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[54] **METHODS AND APPARATUS FOR THE SELECTION OF FOREIGN BODIES OF SMALLER DIMENSIONS, FROM A MAIN MASS**

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[58] **Field of Search**.....209/75, 111.6, 111.7, 109, 209/74

[56] **References Cited**

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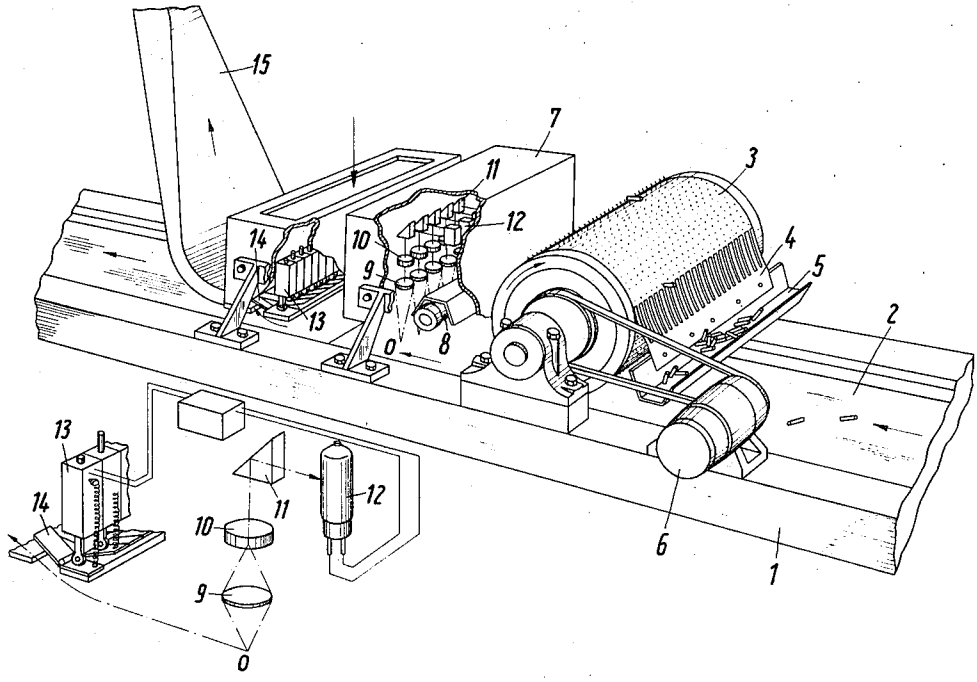
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[57] **ABSTRACT**

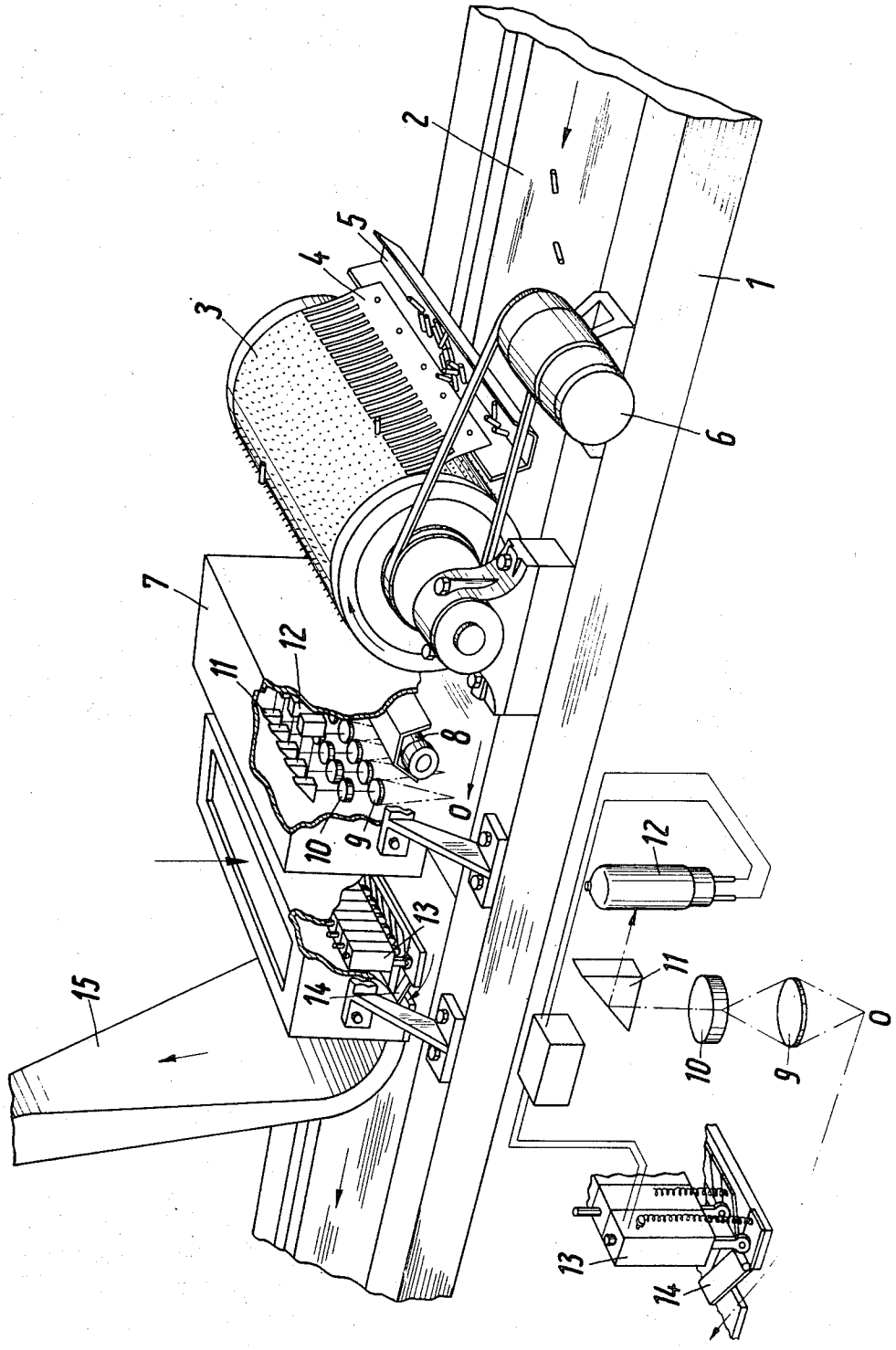
A method and an apparatus for removing foreign bodies from a main mass, especially from tobacco, by electrically optically monitoring the mass and pneumatically removing the foreign bodies.

6 Claims, 1 Drawing Figure



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METHODS AND APPARATUS FOR THE SELECTION OF FOREIGN BODIES OF SMALLER DIMENSIONS, FROM A MAIN MASS

The invention relates to methods for the selection of foreign bodies of smaller dimensions, which permit themselves to be differentiated from a main mass of material optically, and an apparatus for the application of this method to contaminated tobacco.

The waste cigarettes from cigarette machines are normally cut into pieces in a ripping machine in order to be able to re-utilize the tobacco.

For this purpose, pieces of cigarette paper, pieces of packing paper, filter plugs, whole cigarettes, broken pieces of cigarettes and the like have to be separated out of the fleece of tobacco leaving the ripping machine.

It is an object of the present invention to provide a method and an apparatus for carrying out this separation thoroughly and rapidly.

According to one aspect of the invention a method for the selection of foreign bodies of small dimensions which can be differentiated from a main mass of material optically comprises moving the main mass of the material on a conveyor belt in adjacent streams, monitoring the material by an electro-optical system arranged to monitor the main substance over each stream and pneumatically removing the foreign bodies via flaps, provided for each part stream, which are arranged to be opened for a short period under the control of the electro-optical system.

According to another aspect of the invention a selecting apparatus for use with contaminated tobacco coming from a ripping machine, comprises a conveyor belt arranged to run at high speed, a spiked roller provided with a stripping device and arranged above the conveyor belt, electro-optical systems which each control a part of the width of the belt which is arranged to be illuminated by lamps arranged transverse to the direction in which the belt runs and downstream of the spiked roller, flaps individually arranged downstream of each electro-optical system and arranged to be electromagnetically opened for a short period by means of the electro-optical systems on sensing optic reflections from the foreign bodies, and an exhaust channel common to all the flaps for removal of the foreign bodies.

According to a preferred feature the circumferential speed of the spiked roller is adjustable and is less than the speed of the conveyor belt.

It is suitable that the conveyor belt, preferably black, together with the fleece of tobacco lying thereon be illuminated by fluorescent lamps, which are driven with an electronically stablished rectangular voltage having a frequency of for example 7 kilocycles per second.

The apparatus preferably includes color filters in the optical system, by means of which the reflection from the main mass of the material is extensively suppressed, and photo-cells having spectral selection in their sensitivity, whose maximum lies in the region wherein the main mass of the material has the weakest and the foreign bodies a strong reflection provides a selection of the illumination. By means of this arrangement a particularly strong contrast is produced between the main mass of the material and the foreign bodies.

The invention may be performed in various ways and one specific embodiment will now be described by way of example with reference to the accompanying drawing which is a perspective view of an apparatus according to the invention with the electro-optical system shown separately.

Described generally, in the apparatus the fleece to be selected leaves the ripping machine by means of a conveyor belt. The further treatment may, conveniently, be divided into three sections:

1. Reduction of the fleece by sieving

The contaminated fleece, which consists predominantly of short fibers, runs on a sieve conveyor gutter about 2.5m long having a sieve base with meshes of substantially 3mm inner measurement, through which about 90 percent of the material falls. Impurities below 3mm are also sieved out and due to their minuteness do not damage the sieved material. The sieved material is, with advantage, re-fed to the production of cigarettes by means of pneumatic conveyance.

2. The elimination of coarse bodies

The material remaining on the sieve consists of long fibered tobacco and impurities which are coarser than 3mm. This material passes on to a conveyor belt running at speed.

There are two reasons for the high speed of the conveyor of about 1.4m/sec. In the first place the fleece is thinned by the drawing apart of the individual particles and in the second, a higher flank parity of the impulse is obtained when the signal is received by the electro-optical system.

A roller provided with spikes is mounted above the belt in such a way that coarse impurities such as filter plugs and cigarettes are speared by the spikes. A comb engaging between the spikes may, for example, strip off the bodies speared.

The roller is adjustable as to its distance from the belt so that the size of the unsieved bodies such as particles of tobacco may be adjusted thereby. The roller has with advantage a separate drive. Its circumferential speed can be adjusted. When the spikes are inclined slightly against the direction in which the belt runs, the circumferential speed of the roller is, with advantage, adjusted to a speed somewhat less than the speed of the belt. In this way the coarse bodies are more surely speared.

Improvements are possible by means of a slightly inclined roller, a spiked belt instead of a roller, spikes adapted to be drawn in for stripping etc.

3. Separation of fine bodies

Individual long tobacco fibers and individual pieces of paper remain on the belt. For example 15 groups of photo-cells are arranged above the belt transverse to the direction in which it runs, each of which groups controls a 2cm wide strip of the belt. An optical arrangement consisting of lens, color filter and prism is placed, with advantage in front of each photo-cell. Two fluorescent lamps, for example, light up or illuminate the fleece passing under this arrangement. The transmission curve of the color filter is preferably so selected that the black belt and the brown tobacco fibers only produce slight light reflection. If however a white piece of cigarette paper or a light brown piece of packet paper, or the like, passes the controlled zone then the reflection on the photo-cell concerned is stronger and the photo stream thereby released exceeds an adjustable threshold value.

The impulse then released by the photo-cell may be further amplified and is then transmitted to an elec-

tromagnet arranged downstream of the photo-cell concerned. The magnet is disposed downstream of the cell and opens, on receipt of an impulse, a flap, for a short period of time, which can be adjusted electrically, and thereby an aperture is freed to an exhaust channel associated with all the flaps. The piece of paper which caused the impulse is sucked away. If a larger piece of paper arrives, two or more adjacent cells give an impulse, the related flaps are opened and free a through-slot, wide enough to allow the large piece of paper to be sucked away without any trouble.

The fluorescent lamps are conveniently driven by an electronically stabilized rectangular voltage of a frequency of for example 7 kilocycles, in order to avoid wrong signals due to interspersions in the electric mains and fluctuations of light.

Electric filters in the system can suppress the high frequency of the drive so that it does not respond to the rapid fluctuations of light, which it would do when driven at mains frequency. The rectangular voltage provides, in addition to this, a higher strength of light.

Fluorescent tubes were chosen which have the highest output of light in the transmission region of the color filter. In the same way the photo-cells have the highest sensitivity in this region of the spectrum, while the tobacco has here the least reflection so that the contrast is here greatest.

On correct selection of these filter combinations other objects desired could be sought out from other material by this method.

Referring in more detail to the drawings, a conveyor belt **2** running in a frame **1** conveys the material from the ripping machine by means of a sieve conveyor gutter below a spiked roller **3** from which the impurities speared thereon are stripped off by a comb **4** into a gutter **5** and from thence led away. The roller **3** is driven separately by means of a motor **6**.

After passing the spiked roller **3**, the material comes under the electro-optical system in that it is illuminated by fluorescent lamps **8**. Light-colored particles reflect the light which is directed through lenses **9**, color filters **10** and prisms **11** onto photo-cells **12**, which in turn control an electromagnetic system **13**, by means of which adjacent flaps **14** are opened or closed.

Impurities signalled by the system are blown out by means of the exhaust channel **15** common to all flaps **14**.

We claim:

1. A method for the selection of foreign bodies of small dimensions, which can be differentiated from a main mass of material optically comprising moving the main mass of the material on a conveyor belt in adjacent streams, monitoring the material by an electro-optical system arranged to monitor the main substance over each stream, and pneumatically removing the foreign bodies via flaps, provided for each part stream, which are arranged to be opened for a short period under the control of the electro-optical system.

2. A selecting apparatus, for use with contaminated tobacco coming from a ripping machine, comprising a conveyor belt arranged to run at high speed, a spiked roller provided with a stripping device and arranged above the conveyor belt, electro-optical systems which each control a part of the width of the belt which is arranged to be illuminated by lamps arranged transverse to the direction in which the belt runs and downstream of the spiked roller, flaps individually arranged downstream of each electro-optical system and arranged to be electromagnetically opened for a short period by means of the electro-optical systems on sensing optic reflections from the foreign bodies, and an exhaust channel common to all the flaps for removal of the foreign bodies.

3. An apparatus according to claim **2**, in which the circumferential speed of the spiked roller is adjustable and is arranged to be lower than the speed of the conveyor belt.

4. An apparatus according to claim **2**, in which the conveyor belt together with the fleece of tobacco lying thereon is arranged to be illuminated by fluorescent lamps which are driven with an electronically stabilized rectangular voltage.

5. An apparatus according to claim **4**, comprising color filters in the electro-magnetic systems by means of which the reflection of the main mass of the material is extensively suppressed, and photo-cells having spectral selection of their sensitivity, whose maximum lies in the region in which the main mass of the material has the least, and the foreign material a strong, reflection.

6. Apparatus according to claim **2**, in which the conveyor belt is black.

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