United States Patent

Doi

[15] **3,636,442**

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[54] DETECTION SYSTEM FOR DETECTING HOLES IN PHOTOCOPYING PAPER

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[52] **U.S. Cl.** **324/65**, 118/9

[51] **Int. Cl.** **G01r 27/02**

[58] **Field of Search** 324/54, 65; 118/8, 9, 10

[56] **References Cited**

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Attorney—Burgess, Ryan and Hicks

[57] **ABSTRACT**

A device for detecting defect holes and the like in photocopying paper wherein an electrically conductive detection roller is disposed in electrically insulated relation with a main body of a photographic sensitizing agent application device at a position where a base sheet passes with its back surface being wrapped over said detection roller while the agent applied to the front surface being not yet sufficiently dried. The detection roller is electrically partitioned in the axial direction into a plurality of sections so that depending upon the width of the base sheet to be used, a required number of said sections is electrically connected with each other through slip rings.

4 Claims, 5 Drawing Figures

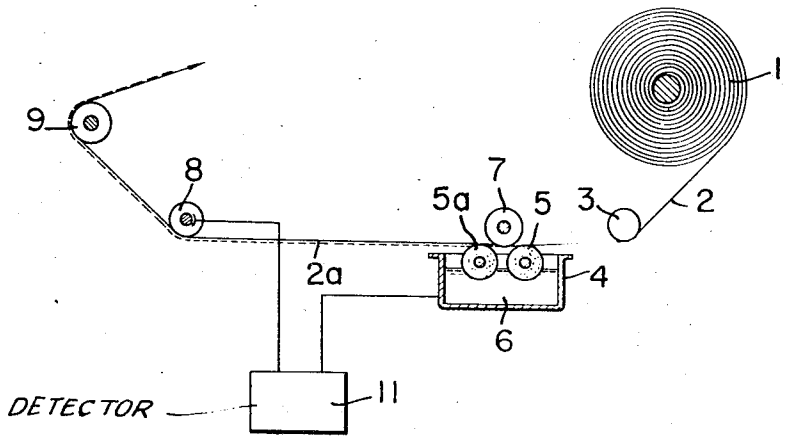


FIG. 1

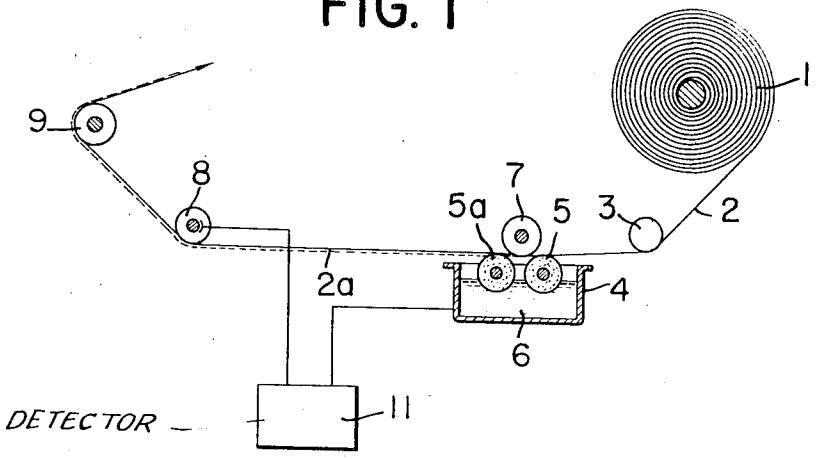


FIG. 2

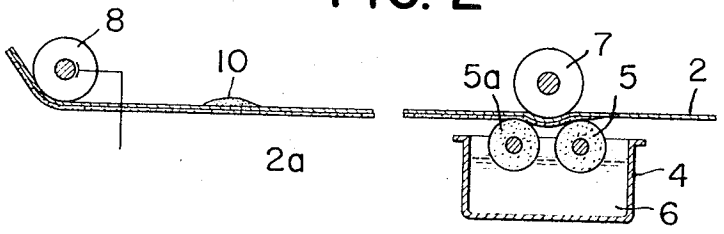


FIG. 3

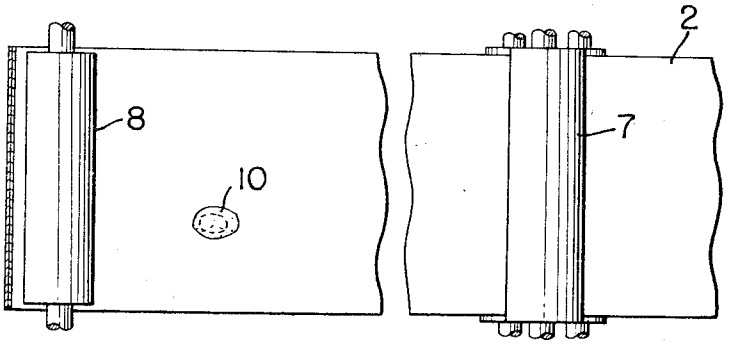


FIG. 4

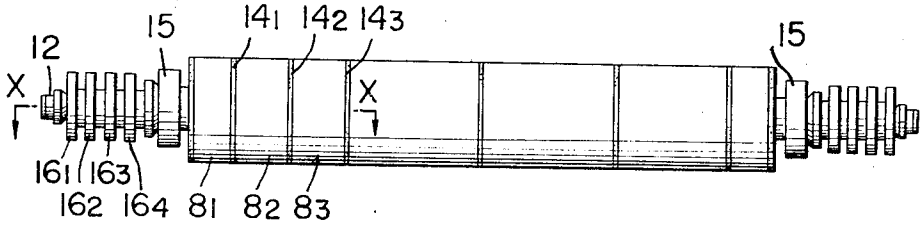
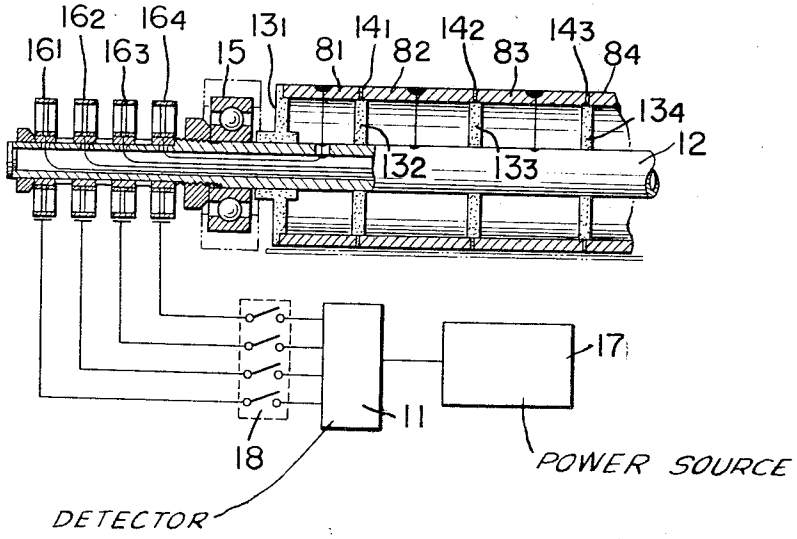

12
15
141
142
143
15
X
X
161
163
162
164
81
82
83

FIG. 5


162
164
161
163
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131
81
141
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142
83
143
84
134
12
132
133
17
11
18
POWER SOURCE
DETECTOR

DETECTION SYSTEM FOR DETECTING HOLES IN PHOTOCOPYING PAPER

BACKGROUND OF THE INVENTION

The present invention relates to a photographic sensitizing agent application device and more particularly to a device for detecting defect holes and the like in sensitized paper or photocopying paper for use with said application device.

It is preferable that the thickness of the photocopying paper used in photocopying machines and the like may be as thin as possible, but when it is thin, the agent or emulsion-forming agent spreads over the back surface of the base sheet through small defect holes, thereby deteriorating the quality of the photocopying paper.

In order to detect such defect holes and the like in the photocopying paper, there has been proposed a method in which light is irradiated over the base sheet of photocopying paper so as to detect a light beam passing through the defect holes and the like or a method in which the radiation rays are irradiated over the base sheet in order to detect the radiation passing through the defect holes and the like. These methods are effective to some extent, but when the defect holes and the like are too small or when the base sheet is passing at relative high speed, the detection becomes difficult.

SUMMARY OF THE INVENTION

The underlying principle or the present invention resides in the fact that the defect holes and the like in the base sheet of photocopying paper may be detected by utilizing the fact that the conductivity of the sensitizing agent is higher than that of the base sheet unless the agent is sufficiently dried.

According to the present invention, an electrically conductive detection roller over which is wrapped the back surface of the base sheet of photocopying paper is disposed in electrically insulated relation with the main body of a photographic sensitizing agent application device at a position where the agent coated upon the front surface of the base sheet is not yet sufficiently dried, and a detector has one terminal connected to said application device and the other terminal connected to said detection roller. When the agent oozes out of the defect holes in the base sheet and spreads over the back surface thereof, a large current flows through the detector because the agent has a high conductivity so that the defect holes and the like may be immediately detected.

When the agent is applied to the front surface of the base sheet, it tends to spread over the back surface thereof along the ears or side edges. The widths of the base sheets used are different so that various detection rollers having different lengths must be prepared, which is very uneconomical. However, according to the present invention, such defect can be eliminated by electrically dividing in the axial direction the detection roller into a plurality of sections, which are electrically insulated from each other.

One of the objects of the present invention is to provide a device for detecting the defect holes and the like in the base sheet of photocopying paper which is simple in construction and reliable in operation.

Another object of the present invention is to provide a device for detecting the defect holes and the like in the base sheet of photocopying paper which can be economically used with the base sheet having a wide variety of width.

The above and other objects, features and advantages of the present invention become more apparent from the following description of one illustrative embodiment thereof with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view partly in section of one embodiment of the present invention;

FIG. 2 is a side view partly in section illustrating only the principal parts thereof;

FIG. 3 is a plan view thereof;

FIG. 4 is a side view of a detection roller in accordance with the present invention, and

FIG. 5 is an enlarged sectional view taken along the chain line X—X of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a base sheet 2 unrolled from a rolled base sheet 1 is fed or advanced substantially horizontally over a photographic sensitizing agent tray 4 through a guide roller 3. In the tray 4 are disposed a pair of application rollers 5 and 5*a* with their lower sides being immersed in the sensitizing agent 6 and a tension roller 7 is arranged above the pair of application rollers. The base sheet 2 passes through the nips between the tension roller 7 and the application rollers 5 and 5*a* so that the sensitizing agent 6 may be uniformly applied upon the surface of the base sheet 2. The coated base sheet 2 is advanced through guide rollers 8 and 9 and then dried in a drier (not shown) and rolled.

If the base sheet 2 has a hole, the sensitizing agent 6 oozes through the hole onto the back surface of the base sheet 2 as shown by 10 in FIGS. 2 and 3, thereby deteriorating the product, a photocopying paper. The detection of such a hole may be made by utilizing the fact that the agent is electrically conductive. For this purpose, the guide roller 8 is made of a metal and is electrically insulated from the frame of the application device (not shown), and a detector 11 is disposed between the guide roller 8 and the tray 4. Therefore the guide roller 8 (to be referred to as "detection roller" hereinafter), the portion 2*a* of the base sheet 2 between the pair of application rollers 5 and 5*a* and the detection roller 8, the portion 2*a* being not yet dried, the application rollers 5 and 5*a* and the detector 11 establish one electric circuit. This circuit is normally opened because the detection roller 8 is electrically insulated from the agent by the electrically insulating base sheet 2. If the base sheet 2 has a hole and the agent 6 oozes therethrough upon the back surface as shown by 10 in FIGS. 2 and 3, the resistance across the base sheet 2 will be changed to such an extent that the defect hole may be detected. It may be considered that the length of the spread of the agent 6 oozed out of the defect hole is a function of a diameter of this hole so that the diameters of the defect holes may be electrically detected by the duration of the signal which is generated when the agent oozes out of the defect hole and spreads over the back surface of the base sheet 2.

In some cases, the agent will spread over the back surface of the base sheet 2 through its ears or side edges so that the resistance across the base sheet 2 will be varied, thereby causing the faulty detection of the defect holes. Therefore, preferably the length of the detection roller 8 is made relatively shorter than the width of the base sheet 2. Thus when base sheets having different widths are used, detection rollers 8 having different lengths must be replaced, which is very disadvantageous. In order to eliminate this disadvantage, the end portions of the detection roller 8 may be electrically partitioned into sections depending upon the expected widths of the base sheets to be used. That is, depending upon the width of the base sheet 2 used, the length of the detection roller 8 may be electrically varied.

One embodiment of a detection roller in accordance with the present invention is illustrated in FIGS. 4 and 5. Over a hollow shaft steel 12 are coaxially fitted electrically conductive cylinders 8_1, 8_2, 8_3 spaced apart from each other by insulating disks 13_1, 13_2, 13_3 and 13_4 respectively and water-repellant, electrically insulating rings 14_1, 14_2, 14_3, and so on respectively, the width or thickness of each of these rings being shorter than the minimum diameter of a defect hole to be detected. At both ends of the assembled detection roller are fixed roller bearings 15 and slip rings 16_1, 16_2 and so on, the number of these slip rings being equal to that of the conductive cylinders 8_1, 8_2, 8_3 and so on and these rings electrically insulated from each other, but electrically connected with their corresponding conductive cylinders 8_1, 8_2 and so on by means of lead wires. Reference numerals 11 and 17 designate the detector and a power source respectively; and 18, selection or changeover switches.

As described above, the lengths of the conductive cylinders 8_1, 8_2 and so on may be determined depending upon the widths of the base sheets to be used in normal operation. Thus when the conductive cylinders upon which no ears or side edges of the base **2** are wrapped are electrically connected so as to establish the electric circuit of the character described hereinabove, there is no fear that the detection circuit is erroneously actuated by the agent **6** spreading over the back surface of the base sheet **2** along its ears or side edges. When the detection roller **8** is further electrically divided or partitioned at its center portion in addition to the above-described partition at the end portions thereof, the base detection zone is further divided into smaller zones and the leakage current is reduced so that the more sensitive detection may be ensured because the resistance ratio will vary greatly between the zone having a defect hole and and the zone having no defect hole. This method is particularly advantageous and effective when the base is very thin.

By reversing the electrical connection, it is possible to detect whether the agent spreads over the back surface of the base sheet **2** along its ears or side edges or not.

I claim:

1. A system for detecting defect holes in photocopying paper used with a photographic sensitizing agent comprising

a container having fluid sensitizing agent therein, said sensitizing agent being electrically conductive;

roller means partially submerged in said sensitizing agent;

a tension roller positioned above said roller means in abutting relation and providing a nip for said paper to pass therethrough;

an electrically conductive guide roller spaced from said tension roller and positioned so that said paper can pass therearound;

a power source and electrical detector provided in a circuit connected to said sensitizing agent, said guide roller and said photocopying paper, said photocopying copy paper being electrically insulating and normally preventing completion of said circuit when said paper is free from defects;

said guide roller formed with spaced areas, each area being in the form of a cylinder and separated from an adjacent area by insulating means;

individual electrical conducting means connected respectively between said detector and each cylindrical area; and

said detector providing a signal corresponding to the number of individual circuits completed to said cylindrical areas when a defect hole in said paper allows electrically conductive sensitizing agent to pass through said paper into contact with said areas.

2. A system according to claim **1** in which a hollow shaft is provided for said guide roller, said individual electrical conducting means comprises a plurality of slip rings mounted on said shaft, said slip rings corresponding in number to the number of said cylindrical areas, and each slip ring having an electrical connection passing through said hollow shaft for connection to its respective corresponding area.

3. A system according to claim **1** in which the widths of said cylindrical areas vary with respect to each other.

4. A system according to claim **1** in which the dimension of said tension roller along its longitudinal axis is less than the width of said photocopying paper.

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