ABSTRACT OF THE DISCLOSURE

A mechanism for inspecting the ends of cigarettes in a production line to detect and reject those with loosely packed tobacco and missing filters, comprising a fluted drum mounted on a rotating shaft member, each of which flutes is provided with an individual inspection means and a memory system, so as to permit a longer period of inspection and more efficient operation and rejection of defective cigarettes. Each flute is provided with: (1) associated porting for introducing and detecting air of inspection air; (2) a memory device in the form of an individual spool valve whose position is controlled by air from a reject port. When a defective end is detected by the inspection air, a blast of air through the reject port moves the spool valve contained in the drum at the particular flute to a position communicating a holding vacuum to the flute. At the point in drum rotation where the good cigarettes are transferred to a removal conveyor, the defective cigarette is held in the flute by the vacuum until release at a later reject point.

BACKGROUND OF THE INVENTION

The present invention relates to the cigarette inspection art and more particularly to a method and means for inspecting cigarette ends for loosely packed tobacco and missing filters.

A particular problem in present day high speed cigarette manufacturing is the detection, in the line, of cigarettes which are defective in that the tobacco at an end is missing or loosely packed (commonly termed "loose ends"), and in the case of filter tipped cigarettes, those with missing filter units. Apparatus has been developed to inspect cigarette ends as the cigarettes move along a conveyor by using either mechanical or pneumatic probes. Generally the probe unit is stationary along the manufacturing line and each cigarette is tested as it passes the probe or the probe may be moved parallel to the cigarette for a portion of its path. Suitable memory devices are provided which in response to signals from the probe unit reject defective cigarettes at an appropriate position further along the path of travel. The rejection has generally been accomplished by blowing off a source of vacuum used to hold the cigarettes on the conveyor by or by a positive means such as a blast of air which will blow the cigarette off the conveyor.

With increases in the speed of cigarette production, now of the order of 3000 to 4000 per minute, these prior inspection systems have been found to be unsatisfactory because of the attendant reduction in test accuracy with the necessary decrease in inspection time and resulting inefficient memory and rejection system operation. Two recent systems directed to overcoming the inspection problems arising with increased manufacturing speeds are disclosed in the copending applications of Colin S. McArthur, Ser. No. 515,878, now abandoned, filed Jan. 31, 1967 and Ser. No. 682,340, filed Nov. 13, 1967, which are assigned to the assignee of the present invention.

FIG. 1 is a somewhat diagrammatic view in elevation of a detector-rejector mechanism embodying the present invention in association with cooperating apparatus in a high speed manufacturing line; FIG. 2 is a sectional view of the detector-rejector mechanism of the present invention showing the details of the inspection and memory and reject systems; FIG. 3 is a sectional view taken along the lines 3-3 in FIG. 2 and showing the associated inspection control apparatus at the inspection station; FIG. 4 is a fragmentary sectional view, showing a good cigarette passing a portion of the inspection system; FIG. 5 is a view as in FIG. 4 showing the inspection of a defective cigarette; FIG. 6 is a sectional view taken on the line 6-6 of FIG. 2, but in the angular orientation of FIG. 1, showing the sequence of gating of the operating fluid of the present invention.

DETAILED DESCRIPTION

A detector-rejector mechanism is shown in FIG. 1 in association with cooperating apparatus in a high speed cigarette manufacturing line. The mechanism is shown in the form of rotating drums but it will be understood that the present invention may be used with other equivalent conveying means well known to those skilled in the art.

The large drum 1 is of the turn-around type which receives a line of double length filter cigarettes, that have just been cut in the center into single lengths, and which rotates one of the rows end to end to present a line of single cigarettes with their filter tips and tobacco ends aligned. Such a turn-around drum is shown in the copending application of Everhart, Ser. No. 708,745, filed Feb. 20, 1968 and assigned to the assignee of the present application.

A line of single aligned cigarettes is thus received from drum 1 by a transfer drum 2. The cigarettes S are held in fluted members on transfer drum 2 by a fixed guide rail 3 and are then passed to an end inspection drum 4 which incorporates the present invention. The cigarettes S on this inspection drum 4 undergo testing while passing through a region A and the good cigarettes are dropped onto a conveyor S to be carried for further processing. While passing the inspection zone A, all the cigarettes are held in fluted members on the drum 4 by means
of a guide rail 6. Cigarettes found to be defective are held on the drum 4 beyond the transfer station by the initiation of a holding vacuum in their respective fluted members and are subsequently rejected in a region B which defines the path of travel.

The particular features of the improved detector-rejector mechanism can best be understood with reference to FIG. 2. For the sake of clarity and brevity, the drum is shown equipped for testing only one end of a cigarette and will be so described, but it will be seen upon consideration of the descriptions that the various inspection and memory systems may be duplicated to inspect both ends of a cigarette, and operate the same reject mechanism if either end is found to be defective.

As shown in FIG. 2, the drum 4 is mounted for rotation by means of suitable bearings 7 on a fixed support shaft 8. It is constructed of a central body portion 10 and two end plates 11 and 21. The surface of the drum 4 is provided with a number of individual cigarette holders or flutes 9 which are adapted to receive cigarettes to be inspected. Each flute 9 has an opening 18a in its interior which is in communication with a fluid conduit 18 formed in the body portion 10 of the drum 4 and which will be more fully described presently in connection with the memory and reject systems.

Turning firstly to the inspecting means of the present invention the preferred embodiment is shown partly incorporated in the end plate 11 on the drum 4 which has three ports 12, 13 and 14 in its periphery aligned with each of the flutes 9 on the central portion 10 of the drum 4. The center port 13 is the probe port, the right port 12 is the sensor port and the left port 14 is the reject port. A chamber 13a communicates with the probe port 13 and sensor port 12. The test fluid, usually compressed air, is introduced into the probe port 13 from a control unit P (FIG. 3) through line 30 and a shoe 15 located at the inspection station A in sliding engagement with the outer surface of the end plate 11. The deflection of the test fluid, issuing from chamber 13a, by the ends of the cigarettes will be sensed through port 12 when a defective cigarette is present. When a defect signal is sensed at port 13 through line 31, an appropriate signal will be sent through line 32 and the shoe 15 to reject port 14. This signal acts to set the memory and reject systems.

The improved memory and reject systems are within the central portion 10 of the drum 4. A spool valve 16 is provided in chambers 17 located in conduits 18 which communicate with the interiors of the cigarette holding flutes 9. Such a valve is provided for each flute 9. The chambers 17 have passages 19 and 20 at their opposite ends which respectively communicate with the ported plate 11 on the left end of the drum 4 and the ported plate 21 on the right end of the drum 4. The left-hand passage 19 communicates with a reject port passage 14a in end plate 11 while the right-hand passage 20 may, during drum rotation, communicate for a time through a port 23 in end plate 21 with a source of compressed air admitted through an aperture 23 in a fixed member 24 which is in sliding engagement with the outer face of plate 21. This member 24 is also provided with suitable ports 25 and 26 (FIG. 6) for respectively communicating a source of vacuum or compressed air to the conduit 18.

It will be seen that while the memory and reject systems are shown and described in combination with the improved loose end inspecting means, they are also capable of use with other inspection systems such as cigarette leak testing or pull testing systems or the like. This is possible since, as will be more fully explained hereinafter, the operation of the memory and reject systems is independent of the associated inspection system and is initiated by a simple pneumatic signal irrespective of the signal source.

OPERATION

With regard to the operation of the improved apparatus, as seen in FIG. 1, individual cigarettes S provided by drum 1 are fed from transfer drum 2 into the cigarette-holding flutes 9 on drum 4. As a given flute reaches the inspection zone A, its associated ports 12, 13 and 14 in the end plate 11 comes into communication with the corresponding ports in the fixed sliding shoe 15 as shown in FIGS. 2 and 3. At this point, a jet of air from the control unit P is introduced through the probe port 13 into the chamber 13a. The air jet is directed through chamber 13a and impinges against the end of the adjacently situated cigarette S as shown in FIGS. 4 and 5.

The jet passing through the end of the cigarette establishes a given pressure level which is dependent upon the supply pressure and the spacing between the chamber outlet and the end of the adjacent cigarette. If the chamber outlet-to-cigarette end spacing is no larger than ⅛ of an inch, the supply pressure may range from about 0.5 to about 5 pounds per square inch to achieve the inspector results. A lower supply pressure results in a loss of sensitivity while a greater pressure may tend to damage the ends of the cigarettes by blowing tobacco out of the ends of even solidly packed cigarettes.

On striking a properly packed end of cigarette S with an inspection jet of air issued from probe port 13, the impinging air is caused to flow radially as depicted in FIG. 4, resulting in only a slight increase, if any, in the pressure communicated to sensor by port 12 via chamber 13a. In any event, any change in pressure sensed by port 12 is insufficient to exceed the predetermined threshold value required to trigger the memory-reject mechanism.

If, however, the cigarette end is of an undesired looseness of construction, i.e. defective as depicted in FIG. 5, the impinging inspection jet becomes sufficiently reversed to generate a pressure pulse within port 12 sufficient to trigger the memory-reject circuit. Thus, a pulse of positive pressure is communicated through line 31 to the control unit P where it may be amplified such as by fluid amplifying means. A resulting signal in the form of another air jet is then introduced through the line 32 and the reject port 14 to operate the memory spool value 16.

In testing for missing filters at the opposite end of the drum, the behavior is analogous to that encountered with loose ends. It has been observed that the pressure increase engendered by a missing filter is less than that in the case of a loose end. Accordingly, the threshold pulse required to effect rejection may be maintained at a lower level, which level is readily ascertained by trial and error.

When the spool valve 16, arrives at the inspection station A, it is located in the position blocking the communication of the flute interior 18a with the passage 18, as shown in the lower portion of FIG. 2. If a defective cigarette is present, the reject air from port 14 acts against the left-hand face of the valve 16 forcing it to the right-hand position as shown in the upper portion of FIG. 2.

At a point in drum rotation where inspection station A, a source of vacuum is communicated to the passage 18 through port 25 in the fixed member 24 and this vacuum then acts within the flute at 18a to hold the defective cigarette S therein. In the case of good cigarettes, the spool valve 16 remains in the left-hand position blocking the communication of the vacuum to the interior 18a of the flute 9.

The ports in member 24 for operating the memory and reject systems are shown in FIG. 6. It will be seen that the port 25 is communicated with the inspection passages 18 of the flutes immediately after they pass through the region of the inspection station A. Just beyond this point in drum rotation, it may be seen by reference to FIG. 1 that the cigarettes are no longer held externally by the guide rail 6 and thus drop onto the surface of the conveyor 5 at C to be carried away for further processing.
However, cigarettes which have been found to be defective and which have displaced spool valves 16 are held in the flutes 9 by means of the vacuum communicated thereto and carried further along the path of rotation of the drum 4 for rejection at a subsequent point B.

Rejection may be accomplished merely by permitting centrifugal forces to overcome the holding vacuum since the high speed operation of the drum 4 will generally impart large "C" forces to the cigarettes conveyed on its surface. A positive pressure purging system may also be used if desired. A suitable receptacle 40 is provided near the drum 4 at region B to collect the defective cigarettes.

The preferred rejection system as shown in FIG. 6 utilizes centrifugal forces to overcome the vacuum in the region B. As the drum 4 continues along its cycle a source of purging air is communicated through the port 26 in member 24 to passage 18. This air clears any residual vacuum remaining in the flutes 18a and passage 18 as well as any defective cigarettes which may not have been released at the reject station B. Just beyond the purging point, a further compressed air signal is introduced through port 23 in member 24 into passage 20. This air acts against the right-hand face of spool valve 16 to reposition the displaced values which have indicated defective cigarettes. All of the valves are then in the left-hand position blocking communication of passage 18 with the flutes 18a as the flutes reach the inspection station A. The vacuum source at no time communicates with passage 18 during actuation of the spool valve 16 so that a minimum of operating power is required when actuating the memory system herein.

It is thus seen that an improved loose end inspection and rejection system is provided having inspection means mounted on the conveying means at the individual cigarettes for travel therewith to permit longer testing times and with a simple and compact memory unit which permits improved inspection for loose ends, missing filter plugs and other defects in high speed cigarette manufacturing while reducing the amount of power required to operate the compactly constructed apparatus.

I claim:

1. Apparatus for inspecting cigarette ends comprising:
   (a) means for conveying cigarettes in individual holders through an inspection station;
   (b) means for inspecting the cigarettes for defective ends;
   (c) means for rejecting the cigarettes found to be defective; 
   (d) a plurality of inspecting devices, each mounted on said conveying means at an individual holder for travel with and spaced from the ends of a cigarette held therein as it moves through said station;

2. Apparatus as claimed in claim 1 wherein said inspecting devices comprise:
   (e) a member having a chamber therein open at one end, said open end being positioned adjacent the end of the cigarette held in the individual holder;
   (f) means in said member defining a first port communicating with said chamber through a wall of said chamber opposite the open end; and
   (g) means defining a second port in said member communicating with said chamber through a wall of said chamber adjoining said open end.

3. Apparatus as claimed in claim 2 comprising means located at the inspection station communicating a jet of compressed air to said port in the chamber wall opposite said open end for directing the jet against the end of the cigarette held in the individual holder;

4. Apparatus as claimed in claim 2 comprising means located at the inspection station for communicating a pressure sensing means with said port in the chamber wall adjoining said open end to detect pressure changes in said chamber.

5. Apparatus as claimed in claim 4 wherein said port in the chamber wall adjoining said open end is positioned for receiving at least a portion of the air deflected from the end of a defective cigarette.

6. Apparatus as claimed in claim 4 comprising means for actuating said rejecting means in response to a predetermined change in pressure in said chamber.

7. Apparatus as claimed in claim 6 comprising rejecting means mounted on said conveying means at the individual holders for travel with the cigarettes being conveyed.

8. Apparatus as claimed in claim 7 comprising means in said member defining a path for conducting a signal to said rejecting means, which signal is produced by said means for actuating said rejecting means.

9. Apparatus as claimed in claim 8 wherein said rejecting means comprises a two-position valve responsive to the signal from said actuating means for communicating the interior of the individual holder with a source of vacuum.

10. Apparatus for inspecting cigarette ends comprising:
    (a) means for conveying cigarettes in individual holders through an inspection station;
    (b) means for detecting cigarettes with defective ends;
    (c) means responsive to a signal from said detecting means for indicating the defective cigarettes; and
    (d) means for rejecting said defective cigarettes, wherein the improvement comprises:
    (e) said indicating means comprising a plurality of valve means on said conveying means, each at an individual holder for travel with the cigarettes being conveyed;
    (f) said valve means comprising a two-position spool valve.

11. Apparatus as claimed in claim 10 wherein said rejecting means comprises means on said conveying means defining a passage for communicating a cigarette holding vacuum to the interior of an individual holder, and said valve means in said passage for interrupting the communication.

12. Apparatus as claimed in claim 11 wherein said valve means is displaced by the signal from said detecting means to communicate the interior of an individual holder with a vacuum communicating passage when a defective cigarette is detected.

13. Apparatus as claimed in claim 12 wherein said conveying means is rotatable past said inspection station and comprises means for resetting said valve means prior to each subsequent arrival at said inspection station.

14. Apparatus for inspecting the ends of cigarettes moving along a normal path of travel comprising:
    (a) means for conveying cigarettes along said path in individual holders through an inspection station;
    (b) means for maintaining the cigarettes in said holders during passage through said station;
    (c) individual test head means located at the individual holders for testing the adjacent end of the held cigarette and for sensing a defect therein;
    (d) means located at said inspection station for actuating said test head means and for detecting the sensing of a defective end; and
    (e) individual two-position valves located at the individual holders responsive to a defect indicating signal from said means at the inspection station for communicating the interior of the individual holder with a vacuum source, whereby the cigarette held therein is removed from the normal path of travel.

15. Apparatus for inspecting cigarette ends comprising:
    (a) a rotating drum having cigarette holding flutes on its surface for conveying cigarettes through an inspection station;
    (b) guides rails for maintaining the cigarettes in the flutes while passing through said station;
    (c) an end plate on said drum having porting therein
adjacent each of the flutes, said porting directing a jet of compressed air against the ends of a cigarette when at the inspection station and being positioned to intercept the jet when deflected by a defective end;

(d) a member located at the inspection station in sliding engagement with the outer surface of said end plate for conducting compressed air to said porting and conducting the intercepted jet indicating the detection of a defective end from said porting;

(e) means at said inspection station responsive to the porting directing a jet of compressed air against the ends of a cigarette for supplying a pneumatic signal through said porting in said end plate to said drum;

(f) valve means in said drum responsive to said pneumatic signal for communicating a vacuum source with the interior of said flutes for holding the defective cigarette therein;

(g) means for rejecting defective cigarettes at a point in drum rotation beyond the inspection station; and

(h) means for resetting the valve means to close off said vacuum to the flutes prior to subsequent passage of the flutes to the inspection station.

16. Apparatus for inspecting cigarettes comprising:

(a) conveyor means including a drum rotatable about a horizontal axis and a plurality of holders for individual cigarettes on said drum;

(b) an inspection station through which the cigarettes and carried by the conveyor means;

(c) means at the inspection station for testing the acceptability of each cigarette as to predetermined condition and producing a signal indicating whether or not the cigarette is acceptable;

(d) fluid amplifier means at said testing station controlling the testing means, said fluid amplifier means being effective to direct a fluid stream through an outlet conduit only if the cigarette is not acceptable;

(e) a plurality of valves on the conveyor drum, one for each cigarette holder, each valve being movable between a cigarette accepting position and a cigarette rejecting position;

(f) means for moving each valve to its accepting position as it approaches the inspection station;

(g) means at the testing station, including said fluid amplifier means, for actuating the valves associated with defective cigarettes to their rejecting positions; and

(h) a path selection station into which the cigarettes are moved by the conveyor means after they leave the inspection station, including:

(1) means for moving all cigarettes whose valves are in the accepting position along one path; and

(2) means for moving all cigarettes whose valves are in the rejecting position along another path;

wherein the improvement comprises:

(i) each of said valves comprising a cylindrical member movable axially in a horizontal passage in the drum, the ends of the passage determining the accepting and rejecting positions of the valve, said passage ends having ports for the admission of fluid under pressure;

(j) said valve moving means comprising means for supplying fluid under pressure to one of said ports;

(k) said valve actuating means comprising means for supplying fluid under pressure to the other of said ports from said output conduit of the fluid amplifier means.

17. Apparatus as claimed in claim 16 comprising means in the drum defining passages communicating a vacuum to said holders, said valves closing said vacuum passages in the accepting position.

18. Apparatus for inspecting cigarettes to detect loosely packed ends, comprising:

(a) test head means for directing a jet of gas toward a cigarette end;

(b) means for supporting a cigarette with an end in alignment with and spaced from said test head means;

(c) means for sensing a gas pressure in said test head;

wherein the improvement comprises:

(d) means defining an outlet of circular cross-section in said test head means;

(e) said supporting means being effective to support the cigarette with its axis in alignment with the axis of said outlet;

(f) means for supplying a flow of gas through said outlet in a stream eccentric with respect to the axis of the outlet and of the cigarette, so that a loosely packed cigarette end deflects a portion of the stream back into the outlet at the opposite side from said stream, while a tightly packed cigarette disperses the stream; and

(g) means for sensing the gas pressure in the outlet at the opposite side from said stream.

19. Apparatus as claimed in claim 18 comprising:

(h) means in said test head means defining a chamber having said outlet at one end;

(i) means in said test head means defining a first port in a wall of said chamber opposite the outlet through which said gas is supplied;

(j) means in said test head means defining a second port in a wall of said chamber adjoining said outlet through which the gas pressure is sensed.

20. Apparatus as claimed in claim 18 comprising a rotatable drum for conveying cigarettes through an inspection station; a plurality of said cigarette supporting means on said drum; and a plurality of test head means on said drum adjacent said supporting means.

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