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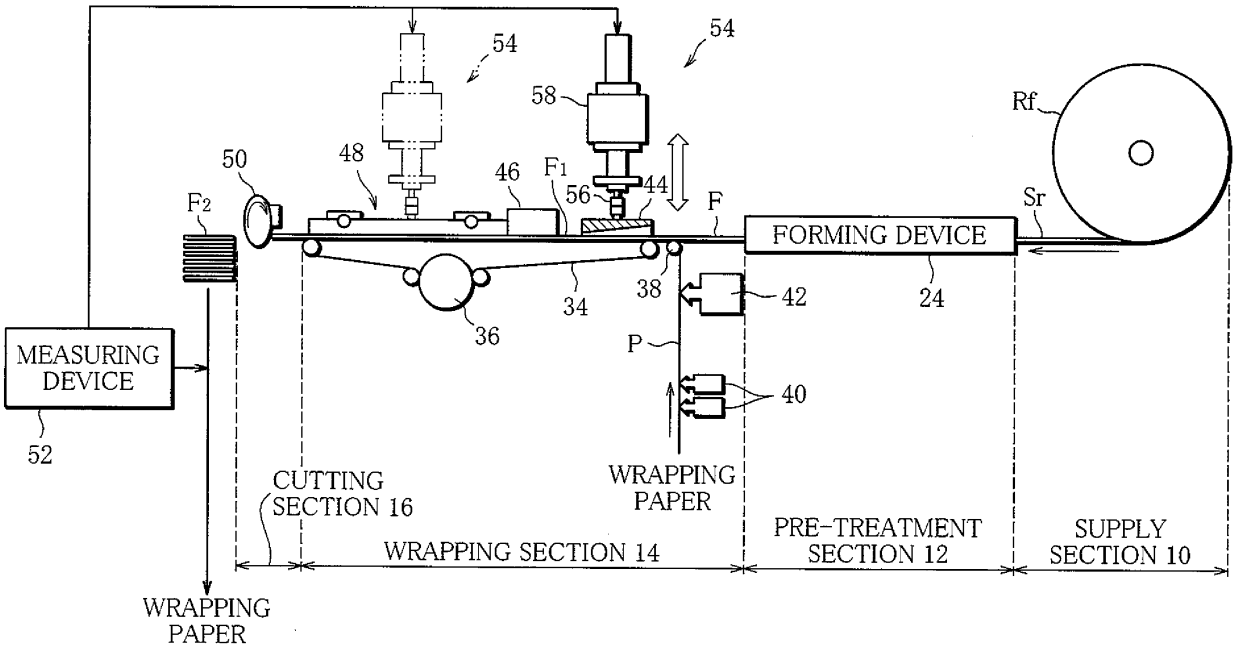
(54) **Rod forming machine**

(57) A rod forming machine is provided with a measuring device (52) for measuring a circumferential length of a formed filter rod (F2) and an adjusting device (54) for adjusting a diameter of a rod-shaped continuum (F1) formed at a wrapping section (14) on the basis of a measurement result by the measuring device (52), the filter rod (F2) being obtained by cutting the continuum (F1) and the adjusting device (54) elevates at least one of a forming tongue (44) and a cooler (48) with heater (46) up/down.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a rod forming machine for forming a filter rod for a cigarette, for example.

Description of the Related Art

[0002] This type of rod forming machine is disclosed in National Publication of International Patent Application No. WO02/017738, for example. The rod forming machine in this gazette is provided with a wrapping section. To this wrapping section, a sheet material (filler material) and paper (wrapping material) are supplied, respectively, and the wrapping section forms a rod-shaped continuum from the sheet material and the paper.

[0003] In more detail, the wrapping section includes a transfer path for guiding transfer of the sheet material and paper and this transfer path has a forming bed. Immediately above the forming bed, a forming tongue, forming holders, and a cooler with heater are arranged in order from the upstream side. The forming tongue defines a compression/forming passage between the tongue and the forming bed. When the sheet material and paper passes through the compression/forming passage, the forming tongue compresses and forms the sheet material in a rod shape in cooperation with the forming bed. After that, when the rod-shaped sheet material and paper pass through the forming holders, the forming holders wrap the rod-shaped sheet material with paper, by which the continuum is formed. Thus-formed continuum has a paper wrap portion, and the wrap portion is formed by overlapping both side edges of the paper with each other, and the both side edges are bonded by an adhesive.

[0004] After that, when the continuum passes through the cooler with heater, the cooler with heater once heats the adhesive at the wrap portion and then, cools it, and the continuum is fed out of the wrapping section.

[0005] The continuum fed out of the wrapping section passes through a cutting section and at this time, the continuum is cut by a cutting knife of the cutting section to a predetermined length, by which an individual filter rod is manufactured.

[0006] After that, the manufactured filter rod is supplied to a manufacturing machine for filter cigarette and used for manufacture of the filter cigarette at this manufacturing machine. Specifically, in the manufacturing machine, the filter rod is further cut to a filter plug with a predetermined length and then, by connecting two cigarettes to both ends of the filter plug through wrapping of tip paper, a double-filter cigarette is formed. Moreover, the double-filter cigarette is cut at the center of the filter plug to form individual filter cigarettes, and such filter cigarette has a half-body of the filter plug, that is, a filter.

[0007] As mentioned above, when the filter of the filter cigarette is manufactured from the filter rod, a circumferential length (outer diameter) of the filter rod should be maintained to its normal value with high accuracy. That is, if the circumferential length of the filter rod is not controlled accurately, when the filter plug and the cigarette are connected to each other through wrapping of the tip paper, a gap is generated between the tip paper and the filter plug or the tip paper and the cigarette. The gap between the filter plug, that is, the filter and the tip paper increases a diluted air amount to be introduced into the filter through a row(or rows) of perforations of the tip paper. Such increase in the diluted air adversely affects amounts of tar (T) and nicotine (N) in the filter cigarette, and flavor and taste of the filter cigarette. On the other hand, the gap between the tip paper and the cigarette becomes a serious factor to incur removal of the filter from the cigarette.

[0008] Moreover, if the circumferential length of the filter rod is largely deviated from the normal value, a defect would occur in the wrapping of the tip paper itself, and assured connection between the cigarette and the filter plug, that is, manufacture of the filter cigarette itself becomes impossible.

[0009] Factors that the circumferential length of the filter rod is deviated from the normal value include fluctuation in basic weight or thickness of the above-mentioned sheet material, at replacement of the garniture tape used for forming the continuum, difference in thickness between new and old garniture tapes and the like.

[0010] From the above reasons, when the filter rod is manufactured by the above-mentioned rod forming machine, the circumferential length of the manufactured filter rod is regularly measured off-line. If the measurement result is deviated from the normal value at this time, operation of the rod forming machine is stopped, and readjustment is applied to the rod forming machine.

[0011] However, since restart of the operation of the rod forming machine and re-measurement of the circumferential length of the filter rod should be repeated from operation stop of the rod forming machine to completion of the readjustment, it takes a long time to complete the readjustment, which considerably lowers productivity of the filter rod.

SUMMARY OF THE INVENTION

[0012] An object of the present invention is to provide a rod forming machine that can control the circumferential length of the rod easily and with accuracy and does not lower productivity of the filter rods.

[0013] In order to achieve the above object, the rod forming machine of the present invention is provided with a wrapping section for forming a rod-shaped continuum by wrapping a filler material with a wrapping material and for feeding out the formed continuum, the continuum having an overlap portion of the wrapping material on an outer circumferential face thereof, and the overlap portion being formed by both side edges of the wrapping material overlapped with each other and bonded by an adhesive; and a cutting section for cutting the continuum fed out of the wrapping section to a rod of a predetermined length.

[0014] In more detail, the wrapping section includes a transfer path for guiding transfer of the filler material and the wrapping material, and the transfer path has a compression/forming passage for compressing and forming the filler material in a rod shape, a wrapping passage connected to downstream of the compression/forming passage for forming the continuum by wrapping the compressed/formed filler material with the wrapping material, and a heating/cooling passage connected to downstream of the wrapping passage for heating the adhesive at the overlap portion of the continuum and then, cooling the adhesive of the overlap portion.

[0015] And the rod forming machine of the present invention is characterized to be provided with measuring means for measuring the circumferential length of the rod and adjusting means for adjusting a passage sectional area of at least one of the passages in the wrapping section on the basis of a measurement result by the measuring means.

[0016] Specifically, the transfer path further has a forming bed, the compression/forming passage is defined between the forming bed and a forming tongue, and the heating/cooling passage is defined between the forming bed and a cooler with heater.

[0017] In this case, the above-mentioned adjusting means may include an actuator for bringing/separating the forming tongue close to/from the forming bed or an actuator for bringing/separating the cooler with heater close to/from the forming bed.

[0018] According to the rod forming machine of the present invention, upon receipt of a measurement result by the measuring means, the adjusting means, that is, the actuator brings/separates at least either one of the forming tongue and the cooler with heater close to/from the forming bed so as to increase or decrease the passage sectional area of the corresponding passage. Thus, throttling of at least either one of the filler material and the continuum is adjusted, and the circumferential length of the continuum is maintained within a tolerable range.

[0019] That is, the rod forming machine of the present invention maintains the circumferential length of the continuum within the tolerable range by controlling throttling of the filler material prior to the formation of the continuum or by controlling the throttling of the continuum in a forming process of the continuum. Thus, the circumferential length of the continuum is controlled with high accuracy in the rod forming machine, that is, online, and the control does not lower productivity of the rod.

[0020] Specifically, the rod forming machine may be further provided with a supply section of the filler material. The supply section is arranged on upstream of the wrapping section and includes a roll of a sheet material as a filter material of the cigarette and a pre-treatment section arranged between the supply section and the wrapping section, for forming the rod-shaped filler material by folding the sheet material supplied from the roll and supplying the formed filler material to the wrapping section. In this case, the sheet material preferably contains particles of activated carbon distributed on one face thereof.

[0021] Even if the filler material is formed by folding of the sheet material and thus, the circumferential length of the continuum may easily fluctuate, the rod forming machine of the present invention can maintain the circumferential length of the filler material, that is, the rod within the tolerable range with high accuracy.

[0022] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirits and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus, are not limitative of the present invention, and wherein:

Fig. 1 is an outline diagram illustrating a rod forming machine of an embodiment;
Fig. 2 is a perspective view illustrating a sheet material supplied from a sheet roll in Fig. 1;
Fig. 3 is a view illustrating a cross section of a filter material supplied to a wrapping section from the forming device

in Fig. 1; and
Fig. 4 is a cross-sectional view of a compression/forming passage defined between a transfer path and a forming tongue.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Fig. 1 shows a rod forming machine of an embodiment.

[0025] The rod forming machine is provided with a supply section 10 of a sheet material, a pre-treatment section 12, a wrapping section 14, and a cutting section 16, and these sections are sequentially arranged from the left side in Fig. 1.

[0026] The supply section 10 includes a roll Rf of a sheet material Sr, and the sheet material Sr is supplied from the roll Rf. As shown in Fig. 2, the sheet material Sr has a web S made of an unwoven fabric of pulp fibers and particles r of activated carbon distributed on the whole area of one face of the web S.

[0027] The sheet material Sr supplied from the roll Rf is received by the pre-treatment section 12, that is, its forming device 24. When the sheet material Sr passes through the forming device 24, the forming device 24 folds the sheet material Sr so as to form a multi-layered structure, that is, a rod-shaped filter material (filler material) F as shown in Fig. 3. Therefore, the supply section 10 and the pre-treatment section 12 collaborate with each other so as to supply the filter material F toward the wrapping section 14.

[0028] The wrapping section 14 is provided with a horizontal transfer path for receiving the filter material F. In more detail, the transfer path includes a forming bed 60 (See Fig. 4), and the forming bed 60 has a forming groove 62 extending along the transfer path on an upper face thereof. To this forming groove 62, an endless garniture tape 34 is introduced through guide rollers, and the garniture tape 34 is passed around a driving drum 36 under the transfer path. When the driving drum 36 is rotated, the garniture tape 34 runs in a transfer direction of the filter material F in the forming groove 62.

[0029] On the other hand, one 38 of the guide rollers is arranged between the transfer path, that is, the forming bed 60 and the forming device 24, and to the guide roller 38, wrapping paper P is supplied. The wrapping paper P is fed onto the garniture tape 34 in the transfer path via the guide roller 38. When the above-mentioned filter material F is supplied to the garniture tape 34 from the forming device 24, the filter material F is overlapped over the garniture tape 34 through the wrapping paper P. Thus, when the garniture tape 34 is made to run, the filter material F and the wrapping paper P are transferred along the transfer path together with the garniture tape 34.

[0030] Also, in the supply path of the wrapping paper P, a pair of glue applicators 40 is arranged on upstream of the guide roller 38. The glue applicators 40 apply glue (vinyl acetate) on the center in the width direction of the wrapping paper P and forms two glue bands on the wrapping paper P, and the glue bands extend in parallel with each other in the longitudinal direction of the wrapping paper P. Therefore, when the filter material F is supplied onto the wrapping paper P, the filter material F and the wrapping paper P are bonded to each other through the glue bands. Moreover, another glue applicator 42 is arranged between the glue applicators 40 and the guide roller 38, and the glue applicator 42 applies an adhesive (hot melt) on one side edge of the wrapping paper P.

[0031] The wrapping section 14 includes a forming tongue 44, forming holders (not shown), a cooler 48 with a heater 46 and the like. The forming tongue 44, the forming holders, and the cooler 48 are sequentially arranged immediately above the transfer path from the beginning end side of the wrapping section 14 and define a compression/forming passage, a wrapping passage, and a heating/cooling passage, respectively, between them and the forming bed.

[0032] The compression/forming passage has a substantially circular section, but the passage sectional area is gradually decreased from its upstream end toward the downstream end. Therefore, when the filter material F and the wrapping paper P pass through the compression/forming passage together with the garniture tape 34, the rod-shaped filter material F is gradually throttled between the forming tongue and the forming groove of the forming bed through the garniture tape 34 and the wrapping paper P, while the rod shape is maintained. As a result, the filter material F is compressed and formed to a desired diameter. At this time, the wrapping paper P is folded in the U-shape together with the garniture tape 34.

[0033] After that, when the filter material F passes through the forming holders, that is, the wrapping passage with the wrapping paper P, prior to one side edge of the above-mentioned wrapping paper P, the other side edge of the wrapping paper P is formed in an arc state so as to cover an upper half of the filter material F. Subsequently, the one side edge of the wrapping paper P is formed in the arc state so as to cover the remaining upper half of the filter material F, overlapped with the other side edge of the wrapping paper P through the hot melt and bonded to the other side edge. At this time, the filter material F is completely wrapped by the wrapping paper P to be a continuum F1, and the continuum F1 has an overlap portion formed by both side edges of the wrapping paper P on its outer face.

[0034] After that, when the continuum F1 passes through the cooler 48 with the heater 46, that is, the heating/cooling passage, the adhesive of the overlap portion, that is, the hot melt is once heated and melted by the heater 46 and then, rapidly cooled by the cooler 48. Thus, the hot melt is solidified so as to firmly bond the both side edges of the wrapping paper P at the overlap portion.

[0035] After that, the continuum F1 is fed out from the terminal end of the wrapping section 14 toward the cutting

section 16. When the continuum F1 passes through the cutting section 16, the continuum F1 is cut by a rotary knife 50 in the cutting section 16 to a predetermined length, by which an individual filter rod F2 is formed. The filter rods F2 are received by a conveyer (not shown) from the cutting section 16. The conveyer transports the filter rods F2 toward a packing machine (not shown).

[0036] In a process where the filter rods F2 are transported on the conveyer, the filter rods F2 are regularly sampled by a measuring device 52. The measuring device 52 measures a circumferential length of the sampled filter rod F2 and supplies the measurement result to an adjusting device 54.

[0037] In more detail, the measuring device 52 continuously measures diameters of the filter rod F2 in the circumferential direction and first acquires an average diameter of the filter rod F2. After that, the measuring device 52 determines if the circumferential length calculated from the average diameter is within a tolerable range or not. Based on the determination result, if the circumferential length of the filter rod F2 is deviated from the tolerable range, the measuring device 52 supplies a control signal to increase or decrease the circumferential length of the filter rod F2 to the adjusting device 54.

[0038] As obvious from Fig. 1, the adjusting device 54 is arranged at the above-mentioned forming tongue 44. Specifically, the adjusting device 54 includes a vertical rod 56 connected to the forming tongue 44 and an actuator for elevating up/down the rod 56, that is, a servo motor 58, and the servo motor 58 is operated on the basis of the above-mentioned control signal from the measuring device 52. That is, when the servomotor 58 receives a control signal to increase the circumferential length, the servo motor 58 operates to raise the rod 56, that is, the forming tongue 44.

[0039] In this case, as obvious from Fig. 4, the compression/forming passage 64 defined between the forming groove 62 of the forming bed 60 and the tongue 44 has an increased passage sectional area at the outlet thereof, by which the diameter of the filter material F, that is, the diameter of the continuum F1 is increased.

[0040] On the other hand, when the servo motor 58 receives a control signal to decrease the circumferential length, the servo motor 58 operates to lower the forming tongue 44, by which the passage sectional area at the outlet of the compression/forming passage 64 is decreased, and the diameter of the continuum F1 is decreased.

[0041] As mentioned above, on the basis of the circumferential length of the filter rod F2 measured by the measuring device 52, the diameter of the continuum F1 is feed-back controlled by the forming tongue 44, and as a result, the circumferential length of the filter rod F2 is maintained in the tolerable range including the normal value with high accuracy.

[0042] In control of the circumferential length of the filter rod F2, even if the forming tongue 44 is elevated up/down as mentioned above, the above-mentioned cooler 48 with the heater 46 can give a constant pressing force to the overlap portion of the continuum F1. Thus, there is not excess or loss generated in a compression bonding force onto the overlap portion, but adhesion at the overlap portion can be stably maintained. As a result, without incurring breakage in the wrapping paper P, stable formation of the continuum F1 is realized.

[0043] The present invention is not limited to the above-mentioned embodiment but capable of various variations.

[0044] For example, the above-mentioned adjusting device 54 may be provided at the cooler 48 with heater 46 in addition to the forming tongue 44, and in this case, the adjusting device 54 brings/separates the cooler 48 with heater 46 close to/from the transfer path vertically on the basis of the result measured by the measuring device 52. Even if the cooler 48 with heater 46 is moved up/down as above, the passage sectional area of the heating/cooling passage is increased or decreased, and the diameter of the continuum F1 can be similarly adjusted.

[0045] Using the rod forming machine provided with the adjusting device 54 at the cooler 48 with heater 46, the filter rods F2 are manufactured from October to December and then, arrangement of the adjusting device 54 is changed from the cooler 48 with heater 46 to the tongue 44 and the filter rods F2 are manufactured from January to April.

[0046] At this time, Tables 1, 2 show change in occurrences of wrapping defects of the wrapping paper P in the continuum F1, average values of the circumferential length and roundness averages of the filter rod F2, and variations of the circumferential length and roundness, respectively.

Table 1

	Arrangement of adjusting device: cooler			Arrangement of adjusting device: forming tongue			
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Occurrences of wrapping defects	4	6	4	0	0	1	0
Number of manufactured rods (million)	38	41	24	37	43	36	25

Table 2

	Arrangement of adjusting device: cooler			Arrangement of adjusting device: forming tongue			
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Average of circumferential length (mm)	24.12	24.13	24.13	24.13	24.13	24.13	24.13
Variation in circumferential length	0.100	0.092	0.090	0.096	0.090	0.085	0.085
Average of roundness (mm/10)	2.5	2.5	2.7	2.5	2.5	2.4	2.3
Variation in roundness	0.70	0.73	0.75	0.72	0.72	0.62	0.64

[0047] As obvious from Table 1, the rod forming machine provided with the adjusting device 54 at the forming tongue 44 more effectively prevents occurrence of wrapping defects of the wrapping paper P in the continuum F1 than the rod forming machine provided with the adjusting device 54 at the cooler 48 with heater 46. Thus, it is preferable that the adjusting device 54 is arranged at the forming tongue 44 rather than at the cooler 48 with heater 46.

[0048] However, as obvious from Table 2, whether the adjusting device 54 is arranged at either of the forming tongue 44 or the cooler 48 with heater 46, there is no difference in the average of the circumferential length, roundness average and the like of the filter rod F2. Thus, if the adjusting device 54 is arranged at both of the forming tongue 44 and the cooler 48 with heater 46, respectively, the circumferential length of the filter rod F2 can be controlled with higher accuracy.

[0049] In this case, the adjusting devices 54 on the side of the forming tongue 44 and the side of the cooler 48 with heater 46 may be also used for rough adjustment and fine adjustment of the circumferential length in the filter rod F2, respectively.

[0050] On the other hand, the rod forming machine of the present invention may be a machine for forming a rod using a sheet material not including particles of activated carbon and a filter material made of a bundle of acetate fibers, a filter material including a particle of activated carbon in the bundle or a sheet material disclosed in the above-mentioned document as the filler material.

[0051] Also, the present invention is not limited to a rod forming machine for forming a filter rod for a filter cigarette but can be similarly applied to a rod forming machine for forming various rods.

[0052] Moreover, the adjusting device may be capable of manually adjusting elevation of the forming tongue at replacement of the garniture tape or roll.

Claims

1. A rod forming machine comprising:

a wrapping section (14) for forming a rod-shaped continuum (F1) by wrapping a filler material with a wrapping material and feeding out the formed continuum (F1), the continuum (F1) having an overlap portion of the wrapping material on an outer circumferential face thereof and the overlap portion being formed by both side edges of the wrapping material overlapped with each other and bonded by an adhesive,
wherein said wrapping section (14) further includes a transfer path for guiding transfer of the filler material and the wrapping material, the transfer path having a compression/forming passage for compressing and forming the filler material in a rod shape, a wrapping passage connected to downstream of the compression/forming passage, for forming the continuum by wrapping the compressed/formed filler material with the wrapping material, and a heating/cooling passage connected to downstream of the wrapping passage, for heating the adhesive of the overlap portion section of the continuum and then, cooling the adhesive of the overlap portion; and
a cutting section (16) for cutting the continuum (F1) fed out of said wrapping section (14) to a rod (F2) of a predetermined length,
characterized in that said rod forming machine further comprises measuring means (52) for measuring a circumferential length of the rod; and
adjusting means (54) for adjusting a passage sectional area of at least one passage in said wrapping section (14) on the basis of a measurement result by said measuring means (52).

2. The rod forming machine according to claim 1, **characterized in that**

the transfer path further has a forming bed (60).

3. The rod forming machine according to claim 2, **characterized in that**

the compression/forming passage is defined between the forming bed (62) and a forming tongue (44); and said adjusting means (58) includes an actuator (58) for bringing/separate the forming tongue (44) close to/from the forming bed (60).

4. The rod forming machine according to claim 2, **characterized in that**

the heating/cooling passage is defined between the forming bed (60) and a cooler (48) with heater; and said adjusting means (54) includes an actuator (58) for bringing/separate said cooler (48) with heater close to/from the forming bed (60).

5. The rod forming machine according to claim 3 or 4, **characterized in that**

said rod forming machine further comprises a supply section (10) of the filler material arranged on upstream of said wrapping section and including a roll (Rf) of a sheet material (Sr) as a filter material of a cigarette; and a pre-treatment section (12) arranged between said supply section (10) and said wrapping section (14), for forming a rod-shaped filler material (F) by folding the sheet material (Sr) supplied from the roll (Rf) and supplying the formed filler material (F) toward said wrapping section (14).

6. The rod forming machine according to claim 5, **characterized in that**

the sheet material (Sr) includes particles (r) of activated carbon distributed over one face thereof.

FIG. 1

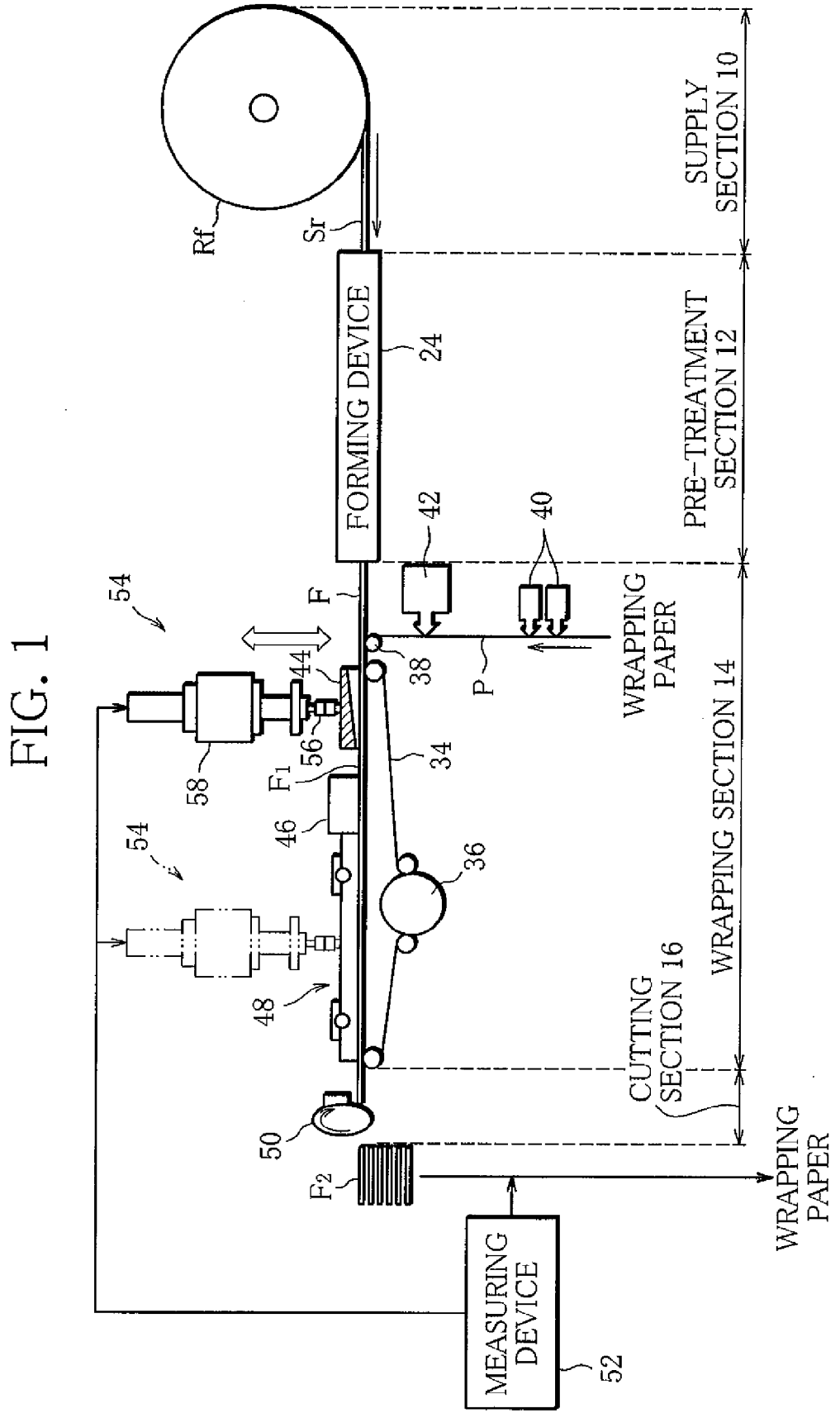

SUPPLY SECTION 10
PRE-TREATMENT SECTION 12
WRAPPING SECTION 14
CUTTING SECTION 16
FORMING DEVICE
24
Rf
Sr
42
40
38
P
WRAPPING PAPER
54
F
44
56
58
F1
34
46
36
48
50
F2
MEASURING DEVICE
52
WRAPPING PAPER

FIG. 2

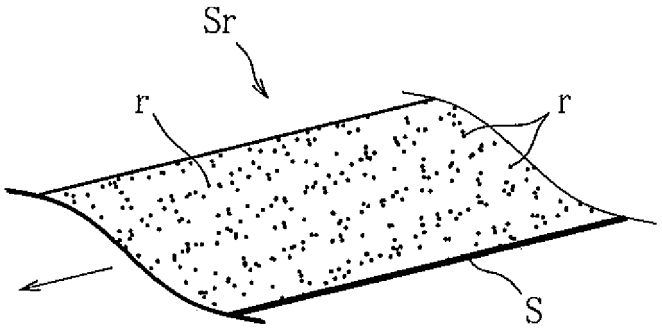


FIG. 3

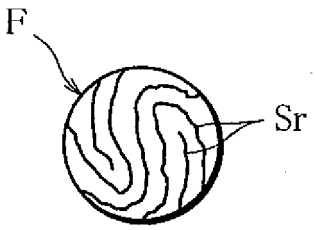
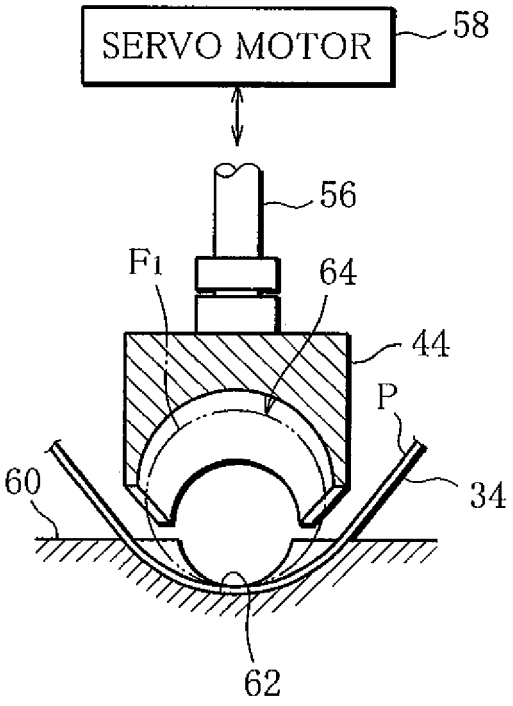


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 08 16 8433

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 3 380 351 A (COX EDWARD W ET AL) 30 April 1968 (1968-04-30) * column 2, line 35 - column 8, line 54; figures 12-5 *	1	INV. A24C5/34 A24D3/02
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A	US 3 345 917 A (AGETT ALBERT H ET AL) 10 October 1967 (1967-10-10) * column 3, line 51 - column 4, line 73; figures 1,10 *	1	
D,A	EP 1 314 363 A1 (JAPAN TOBACCO INC [JP]) 28 May 2003 (2003-05-28) * paragraph [0022] - paragraph [0037]; figure 1 *	1-6	TECHNICAL FIELDS SEARCHED (IPC) A24C A24D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 March 2009	Maier, Michael

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 16 8433

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09-03-2009

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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