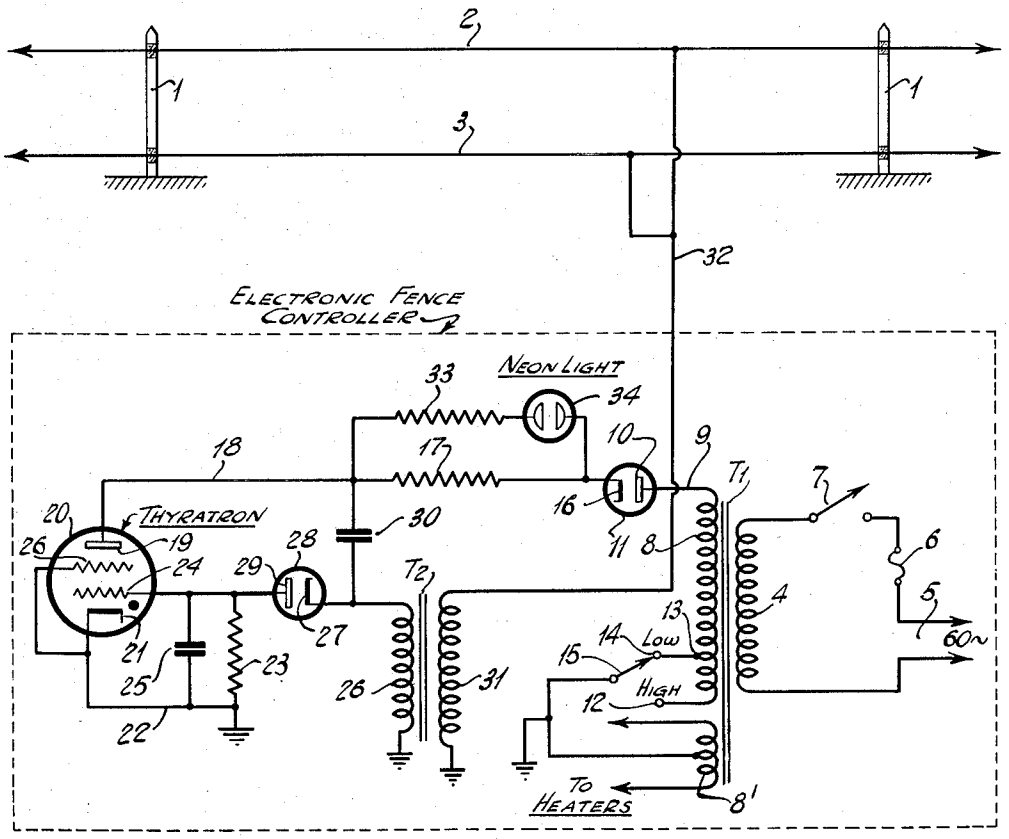
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ELECTRONIC FENCE CONTROLLER

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ELECTRONIC FENCE CONTROLLER

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My present invention relates generally to electric fences, and more particularly to a novel and improved form of electronic fence controller circuit.

It is an important object of my present invention to provide an electronic fence controller system which utilizes a grid-controlled, gas-filled tube to provide periodic high voltage pulses on the fence to be charged, there being employed means to prevent the production of high voltages capable of injurious shocks to human beings.

Another object of my invention is to provide an electronic fence controller system wherein if a sufficient short circuit is applied to the fence wire, the voltage built up across the primary winding of the ouput transformer will be small and thereby not permit pulses of energy to be applied to the fence wire.

A more specific object of the invention is to provide an electric fence circuit utilizing a thyratron device for producing high voltage pulses on the fence wire, means being employed to permit the approximate resistance of the fence to be calculated by the number of pulses per minute.

Further objects of my invention are to provide a fence charger system which can be grounded independent of the power supply line; to obtain a source of low frequency voltage independently of the charging voltage frequency; to provide a system that cannot produce harmful shocks to either cattle or human beings.

Still other features and objects of my invention will best be understood by reference to the following description, taken in connection with the drawing, in which I have indicated diagrammatically a circuit organization whereby my invention may be carried into effect.

Referring now to the accompanying drawing, there is shown a portion of a fence which is to be electrically charged so as to keep livestock within the confines of the area which is fenced in. I have shown a pair of spaced fence stakes 1. The stakes are made of wood, steel or concrete. The numeral 2 denotes metallic wire commonly employed in the construction of the fence. I show a second wire 3 which is located a short distance above the ground so as to provide a low level charged wire to handle small animals, such as pigs, sheep and the like. It will be understood that the metallic wires 2 and 3 are insulated from the stakes 1 by any suitable insulating devices, usually porcelain insulators.

Many various circuits have been proposed in the past to charge the fence wire with a sufficiently high voltage to cause livestock coming in contact with the wire to react away from the fence and thereby keep within desired bounds. In these prior systems the voltage has been applied to the fence wire as periodic pulses, but in many instances the circuit has been complicated, or has not included a provision for safe-guarding human beings from high voltage shocks produced in response to defects in the controller apparatus. Further, apparatus heretofore was mostly mechanical and weathering and rusting gave a great deal of trouble to the moving parts. In my system there are no moving parts.

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In my present system, in which various advantages are secured over the prior systems, there is utilized an input transformer T_1 whose primary winding 4 is connected at its opposite ends to the source of energizing current 5. The source 5 may be a plug adapted to be connected to the usual commercial alternating current source, say 60 cycles at 110 to 117 volts. The numeral 6 indicates a fuse of suitable design, and numeral 7 denotes an "on-off" switch for throwing the entire controlling apparatus into or out of operation. The secondary winding 8 has its upper end connected by lead 9 to the anode 10 of a diode 11. The lower end of winding 8 has a contact 12 to which has been applied the word "High." A tap 13 on the winding is connected to contact 14 to which has been applied the word "Low." A separate secondary winding 8' is adapted to be connected to the heater elements of the various cathodes of the tubes. The midpoint of winding 8' and the adjustable arm 15 are grounded. By switching arm 15 to either of contacts 14 or 12 it is possible to apply a lower or higher voltage pulse to the fence wire.

The cathode 16 of diode 11 is connected through resistor 17 and lead 18 to the plate 19 of a thyratron tube 20. The black dot within the tube envelope denotes a suitable gas filling, and is to be understood that the thyratron tube may be of any well-known and suitable type such as, for example, the 2050 type tube. In general, tube 20 is a grid-controlled, gas-filled tube. It is not believed necessary to describe in detail the construction and functioning of a thyratron tube, since those skilled in the art of tube construction are fully aware of the characteristics of such a tube.

It is believed sufficient to point out that the cathode or electron emitter 21, which may be indirectly heated by a suitable filament (not shown), is connected by lead 22 to the grounded end of a resistor 23. The control grid 24 of tube 20 is connected to the upper end of resistor 23,

and condenser 25 is shunted across resistor 23. The shield grid 26 of tube 20 is returned to the cathode 21, as is customary in thyratron tube construction. The output transformer is designated by the reference character T_2, and its primary winding 26 has one end thereof grounded, while its ungrounded end is connected to the cathode 27 of a second diode 28.

The anode 29 of diode 28 is connected to the ungrounded end of resistor 23. The plate end of resistor 17 is connected by condenser 30 to the cathode 27 of diode 28. The secondary winding 31 of the output transformer T_2 has the lower end thereof grounded, while the upper end of the winding is connected by lead 32 to the metallic wires 2 and 3 of the fence. In shunt with resistor 17 is connected a series path consisting of resistor 33 and the neon bulb or light 34, it being understood that the neon device 34 functions as an indicator of the number of pulses per minute applied to the fence wire. It is to be clearly understood that the electrodes of diodes 11 and 28 may be located within a common tube envelope, such as in the case of 6H6.

It is desired to apply about 40 voltage pulses a minute to the fence wire, and the voltage pulses are desired to be of relatively high magnitude. The voltage value developed across the secondary 31 will be about 5000 volts, provided a 40:1 transformer ratio is used. Of course, the voltage pulse will be a function of the transformer ratio as well as the voltage on condenser 30. The condenser 30 itself is charged by the rectified voltage output of diode 11 which rectifies the 60 cycle current. The diode 28 charges condenser 25 for the timing cycle. Condenser 30, then, is used to store up the energy for the pulse applied to the fence wire. The resistor 17 charges condenser 30 and has a value high enough so that no harmful voltage can be obtained from secondary 31, if for any possible condition condenser 30 is short-circuited. The resistor, also, limits the current that would flow through the thyratron in a continuous conduction state. Resistor 33 limits the current through lamp 34. Resistor 23 is the timing resistor, and is used with condenser 25 so that the "off-time" is a function of this RC constant. The RC constant of condenser 30 and resistor 17 should be small enough to permit peak charging of condenser 30. High and low power may be selectively obtained by changing the amount of voltage on condenser 30 by means of the adjustment of switch element 15. The resistance of the fence wire can be calculated by the number of pulses per minute or flashes of neon light 34, since the amount of voltage across the primary winding 26 is dependent upon the inductance of the primary and the primary inductance is, in turn, dependent on the secondary loading.

Considering the operation of the system in more detail, the condenser 30 charges fully long before the grid 24 of tube 20 permits the thyratron tube to "fire." The action of the diodes 11, 28 and thyratron 20 through one complete cycle is as follows: When the alternating voltage on secondary 8 is positive for the anode 10 of diode 11, the latter will become conductive thereby charging condenser 30 through resistors 17 and 33. When the control grid 24 of thyratron 20 attains the critical voltage the thyratron will fire thereby discharging condenser 30 through primary winding 26. This discharge current through primary 26 produces a negative voltage at the cathode 27 of diode 28. Hence, the condenser 25 will be charged negatively. While condenser 30 is charging for the next cycle condenser 25 is discharging through resistor 23. As soon as the voltage on condenser 25 reaches the critical grid value for the thyratron the cycle will repeat.

If a sufficient short-circuit is applied to the fence wire, the voltage built up across the primary winding 26 of the output transformer will be small and not hold off the thyratron. Immediately after the short circuit is applied, the period between successive firings of the thyratron becomes so short that the capacitor 30 does not have time to charge fully. The charge on the capacitor finally drops so low that the voltage across the primary winding 26 drops to a value which will not provide sufficient negative bias on the control grid of the thyratron to cut off the flow of current through the tube. This causes the thyratron to be continuously conductive during each positive half cycle of the power source, and will not allow pulses of energy to be put on the fence wire. Although during each negative half cycle of the power source neither the thyratron nor the diode tube 11 is conductive, if the sufficient short-circuit applied to the fence wire is not relieved, the thyratron tube will conduct during each positive half cycle of the power source. As soon as the short-circuit is removed, the pulsing of the voltage at the fence wire will recommence. My system, then, acts to prevent shocks to human beings, if the thyratron is shorted, by by-passing the current through the shorted thyratron instead of primary 26.

While I have indicated and described a system for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organization shown and described, but that many modifications may be made without departing from the scope of my invention.

What I claim is:

1. In a fence wire charging system, a source of low frequency voltage, a transformer having its primary coupled to the source, a second transformer, a rectifier and a charging condenser in a closed series circuit with the primary winding of the second transformer, means for limiting the rate of charging of said charging condenser and for limiting current flow through said primary winding of the second transformer when said charging condenser is short-circuited, a thyratron, a device of unidirectional conductivity connecting the thyratron control grid to the negative terminal of the condenser, a second condenser connecting the control grid and cathode of the thyratron, said second condenser being in a closed series circuit with the said device and second transformer primary winding, said charging condenser being in a closed series circuit with the said device between the anode and control grid of the thyratron, and means conductively connecting the fence wire to the second transformer secondary.

2. In combination with a source of alternating current voltage, a first rectifier in circuit with said source, a condenser in circuit with the rectifier adapted to be charged to a desired voltage, means for limiting the rate of charging of said condenser, a grid-controlled tube having a timing condenser between its control grid and electron emitter, a second rectifier arranged in a series circuit including said first condenser, the anode of the tube and said control grid, and means for deriving in pulse form the voltage across the first condenser.

3. In a fence wire charging system, a source of low frequency voltage, a transformer having its primary coupled to the source, an output transformer, a rectifier and a charging condenser in a closed series circuit with the primary winding of the output transformer, means for limiting the rate of charging of said charging condenser and for limiting current flow through the primary of said output transformer if said charging condenser is short-circuited, a thyratron, a diode connecting the thyratron control grid to the negative terminal of the condenser, a timing condenser connecting the control grid and cathode of the thyratron, said timing condenser being shunted by a resistor and being connected in a closed series circuit with the said diode and output transformer primary winding, said charging condenser being in a closed series circuit with the said diode between the anode and control grid of the thyratron, and means conductively connecting the fence wire to the output transformer secondary.

4. In combination with a source of alternating current voltage and a conductor to be periodically charged, a first rectifier in circuit with said source, a first condenser in series circuit with said first rectifier and said source, said first condenser being adapted to be charged to a desired voltage by said source, a grid-controlled gas-filled tube having a second condenser in circuit between its control grid and electron emitter, a second rectifier arranged in series circuit with said first condenser and said second condenser for charging said second condenser while said first condenser is discharging, means for limiting the rate of charging of said first condenser by said source and for limiting current flow to said conductor when said first condenser is short-circuited, and means for applying in pulse form to said conductor the voltage across said first condenser.

5. In combination with a source of alternating current voltage, a first rectifier in circuit with said source, a first condenser in series circuit with said first rectifier and said source, said first condenser being adapted to be charged to a desired voltage by said source, a grid-controlled, gas-filled tube having a second condenser between its control grid and electron emitter, a second rectifier arranged in series with the first condenser between the anode of the tube and said control grid, means for limiting the rate of charging of said first condenser by said source, a resistor in shunt with said second condenser to provide a timing circuit, and means for producing in pulse form the voltage across the first condenser.

6. In an electrical system, a source of low frequency voltage, a first transformer having its primary coupled to the source, a second transformer, a rectifier and a charging condenser in a closed series circuit with the primary winding of said second transformer and with the secondary winding of said first transformer, means for limiting the rate of charging of said charging condenser, a thyratron, a device of unidirectional conductivity connecting the thyratron control grid to the negative terminal of said charging condenser, a timing condenser connecting the control grid and cathode of the thyratron, said timing condenser being in closed series circuit with said device and said second transformer primary winding, and said charging condenser being in a closed series circuit with the said device between the anode and control grid of the thyratron.

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