Nov. 11, 1969 R. J. ZIELINSKI ET AL 3,477,797

PROXIMITY-RESPONSIVE GAS BURNER IGNITER

Filed Oct. 13, 1967

FIG. 1.

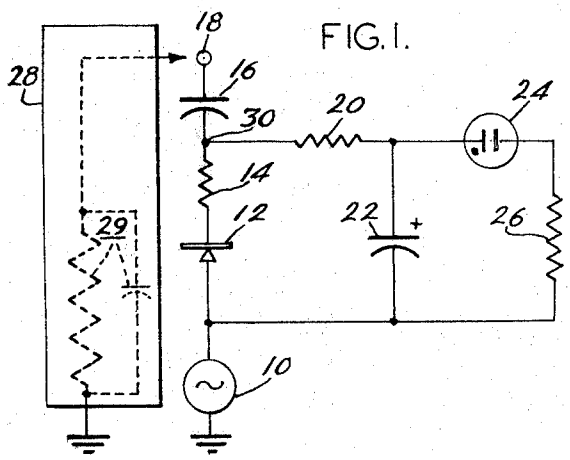


FIG. 2.

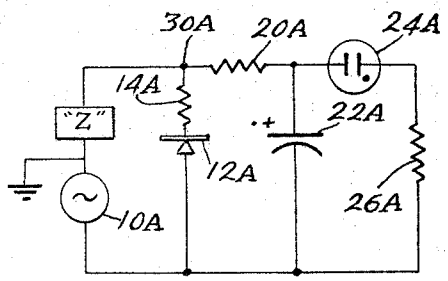


FIG. 3.

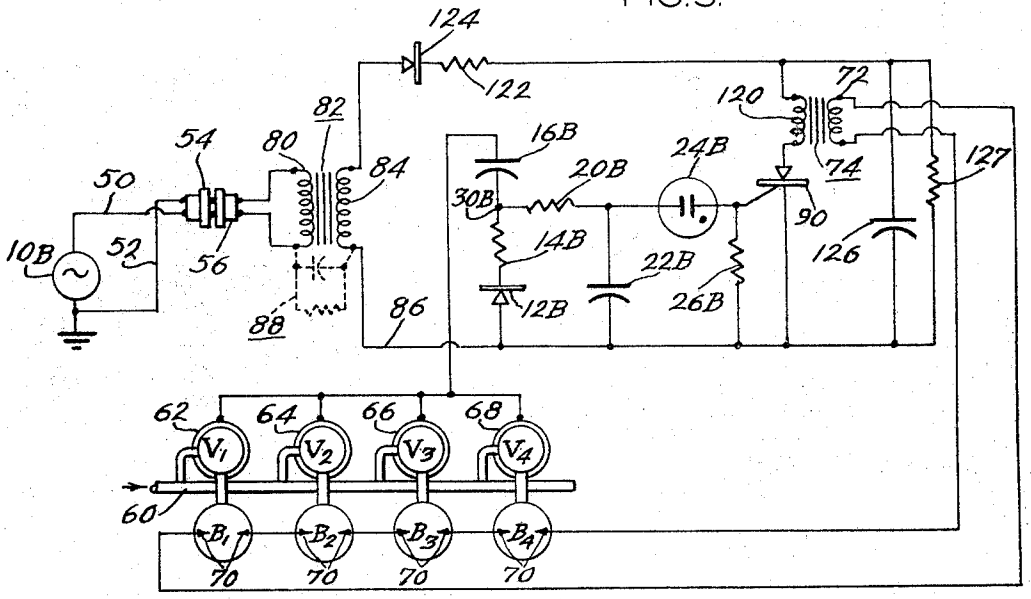
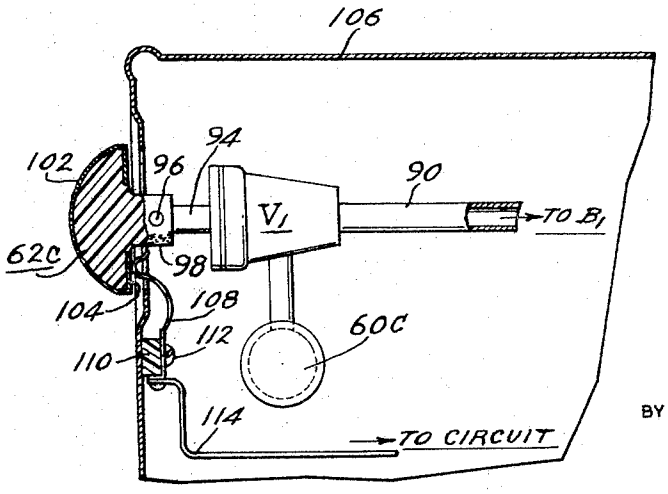


FIG. 4.



INVENTORS:
ROBERT J. ZIELINSKI
DAVID P. METZGER

BY Howson & Howson

ATTYS.

United States Patent Office 3,477,797
Patented Nov. 11, 1969

3,477,797

PROXIMITY-RESPONSIVE GAS BURNER IGNITER

Robert J. Zielinski, Rochester, N.Y., and David P. Metzger, Berea, Ohio, assignors to American Gas Association, Inc., New York, N.Y., a corporation of New York

Filed Oct. 13, 1967, Ser. No. 675,120
Int. Cl. F23q 7/12
U.S. Cl. 431—256 3 Claims

ABSTRACT OF THE DISCLOSURE

A system which responds to touching by an operator to generate pulses, for example to generate ignition pulses for gas burners. An alternating voltage source, such as the usual A.C. power line, having one output terminal grounded is connected with its ungrounded upper terminal in series with a rectifier and a "touch point" electrode. A series combination of a resistor and a capacitor is connected in parallel with the rectifier, and the glow lamp is connected in parallel with the capacitor. When an operator who is electrically connected to ground, as by standing on a floor or on the ground, touches the touch-point electrode, the circuit for the alternating voltage source is completed so that a series of rectified voltage pulses is produced across the rectifier. These successive voltage pulses cause the capacitor to charge up incrementally to a level at which the normally non-conductive glow lamp fires and discharges the capacitor. In this way repetitive current pulses are produced through the glow lamp at a rate lower than the frequency of the alternating source. The pulses through the glow lamp may be used to operate a spark igniter for a gas burner, and the touch point is preferably located on a manual gas-control valve for the burner, so that when an operator turns on the burner his touching of the valve control will generate the ignition sparks required to ignite the burner.

Background of the invention

This invention relates to apparatus for producing electrical pulses in response to proximity of an object, and especially to such apparatus for the electrical ignition of a gas burner in response to the touch of an operator.

There are various applications in which it is desirable to control or initiate electrical action in response to proximity of an object, without requiring operation of a mechanical switch. Such apparatus is commonly known as a "touch control" system, one form of which is commonly used, for example, in connection with the floor-selection buttons in elevator cars. While there are many applications for the subject of the present invention, it will be described primarily with reference to electrical ignition systems for automatically igniting gas emanating from gas burners.

It is known that a gas burner may be ignited by sparks produced at spark electrodes adjacent the burner in response to pulses of current applied to a spark transformer supplying the spark electrodes. The present invention in one form provides apparatus for producing ignition sparks in such a system in response to touching of a touch point by an operator.

It is therefore an object of the invention to provide new and useful apparatus for producing electrical pulses in response to the proximity of an electrically-conductive object.

Another object is to provide such apparatus which is reliable in a wide range of applications.

A further object is to provide new and useful apparatus for producing sparks adjacent a gas burner in response to touching of a portion of the apparatus by an operator.

A still further object is to provide a system including a gas burner and a manually-controllable valve for supplying gas to the burner, in which electrical ignition sparks are produced adjacent the burner to ignite it in response to touching of the control valve by the hand of an operator.

Summary of the invention

These and other objects of the invention are achieved by the provision of a system comprising a source of varying voltage, electrode means, asymmetrically-conductive means connected between said electrode means and one terminal of said source, a series combination of capacitive means and resistive means connected in parallel with said asymmetrically-conductive means, and voltage threshold means in parallel with said capacitive means. The electrode means is normally effectively isolated electrically from the other terminal of the voltage source so that charge does not build up on the capacitive means and the voltage threshold means is not operated. However, when an electrically-conductive movable object, such as a human body, which is coupled to the other terminal of the source is brought into proximity to the electrode means so as to be only very closely spaced from it or to touch it, rectified voltage pulses are produced across the asymmetrically-conductive means which charge the capacitive means in successive increments until the voltage thereacross exceeds the threshold voltage of the voltage threshold means thereby discharged and the cycle repeated. Accordingly, when the electrically-conductive movable object is in proximity to the electrode means, repetitive pulses of current are produced through the voltage threshold means, these pulses terminating when the movable object is removed from proximity to the electrode means.

In a preferred embodiment, the electrode means are located on one or more manual controls for the valves supplying gas to one or more gas burners, and the current pulses through the voltage threshold means, which may be an ordinary glow lamp, are used to produce sparks at spark electrodes adjacent the one or more burners. With this arrangement, an operator manually operating one of the valves to turn on the gas thereby causes ignition sparks to occur automatically at the burners, the sparks terminating when the operator removes his hand from the control knob.

Because in the arrangement of the invention successive cycles of the alternating voltage have a cumulative effect in causing voltage across the capacitor to approach the threshold level of the threshold means, repetitive pulses pulses are produced in the voltage threshold means despite substantial variation in the impedance of the movable object, and particularly despite relatively high impedance values of the movable object which tend to reduce the speed with which a capacitor can be charged through the movable object. In addition, the capability of producing pulses at a rate substantially lower than that of the alternating voltage source enhances and simplifies the production of sparks for ignition purposes; thus, in a preferred embodiment in which the sparks are produced by discharge of a capacitor, the larger time between successive pulses permits use of a larger discharge capacitor and thereby makes available larger discharge energies for operating the spark-generating equipment.

Brief description of the figures

These and other objects and features of the invention will be more readily understood from a consideration of

the following detailed description, taken in connection with the accompanying drawings, in which:

FIGURE 1 is a schematic electrical diagram illustrating one embodiment of a circuit in accordance with the invention for producing pulses in response to proximity of an object to a touch point;

FIGURE 2 is an electrical schematic diagram illustrating a simplified equivalent-circuit diagram corresponding to the circuit of FIGURE 1;

FIGURE 3 is a schematic diagram illustrating an application of the invention to automatic ignition of gas burners; and

FIGURE 4 is an elevational fragmentary view, partially in section, illustrating a touch-control valve knob arrangement suitable for use in the system of FIGURE 1.

Description of preferred embodiments

Referring now to the embodiment of the invention illustrated in FIGURE 1, a source **10** of varying voltage, which may be the usual 60-cycle power line, has its lower terminal grounded and its upper terminal connected to the anode of a diode rectifier **12**, the cathode of which is connected through a resistor **14** and a capacitor **16** to a touch-point electrode **18**. A series combination comprising resistor **20** and a capacitor **22** is connected in parallel with rectifier **12** and resistor **14**. A voltage threshold device **24**, illustrated as a gaseous glow lamp, and a load resistor **26** are connected in series with each other and in parallel with capacitor **22**. An electrically-conductive movable object **28** connected to ground at one end is movable into close proximity to touch-point electrode **18**, preferably into direct contact therewith; the broken-line resistor and capacitor combination **29** represent the equivalent impedance to ground produced by the movable object **28**. Object **28** may comprise the body of an operator whose feet are effectively connected to ground potential and whose hand is movable into contact with touch-point electrode **18**.

In the operation of the arrangement of FIGURE 1, touch-point electrode **18** is normally effectively isolated from ground, there is therefore no return path for current from source **10**, capacitor **22** remains discharged and glow lamp **24** is non-conductive. However, when the upper end of movable object **28** touches touch-point electrode **18**, e.g. when the operator touches the latter electrode, a circuit is completed for source **10** by way of rectifier **12**, resistor **14**, capacitor **16**, touch-point electrode **18** and the resistance and capacitance to ground of object **28**. Under these conditions, rectifier **12** causes positive rectified half-wave pulses of voltage to appear at junction point **30** between resistor **14** and capacitor **16**, rectifier **12** serving in effect as a clipper to remove the negative half-cycles of the alternating voltage waveform. Resistor **20** and capacitor **22** are sufficiently large that capacitor **22** responds to the first rectified voltage pulse to charge only to a small fraction of the peak value thereof, but responds to succeeding rectified voltage pulses to charge progressively further in increments toward an equilibrium value approximately equal to the average value of the half-wave voltage pulses.

However, before this equilibrium value of voltage on capacitor **22** is reached, the voltage on capacitor **22** reaches a threshold level at which glow lamp **24** "fires" and becomes highly conductive, and at this time capacitor **22** is substantially discharged through glow lamp **24** and load resistor **26**. After such discharge, glow lamp **24** resumes its non-conductive state, the incremental charging of capacitor **22** begins again, and the cycle repeats itself. In this way repetitive pulses of current through, and voltage across, load resistor **26** are produced at a rate which is a submultiple of the frequency of the alternating voltage source **10**, so long as touch-point electrode **18** is contacted by object **28**. When object **28** is removed from the vicinity of touch-point electrode **18**, charging of capacitor **22** ceases and pulses at load resistor **26** no longer occur.

Resistor **14** and capacitor **16** are provided in the preferred embodiment merely to minimize shock hazard. The basic operating elements of FIGURE 1 may therefore be represented in simplified form as shown in the equivalent circuit of FIGURE 2, wherein corresponding parts are indicated by numerals corresponding to those of FIGURE 1 with the suffix A added thereto, and wherein the block Z represents the combined impedances of the movable object (e.g. the body of the operator when touching the touch point) and of the capacitor **16**. The value of resistor **14A** is significantly lower than that of the impedance Z, so that most of the voltage of the half-wave pulses appears at junction point **30A**. The time constant of resistor **20A** and capacitor **22A** is sufficiently long compared with the rectified voltage pulses that capacitor **22A** is only partially charged in response to each rectified pulse, thereby producing the desired incremental increase in charge in response to successive rectified pulses.

The voltage pulses across, and the current pulses through, resistor **26** of FIGURE 1 may be used for any of a variety of purposes; and, in fact, where a visual or optical indication of touching is desired, the pulses of light from glow lamp **24** may be used as the indications, in which case resistor **26** may be short-circuited and eliminated. As will be described with reference to FIGURE 3, the pulses of current through the glow lamp may advantageously be used to drive an ignition spark generator circuit for igniting a gas burner.

Referring now particularly to FIGURE 3, in which parts corresponding to those of FIGURE 1 are indicated by corresponding numerals followed by the suffix B, the alternating voltage source **10B** has its lower ouput terminal grounded and may be the usual public-service power generator supplying power lines **50** and **52**, which terminate in an ordinary household electrical outlet socket **54**. The remainder of the apparatus of FIGURE 3 may comprise the surface burner unit of a domestic gas range and electrical ignition circuitry therefor mounted on an interior wall of the range cabinet and connected to electrical outlet **54** by means of an appropriate plug **56**.

More particularly, the usual four gas burners of a domestic range represented as B_1, B_2, B_3 and B_4 are supplied with fuel gas from a common gas manifold **60** by way of manually-operable gas valves V_1, V_2, V_3 and V_4, respectively; corresponding manual control knobs for the valves are represented, respectively, at **62**, **64**, **66** and **68**. Each of the burners is provided with a pair of spark electrodes such as **70**, these pairs being connected in series with each other and with the secondary **72** of a spark transformer **74** which generates pulses of voltage to operate all of the spark electrodes simultaneously. The function of the circuitry of the invention now to be described is therefore to produce such spark ignition pulses only when an operator touches one of the four manual gas control knobs **62**, **64**, **66** and **68**.

Referring now to the detailed structure of the electrical circuitry of FIGURE 3, the two leads from the plug **56** are connected to opposite ends of the primary **80** of an isolation transformer **82** having a secondary winding **84**. Such isolation transformers are commonly utilized for commercial apparatus to minimize shock hazard and to minimize the effects of short-circuits. However, an isolation transformer is not necessary in all applications, and when it is not utilized the input leads to transformer primary **80** are directly connected to the pair of output leads from output transformer secondary **84** to provide the type of connection shown in FIGURE 1.

Even though such an isolation transformer provides adequate isolation for safety purposes, it has been found that there is generally sufficient unbalanced coupling between primary and secondary thereof to provide the required circuit action, provided that the polarity of the

pair of leads to the primary and the polarity of the pair of leads to the secondary are appropriate. Thus in the embodiment of FIGURE 3 it is the output lead **86** of transformer secondary **84**, connected to the anode of diode **12B** and to the lower, negative plate of capacitor **22B**, which should be the off-ground or "hot" side of the circuit. The parallel resistance and capacitance circuit **88** shown in broken line between the lower end of transformer primary **80** and transformer secondray **84** represents such unbalanced coupling which, in effect, couples the "hot" side of the power line to line **86** as desired. Since there are only four combinations of polarities for the primary and secondary windings of transformer **82**, a suitable combination may be readily determined when the circuit is being constructed by trying the four different combinations, i.e. reversing the polarity of plug **56** and the polarity of the connections to the secondary **84** of the transformer. The result is that, once the construction of the system has been completed, the line **86** receives alternating voltage with respect to ground similar to that provided by the ungrounded terminal of source **10** in FIGURE 1, so long as the plug **56** is inserted in the correct polarity.

The circuit elements **12B**, **14B**, **16B**, **20B**, **22B**, **24B** and **26B** all act as previously described with reference to FIGURE 1, although the load for the glow lamp **24B** in this case includes the gate-to-cathode current path of a silicon controlled rectifier **90** and the touch-point electrode comprises any one of the valve control knobs **62**, **64**, **66** or **68**, the latter knobs having exposed conductive portions which are connected in parallel and to the upper plate of capacitor **16B**.

One suitable construction for the touch-point control knobs is shown in FIGURE 4, in which parts corresponding to those of FIGURE 3 are indicated by corresponding numerals with the suffix C. Thus the gas supply manifold line **60C** provides fuel gas to a gas valve such as V_1 for supply through pipe **90** to burner B_1, for example. The rotatable shaft **94** for controlling valve V_1 is fastened by an appropriate transverse pin **96** to a sleeve portion **98** of the control knob **62C**. The latter knob is composed primarily of an insulating material, such as plastic, but is provided on the etxernal front portions thereof with an electrically-conductive coating **102** of metal which extends over a peripheral region on the back side of the knob as at **104**. The entire assembly is mounted by any suitable means (not shown) within the range cabinet **106**. An electrically-conductive sliding spring contact **108** is mounted on an insulating support block **110** on the interior of cabinet **106** by an appropriate screw **112** so as to bear against, and provide electrical contact to, the rearward portion **104** of metal coating **102** as cotnrol knob **62C** is turned. A wire lead **114** is also connected to spring contact **108** and leads to the upper side of capacitor **16B** in FIGURE 3. A similar arrangement is provided for all of the control knobs. The conductive coating on any of the control knobs therefore serve as an actuating touch point for the system.

Returning now to FIGURE 3, the anode-cathode elements of silicon controlled rectifier (SCR) **90** are supplied with filtered direct voltage by connecting the cathode element thereof to line **86** and by connecting the anode element thereof to the opposite or upper end of isolating transformer secondary **84** by way of spark transformer primary **120**, resistor **122**, and diode rectifier **124**. A capacitor **126** connected in parallel with the series combination of spark transformer primary **120** and SCR **90** serves as a discharge capacitor on which charge is stored until it is discharged abruptly through transformer primary **120** by conduction through SCR **90** produced in response to "firing" of glow lamp **24B**. Each such discharging of capacitor **126** through spark transformer primary **120** produces a corresponding high voltage pulse across the secondary **72** of the spark transformer, which is applied to the series combination of the burner spark electrodes **70**. Resistor **127** in parallel with capacitor **126** is not essential to operation, but serves to damp extreme transient voltages and to discharge capacitor **120** when the system is not plugged in.

In the operation of the arrangement shown in FIGURES 3 and 4, with the system arranged as shown and all gas control valves in their OFF positions, no gas emanates from any of the burners and no ignition sparks are produced. However, as soon as an operator touches the conductive portion of one of the control knobs to turn on the gas to one of the burners, this touching produces the previously-described incremental buildup of charge on capacitor **22B** in response to successive rectified voltage pulses at junction point **30B**, until the voltage across capacitor **22B** reaches the firing voltage for glow lamp **24B**. At the latter time the glow lamp **24B** "fires," producing a pulse of current through the gate electrode of silicon controlled rectifier **90** and a corresponding pulse of current through spark transformer primary **120** as capacitor **126** discharges through it. This pulse of current produces a high-voltage pulse across all of the burner spark electrodes in series, including the one then being supplied with gas. When the glow lamp **24B** has discharged capacitor **22B**, the voltage across the glow lamp **24B** falls below the extinction level thereof and the lamp becomes non-conductive. This permits capacitor **22B** to recharge and also turns off silicon controlled rectifier **90** so that capacitor **126** is recharged by way of rectifier **124**. In this way repetitive high voltage ignition pulses are applied to all of the burner spark electrodes including the pair adjacent the burner from which gas is emanating so that the latter burner is ignited. The ignition sparks continue as long as the operator touches the control knob, but as soon as his hand is removed the sparks terminate.

Without in any way thereby limiting the scope of the invention, the following specific example of parameters, values and elements of a typical system in accordance with FIGURE 3 are given in the interest of complete definiteness.

Capacitor **126**—4 microfarad electrolytic capacitor, 250 volt D.C. rating

Capacitor **22B**—0.002 microfarad capacitor, 200 volt D.C. rating

Capacitor **16B**—0.001 microfarad capacitor, 100 volt D.C. rating

Diode **124**—400 volts peak inverse rating

Diode rectifier **12B**—200 volt peak inverse rating

Glow lamp **24B**—type NE-2 glow lamp, fires at 75 volts

Resistor **122**—1,000 ohms, ½ watt rating

Resistor **127**—1.5 megohms, ½ watt rating

Resistor **20B**—22 megohms, ½ watt rating

Resistor **14B**—1.5 megohms, ½ watt rating

Isolation transformer **82**—115 volt A.C. isolation transformer with H-type laminate iron core, primary and secondary wound one on top of the other.

Spark transformer **74**—commercial spark transformer, AMGLOW type MT55

Silicon controlled rectifier **90**—General Electric type C106B, 200 volt peak inverse rating

Alternating voltage source **10B**—Standard 110-volt power line source

With this specific arrangement, three high voltage spark pulses per second were produced, although where the operator is more than ordinarily insulated from ground by rubber shoe soles or the like the pulsing rate may be somewhat slower.

It will be noted that the external impedance between touch point and ground is not as critical a factor as in a system in which a capacitor must be fully charged by each cycle of line voltage. In the latter type of system a substantial increase above normal of the external impedance will prevent the glow lamp from firing at all, whereas in the system of the present invention the effect of such increases in external impedances, over a substan-

tial range, is merely to require more cycles for charging the capacitor **22B** and hence a reduced output pulse rate. Also, because of the relatively low pulse rate there is more time for capacitor **126** to charge between pulses, the capacitor can be made larger than otherwise would be the case, and with a given pulse therefrom more pairs of spark electrodes more reliably operated.

As mentioned above, the system can be operated with or without the isolation transformer; also, capacitor **16B** and resistors **30B** and **26B** can be eliminated, the polarity of diode **12B** can be reversed provided the SCR circuit is suitably modified, and other forms of voltage threshold device an of spark generating apparatus can be used in various applications.

Thus while the invention has been described with particular reference to specific embodiments thereof in the interests of complete definiteness, it will be obvious to one skilled in the art that it may be embodied in a variety of forms diverse from those specifically described without departing from the spirit and scope of the invention as defined by the appended claims.

We claim:

1. A touch-control system for igniting gas burners, comprising:

electrical ignition means disposed adjacent a gas burner and responsive to voltage pulses applied thereto to produce a spark for igniting gas from said burner;

a source of alternating voltage, one output terminal of said source being grounded;

manual control means for turning said burner on and off, said control means comprising electrode means positioned to be electrically coupled to the hand of an operator manipulating said control means;

rectifying means connected between said electrode means and the other output terminal of said source for producing rectified voltage pulses across said rectifying means when said operator touches said control means;

a series combination of capacitive means and resistive means in parallel with said rectifying means whereby said capacitive means is charged incrementally to a predetermined level in response to a series of said rectified voltage pulses;

voltage threshold means in parallel with said capacitive means and responsive to the voltage across said capacitive means to become strongly conductive each time said last-named voltage reaches said predetermined level, thereby repetitively to discharge said capacitive means and to produce repetitive pulses of current through said voltage threshold means; and

means responsive to said repetitive pulses of current for applying voltage pulses to said ignition means.

2. The system of claim **1**, in which said voltage threshold means comprises a gaseous discharge device, and said means responsive to said repetitive pulses comprising a silicon controlled rectifier supplied with said repetitive pulses and a spark transformer operated by the output of said silicon controlled rectifier.

3. The system of claim **1**, comprising an iron-core isolating transformer connecting said other output terminal of said source to the side of said rectifying means opposite that connected to said electrode means.

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FREDERICK L. MATTESON, JR., Primary Examiner

H. B. RAMEY, Assistant Examiner

U.S. Cl. X.R.

340—258

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,477,797 Dated November 11, 1969

Inventor(s) Robert J. Zielinski and David P. Metzger

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

Column 2, line 31, after "means" insert -- , and the voltage threshold means thereby becomes strongly conductive. The capacitive means is --.

Column 7, line 13, for "an" read -- and --.

SIGNED AND
SEALED
JUL 21 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents