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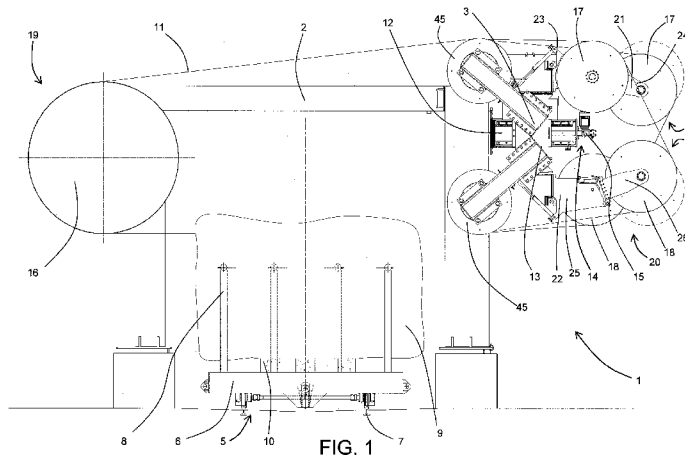


FIG. 1

(57) Abstract: A machine for multiple wire cutting of stone material comprising a plurality of cutting devices (4) mounted on a supporting structure (3), each comprising an annular cutting wire (11), driving means (16) for the cutting wire (11), and at least one upper return pulley (17) and one lower return pulley (18) which are vertically distanced from each other on the same side of the machine. The upper pulleys (17) of two adjacent devices (4) are supported respectively by a first part (23) and by a second part (24) of the same upper arm (21) of the supporting structure (3). The lower pulleys (18) of two adjacent devices (4) are supported respectively by a third part (25) and by a fourth part (26) of the same lower arm (22) of the supporting structure (3). The second parts (24) and the fourth parts (26) can also move respectively relative to the first parts (23) and relative to the third parts (25) in such a way as to vary the tensioning of the cutting wire (11) looped around the pulleys mounted on them. Moreover, if the upper pulley (17) of a cutting device (4) is mounted on the first part (23) or respectively on the second part (24) of an upper arm (21), the lower pulley (18) of the same cutting device (4) is mounted on the fourth part (26) or respectively on the third part (25) of a lower arm (22).



MACHINE FOR MULTIPLE WIRE CUTTING OF STONE MATERIAL

* * *

DESCRIPTION

This invention relates to a machine for multiple wire cutting of stone material.

In particular, this invention relates to a machine for multiple wire cutting of the type in which each cut is obtained using an independent cutting device, equipped with its own looped diamond-coated cutting wire.

In general, a cutting machine of this type comprises a main frame which is normally gantry-shaped, on which a plurality of cutting devices is mounted, the devices arranged parallel with each other in planes which lie substantially vertically. The cutting devices are also supported by a supporting structure which, to allow the cutting of a block of material positioned under the gantry, is able to translate vertically along the main frame, between an upper position and a lower position.

Each cutting device in turn comprises on one side at least means for driving the cutting wire, which may be a motor-driven pulley for each device or a single drum for all of the devices, and on the other side at least one idle return pulley. Further idle pulleys may be provided on each side (in particular if the diameter of the motor-driven pulley/drum and of the other idle pulley is small). However, in most of the solutions, the cutting wire as a whole is looped around two, three or four pulleys/drums. Further, smaller pulleys may be provided as wire guides along the cutting wire path.

Moreover, to guarantee correct tensioning of the cutting wire, each cutting device is equipped with specific tensioning means which in the prior art machines may have the most diverse forms.

According to a first solution, tensioning may be achieved by a movement of the pulley relative to its supporting shaft. Examples of this solution are described in patents EP 1 024 314 and WO 2007/036784.

In contrast, according to a second solution, tensioning is achieved using tensioning means which act on the stretch of wire interposed between two

return pulleys positioned one above the other, at one side of the machine. Examples of that solution are described in patents EP 1 131 179 and ES 2 188 362.

In a further solution tensioning is achieved by moving one or more return pulleys, as described for example in patents WO 2009040841 and WO 2009098721.

Although all of the prior art solutions allow good cutting of stone material, they all have limits which the various manufacturers are increasingly attempting to overcome.

10 A first critical aspect relates to the thickness of the slabs which can be obtained. Indeed, while it is relatively easy to obtain slabs which are several centimetres thick, it is currently quite difficult to obtain very thin slabs. This is due on one hand to the size of the cutting wire, and on the other hand to the thickness of the pulleys and the fact that it is impossible to bring them
15 closer to each other.

At the same time, a further problem is linked to the life of the various parts of the machine and in particular to the life of the bearings supporting the pulleys, which after a certain time must be substituted. In particular, that problem grows with an increase in the diameter of the bearings and with a
20 reduction in the diameter of the pulleys, since the wear on the bearings depends on their speed of rotation.

A further disadvantage is the relative complexity of many tensioning systems, in particular those acting from the inside of the pulleys or in which two or more pulleys are moved simultaneously.

25 In this context, the technical purpose which forms the basis of this invention is to provide a machine for multiple wire cutting of stone material which is a valid alternative to the prior art machines.

The technical need specified and the aims indicated are substantially achieved by a machine for multiple wire cutting of stone material as
30 described in the appended claims.

Further features and advantages of this invention are more apparent in the

detailed description below, with reference to several preferred, non-limiting embodiments of a machine for multiple wire cutting of stone material, illustrated in the accompanying drawings, in which:

- 5 - Figure 1 is a schematic front view of a machine for multiple wire cutting made according to this invention;
- Figure 2 is an axonometric three-quarter view of a detail of the machine of Figure 1;
- Figure 3 is a partial schematic front view of an alternative embodiment of the machine of Figure 1;
- 10 - Figure 4A is a front view of a detail of the machine of Figure 1, with some parts cut away for clarity;
- Figure 4B is a rear view of a detail of the machine of Figure 1, with some parts cut away for clarity;
- Figure 5 is a top view of the detail of Figure 4A;
- 15 - Figure 6 shows the detail of Figure 4A in cross-section according to the line VI - VI;
- Figures 7 and 8 are schematic views of the extension of two adjacent cutting devices of the machine of Figure 1;
- Figure 9 is a view of the detail IX from Figure 6;
- 20 - Figure 10 is a view of the detail X from Figure 6;
- Figure 11 is a transparent view, to better illustrate the various parts, of a second alternative embodiment of a detail of the machine according to this invention;
- Figure 12 is a transparent view, to better illustrate the various parts, of a
25 third alternative embodiment of a detail of the machine according to this invention;
- Figure 13 is a partial view of a fourth alternative embodiment of a detail of the machine according to this invention;
- Figure 14 is a view of the detail from Figure 13 according to the line XIV -
30 XIV; and
- Figure 15 is a view of a detail of the machine of Figure 1 in two different

positions.

With reference to the accompanying drawings, the numeral 1 denotes in its entirety a machine for multiple wire cutting of stone material according to this invention.

5 The machine 1 for multiple wire cutting of stone material according to this invention comprises first a main frame 2 which, in the embodiment illustrated, is gantry-shaped. Mounted on the main frame 2 there is at least one supporting structure 3 on which there is mounted a plurality of cutting devices 4 arranged parallel with each other in planes which lie substantially
10 vertically. In particular, in the embodiment illustrated, the supporting structure 3 is divided into two separate sections, one (not visible but of the known type) intended to support the cutting devices 4 at a first side of the machine 1 (the left side in Figure 1), and one intended to support the cutting devices 4 at a second side of the machine 1 opposite to the first side
15 relative to the actual cutting zone (the right side in Figure 1). The two sections are, however, able to move together, as is described in more detail below. However, in other embodiments, in the known way, said two sections of the supporting structure 3 may also be rigidly connected to each other to form a single supporting structure 3.

20 The machine 1 also comprises supporting means 5 for supporting at least one block 9 of stone material to be cut. These supporting means may be positioned under the cutting devices 4. In the embodiment illustrated in Figure 1 the supporting means 5 comprise a carriage 6 which can be brought under the cutting devices 4 by means of a track 7 fixed to the
25 ground. The carriage is equipped with a plurality of vertical slab holder rods 8 (of the known type and therefore not described in detail). When the block 9 to be cut is positioned on the carriage 6, spacer elements 10 are normally interposed between them to prevent the cutting wires 11 from touching the carriage 6 at the end of cutting.

30 In the embodiment illustrated, the supporting structure 3 can also move vertically along the gantry between an upper home position, in which it

allows insertion of a block 9 under the cutting devices 4, and a lower end of cutting position. Figure 1 shows an intermediate position in which the cutting has just been started.

However, in general the machine 1 comprises means for creating a relative
5 movement in a substantially vertical direction, between the supporting means 5 and the supporting structure 3 with the cutting devices 4 mounted on it. The supporting structure 3 may even be held still and the supporting means 5 moved upwards. However, since both such solutions are of the known type, they are not described in detail herein.

10 Moreover, advantageously, the supporting structure 3 comprises at least one portion 12 for connection to the main frame 2 and one supporting portion 13 able to move by sliding relative to the connecting portion 12 in a substantially horizontal direction, parallel with the planes in which the cutting devices 4 lie. In the preferred embodiment, the machine 1 also comprises
15 rough tensioning means 14 which act simultaneously on all of the cutting wires 11 to substantially tension them before the start of cutting. Said rough tensioning means 14 comprise at least one actuator 15 mounted between the connecting portion 12 and the supporting portion 13 for pushing the latter towards the outside of the machine 1. In the embodiment illustrated
20 the actuator 15 is of the electric type.

With reference to the cutting devices 4, each comprises first a cutting wire 11 extending along an annular extension trajectory. The cutting wire 11 is looped around at least driving means 16 and around return pulleys 17, 18. Advantageously, the driving means 16 for the cutting wire 11 are mounted at
25 a first side 19 of the device and are designed to make the cutting wire 11 run substantially along its own extension trajectory. In contrast, at the second side 20 of the device (the sides of the device coincide with those of the machine 1) there is at least one upper return pulley 17 and at least one lower return pulley 18, which are vertically distanced from each other.

30 The driving means 16 may have any form, according to requirements. However, in the embodiment illustrated they comprise a single drum for all

of the cutting devices 4.

According to a first innovative aspect of this invention, as Figures 1, 2 and 4 clearly show, the upper pulleys 17 of two adjacent cutting devices 4 are supported by the same upper arm 21 of the supporting structure 3, while the
5 lower pulleys 18 of two adjacent cutting devices 4 are supported by the same lower arm 22 of the supporting structure 3. The supporting structure 3 comprises a plurality of arms 21, 22 at both the lower pulleys 18 (lower arms 22) and at the upper pulleys 17 (upper arms 21). Each of the arms 21, 22 is intended to support two pulleys 17, 18 of two adjacent cutting devices
10 4.

According to a second innovative aspect of this invention, the upper arm 21 comprises a first, inner part 23 with which one of the two upper pulleys 17 mounted on it is associated, and a second, outer part 24 with which the other of the upper pulleys 17 mounted on it is associated. The second, outer
15 part 24 can also move relative to the first part 23, for moving the respective upper pulley 17 in such a way as to vary the tensioning of the cutting wire 11 wound around it (thus varying the length of the annular path).

In the same way, the lower arm 22 comprises a third, inner part 25 with which one of the two lower pulleys 18 mounted on it is associated, and a
20 fourth, outer part 26 with which the other of the lower pulleys 18 mounted on it is associated. In turn, the fourth, outer part 26 can move relative to the third part 25, for moving the respective lower pulley 18 in such a way as to vary the tensioning of the cutting wire 11 wound around it.

Moreover, according to this invention, if the upper pulley 17 of one cutting
25 device 4 is mounted on the first part 23 or respectively on the second part 24 of an upper arm 21, the lower pulley 18 of the same cutting device 4 is of necessity mounted on the fourth part 26 or respectively on the third part 25 of a lower arm 22.

In the preferred embodiment, if the upper pulleys 17 of two adjacent cutting
30 devices 4 are mounted on the same upper arm 21, then the lower pulleys 18 of those cutting devices are mounted on a single lower arm 22 in

accordance with the methods indicated above.

As shown in Figure 1, in the preferred embodiment, both the upper arms 21 and the lower arms 22 have a direction of extension whose main component is substantially horizontal, meaning that the projections of the upper return pulleys 17, 18 of two adjacent cutting devices 4 in a plane in which a cutting device 4 lies are offset relative to each other, just as the projections, in said plane in which the device lies, of the lower return pulleys 17, 18 of two adjacent cutting devices 4 are offset relative to each other. In both cases the pulleys 17, 18 are advantageously offset by a distance greater than their radius in such a way that the central hub 27 of each pulley 17, 18 is not opposite the pulley 17, 18 of the immediately adjacent cutting device 4.

With regard to the methods for fixing the pulleys 17, 18 to the arms 21, 22, advantageously each upper pulley 17 mounted on a first part 23 and/or each lower pulley 18 mounted on a third part 25 is mounted cantilever-style, and each second part 24 and/or fourth part 26 is instead fork-shaped and supports the respective return pulley on both sides. Indeed, while the first part 23 and the third part 25 may have relatively large thicknesses, which allow cantilever-style support without problems, the second part 24 and the fourth part 26 must have a relatively limited thickness, which makes support on both sides preferably to avoid deformations. The detail of the central hub 27 of the pulleys 17, 18 in the two cases is illustrated in Figures 9 and 10. As can be seen, according to this invention each hub 27 advantageously always comprises two separate bearings 28 mounted side by side.

Returning to the movement of the second part 24 and the fourth part 26, it should be noticed that in the preferred embodiments they can move, respectively relative to the first part 23 and to the third part 25, either by rotation or by sliding. The former case is illustrated in Figures 1 to 10 and 13 to 15, while the latter case is illustrated in Figures 11 and 12. In both cases there are advantageously means 29 for moving the second part 24 and the fourth part 26, interposed respectively between the first part 23 and the

second part 24 and between the third part 25 and the fourth part 26. In the preferred embodiments, the movement means 29 comprise at least one hydraulic, pneumatic or electric actuator, but preferably a hydraulic actuator 30. Each second part 24 and each fourth part 26 forms, with the relative movement means 29, the precision tensioning means of the respective cutting device 4.

Figure 4A, which relates to a lower arm 22, shows in detail the movement of the fourth part 26 relative to the third part 25. In particular, the drawing with a continuous line shows an intermediate position of the fourth part 26, while the two drawings with dashed lines show the two limit positions which the fourth part 26 and the respective lower pulley 18 can adopt and which correspond to minimum tensioning (the upper one) and maximum tensioning (the lower one). A similar representation is also used in Figure 13. As can be seen, in the preferred embodiment the fourth part 26 of each lower arm 22 pivots at the third part 25 according to a first axis of rotation perpendicular to the plane in which the cutting device 4 lies. In more detail, the pivot 31 is made at a lower portion 32 of its side facing towards the third part 25. In turn, the movement means 29 cause an increase in tensioning by making the fourth part 26 rotate downwards. For that purpose, the respective actuator 30 is positioned at an upper portion 33 both of the third part 25 and of the fourth part 26.

As shown in Figure 4B (which illustrates an upper arm 21 seen from behind relative to the front view of Figure 1), the structure is exactly the same as regards the upper arms 21, the only difference being that they are substantially specular relative to the lower arms 22. The second part 24 of each upper arm 21 in fact pivots at the first part 23 according to a second axis of rotation perpendicular to the plane in which the cutting device 4 lies, but by means of a pivot 46 located at an upper portion 47 of its side facing towards the first part 23. In turn, the movement means 29 in this case cause an increase in tensioning by making the second part 26 rotate upwards. As a result, the respective actuator 30 is positioned at the lower portion 48 both

of the first part 23 and of the second part 24.

Moreover, in the embodiment illustrated, since the weight force tends to make the second parts 24 and the fourth parts 26 rotate downwards (having the opposite effect as regards tensioning), advantageously the movement
5 means 29, which comprise at least one fluid actuator 30 for each arm, also comprise at least two independent circuits for feeding the operating fluid to the actuators 30. In this way, the two circuits can be used for separately feeding respectively the actuators 30 of the upper arms 21 and the actuators 30 of the lower arms 22. In particular, the circuit for feeding the
10 lower arms 22 will operate with an operating fluid pressure which is lower than that of the circuit for the upper arms 21.

In contrast, as regards the embodiments in Figures 11 and 12 (in which the various parts are shown as being transparent), the second parts 24 and the fourth parts 26 can move, respectively relative to the first parts 23 and
15 relative to the third parts 25, by sliding. For this purpose, each second part 24 and each fourth part 26 is slidably mounted on two horizontal guide bars 34 extending cantilever-style from the respective first part 23 or third part 25. Again in this case the movement is achieved by means of an actuator
30.

20 In all of the embodiments, the movement of the second parts 24 and of the fourth parts 26 can be continuously monitored depending on system operation, for example using a control system such as that described in patent EP 1 951 464 whose content is incorporated herein by reference. As is clearly shown in Figures 4 and 15, a position detector sensor 35 is
25 coupled to the movement means 29.

While in the embodiment in Figure 1 the horizontal distance between the various cutting devices 4 is fixed, meaning that it is possible to vary the thickness of the slabs to be obtained only by removing several cutting wires 11, Figures 13 and 14 show an alternative embodiment in which the cutting
30 thickness can be changed with greater freedom (but still by removing several of the cutting wires 11 to obtain slabs which all have the same

thickness). In this embodiment, the supporting portion 13 is equipped with one or more supporting shafts 36 (two in the accompanying drawings) which extend perpendicularly to the planes in which the cutting devices 4 lie. The upper arms 21 and the lower arms 22 are in turn slidably mounted on the supporting shafts 36 by means of connecting plates 38. Moreover, there are positioning means (not illustrated) for varying the distance between the adjacent arms 21, 22 and consequently adjusting the cutting thickness. Advantageously, the positioning means are simple spacers. Moreover, in the preferred embodiment, the connecting plates 38 are preferably joined in pairs, constraining to each other the upper arm 21 and the lower arm 22 which support the same cutting devices 4.

Another optional aspect of this invention is a device which facilitates access to the individual return pulleys 17, 18 in the event of maintenance. Said aspect is illustrated in Figure 15 and partly in Figures 11 and 12.

According to this aspect of the invention, each upper arm 21 and each lower arm 22 can move relative to the rest of the supporting structure 3 (and also relative to the connecting plates in Figure 13), between an operating position and a maintenance position. For a lower arm 22, the operating position is that illustrated with a continuous line in Figure 15, where the return pulleys 18 are correctly positioned for cutting. The maintenance position is shown in the same figure with a dashed line. As can be seen, when the arm 21, 22 is in the maintenance position, the return pulleys 17, 18 mounted on it are out of alignment relative to the corresponding return pulleys 17, 18 mounted on the other arms 21, 22 placed in the operating position, in such a way as to allow their removal from and/or mounting on the arm 21, 22 without having to disassemble the other pulleys 17, 18.

To obtain this result each arm 21, 22 pivots at the rest of the supporting structure 3 and can rotate between the operating position and the maintenance position. In particular, the upper arms 21 rotate upwards while the lower arms 22 rotate downwards. To control that rotation, the machine 1 also comprises suitable rotation means 39.

In the embodiment in Figure 15, which relates to a lower arm 22, the rotation means 39 comprise a double acting hydraulic actuator 40, which can be activated by means of a manually activated diverter valve 41, mounted between the upper arm 21 and the rest of the supporting portion

5 13. The passage from the maintenance position is achieved by feeding an operating fluid in such a way as to cause a contraction of the actuator 40, while the reverse passage is achieved by using the operating fluid to partly oppose the force of gravity. In contrast, in the case of the upper arm 21, operation is similar although with the appropriate differences given that the
10 force of gravity acts towards the operating position. The embodiment in Figure 11 is also exactly the same.

In contrast, the embodiment in Figure 12 differs due to the fact that in place of the hydraulic actuator 40 there is a device using a cable/chain 42 which is wound on, and unwound from, a suitable reel 43 (directly in the case of the
15 upper arm 21, and by means of a return roller 44 in the case of the lower arm 22). In particular, the passage from the operating position to the maintenance position is achieved by winding the cable/chain 42 relative to the upper arm 21 and unwinding it relative to the lower arm 22.

Moreover, in all of the cases illustrated, there may also be removable fixing
20 means for fixing the arm 21, 22 in the operating position (for increasing system rigidity) and if necessary in the maintenance position (for unburdening the rotation means 39).

According to requirements, the machine 1 according to this invention may comprise further elements such as guide rollers 45 for the cutting wire 11 (in
25 themselves of the known type). Such guide rollers 45 may be fixed both to the supporting portion 13 (Figure 1) and to the connecting portion 12 (Figure 3).

Finally, Figure 2 clearly shows the case of a machine 1 equipped with four cutting devices 4 which, on the second side 20, are supported in pairs by
30 two upper arms 21 and by two lower arms 22.

Operation of the machine 1 according to this invention is the same as that of

the prior art machines as regards the cutting methods, while it follows what has already been indicated as regards the innovative aspects of this invention.

This invention brings important advantages.

- 5 First, thanks to this invention it was possible to provide a multiple cutting machine which allows slabs with extremely limited thickness to be obtained, using at the same time idle pulleys which are not too small and with supporting bearings that have a limited diameter.

Moreover, even the tensioning system is particularly advantageous, since it
10 is particularly simple from a construction, management and maintenance viewpoint.

Finally, it should be noticed that this invention is relatively easy to produce and that even the cost linked to implementing the invention is not very high.

The invention described above may be modified and adapted in several
15 ways without thereby departing from the scope of the inventive concept.

Moreover, all details of the invention may be substituted with other technically equivalent elements and the materials used, as well as the shapes and dimensions of the various components, may vary according to requirements.

20

* * *

CLAIMS

1. A machine for multiple wire cutting of stone material comprising:
- a main frame (2);
 - a plurality of cutting devices (4) arranged parallel with each other in
5 planes which lie substantially vertically and mounted on the main frame (2)
by means of at least one supporting structure (3);
 - supporting means (5) for supporting at least one block (9) of stone
material to be cut, positionable under the cutting devices (4); and
 - means for creating a relative movement in a substantially vertical
10 direction, between the supporting means (5) and the supporting structure
(3) with the cutting devices (4) mounted on it;
- each cutting device (4) in turn comprising:
- a cutting wire (11) extending along an annular extension trajectory;
 - driving means (16) for the cutting wire (11) which are mounted at a first
15 side (19) of the device for making the cutting wire (11) run substantially
along its own extension trajectory;
 - at least one upper return pulley (17) mounted at a second side (20) of
the device which is opposite to and distanced from the first side; and
 - at least one lower return pulley (18) mounted at the second side (20) of
20 the device;
- the two return pulleys (17), (18) being vertically distanced from each other
and the cutting wire (11) being looped at least around the driving means
(16) and the return pulleys (17), (18);
- characterised in that the upper pulleys (17) of two adjacent cutting devices
25 (4) are supported by the same upper arm (21) of the supporting structure
(3), the upper arm (21) comprising a first, inner part (23) with which one of
the upper pulleys (17) is associated, and a second, outer part (24) with
which the other of the upper pulleys (17) is associated, the second, outer
part (24) also being able to move relative to the first part (23) for moving the
30 respective upper pulley (17) in such a way as to vary the tensioning of the

cutting wire (11) looped around it, and also being characterised in that the lower pulleys (18) of two adjacent cutting devices (4) are supported by the same lower arm (22) of the supporting structure (3), the lower arm (22) comprising third, inner part (25) with which one of the lower pulleys (18) is associated, and a fourth, outer part (26) with which the other of the lower pulleys (18) is associated, the fourth, outer part (26) also being able to move relative to the third part (25) for moving the respective lower pulley (18) in such a way as to vary the tensioning of the cutting wire (11) looped around it, and also being characterised in that if the upper pulley (17) of a cutting device (4) is mounted on the first part (23) or respectively on the second part (24) of an upper arm (21), the lower pulley (18) of the same cutting device (4) is mounted on the fourth part (26) or respectively on the third part (25) of a lower arm (22).

2. The machine according to claim 1, characterised in that the second part (24) and the fourth part (26) can move respectively relative to the first part (23) and relative to the third part (25) by rotation or sliding, and also being characterised in that it also comprises means (29) for moving the second part (24) and the fourth part (26) which are interposed respectively between the first part (23) and the second part (24) and between the third part (25) and the fourth part (26).

3. The machine according to claim 2, characterised in that the movement means (29) comprise at least one hydraulic, pneumatic or electric actuator (30).

4. The machine according to claim 2 or 3, characterised in that the second part (24) of each upper arm (21) pivots at the first part (23) according to a first axis of rotation perpendicular to the plane in which the cutting device (4) lies, and at an its upper portion (47), the movement means (29) causing an increase in the tensioning by rotating the second part (24) upwards.

5. The machine according to claim 2, 3 or 4, characterised in that the fourth part (26) of each lower arm (22) pivots at the third part (25) according

to a second axis of rotation perpendicular to the plane in which the cutting device (4) lies, and at an its lower portion (32), the movement means (29) causing an increase in the tensioning by rotating the fourth part (26) downwards.

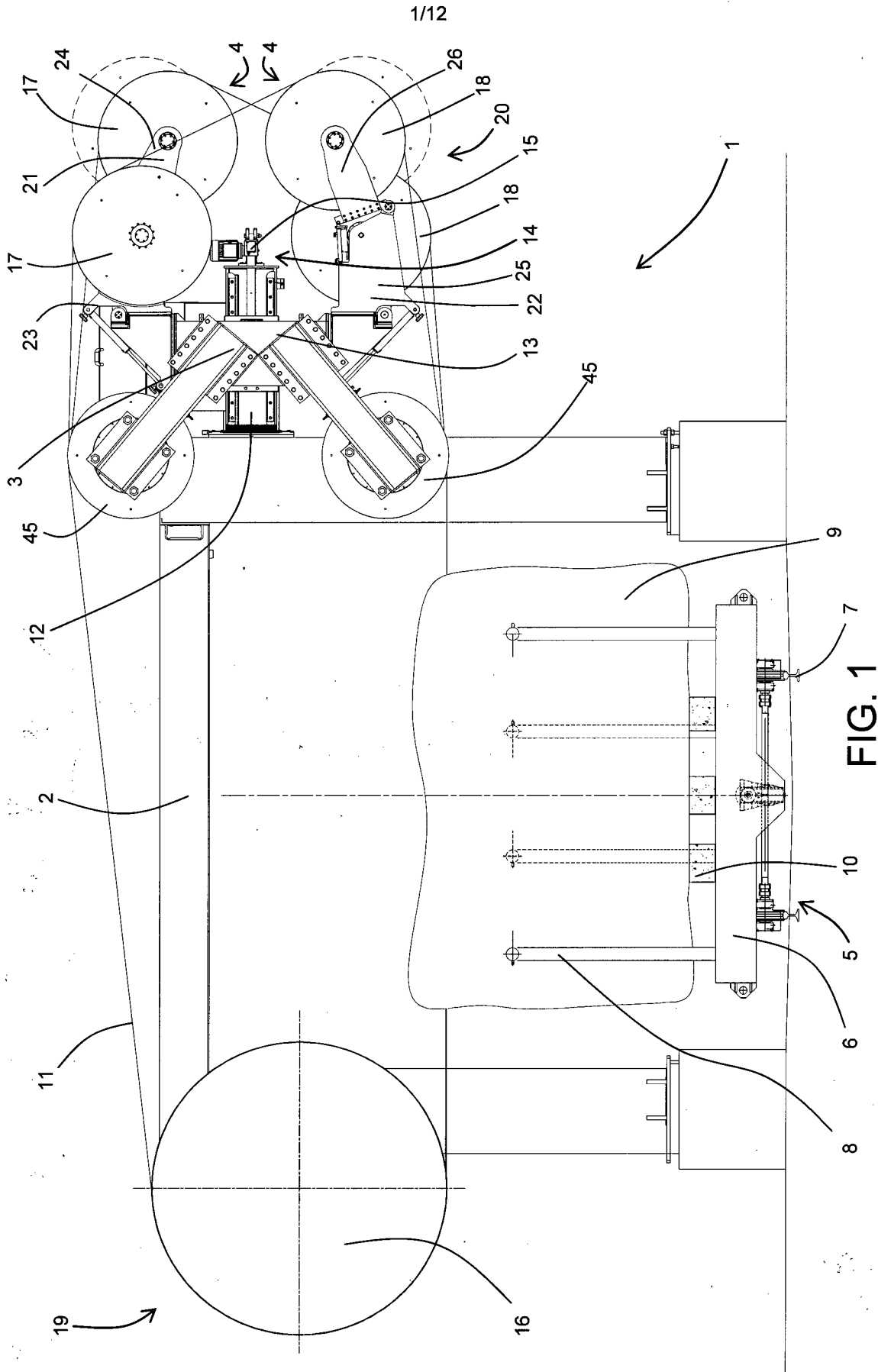
- 5 **6.** The machine according to claims 4 and 5, characterised in that the movement means (29) comprise at least one fluid actuator (30) for each arm and at least two independent operating fluid feed circuits, for separately feeding respectively the actuators (30) of the upper arms (21) and the actuators of the lower arms (22).
- 10 **7.** The machine according to any of the foregoing claims, characterised in that the projections in a plane in which a cutting device (4) lies of the upper return pulleys (17) of two adjacent cutting devices (4) are offset relative to each other by a distance greater than the radius of the pulleys (17), and also being characterised in that the projections in a plane in which a cutting
15 device lies (4) of the lower pulleys (18) of two adjacent cutting devices (4) are offset relative to each other by a distance greater than the radius of the pulleys (18).
- 8.** The machine according to any of the foregoing claims, characterised in that if the upper pulleys (17) of two adjacent cutting devices (4) are mounted
20 on the same upper arm (21), the lower pulleys (18) of those cutting devices (4) are mounted on a single lower arm (22).
- 9.** The machine according to claim 8, characterised in that the upper arms (21) and the lower arms (22) are slidably mounted on at least one supporting shaft (36) which extends perpendicularly to the planes in which
25 the cutting devices (4) lie, and also being characterised in that it comprises positioning means for varying the distance between the adjacent arms (21), (22) and for consequently adjusting the cutting thickness.
- 10.** The machine according to any of the foregoing claims, characterised in that it also comprises rough tensioning means (14) which act
30 simultaneously on all of the cutting wires (11).

11. The machine according to claim 10, characterised in that the supporting structure (3) comprises at least one portion (12) for connection to the main frame (2) and one supporting portion (13) for the arms (21), (22), and also being characterised in that the supporting portion (13) can move by sliding
5 relative to the connecting portion (12) in a substantially horizontal direction parallel with the planes in which the cutting devices (4) lie, and also being characterised in that the rough tensioning means (14) comprise at least one actuator (15) mounted between the connecting portion (12) and the supporting portion (13) for pushing the latter towards the outside of the
10 machine (1).

12. The machine according to any of the foregoing claims, characterised in that each upper pulley (17) mounted on a first part (23) and/or each lower pulley (18) mounted on a third part (25) is mounted cantilever-style, and/or also being characterised in that each second part (24) and/or fourth part
15 (26) is fork-shaped and supports the respective return pulley on both sides.

13. The machine according to any of the foregoing claims, characterised in that the upper arms (21) and the lower arms (22) have a direction of extension with a main component which is substantially horizontal.

14. The machine according to any of the foregoing claims, characterised in
20 that each upper arm (21) and each lower arm (22) can move relative to the rest of the supporting structure (3) between an operating position and a maintenance position; with the arm (21), (22) in the maintenance position the return pulleys (17), (18) mounted on it being out of alignment with the corresponding return pulleys (17), (18) mounted on the other arms (21), (22)
25 which are in the operating position; and also being characterised in that at least when a single arm (21), (22) is in the maintenance position, the return pulleys (17), (18) mounted on it are arranged in such a way that they can be freely removed from and/or mounted on the arm (21), (22).



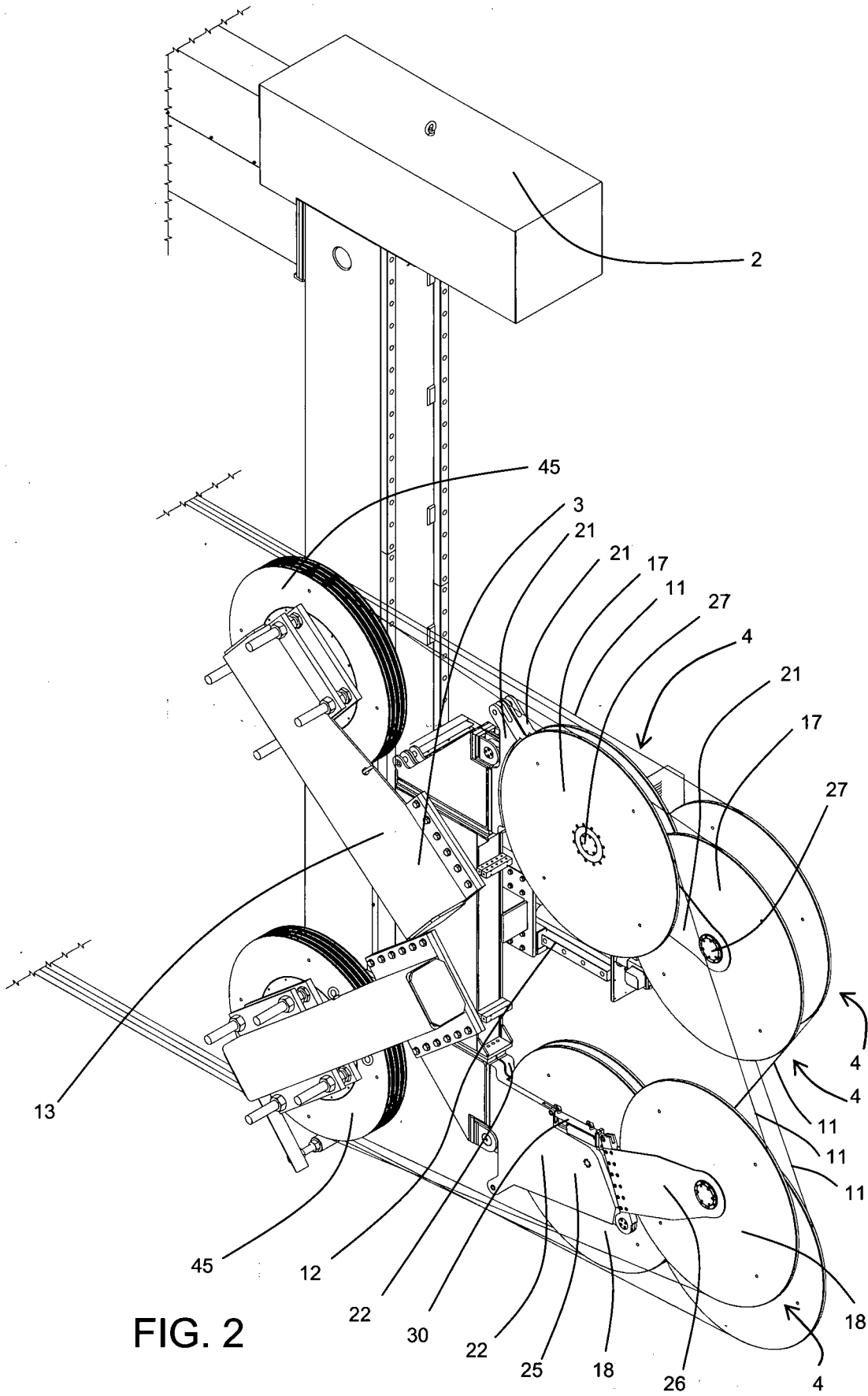


FIG. 2

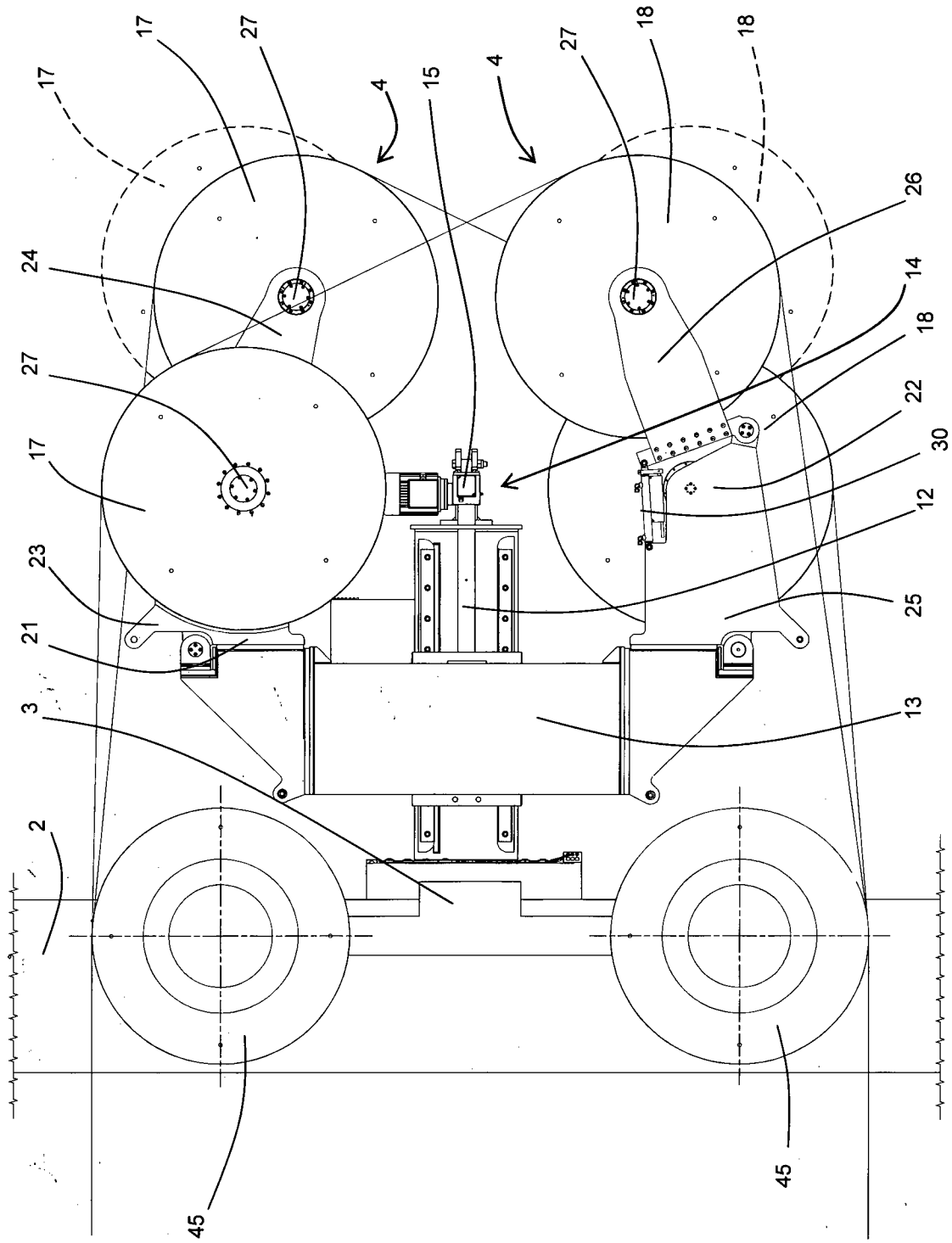


FIG. 3

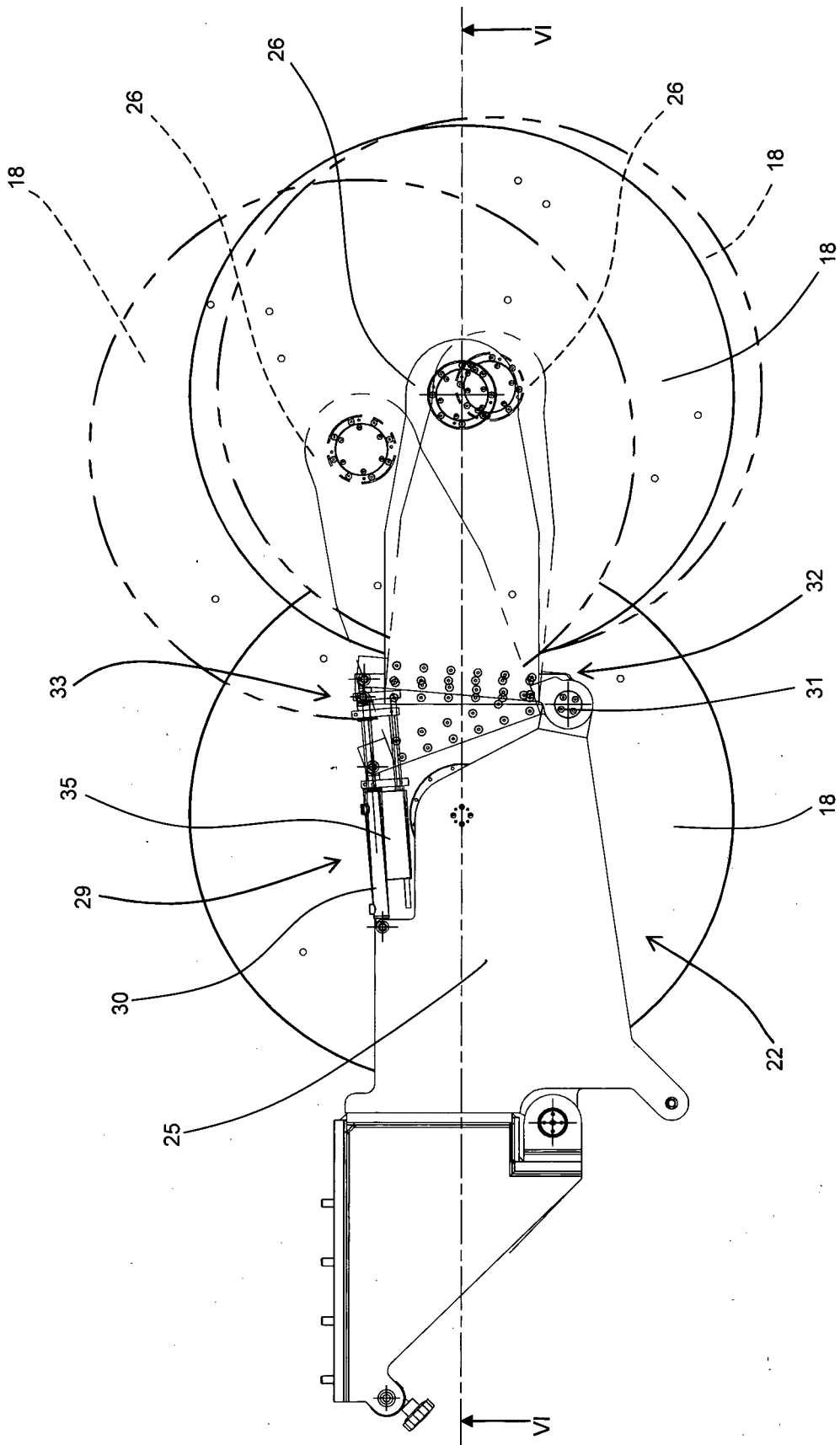


FIG. 4A

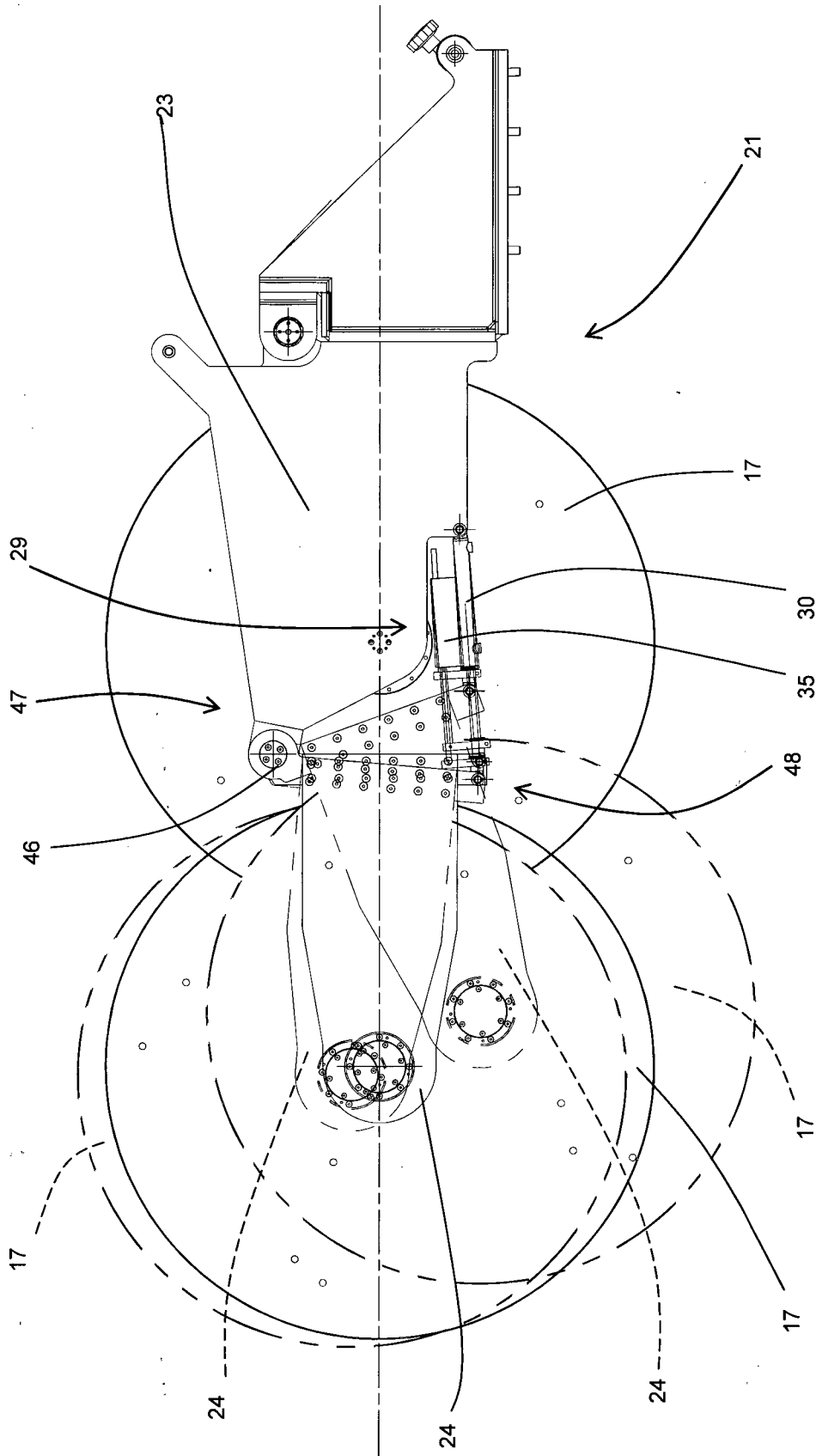
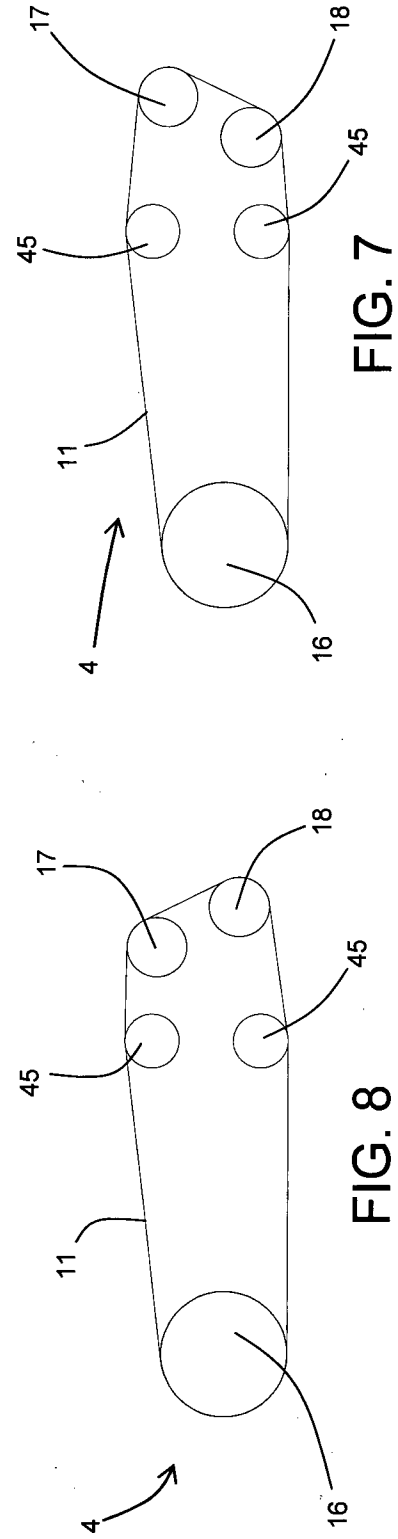
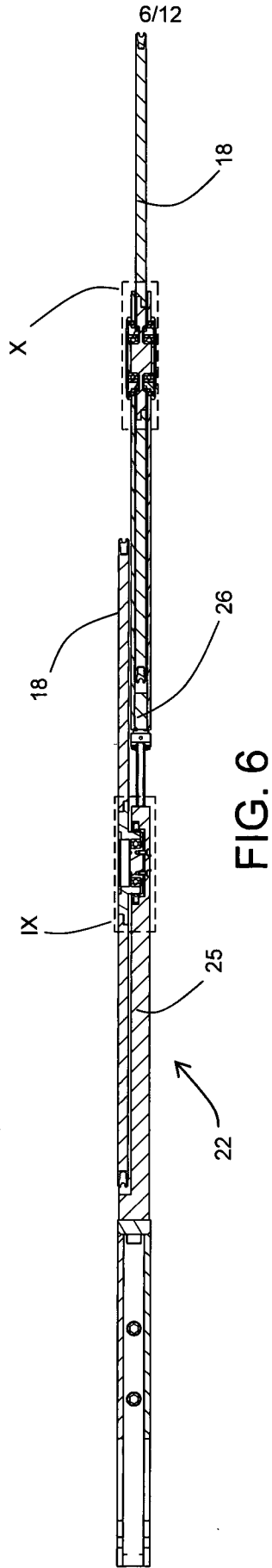
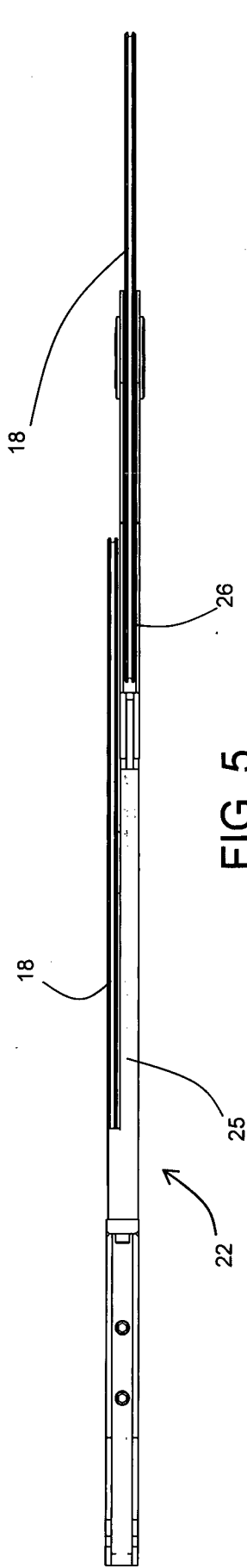


FIG. 4B



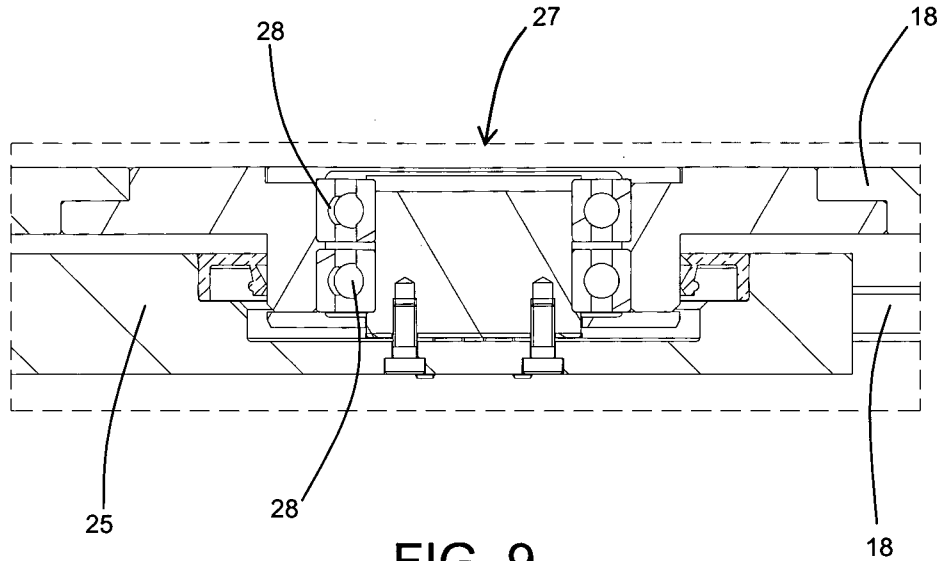


FIG. 9

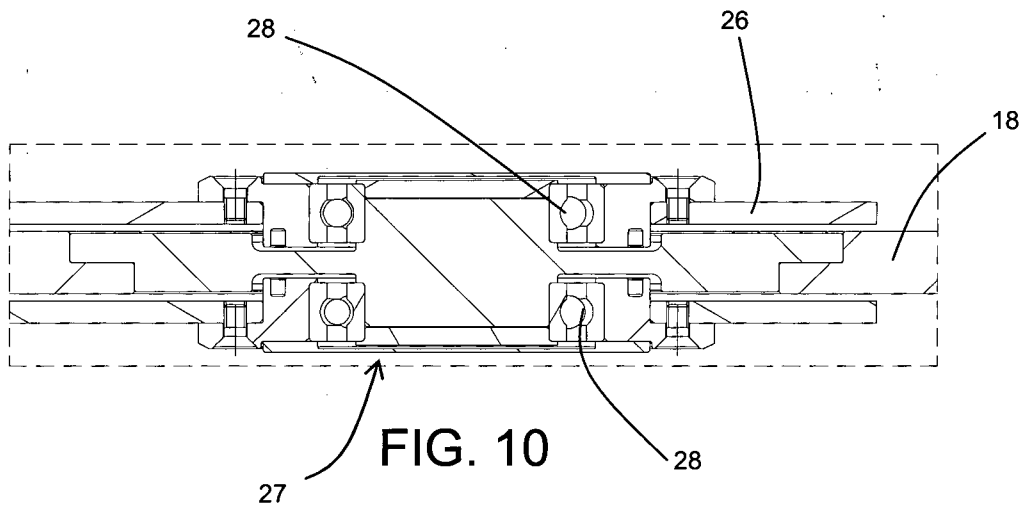


FIG. 10

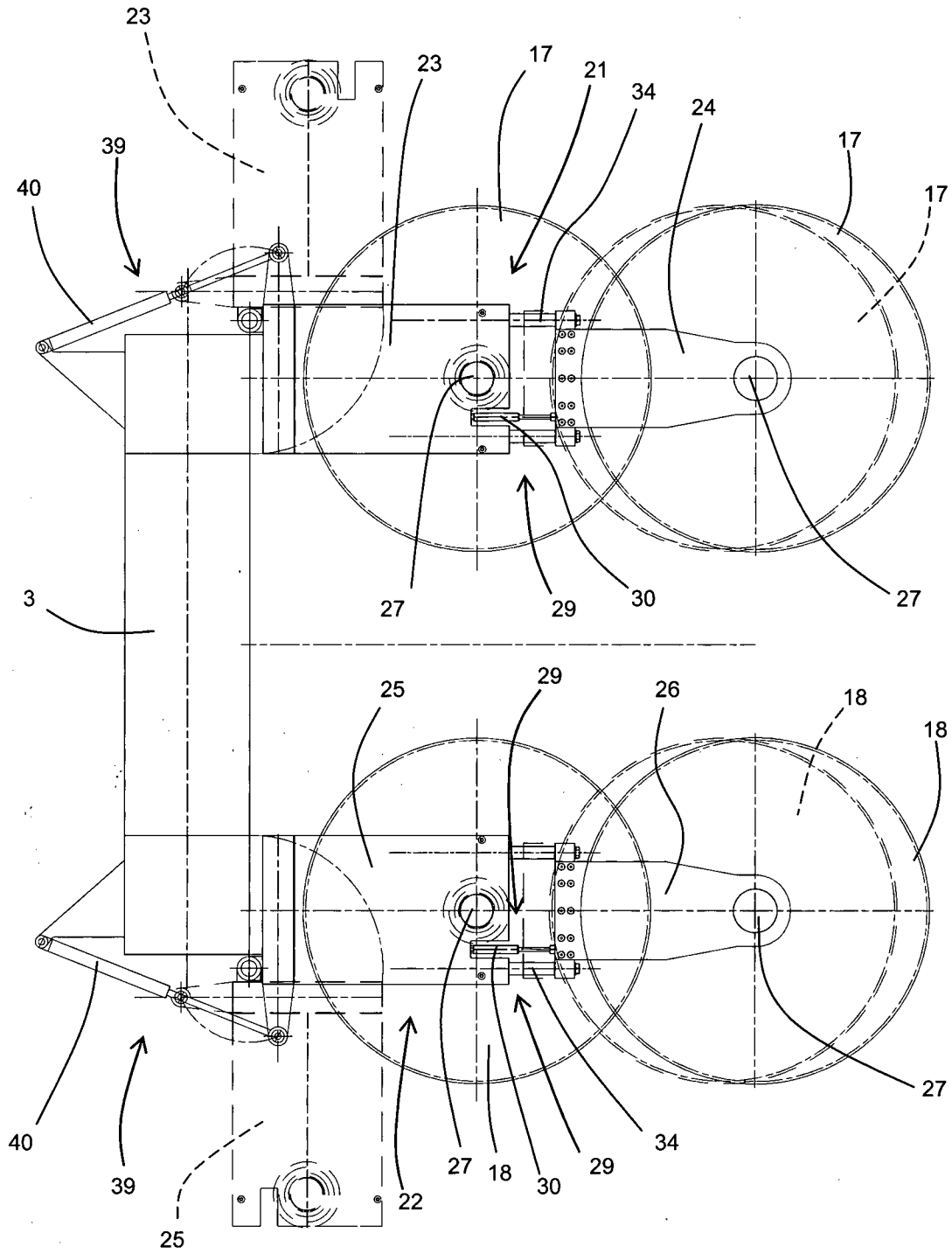


FIG. 11

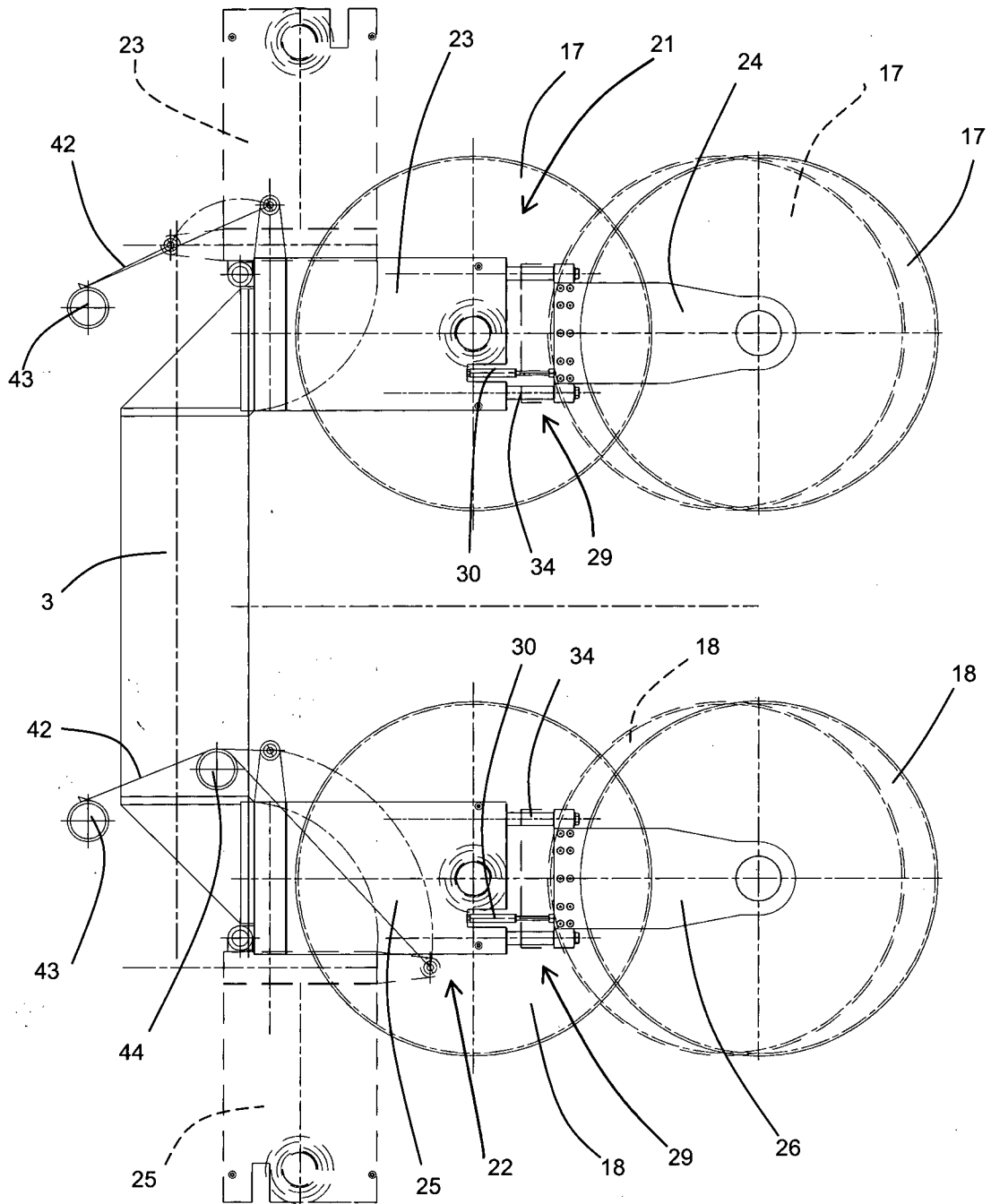


FIG. 12

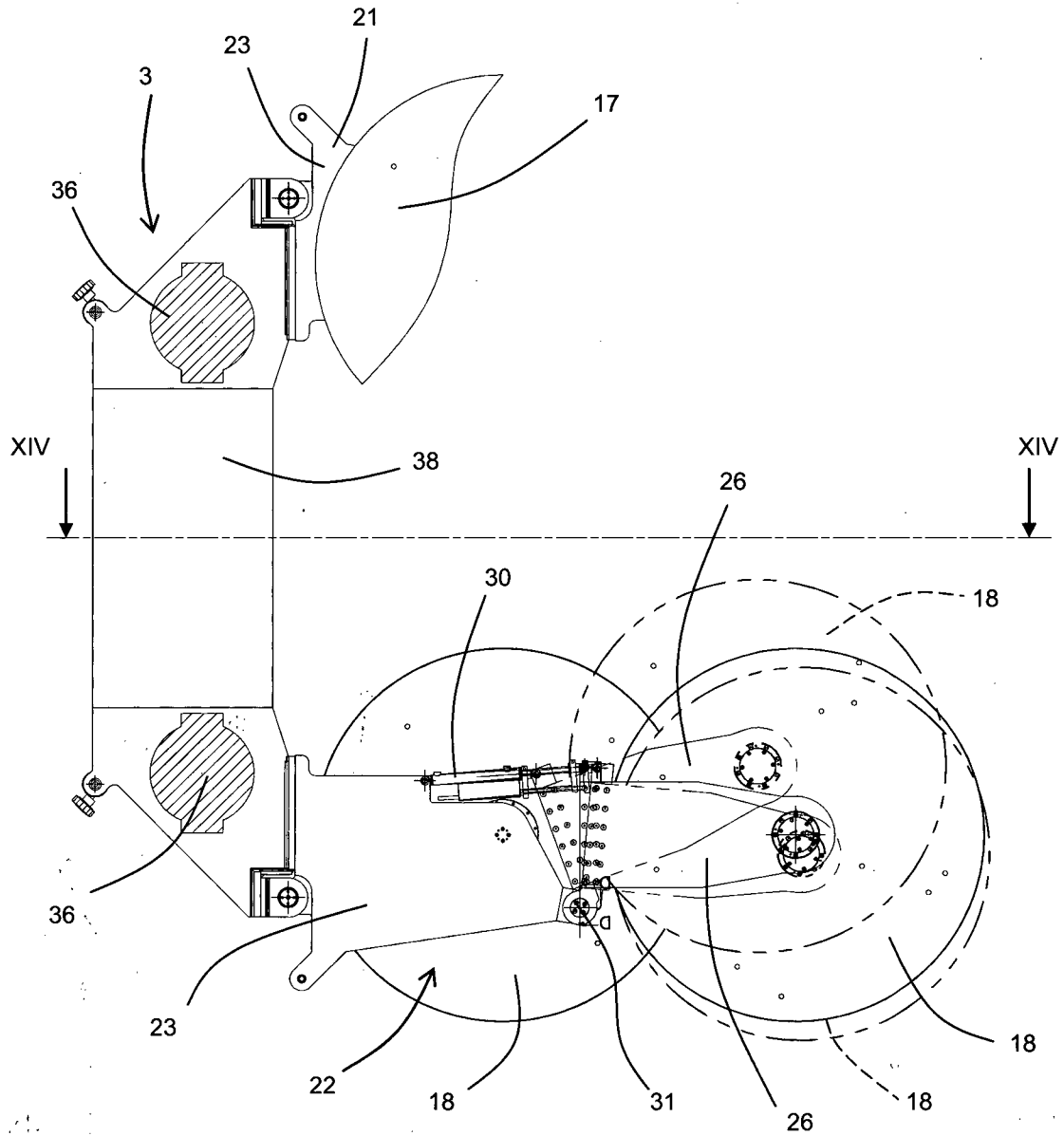


FIG. 13

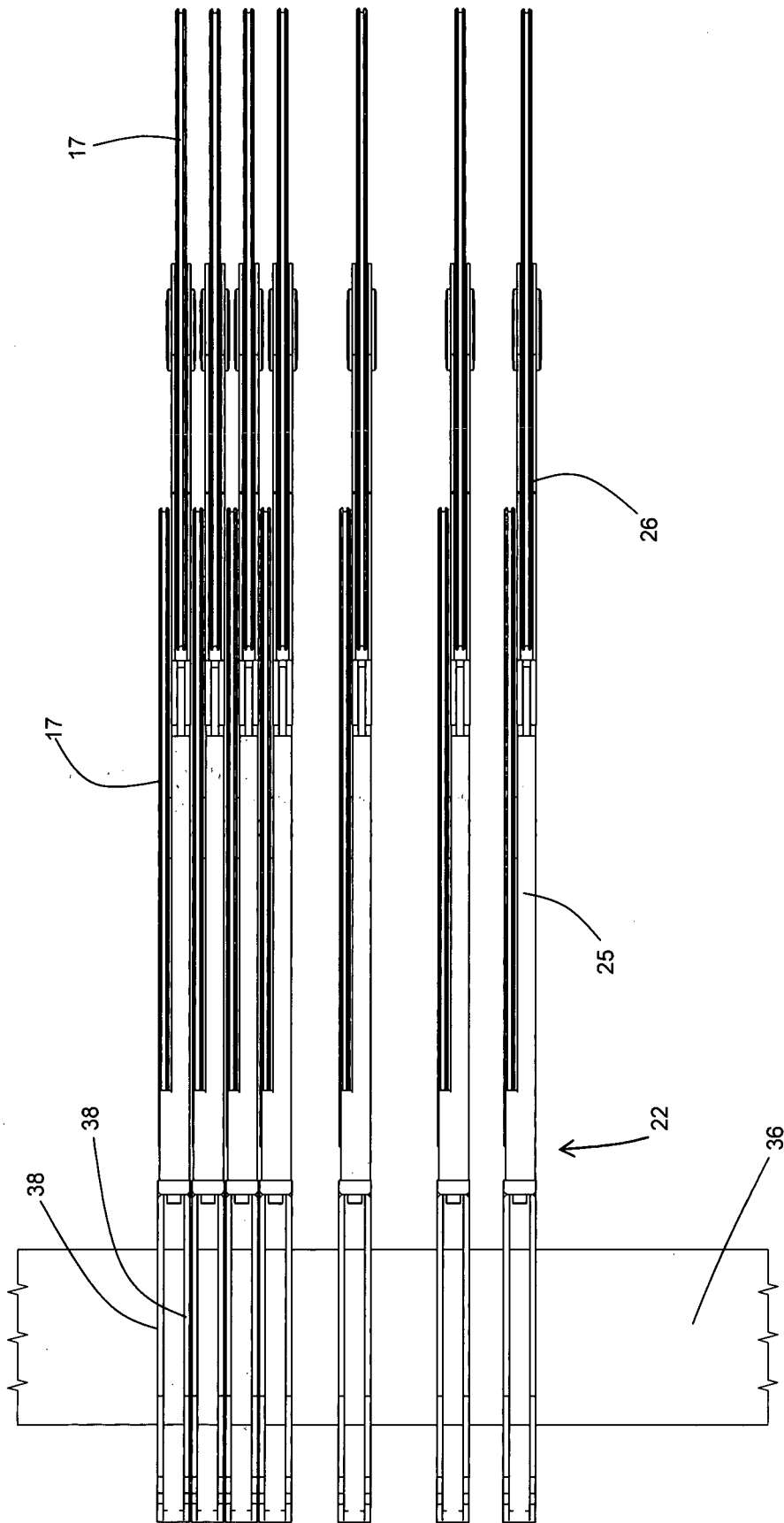


FIG. 14

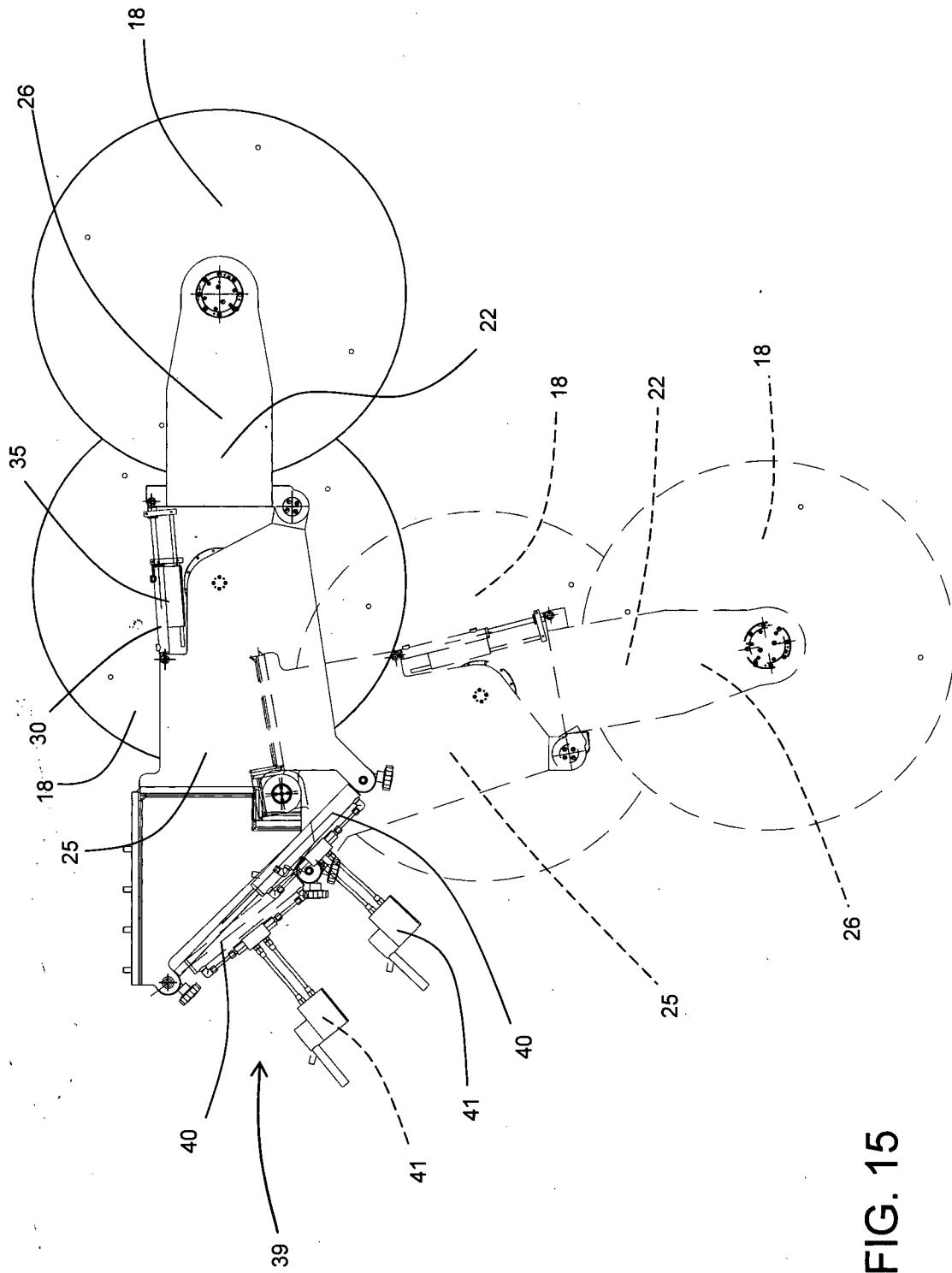


FIG. 15

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2011/000122

| A. CLASSIFICATION OF SUBJECT MATTER INV. B23D57/00 B28D1/08 ADD. | | |
|--|---|--|
| According to International Patent Classification (IPC) or to both national classification and IPC | | |
| B. FIELDS SEARCHED | | |
| Minimum documentation searched (classification system followed by classification symbols) B23D B28D | | |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched | | |
| Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data | | |
| C. DOCUMENTS CONSIDERED TO BE RELEVANT | | |
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
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| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex. | | |
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| Date of the actual completion of the international search 13 February 2012 | | Date of mailing of the international search report 20/02/2012 |
| Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016 | | Authorized officer Popma, Ronald |

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| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT | | |
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