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(72) Inventor; and
(71) Applicant : **BARKER, Thomas James** [GB/GB]; Tarka Holiday Park, Braunton Road, Barnstable, North Devon EX31 4AU (GB).

(74) Agent: **WALKER, Neville**; IP Consult, 21a Commercial Road, Swanage, Dorset BH19 1DF (GB).

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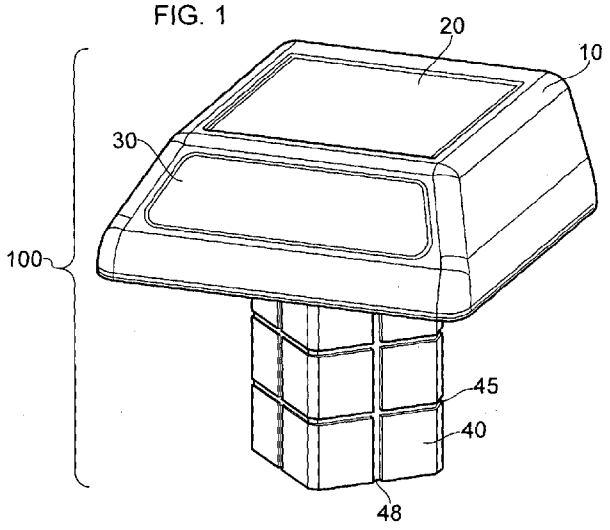
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FIG. 1



(57) Abstract: The present invention is a stud (100) for use on a surface over which a vehicle passes. The stud has a casing (10) that encloses a visible radiation source (60) which is adapted to scan visible radiation so that, in use, visible radiation is projected onto the surface extending from the stud to a distance exceeding 0.1m. Power is supplied to the laser via a rechargeable battery (70) which receives charging current form a photovoltaic cell (20) mounted on the stud. There is an optional associated safety system comprising a plurality of studs, characterised in that in use light links from one stud to another.

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A STUD AND SAFETY SYSTEM

Field of the Invention

The present invention relates to an illuminated stud and associated safety system, more particularly the invention relates to illuminating a pathway for pedestrians, cyclists and vehicles, especially road vehicles, automobiles and aircraft.

Background

Increasingly users and states are concerned over matters of safety and security. Authorities, planners and designers are concerned with providing safer systems for transport with an aim to avoiding injury and death of road users.

For example there is great concern with reducing the numbers of accidents that occur on roads. Legislators are constantly aiming to improve vehicle safety and there is a trend to focus on road safety including signs, layout and lighting.

Additionally procedures tend towards sustainability and cost awareness. A cost effective means of providing safety on roads, highways and runways, or indeed pedestrian walkways is to provide lighting.

In particular given most vehicles provide their own lighting for a number of years cats eye reflectors have provided a cost-effective, efficient and simple means of lighting paths so as to indicate the path of a road or carriageway using retro-reflectors which are sometimes referred to as "cats eyes" or "cats eye" road studs. These provide a passive reflector that is mounted in the road and which reflect incident light from a vehicle headlamp.

However, even with such reflectors sometimes roads can be hazardous for drivers, especially at sharp bends or curves.

Another disadvantage is that traditional "cats eye" road studs are only active when incident light from a vehicle headlamp is reflected to the driver and for this to occur the vehicle has to be relatively close to the "cats eye" road stud with direct line of sight from the vehicle headlamp to the "cats eye" road stud and from the "cats eye" road stud to the driver. Therefore with such traditional "cats eye" road studs there is often no way that a driver can judge the lie of the road further ahead than the vehicle headlamp can illuminate.

At airports and runways tend to employ ground level lighting to illuminate pathways and routes to be taken by aircraft. These ground level lights are not practical for road use – over long distances - due to the need to excavate roadways in order to supply a power supply and control/monitoring of such ground level lights. They may also be prone to failure of power supply.

Prior Art

A number of patent applications have been filed in respect of devices which have attempted to resolve the problem, including the following:

United States patent application US 2007 297 805 (Rabinovich) discloses an optical communication system comprising: a first terminal having a transmitter for transmitting an interrogating light beam and a receiver for receiving the interrogating light beam. A second terminal has a cats-eye modulating retro-reflector (MRR) assembly, which includes a cats-eye MRR, wherein the cats-eye MRR includes a modulator for modulating the interrogating light beam received from the transmitter.

An optical focusing device focuses the interrogating light beam from the transmitter to the modulator and a reflector reflects the modulated light beam to the receiver. The cat's eye MRR assembly further includes a beam

deflector positioned at an optical aperture of the cat's eye MRR to coarsely deflect the interrogating light beam from the transmitter to the focusing device of the cats-eye MRR.

Korean patent application KR 2005 0 006 031 (Kim) discloses a road stud for increasing the reflective brightness of a reflector and to reduce the manufacturing cost by using a solid reflector which is easy to manufacture. The road stud contains: an anchor buried under the road; a head installed on the anchor to be projected to the road surface; and a reflector composed of a fixed plate attached to the side of the head. Several reflection units are provided on the fixed plate and planes reflect the light. The reflector is made with light transmissible materials, such as glass or transparent synthetic resin, and mixed with pigments to light up in a specific colour if necessary.

Granted European patent EP 1 281 021 (Rizkin et al) discloses a light transformer for directing light from a light source with low divergence or substantially parallel with an axis of light direction. The device comprises: a first end for receiving light from the light source; a second end for outputting the received light, the second end located on an opposite end of the device from the first end; a first member located on a third end of the device; and a first planar optical window located at an end of the first member.

The first planar optical window is substantially perpendicular to the axis of the light direction, wherein the first member has an outer wall comprising a total internal reflection surface for reflecting received light through the first planar optical window in a direction with low divergence or substantially parallel to the axis of light direction.

Australia patent application AU 690 674 (Ishida) discloses a self-emission road stud comprising a body having a reduced-diameter bottom portion serving as a retaining leg and a top portion which is at least partially transparent, and a light source within the body for emitting light through the top portion.

United Kingdom patent application GB 494 297 (Barrs et al) discloses reflectors that are arranged in a straight line along a kerb or other edging of a road. The reflectors are so arranged that a beam of light from the headlamp of a car can pass from the outer edge of each reflector to the next adjacent reflector, in order to give the effect to the driver of a continuous band of light along the kerb.

Reflectors are mounted in a groove in a kerb and are illuminated by the headlamps of a car. The groove may be continuous or a series of grooves may be provided. The reflectors may be disposed at right-angles to the line of kerb or at an angle normal to the beam from the headlight. In a modification auxiliary reflecting surfaces are disposed on either side of the main reflectors.

United Kingdom patent application GB 485 940 (Mitchell) discloses a top surface of a kerb or like road edging is formed to present a number of indentations or corrugations having reflecting surfaces which present a continuous or practically continuous strip of light to the driver of a vehicle. The indentations or corrugations may be formed in the material of the kerb or on members set into the kerb. In one construction, a tile having a metal reinforcement is set into the upper surface of the kerb with its upper reflecting face flush with the face of the kerb.

Whilst the aforementioned systems were of use in many situations, they suffered from drawbacks to the extent that they required a dedicated power supply, were complex and expensive to fabricate. Some also required a skilled person to install them, due to the need to ensure the orientation of adjacent devices.

In contrast to the foregoing the present invention provides a means of delineating a runway, pathway or roadway in a simplistic manner, so improving safety and encouraging improved navigation.

Summary of the Invention

According to a first aspect of the present invention there is provided a stud for use on a surface over which a vehicle passes, the a stud has a casing that encloses a visible radiation source which is adapted to scan visible radiation so that, in use, visible radiation is projected onto the surface extending from the stud to a distance exceeding 0.1m, preferably exceeding 1.0m and most preferably exceeding 10m.

Preferably a beam steering means is provided in the stud for deflecting radiation from the source. Ideally the visible radiation emitted as visible light from a laser or laser diode and is scanned so as to define a predefined pattern on the surface over which a vehicle passes. Patterns can include lines or warning notices or traffic signs, projected in an axonometric manner on a road so as to be visible by approaching vehicles.

Ideally a sensor is provided which detects the proximity of a vehicle and switches on the radiation source when a vehicle is within a predefined range. The sensor may be a light sensor, adapted to detect light from an oncoming vehicle headlamp; a vibration sensor adapted to detect motion of the vehicle or a noise sensor which detects the sound of the vehicle engine. Alternatively an ambient light level sensor, such as a photocell, may switch on the light at a pre-set light level so that light is scanned continuously during darkness.

According to a second aspect of the present invention there is provided a stud for use in a system, the a stud having a casing that encloses a light source which is adapted to emit light towards an associated second stud so that, in use, a pathway is defined between the stud and the second stud whereby light from the stud is detected at a plurality of locations on the second stud and a light source in the second stud is adapted to emit light upon receipt of light from the stud and in a direction that is dependent upon a location of incident light on the second stud.

According to a further aspect of the present invention there is provided a safety system comprising: a plurality of studs, adapted to be arranged in succession wherein each stud has a casing that encloses a light source which is adapted to emit light towards an associated second stud so that, in use, a pathway is defined between studs and whereby light from a first stud is detected at a plurality of locations on a second stud and a light source in the second stud is adapted to emit light upon receipt of light from the first stud and in a direction that is dependent upon a location of incident light on the second stud, thereby defining a path between adjacent studs.

In this way a row or groups of studs are provided so that when light is incident on one of the studs, that stud radiates light towards an adjacent stud so as to illuminate a pathway. The pathway can then be followed by a user for example a driver navigating a road.

Optionally a reflector, such as a prism, may be used in conjunction with a radiation source so as to reflect radiation along a predefined pathway.

In preferred embodiments and according to a second aspect of the present invention the studs include solar panels capable of generating electricity such as for example a photovoltaic cell adapted to provide energy to the light source or to a rechargeable battery for storage during daylight hours. In this way the stud is ideally self-sufficient and not require connections to external power sources.

Optionally a photovoltaic cell is ideally provided on a top surface of the casing or stud housing for providing a charging current to a rechargeable battery housed in the stud housing.

Optionally studs may operate independently of one another supplying their own electricity to activate light at certain levels of darkness, therefore not being reliant on other studs or external power supplies.

In further embodiments a sequence of mirrors or prisms may be employed in order to relay energy. In yet further embodiment's kinetic energy capture may be possible which rely on energy imparted from a vehicle in order to displace a suitable energy harvester, such as piezoelectric micro electrical mechanical systems (MEMS) generators.

In an alternative embodiment or in addition to the aforementioned embodiments, the studs may be adapted to receive light energy from a vehicle and modify it so that it is relayed to an adjacent stud. This may be achieved using a combination of mechanical components and optical devices such as mirrors and/or lenses and/or light guides. Optionally one or more actuators may be provided to displace the components and devices housed in the stud so as to vary the direction of a light beam from one stud, so that it is directed to an adjacent stud.

Incident light from a vehicle may be directed through the stud housing and transmitted to one or more different faces of the stud, in an opposing side from the vehicle, in order to illuminate a region beyond the stud. This 'daisy chain' effect improves safety of more distant parts of a road for the vehicle.

Preferably the casing or stud housing is substantially trapezoidal or frustum shaped so as to be suitable to be received in a recess in a road, walkway or similar driving surface. The casing or stud housing is ideally square or rectangular based when viewed from above.

In use the casing or stud housing has angled side faces which taper from base to top, in a pyramid-like manner, so as to provide a ramped finish over which any wheeled or tracked vehicle may readily pass over without damage to either the stud or vehicles tyres, so obviating the need for the vehicle to change direction.

Preferably the stud sides are angled to at least 30 degrees and preferably no greater than 50 degrees so as to be readily passed over and so as to ensure the stud does not present too large a profile above the road surface.

Ideally the stud has rounded edges and/or corners thereby ensuring no sharp regions are exposed which may for example damage a tyre/wheel of a vehicle.

Advantageously drivers passing over the studs receive noticeable feedback, in the form of a raised projection thereby notifying the user that they have passed over the stud which may for example be marking the side of the road.

Ideally the casing or stud housing includes at least one transparent or translucent lens so as to allow light to penetrate. In this way light from within the stud can be emitted without requirement for an opening thereby protecting the stud contents.

Ideally the casing is formed from a strong, durable heavy duty material that is cable or withstanding regular passing over by vehicles. For example the stud may include a metal casing coated in resin, cast iron or stainless steel.

Typically the transparent or translucent lens may be formed from glass or synthetic plastic set within the casing.

In use the studs are embedded on a track, roadway, highway, runway or other vehicular surface area using an adhesive. The stud is therefore fixed in permanent position preventing movement from its location. The adhesive is ideally a flexible compound which gives and this allows the stud to be run over by a vehicle and to remain in position.

Alternatively studs are embedded by means of an anchor or plurality of anchors which serve to secure them to the ground. In some embodiments the anchor may comprise walls that extend from each side of the stud, typically

perpendicular to the ground, so as to provide a portion of the stud which may be located underground in use. Therefore only part of the stud is visible over ground.

In this embodiment the anchor may house some components required for the stud to operate, as some of the lighting means, control, actuators and/or battery.

In other embodiments the anchor may be a rod or shaft that pierces the ground to provide an anchor for the stud.

In preferred embodiments the casing houses the lighting means so that the means are protected in use. Preferably the casing is sealed or sealable so that in use the lightings are fully protected and not liable to become damaged for example due to ingress of water.

In preferred embodiments the stud is formed, at least in visible portions, in a coloured polycarbonate resin; wherein the stud is highly resistant to wear and weight.

Preferably the light is powered by the photovoltaic cell which is ideally positioned on the casing top in use. In this way the cell is readily exposed to light sources to enable the cell to charge. In preferred embodiments the stud includes at least one battery so as to store energy generated by the photovoltaic cell for use when light is not available to operate the cell.

In preferred embodiments the stud is activated in response to lack of light detected by the photovoltaic cell for example at night when it is dark. Activation of the stud causes the light to be turned on and therefore the light turned on. Typically activation of the light is triggered when the photovoltaic cell is generating less than 0.5V. The light will typically operate in these conditions from the battery.

Advantageously light from passing vehicles travelling in darkness may serve to temporarily activate the photovoltaic cell so as to top of the battery even during the hours of darkness.

Preferably the lighting means may comprise a light directed to a photomultiplier or other type of amplifier so as to amplify and/or focus the light produced from its source in order to produce a more distinguishable emitted light beam. For example, an acrylic tube may be arranged to conduct light to a suitable amplifier.

Ideally the light may be focused in to a beam so provide a directional spot light rather than a flooding light when emitted. In this way the light beam provides a visual line which serves as a pathway. For example the stud may direct the light in a focussed manner, so that the area may be illuminated in specific or definable sections, for example following a roadway around a corner or by delineating a continuous line from one stud to another.

In order to ensure that such a line is visible in a majority of light conditions the stud ideally transmits or passes light to a following stud or in the direction of a following stud at a beam angle or arc that does not extend above horizontal to the ground or studs or uppermost part of said studs in use.

Light may be provided by a lamp or bulb, light emitting diode (LED) laser, laser light emitting diode (LED) or other light emitting device.

In some embodiments the stud may diverge the light passed through the stud, in order to spread the light across the area in a relatively wide solid angle or arc.

In some embodiments the stud may include a hood or cover so as to aid the direction of light and contain emitted light within a predefined conical angle so as to prevent light from being emitted beyond predefined angles beyond a particular height off the ground.

In this way it may be envisaged that within the beam arc much of the light beam shines on the ground, allowing visibility.

In another aspect a programmable intelligent road stud is provided which is adapted to reproduce a user definable image on a road surface. The programmable intelligent road stud is optionally provided with a means to update a scanner with a new image or pattern or template and this is adapted to reproduce a user definable image on a road surface. A user definable image may be provided by way of a remote update via a wireless link.

Optionally smart sensors may be included in the stud, which may monitor local conditions, such as light levels, temperature and the state of the road surface. A transmitter is optionally included that is capable of relaying this information to a remote received, for example in a control centre.

In another preferred embodiment studs provide a beam of light directed in specific directions, for example, to indicate a junction or to mark the centre of a road or other road markings, so that vehicles approaching the studs from both directions are shown road markings or indicia which may be presented in diametric or trimetric format. Different road markings or indicia, including a simple projected line of light, may be displayed from different sides of the stud. Optionally these may be in different colours, such as, for example amber and green.

Ideally a scanning light source, such as a scanning laser, may be employed to write a word or project an image or a temperature on the road surface.

Typically in order to increase visibility, the beam is within a visible part of the electro-magnetic spectrum, although further embodiments may prefer further colours.

Optionally studs may be adapted to transmit or refract light into or onto a focussed pathway.

In some embodiments studs may require deployment or fitting in a predefined direction, for example whereby the stud refracts light in different ways according to how it is fitted.

Optionally a refraction device may be combined with a colouring lens or portion, which is arranged to ensure light arrives from, or travels to, a particular location and in the light varies in colour in different directions.

In this way in addition or the alternative a stud may produce a coloured light pathway when a standard white light from a vehicle headlight is shone on it. This might be useful in for example studs that mark a particular part of a motorway carriageway, such as an entry or exit road where different sides of a road stud may be seen from traffic approaching in different directions so as to indicate a different meaning to respective drivers.

In another embodiment two different colours may be projected from either side of the stud. Likewise the stud may produce a different colour when refracting, transmitting or reflecting light through from each side meaning that for example more than one set of studs may be laid, enabling the studs to effectively demarcate two sides of a roadway or other elongate area to users approaching from two or all directions.

According to another aspect of the invention there is provided a method of installing studs into a vehicle surface or walkway in order that they are so arranged as to define a path for pedestrians or vehicles when activated.

Such a method or system allows provision of a landing aid to aircraft in low light conditions, in order that a runway may be laid out by studs rather than lights, thereby reducing on-going costs and minimising light pollution.

A system that includes the studs is believed to encourage a driver to drive or travel in a correct part of the roadway or runway thereby promoting improved lane discipline as the pathway defined by the studs is more noticeable as a driver, pilot or user approaches the defined pathway. The pathway is described by light being focussed towards more centrally arced or flatter deviations or refraction.

In another embodiment, the studs may include a separate communication channel that enables communication between adjacent studs or groups of studs so as to modulate the light sources in a manner that a groups of light sources in an entire pathway or part of a route are switched on and off in unison, so as to draw attention to a route or pathway.

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

Brief Description of Figures

Figure 1 shows an isometric view of a preferred embodiment of the stud;

Figure 2 shows a view from front of the embodiment in Figure 1;

Figure 3 shows a view from rear of the embodiment in Figure 1;

Figure 4 shows a side view of the embodiment in Figure 1;

Figure 5 shows a view from above of the embodiment in Figure 1;

Figure 6 shows a view from below of the embodiment in Figure 1;

Figure 7 shows a top elevation of a second embodiment of the stud:

Figure 8 shows an underside view of the second embodiment;

Figure 9 shows a side view of the second embodiment;

Figure 10 shows a front view of the second embodiment;

Figure 11 shows a back view of the second embodiment;

Figure 12 shows an isometric view of the second embodiment;

Figure 13 shows a top elevation of a third embodiment of the stud:

Figure 14 shows an underside view of the third embodiment;

Figure 15 shows a front view of the third embodiment;

Figure 16 shows a back view of the third embodiment;

Figure 17 shows a side view of the third embodiment;

Figure 18 shows an isometric view of the third embodiment;

Figure 19 shows a cross section of the second embodiment;

Figure 20 shows a cross section of the third embodiment; and

Figure 21 show an example of a light level control circuit for use in the stud.

Detailed Description of Figures

Referring to the Figures, there is shown a stud casing 10 which is formed from resistant polycarbonate, cast stainless steel or aluminium. The stud casing 10 is ribbed for strength and in the preferred embodiment is formed from stainless steel so as to be both strong and corrosion resistant.

A preferred embodiment of the stud casing 10, shown in Figures 1 to 5 includes a solar powered stud which is permanently affixed to a road surface and creates a beam of light adjacent the stud. The light beam is generated by a laser that shines along the road when activated, for example by a headlamp or sound of an oncoming vehicle.

A reflector 30 is bonded to a rear portion of the stud 10. The reflector 30 faces headlights so as to reflect as a vehicle approaches.

In some embodiments the casing or housing may be coloured in bright colours so that road stud stands out in daylight. Optionally coated bolts are used to secure end caps to the metal body.

A photocell detects the presence of oncoming vehicles. A photovoltaic cell 20 collects incident sunlight and converts this to electricity to recharge battery 70. The photovoltaic cell 20 is fitted to a top surface 25 of the stud 10. Lens 50 is angled so that light 60 beam is always directed towards the road surface and is never able to shine into the eyes of a driver of an oncoming vehicle.

The stud includes a rechargeable 1.2 V/800mAh nickel metal hydride (NiMH) temperature resistant battery 70 and a small hardened solar panel 20 2.5V/90mA (for example monocrystalline silicon) that is set in the stud body to provide a trickle charge power supply to recharge battery 70. A printed circuit board 75 (PCB) cooperates with an ambient light sensor 80 and laser emitter 60.

The anchor 40 is in the form of a boss. The anchor 40 is used to secure the road stud in the road, and is indented 45 to create a better bond with the tar macadam.

Therefore in the pictured embodiment during the day the photovoltaic cell collects energy and charges the battery 60, and when ambient light level

drops below a threshold, the laser that generates the beam of light, is switched on.

When several studs are illuminated they create a single band of continuous light showing the lie of the path-, run- or roadway ahead. This defines a safer illuminated way. A continuous beam is created by using a regular array of studs. The beam may be red or amber or green.

A fibre-optic concept may be based on the idea of laying a small fibre-optic line between the studs allowing light to refract along it essentially creating a beam of light.

Radiation beam is deflected against the road surface along to the next road stud.

In further embodiments a curved lens may spread the laser beam, for example a semi circular lens will create a laser that points downward and forward but never above the level of the stud.

Ideally in all preferred embodiments the lens is shrouded by the top of the stud to help reduce damage or dirt cover.

A dashed yellow or amber beam may be created by missing out every other stud and letting the light fade to nothing and may be used down the centre of the road. An alternative colour may be white or green and this may be implemented in a broken green line may be created by missing out every other stud and letting the light fade to nothing and may be used to mark out when there is a slip road, lay-by, or turning.

Further fibre-optic embodiments may be based on the idea of laying a small hard-wearing fibre-optic line between the studs allowing light to refract along it, creating a beam of light. The drawbacks of the concept are that it is hard to implement and may easily get worn or damaged.

Figures 1 to 6 show a first embodiment of the stud 100 wherein the stud is dimensioned to receive oncoming traffic wherein the face furthest from the vehicle is inverted to create an overhang so as to direct the light to the ground and prevent damage to the lens. The casing has a top overhang to avoid damage to the lens 50, wherein hardened glass lens 50 is purposely designed to ensure the laser beam can only shine in the correct direction. This glass may preferably be self-cleaning.

Figures 7 to 12 show a second embodiment of the stud 200 wherein the stud is trapezoid so that it may be readily passed over by a vehicle in any direction. Typically the sides are angle at 40 degrees so as to be readily passed over by vehicles and bikes alike. The front includes two reflectors 30 and the stud top 25 houses the photovoltaic cell 20.

The lens 50 is shown recessed in a channel 55 so as to protect the lens 50 in use and to provide directed light.

Figures 13 to 18 show a third embodiment of the stud 300 with an anchor 40 comprising 4 walls 40 A,B,C,D that extend from the casing 10 sides.

Figures 19 and 20 reveal cross sectional views of embodiments 200 and 300 wherein component parts within the casing are shown including: the light 60, light tube 65, PCB 75, battery 70, sensor 80 that monitors voltage and triggers activation and deactivation of the light 60 and an access panel 15.

Figure 21 shows a circuit detailing how the stud operates. In this example if a voltage of less than 0.5v is generated by the photovoltaic cell 20 (no or low light) no current is passed and therefore the light is activate. The stud includes a sensor 80 which monitors the voltage levels associated with the photovoltaic cell 20 and when voltage generated by the cell 20 is below a certain level the light 60 is activated, and when voltage generated by the cell 20 is above a certain level the light 60 is turned off.

Referring briefly to Figure 21 there is shown an example of a control circuit 500 on which key components and values are annotated. Section P is the output terminal to laser 60; section Q is a microprocessor which determines the threshold of ambient light levels upon receipt of a signal from photovoltaic diode. Circuitry in section R oversees the switching on and off of rechargeable battery 70 to power laser 60 and the charging of the rechargeable battery 70. Circuitry in section S ensures the correct driver signal is applied to the laser 60 at the correct frequency and voltage as controlled by the microprocessor in section Q.

The invention has been described by way of examples only and it will be appreciated that variation may be made to the above-mentioned embodiments without departing from the scope of invention.

With respect to the above description then, it is to be realised that the optimum dimensional relationships for the parts of the invention, to include variations in size, materials, shape, form, function and manner of operation, assembly and use, are deemed readily apparent and obvious to one skilled in the art, and all equivalent relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the present invention.

Therefore, the foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention. For example a communication device, such as a radio receiver, may be included in the stud housing for receiving information for controlling the nature, time, colour or any other variable associated with the radiation that is emitted.

The stud may be fitted with a radio receiver which is capable of being updated with software to drive the scanner to scan a template, such as the outline of a snowflake onto the road surface, for example when icy conditions are expected. In this sense a programmable intelligent road stud is provided which is adapted to reproduce a user definable image on a road surface.

Claims

1. A stud for use on a surface over which a vehicle passes, the stud has a casing that encloses a visible radiation source which is adapted to scan visible radiation so that, in use, visible radiation is projected onto the surface extending from the stud to a distance exceeding 0.1m.

2. A stud according to claim 1 wherein the radiation is projected onto the surface extending from the stud to a distance exceeding 1.0m.

3. A stud according to claim 1 or 2 wherein the radiation is projected onto the surface extending from the stud to a distance exceeding 10.0m.

4. A stud according to any preceding claim includes a beam steering means for deflecting radiation from the source.

5. A stud according to any preceding claim wherein radiation is visible light.

6. A stud according to any preceding claim wherein radiation is supplied by a laser or laser diode.

7. A stud according to any preceding claim includes a sensor for sensing the presence of a vehicle and switches on the radiation source when a vehicle is within a predefined range.

8. A stud according to claim 7 wherein the sensor is from the group comprising: a light sensor, adapted to detect light from an oncoming vehicle headlamp; a vibration sensor adapted to detect motion of the vehicle or a noise sensor which detects the sound of the vehicle engine.

9. A stud according to any preceding claim includes an ambient light level sensor, such as a photocell, adapted to switch on the radiation at a pre-set light level.

10. A stud for use in a system, the a stud having a casing that encloses a light source which is adapted to emit light towards an associated second stud so that, in use, a pathway is defined between the stud and the second stud whereby light from the stud is detected at a plurality of locations on the second stud and a light source in the second stud is adapted to emit light upon receipt of light from the stud and in a direction that is dependent upon a location of incident light on the second stud.

11. A stud according to any preceding claim includes a photovoltaic cell capable of generating electricity.

12. A stud according to any preceding claim includes a rechargeable battery.

13. A stud according to any preceding claim wherein the stud includes at least one anchor.

14. A stud according to any preceding claim wherein the casing includes at least one reflective portion.

15. A stud according to any preceding claim wherein a profile of an exposed portion of the stud, in use, is substantially trapezoidal.

16. A stud according to claim 15 wherein the sides of the trapezoid are angled between 30 and 50 degrees.

17. A stud according to any preceding claim wherein the casing is accessible through the base by means of a plate.

18. A stud according to any preceding claim wherein light passes through a coloured lens.

19. A stud according to any preceding claim wherein different colour light is emitted from different sides of the stud.

20. A safety system comprising: a plurality of studs according to any of claims 1 to 19, is adapted to be arranged in succession wherein each stud has a casing that encloses a light source which is adapted to emit light towards an associated second stud so that, in use, a pathway is defined between studs and whereby light from a first stud is detected at a plurality of locations on a second stud and a light source in the second stud is adapted to emit light upon receipt of light from the first stud and in a direction that is dependent upon a location of incident light on the second stud, thereby defining a path between adjacent studs.

21. A method of installing the studs according to any of claims 1 to 19 into a roadway.

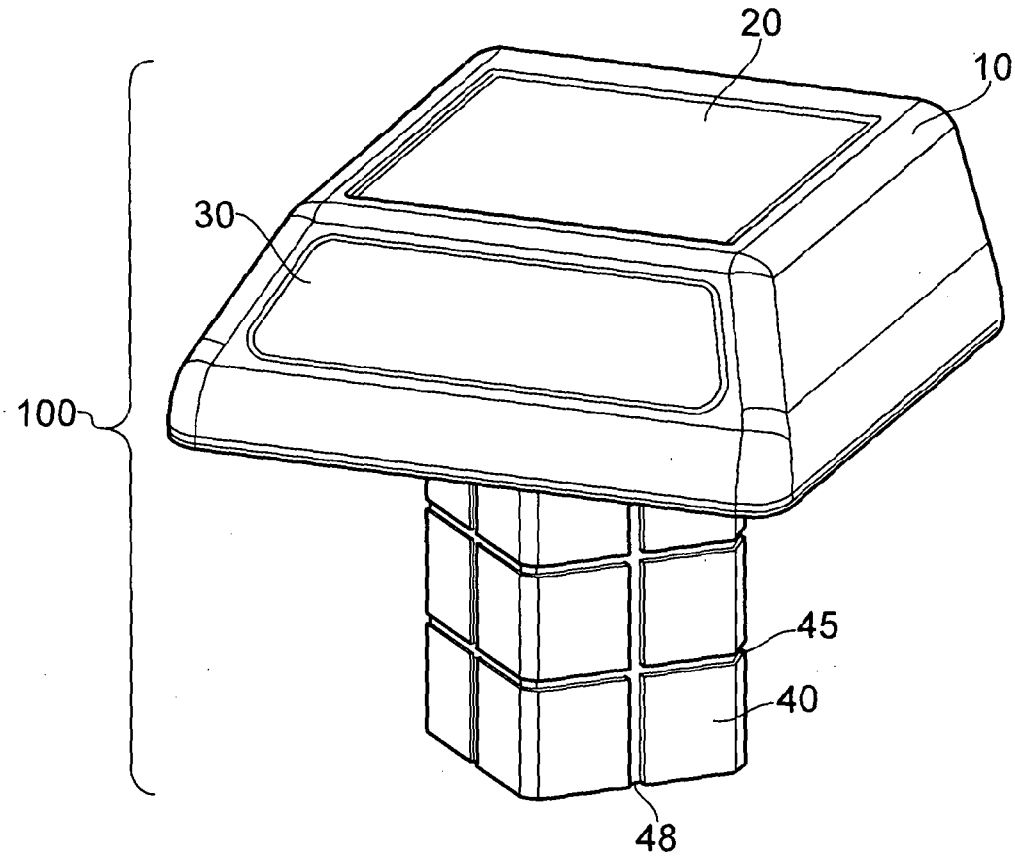


FIG. 1

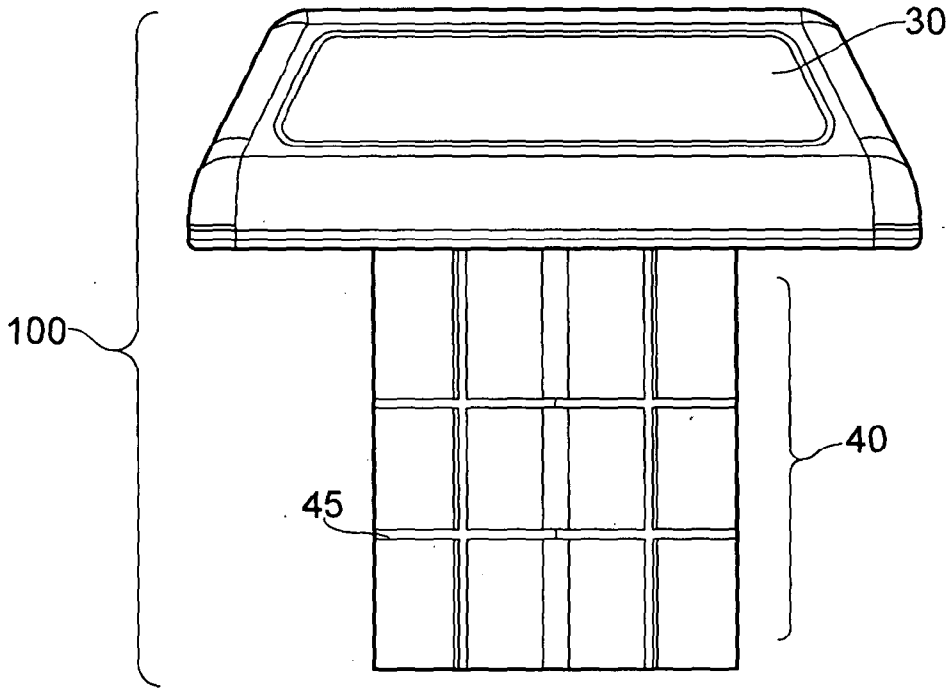


FIG. 2

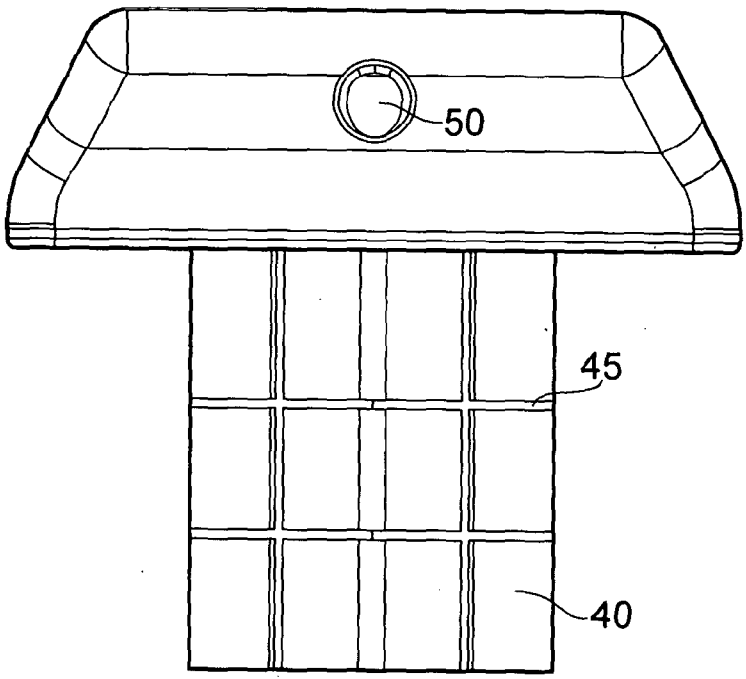


FIG. 3

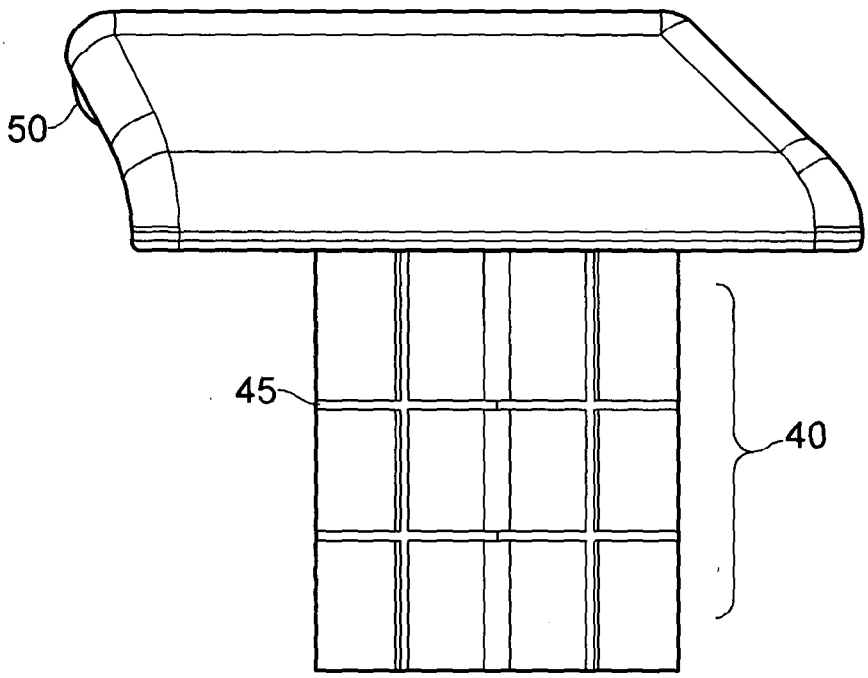


FIG. 4

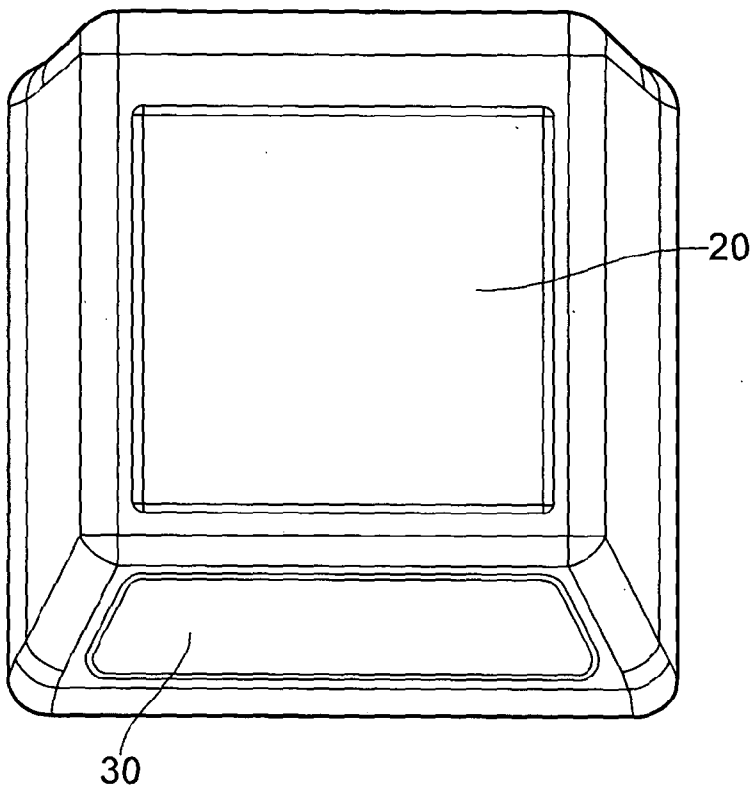


FIG. 5

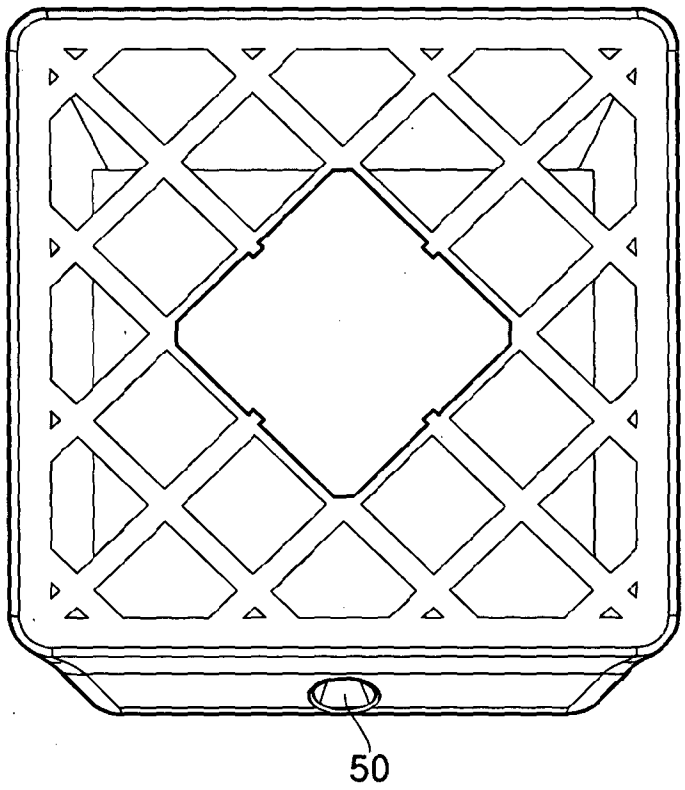


FIG. 6

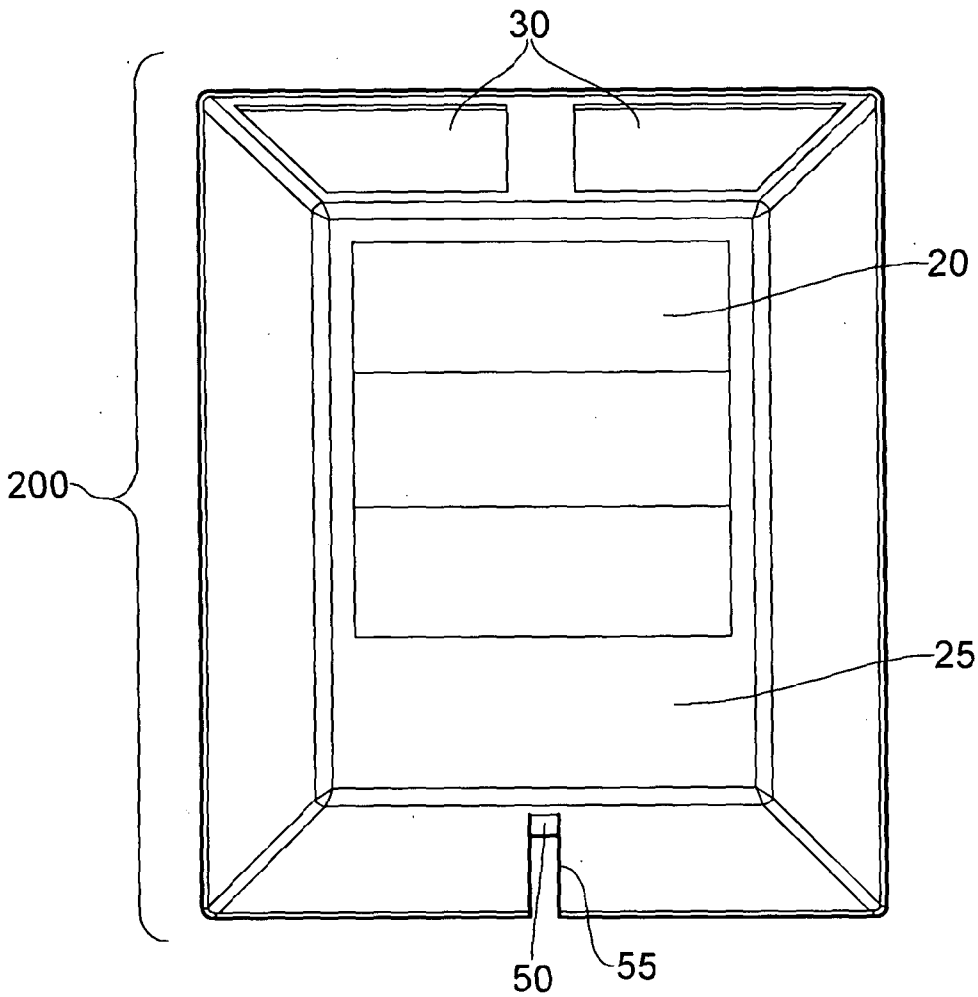


FIG. 7

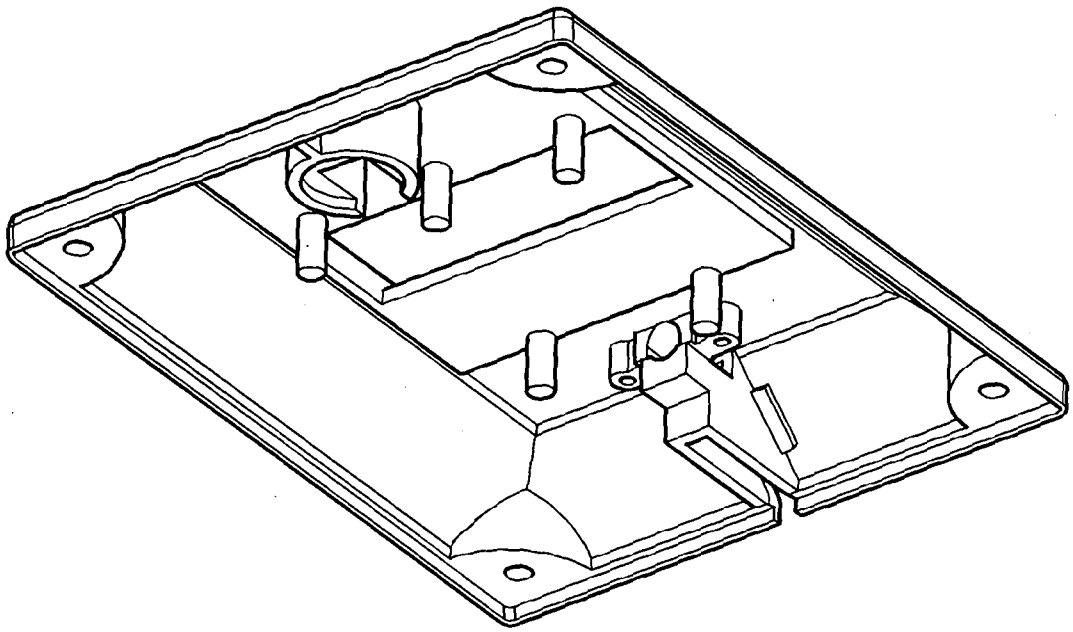


FIG. 8

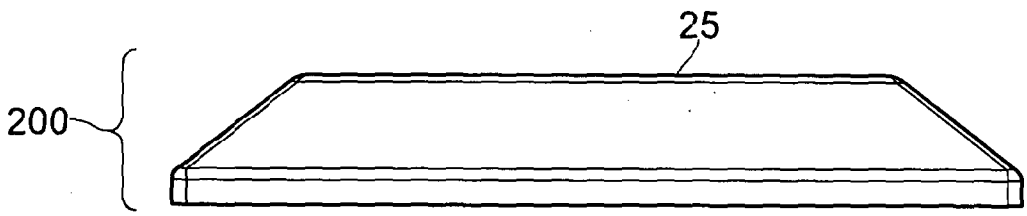


FIG. 9

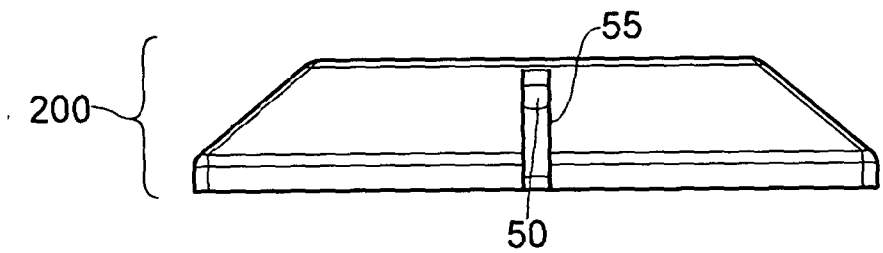


FIG. 10

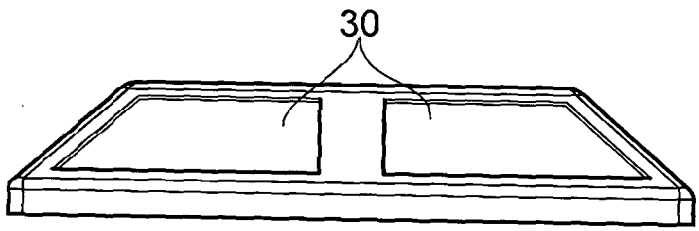


FIG. 11

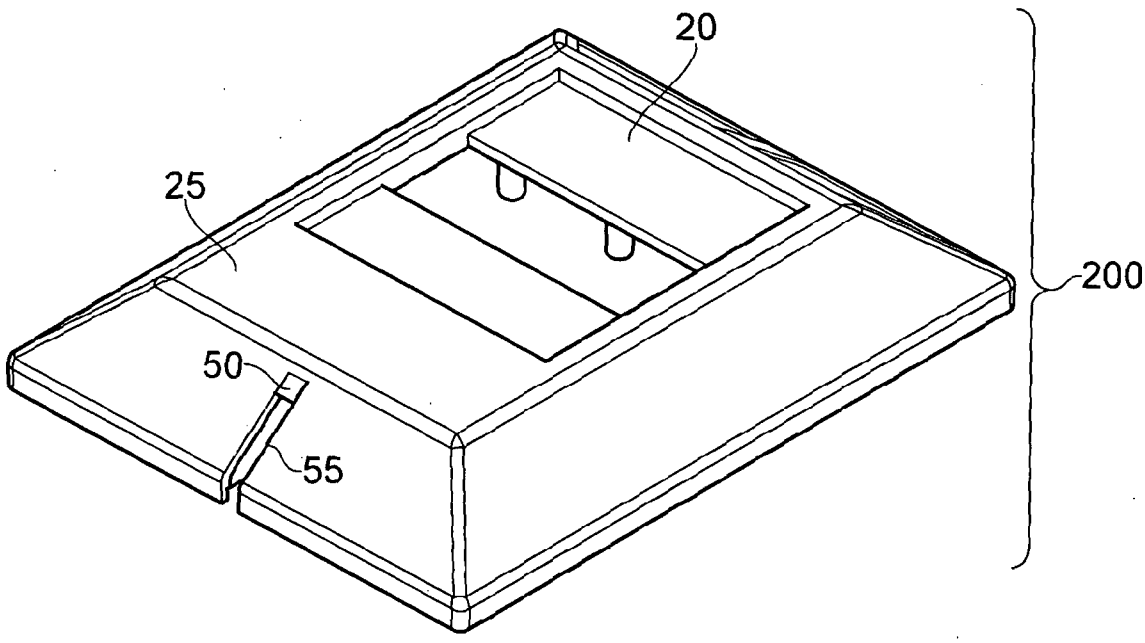


FIG. 12

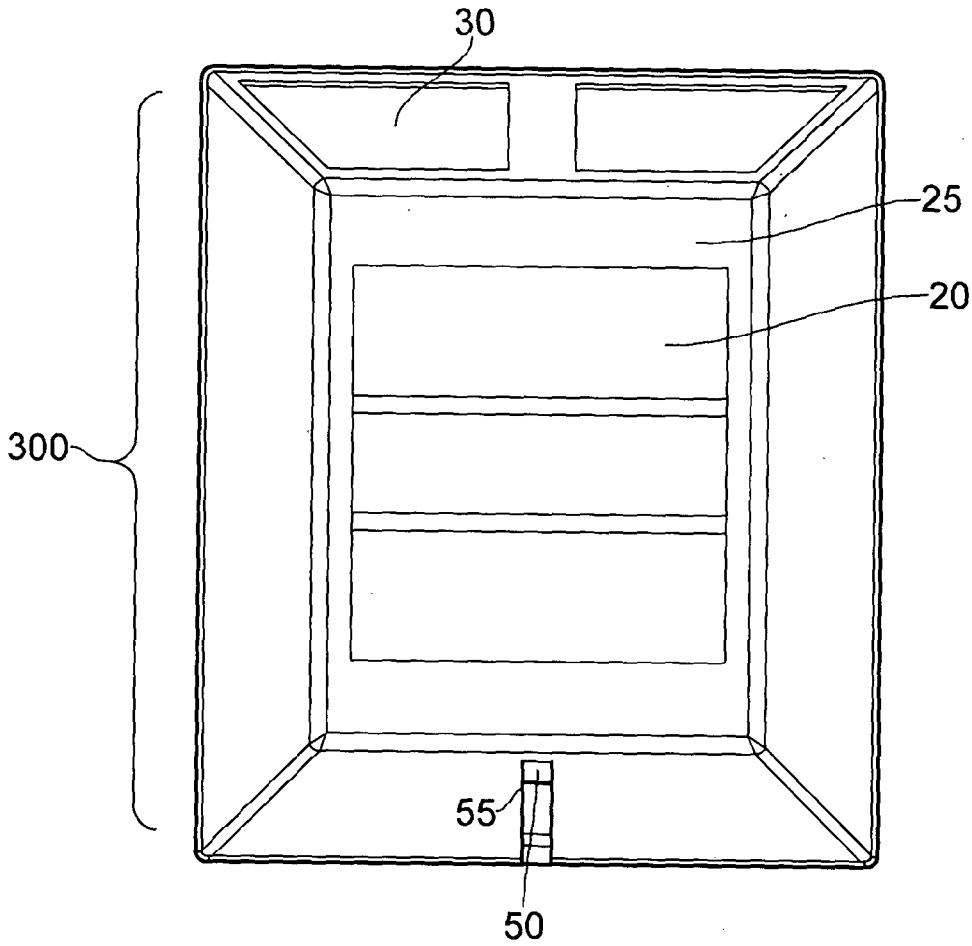


FIG. 13

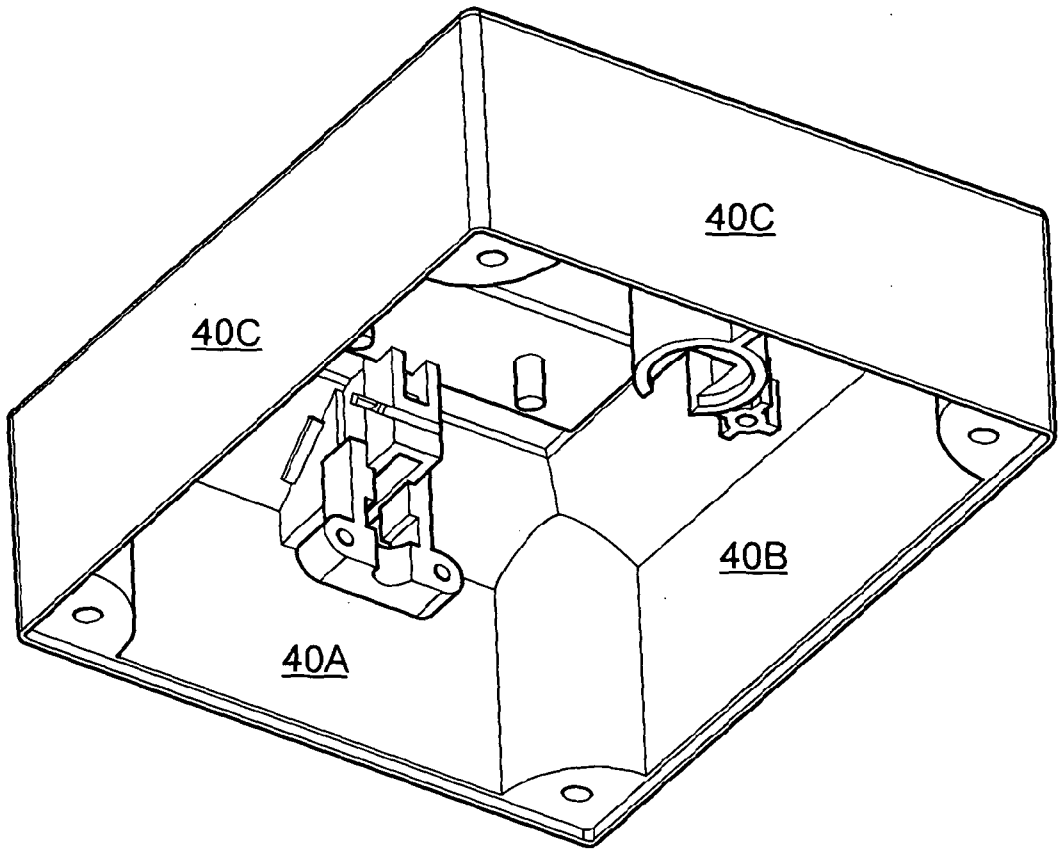


FIG. 14

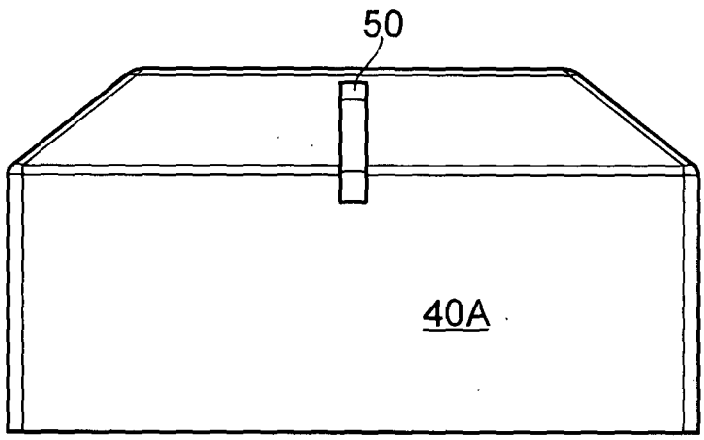


FIG. 15

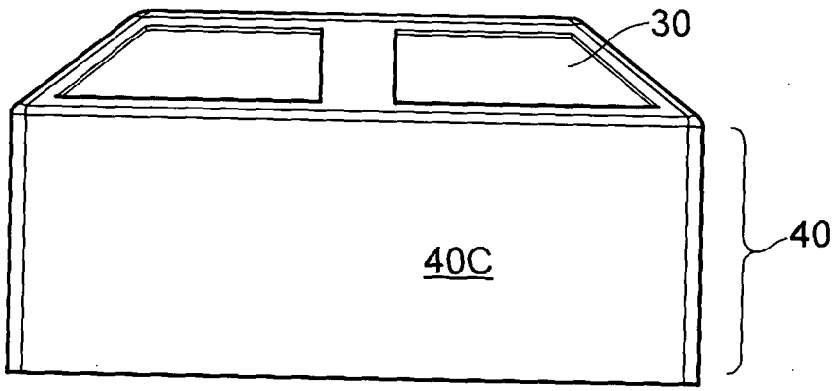


FIG. 16

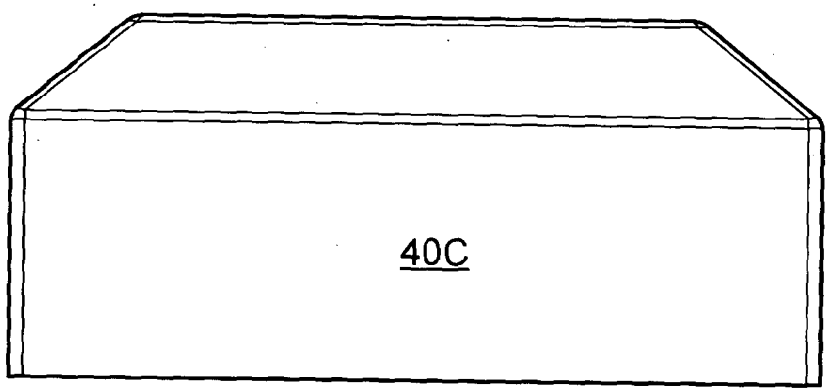


FIG. 17

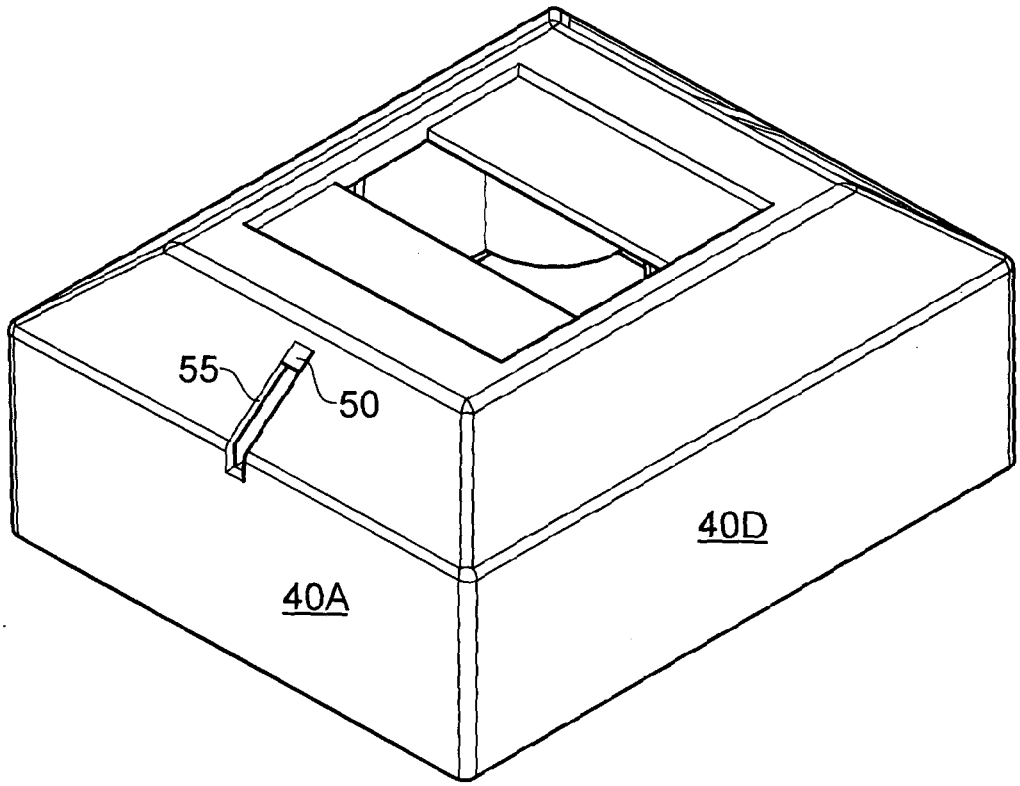


FIG. 18

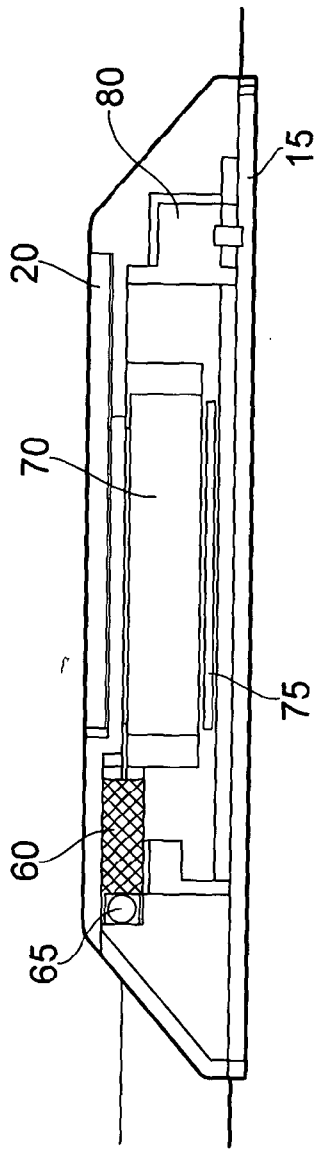


FIG. 19

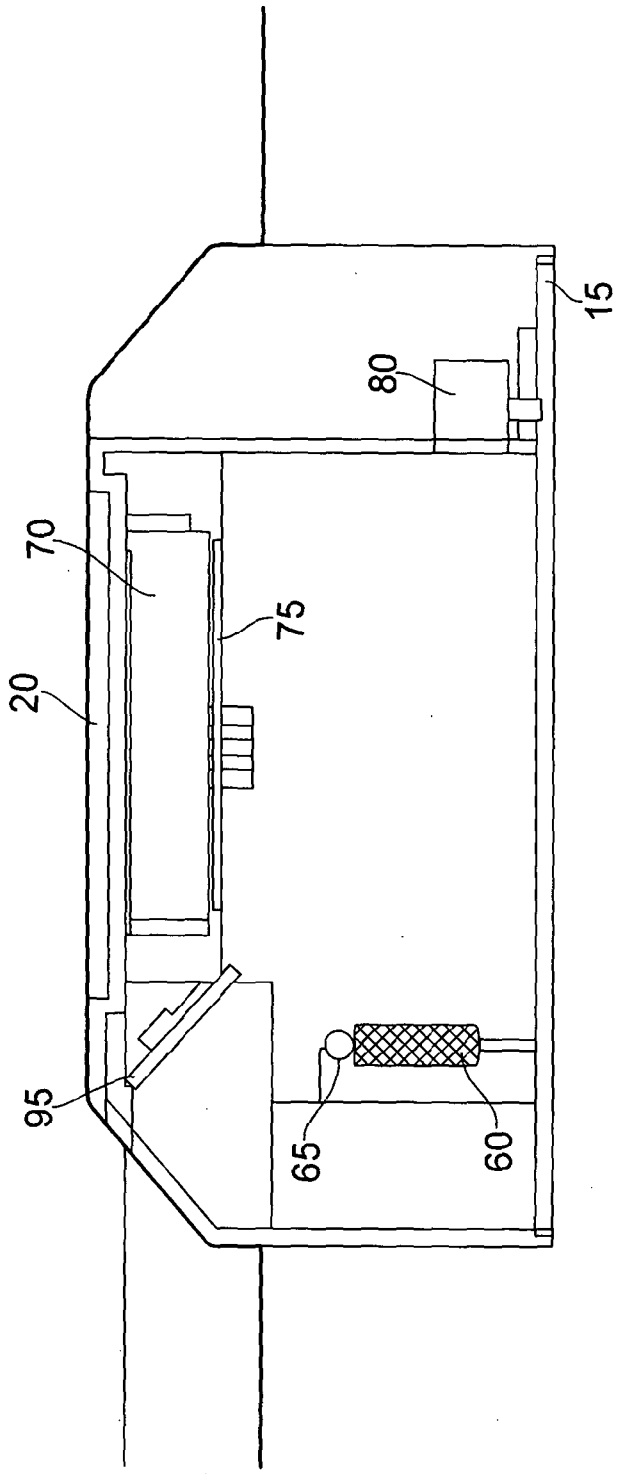


FIG. 20

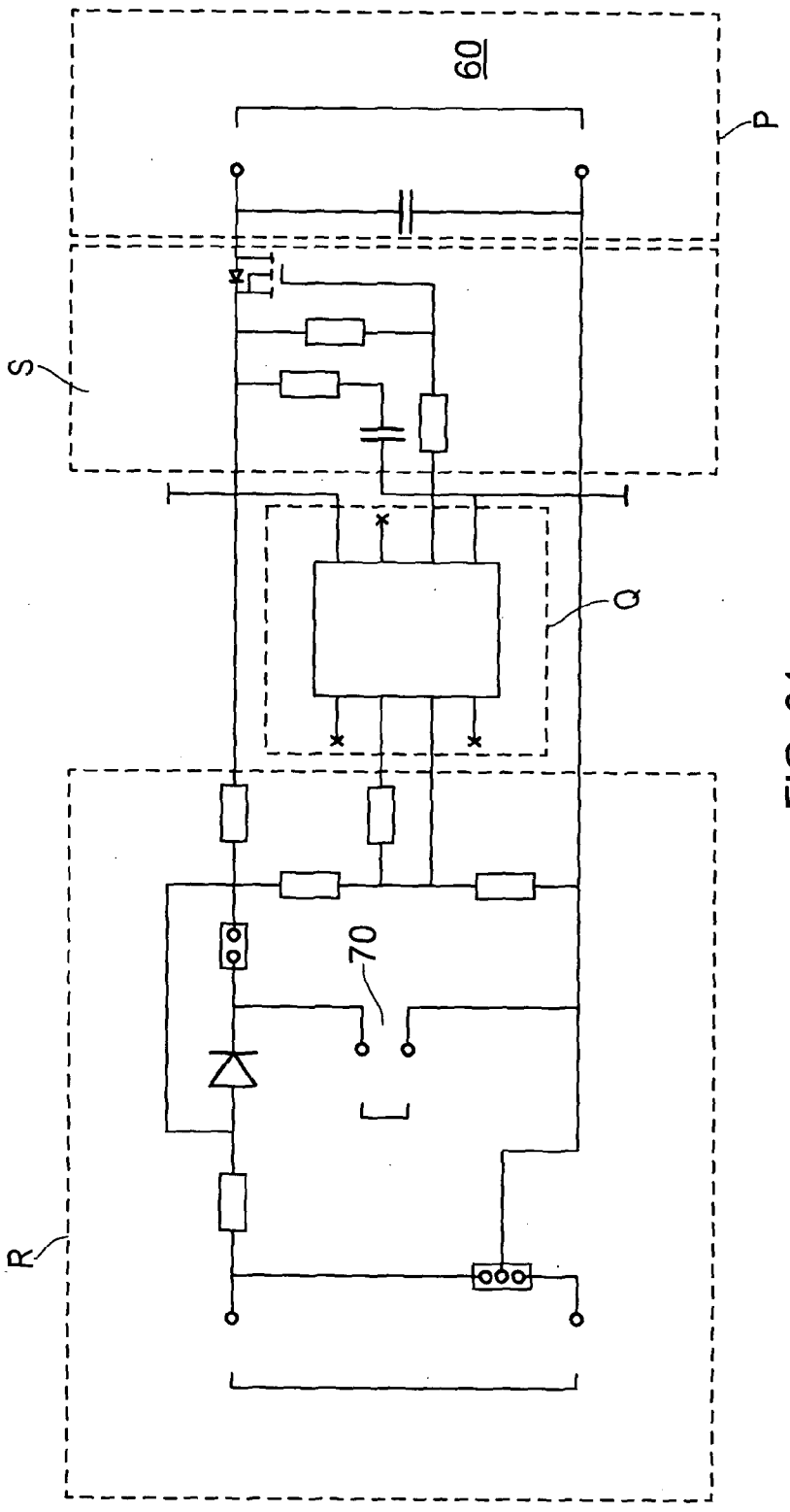


FIG. 21

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2013/000051

A. CLASSIFICATION OF SUBJECT MATTER
INV. E01F9/06
ADD.

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)
E01F

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 practicable, 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 Y	KR 100 787 599 B1 (LEE JONG HUN [KR]) 21 December 2007 (2007-12-21) the whole document -----	1-6,9,21 7,8
Y	JP 2004 353440 A (SEKISUI JUSHI KK) 16 December 2004 (2004-12-16) paragraphs [0006], [0013], [0039] figures 6,11 -----	7,8
X	JP 2000 290943 A (KICTEC INC) 17 October 2000 (2000-10-17) the whole document -----	1
	-/--	

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

[X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 May 2013	06/06/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Kremsler, Stefan

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2013/000051

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 03/034369 A2 (HUTCHINS J MARC [CA]; HUTCHINS NICHOLAS D [CA]) 24 April 2003 (2003-04-24) page 8, line 1 - line 21 page 9, line 26 - page 10, line 9 page 11, line 5 - line 26 figures 1,3,7 -----	1

2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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		US 2005040970 A1	24-02-2005
		WO 03034369 A2	24-04-2003