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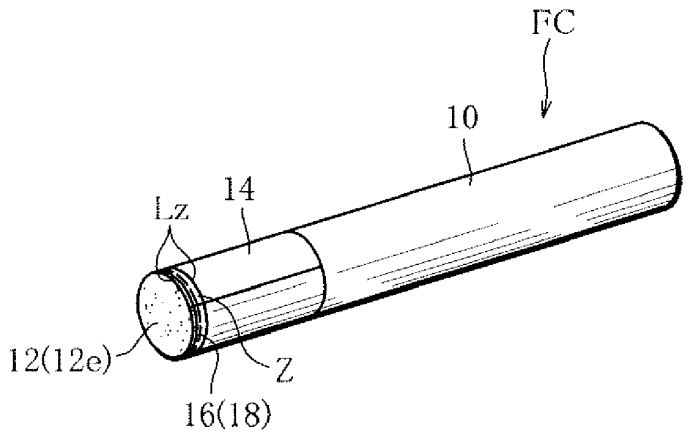
(54) **FILTER CIGARETTE MANUFACTURING METHOD AND FILTER CIGARETTE**

(57) A filter cigarette (FC, FC') comprising a cigarette (10) a filter (12) and a tipping paper (14) including a glue bonding surface formed on a reverse side of the tipping paper and arranged to bond the tipping paper to outer circumferential surfaces of the cigarette and the filter so as to connect them, wherein the tipping paper further includes a non-adhesive region lacking adhesion, wherein the non-adhesive region is provided on the reverse side of the tipping paper, wherein the tipping paper is provided with at least one perforation (18, 18') in the non-adhesive region, and wherein the perforation extends into the filter by penetrating through the tipping paper.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a filter cigarette having at least one perforation line in tipping paper thereof, a manufacturing machine for the filter cigarette, and a manufacturing method for the filter cigarette.

Background Art

[0002] If at least one perforation is formed in tipping paper of a filter cigarette, fresh air is introduced into a filter of the filter cigarette through the perforation. The fresh air introduced in this way dilutes mainstream smoke of the filter cigarette in the filter of the filter cigarette, thereby offering a user a lighter feel of smoking. This type of perforation is formed beforehand in a paper web used to form the tipping paper, and, for example, a laser beam can be used to form the perforation (see Paragraph 0047 of Patent Document 1 below).

Prior Art Document Patent Document

[0003] Patent Document 1: National Publication of International Patent Application No. 2005-535323 (WO 2004/014161)

Summary of the Invention Problems to be solved by the Invention

[0004] The above-mentioned perforation penetrates only the tipping paper, and moreover, is formed in the paper web in advance. Thus, an amount of fresh air introduced into the filter through the perforation, i.e., so-called quantity of ventilation air, cannot be adjusted in a production process of the filter cigarette.

[0005] In this regard, if the perforation is formed during the production process of the filter cigarette, it can extend into the filter by penetrating through the tipping paper and perforation size can be changed as well, making it easy to adjust the above-mentioned quantity of ventilation air.

[0006] However, if the perforation is formed during the production process of the filter cigarette, the following problems occur.

[0007] A reverse side of the tipping paper is coated with glue on an entire region thereof, being formed as a bonding surface for both cigarette and filter. Therefore, if the perforation is formed in the filter by penetrating through the tipping paper as a result of laser beam irradiation, the laser beam irradiation causes combustion products (ashes) to be produced from the glue, tipping paper, and filter material and the combustion products scatter around as adhesive dust.

[0008] The scattering of such dust causes the dust to adhere to outer surfaces of the produced filter cigarettes, and thereby not only mars appearance of the filter cigarettes, but also causes the perforation to be clogged by the dust, becoming a major factor in degrading the quality of the filter cigarettes. Besides, the dust also deposits on various machine components of the filter cigarette manufacturing machine, adversely affecting operation of the manufacturing machine as well.

[0009] An object of the present invention is to provide a filter cigarette manufacturing machine, filter cigarette manufacturing method, and filter cigarette which can greatly reduce scattering of adhesive dust and thereby prevent quality of the filter cigarette from being degraded by the dust in forming perforations penetrating through tipping paper in a manufacturing process of the filter cigarette.

Means for Solving the Problems

[0010] In order to achieve the above object, an aspect of the present invention is directed to providing a filter cigarette manufacturing machine according to the present invention, the filter cigarette manufacturing machine comprising: a filter attaching apparatus adapted to produce a filter cigarette by receiving a cigarette, a filter, and tipping paper coated with glue and attaching the filter to the cigarette via the tipping paper; a laser perforation device adapted to form at least one perforation in the filter by irradiating the tipping paper of the filter cigarette with a laser beam in a process of transferring the filter cigarette from the filter attaching apparatus, where the perforation extends into the filter by penetrating through the tipping paper; a glue layer forming device adapted to provide a bonding surface with respect to the cigarette and the filter by forming a glue layer on a reverse side of the tipping paper in a process of supplying the tipping paper to the filter attaching apparatus, wherein the glue layer forming device includes a configuration for forming a region where the perforation is formed, as a non-adhesive region lacking adhesion on the reverse side of the tipping paper.

[0011] Since the glue layer forming device according to the present invention is provided with the above configuration, when the perforation is formed in the filter by the laser beam through the tipping paper in the manufacturing process of the filter cigarette, even if dust scatters around, the dust is not adhesive. Thus, the manufacturing machine according to the present invention greatly reduces generation of adhesive dust in the process of perforation formation.

[0012] On the other hand, even if dust attaches to outer surfaces of the filter cigarettes, the dust, which is not adhesive, can be removed easily from the outer surfaces of the filter cigarettes in a transfer process of the filter cigarettes in the manufacturing machine.

[0013] Also, even if dust deposits on machine components of the manufacturing machine, the deposited dust can also be removed easily.

[0014] Furthermore, the present invention also provides a filter cigarette manufacturing method and a filter cigarette, whose details are as follows.

[0015] A manufacturing method according to the present invention comprises: a filter attaching step of producing a filter cigarette by receiving a cigarette, a filter, and tipping paper coated with glue and attaching the filter to the cigarette via the tipping paper; a laser perforation step of forming at least one perforation in the filter by irradiating the tipping paper of the filter cigarette with a laser beam in a process of transferring the filter cigarette from the filter attaching step to a succeeding stage, where the perforation extends into the filter by penetrating through the tipping paper; and a glue layer forming step of providing a bonding surface with respect to the cigarette and the filter by forming a glue layer on a reverse side of the tipping paper in a process of supplying the tipping paper to the filter attaching step, wherein the glue layer forming step includes a procedure for forming a non-adhesive region lacking adhesion on the reverse side of the tipping paper in order for the perforation to be formed in the non-adhesive region.

[0016] On the other hand, a filter cigarette according to the present invention comprises: a cigarette; a filter placed next to one end of the cigarette; and tipping paper adapted to connect the cigarette and the filter with each other and provided with at least one perforation, wherein the perforation extends into the filter by penetrating through the tipping paper, the tipping paper includes a glue bonding surface and a non-adhesive region lacking adhesion, where the bonding surface is formed on a reverse side of the tipping paper and adapted to bond the tipping paper to outer circumferential surfaces of the cigarette and the filter, the perforation is provided in the non-adhesive region, and the non-adhesive region extends over an entire circumference of the tipping paper.

[0017] Other objects and advantages of the invention will become clear from the accompanying drawings and following description of the embodiments.

Advantageous Effects of the Invention

[0018] Both the filter cigarette production machine and filter cigarette production method according to the present invention form a perforation by penetrating through the non-adhesive region of the tipping paper while on the other hand, the filter cigarette according to the present invention is provided with the perforation placed in the non-adhesive region of the tipping paper. Thus, when the perforation is formed by a laser beam, scattering of adhesive dust is reduced greatly, and consequently, the quality of the filter cigarette is not degraded by adhesion of dust.

Brief Description of the Drawings

[0019]

FIG. 1 is a perspective view of a filter cigarette according to a first embodiment of the present invention.

FIG. 2 is a sectional view of a filter in the filter cigarette of FIG. 1.

FIG. 3 is a schematic diagram of a manufacturing machine adapted to produce the filter cigarette of FIG. 1.

FIG. 4 is a diagram for describing a function of a filter attachment section shown in FIG. 3.

FIG. 5 is a front view concretely showing a laser perforation device of FIG. 3.

FIG. 6 is a side view of the laser perforation device shown in FIG. 3.

FIG. 7 is a diagram showing a double filter cigarette with perforation lines formed therein.

FIG. 8 is a diagram for describing functions of a cigarette cutting device and a aligning device shown in FIG. 3.

FIG. 9 is a side view concretely showing a glue application device of FIG. 3.

FIG. 10 is a diagram showing three regions provided as non-adhesive regions in a bonding surface of a paper web.

FIG. 11 is a diagram showing a glue transfer roller of FIG. 8 more concretely.

FIG. 12 is a diagram showing a glue application device according to a variation.

FIG. 13 is a diagram showing a disabling mechanism of FIG. 12 more concretely.

FIG. 14 is a diagram showing three regions formed as non-adhesive regions by a heater of FIG. 3.

FIG. 15 is a diagram showing a variation of the disabling mechanism.

FIG. 16 is a perspective view showing a filter cigarette according to a second embodiment of the present invention.

FIG. 17 is a sectional view of a dual filter in the filter cigarette of FIG. 16.

FIG. 18 is a diagram for describing a distribution ratio Qe/Qa of mainstream smoke of the filter cigarette according to the first embodiment.

FIG. 19 is a schematic diagram showing a measuring device for the distribution ratio Qe/Qa of the mainstream smoke.

Mode for Carrying out the Invention

[0020] Referring to FIG. 1, a filter cigarette FC according to a first embodiment of the present invention includes one cigarette 10. A filter 12 is placed next to one end of the cigarette 10, and the cigarette 10 and filter 12 are connected with each other by being wound with tipping paper 14 coated with glue.

[0021] The tipping paper 14 covers the filter 12 and cigarette 10 by extending from a mouth-side end face 12e of the filter 12 to the one end of the cigarette 10.

[0022] Furthermore, the filter cigarette FC has at least one perforation in the tipping paper 14. Specifically, the tipping paper 14 has at least one perforation line 16. The perforation line 16 is formed of a large number of perfo-

rations 18, distributed at intervals in a circumferential direction of the filter 12.

[0023] According to the first embodiment, the perforation line 16 is placed near the mouth-side end 12e. The individual perforations 18 in the perforation line 16 extend into the filter 12 by penetrating through the tipping paper 14 as is apparent from FIG. 2 while being inclined with respect to an axis A of the filter cigarette FC rather than being perpendicular. Thus, each perforation 18 includes an outer end which opens to an outer circumferential surface of the tipping paper 14 near the mouth-side end face 12e and an inner end positioned closer to the cigarette 10 in the filter 12 than to the outer end of the perforation 18.

[0024] Note that the filter 12 in FIG. 2 is shown as a plane filter. The plane filter includes a bundle 12f of filter fibers and wrapping paper 12w wrapped around the bundle 12f in a tubular form, and the above-mentioned perforations 18 extend toward a center (axis A) of the bundle 12f by penetrating through the tipping paper 14 and wrapping paper 12w.

[0025] Furthermore, according to the present embodiment, a non-adhesive region Z is provided on a reverse side of the tipping paper 14. The non-adhesive region Z is a ringshaped region extending over an entire circumference of the tipping paper 14 and is defined by two thin lines Lz added in FIG. 1 for convenience.

[0026] Thus, the tipping paper 14 is bonded to an outer surface of the filter 12 in a region other than the non-adhesive region Z. Also, because the non-adhesive region Z is not adhesive to the outer surface (wrapping paper 12w) of the filter 12, that part of a lap seam formed by lapping together opposite lateral ends of the tipping paper 14, which corresponds to the non-adhesive region Z, remains unbonded.

[0027] As is apparent from FIG. 1, outer ends of the perforations 18 making up the perforation line 16 are all placed in the non-adhesive region Z. Therefore, when the perforation line 16 is formed by the manufacturing machine and manufacturing described later, even if dust such as described above scatters around, the dust is not adhesive. Thus, even if dust touches the outer surface of the filter cigarette FC, the dust does not adhere to the outer surface of the filter cigarette FC. Consequently, appearance of the filter cigarette FC is not marred and the perforations 18 are not clogged by duct adhesion to the outer surface of the filter cigarette FC and quality of the filter cigarette FC is maintained stably.

[0028] Also, even if dust deposits on various machine components of the manufacturing machine, the deposited dust can also be removed easily.

[0029] When smoking the filter cigarette FC described above, a user puts a mouth-side end portion of the filter cigarette FC in his/her mouth by positioning the outer ends of the perforations 18 of the perforation line 16 in the oral cavity. A chain line B shown in FIG. 2 for convenience indicates a boundary between the inside and outside of the oral cavity.

[0030] When the user smokes the filter cigarette FC in this state, most of the mainstream smoke produced by the cigarette 10 passes through inner part of the filter 12 and enters the oral cavity of the user from the mouth-side end 12e along the axis A of the filter cigarette FC (see arrow Cm in FIG. 2).

[0031] On the other hand, part of the mainstream smoke in the filter 12 is sent out radially into the oral cavity of the user through perforations 18 (see arrow Cs in FIG. 2). Compared to the mainstream smoke indicated by arrow Cm, the mainstream smoke indicated by arrow Cs spreads uniformly in the oral cavity, consequently allowing the user to taste and savor the mainstream smoke more effectively.

[0032] Next, the manufacturing machine adapted to carry out the manufacturing method for the above-mentioned filter cigarette FC will be described with reference to FIGS. 3 to 10.

[0033] FIG. 3 schematically shows the whole of the manufacturing machine, which includes a filter attaching apparatus 20. The filter attaching apparatus 20 includes a rod supply path 22, which connects between a cigarette rod production machine and a filter attachment section 24. The cigarette rod manufacturing machine sequentially produces double-length cigarettes WC, and the produced double-length cigarettes WC are supplied to the filter attachment section 24 through the rod supply path 22. The double-length cigarette WC is twice as long as the cigarette 10 described above.

[0034] Also, the filter attaching apparatus 20 includes a filter supply path 26, which connects between the filter attachment section 24 and a hopper 28. A large number of double-length filters WF are stocked up in the hopper 28. The filter supply path 26 takes the double-length filters WF one by one out of the hopper 28 and supplies the double-length filters WF taken out, to the filter attachment section 24 in sequence. The double-length filter WF is twice as long as the filter 12 described above.

[0035] The manufacturing machine further includes a web supply apparatus 30. The web supply apparatus 30 includes a web supply path 32, which connects between the filter attachment section 24 and a web roll WR. The web supply path 32 allows a paper web PW used in forming the above-mentioned tipping paper 14 to be sent out from the web roll WR and leads the paper web PW, which has been sent out, toward the filter attachment section 24.

[0036] Furthermore, the manufacturing machine further includes a web cutting device 36 as well as a glue application device 34 serving as a glue layer forming device. The glue application device 34 and web cutting device 36 are placed on the web supply path 32 in this order starting from the web roll WR side.

[0037] The glue application device 34 applies glue to one side of the paper web PW, thereby forming a bonding surface.

[0038] On the other hand, the web cutting device 36 cuts the paper web PW intermittently along a longitudinal direction of the paper web PW, thereby forming pieces

of double-width paper WP in sequence (see FIG. 4). The double-width paper WP is twice as wide as the tipping paper 14 described above.

[0039] The double-width paper WP formed in this way is supplied to the filter attachment section 24 via the web supply path 32. Therefore, the filter attachment section 24 is supplied with the double-length cigarette WC, double-length filters WF, and double-width paper WP, and forms a double filter cigarette WFC from the double-length cigarettes WC, double-length filter WF and double-width paper WP.

[0040] FIG. 4 shows procedures for forming the double filter cigarette WFC and the procedures will be described below.

[0041] First, the double-length cigarette WC is cut into two cigarettes 10 (FIG. 4(a)). Then, the two cigarettes 10 are separated from each other, securing a predetermined space between these cigarettes 10 (FIG. 4(b)). Subsequently, the double-length filter WF is placed in the space (FIG. 4(c)), and the two cigarettes 10 are moved toward the double-length filter WF and placed in close contact with corresponding end faces of the double-length filter WF (FIG. 4(d)), thereby forming an intermediate product I of the double filter cigarette WFC.

[0042] Then, the double-width paper WP is supplied to the intermediate product I (FIG. 4(f)) and wound around the intermediate product I (FIG. 4(e)). Here, the double-width paper WP spans from an end portion of one of the cigarettes 10 adjacent to the double-length filter WF to an end portion of the other cigarette 10 adjacent to the double-length filter WF. As is apparent from the above description, since the bonding surface is formed on the reverse side of the double-width paper WP, the double-width paper WP integrally connects the two cigarettes 10 and the double-length filter WF, thereby forming the double filter cigarette WFC (filter attaching step) .

[0043] The double filter cigarette WFC formed in this way is sent out from the filter attachment section 24 to a transfer path 38 of the manufacturing machine and transferred on the transfer path 38 (see FIG. 3).

[0044] A laser perforation device 40, cigarette cutting device 42, and aligning device 44 are arranged on the transfer path 38 in this order starting from the side of the filter attachment section 24.

[0045] As shown in FIG. 5, the laser perforation device 40 is placed at a perforating position PP defined by the transfer path 38 and has a laser emitter 46 at the this perforating position PP. The laser emitter 46 is located above the transfer path 38. When the double filter cigarette WFC arrived at the perforating position PP, the laser emitter 46 emits two laser beams Lb1 and Lb2 intermittently to the double-width paper WP of the double filter cigarette WFC.

[0046] The laser beams Lb1 and Lb2 are inclined at same angles but in directions opposite to each other with respect to the axis A of the double filter cigarette WFC, i.e., the filter cigarettes FC.

[0047] Specifically, if the double-width paper WP is divided into left and right parts L and R at a center position CP of the double filter cigarette WFC in the axis direction, one Lb1 of the laser beams is directed at the right-hand part R in FIG. 5 while the other laser beam Lb2 is directed at the lefthand part L. Here, irradiation positions of the laser beams Lb1 and Lb2 are equal to each other in distance from the center position CP, and inclination angles of the laser beams Lb1 and Lb2 coincide with an inclination angle of the perforations 18 described above.

[0048] On the other hand, at the perforating position PP, the double filter cigarette WFC is rotated one turn around the axis A as indicated by arrow CC in FIG. 6. Here, transfer velocity V of the double filter cigarette WFC on the transfer path 38 and reverse velocity of the double filter cigarette WFC resulting from rotation of the double filter cigarette WFC coincide with each other, and the transfer of the double filter cigarette WFC is stopped temporarily at the perforating position PP.

[0049] As a result, the laser beams Lb1 and Lb2 emitted intermittently form two perforation lines 16 such as described above in the double filter cigarette WFC located at the perforating position PP (laser perforation step). The perforation lines 16 are located on opposite sides of the center position CP as shown in FIG. 7. Also, needless to say, each perforation 18 of the perforation lines 16 extends into the double-length filter WF by penetrating through the double-width paper WP.

[0050] Subsequently, the double filter cigarettes WFC are transferred from the perforating position PP along the transfer path 38. When the double filter cigarettes WFC pass through the cigarette cutting device 42 and aligning device 44 in sequence, two filter cigarettes FC are formed from each double filter cigarette WFC and then the filter cigarettes FC are aligned by being oriented in the same direction.

[0051] FIG. 8 shows procedures from formation to alignment of the filter cigarettes FC and the procedures will be described below.

[0052] First, the cigarette cutting device 42 cuts the double filter cigarette WFC at the center position CP (cigarette cutting step) and thereby forms two filter cigarettes FC from the double filter cigarette WFC (FIG. 8(a)). Subsequently, the two filter cigarettes FC are separated from each other (FIG. 8(b)).

[0053] One of the two filter cigarettes FC are turned right side left and its orientation is brought into coincidence with the other filter cigarette FC (FIG. 8(c)). Then, the two filter cigarettes FC are positioned one behind the other in their transfer direction (FIGS. 8(c) to (d)), forming a row of filter cigarettes FC (FIGS. 8(d) and (e)).

[0054] Subsequently, the filter cigarettes FC are supplied to a packaging machine, which then forms a cigarette package.

[0055] The glue application device 34 described above includes a configuration (procedure) for providing at least two non-adhesive regions Z to the double-width paper WP of the double filter cigarette WFC and the non-adhesive regions Z are assigned, respectively, to the two filter

cigarettes FC obtained from the double filter cigarette WFC.

[0056] Specifically, as shown in FIG. 9, the glue application device 34 includes a glue transfer roller 48 and a pinch roller 50. When the paper web PW running on the web supply path 32 passes between the glue transfer roller 48 and pinch roller 50, the glue transfer roller 48 applies, i.e., transfers, glue to the reverse side of the paper web PW, and thereby forms a glue layer, i.e., a bonding surface, excluding target regions described later (glue application step).

[0057] According to the present embodiment, the target regions includes two side regions R1 and R2 corresponding to the two non-adhesive regions Z described above as well as a center region R3 placed at a width center of the paper web PW, where the regions R1 to R3 are shown in FIG. 10 . Note that in FIG. 10, the bonding surface is denoted by reference symbol S.

[0058] To clarify correspondence between the side regions R1 and R2 and the above-mentioned perforation lines 16 as well as correspondence between the center region R3 and the above-mentioned center position CP, FIG. 10 shows the paper web PW and the double-width paper WP of the double filter cigarette WFC together. Also, as is clear from FIG. 10, the regions R1 to R3 are formed in a stripe pattern within the bonding surface S of the paper web PW and extend in parallel to each other along the longitudinal direction of the paper web PW.

[0059] To form the above-mentioned bonding surface S, a circumferential groove 52 is formed in an outer circumferential surface of the glue transfer roller 48 as shown in FIG. 11, extending over an entire circumference of the glue transfer roller 48 to receive glue. The glue in the circumferential groove 52 is transferred from the glue transfer roller 48 to the reverse side of the paper web PW at an application position (glue layer forming position), thereby forming the above-mentioned bonding surface S.

[0060] On the other hand, three circumferential lands 54, 56, and 58 corresponding to the regions R1 to R3 are placed in the circumferential groove 52, being positioned in a central region of the circumferential groove 52 when viewed in a width direction of the glue transfer roller 48. The circumferential lands 54, 56, and 58 extend in a circumferential direction of the glue transfer roller 48, and preferably over the entire circumference of the glue transfer roller 48, forming part of the outer circumferential surface of the glue transfer roller 48. Even if glue attaches to the circumferential lands 54, 56, and 58, the glue on the circumferential lands is removed by a scraper (not illustrated) and the circumferential lands 54, 56, and 58 are not used for glue transfer to the paper web PW.

[0061] That is, according to the present embodiment, in conjunction with the circumferential groove 52, the circumferential lands 54, 56, and 58 implement a first mechanism (first process) adapted to form the bonding surface S excluding the regions R1 to R3.

[0062] As described earlier, when the two perforation lines 16 are formed in the double-width paper WP of the double filter cigarette WFC by laser beam irradiation, even if dust scatters around by being produced from the double-width paper WP and double-length filter WF, since the glue is not applied to the side regions R1 and R2 of the double-width paper WP in which the perforation lines 16 are formed, the dust is not adhesive. Thus, even if the dust touches the outer surfaces of the double filter cigarettes WFC and filter cigarettes FC or the outer surfaces of various machine components of the manufacturing machine, the dust does not adhere to the outer surfaces.

[0063] Note that even if the dust gathers on the above-mentioned outer surfaces, the dust is removed of itself during the transfer process of the double filter cigarettes WFC and filter cigarettes FC or removed easily, for example, by blowing air onto the above-mentioned outer surfaces.

[0064] Since not only the side regions R1 and R2, but also the center region R3 is formed on the paper web PW, when cutting the double filter cigarette WFC into two filter cigarettes FC, the cigarette cutting device 42 can cut the double filter cigarette WFC at the center region R3. In this case, since no glue is applied to the center region R3, no glue attaches to a cutting blade of the cigarette cutting device 42 and the cutting blade does not become blunt due to glue adhesion.

[0065] Furthermore, in addition to the above-mentioned regions R1 to R3, the glue transfer roller 48 can intermittently form non-adherent traverse regions R4 as well on the reverse side of the paper web PW. The traverse regions R4 are placed at intervals in the longitudinal direction of the paper web PW by crossing the paper web PW. Note that the traverse regions R4 are also formed by plural traverse lands (not illustrated) of the glue transfer roller 48, and that the traverse lands are placed at equal intervals in the circumferential direction of the glue transfer roller 48 by crossing the outer circumferential surface of the glue transfer roller 48.

[0066] A distance between two adjacent traverse regions R4 coincides with length (circumferential length) of the double-width paper WP, and consequently the above-mentioned web cutting device 36 cuts the paper web PW in the traverse regions R4, thereby forming the double-width paper WP. Thus, glue does not attach to a cutting blade of the web cutting device 36 either.

[0067] FIGS. 12 and 13 show a glue application device 34' according to a variation.

[0068] A glue transfer roller 48' of the glue application device 34' applies heat-curable glue to an entire area of a reverse side of the paper web PW excluding the above-mentioned traverse region R4, thereby forming a bonding surface S.

[0069] In this case, the glue application device 34' further includes a disabling mechanism (second mechanism) 60 adapted to partially disable adhesive force of the bonding surface S and the disabling mechanism 60 is placed between the glue transfer roller 48' and the web

cutting device 36.

[0070] As shown in FIG. 13, for example, the disabling mechanism 60 includes a heater 61 as a curing device, and the heater 61 has a heater block 62. The heater block 62 is positioned on the reverse side of the paper web PW running on the web supply path 32 and contains a heating element (not illustrated). Note that in FIG. 13, the paper web PW is shown with its bonding surface S turned up.

[0071] Three heating protrusions 64, 66, and 68 are formed integrally on a surface of the heater block 62 opposed to the reverse side of the paper web PW. The heating protrusions 64, 66, and 68 extend in parallel to one another a predetermined distance in the longitudinal direction of the paper web PW and are positioned near the bonding surface S of the paper web PW.

[0072] When the paper web PW passes the heater block 62, the heating protrusions 64, 66, and 68 heat corresponding positions of the bonding surface S by radiating heat thereto and thereby partially cures the glue on the bonding surface S (second process). Thus, as shown in FIG. 14, side and center regions R1' to R3' corresponding to the above-mentioned side and center regions R1 to R3, respectively, are formed on the paper web PW. Since the glue forming the regions R1' to R3' has been cured, i.e., dried, by heating, the regions R1' to R3' are no longer adhesive.

[0073] Therefore, even if perforation lines 16 are formed in the side regions R1' and R2' making up the non-adhesive regions Z, generation and scattering of adhesive dust are avoided as in the case of the above-mentioned side regions R1 and R2, and the side regions R1' and R2' provide an advantage similar to that of the side regions R1 and R2. Also, needless to say, the center region R3' has an advantage similar to that of the center region R3.

[0074] On the other hand, when the glue is an ultraviolet curing adhesive, the above-described disabling mechanism (curing device) 60 can include an ultraviolet emitter 63 as shown in FIG. 15 instead of the heater 61. The ultraviolet emitter 63 has emission windows 64', 66', and 68' corresponding to the heating protrusions 64, 66, 68 described above. The ultraviolet emitter 63 emits ultraviolet rays to the bonding surface S through the emission windows 64', 66', and 68', partially cures the glue on the bonding surface S, and thereby forms the side and center regions R1' to R3'. Again, generation and scattering of adhesive dust are similarly avoided.

[0075] Note that needless to say, a traverse region R4' corresponding to the above-mentioned traverse region R4 can similarly be formed by heating the bonding surface S or irradiating the bonding surface S with an ultraviolet ray. Furthermore, the disabling mechanism (curing device) 60 may use any of electromagnetic waves including visible light, infrared rays, and high-frequency waves instead of ultraviolet rays.

[0076] FIG. 16 shows a filter cigarette FC' according to a second embodiment of the present invention.

[0077] In describing the filter cigarette FC', the same components as those of the filter cigarette FC according to the first embodiment are denoted by the same reference numerals as the corresponding components in the first embodiment, and description thereof will be omitted and differences from the filter cigarette FC will only be described below.

[0078] The filter cigarette FC' includes a dual filter 12' instead of the above-mentioned filter 12, i.e., a plain filter. The dual filter 12' has, for example, a plain filter element 70 and a charcoal filter element 72. The plain filter element 70 has a structure similar to that of the filter 12, but is, for example, shorter in length than the filter 12. On the other hand, the charcoal filter element 72 includes a plain filter element similar to the plain filter element 70 and a large number of activated carbon particles 74 distributed in the plain filter element thereof.

[0079] Furthermore, the dual filter 12' has a forming wrapper 76, which is wound around the plain filter element 70 and charcoal filter element 72, thereby joining the filter elements 70 and 72 integrally.

[0080] The filter cigarette FC' has, for example, two perforation lines 16' instead of the above-mentioned perforation line 16. As is apparent from FIG. 17, perforations 18' making up the perforation lines 16' open to the outer circumferential surface of the tipping paper 14 corresponding to the charcoal filter element 72 while extending into the charcoal filter element 72 perpendicularly to the axis A by penetrating through the tipping paper 14 and forming wrapper 76. In this case, the laser emitter 46 of the laser perforation device 40 emits laser beams perpendicularly to the axis A.

[0081] The above-mentioned perforation lines 16' are also placed in the non-adhesive region Z, which can be formed using the above-mentioned glue application device 34 according to the first embodiment or glue application device 34' according to the variation.

[0082] As for the above-mentioned filter cigarette FC', when the filter cigarette FC' is smoked by the user, fresh air is introduced into the charcoal filter element 72 of the dual filter 12' through each perforation 18' of the perforation lines 16'. The fresh air introduced in this way dilutes the mainstream smoke of the filter cigarette FC', thereby offering the user a lighter feel of smoking.

[0083] In this case, a quantity of ventilation air introduced into the charcoal filter element 72 through the perforations 18' depends on the number, size, and depth of the perforations 18', any of which can be adjusted easily by the laser perforation device 40.

[0084] On the other hand, in the case of the filter cigarette FC according to the first embodiment described above, if a total quantity of the mainstream smoke sent out into the oral cavity of the user is denoted by Qa and a quantity of the mainstream smoke sent out through the perforations 18 is denoted by Qe, a ratio of Qe to Qa, i.e., a distribution ratio Qe/Qa of the mainstream smoke greatly affects flavor and taste of the filter cigarette FC.

[0085] Thus, in manufacturing the filter cigarettes FC, it is necessary to control the number, size, and depth of

the perforations 18 in order to make the distribution ratio Qe/Qa of the mainstream smoke match desired values, and for that, it is indispensable to accurately measure the distribution ratio Qe/Qa of the mainstream smoke.

[0086] As shown in FIG. 18, Qa described above can be expressed by the following equation.

$$Qa = Qc + Qe = Vt + Vp + Vf$$

where

Qc: the quantity of mainstream smoke sent out from the mouth-side end 12e of the filter cigarette FC,
Vt: quantity of air introduced into the cigarette 10 from a distal end of the cigarette 10,
Vp: quantity of air introduced into the cigarette 10 through cigarette paper of the cigarette 10,
Vf: quantity of air introduced into the filter 12 through the perforation line 16'.

[0087] Note that although the filter cigarette FC according to the first embodiment does not have perforation lines 16', it is assumed here that the filter cigarette FC has the perforation lines 16'. This means that the filter cigarette FC according to the first embodiment may have the perforation lines 16' in addition to the perforation line 16.

[0088] FIG. 19 schematically shows a measuring device 78 for the distribution ratio Qe/Qa of the mainstream smoke and the measuring device 78 will be described below.

[0089] The measuring device 78 includes a filter socket 80, which has a cylindrical shape. The filter cigarette FC can be inserted into the filter socket 80 with the mouth-side end of the filter 12 placed at the forefront.

[0090] Two seal rings 82 and 84 are attached to an inner circumferential surface of the filter socket 80, where the seal rings 82 and 84 have elasticity. One of the seal rings 82 is located on the side of the bottom of the filter socket 80, the other seal ring 84 is located on the side of the open end of the filter socket 80.

[0091] Thus, as is apparent from FIG. 19, when the filter 12 is inserted into the filter socket 80, two rooms 86 and 88 are defined in the filter socket 80. The room 86 is defined airtightly between the mouth-side end 12e of the filter 12 and the bottom of the filter socket 80 via the seal ring 82. On the other hand, the room 88 is defined airtightly between the seal rings 82 and 84, surrounding the filter 12 and the perforation line 16 is positioned in the room 88.

[0092] Branch paths 90 and 92 extend from the rooms 86 and 88, respectively, and are connected to a suction path 94. The suction path 94 is connected to a suction pump 98 via a mass flow controller 96. When the suction pump 98 is operated, the mass flow controller 96 sets a flow of sucked air in the suction path 94 at 1050 ml/min.

[0093] On the other hand, a pressure regulator 100 and valve 102 are placed on the branch path 90 in this order starting from the side of the room 86, and a flow meter 104 is placed on the branch path 92. Here, the pressure regulator 100 causes a pressure loss equivalent to that of the flow meter 102.

[0094] Furthermore, the branch paths 90 and 92 are connected with each other through a bypass path 106 upstream of the pressure regulator 100 and flow meter 104, and a valve 108 is placed on the bypass path 106.

[0095] The distribution ratio Qe/Qa of the mainstream smoke is measured according to the following procedures.

Procedure 1:

[0096] The valve 108 is opened and the valve 102 is closed. In this state, air is sucked out of both rooms 86 and 88 and the flow rate Qa is measured by the flow meter 104.

Procedure 2:

[0097] The valve 108 is closed and the valve 102 is opened. In this state, air is sucked out of the room 88 and the flow rate Qe is measured by the flow meter 104.

Procedure 3:

[0098] Based on the measured flow rate Qa and Qe, the distribution ratio Qe/Qa of the mainstream smoke is calculated.

[0099] Since the pressure regulator 100 adapted to cause a pressure loss equivalent to that of the flow meter 104 is placed on the branch path 90, suction pressures in the rooms 86 and 88 become equal to each other during measurements of the flow rates Qa and Qe in procedures 1 and 2. This allows the flow rates Qa and Qe to be measured under same conditions making it possible to accurately measure the flow rates Qa and Qe, i.e., the distribution ratio Qe/Qa of the mainstream smoke.

[0100] The present invention is not restricted by the first embodiment, the second embodiment, or the glue application device 34' according to the variation, which have been described above, and various modifications are possible.

[0101] For example, in the embodiments described above, the double filter cigarette WFC undergoes perforation, but the filter cigarette FC may be subjected to perforation. Also, the perforation lines 16 and 16' may be formed at separate perforating positions. For example, when the perforation line 16 is formed in one of the double filter cigarette WFC and filter cigarette FC, the perforation line 16' will be formed in the other of the double filter cigarette WFC and filter cigarette FC. Also, needless to say, the number and layout of perforation lines may be selected as desired.

[0102] Besides, it is not strictly necessary for the filter cigarette FC to have a perforation line itself, and it is

enough that at least one perforation is provided. In this case, it is enough that a non-adhesive region Z is formed on a spot basis in that portion of the paper web PW in which a perforation is to be formed.

[0103] Also, the bonding surface S can be formed by spraying glue from a nozzle instead of applying (transferring) the glue. On the other hand, the non-adhesive region Z can be obtained as well by chemically changing the glue instead of using heat or the above-mentioned electromagnetic waves.

[0104] Furthermore, the filter cigarette is not limited to the above-mentioned plain filter and dual filter and may include a filter structure such as a triple filter or recessed filter. Besides, various materials are available for use as filter materials.

[0105] Other embodiments are defined in accordance with the below items:

Item 1. A filter cigarette manufacturing machine comprising:

a filter attaching apparatus adapted to produce a filter cigarette by receiving a cigarette, a filter, and tipping paper coated with glue and attaching the filter to the cigarette via the tipping paper;
a laser perforation device adapted to form at least one perforation in the filter by irradiating the tipping paper of the filter cigarette with a laser beam in a process of transferring the filter cigarette from the filter attaching apparatus, where the perforation extends into the filter by penetrating through the tipping paper; and
a glue layer forming device adapted to provide a bonding surface with respect to the cigarette and the filter by forming a glue layer on a reverse side of the tipping paper in a process of supplying the tipping paper to the filter attaching apparatus, wherein
the glue layer forming device includes a configuration for forming a region where the perforation is formed, as a non-adhesive region lacking adhesion on the reverse side of the tipping paper.

Item 2. The filter cigarette manufacturing machine according to item 1, wherein:

a target region corresponding to the non-adhesive region is defined on the reverse side of the tipping paper; and
the configuration includes a first mechanism adapted to cause formation of the glue layer on the target region to be avoided or a second mechanism adapted to disable adhesive force of the glue on the target region after a glue layer is formed on the target region.

Item 3. The filter cigarette manufacturing machine according to item 2, wherein:

the glue layer forming device further includes a glue transfer roller adapted to apply glue to a paper web used in forming the tipping paper and thereby form the bonding surface on the paper web; and
the first mechanism includes a land adapted to form part of an outer circumferential surface of the glue transfer roller, extending in a circumferential direction of the glue transfer roller without being used for glue transfer.

Item 4. The filter cigarette manufacturing machine according to item 3, wherein the land extends over an entire circumference of the glue transfer roller.

Item 5. The filter cigarette manufacturing machine according to item 2, wherein:

the glue layer forming device forms the glue layer on a paper web used in forming the tipping paper and further includes a forming position of the glue layer; and
the second mechanism includes a curing device placed on the transfer path downstream of the forming position and adapted to cure the glue on the target region.

Item 6. The filter cigarette manufacturing machine according to item 5, wherein the curing device generates heat or any of electromagnetic waves including ultraviolet rays, visible light, infrared rays, and high-frequency waves.

Item 7. The filter cigarette manufacturing machine according to any one of items 1 to 6, wherein

the filter attaching apparatus produces a double filter cigarette using two cigarettes, a double-length filter instead of the filter, and double-width tipping paper instead of the tipping paper, the double-length filter being twice as long as the filter and the double-width tipping paper being twice as wide as the tipping paper, where the double filter cigarette includes two filter cigarettes placed in alignment with each other, pointing in opposite directions,
the manufacturing machine further comprising a cigarette cutting device adapted to cut the double filter cigarette into individual filter cigarettes.

Item 8. The filter cigarette manufacturing machine according to item 7, wherein the laser perforation device forms the perforation in at least one of the double-width tipping paper of the double filter cigarette and the tipping paper of the filter cigarette.

Item 9. A filter cigarette manufacturing method comprising:

a filter attaching step of producing a filter cigarette by receiving a cigarette, a filter, and tipping paper coated with glue and attaching the filter to the cigarette via the tipping paper;
a laser perforation step of forming at least one perforation in the filter by irradiating the tipping paper of the filter cigarette with a laser beam in a process of transferring the filter cigarette from the filter attaching step to a succeeding stage, where the perforation extends into the filter by penetrating through the tipping paper; and
a glue layer forming step of providing a bonding surface with respect to the cigarette and the filter by forming a glue layer on a reverse side of the tipping paper in a process of supplying the tipping paper to the filter attaching step, wherein
the glue layer forming step includes a procedure for forming a non-adhesive region lacking adhesion on the reverse side of the tipping paper in order for the perforation to be formed in the non-adhesive region.

Item 10. The filter cigarette manufacturing method according to item 9, wherein:
a target region corresponding to the non-adhesive region is defined on the reverse side of the tipping paper; and the procedure includes a first process of causing formation of the glue layer on the target region to be avoided or a second process of disabling adhesive force of the glue on the target region after a glue layer is formed on the target region.

Item 11. The filter cigarette manufacturing method according to item 10, wherein the procedure forms the non-adhesive region over an entire circumference of the tipping paper.

Item 12. The filter cigarette manufacturing method according to item 11, wherein the second process cures the glue on the target region.

Item 13. The filter cigarette manufacturing method according to item 12, wherein the second process generates heat or any of electromagnetic waves including ultraviolet rays, visible light, infrared rays, and high-frequency waves.

Item 14. The filter cigarette manufacturing method according to any one of items 9 to 13, wherein:

the filter attaching step produces a double filter cigarette using two cigarettes, a double-length filter instead of the filter, and double-width tipping paper instead of the tipping paper, the double-length filter being twice as long as the filter and the double-width tipping paper being twice as wide as the tipping paper, where the double filter cigarette includes the two filter cigarettes placed in alignment with each other, pointing in opposite directions,
the manufacturing method further comprising a cigarette cutting step of cutting the double filter cigarette into individual filter cigarettes; and

the laser perforation step forms the perforation in at least one of the double-width tipping paper of the double filter cigarette and the tipping paper of the filter cigarette.

Item 15. A filter cigarette comprising:

a cigarette;
a filter placed next to one end of the cigarette;
and tipping paper adapted to connect the cigarette and the filter with each other and provided with at least one perforation, wherein the perforation extends into the filter by penetrating through the tipping paper,
the tipping paper includes a glue bonding surface and a non-adhesive region lacking adhesion, where the bonding surface is formed on a reverse side of the tipping paper and adapted to bond the tipping paper to outer circumferential surfaces of the cigarette and the filter,
the perforation is provided in the non-adhesive region, and
the non-adhesive region extends over an entire circumference of the tipping paper.

Explanation of Reference Signs

[0106]

10 Cigarette
12, 12' Filter
14 Tipping paper
16, 16' Perforation line
18, 18' Perforation
20 Filter attaching apparatus
22 Rod supply path
24 Filter attachment section
26 Filter supply path
30 Web supply device
32 Web supply path
34, 34' Glue application device (glue layer forming device)
36 Web cutting device
40 Laser perforation device
42 Cigarette cutting device
46 Laser emitter
48, 48' Glue transfer roller
60 Disabling mechanism
61 Heater (curing device)

63 Ultraviolet emitter (curing device)
S Bonding surface (glue layer)
R1, R2, R1', R2' Non-adhesive region
FC Filter cigarette
WC Double-length cigarette
WF Double-length filter
PW Paper web
WP Double-width paper

Claims

1. A filter cigarette (FC, FC'), comprising:

a cigarette (10);
a filter (12, 12') placed next to one end of the cigarette (10); and
a tipping paper (14) including a glue bonding surface formed on a reverse side of the tipping paper (14) and arranged to bond the tipping paper (14) to outer circumferential surfaces of the cigarette (10) and the filter (12, 12') so as to connect the cigarette (10) to the filter (12, 12'),
wherein the tipping paper (14) further includes a non-adhesive region (R1, R2, R1', R2') lacking adhesion,
wherein the non-adhesive region (R1, R2, R1', R2') is provided on the reverse side of the tipping paper (14),
wherein the tipping paper (14) is provided with at least one perforation (18, 18') in the non-adhesive region (R1, R2, R1', R2'), and
wherein the perforation (18, 18') extends into the filter (12, 12') by penetrating through the tipping paper (14).

2. The filter cigarette (FC, FC') of claim 1, wherein the non-adhesive region (R1, R2, R1', R2') extends over an entire circumference of the tipping paper (14).

3. The filter cigarette (FC, FC') of claim 2, wherein the non-adhesive region (R1, R2, R1', R2') is provided in the form of a stripe.

4. The filter cigarette (FC, FC') of claim 2 or 3, wherein the at least one perforation (18, 18') is arranged in a perforation line (16, 16').

5. The filter cigarette (FC, FC') of claim 4, wherein the perforation line (16, 16') comprises multiple perforations (18, 18') distributed at intervals in a circumferential direction of the filter (12, 12').

6. The filter cigarette (FC, FC') according to any preceding claim, wherein the at least one perforation (18, 18') penetrates through the tipping paper (14) perpendicular to an axis of the filter cigarette (FC, FC').

7. The filter cigarette (FC, FC') according to any preceding claim, wherein the at least one perforation (18, 18') is adapted to cause ventilation of the filter (12, 12').

8. The filter cigarette (FC, FC') according to any preceding claim, wherein the filter (12, 12') is selected from a plain filter, a dual filter, a triple filter and a recessed filter.

9. A filter cigarette (FC, FC') manufacturing method comprising:

a filter attaching step of producing a filter cigarette (FC, FC') by receiving a cigarette (10), a filter (12, 12'), and tipping paper (14) coated with glue and attaching the filter (12, 12') to the cigarette (10) via the tipping paper (14);
a laser perforation step of forming at least one perforation (18, 18') in the filter (12, 12') by irradiating the tipping paper (14) of the filter cigarette (FC, FC') with a laser beam in a process of transferring the filter cigarette (FC, FC') from the filter attaching step to a succeeding stage, where the perforation (18, 18') extends into the filter (12, 12') by penetrating through the tipping paper (14); and
a glue layer forming step of providing a bonding surface with respect to the cigarette (10) and the filter (12, 12') by forming a glue layer on a reverse side of the tipping paper (14) in a process of supplying the tipping paper (14) to the filter attaching step,
wherein the glue layer forming step includes a procedure for forming a non-adhesive region (R1, R2, R1', R2') lacking adhesion on the reverse side of the tipping paper (14) in order for the perforation (18, 18') to be formed in the non-adhesive region (R1, R2, R1', R2').

10. The filter cigarette (FC, FC') manufacturing method according to claim 9, wherein:

a target region corresponding to the non-adhesive region (R1, R2, R1', R2') is defined on the reverse side of the tipping paper (14); and
the procedure includes a first process of causing formation of the glue layer on the target region to be avoided or a second process of disabling adhesive force of the glue on the target region after a glue layer is formed on the target region.

11. The filter cigarette (FC, FC') manufacturing method according to claim 10, wherein the procedure forms the non-adhesive region (R1, R2, R1', R2') over an entire circumference of the tipping paper (14).

12. The filter cigarette (FC, FC') manufacturing method

according to claim 10, wherein the second process cures the glue on the target region.

13. The filter cigarette (FC, FC') manufacturing method according to claim 12, wherein the second process generates heat or any of electromagnetic waves including ultraviolet rays, visible light, infrared rays, and high-frequency waves.

14. The filter cigarette (FC, FC') manufacturing method according to any one of claims 9 to 13, wherein:

the filter attaching step produces a double filter cigarette (WFC) using two cigarettes (10), a double-length filter instead of the filter, and double-width tipping paper (14) instead of the tipping paper, the double-length filter being twice as long as the filter and the double-width tipping paper being twice as wide as the tipping paper (14), where the double filter cigarette (WFC) includes the two filter cigarettes (WFC) placed in alignment with each other, pointing in opposite directions,
the manufacturing method further comprising a cigarette cutting step of cutting the double filter cigarette (WFC) into individual filter cigarettes (WFC); and
the laser perforation step forms the perforation (18, 18') in at least one of the double-width tipping paper of the double filter cigarette (WFC) and the tipping paper (14) of the filter cigarette.

15. The filter cigarette (FC, FC') manufacturing method according to any one of claims 9 to 14, wherein the laser perforation step comprises irradiating the tipping paper (14) of the filter cigarette (FC, FC') with a laser beam that is perpendicular to an axis of the filter cigarette (FC, FC').

FIG. 1

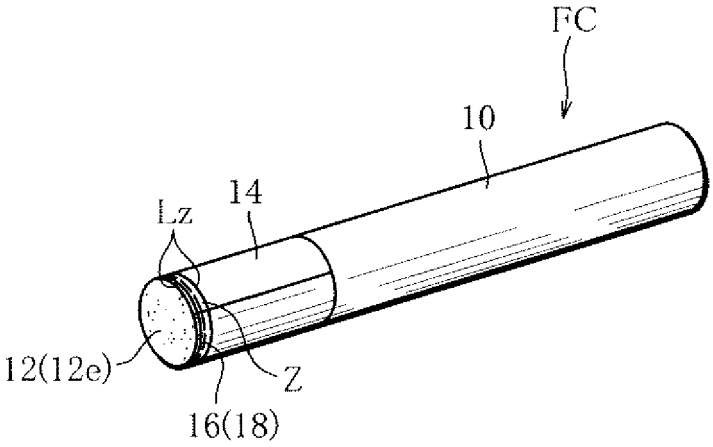


FIG. 2

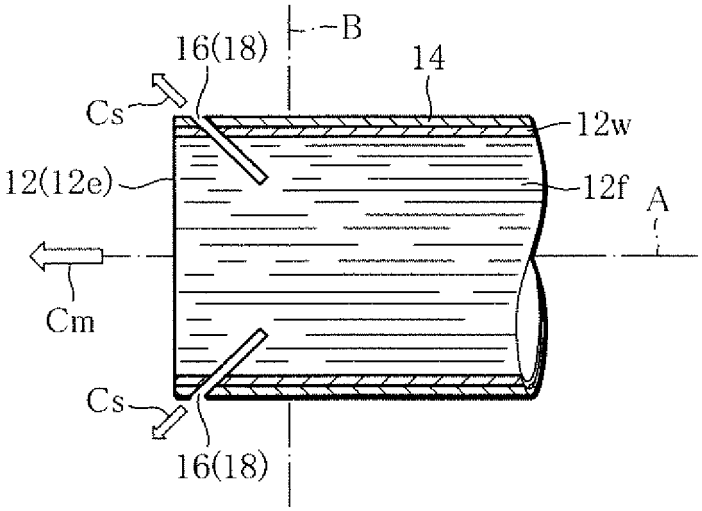


FIG. 3

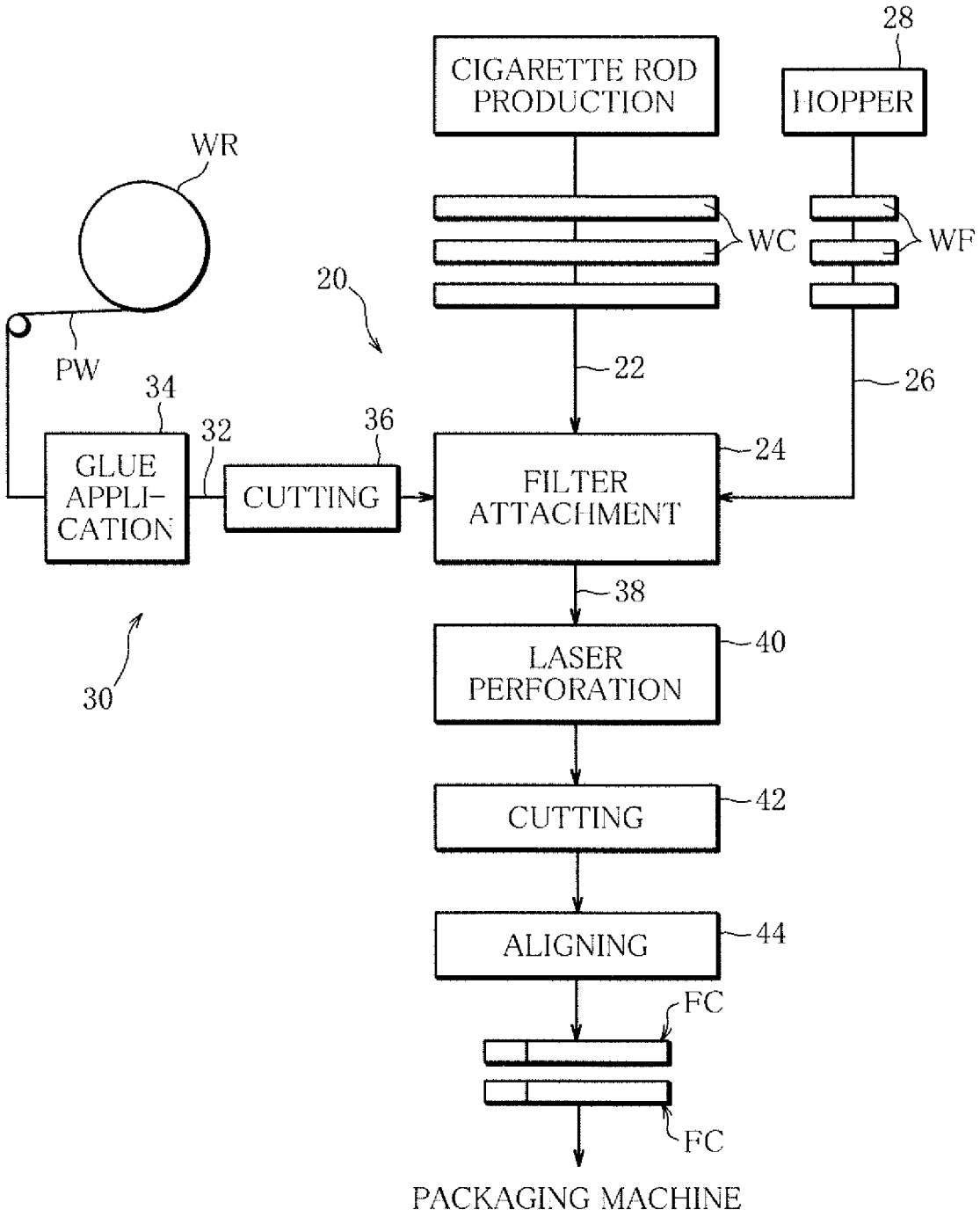

CIGARETTE ROD PRODUCTION
HOPPER
28
WR
WC
WF
20
PW
22
26
34
32
36
GLUE APPLI-CATION
CUTTING
FILTER ATTACHMENT
24
38
30
LASER PERFORATION
40
CUTTING
42
ALIGNING
44
FC
FC
PACKAGING MACHINE

FIG. 4

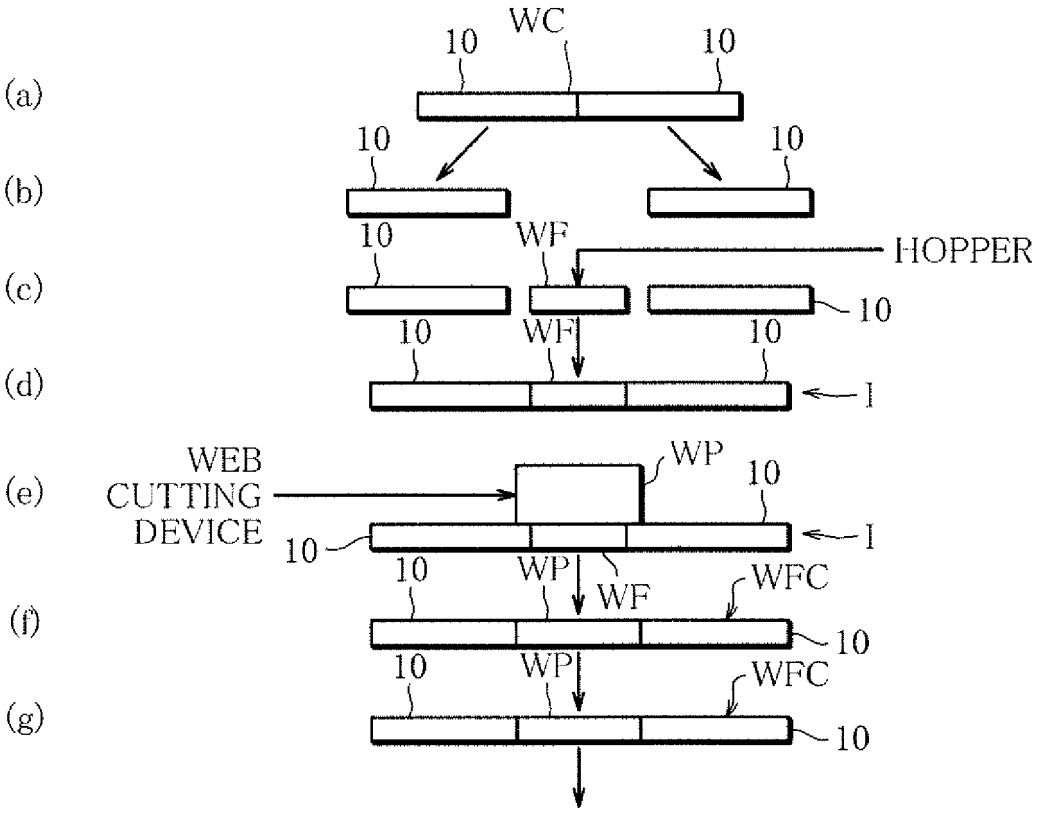


FIG. 5

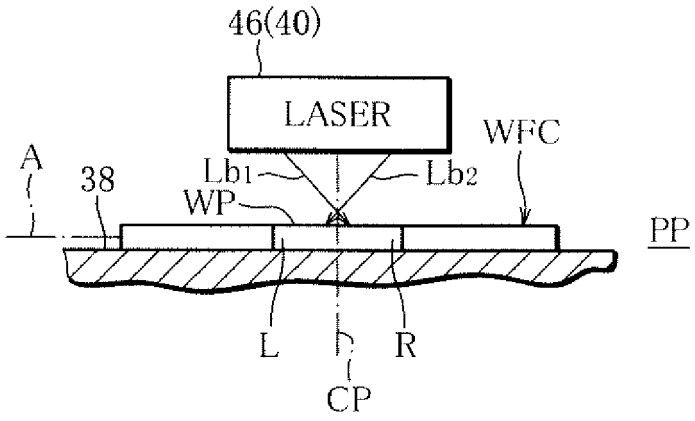

46(40)
LASER
WFC
A
38
Lb1
Lb2
WP
PP
L
R
CP

FIG. 6

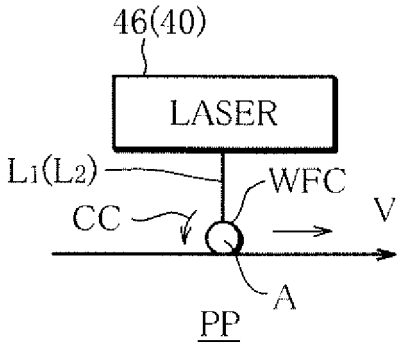

46(40)
LASER
L1(L2)
WFC
CC
V
A
PP

FIG. 7

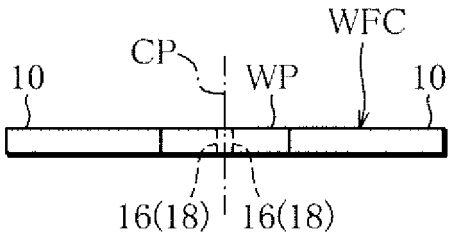

WFC
CP
10
WP
10
16(18)
16(18)

FIG. 8

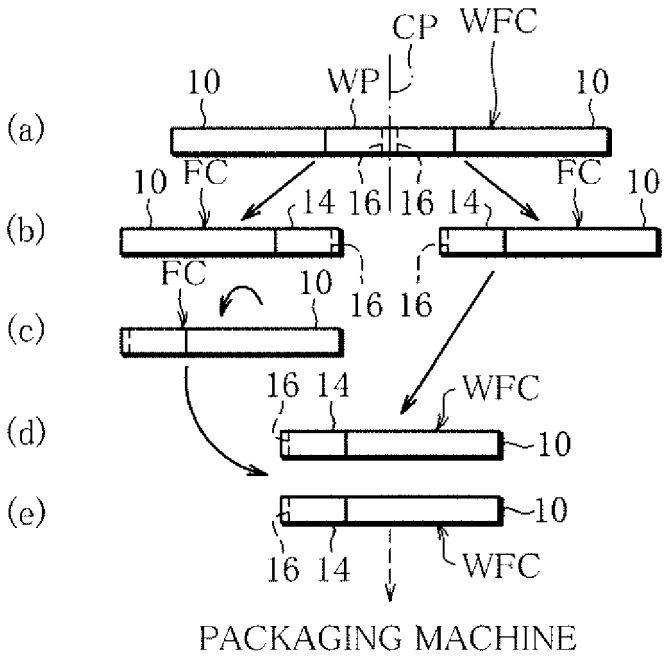

CP
WFC
(a)
10
WP
10
(b)
10
FC
14
16
16
14
FC
10
(c)
FC
10
16
16
(d)
16
14
WFC
10
(e)
10
16
14
WFC
PACKAGING MACHINE

FIG. 9

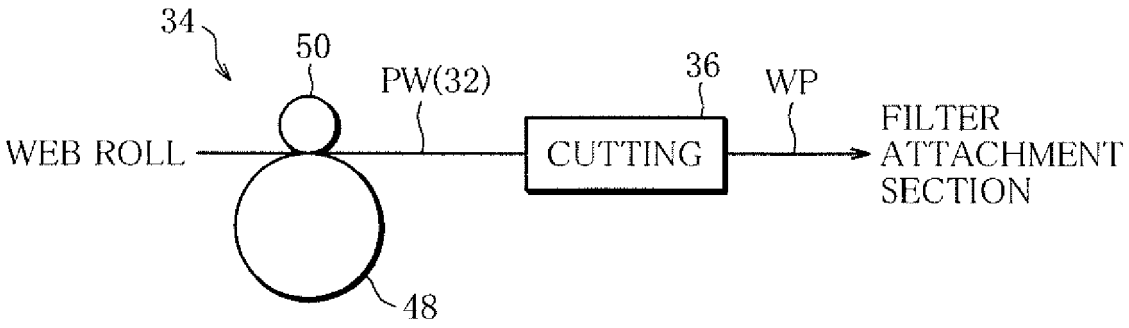

34
50
PW(32)
36
WP
WEB ROLL
CUTTING
FILTER
ATTACHMENT
SECTION
48

FIG. 10

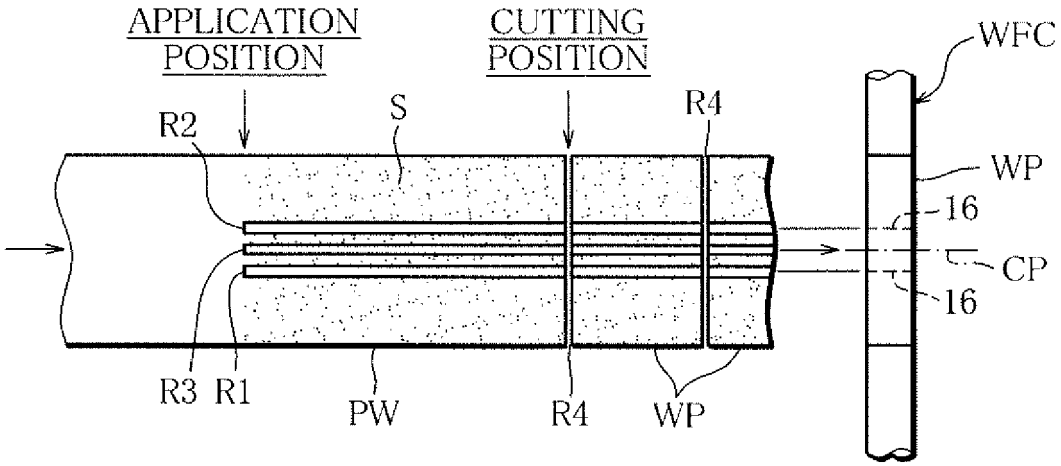

APPLICATION
POSITION
CUTTING
POSITION
WFC
R2
S
R4
WP
16
CP
16
R3
R1
PW
R4
WP

FIG. 11

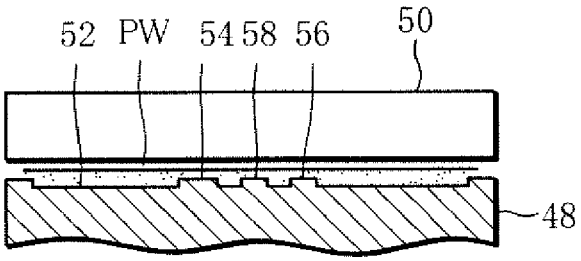


FIG. 12

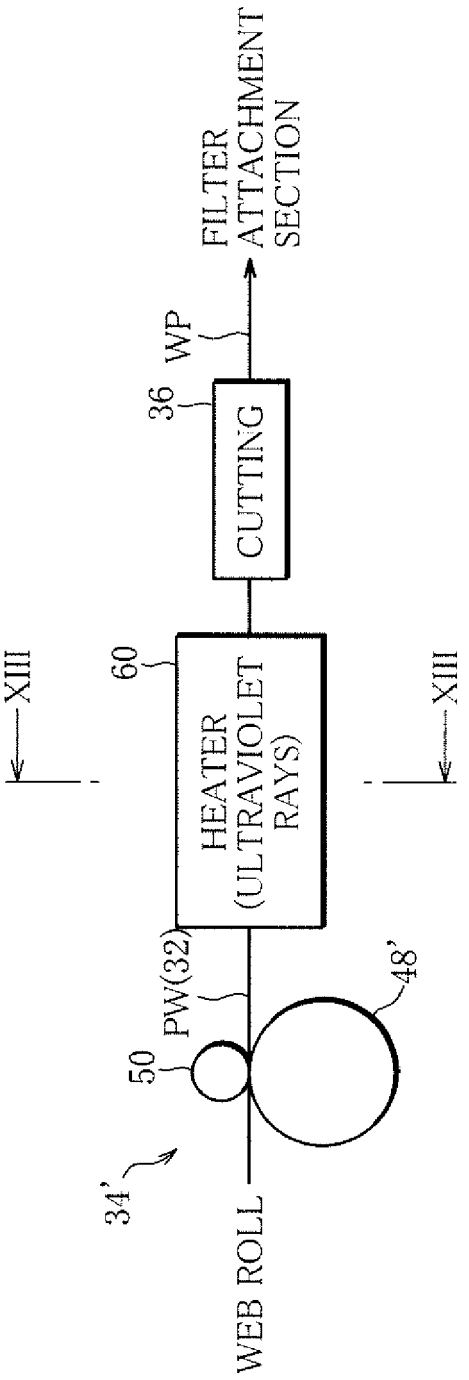

WEB ROLL
34'
50
PW(32)
48'
HEATER (ULTRAVIOLET RAYS)
60
XIII
XIII
CUTTING
36
WP
FILTER ATTACHMENT SECTION

FIG. 13

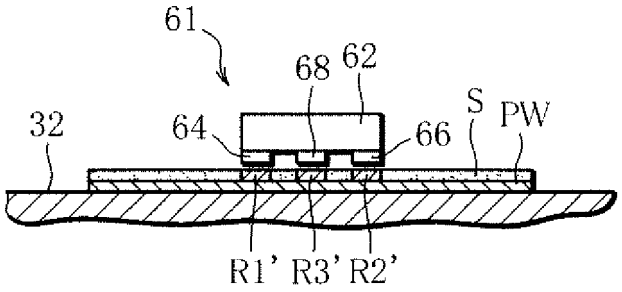

61
68
62
S
PW
32
64
66
R1'
R3'
R2'

FIG. 14

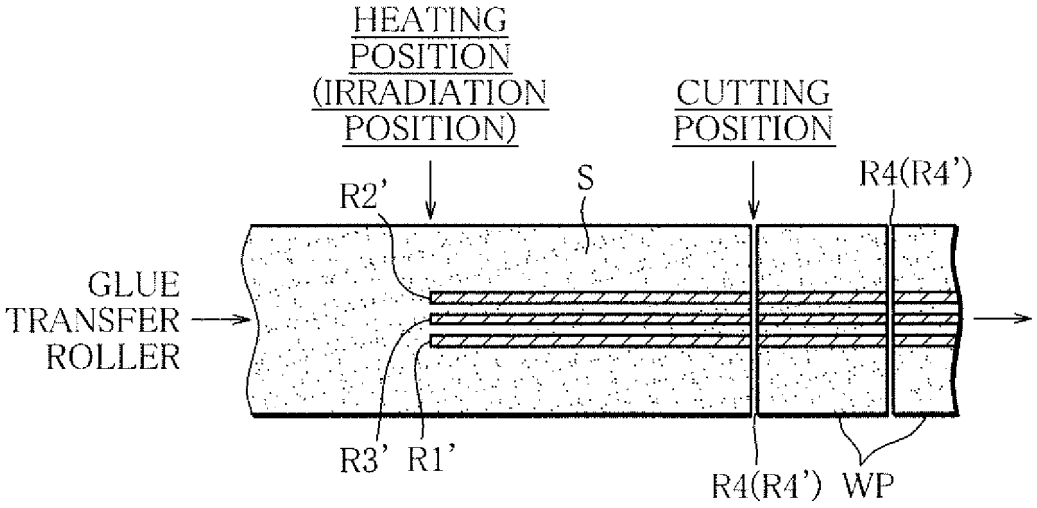

HEATING POSITION (IRRADIATION POSITION)
CUTTING POSITION
R2'
S
R4(R4')
GLUE TRANSFER ROLLER
R3'
R1'
R4(R4')
WP

FIG. 15

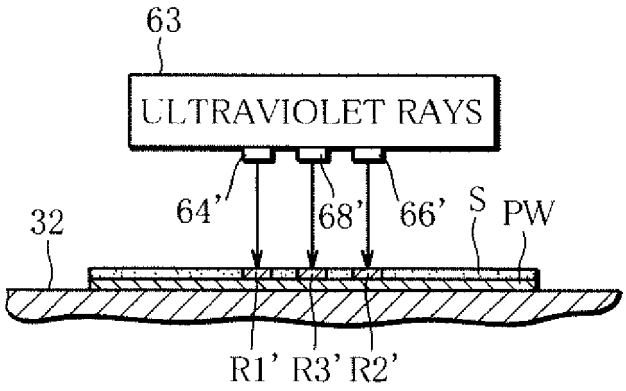


FIG. 16

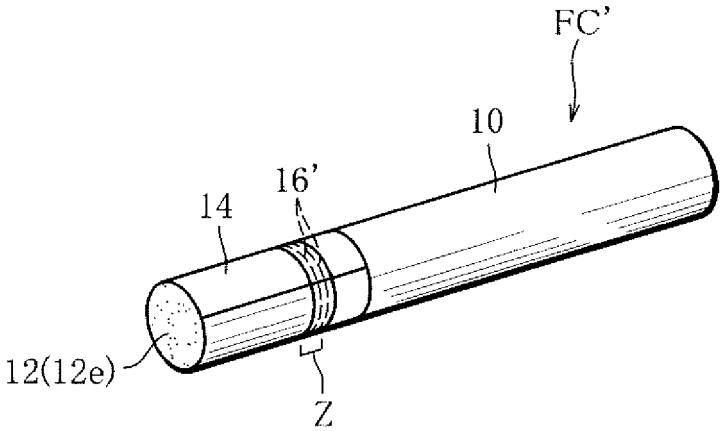


FIG. 17

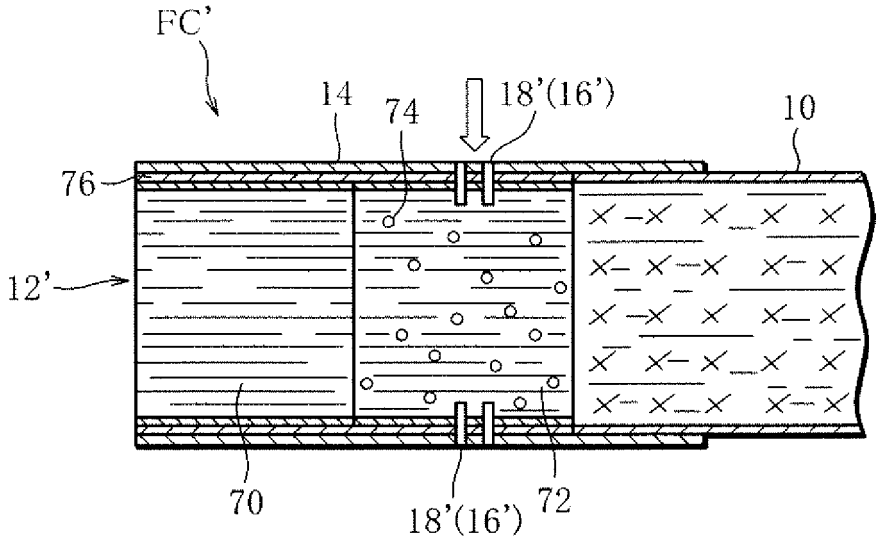

FC'
14
74
18'(16')
10
76
12'
70
18'(16')
72

FIG. 18

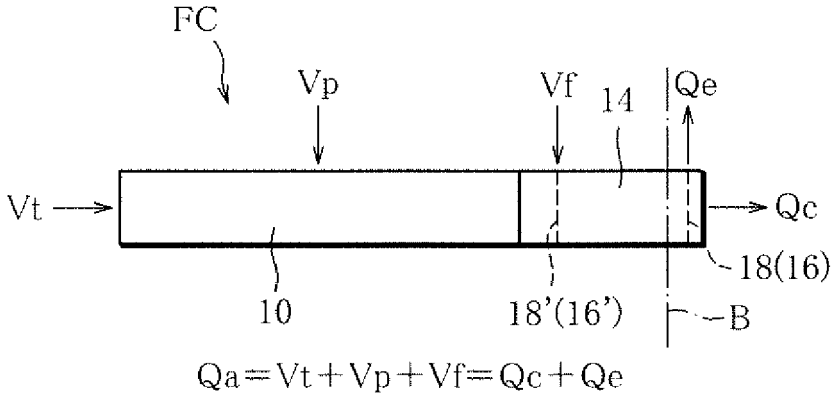
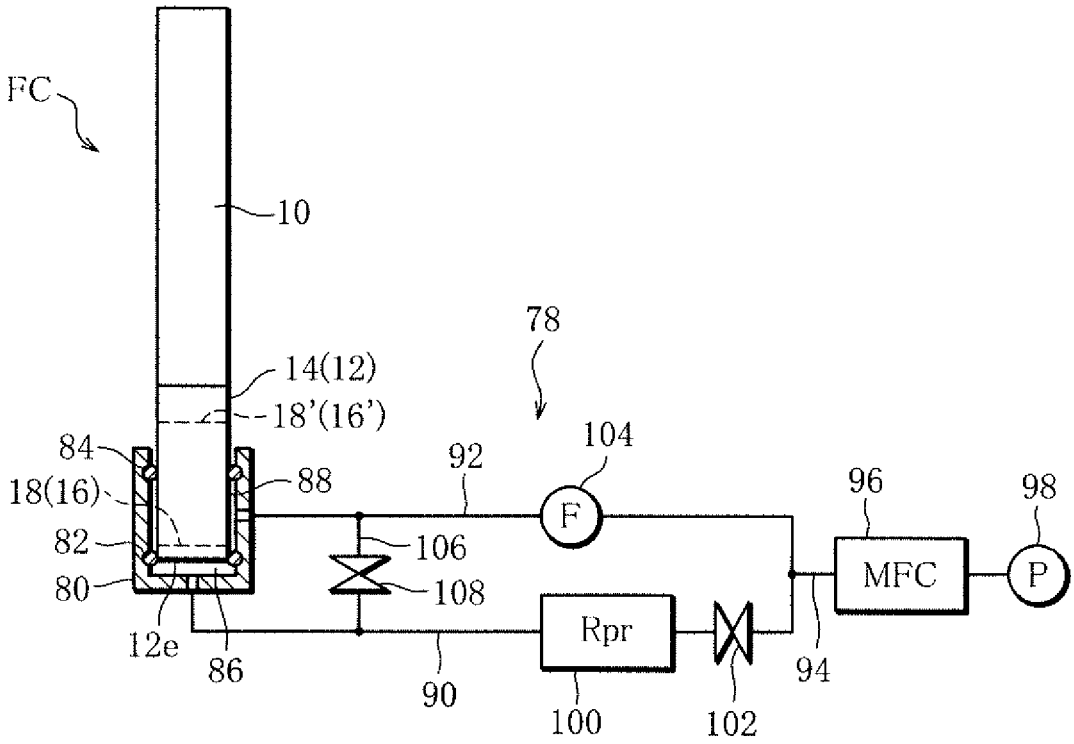

FC
Vp
Vf
14
Qe
Vt
Qc
18(16)
10
18'(16')
B
Qa=Vt+Vp+Vf=Qc+Qe

FIG. 19


FC
10
78
14(12)
18'(16')
84
18(16)
82
80
88
92
104
F
106
108
96
98
MFC
P
12e
86
90
Rpr
94
100
102

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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 0516

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