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ABSTRACT

There is described a portable light including: a light source; a powering means; a drive circuit connecting the powering means to the light source, said drive circuit configured to drive the light source in a flashing mode or constant mode; a unitary casing adapted to hold the light source, power supply and drive circuit; said unitary casing having a hard chassis overmoulded with a resilient material to form a body, said body including an integral flexible attachment means for allowing attachment of the casing to another object.

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COMPLETE SPECIFICATION INNOVATION PATENT

Invention Title: Portable light

The following statement is a full description of this invention, including the best method of performing it known to us:

PORTABLE LIGHT

5 Field of the Invention

The present invention relates to a portable light, and more particularly to lights adapted for attachment to bicycles, backpacks and the like.

Background to the Invention

- 10 Light-emitting diodes (LEDs) are commonly used for portable lighting sources, and in particular for use by cyclists to both assist them in riding in dim or dark conditions, but also to alert other traffic to their presence on the road.

- While the light can be continuously on, it is easier to attract attention to a cyclist if the light is flashing. It is difficult to manipulate conventional bicycle lights to flash
15 periodically because of the current range which needs to be supplied to the LED. If the LED is to be operated by flashing, it is capable of withstanding greater current than if constantly emitting light.

- Current bicycle lights that provide a flashing mode are unable to control the amount of current supplied to the LED when the light is constantly on. Consequently, the LEDs
20 can be damaged by overdriving or over heating.

Summary of the Invention

- In a first aspect the present invention provides a portable light including: a light source; a powering means; a drive circuit connecting the powering means to the light
25 source, said drive circuit configured to drive the light source in a flashing mode or constant mode; a unitary casing adapted to hold the light source, power supply and drive circuit; said unitary casing having a hard chassis overmoulded with a resilient material to form a body, said body including an integral flexible attachment means for

allowing attachment of the casing to another object.

5 The chassis can be formed of a hard plastic material and the resilient material forming the overmoulded body can be flexible silicon rubber. The flexible attachment means preferably includes a strap formed from resilient material that can be used in conjunction with an attachment means of the chassis to attach the portable light to another object. The unitary casing preferably includes an opening in one end thereof. In this case the portable light can further include a lens through which light is emitted by the light source and which is arranged in use to close the opening in the casing.

10 In a second aspect the present invention includes a portable light including: a light source including a light emitting diode; a powering means; a drive circuit connecting the powering means to the light source, said drive circuit including a switch whereby the user can selectively activate the circuit to drive the light source in a flashing mode or constant mode; a unitary casing including having a hard plastic chassis overmoulded in flexible silicon rubber, said casing having an integrally formed
15 attachment means including a hook and flexible strap configured to allow attachment of the casing to an object, the casing having an opening formed in it in which the light source, powering means and drive circuit are mounted; a lens mounted to close the opening in the casing and protecting the light source.

20 Also described herein is a portable light including: a casing having an opening and adapted for securing to an object; a powering means installed in the casing; a light emitting diode (LED) electrically connected to the powering means and arranged to emit light through the opening of the casing; and a lens arranged for closing the opening and protecting the LED; wherein the powering means includes a microcontroller for controlling current supplied to the LED such that the LED is
25 operable in a constant mode and a non-continuous flashing mode.

The lens can include a central light beam focussing feature and include sideways beam spreader Fresnel lens. The lens includes a structure to control the emitting of light from a single LED. The lens assists in focussing the light from the LED such that

a large percentage of the light of the light is projected directly away from the casing and a small percentage of light is projected to either side of the casing.

5 The portable light can have the casing including an inner chassis mounting the powering means and the LED and having the lens at one end projecting through and closing the opening of the casing; an attachment means in the form of a stretchable loop located at one end of the chassis around the lens; and a hook projecting from an opposite end of the chassis and used in conjunction with the stretchable loop of the casing for fastening the portable light to objects.

10

The chassis preferably is formed from hard plastic. The casing and stretchable loop of the attachment means is formed from flexible silicon rubber to provide a portable light which is substantially shockproof and waterproof.

15 The LED can be activated by an electro-mechanical switch mounted on the chassis and operable by pressing on the casing. The switch activates a number of modes including the continuous and non-continuous modes. The non-continuous modes include modes in which the LED is ON and OFF for equal amounts of time, or the LED is pulsed a number of times remaining OFF for a period of time.

20

It can be seen that the novel structure of the light that includes an LED hidden from the elements and uniquely used in combination with a lens provides a substantial novel advantage in the field of portable lights. Further the unique structure of the portable light in providing a unitary casing that can be attached without tools and results in a sealed unit with all electrical components including LED in a protective inner chassis and an outer overmoulded rubber providing a waterproof and shockproof casing creates an improved portable light that can be used in all weather. However the chassis adds the extra benefit of providing a mount for the lens at one end and the hook of the attachment means at the other end. Still further the lens
25 extending at one end between the two spaced parts of the stretchable loop of the attachment means provides a compact form without compromising the effectiveness of the light emanation through the lens.

30

Further the powering system can enhance the invention. The powering means can
35 include: a circuit board installed in the casing and connectable to a battery; and wherein the light emitting diode (LED) is electrically connected to the circuit board.

The circuit board of the powering means can include two control points by means of one or more microcontrollers; two independent drive transistors controllable by the two control points; and wherein the two drive transistors can be separately driven to provide the overpowering of the LED in the flashing mode for providing intense power to the LED in the flashing mode.

According to one aspect, the present invention provides a portable light including: a casing having an opening and adapted for securing to an object; a chassis carrying a circuit board and installed in the casing; a light emitting diode (LED) electrically connected to the circuit board and arranged to emit light through the opening of the casing; and a lens arranged for closing the opening and protecting the LED; wherein the circuit board includes a microcontroller for controlling current supplied to the LED such that the LED is operable in a constant mode and a non-continuous mode.

The microcontroller can use two output ports to control two independent drive transistors, one for controlling the LED to produce a constant light source and the other for producing a non-continuous light source, such as the light produced by a strobe light.

The drive transistors can be a PNP transistor or a field effect transistor (FET) transistor. Preferably, the LED is a super-bright LED.

The circuit of the present invention provides variable current to the LED. In the constant mode, the LED can be provided with approximately 40 milliamperes (mA), while in the non-constant mode it can be provided with 120 mA. The circuit can operate between 1.6 volts and 6 volts supplied by a battery.

In operation in the non-constant mode, a reserve capacitor on the collector of the transistor can assist in stabilising the battery voltage and also can provide energy to the transistor's collector. The gate or base of the transistor is controlled by an output port of the microcontroller. Drive can be provided by the emitter of the transistor to the LED's cathode and the LED's anode can be connected to ground.

In operation in the constant mode, current to the LED can be limited through a resistor. The value of the resistor will depend on the specifications of the LED used in the circuit. In particular, the value of the resistor will depend on the current required for the LED to remain ON. The gate or base of the transistor can be controlled by an

output port of the microcontroller, while drive can be provided by the emitter of the transistor to the LED's cathode and the LED's anode can be connected to ground.

5 The casing can be formed from flexible silicon rubber. The rubber casing assists in making the portable light robust as is shockproof and waterproof, thus making the portable light suitable for many applications, including but not limited to, cycling, outdoor sports, marine activities and other sporting activities.

10 The casing can include a body for housing the chassis and an attachment means in the form of a loop. The loop allows the portable light to be attached without additional tools or parts. Preferably the casing is unitary.

15 The LED can be activated by an electro-mechanical switch mounted on the chassis and operable by pressing on the casing. The switch can activate a number of modes include the continuous and non-continuous modes. The non-continuous modes can include modes in which the LED is ON and OFF for equal amounts of time, or the LED can be pulsed a number of times remaining OFF for a period of time.

20 The lens can assist in focussing the light from the LED such that a large percentage of the light of the light is projected directly away from the casing and a small percentage of light is projected to either side of the casing. This arrangement is particularly useful when the portable light is used by bicycle riders who require most of the emitted light to illuminate their path and alert drivers and other traffic to their presence.

25 The circuit, and therefore the LED, can be powered by batteries carried on the chassis. The chassis may be formed from hard plastic and can include a hook projecting outside the casing substantially opposite the lens. The hook may be used in conjunction with the loop of the casing to fastening the portable light to objects.

30 The invention also provides a means of providing power to a LED in a flashing mode including the steps of: providing two control points by use of one or more microcontrollers; providing two independent drive transistors controllable by the two control points; wherein the two drive transistors can be separately driven to provide
35 an overpowering of the LED in a flashing mode.

The step of providing two control points can be by two outputs of a single microcontroller.

5 The step of separately driving by the two drive currents can be by two different currents to the same LED.

10 The invention also provides an improved portable light including: an LED light source with a lens for projection of the emitted light; a casing for holding the LED light source, lens and power supply, with integral flexible attachment means for allowing attachment of casing to bicycle tubing; and electronics including two independent drive transistors controllable by the two control points with the two drive transistors can be separately driven to both provide a driving current to the LED in a flashing mode; wherein the electronics can be readily mounted in the casing and provide a portable light.

15 The casing can enclose a chassis with the casing made from a resilient material and overmoulded over a chassis for holding componentry.

20 The chassis can provide an attachment means with hook feature for mounting, internal features for housing the PCB, batteries, LED and lens all in a single part.

The lens can have a light beam focussing feature and sideways beam spreader Fresnel lens.

25 **Brief Description of the Drawings**

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a first embodiment of a portable light in accordance with the invention;

30 Figure 2 is a cross sectional view of the portable light of Figure 1;

Figure 3 is a diagrammatic perspective front view of the portable light of Figure 1;

Figure 4 is a diagrammatic perspective rear view of the portable light of Figure 1;

35 Figure 5 is a diagrammatic overhead view of the portable light of Figure 1;

Figure 6A is cross sectional view of the portable light of Figure 5 along A-A;

Figure 6B is cross sectional view of the portable light of Figure 5 along E-E;

Figure 7 is a first electronic circuit for the portable light of Figure 1; and
Figure 8 an alternative electronic circuit for the portable light of Figure 1.

Description of a Preferred Embodiment of the Invention

5 Referring to the drawings and particularly Figures 1, 2 and 3 there is shown a portable light 11 of the invention which is a small portable consumer light product for use in (and not limited to) the sporting, outdoors, marine and cycling markets. In one use the portable light of the invention is a micro light that mounts to almost anywhere on the bicycle. Due to its unique structure, arrangement and electronics the unit is
10 able to be made quite small while being effective beyond its size.

With regard structure, Figure 2 and Figures 6A and 6B in particular show the method of an internal hard plastic chassis 16 overmoulded with a silicon rubber casing 15. This form has an integral chassis body with the lens 32 at a front end and hook 22
15 extending from the rear with a flexible silicon rubber body 15 overmoulded to the internal hard plastic chassis 16 and including a resilient attachment means in the form of a loop 21 extending from the front of the light from the sides of the lens and able to bend resiliently around cycle stem or tube or the like and hook onto the protruding hook 22 to provide a waterproof, robust, shockproof article that requires
20 no tools to mount to the bicycle.

The chassis 16 further mounts a super-bright LED 31 and internal electronic circuit 42 with batteries 41. The lens 32 in front of the LED and mounted in an opening 30 of the casing 15 has a light beam focussing feature and sideways beam spreader
25 Fresnel lens.

The structure of the portable light of the invention's silicon body provides a number of features and functions. It provides an elastic loop/strap for stretching around the bicycle handlebar, frame, seatpost, etc. and because of its flexible and robust nature;
30 the silicon body is shock-proof and incorporates water-sealing features around each opening (around the lens and battery cap). Access to the batteries is via a battery cap. This can be removed from the underside of the body. The internal chassis part has an integral hook feature that allows the silicon rubber strap to affix and complete the mounting function.

35 The single silicon rubber overmoulded casing 15 provides a unique tool-less mounting system, water and shock proofing and an aesthetic like no other product of

this nature. However for operation the top surface of the silicon rubber casing 15 of the portable light includes a mode switch 25. The mode switch sits just under the top surface of the casing so that the switch is completely obscured and protected from the outside environment.

5 The internal electronic circuit 42 is a PCB consisting of a number of electronic components, ICs, battery contacts and LED 31.

10 The electro-mechanical Mode Switch 25 activates a number of LED flash modes of the portable light of the invention. The LED light emanates through the lens part which provides a focused light projecting forward and a smaller percentage of light projecting sideways. The idea with this is to provide the bicycle rider with a good forward beam of light for 'being seen' by head-on traffic and a small amount of side emitting light for side-on traffic. However to improve usability and make use of power effectively modes of flashing are used. Also the portable light of the invention has a high-burst LED mode. This is provided by some clever electronics.

15 The main problem with powering lights to date is to provide different drive currents to one LED depending on function. In particular it is beneficial to control different current rates without overheating a light emitting diode LED and without pulse width modulation (PWM). An LED has the ability to be flashed at a higher current than when constantly on. Generally lights use one of two devices; off the shelf wire bonded device with a set function and timing or a programmed IC controller. The best of these two is the programmed IC, giving the user the ability to change the timing and output pins of the programmed device. The one limitation that still exists with low cost microcontrollers is that it doesn't have the ability to pulse width modulate the output and overcome the problem of providing more current to the LED when flashing. This is a desirable function as it utilizes the full capabilities of a modern LED without damaging the device through over driving and overheating when a constant on mode is required.

20 In the electronics of the portable light of the invention as shown in one form in the circuit diagram of Figure 7 there is used a low cost effective solution by use of two output ports IO-0 and IO-1 of the microcontroller U1 and two independent drive transistors Q1 and Q2. This provides Flash port IO-0 "Hi Drive" and Constant On port IO-1 "On".

In one mode the Hi Drive Flash Port IO~0 uses a flash function of the LED 31 which is approximately 120ma of current and drives through a standard PNP transistor or FET (Field Effect Transistor) Q2. A reserve capacitor on the collector ensures that the battery voltage stays stable and provides energy to the transistor's collector. The gate or base of the transistor is controlled by the microcontroller's output port IO~0. Drive is provided by the Emitter of the transistor to the LED's cathode and the LED's anode is connected to ground.

- 10 In a second mode the Constant On Port IO~1 has the constant On function of the LED which is approximately 40ma and is limited through a resistor. In the application provided the value is 30 ohms, this value depends on the specification of the LED and the required maximum current when the LED is in a constant On state. The gate or base of the transistor is controlled by the microcontroller's output port IO~1. Drive is provided by the Emitter of the transistor to the LED's cathode and the LED's anode is connected to ground.

The software controls the microcontroller's output ports and a simple push button selects which mode function the microcontroller performs. This provides multiple flash and strobe mode functions to the "Hi Drive" port of the micro and a constant "On" with different driving currents to the same LED. Software also provides a nano-power down mode so that batteries can stay connected in circuit for long periods of time. The example circuit is for portable light of the invention. A low voltage capability allows the circuit to function between 1.6 volts to 6 volts. All components provide good function in this voltage range.

It can be seen that in the embodiment of the invention described there is provided an improved combination of structure, components and electronics to provide an effective small portable light. This includes use of an LED light source with a lens for projection of the emitted light; a casing for holding the LED light source, lens and power supply; with integral flexible attachment means for allowing attachment of casing to bicycle tubing; and electronics including two independent drive transistors controllable by the two control points with the two drive transistors can be separately driven to both provide a driving current to the LED in a flashing mode; wherein the electronics can be readily mounted in the casing and provide a portable light.

5 In the electronics of the portable light of the invention as shown in another form in the circuit diagram of Figure 8 there is illustrated a variation of the circuit diagram which can be used to power an LED to illuminate constantly or to be illuminated intermittently. The circuitry is mounted on 2 separate circuit boards (A and B), one of which (A) carries the LED and another (B) carries some of the components of the circuitry including the battery BT1, the microcontroller U1 and the MOSFET device Q1.

10 The separate circuit boards (A and B), allow the circuit board carrying the LED to be mounted at an angle relative to the circuit board carrying the battery. This allows the circuit boards to be positioned relative to each other in an L-configuration thereby allowing the circuit boards to be mounted inside the portable light 11.

15 The microcontroller is programmed to apply voltage to the MOSFET device thereby connecting the LED to ground. This causes the LED to illuminate as the LED is already connected to the battery illustrated as VCC in Figure 8. The microcontroller is also programmable to apply intermittently a voltage to the MOSFET device so that the LED is Intermittently connected to ground causing the LED to illuminate intermittently.

20 The circuitry also includes a capacitor C1 which in this embodiment has a capacitance of 10 micro farad. The capacitor C1 is able to provide electrical charge to the circuitry for a brief period of time when the battery BT1 loses contact with the circuitry. The use of electrical devices in sport activities such as cycling and including off-road cycling could cause the electrical device to shake. Such shaking
25 could cause loose components of the electrical circuitry such as batteries to briefly lose contact with the circuitry. When this happens, the capacitor C1 allows the circuitry to be powered for the brief periods of time when the battery loses contact with the circuitry. It therefore provides a "bounce powering" effect to maintain
30 continuous powering.

Those of skill in the art will appreciate that such modifications or changes to the particular embodiments exemplified can be made without departed from the scope of the invention. All such modifications and changes are intended to be included within
35 the scope of the appended claims.

We claim:

1. A portable light including:
a light source;
a powering means;
5 a drive circuit connecting the powering means to the light source, said drive circuit configured to drive the light source in a flashing mode or constant mode;
a unitary casing adapted to hold the light source, power supply and drive circuit; said unitary casing having a hard chassis overmoulded with a resilient material to form a body, said body including an integral flexible attachment means for allowing attachment of the casing to
10 another object.
2. A portable light as claimed in claim 1 wherein the chassis is formed of a hard plastic material and the resilient material forming the overmoulded body is flexible silicon rubber.
3. A portable light as claimed in either of claims 1 or 2 wherein the flexible attachment means includes a strap formed from resilient material that can be used in conjunction with an
15 attachment means of the chassis to attach the portable light to another object.
4. A portable light as claimed in any one of the preceding claims wherein the unitary casing includes an opening in one end thereof, and the portable light further includes a lens through which light is emitted by the light source and which is arranged in use to close the opening in the casing.
- 20 5. A portable light including:
a light source including a light emitting diode;
a powering means;
a drive circuit connecting the powering means to the light source, said drive circuit including a switch whereby the user can selectively activate the circuit to drive the light source in a
25 flashing mode or constant mode;
a unitary casing including having a hard plastic chassis overmoulded in flexible silicon rubber, said casing having an integrally formed attachment means including a hook and flexible strap configured to allow attachment of the casing to an object, the casing having an opening formed in it in which the light source, powering means and drive circuit are
30 mounted; a lens mounted to close the opening in the casing and protecting the light source.

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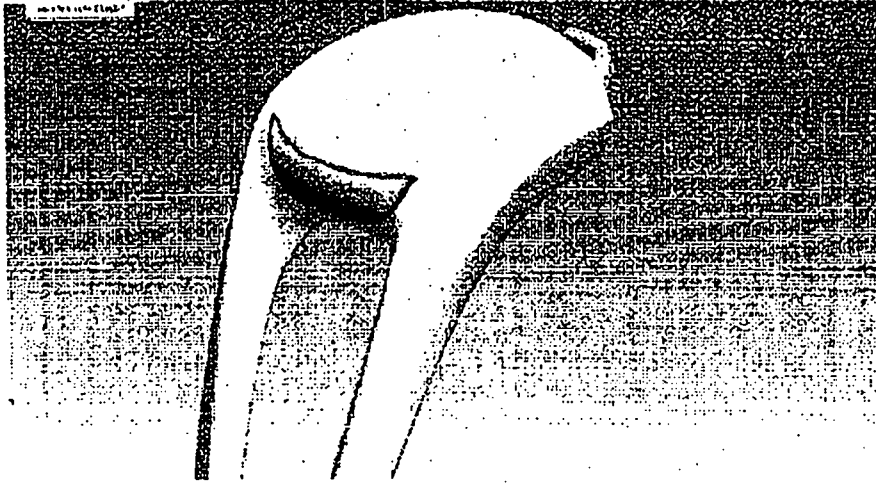


Figure 1

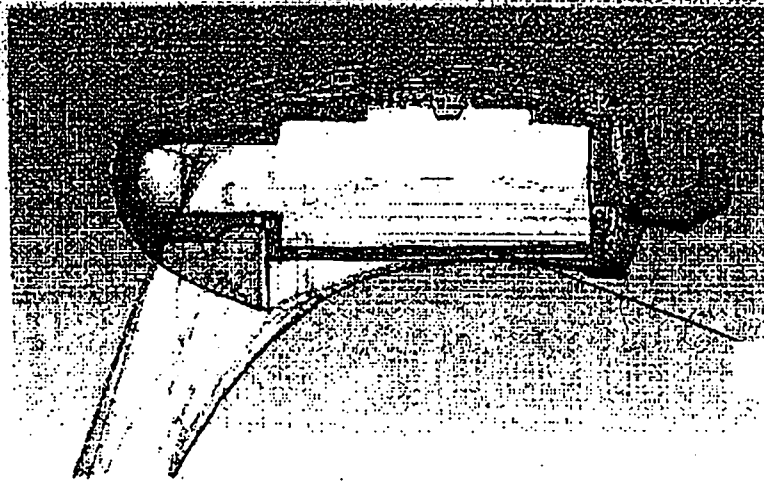


Figure 2

15

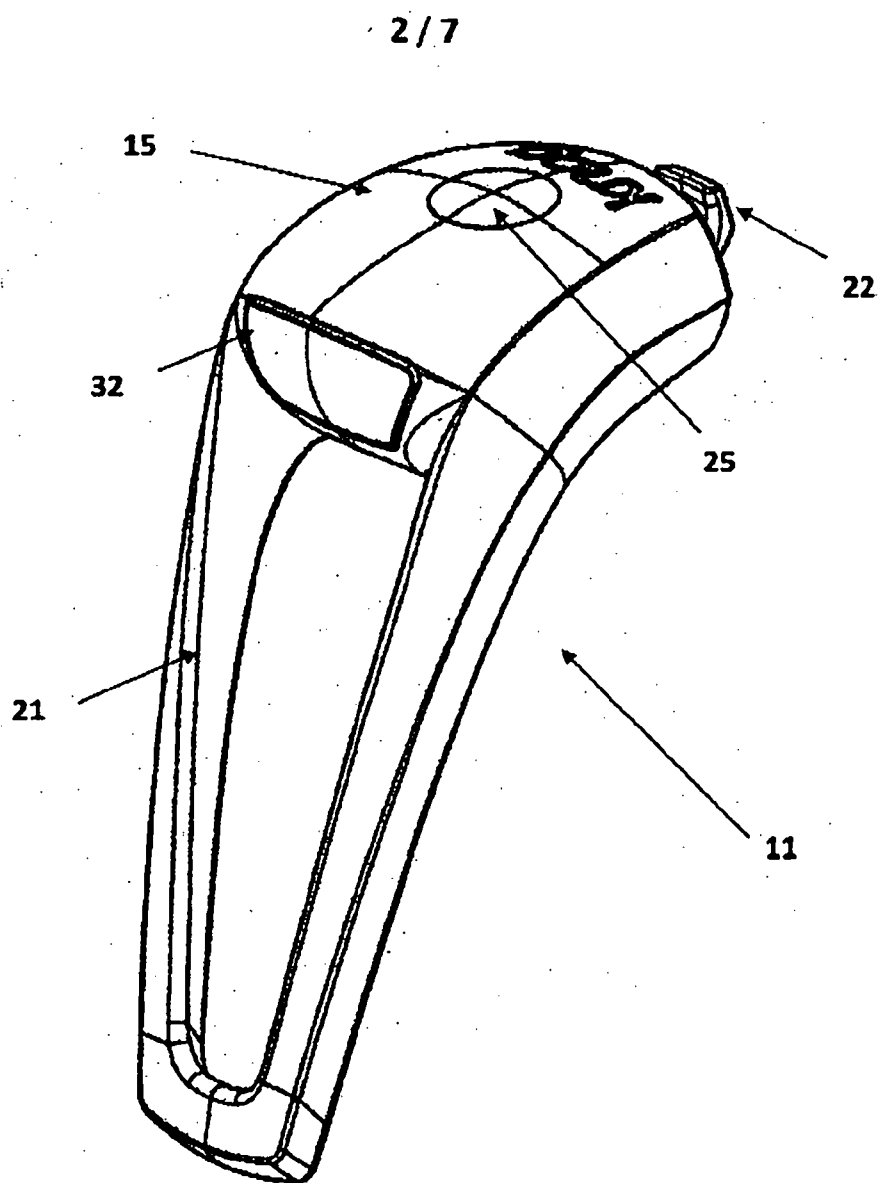


Figure 3

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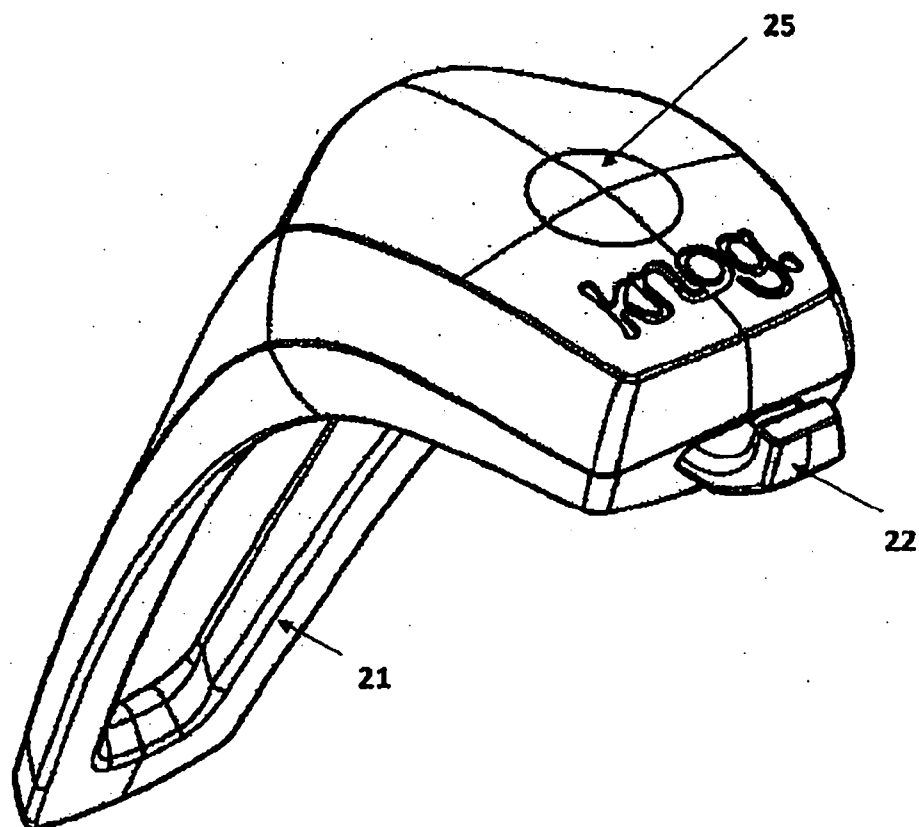


Figure 4

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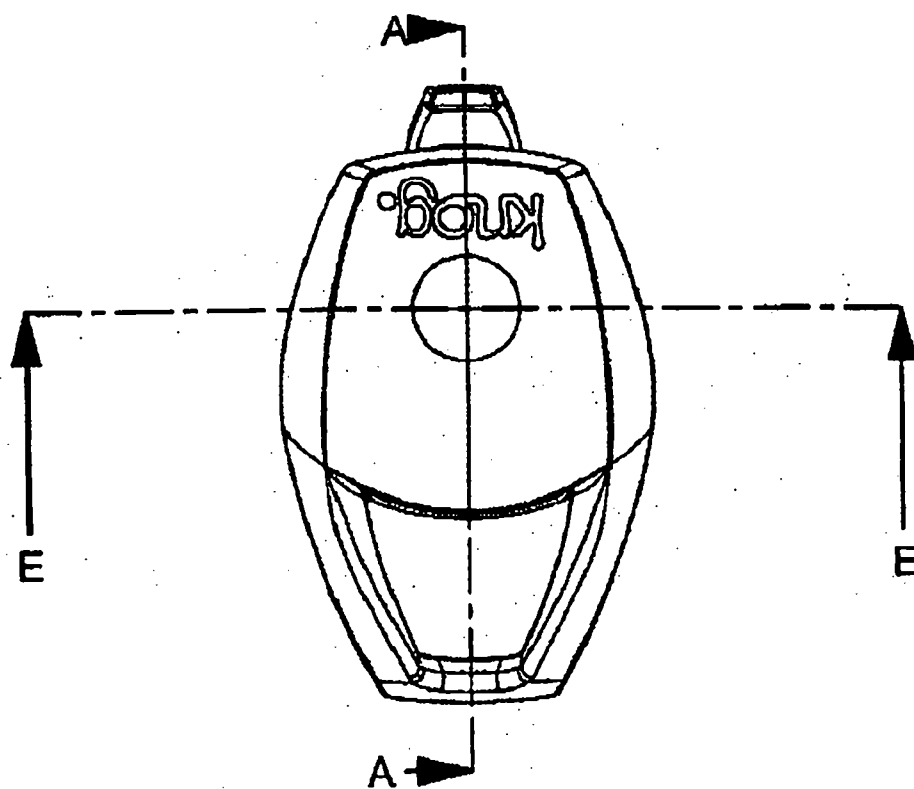


Figure 5

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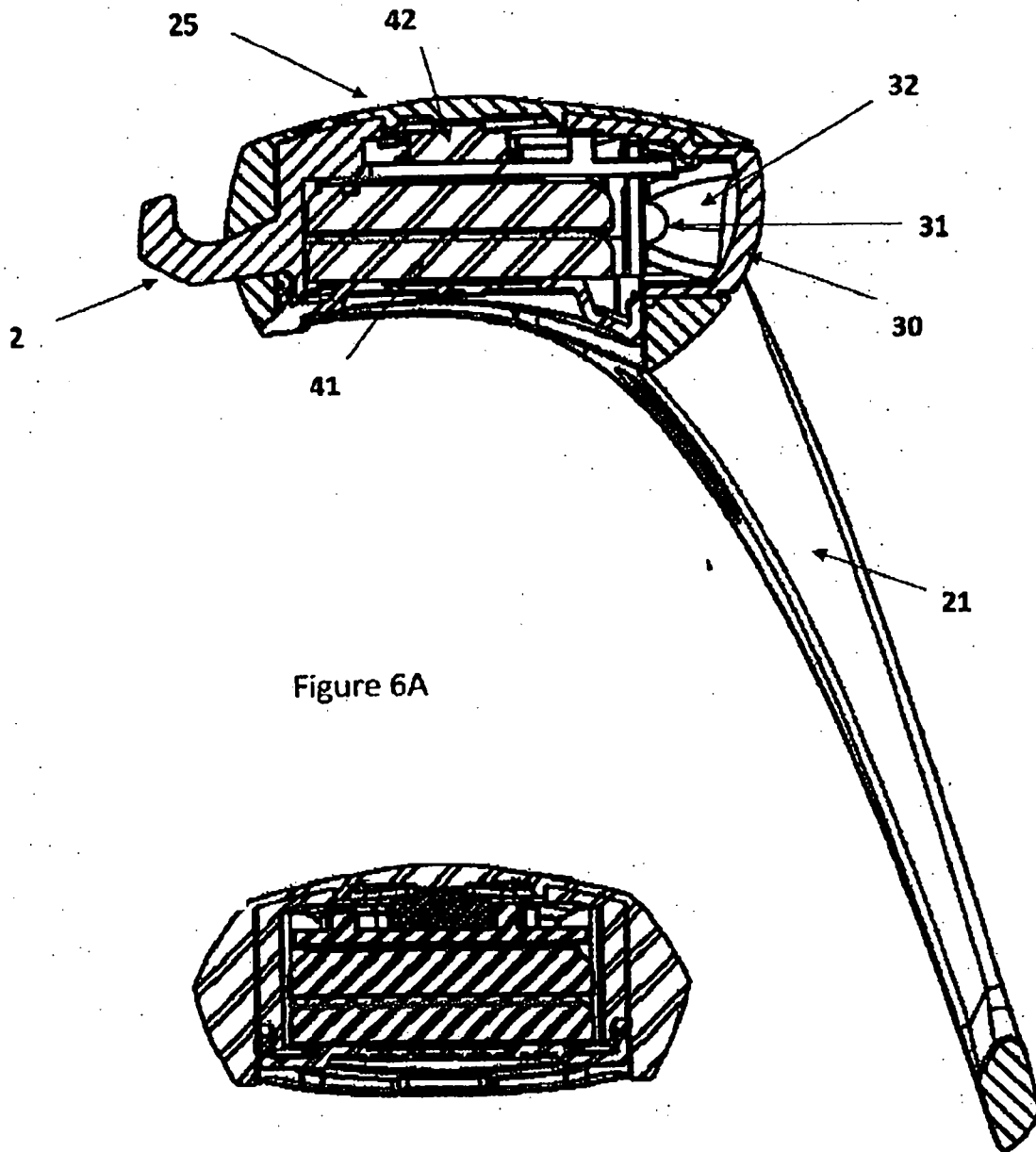


Figure 6A

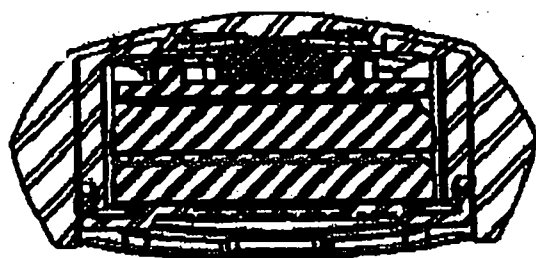


Figure 6B

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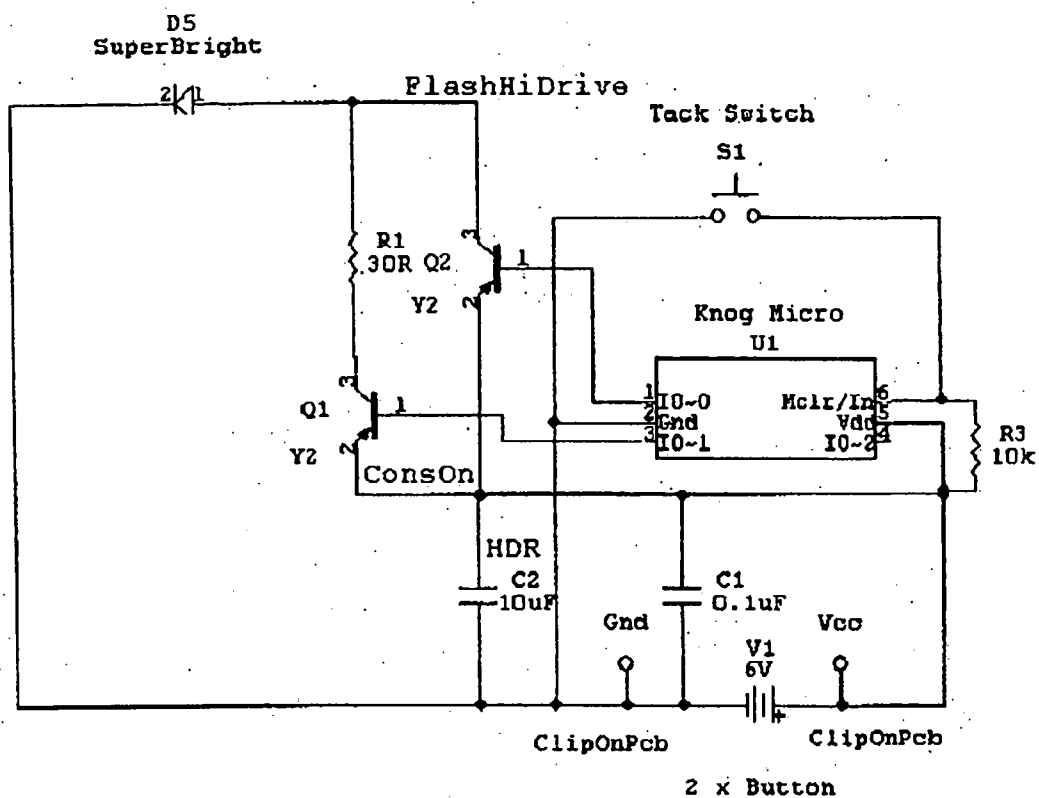


Figure 7

