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(54) **Electric Switching Device**

(57) The invention relates to a electric switching device with a bi-metal tripping device and a latching mechanism with a releasing jack system to be triggered by the tripping device via a tripping bridge, in particular a motor protection switch or a circuit breaker. The invention also relates to a method for compensation of different bending distances of at least two bi-metal tripping devices of in parallel operated conductor rails. The objective of the invention is to provide an electric switching device with at least two conductor rails, which are operated in parallel, a bi-metal tripping device for each conductor rail and a release jack system to be triggered by the tripping device which does not trip under normal operating states, i.e. which does not trip too early. The invention discloses

an electric switching device with at least two conductor rails, which are operated in parallel, a bi-metal tripping device for each conductor rail, a first tripping bridge with jogs for the bi-metals and a releasing jack system to be triggered by the tripping device via the first tripping bridge having a second tripping bridge and a tripping lever, which is able to detect different bending distances of the at least two bi-metal tripping devices of the parallel operated conductor rails and to control the releasing jack system via the tripping lever in such a way, that the forward motion of the more bended bi-metal tripping device will be compensated. The invention also discloses a method for compensating different bending distances of such electric switching device.

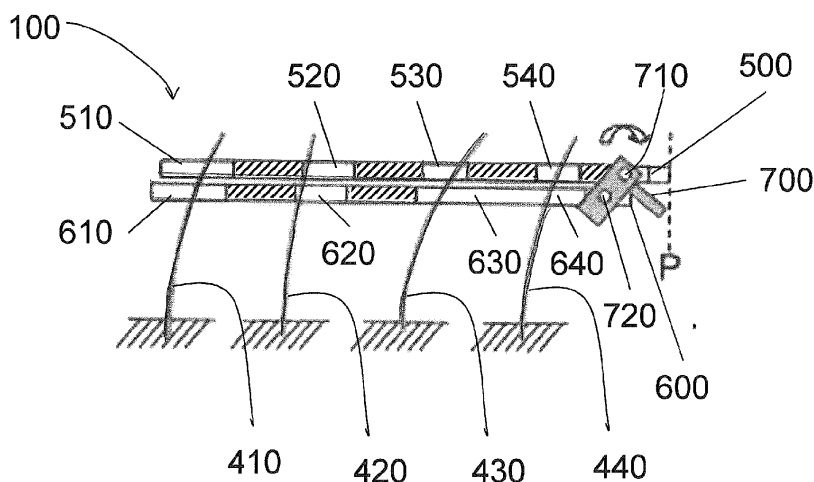


FIG 8

Description

[0001] The invention relates to a electric switching device with a bi-metal tripping device and a latching mechanism with a releasing jack system to be triggered by the tripping device via a tripping bridge, in particular a motor protection switch or a circuit breaker.

[0002] The invention also relates to a method for compensation of different bending distances of at least two bi-metal tripping devices of in parallel operated conductor rails.

[0003] Usually such electric switching devices are designed multiphase. In practice there are tolerances in all components, such as the bi-metal themselves, the releasing jack system, the tripping bridge and so on. Therefore such electric switching devices are to be calibrated by the manufacturer. The tolerances present between the bimetallic strips of the individual phases are to be balanced amongst each other, between the bi-metals and the flip point of the releasing jack system as well as to be balanced with respect to a required empty path of the bi-metals. As a solution of this problem, US 6,466,115 B1 discloses a switch gear in a housing with a removable bridge system. The housing allows to capture the bi-metal device group and the releasing jack system in the finally incorporated state for the purpose of calibration of the still not incorporated bridge system by a measurement technology, then to assemble the correspondingly calibrated bridge system, and finally to close the opening by a protective cover. All tolerances concerning the bi-metal tripping device are captured over the complete production and assembly chain during calibration of the bridge system.

[0004] Often two conductor rails inside the electric switching device are operated in parallel in order to increase the nominal current of the switch gear. In case the current is symmetrically divided between the two conductor rails and the bending factor of the bi-metals is chosen carefully, no additional problem occurs. But in practice the conductor rails are loaded asymmetrically, for instance due to different bulk resistances or different magnetic forces. Such causes may change during operation of the electric switching device. Therefore it is not possible to balance the tripping behavior of such switching devices in advance. In case the conductor rails are loaded asymmetrically, one of the bi-metals will slip forward and trip the releasing jack device via the tripping bridge system. The electric switching device will trip though the total current is not that high. The protected system will stop though there is no abnormal operating state.

[0005] The objective of the invention is to provide an electric switching device with at least two conductor rails, which are operated in parallel, a bi-metal tripping device for each conductor rail and a release jack system to be triggered by the tripping device which does not trip under normal operating states, i.e. which does not trip too early.

[0006] The objective of the invention is also to provide

a method for compensating different bending distances of at least two bi-metal tripping devices of in parallel operated conductor rails.

[0007] According to the invention, this objective is achieved by a device having the features of the independent Claim 1. Advantageous embodiments of the device are likewise set forth in the subordinate Claims 2 through 6. The objective is also achieved by a method according to Claim 7.

[0008] The advantage of the device according to the invention and of the appertaining method realized with this device lies in the effective and reliable combination of a first tripping bridge with a second tripping bridge, the so called differential bridge, and a tripping lever, which is operated by the two bridges. Only in case, both tripping bridges move in general in parallel, the tripping lever will activate the latching mechanism.

[0009] Additional advantages, special features and practical refinements of the invention can be gleaned from the subordinate claims and from the presentation below of preferred embodiments making reference to the figures.

[0010] The figures show the following:

Fig 1 operating diagram of a 4-polar switching device with an overcurrent release, for instance a circuit breaker

Fig 2 operating diagram of a 3-polar switching device with in parallel operated conductor rails in the middle phase and an overcurrent release, for instance a circuit breaker

Fig 3 Principle of a state-of-the-art thermo-mechanical tripping device with in parallel operated conductor rails in phase 2 with no load and bi-metals in basic position at room temperature

Fig 4 Principle of a state-of-the-art thermo-mechanical tripping device with in parallel operated conductor rails in phase 2 with symmetric load

Fig 5 Principle of a state-of-the-art thermo-mechanical tripping device with in parallel operated conductor rails in phase 2 with asymmetric load

Fig 6 Principle of a thermo-mechanical tripping device according to the present invention with in parallel operated conductor rails in phase 2 with no load and bi-metals in basic position at room temperature

Fig 7 Principle of a thermo-mechanical tripping device according to the present invention with in parallel operated conductor rails in phase 2 with symmetric load

Fig 8 Principle of a thermo-mechanical tripping device

according to the present invention with in parallel operated conductor rails in phase 2 with asymmetric load

[0011] In Fig 1 an operating diagram of a 4-polar switching device (10) with an overcurrent release (200) and a latching mechanism (300), for instance a circuit breaker, is shown in the tripped position. The 4 phases are named as L1, L2, L3 and N. In case of an overcurrent, the overcurrent release (200) triggers the latching mechanism (300), which operates the contacts (310, 320, 330, 340) in the tripped position.

[0012] In Fig 2 an operating diagram of a 3-polar switching device (10) with in parallel operated conductor rails in the middle phase L2 with an overcurrent release (200) and a latching mechanism (300), for instance a circuit breaker, is shown in the tripped position. In case of an overcurrent, the overcurrent release (200) triggers the latching mechanism (300), which operates the contacts (310, 320, 330, 340) in the tripped position. In this figure there is no neutral conductor, but the two middle phases - L2 and L3 in Fig 1 - are connected in parallel. Which such method it is possible to increase the nominal current of the switching device (10). The current conducted in phase 2 is divided in two part currents, I2.1 and I2.2, whereas the conducted current in L1 is I1 and in L3 is I3.

[0013] In Fig 3 the principle of a state-of-the-art thermo-mechanical tripping device (100) with in parallel operated conductor rails in phase 2 with no load and bi-metals (410, 420, 430, 440) in basic position at room temperature is shown. The bi-metals (410, 420, 430, 440) are not bent and extend into corresponding jogs (510, 520, 530, 540) of the first tripping bridge (500). The first tripping bridge (500) is in its neutral position as well, i.e. it does not reach the flip point (P) of the latching mechanism (300).

[0014] In Fig 4 the principle of a state-of-the-art thermo-mechanical tripping device (100) with in parallel operated conductor rails in phase 2 with symmetric load with nominal current is shown. All bi-metals (410, 420, 430, 440) are bent in the same extend and have moved the first tripping bridge (500) towards the latching mechanism (300) up to the flip point (P) without exceeding it.

[0015] In Fig 5 the principle of a state-of-the-art thermo-mechanical tripping device (100) with in parallel operated conductor rails in phase 2 with asymmetric load is shown. Due to causes like different bulk resistances of the conductor rails or different magnetic forces or the like, the current in L2.2 is higher than in L2.1. Therefore the corresponding second bi-metal 2.2 for phase 2 (430) is more bent than the other bi-metals (410, 420, 440). In case, the total current is the nominal current, L2.2 is overloaded and the corresponding second bi-metal 2.2 for phase 2 (430) presses the first tripping bridge (500) that much towards the latching mechanism (300) that the flip point (P) is exceeded. The latching mechanism (300) will trip and the switching device (10) breaks the circuit,

though there is no overcurrent in total.

[0016] In Fig 6 the principle of a thermo-mechanical tripping device (100) according to the present invention with in parallel operated conductor rails in phase 2 with no load and bi-metals (410, 420, 430, 440) in basic position at room temperature is shown. In addition to the first tripping bridge (500) there is a differential bridge (600) and a tripping lever (700) shown. The differential bridge (600) is assembled in parallel with the first tripping bridge (500) and has got jogs (610, 620, 630, 640) in such a way that all bi-metals (410, 420, 430, 440) extend in both the jogs (610, 620, 630, 640) in the differential bridge (600) as well as in the jogs (510, 520, 530, 540) in the first tripping bridge (500). But the jog (610) for bi-metal 1 of phase 1 (410) and the jog (640) for bi-metal 3 of phase 3 (440) are that large in the direction of the longitudinal axis of the differential bridge (600) that the corresponding bi-metals (410, 440) are not able to interact with the differential bridge (600). In case the tripping device 100 has not to conduct any load, both the first tripping bridge (500) and the differential bridge (600) are not moved. The tripping lever (700) is assembled movable to both, the first tripping bridge (500) and the differential bridge (600), by pivotable bearings (710, 720) in such an extent, that in case, the first tripping bridge (500) and the differential bridge (600) move in the same manner, it has got its maximum dimension in the direction of the longitudinal axis of the first tripping bridge (500) and the differential bridge (600).

[0017] In case, the in parallel operated part phases L2.1 and L2.2 of the switching device (10) according to the invention are charged with a symmetric load, the tripping bridge (500) and the differential bridge (600) will move in the same manner, like shown in Fig 7. All bi-metals (410, 420, 430, 440) are in mesh with the first tripping bridge (500). Due to the current load they bend in the same direction and in the same dimension and interact with the delimitations of the corresponding jogs (510, 520, 530, 540) of the first tripping bridge (500). Due to reasons like friction between the first tripping bridge (500) and the differential bridge (600), or the manner of assembly of the tripping lever (700) to both, the first tripping bridge (500) and the differential bridge (600), the differential bridge (600) moves in parallel with the first tripping bridge (500). Therefore the tripping lever (700) has got its maximum dimension in the direction of the longitudinal axis of the tripping bridge (500) and the differential bridge (600). In case, the tripping device (100) is charged with its nominal current, all bi-metals (410, 420, 430, 440) are bent in the same extend and have moved the first tripping bridge (500) towards the latching mechanism (300) up to the flip point (P) without exceeding it.

[0018] In Fig 8 the principle of a thermo-mechanical tripping device (100) according to the present invention with in parallel operated conductor rails in phase 2 with asymmetric load is shown. One bi-metal (here: bi-metal 2.2 for phase 2, (430)) bends more than the other bi-

metal of phase 2 (420). Even if the load does not exceed the nominal load, the more bent bi-metal (430) may push the first tripping bridge (500) that much towards the latching mechanism that it exceeds the flip point (P) if there was no differential bridge (600) and tripping lever (700). The second jog (620) in the differential bridge for bi-metal 2.1 and the third jog (630) in the differential bridge for bi-metal 2.2 are dimensioned in direction of the longitudinal axis of the differential bridge (600) in that way that the regarding second and third bi-metals for phase 2 (620, 630) are able to interact with the delimitations of this jogs (620, 630). Here the first bi-metal 2.1 for the first part of phase 2 (420), which is not bent that much as the second bi-metal 2.2 for the second part of phase 2 (430), supports the differential bridge (600), so that the differential bridge (600) cannot move in parallel with the first tripping bridge (500). Therefore the tripping lever (700) turns in its rotatable bearings in the first tripping bridge (500) and the differential bridge (600) in that way that it does not reach its maximum dimension in the direction of the longitudinal axis of the first tripping bridge (500) and the differential bridge (600). The flip point (P) of the latching mechanism (300) is not exceeded and the switching device (10) does not break the circuit.

[0019] For reasons of better explanation of the invention only the case is described where only 2 conduction rails are operated in parallel. Of course the invention will work in the same way in case there are more than 2 conduction rails are connected in parallel. Also the invention can be used in AC as well as in DC switching devices.

List of reference numerals

[0020]

10 switching device

100 tripping device

200 overcurrent release

300 latching mechanism

310 contact for phase 1 (L1)

320 contact for phase 2 (L2)

330 contact for phase 3 (L3)

340 contact for neutral conductor (N)

410 bi-metal 1 for phase 1 (L1)

420 first bi-metal 2.1 for first part of phase 2 (L2.1)

430 second bi-metal 2.2 for phase 2 (L2.1)

440 bi-metal 3 for phase 3 (L3)

500 first tripping bridge

5 510 first jog in the tripping bridge for bi-metal 1

520 second jog in the tripping bridge for bi-metal 2.1

10 530 third jog in the tripping bridge for bi-metal 2.2

540 forth jog in the tripping bridge for bi-metal 3

600 second tripping bridge (differential bridge)

15 610 first jog in the differential bridge for bi-metal 1

620 second jog in the differential bridge for bi-metal 2.1

20 630 third jog in the differential bridge for bi-metal 2.2

640 forth jog in the differential bridge for bi-metal 3

700 tripping lever

25 710 bearing of the tripping lever in the first tripping bridge

30 720 bearing of the tripping lever in the second tripping bridge

800 tripping bridge system

35 L1 phase 1

L2 phase 2

L2.1 first part phase of phase 2 in case, two conductor rails of phase 2 are operated in parallel

40

L2.2 second part phase of phase 2 in case, two conductor rails of phase 2 are operated in parallel

L3 phase 3

45

N neutral conductor

I1 current of phase 1

50

I2 current of phase 2

I2.1 part current 1 of phase 2 in the first connected in parallel conductor rails in case, two conductor rails of phase 2 are operated in parallel

55

Claims

1. Electric switching device (10) with at least two conductor rails, which are operated in parallel, a bi-metal tripping device (100) for each conductor rail, a first tripping bridge (500) with jogs (510, 520, 530, 540) for the bi-metals (410, 420, 430, 440) and a releasing jack system to be triggered by the tripping device (100) via the first tripping bridge (500),
characterized in that,
 additional to the first tripping bridge (500) a system, comprising a second bridge (600) and a tripping lever (700) is installed, which is able to detect different bending distances of the at least two bi-metal tripping devices (100) of the parallel operated conductor rails and to control the releasing jack system via the tripping lever (700) in such a way, that the forward motion of the more bended bi-metal tripping device (100) will be compensated.
2. The electric switching device (10) according to Claim 1,
characterized in that,
 the second tripping bridge (600) features jogs (610, 620, 630, 640) for the bi-metals (410, 420, 430, 440).
3. The electric switching device (10) according to Claim 2,
characterized in that,
 the first tripping bridge (500) and the second tripping bridge (600) are arranged **in that** way that the bi-metals (410, 420, 430, 440) are able to extend in both, the jogs (510, 520, 530, 540) of the first tripping bridge (500) and the jogs (610, 620, 630, 640) of the second tripping bridge (600).
4. The electric switching device (10) according to Claim 3,
characterized in that,
 the jogs (610, 620, 630, 640) for the bi-metals (410, 420, 430, 440) in the second tripping bridge (600) are dimensioned in the direction of the longitudinal axis of the second tripping bridge (600) **in that** way that the bi-metal 1 for phase 1 (410) and the bi-metal 3 for phase 3 (440) are not able to interact with the second tripping bridge (600).
5. The electric switching device (10) according to any of the proceeding claims,
characterized in that,
 the tripping lever (700) is assembled movable to both, the first tripping bridge (500) and the second tripping bridge (600), in such an extent, that in case, the first tripping bridge (500) and the second tripping bridge (600) move in the same manner, it has got its maximum dimension in the direction of the longitudinal axis of the first tripping bridge (500) and the differential bridge (600).
6. The electric switching device (10) according to claim 5,
characterized in that,
 the tripping lever (700) is supported in bearings (710, 720) in both, the first tripping bridge (500) and the second tripping bridge (600), in such an extent, that it is able to rotate around an virtual axis in general perpendicular to the longitudinal dimension of the first or second tripping bridge (500, 600).
7. Method for compensating different bending distances of a bi-metal tripping devices (100) containing at least two different thermo bi-metals (420, 430) of in parallel operated conductor rails,
characterized in that,
 a tripping bridge system (800) is used, which operates in connection with a lever (700), which trips a releasing jack system, wherein the tripping bridge system (800) contains a first tripping bridge (500) and a second tripping bridge (600) and the second tripping bridge (600) is able to rest on the retarded bi-metal (420, 430) and to offset in relation to the first tripping bridge (500), and the lever (700) is able to deviate in such a way that it releases the releasing jack system only if all bi-metals (420, 430) of the parallel operated conductor rails are bent in a sufficient dimension.

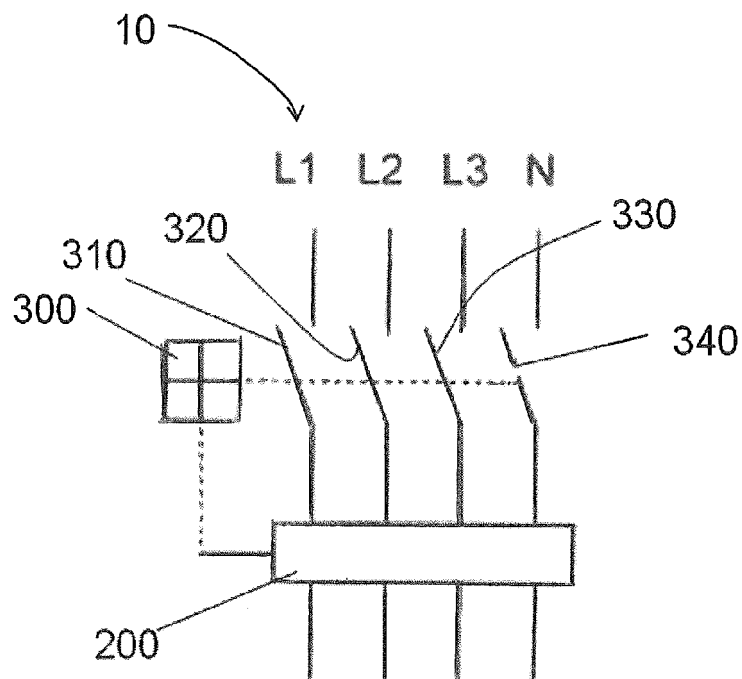


FIG 1

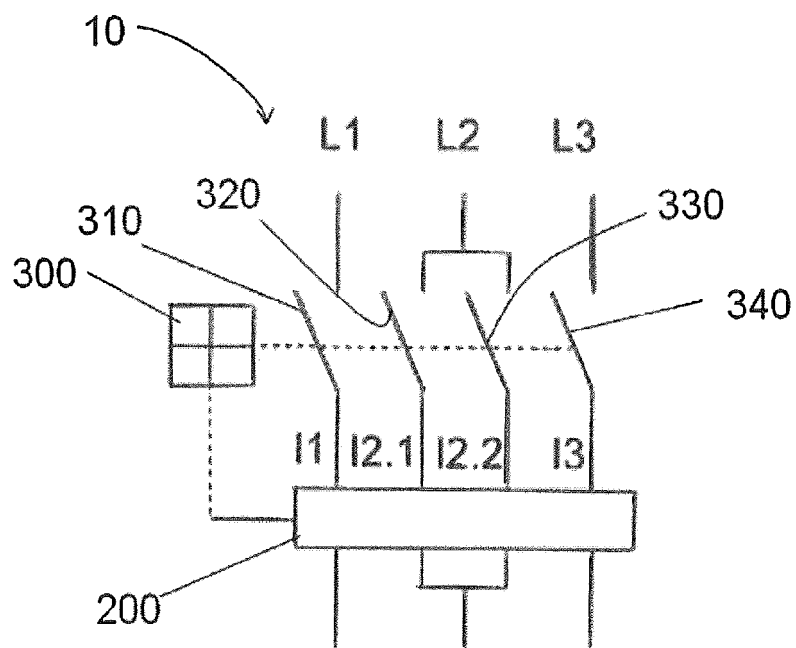


FIG 2

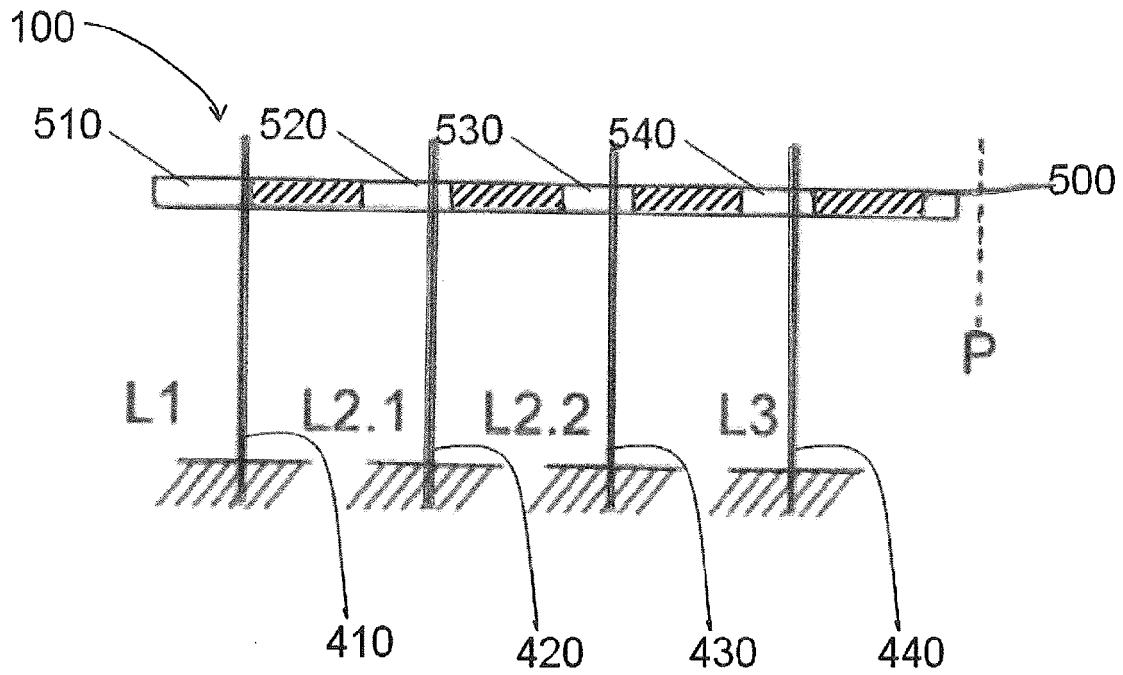


FIG 3

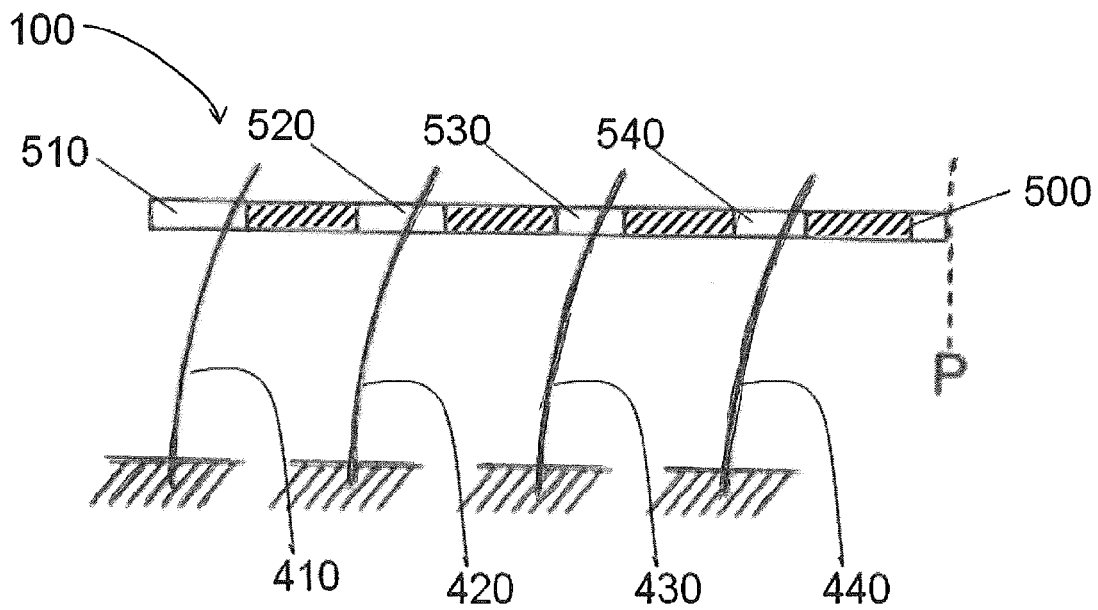


FIG 4

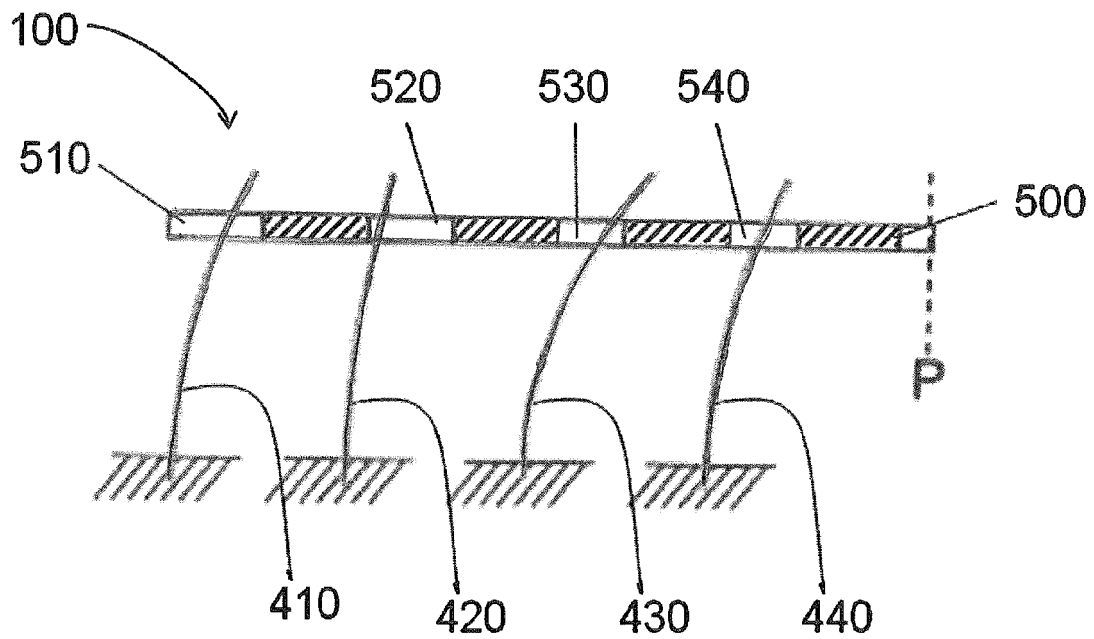


FIG 5

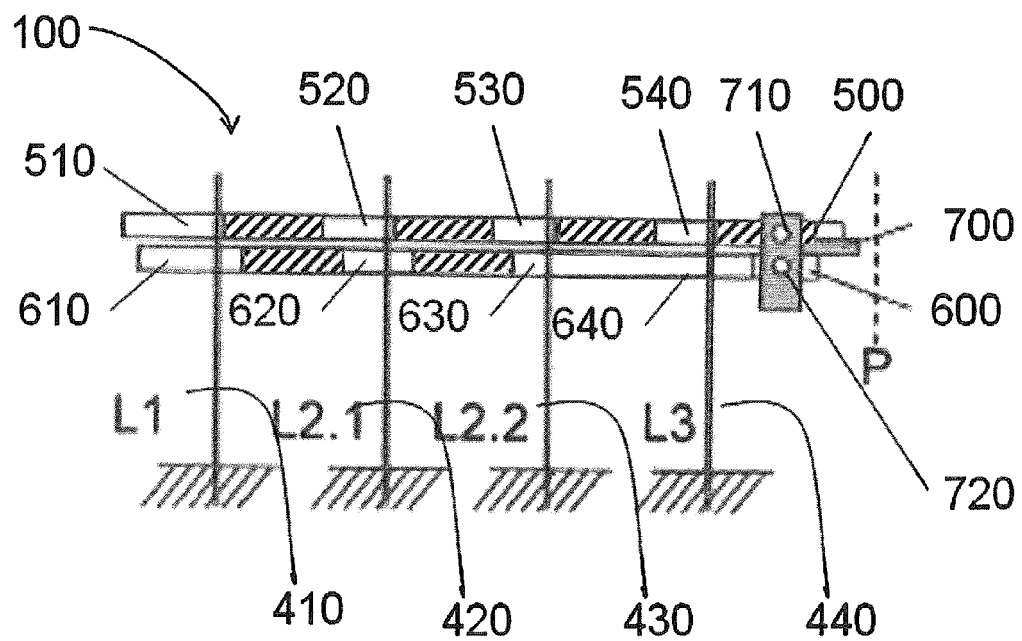


FIG 6

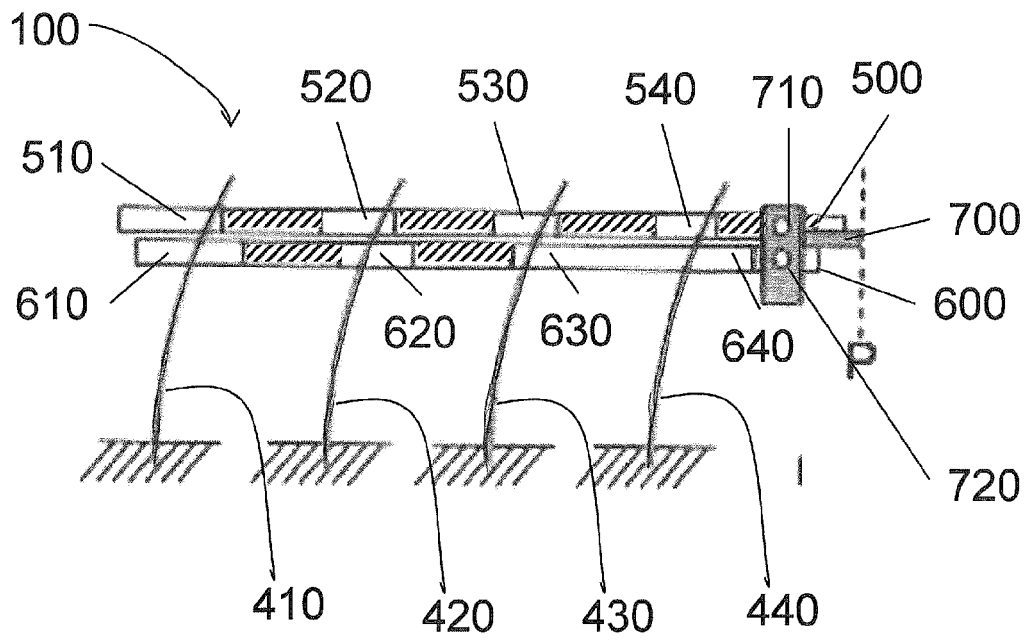


FIG 7

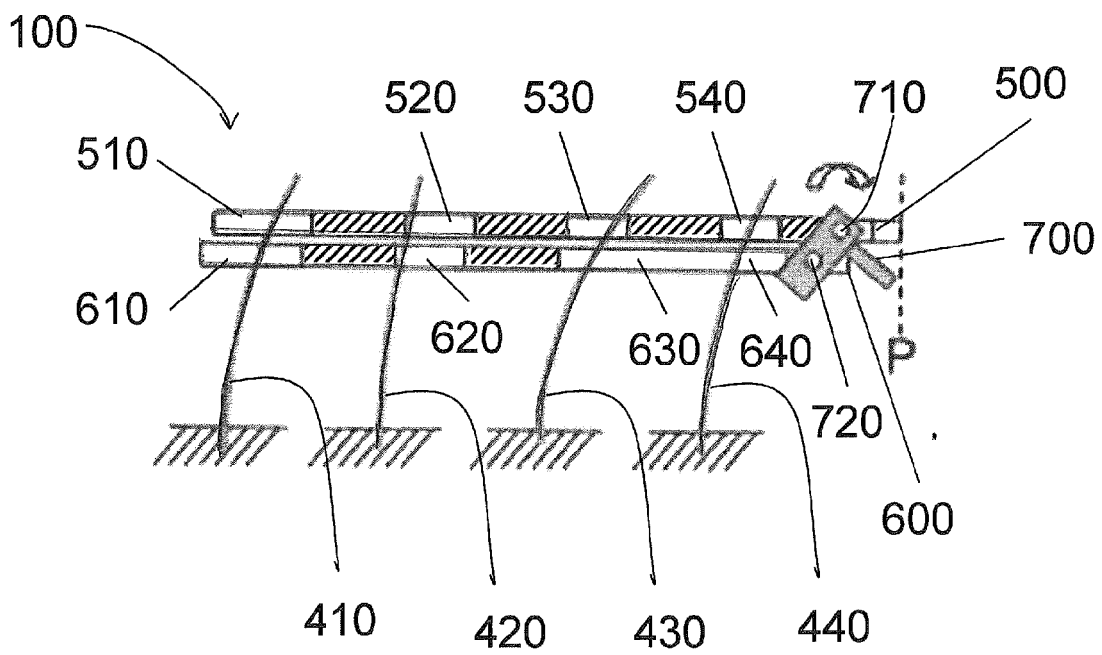


FIG 8



EUROPEAN SEARCH REPORT

Application Number
EP 10 17 0526

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	DE 11 97 169 B (SELCO ELETTRCO COSTRUZIONI S P) 22 July 1965 (1965-07-22) * claim 1; figure 4 *	1-3,7	INV. H01H83/22
A	AT 317 343 B (ELEKTROWERKSTAETTEN BENEDIKT &) 26 August 1974 (1974-08-26) * figures 1,3 *	1,7	
A	GB 1 243 151 A (CIE ELECTROMECHANIQUE [FR]) 18 August 1971 (1971-08-18) * page 3, line 14 - line 115 *	1,7	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			H01H
Place of search		Date of completion of the search	Examiner
Munich		9 December 2010	Socher, Günther
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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 10 17 0526

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09-12-2010

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
DE 1197169	B	22-07-1965	NONE	
AT 317343	B	26-08-1974	NONE	
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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