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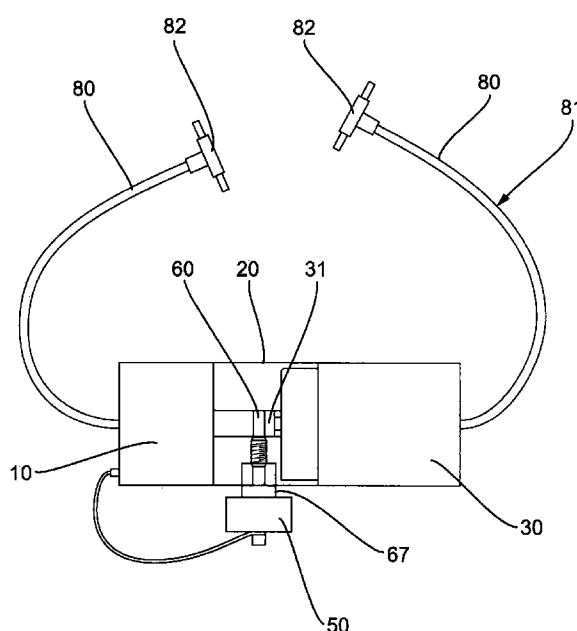
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(54) Title: A STORED VOLTAGE DISCHARGING DEVICE

Fig. 3



(57) Abstract: This invention relates to a device for safely discharging stored voltages and in particular the safe discharging of high voltage capacitors. The device once connected with the electrical connectors (82), provides a discharge pathway having an internal switching means. The switching means is held open by the insulative pin (50) which in use is removed by the operator at a timing and at a distance of their choosing, thus allowing a discharge pathway to be formed and any stored voltage to be discharged to ground. The device would principally be used by service engineers of electrical high voltage circuitry.



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A stored voltage discharging device

This invention relates to a device for safely discharging stored voltages and in particular the safe discharging of high voltage capacitors.

- 10 It is very common within electrical system design to have requirements for stored voltages to be provided or to be available when required. It is common to achieve this through the use of capacitors. In certain fields of use the stored electrical potential voltages can be significant and easily capable of delivering a harmful or lethal shock to anyone inadvertently causing the capacitor to discharge its stored voltage. There are a multitude of scenarios where this might occur but one situation where this
- 15 becomes more probable is during maintenance periods of the electrical circuit, this being primarily driven by the natural and necessary proximity of the maintainer or service person to the stored voltages.

- This drives a requirement to ensure that prior to accessing the circuit any stored voltages are dissipated such that the circuit is electrically safe to be operated upon. In some situations this may be achieved
- 20 through a natural wastage to the electrical earth terminal or by other means. However, often it may be the case that a service person will be unaware of the status of any capacitance type devices, they therefore would normally carry out a preventative discharging process to ensure any resident potential voltage is safely removed.

- 25 It is known in the art to use a device marketed by "SebaKMT" and termed "High Voltage Discharge Rod EST". This device employs a resistor bank such that the stored voltage is drawn into the resistor bank. This provides what is termed in the art as a damp discharge which describes a process whereby the stored voltage is gradually dissipated ultimately through heating of the of the resistor bank which can then impose a significant waiting period between usages. The problem with this type of discharging
- 30 device is that in a high voltage scenario the overall device is necessarily quite long and cumbersome, not easily useable in certain confined environments nor ideally suited to carriage by the service person. This device requires the operator, whilst physically holding the device, to place the contact points of the rod across the capacitor or as in the reference device connect one cable to a suitable grounding point and then still whilst holding the device touch the opposite side of the capacitor. Clearly in a high voltage
- 35 scenario this immediate proximity of the user to the point of stored electrical energy increases the potential for an inadvertent and dangerous electrical shock dissipation to occur.

The applicants previous method to overcome such issues was to use a capacitor discharging tool employing an electrically powered relay which must be connected across each side of the stored

5 voltage, the operator when ready would then press a push button activating the electrical relay closing the relay and making the electrical connection such that the stored energy can be dissipated to an electrical earthing point. The device as disclosed still has resident problems such as, the user still being proximal to the stored voltage and, its necessity of requiring its own extraneous power can be highly undesirable in certain electrical scenarios, as it may present a further local environmental hazard to sensitive componentry or indeed be inappropriate to the user environment. Furthermore, the disclosed device may be susceptible to either transient voltages causing potential inadvertent action of the relay and naturally a dangerous inadvertent dissipation of the stored voltage or, a failure or sub-standard power supply to the switching means may cause the discharging action to fail entirely.

15 There is therefore a need to provide a device that, can be easily carried by a service person, that discharges a stored voltage instantaneously, that can be re-used rapidly, can be used in confined or sensitive environments whilst being operable from an electrically and physically remote safe operator location and in a manner that will not allow for an inadvertent dissipation action until initiated by the user.

20 According to a first aspect of the invention there is provided a stored voltage discharging device comprising: means for connecting the device to the positive and negative nodes of a stored voltage; an electrical discharge pathway; having a biased switching means capable of moving between disconnected and connected positions; characterised in that; the switching means is held in the disconnected position by an electrically insulative pin arranged to counter oppose the biased movement of the switching means and capable of being extracted by an operator from an electrically remote position allowing the stored voltage to be dissipated.

An advantage of the device is that provides a direct electrical discharging pathway which upon connection of the switching means will rapidly dissipate the stored electrical energy to a user selected electrical ground or earthing point. This ensures that the device itself is not dissipating the energy and as such is quickly re-usable.

A further advantage of the device is that it minimises any risk of inadvertent operation of the switching means through use of the counter opposing pin. This provides assurance for the operator that the electrical discharge will not take place until desired. It also allows the initiation of the discharge to be commanded by the operator from an electrically and physically remote location providing greater safety for the operator.

5 A further advantage of the device is that its switching means and counter opposing pin are all mechanical in operation meaning there is no need for extraneous power sources. This allows the device to be more compact than it would otherwise be; allowing it to be more easily carried as a tool by a works person. The mechanical action provides added reliability over an electrically driven one as it is not susceptible to transient voltages and does not require a switch secondary power source which can of course fail. Importantly it also allows the device to be used in environments and situations where any additional power sources may be undesirable or potentially harmful to the surrounding environment.

15 Preferably the means for connecting the device to the positive and negative nodes of the stored voltage is provided by at least one flexible electrical connection wire. This has the advantage of making the connection of the device adjustable such that it can be used on a variety of sizes of electrical componentry.

20 Preferably the flexible electrical connection wire terminates in a biased clip connector. This has the advantage of making the connection and disconnection of the electrical component to be discharged a simple and swift task for the operator.

Preferably the switching means is biased to a connected position. This has the advantage that it makes the removal of the counter opposing pin the actual switch activation event and therefore does not require further additional urging through secondary power sources.

25 Preferably the switching means is biased with a spring. This has the advantage of being a simple and cost economical mechanical method of urging the contacts of the switch together.

30 Preferably the switching means is a single pole single throw switch. This has simplicity benefits that deliver cost and size advantages.

Preferably the device is at least partially enclosed within a device body. Having the device mounted inside a body helps the device to be carried and used as a tool by a works person.

35 Preferably the device body is constructed from an electrically insulative material. This has a distinct benefit that the electrical connection point is electrically isolated from the outside environment and any potential electrical arcing is contained inside the device body. This provides a further safety separation for the operator.

5 Preferably the switching means is at least partially enclosed within a chamber formed within the body of the device. This has the benefit of creating an internal environment, the composition of which can be modified and controlled such that the switching occurs in a specified environment. This may be beneficial if dealing with very high voltages and allows the device to be modified to suit the desired electrical application.

10 Preferably the chamber and switching means are visible through a transparent portion of body of the device. This has the advantage that in combination with the switching means being biased to a connected position, it is possible for the operator after the operation to confirm visually that the connection has been made and the stored voltage discharged.

Preferably the insulative pin has a safety screw thread coupling it to the body of the device. This has the
15 vast advantage of retaining the pin inside the tool and preventing any inadvertent extraction of the pin. This provides a further safety advantage to the operator.

Preferably the insulative pin has an attached extraction lanyard. This has the benefit of allowing the switch initiation to be carried out from a physically remote operator position providing further safety benefits to the operator.

20

One specific embodiment of the device will now be described by way of example only and with reference to the enclosed figures.

Where Fig 1 shows a perspective assembled view of one embodiment of the stored voltage discharging device.

25 Figure 2 shows an exploded perspective view of one embodiment of the stored voltage discharging device.

Figure 3 shows a plan view of one embodiment of the stored voltage discharging device.

Figure 4 shows a sectional view of one embodiment of the striker end assembly.

Figure 5 shows a plan view of one embodiment of stored voltage discharging device post operation.

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In Figure 1, an impact end body 10 is attached by a female screw thread (not shown) cooperating with a transparent middle body 20 having a male thread (not shown). Similarly the transparent middle body 20 having a female thread also (not shown) cooperates with a striker end assembly 30. An insulative pin 50 is attached to the impact end body as can be seen in Figure 2.

35

5 Figure 2, shows the insulative pin 50 which has a plurality of depressions 51 in order to provide an ergonomic grip for an operators fingers and is constructed from DELRINTM being an electrically insulative material. To one axial end of the insulative pin there is a retaining wire 52, that has been bent back upon itself so as to form a loop 53, this loop being crimped in place by a crimp 54 which is squeezed shut such that the retaining wire 52 terminates in the loop 53. The loop 53 of the retaining wire 52 is retained to one end of the insulative pin 50 by a screw fastener 55 mounted axially into the insulative pin 50. The opposite end of the retaining wire 52 is terminated with a crimped loop terminator 56, which is in turn then retained onto the impact end body 10, by a fastener 57 passing through the loop terminator 56 and being screwed into a female thread section 58 of the impact end body 10 also constructed from DELRINTM.

10

15 Passing longitudinally through the impact end body 10 are a series of clearance holes 11 that permit fasteners 12 to pass through the impact end body 10 until heads 13 of the fasteners 12 abut the opposing face of the impact end body 10. The opposite end of the fasteners 12 have a threaded portion (not shown) which are screwed into corresponding female threaded holes 14 of a large terminal 15 which is constructed of Copper. Tightening of the fasteners 12 pull and retain the large terminal 15 within a corresponding internal shoulder formed within the impact end body 10.

20

Figure 2 also shows the impact end body 10, having an axial clearance hole 16 which permits passage of a flexible electrical connection wire (not shown) which is physically and electrically conductively attached to the large terminal 15 at point 17.

Within the impact end body 10 is a female threaded portion (not shown) which cooperates to accept the transparent middle body 20 being constructed from a transparent insulative plastic and having an axial male threaded portion 21. This axial male threaded portion 21 has a further axial recess 22, which when the transparent middle body 20 is screwed into the impact end body 10 until the opposing faces of each abut each other, this encloses the large terminal 15 within an axial recess 22.

25

Passing axially through the transparent middle body is a central clearance hole 23 that is sized to permit travel, during operation of the device, of a sliding terminal 31 being part of a striker assembly 30.

30

Passing perpendicularly into the central clearance hole 23 is an access hole 24 having a threaded internal portion (not shown) that cooperates with the insulative pin 50 having a male threaded portion 59. When the insulative pin 50 is screwed into the access hole 24, until a shoulder portion 67 (as seen in Figure 3) of the insulative pin 50 abuts a perpendicular counter-bored shoulder face 25, of the transparent middle body 20, an end spigot portion 60 substantially occludes the central clearance hole 23 of the transparent middle body 20. The length of intrusion of the end spigot portion 60 into the central clearance hole 23 is greater than the length of the threaded section of the hole 24 of the transparent middle body.

35

- 5 The striker end assembly 30 has a travel guide 70 constructed from DELRIN™ and has an axial male threaded portion 71, this mechanically cooperates with a axial female threaded recess (not shown) within the opposing face of the transparent middle body 20 such that the two opposing faces abut each other. This encloses the sliding terminal 31 within the central clearance hole 23.
- 10 In figure 3 it can be seen that that upon insertion of the striker end assembly 30 into the transparent middle body 20, the sliding terminal 31 perpendicularly abuts the circumference of the end spigot portion 60. Wires 80 can be seen and are constructed of an electrically conductive wire material. The wires 80 are sheathed in a protective electrically insulating layer 81,. Electrical connectors 82 provide a quick and efficient connection means for connecting the device across a potential voltage to be
- 15 discharged.

Figure 4 shows a sectional view of the striker assembly 30. The assembly is comprised of a travel collar 70 made from DELRIN™, the sliding terminal 31,, a sliding terminal spring mount 32, a spring 33, a spring base collar 34 each respectively being constructed from a highly conductive material such as

20 Copper, and a striker end body 35 being constructed from a DELRIN™.

The striker end body 35 has an axial clearance hole 36, that permits passage of one of the wires 80 such that it can be physically and electrically connected by soldering to the spring base collar 34. The spring base collar 34 having been inserted along the axial hole 37 within the striker end body 35. The striker end body 35 has a perpendicular hole 38 that has a threaded portion to accept a grub screw (not shown)

25 that is used to protrude into a corresponding recess 39 within the spring base collar 34 such that its relative position along the axial hole 37 is fixed.

The spring base collar 34 has a concentric shoulder portion 40 that is sized to be inserted within the inner diameter of the spring 33 once it has been inserted along the axial hole 37. Similarly the sliding terminal spring mount 32 has a shoulder portion at 41 such that it may be inserted into the opposing

30 end of the spring once it is inserted along axial hole 37. The sliding terminal spring mount 32 has an axial female threaded portion 42 that cooperates to accept the male threaded portion of the sliding terminal 31 once it has been passed through an axial hole 43 within the travel guide 70. This threaded connection is secured through the usage of an conductive adherent on the threads.

Once the parts of the striker assembly 30 have been co-located the overall assembly is held together by

35 fixation of the travel guide 70 to the striker end body 35 through fasteners (not shown).

Figure 5 shows the device post operation. In use and prior to any discharging operation the device would be assembled such that the sliding terminal 31, abuts the end spigot portion 60 as shown in

5 Figure 3. This is to be considered the safe configuration. The operator would connect wires 80 by using the electrical connectors 82 by attaching them to either side of a stored voltage which is to be discharged. No pathway for discharge is provided at this point due to the sliding terminal 31 being held at a safe distance from the large terminal 15. The separation distance being sufficient that stored voltages of up to 15,000V are not sufficient to cause a breakdown discharge to occur. Also the
10 conductive route passing through the device materials is such that no electrical arcing threat is presented to the operator up to the rated 15,000V.

Once the device has been connected by using the electrical connectors 82, the operator when ready would unscrew the insulative safety pin 50 until the male threaded portion 59 disengages with the threaded portion of hole 24. At this point of the operation sufficient length of the end spigot portion 60
15 remains within the central clearance hole 23 such that any movement of the sliding terminal 31 under urgency from the spring 33 is not yet possible. When the operator decides that they are ready to make the discharge they may extract the insulative pin 50, by either pulling the pin directly or by pulling a further connected lanyard attached to the pin (not shown), such that the end spigot portion 60 is extracted from obscuring the central clearance hole 23 thus permitting the sliding terminal 31 to be
20 urged along it by the spring 33 towards the large terminal 15 until an electrical and physical contact are made and an electrical pathway established such that the stored voltage is removed from the storage medium. The electrical pathway being formed from the electrical connectors 82, through the wires 80 to the large terminal 15, to the sliding terminal 31, onto the sliding terminal spring mount 32, through the spring onto the spring base collar 34 and finally onwards through the other electrical connection wire
25 80. This allows the operator to connect the device whilst in a safe mode and operate or initiate the discharge at a time and location of their choosing. The operator is able to check the operation has occurred by visual inspection of the device through the transparent transparent middle body.

Whilst DELRINTM has been used for many parts of the device a similarly electrically insulative material
30 could also be employed.

Whilst Copper is used for many parts of the device forming part of the discharge pathway, it will be appreciated that another electrically conductive material could also be employed.

35 It will appreciated that by varying the device materials conductivity or the spacing between the terminals or both, other Voltage ratings could be achieved.

5 It will be appreciated that the central clearance hole 23 essentially forms an enclosed cavity. This cavity
can be such that the environment within can be altered to offer different properties such as fluid filled
or a vacuum generated within to, minimise sparking.

The device as described above may also include an electrical resistive portion such that the initial
10 electrical contact does not generate an arc discharge but initiates through a damp discharge.

The device as described above is an embodiment that is foreseen to be used a works person tool
however, there is a variation of the concept that does not require the device body but could have the
underlying invention as a resident part of a circuit to offer a re-assured discharge process.

15 It will also be appreciated that whilst the above embodiment uses the spring 33 to drive the sliding
terminal 31 towards the large terminal 15, this could be achieved through other argument means such
as an electrical pneumatic or magnetic mechanism all respectively held back from making contact by the
insulative pin 50.

20

5 CLAIMS

1. A stored voltage discharging device comprising:

Means for connecting the device to the positive and negative nodes of a stored voltage;

An electrical discharge pathway; having a biased switching means capable of moving between disconnected and connected positions;

- 10 Characterised in that;

The switching means is held in the disconnected position by an electrically insulative pin arranged to counter oppose the biased movement of the switching means and capable of being extracted by an operator from an electrically remote position allowing the stored voltage to be dissipated.

- 15 2. A device according to claim 1 wherein the means for connecting the device to the positive and negative nodes of the stored voltage is provided by at least one flexible electrical connection wire.

3. A device according to claim 2 where in the flexible electrical wire terminates in biased clip connector.

- 20 4. A device according to any preceding claim wherein the switching means is biased to a connected position.

5. A device according to any preceding claim wherein the switching means is biased with a spring.

6. A device according to any preceding claim wherein the switching means is a single pole single throw switch.

- 25 7. A device according to any preceding claim wherein the device is at least partially enclosed within a device body.

8. A device according to claim 7 wherein the device body is constructed from an insulative material.

- 30 9. A device according to claims 7 and 8 wherein the switching means is at least partially enclosed within a chamber formed within the body of the device.

10. A device according to claim 9 wherein the chamber and switching means are visible through a transparent portion of body of the device.

11. A device according to any preceding claim wherein the insulative pin has a safety screw thread coupling it to the body of the device.

- 5 12. A device according to any preceding claim wherein the insulative pin has an attached extraction lanyard.

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Fig. 1

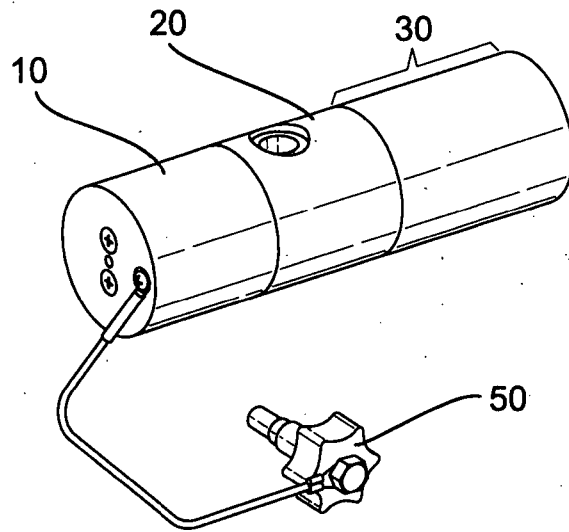
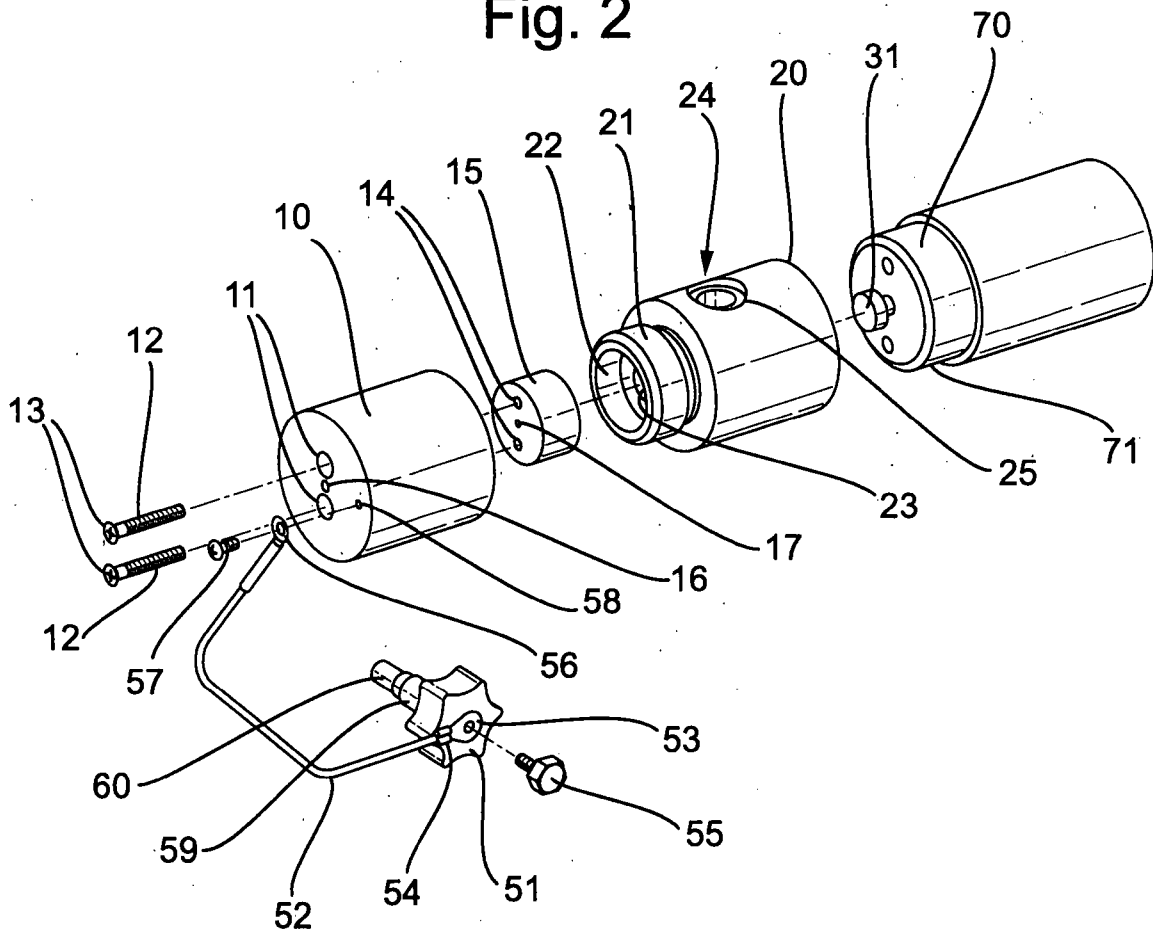
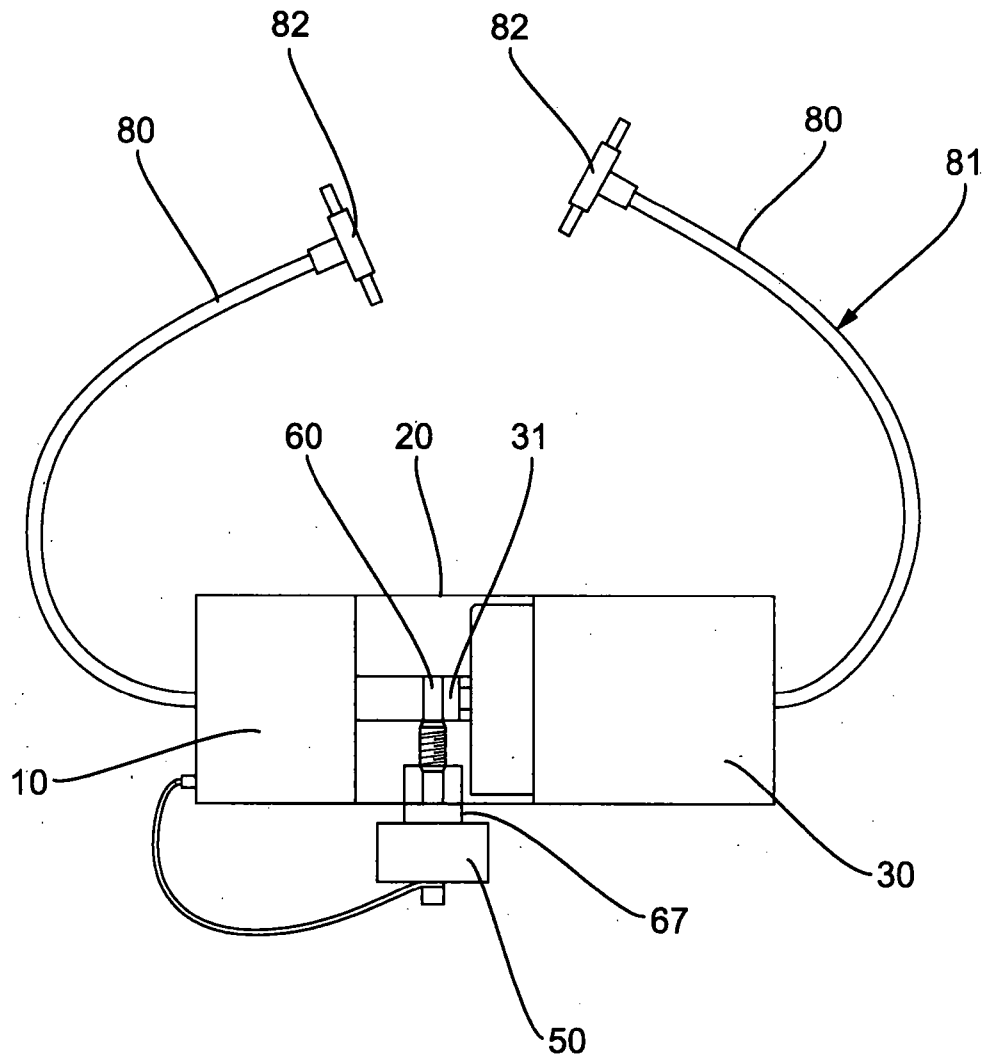


Fig. 2



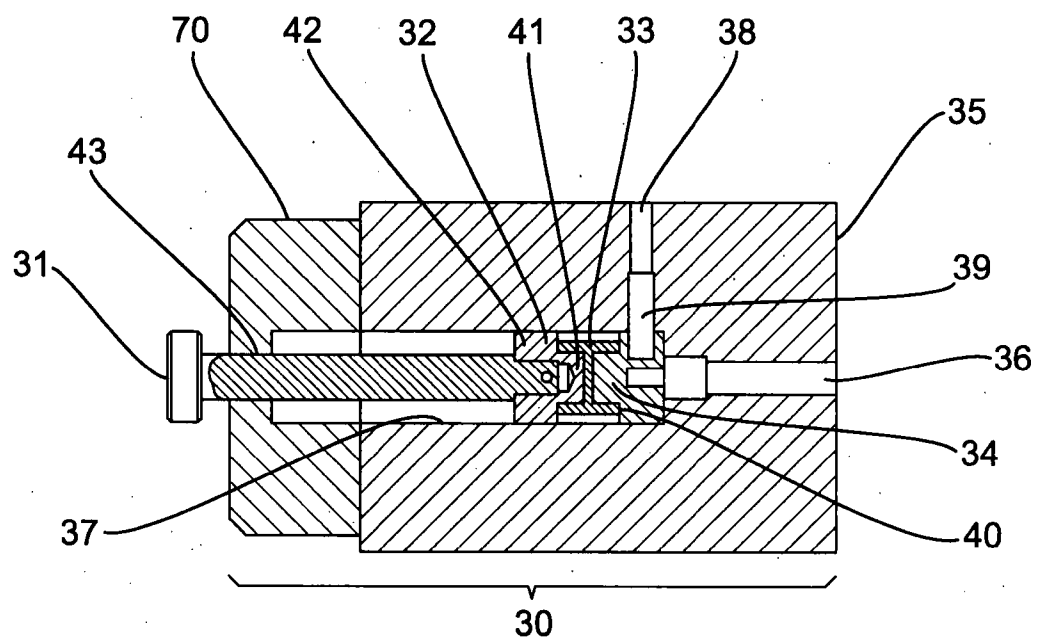
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Fig. 3



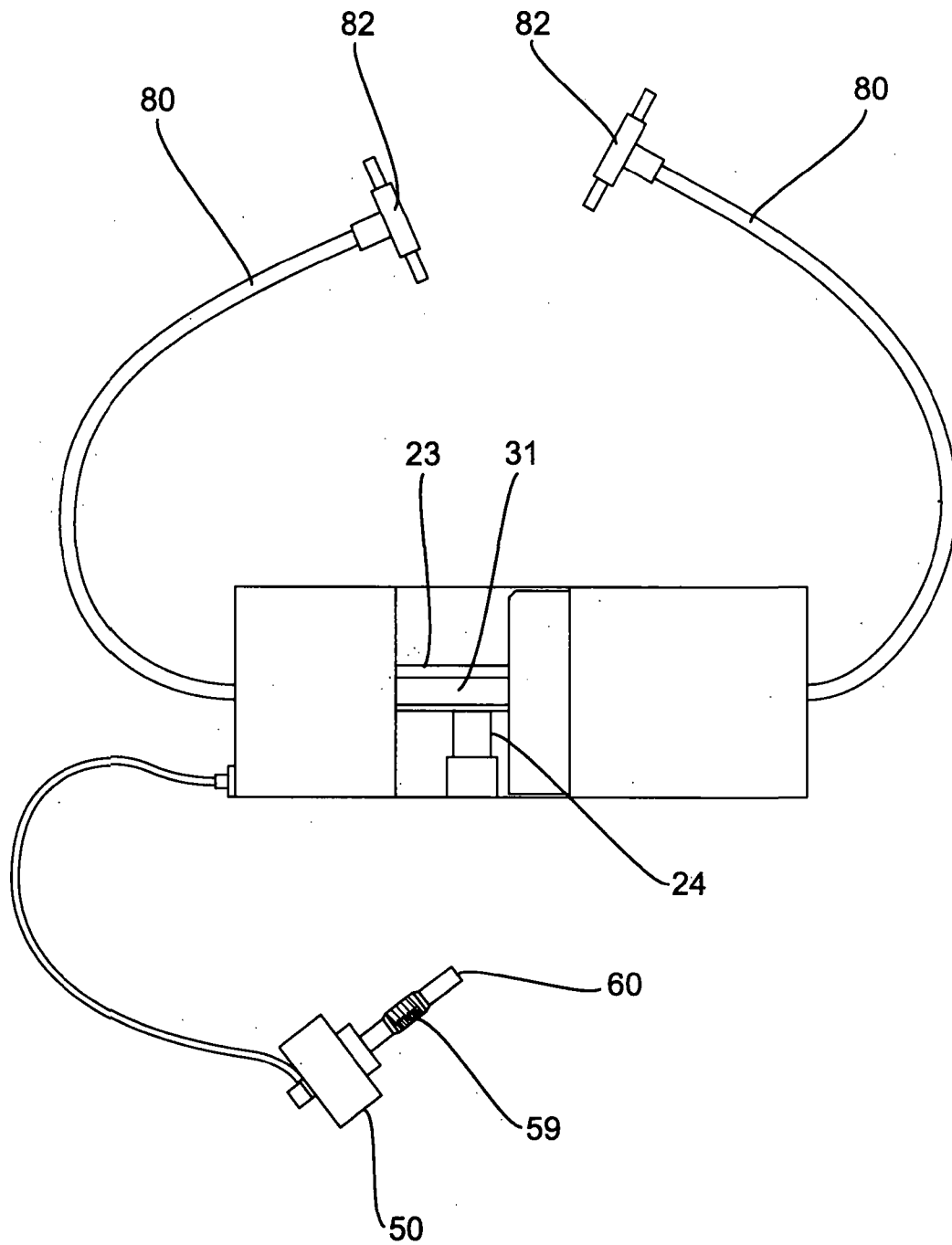
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Fig. 4



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Fig. 5



INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. H01H27/04 H02J7/00 H01H3/30
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)
H01H B60L H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.



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INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2017/000085

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