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TIME CONTROL FENCE CHARGER

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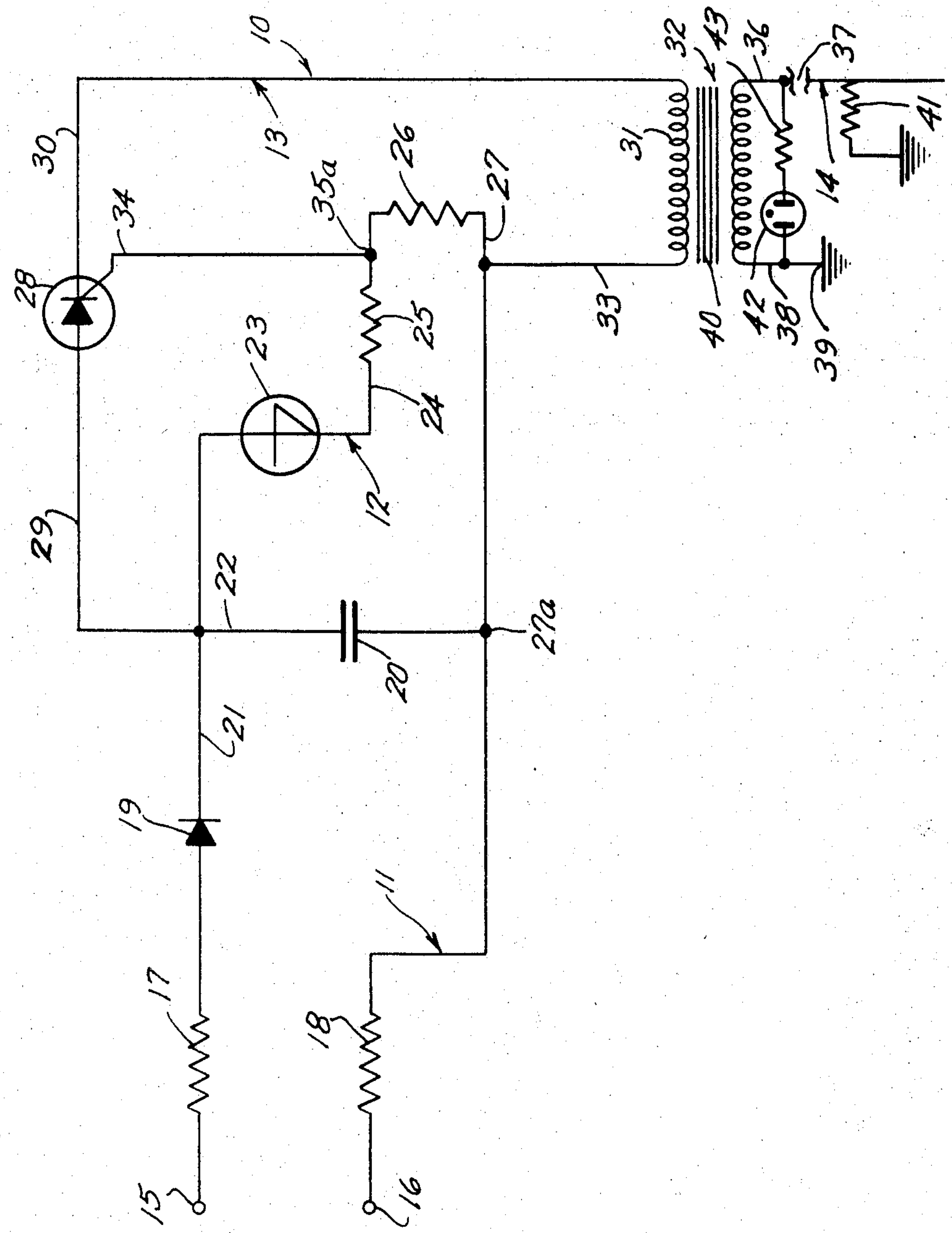

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TIME CONTROL FENCE CHARGER

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ABSTRACT OF THE DISCLOSURE

A time control fence charger circuit including a DC supply means and an SCR for delivering pulses through a transformer to a fence. The SCR has a control circuit which includes a four-layer diode coupled to the gate thereof. A capacitor is coupled across the input circuit and is charged and discharged according to the breakdown loads of the four-layer diode thereby delivering the pulse input which is coupled thereto.

This invention relates to a time control fence charger for applying a periodic energy impulse to an electrical fence and in particular relates to a fence charger employing electronic switching devices for improving the efficiency and safety of an electrically charged fence.

In applying an electrical charge to a fence for confining animals within a selected areas, it has been found desirable to convert a standard AC electrical source into energy pulses which may then be used as the charging signal. Energy pulses of short duration and large magnitude have the advantage of being more effective in repelling animals after contacting the charged fence. Also, discrete pulses have the advantage of being safer in application both to livestock and to humans which may contact the fence. A person contacting such a fence, for instance, may receive an electrical shock for only several milliseconds, whereupon the individual's reflexes will cause the contact with the fence to be broken prior to the application of successive pulses. In contrast, a continuous charge applied to such a fence may result in an individual or livestock contacting the fence for an extended duration and receiving a continuous electrical shock thereby.

Various devices have been developed for applying discrete energy pulses to a fence and thereby avoiding the disadvantages associated with the application of a continuous electrical signal. For instance, a motor-driven switch may be used for alternately connecting and disconnecting an electrical power source to fence terminals in such a manner as to produce a pulse-like energization of the fence. Also, a tilting mercury switch or an oscillating steel ball may be used to perform a similar function. However, all these devices have the principal disadvantage of requiring mechanically moving parts which are subject to wear due to continued use and subject to deterioration due to adverse weather conditions.

To supplant the mechanically operated oscillation type devices, electronic fence chargers have been developed for applying a pulse energy signal from a standard AC source to the fence in such a manner as to avoid many of the disadvantages associated with the mechanical systems. Mechanical systems, however, have had the advantage of being capable of incorporating safety techniques for the purpose of assuring that a continuous energy signal is not applied to the fence. Heretofore, such safety techniques have not been available in electronic type fence chargers.

In addition, electronic fence charging devices currently available have generally used four-layer diodes for directly controlling the output energy applied to the associated fence. Such devices have not been entirely satisfactory in that the current capable of being controlled by a four-layer diode is substantially less than would otherwise be desirable for use directly at the fence circuit. Limiting resistors have had to be employed in such circuits to consume power which would otherwise be destructive of the diode. In addition to consuming power which could otherwise be available at the fence circuit, such resistors have tended to increase the time constant associated with the dicharge of the time control capacitor thereby lengthening the duration of the energy signal applied to the fence.

Accordingly, it is a principal object of this invention to provide a fence charger having an improved charging circuit for applying discrete electrical impulses to the associated fence.

It is another object of this invention to provide a fence charger having electronic means for applying electrical impulses to an associated fence and having a safety electronic switching circuit which prevents the application of a continuous electrical signal to the fence.

It is also an object of this invention to provide a fence-charger utilizing electronic switching devices having a low discharge time constant and a high output current.

It is a further object of this invention to provide a fence charging network using a four-layer diode which is responsive to a time charging capacitor for controlling the gate of a silicon controlled rectifier and for utilizing the output of the rectifier for energizing the associated fence.

It is an additional object of this invention to provide a fence charger having electronic switching devices for converting a continuous electrical signal into discrete energy pulses and having a control circuit which functions substantially independently of an output charging network.

These and other objects, features and advantages of the present invention will be understood from the following description and the associated drawing wherein reference numerals are utilized in designating an illustrative embodiment.

ON THE DRAWING

The single figure is a schematic diagram of an electronic network used in the fence charging device of this invention.

AS SHOWN ON THE DRAWING

The advantages of this invention are particularly adaptable to an illustrative charging network **10**. The network **10** is utilized to receive a standard AC signal such as a standard 120 volt, 60 cycle signal and to convert that signal into discrete energy pulses and for applying those pulses to an electrical fence.

The electronic network **10** consists essentially of four circuits which are cooperable for performing the indicated objects of this invention. In particular, a feed circuit **11** is employed to receive a standard AC signal and to convert that signal into a unidirectional or half-wave rectified waveform. A control circuit **12** cooperates with the feed circuit **11** for utilizing the unidirectional energy signal to develop discrete pulses through an electronic switching device. An input circuit **13** cooperates with the control circuit **12** and with the feed circuit **11** for developing a discrete pulse signal which is separated from but which is in response to the discrete pulse signals produced by the control circuit **12**. Finally, the output circuit **14** utilizes the discrete pulse energy developed by the input circuit **13** for energizing an associated electrical fence.

The feed circuit **11** has input terminals **15** and **16** for receiving a standard AC voltage signal and for applying the signal to the remainder of the network to ultimately energize the electrical fence at the output circuit **14**. Feed resistors **17** and **18** are connected in series with the respective terminals **15** and **16** and may represent either limiting resistors for fixing the current and voltage levels to be made available to the network **10**, or fuses for interrupting the current applied to the charging network in a well understood manner.

A diode **19** is connected in series with the resistor **17** and is used to provide half-wave rectification for the standard AC signal as applied at the terminals **15** and **16**.

A capacitance means or capacitor **20** completes the feed network **11** and provides a conduction path between the resistor **18** and the collector **21** of the diode **19**. Hence, the rectified AC signal available at the collector **21** will tend to charge the capacitor **20** indefinitely through the completed feed circuit consisting of the resistor **17**, the diode **19**, the capacitor **20** and the resistor **18**.

The capacitor **20**, however, will not in fact charge indefinitely due to a discharging circuit which is made available in the form of the control circuit **12**. The capacitor **20** forms a common branch between the feed circuit **11** and the control circuit **12** and has a first terminal **22** connected to an electronic switching means or a four-layer diode **23**. As is well understood, the four-layer diode **23** may be either a PNPN or an NPNP diode having the characteristic of being placed in a conducting state due to a given voltage level applied across its terminals and of being placed in a nonconducting state due to a reduction of current through the diode to a minimum threshold level.

The diode **23** has an input terminal which is identical with the terminal **22** of the capacitor **20** and an output terminal **24** which is connected to a resistor **25**. The resistor **25** is used to control the voltage level applied to the input circuit **13**. The resistor **25** is connected to a resistor **26** which is used to limit the current level within the control circuit **12**. The resistor **26** has a terminal **27** which is connected directly to the terminal **27*a*** of the capacitor **20** for completing the control circuit **12**.

In order for the four-layer diode **23** to function properly, current within the control circuit **12** must be limited to a value determined by the ratings of the diode. This limitation on the circuit current is accomplished through the combination of the resistors **25** and **26**, and the need for such resistors is one of the factors which makes the use of the diode **23** not entirely desirable for directly controlling the current within the output circuit **14**. However, as shown in the charging network **10**, the control circuit **12** is so separated from the output circuit **14** such that current within the circuit **14** is not dependent upon the magnitude of current within the control circuit **12**.

The input circuit **13** may be referred to as a controlled circuit having a current which is controlled, not in magnitude, but in time, by current within the control circuit **12**. The input circuit **13** includes a unidirectional electronic switching means or a silicon controlled rectifier **28** which has a first terminal **29** connected to the terminal **22** of the capacitor **20** and a second terminal **30** connected to a primary winding **31** of an energizing means or coupling transformer **32**. The winding **31** is in series with the silicon controlled rectifier **28** and has a terminal **33** which is connected directly to the terminal **27*a*** of the capacitor **20**.

The silicon controlled rectifier **28** has its gating means or gate terminal **34** connected to a junction point **35*a*** which is intermediate the resistors **25** and **26** of the control circuit **12**. As is well understood, when the gate **34** of the silicon controlled rectifier **28** attains a threshold voltage level, the rectifier **28** will be retained in a conducting state for all voltages at the gate **34**, provided such voltages do not fall below the threshold value. Also, since the input circuit **13** does not require limiting resistors to limit the magnitude of current therein, the current within the input circuit may be allowed to approach a sizeable magnitude in comparison to the current used within the control circuit **12**. In this way, more energy is made available at the transformer **32** for energizing the output circuit **14**.

The output circuit **14** includes a secondary winding **35** of the transformer **32** which is connected at a terminal **36** to a fence **37**. The other terminal **38** of the winding **35** is connected to ground as at the point **39**. Also, a permeable core **40** of the transformer **32** is grounded as at the point **39**. The coupling transformer **32** may have a secondary-to-primary winding ratio of approximately 60:1, indicating a step-up in voltage from the primary winding **31** to the secondary winding **35** by a factor of 60. The voltage received at the secondary winding **35** may be in the order of 3,000 volts or higher.

The secondary or output circuit **14** is completed when an animal engages the electrical fence **37** while standing on ground, such animal being represented by a resistance **41** which may have a value ranging from 10,000 to 100,000 ohms.

A signal device such as a discharge glow tube **42** may be connected in series combination with a high resistance **43** and the combination then placed in parallel with the secondary winding **35**. The glow tube **42** may be of the neon type, for instance, thereby consuming a minimum of power and giving a satisfactory signal whenever the secondary winding **35** is energized.

In operation, an AC, 60 cycle signal applied at the terminals **15** and **16**, is rectified by the diode **19** and used to charge the timing capacitor **20**. The charge on the capacitor **20** will continuously increase due to the lack of a discharge path. Discharge cannot be accomplished through the silicon controlled rectifier **28** or through the four-layer diode **23**, as both these devices are in a nonconducting state initially. However, as the charge on the capacitor **20** increases, a threshold voltage level will be reached at which the four-layer diode **23** becomes conductive.

When the diode **23** conducts, a voltage appears across the resistors **25** and **26** and at the junction point **35**, and hence, the gate **34** is placed at an adequate voltage level for placing the silicon controlled rectifier **28** in a conducting state. With the rectifier **28** in a conducting state, the capacitor **20** then is provided with an immediate discharge path through the rectifier **28** and the primary winding **31** back to the terminal **27*a*** of the capacitor. Therefore, through the use of the control circuit **12**, a high current signal can be applied to the primary winding **31** which has an extremely short time constant. This is because the winding **31** and the silicon controlled rectifier offer only small resistance to the input circuit **13**, and hence the capacitor discharge will be substantially instantaneous.

In addition to the improved magnitude and short duration of the energy signal delivered to the primary winding **31** and hence to the electrical fence **37**, the use of the control circuit **12** introduces a safety device for preventing the application of a continuous energy signal to the fence **37**. In particular, should the four-layer diode **23** fail such that a short-circuit path is effectively provided between the terminal **22** of the capacitor **20** and the resistor **25**, the input circuit **13** will be maintained in a nonconducting state and a continuous energy signal will not be applied to the output circuit **14**. With the diode **23** short-circuited, the capacitor **20** will not develop a sufficient voltage level for energizing the gate **31** of the silicon controlled rectifier **28**. Accordingly, the fence charger of this invention incorporates safety features not currently available in fence charger networks.

It will be understood that the fence charging network **10** is constructed entirely of available solid state components such that the entire network may be encapsulated in an epoxy resin or the like for making the entire network more durable from both shock and adverse weather conditions. Such encapsulation of the network has been made possible due to the development of the safety features of this invention without the use of mechanical or moving components.

It will also be understood that various modifications and combinations of the features disclosed herein may be accomplished by those versed in the art, but I desire to claim all such modifications and combinations as properly come within the spirit and scope of my invention.

I claim as my invention:

1. A time control fence charger comprising:

a circuit including an electronic switching means having three terminals, said switching means being connected by two of said terminals to control the flow of unidirectional current in said circuit, said switching means including gating means for regulating the flow of current between said first and second terminals, and connected to the third of said terminals, energizing means for energizing a fence, said energizing means being responsive to current in said circuit,

capacitance means for developing a time-increasing voltage thereon, said capacitance means being connected to said circuit at such point as to enable the discharge thereof to flow through said switching means, and

a four-layer diode coupled to said third terminal for applying a predetermined gating voltage present on said capacitance means thereto.

2. A time control fence charger comprising:

a transformer,

an input circuit, said input circuit including:

(1) a primary winding of said transformer,

(2) an elcetronic unidirectional switching means,

said switching means having a gating means and first and second terminals, said gating means connected for regulating the flow of current through said primary winding of said transformer,

an output circuit coupled by said transformer to said input circuit, said output circuit including a secondary winding of said transformer and fence terminals connected thereto for being energized by said secondary winding, and

a control circuit, connected to said gating means, for applying a periodic control signal thereto, said control signal rendering said unidirectional switching means conductive, and said control circuit connected for applying said periodic control signal to one of said first and second terminals of the switching means,

said control circuit having a capacitance means and means for charging the same, a four-layer diode connected in parallel with said capacitance means and being rendered conductive by a predetermined voltage developed at said capacitance means, said four-layer diode being connected to the gating means for applying the predetermined voltage on said capacitance means thereto.

3. A time control fence charging network comprising:

a feed circuit, said feed circuit including means for developing a unidirectional current from a standard AC source,

an input circuit, said input circuit having a unidirectional electronic switching means and a primary winding of a coupling transformer connected at a point to enable the current within said primary winding to be controlled by said switching means,

a control circuit, said control circuit having capacitance means for being charged unidirectionally by said feed circuit and having a four-layer diode means for substantially simultaneously applying a control signal to said unidirectional switching means and for discharging said capacitance means in response to a predetermined voltage present on said capacitance means, and

an output circuit, said output circuit having a secondary winding coupled to the primary winding of said input circuit and having means for energizing a fence in response to current in said secondary winding.

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