PATENT OFFICE

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Patents Act 1952

592155

APPLICATION FOR A STANDARD PATENT OR A STANDARD PATENT OF ADDITION

Insert full name(s) of applicant(s)

(71) X/We GALLAGHER ELECTRONICS LIMITED, a New Zealand company

Insert address(es) of applicant(s)

of Kahikatea Drive, Hamilton, New Zealand

Insert title of invention

(54) hereby apply for the grant of a ☒ standard patent ☐ patent of addition for an invention entitled ELECTRONIC FENCE ENERGISER

(tick appropriate box)

which is described in the accompanying ☒ provisional ☐ complete specification.

Insert name of actual inventor

(72) The actual inventor (X) of the said invention is/are XX JEREMY JOHN MCKISSACK

Insert address for service of notices in Australia

(74) My/our address for service is BARKER, BLENKINSHIP & ASSOCIATES, P.O. Box 34, Chatswood, N.S.W. 2067 Attorney Code

**THESE SECTIONS ARE ONLY TO BE COMPLETED WHERE APPLICABLE:*

for Convention cases only

(ONLY TO BE USED IN THE CASE OF A CONVENTION APPLICATION)

Details of basic application (s) –

(31) Number of basic application

(33) Name of Convention country in which basic application was filed ISO Code

(32) Date of basic application

for Divisional applications only

(ONLY TO BE USED IN THE CASE OF A FURTHER APPLICATION MADE BY VIRTUE OF SECTION 51)

(62) Number of original application APPLICATION ACCEPTED AND AMENDMENTS

Person by whom made ALLOWED 26.10.89.

for Patents of addition only

(ONLY TO BE USED IN THE CASE OF AN APPLICATION FOR A PATENT OF ADDITION)

I request that the patent may be granted as a patent of addition to the patent applied for on

(61) Application No. Patent No.

in the name of

I request that the term of the patent of addition be the same as that for the main invention or so much of the term of the patent for the main invention as is unexpired.

Insert day, month and year form signed

Dated this 24th day of February 1986.

Signature of applicant or Australian attorney

TO

GALLAGHER ELECTRONICS LIMITED by attorneys Barker, Blenkinship & Associates:

(Signature)

THE COMMISSIONER OF PATENTS

Julian Blenkinship

This form must be accompanied by either a provisional specification (Form 9 and true copy) or by a complete specification (Form 10 and true copy).

P/00/007

Patent Application No 69121/87

Patents Act 1952

DECLARATION IN SUPPORT OF AN APPLICATION FOR A PATENT

In support of the Application made by GALLAGHER ELECTRONICS LIMITED

for a patent for an invention entitled ELECTRONIC FENCE ENERGISER

I, William Murray Gallagher managing Director

of GALLAGHER ELECTRONICS LIMITED

do solemnly and sincerely declare as follows:-

1. I am the applicant for the patent.

(or, in the case of an application by a body corporate)

1. I am authorized by GALLAGHER ELECTRONICS LIMITED the applicant for the patent to make this declaration on its behalf.

2. I am the actual inventor of the invention.

(or, where a person other than the inventor is the applicant)

2. JEREMY JOHN MCKISSACK of Laxon Road, R.D. 8, Frankton, Hamilton New Zealand is the actual inventor of the invention and the facts upon which ~~I am~~ the company is entitled to make the application are as follows:-

The company is the assignee of the inventor in respect of the invention by virtue of an Employment Contract

Declared at Hamilton this 21st day of March 1986.

TO:

THE COMMISSIONER OF PATENTS.

wm Gallagher

(Signature of Declarant)

(IMPORTANT - Cross out inapplicable words in the above Form.)

(12) PATENT ABRIDGMENT (11) Document No. AU-B-69121/87
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 592155

(54) Title
ELECTRIC FENCE ENERGISER

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(60) Related to Provisional(s) : PH4752

(71) Applicant(s)
GALLAGHER ELECTRONICS LIMITED

(72) Inventor(s)
JEREMY JOHN MCKISSACK

(74) Attorney or Agent
BARKER, BLENKINSHIP & ASSOC.

(56) Prior Art Documents
AU 68340/81 H03K, H05C
AU 523322 38286/78 H05C, H03B, H03K

(57) Claim

1. An electric fence energiser comprising an energy storage capacitor chargeable from a power source, switching means, the action of said switching means being able to cause the discharge of said energy storage capacitor, a trigger circuit, said trigger circuit controlling said switching means, a transformer having an output adapted to be connected to an electric fence, to which transformer the discharge from the energy storage capacitor is conducted, said transformer having a resonant circuit associated with the primary or secondary windings thereof wherein the resonant circuit is adapted to modify the wave form delivered to the output of the transformer via the switching means to reduce the radio frequency interference that can result during operation of the fence energiser.

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Form 10

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

Short Title:

Int. Cl:

Application Number: 69121/87
Lodged:

Complete Specification—Lodged:
Accepted:
Lapsed:
Published:

Priority:

Related Art:

This document contains the amendments made under Section 49 and is correct for printing.

TO BE COMPLETED BY APPLICANT

Name of Applicant: GALLAGHER ELECTRONICS LIMITED

Address of Applicant: Kahikatea Drive, Hamilton, New Zealand

Actual Inventor: Jeremy John McKissack

Address for Service: BARKER, BLENKINSHIP & ASSOCIATES, P.O. Box 34, Chatswood, N.S.W. 2067

Complete Specification for the invention entitled: ELECTRONIC FENCE ENERGISER

The following statement is a full description of this invention, including the best method of performing it known to me:—*

* Note: The description is to be typed in double spacing, pica type face, in an area not exceeding 250 mm in depth and 160 mm in width, on tough white paper of good quality and it is to be inserted inside this form.

14599/78—L

Printed by C. J. THOMPSON, Commonwealth Government Printer, Canberra

This invention relates to electric fence energisers.

By the very nature of their operation, energisers are responsible for radio interference and in countries which rely particularly upon radio communication, a reduction in this source of interference would be welcomed. The interference is caused by sharp changes in voltage across the output terminals of the energiser.

This invention provides an electric fence energiser comprising an energy storage capacitor chargeable from a power source, switching means, the action of said switching means being able to cause the discharge of said energy storage capacitor, a transformer having an output being connected to an electric fence to which transformer the discharge from the energy storage capacitor is conducted, the transformer having a resonant circuit associated with the primary or secondary windings thereof, said resonant circuit including a inductor, the inductance of which is sufficient to slow down the rate of discharge of the energy storage capacitor thus reducing radio frequency interference.

According to a further aspect of the present invention there is provided an electric fence energiser as claimed in claim 1 wherein the resonant circuitry consists of an output transformer, the primary windings of which are in parallel with the energy storage capacitor and an inductor plus a switching capacitor respectively in series from one terminal of the transformer's primary windings forming a closed loop with the other transformer's primary windings.

Aspects of the present invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1: is a block diagram of an electric fence energiser according to the present invention, and

Figure 2: is a circuit diagram showing in more detail components of the electric fence energiser of Figure 1, and

Figure 3: is a circuit diagram of a resonant output transformer circuit according to one alternative construction of the present invention, and

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Figure 4: is a circuit diagram of a resonant output transformer circuit according to a further alternative construction of the present invention.

With respect to Figure 1 of the drawings an electric fence energiser according to the present invention comprises a DC-DC converter 1 connected between a DC power source 2 and an energy storage capacitor 3, a discharge path for said capacitor 3 via a resonant output transformer circuit 4 adapted for connection to a fence system and a controllable switch 6 controlled by an independent pulse trigger 7 to provide discharge of said energy storage capacitor approximately once per second, the voltage across said energy storage capacitor 3 having been brought to a substantially constant peak value immediately prior to discharge by the application of feedback control to said DC-DC converter 1 and the said resonant output transformer circuit 4 providing commutation feedback to said controllable switch 6 such that said energy storage capacitor 3 is discharged to a value dependent upon load conditions of said output circuit and consequently the input energy requirements of said DC-DC converter 1 is also dependent on output circuit load conditions.

The DC power source 2, the DC-DC converter 1 and a feedback circuit 8 and the energy storage capacitor 3 are connected such that the voltage across the capacitor 3 reaches a predetermined value, immediately prior to discharge.

Referring now to Figure 2 of the drawings the DC-DC converter 1 operates such that of the moment voltage is supplied by battery B1, a small current flows through resistor R4 into the base of the transistor Q3. This causes a larger current to flow in the primary windings (a,b) of the converter transformer T1. Regenerative action is produced by current flowing in the tickler windings (c,d) through the base of transistor Q3, diode D1 and resistor R5. Diode D2 ensures that transistor Q3 is not damaged by the unwanted negative voltages that are produced by the inverter action by providing an alternative current path. Resistor R5 controls the regenerative action by limiting the current flowing in the base of transistor Q3. The current in the primary windings (a,b) increases until the transformer Q2 saturates, and at this point the collector current stops increasing thus causing regenerative action to stop. The energy stored in the converter transformer as a magnetic field is then transferred via the secondary windings (a,b) and diode D3 to the energy storage capacitor C4.

Peak voltage across the energy storage capacitor is maintained at a predetermined value by the feedback circuit 8 as zener diode D4 is connected so that negligible current flows through it until the voltage across the energy storage capacitor C4 exceeds the zener voltage. The zener

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voltage is a property of the zener diode type, the type used being selected for the zener voltage and thus the peak voltage across the capacitor C4 required.

Current flowing through the zener diode flows through resistor R6 and into the base of transistor Q2, causing the transformer to conduct, and thus shunt current away from the base of the transistor Q3 which then inhibits the regenerative action of the DC-DC converter, which as a result stops further energy transfer to the capacitor C4. This then limits the peak voltage across capacitor C4 to a level predetermined to the zener voltage of zener diode D4.

Capacitor C4 is discharged into the resonant output transformer circuit 4, via controllable switch 6. This switch is controlled by a trigger circuit 7, which is in the form of a typical unijunction transistor relaxation oscillator, having a period fixed by resistor R1 and capacitor C2, of approximately 1 second. The output pulse from this trigger circuit has a pulse width that is less than the commutated turn-off time of the controllable switch 6.

When there is a light load on the output circuit, the discharge of the energy storage capacitor into the resonant output transformer circuit consisting of the output transformer T2, capacitor C5, and inductor L results in a damped sinusoidal voltage to be produced across the primary of transformer T2. As the sinusoidal voltage falls through zero the controllable switch turns off, the discharge current from the energy storage capacitor falls to zero, and further discharge is inhibited until the time of the next trigger pulse from the trigger circuit 7. At the moment the discharge of the capacitor C4 is inhibited the voltage across this capacitor will be at some value below the predetermined peak value but substantially greater than zero. The DC-DC converter then works to increase the voltage on capacitor C4 back to the predetermined peak value as described herein.

When there is a heavy load on the output circuit the resonant output circuit 4 is over damped so that the sinusoidal voltage across the controlled switch never reaches a value that will commutate the switch off. As a result the capacitor C4 discharges until the voltage across it is approximately zero. The DC-DC converter then works to charge capacitor C4 until the voltage across the capacitor is increased from approximately zero volts to the predetermined peak voltage. It can be seen from the above that the amount of charge that is removed from the energy storage capacitor, and thus ultimately the amount of energy this charged is dependent upon the load on the output circuit of the electric fence energiser.

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Further, the resonant output transformer has the effect of slowing down the rate of discharge of the energy storage capacitor, a result of which is that the radio interference caused by the voltage produced across the output circuit, is reduced.

Figure 3 of the drawings illustrates a resonant output transformer circuit according to the example described in relation to Figure 2. Figure 4 of the drawings illustrates an alternative to the Figure 3 circuit where a capacitor C6 is fixed across the output connections of the transformer 2.

The relationship between the current drawing from the DC power source and the loading of the output circuit can be described as follows:

Vd	=	voltage across C4 at the instant that the controllable switch turns off.
Vc	=	peak voltage across energy storage capacitor C4.
Vs	=	voltage supplied by battery B1.
t	=	time between trigger pulses, and thus time between impulses.
C	=	capacitance value of energy storage capacitor C4.
Is	=	current drain from battery B1.
E	=	efficiency of DC-DC converter, a factor less than 1.

From conservation of energy we have:

$$VsxIsxt = 0.5xCx(Vc-Vd)^2E \text{ - Equation (1)}$$

(energy input = (energy stored) x (energy wastage factor).

Rearranging Equation (1) gives the battery current drain.

$$Is = 0.5xCx(Vc-Vd)^2/E\ (Vsxt) \text{ - Equation (2)}$$

For a given circuit most of the above variables are in fact essentially constant. These can then be lumped together so that Equation (2) can be rewritten:

$$Is = Kx(Vc-Vd)^2 \text{ - Equation (3)}$$

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It is clearly seen from Equation (3) that the battery current is dependent upon Vd. In the case of a heavily loaded output circuit Vd is zero so that (Vc-Vd) and therefor Is, is maximised.

For a lightly loaded output circuit Vd is almost equal to Vc so that (Vc-Vd) and therefor Is is minimised.

Although in the embodiment described herein by way of example, the electric fence energiser is shown to include a DC-DC converter it is to be appreciated that this is not essential to the primary function of the present invention.

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The claims defining the invention are as follows:

1. An electric fence energiser comprising an energy storage capacitor chargeable from a power source, switching means, the action of said switching means being able to cause the discharge of said energy storage capacitor, a trigger circuit, said trigger circuit controlling said switching means, a transformer having an output adapted to be connected to an electric fence, to which transformer the discharge from the energy storage capacitor is conducted, said transformer having a resonant circuit associated with the primary or secondary windings thereof wherein the resonant circuit is adapted to modify the wave form delivered to the output of the transformer via the switching means to reduce the radio frequency interference that can result during operation of the fence energiser.

2. An electric fence energiser as claimed in claim 1 wherein the resonant circuit associated with the primary or secondary windings of the transformer provides commutation feedback to said switching means such that the energy storage capacitor is discharged to a value dependent upon the load on the transformer.

3. An electric fence energiser as claimed in either claim 1 or 2 wherein the resonant circuit comprises a capacitor in parallel with the transformer primary connections and an inductance forming a series circuit

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between one transformer primary connection and said switching means.

4. An electric fence energiser as claimed in either claim 1 or claim 2 wherein the resonant circuit includes a capacitor in parallel with the secondary connections of the transformer.

5. An electric fence energiser as claimed in any one of claims 1 to 4 wherein the power source includes a convertor and the transformer is electrically connected to the convertor via a feed back control circuit, said control circuit controlling input from the power source to be dependant upon the load the fence imposes.

6. An electric fence energiser as claimed in claim 5 hereof wherein the feedback control circuit comprises a Zener diode controlling a transistor, the arrangement being such that the regenerative action of the convertor is inhibited by the feedback control circuit to limit voltage output from the energy storage capacitor to a level determined by the diode.

DATED this 17th day of October 1989

GALLAGHER ELECTRONICS LIMITED

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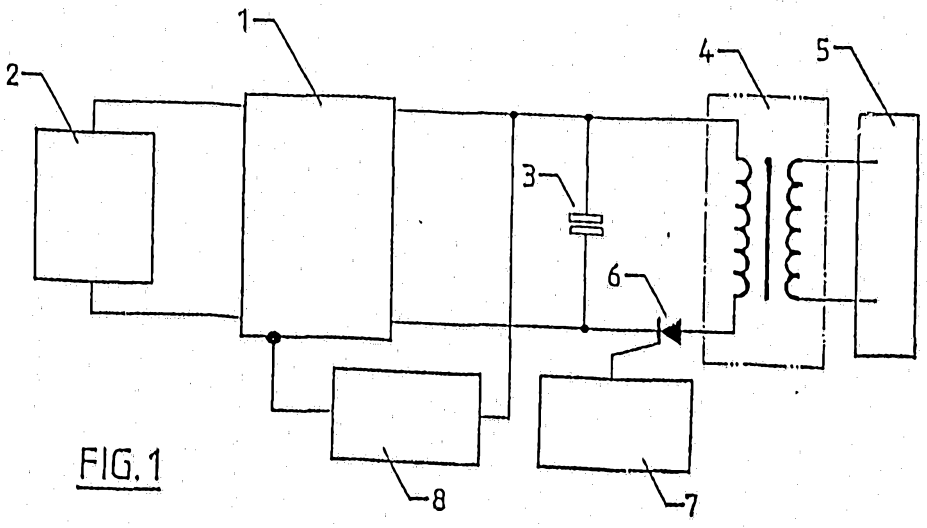

FIG. 1

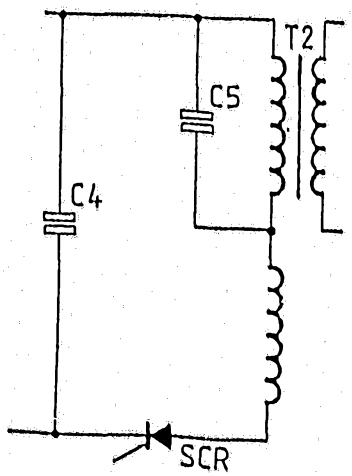

FIG. 3

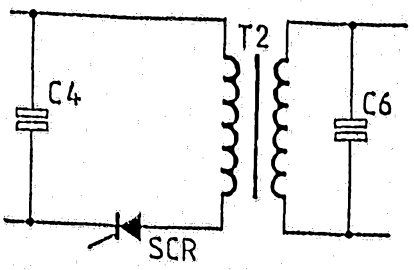

FIG. 4

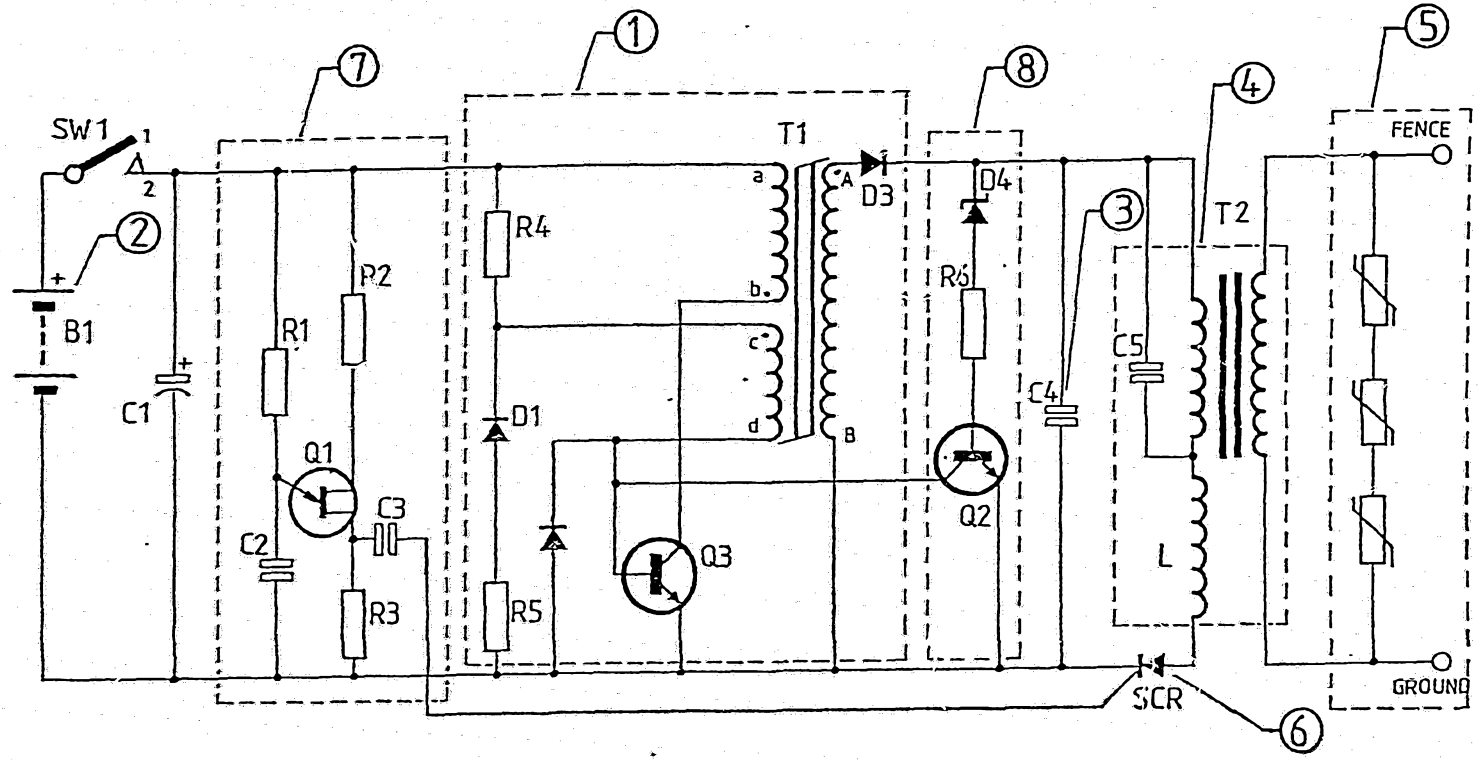

FIG. 2

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