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

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(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**).

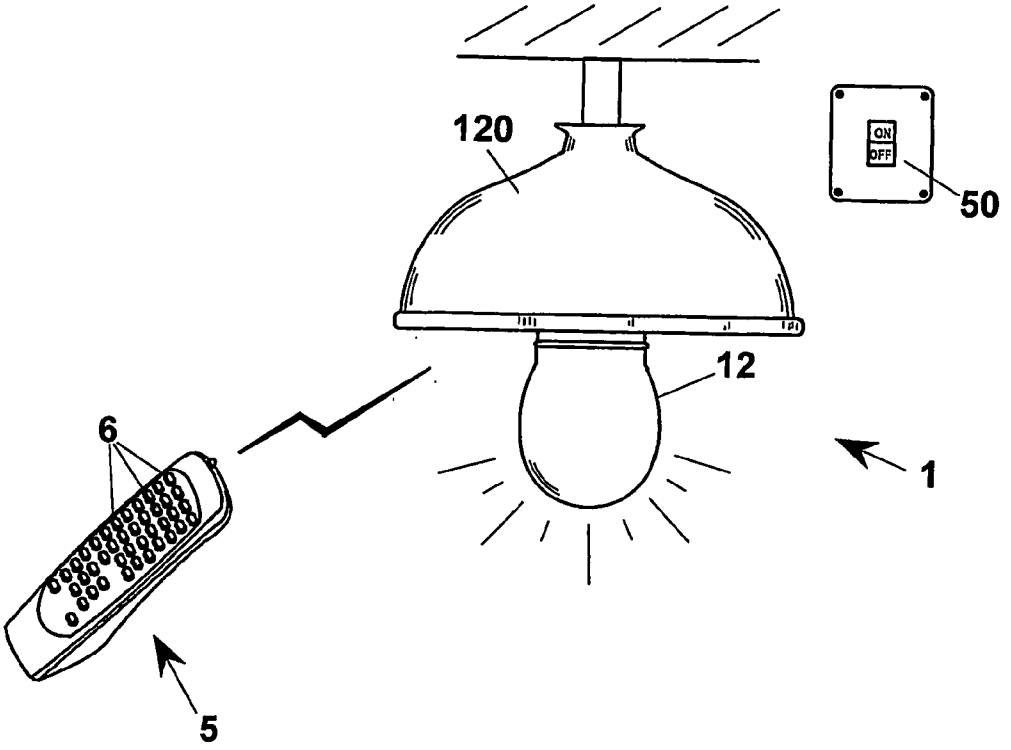


Fig. 1

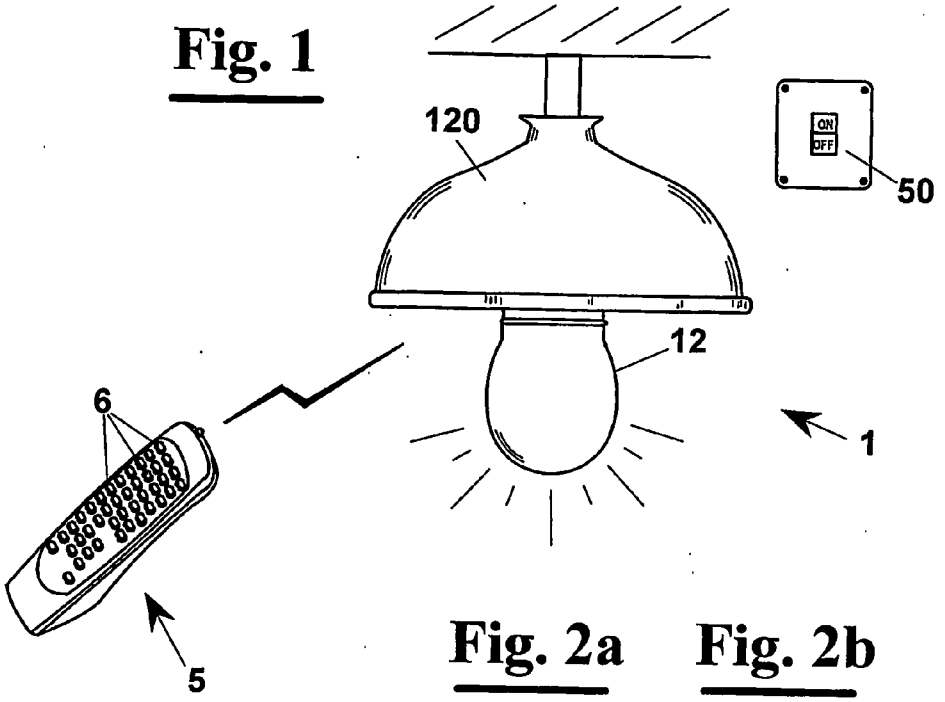



Fig. 2a

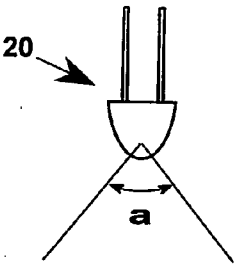



Fig. 2b

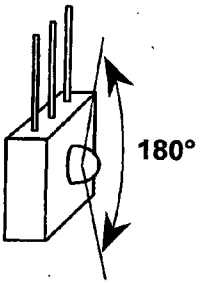



Fig. 3

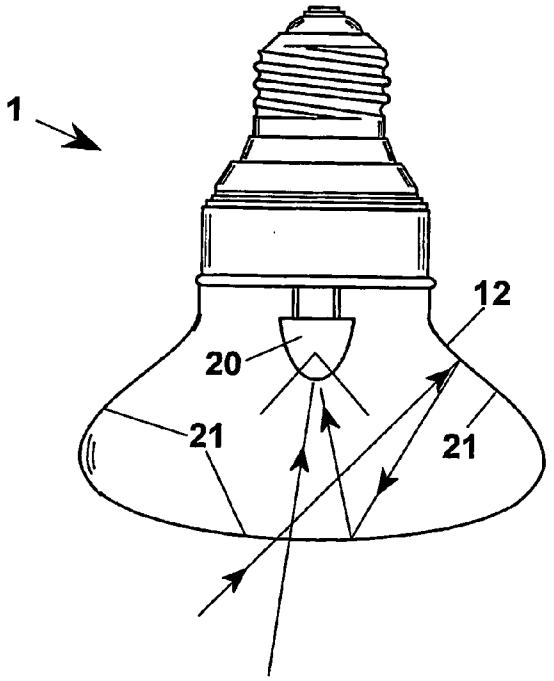


Fig. 4

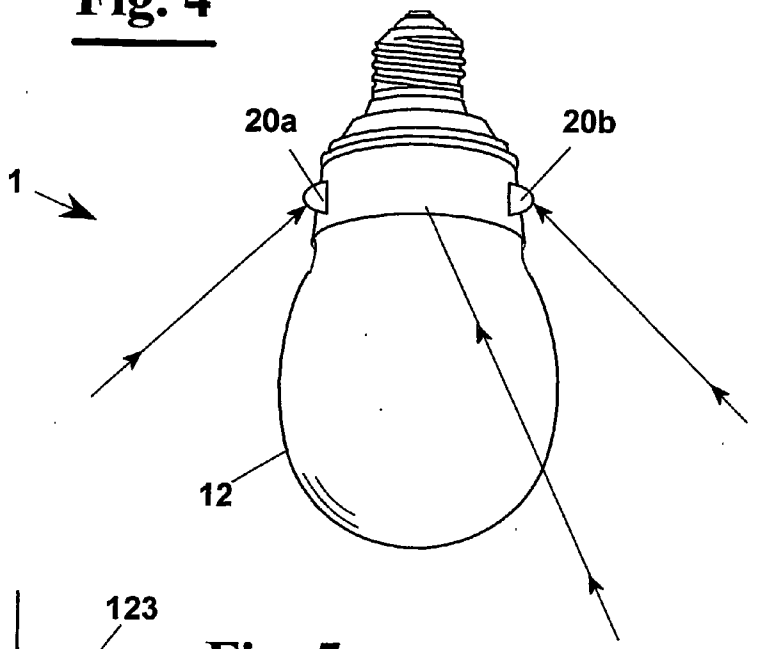
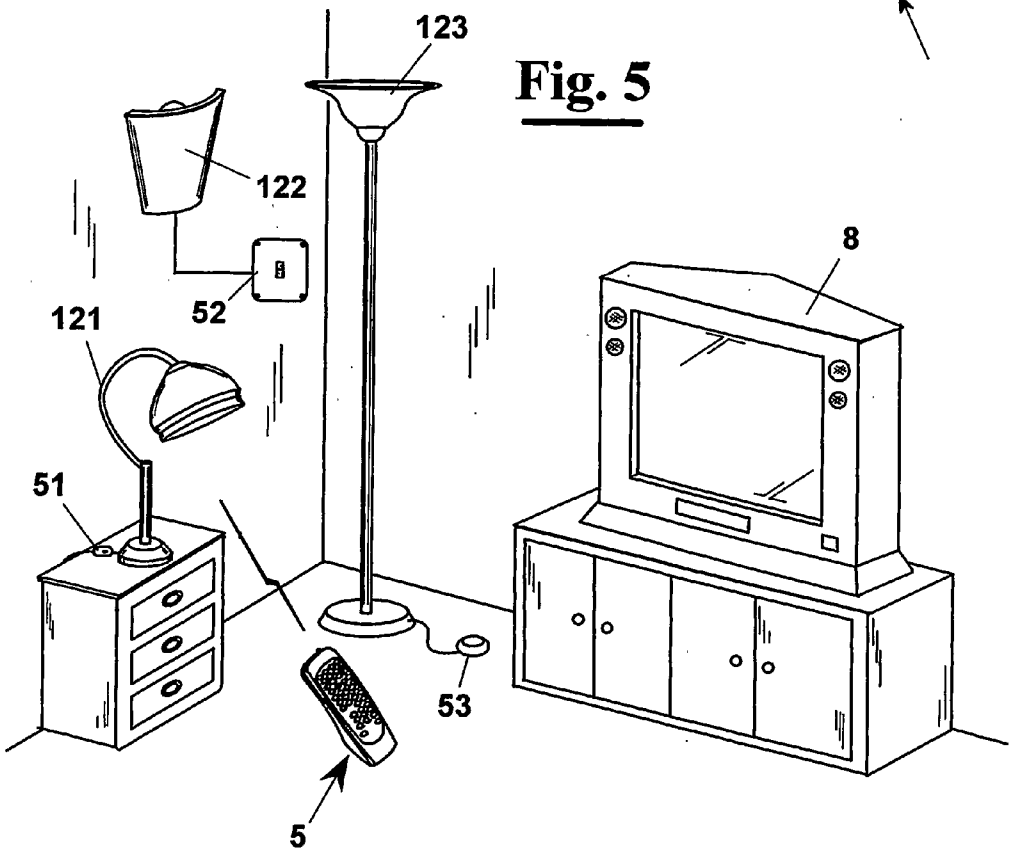



Fig. 5



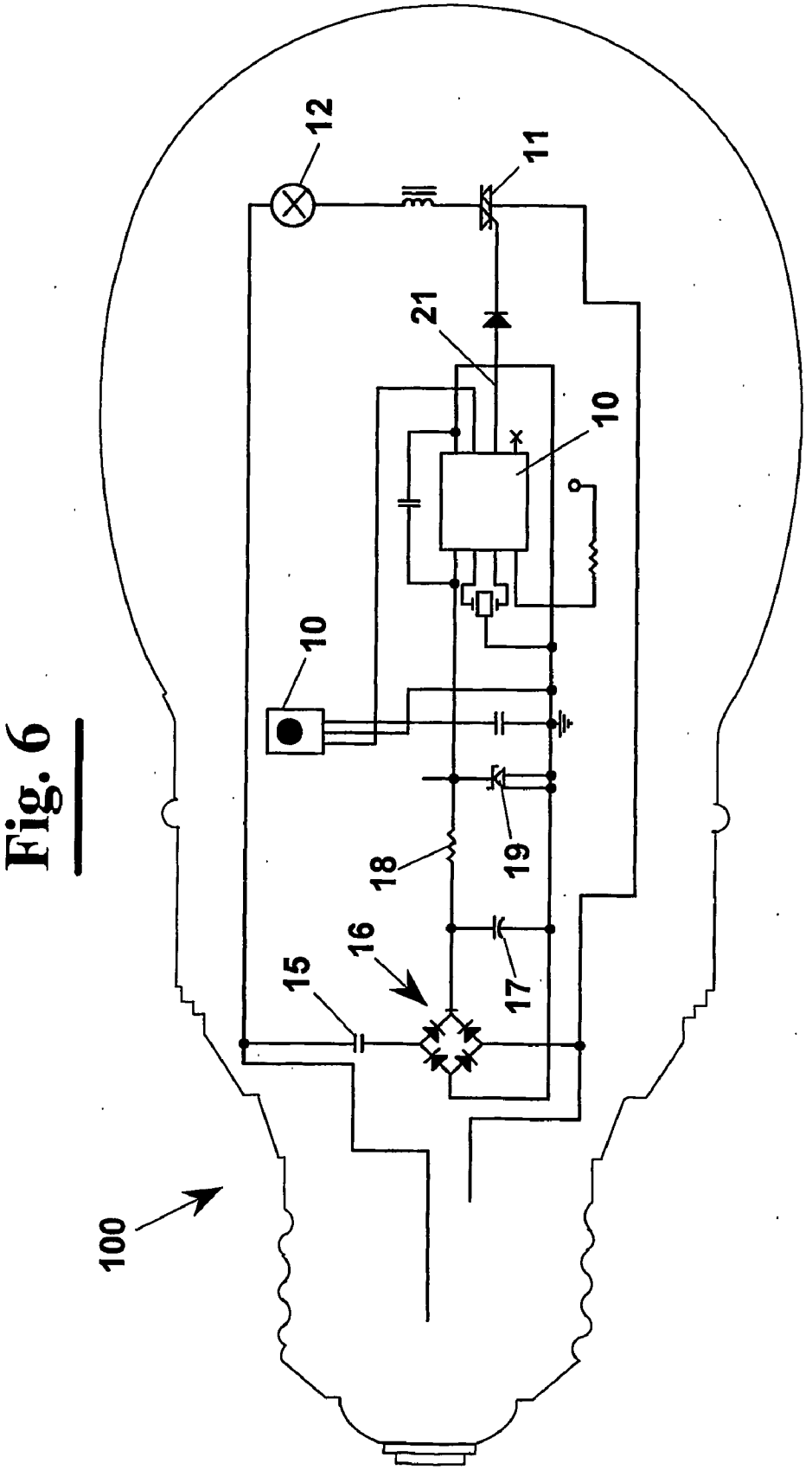
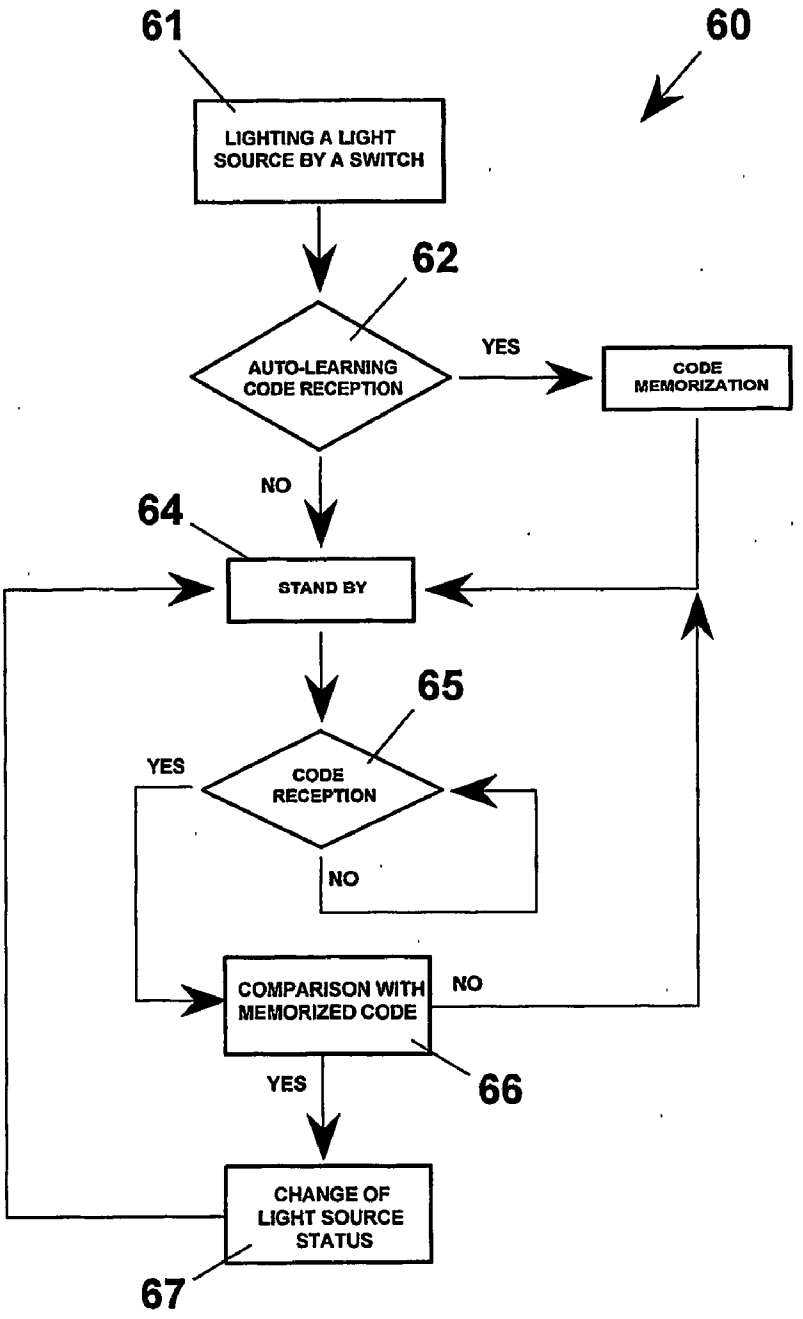
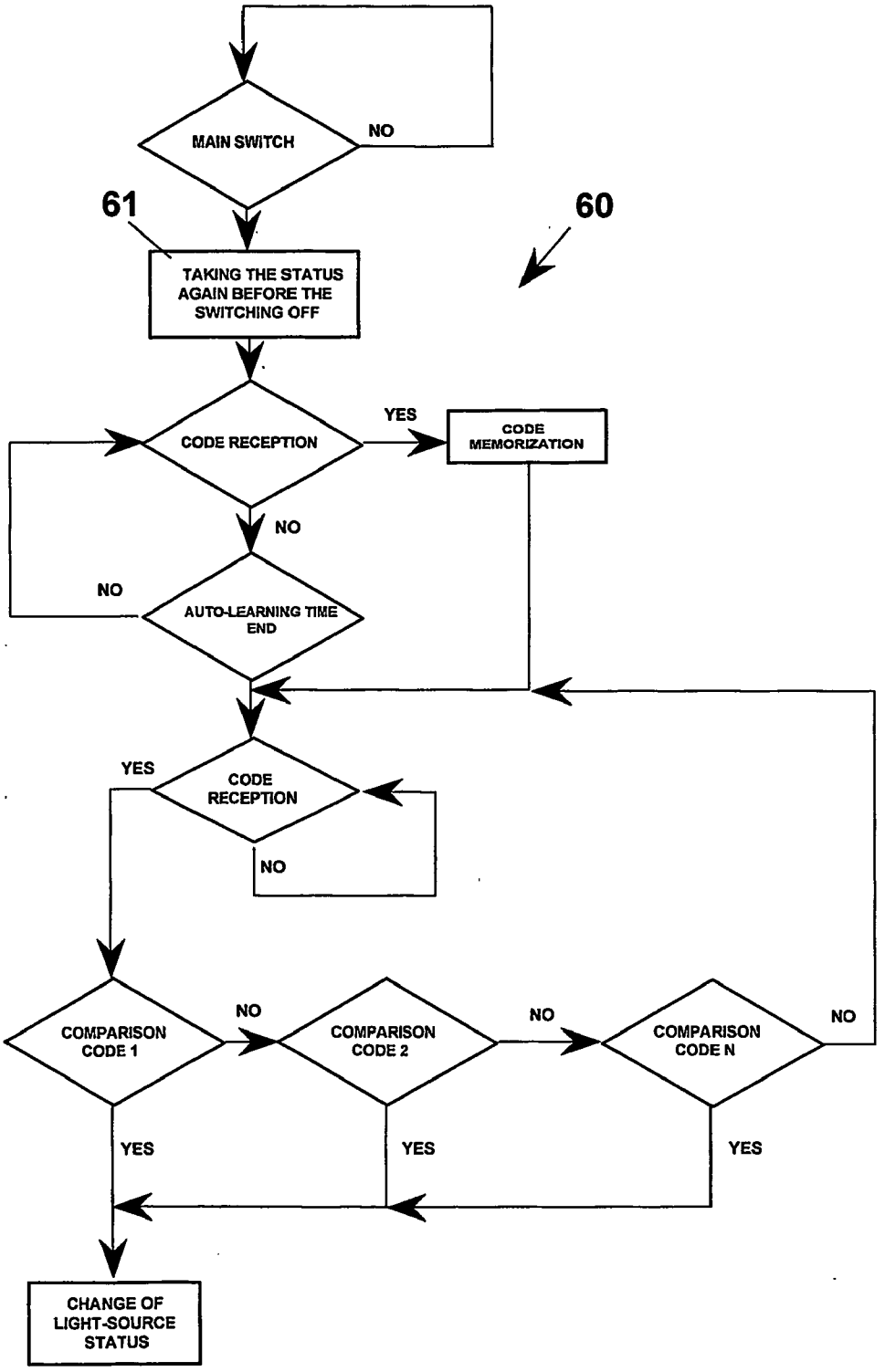



Fig. 6

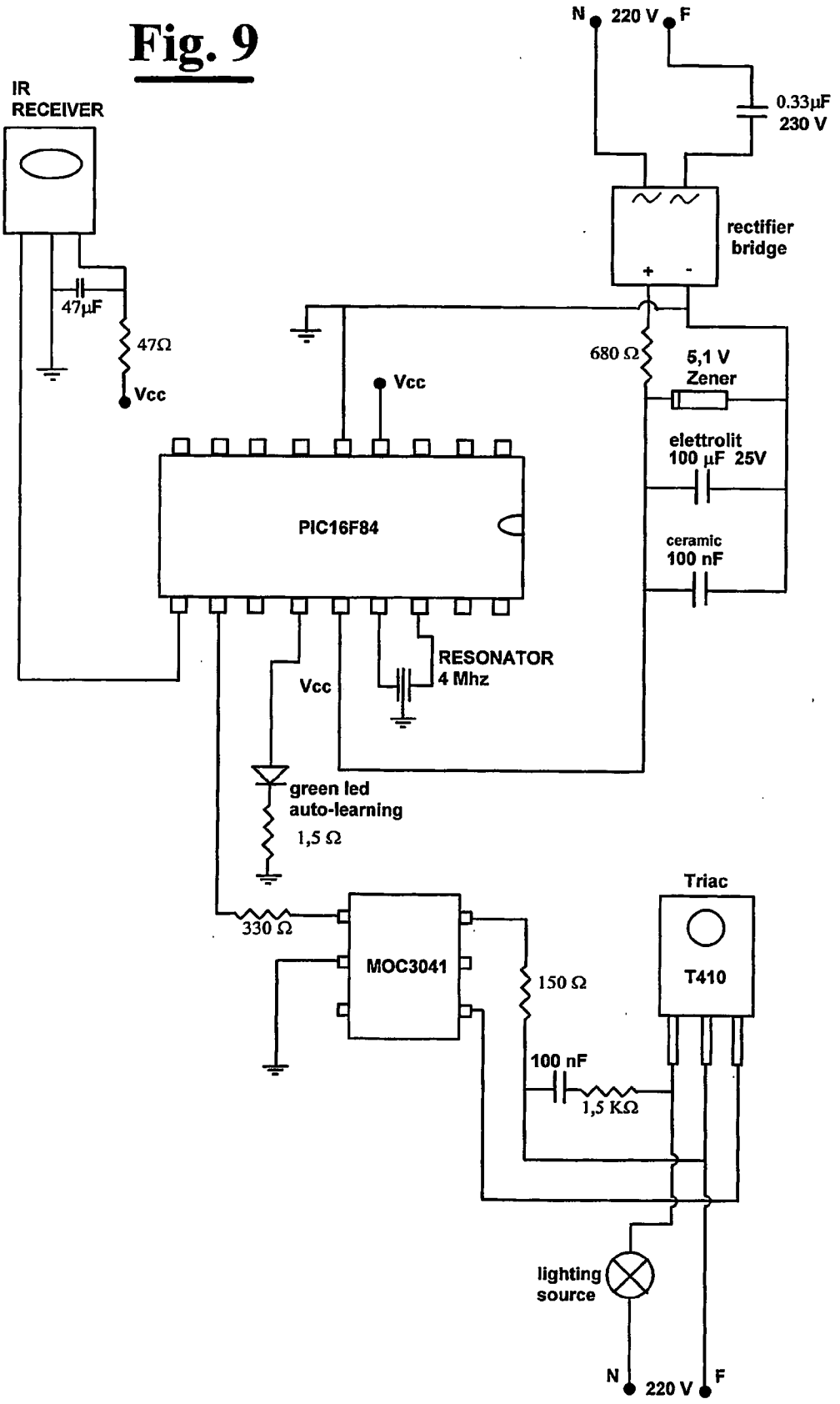
# Fig. 7


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
YES
66
CHANGE OF LIGHT SOURCE STATUS
67

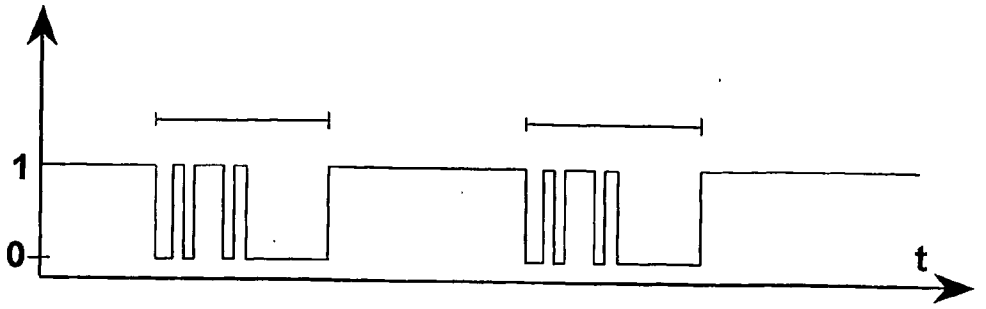
# Fig. 8


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

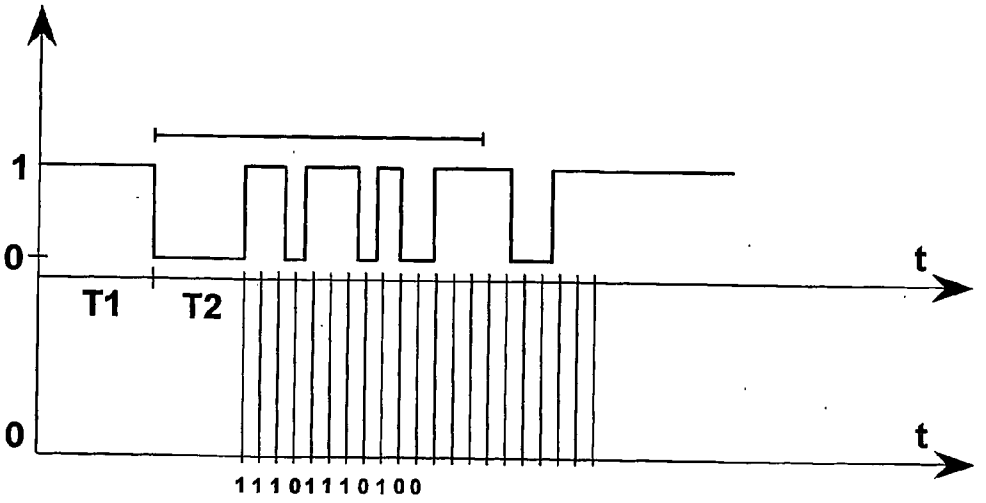
# Fig. 9


N
220 V
F
0.33µF
230 V
rectifier
bridge
+
-
IR
RECEIVER
47µF
47Ω
Vcc
680 Ω
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



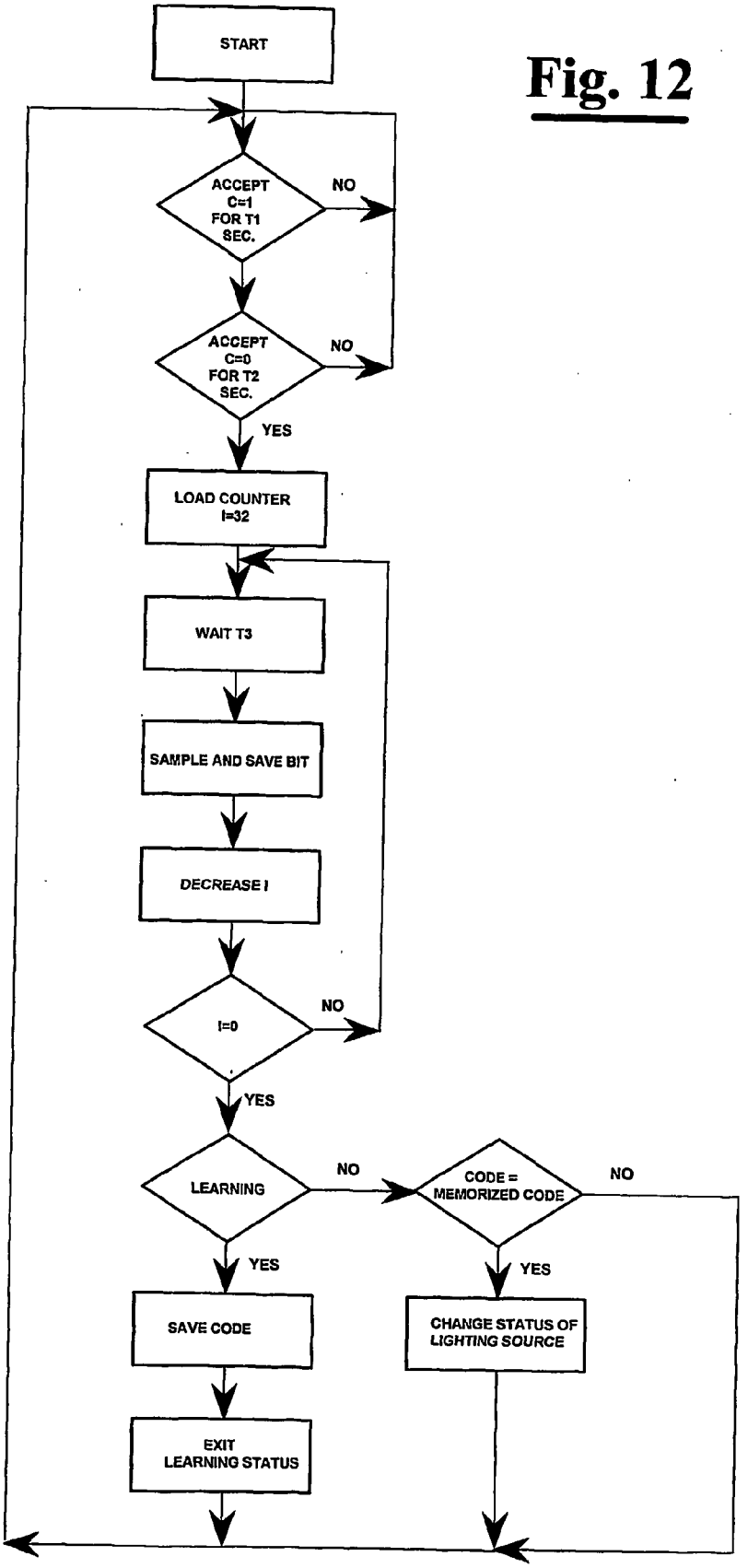

START
ACCEPT C=1 FOR T1 SEC.
NO
ACCEPT C=0 FOR T2 SEC.
NO
YES
LOAD COUNTER I=32
WAIT T3
SAMPLE AND SAVE BIT
DECREASE I
I=0
NO
YES
LEARNING
NO
CODE = MEMORIZED CODE
NO
YES
YES
SAVE CODE
CHANGE STATUS OF LIGHTING SOURCE
EXIT LEARNING STATUS

Fig. 12

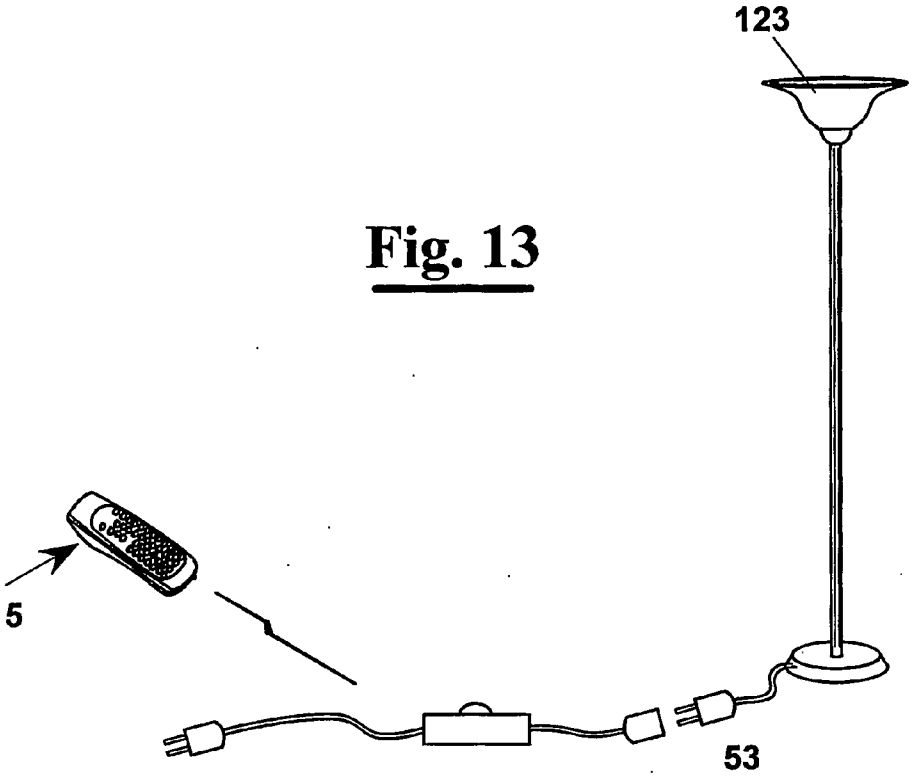



Fig. 13

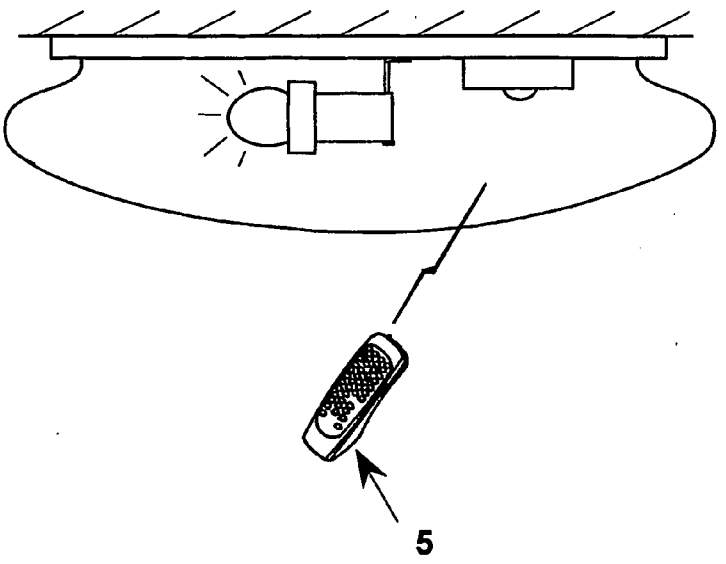



Fig. 14

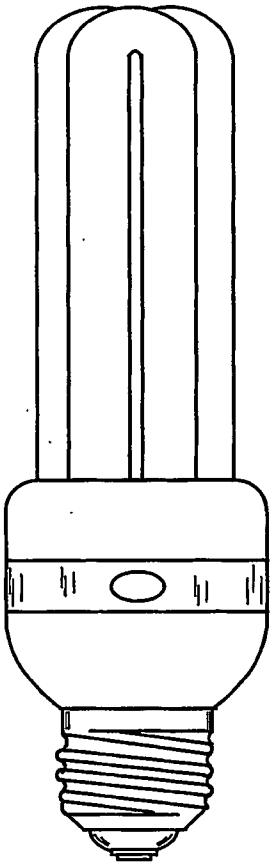


Fig. 15

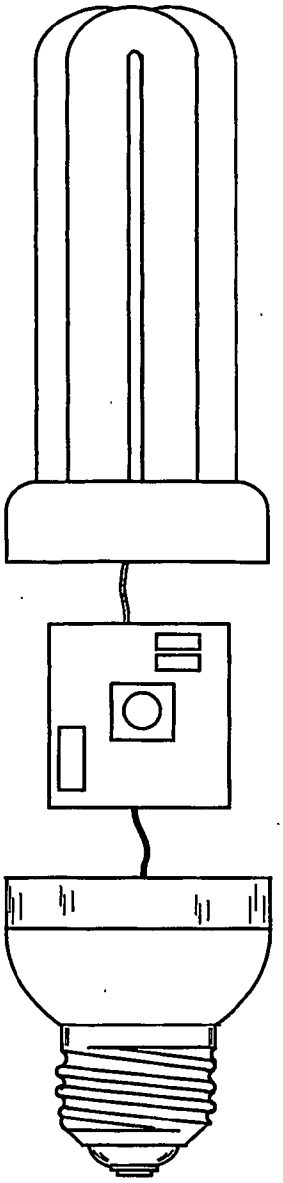
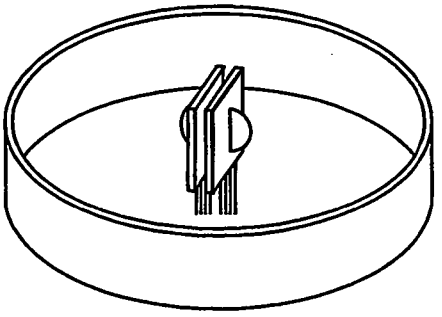


Fig. 16

Fig. 17



# APPARATUS FOR REMOTELY TURNING ON AND OFF LIGHTING DEVICES

## FIELD OF THE INVENTION

[0001] 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

[0002] 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.

[0003] 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.

[0004] 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

[0005] 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.

[0006] It is also a feature of the present invention to provide such a lighting device that is structurally easy and cheap.

[0007] These and other features are accomplished with one exemplary lighting device, according to the present invention, as defined by the attached claims **1-11**.

[0008] 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

[0009] 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:

[0010] FIG. **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;

[0011] FIGS. **2**A and **2**B show a type of receiver that can be used in the device of-figure **1**;

[0012] FIG. **3** shows diagrammatically an elevational front view of the operation of a possible exemplary embodiment of the device of FIG. **1**;

[0013] FIG. **4** shows diagrammatically in a perspective elevational front view the operation of an exemplary embodiment alternative to that of FIG. **1**;

[0014] FIG. **5** shows diagrammatically a perspective view of the possibility of using a same remote control for operating different light sources;

[0015] FIG. **6** shows a possible electric diagram of an IR receiver circuit for turning on/off the light source;

[0016] FIG. **7** shows a possible flow-sheet of a method for turning on/off a light source by a remote control, according to the invention.

[0017] FIG. **8** shows a flow-sheet alternative to that of FIG. **7**.

[0018] FIG. **9** shows a preferred turning on/off circuit associated to a lighting device according to the invention;

[0019] FIGS. **10** and **11** show respectively a pulse-code and a diagram for sampling said code;

[0020] FIG. **12** shows an advantageous flow-sheet of the procedure of reading the code;

[0021] FIG. **13** shows a lighting device according to the invention which can be associated to the feeding cable of a lamp;

[0022] FIG. **14** shows a lighting device according to the invention which can be associated to the feeding fitting of a ceiling lamp;

[0023] FIGS. **15-17** show a lighting device according to the invention which can be associated to a light bulb;

## DESCRIPTION OF A PREFERRED EXEMPLARY EMBODIMENT

[0024] With reference to FIG. **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.

[0025] 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.

[0026] 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 a (FIG. **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**.

[0027] 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 (FIG. **3**). Alternatively, several receivers **20** are provided, for example three receivers **20***a*, **20***b* and **20***c* arranged at an angular distance of about 120° (FIG. **4**).

[0028] 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** (FIG. **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.

[0029] 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.

[0030] Furthermore, it is also possible to change the intensity of the light source as described hereafter.

[0031] With reference to FIG. **6**, a possible circuit **100** will be now described that can be used in device **1** illustrating the functions of some principal elements thereof.

[0032] The example of FIG. **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.

[0033] 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.

[0034] 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 T**1** (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 T**1** 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 T**1**, 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.

[0035] The circuit **100** essentially comprises three sections: a feeding section, a control section and a power section.

[0036] 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 200 Vac to 24 Va; 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**.

[0037] 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.

[0038] 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).

[0039] In flow-sheet **60** of FIG. **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**.

[0040] 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**.

[0041] 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.

[0042] In figures from **8** to **17** further exemplary embodiments of the invention are shown.

[0043] 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 embodi-

ment. 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.

**1-17**. (canceled)

**18**. Light bulb comprising one or more apparatus allowing the switching on/off of said light bulb, such apparatus comprising:

at least one receiver capable of detecting an IR code sent by remote control,

means for storing said code associated to said receiver;

means for turning off/on the light.

**19**. Light bulb according to claim 18 comprising a plurality of said receivers arranged peripherically at a fixed angular distance.

**20**. Light bulb socket comprising a lighting device allowing the switching on/off of said light bulb, such lighting device comprising:

a receiver capable of detecting an IR code sent by remote control,

means for storing said code associated to said receiver;

means for turning off/on the light.

**21**. Light bulb socket according to claim 20 comprising a plurality of said receivers arranged peripherically at a fixed angular distance.

**22**. Light bulb according to claim 18 wherein said means are provided for automatically turning off the light after a predetermined time.

**23**. Light bulb socket according to claim 20 wherein said means are provided for automatically turning off the light after a predetermined time.

**24**. Light bulb according to claim 18 wherein said means for storing the IR code comprise learning means of said code, said learning means being switched on for receiving said code in a predetermined situation and for a predetermined time.

**25**. Light bulb socket according to claim 20 wherein said means for storing the IR code comprise learning means of said code, said learning means being switched on for receiving said code in a predetermined situation and for a predetermined time.

**26**. Light bulb according to claim 18 wherein said means for storing the IR code are capable of changing the intensity of the light.

**27**. Light bulb socket according to claim 20 wherein said means for storing the IR code are capable of changing the intensity of the light.

* * * * *