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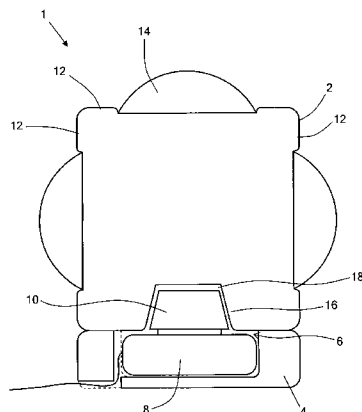


Fig 2

(57) Abstract: Disclosed is a data input device for providing a plurality of input signals responsive to user actions, comprising a resilient body and one or more sensors within the resilient body, which typically has a shape defining one or more modes of deformation, operable to provide the input signals responsive to deformation of the resilient body, by the actions of a user by virtue of the forces transmitted through the resilient body to the one or more sensors. By providing a deformable resilient body, typically defining one or more modes of deformation, only a subset of the plurality of input signals respond significantly to the deformation (typically to degree of deformation), a user lacking fine motor skills is able to better control a plurality of input signals.



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1 Data Input Device and Sound Generating Device

2
3 Field of the invention

4
5 The present invention relates to the field of data input devices and sound generating
6 devices including data input devices.

7
8 Background to the invention

9
10 Issues concerning data input devices according to the present invention will now be
11 discussed with reference to the application of providing sound generating devices
12 which respond to user actions. However, data input devices according to the
13 invention are applicable to a range of other applications where it is necessary to
14 simultaneously provide multiple input signals, each input signal having a value from a
15 range of possible values.

16
17 Commercially available data input devices for computers or other electronic devices
18 are typically designed to function according to the requirements of an average human
19 user conducting common data input tasks. Therefore, the great majority commercially
20 available data input devices are adapted for use by individuals having normal levels
21 of motor control, cognitive ability and/or sensory perception. Consequently, such
22 devices may be unsatisfactory for use by persons with levels of sensory impairment,

1 or whose cognitive abilities fall outside of the normal ranges found in the adult
2 population.

3
4 For example, particularly young children, or special needs children and adults may
5 have lower levels of motor control than an average adult. Consequently, data input
6 devices typically function with greater sensitivity and resolution than such individuals
7 are able to exert. Indeed, the fundamental size and shape of conventional user
8 interface devices (such as computer mice, keyboards, touch screens, tracker balls
9 and the like) may be unsuitable for use by persons with sensory or cognitive
10 impairments.

11
12 For example, it is well known in the fields of special needs education and therapy that
13 music and/or light provides a powerful means of interacting with, stimulating and
14 teaching children and adults. Most electronic or conventional musical instruments are
15 far too complex to operate to provide a satisfactory experience for special needs
16 children and adults. Although a number of computer software packages provide
17 simplified interfaces with which to interact (which might provide interactive musical
18 and/or visual responses to data input), the use of these interfaces necessarily
19 requires the use of one or more conventional data input devices, and these devices
20 are optimised for use by normal adults. Consequently, the utility and effectiveness of
21 the software packages and teaching or therapy strategies may be compromised by
22 the data input device.

23
24 Data input devices are, in addition, not typically designed for use by persons having
25 particular sensory impairments, such as blindness or deafness, or a combination of
26 sensory impairments. The balance of sensory feedback from and sensory input to
27 data input devices required by these individuals may differ substantially from those of
28 the normal adult population. For example, a visually impaired person will be unable or
29 less able to perceive visual feedback from data input devices (such as portions of a
30 device which light up), whereas they might benefit greatly from additional textural
31 feedback (for example surface finish, variety of materials used) than are available
32 from conventional user interface devices.

33
34 Thus, there remains a need for user interface devices adapted for use by individuals
35 having impaired motor control, cognitive ability, or one or more sensory impairments.

Summary of the invention

According to a first aspect of the present invention there is provided a data input device for providing a plurality of input signals responsive to user actions, each said input signal having a value from a range of possible values, the data input device comprising a resilient body and one or more sensors within the resilient body, which one or more sensors are operable to provide the input signals responsive to deformation of the resilient body by the actions of a user by virtue of the forces transmitted through the resilient body to the one or more sensors.

The resilient body preferably has a shape selected to define a plurality of modes of deformation to which at least one of the input signals is responsive. For example, the resilient body may have a shape selected to define a plurality of modes of deformation including one or more of; compression of one or more faces or structures, twisting of one or more faces or structures, and tilting of one or more faces or structures. Preferably, the at least one of the input signals are responsive to the degree of deformation of the resilient body according to one or more of the plurality of modes of deformation.

Preferably, the resilient body has a shape selected to define one or more modes of deformation which are selected such that, when the shape is deformed according to a respective mode of deformation, only a subset of the said plurality of input signals respond significantly to the deformation (typically to the degree of deformation). Preferably, when the shape is deformed according to one or more of the modes of deformation, at most half of the said plurality of input signals change responsive to the deformation (typically to the degree of deformation). Preferably, the said plurality of input signals comprises at least six input signals and, when the shape is deformed according to any one of a plurality of said modes of deformation, at most three of the input signals vary significantly with deformation (typically with the degree of deformation).

Although sensitive sensors providing multiple outputs with multiple independent degrees of freedom are available and are useful for enabling a user to control a plurality of input signals (for example, three-dimensional joysticks), the relatively large number of degrees of freedom can make some such devices difficult to control carefully. For example, fine motor skills are required to vary only one output of a three-dimensional joystick providing six degrees of freedom. Whereas, by providing

1 a resilient body defining one or more modes of deformation selected such that when
2 the shape is deformed according to one of the respective modes of deformation, only
3 a subset of the plurality of input signals respond significantly to the deformation
4 (typically to degree of deformation), a user lacking fine motor skills is able to better
5 control a plurality of input signals.

6
7 The resilient body may have a shape selected to define more modes of deformation
8 to which at least one of the input signals are responsive than the number of
9 independent degrees of freedom of the one or more sensors. The resilient body may
10 have a shape selected to define fewer, or the same number of, modes of deformation
11 to which at least one of the input sensors are responsive, than the number of
12 independent degrees of freedom of the one or more sensors.

13
14 The resilient body may be adapted to provide a user with a plurality of affordances to
15 which at least one of the input signals are responsive. The plurality of affordances
16 may be greater than the number of independent degrees of freedom of the one or
17 more sensors. In some embodiments, the plurality of affordances is less than, or
18 equal to, the number of independent degrees of freedom of the one or more sensors.

19
20 The resilient body is preferably generally in the form of a convex polyhedron having a
21 plurality of faces. For example, the resilient body may be generally in the form of a
22 cube, cuboid, tetrahedron, hexahedron or octahedron.

23
24 A data input device having a resilient body is operable to provide to a user a direct
25 and perceivable relationship between deformation and input signal. For example, the
26 input signal may be input to a device for generating sound such, such that the user is
27 provided with a direct and perceivable relationship between deformation and the
28 sound.

29
30 One or more of the said plurality of faces may comprise a protrusion. The protrusion
31 may be rounded. By providing a protrusion from a face of a polygonal resilient body,
32 the possibility of pressing the protrusion, and thereby deforming the resilient body, is
33 suggested to a user. The or each said protrusion preferably meets the face from
34 which it protrudes at an acute angle, which is preferably less than 75° and more
35 preferably less than 60°. For example, the or each protrusion may be generally in the
36 form of a hemisphere. The or each protrusion may be generally in the form of a
37 spherical cap (by spherical cap we mean the region of a sphere which lies above (or

below) a given plane) which meets the face from which it protrudes at an angle of less than 75° or, preferably, less than 60°. This configuration communicates to a user the possibility of pressing the protrusion.

In alternative embodiments, the resilient body is a geometric shape, such as a sphere, spheroid, or a cylinder and may be provided with a structure, such as a protrusion, or a plurality of structures positioned to suggest the possibility of pressing, or otherwise deforming, the or each protrusion or structure to a user.

The or each protrusion, or structure, may have the same, or a different elastic modulus to the resilient body or to each other. The or each protrusion may be formed from the same, or a different material to the resilient body or to each other and may, for example have a different surface texture to the resilient body, or to each other.

In order to provide input signals by virtue of forces transmitted through the resilient body, some or all of the one or more sensors may be sensitive to motion. By sensitive to motion we include force sensors and strain gauges having a part which moves in use in response to an applied force, even if only on a microscopic scale. For example, some or all of the one or more sensors may comprises a reference member and a force receiving member for receiving forces transmitted through the resilient body, and provide the one or more input signals responsive to movement of the force receiving member relative to the reference member. One or more said sensors may provide input signals responsive to twisting, tilting, or lateral displacement of the force receiving member relative to the reference member. The reference member may, for example, be a sensor body. However, it may be that the reference member and force receiving member are equivalent to each other.

The resilient body may comprise a sensor supporting member, for example a base, which has a higher elastic modulus than the resilient body. The body of the sensor may be mounted to the sensor supporting member. The sensor supporting member may, for example, be substantially rigid, or may be resilient, but with a substantially higher elastic modulus than the resilient body. By providing a sensor supporting member with a higher elastic modulus than the resilient body a relatively stable portion is provided, facilitating the measurement of relative movements. The sensor supporting member may be adapted for fixing to an object, such as an item of furniture, wall, the ground etc. The invention extends to an item of furniture, such as a chair or table, having the data input device fixed thereto.

1
2 Preferably, the resilient body is formed and arranged such that, in respect of one or
3 more modes of deformation of the resilient body to which one or more of the input
4 signals is responsive, the movement of the resilient body is greater than, or
5 preferably at least three times, or more preferably at least ten times, or more
6 preferably at least one hundred, times the corresponding movement in a force
7 receiving member of one or more sensors which provide the input signals responsive
8 to the respective deformation. Thus, compact sensors can be employed while
9 providing a data input device which is responsive to relatively large deformations.
10 This is especially helpful when providing data input devices for use by children and
11 individuals with special needs.

12
13 The one or more sensors may comprise or consist of a sensor having a reference
14 member and a force receiving member, which sensor provides a plurality of signals
15 which respond to movement of the force receiving member, relative to the reference
16 member, in at least two, and typically three, independent axes. For example, the
17 sensor may provide a plurality of signals which are indicative of the displacement of
18 the force receiving member relative to the base in each of three orthogonal axes.

19
20 The one or more sensors may comprise or consist of a sensor having a reference
21 member and a force receiving member, which sensor provides a plurality of signals
22 which respond (typically independently) to rotation of the force receiving member,
23 relative to the reference member, in at least two, and typically three, independent
24 axes. For example, the sensor may provide a plurality of signals which are indicative
25 of the rotation of the force receiving member around the normal of the force receiving
26 member and the rotation of the force receiving member relative to the base around
27 two different, typically orthogonal, axes.

28
29 The one or more sensors may comprise or consist of a joystick having at least five,
30 and typically at least six independent degrees of freedom.

31
32 The resilient body may be in continuous contact with at least the force receiving
33 member of the sensor. Thus, any even small deformations of the resilient body may
34 result in forces being transmitted to the force receiving member of the sensor. The
35 data input device may be adapted to calibrate one or more of the input signals to
36 compensate for offset due to any forces being transmitted to the force receiving
37 member of the sensor when the resilient body is not deformed.

1
2 However, it may be that a space is provided between some or all of the force
3 receiving member of the sensor and the resilient body. The space may, for example,
4 be an air space or a vacuum. This has the benefit of reducing or removing forces
5 acting on the force receiving member of the sensor when the resilient body is not
6 deformed.

7
8 Preferably, the volume of the resilient body is greater than ten times the volume of the
9 one or more sensors. Thus, relatively large movements by a user can be measured
10 using compact sensors.

11
12 The input signals are typically digital signals. Typically the data input device converts
13 analogue user actions into digital input signals and thereby functions as an analogue
14 to digital converter. In some embodiments, the input signals are analogue signals.
15 For example, some data input devices are analogue devices and provide analogue
16 input signals which, in use (for example when the input signals are received by a
17 computer), are converted into digital signals (for example by a computer comprising
18 an analogue to digital converter).

19
20 Typically each input signal is a digital signal having a bit depth of at least four and
21 preferably at least eight. The range of possible values is typically a continuous
22 numerical range. Some or all of the input signals preferably respond proportionately
23 to a corresponding relative movement (e.g. relative displacement or relative rotation)
24 of a force receiving member and a reference member of a sensor.

25
26 The data input device may further provide one or more input signals responsive to
27 translation, rotation, acceleration or angular acceleration of the data input device.

28
29 The data input device may have a major dimension of between 5 and 50cm,
30 preferably between 10 and 30cm. We have found that data input devices within this
31 size range are especially useful as musical instruments and/or to provide input to
32 physical model simulations of one or more musical instruments as they are of suitable
33 dimension to be manually operated.

34
35 The resilient body may comprise one or more recesses for receiving a user's hand,
36 limb or entire body. In some embodiments, the resilient body may comprise an
37 internal chamber for receiving a user's hand, limb or entire body. In this case, a

1 plurality of said sensors is typically provided within the resilient body around the
2 internal chamber.

3
4 The data input device may comprise an interface, which may be wired or wireless, for
5 outputting the input signals to a computing device.

6
7 According to a second aspect of the present invention there is provided a data input
8 device for providing a plurality of input signals responsive to user actions, each said
9 input signal having a value from a range of possible values, the data input device
10 comprising a resilient body formed and arranged to define a plurality of modes of
11 deformation, wherein the one or more input signals are responsive to deformation of
12 the resilient body.

13
14 Optional and preferred features of the second aspect of the invention correspond to
15 those discussed above in relation to the first aspect.

16
17 The invention extends in a third aspect to sound generating apparatus comprising a
18 data input device according to the first or second aspect of the invention, wherein the
19 sound generated by the sound generating apparatus is responsive to the said
20 plurality of input signals.

21
22 Preferably, the sound generating apparatus comprises a physical modelling synthesis
23 module which outputs sound dependent on a physical model of one or more
24 instruments, wherein some or all of the said plurality of input signals are provided as
25 inputs to the physical model synthesis. The physical modelling synthesis model may
26 implement a plurality of physical models, for example physical models of different
27 instruments. Some or all of the input signals may be applied as inputs to the same
28 physical model. Different input signals may be applied as inputs to different physical
29 models. For, example, input signals relating to displacement of a sensor force
30 receiving member relative to a reference member parallel to two or three (typically
31 orthogonal) axes may be applied to two or three respectively different physical
32 models. Some or all of the input signals may be applied as inputs to a plurality of
33 different physical models. For example, an input signal relating to the rotation of a
34 sensor force receiving member relative to a reference member, around an axis may
35 be applied as input to a plurality of different physical models, for example, two or
36 three of the said different physical models.

37

1 The sound generating apparatus may comprise data processing means, such as one
2 or more microprocessors or microcontrollers. The data processing means may be a
3 computer in electronic communication with the data input device. The data
4 processing means, and sounding means, such as a loudspeaker, may be integral to
5 the data input device. Accordingly, the data input device may comprise sound
6 generating apparatus. Thus, the sound generating apparatus and, in some
7 embodiments the data input device, may function as a musical instrument.

8
9 According to a fourth aspect, the invention provides computer program code which,
10 when executed on a computing device, is operable to process input signals received
11 from a data input device according to the first or second aspect of the invention.

12
13 The computer program code may be operable to process said receive input signals to
14 provide audio output, using some or all of the said input signals as inputs to a
15 physical model synthesis of one or more musical instruments.

16
17 The invention further extends to a computer readable medium storing computer
18 program code according to the fourth aspect of the invention.

19 20 Description of the Drawings

21
22 An example embodiment of the present invention will now be illustrated with
23 reference to the following Figures in which:

24
25 Figure 1 is a part cut-away side view of a data input device;

26
27 Figure 2 is a cross-sectional view of a data input device;

28
29 Figure 3 is an exploded cross-sectional view of the data input device of Figure 1;

30
31 Figure 4 is a side view of a data input device, illustrating modes of deformation; and

32
33 Figure 5 is a schematic diagram of sound generating apparatus including the data
34 input device.

Detailed Description of an Example Embodiment

With reference to Figures 1 to 4, a data input device 1 comprises a resilient body 2, generally in the shape of a cube, and a base 4. Within the resilient body, there is provided a sensor in the form of a 3-D joystick 6, comprising a sensor base 8 (functioning as the reference member), and a movable portion 10 (functioning as the force receiving member). The sensor base 8 is retained within the base 4 of the data input device.

The external surfaces 12 of the resilient body are generally flat, with protrusions 14 extending therefrom. The protrusions are each in the form of a part-hemisphere, which meets with the generally flat external surfaces at an angle of around 45°. The interior of the resilient body includes a cutaway portion 16, which extends around the movable portion of the sensor, leaving a small gap, which may be for example 1 mm to 2 mm, around the of the sensor. The cutaway portion may be profiled such that the small gap is substantially constant at all points around the sensor, as shown in the embodiment of Figure 2. Alternatively, for example in order to provide a resilient body suitable to receive more than one size or shape of sensor, the cutaway portion may be a simple cuboid, prismatic or cylindrical shape, as show in Figures 1 and 3.

The resilient body is made from polyurethane, and is formed as a single unitary block of material. However, the resilient body is formed from a multi-stage moulding procedure, and the protrusions, which are also formed from polyurethane, can be selected to have a greater elastic modulus, or a smaller elastic modulus, than the bulk of the resilient body. The outer surface of the resilient body is selected to be readily cleaned, and the protrusions are brightly coloured, for example the protrusions may each be a primary colour. In some embodiments, some or all of the protrusions are provided with a textured surface (such as a roughened surface or a fluffy surface).

Protrusions composed of a different material, having different surface textures and/or a different elastic modulus advantageously provide a user with additional tactile information. This may be particularly important for use by the visually impaired. One or more of the plurality of affordances may be encouraged or emphasised by the properties or texture of the protrusions. Similarly, the properties or texture of the protrusions may more clearly define one or more, or all, of the modes of deformation to a user.

1
2 In some embodiments, the protrusions are detachably secured to the resilient body.
3 For example, detachably secured protrusions may be exchanged for protrusions of
4 different shape, or colour or texture. Detachably secured protrusions enable the
5 resilient body to be adapted for alternative uses. For example a plurality of different
6 coloured protrusions might be replaced with protrusions having a plurality of surface
7 textures, for use by people with impaired vision.

8
9 The 3-D joystick has six degrees of freedom. The moveable portion may be
10 translated, relative to the base, in each of three orthogonal directions. Furthermore,
11 the movable portion may be twisted around the central axis of the 3-D joystick, or
12 rolled around either of two further axes, which are orthogonal to each other and the
13 central axis. The 3-D joystick provides six output signals, each of which is a digital
14 signal extending across an appropriate range, for example 0 to 255, which is
15 proportional to the position of the movable portion, relative to the base, within his
16 range of movement, according to each of the six degrees of freedom. The six signals
17 are digitised and encoded onto two output channels. A suitable 3D-joystick is the
18 SpaceNavigator 3D mouse available from 3Dconnexion. (SpaceNavigator is a Trade
19 Mark of 3Dconnexion Holdings S.A.)

20
21 As illustrated in Figure 4, the resilient body can be manually deformed according to a
22 number of different modes of deformation. For example, each of the five outward
23 facing services may be pressed inwards. Each of the five outward facing services
24 may be rotated, in either direction. Each of the five outward facing services may be
25 tilted. Furthermore, the device as a whole can be sheared. Due to the design of the
26 resilient body, these modes of deformation are apparent to users, and function as
27 affordances.

28
29 As the protrusions (shaped generally as spherical caps) meet the generally flat faces
30 of the resilient body at an angle of around 45° , it is apparent to the user that the
31 protrusions may be pushed, thereby pressing a respective outward facing surface of
32 the resilient body inwards. If the protrusions were hemispheres, for example, which
33 met the generally flat faces at an angle of around 90° , a user would instead be
34 tempted to squeeze the protrusions, which would not transmit forces through the
35 resilient body to the 3-D joystick. There would also be locations on the protrusions,
36 near their circumferences, where they meet the respective generally flat face,

1 whether could be pressed at an orientation which would not result in force is being
2 transmitted through the resilient body to the 3-D joystick.

3
4 In use, a user manipulates the resilient body. When they do not apply any forces to
5 the resilient body, and it adopts its natural undistorted configuration, no forces act on
6 the 3-D joystick, by virtue of the space around the movable portion of the 3-D joystick.
7 Similarly, very small distortions of the resilient body will not affect the outputs of the 3-
8 D joystick. However, once the distortion is sufficient to cause the interior surface of
9 the resilient body to contact the movable portion of the 3-D joystick, further distortion
10 slightly displaces the movable portion of the 3-D joystick and, as a result, causes a
11 change in one or more of the signals produced by the 3-D joystick. In an alternative
12 embodiment, the 3-D joystick fits snugly within the cutaway portion of the resilient
13 body. In this case, the 3-D joystick may be disturbed from its equilibrium position
14 when the resilient body is in its undeformed state. However, the device driver
15 software discussed below, or electronics embedded into the data input device can
16 allow for this by suitable calibration.

17
18 Importantly, the resilient body effectively operates as an amplifier of movement with a
19 gain of much less than 1, for example, less than 0.1 or less than 0.01. Relatively
20 large movements in the surface of the resilient body, for example relatively large
21 depressions of the protrusions, create relatively small corresponding movements of
22 the movable portion of the 3-D joystick relative to the base of the 3-D joystick. This is
23 important in the application, described below, of the data input device for controlling a
24 music synthesiser, for use with children or individuals with special needs, to help
25 them develop their motor skills and musical abilities.

26
27 Furthermore, some of the modes of deformation of the resilient body affect more than
28 one of the signals produced by the 3-D joystick. Thus, the data input device provides
29 many ways for users to express themselves.

30
31 With reference to Figure 5, one application of the data input device is for controlling a
32 music synthesiser. In this example embodiment, the music synthesis is carried out by
33 a computer 100, which receives, as inputs, the signals (which, for example, might
34 comprise the six digitised signals encoded onto two output channels) output by the 3-
35 D joystick of the data input device, by way of a wired connection 102, for example, a
36 USB connector. Alternatively, the data input device that might include a wireless
37 transmitter, or transceiver, for communicating the signals to the computer. The

1 computer is properly connected to a loudspeaker 104, for outputting generated
2 sound.

3
4 Signals are received from the data input device or process by a device driver
5 software module 106, which processes the receives signals and outputs a plurality of
6 independent signals 108 (for example the six digitised signals might be extracted
7 from the two output channels), corresponding to the signals produced by the 3-D
8 joystick, or driver. The signals are communicated to a software application 110,
9 which controls the generation of music. The signals received from the device driver
10 software are provided as independent inputs to physical models 112 of one or more
11 instruments, and the software application uses the physical models to generate
12 sound responsive to the deformations of the data input device by a user, in use. For
13 example, the signals related to the displacement of the moveable portion parallel to
14 each of three orthogonal axes may be applied to the inputs of different physical
15 models, for example physical models concerning different instruments. Sounds
16 generated according to each physical model can be combined. One or more of the
17 three further rotation/tilt signals may each be input as parameters to more than one of
18 the physical models.

19
20 Thus, a musical instrument can be provided in which the various manual
21 manipulations of the resilient body by the user control and/or modify, the sounds
22 which are generated. Thus, for example, pushing one protrusion inwards might affect
23 the volume of the output sound. Pressing another protrusion might amend another
24 input to the physical model of an instrument, for example, the simulated lip pressure
25 on a wind instrument, or the bowing speed or bow pressure on the strings of a bow
26 instrument. The base of the data input device is typically secured to a surface, for
27 example, a table, although a hand-held version could be contemplated.

28
29 The musical instrument is especially useful with children, or individuals with special
30 needs, as they are provided with various modes in which they can control, or
31 influence, the sounds which are generated. They can make relatively large motions,
32 using a convenient, tactile and visually attractive data input device. As the input
33 signals are used as inputs to a physical model synthesis, it is easier for the user to
34 generate a desired sound than with a conventional musical instrument. The resilient
35 body provides a user with a tactile response to applied pressure, having a direct and
36 perceivable relationship to the pressure that the user applies.

37

1 As a result of the resilient nature of the resilient body, the data input device is difficult
2 to break. It may be provided in a waterproof form by sealing the connection between
3 the resilient body and the base.

4
5 The resilient body may take any of the range of different forms. Typically, the resilient
6 body is generally polygonal. Polygonal bodies provide a suitable range of modes of
7 deformation, which are neither so few as to provide only a very limited range of
8 affordances to a user, nor so large as to make the device difficult to control or use.
9 Nevertheless, the resilient body may take another form, for example, it may be
10 amorphous or generally spherical.

11
12 In some embodiments, music synthesis apparatus may be provided which has the
13 data input device included therein. Thus, a device with the general appearance
14 illustrated in Figures 1 to 5 may function as a standalone music synthesis device.

15
16 In some embodiments, recesses may be provided into which a user can insert their
17 hand or a limb. In large-scale embodiments, a user may climb into a recess or space
18 within the resilient body. Large-scale embodiments may respond to affordances such
19 as users lying on, sitting on, or throwing themselves on or against the resilient body.

20
21 The data input device is also useful in other applications where it is desirable to
22 generate several input signals simultaneously, which input signals have a value from
23 a range (typically a continuous numeric range) of values.

24
25 Further variations and modifications may be made within the scope of the invention
26 herein disclosed.

1 Claims

- 2
- 3 1. A data input device for providing a plurality of input signals responsive to user
4 actions, each said input signal having a value from a range of possible values,
5 the data input device comprising a resilient body and one or more sensors
6 within the resilient body, which one or more sensors are operable to provide
7 the input signals responsive to deformation of the resilient body by the actions
8 of a user by virtue of the forces transmitted through the resilient body to the
9 one or more sensors.
- 10
- 11 2. A data input device according to claim 1, wherein the resilient body has a
12 shape selected to define a plurality of modes of deformation to which at least
13 one of the input signals is responsive.
- 14
- 15 3. A data input device according to claim 2, wherein the at least one of the input
16 signals are responsive to the degree of deformation of the resilient body
17 according to one or more of the plurality of modes of deformation.
- 18
- 19 4. A data input device according to claim 2 or claim 3, wherein the resilient body
20 has a shape selected to define one or more modes of deformation which are
21 selected such that, when the shape is deformed according to a respective
22 mode of deformation, only a subset of the said plurality of input signals
23 respond significantly to the deformation.
- 24
- 25 5. A data input device according to any one preceding claim, wherein the
26 resilient body is generally in the form of a convex polyhedron having a
27 plurality of faces.
- 28
- 29 6. A data input device according to claim 5, wherein one or more of the said
30 plurality of faces comprises a protrusion.
- 31
- 32 7. A data input device according to claim 6, wherein the or each said protrusion
33 meets the face from which it protrudes at an acute angle.
- 34
- 35 8. A data input device according to any one preceding claim, wherein some or all
36 of the one or more sensors are sensitive to motion.
- 37

- 1 9. A data input device according to any one preceding claim, wherein the
2 resilient body comprises a sensor supporting member which has a higher
3 elastic modulus than the resilient body.
4
- 5 10. A data input device according to any one preceding claim, wherein the
6 resilient body is formed and arranged such that, in respect of one or more
7 modes of deformation of the resilient body to which one or more of the input
8 signals is responsive, the movement of the resilient body is greater than the
9 corresponding movement in a force receiving member of one or more sensors
10 which provide the input signals responsive to the respective deformation.
11
- 12 11. A data input device according to any one preceding claim, wherein the one or
13 more sensors comprise or consist of a sensor having a reference member and
14 a force receiving member, which sensor provides a plurality of signals which
15 respond to movement of the force receiving member, relative to the reference
16 member, in at least two independent axes.
17
- 18 12. A data input device according to any one preceding claim, wherein the one or
19 more sensors comprise or consist of a joystick having at least five
20 independent degrees of freedom.
21
- 22 13. A data input device according to any one preceding claim, wherein a space is
23 provided between some or all of the force receiving member of the sensor and
24 the resilient body.
25
- 26 14. A data input device according to any one preceding claim, wherein the volume
27 of the resilient body is greater than ten times the volume of the one or more
28 sensors.
29
- 30 15. A data input device according to any one preceding claim, wherein the input
31 signals are digital signals having a bit depth of at least four.
32
- 33 16. A data input device according to any one preceding claim, having a major
34 dimension of between 5 and 50cm.
35

- 1 17. A data input device according to any one preceding claim, wherein the
2 resilient body comprises one or more recesses for receiving a user's hand,
3 limb or entire body.
4
- 5 18. An item of furniture having a data input device according to any one preceding
6 claim fixed thereto.
7
- 8 19. A data input device for providing a plurality of input signals responsive to user
9 actions, each said input signal having a value from a range of possible values,
10 the data input device comprising a resilient body formed and arranged to
11 define a plurality of modes of deformation, wherein the one or more input
12 signals are responsive to deformation of the resilient body.
13
- 14 20. Sound generating apparatus comprising a data input device according to any
15 one of claims 1 to 17, or claim 19, wherein the sound generated by the sound
16 generating apparatus is responsive to the said plurality of input signals.
17
- 18 21. Sound generating apparatus according to claim 20, wherein the sound
19 generating apparatus comprises a physical modelling synthesis module which
20 outputs sound dependent on a physical model of one or more instruments,
21 wherein some or all of the said plurality of input signals are provided as inputs
22 to the physical model synthesis.
23
- 24 22. Sound generating apparatus according to claim 21, wherein the physical
25 modelling synthesis module implements a plurality of physical models and
26 different input signals are applied as inputs to different physical models.
27
- 28 23. Sound generating apparatus according to claim 21 or claim 22 operable to
29 function as a musical instrument.
30
- 31 24. Computer program code which, when executed on a computing device, is
32 operable to process input signals received from a data input device according
33 to any one of claims 1 to 17, or claim 19.
34
- 35 25. A computer readable medium storing computer program code according to
36 claim 24.

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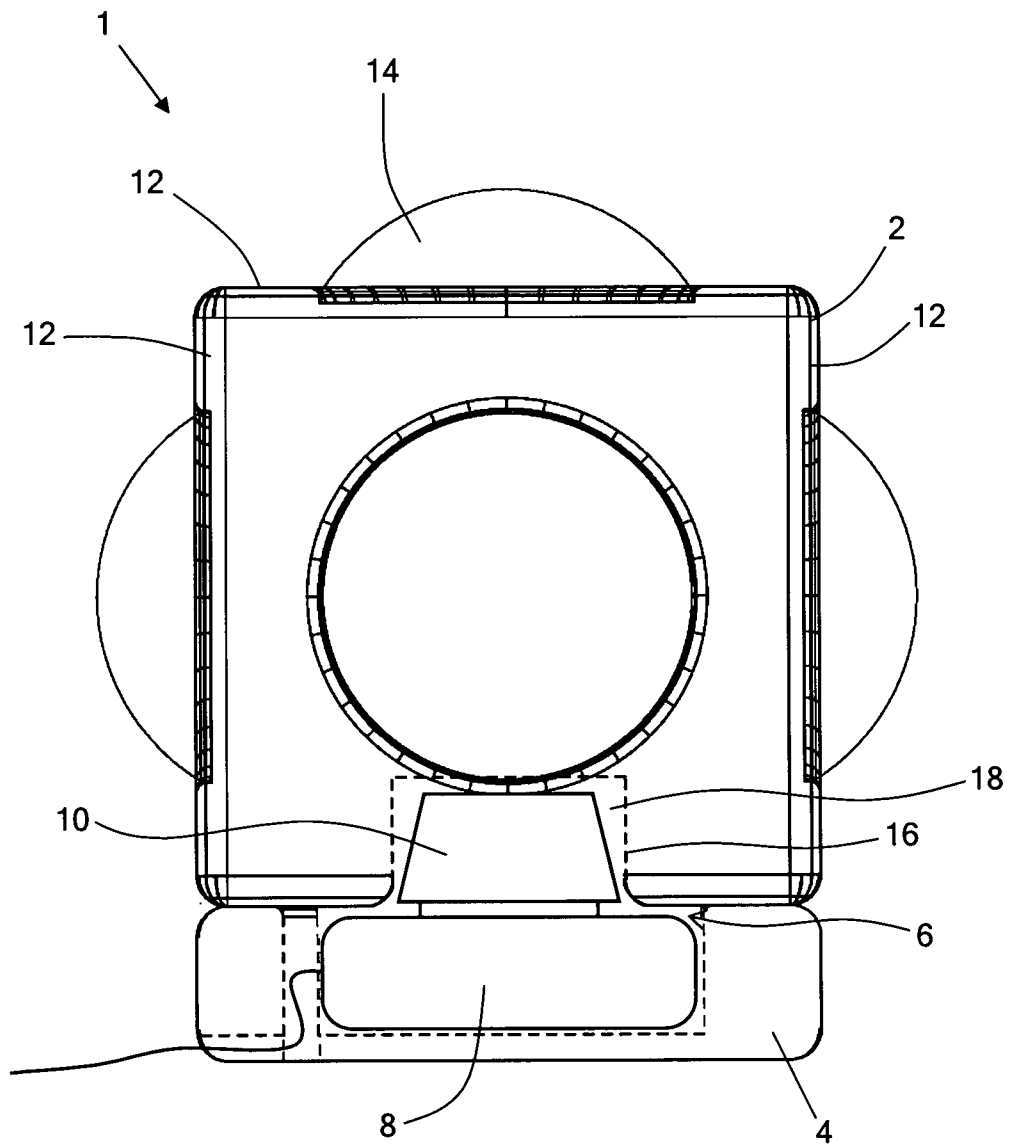


Fig 1

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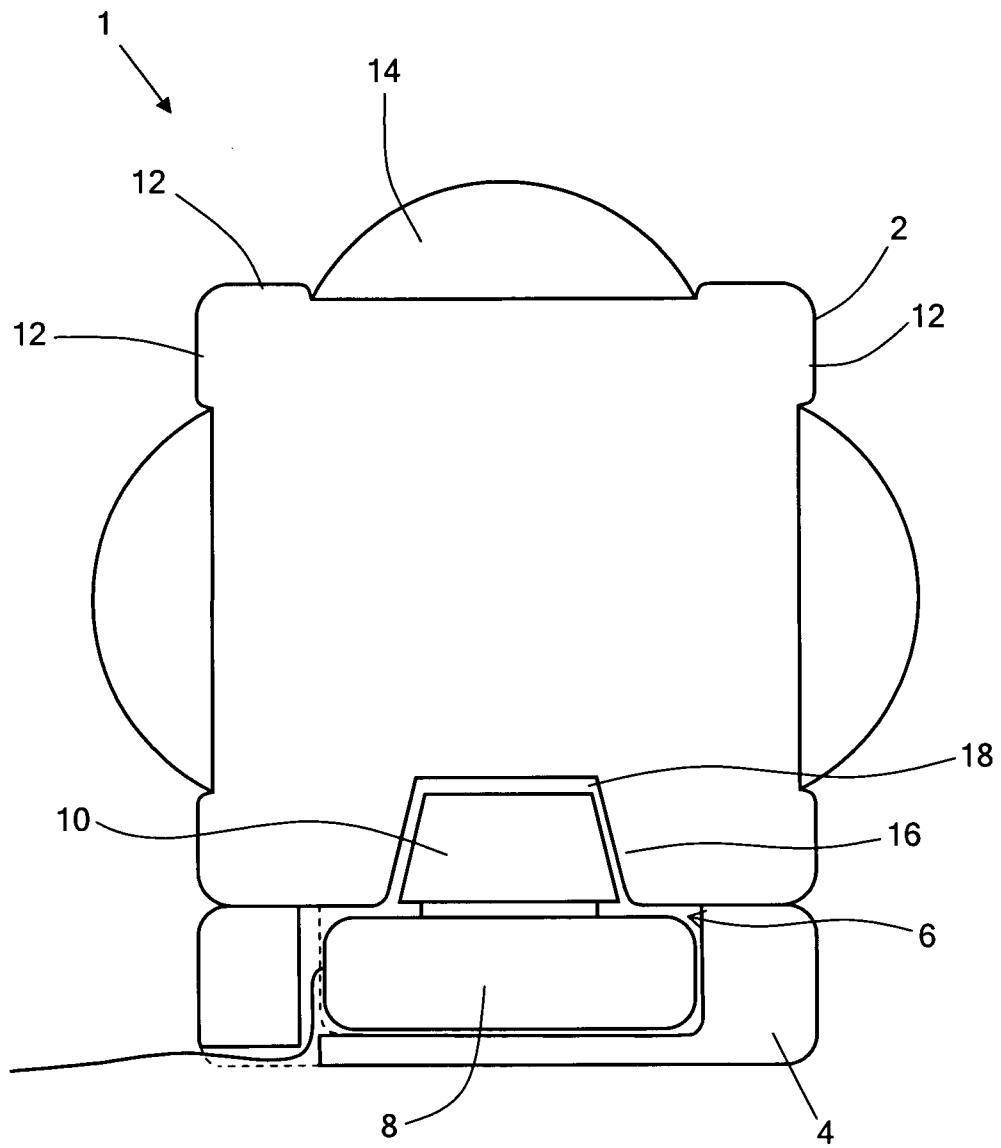


Fig 2

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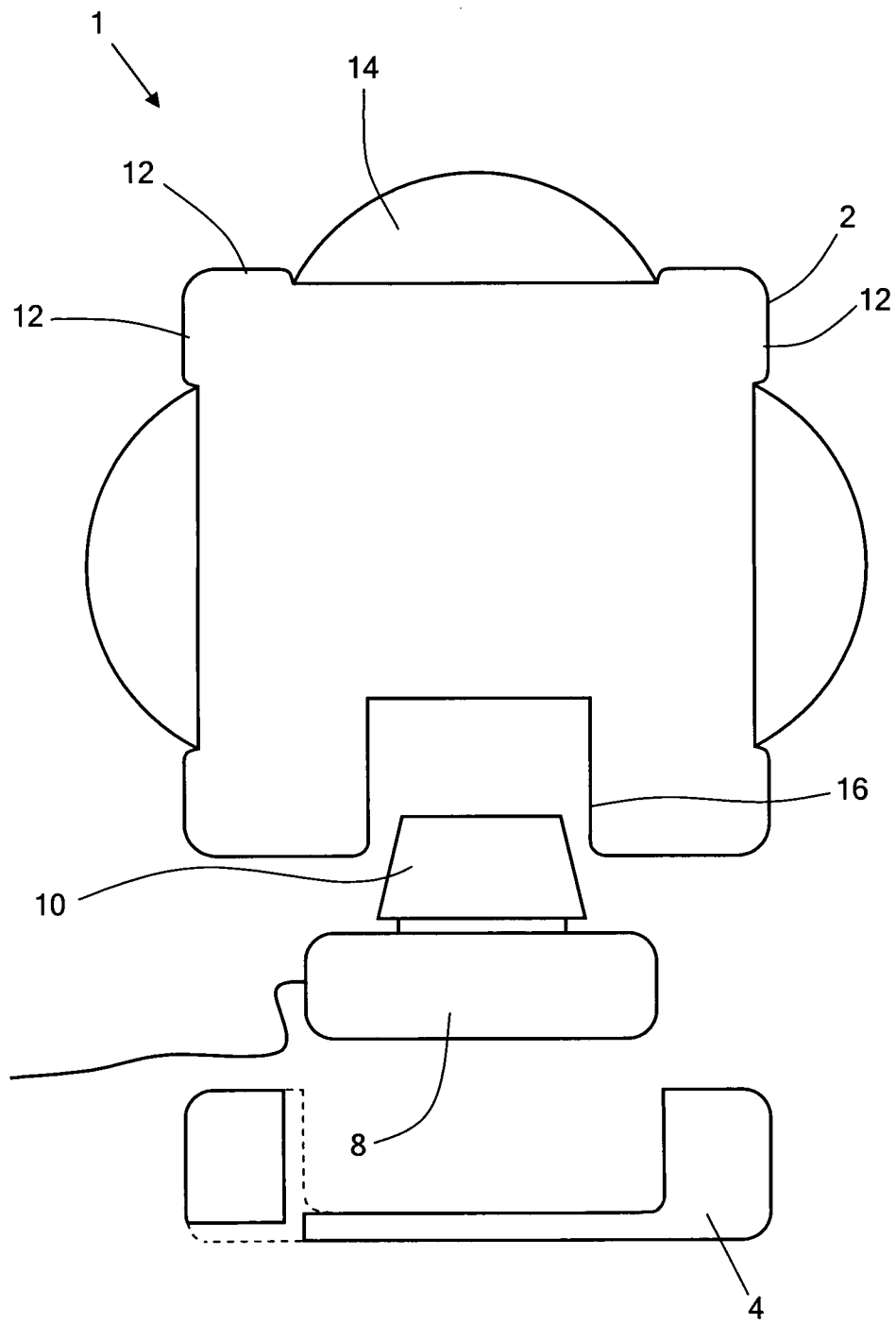


Fig 3

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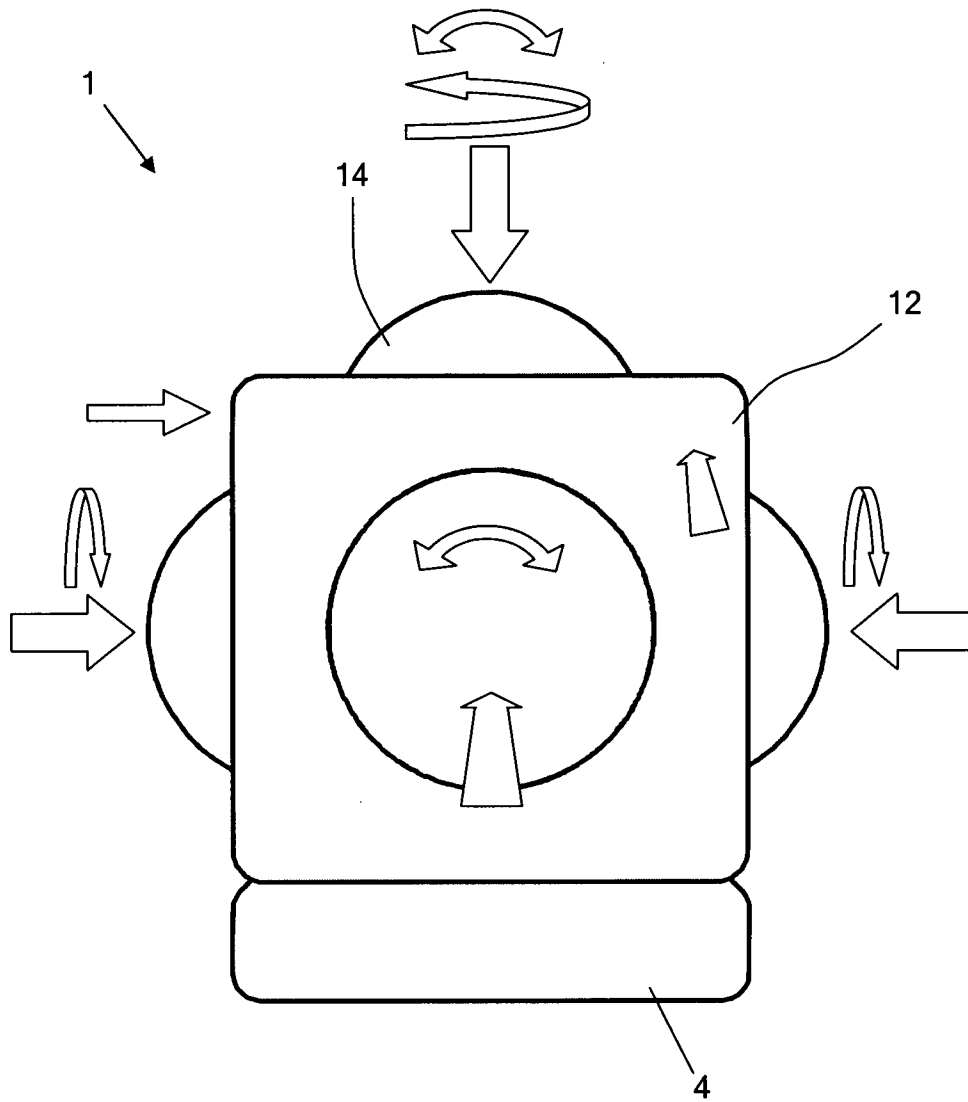


Fig 4

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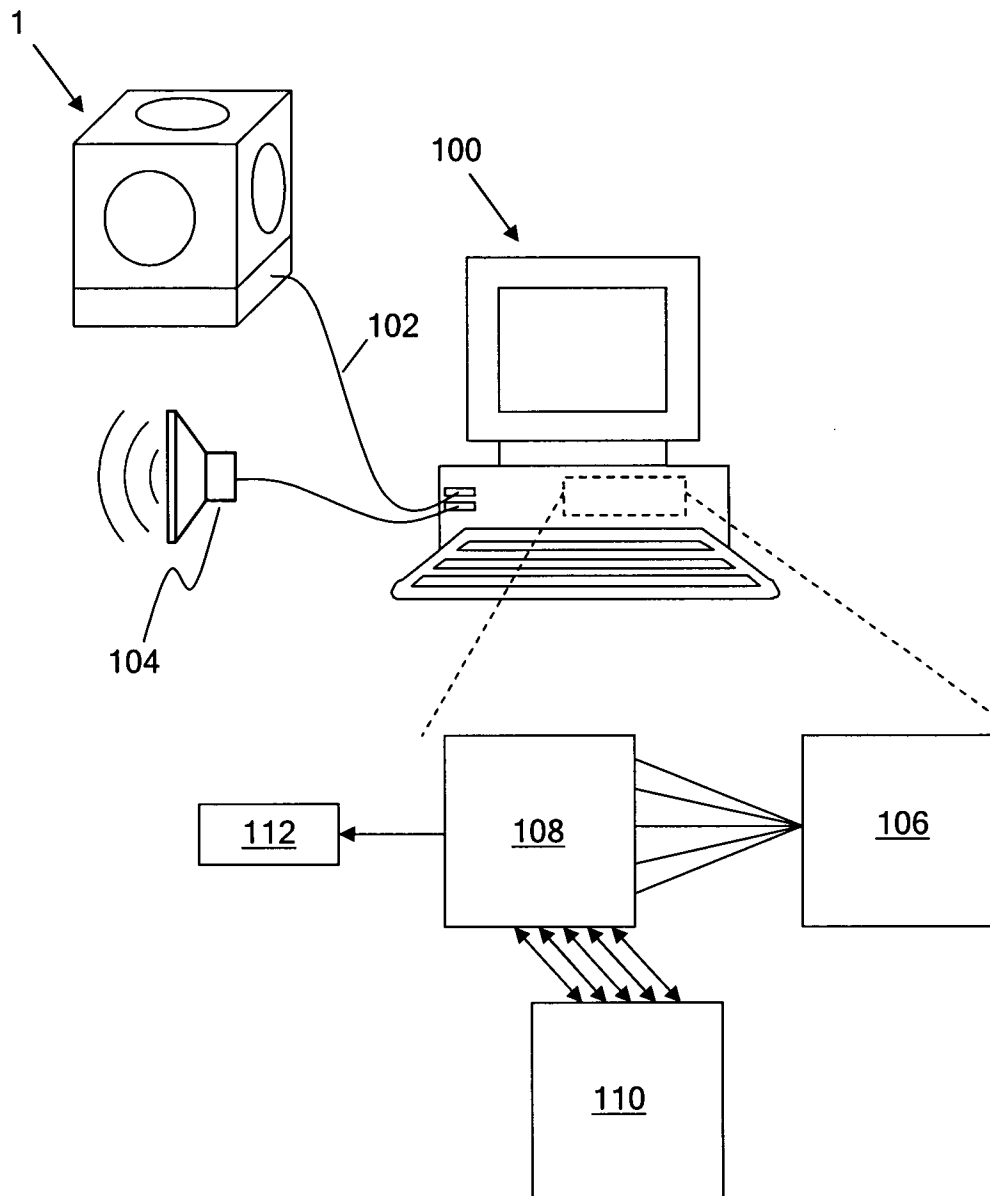


Fig 5

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2010/000205

A. CLASSIFICATION OF SUBJECT MATTER

INV. G10H1/00 G06F3/033 G10H1/32
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)

G06F G10H A63F

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 practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 93/08540 A1 (STANFORD RES INST INT [US]) 29 April 1993 (1993-04-29)	1-8, 11, 13-16, 18, 19, 24, 25 20-23
Y	the whole document ----- -/--	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"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

11 June 2010

Date of mailing of the international search report

23/06/2010

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INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2010/000205

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 597 347 B1 (YASUTAKE TAIZO [US]) 22 July 2003 (2003-07-22)	1,2,4,5, 9,10, 12-19, 24,25 20-23
Y	abstract; figures 1,2,5,25a-25b,27,34,41a-41h,42a-42f,43,43a-43d,45a figures 51a-51c,53a, column 1, line 24 - column 5, line 12 claim 10 column 8, line 43 - column 11, line 9 column 16, lines 12-58 column 20, line 31 - column 23, line 5 column 28, line 1 - column 33, line 24 -----	
Y	WO 02/23323 A2 (VON PRITZWITZ BERND [DE]) 21 March 2002 (2002-03-21) abstract; figure 1 pages 1-2 -----	20-23
Y	EP 0 440 174 A2 (YAMAHA CORP [JP]) 7 August 1991 (1991-08-07) abstract; figures 1-8,9a-9b column 1, line 5 - column 3, line 35 -----	20-23
X	US 5 178 012 A (CULP GORDON W [US]) 12 January 1993 (1993-01-12)	1-5,8,9, 11,19, 24,25 20-23
Y	abstract; figures 1-23 column 1, line 13 - column 6, line 44 -----	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2010/000205

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9308540	A1	US 5262777 A	16-11-1993
US 6597347	B1	NONE	
WO 0223323	A2	AU 1213702 A DE 10045117 A1 EP 1319207 A2 US 2004080507 A1	26-03-2002 28-03-2002 18-06-2003 29-04-2004
EP 0440174	A2	DE 69123467 D1 DE 69123467 T2 HK 1000332 A1 US 5200568 A	23-01-1997 10-07-1997 27-02-1998 06-04-1993
US 5178012	A	NONE	