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(72) Inventor: **Morskate, Bernardus Petrus Paulus**
7554 PH Hengelo (NL)

(74) Representative:
Schumann, Bernard Herman Johan
Schumann Patent Consultancy B.V.,
Kerkedennen 43
7621 EB Borne (NL)

(71) Applicant: **Osiris Technology B.V.**
7555 BS Hengelo (NL)

(54) **Endless conveyor belt in an apparatus for printing a textile web**

(57) An apparatus for printing a web of textile (2) comprises:

an endless conveyor belt (6) which is guided over a driven roller (4) and a reversing roller (5) and which is driven at a chosen constant speed; and
printing means (16) for printing the passing textile web (2) in the zone of the upper active part (9) of the conveyor belt (6) in a number of colours in accordance with an adjustable pattern for selecting;

and is characterized by a number of support surfaces (31,32,33,34,35,36,37,38) distributed

over the length of the upper active part (9) and disposed thereunder at fixed positions and in pressing co-action with the downward directed surface of the conveyor belt (6), each of which support surfaces (31,32,33,34,35,36,37,38) has a certain minimal speed relative to the upper active part (9), which minimal relative speed is above the relative speed corresponding with the coulomb friction.

The support surfaces (31,32,33,34,35,36,37,38) are for instance embodied as cylindrical rollers extending in transverse direction relative to the upper active part (9), which rollers are driven or braked.

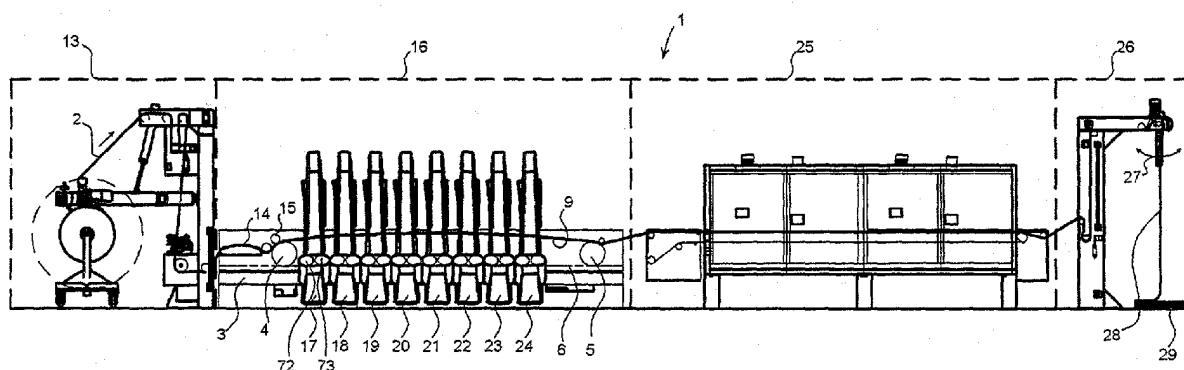


Fig. 2

Description

[0001] The invention relates to an apparatus for printing a web of textile, which apparatus comprises:

a main frame;
 an endless conveyor belt which is guided over a driven roller and a reversing roller disposed substantially parallel thereto and which is driven by motor means at a chosen constant speed;
 glue dispensing means for applying a glue layer upstream of the active upper part of the conveyor belt for temporary light adhesion of the textile web to this active part such that this web is fixed non-movably relative to the conveyor belt;
 optional washing means placed downstream relative to the active part for removing the glue from the conveyor belt;
 supply and feed means for feeding a textile web from a supply to the active part of the conveyor belt;
 printing means for printing the passing textile web in the zone of the active part of the conveyor belt in a number of colours in accordance with an adjustable pattern for selecting; and
 discharge and storage means for removing the printed textile web from the conveyor belt and subsequent storage thereof.

[0002] It is an object of the invention to embody an apparatus of this type such that the precision with which the printing is applied to the textile web is very high. A resolution of about 10 μm is envisaged according to the invention.

[0003] A significant aspect in determining the said precision and the resolution is the complete uniformity of the speed of the active part of the conveyor belt and the direction thereof, while it is also necessary to ensure that the upper surface of the textile web for printing is carried along at a very precisely controlled distance from the nozzles of the inkjet heads.

[0004] One possibility would be to support the active part at regular distances with freely rotating cylindrical rollers, the rotation axis of which extends exactly in transverse direction relative to the direction of transport. It is found in practice however that such a support structure even has an adverse effect on the belt transport in that a transversely directed force component is exerted on the belt by each roller because the direction of transport and the direction of the rotation axis of the rollers are never sufficiently perpendicular to each other. The conveyor belt will therefore always be urged to one side until sufficient force has developed to overcome the friction force between roller and conveyor belt. The consequence is that at that moment the conveyor belt will move back suddenly over a small distance, and this can be seen in the printed ink pattern. The printing quality thus leaves something to be desired.

[0005] In order to obtain a very great constancy with-

out the conveyor belt being locally urged in lateral direction, the invention provides an apparatus of the above stated type which is characterized by

a number of support surfaces distributed over the length of the active part and disposed thereunder at fixed positions and in pressing co-action with the downward directed surface of the conveyor belt, each of which support surfaces has a certain minimal speed relative to the active part, which minimal relative speed is above the relative speed corresponding with the coulomb friction.

[0006] The apparatus can particularly have the special feature that the support surfaces are embodied as cylindrical rollers extending in transverse direction relative to the active part, which rollers are driven or braked.

[0007] The embodiment is very simple in which the rollers are stationary. This latter embodiment can be implemented in other manner with the same result. In this implementation the apparatus has the feature that the support surfaces are stationary and each have a prismatic form, the main direction of which extends in transverse direction relative to the active part.

[0008] In a specific embodiment, the apparatus according to the invention has the feature that

the printing means comprise a number of, for instance 2-8, frame beams extending in transverse direction above said active part at determined mutual longitudinal distances along the direction of transport, each of which frame beams carries an array of inkjet heads and each of which is immobile during operation relative to the plane defined by the active part;

control means are present which fulfil at least the following functions of:

storing a chosen printing pattern by means of inputting pattern information, for instance from a scanner;

energizing the inkjet heads, also in relation to the chosen set speed of the conveyor belt and the mutual distances in the direction of transport between successive inkjet heads for the respective colours, such that each head sprays droplets of ink of the relevant colour onto the web at the positions on the web determined by the control means;

each support surface is placed at a position corresponding to the position of an array of inkjet heads.

[0009] Through placing of the support surfaces in the zone of the inkjet head arrays, urging of conveyor belt in lateral direction, and thereby the textile web, as described above is wholly prevented, while owing to the local support at a fixed height the mutual distance between the upper surface of the textile web and the nozzles of the inkjet heads can moreover be precisely maintained at a preselected and preset distance.

[0010] In order to realize a certain positive pressing force under all conditions between the lower surface of the active part of the conveyor belt and the support sur-

faces, the embodiment of the invention is recommended in which the support surfaces are placed relative to each other such that the active part of the conveyor belt is deflected through a certain angle by each support surface.

[0011] This embodiment of the invention can for instance be implemented such that the angle has a value in the order of magnitude of 1°.

[0012] In order to ensure an optimal constancy of the belt transport over the active part, the apparatus according to the invention can have the special feature that said angles are substantially the same for all support surfaces.

[0013] The summary review below may serve to elucidate the possibilities of the invention.

[0014] Use can be made of a desired number of colours and a corresponding number of beams with units of inkjet heads. The number of colours can amount for instance to a maximum of 12, while the beams are placed at mutual distances of 10-100 cm. Printing speeds can be realized of 1-40 m/min. A printing width of for instance 1 cm to 50 m can be realized according to the invention. Given the use of high-quality inkjet heads, the resolution of the finally obtained printed image can amount to 120-400 dpi. It will be apparent that this resolution is also determined by the precision with which the mutual distance between nozzles of the inkjet heads can be maintained relative to the textile web to be printed.

[0015] It will be further apparent from the above description that one colour is sprayed per stationary array of nozzles.

[0016] It must be ensured that the points of impact of the ink droplets must lie with great precision at a determined distance relative to the inkjet heads. It is of the greatest importance in this respect that the conveyor belt passes the inkjet heads in very stable manner and without notable height difference at the position of these heads. The maximum height variation between the nozzles and the textile surface for printing amounts to about 10 µm.

[0017] Printing can take place with different colour systems.

(1) Printing in accordance with the process colour principle.

Here a design is printed with the classical colour graduations (cyan, magenta, yellow, black) or dilutions thereof. The colour image is created by differently coloured droplets which together provide a colour graduation.

In order to obtain a maximum efficiency of colour space for improvement of the printed image, the system can also be used by working with colour graduations other than the traditional ones. Specific colours are then mixed and used instead of the above stated colours.

(2) Printing in accordance with the spot colour prin-

ciple.

Here a colour separation of a design is made. Each colour separation is printed with a so-called spot colour, i.e. a specific proposed colour.

(3) Combined printing with process colour(s) and spot colours.

[0018] The colours which it is wished to print in accordance with the spot colour principle are separated. The remaining part of the design is printed with process colours.

[0019] The invention will now be elucidated with reference to the annexed drawings, wherein:

Fig. 1 shows a cut-away schematic perspective view of an apparatus according to the invention; Fig. 2 shows a schematic side view of the apparatus of Fig. 1;

Fig. 3 is a schematic side view of a conveyor with an active upper part which is straight;

Fig. 4 is a view corresponding with Fig. 3 of a conveyor with an active upper part which has a generally curved form;

Fig. 5 shows a more detailed side view of the conveyor according to Fig. 4;

Fig. 6 shows a schematic perspective view of the conveyor according to Fig. 4 and 5;

Fig. 7 is a front view along the direction of transport of a U-shaped frame which can be moved in and out of the apparatus;

Fig. 8a, 8b and 8c show respective stages of the positioning and removal from the apparatus of a beam carrying an inkjet array;

Fig. 9 shows a schematic perspective transparent view of the beam according to Fig. 8 with the associated positioning means;

Fig. 10 is a schematic view of the adjustment in a vertical plane of rollers forming part of the conveyor according to Fig. 3, 4, 5 and 6; and

Fig. 11 is a perspective view of the construction enabling a vertical angular setting of the roller according to Fig. 10.

[0020] Corresponding elements and components are designated with the same reference numerals in all the figures to be described hereinbelow.

[0021] Fig. 1 shows an apparatus 1 for printing a textile web 2 (see also Fig. 2). The apparatus comprises a main frame 3 placed on the ground or a shop floor.

[0022] As is particularly apparent from Fig. 3, 4, 5 and 6, apparatus 1 comprises an endless conveyor belt 6 which is guided over a driven roller 4 and a reversing roller 5 disposed substantially parallel thereto and which is driven by motor means (not shown) at a chosen constant speed as according to arrow 7.

[0023] The apparatus further comprises glue dispensing means 8 for applying a glue layer upstream of the active upper part 9 of conveyor belt 6 for temporary light

adhesion of textile web 2 to this active part 9 such that web 2 is fixed non-movably relative to the conveyor belt during transport by said upper part 9.

[0024] A washing device 10 shown in Fig. 5 contains sponge means 11 and a scraper 12 for removing glue residues from conveyor belt 9. These washing means 10 are placed downstream of the active part 9.

[0025] Fig. 2 shows a supply and feed unit and a pressure roller 15 which co-acts with roller 4 and which provides an intimate and adhering contact between the active upper part 9 and textile web 2.

[0026] A printing unit 16 comprises eight U-shaped frames 17, 18, 19, 20, 21, 22, 23, 24, which are each adapted to generate, under the control of a control unit (not shown), a very small droplet of coloured ink at any point in time determined by the control unit by means of an inkjet head unit added to each frame, one colour for each frame. Printing means 16 are operative in the zone of the active part 9 of the conveyor belt. The printing takes place in accordance with an adjustable pattern to be selected.

[0027] Connecting onto printing unit 16 is a dryer 25 which is finally followed by a discharge and storage unit 26 in which the dried web, otherwise than in the infeed unit 13, is not rolled up onto a roll but, swinging back and forth as according to arrow 27 in per se known manner, comes to lie under its own weight in layers of the now printed textile web 28 on a stack 29.

[0028] The printing means, of which frames 17-24 form part, comprise frame beams which are added to the respective frames and supported thereby, and each of which carries an array of inkjet heads. During operation each of these arrays is immobile relative to the upper surface defined by the active part.

[0029] As shown in Fig. 3, conveyor belt 6 is supported over active part 9 by support surfaces, drawn in this case as rollers 31, 32, 33, 34, 35, 36, 37, 38, where the support positions for the conveyor belt correspond with the zones of the inkjet arrays situated thereabove. Rollers 31-38 are incorporated in the structure such that during operation they have a substantial difference in speed from that of conveyor belt 6. The rollers can for instance be driven or braked or, in the simplest case, be fixed.

[0030] Fig. 4, 5 and 6 show an embodiment in which the rollers are ordered in an arc such that active part 9 of conveyor belt 6 is deflected by each roller through an angle in the order of 1°.

[0031] Conveyor belt 6 is arranged under tensile stress over rollers 4 and 5.

[0032] Fig. 7 shows the U-shaped frame 22 which can be displaced laterally out of apparatus 1 in the manner shown in Fig. 1. The U-shape leaves clear an opening 41 such that with a lateral displacement as according to arrow 42 the frame 22 can be moved to the right in the drawing without disrupting the operation of the rest of the apparatus. During normal operation with seven colours for instance one beam corresponding to a colour not in use can thus be removed for service lines.

[0033] The upper leg of the U bears a beam 43 which carries an inkjet array in a manner not shown. Beam 43 can be positioned very precisely relative to lower leg 44 by means of respective recesses and protrusions.

[0034] Reference numeral 71 designates a supply station for coloured ink. As shown particularly clearly in Fig. 2, this station 2 contains two containers 72, 73, each with its own colour, between which it is possible to switch, or with the same colour for continuation of the printing process when one container is completely empty.

[0035] Fig. 8a shows that beam 43 is positioned as according to an arrow 45 such that it comes to lie in its nominal position with great precision in three independent directions.

[0036] Fig. 8b shows that by means of a drive 46 the beam 43 can be lifted out of positioning means 47, thus becomes freely suspended and can then be pushed as according to Fig. 8c to the right out of the frame in the direction of arrows 48.

[0037] Fig. 9 shows by way of example a beam 43 which is provided on its underside with three V-shaped grooves 51, 52, 53 which co-act with respective balls 54, 55, 56.

[0038] Fig. 10 shows the manner in which roller 5 can be tilted in a vertical plane, whereby a certain torsion is created in conveyor belt 6 which has the consequence that the belt undergoes a force whereby it leaves the transverse position it occupies and undergoes a gradual lateral displacement. By appropriate control it is thus possible to achieve that conveyor belt 6 retains its nominal transverse position with very great precision. In this example, not drawn to scale, the Δz displacement can amount for instance to a maximum of 0.1 μm . The indicated displacement Δy depends on the length of roller 5. This displacement is a second order effect compared to Δz , and is therefore wholly negligible.

[0039] In the exemplary embodiment of Fig. 10, a tilting takes place around the centre of axis 51 to the position 51'. Where this tilting takes place is wholly unimportant. What is important is that the belt undergoes a certain torsion, whereby the side edges of the belt acquire a helical shape with a very small angle.

[0040] The bearing on the one side can for instance have a substantially fixed arrangement, while the bearing on the other side of roller 5 is vertically displaceable. This is a mechanically very simple but nevertheless wholly reliable solution. Fig. 11 shows such an embodiment wherein on the side which is not drawn roller 5 is rotatable on its rotation shaft 52 substantially at a fixed position, while on the side shown in Fig. 11 it is supported by a bearing 53 which is pivotable relative to a frame beam 56 forming part of a frame by means of a pull rod 54 with a nut 55. A stepping motor 57 is provided with a rotatingly driven nut and an associated screw spindle 58 which, when driven by the stepping motor, can make a reciprocating movement as according to an arrow 59. The upper surface 60 of a cam lever 61 is hereby dis-

placed against sub-frame 62, which can thereby undergo an upward and respectively downward directed displacement with associated adjustment of the position of the axis of shaft 52, whereby the above mentioned helix angle is changed. Not shown is that the control of stepping motor 57 takes place by a control unit which receives transverse position signals from an optical sensor situated in the immediate vicinity of the reversing roller. The embodiment is such that the optical sensor always performs a transverse position measurement at the same longitudinal point of the edge of the conveyor belt, thereby obtaining a determination of the transverse position.

[0041] Owing to the measures stated in the introduction the apparatus can display an exceptional accuracy, whereby the printed images realized with the apparatus are of a quality unknown up until now.

Claims

1. Apparatus for printing a web of textile, which apparatus comprises:

a main frame;
 an endless conveyor belt which is guided over a driven roller and a reversing roller disposed substantially parallel thereto and which is driven by motor means at a chosen constant speed;
 glue dispensing means for applying a glue layer upstream of the active upper part of the conveyor belt for temporary light adhesion of the textile web to this active part such that this web is fixed non-movably relative to the conveyor belt;
 optional washing means placed downstream relative to the active part for removing the glue from the conveyor belt;
 supply and feed means for feeding a textile web from a supply to the active part of the conveyor belt;
 printing means for printing the passing textile web in the zone of the active part of the conveyor belt in a number of colours in accordance with an adjustable pattern for selecting; and
 discharge and storage means for removing the printed textile web from the conveyor belt and subsequent storage thereof;

characterized by

a number of support surfaces distributed over the length of the active part and disposed thereunder at fixed positions and in pressing co-action with the downward directed surface of the conveyor belt, each of which support surfaces has a certain minimal speed relative to the active part, which minimal relative speed is above the relative speed corresponding with

the coulomb friction.

2. Apparatus as claimed in claim 1,
characterized in that
 the support surfaces are embodied as cylindrical rollers extending in transverse direction relative to the active part, which rollers are driven or braked.
3. Apparatus as claimed in claim 2,
characterized in that
 the rollers are stationary.
4. Apparatus as claimed in claim 1,
characterized in that
 the support surfaces are stationary and each have a prismatic form, the main direction of which extends in transverse direction relative to the active part.
5. Apparatus as claimed in any of the foregoing claims,
characterized in that
 the printing means comprise a number of, for instance 2-8, frame beams extending in transverse direction above said active part at determined mutual longitudinal distances along the direction of transport, each of which frame beams carries an array of inkjet heads and each of which is immobile during operation relative to the plane defined by the active part;
 control means are present which fulfil at least the following functions of:
 storing a chosen printing pattern by means of inputting pattern information, for instance from a scanner;
 energizing the inkjet heads, also in relation to the chosen set speed of the conveyor belt and the mutual distances in the direction of transport between successive inkjet heads for the respective colours, such that each head sprays droplets of ink of the relevant colour onto the web at the positions on the web determined by the control means;
 each support surface is placed at a position corresponding to the position of an array of inkjet heads.
6. Apparatus as claimed in any of the foregoing claims,
characterized in that
 the support surfaces are placed relative to each other such that the active part of the conveyor belt is deflected through a certain angle by each support surface.

7. Apparatus as claimed in claim 6,
characterized in that
the angle has a value in the order of magnitude of 1° .

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8. Apparatus as claimed in claim 7,
characterized in that
said angles are substantially the same for all support surfaces.

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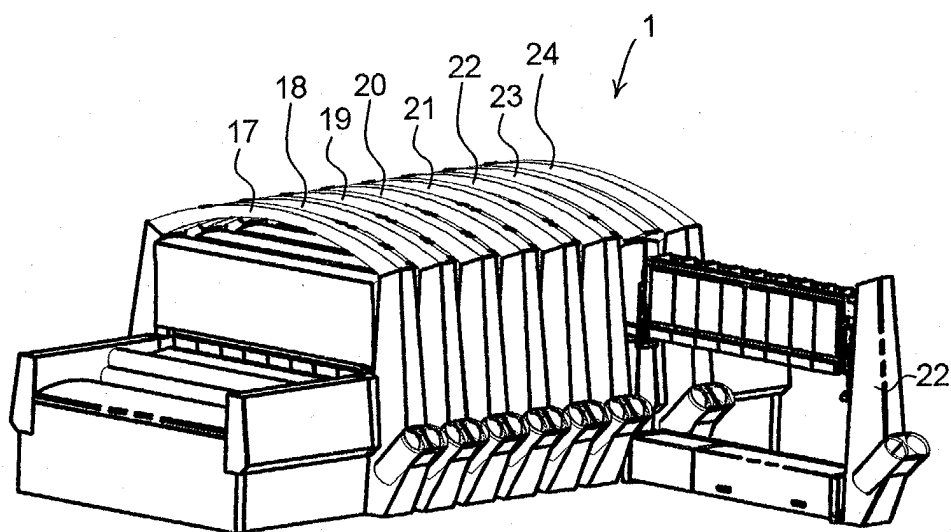


Fig. 1

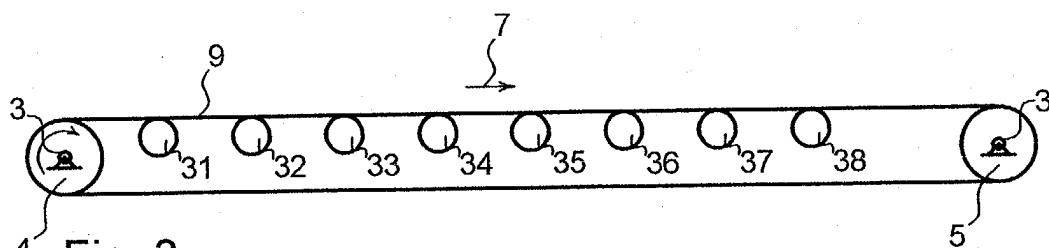


Fig. 3

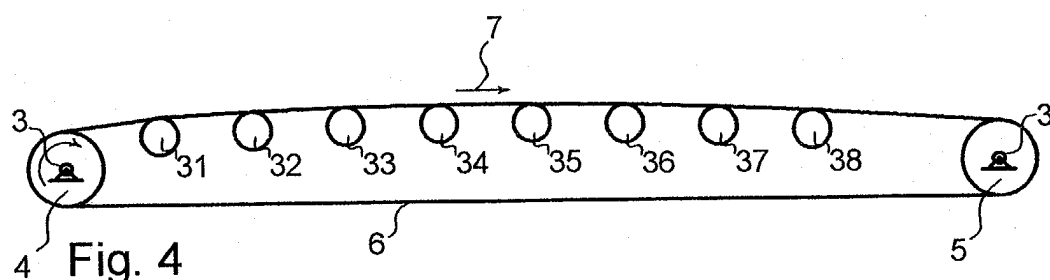


Fig. 4

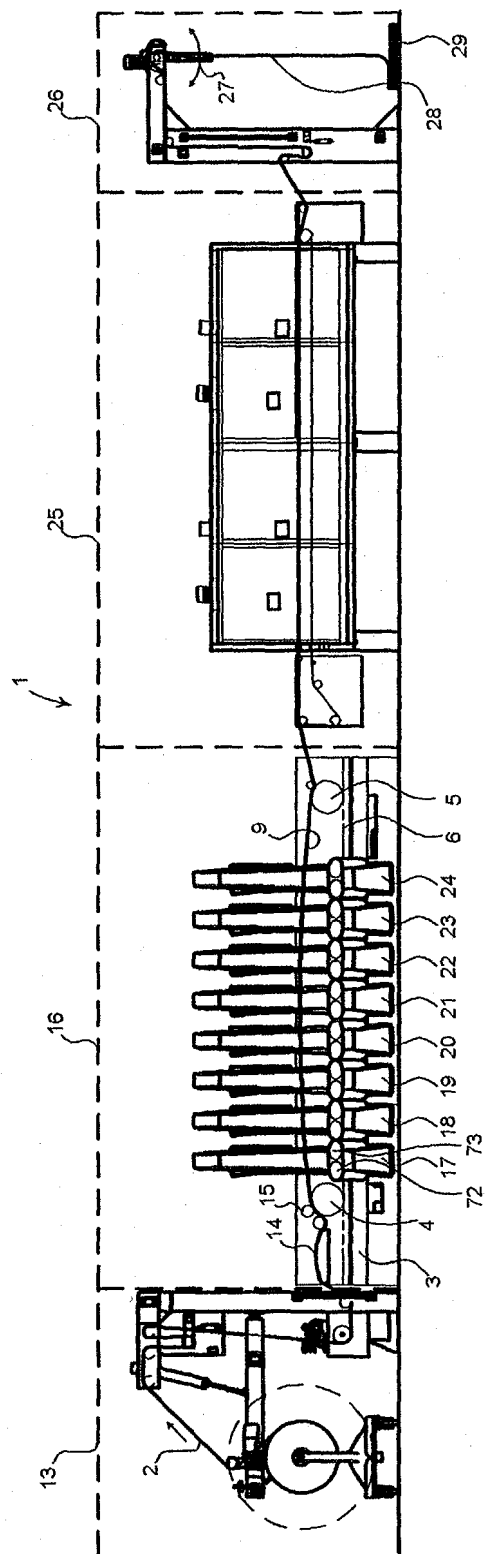


Fig. 2

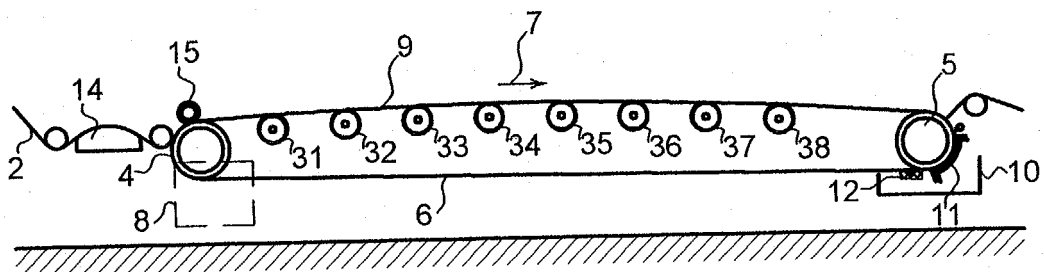


Fig. 5

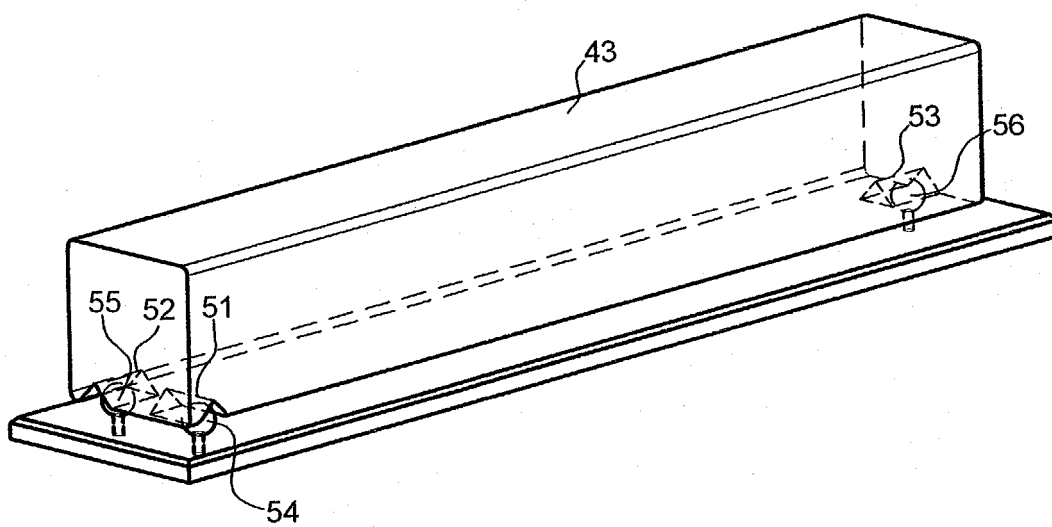


Fig. 9

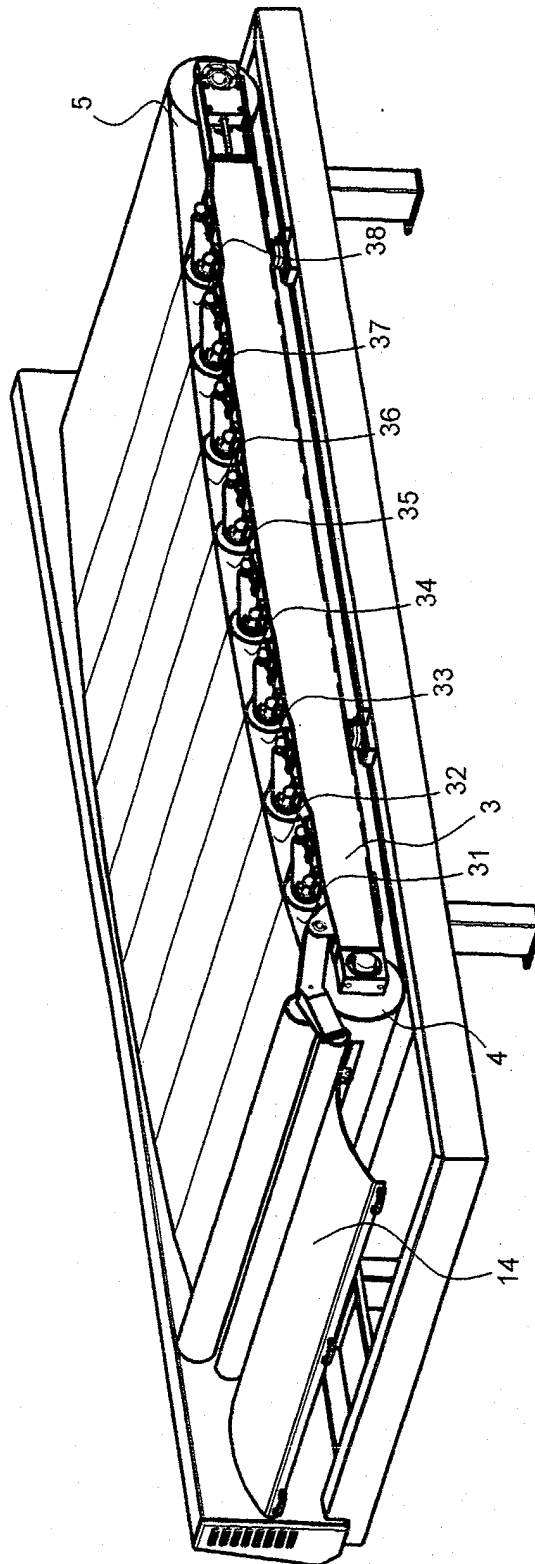


Fig. 6

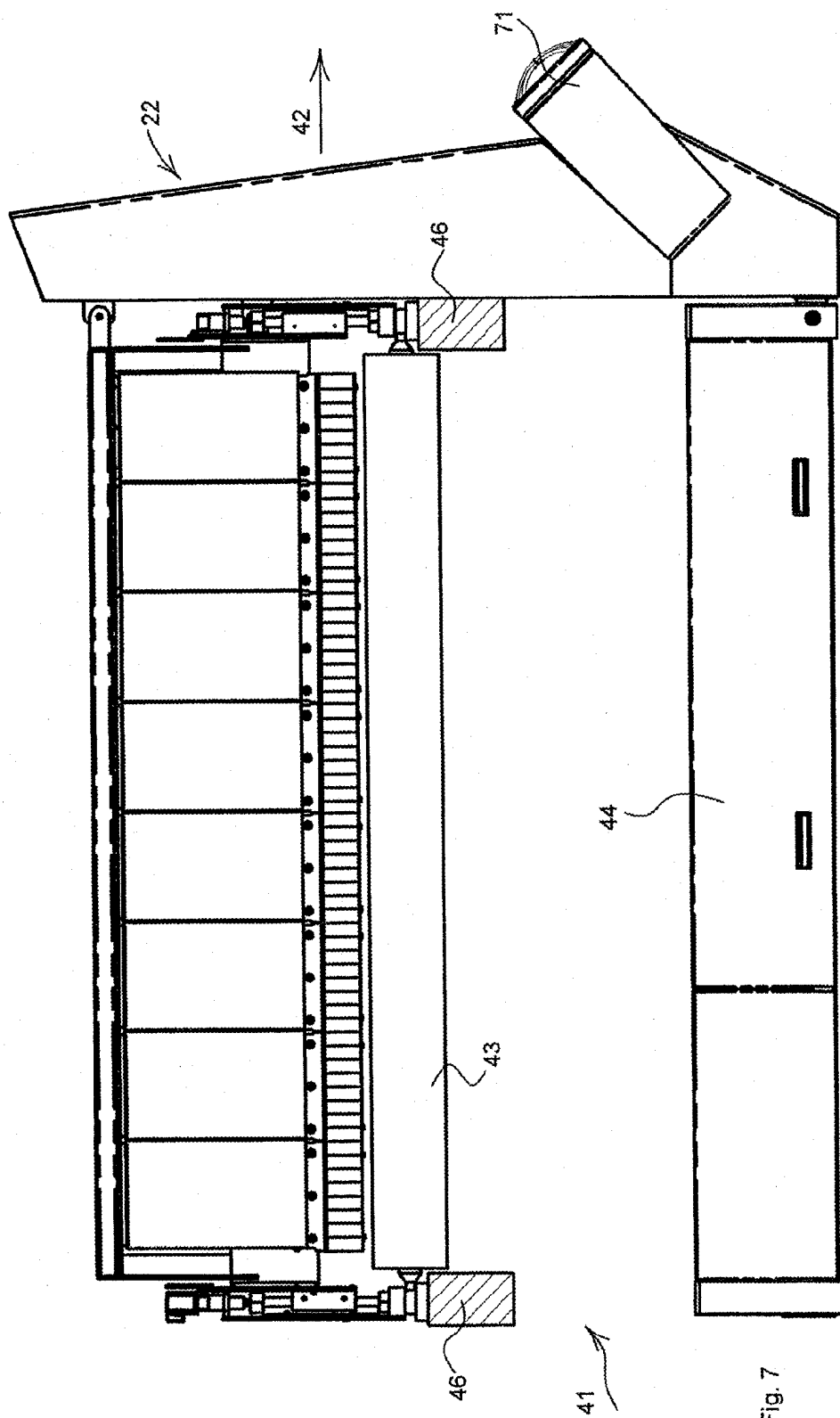


Fig. 7

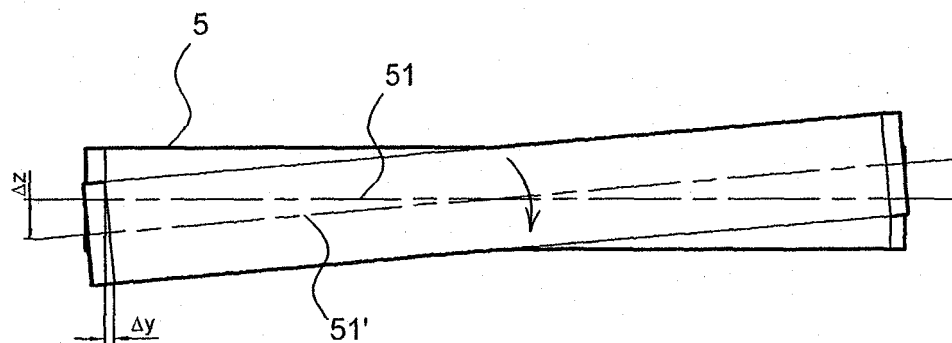


Fig. 10

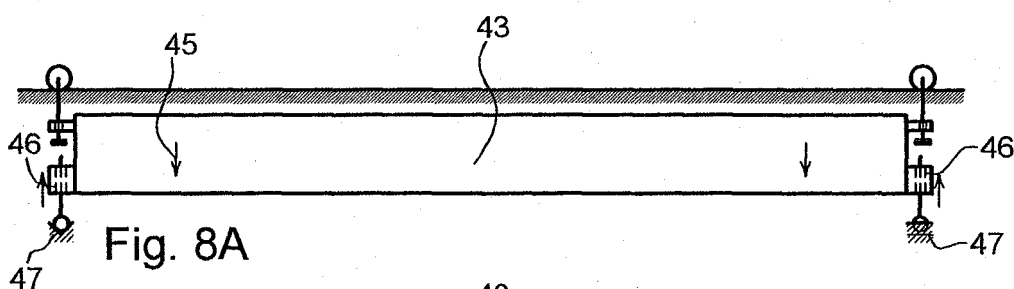


Fig. 8A

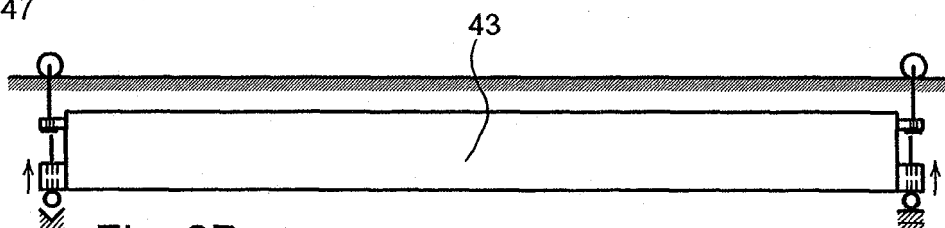


Fig. 8B

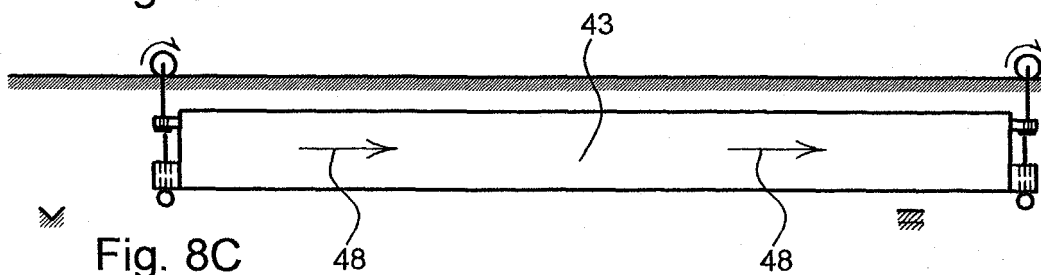


Fig. 8C

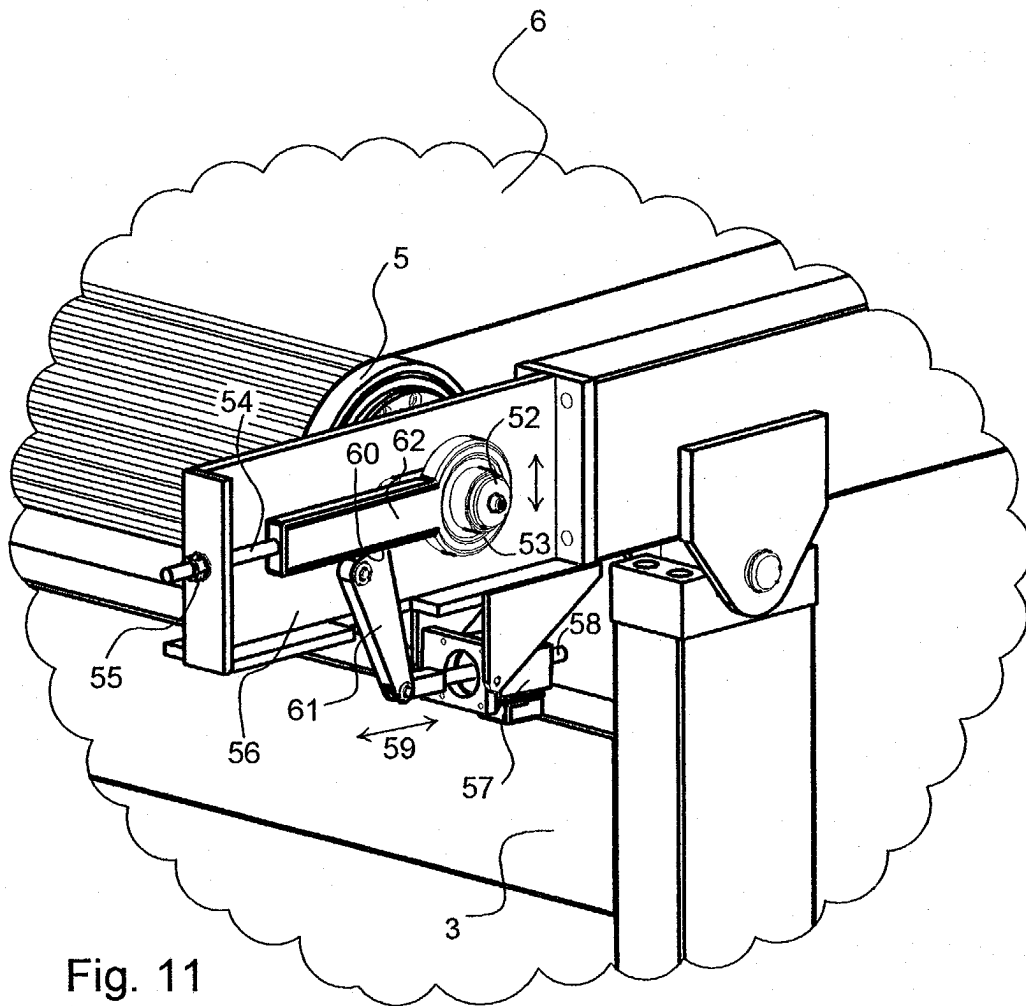


Fig. 11



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Application Number
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Place of search The Hague		Date of completion of the search 20 October 2004	Examiner Duquénoy, A
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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