have further circular-shaped recesses **35**, and inclined surfaces **42** lie directly below the recesses within which the rotatable armature **36** is movable. The recesses **35** and the inclined surfaces **42** serve the purpose of reducing the stray magnetic flux. As may be seen from FIG. **3**, the core **31** is particularly well adapted for mass production. The core laminations **31**, lie directly against each other when they are stamped, and only very small waste pieces **39** are incurred.

FIG. **4** shows a circular armature **36*a*** which is rotatably mounted upon an axle **37** and is shown, in FIG. **4**, in a position corresponding to its maximum angular rotation. This armature has two wedged-shaped recesses **38*a***. The exterior surfaces of the armature, which face the core poles, have the form of spiral-shaped curves with linearly increasing radius.

FIG. **5** shows a segment armature **36*b***, also in its maximum possible angular position. The segment armature **36*b*** has straight-lined bordering side surfaces **41**, and circular-shaped bordering recesses **38*b***. The outer surfaces of the segment armature **36*b***, which face the core **31**, have the shape of spirals with linearly increasing radius.

FIG. **6** shows the circuit arrangement of the electronic speed regulator **24**. This circuit consists of a current supply stage **50**, a pulse shaping stage **60**, a monostable multivibrator **70**, a low pass filter **80**, a regulating or control signal generating stage **90** and a power amplifier **100**. A generator winding **49** has a center tap connected to the minus voltage supply line **56**. The other two end terminals of the winding **49** are connected respectively, through diodes **51** and **52**, with the positive voltage supply line **55**. For purposes of smoothing and filtering the DC voltage, a Zener diode **53** and capacitor **54** are connected across the positive voltage supply line **55** and the negative voltage supply line **56**. The capacitor **54** connected in parallel with the Zener diode **53**, is an electrolytic capacitor.

The pulse shaping stage **60** is connected to both end terminals of the generator winding **49**, through the two diodes **61** and **62**. The pulse shaping stage has a series circuit including a resistor **63**, a differentiating capacitor **65**, and a diode **67**. From the junction between the resistor **63** and the capacitor **65**, leads a resistor **64**. A diode **66** is connected between the negative voltage supply line **56** and the junction between the capacitor **65** and the diode **67**.

The monostable multivibrator **70** includes two transistors **71** and **72** having their emitters directly connected to the minus voltage supply line **56**. The collectors of these two transistors lead, through respective resistors **73** and **74**, to the positive voltage supply line **55**. The collector of the first transistor **71** is capacitively coupled, through a capacitor **75** to the base of the second transistor **72**. The collector of the second transistor **72** is galvanically connected, through a resistor **76**, with the base of the first transistor **71**. A resistor **77**, furthermore, is connected between the base of the first transistor **71** and the minus voltage supply line **56**. A resistor **78**, on the other hand, is connected between the base of the transistor **72** and the positive voltage supply line **55**.

The low pass filter **80** is in the form of a series circuit of two resistors **81** and **82**. An electrolytic capacitor **83** is connected between the negative voltage supply line **56**, and the junction between these two resistors **81** and **82**.

The regulating stage **90** includes, as its active component, an operational amplifier **91**. The negative input to the amplifier **91** is connected first to the output of the low pass filter **80**, secondly to a terminal **98**, and thirdly to an adjustable speed-selecting means, here a resistor **97**, which has one terminal of its winding connected to the negative voltage supply line **56**. The other or uninverted input to the operational amplifier **91**, corresponding to the positive input, is connected to the junction of two resistors **94** and **95** forming a voltage divider. The output of the operational amplifier **91** is connected, through a resistor **96** with the positive voltage supply line **55**. A series circuit, furthermore, including a capacitor **93** and adjustable resistor **92**, is connected between the output of the amplifier **91** and the negative or inverted input of the amplifier.

The power amplifier or electromagnetic control means **100** contains a modified Darlington circuit with a transistor **101** and a power transistor **102**. The emitters of the two transistors are each connected to one terminal of a resistor **104**. The coil **34** of the rotatable armature electromagnet **20**, is connected between the emitter of the power transistor **102**, and the negative voltage supply line **56**. The base of the transistor **101** is connected, through a resistor **103**, to the output of the regulating stage **90**.

FIG. **7** shows the circuit diagram of an error correcting stage which has its output connected to the terminal **98** of the regulating stage **90**. At the input of the error correcting state **110** is a current transformer **112**. The terminals **111** of the primary winding of this current transformer **112**, are connected to the output of an electrical generator which is driven by the internal combustion engine. The secondary winding of the current transformer **112** is connected across a trimming potentiometer **113**. A rectifying bridge of the Graetz design is connected between the sliding contact of the trimming potentiometer **113** and one terminal of the winding of this potentiometer. The positive output of the rectifying bridge **114** is connected to the negative voltage supply line **56**. The negative output of the rectifying bridge **114**, furthermore, is connected to an electrolytic capacitor **115**, which is connected parallel with a resistor **116**. The capacitor **115** and resistor **116** have each one terminal connected to the negative voltage supply line **56**. The negative output of the rectifying bridge **114**, moreover, is connected to a series circuit having a differentiating capacitor **117** and a resistor **118**. The terminal **98** is connected to the resistor **118**.

Since the speed regulating arrangement, in accordance with the present invention is also to be used in smaller internal combustion engines which do not possess a light generator, a separate generator winding **49** is required, which is held within the ignition generator **15**. In operation of the arrangement, in accordance with the present invention, the built-in magnetic ring and the ignition generator **15**, induces, through its rotation, a voltage within the ignition winding as well as in the auxiliary generator winding **49**. The ignition winding itself is not adapted to supply current for the speed regulating arrangement itself, because the form as well as the ignition instant of the ignition pulse would be influenced in a disadvantageous manner thereby.

The generator winding **49** supplies the voltage for the speed regulating arrangement, and at the same time, the control pulse for the monostable multivibrator **70**. The generator winding **49** is thereby constructed so that it has a relatively high internal impedance. At the same time, the generator winding will provide, when not under load, an alternating voltage exceeding 100 volts. The voltage increases within a few milliseconds, after passing through zero, to the level of approximately 15 volts, determined by the Zener diode **53**. In view of the high internal impedance of the generator winding **49**, no resistor is required in front of the Zener diode **53**. As a result of the steep voltage rise after passing through zero, the voltage on the positive line **55** drops to zero only for a small portion of the period, upon omission of the capacitor **54**. When using the capacitor **54**, at the same time, a smaller capacitance for this component can be used, in contrast with the conventional smoothing circuit which would require large capacitance values for this component. It has been found advantageous to connect the center tap of the generator winding with the negative voltage supply line **56**, and to actuate the monostable multivibrator **70** by the end terminals of this winding through respective diodes **61** and **62**. With this arrangement, it is possible to attain double the frequency of the input pulses, and the low pass filter **80** can, thereby be designed for a higher limiting frequency. At the same time, the regulating time constants of the speed regulating arrangement can be reduced.

The pulse shaping stage **60** has the task of differentiating the output pulses of the generator winding **49**, for the purpose of creating steeper control pulses or actuating pulses for the monostable multivibrator **70**.

The output pulses of the generator winding **49** are not of sinusoidal form, since the magnet for the ignition generator is designed so that the steepest possible pulses result in the ignition winding. The two diodes **66** and **67** provide for the feature that only positive control pulses are applied the monostable multivibrator circuit **70**. The negative pulses are short-circuited to the negative voltage supply line **56**. The resistors **63** and **64** form a voltage divider for the output pulses of the generator winding **49**.

A monostable multivibrator **70** produces, in the conventional manner, rectangular-shaped pulses of definite duration, from the output pulses of the generator winding **49**. The pulse repetition frequency of these rectangular-shaped pulses is equal to the frequency of the input pulses. The low pass filter **80** forms the time average of the output voltage of the monostable multivibrator **70**, and provides thereby at its output a DC voltage which has a level proportional to the pulse repetition frequency of the monostable multivibrator **70**.

At the output of the low pass filter **80**, therefore, is a DC voltage which is proportional to the rotational speed of the internal combustion engine. The regulating stage **90** has the task to compare this DC output voltage with an adjustable input voltage signal, and to increase the opening of the throttle flap with the aid of the rotatable armature magnet **20**, when the speed is below the desired input speed. The reverse situation takes place, and the throttle flap opening is reduced when the desired input speed is exceeded. For the purpose of applying the desired input speed, an adjustable resistor **97** is provided in accordance with the exemplary embodiment described above. This resistor **97** serves to load the output of the low pass filter **80**. The throttle flap is increased in its opening, when the output voltage of the operational amplifier **91** becomes more positive. The input voltage of the negative or inverted input of this amplifier must, therefore, be below the input voltage of the positive input or non-inverting input of the amplifier. The negative or inverting input of the amplifier is lower for a predetermined or given output actual speed, when the resistor **97** has a lower set resistance. Accordingly, it is possible to attain a higher desired speed by setting the resistor **97** to a lower resistance value. In another method for this arrangement, the desired input setting is carried out with the resistor **97** omitted. In place of the resistors **94** and **95** furthermore, a potentiometer is provided. The desired input value can then be applied through the voltage on the non-inverting input or positive input of the amplifier.

Through the use of the resistor **92** and the capacitor **93**, the operational amplifier **91** is in the form of a regulator which has a regulating characteristic determined through the resistor **92**, and which has a proportional component of response. When the speed of the internal combustion engine increases and the output voltage of the low pass filter also increases thereby, then the throttle flap closes for as long as the desired input value is not changed. The capacitor **93** however, also serves to apply an integral component for the regulating characteristics, whereby variations in the speed are integrated and delayed before applying to the power amplifier **100**. With this arrangement, overshoot of the speed is considerably reduced or avoided. In addition, it is possible to fully smooth out or compensate against speed variations resulting from load changes, in contrast to the action obtainable from centrifugal regulators.

In the regulating arrangement in accordance with the present invention, therefore, a DC voltage which is proportional to the speed of the engine is applied to the inverting input of a regulating amplifier which has its output voltage applied directly, without further inversion, to the coil **34** of the electromagnet with rotatable armature. In view of the proportional section of the regulating arrangement, the latter operates more rapidly than the conventional mechanical centrifugal regulators. When the engine is used for driving an electrical generator as in case of emergency situations, for example, it is desirable to have rapid response of the regulating circuit relative to variations of the load. This feature can be attained with the aid of the arrangement of FIG. 7, through the use of an error correcting stage adapted to alternating current generators. The current converter **112** provides a DC voltage having a magnitude proportional to the intensity of the current in the primary winding. This DC voltage is supplied through the rectifying bridge **114** and filter **115, 116,** to the capacitor. When the current intensity varies rapidly in the positive direction, then the differentiating capacitor **117** transmits a negative voltage pulse to the terminal **98,** and thereby to the inverting input of the operational amplifier **91.** As a result, the throttle flap is rapidly increased in opening, through the coil **34.** With the use of three phase generators, it is possible to introduce a separate correction into each phase, and to sum the voltage pulses at the terminal **98.**

When the internal combustion engine is used for driving a DC generator, it is possible to save or omit the rectifying bridge **114,** and the filter **115,116.** This results from the condition that the current converter **112** is then self-differentiated and provides an output only upon variation of the current.

The functional operation of the rotatable armature shown in FIGS. **2** to **5,** is based on the condition that the width of the air gap between the rotatable armature and the core is dependent upon the angle of rotation, or the position of the rotatable armature. Another condition is that the outer border or surface of the rotatable armature is not of circular shape, but is instead of spiral shape. For actuating a throttle flap, it is essential that the rotatable armature provides a constant torque over a relatively large rotational angle, as approximately 90°, at constant magnetic field intensity, for resetting the rotatable armature a spring with linear spring characteristics is used, and as a result a linear increase in the rotational angle is achieved as a function of control current. The torque is to maintain its maximum value of its entire rotatable or positionable region of the armature. In order to attain a steep rise of torque characteristics upon rotation of the armature, the stray magnetic flux must be retained as small as possible. For this purpose, the recesses **38***a* in the circular armature **38***b* in the segment armature as well as the recesses **35** and **42** of the core cooperate with the respective recesses as may be seen in FIG. **2.** The circular armature in accordance with FIG. **4,** has, for example, a maximum rotational angle of 120° for a core width of 60°. By further reducing the core width, even larger rotational angles are possible. The segment armature of FIG. **5,** thereby makes it possible that a rotational angle of 90° is realized for a core width which is also 90°. The advantage of the segment armature resides in the condition that for equal magnetic field intensity, the torque is greater. The advantage of a segment armature is also based on the condition that in view of the straight lined surfaces **41** the initial torque rises rapidly at smaller rotational angles, than in the circular armature. In general, threfore, the segment armature is better adapted for rotational angles up to 90°.

As described in the foregoing, all requirements are fulfilled through the combination of the circuit of FIG. **6** in conjunction with the rotational armature illustrated in FIGS. **2** to **5.** Regulation of the speed of an internal combustion engine is made possible, in accordance with the present invention through essentially more rapid response than is possible with conventional mechanical centrifugal regulators. Furthermore, the present invention provides a significantly greater regulating precision than the conventional devices. The failure rate in operation of the present invention is also less than in conventional devices, since mechanical centrifugal regulators have an essentially higher frictional effect than is applicable to the corresponding electronic arrangement.

When the internal combustion engine has a light generator and an arrangement for battery ignition, or when the engine is used for driving an alternating current generator, the input circuitry of the electronic speed regulator **24** is modified accordingly: no generator winding **49** for producing a supply voltage is then required. The supply voltage can, instead be more directly obtained from the light generator or from the output of the alternating current generator. Under these conditions, it is also no longer necessary to provide the generator winding **49** as a pulse generator. The input pulses for the monostable multivibrator **70** can, in this case, be obtained through a switching contact in the ignition arrangement for the engine. The output voltage from the alternating current generator driven by the engine can also be just as well coupled to the pulse shaping stage **60,** through the diodes **61** and **62.**

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of speed regulators for internal combustion engines, differing from the types described above.

While the invention has been illustrated and described as embodied in speed regulators for internal combustion engines, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

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 claims.

We claim:

1. An arrangement for regulating the speed of an internal combustion engine having a throttle valve, comprising, in combination, speed-selecting means for selecting a speed for the engine; speed-monitoring means for determining the actual speed of the engine; control-signal generating means provided with input means connected to both said speed-selecting means and said speed-monitoring means and having an output, and operative for generating at said output a control signal comprised of a first signal component proportional to the difference between the selected speed and the actual speed and a second signal component proportional to the time integral of said difference; and electromagnetic control means coupled to said throttle valve and having a control input connected to the output of said control-signal generating means for receiving said control signal and operative for controlling the position of said throttle valve in dependence upon said control signal wherein both said speed-selecting means and said speed-monitoring means have an electrical output, and wherein said control-signal generating means comprises an operational amplifier provided with input means connected to the electrical output of said speed-selecting means and of said speed-monitoring means, and wherein said operational amplifier has an output connected to said control input for applying the output signal of said operational amplifier to said control input, and wherein said operational amplifier further includes a feedback network connected between the output of said operational amplifier and said input means thereof, said feedback network comprising a resistor and a capacitor connected in series so as to establish a proportional-plus-integral transfer function for said operational amplifier.

2. An arrangement for regulating the speed of an internal combustion engine having a throttle valve, comprising, in combination, speed-selecting means for selecting a speed for the engine; speed-monitoring means for determining the actual speed of the engine; control-signal generating means provided with input means connected to both said speed-selecting means and said speed-monitoring means and having an output, and operative for generating at said output a control signal comprised of a first signal component proportional to the difference between the selected speed and the actual speed and a second signal component proportional to the time integral of said difference; and electromagnetic control means coupled to said throttle valve and having a control input connected to the output of said control-signal generating means for receiving said control signal and operative for controlling the position of said throttle valve in dependence upon said control signal; and further comprising additional means connected to said control input and connectable to an electrical generator driven by the engine and operative for applying to said control input an electrical signal in response to a change in the output of such electrical generator for causing said control means to vary the position of said throttle valve in a direction counteracting such change.

3. An arrangement as defined in claim 1, wherein said speed-monitoring means comprises pulse generating means synchronized with engine rotation and operative for generating a train of pulses whose pulse-repetition frequency is proportional to engine speed, and means for converting said train of pulses into a steady-value D.C. voltage proportional to engine speed.

4. An arrangement as defined in claim 3, wherein said means for converting comprises a monostable multi-vibrator having an input connected to said pulse-generating means and operative for generating in response to each of said pulses a pulse of predetermined duration, and low-pass filter means connected to said monostable multi-vibrator to receive said pulses of predetermined duration and operative for generating said steady-value D.C. voltage proportional to engine speed.

5. An arrangement as defined in claim 1 wherein said control-signal generating means comprises means for generating a continuously variable control signal whose value varies continuously in response to changes in said difference.

6. An arrangement as defined in claim 1, wherein said control-signal generating means comprises means for generating a control signal composed of a first signal component proportional to the difference between the selected speed and the actual speed and a second signal component proportional to the time integral of said difference.

7. An arrangement as defined in claim 3, said engine including an ignition arrangement of the type including a rotating magnet arrangement synchronized with engine rotation, and wherein said pulse-generating means comprises a winding so located with respect to said magnet arrangement that rotation of said magnet arrangement induces voltage pulses in said winding.

8. An arrangement as defined in claim 3, said engine including an ignition arrangement of the type including an interruptor switch synchronized with engine rotation, said interruptor switch constituting said pulse-generating means.

9. An arrangement as defined in claim 3, wherein said pulse-generating means comprises an A.C. current generator mechanically coupled to the engine so as to be driven in synchronism with engine rotation.

10. An arrangement as defined in claim 3, wherein said control means includes an electromagnet so coupled to said throttle valve as to vary the position of said throttle valve in dependence upon the extent of energization of said electromagnet, and a power amplifier having an output connected to said electromagnet to furnish energizing current to the latter and having an input constituting said control input and connected to said output of said operational amplifier.

11. An arrangement as defined in claim 4, wherein said speed-monitoring means further includes pulse-shaping means connected between the output of said pulse-generating means and the input of said monostable multivibrator.

12. An arrangement as defined in claim 11, wherein said pulse-shaping means comprises differentiating capacitor means operative for differentiating said train of pulses and applying the resulting pulses to said input of said monostable multivibrator.

13. An arrangement as defined in claim 2, wherein said additional means comprises a current transformer having a secondary winding connected to said control input and having a primary winding connectable in the current path of such electrical generator.

14. An arrangement as defined in claim 3, wherein said pulse-generating means comprises winding means and means for generating voltage pulses across said winding means in synchronism with engine rotation, and means connecting said winding means to said operational amplifier for applying to the latter biasing voltage derived from the voltages generated across said winding means.

15. An arrangement as defined in claim 14, and further including a Zener diode connected across said winding means and also a capacitor connected across said winding means, for smoothing the biasing voltage applied to said operational amplifier.

* * * * *