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 149; 131/20, 21; 250/202, 203, 207, 208, 209,  
 214, 220MX, 222, 223

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[54] **ARRANGEMENTS FOR TESTING BLOCKS OF CIGARETTES BY OPTICALLY IMAGING THEIR ENDS ON A VIDICON TUBE**  
**2 Claims, 7 Drawing Figs.**

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**131/21, 250/216, 250/223**  
 [51] Int. Cl..... **A24b 7/14,**  
**G06m 7/00**

**ABSTRACT:** An arrangement for checking blocks of cigarettes comprises an electron camera tube for forming an image of ends of cigarettes of the block, and electric means responsive to illumination of elements of said image for creating a control effect under the control of said element illumination.

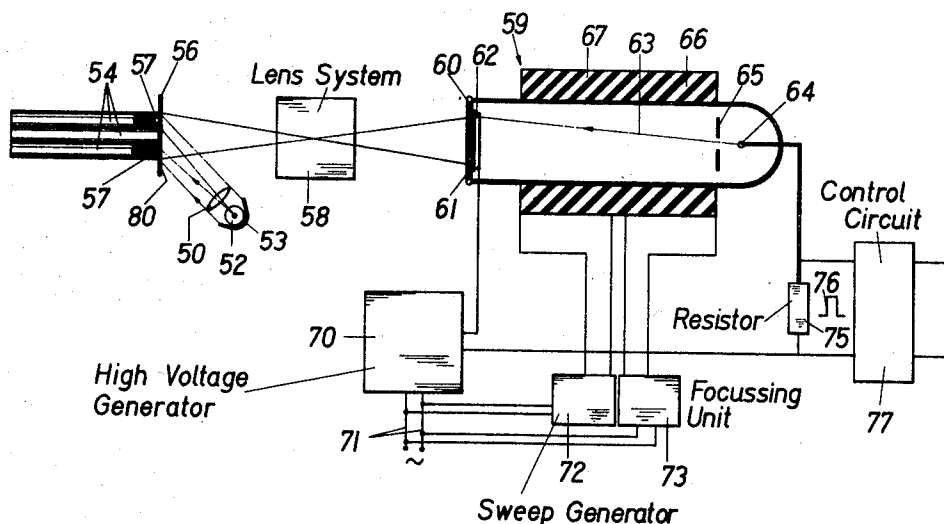
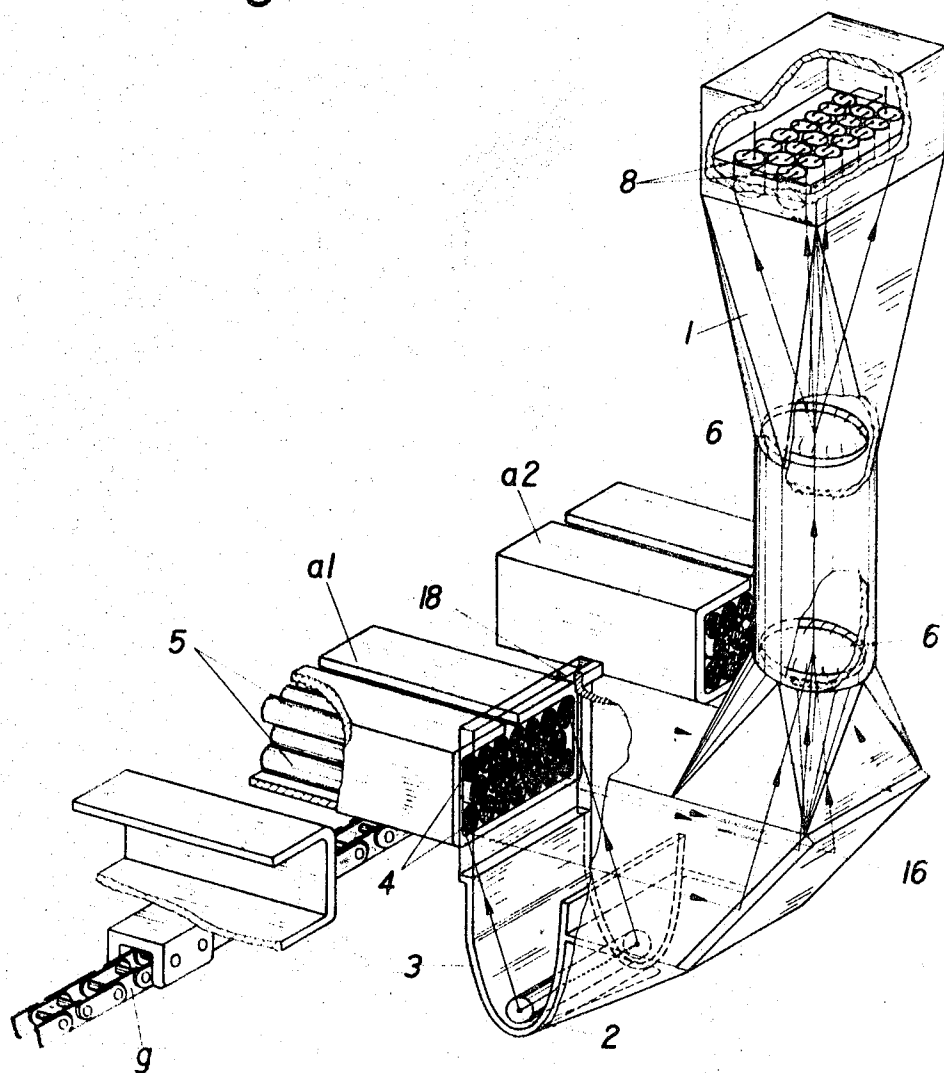


Fig. 1



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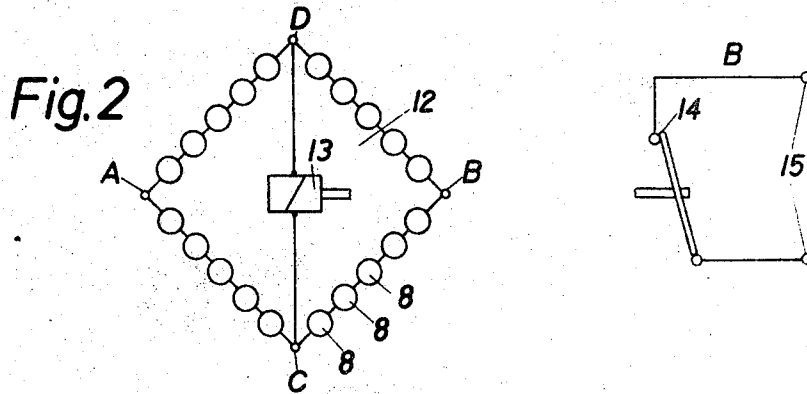


**Fig. 3**

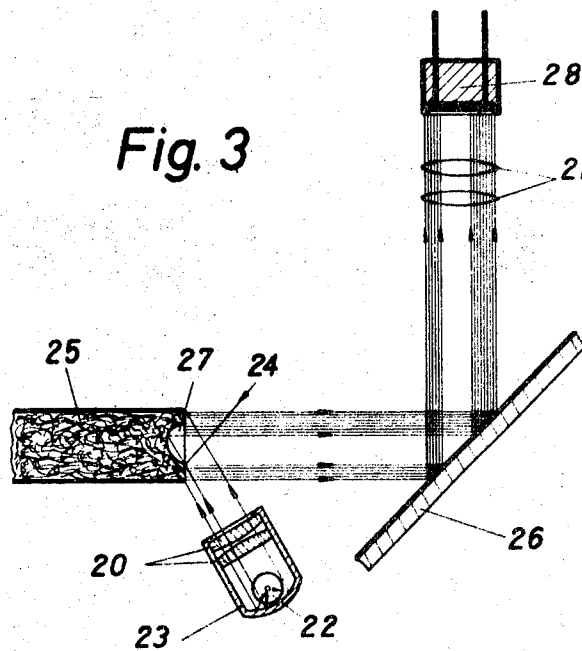
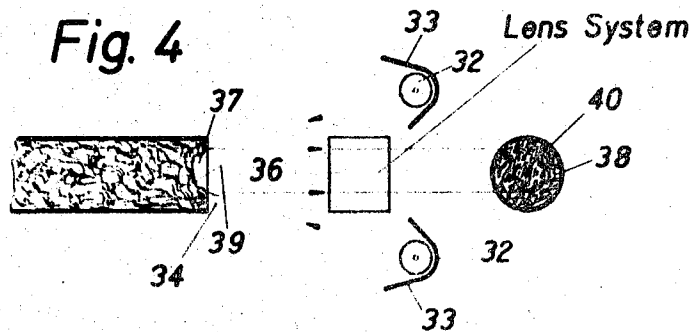


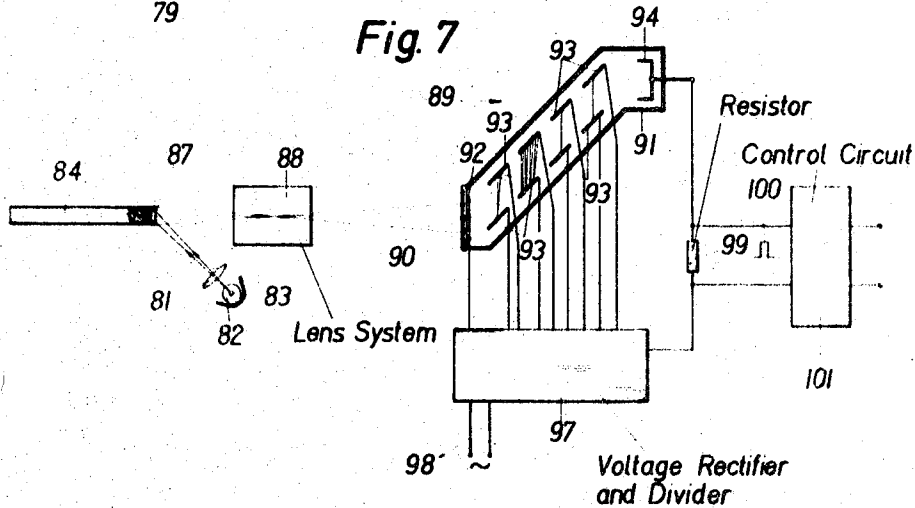
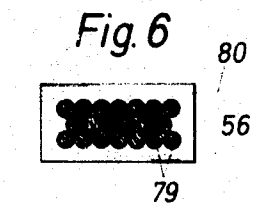
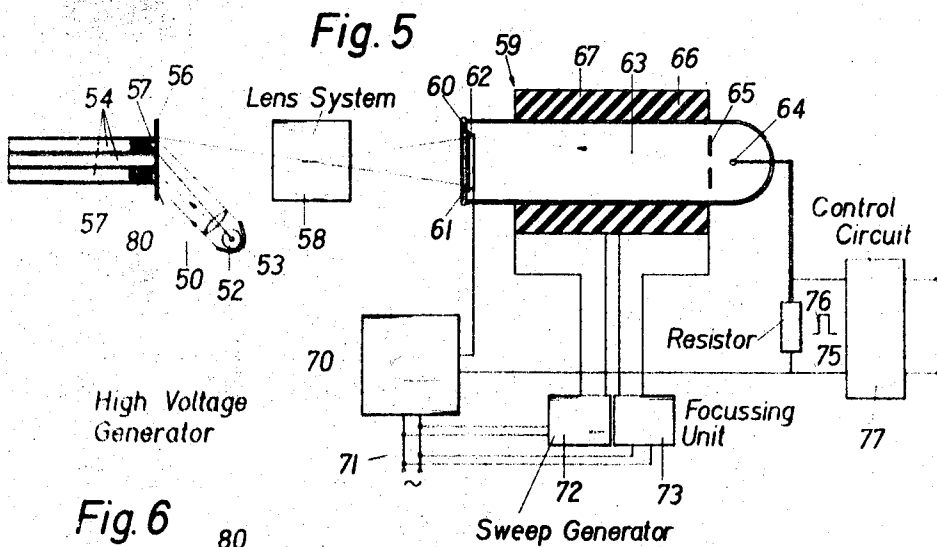
**Fig. 4**



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# ARRANGEMENTS FOR TESTING BLOCKS OF CIGARETTES BY OPTICALLY IMAGING THEIR ENDS ON A VIDICON TUBE

## Disclosure of the Invention

This is a division of application Ser. No. 532,635, filed Mar. 8, 1966, now U.S. Pat. No. 3,473,037.

The invention relates to arrangements for checking blocks of cigarettes and for exerting a control effect when a cigarette of a block is missing or is faulty at a cigarette end.

Such devices may for example be included in cigarette packaging machines for controlling mechanisms for rejecting or diverting blocks of cigarettes in which one or more of the cigarettes is missing or is incorrectly filled.

An object of the present invention is to provide a novel and improved cigarette inspection device wherein photoelectric sensing is employed to detect faulty or missing cigarettes.

The present invention visualizes a cigarette inspection device having optical means for forming an image of the ends of cigarettes on a photoelectric sensing means, and electrical means controlled by the photoelectric photoelectric sensing means for performing a control function in response to sensing of faulty or missing cigarettes by the photoelectric sensing means.

Further features, objects and advantages of the invention will be readily understood by those skilled in the art from the following description of embodiments thereof, which is given by way of example and not limitation, in conjunction with the accompanying drawings, wherein:

FIG. 1 shows a perspective view, partly broken away, of parts of a cigarette inspection device;

FIG. 2 shows an electric bridge;

FIG. 3 shows a modification of parts of FIG. 1 on a larger scale;

FIG. 4 shows a further modification of parts of FIG. 1;

FIG. 5 shows a diagrammatic side view of a cigarette inspection device incorporating a vidicon;

FIG. 6 shows a front view of a detail of FIG. 5; and

FIG. 7 shows a diagrammatic side view of a cigarette inspection device incorporating a photomultiplier.

The device shown in FIG. 1 is provided in a casing 1 housing an electric light source 2. Light omitted from the light source 2 is reflected by a parabolic mirror 3 onto ends 4 of cigarettes 5 arranged in three layers of seven, six and seven cigarettes to form a block of cigarettes. Light is diffusely reflected by the ends 4 and, by means of a reflecting surface 16, reaches an optical system 6, which focuses the light to form an image of the cigarette ends in a plane in which the ends of twenty photoconductive cells 8 are provided, the cells 8 being arranged in three layers of seven, six and seven cells corresponding to the arrangement of the cigarettes, Cigarette blocks a1, a2 are carried by and fed into checking position by a conveyor 9 of any suitable known construction.

The cells 8 are connected in series to each other in one arm II (FIG. 2) of a Wheatstone bridge 12, to terminals A and B of which a suitable electric supply source (not shown) is connected and to terminals C and D of which a relay 13 is connected. The relay 13 controls a contact 14 which, when the relay 13 is energized, connects terminals 15 for operating a control circuit (not shown). The three other arms of the bridge 12 are shown to comprise photoelectric cells similar to those of the arm II, which, however, may in practice be replaced in known manner by suitable resistors. The bridge 12 is so adjusted that when all the photoconductive cells 8 are uniformly illuminated no substantial current flows through the relay 13 but that if a substantial fault occurs at the cigarette ends 4, such as a cavity in one of the cigarettes or a missing cigarette, and the illumination of one of the cells 8 is consequently reduced, a current flows through the relay 13 whereby its contact 14 is closed and the control circuit connected to the terminals 15 is operated. Preferably, a glass plate 18 closes the casing 1 adjacent to cigarette ends 4 (see FIG. 1) and enables the casing 1 to be sealed in an airtight manner.

FIG. 3 in which various parts are diagrammatically shown on a larger scale, illustrates a modification of the device shown in FIG. 1, the parabolic mirror 3 of FIG. 1 being replaced by a mirror 23 for reflecting light from an elongate electric light source 22 onto a cigarette end 24 of a cigarette 25 which is one of a block of cigarettes, the remaining cigarettes having been omitted from FIG. 3. Some of the tobacco filling in the end 24 is missing, so that a cavity 27 is formed.

Light from the light source 22 is reflected by the mirror 23, passes through a lens system 20 and reaches the end 24 of the cigarette 25, where it is reflected from the correctly filled portions of the cigarette and 24 onto a reflecting surface 26, corresponding to the reflecting surface 16 of FIG. 1, and from the reflecting surface 26 through a lens system 21 to a photoconductive cell 28.

As indicated in an exaggerated manner in FIG. 3, less light per unit area reaches the photoconductive cell 28 from the cavity 27 than from the remaining, correctly filled areas of the cigarette end 24, since the sidewalls of the cavity 27 create dark shadows. The total illumination of the photoconductive cell 28 is consequently less than it would be if the whole of the cigarette end 24 were correctly filled, which causes a change in the resistance of the photoconductive cell 28.

The photoconductive cell 28 is one of a plurality of such cells, one of the cells being provided for each cigarette. For convenience, only one cell 28 has been shown in FIG. 3. The cells are connected in the arm II of the bridge 12 of FIG. 2, in place of the cells 8 of FIG. 1. The change of resistance of the photoconductive cell 28 disturbs the balance of the bridge 12 and causes the relay 13 to operate.

FIG. 4 shows a further modification of the devices described above. In the device illustrated in FIG. 4, two light sources 32 are provided in parabolic reflectors 33 for illuminating a cigarette end 34. An optical lens system 36 is provided for focusing an image of the end surface areas of the correctly filled portions of the cigarette end 34 on a photoconductive cell 38 connected in the bridge 12, while the image of the bottom 39 of a cavity 37 in the cigarette end 34 is out of focus on the cell 38 as indicated by reference numerals 40, so that the total light intensity incident on the cell 38 is reduced and the relay 13 of FIG. 2 is operated.

It will of course be understood that the cigarette end 34 is one of a number of ends of cigarettes in a block and that likewise the photoconductive cell 38 is one of a corresponding number of such cells connected in the bridge circuit 12, and that for convenience only one cigarette end 34 and one photoconductive cell 38 have been shown in FIG. 4.

In order to reduce the influence of colour, the light sources 2, 22 and 32 may emit ultraviolet or infrared light, in which case the reflecting surface 16 and 26, the mirrors 3, 23 and 33, the optical system 6, and 36 are adapted for use with ultraviolet light or infrared light.

FIG. 5 shows an embodiment of the invention which employs a photoelectric sensing means in the form of an electron camera tube.

Light is directed through a lens 50 from a light source 52 by a parabolic reflector 53 to the ends of cigarette 54 (only two of which are shown) arranged in a block having two outer rows of seven cigarettes and an inner row of six cigarettes, a glass plate 56 being disposed in front of the cigarettes 54. Cavities 57 have been shown in two of the cigarettes 54.

From the ends of the cigarettes 54 the light is reflected in the same manner as in the above-described embodiments, and is focused by a lens system 58 onto a vidicon, which is indicated generally by reference numeral 59.

The vidicon 59, which is of conventional, commercially available construction, has a window 60 with a vacuum-deposited metal coating 61 and a photoconductive target 62. An electron beam 63 emitted from a cathode 64 passes through an aperture in a mask 65 and is focused on the photoconductive target 62 by a focus coil 66 and deflected by a deflector coil 67, so as to scan the photoconductive target

A high voltage generator 70 having input conductors 71 for connection to an alternating current source is connected across the photoconductive target 62 and the cathode 64. A sweep generator 72 has its input terminals connected to the conductors 71 and its output terminals to the deflector coil 67. A focusing unit 73 is connected to the focusing coil 66.

A resistor 75 is connected between the high voltage generator 70 and the cathode 64, and a control circuit 77 of conventional construction is connected across the resistor 75.

The operation of the device shown in FIG. 5 is as follows:

Light emitted by the light source 52 and directed by the reflector 53 and the lens 50 through the glass plate 56 is reflected by the ends of the cigarettes 54 and passes through the lens system 58 to the window 60 of the vidicon 59.

Under the control of the focusing coil 66 and the deflector coil 67, the electron beam 63 scans the photoconductive target 62.

In the image of the ends of the cigarettes 54 formed on the vidicon 59, the cavities 57 appear as dark spots, and each time one of these dark is scanned by the electron beam 63 a voltage drop occurs across the resistor 75. This voltage drop provides an error signal 76 for operating the control circuit 77.

Since the cigarettes 54 are of circular cross section, interstices are formed between the cigarettes 54. In order to avoid the formation of dark spots corresponding to these interstices on the image on the vidicon 59, the glass plate 56 may be provided with a light-coloured coating 80, for example of sprayed or vacuum deposited metal, for reflecting the light from the light source 52 to the lens system 58, the coating 80 being interrupted at circular areas 79 is disposed in front of the cigarettes 54 (see also FIG. 6).

Instead of employing the coating 80, the vidicon 59 may be provided with means for interrupting the electron beam 63 as it scans areas of the photoconductive target 62 corresponding to the interstices.

A mirror (not shown) may be provided for reflecting the light from the cigarettes before it reaches the vidicon 59.

FIG. 7 shows a further embodiment of the invention in which a lens 81, a light source 82, a reflector 83 and a lens system 88, which are similar to the corresponding parts described above with reference to FIG. 5, are employed to project an image of the ends of a block of cigarettes, of which only one cigarette 84 is shown. A cavity 87 has been shown in the cigarette 84.

In the embodiment of FIG. 7, instead of a vidicon, a photomultiplier tube indicated generally by reference numeral 89 is employed as the sensing means.

The photomultiplier 89 is of conventional construction and has a window 90 in a glass envelope 91 with a photocathode 92 behind the window 90 and eight dynodes 93 distributed along the interior of the tube between the photocathode 92 and an output anode 94.

A high voltage rectifier and voltage divider 97 has input conductors 98 for connection to an AC source, and has its

output terminals connected across the photocathode 92 and the output anode 94 and to the dynodes 93 in the usual way so that when the photomultiplier tube is in use electrons are emitted in cascade by secondary emission from the dynodes 93 in response to photoemission from the photocathode 92.

A resistor 99 is connected between the high voltage rectifier and voltage divider 97 and the output anode 94.

When the device is in use, the voltage across the resistor 99 corresponds to the intensity of the light incident on the photocathode 92 and drops considerably to provide an error signal 100 when dark spots corresponding to cavities 87 in the cigarettes 84 or to missing cigarettes appear on the photocathode 92. A conventional control circuit 101 connected across the resistor 99 responds to these voltage drops.

It should be clearly understood that this embodiments of the invention hereinbefore described are given by way of example and that various modifications may be made in the above-described constructions. For example, instead of the vidicon shown in FIG. 7, another type of electron camera tube, such as an iconoscope or an orthicon, may be employed. Moreover, the cigarette inspection devices described above with reference to FIGS. 1 through 7 of the accompanying drawings can of course be readily adapted for inspecting a different number of cigarettes, for example a single cigarette or a block of ten, twelve, twenty-four or more cigarettes. Many other modifications, omissions and additions are possible without departure from the spirit of this invention.

I claim:

1. A cigarette inspection device comprising a vidicon including a window, a light source arranged to direct light obliquely onto the end faces of a block of cigarettes located in a checking position, a lens system arranged to focus an individual image of only the end face of each cigarette onto said window, the lens system being such that said images are formed by light reflected from a plane defined by said end faces, whereby said vidicon generates an electrical error signal when the intensity of an image is reduced in correspondence to the absence of a properly filled cigarette, and electrical means responsive to said electrical error signal for performing a control function.

2. An arrangement for checking cigarettes comprising means for successively placing blocks of cigarettes into a checking position, a vidicon including a window, a light source arranged to direct light obliquely onto the end faces of a block of cigarettes located in the checking position, a lens system arranged to focus an individual image the lens system being that said images are formed by of only the end face of each cigarette onto said window, light reflected from a plane defined by said end faces, whereby said vidicon generates an electrical error signal when the intensity of an image is reduced in correspondence to the absence of a properly filled cigarette, and electrical means responsive to said electrical error signal for performing a control function.

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