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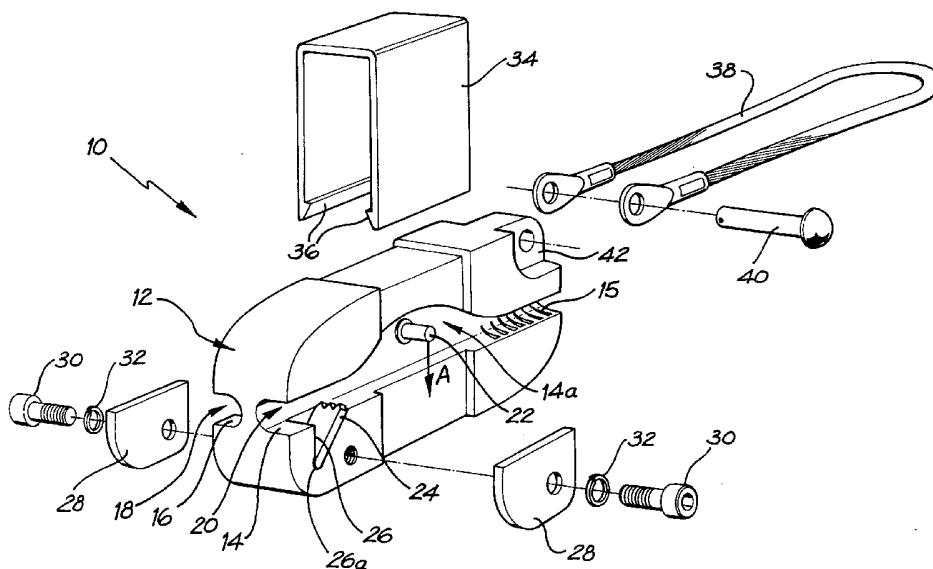
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[Continued on next page]

(54) Title: SAFETY DEVICE FOR CABLES



(57) Abstract: A safety device (10) for severing, in controlled manner, a deployed cable, preferably an electricity carrying power cable, including a housing body (12) adapted to receive and house a deployed cable, a cable cutting mechanism having at least one movable cutting member (24) arranged to engage and sever the cable at the housing body (12), the housing body (12) being preferably configured to retain one end of the cable after severance, and a force or strain sensing arrangement operatively engaged with the cable and the cutting mechanism and configured such that when a force is exerted on the cable which causes the cable to strain or stress beyond a predetermined threshold value, the cutting member (24) is moved to sever the cable.



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## **SAFETY DEVICE FOR CABLES**

### **TECHNICAL FIELD**

The present invention relates to safety devices, particularly in relation to cables where it is desired to prevent injuries as consequence of unintentional  
5 cable breakage.

### **BACKGROUND OF THE INVENTION**

Power cables deliver electricity from power generation stations to distributor stations from where it is then supplied to end users, eg farms, businesses and homes. Whilst high tension power cables are generally  
10 supported overhead at considerable height over the ground, in urban environments power pole heights are reduced and minimum height regulations apply to all power carrying cables. In particular, service lines from power poles to houses, businesses and other premises that cover any part of a road or driveway, or cross any area used by vehicles, have minimum height requirements, for  
15 example in Victoria, Australia, this is approximately 4.6m above ground.

Regulation heights have been conceived with safety in mind to prevent accidental breaking of such cables by, for example, council work vehicles or trucks.

Despite this, it is not unusual for such service lines to be damaged to an  
20 extent that these break, for example by falling trees, ladders or car accidents, leaving live wires that may reach the ground and pose a safety hazard.

Proposals have been made to mount safety devices to service lines that aim to interrupt power supply from the main power line to the service line in case of breakage of the service line.

25 One such solution is to fit service lines with a coupling/connector close to the power pole such that excessive force applied along the line will cause the coupling to disconnect, whereby the loose cable end that falls to the ground is cut from the power supply. There are a number of disadvantages with such an approach. Firstly, with existing service lines, in order to retrofit such a safety  
30 device, the line has to be cut to allow fitting of connector couplings to the free ends. That is, a perfectly sound cable is cut and a weak link is introduced. Secondly, such plug-type connectors are susceptible to corrosion, be it due to environmental and/or electric contact corrosion, thus requiring added corrosion

prevention measures. Thirdly, mains power supply is interrupted during the time it takes to install such a device. Fourthly, other failure modes exist for connector contacts over a long time period, for example in the case of fatigued metal contacts.

5           It would be desirable to provide a safety device for cables that can easily be retrofitted, for example to existing power lines, without the need to sever the cable in order to install the safety device. In this context, the device could be advantageously constructed in such a manner that it will safely interrupt power at a location close to the suspension point of the cable at a power pole when forces  
10           are exerted on the cable that would cause breakage of the cable at random locations.

### **SUMMARY OF THE INVENTION**

          In a broad form, the present invention provides a safety device for severing, in controlled manner, a deployed cable, preferably an electricity carrying  
15           power cable, including a housing body adapted to receive and house a deployed cable, a cable cutting mechanism having at least one movable cutting member arranged to engage and sever the cable at the housing body, the housing body being preferably configured to retain one end of the cable after severance, and a force or strain sensing arrangement operatively engaged with the cable and the  
20           cutting mechanism and configured such that when a force is exerted on the cable which causes the cable to strain or stress beyond a predetermined threshold value, the cutting member is moved to sever the cable.

          Broadly speaking, different force or strain sensing arrangements may be employed with the invention.

25           Embodiments of the safety device which are devised to utilize external or internal electric power sources may incorporate strain gauges, stress gauges, tensometers or other types of strain and/or stress measuring devices which are mountable to the cable so as to detect either strain or stress (as the case may be) thereby to provide an output signal representative of such strain/stress to which  
30           the cable is subject to in reacting/transferring forces from the location where such are applied to the cable's fastening points. The output signal of the strain or stress gauge is compared in a suitable, microprocessor operated control unit carried at the housing body, with a threshold value that has been pre-

programmed and applies for the specific cable which is to be secured against uncontrolled rupture. The threshold value may be selected to be the cable specific stress or yield stress value, the ultimate tensile strength of the cable or any other set value which would indicate or be representative of cable failure due to stress loading. The control unit is advantageously arranged to generate a signal representative of the comparison of the actual stress or strain measured at the cable with the set threshold value and yield a differential signal which, if outside of set deviation allowance, may be used directly or indirectly in triggering release of the cutting mechanism cutting member. A simple solenoid mechanism may serve to hold the cutting member in a rest position, which when triggered would release and forcibly bias the cutting member into severing the cable at the device's housing.

Preferably, however, safety devices in accordance with preferred forms of the invention, can be implemented which require no external (or internal) power source to effect strain/stress detection, and which avoid use of electronic control units or power actuated cutting mechanisms. Accordingly, a mechanical implementation of the force or strain sensing arrangement as well as the cutting mechanism may be employed which provide low or no maintenance once mounted to a power cable.

In a simple mechanical implementation, the force or strain sensing arrangement includes a force-sensitive coupling structure that connects the housing body with a clamp or similar structure that can be fixed against movement on the power cable, the housing body being devised to allow movement of the power cable in axial extension of the cable and to allow attachment to a support structure at or in vicinity of an anchoring location of the power cable, the force-sensitive coupling structure being calibrated to decouple and allow movement of the clamp structure away from the housing body upon a force being transferred along the power cable that exceeds a threshold value that is below that which would lead to uncontrolled snapping of the cable. In such arrangement, the cutting mechanism would be devised to move the cutting member(s) in response to relative movement of the cable with respect to the housing body.

A force-sensitive coupling may incorporate two components that are force-fittingly or form-fittingly engaged with one another, or which are joined together by means of a frangible connector, the coupling and/or connector being dimensioned or otherwise calibrated to disengage or break at loads below that at which the power cable would fail (ie snap in two).

In a preferred (but not exclusive) embodiment, the invention provides a safety device for power cables that includes a housing body with at least one receptacle channel adapted to receive a deployed power cable, the housing body being devised for attachment to a support structure at or in vicinity of an anchoring location of the power cable, a cable clamp in which the power cable is receivable in fixed manner against displacement, a force-sensitive coupling structure which secures in removable manner the cable clamp to the housing body, the force-sensitive coupling structure being calibrated to disengage under a predetermined stress that is smaller than a stress which would lead to uncontrolled snapping of the power cable under tensile load; and a cutting mechanism disposed at the housing body and including at least one cutting member that is located to engage with the power cable when received in the receptacle channel and arranged such that upon disengagement of the cable clamp from the housing body and relative movement of the power cable within the housing body, the cutting member is dragged by the power cable to move and sever it.

A simple force-sensitive coupling structure can include a frangible shear or tensile pin that is held in place, and serves to join, the cable clamp and the housing body, the pin being dimensioned and made of a material which will ensure the pin shears or breaks when subject to loads which are a predetermined amount below such which would otherwise lead to snapping of the power cable. Thus, the frangible connector is devised to have an ultimate tensile strength that is smaller, by a chosen tolerance value, to that of the cable on which the safety device is to be installed. In other words, the frangible connector has to be made of a material and/or be so constructed that it breaks below a stress which would cause rupture of the cable.

In a preferred embodiment of the above safety device, two receptacle channels may be provided at the housing body to receive neutral and active lines

of the deployed power cable in a spaced apart relationship, the cable clamp will preferably also have two mounting channels arranged to receive and fix the neutral and active lines in a spaced apart relationship against displacement with respect to the clamp, and the cutting mechanism will have individual, movable  
5 cutting members, preferably blades, assigned to each receptacle channel. In operation, each of the power cable lines will be severed separately by the respectively associated one of the cutting members, thus avoiding short-circuiting or bridging upon severing of the cable, the live ends of the lines remaining isolated from one another at the housing body.

10 It will be understood that such a device can readily be adapted for a four line version, in which four channels are arranged in the one device or two devices as described above are arranged in a "double-decker" type arrangement.

Such safety device can be easily mounted, for example, to an existing aerial service cable carrying power overhead from a power pole to a building or  
15 between power poles, without the need to interrupt power supply given that the device housing is devised for attachment to the cable without severing same. In order to effect mounting, it is only necessary to identify the neutral and active cable lines and locate these in the respective receptacle channels at the housing body and the mounting channels at the clamp portion. The lines are then fixed  
20 against axial movement within the clamp portion (see examples below), and the housing body secured to the power pole (examples of how this may be effected being referred to below).

Generally speaking, safety device embodiments of the present invention provide or create a rated break point when installed to the cable, and thus provide  
25 for a predictable breakage location for cases where an object such as a truck or falling tree branch strikes the cable with a force that would normally break the cable in an ad hoc fashion and location. The danger of a live cable end dropping to the ground is removed given that the housing body is devised to retain therein the cut ends of the live, electricity carrying cables, and a suitable anchoring  
30 device is used to secure the device to a power pole, building wall etc. The 'dead' power cable ends will remain in the clamp portion which will fall to ground.

As noted above, the force-sensitive coupling structure, eg shear pin, will be rated essentially to ensure that the cutting mechanism will perform its severing function before loads in the cable arise which will cause it to snap.

5 A further preferred feature of the invention comprises the use or addition of a transient load discriminator device either located within the safety device, eg in the force-sensitive coupling structure between housing body and clamp portion, or between the safety device and a power pole or support structure to which the device is secured. The discriminator is devised to discriminate between "longer" time-frame forces that will lead to cable rupture, and "short" time, impact-like or  
10 glancing loads that would not threaten the integrity of the cable but could otherwise cause the force-sensitive coupling structure of the safety device to activate. Thus, the discriminator device will act to smooth out vibration and casual impacts that should not activate the device.

In a simple mechanical embodiment thereof the discriminator will include  
15 one or more tension spring elements that have a spring constant that will be chosen dependent on the maximum tensile load carrying capacity of the cable. The spring arrangement is designed to "bottom out" or resist further elongation at force values below that would cause cable rupture, and beyond values at which the shear pin will rupture.

20 In accordance with a preferred form of the above described mechanical safety device, an anchoring device for securing the housing body to a support structure nearby or at a location at which the power cable is supported may include a bridle cable having a tensile strength substantially above that of the shear pin. This measure will ensure that the safety device triggers below cable  
25 breakage loads and is not itself detached from its supporting structure. The attachment of the clamp to the pole can be achieved with the use of a flexible cable capable of twisting to accommodate a force from any direction.

Advantageously, the cable clamp of the safety device may be comprised of a mounting bracket or clamp body portion and one or more clamp caps  
30 removably securable to the clamp body, the clamp body portion and clamp cap(s) defining between them the mounting channel(s) in which the deployed cable is received.



In order to increase retention capability against axial movement of the cable, the mounting channel(s) can include gripping members, such as barbs or serrations.

5 In an embodiment where the cable clamp comprises two of said clamp caps disposed on opposite side faces of the clamp body portion, these caps are advantageously displaceably secured to one another thereby allowing relative movement with respect to each other as well as jointly relative to the clamp body portion to effect clamping of the cable lines to the clamp body portion. Joint movement with respect to the clamp body facilitates inserting the cable lines into  
10 the mounting channels.

In an alternative embodiment of the safety device according to the invention, one can omit the clamp structure and have a single housing body with receiving channel(s), the mechanical implementation of the force or strain sensing arrangement being then effected by providing a shear pin that extends or  
15 protrudes into an enlarged portion of the receiving channel in a manner such that the cable, when received in the channel, is caused to deflect about the pin and assume a non-rectilinear or curved shape at the housing body, the shear pin being calibrated to shear-off and allow the cable to assume a rectilinear configuration within the housing body upon a force being transferred along the  
20 power cable that exceeds a threshold value that is below that which would lead to snapping of the cable. In such arrangement, the cutting mechanism is equally devised to move the cutting member(s) in response to relative movement of the cable with respect to the housing body.

Embodiments of the safety device can incorporate different types of  
25 retaining elements or structures which act to retain the live cable end, once the cable has been severed, safely within the housing body. A first retaining means is preferably arranged to specifically prevent the cable from being pulled from the housing body in longitudinal extension of the receptacle channel(s), while a second retaining means is preferably provided in form of a cover or other  
30 structure that at least partly covers the preferably semi-circular, side-wise open receptacle channel(s) that are present at the housing body, thereby preventing removal of the cable in other directions. The first retaining means are preferably retention barbs extending into the receptacle channels, while the second retention

means is preferably a resilient saddle bracket that straddles the housing body and its receptacle channel(s). It will be appreciated that housing body embodiments having two of said receptacle channels, may cover implementations where these are disposed on one side or on either side of a central body portion.

5           A cutting mechanism for use in the safety device embodiments of the present invention may advantageously comprise one cutting blade per receptacle channel, which is pivoted at the housing body in a manner such as to protrude, in a first rest position, with a cutting blade edge into the respectively associated  
10           receptacle channel to an extent that enables said edge to engage with the outer surface of the cable when received therein, and be forced to rotate about its pivot point towards a second rest position upon and pursuant displacement of the cable along the receptacle channel thereby severing the cable.

          As noted above, in a preferred embodiment, the housing body has two receptacle channels disposed to receive the active phase and neutral wires of the  
15           power cable separately. In such embodiment, it is advantageous to calibrate the cutting mechanism in such manner that complete severance of the active phase wire takes place prior to that of the neutral wire. In practice this may be implemented by calibration of the length of the cutting blades, the height of the receptacle channels and depth of the cutting blades.

20           The cutting blade(s) may be loosely received (ie without additional fastening members) and pivoted at a fulcrum channel at an end of recess of the housing body that merges into the receptacle channel, the length of the cutting blade, height of the receptacle channel and depth of the cutting blade recess being such that in said first rest position of the cutting blade within the recess, the  
25           free end of the cutting blade slightly bites into or otherwise secures onto the cable line when received in the receptacle channel, and upon linear displacement of the cable line along the receptacle channel the cutting blade is caused to pivot about the fulcrum channel thereby rotating and progressively cutting through the cable line until reaching said second rest position at the recess.

30           The safety device for cables will advantageously have a housing body made of insulating, plastic material. This provides additional insulation safety against short circuiting of the two live wires that remain in the body upon severance of the cable.

In applications where the safety device is mounted at the same time as a new power cable is deployed, a preferred embodiment thereof would incorporate a fastening arrangement of the type normally employed to retain the power cable at an anchoring location at a power pole or similar, and which is devised to take  
5 the strain of the cable at its connection point at the power pole. In other words, the device can act as both a retention/mounting device for the cable at the power pole, as well as an emergency pre-determined breakage point mechanism.

It will be appreciated by the skilled worker in this field, that embodiments of the safety device in accordance with the present invention can also be used in  
10 other application areas where safe cutting of a cable (not necessarily a power cable) is required in order to prevent cable breakage at a random location under breakage loads, and where such randomness may represent a health hazard.

Illustrative embodiments of the present invention will be described with reference to the accompanying figures.

## 15 **BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 shows a first embodiment of a safety device in accordance with the invention in perspective schematic view;

Figure 2 shows in perspective a schematic illustration of a second embodiment which can be used to secure power cables on new or existing  
20 installations; and

Figure 3 shows an isometric perspective, in partially disassembled manner, a third embodiment in accordance with the invention that is similar to the one of figure 2.

Figure 4 shows in perspective a schematic illustration, in partially  
25 disassembled manner, of a fourth embodiment in accordance with the invention that is similar to the one of figure 3.

## **DESCRIPTION OF EMBODIMENT**

Figure 1 shows a first embodiment of a safety device that allows for controlled and safe severing of deployed power cables in situations where forces  
30 are experienced by the cable, eg as consequence of a tree falling on it, which would otherwise lead to snapping of the cable at a random location. The device is intended for retrofitting on existing power lines but may equally be mounted during initial deployment of the power cable.

Safety device 10 has a main housing body 12 made of a suitable polymeric plastic, insulating material. The roughly box-like, elongate body 12 has on opposite lengthwise side faces two receptacle channels 14, 16 of a dimension and cross-section suitable to receive non-illustrated pole lines of a power cable, i.e. a live or phase wire as well as the neutral line which would be located at the locations indicated by reference arrows 18 and 20. Each of receptacle channels 16, 14 has an enlarged portion in about the middle section of body 12, illustrated by reference numeral 14a. A shear pin 22 is received within a bore in body 12 so as to protrudes in traverse direction into the enlarged portion 14a of channel 14 (and equally into the enlarged channel portion of channel 16 on the other side of the body which is not visible in Figure 1). The pin 22 is located such that a cable wire which is inserted sideways into the receptacle channel 14, 16 is made to curve above the pin 22. This curved cable path over pin 22 is devised such that upon the cable being tensioned, a force will be exerted in downward direction as illustrated by arrow A in Figure 1. The magnitude of the force is directly related to the tension force to which the cable is subjected..

The shear pin 22 is dimensioned (or otherwise calibrated) such as to shear and brake at its base under a predetermined load, as explained below, thereby enabling the cable line received within channel 14, 16 to attain a rectilinear form.

Reference numeral 24 identifies a cutting blade with corrugated free cutting end which is received in a triangular, open-sided recess 26 that merges into receptacle channel 14, the recess 26 having a terminal fulcrum channel 26a at a depth such that the blade 24, upon rotating from its rest position illustrated in Figure 1, into its fully upright position, substantially reaches the upper end of channel 14 without prior interference. In its rest position, the blade edge protrudes slightly into the channel 14. The blade 24 which is loosely received within its recess 26 is prevented from falling out sideways by a blade holding plate 28 which is secured by means of a cap screw 30 and washer 32 onto the housing body 12. A similar recess, blade holding plate, cap screw and washer are provided on the opposite, non visible side of housing body 12 for the cutting blade which is provides to interact with receptacle channel 16. Blade 24 may also be a blade with a flat, or other suitable, edge.

The metallic cutting blades 24 are made of a material that is able to sever cable strands usually employed in power cable applications, as will be described herein below.

5 Since the safety device 10 is usually deployed in conditions where environmental corrosion may take place, it is preferred to use a filler material in the recess 26 where the cutting blades 24 are received in order to prevent vermin or dust building up over time in that area which could otherwise impede or hinder free blade operation. A preferred filler is silicon or a closed cell sponge which can easily be compacted.

10 In order to prevent accidental dislodgement of the cable pole lines received in receptacle channels 16 and 14 away from housing body 12, there is provided a saddle bracket 34, preferably made of resilient and electricity-insulating material, which straddles the central portion of body 12 and is kept securely engaged therewith by means of retention lugs 36 at the terminal end of the arms of saddle  
15 bracket 34.

Equally, the receptacle channels 16 and 14 of the housing body 12 are dimensioned at the rear end of the body in such a manner that a press fit of the cable lines, when received therein, is achieved, i.e. such that the ends of the cable lines close to the fastening location of the safety device 10 at a power pole  
20 (see below), will remain securely received within the safety device 10 upon the cutting mechanism coming into action. Retention barbs 15 may also be present at this end of the receptacle channels 14, 16, to counter forces that would tend to otherwise pull-out the cable lines along the extension of the receptacle channels.

The entire safety device 10 can be secured to a power pole (not illustrated)  
25 by means of a bridal or anchor cable 38 whose tensile strength is substantially greater than that of the power cable. Anchor cable 38 is secured to the rear part of body 12 using a suitably dimensioned clevis pin 40 or in an otherwise known manner. To allow restricted rotation of the anchor cable 38 about pin 40, a cutout or recessed fastening region 42 is formed at the rear top end of the housing 12  
30 where clevis pin 40 is secured.

In operation, for mounting the safety device onto deployed power cables or lines, it is only necessary to identify the neutral and power phase lines, and then separate the separately insulated power phase line from the neutral phase line.

The housing body 12 is then located between these lines in such a manner that the cable lines come to rest in the respective side channels 14, 16 and in a manner that these lines are deflected over the shear pin 22. In pushing the cable lines into the receptacle channels 14, 16, one ensures that the edges of the cutting blades 24 bite or otherwise securely engage into the insulation of the cable lines without causing actual damage to the electricity-carrying cable line cores. The saddle cover 34 is then slipped over the housing body 12 to prevent dislodgement of the cable lines from the safety device 10.

It will be noted that the shear pin 22 acts as "power cable tension detection device", due to the otherwise rectilinear cable having to curve around it whilst being guided in the receptacle channels 14, 16 of the device 10. The shear pin 22 equally performs the function of a "release mechanism" for the cutting blades 24 in order for these to perform their intended power cable severing function, as is explained herein below.

As noted above, when the cable lines are inserted into the receptacle channels 14, 16, the serrated, or flat, edges of cutting blades 24 will slightly penetrate or grip into the external insulation of the lines without cutting through it or coming into contact with the metallic core of the cable.

In use, loads to which the power cable is subjected will be detected and reacted at the shear pin 22. If the loads are excessive, tension forces within the power cable lines will generate a substantial shearing force onto pin 22. If the shearing force is greater than the shear pin design load, it will break and allow the cable lines to slacken and subsequently be pulled into their un-curved states, whilst still being supported at the power pole at which device 10 is secured. Consequently, during this movement, and since the cable lines are already in gripping engagement with the cutting blade edges, the blades 24 will be caused to follow cable movement and be pivoted towards the front of the device and in the process sever through the power cable lines received at the device 10.

By appropriately calibrating the length of the blades at opposite sides of the device 10, it is possible to ensure that the neutral cable of the power line will sever at a stage which is slightly after the phase cable is severed. The now free ends of the severed cable which are no longer electricity carrying will be able to

drop safely onto the ground leaving the insulated cable ends within the device 10 and hanging from the power pole.

Three further embodiments of a power cable safety device are illustrated in figures 2, 3 and 4. These embodiments share some components with the first embodiment of figure 1, in so far as functionality but not necessarily physical appearances are concerned, and thus similar reference numerals as used in figure 1, but in the 100 numbering range, have been used in figures 2, 3 and 4 to designate parts or components of similar functionality. Reference should therefore also be had to the above description, in particular in so far as cutting mechanism description is concerned.

The safety device 100 of figures 2, 3 and 4 comprises two main subassemblies, namely a housing subassembly 102 and a cable clamp subassembly 104, which are detachably joined together as described below. In figure 3, some components have been omitted for clarity of illustration purposes.

Housing subassembly 102 has a body part 112 of essentially similar make-up and layout to that of figure 1, but for the differences noted herein. The receptacle channels 114 and 116 omit the enlarged portion 14a shown in figure 1 but are otherwise of similar lay-out. The location of the cutting blade receptacle recesses 126 (reference numeral 26 in figure 1) are located further aft and closer to the location where the anchor cable 138, for securing the device 100 at a power pole, is located. Whilst a single retention barb 115 is shown to be present in the receptacle channel 114 of the embodiment of figures 3 and 4, more than one or differently shaped retention elements may be provided. A useful feature of the retention barb 115 is that, on severance of the cable, retention barb 115 prevents the power-pole end of the cable leaving the housing subassembly 102. The live end of the severed cable is thereby held captive and reduces the risk of electrocution.

The lay-out of the cutting mechanism of the embodiment of figure 2 with its cutting blades 124, covers 128 and fastening screws 130, as well as the dimensions and lay-out of the blades 124 and receptacle recesses 126 are otherwise the same as was described above with reference to figure 1. In figure 3, the screw-fastened covers 128 of the previous embodiments have been

replaced by covers 128' which include integral mounting pins 129 which are force-fit into suitable receptacle bores 129' in the side of the housing part 112.

Housing body part 112 additionally has an internal slot or groove that extends along part of its longitudinal axis (not illustrated) and which is open  
5 towards the cable clamp subassembly 104. This slot serves to receive in form-fitting manner a tongue portion, not illustrated in fig 2; but see figures 3 and 4, reference numeral 106, which is present at a main clamp body part 150 of cable clamp subassembly 104. The tongue and slot ensure positive and orientational connectivity of the subassemblies 102 and 104 to one another.

10 A traverse bore 121 extends through the main body part 112 at a location where the slot is present, and equally through a bore 121a (see heretofore the similar arrangement shown in figures 3 and 4; reference numeral 121a) in the tongue 106 present at body part 150.

A shearing pin 122 is received with interference fit in traverse bores 121,  
15 121a and thus retains the subassemblies 102, 104 connected to one another. The shearing pin 122 is gauged and calibrated to withstand a threshold pulling force along arrow B (and the consequential shearing stress) and maintain the subassemblies 102 and 104 connected to one another, and otherwise break when the threshold pulling force is exceeded. It will be appreciated that the  
20 threshold value can be readily determined (and a suitable shear pin geometry and/or material selected) and will be somewhat below the tensile strength value of the power cable to be fitted with the safety device 10, 100.

It will be further noted that whilst the embodiment of figure 2 uses a similar principle for attaching the bridal anchoring cable 138 to that of figure 1. A clevis  
25 pin 140 is used but the recessed portion 42 has been modified and instead a flange ear 142 stands proud from the rest of the body portion 112. In contrast, the embodiment of figure 3 incorporates further differences to those present in figure 2. There, instead of having a flange ear 142, a pommel-like portion 143 serves to retain an end loop 139 of a single anchoring cable 138'. Even further differences  
30 are noted in figure 4. Here, a double anchoring cable 138'', is attached to two pommel-like portions 143, 143' either side of the housing body 112. Each end of the double anchoring cable 138'' has an end loop 139 retained by the pommel-like portions 143, 143'.



As with the embodiment of figure 1, a saddle cover 134 serves to cover part of the receptacle channels 114, 116 which receive the power cable lines in order to prevent sidewise displacement thereof from the channels. In the embodiment of figures 3 and 4, the saddle cover 134' has been modified to fit the contour of and cover the entire housing part subassembly 102, which provides additional protection against environmental degradation. Saddle cover 134' has an upper surface 141 of stepped appearance (to cater for the pommel portion(s) 143), and has additionally two retention holes 144, 145 which respectively engage over and cooperate with two, two-pronged, mushroom-head retention knobs 146 and 147 provided on housing body part 112. This not only provides additional retention elements to secure the cover 134' to the housing part 112, but ensures that the loop end(s) 139 of anchoring cable 138 remains secured onto housing 112, given that one of the retention knobs 146 is provided at the pommel(s) 143.

In all embodiments illustrated in figures 2, 3 and 4, the cable clamp subassembly 104 essentially is a double vice with two receptacle zones that allow secure clamping of the power cable active and neutral lines onto the above mentioned main clamp body part 150 by means of a pair of jaw or clamping bracket members 152, 154 which are movably secured to widthwise opposite side faces of the central body part 150. Parts 150, 152 and 154 are made of the same material as the housing body part 112.

Clamp body part 150 and bracket members 152, 154 have facing, axially extending grooves 155, 155' (see figures 3 and 4) which together define two receptacle channels 156, 158 (see figure 2) which are coaxial with the receptacle channels 114, 116 present at the housing part 112. Movable jaw brackets 152 and 154 are held to clamp body part 150 by bolts 160 and 162 that extend through respective bores 163 that traverse body part 150 and which in turn are secured using nuts 164 and 166. A helical compression spring 168 is received in another through-bore 165 of central body part 150 and abuts with its terminal opposite ends against the inward facing surfaces of movable jaw brackets 152 and 154 thereby to maintain these biased in opposing orientation, but allow individual and joint movement thereof towards and away from the central clamp body 150 to effect clamping. Reference numerals 170 and 171 seek to identify

serrations or corrugations which are present on the surfaces of the grooves 155, 155' in the central body part 150 and bracket members 154 that form the mounting channels 156, 158. Of course, other measures may be implemented in order to ensure that the power cable lines, once received within mounting  
5 channels 156, 158 and clamped between the jaw brackets 152, 154 and central clamp body 150, are secured against slippage at and axial movement with respect to the clamp subassembly 104.

This last measure is important so as to ensure that tension forces and stresses that are carried by the deployed power cable in normal operation, as well  
10 as consequential upon unusual situations such as a tree branch falling onto the power cable or similar occurrences, may directly be transmitted by virtue of the substantially irresilient clamping action from the cable clamp subassembly 104 via the shearing pin 122 into housing subassembly 102. In other words, tensile loads of the power cable will be experienced by the shear pin 122, and where these  
15 loads exceed the rated shear strength of the pin 122, the latter one will break and allow relative displacement of the subassemblies 102 and 104 with respect to one another, thereby triggering / actuating the cutting mechanism.

In order to retrofit the safety device 110 of the embodiments of figures 2 - 4, as was the case with the embodiment of figure 1, the two power cable lines  
20 (phase and neutral) are inserted from the sides into the receptacle and mounting channels 114, 116 and 156, 158 of the housing and cable clamp subassemblies 102, 104. As described above, the cutting blade edges will bite hereby into the insulation of the individual lines without otherwise damaging the power cable. Subsequently, saddle bracket 134 is secured onto housing subassembly 102, and  
25 clamping jaw brackets 152 and 154 displaced towards central clamp part 150 and secured upon tensioning of nuts 164 and 166, thereby securely fixing the cable lines to the cable clamping subassembly 104.

In the event of tension stress being experienced in the power cable that is close to breaking magnitude, that is beyond a predetermined acceptable safety  
30 value, the power cable tension stress will lead first to the shearing pin 122 failure, whereupon the clamping subassembly 104 of the device 110 will be disconnected from and tend to seek and move away from the housing subassembly 102. In the process of displacement, the power cable will move within housing subassembly

channels 114 and in so doing pivot the cutting blades 124 thereby severing the phase cable line first and subsequently the neutral cable line.

As with the embodiment of figure 1, the live ends of the cable lines are retained in the receptacle channels 114 by retention barbs 115, and saddle  
5 bracket 134, while anchor wire 138', 138'' prevents the housing subassembly 102 from falling to the ground. The dead power cable fall to the ground with the cable clamp subassembly 104.

It is likely that, on occasions, power cables will be subject to transient and 'short time' forces which, whilst nominally having a magnitude that may be higher  
10 than the nominal, longer time-frame tensile strength of the shear pin, will most likely not lead to uncontrolled power cable rupture, and could be safely carried. In order to avoid that such transient excess forces trigger the safety device 10 or 110, ie lead to failure of the shearing pin 22, 122 despite the cable still being secure, it is desirable to install a transient force discriminator, which may  
15 elastically absorb some deformation energy which would otherwise be fully applied to the shearing pin.

In figures 3 and 4 there is illustrated an embodiment of such force discriminator 170, which consists of a helical tension spring 171 inside which are received two, essentially inextensible tension transmission members 172, 172',  
20 each consisting of a u-bent, heavy gauge wire, the terminal ends 173 of which are bent backwards towards the u-bent end 174 which itself is formed into a closed eye hook. The tension transmission members 172, 172' are disposed in opposite orientation, ie with their respective closed eye hook ends 174 on opposite axial ends of the spring 171. The discriminator 170 may be used instead of or in  
25 addition to anchoring cable 138', 138'', in which case it is suitably secured to one of the terminal ends of cable 138', 138''. As shown in figure 4, the discriminator is used in addition to the anchoring cable 138''. In this configuration, the anchoring cable 138'' also allows articulation of the safety device 100 in each direction in which a force may strike the power cable (ie from above, below or side-on), or a  
30 combination of such forces.

Examples of transient loads that are intended to be taken up by the discriminator 170 include a branch hitting the cable or animals jumping on or hitting the cables.

The invention has been described above with reference to preferred but by no means exhaustive embodiments thereof, and variations to the specific embodiments or other embodiments will be apparent to the skilled reader.

CLAIMS:

1. A safety device for severing, in controlled manner, a deployed cable, preferably an electricity carrying power cable, including a housing body adapted to receive and house a deployed cable, a cable cutting mechanism having at least one movable cutting member arranged to engage and sever the cable at the housing body, the housing body being preferably configured to retain one end of the cable after severance, and a force or strain sensing arrangement operatively engaged with the cable and the cutting mechanism and configured such that when a force is exerted on the cable which causes the cable to strain or stress beyond a predetermined threshold value, the cutting member is moved to sever the cable.
2. A safety device according to claim 1, wherein a mechanical force or strain sensing arrangement is provided which includes a coupling structure that connects the housing body with a clamp or similar structure that can be fixed against movement on the power cable, the housing body being devised to allow movement of the power cable in axial extension of the cable and to allow attachment to a support structure at or in vicinity of an anchoring location of the power cable, the force-sensitive coupling structure being calibrated to decouple and allow movement of the clamp structure away from the housing body upon a force being transferred along the power cable that exceeds a threshold value that is below that which would lead to uncontrolled snapping of the cable at random locations.
3. A safety device according to claim 2, wherein the coupling structure incorporates two components that are force-fittingly or form-fittingly engaged with one another, or which are joined together by means of a frangible connector, the coupling and/or connector being dimensioned or otherwise calibrated to disengage or break at loads close to those at which the power cable would snap in two.
4. A safety device for power cables, including a housing body with at least one receptacle channel adapted to receive a deployed power cable, the housing

body being devised for attachment to a support structure at or in vicinity of an anchoring location of the power cable, a cable clamp in which the power cable is receivable in fixed manner against displacement, a force-sensitive coupling structure which secures in removable manner the cable clamp to the housing  
5 body, the force-sensitive coupling structure being calibrated to disengage under a predetermined stress that is smaller than a stress which would lead to uncontrolled snapping of the power cable under load; and a cutting mechanism disposed at the housing body and including at least one cutting member that is located to engage with the power cable when received in the receptacle channel  
10 and arranged such that upon disengagement of the cable clamp from the housing body and relative movement of the power cable within the housing body, the cutting member is dragged by the power cable to move and sever the cable.

5. A safety device according to claim 4, wherein the force-sensitive coupling structure includes a frangible shear or tensile pin that is held in place at both of  
15 and serves to join the cable clamp and the housing body, the pin being dimensioned and made of a material which ensure the pin shears or breaks when subject to loads which are a predetermined amount below such which would otherwise lead to snapping of the power cable.

6. A safety device according to claim 4 or 5, wherein two of said receptacle  
20 channels are provided at the housing body to receive neutral and active lines of the deployed power cable in a spaced apart relationship, wherein the cable clamp has two of said mounting channels arranged to receive and fix the neutral and active lines in a spaced apart relationship against displacement with respect to the clamp, and wherein the cutting mechanism includes individual, movable  
25 cutting members, preferably blades, assigned to each receptacle channel.

7. A safety device according to claim 4, 5 or 6, further including a transient load discriminator device either located in the force-sensitive coupling structure between housing body and clamp portion, or in-line between the safety device and a power pole or support structure to which the device is securable

8. A safety device according to any one of claims 4 to 7, wherein the cable clamp of the safety device includes a mounting clamp body portion and one or more clamp caps securable in displaceable manner to the clamp body, the clamp body portion and clamp cap(s) defining between them the mounting channel(s) in which the deployed cable is arrested against movement.
9. A safety device according to claim 8, wherein the mounting channel(s) include gripping members, such as barbs or serrations disposed to increase retention capability against axial movement of the cable beyond that provided by normal clamping action.
10. 10. A safety device according to claim 8 or 9, wherein the cable clamp comprises two of said clamp caps disposed on opposite side faces of the clamp body portion, the clamp caps being secured to one another in a manner that allows relative movement with respect to each other as well as jointly relative to the clamp body portion to effect clamping of the cable lines to the clamp body portion.
11. A safety device for mounting onto deployed power cables, having a housing body with receiving channel(s), a mechanical force or strain sensing arrangement that includes a shear pin that extends or protrudes into an enlarged portion of the receiving channel in a manner such that the cable, when received in the channel, is caused to deflect about the pin and assume a non-rectilinear or curved shape at the housing body, the shear pin being calibrated to shear-off and allow the cable to assume a rectilinear configuration within the housing body upon a force being transferred along the power cable that exceeds a threshold value that is below that which would lead to snapping of the cable, and a cutting mechanism disposed at the housing body and including at least one cutting member that is located to engage with the power cable when received in the receptacle channel and arranged such that upon relative movement of the power cable within the housing body, the cutting member is dragged by the power cable to move and sever the cable.

12. A safety device according to any one of claims 4 to 11, wherein first retaining means are arranged to counter forces in longitudinal extension of the receptacle channel(s) which would otherwise tend to pull the cable from the housing body.

5 13. A safety device according to claim 12, wherein the first retaining means is a barb arranged to counter forces in longitudinal extension of the receptacle channel(s) which would otherwise tend to pull the cable from the housing body, thereby preventing the live ends of the cable being exposed outside the housing body after the cable has been severed.

10 14. A safety device according to any one of claims 4 to 13, wherein second retaining means are provided, preferably in form of a cover or other structure that at least partly covers the otherwise open receptacle channel(s), that are devised to maintain the deployed cable at the housing body against forces acting in a direction other than longitudinal extension of the cable.

15 15. A safety device according to any one of claims 4 to 14, wherein the cutting mechanism includes at least one cutting blade per receptacle channel, which blade is pivoted at the housing body in a manner such as to protrude, in a first rest position, with a cutting blade edge into the respectively associated receptacle channel to an extent that enables said edge to engage with the outer surface of  
20 the power cable when received therein, and be forced to rotate about its pivot point towards a second rest position upon and pursuant displacement of the cable along the receptacle channel.

16. A safety device according to claim 15, wherein each cutting blade is pivoted at a terminal end fulcrum in a respective recess of the housing body, the  
25 length of the cutting blades, height of the receptacle channels and depth of the cutting blade recesses being such that in a first rest position of the cutting blade at its respective recess, the free end of the cutting blade bites into or otherwise secures onto the cable line when received in the receptacle channel, and upon linear displacement of the cable line along the receptacle channel the cutting  
30 blade is caused to pivot about its fulcrum thereby rotating and progressively



cutting through the cable line until reaching a second rest position at the recess in which the blade has completely severed the cable line.

17. A safety device according to claim 15 or 16, wherein in embodiments of the housing body having two receptacle channels disposed to receive an active  
5 phase wire and a neutral phase wire of the power cable separately, the cutting blades mechanism is calibrated in such manner that complete severance of the active phase wire takes place prior to that of the neutral wire.

18. A method for preventing uncontrolled breakage of a cable under load, wherein a safety device according to any one of the preceding claims is fitted to  
10 said cable.

19. The safety device substantially as herein described with reference to any of the accompanying drawings.

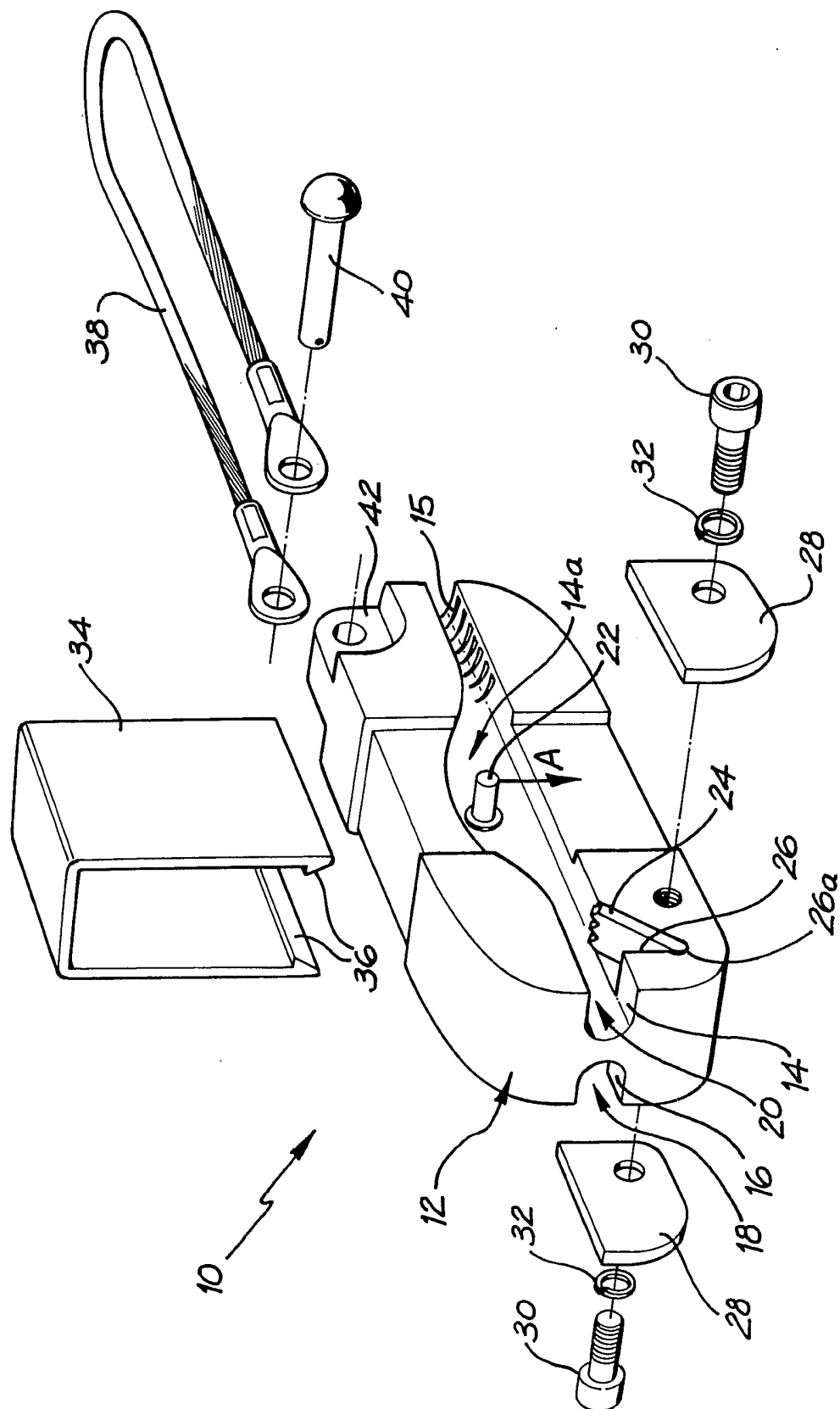
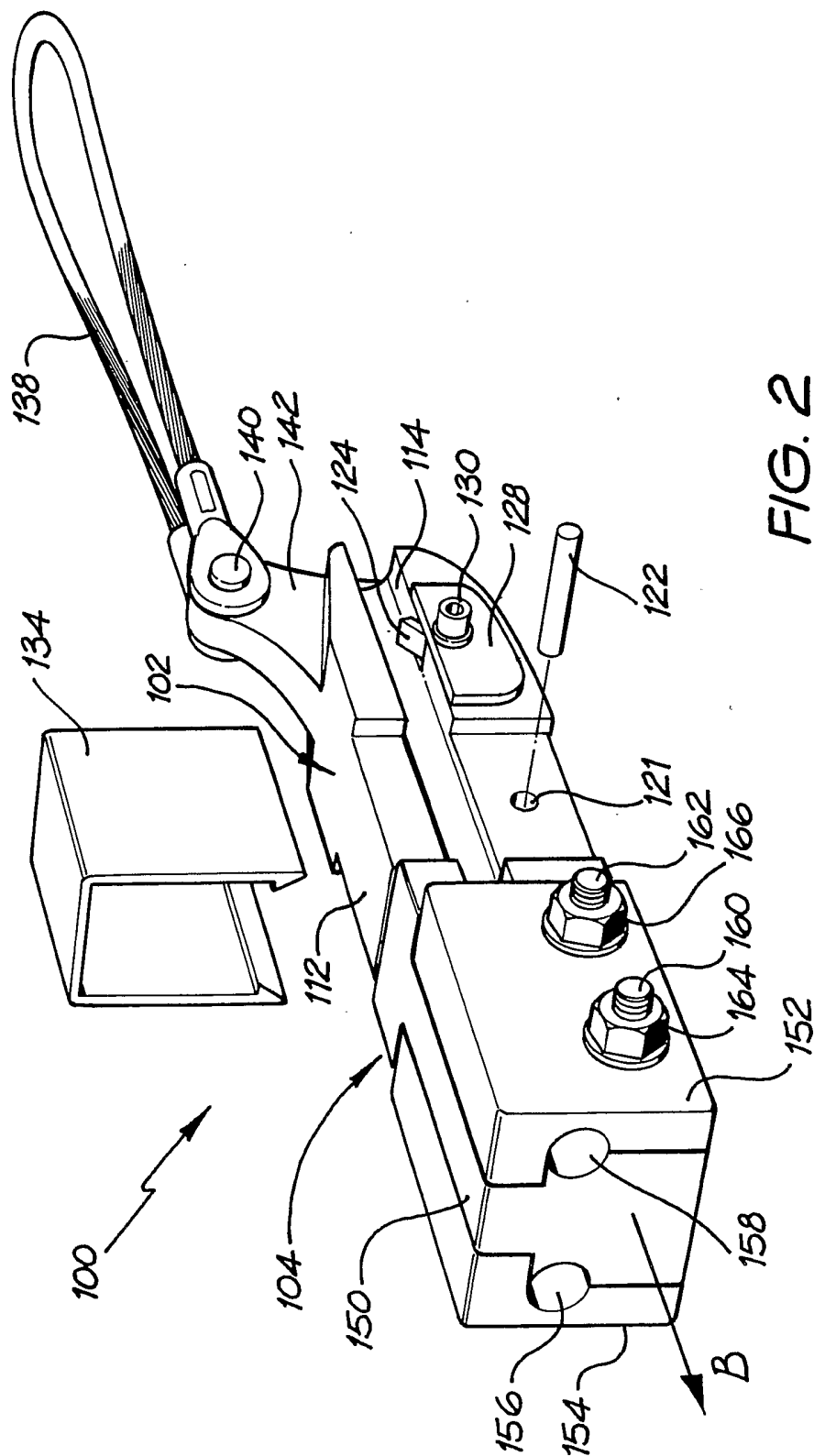


FIG. 1



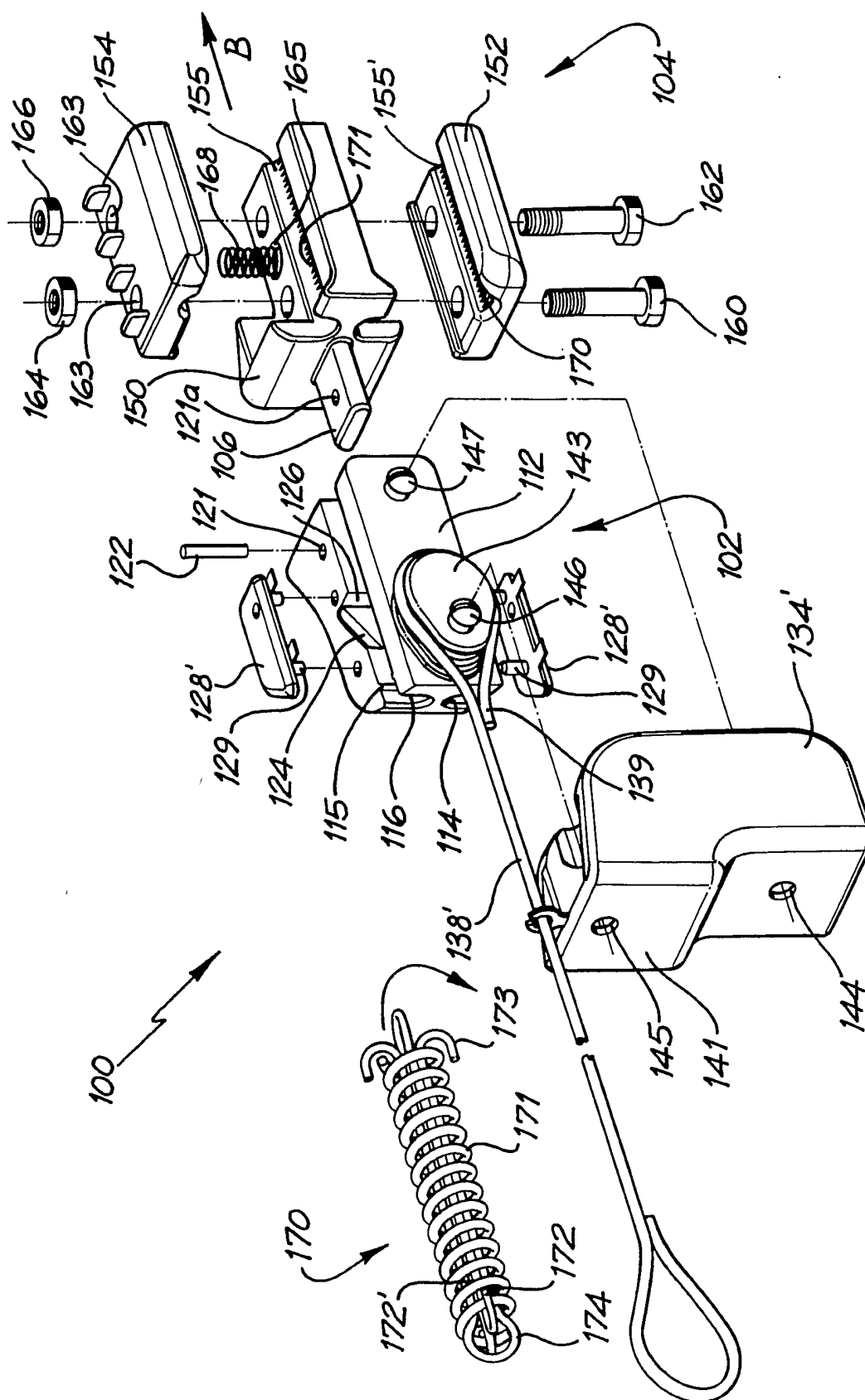


FIG. 3

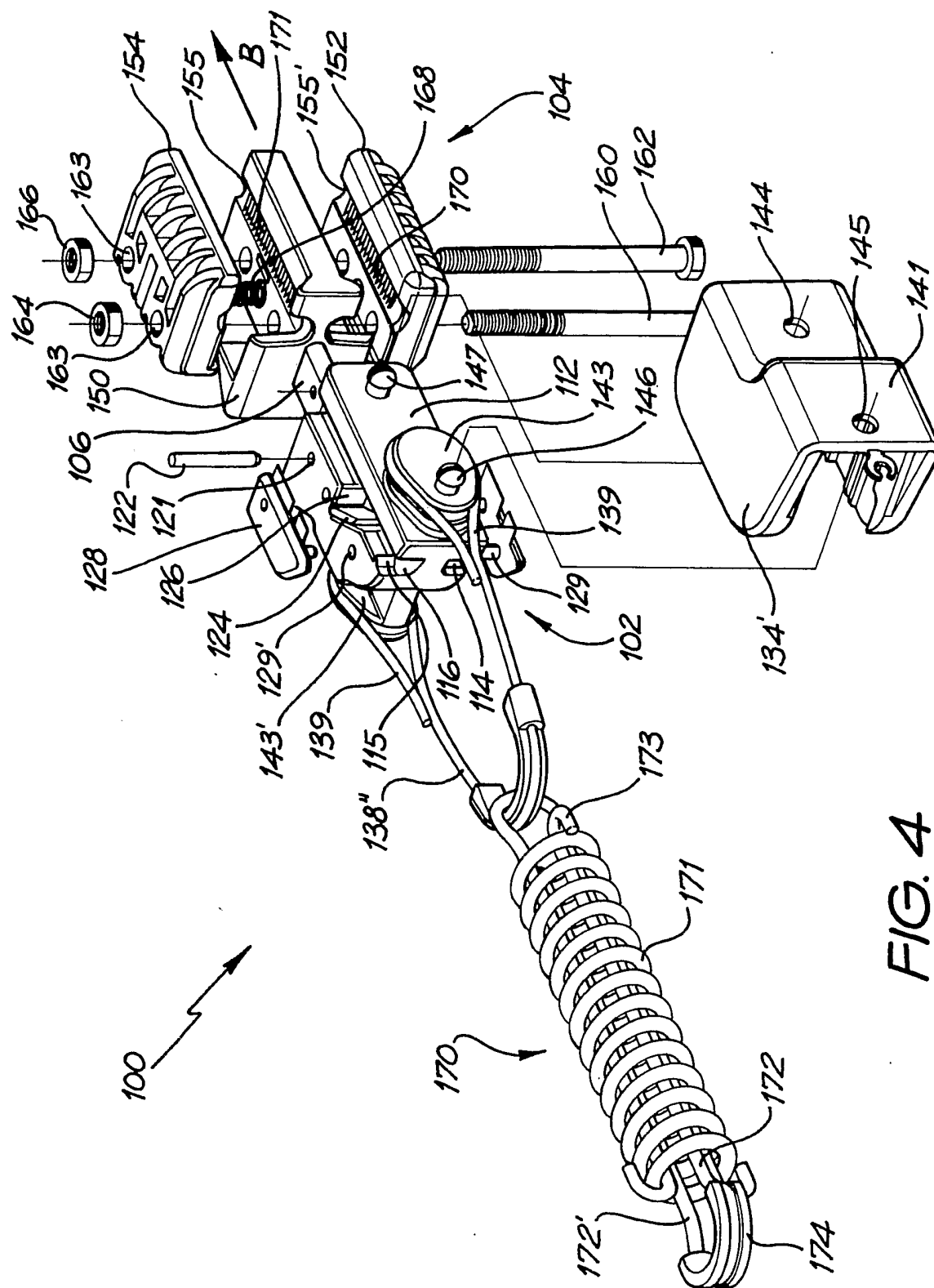


FIG. 4

# INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/AU2005/000381**

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> Int. Cl. <sup>7</sup> : H02G 7/18, 1/00 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) 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) DWPI IPC: H02G 1/-, 3/-, 7/-, 15/- & keywords cut, sever, shear, break, tension, force, load, strain, sense, measure, detect, limit, threshold, value, exceed, actuate, mechanism, safety, protect & others		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Derwent Abstract Accession No. 83-820072/46, Class X12, SU 993372 A (LENGD GIDROPROEKT) 30 January 1983 see abstract	
A	GB 190602548 A (LETROTEUR) 9 August 1906 see entire specification	
A	US 4695677 A (RUTH et al) 22 September 1987 see abstract	
A	Derwent Abstract Accession No. 95-137890/18, Class X12, SU 1836765 A3 (SOVMESTYNYI PUT SOVIET AMERICAN ENTERP) 23 August 1993 see abstract	
<input type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> 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 26 May 2005		Date of mailing of the international search report 31 MAY 2005
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929		Authorized officer <b>M.S. HAYNES</b> Telephone No : (02) 6283 2170

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2005/000381

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member
SU	993372	NIL
GB	190602548	NIL
US	4695677	NIL
SU	1836765	NIL
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.		
END OF ANNEX		