(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 June 2015 (11.06.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/085329 A1

(51) International Patent Classification:
H02H 3/20 (2006.01)

(21) International Application Number:
PCT/ZA2014/000053

(22) International Filing Date:
29 September 2014 (29.09.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2013/09086 4 December 2013 (04.12.2013) ZA

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) **Title**: A SURGE PROTECTION DEVICE

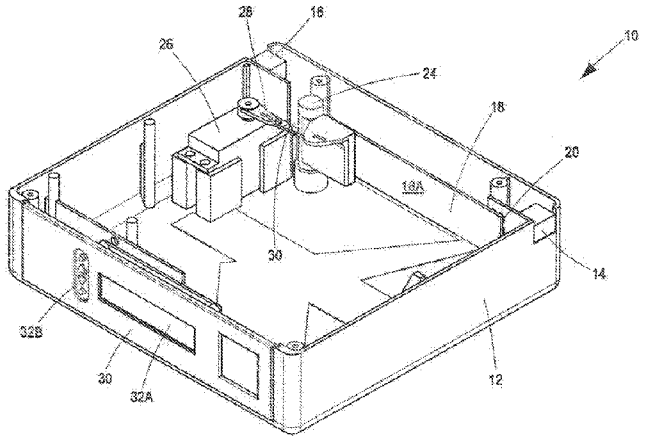

Figure 2

(57) **Abstract**: This invention relates to a surge protection device (10). More specifically, the invention relates to a surge protection device for protecting electronic equipment against damage from high voltage spikes induced in power, television/satellite and/or telecommunication lines arising mainly from localised lightning strikes. The surge protection device Includes a housing (12) with a plurality of input and output sockets(14, 16) for connecting to inputs (i.e. power, TV antenna, etc.) and outputs (i.e. electronic equipment): respectively. The device further includes a switch (18) for electrically connecting and disconnecting the input sockets (14) from the output sockets (16), the switch (18) comprising stationary contacts (20) and movable contacts (22) located on a movable switch arm (18A), the movable arm (18A) being movable between a connected state wherein the stationary (20) and movable contacts(22) are in electrical connection with one another, and a disconnected state, wherein the stationary (20) and movable contacts (22) are displaced from one another to form an air gap there between. The device (10) further includes a motor (26) for moving the movable switch arm (18A), a controller for actuating operation of the motor (26) and a detector for detecting; an event thereby to trigger operation of the controller.

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A SURGE PROTECTION DEVICE

BACKGROUND OF THE INVENTION

THIS invention relates to a surge protection device. More specifically, the invention relates to a surge protection device for protecting electronic equipment against damage from high voltage spikes induced in power, television/satellite and/or telecommunication lines arising from localised lightning strikes.

For decades man has grappled with the unpredictable damaging effects of lightning on electrical equipment. With our dependency on connected electronic equipment ever increasing, we have continually become more vulnerable to damage caused by lightning.

Lightning often induces high voltages in ground based infrastructure, even without a direct ground strike occurring. A cloud to cloud strike in the sky can induce voltages in wires such as telecommunications and power cables lying parallel to the ground. A direct ground strike in the vicinity of cabling will also induce high voltages at the strike point.

These high voltages then travel outwards from the source along the wiring, becoming lower in intensity as the surge travels outwardly there from, until completely dissipating. The distance required to completely dissipate the surge energy is entirely unpredictable, varying with the energy intensity of the strike, the nature of the terrain and cabling infrastructure present.

Steps to counter the effects of lightning have not kept pace with the proliferation of devices and our dependency on technology. In fact, today's devices have become are more vulnerable than the devices of the past, with operating voltages of present day devices being far lower than in the past, making such devices more sensitive to damaging high voltage transients.

Very often the best surge protection devices available fail as a result of the high voltages induced by lightning arcing right through the protection devices, destroying

them as well as the electronic equipment they were meant to protect. Conventional surge protectors are more effective when the protected line is carrying higher voltages. Here a combination of discharge tubes, transorbs and metal oxide varistors are employed to divert energy spikes safely to earth when the voltage increases beyond a safe limit.

However, the aforementioned devices are not as effective when protecting sensitive low voltage electronic equipment, due to their inherently slow response and due to the fact that the effective voltage ranges remain too high for the equipment.

It appears that the only safe, certain way to protect electronic equipment from lighting damage is to physically unplug them, thereby disconnecting them from the source of lightning induced high voltages. However, this is very inconvenient and requires someone to be physically present at the start of a lightning storm to unplug the equipment. Various attempts have been made over the years to build better surge protection devices, with some previous products using relays or solenoids to disconnect circuits and others aimed specifically at physically unplugging the electronic equipment from the wall.

Some such devices are described in US patent no. 5,453,899. In one embodiment described in the aforementioned patent document, the device operates to retract a plug out of the wall socket thereby physically unplugging the electronic equipment. Although effective, this solution remains inconvenient requiring someone to reconnect the equipment by physically plugging the plug back into the wall socket.

In an attempt to solve this inconvenience, subsequent embodiments described in the aforementioned patent include means for disconnecting and automatically reconnecting the plugs through the use of solenoids. However solenoids and relays are typically ineffective with the gap created between the contacts in a disconnected state being too small, enabling high voltage transient simply to arc across the gap.

It is therefore an object of the present invention to provide a surge protection device having a means for detecting lightning activity and means for switching contacts between disconnected and connected states, with the device configured to enable a

sufficiently safe distance to be defined between contacts in the disconnected state yet compact enough for domestic or similar use.

SUMMARY OF THE INVENTION

According to the invention there is provided a surge protection device including:

a housing;

one or more input sockets into which power, television antenna, satellite and/or data inputs are connectible;

one or more output sockets into which electronic equipment is connectible;

a switch for electrically connecting and disconnecting the input sockets from the output sockets, the switch comprising:

one or more stationary contacts; and

one or more movable contacts, the movable contacts being located on a movable switch arm movable between a connected state, wherein the stationary and movable contacts are in electrical connection with one another; and a disconnected state, wherein the stationary and movable contacts are displaced from one another to form an air gap there between;

a motor for moving the movable switch arm between the connected and disconnected states;

a detector for detecting the presence of an electric storm, and/or for detecting an input signal at the one or more input sockets; and

a controller for controlling the motor, the controller being triggerable by the detector so as to:

actuate movement of the motor towards the disconnected state on:

(i) detection of the presence of an electric storm; and/or

(ii) detection of the absence of an input signal at the one or more input sockets; and

actuate movement of the motor towards the connected state where:

(i) the presence of an electronic storm is not detectible; and/or

(ii) signal to the one or more input sockets is restored.

The surge protection device includes a power source for powering the surge protection device.

Preferably, the switch arm is a pivotally displaceable, the switch arm being pivotally movable between the connected and disconnected states about a pivot formation located within the housing.

Typically, the switch arm is pivotally displaceable between the connected and disconnected states from 0 degrees to about 90 degrees respectively. Generally, from 0 degrees to about 80 degrees. Preferably, from 0 degrees to about 70 degrees.

The air gap, being the distance between the stationary and movable contacts with the switch arm in the disconnected state, may be as little as 20 millimetres in applications where the transient voltages are known to be limited (i.e. less than 22 kilo volts). In applications where transient voltages are higher or unknown as in the case of telecommunication lines, the air gap is preferably 115 millimetres, or where very high

voltages may be found more preferably between 115 to 300 millimetres and most preferably between 115 to 500 millimetres.

It will be appreciated that the surge protection device may be scaled up to any size, but is preferably within the aforementioned dimensions for domestic or similar applications, i.e. small business.

The switch arm is typically made from a resiliently deformable material, flexible enough to take up any small tolerance inconsistencies, while stiff enough to apply sufficient force between the contacts in the connected state. A suitable material from which the switch arm may be made is fibreglass or, specifically to ease construction, woven glass and epoxy printed circuit board (PCB).

The surge protection device may include secondary stationary contacts to which the movable contacts are electrically connectable in the disconnected state, thereby to connect the output sockets to a secondary circuit, for example, an alternative power and/or data source.

In one alternative embodiment, any one or more of the contacts may be spring loaded.

The motor comprises a pivotally displaceable drive arm being connectible to the switch arm directly, or preferably indirectly by a drive linkage. It will be appreciated that the pivot axes of the drive arm and switch arm, as well as the connection points of the drive linkage on the drive arm and switch arm are configured relative to one another such that a torque multiplier is created for converting a rotational movement of the switch arm into a small linear movement just prior to the switch arm coming completely to rest in the connected state.

The detector is preferably an electromagnetic energy detector for detecting electromagnetic energy arising from an electric storm. The detector, or a secondary detector, may be a detector for detecting the presence of power and/or signal at the input sockets.

The controller is typically a programmable processor, preferably a microprocessor.

The surge protection device further includes a user input means for enabling input, amongst other inputs, of a safe zone and/or a safe time delay for triggering movement of the motor towards the connected and/or disconnected states.

Typically, the safe zone is defined by a radius about the surge protection device within which detection of the presence of an electric storm triggers movement of the motor and consequently the switch arm to move towards the disconnected state.

Generally, the safe time delay is the amount of time lapsing in use between: (i) the presence of an electric storm no longer being detectible by the detector within the safe zone; and/or (ii) the presence of an input signal being detected by the detector after a period of the input signal being absent; and the triggering of the motor to move the switch arm back towards the connected state, the time being resettable on detection of the presence of an electric storm or absence in input signal. The safe time delay may be timed by a timer, independent of or built into the microprocessor.

Preferably, the microprocessor comprises means for analysing an electromagnetic pulse receivable from the detector to determine whether or not the electromagnetic pulse is as a result of a lightning strike or otherwise. Typically, the analysing means is one or more algorithms.

In a particularly preferred embodiment of the invention, detection by the detector of an electric storm, in the safe zone or otherwise, and/or detection by the detector of the absence of an input signal, causes the surge protection device to output a warning signal. The warning signal may be a visual output and/or an audible output.

Typically, the visual output is a warning displayed on the display or screen, and/or a flashing warning light, and the audible output is an alarm. Alternatively or jointly with the aforementioned visual and audible outputs, the warning signal may be a telecommunications output signal outputted by a transmitter to a mobile telecommunications device of the user. The warning signal may include information about an incoming storm and/or the absence of input signal, together with the likelihood of impending disconnection and timing information.

Preferably, the surge protection device includes a receiver for receiving a telecommunications input signal from the user's mobile telecommunications device. The telecommunications input may cause the microprocessor to actuate the motor to move towards the disconnected state.

Typically, the motor includes positional feedback control. Generally, the motor includes a gearbox. The motor may be a linear motor or a rotary motor. Furthermore, the motor may be electrically driven or fluid driven. Preferably, the motor is a stepper motor. More preferably, the motor is a servomotor.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a surge protection device in accordance with a preferred embodiment of the present invention;

Figure 2 is a perspective view of the surge protection device of figure 1 with the housing lid removed there from;

Figure 3 is a top view of the surge protection device of figure 2 with the switch in the connected state;

Figure 4 is a top view of the surge protection device of figure 2 with the switch in an intermediate position between the connected and disconnected states; and

Figure 5 is a top view of the surge protection device of figure 2 with the switch in the disconnected state.

DETAILED DESCRIPTION OF THE DRAWINGS

A surge protection device according to a preferred embodiment of the invention is designated generally in figure 1 with reference numeral 10. With reference now also to figure 2, the surge protection device includes a housing 12 with a housing lid 12A, an input socket 14, an output socket 16 and a switch 18 located between the input socket 14 and the output socket 16.

With reference now also to figures 3 to 5, the switch 18 comprises stationary contacts 20 and movable contacts 22 located on a switch arm 18A of the switch 18, the switch arm 18A being pivotally displaceable about a pivot formation 24 between a connected state, wherein the stationary and movable contacts are in electrical connection with one another (see figure 3), a disconnected state, wherein the stationary and movable contacts are displaced from one another to form an air gap there between (see figure 5).

Although it may be possible to move the movable contacts relative to the stationary contacts in many other ways (i.e. linearly), it is preferable that the movement is pivotal thereby to define a substantial air gap (that is direct distance between the movable and stationary contacts in the disconnected state), while at the same time keeping the surge protection device 10 compact for domestic and other similar applications.

The switch arm 18A is pivotally movable between the connected and disconnected states by a motor, preferably a servomotor 26, having a pivotally displaceable drive arm 28 connected to the switch arm 18A via a drive linkage 30.

It will be appreciated that the motor may be any type of linear or rotary motor having positional feedback control. Furthermore, the motor may have a gearbox and driven electrically (i.e. a stepper motor) or by fluid (i.e. vacuum or hydraulic actuator). Servomotors inherently consists of a motor, a gearbox and feedback control for controlling angular position, acceleration and speed and as such, is a suitable choice for this application.

To obtain a sufficiently sized air gap to reduce the possibility of arcing between disconnected contacts (about 20 millimetres for low voltage transient voltages, or between 115 to 500 millimetres for higher voltage transient voltages), the switch arm 18A is pivotally displaceable between the connected and disconnected states from 0 degrees to about 90 degrees respectively. It will be appreciated that the switch arm 18A may not be required to pivot by a full 90 degrees (for example only by 70 to 80 degrees) to obtain the required air gap.

The switch arm 18A is preferably made from a resiliently deformable material, flexible enough to take up any small tolerance inconsistencies, while possessing sufficient tensile strength to apply sufficient force between the contacts 20,22 in the connected state. A suitable material from which the switch arm 18A may be made is fibreglass, or for example, strips of woven glass and epoxy printed circuit board (PCB).

The surge protection device 10 includes a detector, more particularly an electromagnetic energy detector (not shown) for detecting the presence of an electric storm. Furthermore, the surge protection device 10 includes a controller, preferably in the form of a programmable microprocessor (not shown) for receiving one or more inputs and outputting one or more outputs, for example, a servomotor output to cause the servomotor to displace the switch arm 18A towards the connected and/or disconnected states.

One such input is user type inputs, including a safe zone input and a safe time delay input. Typically, the surge protection device 10 includes a user input means 32 through which the microprocessor is programmable. The user input means 32 may be in the form of a display 32A (i.e. a liquid crystal display) and a plurality of input buttons 32B as illustrated, or some other user input means, for example, a touch screen.

A user, depending on his needs, the typography of his location and the cable infrastructure in his vicinity may customise the safe zone and the safe time delay. The safe zone may be programmed by selecting a radius around the surge protection device 10 defining the safe zone within which the microprocessor must actuate the servomotor 26 to the disconnected state where the presence of an electric storm within the safe zone is detected by the detector. It will be appreciated that the output of the

detector is another form of input into the microprocessor and the trigger event causing movement of the switch arm 18A from the connected state to the disconnected state.

The safe time delay may be programmed by selecting an amount of time that should lapse between the presence of an electric storm no longer being detected in the safe zone and the triggering of the servomotor 26 by the microprocessor to move the switch arm 18A from the disconnected state back towards the connected state.

It will be appreciated that the time will be automatically reset every time the detector detects the presence of an electric storm within the safe zone. It will be appreciated further that the time may be counted by an independent timer or a timer built into the microprocessor, and that the output of such timer is yet another input into the microprocessor.

The microprocessor further includes means for analysing the electromagnetic pulse input received from the detector to determine whether or not the electromagnetic pulse input is as a result of a lightning strike or otherwise. On confirmation of the electromagnetic pulse input being as a result of a lightning strike, the microprocessor will trigger actuation of the servomotor 26 to move the switch arm 18A towards the disconnected state. Typically, the analysing means in the microprocessor is one or more algorithms.

It will be appreciated that the surge protection device 10 may be powered by an independent power source, for example a battery which is rechargeable by the mains when the surge protection device 10 is in the connected state.

During installation, the incoming line(s) (i.e. telephone / data lines, television antenna, satellite antenna, etc) is connected into the input socket 14 of the surge protection device 10. The electrical equipment to be protected (i.e. telephone, television, computer, modem, satellite tuner, etc.) is connected to the output socket 16 of the surge protection device 10. The user may then program his required safe zone and safe time delay into the microprocessor through the user input means 32A,32B.

Where the device is configured to protect against surges present on electrical supply lines (i.e. mains), the power source is connected into the input socket 14 of the surge protection device 10. The electrical equipment to be protected is connected to the output socket 16 of the surge protection device 10. The user may then program his required safe zone and safe time delay into the microprocessor through the user input means 32A,32B.

In use, and as illustrated in figure 3, the switch 18 remains in the connected state with no electric storm being detected within the safe zone by the detector. In the connected state, the electrical equipment is connected to the power and/or data sources.

A warning signal may be outputted by the surge protection device 10 on detection of an electric storm within the safe zone or otherwise. The warning signal may be outputted as:

- a visual output in the form of a textual output on the display 32A or flashing thereof;
- a visual output in the form of a flashing light on the surge protection device 10;
- an audible output in the form of an alarm; and/or
- a telecommunications output signal outputted by a surge protection device transmitter to a mobile telecommunications device of the user.

Furthermore, the surge protection device 10 may also include a receiver for receiving a telecommunications input signal from the user's mobile telecommunications device for, as an example, remotely actuating the servomotor to move towards the disconnected state in an event other than a lightning threat, i.e. a hacking threat.

In the event of the detector detecting the presence of an electric storm within the safe zone, the microprocessor triggers actuation of the servomotor 26 to actuate pivotal displacement of the switch arm 18A from the connected state towards the disconnected state as illustrated in figure 4 and 5. The friction of the servomotor 26 is sufficient to hold the switch arm 18A in the disconnected state, thereby enabling the servomotor 26 to be optionally switched off in this position.

In the disconnected state, the electrical equipment is disconnected from the power and/or data sources, thereby safe-guarding them from high voltage spikes induced into the cable infrastructure by lightning activity.

The detector continually scans the safe zone for the presence of an electric storm and, on the presence of an electric storm no longer being detectible within the safe zone, the timer begins to count down the pre-programmed safe time delay. Once the safe time delay has lapsed, the microprocessor actuates the servomotor 26 so as to cause the switch arm 18A, a large throw switch arm, to pivotally displace towards the connected state, thereby safely reconnecting the electrical equipment to the power and/or data source.

The servomotor 26, the drive arm 28, drive linkage 30, switch arm 18A and the axes about which the drive arm 28 and the switch arm 18A are pivotally displaceable are configured and laid out relative to one another thereby to create a very particular motion, torque and force.

The angular displacement of the drive arm 28 is converted to a reduced angular displacement of the switch arm 18A via the drive linkage 30. Furthermore, the angular displacement of the drive arm 28 and the switch arm 18A, in the final moments of movement into the connected state, is converted to a very small linear motion toward the contacts 20. Accordingly, a torque multiplier effect is created, providing the required torque to retain the switch arm 18A in the connected state.

A further feature of this configuration and layout is that when the switch arm 18A is in the connected state, where maximum force is required between the contacts 20,22, all moving parts are stopped in perfect alignment under compression, such that there is no load on the servomotor 26. In this position, the servomotor 26 may be turned off by the microprocessor to extend its useful life and to save power.

Although the invention has been described above with reference to preferred embodiments, it will be appreciated that many modifications or variations of the invention are possible without departing from the spirit or scope of the invention.

For example, an alternative embodiment of the device may include, as a supplementary or alternative feature of the detector described herein before, a detector for detecting the presence or absence of an input signal (i.e. power) at the input sockets. On detection of an absence of input signal (i.e. power from mains being cut), the contacts are moved to the disconnected state, fro example, by an on-board reserve power supply.

On detection of restoration of input signal at the input sockets, the contacts are moved to the connected state either immediately or after a sufficient predetermined period of time.

It will be appreciated that although drive means other than a servomotor may be employed, the servomotor provides a high speed response for disconnecting the contacts from one another.

Although the surge protection device may be scaled up to any size, it is preferable that it remains the described dimensions for domestic use or other similar applications (i.e. for small businesses).

The surge protection device may further include secondary stationary contacts to which the movable contacts are electrically connectable in the disconnected state, thereby to connect the output sockets to a secondary circuit, for example, an alternative power and/or data source.

The surge protection device may further include a means of monitoring power from the mains. In this manner, in the event of power being restored after a power outage, the switch might be restored to the connected state after the lapse of the safe time delay thereby to prevent exposure of the electrical equipment to any power surges caused by the restoration of the power.

CLAIMS

1. A surge protection device including:

a housing;

one or more input sockets into which power, television antenna, satellite and/or data inputs are connectible;

one or more output sockets into which electronic equipment is connectible;

a switch for electrically connecting and disconnecting the input sockets from the output sockets, the switch comprising:

one or more stationary contacts; and

one or more movable contacts, the movable contacts being located on a movable switch arm movable between a connected state, wherein the stationary and movable contacts are in electrical connection with one another; and a disconnected state, wherein the stationary and movable contacts are displaced from one another to form an air gap there between;

a motor for moving the movable switch arm between the connected and disconnected states;

a detector for detecting the presence of an electric storm, and/or for detecting an input signal at the one or more input sockets; and

a controller for controlling the motor, the controller being triggerable by the detector so as to:

actuate movement of the motor towards the disconnected state on:

(i) detection of the presence of an electric storm; and/or

(ii) detection of the absence of an input signal at the one or more input sockets; and

actuate movement of the motor towards the connected state where:

(i) the presence of an electronic storm is not detectible; and/or

(ii) signal to the one or more input sockets is restored.

2. The surge protection device according to claim 1 including a power source for powering the surge protection device.

3. The surge protection device according to claim 1 or claim 2, wherein the switch arm is pivotally displaceable, the switch arm being pivotally movable between the connected and disconnected states about a pivot formation located within the housing.

4. The surge protection device according to claim 3, wherein the switch arm is pivotally displaceable between the connected and disconnected states from 0 degrees to about 90 degrees respectively.

5. The surge protection device according to claim 3, wherein the switch arm is pivotally displaceable between the connected and disconnected states from 0 degrees to about 80 degrees respectively.

6. The surge protection device according to claim 3, wherein the switch arm is pivotally displaceable between the connected and disconnected states from 0 degrees to about 70 degrees respectively.

7. The surge protection device according to any one of claims 3 to 6, wherein the air gap, being the distance between the stationary and movable contacts with the switch arm in the disconnected state, is 20 millimetres.

8. The surge protection device according to any one of claims 3 to 6, wherein the air gap, being the distance between the stationary and movable contacts with the switch arm in the disconnected state, is about 115 millimetres.

9. The surge protection device according to any one of claims 3 to 6, wherein the air gap, being the distance between the stationary and movable contacts with the switch arm in the disconnected state, is between about 115 and 300 millimetres.

10. The surge protection device according to any one of claims 3 to 6, wherein the air gap, being the distance between the stationary and movable contacts with the switch arm in the disconnected state, is between about 115 and 500 millimetres.

11. The surge protection device according to any one of claims 7 to 10, wherein the switch arm is resiliently deformable.

12. The surge protection device according to claim 11, wherein the surge protection device may include secondary stationary contacts to which the movable contacts are electrically connectable in the disconnected state, thereby to connect the output sockets to a secondary circuit and/or alternative power and/or data source.

13. The surge protection device according to claim 12, wherein any one or more of the contacts may be spring loaded.

14. The surge protection device according to claim 13, wherein the motor comprises a pivotally displaceable drive arm being connectible to the switch arm directly, or indirectly by a drive linkage.

15. The surge protection device according to claim 14, wherein the detector is an electromagnetic energy detector for detecting electromagnetic energy arising from an electric storm.

16. The surge protection device according to claim 14 or claim 15, wherein the detector, or a secondary detector, is a detector for detecting the presence of power and/or signal at the input sockets.

17. The surge protection device according to claim 15 or claim 16, wherein the controller is a programmable microprocessor.

18. The surge protection device according to claim 17, wherein the surge protection device further includes a user input for enabling input of at least a safe zone and/or a safe time delay for triggering movement of the motor towards the connected and/or disconnected states.

19. The surge protection device according to claim 18, wherein the safe zone is defined by a radius about the surge protection device within which detection of the presence of an electric storm triggers movement of the motor and consequently the switch arm to move towards the disconnected state.

20. The surge protection device according to claim 19, wherein the safe time delay is the amount of time lapsing in use between: (i) the presence of an electric storm no longer being detectible by the detector within the safe zone; and/or (ii) the presence of an input signal being detected by the detector after a period of the input signal being absent; and the triggering of the motor to move the switch arm back towards the connected state, the time being resettable on detection of the presence of an electric storm or absence in input signal.

21. The surge protection device according to claim 20, wherein the safe time delay is timed by a timer, independent of or built into the microprocessor.

22. The surge protection device according to claim 21, wherein the microprocessor comprises means for analysing an electromagnetic pulse receivable from the detector to determine whether or not the electromagnetic pulse is as a result of a lightning strike or otherwise.

23. The surge protection device according to claim 22, wherein the analysing means is one or more algorithms.

24. The surge protection device according to claim 23, wherein the user input is a display and one or more buttons for inputting the user inputs.

25. The surge protection device according to claim 24, wherein the user input is a touch screen.

26. The surge protection device according to claim 23 or 24, wherein detection of by the detector of an electric storm, in the safe zone or otherwise, and/or detection by the detector of the absence of an input signal, causes the surge protection device to output a warning signal.

27. The surge protection device according to claim 26, wherein the warning signal is a visual output and/or an audible output.

28. The surge protection device according to claim 27, wherein the visual output is a warning displayed on the display or screen and/or a flashing warning light, and the audible output is an alarm.

29. The surge protection device according to any one or more of claims 26 to 28, wherein the warning signal is a telecommunications output signal outputted by a transmitter to a mobile telecommunications device of the user.

30. The surge protection device according to claim 29 including a receiver for receiving a telecommunications input signal from the user's mobile telecommunications device.

31. The surge protection device according to claim 30, wherein telecommunications input causes the microprocessor to actuate the motor to move towards the disconnected state.

32. The surge protection device according to any one of the preceding claims wherein the motor includes positional feedback control and/or a gearbox.

33. The surge protection device according to claim 32, wherein the motor is a linear motor or a rotary motor, the motor being driven electrically or by fluid.

34. The surge protection device according to claim 33, wherein the motor is a stepper motor.

35. The surge protection device according to claim 33, wherein the motor is a servomotor.

36. The surge protection device as herein described and illustrated.

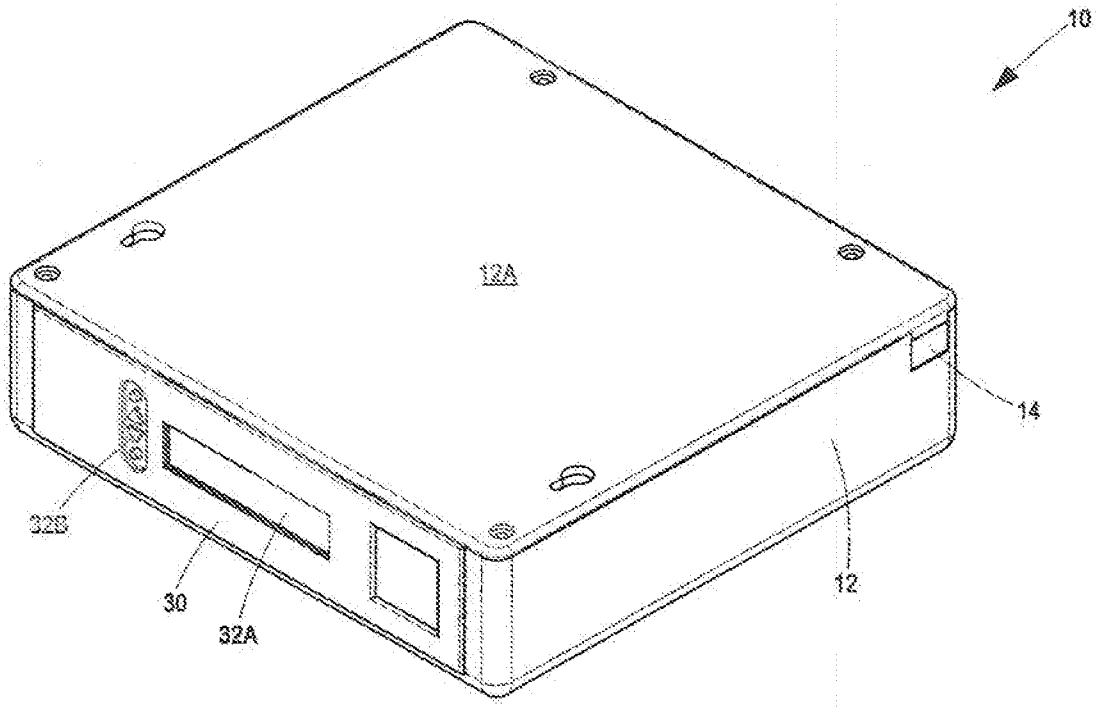

Figure 1

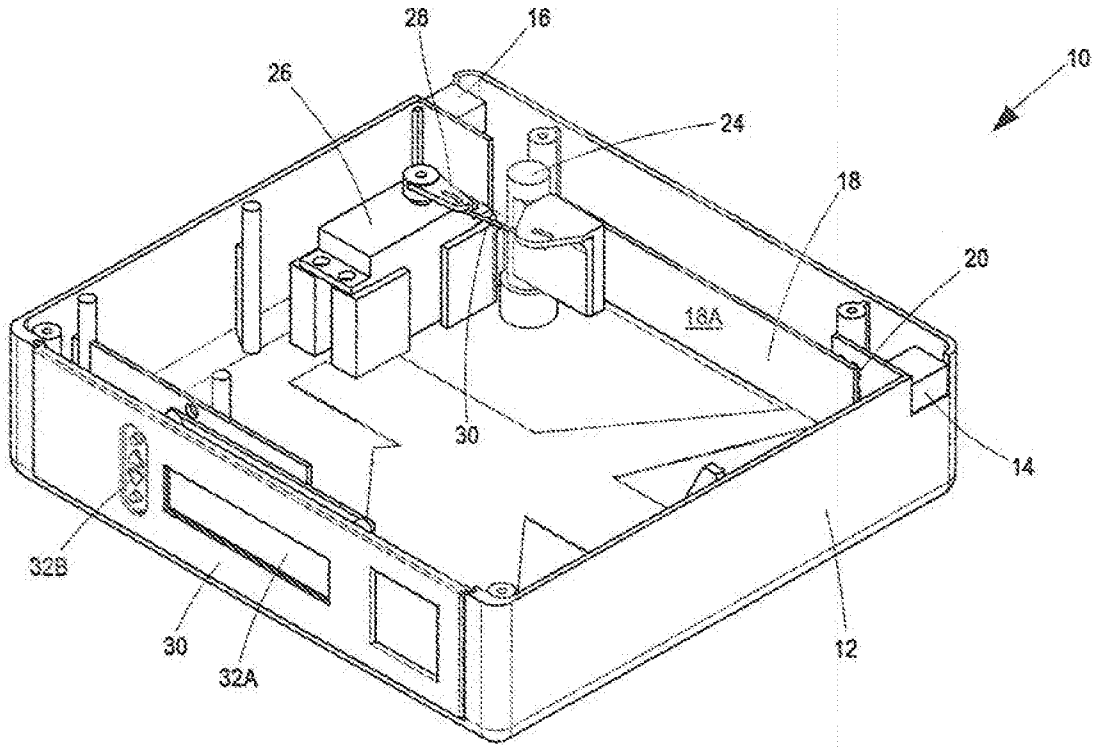

Figure 2

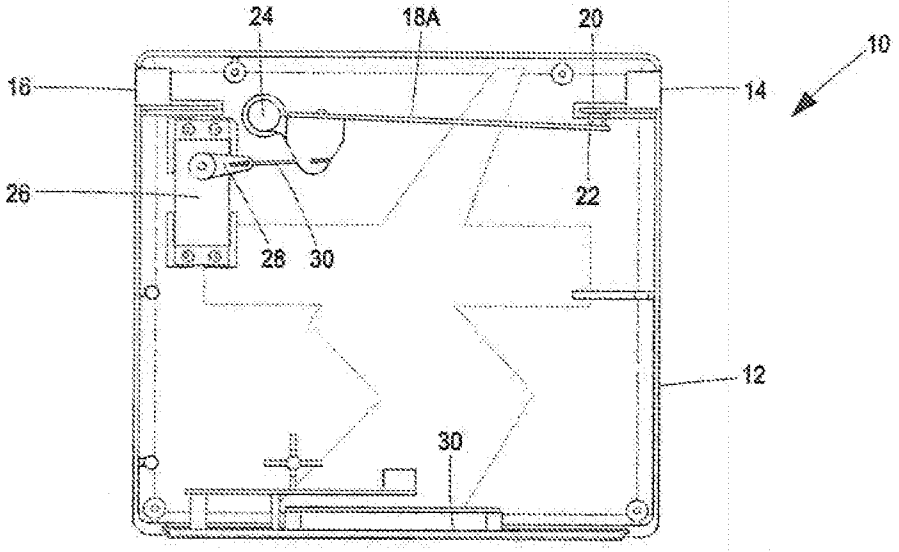

Figure 3

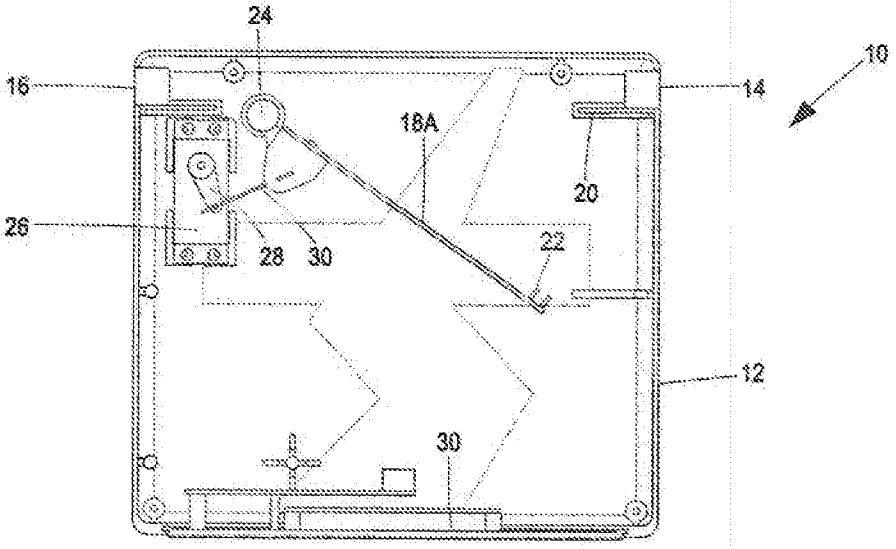

Figure 4

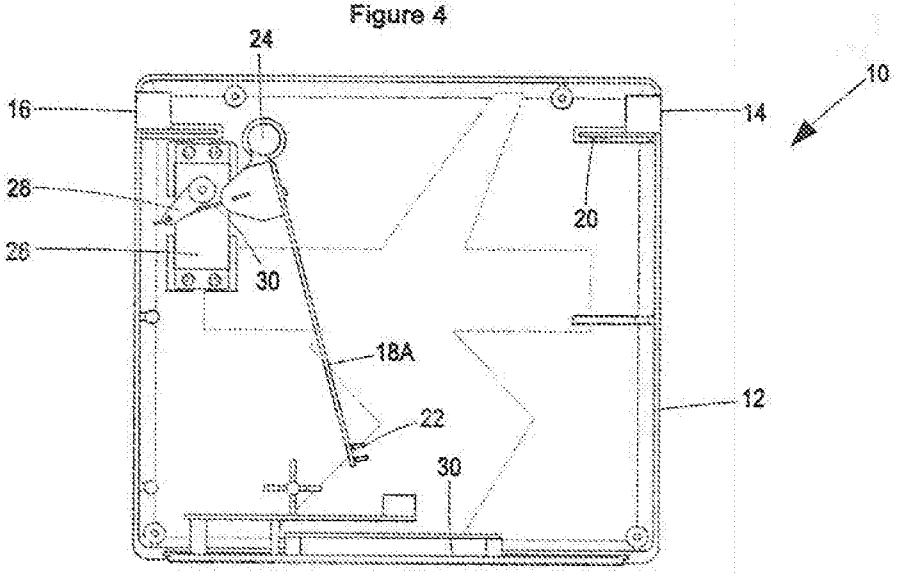

Figure 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT / ZA 2014/000053

A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***H02H 3/20*** (2006.01)

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)

H02H

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)

WPI, Epodoc, X-Full

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6061216 A (FUQUA et al.) 09 May 2000 (09.05.2000) claims 1 - 4	1 - 35
A	US 2009213518 A1 (DOMEJEAN ERIC et al.) 27 August 2009 (27.08.2009) abstract	1 - 35
A	US 2013088310 A1 (YANG GUANG et al.) 11 April 2013 (11.04.2013) abstract	1 - 35

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"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)

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 March 2015 (26.03.2015)	07 April 2015 (07.04.2015)
Name and mailing address of the ISA/AT	Authorized officer
Austrian Patent Office Dresdner Straße 87, A-1200 Vienna	PAVDI D.
Facsimile No. +43 / 1 / 534 24-535	Telephone No. +43 / 1 / 534 24-374

INTERNATIONAL SEARCH REPORT

International application No.

PCT / ZA 2014/000053

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.: 36
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:

The international search report has not been established in respect of claim 36 because this claim does not express any technical features of the invention. The claim is only written in a statement containing a reference to the description and the drawings.

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 additional fees, this Authority did not invite payment of additional fees.

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 and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT / ZA 2014/000053

Patent document cited in search report			Patent family member(s)			Publication date
US	A	6061216	US	A	6061216	2000-05-09
US	A1	2009213518	CN	A	101521128	2009-09-02
			ES	T3	2496668	2014-09-19
			FR	A1	2928026	2009-08-28
			US	A1	2009213518	2009-08-27
			EP	A1	2096657	2009-09-02
			BR	A2	PI0900690	2009-06-13
US	A1	2013088310	US	A1	2013088310	2013-04-11
			WO	A1	2013052069	2013-04-11
			US	A1	2013234809	2013-09-12
			US	A1	2014008189	2014-01-09