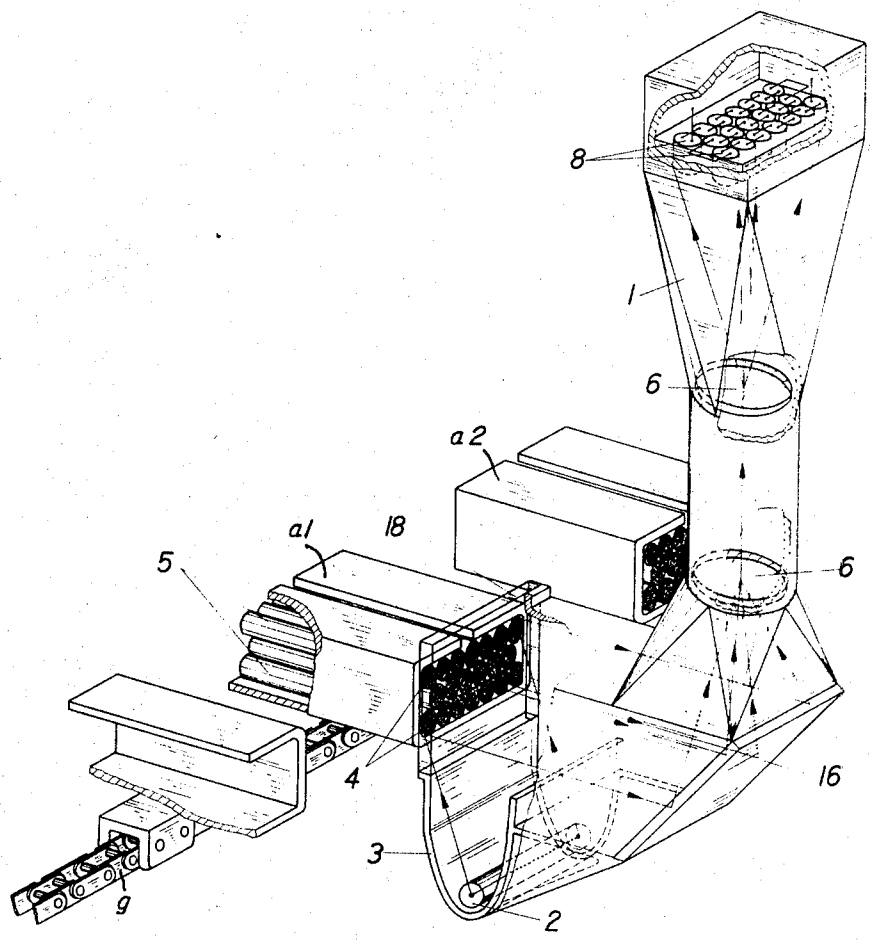
Oct. 14, 1969 A. SCHMERMUND 3,473,037

APPARATUS FOR CHECKING BLOCKS OF CIGARETTES BY OPTICALLY IMAGING THEIR ENDS UPON A MATRIX OF PHOTOCELLS WHICH CONFORMS TO A NORMAL IMAGE

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Fig. 1



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Fig. 2

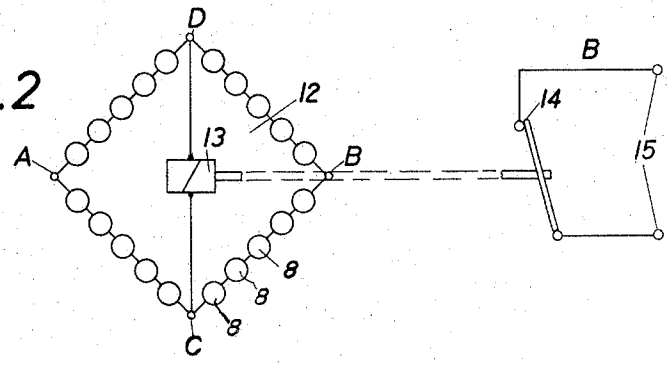


Fig. 3

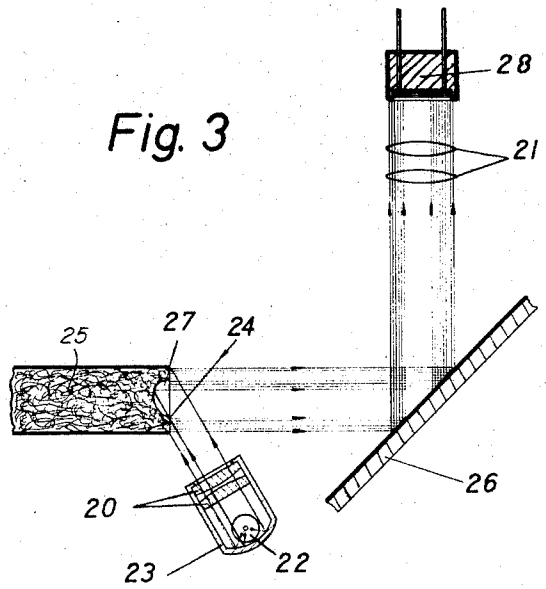
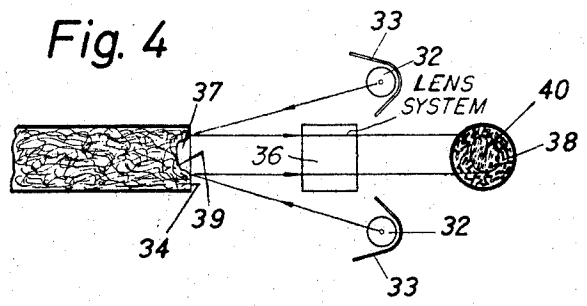


Fig. 4



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Fig. 5

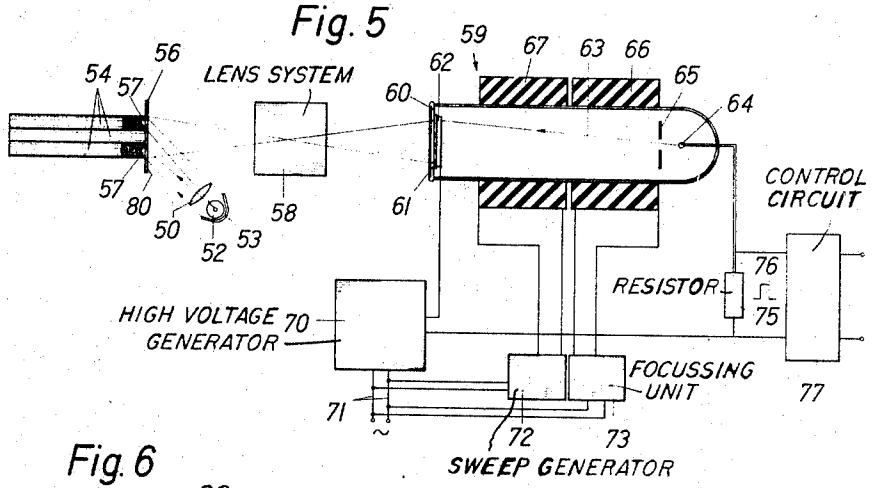


Fig. 6

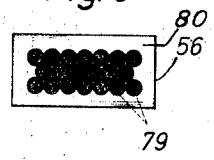
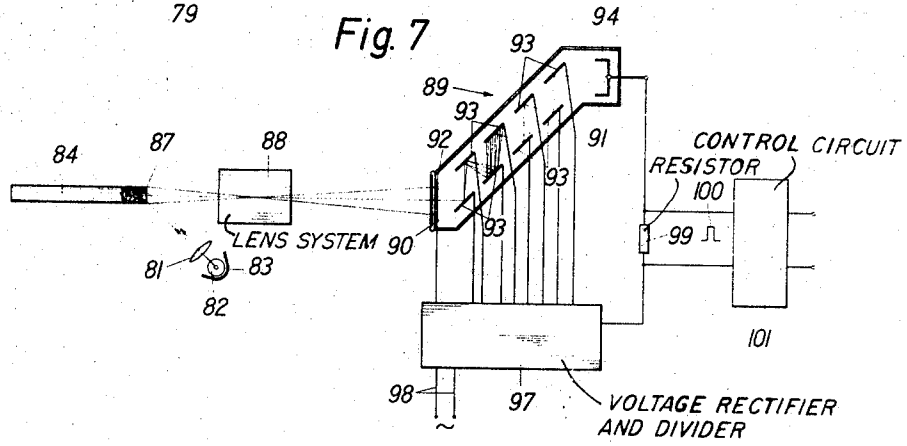


Fig. 7



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3,473.037

APPARATUS FOR CHECKING BLOCKS OF CIGARETTES BY OPTICALLY IMAGING THEIR ENDS UPON A MATRIX OF PHOTOCELLS WHICH CONFORMS TO A NORMAL IMAGE

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U.S. Cl. 250—223 6 Claims

ABSTRACT OF THE DISCLOSURE

An arrangement for checking blocks of cigarettes comprises means for forming an image of ends of cigarettes of the block on photoelectric elements corresponding in number to the number of cigarettes in a faultless block, said photoelectric elements being arranged in close proximity to one another in an array corresponding to that of said cigarette ends, and electric means responsive to the illumination of said photoelectric elements for creating a control effect under the control of said photoelectric elements.

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 be 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 photo-electric sensing means, and electrical means controlled by the photo-electric 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 *a*1, *a*2 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 **11** (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 **11**, 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 substatial 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 air-tight 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 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 end **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 side walls 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 **11** 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 modifications 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 focussing 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 of FIG. 2 is operated.

It will be 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 ultra-violet or infra-red light, in which case the reflecting surface 16 and 26, the mirror 3, 23 and 33 the optical system 6, 21 and 36 are adapted for use with ultra-violet light or infra-red light.

FIG. 5 shows an embodiment of the invention which employs a photo-electric 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 cigarettes 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 focussed 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 focussed on the photoconductive target 62 by a focus coil 66 and deflected by a deflector coil 67 so as to scan the photo conductive target 62.

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 focussing unit 73 is connected to the focussing 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 focussing 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 spots 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 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 alternating current 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 the 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. An arrangement for checking blocks of closely packed cigarettes, comprising a plurality of photoelectric cells, the number of said cells corresponding to the number of cigarettes normally in one of said cigarette blocks, said cells being arranged side by side immediately adjacent to one another in an array corresponding to the array of ends of cigarettes at one side of said cigarette blocks, means for successively placing said cigarette blocks into a checking position, a light source, means for directing light from said light source onto said cigarette ends, optical means for imaging, on said cells, the cigarette ends in a cigarette block when in said checking position, each of said cigarette ends being formed on one of said cells, and electrical means for performing a control function under the control of said photoelectric cells.

2. An arrangement as defined in claim 1, wherein said light source is a source of ultra-violet light.

3. An arrangement as defined in claim 1, wherein said light source is a source of infra-red light.

4. An arrangement as defined in claim 1, wherein said electrical means comprise a Wheatstone bridge and a relay, said photoelectric cells being photoconductive and connected in an arm of said bridge, said relay being connected diagonally of said bridge.

5. An arrangement as defined in claim 1, wherein said optical means comprise a lens system and a reflector for reflecting light coming from said cigarette ends towards said lens system for focusing said reflected light to image said cigarette ends on said cells.

6. An arrangement as defined in claim 1, wherein said optical means comprise a lens system for focusing light from said cigarette ends to image said cigarette ends on said cells, and cigarette ends, lens system and cells lying in substantially straight lines.

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U.S. Cl. X.R.

250—211, 217, 220, 222