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(54) **Device for overvoltage protection**

(57) The invention relates to device for overvoltage protection comprising the terminals (00) for connection to the protected electric circuit, between which there is arranged the current path, in which the varistor protective element (3) is connected, between whose one output electrode and one terminal (00) for connection to the protected electric circuit in the current path the point (X) of intentional cutting off the current path is created, while to the point (X) the thermal cut out device (TCD) is assigned. Between the point (X) of intentional cutting off the current path and the adjacent outmost varistor (30) of the varistor protective element (3) in the current path an electric element being switched by voltage (4) is connected.

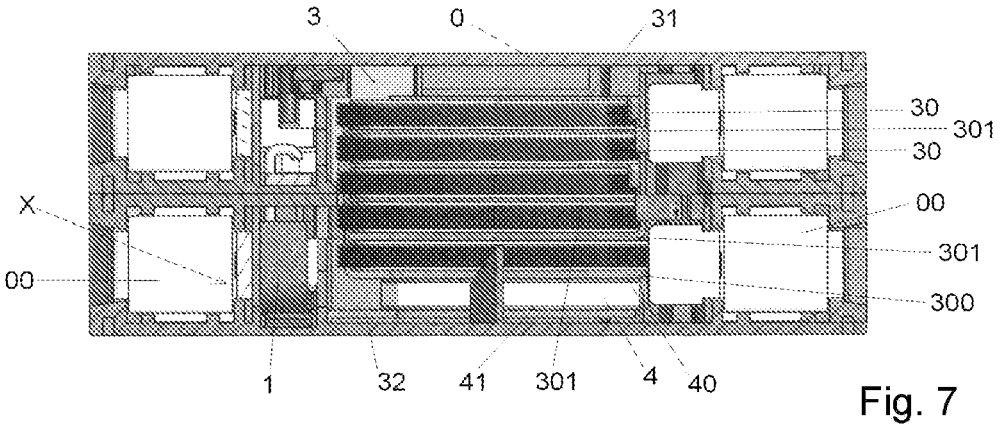

Fig. 7

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Description

Technical field

[0001] The invention relates to the device for overvoltage protection comprising the terminals for connection to the protected electric circuit. Between the terminals there is arranged the current path, in the current path there is connected varistor protective element. In the current path there is between one output electrode of the varistor protective element and one terminal created a point (X) of intentional cutting off the current path, while to the point (X) a thermal cut out device (TCD) is assigned.

Background art

[0002] CZ PV 2009-164 discloses a device for overvoltage protection comprising terminals for connection to protected electric circuit, while between the terminals there is arranged the current path, in which the protective element is connected. In the current path there is created a point of intentional cutting off the current path, to which the device for signalling of protection status is assigned. In the point of intentional cutting off the current path there is further created an additional fusible cut-out with pre-set parameters of fusing. Elements of current path being intentionally disconnected are connected by means of the first solder, and the additional fusible thermal cut-out with pre-set parameters of fusing is formed of a second solder. The second solder has the same or approximately same fusing temperature as the first solder, but simultaneously the second solder has lower, or in dependence on structural embodiments and materials selected, also the same value of thermal conductivity than the first solder. Function of this device is such, that disconnecting of TCD immediately after fusing the first solder connecting elements of the current path is prevented, while fusing of the second solder lasts longer with respect to a larger dimension of the second solder, which must be heated and fused. Through this period of flowing the current through TCD without undesired disconnecting of TCD is prolonged substantially, which enables to increase dimensioning of overcurrent protection, which is arranged before the device for overvoltage protection in compliance with requirements of provisions of the ČSN EN 61643-11 norm, revision A11, paragraph 7.7.3.b). Due to a time span in acting of a low short-circuit current and setting of conditions of its action, there is not an excessive thermal effect to the vicinity of TCD. A particular structural embodiment of this invention is described by the solution according to which the additional fusing thermal cut-out with per-set parameters of fusing is formed of a fusing pin which is positioned in a through hole, that is created in the current path elements being intentionally disconnected. Another particular structural embodiment is described by the solution, at which the additional fusing thermal cut-out with pre-set parameters of fusing is formed of a fusing rivet, which is positioned in a through hole, that is created in the current path elements being intentionally disconnected, while the heads of the fusing rivet abut against the outer external surfaces of the current path elements being intentionally disconnected. In both particular structural embodiments there is possible also a preferred position of the additional fusing thermal cut-out in ground-plan surface of the current path elements being intentionally disconnected or in the nose, which protrudes from the current path elements being intentionally disconnected, through which it is possible even more influence or set the time duration for fusing the second solder with lower thermal conductivity.

[0003] Though the principle of the invention as such proved to be very efficient and enables a safe usage of the device for overvoltage protection on basis of varistor also for higher energies (category I, type I), still at particular structural embodiments according to the invention application CZ PV 2009-164 there exists a certain restriction of their application for higher energies, than the particular structural solutions according to the CZ PV 2009-164 permit, which is given especially by structure of current path at particular structural embodiments of solutions according the patent application CZ PV 2009-164.

[0004] CZ invention application No. 2009-683 discloses arrangement designated for even higher energies, than for which the solution according to CZ PV 2009-164 is designated. Solution according to CZ PV 2009-683 is based on fact that the additional thermal cut-out is formed of the second solder arranged between the flexible electric conductor and the fixed electric conductor parallel to the point of intentional cutting off the current path and outside the joint of the flexible electric conductor and the fixed electric conductor by the first solder, while the second solder is at least thermally conductively connected with the flexible electric conductor and with the fixed electric conductor, and the first solder and the second solder have the same or approximately same fusing temperature. In the second solder the first end of cut-out lever and one end of auxiliary plate is mounted, while the cut-out lever is coupled with flexible electric conductor and its second end is coupled with the spring-loaded shifting part of the cut-out device which is slideably mounted in frame of the device, and the second end of the auxiliary plate is assigned to the fixed electric conductor. On the flexible electric conductor there is mounted the plate with through hole, through which the first end of cut-out lever is passing. The auxiliary plate is connected with lower surface of the fixed electric conductor and it is bent towards the first end of cut-out lever, where it is provided with a groove, through which there is passing the first end of the cut-out lever, which is here by the second solder connected with auxiliary plate. Between the auxiliary plate and the adjacent part of the flexible electric conductor and the plate there is situated the first cutting

off means. Between the auxiliary plate and the fixed electric conductor there is situated the second cutting off means. The fixed electric conductor is formed of varistor electrode.

[0005] The disadvantage of this arrangement is that at further increasing the loading of protective element the development of heat in the protective element - varistor or a group of parallel connected varistors, which are positioned in strongly limited and dense occupied space of the device for overvoltage protection, is so big that there occurs a premature increase of temperature of TCD above the temperature for cutting out the TCD, by which an undesired cut out of TCD occurs earlier than the maximum loading of varistor or a group of parallel connected varistors according to the testing conditions of CSN EN 61643-11 norm is achieved. Hence, this premature undesired disconnection of TOZ does not enable to utilise the maximum load capacity of varistor or a group of parallel connected varistor, i.e. it does not allow to utilise the full potential of varistors or a group of parallel connected varistors.

[0006] The goal of this invention is to increase the applicability limit of the device for overvoltage protection on basis of varistor from the point of view of a high energetic loading while fully using the varistor potential.

Principle of the invention

[0007] The goal of the invention has been achieved by the device for overvoltage protection, whose principle consists in that, between the point (X) of intentional cutting off the current path and the adjacent outmost varistor of the varistor protective element is in the current path connected electric element switched by voltage.

[0008] Electric element switched by voltage here acts not only for securing of the insulating status, but due to its structure the element shows high thermal resistance and it acts here first of all as a thermal brake between the TCD and varistors, by which the heat transfer form varistors into TCD is slowed down and the time of disconnecting the TCD is postponed, so that higher parameters in loading of the varistor protective element may be achieved.

[0009] The preferred embodiments of the invention are subject of dependent patent claims.

Description of the drawing

[0010] The invention is schematically represented on the drawing, where the Fig. 1 shows a cross-section of the device for overvoltage protection with one particular embodiment of TCD in operating status, the Fig. 2 a cross-section of the device for overvoltage protection with one particular embodiment of TCD in disconnected status, the Fig. 3 a side view to a system of varistors in arrangement according to the invention, the Fig. 4 a view in skew direction from above to system of varistors in arrangement according to the invention, the Fig. 5 disassembled configuration of varistor system, the Fig. 6 a ground-plan representation of arrangement of varistor protective element in device for overvoltage protection and the Fig. 7 cross representation of arrangement from the Fig. 6.

Examples of embodiment

[0011] The invention will be described on an example of embodiment for overvoltage protection on basis of varistor with structural solution of thermal cut-out device (hereinafter TCD only).

[0012] The device comprises frame **0** in the form of lockable box, in which the current path is arranged. The current path of the device for overvoltage protection on both ends is terminated with terminals **00** for electrical connection of the device for overvoltage protection to the protected electric circuit. Individual parts of the device are dimensioned towards expected big energy, so as to meet the requirements specified by norms, in compliance with declared parameters of the device.

[0013] In the current path of the device for overvoltage protection the varistor protective element **3** is connected. The varistor protective element **3** by its first output electrode **31,** directly or through other electrically conductive elements is connected with the first terminal for electrical connection of the device for overvoltage protection to protected electric circuit. The varistor protective element **3** by its second output electrode **32** is connected, through other electrically conductive elements, with the second terminal for electrical connection of the device for overvoltage protection to protected electric circuit.

[0014] Between the second output electrode **32** of varistor protective element **3** and the second terminal for electrical connection of the device for overvoltage protection to protected electric circuit there is in the current path of the device for overvoltage protection situated the point **X** of intentional cutting off the current path. To the point **X** there is assigned the thermally initiated cut out device, in short the thermal cut out device - abbreviation TCD used in the following text.

[0015] In the represented example of embodiment the point **X** of intentional cutting off the current path is performed in the place of contact of lower surface of one end of flexible, e.g. copper electric conductor **1** and of the second output electrode **32** of the varistor protective element **3,** while the end of flexible electric conductor **1** and the end of second output electrode **32** of varistor protective element **3** are connected by the first solder having the required fusing temperature. The end of the flexible electric conductor **1** connected with end of fixed electric conductor **2** is strengthened through stiffening. The second end of flexible electric conductor **1** is electrically conductively by means of auxiliary conductor **01** connected with second terminal for electric connection of the device for overvoltage protection to protected electric circuit.

[0016] Varistor protective element **3** comprises at least

one flat varistor **30** or it comprises a group of parallel by means of electrodes **301** connected flat varistors **30,** as it is represented in the Fig. 3 to 5 and Fig. 7. Between the second output electrode **32** of varistor protective element **3** and to it adjacent output electrode **300** of the last varistor **30** in series is connected the electric element switched by voltage **4.** The electric element switched by voltage **4** is thus connected between TCD and varistor **30** or a group of parallel connected varistors **30.**

[0017] As represented in the Fig. 3 to 5 and Fig. 7, the electric element switched by voltage **4** is in varistor protective element **3** positioned so, that it abuts by its first electrode **40** against the output electrode **300** of the last varistor **30.** The second electrode **41** of electric element switched by voltage **4** abuts against the second output electrode **32** of the varistor protective element **3.** Individual parts of the varistor protective element **3** mostly for the reason to save space are performed as flat ones, including electrodes.

[0018] The electric element switched by voltage **4** is in the represented example of embodiment formed of lightning arrester, namely by lightning arrester being sufficiently flat (thin), so that it may be applied between varistor **30** or a group of parallel connected varistors **30** and the point **X,** this in the place with very limited internal space. In the represented example of embodiment the thickness of the lightning arrester is comparable with thickness of varistors **30,** while the lightning arrester has a shape of disk, respectively of a coin.

[0019] When performing the prescribed operation test of the device for overvoltage protection, the device for overvoltage protection is always loaded with a certain number of loading pulses with subsequent time delay and subsequent loading with a further number of load pulses (5 pulses - 30 minutes standstill (cooling), 5 pulses - 30 minutes standstill (cooling)). By this loading the varistor **30** or a group of parallel connected varistors **30** get gradually warmer. From the varistor **30** or group of parallel connected varistors **30** gradually the upper electrode **40** is warmed by the electric element switched by voltage **4.** Thanks to a high thermal resistance of the electric element switched by voltage **4** the transfer of heat from varistor **30** or group of parallel connected varistors **30** to the lower electrode **41** of electric element switched by voltage **4** and further through the second output electrode **32** of the varistor protective element **3** into a point **X** is substantially reduced, by which the time of cutting off the current path in the point **X** is delayed once the TCD becomes active. At operation test the TCD cuts out the current path in the point **X** at a substantially higher loading than at arrangement without the electric element switched by voltage **4** inserted between the varistors **30** and the point **X,** so that it is possible to achieve higher parameters of loading of varistor protective element 3. Nevertheless after a certain time there occurs undesired warming of the respective parts in the point **X** and the TCD is disconnected, by which the current path is cut off and the varistor protective element **3** is disconnected from the protected electric circuit. By disconnecting the TCD also the signalling of status change of overvoltage protection becomes active. Similarly the device also behaves at the short-circuit test, when the TCD cut off the current path in the point **X** also at a substantially higher loading only after the time (5 seconds) prescribed by the norm for reaction of before arranged overcurrent protection (the fuse).

Applicability

[0020] The invention is applicable for protection of electric circuits against overvoltage.

List of referential markings

[0021]

0	frame of the device
00	terminal for electric connection of device for overvoltage protection to a protected electric circuit
01	auxiliary conductor
1	flexible electric conductor
3	varistor protective element
30	varistor
31	first output electrode of varistor protective element
32	second output electrode of varistor protective element
4	electric element switched by voltage
40	upper electrode of flat electric element switched by voltage
41	lower electrode of flat electric element switched by voltage
X	point of intentional cutting off the current path

Claims

1. Device for overvoltage protection comprising terminals (00) for connection to the protected electric circuit, between the terminals there is arranged the current path, in the current path there is connected varistor protective element (3), between one output electrode of the varistor protective element (3) and one terminal (00) there is in the current path created a point (X) of intentional cutting off the current path, while to the point (X) a thermal cut out device (TCD)

is assigned, **characterised in that**, between the point (X) of intentional cutting off the current path and the adjacent outmost varistor (30) of the varistor protective element (3) there is in the current path connected an electric element switched by voltage (4).

2. Device according to the claim 1, **characterised in that**, the outmost varistor (30) of varistor protective element (3) is formed of the flat varistor (30), against whose output electrode (300) the first flat electrode (40) of the electric element switched by voltage (4) is abutting, while against the flat second electrode (41) of electric element switched by voltage (4) the output electrode (32) of varistor protective element (3) is abutting.

3. Device according to the claim 2, **characterised in that**, the electric element switched by voltage (4) is formed of an lightning arrester.

4. Device according to the claim 3, **characterised in that**, the electric element switched by voltage (4) is formed of a flat lightning arrester having shape of a disk.

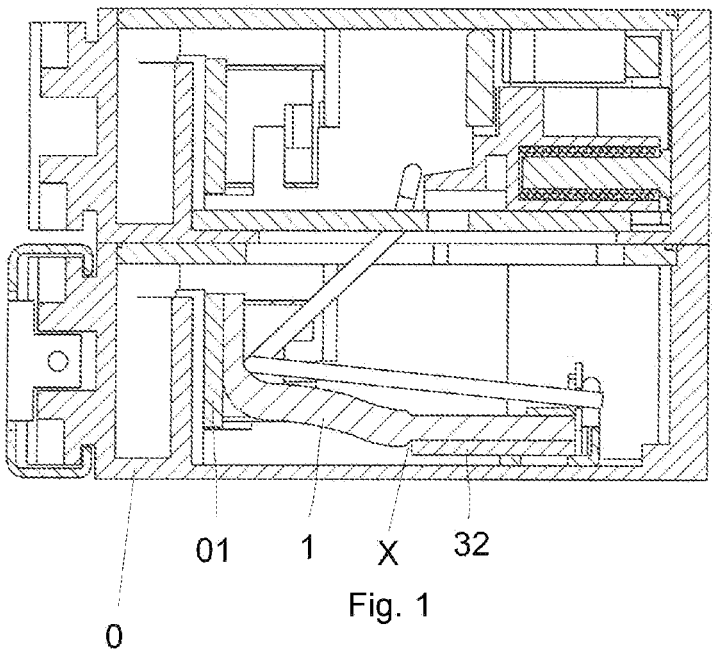

Fig. 1

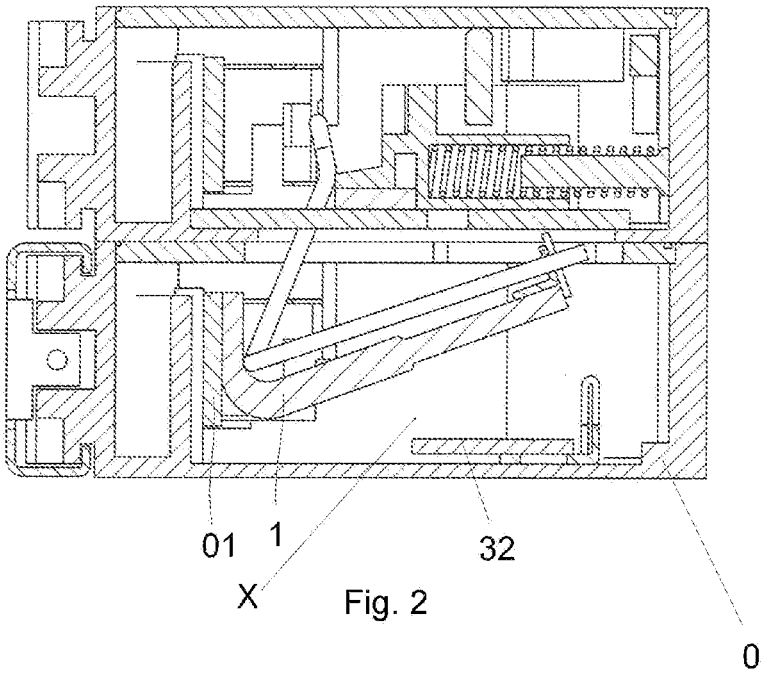

Fig. 2

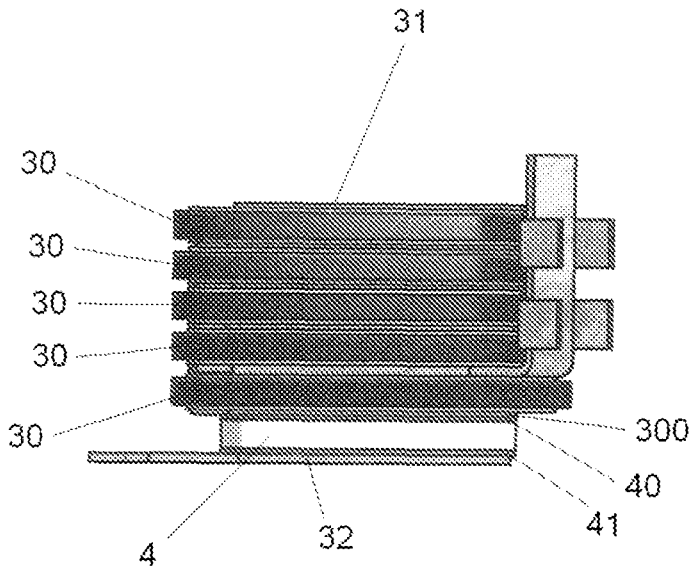

Fig. 3

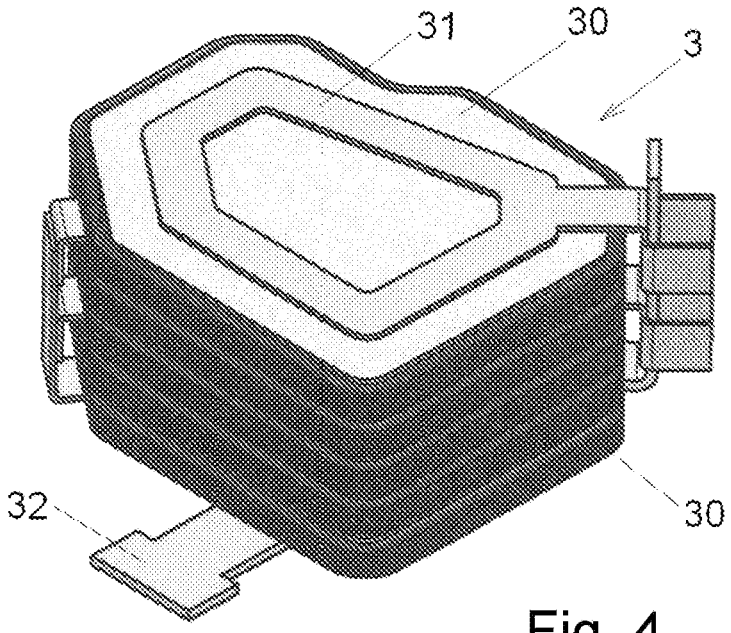

Fig. 4

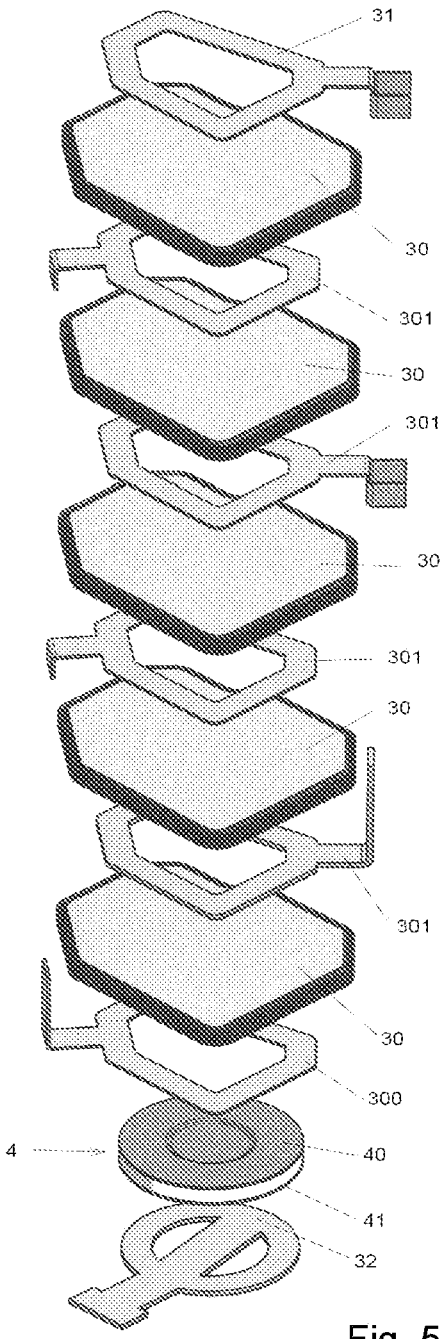

Fig. 5

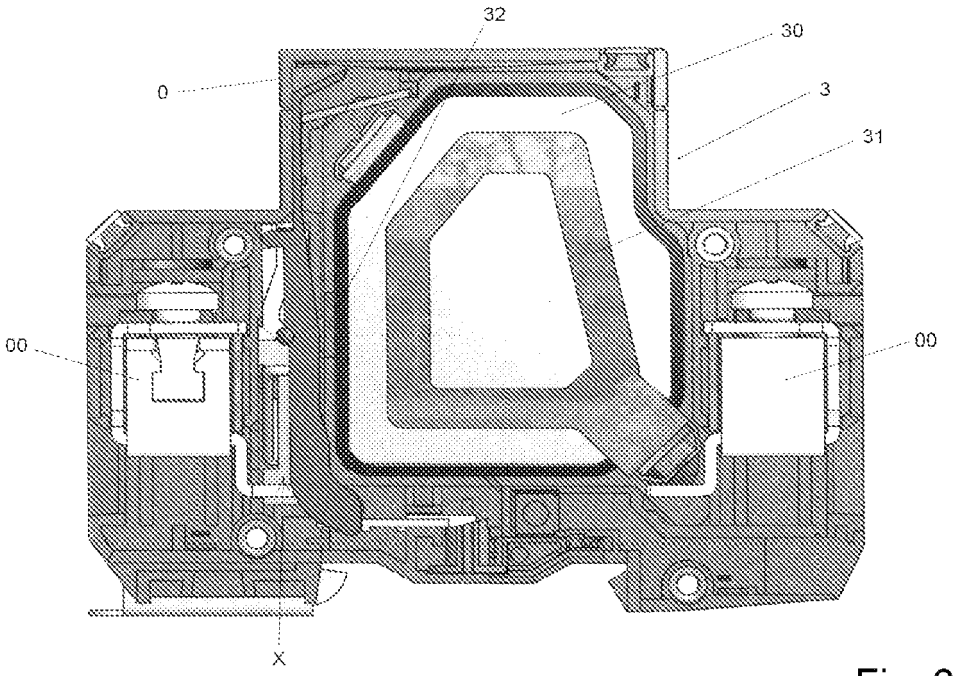

Fig. 6

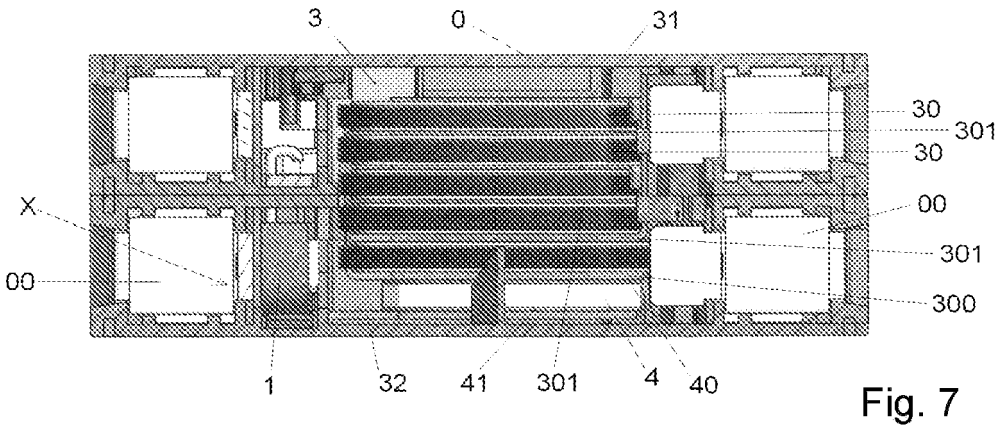

Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CZ PV2009164 **[0002] [0003] [0004]**
- CZ PV2009683 **[0004]**