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PHOTOELECTRIC SCANNER WITH SYNCHRONIZED CUTTER
AND PHOTOCELL OFFSET FROM LIGHT SOURCE

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2 Sheets-Sheet 1

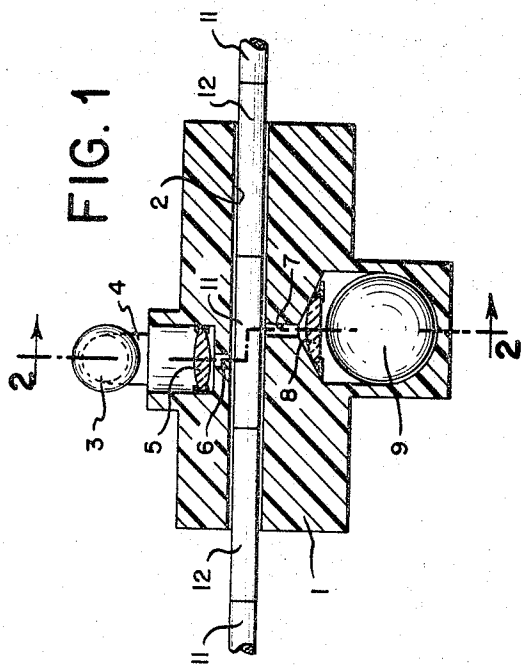


FIG. 1

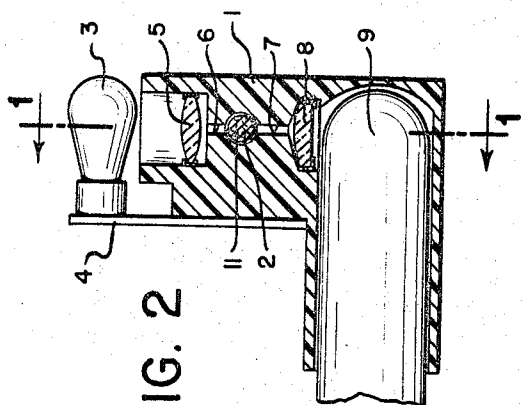


FIG. 2

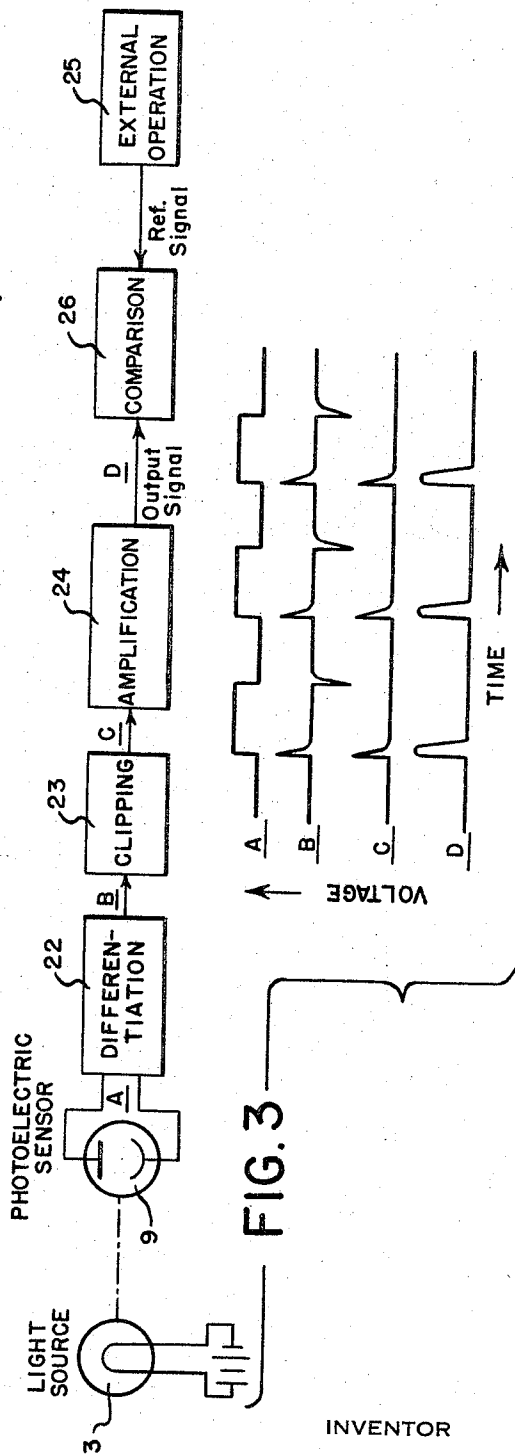


FIG. 3

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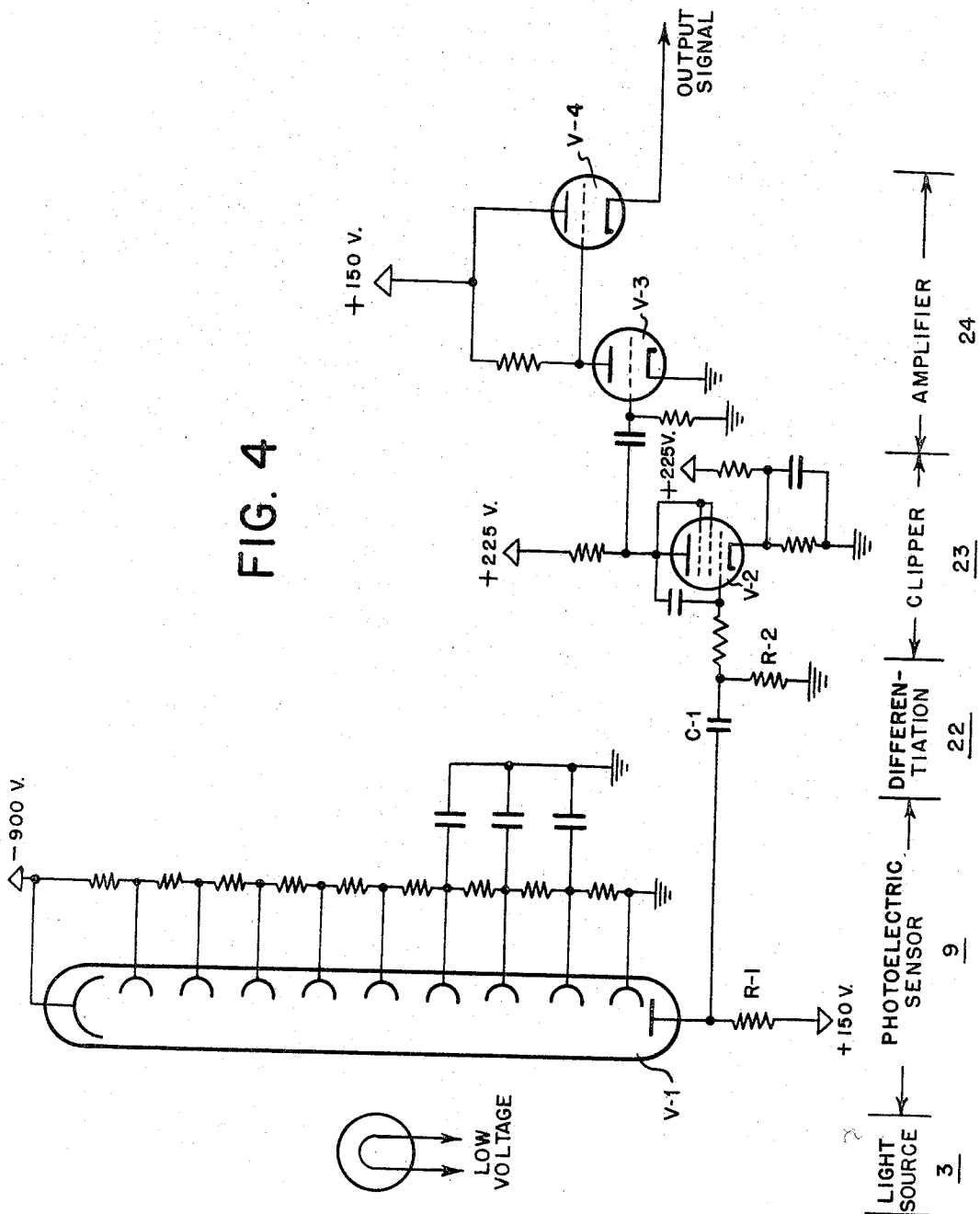
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PHOTOELECTRIC SCANNER WITH SYNCHRONIZED CUTTER AND PHOTOCELL OFFSET FROM LIGHT SOURCE

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3 Claims. (Cl. 250-223)

ABSTRACT OF THE DISCLOSURE

A photoelectric scanner having a light source and photocell is shown for scanning a rod of cigarette filter material comprising alternate segments of carbon and cellulose and for generating a timing signal to control a synchronized filter cutting operation. The photocell is offset from the light source along the length of the rod so that only changes in the intensity of light indirectly diffusing through the rod are sensed, thereby providing sharper light transitions and more accurate timing signals.

This invention relates to a photoelectric scanning unit and, more particularly, to a photoelectric sensing device for use in the measurement and manufacture of composite filters for cigarettes.

Cigarettes are commonly manufactured with integral filter tips which are often of a composite type, i.e., each filter comprises two or more cylindrical segments of dissimilar materials. The composite filter segments are generally assembled in a filter-making machine to form a continuous rod of alternating type segments (e.g., a white cellulose segment, followed by a black carbon-containing paper segment, followed by another white cellulose segment, etc.) and are wrapped in a continuous paper tube. The continuous rod of filter segments is cut into short lengths, each length containing several filter segments. These lengths are then fed to a cigarette-making machine where they are further subdivided by cutting to produce composite filter tips for individual cigarettes.

The cutting of the continuous rod of filter segments into short lengths must be held to close tolerances or the composite filter segments will be too long or too short for satisfactory use in cigarettes. To obtain this synchronization of the cutting operation, my invention makes use of the fact that the segments used in composite cigarette filters customarily have markedly dissimilar light transmission properties. Pursuant to my invention, a beam of light is focussed on the moving continuous rod of filter segments, and a photoelectric sensor detects the amount of light passing or diffusing through the rod. The amount of light diffusing through the rod varies as the different type filter segments move past the sensing station, and the electrical output voltage of the photoelectric sensor varies accordingly. This voltage is then differentiated with respect to time so that an electrical output signal is generated whenever an interface between two dissimilar type segments moves past the sensing station.

By comparing this output signal of the photoelectric scanning unit with a reference signal from the cut-off knife of the filter making machine, appropriate controls can be operated to advance or retard the filter feed system to insure accurate cutting of the continuous rod of filter segments. Also, with a fixed feeding speed, the length of time between scanner output signals may be measured to detect and measure varying filter segment lengths.

I have now observed that when a filter rod interface moves past a light source, the fluctuations of the light indirectly diffusing through the rod are sharper (i.e., the

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transitions from light to dark, and vice versa, take a shorter time) than the corresponding fluctuations of the light directly diffusing through the rod. The broadening of the transitions with directly diffusing light is caused by the shadow of the filter interface sweeping across the sensing device. There is no such shadow effect when only light indirectly diffusing through the rod is permitted to reach the light sensor.

The exclusion of directly diffused light from the sensor is accomplished in my invention by offsetting the sensor from the light source along the length of the filter rod by a distance great enough so that no direct radiation from the light source falls on the sensor. The exact distance of this offset depends upon the sharpness of the focus of light from the light source upon the surface of the filter rod, the angle of incidence of direct radiation from the light source within the rod, and the size of the light aperture associated with the sensor.

Accordingly, my invention includes a control device for synchronizing the movement of a cutting blade with the passage therepast of a composite cigarette filter rod composed essentially of alternate sections of different degrees of opacity to light. The control device comprises a light source, a photoelectric sensing device positioned to receive solely the light transmitted from the light source through the filter rod, means for guiding the movement of the filter rod axially between the light source and the sensing device, and means for producing an electrical output signal responsive to the passage between the light source and the sensing device of an interface between adjoining alternate filter rod sections. The electrical output signal is capable of comparison with a reference signal responsive to the movement of the cutting blade. The sensing device is axially offset from the light source by a distance sufficient to prevent passage of light transversely through the filter rod directly into the sensing device.

These and further objects and advantages of my invention will be more readily understood when the following description is read in connection with the accompanying drawings, in which:

FIG. 1 is a sectional side view of the photoelectric scanning station of a preferred embodiment of my invention;

FIG. 2 is a sectional view taken along line 2-2 of FIG. 1;

FIG. 3 shows the electrical assembly of the embodiment in block diagram form; and

FIG. 4 shows the detailed electronic circuitry employed in the embodiment.

Referring to FIGS. 1 and 2, a housing 1 of Bakelite or similar material contains a tubular passage 2 through which the continuous rod of alternating filter segments 11 and 12 passes. An incandescent light source 3, supported by a brace 4, is positioned above the housing. The top of the housing is drilled out to accommodate a condenser lens 5, and a smaller light channel hole 6 communicates with the filter rod passage 2. The under portion of the housing has a cavity which contains a photo multiplier tube 9 and an aperture lens 8. A small light channel hole 7 connects this cavity with the filter rod passage 2.

In operation, light from the incandescent light source 3 is focused by means of the condenser lens 5 through the hole 6 on the top of the continuous rod of alternating filter segments 11 and 12 passing through the passage 2. This light diffuses through the rod and into the hole 7. The diffused light is collected by the aperture lens 8 and falls on the cathode of the photomultiplier tube 9. The bottom light channel hole 7 is not located directly beneath the top light channel hole 6 but is offset approxi-

mately one-quarter inch along the length of the filter rod passage 2. As previously described, this offset excludes the light directly diffusing through the filter rod and reduces the effect which the shadow of an interface between two segments 11 and 12 has upon the light falling on the photomultiplier 9.

As the filter rod moves between the light source 3 and the photomultiplier tube 9, the voltage of the photomultiplier varies according to the amount of diffused light falling upon the cathode of the tube 9 and describes a rectangular waveform as shown at A in FIG. 3. This photomultiplier voltage is applied to a resistor-capacitor differentiator 22 to produce the waveform B. The negative portion of this waveform B is electronically removed by a clipping circuit 23 and the resulting clipped waveform C is electronically amplified by a circuit 24 to produce a scanner output signal D. The clipping operation permits the scanning unit to distinguish one type of segment transition only, e.g., a white to black transition and not black to white transitions.

The generation of a reference signal from an external operation 25 to be controlled and a comparison 26 of that signal with the scanner output signal D is also depicted in FIG. 3.

The details of the electronic circuitry used in the aforementioned embodiment of the invention are shown in FIG. 4. V-1 is the photomultiplier tube, R-1 is its load resistor. C-1 and R-2 form the differentiation circuit 22. V-2 and its associated circuitry form the clipping circuit 23. The cathode of V-2 is biased slightly positive so that only the positive excursions of the differentiated signal at its grid are amplified. V-3 and V-4 together with their associated conventional circuitry comprise the amplifier 24. The output signal of the scanning unit appears at the cathode of V-4.

It will be understood that various changes in the details, materials, steps and arrangement of parts which have been hereindescribed and illustrated in order to explain the nature of my invention may be made by those skilled in the art within the principles and scope of my invention as expressed in the appended claims.

I claim:

1. A control device for synchronizing the movement of a cutting blade with the passage therepast of a composite cigarette filter rod composed essentially of alternate sections of different degrees of opacity to light, the device comprising a light source, a photoelectric sensing device positioned to receive solely the light transmitted from the light source through the filter rod, means for guiding movement of the filter rod axially between the light source and the sensing device, means for producing an electrical output signal responsive to the passage between the light source and the sensing device of an interface between adjoining alternate filter rod sections,

said output signal being capable of comparison with a reference signal responsive to the movement of the cutting blade, the sensing device being axially offset from the light source by a distance sufficient to prevent passage of light transversely through the filter rod directly into the sensing device.

2. A control device for synchronizing the movement of a cutting blade with the passage therepast of a composite cigarette filter rod composed essentially of alternate sections of different degrees of opacity to light, the device comprising a light source, a photoelectric sensing device positioned to receive solely the light transmitted from the light source through the filter rod, means for guiding movement of the filter rod axially between the light source and the sensing device, means for producing an electrical output signal responsive to the passage between the light source and the sensing device of an interface between adjoining alternate filter rod sections, said output signal being capable of comparison with a reference signal responsive to the movement of the cutting blade, the sensing device being axially offset from the light source by a distance greater than the greatest axial distance within the material attained by direct radiation from the light source.

3. A control device for synchronizing the movement of a cutting blade with the passage therepast of a composite cigarette filter rod composed essentially of alternate sections of different degrees of opacity to light, the device comprising a light source, a photoelectric sensing device positioned to receive solely the light transmitted from the light source through the filter rod, means for guiding movement of the filter rod axially between the light source and the sensing device, means for producing an electrical output signal responsive to the passage between the light source and the sensing device of an interface between adjoining alternate sections of the filter rod, said output signal being capable of comparison with a reference signal responsive to the movement of the cutting blade, the sensing device being axially offset from the light source by a distance greater than the axial distance from the axis of the light source to the furthest portion of the filter rod illuminated by direct radiation from the light source.

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