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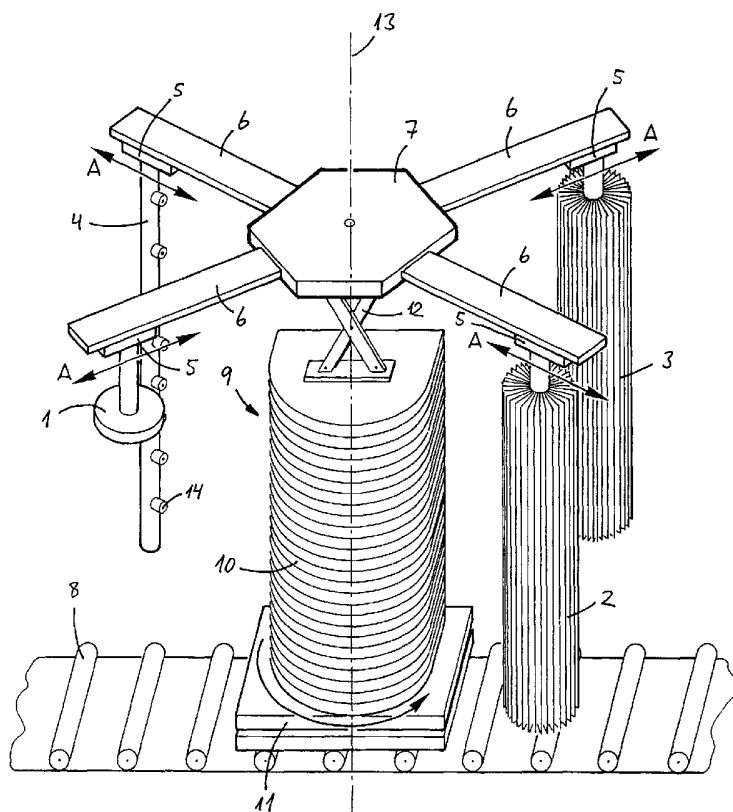
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(54) Title: WORKING DEVICE AND METHOD FOR WORKING A STACK OF PLATE-SHAPED ELEMENTS



(57) Abstract: A working station for working vertical edges of a stack (9) of plate-shaped elements (10). The working station comprises a support (11) for supporting the stack (9) and a number of working devices (1, 2, 3, 4) that are each configured for being able to slide towards and away from the stack (9). The support (11) is configured for being able to rotate the stack (9) about a vertical axis (13), and the working devices (1, 2, 3, 4) are configured for being, in a fixed path, able to slide between an outermost position away from the stack (9) and an innermost position towards or in proximity away from the stack (9) and an innermost position towards or in proximity of the vertical edges of the stack (9), irrespective of the angulation of the stack (9). Furthermore, a method is disclosed for working vertical edges of a stack (9) of plate-shaped elements (10) by means of such working station.



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Working device and method for working a stack of plate-shaped elements.

5 The invention relates to a working station for working vertical edges of a stack of plate-shaped elements, which working station comprises a support for supporting the stack and a number of working devices that are each configured to be brought towards and away from the stack.

10 The invention also relates to a method of working vertical edges of a stack of plate-shaped elements by means of a number of working devices that are successively brought towards the vertical edges of the stack and work them along their entire circumference.

15 Such working station is used eg for grinding or intermediate grinding of edges of tabletops, shelves or other furniture elements that can be stacked for forming a stack, wherein, in this case, the working station comprises a number of grinding cylinders that can be caused to abut on the vertical edges of the stack. EP-A2-1,034,882 teaches one such grinding device, wherein the stack of plate-shaped elements is secured on a roller belt, while the grinding
20 device with two grinding cylinders can be conveyed around the stack with one of the grinding cylinders in contact with the peripheral edges of the stack. The grinding cylinders are mounted in a common holder device that is turnably suspended in a travelling trolley that can be caused to slide in a first direction along a transverse beam that can further be caused to slide in a
25 second direction perpendicular thereto. This construction means that the grinding cylinders can be conveyed around the stack while one of them abuts on the vertical edges of the stack and grinds them. When the grinding with the first grinding cylinder is finished, the holder device of the grinding cylinders is turned 180°, whereby the second cylinder is caused to abut on
30 the periphery of the stack. Then this second grinding cylinder is conveyed around the stack, preferably with an oppositely oriented direction of rotation.

It is a drawback of this grinding device that the entire grinding device with two grinding cylinders is to be conveyed around the stack of plate-shaped elements, which for one thing requires excessive energy and for another requires complex guiding of the grinding device. Besides, the grinding
5 process is time-consuming, since the entire grinding device must be conveyed twice around the stack.

A further working station is also known in the form of a grinding device that is automated. By this grinding device the stack of plate-shaped elements is also
10 secured, while the working devices rotate about the stack. In this device the peripheral geometry of the stack is measured by a measuring wheel that rotates about the stack in order to subsequently revert to its starting point. Then a grinding cylinder with double-coated flexible grinding cloth is conveyed around the stack while it rotates in one direction. Upon return the
15 grinding cylinder rotates in the opposite direction. Finally a blow cleaner is conveyed around the stack to remove grinding dust and it also reverts to its starting point. Thus the stack is caused to run around six times during this grinding process, of which the two involve no kind of working.

20 It is the object of the invention to provide a working station that can be used eg as a grinding device for grinding the vertical edges of a stack of plate-shaped elements without being in possession of the above-described drawbacks of the prior art.

25 This is achieved by configuring the working station described above such that the support is configured for being able to rotate the stack about a vertical axis, and that the working devices are configured for being, in a fixed track, displaceable between an outermost position away from the stack and an innermost position towards or in proximity of the vertical edges of the stack,
30 irrespective of the angulation of the stack. It is also obtained by the method described above being configured such that the stack is rotated about a vertical axis, and that the working devices are displaced in a fixed track for working of the vertical edges of the stack.

Hereby a working station is achieved for working the vertical edges of a stack of plate-shaped elements, said working station having firstly a more simple construction than the prior art grinding device described above, the number of
5 degrees of freedom for the individual working devices being considerably reduced. Furthermore this construction of a working station, where the stack is the rotating element as opposed to the prior art where it is the working devices that are conveyed around a fixed stack, means that the working time can be reduced since return of the working devices no longer takes place.

10

According to the preferred embodiment, each of the working stations is mounted on a sliding carriage that can be caused to slide radially towards and away from the stack. Such mounting of the working devices is particularly simple and gives rise to a comparatively simple monitoring of the
15 management of the working station.

As mentioned, a working station according to the invention is particularly suitable as grinding device for grinding vertical edges of a stack of plate-shaped elements. In this embodiment the working devices comprise at least
20 one grinding cylinder that is configured to be turnable about a vertical axis. The grinding cylinder is preferably provided with a flexible grinding material, which causes the grinding effect of the grinding cylinder to be maintained over time.

25 According to a particularly preferred embodiment, the working station comprises precisely two grinding cylinders that are configured for rotation in opposite directions, whereby uniform working is performed on the edges of plate-shaped elements.

30 The working station according to the invention is preferably provided with measuring means for detecting the peripheral geometry of the stack, since guide means are also provided for automatically moving the working devices towards the and away from the stack in response to the detected geometry

and the rotation of the stack. By configuring the working station in this manner, fully automated control of the working is obtained.

5 The measuring means may comprise a measuring wheel that is mounted on a carriage that can be caused to slide radially towards and away from the stack. The measuring wheel is thus mounted in the same manner as the working devices, thereby simplifying the construction.

10 When the working station is configured with grinding cylinders, means may be provided for removing grinding dust from the vertical edges of the stack. These means may be in the form of a blower device that is mounted on a carriage that can be displaced radially towards and away from the stack, or they may be in the form of a brush that rotates about a vertical axis and is mounted on a carriage that can be caused to slide radially towards and away
15 from the stack.

The working station according to the invention may, as mentioned, be a grinding device, but it may also be configured as a painting or varnishing device, whereby the working devices are configured with a paint or varnish
20 applicator device, and optionally a working device provided with hardening means, such as UV lamps, for the paint or the varnish. These paint or varnish applicator devices and a hardening device, if any, may be arranged in the same working station as the grinding device, but preferably, however, they are separate, as they may be arranged eg within each their dustproof
25 enclosure.

By the preferred embodiment of the method of working vertical edges on a stack of plate-shaped elements, the latter are subjected to grinding in the following steps:

- 30
- a measuring wheel is displaced radially for abutment on the periphery of the stack, the stack is rotated one full revolution while simultaneously its peripheral geometry is registered, the measuring wheel is displaced radially away from the stack;

- a first grinding cylinder that rotates in a first direction about a vertical axis is displaced radially for abutment on the vertical edges of the stack, while the stack rotates one full revolution, the first grinding cylinder is displaced radially away from the stack;
- 5 - a second grinding cylinder that rotates in a second direction about a vertical axis is displaced radially for abutment on the vertical edges of the stack, while the stack rotates one full revolution, the second grinding cylinder is caused to slide radially away from the stack;
- 10 - a blower device or a rotating brush is caused to slide radially towards the vertical edges of the stack, while the stack rotates one full revolution, the blower device or the brush is caused to slide radially away from the stack.

15 The invention will now be explained in further detail with reference to the drawing, wherein

Figure 1 schematically shows a working station according to the invention in accordance with a preferred embodiment;

20 Figures 2a-2d schematically show the operation of the working station shown in Figure 1, seen from the top when the vertical edges of a stack of plate-shaped elements are subjected to grinding; and

25 Figure 3 schematically shows an alternative embodiment of a working station according to the invention.

Figure 1 schematically shows a working station according to the invention in a preferred embodiment, wherein the working station is configured as a grinding device, wherein the grinding devices are configured with a
30 measuring wheel 1, two grinding cylinders 2,3 and a blower device 4.

Each of the working devices 1-4 is mounted on a carriage 5 that is configured to be slidable on a radially protruding bracket 6, as is outlined by the double

arrows A at each carriage 5. For causing the carriage 5 to slide, suitable means are provided, eg in the form of pneumatic cylinders, hydraulic cylinders, servomotors or other purely mechanical constructions. A person skilled in the art will be able to readily point to such means and they will not be subject to further discussion herein.

The brackets 6 are secured on a central unit 7, from where they project radially. The central unit 7 and/or the brackets 6 is/are attached to a machine frame, not shown in further detail, that imparts to the working station the requisite strength and rigidity. Such machine frame can be of any given type and a person skilled in the art will be able to readily point to such frame.

Underneath the working station a roller path 8 is provided on which a stack 9 of plate-shaped elements 10, such as tabletops, shelves or other plate-shaped elements, are transported into the working station. In figure 1 one such stack 9 has already been arranged on a support 11 and is ready for working. The stack 9 is located centrally in the working station and rests on a support 11 that is configured as a rotary table that is, in a controlled manner, able to rotate the stack 9 continuously about a vertical axis 13, as will be described below. Also the means for rotating the stack 9 can readily be pointed to by the person skilled in the art and they will not be subject to further discussion herein. For securing the stack 9 on the support 11 a clamping device 12 is provided in the form of a scissor mechanism that clamps in the stack 9 between the support 11 and the central unit 7 of the working station. Of course, the clamping device 12 can be configured in other ways than the shown scissor mechanism, as it is possible to use eg a hydraulic or pneumatic cylinder or some other kind of mechanical securing means.

The operational steps undertaken when the vertical edges of the stack 9 are to be worked will be described in the following with reference to Figures 2a-2d that schematically show the working station shown in Figure 1, seen from

above, when the vertical edges of a stack 9 of plate-shaped elements 10 are subjected to grinding.

First, a stack 9 of plate-shaped elements 10 are conveyed into the support 11 underneath the central unit 7 of the working station and the clamping device 12 is activated to achieve the position shown in Figure 1. Then the measuring wheel 1 is taken for abutment on the vertical edges of the stack 9, its associated carriage 5 being caused to slide radially inwards from the position shown in Figure 1. Hereby the position shown in Figure 2a is obtained. The support 11 and hence the stack 9 is now caused to rotate one full revolution, while the measuring wheel 1 maintains its abutment on the periphery of the stack 9 during further displacements towards or away from the centre of the working station. A registration unit not described more specifically herein, such as a computer, registers and stores the detected data concerning the peripheral geometry of the stack 9, and this information is used for subsequent control of the remaining working devices of the working station. Here it shall be mentioned that the working device for measuring the peripheral geometry of the stack 9 may comprise two measuring wheels 1 located vertically above each other, whereby any deviations from the vertical plane of the vertical edges of the stack 9 can be registered.

When the peripheral geometry of the entire stack 9 has been detected, the measuring wheel 1 is taken radially away from the stack 9 again. Now the stack 9 is caused to rotate yet one full revolution, while simultaneously a rotating first grinding cylinder 2 is caused into abutment on the vertical edges of the stack 9 as shown in Figure 2b. The grinding cylinder 2 is preferably of the type that is provided with protruding, flexible grinding cloths or sandpaper, whereby a high grinding effect is ensured even after protracted periods of use. Sliding of the grinding cylinder 2 towards or away from the centre of the working station is, in the preferred embodiment, controlled by a (not shown) computer, since data concerning the peripheral geometry of the stack just detected is used to ensure that there is at all times an optimal grinding abutment on the vertical edges of the stack 9, irrespective of the

angulation of the stack 9. As it is, these data are used in the same way for all subsequent working devices in the working station.

When the stack 9 has rotated one full revolution and has been subjected to grinding in a first direction, the first grinding cylinder 2 is caused to slide away from the stack 9. The stack 9 is now once again caused to rotate one full revolution while simultaneously a second grinding cylinder 3 is caused to abut on the vertical edges of the stack 9. This second grinding cylinder 3 rotates in the opposite direction of the first grinding cylinder 2, as shown in Figure 2c.

When this second grinding operation is completed, the stack 9 is caused to rotate one final revolution while simultaneously a blower unit 4 for the removal of grinding dust from the vertical edges of the stack 9 is caused to slide towards the stack 9 as shown in Figure 2d.

The blower device 4 may comprise a number of blow nozzles 14 as shown in Figure 1, or it may optionally be configured as a narrow air gap. According to an alternative embodiment, the device for the removal of grinding dust may be configured as a brush that rotates about a vertical axis that is caused to abut on the vertical edges of the stack 9.

When the stack 9 has rotated this final full revolution and has been cleaned of grinding dust, the stack 9 of plate-shaped elements 10 may continue along the roller path 8 for further processing.

This further processing may consist eg of varnishing or painting of the edges of the plate-shaped elements 10. This process may take place in a working station of the same type as just described, wherein the working devices in the form of grinding cylinders and blower device are replaced by paint or varnish applicator devices and hardening devices, eg in the form of UV lamps. Such working station is shown in Figure 3 and operates in accordance with the

same functional principles as the working station shown in Figures 1 and 2a-2d.

5 Likewise, the working station shown in Figure 3 comprises a central unit 7, from where brackets 6 project radially. On two of the brackets there are, via carriages 5, slidably arranged a varnish applicator 15 with spray nozzles 16 and a hardening device 17 with UV lamps 18.

10 The stack 9 of plate-shaped elements 10 are again conveyed towards the working station via a roller path 8 and is located on a support 11 in the form of a rotary table that enables the stack 9 to be rotated continuously about a vertical axis 13. The working station shown in Figure 3 is configured for being located immediately in extension of the working station shown in Figures 1 and 2a-2d and data concerning the peripheral geometry of the stack can therefore be reused in this working station. This is why no measuring device is provided for detecting the peripheral geometry of the stack 9.

20 When the vertical edges of the stack 9 are varnished, the varnish applicator device 15 is first caused to slide inwards until a suitable distance from the stack 9 has been reached, following which the stack 9 is caused to rotate one full revolution while the varnish is applied by spraying via the spray nozzles 16 on the varnish applicator device 15. Now the hardening device 17 with UV lamps is caused to slide inwards until a suitable distance from the stack 9 has been reached, and the stack 9 rotates yet a full revolution. The varnishing procedure is now completed and the stack 9 may be removed for further processing, if any, of the plate-shaped elements 10.

30 In the work stations shown in Figures 1-3, the working devices (measuring wheel 1, grinding cylinders 3,4, blower device 5, varnish applicator device 15 and hardening device 17) are suspended in brackets 6 that are secured to a central unit 7, which is in turn secured to a machine frame in a not shown manner. The working devices may, however, advantageously be controlled by means of brackets 6, both at the top and at the bottom of the working

station in order to obtain improved control thereof. Furthermore, the entire working station will in practice often be built into a closed enclosure to ensure that grinding dust and paint or varnish residue are not spread in the production premises.

5

Finally, there will usually be provided automatic control of both the rotation of the stack 9 and the sliding of the working devices towards or away from the stack. However, such control could easily be recommended and for the sake of overview Figures 1-3 show only the technical measures necessary for understanding the present invention.

10

Claims

1. A working station for working vertical edges of a stack (9) of plate-shaped elements (10), which working station comprises a support (11) for supporting the stack (9) and a number of working devices (1, 2, 3, 4; 15, 17) that are each configured to be able to slide towards and away from the stack (9), **characterised in** that the support (11) is configured for being able to rotate the stack about a vertical axis (13); and that the working devices (1, 2, 3, 4; 15, 17) are configured for being, in a fixed path, able to slide between an outermost position away from the stack (9) and an innermost position towards or in proximity of the vertical edges of the stack (9), irrespective of the angulation of the stack (9).
2. A working station according to claim 1, **characterised in** that each of the working devices (1, 2, 3, 4; 15, 17) is mounted on a carriage (5) that can be caused to slide radially towards and away from the stack (9) along a bracket (6).
3. A working station according to claim 1 or 2, **characterised in** that the working devices comprise at least one grinding cylinder (2, 3) that is configured to be turnable about a vertical axis.
4. A working station according to claim 3, **characterised in** that the grinding cylinder (2, 3) is provided with a flexible grinding material.
5. A working station according to claim 3 or 4, **characterised in** that precisely two grinding cylinders (2, 3) are provided that are configured for rotation in opposite directions.
6. A working station according to any one of claims 3-5, **characterised in** that measuring means are provided for detecting the peripheral geometry of the stack (9); and that control means are provided for automatically moving

the working devices (1, 2, 3, 4; 15, 17) towards and away from the stack (9) in response to the detected geometry and the rotation of the stack (9).

5 7. A working station according to claim 6, **characterised in** that the measuring means comprise a measuring wheel (1) mounted on a carriage (5) that can be caused to slide radially towards and away from the stack (9).

10 8. A working station according to any one of claims 3-7, **characterised in** further comprising means for removing grinding dust from the vertical edges of the stack (9).

15 9. A working station according to claim 8, **characterised in** that the means for removing grinding dust comprise a blower device (4) mounted on a carriage (5) that can be caused to slide radially towards and away from the stack (9).

20 10. A working station according to claim 8, **characterised in** that the means for removing grinding dust comprise a brush that rotates about a vertical axis and is mounted on a carriage that can be caused to slide radially towards and away from the stack.

11. A working station according to any one of claims 2-10, **characterised in** that the working devices comprise a paint or varnish applicator device (15).

25 12. A working station according to claim 11, **characterised in** further comprising a hardening device (17) provided with hardening means for the paint or the varnish.

30 13. A working station according to claim 12, **characterised in** that the hardening means are UV lamps (18).

14. A method of working vertical edges of a stack (9) of plate-shaped elements (10) by means of a number of working devices (1, 2, 3, 4; 15, 17)

that are caused to successively move towards the vertical edges of the stack (9) and to work same along their entire circumference, **characterised in** that the stack (9) is rotated about a vertical axis (13); and that the working devices (1, 2, 3, 4,; 15, 17) are caused to slide in a fixed path for working of the vertical edges of the stack (9).

15. A method according to claim 14, **characterised in** that the working devices (1, 2, 3, 4; 15, 17) are displaced radially towards the stack (9).

- 10 16. A method according to claim 15, **characterised in** that the vertical edges of the stack (9) are subjected to grinding in the following steps:
- a measuring wheel (1) is displaced radially for abutment on the periphery of the stack (9), the stack (9) is rotated one full revolution while simultaneously its peripheral geometry is registered, the measuring wheel (1) is displaced radially away from the stack (9);
 - a first grinding cylinder (2) that rotates in a first direction about a vertical axis is displaced radially for abutment on the vertical edges of the stack (9), while the stack (9) rotates one full revolution, the first grinding cylinder (2) is displaced radially away from the stack (9);
 - 20 - a second grinding cylinder (3) that rotates in a second direction about a vertical axis is displaced radially for abutment on the vertical edges of the stack (9), while the stack (9) rotates one full revolution, the second grinding cylinder (3) is caused to slide radially away from the stack (9);
 - 25 - a blower device (4) or a rotating brush is caused to slide radially towards the vertical edges of the stack (9), while the stack (9) rotates one full revolution, the blower device (4) or the brush is caused to slide radially away from the stack (9).

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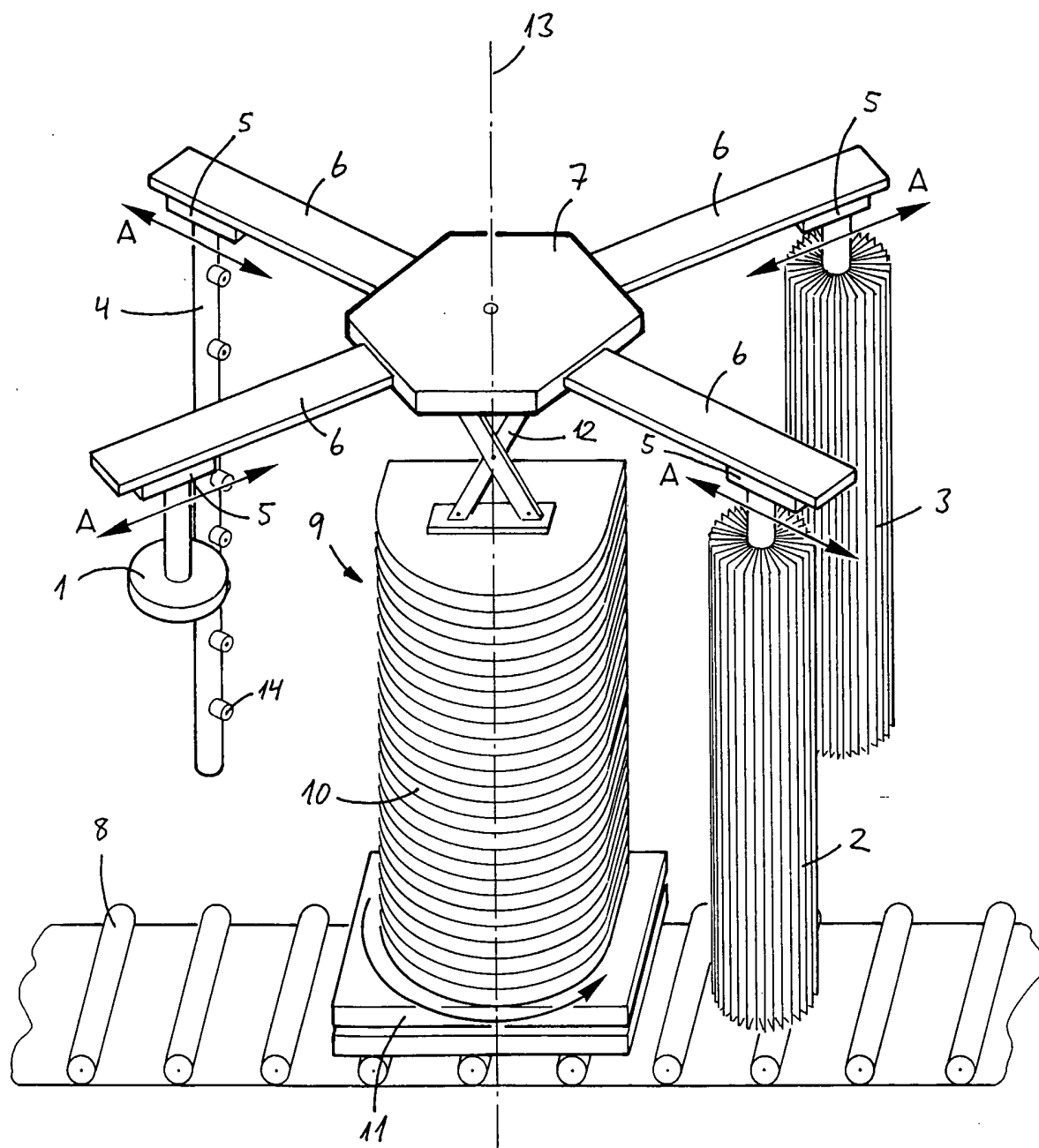


Fig.1

2/3

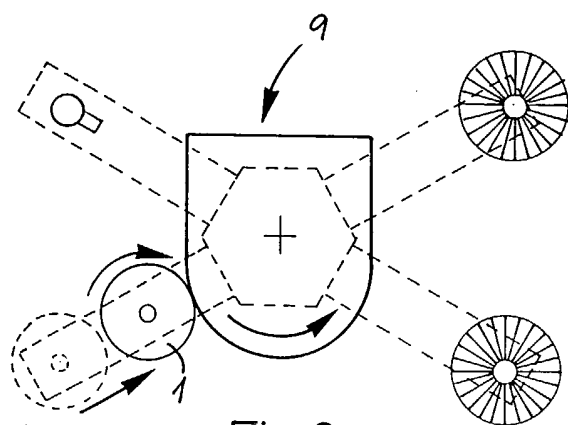


Fig. 2a

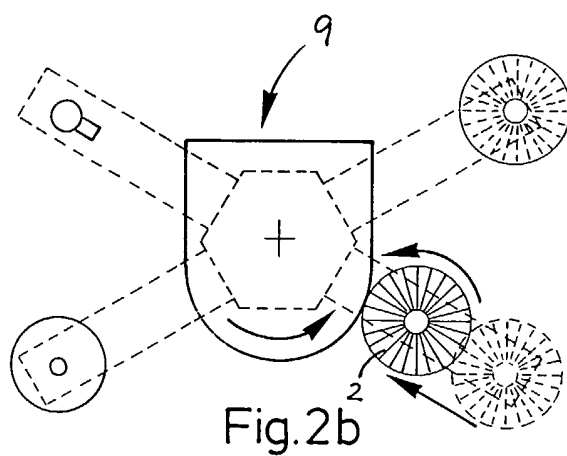


Fig. 2b

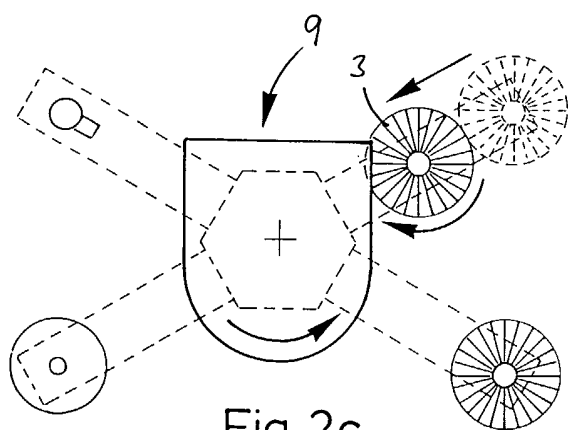


Fig. 2c

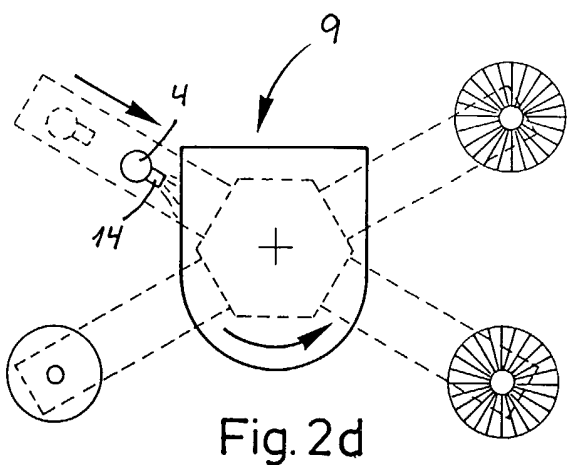


Fig. 2d

INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 02/00523

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B24B 9/00

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)

IPC7: B24B, B28B, B27B, B05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI DATA, EPO-INTERNAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1183753 A (JAMES BROADHURST AND SONS LIMITED), 11 March 1970 (11.03.70), column 2, line 80 - column 3, line 37, figure 1, abstract	1-5,8-10, 13-15
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☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

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26-11-2002

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 02/00523

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

28/10/02

International application No.

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