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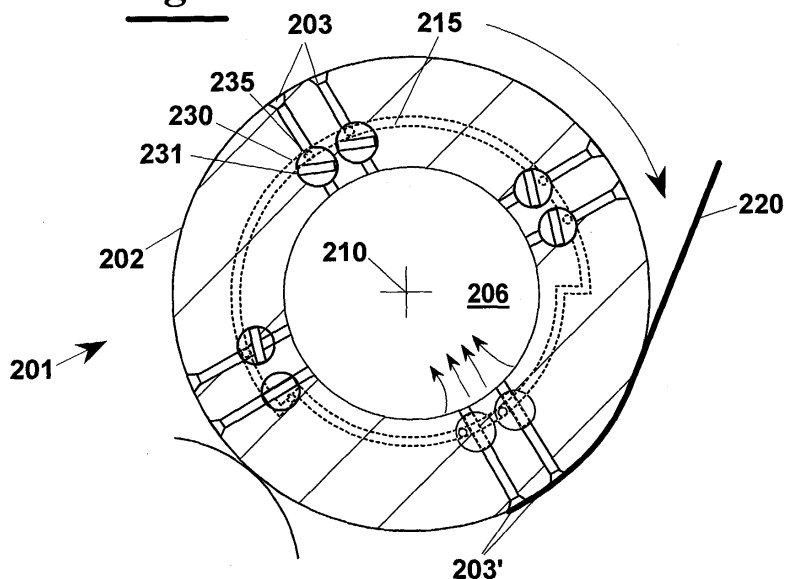
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(54) **Interfolding machine of a web or sheet of paper with a vacuum conveying roller**

(57) The roller (1) is used for conveying a web or sheet of paper (20) in paper converting machines, for example, a rewinding, a winding, an interfolding machine. It comprises a first outer cylindrical tubular body (2) equipped with a plurality of radial holes (3), arranged according to substantially longitudinal rows, capable of rotating with respect to a second inner fixed body (4) coaxial to it and connected to a suction system. The second body (4) has tubular cylindrical geometry like the first body (2) and has a plurality of apertures (5) and two radial boards (7) arranged at opposite sides with respect to the apertures (5). The inner surface of the first cylin-

drical tubular body (2), together with the radial boards (7) and to the external surface of the second tubular body (4), define a suction chamber (6) that brings selectively in communication selected rows of holes (3) of the first cylindrical tubular body (2) with the apertures (5) of the second tubular body (4) and then with the suction system of the machine during the relative rotation of the two bodies. Therefore, a web or sheet of paper (20) adheres to the external surface of the first body (2) only in the portion P_1P_2 of surface set between the rows of holes (3') that communicates with the suction chamber (figure 4).

Fig. 6



Description

Field of the invention

[0001] The present invention relates to the field of machines for converting paper and similar products, and in particular it relates to an interfolding machine of a web or sheet of paper.

[0002] In particular, the invention relates to an interfolding machine having a paper conveying roller having circumferentially a plurality of holes which, connected to a vacuum system, allow the sheet or web of paper to adhere on their surface.

Description of the prior art

[0003] As known, many machines used in the paper converting field, for example rewinding and interfolding machines, are equipped on the surface of their rollers with systems for capturing the web or the sheet of processed paper, in certain operative phases, in order to cause the paper to follow a predetermined path.

[0004] In particular, such systems are used to provide the main operations of cutting the paper, of transferring it quickly from a roller to another, of final folding the paper same. To this object, the machines are normally equipped either with mechanical clamps or with pneumatic suction means.

[0005] In the latter case, the air suction systems, owing to a certain vacuum grade created within the rollers, cause the processed paper to adhere on the roller surface by means of rows of suction holes.

[0006] In more detail, as shown diagrammatically in figures 1 and 2, in a paper conveying roller 101, of known art, the vacuum is transmitted through a plurality of longitudinal channels 102 into roller 101, causing the paper 120 to adhere selectively to the roller surface same by means of a plurality of holes 103. Normally, holes 103 are arranged according to longitudinal rows with respect to the axis 104 of the cylinder (transversal with respect to the paper) since the vacuum is made selectively by distributor means. This causes a division of the roller surface into paper suction fields, i.e. where the rows of holes are enabled for suction, and into fields where the processed paper is instead freed from the roller for being for example transferred onto another roller or folded, i.e. the respective rows of holes are not enabled for suction.

[0007] In particular, the paper conveying roller is normally coupled, at an end thereof, to a bell-shaped vacuum distributor element 110 to it co-axial but whose rotation is impeded by means of suspension on ball bearings. The vacuum distributor 110 is equipped with an inlet 111 connected to the suction system of the machine and communicating with a curved opening 112 determined on the distributor same. More in detail, the curved opening 112 extends for a certain angle and, during the rotation of the roller about its own axis, selectively com-

municates with longitudinal channels 102 and then with the respective rows of holes 103. This way, a portion of roller surface (hatched area in figure 1) is obtained in which the sheet or the web of paper is captured by suction and adheres on the roller surface.

[0008] With this system, channels 102 are at atmospheric pressure except from when they are in communication with the vacuum distributor. This causes, however, the row of holes 103, which is enabled to suction by alignment with curved opening 112, to start the suction of the sheet on the roller surface 101 only after that the air present in the respective longitudinal channel 102 has been removed. Therefore, there is a delay between the beginning of the suction in channel 102 and the moment where the portion of roller surface located at holes row 103 can actually start the suction of the paper, owing to the vacuum inertia for the presence of air channel 102 and the propagation time of the vacuum for all the row of holes length. Furthermore, as soon as channel 102 is not more enabled for suction, even if there is a delay of the vacuum to disappear, then, in any case, the vacuum is lost and the channel returns to the atmospheric pressure.

[0009] A not efficient suction by the holes, on the other hand, can affect the successive operations of the machine causing paper jamming and stop of production.

[0010] In any case, the maximum air flow rate is limited.

[0011] In order to limit this drawback it is therefore necessary:

- to limit the length of the roller and then the volume of the chambers in it; this causes a subsequent limitation in the maximum width of the paper that can be processed and then reduces productivity of the machines that have such rollers;
- starting/stopping the suction of the air channel with a vacuum advance, so that the suction in all the holes starts/stops at a predetermined moment; with a vacuum advance, it is necessary to change the vacuum timing as varies the speed of operation of the machine;
- working with a high vacuum grade for reducing the time necessary for a row of suction holes to be fully operative.

[0012] As described in US4207998 paper dragging rollers also exist formed by a fixed cylinder that form a longitudinal chamber, about which a concentric roller rotates formed by a inner stiff tubular shell having a plurality of holes, and an outer resilient tubular shell, having a plurality of deformable holes. When contacting the paper the deformable holes are open and bring into communication the paper with the holes of the inner shell and the suction chamber, preventing the roller from sliding with respect to the paper. The sealing ability of the holes, however is limited to the contact with a web of paper and with a certain pressure, whereby this type of

roller is unsuitable for applications with sheets of paper. Furthermore, it is suitable only for narrow fields of suction.

[0013] The document US 3037557 describes a vacuum roller that can be used in printing presses and coating apparatus, in paper making machines, for stretching a web of paper in order to remove the humidity surplus, as well as in machines for laminating a film thin. It comprises a fixed inner body and an outer cylinder having a plurality of longitudinal radial holes capable of rotating with respect to the inner body. The fixed inner body has inside a suction chamber communicating with vacuum means and having a peripheral opening. In the external surface of the fixed body are sectors are provided having each friction seals that slide against the inner wall of the outer cylinder. The seals define a zone communicating with the suction chamber through said opening and that transmit then a vacuum to the corresponding holes of the cylindrical body. Such a roller, however, is not suitable for interfolding machines as the present invention. In fact, interfolding machines must move with precision a web of paper for all the length of the roller, even 2-3 metres, and such a division into sectors is not feasible.

Summary of the invention

[0014] It is a feature of the present invention to provide an interfolding machine having a roller a roller equipped with suction points for conveying a web or sheet of paper which allows to provide a high production rate even with a low vacuum grade and then not much expensive with respect to the prior art.

[0015] It is another feature of the present invention to provide an interfolding machine having such a paper conveying roller for increasing productivity and flexibility of the machine on which it is mounted, in order to work webs or sheets of paper of different type and wide enough without affecting the efficiency of the process.

[0016] These and other objects are achieved according to the invention by the interfolding machine of a web or sheet of paper comprising at least one roller for moving said web or sheet, wherein said roller comprises:

- a cylindrical tubular body capable of rotating about an axis of rotation, said cylindrical tubular body having a plurality of radial holes arranged according to substantially longitudinal rows,
- a chamber in said roller that extends for all its length and is that is always connected to a suction system, whereby said chamber is that is always under vacuum,
- interposition means between said chamber and at least one row of radial holes suitable for selectively connecting said chamber with said at least one row of holes at determined angular positions of said roller to provide a suction effect on the sheet or web of processed paper only at said positions.

[0017] Preferably, in the roller actuation means are provided suitable for operating said interposition means between a first position where they bring in pneumatic connection the chamber and at least one row of holes and a second position they pneumatically insulate the chamber from said or each row of holes.

[0018] Advantageously, said interposition means comprise a longitudinal rod associated to at least one row of holes and provided with through holes that are aligned with the relative holes of said roller bringing them in suction operability at said first position.

[0019] Preferably, said actuating means comprises cam means located at least at one end of said rod and suitable for engaging with fixed cam means at the rotation of said roller.

[0020] In particular, the rod is free of rotating about its own axis between said first and second position or, alternatively, is free of translating along its own axis between said first and second position.

[0021] The cam means can be selected from the group: a pin eccentric with respect to a longitudinal axis of said rod, a cam integral to said rod, a cam surface associated to a spring, said fixed cam means providing a fixed shaped guide.

[0022] The chamber that is always under vacuum can be defined by the inner surface of said cylindrical tubular body or, alternatively, by a hollow body fixed in said cylindrical tubular body. In the latter case, the interposition means comprise sealing elements sliding against the inner surface of the cylindrical tubular body.

[0023] The sliding sealing elements can be forced elastically against the inner surface of the cylindrical tubular body. In particular, the interposition means provides two radial boards, between which at least one opening is present, which extends between the first and the second tubular body for all the length of the roller in order to define the suction chamber.

[0024] Each radial board, preferably, can comprise a fixed portion, forming a guide arranged longitudinally with respect to the conveying roller, within which a bar can slide radially forced elastically against the inner surface of the first cylindrical tubular body, forming said sliding sealing element.

Brief description of the drawings

[0025] In the drawings, figures 1 and 2 already commented in the introductory part show the following:

- figure 1 is a perspective view of a paper conveying roller for paper converting machines and of the vacuum distributor to it associated, as known in the art;
- figure 2 shows a longitudinal cross section of a conveying roller according to the prior art coupled to a vacuum distributor.

[0026] Further characteristics and the advantages of the roller according to the present invention, equipped

with suction points for conveying a web or sheet of paper in paper converting machines, will be made clearer with the following description of an embodiment thereof exemplifying but not limitative, with reference to the attached drawings wherein:

- figures 3 and 4 show a cross sectional view of a paper conveying roller for paper converting machines, according to the present invention, in two relative different positions between the first and the second cylindrical tubular body;
- figure 5 shows a cross sectional view of a interfolding machine that has conveying rollers according to the invention
- figures 6 and 7 show a cross sectional view of two possible exemplary embodiments of the roller of figure 3;
- figure 8 shows a longitudinal cross section of an exemplary embodiment of figure 6.
- figure 9 shows a longitudinal cross section of a further exemplary embodiment alternative to that of figure 6.

Description of a preferred exemplary embodiment

[0027] In figures 3 and 4 a cross sectional view is shown of a roller 1 used for conveying a web or sheet of paper 20 for paper converting machines, for example, a rewinding machine, a winding machine, an interfolding machine. It comprises a first outer cylindrical tubular body 2, equipped with a plurality of radial holes 3 arranged according to substantially longitudinal rows, capable of rotating with respect to a second inner fixed body 4, co-axial to the former and connected to a suction system not shown. The second body 4, which as shown in the embodiments of figures 3 and 4 has tubular cylindrical geometry like first body 2, has a plurality of apertures 5 and two radial boards 7 at opposite sides with respect to apertures 5.

[0028] The inner surface of first cylindrical tubular body 2, radial boards 7 and the external surface of second tubular body 4 define a suction chamber 6 that, during the relative rotation of the two bodies, brings selectively in communication some rows of holes 3 of first cylindrical tubular body 2 with the apertures 5 of second tubular body 4 and then with the suction system of the machine. Therefore, a web or sheet of paper 20 adheres to the external surface of first body 2 only in the portion P_1P_2 of the surface set between the rows of holes 3' that communicate with the suction chamber (figure 4).

[0029] The apertures 5 made on the surface of second tubular body 4 are arranged longitudinally and are enough to allow a quick outlet of the air present in holes 3' that in turn overlap to the suction chamber 6. This is possible also because chamber 6 is fixedly kept at a determined vacuum grade.

[0030] In particular, radial boards 7, between which the apertures 5 extend, are arranged radially for all the

length of second cylindrical tubular body 4 and are have high sealing capability of the suction chamber from the remaining space comprised between bodies 2 and 4. This result is obtained with radial boards having a fixed portion 10, integral to second inner tubular body 4 and forming a longitudinal channel, and a movable portion 7 that engages with fixed portion 10 and pushes elastically against the inner surface of first tubular body 2 urged by springs 9. Springs 9 can be located, as in the case of figures 3 and 4, about pins 11 which are constrained in a housing within fixed portion 10.

[0031] This way, it is possible to define with high precision the portion of the roller surface 1 enabled for the suction of the paper and to make easier possible cutting operations, which can be made between two adjacent rows of holes 3.

[0032] This is for example effected in case of an interfolding unit shown diagrammatically in figure 5. In particular, conveying rollers 1 are provided as above described that work in cooperation with folding rollers 40. The unit works for example in the way described in EP0982255 or in EP0982256 in the name of the same applicant. Differently by rollers 1, rollers 40 have six couples of rows, wherein three couples of rows of holes spaced 120° capture the end of a sheet, and other three couples of rows of holes spaced 120° , shifted 60° with respect to the former, capture through the central portions of a sheet, the end of a second overlapped sheet and ready for being interfolded. Therefore, the first three couples of holes must be enabled for suction between two consecutive cuts, for a sector between the point of contact of rollers 1 with rollers 40 up to the contact between the two opposite rollers 1, whereas the other three couples of holes must be enabled for suction between the contact between the two rollers 40 and the point where the fold is made.

[0033] Therefore, rollers 40 are shown in figure 5 having a "mixed" structure as a combination of a roller of prior art and a roller 1 according to the invention. More in detail:

- the sheet is captured by roller 1 up to the point of contact between two rollers 40 by means of a traditional suction system, with suction channel and bell-shaped vacuum distributor; in fact, for capturing and holding the sheet a light vacuum grade and a not high angular precision are enough and this system is sufficient;
- the passage of a sheet from an interfolding roller 40 to the other is made with a system according to the invention, since higher angular precision and higher vacuum in suction are required.

[0034] Obviously, a roller can be made that enables to suction three couples of rows of holes all with a system according to the invention. For example, the inner second body may have three radial boards, forming three chambers, one not enabled to suction and two en-

abled to suction with a different vacuum grade.

[0035] In figures from 6 to 8 two possible different exemplary embodiments are shown of the roller 1 shown in figures from 1 to 5. The roller provides a cylindrical tubular body 202 capable of rotating about an axis 210 and a chamber 206 pneumatically connected to a suction system. According to this exemplary embodiment at each row of holes 203 a longitudinal rod 230 is provided free of rotating about its own axis with respect to roller 202 and equipped with holes 231. In particular, holes 231 are aligned with holes 203 bringing them in suction operability at a first position R1, while they rotate and insulate pneumatically the same row of holes from the suction chamber at a position R2.

[0036] More in detail, in the exemplary embodiment of figure 6 the rod 230 has at an end a pin 235 that is suitable for sliding in a fixed guide 215 co-axial to roller 202. Fixed guide 215 is shaped for causing rod 230 to rotate, by eccentric pin 235, with respect to roller 202 at first position R1 (see fig. 7) to allow suction through holes 203' that is located in a portion 202' of the roller, as well as for causing the same rod 230 to rotate further, insulating pneumatically the same row of holes 203 from the suction chamber 206 at the second position R2.

[0037] Alternatively (fig. 7), a cam 335 can be provided hinged to rod 230, for example at one end thereof, which is operated at R1 and R2 by abutments for causing the rod 230 same to rotate.

[0038] In figure 9 an exemplary embodiment is shown where the bars, instead of rotating, can translate since they are pushed axially by a cam surface, carrying thus the holes from the first to the second position.

[0039] The foregoing description of a specific embodiment 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 an embodiment without further research and without parting from the invention, and it is therefore to be understood that such adaptations and modifications will have to be considered as equivalent to the specific embodiment. The means and the materials to realise the 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 employed herein is for the purpose of description and not of limitation.

Claims

1. An interfolding machine of a web or sheet of paper comprising at least one roller for moving said web or sheet **characterised in that** said roller comprises:

- a cylindrical tubular body capable of rotating about an axis of rotation, said cylindrical tubular

body having a plurality of radial holes arranged according to substantially longitudinal rows,

- a chamber in said roller that extends for all its length and is that is always connected to a suction system, whereby said chamber is that is always under vacuum,
- interposition means between said chamber and at least one row of radial holes suitable for selectively connecting said chamber with said at least one row of holes at determined angular positions of said roller to provide a suction effect on the sheet or web of processed paper only at said positions..

2. Interfolding machine, according to claim 1, where in the roller actuation means are provided suitable for operating said interposition means between a first position where they bring in pneumatic connection the chamber and at least one row of holes and a second position they pneumatically insulate the chamber from said or each row of holes.

3. Machine interfolding machine, according to claim 2, wherein said interposition means comprise a longitudinal rod associated to at least one row of holes and provided with through holes that are aligned with the relative holes of said roller bringing them in suction operability at said first position.

4. Machine interfolding machine, according to claim 2, wherein said actuating means comprises cam means located at least at one end of said rod and suitable for engaging with fixed cam means at the rotation of said roller.

5. Machine interfolding machine, according to claim 2, wherein said rod is free of rotating about its own axis between said first and second position.

6. Machine interfolding machine, according to claim 2, wherein is free of translating along its own axis between said first and second position.

7. Machine interfolding machine, according to claim 4, wherein said cam means are selected from the group: a pin eccentric with respect to a longitudinal axis of said rod, a cam integral to said rod, a cam surface associated to a spring, said fixed cam means providing a fixed shaped guide.

8. Machine interfolding machine, according to claim 1, wherein said chamber is defined by the inner surface of said cylindrical tubular body

9. Machine interfolding machine, according to claim 1, wherein said chamber is defined by a hollow body fixed in said cylindrical tubular body, said interposition means comprising sealing elements sliding

against the inner surface of said cylindrical tubular body.

10. Machine interfolding machine, according to claim 9, where the suction chamber is sealed by forcing elastically said sliding sealing elements against the inner surface of said cylindrical tubular body. 5
11. Machine interfolding machine, according to claim 9, wherein said interposition means provides two radial boards, between which at least one opening is present, which extends between the first and the second tubular body for all the length of the roller in order to define the suction chamber. 10
12. Machine interfolding machine, according to claim 10, wherein each radial board comprises a fixed portion, forming a guide arranged longitudinally with respect to the conveying roller, within which a bar can slide radially forced elastically against the inner surface of the first cylindrical tubular body, forming said sliding sealing element. 15 20

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Fig. 1
(prior art)

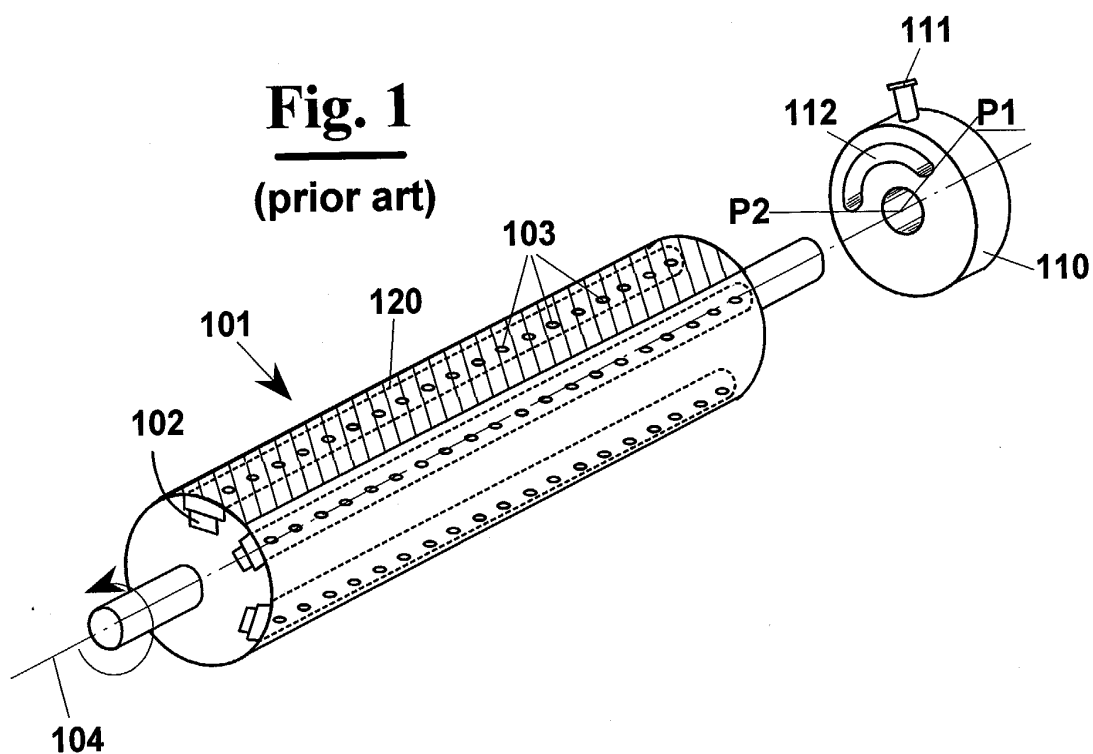


Fig. 2
(prior art)

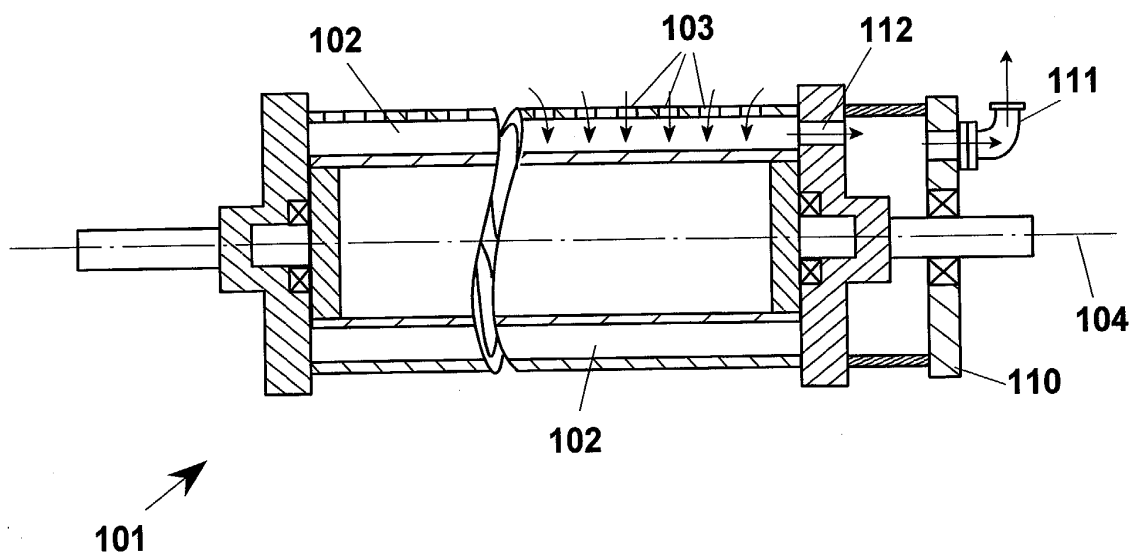


Fig. 3

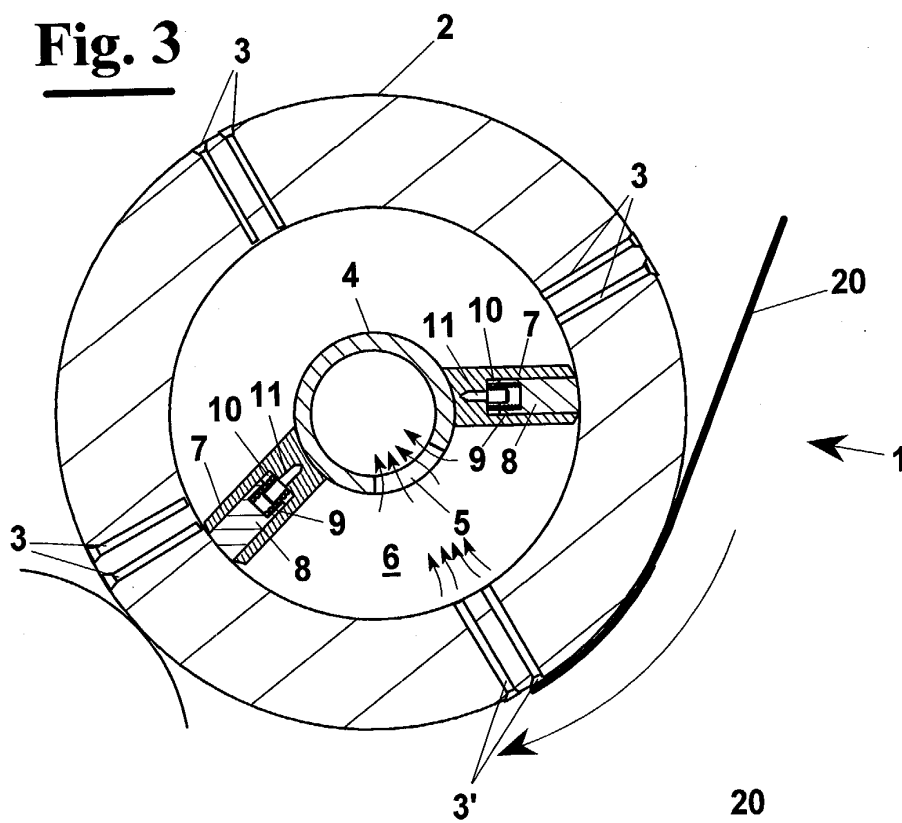
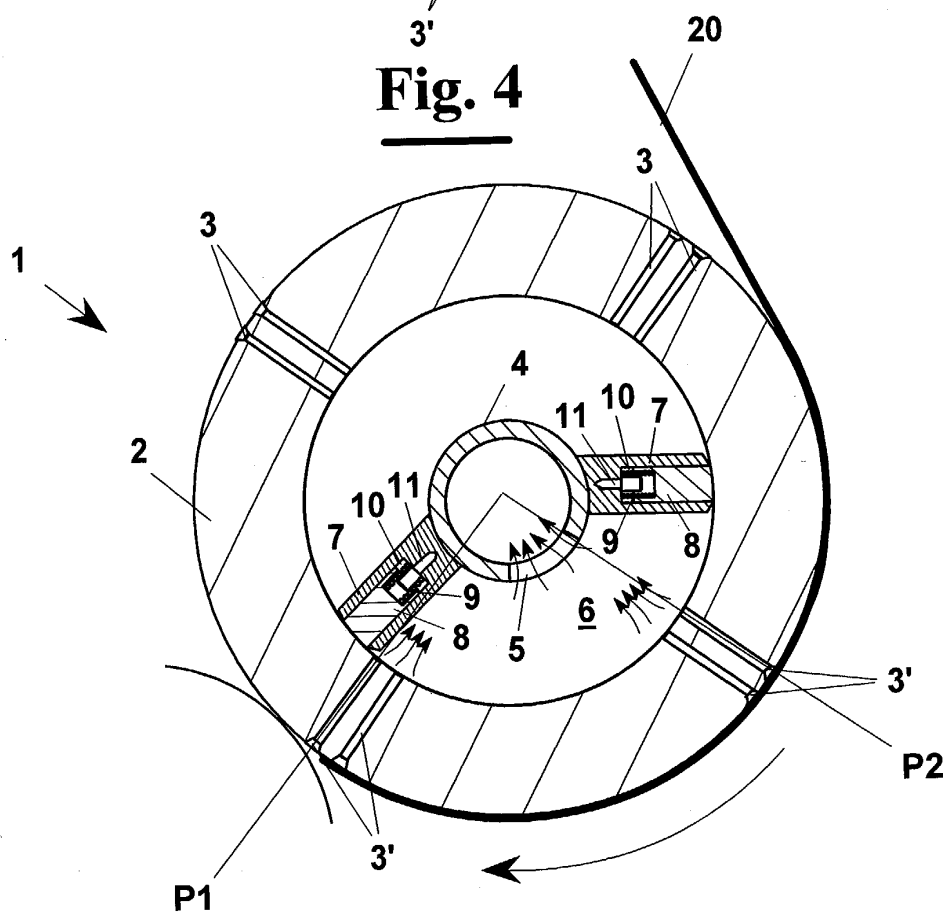


Fig. 4



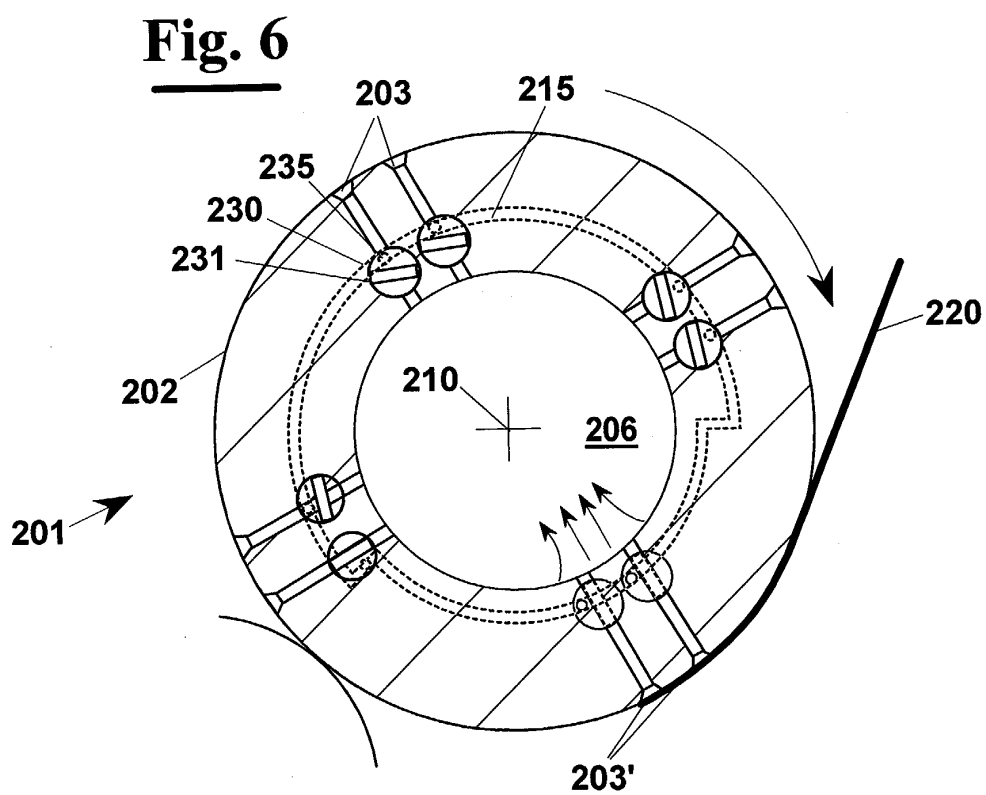
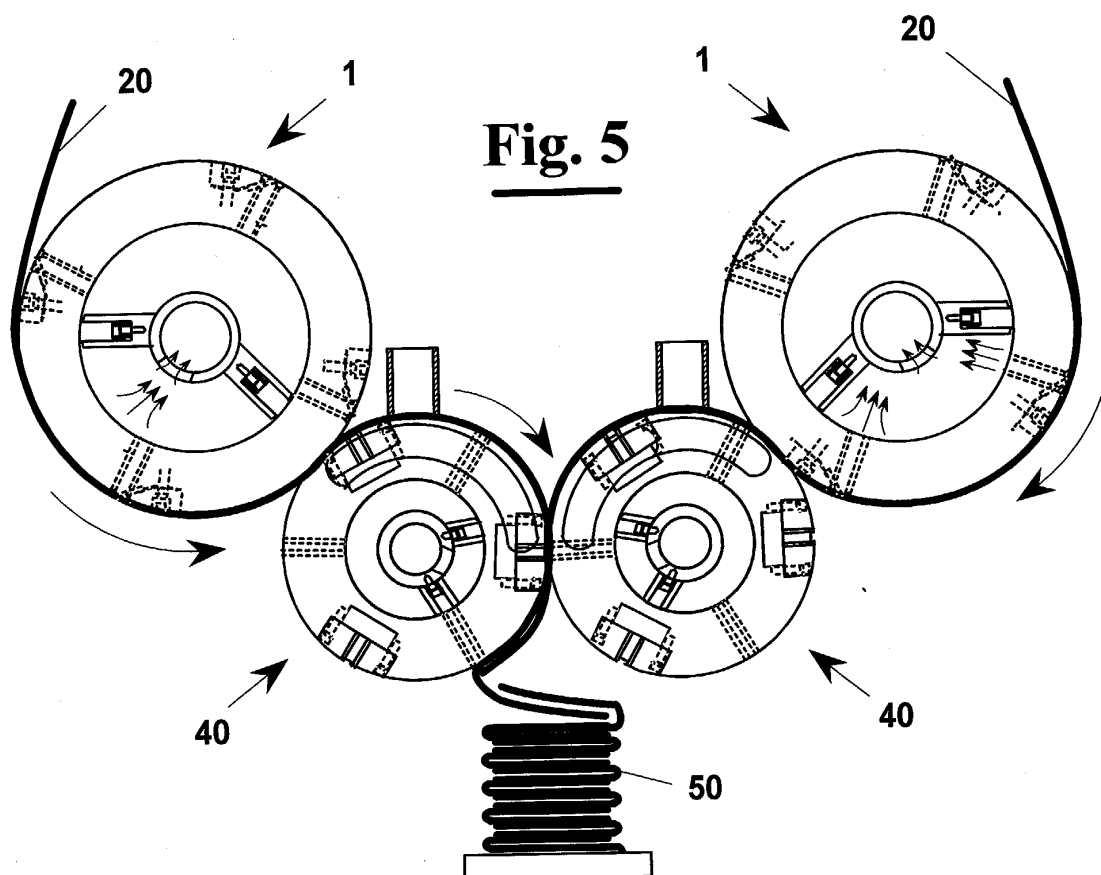


Fig. 7

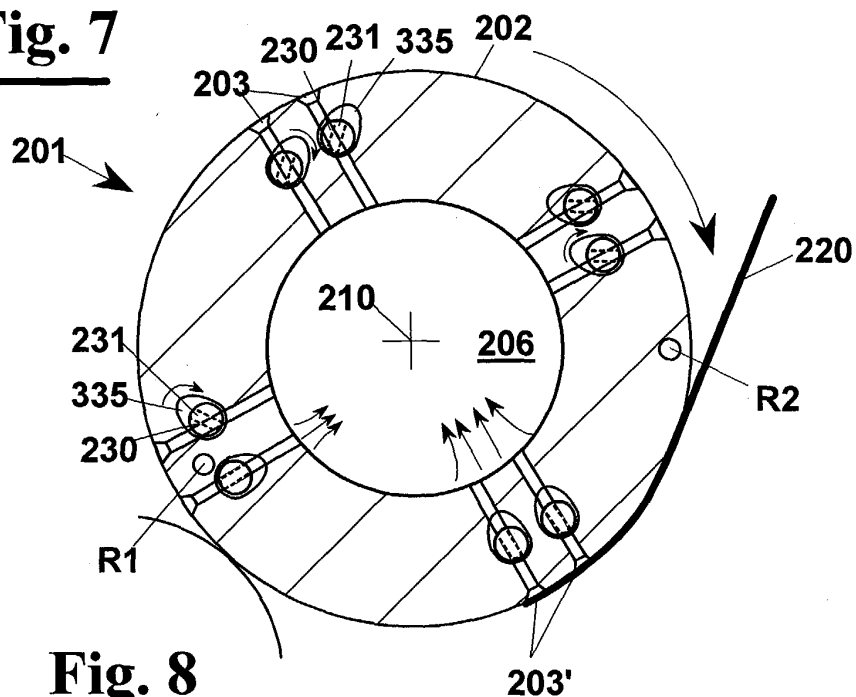


Fig. 8

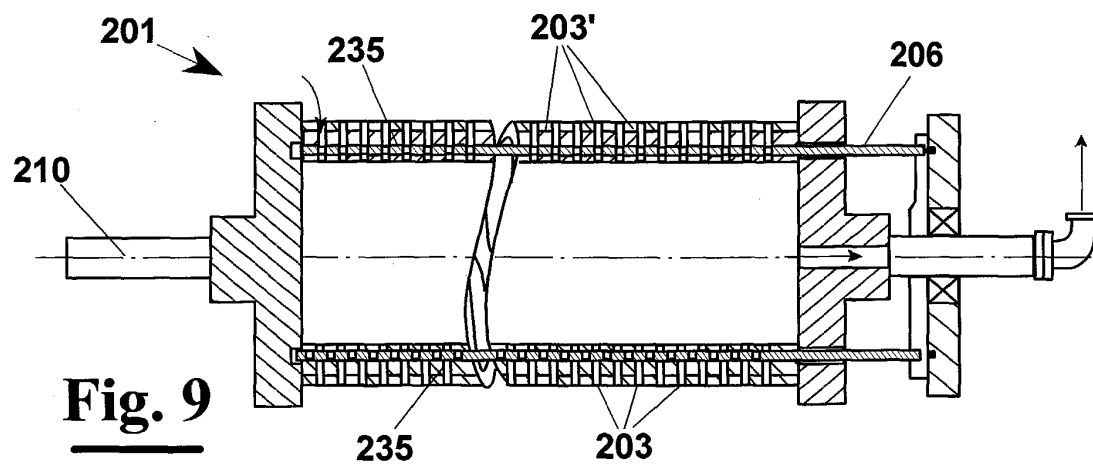
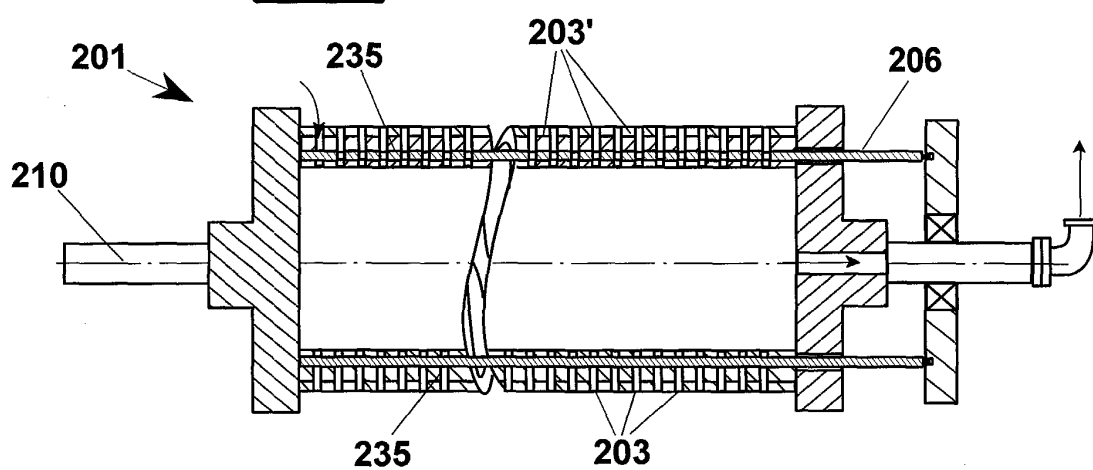


Fig. 9