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(54) **Connecting device**

(57) A connecting device suitable for connecting a movable conducting terminal of a switching device to a stationary conducting terminal of a switchgear apparatus, comprises:
- a support body suitable for being fastened to the movable conducting terminal;
- a plier assembly projecting from the support body parallely to a first axis and delimiting a coupling cavity for receiving the stationary conducting element, the coupling cavity extending along the first axis and along a second axis orthogonal to the first axis,
- insertion-contact-means having leading-surfaces configured for promoting a resilient deformation of the plier assembly upon a contacting-pushing-action of the stationary conducting terminal for enabling insertion of the latter into the coupling cavity,
the leading-surfaces comprising zones sloping along planes which are parallel to the second axis and tilted with respect to the first axis, and further zones sloping along further planes which are tilted with respect to the second axis, so as to enable an insertion of the stationary conducting element into the coupling cavity along an insertion-direction which can be parallel or transversal to the first axis.

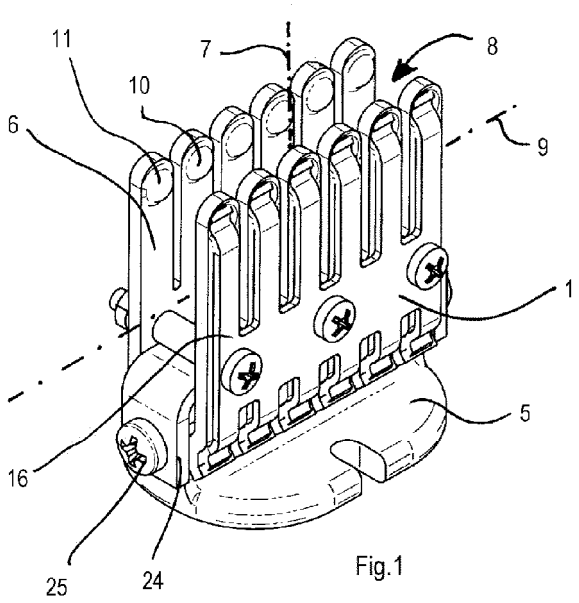

Fig.1

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Description

[0001] The present disclosure relates to a connecting device suitable for connecting a movable conducting terminal of a switching device, in particular of a circuit-breaker, to a stationary conducting terminal of a switchgear apparatus.

[0002] A pliers-contact-device is known for electrically connecting each movable terminal of a circuit breaker to a respective stationary terminal provided into a medium voltage switchgear. The stationary terminal comprises a busbar which extends with a rectangular cross-section. The pliers-contact-device comprises an electrically conducting support body having a fixing surface intended to be attached to the movable terminal, and, at an opposite side with respect to the fixing surface, a parallelepiped-supporting-portion extending longitudinally along a longitudinal axis parallel to such a fixing surface. From the two opposite largest sides of the parallelepiped-shaped-portion two respective conducting finger-clusters protrude which extend parallel to a second, approximately central axis which is orthogonal to the above mentioned fixing surface and to the above mentioned longitudinal axis.

[0003] The two finger-clusters are mutually spaced so as to define therebetween a coupling cavity for receiving, and coupling with, an end portion of the stationary terminal.

[0004] Each finger-cluster comprises a plurality of finger portions adjacent to one other, each extending with a respective finger-axis parallel to the above-mentioned central axis. Each finger portion is resiliently movable in a plane parallel to the central axis and orthogonal to the above mentioned longitudinal axis. At an end of the finger portion, opposite to the support body, there is provided an enlarged part protruding into the coupling cavity and shaped for ensuring a contact between the-pliers-contact device and the stationary terminal in an in-service-insertion position of the circuit breaker in the switchgear.

[0005] Such enlarged part has a tip which is outwards tapered along the respective finger-axis. In other words, each tip comprises a ramp-surface lying along a plane which is tilted relative to the central axis and arranged parallel to the longitudinal axis of the parallelepiped-supporting-portion.

[0006] In order to establish a coupling of each movable terminal with the respective stationary terminal, the circuit-breaker must be necessarily moved along an in-service-insertion direction which is parallel to the above mentioned central axis. In other words, a relative approaching movement of the busbar and the respective pliers-contact-device has to be accomplished necessarily in a direction along the central axis of the latter, so that the busbar, by acting on the tapered tips, can resiliently spread the finger portions thus entering the coupling cavity. Therefore, the known pliers-contact-device mounted on a circuit-breaker imposes on the latter a prefixed and not adjustable direction along which it must be moved for achieving an in-service-position. For example, if the known pliers-contact-device is assembled on the circuit breaker with the central axis in a horizontal position, the circuit breaker must be mounted within the switchgear necessarily in such a way that it results horizontally slidable between an extraction position and the in-service-insertion position. Therefore, only one possible installing configuration of the circuit-breaker is possible inside the switchgear which depends from the spatial configuration of the stationary terminals and/or of the movable terminals.

[0007] Therefore such a pliers-contact-device, although performing in a quite satisfying way, presents assembling limitations in particular geometrical configurations of the circuit breaker and/or of the switchgear. Therefore, there is still room for further improvements. In particular, it would be desirable to provide a highly versatile technical solution which makes possible to freely choose amongst more possible installing configurations for a given circuit breaker, or which enables to adapt a given circuit breaker to one or more particular arrangements of the stationary terminals in the switchgear. This is achieved by a connecting device as defined in the appended claims and described hereinafter in details. According to the disclosure, there is provided a connecting device suitable for connecting a movable conducting terminal of a switching device to a stationary conducting terminal of a switchgear apparatus, comprising:

- a support body suitable for being fastened to said movable conducting terminal;
- a plier assembly projecting from said support body parallel to a first axis and delimiting a coupling cavity for receiving said stationary conducting element, said coupling cavity extending along said first axis and along a second axis orthogonal to said first axis,
- insertion-contact-means having leading-surfaces configured for promoting a resilient deformation of said plier assembly upon a contacting-pushing-action of said stationary conducting terminal for enabling insertion of the latter into said coupling cavity, **characterised in that** said leading-surfaces comprises zones sloping along planes which are parallel to said second axis and tilted with respect to said first axis, and further zones sloping along further planes which are tilted with respect to said second axis, so as to enable an insertion of said stationary conducting element into said coupling cavity along an insertion-direction which can be parallel or transversal to said first axis.

[0008] Owing to the disclosure, a connecting device is provided which fits several different configurations of the circuit breaker and/or of the switchgear, thus drastically simplifying the overall production, assembly, and storage procedures of the circuit breakers and of the switchgears. The present disclosure encompasses also a switching device, in particular a circuit breaker comprising one or

more connecting devices as defined in the related appended claims and described herein, and also an electric switchgear, equivalently called with the term panel or cabinet or switchboard, including such a circuit breaker. Characteristics and advantages of the present disclosure will result from the description and from claims.

[0009] The present disclosure can be better understood and implemented with reference to the attached drawings that illustrate an embodiment thereof by way of a non-limiting example, in which:

Figure 1 is a perspective view of a connecting device according to the present disclosure;
Figure 2 is a front view of the connecting device shown in Figure 1,
Figure 3 is a lateral view of the connecting device shown in Figure 2;
Figure 4 is a top view of the connecting device shown in Figure 3;
Figure 5 is an exploded view of the connecting device;
Figure 6 and 7 shows two different possible operative configurations of the connecting device according to the present disclosure;
Figure 8 show three connecting devices of the present disclosure which are mounted on a movable circuit breaker and which operate according to the operative configuration schematically shown in Figure 7.

[0010] With reference to the attached Figures, a connecting device 1 is shown, which is particularly suitable to be used in the Medium Voltage field, where, for the purposes of the present application, the term medium voltage refers to applications in the range from 1kV up to some tens of kV, e.g. 52 kV. The connecting device 1 is suitable for being fixed to a conducting terminal 2 of a switching device, such as a circuit breaker 3, in particular a draw-out circuit breaker 3 housed in a switchgear apparatus. Such a circuit breaker 3, in particular, is of the type which is supported by a trolley that can move from an extraction position with respect to a switchgear, in which the movable conducting terminal is disengaged from the stationary conducting terminal, to an insertion position in the switchgear, in which the movable conducting terminal engages with the stationary conducting terminal.

[0011] In the following exemplary and not limitative description, reference is made to a connecting device 1 which is fixed to a movable conducting terminal 2 mounted on the circuit breaker 3, and which engages with a stationary conducting terminal 4 of a busbar of the switchgear, where the stationary conducting terminal 4 generally has a rectangular cross-section. However, in an alternative further possible application, the connecting device 1 can also be assembled on a stationary conducting terminal of the switchgear in order to receive and engage with a movable terminal.

[0012] The connecting device 1 comprises a support body 5 suitable for being fastened to the movable conducting terminal 2, and a plier assembly 6 which projects from such a support body 5 parallel to a first axis 7.

[0013] In particular, the support body 5, having a plate-shape, comprises a fixing surface 12 intended to be stationarily applied to the movable conducting terminal 2. At an opposite side with respect to the fixing surface 12, a parallelepiped-supporting-portion 13 (Figure 5) is obtained on the support body 5, longitudinally extending in a direction transversal, in particular orthogonal to the first axis 7.

[0014] The plier assembly comprises a pair of mutually spaced plier units 6 which extend from respective opposite sides, in particular the largest sides, of the parallelepiped-shaped-portion 13.

[0015] The two plier units 6 extend parallel to one other and parallel to the first axis 7, so as to delimit a coupling cavity 8 suitable for internally receiving a portion of the stationary conducting element 4 in order to establish an electrical connection. The coupling cavity 8 extends with a first dimension along the first axis 7 and with a second dimension along a second axis 9 orthogonal to the first axis 7 (shown in Figures 1 to 4).

[0016] Each plier unit 6 comprises a contacts-cluster-element 14, of a copper material, which includes a plurality of mutually adjacent and parallel contact-finger-portions 15 each extending with a finger-axis parallel to the above-mentioned first axis 7 and being suitable for going into contact with the stationary conducting terminal 4. The plier units 6 further comprise insertion-contact-means 10, having leading-surfaces 11 configured for promoting a resilient deformation of the plier units 6 upon a contacting-pushing-action of the stationary conducting terminal 4. Such a resilient deformation enables the stationary conducting terminal 4 to be inserted into the coupling cavity 8 of the connecting device 1, as will be described in detail in the following. The leading-surfaces 11 comprises zones 20 sloping along planes 21 which are parallel to the second axis 9 and tilted with respect to the first axis 7 (shown in Figure 3), and further zones 22 sloping along further planes 23 which are tilted with respect to the second axis 9, (shown in Figure 4) so as to enable an insertion of the stationary conducting element 4 into the coupling cavity 8 along an insertion-direction which can be parallel or transversal to the first axis 7.

[0017] In the embodiment here described, the insertion-contact-means comprise a plurality of bulge-portions 10, each bulge-portion 10 being provided on an end of a respective contact-finger-portion 15 and protruding into the coupling cavity 8. Each bulge-portion 10 has a convex curved surface, in particular is configured as a dome-shaped-portion. The bulge-portion 10, more particularly, is configured with a hemispherical shape, or as a part of a spherical surface. However, also other equivalent shapes can be envisaged for the insertion-contact-means 10 in order to enable a relative engagement movement of the stationary-conducting-terminal 4 with the

connecting device 1 along an insertion direction parallel to the first axis 7 or transversal to the first axis 7, in particular orthogonal to the first axis 7 (i.e. parallel to the second axis 9).

[0018] Each plier unit 6 includes a spring-comb-element 16 configured for elastically urging the contacts-cluster-element 14 against a contact-surface 30 of the stationary conducting terminal 4. The spring-comb-elements 16 are made of a spring steel material, and is designed with suitable dimension and stiffness parameters in such a way to also ensure a good contact for allowing transfer of electrical current between the movable and stationary conductors.

[0019] Each spring-comb-element 16 includes a plurality of prong-portions 17 each coupled with a respective contact-finger-portion 15. Each prong-portion 17 comprises a bent-end 18 shaped for exerting an elastic-pushing action inside a respective recess 19 obtained on the respective contact-finger-portion 15 at an opposite side with respect to the associated bulge-portion 10.

[0020] Each contacts-cluster-element 14 is pressed against the parallelepid-shaped portion 13 of the support body 5 by the respective spring-comb-element 16. There are provided fastening threading elements 31 and spacing elements 32 which mutually connect the two plier units 6 and keep the latter spaced and pressed against the parallelepid-shaped portion 13.

[0021] The contacts-cluster-elements 15 comprise a curved edge-portions 33 having convex surfaces for resting against resting-surfaces 34 of the parallelepid-shaped portion 13.

[0022] A C-shaped-bracket-element 24 is provided for securing the pliers units 6 to the support body 5. The C-shaped-bracket-element 24 is coupled to the parallelepid-shaped portion 13 through a screw element 25 and a spacer washer 26, which enable a pivotal movement around a rotation axis 35, shown in Figure 5, which is parallel to the above mentioned second axis 9. The curved edge-portions 33 enable a rotation of the pliers units 6 on a plane orthogonal to such a rotation axis 35.

[0023] Owing to the structural configuration of the plier assembly 6, more precisely owing to the bulge-portions 10, in particular having a dome-shape, the connecting device 1 is highly versatile and makes possible to freely choose amongst more possible installing configurations for a given circuit breaker. For example, such a circuit breaker can be mounted for sliding along a horizontal direction 40 whatever the spatial orientation of the movable conducting terminals 2 is. For example, the circuit breaker 3 can slide along the horizontal direction 40 whether the stationary conducting terminal 4 and the movable conducting terminal 2 are horizontally arranged or vertically arranged, as shown in Figure 6 and 7 respectively.

[0024] The operative configuration of Figure 7 is also schematically shown in Figure 8 where three connecting devices 1 for the three poles of a switchgear are visible.

[0025] In the operative configuration of Figure 6, the relative approaching movement between the circuit breaker 3 and the stationary conducting terminals 4 occurs along the horizontal direction 40 which is parallel to the first axis 7, whereas in the operative configuration of Figure 7, the horizontal direction 40 is orthogonal to the first axis 7 of the connecting device 1. In both cases, the bulge-portions 10, upon a pushing contact action received from the stationary conducting terminal 4, enable a resilient spreading movement of the finger portions 15, thus allowing the stationary conducting terminal 4 to enter the coupling cavity 8 of the connecting device 1. In other words, the stationary conducting terminal 4 is able to enter the coupling cavity 8 whatever its angular position with respect to the connecting device 1 is.

[0026] Therefore, owing to the connecting device 1 according to this disclosure, it is possible to adapt a given circuit breaker to a plurality of possible mounting configurations within a switchgear apparatus, differently from the pliers device of the prior art which allowed a connection to a busbar in only one direction.

[0027] A general simplification of the production, assembly, and storage procedures of the circuit breakers and of the switchgears is obtained, with respect to the prior art where for each circuit breaker typology several dedicated components are required to allow a correct insertion of the circuit breaker in the switchgear. On the contrary, the present connecting device 1, advantageously, is a common device usable for many different configurations of circuit breakers/switchgears.

[0028] The connecting device 1 is susceptible of modifications or variations all within the scope of the inventive concept as defined by the appended claims; any details may be replaced with technically equivalent elements.

[0029] One or more of the elements above described may be differently shaped and/or positioned, can be realized in one or more pieces and/or can be differently coupled or positioned, etcetera.

[0030] The materials, so long as they are compatible with the specific use, as well as the individual components, may be any according to the requirements and the state of the art.

Claims

1. Connecting device suitable for connecting a movable conducting terminal (2) of a switching device (3) to a stationary conducting terminal (4) of a switchgear apparatus, comprising:

   - a support body (5, 13) suitable for being fastened to said movable conducting terminal (2);
   - a plier assembly (6) projecting from said support body (5) parallely to a first axis (7) and delimiting a coupling cavity (8) for receiving said stationary conducting element (4), said coupling cavity (8) extending along said first axis (7) and along a second axis (9) orthogonal to said first

axis (7),
- insertion-contact-means (10) having leading-surfaces (11) configured for promoting a resilient deformation of said plier assembly (6) upon a contacting-pushing-action of said stationary conducting terminal (4) for enabling insertion of the latter into said coupling cavity (8),

characterised in that said leading-surfaces (11) comprises zones (20) sloping along planes (21) which are parallel to said second axis (9) and tilted with respect to said first axis (7), and further zones (22) sloping along further planes (23) which are tilted with respect to said second axis (9), so as to enable an insertion of said stationary conducting element (4) into said coupling cavity (8) along an insertion-direction (40) which can be parallel or transversal to said first axis (7).

2. Connecting device according to claim 1, wherein said insertion-contact-means comprise bulge-means (10) projecting from said plier assembly (6) into said coupling cavity (8), said bulge-means (10) enabling an insertion of said stationary conducting terminal (4) along an insertion-direction (40) parallel to said first axis (7) or parallel to said second axis (9).

3. Connecting device according to claim 2, wherein said bulge-means (10) have a dome-shape.

4. Connecting device according to anyone of the preceding claims, wherein said leading-surfaces (11) are configured with a hemispherical shape.

5. Connecting device according to any one of the preceding claims, wherein said plier assembly comprises a pair of mutually spaced plier units (6) which extend parallel to said first axis (7) and delimit said coupling cavity (8), each plier unit (6) comprising a contacts-cluster-element (14) suitable for going into contact with the stationary conducting terminal (4), and a spring-comb-element (16) configured for elastically urging said contacts-cluster-element (14) against a contact-surface (30) of said stationary conducting terminal (4).

6. Connecting device according to claim 5, wherein each contacts-cluster-element (14) comprises a plurality of adjacent and mutually parallel contact-finger-portions (15), and wherein said insertion-contact-means comprises a plurality of bulge-portions (10) each provided on a respective contact-finger-portion (15) and having a convex curved shape.

7. Connecting device according to claim 6, wherein each spring-comb-element (16) comprises a plurality of prong-portions (17) each coupled with a respective contact-finger-portion (15), each prong-portion (17) having a bent-end (18) shaped for exerting an elastic-pushing action inside a respective recess (19) obtained on the respective contact-finger-portion (15), said recess (19) being placed at an opposite side with respect to the associated bulge-portion (10).

8. Connecting device according to any one of claims 5 to 7 said contacts-cluster-elements (14) are connected at respective opposite sides of a parallelepid-shaped portion (13) provided on said support body (5), each contacts-cluster-element (14) comprising a curved edge-portion (33) having a convex surface for resting against a respective resting-surface (30) of said parallelepid-shaped portion (13).

9. Connecting device according to claim 8, further comprising spacing means (32) interposed between said two plier units (6) and fastening means (31, 25) for keeping said plier units (6) coupled to said support body (5).

10. Connecting device according to claim 9, wherein said fastening means comprise threading elements (31) and a C-shaped-bracket-element (24) for securing said pliers units (6) to said support body (5), said C-shaped-bracket-element (24) being pivotally movable around a rotation axis (35) which is parallel to said second axis (9), said curved edge-portions (33) enabling a rotation of the pliers units (6) on a plane orthogonal to said rotation axis (35).

11. Connecting device according to any one of claims 5 to 10, wherein said contacts-cluster-elements (14) are made of copper material and said spring-comb-elements (16) are made of a spring steel material.

12. Switching device comprising one or more connecting device (1) according to any one of the preceding claims.

13. Switchgear apparatus comprising a switching device (3) according to claim 12.

14. Switchgear apparatus according to claim 13, wherein said switching device comprises a circuit breaker (3).

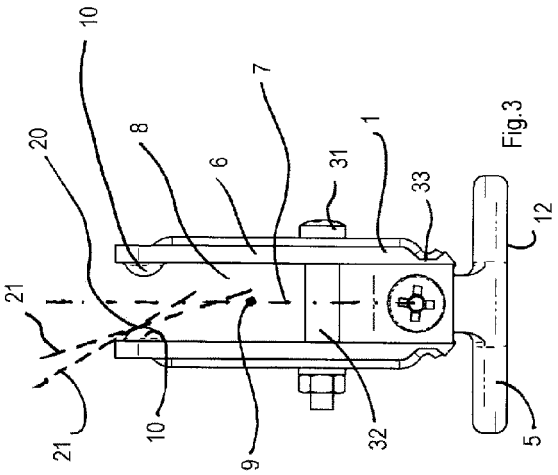

Fig.3

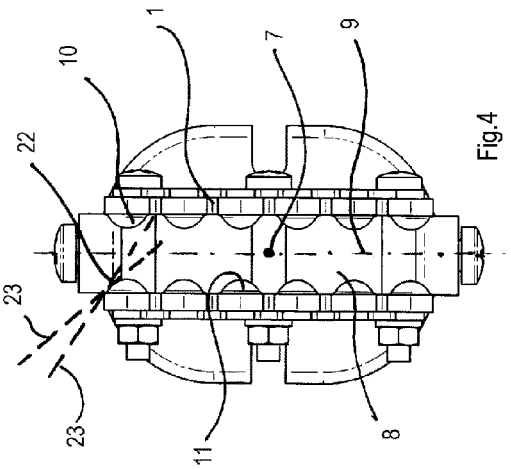

Fig.4

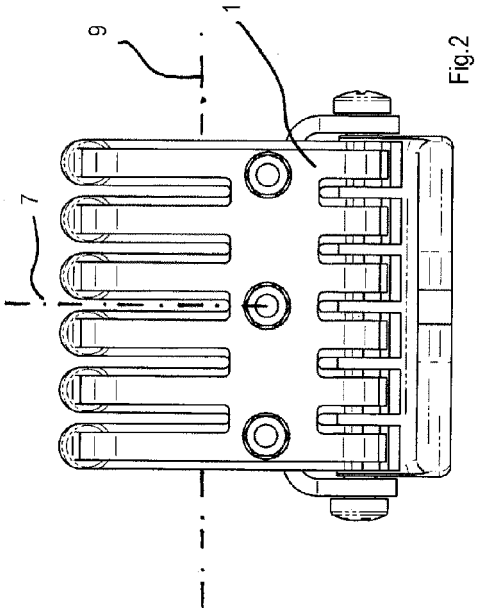

Fig.2

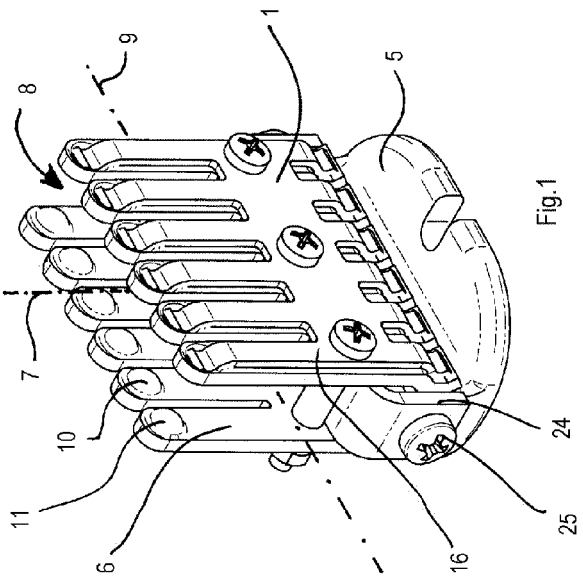

Fig.1

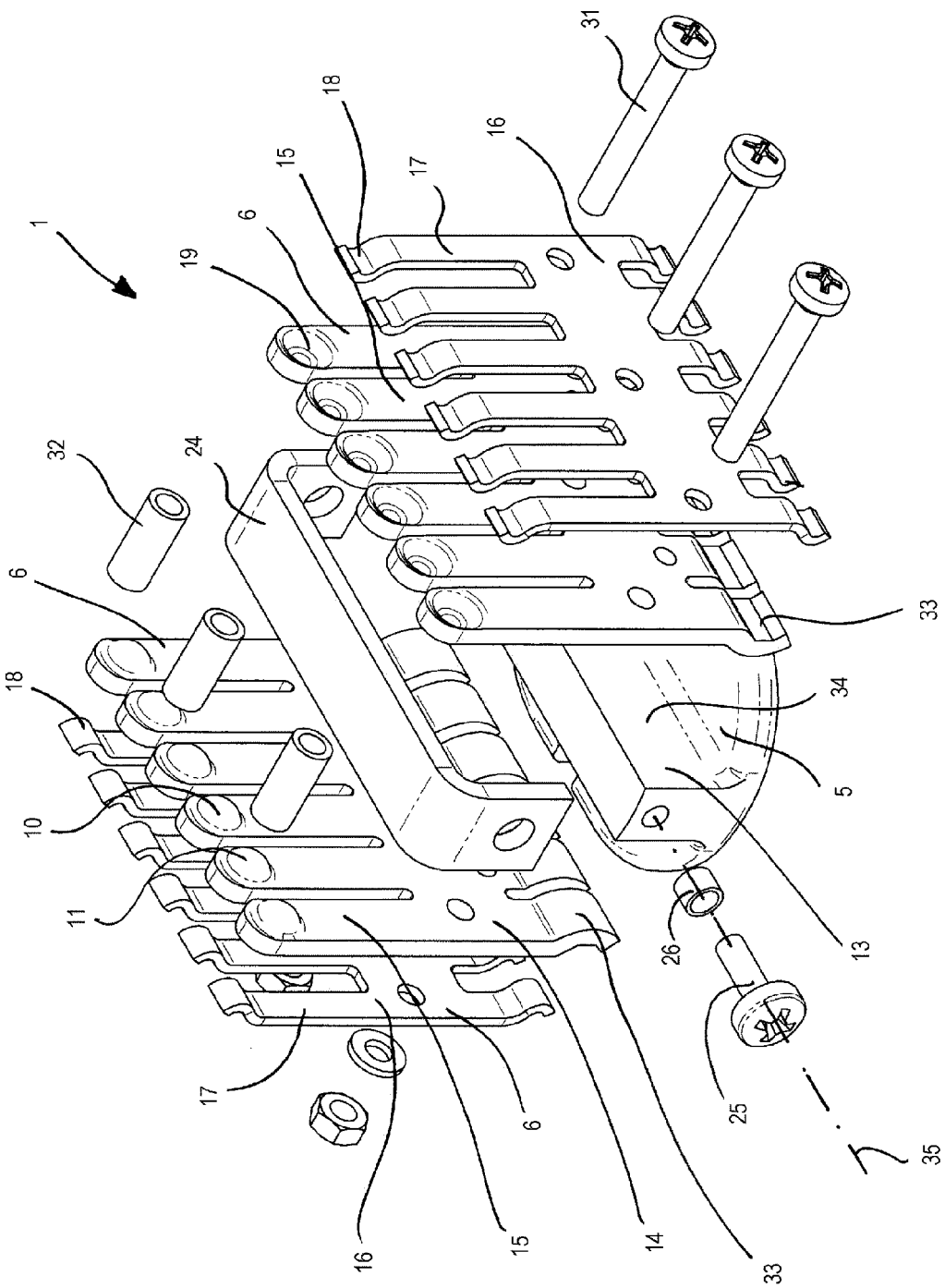

Fig.5

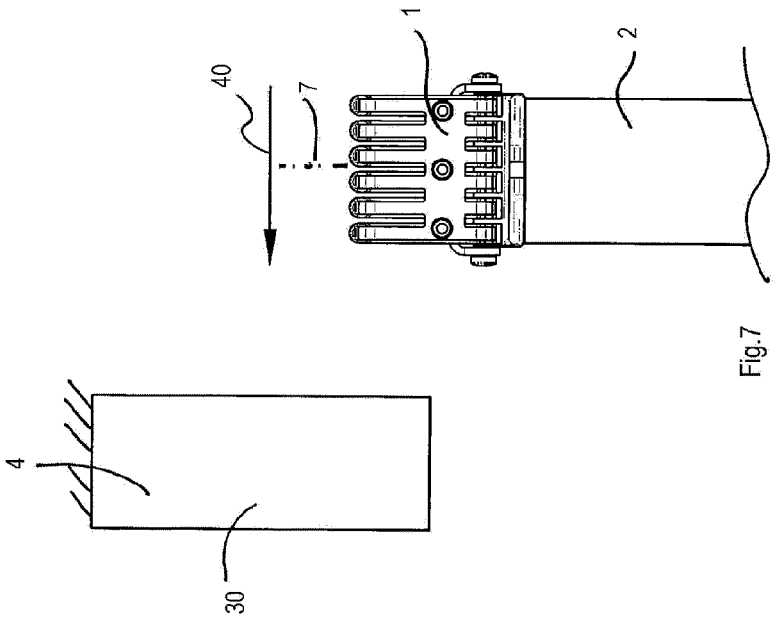

Fig.7

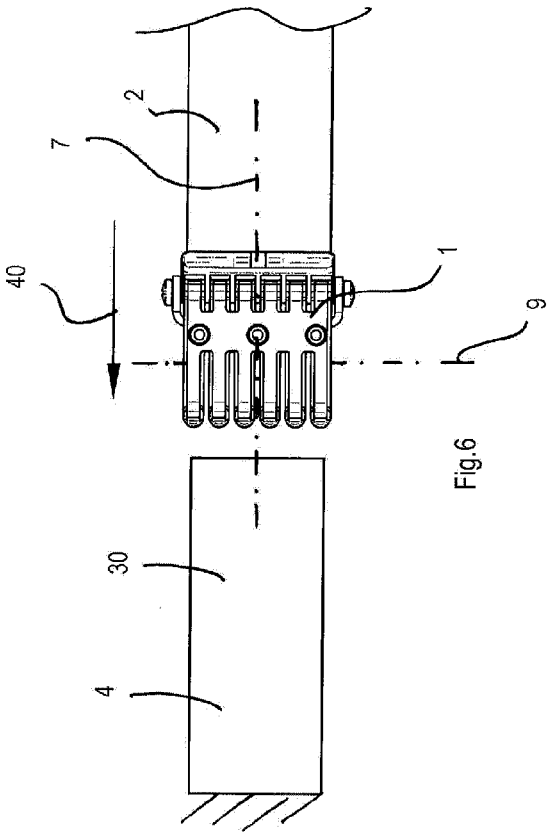

Fig.6

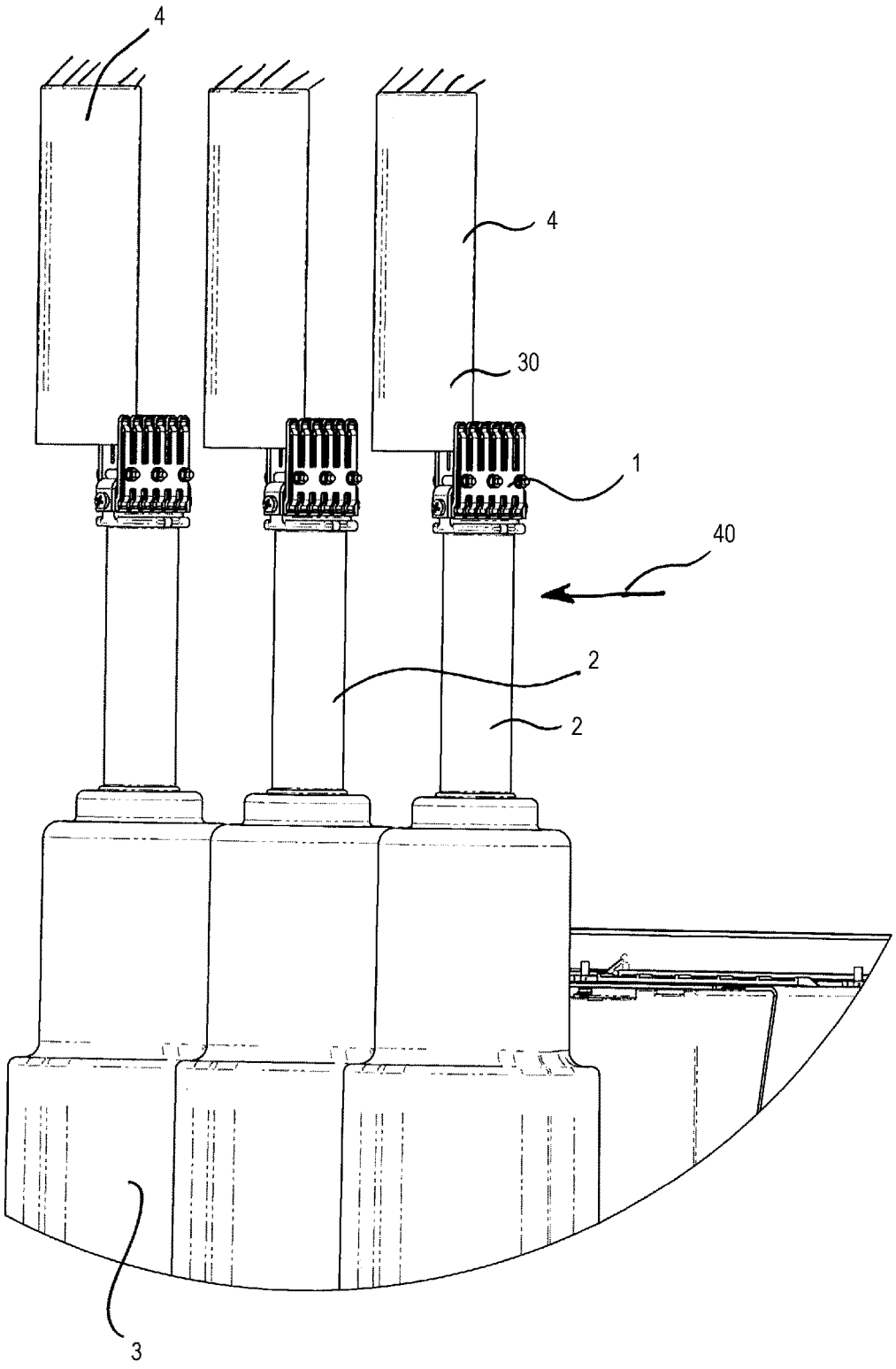

Fig.8

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EUROPEAN SEARCH REPORT

Application Number
EP 12 17 7501

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 Y	DE 16 65 986 A1 (SIEMENS AG) 15 April 1971 (1971-04-15) * page 5, paragraph 1 - page 8, paragraph 2; claim 4; figures 1-4 *	1,2,5,8, 11-14 3,4,6,7, 9,10	INV. H01H1/42 H01H31/00
X Y	DD 133 875 A1 (WOLDMANN GERD; BOETZER GUENTER; WINTER ARNOLD) 24 January 1979 (1979-01-24) * page 4, paragraph 2 - page 5, paragraph 1; figures 1-4 *	1-4, 12-14 5-11	
Y	DE 695 10 154 T2 (GEC ALSTHOM T & D SA [FR]) 16 December 1999 (1999-12-16) * page 8, paragraph 4 - page 14, paragraph 3; figures 1-8 *	3,4,6,7	
Y	US 8 197 289 B1 (FABER TIMOTHY R [US] ET AL) 12 June 2012 (2012-06-12) * column 4, line 58 - column 12, line 56; figures 2-13 *	5-11	

TECHNICAL FIELDS SEARCHED (IPC)
H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 December 2012	Pavlov, Valeri

CATEGORY OF CITED DOCUMENTS

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17-12-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 1665986 A1	15-04-1971	NONE	
DD 133875 A1	24-01-1979	NONE	
DE 69510154 T2	16-12-1999	AT 181175 T	15-06-1999
		BR 9504415 A	27-05-1997
		CN 1128415 A	07-08-1996
		DE 69510154 D1	15-07-1999
		DE 69510154 T2	16-12-1999
		EP 0708462 A1	24-04-1996
		ES 2132563 T3	16-08-1999
		FR 2725838 A1	19-04-1996
		NO 954107 A	18-04-1996
US 8197289 B1	12-06-2012	US 8197289 B1	12-06-2012
		WO 2012102866 A1	02-08-2012

EPO FORM P0459

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