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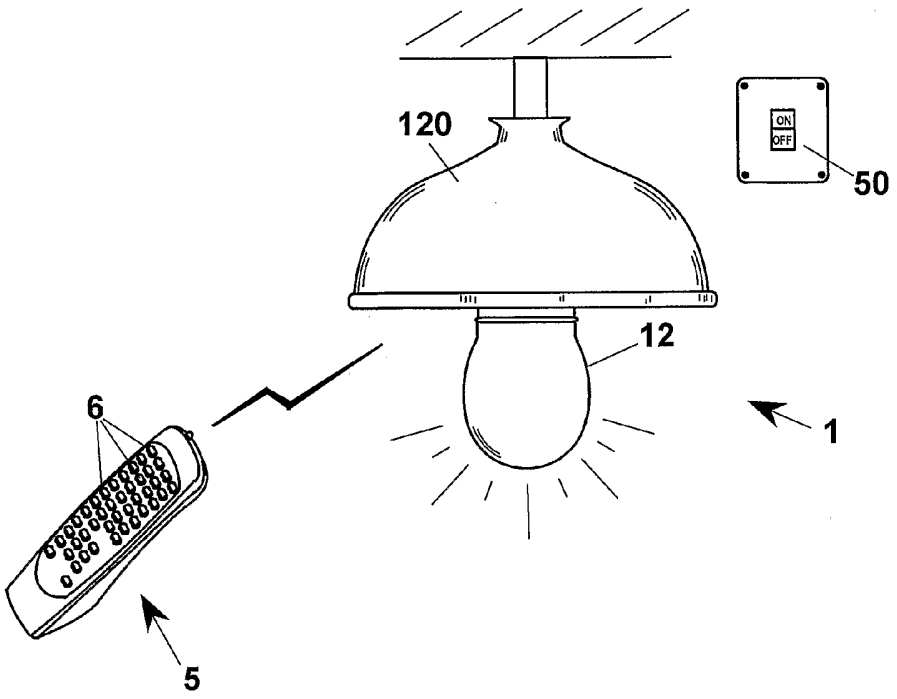
(54) Title: APPARATUS FOR REMOTELY TURNING ON AND OFF LIGHTING DEVICES



(57) Abstract: Lighting device (1) installable on a light bulb (12), or a bulb socket, which can be operated by any remote control, for example an IR remote control (5) of a TV set. The device (1) comprises at least one receiver (20) capable of detecting an IR code sent by the remote control (5). A memory stores the code and switching means turn on or off the lighting device at each following code transmitted by the remote control (5).

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TITLE

APPARATUS FOR REMOTELY TURNING ON AND OFF LIGHTING DEVICES

DESCRIPTION

Field of the invention

The present invention relates to the field of lighting, and in particular it relates to a system for remotely switching lighting apparatus.

Background of the invention

As known, lighting apparatus installed in public and private buildings provide usually an electric circuit feeding one or more light sources, such as ceiling, wall, floor lamps, etc., which are electrically connected to one or more ON/OFF switches by means of cables, which can be embedded in the building walls. For turning on/off the lighting apparatus of traditional type the user has to go to the switch. In case of wide rooms, such as for example public places, cinema, gymnasium, etc., the user can be quite far off the switch.

Lighting apparatus also exist operated by a dedicated remote control that allows turning on/off the light source from a distance. Such apparatus comprise a wall infrared (IR) receiver facing the environment to illuminate and connected electrically to the light source. The user then operates the apparatus by a remote control. It is also possible, with dedicated remote controls, to turn on/off each single light source.

However, when such lighting apparatus are not installed at the construction of the building, they involve expensive work to lay the electric cables.

Summary of the invention

It is therefore a feature of the present invention to provide a lighting device that can be operated by whichever remote control, for example a TV remote control, and that can be applied to existing lighting apparatus.

It is also a feature of the present invention to provide such a lighting device that is structurally easy and cheap.

These and other features are accomplished with one exemplary lighting device, according to the present invention, as defined by the attached claims 1-11.

According to another aspect of the invention a method for turning on/off a light source by a remote control, said light source being equipped with a turning on/off circuit defined by the attached claims from 12 to 17.

Brief description of the drawings

Further characteristics and advantages of the present invention will be made clearer with the following description of possible exemplary embodiments, with reference to the attached drawings, in which like reference characters designate the same or similar parts throughout the figures of which:

- figure 1 shows diagrammatically a perspective view of a lighting device, according to the invention, and furthermore, shows the possibility of operating the device with whichever remote control;
- figures 2A and 2B show a type of receiver that can be used in the device of figure 1;
- figure 3 shows diagrammatically an elevational front view of the operation of a possible exemplary embodiment of the device of figure 1;
- figure 4 shows diagrammatically in a perspective elevational front view the operation of an exemplary

embodiment alternative to that of figure 1;

- figure 5 shows diagrammatically a perspective view of the possibility of using a same remote control for operating different light sources;
- figure 6 shows a possible electric diagram of an IR receiver circuit for turning on/off the light source;
- figure 7 shows a possible flow-sheet of a method for turning on/off a light source by a remote control, according to the invention.
- figure 8 shows a flow-sheet alternative to that of figure 7.
- figure 9 shows a preferred turning on/off circuit associated to a lighting device according to the invention;
- Figures 10 and 11 show respectively a pulse-code and a diagram for sampling said code;
- figure 12 shows an advantageous flow-sheet of the procedure of reading the code;
- figure 13 shows a lighting device according to the invention which can be associated to the feeding cable of a lamp;
- figure 14 shows a lighting device according to the invention which can be associated to the feeding fitting of a ceiling lamp;
- Figures 15-17 show a lighting device according to the invention which can be associated to a light bulb;

Description of a preferred exemplary embodiment

With reference to figure 1 a lighting device 1, according to the present invention, can be operated by whichever remote control, for example a remote control 5 of a TV set. Device 1 can be associated to a light bulb 12. In this case, the light bulb 12 can be fitted on a desired type of lamp 120 without that the latter has to be modified

in any part thereof, in order to use the lighting device with any existing lamps.

Alternatively, the lighting device 1 can be mounted on board of a bulb socket. In this case the light bulb 12 can be of common type.

Some of the essential elements of the lighting device 1 will be described below, and then a more detailed description will follow of the circuit in it integrated. Lighting device 1 comprises a receiver 20 capable of detecting an IR code sent by remote control 5 if this is oriented within a determined cone whose angle begins at the vertex α (figure 2). A memory is provided, for example an EEPROM, capable of keeping the data even without electric voltage, for recording this code and turning on/off means are provided for switching the lighting device at each successive detection of an admissible code transmitted by the remote control 5.

In particular, the device can comprise a single receiver 20 associated to optical surfaces 21 that deflect the infrared waves sent by the remote control 5 at the receiver 20 same (figure 3). Alternatively, several receivers 20 are provided, for example three receivers 20a, 20b and 20c arranged at an angular distance of about 120° (figure 4).

In both cases, a preliminary step is provided of activating device 1 when voltage is supplied to lamp 120, for example a bedside table lamp 121, a wall lamp 122, a floor lamp 123, etc., by a respective manual switch 51, 52 or 53 (figure 5). At this point by remote control 5 of a TV set 8 an IR code is sent that can be the same for all lamps 120 or it can be different for each of them. In particular, to each key 6 an IR code corresponds and then for turning

on or off lamps 121-123 at the same time, it is sufficient to set a same code in all the devices 1 mounted on them using a same key 6. On the contrary, for each lamp 121-123 a different key 6 and, then, a different code, is used.

More in detail, when a key 6 of remote control 5 is pressed, the means for recording device 1 enters in a self-learning loop that lasts a predetermined time, at the end of which the IR code is recorded and cannot be modified until device 1 is again in a self-learning mode.

Furthermore, it is also possible to change the intensity of the light source as described hereafter.

With reference to figure 6, a possible circuit 100 will be now described that can be used in device 1 illustrating the functions of some principal elements thereof.

The example of figure 6 shows the use of a microcontroller 10, of type Pic 12CE519, which, in addition to a reduced size - necessary for introducing the circuit in the light bulb -, is equipped with an EEPROM memory (not volatile memory) used for recording the code of the key of the remote control chosen for this function.

When circuit 100 is supplied with voltage, the software in it residing activates immediately an output which drives the gate of a TRIAC 11 turning on the lamp 12 and setting the light intensity that it had when it was turned off the last time by cutting off voltage: this way the lamp 12 works as a normal light bulb that can be turned on and off directly by the manual switch present in the apparatus and already used for this function.

In this first step, i.e. when the light bulb 12 is turned on, the circuit 100 starts a self-learning loop for a period T1 (for example 10 seconds). In this period, if a

code is sent to the microcontroller, this is stored in the EEPROM of microcontroller 10 same. After that time T1 has lapsed, the software starts a normal operation routine; once detected a code by remote control 5, it is compared with the recorded code present in the memory and, if it is identical, the on/off status of light bulb 12 is switched. When sending a code a key of the remote control is pressed, and if the sending step is longer than said predetermined time, the microcontroller 10 starts adjusting the duty cycle and the intensity of the light bulb is changed; once reached a desired intensity the key of the remote control is released and the intensity value is recorded in the EEPROM of the microcontroller and remains the same up to a further change. The EEPROM has the property of keeping the data even when electric voltage is interrupted, and this assures to the circuit the possibility of turning on again the light maintaining the previously set light intensity and recognizing the same key of the remote control. When sending again a code to the microcontroller within the self-learning period T1, it replaces the previous code present in the memory; this feature allows the device to be programmed in a flexible way concerning the choice of the key that can be used for this function.

The circuit 100 essentially comprises three sections: a feeding section, a control section and a power section.

In particular, the feeding section is supplied by the voltage at the bulb socket; a condenser 15, characterised by a capacitive reactance, transforms the network voltage from 220Vac to 24Va; a diode bridge 16 rectifies the voltage, whereas an equalizing condenser 17 along with a resistance 18 and a Zener diode 19 equalize the feeding voltage at +5,6V necessary for feeding the microcontroller

10 and the receiver IR 20.

The control section comprises an amplified IR receiver 20, for example of TSOP18type, and microcontroller 10. The signal received by the IR receiver 20 is amplified and turned into a square wave by the same receiver and then sent to microcontroller 10 which, once verified the admissibility of the code, through output line 21 drives the power section through the gate of Triac 11, which operates as a switch for turning on or off the lamp. Furthermore, if a PWM modulation technique is used, it is possible to adjust the duty cycle of the voltage on the lamp thus allowing the light intensity variation.

A useful function of the software of microcontroller 10 is that of turning off the lamp 12 if it remains turned on for a predetermined time T (for example about 24 hour), in order to save energy (if the lamp is forgotten turned on).

In flow-sheet 60 of figure 7 the succession of steps is shown for turning on/off the light source with device 1. The software residing in device 1 provides a starting step with the application of voltage to the circuit when switching on the light source, block 61. This starts the self-learning procedure for a predetermined time during which device 1 awaits an IR code, block 62.

In particular, if during the self-learning time the circuit detects an IR code, the IR code is recorded, block 63. Once ended the self-learning time or once recorded the code a loop is started waiting an IR code coming from the remote control 5, blocks 64 and 65.

When a code is detected it is compared with the code already recorded, block 66. If the codes are identical, the light source is switched, block 67. In the contrary, the

circuit returns to the waiting condition.

In figures from 8 to 17 further exemplary embodiments of the invention are shown.

The foregoing description of a specific embodiment will so fully reveal the invention according to the conceptual point of view, so that others, by applying current knowledge, will be able to modify and/or adapt for various applications such an embodiment without further research and without parting from the invention, and it is therefore to be understood that such adaptations and modifications will have to be considered as equivalent to the specific embodiment. The means and the materials to realise the different functions described herein could have a different nature without, for this reason, departing from the field of the invention. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

CLAIMS

1. Lighting device, **characterised in that** it comprises a circuit for turning on/off a light source comprising:

- at least one receiver suitable for detecting at least one signal code, in particular an IR code, sent by a remote control;
- means for recording said or each code in a predetermined situation during the use of the light source;
- turning on/off means of said lighting device at each successive detection of an identical code transmitted by said remote control.

2. Lighting device, according to claim 1, **characterised in that** said means for recording comprise learning means of said or each code, said learning means being switched on for receiving said code in said predetermined situation and for a predetermined time.

3. Lighting device, according to claim 2, **characterised in that** said predetermined situation starts with the application of voltage to said lighting device after a situation without voltage.

4. Lighting device, according to claim 1, **characterised in that** said turning on/off means comprise a circuit that compares a code detected by said receiver with said or each recorded code, the circuit turns on/off the light source when said code detected by said receiver is identical to said or each recorded code.

5. Lighting device, according to claim 1, **characterised in that** it is selected from the group: a light bulb integrating said receiver; a bulb socket integrating said receiver; an electric feeder of a light source integrating

said receiver; an adapter integrating said receiver and arranged between a light source and a bulb socket.

6. Lighting device, according to claim 1, wherein when sending a code by keeping pressed a key of the remote control, if the sending step is shorter than a predetermined time the device turns on/off the light source, whereas if the sending step is longer than said predetermined time the intensity of the light source is changed.

7. Lighting device, according to claim 1, wherein said means for recording comprise at least one EEPROM capable of keeping the data even without electric voltage, whereby when turning on again the light said circuit keeps the previously set light intensity and recognizes the same key of the remote control.

8. Lighting device, according to claim 1, wherein said means for turning on/off a light source comprises a plurality of IR code receivers arranged peripherally at a fixed angular distance.

9. Lighting device, according to claim 1, wherein said means for turning on/off said light source has a single receiver associated to optical surfaces suitable for leaving said signal sent from said remote control against said receiver.

10. Lighting device, according to claim 1, wherein means are provided for automatically turning off the light source after a predetermined time.

11. Lighting device, according to claim 1, wherein said receiver comprises:

- an electric feeding section;
- a power circuit that turns on/off said light source from said feeding section;

- a control section for detecting said or each IR code, for comparing the code and for operating said power circuit.

12. Method for turning on/off a light source by a remote control, wherein said light source is associated to a turning on/off circuit, **characterised in that** it comprises the steps of:

- starting a self-learning waiting loop for a predetermined time in a predetermined situation during the use of the light source;
- learning by said circuit at least one code, in particular an IR code, sent by a remote control during said self-learning time;
- recording the IR code code;
- once ended the self-learning time or once recorded the IR code, starting a waiting loop for detecting a code coming from said remote control;
- comparing a detected code with the recorded learnt code;
- turning on/off of a light source if the compared code and the recorded code are identical.

13. Method, according to claim 12, wherein said predetermined situation during the use of the light source consists of the application of a voltage to said circuit after a situation without voltage.

14. Method, according to claim 12, wherein a step is provided of signalling the recordal of said code by said light source.

15. Method, according to claim 14, wherein said step of signalling the recordal of said code is selected from the group: transmitting an intermittent light by said light

source; transmitting an intermittent light by a LED associated to said circuit.

16. Method, according to claim 13, wherein different codes can be recorded in different self-learning steps, and wherein said step of comparing a detected code is carried out with respect to all the recorded codes, said step of turning on/off a light source being carried out if the if the compared code and at least one recorded code are identical.

17. Method, according to claim 13, wherein by supplying voltage to said light source after a situation without voltage said light source is turned on or off according to whether said light source was respectively on or off the last time the voltage was turned off.

Fig. 1

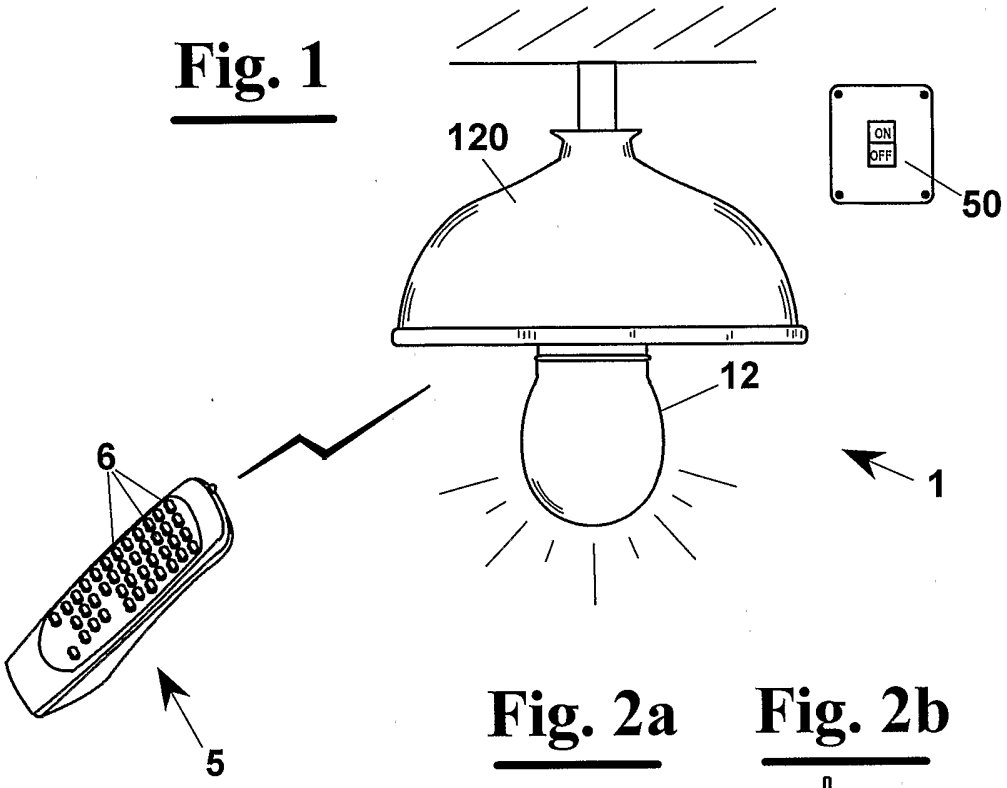


Fig. 2a

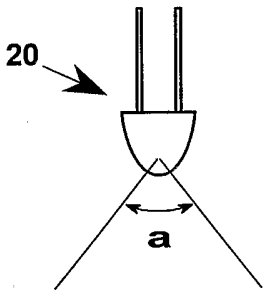


Fig. 2b

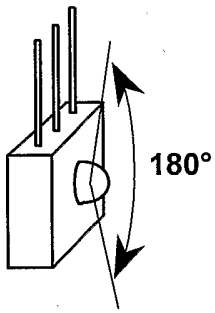


Fig. 3

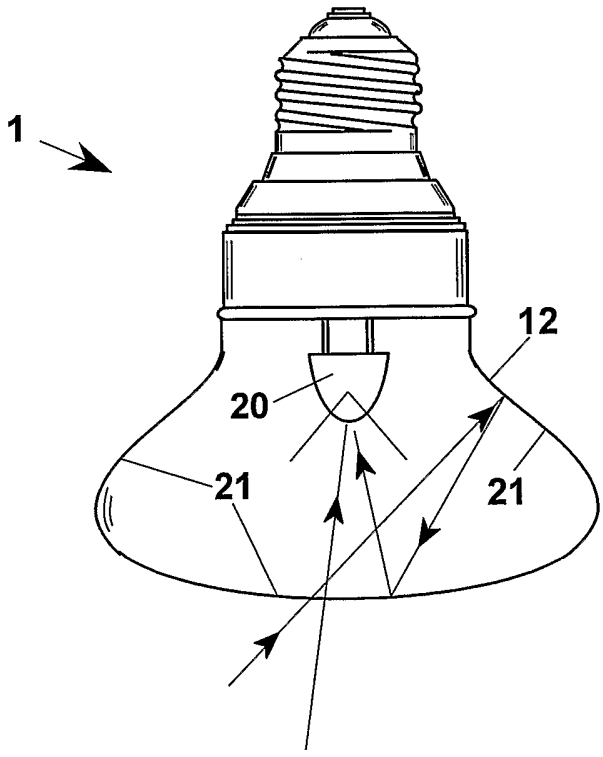


Fig. 4

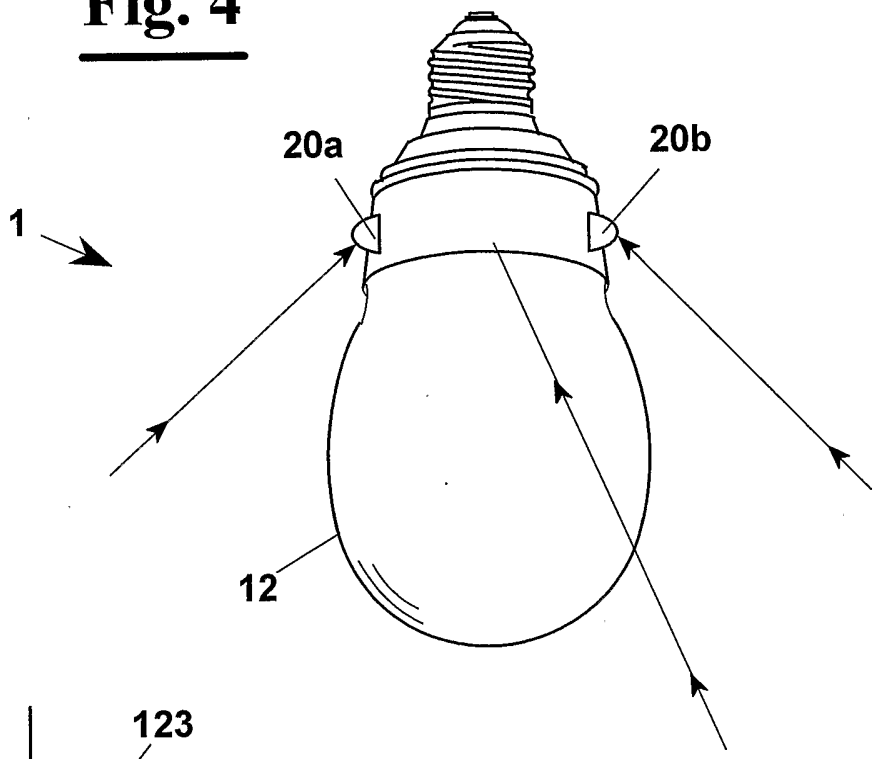


Fig. 5

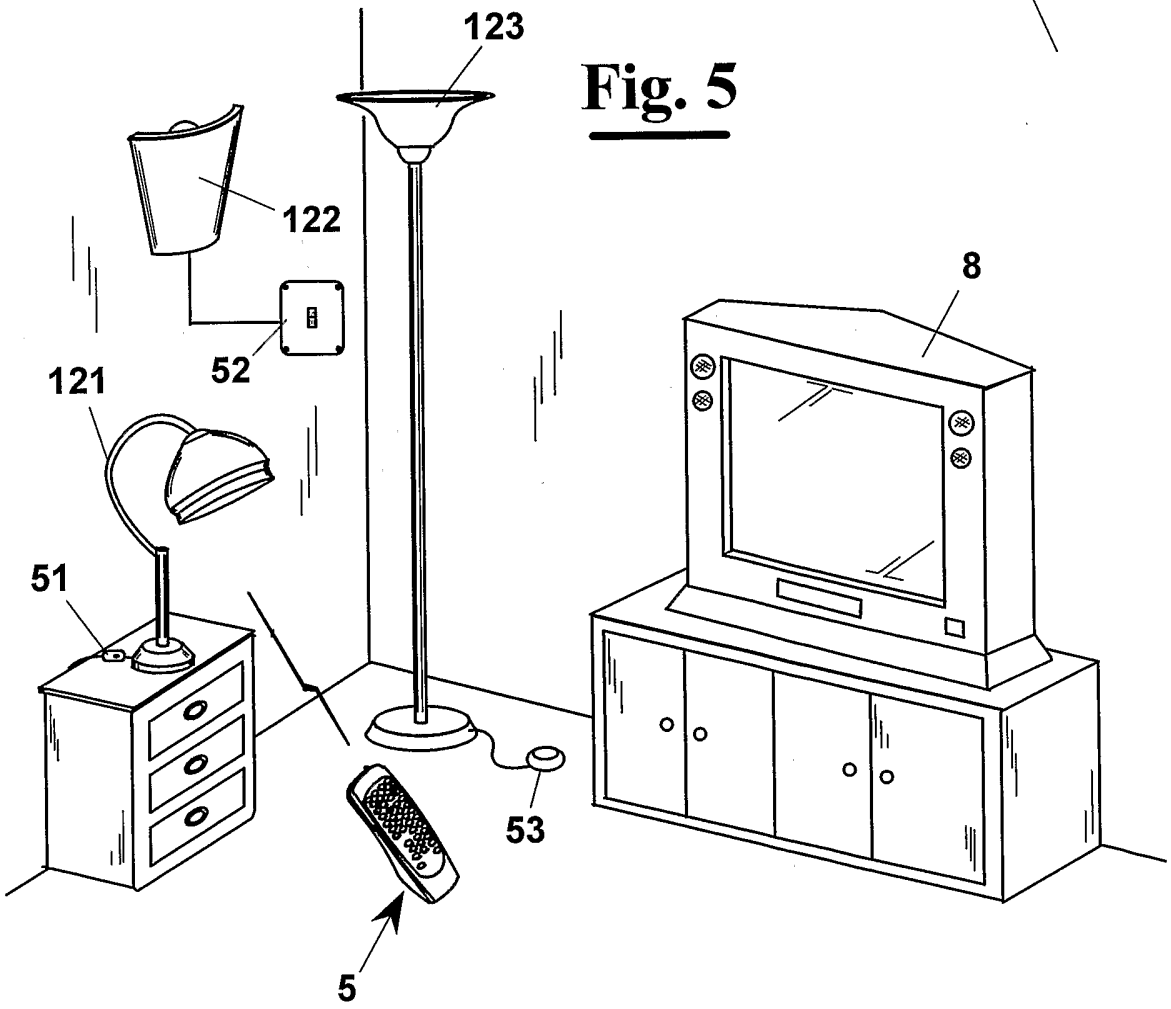


Fig. 6

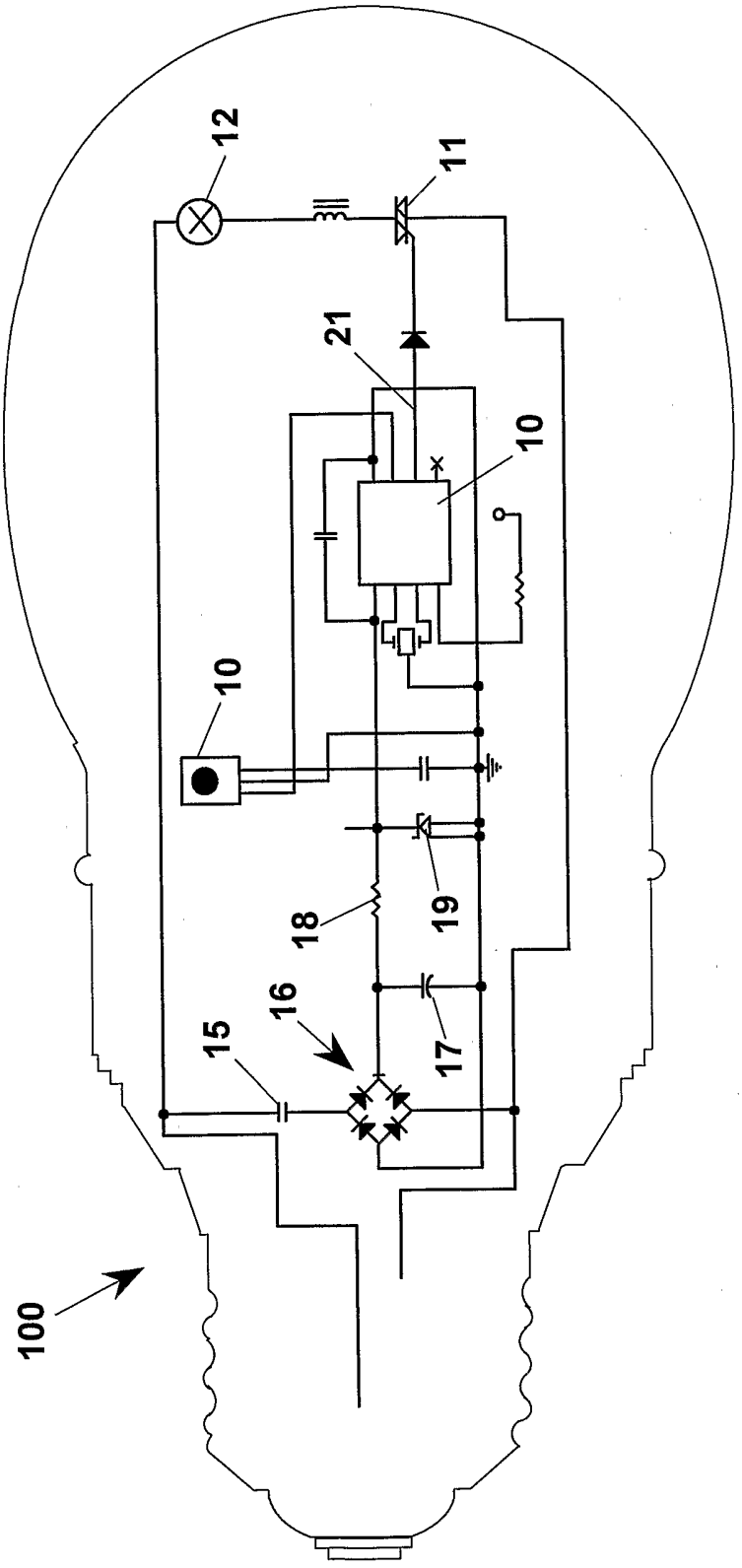


Fig. 7

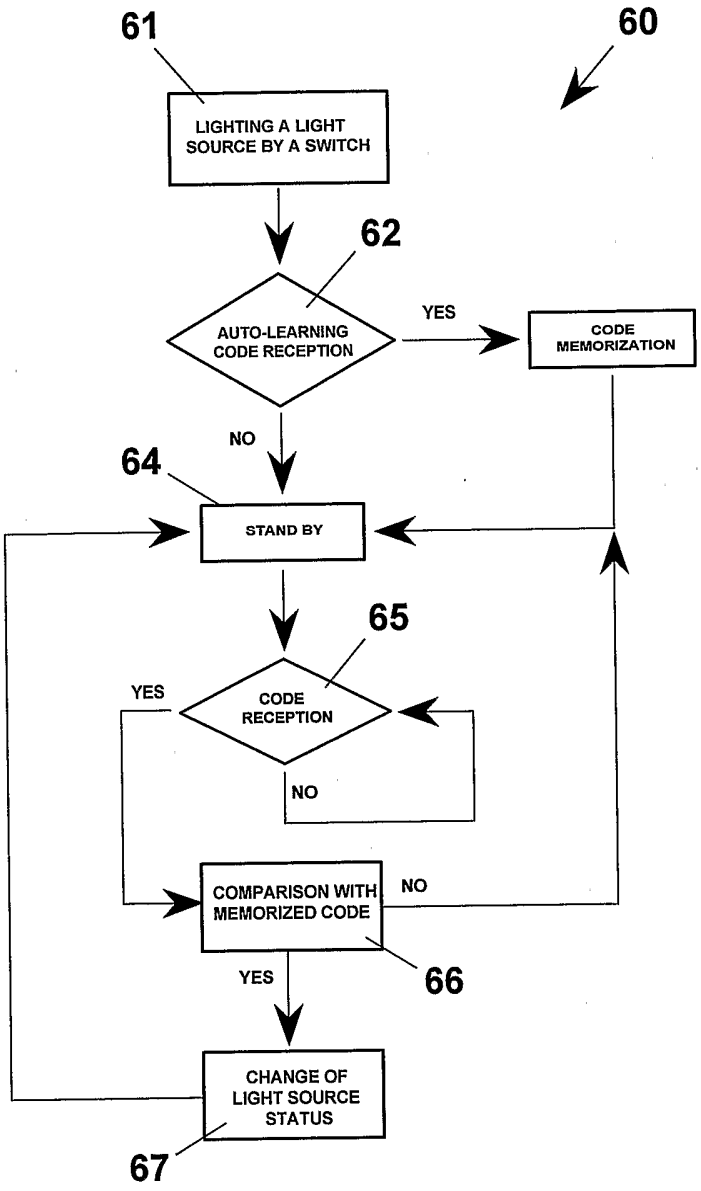

61
60
LIGHTING A LIGHT SOURCE BY A SWITCH
62
AUTO-LEARNING CODE RECEPTION
YES
CODE MEMORIZATION
NO
64
STAND BY
65
YES
CODE RECEPTION
NO
COMPARISON WITH MEMORIZED CODE
NO
66
YES
CHANGE OF LIGHT SOURCE STATUS
67

Fig. 8

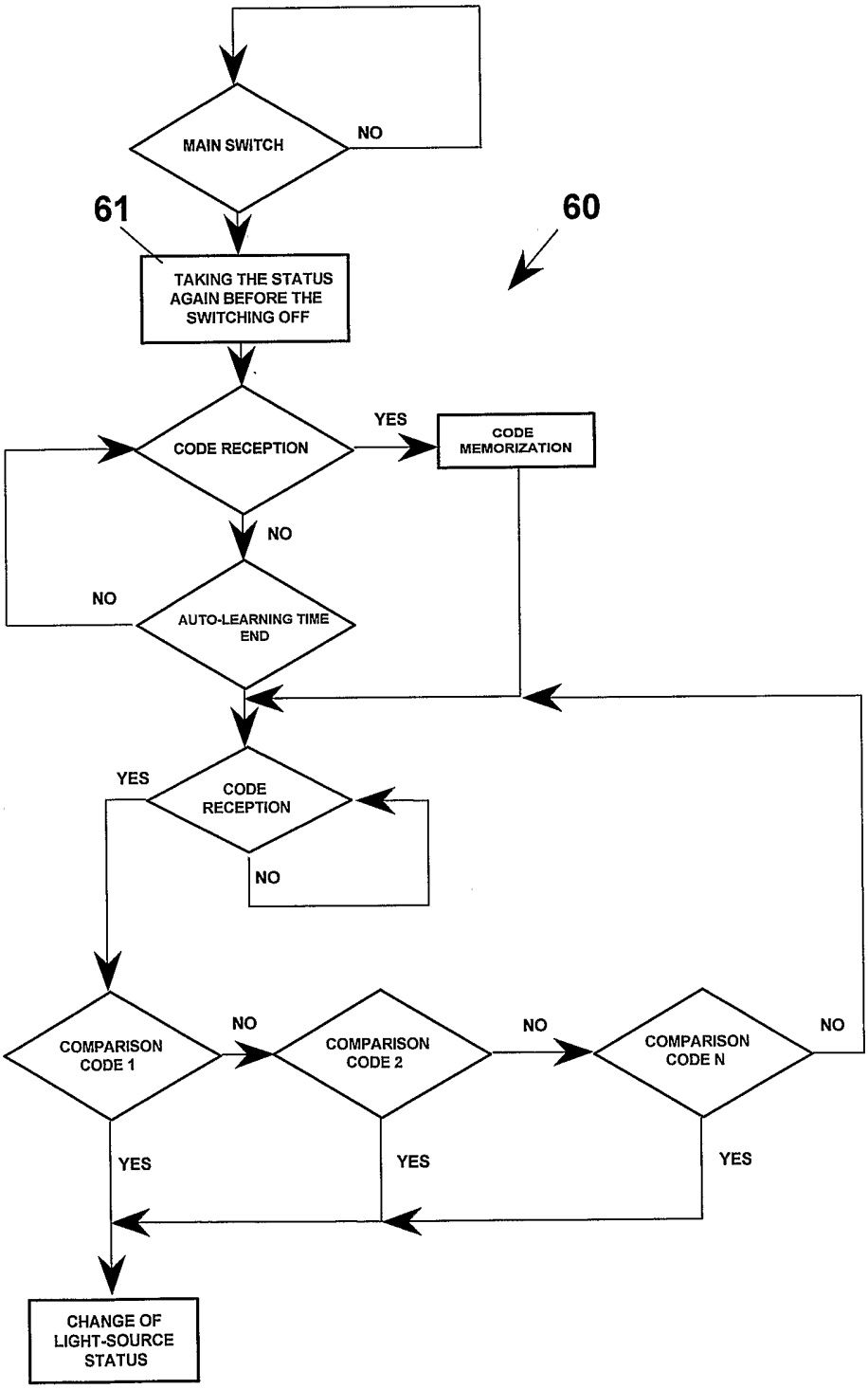
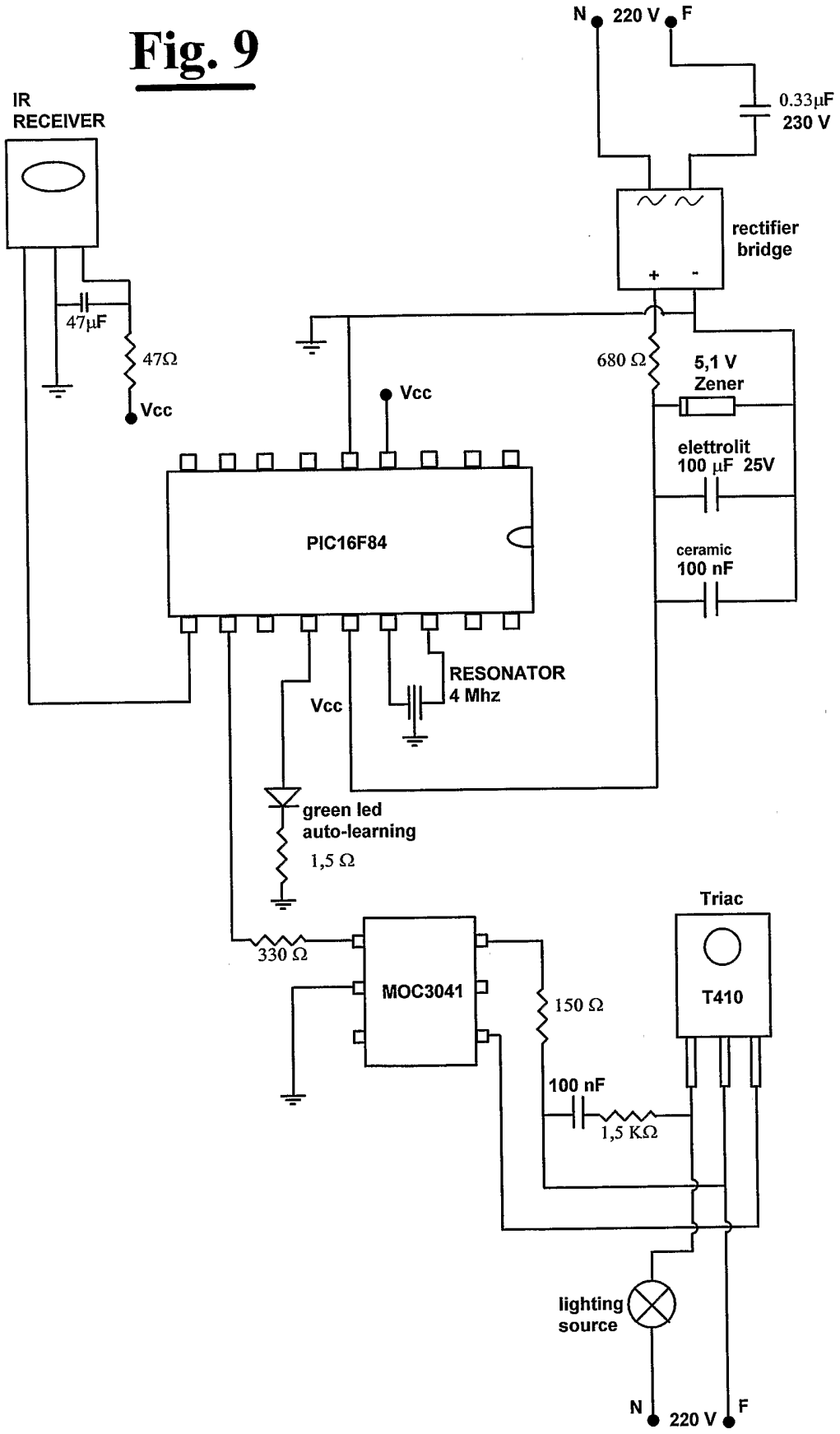

MAIN SWITCH
NO
61
60
TAKING THE STATUS AGAIN BEFORE THE SWITCHING OFF
CODE RECEPTION
YES
CODE MEMORIZATION
NO
NO
AUTO-LEARNING TIME END
YES
CODE RECEPTION
NO
COMPARISON CODE 1
NO
COMPARISON CODE 2
NO
COMPARISON CODE N
NO
YES
YES
YES
CHANGE OF LIGHT-SOURCE STATUS

Fig. 9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F
0.33µF
230 V
IR
RECEIVER
rectifier
bridge
+
-
47µF
47Ω
Vcc
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5,1 V
Zener
Vcc
elettrolit
100 µF 25V
PIC16F84
ceramic
100 nF
RESONATOR
4 Mhz
Vcc
green led
auto-learning
1,5 Ω
Triac
330 Ω
MOC3041
150 Ω
T410
100 nF
1,5 KΩ
lighting
source
N
220 V
F

Fig. 10

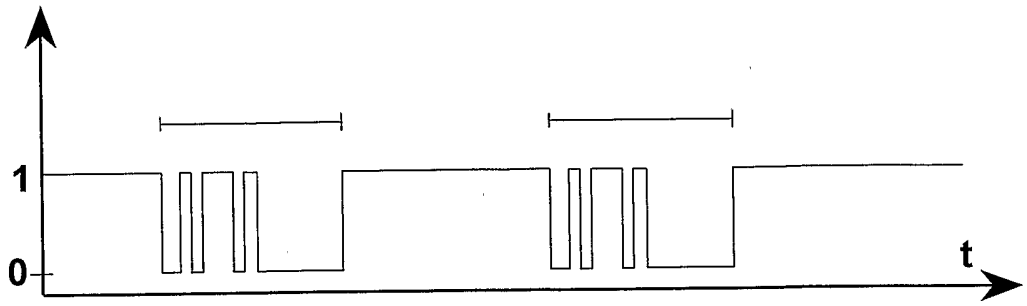


Fig. 11

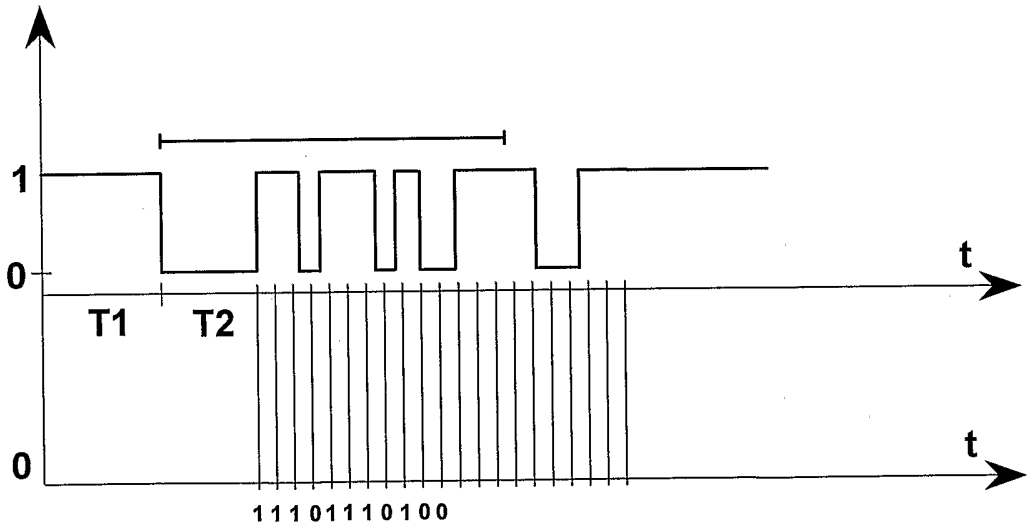
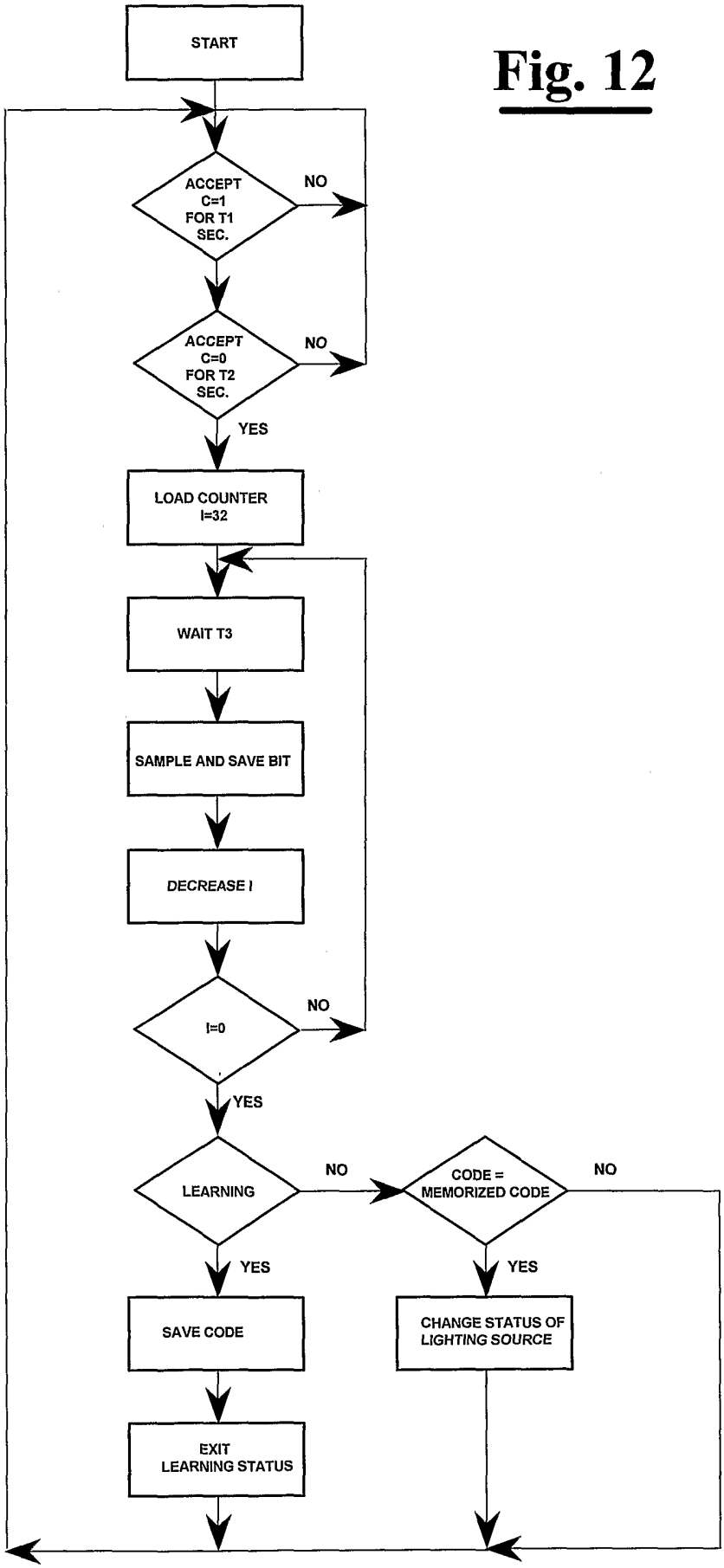


Fig. 12


START
ACCEPT C=1 FOR T1 SEC.
NO
ACCEPT C=0 FOR T2 SEC.
NO
YES
LOAD COUNTER I=32
WAIT T3
SAMPLE AND SAVE BIT
DECREASE I
I=0
NO
YES
LEARNING
NO
CODE = MEMORIZED CODE
NO
YES
YES
SAVE CODE
CHANGE STATUS OF LIGHTING SOURCE
EXIT LEARNING STATUS

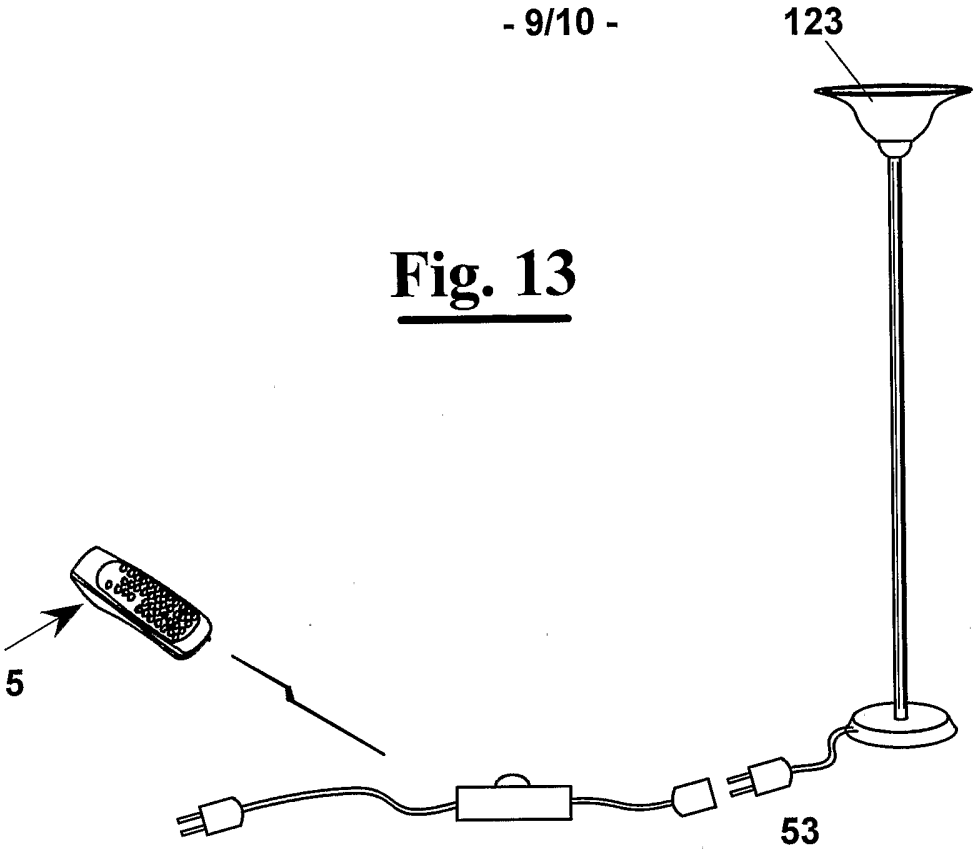


Fig. 13

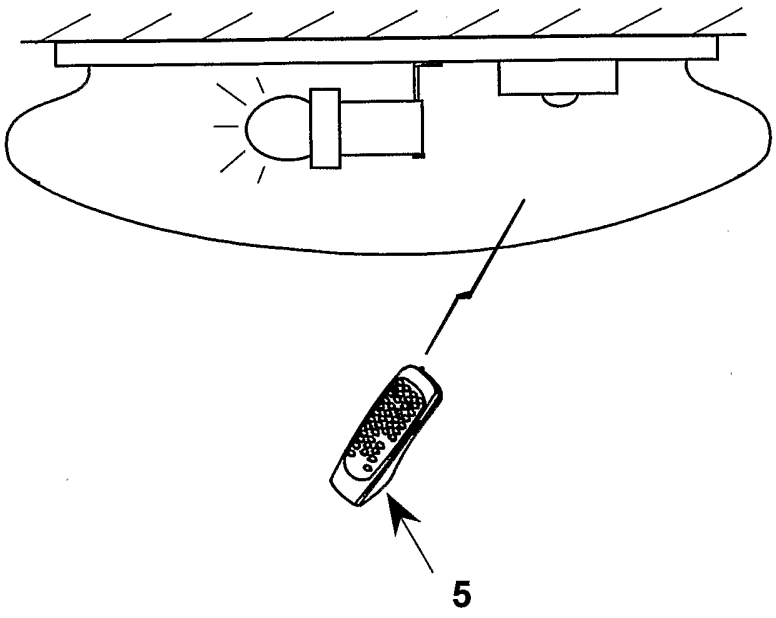


Fig. 14

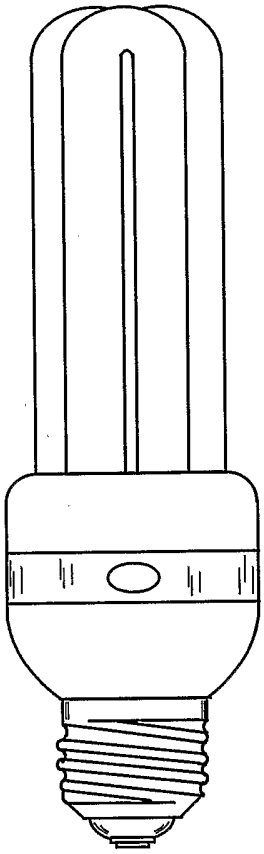


Fig. 15

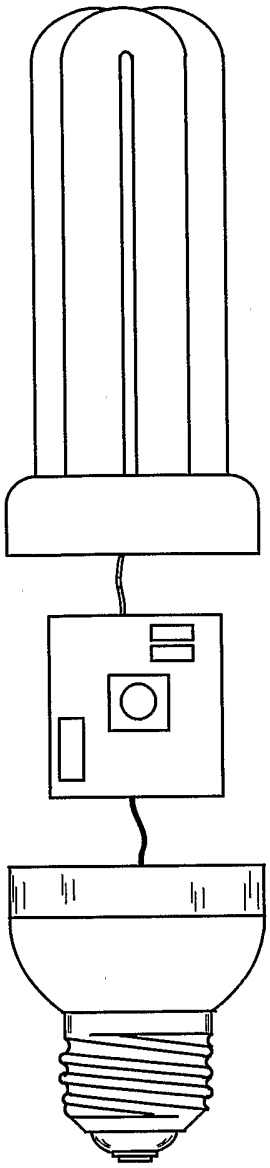
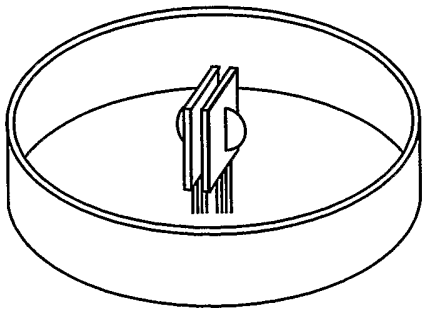


Fig. 16

Fig. 17



INTERNATIONAL SEARCH REPORT

onal Application No
IB2004/001577

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H05B37/02

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)
IPC 7 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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 734 197 A (LUTRON ELECTRONICS CO) 25 September 1996 (1996-09-25) column 1, line 5 - column 2, line 32 column 2, line 56 - column 3, line 43 column 4, lines 3-9 column 4, line 50 - column 5, line 20 column 7, lines 15-37 column 8, lines 2-6 column 9, lines 33,34 column 11, lines 8-16 column 13, lines 30-35 column 14, lines 22-49 figures 1,5,16,18-22 ----- -/--	1-7,9-17

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
2 September 2004	13/09/2004

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INTERNATIONAL SEARCH REPORT

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