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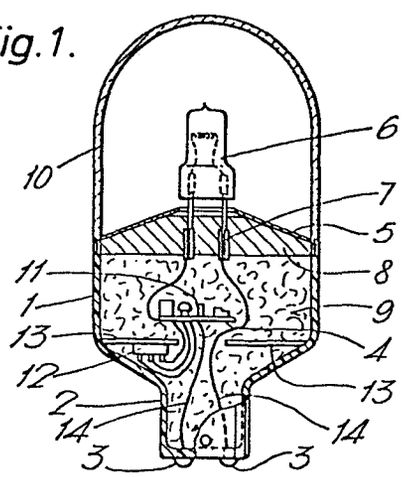
(54) **Load supply circuit and lamp module.**

(57) A direct replacement for an ordinary domestic G.L.S. bulb consists of a low voltage tungsten-halogen lamp (6), which has a greater efficiency at low voltages, and an electronic circuit (11) for stepping down the mains voltage to a suitable level, all within a lamp replacement unit for fitting into an ordinary lamp socket, The electronic circuit includes a gate-turnoff thyristor (12) for switching the lamp into and out of the supply circuit and an i.c, (25) for triggering the thyristor at a desired phase angle of the mains supply (20).

Fig.1.



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Load Supply Circuit and Lamp Module

This invention relates to load supply circuits, and particularly to such a circuit enabling low voltage lamps to be used from a high voltage source such as a domestic mains supply, and to lamp modules incorporating such a circuit.

It is known that ordinary general lighting service (G.L.S.) domestic tungsten lamps are a rather inefficient source of light considering their power consumption, and that tungsten-halogen lamps are more efficient because they are smaller and operate at higher pressures and temperatures. Tungsten-halogen lamps are, however, more efficient at lower voltages, for the same filament length, than the usual 240 volts mains supply: the peak of efficiency for a given filament length being at about 18-20 volts.

Clearly, therefore, it would be desirable to use a low voltage tungsten-halogen lamp for domestic purposes so as to increase efficiency and decrease power consumption. One way of reducing the mains voltage to that required for the lamp is by using a transformer, but this is rather large and heavy. An alternative method is to use an electronic circuit to step down the voltage. Electronic circuits for reducing voltages are known as in, for example, domestic dimming circuits, but such circuits only operate down

to about 50-60 volts.

It is thus an object of the present invention to provide a load supply circuit which reduces the mains voltage to a voltage suitable for a low voltage tungsten-halogen lamp.

Accordingly, the invention provides a load supply circuit which supplies a low voltage load from a high voltage a.c. supply, comprising an a.c./d.c. switch means for switching said load into and out of the supply circuit and control means for triggering the said switch means at a desired phase angle of the high voltage a.c. supply.

Preferably the circuit is integrally assembled in a complete unit to facilitate its use as a direct plug in replacement for a G.L.S. filament lamp.

However, it may possibly be used separately, say by inclusion in a wall switch.

The load is preferably a low voltage tungsten-halogen lamp and the a.c. supply is the domestic mains supply.

The switch means is preferably a solid state switch and may conveniently be a Gate Turn Off Thyristor (G.T.O.) or may possibly be a triac.

The control means for triggering the said switch means is preferably an integrated circuit which may also have incorporated therein, means for limiting the surge current when the circuit is first switched on, and/or means for feedback controlling the output of the integrated circuit to withstand varying temperature conditions.

Preferably, the supply circuit includes filter means for reducing radio frequency interference from the mains which can falsely trigger the a.c. switch, and may also include an overcurrent trip means to safeguard the circuit in the event of a short-circuit in the load.

If the switch means is a G.T.O., the supply

circuit may further include means for rectifying the supply voltage.

Conveniently, the load supply circuit is positioned, with a low voltage tungsten-halogen lamp as the load, within a lamp replacement unit shaped like an ordinary tungsten lamp and which is a direct replacement for such a lamp. The tungsten-halogen lamp is preferably, however, removeable from said unit and is itself replaceable within the unit.

The invention further comprises an overcurrent trip circuit including sensing means to sense the level of current through the part of the circuit to be protected and to produce a first signal consequent to a level of build-up of said current above a predetermined level, and signalling means for producing a second signal upon receiving said first signal, and means responsive to said second signal for effecting the tripping function.

Preferably, said sensing means is a capacitor connected to the base of a transistor and said signalling means is a timer or thyristor also connected to the base of a transistor.

One embodiment of the invention will now be more fully described, by way of example, with reference to the drawings, in which:

Figure 1 is a schematic cross-sectional view through a lamp replacement unit according to the invention;

Figure 2 is a schematic diagram of a load supply circuit in accordance with the invention; and

Figure 3 is a schematic diagram of an overcurrent trip circuit according to the invention.

The lamp replacement unit shown in Figure 1 comprises a thermoplastic resin base 1 injection moulded to produce a cap 2 positioned at one end, shown lowermost. The cap 2 is of standard size and fitting so that it can be inserted into ordinary domestic lamp sockets, and has two contacts 3 to form

the electrical connections with the socket. A component board 4 is contained within the body and thermally insulated from the lamp 6 by being wrapped in a suitable heat resisting and thermally insulating wool 9. The lamp 6 is a low voltage tungsten-halogen lamp and is positioned within socket 7 positioned on a support member 8 fastened to a heat shield 5 between the shield and the board 4. A transparent glass cover 10 surrounds the lamp 6 and is fastened to the base 1.

The component board 4 has electronic components mounted thereon, the components 11 forming part of a load supply circuit as shown diagrammatically in Figure 2. The board also has mounted thereon, connections to a Gate Turn-Off Thyristor 12 (G.T.O.) mounted on a heat sink 13 and connections 14 to a mains supply via the contacts 3 on the cap 2 when in place in a socket. As will be further explained below, the G.T.O. 12, and other components 11 form part of a circuit to power the lamp 6 from the mains supply.

Thus, as shown in Figure 2, the load supply circuit for supplying the low voltage tungsten-halogen lamp 6 from an a.c. mains supply 20, comprises a bridge rectifier part 21, a mains radio frequency interference filter circuit (A), a mains isolated low power d.c. supply circuit (B), a pulse supply part 22, a pulse conversion part 23, an overcurrent trip circuit (C) and a G.T.O. 12.

The circuit is designed such that a negative going pulse is provided by the pulse supply part 22 including integrated circuit 25 at a desired phase angle regulated by the variable resistance 24. This pulse is converted from negative going to positive going by the pulse conversion part 23 of the circuit and the positive going pulse is used to trigger the G.T.O. 12 to conduct and switch the lamp 6 on. The G.T.O. automatically turns "off" when the phase angle

of the supply reaches zero, so by producing the pulse at an appropriate phase angle, only the controlled part of the cycle will be passed via the G.T.O. to suit the low voltage lamp. The integrated circuit 25 provides this initial pulse and also provides, if necessary, a slow start feature to overcome the problem of initial switch on inrush surge current of the cold filament. Since the G.T.O. is a d.c. switch, the bridge rectifier part 21 of the circuit provides the G.T.O. with a full wave rectified d.c. from the mains a.c. supply. The mains isolated low power d.c. supply circuit (B) is used merely to provide the input supply for the integrated circuit 25 and other components at an appropriate level, whilst the mains radio frequency interference filter circuit (A) is used to remove the mains interference which could otherwise trigger the G.T.O. falsely. Both of circuits (A) and (B) are conventional and will not be further described.

The overcurrent trip circuit (C) is shown in more detail in Figure 3 and is basically composed of a sensing part 30 and a signal producing part 31. The sensing part 30 is connected to point X in Figure 2 and comprises a capacitor 32 which passes a voltage if a sharply rising current is passing through point X, for example, in the event of a filament end of life flashover producing a short circuit current. This voltage is passed to the base of a transistor 33 which produces a pulse. The signal producing part 31 receives this pulse at a timer 34 which, with the rest of the components of the signal producing part 31, produces a signal at X' for long enough to turn off the G.T.O. and thus protect the electronic components from a damaging high current. The G.T.O. is only switched off for the particular half-cycle in which the short-circuit occurred and then the normal pulses switch it on again provided the lamp has not gone short circuit or into an arc condition. The timer could be replaced by

a small thyristor if desired.

It will be appreciated that although the invention has been described with the load supply circuit within the lamp replacement unit, it could be positioned in the wall switch or anywhere else as required. Further, the transparent glass cover 10 may be replaced by suitable coloured covers made of similar material and may even if desired be made in novel shapes for decorative purposes.

List of Components in Figures 2 and 3

GTO	Gate Turnoff Thyristor	BT157
D1 to D4	diodes	IN4004
C1	capacitor	47μF. 16V
C2	"	47nF
C3	"	0.1μF
C4	"	1 μF
C5	"	10 μF
C6	"	47nF
R1	Resistor	200KΩ
R2	"	330KΩ
R3	"	100KΩ
R4	"	330KΩ
R5	"	1KΩ
R6	" (Variable)	5KΩ
R7	"	10KΩ
R8	"	10KΩ
R9	"	47Ω
R10	"	50mΩ
TR1	Transistor	BCY70
I.C.1.		TDA 2085
D5	ZENER diode	BZX87 - C10
C7	capacitor	47μF
C8	"	1.nF
C9	"	1.nF
R11	resistor	1KΩ
R12	"	10KΩ
R13	"	1KΩ
R14	"	10KΩ
R15	"	470Ω
TR2	Transistor	BD 675
TR3	"	BC 107
I.C.2.	Timer I.C.	555

CLAIMS

1. A load supply circuit which supplies a low voltage load from a high voltage a.c. supply, characterised in that the circuit comprises an a.c./d.c. switch means for switching said load into and out of the supply circuit and control means for triggering the said switch means at a desired phase angle of the high voltage a.c. supply.

2. A load supply circuit according to Claim 1 wherein said load is a low voltage tungsten-halogen lamp and the a.c. supply is the domestic means supply.

3. A load supply circuit according to either Claim 1 or Claim 2 wherein said switch means is a solid state switch such as a Gate Turn Off Thyristor or a triac.

4. A load supply circuit according to Claim 3 further including means for rectifying the supply voltage.

5. A load supply circuit according to any preceding claim wherein said control means for triggering said switch means is an integrated circuit further incorporating means for limiting the surge current when the circuit is first switched on and means for feedback controlling the output of the integrated circuit to withstand varying temperature conditions.

6. A load supply circuit according to any preceding claim further including filter means for reducing radio frequency interference from the mains supply.

7. A load supply circuit according to any preceding claim further including an overcurrent trip means to safe-guard the circuit in the event of a short-circuit in the load.

8. A load supply circuit according to any one of Claims 2 to 7 which is integrally assembled into a complete lamp-replacement unit as a replacement for a G.L.S. tungsten filament lamp.

9. A load supply circuit according to Claim 8 wherein said low voltage tungsten-halogen lamp is positioned in said unit but is replaceable within the unit.

10. An overcurrent trip circuit including sensing means to sense the level of current through the part of the circuit to be protected and to produce a first signal consequent to a level of build-up of said current above a predetermined level, and signalling means for producing a second signal upon receiving said first signal, and means responsive to said second signal for effecting the tripping function.

Fig.1.

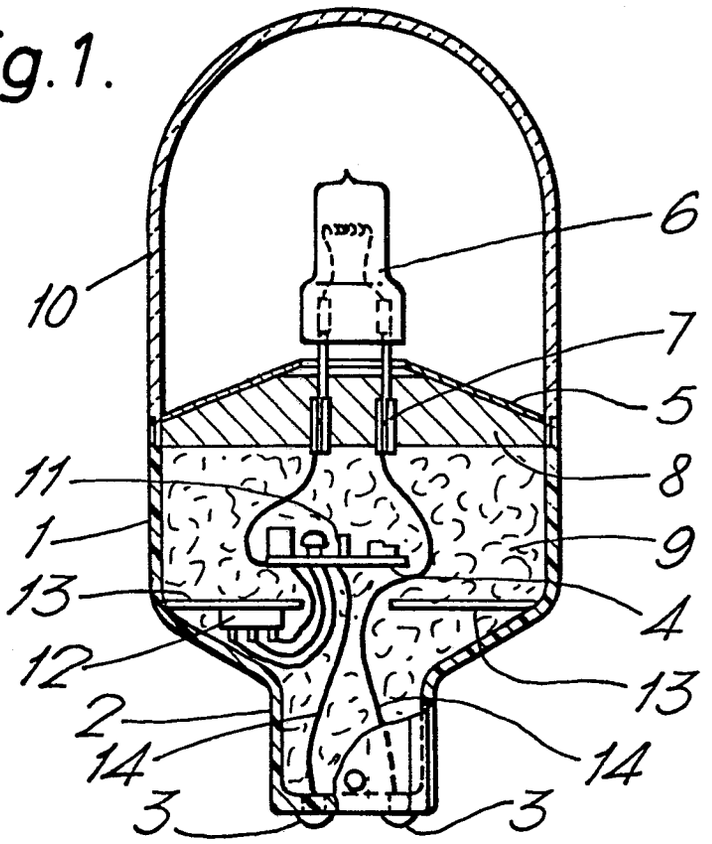

6
10
7
5
11
8
1
9
13
4
12
13
2
14
14
3
3

Fig.3.

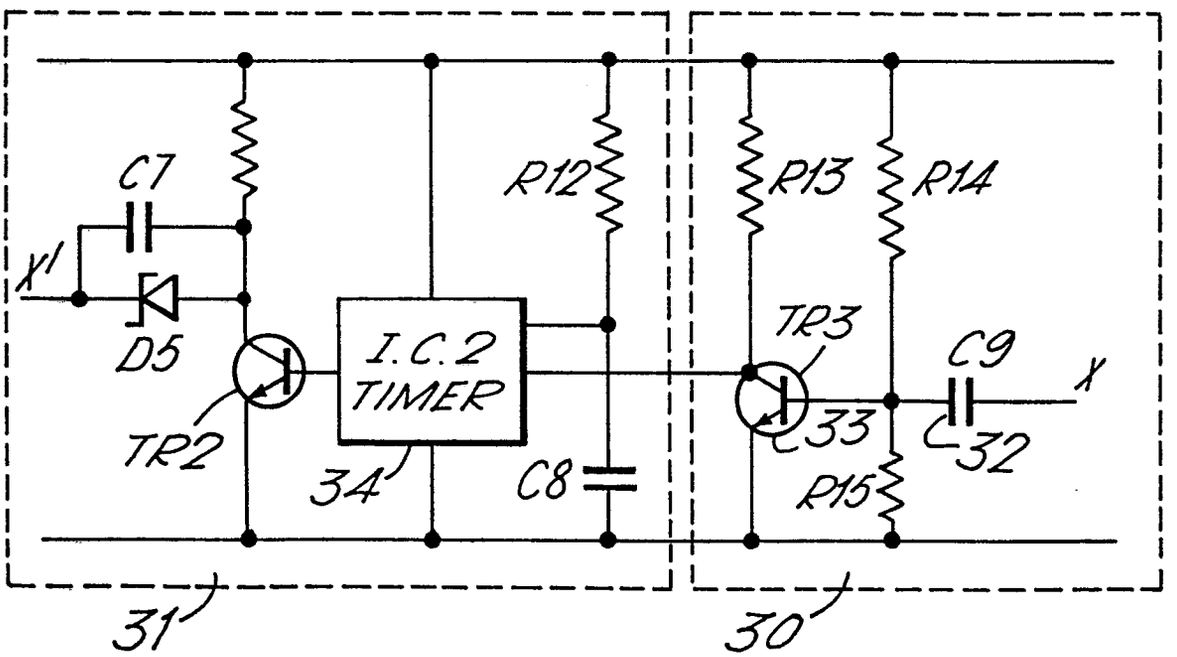
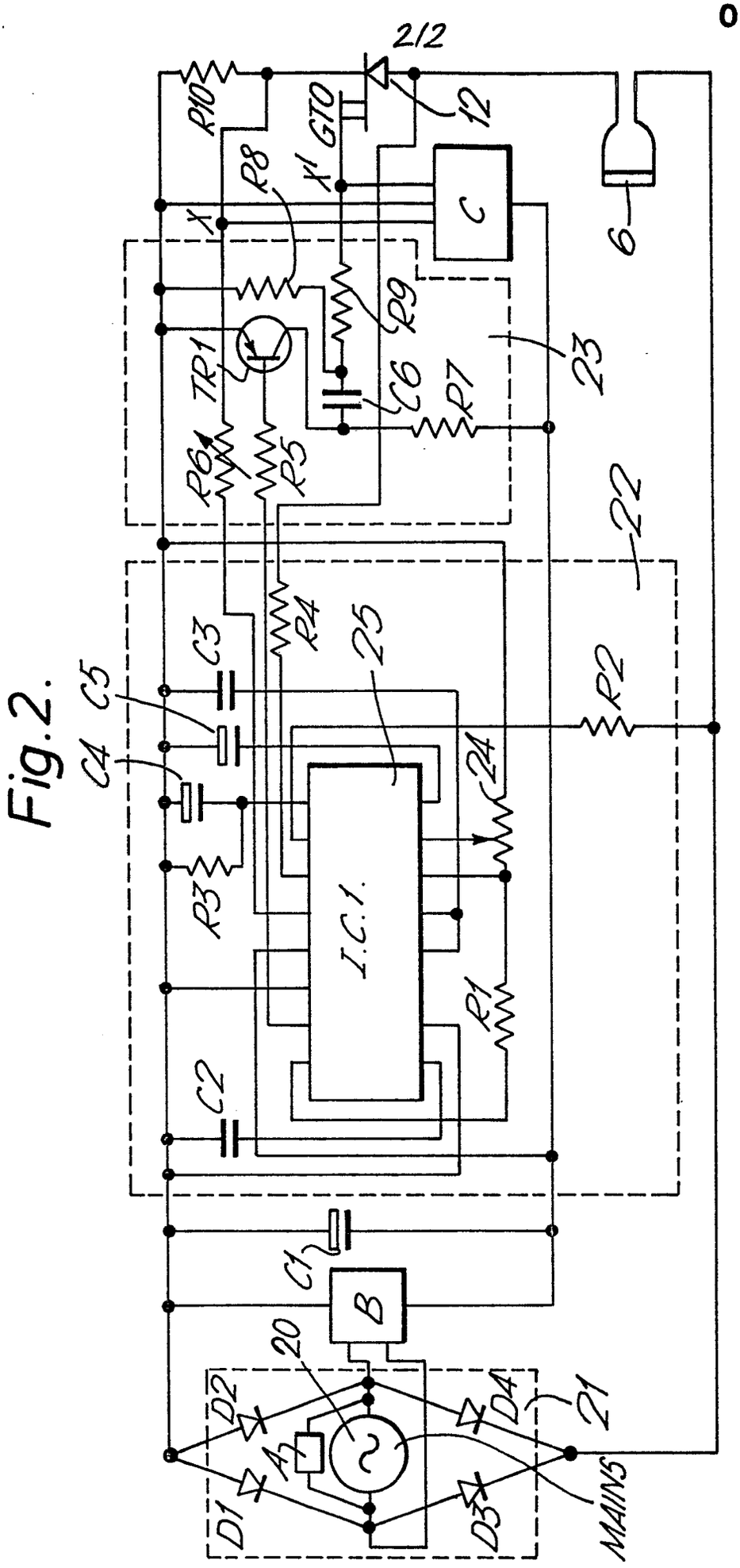

C7
R12
R13
R14
X1
TR3
D5
I.C.2
TIMER
C9
X
TR2
33
32
34
C8
R15
31
30

Fig.2.


R10
GTO
X'
12
X
R8
C
6
R9
TR1
C6
R7
23
R6
R5
22
C3
R4
25
C5
R2
C4
24
R3
I.C.1.
R1
C2
C1
B
20
D2
D4
21
A2
D1
D3
MAINS

European Patent Office

EUROPEAN SEARCH REPORT

0165701
Application number

EP 85 30 3410

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	US-A-4 359 670 (HOSAKA) * Column 1, lines 20-57; column 6, line 66 - column 7, line 19 *	1-4	H 05 B 39/08 H 05 B 39/00 H 01 K 1/62
Y		8,9	
Y		6,7,10	
X	FR-A-2 505 601 (KEREKES) * Claim 1 *	1,2,8,9	
Y	FR-A-2 438 406 (PHILIPS') * Page 4, line 15 - page 6, line 7 *	8,9	
Y	DE-A-2 831 629 (GREB) * Page 6, lines 27-33; page 9, line 7 - page 10, line 11 *	6,7,10	TECHNICAL FIELDS SEARCHED (Int. Cl.4) H 05 B 39/00 H 05 B 35/00 H 05 B 41/00 H 01 J 61/00
P,X	FR-A-2 550 383 (GENERAL ELECTRIC) * Abstract *	1,8,9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	08-08-1985	BERTIN M.H.J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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