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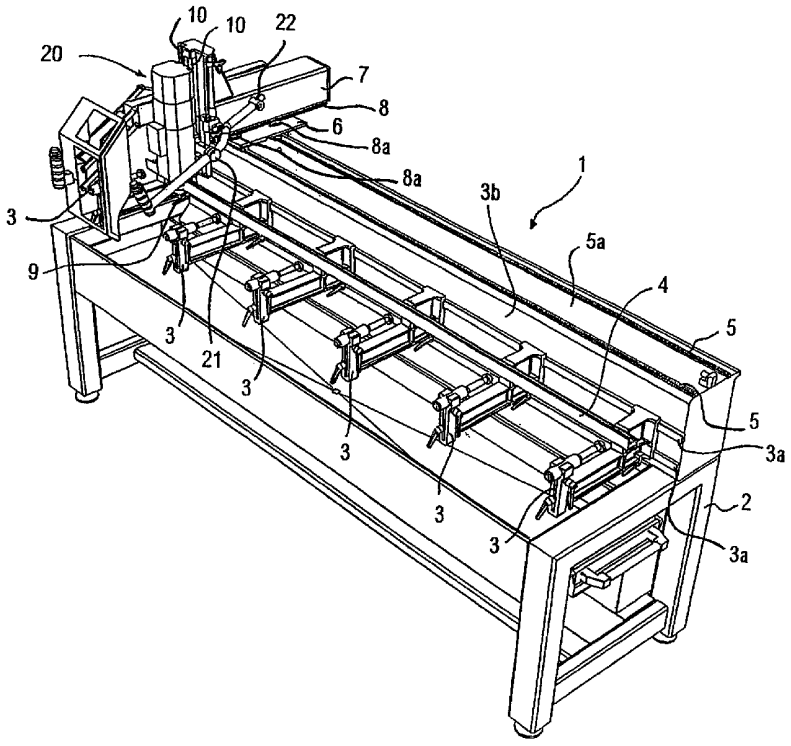
(54) Title: APPARATUS FOR WORKING PROFILED ELEMENTS AND RELATIVE METHOD



(57) Abstract: A machine (1) for working semi-worked pieces (4), in particular elongated semi-worked pieces, comprises machine bed means (2) suitable for receiving said semi-worked pieces (4), blocking means (3) suitable for blocking said semi-worked pieces (4) on said machine bed means (2), tool means (9) movable along three mutually perpendicular axes, an automatic control device (31) suitable for controlling the movement of said tool means (9) along a first and a second axis of said three axes and manually controlled actuating means (11B, 12; 32, 33) for moving said tool means (9) along a third axis of said three axes. A method for working a semi-worked piece (4), in particular an elongated semi-worked piece, using tool means (9) movable along three mutually perpendicular axes, comprises positioning said tool means (9) with respect to said semi-worked piece by displacing said tool means (9) along a first and a second axis of said three axes, translating said tool means (9) along a third axes of said three axes for bringing said tool means (9) in contact with said semi-worked piece (4), actuating said tool means (9) and moving said tool means (9) along said first and second axis for carrying out a working on said semi-worked piece (4); said positioning and said moving are performed through an automatic control device (31) and said translating is performed through manual control means (11B, 12; 32, 33).

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Apparatus for working profiled elements and relative method

The invention relates to a machine and a method for working elongated elements, particularly wooden rods and profiled elements made of metallic, or plastic, or composite material, for example used for producing door and window frames, or for general structural elements.

Prior art comprises pantograph-type machine tools wherein a profiled element to be worked is kept in a working position on a machine bed by a plurality of fixing clamps which can be positioned on said machine bed at longitudinally consecutive cross sections of the machine bed. The pantograph-type machine tools comprise a tool, usually a milling cutter, rotating around its longitudinal axis and arranged in a vertical position.

In those machines, the tool is positioned in a vertical direction and along two directions in a horizontal plane through positioning means manually actuated by the operator. These positioning means comprises an articulated quadrilateral carrying the tool at one of its vertices and supporting, at a further vertex, a pointed tracer which is forced to slide inside a template whose profile corresponds to the working profile that has to be machined on the profiled element: when the tracer is forced to slide along the template profile, that profile is copied by the tool path and so reproduced on the profiled element being worked. Dimensions of the working profile can be equal to those of template, or different from them, i.e. varied by a reduction ratio with respect to the template profile dimensions, which is obtained by varying pointed tracer dimensions or tool diameter.

To carry out working, the operator vertically actuates the spindle carrying the tool with an arm of his, controlling the spindle upstroke and down-stroke, and drives the tracing tip with the other arm by keeping said tracing tip in contact with

the template inner edge, thus controlling tool motion in the horizontal plane.

A first drawback of pantographs consists in a really short stroke, often roughly of some hundred of millimetres, along the axes defining the horizontal plane, which implies - for profiled elements having a greater extension - that a profiled element has to be positioned more times in order to carry out a complete working, with consequent waste of time.

Furthermore, owing to multiple placements, working inaccuracies may arise, for example due to the absence of suitable references allowing the piece to be accurately repositioned on the machine, after each working step.

Another drawback of pantographs is that the achievement of accurate working only depends on the operator skill and care. Since keeping the pointed tracer continuously in contact with the template profile is a difficult operation requiring great care, working errors often occur.

A further drawback of pantographs consists in difficulties in carrying out complex workings since, first of all, a suitable template needs to be prepared, and, secondly, if the template has a complex profile the operator may meet difficulties in reproducing it.

Furthermore, the continuous friction of pointed tracer on the template causes template wear, which implies remarkable accuracy loss.

A still further drawback of pantograph-type machine tools consists in that, since rough reference systems are used, an equal set of workings can be hardly reproduced on consecutive pieces.

It is an object of the present invention to improve pantograph-type machine tools of the known type.

It is another object of the present invention to provide a machine for working profiled elements which allows a high working precision.

Again, it is another object of the invention to provide a machine for working profiled elements wherein the element does not need to be repositioned between one working step and the next one.

It is a further object of the invention to provide a machine having high working repetition.

It is a still further object to provide a machine which can easily and quickly carry out workings of a particular shape.

In a first aspect of the present invention a machine is provided for working semi-worked pieces, in particular elongated semi-worked pieces, comprising machine bed means suitable for receiving said semi-worked pieces, blocking means suitable for blocking said semi-worked pieces on said machine bed means and tool means movable along three mutually perpendicular axes, characterized in that it further comprises an automatic control device suitable for controlling the movement of said tool means along a first and a second axis of said three axes and manually controlled actuating means for moving said tool means along a third axis of said three axes.

In a second aspect of the present invention a method is provided for working a semi-worked piece, in particular an elongated semi-worked piece, using tool means movable along three mutually perpendicular axes, comprising positioning said tool means with respect to said semi-worked piece by displacing said tool means along a first and a second axis of said three axes, translating said tool means along a third axis of said three axes in order to bring said tool means in contact with said semi-worked piece, actuating said tool means and moving said tool means along said first and said second axis for carrying out a working on said semi-worked piece, characterized in that said positioning and said moving are performed through an automatic control device and said translating is performed through manual control means.

The invention will be better understood and carried out with reference to the enclosed drawings, which illustrate some exemplifying and not restrictive embodiment forms thereof, wherein:

Figure 1 is a perspective view of a machine for working profiled elements according to the invention;

Figure 2 is an enlarged and broken view of the machine of Figure 1 highlighting its tool means in a working position;

Figure 3 is a view like Figure 2, but regarding a raised, stand-by position of the tool means;

Figure 4 is a perspective front view of another version of the machine according to the invention;

Figure 5 is a detail of Figure 4;

Figure 6 is perspective, side view of the machine of Figure 4;

Figure 7 is a perspective view of the control means of the machine of Figure 4, shown in a first position corresponding to a stand-by position of the tool means;

Figure 8 is a view like Figure 7 highlighting the control means in a second position corresponding to a working position of the tool means;

Figure 9 is a perspective view of a version of the machine according to the invention wherein the tool means is associated with swivel cutter head means;

Figure 10 is a perspective, broken view of a machine according to the invention highlighting the automatic control device.

With reference to Figure 1, a machine 1 is shown comprising a machine bed 2 provided with a plurality of clamp means 3 suitable for blocking a profiled element 4 to be worked; the clamp means 3 can be longitudinally positioned in a cantilever arrangement on a pair of parallel positioning guides 3a fixed to a vertical wall 3b of the machine bed 2. A first pair of longitudinal working guides 5 is fixed to the machine bed 2, said working guides 5 being fixed to a horizontal wall 5a of the machine bed 2. Trolley means 6 can move along the

longitudinal working guides 5 through first sliders 5b, and supports a working head 7 of the machine 1 through second sliders 8a, engaged with a second pair of transversal working guides 8, said second pair being oriented in a perpendicular direction with respect to the direction identified by the first pair of longitudinal guides 5.

Movement of the working head 7, and consequently of the tool 9 connected thereto, in the two mutually perpendicular direction now identified, is controlled by an automatic control device 31 (Figure 4), managed by a computer.

The working head 7 is provided with a third pair of working guides 10 allowing slide means 30 to be vertically translated; a tool 9 is fixed to said slide means 30, said tool 9 being actuated by a respective spindle 20 coupled with an electric motor which rotates the tool 9 around its longitudinal axis. The tool 9 is for example a milling cutter with a rotation axis parallel to said third pair of guides 10.

The displacement along a vertical direction of slide means 30 is not carried out by the automatic control device 31, but is manually performed by an operator as it will be below described more in detail.

With reference to Figure 2, handle means 11A and 11B are shown suitable for allowing the tool 9 to be vertically actuated; in particular, the handle means 11B is connected to an actuating arm 12 coupled, at its end opposite to the handle means 11B, with the head 7 through first hinge means 22 and further coupled, in an intermediate region, with the framework of the spindle 20 through second hinge means 21: thus the handle means 11B are movable between a raised stand-by position and a lowered working position.

The handle means 11A is connected with guarding means 15 provided with a window 16 made of transparent material suitable for allowing the operator to control the working progress; said handle means 11A is connected with a protruding

portion 23 of the head 7 together with the guarding means 15 by a system of levers 24 defining an articulated parallelogram: thus the handle means 11A and the respective guarding means 15 are movable between a raised stand-by position and a lowered working position.

The handle means 11A and 11B are provided with respective control levers 14A and 14B, by acting on which an enable signal is produced; said signal is sent to the automatic control device 31 in order to enable the tool 9 to be rotated and the head 7 to be moved in the horizontal plane defined by the pairs of working guides 5 and 8. Since the enable signal is sent only when the control levers 14A and 14B are simultaneously pressed, they also act as a safety device suitable for protecting the operator from possible accidents.

The handle means 11A and 11B further comprises respective push-button means 13A and 13B by acting on which some working cycle operations can be managed as explained below.

The working cycle of a profiled element 4 occurs as below described.

A profiled element 4 is positioned on the machine bed 2 with the aid of not shown stop means and blocked thereto through the clamps 3.

The required workings are established through the automatic control device 31, by defining their shape and position on the profiled element 4.

By grasping both the handle means 11A and 11B and pressing the control levers 14A and 14B, the operator sends a signal to the automatic control device 31, thus enabling the working cycle to be started: the automatic control device 31 places the working head 7 in the point where the first working has to be carried out and controls the start of tool 9.

The operator then manually actuates the down-stroke of tool 9 by lowering the lever system 24 and the lever 12 until the lowered position of working start is reached and, by pressing

one of the push-button means 13A, 13B, for example the push-button means 13B, causes the vertical sliding of the tool 9 to be blocked and the first step of the working cycle to be started by the automatic control device 31. When said first working step is finished, the automatic control device 31 enables the slide means 30 to be vertically slid. If the just finished working step has to be repeated, or if the same working step has to be carried out in the same position on said horizontal plane, but in a new position along said vertical axis, the operator drives the tool 9 to the required vertical position and causes the slide means 30 to be blocked and the working step to be started, by acting on the push-button means 13B.

If, on the contrary, a subsequent working step has to be carried out in a different position along the profiled element 4, the operator causes the slide means 30 to rise again along said vertical axis until it actuates an upstroke limit sensor and, by pressing the other push-button means 13A, releases the vertical sliding of the tool 9.

Therefore the operator, acting on the push-button means 13A, causes the automatic control device 31 to start said subsequent working step by positioning the tool means 9 in a new position on said horizontal plane.

Finally, the operator vertically positions the tool as previously described in order to start said subsequent working step, and so on.

With reference to Figures 4 to 8, a different embodiment of the machine 1 is shown wherein a motor 32 is associated with the slide means 30, said motor 32 controlling said slide means 30 to be vertically translated along the third pair of working guides 10.

The machine 1 further comprises manually actuated control means 33 arranged for controlling the motor 32 allowing the vertical position of the tool 9 to be changed. The control

means 33 comprises reference means 34 suitable for being detected by convenient detecting means 35 associated thereto.
The reference means 34 comprises magnetic strip means 36 fixed to support means 37, having a circular sector shape, which are firmly connected to the handle means 11B, through a pin 29.
Said magnetic strip means 36 comprises a plurality of permanent magnets distributed along said strip, at pre-established positions.
The detecting means 35 comprises a head 38 suitable for detecting the presence of permanent magnets associated with the magnetic strip means 36.
Alternatively to control means 33 of a magnetic type, control means 33 of an optical or mechanical type may be used.
In the first case, the detecting means 35 comprises a laser beam suitable for detecting bar code means with which the reference means 34 is provided.
In the second case, the reference means 35 comprises a mechanical tracer capable of interacting with suitable protrusions, or cavities, made on the reference means 34.
When an operator assigned to the actuation of machine 1, during a working cycle, rotates the handle means 11B so as to bring it from a first position A, shown in Figure 7 and corresponding to a stand-by position of the tool means 9, to a second position B, shown in Figure 8 and corresponding to an operating position of said tool means 9, the magnetic strip means 36 fixed to the support means 37 interacts with the head 38 so as the detecting means 35 sends the motor 32 a signal causing the tool 9 to be forwarded proportionally to the number of magnets passed into the working range of the head 38, during the displacement of the handle means 11B from said first position A to said second position B.
Thus, the above-mentioned operator is not subjected to the heavy task of causing, during every working, the down-stroke

of the tool 9 carrying the weight of the spindle 20 and its relative equipment.

Furthermore, since the slide means 30 is not manually actuated by the operator, but it is actuated by the motor 32, the risks of damaging portions of profiled element 4 which do not require to be drilled are strongly reduced.

In order to improve the working accuracy it is possible to change the ratio between the angular displacement of the support means 37 and the vertical translation of the tool 9: i.e. an extremely short stroke of the slide means 30 may correspond to remarkably wide arcs, which allows an optimum control of the working in progress.

The machine 1 further comprises a position sensor which measures the height of tool 9 and informs the operator of it.

If the control device 31 detects that the vertical height of tool 9 has not significantly changed although the operator is rotating the handle means, which means that the tool means 9 are stumbling over the profiled element 4, said device stops the rotation of spindle 20, in order to prevent damages of the tool 9.

The control means 33 further comprises brake means 39 arranged for stopping the rotation of support means 37 and consequently the vertical sliding of tool 9.

The brake means 39 comprises an actuator 40 controlling a brake shoe, not shown, which clamps the support means 37 preventing any further movement thereof.

Working on a profiled element 4 occurs as explained below.

As previously described, the automatic control device 31 places the working head 7 in the position of the profiled element 4, previously positioned on the machine bed 2, in which the first working has to be carried out and controls the tool 9 start.

An operator grasps the handle means 11B and rotates it, causing the tool 9 to be lowered and the profiled element 4 to

be drilled. The handle means 11B are rotated until the tool reaches the desired height, indicated to the operator by the position sensor. The operator then acts on the brake means 39 preventing further vertical translations of the slide means 30. Working is then completed as previously described.

The control device 31 allows the machine to work in a self-learning mode: if a certain number of profiled elements with the same workings has to be produced, as it often practically happens, the first piece will be machined with manual control by the operator, whereas the remaining pieces will be worked in a completely automatic manner.

In particular, during the first piece production, the control device 31 will store, for every working carried out, the vertical height at which the operator has stopped the down-stroke of tool 9 and will use it in the next cycles.

This greatly simplifies the use of machine 1 and enables even unskilled operators, who would not be able to program a totally automatic cycle, to use said machine.

As shown in Figure 9, swivel cutter head means 41 can be associated with the spindle 20, said swivel cutter head means 41 being arranged for orienting the tool 9 in a desired direction.

In particular, owing to the swivel cutter head means 41 it is possible to carry out workings not only on the upper face of the profiled element 4, or on portions thereof arranged substantially parallel to the machine bed 2, but also on side faces and ends of the profiled element 4, i.e. on the so-called "heads" whose machining is impossible with the prior art machines.

The use of swivel cutter head means 41 can be associated with the possibility of switching the manually controlled axis of the machine 1. By acting on the control device 31 it is actually possible to cause the control means 33 to send the signal not to the motor 32, but to the actuating means

controlling the translation of the trolley means 6 along the first pair of guides 5, or the translation of the head 7 along the second pair of guides 8, thus controlling the displacements in the horizontal plane.

With reference to Figure 10, it is shown how the control device 31 is connected to the machine bed 2 through a oscillating arm 42 movable between the operating position of Figure 10 and a stand-by position, not shown, wherein the control device 31 is kept inside the profile of the machine 1, thus limiting its overall dimensions and drastically reducing its transport costs.

The oscillating arm 42 is provided with an appendix, not shown, housed inside one of the uprights 43 of the machine 1 and rotatably coupled with it.

For switching from the operating position to the stand-by position, the arm 42 is partially raised in a vertical direction, so that it does not interfere with the machine bed 2, and is then rotated according to the arrow F so as to bring the control device inside the machine 1 overall dimensions.

In an embodiment not shown, the motor 32 is a stepping motor, and the control means 33 comprises adjusting devices for adjusting said stepping motor, for example rheostat means, or joystick means, manually actuatable by an operator for controlling the translation of the slide means 30.

CLAIMS

1. Machine (1) for working semi-worked pieces (4), in particular elongated semi-worked pieces, comprising machine bed means (2) suitable for receiving said semi-worked pieces (4), blocking means (3) suitable for blocking said semi-worked pieces (4) on said machine bed means (2) and tool means (9) movable along three mutually perpendicular axes, characterized in that it further comprises an automatic control device (31) suitable for controlling the movement of said tool means (9) along a first and a second axis of said three axes and manually controlled actuating means (11B, 12; 32, 33) for moving said tool means (9) along a third axis of said three axes.

2. Machine according to claim 1, wherein a pair of guides (5), along which trolley means (6) is movable, is fixed to said machine bed means (2), said pair of guides (5) being parallel to a first axis of said three axes.

3. Machine according to claim 2, wherein said trolley means (6) is provided with guide means (8) for guiding a working head (7) to which said tool means (9) is supported, said guide means (8) being parallel to a second axis of said three axes.

4. Machine according to claim 3, wherein said working head (7) comprises a further pair of guides (10), along which slide means (30), to which said tool means (9) is supported, are movable, said further pair of guides (10) being parallel to a third axis of said three axes.

5. Machine according to any of preceding claims, wherein said manually controlled actuating means comprises handle means (11A, 11B) suitable for controlling the translation of said slide means (30) along said further pair of guides (10).

6. Machine according to claim 5, wherein said handle means (11A, 11B) is provided with first control means (14A, 14B), suitable for interacting with said automatic control device (31).

7. Machine according to claim 5, or 6, wherein said handle means (11A, 11B) is provided with further control means (13A, 13B) suitable for interacting with said automatic control device (31).

8. Machine according to any of preceding claims, wherein said manually controlled actuating means comprises motor means (32) suitable for actuating said slide means (30).

9. Machine according to claim 8, wherein said manually controlled actuating means comprises control means (33) suitable for interacting with said motor means (32).

10. Machine according to claim 9, wherein said control means (33) can be actuated by said handle means (11B).

11. Machine according to claim 9, or 10, wherein said control means (33) comprises reference means (34) suitable for being detected by detecting means (35) associated thereto.

12. Machine according to claim 13, wherein said reference means (34) is associated with support means (37).

13. Machine according to claim 12, wherein said support means (37) has the shape of a circular sector and is firmly connected to said handle means (11B).

14. Machine according to any of claims 11 to 13, wherein said detecting means (33) is magnetic type means.

15. Machine according to any of claims 11 to 14, wherein said reference means (34) comprises magnetic strip means (36) fixed to said support means (37).

16. Machine according to claim 15, wherein said magnetic strip means (36) comprises a plurality of permanent magnets distributed at pre-established positions along an edge of said support means (37).

17. Machine according to claim 16, wherein said detecting means (35) comprises a head (38) suitable for detecting the presence of said permanent magnets.

18. Machine according to any of claims 11 to 13, wherein said detecting means (35) is of an optical type.

19. Machine according to claim 18, wherein said detecting means (35) comprises laser beam means.

20. Machine according to claim 18, or 19, wherein said reference means (34) comprises bar code means.

21. Machine according to any of claims 11 to 13, wherein said detecting means (35) is of a mechanical type.

22. Machine according to claim 21, wherein said detecting means (35) comprises tracer means suitable for interacting with protrusions, or cavities, made on said reference means (34).

23. Machine according to any of claims 8 to 10, wherein said motor means comprises a stepping motor (32).

24. Machine according to claim 23, wherein said control means (33) comprises adjusting means for adjusting said stepping motor (32).

25. Machine according to claim 24, wherein said adjusting means comprises rheostat or joystick means.

26. Machine according to any of preceding claims, and further comprising sensor means suitable for detecting the position of said tool means (9) along said third axis.

27. Machine according to claim 26, when appended to any of claims 4 to 25, wherein said sensor means is associated with said slide means (30).

28. Machine according to any of preceding claims, and further comprising brake means (39) suitable for stopping the movement of said tool means (9) along said third axis.

29. Machine according to claim 28, when appended to any of claims 13 to 27, wherein said brake means (39) is operationally associated with said support means (37).

30. Machine according to any of preceding claims, wherein said tool means (9) is associated with swivel cutter head means (41), for orienting said tool means (9) in a desired direction.

31. Machine according to any of preceding claims, wherein said control device (31) is arranged so as to allow the machine to work in a self-learning mode.

32. Method for working a semi-worked piece (4), in particular an elongated semi-worked piece, using tool means (9) movable along three mutually perpendicular axes, comprising positioning said tool means (9) with respect to said semi-worked piece by displacing said tool means (9) along a first and a second axis of said three axes, translating said tool means (9) along a third axis of said three axes in order to bring said tool means (9) in contact with said semi-worked piece (4), actuating said tool means (9) and moving said tool means (9) along said first and said second axis for carrying out a working on said semi-worked piece (4), characterized in that said positioning and said moving are performed through an automatic control device (31) and said translating is performed through manual control means (11B, 12; 32, 33).

33. Method according to claim 32, wherein said first and said second axis define a working plane.

34. Method according to claim 32, or 33, wherein said tool means (9) is orientable with respect to said three axes.

35. Method according to any of claims 32 to 34, further comprising detecting the position of said tool means (9) with respect to said third axis.

36. Method according to any of claims 32 to 35, and further comprising blocking the translation of said tool means (9) with respect to said third axis.

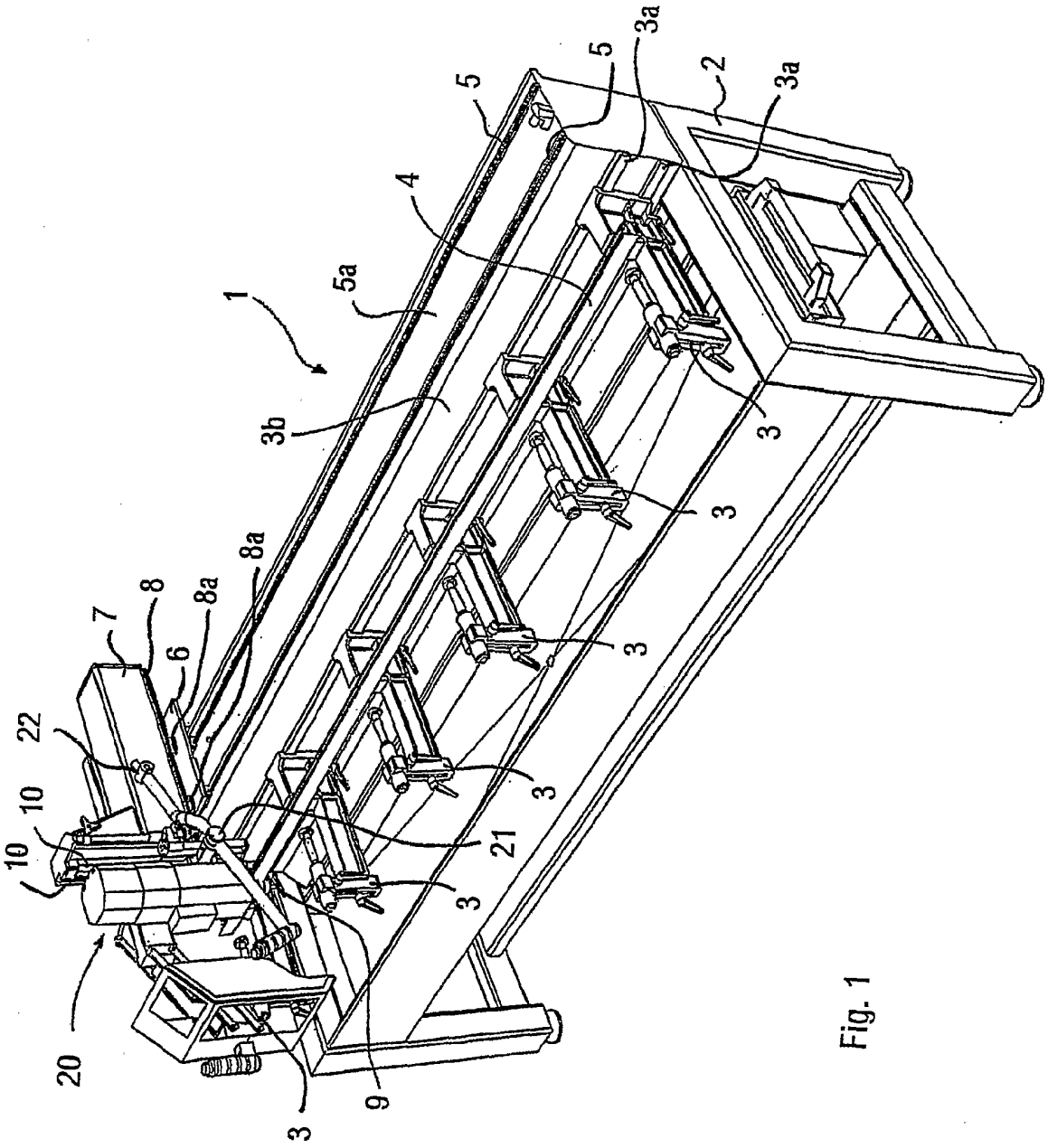

Fig. 1

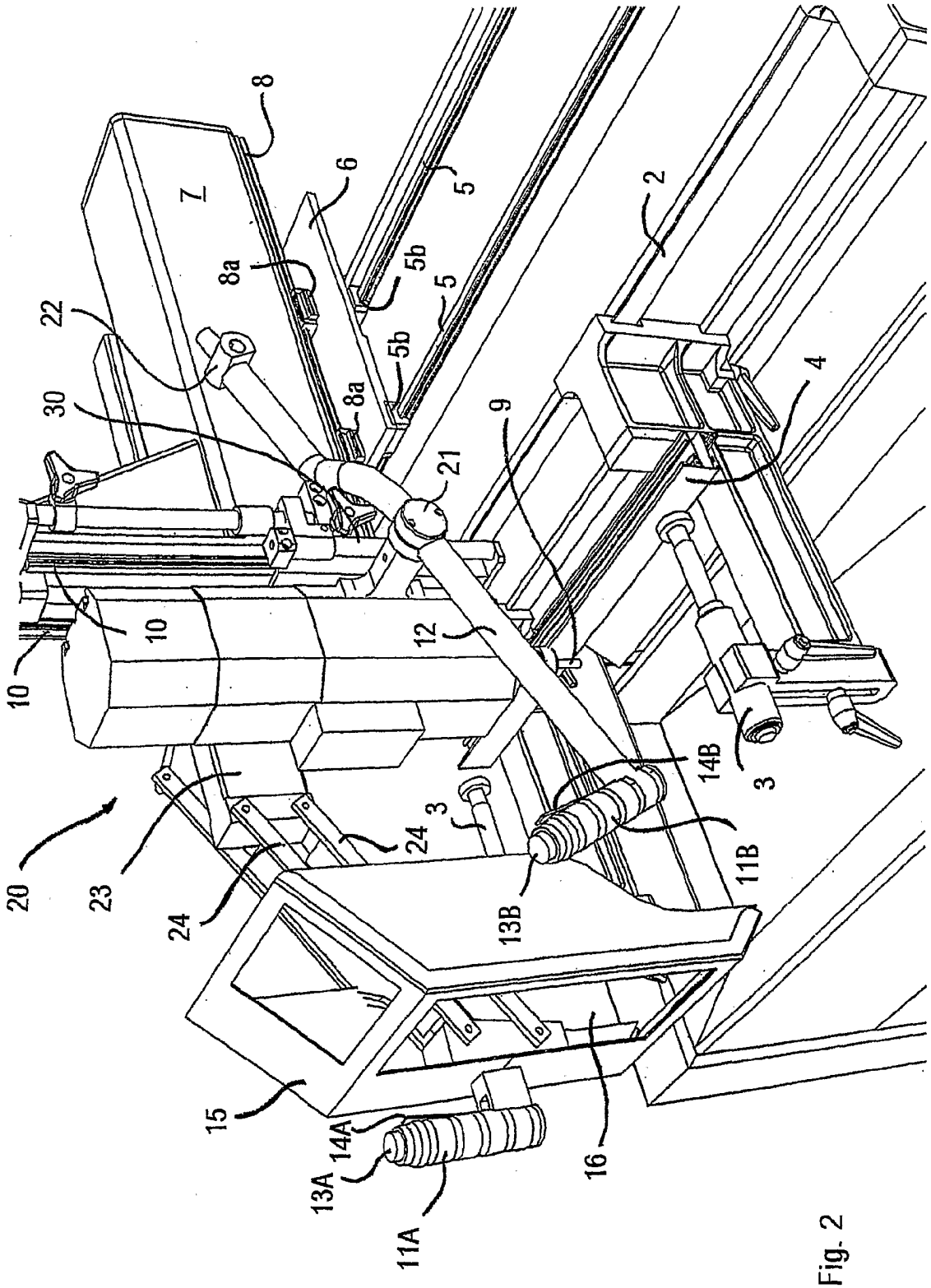
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Fig. 2

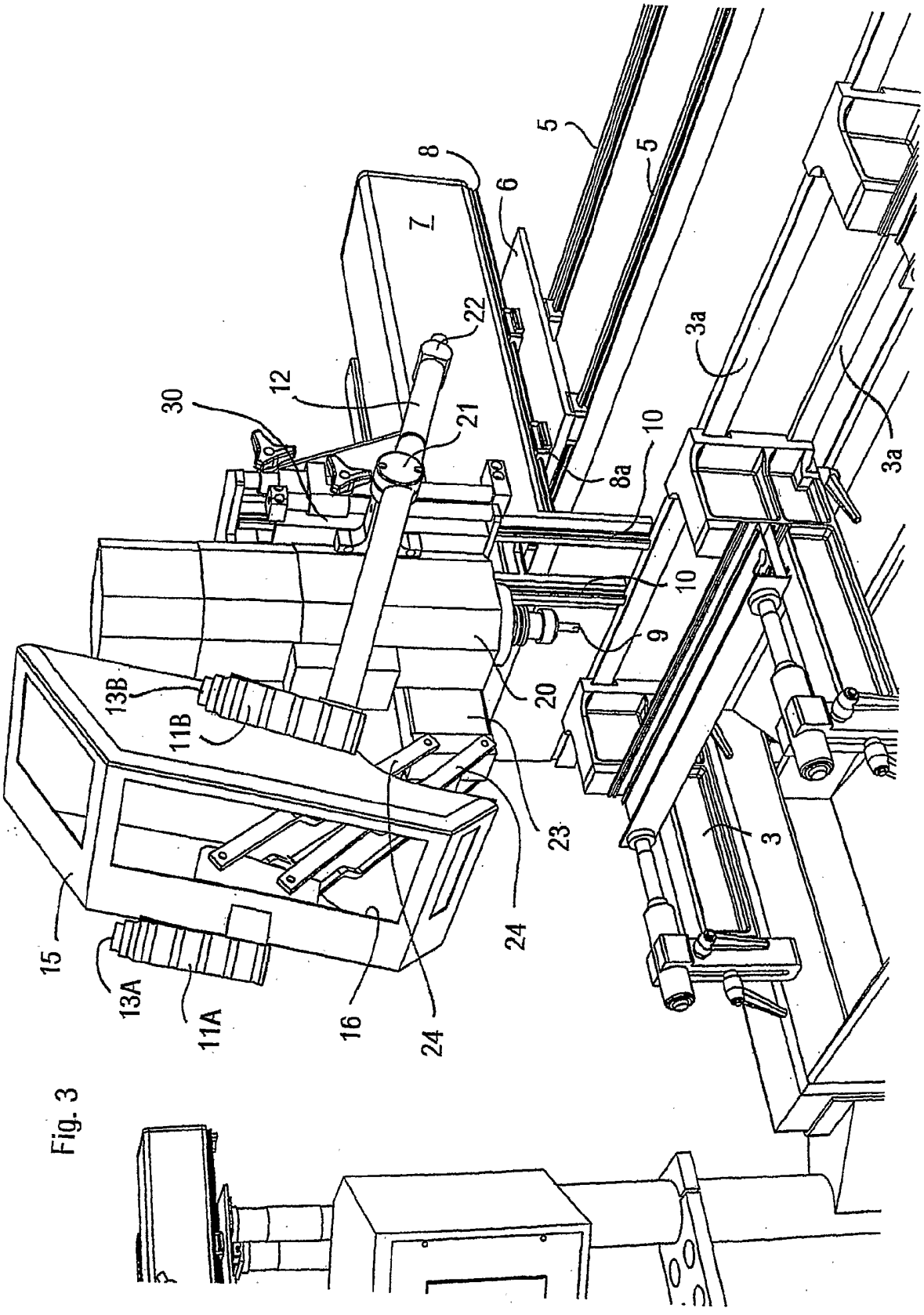

Fig. 3

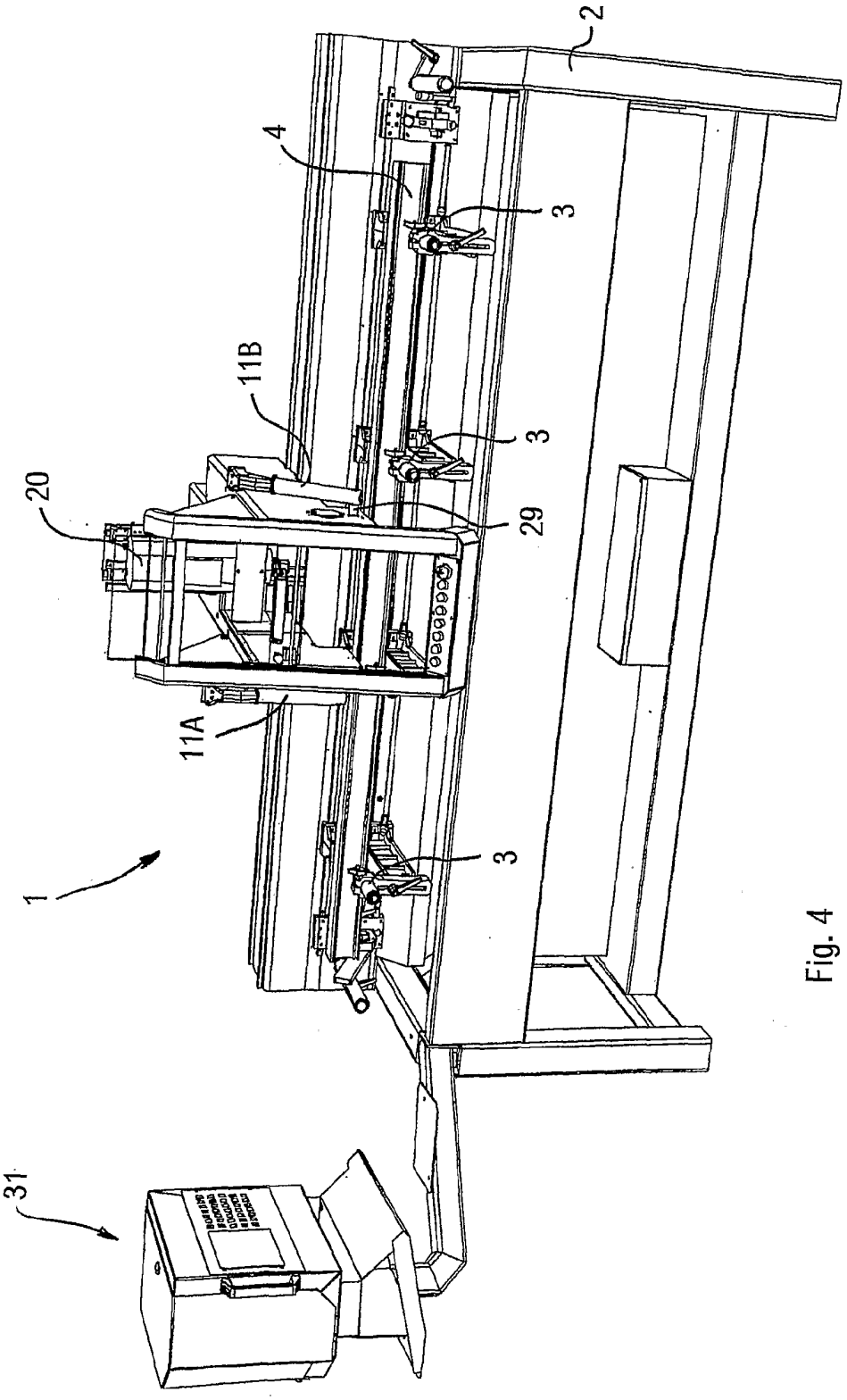

Fig. 4

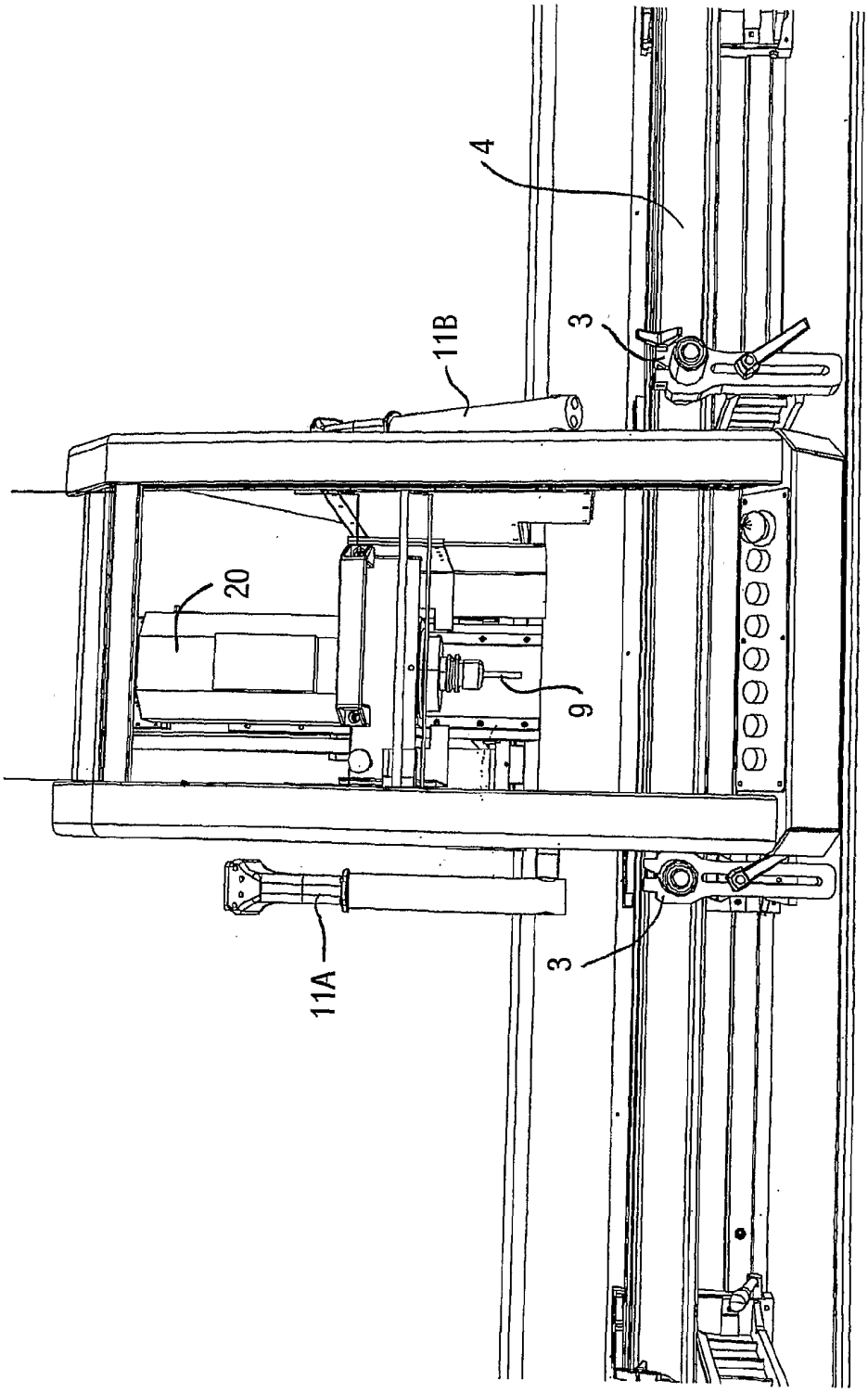

Fig. 5

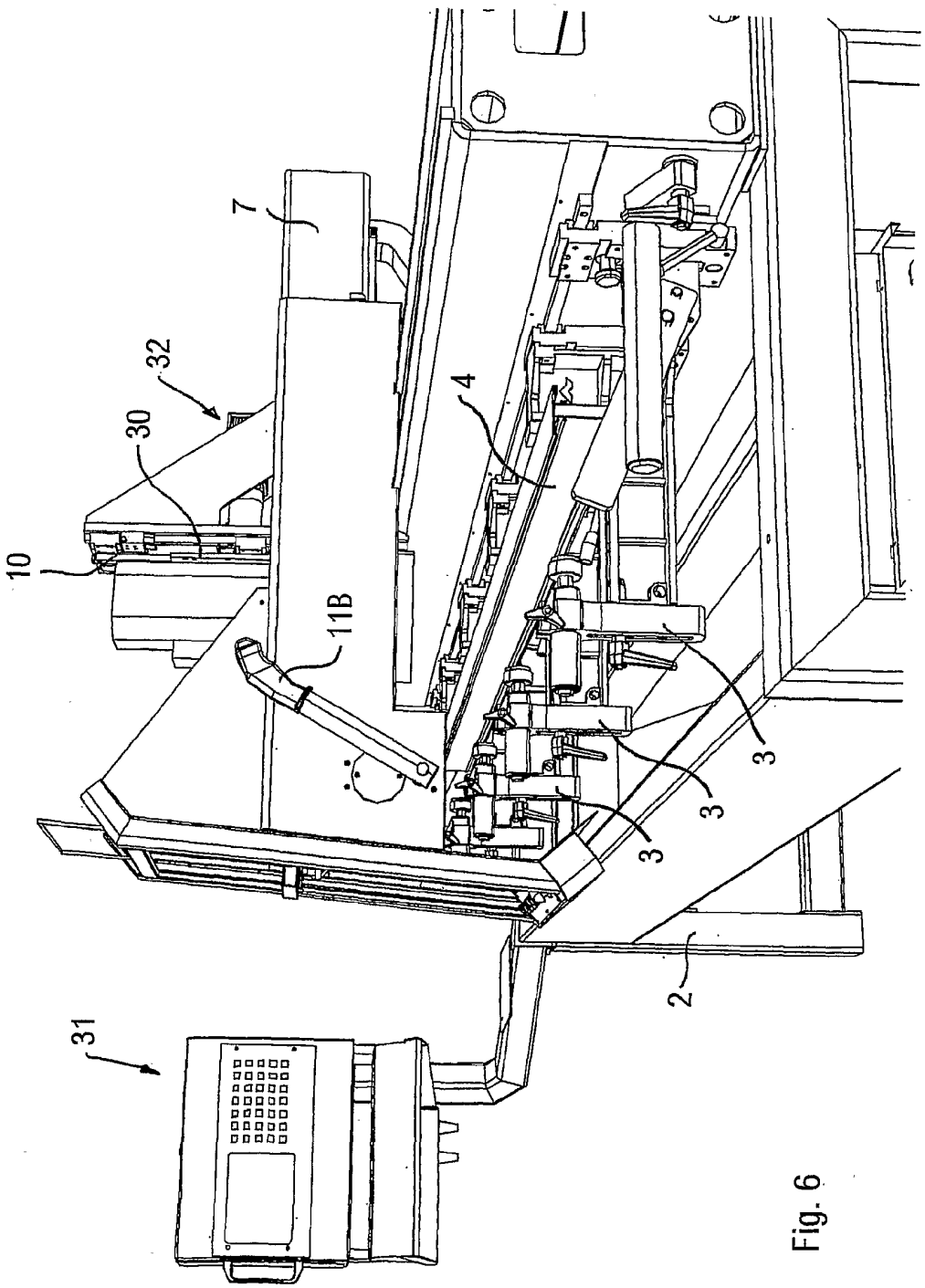

Fig. 6

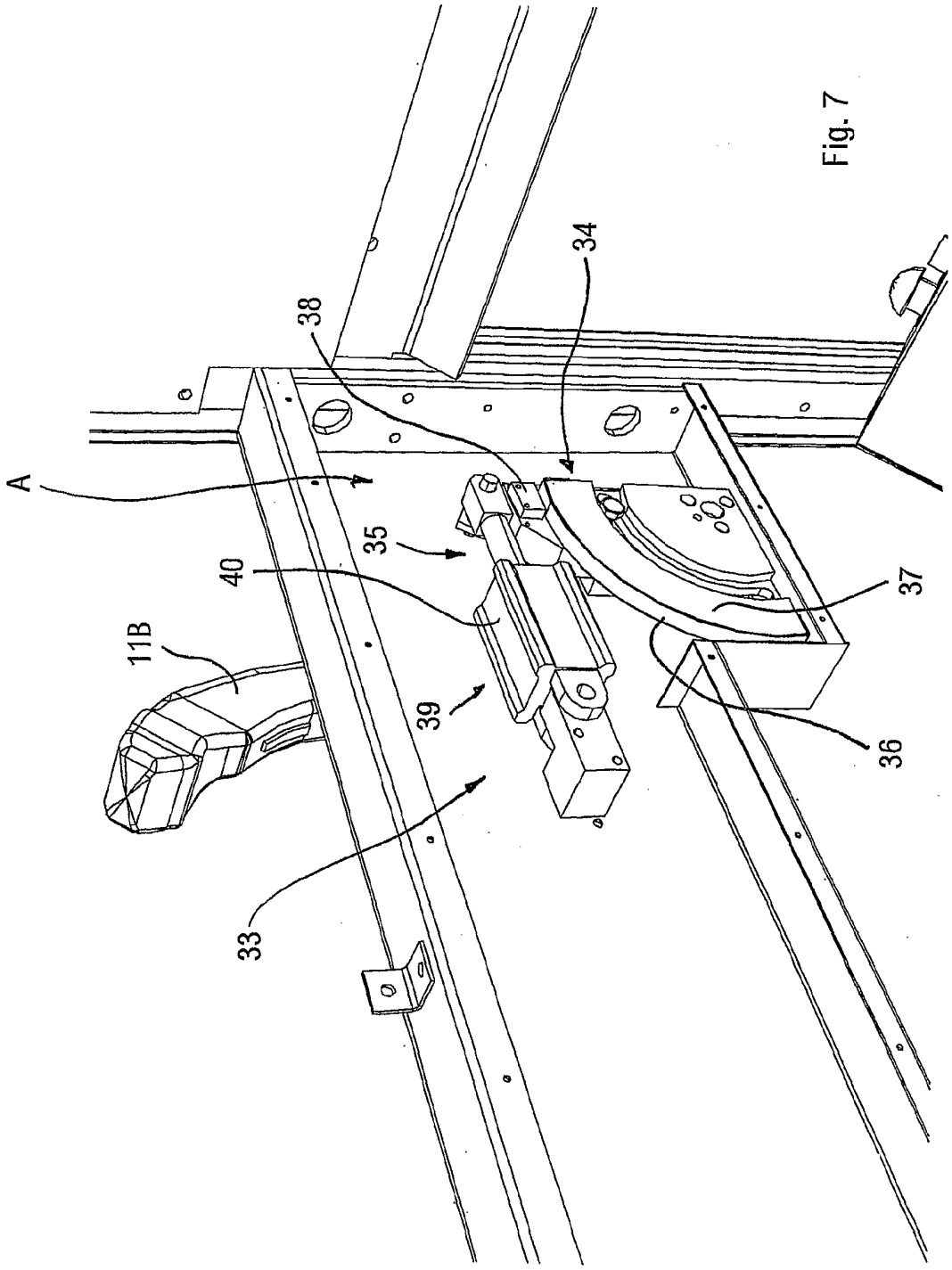

Fig. 7

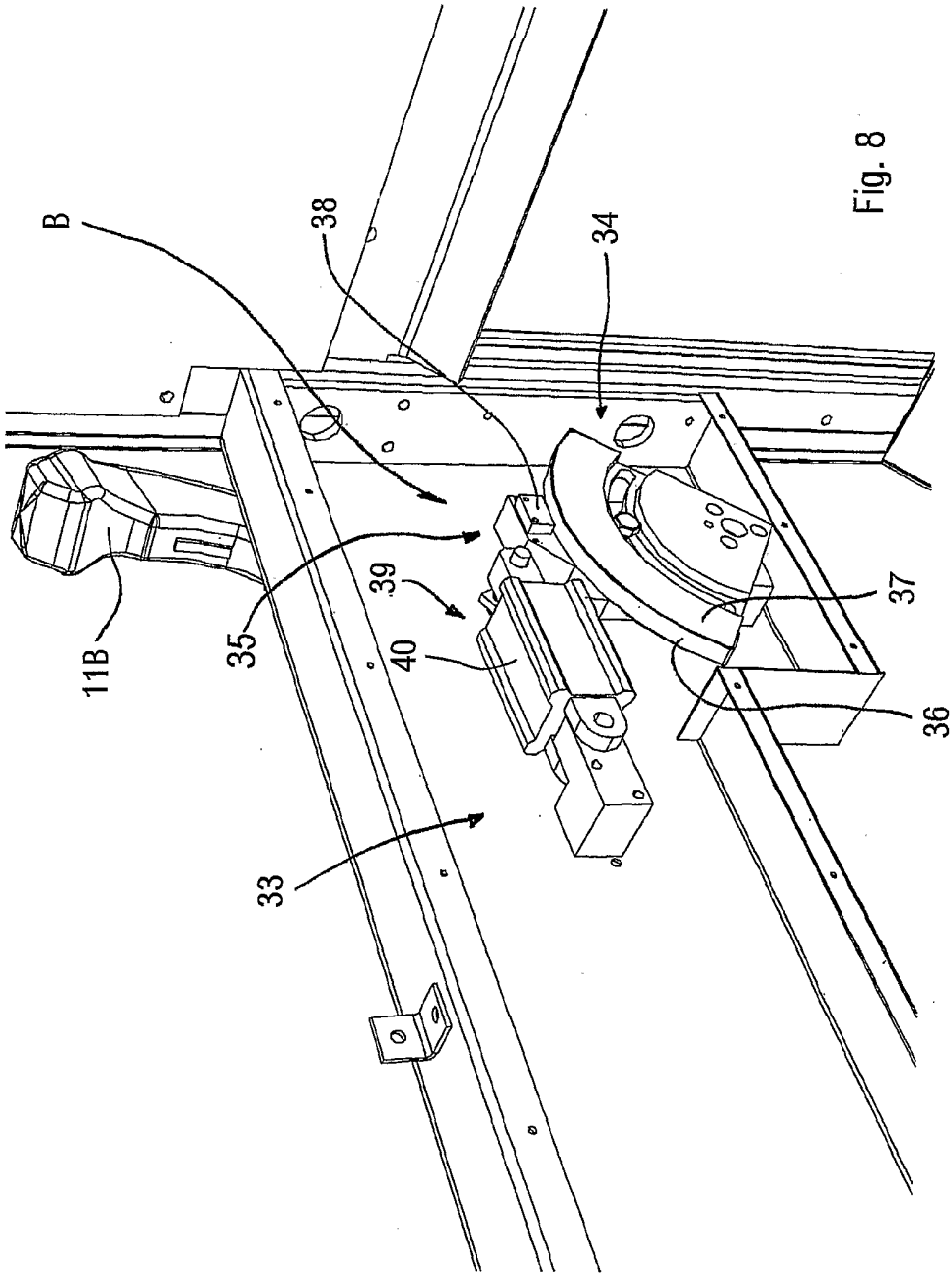

Fig. 8

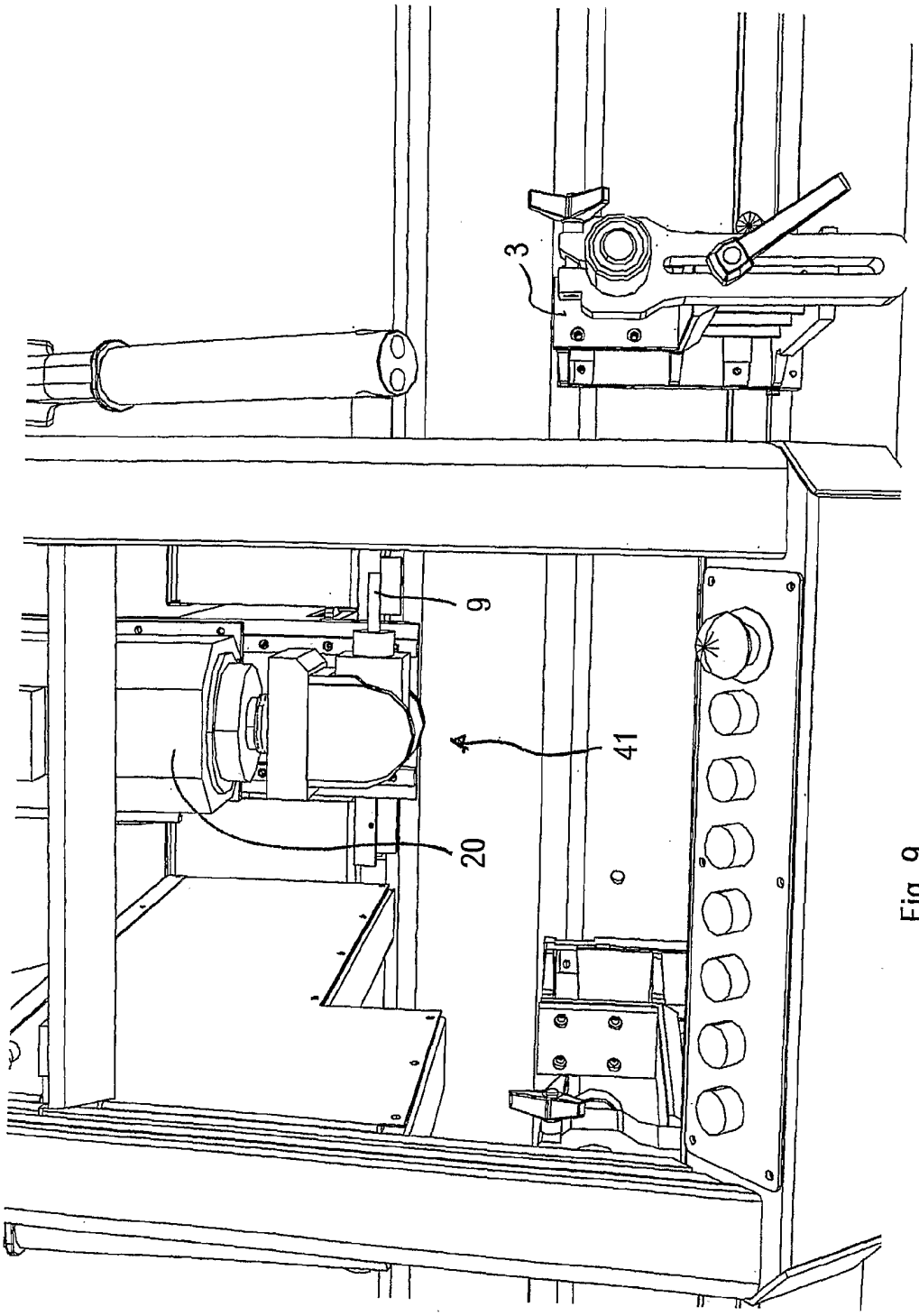

Fig. 9

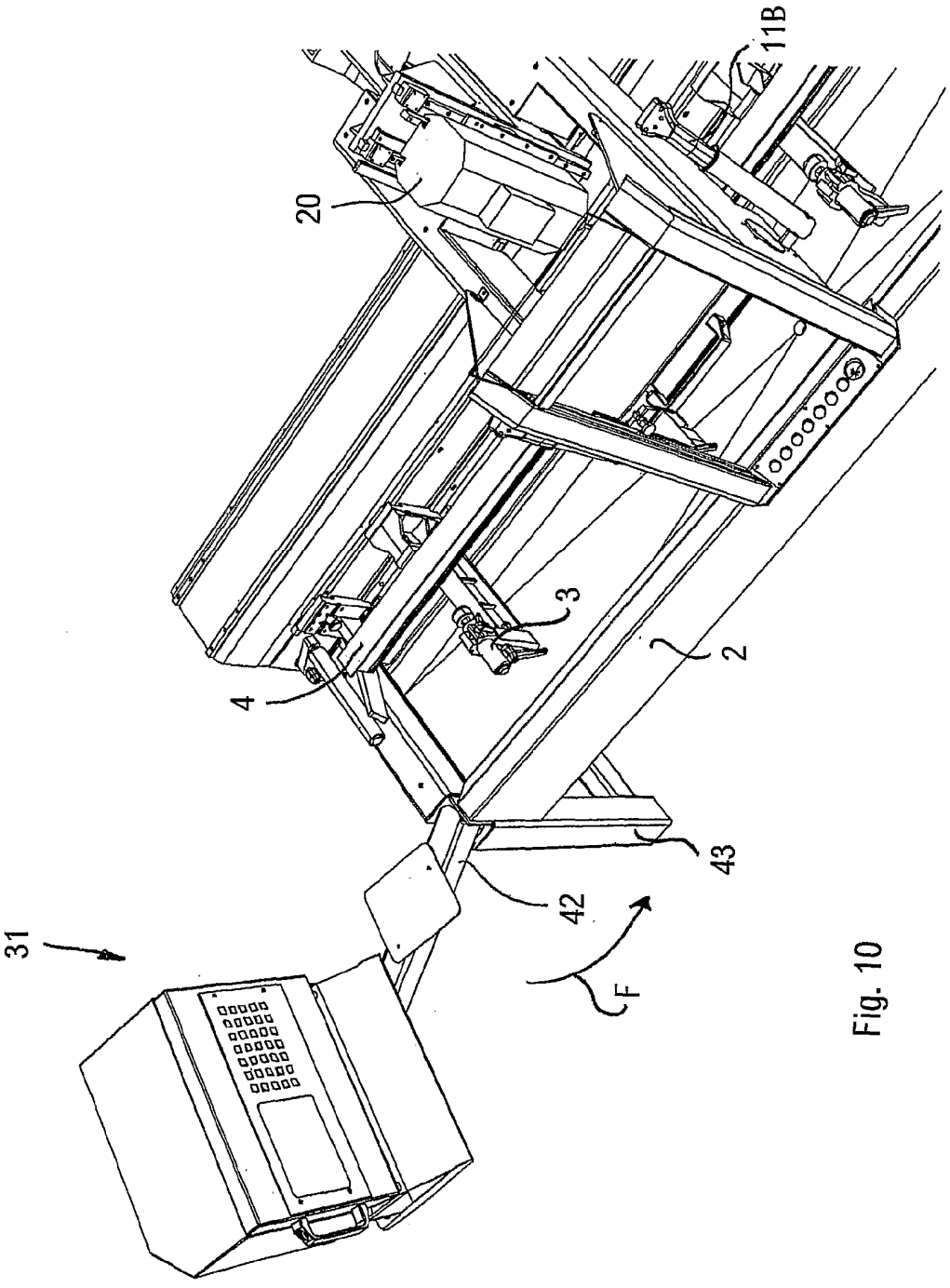

Fig. 10