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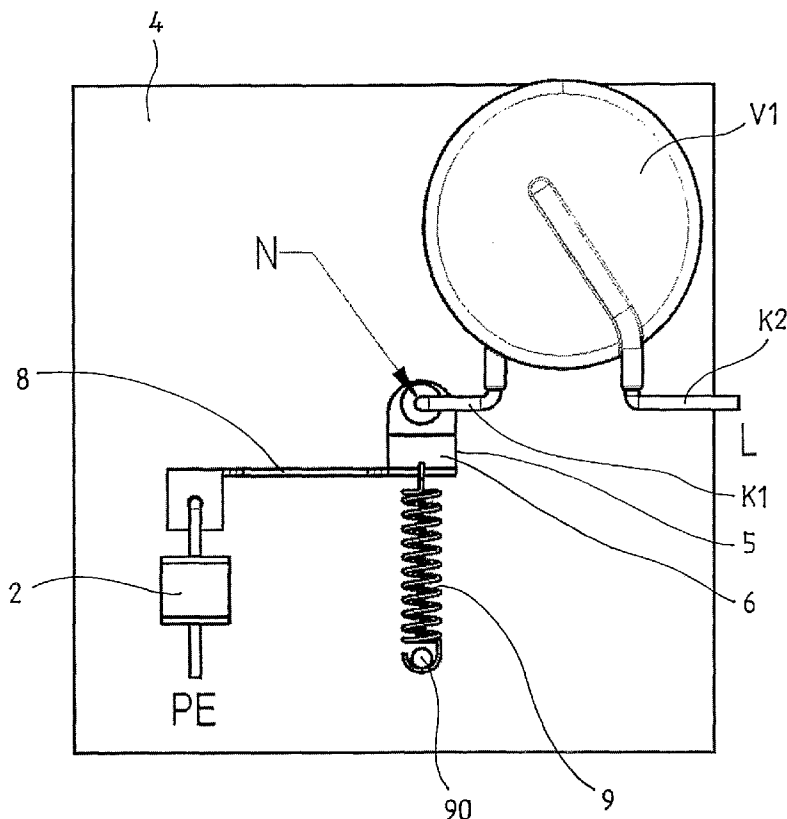
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(54) Title: DEVICE FOR OVERVOLTAGE PROTECTION



(57) Abstract: The invention relates to the device for overvoltage protection containing between the pair of connection points L/N and N/L being connected at least one varistor (V1), which is through the thermal activation disconnectable from the protected electrical circuit, while between the pair of connection points L/N, N/L and the connection point PE of grounding there is connected the aerial discharge (2), and the device further incorporates a basic board (4) created as a printed circuit and containing electrically conductive layer forming at least a part of conductive connections between individual elements of the device. The varistor (V1) is with its one contact (K1) attached to the electric conductive layer of the basic board (4), and in the place of connection of outlet (K1) of varistor (V1) to electric conductive layer of the basic board (4) to the electric conductive layer of the basic board (4) by means of low-fusing joint (5) is attached the electric conductive breaking-off body (6), which is by means of electric conductive heat resistant link (8) connected to one outlet of the aerial discharge (2) and is coupled with the put off means (9).

Device for overvoltage protection**Technical field**

The invention relates to a device for overvoltage protection containing
5 between the pair of connection points L/N and N/L being connected at least
one varistor, which is through the thermal activation disconnectable from the
protected electrical circuit, while between the pair of connection points L/N,
N/L and the connection point PE of grounding there is connected the aerial
discharge, and the device further incorporates a basic board created as a
10 printed circuit and containing electrically conductive layer forming at least a
part of conductive connections between individual elements of the device.

Background art

The device for overvoltage protection of the D class (according to the
15 DIN VDE 675 Teil 6/A1 norm) serves for protection of power consumers
connected to the terminal equipment of electric current distribution against
destructive effects of overvoltage acting upon these consumers. Among
others overvoltage spreads through the distributions of electric current and it
is able to damage or totally destroy the connected power consumers, while
20 the vicinity of these power consumers may be damaged, e.g. by fire or
explosion caused by damage or destroy of the respective power consumer.

There are known many devices for overvoltage protection of the D
class, which can be created either as modules for placing in the wiring box of
electric socket or they may be created as so called intermediate adaptors
25 forming an interface between electric socket and electrical connection element
of the respective power consumer.

The known devices for overvoltage protection of the D class contain at
least one varistor, which at normal conditions does not conduct electric
current, nevertheless upon voltage increase above the specified limit
30 (overvoltage) it already conducts electric current, through which the
overvoltage is limited. Nevertheless upon elimination of overvoltage the
varistor is heated up, which deteriorates the same, so varistor may due to

abnormal loading let through always increasing electric current even at normal operation conditions, or it may be totally destroyed and varistor does not fulfil its function at all, even it may damage the system of overvoltage protection. Therefore it is necessary upon varistor overheating to secure that varistor is disconnected from the protected electric circuit. This disconnection is being done in various manners, while the used manners of disconnection exhibit various features in dependence on their structural solution.

From the DE G 94 14 357 there is known the thermal disconnecting device of varistor, which contains a pair of parallel side by side positioned varistors, between which there is situated a flat element provided on both its ends with one springy arm. This one arm is soldered to one outlet of the first varistor on one side of the equipment for overvoltage protection and the second arm is soldered to one outlet of the second varistor on the other side of the device for overvoltage protection. To each arm, in its disconnected position, there is allocated a switch which disconnects the varistors from the protected electrical circuit. Upon occurrence of overvoltage by electric current passing through one of varistors the flat element warms up and due to this the low-fusing soldered joints of springy arms and of the cross-wise situated varistor outlets are melted, so that the springy arms are released and press on the switch, which disconnects the varistors from the protected electrical circuit. The whole device is placed in a plastic bushing. In spite of applicability of this device in electric systems at which the mutual non-exchangeability of position of the phase and zero wire is not guaranteed, the disadvantage of this embodiment is a relatively great thickness of the device, which limits its applicability in narrow slots of terminal equipment of electric distributions, electric sockets or small wiring boxes of intermediate adaptors. Another disadvantage is the required high precision of production of individual parts of the equipment for overvoltage protection, which increases the costs for the device.

The shortcomings of the above mentioned state of the art were reduced or remedied by the solution as per CZ PV 2002 – 877, that describes the equipment for overvoltage protection which contains a pair of varistors connected in series between a pair of connection points L/N and N/L. Each

varistor contains a pair of outlets and is disconnectable by a thermal activation from the protected electrical circuit. Between a pair of connection points L/N, N/L in the section of electrical circuit between the pair of varistors and connection point PE for grounding there is also connected the aerial
5 discharge. One outlet of the first varistor and with it neighbouring one outlet of the second varistor are hereby by means of low-fusing soldered joints connected with a breaking-off body, through which they are interconnected. The breaking-off body is by means of a link which is heat resistant coupled with the put off means. Next, the breaking-off body is by means of an
10 electrically conductive joint, which is heat resistant and enables the breaking-off movement of the breaking-off body connected with one outlet of the aerial discharge. The breaking-off body is in the particular example embodiment formed by a flat metal body and it possibly contains also a calibration element situated in the direction of breaking-off movement of the breaking-off body on
15 its backside in the area passing between both neighbouring outlets of varistors being broken-off. The put off means is by example formed by a spring which is by one its end positioned on the breaking-off body and by its second end it is positioned in the structure of the device. Electric conductive joint, which is heat resistant and enables the breaking-off movement of the
20 breaking-off body is by example formed by a flexible electric conductor, e.g. by a copper wire. Neighbouring outlets of a pair of varistors connected by means of a low-fusing soldered joint with the breaking-off body are in the place in which they are connected to the breaking-off body provided at least with one at least partial bending situated in the plane of the breaking-off body.
25 The disadvantage of this arrangement is a relatively high complexity and the related high work difficulty which result in a relatively high production costs.

The aim of this invention is to reduce the complexity, work difficulty and a costly acquisition of the device for overvoltage protection.

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Principle of invention

The aim of the invention has been reached by the device for overvoltage protection whose principle consists in that the varistor is with its

one contact attached to the electrically conductive layer of the basic board and in the vicinity of connection place of varistor outlet to electrically conductive layer of the basic board to the electrically conductive layer of the basic board by means of low-fusing joint is attached the electrically conductive breaking-off
5 body, which is by means of electrically conductive heat resistant link connected to one outlet of the aerial discharge and is coupled with the put off means.

This arrangement markedly reduces complexity and the related work difficulty of the device and it contributes to decrease in costs while the
10 functions and reliability are preserved.

At the embodiment of the device with a pair of varistors being connected in series between a pair of connection points (L/N) and (N/L) it is advantageous, if each varistor at least with its one outlet is attached to the electrically conductive layer of the basic board, at the same time between one
15 outlet of the first varistor and one outlet of the second varistor there is electrically conductive layer of the basic board interrupted, and in the vicinity of place of connection of outlet of the first varistor and outlet of the second varistor to electrically conductive layer of the basic board is to electrically conductive layer of the basic board by means of low-fusing joints attached the
20 electrically conductive breaking-off body, which is by an electrically conductive heat resistant link connected to one outlet of the aerial discharge and is coupled with the put off means.

At the same time it is advantageous if the interruption of electric conductive layer of the basic board between one outlet of the first varistor and one outlet of the second varistor is created by a groove which is
25 continuous through the whole thickness of the basic board.

According to an advantageous embodiment the electric conductive heat resistant link of the breaking-off body with one outlet of the aerial discharge designed as an essential part of the breaking-off body.

30 According to another advantageous embodiment the put off means is formed by an extension spring, which is by its one end positioned on breaking off means and by its second end it is coupled with the basic board.

Description of the drawing

The invention is schematically illustrated in the drawing where the Fig. 1 shows wiring diagram of the device for overvoltage protection according to the invention, the Fig. 2 schematic arrangement of the joint for thermal disconnection of a pair of varistors from the protected circuit at device embodiment with a pair of varistors and the Fig. 3 schematic arrangement of the joint for thermal disconnection of varistor from the protected circuit at the device embodiment with one varistor.

Examples of embodiment

The device for overvoltage protection contains between a pair of connection points L/N and N/L in series connected system of pair of varistors V1, V2 and a common thermal disconnecting device 1 of both varistors V1, V2, which disconnects both two varistors at the same time from the protected electrical circuit and which is in the circuit inserted between the both varistors V1, V2.

In the Fig. 2 and 3, L shows the connection point to the phase conductor of the terminal equipment of electric distribution network, e.g. of electric socket, N connection point to zero conductor of the terminal equipment of electric distribution network e.g. of electric socket and PE connection point for grounding of terminal equipment of electric distribution network, e.g. of electric socket. To these connection points L, N, PE the corresponding elements of equipment need not to be, and as a rule they are not, connected directly, but they are coupled with them via further elements of the device for overvoltage protection.

Parallel to the series system of the varistor pair V1, V2 and the thermal disconnecting device 1 between the connection points L/N and N/L there is connected the series system of a pair of resistors R2, R3, between which there is connected the red signalling light Z2. A section of electrical circuit between each of resistance R2, R3 and the red signalling light Z2 is connected with a section of electrical circuit between each of varistors V1, V2

and the thermal disconnecting device 1. Parallel to both parallel connected series systems of a couple of varistors V1, V2 – thermal disconnecting device 1 and a couple of resistance R2, R3 – red signalling light Z2 between connection point L/N and N/L there is connected the series system of the resistor R1 and a green signalling light Z1.

The device for overvoltage protection contains the basic board 4, which contains electrically conductive layer, which by means of technique of printed circuits creates at least one section of individual electrical interconnection of corresponding elements of the device for overvoltage protection.

Both varistors V1, V2 are situated side by side. In the illustrated example of embodiment both varistor V1, V2 are situated in one plane. At the same time the varistors V1, V2 may be situated in the plane parallel with the basic board 4 or in the plane perpendicular to the basic board 4 or in the plane askew to the basic board 4. In another not illustrated example of embodiment the varistors V1, V2 are situated in various planes, which may be parallel, perpendicular or askew towards the basic board 4, or mutually one to another, while both varistors V1, V2 overlap partially or totally, or they do not overlap at all. The particular shape execution and space arrangement of individual parts of the thermal disconnecting device 1 is adapted to individual mutual arrangement of both varistors V1, V2.

Each varistor V1, V2 contains a pair of outlets. Two neighbouring outlets K1, K2 of the varistors V1, V2, i.e. from one varistor V1 one outlet K1 and to this outlet K1 an adjoining one outlet K2 from the second varistor V2, are connected directly to the electrically conductive layer of the basic board 4. Between the outlet K1 of one varistor V1 and the outlet K2 of the second varistor V2 the basic board 4 is provided with an insulation interruption of its electrically conductive layer between the outlet K1 of one varistor V1 and the outlet K2 of the second varistor V2. In the illustrated example of embodiment the interruption of electrically conductive layer of the basic board 4 is performed by means of a groove 40, which may be even continuous through the basic board 4.

In the vicinity of the connection place of outlet K1 of one varistor V1 to the electrically conductive layer of the basic board 4 by means of the low-fusing soldered joint 5 there is attached the first end 60 of electric conductive breaking-off body 6, whose second end 61 is by means of the low-fusing soldered joint 7 attached to the electrically conductive layer of the basic board 4 in the vicinity of outlet K2 of the second varistor V2. The breaking-off body 6 in this way electrically interconnects outlet K1 of one varistor V1 with outlet K2 of the second varistor V2. The breaking-off body 6 is further by means of the electric conductive heat resistant link 8 coupled with one outlet of aerial discharge 2, which is by its second outlet coupled with connection point PE of grounding. In the illustrated example of embodiment only one aerial discharge 2 is used. In the not illustrated example of embodiment instead of a single aerial discharge 2 other functionally identical means are used, e.g. created by a more complex circuit solution with several aerial discharges as it is known e.g. from the CZ patent No. 292 593. Therefore in this context in the whole text and in the patent claims under the term „aerial discharge“ the aerial discharge itself is understood as an independent part, as well as any device fulfilling the same or an equivalent function.

In the illustrated example of embodiment the breaking-off body 6 is with outlet of aerial discharge 2 coupled by means of heat resistant arm, which is an essential part of the breaking-off body 6, i.e. it is produced already during production of the breaking-off body 6, and which is at the side of the aerial discharge 2 connected with electrically conductive layer of the basic board 2, to which at the same time the outlet of the aerial discharge 2 is connected. The arm electrically connecting the breaking-off body 6 with outlet of the aerial discharge 2 is deformable sufficiently, so that it enables breaking-off movement of the breaking-off body 6 and also so that it is possible together with the breaking-off body 6 to adjust it for various modifications of particular illustrated and described arrangements of device for the overvoltage protection. In the not illustrated example of embodiment the breaking-off body 6 is coupled with outlet of the aerial discharge 2 by means of a flexible electrical conductor, e.g. copper wire conductor etc. which is by its one end by

means of a heat resistant link connected with the breaking-off body 6 and with its second end it is connected with outlet of the aerial discharge 2.

The breaking-off body 6 is coupled with the put off means 9 for putting off the breaking-off body 6 from the place of connection of its ends 60, 61 to electrically conductive layer of the basic board 4 and outlet K1 of varistor V1 and outlet K2 of varistor V2 after the low-fusing soldered joints 5, 7 lose their rigidity. In the illustrated example of embodiment the put off means 9 is connected with the breaking-off body 6 by means of a heat resistant link.

In the illustrated example of embodiment the breaking-off body 6 is formed by an oblong thin metal body made of electrically conductive material, from whose one end 60 extends the heat resistant arm connected with its second end to one outlet of the aerial discharge 2, at the same time in the middle section of length of the breaking-off body 6 to the breaking-off body 6 there is attached one end of the put off means 9, while the second end of the put off means 9 is positioned on the basic board 4. The breaking-off body 6 may alternatively be formed by a body of another suitable shape, e.g. it may be of a triangle or square or some other suitable shape.

In the illustrated example of embodiment the put off means 9 is formed by an extension spring, which is by its one end hooked on the middle section of the breaking-off body 6 and by its second end it is hooked on the pin 90 attached to the basic board 4. In the not illustrated example of embodiment the extension spring is by its second end attached directly to the basic board 4. In another not illustrated example of embodiment the put off means 9 is formed by other suitable means, e.g. by a spiral spring, torsion spring etc., or it may be formed by another suitable kind of put off means 9.

In the example of embodiment illustrated in the Fig. 3 the device for overvoltage protection contains a single varistor V1, whose second contact K2 is coupled with connection point L and the first contact K1 is connected to electrically conductive layer of the basic board 4. In vicinity of connection of the first contact K1 to electrically conductive layer of the basic board 4 in analogical manner to execution in the Fig. 2 to electrically conductive layer of the basic board 4 by a low-fusing joint 5 is attached the breaking-off means 6,

which is by means of heat resistant link 8 connected with one outlet of aerial discharge 2, which is with its second outlet coupled with the connection point PE. The breaking-off means 6 is further coupled with the put off means 9. At embodiment according to the Fig. 3 at the same time electrical connection of the device is modified in a respective manner, while this modification of electrical connection is a routine practice for a common specialist. Also variants of execution of individual sections of example of embodiment according to the Fig. 3 are identical or equivalent to those, which are here described or mentioned in connection with execution according to the Fig. 2.

Another possible particular embodiments of individual parts and their arrangement in the device for overvoltage protection represent for an average specialist based on knowledge of the above mentioned solutions a quite trivial matter which simply results from the previous description and from figures and fall into a general specialised skill of each average specialist.

The device for overvoltage protection according to the invention works so that at normal conditions in the protected circuit the green signalling light Z1 is lighting. Upon occurrence of overvoltage at least through one varistor V1, V2 electrical current starts to flow into grounding PE, through which the overvoltage is eliminated without negative influence to the protected electrical circuit. When electrical current passes through varistor V1 or V2, the varistor V1 or V2 is heated and the heat produced is thanks to thermal conductivity guided off to electric conductive layer of the basic board 4 at contacts of the corresponding varistor V1 or V2. Development of heat in varistors V1 or V2 is also increasing due to ageing of varistors V1 or V2. Once the electric conductive layer of the basic board 4 at contacts of the respective varistor V1 or V2 is heated up by this warmth to the temperature of melting of low-fusing soldered joints 5, 7, the low-fusing soldered joints 5, 7 are melted, the soldered joint loses its rigidity and the put off means 9 puts off the breaking-off body 6 from outlets K1, K2 of varistors V1, V2, through which electric connection of both varistors and connection of varistors V1, V2 through aerial discharge 2 to the ground is interrupted. Upon disconnection of varistors V1, V2 from the protected electrical circuit the green signalling light Z1 goes off and the red signalling light Z2 lights up which means that earlier protected

electrical circuit is not protected against overvoltage any more. After restoration of the overvoltage protection of previously protected electrical circuit it is then necessary to install the new device for overvoltage protection. Also the device according to the Fig. 3 works in analogical manner, in this

5 case only one varistor V1 is being disconnected.

List of referential markings

	1	thermal disconnecting device
	2	aerial discharge
5	4	basic board
	40	groove
	5	low-fusing soldered joint
	6	breaking-off body
	60	first end of breaking-off body
10	61	second end of breaking-off body
	7	low-fusing soldered joint
	8	electric conductive heat resistant link
	9	put off means
	90	pin
15	K1	one outlet of the first varistor
	K2	one outlet of the second varistor
	L	connection point to phase conductor of terminal equipment of electric distribution network
	N	connection point to zero conductor of terminal equipment of electric distribution network
20	PE	connection point to grounding of terminal equipment of electric distribution network
	R1	first resistance
	R2	second resistance
25	R3	third resistance
	V1	first varistor
	V2	second varistor
	Z1	green signalling light
	Z2	red signalling light
30		

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CLAIMS

1. The device for overvoltage protection containing between the pair of connection points L/N and N/L being connected at least one varistor, which is
5 through the thermal activation disconnectable from the protected electrical circuit, while between the pair of connection points L/N, N/L and the connection point PE of grounding there is connected the aerial discharge, and the device further incorporates a basic board created as a printed circuit and containing electrically conductive layer forming at least a part of conductive
10 connections between individual elements of the device, **characterised by that the** varistor (V1) is with its one contact (K1) attached to the electrically conductive layer of the basic board (4) and in the place of connection of outlet (K1) of varistor (V1) to electric conductive layer of the basic board (4) to the electrically conductive layer of the basic board (4) by means of low-fusing joint
15 (5) is attached the electrically conductive breaking-off body (6), which is by means of electric conductive heat resistant link (8) connected to one outlet of the aerial discharge (2) and is coupled with the put off means (9).

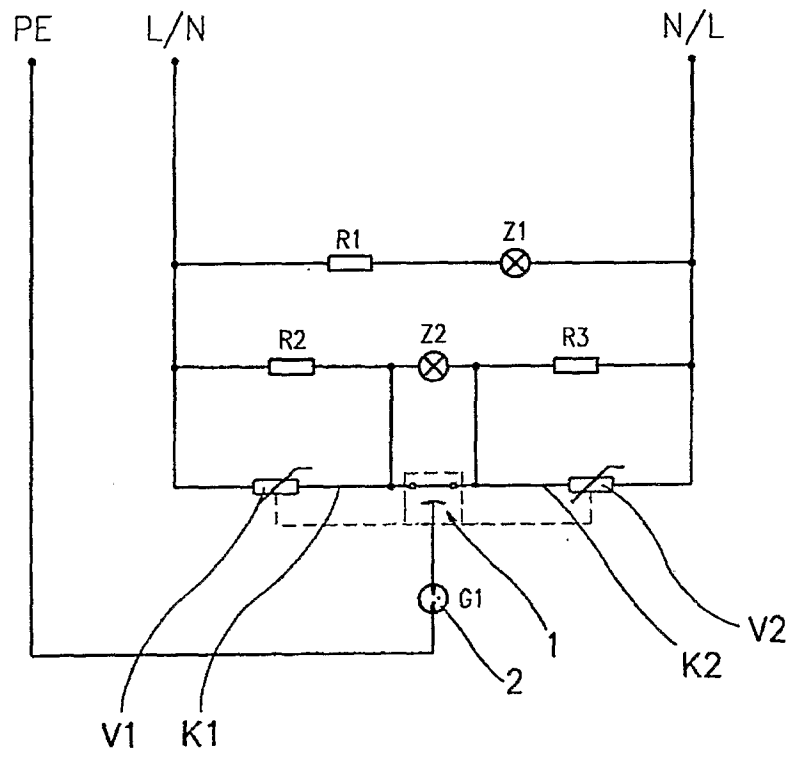
2. The device according to the claim 1, **characterised by that** it contains a pair of varistors (V1, V2) connected in series between the pair of
20 connection points (L/N) and (N/L), at the same time each varistor (V1, V2) is at least with its one outlet (K1, K2) attached to the electrically conductive layer of the basic board (4), at the same time between one outlet (K1) of the first varistor (V1) and one outlet (K2) of the second varistor (V2) the electric conductive layer of the basic board (4) is interrupted, and at the place of
25 connection of outlet (K1) of the first varistor (V1) and outlet (K2) of the second varistor (V2) to electrically conductive layer of the basic board (4) is to electrically conductive layer of the basic board (4) by means of low-fusing joints (5, 7) attached the electric conductive breaking-off body (6), which is by means of electric conductive heat resistant link (8) connected to one outlet of
30 aerial discharge (2) and is coupled with the put off means (9).

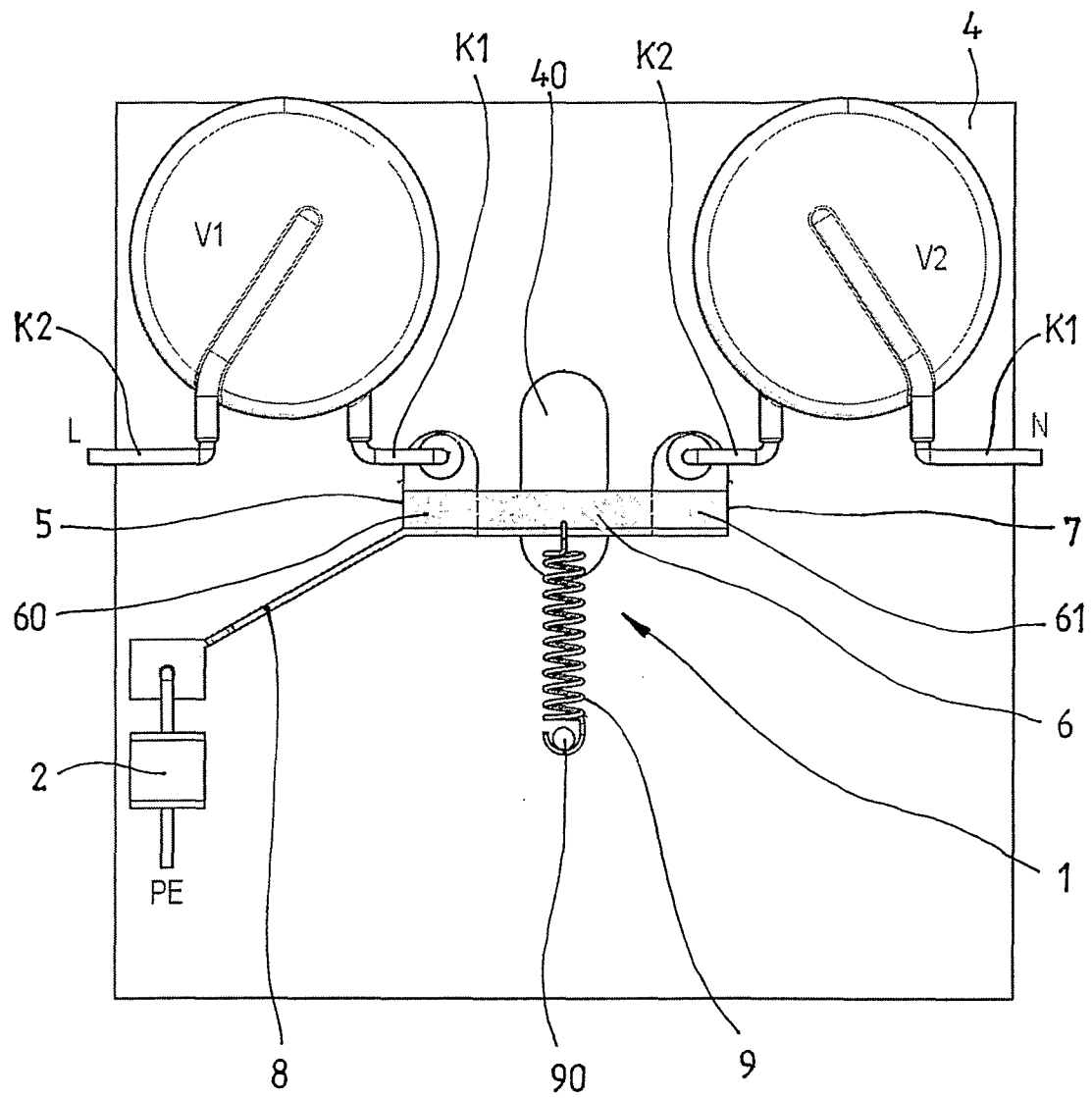
3. The device according to the claim 2, **characterised by that** the interruption of electric conductive layer of the basic board (4) between one outlet (K1) of the first varistor (V1) and one outlet (K2) of the second varistor

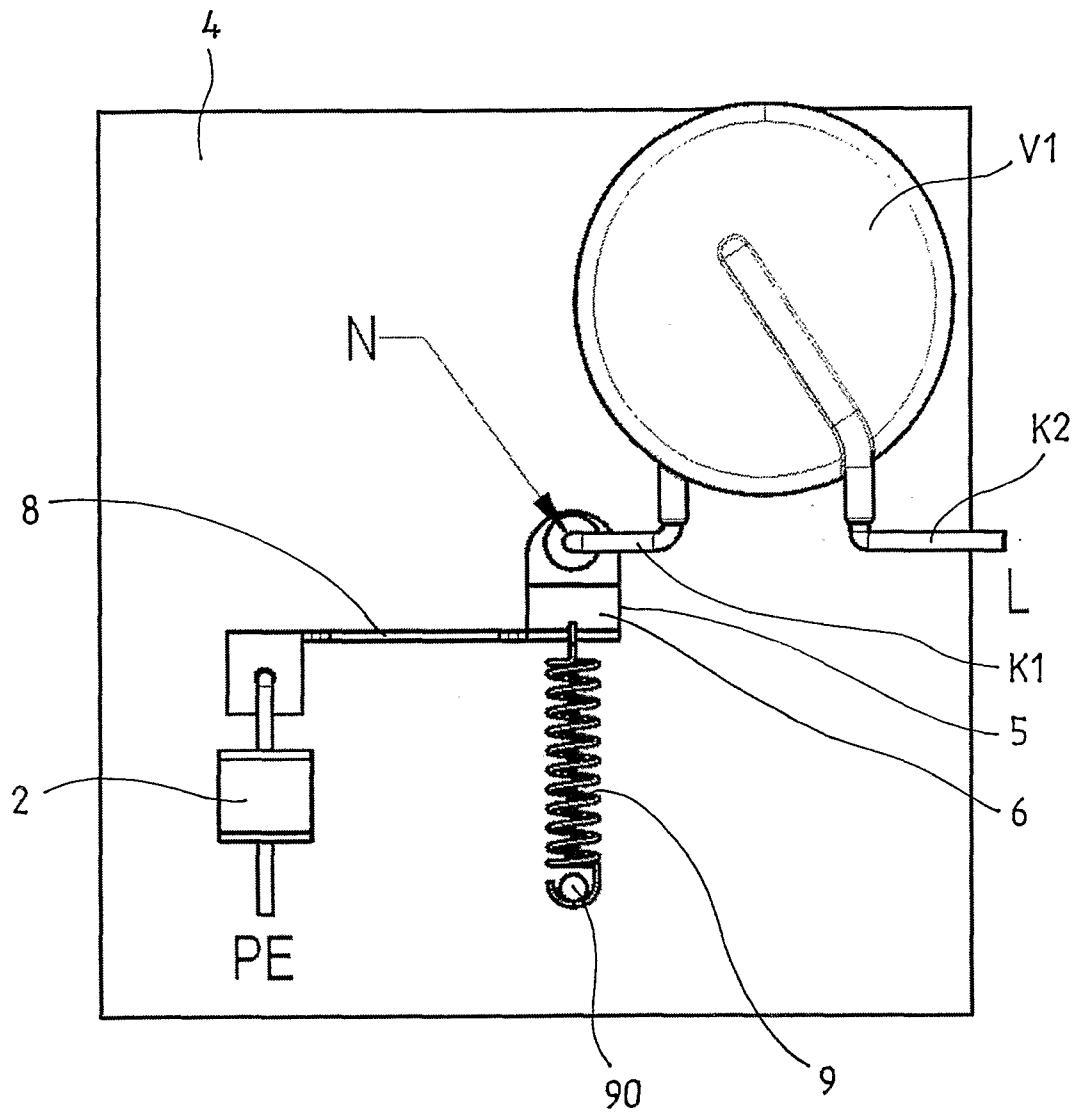
(V2) is created by a groove (40), which is continuous through the whole thickness of the basic board (4).

4. The device to any of the claims 1 to 3, **characterised by that the** electric conductive heat resistant link (8) of the breaking-off body (6) with one
5 outlet of the aerial discharge (2) is designed as an essential part of the breaking-off body (6).

5. The device to any of the claims 1 to 4, **characterised by that the** put off means (9) is formed by an extension spring, which is by its one end
positioned on the breaking-off means (6) and by its second end it is coupled
10 with the basic board (4).

**Fig. 1**

**Fig. 2**

**Fig. 3**

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2007/000585

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01C7/12 H02H9/04 H05K1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01C H05K H02H H01H

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 practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 282 073 B1 (GLASER RONALD WILLIAM [US] ET AL) 28 August 2001 (2001-08-28) column 5, line 62 - column 8, line 15; figures 2-6	1-5
A	DE 94 14 357 U1 (DEHN & SOEHNE [DE]) 20 October 1994 (1994-10-20) cited in the application page 8, line 29 - page 9, line 34; figures 3,8	1
A	EP 1 376 811 A (KIWA SPOL S R O [SK]) 2 January 2004 (2004-01-02) paragraph [0014] - paragraph [0015]; figure 2a	1



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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DE 9414357	U1	20-10-1994	NONE	
EP 1376811	A	02-01-2004	CZ 20021769 A3	15-10-2003