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Illuminated Articles and Devices

The present invention relates to illuminated articles and devices, and particularly, although not exclusively, to novelty illumination articles and devices.

A number of innovative illuminated novelty devices are described in International Patent Application No. PCT/AU03/00982 filed on 2 August 2003 and entitled "A Novelty Device", the contents of which are incorporated herein by reference.

The novelty devices disclosed in that application include a light guide that emits light along its length so as to provide e.g. an illuminated necklace, bracelet or the like. The devices include a control unit having one or more LEDs and a microprocessor for enabling their modulation. Modulation may be in accordance with a preset program stored in the control unit memory and/or in response to detected ambient sound, e.g. music, speech, footsteps or the like. The light may be pulsed, and may be modulated so as to change intensity, pulse frequency or colour.

The devices may be modular in construction, and may comprise e.g. one or more control units (on each of which is mounted one or more LEDs) and one or more light guides that may be mounted between the LEDs of one or more of the control units. The control units and light guides may be mixed and matched so as to provide devices of different sizes, shapes and colour combinations.

An aim of the present invention is to provide further illumination articles and devices, which, in their various new features, may provide a number of advantages.

Viewed from one aspect, the present invention provides a signal line, the line including a side-emissive light guide extending along at least a part of said line, a light source for illuminating the light guide, and a controller for controlling the light source based upon a signal on the line, e.g. based upon a signal current flowing therein.

The signal line may include suitable electrical conductors/wires along its length for transmitting electrical signal current from one end of the line to the other.

The signal line may transmit audio signals. It may for example be the line-out of an entertainment system, e.g. of an audio device, e.g. an audio line-out cable from a music system. The signal line may for example provide a signal to a loudspeaker, mixer, headphones, earphones, or the like. It could
5 also be a line-in signal line/audio lead, e.g. a line from a microphone, musical instrument or the like.

When used to transmit e.g. audio signals, the illuminated line can provide a pleasing display that can complement the music or other sounds played.

The line could also be e.g. a signal line associated with a computer or
10 the like, e.g. a data transmission line. In this case, again, the device would provide a novelty aspect through its illumination, and could also provide a practical information aspect, e.g. its illumination confirming that data is being transferred. The data line could for example be the line of a games controller, e.g. a joystick or games paddle, connected to a games machine or computing
15 device, e.g. a video game machine, home game system or the like.

It will be understood that the term "signal line" should be interpreted broadly and covers illuminated cabling, cables, leads and the like which may be of any suitable size, rating and the like, depending on the use to which the line is to be put. Preferably, the signal lines are electrical lines, but they could take
20 other forms, e.g. fibre optic lines.

The controller may control the light source to illuminate the light guide in any suitable manner. It may for example illuminate the light guide constantly or could pulse the light guide in accordance with a preset illumination sequence, e.g. to flash or pulse the line when signals are being transmitted.

25 In a preferred form, the controller modulates the light based on characteristics of the signal on the electric line. Modulation may for example be carried out in response to signal frequencies and/or intensities, e.g. based on bass and treble signal components. In one preferred embodiment, the controller analyses the frequency spectrum of the signal, and modulates the
30 light source based upon the characteristics of one or more of the frequency components of the signal.

If the signal line transmits data, the light could be modulated for example based on the amount or speed of data transferred. The controller may also analyse or decode the data signal to determine the type of data being

transmitted or to determine the meaning of the actual data itself. The controller may then modulate the light source based on the type of data, the value of the data or the like.

When used with a games controller, the controller could for example
5 detect the input, e.g. keys pressed or the like, and may recognise a particular signal as a particular action, e.g. gun firing or movement, and may illuminate the line from the games controller accordingly, e.g. to flash when a gun is fired or a user jumps, but to ignore other movement. A signal line may also illuminate in accordance with directions from the games console or computing device, e.g.
10 when a player is hit or damaged or some other action occurs, and, for example, the line may be illuminated based on a feedback signal sent to the games controller from the playing machine.

The signal lines will generally transmit analogue signals. The signals could however also be digital.

15 Modulation of the light in the light guide may for example include a change in the intensity of the light, a change in frequency and/or duration of an illumination pulse, and/or a change in the colour or colours (wavelengths) of the light. Modulation may occur in relation to one or more preset programmes stored in the controller, and may be carried out for example in a manner as
20 discussed in PCT/AU/03/00982.

Detection by the controller of a signal on the line may be achieved through circuitry that connects with conductors of the line, e.g. taps into electrical conductors on the line. It could also be through non-contact detectors, e.g. capacitive, magnetic or inductive detectors. Where the signals are used to
25 generate sound, e.g. music, the controller may include a microphone to detect the generated sounds, e.g. from an attached loudspeaker, amplifier or the like, so as to control the lighting accordingly. The controller could also detect e.g. signals on a fibre optic line e.g. by splitting the signal or by including repeater circuitry to intercept and pass on the signal.

30 The light guide may have a light source at one of its ends only. In this case, the other end may be blocked from transmitting light, may be mirrored to reflect light back down the light guide, or may allow light to escape from the end. The light guide could alternatively include a light source at both ends. This can provide a longer length of line without light drop off problems, and/or

can allow for a greater variety of illumination patterns/displays, e.g. by controlling the light sources at each end differently, and/or by having different coloured light sources at each end that can intermingle along the light guide's length.

5 The light guide may also include light sources at one or more intermediate points along its length. The intermediate sources again may allow for the fabrication of longer length lines without light drop off problems, and/or may allow for a large variety of illumination patterns, including for example sequential operation of the light sources so that the light appears to be moving
10 along the line's length.

 The intermediate light sources may emit light in one direction down the guide or in two opposing directions. By using two oppositely directed light sources at each location, the spacing between light source locations may be doubled. This can make fabrication and electrical connections simpler. Also,
15 the light from two opposed light sources may blend together in the light guide section therebetween.

 The signal line may be configured so that light is emitted from the guide only at certain locations along its length, e.g. to produce a number of spot sources of light. This may be achieved for example by shielding the light guide
20 at various points along its length so that the light may not escape along those parts of the guide.

 The signal line may be self-powered, e.g. the controller and the light source, e.g. by batteries. It may also or alternatively receive power from a device with which the signal line is associated, or from mains power, or from the
25 signal line itself, e.g. phantom power.

 The signal line may include any suitable connectors for connecting with the input or output of an associated device, e.g. a music player, and could include a phono plug, jack plug, RCA plug, DIN plug or the like at its ends. Electric conductors between the connectors may take any suitable form for the
30 application, and e.g. could be a simple pair of electrical wires, or two pairs of wires for stereo sound, or a shielded wire, e.g. coaxial wire, or the like. The signal line may include a second (power) jack in alignment with a signal jack for receiving power from the device to which the signal line couples.

The signal line may be manufactured as a single unitary item, i.e. with the light guide, the controller, the light sources and the signal conductors/leads, all mounted together and sold as a single item. It could then be used in place of e.g. ordinary electric cabling, so as to provide novelty illumination or the like.

5 Parts of the signal line, e.g. the controller, could alternatively be provided in a device with which the signal line is associated. This would be particularly applicable to a signal line integral with a device. For example, a set of headphones could include an integral illuminated signal line, with the controller for the light source or sources being mounted in one of the earpieces.

10 Alternatively, the illuminated signal line may be formed from the combination of a standard signal cable and from a light guide attachment, the light guide attachment including the light guide and controller and suitable connectors for mechanically and/or optically and/or electrically attaching/coupling the guide and controller to the signal cable. This would then
15 allow the attachment to be mounted on existing cabling to convert it into the inventive cabling of the present invention.

 The light guide attachment may include a coupling adapter at one end that includes connections, e.g. socket and plug parts, for placement between an electrical device and a standard signal cable. In use, the adapter is connected
20 to the device, e.g. through an output or input socket of the device, and the cable is mounted to the adapter.

 The light guide attachment may also have fasteners, e.g. clips, for attaching to the electric cable along its length.

 The light guide may also be separable from the controller, so that
25 different guides and controllers may be interchanged.

 The light guide light source or sources may take any suitable form, and could be for example small bulbs, e.g. incandescent bulbs. In one preferred embodiment, each light source may comprise a light unit of one or more Light Emitting Diodes (LEDs). Thus, the light guide could have a single LED at one
30 end, a single LED at each end, and/or a single LED at one or more positions in between. It could alternatively have two or more LEDs at one end, two or more LEDs at each end, and/or two or more LEDs at each light source position in between. The use of LEDs is particularly advantageous due to their robustness and low power consumption characteristics.

The LEDs could provide the same or different output colours from one another, and/or each LED unit itself could emit a number of different light colours (wavelengths), e.g. could include a number of semi-conductor elements within the same housing, each emitting a different colour of light.

- 5 The controller may take any suitable form, and preferably includes a microprocessor pre-programmed with one or more control regimes, so as to control the illumination of the light guide based on the signal on the line. The controller may also be reprogrammable so as to allow it to be updated with new control regimes, and/or may include a control interface, e.g. buttons or knobs for
- 10 changing the modulation regime (e.g. between different pre-programmed operating regimes), the light source intensity, the detection sensitivity, signal gain or the like. The gain may also be controlled automatically.

- As well as a directly manually adjustable control interface on the signal line or associated device, the control interface could allow for remote control.
- 15 Thus, a person or a control remote from the signal line may alter the control regime to provide a different lighting effect. This might be useful for example for signal lines used in a stage show, where a sound or lighting person can alter the effects on stage remotely. A person using the line, e.g. a guitar player or the like might also change the line by remote, using an adjacent activator, e.g. a
- 20 pedal or the like. The remote control communication may be achieved for example by infra-red or radio, and e.g. could be Bluetooth™ or the like.

- Where only one light source is provided, at only one end of the guide, then a single controller may be provided at that end of the line to control it. Where a light source is provided at each end of a guide, then a controller may
- 25 be provided at each end of the guide to control its associated light source. Alternatively, a single controller may be used, and control leads may extend along the guide to the remote light source. Where intermediate light sources are used, control leads may be provided along the length of the wire. Where more than one controller is used, e.g. one at each end of a line, they may, if
- 30 required, communicate with one another, e.g. by electrical connectors or wirelessly.

When two or more light sources are used, they may be controlled in the same manner or independently or in groups of commonly controlled light sources.

The number of light source control leads required will depend on e.g. the wiring configuration and on whether and to what extent the light sources are controlled independently or commonly. For example, the light sources may be wired in parallel using separate control leads for each, or all may be in parallel but receive control from the same two leads, or the light sources may be grouped into sets of light sources which each connect with respective group control leads. The light sources could also all be connected in series to receive the same control signal.

The light guide may take any suitable form. It may merely comprise a length of a transparent rod, e.g. a transparent polymer. Typically, it will comprise a light guide core and a core cladding and/or an outer jacket or covering.

The guide should be appropriately flexible for its desired use. Thus, where the signal line is to stay in a set position once installed, the guide may be stiff but easily bent. Alternatively, where the line is used as a signal wire for headphones, earphones, a microphone line or the like, the line should be suitably flexible that a user can move without hindrance.

The light guide may e.g. comprise a polymer core surrounded by a polymer cladding, the core and cladding being suitably transparent and/or translucent. Such a light guide may take the form e.g. as described in WO 02/095289 or US 5067831, the contents of both of which documents are incorporated herein by reference. The light guide may include a protective outer polymer jacket.

In one preferred embodiment, the light guide may comprise a core of a flexible polymer compound with light scattering particles therein, a cladding of polytetrafluoroethylene (PTFE), e.g. TeflonTM, and a protective jacket of polyvinylchloride (PVC). This may be e.g. as described in WO 02/095289 as is available from Poly Optics Australia Pty Ltd, e.g. under the name of "super side light".

In another possible embodiment, the light guide has a liquid core, e.g. enclosed within a polymer sheath and plugged at both ends with a quartz plug. The liquid core may take any suitable form. In one preferred embodiment, the core liquid is an aqueous solution of salts, e.g. a saline solution. Other liquids are also possible, such as fresh water, distilled water, alcohol or the like. The

sheath of the liquid guide may also be made of any suitable material, and is preferably of a suitably transparent or translucent form depending on the required application. It may comprise for example polyvinylchloride (PVC), silicone, polypropylene, or other plastics or rubber materials.

5 The signal wires and/or LED control wires may extend along the signal line within the light guide itself, e.g. within the guide core, within a cladding of the core, and/or within an outer cover or sheath. Alternatively, the wires may be provided on the outside of the guide. When located within the light guide, the wires are protected from damage. There may also be no need to use
10 separately insulated wires, as the light guide material, e.g. polymer core or the like, may provide sufficient insulation.

 More than one light guide could be used in a single signal line, e.g. two parallel light guides could be used. In this case, the signal wires, control wires and the like could run along the sides of the joints between the light guides,
15 although again, they could run within the guides.

 The signal line may be made in any suitable manner. Electrical wires may be provided along the length of the guide during production of the light guide or may be run along the length of the guide after it is formed (e.g. with an outer jacket extruded over the wires for protection and to keep them in place).
20 One or more light sources may be butt coupled to one or both ends of a guide. One end of a guide may be mounted in a housing that includes the controller, and suitable electrical connections may be made.

 In order to provide intermediate light sources, a number of light guides could be coupled end to end, with suitable electrical connections being made at
25 the joints. These light guides could have a light unit at one end, so as to provide a series of intermediate light sources facing in the same direction, or could have a light unit at each end, so that the intermediate light sources face in opposite directions. A protective unifying layer may be extruded over the coupled guides, and may e.g. hold and protect the signal and/or light control
30 wires.

 The signal lines may be of any suitable size and shape. For example, a guide that is illuminated by a single 5mm round high-intensity red LED might have a length of about 1 m to about 1.5 m, whilst the use of one of these LEDs at each end of the guide might provide a guide of twice this length. Any other

suitable LEDs could also be used, and line lengths may be increased by using intermediate LEDs.

As said, the signal line may be used in a many different applications, including in audio signal lines, data lines, communications lines and the like, and may be e.g. used with telephone lines.

As said, the illuminated signal line may be provided by attaching a light guide attachment to an existing signal cable. Thus, viewed from another aspect, the present invention provides an attachment for a signal line to provide an illuminated signal line, the attachment including a light guide, one or more light sources and a controller for determining the state of the signal line and for illuminating the light source or sources in accordance with the detected state of the line.

The present invention also extends to a connector for connecting a light guide with a signal cable for providing an illuminated line, and, viewed from another aspect, the present invention provides a connector for mounting a signal cable and light guide, the connector including a connection for coupling with the signal cable, a connection for coupling with an external electrical connection that the cable is to couple with, a connection for the light guide, e.g. for permanent attachment or for removable coupling with the guide, and a controller for detecting the state of the signal cable and for controlling a light source to light the light guide based on the detected state of the signal cable.

The present invention further extends to an electrical device having an integral illuminated signal line. Viewed from another aspect, therefore, the present invention provides an electrical device including a signal line, the line including a side-emissive light guide extending along at least a part of the line, the device including a light source for illuminating the light guide and a controller for controlling the light source based on the state of the signal line.

The present invention is particularly applicable to audio signal lines, and, viewed from a further aspect, the present invention provides an audio signal line for transmitting signals therealong, the line including a side-emissive light guide extending along at least a part of the line, a light source for illuminating the line, and a controller for detecting the signal on the line and for controlling the light source based upon the detected signal.

A lighted cable need not include a signal line, and could be a light guide and controller that includes a plug for connecting with the line-out socket of a music device or a connector for mating with any other suitable output connector, the cable including a control unit for monitoring the output of the output
5 connector and for illuminating the guide accordingly. It could also relate to an illuminated cable that monitors an input signal instead of an output signal or that monitors both.

Viewed from another aspect, therefore, the present invention provides an illuminated, e.g. novelty, strip or line having a light guide and light source and a
10 connector for connecting to a signal output or input of a device, the line including a controller for monitoring the output or input signal and for controlling the light source to illuminate the guide based on the output or input signal detected.

In one preferred embodiment of this aspect, the illuminated strip or line
15 itself includes a signal output or input connector that allows for connection of a standard signal line. The use of the novelty strip or line does not then exclusively use up an output or input of a device, and may provide a transparent tap into the connection between the signal output or input and a connected signal line.

Such a novelty strip may be used to provide an illuminated element that
20 can be draped over a device or in the surrounding neighbourhood. It could for example take the form of a strip that can be fixed to a guitar strap or the like and that can tap into the output of the guitar, the light strip connector being provided between the guitar output and the signal line passing to the guitar amplifier or
25 the like. A smaller strip could also be used to e.g. decorate a set of headphones, without being tied to the signal line going between the two ear loudspeakers.

The signal monitoring circuitry and the illuminated line and light controller could also be split, with the light controller and monitoring circuit communicating
30 remotely e.g. wirelessly, so that a connector mounted at the input or output of the device can communicate with the light controller of a remote illuminated line.

Above discussion has been mainly concerned with the use of side-emissive light guides, and these indeed have been found to provide good results. The present invention, however, from another aspect, may also be

applied more generally, and may be applied by using any linear lighting element in place of the light guides in any of the above-mentioned arrangements.

Accordingly, viewed from a further aspect, the present invention provides a signal line, the line including a linear light element extending along at least a
5 part of said line, and a controller for controlling the light element based upon a signal on the line, e.g. based upon a signal current flowing therein. The light element could for example take the form of an electroluminescent element, e.g. a wire or tape, otherwise known as ELwire or ELtape.

Thus, in one embodiment, the signal line could include a length of
10 electroluminescent wire having a copper core, a phosphor coating about the core, one or more transmission wires around the coating, and one or more protective and/or colour-altering layers, e.g. PVC layers, around the core, coating and wires. The light controller will apply an a.c. signal between the copper core and transmission wire(s) in order to stimulate the phosphor coating
15 and illuminate the line, and may vary the frequency and/or applied voltage to vary the light intensity. Colour may also be varied in some circumstances, e.g. by varying the frequency of the stimulating voltage, and the actual colour of the line may be varied by using a suitably coloured layer about the phosphor coating and wire(s) to filter the light emitted by the phosphors.

20 The controller in this aspect may include an inverter to alter a d.c. power supply to the required a.c. supply. Frequencies of the applied excitation voltage may for example range from e.g. 40 Hz to 8000 kHz, and voltages may include e.g. 50 to 120 V RMS. The d.c. supply may be e.g. a 3, 9 or 12 v supply. Any other suitable values may however also be chosen.

25 Instead of electroluminescent wire, electroluminescent tape or strips could be used. This may be structured as a pair of opposed electrodes between which is a phosphor layer, with one or both of the electrodes transparent/translucent to the phosphor light. The strip may for example be run straight along the outside of a length of a signal line, and, for example, may be
30 of suitable width that it can wrap about the circumference of the line. In another form, the tape may be wrapped helically around the line along its length.

The present invention extends generally to a signal line that is configured to illuminate in response to a signal on the line. It also extends generally to an illuminated line that is configured to illuminate based upon a monitored signal

on the output or input of an electronic device or on a signal line associated with the device.

It should be noted that any of the features mentioned above in relation to any of the above aspects may be combined with any of the other features

5 mentioned above, as appropriate.

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings. It is to be understood that the particularity of the drawings does not supersede the generality of the preceding description of the invention.

10 In the drawings:

Figure 1 is a diagram shows an entertainment system utilising a number of illuminated lines in accordance with various embodiments of the present invention;

15 Figure 2 is a diagram of a musical instrument system utilising illuminated lines in accordance with further embodiments of the present invention;

Figure 3 is a diagram of a games console or computer device utilising illuminated lines in accordance with another embodiment of the present invention;

20 Figure 4 is a schematic drawing of an end of an illuminated line in accordance with one embodiment of the present invention;

Figure 5 is a schematic drawing of an end of an illuminated line in accordance with another embodiment of the present invention;

25 Figure 6 is a schematic drawing of a pair of headphones utilising an illuminated line in accordance with a further embodiment of the present invention;

Figure 7 is a schematic drawing of an end of an illuminated line in accordance with another embodiment of the present invention;

Figures 8a-8j are cross-sectional views of alternative line arrangements;

30 Figure 9 is an end view of a signal line in accordance with another embodiment of the present invention, viewed from an end of the line distal from a controller;

Figure 10 is an end view of a signal line in accordance with a further embodiment of the present invention, viewed from an end of the line distal from a controller; and

Figure 11 is a schematic drawing similar to that of Fig. 4, but showing an embodiment that uses a different form of linear lighting element than a side-emissive light guide.

Figure 1 shows schematically an entertainment system 1, which could be e.g. a hi-fi system, a karaoke machine or the like. The system includes an audio player, e.g. a music player 2, e.g. a CD, DVD, cassette or MP3 player or the like. Attached to the player 2 are peripheral componentry and accessories, such as a microphone 3, a set of loudspeakers 4, and a set of headphones 5.

The componentry/accessories are connected to the music player 2 via a number of electrical signal lines 6 that transmit electrical signals to and/or from the music player 2. The term "signal line" is to be construed broadly, and should be taken to cover for example cables, e.g. audio cables, and to cover long and/or short lengths of cable, cabling, leads and the like.

In accordance with the present invention, one or more of the signal lines 6 are designed to light up based upon the state of the line 6, e.g. based on the signal currents flowing through the lines 6.

Thus, in accordance with an embodiment of the present invention, the lines 6 are provided with side-emissive light guides along all or at least a part of their lengths. These light guides are illuminated by a suitable light source, e.g. one or more LEDs, the LEDs being controlled by suitable controllers.

The lines may be illuminated fully along their lengths, or at separate points along their length, e.g. so as to provide a row of lights of any suitable design, e.g. points of light or short straight lengths of light. This could be achieved e.g. by masking a sheath of the light guide at suitable points, e.g. by using an opaque outer layer or the like with openings of any desired shape.

The signal lines 6 may remain illuminated with a constant light, may be flashed in accordance with one or more preset programmes, and/or may be modulated in accordance with the music played on the player 2 and/or spoken/sung into the microphone 4.

Light activation may be controlled through a central control unit in the player 2 and/or through separate control units associated with each line 6. These control units/controllers could for example be housed in the player 2, in the microphone 3, in the loudspeakers 4 or in the headphones 5, or could be

provided in electrical connections, e.g. jack plugs or other such connections, at the ends of the signal lines 6.

Monitoring of the signals on the lines 6 may either be by tapping directly into signal wires of the lines or may be by a non-contact/non-invasive method e.g. using a capacitive, magnetic or inductive sensor located adjacent to or about the signal wires, or by use of a microphone that picks up a resultant output from a loudspeaker 4 or the like. Generally, the signal wires will be electrical, but the control units may monitor other lines also, e.g. optical fibre signal wires or the like, and may include suitable coupling elements, e.g. to divert a portion of the light or provide a repeater step.

Where the lines 6 are illuminated based on e.g. audio signals or the like transmitted along the lines, the illumination may complement the sound output of the entertainment system 1, and provides a pleasing and interesting light show.

The light on the lines 6 may be modulated by splitting the signal on the line 6 into various frequency components, and modulating the light in the light guides based on the intensity of these frequency components. For example, the intensity of the light, the frequency and/or duration of light pulses and/or the colour (wavelength) of the light in the guides may be varied based on the signal frequencies or the like.

As well as the signal lines 6, the electrical connection 7 between the earpieces 8 of the headphones 5 (across the headband 9) could also be illuminated to again provide an interesting novelty item. A similar arrangement could apply to a signal line between a pair of loudspeakers 4.

Also, as well as illuminating signal lines 6, the system 1 could include an illumination line 10 that does not transmit signals, e.g. is decorative only. This illumination line 10 is adapted to connect with a signal output jack of the player 2, and is illuminated based on a signal output from the jack. Thus, the line 10 includes a light guide, one or more light sources, e.g. a LED or LEDs, one or more light controllers, and a suitable connector. The illumination line 10 can be suitably laid or hung in the environment of the player 2 to provide a pleasing light show. This line 10 could include a jack connector that itself provides a further signal output socket, in a similar manner to that discussed below in relation to Fig. 7, so that a signal line can connect through the line 10 connector

to the device 2. The illuminated line 10 does not then use up the outputs of the device 2, and for example, the connector of line 10 could be provided transparently between the device 2 and any of the signal lines 6 shown in Fig. 1, so that it can monitor any of the input or output signals and can be illuminated accordingly. Indeed, a separate connector with signal monitoring circuitry could be provided to monitor any of the device's inputs or outputs, and could remotely communicate with the light controller of a separate line 10.

The line 10 could also have a non-contact/non-invasive coupling (e.g. capacitive or inductive coupling) that can be placed adjacent or around a signal line 6, so as to monitor the line and allow the light controller to illuminate the line 10 accordingly.

In a further embodiment, as shown in Fig. 2, an illuminated electric line 6 may be a connection lead for a musical instrument 11, such as an electric guitar. It may for example pass signals from a pick-up in the instrument to an amplifier 12 or the like. Again, the signal line 6 would provide a light show that complements the sound output by the amplifier, e.g. by splitting up the signal into component frequencies and modulating the light in the guides based on these frequencies.

The line 6 may be used with other instruments as well, e.g. other stringed instruments, such as violins, or with keyboards or the like. Again, the controller for the light guide lights may be in connectors of the line 6 or in the instrument 11 or amplifier 12.

Also shown in Fig. 2, is a line 10, similar to that in Fig. 1, but provided on the guitar strap 11a. The line 10 may monitor the signal line 6 by e.g. a non-invasive monitoring circuit, e.g. an inductive loop about the signal line 6, or by providing a piggyback connection e.g. in a similar manner to that discussed later in Fig. 7.

Fig. 3 shows another embodiment, in which the illuminated signal lines 6 are used to connect a games controller 13 and keyboard 13a with a games console or computing device 14, and to connect the games console or computing device 14 with a display 15, e.g. a computer monitor or television.

In this case, the lines 6 may be illuminated based on the type of command or action indicated by the games controller 13 or keyboard 13a. For example, the lines 6 may flash when a user fires a weapon or makes a

particular move, e.g. a type of jump or the like, and the lines 6 could also be sensitive to outputs from the games console or computing device, e.g. when the player is determined to have been hit or damaged in the game. In the latter case, there may be a controller in the console or computing device that receives
5 a signal corresponding to the determined condition, or the controller may be in the games controller/paddle 13 and may monitor game feedback signals. Different coloured lights may indicate different actions, and the rate of flashing, or light intensity, or the like may be dependent on the speed of firing or movement or type of action or the like.

10 Again the controllers for controlling the lighting of the lines 6 may be in connectors of the lines 6, instead of in the games controller 13 or keyboard 13a or in the games console 14 or display 15.

The signal lines 6 may also extend to other peripheral devices P, e.g. a line to a storage device or printer or to a communications connection, e.g. a
15 telephone line or network, e.g. Internet, connection. In this case, as well as being merely decorative, the illumination could provide practical information, e.g. a confirmation that information is flowing, and the illumination could vary depending on the speed of data transfer, type of data, its direction or the like.

Generally, the signal lines 6 in any of the above embodiments may have
20 various different configurations depending on their uses, e.g. depending on the signals passing down the lines, the length of the lines and the like.

One construction of an illuminated signal line 6 is shown in Fig. 4. In this embodiment, the line 6 includes a light guide 16 comprising a core 17, e.g. a transparent polymer, a core cladding 18, e.g. a transparent layer of PTFE, and
25 an outer cover 19, e.g. a transparent sleeve of PVC.

The line 6 also includes a jack plug connection 24 that includes a jack plug 25 and a housing 26 in which is provided a LED 27, as an end light source, and controller circuitry including a microprocessor 28 that controls the LED 27. One or more further intermediate light sources, e.g. LED 29, are provided along
30 the length of the light guide 16, and are also controlled by the microprocessor 28.

In this embodiment, the light guide 16 is made by butt coupling a plurality of light guides 16a, 16b together, e.g. through connectors 30 that also house the intermediate LEDs 29.

The line 6 may for example be used with the loudspeakers 4 or headphones 5, and the jack plug 25 may be inserted into a suitable line-out socket on the player 2.

5 Signals output from the player 2 are received by the jack plug 25 and pass along the length of the electric line 6 through positive and negative signal wires 31 that pass through the jack plug housing 26 and along the light guides 16 within the outer cover 19. Suitable electrical connections are provided by the connectors 30. The other end of the line 6 may include a standard jack plug with which the signal wires 31 connect to provide a connection to the
10 loudspeaker 4 or the like. The signal on the wires 31 can be used by the speakers 4 or headphones 5 as usual, and the illuminated lines 6 can be used as a simple and fun replacement for standard cabling, without requiring any modifications to the original systems.

Clearly, the signal line 6 could be installed in reverse also, with the signal
15 monitoring and control jack 25 provided at e.g. the loudspeaker, and a standard jack being provided at e.g. a signal output of device 2.

By providing the wires 31 within the outer cover 19, the wires 31 are protected from damage. Also, the wires 31 need not necessarily be separately insulated, as the outer cover 19 itself may provide the required insulation.

20 The microprocessor 28 taps into the signal wires 31 and monitors the signals on the wires 31. It then outputs suitable signals on a set of leads 32 to power the end LED 27 and a set of leads 33 to power the intermediate LEDs 29. The leads 33 connect with LED control wires 34 that extend along the length of the light guide 16 again within the outer cover 19 and through suitable
25 connections in the connectors 30. The control wires 34 are on the opposite side of the guide 16 to the signal wires 31, and this may assist in reducing interference effects. The control wires 34 connect with the power leads 35 of the intermediate LEDs 29 through suitable connections in the connector 30.

The LEDs 27 and 29 and the microprocessor 28 may be powered by
30 batteries 36. The high efficiency of the LEDs 27 and 29 means that the batteries 36 will last a long time before requiring replacement. Mains power could also be used, with suitable transformer circuitry, and e.g. the batteries 36 may be replaced or augmented by a mains power connection or some other external power source connection. Also, if power is transmitted along the signal

line 6, e.g. phantom power, then the microprocessor and LEDs may tap into this. In another possibility, the jack plug connection 24 may include a second (power) jack (shown in phantom as jack 25a) parallel to the signal jack 25 that may couple with a power output from the device 2 at the same time as the
5 signal jack 25 couples with a signal output. Thus, the device 2 may be configured to include a pair of signal and power outputs configured to receive such a dual jack connection.

The microcontroller 28 will control the signals on the leads 32 and 33 so as to illuminate the LEDs 27 and 29 in any suitable manner, e.g. in accordance
10 with one or more procedures stored in the memory of the microprocessor 28. Thus, the LEDs 27 and 29 may be flashed/pulsed, and may have the durations of the flashes, the intervals between the flashes and/or the flash intensities controlled based on the various characteristics of the signals on lines 31.

For example, the microprocessor 28 may split the signal on the lines 31
15 into various frequency components, and may modulate the LEDs 27 and 29 based on these frequency components, e.g. based on their intensities.

The LEDs 27 and 29 may be controlled in the same manner, or may be controlled differently. For example, the LED 27 could be controlled based on treble signals, whilst the LED 29 could be controlled based on bass signals, or
20 vice versa.

The LEDs 27 and 29 may be of the same or different kinds, and e.g. could be of the same or different colours.

The above construction may be modified as required so as to provide an electric line 6 for the microphone 3. In this case, for example, the
25 microprocessor 28 could be in the body of the microphone 3 with a standard jack at the opposite end of the line 6.

The construction may also be modified to provide the line 6 between the guitar 11 and amplifier 12 of Fig. 2, or the lines 6 of Fig. 3 associated with the games console or computing device 14.

30 Where the line 6 is used with the games console 14, the microprocessor 28 may determine which controls of the games controller 13 have been hit, and may modulate the LEDs 27 and 29 based on the associated action, e.g. it may flash based on a weapon fired or a player move, such as a jump, or the like. If there is feedback to the controller 13, then it may light the LEDs 27 and 29

based on a hit on the player or the like. Where the line 6 is used with a computing device, the microprocessor 28 may monitor the speed of data transfer or the type of data transferred or the direction of data transfer, and change the illumination accordingly.

5 The microprocessor housing, e.g. socket connection 26 may include an interface for altering the microprocessor control, e.g. by changing between a number of modulation procedures stored in the microprocessor 28 and/or by changing the sensitivity of the microprocessor 28 to the signals on the lines 31 or the like.

10 The interface may be in the form of buttons, switches or knobs or the like, 28a, mounted on the jack plug connection 24. These may then be pressed or actuated so as to change to a different preset illumination regime or the like. The interface may also be achieved by remote control. This may for example allow a sound or lighting person at a stage show or the like to alter the manner
15 of illumination of lines on a stage or the like. A person on the stage may also have a remote controller to alter the illuminations, e.g. a guitarist may have a pedal or the like to change the lighting on their guitar strap. Remote control may occur through e.g. an infrared or radio link, and could use any suitable protocol, e.g. Bluetooth™ or the like.

20 The design of Fig. 4 may also be modified to provide the illumination line 10 by removing the electric signal lines 31, so that the jack 25 merely provides a signal to the microprocessor 28, which then illuminates the LEDs 27 and 29 appropriately.

 The light guide 16 may take any other suitable form. It should however
25 be suitably flexible for the task in hand. In one preferred embodiment, the light guide 16 may be a "super side light" as made by Poly Optic Australia Pty Ltd.

 Other light guide constructions are also possible, e.g. a liquid core surrounded by a PVC sheath and plugged by quartz crystals. The liquid core could for example be a saline solution.

30 The wires 31 and 34 need not be in the outer cover 19, but could be in the core 17 or in the cladding 18, or completely outside of the guide 16 and affixed to it along its length. They may be adjacent each other, or may be spaced apart. In one possible embodiment, the wires may run centrally within the line 6, and may be surrounded by a light guide 16 of annular cross-section.

A light source, such as a ring of LEDs may be provided in the annular guide tube to provide illumination about the whole of the guide.

In one embodiment, the guide 16 has only two light units, one at each end of the guide. Thus, LED 29 in Fig. 4 may be reversed in orientation and provided at the far end of the guide 16, so as to face the LED 27. This then provides a light guide with a LED at each end. The LEDs may be modulated either together or independently to provide a number of pleasing light patterns. If of different colours, the light from the two LEDs will blend together in the intermediate section of guide 16.

The use of LEDs 29 intermediate the ends of the guide 16 helps to ensure uniform light distribution along the guide and facilitates the use of long lengths of guide without loss of illumination quality. It may also allow for added effects, e.g. if the intermediate units are activated in sequence, they may simulate a light running the length of the line.

Fig. 5 shows another embodiment of the electric line 6 having a number of variations on the Fig. 4 design. Similar features are given the same reference numerals as in Fig. 4.

The line 6 of Fig. 5 again includes a light guide 16, LEDs 27 and 29, and a microprocessor controller 28, but in this case, the signal connector is a pair of RCA plugs 37 for providing e.g. stereo sound. Accordingly, there will be four signal wires 31 extending along the length of the light guide 16, so as to provide two signal channels, each having a positive and negative wire.

Also, instead of using a number of LEDs 29 that face in the same direction along the light guide 16, each connector 30 includes two LEDs 29a, 29b, which face in opposite directions. This can then provide sections of the light guide that have opposing LEDs at each end (e.g. the section between the end LED 27 and the first intermediate LED 29a), the light of the two LEDs can blend together in that section to provide pleasing light effects. The use of two LEDs 29a, 29b at each LED location also means that the LED locations can be spaced further apart without problems with dimming of the light along the guide 16. This can simplify construction and also wiring connections.

If all of the LEDs 29a, 29b were to be controlled in the same manner, then the single pair of control wires 34 of Fig. 4 could be used to control them. However, in the present embodiment, the LEDs 29a are controlled in

accordance with one of the signal channels, and the LEDs 29b (and LED 27) are controlled in accordance with the other signal channel. This requires the use of two pairs of LED control lines 34, connected to two pairs of control leads 33 from the microprocessor 28, one for each channel.

- 5 In either of the above embodiments, instead of providing the controller circuitry, e.g. the microprocessor 28, in the electric line 6 itself, the circuitry may be built into a device with which the line 6 is associated.

Thus, as shown in Fig.6, a set of headphones 5 may house the microprocessor 28 and battery 36 in one of the earpieces 8. The jack plug
10 connector 24 may then be a standard jack plug, and the rest of the system may take the form of either of the above embodiments of Figs. 4 or 5. In the line 6 shown, the stereo wires 31 are shown split into two pairs on opposing sides of the guide 16, and the line 6 uses only the end LED 27, so that no intermediate LEDs 29 or associated control wires 34 are required. The end 38 of the guide
15 16 distal from the LED 27 may be mirrored to reflect light back along the guide 16.

The microprocessor 28 could also control a light guide and associated LED or LEDs for an illuminated electrical connection 7 between the earpieces 8 across the headband 9, as shown in Fig. 1. As the light guide will be relatively
20 short, a single LED may be used, or a pair of LEDs could be used, one at each end of the guide, to provide for extra illumination patterns. The illuminated line between the earpieces 8 need not be the electrical connection 7, but could be a non-signal line extending over the headband 9.

Fig. 7 shows another embodiment of an illuminated electric line 6, which
25 is constructed from an attachment 39 that includes the light guide 16 and a connector 40, and a standard electric cable 41, e.g. a guitar cable as shown in Fig. 2.

The connector 40 has both a jack plug 42 and a jack socket 43. The jack plug 42 fits into the input socket of e.g. a guitar amplifier 12, as shown in Fig. 2,
30 and the jack plug 44 of the standard guitar cable 41 can fit into the jack socket 43 of the attachment, in a piggyback or chained manner. Thus, the standard signals from the guitar pick-up will pass along the cable 41 and into the amplifier 12, whilst the microprocessor 28 will tap into the signals and control the LEDs 27, 29a, 29b in the light guide 16 accordingly.

The light guide 16 and cable 41 are connected together along their lengths by one or more clips 45 that may be e.g. a snap-fit over the cable 41. The clips 45 may also provide a mounting for the LEDs 29a, 29b, and a connection between light guide sections 16a and 16b. The clips 45 may have a
5 circular portion as the light guide coupling and a C-clip portion for connecting to the signal cable 41.

The microprocessor 28 and LEDs 27, 29a, 29b can be powered by batteries 36 as above, and/or may be powered by a mains supply through a suitable adaptor 46. Alternatively, power may be received from the device with
10 which the line connects, e.g. through a power jack 42a (shown in phantom) that is parallel to the signal jack 42, and connects with a power outlet of the associated device at the same time as the signal jack 42 connects with the signal outlet.

As can be seen, the light guide 16 includes the LED control wires 34, but
15 not the signal wires 31, as the cable 41 provides the electrical connection.

This attachment configuration can also be applied to any of the electric lines 6 of Fig. 1 or Fig. 3, although in some of these cases, signals will be passing in the opposite direction, that is from the jack 44 along the cable 41 to an associated device. Also, the non-signal line 10 in Fig. 1 could be formed of
20 the guide 16 of attachment 39 without needing the clipping to the signal line 41, so that the guide 16 may extend freely and/or include other connectors to facilitate suitable anchoring of the line 10. This would allow use of a line 10 without using up any of the device 2 output sockets, and would also allow the line 10 to be used with input signal lines to the device 2.

25 The attachment configuration could also be used to provide the guitar strap illumination of Fig. 2.

As well as those lines discussed above, various other line arrangements are possible. Figs. 8a-8j show cross-sections through a number of such arrangements.

30 Thus, Figs 8a-8f show light guides 16 of a core 17 and cladding 18 only, with positive and negative signal wires 31a, 31b at various possible locations, e.g. in the core 17, in the cladding 18, or outside the guide 16, and together or spaced apart. They also show that none, one or both of the wires 31a, 31b may

be insulated or not, e.g. depending on the core and cladding materials and on the signals supplied.

Figs. 8g-8i show light guides 16 having a core 17, cladding 18 and protective jacket 19, with the wires 31 in the protective jacket 19, the jacket 19 providing the insulation for the wires 31. Fig. 8g shows a stereo line with two pairs of wires 31a, 31b, one for each stereo channel.

Fig. 8j shows a line 6 that includes two light guides 16a, 16b running parallel to one another, and connected together by clips or adhesive or the like. In this particular example, the signal wires 31a, 31b are insulated and are provided outside of the guides 16a, 16b at the junction between the two.

Figs. 9 and 10 show end views of two further illuminated line embodiments. In these embodiments, the lines 6 have light sources at both of their ends, with a controller, e.g. the microprocessor 28 of the above embodiments, adjacent one of the light sources, and with LED control wires extending along the line to the other light source. The view in the two drawings is of the end of the line that is distal from the microprocessor.

As can be seen in Fig. 9, the light source in this case comprises four separate LEDs 47a-47d, each of which has leads 48a-48d that connect with its own dedicated pair of control wires 34, the control wires 34 being bunched together and mounted within the outer jacket 19 of the guide 16. The LEDs 47a-47d may be mounted in a suitable coupling unit (not shown) to allow them to butt up against a polished face of the core 17, and the signal wires 31 are also mounted in the jacket 19, opposite to the control wires 34.

Thus, each LED 47a-47d can be controlled independently of the others by the microprocessor 28. The LEDs 47a-47d may be of different colours from one another, and the light guide 16 may be lit by one of the LEDs at a time, or by two or more of the LEDs simultaneously, to provide a number of possible illumination colours.

Fig. 10 shows the end of a line 6 that includes a pair of parallel light guides, with one LED 49a, 49b at the end of each of the guides. The pair of light guides and LEDs are housed within a single protective jacket 19, and the signal wires 31 and LED control wires 34 run within the jacket 19 in the thick portion of the jacket 19 between the two guides. Again, the two LEDs 49a, 49b are controlled independently.

Various modifications can be made to the various embodiments above. For example, it would be possible to have a light source at one end of the light guide only, and e.g. a reflector, such as a silvered mirror, at the other end. In this case, only one controller and no control wires are required.

5 Other light sources would also be possible, e.g. laser diodes, small incandescent bulbs or the like.

The core, cladding and covering materials could be formed of any other suitable materials.

Each light source could also comprise more than one LED, so that two or
10 more LEDs could be mounted in one end of a light guide.

The above signal lines will generally transmit analogue signal. It would however also be possible to transmit digital signals, in which case the LEDs could be modulated based on the speed of data transfer or amount of data or the like, and/or the controller could decode the signals to determine the signals
15 passed, and could then modulate the LEDs based on the data obtained from the decoding.

The LED controller may tap into the signal lines in any suitable manner, including using non-contact sensors, such as magnetic, inductive or capacitive sensors, or could include a microphone for detecting sounds produced by the
20 device receiving the signals.

Although the signal lines will generally be electrical lines, they could also take other forms, e.g. they could be fibre optic lines, in which case the LED controller would need to split off a portion of the signal light or act as a repeater.

The light guides need not extend the full length of the lines. They could
25 also be shielded at various points to define locations where light may or may not escape, and so provide a row of lights or the like.

The signal lines 6 may be used in many different applications including audio lines, data lines and the like, and e.g. may be used with telephone lines.

As well as using light guides, it would also be possible to use other forms
30 of illumination. For example, another form of linear lighting element that could be used would be electroluminescent cables or tapes.

Fig. 11 shows a schematic diagram of a further embodiment of the present invention that uses electroluminescent wire to provide an illuminated

signal line. The arrangement is similar to that in Fig. 4, and like features are given the same reference numerals.

Thus, the signal line 6 includes the jack connection 24, jack 25, housing 26, controller 28, control interface 28a, battery 36 and also the signal wires 31.

5 However, in place of the light guide 16, the signal line 6 utilises an electroluminescent wire 50 to light up the line 6.

The electroluminescent wire 50 is formed from a central copper core 51 that is coated in phosphors, a connection line 52 for connecting the copper core 51 with the controller 28, a pair of transmitter wires 53 that are connected
10 together and that wrap around the phosphor coating along the length of the core 51, a vinyl protective layer 54 and an outer protective layer 55. The signal wires 31 may conveniently run in the outer layer 55, as shown, or in the inner layer 54 or between the two layers.

When an a.c. current is applied between the connection line 52 and the
15 transmitter wires 53, the phosphors emit light and illuminate the signal line 6. The illumination colour may be determined by the phosphors or by suitable coloration of the vinyl layers 54 or 55. Alteration of the frequency of the a.c. signal may also vary the colour in some situations, and intensity may be varied by varying the frequency and also the voltage of the applied a.c. current.

20 Thus, the controller 28 can control the applied voltage and frequency of the a.c. current to control the illumination of the line 6. In order to provide the a.c. current, the controller 28 may include an inverter therein, or may control a separate inverter provided between the controller 28 and the electroluminescent wire 50. The inverter may receive d.c. power from the batteries 36 or from a
25 separate external source, and convert it to the desired frequency and voltage ranges.

As an alternative to the above arrangement, the electroluminescent wire could be replaced by electroluminescent tape comprising a length of phosphor mounted between a pair of elongate electrodes, at least one of which is
30 translucent/transparent to allow light from the phosphors to escape. The controller 28 may apply a suitable a.c. voltage across the two electrodes, and the tape may be wrapped helically around a signal cable that houses the signal wires 31.

These electroluminescent elements may be utilised in any of the light guide embodiments discussed above.

It is to be understood that various alterations, additions and/or modifications may be made to the parts previously described without departing
5 from the ambit of the present invention, and that, in the light of the above teachings, the present invention may be implemented in a variety of manners as would be understood by a person skilled in the art.

Claims

1. A signal line, the line including a side-emissive light guide extending along at least a part of said line, a light source for illuminating the
5 light guide, and a controller for controlling the light source based upon a signal on the line.
2. The line of claim 1, wherein the line is an audio line.
- 10 3. The line of claim 2, wherein the line includes a connection for coupling with an audio-out or an audio-in connection of an audio device.
4. The line of claim 2 or 3, wherein the controller splits the audio signal into separate frequency components, and modulates the light source
15 based on the detected frequency components.
5. The line of claim 1, wherein the line is a data line.
6. The line any preceding claim, wherein the controller controls the
20 light source in accordance with a preset program.
7. The line of any preceding claim, wherein the controller controls the light source based on variations in a signal on the line.
- 25 8. The line of any preceding claim, wherein the controller modulates the light source so as to produce any one or more of a change of light intensity, pulse interval and/or duration and/or light colour.
9. The line of any preceding claim, wherein the controller detects a
30 signal on the line via an electrical connection.
10. The line of any of claims 1 to 8, wherein the controller detects a signal on the line through a non-contact detector.

11. The line of any preceding claim, wherein signal wires are provided along the line.

12. The line of claim 11, wherein the signal wires are provided within
5 the light guide.

13. The line of any preceding claim, including two light sources, one at each end of said guide.

10 14. The line of any preceding claim, including one or more intermediate light sources spaced along the length of the light guide.

15 15. The line of any preceding claim, including at least two light sources that emit light of different colour from one another.

16. The line of any preceding claim, including at least two light sources controlled independently of one another.

17. The line of claim 16, wherein one light source is modulated
20 dependent on bass sounds, and another is modulated based on treble sounds.

18. The line of any preceding claim, including control lines that extend along the light guide for controlling the illumination of one or more light sources remote from the controller.
25

19. The line of any preceding claim, wherein said controller includes a microprocessor.

20. The line of any preceding claim, wherein a said light source
30 includes an LED.

21. The line of any preceding claim, wherein said light guide includes a flexible polymer core within a flexible outer cladding.

22. The line of any one of claims 1 to 20, wherein said light guide includes a liquid core and an outer sheath.

23. The line of any preceding claim, including two or more light guides
5 and associated light sources.

24. The line of any preceding claim, including an electric cable and a light guide attachment, the attachment including the light guide, the light source, the controller, and an electrical adaptor for receiving an electrical connector on
10 one end of the electric cable and for providing a connection to a device with which the line is to be associated.

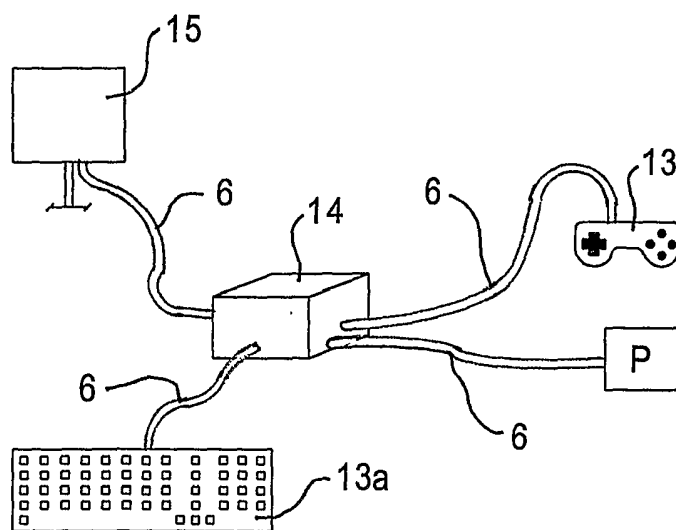
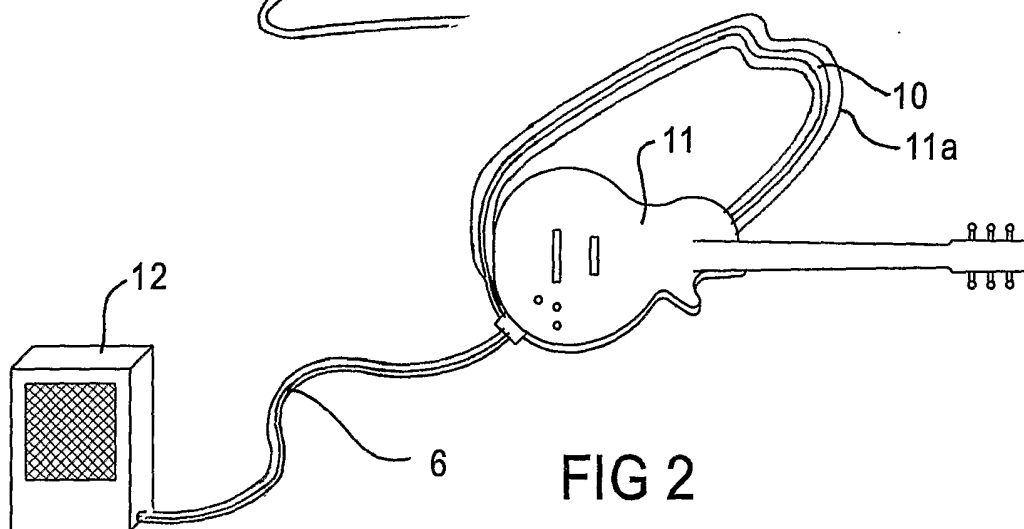
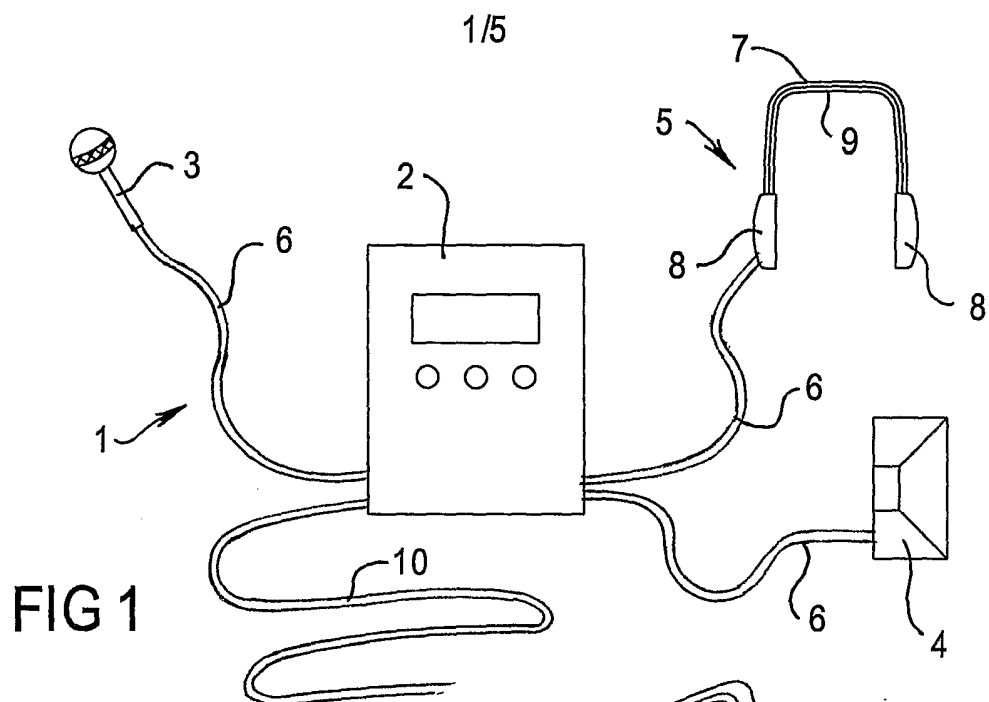
25. The line of any one of claims 1 to 23, wherein the line is integral with an electrical device, and wherein the controller is provided in said device.
15

26. An attachment for a signal cable, the attachment including a side-emissive light guide illuminated by one or more light sources, and a controller for monitoring the signal on the cable and for controlling the light source or sources based on the signal.
20

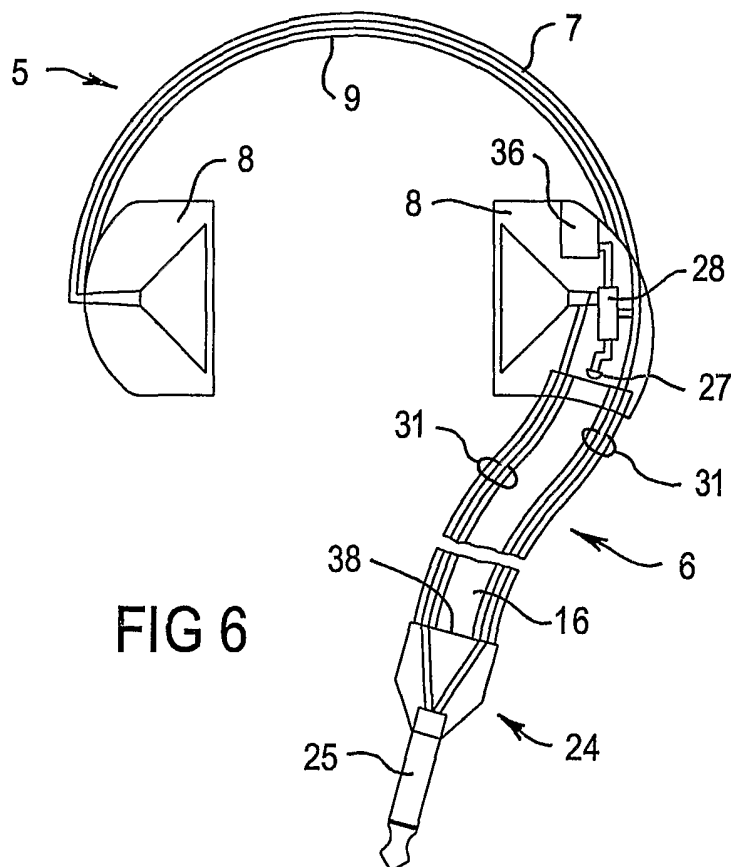
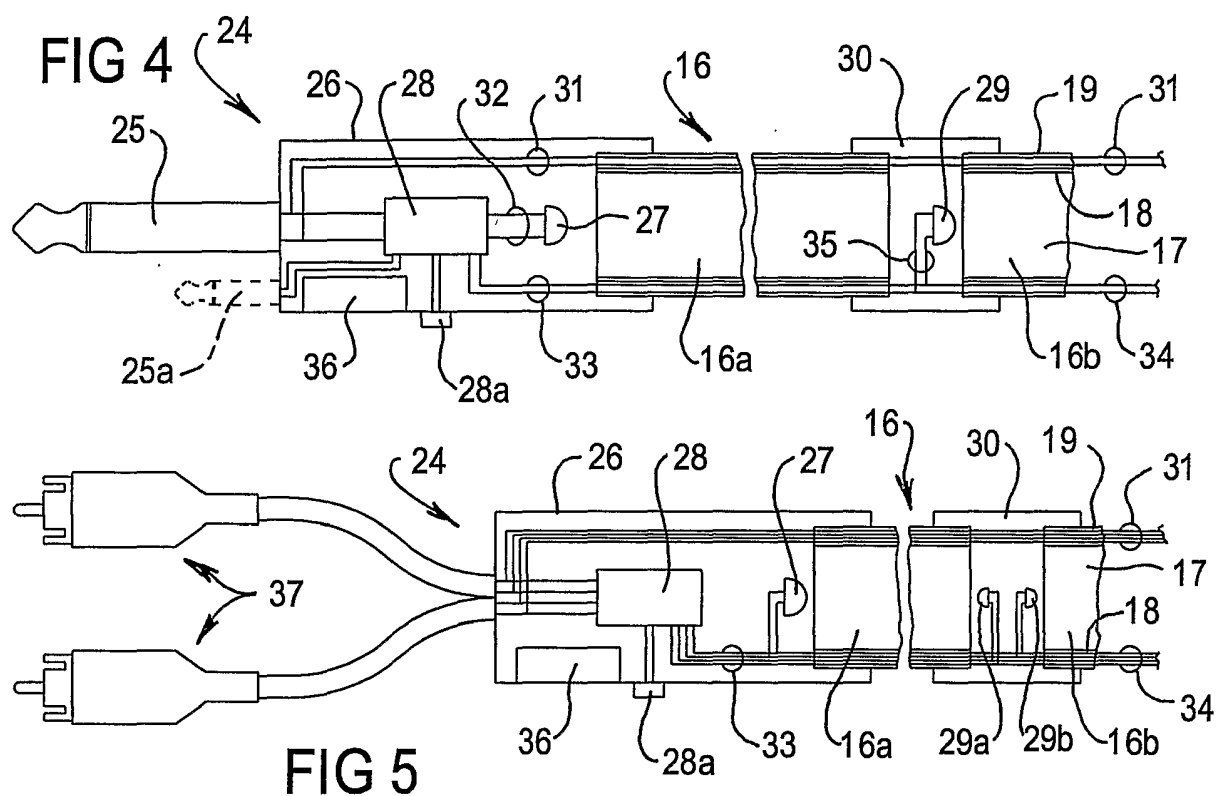
27. A connector for mounting a signal cable and light guide, the connector including a connection for coupling with the cable, a connection for coupling with an external connection that said cable is to couple with, a connection for said light guide, and a controller for detecting the signal on said
25 cable and for controlling a light source to light said light guide based on said detected signal.

28. An electrical device including a signal line, the line including a side-emissive light guide extending along at least a part of said line, the device
30 including a light source for illuminating said light guide and a controller for controlling the light source based on the state of said line.

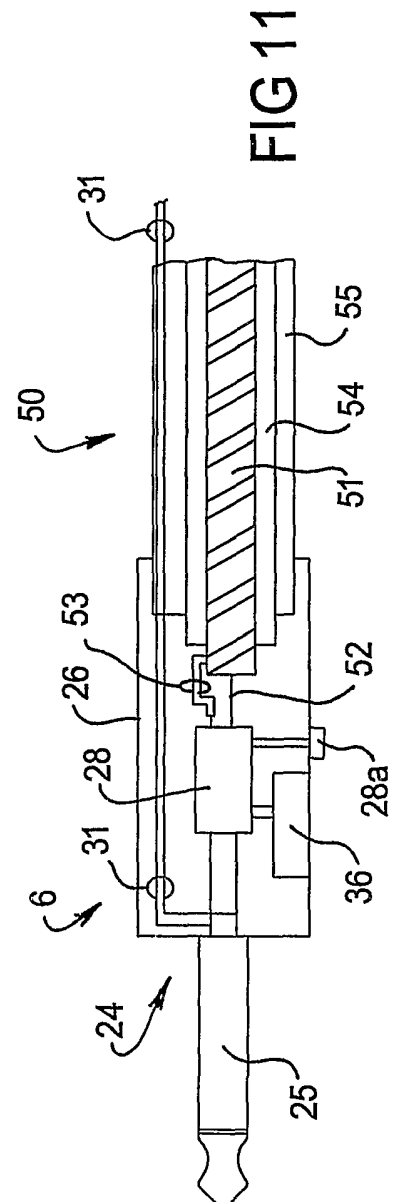
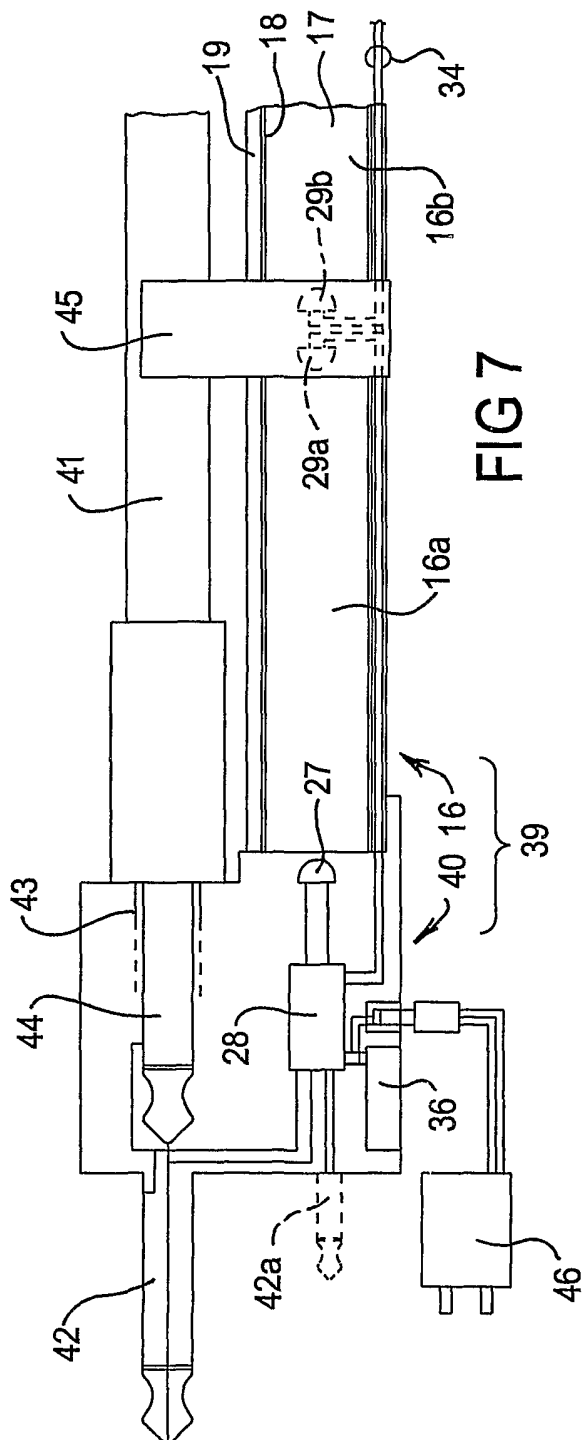
29. An audio signal line for transmitting signals therealong, the line including a side-emissive light guide extending along at least a part of said line,

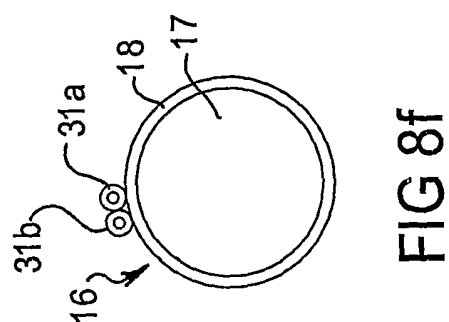
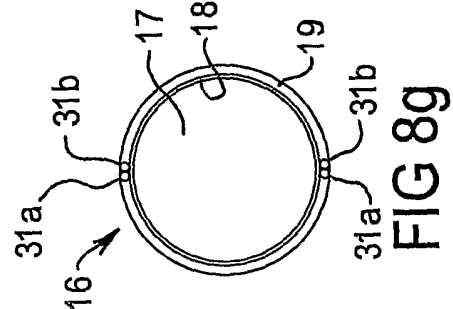
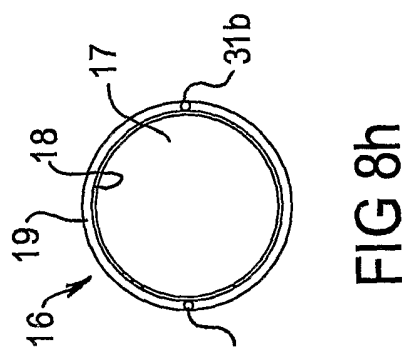
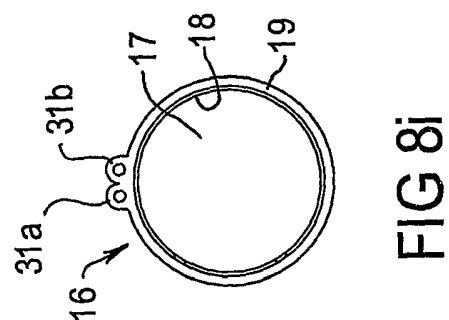
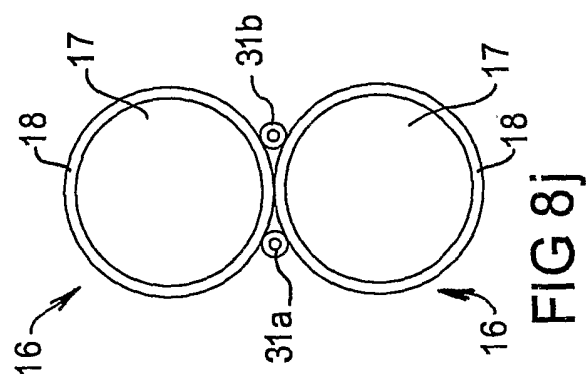
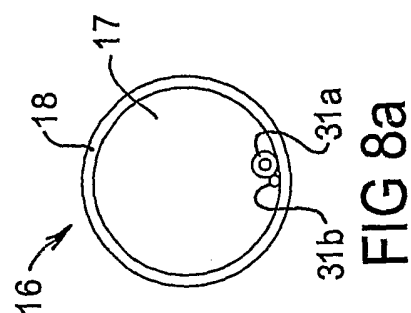
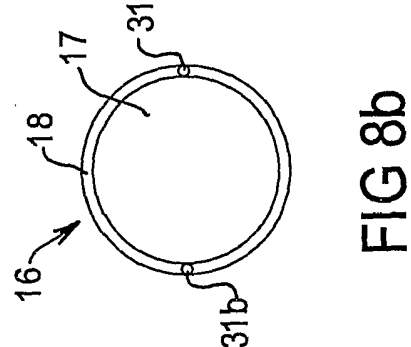
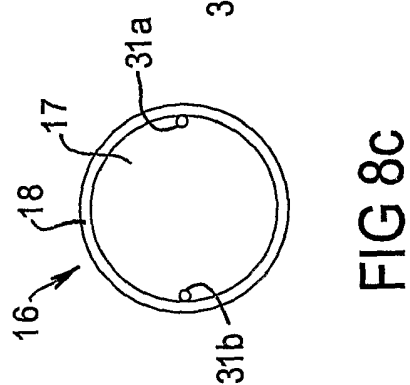
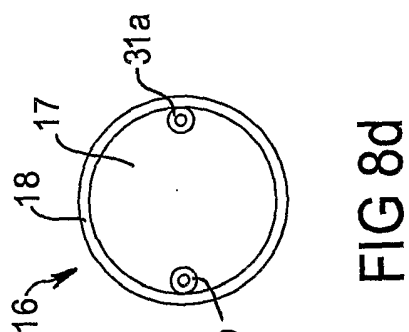
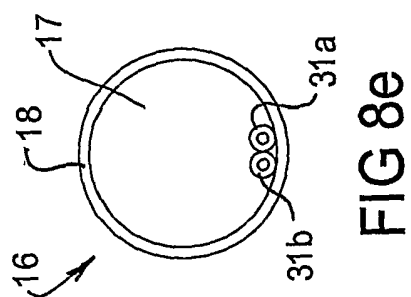


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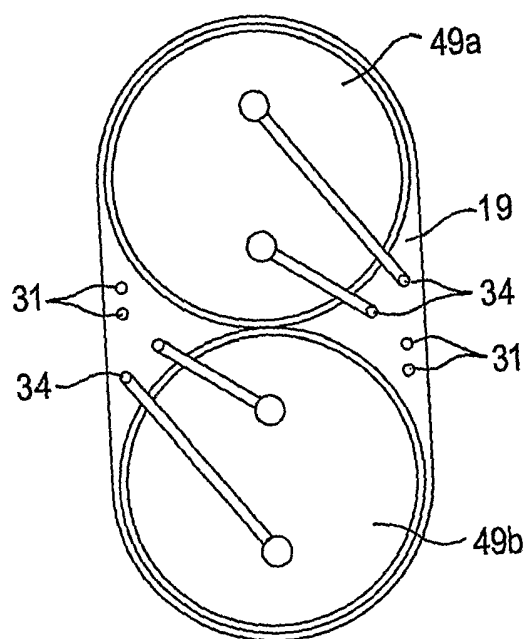
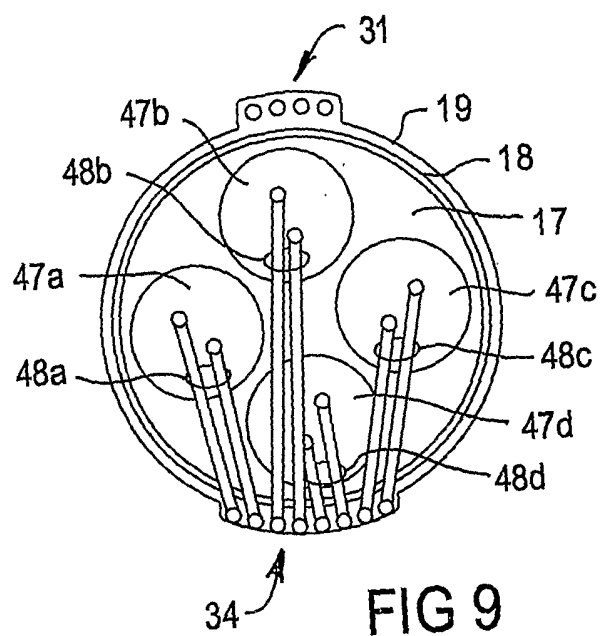


FIG 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2004/001664

A. CLASSIFICATION OF SUBJECT MATTER												
Int. Cl. ⁷ : F21V 33/00												
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)												
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)												
DWPI: line, side, light, audio, audio, modulation and similar terms												
C. DOCUMENTS CONSIDERED TO BE RELEVANT												
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.										
X	JP 2000-195682 A (KUROKAWA et al) 14 July 2000 paragraphs 5-7 of online machine translation retrieved from http://www4.ipdl.ncipi.go.jp on 9 February 2004 figures 1-3	1-3, 5-16, 18-32, 34-37										
☐ Further documents are listed in the continuation of Box C ☒ See patent family annex												
* Special categories of cited documents: <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"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</td> </tr> <tr> <td>"E" earlier application or patent but published on or after the international filing date</td> <td>"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</td> </tr> <tr> <td>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"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</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance	"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	"E" earlier application or patent but published on or after the international filing date	"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	"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"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	"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	"P" document published prior to the international filing date but later than the priority date claimed	
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"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family											
"P" document published prior to the international filing date but later than the priority date claimed												
Date of the actual completion of the international search 9 February 2005		Date of mailing of the international search report 17 FEB 2005										
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929		Authorized officer GREG POWELL Telephone No : (02) 6283 2308										

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2004/001664

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 33
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
There is no claim 33.
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2004/001664

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member
JP	2000195682	NONE
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.		
END OF ANNEX		