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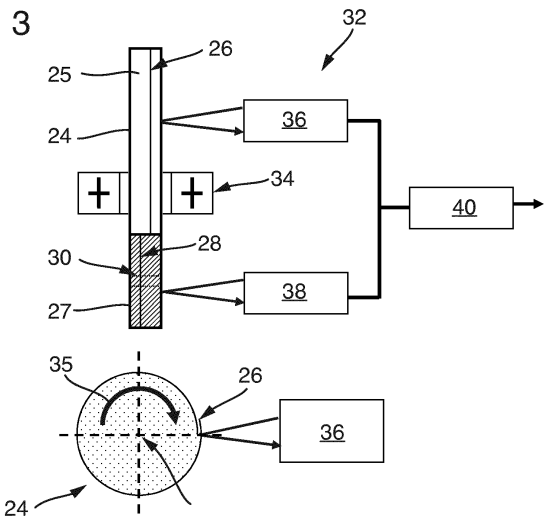
(54) METHOD AND SYSTEM FOR DETERMINING THE TRACK OF ORIGIN OF PRODUCTS OF THE TOBACCO PROCESSING INDUSTRY, CIGARETTE INSPECTION STATION

(57) The invention concerns a method and a system for determining the track of origin (TA, TB, FR-TA, FR-TB, RR-TA, RR-TB) of products of the tobacco processing industry, as well as a cigarette inspection unit. A single length filter cigarette (24) produced in a cigarette making machine having a plurality of tracks (TA, TB) is received in a rotating device (34) and rotated around an axis of rotation (35') which is parallel to a longitudinal axis of the cigarette (24), wherein during rotation of a cigarette (24) held in the rotating device (34) an optical detection of seams (26, 28) of a wrapping paper (25) and of a tipping paper (27) of the cigarette (24) are carried out, wherein from the results of the optical detection the track of origin (TA, TB, FR-TA, FR-TB, RR-TA, RR-TB) of the cigarette (24) is determined.

According to the present invention, the optical detection includes distance measurements carried out using at least one first distance measuring apparatus (36) and at least one second distance measuring apparatus (38), wherein the at least one first distance measuring apparatus (36) is located and oriented so as to produce at least one first raw data signal representing a distance to a wrapping paper (25) of the cigarette (24) and the at least one second distance measuring apparatus (38) is located and oriented so as to produce at least one second raw data signal representing a distance to a tipping paper (27) of the cigarette (24).

Fig. 3



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Description

[0001] The invention concerns a method and a system for determining the track of origin of products of the tobacco processing industry, as well as a cigarette inspection unit. A single length filter cigarette produced in a cigarette making machine having a plurality of tracks is received in a rotating device and rotated around an axis of rotation which is parallel to a longitudinal axis of the cigarette, wherein during rotation of a cigarette held in the rotating device an optical detection of seams of a wrapping paper and of a tipping paper of the cigarette are carried out, wherein from the results of the optical detection the track of origin of the cigarette is determined.

[0002] The manufacture of filter cigarettes in cigarette making machines having multiple tracks, e.g., twin tracks, is known in the art. Such machines may have multiple tracks in a unit preparing endless tobacco rods as well as in a unit producing endless filter rods. The endless tobacco rods are each wrapped in an endless wrapping paper strip, which is wound around the tobacco inside the tobacco rod, and closed by means of an adhesive applied, which connects the wrapping paper with itself in an overlapping region constituting a seam of the wrapping paper strip. The filter rod may or may not be likewise wrapped into a filter paper strip.

[0003] After cutting tobacco rods and filter rods from the endless tobacco rods and filter rods, these are brought together inside a filter tipping unit, creating a common mass flow of cigarettes. In a typical configuration, a double length filter rod is inserted between two single length tobacco rods. A tipping paper that has an end portion to which an adhesive is applied is wrapped around the filter rod while simultaneously overlapping an adjacent part of both adjacent tobacco rods, thereby providing a stable connection between the filter rod and the tobacco rods. To complete the wrapping, the adhesive portion of the tipping paper is applied to the opposing end of the tipping paper. In a next step, the central double length filter rod is cut in the middle, resulting in two single length filter cigarettes.

[0004] Frequently, quality control is performed that may serve to detect problems in the different units of the cigarette making machine, which may be specific to single tracks thereof. One such quality control method is to form the mass flow and subject. These sample cigarettes are subjected to further testing. In order to tribute the findings to the different tracks from the different units, it is necessary to determine the track of origin of the sample cigarette under test.

[0005] EP 2 183 985 B1 discloses techniques for determining the track of origin in a cigarette making machine having a plurality of tracks, wherein sample cigarettes are received by rotating means for rotating the cigarette relative to detecting means arranged to detect radiation from the cigarette and to produce a signal representative of the detected radiation, and processing means are included which are arranged to process the signal produced by the detecting means to identify a shadow cast by the tipping paper seam and a shadow cast by the wrapping paper seam, and wherein the processing means is arranged to determine the difference in the circumferential position of the shadow cast by the tipping paper seam and the circumferential position of the shadow cast by the wrapping paper seam, and to produce a signal indicating the track of origin of the cigarette in dependence thereof. The technique disclosed in EP 2 183 985 B1 rests on the fact that the seam will cast a shadow when hit by light at an oblique angle from one side. Signal processing includes detecting the amplitude and position of a dip in the signal of light detected by a detection means, and comparing the size of dip with a predetermined threshold. Furthermore, the timer is used during rotation of the cigarette to detect the difference in time of the occurrences of the dips for the wrapping paper seam and the tipping paper seam, which then is compared with a predetermined threshold for the difference in time.

[0006] It is an object of the present invention to improve over this technique, in particular in terms of reliability of detecting the seams.

[0007] This object is achieved by a method for determining the track of origin of products of the tobacco processing industry, wherein a single length filter cigarette produced in a cigarette making machine having a plurality of tracks is received by a rotating device, in particular a rotating chuck, and rotated around an axis of rotation which is parallel to a longitudinal axis of the cigarette, wherein during rotation of a cigarette held in the rotating device an optical detection of seams of a wrapping paper and of a tipping paper of the cigarette are carried out, wherein from the results of the optical detection the track of origin of the cigarette is determined, wherein the optical detection includes distance measurements carried out using at least one first distance measuring apparatus and at least one second distance measuring apparatus, wherein the at least one first distance measuring apparatus is located and oriented so as to produce at least one first raw data signal representing a distance to a wrapping paper of the cigarette and the at least one second distance measuring apparatus is located and oriented so as to produce at least one second raw data signal representing a distance to a tipping paper of the cigarette.

[0008] Whereas the technique described in EP 2 183 985 B1 may be perfected by improving lighting conditions, including using sharply defined light sources with small areas of light emission, choosing appropriate wavelengths of detection light and improving on signal processing, it suffers from the fact that the paper seams may be poorly defined, and thus the shadows cast by the seams may vary in width and depth. In contrast, the present invention relies on optical distance measuring instead of the detection of shadows. Optical distance measuring devices are available with precisions in the range of micrometres, and the target area is effectively point-like, whereas in the shadow detecting technique, the field of view to be inspected may be several millimetres long and wide. Therefore, optical distance measurements provide

superior resolution and therefore higher reliability of detecting seams of wrapping papers and tipping papers.

[0009] When rotating the cigarette, the paper seam will produce a step or spike in the distance measurement signal proportional to the thickness of the wrapping paper or tipping paper, which may be in the range between 0.05 to 0.25 mm, depending on the type of wrapping paper or tipping paper used in each particular brand of cigarettes. Such a step is much larger than the resolution of modern distance measuring devices and therefore easily detectable with a good signal-to-noise ratio (SNR). One type of distance measuring devices which may be employed in carrying out the inventive method are laser telemetry devices.

[0010] Preferably, the at least one first raw data signal and/or the at least one second raw data signal is or are filtered using a high frequency pass filter. This measure will filter out most deviations of the cigarettes from the ideal cylindrical shape, but leave the sharp spike or step function produced by the paper seam in place. Furthermore, after having been filtered using a high frequency pass filter, a noise reduction is preferably performed on the at least one filtered first raw data signal and/or the at least one filtered second raw data signal, wherein in particular the noise reduction is carried out using a median filter. The median filter will eliminate or reduce residual noise in the signal by relying on the median value inside the window of several data points, thus cancelling out extreme noise events. Depending on the relative size of the median filter window with respect to the width of the part of the signal influenced by the paper seam, which is also called the paper seam signature, the paper seam signature in the signal may survive the median filter, or the median filter is modified such that signals above or below a predetermined threshold are left unfiltered.

[0011] In an embodiment, seam signatures, in particular peaks or step functions representing paper seams, are detected inside the raw data signals or filtered raw data signals, in particular by detecting signal amplitudes that exceed a threshold range that is chosen or calculated such that random fluctuations of the filtered raw data signals stay inside the threshold range to a statistically significant degree. With this method, statistically significant results for scene detection are, reliably achieved. In a further embodiment, a wrapping direction of a seam is determined by a sign of an amplitude of a seam signature. Depending on the wrapping direction, a peak or a step function representing the paper seam and thus constituting the paper seam signature will appear with a positive sign or a negative sign, indicating a reduction or an increase in the distance between the surface of the wrapping paper or tipping paper of the cigarette and the distance measuring device. If the wrapping paper or tipping paper is wrapped in the same direction as the direction of rotation of the cigarette inside the rotating chuck, the distance will increase when the scene is reached, whereas if the paper is wrapped in the opposite direction to the direction of rotation of the cigarette, the distance will decrease suddenly.

[0012] In a further embodiment, an offset between locations of the wrapping paper seam and the tipping paper seam on the circumference of the cigarette indicative of a track of origin is determined. This may be carried out by recording the time of paper seam signatures on the wrapping paper relative to the tipping paper, as well as the relative positions inside the data signal that correspond to locations on the circumference of the cigarette. In performing the detection of the offset of the locations, offsets of the first distance measuring apparatus and the second distance measuring apparatus in their angular relation with respect to the circumference of the cigarette have to be corrected for. For example, it may be necessary to offset the two distance measuring apparatus by 90° or 180° or still a different angle relative to one another for reasons of available space inside the machine or the cigarette inspection unit.

[0013] The object of the present invention is also achieved by a system for determining the track of origin of products of the tobacco processing industry, comprising a rotating device, in particular a rotating chuck, for receiving and rotating a single length filter cigarette produced in a cigarette making machine having a plurality of tracks around an axis of rotation which is parallel to a longitudinal axis of the cigarette, optical detection means for an optical detection of seams of a wrapping paper and of a tipping paper of the cigarette, a controller and signal processing means for processing raw data signals of the optical detection means, wherein the optical detection means include at least one first distance measuring apparatus and at least one second distance measuring apparatus, wherein the at least one first distance measuring apparatus is located and oriented so as to produce at least one first raw data signal representing a distance to a wrapping paper of the cigarette and the at least one second distance measuring apparatus is located and oriented so as to produce at least one second raw data signal representing a distance to a tipping paper of the cigarette. Preferably, the controller and the signal processing means are configured to carry out the above-described inventive method.

[0014] The system of the present invention thereby encompasses the same characteristics, features and advantages as the above-described inventive method. The controller and the signal processing means may be implemented in one device, for example, a programmable computer, or in several different devices which are interconnected for the transfer of commands and data.

[0015] In an embodiment, at least one first distance measuring apparatus and/or the at least one second distance measuring apparatus include one or more laser telemetry units, thus providing superior resolution and reliability. In further embodiments, the signal processing unit is configured to filter the at least one first raw data signal and/or the at least one second raw data signal using a high frequency pass filter, and in particular to perform a noise reduction on the high-pass filtered at least one first raw data signal and/or at least one second raw data signal, in particular using a median filter.

[0016] In a further embodiment, the signal processing unit is configured to detect seam signatures, in particular peaks

or step functions representing paper seams, inside the raw data signals or filtered raw data signals, in particular by detecting signal amplitudes that exceed a threshold range that is chosen or calculated such that random fluctuations of the filtered raw data signals stay inside the threshold range to a statistically significant degree.

[0017] In a further advantageous embodiment, the signal processing unit is configured to detect a wrapping direction of a seam by detecting a sign of an amplitude of a seam signature and/or to detect an offset between locations of the wrapping paper seam and the tipping paper seam on the circumference of the cigarette indicative of a track of origin.

[0018] The object of the present invention is furthermore achieved by a cigarette inspection unit comprising a previously described inventive system for determining the track of origin of products of the tobacco processing industry. The cigarette inspection unit, thereby embodies the same characteristics, features and advantages as the inventive system and the inventive method.

[0019] Further characteristics of the invention will become apparent from the description of the embodiments according to the invention together with the claims and the included drawings. Embodiments according to the invention can fulfill individual characteristics or a combination of several characteristics.

[0020] The invention is described below, without restricting the general intent of the invention, based on exemplary embodiments, wherein reference is made expressly to the drawings with regard to the disclosure of all details according to the invention that are not explained in greater detail in the text. The drawings show in:

Fig. 1 a schematic representation of double length cigarettes from different tracks,

Fig. 2 schematic representations of wrapping paper seams and tipping paper seams on cigarettes of different tracks of origin,

Fig. 3 a schematic representation of an embodiment of a system according to the invention,

Fig. 4 measuring signals from the system shown in Fig. 3, in various stages of signal processing, and

Fig. 5 various signal processed distance signals from a simple cigarette.

[0021] In the drawings, the same or similar types of elements or respectively corresponding parts are provided with the same reference numbers in order to prevent the item from needing to be reintroduced.

[0022] Fig. 1 shows a schematic representation of double length cigarettes 10 from different tracks of a twin track machine. The two tracks are denominated track A (TA) and track B (TB). The double length cigarettes 10 consist of a double length filter rod 14 in the center, with a single length tobacco rod 12 at either side connected to the filter rod 14 by means of a tipping paper wrapped around the filter rod 14 and an adjacent part of the tobacco rods 12. Two double length cigarettes 10 from tracks TA and TB are depicted being conveyed cross axially in conveying direction 11. The double length cigarettes 10 are subsequently cut along cutting plane 16 to form two single length cigarettes 24, each oriented axially opposite to each other. The two parts are denominated "front rod" (FR) and "rear rod" (RR). The four single length cigarettes resulting from the cutting will therefore have the track combinations FR-TA, RR-TA, FR-TB and RR-TB.

[0023] In a further subsequent step, either the front rods or the real rods are reoriented so as to assume the same orientation as the other cigarettes.

[0024] Fig. 2 shows schematic representations of wrapping paper seams and tipping paper seams on cigarettes of different tracks of origin, wherein the four single length cigarettes 24 are numbered 1 to 4 and correspond to the FR-TA, RR-TA, FR-TB and RR-TB rods of Fig. 1. The set apart of Fig. 2 depicts the single length cigarettes, 24, along with the wrapping paper seams 26 and their tipping paper seams 28, with the direction of overlap indicated by using solid lines for the edge of the upper layer of the paper and dashed lines for the hidden edge of the lower layer of the paper at each seam. Additionally, it can be seen that there are offsets present between the wrapping paper seams 26 and the tipping paper seams 28 of the individual single length cigarettes 24, which also may be indicative of the track of origin of the cigarettes 24.

[0025] Above the center part of Fig. 2, the end sections of the tobacco rods of the single length cigarettes 24 are shown, illustrating the direction of wrapping clockwise or counterclockwise. Below the set apart of Fig. 2, the transition between the tobacco rod and the filter part of the cigarettes 24 are shown, likewise, indicating the wrapping direction of the tipping paper. The wrapping directions of the four's cigarettes 24 can be summed up in the following table:

ID	wrapping paper overlap direction	tipping paper overlap direction
1	+	-

(continued)

ID	wrapping paper overlap direction	tipping paper overlap direction
2	-	+
3	-	-
4	+	+

[0026] This shows, that the combinations achievable by wrapping directions are sufficient to identify up to four cigarettes.

[0027] When taking into account seam alignment or seam offsets, it is possible to expand on this to even more tracks, as shown in the following table:

ID	Seam alignment	Wrapping paper overlap direction	Tipping paper overlap direction
1	0	+	+
2	0	+	-
3	0	-	+
4	0	-	-
5	1	+	+
6	1	+	-
7	1	-	+
8	1	-	-

[0028] This may be expanded even more if there are more values for seam offsets available.

[0029] Fig. 3 shows a schematic representation of an embodiment of a system according to the invention, in this case as part of a cigarette inspection unit 32. The technology used according to the present invention is based on two distance measurement devices, in particular, and by way of example, two or more laser telemetry heads 36, 38 which precisely measure the distance between the measuring head on the surface of the cigarette 24, which in turn is held in place and rotated around its longitudinal axis by a rotating device, in this case a rotating chuck 34. A first telemetry head, namely a tobacco laser telemetry head 36, is directed at the surface of the wrapping paper 25 of cigarette 24, whereas the second telemetry head, namely a filter laser telemetry head 38, is directed at the surface of the tipping paper 27 of cigarette 24. This is depicted in the lower part of Fig. 3 in a cross-sectional view through the tobacco portion of cigarettes 24, together with indicators for the direction of rotation 35 and the axis of rotation 35', which ideally coincides with the center of the cigarette 24.

[0030] During the rotation of the cigarettes 24 on or in the rotating chuck, 34, the laser beams emanating from the laser telemetry heads, 36, 38, will encounter the wrapping paper seam 26 and the tipping paper seam 28, respectively. While the rotating chuck 34 is in rotation, both laser telemetry heads 36, 38 measure precisely and in real-time the distance variation between the respective laser telemetry head 36, 38 and the surface of the cigarettes 24. The laser telemetry heads 36, 38, will each produce a distance signal containing a signature of the changing distance encountered when passing the paper seams 26, 28 due to the thickness of the wrapping paper 25 and tipping paper 27, respectively. Depending on the direction of the variation, the system detects whether it is a clockwise or an anticlockwise wrapping. As both filter and tobacco overlaps are measured simultaneously, the system is able to give the relative angular difference between the two seams.

[0031] The raw data signals produced by the tobacco laser telemetry head 36 and the filter laser telemetry head 38 are transferred to a signal processing unit 40 and undergo signal processing inside the signal processing unit 40 which will be illustrated in Figs. 4 and 5.

[0032] Since there is a wide range of cigarettes lengths on the market, the tobacco laser telemetry head 36 is preferably designed to be adjustable in height. The filter laser telemetry head 38 may be maintained in a fixed position in order to measure right below an area of ventilation holes or perforations 30 that may be present in the tipping paper 27 in order to prevent any unwanted variation of the signal.

[0033] Figs. 4 a) to 4 d) show measuring signals from the system shown in Fig. 3, in various stages of signal processing. In all cases, the vertical axis has the unit of millimetres and shows the deviation of the distance between the surface of the cigarette 24 and the observing laser telemetry head, which in this case may be the tobacco laser telemetry head 36 or the filter laser telemetry head 38. The horizontal axis indicates the number of each measurement period. The meas-

urement is carried out in individual data points at a resolution in this case of ca. 0,76°, or every 0.05 mm on the perimeter of the cigarette.

[0034] The surface of a cigarette 24 is generally irregular and the rotation is generating an additional noise on the measurement signal issued by the laser telemetry heads 36, 38. This irregularity is plainly visible in the raw data signal 50 shown in Fig. 4 a). As the signal 50 repeats itself, it is obvious that the cigarette 24 under test has been rotated more than twice. Plainly visible are narrow peaks in the raw data signal 50 that constitute seam signatures 52. Since the seam signatures 52 have a positive sign, that is, they represent peaks with increasing values for the distance between the surface of the cigarette 24 and the laser telemetry head, making the measurement, this means, that the wrapping direction of the paper is such that the laser beam has encountered the upper layer on the overlapping region of the seam first and then the end of the seam, producing a step within this signal with an amplitude of somewhat less than 0.2 mm, which corresponds to the thickness of the paper. Furthermore, it can be seen that in the data points immediately preceding the seam signatures 52, the distance signal decreases sharply, although the overall trend of the raw distance signal 50 is increasing. This decrease prior to the sudden increase is due to the seam 26, 28 being pushed out by the tobacco or filter material inside the wrapping paper 25 or tipping paper 27. In contrast, if the wrapping direction is reversed with respect to the direction of rotation of the cigarette, the encounter of this scene would suddenly decrease the distance to the laser telemetry head, thus resulting in a negative peak in the raw data signal 50.

[0035] The raw data signal 50 may be processed in order to isolate the seam signatures 52. An appropriate filter for eliminating the variations in the raw data signal 50 caused by the irregularity of the cigarette itself is a high frequency pass filter, which eliminates low-frequency portions of the raw data signal 50. This may be done by no means such as performing a Fast Fourier Transformation on the signal or simply by calculating for all data points n of the raw data signal 50:

$$Y_{highpass}(n) = Y_{raw}(n+1) - Y_{raw}(n),$$

where $Y_{highpass}$ and Y_{raw} symbolise the data points after high-pass filtering and the role data signal points, respectively. This high pass filtering results in the high-pass filtered signal 60 shown in Fig. 4 b). The high-pass filtered signal 60 exhibits the rather stable baseline around zero and markedly pronounced seam signatures 62, indicating the paper thickness of approximately 0.18 mm.

[0036] Whereas the high-pass filtered signal 60 would lend itself already to detection of the location and design of the seam signatures 62 embedded therein, a further data signal processing step may advantageously be applied to the high-pass filtered signal 60, in order to achieve better noise reduction or smoothing of the signal. This may be achieved by using a median filter. The result of applying the median filter with a window size of three data points is shown, as smoothed signal 70 having seam signatures 72 in Fig. 4 c). The median filter works such that of the three different values of data points present inside the future window, the median value is chosen, that is, the highest and lowest values are discarded. The noise in the baseline signal is significantly reduced. Therefore, it is possible to identify the seam signatures 72 in the signal 70 with very high confidence.

[0037] In a further step shown in Fig. 4 d), the seam signatures 72 are identified by imposing the bilateral threshold around the baseline signal 70 according to

$$Threshold = \mu \pm c\,\sigma,$$

wherein μ is the mean of the signal 70 after the median filtering step and σ is the standard deviation of the signal 70 after median filtering. The constant c maybe chosen appropriately to eliminate false positives and may be in the range of between 2 and 4. In the case of figure 4 d) the thresholds are at 2.8 σ or standard deviations above and below the mean of the signal 70. Every peak in the signal 70 which exceeds that bilateral threshold is considered a seam detection. If the system finds a case where more peaks than expected are detected, it may preferentially consider the peak with the highest absolute value of amplitude.

[0038] The inventive method may be carried out independently of the brand or size of the cigarette, since advantageously the cigarette 24 may be rotated more than once, so that the seam signature 72 is encountered more than once. Since the seam signature 72 will therefore be identified multiple times, the subsequent occurrences of the seam signature 72 indicate a full rotation of the cigarette 24.

[0039] A result of the seam signature identification is shown in Fig. 5 a) and Fig. 5 b). In this case, the raw data signals of both the tobacco laser telemetry head 36 and the filter laser telemetry head 38 have undergone high frequency pass filtering and are shown in Fig. 5 a) overlaid on top of each other. The wrapping direction is in both cases the same, indicated by negative amplitudes of the peaks. The seam signatures 76 indicate wrapping paper seam signatures, the seam signatures 78 tipping paper seam signatures.

[0040] The system provides peak positions for the tobacco laser telemetry head 36 at positions 32 and 501 with an

amplitude of ca. -114 μm and a signal to noise ratio of 22.5 dB, whereas the filter laser telemetry head 38 observes peaks at positions 372 and 841 with amplitudes of ca. -140 μm and signal to noise ratios of 23.5 dB. The system, producing the two respective signals employs one tobacco laser telemetry head 36 and one filter laser telemetry head 38 positioned at an angle of 90° to each other with respect to the cigarette 24 due to mechanical constraints. When calculating the offset between the wrapping paper seam 26 and the tipping paper seam 28, this 90° offset between the lesser telemetry heads, 36, 38, has to be taken into account.

[0041] The offset, or, respectively, phase shift A between the two seams 26, 28, expressed in degrees is calculated as

$$A = \frac{\left|\left(\Psi_{tp} + \frac{T}{4}\right) - \Psi_{wp}\right|}{T} \times 360°,$$

wherein T expresses the mean of the two periods and ψ_{tp} and ψ_{wp} express the positions of the tipping paper seam 28 and the wrapping paper seam 26, each in terms of number of sampling points. The 90° offset between the laser telemetry heads, 36, 38, is accounted for by the summand $+T/4$.

[0042] When using the above-referenced positions of the peaks in Fig. 5 a), a mean period *T of* 469 data points is calculated and with ψ_{tp} = 372 and ψ_{wp} = 32, a smallest angle of 9° and a largest angle of 351° between the wrapping paper seam 26 and the tipping paper seam 28 is calculated. This is depicted in Fig. 5 b), although the plot does not account for the 90° offset between the laser telemetry heads, 36, 38.

[0043] The result of the determination of the paper seems is that both seams are oriented in the same wrapping direction, producing negative sign seam signatures, and there is a 9° difference or phase shift between the two papers seems, with the tipping paper seam 28 preceding the wrapping paper seam 26 in the direction of the rotation 35 of the cigarette 24 inside the rotating chuck 34.

[0044] All named characteristics, including those taken from the drawings alone, and individual characteristics, which are disclosed in combination with other characteristics, are considered alone and in combination as important to the invention. Embodiments according to the invention can be fulfilled through individual characteristics or a combination of several characteristics. Features that are combined with the wording "in particular" or "especially" are to be treated as preferred embodiments.

List of reference numbers

[0045]

10	double length cigarettes
11	cross axial conveying direction
12	tobacco rod
14	filter rod
16	cutting plane
18	cross axial conveying direction
20	tip end section
22	filter end section
24	single length cigarette
25	wrapping paper
26	wrapping paper seam
27	tipping paper
28	tipping paper seam
30	perforations
32	inspection unit
34	rotating chuck
35	direction of rotation
35’	axis of rotation
36	tobacco laser telemetry head
38	filter laser telemetry head
40	signal processing unit
50	raw data signal
52	seam signature in raw data signal
60	signal after high pass filtering

62	seam signature
70	signal after high pass and median filtering
72	seam signature
73	seam position in filtered signal
74	upper threshold
75	lower threshold
76	wrapping paper seam signature
78	tipping paper seam signature
TA, TB	track of origin
FR	front rod
RR	rear rod

Claims

1. Method for determining the track of origin (TA, TB, FR-TA, FR-TB, RR-TA, RR-TB) of products of the tobacco processing industry, wherein a single length filter cigarette (24) produced in a cigarette making machine having a plurality of tracks (TA, TB) is received by a rotating device (34) and rotated around an axis of rotation (35') which is parallel to a longitudinal axis of the cigarette (24), wherein during rotation of a cigarette (24) held in the rotating device (34) an optical detection of seams (26, 28) of a wrapping paper (25) and of a tipping paper (27) of the cigarette (24) are carried out, wherein from the results of the optical detection the track of origin (TA, TB, FR-TA, FR-TB, RR-TA, RR-TB) of the cigarette (24) is determined, **characterized in that** the optical detection includes distance measurements carried out using at least one first distance measuring apparatus (36) and at least one second distance measuring apparatus (38), wherein the at least one first distance measuring apparatus (36) is located and oriented so as to produce at least one first raw data signal representing a distance to a wrapping paper (25) of the cigarette (24) and the at least one second distance measuring apparatus (38) is located and oriented so as to produce at least one second raw data signal representing a distance to a tipping paper (27) of the cigarette (24).

2. Method according to claim 1, **characterized in that** the at least one first raw data signal and/or the at least one second raw data signal is or are filtered using a high frequency pass filter.

3. Method according to claim 2, **characterized in that**, after having been filtered using a high frequency pass filter, a noise reduction is performed on the at least one filtered first raw data signal and/or the at least one filtered second raw data signal, wherein in particular the noise reduction is carried out using a median filter.

4. Method according to one of claims 1 to 3, **characterized in that** seam signatures (62, 72), in particular peaks or step functions representing paper seams, are detected inside the raw data signals or filtered raw data signals, in particular by detecting signal amplitudes that exceed a threshold range (74, 75) that is chosen or calculated such that random fluctuations of the filtered raw data signals stay inside the threshold range to a statistically significant degree.

5. Method according to one of claims 1 to 4, **characterized in that** a wrapping direction of a seam (26, 28) is determined by a sign of an amplitude of a seam signature (62, 72).

6. Method according to one of claims 1 to 5, **characterized in that** an offset between locations of the wrapping paper seam (26) and the tipping paper seam (28) on the circumference of the cigarette (24) indicative of a track of origin (TA, TB, FR-TA, FR-TB, RR-TA, RR-TB) is determined.

7. System for determining the track of origin (TA, TB, FR-TA, FR-TB, RR-TA, RR-TB) of products of the tobacco processing industry, comprising a rotating device (34) for receiving and rotating a single length filter cigarette (24) produced in a cigarette making machine having a plurality of tracks (TA, TB) around an axis of rotation (35') which is parallel to a longitudinal axis of the cigarette (24), optical detection means for an optical detection of seams (26, 28) of a wrapping paper (25) and of a tipping paper (27) of the cigarette (24), a controller and signal processing means (40) for processing raw data signals (50) of the optical detection means, **characterized in that** the optical detection means include at least one first distance measuring apparatus (36) and at least one second distance measuring apparatus (38), wherein the at least one first distance measuring apparatus (36) is located and oriented so as to produce at least one first raw data signal representing a distance to a wrapping paper (25) of the cigarette (24) and the at least one second distance measuring apparatus (38) is located and oriented so as to produce at

least one second raw data signal representing a distance to a tipping paper (27) of the cigarette (24).

8. System according to claim 7, **characterized in that** the controller and the signal processing means (40) are configured to carry out the method according to one of claims 1 to 6.

9. System according to claim 7 or 8, **characterized in that** at least one first distance measuring apparatus (36) and/or the at least one second distance measuring apparatus (38) include one or more laser telemetry units.

10. System according to one of claims 7 to 9, **characterized in that** the signal processing unit (40) is configured to filter the at least one first raw data signal and/or the at least one second raw data signal using a high frequency pass filter.

11. System according to claim 10, **characterized in that** the signal processing unit (40) is configured to perform a noise reduction on the high-pass filtered at least one first raw data signal and/or at least one second raw data signal, in particular using a median filter.

12. System according to one of claims 7 to 11, **characterized in that** the signal processing unit (40) is configured to detect seam signatures, in particular peaks or step functions representing paper seams, inside the raw data signals or filtered raw data signals, in particular by detecting signal amplitudes that exceed a threshold range that is chosen or calculated such that random fluctuations of the filtered raw data signals stay inside the threshold range to a statistically significant degree.

13. System according to one of claims 7 to 12, **characterized in that** the signal processing unit (40) is configured to detect a wrapping direction of a seam (26, 28) by detecting a sign of an amplitude of a seam signature (62, 72).

14. System according to one of claims 7 to 13, **characterized in that** the signal processing unit (40) is configured to detect an offset between locations of the wrapping paper seam (26) and the tipping paper seam (28) on the circumference of the cigarette (24) indicative of a track of origin (TA, TB, FR-TA, FR-TB, RR-TA, RR-TB).

15. Cigarette inspection unit comprising a system for determining the track of origin of products of the tobacco processing industry according to one of claims 7 to 14.

Fig. 1

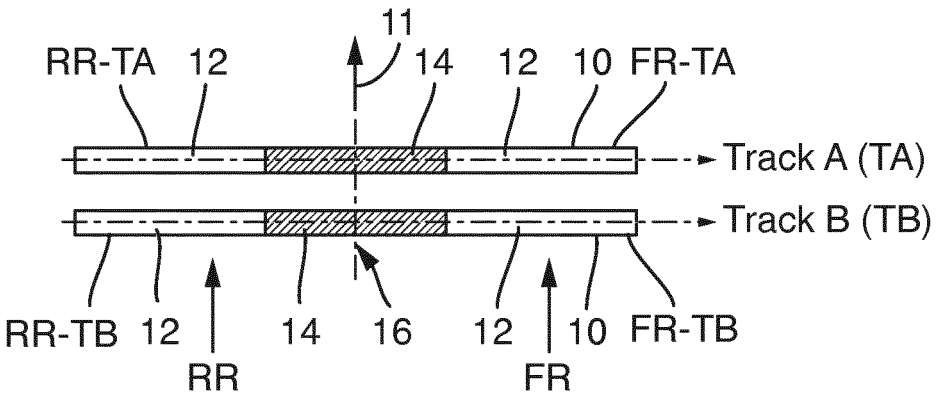

11
RR-TA
12
14
12
10
FR-TA
Track A (TA)
Track B (TB)
RR-TB
12
14
16
12
10
FR-TB
RR
FR

Fig. 2

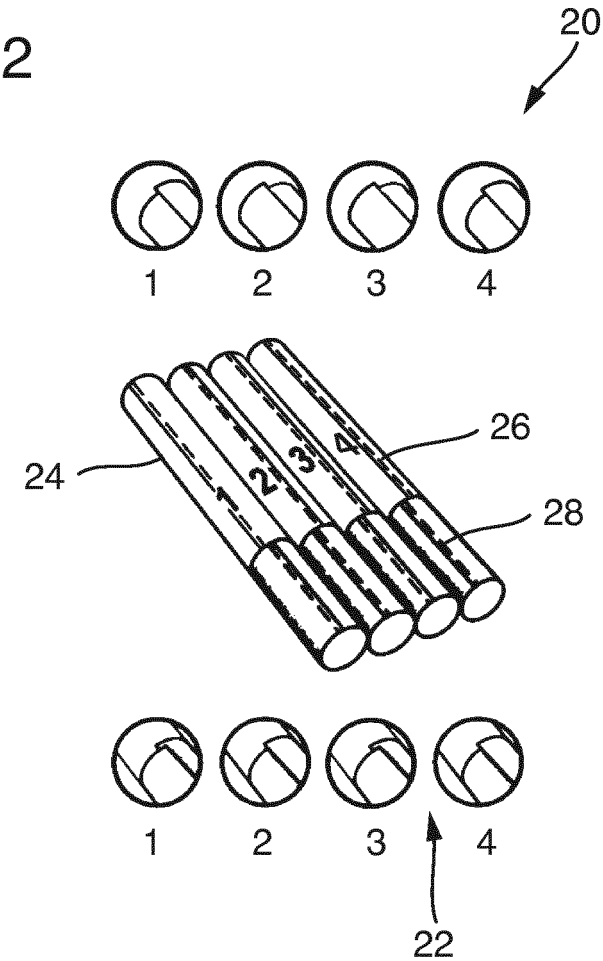

20
1
2
3
4
24
26
28
1
2
3
4
22

Fig. 3

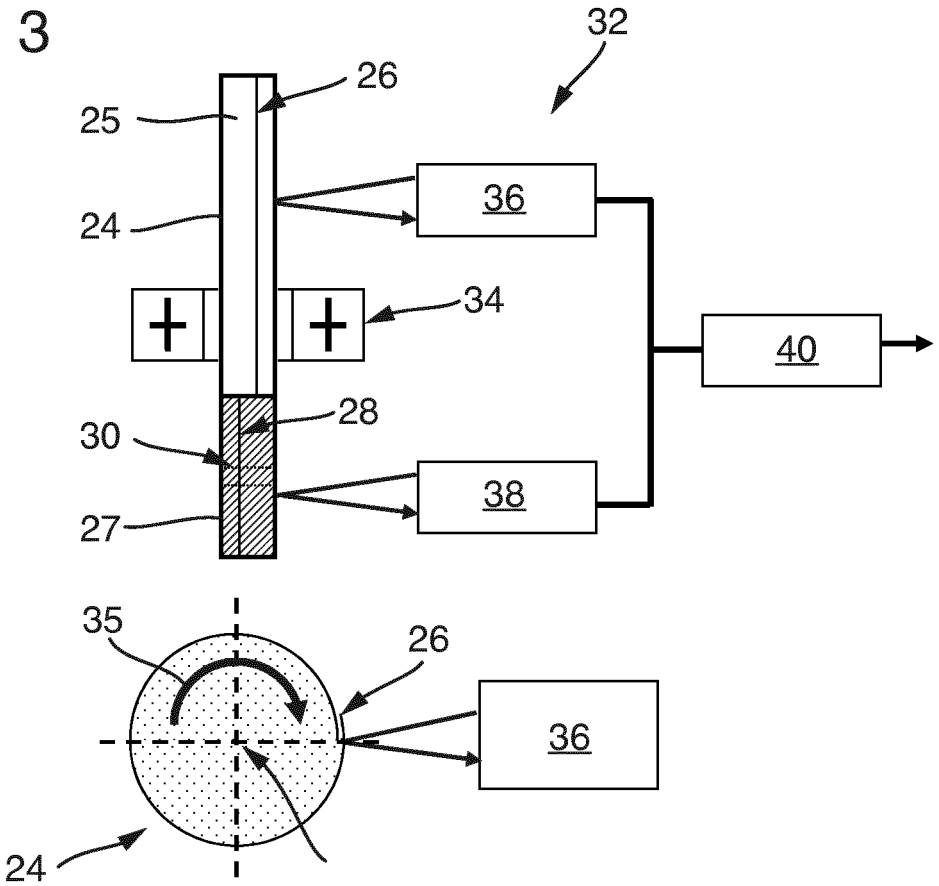


Fig. 4

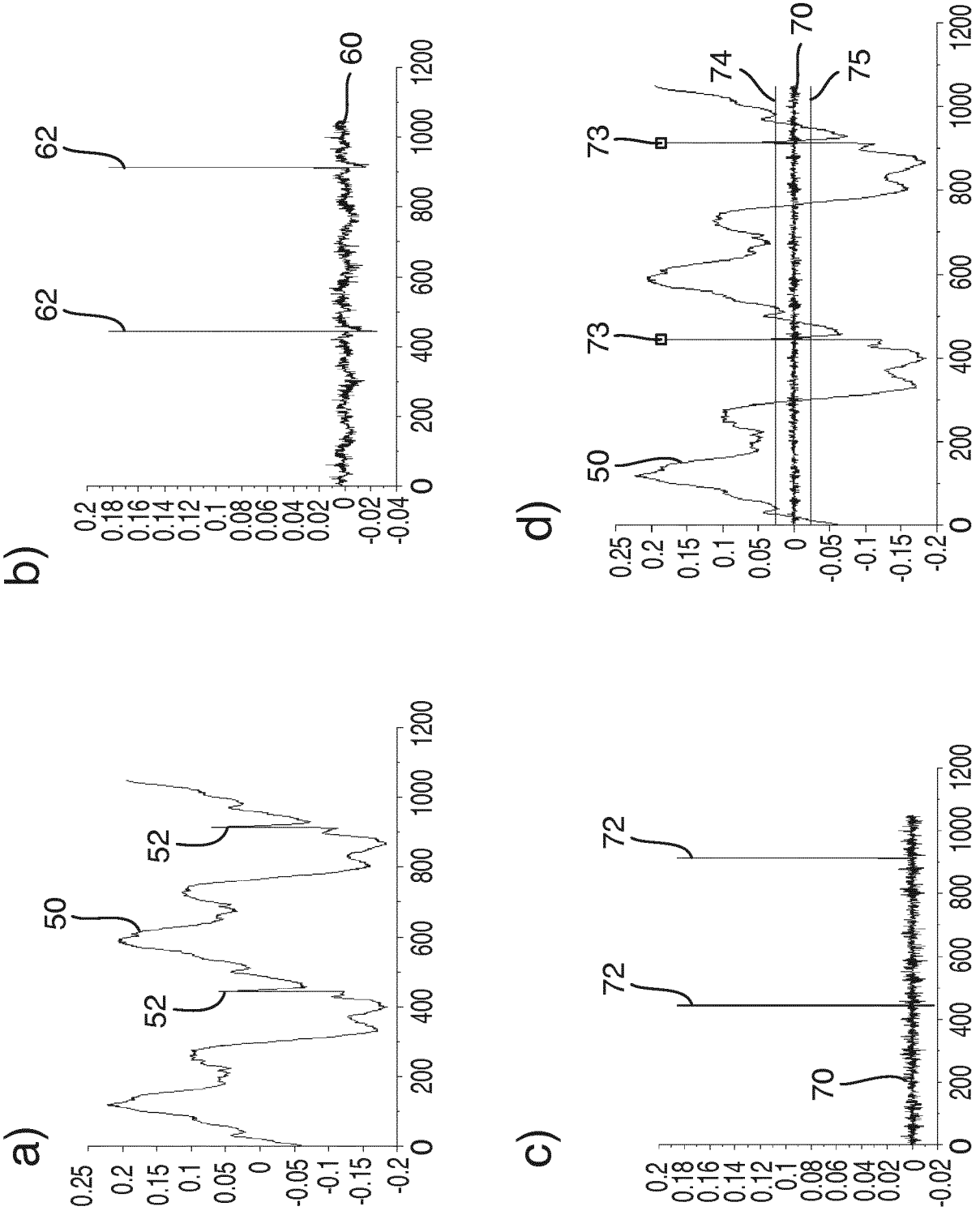
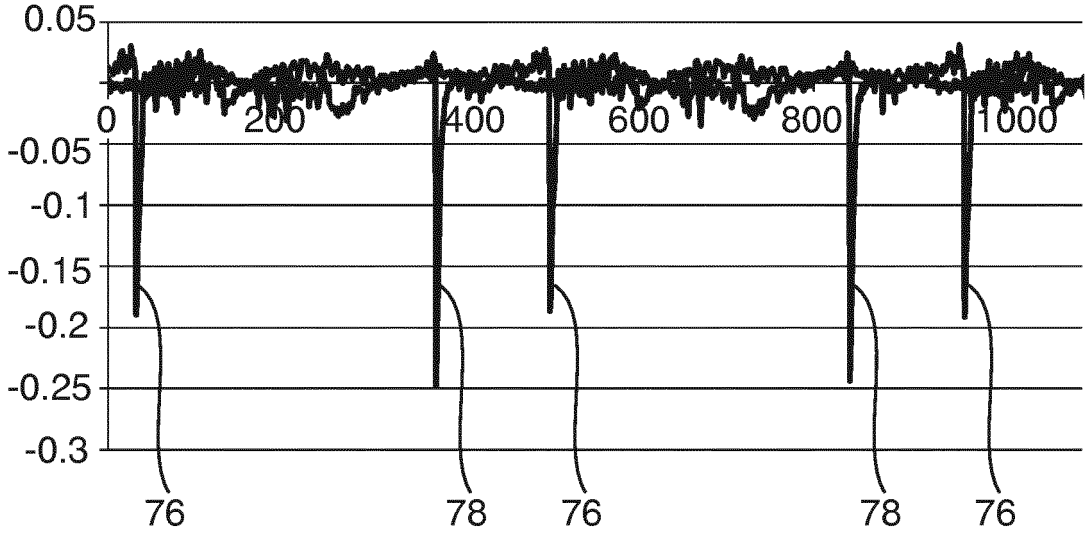


Fig. 5

a)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400
600
800
1000
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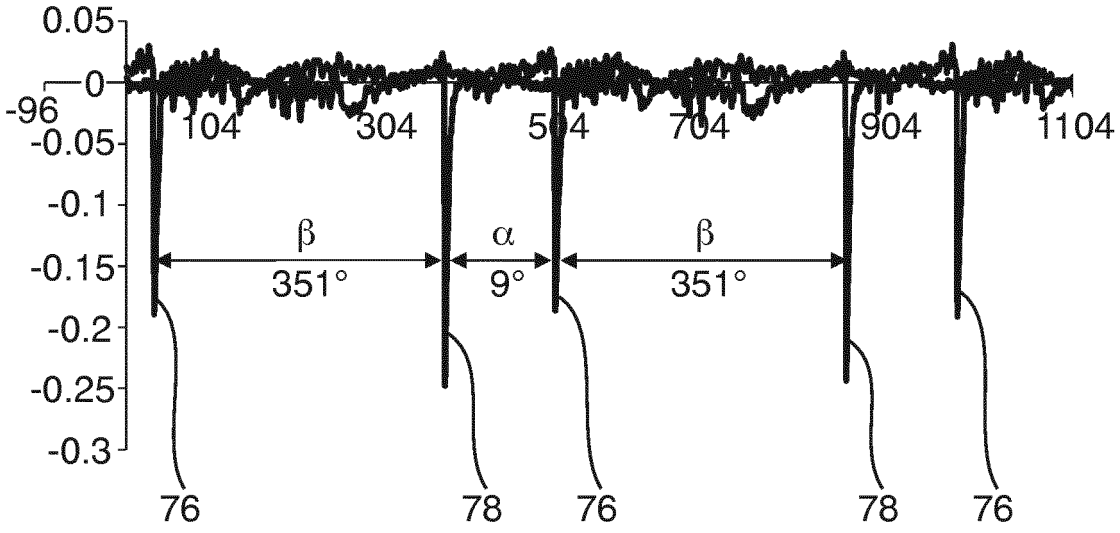
-0.1
-0.15
-0.2
-0.25
-0.3
76
78
76
78
76

b)


0.05
0
-96
104
304
504
704
904
1104
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
β
351°
α
9°
β
351°
76
78
76
78
76

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EUROPEAN SEARCH REPORT

Application Number
EP 17 16 6355

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	GB 2 473 230 A (MOLINS PLC [GB]) 9 March 2011 (2011-03-09) * page 2, lines 20-28; figures 1,4 * * page 5, line 9 - line 18 *	1-15	INV. A24C5/34
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A24C
G01N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	27 September 2017	Schwarzer, Bernd

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