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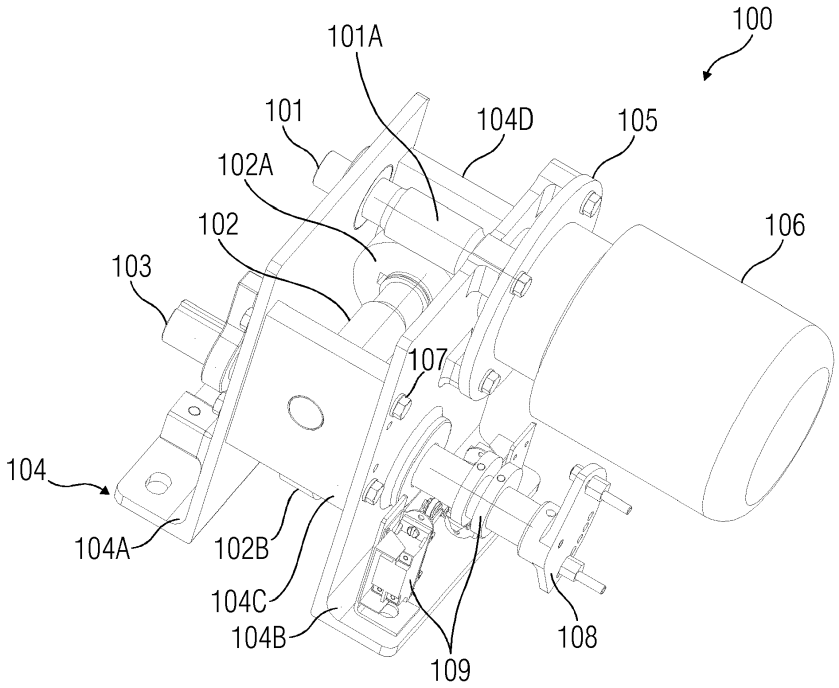
(54) OPERATING MECHANISM FOR A HIGH VOLTAGE SWITCHING DEVICE

(57) An operating mechanism (100), that is, a drive box of an electrical switching device such as a disconnector, an earthing switch, etc., is provided. The operating mechanism (100) has a mechanical transmission unit having one or more transmission stages (101-102, 102-103), and a support structure (104) at least partially accommodating the mechanical transmission unit there-within. The support structure (104) is configurable based on the one or more transmission stages (101-102, 102-103), that is, based on a nature of drive of the operating mechanism (100) including manual and motorized drive.

FIG 1



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Description

[0001] The present disclosure relates to an improved operating mechanism having a support structure for a mechanical transmission unit, in particular, a gear unit, and has a compact structure, is easy to design, suits both manual and motorized operations with minimal variations, is easy to maintain, and belongs to the field of high voltage electrical equipment.

[0002] The high voltage electrical equipment is, for example, an earthing switch or a disconnecting mechanism. A disconnecting mechanism, also referred to as a disconnector 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 disconnector is open, thus isolating the switchgear from electric supply. A commonly known type of disconnector 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 therebetween 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 therebetween. This opening and closing of the moveable arms, is powered either via manual operating mechanism such as via a hand crank, or via motorized operating mechanism. The operating mechanism generates the necessary rotatory movement with specified speed and torque to operate disconnectors and/or earthing switches, of any type. The input speed and torque are transformed in speed and torque necessary for a correct and trouble-free operation of the aforementioned devices. Further the operating mechanism provides a necessary possibility to apply a switching arrangement, so that the operation can be adequately stopped while opening or closing movement.

[0003] Typically, an operating mechanism comprises at least one stage having a device output shaft also typically referred to as a device driving shaft operably connected to a ratio generating shaft also referred to as a worm shaft. This stage forms a mechanical transmission unit powering the operating mechanism of the high voltage electrical equipment. The aforementioned single stage is typically employed in manually driven operating mechanisms. An additional stage is employed for motor driven operating mechanisms. This additional stage includes a motor output shaft operably connected to the worm shaft, that is, the ratio generating shaft of the first stage. These stages form a mechanical transmission unit powering the operating mechanism of the high voltage electrical equipment. A motor is then connected to this motor output shaft for motorizing the operating mechanism. The mechanical transmission unit including one or more stages, is typically mounted on a support structure and housed in a cover sheet to protect the operators against accidental contact with the operating mechanism. Based on the number of stages to be accommodated, the support structure for the operating mechanism has to be designed separately. Moreover, conventional operating mechanisms fail to provide an integrated design of the mechanical transmission units accommodating every shaft employed in the one or more stages. This leads to compromise and/or a limitation in freedom of selection of components, additional designing effort and in turn additional time and costs.

[0004] Accordingly, it is an object of the present invention, to provide an operating mechanism having a mechanical transmission unit which is easy to design in view of potential variations associated with different configurations of the mechanical transmission unit.

[0005] The operating mechanism disclosed herein achieves the aforementioned object by providing a support structure configured to integrally accommodate one or more stages of the mechanical transmission unit based on the type of operation, that is, manual or motorized operation with minimal changes in not only designing, for example, drawing and modeling of the operating mechanism, but also in assembling, and maintenance of the same.

[0006] Disclosed herein is an operating mechanism of an electrical switching device. The operating mechanism refers to a drive box powering switching of the electrical switching device. The electrical switching device is a high voltage electrical switching device, for example, a high voltage disconnector or a high voltage earthing switch.

[0007] The operating mechanism comprises a mechanical transmission unit having one or more transmission stages. As used herein, "mechanical transmission unit" refers to a mechanical arrangement applying a controlled power, that is, controlling speed and torque conversions from a rotating power source to another device. The mechanical transmission unit is a gear unit such as a single staged gear unit or a double-staged gear unit. A single staged gear unit is typically applied in manually driven operating mechanisms. A double staged gear unit is typically applied in motor driven operating mechanisms where the motor is operably attached to one of the stages. Each of the transmission stages comprises shafts operably engaged with one another via engaging elements. The shafts comprise, for example, a motor output shaft, a ratio generating shaft, a device driving shaft, etc. The engaging elements comprise, for example, worm wheels and extension shafts that enable the shafts to operably engage with one another according to the speed and torque conversion requirements.

[0008] The operating mechanism disclosed herein comprises a support structure at least partially accommodating the mechanical transmission unit there-within. According to one aspect, the support structure also supports mounting of a motor, one or more auxiliary electricals such as a limit switch and/or an actuation for auxiliary switches and/or a coil and a limit switch for fail-safe manual operation of the motorized variant, and one or more auxiliary mechanicals such as stoppers, bushings, flang-

es, etc., in case of a motor driven operating mechanism. Advantageously, the support structure disclosed here offers a largely common design that can fit both manually driven operating mechanism and motorized operating mechanism including an optional manual operation for the motorized in emergency cases. The support structure offers aforementioned adaptability while ensuring there are minimal changes required to be made to the support structure so as to reduce time, effort, and costs associated with designing, assembling, and maintenance of the operating mechanism.

[0009] The support structure is configurable based on the one or more transmission stages, that is, based on a nature of the drive including a manual and a motorized drive.

[0010] According to one aspect, the support structure comprises mounting plates and alignment plates adjustably connected with one another. According to this aspect, the mounting plates and the alignment plates are adjusted with respect to one another based on one or more properties of the one or more transmission stages to be accommodated within the support structure. The properties comprise, for example, a number of transmission stages, physical dimensions of the shafts employed in each transmission stage, etc. For example, when a single-staged mechanical transmission unit is to be accommodated, the mounting plates are maintained at a specific distance from one another by the alignment plates and connectors connecting the alignment plates to the mounting plates. The connectors comprise, for example, fasteners, screws, nuts, bolts, adhesive agents, links, etc. This distance is increased laterally and/or longitudinally to accommodate a double-staged mechanical transmission unit. Advantageously, the support structure can be dynamically adjusted to suit requirements of the mechanical transmission unit.

[0011] According to another aspect, the support structure comprises mounting plates and alignment plates rigidly connected with one another. According to this aspect, a die is cast to manufacture the support structure as an integral unit. According to this aspect, one or more of the mounting plates and alignment plates comprise one or more machineable areas. As used herein, "machineable areas" refers to surfaces on the mounting plate(s) and/or alignment plate(s) that are pre-defined and may be easily punched out to remove material there-from. The machineable areas are machined from the support structure based on the one or more transmission stages to be accommodated within the support structure. According to one aspect, when a double-staged mechanical transmission unit is to be accommodated, the machineable areas are removed to create space for accommodating an additional stage. According to another aspect, two separate dies are cast for single-staged and double-staged mechanical transmission units respectively. Advantageously, the design largely remains constant however dimensions are increased or decreased among the two casts thereby, still offering advantages associated with easy assembly and easy maintenance.

[0012] According to one aspect, the mounting plates of the support structure are made at least of cast iron with one or more seatings to accommodate shafts therein and connection arrangements for installing alignment plates, a housing, and auxiliaries such as flanges, electricals, etc., thereon.

[0013] According to one aspect, the alignment plates of the support structure are made at least of steel with one or more seatings for accommodating shafts therein and connection arrangements for installing mounting plates thereon.

[0014] Thus, the operating mechanism disclosed herein enables secure and simple positioning of shafts relative to one another and independent of the application, that is, motorized or manual drive.

[0015] 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.

[0016] The present invention is further described hereinafter with reference to illustrated embodiments shown in the accompanying drawings, in which:

FIG 1	illustrates a perspective view of an active part of an operating mechanism according to the present disclosure, employed to provide a motorized operation of an electrical switching device.
FIGS 2A-2B	illustrate perspective views of different configurations of active parts of an operating mechanism according to the present disclosure, employed to provide a manual operation of an electrical switching device.

[0017] 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.

[0018] FIG 1 illustrates a perspective view of an active part of an operating mechanism 100 according to an embodiment of the present disclosure, employed to provide a motorized operation of an electrical switching device, for example, a high voltage disconnector (not shown) or an earthing switch (not shown). The operating mechanism 100 includes a two-staged mechanical transmission unit. A first transmission stage includes a motor output shaft 101 operably connected to a ratio generating shaft 102. A second transmission stage includes the ratio generating shaft 102 operably connected to a device driving shaft 103. The motor output shaft 101 is engaged with

the ratio generating shaft 102 via a motor output shaft extension 101A and a first worm wheel 102A. The ratio generating shaft 102 is engaged with the device driving shaft 103 via a second worm wheel 102B.

[0019] A support structure 104 supports the mechanical transmission unit inclusive of a motor 106. The support structure 104 shown in FIG 1 is a non-casted version, that is, manufactured to have components that are assembled together with help of fasteners 107, screws, nuts, bolts, etc. The support structure 104 comprises mounting plates 104A and 104B rigidly connected to alignment plates 104C and 104D via multiple fasteners 107. The alignment plates 104C and 104D and the fasteners 107 are configured to increase or decrease a physical separation between the mounting plates 104A and 104B so as to accommodate variations in the mechanical transmission unit, for example, a single-stage or a double-staged mechanical transmission unit. The motor 106 is mounted on the motor output shaft 101 with help of a motor flange 105 biased against one of the mounting plates 104A or 104B of the support structure 104. The mounting plates 104A and 104B and the alignment plates 104C and 104D, are configured to accommodate one or more shafts 101, 102, and 103 there-through via one or more sections (not shown) machined out there-from. Moreover, the mounting plates 104A and 104B and the alignment plates 104C and 104D, are configured to support a housing (not shown) at least partially covering the mechanical transmission unit to prevent physical injuries to operators of the operating mechanism 100. Furthermore, the mounting plates 104A and 104B are configured to support electrical equipment including standardized auxiliary switch arrangement 108 and standardized limit switch arrangement 109 and/or standardized fail-safe manual operation arrangements (not shown) for motorized version only.

[0020] FIGS 2A-2B illustrate perspective views of different configurations of active parts of an operating mechanism 200 according to embodiments of the present disclosure, employed to provide a manual operation of an electrical switching device, for example, a high voltage disconnector (not shown) or an earthing switch (not shown). FIG 2A shows a side-operated manually driven operating mechanism 100 having a support structure 104 accommodating there-within a single-staged mechanical transmission unit including the ratio generating shaft 102 and the device driving shaft 103 operably connected to one another via a worm wheel 102B. The support structure 104 shown here is a casted version, that is, manufactured using a die designed as per dimensions of the mechanical transmission unit to be accommodated there-within. In the casted version, the support structure 104 has the mounting plates 104A and 104B, and the alignment plates 104C and 104D in rigid connection with one another to form one integral unit.

[0021] Physical dimensions including a space 'S' between the mounting plates 104A and 104B and a height 'H' at which the alignment plates 104C and 104D are affixed with respect to the mounting plates 104A and 104B is pre-defined based on intended application of the operating mechanism 100. The intended application being manually driven or motorized operating mechanism 100. For example, to use a similar designed support structure 104 for a motorized application, the space 'S' may be increased to accommodate a two-staged mechanical transmission unit, the height 'H' may be decreased to allow the ratio generating shaft 102 to pass there-through while maintaining stability of the overall support structure 104, and one or more areas 201 and 202 may be machined out from the mounting plates 104A and 104B respectively to accommodate a motor output shaft 101 shown in FIG 2A along the X-X' axis.

[0022] FIG 2B shows a front-operated manually driven operating mechanism 100. The support structure 104 is aligned with respect to the mechanical transmission unit, that is, the ratio generating shaft 102 and the device driving shaft 103, such that, an axis Y-Y' passing centrally through the device driving shaft 103 is orthogonal to a plane Z-Z' in which the mounting plates 104A and 104B are positioned.

[0023] Thus, the support structure 104 serves to be a multi-purpose support structure 104 which accommodates variations not only in design stage including modelling and drawing, but in assembly stage as well as maintenance stage.

[0024] 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.

Reference list

[0025]

100	operating mechanism
101	motor output shaft
101A	motor output shaft extension
102	ratio generating shaft
102A	first worm wheel
102B	second worm wheel
101A, 102A, 102B	engaging elements
103	device driving shaft
104	support structure
104A, 104B	mounting plate
104C, 104D	alignment plate
105	motor flange
106	motor

107	fastener(s)
108	auxiliary switch arrangement
109	limit switch arrangement
201, 202	areas machineable from support structure

Claims

1. An operating mechanism (100) of an electrical switching device, comprising:

- a mechanical transmission unit having one or more transmission stages (101-102, 102-103); **characterized by**:
- a support structure (104) at least partially accommodating the mechanical transmission unit there-within, wherein the support structure (104) is configurable based on the one or more transmission stages (101-102, 102-103).

2. The operating mechanism (100) according to claim 1, wherein each of the transmission stages (101-102, 102-103) comprises shafts (101, 102, 103) operably engaged with one another via engaging elements (101A, 102A, 102B).

3. The operating mechanism (100) according to claim 1, wherein the support structure (104) comprises mounting plates (104A, 104B) and alignment plates (104C, 104D) adjustably connected with one another.

4. The operating mechanism (100) according to claim 3, wherein the mounting plates (104A, 104B) and the alignment plates (104C, 104D) are adjusted with respect to one another based on one or more properties of the one or more transmission stages (101-102, 102-103) to be accommodated within the support structure (104).

5. The operating mechanism (100) according to claim 1, wherein the support structure (104) comprises mounting plates (104A, 104B) and alignment plates (104C, 104D) rigidly connected with one another.

6. The operating mechanism (100) according to claim 5,
wherein one or more of the mounting plates (104A, 104B) and alignment plates (104C, 104D) of the support structure (104) comprise one or more machineable areas (201, 202).

7. The operating mechanism (100) according to claim 6,
wherein the one or more machinable areas (201, 202) are machined from the support structure (104) based on the one or more transmission stages (101-102, 102-103) to be accommodated within the support structure (104).

8. The operating mechanism (100) according to any one of the previous claims, wherein the electrical switching device is one of a high voltage disconnector and a high voltage earthing switch.

FIG 1

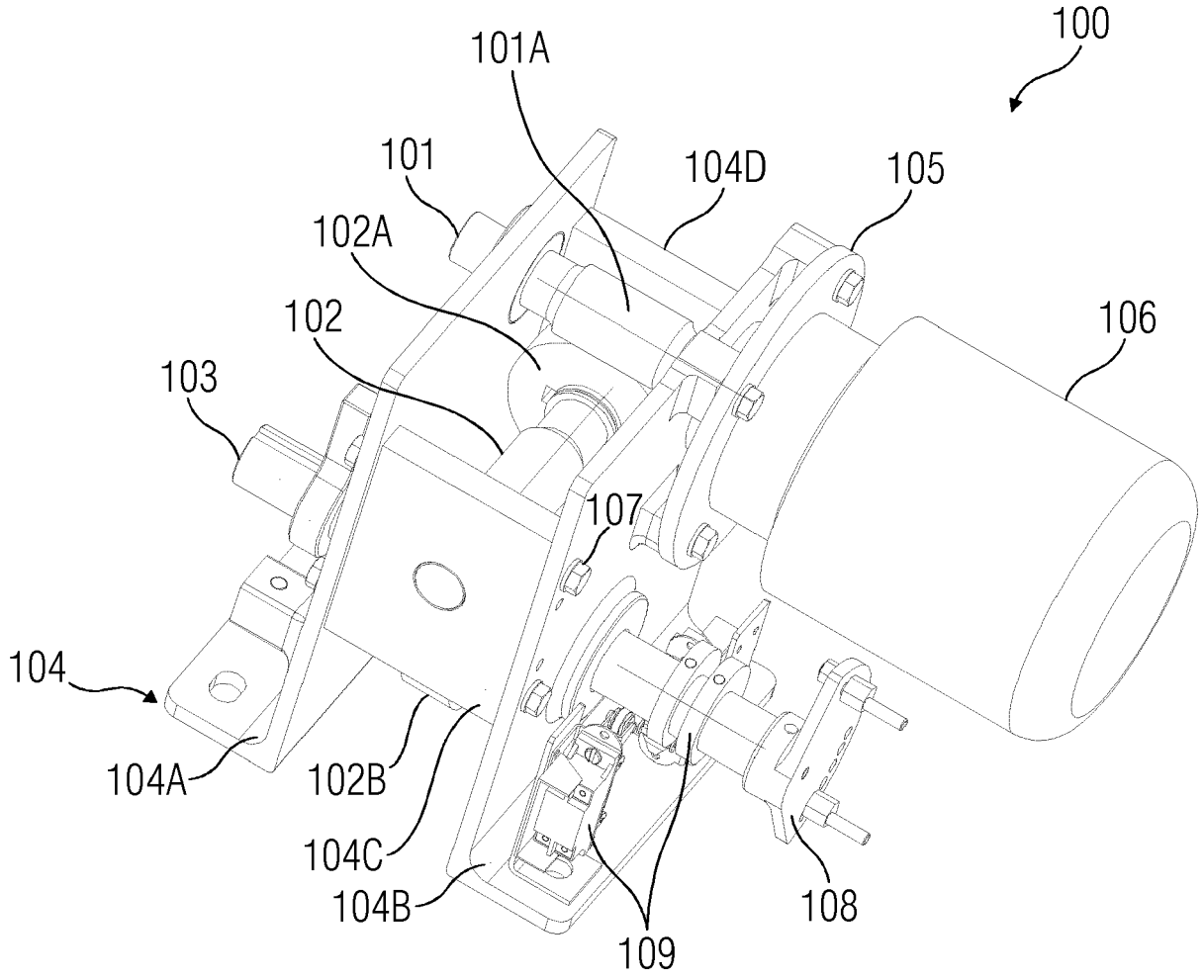

100
101A
101
104D
105
102A
102
106
103
107
104
104A
102B
104C
104B
108
109

FIG 2A

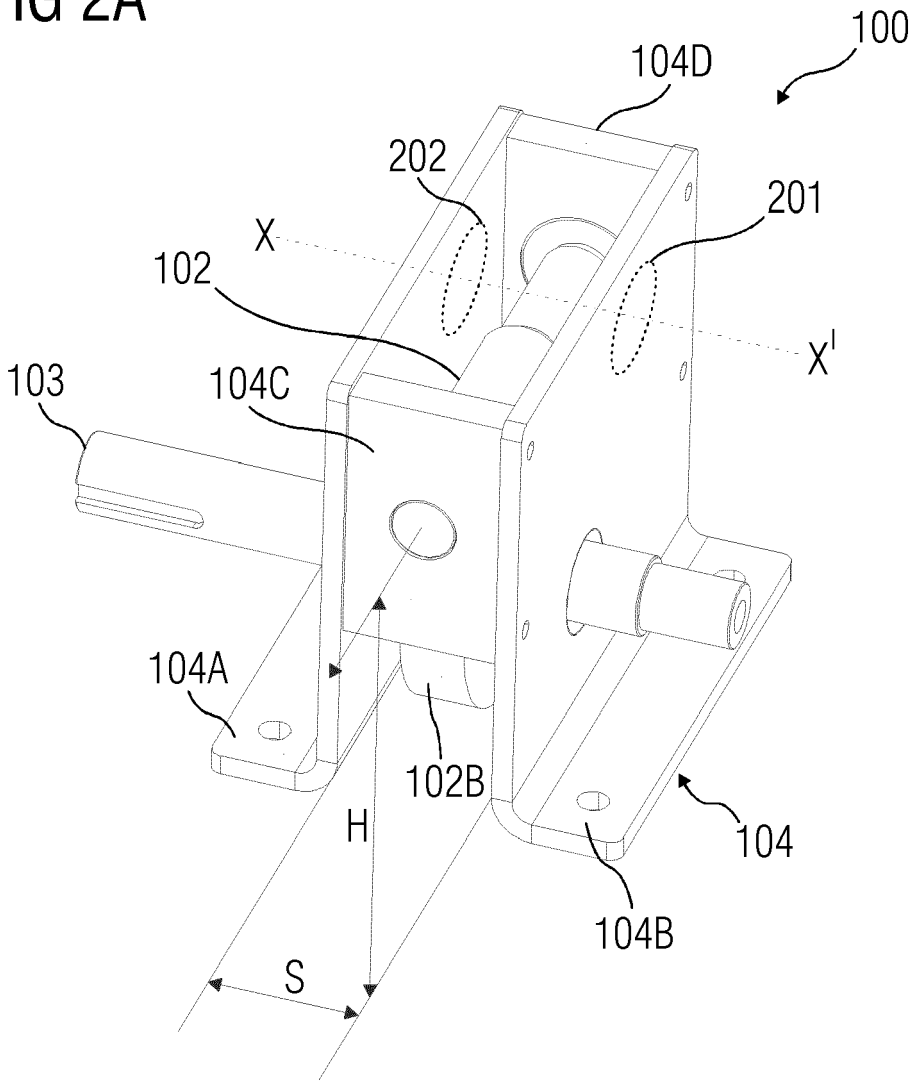
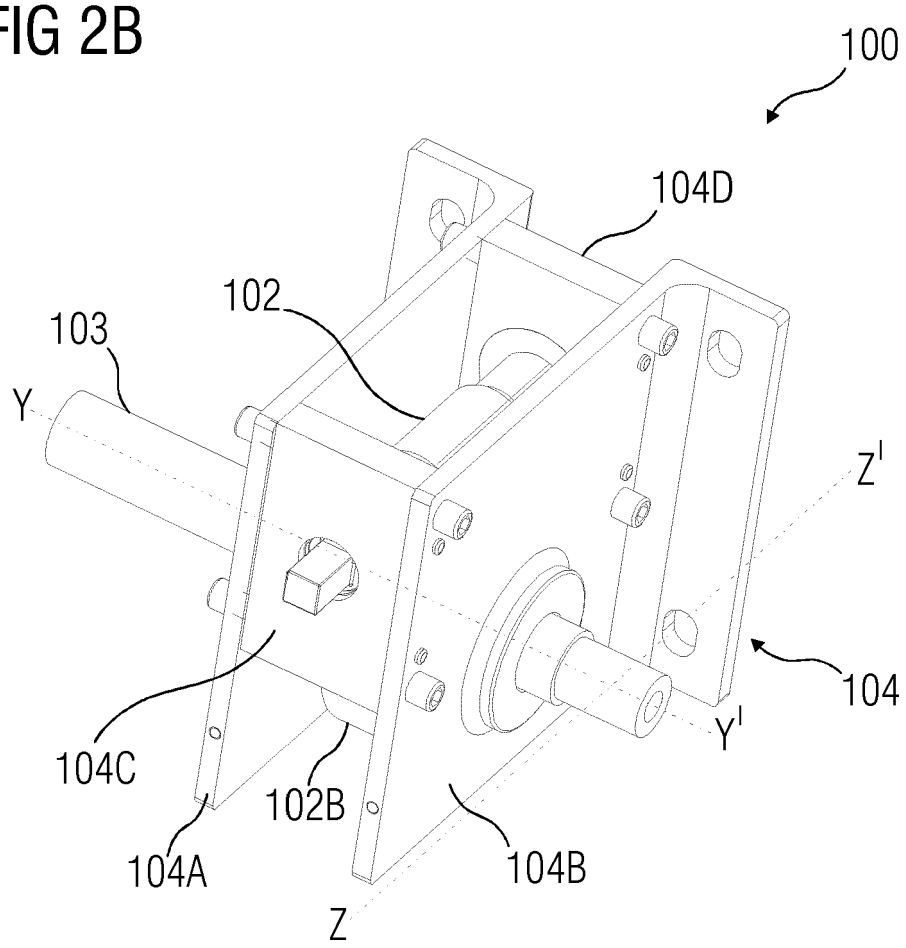


FIG 2B



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EUROPEAN SEARCH REPORT

Application Number
EP 19 20 2717

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 117 701 A (THURIES EDMOND [FR] ET AL) 2 June 1992 (1992-06-02)	1-4	INV. H01H31/02
Y	* column 2, line 52 - column 5, line 65; figures 1-3 *	5-8	ADD. H01H31/00
X	US 3 761 735 A (TURNER J ET AL) 25 September 1973 (1973-09-25)	1,2,8	H01H3/22
Y	* column 2, line 34 - column 11, line 22; claims 4-6; figures 1,3,4,7,8 *	3-7	
X	US 3 324 258 A (AREM FOTI ET AL) 6 June 1967 (1967-06-06)	1,2,8	
Y	* column 3, line 66 - column 10, line 5; figures 3-5B *	3-7	
Y	EP 3 223 290 A1 (ABB SCHWEIZ AG [CH]) 27 September 2017 (2017-09-27)	3-8	
A	* page 2, paragraph 0016 - page 4, paragraph 0019; figures 1-3 *	1,2	

TECHNICAL FIELDS SEARCHED (IPC)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 March 2020	Pavlov, Valeri

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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