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(54) **Needling device**

(57) A needling device for products (**V**) comprising: a needling bar (**2**) movable towards the product (**V**) and provided with a support structure (**3**) to which a plurality of shaped needles (**4**); a first connecting rod (**5**; **105**) and a second connecting rod (**6**; **106**) moved in counter-rotation with respect to each other and each one with eccentric stroke in the connecting rod big end (**7**), the small end (**15**) of each connecting rod (**5**, **6**; **105**, **106**) being rotatably anchored to the support structure (**3**) of the needling bar (**2**) to alternately move it along directions incident the product (**V**) and to induce in said needles (**4**) a movement of penetration into the product (**V**) and back. The device (**1**) comprises a first (**20**; **120**) and a second conditioning group (**21**; **121**) of the connecting rods (**5**, **6**; **105**, **106**) operatively interposed between the connecting rods (**5**, **6**; **105**, **106**) for mechanically connecting them, the first conditioning group (**20**; **120**) having a first portion (**23**) operatively connected to a corresponding second portion (**24**) of the second conditioning group (**21**; **121**) so as to allow exclusively reciprocally counter-rotating movements of the small ends (**15**) of the connecting rods (**5**, **6**; **105**, **106**).

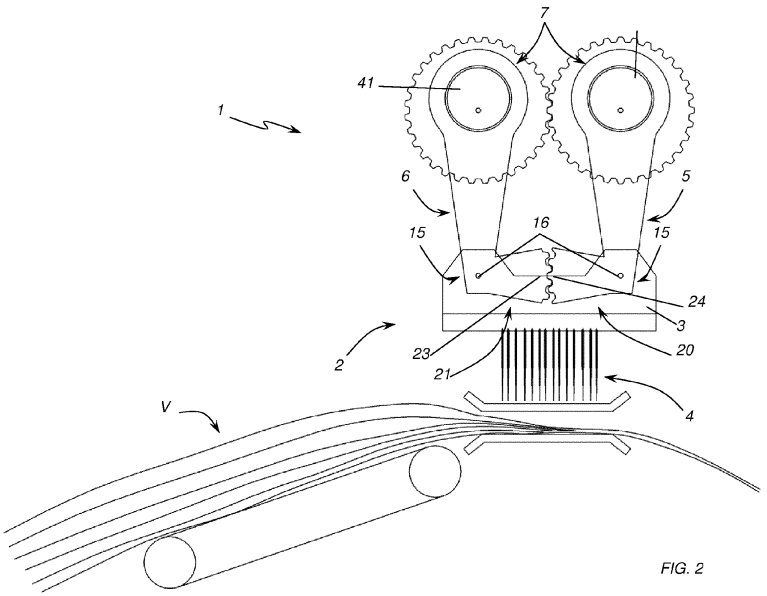

FIG. 2

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Description

Field of the invention

[0001] The present invention generally relates to the textile field and relates to machines for the processing of non-woven fabric.

[0002] More in detail, the present invention concerns a needling device for products typically composed by one or more layers of loose fibre so as to bind these layers with each in a consistent product.

Background of the invention

[0003] In the process of obtaining products consisting of layers of loose fibres, an essential step is the needling of these layers.

[0004] In the example case of production of panels of non-woven fabric, the textile fibre is initially subjected to carding, that is a web is formed, also called card web, which is later layered, that is disposed on more layers overlapped to each other, for obtaining a multi-layered product with the wished thickness. This last one is then typically consolidated by means of a process of needling, that is the needling of the layered webs.

[0005] Whatever the origin of the layers to be sewn, that is whether they are in textile fibre or other, the needling operation is not carried out by needling the layers with each other with a fitting yarn, but making a plurality of needles alternately go into and out from the product to be sewn. These needles are appropriately shake so that in their translation in the product they draw with them the fibres for short stretches. In this way these last ones at least partially dispose themselves transversally to the product in consolidation binding the layers with each other.

[0006] The just mentioned needles are usually connected in bars or boards, that is they are rigidly connected to a support structure so as to form a matrix. These bars are then alternately moved against the product to process so that the needles penetrate into it and are then pulled out from it.

[0007] According to the prior art, some examples of which are described in the patent documents EP 0 596 097 B1, US 2009/0119894 A1, EP 1 939 343 A2, US 5,732,453 B1, the alternate movement is obtained by means of a pair of connecting rods cooperating with each other and moved in counter-rotation with respect to each other with eccentric stroke in the connecting rod big end. The small connecting rod of both of them is rotatably connected to the bar where the needles are disposed, that is the needling bar. In this way, the rotating movement of each connecting rod becomes a translating movement of the needling bar. The use of two connecting rods rotating in counter-rotation allows to have a movement of the bar along a rectilinear direction usually orthogonal to the product to be sewed.

[0008] Actually, one of the problems in the needling is the risk that the penetration and return movement of the needles may cause "tears" to the layers, that is that the consolidated product lose uniformity. Therefore, in this sense, it is essential that the movement of the needles is perfectly orthogonal to the product. The use of a single connecting rod to generate the vertical movement does not allow to reach high production speed, as the connecting rod, because of its movement and of the imbalances in the masses generated by the quick rotation of the eccentric in the connecting rod big end, would subject the connecting rod small end to oscillations on the plane tangent to the multi-layered product. The approach of a second connecting rod moved in counter-rotation corrects this phenomenon nullifying it.

[0009] However, as the product to consolidate is in a continuous advancing movement during the needling, when the needles are inserted into the product they are subjected to stresses transversal to their body, which are transmitted to the connecting rods and to the gears which move them. The stresses increase with the increase of the frequency of insertion of the needles into the product to consolidate, that is with the increase of the processing speed of the needling device.

[0010] With time, the above stresses may cause permanent mechanical damages to the device, as far as the extreme case of mechanical break of the gears which move the connecting rods. In any case, the first effect is to cause a loss of precision and setting of the gears which leads to a possibility that the needles have uncontrolled movements in a tangential direction to the plane defined by the product to be processed.

[0011] Since, as said, this phenomenon is harmful for the quality of the final product, in order to avoid all this facts, the prior art devices, as observable in the above mentioned examples of patent documents, have connecting arms and/or leverages of the connecting rod small ends to the fix structure of the needling device. A further example of this solution is described in DE 7 717 626.

[0012] Therefore, the above embodiments keep the rectilinear movement of the connecting rods transferring on the fix structure of the device the stresses tangential to the needling bars. Although this allows to overcome the above mentioned drawbacks, this solution has some disadvantages.

[0013] First of all it is evident that the executive complexity of the needling device is increased above all in the cases when leverages or complex elastic elements are used to drive the movements of the needling bar transversal to the product to be sewn.

[0014] Secondly, the mass of the parts to move is particularly relevant and such to need the use of more powerful motors and of particularly resistant materials. It is also obvious that this creates more problems when one tries to considerably increase the production speed of the needling device.

[0015] Last but not least, another drawback is an increased mounting complexity of the needling device. All

the movement group of the needling bar, in fact, is connected to the fix structure of the device in two different points: one in correspondence of the movement section of the connecting rod big ends, ad the other ones in correspondence of the arms and/or leverages which prevent movements of the connecting rod small ends transversal to the needling direction. As it is essential that the distances between the different components are precise to ensure the fastening of a complex body to two different connection points on a fix structure, it is evident that upon mounting all mechanisms have to be subject to difficult and long adjustments with more costs and work.

Summary of the invention

[0016] Object of the present invention is to at least partially overcome the above described drawbacks by providing a needling device which has a lower execution difficulty than the prior art devices.

[0017] Another object of the invention is that the needling device is easy to be assembled and mounted and that it does not oblige technicians to long regulations and adjustments.

[0018] A further object of the invention is to provide a needling device which can be manufactured with cheaper materials than the prior art devices.

[0019] In any case, the needling device according to the invention has to ensure to the needle bar a correct movement also in presence of loads applied thereon which submit it to stress along the advancing direction of the product to be sewn. In other words, the needling device according to the invention has to ensure in time the movement stability of the needling bar so that the final product is of excellent quality.

[0020] Last but not least object is that the needling device according to the invention ensures a production speed not lower than the prior art devices although ensuring a quality of the final product not lower than what obtained by the prior art equivalent devices.

[0021] These and other objects, as better explained hereafter, are fulfilled by a needling device according to the following claims which are integrant part of the present description.

[0022] In particular, it may comprise at least one needling bar movable towards the product to be sewn and provided with a support structure to which a plurality of shaped needles are connected.

[0023] Moreover a first connecting rod and at least one second connecting rod may be also present, cooperating with each other and moved in counter-rotation with respect to each other and each one with eccentric stroke in the connecting rod big end.

[0024] The connecting rods may have the connecting rod small end rotatably anchored to the support structure of the needling bar for alternately moving it along directions incident the web. In this way a penetration movement into the product to be sewn and back, by means of which the needling is obtained.

[0025] According to an aspect of the invention, the needling device may comprise at least one first and at least one second conditioning group of the movement of the respective connecting rods interposed between them to mechanically connect them.

[0026] In particular, the first conditioning group may be associated to the first connecting rod and, similarly, the second conditioning group may be associated to the second connecting rod. Moreover, the first conditioning group may have at least one first portion operatively connected to a corresponding second portion of the second conditioning group so as to allow exclusively reciprocally counter-rotating movements of the connecting rod small ends on the support structure.

[0027] In other words, the connecting rod small ends of the two counter-rotating connecting rods may be operatively associated to each other by means of at least two elements connected to each other so as to allow reciprocal movements. These movements are necessary to allow the counter-rotating movements of the connecting rods. However, the same two elements have to prevent non counter-rotating reciprocal movements between the connecting rods.

[0028] In fact, a force applied to the needles along the advancing direction of the product to be sewn tends to cause a translation of the needling bar towards the same direction. This leads to an attempt to make the connecting rod small ends rotate in the same direction on the respective connections to the support structure of the needles. Connecting the two connecting rod small ends with the conditioning groups of the movement thereof which prevent movement which are not counter-rotating, this phenomenon is avoided without involving the movement part of the connecting rods in counter-rotation.

[0029] Advantageously, therefore, there is no risk that the gears which move the connecting rods are subject to stress which in time damage the setting and precision thereof so compromising not only the quality of the processing, but also the mechanical seal of the needling device.

[0030] Advantageously again, the so obtained needling device is easy to manufacture and to assembly consisting of a lower components number and being the needles movement group connected with the fix structure of the needling device only in one point.

[0031] The moving masses are limited, so that the motors necessary to move them can have smaller dimensions than those used in the prior art equivalent devices. The mechanical stress on the single component parts are also smaller than those present in the prior art devices so allowing the use of less resistant and cheaper materials.

Brief description of the drawings

[0032] Further features and advantages of the invention will appear more evident upon reading the detailed description of some preferred, non-exclusive embodi-

ments of a needling device according to the invention, which are described as non-limiting examples with the help of the annexed drawings, in which:

FIG. 1 represents a needling of non-woven fabric webs according to the invention on axonometric view;
FIG. 2 represents a schematization of the device of FIG. 1;
FIG. 3 represents a detail of the device of FIG. 1;
FIGS. 4a to 4d represent an operating sequence of the device of FIG. 1;
FIG. 5 represents an embodiment of a needling device of non-woven fabric webs according to the invention;
FIG. 6 represents an operating instant of the device of FIG. 1;
FIGS. 7a to 7d represent a further operating sequence of the device of FIG. 1.

Detailed description of some preferred embodiments of the invention

[0033] Referring to the above figures, and particularly to FIGS. 1 and 2, a needling device **1** of products **V** to be sewn is described.

[0034] As observable in the figures, the product is composed by a plurality of overlapped layers of loose fibre material. It is evident that this must not be considered as limiting for other uses. For example, the device **1** according to the invention may be used for consolidating even one single layer of loose fibres, whether textile or of different type. The type of the fibres, in particular, as well as the number and size of the layers in which the fibre material to be sewn is disposed, is not a limit for the application of the device **1** according to the invention. A typical employ example is the consolidation of layered carded webs in the production of panels of non-woven fabric.

[0035] As observable in the figures, the above device **1** comprises a needling bar **2** movable towards the product **V** to be sewn and provided with a support structure 3 to which a plurality of shaped needles **4** are associated. These last ones face the product **V**.

[0036] The movement of the needling bar **2** is obtained, as per se known, by means of the cooperation of a first connecting rod **5** with a second connecting rod **6** moved in counter-rotation with respect to each other with eccentric stroke in the connecting rod big end **7**.

[0037] In this sense, the needling device **1** according to the invention comprises motorization means **8**, typically consisting of a motor **9**, operatively connected to the connecting rods **7**. This connection is typically, but not necessarily, fulfilled by means of a reduction box **10** associated to the shaft **9** and from which two crankshafts for the motion transmission **11** to the connecting rods **5** and **6** branch off.

[0038] It is evident that the described and represented embodiment is only an example and must not be considered as limiting. In fact, the generation as well as the transmission of the movement to the connecting rods, as well as the number of connecting rods which are present and the number of needling bars, may be different from what represented.

[0039] According to one aspect of the invention, the small end **15** of each of the connecting rods **5** and **6** is rotatably anchored to the support structure 3 of the needling bar **2**. In particular, the small ends **15** of the connecting rods **5** and **6** are pivoted to the support structure **3** by means of fitting pivots **16**.

[0040] The eccentric movement of the connecting rods **5** and **6** thus allows to obtain a translating movement of the needling bar **2** towards the product **V**. Moreover, the counter-rotation of the connecting rods **5** and **6** allows to balance the negative effects of each one caused by the eccentric movement in the connecting rod big end **7** so as to obtain a regular and, in case of a specular eccentricity, perfectly rectilinear movement of the connecting rods. The needles **4** are therefore subject to an alternate penetration movement into the product **V** and back.

[0041] According to another aspect of the invention, the needling device **1** according to the invention comprises at least one first **20** and one second conditioning group **21** of the movement of the respective first **5** and second connecting rod **6**.

[0042] As observable the conditioning groups **20** and **21** are operatively interposed between the connecting rods **5** and **6** and mechanically connect them. In particular, the first conditioning group **20** is associated to the first connecting rod **5**, whereas the second conditioning group **21** is associated to the second connecting rod **6**.

[0043] The two conditioning groups **20** and **21**, moreover, have, respectively, a first portion **23** and a corresponding second portion **24** operatively connected so as to allow exclusively reciprocally counter-rotating movements of the small ends **15** of the connecting rods **5**, **6** on the support structure **3**.

[0044] As mentioned before, in this way the forces which might be exerted on the needling bar **2** in the advancing direction of the product **V** to be processed are discharged on the connection between the two portions **23** and **24** of the two conditioning groups **20** and **21** rather than on the gears for the moving of the connecting rods **5** and **6**. In this way these last ones are preserved in time.

[0045] Evidently the needling device **1** is simple to be manufactured. As observable, moreover, not only the motorization means **8** are minimized with respect to the prior art, but also the increase of the masses to be moved is minimum. Also the materials used for the manufacturing of the device **1** may be poorer, or, however, the thicknesses of the parts in movement, starting from the gears, may be reduced.

[0046] The mounting of the device **1** according to the invention is simplified. It is in fact pointed out that whereas in the prior art equivalent devices the stabilization of the needling bar in the direction of the advancement of the

product to be sewn takes place by means of means associated to the fix structure of the device, in the device **1** according to the invention the stabilization takes place by means of the conditioning groups **20**, **21** acting between the connecting rods **5** and **6** which have no connection with the fix structure. This not only allows to have smaller moving masses than the prior art, but also to avoid adjustments of the device **1** upon mounting. All movable parts of the needling device **1** according to the invention, in fact, are associated to the fix structure in a single point and not in more points as in the prior art equivalent devices, so that upon assembling it is not necessary to proceed with adjustments and long and expansive regulations.

[0047] According to another aspect of the invention, the first 20 and the second conditioning group **21** respectively comprise a first shaped body **25** and a second shaped body **26** each one having a first end **27** and **28** unitary with the respective connecting rod small end **15**. In particular, as observable in the figure, the conditioning groups **20** and **21** are manufactured in a single body with the respective connecting rods **5** and **6**, but this is only an embodiment and must not be considered as limiting for different embodiments of the invention where the conditioning groups are anchored to the respective connecting rods and not manufactured in a single body. Moreover, they may be of different manufacture from each other or made by means of leverages.

[0048] In the described embodiment, between the first portion **23** of the first conditioning group **20** and the second portion **24** of the second conditioning group **21** a gear **30** susceptible to allow only the above mentioned counter-rotating movements is interposed.

[0049] In particular, the gear **30** includes a first rack **31** connected to the first portion **23** and engaging with a second rack **32** associated to the second portion **24**. As observable, furthermore, the two racks **31** and **32** are arc shaped, and the bending centre of the arcs defined thereby substantially corresponds to the connection **16** to the support structure **3** of the respective connecting rod small end **15**. With this embodiment, the racks **31** and **32** perform, during the movement of the respective connecting rods **5** and **6**, a movement along respective circumference arcs tangent with each other. In other words, the racks **31** and **32** allow a reciprocal rolling movement between the first **23** and the second portion **24** of the conditioning groups **20** and **21**.

[0050] It is evident that also this case is only a non limiting embodiment. The same rolling movement, in fact, can be obtained with curved racks having a variable bending radius such as in the case of ellipse arc.

[0051] Appropriately, in order to promote the above rolling movement, each tooth of each of the racks **31** and **32** has substantially curved side surfaces.

[0052] As observable however consonant rotating movements of the conditioning groups **20** and **21** are not mechanically allowed. The forces which tend to generate these movements become in fact equal and opposed forces which develop between the side walls of the teeth of the first rack **31** in contact with the side walls of the second rack 32 nullifying each other.

[0053] In the figures sequence 4a to 4d it is possible to appraise the movement of the needling bar **2** in the device **1** according to the invention observing the above reciprocal rolling.

[0054] As said before, the embodiment described as far as here is only a non limiting embodiment of a needling device **1** according to the invention. In fig. 5, for instance, it is possible to observe an embodiment thereof where the conditioning groups 120 and **121** are of different manufacture from each other. In particular, the first conditioning group **131** is similar to what described for the preceding embodiment, having a first shaped body **125** similar to the preceding one, but elongated. The second conditioning group **121**, instead, consists of a cog-wheel **126** unitary with the respective connecting rod **106**. The gear **130**, consequently, is made by a first rack **131** present on the first shaped body **125** and by the teeth of the cog-wheel **126**. The working of this embodiment is similar to the preceding one.

[0055] Further embodiments of the invention are admitted although not described. For instance, a possible embodiment provides the substitution of the described gears with a lever system. More in detail, the conditioning groups of the movement of the connecting rods may be more than two and each one may consist of one or more levers operatively interposed between the connecting rods and which cooperate with each other to allow only counter-rotating movements of the connecting rod small ends with respect to the support structure.

[0056] It is evident that to increase the production speed of products V to be sewn they have to be moved with the maximum possible speed. At the same time, also the stroke speed of the needling bar **2** has to be increased. However, as previously noticed, the needles **4** are subject to transversal stress caused by the moving product **V**. Although in the device **1** according to the invention the conditioning groups **20** and **21** allow to prevent this from causing mechanical damages, there is the risk to damage the product **V**. For this reason a solution is known according to which the needles **4** perform a controlled movement also in the advancing direction of the product **V** to be processed. In other words the movement of the needles **4** forms an ellipse.

[0057] In this sense, the known devices have leverages or additional connecting rods the movement of which is appropriately synchronized with the movement of the main connecting rods. The high executive complexity is therefore evident.

[0058] In the case of the device **1** according to the invention it is instead sufficient, as observable in fig. 6, to insert a phase-shift in the positioning of the first cam **40** of the first connecting rod **5** with respect to the corresponding second cam **41** of the second connecting rod **6**. In this sense it is therefore sufficient to insert a phase-shift group **50**, observable in fig. 1, between the motori-

zation means **8** and at least one of the connecting rod big ends **7**. Obviously, according to not described or represented embodiments, the phase-shift groups may be more than one, or one for each connecting rod or they may be part of the gearbox **10**.

[0059] Appropriately, although not represented, the device **1** according to the invention comprises an elaboration and control unit which in turn includes control means of the phase-shift entity.

[0060] In the sequence of figures 7a to 7d it is possible to appreciate the elliptic movement of the needling bar **2** in the device **1** according to the invention.

[0061] The above disclosure clearly shows that the needling device according to the invention overcomes the drawbacks of the prior art having less executive and mounting difficulty than the prior art devices.

[0062] In particular, technicians haven't to carry out changes or long and difficult adjustments to the fix structure upon assembling it.

[0063] On closer inspection, in spite of these simplifications, the needling device according to the invention however ensures a correct movement to the needles bar also in presence of load applied thereto which submit it to stress along the advancing direction of the product to be sewn. In other words, the needling device according to the invention ensure in time the movement stability of the needling bar so that the obtained product is of excellent quality.

[0064] Also the production speed is preserved and may be even higher than the speed of the known devices, because of the mechanical easiness and of the reduced masses with respect to the prior art equivalent devices.

[0065] The needling device according to the invention is susceptible to many changes and variants, all falling within the inventive concept expressed in the annexed claims. All particulars may be replaced by other technically equivalent elements, and the materials may be different according to the needs, without departing from the field of the invention.

[0066] While the needling device has been described with particular reference to the accompanying figures, the numerals referred to in the disclosure and claims are only used for the sake of a better intelligibility of the invention and shall not be intended to limit the claimed scope in any manner.

Claims

1. A needling device for sewing products (**V**) comprising:

- at least one needling bar (**2**) movable towards the product (V) and provided with a support structure (**3**) to which a plurality of shaped needles (**4**) facing the product (**V**) to be sewn;
- at least one first connecting rod (**5**; **105**) and at least one second connecting rod (**6**; **106**) moved in counter-rotation with respect to each other and each one with eccentric stroke in the connecting rod big end (7), the small end (15) of each of said first (5; 105) and second connecting rod (**6**; **106**) rotatably anchored to said support structure (3) of said needling bar (**2**) to alternately move said needling bar (2) along directions incident the product (**V**) and to induce in said needles (**4**) a movement of penetration into the product (**V**) and back,

characterized in comprising at least one first (20; **120**) and at least one second conditioning group (21; **121**) of the movement of said first (**5**; **105**) and second connecting rod (**6**; **106)** operatively interposed between said first (**5**; **105**) and second connecting rod (**6**; **106**) for mechanically connecting them, said first conditioning group (**20**; **120**) being associated to said first connecting rod (**5**; **105**) and said second conditioning group (**21**; **121**) being associated to said second connecting rod (**6**; **106**), said first conditioning group (**20**; **120**) having at least one first portion (**23**) operatively connected to a corresponding second portion (**24**) of said second conditioning group (**21**; **121**) so as to allow exclusively reciprocally counter-rotating movements of said small ends (**15**) of said connecting rods (**5**, **6**; **105**, **106**) on said support structure (3).

2. Needling device according to claim 1, **characterized in that** at least said first conditioning group (**20**; **120**) comprises at least one first shaped body (**25**; **125**) having a first end (**27**) unitary with said small end (**15**) of said first connecting rod (**5**; **105**).

3. Needling device according to claim 2, **characterized in that** also said second conditioning group (**21**; **121**) comprises at least one second shaped body (**26**; **126**) having a first end (**27**) unitary with said small end (**15**) of said second connecting rod (**6**; **106**).

4. Needling device according to any of the preceding claims, **characterized in that** between said first portion (**23**) and said second portion (**24**) at least one gear (**30**; **130**) is interposed, which is susceptible to allow only counter-rotating movements between said first portion (**23**) and said second portion (**24**).

5. Needling device according to claim 4, **characterized in that** said gear (**30**) comprises a first rack (**31**) connected to said first portion (**23**) and engaging with a second rack (**32**) associated to said second portion (**24**).

6. Needling device according to claim 5, **characterized in that** each of said first (**31**) and second rack (**32**) has an arc shaped longitudinal development, the bending centre of which substantially coincides with

the connection (**16**) to said support structure (**3**) of the respective said connecting rod small end (**15**) so that said first (**23**) and second portion (**24**) may perform a rolling movement on each other.

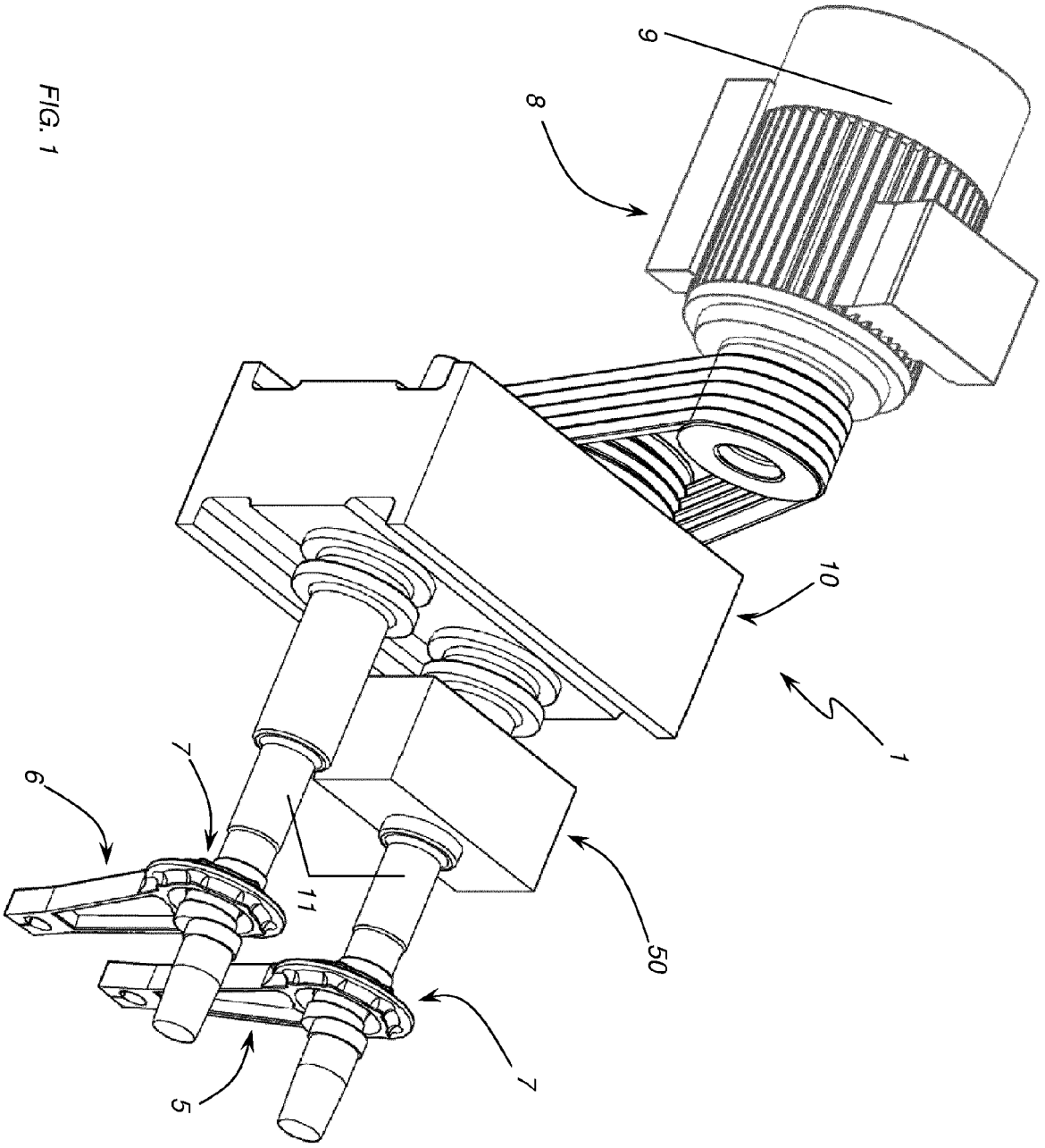
7. Needling device according to claim 6, **characterized in that** each tooth of each of said racks (**31**, **32**) has substantially curvilinear side surfaces for convoying said rolling movement.

8. Needling device according to any of the preceding claims, **characterized in** comprising motorization means (**8**) operatively connected to said big ends (7) of said first (**5**; **105**) and second connecting rod (**6**; **106**) for the counter-rotating movement thereof.

9. Needling device according to claim 9, **characterized in** comprising at least one phase-shift group (**50**) interposed between said motorization means (**8**) and at least one of said connecting rod big ends (**7**) to introduce a phase-shift of the rotation of one of said connecting rods (**5**, **6**; **105**, **106**) with respect to the other of said connecting rods (**5**, **6**; **105**, **106**).

10. Needling device according to claim 9, **characterized in** comprising control means of the entity of said phase-shift operatively connected to said phase-shift group (**50**).

FIG. 1



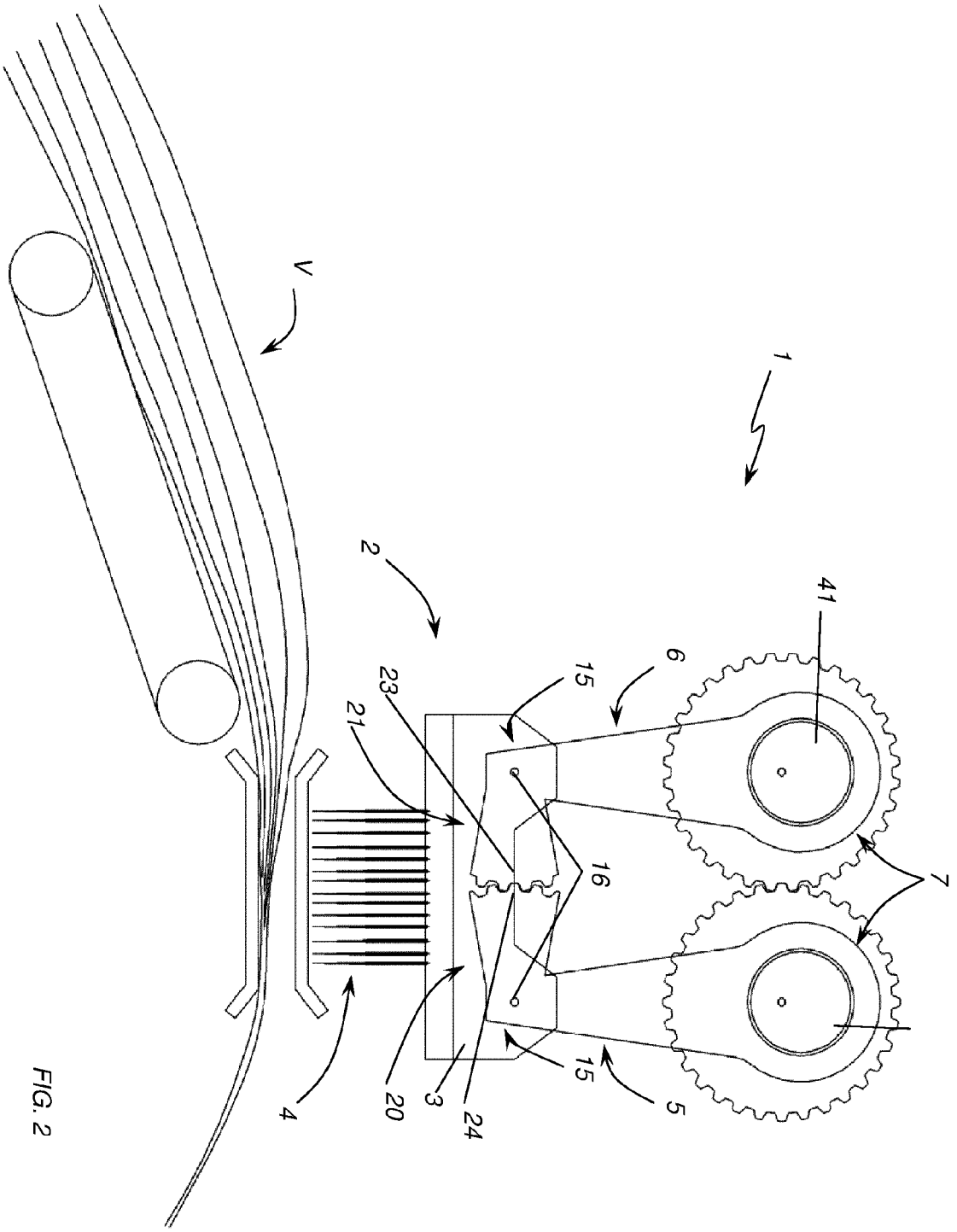


FIG. 2

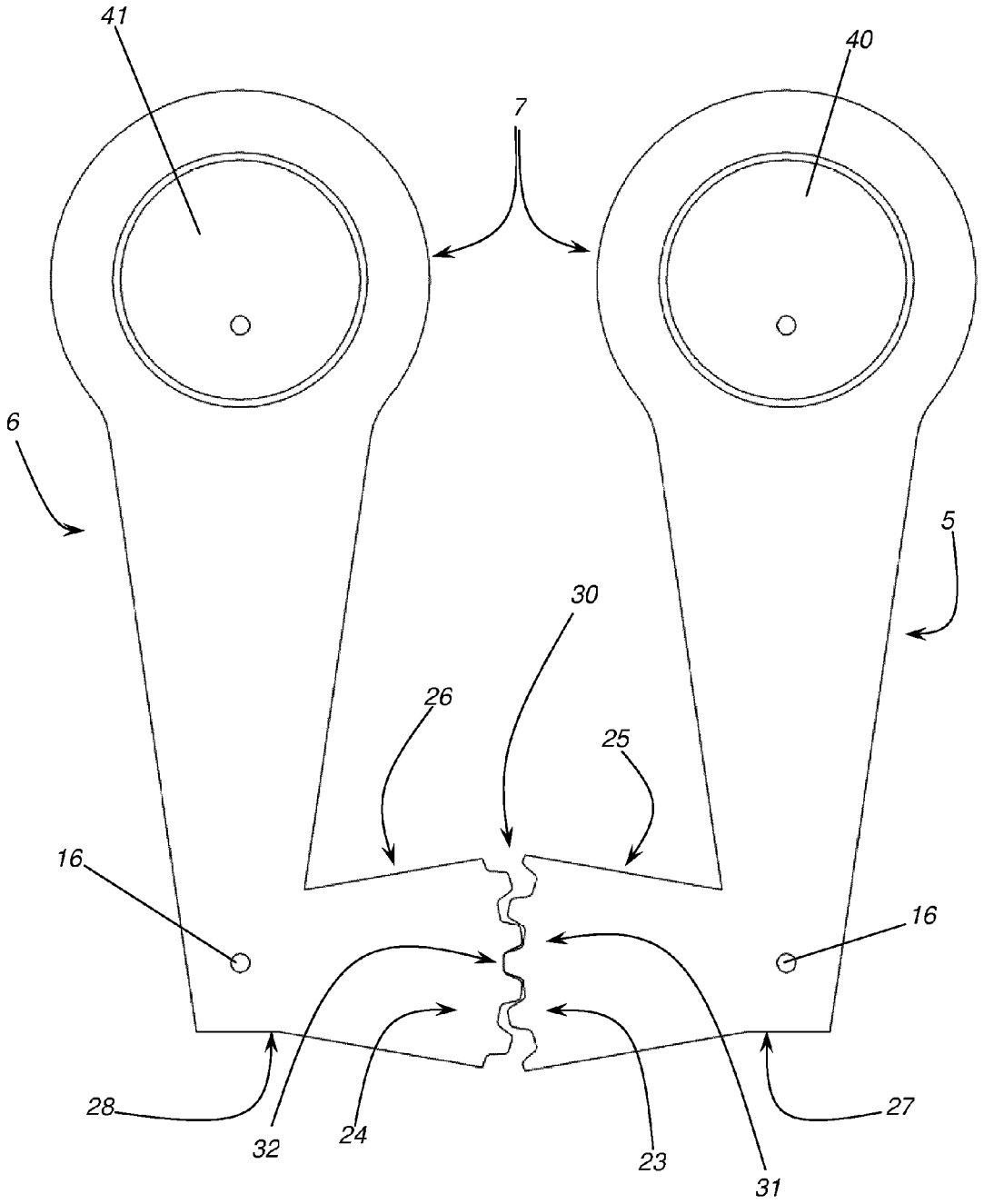


FIG. 3

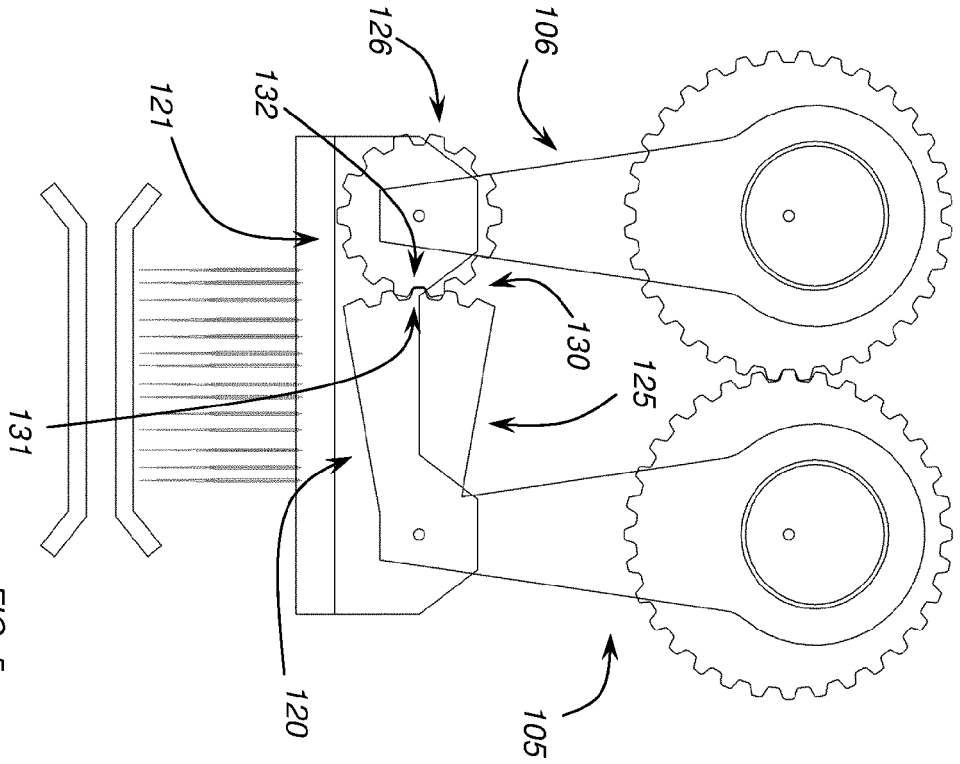


FIG. 5

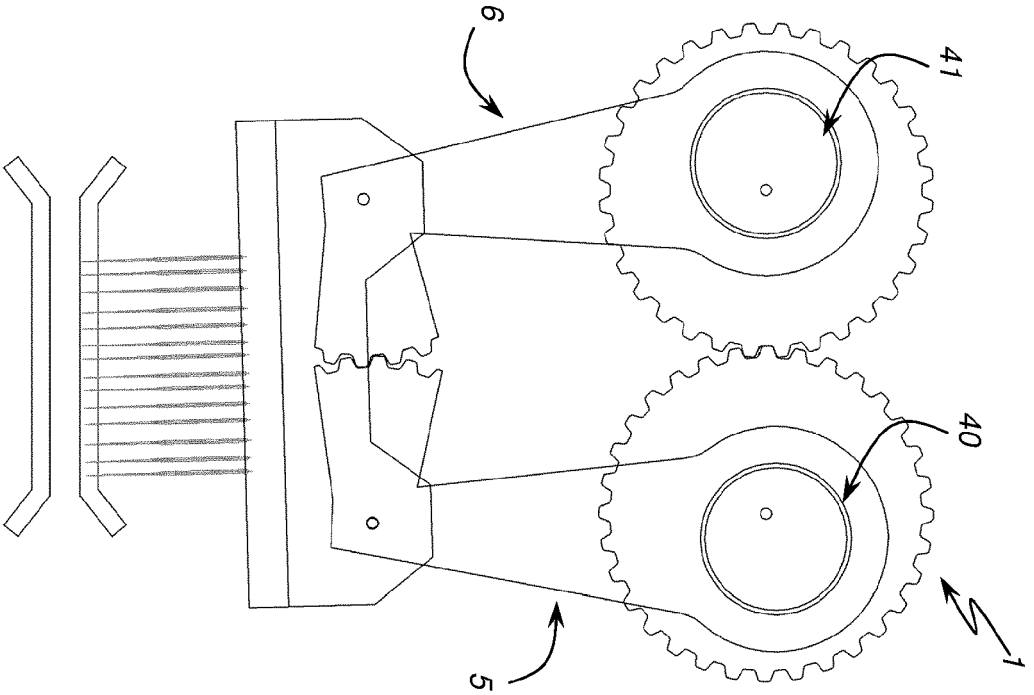


FIG. 6

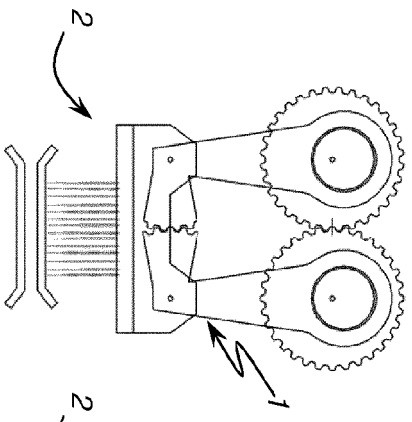


FIG. 4a

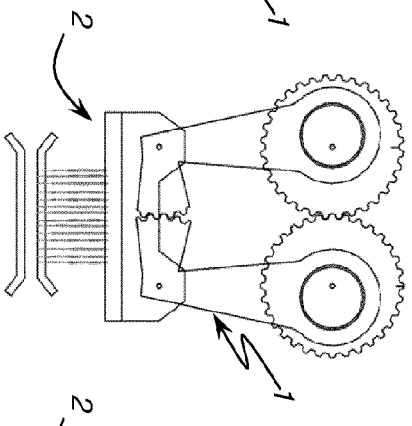


FIG. 4b

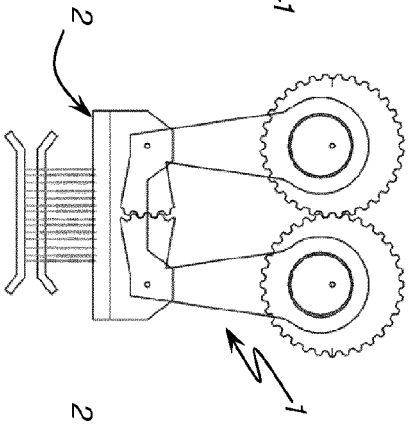


FIG. 4c

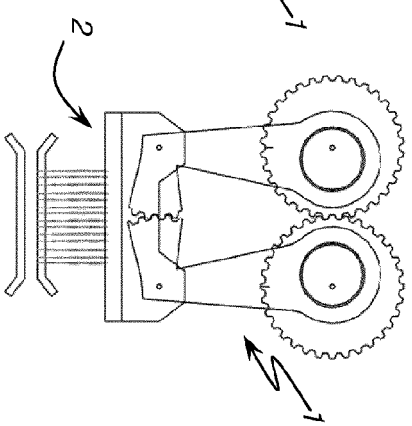


FIG. 4d

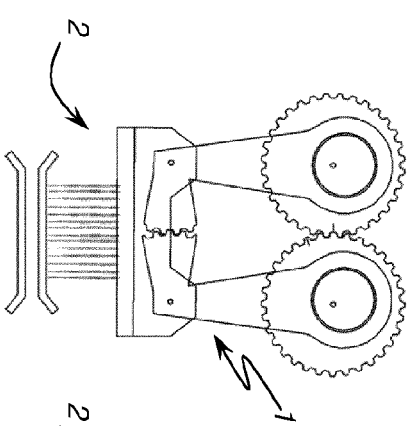


FIG. 7a

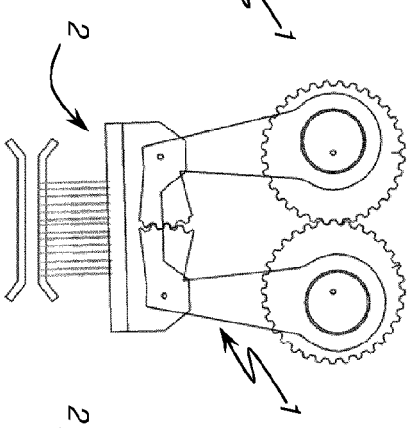


FIG. 7b

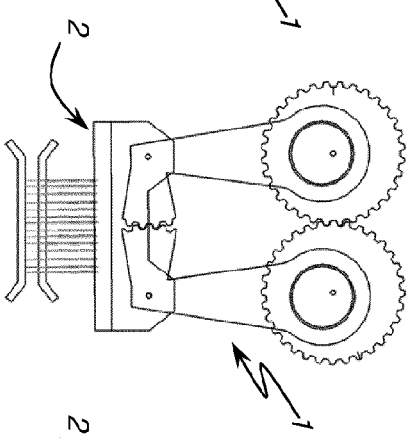


FIG. 7c

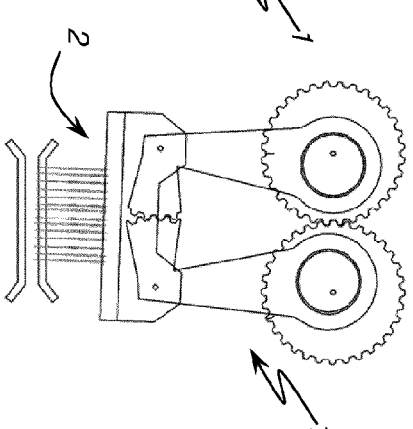


FIG. 7d

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EUROPEAN SEARCH REPORT

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Place of search	Date of completion of the search	Examiner
Munich	12 January 2012	Elsässer, Ralf

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