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(54) **Surge arrester for the protection of electric plants from transient surges**

(57) A surge arrester is disclosed comprising a first and a second electric terminal (1, 2) for connecting to the active leads of an electric plant, between which a protection element (3) is inserted provided with a pair of electrodes (4) electrically wired to said electric terminals, between said first electric terminal (1) and an electrode (4) of the protection element (3) a disconnector being provided comprising a conductive, resilient, flexible lamina (5) having a base end (5a) electrically wired to said first electric terminal (1) and a distal end (5d) maintained electrically connected to said electrode (4), in a state of elastic preload, by a welding with low-melt material. Lamina (5) is mounted elastically biased according to a direction so as to push said distal end (5d) away from said electrode (4) and it is made with a thickness below 0.5 mm and of a conductive material with a conductivity much lower than that of copper (IACS<60) such as to melt/sublimate following heating by Joule effect upon the passing of a short-circuit current. Between said base end (5a) of the lamina (5) and said electrode (4) of the protection element (3) a sliding guide (6) for an intercepting cursor (7) is provided, biased in a longitudinal direction of said sliding guide (6) by preloaded elastic means (8), and at least an inclined portion (5c) of said lamina (5) runs through said sliding guide (6) at a certain angle to the longitudinal sliding axis thereof, said inclined portion (5c) of the lamina acting as abutment and holding element for a head end (7b) of said cursor (7).

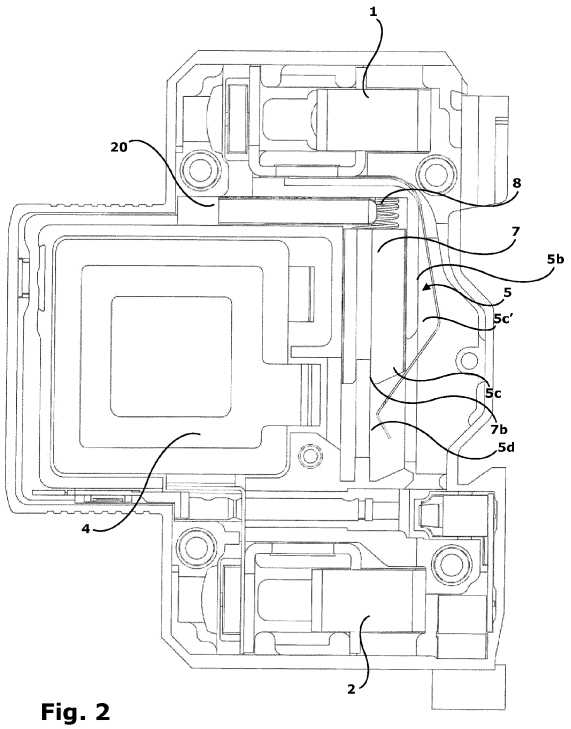

Fig. 2

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to an improved structure of surge arrester, also defined surge limiter or more concisely SPD (Surge Protective Device). By these terms those electric/electronic devices are referred to which, arranged between the live leads of the electric plant and the ground, provide to discharge to the ground electric surge peaks - such as the ones generated by atmosphere lightning bolts and by switching manoeuvres - which might otherwise cause serious damage to the electric plant and to the equipment thereof.

STATE OF THE PRIOR ART

[0002] Direct lightning phenomena are the main sources of devastating destruction effects on electric plants; indirect discharges and switching surges are also sources of heavy damage, the origin of which is not easily identifiable, but the effects of which are equally serious for sensitive plants in which continuity of operation is a critical issue. The duration of these phenomena varies from few microseconds to a few hundreds milliseconds, but in this very short time they release an extremely high energy content. These phenomena must be suitably intercepted in order to protect the plants wired to the electric network and thus guarantee the integrity thereof and the functions thereof. In the modern era, with the growing use of electric and electronic apparatuses and with the exponential increase of the integration level of semiconductors, increasingly greater attention to this issue has become necessary, compared to the past. The awareness that transient surges represent the conditioning factor for the "mean time between failures" (MTBF) of a plant or of an equipment has led to the need to adopt increasingly sophisticated and more effective safety measures.

[0003] All that has led to growing attention in the sector, which has caused, on the one hand, the industry to engage in the development of increasingly performing apparatuses and, on the other, regulating bodies to engage in defining increasingly accurate national and international requirements which meet technological advancements.

[0004] The present invention relates to the implementation of surge protection apparatuses - referred to as arresters in the following- the application of which is regulated, for example, by CEI EN 62305-1/4 Ed. 2 (2011-02), IEC 60364-4-44-443 Ed.2 (2007) e CLC/TS 50539-12 (2010-03) standards for the protection from lightning bolts and switching surges. The requirements and testing methods refer to the IEC 61643-11 Ed. 1 (2011-03) standard and to the CEI EN 50539-11 (2013-02) standard.

[0005] In particular, the present invention relates to the arrester of the most recent prior art, comprising a protection element in the shape of a varistor and meant in particular for LV plants (low voltage, that is, nominal voltage up to 1000 V AC and 1500 V DC) and to photovoltaic plant (AC side and DC side).

[0006] The varistor employed in the arresters is an already well-known component; the behaviour thereof equals that of a variable (non-linear) resistance in the voltage/current ratio. Once the reference voltage has been exceeded, for example when a short-lived surge/overcurrent peak occurs, the varistor abruptly lowers the resistance thereof, so that the peak may be easily discharged therethrough, to the ground, and does not continue towards other, higher-resistance equipment or parts of the plant. A varistor typically consists of a mass of semiconductor material (for example, ZnO) arranged sandwich-like between two opposite metal surfaces, which make up the electrodes to which the contacts of the electric terminals connecting to the arrester are electrically joined. Typically, in these devices, the two electric terminals are then wired to a phase lead and to the protection lead and/or to the neutral lead, respectively.

[0007] In the inner circuit of the arrester, connected in series to the protection element in the form of varistor, a "disconnector" is typically provided which makes up the specific object of the invention and the function of which is better described here in the following. The disconnector is a complex cutting-off device, with protective functions in case of failure of the protection element.

[0008] In standard conditions, that is, in the absence of surges/overcurrents, the protection element has such a high impedance as to represent an interruption of the ground-bound circuit and the current circulating within the arrester is not significant. Consequently a current which can generate dangerous conditions for people's safety does not circulate towards the ground. This well-known system operates in a highly effective manner as long as the protection element (for example the varistor) is fully integer and working.

[0009] Upon various overloads, for example due to high widths of the transient currents discharged to the ground, to an excessive number of operation cycles or to abnormal conditions of the supply network, the protection element (typically the varistor) undergoes an aging and deterioration process, so that it gradually begins to decrease the impedance thereof and hence to discharge to the ground, even in the absence of surges/overcurrents, increasing and ever more significant current values. As long as the impedance decrease is modest, and the value of the ground-bound current with it, the operation of the arrester is still acceptable, but beyond certain values the arrester becomes unusable and dangerous to users. At this point it must necessarily be turned off (disconnected) from the plant.

[0010] The disconnector is hence entrusted with the task of interrupting the circuit, both in case of modest currents (an operation typically carried out with inherent features), and in case of high short-circuit currents (an operation typically carried out with the aid of fuses). The activation of the disconnector occurs by heat effect (Joule

effect). The "disconnector" which normally performs this circuit-opening function may be inside/outside the arrester.

[0011] The thermal disconnector substantially consists of an electric lead of a various shape connected in series to the electrode of the varistor. It consists of a complex unit, typically comprising a resilient, metal lamina joined to the varistor electrode through a welding with a low-melt welding material, that is, capable of melting at a relatively low temperature (120-180°C). The resilient lamina is welded in an elastically flexed or spring-loaded attitude, in any case arranged in such an elastically-loaded condition as to impart a stress which tends to move it away from the varistor electrode. Due to this arrangement, when - following deterioration - the varistor begins to discharge a significant current to the ground, no longer in a transient way but continuously, it tends to heat up due to the Joule effect. Such temperature transfers to the welding and when the temperature of the low-melt alloy is reached, the retaining ability of the welding ceases, releasing the metal lamina from the contact with the varistor electrode, thus opening the electric circuit and restoring safe conditions.

[0012] Some examples of this general layout are disclosed in US2012/14028 and EP2541577.

[0013] This system has proved rather effective, but not entirely devoid of drawbacks. As a matter of fact, upon the opening of an electric circuit run through by a current, an electric arc tends to establish itself which tries to maintain circuit continuity. If the arc does not naturally extinguish or the disconnector fails to interrupt it, a danger situation arises both in the arrester (overheating with possible fire and/or explosion) and in the relevant electric plant. In order to interrupt high short-circuit currents it is often resorted to support fuses arranged outside or inside the arrester itself.

[0014] Possible solutions to this problem which imply the introduction in the disconnector of the arrester of the complex mechanisms of arc interruption have already been offered on the market. In particular it has already been disclosed to use rotating discs or partitions, arranged on a plane parallel to that of the varistor, or oscillating-lever arms, all meant to arrange themselves in the path of the arc upon the disconnector opening. However, these prior-art mechanisms are complicated and not always effective, because the arc tends to by-pass the intercepting device.

[0015] The bulk of these mechanisms and of the support fuses represents a significant obstacle to the application of the arresters, since it is wished to design them so as to allow the housing of the entire protection surge system in the "classic" modular frames typical of LV apparatuses, with mounting on DIN bar, modular configurations more than consolidated for electric boxes for civil and industrial use.

SUMMARY OF THE INVENTION

[0016] The technical problem to be addressed is therefore to suggest an arrester structure which overcomes the mentioned drawbacks. In particular an arrester with a disconnector which allows: to safely open the circuit in case of slow deterioration of the protection element and to open the circuit equally safely also in case of very fast deterioration (short-circuit) of the protection element, inherently performing the function of the fuse. At the same time it is wished, in both situations, for the disconnector to be capable of effectively extinguishing any forming of an arc, interrupting also high short-circuit currents. The proposed arrester structure, despite performing all these functions, must be able to maintain a small bulk to be housed in standard frames.

[0017] These objects are achieved through the features set forth in essential terms in the attached claims.

[0018] In particular, according to a first aspect of the invention, it is provided a surge arrester comprising a first and a second electric terminal for connection to the active leads of an electric plant, between which a protection element is inserted, provided with a pair of electrodes, between said first electric terminal and the electrode of the protection element a disconnector being provided which comprises a conductive, resilient, flexible lamina having a base end electrically wired to said first electric terminal and a distal end maintained electrically connected to said electrode by a welding of a low-melt conductive material, wherein said lamina is mounted elastically biased according to a direction so as to push said distal end away from said electrode and it is made with a thickness below 0.5 mm and of a conductive material with a conductivity much lower than that of copper (IACS<60) such as to melt/sublimate following heating by Joule effect upon the passing of a short-circuit current.

[0019] According to an additional apsect, between said base end of the lamina and said electrodeof the protection element a sliding guide is provided for an intercepting cursor biased in a longitudinal direction of said sliding guide by preloaded elastic means, and wherein at least an inclined portion of said lamina runs through said sliding guide at a certain angle to the longitudinal sliding axis thereof, said inclined portion of the lamina acting as abutment and holding element for a head end of said cursor.

[0020] Preferably, the head end of said intercepting cursor has a longitudinal groove apt to engage tightly with a tooth protruding from a travel-end wall of said sliding guide.

[0021] Still preferably, the head end of said intercepting cursor has a wedge-like surface, inclined with re-spect to a sliding axis of said sliding guide according to the same angle of said inclined portion of said resilient, flexible lamina.

[0022] Said sliding guide is limited by a partition wall whereon at least a portion of said lamina rests in said preloaded condition.

[0023] According to a different aspect, it is provided a

surge arrester comprising a first and a second electric terminals for connecting to the active leads of an electric plant, between which a protection element is inserted, provided with a pair of electrodes electrically wired to said electric terminals, between said first electric terminal and an electrode of the protection element a disconnector being provided comprising a conductive, resilient, flexible lamina and having a base end electrically wired to said first electric terminal and a distal end maintained electrically connected to said electrode, in a condition of elastic preload, through a welding with low-melt material, wherein between said base end of the lamina and said electrode of the protection element a sliding guide is provided for an intercepting cursor biased in a longitudinal direction of said sliding guide by preloaded elastic means, and in that at least an inclined portion of said lamina runs through said sliding guide at a certain angle to the longitudinal sliding axis thereof, said inclined portion of the lamina acting as abutment and holding element for a head end of said cursor.

[0024] The head end of said intercepting cursor can have a wedge-like surface, inclined with re-spect to a sliding axis of said sliding guide according to the same an-gle of said inclined portion of the resilient, flexible lamina.

[0025] Preferably said cursor has a longitudinal groove apt to engage with a corresponding longitudinal ribbing of the sliding guide.

[0026] Further, the sliding guide is limited by a partition wall whereon at least a portion of said lamina rests in said preloaded condition.

[0027] A further aspect is that said inclined portion of the lamina ends with a bent welding foot, making up said distal end.

[0028] Preferably, said intercepting cursor is made of BMC material (Bulk Moulding Com-pound) complying with the UL 94 standard with a flammability class HB and preferably with degasifying properties through the release of CO_2 in the presence of electric arc.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] Further features and advantages of the invention are in any case more evident from the following detailed description of preferred embodiments, given purely as a non-limiting example and illustrated in the attached drawings, wherein:

fig. 1 is a schematic elevation side view, with parts removed, of the arrester structure according to the invention in an intact condition and with the disconnector at rest;

fig. 2 is a similar view to that of fig. 1, but in a deteriorated condition and with the disconnector in an initial, circuit-opening phase; and

fig. 3 is a similar view to that of fig. 1, in a deteriorated condition and with the disconnector having reached the final condition and having completed the opening of the circuit. DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0030] As the different side views show, an arrester is housed in a box body, module C, of such dimensions as to be housed in a single standard module wired up within an electric box for LV (low voltage) electric plants. In this module C two opposite electric terminals are housed, in a manner known per se - a first electric terminal 1 for the connection of the phase lead and a second electric terminal 2 for the connection of the protection lead or the neutral lead - between which a protection element (typically a varistor) is arranged, schematised here by a wafer 3, on the opposite surfaces of which respective conductive electrodes are arranged (in the drawings an electrode 4 only is shown, the other one on the opposite side being not visible in the drawing).

[0031] Electrode 4 is electrically wired to phase electric terminal 1, while the opposite electrode is wired to the ground or to neutral electric terminal 2. The connection between electrode 4 and phase electric terminal 1 is accomplished through lead means making up an element of the disconnector. In particular, such lead means of the disconnector is in the shape of a flexible lamina 5, which is elastically preloaded and joined to electrode 4 by a suitable low-melt welding in the site marked by 5d.

[0032] The material used in the low-melt welding typically belongs to the group of alloys based on tin, lead, bismuth, indium in binary or ternary, euteptic and non-euteptic formations, with melting ranges comprised between 120°C and 180°C.

[0033] In the exemplifying embodiment illustrated in the drawings, the lamina 5 of the disconnector is generically bent into an S or U shape (so as to have a better shape flexibility), having:

- a first portion 5a physically and electrically joined to the body of electric terminal 1, which continues in
- a second portion 5b which runs adjacent to a rigid wall 11 inside box body C, and in
- a third flexible portion 5c, which projects cantilevered from the rigid support wall 11, forming a resilient flexion knee joint 5c' with the second portion 5b, and in
- a fourth terminal foot-shaped portion 5d, further bent (with an angle of about 60°) with respect to third portion 5c, welded (in the site of standard operation) with low-melt welding material to the electrode 4 of varistor 3.

[0034] The lead means of the disconnector, in form of said metal lamina, is resilient and maintained deflected (hence elastically preloaded) in the operating position illustrated in fig. 1, against the reaction of the fixed rigid wall 11, by the welding on electrode 4.

[0035] During ordinary operation (rest condition of the disconnector), this embodiment ensures electric continuity between electric terminal 1 and the electrode 4 of the varistor, through lamina 5.

[0036] According to an aspect of the invention, lamina 5 is preferably manufactured with a small thickness (in the order of few tenths of millimetre, for example 0.2-0.3 mm) and with a material with electric conductivity below that of copper, for the reasons which will be explained further on. An exemplifying level of conductivity may be an IACS (International Annealed Copper Standard) < 60. The material preferably consists of a copper alloy with such elements as to change the conductivity thereof (copper IACS < 90) and impart resilient properties to a notoriously ductile and malleable but non-elastic material.

[0037] According to a further aspect of the invention, furthermore, between the rigid abutment wall 11 of lamina 5 and an inner compartment 12 housing varistor 3, a cursor 7 for arc intercepting and compressing it is defined, which cursor is guided along a sliding path by guide means 6.

[0038] In particular - as visible in the drawings - guide 6 hs two parallel walls (rigid wall 11 and an opposite perimeter wall of compartment 12), which guide the longitudinal sliding movement of cursor 7, and two travel-end walls, a starting one 13 and a finishing one 14. Cursor 7 is biased and pushed from starting wall 13 towards finishing wall 14 by preloaded elastic means, for example a precompressed spring 8 (better appreciated in the drawings 2 and 3). Cursor 7 is preferably provided with a longitudinal groove 7a, meant to engage with and slide on a longitudinal ribbing 9 arranged inside guide 6.

[0039] Preferably, especially when the device is meant to operate with alternate currents, cursor 7 is made of BMC (Bulk Moulding Compound) material complying with the UL 94 standard with a flammability class HB and preferably with degasifying properties through the release of CO_2 in the presence of electric arc.

[0040] The third inclined portion 5c of resilient lamina 5 is arranged so as to intercept the sliding path of cursor 7: as visible in the drawings, inclined portion 5c runs through guide 6 with a certain inclination angle with respect to the longitudinal guiding axis, typically an inclination angle of the order of 45°-70°, preferably about 60°. Correspondingly, the head end of cursor 7 has at least a front surface portion 7b which is at a certain angle to the longitudinal axis, defining a kind of wedge-like surface 7b which, matching the same inclination angle, rests evenly on the inclined portion 5c of resilient lamina 5.

[0041] With this construction, in the rest condition of the disconnector (when foot 5d is welded to electrode 4), cursor 7 is constrained between starting wall 13 and the inclined portion 5c of lamina 5, overcoming the precompression stress of spring 8.

[0042] Moreover, on the head end of cursor 7 a longitudinal groove 7c is also provided, the function of which is illustrated further on; groove 7c is preferably obtained in correspondence of longitudinal groove 7a. Correspondingly, on finishing wall 14 a tooth 15 is provided, longitudinally projecting, preferably in correspondence of ribbing 9, and apt to engage tightly with the groove 7c of cursor 7.

[0043] In a condition of integrity of the arrester and hence in a rest condition of the disconnector, the portion 5b of the lamina is adjacent to the inner wall 11 which runs longitudinally to the sliding path of guide 6, while inclined portion 5c is bent towards the varistor and intercepts with a certain angle the guide 6 and hence the sliding path of cursor 7, representing an element of stopping and abutment of the head end of cursor 7 biased by spring 8. Therefore cursor 7 is retained in position - significantly loaded by spring 8 (for example with a force of about 5-10 N) - due to the support of head 7b on the inclined portion 5c of lamina 5, which is in turn retained in position by the welding in 5d.

[0044] When, due to the slow deterioration of the protection element in form of a varistor, current (even of low intensity, but continuously) begins to flow through the lamina 5 of the disconnector, it ends up heating the welding site between electrode 4 and foot 5d, until causing the welding material to melt and hence interrupting the constraint.

[0045] When, due to the very fast deterioration (short-circuit) of the protection element (typically a varistor), a high value of current - that of a prospective short-circuit - flows through resilient lamina 5, said lamina behaves like a fuse. As a matter of fact, run-through by high current values, a small portion of lamina 5 tends to melt/sublimate in the proximity of the welding spot interrupting the constraint in this case also. Therefore it is not necessary to insert a further auxiliary fuse in series to the arrester. That advantageously contributes to the reduction of bulk of the system provided with the arrester according to the invention.

[0046] In both activation modes of the disconnector, under its own elastic preload tension, lamina 5 is released and snaps into the opening position shown in fig. 2. The detachment of lamina 5 from electrode 4 is also favoured by the thrust of the cursor 7 preloaded by spring 8 which - due to the wedge-like end surface thereof - tends to impart a force with a transversal component to the welding surface of foot 5d.

[0047] Upon this condition occurring, cursor 7 is no longer retained and is triggered towards the finishing wall 14 (the one at the bottom in the drawing) moving lamina 5 further away from the main area of the sliding guide 6 and hence of electrode 4, as shown in fig. 3.

[0048] With this movement, sliding cursor 7 accomplishes multiple mutually synergistic actions aimed at the interruption of the electric arc:

a) it accelerates to the highest degree the moving away of lamina 5 from the welding site on electrode 4; it hence reduces the opportunity for an arc forming and, should said arc form, it reduces the energy passing through, thereby reducing the duration time of the conduction phase;

b) it remarkably lengthens, through mechanic elongation, any arc which should form between electrode

4 and lamina 5; this is a first effective action aimed at increasing the resistance of the electric arc;
c) the forward displacement of cursor 7 in guiding chamber 6 produces a volume reduction of the arc chamber, with consequent compression of the column of ionised gas, increasing the density thereof; upon the density increasing, the resistance increases: this is a second effective action aimed at increasing the resistance of the electric arc;
d) in the (optional) case of the cursor being made of natural BMC material with flammability class HB according to the UL 94 standard, due to the electric arc, it releases CO_2 into guiding chamber 6, in an amount proportional to the temperature of the electric arc pushed therein. CO_2 disrupts the arc, determining a resulting resistance increase; since the temperature is a function of the developed energy, the disrupting action is proportional to the square of the current, times the time of the arc duration; that intensifies the above-said second effective action aimed at increasing the resistance of the electric arc;
e) the engagement at speed of tooth 15 with groove 7c (position of fig. 3,) in addition to generating a further localised micro-compression of the plasma, creates an effect of final mechanic cutting tending to cut off the residue of the column of ionised gas: this is a third effective action aimed at interrupting the arc.

[0049] This configuration, obtained by the synergistic combination of a resilient lamina and of an elastically loaded cursor, even in its simplicity, is highly effective for the safe turning off of the arc by the disconnecting apparatus. Advantageously, moreover, the compactness of the elements forming the disconnector and the short movements necessary for operation, allow to offer extremely reduced bulk levels, so that the containment box body may be housed in a single standardised module C of the LV electric boards.

[0050] Although it is not considered necessary to describe it in detail, it must be considered that it is advantageous to employ also an element sensitive to the movement of the intercepting cursor, which makes the out-of-order condition of the arrester following the disconnector action visible to the outside of the device. For example, in the drawings a secondary cursor 20 has been represented which is transversally pushed towards intercepting cursor 7, in correspondence of starting wall 13. When the intercepting cursor is activated and moves from the inoperative position thereof, it frees space for secondary cursor 20, which can move from its home position (fig. 1) and perform a minimum displacement (position of fig. 3) which may be detected from the outside by an optical sign easily perceived by an operator's glance. It is evident that such signalling mechanism may take up also other, different shapes without significantly affecting the main teaching provided here.

[0051] Finally, it must be noticed that the preferred embodiment described here advantageously provides that the longitudinal sliding axis of the intercepting cursor be arranged according to a line making up the head of the T shape of containment body C. It is not ruled out that various orientations may be provided, despite obtaining at least part of the inventive results described here.

[0052] However, it is understood that the invention must not be considered limited to the particular arrangement illustrated above, which represents only an exemplifying embodiment thereof, but that different variants are possible, be they internal or external with respect to the SPD, all within the reach of a person skilled in the field, without departing from the scope of protection of the invention, as defined by the following claims.

Claims

1. A surge arrester comprising a first and a second electric terminal (1, 2) for connection to the active leads of an electric plant, between which a protection element (3) is inserted, provided with a pair of electrodes (4), between said first electric terminal (1) and the electrode (4) of the protection element (3) a disconnector being provided which comprises a conductive, resilient, flexible lamina (5) having a base end (5a) electrically wired to said first electric terminal (1) and a distal end (5d) maintained electrically connected to said electrode (4) by a welding of a low-melt conductive material, **characterised in that** said lamina (5) is mounted elastically biased according to a direction so as to push said distal end (5d) away from said electrode (4) and it is made with a thickness below 0.5 mm and of a conductive material with a conductivity much lower than that of copper (IACS<60) such as to melt/sublimate following heating by Joule effect upon the passing of a short-circuit current.

2. Ther surge arrester as claimed in 1, wherein between said base end (5a) of the lamina (5) and said electrode (4) of the protection element (3) a sliding guide (6) is provided for an intercepting cursor (7) biased in a longitudinal direction of said sliding guide (6) by preloaded elastic means (8), and wherein at least an inclined portion (5c) of said lamina (5) runs through said sliding guide (6) at a certain angle to the longitudinal sliding axis thereof, said inclined portion (5c) of the lamina acting as abutment and holding element for a head end (7b) of said cursor (7).

3. The surge arrester as claimed in 2, wherein the head end (7b) of said intercepting cursor (7) has a longitudinal groove (7c) apt to engage tightly with a tooth (45) protruding from a travel-end wall (14) of said sliding guide (6).

4. The surge arrester as claimed in 2 or 3, wherein the head end (7b) of said intercepting cursor (7) has a

wedge-like surface, inclined with respect to a sliding axis of said sliding guide (6) according to the same angle of said inclined portion (5c) of said resilient, flexible lamina (5).

5. The surge arrester as claimed in anyone of claims 2 to 4, wherein said sliding guide (6) is limited by a partition wall (11) whereon at least a portion (5b) of said lamina (5) rests in said preloaded condition.

6. A surge arrester comprising a first and a second electric terminal (1, 2) for connecting to the active leads of an electric plant, between which a protection element (3) is inserted, provided with a pair of electrodes (4) electrically wired to said electric terminals, between said first electric terminal (1) and an electrode (4) of the protection element (3) a disconnector being provided comprising a conductive, resilient, flexible lamina (5) and having a base end (5a) electrically wired to said first electric terminal (1) and a distal end (5d) maintained electrically connected to said electrode (4), in a condition of elastic preload, through a welding with low-melt material, **characterised in that** between said base end (5a) of the lamina (5) and said electrode (4) of the protection element (3) a sliding guide (6) is provided for an intercepting cursor (7) biased in a longitudinal direction of said sliding guide (6) by preloaded elastic means (8), and **in that** at least an inclined portion (5c) of said lamina (5) runs through said sliding guide (6) at a certain angle to the longitudinal sliding axis thereof, said inclined portion (5c) of the lamina acting as abutment and holding element for a head end (7b) of said cursor (7).

7. The surge arrester as claimed in 6, wherein the head end (7b) of said intercepting cursor (7) has a longitudinal groove (7c) apt to engage tightly with a tooth (15) protruding from a travel-end wall (14) of said sliding guide (6).

8. The surge arrester as claimed in 6 or 7, wherein the head end (7b) of said intercepting cursor (7) has a wedge-like surface, inclined with respect to a sliding axis of said sliding guide (6) according to the same angle of said inclined portion (5c) of the resilient, flexible lamina (5).

9. The surge arrester as claimed in 6, 7 or 8, wherein said cursor (7) has a longitudinal groove (7a) apt to engage with a corresponding longitudinal ribbing (9) of the sliding guide (6).

10. The surge arrester as claimed in any one of claims 6 to 9, wherein said sliding guide (6) is limited by a partition wall (11) whereon at least a portion (5b) of said lamina (5) rests in said preloaded condition.

11. The surge arrester as claimed in any one of claims 6 to 10, wherein said inclined portion (5c) of the lamina ends with a bent welding foot, making up said distal end (5d).

12. The surge arrester as claimed in any one of claims 2 to 11, wherein said intercepting cursor (7) is made of BMC material (Bulk Moulding Compound) complying with the UL 94 standard with a flammability class HB and preferably with degasifying properties through the release of CO_2 in the presence of electric arc.

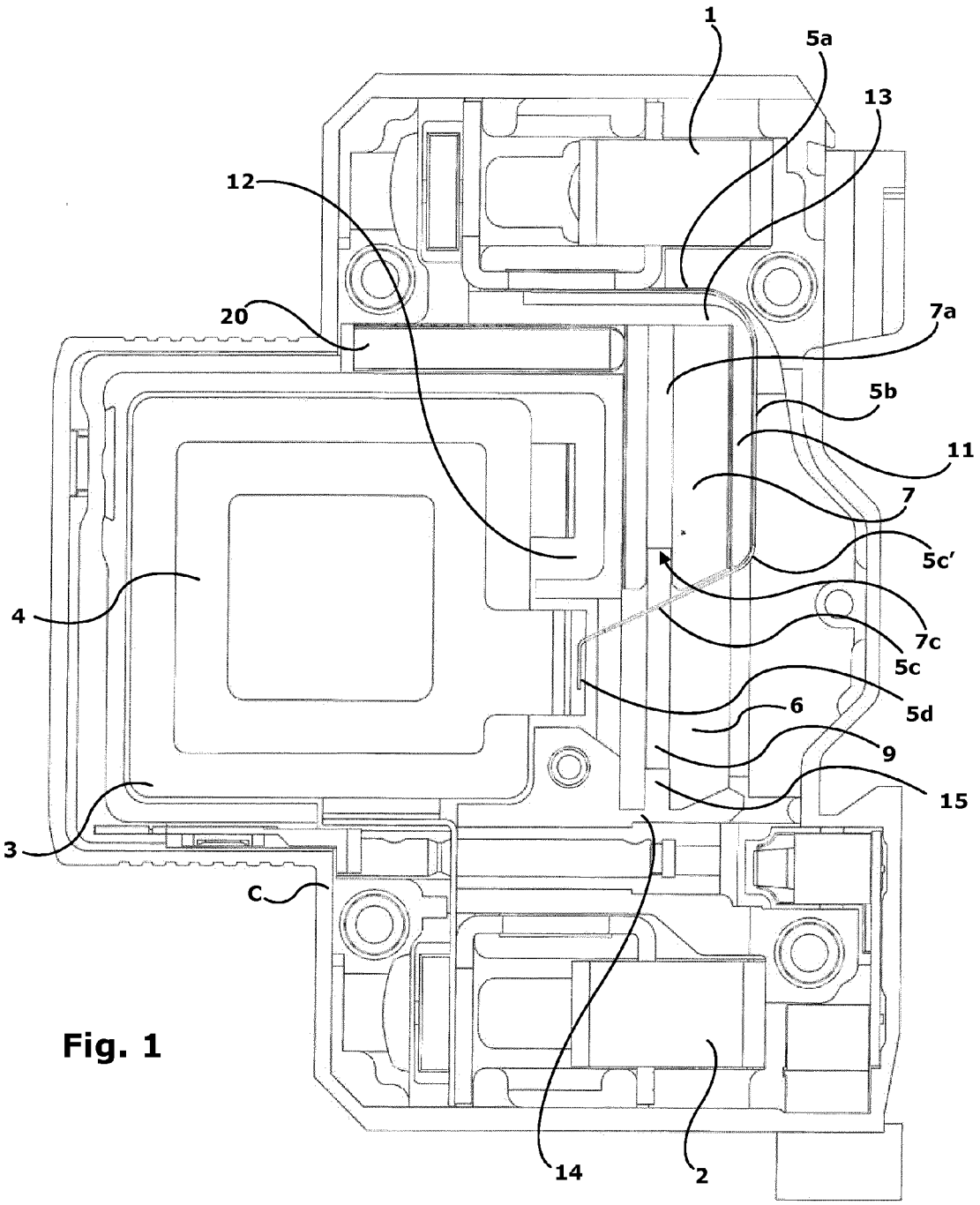

Fig. 1

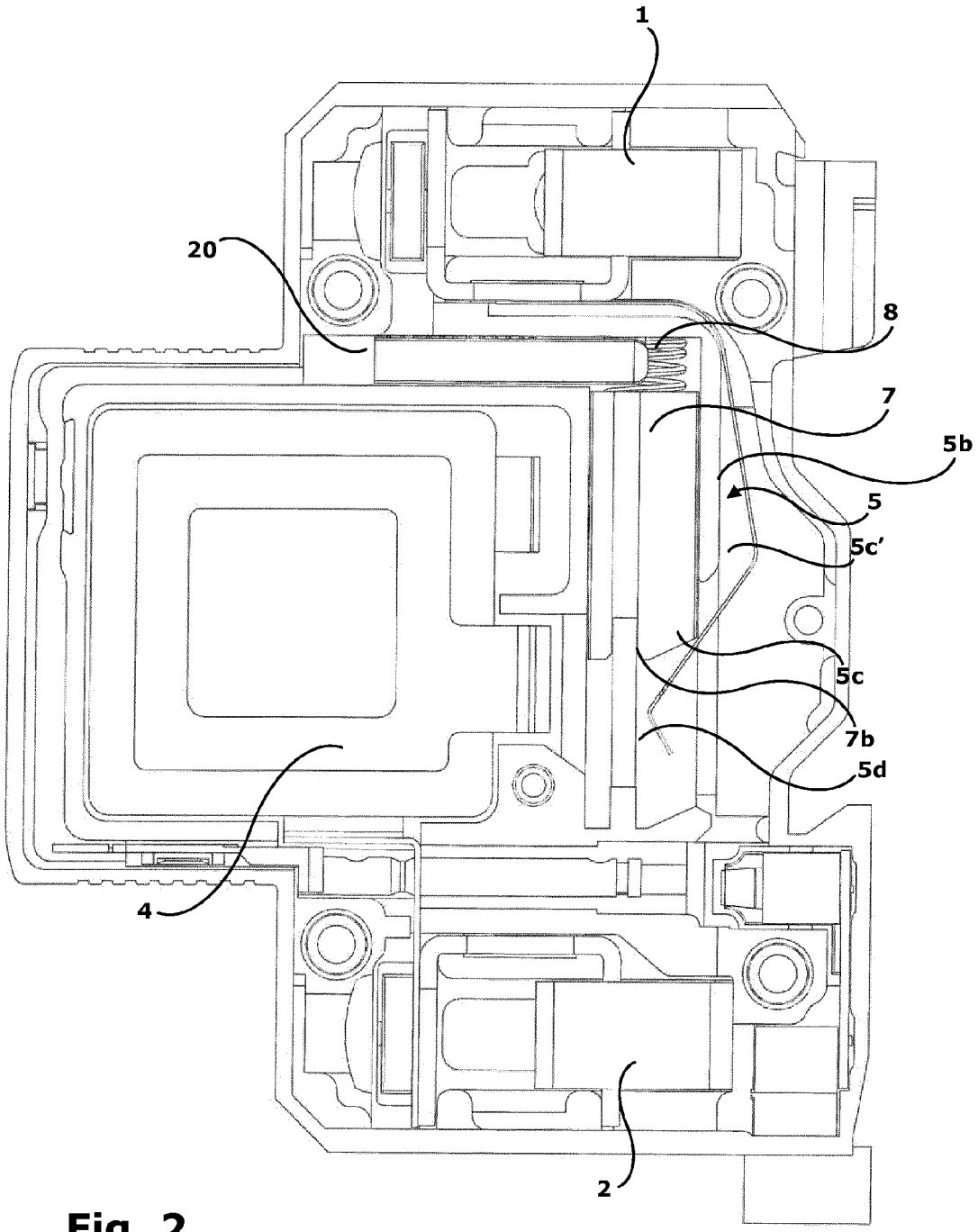

Fig. 2

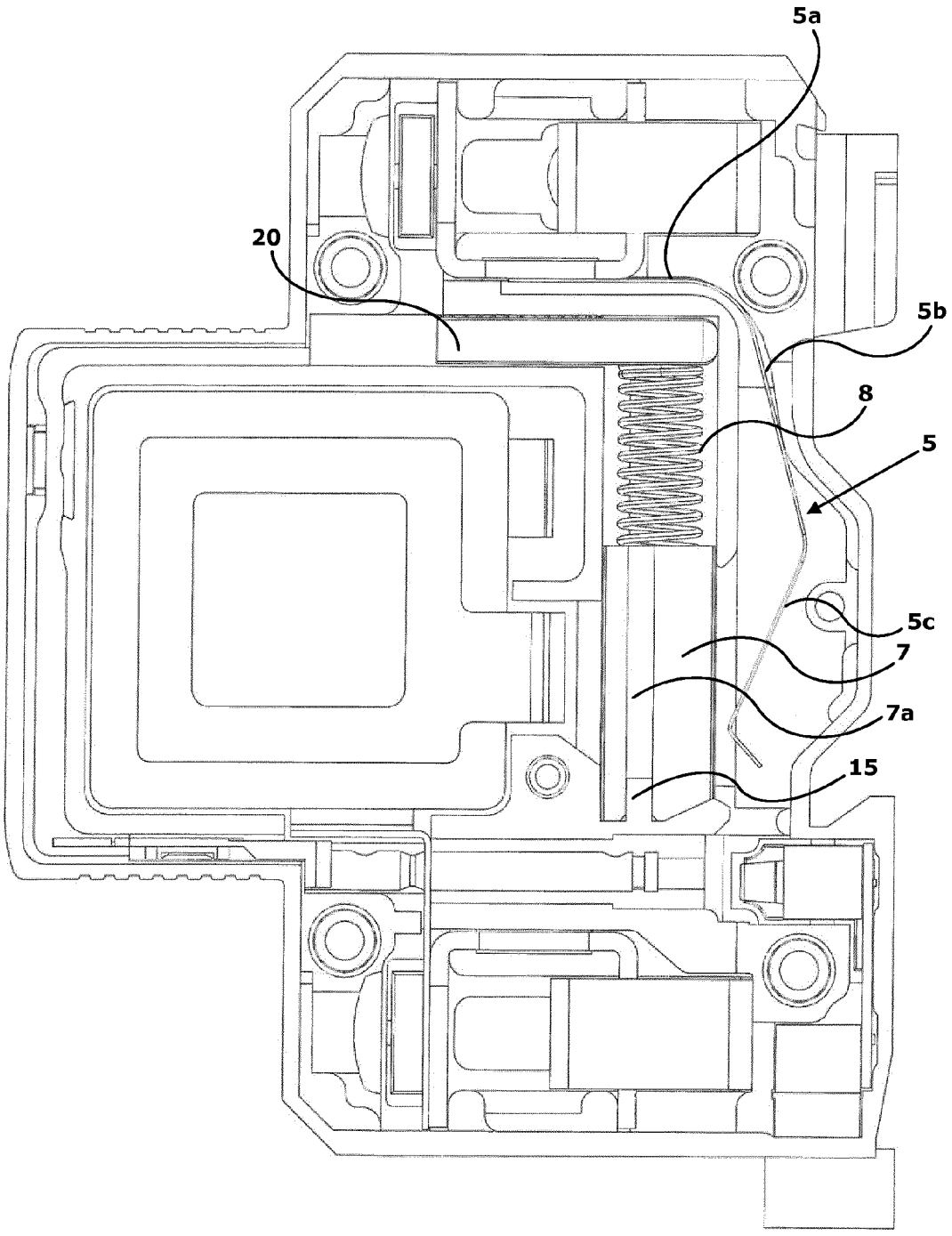

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 14 16 0969

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	EP 2 541 577 A1 (EPCOS AG [DE]) 2 January 2013 (2013-01-02) * column 3, paragraph 20 - column 4, paragraph 25; figures 2,3,8 * * column 7, paragraph 41 - paragraph 43; figures 1-2,7,8 * -----	1 2-7,9	INV. H01C7/12 H01H37/76
A	US 2011/170217 A1 (MAO XIAOMAO [CN] ET AL) 14 July 2011 (2011-07-14) * paragraph [0032] - paragraph [0041]; figures 2,3,4 * -----	1-12	
A	DATABASE WPI Week 200872 Thomson Scientific, London, GB; AN 2008-M16699 XP002719434, -& CN 101 261 893 A (FOSHAN PROSURGE ELECTRONICS CO LTD) 10 September 2008 (2008-09-10) * abstract; figures 1-10 * -----	1-7,9	
A	US 2012/014028 A1 (DAUM RICHARD [DE]) 19 January 2012 (2012-01-19) * paragraph [0034] - paragraph [0045]; figures 1-3 * -----	1-7,9	TECHNICAL FIELDS SEARCHED (IPC) H01C H01T H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 August 2014	Frias Rebelo, Artur

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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Application Number
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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☒ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-12

Surge arrester comprising a first and a second electric terminal for connection to the active leads of an electrical plant, between which a protection element is inserted, provided with a pair of electrodes electrically wired to said connection terminals, between said first terminal (1) and an electrode (4) of the protection element (3) a disconnector comprising a conductive, resilient, flexible lamina (5) being provided having a base end (5a) electrically wired to said first terminal (1) and a distal end (5d) electrically connected to said electrode (4), in a state of elastic preload, through a welding with low-melting material,
characterised in that between said base end (5a) of the lamina (5) and said electrode (4) of the protection element (3) a sliding guide (6) for an interception cursor (7) biased in a longitudinal direction of said sliding guide (6) through preloaded elastic means (8) being provided, and in that at least an inclined portion (Sc) of said lamina (5) crosses said sliding guide (6) with a certain angle with respect to the longitudinal sliding axis thereof, said inclined portion (Sc) of the lamina acting as abutment and holding element for a head end (7b) of said cursor (7).

1.1. claims: 6-11(completely); 12(partially)

A surge arrester comprising a first and a second electric terminal for connecting to the active leads of an electric plant, between which a protection element is inserted, provided with a pair of electrodes electrically wired to said electric terminals, between said first electric terminal and an electrode of the protection element a disconnector being provided comprising a conductive, resilient, flexible lamina and having a base end electrically wired to said first electric terminal and a distal end maintained electrically connected to said electrode, in a condition of elastic preload, through a welding with low-melt material,
characterised in that between said base end of the lamina and said electrode of the protection element a sliding guide is provided for an intercepting cursor biased in a longitudinal direction of said sliding guide by preloaded elastic means , and in that at least an inclined portion of said lamina runs through said sliding guide at a certain angle to the longitudinal sliding axis thereof, said inclined portion of the lamina acting as abutment and holding element for a head end of said cursor .

Please note that all inventions mentioned under item 1, although not

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 14 16 0969

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

necessarily linked by a common inventive concept, could be searched without effort justifying an additional fee.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 16 0969

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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22-08-2014

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		WO 2013000796 A2	03-01-2013
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- US 201214028 B **[0012]**
- EP 2541577 A **[0012]**