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(54) **Removable bridge safety electric contact**

(57) Removable bridge safety electric contact wherein each contact element is supported by its respective contact spring comprising a leaf of resilient spring material, in which a first end (7a) and an end opposite thereto (7b) are separated by an intermediate portion (I), that is folded to assume a wavy profile of boustrophedon type, defined by substantially straight sections (7c) alternating with and connected by curved sections (7d), to allow the first end (7a) to elastically and reversibly move towards the second end (7b) as said substantially straight sections (7c) become more compacted.

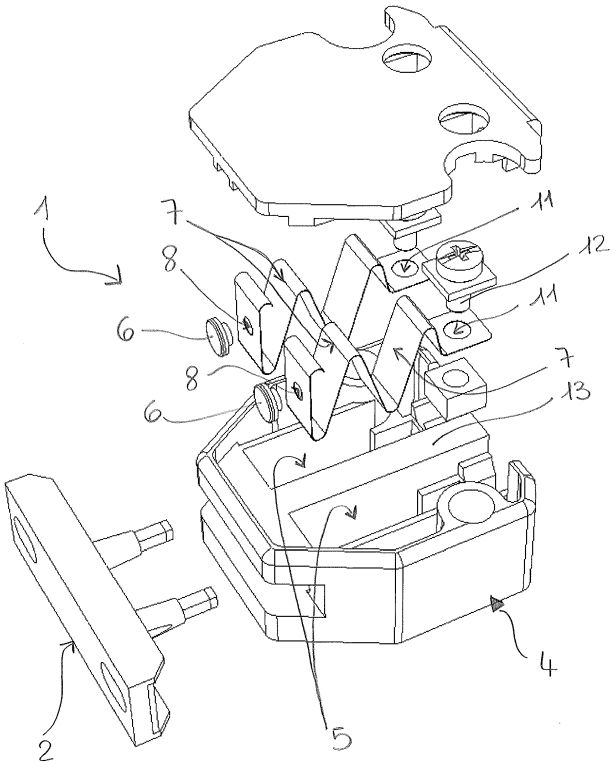

Fig. 2

EP 2 387 053 A1

Description

DESCRIPTION

[0001] The present invention relates to a safety electric contact as defined in the preamble of claim 1.

[0002] For simplicity, reference will be particularly made herein, without limitation, to a removable bridge safety electric contact for use in the structure of a lift system.

[0003] In lift systems, removable bridge safety contacts are widely used to enable/disable certain features, e.g. to deny electric consent to start the lift until an inner door of the car is wholly closed.

[0004] The requirements to be met by safety contacts are generally set forth by stringent standards. For instance, the terminals of the removable contact bridge must fit into the receiving part of the contact, to only electrically close the electric circuit when mechanical closing members have been engaged for a minimum working stroke, generally at least 7 mm.

[0005] Most of current removable bridge safety contacts have leaf contact springs that support contact elements, typically riveted thereto. The silver-coated terminals of the contact bridge push the contact element and cause electric current to pass from one spring to the other.

[0006] While this type of contacts has a good performance, it still suffers from certain drawbacks, namely the overall dimensions of the receiving body of the safety electric contact in which the leaf spring extends. Proper support of leaf springs does not afford size reduction of the receiving body.

[0007] Now, it should be noted that in lift systems the need is strongly felt for removable bridge safety contacts that, in addition to ensuring safety and performance, have a smaller size, for trouble-free positioning.

[0008] In order to fulfill this need, removable bridge safety contacts have been provided, in which the contact elements acted upon by the free end of the terminals of the removable contact bridge are not supported by a straight leaf spring, but at the apex of a cone formed by a leaf spring wound into a conical coil.

[0009] Concerning this contact spring embodiment, it shall be considered that, while it actually affords a reduction of the size and overall dimensions of the body of the receiving part of the safety electric contact, the use of such coil spring is still undesirable due to problematic fixation of the contact element at the apex of the cone formed by the cone-shaped coil spring which, upon extensive operation, can cause failure of the safety electric contact.

[0010] The problem at the basis of the present invention is of devising a removable bridge safety electric contact, suitable for the structure of a lift system, that has such structural and functional characteristics as to fulfill the above need, while obviating the above prior art drawbacks.

[0011] This problem is solved by a safety electric contact apparatus according to the features of claim 1.

[0012] According to a further aspect, this need is also fulfilled by a lift system structure as defined in claim 15.

[0013] Further features and advantages of the safety electric contact as defined by the features of claim 1, as well as the lift system structure as defined in claim 15 will be apparent from the following description of a few preferred embodiments thereof, which is given by way of illustration and without limitation with reference to the accompanying figures, in which:

- Figure 1 is a perspective view of a removable bridge safety electric contact of the invention, with separate parts;
- Figure 2 is an exploded perspective view of the removable bridge safety electric contact of Figure 1 according to a simplified embodiment;
- Figure 3 is a cross-sectional perspective view of the removable bridge safety electric contact of Figure 1;
- Figure 4 is a simplified side view of the contact spring device of the contact of Figure 2;
- Figure 5a is a cross-sectional perspective view of the removable bridge safety electric contact of Figure 1 according to a different embodiment;
- Figure 5b is a front plane view of the electric contact of Figure 5a;
- Figure 5c is a longitudinal sectional perspective view of the electric contact of Figure 5a;
- Figure 5d is a longitudinal sectional plane view of the electric contact of Figure 5a;
- Figure 6 is a diagrammatic perspective view of the removable bridge safety electric contact of Figure 1;
- Figure 7 is a side view of the contact spring of the contact of Figure 6;
- Figure 8 is a diagrammatic perspective view of the leaf of the contact spring of Figure 6;
- Figure 9 is a side view of the leaf of Figure 8.

[0014] Referring to the accompanying figures, numeral 1 generally designates a removable bridge safety electric contact of the invention.

[0015] Particularly, the removable bridge safety electric contact 1 comprises:

- a contact bridge 2 having two rod-like contacts 3 in electrical communication with each other and
- a receiving body 4 in which two corresponding seats 5 are defined, each seat 5 being suitable to receive in an insert/removable way the rod-like contacts 3 of the contact bridge 2 from a front opening.

[0016] Contact elements 6 supported by corresponding contact springs 7 are positioned in the receiving body 4. These contact elements 6 are adapted to be contacted by the free ends of the rod-like contacts 3 of the contact bridge 2, when the contact bridge 2 is engaged with the receiving body 4.

[0017] Namely, each contact element 6 is housed with its contact spring 7 in its respective seat 5 of the receiving body 4.

[0018] As shown in the figures, these seats 5 define in the receiving body 4 corresponding independent housings separated by a partition wall 13. Therefore, the receiving body 4 has tubular containing elements defined therein, for containing and guiding corresponding contact springs 7 in the elastic reversible relative movement of the first portion 7a towards the second portion 7b of the spring 7, in the direction X-X, while preventing the spring in a first seat 5 from inadvertently contacting the contact spring 7 in the other seat 5.

[0019] Each of these contact springs 7 includes a leaf having a small thickness S, indicatively of the order of 0.08÷0,15 mm, preferably 0.10 mm, made from a resilient spring material.

[0020] The leaf has a preset width L, indicatively of the order of 3÷12 mm, preferably 7 mm, well below its length, so that each leaf has the conformation of a strip portion extending in a prevailing longitudinal direction.

[0021] Two distal portions can be defined in each leaf, which define a first portion 7a with its contact element 6 fixed thereto and a second portion 7b, designed for connection to conductor means 12 of an electric circuit. In the example of the figures, this is embodied by the provision of a through hole 11 adapted for engagement of the shank of a screw 12 of a terminal.

[0022] In the illustrated embodiment, the first portion 7a and the second portion 7b form the distal end portions of the leaf 7.

[0023] It shall be noted that at least one intermediate portion I of each blade 7, i.e. a section between the first portion 7a and the second portion 7b, is folded into substantially intermediate sections 7c alternating with and connected by curved sections 7d.

[0024] Due to the above, the intermediate portion I of the leaf 7 has a wavy profile of boustrophedon type, i.e. serpentine profile, in which the curved sections 7d act as flexural springs to allow the first end portion 7a of the leaf 7 to elastically and reversibly move towards the second end portion 7b in a direction X-X as the intermediate portions 7c of the intermediate portion I are more compacted in the direction X-X.

[0025] According to the preferred embodiment of the figures, the above mentioned intermediate sections 7c of the leaf 7 are substantially straight sections.

[0026] In other words, the structure and conformation of the intermediate portion I of each leaf 7 acts as an elastic bellows to impart an elastic accordion-like behavior to the leaf 7, whereby the first portion 7a may be reversibly moved towards the second portion 7b in said direction X-X against a predetermined oppositely-directed elastic action exerted by the intermediate portion I of the leaf 7.

[0027] For this purpose, the leaf 7 is made of a spring material adapted for electric current transmission, such as an AISI 301 austenitic stainless steel or beryllium copper.

[0028] Therefore, as shown, the leaf 7 extends in the above mentioned direction X-X with a wavy profile of boustrophedon type between the first portion 7a and the second portion 7b, which are connected to the intermediate portion I by curved connecting sections 7e and 7f respectively.

[0029] Preferably, the first portion 7a of each leaf spring 7 is inclined with respect to the intermediate portion I to define a wall that is substantially perpendicular to said direction X-X. In short, when the contact spring 7 is in its seat 5 of the receiving body 4, said first portion 7a is proximate the front end of its seat 5 through which the rod-like contact 3 of the contact bridge 2 will be introduced.

[0030] Preferably, each contact element 6 is fixed to the first portion 7a of the contact spring 7 by riveting, a through hole 8 being provided for this purpose in the first portion 7a of the leaf 7.

[0031] It shall be noted that the contact element 6 may be also fixed to the first portion 7a of the leaf 7 otherwise than by the above mentioned riveting, such as by welding or by screw or bolt connection.

[0032] The above mentioned intermediate portion I of each contact leaf spring 7 comprises more than two substantially straight sections 7c, preferably three substantially straight sections, connected in pairs by corresponding curved sections 7d. This imparts an effective elastic bellows or accordion-like behavior to the intermediate portion I, while avoiding distortion or warping of the first portion 7a as it moves towards the second portion 7b due to the action exerted thereupon by the corresponding rod-like contact 3 of the contact bridge 2.

[0033] It shall be noted that the curved sections 7d extend throughout the width S of the leaf 7 substantially perpendicular to the longitudinal direction of extension of the leaf.

[0034] As shown in the figures:

- the intermediate sections 7c, i.e. said substantially straight sections, overlap each other in said direction X-X,
- two contiguous intermediate sections 7c are separated by a curved connecting section 7d and are in such positions as to be inclined to each other and converge at the curved connecting section 7d and
- the contiguous intermediate sections 7c are in mutually facing, overlapped relation.

[0035] It will be appreciated that, during operation of the above described removable bridge safety electric contact 1, when the contact bridge 2 is associated with the receiving body 4, the two terminals fit into the receiving body through the front openings and are thus introduced into the seats 5. This creates a contact between the front end of the contact terminals 3 and their respective contact elements 6, and causes the first portion 7a of the contact spring 7 to retract towards the second por-

tion 7b, which is connected to the conductor means of the electric circuit. Thus, as the contact terminals 3 fit into the seats 5, they cause the contact springs 7 to retract in the direction X-X to a more compressed retracted configuration. When the contact bridge 2 is released from the receiving body 4, the contact spring 7 moves back to its original configuration, in which the contact element 6 supported by the first portion 7a of the leaf is located proximate its front opening of the receiving body 4.

[0036] Preferably, the tubular containing elements defined by said seats 5 allow the contact springs 7 to be guided at the curved sections 7d of the contact springs.

[0037] Preferably, the seats 5 have such a size as to ensure the provision of a predetermined side clearance, as measured in the direction of width L of each contact spring 7, namely in a direction transverse to said direction X-X, passing through both contact springs 7.

[0038] Particularly referring to the embodiment of Figures 5a, 5b, 5c and 5d, it can be appreciated that, in order to guide the contact springs at said curved sections 7d minimize friction and prevent any stick slip, the seats 5 have protrusions 14 in such positions as to be able to contact their respective contact springs 7 at their curved sections 7d. Thus, the protrusions 14 ensure that contact between each contact spring 7 and the wall of its seat 5, particularly of the tubular element defined by such seat, occurs at a limited surface portion, namely the surface defined by the end of the protrusions 14, to reduce friction between the contact spring 7 and its seat 5 during said reversible relative movement of the first portion 7a towards the second portion 7b, in the direction X-X.

[0039] Preferably, the protrusions 14 extend:

- from opposite sides of the tubular containing elements defined by the seats 5,
- substantially all along the tubular containing elements defined by said seats 5 and
- in the direction X-X in which the first portion 7a reversibly moves towards the second portion 7b of its contact spring 7.

[0040] Advantageously, these opposite sides are the sides that extend substantially parallel to the width L of the contact springs 7.

[0041] In accordance with the preferred embodiment as shown in Figures 5a, 5b, 5c and 5d, these protrusions 14 are in such positions as to be substantially at the center line of the tubular containing elements defined by the seats 5.

[0042] Furthermore, the surface of these protrusions 14 which is designed to contact said curved sections 7d of the contact springs 7 is a rounded surface.

[0043] Therefore, each contact spring 7 is supported and guided substantially along the longitudinal center axis defined with reference to the width L of the leaf, by two opposite rounded protrusions. Due to the above, and to the above mentioned side clearance, as the first portion 7a of the contact spring 7 reversibly moves towards the second portion 7b, the spring is substantially free to oscillate/swing in its seat 5 with respect to a center portion of the seat, in the direction of its width L with respect to the rounded surface of the contact ribs. This allows each contact spring 7 to overcome any stick slip caused by friction of the longitudinal sides of the contact spring, i.e. the sides of the contact spring extending in said direction X-X and spaced by said width L, against the wall of the seat 5.

[0044] As the first portion 7a of the contact spring 7 retracts towards the second portion 7b, the straight sections 7c tend to move from a more inclined configuration to a more vertical, less inclined configuration. This increases the height dimension of the contact spring 7 as it moves to its more compressed configuration, upon introduction of the contact terminals 3 into the seats 5. Preferably, in order to compensate for such increase of the height dimension of the contact spring 7, the distance between the opposite portions of the seat 5 designed to contact said curved sections 7d of the contact springs 7, i.e. the rounded protrusions 14, increases, in the direction X-X from the front wall with the front opening for the introduction of the contact terminal 3 towards the opposite bottom wall of the seat 5. In the embodiment of Figures 5a-5d, this is obtained by the provision of ribs 14 that are inclined in the direction X-X to project from their respective walls to a greater extent at the front wall with the front opening for introduction of the contact terminal 3.

[0045] As clearly shown in the above description, the removable bridge safety electric contact of the present invention fulfills the above mentioned need and also obviates the prior art drawbacks as set out in the introduction of this disclosure. Therefore, while the contact springs in the receiving body have such a minimum cross section as to ensure adequate passage of current, they still afford a considerable reduction of the dimensions of the seat in which each contact spring is to be housed, as compared with prior art contact devices involving the use of leaf contact springs. As a result, the size and dimensions of the receiving body of the removable bridge safety electric contact may be also considerably reduced.

[0046] A further advantage of the removable bridge safety electric contact of the present invention is its unique structural simplicity.

[0047] Yet another advantage of the removable bridge safety electric contact of the present invention is the possibility of manufacturing the contact spring by bending and blanking from a continuous strip, thereby achieving considerable savings in terms of manufacturing costs.

[0048] Those skilled in the art will obviously appreciate that a number of changes and variants may be made to the above described removable bridge safety electric contact, still within the scope of the invention, as defined in the following claims.

Claims

1. A removable bridge safety electric contact, comprising:

   - a contact bridge (2) having two rod-like contacts (3) and
   - a receiving body (4) having respective seats (5) for receiving in an insert/removable way the rod-like contacts (3) of said contact bridge (2), in each of said seats (5) being positioned a contact element (6) supported by a corresponding contact spring (7), wherein:
   - when the rod-like contacts (3) of said contact bridge (2) are introduced into said receiving body (4), said rod-like contacts (3) act upon their respective contact elements (6) to push their respective contact springs (7) to a more compressed retracted configuration and
   - each contact spring comprises a leaf of a resilient spring material of preset width (L), extending in a prevailing longitudinal direction, wherein two distal portions (7a, 7b) of said leaf define a first portion (7a) with a contact element (6) fixed thereto and a second portion (7b) for connection to conductor means (11) of an electric circuit, respectively,

   characterized in that:

   - at least one intermediate portion (I) of said leaf, between said first portion (7a) and said second portion (7b), is folded into intermediate sections (7c) alternating with and connected by curved sections (7d), so that said at least one intermediate portion (I) of said leaf can have a wavy profile of boustrophedon type, said curved sections (7d) acting as flexural springs between two successive intermediate sections (7c), to allow said first portion (7a) to elastically and reversibly move towards said second portion (7b) as said intermediate portions (7c) become more compacted, and
   - said seats (5) define in said receiving body (4) respective independent housings, separated by a partition wall, to define in said receiving body (4) respective tubular containing elements, for containing and guiding respective contact springs 7 in the elastic reversible relative movement of the first portion (7a) towards said second portion (7b), while preventing the spring in a first seat (5) from contacting the contact spring (7) in another seat (5).

2. A safety electric contact as claimed in claim 1, wherein said curved sections (7d) extend throughout the width (L) of said leaf substantially perpendicular to said prevailing longitudinal direction.

3. A safety electric contact as claimed in claim 1 or 2, wherein:

   - said intermediate sections (7c) are substantially straight sections,
   - two contiguous intermediate sections (7c) are separated by a curved section (7d) and are inclined to each other and
   - two contiguous intermediate sections (7c) are in mutually facing relation.

4. A safety electric contact as claimed in any claim from 1 to 3, wherein said at least one intermediate portion (I) of said leaf comprises at least three intermediate sections (7c) connected in pairs by respective curved sections (7d).

5. A safety electric contact as claimed in any claim from 1 to 4, wherein said first portion (7a) of said leaf is inclined to the intermediate portion (I) to be substantially perpendicular to the direction of insertion (X-X) of said rod-like contacts into the seats (5) of said receiving body.

6. A safety electric contact as claimed in any claim from 1 to 5, wherein said tubular elements of said receiving body (4) comprise opposite open ends, for access of said receiving body (4) from the outside to said first portion (7a) and said second portion (7b) of said leaf spring (7).

7. A safety electric contact as claimed in any claim from 1 to 6, wherein said contact springs (7) are introduced into their respective seats (5) in such a manner as to contact said tubular containing elements defined by said seats (5) at said curved sections (7d).

8. A safety electric contact as claimed in any claim from 1 to 7, wherein said contact springs (7) are introduced into their respective seats (5) with a measured side clearance in the direction of width (L) of said springs.

9. A safety electric contact as claimed in claim 7 or 8, wherein said seats (5) have protrusions extending from said tubular containing elements defined by said seats (5) to contact said curved sections (7d) of said contact springs (7).

10. A safety electric contact as claimed in claim 9, wherein said protrusions extend from opposite sides of said tubular containing elements defined by said seats (5).

11. A safety electric contact as claimed in claim 9 or 10, wherein said protrusions extend along said tubular containing elements defined by said seats (5) in the direction (X-X) in which said first portion (7a) reversibly moves towards said second portion (7b) of the

corresponding contact spring (7).

12. A safety electric contact as claimed in any claim from 9 to 11, wherein said protrusions are positioned substantially at the center line of said tubular containing elements defined by said seats (5).

13. A safety electric contact as claimed in any claim from 9 to 12, wherein said protrusions contact said curved sections (7d) of said contact springs (7) by a rounded contact surface.

14. A safety electric contact as claimed in any claim from 1 to 12, wherein the distance between the opposite portions of each seat (5), which are designed to contact said curved sections (7d) of the contact springs (7) increases, in the direction of insertion (X-X) of said rod-like contacts (3) into the seats (5) from the front wall with the front opening for access of the contact terminal (3) towards the opposite bottom wall of the seat (5).

15. A lift system structure comprising a removable bridge safety electric contact (1) as claimed in any claim from 1 to 14.

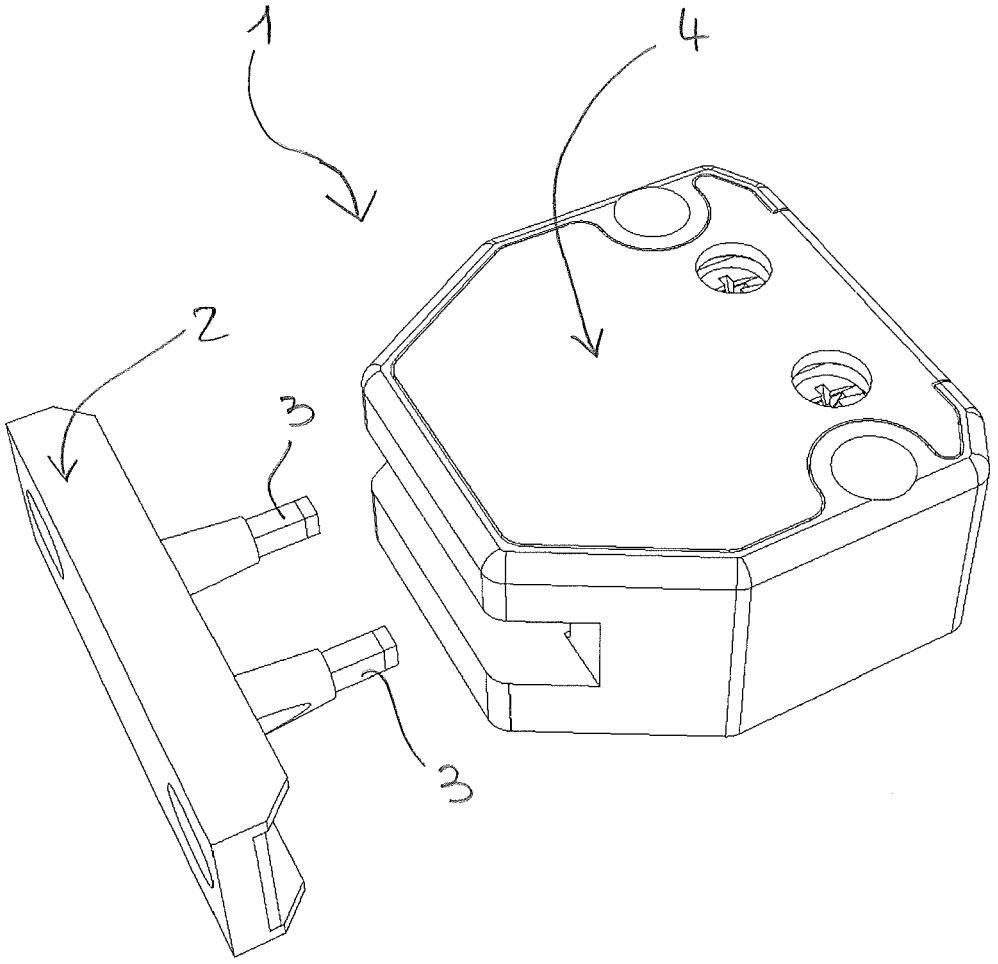

Fig. 1

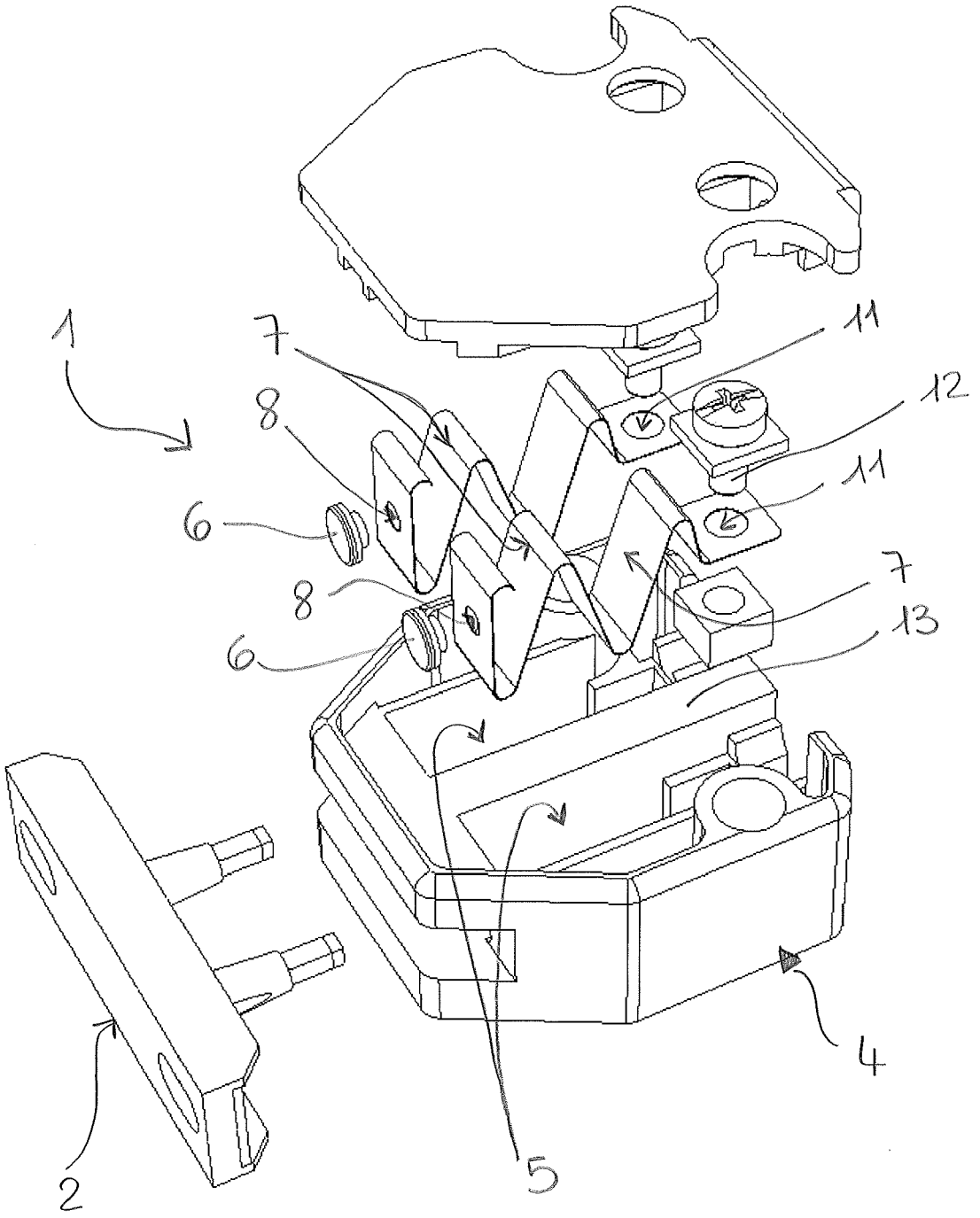

Fig. 2

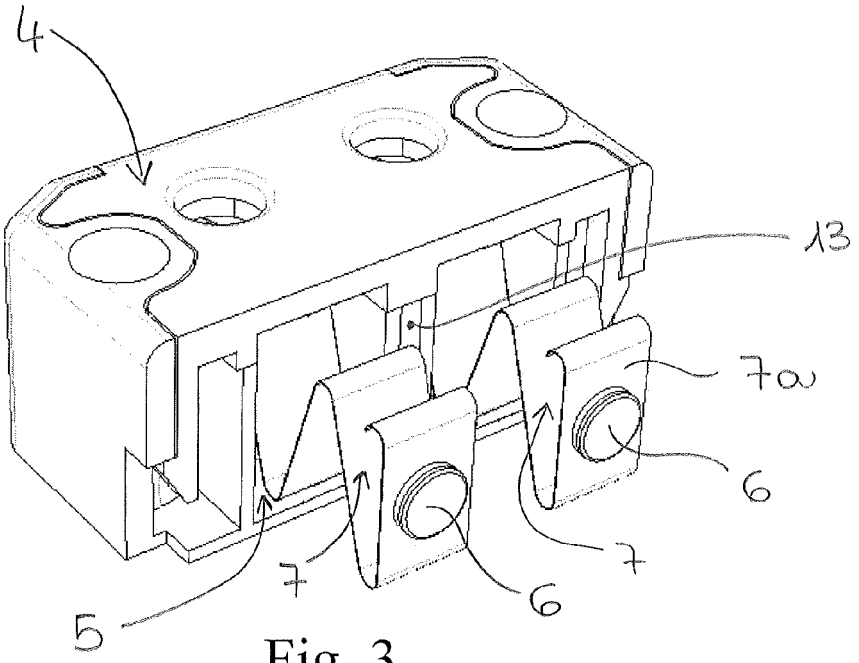

Fig. 3

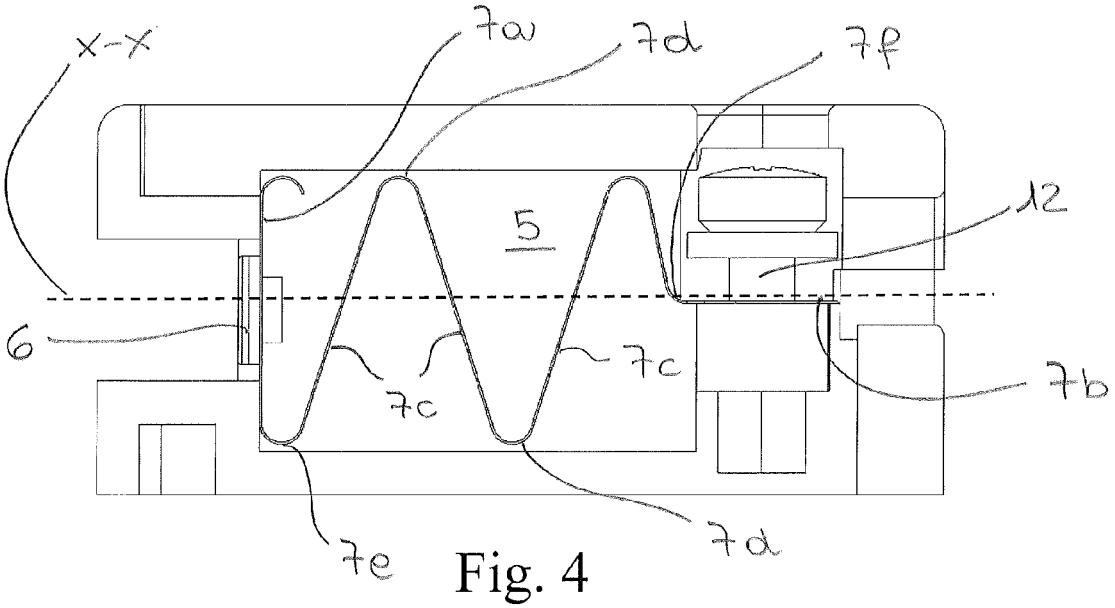

Fig. 4

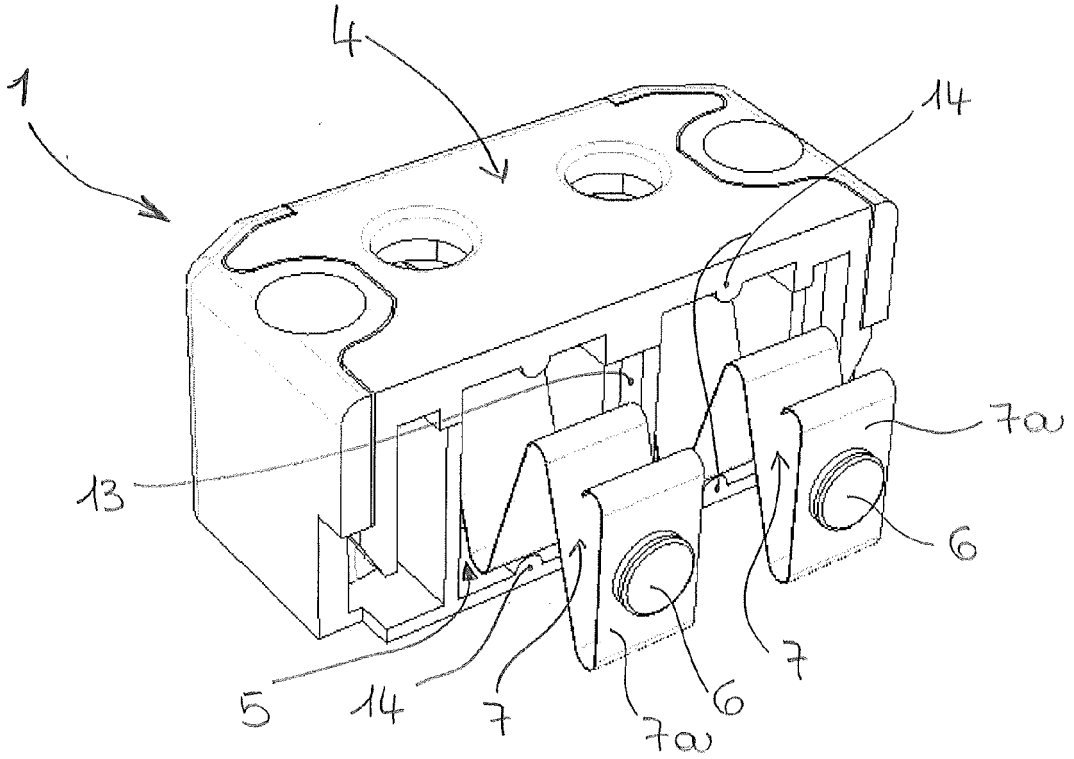

Fig. 5a

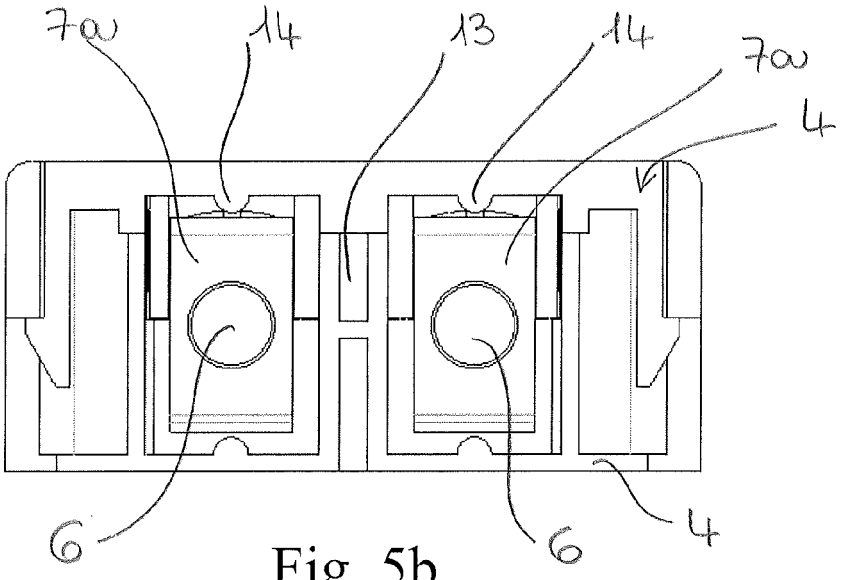

Fig. 5b

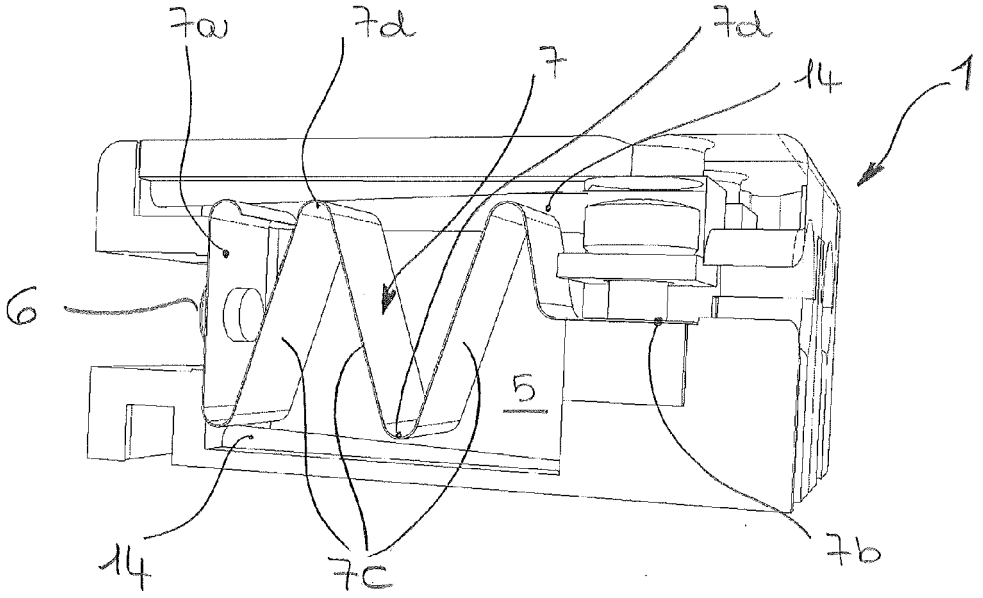

Fig. 5c

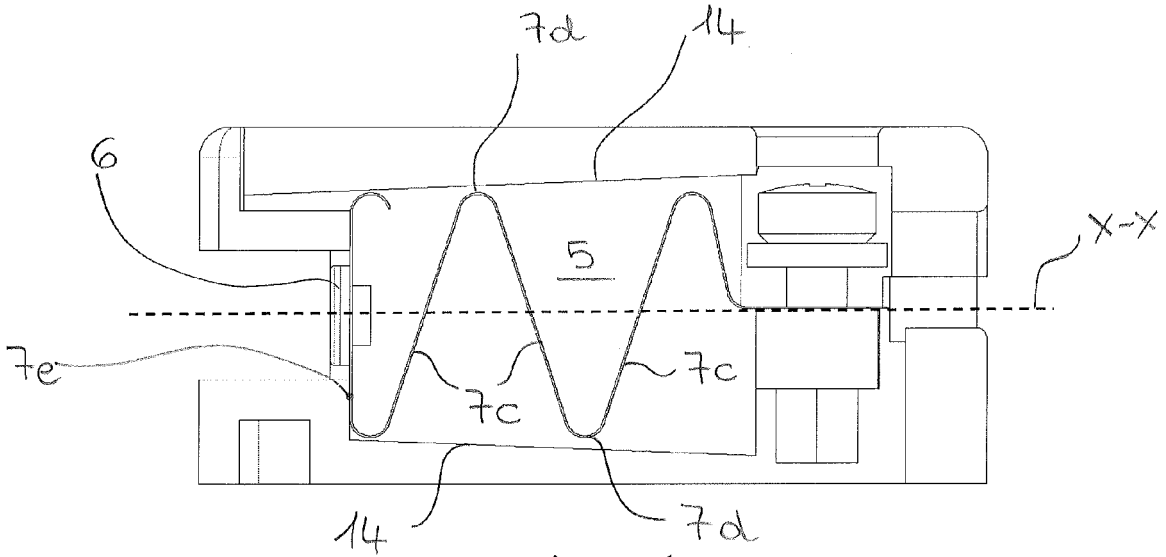

Fig. 5d

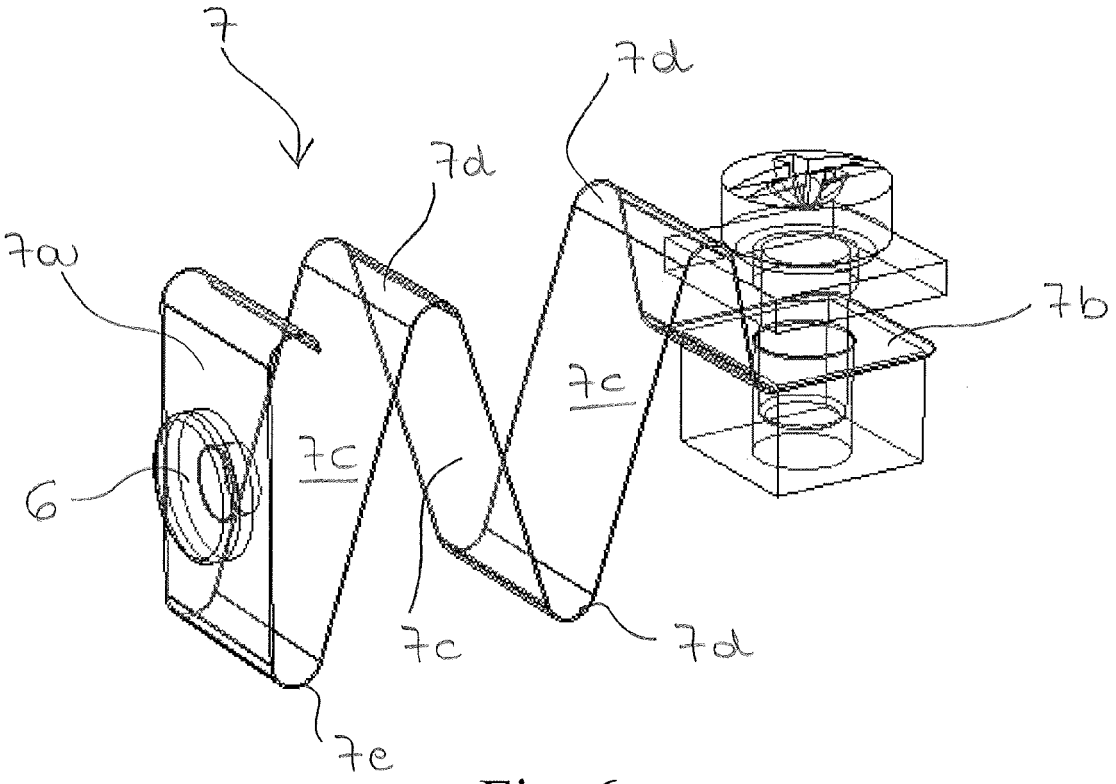

Fig. 6

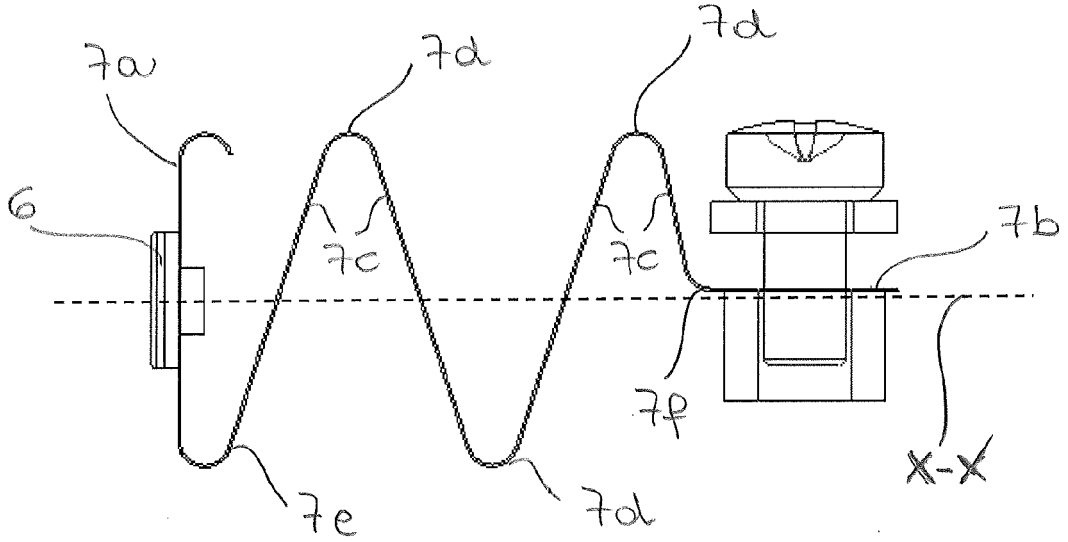

Fig. 7

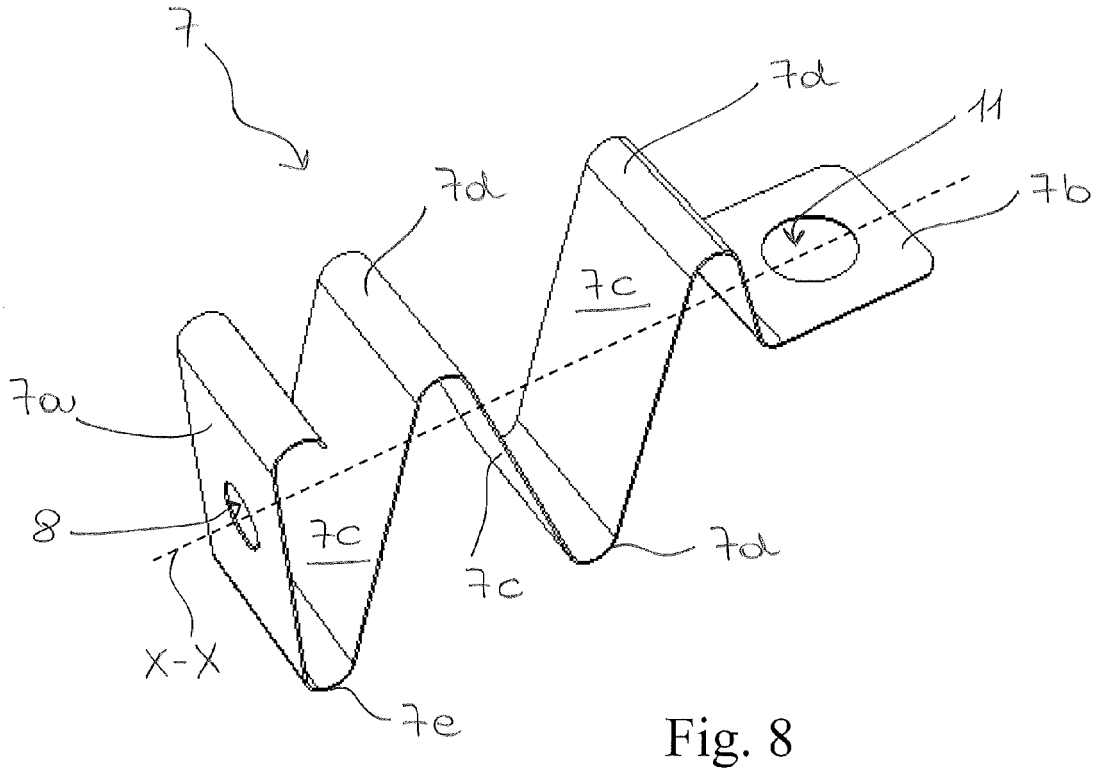

Fig. 8

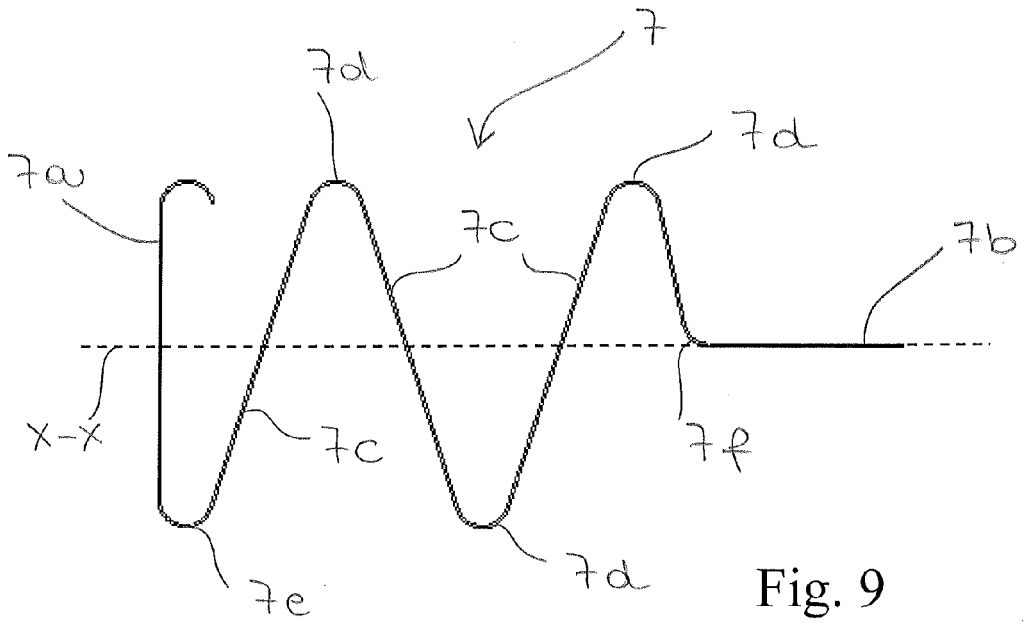

Fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 0522

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	FR 1 280 497 A (HAZEMEIJER CO) 29 December 1961 (1961-12-29) * the whole document *	1-15	INV. H01H1/26 H01H9/08 H01R4/48
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A	DE 12 01 449 B (KRONE KG) 23 September 1965 (1965-09-23) * abstract; figure 1 *	1-15	
A	EP 0 537 751 A1 (YAZAKI CORP [JP]) 21 April 1993 (1993-04-21) * abstract; figures 4,5 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

H01H
H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 May 2011	Ruppert, Christopher

CATEGORY OF CITED DOCUMENTS

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