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(54) **Apparatus and method for manufacturing smoking articles**

(57) There is provided an apparatus and method for manufacturing smoking articles. Each manufactured smoking article comprises at least a first component and a second component, overwrapped with a sleeve. The method comprises the steps of: axially aligning and abutting the first component and a filling tube; overwrapping the first component and the filling tube with the sleeve; positioning the first component, the filling tube and the sleeve in a substantially vertical orientation, the first component at the lower end, the filling tube at the upper end; inserting at least the second component into the filling tube from the upper end of the filling tube; and removing the filling tube. When the filling tube is removed, the second component can expand within the sleeve. The apparatus and method find particular application in the manufacture of heated smoking articles.

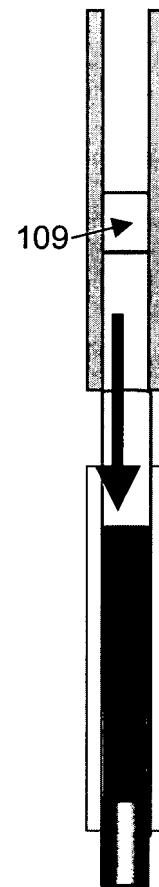


FIG. 2f

Description

[0001] The present invention relates to an apparatus and method for manufacturing smoking articles. Particularly, but not exclusively, the present invention relates to an apparatus and method for manufacturing heated smoking articles.

[0002] In known apparatus for producing smoking articles, smoking material is placed onto a paper web, which is then rolled around the smoking material to form a continuous rod. The rod is then cut into appropriate lengths and a filter is attached to the end of each cut rod using tipping paper. Although this process can work well with conventional smoking articles, as other types of smoking articles, such as heated smoking articles and heated cigarettes, are developed, this process may not be so suitable. This is especially true if the smoking article to be produced comprises several different components along its length, or if any of the components comprise flowable material such as granular material, liquid or gel.

[0003] US-2002/0119873 describes a process and apparatus for the production of cigarette filter mouthpieces. Paper tubes are held upright and conveyed past a vertically moveable plunger which serves to introduce filter material into the paper tubes. US-2006/0112963 describes a process and apparatus for the production of compound cigarette filters in which filter material is deposited into the open ends of vertically oriented filter tubes. Predetermined amounts of granular material are withdrawn by suction from sources of such material, and these amounts are deposited into the tubes. The overwrapped filter tubes must be pre-assembled separately. These production processes both relate to cigarette filters, for which the design and manufacture considerations are different.

[0004] Throughout the specification, the term "smoking articles" should be inferred to mean, not only conventional smoking articles, in which the substrate, usually tobacco, is combusted, but also other smoking articles, for example heated smoking articles, in which the substrate is heated rather than combusted and which rely on aerosol formation from the heated substrate. Such heated smoking articles include distillation-based smoking articles.

[0005] The apparatus and method of the invention may be used in a number of different applications. However, the apparatus and method are particularly useful in the manufacture of heated smoking articles such as those described in granted patents US-4,714,082, US-5,819,751 and US-5,040,551, distillation-based smoking articles such as those described in pending patent application EP 07253142.9 and heated cigarettes such as those marketed by the R.J. Reynolds Tobacco Company under the brand names Premier® and Eclipse®.

[0006] According to a first aspect of the invention there is provided apparatus for manufacturing smoking articles, each manufactured smoking article comprising at least a first component and a second component, over-

wrapped with a sleeve, the apparatus comprising means for axially aligning and abutting the first component and a filling tube; means for overwrapping the first component and the filling tube with the sleeve; at least one holder for positioning the first component, the filling tube and the sleeve in a substantially vertical orientation, the first component at the lower end, the filling tube at the upper end; means for inserting at least the second component into the filling tube from the upper end of the filling tube; and means for removing the filling tube.

[0007] The apparatus is advantageous because the substantially vertical orientation allows the second component to be inserted, even if the second component comprises flowable material. In addition, the filling tube maintains the integrity of the sleeve during filling so that deformation and misalignment of the sleeve is unlikely. In addition, the apparatus provides for formation of the sleeve, so no pre-formed sleeves are required. The second component is expandable such that removing the filling tube allows at least the second component to expand within the sleeve and this ensures that the second component is held securely within the sleeve. This is advantageous since it ensures that the integrity of the smoking article is maintained after manufacture.

[0008] The second component may be expandable because it has been compressed or because it has been pre-formed as expandable. The second component may be compressible. In that case, the apparatus may further comprise means for compressing the second component before the means for inserting the second component into the filling tube. In that case, the compression of the second component before insertion may allow the expansion of the second component when the filling tube is removed.

[0009] Preferably, the apparatus is automated, thereby allowing mass production of smoking articles.

[0010] Preferably, the sleeve comprises thin, sheet-like material. The thin, sheet-like material may be paper-like material. The paper-like material may be cigarette paper.

[0011] In one preferred embodiment, the apparatus comprises: a first module including the means for axially aligning and abutting the first component and the filling tube, and the means for overwrapping the first component and the filling tube with the sleeve; a second module including the means for inserting at least the second component into the filling tube; a third module including the means for removing the filling tube; and a coordinating module for transferring the at least one holder between the first, second and third modules. The modular structure ensures flexibility of the apparatus. Individual modules can easily be replaced to take into account different requirements for the smoking articles and their manufacture.

[0012] If the apparatus comprises means for compressing the second component, the means for compressing the second component may form part of the second module.

[0013] Preferably, the apparatus further comprises means for partially lining the sleeve with a heat conducting element. Preferably, the step of partially lining the sleeve is performed before the step of overwrapping the first component and the filling tube with the sleeve. The means for partially lining the sleeve may form part of the first module. Alternatively, the sleeve may be pre-lined with a heat conducting element. In one embodiment, the heat conducting element comprises metallic material. The metallic material may be aluminium foil.

[0014] Preferably, the first module is arranged to receive an empty holder from the coordinating module and to position the first component and the filling tube, with overwrapped sleeve, in the holder, for the coordinating module to pass the holder to a subsequent module.

[0015] In a preferred embodiment, the manufactured smoking article comprises a heated smoking article. In that case, the first component may comprise a heat source and the second component may comprise an aerosol-generating substrate. The heated smoking article may further comprise a third component, which may be an expansion chamber, and may further comprise a fourth component which may be a mouthpiece. In an alternative embodiment, the manufactured smoking article comprises a conventional smoking article. In that case, the first component may comprise a filter and the second component may comprise tobacco material. In alternative embodiments, the manufactured smoking article comprises a heated cigarette. The apparatus is particularly advantageous for smoking articles comprising at least three, and even more particularly, four components.

[0016] The first component may comprise a heat source. The heat source may be a combustible heat source. The heat source may be a carbon-based heat source. The heat source may be a pyrolysed carbon-based heat source. Preferably, the heat source is cylindrical. The heat source may include one or more airflow channels there through.

[0017] The second component may be an aerosol-generating substrate. The substrate may comprise smoking material. The substrate may comprise shreds of smoking material. The substrate may comprise tobacco material. The second component may comprise a plug of homogenised tobacco material. The substrate may comprise glycerine as aerosol former. The substrate may comprise additional components, for example flavourings. Preferably, the substrate is cylindrical.

[0018] In one embodiment, the second component comprises a plug of homogenised tobacco material. In that embodiment, the apparatus may further comprise means for compressing the tobacco material. In that embodiment, the apparatus may further comprise means for spreading out the tobacco material before the means for compressing the tobacco material. The means for spreading out the tobacco material may comprise a rotating spiked roller. Spreading out the tobacco material may comprise evenly distributing the tobacco material. The means for spreading out the tobacco material may

form part of the second module. The apparatus may further comprise means for weighing the second component. The means for weighing may form part of the second module.

[0019] The means for inserting at least the second component into the filling tube from the upper end of the filling tube, may comprise a vertically movable filling rod for pushing the second component into the filling tube. Preferably, the rod is a metal rod. Alternatively, the rod may be a plastic rod. Preferably, the rod is robust. Preferably, the rod is sized appropriately for the inside of the filling tube, so that no remnants of the second component remain attached to the inside of the filling tube.

[0020] Preferably, the second module is arranged to receive a holder from a preceding module, via the coordinating module, and to pass the holder to a subsequent module, via the coordinating module.

[0021] Preferably, the manufactured smoking article further comprises a third component, and the apparatus further comprises means for inserting the third component into the filling tube from the upper end of the filling tube. In that case, features described above in relation to the means for inserting the second component also apply to the means for inserting the third component. Preferably, the manufactured smoking article further comprises a fourth component, and the apparatus further comprises means for inserting the fourth component into the filling tube from the upper end of the filling tube. In that case, features described above in relation to the means for inserting the second component also apply to the means for inserting the fourth component. The means for inserting the third component may form part of a further module. If the third component is compressible, the apparatus may further comprise means for compressing the third component. The means for compressing the third component may form part of the further module. Preferably, the further module is arranged to receive a holder from a preceding module, via the coordinating module, and to pass the holder to a subsequent module via the coordinating module. The third component may comprise an expansion chamber. The expansion chamber may be elongate. The expansion chamber may comprise a cylindrical open-ended tube of cardboard. The means for inserting the fourth component may form part of a second further module. If the fourth component is compressible the apparatus may further comprise means for compressing the fourth component. The means for compressing the fourth component may form part of the second further module. Preferably, the second further module is arranged to receive a holder from a preceding module, via the coordinating module, and to pass the holder to a subsequent module via the coordinating module. The fourth component may comprise a mouthpiece. The mouthpiece may comprise a filter. The filter may comprise cellulose acetate tow.

[0022] The first component, second component and optionally third component and optionally fourth component do not need to be adjacent in the finished smoking

article. Each component may comprise a single item or may comprise two, three, four or more items.

[0023] Preferably, the coordinating module comprises a robot arm for transferring the at least one holder between the first, second, third and any further modules. Preferably, the coordinating module further comprises storage for unused holders.

[0024] The filling tube may comprise a rigid open-ended tube. Preferably, the filling tube comprises a forming portion for assisting with insertion of the second component and any further components. Preferably, when the first component and the filling tube are overwrapped with the sleeve, the filling tube extends upwardly out of the sleeve. This is advantageous since it allows the exposed portion of the filling tube to be gripped.

[0025] According to a second aspect of the invention, there is provided a method for manufacturing smoking articles, each manufactured smoking article comprising at least a first component and a second component, overwrapped with a sleeve, the method comprising the steps of: axially aligning and abutting the first component and a filling tube; overwrapping the first component and the filling tube with the sleeve; positioning the first component, the filling tube and the sleeve in a substantially vertical orientation, the first component at the lower end, the filling tube at the upper end; inserting at least the second component into the filling tube from the upper end of the filling tube; and removing the filling tube.

[0026] The method is advantageous because the substantially vertical orientation allows the second component to be inserted, even if the second component comprises flowable material. In addition, the filling tube maintains the integrity of the sleeve during filling so that deformation and misalignment of the sleeve is unlikely. In addition, the method provides for formation of the sleeve, so no pre-formed sleeves are required. The step of removing the filling tube allows at least the second component to expand within the sleeve and this ensures that the second component is held securely within the sleeve. This is advantageous since it ensures that the integrity of the smoking article is maintained after manufacture.

[0027] The second component may be compressible. In that case, the method may further comprise the step of compressing the second component before the step of inserting the second component into the filling tube. In that case, compression of the second component before insertion may allow expansion of the second component when the filling tube is removed.

[0028] Preferably, the method is automated, thereby allowing mass production of smoking articles.

[0029] Preferably, the sleeve comprises thin, sheet-like material. The thin, sheet-like material may be paper-like material. The paper-like material may be cigarette paper.

[0030] Preferably, the method further comprises the step of partially lining the sleeve with a heat conducting element. Preferably, the step of partially lining the sleeve is performed before the step of overwrapping the first

component and the filling tube with the sleeve. Alternatively, the sleeve may be pre-lined with a heat conducting element. In one embodiment, the heat conducting element comprises metallic material. The metallic material may be aluminium foil.

[0031] In a preferred embodiment, the manufactured smoking article comprises a heated smoking article. In that case, the first component may comprise a heat source and the second component may comprise an aerosol-generating substrate. The heated smoking article may further comprise a third component, which may be an expansion chamber, and may further comprise a fourth component which may be a mouthpiece. In an alternative embodiment, the manufactured smoking article comprises a conventional smoking article. In that case, the first component may comprise a filter and the second component may comprise tobacco material. In alternative embodiments, the manufactured smoking article comprises a heated cigarette. The method is particularly advantageous for smoking articles comprising at least three, and even more particularly, four components.

[0032] In one embodiment, the second component comprises a plug of homogenised tobacco material. In that embodiment, the method may further comprise the step of compressing the tobacco material. In that embodiment, the method may further comprise the step of spreading out the tobacco material before the step of compressing the tobacco material. Spreading out the tobacco material may comprise evenly distributing the tobacco material. The method may further comprise the step of weighing the second component.

[0033] Preferably, the step of inserting at least the second component into the filling tube from the upper end of the filling tube, may comprise pushing the second component into the filling tube with a vertically movable filling rod. Preferably, the rod is a metal rod. Alternatively, the rod is a plastic rod. Preferably, the rod is robust. Preferably, the rod is sized appropriately for the inside of the filling tube.

[0034] Preferably, the manufactured smoking article further comprises a third component, and the method further comprises the step of inserting the third component into the filling tube from the upper end of the filling tube. In that case, features described above in relation to the step of inserting the second component also apply to the step of inserting the third component. Preferably, the manufactured smoking article further comprises a fourth component, and the method further comprises the step of inserting the fourth component into the filling tube from the upper end of the filling tube. In that case, features described above in relation to the step of inserting the second component also apply to the step of inserting the fourth component. If the third component is compressible, the method may further comprise the step of compressing the third component. The third component may comprise an expansion chamber. The expansion chamber may be elongate. The expansion chamber may comprise a cylindrical open-ended tube of cardboard. If the

fourth component is compressible, the method may further comprise the step of compressing the fourth component. The fourth component may comprise a mouthpiece. The mouthpiece may comprise a filter. The filter may comprise cellulose acetate tow.

[0035] If the manufactured smoking article comprises a third component, or a third component and a fourth component, the step of removing the filling tube may be performed after all the components have been inserted into the filling tube. Alternatively, the filling tube may be partially removed after each component is inserted.

[0036] According to a third aspect of the invention, there is provided apparatus for manufacturing heated smoking articles, each manufactured heated smoking article comprising: a heat source, an aerosol-generating substrate downstream of the heat source, an expansion chamber downstream of the aerosol-generating substrate, a mouthpiece downstream of the expansion chamber, and a paper sleeve overwrapping the heat source, substrate, expansion chamber and mouthpiece, the apparatus comprising: means for axially aligning and abutting the heat source and a filling tube; means for overwrapping the heat source and the filling tube with the paper sleeve; at least one holder for positioning the heat source, the filling tube and the paper sleeve in a substantially vertical orientation, the heat source at the lower end, the filling tube at the upper end; means for inserting the aerosol-generating substrate into the filling tube from the upper end of the filling tube; means for inserting the expansion chamber into the filling tube from the upper end of the filling tube; means for inserting the mouthpiece into the filling tube from the upper end of the filling tube; and means for removing the filling tube.

[0037] The apparatus may comprise: a first module including the means for axially aligning and abutting the heat source and the filling tube, and the means for overwrapping the heat source and the filling tube with the paper sleeve; a second module including the means for inserting the aerosol-generating substrate into the filling tube; a third module including the means for inserting the expansion chamber into the filling tube and the means for inserting the mouthpiece into the filling tube; a fourth module including the means for removing the filling tube; and a coordinating module for transferring the at least one holder between the first, second, third and fourth modules.

[0038] According to a fourth aspect of the invention, there is provided a method for manufacturing heated smoking articles, each manufactured heated smoking article comprising: a heat source, an aerosol-generating substrate downstream of the heat source, an expansion chamber downstream of the aerosol-generating substrate, a mouthpiece downstream of the expansion chamber, and a paper sleeve overwrapping the heat source, substrate, expansion chamber and mouthpiece, the method comprising the steps of: axially aligning and abutting the heat source and the filling tube; overwrapping the heat source and the filling tube with the paper

sleeve; positioning the heat source, the filling tube and the paper sleeve in a substantially vertical orientation, the heat source at the lower end, the filling tube at the upper end; inserting the aerosol-generating substrate into the filling tube from the upper end of the filling tube; inserting the expansion chamber into the filling tube from the upper end of the filling tube; inserting the mouthpiece into the filling tube from the upper end of the filling tube; and removing the filling tube.

[0039] Features described in relation to one aspect of the invention may also be applicable to another aspect of the invention. Preferred features described in relation to one aspect of the invention may also be preferred in relation to another aspect of the invention.

[0040] The invention will be further described, by way of example only, with reference to the accompanying drawings in which:

Figure 1	shows a heated smoking article;
Figures 2a to 2i	show the steps of a method for manufacturing the smoking article of Figure 1, according to an embodiment of the invention;
Figure 3	is a schematic plan view of apparatus according to an embodiment the invention;
Figure 4a	is a perspective view of a filling tube with integral forming tube;
Figure 4b	is a perspective view of a tube holder of smoking articles during manufacture;
Figures 5a to 5c	show perpendicular operation of the aluminium foil applicator;
Figure 6a and 6b	show parallel operation of the aluminium foil applicator;
Figure 7a	is a perspective view of the rolling guide;
Figure 7b	is a perspective view of the rolling guide gripper;
Figure 8	is a schematic perspective view of the Second Component Module of Figure 3;
Figure 9	is a schematic perspective view of one device of the Third Component Module of Figure 3; and
Figure 10	is a schematic perspective view of the Unloading Module of Figure 3.

[0041] One preferred exemplary embodiment will now be described for manufacturing a heated smoking article like the distillation-based smoking article described in EP 07253142.9. The distillation-based smoking article described in EP 07253142.9 is shown in Figure 1. The smoking article 101 comprises a combustible heat source 103, an aerosol-generating substrate 105, an elongate expansion chamber 107 and a mouthpiece 109 in abutting coaxial alignment, which are overwrapped in an outer wrapper of paper 111. The combustible heat source 103

is a pyrolysed porous carbon-based heat source. The aerosol-generating substrate 105 is located immediately downstream of the combustible heat source 103 and comprises a cylindrical plug of homogenised tobacco material 117. A heat-conducting element 121 consisting of a tube of aluminium foil, surrounds and is in contact with a rear portion of the combustible heat source 103 and an abutting front portion of the aerosol-generating substrate 105. The elongate expansion chamber 107 is located downstream of the aerosol-generating substrate 105 and comprises a cylindrical open-ended tube of cardboard 123. The mouthpiece 109 is located downstream of the expansion chamber 107 and comprises a cylindrical plug of cellulose acetate tow 125 circumscribed by filter plug wrap 127. In this embodiment, the outer wrapper of paper 111 includes perforations 129 around its circumference, just upstream of the heat conducting element 121. The smoking article 101 is circumscribed by tipping paper 131.

[0042] Figures 2a to 2i show an exemplary embodiment of the overall process for vertical manufacture for a heated smoking article, like that described above with reference to Figure 1. Although the method is described with reference to the heated smoking article of Figure 1, it will be appreciated that the method may be used for manufacture of any conventional smoking article, heated smoking article or heated cigarette.

[0043] Referring to Figure 2a, firstly the heat source 103 is axially aligned with and in contact with a filling tube 201. The filling tube 201 comprises a cylindrical open-ended tube of cardboard. The filling tube 201 is used for construction of the smoking article but does not form part of the smoking article itself. The heat source 103 and filling tube 201 are overwrapped with paper 111 lined with an aluminium foil heat conducting element 121. The filling tube 201 protrudes from the paper 111. The resultant article comprising heat source 103, filling tube 201 and overwrapped paper 111 and foil 121, is shown in Figure 2b.

[0044] Referring to Figure 2c, the heat source, filling tube and overwrapped paper are oriented vertically, with the heat source 103 at the lower end and the filling tube 201 at the upper end. Referring to Figure 2d, a forming tube 203 is introduced and axially aligned above the filling tube 201. The forming tube 203 is used for the insertion of the smoking article components into the filling tube 201. Although not shown in Figures 2d to 2g, the forming tube may be conical, thereby providing a funnel for introduction of the smoking article components. The forming tube 203 may be joined to or integral with the filling tube 201. Firstly, the aerosol-generating substrate 105 is inserted, as shown in Figure 2d. Then, the expansion chamber 107 is inserted, as shown in Figure 2e. Then, the mouthpiece 109 is inserted, as shown in Figure 2f. As the aerosol-generating substrate, expansion chamber and mouthpiece are inserted, they may be compressed. Referring to Figure 2g, the forming tube 203 is then removed. Referring to Figure 2h, the filling tube 201 is then

removed from within the paper 111. If the filling tube 201 and forming tube 203 are joined together or integral, these two steps can be carried out as a single step. As the filling tube 201 is removed, one, two or all of the aerosol-generating substrate 105, expansion chamber 107 and mouthpiece 109 may expand slightly within the paper 111 thereby achieving the correct density, shape and firmness for the smoking article. The expansion also assists to keep the aerosol-generating substrate, expansion chamber and mouthpiece within the paper, after the filling tube 201 has been removed. As the filling tube 201 is being removed, the components may be compressed downwardly to ensure they remain in the paper sleeve. The resultant smoking article is shown in Figure 2i.

[0045] In Figures 2a to 2i, the filling tube 201 is removed, once the aerosol-generating substrate, expansion chamber and mouthpiece have been inserted. However, the filling tube 201 could be removed, step by step, as each of those components is inserted. For example, once the substrate 105 has been inserted, the filling tube 201 could be partially removed, so that its lower end is close to the top of the substrate 105. Then, once the expansion chamber 107 has been inserted, the filling tube 201 could be further removed so that its lower end is close to the top of the expansion chamber 107. Then, once the mouthpiece 109 has been inserted, the filling tube 201 could be fully removed. In that case, each of those components will expand into the paper sleeve, as the filling tube is removed from around it.

[0046] Figures 2a to 2i show schematically the process for manufacture of the heated smoking article of Figure 1, according to an exemplary embodiment of the method of the invention. An exemplary embodiment of apparatus for manufacturing the heated smoking article, in accordance with the procedure shown in Figures 2a to 2i, will now be described.

[0047] Figure 3 is a schematic plan view of an exemplary embodiment of the apparatus 301. The apparatus comprises a number of modules 303 to 311, each module having a different function. In this embodiment, the apparatus comprises five modules. However, any suitable number of modules could be used, depending on the smoking article to be manufactured. In this embodiment, the apparatus comprises coordinating module in the form of Central Module 303, first module in the form of Rolling Module 305, second module in the form of Second Component Module 307, third module in the form of Third Component Module 309 and a further module in the form of Unloading Module 311. Rolling Module 305 will be described further with reference to Figures 5 to 7. Second Component Module 307 will be described further with reference to Figure 8. Third Component Module 309 will be described further with reference to Figure 9. Unloading Module 311 will be described further with reference to Figure 10.

[0048] Figure 4a shows an individual filling tube 201, with integral forming tube 203, as used in the apparatus of Figure 3, for manufacture of the smoking articles. De-

pending on the material or materials used for the filling tube and forming tube, the two tubes may be glued or welded together, or joined in another way. Alternatively, the filling tube and forming tube could be integrally formed as a single item.

[0049] Figure 4b shows a holder in the form of tube holder 401, as used in the apparatus of Figure 3, to hold a plurality of smoking articles during manufacture. As shown in Figure 4b, each tube holder 401 can hold a plurality of smoking articles during manufacture, at a plurality of support sites 403. In Figure 4b, each smoking article is shown in the process of manufacture, as shown in Figure 2b. Each heat source 103 is at the lower end of the tube holder 401. Each forming tube 203 is at the upper end of the tube holder 401. The filling tube 201 and overwrapped paper 111 extend between the upper end of the tube holder and the lower end of the tube holder. Thus, the heat sources, filling tubes and overwrapped paper are vertically oriented, as shown in Figure 2c.

[0050] Referring once again to Figure 3, the Central Module 303 comprises a robot arm 313 for transferring tube holders 401 between the other modules 305, 307, 309 and 311, and storage 315 for storing unused tube holders. The function of the Central Module 303 is to provide communication between the modules 305, 307, 309 and 311 and to transfer the tube holders between the modules. Each of the modules 305, 307, 309 and 311 has a separate function.

[0051] Referring once again to Figure 3, in this embodiment, the functions of the Rolling Module 305 are to glue the aluminium foil heat conductor 121 on paper 111, to axially align the heat source 103 and filling tube 201 and to roll the paper and aluminium foil around the heat source 103 and filling tube 201.

[0052] In this embodiment, the Rolling Module 305 comprises paper feed roll 317, aluminium foil feed roll 319 and aluminium foil applicator 321. The Rolling Module 305 further comprises heat source supplier 323, heat source delivery belt 325, filling tube supplier 327, rolling guide 329 and tipping paper feed roll 331. In the embodiment shown, the aluminium foil applicator 321 operates by introducing the paper and the aluminium foil substantially perpendicularly. Such perpendicular operation of the aluminium foil applicator 321 is described below with reference to Figures 5a, 5b and 5c. However, the aluminium foil applicator 321 could alternatively operate by introducing the paper and the aluminium foil substantially in parallel. In that case, the aluminium foil feed roll 319 would need to be positioned differently from the position shown in Figure 3. Operation of the aluminium foil applicator 321 in parallel operation is described below with reference to Figures 6a and 6b.

[0053] Operation of the aluminium foil applicator 321 in perpendicular operation will now be described with reference to Figures 5a to 5c. As shown in Figure 5a, paper is fed from feed roll 317 and aluminium foil is fed from feed roll 319. The aluminium foil is fed in at a substantially

90° angle from the paper. The dimension 501 of the paper on feed roll 317 corresponds to the height of the paper 111 on a finished smoking article (see Figure 2i). The dimension 503 of the aluminium foil feed roll 319 corresponds to the circumference of a finished smoking article. As shown in Figure 5b, the aluminium foil is applied to paper to form the aluminium foil heat conductor 121. The dimension 505 is chosen according to the desired coverage of the heat source 103 and aerosol generating substrate 105 by heat conductor 121 in the finished smoking article. A margin 507 is left for gluing. Then, as shown in Figure 5b, the paper is cut along cut line 509. The resultant paper overwrap 111 with aluminium foil heat conductor 121 pre-applied, is shown in Figure 5c.

[0054] Operation of the aluminium foil applicator 321 in parallel operation will now be described with reference to Figures 6a and 6b. As shown in Figure 6a, paper is fed from feed roll 317 and aluminium foil is fed from feed roll 319. The aluminium foil is fed in substantially parallel to the paper. As in Figures 5a to 5c, the dimension 501 of the paper on feed roll 317 corresponds to the height of the paper 111 on a finished smoking article. However, in this case, the dimension 505 of the aluminium foil feed roll 319 is selected according to the chosen length of the heat conductor 121 in the finished smoking article. As the aluminium foil is fed towards the paper, in this embodiment, it is slit and separated at 601. Then, the aluminium foil is glued to the paper at 603. Finally, the paper and aluminium foil are cut along lines 605, at appropriate intervals according to the circumference 503 of a finished smoking article. The resultant paper overwrap 111 with aluminium foil heat conductor 121 pre-applied, is shown in Figure 6b.

[0055] In Figures 5a to 5c, there is a single heat conductor 121 (as in Figure 1), whereas in Figures 6a to 6b, there are two heat conductors 121, longitudinally spaced along the smoking article. The preferred arrangement has a single heat conductor 121 as shown in Figure 1 and Figures 5a to 5c. However, there may be two heat conductors, as shown in Figures 6a to 6c. In that case, the first heat conductor is as shown in Figure 1 and the second heat conductor is positioned slightly downstream of the first heat conductor, with a small gap (typically 1 to 3 mm maximum) between the two heat conductors. This may assist with heat distribution.

[0056] Operation of the heat source supplier 323, heat source delivery belt 325 and filling tube supplier 327 will now be described. The heat sources are supplied via a hopper in the heat source supplier 323. The heat sources fall from the hopper onto the delivery belt 325 and, as they do so, are oriented vertically on the belt. The vertically oriented heat sources are then fed, one by one, into the rolling guide 329, which will be described below. The filling tubes are also fed into the Rolling Module 305 from the filling tube supplier 327 (not shown in Figure 3). A small robot arm (also not shown) is then used to feed the filling tubes, one by one, into the rolling guide 329. Note that, in this embodiment, each filling tube comprises an

integral forming tube, as shown in Figure 4a. Preferably, the heat sources and filling tubes are retained on the rolling guide by suction.

[0057] Figure 7a shows the rolling guide 329 in more detail. In the rolling guide of Figure 7a, there is one rolling site 701, but further rolling sites may be included. In Figure 7a, the rolling site 701 contains a heat source 103 at the lower end of the rolling guide and a forming tube 203 at the upper end of the rolling guide. Filling tube 201 extends between the upper end and the lower end of the rolling guide. The heat source 103 and filling tube 201 are axially aligned, with the filling tube above the heat source. Figure 7b shows the rolling guide gripper 703 (not shown in Figure 3). The rolling guide 329 and the rolling guide gripper 703 cooperate to overwrap the paper, with pre-applied aluminium heat conducting element, onto the heat source and filling tube.

[0058] Once the paper overwrap 111 with aluminium foil heat conductor 121 pre-applied, has been prepared by the aluminium foil applicator 319, a small robot arm (not shown in Figure 3) transfers the paper overwrap 111 with aluminium foil heat conductor 121, to rolling guide gripper 703. The position of the paper overwrap 111, with aluminium foil heat conductor 121, in the rolling guide gripper is shown in Figure 7b (which shows two heat conductors 121 as in Figure 6b). The rolling guide gripper comprises two plates 705, which are laterally movable, as shown by the arrow in Figure 7b. The paper overwrap is positioned by the robot arm on one of the plates 705, with the aluminium foil element facing inward.

[0059] During operation, the rolling guide gripper 703 approaches the rolling guide 329 and the two plates 705 move together to grip a filling tube at rolling site 701. Then, the rolling guide gripper 703 rotates around the rolling guide 329, thereby overwrapping the heat source and filling tube with the paper and heat conducting element. Thus, the heat source, filling tube and overwrapped paper, shown in Figure 2b is produced. At this stage, tipping paper from feed roll 331 may also be applied to the heat source, filling tube and overwrapped paper by a similar process.

[0060] The heat source, filling tube and overwrapped paper are then removed from the top of the rolling guide, by gripping the forming tube 203, and inserted into a tube holder 401. Once the tube holder 401 is filled with heat sources, filling tubes and overwrapped paper, the tube holder can be transferred to the next module, by the central robot arm 313.

[0061] The embodiment of the Rolling Module 305 described above is very flexible. For example, the Rolling Module can be adapted for different types of heat sources. The length and diameter of the heat source, the material used for construction of the heat source, the position, size and number of channels in the heat source and the coating in the channel(s) can all be varied. Further, the Rolling Module can be adapted for different types and sizes of paper and aluminium foil. The size of the smoking article, and hence the widths of feed rolls 317 and 319,

and the thickness of the aluminium foil, can be varied. Further, the operation of the Rolling Module can be adapted to change the position, size and number of the foil elements on the paper.

[0062] Figure 8 is a schematic perspective view of one exemplary embodiment of the Second Component Module 307, including an inset showing operation of part of the Second Component Module in more detail. The function of the Second Component Module 307 is to insert the second component of the smoking article into the filling tube. In this case, the Second Component Module 307 is used to form the aerosol generating substrate and insert it. In this embodiment, the aerosol generating substrate comprise shreds of tobacco material.

[0063] The Second Component Module 307 comprises hopper 801, means for spreading out the tobacco material in the form of spiked roller 803 and a vibrating delivery channel 805, to align the tobacco material, the delivery channel having a downstream end 805a. The Second Component Module 307 further comprises weighing and grouping means 807 and filling rod 809.

[0064] During operation, the tobacco material follows the route shown by the arrows. The tobacco material falls down through hopper 801 and the tobacco material is evenly distributed across the vibrating delivery channel 805 by spiked roller 803. The tobacco material is aligned by the vibration of the channel 805. The aligned tobacco material passes along channel 805 towards the downstream end 805a.

[0065] At the downstream end 805a, the tobacco material falls onto the weighing and grouping means 807. In this embodiment, the weighing and grouping means comprises a flexible metal plate onto which the tobacco material falls. When the tobacco material is on the metal plate, it is weighed. When the desired weight of tobacco material has been received on the plate, the plate flexes and rolls around the tobacco material to compress the tobacco material and form a plug of tobacco material, which will ultimately form the aerosol generating substrate in the finished smoking article. Then, the plug is rotated to a vertical orientation.

[0066] A tube holder of heat sources, filling tubes and overwrapped paper, from Rolling Module 305, is positioned beneath the downstream end 805a of the vibrating delivery channel 805. The tube holder 401 is rotatable, such that each heat source, filling tube and overwrapped paper item is located at the downstream end of the channel 805, underneath the weighing and grouping means 807 and filling rod 809. When a formed plug is vertically oriented and positioned above a filling tube, the filling rod 809 moves downwards repeatedly into a filling tube 201 via forming tube 203, to insert the plug into the filling tube. The filling rod may be pushed down as much as required to further compress the plug and form the correct density substrate. Then, the tube holder rotates and the process is repeated with the next filling tube in the tube holder.

[0067] Once all the heat sources, filling tubes and overwrapped paper in the tube holder have been filled with a

plug of tobacco material, to form the aerosol generating substrate in each finished smoking article, the tube holder can be transferred to the next module, by the central robot arm 313.

[0068] The embodiment of the Second Component Module 307 described above with reference to Figure 8 is very flexible. For example, the Second Component Module can be used with any smoking material type, blend and size. In addition, the operation of the Second Component Module can be adapted to change the weight and orientation of material in the plug and the size and density of the resultant aerosol-generating substrate.

[0069] As shown in Figure 3, in this embodiment, the Third Component Module 309 comprises two identical devices 901. Figure 9 is a perspective view of one exemplary embodiment of one device 901 of the Third Component Module 309.

[0070] The function of the Third Component Module 309 is to insert a further component or components of the smoking article into the filling tubes. In this case, the Third Component Module 309 comprises two devices 901. The first device 901 is used to supply the expansion chambers 107, to cut the expansion chambers 107 to the required length, and to insert the cut expansion chambers into the filling tubes. The second device 901 is used to supply cellulose acetate tow rods, to cut the cellulose acetate tow rods to the required length to form the mouthpieces 109, and to insert the mouthpieces into the filling tubes. The device 901 will be described once, since operation with the expansion chambers and operation with the mouthpieces are substantially identical.

[0071] The device 901 comprises hopper 903, cutter 905, length measuring means 907, delivery means 909 and filling rod 911. During operation, long lengths of cylindrical cardboard tubing or cellulose acetate tow rod fall down through the hopper 903, in a horizontal orientation. As each piece of tubing or rod falls to the bottom of the hopper 903, it is cut to the desired length by cutter 905. The desired length is set by the length measuring means 907. Once the tubing or rod has been cut, any wastage is disposed of (and preferably re-used) and the expansion chambers or mouthpieces so formed are rotated into a vertical orientation and are supplied to delivery means 909. The delivery means supplies the expansion chambers or mouthpieces to each heat source, filling tube and overwrapped paper item located in the tube holder 401. Then, the filling rod 911 moves vertically downwards to push the expansion chambers or mouthpieces into the filling tubes 201.

[0072] Once the first device 901 has inserted the expansion chambers, the robot arm 313 of the Central Module 303 moves a tube holder to the next device 901. Once the next device 901 has inserted the mouthpieces, the robot arm 313 of the Central Module 303 moves the tube holder to the next module.

[0073] The embodiments of the devices 901 of the Third Component Module 309 described above with reference to Figure 9 are very flexible. For example, the

diameter and material of the expansion chambers and mouthpieces can easily be varied. The device can cut to any required length. In addition, the Third Component Module 309 can include as many devices as required for the particular smoking article being manufactured.

[0074] Figure 10 is a schematic perspective view of one exemplary embodiment of the Unloading Module 311. The function of the Unloading Module 311 is to unload the finished smoking articles from the tube holder 401 and to send the smoking articles for packaging.

[0075] The Unloading Module 311 comprises a gripper 1001, a lifter 1003 and a shoot 1005. A full tube holder of finished smoking articles is received from the preceding module, by the robot arm 313. One by one, the heat source 103 of each smoking article is gripped by the gripper 1001, while the lifter 1003 grips the forming tube 203 and lifts out the filling tube 201 and forming tube 203. As the filling tube 201 is removed from within the paper sleeve, some or all of the components expand within the sleeve. Then, the gripper 1001 rotates and supplies the smoking article to the shoot 1005 for packaging. The forming tube 203 and filling tube 201 can be returned to the filling tube supplier for re-use (optionally after cleaning). The tube holder then rotates to the next finished smoking article.

[0076] As will be appreciated, the apparatus can be altered considerably depending on the requirements of the smoking articles to be manufactured. Indeed, this is one aspect of the apparatus of the invention that is particularly advantageous. Some examples of features that may change will now be discussed.

[0077] Firstly, the entire apparatus may include any number of modules, all coordinated by a Central Module like that shown in Figure 3. For example, there may be further modules for cleaning the filling tubes, or for packaging the smoking articles. Or, one of the modules shown in Figure 3 may be removed entirely. For example, if the smoking article to be manufactured requires only a single component to be inserted into the filling tube, only one of module 307 and 309 may be required.

[0078] Secondly, the Rolling Module 305 may include an extra bobbin for reconstituted tobacco sheet. This could be included in the heated smoking article of Figure 1 outside the tobacco aerosol-generating substrate, but inside the sleeve.

[0079] Thirdly, the Second Component Module 307 may include additional apparatus similar or identical to that described in Figure 8, for example if two types of smoking material are being supplied.

[0080] Fourthly, the Third Component Module 309 may include any number of similar devices 901, for instance to insert other components such as pre-formed tobacco rods or ceramic discs.

[0081] A further module may also be included, to form the perforations in the sleeve, like perforations 129 in Figure 1. The perforations may be made by mechanical means, or by a laser, or in any other suitable way.

[0082] The smoking article may further include an out-

er ring, outside the sleeve, which can be moved down the smoking article after use to extinguish the combustible heat source. In that case, a further module may also be included to add such an extinguisher ring.

[0083] The tube holders can also be any suitable size and shape and can hold any number of smoking articles.

[0084] Although the above description relates to the manufacture of a particular heated smoking article, the manufacturing process could equally be used for another sort of smoking article, such as a conventional smoking article or a heated cigarette. In the case of a conventional smoking article, the filter, instead of the heat source, could be at the lower end of the tube holder and overwrapped in Rolling Module 305. And, the tobacco material could be inserted at Second Component Module 307.

[0085] One of the advantageous aspects of the above embodiment of the apparatus is that it is modular, so individual modules can be replaced, inserted or removed as required. Also, one of the advantageous aspects of the method and apparatus of the invention is the fact that the smoking articles are positioned substantially vertically during their manufacture. This is particularly advantageous if one or more of the components of the smoking article comprises flowable material such as granular material, liquids or gels. The filling tube used in the method and apparatus of the invention provides support to the overwrapped sleeve and prevents misalignment or damage of the cigarette paper. Also, no pre-formed sleeves are required. In addition, as the filling tube is removed, the expansion of the components within the sleeve serves to keep the components within the sleeve and the smoking article in tact.

Claims

1. Apparatus for manufacturing smoking articles, each manufactured smoking article comprising at least a first component and a second component, overwrapped with a sleeve, the apparatus comprising:

means for axially aligning and abutting the first component and a filling tube;
 means for overwrapping the first component and the filling tube with the sleeve;
 at least one holder for positioning the first component, the filling tube and the sleeve in a substantially vertical orientation, the first component at the lower end, the filling tube at the upper end;
 means for inserting at least the second component into the filling tube from the upper end of the filling tube; and
 means for removing the filling tube.

2. Apparatus according to claim 1, wherein the apparatus comprises:

a first module including the means for axially

aligning and abutting the first component and the filling tube, and the means for overwrapping the first component and the filling tube with the sleeve;

a second module including the means for inserting at least the second component into the filling tube;

a third module including the means for removing the filling tube; and

a coordinating module for transferring the at least one holder between the first, second and third modules.

3. Apparatus according to claim 1 or claim 2, wherein the apparatus further comprises means for partially lining the sleeve with a heat conducting element.

4. Apparatus according to any preceding claim, wherein the manufactured smoking article further comprises a third component, and the apparatus further comprises means for inserting the third component into the filling tube from the upper end of the filling tube.

5. Apparatus according to claim 4, wherein the manufactured smoking article further comprises a fourth component, and the apparatus further comprises means for inserting the fourth component into the filling tube from the upper end of the filling tube.

6. A method for manufacturing smoking articles, each manufactured smoking article comprising at least a first component and a second component, overwrapped with a sleeve, the method comprising the steps of:

axially aligning and abutting the first component and a filling tube;
 overwrapping the first component and the filling tube with the sleeve;
 positioning the first component, the filling tube and the sleeve in a substantially vertical orientation, the first component at the lower end, the filling tube at the upper end;
 inserting at least the second component into the filling tube from the upper end of the filling tube;
 and
 removing the filling tube.

7. A method according to claim 6, further comprising the step of compressing the second component before the step of inserting the second component into the filling tube.

8. A method according to claim 6 or claim 7, further comprising the step of partially lining the sleeve with a heat conducting element.

9. A method according to any of claims 6 to 8, wherein

the manufactured smoking article further comprises a third component, and the method further comprises the step of inserting the third component into the filling tube from the upper end of the filling tube.

- 10.** A method according to claim 9, wherein the manufactured smoking article further comprises a fourth component, and the method further comprises the step of inserting the fourth component into the filling tube from the upper end of the filling tube.

- 11.** Apparatus for manufacturing heated smoking articles, each manufactured heated smoking article comprising: a heat source, an aerosol-generating substrate downstream of the heat source, an expansion chamber downstream of the aerosol-generating substrate, a mouthpiece downstream of the expansion chamber, and a paper sleeve overwrapping the heat source, substrate, expansion chamber and mouthpiece, the apparatus comprising:

means for axially aligning and abutting the heat source and a filling tube;

means for overwrapping the heat source and the filling tube with the paper sleeve;

at least one holder for positioning the heat source, the filling tube and the paper sleeve in a substantially vertical orientation, the heat source at the lower end, the filling tube at the upper end;

means for inserting the aerosol-generating substrate into the filling tube from the upper end of the filling tube;

means for inserting the expansion chamber into the filling tube from the upper end of the filling tube;

means for inserting the mouthpiece into the filling tube from the upper end of the filling tube; and

means for removing the filling tube.

- 12.** Apparatus according to claim 11, wherein the apparatus comprises:

a first module including the means for axially aligning and abutting the heat source and the filling tube, and the means for overwrapping the heat source and the filling tube with the paper sleeve;

a second module including the means for inserting the aerosol-generating substrate into the filling tube;

a third module including the means for inserting the expansion chamber into the filling tube and the means for inserting the mouthpiece into the filling tube;

a fourth module including the means for removing the filling tube; and

a coordinating module for transferring the at least one holder between the first, second, third and fourth modules.

- 13.** A method for manufacturing heated smoking articles, each manufactured heated smoking article comprising: a heat source, an aerosol-generating substrate downstream of the heat source, an expansion chamber downstream of the aerosol-generating substrate, a mouthpiece downstream of the expansion chamber, and a paper sleeve overwrapping the heat source, substrate, expansion chamber and mouthpiece, the method comprising the steps of:

axially aligning and abutting the heat source and the filling tube;

overwrapping the heat source and the filling tube with the paper sleeve;

positioning the heat source, the filling tube and the paper sleeve in a substantially vertical orientation, the heat source at the lower end, the filling tube at the upper end;

inserting the aerosol-generating substrate into the filling tube from the upper end of the filling tube;

inserting the expansion chamber into the filling tube from the upper end of the filling tube;

inserting the mouthpiece into the filling tube from the upper end of the filling tube; and

removing the filling tube.

FIG. 1

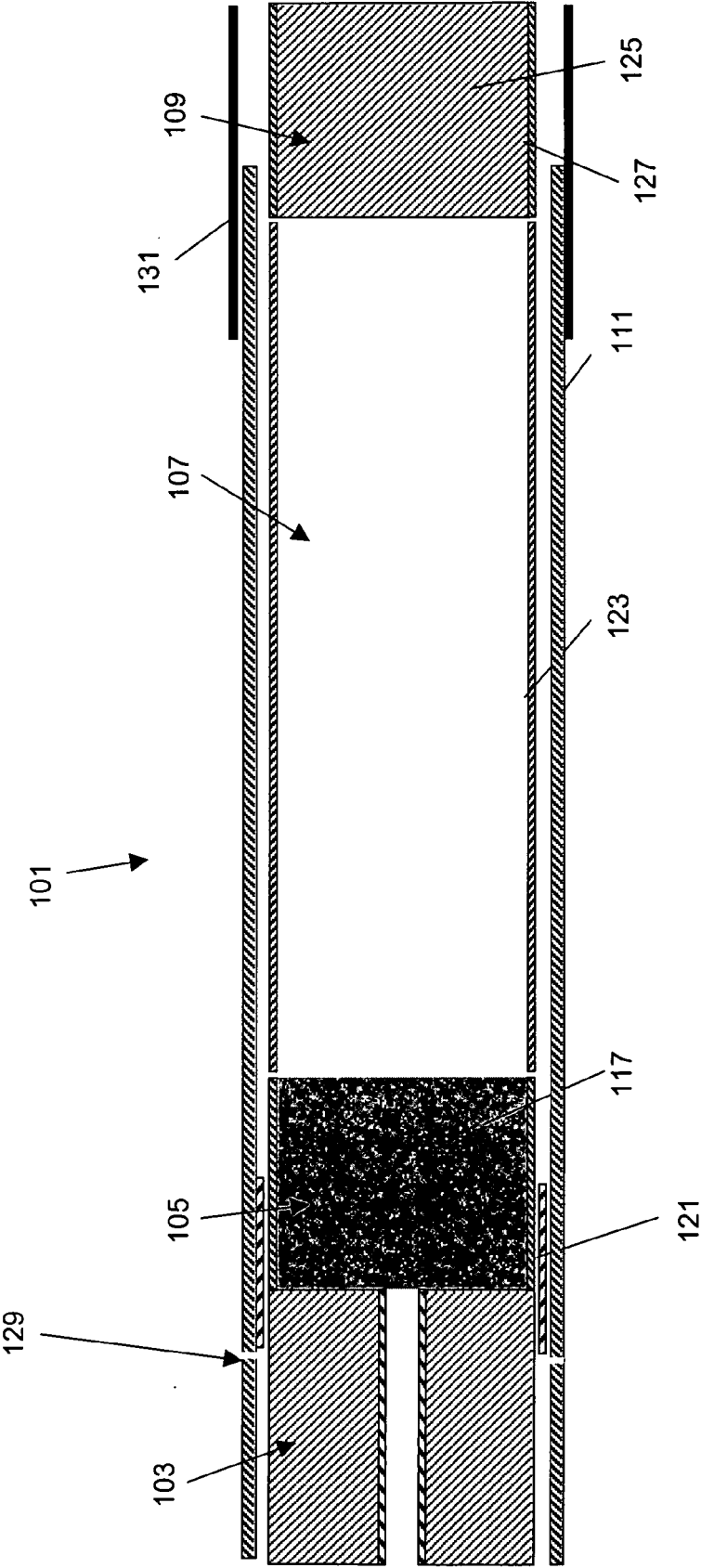


FIG. 2a

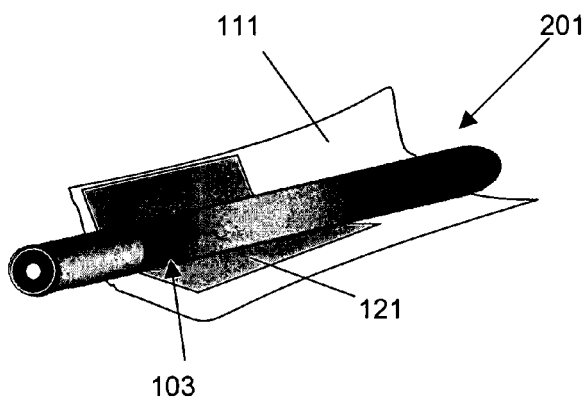


FIG. 2b

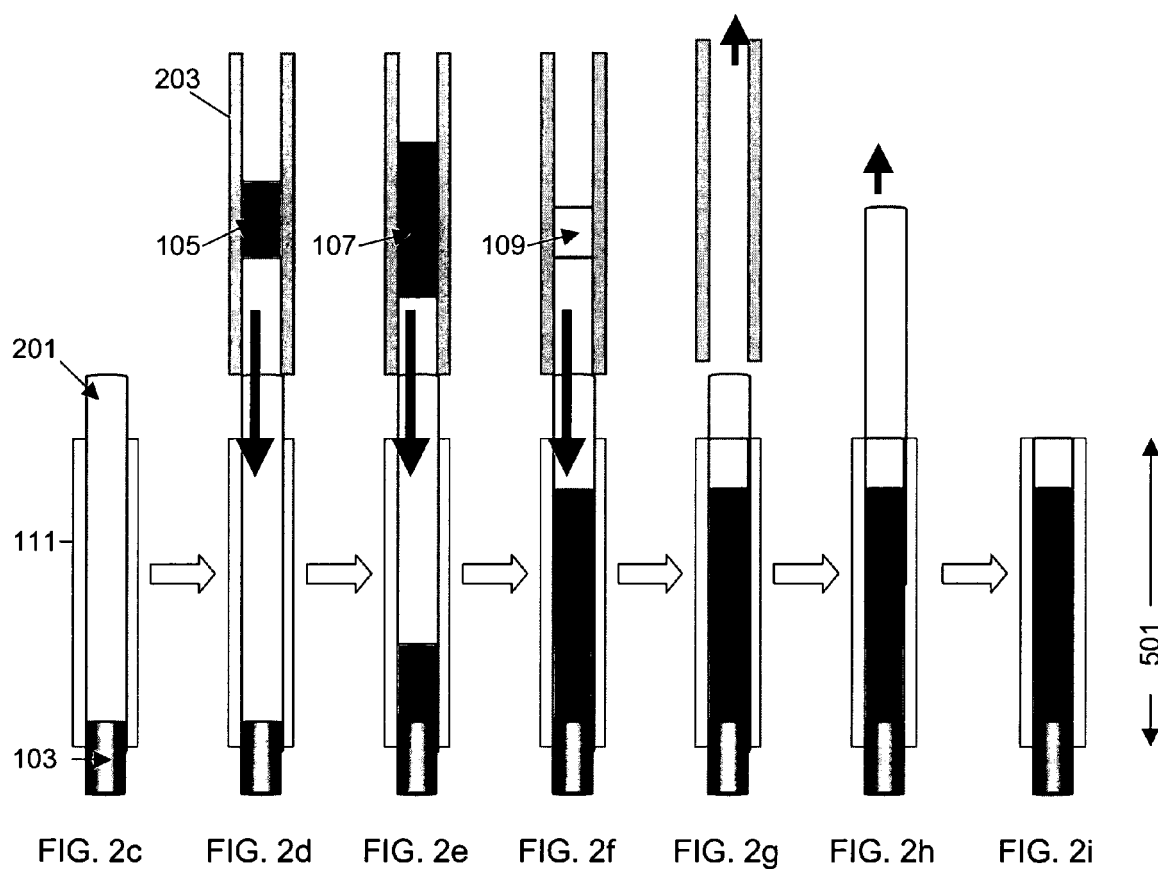
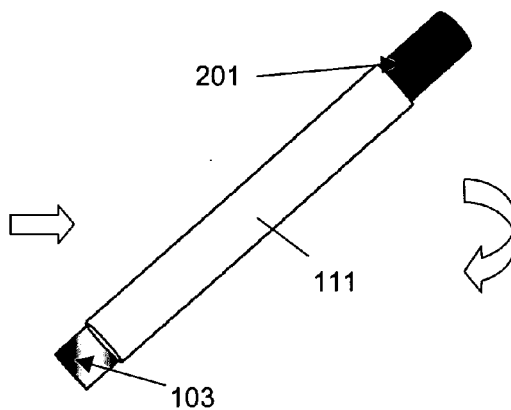


FIG. 2c

FIG. 2d

FIG. 2e

FIG. 2f

FIG. 2g

FIG. 2h

FIG. 2i

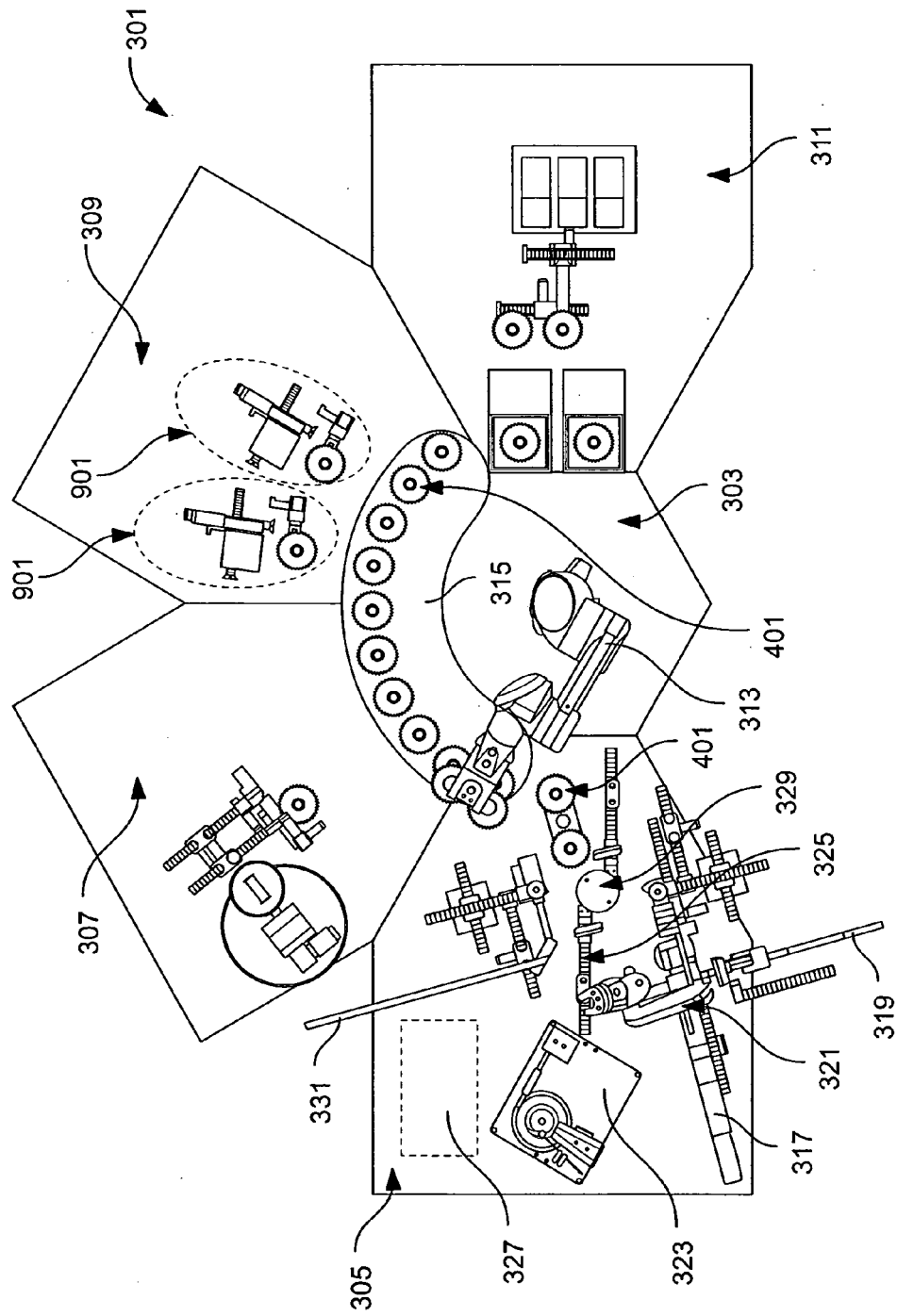


FIG. 3

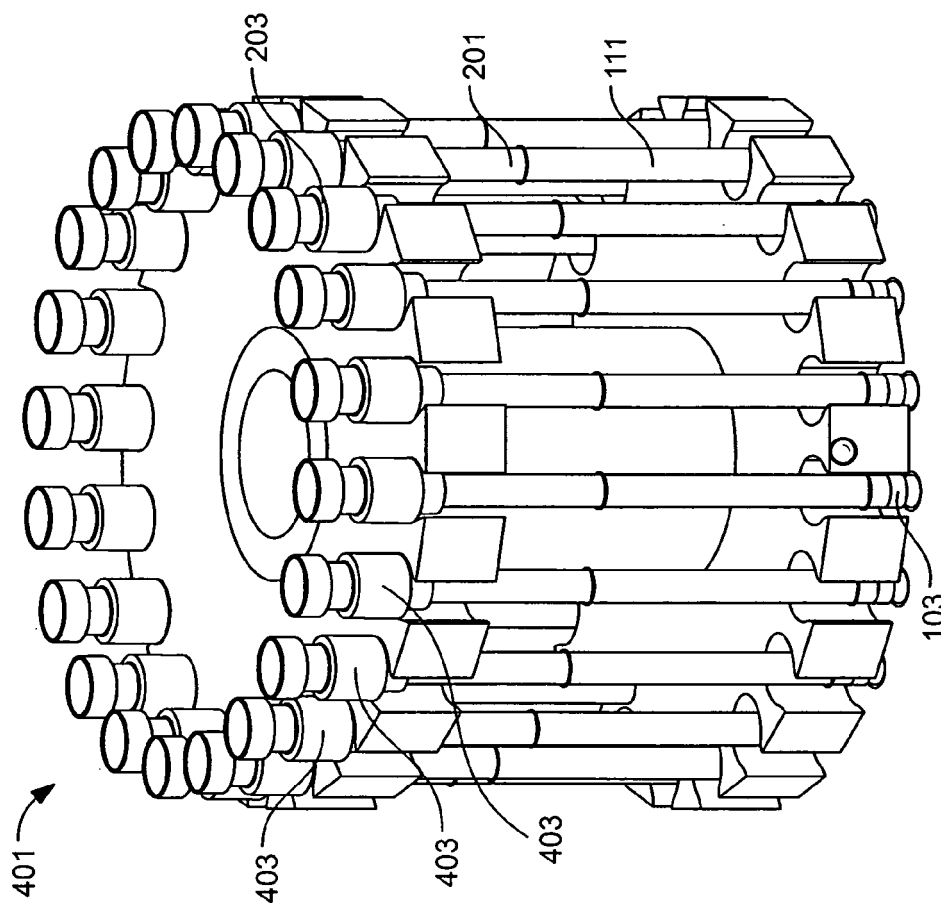


FIG. 4b

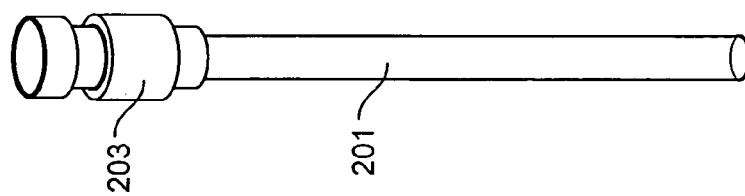
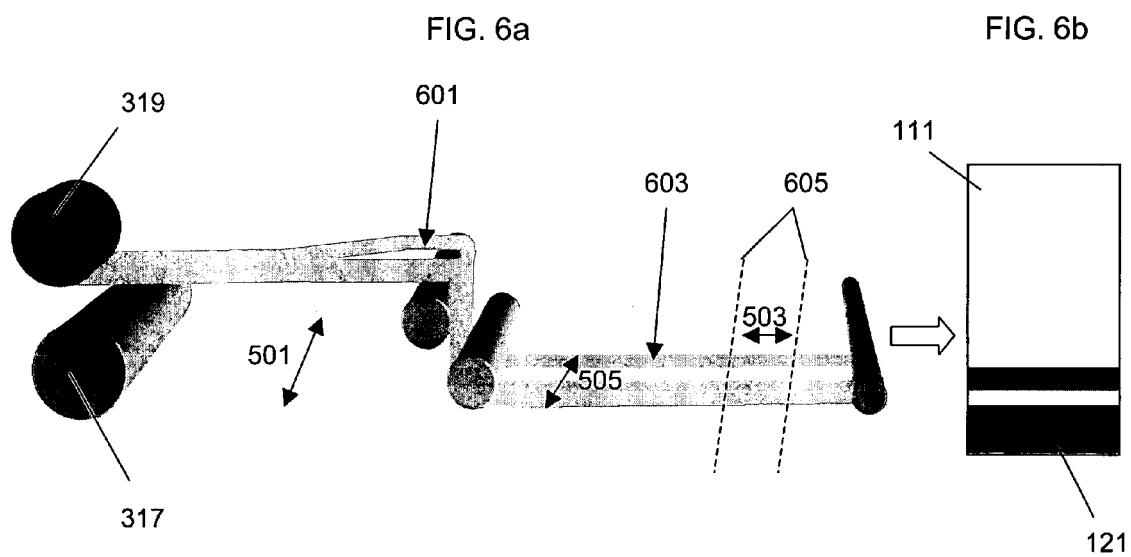
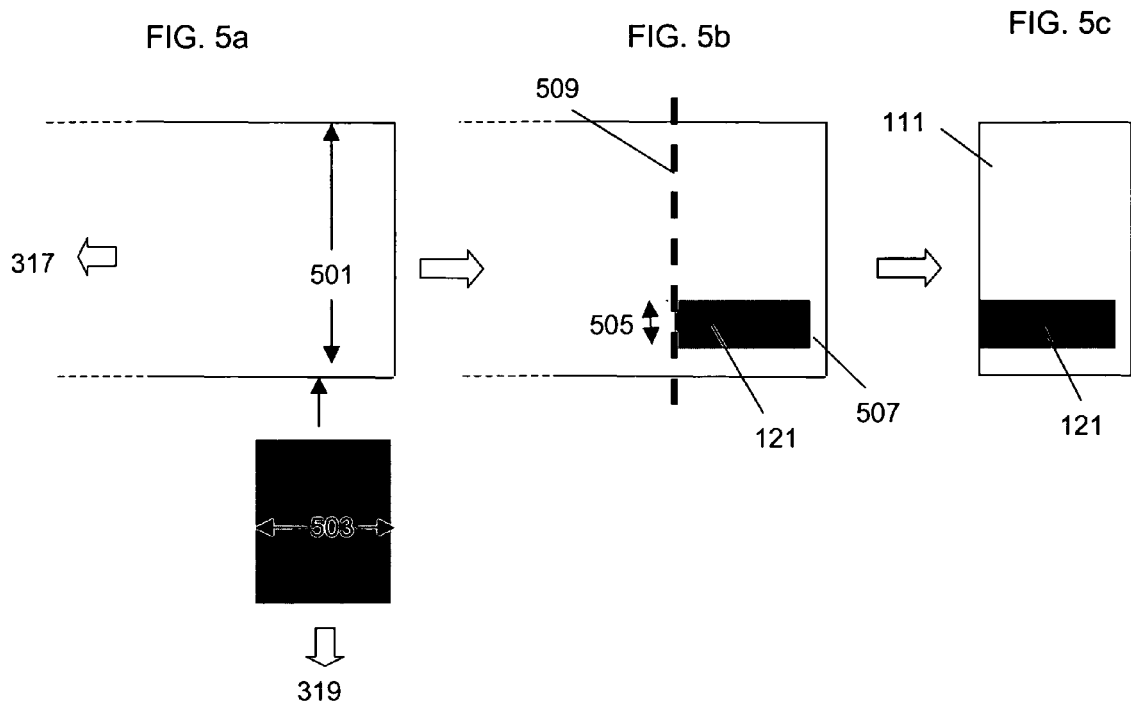
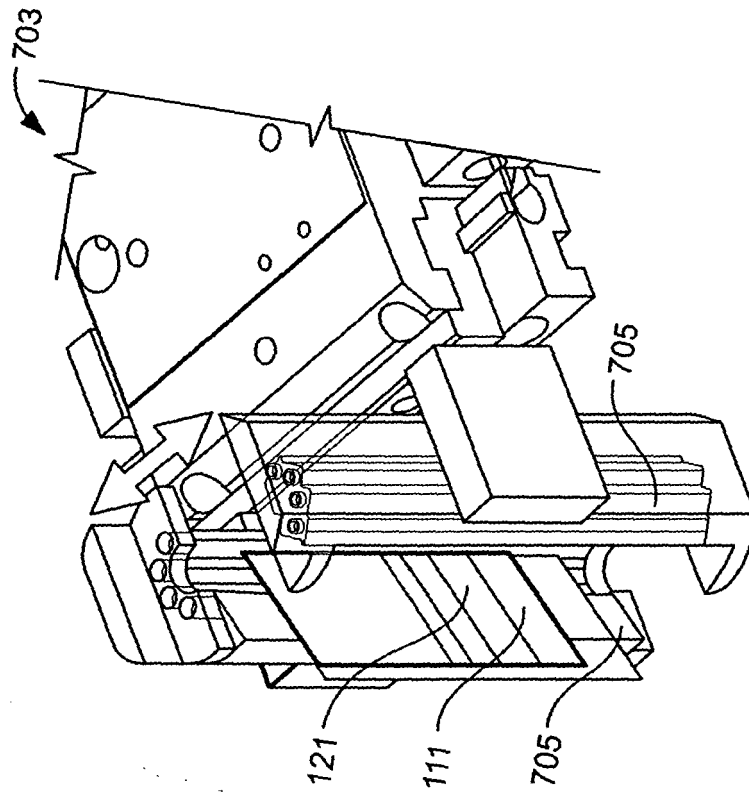
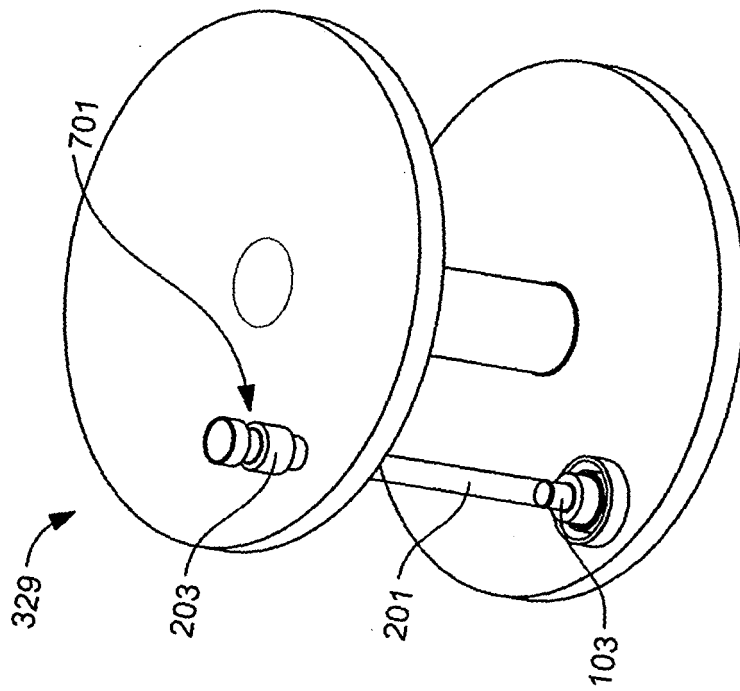


FIG. 4a





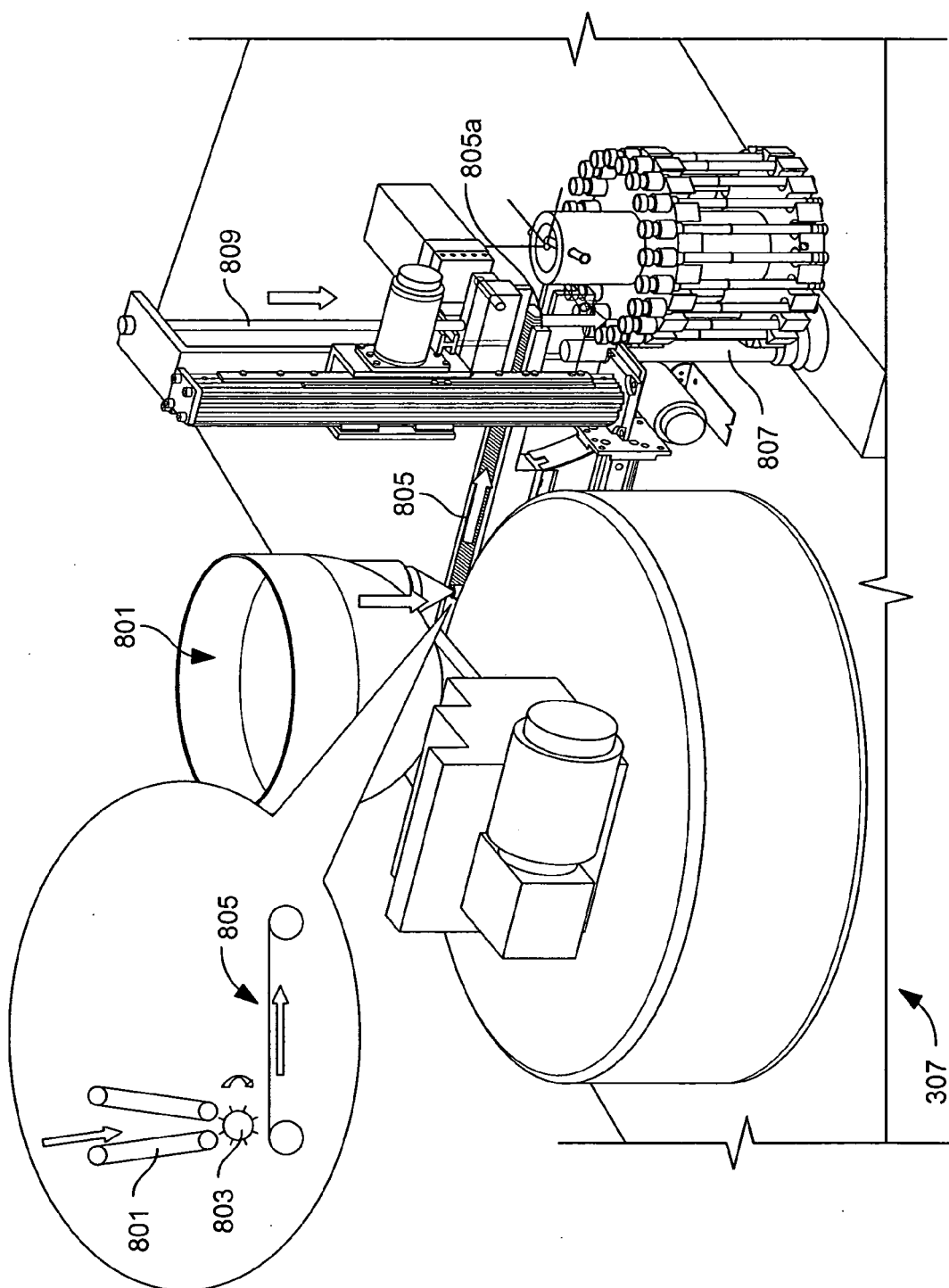


FIG. 8

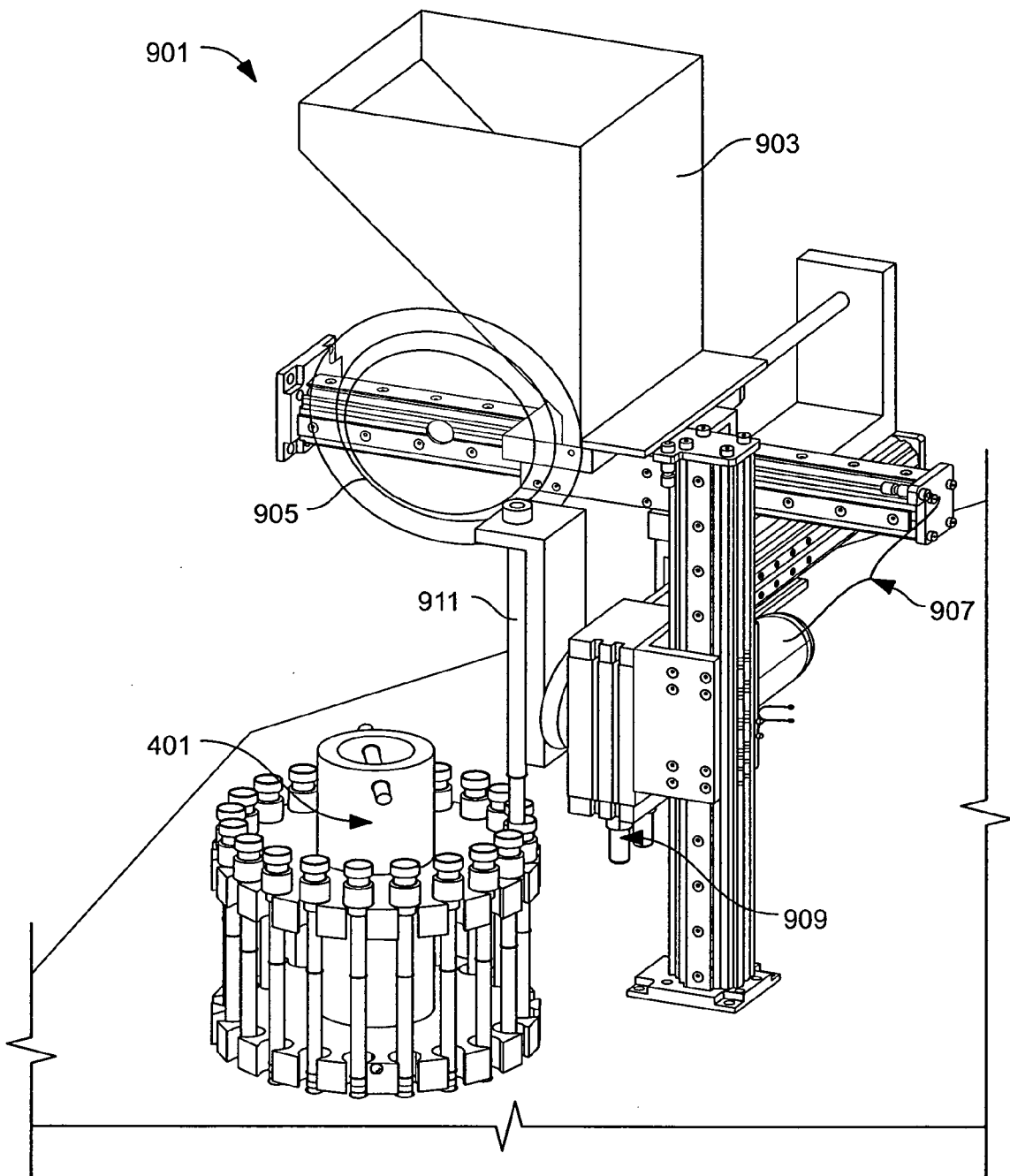


FIG. 9

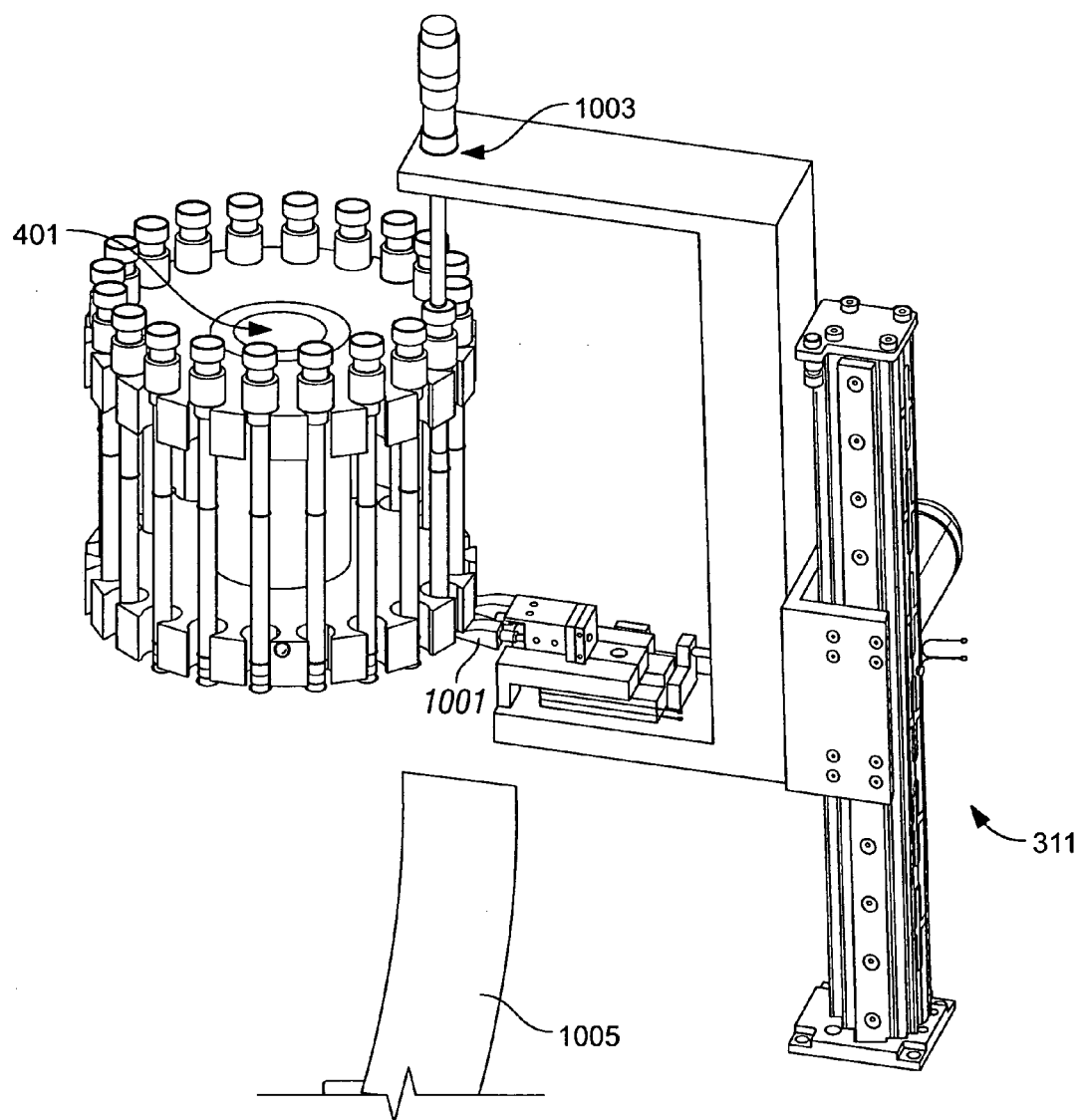


FIG. 10



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Application Number
EP 08 25 1578

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Place of search Munich		Date of completion of the search 2 October 2008	Examiner Maier, Michael
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EPO FORM 1503 03.82 (P04C01)



EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 2 October 2008	Examiner Maier, Michael
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