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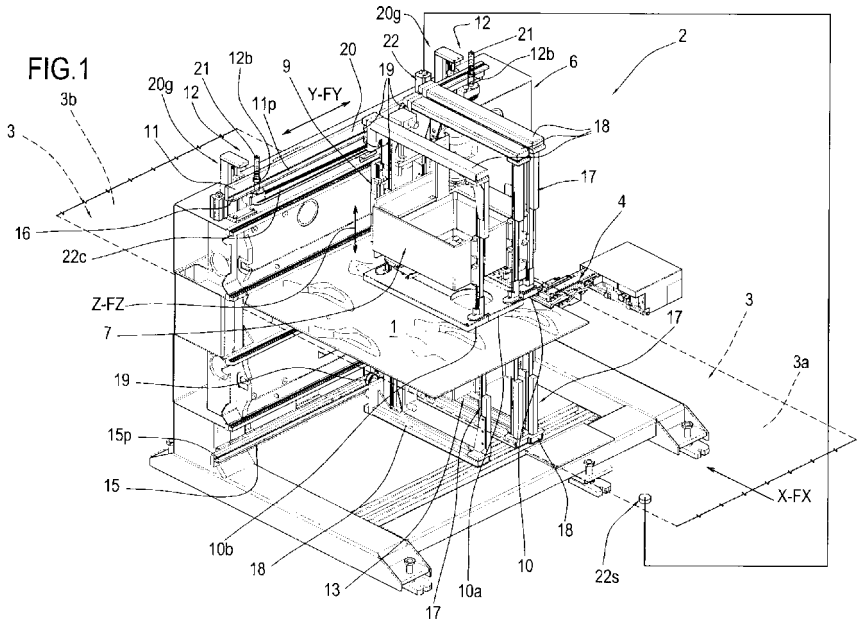
(54) **Machining centre for machining workpieces made of wood or the like.**

(57) A machining centre for machining workpieces (1) made of wood or the like comprises: a worktable (3) supporting the workpiece (1) and equipped with at least one holding part (4) positioned at the side of the worktable (3) and designed to clamp the workpiece (1) and, respectively, to move it in a direction of feed coinciding with a first axis (X) towards a frame (6), extending transversally to the worktable (3), and supporting a machining head (7) slidably movable along a second axis (Y) transversal to the worktable (3) and along a third, vertical axis (Z); a holding table (10) is inserted between the machining head (7) and the workpiece (1), movable with the machining head (7) along the second, transversal axis (Y); the table (10) slidably associated with a first supporting guide (11), positioned on the frame (6) and extending parallel with the second, transversal axis (Y); means (12) for adjusting the table (10) along the third, vertical axis (Z), positioned on the first guide (11) and acting on the table (10) in such a way as to position the table (10) relative to the workpiece (1) and irrespective of the position which the machining head (7) can assume along the third, vertical axis (Z).

FIG.1



EP 1 857 239 A2

Description

[0001] The present invention relates to a machining centre for machining workpieces made of wood or the like.

[0002] The machining centre which is the subject matter of the present invention is used for stock removal machining processes (vertical and horizontal boring, routing and cutting) on wooden workpieces which will be used to form parts of furniture units (for example kitchen cabinets).

[0003] In this particular case, in the machining centre the workpiece to be machined and the machining units are able to move relative to one another.

[0004] More precisely, the machining centre basically comprises:

- a worktable for supporting the workpiece to be machined, extending horizontally and having one or more lateral grippers designed to clamp the workpiece along a portion of its lateral surface and move it in a direction of feed coinciding with an axis X of extension of the worktable;
- a machining zone comprising a portal frame positioned transversally to the worktable and designed to divide the worktable into two halves, and supporting
- at least two machining units or heads, respectively positioned below and above the line defined by the workpiece supporting worktable, each having a plurality of machining tools, and movable along an axis Y transversal to the worktable and along a vertical axis Z so as to be able to move towards and perform machining on the workpiece positioned by the grippers below the machining zone and in accordance with the selected machining cycle.

[0005] Since the workpiece being machined is subjected to machining on all three axes (X, Y, Z), said workpiece is obviously subject to significant forces applied by the tools and, therefore, it must be rigidly held at least in the machining zone.

[0006] Said task cannot be performed by the grippers, since for obvious workpiece machining reasons they must occupy a limited area of the workpiece.

[0007] Therefore, for holding and locating the workpiece in the machining area, at least along the vertical axis Z, tables are used (suitably shaped with holes and slots through which the tools may pass) which are preferably supported directly by the machining heads and so can move with them at least along the transversal machining axis Y.

[0008] Obviously, these locating tables must be height-adjustable along the axis Z, irrespective of the movement of the machining heads, to prevent collisions with any tools during machining and, above all must be retracted (that is to say, moved away from the workpiece) if they approach the area of the workpiece where the movement gripper is present.

[0009] For this reason, the tables are supported by additional independent guides present on the machining head and controlled by linear actuators designed to allow them to move along the vertical axis Z.

[0010] Said system for adjustment of the tables has several disadvantages due to its complex construction and operation.

[0011] The need for additional actuators and guides for the tables on the machining heads tends to increase the overall cost of the machine, whilst the operations needed to adjust and move the tables tend to significantly slow down the machining steps, since the machine cycle programs must include steps comprising the table movements (from the operating position to the non-operating position and vice versa) and "feedback" signals from the systems in order to be certain that the tables have been positioned.

[0012] The present invention therefore has for an aim to overcome the above-mentioned disadvantages with a machining centre for machining workpieces made of wood or the like structured in such a way that it has an extremely simple architecture for the machining head and locating table movement and adjustment systems in terms of the adjusting elements and such that it maintains a high level of productivity for the machining centre in the unit of time.

[0013] Accordingly, the present invention achieves this aim with a machining centre, and in particular a machining centre for machining workpieces made of wood comprising the technical features described in one or more of the claims herein.

[0014] The technical features of the invention, with reference to the above aims, are clearly described in the claims below and its advantages are more apparent from the detailed description which follows, with reference to the accompanying drawings which illustrate a preferred embodiment of the invention provided merely by way of example without restricting the scope of the inventive concept, and in which:

- Figure 1 is a partial perspective view with some parts cut away to better illustrate others of a machining centre for machining workpieces made of wood or the like in accordance with the present invention;
- Figure 2 is a front view with some parts cut away to better illustrate others of the machining centre of Figure 1;
- Figure 3 is a side view with some parts cut away to better illustrate others of the machining centre of Figure 1;
- Figures 4 and 5 are partial perspective views with some parts cut away of two details of the machining centre of Figure 1, specifically, the upper and lower guides;
- Figure 6 is a front view of an enlarged detail from Figure 1 compared with a cam profile which is part of the guides of Figures 4 and 5.

[0015] With reference to the accompanying drawings, in particular Figures 1 to 3, the numeral 2 denotes as a whole the machining centre according to the invention, used for machining workpieces 1 made of wood or the like which will be used to form parts of furniture units.

[0016] In particular, this machining centre 2 performs a plurality of machining operations, for example boring, routing, cutting to size, etc., using the combination of the movement (usually intermittent) of the workpiece 1 along a first axis X with the movements of the one or more machining heads present along a second axis Y transversal to the first axis X and a third, vertical axis Z.

[0017] More precisely, this machining centre 2 basically comprises:

- a worktable 3 for supporting the workpiece 1 having at least one holding part 4, one or more grippers, positioned on a respective guide 5 at the side of the worktable 3 and designed to clamp the workpiece 1 along a portion of its lateral surface and, respectively to move it in a direction of feed (see arrow FX) coinciding with a first axis X of extension of the worktable 3, towards
- a frame 6, extending transversally to the worktable 3 and designed to divide the worktable 3 into two halves 3a and 3b, and supporting at least one machining unit 7 or head having a plurality of tools 8 (partly visible in Figure 2), and slidably movable, thanks to respective means 9, along a second axis Y transversal to the worktable 3 and along a third, vertical axis Z (see arrows FY and FZ), so as to perform the machining on the workpiece 1 in such a way that is it co-ordinated with the movement of the workpiece 1 along the first axis X;
- at least one holding and locating table 10, inserted between the machining head 7 and the workpiece 1, movable with the machining head 7 along the second, transversal axis Y, and designed to locate the workpiece 1 along the third, vertical axis Z.

[0018] As shown in Figures 1 to 3, the worktable 3 is illustrated with a dashed line, since it is of the widely known type, whilst only one holding gripper 4 can be seen, although obviously along the side of the worktable 3 there may be two or more clamps 4 sliding, in both directions, in X along the guide 5.

[0019] Similarly, the means 9 for adjusting the machining head 7 are not described, being of the widely known type (for example suitably motor-driven male and female screw couplings between the frame 6 and the machining head 7).

[0020] The tables 10 are also not illustrated in detail (for example in terms of internal form) since their use for the machining work to be done is well known.

[0021] In addition to the above-mentioned elements, the machining centre 2 comprises:

- the table 10 slidably associated with a first supporting guide 11, positioned on the frame 6 and extending parallel with the second, transversal axis Y; and
- means 12 for adjusting the table 10 along the third, vertical axis Z, positioned on the first guide 11 and acting on the table 10 in such a way as to position the table 10 relative to the workpiece 1 and irrespective of the position which the machining head 7 can assume, also along the third, vertical axis Z.

[0022] Basically, the initial adjustment and any table 10 retracted - reactivation positions necessary are achieved using the first guide 11, releasing the table 10 from the machining head 7 at least for the third, vertical axis Z.

[0023] More precisely, in the example visible again in Figures 1 to 3 by way of example only, the first machining head 7 and the respective table 10 are positioned and movable above the line defined by the worktable 3.

[0024] In this case, part of the adjusting means 12 are positioned on the first supporting guide 11, acting between the frame 6 and the first guide 11, and designed at least to position the table 10 above a height, relative to the worktable 3 line, which depends on the thickness of the workpiece 1 to be machined and irrespective of the height at which the machining head 7 may position itself.

[0025] Another part of the adjusting means 12 consists of a cam profile 16, present along at least one lateral zone of the first guide 11 and acting on the table 10 in such a way as to allow it a retracted position, that is to say a position in which the table 10 is moved away from the workpiece 1 along the third, vertical axis Z (see arrow F10), when it moves, in one direction, along the second, transversal axis Y, and close to the workpiece 1 holding gripper 4 engagement zone. Said configuration is described in detail below. Obviously, movement in the opposite direction along the axis Y allows the table 10 to be returned to an active operating position.

[0026] Figures 1 to 3 also illustrate a machining centre 2 solution in which there is a second machining head 13 positioned below the worktable 3 line.

[0027] This second machining head 13 also moves slidably, similarly to the previous one, along the second, transversal axis Y and along the third, vertical axis Z.

[0028] There is also at least one lower holding and locating table 14, inserted between the second machining head 13 and the workpiece 1, movable with the second machining head 13 along the second, transversal axis Y, and designed to locate the workpiece 1 along the third, vertical axis Z.

[0029] In said configuration, the lower table 14 is also slidably associated with a second supporting guide 15, positioned on the bottom of the frame 6 and extending parallel with the second, transversal axis Y.

[0030] As also illustrated in Figures 4 and 5, the first and second guides 11 and 15 are equipped with the above-mentioned part of the adjusting means 12 consisting of the cam profile 16 present in the lateral zone of the

guides 11 and 15.

[0031] In this case, as Figure 2 clearly shows, the cam profile 16 acts simultaneously on the upper and lower tables 10 and 14 to allow them a retracted position, that is to say a position in which the tables 10 and 14 are moved away from the workpiece 1 along the third, vertical axis Z, after their movement along the second, transversal axis Y, and close to the workpiece 1 holding gripper 4 engagement zone. The detail of the table 10 and 14 retraction path and the profile of the cams 16 is clearly visible in Figure 6.

[0032] Obviously, this description is of one cam profile configuration, but it may be present on other zones of the guides 11 and 15 depending on the machining centre 2 operating requirements, without thereby limiting the scope of the invention.

[0033] Looking in more detail at the construction, again with reference to Figures 1 to 3, each table, upper and lower 10 and 14 is supported by a plurality of vertical guides 17 associated, at the other end, with a rigid supporting structure 18 (also forming a frame for the machining heads 7 and 13), equipped with at least one pair of wheels 19, positioned on the respective first and second guides, upper or lower 11 and 15.

[0034] Each guide 11 and 15 in turn has a sliding track 11p and 15p along the second, transversal axis Y inserted between the pair of wheels 19 and having the cam profile 16.

[0035] As Figure 6 also clearly shows, the cam profile of the first, upper guide 11 is at least formed by a track 11p connecting curvature or ramp 16 designed to allow the upper table 10 to be lifted, together with the supporting structure 18, relative to the workpiece 1 and along the third, vertical axis Z (see arrow F10).

[0036] Similarly, the cam profile of the second, lower guide 15 is at least formed by a track 15p connecting curvature or ramp 16 designed to allow the lower table 14 to be lowered, together with its supporting structure 18, relative to the workpiece 1 and along the third, vertical axis Z (see arrow F14).

[0037] As regards the part of the upper table 10 adjusting means 12 dedicated at least to its initial height setting depending on the workpiece 1 thickness, the adjusting means 12 may comprise, as an example of the construction, a pair of threaded bushings 12b, associated with a cross member 20 supporting the first, upper guide 11, which can be connected by screwing to respective lead nuts 21 with a vertical axis and rotatably associated with the frame 6.

[0038] A motor-driven unit 22 is kinematically connected to the lead nuts 21 (for example by a chain 22c meshing with respective gear wheels 22r keyed on the lead nuts 21), to allow synchronised lifting or lowering of the cross member 20 along the third, vertical axis Z (partly thanks to the bilateral presence of a pair of guides 20g on which the cross member 20 slides).

[0039] The position is decided and controlled, for example, with the aid of a sensor 22s placed on the worktable 3 and upstream of the frame 6, relative to the workpiece 1 direction of feed X, so as to allow table 10 adjustment in advance (see Figure 1 with respective block).

[0040] The lower table 14 does not usually need a height setting adjustment before workpiece 1 arrival, since the lower table 14 is already in line, that is to say "aligned" with the worktable, but Figure 5 shows, with a dashed line, similar means 12 for adjusting the setting of the lower table 14 acting on the second, lower guide 15 and acting between the frame 6 and the second guide 15 so that, if necessary, the lower table 14 can be positioned at a predetermined height along the third, vertical axis Z.

[0041] Again in terms of a construction example, clearly illustrated in Figure 2, each of the tables, upper and lower 10 and 14, may be divided into a plurality of subtables (in this example there are three, labelled 10, 10a, 10b; 14, 14a, 14b) coplanar and each having respective vertical guides 17 which, at the other end, are associated with the rigid supporting structure 18.

[0042] The guides 17 have a pair of wheels 19 for each sub-table 10, 10a, 10b; 14, 14a, 14b to run on and positioned so that they run on the respective first and second guides, upper and lower 11 and 15.

[0043] Finally, it should be noticed that the vertical guides 17 supporting the tables 10 and 14 also form independent sliding guides for the respective machining head 7 and 13 along the third, vertical axis Z.

[0044] A machining centre structured in this way therefore fully achieves the preset aims thanks to the separation of adjustment of the tables from the machining heads along the vertical axis Z. Said independent adjustment makes initial setting of the position of the tables easier and faster and, thanks to the presence of cam profiles, the table movements are instant, during shared movement of the machining head and tables along the second, transversal axis Y, retracting them from and moving them back towards the workpiece, without the need to programme control units present on the machining centre.

[0045] Said device therefore allows the table transition steps during machining to be significantly streamlined, in particular the most delicate ones, close to the side affected by the workpiece movement grippers.

[0046] The invention described above is susceptible of industrial application and may be modified and adapted in several ways without thereby departing from the scope of the inventive concept. Moreover, all the details of the invention may be substituted by technically equivalent elements.

Claims

1. A machining centre for machining workpieces (1) made of wood or the like, the machining centre (2) being of the type comprising at least:

- a worktable (3) supporting the workpiece (1)

and equipped with at least one holding part (4) positioned on a respective guide (5) at the side of the worktable (3) and designed to clamp the workpiece (1) along a portion of its lateral surface and, respectively to move it in a direction of feed coinciding with a first axis (X) of extension of the worktable (1), towards
- a frame (6), extending transversally to the worktable (3), and supporting
- at least a first machining unit (7) or head, having a plurality of tools (8), and being slidably movable, thanks to respective means (9), along a second axis (Y) transversal to the worktable (3) and along a third, vertical axis (Z), allowing machining on the workpiece (1) co-ordinated with the movement of the workpiece (1) along said first axis (X);
- at least one holding and locating table (10), inserted between the machining head (7) and the workpiece (1), movable with the machining head (7) along the second, transversal axis (Y), and designed to locate the workpiece (1) along the third, vertical axis (Z), the machining centre (2) being **characterised in that** it comprises:
- at least said table (10) slidably associated with a first supporting guide (11), positioned on the frame (6) and extending parallel with the second, transversal axis (Y);
- means (12) for adjusting the table (10) along the third, vertical axis (z), positioned on the first guide (11) and acting on the table (10) in such a way as to position the table (10) relative to the workpiece (1) and irrespective of the position which the machining head (7) can assume along the third, vertical axis (Z).

2. The machining centre according to claim 1, wherein the machining head (7) and the table (10) are positioned and movable above the line defined by the worktable (3), **characterised in that** part of the adjusting means (12) are positioned on the first supporting guide (11), acting between the frame (6) and the first guide (11), and designed at least to position the table (10) above a height, relative to the worktable (3) line, which depends on the thickness of the workpiece (1) to be machined and irrespective of the height at which the machining head (7) may position itself.

3. The machining centre according to claim 1, **characterised in that** part of the adjusting means (12) consists of a cam profile (16), present along at least one lateral zone of the first guide (11) and acting on the table (10) in such a way as to allow it at least a retracted position, that is to say a position in which the table (10) is moved away from the workpiece (1) along the third, vertical axis (Z), when it moves along the second, transversal axis (Y), and close to the workpiece (1) holding part (4) engagement zone.

4. The machining centre according to claims 1 and 2, including at least one second machining head (13) positioned below the line defined by the worktable (3); the second machining head (13) being slidably movable, thanks to respective means (9), along the second, transversal axis (Y) and along the third, vertical axis (Z); at least one lower holding and locating table (14) being inserted between the second machining head (13) and the workpiece (1), movable with said machining head (13) along the second, transversal axis (Y) and designed to locate the workpiece (1) along the third, vertical axis (Z), the machining centre being **characterised in that** said at least one lower table (14) is slidably associated with a second, lower supporting guide (15) positioned on the frame (6) and extending parallel with the second, transversal axis (Y).

5. The machining centre according to claims 1, 2 and 4, **characterised in that** each of the first and second guides (11, 15) is equipped with part of the adjusting means (12) consisting of a cam profile (16), present at least in a lateral zone of each of the first and second guides (11, 15), and acting on the upper and lower tables (10, 14) in such a way as to allow them a retracted position, that is to say a position in which the respective tables (10, 14) are moved away from the workpiece (1) along the third, vertical axis (Z), when they move along the second, transversal axis (Y), and close to the workpiece (1) holding part (4) engagement zone.

6. The machining centre according to claims 1 to 5, **characterised in that** each table, upper and lower (10, 14) is supported by a plurality of vertical guides (17) associated, at the other end, with a rigid supporting structure (18), equipped with at least one pair of wheels (19) to run on, positioned on the respective first and second guides, upper or lower (11, 15); each guide (11, 15) having a sliding track (11p, 15p) along the second, transversal axis (Y) inserted between the pair of wheels (19) and having the cam profile (16).

7. The machining centre according to claims 5 and 6, **characterised in that** the cam profile of the first, upper guide (11) is at least formed by a track (11p) connecting curvature or ramp (16) designed to allow the upper table (10) to be lifted, together with the supporting structure (18), relative to the workpiece (1) and along the third, vertical axis (z).

8. The machining centre according to claims 5 and 6, **characterised in that** the cam profile of the second, lower guide (15) is at least formed by a track (15p) connecting curvature or ramp (16) designed to allow

the lower table (14) to be lowered, together with the supporting structure (18), relative to the workpiece (1) and along the third, vertical axis (Z).

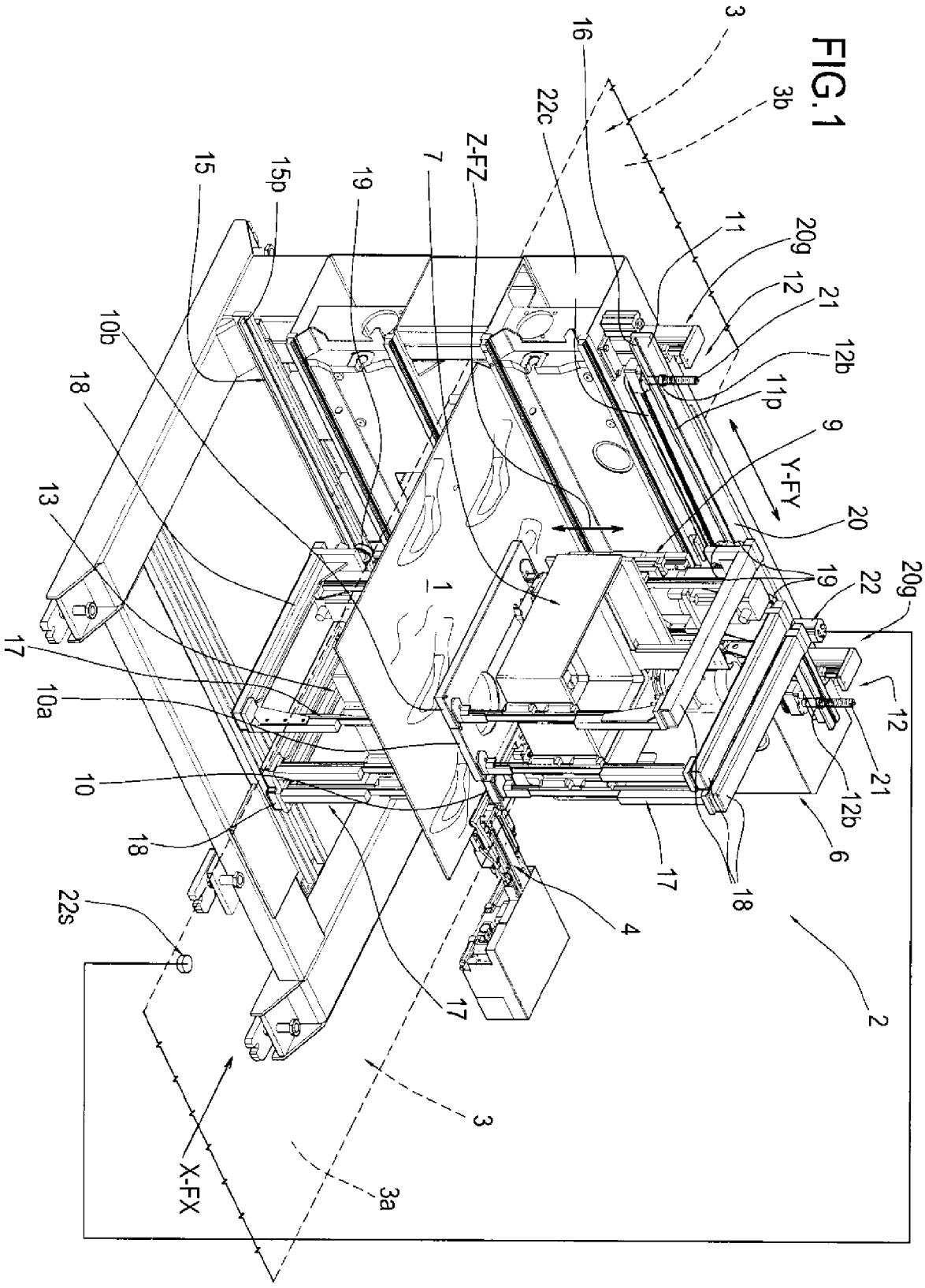
9. The machining centre according to claims 1 and 2, **characterised in that** part of the means (12) for adjusting the first guide (11) along the third, vertical axis (Z) comprises a pair of threaded bushings (19), associated with a cross member (20) supporting the first, upper guide (11), which can be connected by screwing to respective lead nuts (21) with a vertical axis and rotatably associated with the frame (6); a motor-driven unit (22) being kinematically connected to the pair of lead nuts (21), allowing synchronised lifting or lowering of the cross member (20) along the third, vertical axis (Z).

10. The machining centre according to claims 1, 2 and 4, **characterised in that** the second, lower guide (15) has respective adjusting means (12), acting between the frame (6) and the second guide (15) so as to position the lower table (14) at a predetermined height along the third, vertical axis (Z).

11. The machining centre according to claims 1 to 5, **characterised in that** each table, upper and lower (10, 14) is divided into a plurality of sub-tables (10, 10a, 10b; 14, 14a, 14b) coplanar and each having respective vertical guides (17) which, at the other end, are associated with the rigid supporting structure (18), the guides (17) being equipped with a pair of wheels (19) for each sub-table (10, 10a, 10b; 14, 14a, 14b) to run on and positioned so that they run on the respective first and second guides, upper and lower (11, 15).

12. The machining centre according to claims 1 to 5, **characterised in that** the vertical guides (17) supporting the tables (10, 14) also form independent sliding guides for the respective machining head (7, 13) along the third, vertical axis (Z).

FIG.1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9
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10b
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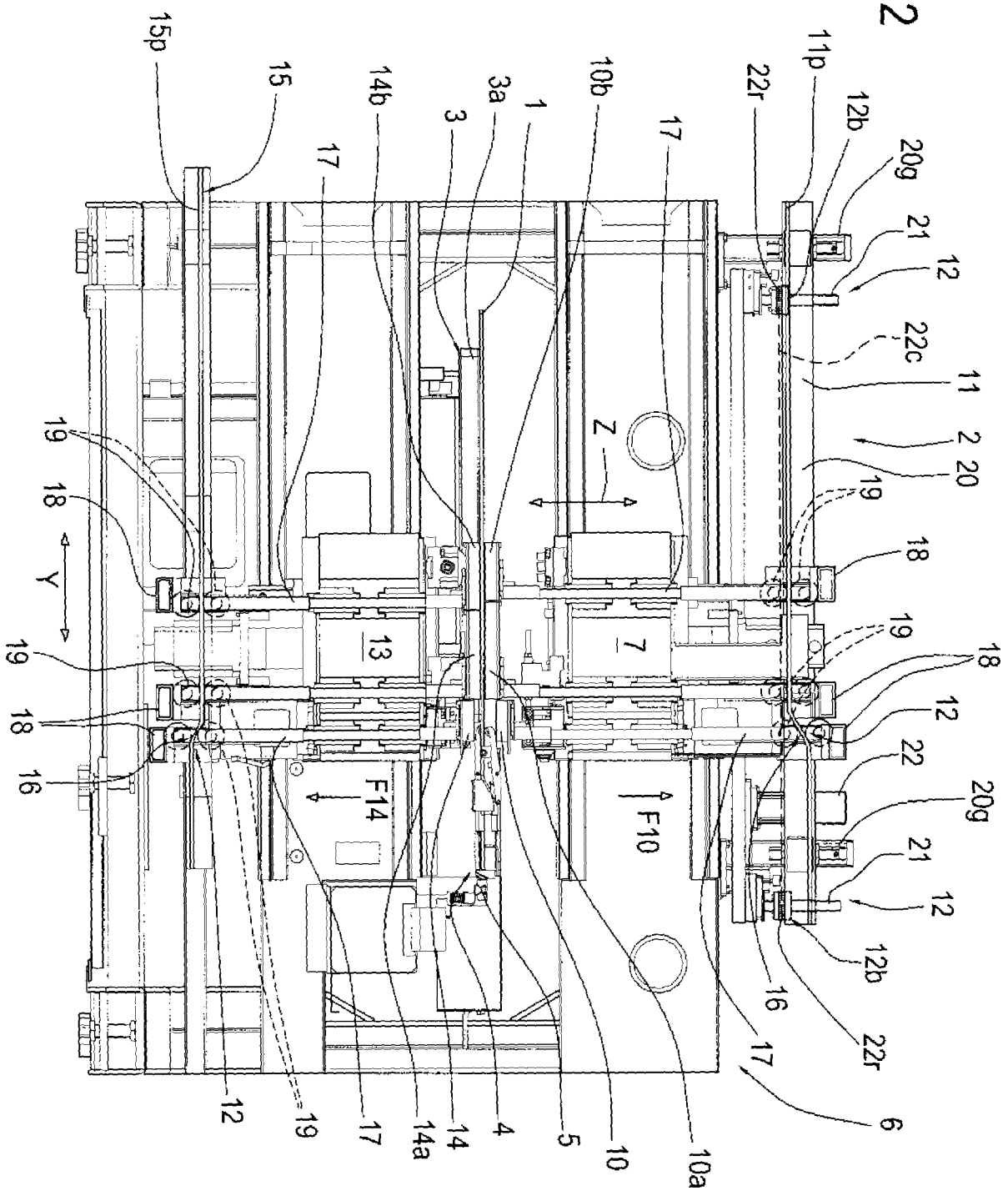
FIG.2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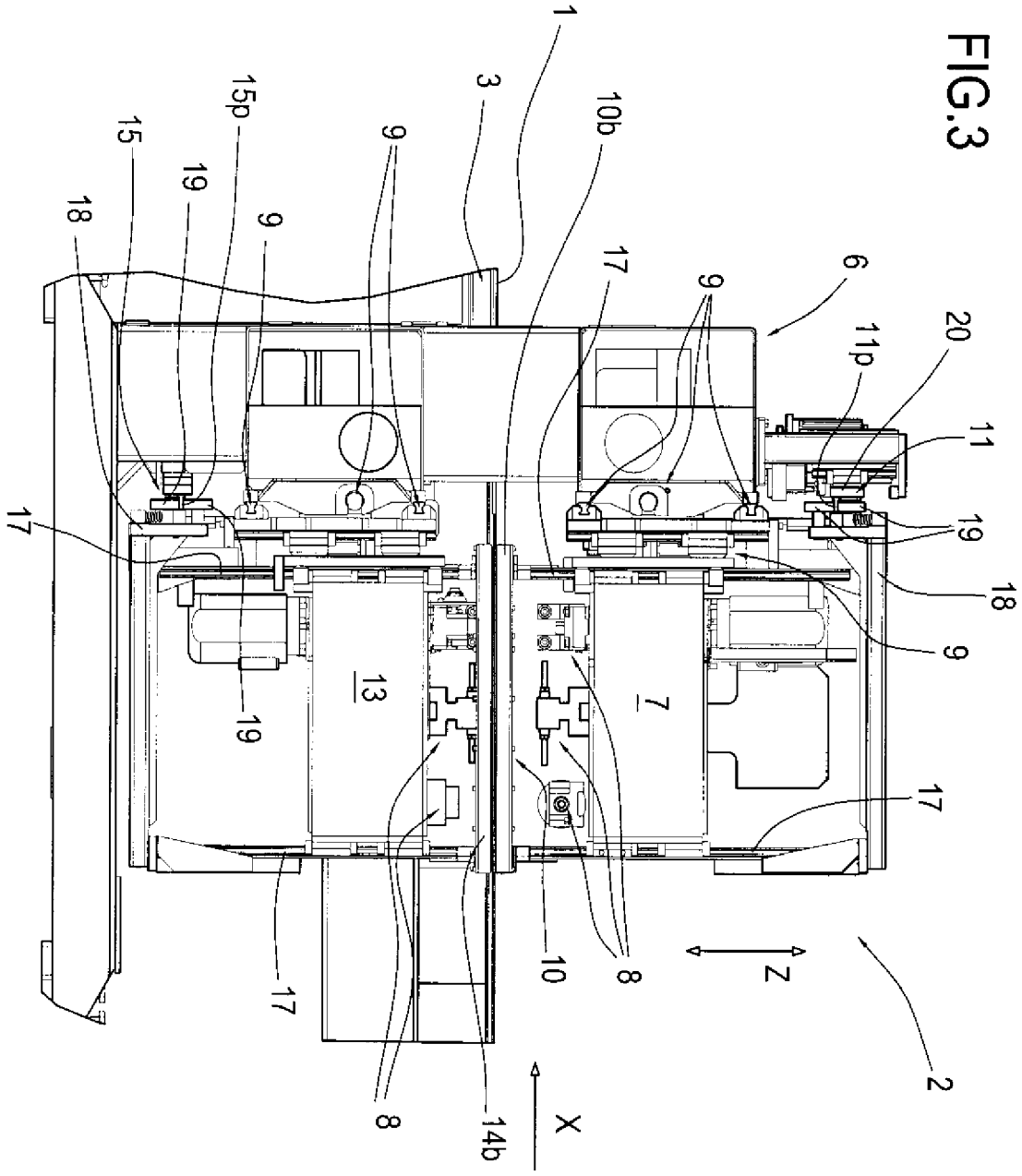
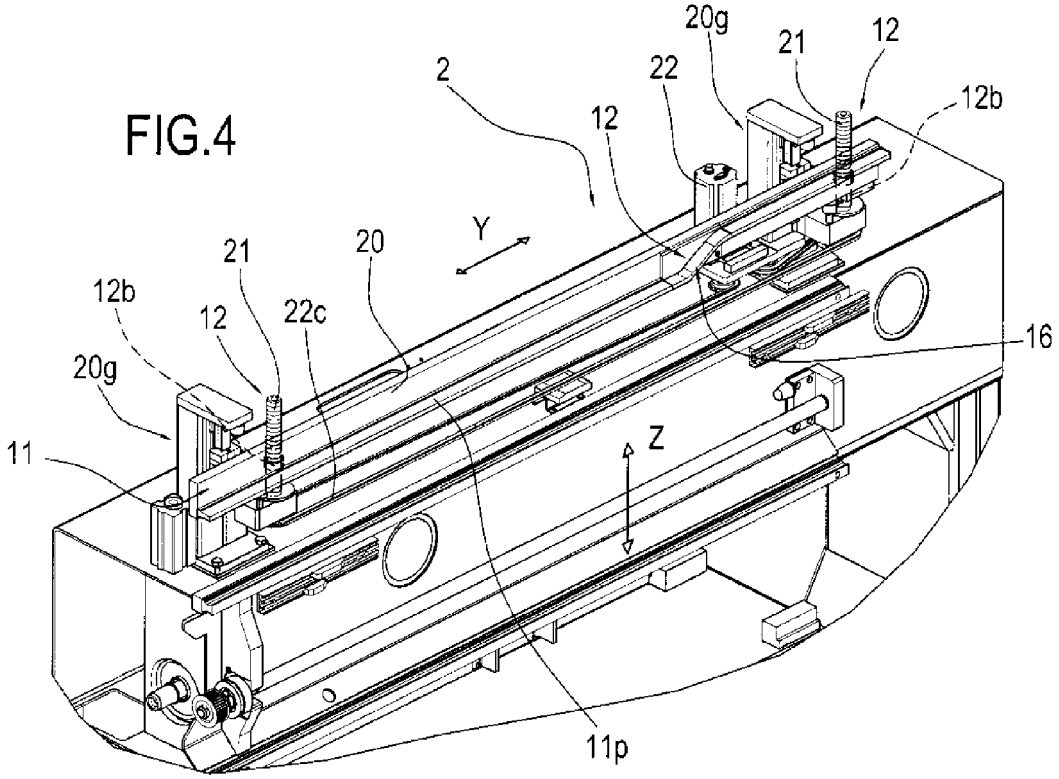


FIG.3

FIG.4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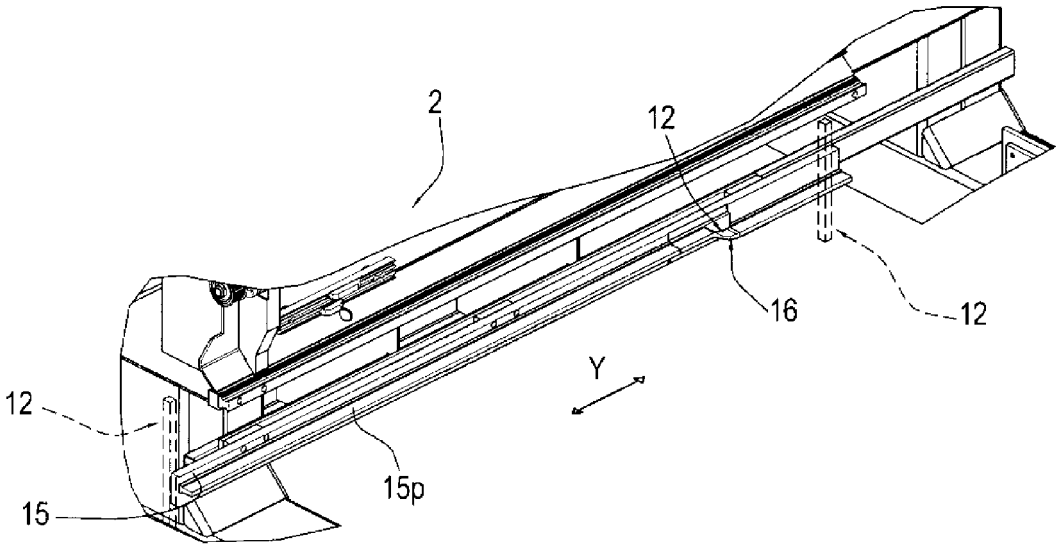
11p

FIG.5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12
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12
Y
12
15p
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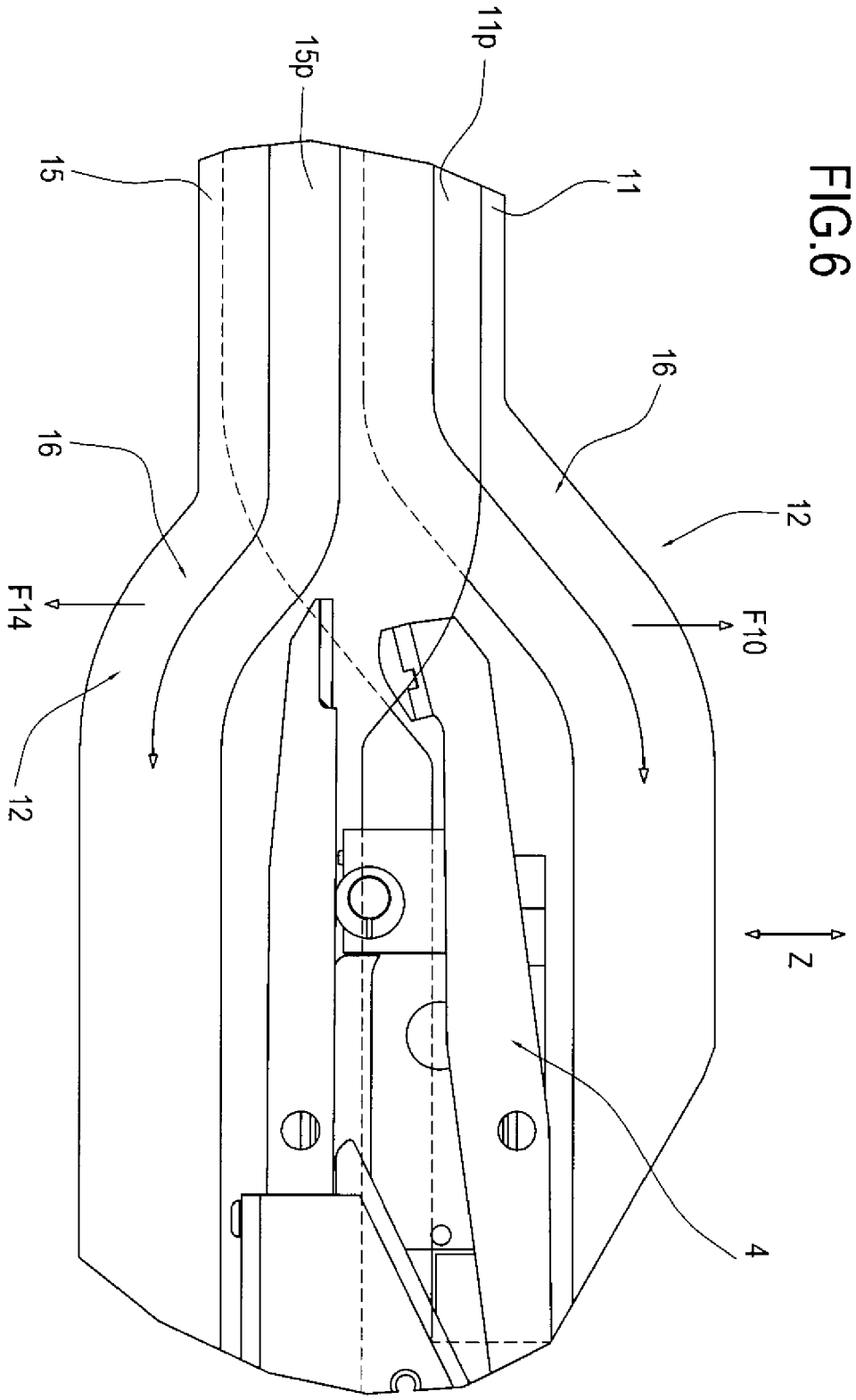

FIG.6