



(11) **EP 2 362 406 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
31.08.2011 Bulletin 2011/35

(51) Int Cl.:
H01H 31/36 ^(2006.01) **H01H 3/42** ^(2006.01)

(21) Application number: **10175102.2**

(22) Date of filing: **02.09.2010**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
BA ME RS

(30) Priority: **23.02.2010 IT PD20100050**

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(54) **Semi-pantograph disconnecter**

(57) A semi-pantograph disconnecter, comprising
- a base (11), which supports a motor kinematic system (12),
- an arm (13), which has a shoe (14) for gripping a dropper (15) and is hinged to the base (11) so as to be able to oscillate in order to pass reversibly from a disconnection configuration, in which the arm (13) is collapsed onto the base (11), to a contact configuration, in which the arm (13) is divaricated from the base (11) so as to connect by means of the shoe (14) to the dropper (15),
- a rod (16), which is functionally connected to the shoe (14) in order to actuate it,
- a cam device (17) for actuating the rod (16), which co-

ordinates kinematically the opening of the shoe (14) and a first rotation of the arm (13) from the disconnection configuration to the contact configuration,
- a semi-pantograph device (18), which is functionally connected to the rod (16), to the arm (13) and to the motor kinematic system (12), defining a kinematic sequence for closing the shoe (14), after the first rotation of the arm (13), and a kinematic sequence for opening the shoe (14), which is preliminary to a second rotation of the arm (13) which moves it from the contact configuration to the disconnection configuration.

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Description

[0001] The present invention relates to a semi-pantograph disconnector.

[0002] Several models of pantograph or semi-pantograph disconnector are currently known.

[0003] In particular, so-called vertical-break disconnectors of the pantograph or semi-pantograph type are known.

[0004] In the former, the contact force is linked to the elasticity of the material and therefore to the rigidity of the tubes of the active part, and in order to have high contact forces it is necessary to have a high working torque.

[0005] In semi-pantographs, instead, a spring-operated device ensures a high contact force. An additional spring allows to have low working torques because it balances the closing motion of the disconnector.

[0006] Disconnectors with an oscillating arm are further known which have an arm which, on command, rotates during closure, straddling the dropper with a shoe so as to provide with it the desired electric contact, and then the shoe is closed to ensure the durable efficiency of this contact.

[0007] During opening, the shoe opens, leaving the dropper, and then the arm rotates and moves away from it.

[0008] The correct sequentiality of the movements for closing and opening the shoe with respect to the rotations of the arm are achieved with a semi-pantograph kinematic system.

[0009] It is known that in the field of this type of disconnector the need is always felt to simplify their structure so as to make them more durable and reliable over time.

[0010] Moreover, known disconnectors of this type have the drawback of having, when they are open, their shoe exposed to the effects of weather, so that it can become covered with ice, to the full detriment of an effective electrical contact during closure.

[0011] The aim of the present invention is to provide a semi-pantograph disconnector that meets this requirement, having a structure and an operation which are simpler than known currently known semi-pantograph disconnectors.

[0012] Within this aim, an object of the invention is to propose a disconnector that is reliable and has a durable precision of the grip of the dropper to close the electrical contact.

[0013] Another object of the invention is to provide a semi-pantograph disconnector that allows reliable grip of the dropper, allowing to adjust the grip force.

[0014] This aim, as well as these and other objects that will become better apparent hereinafter, are achieved by a semi-pantograph disconnector, comprising

- a base which supports a motor kinematic system,
- an arm which has, at a first end, a grip shoe for a dropper and is hinged to said base at the second

end so as to be able to oscillate about a rotation axis in order to pass reversibly from a disconnection configuration, in which said arm is collapsed onto said base, to a contact configuration, in which said arm is divaricated from said base so as to connect by means of said shoe to a dropper,

characterized in that it comprises

- a rod, which is functionally connected to said shoe in order to actuate it,
- a cam device for actuating said rod, which coordinates kinematically the opening of said shoe, by means of said rod, and a first rotation of said arm, which corresponds to the transition from said disconnection configuration to said contact configuration,
- a semi-pantograph device which is functionally connected to said rod, to said arm and to said motor kinematic system, defining a kinematic sequence for closing said shoe, by way of the action of said rod, after said first rotation of said arm, and a kinematic opening sequence of said shoe, by means of said rod, which is preliminary to a second rotation of said arm which corresponds to the transition from said contact configuration to said disconnection configuration.

[0015] Further characteristics and advantages of the invention will become better apparent from the following detailed description of a preferred but not exclusive embodiment of the semi-pantograph disconnector according to the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a perspective view of a semi-pantograph disconnector according to the invention in a contact configuration;

Figure 2 is a side elevation view of a second embodiment of a semi-pantograph disconnector according to the invention in a disconnection configuration;

Figure 3 is a side elevation view of the semi-pantograph disconnector according to the invention of Figure 1, in a contact configuration;

Figure 4 is an enlarged-scale and partially sectional view of a detail of a semi-pantograph disconnector according to the invention in the second embodiment;

Figure 5 is an enlarged-scale perspective view of a detail of a semi-pantograph disconnector according to the invention in a further embodiment;

Figure 6 is another enlarged-scale and partially sectional view of a detail of a semi-pantograph disconnector according to the invention;

Figure 7 is an enlarged-scale and partially sectional view of a further detail of a semi-pantograph disconnector according to the invention.

[0016] It is noted that anything found to be already

known during the patenting process is understood not to be claimed and to be the subject of a disclaimer.

[0017] With reference to the figures, the reference numeral 10 generally designates a semi-pantograph disconnector, which comprises

- a base 11, which supports a motor kinematic system 12,
- an arm 13, which has, at a first end 13a, a shoe 14 for gripping a dropper 15 and is hinged, at the second end 13b, to the base 11 so that it can oscillates about a rotation axis A.

[0018] In this manner, the arm 13, by rotating by actuation of the motor kinematic system 12 about the rotation axis A, can pass reversibly from a disconnection configuration, in which the arm 13 is collapsed onto the base 11, to a contact configuration, in which the arm 13 is divaricated from the base 11 in electrical contact by means of the shoe 14 with a dropper 15.

[0019] According to the invention, a particularity of the disconnector 10 consists in that it comprises

- a rod 16, which is functionally connected to the shoe 14 in order to actuate it,
- a cam device 17 for actuating the rod 16, which coordinates kinematically the opening of the shoe 14, by means of the rod 16, and a first rotation of the arm 13, which corresponds to the transition from the disconnection configuration to the contact configuration,
- a semi-pantograph device 18, which is functionally connected to the rod 16, to the arm 13 and to the motor kinematic system 12, which defines a kinematic sequence for closing the shoe 14, by way of the action of the rod 16, subsequent to the first rotation of the arm 13, and a kinematic sequence for opening the shoe 14, by means of the rod 16, which is preliminary to a second rotation of the arm 13 that corresponds to the transition from such contact configuration to such disconnection configuration.

[0020] Moreover, the shoe 14 conveniently has a fixed jaw 19, which is jointly connected to the first end 13a of the arm 13, and a movable jaw 20, which is pivoted thereto and is connected to a first end 16a of the rod 16 in order to be rotated by it, so as to close and open the shoe 14.

[0021] Conveniently, the disconnector 10 comprises an element 21 for connecting the movable jaw 20 to the first end 16a of the rod 16, which substantially is elastically flexible.

[0022] In particular, the connecting element 21 comprises a spring 22, which is compressed between an abutment 23 of the rod 16 and a connector 24 to the movable jaw 20, in order to transmit between them a predefined force for closing the shoe 14.

[0023] The connector 24 is connected to the rod 16 so

that it can slide axially with respect to it.

[0024] More particularly, the connector 24 advantageously comprises a joint 25 which is pivoted to the movable jaw 20 in order to rotate it, and is connected by means of a threaded stem 26 to an abutment washer 27 for the spring 22.

[0025] Conveniently, abutment nuts 28 for the washer 27 are screwed onto the threaded stem 26 and are adapted to adjust the preloading of the spring 22 in order to define the grip force of the shoe 14 on the dropper 15.

[0026] The cam device 17 is preferably provided by a pin 29 which is jointly connected to the rod 16 and can slide along a guide 30 formed on the base 11.

[0027] The guide 30 conveniently forms for the pin 29 a trajectory B for spacing, for the opening of the shoe 14, and for subsequent radial approach with respect to the rotation axis A, the pin 29 following the trajectory B during such first and second rotations of the arm 13.

[0028] Moreover, the semi-pantograph device 18 advantageously comprises

- a rocker 31, which is pivoted to the base 11 and has a first arm 32a which is connected to the kinematic motor system 12,
- a linkage 33 for connection between the second arm 32b of the rocker 31, which lies opposite the first arm 32a, and a slider 34, which is jointly connected to the rod 16 and can slide in an elongated slot 35 formed on the arm 13 substantially longitudinally thereto.

[0029] Preferably, the rocker 31 is pivoted to the base 11 by means of a shaft 36, which is supported at its opposite ends by two plates of the base 11.

[0030] A stop element 37 is conveniently associated with the shaft 36 and is adapted to limit the sliding of the rod 16 along the arm 13 when it is collapsed onto the base 11.

[0031] In this configuration, the stop element 37 conveniently is inserted in a slot 38 of a base element 39 of the rod 16 and engages an end edge 40 thereof, thus preventing the movement of the rod 16 in the direction for opening the shoe 14.

[0032] Further, the base element 39 conveniently has slotted eyes 41 which are longitudinal thereto and within which the shaft 42 for pivoting the arm 13 to the base 11 passes, such shaft being free to slide longitudinally therein during the relative sliding of the rod 16 with respect to the arm 13 for opening and closing the shoe 14.

[0033] The axis of the shaft 42 conveniently defines the rotation axis A. Advantageously, the fixed jaw 19 comprises

- oscillating contacts 43, which are pivoted to the arm 13, from which they protrude toward the movable jaw 19,
- abutments 44, which support the oscillating contacts 43 so as to contrast elastically the recession of the

oscillating contacts 43 toward the arm 13 when the shoe 14 is closed on the dropper 15.

[0034] As an alternative, depending on the contingent requirements, the fixed jaw 19 can comprise fixed contacts 45, bolted to the arm 13, as shown by way of non-limiting example in Figures 2 and 5.

[0035] The operation of the disconnecter 10 according to the invention is as follows.

[0036] In the closed configuration, the disconnecter has

- the arm 13 divaricated from the base 11, in the contact configuration,
- the shoe 14 closed so as to grip the dropper 15,
- the rod 16 pushed by the semi-pantograph device 18, by means of the slider 34, in a configuration of maximum stroke toward the shoe 14, so as to force it to close by means of the compression of the spring 22.

[0037] The pivot 29 engages a first portion 30a of the guide 30, which is extended substantially in a direction which is aligned with the arm 13 when it is in the contact configuration.

[0038] It should be noted that this configuration is fully to the advantage of the locking of the arm 13 in the contact configuration, since the pivot 29 contrasts the rotation of the arm 13, abutting against the edges of the first portion 30a if it is not moved away from them first by way of the action of the rod 16.

[0039] The opening of the disconnecter 10 is provided as follows.

[0040] The motor kinematic system acts on the rocker 31, pushing its first arm 32a in order to make it rotate about an auxiliary rotation axis C, which is parallel to the rotation axis A and is formed by the axis of the shaft 36, counterclockwise with reference to Figures 2 and 3.

[0041] Thus, the second arm 32b pulls the rod 16 so as to slide in the arm 13 toward the second end 13b, by means of the linkage 33 that acts on the slider 34.

[0042] By jointly following the rod 16, the pin 29 descends, disengaging the first portion 30a of the guide 30, moving away from the rotation axis A.

[0043] Simultaneously, the abutment 23 jointly connected to the first end 16a of the rod 16 moves away from the joint 25, partially relaxing the spring 22, thus reducing the tightness of the shoe 14 on the dropper 15.

[0044] Conveniently, the threaded stem 25 has, at one end 25a, inserted in the first end 16a, a shoulder 25b for engaging a complementary shoulder 16b of the first end 16a.

[0045] Thus, at a predefined distance of the abutment 23, during the descent of the rod 16, the shoulder 25b abuts against the complementary shoulder 16b, which thus draws the connector 24 to descend along the arm 13.

[0046] In this manner, the connector 24, by descending toward the second end 13b of the arm 13, turns the mov-

able jaw 20 with respect to a pivot 46 thereof, which pivots it to the arm 13.

[0047] In this manner, the shoe 14 releases the dropper 15.

[0048] Advantageously, a return spring, not shown in the accompanying figures, is provided between the shaft 42 and the slider 34, to draw it back toward the second end 13b of the arm 13, in order to facilitate the opening of the shoe 14.

[0049] When the slider 34 abuts against the lower end 35a of the slot 35, the rod 16 has completed its stroke toward the second end 13b of the arm 13 and the pin 29 has exited from the first portion 30a of the guide 30.

[0050] In this configuration, the movable jaw 20 is conveniently divaricated from the fixed jaw 19 enough to avoid interfering with the dropper 15 during the subsequent rotation of the arm 13 that collapses onto the base 11.

[0051] The further thrust of the motor kinematic system 12 on the first arm 32a of the rocker 31 causes the rotation of the arm 13 about the rotation axis A, up to the disconnection configuration, in which it is collapsed onto the base 11, as shown for example in Figure 2.

[0052] Conveniently, there is a pair of torsion springs 47, which connects the base 11 and the arm 13 so as to contrast its collapse onto such base and in order to facilitate vice versa its divarication.

[0053] During the collapsing rotation of the arm 13, the pin 29 engages the second portion 30b of the guide 30, making the rod 16 rise in the arm 13, such rod thus closing partially the shoe 14.

[0054] In this manner, when the disconnecter 10 is open, the shoe 14 is at least partially closed, so as to be protected against atmospheric agents and in particular against the formation of ice.

[0055] Vice versa, starting from this configuration, closure of the disconnecter 10 occurs as follows.

[0056] The motor kinematic system draws the first arm 32a so as to turn the rocker 31 about the auxiliary axis C clockwise with reference to Figures 2 and 3.

[0057] In this manner, the second arm 32b pushes the linkage 33, which however is locked by the slider 34, which is retained jointly by the rod 16, which with the pin 29 engages the edge of the second portion 30b of the guide 30.

[0058] Thus, the rocker 31 transmits its rotation to the arm 13, which is divaricated from the base 11 to the contact configuration, in which the shoe 14 has the fixed jaw 19 in abutment against the dropper 15.

[0059] The movable jaw 20, during this rotation of the arm 13, is divaricated from the fixed jaw 19 by the action of the rod 16, which is entrained by the pin 29, which slides along the guide 30 so as to move away from the rotation axis A, thus drawing the rod 16 toward the second end 13b of the arm 13.

[0060] When the arm 13 has reached the contact configuration, the further rotation of the rocker 31 causes the sliding of the rod 16 toward the first end 13a of the arm,

pushed by means of the linkage 33, which acts on the slider 34.

[0061] When the rod 16 rises in the arm 13,

- first the spring 22 transmits the closure thrust from the rod 16 to the movable jaw 20, which closes on the dropper 15 in abutment on the fixed jaw,
- then, upon the further rise of the rod 16 in the arm 13, the spring 22 imparts to the movable jaw the pre-defined force for clamping the shoe 14 on the dropper 15.

[0062] Moreover, advantageously the arm 13 is composed of four parallel plates 48, within which the rod 16 is accommodated longitudinally.

[0063] In alternative and substantially equivalent embodiments, depending on the contingent requirements, such arm can be provided by means of just two plates, or with more than four plates, or such arm can be tubular or can have an open profile, such as a C-shaped profile.

[0064] In practice it has been found that the invention achieves the intended aim and objects, providing a semi-pantograph disconnecter that has a simpler structure and operation than currently known semi-pantograph disconnectors despite being at least as reliable and durable.

[0065] Moreover, a disconnecter according to the invention allows to adjust the grip force of the shoe on the dropper, to the full advantage of its adaptability to the most disparate contingent requirements.

[0066] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims; all the details may further be replaced with other technically equivalent elements.

[0067] In practice, the materials used, as well as the contingent shapes and dimensions, may be any according to requirements and to the state of the art.

[0068] The disclosures in Italian Patent Application No. PD2010A000050 from which this application claims priority are incorporated herein by reference.

[0069] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A semi-pantograph disconnecter, comprising

- a base (11) which supports a motor kinematic system (12),
- an arm (13) which has, at a first end (13a), a grip shoe (14) for a dropper (15) and is hinged to said base (11) at the second end (13b) so as

to be able to oscillate about a rotation axis (A) in order to pass reversibly from a disconnection configuration, in which said arm (13) is collapsed onto said base (11), to a contact configuration, in which said arm (13) is divaricated from said base (11) so as to connect by means of said shoe (14) to a dropper (15),

characterized in that it comprises

- a rod (16), which is functionally connected to said shoe (14) in order to actuate it,
- a cam device (17) for actuating said rod (16), which coordinates kinematically the opening of said shoe (14), by means of said rod (16), and a first rotation of said arm (13), which corresponds to the transition from said disconnection configuration to said contact configuration,
- a semi-pantograph device (18), which is functionally connected to said rod (16), to said arm (13) and to said motor kinematic system (12), defining a kinematic sequence for closing said shoe (14), by way of the action of said rod (16), after said first rotation of said arm (13), and a kinematic opening sequence of said shoe (14), by means of said rod (16), which is preliminary to a second rotation of said arm (13) which corresponds to the transition from said contact configuration to said disconnection configuration.

2. The disconnecter according to claim 1, **characterized in that** said arm (13) is tubular, said rod (16) being supported therein so that it can slide substantially coaxially.

3. The disconnecter according to one or more of the preceding claims, **characterized in that** said shoe (14) has a fixed jaw (19), which is connected to said arm (13), and a movable jaw (20), which is pivoted to said arm (13) and is connected to a first end (16a) of said rod (16) in order to be turned by it so as to close and open said shoe (14).

4. The disconnecter according to claim 3, **characterized in that** it comprises an element (21) for connecting said movable jaw (20) to said first end (16a) of said rod (16), said element being elastically flexible.

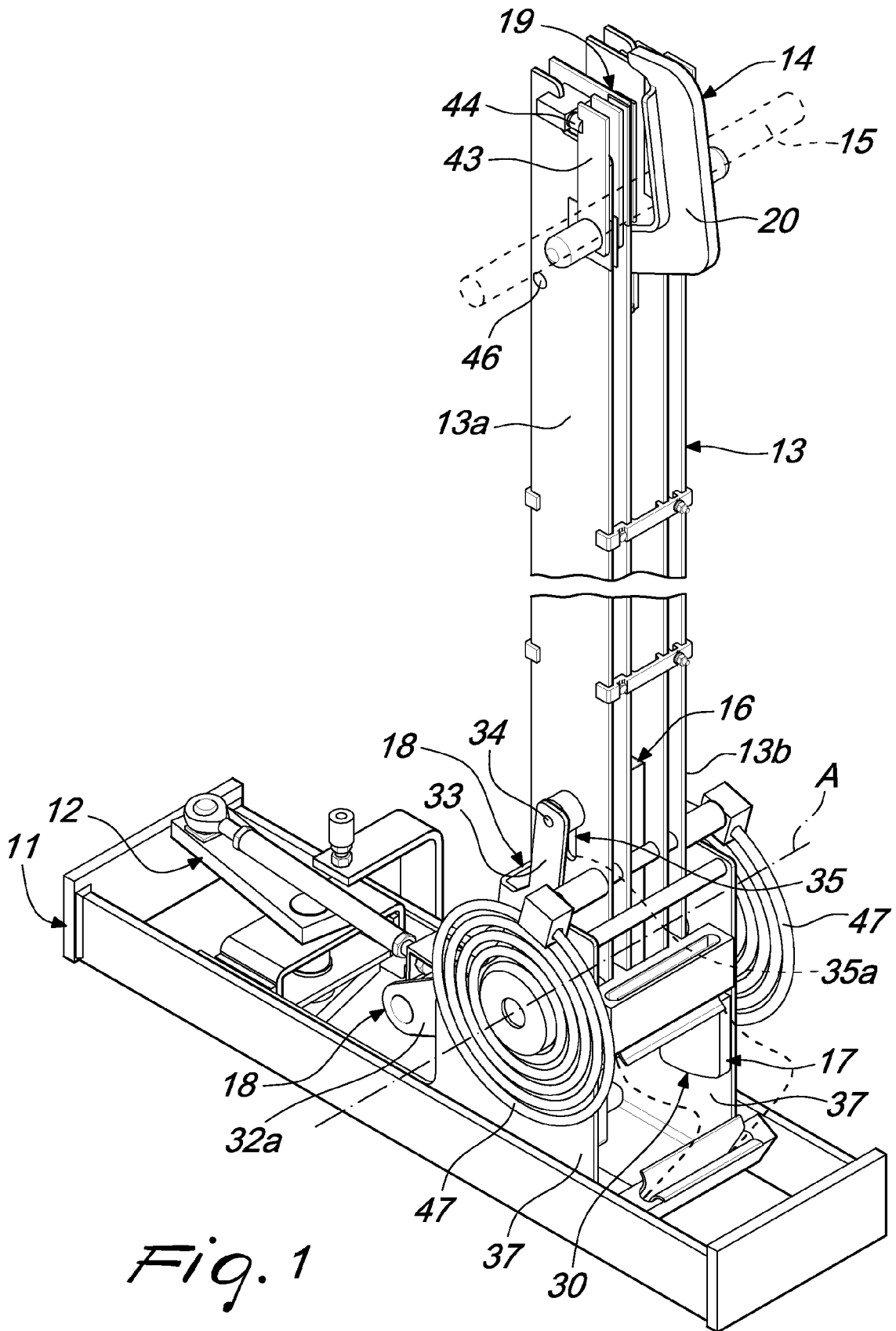
5. The disconnecter according to claim 4, **characterized in that** said connecting element (21) comprises a spring (22) which is compressed between an abutment (23) of said rod (16) and a connector (24) for connection to said movable jaw (20), in order to transmit between them a predefined closing force of said shoe (14), said connector (24) being connected to said rod (16) so that it can slide axially with respect to it.

6. The disconnecter according to one or more of the preceding claims, **characterized in that** said cam device (17) is formed by a pivot (29) which is jointly connected to said rod (16) and can slide along a guide (30) formed on said base (11). 5
7. The disconnecter according to claim 6, **characterized in that** said guide (30) defines for said pin (29) a spacing trajectory (B), for the opening of said shoe (14), and for subsequent radial approach with respect to said rotation axis (A), said pin (29) traveling along said trajectory (B) during said first and second rotations of said arm (13). 10
8. The disconnecter according to one or more of the preceding claims, **characterized in that** said semi-pantograph device (18) comprises 15
- a rocker (31), which is pivoted to said base (11) and has a first arm (32a) which is connected to said motor kinematic system (12), 20
 - a linkage (33) for connection between the second arm (32b) of said rocker (31), which is opposite with respect to said first arm (32a), and a slider (34), which is jointly connected to said rod (16) and can slide in an elongated slot (35), which is formed on said arm (13) substantially longitudinally thereto. 25
9. The disconnecter according to one or more of the preceding claims, **characterized in that** said fixed jaw (19) comprises 30
- oscillating contacts (43), which are hinged to said arm (13), from which they protrude toward said movable jaw (19), 35
 - abutments (44), which support said oscillating contacts (43) so as to contrast elastically a recession of said oscillating contacts (43) toward said arm (13) when said shoe (14) is closed onto said dropper (15). 40

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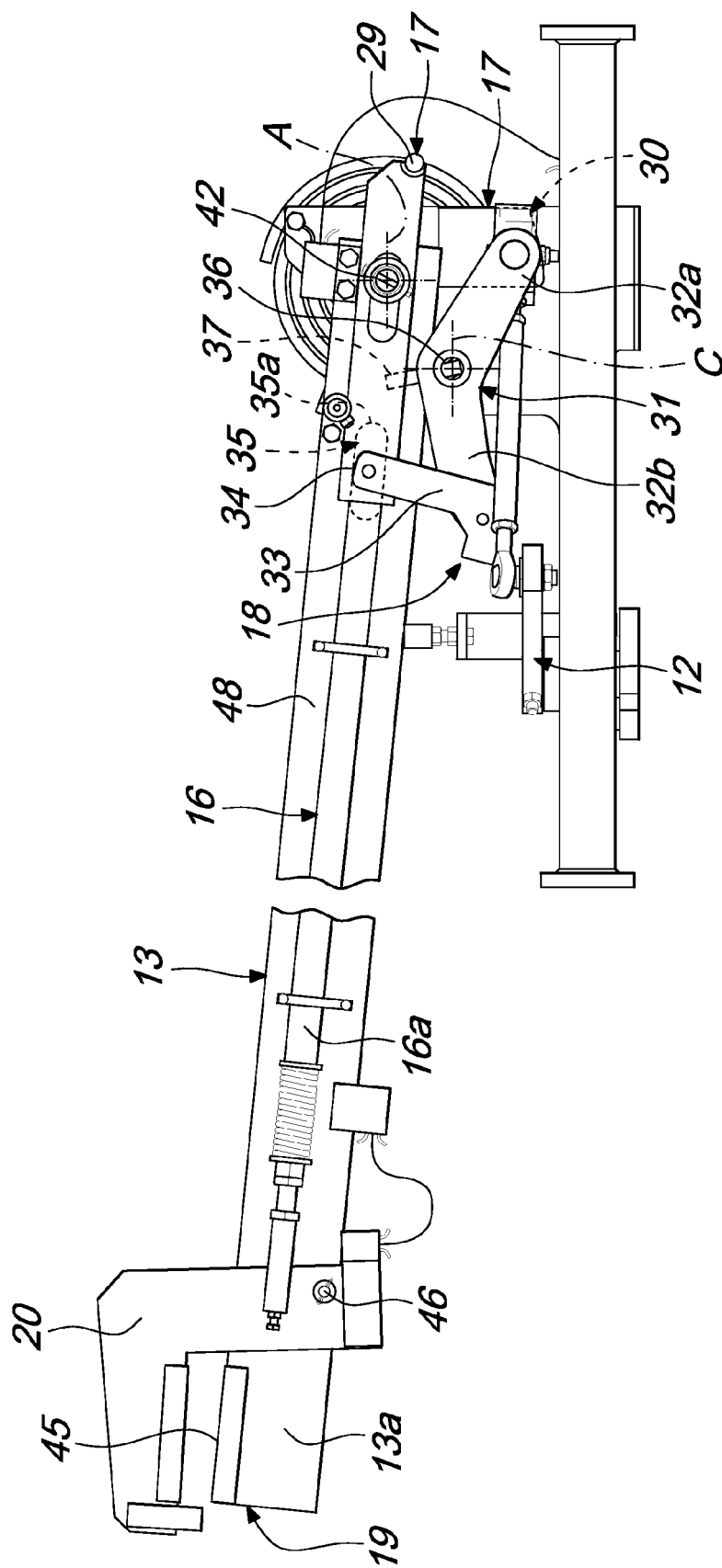
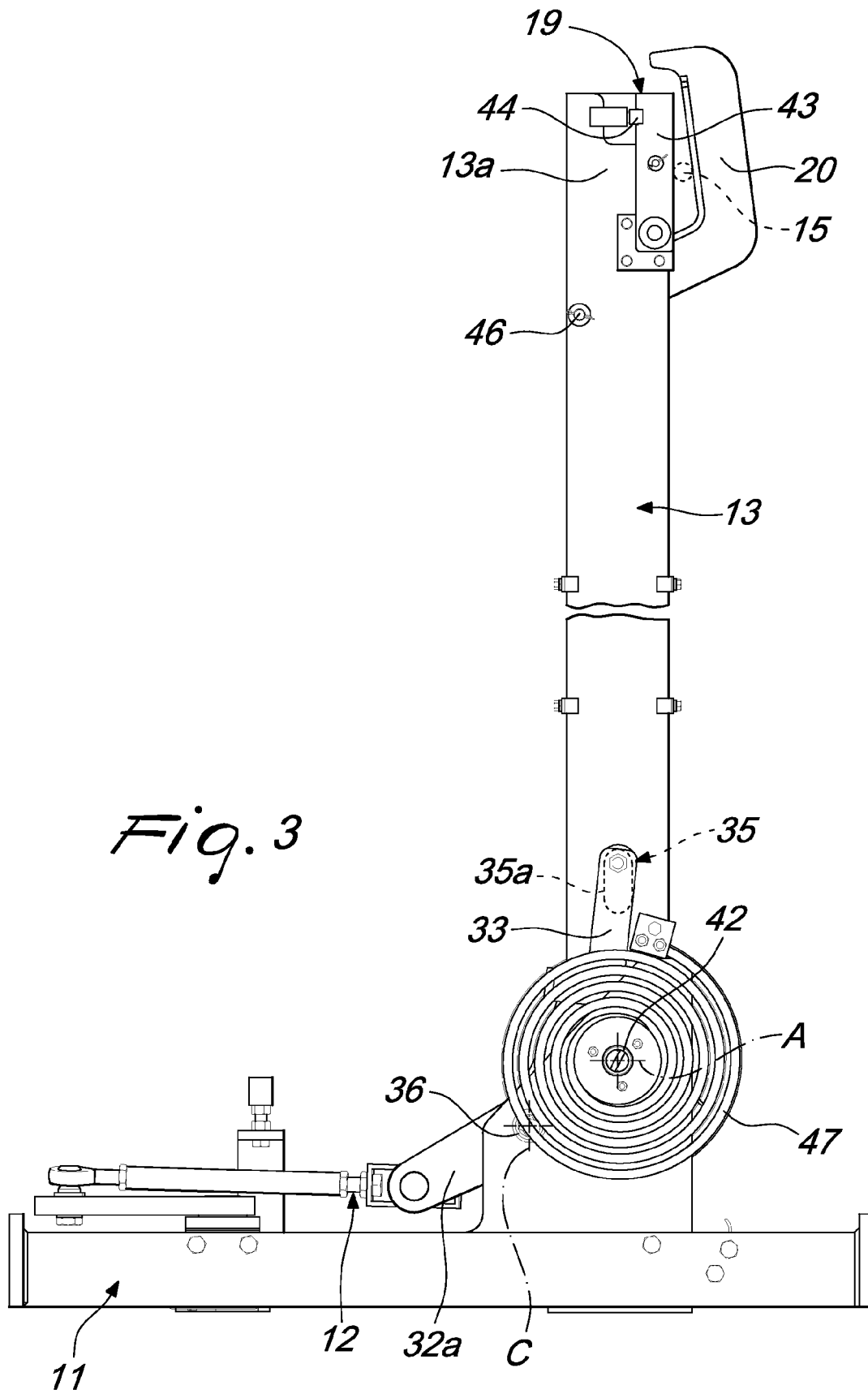


Fig. 2



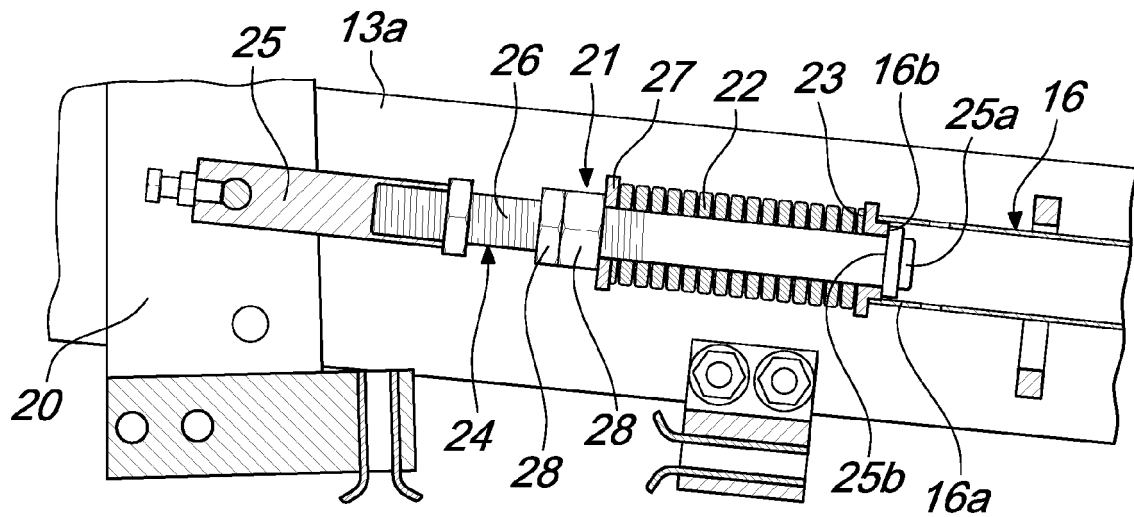


Fig. 4

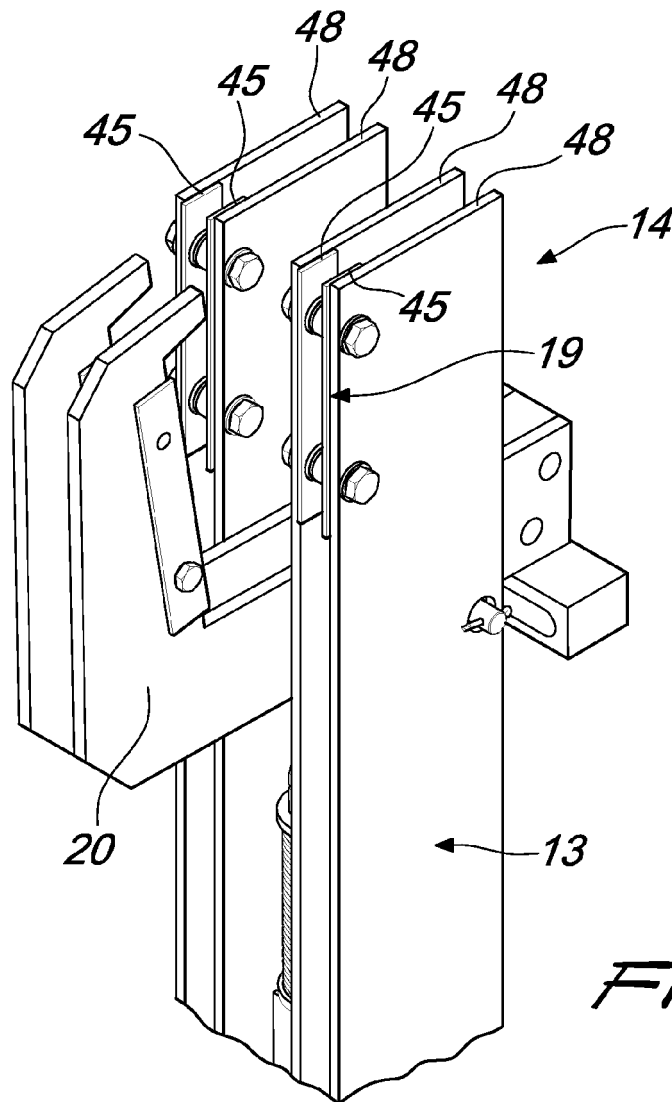


Fig. 5

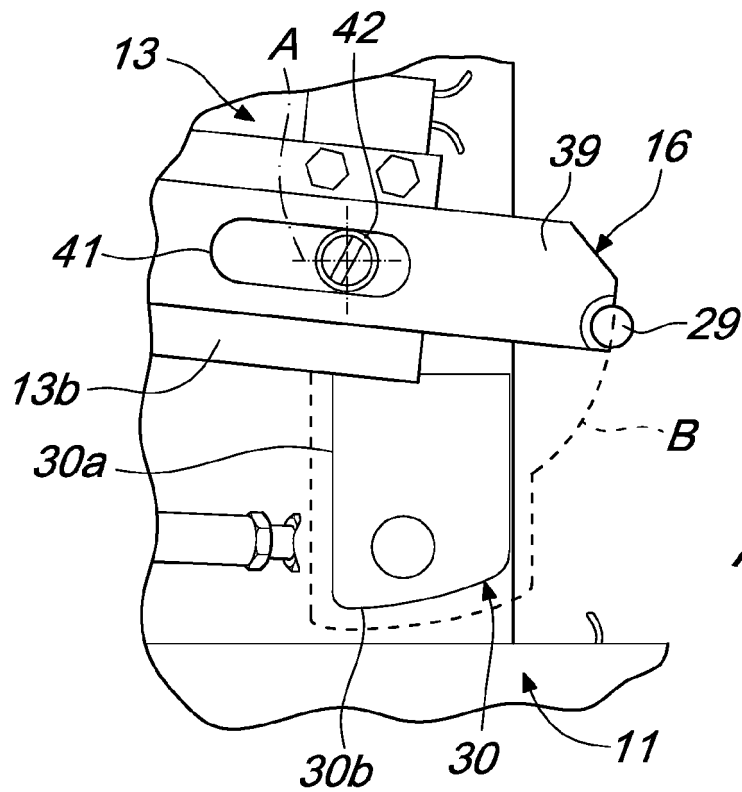


Fig. 6

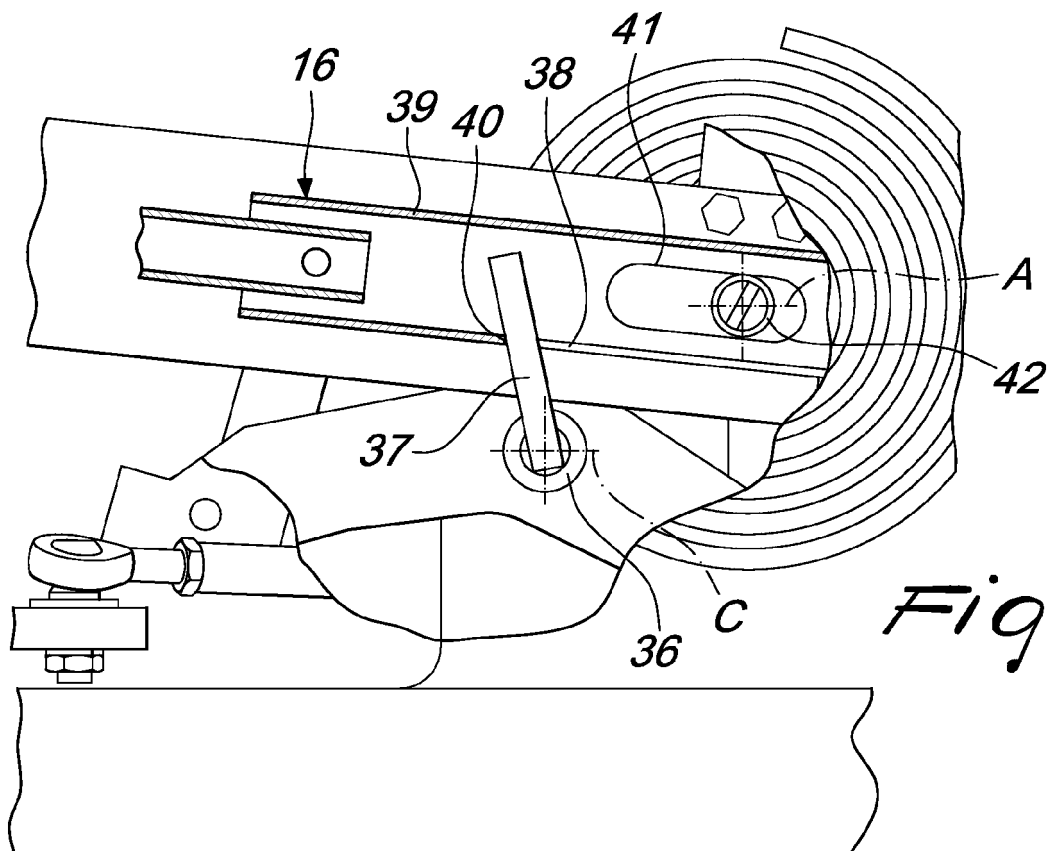


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 10 17 5102

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	US 5 186 315 A (KOPPE DENIS [FR] ET AL) 16 February 1993 (1993-02-16) * abstract; figure 1 *	1-9	INV. H01H31/36
A	FR 1 204 754 A (MERLIN GERIN) 28 January 1960 (1960-01-28) * figures 1,3,5 *	1	ADD. H01H3/42
			TECHNICAL FIELDS SEARCHED (IPC)
			H01H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 1 June 2011	Examiner Simonini, Stefano
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			

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

EP 10 17 5102

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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01-06-2011

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REFERENCES CITED IN THE DESCRIPTION

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