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(54) A spindle for an abrasive band strip and an apparatus for replacing it with a new one

(57) The invention relates to a round-surfaced, elongated spindle (23) comprising in its end an axial slot (24) for receiving a double-folded abrasive band (2'). For automating the replacement of this abrasive band the surface (26), with a circular cross-section, of the spindle (23) comprises a level surface (25) for directing the slot (24) when the level surface (25) meets the guiding surface during the rotation of the spindle (23) along the external guiding surface, stopping the rotation movement of the spindle.

In addition, an apparatus is described for automated double-folding the abrasive band, cut to desired length, and placed with the abrasive surface outwards, and for inserting it into the slot (24) of the said spindle (23).

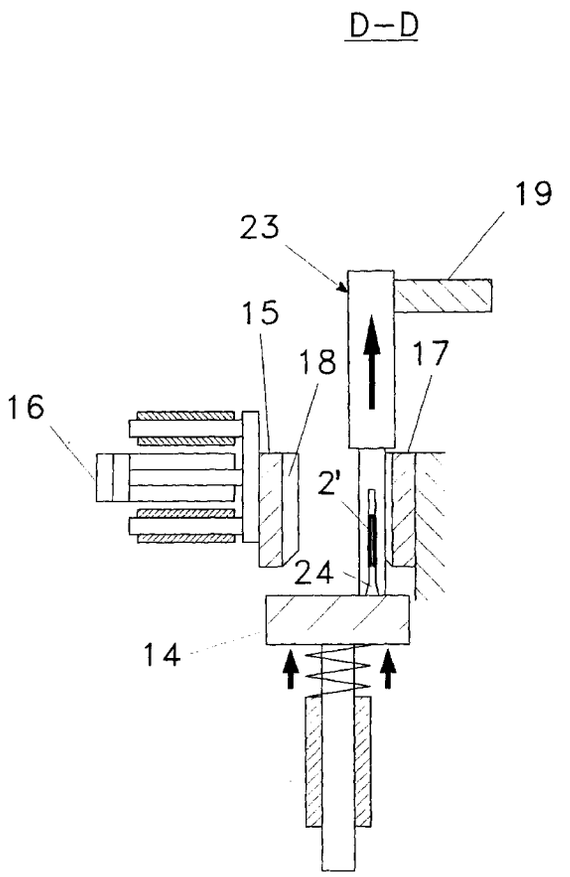

Fig. 5d

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E–E

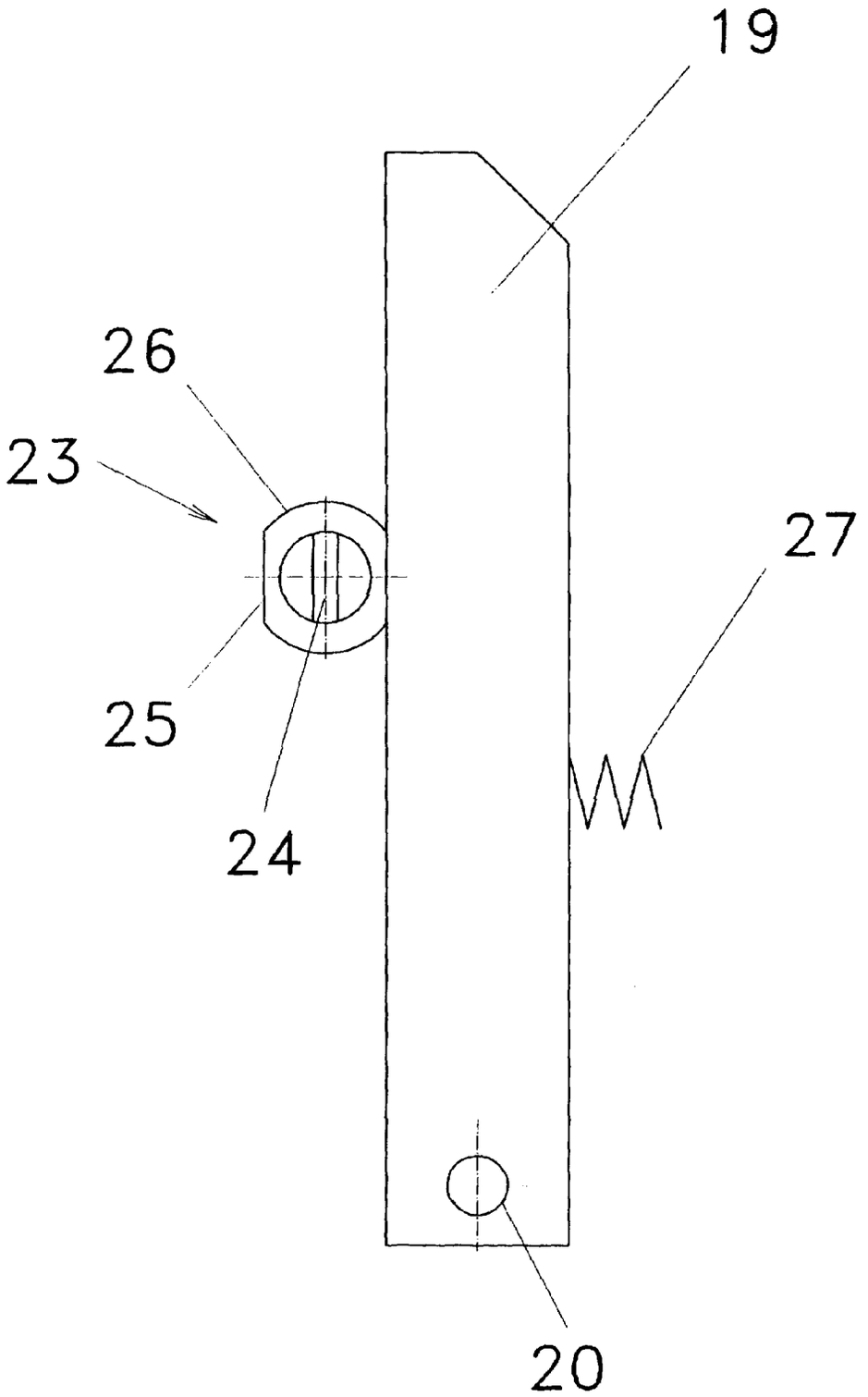

Fig. 6

Description

[0001] This invention relates to a spindle for an abrasive band stripe and, in particular, to a spindle with a curved, advantageously circular cross-section, and which elongated spindle has in its end an axial slot to receive the double-folded, transversal abrasive band. In addition, this invention relates to an apparatus to double-fold the abrasive band, cut to desired lenght, the abrasive surface outwards, and to insert this transversally to the slot of said spindle, replacing the used abrasive band taken away from the slot.

[0002] Previously, it has been well known to use spindles of said type, with axial slots in the end to receive a double-folded abrasive band, the abrasive surface turned outwards, and it has been possible to fix the spindle e.g. to the socket of a boring machine enabling it to hone holes, orifices and other narrow and inconvenient spots. In this case, the length of the abrasive band is selected in accordance with the size of the hole, orifice or cavity to be honed.

[0003] However, the abrasive band will wear relatively fast and then it has to be replaced, e.g. by removing the spindle from its socket and by replacing it with another having an unused abrasive band. However, the used abrasive band has to be removed from the removed spindle and an unused abrasive band has to be first folded and then inserted to the slot. Previously, this has been done manually, and the aim of the present invention is to automate the replacement of the abrasive band in the spindles of said type.

[0004] The main characteristics of the invention are disclosed in the appended Claims.

[0005] For the replacement of the abrasive band, it is vital that the slot in the end of the spindle can be directed so that it is at the same level with the double-folded abrasive band intended to be inserted in it; this is achieved by forming to the advantageously round surface, with curvedcross-section, a level surface that will finally come against the guiding surface, after the spindle has freely rotated or rolled along this external guiding surface, stopping the rotating movement of the spindle, despite the fact that the spindle is still sliding along said level surface to the installing point of the abrasive band.

[0006] The level surface and the slot are advantageously parallel and, in order to accelerate directing, the spindle has advantageously two parallel level surfaces on its opposite sides.

[0007] In addition, the curved and advantageously round surface is advantageously roughened to ensure that the spindle will rotate freely or will roll along the said external guiding surface until the level surface on it meets the guiding surface. However, the level surface is not roughened, as its aim is to slide along the smooth guiding surface.

[0008] A spindle in accordance with the invention enables the replacement of the abrasive band being automated using an apparatus comprising a folding table to receive the abrasive band, two folding surfaces to be brought against each other along the folding table, the folding surfaces comprising parallel grooves directed away from the folding table, means to move at least one of the folding surfaces towards the other one on the folding table so that the groove pairs against each other on the folding surfaces form recesses where the spindle can be pushed when its slot is at the same level with the folding levels being against each other, and a guiding surface on the incoming path of the spindle to make the spindle roll or rotate around its longitudinal axle as its curved and advantageously round surface moves along the guiding surface, and to stop the rotating movement when the level surface in the advantageously round surface, with a curved cross-section, meets the guiding surface, whereby said guiding level continues onto the folding table directed so that the slot of the spindle is at the same level with the folding surfaces, these then pressing the double-folded abrasive band between themselves.

[0009] The special design of the spindle and the guiding surface in the apparatus in accordance with the invention ensure that the slot of the spindle is at the same level with the double-folded abrasive band folded between the folding surfaces so that the abrasive band is pushed to the slot of the spindle as the spindle is pushed to the recess formed by the guiding surfaces led against each other. The chosen recess depends on the length of the abrasive band so that such a recess is selected that approximately matches with the length of the abrasive band at its centre.

[0010] In the preferable embodiment of the invention, the abrasive band is fed from the storage roll to the folding table by means of a pair of rollers and cut to desired length by a cutter placed between the pair of rollers and the folding table. The cutter may be a bevelled blade protruding from the folding table, advantageously formed as an upside-down letter V and co-operating like a guillotine with the fixed edge on the opposite side of the fed abrasive band. In a particularly advantageous way, the blade is a polygonal disc the turning of which enables a new section of the blade to be used, thus lengthening its usable life and diminishing its need of replacement.

[0011] To ensure that the abrasive band is securely folded at a right point, at least in one of the rollers and at least in the roller which is against the smooth, against the folding table coming, side of the abrasive band, comprises a central, low, and with a spike-like cross-section, advantageously uniform ridge, parallel with the roller periphery, to form a crease line in the longitudinal middle line of the abrasive band.

[0012] The removal of the used abrasive band from the slot of the spindle can also be automated by providing the apparatus in accordance with the present invention, with means to remove the abrasive band from the slot of the spindle before replacing it with a new one. This separating means is advantageously situated in the

beginning of the guiding surface, a little above the slot of the spindle, moving along the guiding surface, and beside the path of the spindle a gap opened towards it and within which the spindle fits, whereby at least the beginning end of the guiding surface is laterally movable against the force of a spring in order to force the spindle into said gap. When the spindle in the gap is lifted axially upwards the used abrasive band is removed from the slot and the spindle can then be transferred further along the said guiding surface to the installing point of the new abrasive band.

[0013] Below, the invention is described in further detail by means of a particularly advantageous embodiment, illustrated in the attached figures, in which:

Figure 1 shows an overview of the preferred embodiment of the invention,

Figure 2 shows the cross-section along the line A - A in Fig. 1,

Figure 3 shows the cross-section along the line B - B in Fig. 2,

Figure 4 shows the cross-section along the line C - C in Fig. 2,

Figures 5a to 5d show the section along the line D - D in Fig 2 in various operating phases of the apparatus,

Figure 6 shows the section along the line E - E in Fig. 2, and

Figure 7 shows the section along the line F - F in Fig. 2.

[0014] The abrasive band 2 is drawn, as shown in Fig. 2, from the abrasive band storage roll 1 to the guiding groove 3 above which a rotatable roller 4 is fixed, supported by a rod 7 turning around a horizontally fitted transversal axle 6, and under it a counter-roller 5 which rollers 4 and 5 form between themselves a nip at the level of the guiding groove 3 by means of which the abrasive band 2 is drawn from the storage roll 1 to feed the stored band to the folding table 14, arranged as an extension to the guiding groove 3, via the cutting guide 10 fitted between the guiding groove 3 and the folding table 14.

[0015] As seen in more detail in Fig. 3, the upper roller 4 is driven by an electric motor 9 fitted to its axle, and, further, Fig. 3 shows that on the periphery of the lower counter-roller 5 there is a low ridge 8, positioned centrally and parallel with the roller periphery, with a spike-like cross-section, by means which a crease line is formed on the smooth lower surface of the abrasive band, on the longitudinal central line of the abrasive band 2.

[0016] Additionally, between the cutting guide 10 and the folding table 14, there is a cutter 12 sliding vertically against the transversal, vertical end surface of the cutting guide 10, and, as is seen in more detail in Fig. 4, the cutter 12 is formed like a polygonal disc having on its periphery several blades, formed like upside-down letters V, the form of which corresponds to the form of the narrow slot 11 in the cutting guide 10 through which slot the pair of rollers 4, 5 feeds the abrasive band 2 to the folding table 14. Fig. 2 shows that the cutter 12 is equipped with a piston 13 to produce the upward directed impact of the cutter 12 so that its uppermost blade is moving like a guillotine along the end surface of the cutting guide 10 and across the opening 11, cutting the abrasive band 2, fed through the opening, to an abrasive band 2' of desired length and to be left on the folding table 14. By rotating the disc-like cutter 12, a new section of the blade can be used after the wearing down of the preceding one, and in this way it is possible to significantly increase the usable life of the cutter and the intervals of replacement.

[0017] In order to enable the double-folding of the abrasive band 2' on the folding table 14, there are on this folding table 14, on both sides of the abrasive band 2', folding surfaces 15 and 17, out of which one 17 is fixed and the folding surface 15 located on the opposite side of the abrasive band 2' is, by means of its operative means 16, to be laterally moved in order to fold the abrasive band 2' and to press the already double-folded abrasive band 2' between the folding surfaces 15 and 17, as shown in more detail in Fig. 1.

[0018] In addition, the folding surfaces 15 and 17 comprise vertical grooves 18, with cross-sections essentially formed like semi-circles, at such a mutual distance from each other that they form, as pairs, when the folding surfaces 15 and 17 have been pressed together, recesses with circular cross-sections, as the diameter of which the double-folded abrasive band 2' between the folding surfaces 15 and 17 is functioning. Vertically, the grooves 18 extend to the height of the folding surfaces 15 and 17 but, at their lower ends, they are advantageously bevelled so that the folding levels 15 and 17 do not press the abrasive band 2' between them against the folding table 14.

[0019] Thus, on the folding table 14, there are, on both sides of the abrasive band 2' on it, folding levels 15 and 17, of which the folding level 17 is fixed, and the other folding level 15 is movable towards the fixed folding level 17 forced by the cylinder 16, as shown in more detail in Fig. 5a. Fig. 5b. shows the folding levels 15 and 17 pressed together, whereby the abrasive band 2' between them has been pressed double-folded between them and the vertical grooves 18 extending to the entire height of the folding surfaces 15 and 17 forming pairs of vertical recesses with circular cross-sections.

[0020] Above the folding table 14 and the fixed folding surface 17 on it, there is a guide 19 along which the spindle 23, with an axial slot 24 in its lower end, moves until

it has come above the recess at about the middle point of the cut abrasive band 2'. The guide 19 and the spindle 24 co-operate in such a way that the slot 24 is then at the same level with the double-folded abrasive band 2' pressed between the folding surfaces 15 and 17, whereby the spindle 23 can be axially pushed, as shown in Fig. 5b, to said recess as far as to the folding table 14. Thereby, the folding table is advantageously provided with a spring so that the double-folded abrasive band 2' is pushed sufficiently deep in the slot 24, as shown in more detail in Fig. 5c. Finally, the folding surface 15 is moved away from the fixed folding surface 17, whereby the spindle 23 in the slot 24 of which the double-folded abrasive band 2' is, with its abrasive surfaces facing outwards, can be removed, as shown in more detail in Fig. 5d. As is shown in more detail in Figs. 1, 2, and 6, there is, above the folding table 14 and the fixed folding surface 17 on it, a guide 19 turning round the vertical axle 20 horizontally against the force of the spring 27, along which guide the spindle is moved by a robot (not shown) known as such, above the surface levels 15 and 17, pressed together on the folding table 14, at the desired opening.

[0021] To ensure that the slot 24 of the spindle 23 is at the same level with the double-folded abrasive band 2' between the folding surfaces 15 and 17, on the surface 26 of the spindle with otherwise circular cross-section, there have been formed two level surfaces 25 on the opposite sides of the spindle 23, parallel to the slot 24. The rounded surfaces 26 of the spindle 23 are advantageously roughened so that when the spindle is led along the side of the guide 19 it rotates freely round its axle under the spring load 27, whereby the spindle 23 can be rolled round its longitudinal axle until one of the level surfaces 25 comes against the side surface of the guide 19, stopping the rotating movement of the spindle by itself, and then it slides further to the desired opening above the folding surfaces 15 and 17, still pressed together, the slot 24 being then at the same level with the double-folded abrasive band 2' between the folding surfaces 15 and 17.

[0022] Under the guide 19, there is a parallel fixed gap 22 placed before the folding surface 17, seen in the direction of the movement of the spindle 23, within which guide the end of the spindle 23 provided with the slot 24 fits, when the spindle is forced laterally to said gap 22 against the force of the spring of the guide 19.

[0023] Using this solution presented in Fig. 7, the used abrasive band in the slot 24 of the spindle 23 can be removed from the slot by lifting the spindle 23 axially upwards, whereby the gap 22 prevents the used abrasive band from moving together with the spindle 23, after which the spindle 23 can be moved further along the guide 19 to receive the new abrasive band 2' to be installed in it.

[0024] For the professionals in the art, it is evident that the present invention can be modified within a very large range within the scope of the appended Claims. Thus, it is evident that e.g. the level surface or surfaces directing the slot of the spindle can be situated in the robot moving the spindle, for instance in its socket where the spindle is fixed, provided that the spindle can be fixed into the socket only in a determined position in relation to the level surface or surfaces in the socket, and that the socket is freely rotating. It is also evident that any details of the apparatus in accordance with the invention can be modified without deviating from the scope of the Claims.

Claims

1. A spindle for an abrasive band, at the end of which elongated spindle (23), having a curved cross-section and round surface (26), there is an axial slot (24) to receive a double-folded transversal abrasive band, **characterized by** a level surface (25) in the advantageously round surface (26), with curved cross-section, for directing the slot (24), as the spindle (23) is rotating along the external guiding surface and as the level surface (25) moves against the guiding surface, stopping the rotating movement of the spindle.

2. A spindle in accordance with Claim 1, **characterized in that** the level surface (25) and the slot (24) are parallel.

3. A spindle in accordance with Claim 1 or 2, **characterized by** two parallel level surfaces (25) on opposite sides of the spindle (23).

4. A spindle in accordance with one of the previous Claims, **characterized in that** its curved, advantageously round surface (26) is roughened.

5. An apparatus for double-folding the abrasive band, cut to desired length and with the abrasive surface facing outwards, and for inserting it transversally to the axial slot (24) in the end of the elongated spindle (23) with an advantageously round surface (26) and curved cross-section, **characterized by**:

   - a folding table (14) to receive the abrasive band (2'),
   - two folding surfaces (15 and 17) to be moved along the folding table (14) against each other, for double-folding the abrasive band between them, whereby in the folding surfaces (15 and 17) there are parallel grooves (18) directed away from the folding table (14),
   - means (16) for moving at least one of the folding levels (15) toward the other (17) on the folding table (14) for double-folding the abrasive band (2') and for pressing it between the folding surfaces (15 and 17) so that the parallel

grooves (18), in pairs against each other, form recesses wherein the spindle (23) can be pushed, its slot (24) being at the same level with the folding levels (15 and 17), and thus with the abrasive band (2') double-folded between them, and

- a guiding surface (19) in the incoming path of the spindle (23) for rotating the spindle round its longitudinal axle, as its curved and advantageously round surface (26) is simultaneously moving along the guiding surface (19), and as the level surface (25) in the advantageously round surface (26), with curved cross-section, meets the guiding surface (19), in order to stop the rotating movement of the spindle (23) which guiding surface extends onto the folding table (14) directed in such a way that the slot (24) of the spindle is at the same level with the folding surfaces (15 and 17) when these are pressing the double-folded abrasive band (2') between them.

6. An apparatus in accordance with Claim 5, **characterized by** a pair of rollers (4 and 5) of which rollers at least one (4) is used (9) to feed a desired length of the abrasive band (2) to the folding table (14) from the storage roll (1) of the abrasive band and by the cutter (12) between the pair of rollers (4 and 5) and the folding table (14).

7. An apparatus in accordance with Claim 6, **characterized in that** at least one of the rollers, and advantageously in the roller (5) that touches the smooth side of the abrasive band (2) coming against the folding table (14), comprises an advantageously central, low and advantageously uniform ridge (8) with a spike-like cross-section and parallel with the periphery of the roller (5), for forming a crease line on the longitudinal central line of the abrasive band (2).

8. An apparatus in accordance with Claim 6 or 7, **characterized in that** the cutter is a bevelled, advantageously an upside-down V-formed blade (12) protruding from the level of the folding table (14) and co-operating like a guillotine with a fixed edge (10) situated on the opposite side of the fed abrasive band (2).

9. An apparatus in accordance with Claim 8, **characterized in that** the blade (12) is a polygonal disc by rotation of which a new section of the blade becomes operative.

10. An apparatus in accordance with one of the Claims 5 to 9, **characterized by** the means (21) for removing the used abrasive band from the slot (24) of the spindle (23) before the insertion of a new one, which removing means (21) comprises, in the beginning of the guiding surface (19), at the side of the path of the spindle (23) situated a little above the slot (24) of the spindle which is moving along the guiding surface, an open gap (22) wherein the spindle (23) fits, and in that at least the beginning of the guiding surface (19) is laterally movable to force the spindle (23) to the said gap (22) against the force of the spring (27).

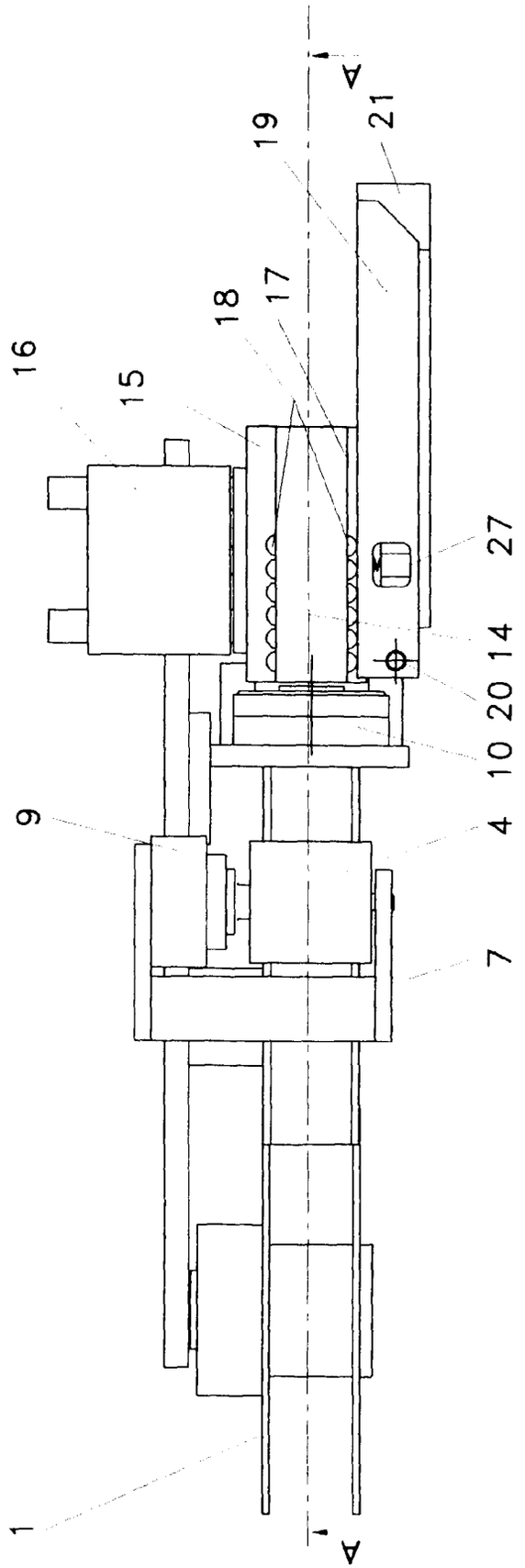

Fig. 1

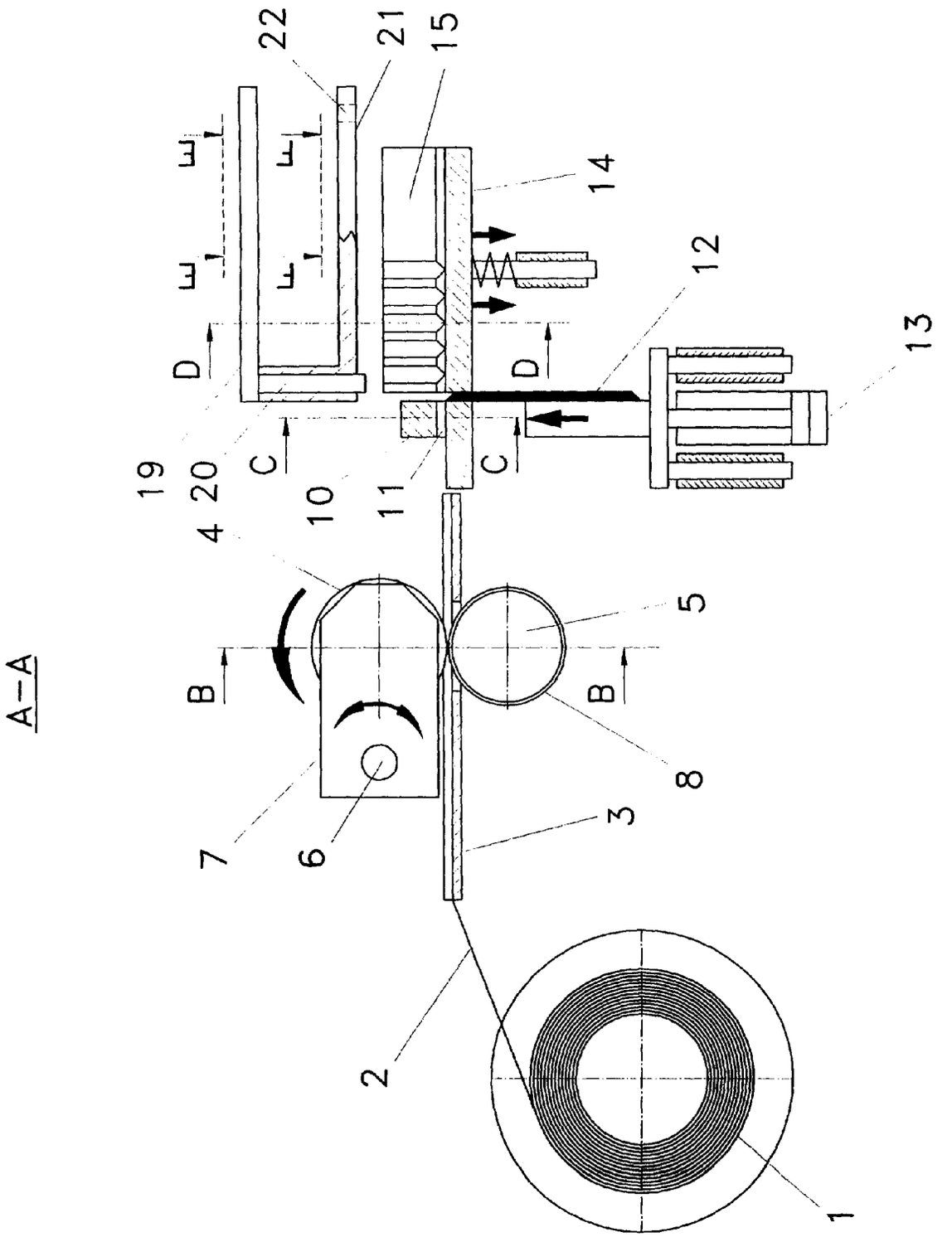

Fig. 2

B–B

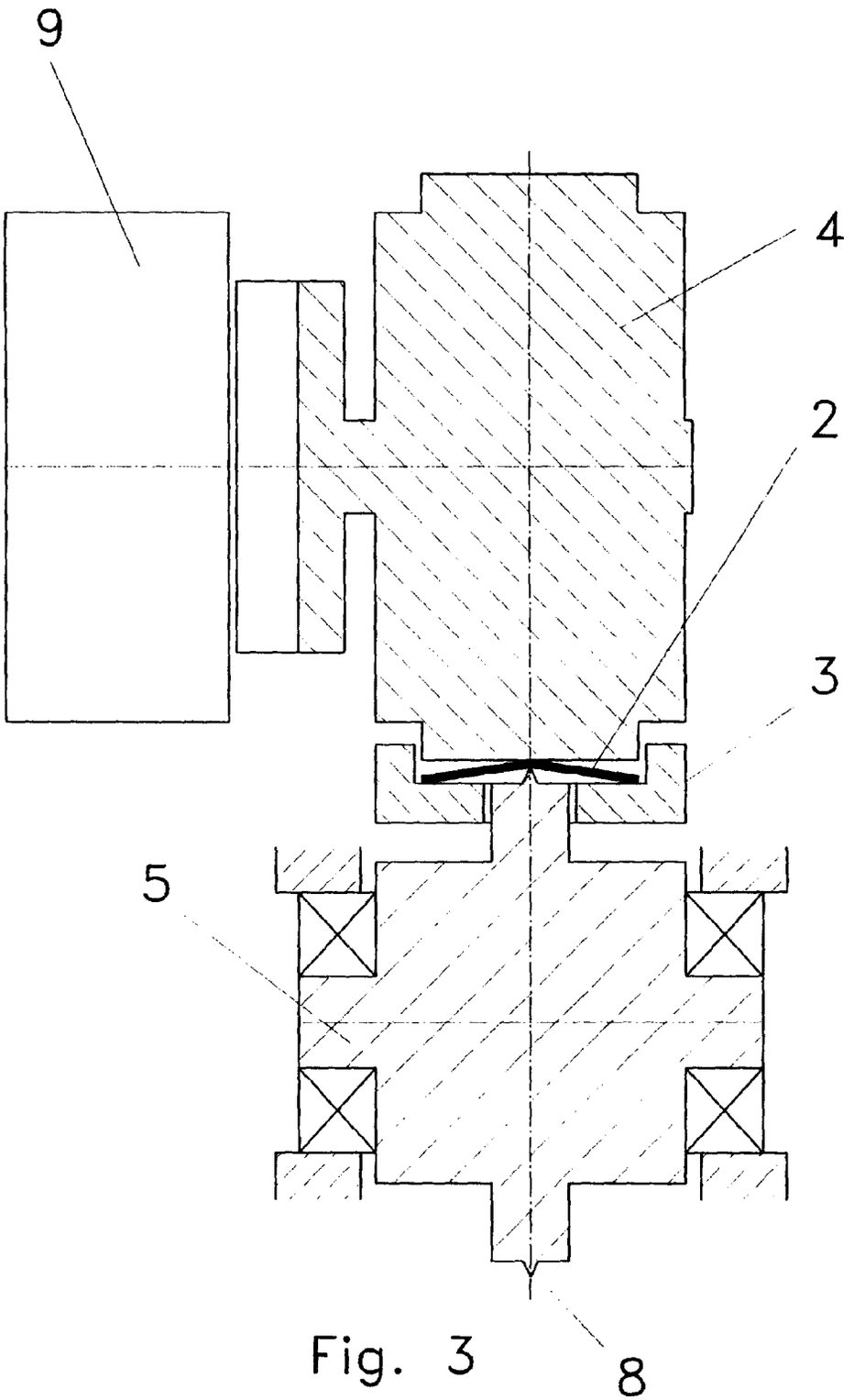

Fig. 3

C–C

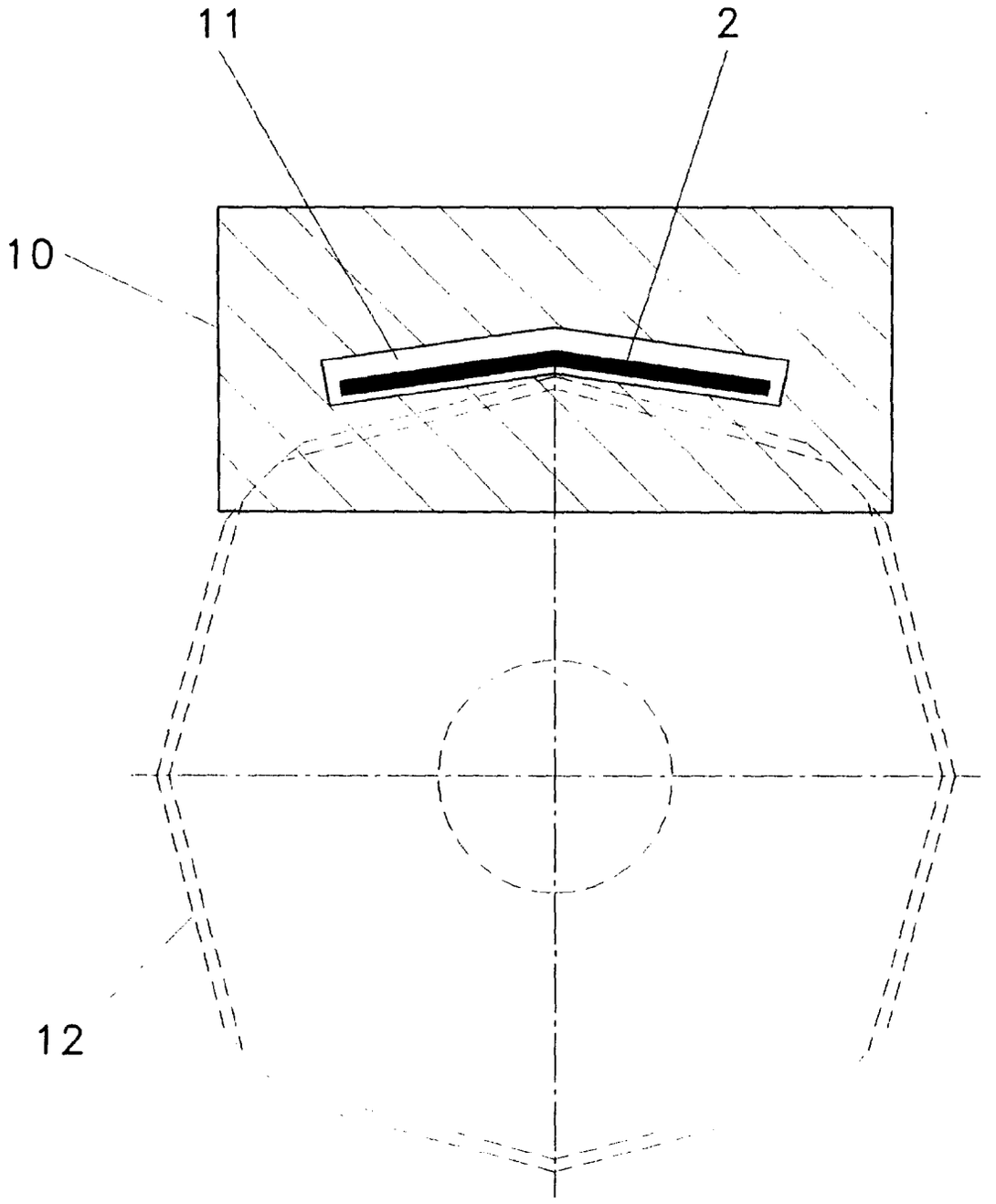

Fig. 4

D–D

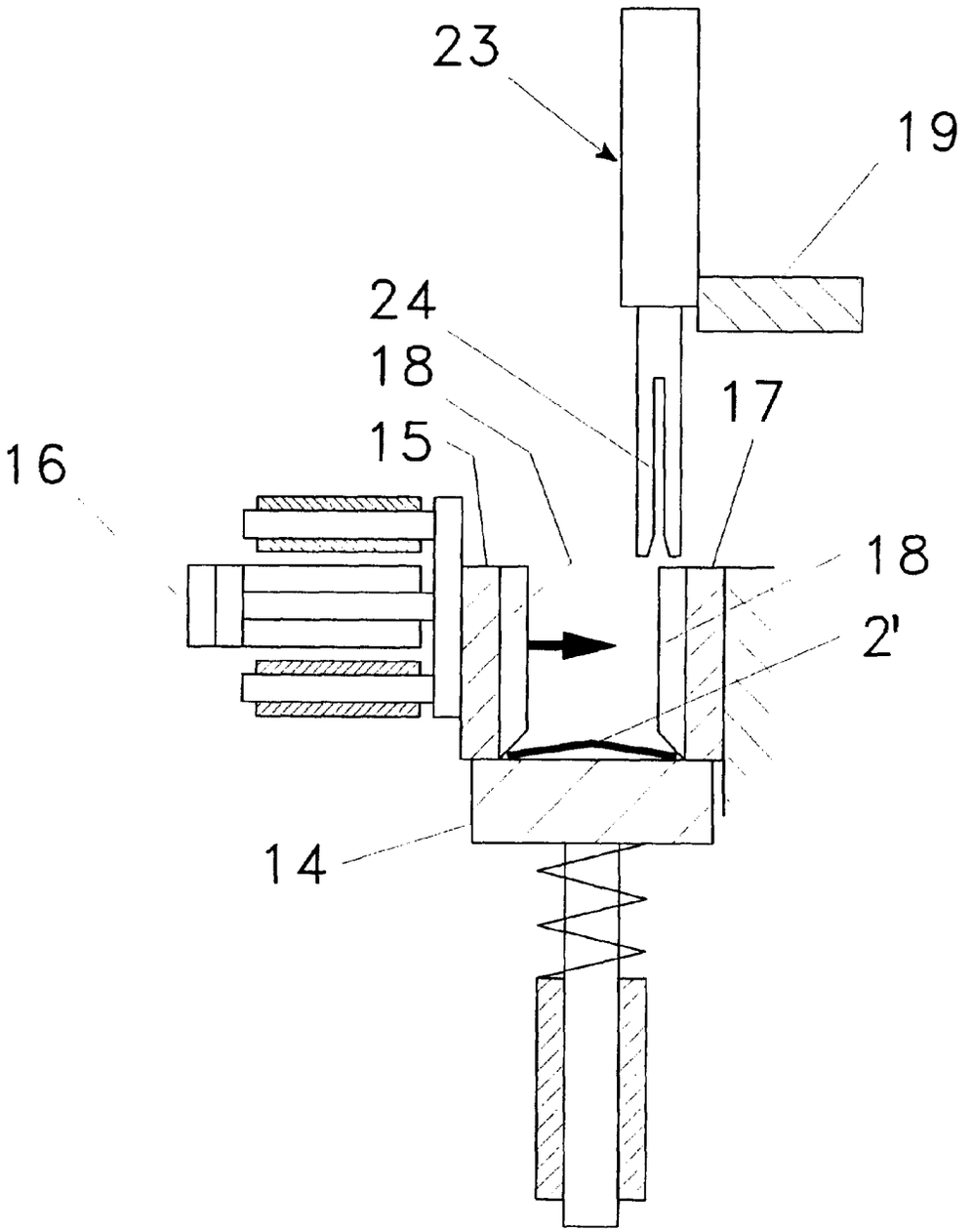

Fig. 5a

D–D

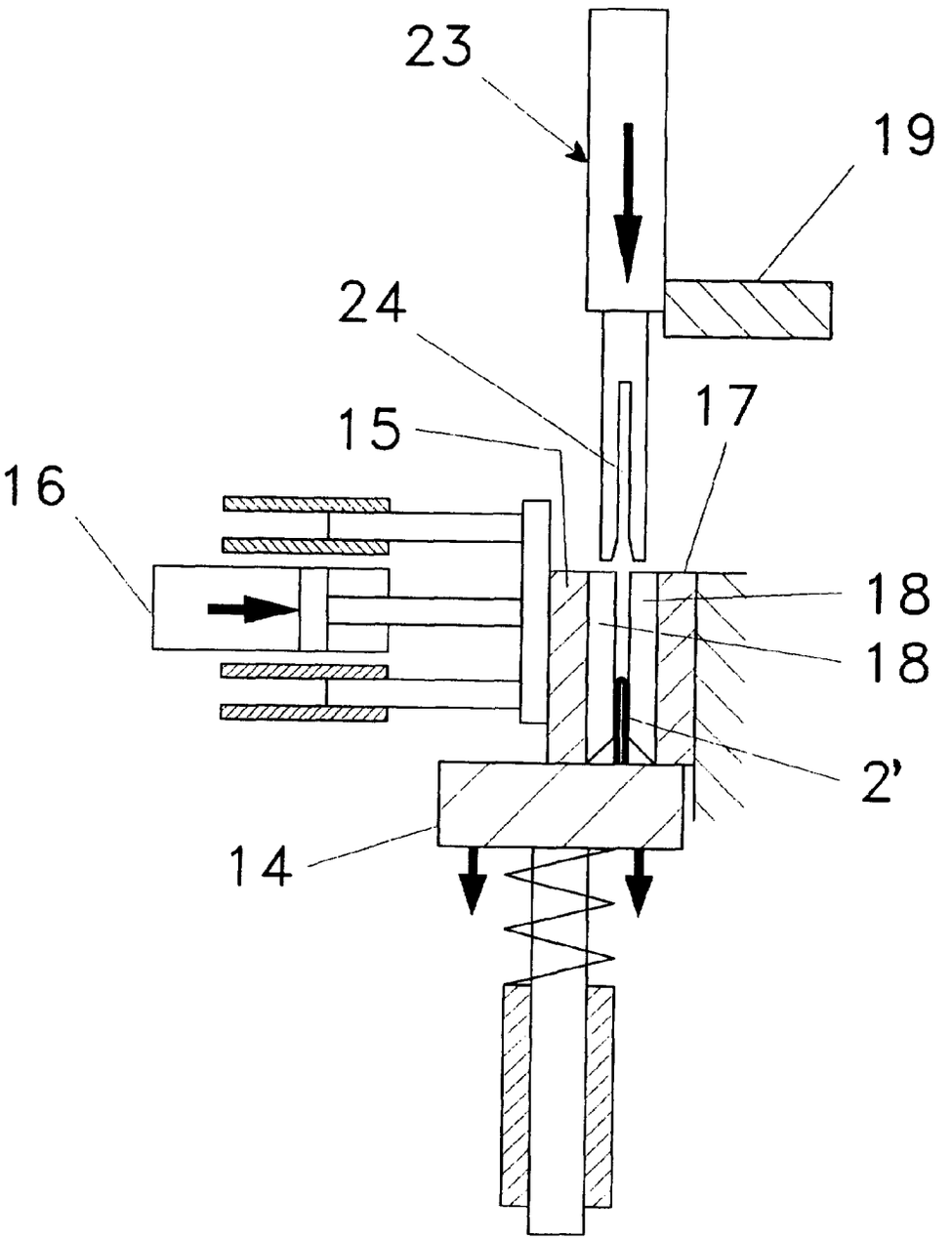

Fig. 5b

D–D

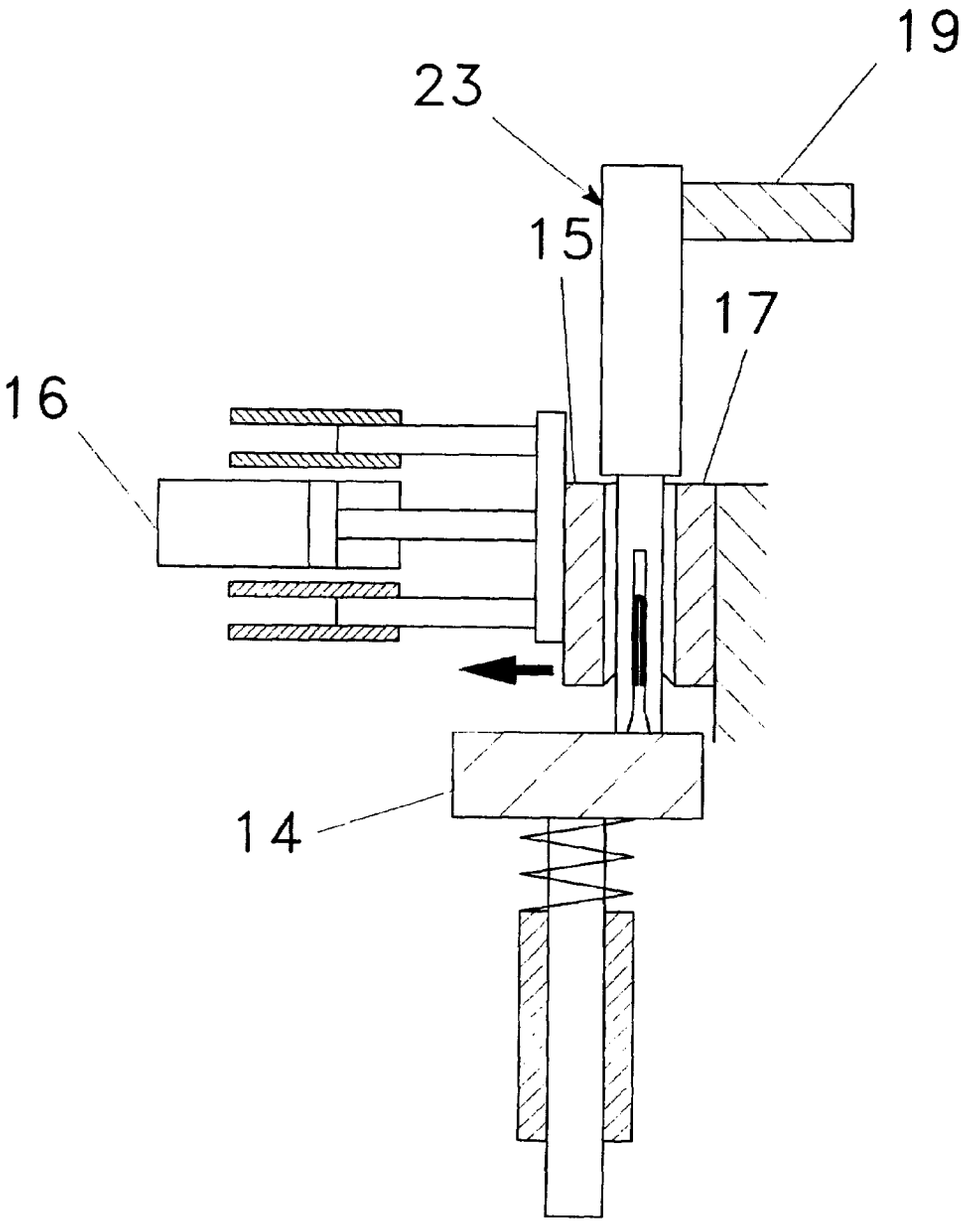

Fig. 5c

D–D

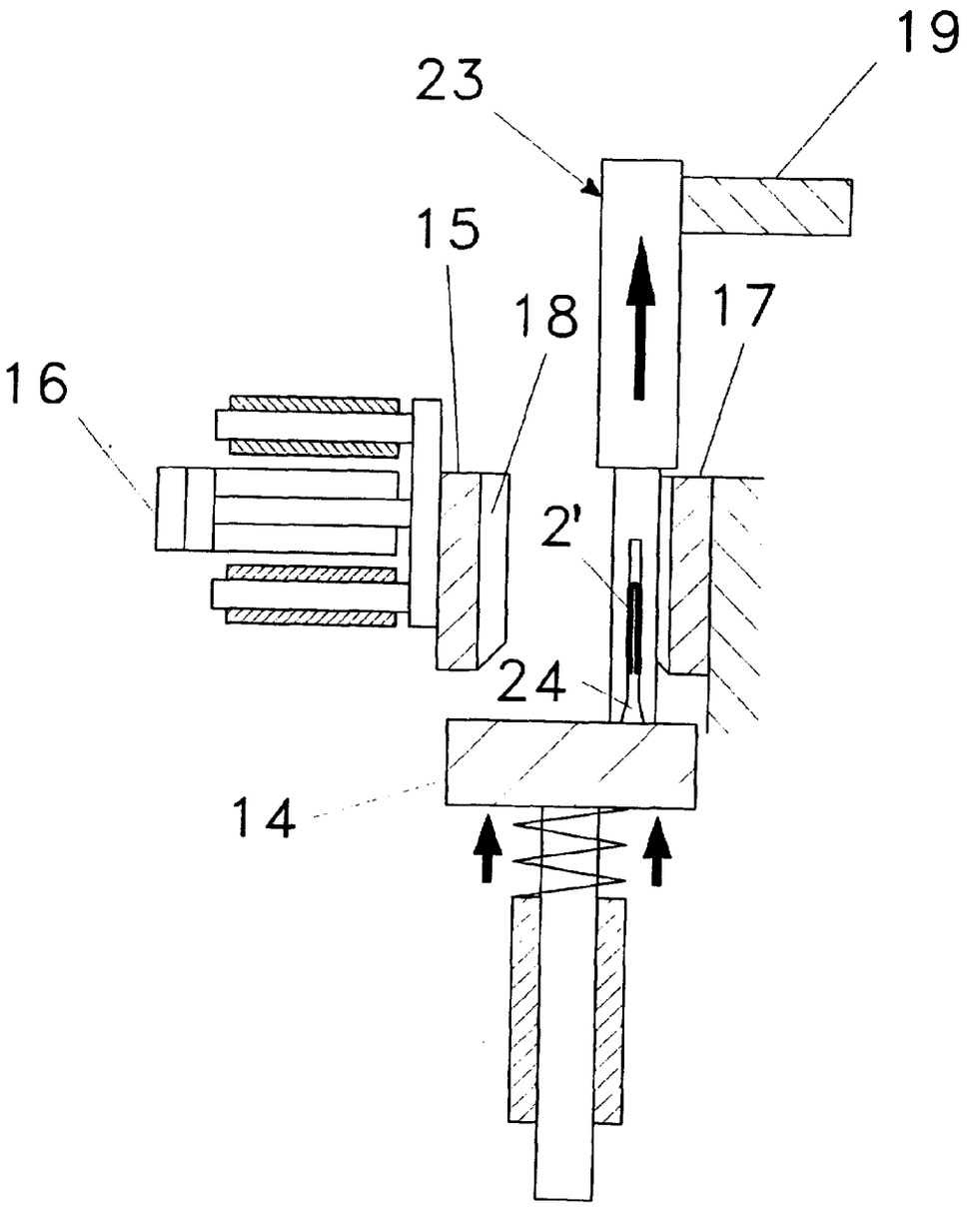

Fig. 5d

E–E

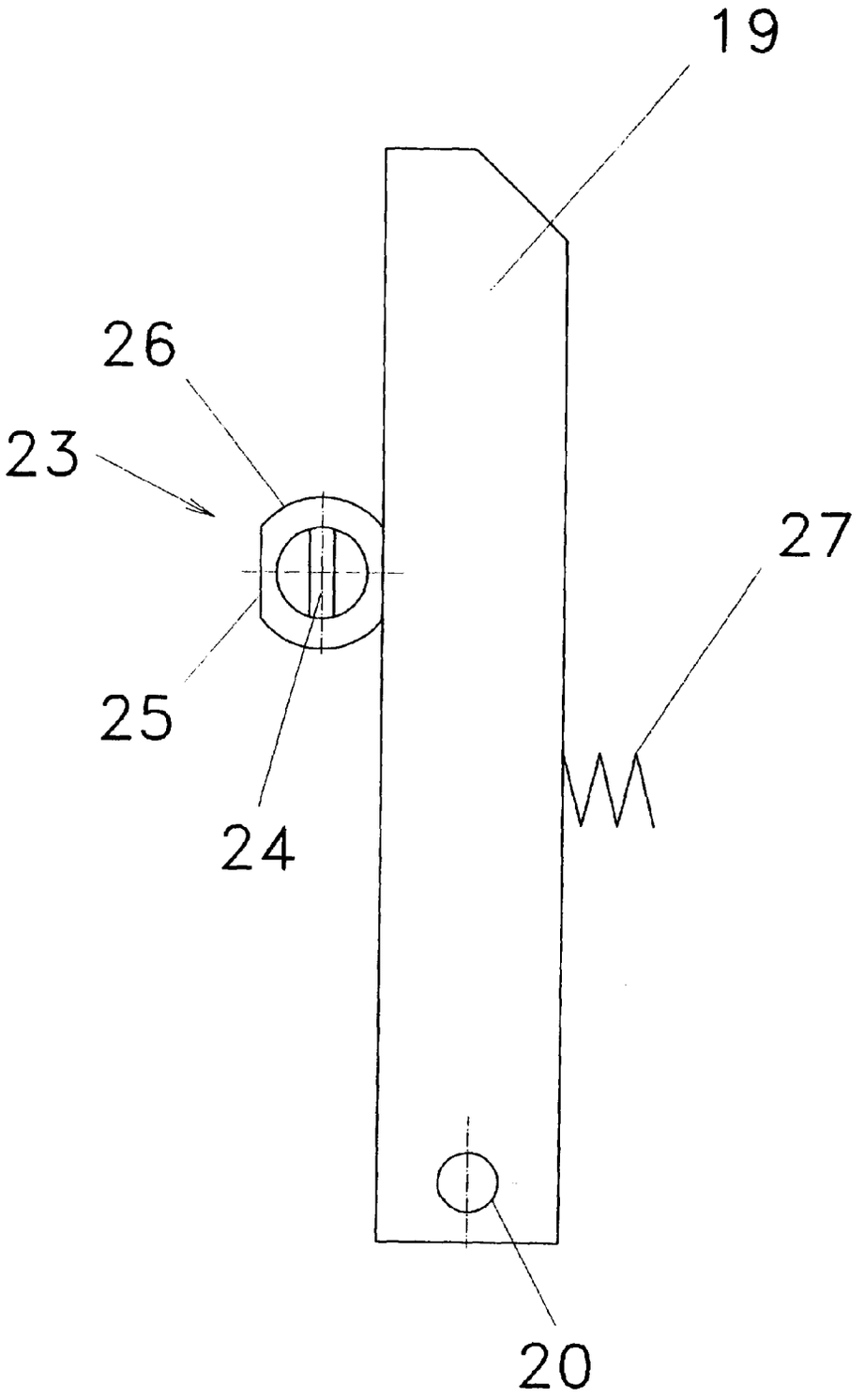

Fig. 6

F—F

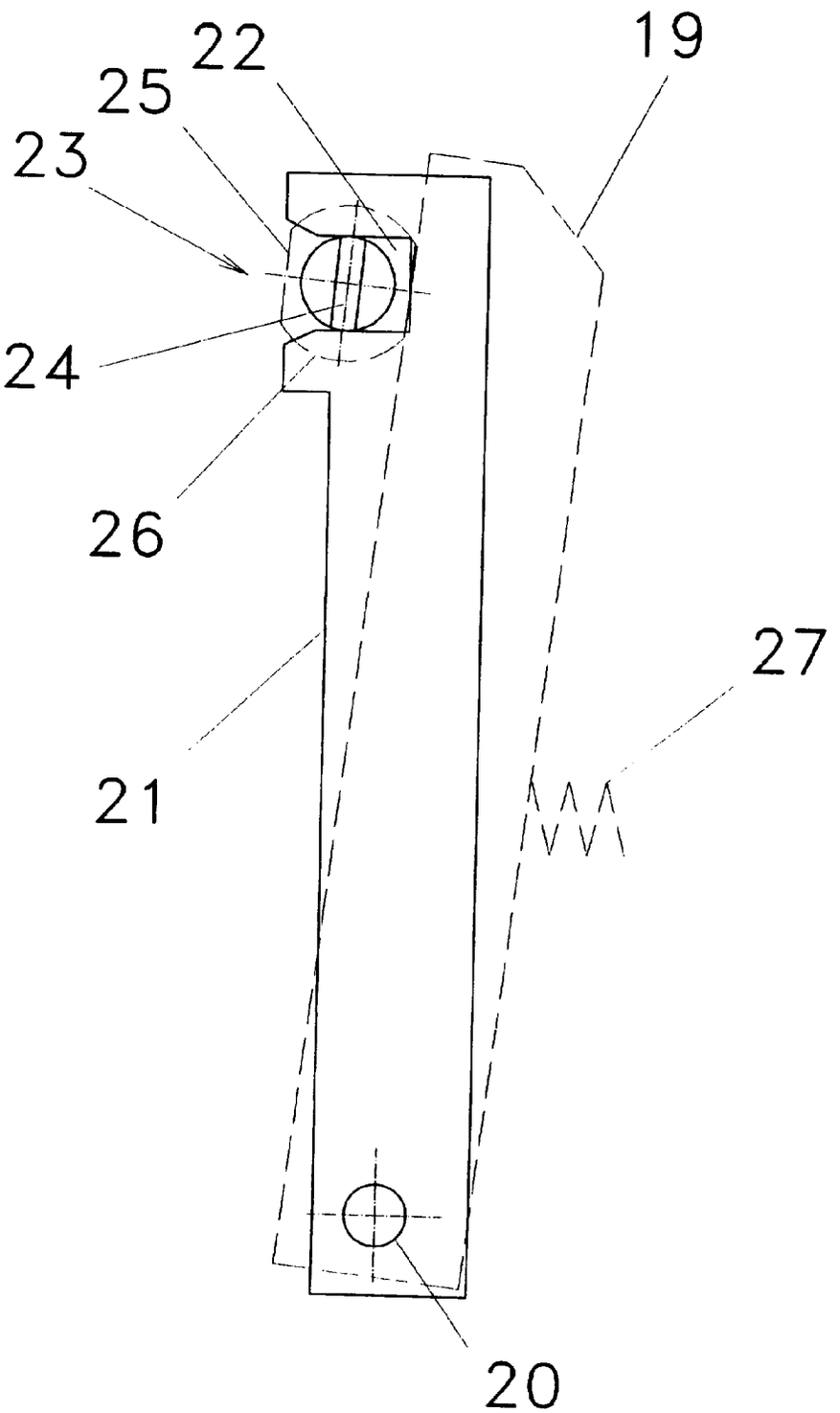

Fig. 7