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(54) PAPER CIGARETTE FILTER AND METHOD AND APPARATUS FOR MANUFACTURING THE SAME

(57) In order to improve manufacturing precision, the present disclosure provides an apparatus for manufacturing a paper cigarette filter, the apparatus including: a supply device (10) configured to withdraw paper tow (211) made of a paper material at a predetermined withdrawal speed and transfer the withdrawn paper tow; a crimping device (20) disposed on one side of the supply device that corresponds to a direction in which the paper tow is transferred and including a pair of crimping rollers (21) from which a plurality of crimping protrusions protrude radially outward in a circumferential direction so that the paper tow is crimped while passing between the crimping rollers; a cutting device (30) disposed on one side of the crimping rollers and including a plurality of cutting blades configured to cut the paper tow so that the paper tow is separated into a plurality of separated paper portions (211a, 211b, 211c) at predetermined gaps in a width direction; an embossing formation device (40) disposed on one side of the cutting device and including an embossing roller (41) having a plurality of embossing protrusions (41a) protruding from an outer circumferential surface thereof so that a plurality of capsule-holding embossing grooves are formed to be recessed in a surface of at least any one of the separated paper portions; and a capsule addition device (80) disposed on one side of the embossing roller and configured to add a capsule (220) from top to bottom at predetermined gaps in a longitudinal direction on the surface of at least any one of the separated paper portions in which the embossing grooves are formed.

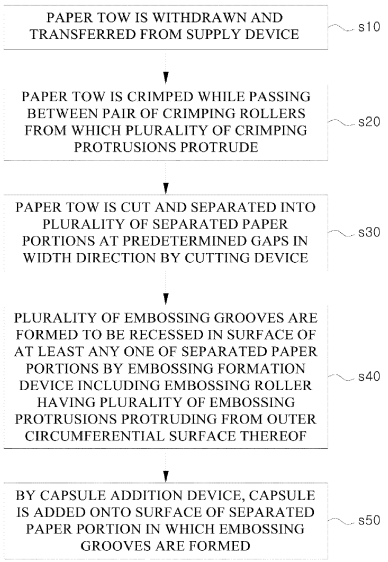

FIG. 1

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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2022-0105861, filed on August 24, 2022, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

1. Field of the Invention

[0002] The present disclosure relates to a paper cigarette filter and a method and apparatus for manufacturing the same, and more particularly, to a paper cigarette filter with improved manufacturing precision and a method and apparatus for manufacturing the same.

2. Discussion of Related Art

[0003] Generally, cigarettes have tobacco, such as tobacco leaves, wrapped in cigarette paper, allow inhalation of cigarette smoke which is generated due to burning the cigarette paper and tobacco, and include a filter disposed on an inhalation part to filter harmful components from the smoke and enhance the taste of the smoke.

[0004] Currently, most commercially available filters are manufactured based on cellulose acetate fibers, and these cellulose acetate-based filters require a decomposition period of up to three years or more depending on environmental conditions. As a result, the discarded filters themselves or toxic substances adsorbed in the filters cause various environmental problems.

[0005] Accordingly, various biodegradable fibers to replace cellulose acetate fibers have been developed, but filters manufactured based on such biodegradable fibers have not reached commercialization due to having difficulty filtering harmful components from smoke and maintaining the taste of the smoke.

[0006] In particular, polylactic acid (PLA) fibers manufactured based on lactic acid fermented with sugars such as cornstarch are gaining attention for their high productivity, low price, biodegradability, and the like but have a problem that, due to their low elasticity and adsorption, it is impossible to manufacture a filter with sufficient filtration performance by a conventional stretching process. That is, when manufacturing a filter based on PLA fibers, a high-ratio stretching process is required, but there is a problem that productivity is low due to frequent breakage of single yarn, and when a filter is manufactured based on PLA fibers stretched with a low ratio, there is a problem that the filtration performance is low and a taste of smoke is degraded.

[0007] Also, in the case of a cigarette filter including a flavor-enhancing capsule, there is a problem that, in a process of adding the capsule onto a surface of the cigarette filter, the capsule rolls and moves away from an initial position where the capsule is desired to be added, thus degrading product quality.

[Related Art Documents]

[Patent Documents]

[0008] Korean Patent Registration No. 10-0969596

SUMMARY OF THE INVENTION

[0009] The present disclosure is directed to providing a paper cigarette filter with improved manufacturing precision and a method and apparatus for manufacturing the same.

[0010] The present disclosure provides an apparatus for manufacturing a paper cigarette filter, the apparatus including: a supply device configured to withdraw paper tow made of a paper material at a predetermined withdrawal speed and transfer the withdrawn paper tow; a crimping device disposed on one side of the supply device that corresponds to a direction in which the paper tow is transferred and including a pair of crimping rollers from which a plurality of crimping protrusions protrude radially outward in a circumferential direction so that the paper tow is crimped while passing between the crimping rollers; a cutting device disposed on one side of the crimping rollers and including a plurality of cutting blades configured to cut the paper tow so that the paper tow is separated into a plurality of separated paper portions at predetermined gaps in a width direction; an embossing formation device disposed on one side of the cutting device and including an embossing roller having a plurality of embossing protrusions protruding from an outer circumferential surface thereof so that a plurality of capsule-holding embossing grooves are formed to be recessed in a surface of at least any one of the separated paper portions; and a capsule addition device disposed on one side of the embossing roller and configured to add a capsule from top to bottom at predetermined gaps in a longitudinal direction on the surface of at least any one of the separated paper portions in which the embossing grooves are formed.

[0011] The present disclosure provides a method of manufacturing a paper cigarette filter, the method including: a first operation in which, from a supply device supplying paper tow made of a paper material, the paper tow is withdrawn at a predetermined withdrawal speed and transferred; a second operation in which the paper tow is crimped while passing between a pair of crimping rollers which are disposed on one side of the supply device that corresponds to a direction in which the paper tow is transferred and which have a plurality of crimping protrusions protruding radially outward therefrom in a circumferential direction; a third operation in which the paper tow is cut and separated into a plurality of separated paper portions at predetermined gaps in a width direction by a cutting device disposed on one side of the crimping

rollers and including a plurality of cutting blades; a fourth operation in which a plurality of capsule-holding embossing grooves are formed to be recessed in a surface of at least any one of the separated paper portions by an embossing formation device disposed on one side of the cutting device and including an embossing roller having a plurality of embossing protrusions protruding from an outer circumferential surface thereof; and a fifth operation in which, by a capsule addition device disposed on one side of the embossing roller, a capsule is added from top to bottom at predetermined gaps in a longitudinal direction on the surface of the separated paper portion in which the embossing grooves are formed.

[0012] The present disclosure provides a paper cigarette filter including: a rod portion formed in which paper tow made of a paper material and extending in a longitudinal direction is separated into a plurality of separated paper portions in a width direction, a plurality of capsule-holding embossing grooves are formed to be recessed in the longitudinal direction and the width direction in a surface of any one separated paper portion disposed at a lower center among the separated paper portions, and the rest of the separated paper portions are disposed at both sides in the width direction; and a capsule added onto the surface of any one of the separated paper portions, in which the embossing grooves are formed to be recessed, and wrapped in the separated paper portions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The above and other objects, features and advantages of the present disclosure will become more apparent to those of ordinary skill in the art by describing exemplary embodiments thereof in detail with reference to the accompanying drawings, in which:

FIG. 1 is a flowchart illustrating a method of manufacturing a paper cigarette filter according to one embodiment of the present disclosure;

FIG. 2 is an exemplary view illustrating an apparatus for manufacturing a paper cigarette filter according to one embodiment of the present disclosure;

FIG. 3 is a lateral view illustrating the apparatus for manufacturing a paper cigarette filter according to one embodiment of the present disclosure;

FIG. 4 is a front view illustrating an embossing formation device in the apparatus for manufacturing a paper cigarette filter according to one embodiment of the present disclosure;

FIG. 5 is an exemplary view illustrating a use state of the apparatus for manufacturing a paper cigarette filter according to one embodiment of the present disclosure;

FIG. 6 is an exemplary view illustrating forming guides in the apparatus for manufacturing a paper cigarette filter according to one embodiment of the present disclosure;

FIG. 7 is an exemplary view illustrating a process of manufacturing a rod portion in the apparatus for manufacturing a paper cigarette filter according to one embodiment of the present disclosure;

FIG. 8 is a front cross-sectional view illustrating a paper cigarette filter according to one embodiment of the present disclosure;

FIG. 9 is an exemplary view illustrating a separated paper portion having embossing grooves formed therein in the paper cigarette filter according to one embodiment of the present disclosure;

FIG. 10 is a lateral cross-sectional view illustrating the paper cigarette filter according to one embodiment of the present disclosure;

FIGS. 11 and 12 are graphs showing whether a defect occurs according to a capsule position error in the paper cigarette filter according to one embodiment of the present disclosure; and

FIG. 13 is an exemplary view illustrating a forming guide in an apparatus for manufacturing a paper cigarette filter according to another embodiment of the present disclosure.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0014] Hereinafter, a paper cigarette filter and a method and apparatus for manufacturing the same according to an exemplary embodiment of the present disclosure will be described in detail with reference to the accompanying drawings.

[0015] FIG. 1 is a flowchart illustrating a method of manufacturing a paper cigarette filter according to one embodiment of the present disclosure, and FIG. 2 is an exemplary view illustrating an apparatus for manufacturing a paper cigarette filter according to one embodiment of the present disclosure. Also, FIG. 3 is a lateral view illustrating the apparatus for manufacturing a paper cigarette filter according to one embodiment of the present disclosure, and FIG. 4 is a front view illustrating an embossing formation device in the apparatus for manufacturing a paper cigarette filter according to one embodiment of the present disclosure. Also, FIG. 5 is an exemplary view illustrating a use state of the apparatus for manufacturing a paper cigarette filter according to one embodiment of the present disclosure, and FIG. 6 is an exemplary view illustrating forming guides in the apparatus for manufacturing a paper cigarette filter according to one embodiment of the present disclosure. Also, FIG. 7 is an exemplary view illustrating a process of manufacturing a rod portion in the apparatus for manufacturing a paper cigarette filter according to one embodiment of the present disclosure, and FIG. 8 is a front cross-sectional view illustrating a paper cigarette filter according to one embodiment of the present disclosure. In addition, FIG. 9 is an exemplary view illustrating a separated paper portion having embossing grooves formed therein in the paper cigarette filter according to one embodiment of the present disclosure, and FIG. 10 is a lateral cross-sec-

tional view illustrating the paper cigarette filter according to one embodiment of the present disclosure.

[0016] As shown in FIGS. 1 to 10, the method of manufacturing a paper cigarette filter according to one embodiment of the present disclosure includes an operation in which paper tow is withdrawn and transferred from a supply device (s10). Also, the method of manufacturing a paper cigarette filter according to one embodiment of the present disclosure includes an operation in which the paper tow is crimped while passing between a pair of crimping rollers from which a plurality of crimping protrusions protrude (S20). Also, the method of manufacturing a paper cigarette filter according to one embodiment of the present disclosure includes an operation in which the paper tow is cut and separated into a plurality of separated paper portions at equal gaps in a width direction by a cutting device (S30). Also, the method of manufacturing a paper cigarette filter according to one embodiment of the present disclosure includes an operation in which a plurality of embossing grooves are formed to be recessed in a surface of at least any one of the separated paper portions by an embossing formation device including an embossing roller having a plurality of embossing protrusions protruding from an outer circumferential surface thereof (S40). Also, the method of manufacturing a paper cigarette filter according to one embodiment of the present disclosure includes an operation in which, by a capsule addition device, a capsule is added on the surface of the separated paper portion in which the embossing grooves are formed.

[0017] In addition, an apparatus 100 for manufacturing a paper cigarette filter according to one embodiment of the present disclosure includes a supply device 10, a crimping device 20, a cutting device 30, an embossing formation device 40, and a capsule addition device 80. The apparatus 100 for manufacturing a paper cigarette filter may be provided to include a frame 1 in which the supply device 10, the crimping device 20, the cutting device 30, the embossing formation device 40, and the capsule addition device 80 are installed. Also, the supply device 10, the crimping device 20, the cutting device 30, the embossing formation device 40, and the capsule addition device 80 may be disposed to be spaced apart from each other while corresponding to a direction in which paper tow 211 made of a paper material is transferred.

[0018] First, the paper tow 211 is withdrawn at a predetermined withdrawal speed and transferred from the supply device 10 configured to supply the paper tow 211 (s10).

[0019] Here, the supply device 10 is provided to supply the paper tow 211 made of a paper material, withdraw the paper tow 211 at a predetermined withdrawal speed, and transfer the paper tow 211. The supply device 10 may be provided to include a pair of winding rolls 10a, a splicer 10b, a plurality of supply rollers 10c, and a slitting unit 10d.

[0020] Here, the winding rolls 10a may be provided so that the paper tow 211 having a predetermined width is wound and stored. Also, the splicer 10b may be disposed above the winding rolls 10a so that the paper tow 211 supplied from the pair of winding rolls 10a is connected. Also, the plurality of supply rollers 10c may be disposed to be spaced apart from and aligned with each other in a zigzag shape above the splicer 10b and may be provided to guide the paper tow 211 supplied from the splicer 10b. In addition, the slitting unit 10d may be disposed to be spaced apart from the supply rollers 10c above the splicer 10b and may be provided to selectively slit the paper tow 211.

[0021] Further, first tension devices 11 configured to maintain the paper tow 211 in a taut state may be provided on one side of the supply device 10 that corresponds to a direction in which the paper tow 211 is transferred. Here, the first tension devices 11 may be disposed between the supply device 10 and the crimping device 20 and provided as a pair of cylindrical rollers aligned with each other in a vertical direction. Also, the paper tow 211 passing between the first tension devices 11 provided as a pair of rollers may be supplied in a flat state to the crimping device 20.

[0022] Meanwhile, the paper tow 211 is crimped while passing between a pair of crimping rollers 21 which are disposed on the one side of the supply device 10 that corresponds to the direction in which the paper tow 211 is transferred and which have a plurality of crimping protrusions 21a protruding radially outward therefrom in a circumferential direction (S20).

[0023] Here, the crimping device 20 is disposed on the one side of the supply device 10 that corresponds to the direction in which the paper tow 211 is transferred and includes the pair of crimping rollers 21 from which the plurality of crimping protrusions 21a protrude radially outward in the circumferential direction so that the paper tow 211 is crimped while passing between the crimping rollers 21.

[0024] Here, the crimping rollers 21 may be disposed to be aligned with each other in the vertical direction, and as the paper tow 211 passes between the crimping rollers 21, creep may be formed on a surface of the paper tow 211, and the paper tow 211 may be crimped.

[0025] Here, on each of the crimping rollers 21, the crimping protrusions 21a may be spaced apart from each other at predetermined gaps in the circumferential direction and protrude radially outward at a predetermined height. Also, an outer surface of each of the crimping protrusions 21a may be formed as a flat surface. For example, the gaps between the crimping protrusions 21a in the circumferential direction may be set to be in a range of 0.8 mm to 1.2 mm, and heights of each of the crimping protrusions 21a protruding from an outer surface of each of the crimping rollers 21 may be set to be in a range of 1.3 mm to 1.7 mm, but the present disclosure is not limited to the above example.

[0026] Also, on one side of the crimping device 20 that corresponds to the direction in which the paper tow 211

is transferred, second tension devices 12 configured to maintain the crimped paper tow 211 in a taut state may be provided.

[0027] Here, the second tension devices 12 may be disposed between the crimping device 20 and the cutting device 30 and may be provided as a plurality of cylindrical rollers aligned with each other in the vertical direction and the direction in which the paper tow 211 is transferred. Also, the paper tow 211 guided by the second tension devices 12 may be supplied in a flat state to the cutting device 30.

[0028] Meanwhile, the paper tow 211 is cut and separated into a plurality of separated paper portions 211a, 211b, and 211c at equal gaps in the width direction by the cutting device 30 disposed on one side of the crimping rollers 21 and including a plurality of cutting blades (S30).

[0029] Here, the paper tow 211 may be cut at equal gaps in the width direction and separated into a first separated paper portion 211a which is disposed at a center in the width direction and a second separated paper portion 211b and a third separated paper portion 211c which are disposed at both sides of the first separated paper portion 211a in the width direction. That is, in one embodiment of the present disclosure, a case in which the paper tow 211 is separated into three strands is illustrated and described as an example. Also, in the present disclosure, the direction in which the paper tow 211 is transferred may be understood as being the same as a direction in which the separated paper portions 211a, 211b, and 211c are transferred. That is, the paper tow 211 may be understood as being transferred in the same transfer direction even after being separated into the plurality of separated paper portions 211a, 211b, and 211c.

[0030] Also, the cutting device 30 is disposed on the one side of the crimping rollers 21 and includes a plurality of cutting blades configured to cut the paper tow 211 so that the paper tow 211 is separated into the plurality of separated paper portions 211a, 211b, and 211c in equal gaps in the width direction.

[0031] Here, the cutting blades provided in the cutting device 30 may be provided as a pair of cutting blades and disposed to be spaced apart from each other in the width direction of the cutting device 30 at a gap that corresponds to a width of the first separated paper portion 211a. For example, the cutting blades may be provided as a pair of cutting blades and may be disposed to be spaced apart from each other at a gap that allows the paper tow 211 to be divided into three portions in the width direction of the paper tow 211. For example, a gap between the pair of cutting blades in the width direction may be set to be in a range of 30 mm to 40 mm.

[0032] Also, the cutting blades may be disposed in the direction in which the paper tow 211 is transferred. Accordingly, the paper tow 211 supplied to the cutting device 30 may be consecutively separated into the plurality of separated paper portions 211a, 211b, and 211c in the longitudinal direction of the paper tow 211.

[0033] That is, the first separated paper portion 211a, the second separated paper portion 211b, and the third separated paper portion 211c may be understood as being cut from each other in the width direction of the paper tow 211 by the cutting device 30 and consecutively supplied in the longitudinal direction. Also, the longitudinal direction of the first separated paper portion 211a, the second separated paper portion 211b, and the third separated paper portion 211c may be understood as being the same as the direction in which the paper tow 211 is transferred.

[0034] Meanwhile, by the embossing formation device 40, a plurality of capsule-holding embossing grooves 212 for capsule holding are formed to be recessed in a surface of at least any one of the separated paper portions 211a, 211b, and 211c (S40).

[0035] Here, the capsule holding refers to, after a capsule 220 falls onto the surface of at least any one of the separated paper portions 211a, 211b, and 211c in which the embossing grooves 212 are formed to be recessed, maintaining the capsule 220 in a stationary state so that the capsule 220 does not move away by rolling. That is, as a lower end of the capsule 220 is inserted into the embossing groove 212 formed in the surface of at least any one of the separated paper portions 211a, 211b, and 211c, a change in the position of the capsule 220 due to rolling of the capsule 220 can be minimized.

[0036] Here, the embossing formation device 40 may be disposed on one side of the cutting device 30 and include an embossing roller 41 formed in a cylindrical shape and having a plurality of embossing protrusions 41a protruding from an outer circumferential surface thereof. Here, the embossing protrusions 41a may be spaced apart from each other in the circumferential direction and the width direction on the outer circumferential surface of the embossing roller 41 and may protrude radially outward at a plurality of sites.

[0037] For example, the embossing protrusions 41a may include a plurality of first embossing protrusions 41b disposed to be spaced apart from each other at equal gaps to have a predetermined first width in the circumferential direction on a central outer surface of the embossing roller 41 in the width direction. That is, the first embossing protrusions 41b may be spaced apart from each other at equal gaps in the circumferential direction and the width direction on the central outer surface of the embossing roller 41 in the width direction and may each protrude radially outward.

[0038] Also, the embossing protrusions 41a may include a plurality of second embossing protrusions 41c which are spaced apart from the first embossing protrusions 41b and disposed to be spaced apart from each other at equal gaps to have a predetermined second width in the circumferential direction on an outer surface of the embossing roller 41. Here, the second width may be set to exceed the first width. That is, the second embossing protrusions 41c may be spaced apart from each other at equal gaps in the circumferential direction and the width direction on the outer surface of the embossing

roller 41 and may each protrude radially outward. Also, the second embossing protrusions 41c may be spaced apart from the first embossing protrusions 41b in the circumferential direction and the width direction of the embossing roller 41.

[0039] Also, the embossing formation device 40 may include an embossing driving device 46 drivably connected to an end portion of the embossing roller 41. Here, the embossing driving device 46 may be provided as a motor, and the end portion of the embossing roller 41 may be drivably connected to a rotating shaft of the embossing driving device 46 and simultaneously rotate therewith.

[0040] Here, the embossing formation device 40 may further include a support 43 to which both ends of the embossing roller 41 are rotatably connected and to which the embossing driving device 46 is connected. Here, the embossing roller 41 and the embossing driving device 46 may be disposed above the support 43, and a space for arrangement of an embossing facing roller 42, which will be described below, may be secured below the embossing roller 41. Also, a lower end of the support 43 may be connected to the frame 1.

[0041] Further, the embossing formation device 40 may include the embossing facing roller 42 which is formed in a cylindrical shape, is disposed below the embossing roller 41 and spaced apart therefrom at a gap corresponding to the paper tow 211, and has an outer surface made of an elastic material. Of course, in some cases, the embossing facing roller 42 may be disposed above the embossing roller 41.

[0042] Also, the outer surface of the embossing facing roller 42 may be made of a silicone material having elasticity. Also, the embossing facing roller 42 may be provided to have a length and a diameter that correspond to a length and a diameter of the embossing roller 41, but the present disclosure is not limited thereto.

[0043] Specifically, an outer circumferential surface of the embossing facing roller 42 may be disposed to face an outer circumferential surface of the embossing roller 41 in the vertical direction and may be spaced apart therefrom at a gap that allows at least any one of the separated paper portions 211a, 211b, and 211c to pass.

[0044] Here, the embossing protrusions 41a may simultaneously press a surface of at least any one of the separated paper portions 211a, 211b, and 211c and the outer surface of the embossing facing roller 42. In this way, the embossing grooves 212 may be stably formed in the surface of at least any one of the separated paper portions 211a, 211b, and 211c.

[0045] Here, since the outer surface of the embossing facing roller 42 is temporarily elastically deformed when pressed by the embossing protrusions 41a, the embossing grooves 212 can be more clearly formed in the surface of at least any one of the separated paper portions 211a, 211b, and 211c.

[0046] Also, the embossing formation device 40 may further include a lifting/lowering plate 44 rotatably connected to both ends of the embossing facing roller 42 in the width direction. Here, the lifting/lowering plate 44 may be disposed at a position lower than the position of the embossing roller 41. Here, the lifting/lowering plate 44 may be disposed on an inside of the support 43 in the width direction.

[0047] Also, the embossing formation device 40 may further include a lifting/lowering driving device 45 drivably connected to both sides of the embossing facing roller 42 in the width direction so that the embossing facing roller 42 is selectively lifted and lowered in the vertical direction. Here, the lifting/lowering driving device 45 may be disposed in the frame 1 and drivably connected to the lifting/lowering plate 44. Also, as the lifting/lowering plate 44 is lifted and lowered in the vertical direction in response to the lifting/lowering driving device 45 being driven, the embossing facing roller 42 may be interlocked thereto and be lifted and lowered.

[0048] Here, while the embossing facing roller 42 is lifted and lowered by the lifting/lowering driving device 45, the embossing roller 41 and the embossing facing roller 42 may be set to remain spaced apart from each other. To this end, the maximum height of the lifting/lowering plate 44 which is lifted and lowered in the vertical direction may be set to a position that is below the embossing roller 41 and spaced a predetermined gap therefrom.

[0049] In this way, at least any one of the separated paper portions 211a, 211b, and 211c may pass between the embossing roller 41 and the embossing facing roller 42. Also, the plurality of embossing grooves 212 having a predetermined size for capsule holding may be clearly formed to be recessed in a surface of at least any one of the separated paper portions 211a, 211b, and 211c.

[0050] Here, in one embodiment of the present disclosure, the case in which the first separated paper portion 211a passes between the embossing roller 41 and the embossing facing roller 42 and the embossing grooves 212 are formed to be recessed in the surface of the first separated paper portion 211a is described as an example. Also, the second separated paper portion 211b and the third separated paper portion 211c may be understood as not passing between the embossing roller 41 and the embossing facing roller 42.

[0051] Here, the apparatus 100 for manufacturing a paper cigarette filter according to one embodiment of the present disclosure may include a first guide roller 51, a second guide roller 52, a third guide roller 53, and a fourth guide roller 54.

[0052] Here, the first guide roller 51 may be disposed between the cutting device 30 and the embossing roller 41 and provided to allow at least any one of the separated paper portions 211a, 211b, and 211c to be guided to a portion between the embossing roller 41 and the embossing facing roller 42.

[0053] Also, the second guide roller 52 may be disposed below the first guide roller 51 and spaced apart therefrom and provided to allow the rest of the separated

paper portions 211a, 211b, and 211c to be supplied while spaced apart from the embossing roller 41.

[0054] Also, the third guide roller 53 and the fourth guide roller 54 may be disposed between the embossing roller 41 and forming guides 60 which will be described below. Here, the third guide roller 53 and the fourth guide roller 54 may be disposed to be aligned with each other in the vertical direction, and the third guide roller 53 may be disposed below the fourth guide roller 54.

[0055] Also, the third guide roller 53 and the fourth guide roller 54 may be disposed below the embossing formation device 40 and spaced apart therefrom. At the same time, a height between the third guide roller 53 and the fourth guide roller 54 and a height of a lower end of the second guide roller 52 may be aligned with and correspond to each other.

[0056] Here, among the separated paper portions 211a, 211b, and 211c supplied from between the embossing roller 41 and the embossing facing roller 42, the first separated paper portion 211a may be guided to a lower side of the third guide roller 53. At the same time, the separated paper portion supplied from the second guide roller 52 may be guided to a portion between an upper side of the third guide roller 53 and a lower side of the fourth guide roller 54.

[0057] For example, the first separated paper portion 211a may be guided to the portion between the embossing roller 41 and the embossing facing roller 42 via the first guide roller 51 and may pass between the embossing roller 41 and the embossing facing roller 42. Then, the first separated paper portion 211a may be supplied by being guided to the lower side of the third guide roller 53 between the embossing roller 41 and the embossing facing roller 42.

[0058] At the same time, the second separated paper portion 211b and the third separated paper portion 211c may be supplied by being guided from the first guide roller 51 to the second guide roller 52. Then, the second separated paper portion 211b and the third separated paper portion 211c may be guided from the second guide roller 52 to a portion between the third guide roller 53 and the fourth guide roller 54 while being disposed below the embossing roller 41 and the embossing facing roller 42 and spaced apart therefrom.

[0059] Here, a first separator (not illustrated) configured to guide the first separated paper portion 211a from the first guide roller 51 to the portion between the embossing roller 41 and the embossing facing roller 42 may be further provided. Also, a second separator (not illustrated) configured to guide the second separated paper portion 211b and the third separated paper portion 211c to the second guide roller 52 may be further provided.

[0060] Also, the first separated paper portion 211a may be understood as being transferred in the direction in which the paper tow 211 is transferred. Further, the second separated paper portion 211b and the third separated paper portion 211c may be understood as, while being spaced apart from both sides of the first separated paper portion 211a in the width direction, being transferred in the direction in which the paper tow 211 is transferred.

[0061] Meanwhile, the apparatus 100 for manufacturing a paper cigarette filter according to one embodiment of the present disclosure may include the forming guides 60 and an auxiliary forming guide 61.

[0062] Here, the forming guides 60 may be disposed between the embossing roller 41 and the capsule addition device 80. The forming guides 60 may be disposed between the embossing roller 41 and a rod formation device 70 which will be described below.

[0063] Also, the forming guides 60 may be provided as a plurality of forming guides 60, may be spaced apart from each other at a certain gap in the width direction, may extend in the direction in which the paper tow 211 is transferred, and may have both ends bent downward and extended. For example, the forming guides 60 may be provided as a pair of forming guides, may be spaced apart from each other in the width direction, and may each be provided as a metal bar having a right-angled C-shape.

[0064] Further, the auxiliary forming guide 61 may be provided as a single auxiliary forming guide 61, may be disposed between the embossing roller 41 and the capsule addition device 80, and may be disposed on one side of the forming guides 61 and spaced apart therefrom in the direction in which the paper tow 211 is transferred. Here, the auxiliary forming guide 61 may be disposed between the forming guides 60 and the rod formation device 70.

[0065] Here, the auxiliary forming guide 61 may extend in the width direction perpendicular to the direction in which the paper tow 211 is transferred and may have both ends bent downward and extended. For example, the auxiliary forming guide 61 may be provided as a metal bar having a right-angled C-shape. That is, the forming guides 60 and the auxiliary forming guide 61 may be provided in the same shape. Also, the forming guides 60 and the auxiliary forming guide 61 may be disposed perpendicular to each other.

[0066] Further, both ends of the forming guides 60 and both ends of the auxiliary forming guide 61 which are bent downward may be fixed to a fixing plate provided on one side of the apparatus 100 for manufacturing a paper cigarette filter according to one embodiment of the present disclosure.

[0067] Here, in one embodiment of the present disclosure, the first separated paper portion 211a may be guided from the third guide roller 53 to a portion between the forming guides 60, guided to a lower side of the auxiliary forming guide 61, and then supplied to a lower side of an input end of the rod formation device 70.

[0068] At the same time, the second separated paper portion 211b and the third separated paper portion 211c may be guided from between the third guide roller 53 and the fourth guide roller 54 to both sides of the forming guides 60 in the width direction. That is, by the forming guides 60, the first separated paper portion 211a, the

second separated paper portion 211b, and the third separated paper portion 211c may be spaced apart and partitioned from each other in the width direction.

[0069] Then, the second separated paper portion 211b and the third separated paper portion 211c may be guided from both sides of the forming guides 60 in the width direction to an upper side of the auxiliary forming guide 61 and then may be supplied to both sides of the input end of the rod formation device 70 in the width direction.

[0070] That is, the first separated paper portion 211a may be supplied to a lower side of the input end of the rod formation device 70 by the forming guides 60 and the auxiliary forming guide 61. At the same time, the second separated paper portion 211b and the third separated paper portion 211c may be supplied to both sides of the input end of the rod formation device 70 in the width direction by the forming guides 60 and the auxiliary forming guide 61. In this way, the capsule 220 can be stably added from top to bottom onto an upper surface of the first separated paper portion 211a in which the embossing grooves 212 are formed.

[0071] Here, the rod formation device 70 may have both ends formed to be penetrated in the direction in which the paper tow 211 is transferred and may be formed in the shape in which an outer circumference thereof corresponds to the shape of a funnel and gradually narrows from the input end toward an output end. Here, a diameter of the input end of the rod formation device 70 may be set to exceed a diameter of the output end of the rod formation device 70.

[0072] Also, the separated paper portions 211a, 211b, and 211c may be manufactured into a rod-shaped rod portion 210 due to being compressed while moving from the input end of the rod formation device 70 to the output end thereof.

[0073] Here, the first separated paper portion 211a may be supplied to the lower side of the input end of the rod formation device 70, and the second separated paper portion 211b and the third separated paper portion 211c may be supplied to both sides of the input end of the rod formation device 70 in the width direction.

[0074] Referring to FIG. 8, the separated paper portions 211a, 211b, and 211c may be manufactured into the rod portion 210 while passing through the inside of the rod formation device 70, and here, the first separated paper portion 211a having a surface in which the embossing grooves 212 are formed may be disposed at a lower center of the rod portion 210. Also, the second separated paper portion 211b and the third separated paper portion 211c may be disposed at both sides of the rod portion 210 in the width direction. Here, a slit 211d for adding the capsule 220 may be formed between the second separated paper portion 211b and the third separated paper portion 211c which are compressed into a rod shape.

[0075] Here, the slit 211d may have an open upper side and a lower side that communicates with a central upper surface of the first separated paper portion 211a. To this end, a slit forming protrusion (not illustrated) that corresponds to the shape of the slit 211d may extend downward from a central upper side inside the rod formation device 70.

[0076] Meanwhile, by the capsule addition device 80, the capsule 220 is added from top to bottom at predetermined gaps in the longitudinal direction on the surface of at least any one of the separated paper portions 211a, 211b, and 211c in which the embossing grooves 212 are formed (S50). Here, in one embodiment of the present disclosure, the capsule 220 may be added onto the surface of the first separated paper portion 211a in which the embossing grooves 212 are formed.

[0077] Here, in the surface of the first separated paper portion 211a, the plurality of embossing grooves 212 may be formed to be recessed at gaps corresponding to the shapes of the embossing protrusions 41a in the longitudinal direction and the width direction of the first separated paper portion 211a. Here, sizes and diameters of the embossing protrusions 41a and the embossing grooves 212 may be set to correspond to a size and diameter of the capsule 220, but the present disclosure is not limited thereto.

[0078] Also, the capsule addition device 80 may be disposed on one side of the embossing roller 41 or may be disposed to be spaced apart from an upper portion of one side of the rod formation device 70. Also, the capsule addition device 80 may be provided as a device configured to add the capsule 220 from top to bottom at predetermined gaps in the longitudinal direction on the surface of the first separated paper portion 211a in which the embossing grooves 212 are formed.

[0079] For example, capsule transfer grooves may be formed to be recessed radially inward in the circumferential direction in an outer circumferential surface of the capsule addition device 80. Also, the capsule 220 may be transferred as the capsule addition device 80 rotates about a central axis due to a rotation driver (not illustrated) for rotation. Also, the capsule 220 may be added by falling from the capsule addition device 80 toward an upper side of the surface of the first separated paper portion 211a in which the embossing grooves 212 are formed. For example, the capsule 220 may be adsorbed through an air suction port (not illustrated) provided in the capsule addition device 80 during rotation of the capsule addition device 80, may fall from top to bottom due to an air pressure at a predetermined position, and may be added onto the surface of the first separated paper portion 211a. Here, the capsule 220 may pass through the slit 211d and fall, and then be added onto the surface of the first separated paper portion 211a.

[0080] Also, a paper cigarette filter 200 may be finally manufactured as an outer side of the rod portion 210 into which the capsule 220 is added is wrapped with wrapping paper made of a paper material.

[0081] Meanwhile, the paper cigarette filter 200 manufactured according to one embodiment of the present disclosure includes the rod portion 210 and the capsule

220.

[0082] Here, the rod portion 210 may be formed by the paper tow 211, which is made of a paper material and extends in the longitudinal direction, being separated into the plurality of separated paper portions 211a, 211b, and 211c in the width direction.

[0083] Here, in the rod portion 210, the plurality of embossing grooves 212 may be formed to be recessed in the longitudinal direction and the width direction in a surface of any one separated paper portion disposed at the lower center among the separated paper portions 211a, 211b, and 211c. That is, the rod portion 210 may include the first separated paper portion 211a which is disposed at the lower center of the rod portion 210 and has a surface in which the embossing grooves 212 are formed to be recessed.

[0084] Also, in the rod portion 210, the rest of the separated paper portions 211a, 211b, and 211c in which the embossing grooves 212 are not formed may be disposed at both sides in the width direction. That is, the rod portion 210 may include the second separated paper portion 211b and the third separated paper portion 211c which are disposed at both sides of the rod portion 210 in the width direction.

[0085] Here, the first separated paper portion 211a, the second separated paper portion 211b, and the third separated paper portion 211c may be understood as having been crimped by the crimping device 20 and may be understood as having been compressed by the rod formation device 70.

[0086] Also, the capsule 220 may be added onto a surface of any one of the separated paper portions 211a, 211b, and 211c, in which the embossing grooves 212 are formed to be recessed, and wrapped with the separated paper portions 211a, 211b, and 211c. That is, the capsule 220 may be added onto a surface of the first separated paper portion 211a and then be wrapped with the first separated paper portion 211a, the second separated paper portion 211b, and the third separated paper portion 211c.

[0087] Moreover, the paper cigarette filter 200 may further include a hollow portion 230 which is provided on one end portion of the rod portion 210 and has a hollow hole 231 formed to be penetrated in the longitudinal direction in a central portion. Here, the hollow portion 230 may be made of a paper material but may also be made of an acetate material in some cases. In addition, the paper cigarette filter 200 may further include an acetate filter portion 240 provided on one end portion of the hollow portion 230. Here, the acetate filter portion 240 may be made of an acetate material. Also, the paper cigarette filter 200 may include a capsule adding portion 250 provided between the hollow portion 230 and the acetate filter portion 240. Here, the capsule 220 may be added to a central portion of the capsule adding portion 250.

[0088] In this way, according to the present disclosure, the paper tow 211 made of a paper material is crimped by passing through the pair of crimping rollers 21 and is separated into the plurality of separated paper portions 211a, 211b, and 211c by the cutting device 30 so as to be manufactured into the rod portion 210. Therefore, the present disclosure can provide the paper cigarette filter 200 of high quality that has a uniform cross-sectional density.

[0089] Also, in addition to the paper tow 211 being cut by the cutting device 30 and separated into the separated paper portions 211a, 211b, and 211c, the plurality of embossing grooves 212 are formed to be recessed in a surface of at least any one of the separated paper portions 211a, 211b, and 211c. Accordingly, when the capsule 220 is added, rolling of the capsule 220 on the surfaces of the separated paper portions 211a, 211b, and 211c is prevented, and a position to which the capsule 220 is added is held. Therefore, during manufacture of the paper cigarette filter 200, a defect rate can be minimized, and manufacturing precision can be significantly improved. Also, since high-speed production of the paper cigarette filter 200 is possible, productivity can be significantly improved.

[0090] Also, when the embossing grooves 212 are formed by the embossing protrusions 41a pressing the separated paper portions 211a, 211b, and 211c, the separated paper portions 211a, 211b, and 211c are supported by an outer surface of the embossing facing roller 42 made of an elastic material. Accordingly, since outlines of the embossing grooves 212 are clearly and precisely formed on at least any one of the separated paper portions 211a, 211b, and 211c, manufacturing precision can be improved.

[0091] Also, the plurality of forming guides 60 which are spaced apart from each other at a certain gap in the width direction, extend in the direction in which the paper tow 211 is transferred, and have both ends bent and extended are provided between the embossing roller 41 and the capsule addition device 80. Also, the auxiliary forming guide 61 which extends in the width direction perpendicular to the direction in which the paper tow 211 is transferred and which has both ends bent downward and extended is provided between the embossing roller 41 and the capsule addition device 80. Therefore, since the separated paper portions 211a, 211b, and 211c are guided to be partitioned by the forming guides 60 and are manufactured into the rod portion 210, a high-quality paper cigarette filter having a uniform density can be provided.

[0092] Meanwhile, FIGS. 11 and 12 are graphs showing whether a defect occurs according to a capsule position error in the paper cigarette filter according to one embodiment of the present disclosure.

[0093] Specifically, FIGS. 11 and 12 show results of testing, for a plurality of rod portions, whether a gap between an initially set position and an actual addition position deviates from a predetermined gap while adding the capsule in the manufactured paper cigarette filter.

[0094] Here, lengths of the rod portions were set to 110 mm and 120 mm, and the test was performed for 200 rod

portions. Also, FIG. 11 shows a result of testing when the predetermined gap was set to 1.0 mm, and FIG. 12 shows a result of testing when the predetermined gap was set to 1.5 mm.

[0095] As a result of testing, referring to the part indicated as "Normal" and "Case 1" in FIG. 11, when the rod portions were manufactured to have a length of 110 mm without cutting of paper tow as in the conventional case, 150 rod portions were found to be normal, and 50 rod portions were found to be defective. Also, when the rod portions were manufactured to have a length of 120 mm without cutting of paper tow as in the conventional case, 183 rod portions were found to be normal, and 17 rod portions were found to be defective.

[0096] Here, being normal refers to a case in which the gap between the initially set position and the actual addition position is less than the predetermined gap while adding the capsule. Also, being defective refers to a case in which the gap between the initially set position and the actual addition position is larger than or equal to the predetermined gap while adding the capsule.

[0097] Also, referring to the part indicated as "with Cutting (Center 30 mm)" and "Case 2" in FIG. 11, the paper tow may be cut by the cutting device and separated into the plurality of separated paper portions, and a width of the first separated paper portion may be set to 30 mm. Here, when the rod portions were manufactured to have a length of 110 mm, 136 rod portions were found to be normal, and 64 rod portions were found to be defective. In addition, when the rod portions were manufactured to have a length of 120 mm, 103 rod portions were found to be normal, and 97 rod portions were found to be defective.

[0098] Meanwhile, referring to the part indicated as "with Cutting & Embossing (Center 40 mm)" and "Case 3" in FIG. 11, the paper tow may be cut by the cutting device and separated into the plurality of separated paper portions, and a width of the first separated paper portion may be set to 40 mm. Also, the plurality of embossing grooves may be formed to be recessed in a surface of the first separated paper portion. Here, when the rod portions were manufactured to have a length of 110 mm, 190 rod portions were found to be normal, and 10 rod portions were found to be defective. In addition, when the rod portions were manufactured to have a length of 120 mm, 149 rod portions were found to be normal, and 51 rod portions were found to be defective.

[0099] Meanwhile, referring to the part indicated as "Normal" and "Case 1" in FIG. 12, when the rod portions were manufactured to have a length of 110 mm without cutting of paper tow as in the conventional case, 175 rod portions were found to be normal, and 25 rod portions were found to be defective. Also, when the rod portions were manufactured to have a length of 120 mm without cutting of paper tow as in the conventional case, 196 rod portions were found to be normal, and 4 rod portions were found to be defective.

[0100] Also, referring to the part indicated as "with Cutting (Center 30 mm)" and "Case 2" in FIG. 12, the paper tow may be cut by the cutting device and separated into the plurality of separated paper portions, and a width of the first separated paper portion may be set to 30 mm. Here, when the rod portions were manufactured to have a length of 110 mm, 170 rod portions were found to be normal, and 30 rod portions were found to be defective. In addition, when the rod portions were manufactured to have a length of 120 mm, 177 rod portions were found to be normal, and 23 rod portions were found to be defective.

[0101] Meanwhile, referring to the part indicated as "with Cutting & Embossing (Center 40 mm)" and "Case 3" in FIG. 12, the paper tow may be cut by the cutting device and separated into the plurality of separated paper portions, and a width of the first separated paper portion may be set to 40 mm. Also, the plurality of embossing grooves may be formed to be recessed in a surface of the first separated paper portion. Here, when the rod portions were manufactured to have a length of 110 mm, 197 rod portions were found to be normal, and 3 rod portions were found to be defective. In addition, when the rod portions were manufactured to have a length of 120 mm, 179 rod portions were found to be normal, and 21 rod portions were found to be defective.

[0102] That is, the gap between the initially set position and the actual addition position while adding the capsule was found to be minimized when the paper tow was separated into the plurality of separated paper portions and, simultaneously, the plurality of embossing grooves were formed to be recessed in the surface of the first separated paper portion.

[0103] Meanwhile, FIG. 13 is an exemplary view illustrating a forming guide in an apparatus for manufacturing a paper cigarette filter according to another embodiment of the present disclosure. Here, since, in the other embodiment of the present disclosure, components other than the forming guide 160 are the same as in the above-described embodiment, detailed description thereof will be omitted, and the same components will be denoted by the same reference numerals in the following description.

[0104] As shown in FIG. 13, in the other embodiment of the present disclosure, the forming guide 160 may be provided to include a ring-shaped forming body 160a and forming protrusions 161, 162, and 163 which integrally protrude from the forming body 160a.

[0105] Here, the forming body 160a may be provided in the shape of a ring made of a metal material and may have a hollow formed therein to allow any one of the separated paper portions 211a, 211b, and 211c (see FIG. 5) to pass. Also, the forming protrusions 161, 162, and 163 may integrally protrude radially outward from the forming body 160a in the circumferential direction at a plurality of sites.

[0106] For example, the forming protrusions 161, 162, and 163 may include a first forming protrusion 161, a second forming protrusion 162, and a third forming pro-

trusion 163 which protrude radially outward from the forming body 160a in the circumferential direction while being spaced apart from each other at equal gaps.

[0107] Here, the rest of the separated paper portions 211a, 211b, and 211c (see FIG. 5) may pass between the first forming protrusion 161, the second forming protrusion 162, and the third forming protrusion 163.

[0108] For example, the first separated paper portion 211a (see FIG. 5) may pass through the hollow inside the forming body 160a. At the same time, the second separated paper portion 211b (see FIG. 5) may pass between the first forming protrusion 161 and the second forming protrusion 162. Also, the third separated paper portion 211c (see FIG. 5) may pass between the first forming protrusion 161 and the third forming protrusion 163.

[0109] In this way, since the separated paper portions 211a, 211b, and 211c (see FIG. 5) introduced into the rod formation device 70 (see FIG. 2) are stably guided by the forming guide 160, manufacturing precision of the paper cigarette filter 200 being manufactured can be improved.

[0110] The present disclosure provides the following advantageous effects.

[0111] First, since paper tow made of a paper material is crimped by passing between a pair of crimping rollers and separated into a plurality of separated paper portions by a cutting device so as to be manufactured into a rod portion, a high-quality paper cigarette filter having a uniform cross-sectional density can be provided.

[0112] Second, in addition to the paper tow being cut and separated into the plurality of separated paper portions by the cutting device, a plurality of capsule-holding embossing grooves are formed to be recessed in a surface of at least any one of the separated paper portions. Accordingly, when a capsule is added, rolling of the capsule is prevented, and a position to which the capsule is added is held, thus minimizing a defect rate and significantly improving productivity and manufacturing precision.

[0113] Third, the rod portion is manufactured by the separated paper portions being partitioned from each other and guided by a plurality of forming guides which are spaced apart from each other at a certain gap in a width direction between an embossing roller and a capsule addition device, extend in a direction in which the paper tow is transferred, and have both ends bent and extended. Thus, it is possible to provide a high-quality paper cigarette filter having a uniform density.

[0114] Here, unless particularly stated otherwise, the terms such as "including," "configuring," or "providing" used above indicate that the corresponding component may be embedded and thus should be interpreted as indicating that another component may be further included instead of excluding another component. Unless defined otherwise, all terms including technical or scientific terms have the same meaning as commonly understood by those of ordinary skill in the art to which the present disclosure pertains. Terms such as those defined in commonly used dictionaries should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and should not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0115] As described above, the present disclosure is not limited to the embodiments described above, those of ordinary skill in the art to which the present disclosure pertains may make various modifications without departing from the scope of the claims of the present disclosure, and such modifications also belong to the scope of the present disclosure.

Claims

1. An apparatus (100) for manufacturing a paper cigarette filter, the apparatus comprising:

   a supply device (10) configured to withdraw paper tow (211) made of a paper material at a predetermined withdrawal speed and transfer the withdrawn paper tow;
   a crimping device (20) disposed on one side of the supply device (10) that corresponds to a direction in which the paper tow is transferred and including a pair of crimping rollers (21) from which a plurality of crimping protrusions (21a) protrude radially outward in a circumferential direction so that the paper tow (211) is crimped while passing between the crimping rollers;
   a cutting device (30) disposed on one side of the crimping rollers (21) and including a plurality of cutting blades configured to cut the paper tow (211) so that the paper tow is separated into a plurality of separated paper portions (211a, 211b, 211c) at predetermined gaps in a width direction;
   an embossing formation device (40) disposed on one side of the cutting device (30) and including an embossing roller (41) having a plurality of embossing protrusions (41a) protruding from an outer circumferential surface thereof so that a plurality of capsule-holding embossing grooves are formed to be recessed in a surface of at least any one of the separated paper portions (211a, 211b, 211c); and
   a capsule addition device (80) disposed on one side of the embossing roller (41) and configured to add a capsule (220) from top to bottom at predetermined gaps in a longitudinal direction on the surface of at least any one of the separated paper portions (211a, 211b, 211c) in which the embossing grooves are formed.

2. The apparatus of claim 1, wherein:

the plurality of embossing protrusions (41a) protrude in the circumferential direction and the width direction from the outer circumferential surface of the embossing roller (41); and
the embossing formation device (40) includes an embossing facing roller (42) which is disposed below the embossing roller (41) and spaced apart therefrom at a gap corresponding to the paper tow (211) and which has an outer surface made of an elastic material.

3. The apparatus of claim 2, wherein the embossing formation device (40) further includes a lifting/lowering driving device (44) drivably connected to both sides of the embossing facing roller (42) in the width direction so that the embossing facing roller (42) can be selectively lifted and lowered in a vertical direction.

4. The apparatus of one of claims 1 to 3, further comprising a plurality of forming guides (60) which are disposed between the embossing roller (41) and the capsule addition device (80), are spaced apart from each other at a certain gap in the width direction, extend in the direction in which the paper tow (211) is transferred, and have both ends bent downward and extended.

5. The apparatus of claim 4, further comprising an auxiliary forming guide (61) which is disposed between the embossing roller (41) and the capsule addition device (80), extends in the width direction perpendicular to the direction in which the paper tow (211) is transferred, and has both ends bent downward and extended.

6. The apparatus of one of claims 1 to 5, further comprising:

a first guide roller (51) disposed between the cutting device (30) and the embossing roller (41) and provided to allow at least any one of the separated paper portions (211a, 211b, 211c) to be guided to the embossing roller (41); and
a second guide (52a) roller disposed below the first guide roller (51) and spaced apart therefrom and provided to allow the rest of the separated paper portions to be supplied while spaced apart from the embossing roller (41).

7. The apparatus of claim 6, further comprising a third guide roller (53) disposed between the embossing roller (41) and the forming guides (60) and configured to guide the separated paper portion (211a, 211b, 211c) supplied from the embossing roller (41) to a lower side and guide the separated paper portion supplied from the second guide roller (52a) to an upper side.

8. A method of manufacturing a paper cigarette filter, the method comprising:

a first operation in which, from a supply device supplying paper tow (211) made of a paper material, the paper tow is withdrawn at a predetermined withdrawal speed and transferred;
a second operation in which the paper tow is crimped while passing between a pair of crimping rollers which are disposed on one side of the supply device that corresponds to a direction in which the paper tow is transferred and which have a plurality of crimping protrusions (21a) protruding radially outward therefrom in a circumferential direction;
a third operation in which the paper tow is cut and separated into a plurality of separated paper portions (211a, 211b, 211c) at predetermined gaps in a width direction by a cutting device (30) disposed on one side of the crimping rollers (21) and including a plurality of cutting blades;
a fourth operation in which a plurality of capsule-holding embossing grooves are formed to be recessed in a surface of at least any one of the separated paper portions (211a, 211b, 211c) by an embossing formation device (40) disposed on one side of the cutting device (30) and including an embossing roller (41) having a plurality of embossing protrusions (41a) protruding from an outer circumferential surface thereof; and
a fifth operation in which, by a capsule addition device (80) disposed on one side of the embossing roller (40), a capsule (220) is added from top to bottom at predetermined gaps in a longitudinal direction on the surface of the separated paper portion in which the embossing grooves are formed.

9. The method of claim 8, wherein:

in the fourth operation, the plurality of embossing protrusions (41a) protrude in the circumferential direction and the width direction from the outer circumferential surface of the embossing roller;
the embossing formation device (40) includes an embossing facing roller (42) which is disposed below the embossing roller and spaced apart therefrom at a gap corresponding to the paper tow and which has an outer surface made of an elastic material; and
at least any one of the separated paper portions (211a, 211b, 211c) passes between the embossing roller (41) and the embossing facing roller (42).

10. A paper cigarette filter comprising:

a rod portion formed in which paper tow (211)

made of a paper material and extending in a longitudinal direction is separated into a plurality of separated paper portions in a width direction, a plurality of capsule-holding embossing grooves are formed to be recessed in the longitudinal direction and the width direction in a surface of any one separated paper portion disposed at a lower center among the separated paper portions, and the rest of the separated paper portions are disposed at both sides in the width direction; and

a capsule (220) added onto the surface of any one of the separated paper portions, in which the embossing grooves are formed to be recessed, and wrapped in the separated paper portions.

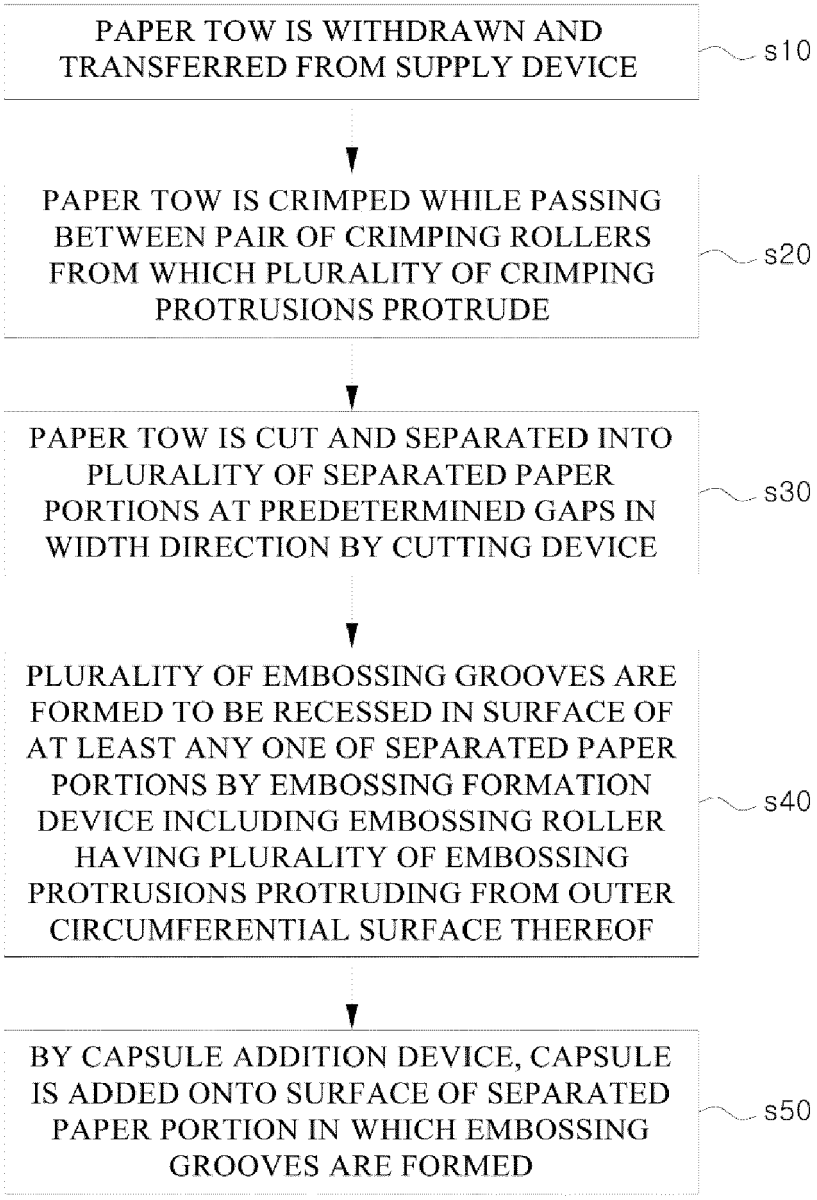
PAPER TOW IS WITHDRAWN AND TRANSFERRED FROM SUPPLY DEVICE
s10
PAPER TOW IS CRIMPED WHILE PASSING BETWEEN PAIR OF CRIMPING ROLLERS FROM WHICH PLURALITY OF CRIMPING PROTRUSIONS PROTRUDE
s20
PAPER TOW IS CUT AND SEPARATED INTO PLURALITY OF SEPARATED PAPER PORTIONS AT PREDETERMINED GAPS IN WIDTH DIRECTION BY CUTTING DEVICE
s30
PLURALITY OF EMBOSSING GROOVES ARE FORMED TO BE RECESSED IN SURFACE OF AT LEAST ANY ONE OF SEPARATED PAPER PORTIONS BY EMBOSSING FORMATION DEVICE INCLUDING EMBOSSING ROLLER HAVING PLURALITY OF EMBOSSING PROTRUSIONS PROTRUDING FROM OUTER CIRCUMFERENTIAL SURFACE THEREOF
s40
BY CAPSULE ADDITION DEVICE, CAPSULE IS ADDED ONTO SURFACE OF SEPARATED PAPER PORTION IN WHICH EMBOSSING GROOVES ARE FORMED
s50

FIG. 1

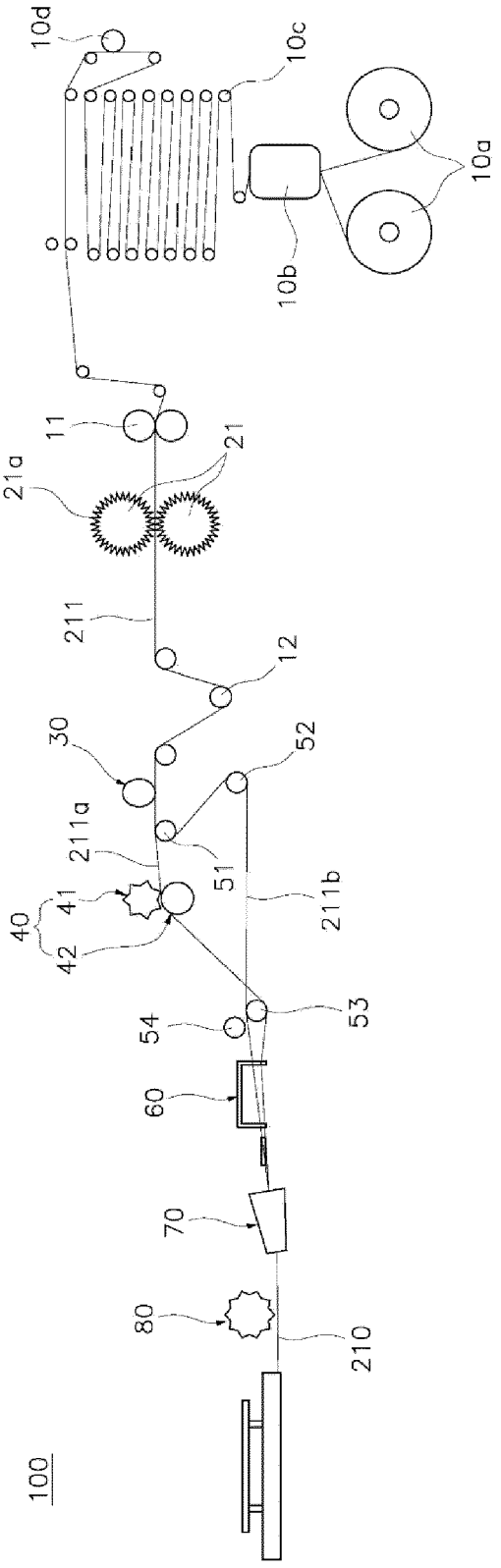
10d
10c
10a
10b
11
21
21a
211
12
30
52
211a
51
211b
40
41
42
53
54
60
70
80
210
100

FIG. 2

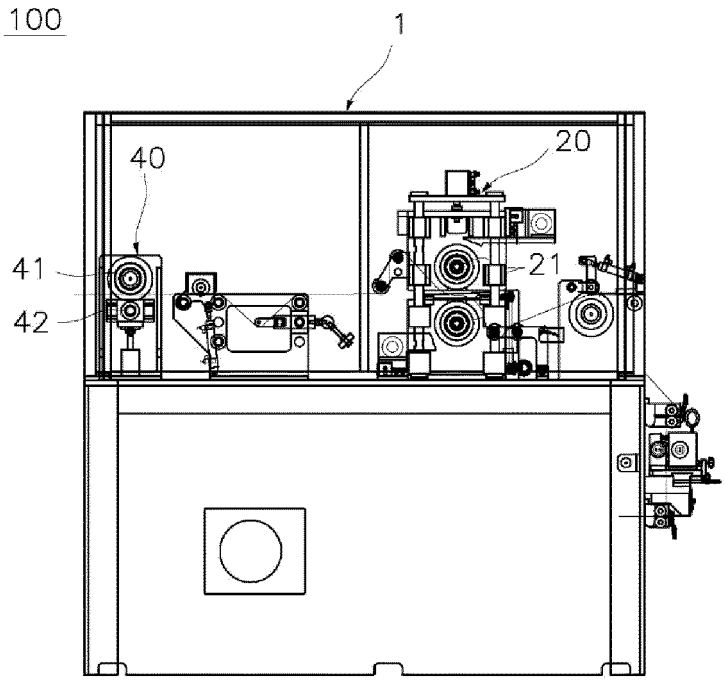

FIG. 3

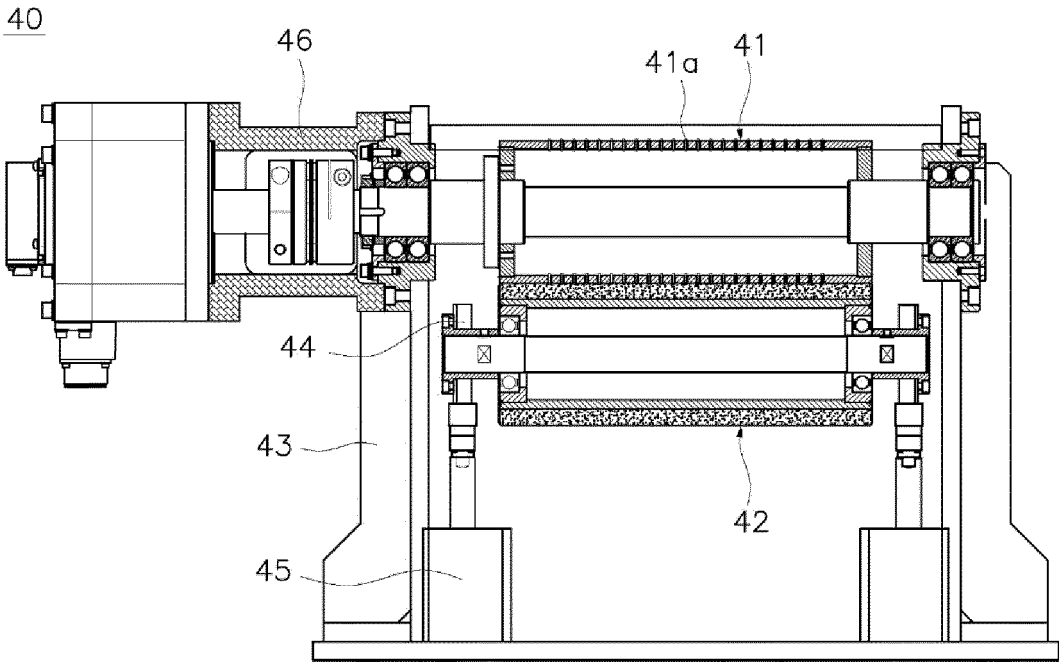

FIG. 4

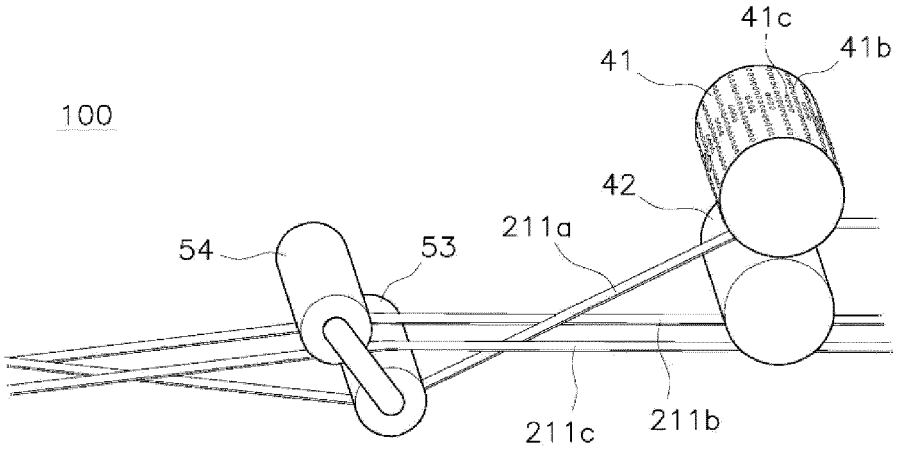

FIG. 5

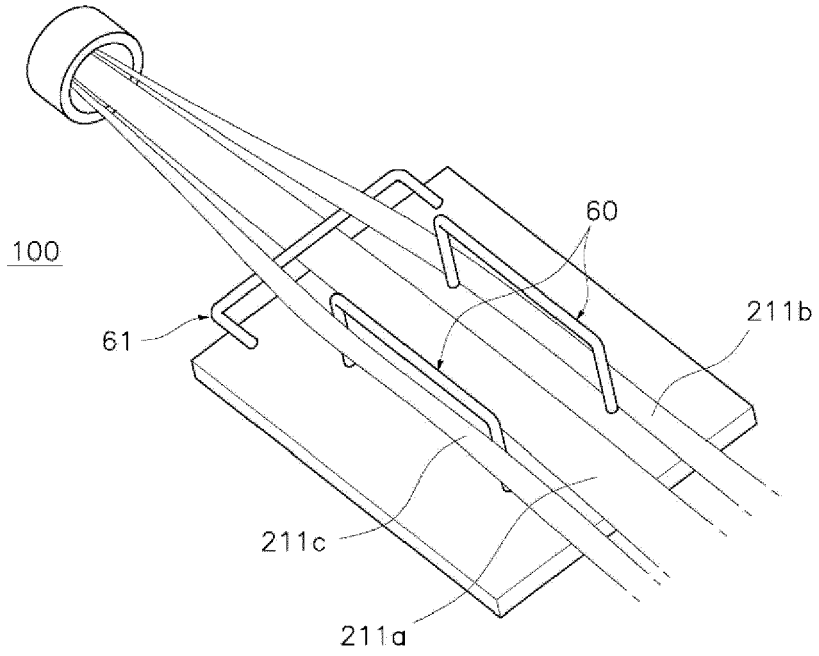

FIG. 6

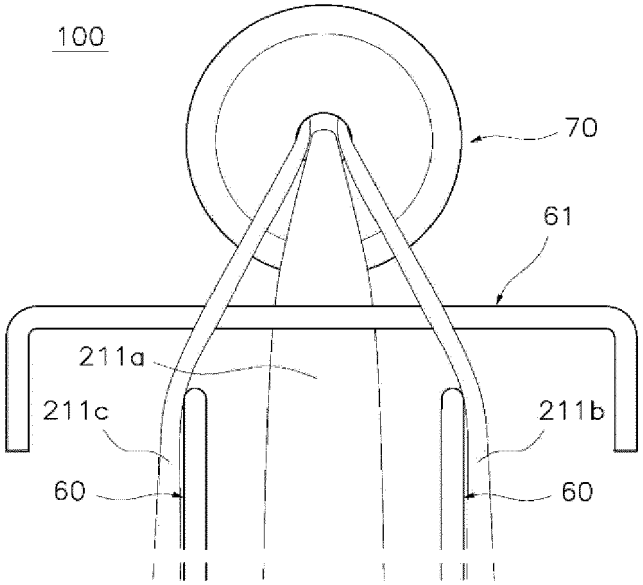

FIG. 7

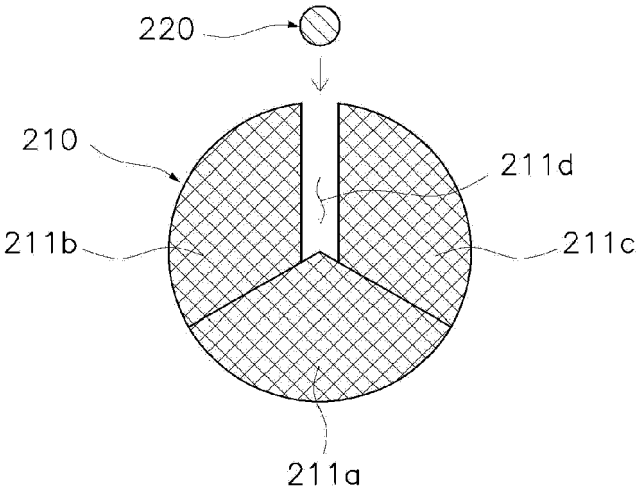

FIG. 8

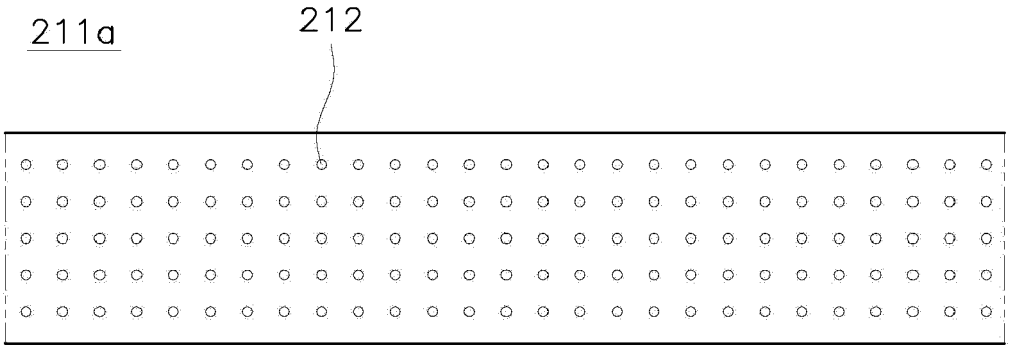

FIG. 9

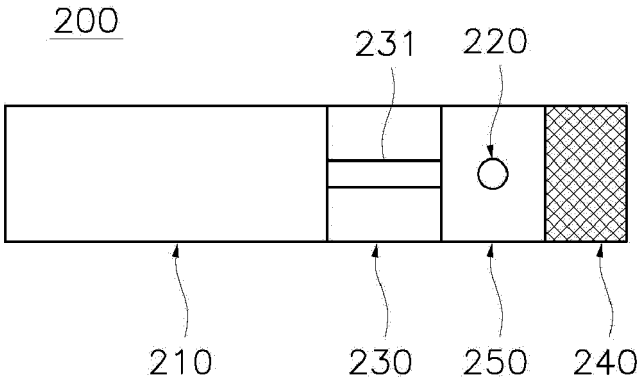

FIG. 10

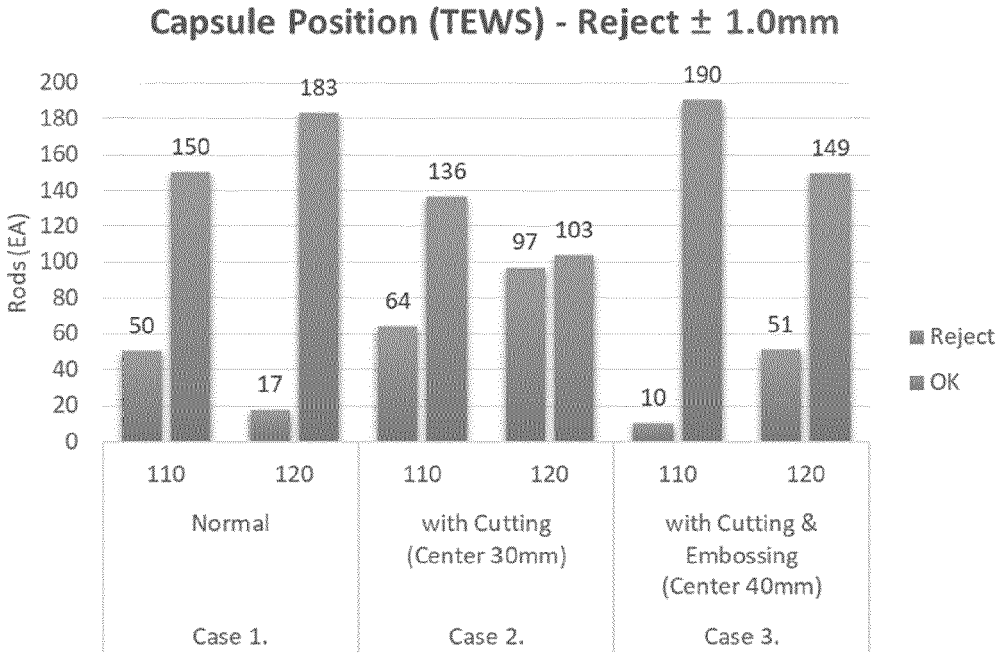
Capsule Position (TEWS) - Reject ± 1.0mm
Rods (EA)
200
180
160
140
120
100
80
60
40
20
0
50
150
17
183
64
136
97
103
10
190
51
149
110
120
110
120
110
120
Normal
with Cutting
(Center 30mm)
with Cutting &
Embossing
(Center 40mm)
Case 1.
Case 2.
Case 3.
Reject
OK

FIG. 11

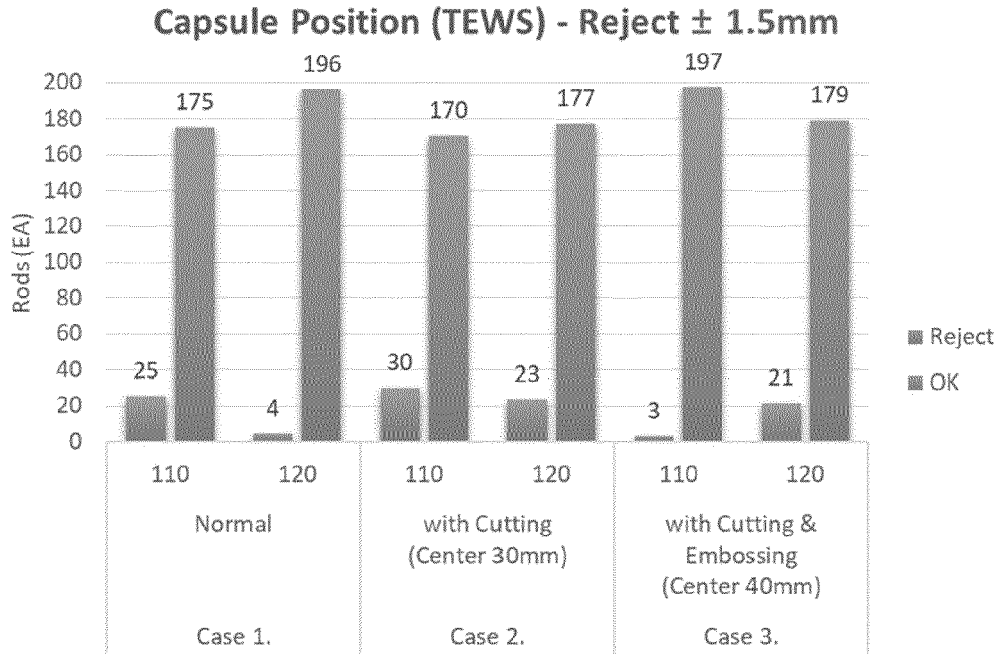
Capsule Position (TEWS) - Reject ± 1.5mm
Rods (EA)
200
180
160
140
120
100
80
60
40
20
0
25
175
4
196
30
170
23
177
3
197
21
179
110
120
110
120
110
120
Normal
with Cutting
(Center 30mm)
with Cutting &
Embossing
(Center 40mm)
Case 1.
Case 2.
Case 3.
Reject
OK

FIG. 12

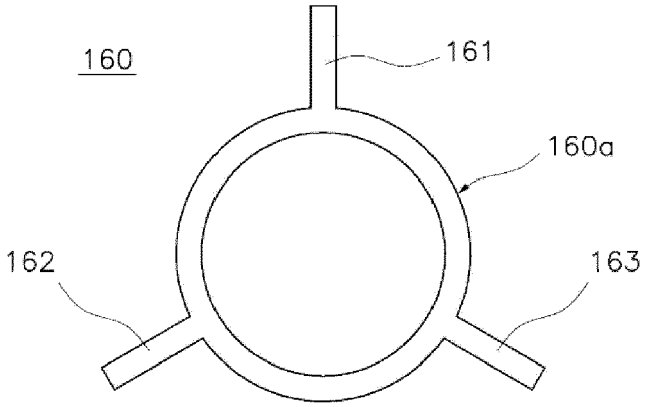

FIG. 13

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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 8517

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A24D A24B A24C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 August 2023	Koob, Michael

CATEGORY OF CITED DOCUMENTS

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22-08-2023

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