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(54) **Device for finishing edges and/or outer surfaces of workpieces**

(57) A device (1) for finishing edges and/or outer surfaces of workpieces comprises at least one tool-holder 17 for rotatably supporting a tool 16 around a rotation axis, at least one tool-holding unit 39 for rotatably supporting this at least one tool-holder (17) around a further rotation axis and a crosspiece element (7) for supporting

this at least one tool-holding unit (39).

In order to improve and make more uniform the surface quality of the machined workpieces, the device (1) comprises first driving means (8) to make the crosspiece element (7) oscillate along a direction (8) that is transverse, in particular perpendicular, to an advancing direction (A) of the workpieces.

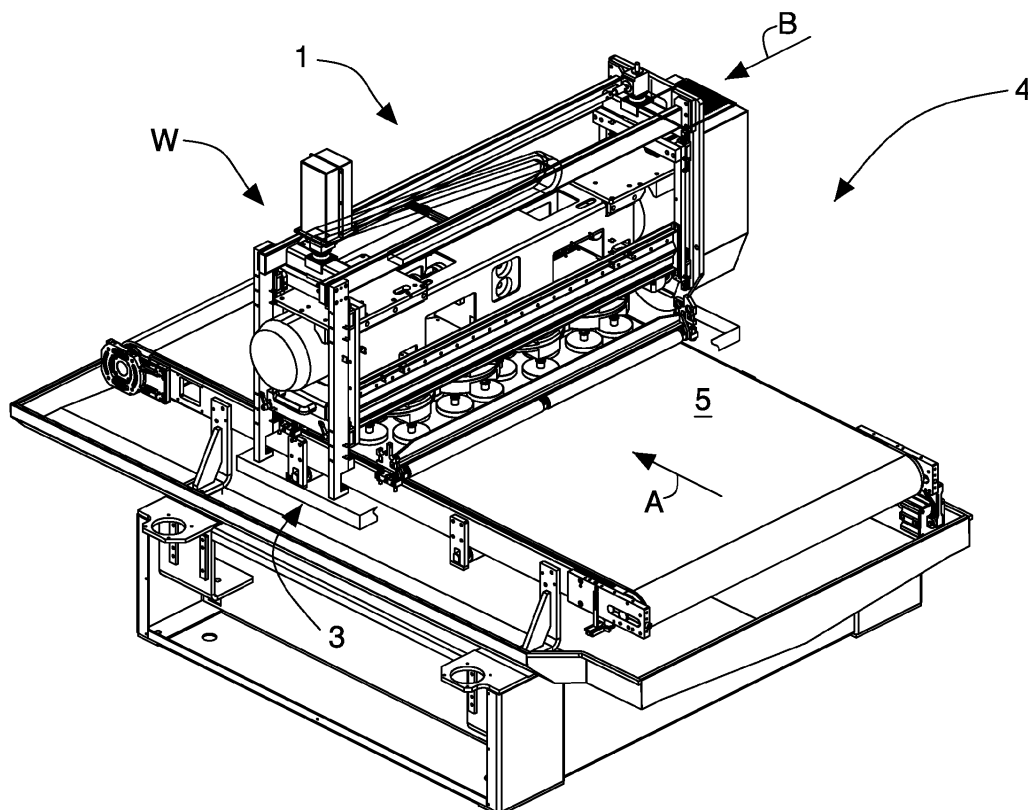


Fig. 1

Description

[0001] The invention relates to a device for finishing edges and/or outer surfaces of workpieces, a sander machine including this device and a method for finishing edges and/or outer surfaces of workpieces.

[0002] In particular, the invention refers to a device for finishing edges and/or outer surfaces of flat elements made of wood or similar materials, or of ferrous metal materials, or of copper alloys, or of aluminium alloys or similar materials.

[0003] Devices are known for finishing edges and/or outer surfaces of workpieces comprising pairs of tool holders, each tool-holder being arranged for rotationally supporting an abrasive disc around a respective rotation axis.

[0004] These devices further comprise a plurality of tool-holding units, each tool-holding unit rotatably supporting a pair of tool holders around a further rotation axis.

[0005] The tool-holding units are positioned in succession along a direction that is perpendicular to an advancing direction of the workpieces in such a manner that circular machining trajectories of respective abrasive discs of adjacent tool-holding units overlap partially.

[0006] Also, known devices comprise a crosspiece supporting the tool-holding units and positioned transversely and above a conveyor belt arranged for conveying the workpieces.

[0007] In use, each abrasive disc is rotated around the corresponding tool holder around the respective rotation axis and by the corresponding tool-holder unit around the respective further rotation axis in such a manner as to perform an epicycloidal motion, the circular machining trajectories of respective abrasive discs of adjacent tool-holding units being superimposed partially.

[0008] One drawback that affects the aforesaid devices is that they do not allow uniform finishing of the surface to be polished.

[0009] In fact, longitudinal zones of the workpieces positioned where the aforesaid machining trajectories are superimposed on one another and will have a different surface quality from further longitudinal zones of the workpieces which are external with respect to the aforesaid longitudinal zones. This is due to the fact that where the machining trajectories are superimposed, i.e. at the aforesaid longitudinal zones, the workpiece is subjected to a double polishing action by respective tools of adjacent tool-holding units, whilst where the machining trajectories are not superimposed, that is at the further longitudinal zones, the workpiece is processed only by the tools of a single tool-holder unit.

[0010] In order to overcome this drawback, it would be possible to arrange in succession, above the conveyor belt and along the advancing direction of the workpieces, two devices, which are staggered in relation to one another, of the type disclosed above, so as to ensure a more uniform surface finishing of the workpieces.

[0011] Nevertheless, it is clear how, in addition to en-

tailoring a financial burden, it entails difficulties in designing the layout of a sander machine including such devices.

[0012] One object of the invention is to improve devices for finishing edges and/or outer surfaces of workpieces.

[0013] A further object is to obtain devices for finishing edges and/or outer surfaces of workpieces that improve the surface quality of the machined workpieces compared with known devices.

[0014] A still further object is to obtain compact sander machines. Still another object is to provide a method for finishing edges and/or outer surfaces of workpieces that enables the surface quality of the machined workpieces to be improved. The invention provides a device for finishing edges and/or outer surfaces of workpieces as defined in independent claim 1.

[0015] The invention further provides a method for finishing edges and/or outer surfaces of workpieces as defined in independent claim 18.

[0016] Owing to the invention it is possible to improve the surface quality of the machining.

[0017] In fact, said first moving means enables said tools to be moved also transversely, in particular perpendicularly, with respect to said advancing direction, this permitting a better and more uniform surface quality of the machined workpieces.

[0018] This furthermore makes it unnecessary to provide a plurality of devices positioned in succession above the conveyor belt along said advancing direction of the workpieces, which simplifies and makes more compact a sander machine including the device according to the invention.

[0019] The invention can be better understood and implemented with reference to the attached drawings, which illustrate an embodiment thereof by way of non-limiting example, in which:

Figure 1 is a perspective view, with certain elements removed to show others better, of a sander machine including a device according to the invention;

Figure 2 is a perspective view of the device in Figure 1 in a non-operating configuration;

Figure 3 is a perspective view of the device in Figure 1 with certain parts removed to show others more clearly;

Figure 4 is a partial and fragmentary section of the device in Figure 1;

Figure 5 is an enlarged detail of Figure 4;

Figure 5bis is an enlarged detail of Figure 5;

Figure 6 is a perspective view showing some details of the device in Figure 1;

Figure 7 is a bottom view of the device in Figure 1;

Figure 8 and 9 are perspective views of a tool-holding unit included in the device in Figure 1;

Figure 10 is a frontal view of first driving means included in the device in Figure 1;

Figure 11 is a partially sectioned top view of the first driving means in Figure 10;

Figure 12 is a perspective view of a quick connection included in the device in Figure 1;

Figure 13 is a section of the quick connection in Figure 12;

Figure 13bis is a detail of Figure 12;

Figure 14 is an exploded view of Figure 12.

[0020] With reference to Figure 1, there is shown a device 1 for finishing edges and/or outer surfaces of workpieces, which are not shown, for example flat elements made of wood or similar materials, or of ferrous metal materials, or of copper alloys, or of aluminium alloys or similar materials. The device 1 comprises a supporting structure 2 fixed to a frame 3 of a sander machine 4 shown in Figure 1 with some elements removed to show the device 1 better.

[0021] The frame 3 supports a conveyor belt 5 arranged for conveying the workpieces along an advancing direction A.

[0022] The device 1 comprises a body 6 (Figure 2) slidably mounted on the supporting structure 2.

[0023] In this manner, in use, the body 6 is movable manually or by automatic moving means, which is not shown, between an operating position W (Figure 1), in which the body 6 is positioned above the conveyor belt 5 in such a manner that the device 1 can finish the workpieces, and a non-operating position NW (Figure 2), in which the body 6 is supported in a cantilevered manner by the supporting structure 2 to enable an operator, who is not shown, to perform, for example, maintenance tasks on the device 1.

[0024] The body 6 comprises a framework 13 (Figure 2) and a crosspiece 7 (Figure 3), the crosspiece 7 being slidably mounted on the framework 13 by guides 14 fixed to the crosspiece 7 and sliding blocks 15 fixed to the framework 13.

[0025] The crosspiece 7 extends along a direction B that is transverse, in particular perpendicular, to the advancing direction A.

[0026] The device 1 further comprises first driving means 8 to make the crosspiece 7 oscillate along the direction B.

[0027] In this manner, in use, the crosspiece 7, driven by the first driving means 8, oscillates with reciprocating motion along the direction B with respect to the framework 13.

[0028] The first driving means 8, shown in detail in Figures 10 and 11, comprises a first motor 9, fixed to the framework 13, and a crank-connecting rod mechanism 10 connected to and driven by the first motor 9.

[0029] In particular, the crank-connecting rod mechanism 10 comprises a pair of connecting rods 11, fixed, on opposite sides of the crosspiece 7, to an end portion 12 of the crosspiece 7, and a pair of cranks 64 connected to and rotated by the first motor 9.

[0030] The device 1 further comprises a plurality of tool-holders 17 (Figure 5), each tool-holder 17 extending along, and being rotatable, as will be explained better

below, around a respective rotation axis R.

[0031] Each tool-holder 17 comprises a spindle shaft 20 with a shank 21 provided at one end thereof, for example a tapered shank 21 (Figures 5, 5bis and 8).

[0032] Each shank 21 comprises a circumferential groove 23, the function of which will be explained below.

[0033] Also, to each shank 21 a pin 22 is fixed that extends transversely to the rotation axis R.

[0034] Each tool-holder 17 rotatably supports a respective tool 16 (Figure 3), in particular a frontal abrasive tool such as, for example, an abrasive disc.

[0035] This abrasive disc, which is of known type and for this reason is not disclosed in detail, comprises a lower surface from which a plurality of supports project that are positioned radially, each arranged for supporting abrasive blades 65. Alternatively, abrasive paper or bunches of abrasive wires (for example wires made of steel, Tynex®, etc) can be fixed to the lower surface of the disc.

[0036] Each tool 16 is releasably connected to the corresponding shank 21 of a tool-holder 17 by a quick connection 18 (Figures 12 to 14).

[0037] The quick connection 18 comprises a substantially cylindrical main body 19, provided with an internally threaded portion 24 that is screwable to a pivot 66 associated with and projecting from a tool 16.

[0038] The main body 19 comprises a tapered seat 25, that is shaped in such a manner as to house a respective shank 21.

[0039] The main body 19 is further provided with a side wall 26 in which holes 27 are obtained, for example four holes 27 that are angularly spaced apart from one another, each arranged for housing a ball 31.

[0040] In particular, each hole 27 is shaped in such a manner as to enable the respective ball 31 to project partially inside the tapered seat 25, and to prevent the ball 31 from falling into the latter.

[0041] Also, the main body 19 comprises a front wall 28, or rim, provided with a pair of notches 29 that are diametrically opposite and arranged for coupling in a shapingly manner with the pin 22.

[0042] In this manner, in use, the pin 22 rotatably drags the quick connection 18 and the tool 16 therewith around the respective rotation axis R.

[0043] The quick connection 18 further comprises a ring 30 mounted slidably on the main body 19.

[0044] The ring 30, which is, for example, knurled externally, comprises an internal wall 32 with a substantially conical shape with the concavity facing the front wall 28.

[0045] In particular, the internal wall 32 comprises a first, tapered, surface 33, and a second, cylindrical, surface 34, the second surface 34 having a greater diameter than the first surface 33.

[0046] The quick connection 18 further comprises a washer 35 that is fixed, by screws 37, to a bottom wall 36, opposite the front wall 28, of the main body 19.

[0047] Also, the quick connection 18 comprises a spring 38 that is interposed and acts between the washer 35 and the ring 30.

[0048] In use, to connect the quick connection 18 to the shank 21, it is sufficient, after fixing the quick connection 18 to the pivot 66, to act on the ring 30 in contrast with the spring 38, so as to move the ring 30 towards the washer 35, and retain the ring 30 in this position.

[0049] In this manner, the balls 31, facing the second surface 34 can exit the tapered seat 25 whilst remaining housed in the respective holes 27.

[0050] Subsequently, the shank 21 is inserted into the seat 25, paying attention that the notches 29 engage with the pin 22, and the ring 30 is released that, pushed by the spring 38, is moved towards the front wall 28.

[0051] In this manner, the balls 31, in contact with the first surface 33 having a smaller diameter than the second surface 34, are moved inside the seat 25 and engage in the groove 23 obtained in the shank 21 so as to connect the quick connection 18 to the shank 21.

[0052] The device 1 further comprises a plurality of tool-holding units 39, for example four (Figures 3 to 9), supported by the crosspiece 7 and arranged in succession along the direction B.

[0053] Each tool-holding unit 39, as will be explained better below, is rotatable, and rotationally supports four tool-holders 17, around a respective further rotation axis UR.

[0054] In particular, the four tool-holders 17 are supported by the respective tool-holding unit 39 in such a manner as to be angularly spaced by an angle that is substantially equal to 90°.

[0055] Also, adjacent tool-holding units 39 are positioned in such a manner that respective tool-holders 17 face one another. The device 1 further comprises second driving means to rotate the tool-holders 17.

[0056] The second driving means comprises, included in each tool-holding unit 39, a drive shaft 41.

[0057] To an end portion of the drive shaft 41 a central gear 42 is fixed that meshes planetary gears 43 that are each fixed to the respective tool-holders 17, the central gear 42 and the planetary gears 43 forming planetary gearing.

[0058] The second driving means further comprises first gears 44 (Figure 6) fixed to a further end of the respective drive shafts 41 and further first gears 45 interposed between and meshing the first gears 44.

[0059] The second driving means further comprises a second motor 46 (Figure 3).

[0060] The second motor 46 is fixed to the framework 13 and comprises a drive shaft, which is not shown, to which a sleeve 48 is fixed.

[0061] To an end of the sleeve 48 a grooved sleeve 49 is fixed that is provided with further grooves, which are not shown.

[0062] In particular, in these further grooves further balls are supported and received, which are not shown.

[0063] In the sleeve 48 a grooved shaft 47 is at least partially received that is provided with respective grooves, which are not shown, facing the aforesaid further grooves and arranged for engaging the further balls.

[0064] In this manner, in use, the further balls enable the grooved shaft 47 to slide axially in the sleeve 48 and to transmit rotation from the sleeve 48 to the grooved shaft 47.

5 **[0065]** An end of the shaft 47 is fixed to a first drive, non shown, included in a box element 51 fixed to the crosspiece 7.

[0066] The first drive is connected to a first right angle gear transmission, which is not shown, present in the box element 51.

10 **[0067]** The first right angle gear transmission, for example including a pair of bevel gears, comprises in turn a first drive gear 52 meshing a first driven gear 53 (Figure 4).

15 **[0068]** The first drive gear 52 and the first driven gear 53 in turn meshes with the first gears 44, which in turn rotate the further first gears 45 and the drive shafts 41.

[0069] The latter rotate the respective central gear, which in turn rotates the respective planetary gears 43.

20 **[0070]** The device 1 further comprises third driving means to rotate the tool-holding units 39.

[0071] The third driving means comprises, for each tool-holding unit 39, a gear 55 that is rotatably mounted on the drive shaft 41 and fixed to the respective tool-holding unit 49. The third driving means further comprises second gears 56 (Figure 6) interposed between, and meshing, the gears 55.

[0072] In particular, the gears 56 are coaxial to respective further first gears 45.

30 **[0073]** The third driving means further comprises a third motor 57 (Figure 3).

[0074] The third motor 57 is fixed to the framework 13 on the side opposite the second motor 46 with respect to the box element 51.

35 **[0075]** The third motor 57 includes a further drive shaft, which is not shown, to which a further sleeve 58 is fixed.

[0076] To an end of the further sleeve 58 a further grooved sleeve 60 is fixed that is provided with respective further grooves, which are not shown.

40 **[0077]** In particular, in these further grooves further balls are supported and received, which are not shown.

[0078] In the further sleeve 58 a further grooved shaft 59 is received at least partially that is provided with respective grooves 69 facing the aforesaid further grooves and arranged for engaging the further balls.

45 **[0079]** In this manner, in use, the further balls enable the further grooved shaft 59 to slide axially in the further sleeve 58 and to transmit rotation from the further sleeve 58 to the further grooved shaft 59.

50 **[0080]** An end of the further shaft 59 is fixed to a second drive 82 included in the box element 51.

[0081] The second drive 82 is connected to a second right angle gear transmission, which is not shown, which is present in the box element 51.

55 **[0082]** The second right angle gear transmission, for example including a further pair of bevel gears, comprises in turn a second drive gear 62 meshing a second driven gear 63 (Figure 4).

[0083] The second drive gear 62 and the second driven gear 63 in turn meshes with the gears 55, which in turn rotate the second gears 56 and the tool-holding units 39.

[0084] The device 1 further comprises control and management means, which is not shown, to control and manage respectively the first motor 9, the second motor 46 and the third motor 57. In particular, the first motor 9 is driven at a constant rotation speed, whilst the rotation speeds of the second motor 46 and of the third motor 57 are adjustable by respective inverters, which are not shown.

[0085] In one embodiment of the invention that is not illustrated also the first motor 9 is adjustable by a respective inverter.

[0086] In one preferred embodiment, the rotation speed of each tool-holder unit 39 is for example substantially the same as a third of the rotation speed of the respective tools 16.

[0087] In this embodiment, moreover, the tool-holders 17 of each tool-holding unit 39 have the same rotation direction, which is the opposite direction to the rotation direction of the respective tool-holding unit 39.

[0088] Also, in this embodiment, the adjacent tool-holding units 39 have rotation directions that are opposite to one another and are positioned near one another in such a manner that substantially circular machining trajectories of respective tools 16 are not superimposed on one another.

[0089] In use, each tool 16 is rotated by the respective tool-holder 17 and by the respective tool-holding unit 39 with an epicycloidal motion and is made to oscillate by the crosspiece 7 with a reciprocal motion.

[0090] This enables the surface quality of the machining to be improved and made more uniform.

[0091] Also, this makes it unnecessary to provide a plurality of devices positioned in succession above the conveyor belt 5 along the advancing direction A of the workpieces, which simplifies and makes more compact the sander machine 4 including the device 1.

[0092] In one embodiment of the invention, which is not shown, the first driving means 8 makes the crosspiece element 7 oscillate along a further direction that is substantially parallel to the advancing direction A.

[0093] In a further embodiment of the invention, which is not shown, the first driving means 8 makes the crosspiece element 7 oscillate along a closed path.

[0094] In another embodiment of the invention, which is not shown, the crosspiece element 7 is a movable element of an articulated quadrilateral, this articulated quadrilateral being connected to and driven by the first motor 9.

[0095] Also, in another further embodiment of the invention, which is not shown, the tool-holding units 39 rotate around the respective further rotation axes UR in the same rotation direction.

[0096] Also, in another embodiment of the invention, which is not shown, the tool-holders 17 rotate around the respective rotation axes R in rotation directions that are

opposite one another.

[0097] Also, in another further embodiment of the invention, which is not shown, the tool-holders 17 rotate in respective rotation directions that are the same as the rotation directions of the respective tool-holding units 39.

[0098] Also, in a further embodiment of the invention, which is not shown, adjacent tool-holding units 39 are positioned near one another in such a manner that respective tool-holders 17 are rotated in relation to one another, i.e. staggered, by 45°.

[0099] Also, in another embodiment of the invention, which is not shown, adjacent tool-holding units 39 are positioned near one another in such a manner that machining trajectories of respective tools 16 are partially superimposed on one another.

[0100] Also, in a further embodiment of the invention, which is not shown, each tool-holding unit 39 supports a number of tool-holders 17 that is lesser or greater than four.

[0101] Lastly, in another further embodiment of the invention, which is not shown, the crosspiece 7 supports a number of tool-holding units 39 that is lesser or greater than four.

Claims

1. Device (1) for finishing edges and/or external surfaces of workpieces, comprising at least one tool-holder (17) for rotatably supporting a tool (16) around a rotation axis (R), at least one tool-holder unit (39) for rotatably supporting said at least one tool-holder (17) around a further rotation axis (UR) and a crosspiece element (7) for supporting said at least one toolholding unit (39), **characterised in that** it comprises first driving means (8) for making said crosspiece element (7) oscillate along a direction (B) which is transverse, in particular perpendicular, with respect to an advancing direction (A) of said workpieces.
2. Device (1) according to claim 1, wherein said first driving means (8) makes said crosspiece element (7) oscillate along a further direction that is substantially parallel to said advancing direction (A).
3. Device (1) according to claim 1, or 2, wherein said first driving means (8) makes said crosspiece element (7) oscillate along a closed path.
4. Device (1) according to any preceding claim, wherein said first driving means (8) comprises a first motor (9) and a crank-connecting rod mechanism (10), the crank-connecting rod mechanism (10) being interposed between said crosspiece element (7) and said first motor (9) and being driven by the latter.
5. Device (1) according to any one of claims 1 to 3,

- wherein said first driving means (8) comprises a first motor (9) and said crosspiece element (7) is a movable element of an articulated quadrilateral, said articulated quadrilateral being connected to and driven by said first motor (9).
- 5
6. Device (1) according to any preceding claim, and comprising a plurality of said tool-holders (17) each arranged for rotatably supporting a corresponding tool (16) around a respective rotation axis (R), said tool-holders (17) being rotatably supported by said at least one tool-holder unit (39) around said further rotation axis (UR) .
- 10
7. Device (1) according to any preceding claim, and comprising a plurality of said tool-holder units (39) each arranged for rotatably supporting one or more of said tool-holders (17) around a respective further rotation axis (UR), said tool-holder units (39) being supported by said crosspiece element (7) and being positioned alongside one another along said direction (B).
- 15
8. Device (1) according to claim 7, wherein at least two of adjacent tool-holder units (39) are positioned near one another such that machining trajectories of respective tools (16) do not overlap.
- 20
9. Device (1) according to claim 7, or 8, wherein at least two of adjacent tool-holder units (39) are rotated in respective rotation directions that are opposite one another.
- 25
10. Device (1) according to any one of claims 7 to 9, wherein at least two of adjacent tool-holder units (39) rotate in respective rotation directions that are opposite the rotation directions of respective tool-holders (17).
- 30
11. Device (1) according to any preceding claim, and comprising second driving means for rotating said at least one tool-holder (17).
- 35
12. Device (1) according to claim 11, wherein said second driving means comprises a second motor (46) and planetary gearing means (42, 43).
- 40
13. Device (1) according to claim 12, wherein said planetary gearing means comprises a central gear (42) connected to and rotated by said second motor (46) and a planetary gear (43) connected to said at least one tool-holder (17) and meshing said central gear (42).
- 45
14. Device (1) according to any preceding claim, and comprising third driving means for rotating said at least one tool-holder unit (39).
- 50
15. Device (1) according to claim 14, wherein said third driving means comprises a third motor (57) and gear means (55, 56), said gear means (55, 56) connecting said at least one tool-holder unit (39) to said third motor (57) and being driven by the latter.
- 55
16. Device (1) according to any preceding claim, and comprising quick connection means (18) for releasably connecting each tool-holder (17) to a respective tool (16).
17. Sander machine (4) for finishing edges and/or external surfaces of workpieces comprising a device (1) as claimed in any preceding claim.
18. Method for finishing edges and/or external surfaces of workpieces, comprising moving at least one tool (16) with an epicycloidal motion, **characterised in that** said moving comprises making at least one tool (16) oscillate along a direction (B) which is transverse, in particular perpendicular, with respect to an advancing direction (A) of said workpieces.
19. Method according to claim 18, wherein said moving comprises oscillating said at least one tool (16) along a further direction that is substantially parallel to said advancing direction (A).
20. Method according to claim 18, or 19, wherein said moving comprises making said at least one tool (16) oscillate along a closed path.

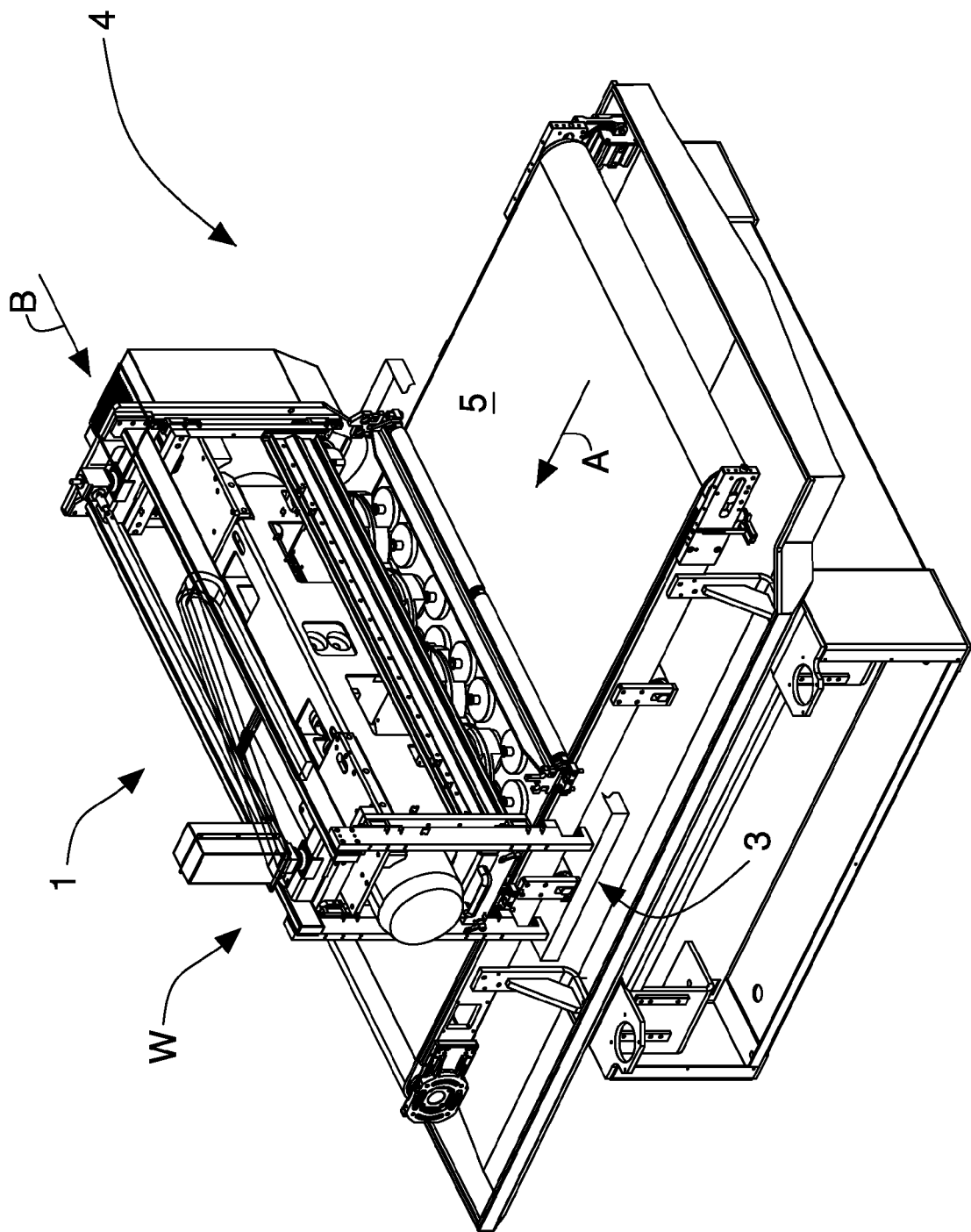


Fig. 1

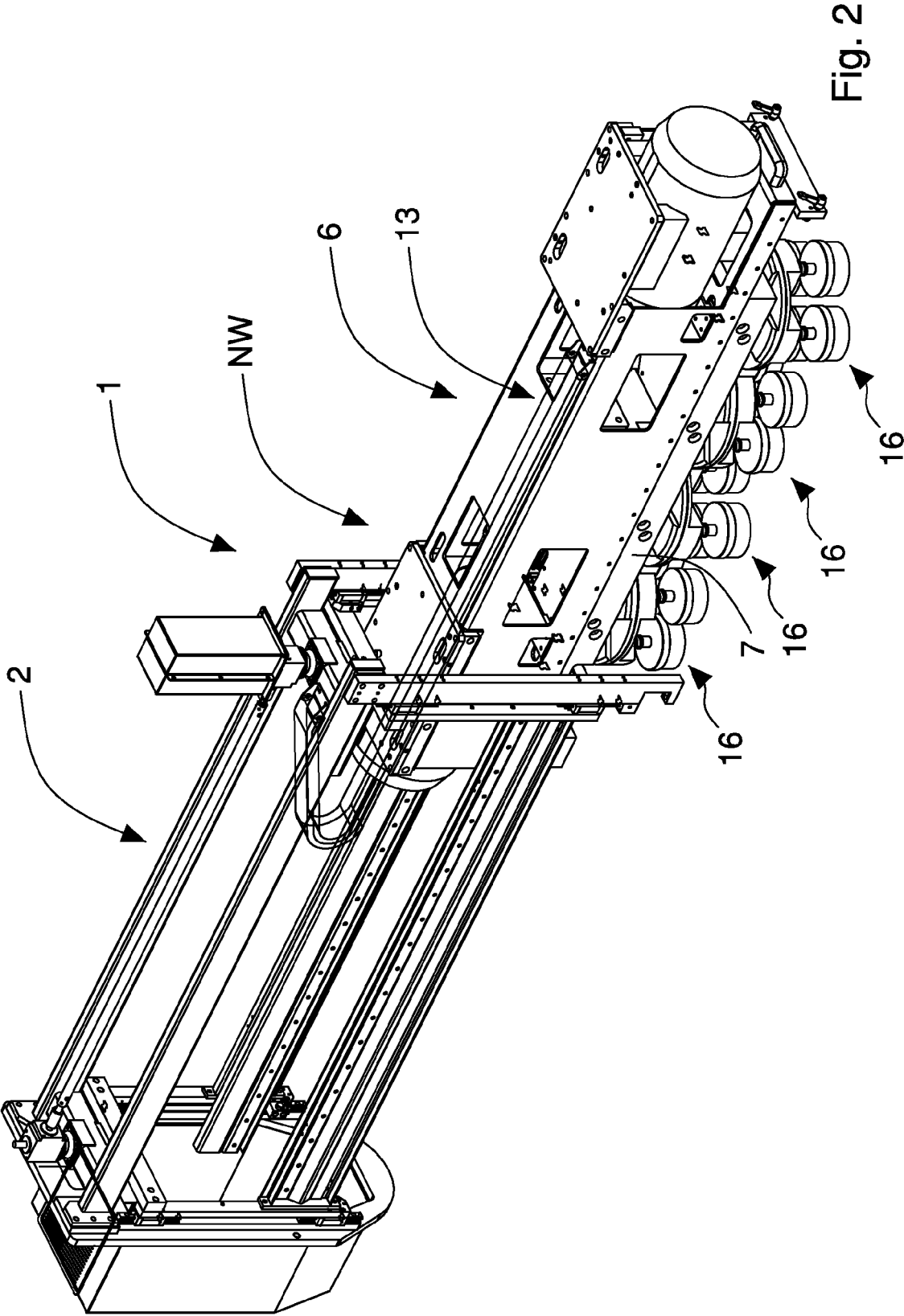
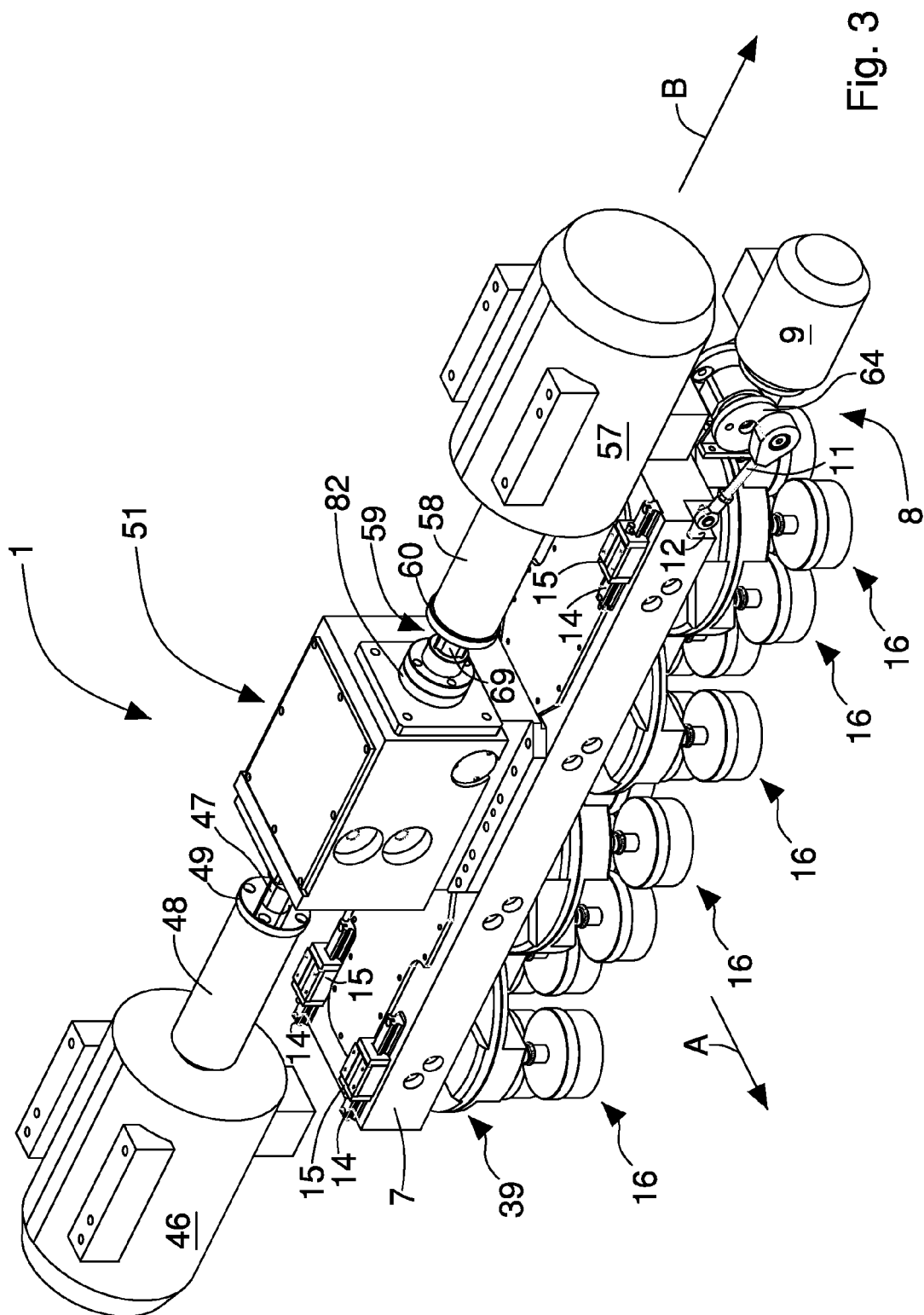


Fig. 2



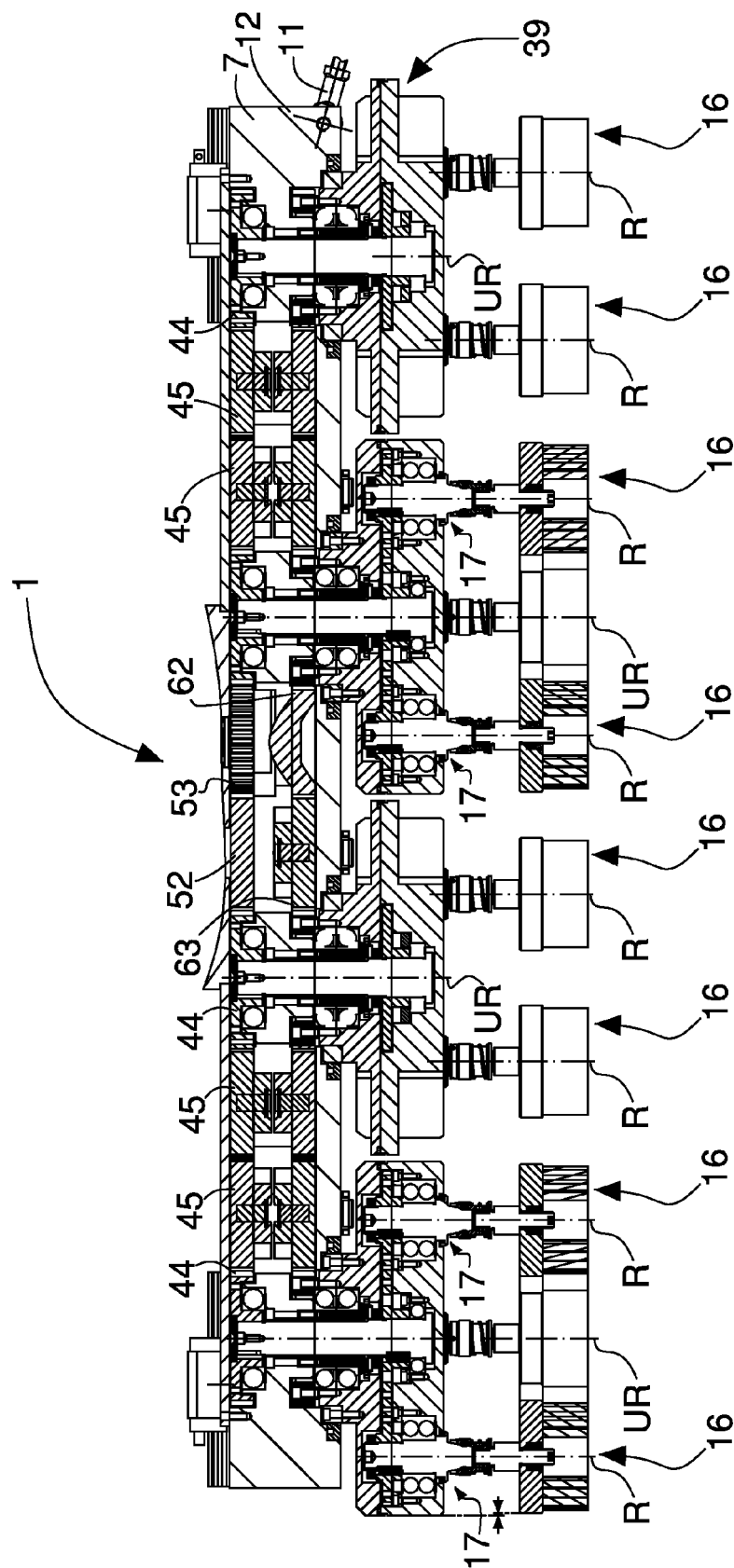
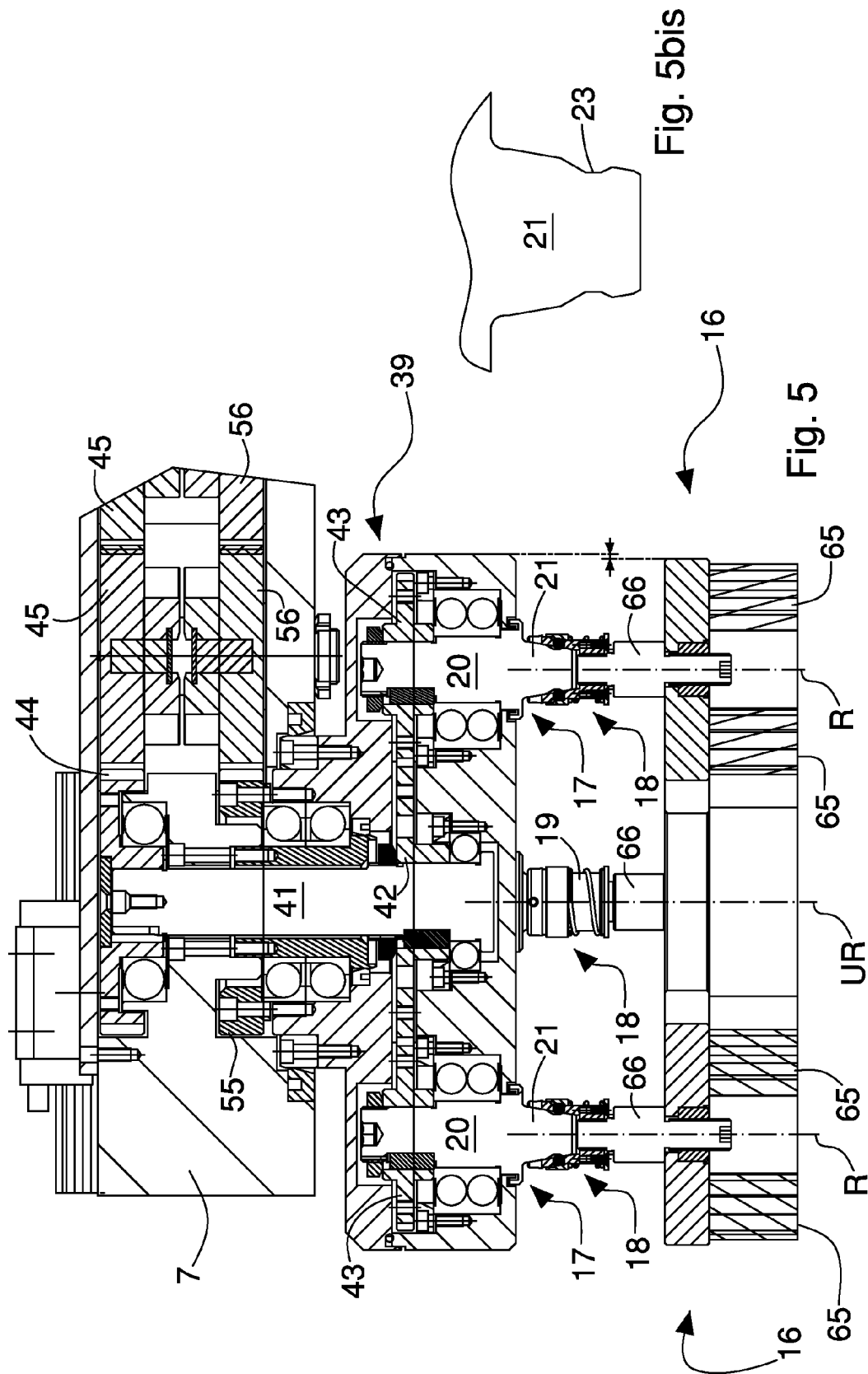


Fig. 4



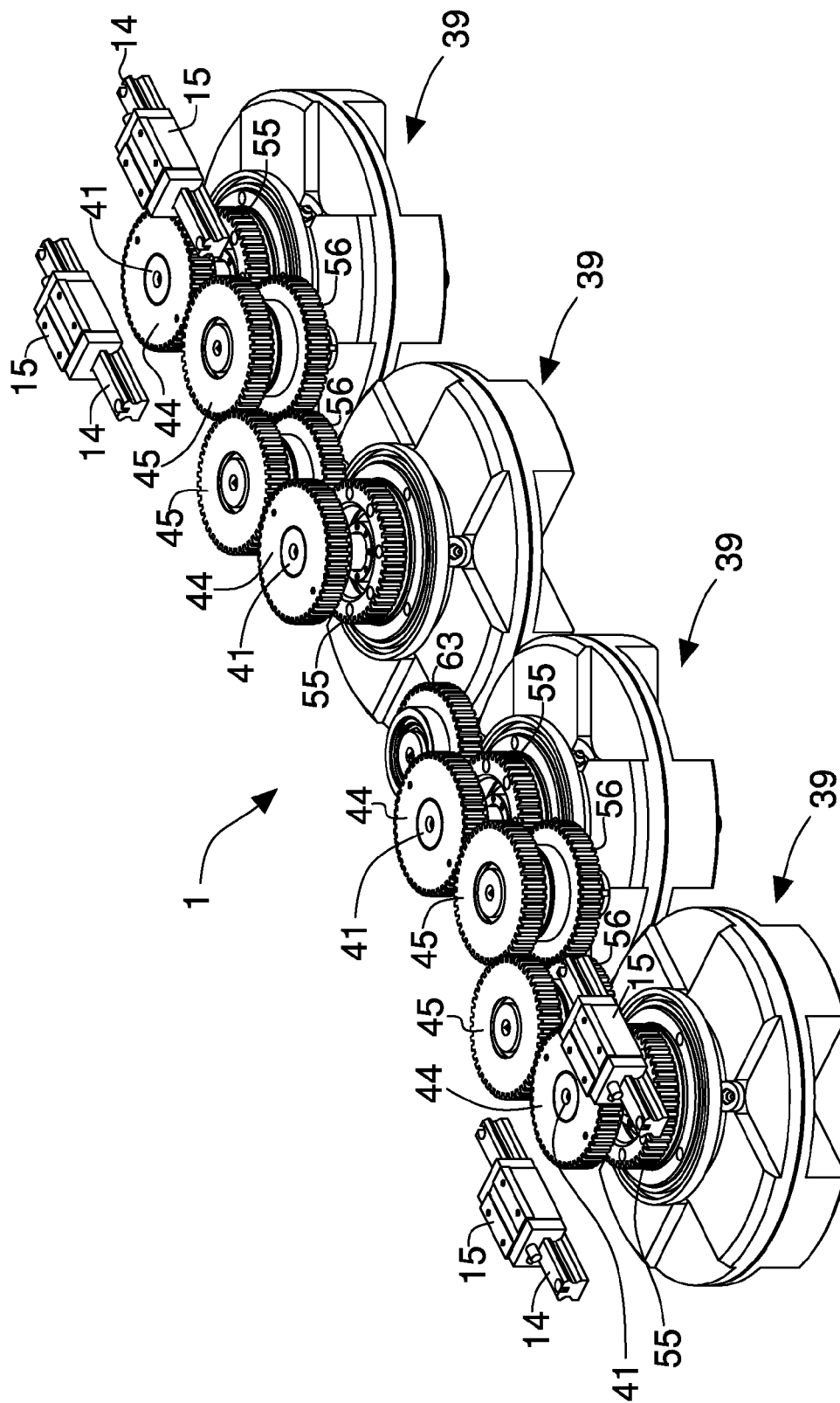


Fig. 6

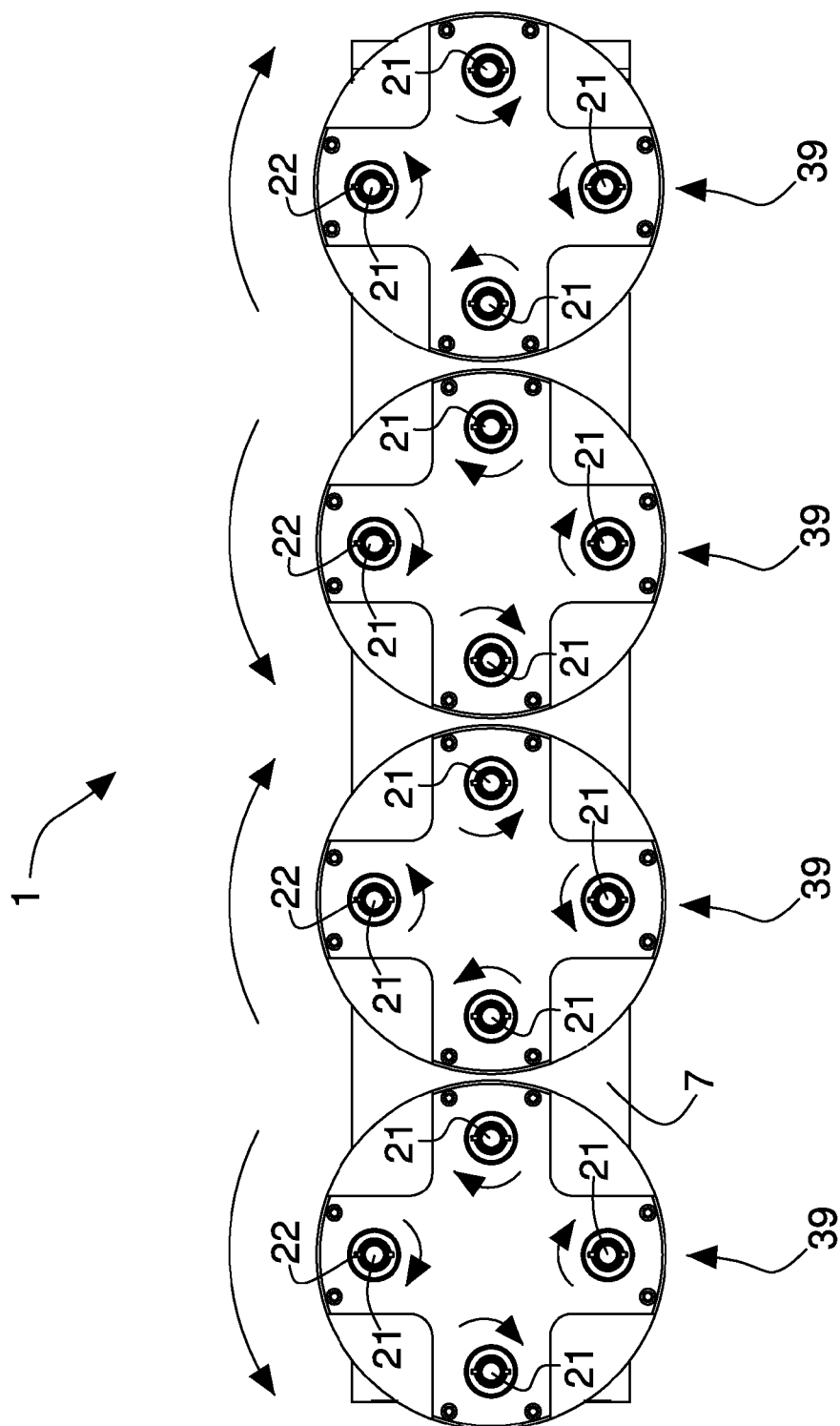
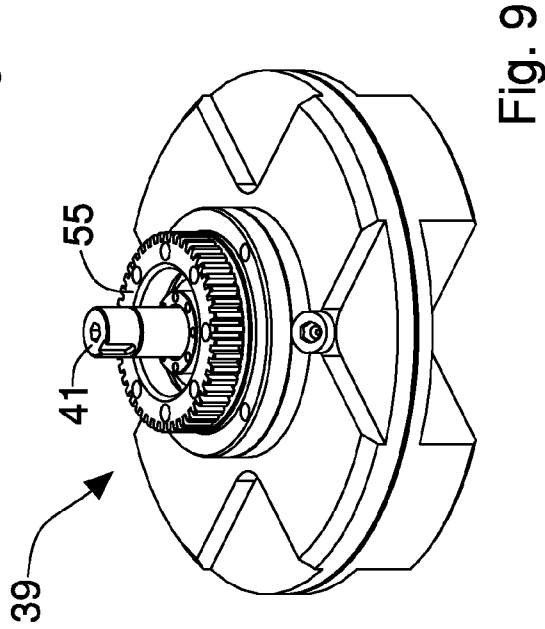
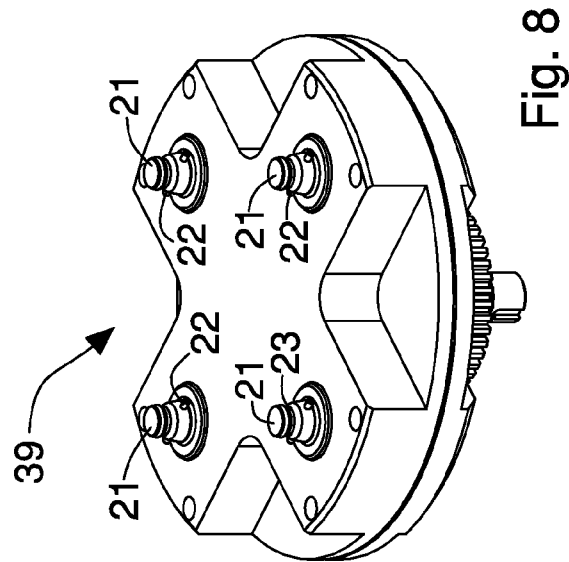
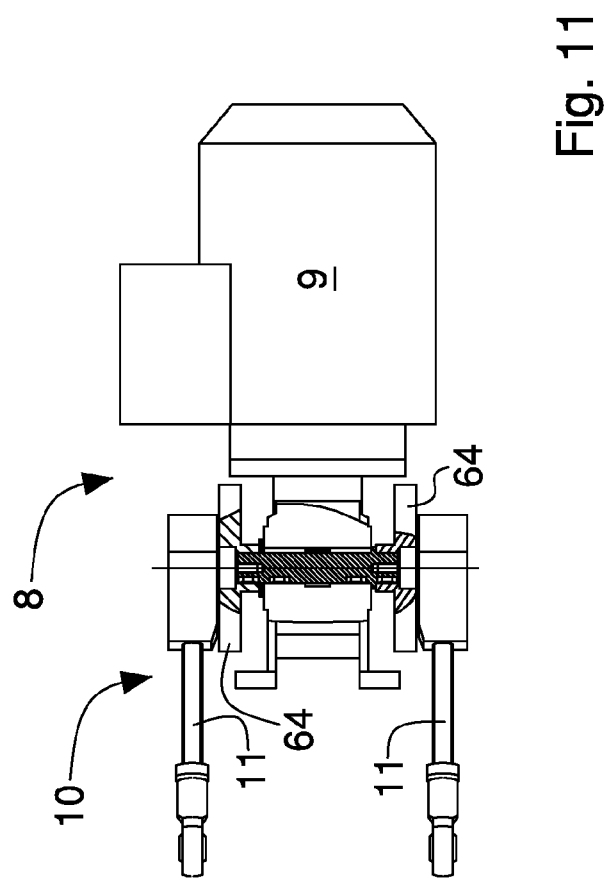
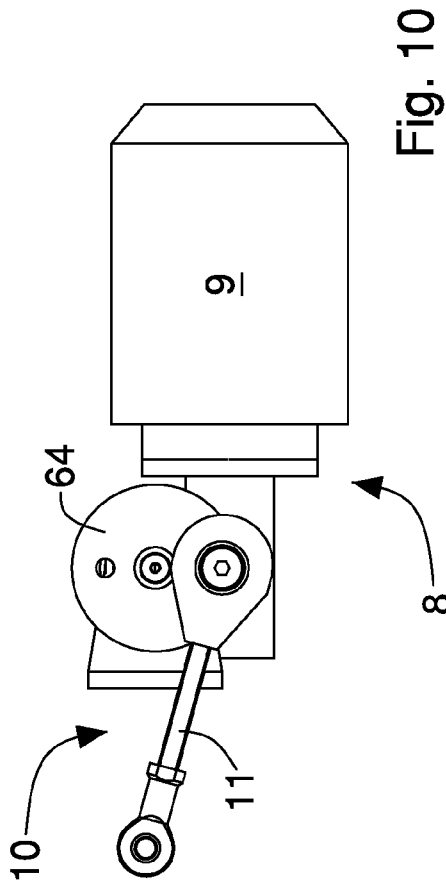
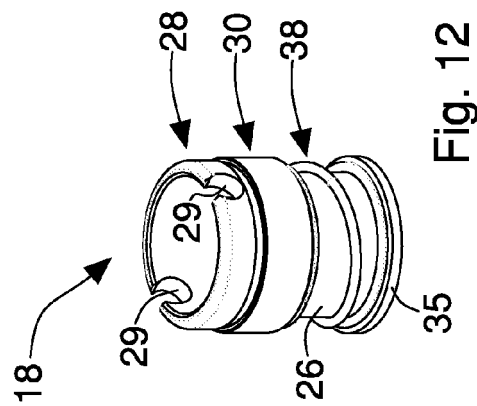
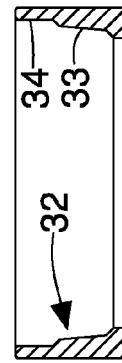
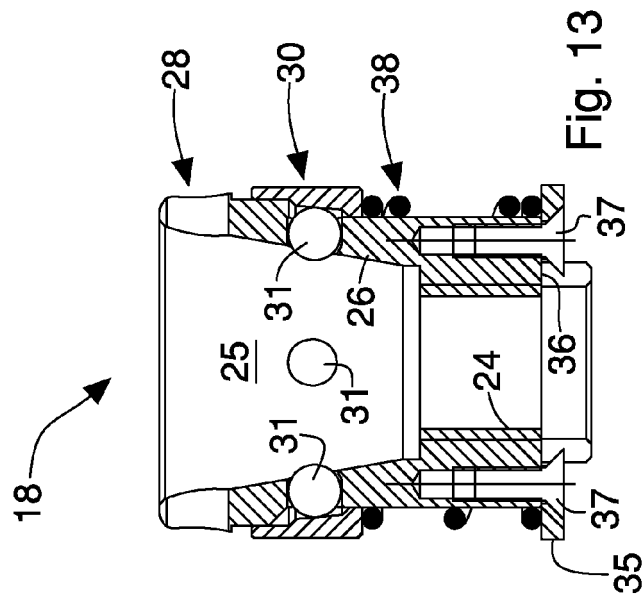
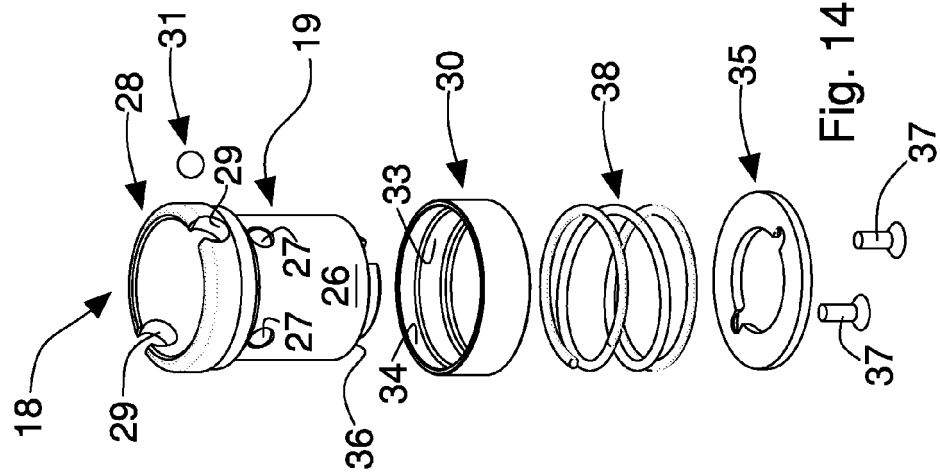


Fig. 7







EUROPEAN SEARCH REPORT

 Application Number
 EP 11 16 2882

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	DE 20 2007 010059 U1 (JACOB LOEWER INH VON SCHUMANN [DE]) 18 October 2007 (2007-10-18)	1-3, 5-15, 17-20	INV. B24B7/06 B24B9/00 B24B41/047 B24B47/04 B24B47/12
Y	* paragraphs [0042] - [0061]; figures * -----	4,16	
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Y	US 2 985 989 A (KNOST LLOYD H) 30 May 1961 (1961-05-30) * figure 3 *	4	
Y	EP 1 000 702 A2 (TONIOLO ROMEO [IT]) 17 May 2000 (2000-05-17) * figures 6,7 *	16	
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The present search report has been drawn up for all claims			
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