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(54) **METHOD IN MAKING A ROD-SHAPED ARTICLE COMPRISING A REMOVABLE SEGMENT AND APPARATUS FOR USE IN THE PRODUCTION OF SUCH AN ARTICLE**

(57) A method in making a rod-shaped article (1) comprising a removable segment (10). The method comprises providing a sheet material (20) and providing the sheet material (20) with a single line of weakness (40) with non-rectangular undulations. The method further comprises positioning of the sheet material (20) provided with the line of weakness (40) in registration with a first (10) and a second (11) rod-shaped segment arranged in

an end-to-end position, and wrapping the sheet material (20) comprising the line of weakness (40) around the first (10) and the second (11) rod-shaped segments forming at least a part of a rod-shaped article (1). The first segment (10) is removable from the rod-shaped article (1) together with a portion of the sheet material (20) by tearing the line of weakness (40).

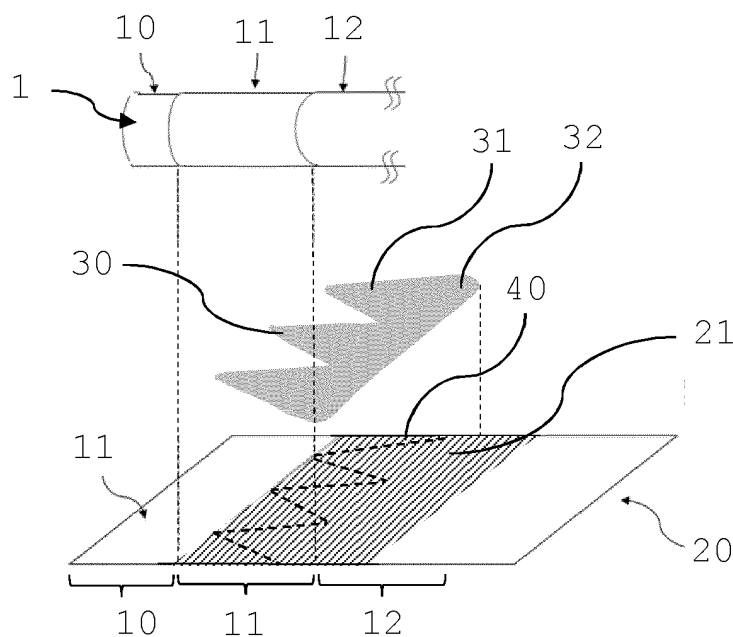


Fig. 2

Description

[0001] The present disclosure relates to a method in making a rod-shaped article comprising a removable segment and an apparatus for the use in the production of such articles.

[0002] There are smoking articles comprising an aerosol-forming substrate and a heat source, for example as described in WO2014/086998 A1. In order to protect the heat source, a most distal segment of the rod-shaped article is a removable cap attached via wrapper to the rest of the article. Prior to use of the article, in order to expose the heat source, the cap is removed by breaking a weakening line arranged around the circumference of the article in between the heat source and the cap.

[0003] A weakening line at this position may bear the risk that the cap is inadvertently torn off, for example, if a force acts laterally on the tip of the article. In addition, the heat source is completely covered by the wrapper and possibly weakly ventilated risking going out of the heat source.

[0004] There is need for a method and apparatus in making a rod-shaped article comprising a removable cap taking care of the disadvantages of the prior art. In particular, there is need for such a method and apparatus that allow for a safe attachment of a cap to an article and a clean removal of the cap from the article.

[0005] According to an aspect of the present invention, there is provided a method in making a rod-shaped article comprising a removable segment. The method comprises:

providing a sheet material,
providing the sheet material with a single line of weakness with non-rectangular undulations; positioning of the sheet material provided with the line of weakness in registration with a first and a second rod-shaped segment arranged in an end-to-end position; and
wrapping the sheet material comprising the line of weakness around the first and the second rod-shaped segments forming a rod-shaped article, where the first segment is removable from the rod-shaped article together with a portion of the sheet material by tearing the line of weakness.

[0006] The sheet material is wrapped around at least a portion of each of the first and the second segment. Preferably, the sheet material is wrapped around an entire length of the first and the second segment. If further segments are provided in the rod-shaped article, the sheet material may also be wrapped around some or all of the further segments.

[0007] The provision of a single line of weakness with non-rectangular undulations in a sheet material that is used as wrapper for segments of a rod-shaped article provides several advantages. As mentioned relating to the article of WO2014/086998 A1, a straight single line

of weakness bears the risk that the cap is inadvertently removed before use of the article. In addition, since the wrapper is attached to the cap as well as to the heat source in the article of WO2014/086998 A1, after removal of the cap, the wrapper still entirely surrounds the heat source possibly allowing little or no ventilation of the heat source through the wrapper.

[0008] To improve ventilation of an aerosol-generating article comprising a heat source, there are suggestions to provide a wrapper with rectangular windows to allow ventilation of the heat source from a side of the article through these windows. However, it is preferred that an outer circumference of a heat source is completely covered by the wrapper before removal of the cap, thus until actual use of the article. In addition, a section of a wrapper divided from the remaining section of the wrapper by a single line of weakness having non-rectangular undulation has shown to result in a very clean and complete removal of the section of the wrapper connected to a first segment, for example a cap.

[0009] Preferably, after wrapping, the single line of weakness extends about an entire circumference of a second segment or of the rod-shaped article, respectively. By this, a removal of the first segment including a clean and complete tearing off of a section of the sheet material attached to the first segment may be achieved.

[0010] Preferably, positioning the sheet material provided with the line of weakness comprises positioning portions of the line of weakness in registration with a contact area of the first and second segment. Preferably, the portions of the line of weakness in registration with a contact area of the first and second segment are maximum extensions of the non-rectangular undulations. Thus, preferably, the line of weakness extends up to but not into the first segment. By this, after removal of the first segment and the portion of the sheet material wrapped around the first segment, the remaining sheet material extends up to a longitudinal end of the second segment but not beyond. In addition, entire connected portions of the sheet material formed by non-rectangular undulations are removed upon removing the first segment. Thus, large areas of a circumference of the second segment are exposed after the first segment has been removed. This may in particular be advantageous if the second segment is a heat source or similar segments requiring venting or exposure to the environment.

[0011] Preferably, the method comprises providing the single line of weakness with regular non-rectangular undulations. A regular arrangement of non-rectangular undulations allows for a symmetric design of an article and a regular removal of a portion of the sheet material together with removal of a first segment.

[0012] Preferably, the method comprises providing the single line of weakness in the form of a sine wave.

[0013] Preferably, the method comprises providing the single line of weakness in the form of a triangle wave pattern. The triangles of the triangle wave pattern may be acute triangles, right triangles or obtuse triangles.

[0014] Preferably, the method comprises providing the single line of weakness in the form of a saw tooth wave pattern. Preferably, the saw tooth wave pattern comprises triangular shaped teeth, wherein one side of the triangle is preferably arranged parallel to a longitudinal axis of the rod-shaped article when the sheet material has been wrapped around the segments of the article.

[0015] The single line of weakness may have a wavelength of the non-rectangular undulations corresponding to a circumference of the second segment.

[0016] The single line of weakness may have a wavelength of the non-rectangular undulations corresponding to a full fraction of a circumference of the second segment.

[0017] Preferably, the wavelength of the non-rectangular undulations corresponds to 1 to 1/5 of the circumference of the second segment. More preferably, the wavelength of the non-rectangular undulations corresponds to 1 to 1/4 of the circumference of the second segment. Most preferably, the wavelength of the non-rectangular undulations corresponds to half or one third (1/2 or 1/3) of the circumference of the second segment.

[0018] These relations of wavelength and circumference allow to provide an arrangement of non-rectangular undulations, in particular a regular arrangement of undulations, around the circumference of a rod-shaped segment, while the line of weakness may extend continuously around the circumference of the segment and meets onto itself.

[0019] Preferably, the single line of weakness extends about the entire circumference of the second segment after wrapping.

[0020] Thus, preferably, a wavelength of the non-rectangular undulations corresponds to a full fraction of the circumference of the second segment such that the line of weakness meets itself when the sheet material is wrapped around the first and the second segment.

[0021] An amplitude of the non-rectangular undulations of the line of weakness is preferably adapted to a size of the second segment, in particular a length of the second segment. In addition, the amplitude of the non-rectangular undulations may be adapted according to a desired line pattern or pattern of a sheet material to remain on the article, when the first segment has been removed.

[0022] Preferably, the method comprises providing the single line of weakness with an amplitude of the non-rectangular undulations corresponding to between 30 percent and 100 percent of a length of the second segment. More preferably, the amplitude of the non-rectangular undulations corresponds to between 40 percent and 90 percent of the length of the second segment. Most preferably, the amplitude of the non-rectangular undulations corresponds to between 60 and 80 percent of the length of the second segment.

[0023] An amplitude of undulations in a line of weakness may, for example, correspond to between 0.2 millimeter and 5 millimeter. Preferably, an amplitude of the

non-rectangular undulations corresponds to between 0.5 millimeter and 4 millimeter. More preferably, an amplitude of the non-rectangular undulations corresponds to between 1 millimeter and 3 millimeter.

[0024] These ranges of amplitudes are advantageous, for example, for segments used in heat sticks comprising or not comprising a heat source, segments generally used in aerosol-generating articles which are heated rather than combusted, or other rod-shaped articles, for example, used in the food industries.

[0025] Preferably, the first segment is a removable cap.

[0026] The first segment may, for example, be a hollow acetate tube (HAT), a filter segment, preferably a biodegradable filter, or a cardboard tube.

[0027] A first segment or 'cap' refers to a protective cover that substantially surrounds the distal end of the rod-shaped article, including the end face. Providing a removable cap that is removed prior to use of the article, in particular prior to ignition of a smoking article comprising a heat source may lead to user to be inhibited from readily igniting the heat source until the cap is removed, unlike paper wrappers. Similarly, providing a removable cap that is removed prior to ignition of the smoking article may lead to a reduction in ash generation and flaming compared to smoking articles with a paper wrapper that covers the heat source during ignition. In general, during manufacture, the provision of a removable cap advantageously reduces the risk of the second segment dirtying the manufacturing equipment, and staining adjacent articles. In effect, the removable cap acts to isolate the second segment, in particular a heat source, from the surrounding equipment and articles. In addition, it provides physical protection during manufacture to help prevent the second segment from breaking or chipping off.

[0028] The second segment may, for example, be a heat source such as, for example, a carbonaceous heat source, or an aerosol-forming substrate plug, for example a tobacco material containing substrate plug such as, for example a homogenized tobacco containing plug.

[0029] A third or further segment may, for example, be a filter segment, an aerosol-cooling segment or a support segment.

[0030] A length of a first segment may, for example, be between about 3 mm to about 13 mm, preferably between about 5 mm to about 10 mm, and more preferably of about 8 mm.

[0031] Preferably, a diameter of the first segment corresponds to a diameter of the second segment.

[0032] A length of a second segment may, for example, be between about 7 mm and about 17 mm, more preferably between about 7 mm and about 15 mm, most preferably between about 7 mm and about 13 mm.

[0033] Preferably, the second segment has a diameter of between about 5 mm and about 9 mm, more preferably of between about 7 mm and about 8 mm.

[0034] Preferably, the second segment is of substantially uniform diameter.

[0035] The sheet material may be wrapped around the first and the second segment only. The sheet material may be wrapped around more than two segments, for example around three, four or five segments. The sheet material may be wrapped around an entire rod-shaped article, while the article may comprise two or more segments, including the first segment to be removed prior to use of the article.

[0036] The method according to the invention may further comprise:

applying a glue pattern to the sheet material; and bringing the glue pattern in registration with the single line of weakness before wrapping the sheet material around the first and the second segment.

[0037] Preferably, the method comprises applying the glue pattern next to the line of weakness. Preferably, the method comprises applying the glue pattern on the sheet material at one side of the line of weakness only.

[0038] If glue pattern and line of weakness are in registration, the sheet material may very precisely be adhered to the segment(s) upon wrapping. Sheet material that shall stick to a segment and sheet material that shall not stick to a segment may exactly be defined. In particular, sheet material that shall be removed by removal of the first segment including a portion of the sheet material may exactly be defined.

[0039] Preferably, a glue pattern is adapted to a size and shape of a line of weakness, in particular to a size and shape of non-rectangular undulations of the line of weakness.

[0040] Next to this, a glue pattern preferably comprises a base line that preferably extends around an entire circumference of a segment, preferably the second segment, in order to fix the sheet material to said segment over the entire circumference of the segment.

[0041] Preferably, the glue pattern comprises a base line and at least a protruding area extending from the base line. Preferably, the method comprises to arrange the at least a protruding area within a non-rectangular undulation of the single line of weakness.

[0042] Preferably, a glue pattern, in particular areas of the glue pattern, is entirely filled with glue. A glue pattern may also be formed by dots or lines.

[0043] Preferably, the method comprises providing the glue pattern with a same number of protruding areas as non-rectangular undulations on one side of the line of weakness. By this, the sheet material may be fixed to a segment in the region of the line of weakness, in particular the sheet material may be fixed to the second segment up to the line of weakness.

[0044] Preferably, the base line is a straight line extending around the circumference of the second segment after wrapping. Preferably, the base line is an uninterrupted line of glue or other adhesive applied to the sheet material.

[0045] The single line of weakness is a single contin-

uous line provided with weaknesses, for example in the form of cuts or perforations. The weaknesses itself along the line of weakness may be continuous or non-continuous. For example, if the weaknesses in a line of weakness are created by thinning the sheet material, the line of weakness comprises thinned sheet along the line of weakness. Accordingly, the thinned material may be continuous along the entire line of weakness. However, if the weaknesses in a line of weakness are created, for example, by cutting or perforation, cuts or perforations are provided in a non-continuous manner in order for the sheet material to remain connected on each side of the line of weakness.

[0046] Thus, the single line of weakness with non-rectangular undulations may have continuous or non-continuous weaknesses. Preferably, the single line of weakness with non-rectangular undulations has non-continuous weaknesses, preferably in the form of perforation or cuts.

[0047] According to another aspect of the present invention, there is provided an apparatus for use in the production of a rod-shaped article comprising a removable segment. The apparatus comprises a supply unit for providing a sheet material and a weakening unit for providing the sheet material supplied by the supply unit with a single line of weakness with non-rectangular undulations. The apparatus further comprises a positioning unit for placing the sheet material comprising the line of weakness in a wrapping position and a detector in operational connection with the positioning unit to determine the wrapping position such as to allow to bring a first and a second rod-shaped segment arranged in an end-to-end position and the line of weakness into registration. The apparatus also comprises a wrapping unit for receiving the sheet material comprising the line of weakness and for wrapping the sheet material comprising the line of weakness around the first segment and the second segment. The wrapping is preferably done such that at least a majority of the line of weakness is aligned around a circumference of the second segment. More preferably, the entire line of weakness is aligned around the circumference of the second segment.

[0048] The weakening unit may, for example, be a cutting unit for producing a single line of weakness in the form of a cutting line.

[0049] The weakening unit may, for example, be a perforation unit for producing a single line of weakness in the form of a line of perforations.

[0050] The weakening unit may, for example, be a punch unit for producing a single line of weakness in the form of a thinned material line.

[0051] The weakening unit may be a combination of two or all of the above weakening units.

[0052] Preferably, the weakening unit comprises regularly arranged weakening elements adapted to produce a single line of weakness provided with regular non-rectangular undulations in the sheet material.

[0053] The weakening elements may be arranged and

adapted to form a single line of weakness in the form of a triangle wave pattern or in the form of a saw tooth wave pattern. In these embodiments, preferably, weakening elements are perforation pins arranged in a triangle or saw tooth line arrangement or weakening elements comprise straight weakening edges that are arranged in a triangle or saw tooth line arrangement.

[0054] The weakening elements may be arranged and adapted to form a single line of weakness in the form of a sine wave. In these embodiments, preferably, weakening elements are perforation pins arranged in the form of a sine wave, or weakening elements comprise curved weakening edges that are arranged in the form of a sine wave.

[0055] Preferably, the weakening unit comprises a rotary weakening drum.

[0056] A least one set of weakening elements is arranged on the circumference of the weakening drum. The at least one set of weakening elements is adapted to produce a single line of weakness.

[0057] Preferably, two or more sets of weakening elements are arranged on the circumference of the weakening drum, wherein each set of weakening elements is adapted to produce a single line of weakness.

[0058] Preferably, the rotary weakening drum is a cutting drum comprising at least one set of cutting edges distanced from each other for providing a single cutting line comprising several interrupted cuts.

[0059] Preferably, in an apparatus according to the invention, weakening elements are chosen in size, number and arrangement to allow the manufacture of one or more line of weakness having the size and shape, in particular amplitude of undulations and wavelength, as defined and referred to above relating to the method.

[0060] The apparatus may further comprise a glue applicator for applying a glue pattern to the sheet of material.

[0061] Preferably, the detector is in operational connection with the glue applicator such as to allow to bring the cutting unit and the glue applicator into registration such as to bring the glue pattern into registration with the single line of weakness provided in the sheet material.

[0062] Preferably, the glue applicator comprises at least one glue application area in the form of a glue pattern to be applied to the sheet material.

[0063] Preferably, the glue application area comprises a longitudinal base portion and at least a protruding portion extending from the base portion.

[0064] Preferably, the cutting unit and the glue applicator are adapted to be brought into registration such as to allow to bring the at least one protruding area of the glue pattern into registration with a non-rectangular undulation of the line of weakness provided in the sheet material.

[0065] Preferably, the glue applicator is a glue roller. The at least one glue application area is provided on the circumference of the glue roller.

[0066] Preferably, two or more glue application areas are provided around the circumference of the glue roller.

[0067] Preferably, a number of glue application areas on the circumference of the glue roller corresponds to a number of sets of weakening elements arranged on the circumference of a weakening drum.

[0068] The invention also refers to a rod-shaped aerosol-generating article comprising at least a first and a second segment arranged in an end-to-end position and wrapped with a sheet material. The sheet material is provided with a single line of weakness with non-rectangular undulations. The first segment is removable from the rod-shaped article at the single line of weakness together with a portion of the sheet material by tearing said line of weakness.

[0069] Preferably, the single line of weakness with non-rectangular undulations is arranged along the circumference of the second segment.

[0070] Preferably, the single line of weakness with non-rectangular undulations is arranged along the entire circumference of the second segment only.

[0071] Preferably, the single line of weakness has the form of a sine wave, a triangle wave pattern or a saw tooth wave pattern.

[0072] A wavelength of the non-rectangular undulations may correspond to 1 to 1/5 of the circumference of the second segment. A wavelength of the non-rectangular undulations may correspond to 1 to 1/4 of the circumference of the second segment. Preferably, a wavelength of the non-rectangular undulations corresponds to half or one third (1/2 or 1/3) of the circumference of the second segment.

[0073] The single line of weakness may, for example, have an amplitude of the non-rectangular undulations corresponding to between 30 percent and 100 percent of a length of the second segment.

[0074] Preferably, an amplitude of the non-rectangular undulations corresponds to between 40 percent and 90 percent of the length of the second segment. More preferably, an amplitude of the non-rectangular undulations corresponds to between 60 and 80 percent of the length of the second segment.

[0075] An amplitude of the non-rectangular undulations may, for example, correspond to between 0.2 millimeter and 5 millimeter.

[0076] Preferably, an amplitude of the non-rectangular undulations corresponds to between 0.5 millimeter and 4 millimeter. More preferably, an amplitude of the non-rectangular undulations corresponds to between 1 millimeter and 3 millimeter.

[0077] Preferably, the rod-shaped article is manufactured with the method according to the present invention and as described herein.

[0078] The term 'rectangular undulations' is understood as undulations exclusively comprising lines that are arranged parallel or perpendicular to each other, and wherein all lines of the rectangular pattern are either arranged parallel or perpendicular to a longitudinal axis of a segment or article, respectively, when the segment or article is wrapped with the sheet material comprising a

line pattern with rectangular undulations.

[0079] Accordingly, the term 'non-rectangular undulations' is herewith understood as comprising any kind of wave-like pattern except having rectangular undulations. Examples of 'non-rectangular undulations' are in particular, but not exclusively, sine waves, triangle waves and saw tooth waves.

[0080] The invention is defined in the claims. However, below there is provided a non-exhaustive list of non-limiting examples. Any one or more of the features of these examples may be combined with any one or more features of another example, embodiment, or aspect described herein.

[0081] Example Ex1: A method in making a rod-shaped article comprising a removable segment, the method comprising:

providing a sheet material,
providing the sheet material with a single line of weakness with non-rectangular undulations; positioning of the sheet material provided with the line of weakness in registration with a first and a second rod-shaped segment arranged in an end-to-end position; and wrapping the sheet material comprising the line of weakness around the first and the second rod-shaped segments forming at least a part of a rod-shaped article, wherein the first segment is removable from the rod-shaped article together with a portion of the sheet material by tearing the line of weakness.

[0082] Example Ex2: The method according to example Ex1, wherein positioning the sheet material provided with the line of weakness comprises positioning portions of the single line of weakness in registration with a contact area of the first and the second segment.

[0083] Example Ex3: The method according to any one of the preceding examples, providing the single line of weakness with regular non-rectangular undulations.

[0084] Example Ex4: The method according to any one of the preceding examples, providing the single line of weakness in the form of a sine wave.

[0085] Example Ex5: The method according to any one of the preceding examples, providing the single line of weakness in the form of a triangle wave pattern.

[0086] Example Ex6: The method according to any one of the preceding examples, providing the single line of weakness in the form of a saw tooth wave pattern.

[0087] Example Ex7: The method according to any one of the preceding examples, providing the single line of weakness with a wavelength of the non-rectangular undulations corresponding to a circumference of the second segment or to a full fraction of the circumference of the second segment.

[0088] Example Ex8: The method according to example Ex7, wherein the wavelength of the non-rectangular undulations corresponds to 1 to 1/5 of the circumference of the second segment.

[0089] Example Ex9: The method according to any one of examples Ex7 to Ex8, wherein the wavelength of the non-rectangular undulations corresponds to 1 to 1/4 of the circumference of the second segment.

[0090] Example Ex10: The method according to any one of examples Ex7 to Ex9, wherein the wavelength of the non-rectangular undulations corresponds to half or one third (1/2 or 1/3) of the circumference of the second segment.

[0091] Example Ex11: The method according to any one of examples Ex7 to Ex10, wherein the wavelength of the non-rectangular undulations corresponds to a full fraction of the circumference of the second segment such that the line of weakness meets itself when the sheet material is wrapped around the first and the second segment.

[0092] Example Ex12: The method according to any one of the preceding examples, wherein the single line of weakness extends about the entire circumference of the second segment after wrapping.

[0093] Example Ex13: The method according to any one of the preceding examples, providing the single line of weakness with an amplitude of the non-rectangular undulations corresponding to between 30 percent and 100 percent of a length of the second segment.

[0094] Example Ex14: The method according to example Ex13, wherein the amplitude of the non-rectangular undulations corresponds to between 40 percent and 90 percent of the length of the second segment.

[0095] Example Ex15: The method according to any one of examples Ex13 to Ex14, wherein the amplitude of the non-rectangular undulations corresponds to between 60 and 80 percent of the length of the second segment.

[0096] Example Ex16: The method according to any one of examples Ex13 to Ex15, wherein the amplitude of the non-rectangular undulations corresponds to between 0.2 millimeter and 5 millimeter.

[0097] Example Ex17: The method according to any one of examples Ex13 to Ex16, wherein the amplitude of the non-rectangular undulations corresponds to between 0.5 millimeter and 4 millimeter.

[0098] Example Ex18: The method according to any one of examples Ex13 to Ex17, wherein the amplitude of the non-rectangular undulations corresponds to between 1 millimeter and 3 millimeter.

[0099] Example Ex19: The method according to any one of the preceding examples, wherein the first segment is a removable cap.

[0100] Example Ex20: The method according to example Ex19, wherein the first segment is a hollow acetate tube (HAT), a filter segment, preferably a biodegradable filter, or a cardboard tube.

[0101] Example Ex21: The method according to any one of the preceding examples, comprising applying a glue pattern to the sheet material; and bringing the glue pattern in registration with the single line of weakness before wrapping the sheet material

around the first and the second segment.

[0102] Example Ex22: The method according to example Ex21, therein applying the glue pattern next to the line of weakness.

[0103] Example Ex23: The method according to any one of examples Ex21 to Ex22, applying the glue pattern on the sheet material at one side of the line of weakness only.

[0104] Example Ex24: The method according to any one of examples Ex21 to Ex23, wherein the glue pattern comprises a base line and at least a protruding area extending from the base line; and arranging the at least a protruding area within a non-rectangular undulation of the single line of weakness.

[0105] Example Ex25: The method according to examples Ex24, providing the glue pattern with a same number of protruding areas as non-rectangular undulations on one side of the line of weakness.

[0106] Example Ex26: The method according to any one of examples Ex24 to Ex25, wherein the base line is a straight line extending around the circumference of the second segment after wrapping.

[0107] Example Ex27: An apparatus for use in the production of a rod-shaped article comprising a removable segment, the apparatus comprising:

- a supply unit for providing a sheet material;
- a weakening unit for providing the sheet material supplied by the supply unit with a single line of weakness with non-rectangular undulations;
- a positioning unit for placing the sheet material comprising the line of weakness in a wrapping position;
- a detector being in operational connection with the positioning unit to determine the wrapping position such as to allow to bring a first and a second rod-shaped segment arranged in an end-to-end position and the line of weakness into registration; and
- a wrapping unit for receiving the sheet material comprising the line of weakness and for wrapping the sheet material comprising the line of weakness around the first and second segment.

[0108] Example Ex28: The apparatus according to example Ex27, wherein the weakening unit is a cutting unit for producing a single line of weakness in the form of a cutting line.

[0109] Example Ex29: The apparatus according to example Ex27, wherein the weakening unit is a perforation unit for producing a single line of weakness in the form of a line of perforations.

[0110] Example Ex30: The apparatus according to example Ex27, wherein the weakening unit is a punch unit for producing a single line of weakness in the form of a thinned material line.

[0111] Example Ex31: The apparatus according to any one of examples Ex27 to Ex30, wherein the weakening unit comprises regularly arranged weakening elements adapted to produce a single line of weakness provided

with regular non-rectangular undulations in the sheet material.

[0112] Example Ex32: The apparatus according to example Ex31, wherein the weakening elements are arranged and adapted to form a single line of weakness in the form of a triangle wave pattern.

[0113] Example Ex33: The apparatus according to any one of examples Ex31 to Ex32, herein the weakening elements are arranged and adapted to form a single line of weakness in the form of a saw tooth wave pattern.

[0114] Example Ex34: The apparatus according to example Ex33, wherein the weakening elements are perforation pins arranged in a triangle or saw tooth line arrangement, or wherein the weakening elements comprise straight weakening edges that are arranged in a triangle or saw tooth line arrangement.

[0115] Example Ex35: The apparatus according to example Ex31, where the weakening elements are arranged and adapted to form a single line of weakness in the form of a sine wave.

[0116] Example Ex36: The apparatus according to example Ex35, wherein the weakening elements are perforation pins arranged in the form of a sine wave, or wherein the weakening elements comprise curved weakening edges that are arranged in the form of a sine wave.

[0117] Example Ex37: The apparatus according to any one of examples Ex27 to Ex36, wherein the weakening unit comprises a rotary weakening drum.

[0118] Example Ex38: The apparatus according to example Ex37, wherein at least one set of weakening elements is arranged on the circumference of the weakening drum, the at least one set of weakening elements adapted to produce a single line of weakness.

[0119] Example Ex39: The apparatus according to example Ex38, wherein two or more sets of weakening elements are arranged on the circumference of the weakening drum, each set of weakening elements adapted to produce a single line of weakness.

[0120] Example Ex40: The apparatus according to any one of examples Ex37 to Ex39, wherein the rotary weakening drum is a cutting drum comprising at least one set of cutting edges distanced from each other for providing a single cutting line comprising several interrupted cuts.

[0121] Example Ex41: The apparatus according to any one of examples Ex27 to Ex40, further comprising a glue applicator for applying a glue pattern to the sheet of material.

[0122] Example Ex42: The apparatus according to example Ex41, where the detector is in operational connection with the glue applicator such as to allow to bring the cutting unit and the glue applicator into registration such as to bring the glue pattern into registration with the single line of weakness provided in the sheet material.

[0123] Example Ex43: The apparatus according to any one of examples Ex41 to Ex42, wherein the glue applicator comprises at least one glue application area in the form of the glue pattern to be applied to the sheet material.

[0124] Example Ex44: The apparatus according to ex-

ample Ex43, wherein the glue application area comprises a longitudinal base portion and at least a protruding portion extending from the base portion.

[0125] Example Ex45: The apparatus according to example Ex44, wherein the cutting unit and the glue applicator are adapted to be brought into registration such as to allow to bring the at least one protruding area of the glue pattern into registration with a non-rectangular undulation of the line of weakness provided in the sheet material.

[0126] Example Ex46: The apparatus according to any one of examples Ex41 to Ex45, wherein the glue applicator is a glue roller.

[0127] Example Ex47: The apparatus according to example Ex46, wherein the at least one glue application area is provided on the circumference of the glue roller.

[0128] Example Ex48: The apparatus according to example Ex47, wherein two or more glue application areas are provided around the circumference of the glue roller.

[0129] Example Ex49: The apparatus according to any one of examples Ex47 to Ex48, wherein a number of glue application areas on the circumference of the glue roller corresponds to a number of sets of weakening elements arranged on the circumference of a weakening drum.

[0130] Example Ex50: A rod-shaped aerosol-generating article comprising at least a first and a second segment arranged in an end-to-end position and wrapped with a sheet material, wherein the sheet material is provided with a single line of weakness with non-rectangular undulations, and wherein the first segment is removable from the rod-shaped article at the single line of weakness together with a portion of the sheet material by tearing said line of weakness.

[0131] Example Ex51: The rod-shaped article according to examples Ex50, wherein the single line of weakness with non-rectangular undulations is arranged along the circumference of the second segment.

[0132] Example Ex52: The rod-shaped article according to any one of examples Ex50 to Ex51, wherein the single line of weakness with non-rectangular undulations is arranged along the entire circumference of the second segment only.

[0133] Example Ex53: The rod-shaped article according to any one of examples Ex50 to Ex52, wherein the single line of weakness has the form of a sine wave.

[0134] Example Ex54: The rod-shaped article according to any one of examples Ex50 to Ex52, wherein the single line of weakness has the form a triangle wave pattern.

[0135] Example Ex55: The rod-shaped article according to any one of examples Ex50 to Ex52, wherein the single line of weakness has the form of a saw tooth wave pattern.

[0136] Example Ex56: The rod-shaped article according to any one of examples Ex50 to Ex55, wherein a wavelength of the non-rectangular undulations corresponds to 1 to 1/5 of the circumference of the second segment.

[0137] Example Ex57: The rod-shaped article according to any one of examples Ex50 to Ex56, wherein a wavelength of the non-rectangular undulations corresponds to 1 to 1/4 of the circumference of the second segment.

[0138] Example Ex58: The rod-shaped article according to any one of examples Ex50 to Ex57, wherein a wavelength of the non-rectangular undulations corresponds to half or one third (1/2 or 1/3) of the circumference of the second segment.

[0139] Example Ex59: The rod-shaped article according to any one of examples Ex50 to Ex58, wherein the single line of weakness has an amplitude of the non-rectangular undulations corresponding to between 30 percent and 100 percent of a length of the second segment.

[0140] Example Ex60: The rod-shaped article according to claim example Ex59, wherein the amplitude of the non-rectangular undulations corresponds to between 40 percent and 90 percent of the length of the second segment.

[0141] Example Ex61: The rod-shaped article according to any one of examples Ex59 to Ex60, wherein the amplitude of the non-rectangular undulations corresponds to between 60 and 80 percent of the length of the second segment.

[0142] Example Ex62: The rod-shaped article according to any one of examples Ex50 to Ex61, wherein an amplitude of the non-rectangular undulations corresponds to between 0.2 millimeter and 5 millimeter.

[0143] Example Ex63: The rod-shaped article according to any one of examples Ex50 to Ex62, wherein an amplitude of the non-rectangular undulations corresponds to between 0.5 millimeter and 4 millimeter.

[0144] Example Ex64: The rod-shaped article according to any one of examples Ex50 to Ex63, wherein an amplitude of the non-rectangular undulations corresponds to between 1 millimeter and 3 millimeter.

[0145] Example Ex65: The rod-shaped article according to any one of examples Ex50 to Ex64, manufactured with the method according to any one of examples Ex1 to Ex26.

[0146] Examples will now be further described with reference to the figures in which:

Figure 1 shows a schematic composition of a rod-shaped article;

Figure 2 shows a schematic configuration of a rod-shaped article in exploded view;

Figure 3 shows a rotary weakening drum;

Figure 4 shows a cutting die for a cutting drum; and

Figure 5 shows a glue roller.

[0147] In Fig. 1 an exemplary composition of an example of a rod-shaped article 1 comprising several segments including a cap 10 is schematically shown.

[0148] The rod-shaped article 1 is a smoking article comprising a heat source 11 and an aerosol-forming sub-

strate 12 arranged downstream adjacent the heat source 11. The aerosol-forming substrate 12 may comprise tobacco material or, for example, a nicotine containing substrate. Preferably, the aerosol-forming substrate comprises or is made of crimped tobacco sheet material.

[0149] Further segments of the article 1 are a diffuser 13, for example, a hollow acetate tube, arranged adjacent the aerosol-forming substrate 12, a filter plug 14, for example a biodegradable filter arranged adjacent the diffuser 13, and a mouthpiece 15. In the example of Fig. 1, a cavity is arranged between the filter plug 14 and the mouthpiece 15.

[0150] The cap 10 is arranged at the distal or upstream end of the article 1. The mouthpiece 15 is arranged at the proximal or downstream end of the article 1.

[0151] 'Upstream' and 'downstream' is seen in view of an airflow passing from the heat source 11 to the user puffing at the mouthpiece 15. Accordingly, a 'distal end' of the article is understood as an article end most distal to a user using the article 1.

[0152] The mouthpiece segments, such as the mouthpiece 15, the cavity and the filter plug 14, are wrapped and connected with each other as well as with the other segments by a tipping paper 22. The tipping paper 22 wraps the mouthpiece segments as well as a portion of an outer wrapper 20 arranged around the more distally arranged segments of the article 1.

[0153] Cap 10, heat source 11, aerosol-forming substrate 12 and diffuser 13 are wrapped and connected to each other by the outer wrapper 20, preferably a paper wrapper. A heat conducting metal sheet, for example an aluminium patch 21, is arranged around at least a portion of the heat source 11 and a portion of the aerosol-forming substrate 12. The aluminium patch 21 may combine the two segments heat source 11 and aerosol-forming substrate 12. The aluminium patch 21 mainly helps to transfer heat from the heat source 11 to the aerosol-forming substrate 12 and supports distribution of the heat generated in the heat source 11 to the aerosol-forming substrate 12.

[0154] The outer wrapper 20 including the aluminium patch 21 is provided with a single line of weakness 40 in the form of a zig-zag or triangle wave pattern. Preferably, the line of weakness 40 is a cutting line or a perforation line. Adjacent to the line of weakness 40 on a downstream or proximal side of the article, a glue pattern 30 is provided. The glue pattern 30 follows the line of weakness 40 such that the triangles of the zig-zag wave form of the line of weakness 40 are provided with glue.

[0155] Optional venting means in the form a perforation line 200 circumscribing the article 1 may be arranged in the outer wrapper 20. The perforation line 200 forms a line of air holes in the outer wrapper 20. Air entering the article 1 by holes of the perforation line 200 may vent the aerosol-forming substrate 12 and cool aerosol formed in the aerosol-forming substrate 12 passing the diffuser 13 downstream of the aerosol-forming substrate segment 12.

[0156] The perforation line 200, if provided, and the line of weakness 40 may be formed by means on a same cutting drum.

[0157] Prior to use of the article 1, the cap 10 protecting the heat source 11 is removed. Generally, the part of the outer wrapper 20 connected with the cap 10 is removed as well upon removal of the cap 10. The heat source 11 gets exposed and may be lighted. The substrate 12 is heated by the lighted heat source 11 to form an aerosol that is transported to the distal end of the article 1 through the mouthpiece 15 to a user sucking at the mouthpiece 15.

[0158] Fig. 2 is a schematic, partially exploded illustration of an exemplary configuration of an exemplary aerosol-generating article 1. The article 1 may, for example, be an article as in Fig. 1 or any other rod-shaped article with a removable cap 10 but including an embodiment with improved manufacture of such an article.

[0159] The article 1 is shown with cap 10, heat source 11 and distal portion of the aerosol-generating substrate 12.

[0160] The outer wrapper 20 is a piece of sheet material for wrapping the cap 10, the heat source 11, preferably the entire aerosol-forming substrate 12 and preferably even further segments if provided in the article 1. The outer wrapper 20 may be designed to wrap the entire article 1, for example including a mouthpiece.

[0161] On an inner side of the outer wrapper 20, an aluminium patch in the form of an aluminium strip, is attached to the outer wrapper 20. Preferably, the aluminium patch 21 is glued on its entire outer surface to the inner surface of the outer wrapper 20 to be securely attached to the outer wrapper 20. The outer wrapper 20 including the aluminium patch 21 is provided with a single line of weakness 40 in the form of a zig-zag or triangle wave pattern. Preferably, the line of weakness 40 is a cutting line or a perforation line.

[0162] In Fig. 2, when wrapped, the line of weakness 40 extends around the entire circumference of the heat source 11. In Fig. 2 the line of weakness 40 is arranged such that the tips of the triangles of the triangle wave pattern are in registration with a contact area between cap 10 and heat source 11. Thus, the tips of the triangle wave pattern extend to an upstream end of the heat source 11.

[0163] In Fig. 2, the line of weakness 40 extends around the heat source 11 only. Thus, when the article 1 is wrapped, the line of weakness 40 undulates along a majority of the length of the heat source 11 and around the circumference of the heat source 12 only.

[0164] A glue pattern 30 comprising a straight base line 32 and triangularly shaped glue areas 31 (here three) arranged next to the base line 32 is provided to the inner side of the outer wrapper 20, or to the inner side of the aluminium patch 21, respectively. The glue pattern 30 is arranged in registration with the line of weakness 40 at the proximal or downstream side of the line of weakness 40. Thus, the glue pattern 30 is designed such that in

particular the triangles of the triangle wave pattern shaped line of weakness are provided with adhesive.

[0165] When the outer wrapper 20 is wrapped around the article 1 or to the respective segments 10, 11, 12, these are wrapped and combined by the outer wrapper 20.

[0166] The glue pattern 30 safely sticking a downstream portion of the outer wrapper - downstream of the line of weakness 40 - to at least the heat source 11, keeps the protruding triangles of the outer wrapper 20 and aluminium patch 21 in place during and after de-capping of the article 1.

[0167] The cap 10 is securely connected to the heat source 10 by the outer wrapper 20. Due to the line of weakness 40 being arranged in non-rectangular undulations and around the circumference of the heat source 11, the part of the outer wrapper 20 wrapping the cap 10 remains fully connected to the parts of the outer wrapper also wrapping the heat source 12 and further portions of the article 1 before use of the article.

[0168] Upon de-capping of the article 1, the article 1 may be held by the cap 10. By applying a removing force, the outer wrapper 20 is torn apart at the position of the line of weakness 40. Thus, the cap 10 including the part of the outer wrapper 20 arranged distal to or upstream of the line of weakness 40 is removed upon de-capping of the article 1. Thereby, parts of the outer circumference of the heat source 11 are exposed, allowing easier venting of the heat source 11 upon use of the article 1. In addition, complete removal of the wrapper 20 upstream or distal of the heat source 11 is performed such that no left-over wrapper portions exist upstream of the heat source 11 that could lead to unwanted burnt paper upon lighting of the heat source 11.

[0169] Fig. 3 shows a perspective view of a rotary weakening drum in the example of a cutting drum 4. The cutting drum 4 comprises four cutting dies 44 arranged every 90 degrees around the circumference of the cutting drum 4 at each of four straight side portions of the cutting drum 4. Also shown in Fig. 3 is a counter roller 48. A sheet of material (not shown) to be provided with a line of weakness 40 according to the invention is guided in between cutting drum 4 and counter roller 48, in particular in between cutting die 44 and counter roller 48.

[0170] Each cutting die 44 is designed to cut one single line of weakness 40 with undulations into a sheet of material such as, for example, an outer wrapper 20.

[0171] Fig. 4 is a schematic view of a cutting die 44 to be attached, for example screwed, to a cutting drum 4, for example as shown in Fig. 3.

[0172] The cutting die 44 is a rectangular plate provided with six cutting edges 41 arranged in the form of a zig-zag line to create a cutting line with undulations in the form of a triangle wave pattern. The cutting edges 41 are interrupted in order for a sheet material to be provided with a cutting line but to stay connected. The cutting die 44 is provide with screws 440 or screw holes to be fixed to a cutting drum 4.

[0173] Fig. 5 is a perspective view of a glue roller 5. The glue roller 5 comprises a circular circumference and four glue areas 55 provided in the circumference (in Fig. 5 two glue areas to be seen only). The glue areas 55 are openings in the circumference of the glue roller 5 such that glue provided and supplied to the inside of the glue roller 5 may pass through the glue areas 55 to the outside of the glue roller 5. The glue having the extension of the pattern of the glue areas 55 may then be applied to a sheet material passing the glue roller 5. The glue areas 55 are adapted in form and size to correspond to the line of weakness 40 as shown in Figs. 2 and 3.

[0174] The glue area 55 comprises a straight rectangular base opening 52 as well as three triangle shaped openings 51 extending from the base opening 52. The glue roller 5 is brought in registration with the cutting roller 4 such that a glue area 55 is in registration with the line of weakness 40 created in the sheet material, for example in the outer wrapper 20. Thereby, a glue pattern 30 is applied to the sheet material in registration with the line of weakness 40 in order to make sure that in particular the triangles of the sheet material, formed by the line of weakness, that shall remain around the article during but also after de-capping of the article 1, are safely and completely fixed to the article 1.

[0175] For the purpose of the present description and of the appended claims, except where otherwise indicated, all numbers expressing amounts, quantities, percentages, and so forth, are to be understood as being modified in all instances by the term "about". Also, all ranges include the maximum and minimum points disclosed and include any intermediate ranges therein, which may or may not be specifically enumerated herein. In this context, therefore, a number A is understood as $A \pm 10\%$ of A. Within this context, a number A may be considered to include numerical values that are within general standard error for the measurement of the property that the number A modifies. The number A, in some instances as used in the appended claims, may deviate by the percentages enumerated above provided that the amount by which A deviates does not materially affect the basic and novel characteristic(s) of the claimed invention. Also, all ranges include the maximum and minimum points disclosed and include any intermediate ranges therein, which may or may not be specifically enumerated herein.

Claims

1. Method in making a rod-shaped article comprising a removable segment, the method comprising:
 - providing a sheet material,
 - providing the sheet material with a single line of weakness with non-rectangular undulations;
 - positioning of the sheet material provided with the line of weakness in registration with a first and a second rod-shaped segment arranged in

- an end-to-end position; and
wrapping the sheet material comprising the line
of weakness around the first and the second rod-
shaped segments forming at least a part of a
rod-shaped article, wherein
the first segment is removable from the rod-
shaped article together with a portion of the
sheet material by tearing the line of weakness.
2. Method according to claim 1, wherein positioning the
sheet material provided with the line of weakness
comprises positioning portions of the single line of
weakness in registration with a contact area of the
first and the second segment.
 3. Method according to any one of the preceding
claims, providing the single line of weakness with a
wavelength of the non-rectangular undulations cor-
responding to a circumference of the second seg-
ment or to a full fraction of the circumference of the
second segment.
 4. Method according to any one of the preceding
claims, wherein a wavelength of the non-rectangular
undulations corresponds to half or one third ($1/2$ or
 $1/3$) of the circumference of the second segment.
 5. Method according to any one of claims 3 to 4, where-
in the wavelength of the non-rectangular undulations
corresponds to a full fraction of the circumference of
the second segment such that the line of weakness
meets itself when the sheet material is wrapped
around the first segment and the second segment.
 6. Method according to any one of the preceding
claims, providing the single line of weakness with an
amplitude of the non-rectangular undulations corre-
sponding to between 30 percent and 100 percent of
a length of the second segment.
 7. Method according to any one of the preceding
claims, wherein an amplitude of the non-rectangular
undulations corresponds to between 0.2 millimeter
and 5 millimeter.
 8. Method according to any one of the preceding
claims, comprising applying a glue pattern to the
sheet material; and
bringing the glue pattern in registration with the sin-
gle line of weakness before wrapping the sheet ma-
terial around the first and the second segment.
 9. Method according to claim 8, providing the glue pat-
tern with a same number of protruding areas as non-
rectangular undulations on one side of the line of
weakness.
 10. Apparatus for use in the production of a rod-shaped

article comprising a removable segment, the appa-
ratus comprising:

- a supply unit for providing a sheet material;
a weakening unit for providing the sheet material
supplied by the supply unit with a single line of
weakness with non-rectangular undulations;
a positioning unit for placing the sheet material
comprising the line of weakness in a wrapping
position;
a detector being in operational connection with
the positioning unit to determine the wrapping
position such as to allow to bring a first and a
second rod-shaped segment arranged in an
end-to-end position and the line of weakness
into registration; and
a wrapping unit for receiving the sheet material
comprising the line of weakness and for wrap-
ping the sheet material comprising the line of
weakness around the first and second segment.
11. Apparatus according to claim 10, wherein the weak-
ening unit is a cutting unit for producing a single line
of weakness in the form of a cutting line.
12. Apparatus according to any one of claims 10 to 11,
wherein the weakening unit comprises a rotary weak-
ening drum comprising two or more sets of weak-
ening elements arranged on the circumference of the
weakening drum, each set of weakening elements
adapted to produce a single line of weakness.
13. Apparatus according to any one of claims 10 to 12,
comprising a glue applicator for applying a glue pat-
tern to the sheet of material, wherein the detector is
in operational connection with the glue applicator
such as to allow to bring the cutting unit and the glue
applicator into registration such as to bring the glue
pattern into registration with the single line of weak-
ness provided in the sheet material.
14. Apparatus according to claim 13, wherein the glue
applicator comprises at least one glue application
area comprising a longitudinal base portion and at
least a protruding portion extending from the base
portion, and wherein the cutting unit and the glue
applicator are adapted to be brought into registration
such as to allow to bring the at least a protruding
area of the glue pattern into registration with a non-
rectangular undulation of the line of weakness pro-
vided in the sheet material.
15. Rod-shaped aerosol-generating article comprising
at least a first segment and a second segment ar-
ranged in an end-to-end position and wrapped with
a sheet material, wherein the sheet material is pro-
vided with a single line of weakness with non-rec-
tangular undulations, and wherein the first segment

is removable from the rod-shaped article at the single line of weakness together with a portion of the sheet material by tearing said line of weakness.

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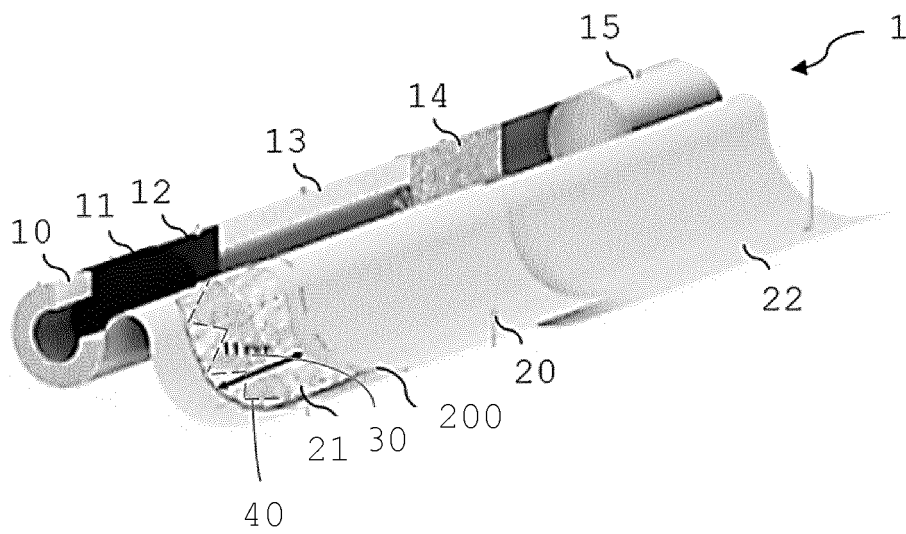


Fig. 1

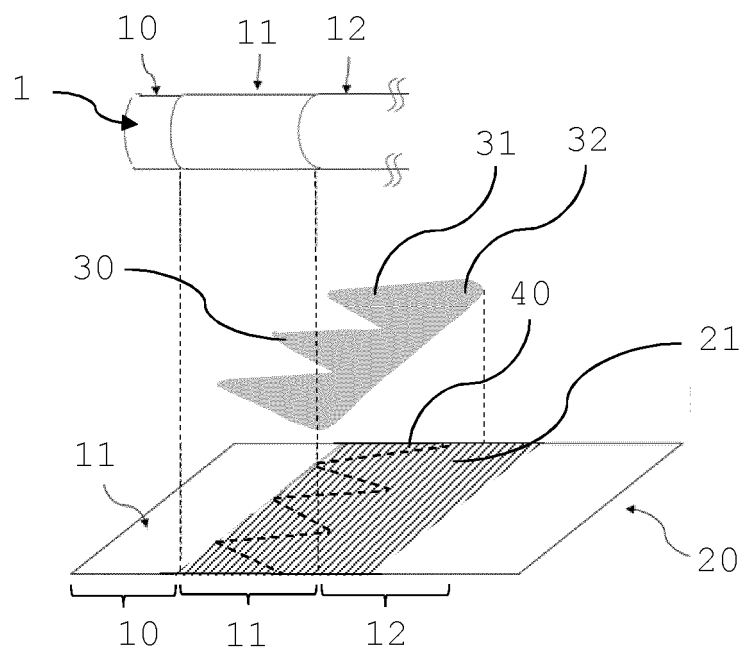


Fig. 2

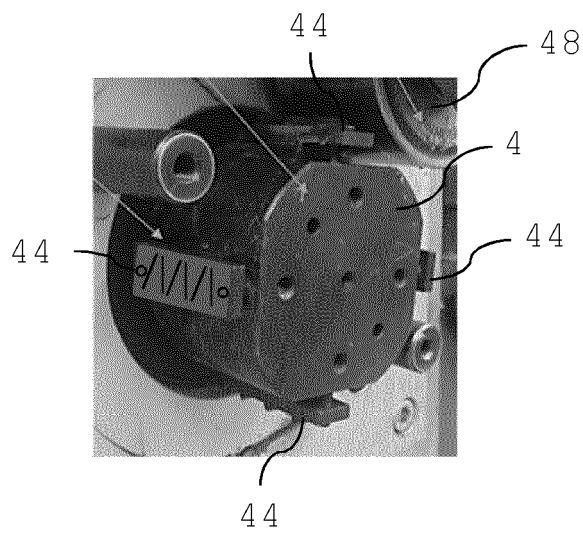


Fig. 3

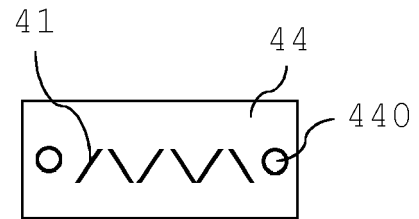


Fig. 4

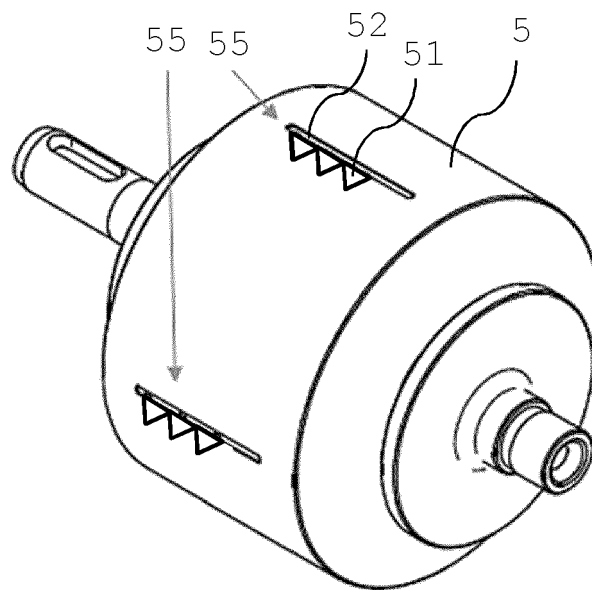


Fig. 5



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Place of search Munich		Date of completion of the search 12 July 2023	Examiner Schwarzer, Bernd
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