Feb. 13, 1968 H. KAEDING 3,368,671

METHOD AND APPARATUS FOR DETECTING DEFECTIVE CIGARETTES OR THE LIKE

Original Filed July 6, 1962 4 Sheets-Sheet 1

Fig. 1

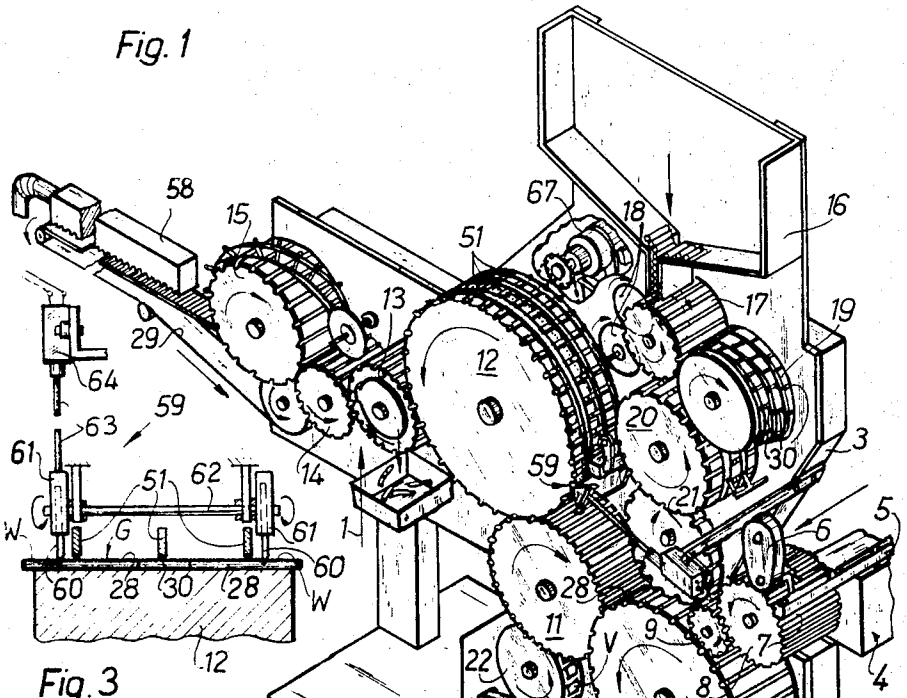


Fig. 3

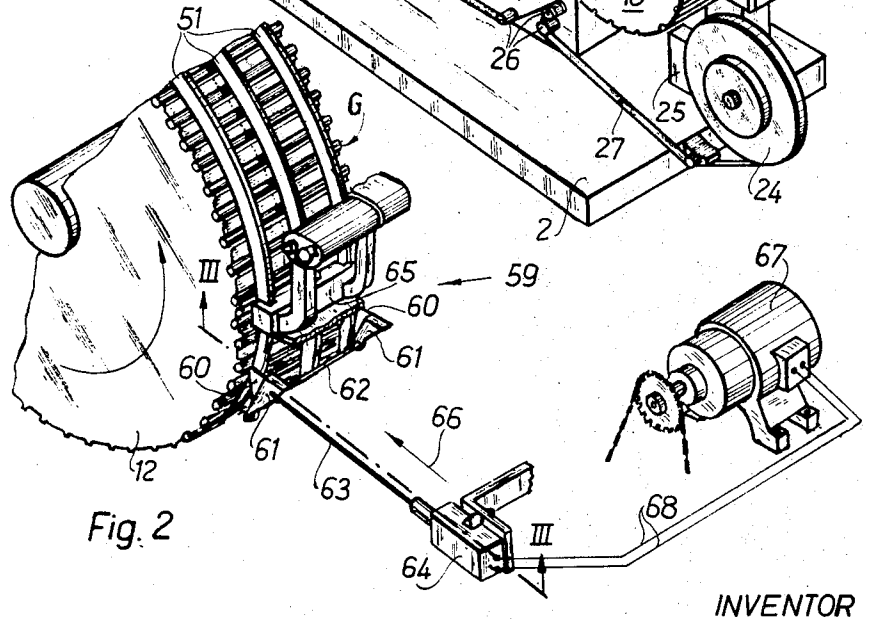
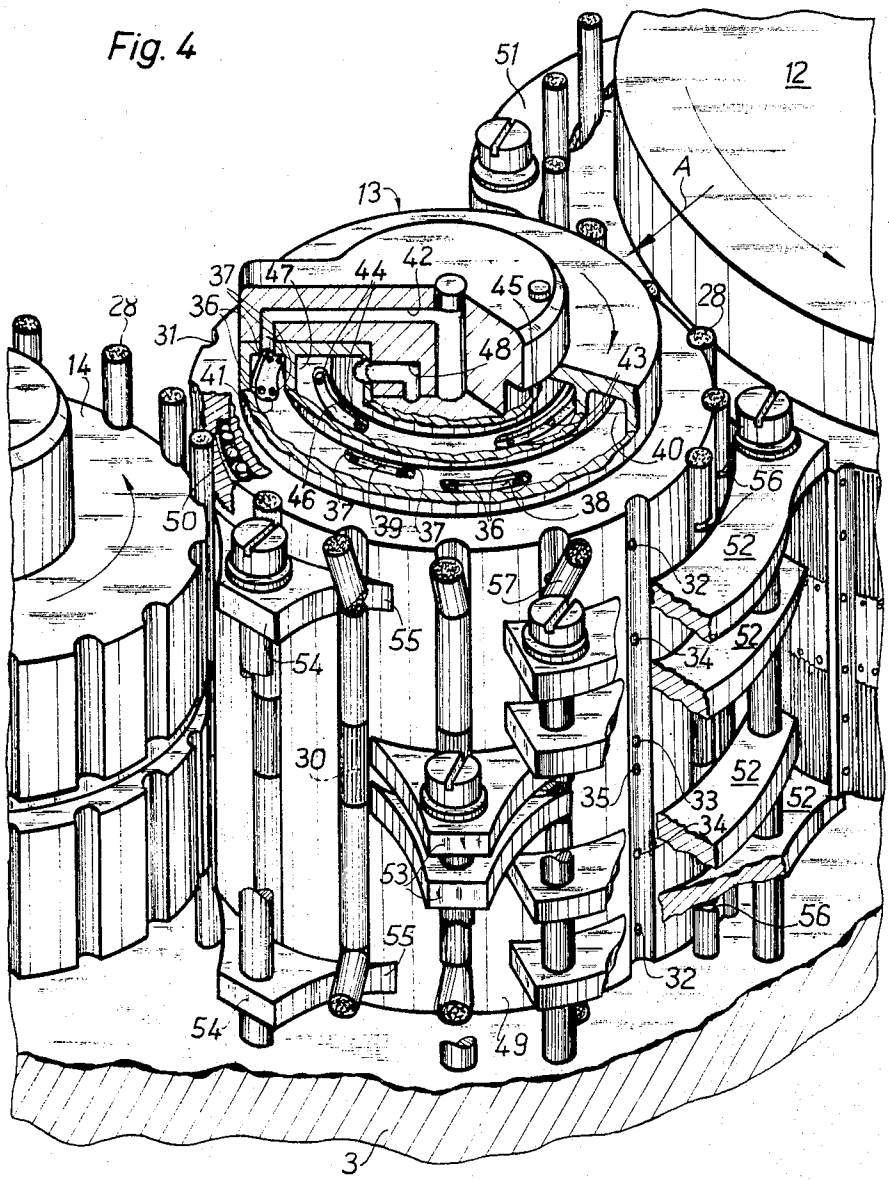


Fig. 2

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Fig. 4



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Original Filed July 6, 1962 4 Sheets-Sheet 3

Fig. 5

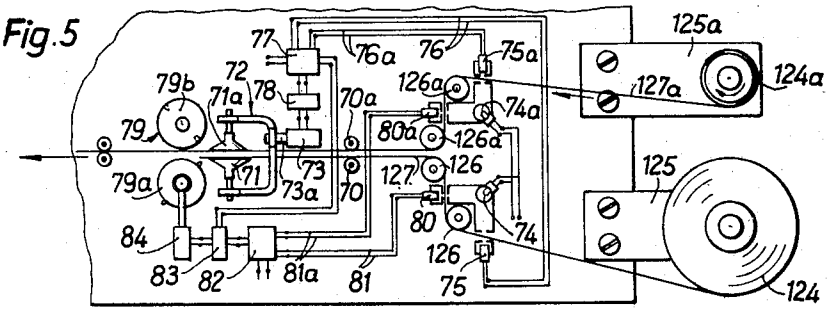


Fig. 6

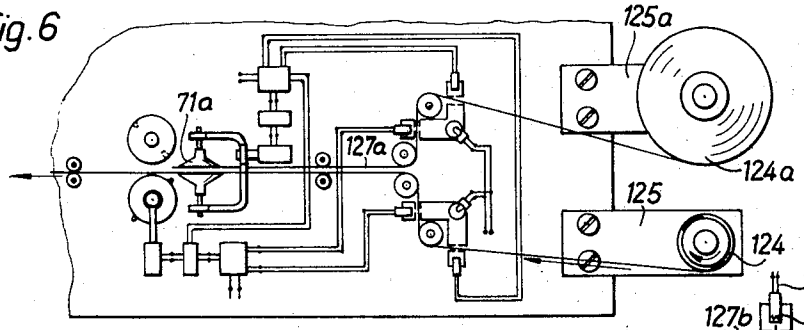


Fig. 7a

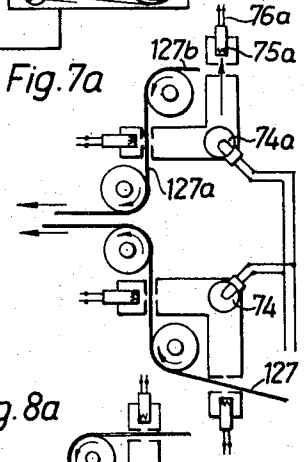


Fig. 7b

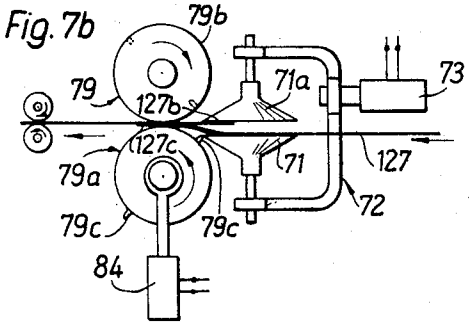


Fig. 8a

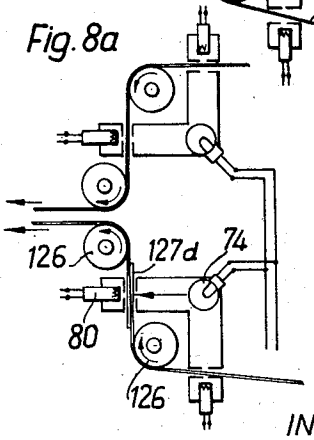
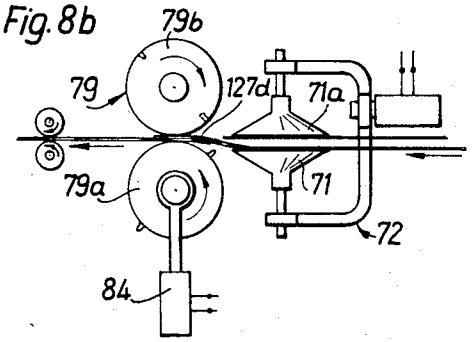


Fig. 8b



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Feb. 13, 1968 H. KAEDING 3,368,671

METHOD AND APPARATUS FOR DETECTING DEFECTIVE CIGARETTES OR THE LIKE

Original Filed July 6, 1962 4 Sheets-Sheet 4

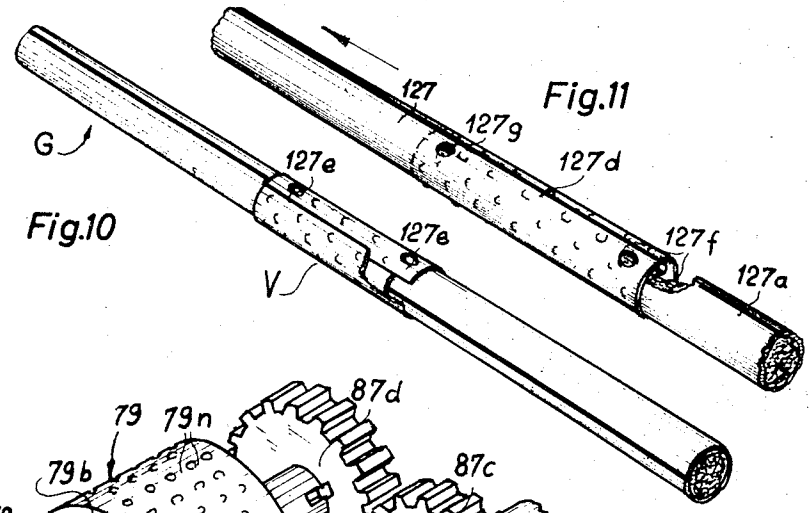


Fig.10

Fig.11

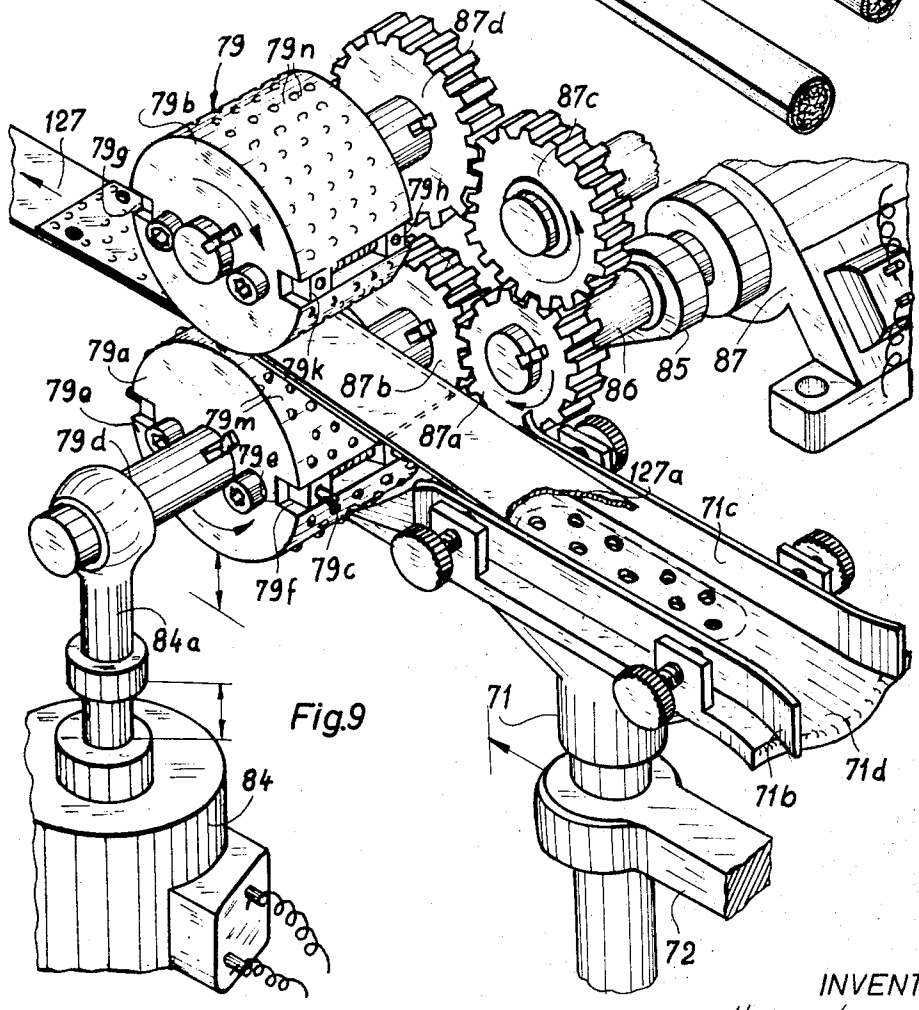


Fig.9

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United States Patent Office 3,368,671
Patented Feb. 13, 1968

3,368,671

METHOD AND APPARATUS FOR DETECTING DEFECTIVE CIGARETTES OR THE LIKE

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Original application July 6, 1962, Ser. No. 208,030. Divided and this application Apr. 20, 1966, Ser. No. 544,025
Claims priority, application Great Britain, July 7, 1961, 24,631/61
17 Claims. (Cl. 209—73)

This is a division of my copending application Ser. No. 208,030, filed on July 6, 1962.

The present invention relates generally to the production of rod-shaped objects, such as, cigarettes, cigars, cigarillos and the like, with or without filters or mouthpieces.

It is essential that, during the production of such rod-shaped objects or the further treatment thereof following such production, defective objects should be discarded either prior to, or following the further processing. There are a variety of ways in which defects are apt to arise during the production of cigarettes and filters, or during the joining together of the cigarettes and filters. Some of the defects occur during commencement of the operation of the machine, and upon replacement of the supply spools of paper or other wrapping material in which the rods of tobacco or the filters are encased, or by which the cigarettes and filters are joined to each other.

It is an object of this invention to provide a process and devices by which cigarettes and filters, or other rod-shaped objects having manufacturing defects are sensed or detected and rejected or discharged from the machine.

In accordance with an important aspect of this invention, the rod-shaped objects, or the materials used in producing such objects, for example, the paper or other wrapping material, or provided with characteristic indications during the periods of operation of the machine during which manufacturing defects occur, for example, during the commencement of operation of the machine, or upon replacement of the supply spools of paper or other wrapping material, and such characteristic indications provided on the rod-shaped objects or in the material from which the latter are formed are thereafter sensed to cause rejection or discharge from the machine of the defective objects.

In a preferred embodiment of this invention, the defective rod-shaped objects or the defective materials used for the production of the rod-shaped objects are automatically provided with apertures or incisions which weaken the defective rod-shaped objects so that, when the latter are scanned by a suitable testing device, the weakened defective objects are deformed from their normal shape and thus acted upon by a rejecting device for discharge from the machine.

Further, the testing device may be sensitive to the air permeability of the wrapping material of the rod-shaped objects so that the apertures or incisions provided in the defective objects or in the wrapping material from which the latter are formed alter the air permeability of the defective objects sufficiently to permit the testing device to detect the altered air permeability and to cause operation of the device by which the defective rod-shaped objects are rejected or discharged from the machine.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view illustrating a machine for producing rod-shaped objects, and which is provided with devices embodying the present invention for identifying and rejecting defective objects;

FIG. 2 is a fragmentary perspective view illustrating details of a device provided in the machine of FIG. 1 for the purpose of identifying defective rod-shaped objects;

FIG. 3 is a sectional view taken along the line III—III of FIG. 2;

FIG. 4 is a detail perspective view of the testing and rejecting devices as viewed in the direction of the arrow 1 in FIG. 1;

FIG. 5 is a schematic side elevational view of a reel or spool changing device that can be employed on the machine of FIG. 1 to identify the joints or splices connecting the ends of the wrapping material fed from successive supply reels;

FIG. 6 is a view similar to that of FIG. 5, but showing the condition of the reel changing device when the supply of wrapping material on a reel is almost depleted;

FIG. 7*a* is an enlarged view of a part of the device shown in FIG. 5, and illustrates the operation of such device in detecting the exhaustion of the wrapping material on one of the reels;

FIG. 7*b* is an enlarged view of another part of the device shown in FIG. 5, and illustrates the splicing together of the wrapping material on successive reels;

FIG. 8*a* is a view similar to that of FIG. 7*a*, but illustrates the operation of the device in sensing a splice in a continuous web of wrapping material;

FIG. 8*b* is a view similar to that of FIG. 7*b*, but illustrating the operation of the device in perforating the splice sensed in a continuous web of the wrapping material, as in FIG. 8*a*;

FIG. 9 is a detail perspective view illustrating structural details of a portion of the device shown in FIG. 5;

FIG. 10 is an enlarged perspective view of a rod-shaped object of the kind handled by the machine of FIG. 1; and

FIG. 11 is a perspective view of a portion of a continuous rod or shaft of cigarette tobacco encased in cigarette paper or wrapping material in which perforations have been formed in a splice connecting ends of the wrapping material drawn from successive reels.

Referring to the drawings in detail, and initially to FIG. 1 thereof, it will be seen that a machine for producing filter cigarettes and having devices for detecting and rejecting defective products in accordance with the present invention generally includes a base plate **2** and a frame **3** extending upwardly from the latter. The illustrated machine receives successive cigarettes which are transported in longitudinal alignment on the discharge conveyor **5** of a conventional cigarette making machine **4**. The conveyor **5** terminates adjacent the periphery of a cigarette receiving drum **8** at one side of the latter, and a cigarette transfer unit **7** rockably mounted on a crank arm **6** receives cigarettes **28** from the conveyor **5** and deposits such cigarettes, two at a time, in the axially extending grooves spaced apart around the circumference of the drum **8**.

The pairs of cigarettes thus deposited in the grooves of receiving drum **8** are transferred, by way of an intermediate drum **9**, to axially extending, spaced apart grooves formed in the surface of an assembling drum **10** on which each pair of cigarettes is axially spaced apart in the related groove and a double filter plug or member **30** is interposed therebetween. The double filter plugs **30** are received from a filter cutting and arranging device which is preferably of the kind disclosed in the copending application for United States Letters Patent, Ser. No. 60,929,

now Patent No. 3,164,243. Such a filter cutting and arranging device generally comprises a magazine **16** delivering filter elements each intended to form a plurality, for example, three, of the double filter plugs **30**. These relatively long filter elements are deposited in the axially extending grooves on the surface of a transfer drum **17** mounted rotatably below the magazine **16** and cooperating with two rotary cutting blades **18** disposed at axially spaced apart locations along the surface of drum **17** so that each filter element is thereby cut into three double filter plugs. The three double filter plugs **30** in each groove of the drum **17** are transferred to a drum **19** of stepped diameter which cooperates with a filter plug displacing drum **20** to bring all of the filter plugs **30** into a single plane of rotation, whereupon the filter plugs **30** are deposited successively by a transfer drum **21** of relatively small axial extent in the central portions of the grooves of assembling drum **10** between the pairs of cigarettes previously deposited in such grooves.

Each filter plug **30** is intended to form the filters for the two cigarettes deposited in the same groove of assembling drum **10**. Each group of two cigarettes **28** and a double filter plug **30** therebetween is transferred from drum **10** to a groove in the surface of a consolidating drum **11** which is provided with conventional mechanism for moving the two cigarettes into end-to-end abutment with the intervening filter plug, for example, as in United States Letters Patent No. 2,821,201.

The illustrated machine further operates to join each filter plug **30** to the adjacent ends of the two cigarettes **28** between which the filter plug is located by means of a sleeve V of paper or other wrapping material (FIG. 10) so as to form a cigarette and filter unit G. In order to form the connecting sleeves V, the illustrated machine includes a holder **25** rotatably supporting a spool or reel **24** from which a web or strip **27** of paper or other wrapping material is unwound. The web or strip **27** passes around feed and guide rollers **26** and then through a sheeting unit that includes a back-up drum **22** and a revolving knife **23** having axially extending, spaced apart blades projecting from the surface thereof to cooperate with the surface of drum **22** in cutting the strip or web **27** into successive sections of paper or wrapping material each intended to form a connecting sleeve V. The successive paper sections are carried on the surface of drum **22** and are each made to adhere to a filter plug **30** and a pair of cigarettes **28** in a groove of the consolidating drum **11**.

The filter plugs, cigarettes and paper sections adhering thereto are transferred from the successive grooves of consolidating drum **11** to axially extending grooves in the surface of a rolling drum **12** which operates to roll each paper section and to form the sleeve V by which each pair of cigarettes **28** and the double filter plug **30** interposed therebetween are connected together to form a cigarette and filter unit G. The successive cigarette and filter units G are transferred from drum **12** to an ejecting device **13** provided in accordance with the present invention and which is hereinafter described in detail. At this point, it is sufficient to note that the device **13** singles out and ejects the defective units G which are deposited in an underlying receptacle, while those units G having the desired properties and characteristics are further transferred into the axial grooves of a transfer drum **14** cooperating with a rotary cutting blade associated therewith to cut each unit G at the center thereof, and thereby provide two filter cigarettes from each unit. Since the filter cigarettes cut from each unit on the drum **14** have their filtered ends extending toward each other, the pairs of filtered cigarettes are transferred by way of a turning drum **15** to a belt conveyor **29**, and the turning drum **15** operates, in a known manner, to reverse the direction of one of the filtered cigarettes in each groove so that the filtered ends of the cigarettes delivered to the conveyor **29** will all lie at one side of the latter. The filtered cigarettes delivered to the belt conveyor **29** in the manner indicated above are further transported to a packaging or other machine (not shown) by way of a suction device **58**.

It is to be noted that, with the exception of the ejecting device **13** mentioned briefly above, the described machine for producing filtered cigarettes does not form a part of the present invention, and has merely been described for the purpose of indicating a machine in which devices embodying the invention may be advantageously employed.

It will be apparent that, when operation of the described filtered cigaratte making machine is halted for any substantial period of time, the adhesive by which the successive sections of paper cut from the web **27** are to be joined to the related filter plugs and cigarettes to form the units G will dry out so that, upon subsequent restarting of the machine, the initially produced units G will not be properly secured or joined. In accordance with the present invention, the units G produced by the machine during the commencement of operation thereof are characteristically identified, for example, by characteristic indications or markings in the form of apertures or incisions cut therein as hereinafter described in detail, so that such units may be readily singled out by the device **13** and ejected from the machine, thereby avoiding the discharge onto the conveyor **29** of defective filtered cigarettes.

Referring now to FIGS. 2 and 3, it will be seen that the recording device **59** provided in accordance with the present invention for identifying by markings or characteristic indications those cigarette and filter units G produced upon commencement of operation of the machine may include a pair of knife blades **60** carried by knife holders **61** which are rockable together on a shaft **62** which is suitably supported on the usual outer guides **51** of the rolling drum **12**. The assembly of knife blades **60**, holders **61** and shafts **62** may be disposed immediately below a sleeve rolling member **65** (FIG. 2) associated with drum **12**, and the knife blades **60** are spaced apart so as to be disposed adjacent the opposite end portions of the cigarettes **28** in each of the grooves of drum **12**. Further, the knife blades **60** are rockable simultaneously between an operative position where such blades are closely adjacent to the surface of the drum **12** and cut partially through the end portions of the cigarettes passing the location of the knife blades, and an inoperative position where the knife blades **60** are spaced a substantial distance from the surface of drum **12** and thereby avoid contact with the cigarettes included in each unit G transported by the drum. One of the knife holders **61** is pivotally connected through a link or rod **63** to the armature of a solenoid **64** so that, when the latter is energized, and thereby displaces its armature in the direction of the arrow **66** (FIG. 2), the blades **60** are moved to their operative positions and thereby cut incisions or markings in the paper envelopes or casings W of each pair of cigarettes **28** passing the location of the knife blades. The solenoid **64** is energized to move the knife blades **60** to their operative positions only when the operative speed of the associated filter cigarette making machine is less than a predetermined value. When the operating speed of the machine reaches such predetermined value, the solenoid **64** is automatically deenergized and thereby returns the blades **60** to their inoperative positions. Such control of the energization of solenoid **64** may be effected by a centrifugal switch **67** interposed in the energizing circuit **68** and driven, as by the illustrated chain and sprocket transmission, from the main drive of the cigarette making machine.

The time normally required for the filtered cigarette making machine to attain the predetermined speed at which centrifugal switch **67** opens is sufficient to ensure that blades **60** will form cuts or incisions in all of those cigarettes **28** of the units G which remained on drum **12**

during the shut-down period of the machine and to which paper sections were adhesively applied, but not rolled prior to shutdown of the machine. Thus, upon commencement of the operation of the filter cigarette making machine, all of those initially produced units G to which the sleeves V are inadequately secured are identified by the incisions or markings **56** formed therein by the blades **60**. If the centrifugal switch **67** does not provide for energization of the solenoid **64** for a period of time sufficient to ensure the indentifying cutting of all of the units G which are defective, then a conventional time delay relay can be interposed between the centrifugal switch **67** and the solenoid **64** for further delaying the deenergization of the latter.

In accordance with the present invention, the testing an ejecting device **13** which receives successive units G from drum **12** is operative to sense to detect each of the unit G having incisions or markings **56** cut therein, as described above, and further to eject or discharge such defective units from the machine. The device **13**, as hereinafter described in detail, is also effective to detect and reject otherwise defective units G, for example, units from which either the cigarettes **28**, the filter plugs **30** or the connecting sleeves V are missing, or units in which the connecting sleeves are not securely attached to the cigarettes or the cigarettes are improperly filled.

As shown in FIG. 4, the ejecting device **13** is generally in the form of a drum made up of an outer cylinder **49** having a circumferentially spaced apart series of axially extending grooves **31** in its outer surface and being rotatably mounted, as by bearings **50**, on a stationary core unit. Each groove **31** which receives a cigarette and filter unit G from the rolling drum **12** is provided with ports **32** adjacent its opposite ends and a centrally located port **33** which, when the related groove **31** passes through predetermined zones during rotation of cylinder **49** about the stationary core unit, are in communication with a source of compressed air so that blasts of compressed air then issue radially outward from the ports **32** and **33**. Further, each groove **31** is provided with additional ports **34** located approximately midway between the ports **32** and **33** and with a centrally located port **35**, and the ports **34** and **35** are intended to be in communication with a source of partial vacuum during movement of the related groove **31** through other predetermined zones around the stationary core unit.

As shown in FIG. 4, the stationary core of the ejecting device **13** has a cylindrical body provided with axially extending ducts **36** which open radially at suitable locations on the surface of the cylindrical body so as to communicate with the compressed air ports **32** as the latter pass the location of the ducts **36**. The ducts **36**, at one axial end, open into a control slot **38** which in turn communicates with a compressed air chamber **40** formed in a cap at one end of device **13**. The annular compressed air chamber **40** communicates with a passage **42** in the cap which is suitably connected to a source of compressed air (not shown). The compressed air chamber **40** of the cap further communicates with a slot **39** located after the slot **38**, considered in the direction of rotation of the outer cylinder **49**, and the slot **39** further communicates with the axial openings at one end of ducts **37** which open radially adjacent the center of the body of the fixed core so as to communicate with the central compressed air ports **33** of the successive grooves **31**. Another slot **41** is formed in the end of the body to communicate with the compressed air chamber **40** and is located after the line of tangency of the cylinder **49** with the transfer drum **14**. Axial ducts **36** and **37** also extend from the slot **41** and open radially at the surface of the body of the central core at locations for communication with the ports **32** and **33**, simultaneously, thereby to blow out any material remaining in the grooves **31** after the latter have passed the point at which the units G are transferred to the drum **14**.

The cap at one end of the stationary core of device **13** further has an annular suction chamber **47** disposed concentrically within the compressed air chamber **40** and communicating through a passage **48** with a suitable source of suction or partial vacuum (not shown). Formed in the end surface of the body of the stationary core and communicating with the suction chamber **47** are slots **45** and **46** which in turn communicate with axial ducts **43** and **44** located angularly in advance of the ducts **36** and following the ducts **37**, respectively, considered in the direction of rotation of cylinder **49**. The ducts **43** and **44** open radially at the surface of the cylindrical body of the core at locations for communication with the suction ports **34** and **35**, respectively.

Each of the grooves **31** moves with cylinder **49** from the station or location A of tangency with the rolling drum **12**, at which each groove receives a cigarette and filter unit G, to the substantially diametrically opposed location at which the successive units are transferred to the drum **14**, the ports **32** and **33** and the ports **34** and **35** of the groove are connected to the sources of compressed air and partial vacuum, respectively, in the following order: initially partial vacuum is applied to the suction ports **34**, then compressed air is applied, in sequence, to the outer ports **32** and to the central port **33**, and thereafter suction is applied to the central suction port **35**.

Further, as shown in FIG. 4, the device **13** includes arcuate guides **52**, **53** and **54** extending, in sequence, around the lower portion of cylinder **49** substantially between the station A at which units G are received from drum **12** and the station at which the units G are transferred from cylinder **49** to the drum **14**. Four of the guides **52** are provided and are spaced apart so as to be engageable with the cigarettes **28** of each unit G, with the outer guides **52** being spaced inwardly from the locations at which the incisions **56** are formed in the cigarettes by the knife blades **60** upon operation of the identifying or recording device **59**. Only two of the guides **53** are provided, and these guides are located adjacent the central portion of the cylinder **49** so as to be engageable only with the double filter plugs **30** of the successive units G. Two of the guides **54** are also provided, but these guides are located adjacent the opposite ends of cylinder **49**, that is, between the incisions **56** that may be formed in the cigarettes **28** and the outer ends of the latter, and the guides **54** have their ends **55** which extend in the direction opposed to the rotation of cylinder **49** formed as deflectors. The deflectors **55** are located relative to the surface of cylinder **49** so that the end portions **57** of the cigarettes **28** can pass freely over the deflectors **55** when the end portions of the cigarettes lie closely within the related grooves **31**. However, if the end portions **57** of the cigarettes are bent or projected outwardly from the related grooves **31**, as shown in FIG. 4, then the deflectors **55** at the ends of guides **54** engage between such outwardly bent end portions **57** and cylinder **49** and thereby strip the cigarette and filter unit G from the slot of cylinder **49** for discharge into the underlying receptacle.

The device **13** operates as follows:

If cigarette and filter units G are delivered to the grooves **31** of device **13** from the drum **12**, but the cigarettes of such units have incisions **56** formed therein to indicate that the same were produced during the commencement of operation of the machine, as previously described herein, then the end portions **57** of the cigarettes are blown radially outward from the related grooves **3** by jets of compressed air issuing from the ports **32** when the latter communicates with the compressed air supply ducts **36**. During the action of the compressed air issuing from ports **32** against the outer end portions **57** of the cigarettes, the middle portions of the unit G are held in the related groove **31** by the guides **52**. Since the outer end portions **57** are deflected out of the grooves **31**, the deflectors **55** of guides **54** can pass between such end por-

tions 57 and the surface of cylinder 49 for stripping the defective unit G from the latter. During such stripping of the defective unit G from the related groove 31, the central port 33 of the latter is communicated with the ducts 37 supplying compressed air so that a jet of compressed aid also acts outwardly against the central portion of the defective unit G to further cause ejection of the latter from the groove. Such parts of the structure shown in FIG. 4 which produce jets of air issuing from the ports 32 constitute what I call enabling means because they enable the deflectors 55 to eject or segregate defective (marked) articles.

If a unit transferred to a groove 31 of cylinder 49 is lacking the cigarettes 28 normally forming a part thereof, for example, by reason of an interruption in the feeding of cigarettes to the machine, then such unit is rejected immediately after it advances beyond the guides 53, at which time the central port 33 of the related groove is connected with the compressed air supplying ducts 37 so that the jet of compressed air issuing from the port 33 then drives the filter plug of the incomplete unit out of the related groove.

If a unit received in a groove 31 of cylinder 49 consists only of two cigarettes 28, for example, by reason of an interruption in the feeding of filters 30 from the magazine 16 to the machine, then such unconnected cigarettes are ejected downwardly from the related groove 31 immediately upon the movement of the latter beyond the guides 52 at which time jets of compressed air issue from the ports 32 by reason of the continued communication of the latter with the compressed air supplying ducts 36.

If a defective or incomplete unit G delivered to a groove 31 of cylinder 49 consists of two cigarettes 28 joined together by a hollow connecting sleeve V, that is, a sleeve without a filter plug therein, the jets of air issuing from the outer ports 32 while the hollow connecting sleeve is engaged by the guides 53 exerts sufficiently strong forces to overcome the strength of the hollow connecting sleeve, whereby the latter is bent or pinched and the cigarettes 28 are deflected outwardly from the related groove 31 and thereby are engageable by the deflectors 55 at the ends of guides 54 for ejection of the unit G from the related groove.

If a cigarette and filter unit G is delivered to a groove 31 of cylinder 49 without a connecting sleeve V joining together the filter plug and cigarettes, then the cigarettes 28 are ejected from the groove 31 when the ports 32 thereof communicate with the compressed air supplying ducts 36, and the double filter plug 30 is ejected from the groove when the latter clears the guides 53 and the central port 33 is in communication with the compressed air supplying ducts 37.

Finally, if a complete cigarette and filter unit G is delivered to a groove 31, but the cigarettes of such unit are inadequately filled or too soft, or if the connecting sleeve V is inadequately adhered to the cigarettes 28, then the compressed air issuing from the ports 32 during communication of the latter with the compressed air supplying ducts 36, and while the central portion of the unit G is engaged by the guides 53, will cause the cigarettes 28 to be bent outwardly from the related groove 31 and thereby moved into the range of effectiveness of the deflectors 55 of guides 54 for stripping of the defective unit G from cylinder 49.

It will be noted that the recording device 59 is operative to identfy the defective cigarette and filter units G which are produced upon the commencement of operation of the machine, and does so by cutting markings or incisions in the paper envelopes or casings W of the cigarettes, which incisions also extend partly through the tobacco filling of the cigarettes. However, in accordance with the present invention, the defective units or other rod-shaped objects being produced may be identified for convenient detection thereof merely by forming perforations or apertures in the paper or other wrapping material.

In the machine described above with reference to FIG. 1, the connecting sleeves V which join together the cigarettes 28 and filter plugs 30 of the units G are formed from sections cut from a strip 27 of paper or other wrapping material which is unwound from a roll on a spool or reel 24. When the roll of wrapping material on the spool or reel 24 is depleted, the operation of the filter cigarette making machine has to be halted to permit replacement of the empty spool or reel with one having a new supply of wrapping material thereon. However, FIGS. 5 to 9, inclusive, illustrate a device that can be substituted for the single spool 24 on the holder 25 of FIG. 1 and that is adapted to supply a continuous and uninterrupted strip of paper or other wrapping material to a cigarette making machine to be formed by the latter into connecting sleeves for securing filter plugs to cigarettes, as in the machine of FIG. 1, or to form the paper casings or envelopes of cigarettes.

The device shown in FIG. 5 includes two spaced apart holders 125 and 125*a* respectively supporting reels or spools 124 and 124*a* from which strips or webs 127 and 127*a* of paper or other wrapping material may be unwound successively. During the unwinding of the strip of paper from one of the spools or reels, for example, from the spool 124*a* as shown on FIG. 5 and the feeding of the unwound strip to the drums 22 and 23 (FIG. 1) by which the strip is cut into sections intended to form the connecting sleeves V of the units G, a full spool or reel of paper or other wrapping material, for example, the spool 124 on FIG. 5, is held in readiness and, upon exhaustion or depletion of the paper strip on the spool 124*a* from which the wrapping material is being unwound, the device operates automatically to splice the leading end of the strip 127 on the full spool 124 to the trailing end of the strip 127*a* unwound from the empty spool 124*a*.

The strips 127 and 127*a* withdrawn from the spools 124 and 124*a* pass around guide pulleys 126 and 126*a* and then travel along parallel, closely spaced apart paths past two guide rolls 70 and 70*a*. Lower and upper suction heads 71 and 71*a* arranged beyond the guide rolls 70 and 70*a* and suitably connected to a source of partial vacuum (not shown) are provided with perforated surfaces for adhering engagement with the strips 127 and 127*a*, respectively. The suction heads 71 and 71*a* are located immediately ahead of a recording means comprising a splicing and perforating mechanism 79 that includes an upper roller 79*b* rotated about a fixed axis and a lower roller 79*a* rotated about a vertically movable axis, and being normally downwardly spaced from the upper roller 79*b*. Both of the suction heads 71 and 71*a* are mounted in a common support 72 that is movable parallel to the paths of travel of strips 127 and 127*a* between the suction heads, that is, toward and away from splicing and perforating mechanism 79. The support 72 is normally disposed in the position illustrated in FIGS. 5 and 6, that is, with the suction heads 71 and 71*a* spaced a relatively large distance from rollers 79*a* and 79*b*, and the support 72 is connected to the armature 73*a* of a solenoid 73 so that, upon energization of the latter, support 72 is moved towards rollers 79*a* and 79*b* to the position illustrated on FIG. 7*b*.

The lower roller 79*a* of the splicing and perforating mechanism 79 is connected to the armature of a solenoid 84 so that, upon energization of the latter, the roller 79*a* is moved upwardly from its normal inoperative position (FIGS. 5 and 6) against the upper roller 79*b* (FIGS. 7*b* and 8*b*).

In order to control the energization of the solenoids 73 and 84, the device illustrated in FIGS. 5 and 6 further includes light sources 74 and 74*a* each directing two beams of light against the strips 127 and 127*a*, respectively, at spaced apart locations along the path of travel of the respective strips around the guide pulleys 126 and 126*a*. Photoelectric cells 75 and 80 and photoelectric cells 75*a* and 80*a* are disposed adjacent the paths of travel of the strips 127 and 127*a* at the inspecting stations where

the beams of light are directed against such strips by the light sources 74 and 74*a*, respectively. The photoelectric cells 75 and 75*a* are connected by conductors 76 and 76*a* to a control unit 77 which is, in turn, connected to relays 78 and 83 for energizing the solenoids 73 and 84, respectively. When either one of the photoelectric cells 75 and 75*a* is energized by a light beam from the related light source 74 or 74*a*, the resulting electrical signal fed to the control unit 77 causes the latter to energize both relays 78 and 83, and thereby close the contacts of the relays. for a predetermined period of time during which solenoids 73 and 84 are energized.

The photoelectric cells 80 and 80*a* are connected by conductors 81 and 81*a* to a control unit 82 which controls the relay 83 in the energizing circuit of solenoid 84. The control unit 82 is operative to energize the relay 83 and thereby close its contacts for energizing the solenoid 84 for a predetermined period of time whenever the diffused light reaching one or the other of the photoelectric cells 80 and 80*a* through the related paper strip 127 or 127*a* is further reduced in intensity by the passage of a double thickness of paper.

As shown in detail on FIG. 9, from which the upper suction head 71*a* has been eliminated for the purpose of clarity, the lower roller 79*a* of the splicing and perforating mechanism 79 is mounted on a shaft 79*d*. One end of the shaft 79*d* is journalled in a bearing carried by the armature 84*a* of solenoid 84, while the opposite end of shaft 79*d* is journalled in a bearing carried by an arm 85 which is rockably supported on the output shaft 86 of the reduction gearing of an electric motor 87. A gear transmission is provided for driving rollers 79*a* and 79*b* from the motor shaft 86 and includes meshing spur gears 87*a* and 87*b* respectively secured on the shafts 86 and 79*d*, and a further spur gear 87*c* meshing with the gear 87*a* and also with a spur gear 87*d* fixed on the shaft of the upper roller 79*b*. The lower roller 79a has two diametrically opposed, axially extending grooves 79*e* in which blocks 79*f* are secured at axially adjusted positions, and punches or pins 79*c* project radially outward from the blocks 79*f*. The upper roller 79*b* is similarly provided with diametrically opposed axial grooves 79*g* having blocks 79*k* adjustably secured therein and provided with bores 79*h* into which the punches or pins 79*c* are adapted to extend. The bottom roller 79*a* has rounded projections 79*m* extending from its surface, while the upper roller 79*b* has its surface formed with corresponding recesses or dimples 79*n*.

Further, as is apparent in FIG. 9, the perforated surface 71*d* of each of the suction heads, for example, of the suction head 71 appearing in FIG. 9, is transversely arcuate or concave so that, when the leading end portion of the strip 127 or 127*a* is held to the surface 71*d*, as hereinafter described, such end portion of the strip is longitudinally stiffened and thereby prevented from dipping downwardly from a path directed toward the nip between the rollers 79*a* and 79*b*. Further, each suction head is provided with laterally adjustable guides 71*b* and 71*c* at the opposite sides thereof for laterally guiding the related strip 127 or 127*a*.

The device described above with reference to FIGS. 5 to 9, inclusive, operates as follows:

When the strip 127*a* from spool or reel 124*a* is to be initially fed to the cigarette making machine, as in FIG. 5, the strip 127 is threaded around guide pulleys 126 and over guide roller 70 so that its leading end portion is held by the suction head 71 and projects a small distance beyond the latter toward the splicing and perforating mechanism 79. If a break occurs in the strip 127*a*, or when the strip 127*a* is completely unwound from its spool 124*a* so that its trailing end 127*b* moves past the associated photoelectric cell 75*a*, as in FIG. 7*a*, whereby the beam of light from source 74*a* is unimpeded by the strip, then solenoids 73 and 84 are both simultaneously energized in response to the increased intensity of illumination received by the photoelectric cell, as described above. The energization of solenoid 73 moves support 72 toward mechanism 79 so that the leading end 127*c* is projected between rollers 79*a* and 79*b* and, after a suitable time delay, the solenoid 84 raises roller 79*a* so that, when the trailing end 127*b* of the strip 127*a* reaches the location of rollers 79*a* and 79*b*, the latter press together the trailing end portion 127*b* and the leading end portion 127*c* to provide an adhesive bond therebetween, as shown in FIG. 7*b*. Thus, strip 127 is connected to strip 127*a* to permit the continuous, uninterrupted feeding of the paper or wrapping material to the filter cigarette making machine. During the feeding of the strip 127 from spool or reel 124, the empty reel on support or holder 125*a* is replaced by a full reel 124*a* and the strip unwound from the latter is threaded around the guide pulleys 126*a* and past the guide roller 70*a* so that its leading end portion is then held by the upper suction head 71*a*, as shown in FIG. 6. Thus, the strip unwound from the new reel or spool 124*a* is then positioned for attachment or splicing to the trailing end of the strip 127 then being unwound from the spool 124.

Since the double thickness of paper or wrapping material occurring at the location of the splice or joint between the dns 127*b* and 127*c* of the joined together strips 127*a* and 127, respectively, would produce a connecting sleeve V of double thickness, which is not desired, the punches or pins 79*c* and the cooperating bores 79*k* provided on the rollers 79*a* and 79*b*, in accordance with this invention, act to form perforations or markings or characteristics indicia in the portion of the strip having a double thickness of material so that, when the perforated portion of the strip is formed into a connecting sleeve V joining two cigarettes 28 to a double filter plug 30, as in FIG. 10, the perforations 127*e* appear adjacent the opposite ends of the sleeve and can be easily detected so that the unit G including the sleeve of double thickness can be ejected or discharged from the filter cigarette making machine. It will be apparent that the perforations 127*e* appearing adjacent the ends of the connecting sleeve V substantially weaken the connection between the cigarettes 28 and the centrally located filter plug 30. Thus, when the unit G having a connecting sleeve with the perforations 127*e* therein passes through the ejecting device 13 previously described herein with reference to FIG. 4, the jets of compressed air issuing from the ports 32 of the related groove 31 while the central portion of the unit G is retained by the guides 53 is effective to bend the cigarettes 28 outwardly from the groove 31 at the weakened connections to the sleeve V defined by the perforations 127*e*. Thus, the deflectors 55 of guides 54 can thereafter engage between the outwardly bent cigarettes and the surface of cylinder 49 for ejecting the defective unit from the machine.

Although the operation of the device illustrated in FIGS. 5 and 6 has been described above with respect to a splice appearing at the connection between strips of paper or wrapping material fed successively from two rolls or spools 124 and 124*a*, it will be apparent that each strip of paper wound on each roll 124 or 124*a* may be, in turn, formed of several strips which are united by similar splices or overlapping joints, as at 127*d* on FIG. 8*a*. When a splice 127*d* is sensed by the related photoelectric cell 80 or 80*a*, the control unit 82 and relay 83 cause energization of the solenoid 84 after a suitable time delay so that, when the splice or overlap joint 127*d* passes between rollers 79*a* and 79*b*, as in FIG. 8*b*, the lower roller 79*a* is pressed upwardly against the upper roller 79*b* and the punches or pins 79*c* again cooperate with the bores 79*k* to form perforations in the joint or splice 127*d*. Such perforations can be sensed, as indicated above, by the device 13 which causes ejection of the units G having connecting sleeves formed from the joint 127*d*.

It is further to be noted that the projections 79*m* and the corresponding recesses 79*n* of the rollers 79*a* and 79*b*

cooperate to dimple the splice or overlapped joint simultaneously with the forming of the perforations in the latter, so that, when the corresponding portion of the paper strip is rolled into the form of a connecting sleeve V, the dimples prevent secure adherence of the sleeve to itself and also to the adjacent cigarettes **28**, thereby to further ensure the correct operation of the device **13** in detecting and ejecting those units G having connecting sleeves formed from the splice or joint portion of the strip.

Although the device illustrated in FIGS. 5 to 9, inclusive, has been described above in connection with the supplying of a strip of paper or wrapping material to a filter cigarette making machine, as shown in FIG. 1, in which sections of the paper strip are formed into connecting sleeves securing two cigarettes to an interposed double filter plug, it will be apparent that the described device may be similarly employed for feeding a paper strip to a conventional cigarette making machine in which the successive or joined together paper strips **127** and **127***a* are rolled around a continuous rod of tobacco to form the paper casing or envelope of successive cigarettes cut from the rod. In this case, as shown in FIG. 11, the splice or overlapped joint between the paper strips **127** and **127***a* is formed with pairs of perforations **127***f* and **127***g* adjacent the opposite ends of the joint **127***d* and the latter is further dimpled, whereby a cigarette cut from the portion of the tobacco rod encased in the splice or joint **127***d* may be conveniently detected and rejected.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contributions to the art and, therefore, such adapations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is:

1. In an apparatus for detecting defects in cigarettes or similar rod-shaped articles and in portions of such articles which travel in a predetermined path extending past a plurality of inspecting stations and thereupon along a single ejecting station, recording means for producing markings whenever at least a portion of a defective article passes an inspecting station; means for transporting said markings in synchronism with the speed at which the articles travel in said path; ejecting means provided at said ejecting station and operative to eject defective articles; and enabling means enabling ejection of defective articles by said ejecting means in response to said markings and with such a delay that the defective article, at least a portion of which initiated the production of a marking when passing one of said inspecting stations, reaches said ejecting station after the respective marking was detected by said enabling means and said enabling means has enabled ejection of said defective article by said ejecting means.

2. A structure as set forth in claim **1**, wherein the articles travel sideways and said ejecting means comprises means for producing blasts of compressed fluid and for directing such blasts against defective articles to eject the articles from said path.

3. A structure as set forth in claim **1**, wherein the articles travel sideways and said recording means is arranged to produce markings in response to detection of a specific defect on at least a portion of an article passing one of said inspecting stations.

4. A structure as set forth in claim **1**, wherein the articles travel sideways and said recording means is arranged to produce markings in response to detection of at least one of a plurality of different defects whenever at least a portion of a defective article passes one of said inspecting stations.

5. A structure as set forth in claim **1**, wherein said transporting means includes rotary carrier means for the markings.

6. A structure as recited in claim **1**, wherein said recording means is arranged to produce markings in at least a portion of each defective article and wherein said transporting means is arranged to convey the articles in said path.

7. A structure as set forth in claim **1**, wherein said recording means comprises means for producing and recording different types of markings in response to detection of different types of defects on portions of defective articles passing the respective inspecting stations.

8. A structure as set forth in claim **1**, further comprising means for feeding portions of articles into said path and means for receiving from said path satisfactory articles in a zone other than at said ejecting station.

9. A structure as set forth in claim **8**, wherein at least one of said inspecting stations includes light-sensitive inspecting means.

10. A method of detecting defects in cigarettes or similar rod-shaped articles and in portions of such articles, comprising the steps of conveying the articles in a predetermined path wherein at least a portion of each article travels past a plurality of inspecting stations and thereupon along a single ejecting station; producing and recording markings in response to detection of portions of defective articles at said inspecting stations and transporting such markings in synchronism with the speed of travel of articles in said path; detecting the travelling markings at a point other than said inspecting stations; and ejecting defective articles subsequent to detection of respective markings and with such a delay that the ejection of each defective article takes place at said ejecting station.

11. A method as set forth in claim **10**, wherein the articles are conveyed sideways and are equidistant from each other, said recording step including producing and recording markings in response to detection of at least one specific defect in a portion of an article passing one of said inspecting stations.

12. A method as set forth in claim **10**, wherein the defective articles are ejected by blasts of compressed air.

13. A method as set forth in claim **10** wherein, at each of said inspecting stations, the articles are examined for the presence of different types of defects.

14. A method as set forth in claim **10**, wherein said transporting step includes transporting the markings at the exact speed of the articles.

15. A method as set forth in claim **10**, wherein said markings are produced in at least a portion of each defective article and travel with the respective articles in said predetermined path.

16. In an apparatus for detecting defects in cigarettes or similar rod-shaped articles and portions of such articles which travel in a predetermined path extending past a plurality of inspecting stations past a recording station and thereupon along a single ejecting station, recording means at said recording station for producing characteristic indications in response to movement of at least a portion of a defective article past one of said inspecting stations; means for delaying the production of said characteristic indications according to the distances which the articles or portions thereof cover in said path from the respective inspecting stations to said recording station; ejecting means provided at said ejecting station and operative to eject defective articles; and enabling means for enabling operation of said ejecting means in response to said characteristic indications and with such a delay that the defective article, at least a portion of which initiated the production of a characteristic indication at one of said inspecting stations, reaches said ejecting station at the time the enabling means enables operation of said ejecting means in response to the respective characteristic indication.

17. A method of detecting defects in cigarettes or sim-

ilar rod-shaped articles and portions of such articles, comprising the steps of conveying the articles in a predetermined path wherein at least a portion of each article travels past a plurality of inspecting stations past a recording station and thereupon along a single ejecting station; producing and recording at said recording station characteristic indications in response to detection of portions of defective articles at least at one of said inspecting stations and delaying the production of such characteristic indications according to the distances which the articles cover in said path from the respective inspecting stations to said recording station; and ejecting defective articles in response to the respective characteristic indications and with such a delay that the ejection of each defective article takes place at said ejecting station.

References Cited

UNITED STATES PATENTS

2,732,503	1/1956	Jacobs.	
2,817,438	12/1957	Birchall	209—74 X
2,989,735	6/1961	Gumpertz	209—111.8 X
3,016,141	1/1962	Lucas	209—72
3,033,366	5/1962	Atanasoff et al.	209—111.8 X
3,237,444	3/1966	Kaeding et al.	209—72 X
3,260,349	7/1966	Vander Meer	209—111.8 X

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