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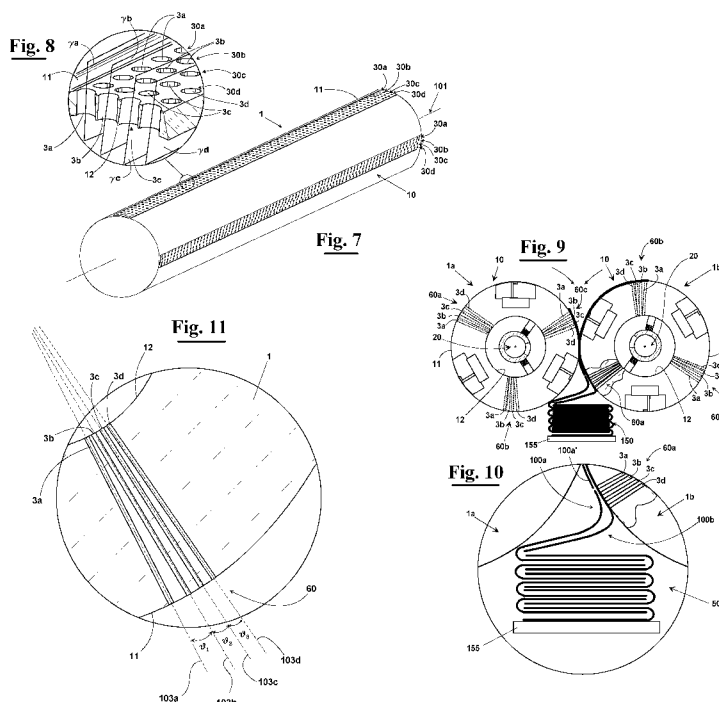
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(54) Title: IMPROVED SUCTION ROLL FOR PAPER CONVERTING MACHINES



(57) Abstract: A roll (1) for folding, or interfolding, a web, or sheet, of paper, (100) fed along an advancing direction in a paper converting machine, or similar machines, comprises a tubular body (10) configured to rotate about a longitudinal rotation axis (101), and having an external lateral surface (11) and an internal lateral surface (12) pneumatically communicating through a plurality of suction holes (3a, 3b) organized in a predetermined number of suction groups (60). Each suction group (60) comprises a predetermined number of close longitudinal rows (30a, 30b) of suction holes (3a, 3b) distributed along the tubular body (10). A suction chamber (20) is, then, provided arranged internally to the roll (1) for folding, or interfolding, and pneumatically connected to a suction device generating a predetermined vacuum level. Each suction group (60) comprises at least 3 close longitudinal rows (30a, 30b, 30c) of suction holes (3a, 3b, 3c) configured to hold each sheet, or web, of paper (100) on the roll (1) at a respective portion of the external lateral surface (11).

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TITLE

IMPROVED SUCTION ROLL FOR PAPER CONVERTING MACHINES

DESCRIPTIONField of the invention

5 The present invention relates to the technical field of paper converting and related products, and in particular relates to a machine for interfolding a web, or sheet of paper, equipped with at least a suction roll, in particular a folding, or interfolding, roll, providing a
10 particular arrangement of the suction holes, which connected to a vacuum generation system, cause the sheet, or web, of paper to adhere on the roll surface.

Description of the prior art

15 As it is known, a lot of machines used in the paper industry, for example, winding and interfolding machines, provide systems for causing the adhesion of the processed web, or sheet, of paper, on the surface of the rolls, in determined operating steps, in such a way that the paper follows a desired path.

20 In particular, these systems are used to carry out the fundamental operations of cutting the paper, or transferring very quickly the paper same from a roll to another one, or also folding the paper. The systems causing the above mentioned adhesion provide mechanical
25 clamps, or pneumatic suction systems.

 In the case of air suction systems, a device is provided for generating a determined vacuum level, that is pneumatically connected with the internal part of the rolls. More precisely, the surface of the advancing rolls

provides a determined number of couples of longitudinal rows of suction holes, normally 3, or 4, couples of rows of holes. These are pneumatically connected to the vacuum generation device in such a way to cause the processed
5 paper to adhere at a determined sector of the roll surface.

A known kind of advancing rolls provides a bell distributor that is coupled to the roll for folding, or interfolding, at an its end, and that divides the roll
10 surface in sectors where the paper is sucked, i.e. where the rows of holes suck, and in sectors where the processed sheet is, instead, not held by the roll and, therefore, can be transferred on another roll, for example in order to carry out the folding of the sheet.

15 However, this kind of roll for folding, or interfolding, has some drawbacks. In the first place, till the longitudinal channels are pneumatically connected with the vacuum generation device, the longitudinal channels are at atmospheric pressure. Therefore, a row of holes
20 starts to suck the sheet of paper on the roll surface only after that all the air has been removed from the longitudinal channel through which pneumatically communicates with the suction device. Therefore, a delay occurs between the time when the longitudinal channel is
25 put in pneumatic communication with the vacuum generation device through the curved opening of the distributor, and the time when the surface portion of roll of the corresponding row of holes really starts to suck the paper on the roll surface. Analogously, when the longitudinal
30 channel is arranged in a position that is external to the position of the curved opening, even if is no more

pneumatically connected with the vacuum generation device.

A different kind of roll for folding, or interfolding, that is able to overcome, at least in part, the above mentioned drawbacks is described in EP0982256 in the name
5 of the same Applicant. In this case, the folding, or interfolding method provides to transversally cut, or separated by tears, the sheets obtained from at least a web. Then, a staggering of the sheets is obtained, in order to create a sequence of staggered sheets. These are,
10 then, transferred on rolls for folding, or interfolding, having rows of suction holes in order to alternately hold the sheets on their surfaces and to obtain an interfolded configuration. Downstream of the folding rolls, therefore, a continuous stack of interfolded sheets
15 is obtained that is moved away from the working zone in order to be subjected to following operations, in particular the packaging and the wrapping. More precisely, the rolls for folding, or interfolding, described in EP0982256 provide a determined number of couples of rows
20 of suction holes distributed on the surface of the interfolding rolls. In particular, the suction holes of each couple are oriented according to parallel directions.

However, also this kind of solution, as well as other analogous solutions of prior art, has some drawbacks.

25 In fact, since the axes of the suction holes of the close rows are oriented according to parallel directions, the 2 close rows of suction holes, that means the one sucking the tail of a sheet, and the one sucking the head of the following sheet, does not release the respective
30 processed sheet, or web, of paper at a same angular position, that means corresponding to a same central

angle.

However, also this kind of solution, as well as other similar solutions of prior art, have some drawbacks.

In particular, with reference to figures 1 and 2 in a
5 folding, or interfolding, section, of a machine equipped with the rolls of prior art, at the moment of releasing the sheets 100', and precisely, the first half of sheet 100'b advancing on a suction roll, for example the right roll 1'b, on which the tail of sheet 100'a coming from the
10 other roll is positioned, in the figures 1 and 2 the left roll 1'a, the couple of suction holes 3'a and 3'b of the right roll 1'b is not able to accurately control the folding of sheets 100'a and 100b. This causes the formation of a series of undesirable folds, or wrinkles,
15 105' on the sheets at the moment of the realising from the roll.

Then, when the "folding fingers" operates to transfer the sheets 100'a and 100'b on a formation table positioned downstream of the rolls for folding, or interfolding, the
20 above mentioned folds and wrinkles 105' of the sheets are also produced in the forming stack, i.e. in the stack of folded, or interfolded, sheets, thus compromising the quality of the final product.

Therefore, in order to try to overcome the above
25 mentioned drawback it is necessary to operate at low speed thus reducing the productivity of the machine.

Some solutions of prior art having the above mentioned drawbacks are described in US843781, US6024685, US5000729, US2012/152695 and US5176611.

30 In particular, in US843781 an apparatus for folding sheets is described providing a folding group comprising a

first and second cutting rolls, which cut the web into sheets of determined length, and, then, alternately suck the cut sheets on the respective surfaces. The sheets are, then, transferred to a folding device comprising a sliding
5 element, which, operated by a transmission system with toothed members, slides alternately towards right and left, in order to fold the sheets. However, this solution seems to be complex, not accurate, and does not allow to reach a high productivity.

10 Summary of the invention

It is therefore an object of the present invention to provide a folding, or interfolding, roll, that is able to overcome the drawbacks of prior art rolls.

It is, in particular, an object of the present
15 invention to provide a folding, or interfolding, roll, that is able to avoid folds, or "wrinkles", on the processed sheets and therefore to guarantee to obtain a final product of excellent quality.

It is also an object of the present invention to
20 provide a folding, or interfolding, machine, equipped with a couple of similar folding, or interfolding, rolls, that is able to operate at high speed without compromising the quality of the final product.

It is also an object of the present invention to
25 provide a method for producing folded, or interfolded, products having the above mentioned advantages with respect to the methods of prior art.

These and other objects are achieved by a roll,
according to the invention, for folding, or interfolding a
30 web, or sheet of paper, fed along an advancing direction

in a paper converting machine, or similar machines, said roll for folding, or interfolding, comprising:

- a tubular body configured to rotate about a longitudinal rotation axis, said tubular body being provided of an external lateral surface and an internal lateral surface pneumatically communicating through a plurality of suction holes organized in a predetermined number of suction groups, each suction group comprising a predetermined number of close longitudinal rows of suction holes distributed along said tubular body;

- a suction chamber provided internally to said roll for folding, or interfolding, and pneumatically connected to a suction device configured to generate a predetermined vacuum level;

- a vacuum distribution device configured to selectively put in pneumatic connection said suction chamber with at least a row of suction holes of said plurality, at predetermined angular positions of said tubular body in such a way to cause the suction of the processed sheet, or web, of paper, and the adhesion of the same to corresponding portions of said external lateral surface of said roll for folding, or interfolding;

whose main characteristic is that each suction group comprises at least 3 close longitudinal rows of suction holes configured to hold each sheet, or web, of paper on said roll at a respective portion of said external lateral surface.

Further technical characteristics of the present invention are set out in the dependent claims.

In particular, each suction group can comprise at least 4 close longitudinal rows of suction holes.

In a possible embodiment of the invention, at least 2 of the above mentioned close longitudinal rows of suction
5 holes of each suction group arranged according to directions lying on incident planes.

Advantageously, the above mentioned incident planes intersect each other in a line (t_i) parallel to the longitudinal rotation axis of the roll.

10 More in particular, the intersection line (t_i) is positioned at a distance d_i from the above disclosed suction holes that is smaller than the distance of the external lateral surface from radius r of roll.

In particular, the above mentioned incident planes
15 form an angle θ , more in particular a plurality of angles θ , each of which having a predetermined amplitude, for example, an amplitude comprised between 1° and 5° .

In a possible embodiment, the close longitudinal rows of the suction holes of the same suction group are aligned
20 with respect to the direction longitudinal to roll. Therefore, the axes of the suction holes of the close longitudinal rows of each suction group lie on the same plane orthogonal to said longitudinal rotation axis.

In an alternative embodiment at least two rows of the
25 close longitudinal rows of suction holes of a same suction group are staggered to each other longitudinally to roll. Therefore, in this case, the axes of the respective suction holes lie on different planes.

According to a further aspect of the invention, a
30 machine for folding, or interfolding a web, or sheet, of paper, comprises an interfolding unit equipped with a

first and a second interfolding roll, as above disclosed, configured to counter-rotate.

According to still another aspect of the invention, a method for making the suction holes of a roll for folding, or interfolding, in a paper converting machine comprises the steps of:

- disposing a roll having a tubular body having an external lateral surface and an internal surface, said roll being provided of a longitudinal rotation axis;

- disposing a drilling tool;

- making, by the above mentioned drilling tool, a plurality of suction holes arranged to pneumatically connect the external lateral surface with the internal surface, the above mentioned plurality of suction holes being organized in a predetermined number of close longitudinal rows;

wherein said close longitudinal rows of suction holes comprise at least 3 close rows of suction holes in order to hold each sheet, or web, of paper on said roll at a respective portion of said external lateral surface, in such a way to avoid undesirable folds at the tail.

Brief description of the drawings

The invention will now be shown with the following description of its exemplary embodiments, exemplifying but not limitative, with reference to the attached drawings in which:

- Fig. 1 diagrammatically shows a folding, or interfolding, unit, of prior art;

- Fig. 2 shows an enlargement of the releasing zone of the sheets in machine in figure 1 in order to

highlight some characteristics;

– Fig. 3 diagrammatically shows in a perspective side elevation view a first embodiment of a roll for folding, or interfolding, according to the invention;

5 – Fig. 4 diagrammatically shows an enlargement partially sectioned, of a portion of the external lateral surface of the roll for folding, or interfolding of figure 3;

10 – Fig. 5 diagrammatically shows a first embodiment of a folding, or interfolding, unit, according to the present invention;

– Fig. 6 shows an enlargement of the releasing zone of the sheets in the machine of figure 5 in order to highlight some technical characteristics;

15 – Fig. 7 diagrammatically shows in a perspective side elevation view an alternative embodiment of the roll for folding, or interfolding, figure 5;

20 – Fig. 8 diagrammatically shows an enlargement partially sectioned, of a portion of the external lateral surface of the roll for folding, or interfolding, of figure 7;

– Fig. 9 diagrammatically shows a folding, or interfolding, unit, equipped with 2 rolls for folding, or interfolding, according to the invention;

25 – Fig. 10 shows an enlargement of the realising zone of the sheets in the machine of figure 9 in order to highlight some technical characteristics;

30 – Fig. 11 diagrammatically shows an enlargement of a suction group of a further alternative embodiment of a roll for folding, or interfolding, according to the present invention.

Detailed description of some exemplary embodiments of
the invention

As diagrammatically shown in figures 3 and 4, a roll 1
5 for folding, or interfolding, a web, or sheet, of paper,
100 fed along an advancing direction in a paper converting
machine, or similar machines, comprises a tubular body 10
configured to rotate about a longitudinal rotation axis
101. More precisely, the tubular body 10 of roll 1 has an
10 external lateral surface 11 and an internal lateral
surface 12 pneumatically communicating through a plurality
of suction holes 3. In particular, the suction holes 3 of
roll 1 are organized in a predetermined number of suction
groups, for example 3 suction groups 60a, 60b, 60c
15 positioned in predetermined angular positions of roll 1,
for example each 120° . In general, the angular position of
suction groups 60 depends on the number of sheets 100
that can lie adjacent to each other on the external
lateral surface 11 of roll 1. The arch of circumference
20 arranged between a suction group and the following one is
equal to the length of a sheet 100 and, therefore,
depending on the diameter of roll 1 is possible to have
two, three, four or more suction groups 60. For example if
on roll 1 five suction groups 60 are present, the angular
25 position between the suction groups 60 is 72° . According
to the invention, each suction group 60a-60c comprises at
least 3 close longitudinal rows 30a, 30b and 30c of
suction holes 3a-3c. The roll 1 for folding, or
interfolding, furthermore, provides a suction chamber 20

arranged internally to the above mentioned tubular body 10, and pneumatically connected to a suction device, not shown in the figure for reasons of simplicity, but, however, of known type to a skilled person in the field, and configured to generate a predetermined vacuum level. A vacuum distribution device 50 is, furthermore, provided positioned between the internal lateral surface 12 of roll 1 and the suction chamber 20. More precisely, the vacuum distribution device 50 is configured to selectively put in pneumatic connection la suction chamber 20 with at least a row 30a-30c of suction holes 3a-3c of the above mentioned plurality, at predetermined angular positions of the tubular body 10. In this way the suction of a processed sheet, or web, of paper 100, is carried out and its adhesion only at determinate portions of the external lateral surface 11 of roll 1. Therefore, the particular technical solution of the present invention with respect to the prior art solutions, in addition to the two close longitudinal rows 30a and 30b of holes 3a and 3b that are normally present in each suction group of the suction rolls of the interfolding, or folding, machines of the prior art, provides for each suction group 60a-60c, at least a further row 30c of suction holes 3c close to the first two. In this way, with respect to the solutions of prior art, it is possible to control in a more accurate way the fold of the sheet 100, or web, of paper during formation of the stack 150 of folded, or interfolded sheets on the formation table 155. More in particular, the technical solution according to the invention allows to control the folding of the first half of the whole sheet, in the case of figure 6 the sheet 100b coming from right

roll 1b, on which the tail of the previous sheet is overlapped, in figure, the sheet 100a coming from the left roll. Preferably, the auxiliary suction holes 3c of the longitudinal rows 30c are arranged downstream of the
5 "standard" holes 3a and 3b of the respective group 60a, with respect to the rotation direction of the rolls 1a and 1b for folding, or interfolding. Therefore, it is possible to avoid that folds, or wrinkles, can be formed, thus considerably increasing the quality of the final product
10 with respect to the prior art solutions.

In the alternative embodiment shown in the figures from 7 to 10, each suction group 60a-60c provides 4 close longitudinal rows 30a-30d of suction holes 3a-3d. In this way, it is possible to further increase the accuracy of
15 the fold of the sheet 100b when the same releases the respective roll 1b.

As diagrammatically shown in figures 4 and 8, respectively, where each suction group 60a-60c comprises 3, or 4, close longitudinal rows 30a-30c, or 30a-30d, of
20 suction holes 3a-3c, or 3a-3d, at least 2 of the close longitudinal rows of each suction group 60a-60c can be positioned according to the directions lying on incident planes γ_a , γ_b , γ_c , γ_d . In this way the sheet 100 held due to the suction action of the holes 3a, 3b, 3c, 3d on the
25 external lateral surface 11 of roll 1, is released at a same releasing angle, i.e. at a same angular position, thus overcoming the drawbacks of the prior art solutions providing parallel close longitudinal rows of suction holes. In this way a greater suction force and a better
30 suction distribution on the sheets 100a and 100b is achieved, thus assuring a better adhesion of the sheets

100a and 100b on the external lateral surface 11 of roll 1. The improved adhesion of the sheets 100a and 100b to the external lateral surface 11 of roll 1 avoids can be released in advance, thus avoiding formation of
5 undesirable wrinkles in the stack of sheets in particular when the rolls for folding 1a and 1b operate at high speed.

In a possible alternative embodiment, at least 2 of the above mentioned close longitudinal rows 30a-30c, or
10 30a-30d, of rows of suction holes, of each suction group 60a-60c are staggered to each other along the direction longitudinal to roll 1. The suction holes 3a-3c, or 3a-3d, of each suction group 60a-60c are, therefore, arranged at respective directions that can intersect each other before
15 reaching axis 101 of the roll 1 for folding, or interfolding.

In the embodiment shown in particular in figure 11, the close longitudinal rows 30a-30d of the same suction group 60a-60d, are arranged aligned with respect to the
20 direction longitudinal to the roll 1. Therefore, the axes 103a-103d of the suction holes 3a-3d of a same suction group 60a-60d lie on a same plane orthogonal to the longitudinal rotation axis 101. In other words, the axes 103a-103d of the suction holes 3a-3d of at least a same
25 suction group 60a-60d, that are positioned on a same circumference coaxial to the longitudinal rotation axis 101 of roll 1, are positioned on a plane orthogonal to the longitudinal rotation axis 101.

In a particular embodiment of the invention, the above
30 mentioned incident planes $\gamma_a - \gamma_d$ define angles $\theta_1 - \theta_3$. These can have the same, or different, amplitude,

advantageously an amplitude, anyway, comprised between 0.1° and 5° , preferably between 1° and 5° .

Alternatively, the amplitude of the above mentioned angles can be comprised between 2° and 20° , advantageously
5 between 4° and 15° .

In an alternative embodiment, not shown in the figure for reason of simplicity, at least 2 of the above mentioned close longitudinal rows 30a-30c, or 30a-30d, of rows of suction holes, are staggered to each other along
10 the direction longitudinal to roll 1. Therefore, the suction holes 3a-3c, or 3a-3d, of 2 the close longitudinal rows 30a and 30b, are oriented with the respective axes 103a-103d positioned along respective skew directions that means belonging to different planes. According to the
15 invention, a "mixed" solution of the above mentioned embodiments is also possible, i.e. an embodiment wherein roll 1 for folding, or interfolding, provides a plurality of suction holes comprising both suction groups with close rows 30a-30d of suction holes 3a-3d such that the axes
20 103a-103d of the suction holes of at least two close longitudinal rows 30a-30d of a same group 60a-60d are arranged on a same plane orthogonal to the longitudinal rotation axis 101 of roll 1, and suction groups 60 wherein the close longitudinal rows 30a-30c, or 30a-30d, are
25 longitudinally staggered to each other.

In the figures 5 and 9, two different embodiments are diagrammatically shown having, respectively, 3 close longitudinal rows 30a-30c, and 4 close longitudinal rows 30a-30d for each suction group 60a-60c, of a folding, or
30 interfolding, unit of a paper converting machine, equipped with first and second rolls 1a and 1b for folding, or

interfolding, according to the invention configured in such a way to be counter-rotating.

As shown for example in figure 5, in a possible embodiment of the invention, the vacuum distribution
5 device 50 can provide a fixed tubular body 25 coaxially mounted within the above mentioned tubular body 10, communicating with a system for generating a predetermined vacuum level. More precisely, the fixed tubular body 25 provides an opening 26 and is associated to two walls 27a
10 and 27b arranged longitudinally to tubular body 10. In this way, the volume delimited between the two walls 27a and 27b, the fixed tubular body 25 and the internal surface 12 of roll 1 define the above mentioned suction chamber 20 constantly pneumatically communicating with the
15 vacuum generation system. Therefore, the rotation of roll 1 about its longitudinal rotation axis 101, selectively brings the different longitudinal rows 30a-30c of suction holes 3a-3c of roll 1 to pneumatically communicate with the vacuum generation system, thus causing the adhesion of
20 the web, or sheet, of paper on the roll surface, between the position of the first longitudinal wall 27a and the position of the second longitudinal wall 27b.

In particular, the two longitudinal walls 27a and 27b, at ends directed towards the internal surface 12 of roll
25 1, are advantageously provided of pneumatic sealing elements 28a and 28b, in particular made of rubber, plastic, or similar materials, in order to guarantee the necessary conditions of pneumatic sealing, thus insulating the suction chamber from the remaining portion of volume
30 defined between the internal surface 12 of roll 1 and the fixed tubular body 25. Furthermore, the longitudinal walls

27a, 27b can provide push elements, preferably springs, not shown in the figure for reasons of simplicity, and configured to push the above mentioned sealing elements 28a and 28b against the internal surface 12 of roll 1.

5 The foregoing description exemplary embodiments of the invention will so fully reveal the invention according to the conceptual point of view, so that others, by applying current knowledge, will be able to modify and/or adapt for various applications such
10 embodiment without further research and without parting from the invention, and, accordingly, it is therefore to be understood that such adaptations and modifications will have to be considered as equivalent to the specific embodiments. The means and the materials to realize the
15 different functions described herein could have a different nature without, for this reason, departing from the field of the invention. It is to be understood that the phraseology or terminology that is employed herein is for the purpose of description and not of
20 limitation.

CLAIMS

1. A roll (1) for folding, or interfolding, a web, or sheet, of paper, (100) fed along an advancing direction in a paper converting machine, or similar machines, said roll (1) for folding, or interfolding, comprising:

- a tubular body (10) configured to rotate about a longitudinal rotation axis (101), said tubular body (10) being provided an external lateral surface (11) and of an internal lateral surface (12) pneumatically communicating through a plurality of suction holes (3a,3b) organized in a predetermined number of suction groups (60), each suction group (60) comprising a predetermined number of close longitudinal rows (30a,30b) of suction holes (3a,3b) distributed along said tubular body (10);

- a suction chamber (20) provided internally to said roll (1) for folding, or interfolding, and pneumatically connected to a suction device configured to generate a predetermined vacuum level;

- a vacuum distribution device (50) configured to selectively put in pneumatic connection said suction chamber (20) with at least a row of suction holes (3a,3b) of said plurality, at predetermined angular positions of said tubular body (10) in such a way to cause the suction of the processed sheet, or web, of paper (100), and its adhesion at corresponding portions of said external lateral surface (11) of said roll (1) for folding, or interfolding;

said roll (1) for folding, or interfolding, being
characterised in that each suction group (60)
comprises at least 3 close longitudinal rows
(30a,30b,30c) of suction holes (3a,3b,3c) configured
5 to hold each sheet, or web, of paper (100) on said
roll (1) at a respective portion of said external
lateral surface (11).

2. Roll (1) for folding, or interfolding, a web, or
sheet, of paper, according to claim 1, wherein each
10 suction group (60) comprises at least 4 close
longitudinal rows (30a,30b,30c,30d) of suction holes
(3a,3b,3c,3d).

3. Roll (1) for folding, or interfolding, a web, or
sheet, of paper, according to any of the previous
15 claims, wherein at least 2 of said close longitudinal
rows (30a,30b,30c,30d) of suction holes (3a,3b,3c,3d)
of each suction group (60a,60b,60c,60d) are arranged
according to directions lying on incident planes
($\gamma_a, \gamma_b, \gamma_c, \gamma_d$) arranged to intersect each other in a
20 line (t_i) parallel to said longitudinal rotation axis
(101) of said roll (1).

4. Roll (1) for folding, or interfolding, a web, or
sheet, of paper, according to claim 3, wherein said
line (t_i) is positioned at a distance (d_i) from said
25 external lateral surface that is smaller than the
radius r of said roll.

5. Roll (1) for folding, or interfolding, a web, or
sheet, of paper, according to any of the previous
claims, wherein said close longitudinal rows
30 (30a,30b,30c,30d) of suction holes (3a,3b,3c,3d) of a

same group (60a,60b,60c,60d) are aligned with respect to the direction longitudinal to said roll (1), in such way that the axes (103a,103b,103c,103d) of the respective suction holes (3a,3b,3c,3d) lie on a same plane orthogonal to said longitudinal rotation axis (101).

6. Roll (1) for folding, or interfolding, a web, or sheet, of paper, according to any claims from 1 to 4, wherein said close longitudinal rows (30a,30b,30c,30d) of suction holes (3a,3b,3c,3d) of a same group (60a,60b,60c,60d) are staggered to each other with respect to the direction longitudinal to said roll (1), in such way that the axes (103a,103b,103c,103d) of the respective suction holes (3a,3b,3c,3d) lie on different planes.

7. Roll (1) for folding, or interfolding, a web, or sheet, of paper, according to any claims from 3 to 6, wherein said incident planes ($\gamma_a, \gamma_b, \gamma_c, \gamma_d$) form an angle ($\theta_1, \theta_2, \theta_3$) having an amplitude comprised between 0.1° and 5° .

8. Roll (1) for folding, or interfolding, a web, or sheet, of paper, according to claim 7, wherein said incident planes ($\gamma_a, \gamma_b, \gamma_c, \gamma_d$) form an angle ($\theta_1, \theta_2, \theta_3$) having an amplitude comprised between 1° and 5° .

9. Roll (1) for folding, or interfolding, a web, or sheet, of paper, according to any claims from 3 to 6, wherein said incident planes ($\gamma_a, \gamma_b, \gamma_c, \gamma_d$) form an angle ($\theta_1, \theta_2, \theta_3$) having an amplitude comprised between 2° and 20° .

10. Roll (1) for folding, or interfolding, a web, or sheet, of paper, according to claim 9, wherein said incident planes ($\gamma_a, \gamma_b, \gamma_c, \gamma_d$) form an angle ($\theta_1, \theta_2, \theta_3$) having an amplitude comprised between 4° and 15° .

5 11. Machine for folding, or interfolding, a web, or sheet, of paper, **characterised in that** it comprises an interfolding unit equipped with first and second rolls for folding, or interfolding, according to any claims from 1 to 10, configured in such a way to be counter-rotating.

12. Method for making the suction holes of a roll for folding, or interfolding, in a paper converting machine comprising the steps of:

- disposing a roll having a tubular body having an external lateral surface and of an internal surface, said roll being provided of a longitudinal rotation axis;

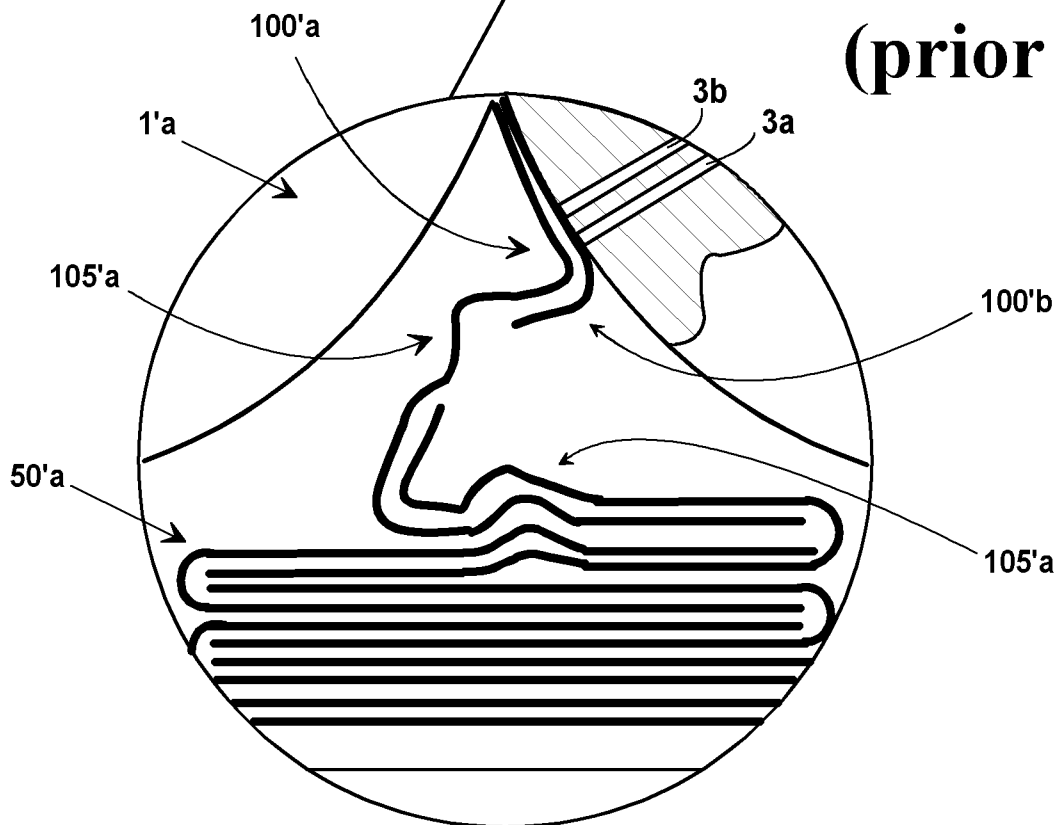
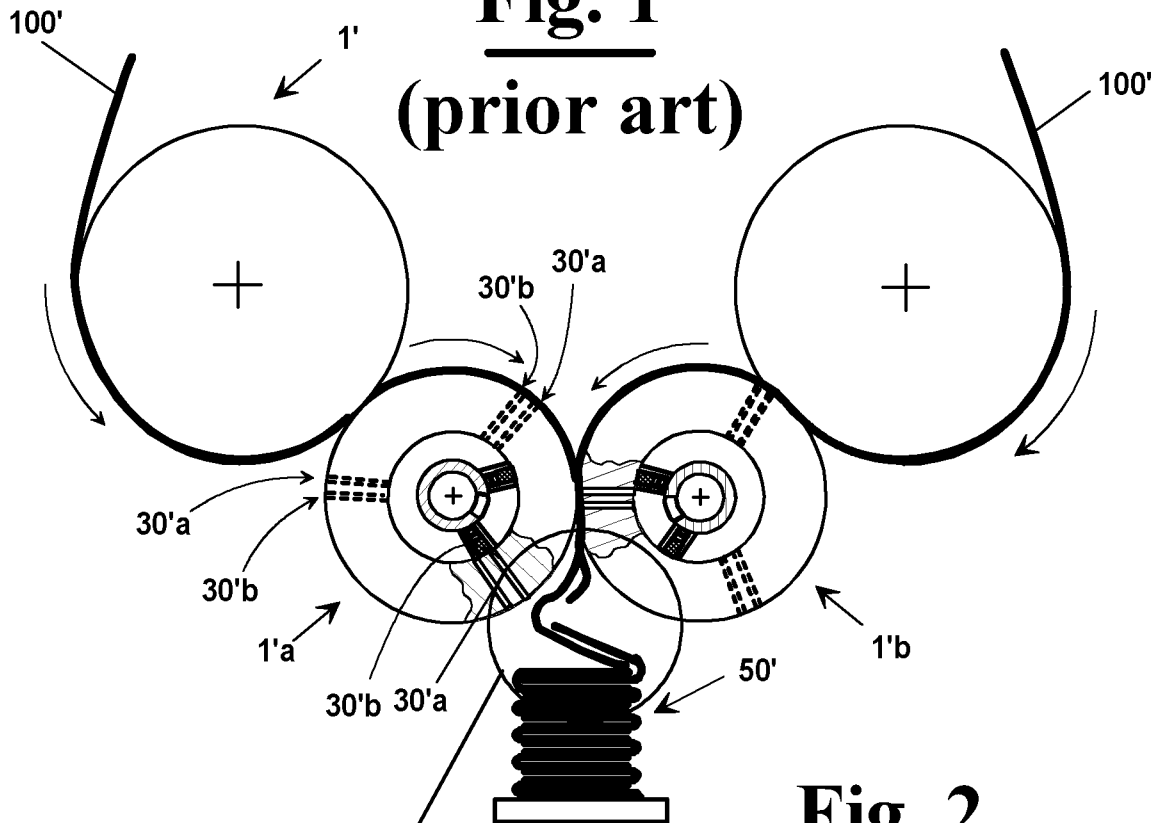
- disposing a drilling tool;

- making by said drilling tool a plurality of suction holes arranged to put into pneumatic communication said external lateral surface with said internal surface, said plurality of suction holes being organized in a predetermined number of suction groups, each suction group comprising a predetermined number of close longitudinal rows of suction holes distributed along said tubular body;

said method being **characterised in that** each suction group (60) comprises at least 3 close longitudinal rows (30a, 30b, 30c) of suction holes (3a, 3b, 3c)

configured to hold each sheet, or web, of paper on

said roll at a respective portion of said external lateral surface (11), in such a way to control in an accurate way the folding of each said sheet (100), or web, of paper during formation of a stack (150) of
5 folded, or interfolded, sheets.



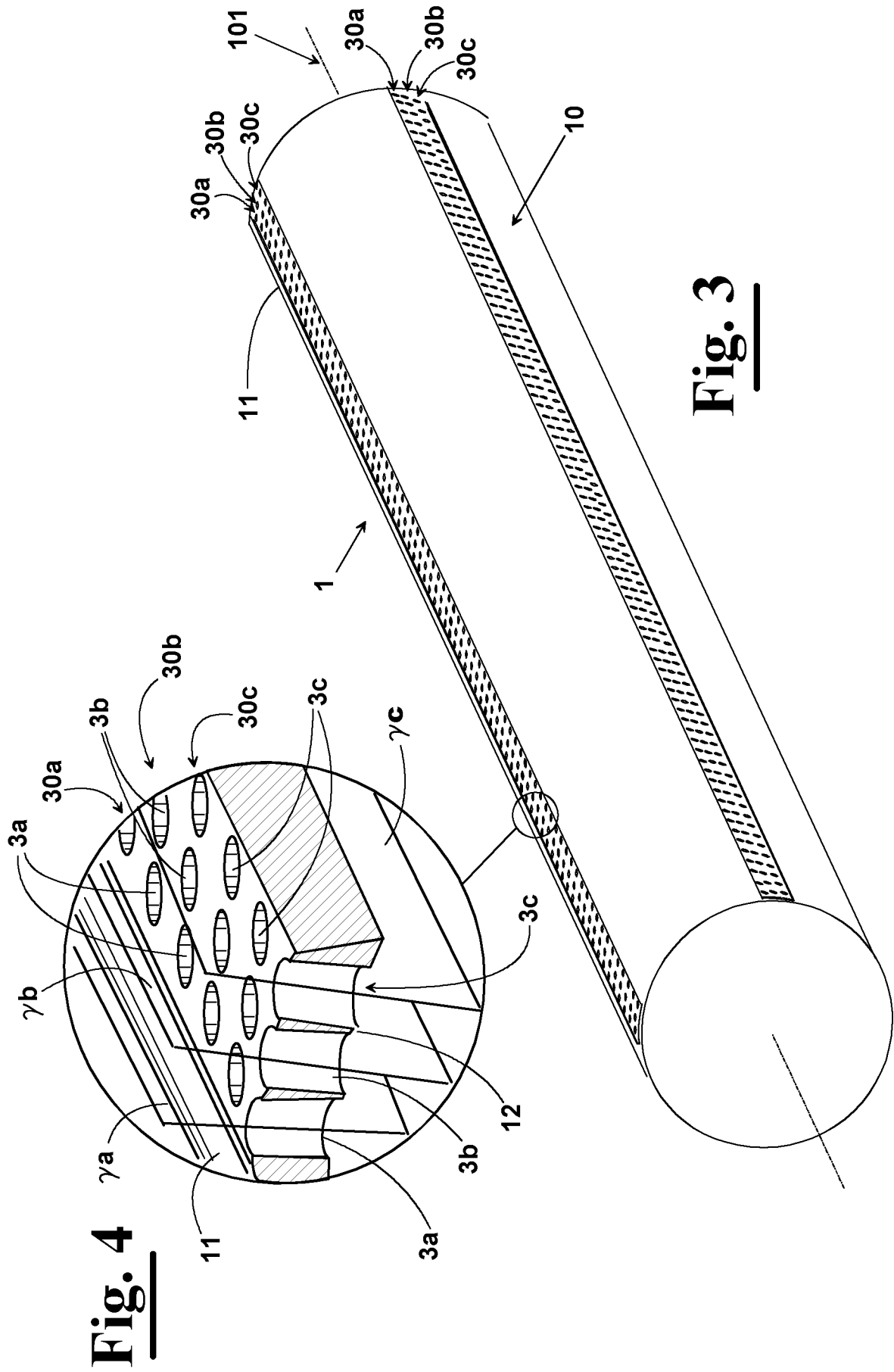
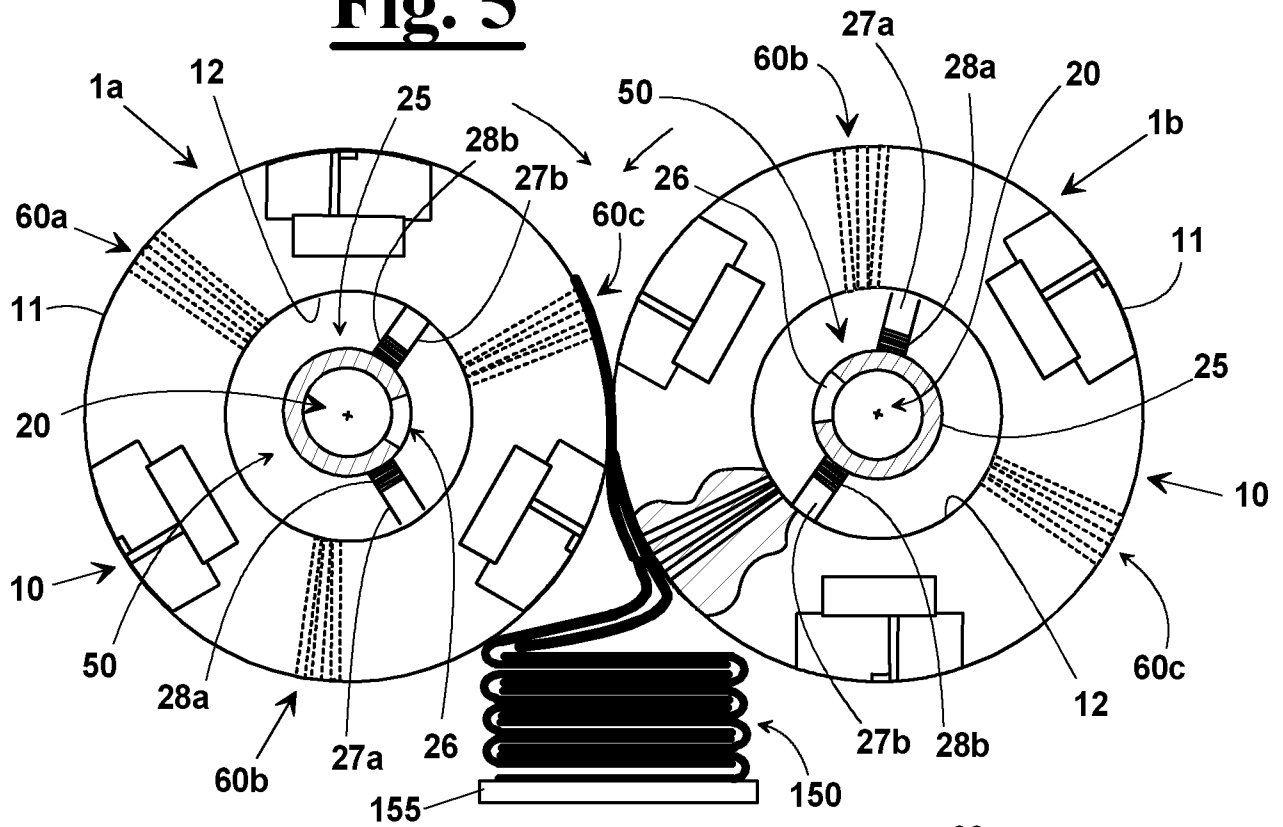
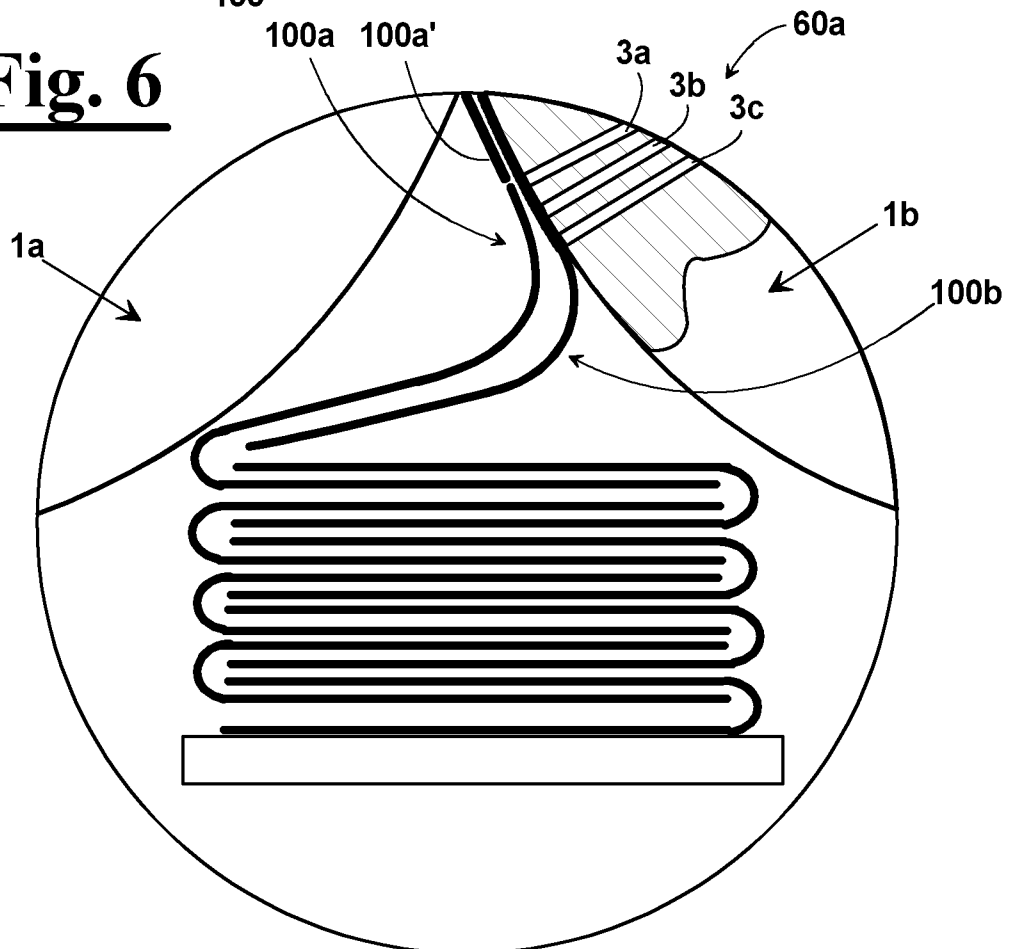
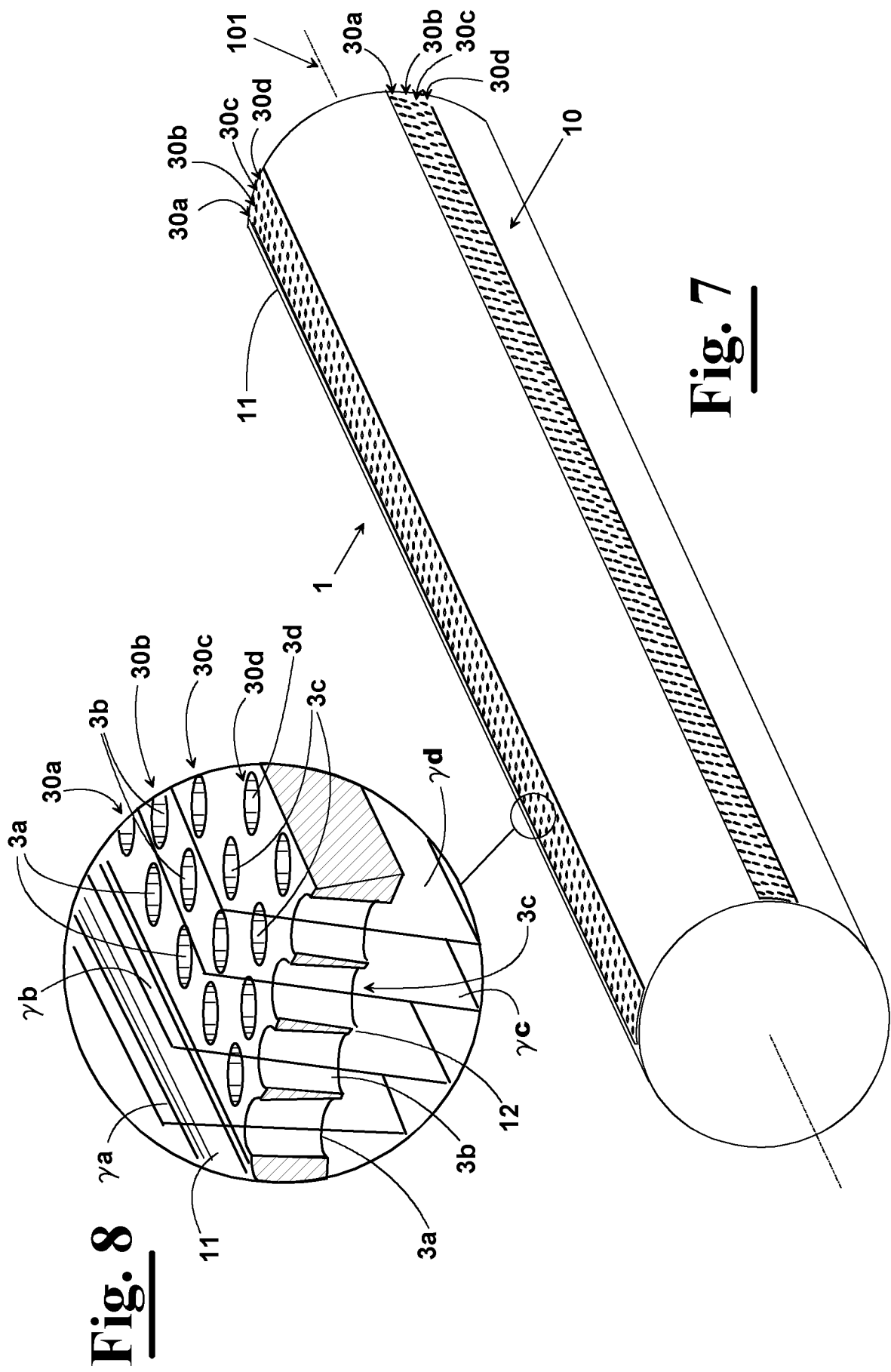


Fig. 5**Fig. 6**



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/056364

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65H45/24
ADD.

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)
B65H

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 843 781 A (WHEELER SETH [US]) 12 February 1907 (1907-02-12) the whole document	1,2,5-8, 11
X	US 6 024 685 A (KIRSCH KLAUS [DE]) 15 February 2000 (2000-02-15) the whole document	12
A	US 5 000 729 A (YAMAUCHI SACHIO [JP]) 19 March 1991 (1991-03-19) column 12, line 20 - column 14, line 4; figures 20-22	3,4,9,10
A	US 2012/152695 A1 (COENEN JOSEPH DANIEL [US] ET AL) 21 June 2012 (2012-06-21) paragraph [0089]; figures 23-30,45-49 -/-	7,8



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

14 November 2019

Date of mailing of the international search report

20/11/2019

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INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2019/056364

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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