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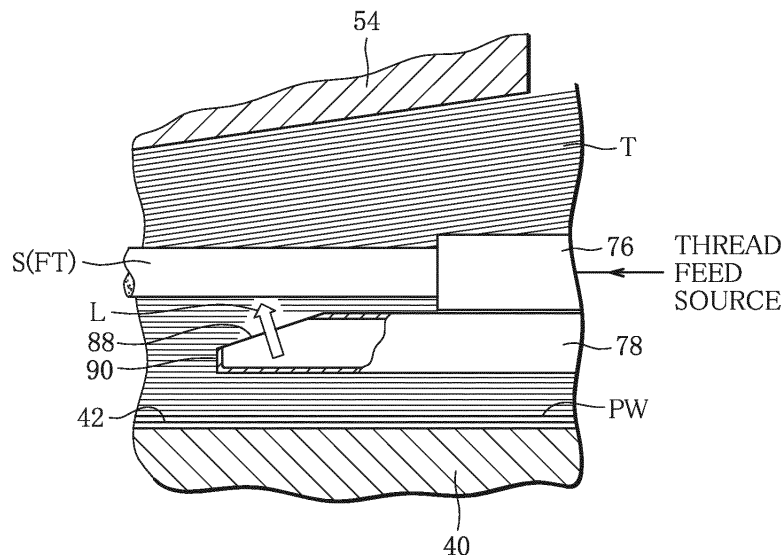
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(54) **FILTER ROD MANUFACTURING MACHINE AND FILTER ROD MANUFACTURING METHOD**

(57) A manufacturing machine carrying out a filter rod manufacturing method of the present invention includes: a thread feed-out end (80) located more downstream than a merging position (MP) where a filter tow (T) and a paper web (PW) are merged together in a process of forming a tow rod (TR) from the filter tow (T) and the paper web (PW); a thread feed-out nozzle (76) for feeding a thread member (S) from the thread feed-out

end (80) into the filter tow (T) inside the tong (54); and a liquid discharge outlet (88) located more downstream than the thread feed-out end (80), and further includes a liquid supply nozzle (86) for discharging a flavor liquid (L) from the liquid discharge outlet (88) toward the thread member (S) in a manner as to impregnate the flavor liquid (L) into the thread member (S).

FIG. 6



Description**Technical Field**

5 [0001] The present invention relates to a filter rod manufacturing machine and a filter rod manufacturing method for manufacturing a filter rod several times longer than a filter prior to manufacturing of a filter cigarette including a thread into which an additive liquid is impregnated inside the filter.

Background Art

10 [0002] A manufacturing machine of this type includes a wrapping section for wrapping a filter tow with a wrapping material into a rod shape to form a tow rod, a cutting unit so disposed downstream of this wrapping section as to cut the tow rod into filter rods, and a thread feed-out unit for feeding an additive-impregnated thread into the filter tow in a process of conveying the filter tow toward the wrapping section (see FIG. 3 of Patent Document 1, for example). Hence, each
15 filter rod includes the additive-impregnated thread in its filter tow.

[0003] Specifically, the thread feed-out unit of Patent Document 1 includes a feed-out path of a thread member extending from a feed reel of the thread toward the wrapping section and a liquid tank disposed in this feed path, an additive liquid is reserved in this liquid tank, and a flavor is dissolved in this additive liquid. The thread member is conveyed through the additive liquid in the liquid tank before being fed into the filter tow, thereby impregnating the additive liquid
20 into the thread member to obtain the additive-impregnated thread.

Prior Art Document**Patent Document**

25 [0004] Patent Document 1: Japanese Patent Laid-Open No. S55-58084 (JP1980-58084 A)

Summary of the Invention**Problems to be solved by the Invention**

[0005] The above described thread feed-out unit of Patent Document 1 further includes a thread guide and a thread nozzle in the thread feed-out path downstream of the liquid tank, and the thread guide and the thread nozzle enable the additive-impregnated thread to be accurately fed into the filter tow.

35 [0006] Unfortunately, if the additive-impregnated thread slidably comes into direct contact with the thread guide and the thread nozzle, the additive-impregnated thread is compressed by the thread guide and the thread nozzle, so that the additive liquid may be squeezed from the additive-impregnated thread. This causes variation in impregnated amount of the additive liquid into the additive-impregnated thread, that is, variation in content of the additive per filter rod, and this variation deteriorates quality of the filter rods.

40 [0007] An object of the present invention is to provide a filter rod manufacturing machine and a filter rod manufacturing method capable of effectively reducing variation in impregnated amount in terms of the impregnated amount of an additive liquid contained in an additive-impregnated thread in each filter rod.

Means for Solving the Problems

45 [0008] The above object is achieved by a filter rod manufacturing machine of the present invention, and the manufacturing machine includes:

a tow converging section for converging a filter tow during conveyance of the filter tow in a web shape;
50 a wrapping section for respectively receiving the converged filter tow and a wrapping material at a merging position defined to be downstream of the tow converging section if viewed in a conveyance direction of the filter tow so as to wrap the filter tow with the wrapping material into a tow rod;
a thread feed-out nozzle for guiding a thread member toward the wrapping section, the thread feed-out nozzle including a thread feed-out end located more downstream than the merging position, the thread feed-out nozzle
55 feeding the thread member from the thread feed-out end into the filter tow, thereby forming the tow rod including the thread member therein;
a liquid supply nozzle extending along the thread feed-out nozzle to supply an additive liquid to be impregnated into the thread member, the liquid supply nozzle including a liquid discharge outlet so located more downstream than

the thread feed-out end as to discharge the additive liquid toward the thread member fed from the thread feed-out end; and
 a cutting unit so located downstream of the wrapping section as to cut the tow rod into filter rods, each having a predetermined length.

[0009] According to the above described manufacturing machine, the thread member is fed into the filter tow located more downstream than the merging position between the filter tow and the wrapping material, and the additive liquid is discharged toward this thread member at the same time. Specifically, the additive-impregnated thread made by impregnating the additive liquid into the thread member is not formed outside the filter tow, but inside the filter tow; thus it is possible to eliminate the aforementioned thread guider and thread nozzle for leading the additive-impregnated thread into the filter tow.

[0010] Hence, the additive-impregnated thread does not slidingly come into direct contact with the thread guide and the thread nozzle; therefore, it is prevented that the thread guide and the thread nozzle squeeze the additive liquid from the additive-impregnated thread, and then the squeezed additive liquid adheres to the thread guide and the thread nozzle. Accordingly, variation in impregnated amount of the additive liquid is suppressed in terms of the impregnated amount of the additive liquid contained in the additive-impregnated thread per filter rod.

[0011] The wrapping section includes the tong so located downstream of the merging position as to squeeze the filter tow into a rod shape, and in this case, the thread feed-out end and the liquid discharge outlet are preferably disposed inside the tong.

[0012] If the thread feed-out end and the liquid discharge outlet are disposed inside the tong as described above, the thread feed-out end and the liquid discharge outlet are surrounded by the filter tow in a process of forming the filter tow into a rod shape. Hence, even if part of the additive liquid discharged from the liquid discharge outlet is not impregnated into the thread member, the part of the additive liquid is prevented from adhering to the adjacent filter tow, and thus the tong and the wrapping material are prevented from being unclean with this additive liquid.

[0013] The liquid discharge outlet is preferably disposed at the front end of the liquid supply nozzle. This configuration minimizes the insertion length of the liquid supply nozzle into the tong.

[0014] In addition, the liquid supply nozzle may extend immediately under the thread feed-out nozzle, and the liquid discharge outlet may upwardly open. In this case, the additive liquid upwardly discharged from the liquid discharge outlet is so applied to the lower surface of the thread member as to be impregnated into the thread member. With the liquid discharge outlet upwardly opening, the additive liquid is prevented from oozing out from the liquid discharge outlet because of gravity even if the additive liquid is stopped to be discharged from the liquid discharge outlet.

[0015] In addition, it is preferable that the liquid supply nozzle and the thread feed-out nozzle are integrally supported by a common holder plate.

[0016] The present invention also provides a filter rod manufacturing method carried out by the aforementioned manufacturing machine.

Advantageous Effects of the Invention

[0017] The filter rod manufacturing machine and the filter rod manufacturing method of the present invention form the additive-impregnated thread in the filter tow; therefore, it is possible to effectively suppress variation in impregnated amount of the additive liquid in terms of the impregnated amount of the additive liquid contained in the additive-impregnated liquid per filter rod.

Brief Description of the Drawings

[0018]

FIG. 1 is a perspective view showing a filter cigarette.

FIG. 2 is a perspective view showing a partially broken filter rod used for forming a filter of the filter cigarette of FIG. 1.

FIG. 3 is a schematic view showing a part of a manufacturing machine for manufacturing the filter rod of FIG. 2.

FIG. 4 is a drawing showing a thread feed unit included in the manufacturing machine of FIG. 3.

FIG. 5 is a perspective view showing the partially enlarged thread feed unit of FIG. 4.

FIG. 6 is a drawing for explaining operation of the thread feed unit of FIG. 4.

FIG. 7 is a graph showing CV values between Examples and Comparative Examples in terms of amount of menthol contained in a flavor-impregnated thread per filter rod.

FIG. 8 is a graph showing CV values in Examples in which the impregnated amount of the menthol into the additive-impregnated thread is increased.

Mode for Carrying out the Invention

[0019] With reference to FIG. 1, a filter cigarette FC includes a cigarette C, and a filter F connected to a base end of the cigarette C by wrapping them with a tipping paper TP. The filter F includes a flavor-impregnated thread FT thereinside, and the flavor-impregnated thread FT contains a flavor.

[0020] Specifically, the filter F is produced by cutting a filter rod FR shown in FIG. 2. The filter rod FR includes a filter tow T formed of a bundle of acetate fibers, a wrapping material for wrapping the filter tow T into a rod shape, that is, a wrapping paper WP, and the flavor-impregnated thread FT disposed at a center of the filter tow T.

[0021] FIG. 3 schematically shows a structural outline of a manufacturing machine of the filter rod FR, and a manufacturing method of the filter rod FR carried out by this manufacturing machine will be apparent from the following description according to the manufacturing machine.

[0022] The manufacturing machine includes a tow bale formed of acetate fibers, that is, the filter tow T in a web shape, and the filter tow T forms a pile 12 on a wagon 10. A conveyance path 16 of the filter tow T extends from the pile 12 toward a tow converging section 14, and in this conveyance path 16, there are sequentially disposed a ring guide 18, a first banding jet 20, a second banding jet 22, pretension rolls 24, blooming rolls 26, a third banding jet 28, an plasticizer applying unit 30, and conveyance rolls 32 in the order from the pile 12 of the filter tow T.

[0023] The first to third banding jets 20, 22, 28 respectively inject compressed air to the filter tow T, and this injection of the compressed air opens crimped acetate fibers, thus opening the filter tow T. The pretension rolls 24 apply a predetermined tension to the filter tow T, and the blooming rolls 26 stretch out the filter tow T incorporation with the pretension rolls 24 therebetween.

[0024] When the filter tow T is conveyed through the applying unit 30, the applying unit 30 evenly applies liquid triacetin as a plasticizer to the filter tow T. Subsequently, the filter tow T is conveyed from the conveyance rolls 32 to the tow converging section 14.

[0025] In the present embodiment, the tow converging section 14 includes a trumpet jet 34 and a trumpet guide 36, and the trumpet jet 34 and the trumpet guide 36 are disposed sequentially in the order from the conveyance rolls 32 in a manner as to be adjacent to each other. The trumpet jet 34 generates a compressed air flow thereinside to flow toward the trumpet guide 36, and this compressed air flow converges the filter tow T conveyed from the conveyance rolls 32 into a cylindrical shape in the trumpet jet 34 (tow converging step) to introduce this filter tow T into the trumpet guide 36. Subsequently, the filter tow T in a cylindrical shape entering the trumpet guide 36 once expands in its radial direction, and then is conveyed toward a wrapping section 38.

[0026] The wrapping section 38 includes a forming bed 40, and this forming bed 40 extends in the horizontal direction, and has a starting end 40a located near the trumpet guide 36 and a terminal end 40b spaced apart from the trumpet guide 36. There is provided a forming groove (not shown) on an upper surface of the forming bed 40, and this forming groove extends from the starting end 40a to the terminal end 40b. Specifically, the forming groove is configured to be flat at the starting end 40a, but gradually increased in depth toward the terminal end 40b while its width is gradually decreased toward the terminal end 40b. Accordingly, the forming groove has a semi-circular cross section at the terminal end 40b.

[0027] A part of a garniture tape 42 is disposed in the forming groove. This garniture tape 42 is formed to be endless, and is wound around a driving drum 44 below the forming bed 40 at a predetermined winding angle, and is guided by plural guide rollers 46 at the same time. As apparent from FIG. 3, one of the guide rollers 46 is disposed immediately under the trumpet guide 36. When the driving drum 44 is rotated, the above described part of the garniture tape 42 travels on the forming groove of the forming bed 40 from the starting end 40a toward the terminal end 40b of the forming bed 40.

[0028] Meanwhile, on the forming bed 40, a paper web PW is laid over the garniture tape 42, and this paper web PW is led from a web roll WR through plural guide rollers 48 onto the garniture tape 42. One of these guide rollers 48 is disposed adjacent to the above described guide rollers 46 immediately under the trumpet guide 36.

[0029] Spray guns 50, 52 are disposed in a feed path of the paper web PW. The spray gun 50 applies a rail glue at the center of the paper web PW if viewed in the width direction of the paper web PW, while the spray gun 52 applies a lap glue at one side edge of the paper web PW.

[0030] The filter tow T fed through the trumpet guide 36 is laid over the paper web PW at a merging position MP defined at or in front of the starting end 40a of the forming bed 40, and is bonded to the paper web PW with the rail glue. Thereafter, the paper web PW and the filter tow T travel together with the garniture tape 42 on the forming bed 40 along the forming groove.

[0031] Immediately above the forming bed 40, a tong 54, a former 56, a heater 58, and a cooler 60 are disposed sequentially in the order from the starting end 40a. When filter tow T together with the paper web PW and the garniture tape T travel through the tong 54, the tong 54 squeezes the filter tow T from above (squeezing process) to compressively form the filter tow T into a rod shape in cooperation with the forming groove of the forming bed 40. At this time, the garniture tape 42 and the paper web PW are bent in a U shape along the forming groove in a manner as to wrap up the

filter tow T therewith from below.

[0032] Specifically, the tong 54 defines a compressive forming passage in cooperation with the forming groove of the forming bed 40, and this compressive forming passage has a ceiling surface defined by the tong 54, and this ceiling surface has a shape of an upside-down forming groove. Accordingly, the compressive forming passage has a circular cross section at the terminal end 40b of the forming bed 40, that is, the terminal end of the compressive forming passage.

[0033] Thereafter, during conveyance of the filter tow T, the paper web PW, and the garniture tape 42 all together through the former 56, the paper web PW is sequentially bent at its both side edges toward the filter tow T via the garniture tape 42. Accordingly, the both side edges of the paper web PW are laid over each other on the filter tow T in a manner as to be adhesively bonded to each other with the aforementioned lap glue into a lap portion. At this time, the filter tow T is completely wrapped up with the paper web PW (wrapping step) into the tow rod TR.

[0034] Thereafter, the tow rod TR is provided with firm bonding at its lap portion during traveling through the heater 58 and the cooler 60.

[0035] A cutting unit 70 is disposed immediately downstream of the wrapping section 38, and the tow rod TR is conveyed through this cutting unit 70. At this time, the cutting unit 70 cuts the tow rod TR in a predetermined length into individual filter rods FR (cutting step).

[0036] The filter rods FR formed in this manner are received by a receiver 72 from the cutting unit 70, and thereafter, are conveyed toward a manufacturing machine of filter cigarettes, that is, a filter installation machine.

[0037] In this filter installation machine, the filter rod FR is cut into double filters, each having a length twice as long as that of the filter F. The double filter is disposed between two cigarettes C, and the cigarettes and the double filter are connected by being wrapped with the tipping paper to be formed into a double filter cigarette. Thereafter, the double filter cigarette is cut into individual filter cigarettes.

[0038] Although not shown in FIG. 1, the aforementioned the filter rod FR manufacturing machine further includes a thread feed unit 74 for embedding the flavor-impregnated thread FT in the tow rod TR, and the details of this thread feed unit 74 are shown in FIG. 4.

[0039] The thread feed unit 74 includes a thread feed-out nozzle 76. The thread feed-out nozzle 76 is formed of a pipe member, and extends from the outside of the tow converging section 14 through the tow converging section 14 toward the wrapping section 38.

[0040] Specifically, the thread feed-out nozzle 76 extends through the trumpet jet 34 and the trumpet guide 36, and has its both ends, that is, an inlet end 78 and a thread feed-out end (thread feed-out position) 80. The inlet end 78 is located outside the trumpet jet 34, and the thread feed-out end 80 is located more downstream than the above described merging position MP if viewed in the conveyance direction of the filter tow T. In the present embodiment, as apparent from FIG. 4, the thread feed-out end 80 enters the tong 54, and has an opening toward the downstream if viewed in the conveyance direction of the filter tow T. In addition, supposing a horizontal axial line (not shown) extending through the center of the circular terminal end in the aforementioned compressive forming passage, the thread feed-out end 80 is located on this axial line.

[0041] The thread feed-out nozzle 76 receives a thread member S at the inlet end 78, and guides the received thread member S toward the thread feed-out end 80 so as to feed this thread member S from the thread feed-out end 80 into the tong 54 (thread feed-out step). The thread member S is fed from a thread feed source 82, and led to the inlet end 78 of the thread feed-out nozzle 76. Although not shown in FIG. 4, the thread feed source 82 includes a thread reel around which the thread S is wound, and a feed roll and the like for feeding the thread member S from the thread reel along a guide path toward the thread feed-out nozzle 76; and FIG. 4 shows a guide roller 84 which is one of components defining the guide path, and this guide roller 84 is disposed in the vicinity of the inlet end 78.

[0042] The thread feed unit 74 further includes a liquid supply nozzle 86. The liquid supply nozzle 86 is also formed of a pipe member, and extends along the thread feed-out nozzle 76. Specifically, the liquid supply nozzle 86 also extends through the trumpet jet 34 and the trumpet guide 36. As apparent from FIG. 4, in the present embodiment, the liquid supply nozzle 86 is located immediately under the thread feed-out nozzle 76, and has a front end located inside the tong 54, that is, a liquid discharge outlet (liquid discharging position) 88. This liquid discharge outlet 88 upwardly opens more downstream than the thread feed-out end 80. Hence, the liquid discharge outlet 88 is located immediately under the thread member S fed out from the thread feed-out end 80, and opens toward the lower surface of this thread member S.

[0043] Specifically, as apparent from FIG. 5, the front end of the liquid supply nozzle 86 is formed as a closed end 90, and the liquid discharge outlet 88 is formed by obliquely cutting off the upper portion of the liquid supply nozzle 86 in a predetermined length from the closed end 90. It should be noted that the lower portion of the closed end 90 still remains.

[0044] Meanwhile, the liquid supply nozzle 86 projects from the trumpet jet 34, and is integrally supported together with the thread feed-out nozzle 76 by a holder plate 92. With this integral support of the liquid supply nozzle 86 and the thread feed-out nozzle 76 relative to the holder plate 92, by simply installing the liquid supply nozzle 86 and the thread feed-out nozzle 76 to the holder plate 92 at respective predetermined installation positions, it is possible to automatically determine positioning of the liquid discharge outlet 88 and the thread feed-out end 80 inside the tong 54, as well as relative positioning between the thread feed-out end 80 and the liquid discharge outlet 88. Accordingly, it is unnecessary

to perform subsequent positional adjustment of the thread feed-out end 80 and the liquid discharge outlet 88, and it is possible to reduce variation in addition of the flavor liquid as well as it is effective for enhancement of productivity.

[0045] In addition, the liquid supply nozzle 86 is connected to a liquid supply pipe 94 at the holder plate 92, and this liquid supply pipe 94 extends toward a liquid supply source 96 so as to be connected to this liquid supply source 96. The liquid supply source 96 is capable of quantitatively supplying the flavor liquid through the liquid supply pipe 94 to the liquid supply nozzle 86. Although not shown in FIG. 4, the liquid supply source 96 includes a liquid tank for reserving the flavor liquid, and a quantitative pump for supplying the flavor liquid from this liquid tank.

[0046] In the case of the present embodiment, the flavor liquid contains propylene glycol (PG) as a solvent and menthol (M) as a flavor dissolved in this propylene glycol.

[0047] According to the above described thread feed unit 74, the thread member S is fed from the thread feed-out end 80 of the thread feed-out nozzle 76 (thread feed-out step) into the center of the filter tow T entering the tong 54 (during the squeezing process); meanwhile, in FIG. 6, the flavor liquid is discharged obliquely upward from the liquid discharge outlet 88 of the liquid supply nozzle 86, that is, toward the thread member S as shown by an arrow L in FIG. 6 (liquid discharging step). The flavor liquid discharged in this manner is applied to the thread member S, and is impregnated into the thread member S during the process of forming the tow rod TR. As a result, the tow rod TR, that is, the filter rod FR formed from the tow rod TR includes the flavor-impregnated thread FT at the center thereof.

[0048] As aforementioned, the flavor liquid is applied to the thread member S fed from the thread feed-out end 80 of the thread feed-out nozzle 76, and subsequently, the thread member S to which the flavor liquid is applied, that is, the flavor-impregnated thread FT is surround by the filter tow T; thus the flavor-impregnated thread FT comes into contact with the filter tow T, but out of contact with the thread feed-out nozzle 76 and the peripheral mechanical components, such as the tong 54, the garniture tape 42, and the forming bed 40. Hence, the flavor liquid once impregnated into the flavor-impregnated thread FT is unlikely to ooze out from the flavor-impregnated thread FT. Even if the flavor liquid oozes out from the flavor-impregnated thread FT, the flavor liquid in this state adheres to only the filter tow T, but is prevented from adhering to the thread feed-out nozzle 76 and the peripheral mechanical components.

[0049] Accordingly, if the flavor liquid is discharged from the liquid discharge outlet 88 at a constant discharge rate, it is possible to effectively suppress variation in impregnated amount of the flavor liquid in terms of the amount of the flavor liquid impregnated into the flavor-impregnated thread FT per filter rod FR. As aforementioned, even if part of the flavor liquid adheres to the filter tow T, the content of the flavor liquid per filter rod FR becomes constant.

[0050] Furthermore, in the case of the present embodiment, because the liquid discharge outlet 88 upwardly opens, the flavor liquid is prevented from dropping from the liquid discharge outlet 88 because of gravity even if the operation of the manufacturing machine is stopped, that is, the flavor liquid is stopped to be supplied from the liquid supply source 96. Hence, the peripheral mechanical components are prevented from becoming unclean with the flavor liquid; therefore, it is possible to reduce load required for cleaning the mechanical components.

[0051] With respect to filter rods FR of Examples E1, E2 manufactured by the aforementioned manufacturing machine, the following Table 1 shows measurement results of respective average values of the amount of menthol M contained in the flavor-impregnated thread FT and respective CV values thereof. In Table 1, Qo and M amount respectively represent a target content and actual impregnated amount of the menthol M per flavor-impregnated thread FT.

[0052] Table 1 also shows results of the same measurement on filter rods of Comparative Examples C1 to C3 manufactured by the manufacturing machine of Patent Document 1. The difference between Examples E1 and E2, and the differences among Comparative Examples C1 to C3 represent respective differences in manufacturing date.

[Table 1]

		Qo (g/filter rod)	Number of filter rods N	M amount (g/filter rod)
Example E1	Average	0.026	10	0.024
	CV value(%)			2.81
Example E2	Average	0.026	10	0.025
	CV value(%)			3.60
Comparative Example C1	Average	0.026	5	0.0245
	CV value(%)			9.65
Comparative Example C2	Average	0.026	5	0.0245
	CV value(%)			17.57
Comparative Example C3	Average	0.026	5	0.0253
	CV value(%)			12.18

[0053] FIG. 7 shows the CV values of the menthol M in Table 1 in a bar graph. As apparent from FIG. 7, the CV values of Examples E1, E2 are significantly reduced compared with the CV values of Comparative Examples C1 to C3. This means that the amount of the menthol M contained per filter rod FR, that is, per filter F becomes stable, which enables manufacturing of the filter cigarettes FC in high quality.

[0054] FIG. 8 shows the CV values of the menthol M in Examples E3, E4 with respect to the filter rods FR of Examples E3, E4 manufactured in such a manner that the target impregnated amount Qo of the flavor liquid was changed to 0.056g/filter rod. As apparent from FIG. 8, if the target impregnated amount Qo of the menthol M is increased, the manufacturing machine of the present embodiment can further reduce the CV value of the menthol M.

[0055] The present invention is not limited to the manufacturing machine and the manufacturing method according to the aforementioned embodiment, and various modifications may be made.

[0056] For example, the liquid discharge outlet 88 of the liquid supply nozzle 86 may upwardly open in the vertical direction, or may open toward a side surface of the thread member S. There may be provided multiple liquid supply nozzles 86.

[0057] In one exemplary embodiment, the thread feed-out nozzle 76 and the liquid supply nozzle 86 extend together through the trumpet jet 34 and the trumpet guide 36 into the tong 54, but at least the thread feed-out nozzle 76 may once enter between the tong 54 and the trumpet guide 36 or between the trumpet guide 36 and the trumpet jet 34 in a direction vertical to the conveyance direction of the filter tow T, and then may be bent to extend into the tong 54 along the conveyance direction of the filter tow T.

[0058] In addition, the additive liquid to be impregnated into the thread member may contain other flavors than the menthol, and the solvent is not limited to propylene glycol. Although not limited to specific one, the combination ratio between the menthol and the solvent may be 9:1 to 5:5.

Explanation of Reference Signs

[0059]

14 tow converging section
38 wrapping section
54 tong
70 cutting unit
76 thread feed-out nozzle
80 thread feed-out end
86 liquid supply nozzle
88 liquid discharge outlet
FR filter rod
FT flavor-impregnated thread
S thread member
T filter tow

Claims

1. A filter rod manufacturing machine comprising:

a tow converging section for converging a filter tow during conveyance of the filter tow in a web shape;
a wrapping section for respectively receiving the converged filter tow and a wrapping material at a merging position defined to be downstream of the tow converging section if viewed in a conveyance direction of the filter tow so as to wrap the filter tow with the wrapping material into a tow rod;
a thread feed-out nozzle for guiding a thread member toward the wrapping section, the thread feed-out nozzle including a thread feed-out end located more downstream than the merging position, the thread feed-out nozzle feeding the thread member from the thread feed-out end into the filter tow, thereby forming the tow rod including the thread member thereinside;
a liquid supply nozzle extending along the thread feed-out nozzle to supply an additive liquid to be impregnated into the thread member, the liquid supply nozzle including a liquid discharge outlet so located more downstream than the thread feed-out end as to discharge the additive liquid toward the thread member fed from the thread feed-out end; and
a cutting unit so located downstream of the wrapping section as to cut the tow rod into filter rods, each having a predetermined length.

2. The filter rod manufacturing machine according to claim 1, wherein the wrapping section includes a tong so located downstream of the merging position as to squeeze the filter tow into a rod shape,
and
the thread feed-out end and the liquid discharge outlet are disposed together inside the tong.
3. The filter rod manufacturing machine according to claim 2, wherein the liquid discharge outlet is disposed at a front end of the liquid supply nozzle.
4. The filter rod manufacturing machine according to claim 3, wherein the liquid supply nozzle extends immediately under the thread feed-out nozzle, and the liquid discharge outlet upwardly opens.
5. The filter rod manufacturing machine according to claim 1, wherein the liquid supply nozzle and the thread feed-out nozzle are integrally supported by a common holder plate.
6. A filter rod manufacturing method comprising:

a tow converging step of converging a filter tow during conveyance of the filter tow in a web shape;
a wrapping step of respectively receiving the converged filter tow and a wrapping material at a merging position so as to wrap the filter tow with the wrapping material into a tow rod;
a thread feed-out step of feeding a thread member into the filter tow at a thread feed-out position defined to be more downstream than the merging position, thereby forming the tow rod including the thread member thereinside;
a liquid discharging step of discharging an additive liquid toward the thread member at a liquid discharging position defined to be more downstream than the thread feed-out position in a manner as to impregnate the discharged additive liquid into the thread member; and
a cutting step of cutting the tow rod formed in the wrapping step into filter rods, each having a predetermined length.
7. The filter rod manufacturing method according to claim 6, wherein the wrapping step includes a squeezing process of squeezing the filter tow into a rod shape at a position downstream of the merging position,
and
the thread feed-out step and the liquid discharging step are carried out during the squeezing process.
8. The filter rod manufacturing method according to claim 7, wherein in the liquid discharging step, the additive liquid is upwardly discharged at the liquid discharging position.

FIG. 1

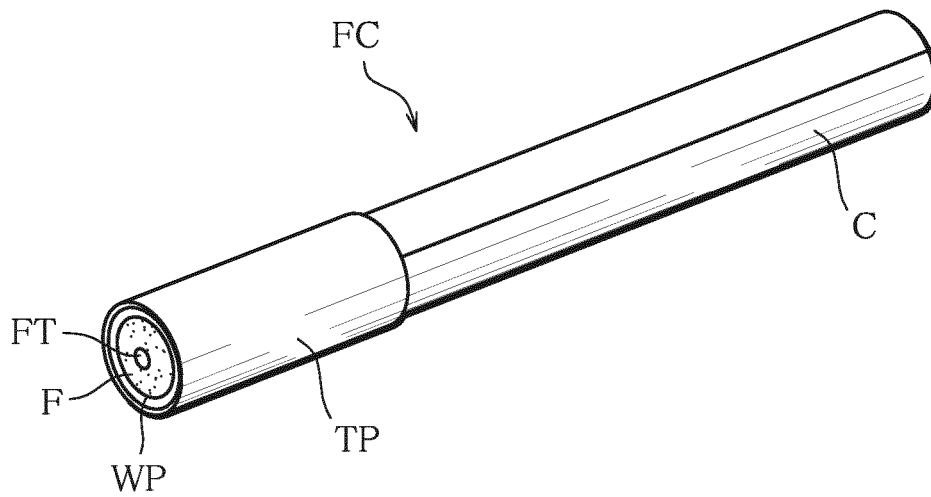


FIG. 2

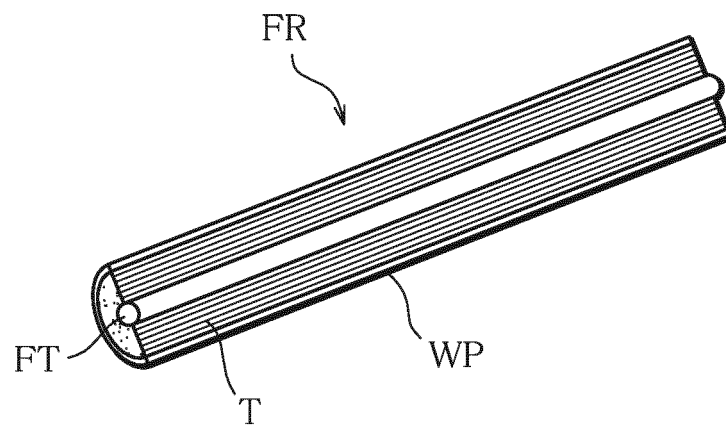


FIG. 3

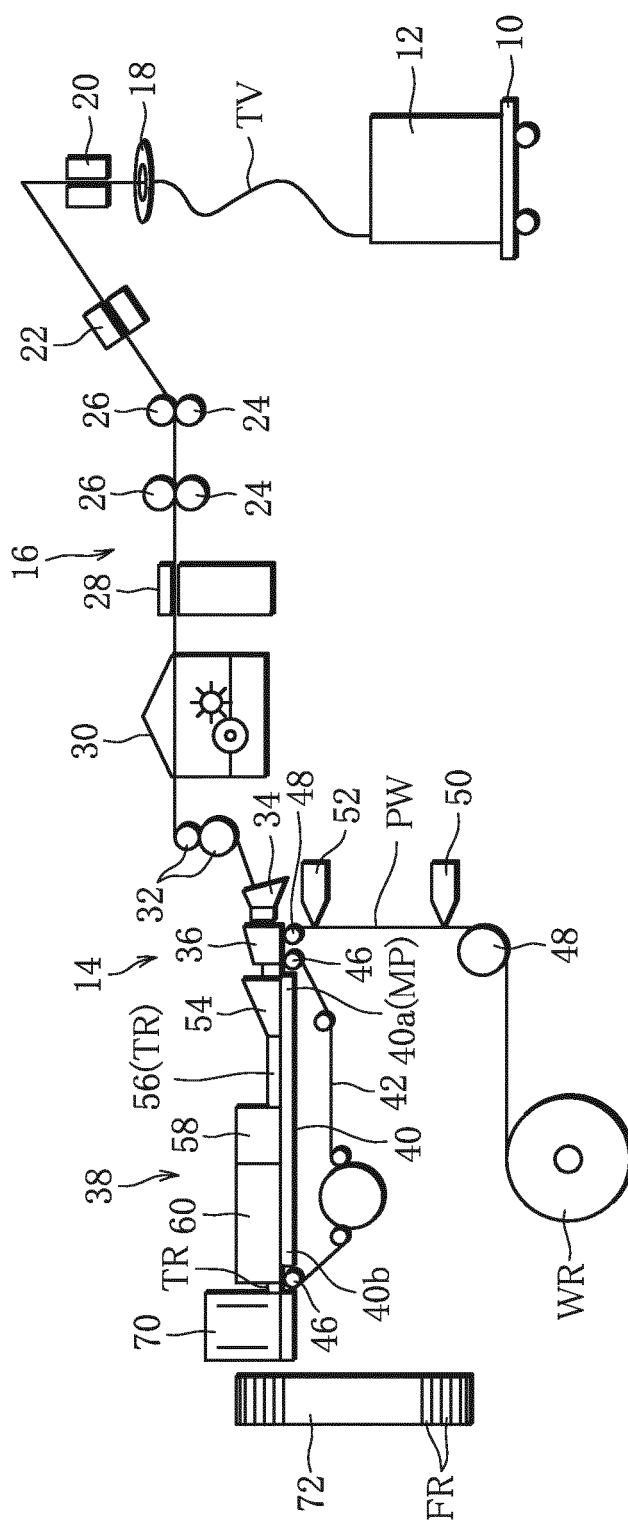


FIG. 4

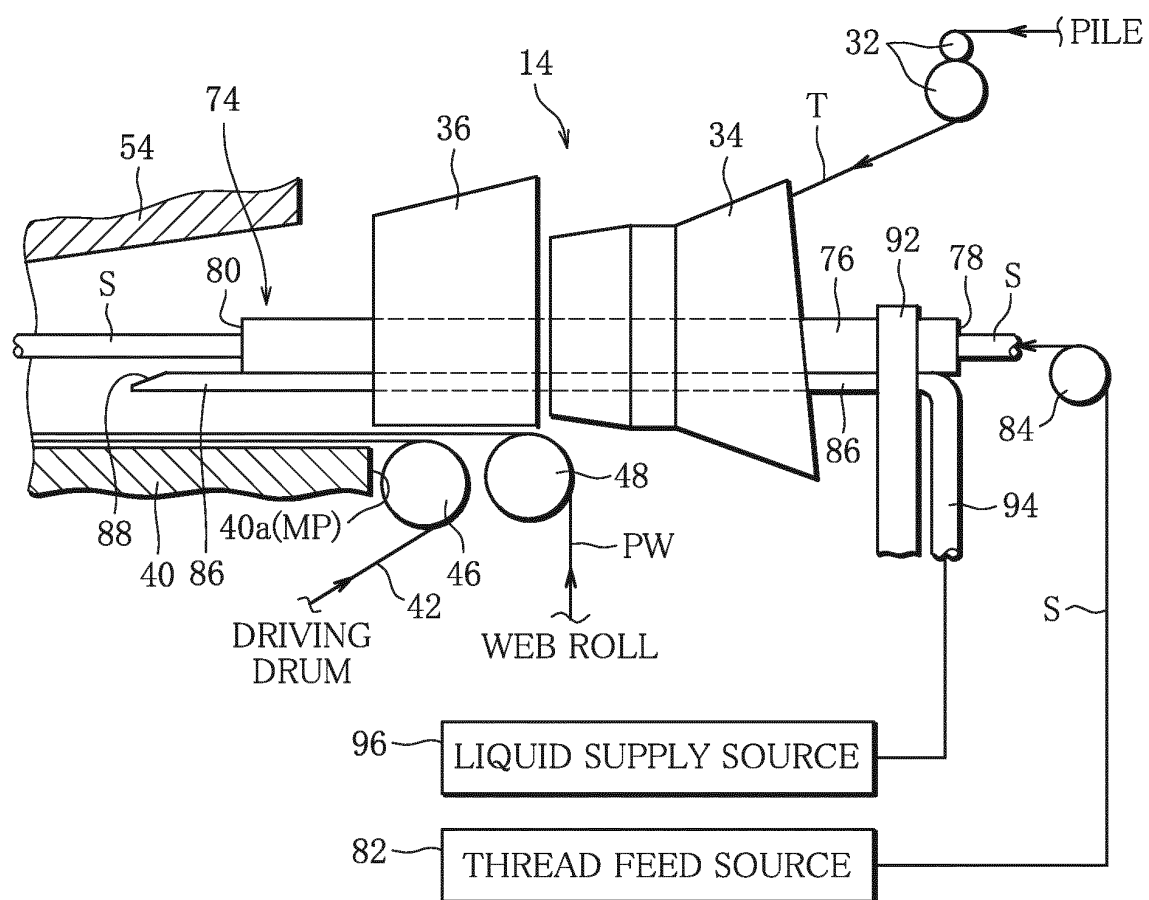


FIG. 5

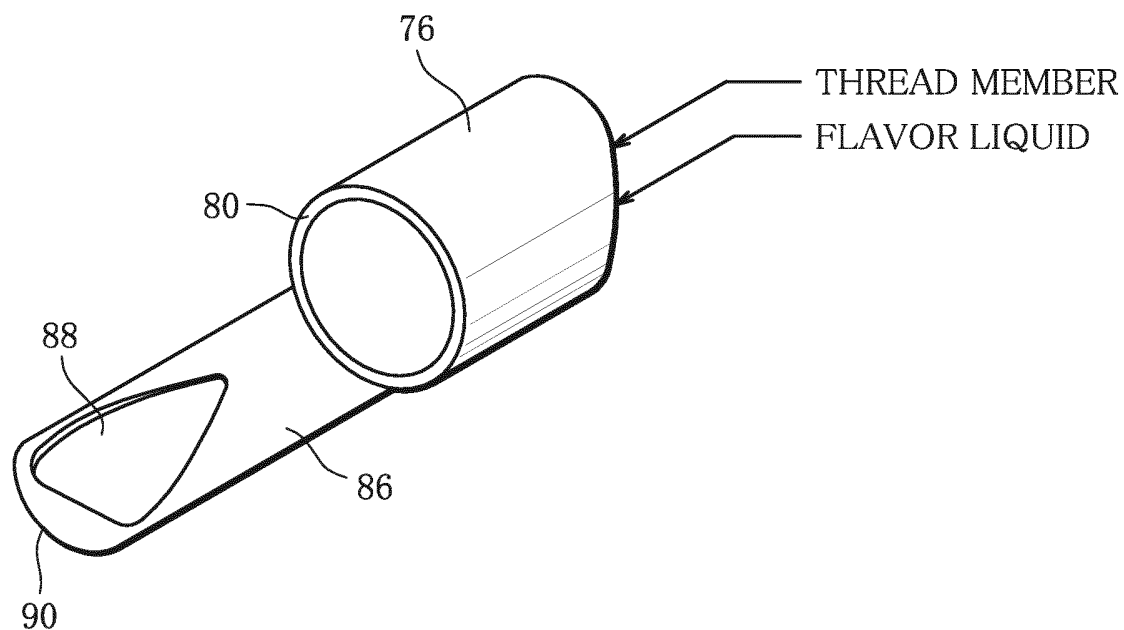


FIG. 6

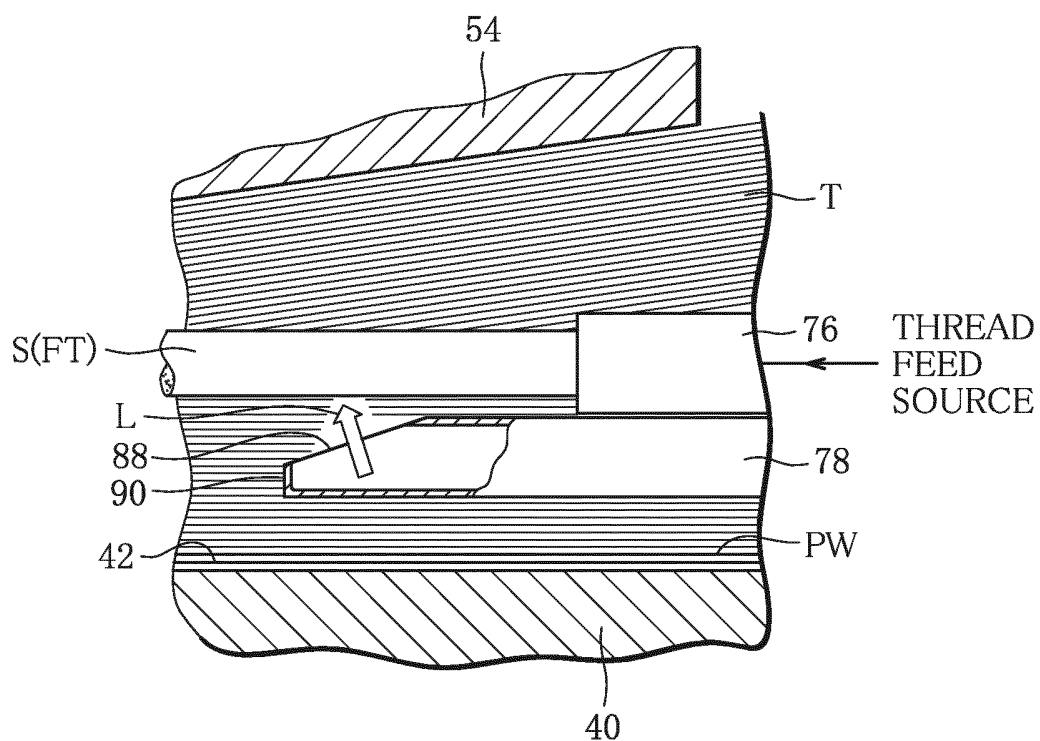


FIG. 7

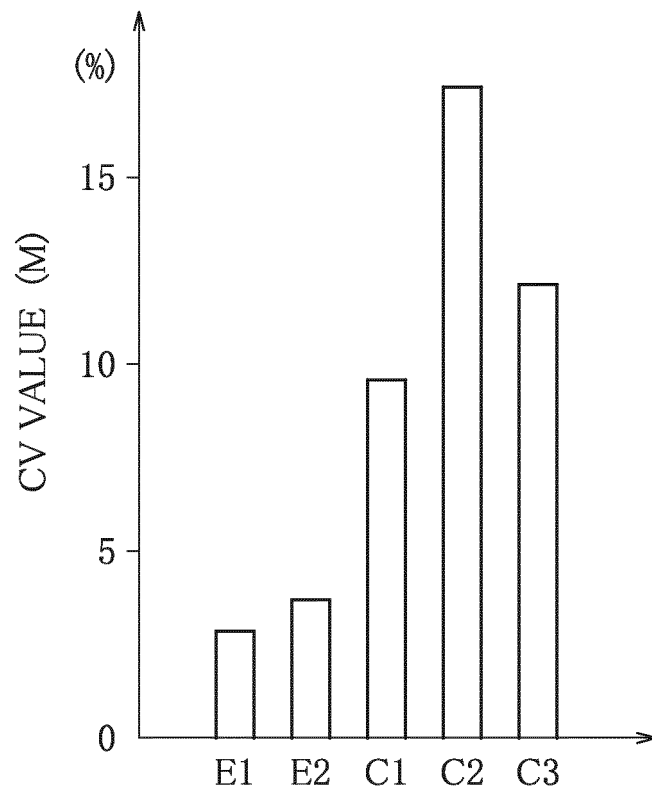
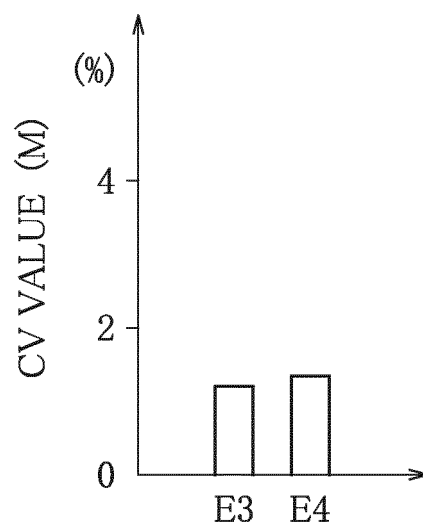


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/083609

A. CLASSIFICATION OF SUBJECT MATTER

A24D3/02 (2006.01) i, A24D3/04 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A24D3/02, A24D3/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013

Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2005-521399 A (Philip Morris Products S.A.), 21 July 2005 (21.07.2005), entire text; all drawings & US 2003/0224918 A1 & US 2005/0255978 A1 & US 2010/0152008 A1 & EP 1513675 A & EP 2468115 A1 & WO 2003/082558 A1 & BR 308847 A & CA 2480886 A & PL 371504 A & CN 1642724 A & ZA 200406975 A & EA 5979 B & AR 39193 A & AU 2003220577 A & TWB 00I308063	1-8



Further documents are listed in the continuation of Box C.



See patent family annex.

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document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

27 March, 2013 (27.03.13)

Date of mailing of the international search report

09 April, 2013 (09.04.13)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/083609

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2008-035861 A (Philip Morris Products S.A.), 21 February 2008 (21.02.2008), entire text; all drawings & JP 2011-41574 A & US 2008/0029114 A1 & US 2010/0154809 A1 & EP 1889550 A1 & EP 1958523 A2 & WO 2008/015570 A2 & DE 602006008137 D & BRA PI0703419 & KR 10-2008-0012749 A & UA 82969 C & AR 62901 A & NO 20090904 A & KR 10-2009-0017464 A & EA 200701446 A	1-8
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