(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 165 701**
**B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **03.10.90**

(51) Int. Cl.[5]: **H 05 B 39/08,** H 05 B 39/00, H 01 K 1/62

(21) Application number: **85303410.6**

(22) Date of filing: **15.05.85**

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

(30) Priority: **18.05.84 GB 8412699**

(43) Date of publication of application:
**27.12.85 Bulletin 85/52**

(45) Publication of the grant of the patent:
**03.10.90 Bulletin 90/40**

(84) Designated Contracting States:
**BE DE FR IT NL**

(56) References cited:
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**EP 0 165 701 B1**



Courier Press, Leamington Spa, England.

**Description**

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. Such circuit is known from document US—A—4359670.

It is known that ordinary general lighting serice (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 for supplying a load from an a.c. supply, incorporating switch means for switching the load into and out of the supply circuit and control means for triggering said switch means to energise the load in each phase of the a.c. supply, wherein the load is in the form of a tungsten-halogen lamp operable at a voltage which is only a fraction of the a.c. supply, and in that the circuit incorporates an overcurrent trip means which is activated as a result of a fault condition occurring in any half cycle of the supply which results in an excessive current rise, and which remains operative to prevent energisation of the lamp during the remainder of the half cycle.

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 partiuclar 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 is 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 | " | 1µF |
| C5 | " | 10µF |
| 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 for supplying a load from an a.c. supply, incorporating switch means for switching the load into and out of the supply circuit and control means for triggering said switch means to energise the load in each phase of the a.c. supply, characterised in that the load is in the form of a tungsten-halogen lamp operable at a voltage which is only a fraction of the a.c. supply, and in that the circuit incorporates an overcurrent trip means which is activated as a result of a fault condition occurring in any half cycle of the supply which results in an excessive current rise, and which remains operative to prevent energisation of the lamp during the remainder of the half cycle.

2. A load supply circuit according to Claim 1 characterised in that 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.

3. A load supply circuit according to Claim 1 or 2 characterised in that the integrated circuit incorporates means for feedback controlling the output of the integrated circuit to withstand varying temperature conditions.

4. A load supply circuit according to Claim 1 or 2 which is integrally assembled into a complete lamp-replacement unit as a replacement for a G.L.S. tungsten filament lamp.

5. A load supply circuit according to Claim 4 wherein said low voltage tungsten-halogen lamp is positioned in said unit but is replaceable within the unit.

6. A load supply circuit according to any preceding Claim characterised in that the overcurrent trip circuit includes 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, signalling means for producing a second signal upon receiving said first signal, and means responsive to said second signal for effecting the tripping function of the trip circuit.

## Patentansprüche

1. Lastspeisungsschaltung zur Speisung einer Last von einer Wechselstromversorgung aus, enthaltend eine Schaltereinrichtung zum Einschalten der Last in die Speisungsschaltung und zum Ausschalten der Last aus der Speisungsschaltung und eine Steuereinrichtung zum Triggern der Schaltereinrichtung zur

Energieversorgung der Last in jeder Phase der Wechselstromversorgung, dadurch gekennzeichnet, daß die Last in Form einer Wolfram-Halogenlampe vorgesehen ist, die bei einer Spannung betreibbar ist, welche nur ein Bruchteil der Wechselstromversorgung ist, und daß die Schaltung eine Überstromauslöseeinrichtung enthält, die aufgrund eines in irgendeiner Halbperiode der Versorgung austretenden Störzustands, der in einem übermäßigen Stromanstieg resultiert, aktiviert wird und die wirksam bleibt, um eine Energieversorgung der Lampe während der restlichen Halbperiode zu verhindern.

2. Lastspeisungsschaltung nach Anspruch 1, dadurch gekennzeichnet, daß die Steuereinrichtung zum Triggern der Schaltereinrichtung eine integrierte Schaltung ist, die ferner eine Einrichtung zum Begrenzen des Stoßstroms enthält, wenn der Strom anfangs eingeschaltet wird.

3. Lastspeisungsschaltung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die integrierte Schaltung eine Einrichtung zur Rückführungssteuerung des Ausgangs der integrierten Schaltung enthält, um veränderlichen Temperaturbedingungen zu widerstehen.

4. Lastspeisungsschaltung nach Anspruch 1 oder 2, die integral montiert ist in einer vollständigen Lampen-Ersatzeinheit als Ersatz für eine Wolfram-Glühlampe für allgemeine Beleuchtungszwecke.

5. Lastspeisungsschaltung nach Anspruch 4, bei der die Wolfram-Halogen-Niederspannungslampe in der Einheit vorgesehen ist, jedoch innerhalb der Einheit austauschbar ist.

6. Lastspeisungsschaltung nach irgendeinem vorangehenden Anspruch, dadurch gekenneichnet, daß die Überstromauslöseschaltung enthält eine Fühlereinrichtung zum Abfüllen der Größe des Stroms durch den zu schützenden Teil der Schaltung und zum Erzeugen eines ersten Signals aufgrund einer Anstiegsgröße des Stroms über einen vorbestimmten Wert, eine Signalisiereinrichtung zum Erzeugen eines zweiten Signals beim Empfang des ersten Signals und eine auf das zweite Signal ansprechende Einrichtung zum Ausführen der Auslösefunktion der Auslöseschaltung.

**Revendications**

1. Circuit d'alimentation destiné à alimenter une charge à partir d'une alimentation alternative, comprenant un dispositif de commutation de la charge afin qu'elle soit reliée au circuit d'alimentation ou non et un dispositif de commande destiné à déclencher le dispositif de commutation afin qu'il alimente la charge à chaque phase de l'alimentation alternative, caractérisé en ce que la charge est sous forme d'une lampe à halogène à filament de tungstène travaillant avec une tension qui n'est qu'une fraction de la tension d'alimentation alternative, et en ce que le circuit comprend un dispositif de déclenchement en cas de surintensité qui est activé à la suite d'une condition de panne apparaissant à un demi-cycle quelconque de l'alimentation qui provoque une augmentation excessive du courant, et qui continue à fonctionner et empêche l'alimentation de la lampe pendant le reste du demi-cycle.

2. Circuit d'alimentation d'une charge selon la revendication 1, caractérisé en ce que le dispositif de commande destiné à déclencher le dispositif de commutation est un circuit intégré comprenant en outre un dispositif destiné à limiter le courant excessif lorsque le circuit est mis initialement sous tension.

3. Circuit d'alimentation d'une charge selon la revendication 1 ou 2, caractérisé en ce que le circuit intégré comporte un dispositif de commande par rétroaction du signal de sortie du circuit intégré afin qu'il supporte des conditions variables de température.

4. Circuit d'alimentation d'une charge selon la revendication 1 ou 2, qui est monté en une seule pièce dans un ensemble complet de rechange de lampe destiné à remplacer une lampe à filament de tungstène d'éclairage ordinaire.

5. Circuit d'alimentation d'une charge selon la revendication 4, dans lequel la lampe à halogène à filament de tungstène à basse tension est placée dans l'ensemble mais est remplaçable à l'intérieur de l'ensemble.

6. Circuit d'alimentation d'une charge selon l'une quelconque des revendications précédentes, caractérisé en ce que le circuit de déclenchement en cas de surintensité comporte un dispositif capteur destiné à détecter l'intensité du courant dans la partie du circuit à protéger, et à créer un premier signal correspondant au dépassement du niveau prédéterminé par ledit courant, un dispositif de signalisation destiné à créer un second signal lorsqu'il reçoit le premier signal, et un dispositif commandé par le second signal et destiné à assurer la fonction de déclenchement du circuit de déclenchement.

Fig.1.

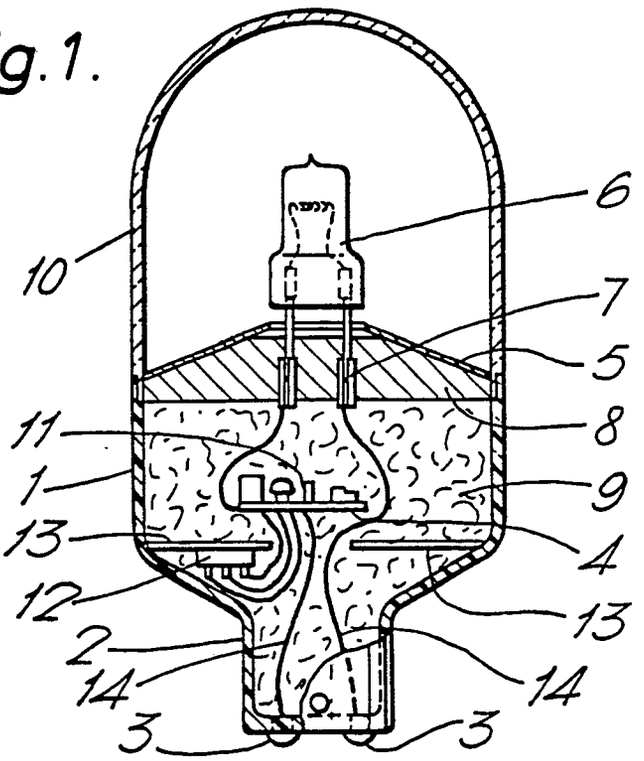

6
10
7
5
11
8
1
9
13
4
12
13
2
14
14
3
3

Fig.3.

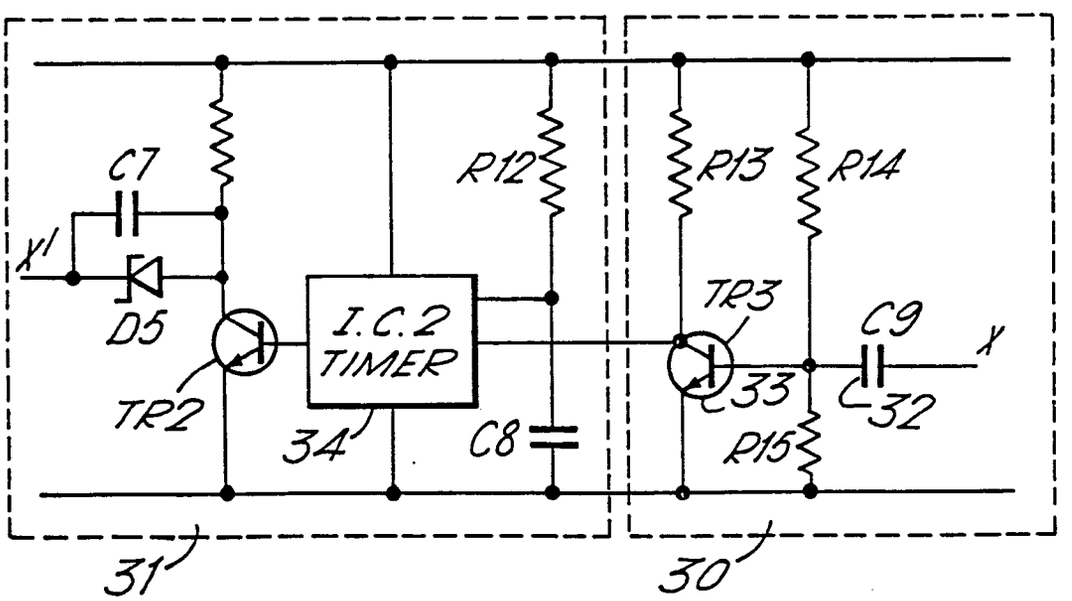
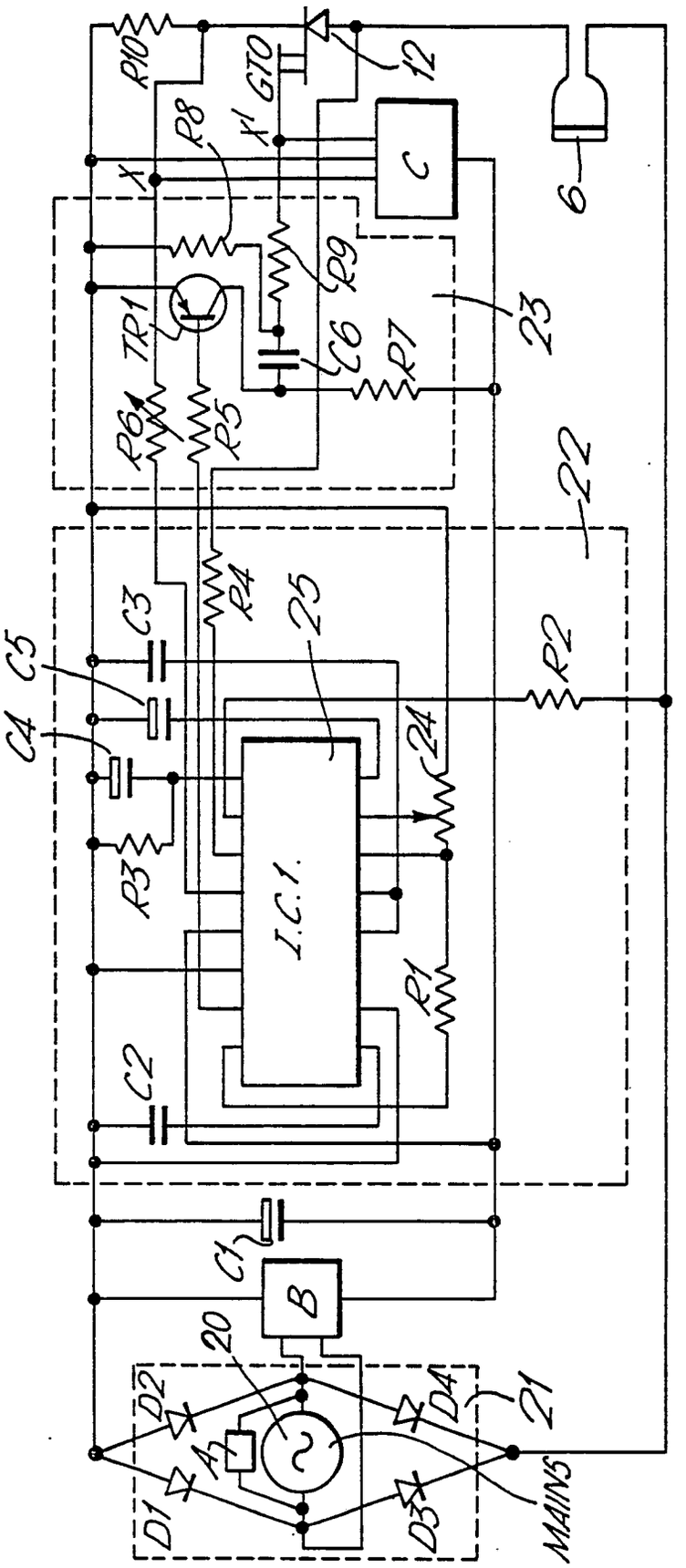

C7
R12
R13
R14
X1
D5
I.C.2
TIMER
TR3
C9
X
TR2
34
C8
C33
C32
R15
31
30

Fig.2.


R10
GTO
12
P8
C
6
TR1
R9
C6
P7
23
R6
R5
22
C3
R4
25
C5
R2
C4
24
I.C.1.
R3
R1
C2
C1
B
20
21
D2
D4
A
D1
D3
MAINS