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## (54) Procedure for analysing the visible clouding of safety paper and device for the performance thereof

(57) The paper to be analysed is made to pass through an acquisition unit (2), on a platform (5) thereof, from an entrance (6) to an exit (7), conveniently directed by a guide (8) and drawn by a traction motor (10) with the collaboration of photocells (9-9') which detect the entrance and the exit of the paper, specifically making it pass through an emitter-receiver combination (12), in which the light beam is modulated by the nonuniformity in the thickness of the paper, variations in the modulation of light which are converted into voltage variations to be applied to a processing and display unit in which participates a data acquisition card and a computer, where the signal is converted into digital form and wherein the processing thereof is carried out to extract the parameters which will characterise the cloudiness of the paper sample.

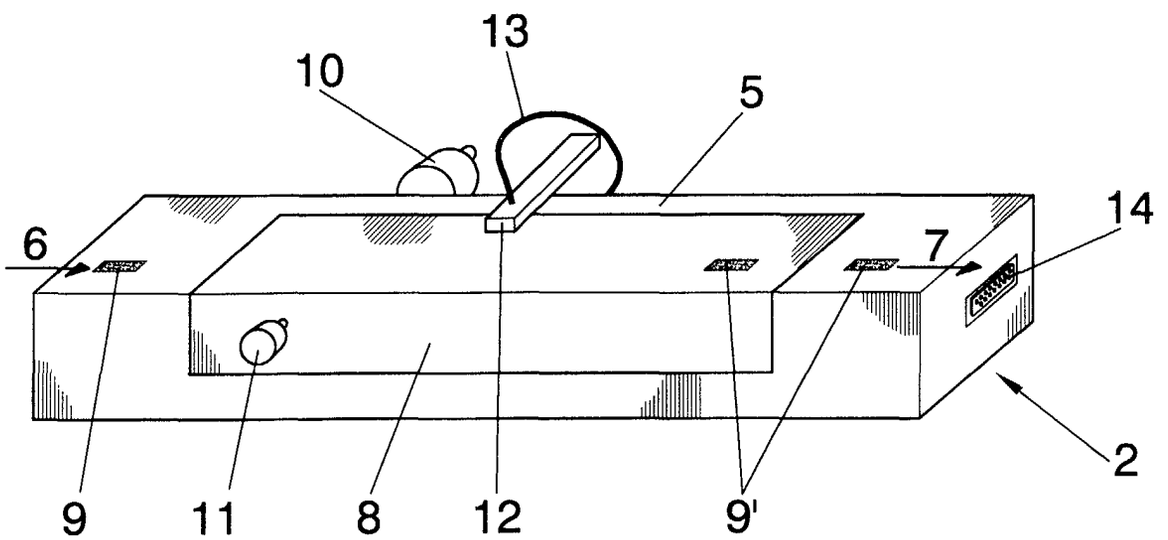


FIG.4

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## Description

### OBJECT OF THE INVENTION

**[0001]** The present invention relates to a new procedure for analysing the visible appearance presented by security paper, like paper for currency for example, after being fabricated and before being printed, an appearance very similar to that of a cloudy sky, whereby internationally this visible property is termed "cloudiness", which term will be employed throughout the present description.

**[0002]** The measurement of this visible characteristic is of supreme importance since the cloudiness of the substratum alters several characteristics of the final document.

**[0003]** The invention also concerns the procedure for the performance of said method.

### BACKGROUND OF THE INVENTION

**[0004]** Many different solutions are known for measuring or determining the translucency of a document to determine the cloudiness or visible appearance which a paper sample has, or to characterise them in some other way. In this sense mention can be made of those, among others, to be found in the Patents US P/N 4,630,845 for "AUTHENTICATION DOCUMENT SYSTEM" and EP 0268450 for "METHOD AND SYSTEM OF AUTHENTICATION", which describe systems of document authentication based on the translucency of a document. However, in these documents said translucency is measured only in a certain area of a document in order to so characterise it and authenticate it, the information being recorded in a visible magnetic mark which the document itself incorporates and which is where the information is stored which will later be compared with a certain master.

### DESCRIPTION OF THE INVENTION

**[0005]** The method which the invention discloses allows the visible appearance which the paper presents to be analysed, that is, the cloudiness, after being fabricated and before being printed, to establish any type of valuation in this respect.

**[0006]** For this and more specifically, in said procedure the following operational phases are defined:

- the paper is made to pass between a light emitter and receiver, duly facing each other, the working frequency of these elements corresponding to the near infrared, that is, having a wavelength of between 870 and 980 nanometres.

- The non uniformity of the paper generates a modulation in the incident light beam, and the variations in the modulation are converted into voltage variations, which after being amplified and filtered are transferred to a data acquisition card.

- The signal captured by the data acquisition card is processed in a computer by means of software specifically developed for this purpose.

**[0007]** The device for the performance of said method consists of an electro-mechanical acquisition unit, and of a control computer which runs a software program exclusively developed for this purpose. The electromechanical acquisition unit includes a casing through which the paper is guided by means of a traction motor, photocells for the detection of the position of the paper during its passage, and guides for a correct centring and displacement thereof. Also, this electro-mechanical unit includes the corresponding adjustment systems, both of the speed of the traction motor, and of the sensitivity of the emitter-receiver pair.

**[0008]** The adjustment unit serves for controlling the speed of the aforementioned paper traction motor, as well as for adjusting the symmetry and sensitivity levels of the emitter-receiver pair.

**[0009]** The processing unit converts the analogue voltage signal coming from the detector of the acquisition unit into a digital signal by means of the corresponding acquisition card connected to the computer, wherein the aforementioned computer program will deduce the parameters which characterise the cloudiness quantitatively.

### DESCRIPTION OF THE DRAWINGS

**[0010]** To complete the description being made and with the object of assisting in a better understanding of the characteristics of the invention, according to a preferred example of practical embodiment thereof, said description is accompanied by, as an integral part thereof, a set of drawings wherein, by way of illustration and not restrictively, the following has been represented:

Figure 1. - It shows a photographic representation of a banknote paper in which the cloudiness or visible appearance of the paper is appreciated.

Figure 2. - It shows a block diagram corresponding to the device for analysing cloudiness which constitutes the object of the present invention.

Figure 3. - It shows, according to a view in perspective, the body of elements corresponding to the diagram of the previous figure, with the exception of the computer.

Figure 4. - It shows, according to a schematic view in perspective, the acquisition unit which participates in the body of figures 2 and 3.

## PREFERRED EMBODIMENT OF THE INVENTION

**[0011]** In the light of the figures indicated above, it can be observed how, to analyse the cloudiness of the paper (1) represented in figure 1, use is made of an acquisition unit (2), a control and adjustment unit (3) and a processing and display unit (4), this last materialized in the combination of a data acquisition card and a computer.

The acquisition unit (2) is materialized in an electromechanical element, in which participates a casing defining an upper platform (5) over which the paper (1) to be analysed must pass, from an entrance (6) to an exit (7), platform on which a guide (8) is implemented for correct positioning and displacement of the paper.

**[0012]** An entrance photo cell (9) detects the presence of the paper on the acquisition unit (2), and sets a traction motor (10) in operation, with the collaboration of a potentiometer (11), whilst exit photocells (9') interrupt the motion of said motor (10).

**[0013]** In the middle area of the platform (1) an emitter-receiver assembly (12) set up, for example materialized in a light emitting diode (LED), both the emitter and the receiver having a working frequency corresponding to the near infrared, that is, a wavelength of between 870 and 980 nanometres, with the emission peak situated at 930 nanometres.

**[0014]** The beam of light coming from the emitter traverses the paper and is picked up by the detector, whereby as a consequence of the non-uniformity in the thickness of the paper, the light beam incident upon the detector is modulated, determining the characteristics of the cloudiness.

**[0015]** The aforementioned casing has a connector (14) through which the acquisition unit (2) is linked with the control and adjustment unit (3), which serves for controlling the speed of the traction motor (10) of the paper, as well as for adjusting the symmetry and sensitivity levels of the emitter-receiver pair, through a series of controls (15). This unit also has an electronic filter which applies the appropriate signal to the control computer (4) for its later processing and display.

**[0016]** As for the processing unit (4), this receives the analogue voltage signal coming from the detector of the acquisition unit (2), converts it into a digital signal by means of the corresponding acquisition card and, once stored in memory, the computer carries out the necessary processing to extract the parameters which will characterise the cloudiness of the paper sample (1). This analysis stage is the fundamental part of the process, from which the parameters will be deduced that characterise the cloudiness quantitatively. The evaluated parameters concern the digitised signal, both in the space domain and in the transform domain (frequency). The analysis includes statistical signal processing in both domains.

**[0017]** From the operational point of view, the device requires a prior adjustment, specifically an adjustment of the motor (10) until a constant speed is achieved, using the potentiometer (11), and after achieving said adjustment of the motor, one proceeds to adjust the opacity to its central value over the dynamic range possible. To achieve this, the symmetry control potentiometer of the control unit (3) is adjusted, so that the output voltage level provided by the sensor falls in the centre of the vertical scale.

**[0018]** After the centre adjustment of opacity, the paper sample is again passed through the device, the opacity signal being captured over the whole length of the paper, which signal is subsequently processed.

## Claims

1. Procedure for analysing the visible cloudiness of security paper, the object of which being to extract information concerning the uniformity of the paper with reference to level of opacity or cloudiness, is **characterised in that** therein the following operational phases are established:

   - the paper to be analysed is made to pass between an emitter and a detector, duly facing each other;
   - the non-uniformity of the paper generates a modulation in the incident light beam, and the variations in the modulation are converted into voltage variations which are amplified, filtered and transferred to the data acquisition card;
   - the signals stored in the data acquisition card are processed in a computer by means of specific software.

2. Procedure according to claim 1, **characterised in that** the working frequency at which the emitter and receiver elements operate belongs in the near infrared, that is, at a wavelength of between 870 and 980 nanometres.

3. Device for the performance of the procedure of the previous claims, **characterised in that** therein form part an acquisition unit (2), a control and adjustment unit (3) and a processing and display unit (4) which comprises the aforementioned acquisition card and a computer.

4. Device, according to claim 3, **characterised in that** the acquisition unit (2), of electromechanical nature, incorporates a casing in which a upper platform (5) is established, for displacement of the paper (1) to be analysed from an entrance (6) to an exit (7), platform (5) assisted by a guide (8) for positioning of the paper and on which an emitter-receiver (12) is mounted, assisted by a fibre optic support (13), said unit also incorporating a traction motor (10) for the

paper, controlled by an entrance photocell (9) and at least one exit photocell (9'), as well as with the control and adjustment unit (3), having to such an end a connector (14) for connection of the units of acquisition (2) and of control and adjustment (3).

**5.** Device according to claim 3, **characterised in that** the adjustment unit (3), serving to control the speed of the traction motor (10) of the paper, as well as to adjust the symmetry and sensitivity levels of the emitter-receiver combination (12), incorporates an electronic filter which supplies the appropriate signal to the computer of the processing unit (4), for subsequent processing and display thereof.

**6.** Device according to claim 3, **characterised in that** the processing unit (4) receives the analogue voltage signal coming from the detector (12) of the acquisition unit and converts it into digital form by means of the acquisition card, stores it in memory and the computer carries out the necessary processing to extract the parameters which will characterise the cloudiness of the paper sample (1).

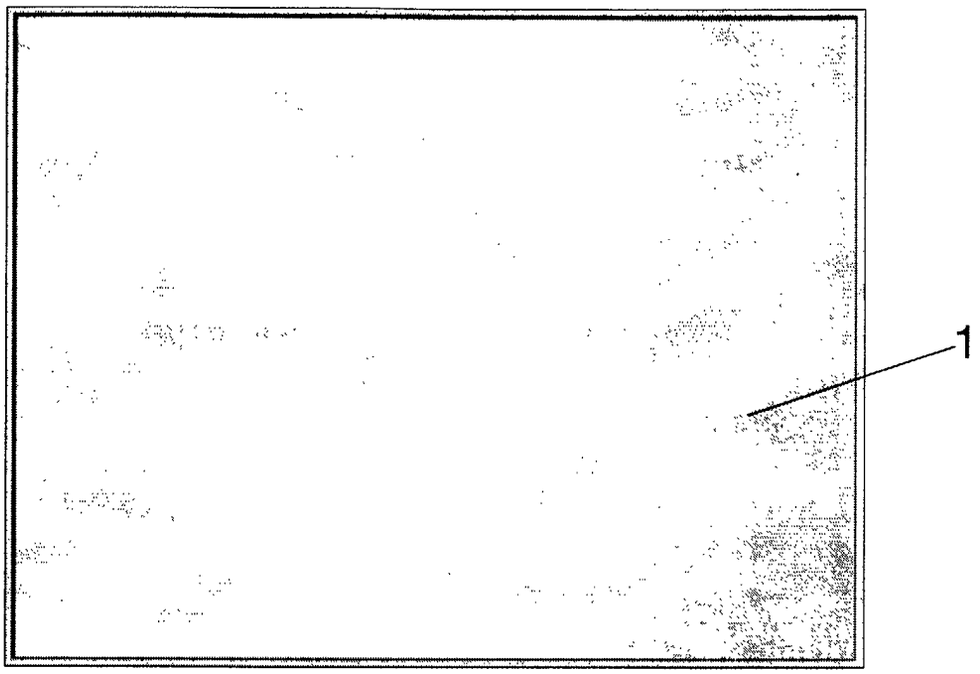


FIG.1

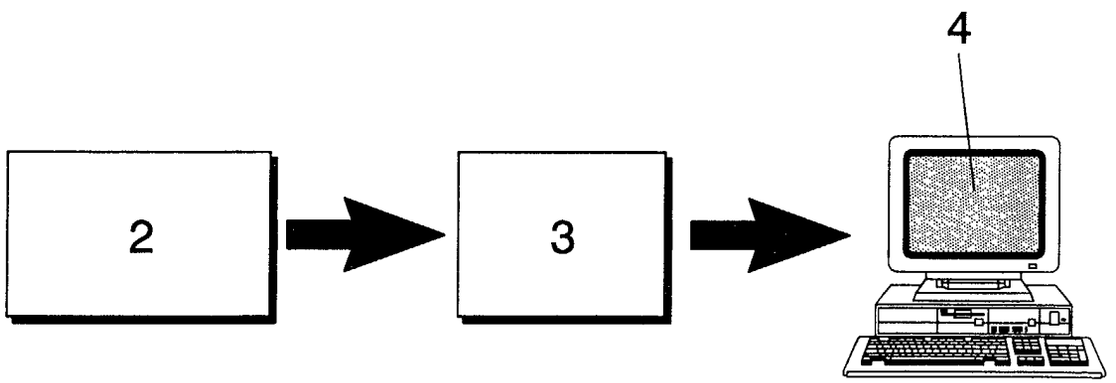


FIG.2

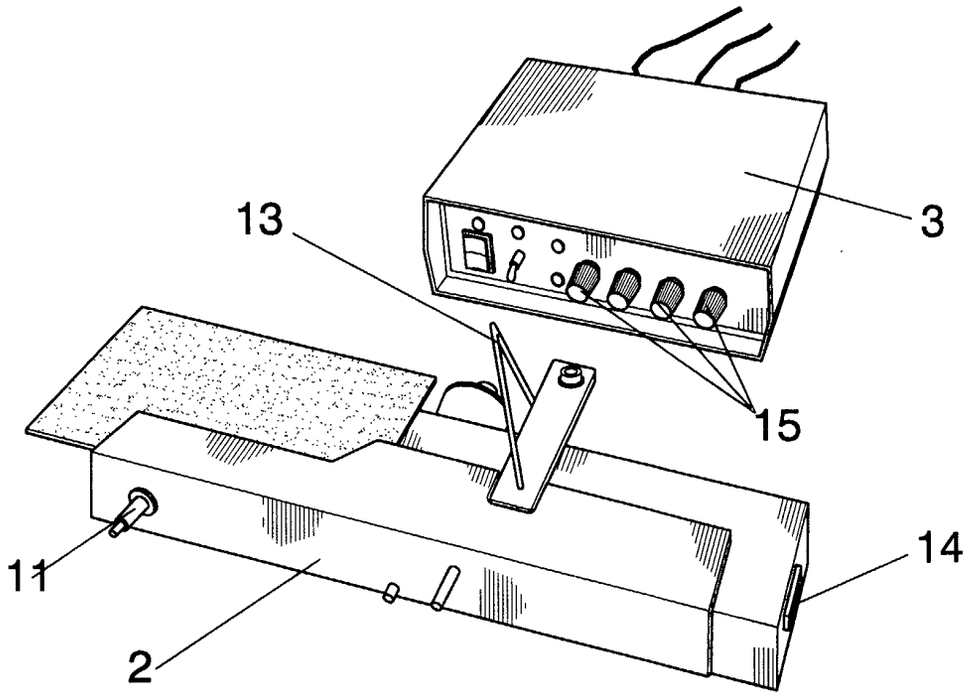


FIG.3

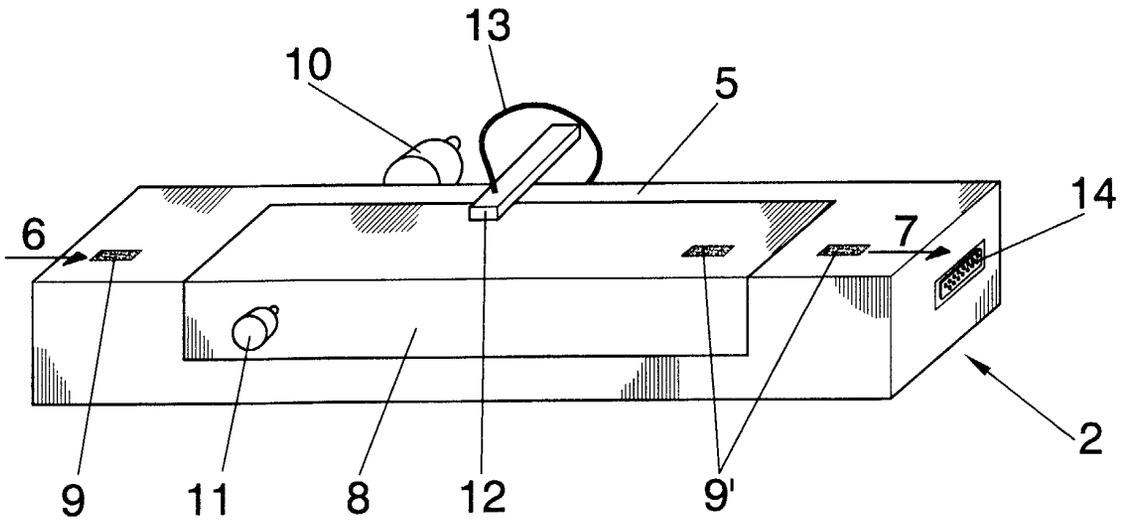


FIG.4