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(54) **Electrical fuse device**

(57) An electrical fuse device comprising first and second main electrical contacts between which a primary fuse is electrically connectable; a secondary fuse having one end electrically connected to the first main contact; a switch for selectably connecting the other end of the secondary fuse to the second main contact; and means for detecting a failure of the primary fuse, and causing the switch to connect the other end of the secondary fuse to the second main contact in response to a detected failure of the primary fuse. An actuator is provided for actuating the switch, the actuator and a primary fuse carrier both being provided on a removable part of the device.

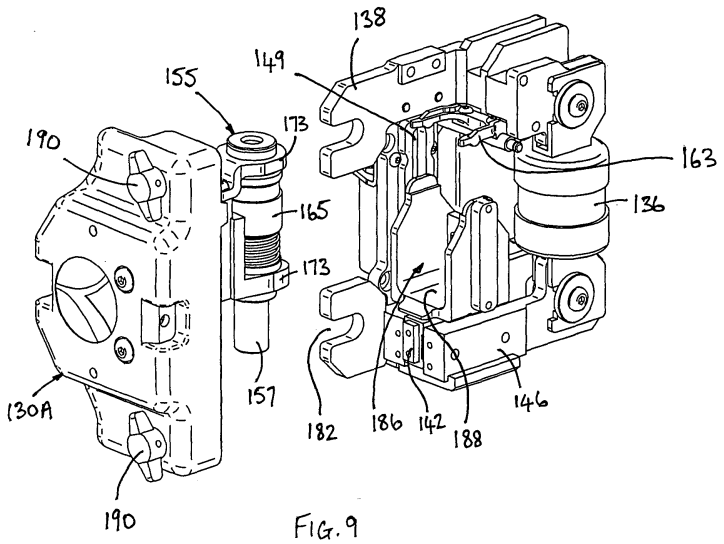

FIG. 9

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Description

Field of the Invention

[0001] The present invention relates to an electrical fuse device.

Background to the Invention

[0002] An electricity supply system typically comprises an electricity generator, a plurality of transformers and a plurality of consumer outlets, the aforesaid being interconnected by a network of electricity supply lines. The electricity supply network usually comprises a transmission network, for carrying electricity between the generator and a first set of transformers; a distribution network, for carrying electricity between the first set of transformers and a second set of transformers; and a mains network, for supplying electricity to the consumers. By way of example, the transmission network may carry high voltage (HV) signals of 66kV or above. The distribution network usually carries medium voltage (MV) signals of 11kV or 22kV. The mains network usually carries low voltage (LV) signals which are, for example, 240V in the United Kingdom and 110V in the USA.

[0003] The electricity supply can be disrupted by a fault in a supply line or in the equipment connected to a supply line. A fault can cause widespread disruption of the electricity supply and, accordingly, the management of faults is an important aspect of the operation of an electricity supply system.

[0004] Typically, a fault causes one or more fuses in the supply line to blow thereby causing an outage in the supply to consumers. Electricity providers can be heavily penalised for outages, the penalty level usually depending on the duration of the outage. It is known to provide automatic circuit reclosers at various locations in a network instead of fuses. A typical recloser comprises a normally closed circuit beaker which opens upon detection of a fault. Reclosers may be configured to close again after a predetermined period of time. If the fault is a permanent fault, then the recloser will open again but if the fault is intermittent, it remains closed until the next time a fault is detected. Reclosers are therefore useful in the management of intermittent faults. However, reclosers tend to be relatively large and expensive and this places a practical limitation on their use.

[0005] It would be desirable, therefore, to provide a relatively small and inexpensive device for managing faults, especially intermittent faults, in an electricity supply network.

Summary of the Invention

[0006] Accordingly, a first aspect of the invention provides an electrical fuse device comprising first and second main electrical contacts between which a primary fuse is electrically connectable; means for receiving a secondary fuse such that one end of said second fuse is electrically connected to said first main contact; means for selectably connecting the other end of said secondary fuse to said second main contact; and means for causing said connecting means to connect said other end of said secondary fuse to said second main contact in response to a detected failure of the primary fuse. The device typically also includes means for detecting a failure of said primary fuse, although in some embodiments this may be provided externally of the device and arranged to communicate a detected failure to the device.

[0007] In preferred embodiments, the device is adapted for use in place of a conventional fuse in an electrical circuit. The device automatically restores electrical supply to a circuit after a fault condition. Advantageously, the device permits a blown fuse to be replaced without interrupting the electrical supply to the circuit. In a typical use, the device is installed in an electrical distribution panel in place of a conventional fuse.

[0008] In preferred embodiments, an actuator is provided for actuating said connecting means into a closed state in which said other end of the secondary fuse is connected in use to said second main contact, and wherein said actuator is carried by a removable part of the device. The actuator is thus removable from and insertable into its working position in the device by respectively removing and replacing said removable part of the device.

[0009] Preferably, a carrier for said primary fuse is provided on a removable part of the device. In preferred embodiments, said actuator and said primary fuse carrier are both provided on the same removable part of the device. The, or each, removable part of the device is preferably adapted to be clipped or plugged into the device, conveniently by a manual pulling action.

[0010] Preferably, said actuator is adapted to be primed for actuation, preferably manually primed, when removed from the device.

[0011] In preferred embodiments, said connecting means comprises a movable contact cooperable with first and second, preferably fixed, contacts, said movable contact being movable between an open state in which said first and second preferably fixed contacts are electrically isolated from one another, and a closed state in which said first and second preferably fixed contacts are electrically connected to one another. Typically, one of said preferably fixed contacts being connected in use to said other end of said secondary fuse, the other of said preferably fixed contacts being connected to said second main contact.

[0012] The actuator, when inserted into the device, is arranged to actuate said movable contact into its closed state. The movable contact is typically carried by a support including a strike plate, the actuator including a deployable, preferably linearly deployable, actuating member arranged to act on said strike plate.

[0013] In some embodiments, said selectably connecting means also includes means for actuating said mov-

able contact between the open and closed states, or at least from said open state to said closed state. The actuation means preferably includes a spring, or other resilient biasing means, arranged to act directly or indirectly on said movable contact. Preferably, the spring, or other resilient biasing means, is held under tension when said movable contact is in the open state and, when released, causes the movable contact to adopt the closed state.

[0014] The movable contact is preferably movable substantially linearly. The actuation means may comprise a line or rod connected to the movable contact and arranged to pull the movable contact from the open state to the closed state. The actuation means may include a pivotable or rotatable lever mechanism acted upon by said spring, or other resilient biasing means, and acting on said movable contact, for example via said line or rod.

[0015] Said detecting means may comprise a voltage monitor arranged to monitor the voltage across the first fuse or main contacts.

[0016] Other advantageous aspects of the invention will become apparent to those ordinarily skilled in the art upon review of the following description of a specific embodiment and with reference to the accompanying drawings.

[0017] It will be understood that the word "supply" as used herein may embrace electricity supply, power supply and voltage supply, as appropriate.

Brief Description of the Drawings

[0018] Specific embodiments of the invention are now described by way of example and with reference to the accompanying drawings in which like numerals are used to indicate like parts and in which:

Figure 1 is a schematic view of a conventional electricity supply network in the form of an open ring network;

Figure 2 is an end view of a fuse device embodying the invention;

Figure 3 is a side view of the device of Figure 1;

Figure 4 is a more detailed side view of part of the device of Figures 1 and 2;

Figures 5A and 5B are circuit diagrams illustrating the fuse device;

Figure 6A is a perspective view of a preferred fuse device, shown in a disassembled state, embodying the invention;

Figure 6B shows the device of Figure 6A in an assembled state;

Figure 6C shows the device of Figure 6A in the assembled state with part of its housing removed.

Figures 7A and 7B show respective perspective views of the device of Figure 6A in an assembled state with its switch open and with its housing removed;

Figure 8 is a perspective view of the device of Figure 6A in the assembled state with its switch closed and with its housing removed;

Figure 9 shows the device of Figure 6 in the disassembled state with its switch closed and its housing removed;

Figure 10 shows a removed part of the device of Figure 6A; and

Figure 11 shows the device of Figure 6A reassembled with its switch closed and its housing removed.

Detailed Description of the Drawings

[0019] With reference to Figure 1 of the drawings, there is shown, generally indicated as 10, a conventional electricity supply network. The network 10 may form part of a larger electricity network, or system (not shown). In Figure 1, the network 10 takes the form of an open ring network by way of example only. The network 10 is of the type that may for example be used in a mains supply network and may include supply lines that are located underground.

[0020] The network 10 comprises a plurality of electrical supply lines including an open ring line 14 to which a plurality of feeder lines 16 are connected. The network 10 is connectable to an electricity supply which, in the present example, is provided by electrical substations or distribution units 18. Each end of open ring line 14 is connectable to a respective substation or distribution box 18 via a respective isolating device 12 which may, in a conventional network, take the form of a fuse or an automatic circuit recloser. The distribution units 18 may include one or more transformers (not shown) for transforming the electrical supply voltage to a level suitable for the network 10. The particular nature of the units 18 depends on which part of the supply system is being implemented by the network 10. The ring line 14 includes a normally open switch 20 which provides a normally open point (NOP) in the ring line 14. The electricity supply is usually a three phase supply but this is not described herein for reasons of clarity and since it is not instrumental in understanding the invention.

[0021] The network 10 may comprise, or form part of, a transmission network, a distribution network or a mains network and may be arranged to carry high voltage (HV), medium voltage (MV) or low voltage (LV) signals. In the present example, it is assumed that the network 10 is arranged for carrying MV (e.g. 11kV or 22kV) or LV (e.g.

110V or 240V) signals. In the case where network 10 comprises an MV network, the network 10 typically comprises a distribution network and substations 18 are typically supplied by an electricity generator, for example a power station (not shown), via an HV transmission network (not shown). For an MV network, the feeders 16 normally supply electricity to further networks, or network portions, or to distribution substations, distribution transformers, or even large consumers, such as factories (not shown). In the case where network 10 comprises an LV network, the network 10 normally comprises a mains network and substations 18 are normally supplied by a distribution network (not shown). For an LV network, the feeders 16 normally supply electricity directly to domestic or commercial consumers.

[0022] A fault occurring in the line 14 or feeders 16 causes the isolating devices 12 to blow (in the case of a fuse) or to open (in the case of a recloser) thereby isolating the network 10 (or at least a portion of it) from the substation units 18. Where the fault is intermittent, a conventional fuse can be replaced manually by an engineer but this is time consuming and tends to prolong the outage caused by the fault. The use of a recloser overcomes this problem but reclosers are relatively expensive and tend to be too large to fit into local distribution boxes.

[0023] Figures 2 to 4 illustrate a fuse device 30 which embodies the present invention and which is suitable for use as the isolation device 12 in place of a conventional fuse or recloser. The device 30 comprises a housing 32 which houses a first fuse 34 and a second fuse 36. The first fuse 34 is connected between first and second main electrical contacts or terminals 38, 40 in order to make an electrical connection between the main contacts 38, 40 when the fuse 34 is intact, i.e. not blown.

[0024] The second fuse 36 has a first end or terminal connected (at least electrically) to the first main contact 38. The second end or terminal of the second fuse 36 is connectable (at least electrically) to the second main contact 40 depending on the position or state of a movable contact 42. A support structure 39 may be provided for supporting the second fuse 36.

[0025] The movable contact 42 is co-operable with contacts 44, 46, which are preferably fixed, such that, in an open state (as illustrated in Figures 3 and 4), the movable electrical contact 42 does not make an electrical connection between the fixed electrical contacts 44, 46, and in a closed state (not illustrated), the movable contact 42 contacts each of the fixed contacts 44, 46 to make an electrical connection therebetween. Conveniently, in the open state, the movable contact 42 is physically spaced apart from one or both of the fixed contacts 44, 46, while in the closed state, the movable contact 42 makes a physical connection between the contacts 44, 46. The contacts may comprise any suitable electrically conducting material, typically a metal or metal alloy. The contacts 42, 44, 46 may be said to constitute all or part of a switching mechanism and it will be understood that alternative switching mechanisms may be used in alternative embodiments. The switching mechanism, and more particularly the contact 42 may be configured for substantially linear movement (as per the illustrated embodiment), or may alternatively employ rotary or pivoting movement.

[0026] In the illustrated embodiment, the fixed contacts 44, 46 are mutually spaced apart, one contact 46 being electrically (and conveniently physically) connected to the second end of the second fuse 36, the other contact 44 being electrically (and conveniently physically) connected to the second main contact 40. In the open state, the movable contact 42 makes no connection between the fixed contacts 44, 46 such that the fixed contacts 44, 46 are electrically isolated from one another. In the closed state, the movable contact 42 adopts a position where it makes contact with each contact 44, 46 to establish an electrical connection between them. Preferably, at least a portion 42' (Figure 4) of the movable contact 42 is arranged to fit between the contacts 44, 46 and to be in contact with each.

[0027] One or more tracks or guides (not shown) may be provided in the housing 32 to support, and to guide the movement of, the movable contact 42.

[0028] The device 30 further includes means for actuating the movable contact between the open and closed states, or at least from the open state to the closed state. Preferably, the actuating means comprises a spring 50, or other resilient biasing means, arranged to act indirectly (in the illustrated embodiment) or directly on the movable contact 42. In a preferred arrangement, the spring 50 is held under tension while the movable contact 42 is in the open state, the arrangement being such that, when the spring 50 is released, it causes the movable contact 42 to move to the closed state. In the illustrated embodiment, the spring 50 acts on the movable contact 42 via a linkage mechanism which includes a line or rod 52 connected to the movable contact 42 and a lever mechanism 54 which couples the rod 52 to the spring 50. The lever mechanism 54 is pivotable or rotatable with respect to the housing 32 (for example at pivot point P) and may include an operating cam 56 acting on the rod 52. A first end 51 of the spring 50 is connected to a fixed point in the housing 32, the other end 53 being connected or coupled to the lever mechanism 54. Rotation or pivoting movement of the lever mechanism 54 (in a clockwise direction as viewed in Figures 3 and 4) causes the rod 52 to pull the movable contact 42 into the closed state. The spring 50 may be held under tension by any suitable releasable mechanism (not shown), e.g. a latching mechanism, typically an electro-mechanical mechanism. For example, the mechanism may comprise a mechanical latch mechanism controlled by a solenoid device (not shown).

[0029] The device 30 also includes means for detecting when the first fuse 34 is ruptured or blown. For example, the detecting means may take the form of a voltage monitor (not shown) arranged to monitor the voltage across the first fuse 34 or across the main contacts 38, 40 - the rupturing of fuse 34 may be detected by an increase in the voltage across it. The voltage monitor, or

other detecting means, is advantageously arranged to control (directly or indirectly) the mechanism which holds the spring 50 under tension. In response to detecting that fuse 34 has ruptured, the voltage monitor causes the spring 50 to be released. It is preferred to introduce a delay (typically of between 10 and 60 seconds) between detecting that the fuse 34 is blown and causing the spring to be released. This allows time for an intermittent fault to disappear while keeping the outage period relatively short. To this end, the device 30 may include a controller comprising microprocessor, microcontroller, PLC or other programmable device (not shown) for controlling the operation of the spring 50. The controller may monitor the output of the voltage monitor, determine when the fuse 34 is blown and, after an appropriate delay, cause the spring 50 to be released.

[0030] In use, the device 30 is incorporated into an electricity supply line, for example as component 12 in Figure 1, or other electrical circuit, such that the main contacts 38, 40 are included in the electrical path of the circuit. When the first fuse 34 is intact, electricity is supplied through the contacts 38, 40 and fuse 34. In this state of use, the voltage across fuse 34 is relatively low. When a fault occurs with an over-current sufficient to blow fuse 34, the voltage monitor detects a corresponding rise in the voltage across fuse 34. In response, and after the predetermined delay, spring 50 is released and the movable contact 42 is closed. The electrical circuit between the main contacts 38, 40 is now made via the second fuse 36.

[0031] In alternative embodiments, the actuation means may comprise one or more power operated actuator, e.g. an electrically, hydraulically or pneumatically powered actuator, arranged to act directly or indirectly on the movable contact.

[0032] In alternative embodiments, more than one "second" fuse may be provided, each associated with a respective movable contact which may be arranged and be operable in turn in a manner substantially the same or similar to that described herein.

[0033] Figures 5A and 5B show circuit diagrams illustrating the fuse device more generally. In Figure 5A, the circuit between main contacts 38, 40 is via the first fuse 34. The voltage across fuse 34 is monitored by a controller 60 (e.g. the voltage monitor and controller described above) which, in normal circumstances is relatively low. In the event of a fault, high current passes through the fuse 34 causing it to rupture. The voltage across fuse 34 increases to approximately the supply line voltage (e.g. about 230 V). Upon detection of the increased voltage, the controller 60 activates a switching mechanism 62 (e.g. the actuation means described above) after the preset delay to make the circuit between contacts 38, 40 via the second fuse 36 (Figure 5B).

[0034] The contact of the switching mechanism connecting to fuse 34 must be capable of carrying fault current, but is only required to be load make or break. The contact connecting to fuse 36 (e.g. the contacts 42, 44, 46) should be capable of carrying fault current and be able to make onto fault current, but will only be required to be load break.

[0035] Referring now to Figures 6 to 11, there is shown, generally indicated as 130, a preferred fuse device embodying the invention. The fuse device 130 is suitable for use in the circuit of Figures 5A and 5B. The fuse device 130 is similar to the fuse device 30 and, where applicable, like numerals have been used to indicate like parts and relevant portions of the foregoing description apply to the embodiment of Figures 6 to 11 as will be apparent to a skilled person.

[0036] The device 130 comprises a housing 132 which houses a first, or primary, fuse 134 and a secondary fuse 136. In Figure 6, the device 130 is shown in two separable parts, namely a first part 130A including the primary fuse 134 and a second part 130B including the secondary fuse 136. The second part 130B is typically, in use, fixed to a terminal 131, e.g. in an electricity distribution box, as shown in Figure 6. The primary fuse 134 is connectable between first and second main electrical contacts or terminals 138, 140 in order to make an electrical connection between the main contacts 138, 140 when the fuse 134 is intact. The contacts 138, 140 are in use connected to an electrical circuit such that the fuse 134 forms part of the circuit. The secondary fuse 136 has a first end 137 or terminal connected (at least electrically) to the first main contact 138. The second end 139 or terminal of the second fuse 136 is connectable (at least electrically) to the second main contact 140 depending on the position or state of a movable contact 142.

[0037] The contact 142 forms part of a switch device 143. The switch device 143 also includes fixed contacts 144, 146 which are cooperable with the movable contact 142 to make or break an electrical circuit and, in particular, to make or break the electrical connection between the second end 139 of the fuse 136 and the second main contact 140. In the preferred embodiment, the contacts 144, 146 are spaced-apart and arranged to receive the movable contact 142 therebetween such that the movable contact 142 makes an electrical connection between the fixed contacts 144, 146. Optionally, the movable contact 142 is wedge-shaped such that its leading end (in the direction of movement towards the fixed contacts) is narrower in transverse cross-section than its trailing end. The gap 145 between the fixed contacts 144, 146 is correspondingly wedge-shaped. The contact 142 and gap 145 may take any other suitable shape and, typically, are substantially rectangular in transverse cross-section.

[0038] In the preferred embodiment, the movable contact 142 is carried by a support or carriage 147. The carriage 147 is movable between a first state (as shown in Figure 7B) in which the contact 142 is isolated, or spaced apart from, the fixed contacts 144, 146, and a second state (as shown in Figures 8 and 9) in which the contact 142 is located between the contacts 144, 146. Conveniently, the carriage 147 is slidable between its first and second states by any convenient sliding mechanism. For

example a slot 149 may be provided in which a corresponding projection (not visible) is slidably located. A second projection 151' may be provided on the other side of the carriage 147 for sliding engagement with a second slot (not shown) provided adjacent the other side of the carriage 147.

[0039] The switch 143 further includes means for actuating the switch 143 at least from its open state (Figure 7B) in which the contact 142 is in its first state, into its closed state (Figures 8 and 9) in which the contact 142 is in its second state. The actuating means comprises an actuator 155 having a deployable member, conveniently in the form of a rod 157, that is deployable, preferably linearly deployable, between a retracted state (Figures 6 and 10) and an extended state (Figures 8 and 9) or partially extended state (Figure 7B). Operation of the actuator 155 into the extended state drives the contact 142 between the contacts 144, 146. A preferred arrangement is such that, when the carriage 147 is in the open state and the rod 157 is retracted, the rod 157 abuts, or substantially abuts, against the carriage 147 so that, when actuated, the rod 157 pushes against the carriage 147 rather that impacts upon it before pushing.

[0040] The actuator 155 may take any suitable form and may be operated by any suitable means, e.g. it may be pneumatically, hydraulically, electrically and/or mechanically powered. In the illustrated embodiment, the actuator 155 includes resilient biasing means in the form of a spring (not visible but typically located inside the body of the actuator 155) arranged to urge the rod 157 into its extended state. The actuator 155 also includes activation means for the actuator 155 in the form of a latch mechanism 161arranged to hold the actuator 155 in the retracted state, and, when activated, to cause the rod 157 to be released so that it may adopt the extended state. In the illustrated embodiment, the latch mechanism 161 includes an activating member in the preferred form of cradle 163 in which the actuator 155 may be removably received. The cradle 163 is cooperable with an operating member in the preferred form of collar 165 on the actuator 155 and is movable to cause the operating collar 165 to release the rod 157. The cradle 163 may be operated by any suitable means, for example an electro-mechanical actuator 167 coupled to the cradle 163 by a linkage 169, as shown in Figure 7A. In the present example, the collar 165 is urged into a latching position by resilient biasing means, e.g. spring 159, and is movable out of its latching position by cradle 163. The collar 165 is coupled to one or more retaining members (not visible), e.g. ball bearings, which pass through the body of the actuator and hold the internal biasing means in its primed state until the collar 165 is moved out of its latching position whereupon the internal biasing means is released to drive the rod 157.

[0041] The device 130 also includes means for opening the switch 143, i.e., returning the movable actuator to its first state. The switch opening mechanism may take any suitable form and may be operated by any suitable means, e.g. it may be pneumatically, hydraulically, electrically and/or mechanically powered. In the illustrated embodiment, one or more levers 175 are provided for this purpose. The levers may for example be arranged to act on the carriage 147, e.g. via the projection 151', and may be manually operable, and/or spring assisted, to lift the carriage 147 upwards (as viewed in the drawings) and so to disengage the contact 142 from the contacts 144, 146.

[0042] The device 130 includes, or is cooperable with, a controller (not shown) for detecting the failure of the primary fuse 134 and, upon such detection, causing the switch 143 to close. The controller may same the same or similar to the controller 60 described above and, typically, monitors the voltage across and/or current in the primary fuse. The device 130 (or the device 30) may also include a communications module (not shown) for communication, typically wireless communication, of its condition to a remote monitoring station (not shown).

[0043] The first part 130A of the device 130 is removable from the second part 130B. In the preferred embodiment, the first part 130A includes not only the primary fuse 134, but also the actuator 155. It will be seen from Figures 9 and 10 that the first part 130A includes part of the housing 132, a carrier or holder 171 for the primary fuse 134 and a carrier or holder 173 for the actuator 155. The holder 171 may include a respective removable fastener in the preferred form of a pin 180 for releasably connecting each end of the primary fuse 134 to the first part 130A of the device. The contacts 138, 140 are adapted to receive a respective one of the pins 180. To this end, it is preferred that the contacts 138, 140 each define a recess 182 for receiving the pins 180, the recesses 182 facing outwardly of the second part 130B of the device in the same direction, said direction conveniently being substantially perpendicular with the direction in which they are spaced apart.

[0044] The holder 173 for the actuator 155 may take any suitable form, e.g. one or more collars 184. The second part 130B of the device defines a station 186 for receiving the actuator 155, and typically also its holder 173, when the two parts 130A, 130B are assembled together. In the station 186, the actuator 155 is positioned such that the rod 157 can act directly or indirectly on the movable contact 142 without being fixed thereto. In the preferred embodiment, the carriage 147 defines part of the station 186 and includes a base or abutment/striking surface 188 on which the rod 157 acts. There is no fixed connection between the actuator 155 and the carriage 147 and so the actuator 155 can readily be removed. Means for activating the actuator 155 are preferably provided in the station 186 and are adapted to releasably couple with the actuator 155 when the actuator is in the station 186. In the illustrated embodiment, the releasable coupling is provided by the cradle 163.

[0045] Hence, the contacts 138, 140 on the second part 130B of the device 130 are removably connectable to respective ends of the fuse 134 (or the fuse holder

171). The cradle 163 and carriage 147 are adapted to removably receive the actuator 155 (and/or its holder 173). The preferred arrangement is such that the first part 130A may be removed from the second part 130B by a manual pulling action, and reassembled with the second part 130B by a push fit action. One or more screws or other fasteners 190 may be provided to secure the first part 130A to the second part 130B.

[0046] More generally, the preferred arrangement is such that the removable part 130A may be engaged and disengaged with the rest of the device 130B by a manual pulling action, preferably in a lateral direction as indicated in the drawings. To this end, there is preferably provided a male and female fit between the two parts 130A, 130B. In particular, there is a male/female fit between the primary fuse (and/or its holder) and the main contacts 138, 140, and a male/female fit between the actuator 155 and its station 186. The fit between at least some of the respective parts may be a releasable friction or interference fit.

[0047] During normal operation, the switch 143 is held in the open position and all of the electrical current flowing through the device 130 is carried by the primary fuse 134. If a fault occurs on the circuit in which the fuse device 130 is installed, the primary fuse 134 ruptures, interrupting the current and isolating the electrical supply to the circuit. The device 130 detects this condition and automatically closes the switch 143 (typically under suitable defined conditions, e.g. as described above in relation to the device 30) to bring the secondary fuse 136 into the circuit, thus restoring the electrical supply. Where a communications module is provided, the device 130 can communicate its status to a remote location permitting appropriate remedial action to be initiated.

[0048] While the secondary fuse 136 is in circuit and carrying the load, the part 130A of the device 130 can be removed from the device. This permits the primary fuse 134 to be replaced without interrupting the current flow in the circuit. Moreover, since the actuator 155 is also removed, it can be re-primed for future activation. Being able to prime the actuator 155, and replace the fuse 134, while removed from the device 130 is advantageous since these acts may be performed manually by a single person - some regulations require that such acts can only be performed using a tool and in the presence of a second individual if the relevant components are part of a device that is still connected to the electricity supply.

[0049] Once the primary fuse 134 has been replaced, part 130A can then be refitted to part 130B. The switch 143 may then be opened to restore the device 130 to its initial condition and without interrupting the electrical supply to the circuit.

[0050] If the electrical fault persists after the primary fuse 134 has blown and the secondary fuse 136 is in circuit, then the secondary fuse 136 will also blow and the circuit will remain isolated until manual intervention can replace both fuses and repair the fault on the circuit. The preferred device 130 is also capable of reporting this condition to a remote location as above.

[0051] Optionally, the device 30, 130 may be fitted with visual indications to show which fuse is in circuit, optionally, and how much electrical current is being carried.

[0052] The invention is not limited to the embodiments described herein which may be modified or varied without departing from the scope of the invention.

Claims

1. An electrical fuse device comprising first and second main electrical contacts between which a primary fuse is electrically connectable; means for receiving a secondary fuse such that one end of said second fuse is electrically connected to said first main contact; means for selectably connecting the other end of said secondary fuse to said second main contact; means for detecting a failure of said primary fuse, and causing said connecting means to connect said other end of said secondary fuse to said second main contact in response to a detected failure of the primary fuse.

2. A device as claimed in claim 1, wherein an actuator is provided for actuating said connecting means into a closed state in which said other end of the secondary fuse is connected in use to said second main contact, and wherein said actuator is carried by a removable part of the device,

3. A device as claimed in claim 1 or 2, wherein a carrier for said primary fuse is provided on a removable part of the device.

4. A device as claimed in claim 2 or 3, wherein said actuator and said primary fuse carrier are both provided on the same removable part of the device.

5. A device as claimed in any one of claims 2 to 4, wherein said actuator is adapted to be primable for actuation, preferably manually primed, when removed from the device.

6. A device as claimed in any preceding claim, wherein said connecting means comprises a movable contact cooperable with first and second fixed contacts, said movable contact being movable between an open state in which said first and second fixed contacts are electrically isolated from one another, and a closed state in which said first and second fixed contacts are electrically connected to one another, one of said fixed contacts being connected in use to said other end of said secondary fuse, the other of said fixed contacts being connected to said second main contact.

7. A device as claimed in claim 6 when dependent on

any one of claims 2 to 5, wherein said actuator, when inserted into the device, is arranged to actuate said movable contact into its closed state.

8. A device as claimed in claim 7, further including a station for removably receiving said actuator, part of said station being defined by an abutment surface coupled to said movable contact, the actuator including a deployable, preferably linearly deployable actuating member arranged to act on said abutment surface when the actuator is located in the station.

9. A device as claimed in claim 8, wherein said station includes means for activating said actuator, said activating means being arranged to releasably couple with said actuator.

10. A device as claimed in any preceding claim, wherein said ends of the primary fuse, or the primary fuse carrier, are releasably engagable with respective main contacts.

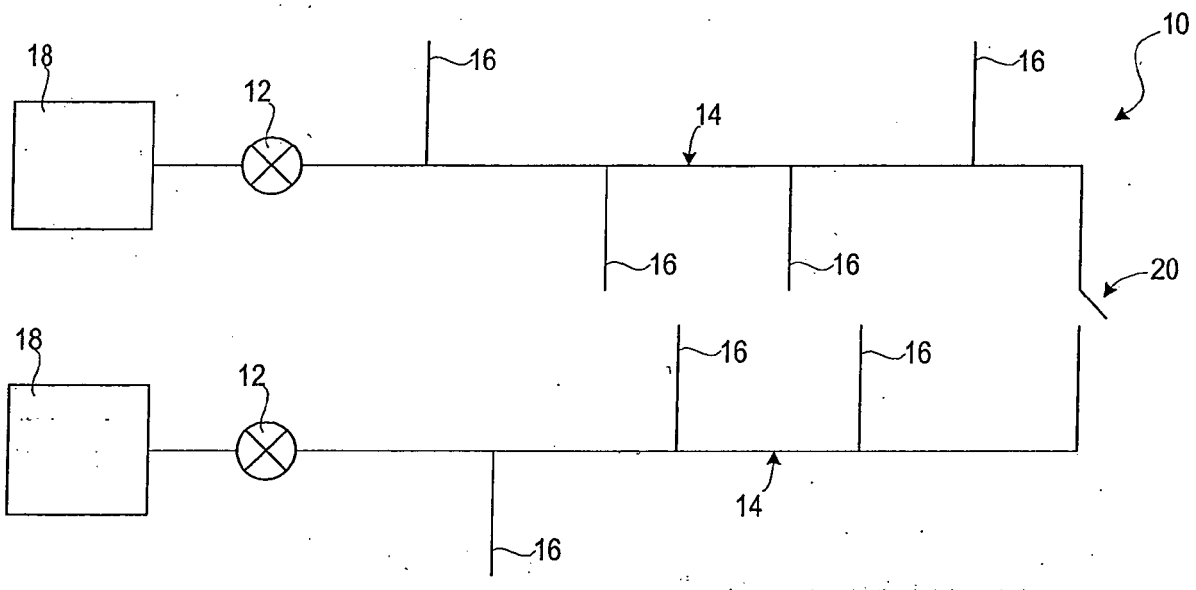


FIG. 1

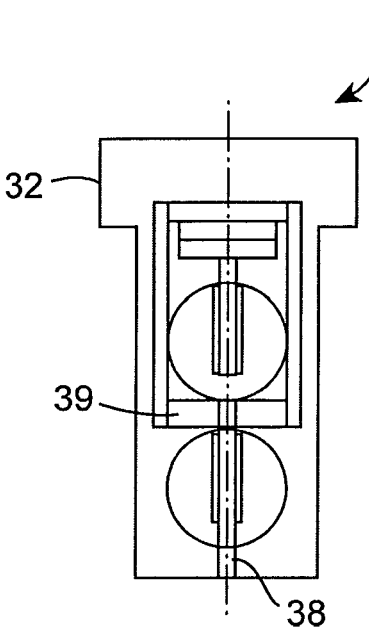


Fig. 2

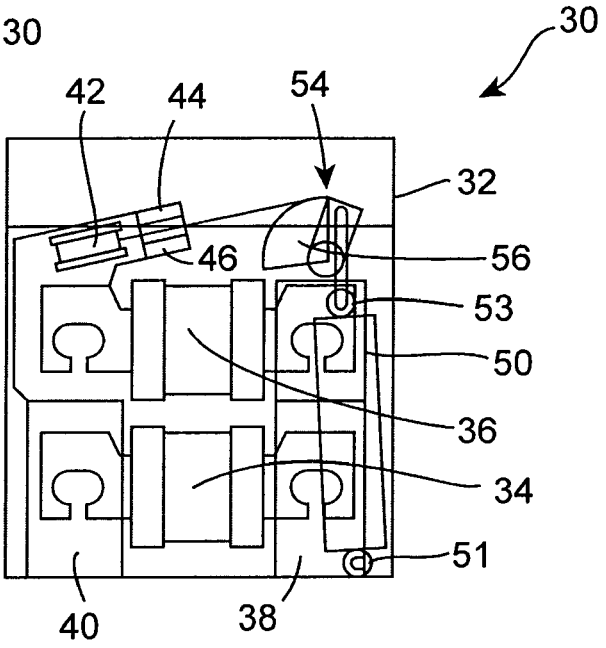


Fig. 3

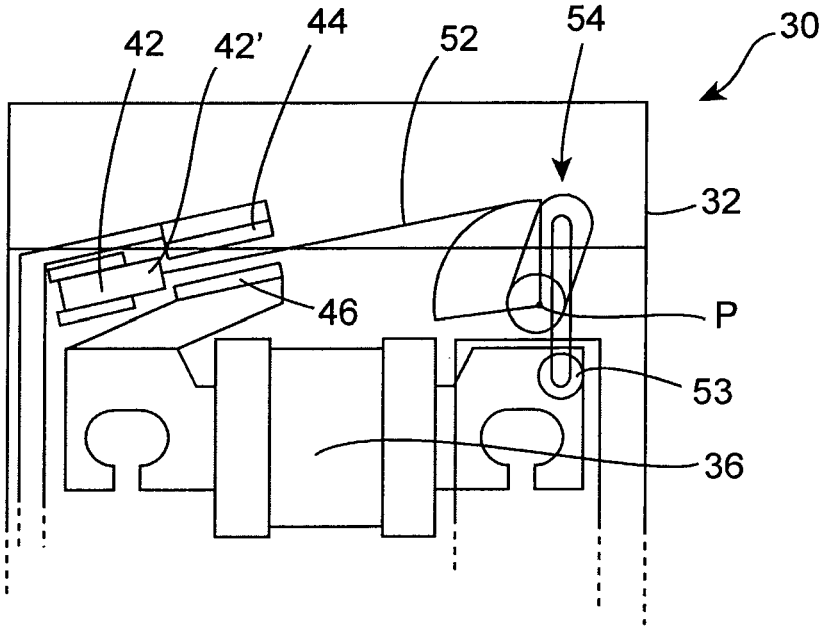


Fig. 4

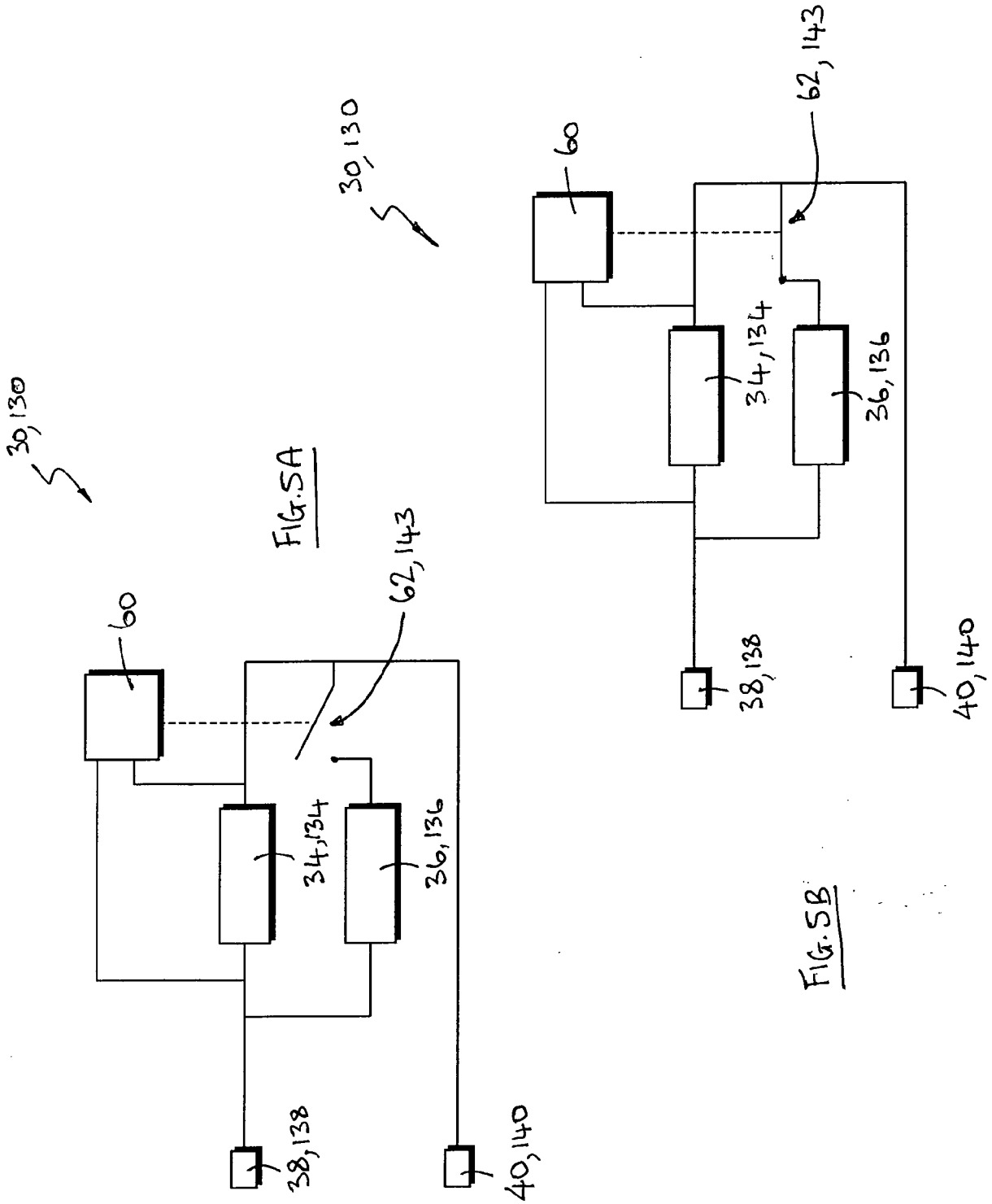

30, 130
60
62, 143
34, 134
36, 136
38, 138
40, 140

FIG. 5A

30, 130
60
62, 143
34, 134
36, 136
38, 138
40, 140

FIG. 5B

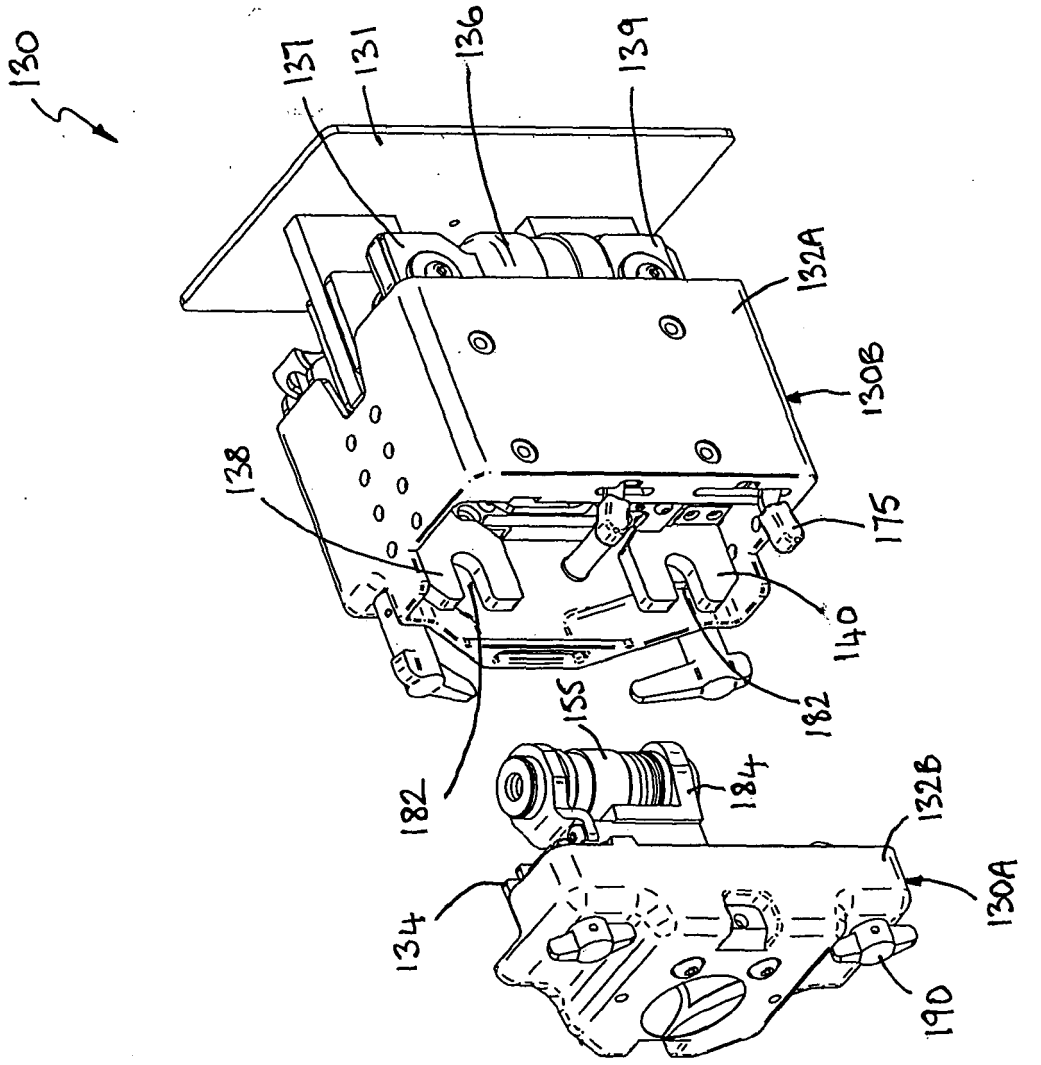

130
137
131
136
139
132A
130B
138
175
140
182
155
184
182
132B
134
130A
190

FIG. 6A

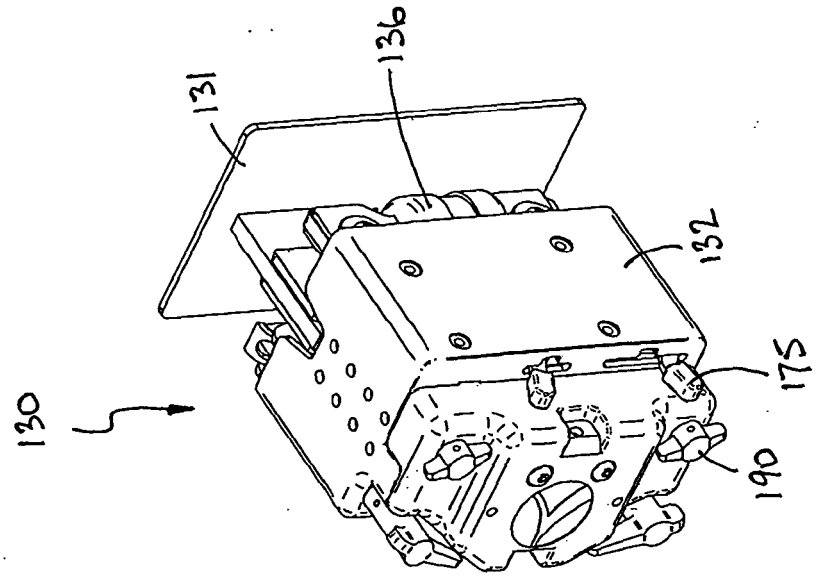


FIG. 6B

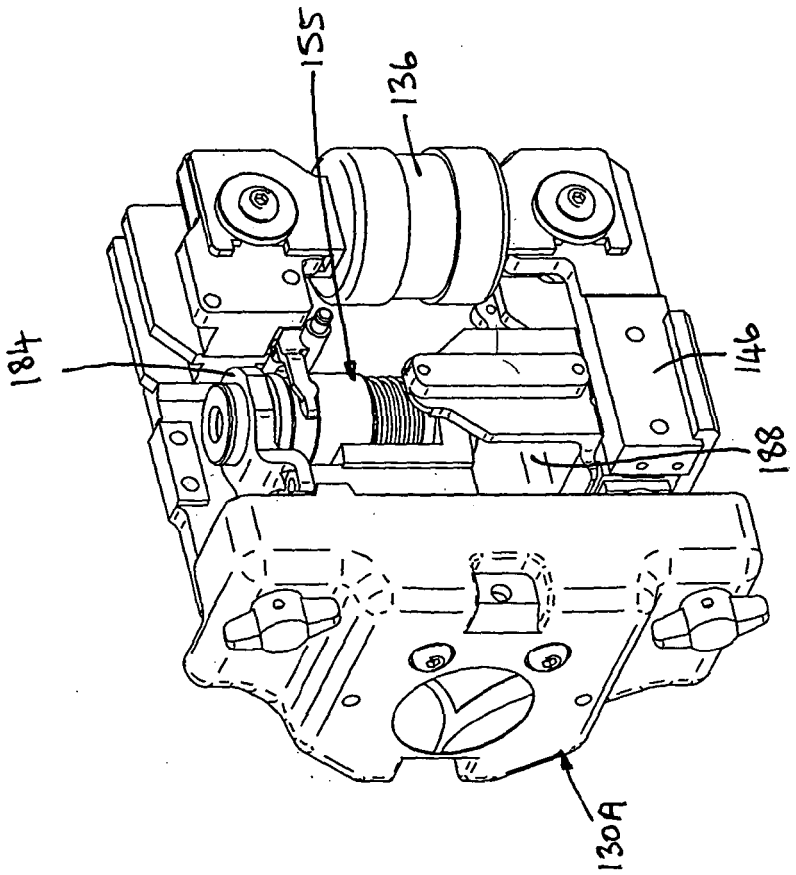
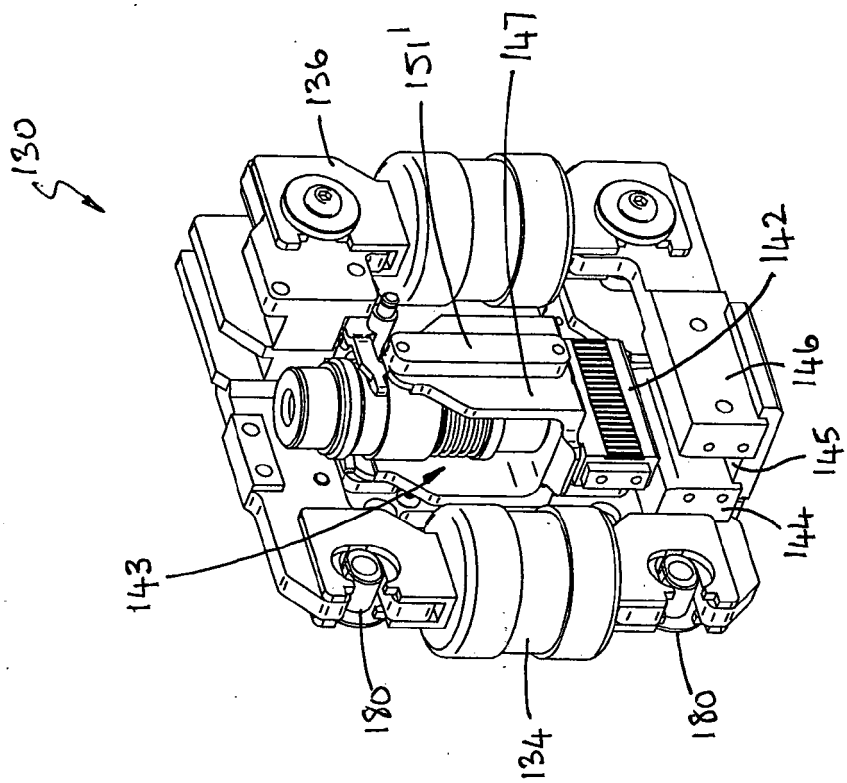


FIG. 6C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136
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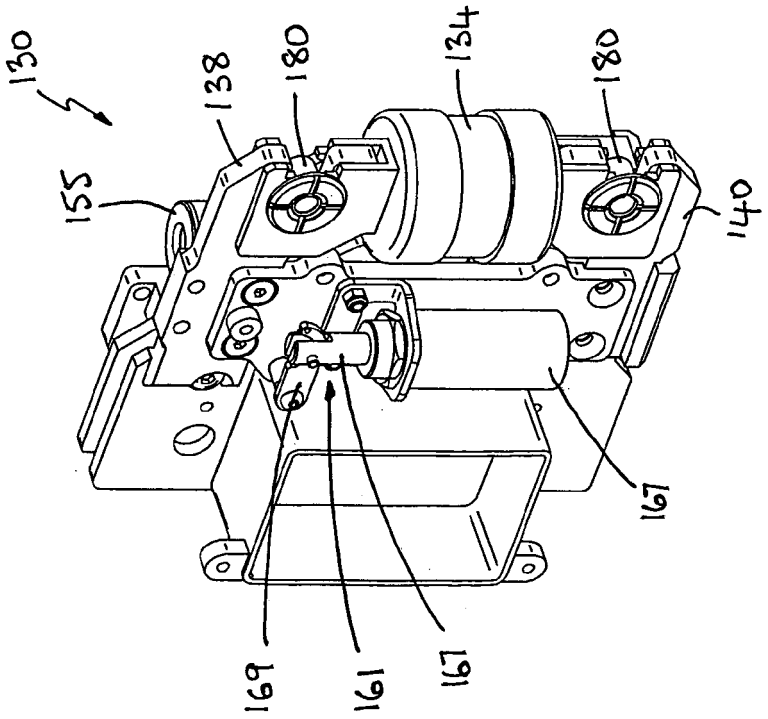
134
180

FIG. 7B


130
138
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155
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167
169
161
167

FIG. 7A

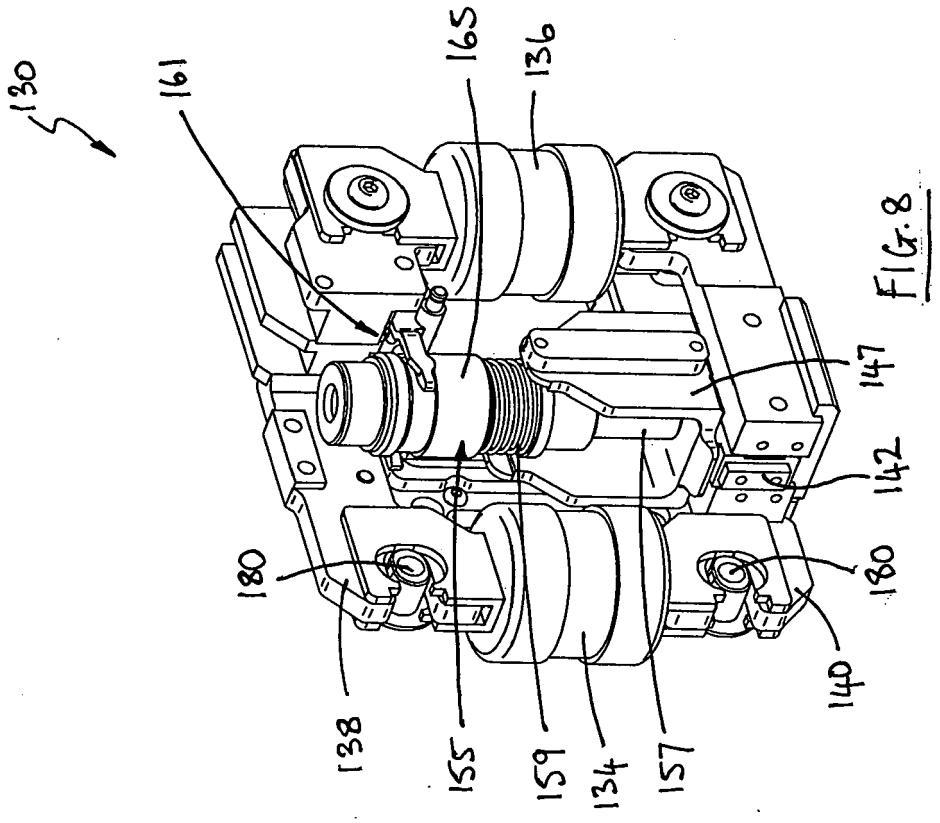
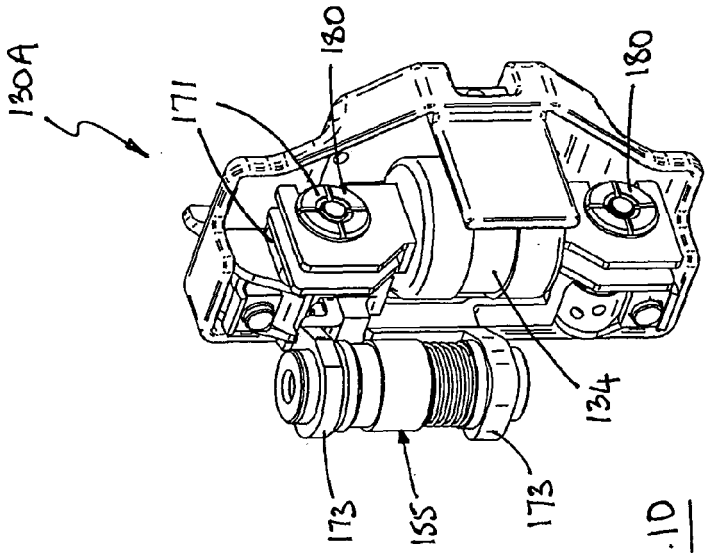


FIG. 8


130A
171
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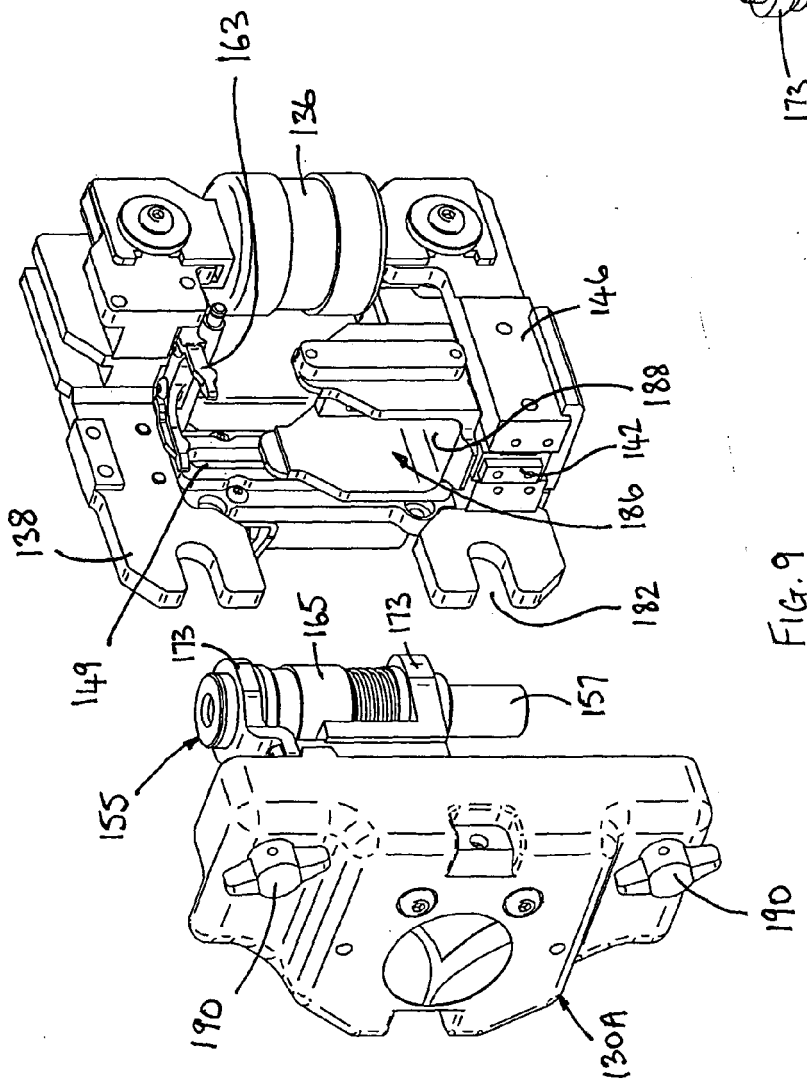
180
134
173
155
173

FIG. 10


162
136
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188
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186
138
182
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173
173
157
155
190
190
130A

FIG. 9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 01 9623

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 11 93 132 B (SACHSENWERK LICHT & KRAFT AG) 20 May 1965 (1965-05-20) * column 3, line 42 - column 4, line 28; figures * -----	1,6,10	INV. H01H85/28
X	US 2 305 996 A (SCHULTZ WILLIAM O ET AL) 22 December 1942 (1942-12-22) * column 3, lines 29-74 - column 4, lines 63-75; figures * -----	1,6,10	
X	US 2 437 310 A (NORBERTO WERBER) 9 March 1948 (1948-03-09) * column 1, line 29 - column 2, line 15; figures * -----	1,6,10	
			TECHNICAL FIELDS SEARCHED (IPC) H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 January 2008	Findeli, Luc

CATEGORY OF CITED DOCUMENTS

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30-01-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82