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(54) Light dimmer device.

(57) A light dimmer device, preferably in the form of an adaptor for inserting between a light fitting and light bulb, is remotely controlled by means of the conventional light switch. When the light switch is first turned on, a detector circuit 14 responds via a power supply circuit 15 to set a regulator circuit 12 at a first power level, e.g. to provide substantially maximum illumination from the light 11. Should the light switch be then turned off and on again within a predetermined period, the detector circuit 14 alters the regulator circuit 12 setting to a second power level, e.g. to provide a dimmed setting of the light 11.

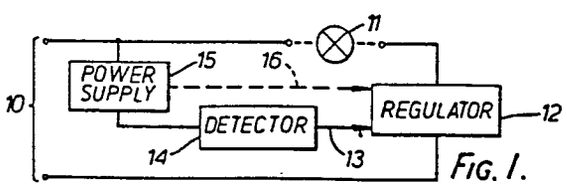

Fig. 1.

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LIGHT DIMMER DEVICE

The present invention relates to a light dimmer device and in particular to such a device for connection between a light emitting unit and a source of electrical power to the light emitting unit.

It is known to provide a dimming regulator circuit in the path between the mains power source and a light unit; the circuit is generally incorporated in a housing intended to replace the conventional light switch, and relies on a semi-conductor switch, such as a triac, being turned on during just a portion of the mains voltage cycle so as to reduce the average power to the light and hence dim the light. The triac is generally controlled by the setting of a potentiometer provided in the switch housing which the user operates to provide a continuously variable range of dimmed settings from full illumination to no illumination.

Such light dimmers have the disadvantage that they must be incorporated in place of the conventional light switch if the light unit to be controlled is connected directly to the household wiring. This will normally require the services of an electrician. Furthermore, this type of light dimmer is relatively expensive. Also, once the dimmer has been installed, there is no flexibility of use in that the dimmer is committed to controlling that particular light unit or units to which it is connected; the dimmer would need to be removed and re-installed in order

to change its usage to a different light.

The present invention provides a light dimmer device of the above type having a dimming regulator circuit for regulating the intensity of illumination of an associated light emitting unit, characterised in that there is provided a detector circuit responsive to interruption of the electrical power source, the regulator circuit being responsive to detection of an interruption by the detector circuit to regulate the power to the light emitting unit and hence the intensity of illumination thereof.

The preferred embodiment of the invention provides a device in the form of an adaptor which may be fitted into a light socket, a light bulb being inserted into the adaptor. The device is then responsive to interruption of the mains supply by means of the conventional light switch to control the light intensity. The preferred mode of operation is for the device to provide substantially full power to the light when turned on initially; if subsequently the light switch is turned off and on again within a predetermined time, the device will reduce the power supplied to the light to provide a dimmed setting.

It will therefore be seen that the dimmer device itself need have no control switches or knobs built in its housing since control of whether the full or a dimmed setting is to be provided is externally and remotely determined by suitable activation of the conventional light switch. In fact, the preferred form of dimmer device includes an externally settable potentiometer, but this is used to preset the dimmed setting to a desired level, remote control between this setting and the substantially full power setting being maintained.

It will be seen that the device can readily be fitted into any light socket without specialised electrical knowledge; also it can easily be removed and fitted into a different socket if required. In practice, it is found

that a single dimmed setting is usually sufficient, but the device could readily be adapted to provide more than one dimmed setting as well as the full illumination setting. Alternatively, a continuously variable arrangement might have a steadily decreasing light intensity which could be halted at a desired level by a short interruption of the mains by the light switch.

In order that the present invention may be more readily understood, an embodiment thereof will now be described by way of example, with reference to the accompanying drawings, in which:-

Figure 1 shows a block diagram of the preferred embodiment of the invention;

Figure 2 shows a more detailed circuit diagram of the embodiment; and

Figure 3 shows one form of adaptor, with bulb inserted, suitable for housing the circuit.

Referring to Figure 1, the device is connected to the mains supply through terminals 10 and controls the intensity of a light 11 through a regulator 12 responsive via a line 13 to a detector 14. A power supply 15 provides low voltage power to the detector 14 and also, if required, to regulator 12, this latter connection being shown by broken line 16 to denote that it is only provided when the regulator requires a low voltage supply. The detector 14 also conveniently detects interruption of the mains supply by monitoring the output of the low voltage power supply 15.

In operation, when mains voltage is applied to terminals 10 upon operation of the remote conventional switch (not shown), the regulator 12 initially applies substantially full power to the light 11. This state can be maintained if desired. Should a dimmed setting be required, the light switch is turned off and then on

again thereby interrupting power to the terminals 10 for a predetermined time, such as two seconds, and the detector 14 responds to the interruption (via low voltage power supply 15) to set the regulator 12 to a dimmed setting. The sequence of events could be reversed if desired so that the lower setting comes on first and the higher setting after the power interruption.

Figure 2 shows the circuit in more detail. The low voltage power supply 15 includes a resistor R1 and zener diode D1 connected across terminals 10, a diode D2 being connected to the junction therebetween, and an electrolytic capacitor C1 and resistor R2 connected in parallel across the output of the diode D2. The zener diode D1 is chosen to provide a stabilised voltage suitable for the circuits to be powered, e.g. 9.1V. A further diode D3 is connected between diode D2 and the output of the power supply V_{cc}. The detector 14 is based around two cross-coupled NAND gates G1, G2 forming an RS flip-flop 20. These gates are conveniently available on a single integrated circuit. The R input to the flip-flop is taken from the output of circuit 15, and the S input is taken from the cathode of diode D3 via resistors R3, R4, an electrolytic capacitor C2 being connected between the junction of resistors R3, R4 and the neutral line. The Q output of flip-flop 20 is connected via a resistor R5 to the gate of an FET switch T1 forming part of the regulator 12. FET switch T1 provides a means of selectively connecting a capacitor C3 in parallel with a capacitor C4 which forms part of a conventional phase control circuit further comprising a potentiometer P1, resistor R6, diac D4 and triac TR. Capacitor C4 is of considerably lower value than capacitor C3 as will be explained; typically capacitor C3 is 47nF and C4 is 2.2 nF.

In operation, the regulator 12 provides two levels of illumination in light 11, dependent on whether FET switch

T1 is switched on or not, i.e. whether the capacitance in the phase control circuit is C4 or C3 + C4. Resistor R6 is included to prevent the possibility of the potentiomete P1 being adjsted to an excessively low (or zero) resistance value and thereby upset the setting of the phase control. By suitable choice of components, with the FET switch T1 off, the firing angle of triac TR will always be kept below a negligeable value, e.g. 20 degrees; such a phase angle will give substantially full power to the light since the "lost" portion of the waveform is just after the zero crossing and hence of very low amplitude. Variation of potentiometer P1 resistance under these conditions will provide such minimal change in illumination as to be unnoticeable in practice.

When FET switch T1 is turned on by a control signal from the detector 14, capacitors C3 and C4 are connect in parallel, giving a delay of the trigger point in each cycle which depends on the setting of potentiometer P1. Thus the setting of P1 will have virtually no effect on the substantially full illumination setting but will vary the dimmed setting over a wide range of illumination.

The manner by which the control signal for turning on FET switch T1 is produced will now be discussed. When the light switch is first turned on, mains voltage appears at terminals 10 which is rectified and lowered in value by resistor R1, zener diode D1 and diode D2. Capacitor C1 will charge faster than capacitor C2 since resistor R3 delays charging of capacitor C2 (resistor R3 is chosen to be significantly greater in value than resistor R1). The effect of this is that a logical "one" is presented to the R input of flip-flop 20 while a logical "zero" is still present at the S input.

An RS flip-flop has the following truth table:

S	R	Q
1	1	Q_o
0	1	1
1	0	0
0	0	1

Q_o being the immediately preceding state of the Q output.

From the truth table it will be seen that the above-described circumstances will produce a logical "one" Q output, which will be held at "one" when capacitor C2 has charged up sufficiently for the S input to also go to "one". Consequently FET switch T1 is held off and full light intensity is provided.

When the light switch is turned off and no voltage is present at terminals 10, the capacitor C1 discharges rapidly through resistor R2, but capacitor C2 discharges slowly as a function of resistances R3 and R4, leakage currents through capacitor C2 and diode D3, and the input bias current to gate G1. It will be seen that the combined leakage path presented by these components should be arranged to present an effective resistance much greater than that of resistor R2. A further resistor can alternatively be connected in parallel with capacitor C2 so as to define the discharge time constant more precisely.

Since the discharge time of capacitor C2 is much slower than that of capacitor C1, a logical "one" is maintained at the S input, the R input having gone to "zero" due to the rapid discharge of capacitor C1. Capacitor C2 also provides the supply voltage Vcc to the integrated circuit forming the gates G1 and G2. From the truth table, it can be seen that when the S input is

at "one" and the R input at "zero", the Q output is at "zero". If the light switch is turned on again within the time period before the capacitor C2 has discharged to a voltage below the threshold of the gate G1, the flip-flop 20 will again have logical "ones" at both R and S inputs and the Q output will hold the previous "zero". The FET switch T1 therefore puts the regulator circuit 12 into the dimmed state, the degree of dimming depending on the setti of potentiometer P1.

If a non-adjustable light setting is acceptable, potentiometer P1 can be omitted and a fixed resistor substituted.

Controlling light intensity by triggering a tria has the disadvantage of generation of radio frequency interferences having an energy spectrum of amplitude inversely proportional to frequency. Capacitor C5 and inductor L are included as shown to suppress such interference. With a value of inductance L of 3mH and capacitance C5 of 100nF, adequate suppression is provided in accordance with British Standard BS 800 and similar standards as recommended by CISPR (Comité International Spécial des Perturbations Radio-électriques). A toroidal coil wound on a core provides a suitable inductor.

Figure 3 shows a partly schematic cross-section of an adaptor suitable for housing the dimmer circuit. Within the housing 30 of the adaptor are included suitable terminations for input 31 and output 32, the toroidal coil L positioned around the output socket part of the adaptor, the interference suppression capacitor C5 and a thick film circuit 34 carrying the majority of the electronic components including the potentiometer P1 provided with an external control knob 35. It has been found that where the adaptor is used in a vertical downwardly suspended light fitting (such as a ceiling fitting)

the effect of heat can be minimised by positioning the circuit 34 off centre as shown. As a further precaution, a heat sensitive device, such as a thermistor, can be incorporated in the power line to switch off the light if the temperature becomes excessive.

Although a bayonet fitting adaptor is shown, any other type suitable for the local standard, such as screw fitting, can readily be provided. Furthermore, the circuit can be provided at any other position between the light switch and the light-emitting element, e.g - it can be built into an actual light fitting, rather than in an adaptor for insertion between the fitting and the bulb.

CLAIMS:

1. A light dimmer device for connection between a light emitting unit and a source of electrical power to the light emitting unit, including a regulator circuit (12) for regulating the intensity of illumination of the light emitting unit, characterised in that there is provided a detector circuit (14) responsive to interruption of the electrical power source, the regulator circuit (12) being responsive to detection of an interruption by the detector circuit to regulate power to the light emitting unit.

2. A light dimmer device according to claim 1, characterised in that the detector circuit (14) is responsive to the power being discontinued and then restored within a predetermined period.

3. A light dimmer device according to claim 1 or 2, characterised in that the detector circuit (14) controls the regulator circuit (12) to provide a first power level of the light emitting unit on initial switch on of power, and is responsive to a subsequent power interruption to provide a second power level, one of the power levels being substantially full power and the other of the levels providing a dimmed setting of the light emitting unit.

4. A light dimmer device according to claim 1, 2 or 3, characterised in that the detector circuit (14) includes a bistable circuit (20) each of whose states sets a respective power level provided to the light emitting unit by the regulator circuit (12),

5. A light dimmer device according to claim 4, characterised in that two capacitors (C1, C2) are provided, one being arranged to be charged by the power source faster than the other, the capacitors providing respective inputs to the bistable circuit (20).

6. A light dimmer device according to claim 5, characterised in that the capacitor (C1) which is arranged to charge faster is also arranged to discharge faster.

7. A light dimmer device according to claim 5 or 6, characterised in that the capacitors (C1, C2) form part of a low voltage supply circuit for powering the bistable (20).

8. A light dimmer device according to any preceding claim, characterised in that the regulator circuit (12) includes a phase controlled semi-conductor switch (TR), and means for altering the firing angle of the semi-conductor switch, said means including a first phase-shifting capacitor (C4) and a second phase-shifting capacitor (C3) selectively switchable in parallel with the first in response to the detector circuit (14).

9. A light dimmer device according to any preceding claim, characterised in that there are provided means (P1) for pre-adjusting a dimmed setting of the regulator circuit (12).

10. A light dimmer device according to any preceding claim, characterised in that the device is in the form of an adaptor to be inserted between a light fitting and a light bulb.

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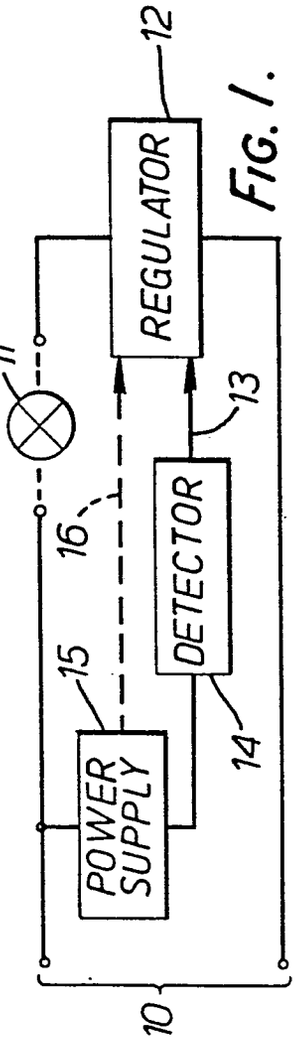
REGULATOR
DETECTOR
POWER SUPPLY
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14
15
16
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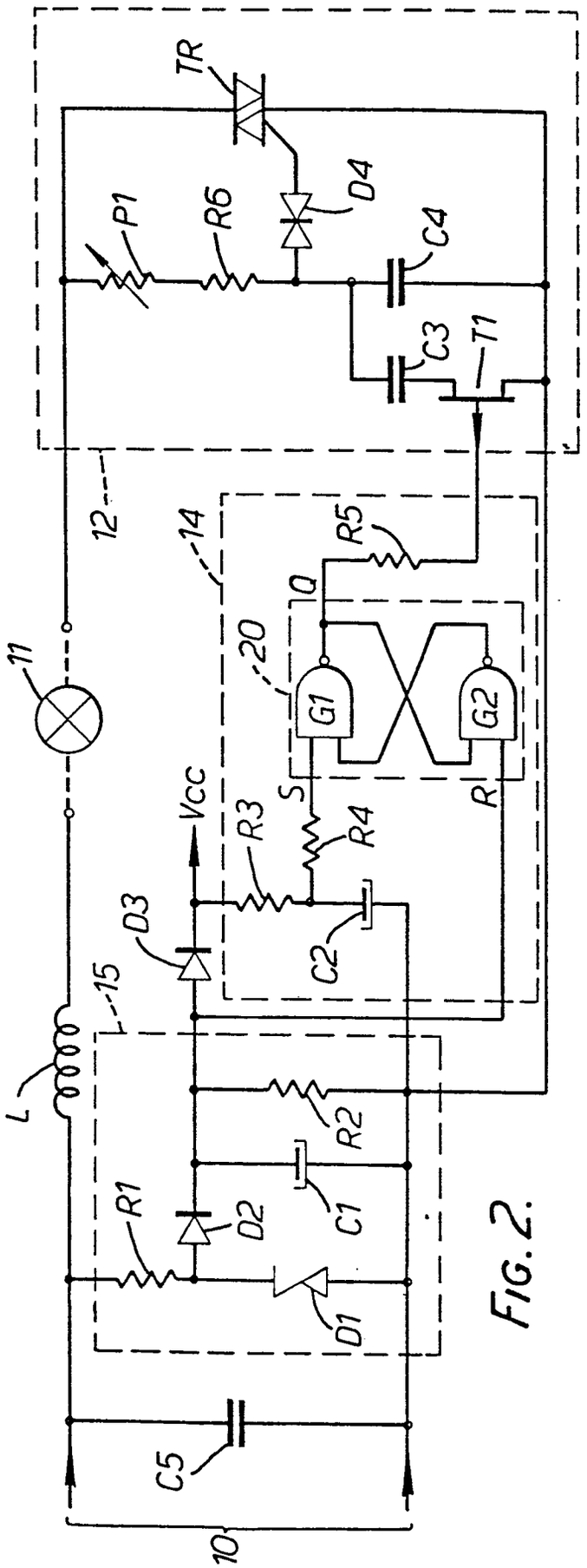
FIG. 1.


TR
D4
P1
R6
C4
C3
T1
12
14
R5
Q
20
G1
G2
11
Vcc
R3
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R4
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D3
C2
15
L
R2
R1
D2
C1
D1
C5
10

FIG. 2.

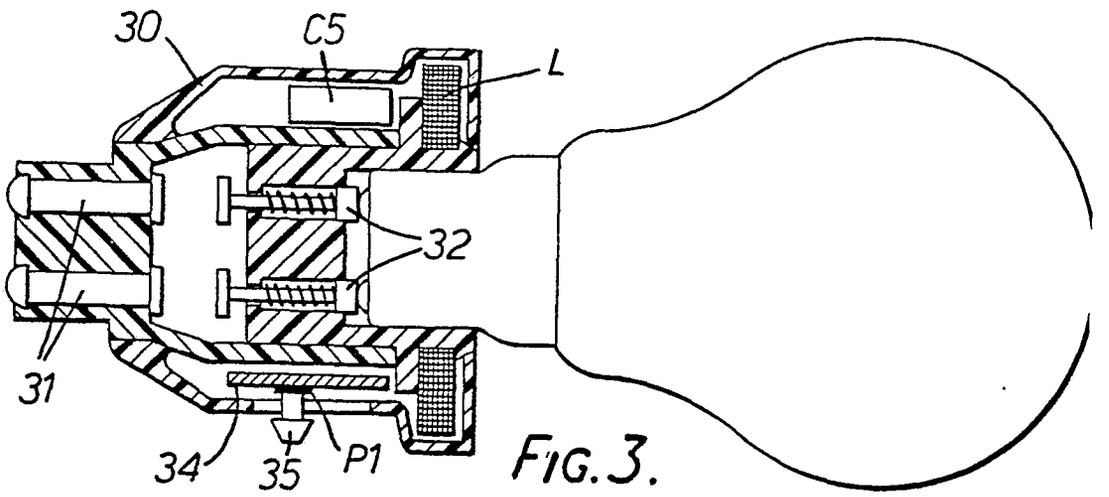

FIG. 3.

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EUROPEAN SEARCH REPORT

Application number
EP 81 30 5579

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
A	US - A - 3 573 543 (GRINDSTAFF) * column 1, line 59 - column 2, line 75; figures 1,2 *	1,8-10
A	FR - A - 2 330 244 (TRANSECO) * pages 1,2; figures I-IV *	1,3

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

H 05 B 39/08

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

H 05 B 39/00
37/00
41/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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A: technological background
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E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	10-03-1982	DUCHEYNE