

(21) Application No: 0702453.2
(22) Date of Filing: 08.02.2007

(51) INT CL:
A61L 2/10 (2006.01) A61L 2/24 (2006.01)
G06F 3/02 (2006.01)

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(56) Documents Cited:
GB 2422807 A GB 2421220 A
WO 1999/038540 A1 US 6458331 B1
US 6278122 B1

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(58) Field of Search:
UK CL (Edition X) A5G, B6F
INT CL A61L, B41J, G06F
Other: Online: EPODOC WPI

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(54) Abstract Title: **A computer input apparatus having ultraviolet light source for sterilisation**

(57) An input apparatus comprising a body (2); a cover (3) pivotally attached to a rear part of the body (2) for pivotal movement about a pivot axis between an open position and a closed position. The body (2) and the cover (3) together define in the closed position of the cover (3) an enclosure. A keyboard (4) mounted to the body (2) so as to lie within the enclosure when the cover (3) is in its closed position. Further an ultraviolet light source (14) is disposed so as to permit illumination of the keyboard (4) when the cover (3) is in its closed position. A shield (15) may be provided such that the ultraviolet light source (14) only illuminates the keyboard (4) when the cover (3) is in its closed position.

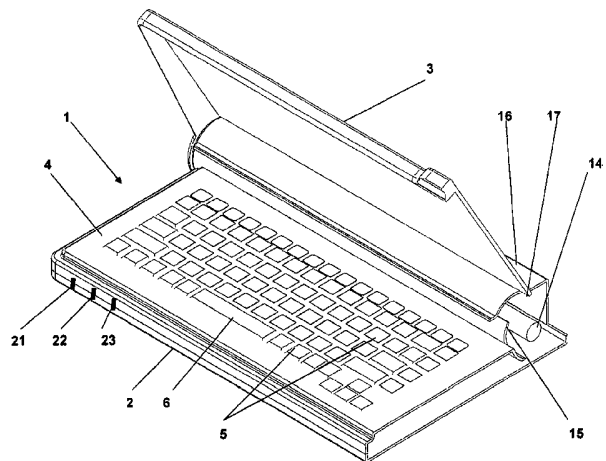


FIG. 1

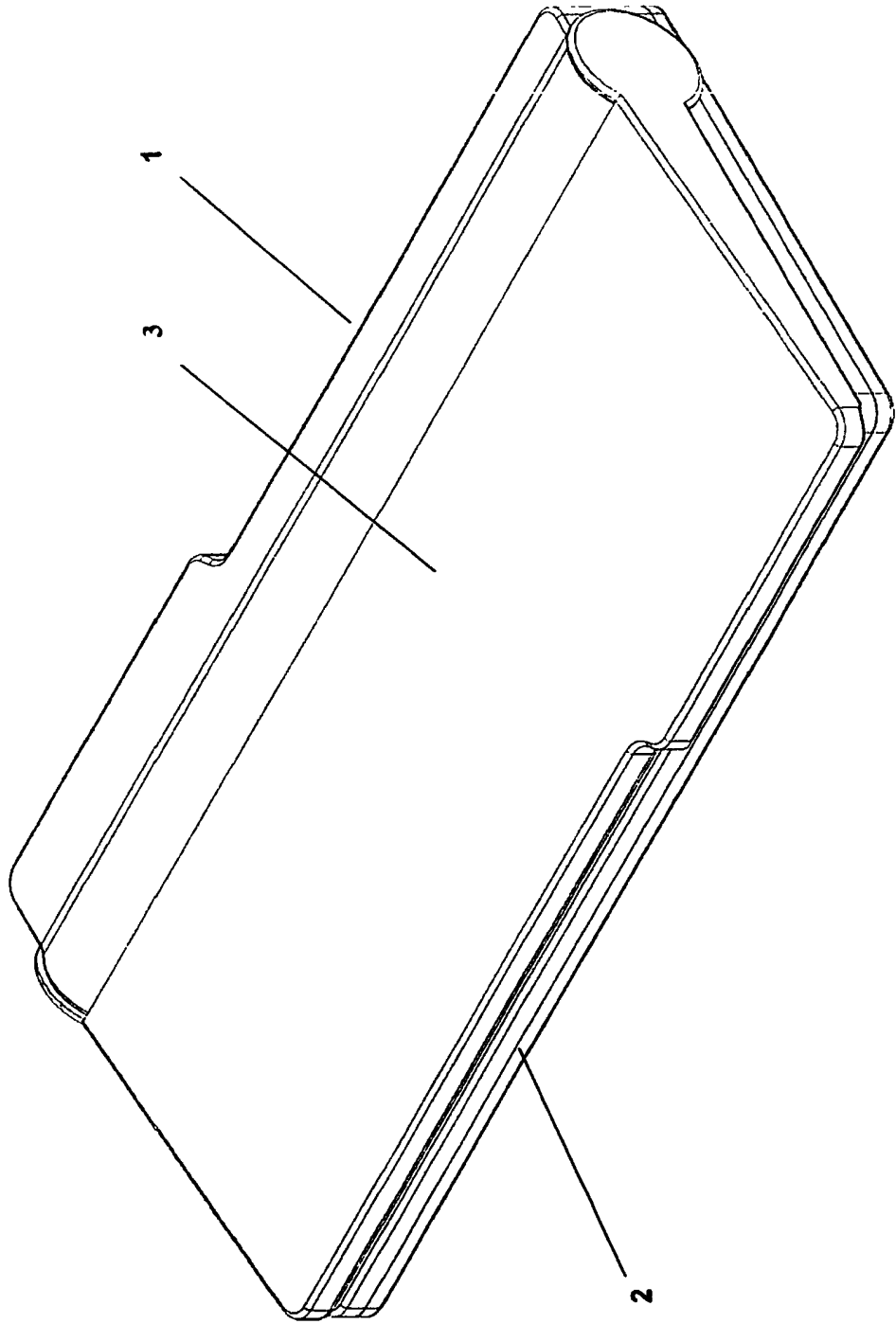


FIG. 2

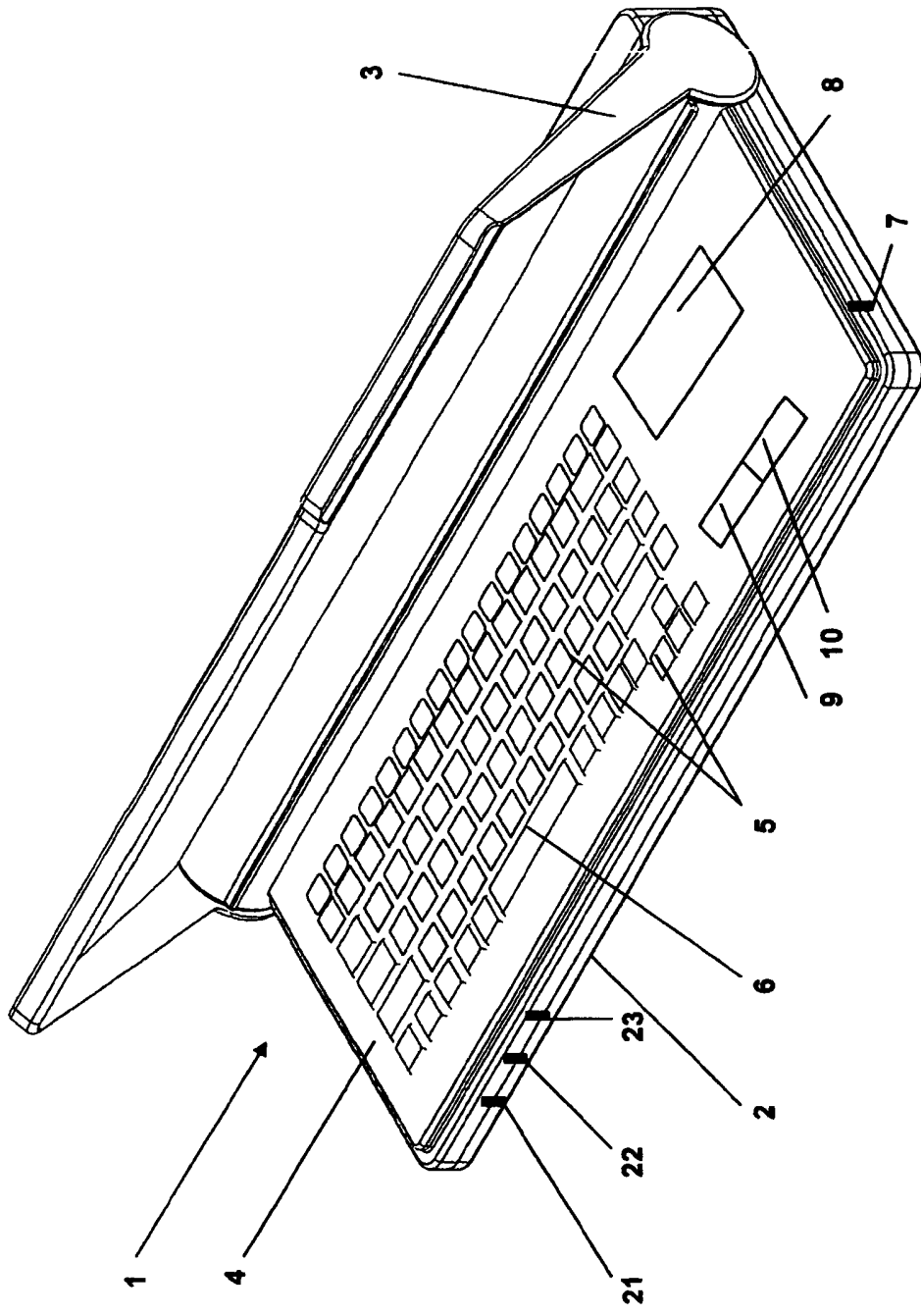


FIG. 3

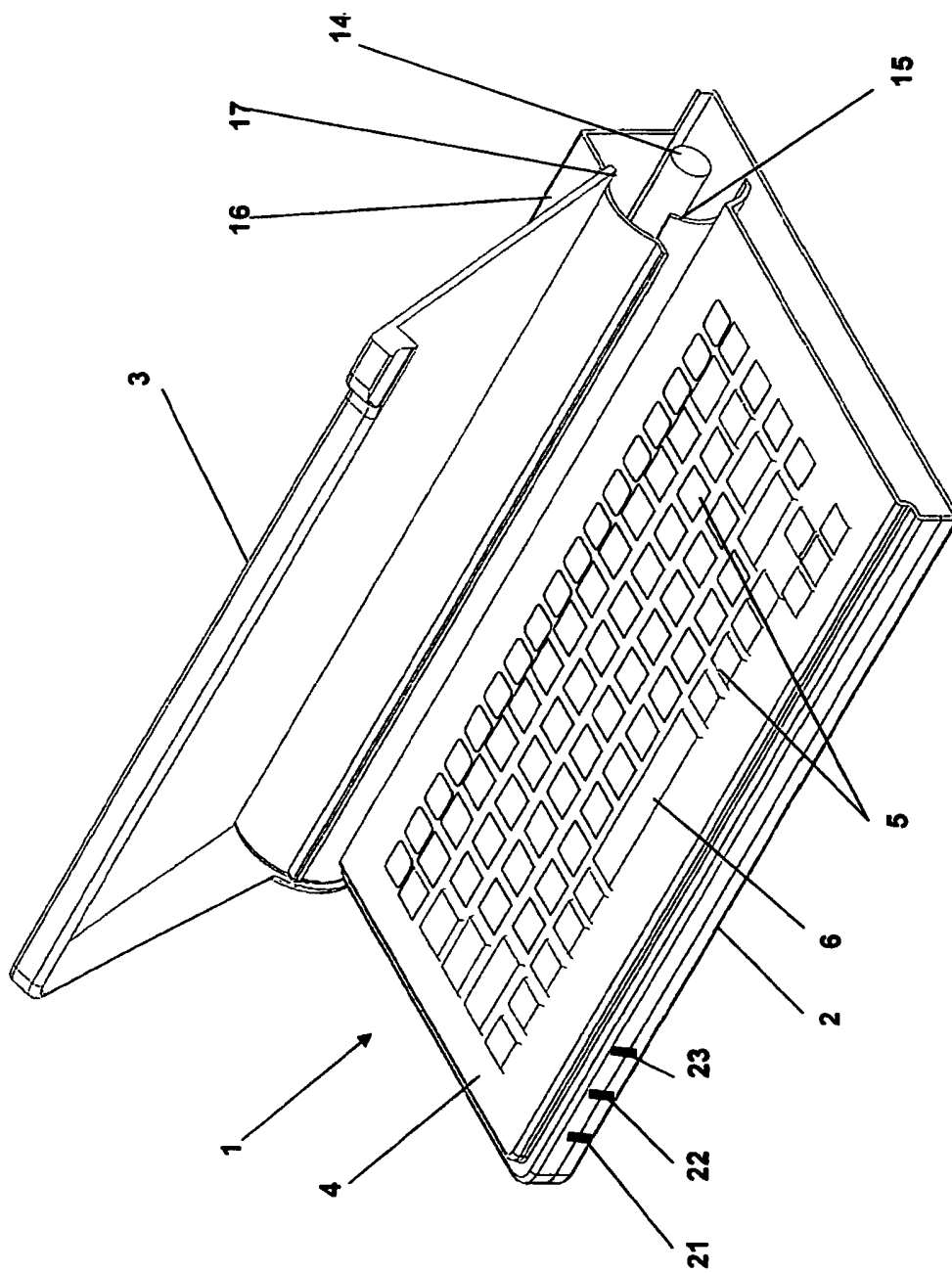


FIG. 4

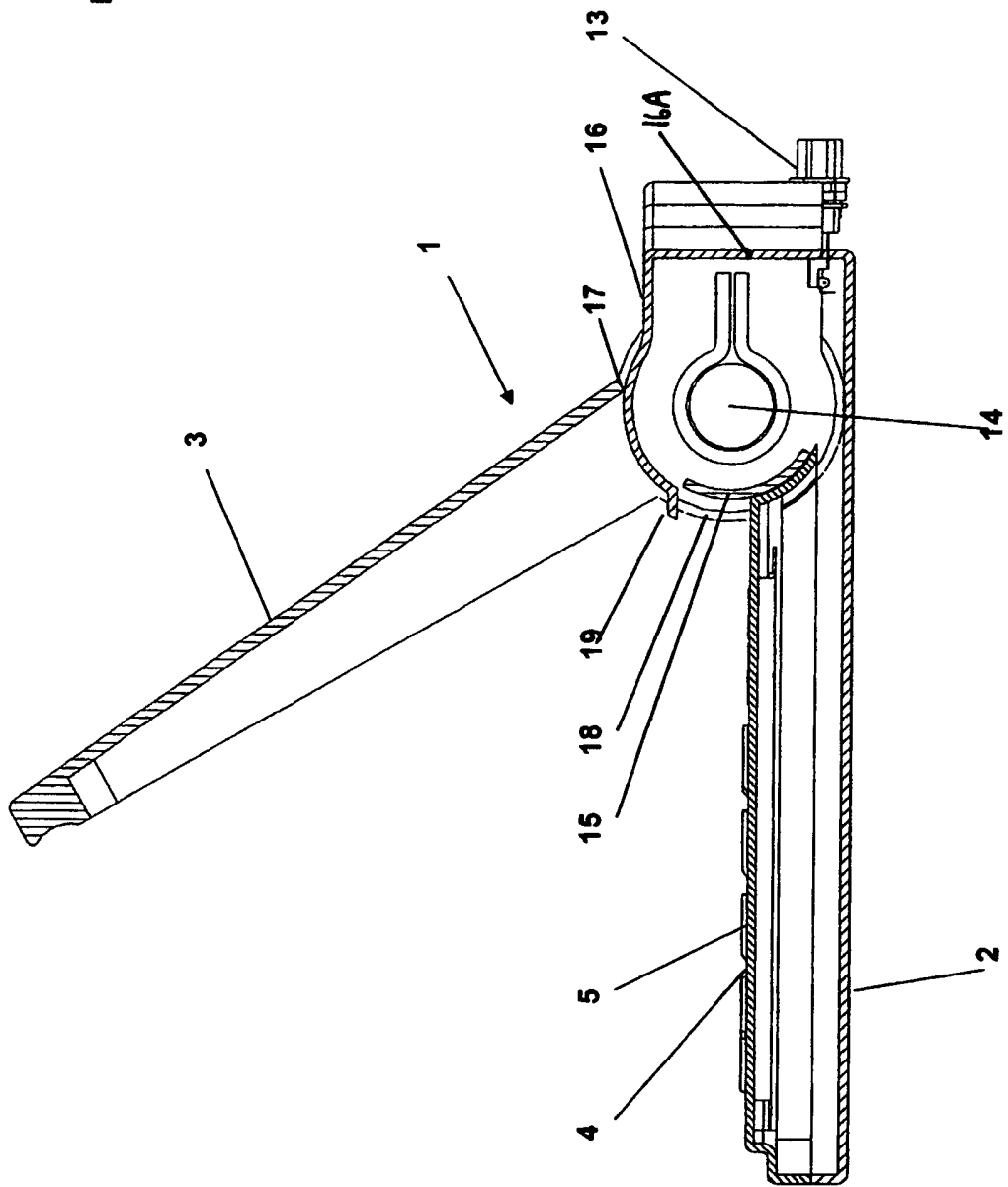


FIG. 5

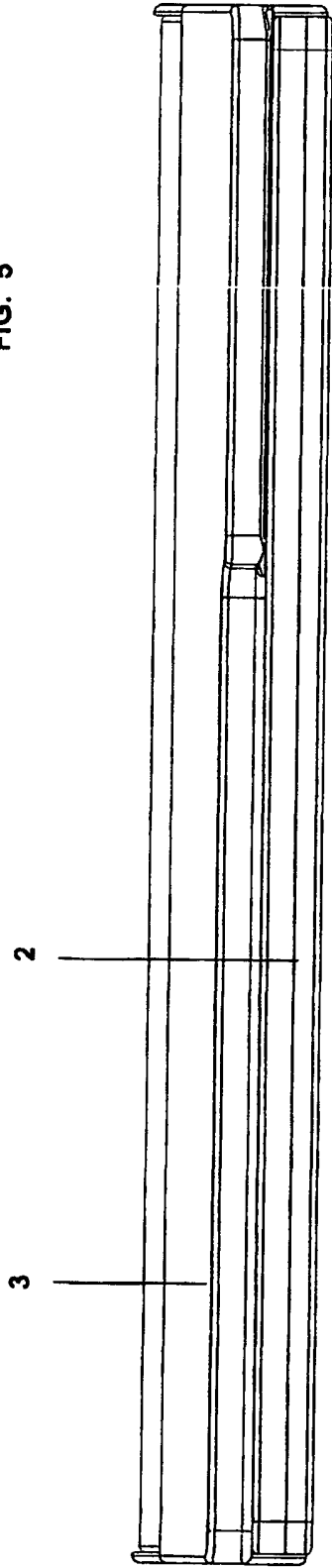


FIG. 6

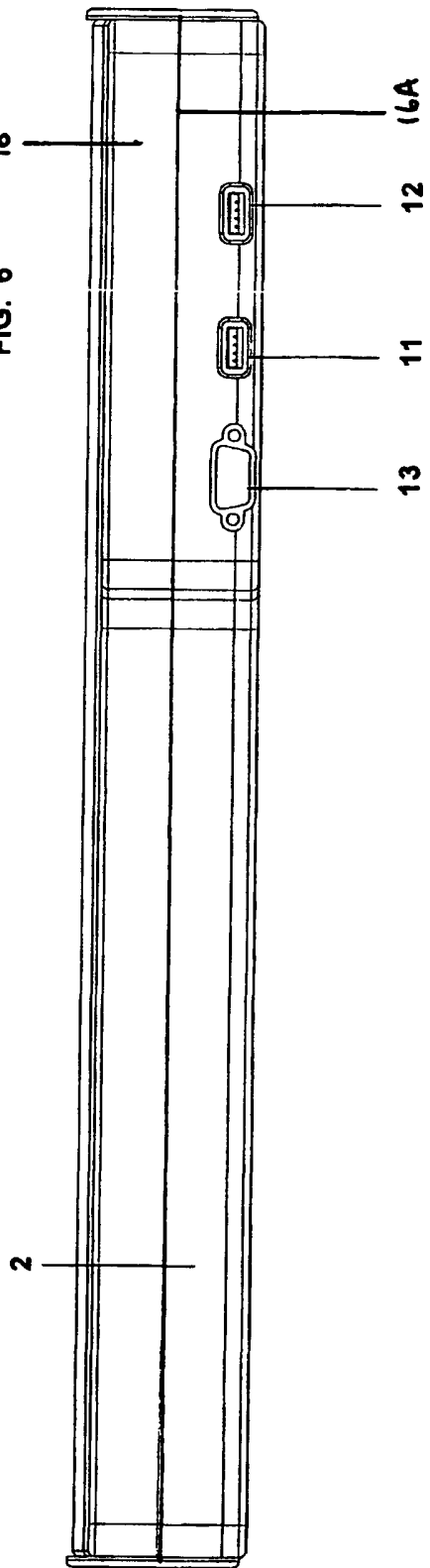
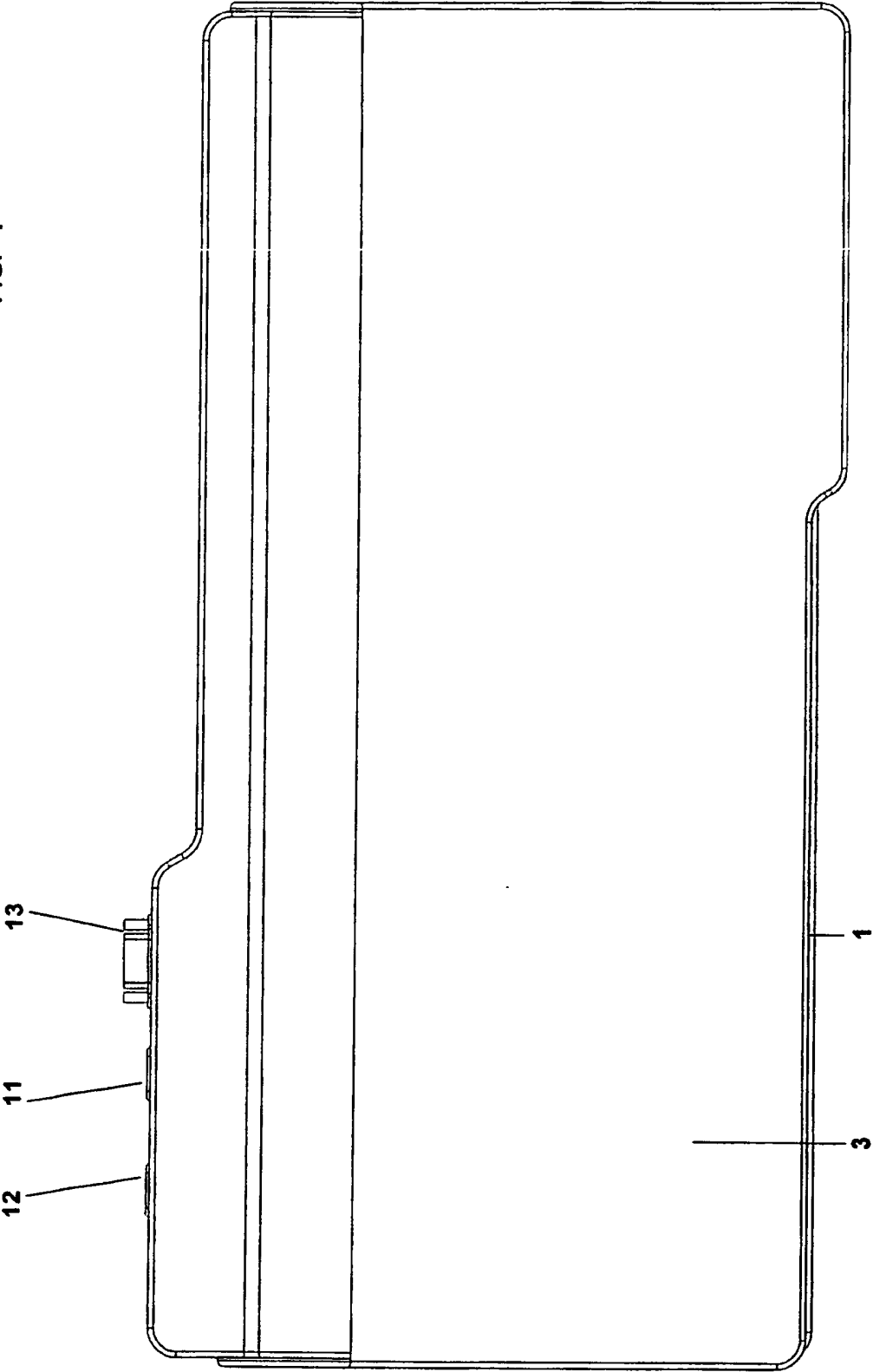


FIG. 7



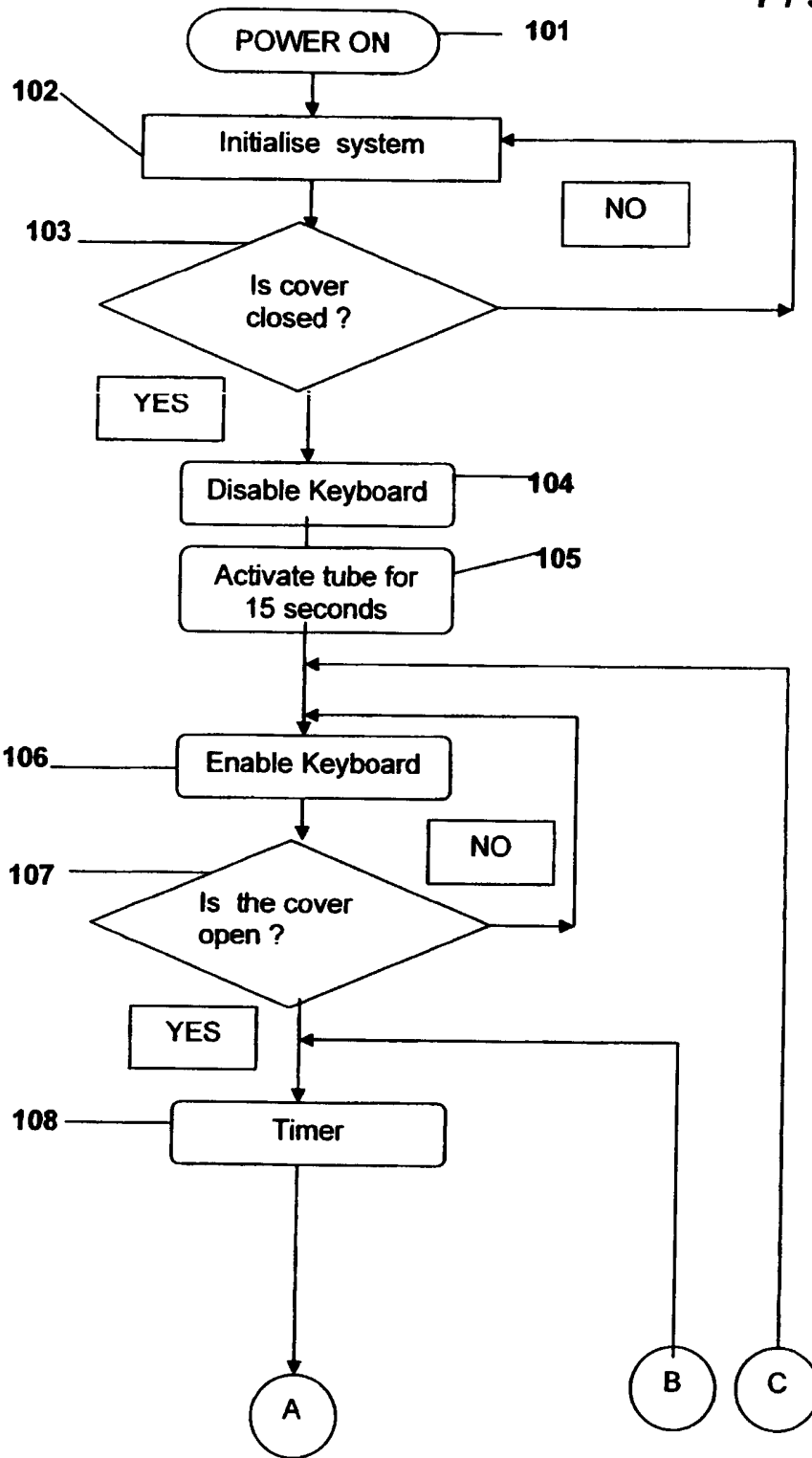


FIG. 8A

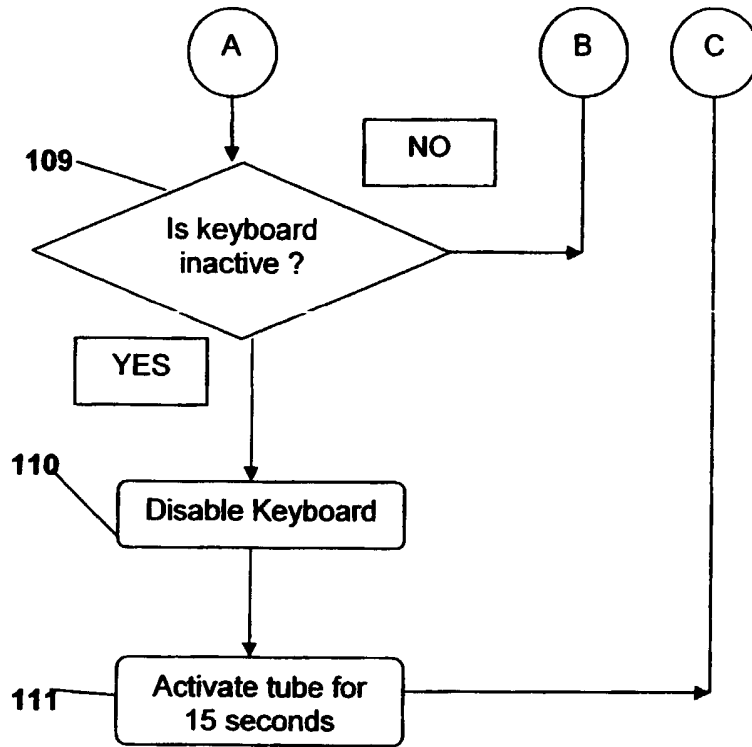


FIG. 8B

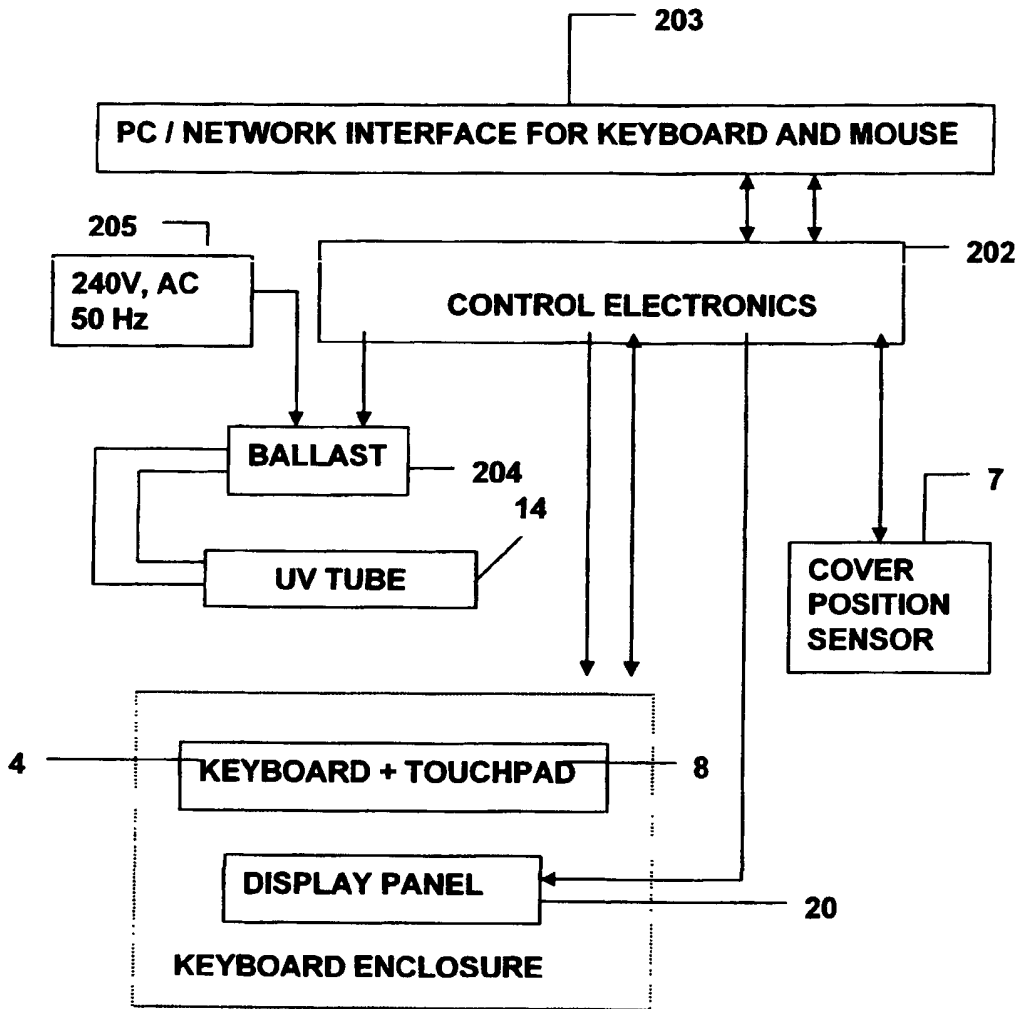


FIG. 9

COMPUTER INPUT APPARATUS

This invention relates to a computer input apparatus, such as a computer keyboard which may be a stand-alone keyboard or a keyboard of a laptop computer. More

5 particularly it relates to a computer input apparatus, such as a computer keyboard, which incorporates a built-in disinfection feature using ultraviolet (UV) light. Such a computer input apparatus is particularly suitable for use with a personal computer (PC) in a hospital environment.

10 The use of ultraviolet light as disinfecting agent helps to minimise the incubation and spread of infectious bacteria, such as methicillin-resistant *Staphylococcus aureus* (also known as MRSA), as well as viruses, in a hospital environment.

15 Present researches in the United Kingdom and recent figures supplied by the United Kingdom National Health Service (NHS) suggest that the rate of spread of infections has risen by 3.4% in the United Kingdom. Thus, more than 7000 patients per year pick up post operative infections.

20 In an effort to control infections in hospitals, the United Kingdom National Health Service today spends an estimated £1 billion on measures designed to minimise such postoperative infections.

It has also been found in various different research
25 projects and trials that one most common frequent carrier and incubating ground for infectious viruses and bacteria (especially MRSA) is the computer keyboard, commonly a PC keyboard, used by doctors or other medical personnel in hospitals and intensive care units (ICU's). Pens used by
30 doctors or other medical personnel are further carriers and incubating grounds for infectious viruses and bacteria.

All of the above problems due to bacteria or viruses possibly present on a computer keyboard could be contained or minimized if the keyboard is cleaned using alcohol wipes
35 after every use. It has been also proven that the rate of spread of infectious viruses is controlled by this activity. However, this method is solely dependent on the user and the

availability of the wipes.

International Patent Publication No. WO 03/061382 A1 discloses use of pulsed light, for example UV light from a xenon lamp in a pulsed system, to deactivate toxic and pathogenic bacteria on articles such as pieces of mail or keyboards.

In United States Patent Application Publication No. 2003/0071790 A1 there is taught a mouse seat with sterilising and deodorising ability wherein an ultraviolet lamp pipe is mounted in a seat coated with a titanium dioxide (TiO₂) layer.

United States Patent Specification No. 6,458,331 B1 proposes a computer input device sterilization apparatus which comprises a box open at one side which contains an ultraviolet source for irradiating a keyboard, mouse, trackball, touchpad or other computer input device when the box is placed over the device to be sterilized. A timer/power circuit is provided which activates the ultraviolet sterilization lamps as well as a recirculation fan for a specific period of time sufficient to achieve sterilization. In addition the apparatus includes an interlocking sterilization switch which is biased in the "off" position so that, in the absence of a keyboard or the like, all lamps are off but which, when the box is placed over the keyboard or other input device, is closed so that power is provided to the lamps.

In United States Patent Specification No. 6,278,122 B1 there is described a computer keyboard and mouse sterilizing system which has a cabinet and extendable base on a slidable rail mechanism for storage and support of a computer keyboard and mouse. There is an ultraviolet light source located inside the cabinet and a front door is hinged on the extendable base so that it can close the front of the cabinet when the extendable base and keyboard are slid into the cabinet. A safety interlock switch is mounted to the inside of the cabinet near to the opening of the front door so as to prevent operation of the ultraviolet lamp unless

and until the base is in the retracted position and the front door is closed.

Sterilization of an information processor is described in Japanese Patent Publication No. 07160362 A. This
5 proposal utilises storage spaces for a computer keyboard and mouse with a sterilizing lamp and with a door. Upon closure of the door a sensor detects the storage of the keyboard and the mouse and a sterilizer lamp is automatically turned on. Then the lamp is automatically turned off after a prescribed
10 sterilizing time set by a timer.

British Patent Specifications Nos. 2 421 217 A and 2 421 220 A disclose several forms of keyboard which include control circuitry to monitor usage thereof and to permit reuse, after a predetermined period of inactivity, only
15 after irradiation of the keyboard with ultraviolet light.

In British Patent Specification No. 2 422 807 there is described an apparatus which includes an enclosure having a lid and a tray that is extended by use of a slide mechanism. A keyboard may be placed on the tray and located inside the
20 enclosure by use of the slidable tray. Sterilisation is carried out by use of ultraviolet light from lamps. The apparatus is controlled by a control unit that is connected to a host computer via a bi-directional interface cable. The host computer controls the sterilisation process and
25 modifies the control parameters of the control unit. The control unit records details of sterilisation processes and transmits details of the sterilisation processes to the host computer. The host computer then logs the details into an audit trail log.

30 Use of ultraviolet light for sterilization of telephone handsets is described in British Patent Specification No. 2 383 225 A.

There is a need to provide an improved form of computer input apparatus for use in environments where risk of
35 infection by bacteria and viruses is a particular problem, such as in hospital environments, including intensive care units where it is desirable that risk of infection, in

particular by virulent microorganisms such as by methicillin-resistant *Staphylococcus aureus* (also known as MRSA) should be avoided as far as humanly possible.

The present invention accordingly seeks to provide an improved form of computer input apparatus which ensures that scrupulous disinfection of a computer keyboard or the like computer input device can be carried out, thereby minimising the risk of a user of the apparatus unwittingly spreading infection by contact with a contaminated computer input device.

According to the present invention there is provided an input apparatus for a computer comprising:

a body;

a cover pivotally attached to a rear part of the body for pivotal movement about a pivot axis between an open position and a closed position, the body and the cover together defining in the closed position of the cover an enclosure;

a digitally operable computer input device mounted to the body so as to lie within the enclosure when the cover is in its closed position; and

an ultraviolet light source disposed so as to permit illumination of the digitally operable computer input device when the cover is in its closed position.

In a preferred form of apparatus the digitally operable computer input device comprises a computer keyboard, which is preferably covered with a sterilisable membrane or a membrane with antimicrobial surface properties. The digitally operable computer input device may alternatively or additionally comprise a touch pad.

In a preferred design of apparatus according to the invention the ultraviolet light source is mounted in the rear part of the body. Preferably the ultraviolet light source comprises a tubular ultraviolet light source. Such a tubular ultraviolet light source preferably has an axis which is arranged to be substantially parallel to the pivot axis or to be substantially aligned with the pivot axis.

It is further preferred that the under face of the cover is provided with a reflective surface, preferably with a polished finish.

A control circuit is preferably arranged to detect
5 keyboard activity and, in the absence of any keyboard activity within a predetermined period, to disable the keyboard until the cover has been closed and the ultraviolet light source activated for a predetermined time to sterilise the computer input device. Such a predetermined period may
10 be, for example, from about 1 minute to about 2 minutes, while the predetermined time is typically from about 10 seconds to about 20 seconds, e.g. about 15 seconds.

In a preferred form of apparatus according to the invention a shield is operably connected to the cover and is
15 movable therewith for shielding the ultraviolet light source from view when the cover is moved away from its closed position and for exposing the digitally operable computer input device to the ultraviolet light source when the cover is in its closed position and the ultraviolet light source
20 is actuated. Conveniently the shield is rigidly connected to the cover.

The rear part of the body may include a forward lip which defines together with the keyboard a gap for passage of ultraviolet light into the enclosure when the cover is in
25 its closed position and the ultraviolet light source is actuated and the shield may be arranged to block the gap when the cover is in its open position.

A microswitch may be positioned so that an operating button thereof is disposed in the path of the cover so as to
30 act as a position sensor for the cover.

The apparatus of the invention preferably further includes a display panel including LEDs to indicate whether the keyboard is inactive, is being sterilised, and/or is available after sterilisation for input of data by an
35 operator.

In order that the invention may be clearly understood and readily carried into effect, a preferred embodiment

thereof will now be described, by way of example only, with reference to the accompanying drawings wherein:-

Figure 1 is an isometric view of an input apparatus for a computer according to the invention with its cover closed;

5 Figure 2 is a similar isometric view of the input apparatus of Figure 1 with its cover open;

Figure 3 is an isometric section through the input apparatus of Figures 1 and 2;

10 Figure 4 is a cross section of the input apparatus of Figures 1 to 3;

Figure 5 is a front view of the input apparatus of Figures 1 to 4;

Figure 6 is a rear view of the input apparatus of Figures 1 to 5;

15 Figure 7 is a top plan view of the input apparatus of Figures 1 to 6;

Figures 8A and 8B depict a flowsheet illustrating a method of operation of the input apparatus of Figures 1 to 7; and

20 Figure 9 is a block diagram of the control circuit for the input apparatus of Figures 1 to 7.

Referring to Figures 1 to 7 of the drawings there is depicted an input apparatus for a computer 1 which comprises a body 2 and a cover 3 hingedly mounted thereon. A flat
25 membrane based keyboard 4 is fitted in the top face of body 2. Such a keyboard has an operating surface which is formed by a flat membrane of a suitable plastics material, such as polyurethane rubber, preferably one having antimicrobial properties, such as for example a Steritouch® polyurethane
30 membrane as sold by SteriTouch Ltd, Unit 15, Roseheyworth Business Park, Abertillery, Gwent NP13 1SP. The "keys" 5 of keyboard 4 are not separate, moving parts, as with the majority of other keyboards, but rather have only outlines and symbols printed on the flexible membrane. Keyboard 4 is
35 provided with low travel, tactile, low profile switches which are located underneath the printed outlines and symbols and which provide electrical contact when keytop

areas are pressed. Such a keyboard is substantially free from crevices, nooks and crannies where bacteria and viruses can develop colonies and is also resistant against dirt and liquids. It can have its "keys" 5 laid out in any
5 convenient layout, for example one of the conventional "QWERTY" keyboard layouts conventionally used in the United States of America or in the United Kingdom. Other layouts may be appropriate for other countries. The "keys" 5 can be printed with luminous ink so as provide an "autoglow"
10 feature.

It is preferred that all external surfaces of the apparatus 1 are coated with an antimicrobial coating. One such technique involves use of a SteriTouch® powder coat as sold by the afore-mentioned SteriTouch Ltd.

15 A loudspeaker (not shown) may be provided in body 2 and the control circuit, which will be described further below, can be arranged so that a gentle "beep" is emitted by the loudspeaker as the user makes each keystroke.

Body 2 contains in its base a control circuit (not
20 shown) which is able to detect activity and inactivity; that is to say, it is able to detect keystrokes or the absence of keystrokes. As shown in Figure 2 a microswitch 7 which serves as a position sensor for the cover 3, as will be further explained below, is also mounted at the right-hand
25 side of body 2. A touch pad 8 and buttons 9 and 10 which are arranged to operate like the left and right buttons of a computer mouse are also located in body 2.

If the keyboard 1 is intended for use in an environment in which the user is likely to be wearing surgical gloves,
30 then it may be preferred to replace touch pad 8 and buttons 9 and 10 by an external computer mouse (not shown). In this case a conventional numeric key pad can replace touch pad 8 and buttons 9 and 10.

In the rear face of body 2 there are provided two USB
35 ports 11 and 12. USB port 11 can be used, for example, for connection of a computer mouse while USB port 12 can be used, for example, for connection to a computer (not shown).

A power input port 13 is also provided in the rear face of body 2 to enable connection to an external ballast (not shown) which runs on an external power supply, e.g. a 240 v AC power supply, and acts as a ballast for an
5 ultraviolet tube 14 which is mounted in body 2 substantially coaxially with the hinge of cover 3.

The ultraviolet tube 14 is preferably of the type sold as instant start germicidal lamps and is desirably made from fused silica. For example, tubes of this type are sold by
10 Arklite Speciality Lamps Ltd., of J-152, MIDC, Bhosari, Pune, Maharashtra, India.

Cover 3 is preferably made of aluminium with a polished under face so that it can reflect ultraviolet light from tube 14 onto keyboard 4 when tube 14 is lit. Cover 3 also
15 has a part-cylindrical shield 15 rigidly attached to it or integrally formed with it so that, when cover 3 is lowered to the closed position depicted in Figure 1, ultraviolet light from ultraviolet tube 14, as well as ultraviolet light reflected from the under surface of cover 3, can irradiate
20 keyboard 4 and thereby sterilise it. However, in the raised position of the cover 3, as depicted in Figure 4, shield 15 is positioned in front of tube 14 so that, in the event that tube 14 remains lit, for example in the event of failure of microswitch 7, in normal usage of the illustrated apparatus
25 on a desk surface the eyes of an operator will be protected against damage by ultraviolet light from tube 14.

In the illustrated apparatus, shield 15 is integrally provided at each end with a disc with a circumferential groove. These grooves engage with corresponding part-
30 circular cut-outs in the sides of body 2 and in a detachable rear part 16 so as to provide bearings for the discs and hence for cover 3 and shield 15. Cover 3 can be secured by screws (not shown) to the afore-mentioned discs. Alternatively cover 3 can be integrally formed with shield
35 15 and its associated discs.

Detachable rear part 16 is secured to body 2 by means of screws passing upwardly into rear part 16 from the

underside of body 2. Reference numeral 16A indicates the line of separation of rear part 16 and body 2 (see Figures 4 and 6).

Figures 3 and 4 illustrate how the upper surface of the detachable rear part 16 of body 2 is curved to conform to the path of travel of the rear edge 17 of cover 3 as it moves between its open and closed positions. These Figures also show how a gap 18 is formed between a front lip 19 of the rear part 16 and the underlying keyboard 4. This gap 18 is closed by shield 15 when the cover 3 is raised and in its open position but remains open when the cover 3 is in its closed position. In this latter position light from ultraviolet lamp 14 can shine through gap 18 onto the keyboard 4 as well as onto the reflective polished under face of cover 3 for sterilising the keyboard 4.

Microswitch 7 has an operating button which is upwardly biased so that, as cover 3 is lifted towards the open position of Figure 4, microswitch 7 will open in order to indicate to the control circuit that cover 3 is open and that ultraviolet tube 14 should be switched off. On the other hand as cover 3 is moved towards its closed position as shown in Figure 1, it will come into contact with the operating button of microswitch 7 and push this downward until, just before the cover 3 is fully closed, microswitch 7 will close to indicate to the control circuit that cover 3 is closed and that it is safe for tube 14 to be switched on to commence irradiation of the keyboard 4. The microswitch 7 should be adjusted so that there is essentially no danger of the tube 14 being lit prematurely and shining into the naked eye of an operator in normal use of the illustrated apparatus.

Mounted near the front of the apparatus 1 is a display panel 20, as can be seen from Figures 2 and 3. Display panel 20 includes three LEDs connected to the control circuit, i.e. a red-emitting LED 21, a yellow-emitting LED 22, and a green-emitting LED 23. When red-emitting LED 21 is lit it indicates that the control circuit has detected a

lack of activity and that the keyboard has been disabled. The yellow-emitting LED 22 indicates that sterilisation is in progress. The green-emitting LED 23 indicates that the keyboard 4 has recently been sterilised and can be used to
5 input data.

The method of use of the apparatus of Figures 1 to 7 is illustrated in Figures 8A and 8B. Upon turning on the power supply in step 101, the control circuit initialises the system in step 102 and then detects in step 103 whether the
10 cover 3 is open and microswitch 7 is "off" or whether the cover 3 is closed and microswitch 7 is "on". If the cover 3 is open then the control circuit returns to the initialisation step 102 and red-emitting LED 21 lights up. On the other hand, if the control circuit detects that the
15 cover 3 is closed, then it disables the keyboard 4, checks that ultraviolet tube 14 is operational and has not burnt out or otherwise failed, and activates the ultraviolet tube 14 for a predetermined time, e.g. 15 seconds, in step 105. While this sterilisation step is taking place yellow-
20 emitting LED 22 is lit. On the other hand, if ultraviolet tube 14 has failed, red-emitting LED 21 remains lit thus indicating that sterilisation cannot proceed; in addition, keyboard 4 remains disabled. After sterilisation is complete the control circuit then enables the keyboard 4 in
25 step 106 and green-emitting LED 23 is lit, thus indicating that the keyboard 4 is ready to receive input by an operator. The control circuit continues to check whether the cover 3 is open in step 107. If the cover 3 is closed, then the control circuit returns to step 106. On the other
30 hand, if the cover 3 is open, then the control circuit starts a timer in step 108 and checks in step 109 whether the keyboard is active; that is to say the control circuit checks whether a keystroke has been made as a result of an
operator touching any of the keys 5 or the space bar 6, or
35 whether the operator has touched the touch pad, 8, buttons 9 or 10, or numeric pad, if present. The timer of step 108 is set to run for a predetermined period ranging from a few

seconds to a few minutes, for example from about 10 seconds to about 10 minutes, typically about 1 to 2 minutes, e.g. 60 seconds. If keyboard activity is detected in step 109 then the control circuit returns to step 108 but, if no such activity is detected, then the control circuit disables the keyboard in step 110 and causes red-emitting LED 21 to be lit so as to indicate to a user that the keyboard has been disabled and cannot receive input until cover 3 is closed and keyboard 4 has been sterilised again. The control circuit waits for cover 3 to be closed sufficiently to activate microswitch 7 before ultraviolet light tube 14 is lit for a predetermined time, for example 15 seconds, in order to sterilise keyboard 4. Red-emitting LED 21 is then switched off and yellow-emitting LED 22 is lit while sterilisation is taking place, whereafter LED 22 is extinguished and green-emitting LED 23 is lit to indicate that the keyboard 4 is again ready to receive input from a user.

In experiments it has been shown that irradiation of a surface seeded with *E coli* cells with ultraviolet light with a wavelength of 254 nm produces a 99.9% kill of *E coli* at a dose of 90 J/m². Further experiments have demonstrated that, upon exposure of a flat membrane computer keyboard, which has been deliberately seeded with MRSA, to ultraviolet light of wavelength 254 nm, a 10 second exposure is sufficient to kill over 99.5% of the MRSA colonies.

Figure 9 is a block diagram of the electronic control system for the apparatus illustrated in Figures 1 to 7. Within the keyboard enclosure 201 there are provided the keyboard 4, the touch pad 8, and the display panel 20. The control electronics 202, i.e. the control circuit mentioned above, which is mounted in body 2 interacts with the keyboard 4, touch pad 8, and display panel 20 as described above, and also with the computer or with a network interface 203 by means of which it is connected to the PC or other computer at the workstation where the apparatus 1 is located and with any other computers on the network.

Ultraviolet tube 14 is connected via ballast 204 to an external power supply 205, which may be, for example, a 240 volt 50 Hz AC supply or a 110 volt 60 Hz AC supply.

CLAIMS:

1. An input apparatus for a computer comprising:
a body;
a cover pivotally attached to a rear part of the body
5 for pivotal movement about a pivot axis between an open
position and a closed position, the body and the cover
together defining in the closed position of the cover an
enclosure;
a digitally operable computer input device mounted to
10 the body so as to lie within the enclosure when the cover is
in its closed position; and
an ultraviolet light source disposed so as to permit
illumination of the digitally operable computer input device
when the cover is in its closed position.
- 15 2. An apparatus according to claim 1, wherein the
digitally operable computer input device comprises a
computer keyboard.
3. An apparatus according to claim 2, wherein the computer
keyboard is covered with a sterilisable membrane.
- 20 4. An apparatus according to any one of the preceding
claims, wherein the digitally operable computer input device
is covered with a membrane with antimicrobial properties.
5. An apparatus according to any one of the preceding
claims, wherein the digitally operable computer input device
25 comprises a touch pad.
6. An apparatus according to any one of the preceding
claims, wherein the ultraviolet light source is mounted in
the rear part of the body.
7. An apparatus according to any one of the preceding
30 claims, wherein the ultraviolet light source comprises a
tubular ultraviolet light source.
8. An apparatus according to claim 7, wherein the tubular
ultraviolet light source has an axis which is arranged to be
substantially parallel to the pivot axis.
- 35 9. An apparatus according to claim 7, wherein the tubular
ultraviolet light source has an axis which is arranged to be
substantially aligned with the pivot axis.

10. An apparatus according to any one of the preceding claims, wherein the under face of the cover is provided with a reflective surface.

11. An apparatus according to claim 10, wherein the under
5 face of the cover has a polished finish.

12. An apparatus according to any one of the preceding claims, which further includes a control circuit which is arranged to detect keyboard activity and, in the absence of any keyboard activity within a predetermined period, to
10 disable the keyboard until the cover has been closed and the ultraviolet light source actuated for a predetermined time to sterilise the computer input device.

13. An apparatus according to claim 12, wherein the predetermined period is from about 1 minute to about 2
15 minutes.

14. An apparatus according to claim 12 or claim 13, wherein the predetermined time is from about 10 seconds to about 20 seconds.

15. An apparatus according to any one of the preceding
20 claims, wherein a shield is operably connected to the cover and is movable therewith for shielding the ultraviolet light source from view when the cover is moved away from its closed position and for exposing the digitally operable input device to the ultraviolet light source when the cover
25 is in its closed position and the ultraviolet light source is actuated.

16. An apparatus according to claim 15, wherein the shield is rigidly connected to the cover.

17. An apparatus according to claim 15 or claim 16, wherein
30 the rear part of the body includes a forward lip which defines together with the keyboard a gap for passage of ultraviolet light into the enclosure when the cover is in its closed position and the ultraviolet light source is actuated and wherein the shield is arranged to block the gap
35 when the cover is in its open position.

18. An apparatus according to any one of the preceding claims, wherein a microswitch is positioned so that an

operating button thereof is disposed in the path of the cover so as to act as a position sensor for the cover.

19. An apparatus according to any one of the preceding claims, further including a display panel including LEDs to
5 indicate whether the keyboard is inactive, is being sterilised, and/or is available after sterilisation for input of data by an operator.

Application No: GB0702453.2

Examiner: Mr Marc Collins

Claims searched: 1-19

Date of search: 22 May 2007

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	GB 2422807 A (MILLER)
A	-	GB 2421220 A (MEDISAFE TECHNOLOGIES (EUROPE) LIMITED)
A	-	WO 99/38540 A1 (ROBERTS)
A	-	US 6458331 B1 (ROBERTS)
A	-	US 6278122 B1 (GAGNON)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X:

A5G; B6F

Worldwide search of patent documents classified in the following areas of the IPC

A61L; B41J; G06F

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI

International Classification:

Subclass	Subgroup	Valid From
A61L	0002/10	01/01/2006

17

Subclass	Subgroup	Valid From
A61L	0002/24	01/01/2006
G06F	0003/02	01/01/2006