Jan. 26, 1960 S. A. RADLEY 2,922,519

AUTOMATIC INSPECTION AND REJECTION MEANS

Filed Dec. 5, 1957 2 Sheets-Sheet 1

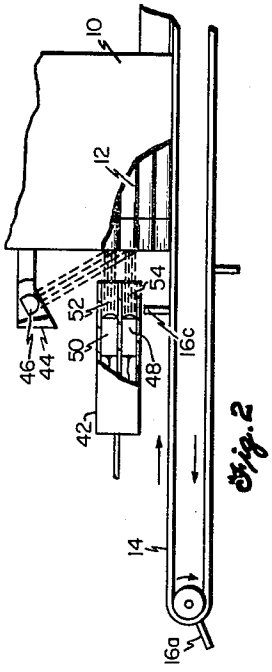


Fig. 2

Fig. 1

INVENTOR
Sidney A. Radley
By Anthony D. Cennamo

Jan. 26, 1960 S. A. RADLEY 2,922,519

AUTOMATIC INSPECTION AND REJECTION MEANS

Filed Dec. 5, 1957 2 Sheets-Sheet 2

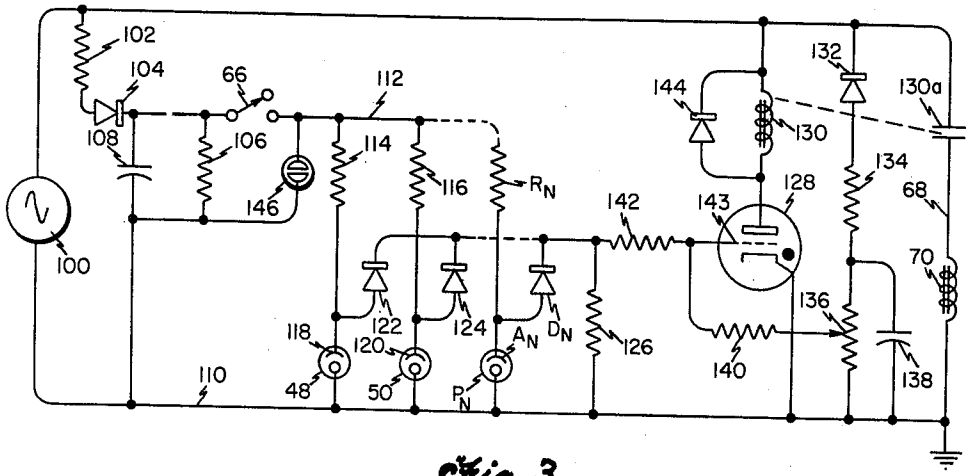


Fig. 3

INVENTOR

Sidney A. Radley

By Anthony D. Cennamo

United States Patent Office 2,922,519
Patented Jan. 26, 1960

2,922,519

AUTOMATIC INSPECTION AND REJECTION MEANS

Sidney A. Radley, Columbus, Ohio, assignor to Industrial Nucleonics Corporation, a corporation of Ohio

Application December 5, 1957, Serial No. 700,881

3 Claims. (Cl. 209—111)

This invention relates to an automatic inspection and defective unit rejection system for an industrial packaging operation; and more particularly it relates to a photoelectric system for checking successive groups of items for a defective item in a group, and for rejecting any group containing one or more defective items.

The invention will be illustrated and described in connection with a filter tip cigarette packaging operation, although a number of analogous uses and modifications will become apparent to one working in the art of automatic or semi-automatic packaging machinery.

In the production of filter cigarettes, the assembly machinery may occasionally produce one or more cigarettes complete except for the filter plug itself. To forestall adverse customer reaction, the producer finds it necessary to carry out 100 percent inspection of cigarettes, which requires a large number of inspectors to provide this one service. The apparatus of the present invention automatically detects and indicates absence of a filter plug in any cigarette going through a packer.

In an exemplary type of cigarette packer, two channels of cigarettes are gravity fed, each to a conveyor, in parallel rows 5 cigarettes wide. Each conveyor moves two layers (ten cigarettes) at a time to the wrapping mechanism. There is a period of about one-half second during which the movement of cigarettes toward the conveyors is halted, each time a group of ten is moved toward the wrapping portion of the packer. The filter ends of the cigarettes are to the outside of the machine. In accordance with this invention, a filter detector assembly is mounted in front of each of the two channels of vertically-moving cigarettes, just above the conveyors. This assembly contains, in this example, ten photocells arranged so that each "looks" at a cigarette end while the cigarettes are at rest, while a light source illuminates the cigarette ends. A switch, mounted adjacent a reciprocating member of the packer and actuated thereby, acts as a trigger device to energize the bank of photocells only when the cigarettes are at rest and in alignment with the respective photocells. In a separate unit is a power supply and a signal output tube and relay.

Existing packers of the type herein described include a delay and rejection mechanism which prevents a pack from being completed if one or more cigarettes are missing from a pack. The same mechanism can be used as part of a filterplug rejection device in connection with the signal output tube and relay of the present invention.

It is the object of this invention to provide, in connection with a packaging machine, an automatic system for simultaneous inspection of a plurality of items in a lot thereof.

It is a further object, in accordance with the above object, to provide a plural channel photoelectric detector for inspecting a plurality of items in a lot thereof, and means for automatically rejecting the lot by reason of one or more defective items therein.

It is a still further object to provide a filter plug

detector and rejection apparatus for a cigarette packaging machine.

It is also an object to provide electronic and mechanical apparatus in accordance with the above objects which is economical to build, simple to install and maintain, and reasonably fail-safe.

Further objects and advantages of the invention will become apparent in the following detailed description, taken in conjunction with the accompanying drawings in which:

Fig. 1 is a diagrammatic showing of an exemplary type of packaging machine in perspective, specifically a cigarette packaging machine, having automatic filter plug inspection and packet rejection means associated therewith in accordance with the present invention.

Fig. 2 is a side elevation, partly in section, of the photoelectric detector head in connection with a portion of the apparatus of Fig. 1.

Fig. 3 is an electrical schematic diagram of the electronic circuitry of the defect signaling system.

Referring to Fig. 1, assembled cigarettes, nominally complete with filter plugs, are delivered by manual or automatic conveyor means to a specially designed hopper 10 wherein the cigarettes are assembled in a vertical stack 12. The width of the stack between its respective retaining walls is such that at least cigarettes near the bottom of the stack lie in strata or horizontal rows of exactly five cigarettes each.

A conveyor belt 14 passes under stack 12, and carries on its periphery a plurality of upstanding cleats as at 16*a* and 16*b*. As each cleat passes under the stack, two successive horizontal rows of cigarettes are slid from the bottom of the stack so that a group of ten cigarettes as at 18 is carried forward upon the conveyor to a wrapping unit 20.

The wrapping machine 20 forms a packet of ten cigarettes as at 22, wrapped in foil or the like, which is carried forward toward a second conveyor 24 which runs at right angles to conveyor 14.

The conveyor 24 carries open, partially formed boxes of cardboard or the like as at 26 which are delivered onto conveyor 24 at suitably spaced intervals by a conventional box-forming or box-unfolding mechanism 28. Since the two conveyors 14 and 24 and the box-forming mechanism 28 are driven in mutually timed relation to one another, a wrapped packet as at 22 is delivered into each box upon its passing the delivery slide 30 which constitutes the terminus of conveyor 14.

At 32 there is shown a further slide, identical with slide 30, which constitutes the terminus of another section of the machine (not shown) which is identical with the section thereof indicated by numerals 10—22. The outer boxes as at 26, which are delivered by unit 28, are adapted to contain two foil-wrapped packets as at 22, one of which is delivered on slide 30 and the other on slide 32 so as to form an assembly as at 34 comprising a box containing two packets of ten cigarettes each, for a total of twenty. The assemblies as at 34 continue on conveyor 24 to a closer and sealer machine indicated at 36, which closes and seals the outer boxes. Completed packages as at 38 issue from the rear of machine 36 to be assembled for later storage or shipment.

The machinery described is of a known type, powered by conventional intermittent motion drive means (not shown). The intermittent drive is necessary due to the need for stopping conveyor 14 while the packets are being wrapped in wrapper 20, and due to the need for stopping conveyor 24 while a box as at 40 is in alignment with a slide as at 32 when a packet is to be delivered thereon.

In accordance with this invention, a detector head 42 and lamp housing 44 are disposed adjacent the stack 12

of cigarettes at the bottom of hopper **10**. It is seen that the bottom of the hopper is cut away to expose the cigarette ends nominally containing filter plugs. This assembly is shown in further detail in Fig. 2, wherein a light source **46** disposed in lamp housing **44** is shown illuminating the filter tip ends of the cigarettes in the third and fourth rows from the bottom of the stack **12**. The detector **42** contains ten photocells as at **48** and **50**, e.g., cadmium selenide cells, each of which is recessed into a tube as at **52** and **54** to prevent an excess amount of stray light from striking the active end of the photocell. The detector head **42** is vertically spaced from the conveyor **14** a sufficient distance to allow a cleat **16***c* carried by the conveyor to clear the same. Normally, each photocell is subjected to a relatively high level of illumination due to the light reflected from a white filter. However, if a filter plug is missing, the photocell sees a relatively dark opening.

Referring again to Fig. 1, the photocells in detector **42** are all connected by a cable to a console **62** containing suitable electronic circuitry to be described hereinafter. Herein the electrical signals produced by the group of photocells are combined. The console **62** and its contained circuitry are also connected by means of cable **64** to a switch **66** associated with the wrapper mechanism **20**. Switch **66** is a means for disabling the operation of the detectors and associated circuitry except when the conveyor **14** and the cigarettes in stack **12** are at rest, thus preventing ambiguous signals from the detectors as a result of stack movement.

When one or more filter plugs in a group of cigarettes presented to the detector are missing, a reject signal is generated by circuitry **62**, and this reject signal is transmitted over line **68** to a solenoid **70**.

Adjacent to solenoid **70** is a memory drum **72** which is driven by a mechanical connection **74** to the drive system of the machine, so as to rotate in suitable timed relation thereto.

Near its outer rim, the drum **72** carries a plurality of axially slideable plungers as at **76**, frictionally engaging bored openings in drum **72**; these openings, or ways, being parallel to the axis of drum **72**. The plungers extend through the drum and project outwardly from both sides thereof, normally occupying the position shown. When the intermittent motion of the machine stops rotation of the drum, a plunger is brought into axial alignment with a striker **78** carried by the armature (not shown) of solenoid **70**. It is also at this point in the machine cycle where switch **66** energizes the filter plug detector circuits, so that the absence of a filter plug in a cigarette causes the actuation of solenoid **70**. Thereupon the striker **78** will push the aligned plunger to a position wherein the right end of the plunger is extended, as is shown by the dotted lines **80**. On further rotation of drum **72**, the extended plunger **80** is carried around until it eventually strikes the actuator **82** of a switch **84**.

Switch **84** may of course be connected to operate any type of rejection means. In the present instance, however, the switch is connected by means of cable **86** to an interrupt mechanism of conventional design in box former **28** so as to withhold the box as at **87** which would otherwise be delivered to conveyor **24** on schedule to permit the box to contain the packet including the cigarette with the missing filter plug. The pair of unboxed packets may be removed from conveyor **24** by an operator stationed ahead of the sealer **36**, or the packets may proceed on through the sealer as in the case of packets **88**, to be separated later from the completed packages.

Referring again to the signal delay device, it is seen that as rotation of the memory drum **72** proceeds, the plungers are carried past a wedge member **90** which pushes any extended plungers as at **80** back to the original position as of plunger **76**.

Fig. 3 depicts the circuitry of the detector head **42**, the console **62**, switch **66** and the solenoid **70** of Fig. 1. These circuits are energized from the conventional A.C. power source **100**.

A unidirectional voltage for operating the missing filter detector is provided by a power supply comprising a rectifier **104** in series circuit with a pair of resistors **102** and **106**. Resistor **102** reduces the peak line voltage to a suitable output voltage level across resistor **106**, which output voltage is filtered by a large capacitor **108** connected across resistor **106**. When switch **66** is closed, a positive potential with respect to ground line **110** appears on line **112**.

A plurality of photocells, including **48** and **50** of Fig. 2, and also including a number not shown, up to and including the *n*th photocell P_N are connected across lines **110** and **112** in series respectively with load resistors **114**, **116** and others to R_N. The photocell anodes **118**, **120** and others to A_N are further respectively connected through diodes **122**, **124** and others to D_N to a common output resistor **126** having its other end grounded on line **110**.

It is known that when a photocell of the type described is in darkness the current carried by the same is small; that is, the cell exhibits a high impedance. Accordingly, there will be a high positive potential on the anode of the cell. On the other hand, when the cell is lighted, its impedance is reduced, and due to the voltage drop across the load resistor, the anode potential falls to a less positive value.

The novel circuit of the present invention, comprising the diode coupling of the anodes to the output resistor **126**, permits sharp differentiation between the signal output of a plurality (in this example, ten) of photocells all lighted and the output when only one of the group is partially darkened. By this means each cell is able to signal its dark condition with a high degree of independence of the lighted condition of the other cells, even though all cells use a common power supply connection and all have a common output. Because the diodes are asymmetrical conduction devices, the potential appearing across the output resistor **126** is always substantially equivalent to the potential on the most positively charged anode; that is, the anode of a darkened cell. This higher positive potential may not be distributed to the other anodes, and thereby attenuated, because the diode substantially blocks current flow in that direction.

The remainder of the circuitry in Fig. 3 provides suitable electronic switching means for controlling the energization of the solenoid **70**, also shown in Fig. 1, in accordance with the signal across the output resistor **126**. This rather conventional switch means preferably comprises a thyratron tube **128** having a relay coil **130** in the plate circuit thereof. The cathode-plate circuit including the relay coil is connected across the A.C. power source **100**. A negative grid bias voltage for thyratron **128** is provided by a D.C. power supply comprising a rectifier **132**, resistor **134**, potentiometer **136** and capacitor **138**. The magnitude of the fixed bias voltage is adjustable by means of potentiometer **136**. A grid bias resistor **140** and an input resistor **142** in series therewith connect the variable tap of potentiometer **136** to the signal voltage appearing across the output resistor **126** of the detector circuits. The grid **143** of the thyratron is connected to the junction of resistors **140** and **142**, so that the potential on the grid is proportional to the difference between the fixed bias voltage and the signal voltage across resistor **126**. Potentiometer **136** is set so that when ten perfect cigarettes are presented to the detector, the negative bias on grid **143** is more than sufficient to keep thyratron **128** cut off, but when one filter plug is missing the decrease in bias is more than sufficient to allow the thyratron to fire, or conduct current. This firing energizes relay **130** which in turn closes its contacts **130***a*, thus actuating solenoid **70** for the purpose above described. A rectifier **144** is con-

nected across relay coil **130** to stabilize the operation of the relay.

A neon lamp **146** is connected between lines **110** and **112** to provide an indication of proper operation of the trigger switch **66**, so that when the light stops flashing the operator is notified of a malfunction. A failure of any photocell or the light source **46** will result in rejection of every package, also providing an immediate indication of trouble.

It should be understood that many changes and modifications may be made of the embodiment herein described and illustrated, particularly where the invention is to be adapted for use with other types of packaging machinery, either for cigarettes or other similar or very different types of products. Several other and different schemes for rejection of defective items may be used. All such changes and modifications are therefore considered to be within the spirit and scope of the invention as is set forth in the appended claims.

What is claimed is:

1. On a production line delivering production items to a packaging station; means for collecting said items into groups each containing a predetermined number of items, an inspection station spaced from said packaging station, means for conveying said groups successively through said inspection station to said packaging station, a light source in connection with said inspection station for illuminating a group of items thereat; a plurality of photoelectric detectors, one such detector corresponding to each item in said group, and each detector responsive to light reflected from said item; a unidirectional voltage source, a plurality of voltage dividers connected across said voltage source, each of said voltage dividers comprising an electrical load impedance and at least one of said photoelectric detectors in series connection therewith; an output impedance having a first terminal connected to one side of said power source, and a second terminal; a plurality of asymmetrical conduction devices, one such device being connected between said second terminal and the junction of said load impedance with said detecting means in one of said voltage dividers; means responsive to the magnitude of the electrical potential across said load impedance for generating a reject signal, means intermediate said inspection station and said packaging station for rejecting a group on receiving said reject signal, and means for transmitting said reject signal to said reject means, said signal transmission means including means for delaying said reject signal pending the arrival on said conveyor of said group at said reject means.

2. The combination as in claim 1 wherein said conveyor means includes intermittent motion means for driving the same and means for disabling a function of said photoelectric detectors when said conveyor is in motion.

3. On a production line delivering production items to a packaging station, means for collecting said items into groups each containing a predetermined number of items, an inspection station spaced from said packaging station, means for conveying said groups successively through said inspection station to said packaging station, a light source in connection with said inspection station for illuminating a group of items thereat; a plurality of photoelectric detectors, one such detector corresponding to each item in said group, and each producing an electrical signal functional of the intensity of light reflected from said item; circuit means for combining said signals from each of said detectors to produce an aggregate signal, means responsive to a characteristic of said aggregate signal for producing a reject signal, means intermediate said inspection station and said packaging station for rejecting a group on receiving said reject signal, means for transmitting said reject signal to said reject means, said signal transmission means including means for delaying said reject signal pending the arrival on said conveyor of said group at said reject means, intermittent motion means for driving said conveyor, and means for disabling a function of said photoelectric detectors when said conveyor is in motion.

References Cited in the file of this patent

UNITED STATES PATENTS

1,812,294	Hohn et al.	June 30, 1931
1,993,619	Neff et al.	July 23, 1932
2,008,870	Little	July 23, 1935
2,209,111	Chalmers	July 23, 1940
2,369,794	Phinney et al.	Feb. 20, 1945
2,618,386	Samain	Nov. 18, 1952
2,696,297	Matthews	Dec. 7, 1954
2,726,762	Aubry	Dec. 13, 1955