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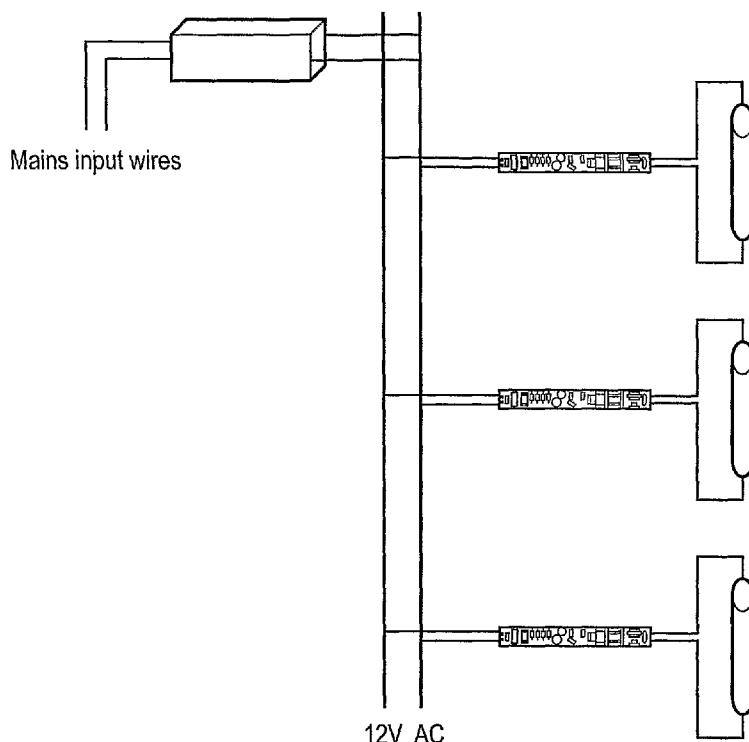
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(54) Title: INVERTERS



(57) Abstract: Drive circuitry for a fluorescent lamp comprising inverter circuitry having outputs for connection to respective terminals of a fluorescent lamp and an extra low voltage transformer connected to the inputs of the inverter circuitry. The drive circuitry can be connected to one or more fluorescent lamps.

Diagram of electronic transformer in combination with inverter  
(Could also be one inverter)

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## Inverters

### Field of the Invention

The present invention relates to inverters. In particular it relates to a low (more preferably  
5 extra low) voltage AC high frequency inverter that can be used in the drive circuitry for a  
gas discharge lamp, for example a fluorescent lamp.

### Background

Gas discharge lamps generate light by passing an electrical discharge through an ionized  
10 gas. The principles of operation of such lamps are well known and need not be explained  
here. Some gas discharge lamps emit ultraviolet radiation that is converted to visible light  
by a fluorescent coating on the inside of the lamp's glass casing. These types of lamp are  
commonly referred to as "fluorescent lamps".

15 Gas discharge lamps, and fluorescent lamps in particular, offer significant advantages  
over incandescent lamps. In particular they tend to be more efficient than incandescent  
lamps of an equivalent brightness and last between 10 and 20 times as long. Their long  
life in particular makes them very attractive for commercial installations where the cost of  
replacing lamps (including labour costs) can be particularly significant.

20

Typically, fluorescent lamps are powered from a mains supply (e.g. 240V AC), a ballast  
being used between the power supply and the lamp to regulate the current flow through  
the lamp.

### Summary of Invention

A general aim of the present invention is to enable fluorescent lighting installations that  
can be powered by conventional extra-low voltage transformers (i.e. power supplies). For  
example, such lighting installations could be beneficially used in commercial shelving  
installations (to light shelves), for example in supermarkets or other shops.

30

"Low voltage" in the context of this application means voltages up to 1000V AC but  
preferably below 240V (i.e. below mains voltage). "Extra low voltage" in the context of  
this application means voltages less than 50 volts RMS (AC), such as 24V, 18V and 12V  
or less.

35

To achieve this aim, it has been necessary to develop a new low- / extra low voltage AC high frequency inverter as known extra low voltage inverters are not suitable.

In particular, there are two main known types of extra low voltage inverters:

5

1. A DC type is powered through a DC power supply. A problem with this type of inverter is that the positive and negative polarities must be strictly insulated and kept clear from contact with the polarities of the adjacent units.

10

2. An AC Low frequency unit, which is powered by *Low frequency* AC traditional heavy wire-wound transformers (non-electronic). A problem with this type of inverter is that the electrical contacts from the output of the transformer to the fitting(s) must be solid, (hard wired) otherwise they could generate excessive heat with consequent Arcs and Sparks and a high noise level. Additionally, from a safety point of view these transformers only have a thermal safety cut out.

15

In contrast, embodiments of the present invention can use a standard electronic transformer to power a fluorescent light fitting. This has never been done before, because these electronic transformers are designed to be directly connected to halogen lamps, rather than connected to a lamp via an inverter as is required for (i.e fluorescent lamps need an inverter between themselves and the transformer). Such an inverter has never been made. This has only been made possible by the use of a combination of tuning capacitors, resistors and copper coils, which are not present in standard inverters.

20

25

Thus, the present invention consists of a Low voltage AC high frequency inverter. This inverter could be powered by a standard Extra low voltage AC *high frequency* electronic transformer (e.g. the same type of electronic transformer as used to power low voltage Halogen incandescent lamps.) These transformer also incorporate an extra safety overload, short-circuit and thermal protection features, offering additional benefits.

30

One difference between low frequency and high frequency transformers that are preferred for use with embodiments of the present invention is that whereas the output of conventional wire wound transformers is at the same frequency as the input (i.e. 50Hz) with a sinusoidal waveform, the output of (high frequency) electronic transformers is an

envelope which is basically sinusoidal at twice the frequency of the input, e.g. modulated with a 35KHz (nominal) square wave.

5 With lighting installations employing preferred embodiments of this new invention, fittings would not be affected if they made contact with polarities of adjacent fittings. Furthermore it only requires touch contacts to function, and the noise problems are alleviated. There would also be the advantage of instantaneous cut-outs if things went wrong.

10 In preferred embodiments, the light fitting also features side springs which make instant contact with conductors mounted on shelving brackets, without using input wires. The brackets make contact with two conductors, which link the inputs of the inverters to the two outputs of the electronic transformer.

#### Brief Description of the Drawings

15 An example of the invention will now be described by referring to the accompanying drawings:

Fig. 1 shows part of an inverter circuit for an embodiment of the present invention;

20 Fig. 2 shows another part of the inverter circuit of fig. 1;

Fig. 3 shows a light-fitting assembly with inverter and side springs in accordance with an embodiment of the present invention;

25 Fig. 4 shows a PCB, which attaches to side bracket of shelves and can be used with embodiments of the present invention;

Fig. 5 shows a side mounting spring that can be used on the side of the fitting in the assembly of fig. 3 (could also be other cushioning material);

30

Fig. 6 shows a diagram of electronic transformers in combination with inverters. (Could also be one inverter);

35 Fig. 7 shows a shelving system with which the present invention can be used to power fluorescent tubes mounted on the shelving system; and

Fig. 8 shows circuit diagrams for an embodiment of the invention.

#### Description of Embodiment

5 An exemplary inverter circuit in accordance with an embodiment of the invention will be described with reference to figures 1 and 2.

Looking first at fig. 1, from left to right, we have two low voltage AC currents outputs from the electronic transformer (A1 & A2) – the electronic transformer itself is not shown. The  
10 flow goes through the inverter circuitry as follows:

- A1 goes through a safety fuse
- A1 & A2 go through a Choke (LO207). The choke acts as a suppressor to smooth  
15 AC supply.
- A1 & A2 go through an AC capacitor. The capacitor stores currents. Both the choke and capacitors act as a filter for AC current.
- 20 - A1 & A2 go through a bridge of 4 Diodes, which changes the current from AC to DC, this also results in a voltage increase.
- DC+ and DC- go through three capacitors.

25 The flow continues in figure 2 (fig1 & fig2 show one circuit)

- DC+ goes through 4 resistors (R1, R2, R3,R4) then through a tuning coil, then to input 1 of the transformer.
- 30 - DC- Goes through one of 3 terminals of two thermal switches (TIP1 & TIP2) which act as tube starters
- R1 & R2 are linked with 3<sup>rd</sup> terminal of Tip1, then to input 3 of the transformer.
- 35 - R3 & R4 are linked with 3<sup>rd</sup> terminal of Tip2, the to input 2 of the transformer

- Centre terminal of TIP1 goes through capacitor C4 then to input 5 of the transformer
- 5 - Centre terminal of TIP2 goes through capacitor C4 then to input 4 of the transformer
- Transformer output1 (TO1) goes through three series linked capacitors ( C5, C6 and C7) to one end of the tube.
- 10 - The second transformer output (TO2) goes directly to the second end of the tube.

Conveniently, the inverter circuitry can be incorporated in a fluorescent lamp fitting, as  
15 shown for example (in exploded form) in Fig. 3. The inverter circuitry can be housed within the body of the fitting, outputs from the circuit being connected to respective terminals of the fluorescent lamp (a fluorescent tube in the present case).

The fitting illustrated in this example also has spring connectors at each end to make  
20 contact with power supply tracks in the shelf brackets on which the fitting is to be mounted (as described, for example, in our earlier patent application GB2428141). A detailed view of the spring mounting clip is shown in fig. 5.

Also as described in GB2428141, the power supply track on the shelf bracket may be  
25 provided by a PCB strip, as illustrated in Fig. 4. This PCB strip attaches to a side bracket of the shelf.

As illustrated schematically in Fig. 6, multiple inverter circuits can be connected to  
30 respective fluorescent lamps in a shelving installation, all powered by a single transformer (e.g. an extra low voltage transformer). In alternative embodiments, a single inverter circuit could be used to drive multiple lamps.

Fig. 7 shows a shelving system with which the present invention can be used to power  
fluorescent tubes mounted on the shelving system.

Fig. 8 shows circuit diagrams for an embodiment of the invention.

Various modifications can be made to the specifically described and illustrated embodiments without departing from the spirit and scope of the present invention.

Fig. 3 parts list

**p1**  
**D283-031**  
**FLUORESCENT RIVERTER**  
**X1**

**p2**  
**D283-033**  
**M3 X 8L COUNTERSUNK SCREW**  
**X4**

**p3**  
**D283-016**  
**LUMINAIRE END CAP RH**  
**X1**

**p4**  
**D283-026**  
**LUMINAIRE SPRING**  
**X2**

**p5**  
**D283-035**  
**4 MM CRIMP CONNECTOR**  
**X2**

**p6**  
**D283-034**  
**M3 SELF TAPPING SCREW**  
**X2**

**p7**  
**D283-019**  
**LUMINAIRE BODY**  
**X1**

**p8**  
**D283-056**  
**POP RIVET**  
**3.2 X 8MM**  
**X2**

**p9**  
**D283-036**  
**RIVET ASSEMBLY**  
**X2**

**p10**  
**D283-032**  
**BJ8**  
**26.642.8601.05**  
**LAMP HOLDER**  
**X2**

**p11**  
**D283-032**  
**BJ8 26.242.106**  
**CLIP**  
**X2**

**p12**  
**D283-030**  
**LAMP 21W HE15-1**  
**X1**

**p13**  
**D283-020.**  
**LUMINAIRE**  
**DIFFUSER**  
**X1**

**p14**  
**D283-017**  
**LUMINAIRE END CAP LH**  
**X1**



Claims

1. Drive circuitry for a fluorescent lamp comprising inverter circuitry having inputs for an extra low voltage alternating current supply from an extra low voltage transformer and  
5 outputs for connection to respective terminals of a fluorescent lamp.
2. Drive circuitry according to claim 1, further comprising an extra low voltage transformer connected to the inputs of the inverter circuitry.
- 10 3. Drive circuitry according to claim 2, wherein the transformer is an electronic transformer.
4. Drive circuitry according to any one of the preceding claims in combination with one or more fluorescent lamps connected to the outputs from the inverter circuitry.
- 15 5. Drive circuitry according to any one of the preceding claims, wherein the inverter circuitry comprises a filter for the AC input current.
6. Drive circuitry according to claim 5, wherein the filter comprises a choke and an AC  
20 capacitor.
7. Drive circuitry according to any one of the preceding claims, wherein the inverter circuitry comprises an AC to DC converter.
- 25 8. Drive circuitry according to claim 7, where there is a voltage increase across the AC to DC converter.
9. Drive circuitry according to claim 7 or claim 8, wherein the AC to DC converter comprises a diode bridge.
- 30 10. Drive circuitry according to any one of the preceding claims comprising one or more thermal switches that serve as starters for the fluorescent lamp(s).

11. Drive circuitry according to any one of the preceding claims, wherein the inverter circuitry comprises a transformer on the output side, respective outputs from the transformer providing the outputs for connection to the fluorescent lamp(s).
- 5 12. A shelving installation comprising one or more fluorescent lamps for lighting the shelving installation, the fluorescent lamps being powered by an extra low voltage power source via drive circuitry according to any one of the preceding claims.
- 10 13. A shelving installation according to claim 12, wherein the fluorescent lamps are mounted in fixtures that house at least the inverter circuitry of the drive circuitry.
14. A shelving installation according to claim 13, wherein the fixtures comprise means for releasable mounting to a support structure of the shelving installation.
- 15 15. A shelving installation according to claim 14, wherein the fixture includes external electrical contacts that make contact with conductors in the support structure when the fixture is mounted on the support structure.
- 20 16. A shelving installation according to claim 15, wherein the contacts are resilient spring elements.
17. A fluorescent lamp fixture for a shelving installation according to any one of claims 12 to 16.
- 25 18. An extra low voltage alternating current high frequency inverter.

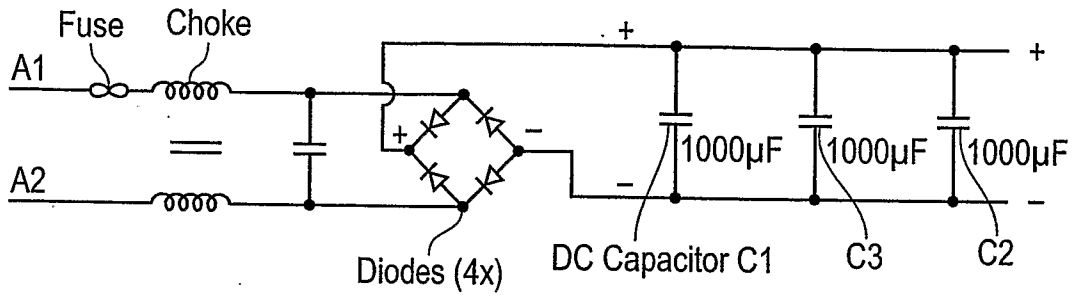


FIG. 1- Inverter Circuitry

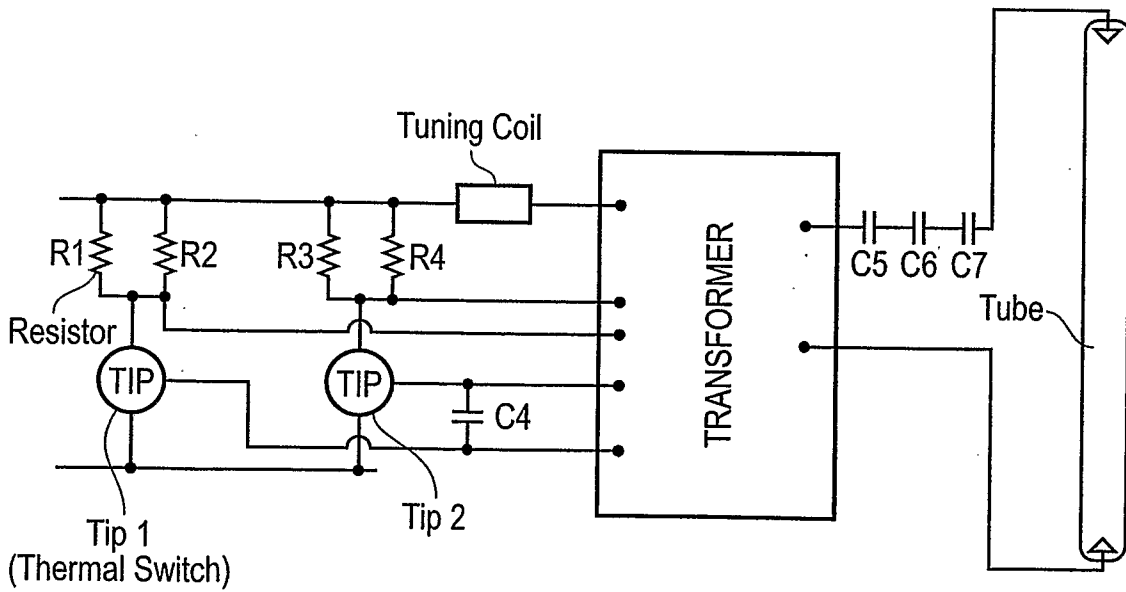


FIG. 2 - Continuation of inverter circuitry

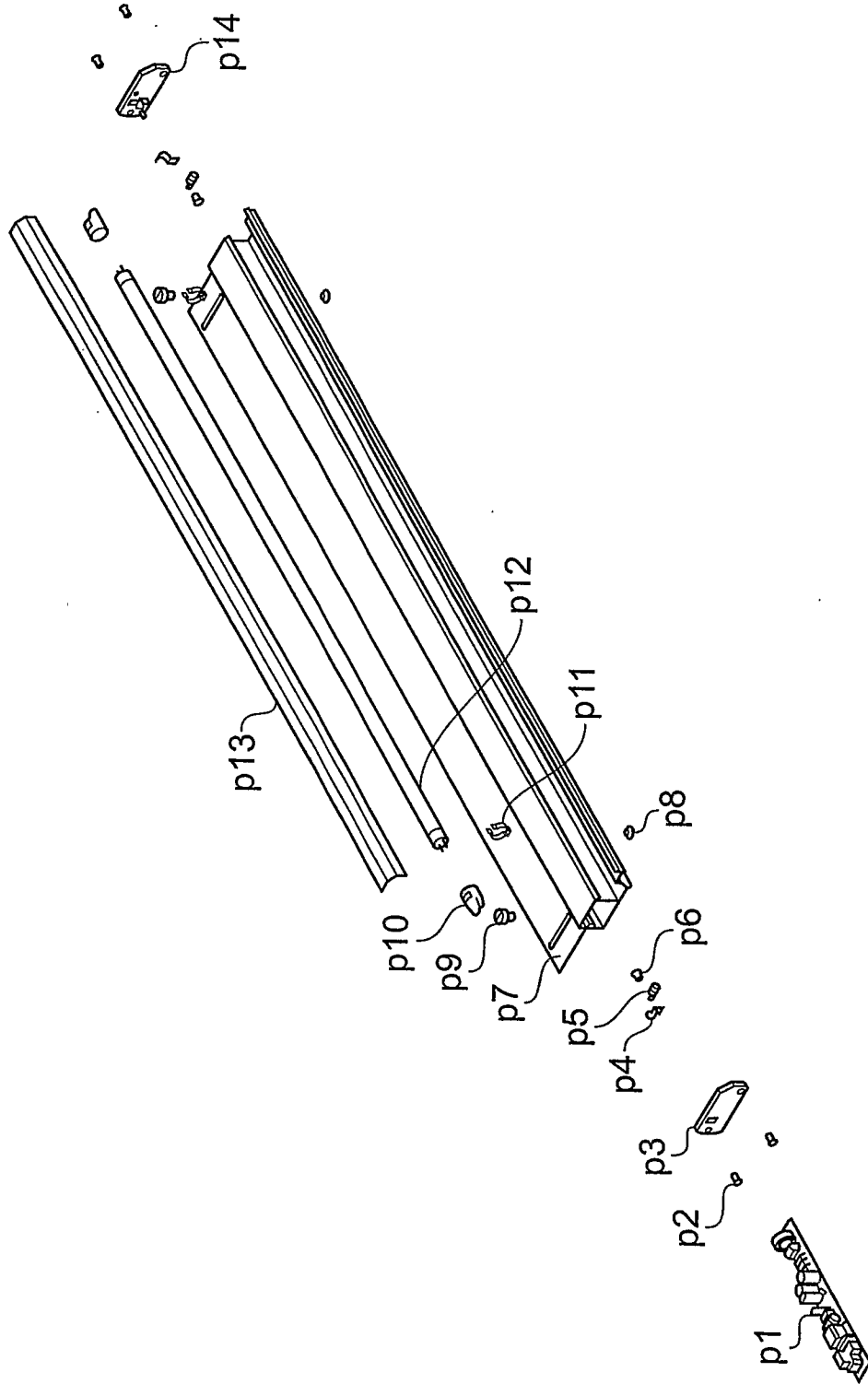


FIG. 3 - Light-fitting assembly with inverter and side springs

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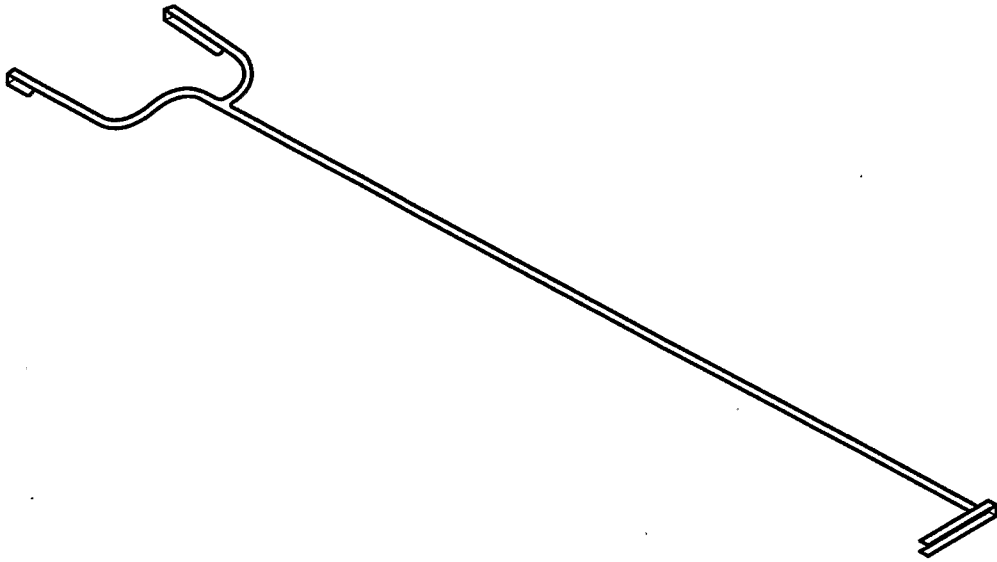


FIG. 4 - PCB, which attaches to the side bracket of shelves

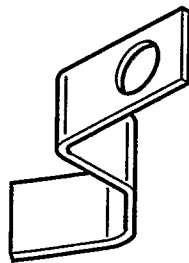


FIG. 5 - Side mounting spring on side of the fitting  
(Could also be other cushioning material)

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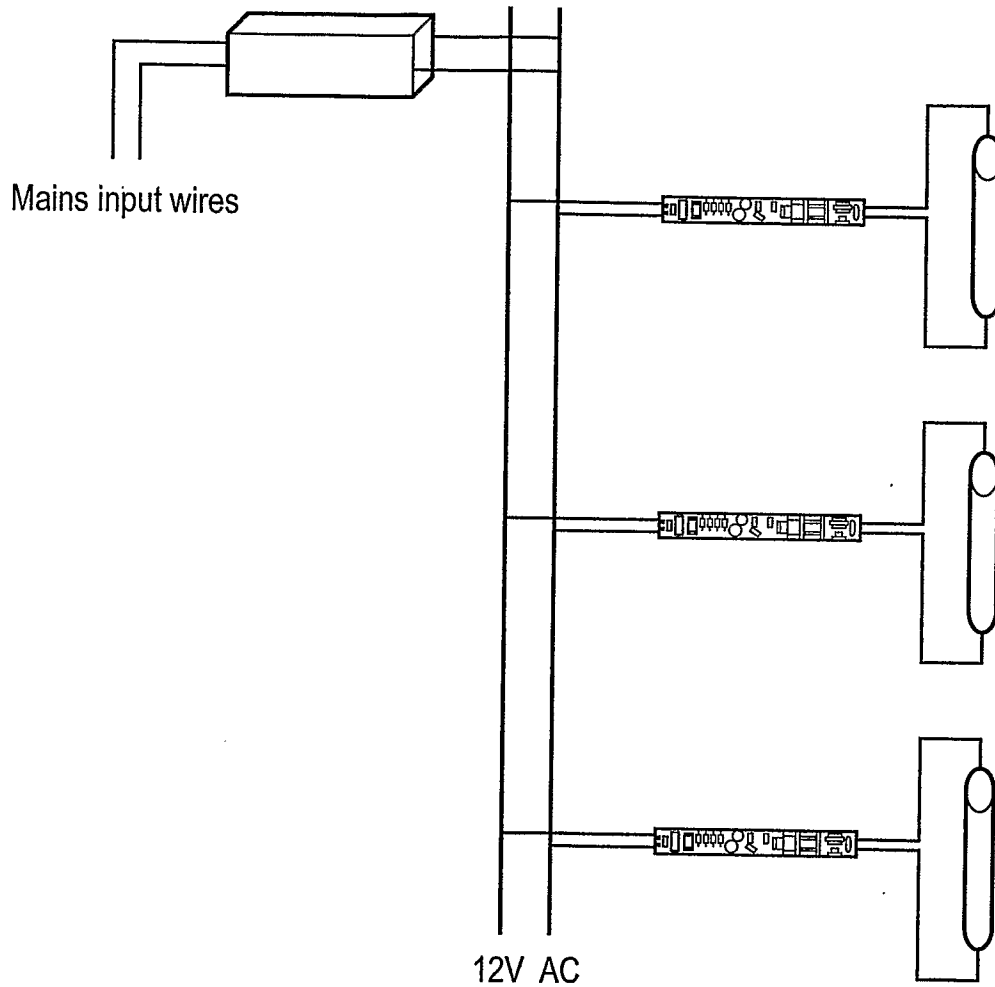


FIG. 6 - Diagram of electronic transformer in combination with inverter  
(Could also be one inverter)

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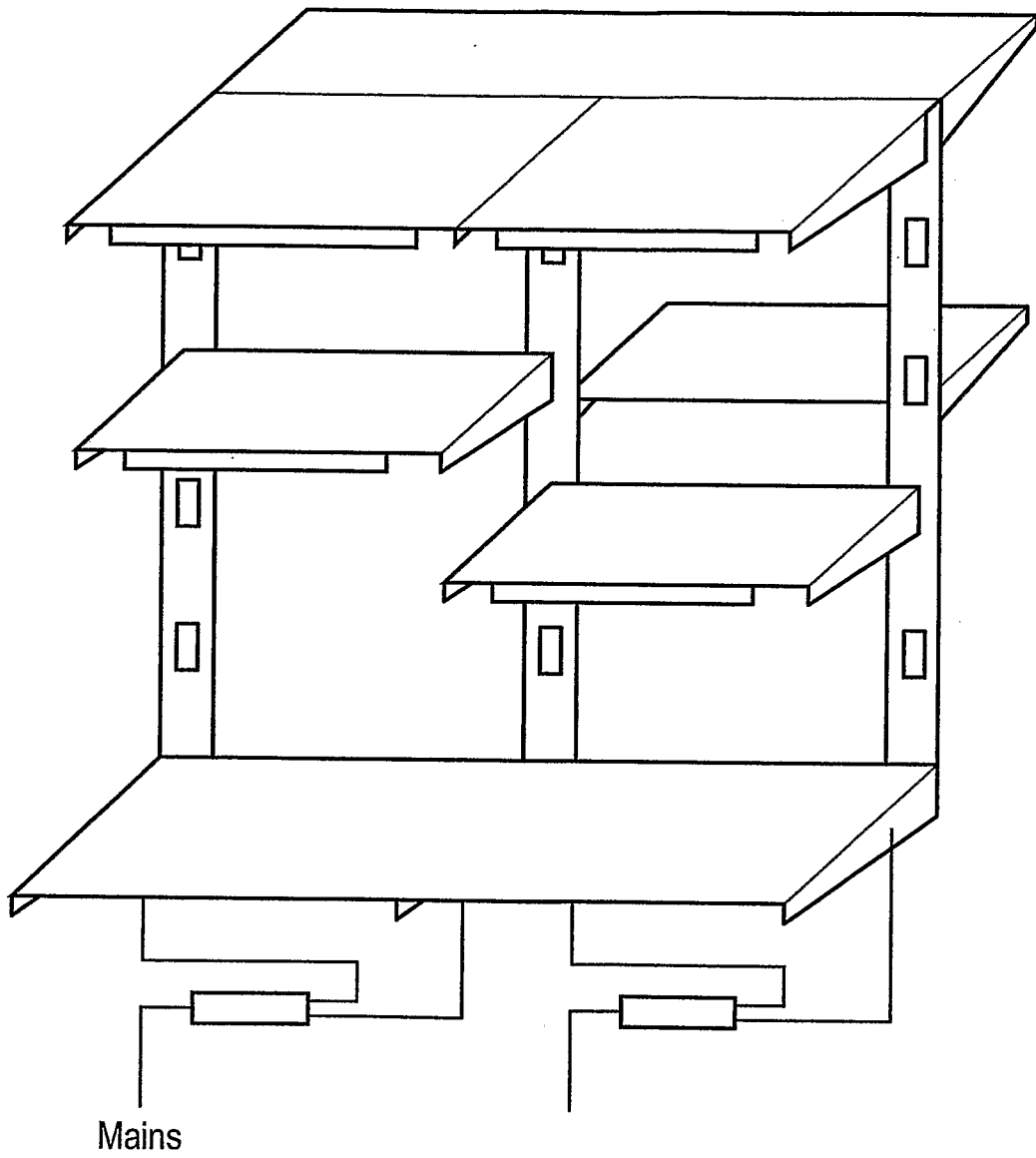


FIG. 7 - Complete System

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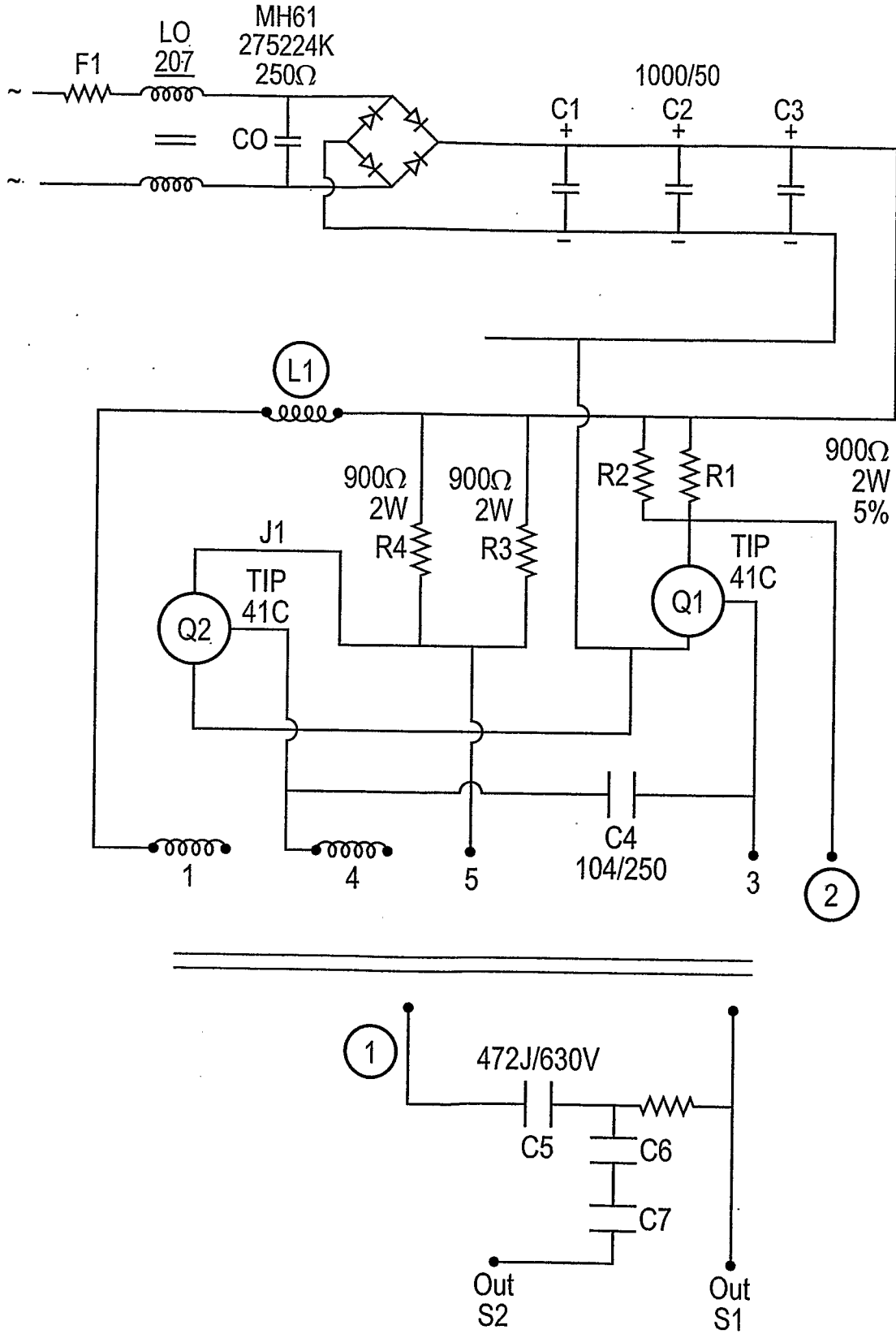


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No  
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A. CLASSIFICATION OF SUBJECT MATTER  
INV. H05B41/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 107 756 A (PARRA JORGE M [US]) 22 August 2000 (2000-08-22) abstract column 1, line 28 - column 2, line 37 column 4, line 32 - column 5, line 56 figures 1-4	1-18
X	US 4 940 921 A (HELLING JAMES C [US] ET AL) 10 July 1990 (1990-07-10) column 2, line 43 - column 4, line 47 column 7, line 39 - column 8, line 47 figures 1,2,11,13,14	1-18

Further documents are listed in the continuation of Box C.

See patent family annex.

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Date of the actual completion of the international search

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Name and mailing address of the ISA/

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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/GB2007/004533

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	<p>US 2003/090903 A1 (NEWMAN JEFFREY JAY [US]) 15 May 2003 (2003-05-15) the whole document</p>	
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A	<p>US 4 904 905 A (OLON THOMAS E [US]) 27 February 1990 (1990-02-27) the whole document</p>	
A	<p>US 2004/232775 A1 (NILSSEN OLE K [US]) 25 November 2004 (2004-11-25) the whole document</p>	
A	<p>US 6 144 445 A (NILSSEN OLE K [US]) 7 November 2000 (2000-11-07) the whole document</p>	

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Information on patent family members

International application No  
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