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(54) **Cutting device**

(57) The invention relates to a cutting device for cutting a segment of honeycomb material from a substantially endless band of honeycomb material, comprising a transport device for transporting the band honeycomb material in a transport direction, a blade mounted downstream of the transport device on a frame below a transport plane of the band of honeycomb material, and positioned for cutting the segment from the band honeycomb material, and an actuator for driving the cutting blade in an upward direction.

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Description

Background

[0001] The present invention relates to a cutting device for cutting honeycomb material.

[0002] An example of an apparatus for producing an endless band of unexpanded honeycomb material is disclosed in US-6.858.109, US-3.257.253, and US-4.133.712, for instance. Usually, the unexpanded honeycomb material is expanded before its use. This can be done in a production step directly after its production. More often, however, the honeycomb material is transported in its unexpanded state and expanded before its use. This can take place remote from the production site.

[0003] After it is expanded, the almost endless band of expanded honeycomb material will often be cut into sheets or segments of honeycomb material for further use. The cutting process is often discontinuous, which disrupts the further processing steps in which the sheets will be used often as a filling material. The cutting process can also cause abutment of material against a cutting blade, or, in case of the use of a cutting device with a guillotine-type of blade, it can result in that the honeycomb material is cut at an angle in case of a cut in transverse direction of a band of honeycomb material.

[0004] Thus, current cutting devices leave room for improvement.

Summary of the Invention

[0005] An object of the invention is to improve current cutting devices for honeycomb material.

[0006] According to a first aspect of the invention this is realized with a cutting device for cutting a segment of honeycomb material from a substantially endless band of honeycomb material, comprising a transport device for transporting the band honeycomb material in a transport direction, a blade mounted downstream of the transport device on a frame below a transport plane of the band of honeycomb material, and positioned for cutting the segment from the band honeycomb material, and an actuator for driving the cutting blade in an upward direction.

[0007] It was found that this device provides the possibility of cutting the honeycomb material very fast, thus allowing increased running speed of the material. Furthermore, it allows very broad bands of honeycomb material, with a width of up to 200 cm, even up to 250 cm.

[0008] The invention furthermore provides a method for cutting a segment of honeycomb material from a substantially endless band of honeycomb material, comprising the steps of feeding the band of honeycomb material in a transport direction to a cutting device having a blade, driving said blade to reciprocate substantially perpendicular to the transport direction in a plane normal to the transport direction, and controlling the speed of feeding of the honeycomb material depending on the position of the blade.

[0009] When coupling the reciprocating speed of the blade and the transport speed of the honeycomb material, it is possible to use the compressibility of the honeycomb material in the transport direction to an advantage. In an embodiment, said blade is positioned for cutting the band of honeycomb material in substantially transverse direction, and wherein said actuator drives said blade up and down, to reciprocate.

[0010] The fast cutting speed further allows the blade to be mounted statically with respect to the running direction of the band of honeycomb material. It is know to have blades moving along with the honeycomb material during cutting and moving back to their starting position after cutting, in order to increase the running speed of the material, of to limit the disruption of the band as much as possible. This, however, requires complex cutting devices and control systems and actuators. These cutting devices are usually actuated using hydraulic cylinders. The current invention provides faster cutting with a very narrow space (in the running direction) of the cutting device. In fact, it can be build to require only about 50 cm. In a very compact building concept, it may require as little as 20 cm.

[0011] In an embodiment, the transport device comprises rollers and a driving device for driving the rollers.

[0012] In an embodiment, the cutting device further comprises a control device, operationally coupled to the actuator and the driving device for mutually tuning the transport speed of the transport device and the reciprocating movement of the blade.

[0013] In an embodiment, the control device is operationally coupled for slowing down the speed of the transport device when the blade cuts through the honeycomb material.

[0014] In an embodiment, the actuator comprises a linear motor.

[0015] In an embodiment, the linear motor is mounted with its direction of motion substantially perpendicular to the plane of the honeycomb material.

[0016] In an embodiment, the frame mounts said blade at its ends and along the edge away from the cutting edge.

[0017] In an embodiment, the cutting device further comprises a transport device mounted downstream of the first transport device and the blade.

[0018] In an embodiment, the blade is mounted for cutting in longitudinal direction of the cells. The cutting edge is mounted in an embodiment upward when the blade is positioned below the band of honeycomb material when the cutting device is in operation.

[0019] The band of expanded honeycomb material is highly flexible and compressible in its longitudinal direction. In the invention in which the transport device is operationally coupled to the movements of the blade, this property is used.

[0020] The invention further relates to a cutting device for cutting a segment of honeycomb material from a substantially endless band of honeycomb material, compris-

ing a blade mounted on a frame and positioned for cutting the segment from the band of honeycomb material, a linear motor operationally coupled to the blade for driving the cutting blade up and down, transverse with respect to the band of honeycomb material, and dampers for biasing motion of the cutting blade between two end positions.

[0021] In an embodiment, in this cutting device the blade is a thin cutting blade.

[0022] The cutting device of the invention allows very accurate cutting. This is in particular of interest for automated production systems in which the cut parts of honeycomb material are automatically handled in a production process.

[0023] It may be devisable to design the cutting device of the invention using the linear electric motor with the blade positioned above a band of honeycomb material. In such an embodiment, the alternative device may be defined as a cutting device for cutting a segment of honeycomb material from a substantially endless band of honeycomb material, comprising a transport device for transporting the band honeycomb material in a transport direction, a blade mounted downstream of the transport device on a frame above a transport plane of the band of honeycomb material, and positioned for cutting the segment from the band honeycomb material, and an actuator for driving the cutting blade, wherein said actuator comprises a lineair electrical motor.

[0024] In that way, it is possible to cut the band very fast and without disrupting its transport. In this device too, the cutting device further comprises a control device, operationally coupled to the actuator and the driving device for mutually tuning the transport speed of the transport device and the reciprocating movement of the blade. Positioning of the blade above the band of honeycomb material will, however, require a heavy frame above the band of material and requires more space in running direction of the material. The alternative cutting device may be the subject of a divisional application.

[0025] The invention further pertains to an apparatus comprising one or more of the characterising features described in the description and/or shown in the attached drawings.

[0026] The invention further pertains to a method comprising one or more of the characterising features described in the description and/or shown in the attached drawings.

[0027] The fast and accuate cutting device of any aspect of the invention can easily be inserted in automated production lines which insert parts which are cut from the band of honeycomb material into other, further products. Furthermore, vibrations are easily avoided as much as possible.

[0028] The various aspects discussed in this patent can be combined in order to provide additional advantages.

Description of the Drawings

[0029] The invention will be further elucidated referring to an embodiment of a cutting device shown in the attached drawings, showing in:

Figure 1 an assembly for expanding and cutting to size honeycomb material;
Figure 1A the expanding of honeycomb material, seen from above;
figure 2 a front view of a cutting device for the assembly of figure 1;
figure 3 again the cutting device with a part of the knife holding elements removed, and
figure 4 a cross section of the cutting device of figure 2.

Detailed Description of Embodiments

[0030] Figure 1 shows an assembly for expanding and cutting honeycomb material 1. The assembly has an expanding stage 2 which as such is well knows in the art. After expanding the honeycomb material, it is wetted and guided through drying ovens 3 in order to consolidate the expanded form of the honeycomb material. After the drying ovens 3, the expanded and dried endless honeycomb material is guided past a cutting device 4 which cuts in general in longitudinal direction of the expanded honeycomb material. After this longitudinal cutter the expanded honeycomb material is transported to a cutting device 5 for cutting off a segment of honeycomb material from the substantially endless brand of honeycomb material.

[0031] Figure 1A shows a top view of the expansion of honeycomb material according to this embodiment. The unexpanded material is produced from endless paper material, usually unwound from a roll of paper (kraft paper, for instance) of about 2-5 meters wide. On the surface of this paper material, longitudinal stripes of glue are applied, and several of these layer are stacked. From this (endless) band of stacked and via stripes of glue adhered paper material strips are cut, with the cut in transverse direction. The width of the strips is the height of the honeycomb material. These strips are also glued together to form an endless band of unexpanded honeycomb material. The cutting device 5 is constructed to cut the honeycomb material (substantially) perpendicular to the plane of the paper, i.e. perpendicular to the plane of the cell of the honeycomb material.

[0032] Figure 2 is a detailed front view of the cutting device 5 of figure 1. The cutting device 5 has a frame 6 onto which a blade or knife and actuator are mounted, and the device provides a transport surface onto which the endless band of honeycomb material rests while it passes the cutting device. The transport direction is out of the paper. In this view towards the reader.

[0033] The cutting device itself has a vertical frame part 7 onto which the knife and driving means of the knife are mounted. The cutting device 5 has a blade 11 which

is mounted onto mounting support members 8 and 10 and a central mounting element 9 onto which also the mounting elements 8 and 10 are mounted. The cutting device further has a driving motor 12 which in thin embodiment is a linear electric drive. In an embodiment, the Tecnotion TB 30 N linear motor is used. It uses two TB288 and one TB192 magnet plates. Furthermore, a position determining device is used. This may be an encoder In the above embodiment, an analog Hall sensor, also obtainable via Technotion, was used. The linear electric drive has one part fixedly mounted on the vertical frame 7 and a driven part which is mounted to support elements 8 and 9 for driving the blade and support elements 8, 10 and 9 up and down in the vertical direction, in a reciprocating way.

[0034] The cutting device further has stops 13, 13', 14 and 14' which provide a stop for the blade and supporting elements.

[0035] Figure 3 shows the view of figure 2 with some parts of the cutting device 5 removed in order to have a better view of its interior.

[0036] Both ends of the support member 8 and 10 have rail elements 19 which are slidingly mounted on rails 18. Furthermore, in this view clearly the driven part 17 of the driving linear motor 12 is visible. In mounted condition, this driven part 17 is fixedly mounted to the central support part 9 which supports the blade 11. In this view, stops 13, 13', 14, 14' are clearly visible. The vertical position of the stops can be adjusted easily. Furthermore, in this view, the rail 15 is visible and guides 16 which run on the rails 15. In mounted condition, the guides 16 are fixedly amounted to the central support part 9 (fig. 2) which supports the blade 11.

[0037] In figure 4, a cross section of figure 2 is shown. In this cross section, the an upper bar 20 can been seen which, when the blade 11 moves upwards, holds the endless band of the honeycomb material from moving upwards. The transport direction of the honeycomb material is indicated with an arrow A and the cutting direction of blade 11 is indicated with an arrow B.

[0038] In operation, unexpanded honeycomb material in an endless band enters the expanding assembly of figure 1 at the position of the arrow, in the direction of the arrow. Next, in the unfolding line 2, the honeycomb material is expanded in a way which is known to the man skilled in the art. Also, if necessary, a small amount of moisture is sprayed on the expanded honeycomb material and the honeycomb material is subsequently transported, via transport rolls 21 which are indicated before and between the drying ovens 3, through the drying ovens 3. In the drying ovens 3, the moisturized and expanded honeycomb material is dried again in order to make the expanded shape permanent. After leaving the drying ovens 3, transported by means of the transport rolls 21, the endless band of honeycomb material now encounters a longitudinal cutting device 4.

[0039] In this shown embodiment, the longitudinal cutting device 4 has two circle saw cutting blade 4 which rotate and are fixedly mounted but can be mounted at different transfers positions. These blades provides cuts in longitudinal direction the honeycomb material in endless smaller bands of honeycomb material.

[0040] Next, the endless band of honeycomb material passes a final transport roll 22 and from this transport roll 22 it encounters the cutting device 5 of the current invention. This cutting device 5 has a blade 11 which reciprocates in with respect to the band of honeycomb material, in vertical direction in order to make a cut in the transfers direction of the band of material. Coupled to the cutting device is a control unit 23 which also controls the speed of the transport rolls 22, dependent on the position of the blade 11.. As the endless band of honeycomb material is relatively flexible in its longitudinal direction, a slowing down of the transport speed of the transport rolls 22 results in a small flexing together of the honeycomb material. The controller is coupled to the movement of the blade. When the blade 11 moves upwards in order to cut the honeycomb material, the controller 23 slows down the transport speed of the transport roll 22, and in this way provides that the endless band of honeycomb material has a speed which is, with respect to the speed of the blade 11, almost zero. In this way, it is possible to provide a clean, transfers cut through the honeycomb material. Furthermore, the honeycomb material is not damaged.

[0041] It will also be clear that the above description and drawings are included to illustrate some embodiments of the invention, and not to limit the scope of protection. Starting from this disclosure, many more embodiments will be evident to a skilled person which are within the scope of protection and the essence of this invention and which are obvious combinations of prior art techniques and the disclosure of this patent.

Claims

1. A cutting device for cutting a segment of honeycomb material from a substantially endless band of honeycomb material, comprising a transport device for transporting the band honeycomb material in a transport direction, a blade mounted downstream of the transport device on a frame below a transport plane of the band of honeycomb material, and positioned for cutting the segment from the band honeycomb material, and an actuator for driving the cutting blade in an upward direction.

2. The cutting device of claim 1, wherein said blade is positioned for cutting the band of honeycomb material in substantially transverse direction, and wherein said actuator drives said blade up and down, to reciprocate.

3. The cutting device of claim 1 or 2, wherein said transport device comprises rollers and a driving device

for driving the rollers.

4. The cutting device according to any one of the preceding claims, wherein said cutting device further comprises a control device, operationally coupled to the actuator and the driving device for mutually tuning the transport speed of the transport device and the reciprocating movement of the blade.

5. The cutting device according to claim 4, wherein said control device is operationally coupled for slowing down the speed of the transport device when the blade cuts through the honeycomb material.

6. The cutting device according to any one of the preceding claims, wherein said actuator comprises a linear motor.

7. The cutting device according to claim 6, wherein said linear motor is mounted with its direction of motion substantially perpendicular to the plane of the honeycomb material.

8. The cutting device of claim 1, wherein said frame mounts said blade at its ends and along the edge away from the cutting edge.

9. The cutting device of claim 1, further comprising a transport device mounted downstream of the first transport device and the blade.

10. The cutting device according to any one of the preceding claims, wherein said blade is mounted for cutting in longitudinal direction of the cells.

11. A method for cutting a segment of honeycomb material from a substantially endless band of honeycomb material, comprising the steps of:

- feeding the band of honeycomb material in a transport direction to a cutting device having a blade;
- driving said blade to reciprocate substantially perpendicular to the transport direction in a plane normal to the transport direction, and
- controlling the speed of feeding of the honeycomb material depending on the position of the blade.

12. A cutting device for cutting a segment of honeycomb material from a substantially endless band of honeycomb material, comprising:

- a blade mounted on a frame and positioned for cutting the segment from the band of honeycomb material;
- a linear motor operationally coupled to the blade for driving the cutting blade up and down, transverse with respect to the band of honeycomb material, and
- dampers for biasing motion of the cutting blade between two end positions.

13. The cutting device of claim 16, wherein the blade is a thin cutting blade.

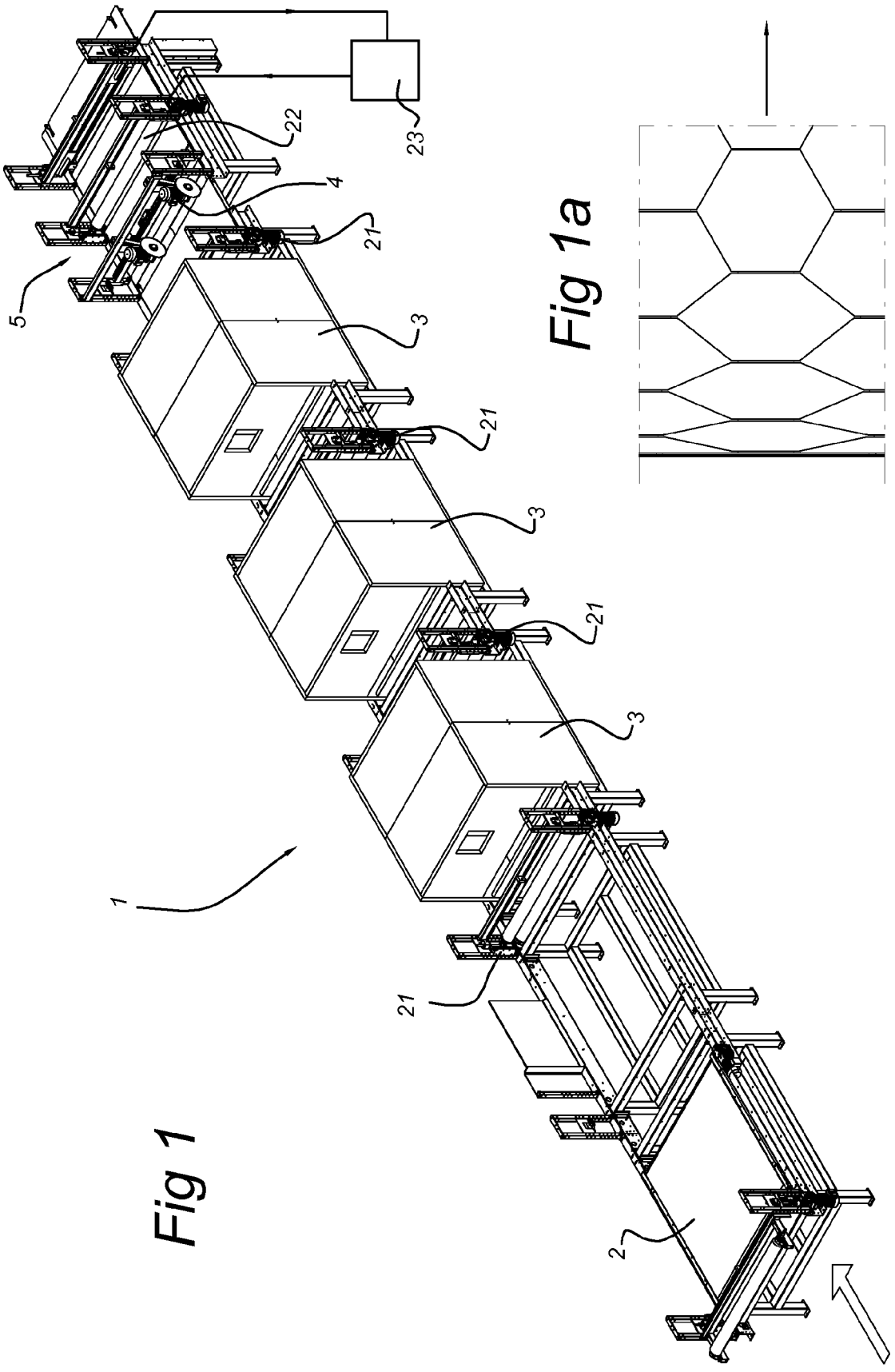


Fig 1

Fig 1a

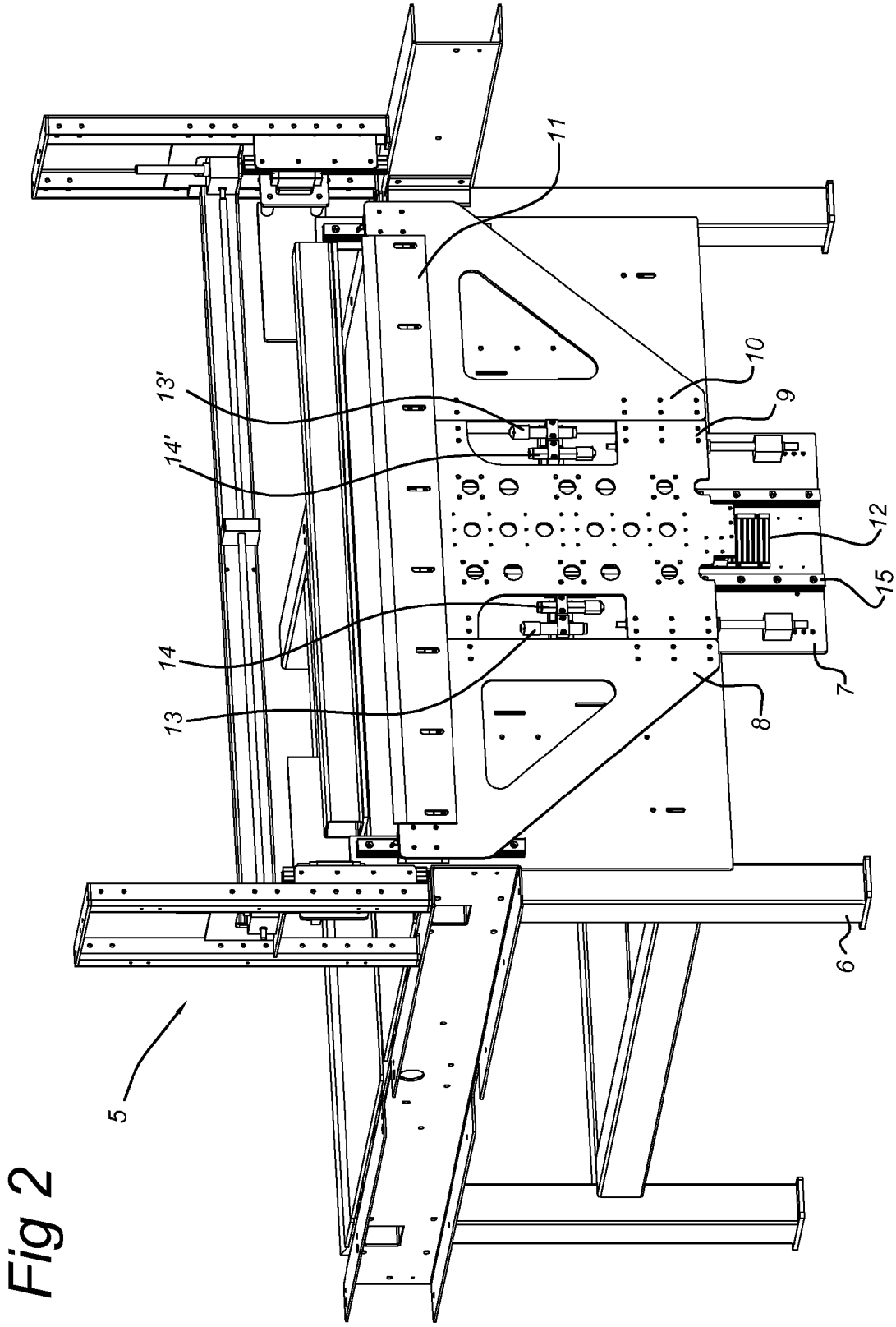


Fig 2

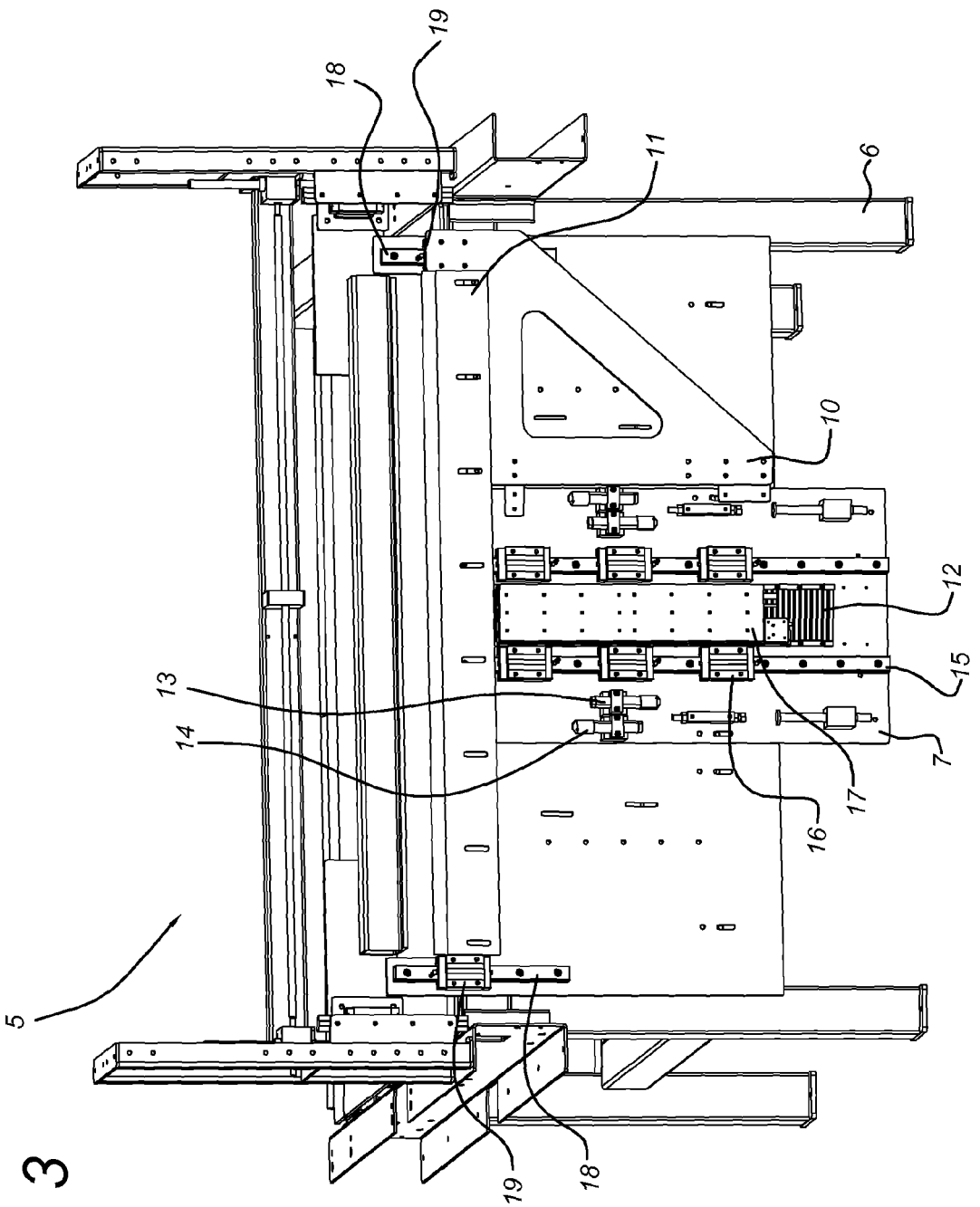
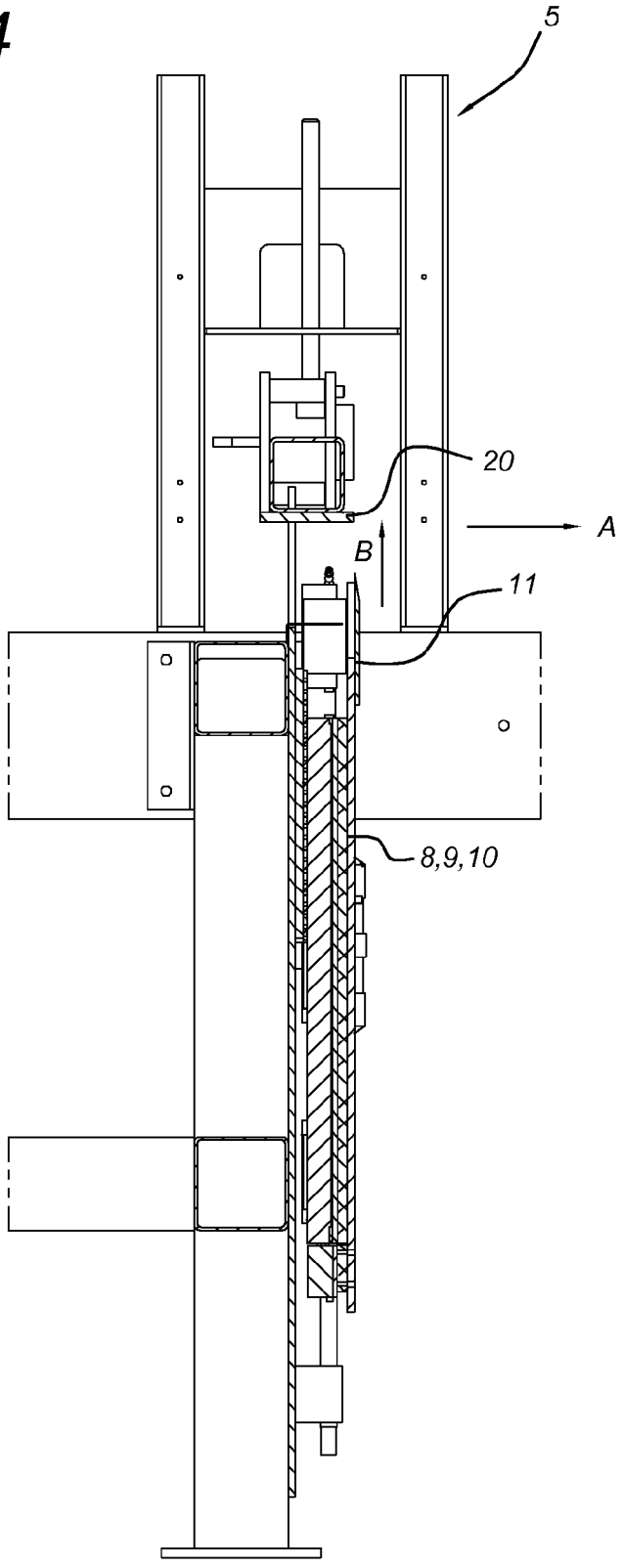


Fig 3

Fig 4



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EUROPEAN SEARCH REPORT

Application Number
EP 08 16 3601

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 March 2009	Canelas, Rui

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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