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(54) Optical device for checking the cigarette tips.

(57) The invention relates to a device for checking the cigarette tips, comprising a stationary measurement head (1) associated with a conveyor means which causes the cigarettes (2) to pass after each other transversely to their longitudinal axes in front of said measurement head (1), with the cigarette tips to be checked facing said head, as well as a device (9) for processing the measurement values and a device (18, 19) for discarding the defective cigarettes, under the control of said processing device. The measurement head (1) is provided with means (4) to generate a scanning beam (5) which is directed against the front surface of the tip of a cigarette (2), and with a sensor (6) for detecting the scanning beam (5') reflected by the tip of the cigarette (2). The processing device, to which the measured values are fed, is provided with a discriminating means (10, 13) having an entered gate-value, and with means (10) for correcting the values which have been measured along the front surface of each cigarette tip, directed towards the measurement head (1). Thanks to a device (14) for synchronizing the inflow of measurement signals, which device controls the processor (9), the number of measurements along the path of the scanning beam (5) on the front surface of the cigarette tip is constant and independent of the speed of travel of the cigarettes in front of the measurement head.

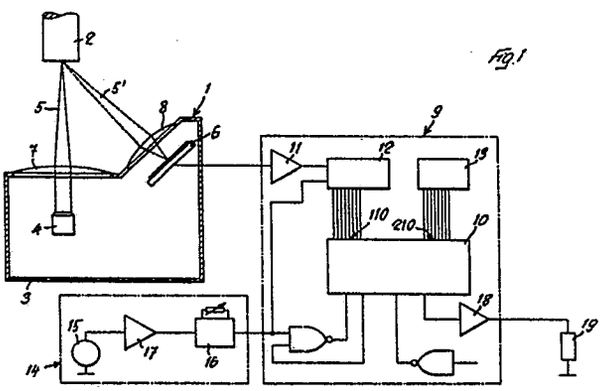

Fig.1

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Optical device for checking the cigarette tips

The invention relates to an optical device for checking the cigarette tips, comprising a stationary measurement head associated with a conveyor means which causes the cigarettes to pass after each other transversely to their longitudinal axes in front of said measurement head, with the cigarette tips to be checked facing said head, as well as a device for processing the measured values and a device for discarding the defective cigarettes, under the control of said processing device.

The use of optical devices for checking the cigarette tips has acquired primary importance because the devices of this type have the considerable advantage of avoiding any physical contact with the cigarette tips, thus avoiding any damage thereto during the checking step.

A device for checking cigarette tips is known, wherein the measurement head forms real images of the front surface of said tips, which, for this purpose, are suitably illuminated. Normal cigarettes are discriminated from the defective ones by means of suitable processing devices and thanks to the fact that the real images of the former exhibit a constant average luminosity, whereas the luminosity of the real images of the defective cigarettes decreases abruptly.

Moreover, another optical checking device of the type described initially is known, wherein the measurement head is provided with a bundle of optical fibres which is divided into two branches, one of which is connected to a source of light and the other to a detecting sensor.

Both these known devices, however, have the disadvantage that the values being detected by the sensors depend upon both the distance of the cigarettes from the measurement head and upon the color shades of tobacco. Measured values, therefore, may be easily confused in a plurality of cigarettes or even over the cross section of a single cigarette tip, for example, as a result of non-uniform alignment of the cigarettes with respect to the measurement head, or due to areas comprising dark-colored or pale-colored tobacco, whereby the discrimination between defective or non-defective cigarettes may be liable of errors.

The invention aims to provide an optical device for checking the cigarette tips, of the type described in the preamble permitting to overcome the disadvantages of said known devices by means of a simple, inexpensive and extremely efficient construction, providing quite reliable measurement values for discriminating the defective cigarettes from the normal ones.

The invention solves this problem by means of an optical checking device of the type described in the preamble, the measurement head of which comprises means to generate a scanning beam directed against the front surface of the cigarette tips, and a sensor for detecting the scanning beam reflected by the cigarette tips.

The processing device, to which the measured values are fed, is provided with discriminating means having an entered gate-value, and with means for correcting the values which have been measured along the front surface of each cigarette tip directed towards the measurement head, for deducting said measured values from one of said values, particularly from the maximum value.

The sensor for detecting the reflected scanning beam is connected to an electronic processor through an interposed device for synchronizing the inflow of measurement signals, a constant number of measurement being provided for each cigarette tip regardless of the speed of travel of said cigarette in front of the measurement head.

The optical device for checking the cigarette tips according to the invention, therefore, is a distance-detector, the intensity of the reflected scanning beam depending upon the distance between the point of incidence on the surface of the cigarette tip and the measurement head. Thus, the disadvantages connected to color-shade variations of tobacco are avoided, while - by referring the measurement values along the tip of a cigarette to one of said measurement values, preferably the maximum value, i.e. by subtracting from the maximum measurement value the other measurement values - the dependence of measurements on the different distances of cigarettes from the measurement head, due to lack of alignment between the cigarettes, is avoided, thus permitting a comparison with the entered gate-value which is correct at all times.

The invention relates, additionally, to further characteristics which improve further said optical device for checking the cigarette tips, and which are the subject of the other sub-claims.

The particular characteristics of the invention and the advantages resulting therefrom will appear with more details from the following description of a preferred embodiment thereof, shown by way of a non-limiting example in the accompanying drawings, wherein:

Figure 1 shows diagrammatically an optical checking device according to the invention;

Figures 2 and 3 are graphic depictions of the result of a measurement concerning defective cigarettes;

Figure 4 is a graphic depiction, similar to Figures 2 and 3, of the result of a measurement

concerning a normal cigarette.

The device of Figure 1 comprises a measurement head indicated generally at 1, in front of which are passed the cigarettes 2 being transported transversely to their longitudinal axes by an associated conveyor device (not shown). The conveyor device may be of any type and, particularly, it may be constituted by the drum of a device for the application of a filter-tip to the cigarettes.

The measurement head comprises a casing 3 which accommodates a source 4 which generates a scanning beam 5, and a sensor 6 for detecting the reflected scanning beam 5′. The source 4 which generates the scanning beam 5 is oriented so that said beam 5 is aligned substantially parallelly to the longitudinal axis of a cigarette 2 and impinges against the face of the tip of the cigarette 2, that is directed towards the head, while said beam is focussed at the face of the tip of the cigarette 2 by means of a focussing lens 7. The source 4 of the scanning beam may be any suitable source for generating a concentrated light beam, for example, a laser beam or a simple beam of light. In the illustrated exemplary embodiment, the invention uses a source generating a laser beam whose frequency is comprised in the infrared spectrum. The sensor 6 is constituted by any type of photo-electric sensor suitable for the type of source being used and is so oriented as to detect a reflected scanning beam 5′ which is at an angle to the incident scanning beam 5, said reflected beam being focussed on the surface of the detecting sensor 6 by means of a lens 8.

The analog electric signal generated by the detecting sensor 6 is fed to an electronic processing circuit indicated generally at 9.

The processing device 9 is formed by a microprocessor 10. the detecting sensor 6 is connected to an inlet 110 of the micro-processor 10 through an operational amplifier 11 and a successive analog/digital converter 12, while an additional inlet 210 of the micro-processor 10 has connected thereto a device for entering the gate-value 13, for example a device which is known as digit-switch. The microprocessor 10 and the analog/digital converter 12 have connected thereto a device for synchronizing the inflow of the measured signals, indicated generally at 14. This device comprises a tachometer generator 15 which is connected to the inlet of a voltage/frequency converter 16 through an operational amplifier 17. Moreover, the microprocessor 10 has connected to the outlet thereof a rejection circuit 18 which controls a solenoid valve 19 of the device for discarding the defective cigarettes (not shown in detail).

When a cigarette 2 is passed in front of the measurement head 1, the scanning beam 5 impinges against the face of a cigarette tip and the reflected scanning beam 5′ is detected by the sensor 6 wherein it generates an electric analog signal. This analog signal is transmitted through the operational amplifier 11 to the analog/digital converter 12 to be transmitted as a digital signal to the microprocessor 10. In order to obtain at all times, during the passage of a cigarette tip in front of measurement head, the same number of measurement points distributed along the path of travel of the scanning beam on the front surface of the cigarette tip, the conversion of the analog signal into a digital signal through the analog/digital converter 12 is controlled by the inflow-synchronizing device 14 for the measured values. The conversion of the analog signal is effected only when the voltage/frequency converter 16 emits an activating signal to the analog/digital converter. Thanks to the tachometer generator 15 which controls the voltage/frequency converter, the conversion frequency of the analog to digital signals, effected by the converter 12, and therefore the flow of measurement signals to the microprocessor 10, are rendered linearly dependent on the cigarette production rate and, therefore, on their speed of travel in front of the measurement head 1. Thus, the number of measurement points, i.e. the number of measurement values along the travel of the scanning beam 5 over the front face of a cigarette tip, are rendered constant and independent of the cigarette production rate. The device 14 for synchronizing the flow of measurement values, should be regulated, advantageously, so as to obtain, preferably, 60 to 80 and particularly 70, analogic/digital conversions (i.e. measurement points) each cigarette.

The microprocessor 10 will store in a programmable memory, for example, a R.A.M. (random access memory) or the like, the measurement signals which have been converted into digital signals. Thereafter, these stored signals will be processed, determining the maximum measurement value and subtracting from this maximum measurement value the values of the individual measurements. Thus, the measurement signals of the intensity of the reflected beam 5′, each constituting a measurement signal of the distance of a different point on the face of the cigarette tip from the source which generates the scanning beam 5, are converted into signals each of which indicates the degree of filling up of a cigarette with respect to the edge of the cigarette tip that is directed towards the measurement head, at the point of the tip's face of the cigarette filling up that is associated with said signal and with respect to a point of the cigarette tip's face having a maximum fill-up degree. Moreover, the measurement signals thus obtained are independent of the distance of each cigarette from the measurement head, so that the measurement val-

ues thus obtained for each cigarette may be compared by the microprocessor 10, with no possibility of errors, with the entered gate-value. If a series of measurement values concerning one cigarette exhibit more than four values which exceed the gate-value, the microprocessor will consider this cigarette as defective and emits a signal to activate the solenoid valve 19 of the discarding device, whereby said cigarette will be rejected.

It is apparent that the measurement values obtained by means of said device, not only may be rendered independent of the distance of the cigarettes from the measurement head, but they are also independent of changes in the color-shades of tobacco, by virtue of the fact that the measurement is not referred to the brightness of said signal, but it is a distance measurement proper which can be carried out very rapidly, reducing the possibility of errors to negligible levels.

Figures 2 to 4 show graphical depictions of measurements concerning the filling up of the tips of three different cigarettes. The ordinate A of each diagram indicates the value of the measurement signal, while the abscissa B indicates the sequential number of the respective measurement along the path of travel of the scanning beam impinging the front face of the cigarette tip. The depicted curve, therefore, shows graphically the degree of fill-up at the various scanned spots. It is apparent that the cigarette concerned in the measurements of Figures 2 and 3 are cigarettes with defective fill-up, shown by the valleys in the respective diagram at the regions indicated generally by the arrow R1 and by the arrows R2 and R2′, whilst the cigarette concerned in the measurement of Figure 4 is a normally filled up cigarette. This is clearly shown by the substantially linear and uniform outline, parallel to the abscissa, of the diagram along the cross section of the cigarette, said outline representing a series of measurement values which are substantially identical to each other.

Of course, the invention is not limited to the embodiments described and shown herein, but many changes and modifications, especially of constructional nature may be made thereto. Thus, for example, the source 4 of the scanning beam could generate a beam of micro-waves or ultrasonic waves to be focussed at the cigarette tip's face, in combination with a corresponding sensor to detect the reflected beam. The above without departing from the basic principle set forth above and claimed hereinafter.

Claims

1 - A device for checking the cigarette tips, comprising a stationary measurement head (1) associated with a conveyor means which causes the cigarettes (2) to pass after each other transversely to their longitudinal axes in front of the measurement head (1), with the cigarette tips to be checked facing said head, as well as a device (9) for processing the measurement values and a device (18, 19) for discarding the defective cigarettes, under the control of said processing device, characterized in that said measurement head (1) is provided with means (4) to generate a scanning beam (5) directed against the front surface of the tip of each cigarette (2) and with a sensor for detecting the scanning beam (5′) reflected by the tips of the cigarettes (2).

2 - A device according to claim 1, characterized in that the processing device to which the measured values are fed is provided with discriminating means (10, 13) having an entered gate-value, and by means (10) for correcting the values which have been measured along the front surface of the tip of each cigarette (2), directed towards the measurement head (1), for subtracting said measurement values from one of said values, particularly from the maximum value.

3 - A device according to claims 1 or 2, characterized in that said sensor (6) for detecting the reflected scanning beam (5′) is connected to an electronic processor (9) through an interposed device (14) for synchronizing the inflow of the measurement signals, a constant number of measurements being provided on each cigarette tip, which is independent of the speed of travel of the cigarette in front of the measurement head (1).

4 - A device according to any one or more of the preceding claims, characterized in that the means for generating the scanning beam (5) comprises a light source (4), particularly a source of laser beams, more particularly with frequencies in the infrared spectrum, while the detecting sensor (6) comprises a sensor of photo-electric type, or the like.

5 - A device according to any one or more of the preceding claims, characterized in that the scanning beam (5) is oriented parallelly to the longitudinal axis of the cigarettes, while the detecting sensor (6) is oriented so as to detect the reflected scanning beam (5′) which is at an angle to the longitudinal axis of the cigarettes.

6 - A device according to any one or more of the preceding claims, characterized in that the processing device comprises an electronic processor (9) including a microprocessor (10), and said discriminating means is constituted by said microprocessor (10), having connected thereto a device (13) for the entry of the gate-value, while the means for correcting the measurement values are constituted by a programmable memory of the RAM type, or the like, included in the microprocessor (10), and

by said microprocessor (10).

7 - A device according to any one or more of the preceding claims, characterized in that the device (14) for synchronizing the inflow of the measurement signals to the microprocessor (10) comprises a tachometer generator (15) connected through an operational amplifier (17) with a voltage/frequency converter (16) which is connected to the control input of an analog/digital converter (12) by means of which the detecting sensor (6) is connected to an input of said microprocessor (10) for controlling the frequency of conversion of the analog signals generated by the detecting sensor into digital signals, and therefore the frequency of inflow of these signals to the microprocessor (10) with linear dependence on the speed of travel of the cigarette tips in front of the measurement head (1).

8 - A device according to any one or more of the preceding claims, characterized in that the number of measurements effected along the path of travel of the scanning beam (5) over the front surface of the tips of cigarettes (2) is constant for each cigarette and is independent of the speed of travel of the cigarette tips in front of the measurement head (1), i.e. the rate of production of cigarettes.

9 - A device according to any one or more of the preceding claims, characterized in that the number of measurements on each cigarette (2) is, preferably, 60 to 80 ao measurements, more particularly 70 measurements.

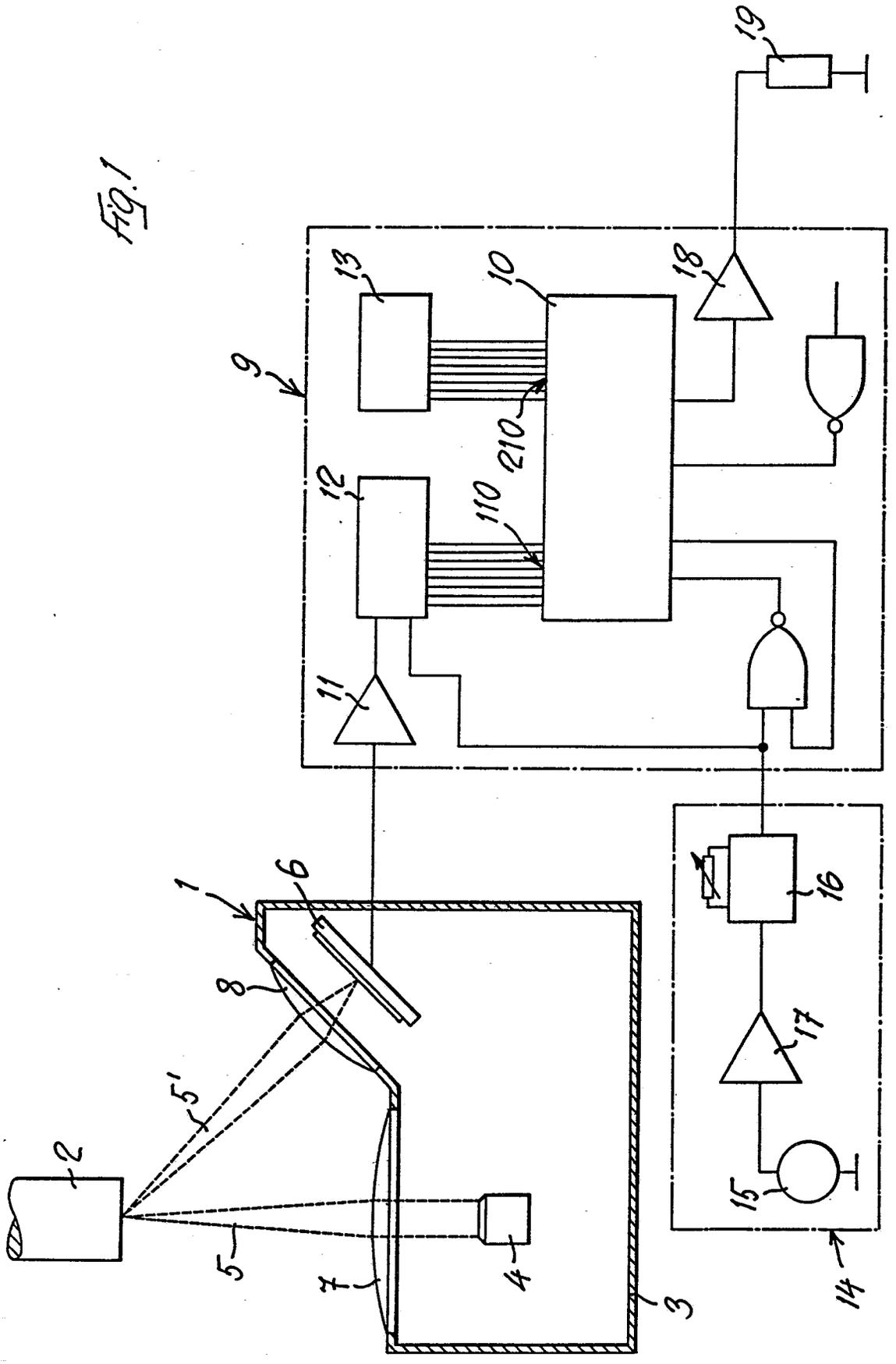
10 - A device according to any one or more of the preceding claims, characterized in that the measured and processed values on a cigarette correspond, each, to the degree of fill-up at the associated point of incidence of the scanning beam onto the front surface of the cigarette tip, with respect to a point of maximum degree of fill-up.

11 - A device according to any one or more of the preceding claims, characterized in that the discarding device comprises a solenoid valve (19) connected to an outlet of the microprocessor (10) by means of a buffer (18).

12 - A device according to any one or more of the preceding cliams, characterized in that said discarding device is activated when, for a cigarette (2), a plurality of processed values, particularly four processed values, exceed the gate-value.

13 - A device according to claim 1, characterized in that the scanning beam source (4) may comprise a source of beams of microwaves, ultrasonic waves, or the like, fucussed at the face of a cigarette (2), while the detecting sensor (6) comprises a sensor adapted to detect said fucussed beams.

Fig.1



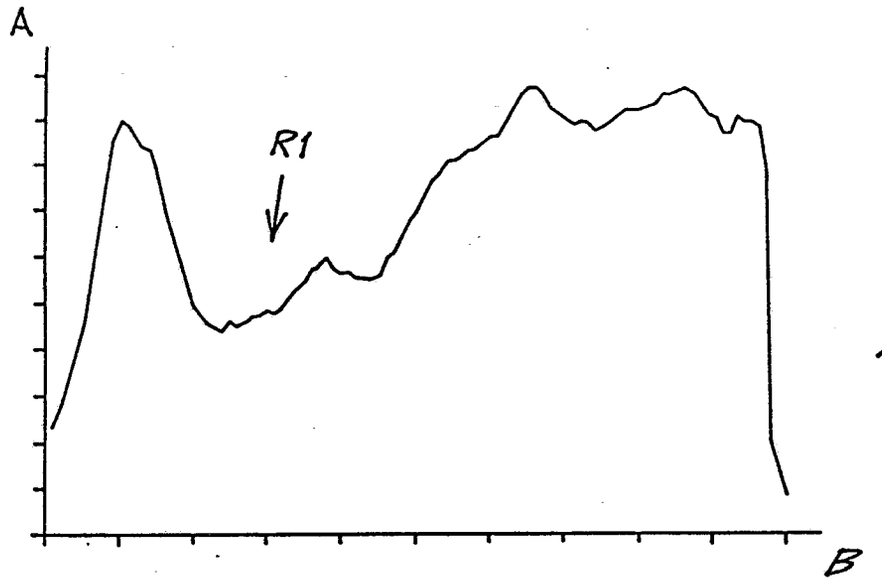


Fig.2

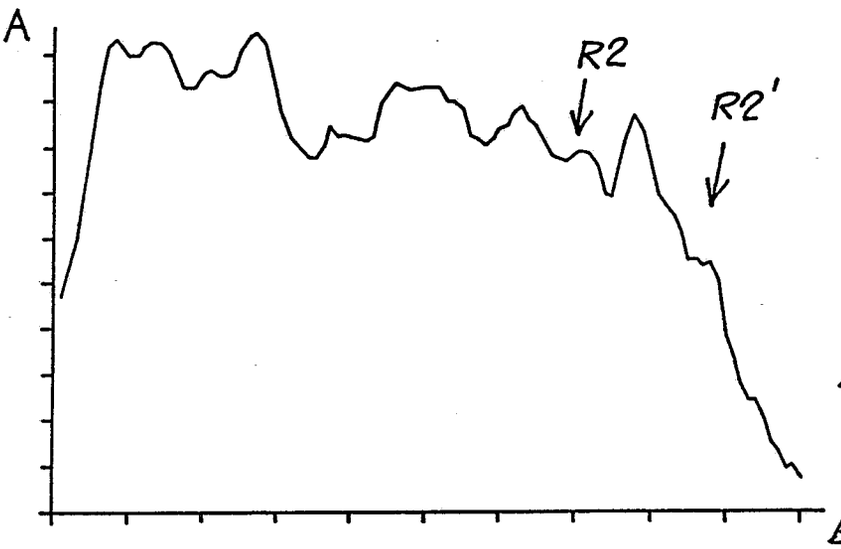


Fig.3

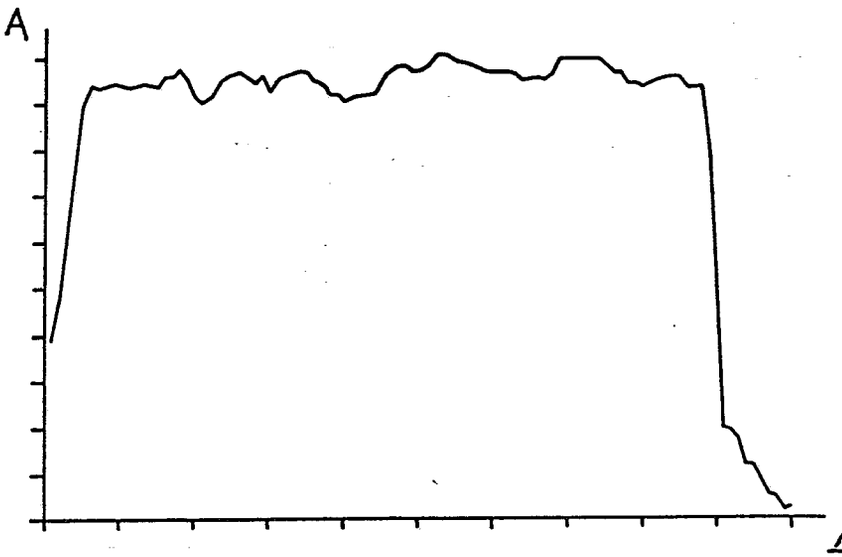


Fig.4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 11 9339

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-3812349 (GUGLIOTTA) * the whole document *	1, 4, 5, 13	A24C5/34 G01N21/47
A	GB-A-2176598 (KORBER) * abstract; figures 1, 4, 5 *	1	
A	GB-A-2141229 (KORBER)		
A	US-A-4165939 (WOODROW)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

A24C
B65B
G01N
B07C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	06 MARCH 1990	RIEGEL R.E.

CATEGORY OF CITED DOCUMENTS

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