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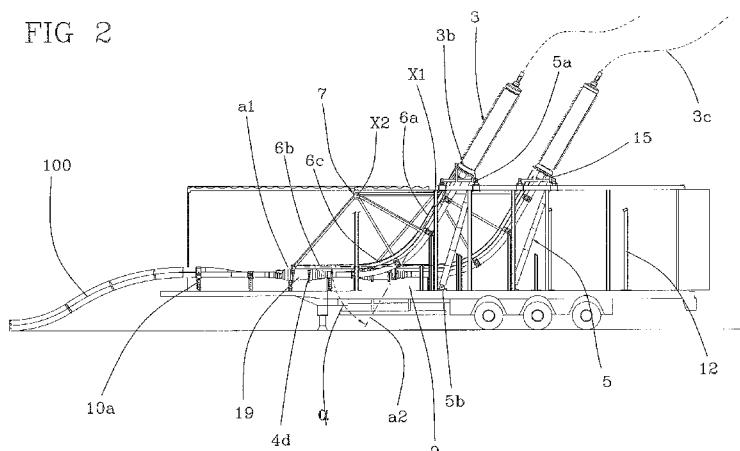
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FIG. 2



(57) Abstract: A by-pass system for overhead power lines comprises bearing frames movable between a stand-by position and an operating position, actuators for moving the bearing frames between the stand-by position and the active position, at least one outdoor termination linked to the bearing frames for being moved between the stand-by position and the operating position of the bearing frames.

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## By-pass system for overhead power lines

### Field of the invention

The present invention relates to a by-pass system for overhead power lines.

5

### Background of the invention

An overhead power line is an aerial electric power transmission line, comprising one or more bare electric conductors suspended by towers or pylons. Since most of the insulation is provided by air, overhead power lines are generally a convenient method of 10 transmission for large quantities of electric energy and are therefore mainly used for carrying high voltage (HV) current (typically higher than 30-35 kV). The overhead power lines need towers for being supported and insulators for insulating the structure of the towers (typically lattice type steel towers) from each conductor of the overhead electric energy transmission line; the ends of the insulated cable are connected to the 15 overhead power lines at the relevant terminal stations or substations by means of components, called terminations, suitable to provide the required transition from the bare conductor of the aerial line, insulated by air, to a cable, having a conductor covered by an insulation layer and an earthed electric screening.

Overhead power lines typically comprise substations as part of electrical 20 generation, transmission, and distribution system. For example, substations transform voltage from high to low, or the reverse, connect the overhead power lines to cabled lines, or perform any of several other functions of the electric network.

Ordinary and extraordinary maintenance need to be performed on overhead power 25 lines, especially in the substations, for example when refurbishment and reconstruction of tower and overhead power lines occurs; when restoration or expansion in substations is required; when power transformers, circuit breakers, switchgears, shunts, or other components of a substation are to be replaced.

Such operations are performed by disconnecting all the components involved in 30 the maintenance activity from the electric transmission line. Temporary by-pass systems which connect input and output points within the substations are used in order to guarantee the continuity of electric power supply to the users during the maintenance period. Typically, at least one of the ends of the by-pass system, or both of them, is connected to the overhead power line.

An example of by-pass system for overhead power lines is described in HVSBL January 2006 by Silec Cable ([www.sileccable.com/Portals/france/pdf/en/2151\\_HVSBL.pdf](http://www.sileccable.com/Portals/france/pdf/en/2151_HVSBL.pdf)).

According to this publication, a three phase High Voltage Stand-By Link (HVSBL) system is composed of three lengths of cable equipped with two synthetic terminations pre-mounted in factory; three dedicated drums allowing storage, transportation and unwinding and rewinding of the lengths equipped with their terminations; six metallic structures for supporting the terminations during use (optional).

The illustrated link systems are conditioned on dedicated metallic drums fitted out to contain and protect the cable equipped with its two terminations. A three phase link system may comprise one single drum of 2.6 m in diameter equipped with three compartments allowing to install on the same drum the three phases of a 90 kV HVSBL of 20 m, to three specific drums of 4.7 m each one containing one phase of a 225 kV HVSBL of 350 m. Generally, the terminations are installed in protections (tube or under-frame) positioned and fastened on the inner side of the drum (for transportation). Termination length increases with voltage and can be comprised between 1.8 m for 90 kV and 2.8 m for 225 kV. Drums delivered, laying equipment and routine tools are transported by truck from a storage yard to the installation site. A metallic structure supporting the terminations during operation can be a metallic structure allowing the mechanical support of a termination; each termination is lifted by a crane for being positioned on the top of a respective metallic structure and mechanically coupled thereto.

Typically, the installation procedure of temporary by-pass links for a three-phase power line comprises the following steps:

- unloading three link-bearing drums from a truck, by means of a crane;
- unwinding a cable length of each link from each drum and lay it down to the site of connection of the outdoor termination thereof;
- providing the site of connection with a supporting structure for each outdoor termination of each link;
- connecting each outdoor termination to the overhead power line and the other cable end to another power line.

Such a procedure takes a substantial amount of time (e.g. many work weeks, especially in case of termination for voltage higher than 200 kV), and this is a critical, especially in case of a line failure to be restored.

Due to the necessity of maintaining or repairing overhead power lines, by-passing 5 certain positions or points of an electric energy transmission line is usually a mandatory operation to guarantee safe condition and to guarantee the electric power supply to the users.

The Applicant has observed that it would be advantageous to have short operating time for providing by-pass on electric energy transmission lines.

10 In particular, the Applicant has tackled the problem of providing a by-pass system for overhead power lines which requires shorter time and few staff for being installed in the field, compared with conventional ones.

#### Summary of the invention

The Applicant found that the above mentioned problems can be solved by a by-pass link system for AC high voltage electric lines comprising, for each phase, an 15 outdoor termination, a cable length and a cable joint, pre-assembled and transportable to the site of connection with the overhead power line.

In particular, the Applicant has found that quick installation of a by-pass link system can be obtained by arranging an outdoor termination, a cable length and a cable 20 joint on a supporting apparatus, movable from an idle position to an operating position and further acting as a bearing structure for supporting the outdoor termination in operation mode for the time during which the by-pass link is operated.

In one aspect, the present invention relates to a by-pass system for overhead power lines comprising

- 25 - a housing;
- a bearing frame in said housing,
- an outdoor termination linked to the bearing frame,

wherein said bearing frame is movable between a stand-by position and an operating position of the outdoor termination;

- 30 - an electrical cable electrically connected to outdoor termination.

In a preferred embodiment the housing of the present by-pass is transportable. In particular, a transportable housing can be arranged on a vehicle or can be part of a vehicle.

In the stand-by position the outdoor termination is inside said housing, so that transportation can be enabled with reduced bulk, and extends at least partially outside said housing in operating position of the outdoor termination.

Preferably, said electrical cable is attached to the bearing frame for being moved 5 integrally with said outdoor termination between the stand-by position and the operating position of the outdoor termination.

Preferably, said bearing frame is rotatable within the housing about an axis of rotation for moving from the stand-by position to the operating position.

Conveniently, typically for use for a three phase electrical line, three bearing 10 frames are housed within the housing.

Preferably, at least two bearing frames are spaced lengthwise within the housing.

Preferably, three bearing frames are housed within the housing, and the relevant axes of rotation are at angle with each other in the vertical plane.

In a preferred embodiment, the bearing frame comprises a beam having a 15 substantially curved shape, said outdoor termination is mechanically secured to a first end of said beam and said electrical cable is attached to said beam. Preferably, said bearing frame comprises a plurality of struts having first ends attached to said beam and second ends converging towards a hinge forming the axis of rotation of the bearing frame.

20 Preferably the by-pass system comprises a central bearing frame and two side bearing frames holding relevant outdoor terminations, arranged on opposite sides relative to the central bearing frame, in which the axis of rotation of the central bearing frame has a substantially horizontal lay and the axes of rotation of the side bearing frames are inclined relative to the axis of rotation of the central bearing frame, whereby 25 the central bearing frame is rotatable in a first substantially vertical plane and the side bearing frames are rotatable in respective second and third planes, diverging upwise.

Preferably, a prefabricated cable joint is connected to the end of the electrical cable opposite to the end connected to the outdoor termination.

30 Advantageously, the cable joint provided at the second end of the electrical cable is of the type enabling quick connection to the electric network (plug-in connection).

Preferably, the housing holds an actuator operably connected with the bearing frame for causing the movement thereof between said stand-by position and said operating position of the outdoor termination.

More preferably, said actuator is a linear actuator, operating on an axis not intersecting the axis of rotation of the bearing frame.

In a second aspect the present invention relates to a method for operating a by-pass of a section of an electric line having an overhead end, which comprises:

- 5     - providing a by-pass system including a bearing frame contained in a housing, with an outdoor termination linked to the bearing frame and an electrical cable electrically connected to said outdoor termination at an end thereof;
- 10    - disposing said by-pass system in the proximity of said section of an electric line, while bearing frame is in a stand-by position;
- 15    - moving said bearing frame in an operating position of the outdoor termination;
- 20    - electrically connecting said outdoor termination to said overhead end of the electric line section.

Preferably, the method further comprises providing a prefabricated cable joint attached to an end of said electrical cable opposite to the end electrically connected to said outdoor termination and electrically connecting said prefabricated joint to an end of said section of an electric line opposite to said overhead end.

Within the present description, the term “transportable” means designed for being transferred from a place, for example a remote storage, to the place of operation.

The term “outdoor termination” as used herein refers to a component in which an end of an insulated electric cable is accommodated, having a connector for connection with an aerial electric line, connected with the cable conductor, and a insulation and screening structure suitable for providing insulation between the connector and the earth.

Within the present description, with “active position” or “operating position” it is meant a position in which the outdoor termination can be electrically connected to an overhead power line. In this position the termination is arranged for operating in the line, both from a mechanical and the electrical point of view.

Within the present description, with “stand-by position” it is meant a position in which the outdoor termination is housed and enveloped inside the housing for protection, storage and transportation.

Within the present description, as “electrical cable” is intended an insulated electrical cable, unless otherwise specified.

The bearing frames allow the electrical connection lines of the by-pass system as a whole, and the outdoor terminations in particular, to be easily and quickly placed in a condition ready for operation. This allows avoiding the need to perform a direct management of the outdoor terminations which require hauling and supporting means for being moved and transported as independent parts of a by-pass link.

5 The bearing frame allows the outdoor termination to be held in position for the electric connection without the need of mounting additional props or the like, as required by the known by-pass systems.

Preferably, the housing is associated with a plurality of wheels for road 10 transportation.

More preferably, the housing is supported on a truck trailer.

Preferably, the housing comprises side walls, a top wall and a base wall, said walls forming a container enclosing the bearing frame and the electrical connection line when the bearing frame is in stand-by position.

15 Preferably, at least said top wall is at least partly removable to provide a top opening in the container.

Within the present description the term "horizontal" denotes a spatial orientation substantially parallel to the ground.

Preferably, the central bearing frame and the respective outdoor termination lie in 20 a substantially vertical plane, the axis of rotation of the bearing frame being perpendicular to such vertical plane.

Within the present description the term "vertical" denotes a spatial orientation substantially perpendicular to the ground.

In the preferred embodiment of the invention the side bearing frames and the 25 respective outdoor terminations lie in planes skewed relative to the vertical plane, the axes of rotation of the side bearing frames being perpendicular to the respective skewed plane.

For the purpose of the present description and of the appended claims, except where otherwise indicated, all numbers expressing amounts, quantities, percentages, and 30 so forth, are to be understood as being modified in all instances by the term "about". Also, all ranges include the maximum and minimum points disclosed and include any intermediate ranges therein, which may or may not be specifically enumerated herein.

Brief description of the drawings

The present invention will be now described more fully hereinafter with reference to the accompanying drawings.

FIG. 1 is a schematic side view of a by-pass system for overhead power lines, according to an embodiment of the present invention, in a stand by position.

5 FIG. 2 is a schematic lateral view of the by-pass system for overhead power lines of Fig. 1 in an operating position.

FIG. 3 is a top view of the by-pass system for overhead power lines of Fig. 2.

FIG. 4 is a rear view of the by-pass system for overhead power lines of Fig. 2.

FIG. 5 is a detail of the bearing frame and of the termination and cable attached 10 thereto.

FIG. 6 is a detail of a phase of the movement to locate the termination and bearing frame in operating position.

FIG. 7 is a detail showing the termination and bearing frame secured in the operating position.

15 Detailed description

With reference to the annexed figures, reference numeral 1 globally denotes a by-pass system for overhead power lines.

The by-pass system of the invention is adapted to be used for by-passing a section 20 of an electrical line wherein at least one by-pass point is overhead. The by-pass system of the invention is preferably used on high and very high voltage electrical lines, wherein by high voltage it is meant a voltage in the range between 30 kV and 150kV and by very high voltage it is meant a voltage higher than 150 kV.

The by-pass system 1 shown in the figures is an example for use on 220 kV voltage lines and the relevant substations.

25 The by-pass system comprises three bearing frames 2, arranged within a housing H, which are movable between a stand-by position (shown in figure 1) and an active or operating position (shown in figure 2).

An electrical connection line 9, comprising an electrical cable 4 and an outdoor termination 3 is supported by each bearing frame 2.

30 As shown in figure 2, the outdoor termination 3 is secured, at its bottom end 3b, to a baseplate 15 of the relevant bearing frame 2 and has its upper end 3a ready for being electrically connected to the overhead power line via an aerial conductor 3c when the by-pass system is in operating position.

The electrical cable 4 has its first end 4a electrically and mechanically connected to the outdoor termination 3. The second end 4b of the electrical cable 4 is ready for being connected to a cable 100 (figures 2 and 3), for example an electrical cable intended to be electrically connected to the second by-pass point (as shall be better explained hereinafter).

The electrical cable 4 is attached to the relevant bearing frame 2 for being moved integrally with the outdoor termination 3 between the stand-by position and the operation position of the by-pass system 1.

The by-pass system 1 further comprises actuators 5 active on the relevant bearing frames 2 for moving the same between the stand-by position and the active position.

The actuators 5 are preferably linear actuators, such as hydraulic jacks, screw jacks or the like. Alternatively, other actuators can be used, such as gear type actuators or the like.

In a further alternative, the actuators can be missing and, in such case, the bearing frames 2 are moved in operating position by means of an external apparatus, such as a crane or the like.

The bearing frames 2 comprise a beam 6 having a substantially curved shape. In particular, the beam 6 has two substantially rectilinear end portions 6a, 6b, upper and lower respectively, joined to each other by a curved portion 6c. As from figure 2, the two rectilinear portions 6a, 6b have axes a1 and a2 which are at an angle  $\alpha$  to each other. The angle  $\alpha$  ranges between  $15^\circ$  and  $80^\circ$ , preferably between  $30^\circ$  and  $60^\circ$ , even more preferably is of about  $45^\circ$ , depending on the overall size of the housing, in order to have the bearing frame 2 and the outdoor termination 3 fully enclosed within the housing H and to have the outdoor termination 3 and the second cable end 4b in a position ready for operation when the bearing frame 2 is raised.

In a preferred embodiment of the invention, the beam 6 is made of steel and has a cross-section designed to maximise the ratio between bending and twisting strength and weight. For example, the beam 6 can be a square tube, or can have T or U shaped cross-section.

The outdoor termination 3 is steadily secured to the upper end portion 6a of the beam 6 and the second end 4b of the electrical cable 4 is mechanically supported to the lower end portion 6b of the beam 6.

Preferably, the electrical cable 4 is secured to the beam 6 in a few points along the beam, in addition to the upper and lower end portions 6a, 6b of the beam 6, by collars 6d or the like.

The bearing frames 2 comprise a hinge 7 rotatable about an axis of rotation X1.

5 In the present description and in the following claims, by "hinge" it is meant any structural element that forms a constraint which allows the bearing frames 2 to rotate about an axis of rotation.

In the embodiment shown in the annexed figures, hinge 7 is an assembly including a sleeve 7a rotating about a pin 7b supported by the crossbeam 18 of the housing H. The 10 hinge 7 is arranged spaced apart from the beam 6 by the side of the beam concavity.

The hinge 7 is connected to the beam 6 by means of a plurality of struts 8 having first ends 8a connected to the beam 6 and second ends 8b converging towards the axis of rotation X1 and connected to the sleeve 7a of hinge 7.

15 The bearing frames 2 are rotatable about the axes of rotation X1, X2, X3, respectively. The passage of the bearing frames 2 from the stand-by position to the active position takes place through the rotation of the same about said axes of rotation X1, X2, X3.

In order to carry out the movement of the bearing frames 2, the actuator 5 is active on the bearing frames 2.

20 The actuator 5 is set up for exerting a direct force along a substantially rectilinear direction that does not intersect the axis of rotation X1, X2, X3 (as the case may be) of the bearing frames 2. In particular, actuator 5 comprises two ends 5a, 5b, respectively hinged to the bearing frame 2 and to a platform 10 of the housing H. In particular, end 5a of the actuator 5, hinged to the bearing frame 2, is arranged near the upper end 25 portion 6a of the beam 6 of the bearing frame 2, close to the outdoor termination 3.

In this way, the force exerted by the actuator 5 causes the rotation of the bearing frame 2 around the hinge 7.

30 The housing H of the by-pass system 1 further comprises supporting elements 11, 12 on which the bearing frames 2 rest when in the stand-by position. The supporting elements 11, 12 are preferably in the form of bracings or struts, solid with the platform 10 of the housing H, so as to hold and lock firmly the bearing frames 2 and the outdoor termination 3 relative to platform 10 during transportation.

The supporting elements 11 preferably act on the upper end portion 6a of the beam 6 of the bearing frame 2.

Preferably, the supporting elements 12 act on the outdoor termination 3 at the upper end 3a of the same (figure 1).

5 As from figure 2, the bearing frames 2 are detached from the supporting elements 11, 12 when the actuators 5 are operated to raise the bearing frames in the operating position.

If convenient, the supporting elements 11, 12 can be removed during the by-pass system operation (and placed again in position for transportation).

10 When a bearing frame 2 is raised in the operating position, as shown in figures 6 and 7, crosspieces 13 are located on the housing H (for example manually) and attached thereto by screws, fasteners or the like.

15 Conveniently, as shown in fig 6, the bearing frame 2 is raised higher than the final operating position, allowing room to insert and secure the crosspieces 13, and thereafter lowered (figure 7) to locate the bearings 13a, attached to the baseplate 15, over the crosspieces 13.

When the bearing frame 2 is in its final operating position the bearings 13a can be firmly secured to the crosspieces 13, enabling the actuator 5 to be relieved from the load.

20 The housing H is conveniently made in the form of a rigid frame extending over the platform 10. Conveniently the housing H has the size of a freight container, so that it can be carried by a truck trailer, or, alternatively, as shown in figures 1-4, it can itself be equipped with a plurality of wheels 14 so as to form a trailer or semitrailer.

25 The housing H conveniently comprises a platform 10, side walls 16, and a top wall 17. Such walls form a containment case enclosing the bearing frames 2 and the outdoor terminations 3 when the bearing frames 2 are in stand-by position.

The top wall 17 is at least partly movable for forming a top opening, so that the outdoor terminations 3 can protrude out of the housing H when the bearing frames 2 are in the active position, as shown in figure 2 and 4.

30 Preferably, the side walls 16 are movable too, for allowing easier access to the inside of the apparatus.

In a preferred embodiment of the invention, a by-pass system 1 comprises three outdoor terminations 3 (one for each of the three phases of an overhead power line) to

each one of which respective bearing frames 2 are associated. The bearing frames 2 and the other elements of the by-pass system 1 described above and associated to each outdoor termination 3 are substantially identical to each other with the exception of the following.

5 The bearing frames 2 of each outdoor termination 3 are supported on a crossbeam 18 of the housing H and are rotatable about respective axes of rotation X1, X2, X3 (figure 4). Such axes of rotation X1, X2, X3 are not parallel to each other.

In particular, the central bearing frame 2C is supported with rotation axis X1 with substantially horizontal lay, while the left and right bearing frames 2L and 2R, arranged 10 on opposite sides relative to the central one, have axes of rotation X2, X3 inclined in opposite directions. Preferably, the axes of rotation X2, X3 of the left and right bearing frames 2L and 2R are inclined mirror-wise relative to the vertical plane P1 of the central bearing frame 2C.

The inclination of the axes of rotation X2, X3 of the left and right bearing frames 15 2L and 2R is such that the corresponding planes P2, P3 (figures 3 and 4) perpendicular thereto are diverging upwise, preferably by an angle  $\beta$  with respect to the vertical plane P1 preferably in the range between  $2^\circ$  and  $45^\circ$ , more preferably in the range between  $5^\circ$  and  $20^\circ$ , even more preferably of about  $10^\circ$  (actual value of angle  $\beta$  depending on the size of the outdoor termination 3 and of the housing H).

20 The central bearing frame 2C and the respective outdoor termination 3 lie in a first substantially vertical plane P1 (figures 3 and 4) and the axis of rotation X1 of the respective bearing frame 2 is perpendicular to the first plane P1.

The left and right bearing frames 2L and 2R and the respective outdoor terminations 3 lie in respective second and third planes P2, P3 (figures 3 and 4) 25 perpendicular to the axes of rotation X2, X3 of the bearing frames 2 and, accordingly, skewed relative to the first plane P1, by the angle  $\beta$ .

In this way, the rotation of the bearing frames 2 of the left and right bearing frames 2L and 2R causes, in addition to the raising of the same, a progressive reciprocal separation between the relevant left and right outdoor terminations and between such 30 terminations and the central termination, allowing the terminations 3 to be kept in close position, so as to have a size suitable for road transportation and to be separated when in operation by an amount sufficient to avoid discharges while connected to the overhead electric network.

The second end 4b of the electrical cable 4 is set up for being electrically and mechanically connected to an extension electrical cable 100 (as shown in figures 2 and 3).

Such electrical cable 100 has the function of linking the by-pass system 1, connected to the overhead electric line by one end of the section to be bypassed, to the 5 second end of the section to be bypassed.

In case the second end of the section to be bypassed is an overhead point, the extension cable 100 shall provide the connection from a first by-pass system 1 and a second, similar by-pass system 1 connected to such overhead point.

In case the second end of the section to be bypassed is a point on the ground (or 10 underground), the extension cable 100 shall provide the connection to such point on the ground with a relevant joint.

In order to allow an easy and correct connection of the electrical cable 4 to the extension cable 100, the by-pass system comprises a cable joint 19 for each electrical cable 4 (that is, for each of the three electrical cables 4).

15 An example of cable joint that may be used is described in document US 5316492; cable joints of this type are commercially available, under the trademark CLICK FIT® (for example the model CFJ-CFJX) sold by the Applicant.

The cable joints 19 are conveniently connected to the relevant bearing frames 2 by means of latches 4d or the like (fig. 5).

20 The platform 10 comprises one or more holding elements 10a for each extension cable 100, to which the extension cable 100 are secured in operation (figure 2).

The extension cable 100 can be conveniently transported in the operation place wound on a drum, wherefrom it is unwound during the laying operations of the by-pass system, so as to provide a sufficiently long connection, for example 50 metres, in a 25 limited space (that determined by the drum).

Preferably, a corresponding extension cable 100, wound on a relevant a drum is provided for each outdoor termination 3.

In operation, the three extension cables 100 are preferably laid close each other and latched together in a trefoil arrangement, so as to form a single cord.

30 Preferably, one end of each extension cables 100 is provided with a connecting connector mating with a respective cable joint 19, and readily insertable thereinto, so as to provide a quick installation.

More preferably, both ends of the extension cables 100 are provided with connecting connectors mating with joints of the same type of the joint 19, in order to speed up the connection phase by both opposite sides of the extension cables 100.

5 In operation, the by-pass system 1 is transported by a truck trailer or the like in the proximity of the overhead power line where the bypass is to be made.

The housing H is then secured in place with suitable stands 20 or the like and the bearing frames 2 are unlatched from the supporting elements 11, 12 for allowing the bearing frames 2 to be moved.

10 During these operations, the side and top walls 16, 17 of the housing H are opened, to provide easy access.

The actuators 5 are then operated, so as to rotate the bearing frames 2, preferably one at a time.

The outdoor terminations 3 then emerge from the top opening of the housing H, reaching the condition suitable for the operation.

15 At that stage, the crosspieces 13 are placed in the relevant positions so as to hold the bearing frames 2 and the outdoor terminations 3 in the reached position.

Subsequent to the rotation of the bearing frames 2, the second end 4b of the cable 4 and the joint 19 attached thereto reach a position suitable for being electrically connected to the extension cable 100.

20 The electrical cables 4 and the extension cables 100 are then mechanically and electrically joined and steadily constrained to platform 10.

Once these operations have ended, the by-pass system is ready to be electrically connected to the electrical line to be by-passed.

Claims

1. By-pass system for overhead power lines comprising
  - a housing (H);
  - a bearing frame (2) in said housing (H),
  - 5 – an outdoor termination (3) linked to the bearing frame (2);  
wherein said bearing frame (2) is movable between a stand-by position and an operating position of the outdoor termination (3);
    - an electrical cable (4) electrically connected to outdoor termination (3).
2. By-pass system according to claim 1, wherein said housing (H) is transportable.
- 10 3. By-pass system according to claim 1, wherein said outdoor termination (3) is inside said housing (H) in a stand-by position and extends at least partially outside said housing (H) in operating position of the outdoor termination (3).
4. By-pass system according to claim 1, wherein said electrical cable (4) is attached to said bearing frame (2) for being moved integrally with said outdoor termination (3)
- 15 5. By-pass system according to claim 1, wherein said bearing frame (2) is rotatable within the housing (H) about an axis of rotation (X1, X2, X3) for moving from the stand-by position to the operating position.
- 20 6. By-pass system according to claim 1, wherein three bearing frames (2) are housed within the housing (H).
7. By-pass system according to claim 1, wherein at least two bearing frames (2) are spaced lengthwise within the housing (H).
- 25 8. By-pass system according to claim 5, wherein three bearing frames (2) are housed within the housing (H), and the relevant axes of rotation (X1, X2, X3) are at angle with each other in the vertical plane.
9. By-pass system according to claim 4, wherein said bearing frame (2) comprises a beam (6) having a substantially curved shape, said outdoor termination (3) being mechanically secured to a first end (6a) of said beam (6) and said electrical cable (4) is attached to said beam (6).
- 30 10. By-pass system according to claim 9, wherein said bearing frame (2) comprises a plurality of struts (8) having first ends (8a) connected to said beam (6) and second ends (8b) converging towards a hinge (7) forming the axis of rotation (X1, X2, X3) of

the bearing frame (2).

11. By-pass system according to claim 8, comprising a central bearing frame (2C) and two side bearing frames (2L, 2R) holding relevant outdoor terminations, arranged on opposite sides relative to the central bearing frame (2C), in which the axis of rotation

5 (X1) of the central bearing frame (2C) has a substantially horizontal lay and the axes of rotation (X2, X3) of the side bearing frames (2L, 2R) are inclined relative to the axis of rotation (X1) of the central bearing frame (2C), whereby the central bearing frame (2C) is rotatable in a first substantially vertical plane (P1) and the side bearing frames (2L, 2R) are rotatable in respective second (P2) and third plane (P3), diverging upwise by an

10 angle ( $\beta$ ) with respect to the vertical plane.

12. By-pass system according to claim 1, comprising a prefabricated joint (19) connected to the end (4b) of the electrical cable (4) opposite to the end (4a) connected to the outdoor termination (3)

13. By-pass system according to claim 1, comprising an actuator (5) hold by the housing and acting on the bearing frame (2) for the movement thereof between said stand-by position and said operating position of the outdoor termination (3).

14. By-pass system according to claim 5 and 13, wherein said actuator (5) is a linear actuator, operating on an axis not intersecting the axis of rotation (X1, X2, X3) of the bearing frame (2).

20 15. Method for operating the by-pass of a section of an electric line having an overhead end, characterized in that it comprises:

– providing a by-pass system (1) including a bearing frame (2) housed in a housing (H), with an outdoor termination (3) linked to the bearing frame (2) and an electrical cable (4) electrically connected to said outdoor termination (3) at an end (4a) thereof;

25 – disposing said by-pass system (1) in the proximity of said section of an electric line, while bearing frame (2) is in a stand-by position;

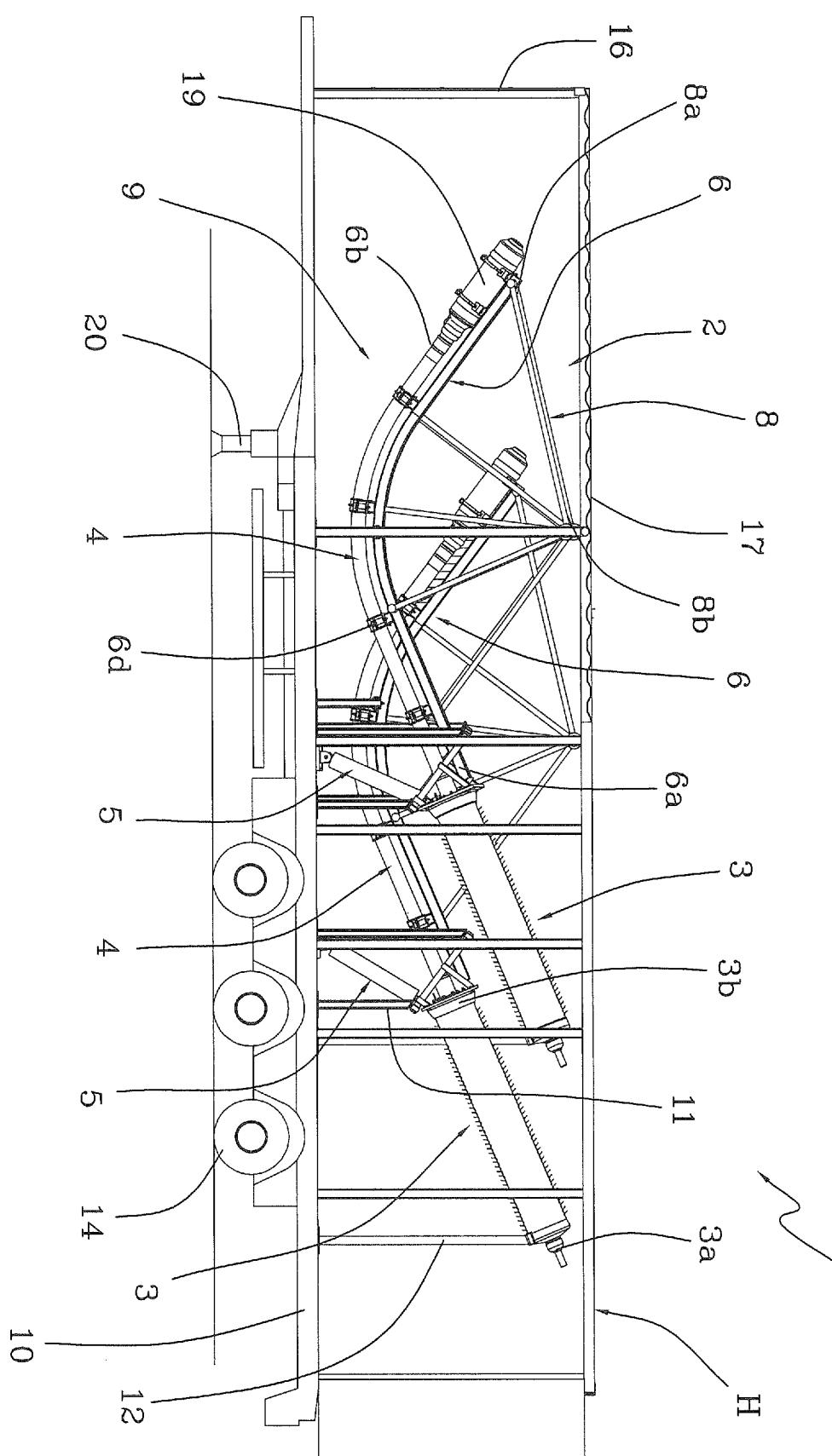
– moving said bearing frame (2) in an operating position of the outdoor termination (3);

– electrically connecting said outdoor termination (3) to said overhead end of the electric line section.

30 16. Method according to claim 15, further comprising providing a prefabricated joint (19) attached to an end (4b) of said electrical cable (4) opposite to the end (4a) electrically connected to said outdoor termination (3) and electrically connecting said

prefabricated joint (19) to an end of said section of an electric line opposite to said overhead end.

FIG 1



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FIG 2

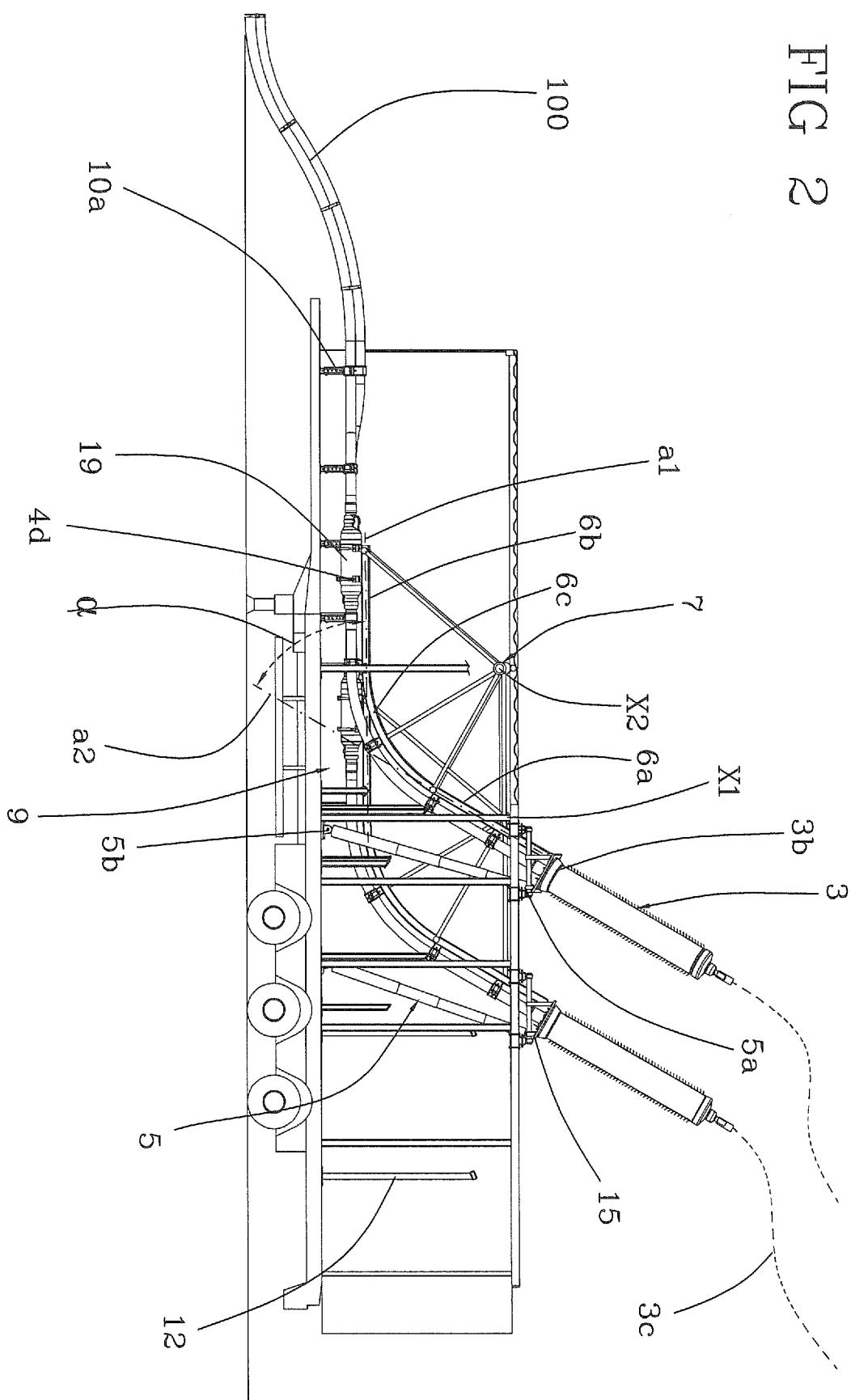
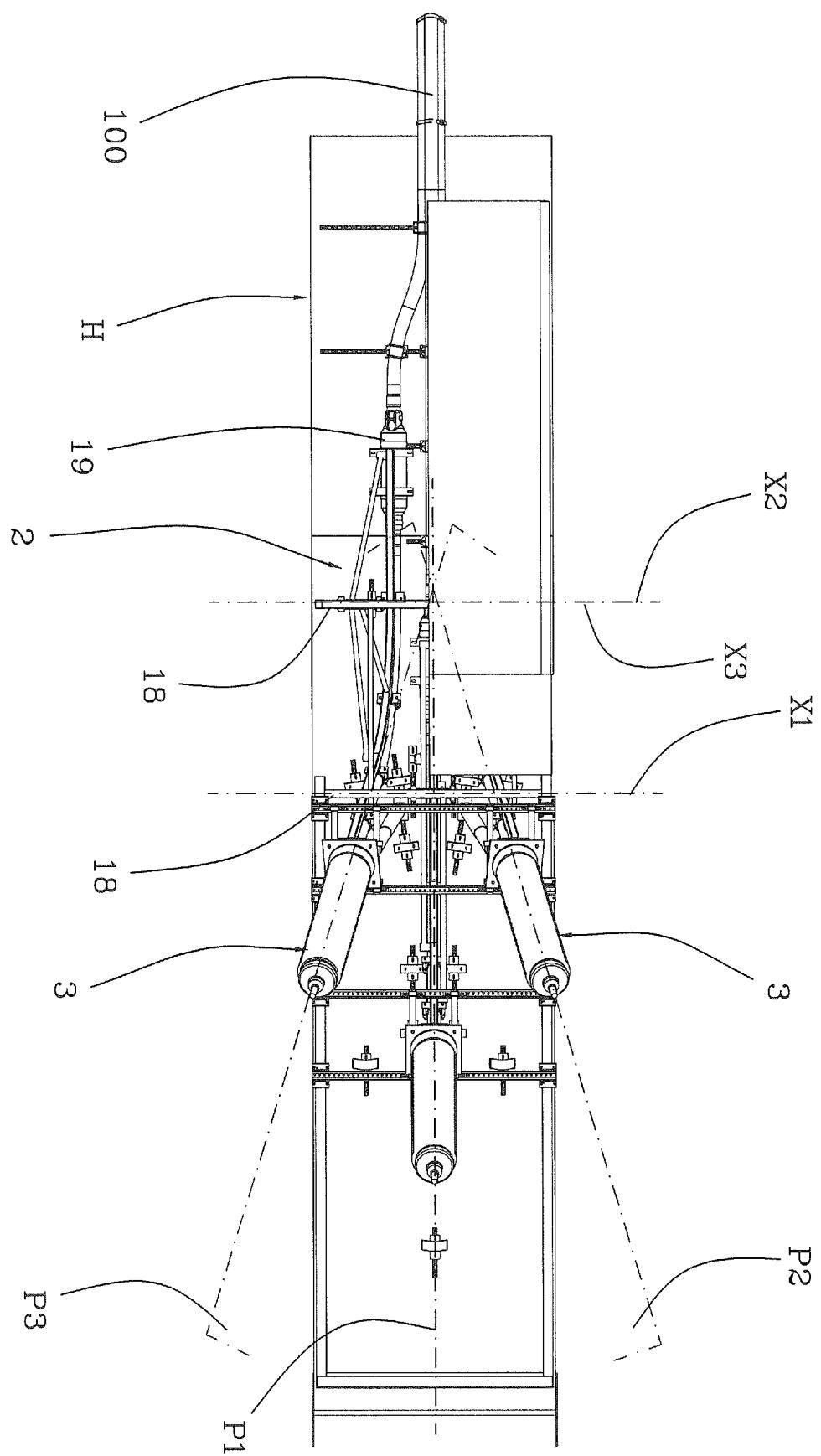


FIG 3



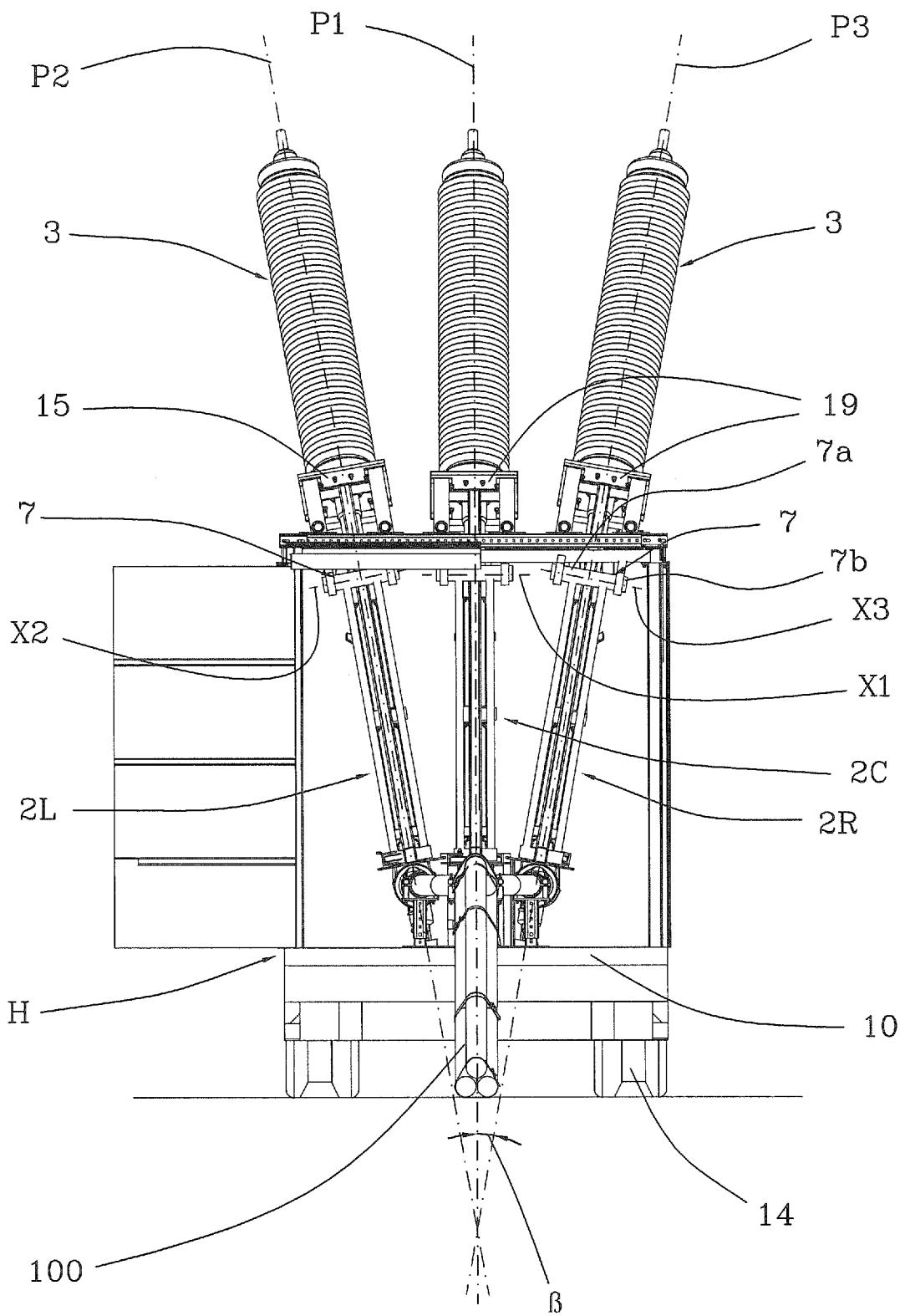


FIG 4

FIG 5

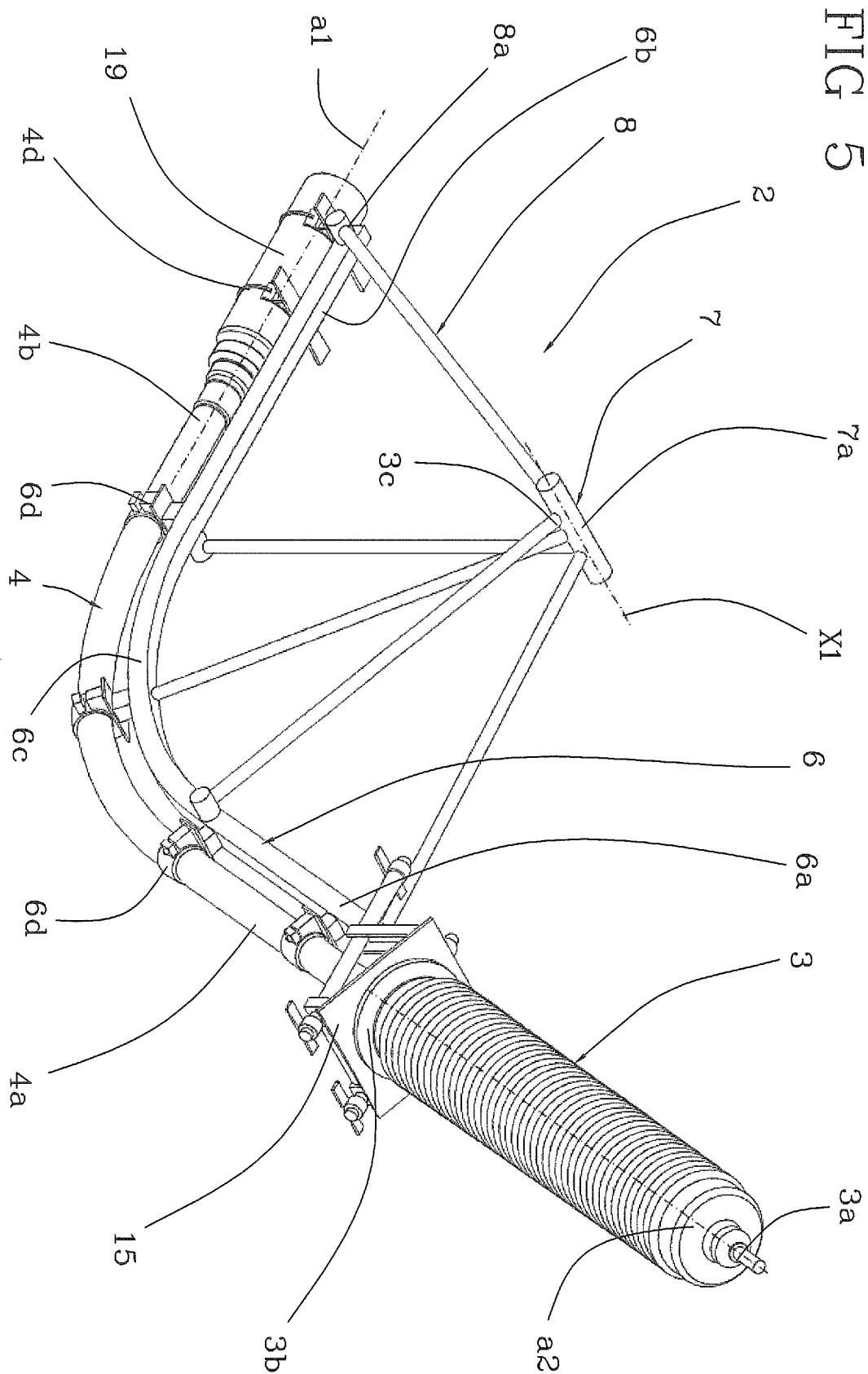


FIG 6

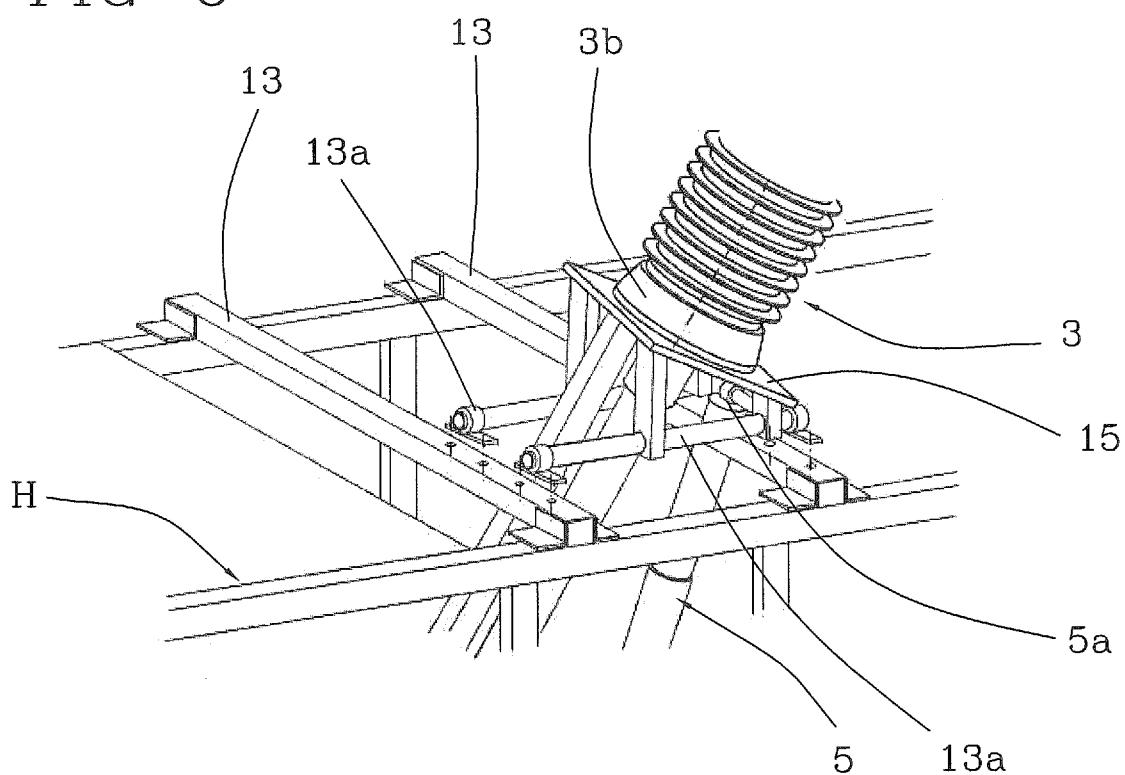
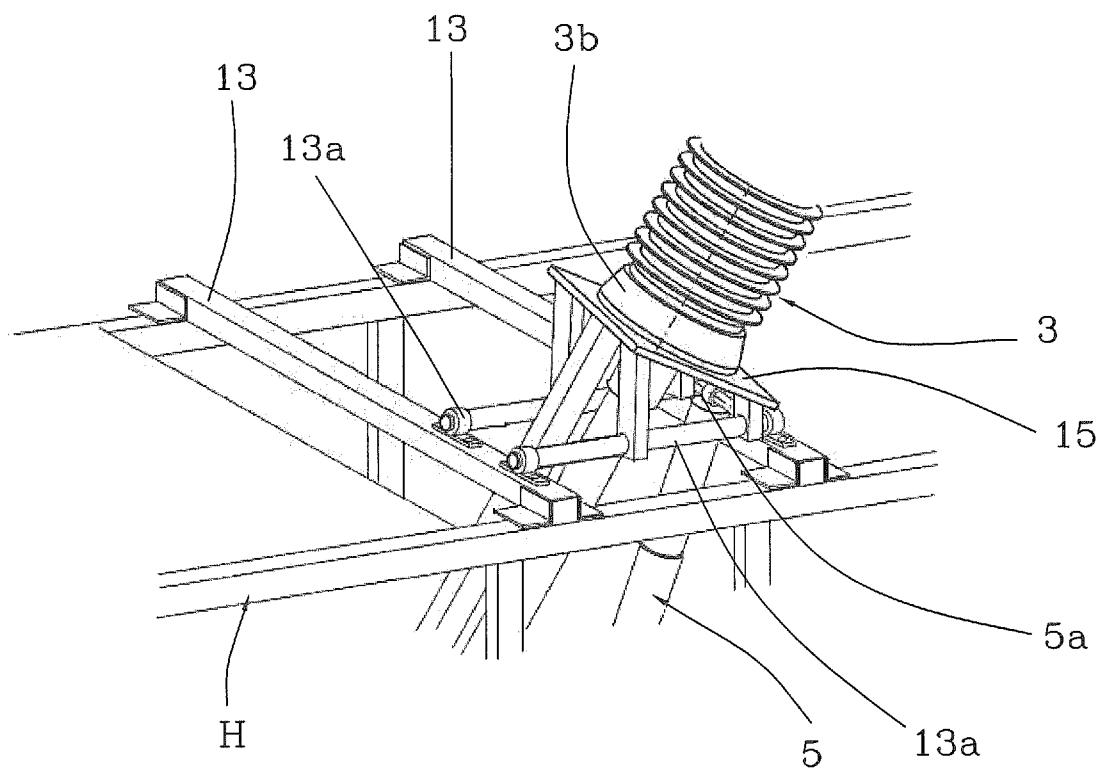


FIG 7



# INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2012/060660

**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. H02G1/04 H02B1/52  
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
H02G H02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 698 737 A1 (SCLE SA [FR]) 3 June 1994 (1994-06-03) the whole document	1-4,15
A	-----	6,13
X	US 2 237 812 A (DE BLIEUX EARL V) 8 April 1941 (1941-04-08) the whole document	1-5,15
Y	----- DE 102 09 658 A1 (ABB PATENT GMBH [DE]) 30 October 2003 (2003-10-30) the whole document	1,2,15
Y	----- US 2009/095522 A1 (BARTHOLD LIONEL O [US]) 16 April 2009 (2009-04-16) the whole document	1,2,15
	----- -/-	

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

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Date of the actual completion of the international search  21 February 2013	Date of mailing of the international search report  05/03/2013
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Bolder, Arthur

## INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/060660

## C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 586 697 B1 (ENNS JONATHAN HERMAN [CA]) 1 July 2003 (2003-07-01) the whole document -----	1,2,15
A	EP 0 774 814 A2 (ABB ADDA S P A [IT] ABB TRASMISSIONE & DISTRIBUZIO [IT]) 21 May 1997 (1997-05-21) the whole document -----	1,2,15
A	US 4 562 360 A (FUJIMOTO TSUNETOMO [JP]) 31 December 1985 (1985-12-31) the whole document -----	1,2,15

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/EP2012/060660
---

Patent document cited in search report	Publication date	Patent family member(s)			Publication date
FR 2698737	A1	03-06-1994	NONE		
US 2237812	A	08-04-1941	NONE		
DE 10209658	A1	30-10-2003	NONE		
US 2009095522	A1	16-04-2009	US 2009095522 A1 WO 2009049283 A1		16-04-2009 16-04-2009
US 6586697	B1	01-07-2003	NONE		
EP 0774814	A2	21-05-1997	AT 222409 T DE 59609559 D1 EP 0774814 A2 IT MI952388 A1		15-08-2002 19-09-2002 21-05-1997 20-05-1997
US 4562360	A	31-12-1985	BE 894671 A1 CA 1205854 A1 CH 661155 A5 JP 58057216 U JP 62011124 Y2 US 4562360 A		31-01-1983 10-06-1986 30-06-1987 18-04-1983 16-03-1987 31-12-1985