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Device for processing stacks of electrostatically chargeable flat items

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(71) Applicant(s)
E.C.H. Will GmbH

(72) Inventor(s)
Herpell, Frank; Gadtke, Thorsten; Hagermann, Gunther

(74) Agent/Attorney
Griffith Hack, Level 29, Northpoint 100 Miller Street, North Sydney, NSW, 2060

Abstract

Described is a device for processing a multi-layered electrostatically chargeable web of material into individual superimposed sheets (12), in particular sheets of paper, with at least one cutting device (2) to cut the multi-layered web of material (10) into corresponding superimposed sheets (12), one electrostatic charging device (30) to electrostatically charge the multi-layered web of material (10), and one first conveyor device located upstream of the cutting device (2) and one second conveyor device (20) located downstream of the cutting device (2), for transporting the multi-layered web of material (10, 12). The particular feature of the invention is that the electrostatic charging device (30) is positioned adjacent to the cutting device (2), in the region of the first or the second conveyor device (20). In accordance with a further aspect of the invention, an electrostatic discharging device is arranged in the area of the pile delivery.

(Fig. 1)

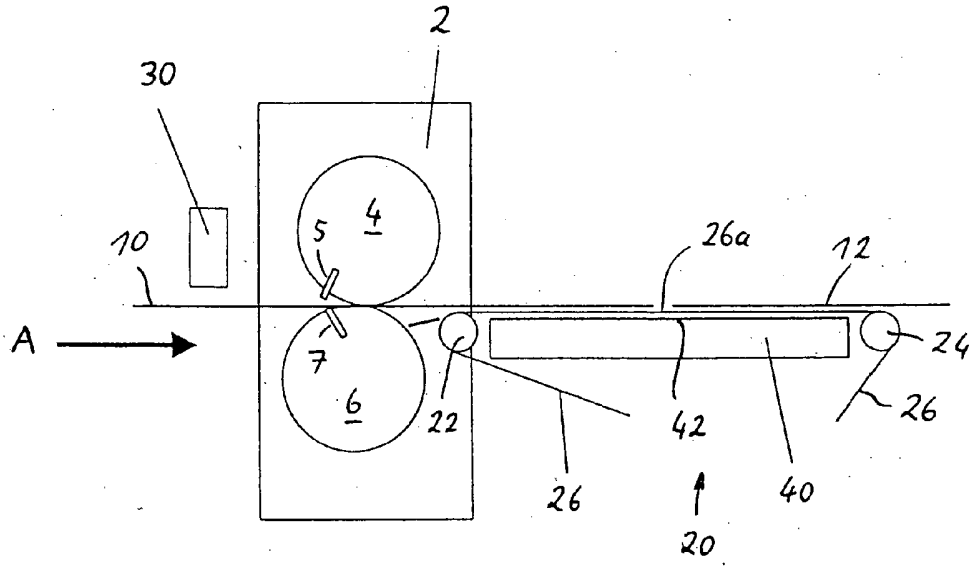
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Fig. 1

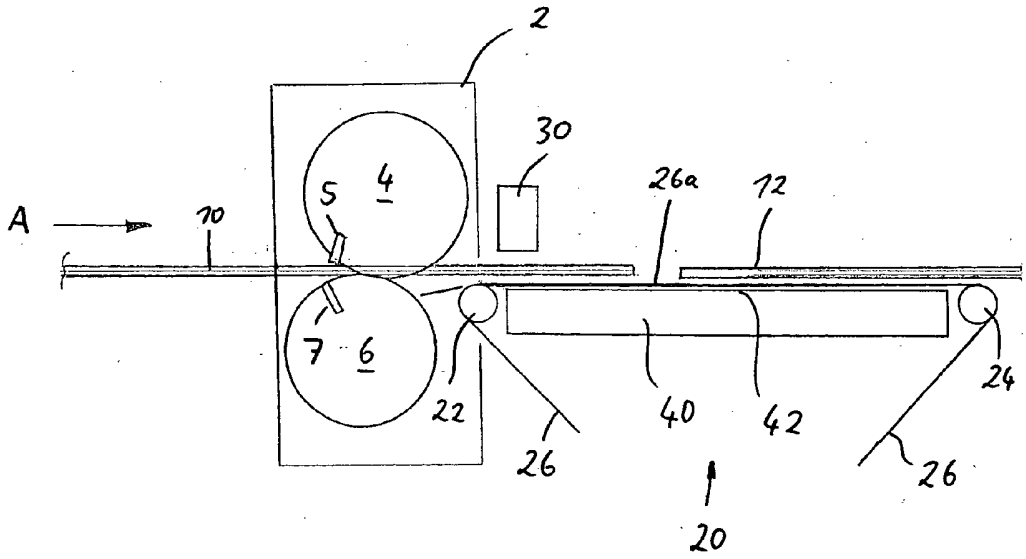
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Fig. 2

AUSTRALIA

Patents Act 1990

COMPLETE SPECIFICATION

STANDARD PATENT

Applicant(s):

E.C.H. WILL GMBH

Invention Title:

DEVICE FOR PROCESSING STACKS OF ELECTROSTATICALLY CHARGEABLE FLAT ITEMS

The following statement is a full description of this invention, including the best method of performing it known to me/us:

DEVICE FOR PROCESSING STACKS OF ELECTROSTATICALLY CHARGEABLE FLAT ITEMS

Field of the Invention

The invention generally concerns a device for processing a multi-layered electrostatically chargeable web of material. The invention relates particularly, though not exclusively, to a device for processing a multi-layered cutting device comprising at least one cutting device for cutting the multi-layered web of material into sheets, at least one electrostatic charging device to electrostatically charge the multi-layered web of material, and one first conveyor device located upstream of the cutting device and one second conveyor device located downstream of the cutting device, to transport the multi-layered web of material.

Background of the Invention

In the paper-processing industry, during the transport of a multi-layered web of material – or superimposed sheets cut from the web - from one processing station to another processing station, to a pile delivery, or to a packaging machine, for example, the sheets are at risk, especially owing to acceleration or deceleration in the conveyor devices, branch-offs, and the like. In particular in the case of high accelerations and abrupt changes in direction of the conveying path, the superimposed sheets can slip with respect to each other. For this reason, the transport mode and the design of the conveyor device have to meet stringent requirements, because stacks of sheets that have slipped and have lost their shape can not be fed to further processing steps or packaging.

For this reason, DE 35 085 14 A1 proposes to electrostatically charge paper stacks, so that the shape of the stacks is temporarily fixed for further processing. In this manner it can be prevented that stacks encounter internal slipping or that individual sheets are lost, in particular during acceleration in a conveyor device.

DE 101 28 653 A1 discloses the use of an ionization device that can be used in a conveyor system to induce an electrostatic charge in a layer of sheets. This prior-art conveyor system is equipped with a vacuum device in the region of an upstream conveyor device, which can be used to admit suction air to at least one area of the layer of sheets.

SUMMARY OF THE INVENTION

The present invention provides a device to process a multi-layered electrostatically chargeable web of material, comprising at least one cutting device to cut the multi-layered web of material into corresponding superimposed sheets, one electrostatic charging device to electrostatically charge the multi-layered web of material, and one first conveyor device located upstream of the cutting device and one second conveyor device located downstream of the cutting device for transporting the multi-layered web of material, characterized in that the electrostatic charging device is arranged adjacent to the cutting device in the region of the first or the second conveyor device . The electrostatic charging device typically is arranged adjacent to or in immediate proximity of the cutting device. In this manner one reduces the risk of a backup of the multi-layered web of material in the region of the cutting device, which significantly reduces the risk of damage to the comparatively expensive cutting device.

In this, it is conceivable to place the electrostatic charging device upstream in front of the cutting device or downstream behind the cutting device. In particular, the electrostatic charging may take place downstream of the cutting device. This is so because it has been found that it is easier to use a second conveyor device to withdraw a web of material that has first been cut and then electrostatically charged than to push an already electrostatically charged web of material through the cutting device. For this case of performing the electrostatic charging downstream of the cutting device it is also

conceivable to omit the first conveyor device that would be located upstream of the cutting device.

In a preferred embodiment of the invention, the electrostatic charging device can be positioned substantially between the cutting device and the first conveyor device located upstream thereof or the second conveyor device located downstream thereof, which however does not rule out an overlapping arrangement with respect to the first or the second conveyor device, as long as the electrostatic charging device is positioned adjacent to the cutting device, so that the electrostatic charging of the web of material can essentially take place immediately before or after the cutting.

Preferably, at least the second conveyor device that is located downstream of the cutting device is equipped with an endless conveyor belt system, which merely has to consist of one or several lower belt tracks, on which the stacked sheets rest that have been cut from the multi-layered web of material. The fact that the electrostatic charge fixes the sheets with respect to each other allows omitting the upper belt tracks in the second conveyor device. Omitting the upper belt track results in considerably less mechanical complexity and thus in substantial cost savings.

Furthermore, in contrast to state-of-the-art systems, no adjusting work is necessary, such as for example adjusting the belt positions to the respective format or adjusting the friction of the lower belt tracks with respect to the upper belt tracks. Moreover, due to the elimination of the upper belt track, the second conveyor device is easily accessible from above, which simplifies the elimination of malfunctions. And finally, performing the transport without upper belt tracks reduces the risk of damage to the sheets being transported, which is especially relevant for coated sheets of paper on account of their high delicacy.

For the purpose of increasing friction in order to ensure a reliable transport of the sheets, the second conveyor device in a further preferred embodiment may comprise a suction device, whereby in a functional way an upper strand of the conveyor belt arrangement runs over the suction device. For suction devices equipped with a vacuum area, an upper strand of the conveyor belt arrangement should rest on such a vacuum area. At least one lower belt should be perforated to increase the vacuum action.

Preferably, the electrostatic charging device is an ionization device.

Preferably the cutting device features a cross cutter.

According to a further aspect of the present invention, there is provided a device for processing a multi-layered electrostatically chargeable web of material into individual sheets lying on top of each other, in particular according to at least one of the preceding claims, with one conveyor device for transporting the sheets, one electrostatic discharging device to electrostatically discharge the sheets, and – located downstream of the conveyor device – one pile delivery to form piles out of the superimposed sheets, characterized in that the electrostatic discharging device is arranged in the area of the pile delivery.

Unless the multi-layered web of material is selectively electrostatically charged by the above-described device and/or electrostatic charging devices at other points of the machine, in particular downstream of the cutting device, the relative motions occurring during further processing between machine parts and the material and/or within the material itself can – depending on the particular material and the ambient conditions – lead to electrostatic charging. These electrostatic charges can impede the further processing steps in a downstream device. For the purpose of neutralizing the electrostatic charge of the material, antistatic units are known in the art, which are installed in the region of the conveyor device across the entire working width and attempt to discharge the material passing by. But the short dwell time of the material below these antistatic

units during transport often may not yield the desired complete discharge result. Moreover, the material has a tendency to reacquire charge on the rest of its way to the pile delivery. For this reason, an embodiment of the invention proposes to arrange the electrostatic discharge device in the area of the pile delivery, where the sheets – cut from the multi-layered material web – come to rest and thus provide adequate dwell time for a complete discharge of the sheets. This completely eliminates the electrostatic adherence between the sheets, which allows trouble-free alignment and stacking of the sheets as well.

The electrostatic discharging device preferably is arranged in the upstream section of the pile delivery, preferably on the upstream side of the pile delivery.

A further preferred embodiment of the invention is characterized in that the electrostatic discharging device comprises one compressed-air device to generate compressed air, one device to electrostatically charge the compressed air with a polarity opposite to that of the sheets, and one blowing device to blow this air against the sheets. Generating an air cushion between the dropping sheets in the pile delivery – in combination with mechanical guide elements – ensures precise corner formation in the forming pile. Generating such an air cushion is known in the art. The embodiment of the invention utilizes the compressed air required for this in a skilful manner to also perform the necessary electrostatic discharging of the sheets, by charging the compressed air with a polarity that is opposite to that of the sheets. Thus, the controlled introduction of blown air with an electrostatic-discharge effect makes the mentioned air cushion available at precisely the location, where this action is absolutely needed, namely in the pile delivery, and provides an electrostatic neutralization of the sheets.

The blowing device preferably blows the air predominantly against the trailing edges of the sheets.

It is expedient for the blowing device to comprise a nozzle arrangement.

In a further preferred embodiment of the invention, the electrostatic discharging device is located in a housing, whereby one section of the housing borders on the pile delivery and preferably forms a limit stop for the pile. Thus, the housing can simultaneously perform the function of a pile limit stop. In this, the blowing device should be contained in the section of the housing that borders the pile delivery. For this purpose, the section of the housing bordering the pile delivery can be equipped with openings to blow out air. These openings are designed in a manner to allow an acceleration of the issuing air with electrostatic discharging effect in the direction towards the forming pile. It is expedient for the housing to consist of an electrically non-conducting material.

In particular, the electrostatic discharging device is a deionization device.

Finally, the lower region of the pile delivery may contain vacuum means that use vacuum action to withdraw undesired air from between the sheets being stacked.

Preferred embodiment examples of the invention will be explained in more detail in the following with the help of the enclosed drawings.

Fig. 1 is a diagrammatic side view showing a region of a paper-processing machine with an ionization device, with the ionization device being arranged upstream of a cross cutter;

Fig. 2 is a diagrammatic side view showing a region of a paper-processing machine with an ionization device; the only difference with respect to figure 1 being that the ionization device is arranged downstream of the cross cutter;

Fig. 3 shows a top view onto the region of the paper-processing machine of fig. 1 and fig. 2, with the ionization device omitted; and

Fig. 4 is a sectional view of a further region of a further paper-processing machine with an ionization device.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Two different designs of a first section of a paper-processing machine with a cross cutter 2 are shown in partial diagrammatic side views in figures 1 and 2, while a general top view thereof is shown in figure 3. In the illustrated embodiment examples, the cross cutter 2 comprises a first knife drum 4 with a first knife 5 extending along the entire length of the knife drum 4, and a second knife drum 6 with a second knife 7 extending along the entire length of the knife drum 6. The two knife drums 4, 6 rotate synchronously in opposite directions in such a manner so that the two knife bars 5, 7 meet to cut a multi-layered web of paper material 10 running between the two knife drums 4, 6 into individual sheets 12 lying on top of each other. In contrast to figure 2, figure 1 schematically shows the multi-layered web of paper material 10 and the individual superimposed sheets 12 cut thereof as solid lines; the same applies to figure 4, which will be explained in detail at a later point.

A first conveyor device (not shown in the figures) is provided upstream of the cross cutter 2 to transport the multi-layered web of paper material 10 in the direction of the arrow A. In addition, arranged downstream of the cross cutter 2 is a second conveyor device 20, which comprises at least one lower belt 26 that revolves endlessly about two tail rollers 22, 24 with its upper strand 26a moving in the direction of the arrow A. Usually, several lower belts 26 are arranged beside each other across the running direction of the sheets 12 in accordance with arrow A.

In the first embodiment example according to figure 1, an ionization device 30 is arranged upstream of the cross cutter 2 and adjacent to the latter, and thus between the first conveyor device (not shown) and the

cross cutter 2, that imparts a static charge upon the multi-layered web of paper material 10. The ionization device 30 preferably consists of an ionizing rod that extends across the paper running direction according to arrow A.

Use of the ionization device 30 has the effect that the individual paper layers of the multi-layered web of paper material 10, and thus subsequently also the layers of superimposed sheets 12 that were cut by the cross cutter 2, cling to each other and cannot slip with respect to each other.

On the other hand, the ionization device 30 of the second embodiment example according to fig. 2 is arranged downstream of the cross cutter 2 and adjacent to the latter, and thus essentially between the cross cutter 2 and the second conveyor device 20.

Downstream of the cross cutter 2, the cut sheets 12 are transported on the lower belt tracks 26 of the second conveyor device 20, whereby it is impossible for individual sheets 12 to lift up because of their electrostatic charge. Vacuum boxes 40 are provided to increase friction between the sheets 12 and the upper strand 26a of the lower belt track 26, whereby the upper surface of the vacuum box 40 forms a vacuum area 42, across which runs one respective upper strand 26a of the upper belt tracks 26. The vacuum boxes are connected to a suction pump (not shown). The vacuum areas 42 that carry the upper strand 26 of the lower belt 26 are perforated, as shown in figure 3. In order to increase the suction effect in the region of the lower belts 26, the lower belts 26 are suitably perforated as well, which is schematically illustrated in figure 3 as well. Due to the suction action of the vacuum boxes 40, the sheets 12 – lying on top of each other and clinging to each other because of the electrostatic charge – are pulled against the upper strand 26a of the lower belts 26, which increases the friction between the sheets 12 and the moving lower belts 26 and thus the adhesion of the sheets 12 to the lower belts 26. In this

manner one can guarantee a secure transport of the sheets 12 by means of the lower belts 26, so that higher transport speeds become possible.

Incidentally, it is also conceivable that the vacuum areas 42 and possibly the vacuum boxes 40 are not constructed continuous along the paper running direction in accordance with arrow A, as is illustrated schematically in figures 1 to 3, but are realized with one or several divisions. It is further conceivable that the vacuum boxes 40 are removable for adjusting and maintenance work, in particular by swinging them downward. Finally, the suction action of individual selected vacuum boxes 40 can be turned off or on – in particular for a change of format – which is of benefit for maintaining a constant negative pressure.

The arrangement described above offers the particular advantage that the second conveyor device 20, which transports the sheets 12 to a downstream overlapping device that is not shown in the drawings, no longer requires the upper belt tracks that were customary up to now. For this reason, the second conveyor device 20 is not equipped with top belt tracks, as a result of which the conveying track formed by the second conveyor device 20 becomes mechanically more simple and more accessible.

Fig. 4 shows in a schematic sectional view a further region of a paper-processing machine in the area of a pile delivery 50, where the sheets 12 that arrive on top of each other are stacked into a pile 14.

Paper-processing machines that pull materials in web form from one or several rolls and process them into sheeted material are predominantly designed so that a scale-like overlapping stream of sheets 12 is generated inside the machine. This scale-like shape is necessary to be able to switch from the high web-pull-off speed and web transport speed that are chosen for system-productivity reasons in the section shown in figures 1 to 3 down to a velocity as low as possible for forming the pile 14.

Unless there is a controlled electrostatic charging, as has been described before with the help of figures 1 to 3, relative motions between the machine parts and the material or within the material itself during the further processing steps will – in dependence on the chosen material and the ambient conditions – result in electrostatic charges. While such static charges are initially desired for the transport by the second conveyor device 20 (figures 1 to 3), they will to some degree impede the forming of a clean pile 14 and in particular will impede the subsequent further processing steps in subsequent stations or devices, where the productivity and quality of the further processing steps may be considerably cut down.

For this reason, a housing 60 is provided that is closed on all sides and consists of a non-conducting material. The housing 60 is equipped with a compressed-air supply connector 62, which is connected to a pressurized-air source (not shown) and through which compressed air is pumped in the direction of arrow B into the housing 60. One side 64 of the housing 60 borders the pile delivery 50. In the illustrated embodiment example, this side 64 – facing the pile delivery 50 – of the housing 60 forms a vertical flat surface, which can act as an end stop for the pile 14. Thus, in the illustrated embodiment example, the side 64 of the housing 60 performs the function of the rear end stop and simultaneously performs the aligning function. Thus, this vertical side 64 of the housing 60 can also be referred to as rear edge aligner.

The pile delivery 50 is bordered in the transport direction by a front edge aligner 68, which serves as limit stop for the sheets 12 delivered to the pile delivery 50 and essentially consists of one vertically arranged plate. Thus the side 64 of the housing 60 facing the pile delivery 50 and the front edge aligner 68 are parts of an aligning mechanism or form the aligning mechanism.

Furthermore, several nozzle-shaped air-discharge openings 66 are formed on the side 64 of the housing 60 that faces the pile delivery 50, in particular in such a way that they form a bore pattern that extends vertically at regular intervals across the entire working width. These openings 66 are designed in such a manner so that they allow an accelerated discharge in the direction towards the forming pile of the compressed air entering through the compressed-air supply connector 62. The air flow generated during this is discharged essentially along the longitudinal direction of the sheets 12 forming the pile 14 and is directed at the trailing edges 12a of the sheets. This generates air cushions between the dropping sheets 12 in the pile delivery 50, whereby the air cushions – in combination with the already mentioned but not shown aligning mechanism – ensure a precise edge formation of the forming pile 14. In forming the pile 14, it is necessary that the sheets 12, which run against the front edge aligner 68 in a scale-like overlapping arrangement, are allowed to easily move with respect to each other on the one hand and are allowed to glide on an air cushion while sinking to the surface of the forming pile 14 on the other hand.

For the purpose of electrostatically discharging the sheets 12, the illustrated embodiment example contains a deionization device 70 that is arranged within the housing 60 and preferably consists of an antistatic rod. This deionization device 70 ionizes the compressed air entering into the housing 60 via the compressed-air supply connection 62 with a polarity opposite to that of the sheets 12, so that the pressurized air issuing from the discharge openings 66 simultaneously exerts a deionizing action upon the sheets 12 of the forming pile 14. Thus, the controlled introduction of blown air with a deionizing effect into the forming pile 14 ensures both an electrostatic neutralization of the sheets 12 and the generation of the above-described air cushion at precisely the location where these actions are absolutely required.

In all this, the housing 60 should not contain any electrically conducting connections. On the side of the air discharge as well, i.e. outside of the housing 60 in the region of the discharge openings 66, it has to be ensured that the issuing deionizing air can under no circumstances come in contact with electrically conducting component parts in the region of the discharge opening 66 and the further air-blow path, since it would be neutralized immediately.

The pile delivery 50 is bordered below by a bottom 52, upon which the sheets 12 are stacked to form the pile 14 and which is supported by a mechanism (not shown) to be moveable in the vertical direction in accordance with the two-headed arrow C. During the forming of the pile 14, the lowering movement of the bottom 52 has to be controlled in such a way that the respective uppermost sheet 12 of the pile 14 – and thus the upper edge being formed – is always on the level of the discharge openings 66, in particular between the upper and lower discharge openings 66, to achieve a functional formation of the air cushion by the deionized compressed air issuing from the discharge openings 66.

Finally, as shown in figure 4, arranged in the lower region of the pile delivery 50 is a vacuum rail 80, which uses suction to withdraw disturbing air from between the sheets 12 of the pile 14 in the shown embodiment example in the pile's lower region.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

A reference herein to a prior art document is not an admission that the document forms part of the common general knowledge in the art in Australia.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Device to process a multi-layered electrostatically chargeable web of material, comprising at least one cutting device to cut the multi-layered web of material into corresponding superimposed sheets, one electrostatic charging device to electrostatically charge the multi-layered web of material, and one first conveyor device located upstream of the cutting device and one second conveyor device located downstream of the cutting device for transporting the multi-layered web of material, characterized in that the electrostatic charging device is arranged adjacent to the cutting device in the region of the first or the second conveyor device.

2. Device according to claim 1 characterized in that the electrostatic charging device is arranged essentially between the cutting device and the first or the second conveyor device.

3. Device according to claim 1 or 2, wherein the second conveyor device comprises an endless conveyor belt arrangement, characterized in that the endless conveyor belt arrangement consists only of one or several lower belts on which the multi-layered web of material rests.

4. Device according to at least one of the preceding claims, characterized in that the second conveyor device comprises a suction device.

5. Device according to claims 3 and 4, characterized in that an upper strand of the conveyor belt arrangement runs above the suction device.

6. Device according to claim 5, wherein the suction device comprises one vacuum area, characterized in that an upper strand of the conveyor belt arrangement rests upon the vacuum area.

7. Device according to claims 5 or 6, characterized in that at least one lower belt is perforated.

8. Device according to at least one of the preceding claims, characterized in that the electrostatic charging device is an ionization device for ionizing the multi-layered web of material.

9. Device according to at least one of the preceding claims, characterized in that the cutting device comprises a cross cutter.

10. Device for processing a multi-layered electrostatically chargeable web of material into individual sheets lying on top of each other, in particular according to at least one of the preceding claims, with one conveyor device for transporting the sheets, one electrostatic discharging device to electrostatically discharge the sheets, and – located downstream of the conveyor device – one pile delivery to form piles out of the superimposed sheets, characterized in that the electrostatic discharging device is arranged in the area of the pile delivery.

11. Device according to claim 10, characterized in that the electrostatic discharging device is located in the upstream section – preferably on the upstream side – of the pile delivery.

12. Device according to claim 10 or 11, characterized in that the electrostatic discharging device comprises one compressed-air device to generate compressed air, one device to electrostatically charge the compressed air with a polarity opposite to that of the sheets, and one blowing device to blow this air against the sheets.

13. Device according to claim 12, characterized in that the blowing device blows the air mainly against the trailing edges of the sheets.

14. Device according to claim 12 or 13, characterized in that the blowing device comprises a nozzle arrangement.

15. Device according to at least one of claims 10 to 14, characterized in that the electrostatic discharging device is located in a housing, one of whose sections borders the pile delivery and preferably forms an edge aligner for the pile.

16. Device according to at least one of claims 12 to 14 and according to claim 15, characterized in that the section of the housing that borders the pile delivery contains the blowing device.

17. Device according to claims 14 and 16, characterized in that the section of the housing that borders the pile delivery is equipped with openings for blowing out the air.

18. Device according to at least one of claims 10 to 17, characterized in that the electrostatic discharging device is a deionization device for deionizing the sheets.

19. Device according to at least one of claims 10 to 18, characterized by suction means in the lower region of the pile delivery.

20. Device to process a multi-layered electrostatically chargeable web of material substantially as herein described with reference to the accompanying drawings.

Dated this 21st day of September 2004

E.C.H. WILL GmbH
By their Patent Attorneys
GRIFFITH HACK

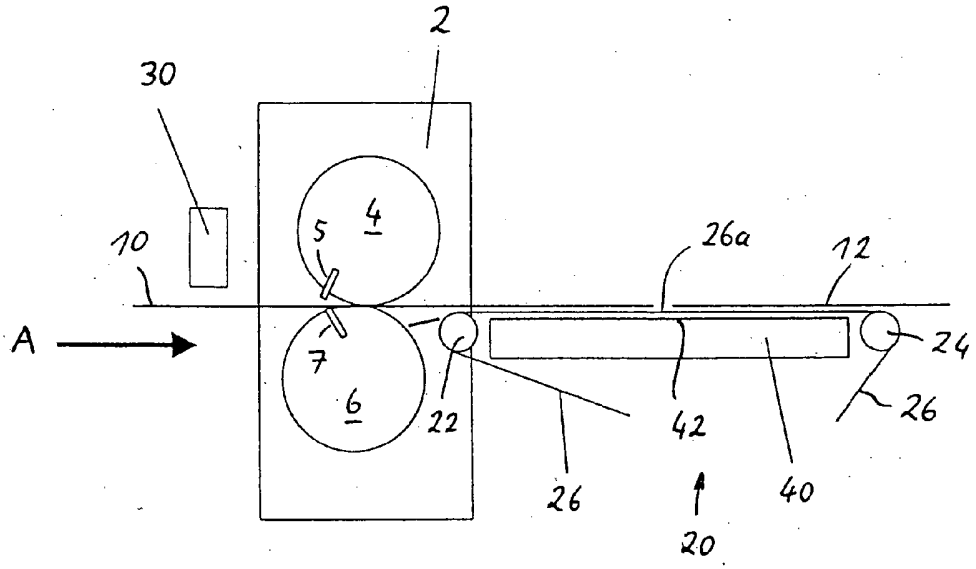
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Fig. 1

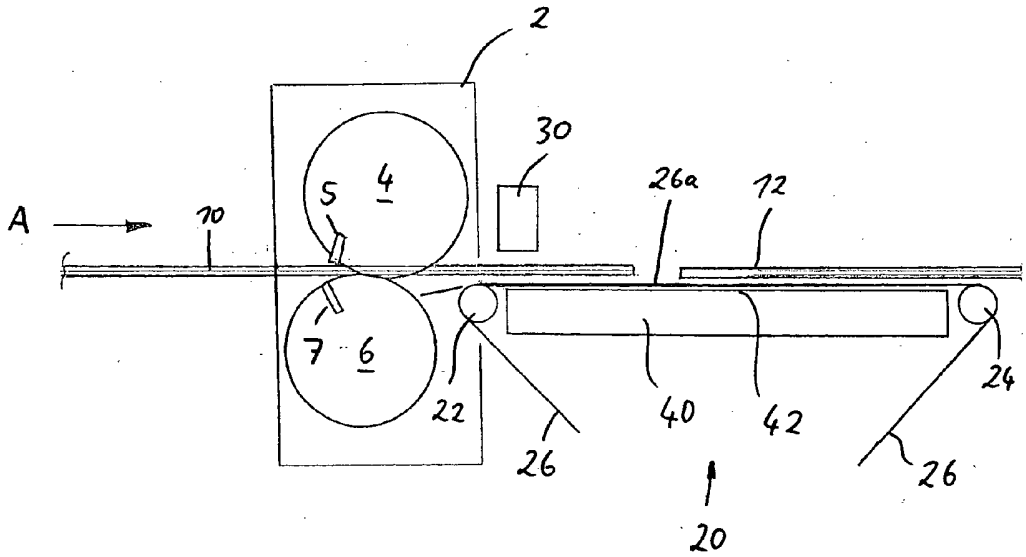
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Fig. 2

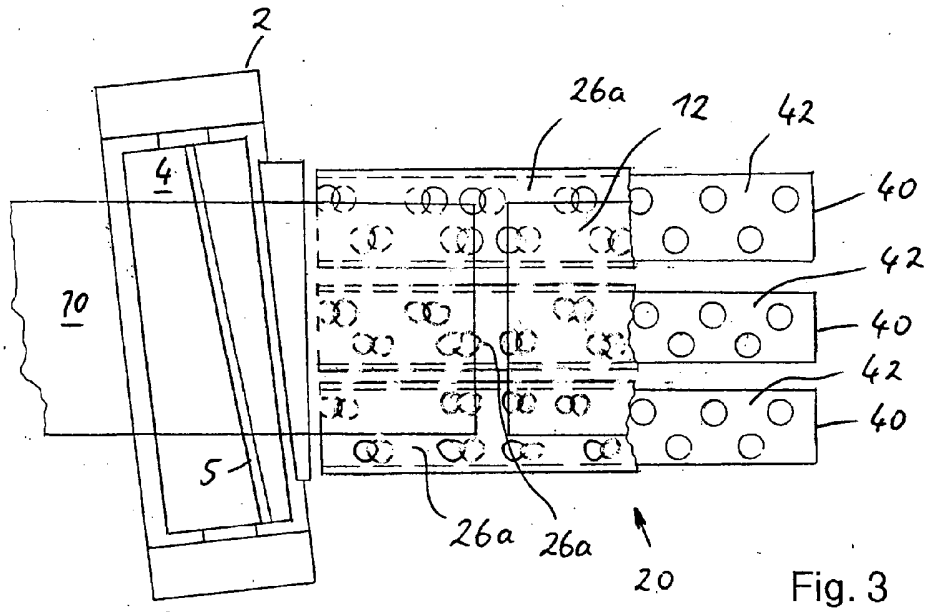
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Fig. 3

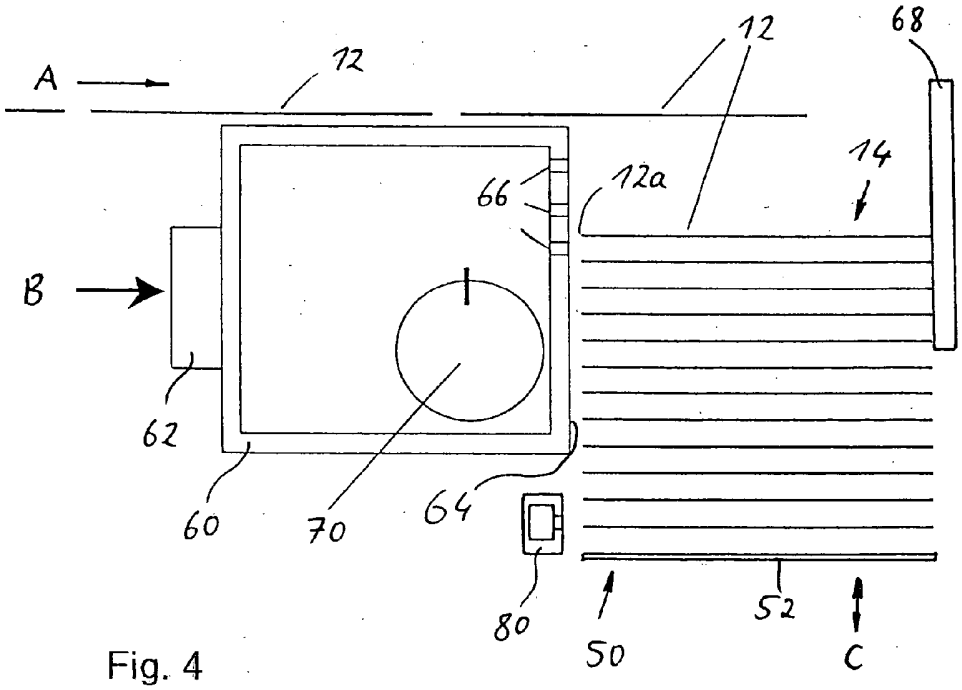
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Fig. 4