

(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. **AU 200238271 B2**
(10) Patent No. **783376**

(54) Title
Device for held conveyance of flat articles in a dense conveying stream

(51)⁶ International Patent Classification(s)
B65H 029/04 **B65H** 029/06

(21) Application No: 200238271 (22) Application Date: 2002 .05 .09

(30) Priority Data

(31) Number (32) Date (33) Country
974/01 2001 .05 .25 CH

(43) Publication Date : 2002 .11 .28

(43) Publication Journal Date : 2002 .11 .28

(44) Accepted Journal Date : 2005 .10 .20

(71) Applicant(s)
Ferag AG

(72) Inventor(s)
Erwin Muller

(74) Agent/Attorney
Griffith Hack,GPO Box 1285K,MELBOURNE VIC 3001

(56) Related Art
EP 0557679
EP 1044907
DE 19906202

ABSTRACT

For conveying flat articles (10) in dense conveying streams, grippers (3) conveyed one behind the other by means of conveying elements (1) are used, each gripper (3) holding one of the articles gripped in an edge zone. For increasing the possibilities for changing the orientation of the flat articles (10) during such conveyance, the grippers (3) are attached to the conveying elements (1) by means of asymmetrically projecting gripper arms (2) and the grippers (3) are designed to be rotated through 360° around the gripper arm axis. The device can be used universally in particular for held conveyance of printed products and it is very easily adjustable for differing applications.

15 **(Figure 1)**

H:\Linda\Keep\spec\P45837.doc 9/05/02

AUSTRALIA
Patents Act 1990

COMPLETE SPECIFICATION
STANDARD PATENT

Applicant(s):

FERAG AG

Invention Title:

DEVICE FOR HELD CONVEYANCE OF FLAT ARTICLES IN A
DENSE CONVEYING STREAM

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

**DEVICE FOR HELD CONVEYANCE OF FLAT ARTICLES IN A
DENSE CONVEYING STREAM**

The invention is situated in the field of materials handling technology and relates to a device according to the generic term of the independent claim. The device serves for conveying individually held flat articles in a
5 dense conveying stream, i.e., in a conveying stream, in which the articles are conveyed one after the other with distances between one another (measured in the conveying direction), which usually are smaller than the dimensions of the articles parallel to their flat extent.

10 Conveying streams of the type mentioned above are customary in the further processing of printed products, i.e., in the field of dispatch room technology, where printed products delivered from a printing machine at different time periods are processed, e.g. are combined in
15 groups, re-arranged and/or packaged, in a manner to be able to be readied for dispatch at an outlet station.

In dispatch room technology, the printed products are e.g. conveyed in imbricated streams, in which the products lie
20 lose on a conveying surface partially overlapping one another or are pressed onto such a surface with suitable means. In such an imbricated stream the spacing between the products corresponds to the distance between the leading edges of each two successive products. Depending
25 on the orientation of the products in the imbricated stream, the leading edges are oriented downwards or

H:\Linda\Keep\spec\P45837.doc 9/05/02

upwards and in the case of folded products the folded edge or the edge opposite the folded edge is the leading edge.

The orientation of the printed products in an imbricated stream can be changed, for example, by twisting or
5 deflecting the imbricated stream, wherein from a stream with leading edges lying on top a stream with leading edges lying underneath can be formed. In doing so, the printed products are inverted (the top side is turned downwards). By reversing the conveying direction of an
10 imbricated stream (winding up and unwinding again), the leading edges become the trailing edges, wherein the products maintain their position (the top side remains on top), the product sequence, however, is inverted. For other re-arrangements, in most instances every product of
15 an imbricated stream is individually gripped, is re-oriented and is then deposited in the stream once again. This however, is a very elaborate operation in particular in respect to the equipment required.

Frequently used in dispatch room technology are also dense
20 conveying streams of individually held printed products, i.e. conveying streams in which the printed products are conveyed one after the other, each one held by a gripper. The grippers are arranged one behind the other on transport elements movable along a conveying track, for
25 example, arranged on the links of a conveyor chain, and each gripper grips and holds a flat article in an edge region, e.g. in the middle region of one edge. Usually, the grippers are arranged symmetrically with respect to the conveying track of the transport elements, i.e., there

is a plane, in which the conveying track is situated and which cuts the grippers conveyed one behind the other into two functionally equivalent parts. In many instances, the grippers are swivelling parallel to the direction of conveyance either freely or in a controlled manner. The transport elements are usually moved in guide channels, which may have a curved course and if so required may be twisted.

Printed products being conveyed in a held manner can be arranged perpendicular to the conveying track (e.g., for horizontal conveyance, they are suspended vertically downwards from the grippers), so that, even if the distances between the products are smaller than the flat extent of the products, there is no overlapping and there are no leading and trailing edges. However, as soon as the products in the conveying stream are not arranged precisely perpendicular to the conveying direction, they overlap one another in a similar manner as in an imbricated stream and there are leading and trailing edges.

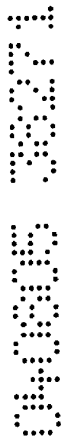
In a conveying stream, in which products are conveyed individually held by grippers, the products can be re-orientated in more ways and in a simpler manner than is the case in an imbricated stream. In particular, it is possible by simply displacing the edges opposite the held edges from a leading to a trailing position, to reverse the products (the leading edge becomes the trailing edge, the product top side becomes the bottom side).

It is the object of the invention to create a device for held conveyance of flat articles in a dense conveying stream, with which device even more re-orientations of the flat articles shall be possible during conveyance and in a most simple manner than is possible with known devices serving the same purpose. Therefore, the device can be used universally in the most diverse applications. Nonetheless, the device shall not be significantly more complicated and elaborate than known devices for held conveyance of flat articles.

This object is achieved by the device as defined in the claims. A preferred embodiment of the invention is briefly summarised hereunder.

The device according to a preferred embodiment of the invention comprises a plurality of grippers for gripping and holding the flat articles in an edge region. The grippers are designed to be opened and closed in a controlled manner. Each gripper is arranged on a gripper arm, the gripper arm being arranged on a transport element from which it projects to one side. The transport elements are movable along a conveying track and they are connected together in a chain or they are independent of one another and they move along the conveying track driven by a suitable drive, for example, guided in a suitable guide channel. The grippers are designed to rotate without limitation around the gripper arm, i.e., in essence by 360°.

By rotating the grippers around the gripper arms during conveyance, flat articles held gripped by the grippers can be brought into the most diverse spatial positions



relative to the conveying track of the transport elements.
For changing their orientations, the flat articles can
also be moved through between adjacent grippers. As shown
further on, the articles can be brought into all possible
5 orientations in the stream, if in addition to the
unlimited gripper rotation, it is possible to arrange the
conveying track to be deflected and/or twisted. Depending
on the application, the rotational position of the
grippers in one area can also be changed over time.
10 Therewith it is easily possible to change the device
according to the invention for receiving articles supplied
with various orientations and delivering them in always
the same orientation.

For a re-orientation which necessitates a movement of the
15 flat articles between adjacent grippers, the spacing
between the grippers may need adjustment to the format and
to the flexibility of the flat articles. If the grippers
are arranged on individual transport elements being
movable along the conveying track in a substantially
20 independent manner, local enlargement of the spacings
between the grippers is no problem at all.

An exemplary embodiment of the device according to the
invention and its function are described in more detail in
connection with the following Figures, wherein:

25 **Figs. 1 and 2** show an exemplary embodiment of the device
according to the invention as a schematic, three-
dimensional view (Fig. 1) and in a cross-section
perpendicular to the conveying track (Fig. 2);

Figs. 3 and 4 show the possible spatial positions of a flexible, flat article being conveyed by a device according to the invention;

5 **Fig. 5** shows conveying streams of flat articles with different object orientations, which streams can all be taken over or can be established and delivered using a device in accordance with the invention;

10 **Fig. 6** shows an exemplary application of the device according to the invention (viewed perpendicular to the conveying direction);

15 **Fig. 7** shows, in the application according to Fig. 6, taking-over of flat articles by the device according to the invention and re-orientation of the flat articles (viewed parallel to the conveying direction);

Figs. 8 and 9 show further applications of the device according to the invention;

Fig. 10 shows a further embodiment of the device according to the invention.

20 **Figs. 1 and 2** illustrate an exemplary embodiment of the device according to the invention each of the Figs. showing a section of the conveying track F and a transport element 1 movable along the conveying track F. A gripper arm 2 is arranged on the transport element. One gripper or
25 a plurality of grippers 3 is arranged on the gripper arm 2. Fig. 1 illustrates this as a schematic, three-dimensional view, Fig. 2 as a section transverse to the conveying track F.

The device comprises a multitude of advantageously identical transport elements 1, which are movable along the conveying track F being connected together in the manner of a chain with fixed and regular distances or with
5 variable distances between one another or which are movable in a manner independent of one another. For moving the transport elements 1, a suitable drive (not illustrated) is provided. One part of the transport element 1 is designed as a roller part or sliding part 4
10 rolling or gliding along in a guide channel 5. The gripper arm 2, for example, is attached to a transport element part 6 projecting from the guide channel 5.

The gripper arm 2 with the gripper 3 is arranged on the transport element 1 in an asymmetrical manner, i.e., such,
15 that the conveying track F is at a distance d from a symmetry plane S cutting the gripper 3 into two functionally equivalent halves (or a plurality of grippers into two equal parts). The distance or projection d is such, that the flat articles 10 to be gripped and to be
20 conveyed in a gripped manner do not come into contact with the guide channel 5. If the articles, as illustrated in the Figs. 1 and 2, are to be gripped in the middle of one edge, then d is to be greater than half the length of the gripped edge.

25 The gripper 3 comprises in a per se known manner two gripper jaws 3.1 and 3.2 movable relative to one another. These jaws are e.g. driven towards each other, i.e., into a closed position by a compression force and can be moved

away from one another , i.e. into an open position,
against the compression force.

For the gripper positioning, the gripper arm is installed
in a bearing in the transport element 1 such that it can
5 be rotated around its own axis substantially without
limitation. For the gripper actuation, the gripper arm
comprises two coaxial arm parts 2.1 and 2.2 capable of
rotating relative to one another within limits, wherein on
each of the arm parts 2.1 and 2.2 one of the gripper jaws
10 3.1 and 3.2 is attached in such a manner, that the gripper
3 is able to be actuated (opened and closed) by relative
rotation of the arm parts 2.1 and 2.2. For generating the
compression force between the two gripper jaws 3.1 and
3.2, e.g. a pre-tensioned spring 11 is provided between
15 the two gripper arm parts 2.1 and 2.2.

The gripper is controlled with respect to its rotational
position and with respect to its opening condition, for
taking over articles, during conveyance of the articles
and for delivering the articles. In Figs. 1 and 2, the
20 gripper 3 is depicted only in its closed state and in two
rotational positions differing from one another by 180°
(positions 3 and 3' of the gripper or positions 10 and 10'
of a flat article held by the gripper). For gripper
control, for example, each arm part 2.1 and 2.2 carries
25 one control roller 12.1 and 12.2 on the gripper arm side
opposite the gripper. For guiding the control rollers,
cams 13.1 and 13.2 are provided along at least part of the
conveying track F, the control rollers 12.1 and 12.2

rolling along the cams, when the transport element 1 is conveyed along the conveying track F.

The control roller 12.2 is arranged on the outer arm part 2.2 and cam 13.2, along which the control roller 12.2
5 rolls, determines the rotational position of the gripper 3. In sections of the conveying path F, in which the rotational position of the grippers 3 is not relevant or in which the grippers are to be freely rotating, cam 13.2 can be missing. The control roller 12.1 is arranged on the
10 central arm part 2.1, which itself is connected with the outer arm part 2.2 through the pre-tensioned spring 11. Cam 13.1, along which this control roller 12.1. rolls, determines the opening condition of the gripper 3. In sections of the conveying track F, in which the grippers
15 are to be constantly closed, this cam 13.1 can be missing.

As is evident from Fig 2, the free end of the gripper arm 2 may be extended in such a manner, that it projects beyond a held flat article 10 on the side opposite the transport element 1. The gripper arm 2 may comprise a
20 supporting roller 15 on this side, which rolls along a guide 16 or in it. Such an arrangement is advantageous in cases, in which the grippers 3 have to hold large articles and the gripper arms 2 for this purpose have to project a long way, in cases in which the grippers 3 have to bear
25 the full weight of the articles 10 and/or in cases in which very accurate positioning of the grippers 3 is necessary. In place of the supporting roller 15, it is also possible to provide a further transport element 1.

The fundamental characteristics of transport element 1, gripper arm 2, gripper 3 and gripper control in accordance with the invention are clearly evident from Figs 1 and 2. For one skilled in the art it is very easily possible to
5 modify the embodiments illustrated in these Figs. in order to create further embodiments of the device according to the invention. In particular, the transport elements 1, the active connection between the two gripper jaws 3.1 und 3.2 and the gripper control means 12.1/12.2 and 13.1/13.2
10 can be designed in the most diverse ways being known by one skilled in the art. In particular, instead of the as such stationary cam 13.1 and 13.2, which act on all grippers conveyed past in the same manner, control means may also be provided, which e.g. for selective delivery of
15 flat articles by the grippers, only act on selected ones of the grippers. Furthermore, it is possible to provide on each gripper arm 2, a plurality of grippers 3 and simultaneously actuating and rotating them.

Figs. 3 and 4 show in a very schematic manner and viewed
20 transverse to the conveying track F, positions 10.1 to 10.18, which a flat object 10 conveyed by a device in accordance with the invention is able to assume (the flat articles are illustrated to be printed products held gripped at their folded edge), when the gripper 3, which
25 holds the article 10, is rotated clockwise (Fig. 3) or counter-clockwise (Fig. 4) around the axis of the gripper arm (not depicted in Figs. 3 and 4). To be noted in particular is the manner in which the article between positions 10.2 and 10.5, 10.6 and 10.8 as well as 10.17
30 and 10.18 is moved through between two adjacent grippers 3 from one side of the conveying track F to its other side.

From Figs. 3 and 4 it is also evident, that such movement of the flat articles may call for an adjustment of the distances between the grippers to the size and to the flexibility of the flat articles 10.

5 Figs. 3 and 4 can also be perceived as a hypothetical snapshot of a conveying stream, in which the gripper positions are continually changed. If a gripper actuation is superimposed on this hypothesis, in the case of which the grippers are closed in a first position and are opened
10 again in a second position downstream of the first one, it also becomes clear, that with the help of the device in accordance with the invention flat articles can be taken over from conveying streams with substantially any orientation of the articles and that by delivering the
15 flat articles by the device according to the invention other conveying streams with substantially any orientation of the articles can be established. This shall be made even more clear by Fig. 5.

Fig. 5 (viewed transverse to the conveying tracks F and
20 F') shows folded printed products held on their folded edge and having a front side (unbroken line) and a back side (broken line) and serving as examples of flat articles 10. The printed products are shown in sections A.1 to A.12 of conveying streams, in which these articles
25 can be conveyed with the help of a device according to the invention.

Every one of the sections A.1 to A.12, which is illustrated on the conveying track F, or F' respectively,

H:\Linda\Keep\apoc\P45837.doc 9/05/02

can be established starting from another section depicted on the same conveying track F or F' respectively by simple rotation of the grippers. Every section A.7 to A.12 illustrated on the conveying track F' can be established
5 from a section A.1 to A.6 illustrated on the conveying track F (and vice-versa) by twisting the conveying track or by a deflection of the conveying track in combination with a gripper rotation. Each one of the illustrated conveying stream sections A.1 to A.12 can depict a just
10 picked up conveying stream, i.e. a conveying stream not yet changed after taking over or a conveying stream ready for delivery. Obviously, all possible conveying streams (front side on top or underneath, folded edge leading or trailing, leading edge on top or underneath) can be taken
15 over and established using the device in accordance with the invention with corresponding gripper positioning and synchronisation between gripper conveyance and supply stream. The same is applicable for conveying streams, in which the flat articles are oriented exactly transverse to
20 the direction of conveyance (front side in front or behind, folded edge on the bottom or on the top).

Figs. 6 to 9 show still schematically but in somewhat more detail than Figs. 3 to 5 applications of the device according to the invention, in particular take-over and
25 handing-over of flat articles 10 by the device in accordance with the invention.

Fig. 6 illustrates a stream transformation by a device in accordance with the invention. With an as such known conveying device 20, folded printed products (flat

articles 10) are supplied, being held gripped and suspended at their edges opposite the folded edges and are taken over by grippers 3 of a device according to the invention 30. The conveying stream being taken over
5 corresponds with respect to the article orientation to section A 2 or A 11 of Fig. 5. After the take-over of the printed products, the grippers 3 are rotated in such a way, that the printed products are brought into a suspended position (section A.5 or A.8 of Fig. 5), in
10 which the edges opposite the folded edges are positioned on the bottom. The articles are opened with suitable means (not illustrated) and, for example, deposited on to saddle-shaped supports 31 of a collecting drum 32.

From Fig. 6 it is clearly evident, how easily the
15 illustrated stream transformation can be implemented using the device according to the invention.

Fig. 7 illustrates, viewed parallel to the conveying track F, the take-over of the articles by the device 30 according to the invention from the conveying device 20,
20 which take-over is viewed transverse to the conveying track F in Fig. 6. Conveying device 20 comprises transport elements 20.1 with grippers 20.2 and with roller or sliding parts rolling or sliding in a conveying channel. In this case, however, the conveying track of the
25 transport elements 20.1 lies in the one plane S' separating the grippers 20.2 into two functionally equivalent parts. In the case of the device according to the invention this does not apply (refer to Fig. 2 and the corresponding parts of the specification).

Fig. 8 illustrates, viewed again transverse to the conveying track F, a further possible handing-over or delivery of flat articles 10 (folded printed products) by a device in accordance with the invention 30, the articles to be delivered e.g. having been taken over as shown in Fig. 6. With their held edges leading, the articles are deposited on L-shaped supports 40, for example, for producing stacks. Thanks to the projection of the gripper arms relative to the conveying elements and relative to the guide channel, which guides the movement of the conveying elements, meshing of grippers and supports necessary for such deposition is easily possible. It goes without saying, that the handing-over illustrated in Fig. 8 can be preceded by a different type of taking-over than the taking-over depicted in Fig. 6, which then, if so required, calls for a re-orientation of the products 10 prior to the handing-over being implemented by gripper rotation.

In the same manner as illustrated in Fig. 8 for the grippers of a device according to the invention and L-shaped supports of a further device, it is possible also for grippers of two devices in accordance with the invention to pass through one another in a comb like or meshing manner. Furthermore, it is possible for grippers of two devices according to the invention to be conveyed alternately in a common conveying stream, wherein the two conveying devices are arranged on opposite sides of the conveying stream and the gripper arms of the two devices are arranged as projecting towards the conveying stream from opposite sides. Printed products conveyed in a common conveying stream of this kind can have alternately

differing orientations, and therefore, for example, are capable of being directly stacked in cross stacks.

Fig. 9 depicts a further example of a take-over of flat articles by a device 30 in accordance with the invention.

5 The supplied stream of flat articles 10 is an imbricated stream of folded printed products with folded edges leading and lying on top of the stream, which, for example, is supplied on a conveyor belt 41 from a rotation. The grippers 3 of the device according to the
10 invention 30 approach the imbricated stream from above and in the take-over zone have a lower speed than the conveyor belt 41, so that the printed products or their folded edges respectively are pushed into grippers 3 for being taken over. Thereupon, the grippers 3 are closed.

15 It is clearly evident from Fig. 9, that an imbricated stream (for example, from a coil), in which the folded edges of the printed products are lying on top in the conveying stream, but are trailing, can also be taken over by the device in accordance with the invention. For such
20 take-over, the grippers are solely rotated by about 180° relative to the gripper position of Fig. 8, so that the gripper mouths are directed forwards in conveying direction, and the supply speed is adjusted such, that the grippers catch up with the products from behind and
25 thereby slide over the folded edges. The device according to the invention 30 and the supply device 41 as illustrated in Fig. 9 can therefore be adapted to selective use for taking-over printed products with leading or with trailing folded edges lying on top by a

very simple conversion, wherein the products independent
of the manner of their supply can be brought into a
predefined handing-over position. Necessary for the
conversion is in essence a displacement of the cam
5 controlling the gripper position in the take-over zone.

Fig. 10 illustrates a further embodiment of the device
according to the invention, which is suitable in
particular for taking-over or for establishing imbricated
streams, in which the flat articles 10 are arranged
10 without edges aligned transverse to the conveying track F.
For this purpose, the grippers arms 2, in contrast to the
depiction in the preceding Figs., are not arranged as
projecting transverse to the conveying track F, but rather
projecting at an angle α . This angle α , for example, may
15 be 60°, 45°, 120° or 135°.

In this specification, except where the context requires
otherwise, the words "comprise", "comprises", and
"comprising" mean "include", "includes", and "including",
respectively. That is, when the invention is described or
20 defined as comprising specified features, various
embodiments of the same invention may also include
additional features.

For the purposes of this specification it will be clearly
understood that the word "comprising" means "including but
25 not limited to", and that the word "comprises" has a
corresponding meaning.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any
5 other country.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Device for held conveyance of flat articles in a dense conveying stream, the device comprising a plurality of grippers being equipped for controlled taking-over,
5 holding and releasing one flat article each in an edge zone and being conveyed with the help of a conveying element, the conveying elements being displaceable along a conveying track one behind the other, characterized in that each one of the grippers is
10 arranged on a gripper arm, the gripper arm with the gripper being arranged on the conveying element asymmetrically projecting, so that the conveying track of the conveying elements is situated at a distance from a symmetry plane separating the gripper into two
15 functionally equivalent parts, and that the gripper is designed for controlled rotation by 360° around a gripper arm axis.

2. Device in accordance with claim 1, characterized in that the gripper arm forms an angle of 45°, 60° or 90°
20 with the conveying track.

3. Device according to any one of claims 1 or 2, characterized in that the gripper comprises two gripper jaws, that the gripper arm comprises two coaxially arranged gripper arm parts, that each one of
25 the gripper jaws is attached to one of the gripper arm parts and that the two gripper arm parts are arranged

H:\Linda\Keep\spec\F45837.doc 9/05/02

to be rotated without limitation relative to the conveying element and to be rotated relative to one another with limitations.

4. Device in accordance with claim 3, characterized in
5 that the two gripper arms parts are pre-tensioned relative to one another in such a manner, that the gripper jaws arranged on them are pressed against one another by the pre-tensioning force.

5. Device according to claim 4, characterized in that for
10 the pre-tensioning of the two gripper arm parts a spring is provided.

6. Device in accordance with any one of claims 3 to 5, characterized in that for controlled gripper actuation and for controlling the rotational position of the
15 grippers relative to the gripper arms, control means are provided on the two gripper arm parts.

7. Device according to claim 6, characterized in that the control means are control rollers rolling along cams.

8. Device in accordance with any one of claims 1 to 7,
20 characterized in that the control means are arranged along the conveying track in such a manner, that in at least one first location of the conveying track the grippers are closed for taking over articles and at a second location downstream of the first location the

grippers are opened for handing over the articles and that at a third location between the first and second locations, the rotational position of the grippers is changed.

- 5 9. Device according to claim 8, characterized in that, depending on the application, the control means are changed at the first, second or third location.
10. Device in accordance with claim 8, characterized in that, in the third location, the control means are
10 designed in such a manner, that the grippers are moved from one side of a gripper conveying track to the other side of it.
11. Device according to claim 10, characterized in that, in the third location of the conveying track, means
15 for enlarging the distances between the grippers are provided.
12. Device in accordance with any one of claims 1 to 11, characterized in that the conveying elements are arranged as sliding or rolling in a conveying channel.
- 20 13. Device according to claim 12, characterized in that the conveying elements are independent of one another.

14. Use of a device in accordance with any one of claims 1 to 13 for the transforming a dense conveying stream of printed products with respect to the orientation of the printed products in the conveying stream.
- 5 15. Use of a device according to any one of claims 9 to 13 for selectively taking over articles from imbricated streams with different article orientations.
16. Use of two devices in accordance with any one of claims 1 to 13 for establishing conveying streams, in
10 which articles with alternating article orientations are conveyed.
17. Use of a device according to any one of claims 1 to 13 for transferring articles to L-shaped supports in a combing manner.
- 15 18. A device substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 9th day of May 2002

Ferag Ag

By Their Patent Attorneys

20 Griffith Hack

Fellows Institute of Patent and
Trade Mark Attorneys of Australia

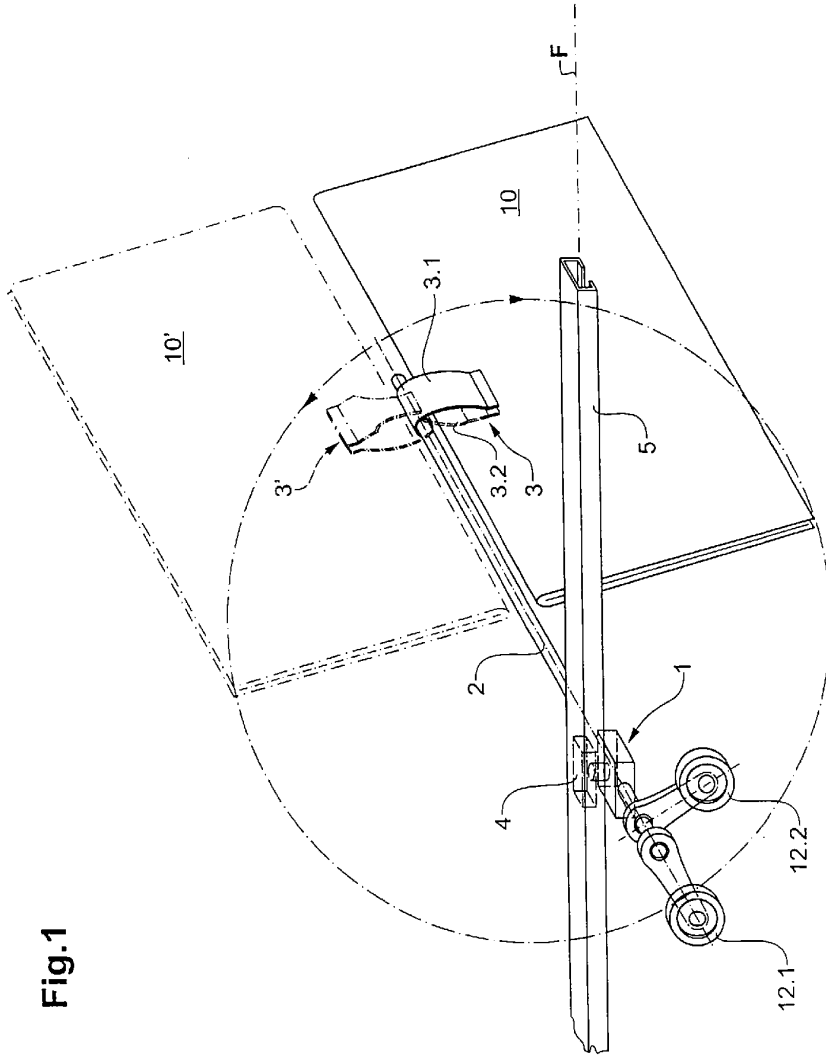


Fig.1

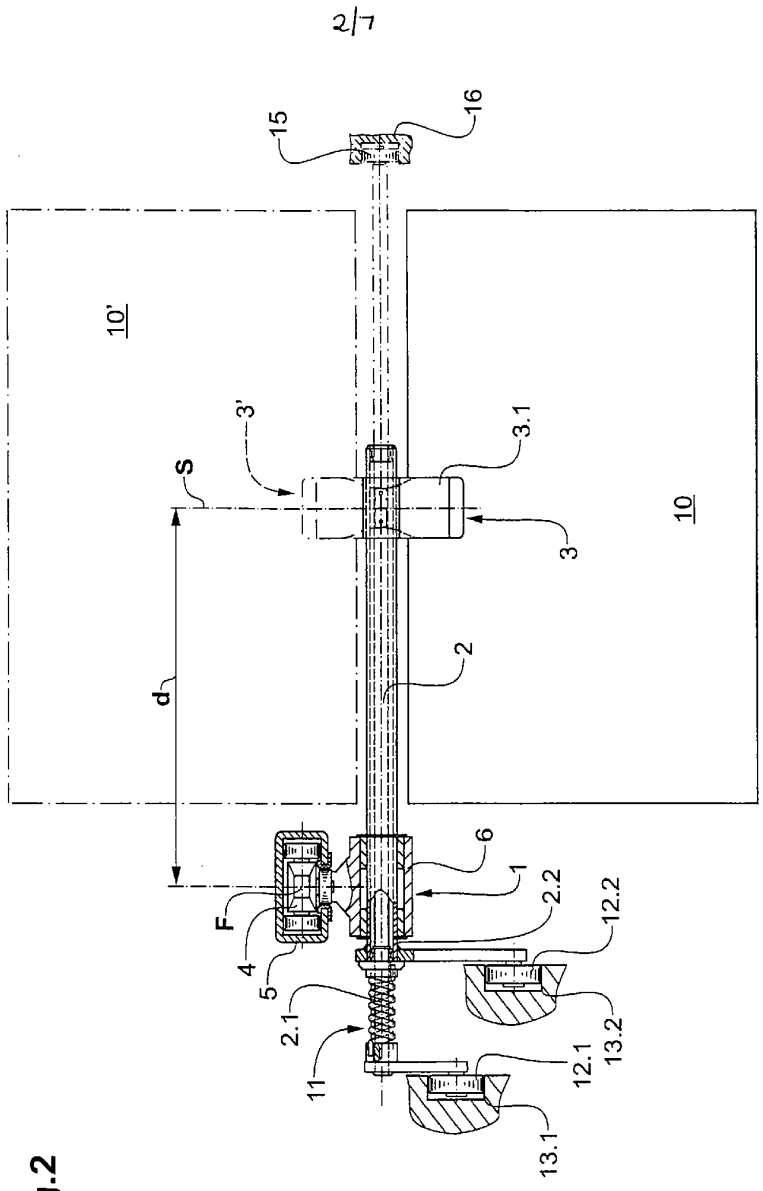


Fig.2

Fig.3

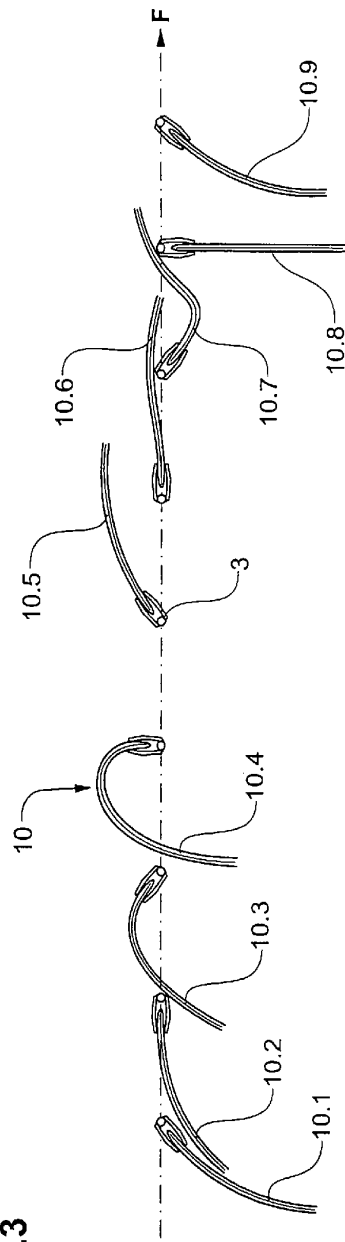


Fig.4

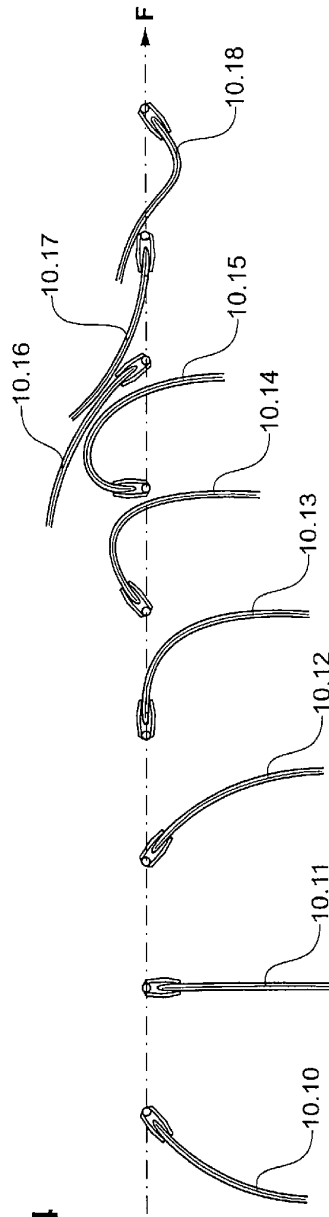
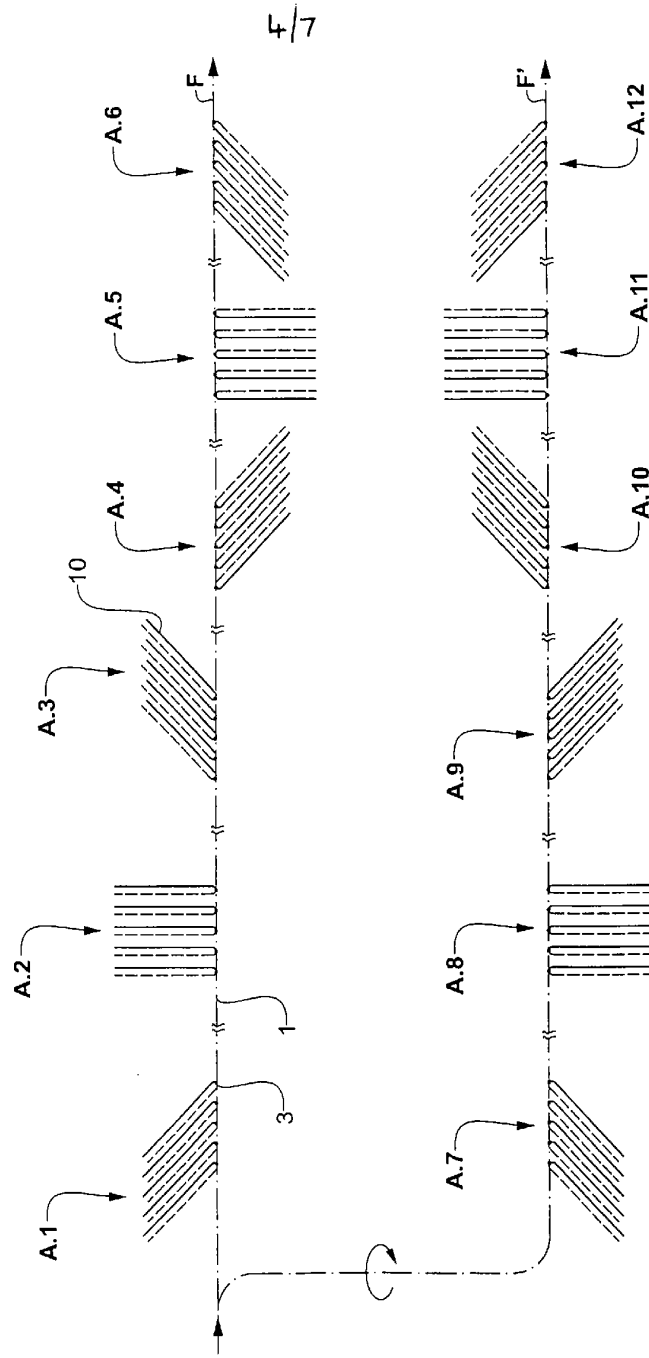
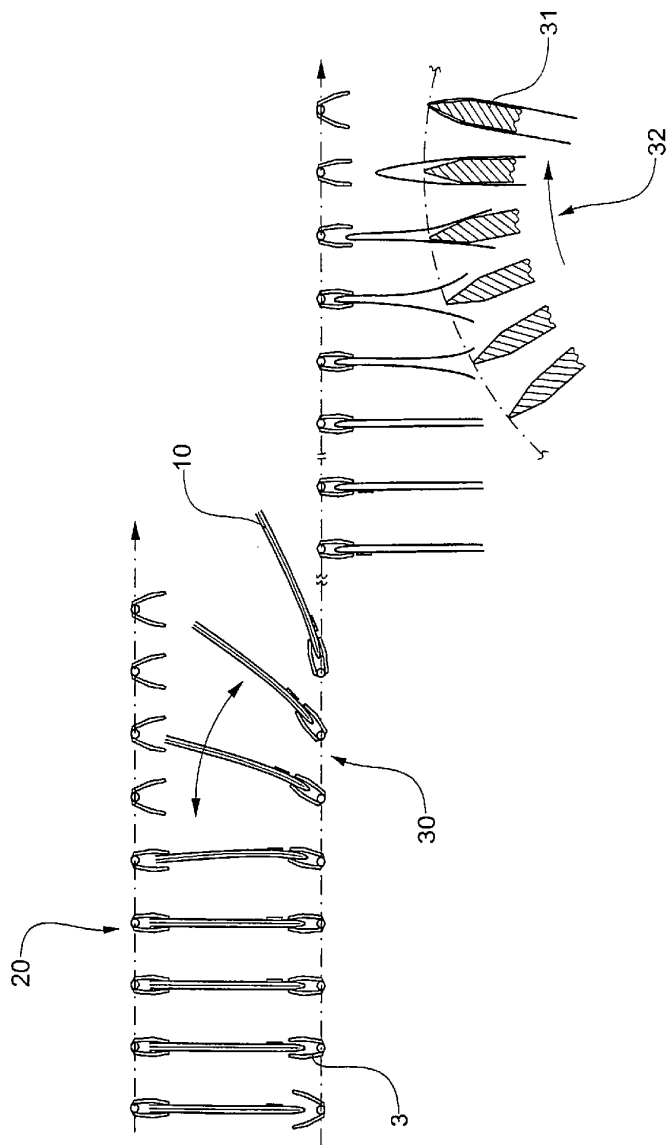


Fig.5



4/7

Fig.6



6/7

Fig.7

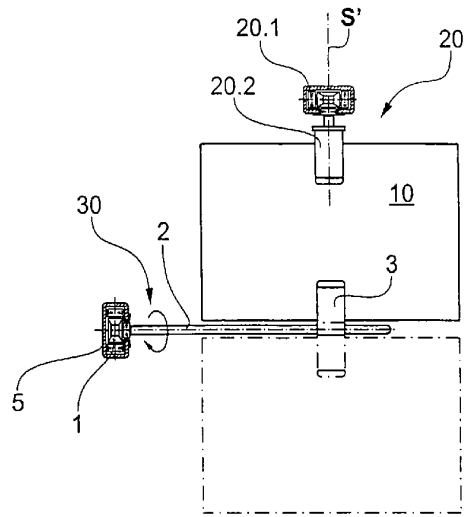
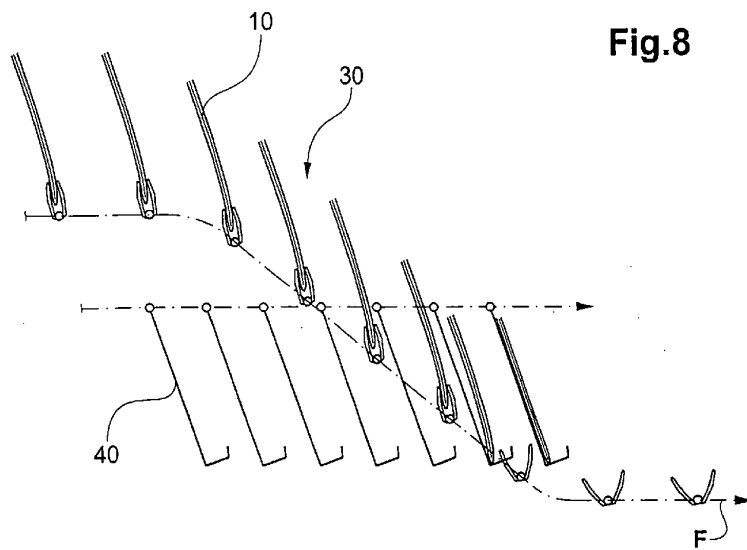


Fig.8



7/7

Fig.9

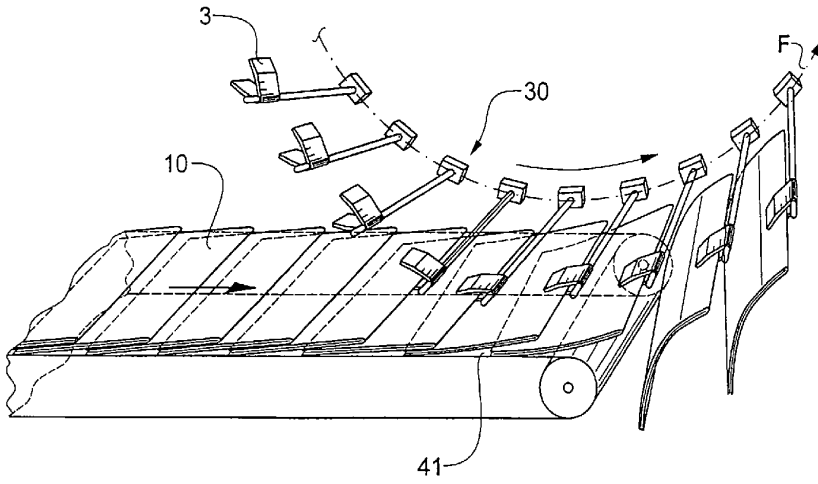


Fig.10

