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[54] **SPEED LIMITING IGNITION SYSTEM**
22 Claims, 2 Drawing Figs.

[52] U.S. Cl. 123/102, 123/148
[51] Int. Cl. F02d 11/10
[50] Field of Search .... 123/148, 148(E), 102; 315/209, 209(CD)

[56] **References Cited**

UNITED STATES PATENTS

3,182,648 5/1965 Scheider et al. .... 123/148(E)UX
3,329,867 7/1967 Stearns .... 123/148(E)UX

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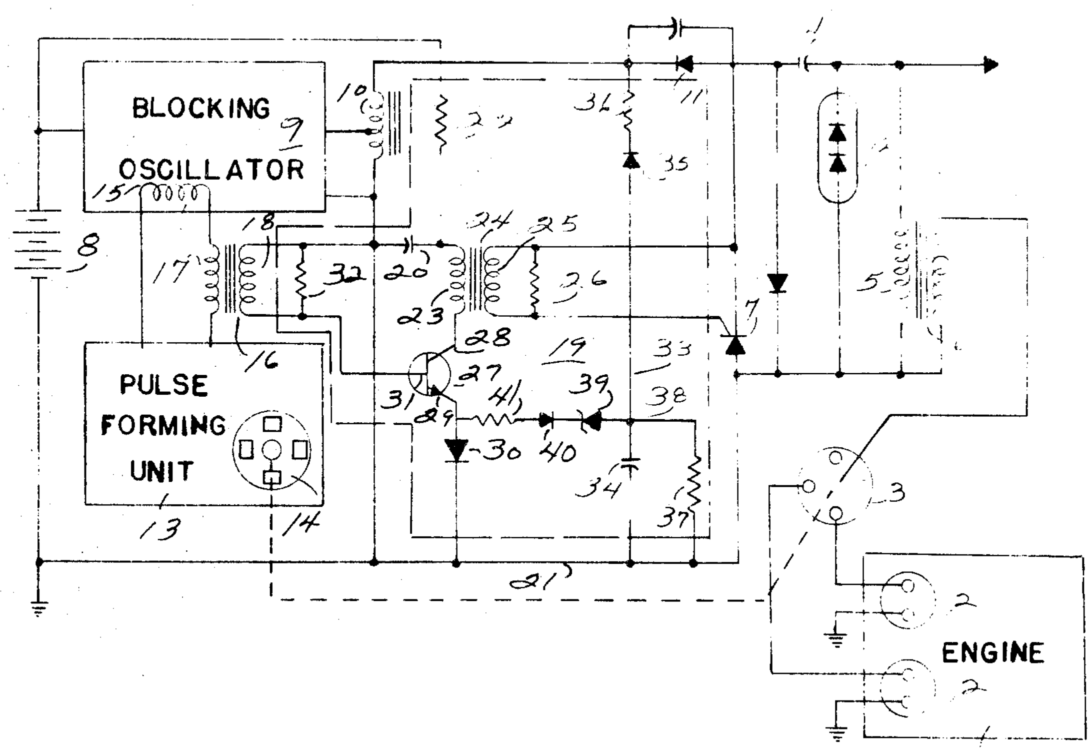
ABSTRACT: This disclosure relates to a capacitor discharge ignition system having a regulated and triggered blocking oscillator charging a capacitor which is discharged through a pulse transformer in series with a silicon controlled rectifier. A trigger capacitor is connected to the battery for charging and interconnected to the gate in a series with a pulse transformer and a common emitter connected transistor. A pulse-forming unit is connected to bias the transistor or in timed relation to the engine. A capacitor in series with a resistor and diode is connected across the output of the blocking oscillator and provides a speed related voltage applied to the transistor through a Zener diode bias the transistor to conduct as common base connected transistor to prevent charging of the trigger capacitor.



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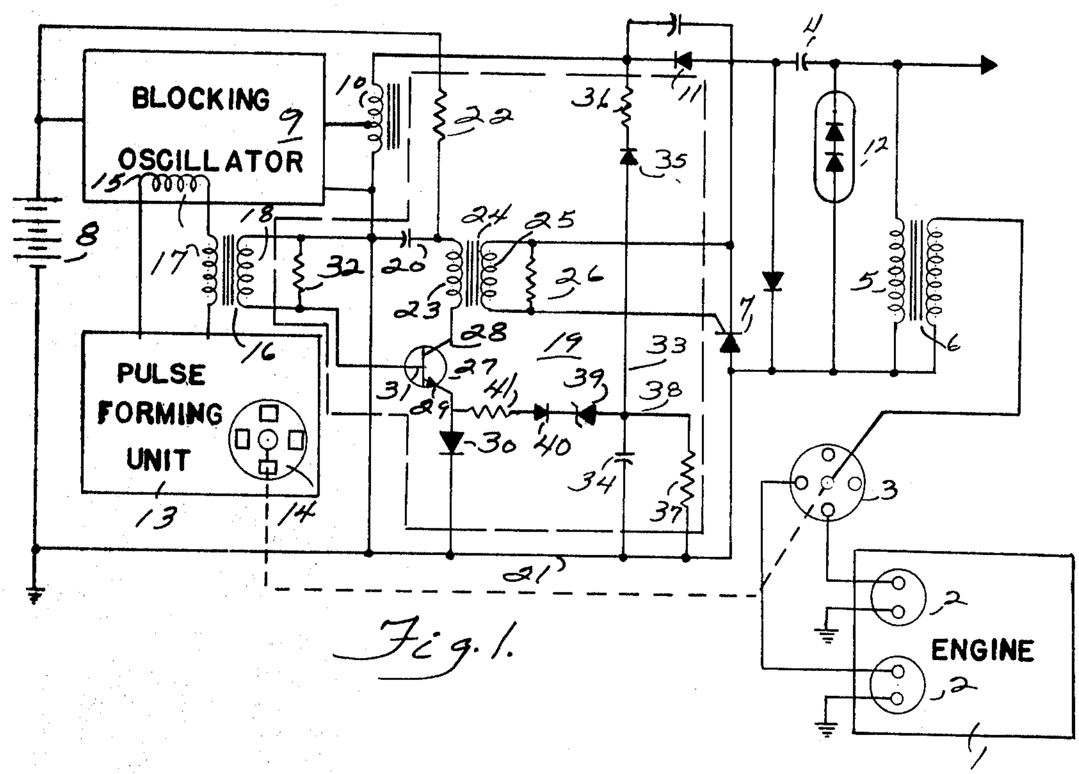

Fig. 1.

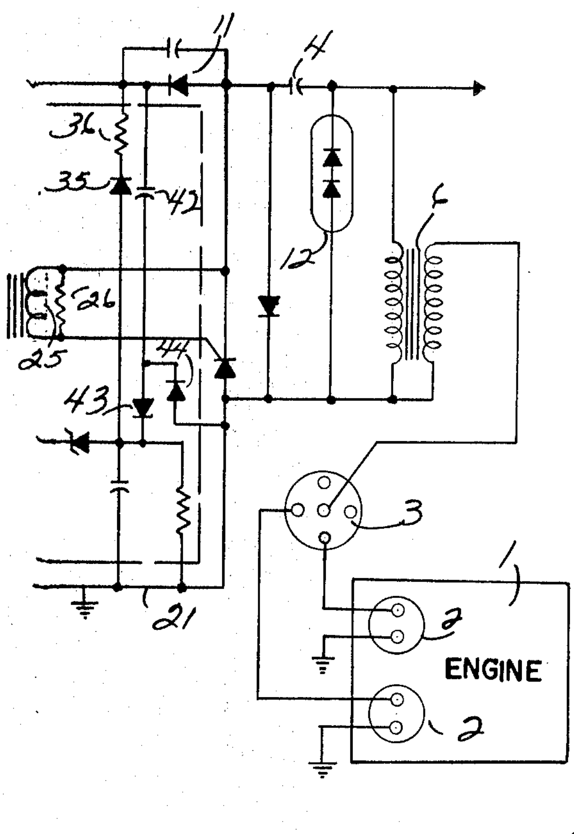

Fig. 2.

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SPEED LIMITING IGNITION SYSTEM

This invention relates to a speed-limiting ignition system and particularly to an ignition system including means to reliably prevent applying ignition power above a selected speed.

Internal combustion engines and the like may advantageously include a governor means to prevent the engine from operating at an excessive speed. Racing outboard motors may often have the propeller momentarily raised completely out of the water. The reduced load tends to permit the engine to race or operate at excessive speeds. In this and other applications, there is a need for a reliable and relatively simple speed-limiting control.

Outboard motors, as well as other internal combustion engines, can advantageously be energized from a capacitor discharge ignition system. For example, applicant's copending application entitled "Pulse Forming Circuit and Capacitor Discharge Ignition Systems Therewith" which was filed on Nov. 3, 1966 with Ser. No. 591,835 provides an unusually satisfactory and reliable capacitor ignition system for internal combustion engines. In that system, a triggered blocking oscillator is interconnected between the battery and a main firing capacitor. The triggered blocking oscillator is periodically turned on by a separate pulse-forming unit and charges the capacitor to a preselected voltage. The capacitor is connected in a discharge circuit including a silicon controlled rectifier and a pulse transformer which is connected through the distributor to the spark plugs. The silicon controlled rectifier has its gate circuit interconnected to the pulse-forming unit which simultaneously turns on the oscillator to initiate a charging cycle and triggers or fires the controlled rectifier to discharge the previously charged capacitor.

The present invention is particularly directed to an improved ignition system having means responsive to the engine speed to control the timed triggering of an output circuit and in a particularly novel aspect of this invention the charged state of a capacitor in the ignition system or the like.

In accordance with a highly satisfactory system, a speed-indicating circuit is connected to the charging circuit for a firing capacitor and provides a speed-responsive voltage signal. The speed-indicating circuit is interconnected to control a switching means in the capacitor-discharging circuit to prevent discharging of the capacitor at a selected speed. As applied to a capacitor discharge ignition system having a separate pulse-forming means for actuating the switching means such as a controlled rectifier, a trigger capacitor is inserted between the pulse-forming unit and the gate circuit of the controlled rectifier. The trigger capacitor is interconnected to the gate circuit in series with a pulse transformer and a control-amplifying element or unit which functions as a control-switching means. The pulse-forming unit is interconnected to provide a first control of the amplifying unit and thereby control the discharging of the trigger capacitor. A speed-indicating circuit which preferably includes a capacitor-resistor network connected across the output of the main blocking oscillator provides a voltage signal which increases with speed. This voltage is applied to the amplifying device and above a selected level operates it in an alternate mode or manner to prevent the charging of the trigger capacitor. Consequently, when the pulse-forming unit provides a turn-on signal, the amplifying unit has already been turned on and no transfer pulse is applied to the controlled rectifier. The amplifying unit is adapted to respond to a signal from the pulse-forming unit and, in the alternative, to the selected signal from the speed-indicating circuit or network.

Applicant has found that an unusually satisfactory circuit includes the connection of the trigger capacitor directly to the battery in series with a suitable charging resistor. The trigger capacitor is connected in series with the primary of a pulse transformer and the collector-emitter circuit of a transistor which is connected in a common emitter configuration to the pulse-forming unit. In addition, the negative side of the capacitor of the speed-indicating network is interconnected to the emitter of the transistor through a voltage breakdown means such as a Zener diode. When the voltage on the capacitor rises to the Zener voltage, a negative voltage is applied directly to the emitter of the transistor and continuously biases it to operate in the common base operating mode. This prevents the charging of the trigger capacitor and prevents triggering and discharging of the main firing capacitor.

As applied to an ignition circuit having a regulated power supply of the previously referred to copending application, the charging of the speed-indicating capacitor may increase slightly with the cutoff of the ignition system. Consequently, the engine speed must drop below the cutoff speed level before the ignition system is reset to again provide firing pulses to the engine. If this action is not desired, it can be eliminated by proper selection of components and/or the addition of a special capacitor bypass circuit connected in parallel with the speed-indicating network.

The invention can be applied to any system employing a triggered switch means and in particular employing a capacitor discharge system wherein energy is stored and subsequently discharged for firing of the engine.

The drawing furnished herewith illustrates the best mode presently contemplated by the inventor for carrying out the subject invention and clearly discloses the above advantages and features as well as others which are set forth in connection with the description of the drawing.

In the drawing:

FIG. 1 is a schematic circuit diagram of a capacitor discharge ignition system employing a speed-limiting circuit constructed in accordance with the present invention; and

FIG. 2 is a fragmentary schematic circuit diagram illustrating a modification to the circuit shown in FIG. 1.

Referring to the drawing and particularly to FIG. 1, the present invention is illustrated as applied to a battery driven capacitor discharge ignition system for energizing of a four-cylinder engine **1** having spark plugs **2**, of which only a pair is shown, for each cylinder. A distributor **3** sequentially interconnects the several spark plugs **2** to the output circuit of a main firing capacitor **4**. The capacitor **4** is connected in series with the primary **5** of an output transformer **6** and a silicon controlled rectifier **7** for discharging of the capacitor **4** and the firing of spark plugs **2**. A battery **8** is interconnected to charge the capacitor **4** through a blocking oscillator **9**, which is preferably constructed as a triggered and regulated oscillator in accordance with the teaching of applicant's previously referred-to application. The oscillator **9** includes an output transformer **10** in which energy is stored and then transferred to the capacitor **4**.

The charging or transfer circuit for the capacitor **4** includes a blocking and rectifying diode **11** connected between the one side of transformer **10** and the one side of capacitor **4**. The opposite side of the capacitor **4** is connected to the opposite side of the transformer in series with a Stabister **12** which is connected in parallel with primary winding **5** as shown in applicant's U.S. Pat. No. 3,369,151.

The control rectifier has a gate to cathode input with a pulse-forming unit **13** interconnected thereto for controlled firing of the rectifier. Generally, this unit **13** is similar to that disclosed in applicant's copending application and includes a control oscillator not shown which is turned on and off in response to the position of a rotatable nonmagnetic metal vane **14** which in turn is interconnected to and driven in synchronism with the distributor **3**.

The output of the pulse-forming unit **13** includes a pair of output transformers **15** and **16** having their primary windings **17** connected in series. Transformer **15** controls the blocking oscillator **9**. Transformer **16** has its secondary winding **18** interconnected to control the pulsing of the control rectifier **7** through a special trigger pulse-control signal circuit **19**.

Generally, under normal speed operating conditions, the pulse-forming unit **13** simultaneously triggers the blocking oscillator to initiate a capacitor charging cycle and triggers the control rectifier **7** to discharge the previously stored energy of the main firing capacitor **4**. If the speed increases to a selected level, however, the signal circuit **19** prevents the effective transfer of the pulse from the pulse-forming unit **13** to fire rectifier **7**.

The illustrated control signal circuit **19** includes a trigger capacitor **20**, one side of which is connected to a common reference potential line, shown as a ground line **21**, which is connected to the ground side of the battery **8**. A coupling or charging resistor **22** interconnects the opposite side of capacitor **20** to the corresponding positive terminal of the battery. The capacitor **20** is charged to essentially battery voltage.

The triggered capacitor **20** is connected in a discharging circuit including the primary winding **23** of a pulse transformer **24**.

The secondary winding **25** of the pulse transformer **24** is connected across the gate to cathode circuit of the control rectifier **7** in parallel with a resistor **26**, which may or may not be employed.

The pulse transformer **24** has the opposite end of the primary winding **23** connected by a transistor **27** and diode **30** to ground line **21**. The transistor **27** is connected in a common emitter configuration to the capacitor **20** which provides the collector voltage and the pulse-forming unit **13** which provides a turn-on signal. Thus, the collector **28** is connected to the primary winding **23** and the emitter **29** is connected to ground in series with a diode **30**. The base **31** is connected to the one side of the secondary winding **18** of the pulse-forming unit transformer **15**, the opposite side of which is connected to the common ground line **21**. A resistor **32** may be connected across the input circuit of the transistor **27** and in parallel with the secondary winding **18**.

Generally, the resistor **26** across the gate of the cathode circuit of the control rectifier **7** and the resistor **32** may tend to reduce the sensitivity of the control rectifier and the transistor and maintain stability of operation. They are not however essential to the satisfactory operation of a circuit.

In operation, a pulse signal is periodically applied by the pulse-forming unit **13** across the base-emitter junction of the transistor **27**. The transistor **27** switches rapidly on and discharges the trigger capacitor **20** though transformer **24** and thereby fires controlled rectifier **7**.

The output of pulse of the transformer **16** may be amplified by the transistor **27**. As the output of pulse-forming unit **13** is normally sufficient to drive the rectifier **7**, the current transformer **16** may therefore be of a stepdown construction. For example, applicant has satisfactorily employed a transformer **16** having a **7** turn primary and a **70** turn secondary. Further, it should be noted that the transistor **27** is primarily functioning as a switch means to permit rapid discharging of the capacitor **20** and not primarily being used as an amplifying device.

The above described circuitry provides the normal firing of the ignition system.

In accordance with the illustrated embodiment of the present invention, a speed-indicating branch or network **33** is connected to selectively prevent charging of the trigger capacitor **20**. The branch **33** includes a capacitor **34** having one side connected to ground line **21** and thus to one side of transformer **10**. The opposite side of the capacitor **34** is connected in series with a diode **35** and a resistor **36** to the opposite side of the secondary winding of transformer **10**. A resistor **37** is also connected parallel with the capacitor **34**. The capacitor **34** and the series resistor **36** is an integrating network having the positive side of capacitor **34** connected to the line **21** and the negative side to junction **38**. The voltage appearing across the capacitor **34** and parallel load resistor **37** increases linearly with the speed of the engines to provide a speed-responsive voltage at junction **38**. The linearity of response is not required however, and a nonlinearly speed indicating circuit can be employed.

In the illustrated embodiment of the invention, the speed-indicating network or branch **33** is connected directly across the secondary of the blocking oscillator-transformer **10** rather than the primary thereof because of the power requirements of the system.

The negative side of the speed-indicating capacitor is connected in series with a reversed biased Zener diode **39**, a forward biased blocking diode **40** and a resistor **41** to the emitter of the transistor **27**. The Zener diode **39** normally blocks the speed-indicating capacitor voltage from the transistor circuit.

When the voltage at junction **38** however reaches the Zener voltage, diode **39** will conduct and apply the negative voltage of the capacitor **34** to the transistor emitter **29**. The application of the negative voltage back biases the diode **30** in the emitter circuit and operates the transistor **27** in a common base configuration.

The biasing of the transistor **27** to conduct provides a low impedance path through the charging resistor **22**, the primary winding **23** of the pulse transformer **24**, the transistor **27** operating in the common base configuration thereby bypassing or shunting charging current from the trigger capacitor **20**. The transistor **27** thus conducts continuously and prevents the charging of the trigger capacitor **20** to a level sufficient to establish a triggering or firing pulse.

The pulse-forming unit **13** will continue to trigger the blocking oscillator **9** to provide output power. This will maintain the charge on the speed-indicating capacitor **34** as long as the repetition rate corresponds to a speed above cutoff. The voltage will therefore be maintained as long as the engine is above the cutoff speed and, in fact, the operation of the illustrated circuit may require that the speed drop below the cutoff speed before the voltage drops below the Zener voltage, as subsequently discussed.

The illustrated resistor **41** and blocking diode **40** are primarily employed as compensating elements. The use of a forward biased diode **40** in series with a Zener diode **39** is a conventional temperature-compensating means.

The resistor **41** in the circuit of the diode **39** constitutes a means to compensate for slight variations for changes in the output of the converter or oscillator **9** with changes in the battery voltage. The main blocking oscillator **9** preferably provides a regulated output. However, it is not perfectly regulated and the output will tend to increase slightly with increased input battery voltage. This increased output voltage is applied to the speed-indicating capacitor **34**. An increased battery voltage, however, also results in an increased current through charging resistor **22** for the trigger capacitor **20**. This current, however, is also bled off or shunted by the transistor **27** when preventing charging of the capacitor **20**. Further, this bypass current flows through the resistor **41** and produces a corresponding voltage drop which is a percentage of the input voltage. The voltage drop in the reference branch including the Zener diode **39**, diode **40** and resistor **41** therefore increases at the same rate as the voltage across the capacitor **34**. This in essence results in a cutoff speed which is effectively insensitive to variations in input voltage. For example, in an actual construction the cutoff speed was set at 6,000 r.p.m. and applicant found that there was a variation of less than 40 r.p.m. with a variation in the input voltage between 10 and 20 volts.

Therefore, in summary, a control voltage is produced across capacitor **34**. When this control voltage exceeds the voltage of a reference branch a voltage is applied to the transistor **27** in the illustrated embodiment of the invention at a selected speed to bias the transistor to bypass the charging of the triggered capacitor **20** and thereby prevents the firing of control rectifier **7** and discharging of the main firing capacitor **4**.

A voltage on the capacitor **34** is assumed to always correspond to a given engine speed. However, this is only completely true with the output voltage across the capacitor **34** small compared to the total input voltage which appears across the winding **10**. This is not necessarily the case in the illustrated embodiment of the invention. The output voltage from the blocking oscillator **9** under normal operation of the ignition system may be approximately 140 volts peak. This voltage will rise when the control rectifier **7** is not firing. The actual peak voltage may rise to above 200 volts. The time integral of the secondary voltage, however, does not change.

The increased peak voltage therefore is more fully integrated by resistor **36** and capacitor **34** slightly raising the voltage of capacitor **34** when SCR7 ceases to fire. Therefore, the speed of the engine will have to drop slightly below the cutoff speed before the pulsing or trigger is reset. Typically, this may be in the order of 200 r.p.m. This creates a dead band portion which will prevent the intermittent firing of different cylinders with a resulting rough running of the engine.

The parallel resistor **37** is employed to control the cutoff speed rather than the Zener diode **39** or other components because it does not effect the voltage or temperature compensating effect as will changing the diode **39** and/or the resistor **36**.

The blocking oscillator **9** or some other means may be provided to dissipate energy of the triggered blocking oscillator if the output voltage rises above a maximum level. For example, applicant's previously referred to copending application provides a highly satisfactory controlled circuit wherein the energy is dissipated through the blocking oscillator circuit.

As previously noted, the embodiment of the invention illustrated in FIG. **1** may include a dead band characteristic. If this characteristic is considered undesirable or it is desired to accentuate it, a modification of the speed-indicating circuit as shown in FIG. **2** may be employed wherein elements corresponding to FIG. **1** are similarly numbered for purposes of simplicity and clarity of explanation.

In the embodiment shown in FIG. **2**, a relatively small capacitor **42** has its one side connected to the cathode of the main blocking diode **11**. A diode **43** is connected between the capacitor **42** and the negative side of the capacitor **34**. The diode **43** is biased in the opposite direction from that of the diode **35** of the speed-indicating circuit branch **33**. A further diode **44** is connected between the junction of the compensating capacitor and the diode **43** and the ground line **21**.

The capacitor **42** and diodes **43** and **44** are selected to respond to the peak output voltage characteristic of the oscillator. As previously noted, when the controlled rectifier **7** is not fired, the peak output voltage of oscillator **9** increases. The capacitor **42** is charged through diode **44** during the charging portion and discharges during the opposite portion of a cycle of the oscillator and provides a voltage signal sensitive to the peak voltage. This voltage, in the illustrated embodiment, effectively reduces the voltage of the capacitor **34** which is applied through the voltage sensitive branch to the transistor **27** and particularly across diode **30** to cut off the ignition pulses as previously described. If desired, the compensating capacitor **42** can be converted to increase the cutoff voltage signal and thereby widen the dead band speed difference by reversing the diodes **43** and **44**.

The present invention thus provides a reliable governor means which can be readily incorporated into a capacitor discharge ignition system.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. An ignition system for an internal combustion engine or similar device and having a power source means, switching means connecting said power source means to said engine and operable periodically for supplying power pulses from said power source means to the engine, said switching means including input circuit means controlling the turn-on and turn-off of said switching means and thereby establishing of said power pulses, the improvement in said ignition system to limit the engine to a preselected maximum firing rate comprising a pulse speed-responsive means having an averaging means for successive pulse signals and generating an electrical signal as a function of the frequency of such succeeding pulse signals, means to generate said pulse signals as a function of the engine speed, and control means connecting said last named means to said input circuit means to prevent said turn-on and turn-off of said switching means in response to a selected signal related to said preselected excessive engine speeds and during the period said speed is in excess of said preselected maximum firing rate.

2. The ignition system of claim **1** wherein said switching means is a triggered switching means having a turn-on gate and said power source means includes a firing capacitor connected in series with said triggered switching means, and said control means connects said speed responsive means to the gate of said triggered switching means to prevent actuation of said switching means and discharge of the firing capacitor.

3. The ignition system of claim **1** wherein said input circuit means includes a trigger capacitor means connected to the power source means, said trigger capacitor being charged and discharged to actuate the switching means, a second switching means connecting said capacitor means to actuate the first switching means, and said control means is connected with said second switching means to prevent charging and discharging of said trigger capacitor means.

4. The ignition system of claim **1** wherein said input circuit means includes a trigger capacitor means connected to the power source means, a second switching means connected in series with said capacitor means to actuate the first switching means each time the capacitor means is discharged, and said control means is connected with said second switching means to prevent charging of said trigger capacitor.

5. The ignition system of claim **1** wherein said input circuit means includes a trigger capacitor means connected to the power source means, an amplifying means connecting said trigger capacitor means in a discharge circuit including the input circuit of said switching means, a first pulse-generating means actuated in synchronism with the engine and connected to actuate said amplifying means to discharge the capacitor means, said speed responsive means establishing a voltage signal related to the engine speed, and said control means connecting said speed-responsive means to said amplifying means and including voltage-sensitive means to apply said voltage signal at a preselected amplitude.

6. The ignition system of claim **1** wherein said input circuit means includes a trigger capacitor connected to the power source means, a transistor having a collector connected in series with said trigger capacitor to a reference potential means and having an emitter and a base, a forward biased rectifying means connected between the emitter and the reference potential means, a pulse-generating means connected between the base and the reference potential means, and said speed-responsive means establishing a voltage signal proportional to speed, and said control means includes a voltage-sensitive means connecting said speed-responsive means across said rectifying means to back-bias said rectifying means at a selected voltage signal and bias said transistor to conduct continuously.

7. The ignition system of claim **1** wherein said input circuit means includes a trigger capacitor, a first pulse transformer having a primary winding and a secondary winding, said secondary winding being connected to said input circuit means of said switch means, a transistor having a collector connected in series with said trigger capacitor and said primary winding to a reference potential means and having an emitter and a base, a diode means connected between the emitter and the reference potential means, a pulse-generating means connected between the base and the reference potential to operate said transistor as a common emitter-connected transistor, said speed-responsive means establishing a voltage signal proportional to speed and said control means connecting said speed-responsive means across said diode means to back-bias said diode means and operate said transistor as a common base connected transistor.

8. The ignition system of claim **1** wherein said input circuit means includes a trigger capacitor, a first pulse transformer having a primary winding and a secondary winding, said secondary winding being connected to said input circuit of said switch means, a transitor having a collector connected in series with said trigger capacitor and said primary winding to a reference potential means and having an emitter and a base, a

diode connected between the emitter and the reference potential means, a pulse-generating means, a second pulse transformer having a secondary winding connected between the base and the reference potential means, said speed-responsive means including a speed-indicating capacitor in series with a diode and a resistor and connected to the ignition system to be periodically charged in proportion to the engine speed, and said control means including a voltage breakdown diode means connected between said emitter and said speed-indicating capacitor to selectively impress the capacitor voltage on said emitter.

9. The discharge ignition system of claim **1** having a battery input and a triggered convertor, a main firing capacitor connected to the triggered convertor, said switching means connecting said firing capacitor to operate the engine, said input circuit means including a trigger capacitor connected to said battery input, a pulse transformer having a primary winding and a secondary winding connected to operate the switching means, an amplifier switch means connecting said primary winding to said trigger capacitor, a pulse-forming unit connected to drive said amplifier switch means for controlled discharge of the trigger capacitor, said speed-responsive means including a speed-indicating capacitor in series with a rectifying means and an impedance means and connected across the output of said convertor to establish a speed-related voltage across said capacitor, and said control means including a voltage-sensitive means connected between said speed-indicating capacitor and an amplifier switch means to continuously actuate the amplifier switch means in response to a selected speed-related voltage.

10. The discharge ignition system of claim **9** wherein said speed indicating capacitor is charged to a greater voltage with the cutoff of said switching means and thereby increases the voltage applied to said amplifier switch means whereby said engine speed must drop below said cutoff speed to reset said voltage-sensitive means.

11. In a capacitor discharge ignition system having a main firing capacitor connected to a triggered converter including a battery and to an output pulse transformer in series with a triggered switch means, wherein the improvement comprises a trigger capacitor connected to said battery, a pulse transformer having a primary winding and a secondary winding connected to the triggered switch means, a transistor having a base, an emitter and a collector, said capacitor being connected in series with the pulse transformer to said collector, a diode connected between said emitter and a reference potential means, a pulse-forming unit, a transformer connecting the pulse-forming unit to the base of the transistor for controlling the conduction of the said transistor, a speed-responsive circuit including a speed-indicating capacitor in series with a diode and a resistor and connected across the output of said converter, a resistor connected in parallel with said speed-indicating capacitor, and a voltage-sensitive means connected between the negative side of said capacitor and the emitter of the transistor to selectively apply a negative potential to the emitter, operate said transistor in a common base configuration and prevent charging of said trigger capacitor.

12. The capacitor discharge ignition system of claim **11** wherein said convertor is a triggered blocking oscillator having means to establish a regulated output and having an oscillator output transformer, a diode connecting said firing capacitor across said output transformer, said triggered switch means being a control rectifier having a gate element, said speed-responsive circuit being connected across said oscillator output transformer, said oscillator establishing an increased voltage output in response to actuation of the transistor from said speed-indicating circuit, and said speed-indicating capacitor being correspondingly charged to a greater voltage with said cutoff and thereby increasing the voltage applied to said emitter whereby said engine speed must drop below said cutoff speed to reset said voltage-sensitive means.

13. The capacitor discharge ignition system of claim **12** having a compensating capacitor and a full wave rectifying means connected across said speed-indicating circuit to control the amount said speed must drop to reset the voltage sensitive means.

14. The capacitor discharge ignition system of claim **12** having a pair of paralleled, oppositely polarized diodes, a compensating capacitor connected in series with said diodes across said speed-indicating circuit to control the amount said speed must drop to reset the voltage sensitive means.

15. The ignition system of claim **1** wherein said input circuit means includes a trigger capacitor connected to said power source means, a pulse transformer connected to said switching means, a transistor connected in a common emitter circuit with said trigger capacitor and said pulse transformer, a pulse-forming unit operated in synchronism with the engine and connected to said transistor to periodically and selectively discharge said trigger capacitor, and said control means includes means connecting said speed-responsive means to said transistor to operate said transistor in a common base circuit and to provide a continuous discharge path for said trigger capacitor and thereby prevent charging of said trigger capacitor.

16. In an ignition system for an internal combustion engine and the like, a capacitor means connected in a circuit for producing firing pulses for said engine and requiring periodic charging and discharging for each engine firing pulse, a contactorless pulse-generating source connected to control the charging and discharging of said capacitor means wherein the improvement comprises means to generate an electrical signal having an amplitude varying as a function of engine speed and connected in said circuit to prevent the periodic charging and discharging of said capacitor means.

17. The ignition system of claim **16** having a main firing capacitor connected in a charging circuit and a discharging circuit, said discharging circuit including a triggered switch means, said capacitor means being connected to actuate said triggered switching means.

18. An ignition system for an internal combustion engine or similar device, with means to establish periodic firing energy pulses for operating the engine wherein the improvement comprises, speed-responsive means to generate an electrical signal as a function of engine speed and connected to disable said first name means at a preselected cutoff speed, and means connected to said speed responsive and responsive to disabling of said first named means to establish a dead band preventing operation of said first name means until said engine speed decreases a selected amount below said preselected cutoff speed.

19. The ignition system of claim **18** wherein said speed-responsive means provides an increased electrical signal in response to disabling of said first named means and thereby establishes the amount the speed must decrease below said preselected cutoff speed.

20. The ignition system of claim **18** wherein said speed-responsive means includes a capacitor charged in accordance with engine speed, with the charge being increased above the speed-related voltage at cutoff to establish said dead band.

21. The ignition system of claim **18** having means to control the dead band.

22. The ignition system of claim **18** having pulse means to establish a series of electrical pulses related to engine speed, said speed-responsive means having an integrating capacitor means connected to said pulse means, a full wave rectifying means, a compensating capacitor connected in series with the full wave rectifying means across said integrating capacitor means to regulate the charging thereof and the width of said dead band.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,534,719 Dated October 20, 1970

Inventor(s) FLOYD M. MINKS

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, Line 27	"unit transformer 15" should read ---unit transformer 16---;
Claim 18 Column 8, Line 47 (Claim 18, Line 6)	after "speed responsive" and before "and" insert ---means---.

Signed and sealed this 20th day of April 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents