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(54) Method and apparatus for indicating the position of impact of light on a target.

(57) A target (1) comprises an array of electro-optical devices (3) such as light-emitting diodes, disposed within light impervious tubes (4). When a ray of light impinges on one of the devices (3) it is detected. Control circuitry (6) then causes the device to emit visible light so as to indicate the point of impact. The target can be for use in optical shooting or can be used as an optical drawing board (8) in conjunction with a light pen (9).

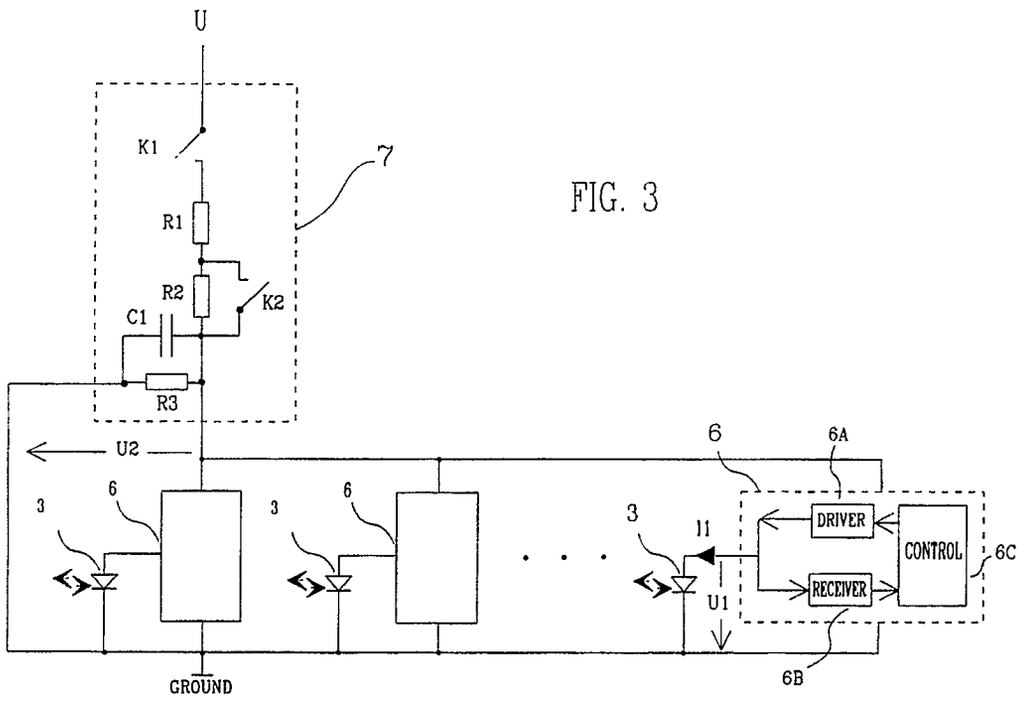

FIG. 3

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This invention relates to a method and apparatus for indicating the position of impact of light on a target. The invention is particularly of use in a system in which continuous or pulse-like rays of light are directed to a target board provided with means for indicating the points of impact of the light rays.

Target boards are known particularly in the field of optical shooting. The apparatus disclosed in German Offenlegungsshcrift DER-A-3,002,923, for example, is based on an infrared light-emitting target wherein each numbered circle emits a coded light pulse. This is received by a directional optoelectronic detector, decoded and numerically shown by a display unit.

Another German Offenlegungsschrift DE-A-2,952,608 discloses an apparatus which is based on the method described above and is used in a training target intended for the police.

A method as disclosed in Swiss Patent CH-A-623,652 is based on a semiconductor camera or a detector board which receives a light pulse, and a monitor which shows the point of impact with an accuracy of a number and sector. The receiver detector is divided into sectors, and each sector is divided into different numbers.

The present methods and devices are very complicated and technically demanding, whereby manufacturing costs would be considerable in terms of mass production. A different device is always needed for detecting and displaying the hit. Furthermore, the devices are essentially larger than the traditional targets used, for example, in airgun shooting. The impression of a hole appearing on a white target when it is hit is also difficult to create by the present methods. Nor is it easy to manufacture targets of different sizes.

Viewed from one aspect of the invention there is provided a method for indicating the position of impact of light on a target, wherein light is directed to a target provided with eletro-optical devices, characterised in that each electro-optical device serves both to detect the impact of light at the position of the device and to emit light so as to indicate the point of impact.

Viewed from another aspect of the invention there is provided Apparatus for carrying out the above method, comprising electro-optical devices arranged as a target board for light characterised in that the electro-optical devices are switchable between a detecting mode that detects the light impinging thereon and an indicating mode that displays the points of impact.

The method and device according to the invention provide a clear improvement on the defects stated above. Moreover, the target according to the invention is suitable not only for use in the context of a shooting target but also in the context of optical indication on signalling in general, eg for manufacturing an optical drawing board. The simplicity of the target according to the invention contributes to this. In preferred embodiments it can be made by mass production, and therefore its price may be kept moderate.

In the context of optical shooting, the impact of a light pulse is detected and displayed by the same device, ie the point of impact and display is the same, whereby the impression can be similar to conventional shooting, for example with an airgun at a cardboard target.

The target need be hardly larger than a target used presently in airgun shooting, and therefore it does not necessarily need separate storage but can be kept at hand all the time, for instance on the wall of a room. To manufacture targets of different sizes is easy. Aiming at the target gives an impression very similar to aiming, for example, at a cardboard target, as the front surface of the target can be made of white paper or plastic which is pervious to light and on which eg the circles and numbers have been printed.

In drawing embodiments, a light pen or some other optical drawing device can be moved over a target board, whereby the signalling devices which are lit form lines, dots and so forth in accordance with the points of impact of the ray of the light pen.

Preferably the electro-optical devices are light-emitting diodes, eg LEDs.

Some embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, in which:-

Figure 1 shows a shooting target in accordance with the invention, viewed from the front;

Figure 2 shows a section on the line I-I of the target of Figure 1;

Figure 3 shows an electronic operating coupling system and light-emitting LED signal lights; and

Figure 4 shows a target board in accordance with the invention for use in drawing.

According to Figure 1 a target 1 comprises an outer casing and a white film, sheet, window or the like 2, which is pervious to light and on which circles and numbers have been printed. Behind the film 2 there are light-emitting diodes 3 densely disposed and surrounded by tubes 4 impervious to light. In particular, GaAs and GaAlAs diodes which emit red or infrared light are suitable for use as the LEDs. At present there are also available superbright LEDs and even laser diodes suitable for the purpose. Red LEDs made of the above-mentioned semiconductor materials have proved to function extremely well as light detectors if their operating point is selected suitably. The voltage change of an LED coupled over a high-impedance control circuit can be of the order of even 1 V when it is hit by a

beam of light having a wavelength close to or identical with that of the light emitted by the LED.

Figure 2 shows also the location of diodes 3, the printed circuit board 5 of control circuits 6 and a controlling circuit 7 which controls the whole target board. The coupling of the control circuits 6 of the LEDs 3 and of the controlling circuit 7 is shown in greater detail in Figure 3 and functions as follows. When a thin beam of light rays hits a LED 3, the light produces a voltage between the anode and cathode of the LED which voltage is proportional to the intensity of the light and is detected in the control circuit 6. A part 6b of the control circuit receives a change of voltage U1 coming from the LED 3 and sends the information to a part 6c. Controlled by the part 6c of the control circuit, a part 6a switches on the current I1 at the LED 3. The LED 3 then emits light and maintains this state until the controlling circuit 7 switches off the LED 3 through the control circuit 6.

The light emitted by the LED 3 is visible through the film 2, showing the point of impact of the beam of light rays. The function of the tubes 4 impervious to light is to prevent light emitted by one LED 3 affecting the adjacent LEDs 3.

The function of the electronic controlling ciruit 7 is to switch off the LED 3 and to bring the control circuit 6 into an operational condition. When the target board is brought into use, a switch K1 is closed, which causes the voltage U2 to increase slowly at a pace set by an RC circuit R1, R2, K2 and C1. The slow increase of the voltage U2 is needed in order that the control circuits 6 should not get incorrect control signals (current peaks) when the switch K1 is closed.

In a shooting or drawing situation, when the switch K2 is closed, the control unit 6 makes the points of impact visible by means of the LEDs 3 as described above.

When the switch K2 is opened, the points of impact of the beams of light rays are stored in the control units 6, but since the resistor R2 is now connected in series with R1, reducing the voltage U2, the LEDs 3 do not show the points of impact, because the current I1 is not sufficient in this situation to switch them on. Such "dimming" of the target board can be accomplished automatically eg by a timer in the controlling circuit 7 or a corrsponding connection suitable for the purpose. Correspondingly, the information on the points of impact stored in the control units 6 can be made visible again by closing the switch K2.

By opening the switch K1, the display of the points of impact in the LEDs 3 and the information stored in the control units 6 can be removed when the capacitor C1 has discharged through a resistor R3.

The device according to the invention can be constructed in such a manner that the control units 6 are situated apart from the light-emitting LEDs 3 either on the same printed circuit board 5 or as a separate part in the case 1.

It is also possible for the control units 6 to be integrated into the same semiconductor cases as the LEDs 3, whereby the manufacturing costs of the device are considerably lower. In this case the device comprises merely a printed circuit board 5 and LEDs 3, into which control units 6 are integrated, and a control circuit 7. In the case of the integrated embodiment, the size of the device can be easily varied and eg the number of the circles to be hit on a target and the LEDs 3, can be increased without any greater difficulty. In the case of the integrated embodiment, it is also easier to construct a board on which one can write or draw with a light pen.

Figure 4 shows the use of a target board in accordance with the invention as a drawing board, the board 8 being used as a drawing board in optical drawing. A line 10, traced by a drawing means such as a light pen 9 which emits lights rays which hit the board, is indicated by means of LEDs 11.

If two-colour LEDs are used, eg diodes for both visible red and infrared light disposed in the same semiconductor case, drawing can be effected in such a manner that a light pen 9 emits visible red light to draw a line 10 or other figure. If one, however, wishes to erase the line, the light pen 9 can be switched to emit infrared light, and the pen is traced over the part of the line which is to be erased. The change of voltage taking place in the poles of the infrared LEDs is sent to the part 6C of the common control circuit of the diodes, which causes the part 6A to switch off the red light-emitting diodes. In the same manner it is possible by means of two-colour LEDs to construct a target for optical shooting wherein the LEDs of the target normally emit visible red light and are switched off at the points of impact when hit by a beam of infrared light rays directed to the target. In this manner it is possible, for instance, to simulate shooting effectively in the dark.

It will be clear to one skilled in the art that the different embodiments of the invention are not restricted to the examples described above, but they can be modified. The size, quality and colour of the light-emitting diodes can vary freely, for example on account of progress in technology, without departing from the spirit of the invention. Furthermore, other light-emitting electro-optical devices may be used, as available to one skilled in the art.

It will be appreciated that in general the light emited by the electro-optical devices should be in the visible part of the spectrum.

Claims

1. A method for indicating the position of impact of light on a target, wherein light is directed to a target (1) provided with eletro-optical devices (3), characterised in that each electro-optical device (3) serves both to detect the impact of light at the position of the device (3) and to emit light so as to indicate the point of impact.

2. A method as claimed in claim 1, characterised in that the target (1) is used as a target in optical shooting, wherein the points of impact of the light rays shot at the target are detected and indicated by means of the electro-optical devices (3).

3. A method as claimed in claim 1, characterised in that the target (8) is used as a drawing board in optical drawing, wherein the positions of a light pen moved over the board are detected and indicated by means of the electro-optical devices (3).

4. Apparatus for carrying out a method according to claim 1, comprising electro-optical devices arranged as a target board for light characterised in that the electro-optical devices (3) are switchable between a detecting mode that detects the light impinging thereon and an indicating mode that displays the points of impact.

5. Apparatus as claimed in claim 4, characterised in that it comprises a controlling circuit (7), eletro-optical devices (3) and their corresponding control circuits (6), which are controlled by the controlling circuit (7).

6. Apparatus as claimed in claim 5, characterised in that the control circuits (6) for the electro-optical devices (3) are separate circuits in a case (1).

7. Apparatus as claimed in claim 5, characterised in that each the control circuit (6) is integrated into the same semiconductor case as its associated electro-optical device (3).

8. Apparatus as claimed in any of claims 4 to 7, characterised in that the electro-optical devices (3) are surrounded by tubes (4) impervious to light.

9. Apparatus as claimed in any of claims 4 to 8, characterised in that the electro-optical devices (3) are disposed behind a film (2) pervious to light.

10. Apparatus as claimed in any of claims 4 to 9, characterised in that the electro-optical devices (3) are light-emitting devices.

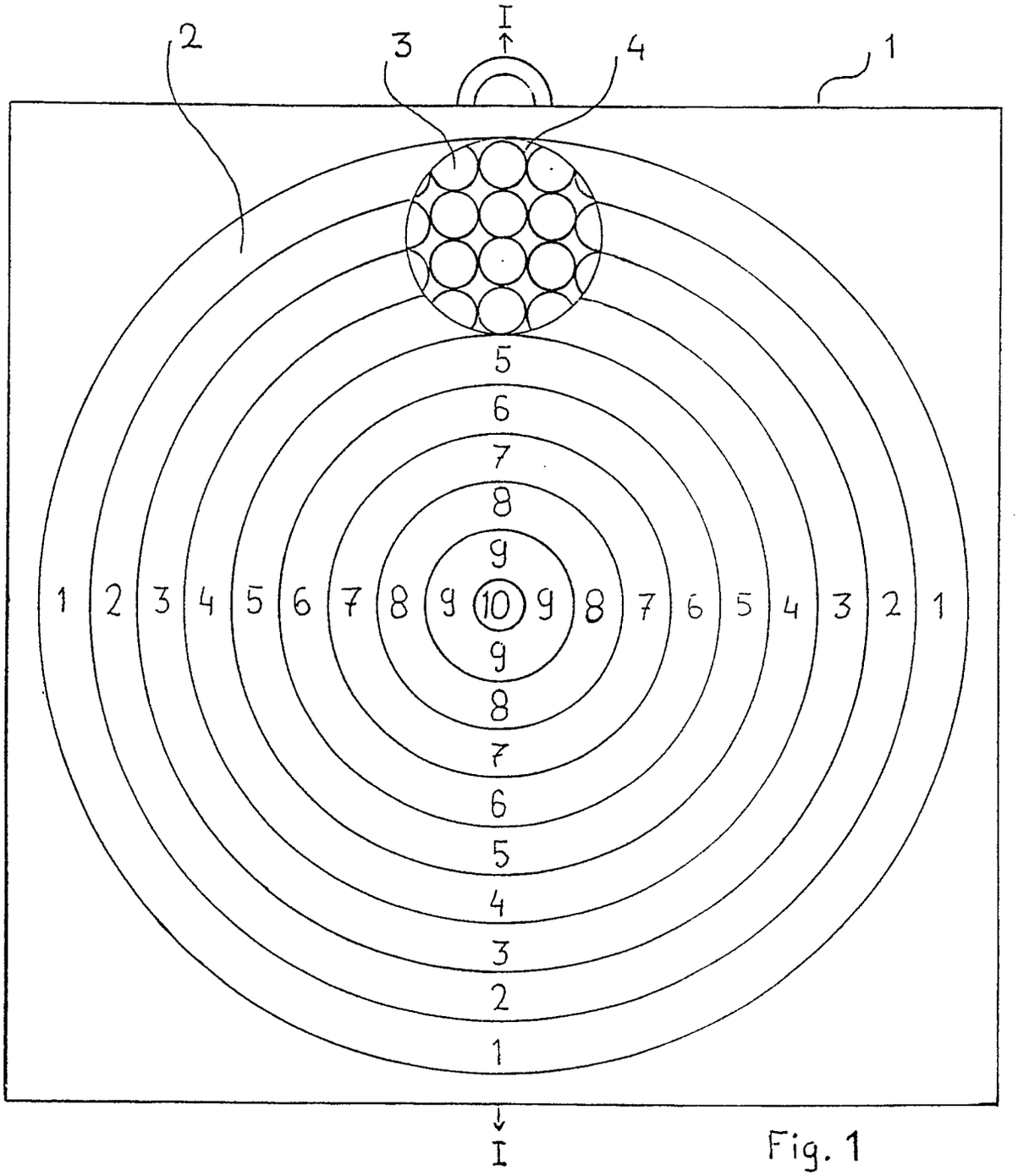

Fig. 1

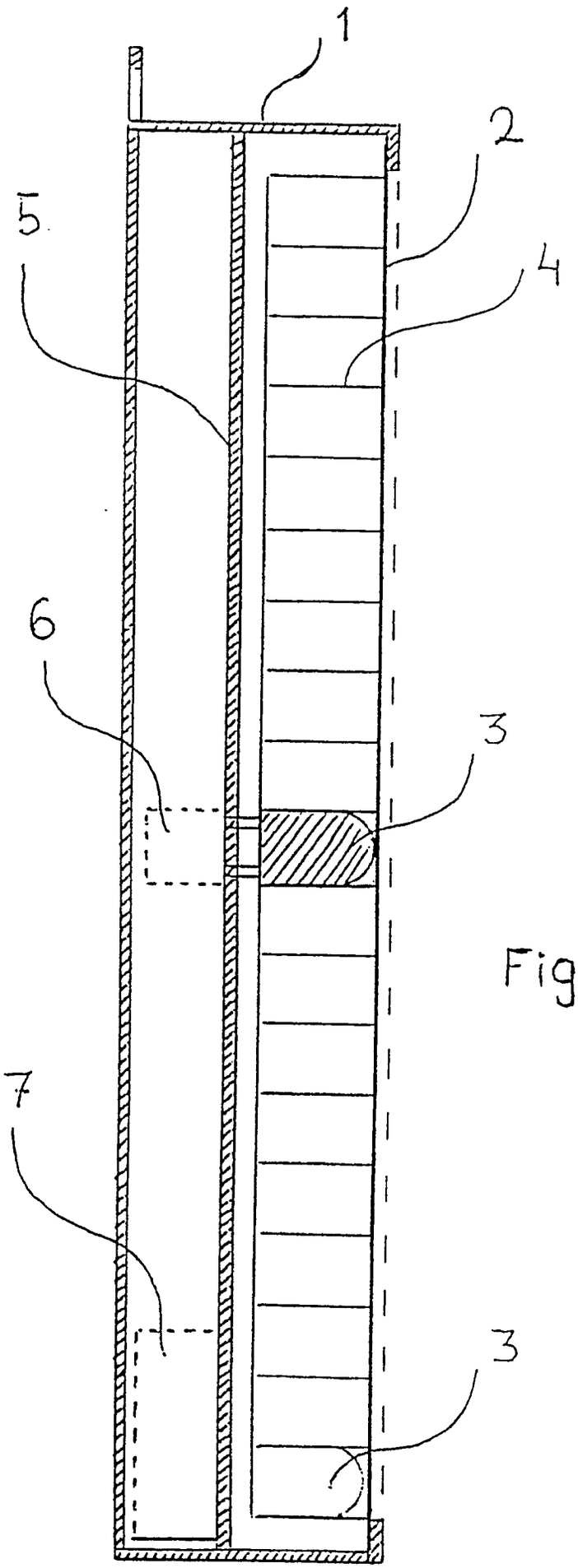

Fig. 2

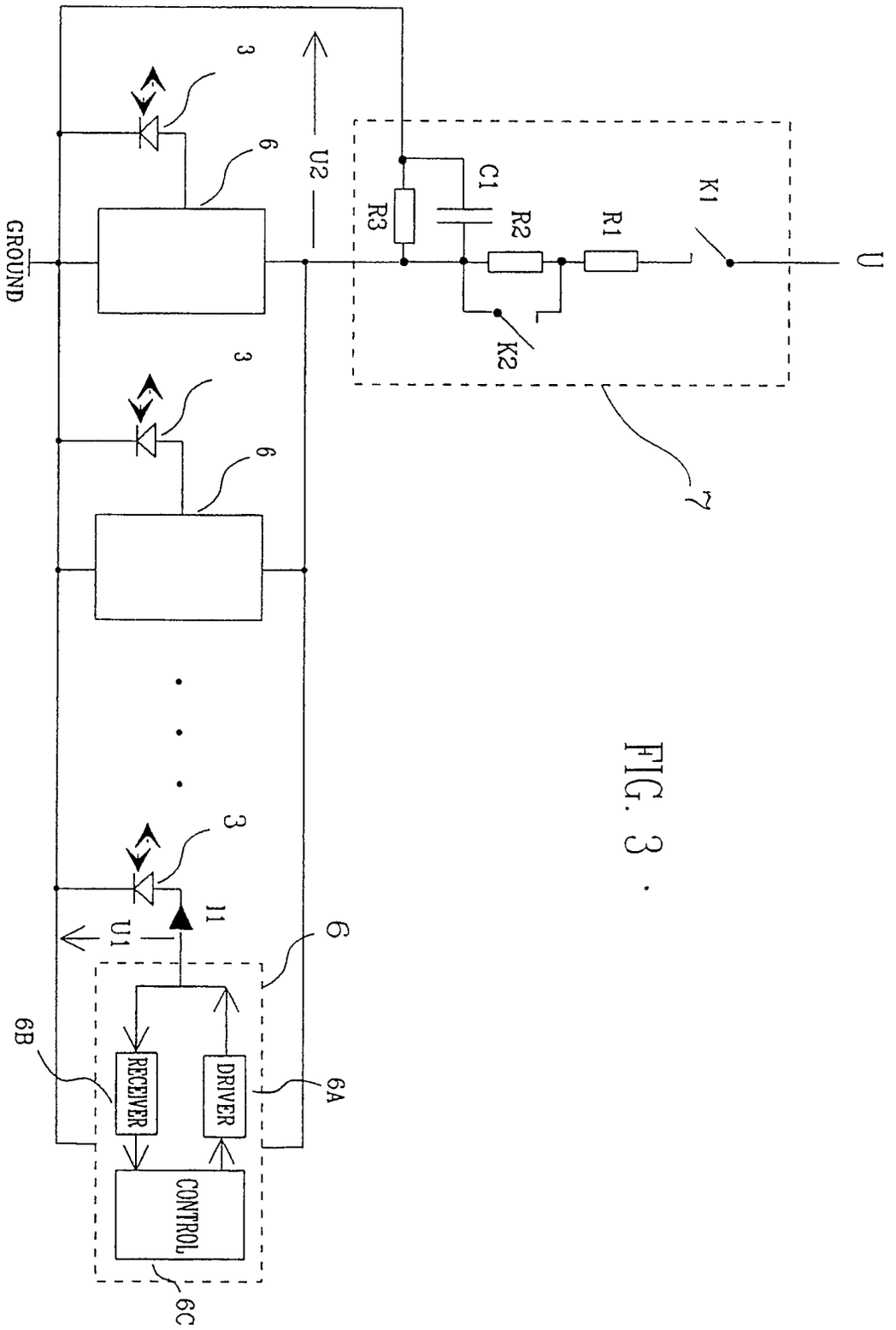
GROUND
U2
U
K1
K2
C1
R1
R2
R3
7
3
6
U1
I1
6A
6B
6C
RECEIVER
DRIVER
CONTROL

FIG. 3.

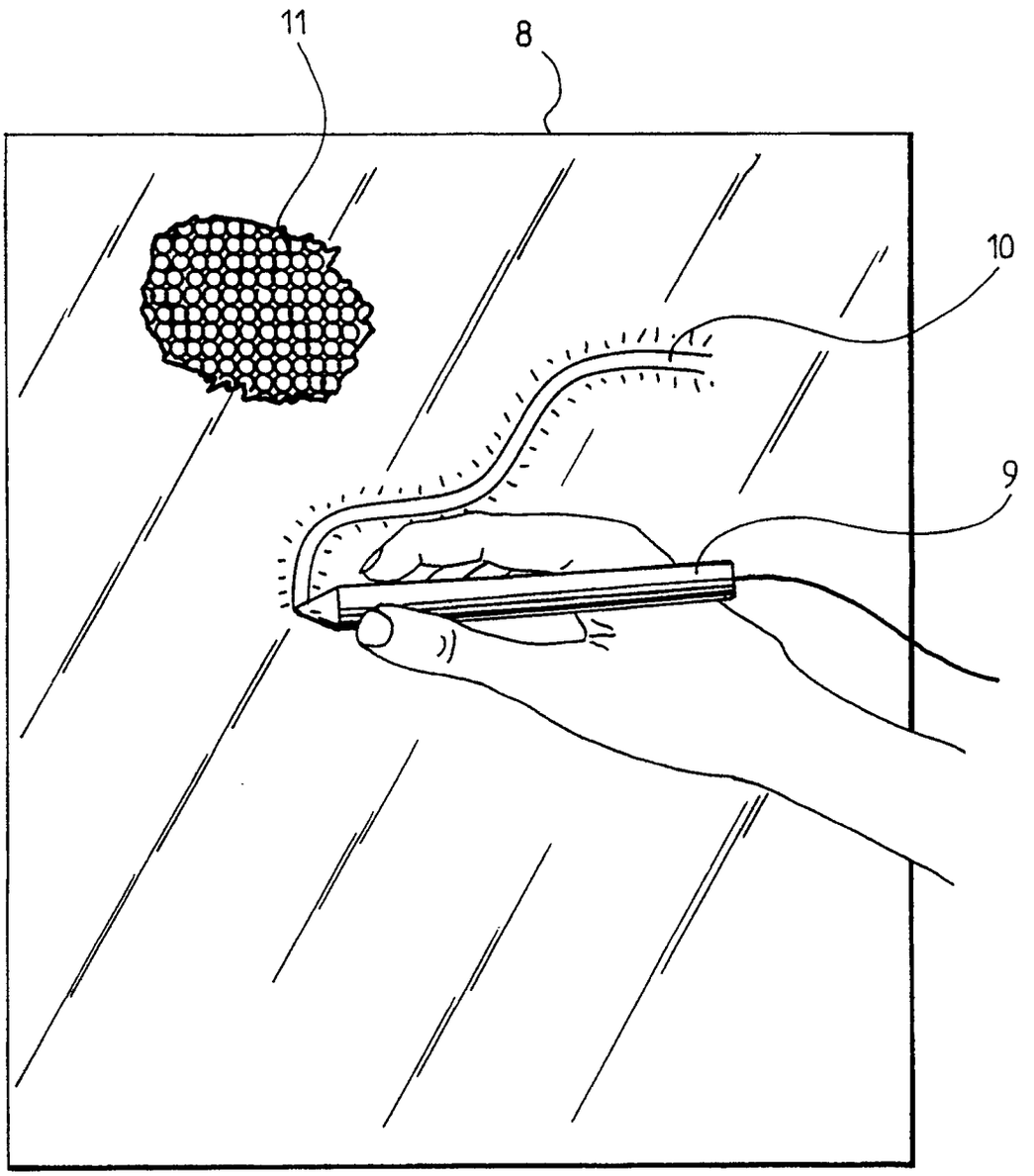

FIG. 4