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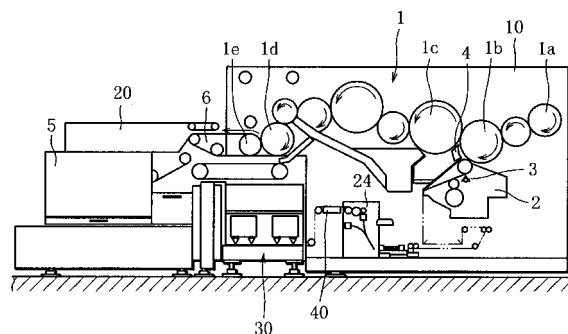
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(54) **CIGARETTE MAKING**

(57) A cigarette making apparatus comprises a filter-plug attachment mechanism arranged to butt a filter plug coaxially against a cigarette and then wrap tip paper around the cigarette and filter plug to cover a joint where the cigarette and the filter plug meet, a laser hole-forming device arranged to form air holes in the tip paper by projecting laser light onto the side of the tip paper intended

to contact the cigarette and filter plug (back side), while the tip paper is being supplied to the filter-plug attachment mechanism, and an air-permeability measurement device arranged to measure the air permeability of the tip paper with the air holes formed, wherein the air-flow resistance V_f of a filter-tipped cigarette is adjusted by feedback-controlling the laser hole-forming device on the basis of the air permeability measured.

FIG. 1



Description

Technical Field

[0001] This invention relates to a cigarette making apparatus for making a filter-tipped cigarette with a filter plug attached to the end of a cigarette, by butting the cigarette and the filter plug and wrapping tip paper around them to cover a joint where they meet.

Background Art

[0002] As disclosed in Japanese Unexamined Patent Publication No. Hei 4-316474, for example, a filter-tipped cigarette is made by butting a filter plug coaxially against a rod-like cigarette, which is formed by wrapping cut tobacco in wrapping paper, and wrapping tip paper around them to cover a joint where they meet. In some cases, in advance of this process, air holes are formed in the tip paper to adjust the air-flow resistance V_f of the filter-tipped cigarette, as disclosed in U.S. Patent No. 6,675,811, for example. In other cases, the air-flow resistance V_f of the filter-tipped cigarette is adjusted by forming air holes in the tip paper already wrapped around the cigarette and filter plug butted.

[0003] The air-flow resistance V_f of a filter-tipped cigarette depends on the quality of cut tobacco, the hardness of a cigarette (the amount of cut tobacco packed), etc. Hence, even if air holes are formed in the tip paper in advance to adjust the air-flow resistance (hole-related air permeability) of the tip paper as in the first-mentioned case, it cannot guarantee the air-flow resistance V_f of the end product, i.e., filter-tipped cigarette. Meanwhile, when air holes (referred to as "rod holes") are formed by projecting a laser beam onto the tip paper already wrapped around the cigarette and filter plug butted as in the second-mentioned case, there is produced a problem such that holes formed extend into the filter plug located inside the tip paper. This also leads to problems such that due to the laser beam projected, the taste of the cigarette changes, and that the filter plug burnt produces a burnt smell. Further, it is necessary to remove ash produced in forming the air holes (residue left after the burning of the tip paper).

Disclosure of the Invention

[0004] The primary object of this invention is to provide a cigarette making apparatus capable of forming appropriate air holes in tip paper without causing the above-mentioned problems and easily adjusting the air-flow resistance V_f of a filter-tipped cigarette.

[0005] In order to achieve this object, a cigarette making apparatus according to this invention comprises, as stated in claim 1,

(a) a filter-plug attachment mechanism arranged to attach a filter plug to the end of a cigarette by butting

the filter plug coaxially against the cigarette and then wrapping tip paper around the cigarette and filter plug to cover a joint where the cigarette and the filter plug meet,

(b) a laser hole-forming device provided in a path along which the tip paper is supplied to the filter-plug attachment mechanism, and arranged to form air holes in the tip paper by projecting laser light onto the side of the tip paper intended to contact the cigarette and filter plug (back side), and

(c) an air-permeability measurement device provided forward of the laser hole-forming device and arranged to measure the air permeability of the tip paper with the air holes formed.

[0006] Desirably, as stated in claim 2 [sic], the laser hole-forming device is arranged such that the output power of the laser light and/or the laser light projection period is feedback-controlled on the basis of output of the air-permeability measurement device.

[0007] Thus, in the cigarette making apparatus according to this invention, the air-flow resistance (hole-related air permeability) of the tip paper can be adjusted in real time by forming minute air-holes in the tip paper by projecting laser light while the tip paper is being supplied to the filter-plug attachment mechanism. In this description, this technique is called pre-forming of holes. Further, by projecting the laser light onto the side of the tip paper intended to contact the cigarette (back side), it is arranged that a burnt part produced around an air hole when the air hole is formed comes to the inner side of the wrapped tip paper in the filter-tipped cigarette completed, and therefore does not appear on the outside of the filter-tipped cigarette (not visible externally).

[0008] Here, it is desirable to control the air-flow resistance (hole-related air permeability) to be imparted to the tip paper, on the basis of the air-flow resistance V_f of the filter-tipped cigarette produced.

[0009] As stated in claim 3 [sic], the cigarette making machine according to the present invention may further comprise

(d) a traveling position sensor provided backward [sic] of the laser hole-forming device and arranged to detect the widthwise position of the tip paper traveling, and

(e) a meandering correction mechanism provided forward [sic] of the laser hole-forming device and arranged to correct the widthwise position of the tip paper traveling, on the basis of the result of detection by the traveling position sensor.

[0010] Desirably, as stated in claim 4 [sic], the meandering correction mechanism includes a turn bar arranged to be oblique relative to the width of the tip paper to change the direction of traveling of the tip paper, and a slide mechanism arranged to slide the turn bar along the width of the tip paper on the basis of the result of

detection by the traveling position sensor.

[0011] Thus, in the cigarette making apparatus according to this invention, by forming air holes in the tip paper by means of the laser hole-forming device while correcting the meandering of the tip paper, the holes are positioned with high accuracy, so that the tip paper with the air holes formed has an improved quality. Further, by forming air holes at regular positions, the filter-tipped cigarette can be easily made to have a fixed air-flow resistance V_f .

[0012] In the cigarette making apparatus arranged as described above, air-holes are formed in the tip paper online while the tip paper is being supplied to the filter-plug attachment mechanism. Hence, the air-flow resistance (hole-related air permeability) to be imparted to the tip paper can be controlled in real time on the basis of the air-flow resistance V_f of the filter-tipped cigarette produced, for example. Thus, even if the air-flow resistance of the cigarette changes due to the properties of cut tobacco, etc., the filter-tipped cigarette, which is the end product, can be easily made to have a fixed air-flow resistance V_f .

[0013] Further, the air holes are formed by projecting laser light onto the back side of the tip paper, i.e., the side intended to contact the cigarette. Hence, even if a burnt part is produced on the side of the tip paper onto which the laser light is projected (back side), the burnt part comes to the inner side of the wrapped tip paper in the filter-tipped cigarette completed, and therefore is not visible externally. Thus, the filter-tipped cigarette can have an improved appearance.

[0014] Further, in the cigarette making apparatus provided with the meandering correction mechanism, the widthwise shift of the tip paper can be easily corrected. Hence, the air holes can be formed in the tip paper at correct positions, stably. Thus, the tip paper with the air holes formed at predetermined positions can be supplied to the filter-plug attachment mechanism, so that the filter-tipped cigarette can be produced with a stable quality.

Brief Description of the Drawings

[0015]

[FIG. 1] A diagram schematically showing the structure of a cigarette making apparatus in one embodiment of this invention.

[FIG. 2] A plan view showing a relevant part of the cigarette making apparatus shown in FIG. 1, with a tip paper transportation path indicated.

[FIG. 3] A diagram showing the structure of the tip paper transportation path in a region near a laser hole-forming unit.

[FIG. 4] A diagram schematically showing the structure of a laser unit constituting the laser hole-forming unit.

[FIG. 5] A diagram showing how the laser unit is controlled.

Best Mode of Carrying out the Invention

[0016] Referring to the drawings, a filter-tipped cigarette making apparatus in one embodiment of this invention will be described.

[0017] This cigarette making apparatus makes a filter-tipped cigarette basically by butting a filter plug coaxially against a rod-like cigarette, which is made by a cigarette rolling-up machine (not shown) by wrapping cut tobacco in wrapping paper, and then wrapping tip paper with a glue (adhesive) applied on one side, around the cigarette and filter plug to cover the joint where they meet to thereby firmly join the cigarette and filter plug butted.

[0018] FIG. 1 schematically shows the overall structure of the cigarette making apparatus, and as shown there, the cigarette making apparatus comprises, as a major constituent, a filter-plug attachment mechanism 10 including a drum series 1, namely a transverse series of transportation drums. The transportation drums in the filter-plug attachment mechanism 10 each have a plurality of holding grooves formed in the cylindrical surface, at equal intervals in the circumferential direction of the drum, parallel to the axis of the drum, for holding a cigarette and a filter plug in a state that they are aligned along the axis of the drum. As the transportation drums rotate, the cigarette and filter plug are transferred from drum to drum successively, or in other words, the cigarette and filter plug are transported along the transportation path given by the drum series 1, in the manner that they transfer from transportation drum to transportation drum successively.

[0019] It is to be noted that the cigarette which is made by the cigarette rolling-up machine (not shown) and supplied to the filter-plug attachment mechanism 10 has twice the length of a single cigarette included in the end product, and is called a double-length cigarette. In the filter-plug attachment mechanism 10, this double-length cigarette is cut into two single cigarettes by a rotary knife (not shown), and the two single cigarettes are separated along the axial direction. Then, a filter plug supplied from a rod hopper (not shown) is placed between the two single cigarettes, and the two single cigarettes are drawn toward the center and coaxially butted against the filter plug on both sides. It is to be noted that the filter plug placed between the single cigarettes has twice the length of a filter included in the end product, i.e., filter-tipped cigarette.

[0020] More specifically, the double-length cigarette made by the cigarette rolling-up machine is supplied to a separation drum 1a in the drum series 1 shown in FIG. 1. On the separation drum 1a, the double-length cigarette is cut by a rotary knife, and the resultant two single cigarettes, which are in a coaxially butted state, are transferred to a hopper drum 1b. Then, on the hopper drum 1b, a filter plug is placed between the two single cigarettes in a coaxially butted manner.

[0021] To the hopper drum 1b, there is also supplied a tip-paper piece prepared by applying a glue (adhesive)

onto one side of tip paper in a gummer unit 2 (described later) and cutting it to a specified length by a cutter drum 3. An end of the tip-paper piece is stuck to the cylindrical surface of the filter plug and two single cigarettes held on the hopper drum 1b, in a region including the two joints where each single cigarette meets the filter plug. As the hopper drum 1b rotates, the filter plug and two single cigarettes rotate between the hopper drum 1b and a rolling plate 4 provided to face the cylindrical face of the hopper drum 1b, so that the tip-paper piece is wrapped around the filter plug and two single cigarettes. Thus, by the tip-paper piece glued to and wrapped around the filter plug and single cigarettes in the region including the two joints, the two single cigarettes are coaxially joined to the filter plug on both sides to form an integrated whole called a double filter cigarette.

[0022] The double filter cigarette formed as an integrated whole by wrapping the tip-paper piece is transported by the transportation drums 1c to 1d following the hopper drum 1b, successively. During this transportation process, the double filter cigarette is cut at the center of the filter plug to form two single filter cigarettes (filter-tipped cigarettes). The single filter cigarettes formed are sent to a roll supply section 5, except for defective ones, which are removed.

[0023] Specifically, one of the two single filter cigarettes formed by cutting a double filter cigarette is sent to the roll supply section 5 with the direction unchanged, while the other is turned by 180° by means of a turning drum 1e and sent to the roll supply section 5 with the reversed direction. Consequently, all the single filter cigarettes 5 are sent to the roll supply section 5 with the same direction. The single filter cigarettes are sent from the roll supply section 5 to a packaging apparatus (not shown), successively.

[0024] The filter-plug attachment mechanism 10 arranged like this is presented in detail in the above-mentioned Japanese Unexamined Patent Publication No. Hei 4-316474, etc. The arrangement of the drum series 1 and the specific structure of the transportation drums 1a, 1c to 1d, hopper drum 1b, etc. can be modified in various ways, according to the specifications. Regarding the gummer unit 2, any type can be used, provided that it has a function of applying a glue (adhesive) onto one side of the tip paper, cutting it into tip-paper pieces of a specified length using a cutter drum 3, and supplying the tip-paper pieces successively to the cigarettes as intermediate products held on the hopper drum 1b.

[0025] FIG. 2 schematically shows the plane structure of this cigarette making apparatus, and as seen from this drawing, the tip paper is continuously supplied to the filter-plug attachment mechanism 10 from a tip paper supply section 20 arranged behind the roll supply section 20. The tip paper supply section 20 supplies the tip paper, which is a long strip of a specified width, to the gummer unit 2 of the filter-plug attachment mechanism 10 along a supply path 22 by continuously unwinding the tip paper wound around a paper drum 21. As shown in FIG. 2, the

supply path 22 is provided such that the tip paper sent from an exist of the tip paper supply section 20 is turned to travel toward the front face of the cigarette making apparatus, then at a front part of the cigarette making apparatus, turned to travel toward a lower part of the front face of the filter-plug attachment mechanism 10, and supplied to the gummer unit 2.

[0026] Thus, the tip-paper supply path 22 is provided such that the tip paper is led from the tip paper supply section 20 located behind (to the back side of) the filter-plug attachment mechanism 10 to the gummer unit 2, utilizing the space left in the existing filter-plug attachment mechanism 10 and changing the direction of traveling, appropriately. In particular, in the middle of the tip-paper supply path 22, a laser hole-forming unit 30 (described later) for forming air holes in the tip paper is provided. The laser hole-forming unit 30 is provided utilizing the space between the filter-plug attachment mechanism 10 and the roll supply section 5. Forward of the laser hole-forming unit 30, there is provided an air-permeability measurement unit 40 for measuring the air-flow resistance (air permeability) of the tip paper with air holes formed.

[0027] More specifically, the tip paper P is sent from the tip paper supply section 20, through a first reservoir 23. The tip paper P coming out of the exist of the tip paper supply section 20 is turned to the front side of the cigarette making apparatus by means of a turn bar 22a, and led to the laser hole-forming unit 30. The tip paper P that has passed through the laser hole-forming unit 30 and therefore has air holes formed is led to the air-permeability measurement unit 40. After the air permeability is measured, the tip paper is led to a second reservoir 24, and from the second reservoir 24 continuously supplied to the gummer unit 2.

[0028] As shown in FIG. 3, forward of the laser hole-forming unit 30, there is provided a feed roller 25 for feeding the tip paper P at a fixed speed. Backward of the laser hole-forming unit 30 is provided a movable turn bar mechanism 26 for changing the direction of the tip paper P sent to the front side of the cigarette making apparatus by 90° to thereby lead the tip paper to the laser hole-forming unit 30. The movable turn bar mechanism 26 includes a turn bar 26a arranged at an angle 45° to the direction of traveling of the tip paper P. By shifting in the direction parallel to the width of the feed roller 25, the turn bar 26a shifts the position of the tip paper P traveling, to thereby change the widthwise position of the tip paper T passing through the laser hole-forming unit 30.

[0029] Between the feed roller 25 and the laser hole-forming unit 30, there are provided photosensors 27a, 27b for detecting the positions of the side edges of the tip paper P, respectively. By the photosensors 27a, 27b, the positions of both side edges of the tip paper P with the air holes formed by the laser hole-forming unit 30 are detected as distances x1, x2 from the respective reference positions predetermined for the photosensors 27a, 27b. On the basis of the distances x1, x2 measured this

way, an operational controller 28 feedback-controls the widthwise position of the tip paper P traveling, by driving a motor 29 and thereby shifting the turn bar 26a of the movable turn bar mechanism 26 so that the difference between the distances $[x1-x2]$ will become zero (0), for example. It is to be noted that if the difference between the distances $[x1-x2]$ exceeds a control limit value, the operational controller 28 determines that the widthwise shift of the tip paper P traveling is abnormally great and gives a removal instruction.

[0030] By this function of correcting the meandering of the tip paper P which the movable turn bar mechanism 26 has, the widthwise position of the tip paper P lead (transported) to the laser hole-forming unit 30 is adjusted with high accuracy. Under this tip paper P traveling position control, air holes are formed in the tip paper P at predetermined positions by means of the laser hole-forming unit 30, successively. As shown in FIG. 3 on an enlarged scale, the laser hole-forming unit 30 is, for example, arranged to project a laser beam onto lines B1, B2, C1, C2, namely, lines located specified distances inward from respective lines A1, A2 representing the side edges of the tip paper P, at intervals, to form air holes in four lines along the length of the tip paper P, successively.

[0031] It is to be noted that the tip paper P is lead to the laser hole-forming unit 30 with the back side facing a laser beam projection source (laser head). The back side of the tip paper P is the side on which the glue is applied by the gummer unit 2 and which contacts the cigarette and filter plug when the tip paper is wrapped around them in the filter-plug attachment mechanism 10. In other words, the back side of the tip paper P is the side which is located inside and not exposed externally when the tip paper P is wrapped around the cigarette and filter plug. Thus, the laser hole-forming unit 30 is arranged to project a laser beam onto the back side of the tip paper P to form air holes.

[0032] The air-permeability measurement unit 40 for measuring the air permeability of the tip paper P with the air holes formed includes, for example, a suction table (not shown) provided along the tip paper P transportation path, and is arranged to draw the tip paper P to the surface of the suction table by means of suction holes formed in the suction table so that the tip paper P travels on the suction table at a fixed speed. The air-permeability measurement unit 40 is designed to determine, from the pressure required to suck a specified amount of air through the tip paper P, the amount of air flowing in through the air holes, and from this, determine the air permeability (air-flow resistance) of the tip paper P.

[0033] The laser hole-forming unit 30 will be described more in detail below. A laser unit which forms the major part of the laser hole-forming unit 30 basically includes a CO₂ laser generation device 31 as shown in FIG. 4, for example. The laser unit is arranged to output-control the laser light L generated by the CO₂ laser generation device 31, by means of an acoustooptic modulator(AOM) 32, such that only part of the laser light L is modulated

into pulses (rectangular) and projected, while the excess laser light, namely the part of the laser light L not allowed to be projected is absorbed by a dumper 33 formed from a laser-light absorbing material. Further, the laser unit is arranged such that the laser light L emitted selectively in the form of pulses by means of the AOM 32 is expanded in diameter by a beam expanding lens 34, then condensed into a beam by means of a condensing lens 35 and projected onto the tip paper P.

[0034] Reference signs 36a, 36b to 36g in FIG. 4 denote total reflecting mirrors determining the light path of the laser light L. Reference sign 37 denotes a light-dividing mirror for dividing the laser light L emitted from the AOM 32 into two light paths. Reference signs 38, 38 denote shutters inserted in the respective light paths of the divided laser light L.

[0035] Specifically, the laser unit is arranged to lead the laser light L emitted from the CO₂ laser generation device 31, which is particularly long and great, to the AOM 32 located over the CO₂ laser generation device 31, by turning the laser light L upward of the CO₂ laser generation device 31 and then backward by means of the total reflecting mirrors 36a, 36b forming two stages. Over the CO₂ laser generation device 31, the laser light L output-controlled by the AOM 32 is divided into two laser beams L, L parallel in a horizontal plane, by means of the light-dividing mirror 37 and the total reflecting mirror 36e, and the resultant laser beams L, L are projected downward by means of the total reflecting mirrors 36f, 36g and the condensing lenses 35, 35. Like this, the laser unit is made compact by arranging an optical system over the long and great CO₂ laser generation device 31, or in other words, arranging the optical system and the CO₂ laser generation device 31 in a two-storied structure.

[0036] The laser hole-forming unit 30 includes two of the laser units as shown in FIG. 4, arranged parallel, so as to project four laser beams L in all onto the tip paper P at widthwise different predetermined positions to thereby form air holes in four lines as mentioned above. Further, as shown in FIG. 2, a cooling unit 39 is attached to the laser hole-forming unit 30 to cool the CO₂ laser generation device 31, dumper 33, etc. to ensure the stable operation thereof.

[0037] The output control of the laser light L by means of the AOM 32 will be described in brief below. As shown in FIG. 5, the CO₂ laser generation device 31 which is a laser light source is driven by applying rectangular laser-trigger pulses. By the application of the laser-trigger pulses, the CO₂ laser generation device 31 emits laser light L whose power increases with a certain delay, and decreases gradually when the laser-trigger pulse ends. If air holes are formed by projecting the laser light L whose power varies like this onto the tip paper P, the air holes formed have an elongated round shape (tear shape) as indicated by a broken line α in FIG. 5.

[0038] Thus, in the above-described laser unit, the laser light L whose power varies is lead to the acoustooptic modulator(AOM) 32, by which the laser light is modulated

into rectangular pulses so that only the part of the laser light L stable in power is projected onto the tip paper P. Consequently, the air holes formed in the tip paper P have an approximately round shape as indicated as a hatched part β in FIG. 5.

[0039] In particular, in this laser unit, when part of the laser light L emitted from the CO₂ laser generation device 31 is cut out by the AOM 32 and projected onto the tip paper P, the driving conditions for the AOM 32 are feed-back-controlled on the basis of the measured air permeability of the tip paper P with the air holes formed by projecting the laser light L. Specifically, the delay (phase) P_f relative to the laser-trigger pulse, the AOM 32 drive period P_w and the output power P_v are controlled to optimize the size and shape of the air hole.

[0040] More specifically, the laser unit extracts laser light with power optimal for forming the air hole by controlling the delay (phase) P_f , adjusts the length of the air hole by controlling the drive period P_w , and adjusts the width of the air hole by controlling the output power P_v . By adjusting the length and width of the air hole, the air permeability of the air hole and therefore the air permeability of the tip paper P is adjusted. In particular, since the output power and the projection period are controlled using the part stable in power of the laser light emitted from the CO₂ laser generation device 31, the air hole formed has a desired size and shape.

[0041] In the cigarette making apparatus arranged as described above, prior to supplying the tip paper P to the gummer unit 2 of the filter-plug attachment mechanism 10, air holes are formed (pre-formed) in the tip paper P successively, by the laser hole-forming unit 30 provided in the middle of the tip-paper transportation path 22 along which the tip paper is continuously supplied from the tip paper supply section 20 to the filter-plug attachment mechanism 10. Hence, even if the air-flow resistance of the cigarette changes due to the properties of cut tobacco and/or the amount of cut tobacco packed, the tip paper P with the air holes capable of imparting the intended air-flow resistance V_f to the end product, i.e., filter-tipped cigarette can be supplied to the filter-plug attachment mechanism 10 online, only by adjusting the size, etc. of the air holes formed in the tip paper P by changing the target value in the tip-paper P air permeability control, i.e., the reference value in the monitoring by the air-permeability measurement unit 40.

[0042] Further, in the above-described cigarette making apparatus, the air holes are formed by projecting laser light onto the back side of the tip paper P, i.e., the side which becomes the inner side when the tip paper P is wrapped around the cigarette. Hence, even if a part around the air hole is burnt, the burnt part is on the inner side of the wrapped tip paper P of the filter-tipped cigarette and not visible externally. Thus, the filter-tipped cigarette can keep a good appearance. Further, when air holes are formed in the tip paper P in the manner described above, the meandering of the tip paper P is suppressed by the movable turn bar mechanism 26, so that

the air holes can be formed in the tip paper P at predetermined positions, stably. Consequently, in the filter-tipped cigarette completed, the air holes are arranged neatly in the wrapped tip paper P. Thus, the filter-tipped cigarette can keep a good appearance.

[0043] The present invention is not limited to the above-described embodiment. Although the laser hole-forming unit 30 arranged to form air holes in the tip paper P in four lines has been presented by way of example, the present invention can be applied likewise to the case in which air holes should be formed in one line along each side edge of the tip paper, namely in two lines in all. Further, the air permeability may be adjusted by changing the pitch between the air holes. Further, the reservoirs 23, 24 may be arranged in the tip paper transportation path 22, backward and forward of the laser hole-forming unit 30, respectively, so that the tip paper P is supplied to the laser hole-forming unit 30 at a fixed speed and that a fixed tension is produced in the tip paper P between the reservoirs 23, 24. It is also favorable to provide another reservoir backward of the gummer unit 2 so that the tip paper P is supplied to the gummer unit 2 at a fixed speed.

[0044] It is also useful to measure the air permeability (air-flow resistance) of a filter-tipped cigarette sampled from those produced continuously, in an offline manner, and feed the measurement back to the laser hole-forming unit 30 to correct control parameters of air-hole forming. The present invention can be modified in other various ways without departing from the spirit and scope of the invention.

Claims

1. A cigarette making apparatus, comprising:

a filter-plug attachment mechanism arranged to butt a filter plug against a cigarette, and then join the cigarette and the filter plug by wrapping tip paper around the cigarette and filter plug to cover a joint where the cigarette and the filter plug meet,

a laser hole-forming device provided in a path along which the tip paper is supplied to the filter-plug attachment mechanism, and arranged to form air holes in the tip paper by projecting laser light onto the side of the tip paper intended to contact the cigarette and filter plug, and an air-permeability measurement device provided forward of the laser hole-forming device and arranged to measure the air permeability of the tip paper with the air holes formed.

2. The cigarette making apparatus according to claim 1, wherein the laser hole-forming device includes an acoustooptic modulator arranged to modulate only part of laser light emitted from a laser generation

device into pulses and emit the pulses.

3. The cigarette making apparatus according to claim 1, wherein the laser hole-forming device is arranged such that the output power of the laser light and/or the laser light projection period is feedback-controlled on the basis of output of the air-permeability measurement device. 5
4. The cigarette making apparatus according to claim 1, further comprising: 10
- a traveling position sensor provided forward of the laser hole-forming device and arranged to detect the widthwise position of the tip paper traveling, and 15
- a meandering correction mechanism provided backward of the laser hole-forming device and arranged to correct the widthwise position of the tip paper traveling, on the basis of the result of detection by the traveling position sensor. 20
5. The cigarette making apparatus according to claim 4, wherein the meandering correction mechanism includes a turn bar arranged to be oblique relative to the width of the tip paper to change the direction of traveling of the tip paper, and a slide mechanism arranged to slide the turn bar along the width of the tip paper on the basis of the result of detection by the traveling position sensor. 25 30

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FIG. 1

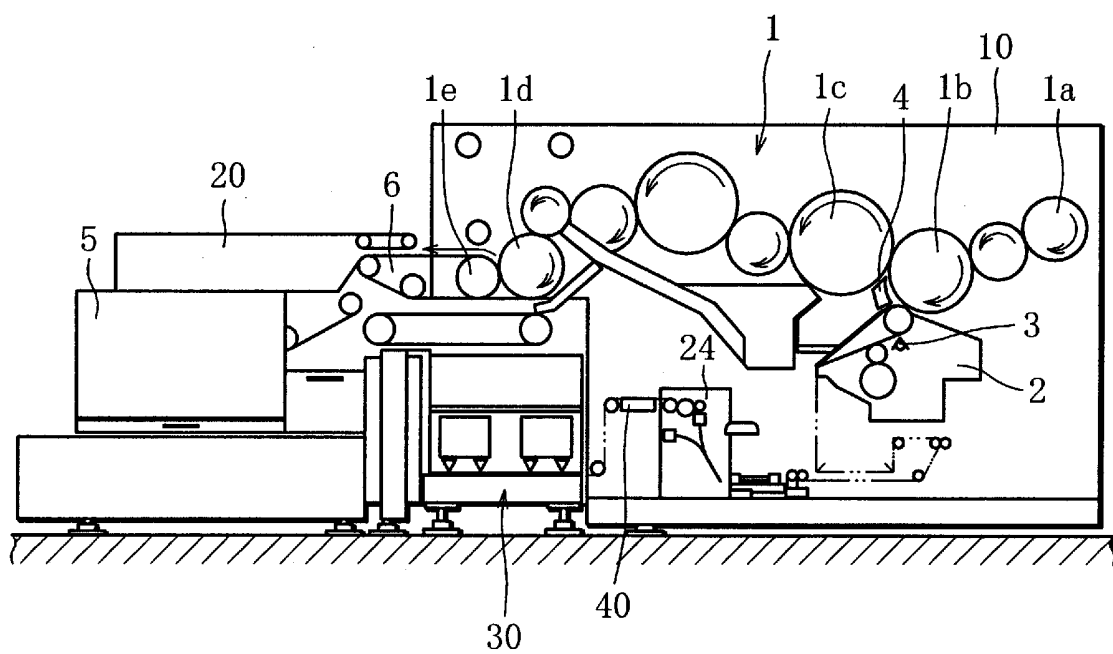


FIG. 2

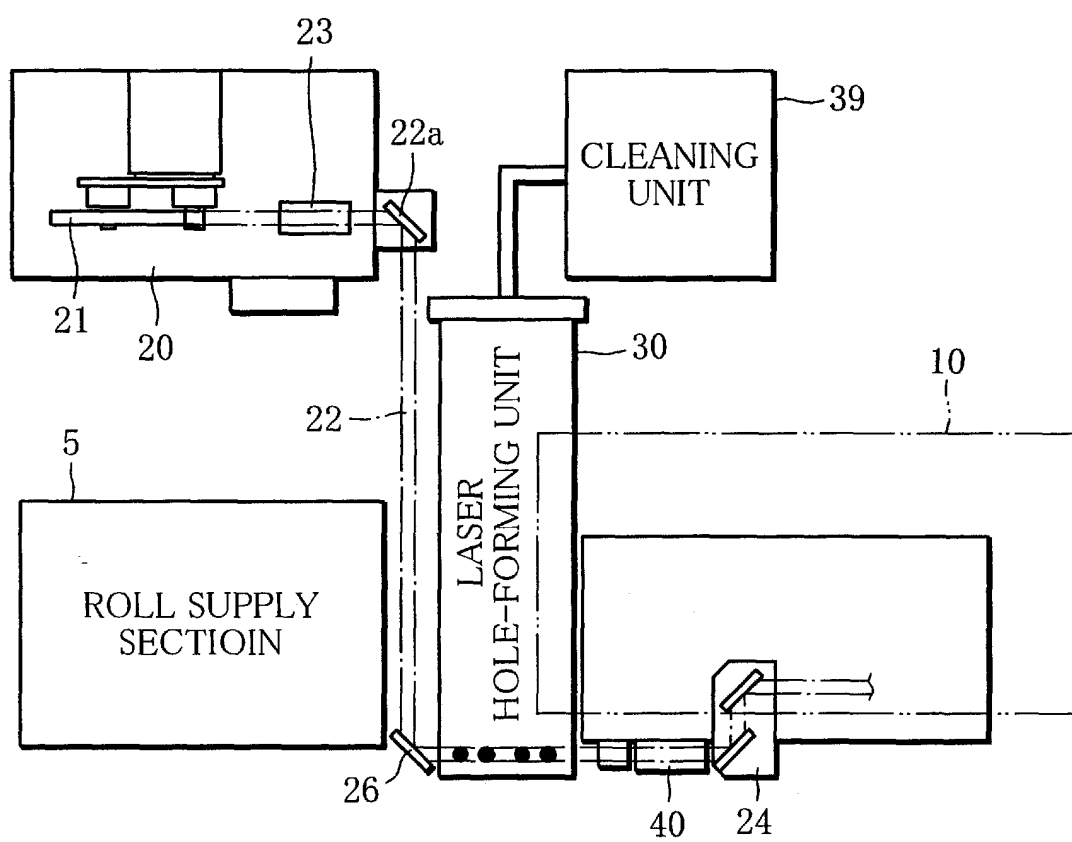


FIG. 3

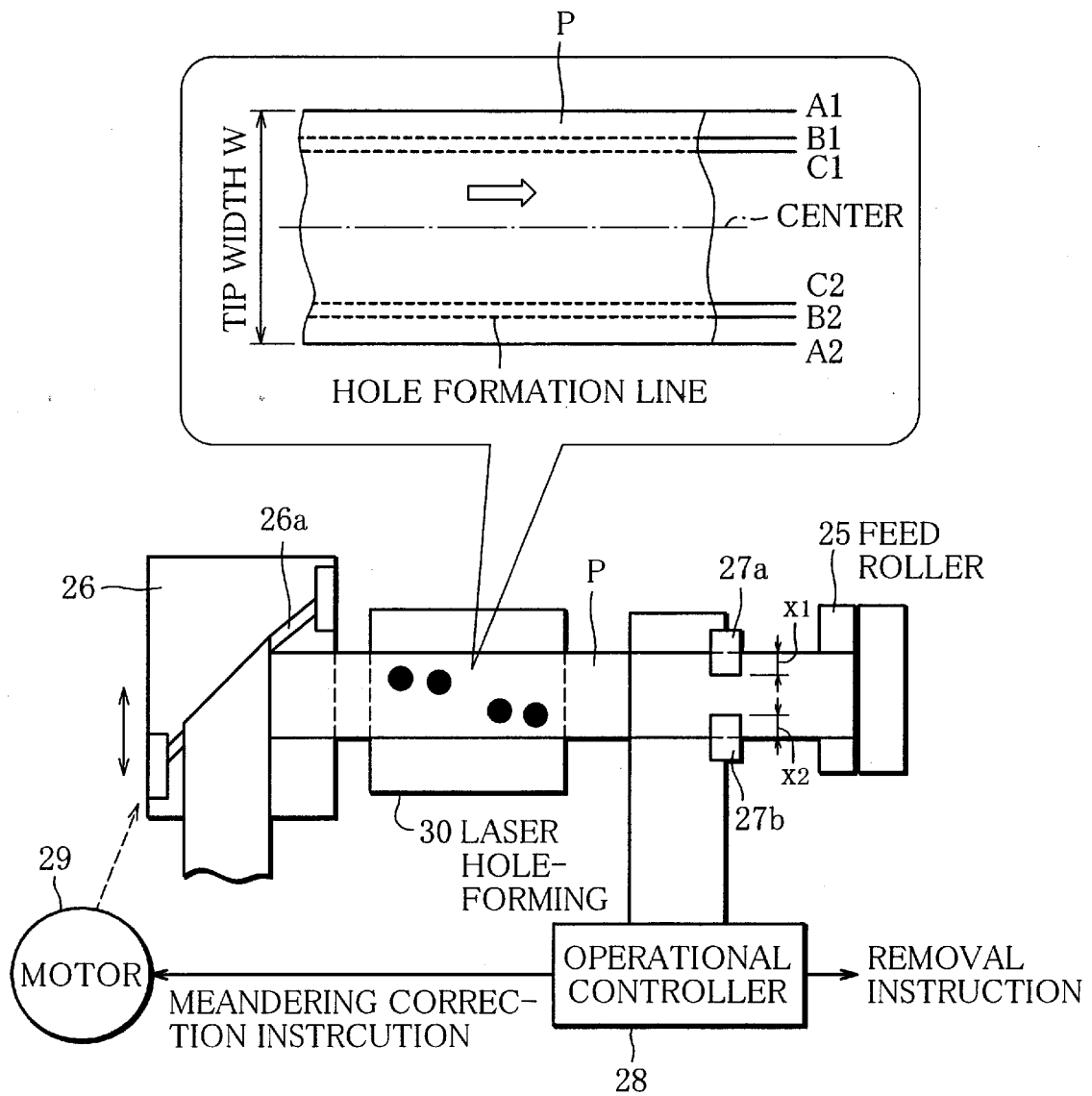


FIG. 4

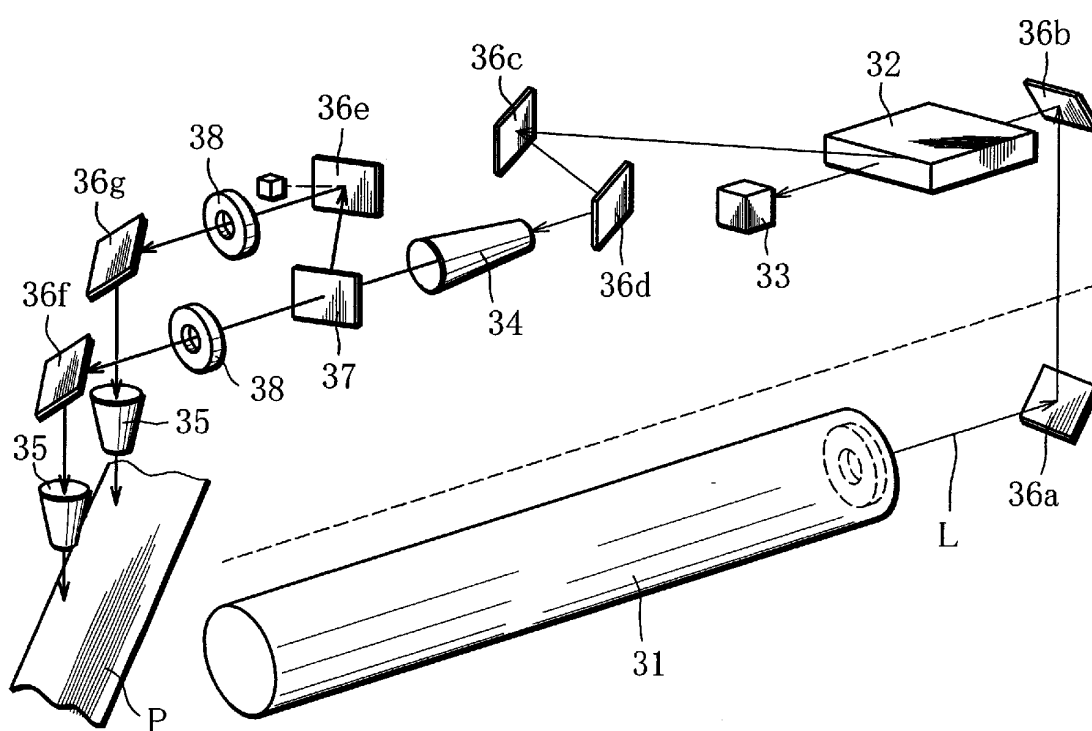
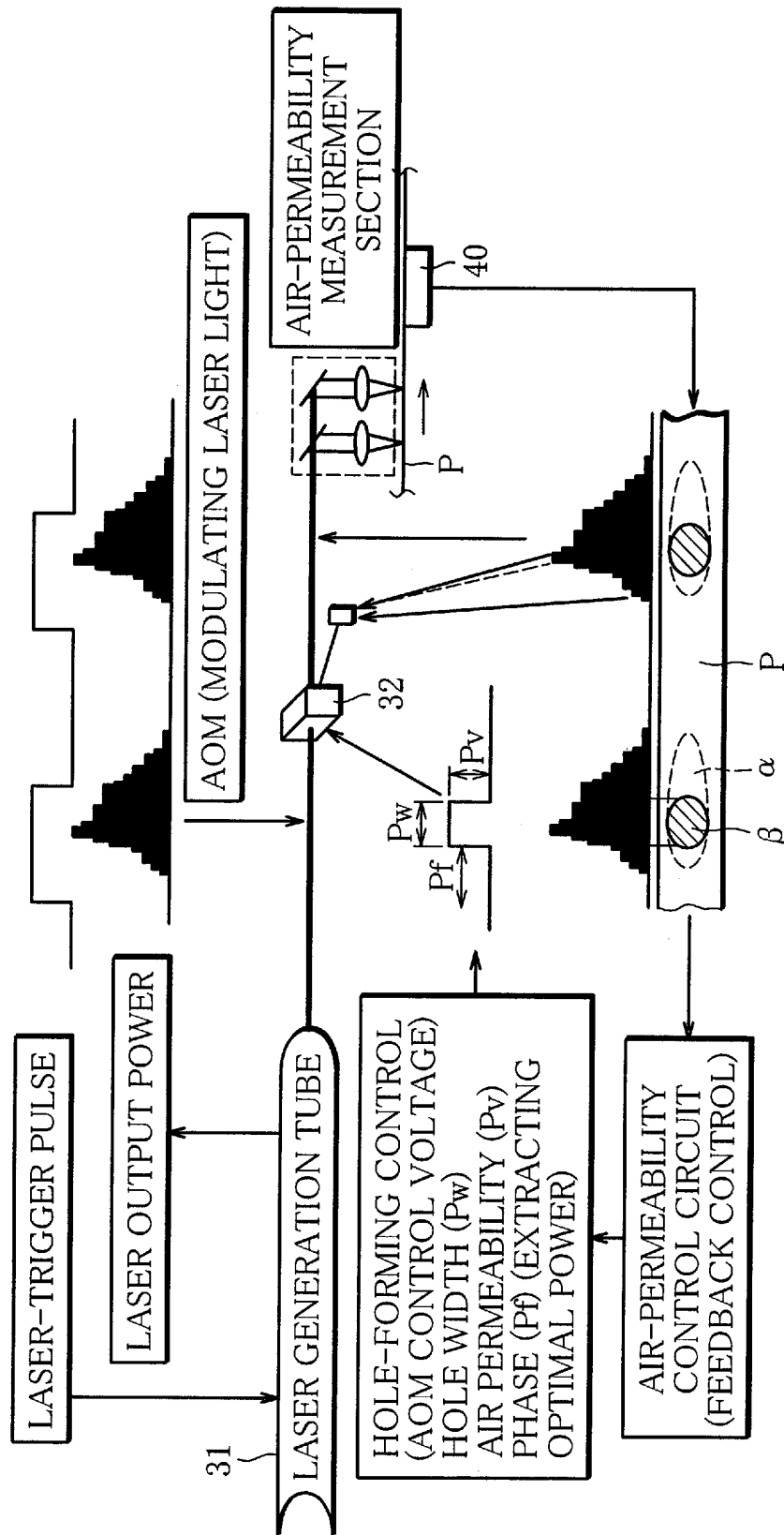


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/009075

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ A24C5/47, A24C5/34				
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) Int.Cl. ⁷ A24C5/47, A24C5/34, A24D1/04				
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 1996-2005 Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005				
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 54-76900 A (Hauni-Werke Koeber & Co., KG.), 19 June, 1979 (19.06.79), & US 4249545 A & GB 1605124 A & DE 275038 A & FR 2408314 A & SU 1071203 A & CA 1097553 A & IT 1100090 A & ZA 7806312 A & IT 1100090 B	1-5		
A	JP 2001-275642 A (Japan Tobacco Inc.), 09 October, 2001 (09.10.01), (Family: none)	1-5		
A	JP 2000-5890 A (Japan Tobacco Inc.), 11 January, 2000 (11.01.00), (Family: none)	1-5		
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.				
<table border="0"> <tr> <td> * Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed </td> <td> "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" 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 </td> </tr> </table>			* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" 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
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" 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 05 August, 2005 (05.08.05)		Date of mailing of the international search report 23 August, 2005 (23.08.05)		
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer		
Facsimile No.		Telephone No.		

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/009075

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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REFERENCES CITED IN THE DESCRIPTION

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