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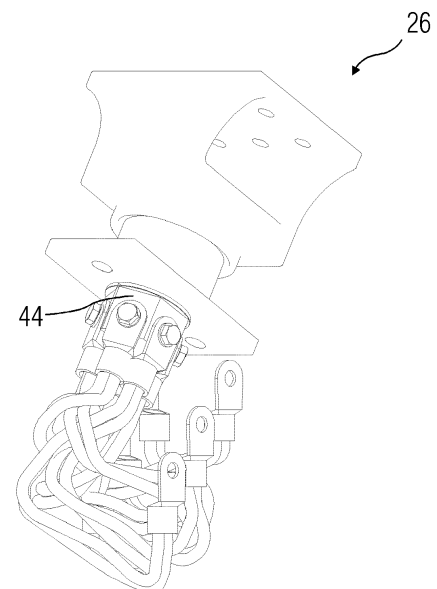
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(54) **DISCONNECTING MECHANISM FOR A HIGH VOLTAGE SWITCHING DEVICE**

(57) A switching device is disclosed herein. The switching device includes a pair of movable current path arms (12 and 14) detachably coupled with one another via a disconnecting mechanism (10) for controlling transfer of electrical current therebetween. The disconnecting mechanism (10) has a transfer contact system (26, 28) for transferring electrical current from a rotatable terminal stem (30, 32) to the movable current path arm (12, 14). The transfer contact system (26, 28) includes a plurality of flexible braided conducting leads (36) each rigidly fixed at both of its ends to the current path arm (12 or 14) and in rigid contact with the terminal stem (30 or 32), and a connector unit (44) rigidly attached to the terminal stem (30 or 32) and designed so as to support the plurality of flexible conducting leads (36) based on an amperage rating of the switching device, which is greater than or equal to 2500A.

FIG 3B



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Description

[0001] The present disclosure relates to switching devices such as switchgears. More particularly, the present disclosure relates to a horizontal center-break type disconnecting mechanism for a switching device.

[0002] A disconnecting mechanism, for example, a disconnecter is an assembly which, when installed in the head of a switchgear, has the function of assuring an interruption of voltage supply line to the switchgear when the disconnecter is open, thus isolating the switchgear from electric supply. A commonly known type of disconnecter comprises a horizontal arrangement having a detachable current path, including a pair of movable arms, tubes, or blades. The movable arms are detachably coupled to each other and can occupy two positions, namely a closed position wherein an electrical contact exists there-between via a main contact system, and an open position wherein the two arms rotate about an axis perpendicular to their length so as to break the electrical contact there-between. The disconnecter assembly also includes a pair of transfer contact systems for connecting the movable arms, at either ends, to the electricity supply and to the distribution bus bars of the switchgear.

[0003] Conventionally, in a horizontal center-break type disconnecting mechanism, the main contact configuration consists of female contacts, provided on one of the moving arms, comprising heli-coil springs to exert a positive contact pressure for transfer of current and also to ensure proper contact to withstand to the electro-dynamic forces during the flow of fault current in the system. The female contacts are housed in the moving arm, which is generally made of an aluminium alloy. A male contact is provided on the other moving arm and is formed out of two copper sheets and electro plated with silver coat to improve the conductivity and thermal withstanding capability of contacts. However, this existing design of the main contact system has several disadvantages. During the open-close operation of the disconnecter, the contacts are rubbed against each other during the course of motion of contacts and requires lubrication to withstand to the frictional resistance. Unless this is lubricated at frequent intervals the silver layer gets eroded causing the damage to the contact. Further, the heli-coil springs used in the system also affect the functioning of the main contact system because, if the springs set permanently due to any reason over a period of time, the contact pressure will be lost causing the temperature rise thus burning the contact system itself.

[0004] Typically, the transfer contact system provides rotary terminal contact jaws with flat spring exerting pressure on a terminal stem to achieve the proper contact to transfer the current. Herein, the contacts are typically silver plated and during the rotary motion while open-close operation of the disconnecter the silver face gets rubbed against the terminal stem. It is therefore, necessary to maintain a proper pressure of contacts on to the terminal stem, in the absence of which, the silver layer existing

on terminal stem as well as on terminal jaws gets eroded, thus reducing the thermal capability of the contacts and increasing the temperature rise beyond the specification limits at transfer point. Hence, in case the transfer contacts are not lubricated at frequent intervals, the contact surface experiences a lot of friction, causing the damage to the silver plating of contacts which reduces the functionality and life the contacts.

[0005] EP2218084 discloses a disconnecter for switching device having a transfer contact system for transferring electrical current from a rotatable terminal stem of the disconnecter to the first movable current path arm wherein, the transfer contact system includes at least one flexible braided conducting lead rigidly fixed on both ends to the first current path arm. The flexible braided conducting lead being further in rigid contact with the terminal stem at a point along its length intermediate to the ends.

[0006] FIG 1 illustrates a front view of a switching device (not shown) such as a high voltage disconnecter having a horizontal center-break type disconnecting mechanism 10 according to state of the art, as disclosed in EP2218084. The disconnecter 10 has movable current path arms 12 and 14 made of an aluminium alloy material or a copper alloy material, having a rectangular cross-sectional profile. The moving arms 12 and 14 are detachably coupled to each other and are capable of rotation about the axes 19 and 21 respectively to occupy two positions, namely a closed position and an open position. The configuration shown in FIG 1 represents the closed position wherein the moving arms 12 and 14 are in electrical contact with each other via a main contact system 16. In the open position, the moving blades 12 and 14 rotate about the axes 19 and 21 respectively in the indicated direction, such that electrical contact between them is broken. The main contact system 16 comprises a female contact interface 18, fixed to the moving blade 12 by studs 24, and a male contact interface 20, fixed to the moving blade 14 by studs 22. Each of the moving blades 12 and 14 are connected to the electricity supply and to the distribution bus bars via transfer contact systems 26 and 28 having rotatable terminal stems 30 and 32 respectively. Each rotation unit (not shown) incorporates a rotation mechanism typically comprising two ball-bearings and is designed for high mechanical loads.

[0007] FIG 2 illustrates a cross-sectional view of a transfer contact system 26 or 28 according to state of the art disclosed in EP2218084, of the horizontal center-break type disconnecting mechanism 10 shown in FIG 1. The transfer contact system 26 is partially contained in a housing 42 which is fixed to the moving blade 12 via studs 43 and 45. Insulation of the terminal stem 30 is provided by bushings 39, typically formed from nylon. In the transfer contact system 26, current is transferred from the rotatable terminal stem 30 to the moving blade 12 by one or more highly flexible braided conducting leads 36. Single or multiple flexible braided conducting leads 36 may be provided based upon the required amperage.

The flexible braided conducting leads 36 are rigidly fixed on both ends to the moving blade 12 by tin plated lugs 38 and 40. The flexible braided conducting leads 36 extend in a generally horizontal orientation, extending upwards to be in rigid contact with the terminal stem 30 via washer 41. The point of rigid contact of the flexible conducting leads 36 with the terminal stem 30 is about the center of the length of the flexible conducting leads 36. This provides two parallel paths for transfer of current between the terminal stem 30 and the moving blade 12, thus enhancing the current carrying capacity of the transfer contact system 26. This design employing flexible conducting leads 36 ensures that the transfer contact system 26 does not have any relative rotational motion between the transfer contacts, that is, between the terminal stem 30 and the conducting leads 36, and between the conducting leads 36 and the moving blade 12.

[0008] However, the transfer contact system 26 or 28 disclosed in EP2218084 and described in description of FIGS 1-2, either fails to operate at high amperage, for example, above 2500 Amperes (A), or calls for a larger diameter of the terminal stem 30, for example, about 60mm due to a need for an increased size and/or quantity of the flexible conducting leads 36. High amperage typically requires the terminal stem 30 to be increased radially to allow a higher number or a larger size of flexible conducting leads 36 to be accommodated there-under and supported by the washer 41. However, this radial increase, in turn calls for a larger size of high voltage terminals or clamps which provide a connection to the busbars and effectively to the electricity supply. This increase in size of the high voltage clamps is not compliant with the standards governing substation layouts which makes its installation inconvenient and unattractive for the customers because, the top flat surface of the terminal stem 30 has to be used for making provisions for a flat connection for the customers by assembling an adaptor, for example, by screwing or as integral part in the case of casting.

[0009] Accordingly, it is an object of the present invention, to provide a switching device having a disconnecting mechanism suitable for handling high amperage, for example, above 2500A without any increase in the terminal stem 30 and ensuring design and/or requirement compliance with industry standards.

[0010] The switching device disclosed herein achieves the aforementioned object by a connector unit rigidly attachable to the rotatable terminal stem of the disconnecting mechanism and configured so as to support numerous flexible conducting leads based on amperage rating requirements of the switching device. According to one aspect, the amperage rating is greater than or equal to 2500A.

[0011] The switching device disclosed herein comprises a first movable current path arm and a second movable current path arm. These arms form contacts to be opened and closed to break or make a circuit there-between. The switching device comprises a disconnecting mechanism

detachably coupling the first movable current path arm and the second movable current path arm for controlling transfer of electrical current therebetween. The disconnecting mechanism comprises a transfer contact system for transferring electrical current from rotatable terminal stem(s) of the switching device to the movable current path arm(s).

[0012] The transfer contact system comprises a plurality of flexible braided conducting lead rigidly fixed on both ends to a current path arm. The flexible braided conducting leads are in rigid contact with the terminal stem. The transfer contact system comprises a connector unit rigidly attached to the terminal stem and configured so as to support one or more of the flexible conducting leads based on amperage rating of the switching device. As used herein, "connector unit" refers to an interface unit between the flexible conducting leads and the terminal stem. That is, the connector unit acts like a washer holding the flexible conducting leads in position and in connection with the terminal stem. The flexible conducting leads are oriented downwards, that is, below the connector unit so as to maintain adequate space within the current path arm in which the transfer contact system is partially accommodated, and to allow free rotary movement of the terminal stem.

[0013] According to one aspect, the connector unit is detachably coupled with the terminal stem. In this aspect, the connector unit is an independent part which is affixed, for example, via studs, screw, bolts, or the like, to be detachably coupled to the terminal stem. According to another aspect, the connector unit is integrated with the terminal stem. In this aspect, the connector unit is configured as an integral part of the terminal stem, for example, via casting, molding, welding, machining, etc., to have one end of the terminal stem as the connector unit. In this aspect, the connector unit enhances stiffness of the terminal stem and eliminates requirements of additional screws and studs for connection to the terminal stem.

[0014] According to one aspect, the connector unit is configured of a material selected based on the amperage rating of the switching device and/or the material of the terminal stem. For example, the connector unit is configured of at least aluminium or copper. As the terminal stem is typically made of aluminium or copper, the connector unit when made of the same materials ensures easy connection of the two metal parts resulting in a static conductive joint there-between. Moreover, an aluminium to aluminium contact provides a low overall resistance thereby, maintaining the current carrying capacity of the switching device. According to another aspect the connector unit is made of an aluminium alloy providing mechanical advantages of being harder and stronger. According to yet another aspect, the connector unit has copper flashed aluminium surfaces for connection with a copper terminal stem. A copper flashed surface of the connector unit avoids requirements for bi-metallic washers which are typically used to control resistance offered by

the tin-plated lugs when connected to the connector unit.

[0015] Thus, the connector unit precludes requirement for change in a cross-section of the terminal stem within current path to establish a rigid connection there-between whilst supporting high amperage.

[0016] According to one aspect, the connector unit is configured to have at least a partially hexagonal surface allowing at least six flexible conducting leads to be connected thereto and thereby, suiting high amperage requirements, for example, allowing the current carrying capacity to be increased beyond 2500A. According to another aspect, assuming there is no further current capacity increase possible based on size of the installed flexible conducting leads, the connector unit can have more than six faces to accommodate additional flexible conducting leads thereby, increasing the current carrying capacity further. The current carrying capacity may be limited by the chosen flexible conducting leads and their connections, that is, the plated lugs used.

[0017] The switching device disclosed herein is a high voltage disconnecter. More specifically, the switching device disclosed herein is a horizontal center-break type disconnecter.

[0018] The above mentioned and other features of the invention will now be addressed with reference to the accompanying drawings of the present invention. The illustrated embodiments are intended to illustrate, but not limit the invention.

[0019] The present invention is further described hereinafter with reference to illustrated embodiments shown in the accompanying drawings, in which:

- FIG 1 illustrates a front view of a switching device such as a high voltage disconnecter having a horizontal center-break type disconnecting mechanism, according to state of the art.
- FIG 2 illustrates a cross-sectional view of a transfer contact system of the horizontal center-break type disconnecting mechanism shown in FIG 1, according to state of the art.
- FIGS 3A-3C illustrate different views of a horizontal center-break type disconnecting mechanism, according to an embodiment of the present disclosure.
- FIG 4 illustrates a perspective view of a hexagonal connector unit of the horizontal center-break type disconnecting mechanism shown in FIGS 3A-3C.

[0020] Various embodiments are described with reference to the drawings, wherein like reference numerals are used to refer like elements throughout. In the following description, for the purpose of explanation, numerous

specific details are set forth in order to provide thorough understanding of one or more embodiments. It may be evident that such embodiments may be practiced without these specific details.

- [0021]** FIGS 3A-3C illustrate different views of a horizontal center-break type disconnecting mechanism 10 shown in FIG 1, according to an embodiment of the present disclosure. FIG 3A illustrates a cross-sectional view of a transfer contact system 26 or 28, according to an embodiment of the present disclosure, of the horizontal center-break type disconnecting mechanism 10 shown in FIG 1. The transfer contact system 26 is partially contained in a housing 42 shown in FIG 2 which is fixed to the moving blade 12 via studs 43 and 45, shown in FIG 2, which respectively are installed on the sides 30A and 30B of the terminal stem 30. The transfer contact system 26 comprises a terminal stem 30 which is rotatable around an axis 19 passing centrally there-through. In the transfer contact system 26, current is transferred from the rotatable terminal stem 30 to the moving blade 12 by a plurality of highly flexible braided conducting leads 36. Based on the required amperage, that is, above 2500A or below 2500A, quantity of the flexible braided conducting leads 36 can be varied. The flexible braided conducting leads 36 are rigidly fixed to the moving blade 12 by tin plated lugs 38B. The flexible braided conducting leads 36 extend upwards to be in rigid contact with the terminal stem 30 by being rigidly fixed to a hexagonal connector unit 44 by tin plated lugs 38A, according to the present disclosure.

[0022] FIG 3B illustrates a perspective view of the transfer contact system 26 shown in FIG 3A, having the hexagonal connector unit 44, according to the present disclosure.

- [0023]** FIG 3C illustrates an exploded view of the transfer contact system 26 shown in FIG 3A, having the hexagonal connector unit 44, according to the present disclosure. The transfer contact system 26 comprises the terminal stem 30, the hexagonal connector unit 44, the flexible braided conducting leads 36, and the plated lugs 38. A terminal stem head 30G is operably connected to the hexagonal connector unit 44 via grooves made on the hexagonal connector unit 44. One or more connecting plates 30C, 30E, and 30F affix the hexagonal connector unit 44 to the terminal stem bottom 30D with help of studs 46. The flexible braided conducting leads 36 are fixedly attached to the hexagonal connector unit 44 with help of the plated lugs 38 and specifically 38A as shown in FIG 3A. The plated lugs 38 are screwed to the hexagonal connector unit 44 with help of studs 47. For an amperage of 2500A and above, about six flexible braided conducting leads 36 are attached on each side of the hexagonal connector unit 44 via the plated lugs 38 and studs 47. For an amperage less than 2500A the number of these flexible braided conducting leads 36 can be decreased.

[0024] FIG 4 illustrates a perspective view of a hexagonal connector unit 44 of the horizontal center-break type disconnecting mechanism 10 shown in FIGS 3A-3C, ac-

according to the present disclosure. The hexagonal connector unit 44 comprises a cylindrical elongate member 44A rigidly attached to a hexagonal base member 44B. The elongate member 44A connects with the terminal stem head 30G shown in FIG 3C. The base member 44B provides an area for accommodating numerous flexible braided conducting leads 36 shown in FIGS 3A-3C thereby, supporting disconnecting mechanisms 10 having a higher amperage rating.

[0025] While the present invention has been described in detail with reference to certain embodiments, it should be appreciated that the present invention is not limited to those embodiments. In view of the present disclosure, many modifications and variations would be present themselves, to those skilled in the art without departing from the scope of the various embodiments of the present invention, as described herein. The scope of the present invention is, therefore, indicated by the following claims rather than by the foregoing description. All changes, modifications, and variations coming within the meaning and range of equivalency of the claims are to be considered within their scope.

List of Reference Numerals

[0026]

10 disconnecting mechanism
 12, 14 movable current path arms
 16 main contact system
 18 female contact interface
 20 male contact interface
 22, 24 studs
 26, 28 transfer contact systems
 30, 32 terminal stems
 30A, 30B sides of the terminal stem 30
 30C, 30E, 30F connecting plates
 30D bottom of the terminal stem
 30G head of the terminal stem
 19, 21 axes of rotation of the terminal stems 30 and 32
 36 flexible braided conducting leads
 38, 40 plated lugs
 39 bushings
 41 washer/connector unit of the state of the art
 42 housing
 43, 45, 46, 47 studs
 44 connector unit (as per present disclosure)/hexagonal connector unit
 38A plated lugs connected to the connector unit
 38B plated lugs connected to the movable contact arm
 44A elongate member
 44B base member

Claims

1. A switching device comprising:

- a first movable current path arm (12);
- a second movable current path arm (14); and
- a disconnecting mechanism (10) for detachably coupling the first movable current path arm (12) and the second movable current path arm (14), for controlling transfer of electrical current therebetween;
- said disconnecting mechanism (10) comprising a transfer contact system (26, 28) for transferring electrical current from a rotatable terminal stem (30, 32) to said movable current path arm (12, 14), wherein said transfer contact system (26, 28) comprises:

- a plurality of flexible braided conducting leads (36) each rigidly fixed at both of its ends to said current path arm (12 or 14);
- the flexible braided conducting leads (36) being in rigid contact with said terminal stem (30 or 32); and

characterized by:

- a connector unit (44) rigidly attached to the terminal stem (30 or 32) and configured to support the flexible conducting leads (36) based on an amperage rating of the switching device.

2. The switching device according to claim 1, wherein the connector unit (44) is detachably coupled with the terminal stem (30 or 32).

3. The switching device according to claim 1, wherein the connector unit (44) is integrated with the terminal stem (30 or 32).

4. The switching device according to any one of the previous claims, wherein the connector unit (44) is configured to have at least a partially hexagonal surface (44B) allowing at least six flexible conducting leads (36) to be connected thereto.

5. The switching device according to any one of the previous claims, wherein the connector unit (44) is configured of a material selected based on one or more of the amperage rating of the switching device and a material of the terminal stem (30, 32).

6. The switching device according to claim 5, wherein the material of the connector unit (44) comprises at least one of aluminium and copper.

7. The switching device according to any one of the previous claims wherein the amperage rating is greater than or equal to 2500A.

8. The switching device according to any one of the previous claims is a high voltage disconnecter.

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FIG 1

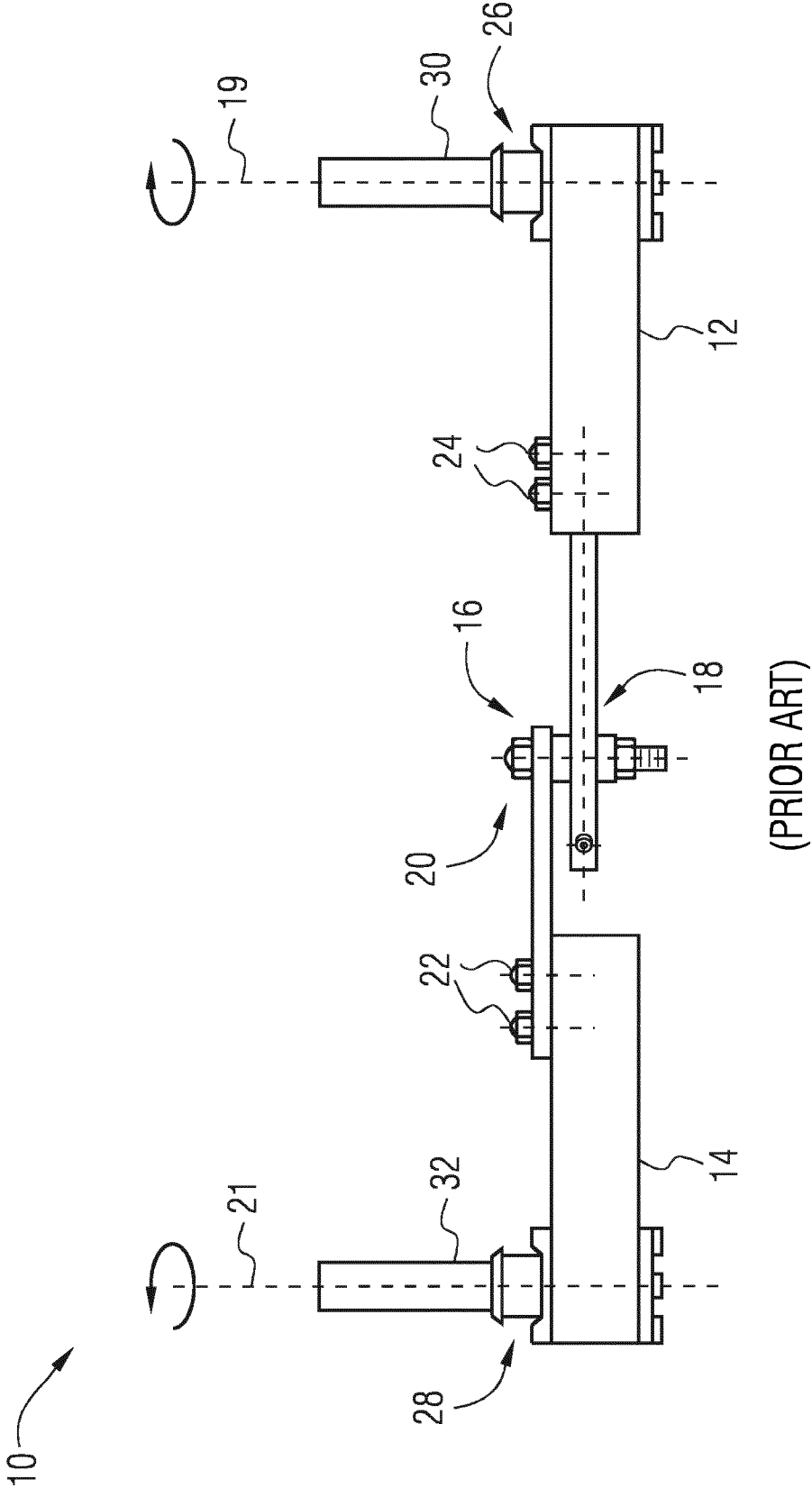
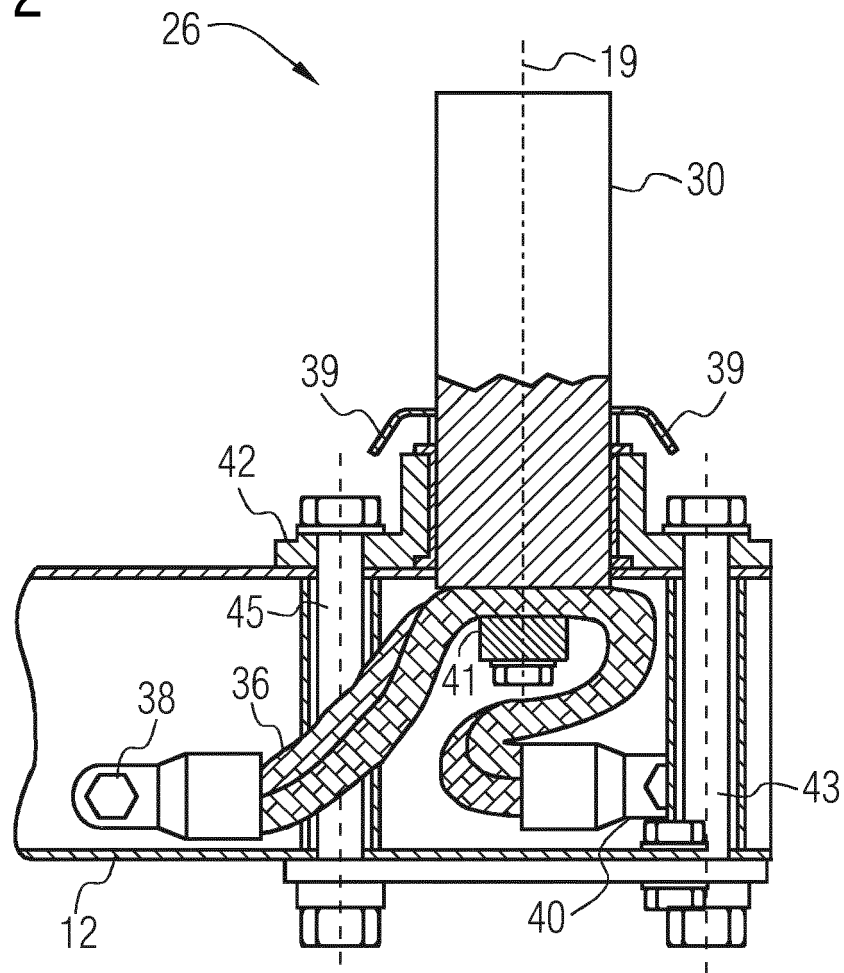


FIG 2



(PRIOR ART)

FIG 3A

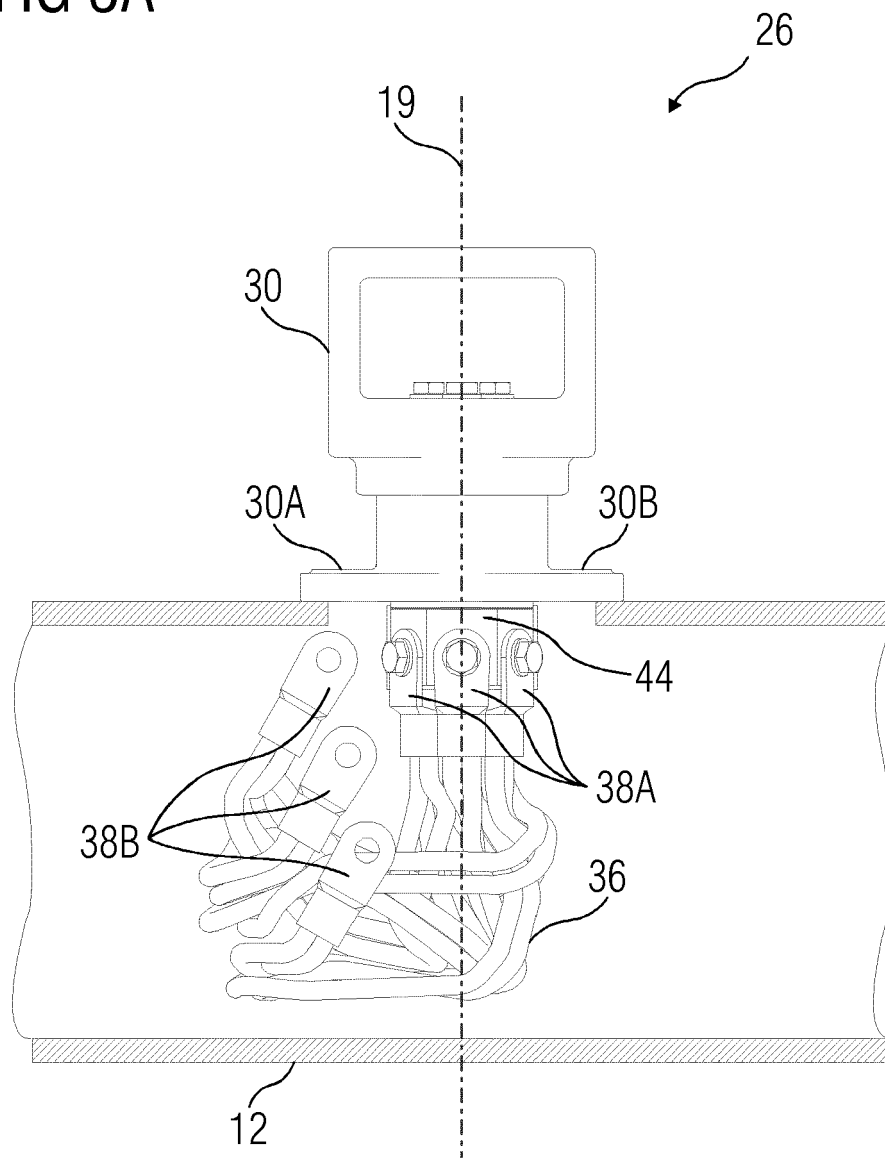


FIG 3B

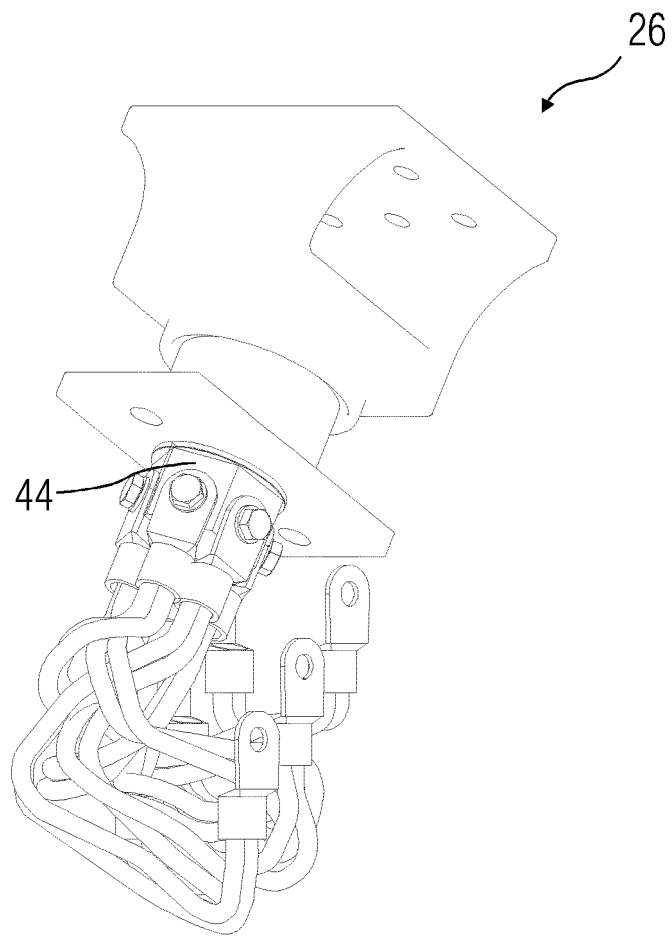


FIG 3C

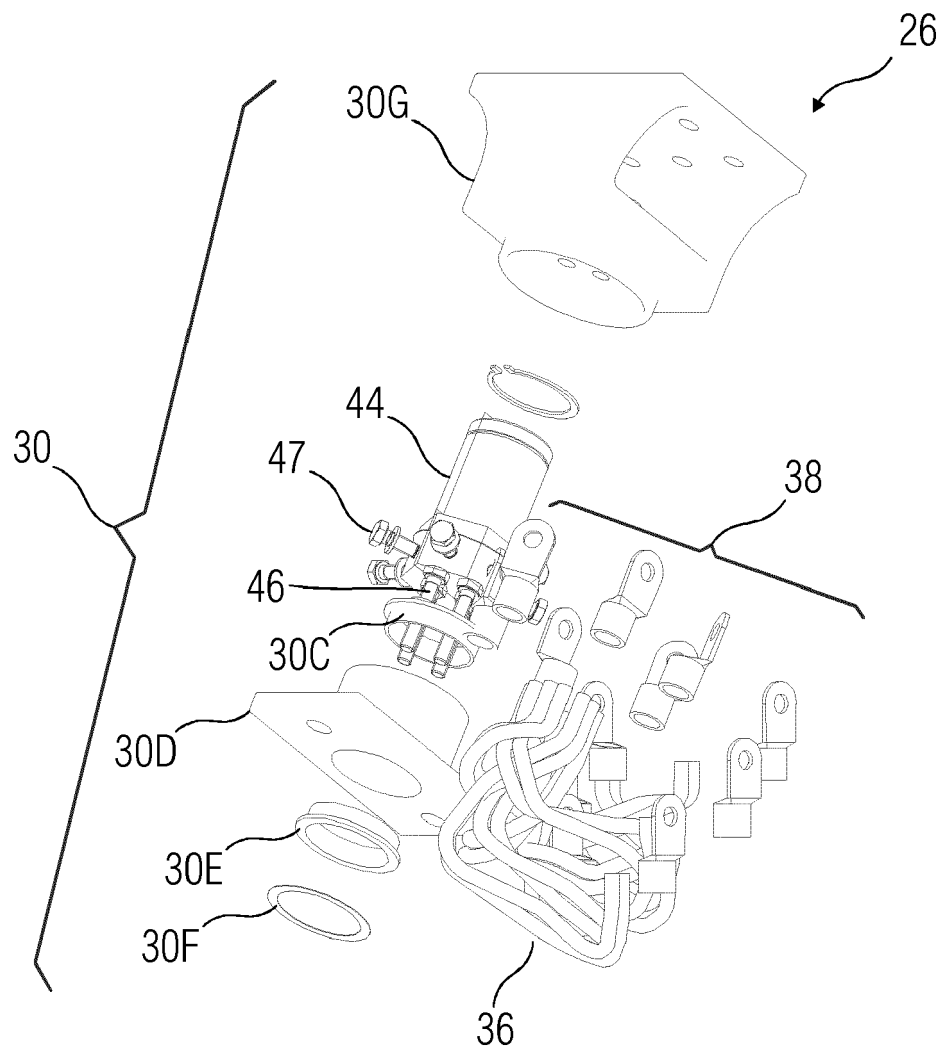
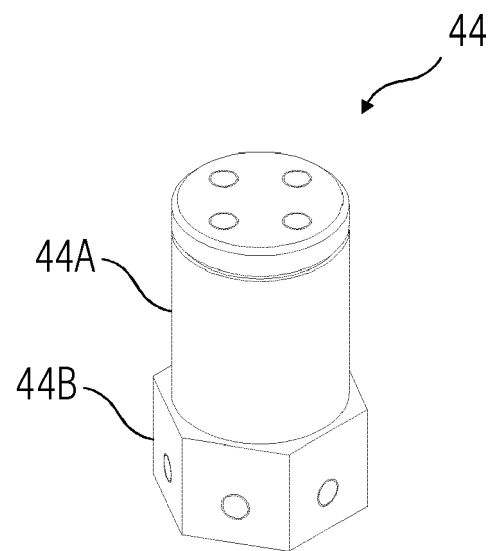


FIG 4





EUROPEAN SEARCH REPORT

Application Number
EP 19 19 4068

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Y	* figure 1 *	4	
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 February 2020	Examiner Arenz, Rainer
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.02 (P04C01)

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

EP 19 19 4068

5 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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18-02-2020

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REFERENCES CITED IN THE DESCRIPTION

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