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(54) **IMPROVED JOYSTICK FOR A WORK VEHICLE**

(57) Joystick for a work vehicle (1), comprising a base (21) configured to be carried by a portion of the work vehicle (1), a stem portion (22) extending from the base (21) along a stem axis (A), an inner portion (23) carried by the stem portion (22), and a plurality of outer portions (24) arranged radially outward from the inner portion (23), wherein each outer portion (24) is movably carried by the inner portion (23) and movable between a first configuration, open, wherein the outer portion (24) is arranged at a first angle with respect to the stem axis (A), and a second configuration, closed, wherein the outer portion (24) is arranged at a second angle with respect to the stem axis (A), the second angle being smaller in absolute value than the first angle.

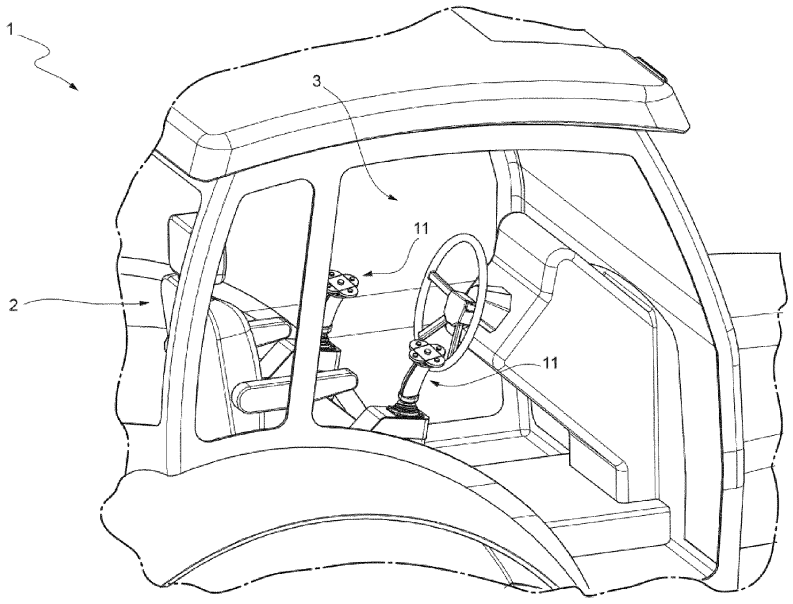

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention concerns a joystick, in particular a joystick for a work vehicle such as an agricultural vehicle or an earth-moving machine.

BACKGROUND OF THE INVENTION

[0002] Work vehicles such as agricultural vehicles, e. g. a tractor, comprise a plurality of operational elements such as a three-point hitch, rear valves, power take off modules which can be controlled by the operator of the vehicle to perform respective work activities.

[0003] A similar situation is present on earth-moving machines, where the operator can activate operational elements such as blades or buckets.

[0004] The control of such operational elements is provided via joysticks movable by the operator. In particular, the work vehicle comprises at least one joystick, which is located in the cabin and can typically move along a longitudinal direction, i.e. along a longitudinal axis of the work vehicle, and/or a transversal direction, i.e. transversal with respect to the aforementioned longitudinal axis.

[0005] The arrangement and possible movement of the joystick by the operator may cause interferences with other cabin elements and/or the operator's body. In particular, since the joystick is operated by a hand of the operator, it is typically located laterally with respect to the operator's legs for ergonomic reasons. However, moving the joystick between the two extremes of the transversal direction may cause interferences with cabin elements such as cabin covers and, respectively, a knee or leg of the operator.

[0006] Furthermore, the peculiar arrangement of the joystick may provide discomfort to the operator. In particular, moving the joystick along the longitudinal direction may be uncomfortable for the operator, especially when the joystick is in its furthermost position from the operator.

[0007] In addition, the joystick typically comprises a base provided with a plurality of control elements, such as buttons, whose arrangement may increase operator discomfort when operating them.

[0008] In order to improve control, the work vehicle may comprise several joysticks, which are typically located on the left and right side of the operator and are different from one another, thus increasing the cost of tools, moulds and management. The aforementioned problems related to interferences with other cabin elements and/or the operator's body are also increased.

[0009] Therefore, the need is felt to improve ergonomics and comfort of the operator.

[0010] An aim of the present invention is to satisfy the above-mentioned needs in a cost-effective and optimised manner.

SUMMARY OF THE INVENTION

[0011] The aforementioned aim is reached by a joystick and a work vehicle as claimed in the appended set of claims.

BRIEF DESCRIPTION OF DRAWINGS

[0012] For a better understanding of the present invention, a preferred embodiment is described in the following, by way of a non-limiting example, with reference to the attached drawings wherein:

- figure 1 is a perspective view of an interior of a work vehicle provided with a joystick according to the invention;
- figure 2 is a front view of the joystick according to the invention;
- figures 3a, 3b are cross-sectional views, along line III-III of figure 2, of a portion of the joystick of figure 2 in two different operative configurations;
- figure 4a is a cross-sectional view, along line III-III of figure 2, of a first embodiment of the joystick of figure 2; and
- figure 4b is a cross-sectional view, along line III-III of figure 2, of a second embodiment of the joystick of figure 2.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Figure 1 shows an exemplarily interior space of a cab of a work vehicle 1, shown only partially for the sake of clarity.

[0014] As is known, the work vehicle 1 comprises a driver seat 2 for an operator of the work vehicle 1 and command means 3, e.g. a steering system and brake pedals.

[0015] The work vehicle 1 comprises a joystick 11 for controlling operational elements (not shown) thereof, such as a three-point hitch, rear valves, power take off modules, blades or buckets. Such operational elements are controlled by the operator, who acts on the joystick 11, so as to perform specific work tasks of the work vehicle 1.

[0016] For ergonomic reasons, the joystick 11 may be located laterally with respect to the driver seat 2, wherein a base 21 of the joystick 11 is conveniently fixed. However, the joystick 11 may be located in other positions within reach of an operator's hand.

[0017] The joystick 11 (figures 4a, 4b) comprises a stem portion 22 extending from the base 21 along a longitudinal axis A thereof, an inner portion 23 carried by the stem portion 22, and a plurality of outer portions 24 arranged radially outward from the inner portion 23, as described in detail hereinafter.

[0018] The stem portion 22 defines a support structure for the inner portion 23 of the joystick 11, and is substantially a rod whose cross-sections orthogonal to the lon-

gitudinal axis A may have any shape, e.g. circular or rectangular. The stem portion 22 has a first end 31 carried by the base 21 and a second end 32, opposite to the first end 31, configured to carry the inner portion 23.

[0019] According to a first embodiment (figure 4a), the second end 32 is rigidly coupled to the base 21. In this embodiment, the stem portion 22 is fixedly carried by the base 21, i.e. the longitudinal axis A is fixed with respect to the base 21.

[0020] According to a second embodiment (figure 4b), the second end 32 (figure 4b) is carried in a movable manner by the stem portion 22. Therefore, the longitudinal axis A is movable with respect to the base 21. In particular, it is carried in a movable manner along a longitudinal direction of the work vehicle 1. According to the exemplarily shown embodiment, the second end 32 of the stem portion 22 is hinged to the base 21, i.e. the longitudinal axis A is rotatable about a hinge axis B which is orthogonal to both the longitudinal axis A and the longitudinal direction of the work vehicle 1.

[0021] The inner portion 23 (figures 3a, 3b) is arranged at the first end 31 of the stem portion 22, i.e. the terminal end of the stem portion 22 which is opposite to the base 21.

[0022] In greater detail, the inner portion 23 is substantially coaxial to the stem portion 22. In particular, the inner portion 23 has a curved shape, e.g. as a sphere or a spherical cap, preferably a hemisphere. In the latter case, the inner portion 23 comprises a circular base 33 whose centre is intersected by an axis, orthogonal thereto, defining the axis of the inner portion 23. Such axis is substantially coincident with the longitudinal axis A.

[0023] The inner portion 23 also comprises a terminal portion 34 extending cantilevered from the circular base 33 and coaxial thereto. The terminal portion 34 is substantially a prism having two m-sided polygon bases, wherein $m \geq \mathbf{3}$. In particular, the terminal portion 34 comprises an m-sided terminal base 41 and a lateral surface 42 defined by m faces. The terminal base 41 is parallel to the circular base 33 and defines a free end of the inner portion 23.

[0024] Coming back to the outer portions 24, the number of outer portions 24 (figure 2) is ***n***, wherein $\boldsymbol{n} \geq \mathbf{2}$, and each outer portion 24 is arranged radially outward from the inner portion 23 and is movably carried by the inner portion 23.

[0025] Each outer portion 24 is movable between a first configuration, open, wherein the outer portion 24 is arranged at a first angle with respect to the longitudinal axis A (figure 3a), and a second configuration, closed, wherein the outer portion 24 is arranged at a second angle with respect to the longitudinal axis A (figure 3b).

[0026] In particular, the first angle, i.e. the angle between the outer portion 24 and the longitudinal axis A in the first configuration (figure 3a), is substantially 90 degrees. In other words, the outer portion 24 is substantially orthogonal to the longitudinal axis A, and thus substantially coplanar to the terminal base 41 of the inner portion 23.

[0027] The second angle, i.e. the angle between the outer portion 24 and the longitudinal axis A in the second configuration (figure 3b), is smaller in absolute value than the first angle. In particular, the second angle is an acute angle, i.e. it is less than 90 degrees.

[0028] Therefore, the outer portion 24 in the second configuration may face the stem 14 (figure 3b) or may be oriented in the opposite direction. In the former case, the movement of the outer portion 24 from the first configuration (figure 3a) to the second configuration (figure 3b) is towards the lateral surface 42 and up to the circular base 33 of the inner portion 23, which may conveniently act as a stop for the outer portion 24.

[0029] Conveniently, the movement of each outer portion 24 between the first configuration and the second configuration is associable with a specific operation controllable by the joystick 1.

[0030] In particular, for each outer portion 24, the movement from the first configuration to the second configuration may be associable with a first operation, and the movement from the second configuration to the first configuration may be associable with a second operation. Furthermore, if the outer portion 24 is movable both towards the stem (figure 3b) and in the opposite direction, a third and a four operations may also be associable to the movement of the outer portion 24 by taking into account whether it is moving towards the stem or in the opposite direction.

[0031] According to the exemplarily shown embodiments, the outer portions 24 are hinged to the inner portion 23 along respective hinge axes. Conveniently, such hinge axes are orthogonal to the longitudinal axis A and are all at the same axial position along the longitudinal axis A. In other words, the hinge axes are coplanar and define a plane orthogonal to the longitudinal axis A. Preferably, such plane is coincident with the terminal base 41 of the terminal portion 34.

[0032] Conveniently, $\boldsymbol{n = m}$, i.e. the number ***n*** of outer portions 24 is equal to the number ***m*** of sides of the terminal base 41. Therefore, each outer portion 24 is movably carried by, and in particular is hinged to, a respective side of the terminal base 41.

[0033] Conveniently, the outer portions 24 have substantially the same shape. In particular, each outer portion 24 is substantially a plate, e.g. shaped as a semicircle and hinged, along its diameter, to the respective side of the terminal base 41. Therefore, the outer portions 24 visually resemble the petals of a "flower".

[0034] Preferably, the shape and arrangement of the ***n*** outer portions 24 is such that they collectively form a structure having discrete axial symmetry of order ***n*** about the longitudinal axis A, i.e. the appearance of such structure is unchanged if rotated about the longitudinal axis A by an angle of $360°/\boldsymbol{n}$. In the embodiments shown, $\boldsymbol{n = 4}$ and indeed the structure of figure 2 is unchanged when rotated by an angle of 90°.

[0035] The joystick 11 also comprises a plurality of con-

trol elements.

[0036] In particular, each outer portion 24 may carry a control element, e.g. a button 51, associable with a specific operation controllable by the joystick 11. Such operation is triggered by the actuation of the button 51. The association between each button 51 and the respective operation is predetermined and may conveniently be customised, e.g. by the operator of the work vehicle 1.

[0037] Conveniently, the work vehicle 1 comprises an electronic control unit (not shown), comprising processing means, which receives signals from the outer portions 24 and/or the buttons 51, and consequently actuates the aforementioned operational element of the work vehicle 1 so as to perform the respective operations.

[0038] Therefore, specific operations are controllable by movements of the outer portion 24 and/or actuations of the buttons 51 carried by the outer portion 24.

[0039] Conveniently, the inner portion 23 may also carry at least one control element, e.g. a button 61, configured to control an operation of the work vehicle 1.

[0040] The operation of the joystick 11 according to the invention as described above is the following.

[0041] When the joystick 11 is not being used by the operator, the outer portions 24 can be left in the second configuration, i.e. the closed configuration, wherein they are closer to the longitudinal axis A and thus leave even more room for the operator of the work vehicle 1.

[0042] When the operator wishes to trigger a specific operation controllable by the joystick 11, it is sufficient to move the respective outer portion 24 and/or to actuate the respective button 51.

[0043] In view of the foregoing, the advantages of the joystick 11 according to the invention are apparent.

[0044] The movement of the outer portions 24 can replace the movement of a prior-art joystick along a longitudinal direction and/or a transversal direction. For example, if n = **4**, i.e. the joystick 11 comprises four outer portions 24, each outer portion 24 can be associated with one of the four main movements of a prior-art joystick, i.e. longitudinal and transversal movements in both directions. Therefore, the stem portion 22 of the joystick 11 does not need to be moved, thus avoiding interferences with other cabin elements and the operator's body.

[0045] In particular, the movement of the joystick 11 along the transversal direction can be prevented by either fixing the stem portion 22 to the base 21 (figure 4a) or only allowing the movement of the stem portion 22 along the longitudinal direction (figure 4b). In the latter case, not only the aforementioned interferences are avoided since the transversal motion is prevented, but also the control possibilities of the joystick 11 are increased with respect to a prior-art joystick, in view of the combination between the movements of the outer portions 24 and the longitudinal movement of the stem portion 22.

[0046] The control elements, e.g. the buttons 51 carried by the outer portions 24 and/or the buttons 61 carried by the inner portion 23, can replace the buttons provided on the base of a prior-art joystick, thus improving ergonomics and comfort of the operator.

[0047] Furthermore, the work vehicle 1 may comprise several joysticks 11, for example (figure 1) two joysticks 11 located on the left and right side of the operator and having the same structure. Such joysticks 11 allow to increase, e.g. to double, the control possibilities without increasing problems related to interferences with other cabin elements and/or the operator's body.

[0048] It is clear that modifications can be made to the described joystick 11 which do not extend beyond the scope of protection defined by the claims.

[0049] For example, the shape of the elements of the joystick 11 may be different from that described.

[0050] Furthermore, the control elements 51, 61 may be displays provided with selectable icons or any other means which can be actuated by the operator of the work vehicle 1.

[0051] As said, the connection of the base 21 via a hinge may be replaced by any other movable connection. Similarly, the outer portions 24 may be connected to the inner portion 23 via other movable connections which guarantee the same operational positions.

Claims

1. Joystick for a work vehicle (1), comprising a base (21) configured to be carried by a portion of the work vehicle (1), a stem portion (22) extending from the base (21) along a stem axis (A), an inner portion (23) carried by the stem portion (22), and a plurality of outer portions (24) arranged radially outward from the inner portion (23), wherein each outer portion (24) is movably carried by the inner portion (23) and movable between a first configuration, open, wherein the outer portion (24) is arranged at a first angle with respect to the stem axis (A), and a second configuration, closed, wherein the outer portion (24) is arranged at a second angle with respect to the stem axis (A), the second angle being smaller in absolute value than the first angle.

2. Joystick as claimed in claim 1, wherein the first angle is substantially 90 degrees.

3. Joystick as claimed in claim 1 or 2, wherein the outer portion (24) in the second configuration faces the stem portion (22).

4. Joystick as claimed in any of the preceding claims, wherein the outer portions (24) are hinged to the inner portion (23).

5. Joystick as claimed in claim 4, wherein hinge axes of the respective outer portions (24) are all at the same axial position along the stem axis (A).

6. Joystick as claimed in any of the preceding claims,

wherein the outer portions (24) have substantially the same shape.

7. Joystick as claimed in any of the preceding claims, wherein the number of outer portions (24) is n and the outer portions (24) have discrete axial symmetry of order n about the stem axis (A).

8. Joystick as claimed in any of the preceding claims, wherein each outer portion (24) is associable with a specific operation controllable by the joystick (11), said specific operation being controllable by a movement of said outer portion (24) and/or an actuation of a control element (51) carried by said outer portion (24).

9. Joystick as claimed in any of the preceding claims, wherein the inner portion (23) carries at least one control element (61) configured to control an operation of the work vehicle (1).

10. Joystick as claimed in claim 8 or 9, wherein the control element (51, 61) comprises at least one button.

11. Joystick as claimed in any of the preceding claims, wherein the inner portion (23) is substantially coaxial to the stem portion (22).

12. Joystick as claimed in any of the preceding claims, wherein the inner portion (23) is arranged at a terminal end (31) of the stem portion (22).

13. Joystick as claimed in any of the preceding claims, wherein the stem portion (22) is fixedly carried by the base (21).

14. Joystick as claimed in any of claims 1 to 12, wherein the stem portion (22) is carried in a movable manner by the base (21) along a longitudinal direction of the work vehicle (1).

15. Work vehicle comprising a joystick (11) as claimed in any of the preceding claims.

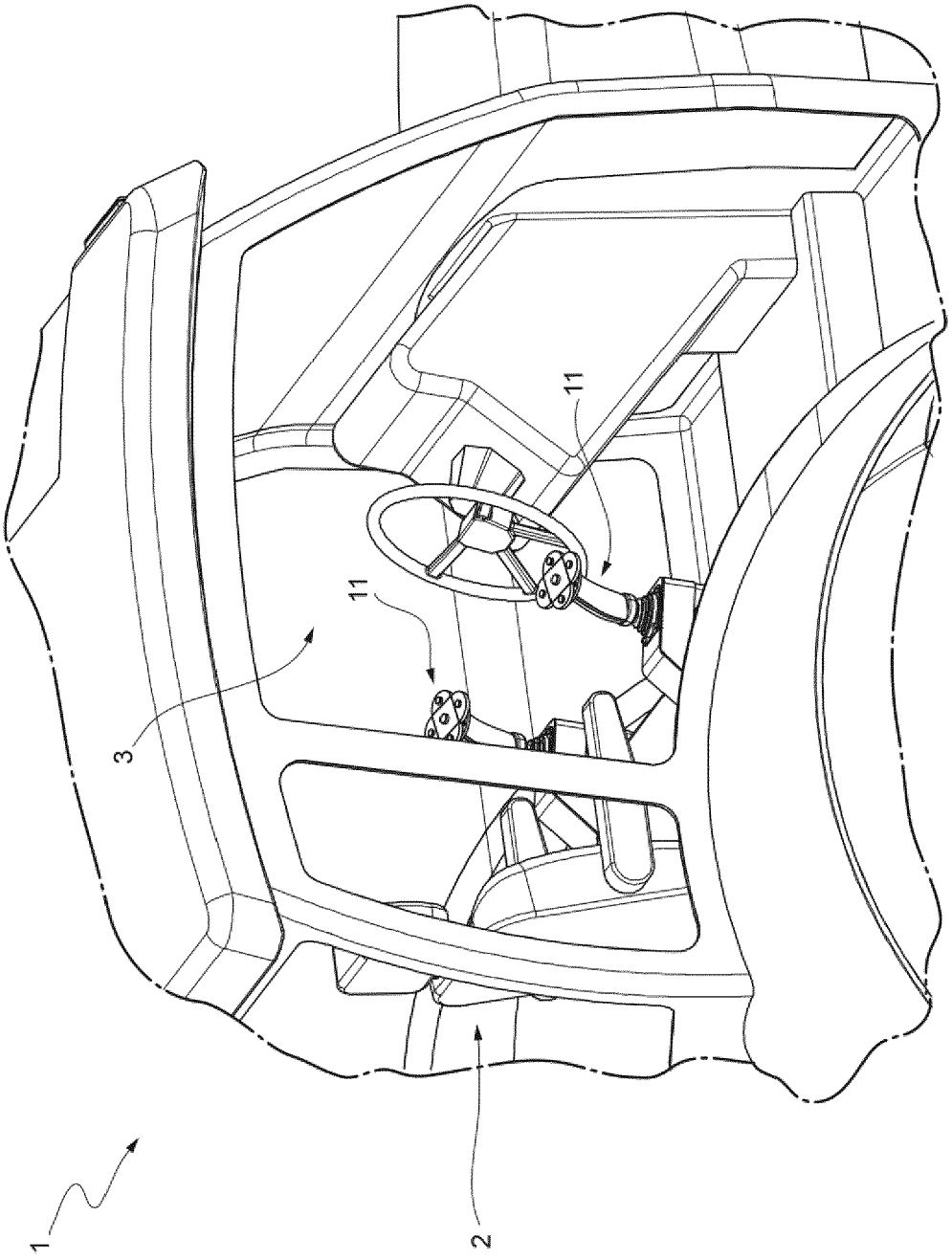

FIG. 1

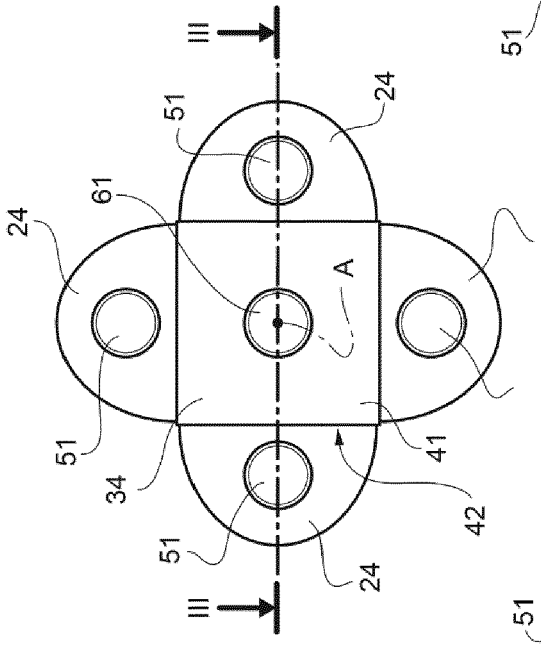

FIG. 2

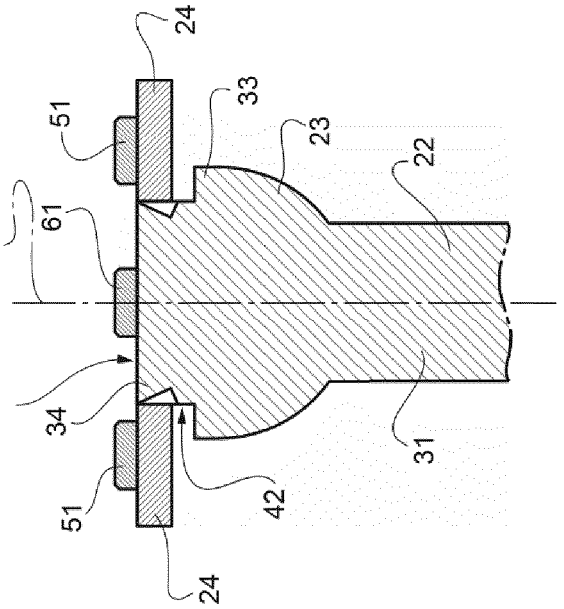

FIG. 3b

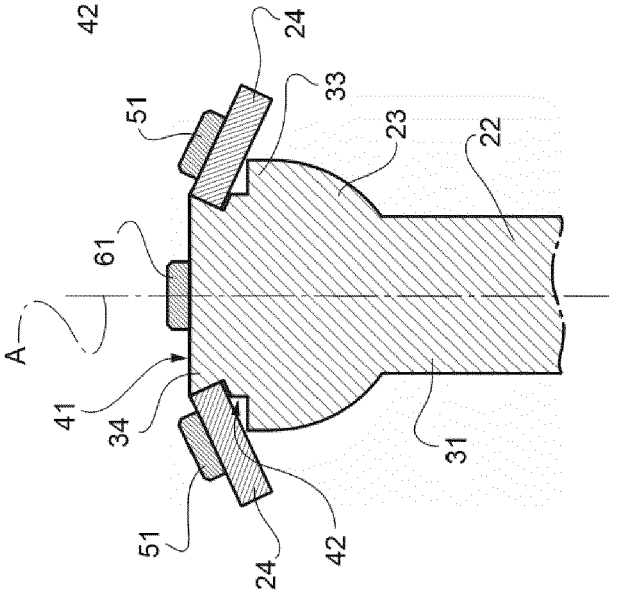

FIG. 3a

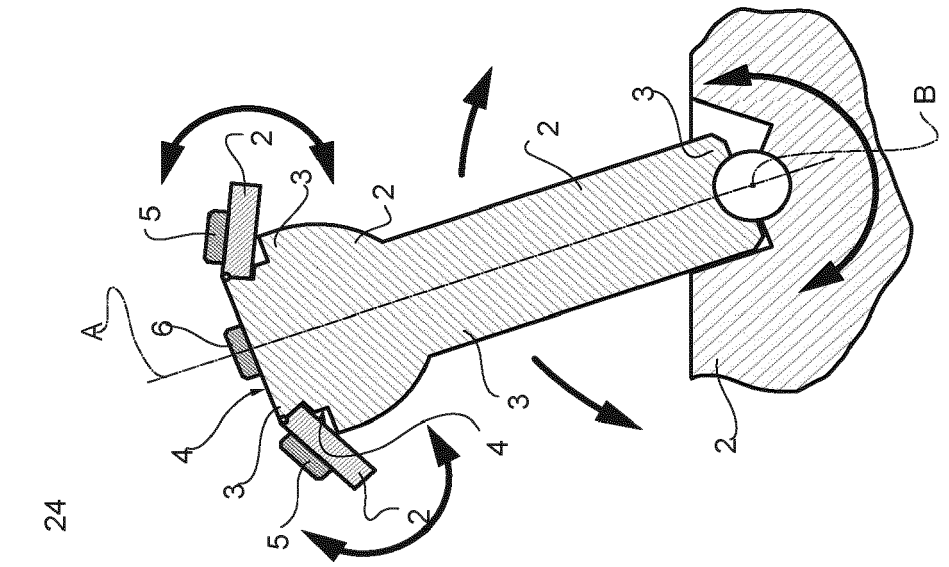

FIG. 4b

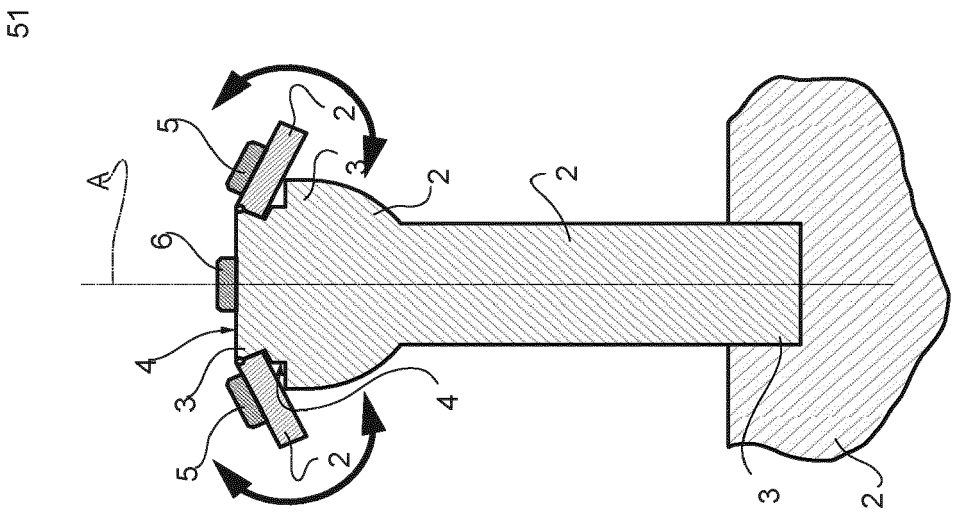

FIG. 4a

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EUROPEAN SEARCH REPORT

Application Number
EP 23 17 1922

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 A	US 2005/174331 A1 (VAYDA MARK [US]) 11 August 2005 (2005-08-11) * figures 3, 6 * * paragraphs [0002], [0060], [0062], [0076] *	1,3-6,8, 10-12,14 2,7,9, 13,15	INV. G05G9/047 E02F9/20
X Y A	US 7 271 796 B1 (MOLL ROBERT E [US] ET AL) 18 September 2007 (2007-09-18) * figure 1 * * column 1, line 7 - line 10 *	1,3,4,8, 11,12,14 13,15 2,5-7,9, 10	
Y A	EP 3 985 180 A1 (CNH IND ITALIA SPA [IT]) 20 April 2022 (2022-04-20) * figures 1, 3 * * paragraphs [0024], [0029], [0036] *	1,3-6,8, 9,11,12, 14,15 2,7,10, 13	
Y A	EP 3 425 487 A1 (SONY INTERACTIVE ENTERTAINMENT INC [JP]) 9 January 2019 (2019-01-09) * figures 4, 5 * * paragraph [0054] *	1,3-6,8, 9,11,12, 14,15 2,7,10, 13	TECHNICAL FIELDS SEARCHED (IPC) G05G E02F
Y A	US 2021/246630 A1 (SIZEMORE TERRY B [US] ET AL) 12 August 2021 (2021-08-12) * figure 1 * * paragraphs [0001], [0002] *	13,15 1	
A	JP 2016 118820 A (TADANO LTD) 30 June 2016 (2016-06-30) * figures 1-3 *	1-15	
A	US 2018/129240 A1 (BARZEN ALEXANDER [DE] ET AL) 10 May 2018 (2018-05-10) * figures 2, 3 *	1-15	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 October 2023	Rossatto, Cédric

CATEGORY OF CITED DOCUMENTS

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EUROPEAN SEARCH REPORT

Application Number
EP 23 17 1922

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 2016/033033 A1 (KOMATSU SHIGERU [JP] ET AL) 4 February 2016 (2016-02-04) * figure 8 * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 October 2023	Rossatto, Cédric

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L : document cited for other reasons

& : member of the same patent family, corresponding document

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04-10-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005174331 A1	11-08-2005	US 2005174331 A1	11-08-2005
		US 2007165000 A1	19-07-2007
		US 2012019439 A1	26-01-2012
		WO 2005114644 A1	01-12-2005
US 7271796 B1	18-09-2007	NONE	
EP 3985180 A1	20-04-2022	NONE	
EP 3425487 A1	09-01-2019	EP 3425487 A1	09-01-2019
		JP 6401418 B2	10-10-2018
		JP 6745307 B2	26-08-2020
		JP 2019032850 A	28-02-2019
		JP WO2017149888 A1	23-08-2018
		US 2019009172 A1	10-01-2019
		WO 2017149888 A1	08-09-2017
US 2021246630 A1	12-08-2021	NONE	
JP 2016118820 A	30-06-2016	JP 6366493 B2	01-08-2018
		JP 2016118820 A	30-06-2016
US 2018129240 A1	10-05-2018	EP 3321763 A1	16-05-2018
		US 2018129240 A1	10-05-2018
US 2016033033 A1	04-02-2016	EP 2982885 A1	10-02-2016
		JP 6305265 B2	04-04-2018
		JP 2016035274 A	17-03-2016
		US 2016033033 A1	04-02-2016

EPO FORM P0459

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