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Overvoltage protection plug with fail-safe device

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INVENTION TITLE:

Overvoltage protection plug with fail-safe device

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

Description

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The invention relates to an overvoltage protection plug.

10 Particularly in telecommunications and data technology, overvoltage protection plugs are used to protect the wired-up double wires against overvoltages and overcurrents caused by technical defects or external disturbances such as lightning strikes. To this end, such plugs have a component which limits the voltage and, generally, the current as well and to 15 which a fuse element, generally in the form of a solder pellet, is assigned. If an overcurrent lasting for a relatively long time occurs in the voltage-limiting component, then the solder pellet melts as a result of the heat losses occurring on the component, as a result 20 of which a mechanical fail-safe device generally short-circuits the wires to ground. This is necessary since the overvoltages or overcurrents that occur could possibly adversely affect the serviceability of the components. In order to make it easier to identify 25 which fail-safe device has tripped, various visual fail-safe signaling means are already known, light-emitting diodes being used predominantly.

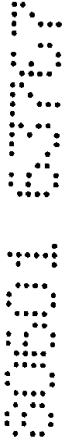
30 Various solutions are known for signaling the tripping of a fail-safe device. When the voltage-limiting component overheats, it is also possible, in addition to the short-circuit from a and b to ground, for a parallel process to be initiated (indirect signaling). The safety-relevant process of fail-safe tripping in this case remains entirely uninfluenced by 35 the signaling process, but the fact that the relationship is only approximate is disadvantageous. Even if the two processes are optimally matched, thermal constellations are always possible in which



this fail-safe device has tripped but signaling does not take place, or vice versa.

Solutions for direct signaling means are known, in which, once a solder pellet has melted, the moving part of the fail-safe device makes contact, by means of spring force on reaching its limit position, not only with the contact points for the wires a and b but also with a further contact point for signaling. The design must in this case be configured such that the contact point for signaling is designed to have weak springing in order to avoid impeding the fail-safe movement. In any case, it is necessary to avoid an excessively low contact force occurring, or even no contact being made whatsoever, by the third contact point on the two contact points a-ground and b-ground.

It is known for the components for the overvoltage protection plug to be arranged on a printed circuit board. Since the visual fail-safe signaling is not always desirable or necessary, two types of printed circuit boards are therefore manufactured, namely one with and one without visual fail-safe signaling. The additional components for visual fail-safe signaling also result in the geometric dimensions of the printed circuit board being increased. However, in order to allow the same housing to be used for both printed circuit board versions, this is designed to match the larger printed circuit board. Furthermore, when the plug is arranged in a housing, this housing must be designed such that the visual fail-safe signaling can be perceived. To this end, the housing has an opening, out of which the light-emitting diode arranged at the plug end can project so that it can be perceived visually. This opening must then be closed for the plug version without visual fail-safe signaling.



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The present invention provides an overvoltage protection plug, including at least one voltage limiting component with an associated fuse element, and a fail-safe device, where the at least one voltage limiting component is arranged on a first printed circuit board with the associated fuse element and the fail-safe device as an enclosed unit; wherein the fuse element trips the fail-safe device in the event of thermal overheating; and wherein the overvoltage protection plug is adapted to be coupled to a visual fail-safe signalling means, where the visual fail-safe signalling means is coupled to a second printed circuit board.

Embodiments of the present invention provide for simple retrofitting of the visual fail-safe signalling means, without any components having to be fitted retrospectively, by designing the overvoltage protection plug as a closed unit on a printed circuit board and by arranging the visual fail-safe signalling on a separate printed circuit board which can be assigned to the first mentioned printed circuit board, if required. By applying the above it is possible to construct an overvoltage protection plug from a first printed circuit board where the dimensions of the first printed circuit board don't change even when a visual fail-safe signalling means is attached. Accordingly, such embodiments allow for a compact construction. Particularly, if the second printed circuit board is arranged above the first printed circuit board, the components of the second printed circuit board can in this case be arranged in the gaps between the components of the first printed circuit board. Advantages of such embodiments include the fact that the first printed circuit board can be manufactured for widespread applicability, and thus in large quantities, thus reducing its unit costs. Furthermore, by applying the above it is possible to construct an overvoltage protection plug that facilitates retrofitting, without the structure of the housing having to be changed retrospectively. To this end, all that is necessary is to provide guides for the two printed circuit boards in the housing, so that the printed circuit boards can



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easily be inserted or removed, as required. The associated housing part can be designed to be transparent, for visual perception. In this case, it is possible to design the associated housing part so that it is always transparent irrespective of
5 whether the visual fail-safe signaling means is or is not required, or else for the corresponding housing parts to be replaced for retrofitting. Furthermore, the design of separate printed circuit boards makes it possible for an aperture to be arranged centrally in the first printed circuit board, so that the
10 first printed circuit board can be moved by means of a suitable

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pulling hook. Further advantageous refinements of the invention result from the dependent claims.

The invention will be explained in more detail in the following text with reference to a preferred embodiment. In the figures:

Fig. 1 shows a side view of the overvoltage protection plug with visual fail-safe signaling in a housing,

Fig. 2 shows a perspective plan view of the first printed circuit board with the associated housing part, and

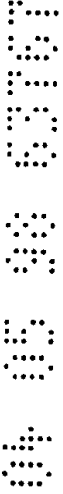
Fig. 3 shows a perspective plan view of the second printed circuit board with the associated housing part.

Fig. 1 shows the side view of a housing which is to be fitted with an overvoltage protection plug and comprises a housing lower part 1 and a housing upper part 2. A three-pole overvoltage suppressor 4, as a voltage-limiting component, and two PTC thermistors 5, as current-limiting components, are arranged on a first printed circuit board 3. The overvoltage suppressor 4 and the PTC thermistors 5 are designed to be cylindrical and are arranged in grooves and/or slots in the printed circuit board 3, where they are then electrically conductively connected, for example by means of reflow soldering. Once the overvoltage suppressor 4 and the PTC thermistors 5 have been soldered, a fail-safe contact 6 is snapped onto the overvoltage suppressor 4, the fail-safe device 6 additionally being fixed via a slot in the printed circuit board 3. The fail-safe contact 6 is in this case permanently connected to ground potential via the central electrode of the overvoltage suppressor 4. A fuse element, which is designed as a solder pellet 7 and is permanently connected to the fail-safe contact 6, is arranged between the overvoltage suppressor 4 and the fail-safe contact 6. If the overvoltage suppressor 4 is overheated, the solder pellet 7 melts and the short-circuit bracket of the fail-safe contact 6, which



is prestressed in the normal state, moves to the left toward the overvoltage suppressor 4, the short-circuit bracket making contact, in the unstressed state, with the two outer electrodes of the overvoltage suppressor 4. However, in consequence, the two outer electrodes are at ground potential, as well as a double wire connected to the outer electrodes. Furthermore, a sprung ground contact 8 is arranged on the printed circuit board 3, via which ground contact 8 the ground potential is passed to the printed circuit board 3. The sprung ground contact 8 is in this case arranged outside the housing, so that the latter is relatively freely accessible. The mating piece which makes contact and forms the ground rail 19 may thus be bent, for example as a lug, out of the mounting trough of a distribution board in a manner that is convenient for production. An aperture 9 is located centrally in the end region of the printed circuit board 3 and allows the printed circuit board 3 to be pulled by means of an associated tool, in which case it is possible for the tool to be inserted into the interior of the housing through an aperture 18 in the housing lower part 1. The printed circuit board 3 is pressed into the housing lower part 2 for installation, and is connected to the latter such that it latches in place. In the inserted state, the printed circuit board 3 is completely covered on the underneath by the housing lower part 1 so that there is no need for any additional passivation to protect conductor tracks against being touched or against being damaged.

The visual fail-safe signaling means, which may be required, is provided by a second printed circuit board 10. A light-emitting diode 11, a current-limiting resistor 12, an operating-voltage contact 13 and a connecting contact 14 are arranged on the printed circuit board 10. The light-emitting diode 11 and the current-limiting resistor 12 are preferably both designed as surface mounted devices and form the actual fail-safe signaling means. The operating-voltage



contact 13 is designed, in the same way as the ground contact 8, to be sprung and extends out of the housing upper part 2 so that its mating piece for making contact can likewise be produced by bending out a lug in a signal plate 20 which carries the operating voltage. The design of the ground contacts 8 and that of the operating-voltage contacts 13 allow simultaneous contact with up to 200 double wires by means of one plate, without any additional intermediate pieces. When the fail-safe contact 6 trips, the connecting contact 14 makes the connection between the first printed circuit board 3 and the second printed circuit board 10. For this purpose, the connecting contact 14 is prestressed against the solder pellet 7, an insulation layer 15 being arranged between the solder pellet 7 and the connecting contact 14. Until the fail-safe contact 6 trips, the circuit for the light-emitting diode 11 is open. If the solder pellet 7 now melts, then the prestressed connecting contact 14 moves in the direction of the fail-safe contact 6, making contact with the latter underneath the solder pellet 7 and the insulation layer 15, by means of a bent projection. As a result of the fact that the fail-safe contact 6 and the connecting contact 14 move in the same direction, the visual fail-safe signaling does not result in any weakening of the actual fail-safe process. Instead of the solder pellet 7 with the insulation layer 15, an electrical insulator having a similar temperature-dependent melting behavior could also be used. Like the printed circuit board 3, the printed circuit board 10 is pressed into the housing upper part 2 such that it latches in place. To this end, the printed circuit board 10 is pushed behind a projection 16 and is pressed upward, where it is held by a latching tab 17 that grips around it. The housing upper part 2 is designed to be at least partially transparent, so that the visual fail-safe signaling can be perceived outside the housing. Since the light-emitting diode 11 is



mechanically protected by the housing, it can be designed as an SMD diode which radiates to the side.

In order to assemble the overvoltage protection plug, the printed circuit boards 3, 10 are connected in a latching manner to the associated housing lower part 1 and, respectively, the housing upper part 2, as is shown, respectively, in Fig. 2 and Fig. 3. The housing lower part 1 and the housing upper part are then latched to one another, the latching elements 21 in the housing lower part 1 snapping into corresponding latching openings 22 in the housing upper part 2, and making a firm connection.

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List of reference symbols

- 1) Housing lower part
- 2) Housing upper part
- 3) Printed circuit board
- 4) Overvoltage suppressor
- 5) PTC thermistor
- 6) Fail-safe contact
- 7) Solder pellet
- 8) Ground contact
- 9) Aperture
- 10) Printed circuit board
- 11) Light-emitting diode
- 12) Current-limiting resistor
- 13) Operating-voltage contact
- 14) Connecting contact
- 15) Insulation layer
- 16) Projection
- 17) Latching tab
- 18) Aperture
- 19) Ground rail
- 20) Signal plate
- 21) Latching elements
- 22) Latching openings



Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that that prior art forms part of the common general knowledge in Australia.

The reference numerals in the following claims are not to be construed as imposing any limitations on the claims.



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An overvoltage protection plug, including at least one voltage limiting component with an associated fuse element, and a fail-safe device, where the at least one voltage limiting component is arranged on a first printed circuit board with the associated fuse element and the fail-safe device as an enclosed unit; wherein the fuse element trips the fail-safe device in the event of thermal overheating; and wherein the overvoltage protection plug is adapted to be coupled to a visual fail-safe signalling means, where the visual fail-safe signalling means is coupled to a second printed circuit board.
2. The overvoltage protection plug claimed in claim 1, wherein the first and second printed circuit boards are arranged at least partially in a common housing whose surface facing the visual fail-safe signalling means is designed to be transparent.
3. The overvoltage protection plug claimed in claim 2, wherein the first and second printed circuit boards are mounted in a latching manner, at a defined distance from one another, in the housing.
4. The overvoltage protection plug claimed in any one of the preceding claims, wherein the voltage-limiting component is designed as an overvoltage suppressor.
5. The overvoltage protection plug claimed in any one of the preceding claims, wherein the voltage-limiting component is designed essentially cylindrically and is arranged in slots and/or grooves in the first printed circuit board.
6. The overvoltage protection plug claimed in any one of the preceding claims, wherein the fail-safe device is snapped onto the voltage-limiting component and is fixed in a slot in the first



printed circuit board.

7. The overvoltage protection plug claimed in any one of the preceding claims, characterized in that the first printed circuit board is designed with a sprung ground contact which, if the first printed circuit board is arranged partially inside the housing, is located outside the latter.

8. The overvoltage protection plug as claimed in any one of the preceding claims, wherein the first printed circuit board has an aperture in the end region.

9. The overvoltage protection plug claimed in any one of the preceding claims, characterized in that the visual fail-safe signalling means has a light-emitting diode, a limiting resistor, an operating-voltage contact and a connecting contact which connects the first and second printed circuit boards electrically to one another when the fail-safe device trips.

10. The overvoltage protection plug claimed in claim 9, wherein the light-emitting diode and/or the limiting resistor are/is designed as surface mounted devices.

11. The overvoltage protection plug claimed in claim 9 or claim 10, characterized in that the operating-voltage contact is designed as a sprung contact which, when the second printed circuit board is arranged partially inside the housing is located outside the latter.

12. The overvoltage protection plug claimed in any one of the preceding claims, wherein the fail-safe device and the visual fail-safe signalling means are assigned the same fuse element, which is arranged partially between the fail-safe device and the voltage-limiting component and partially between the fail-safe device and the connecting contact, the connecting contact being



prestressed by the fuse element so that when the fail-safe device for the connecting contact trips a movement can be carried out in the direction of the fail-safe device.

5 13. The overvoltage protection plug claimed in claim 12, wherein the fuse element is designed as a solder pellet, and an insulation layer is arranged between the solder pellet and the connecting contact.

10 14. The overvoltage protection plug claimed in claim 12, wherein the fuse element is designed as an electrical insulator with a temperature-dependent melting behaviour.

15 15. An overvoltage protection plug substantially as hereinbefore described with reference to the drawings and/or Examples.

DATED this 7th day of June, 2001

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Krone GmbH

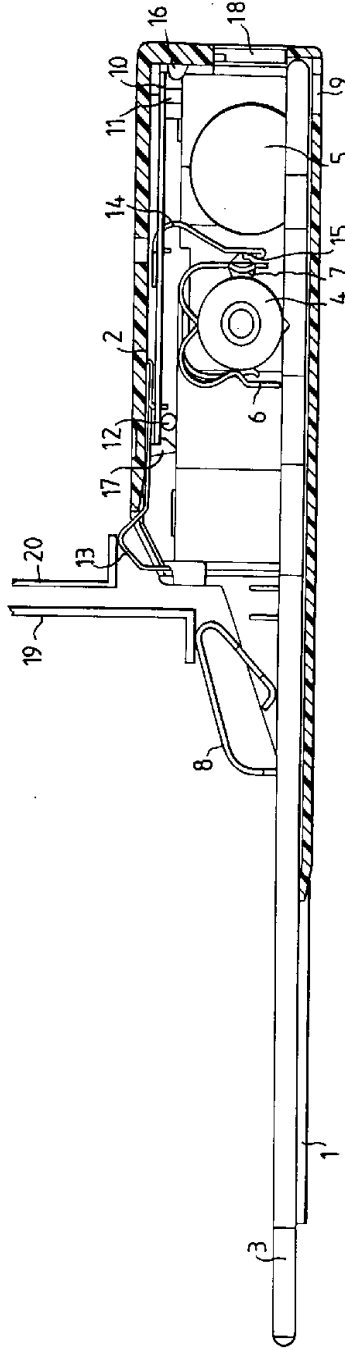
By its Patent Attorneys

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FIG.1



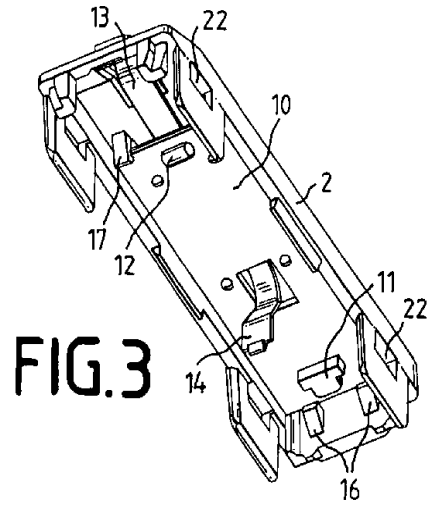


FIG. 3

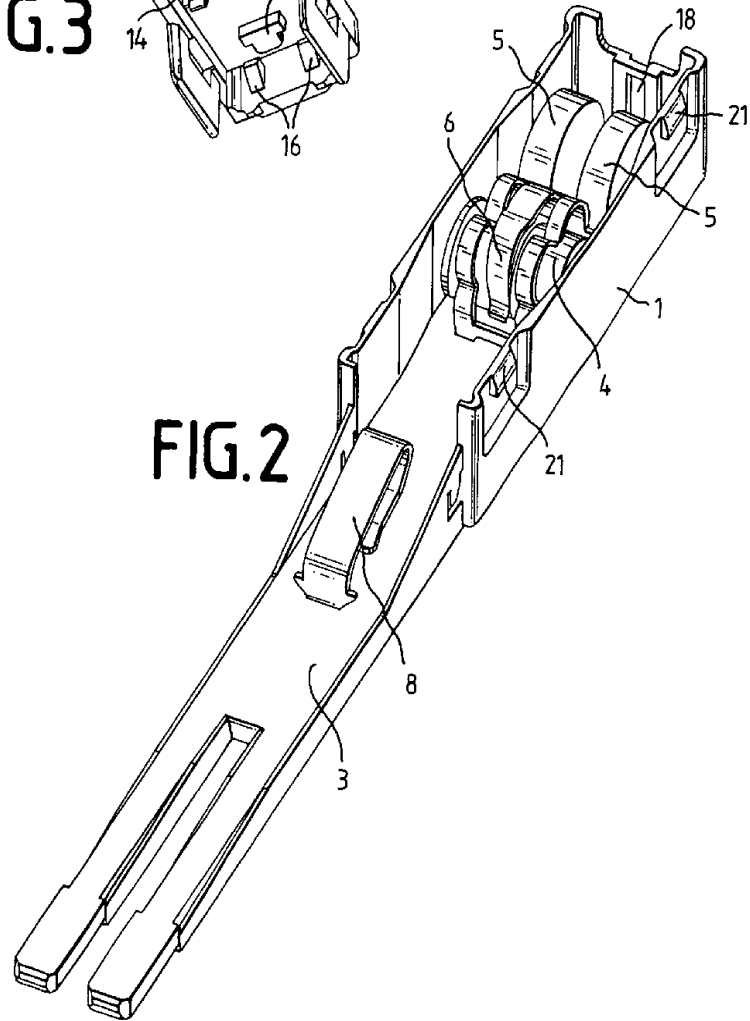


FIG. 2

