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Molins et al.

[11] **3,863,491**

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[54] **METHOD AND APPARATUS FOR TESTING CIGARETTES**

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[58] **Field of Search** 73/37, 37.6, 38, 41, 45, 73/45.1, 45.2, 69; 209/79, 80, 73

[56] **References Cited**

UNITED STATES PATENTS

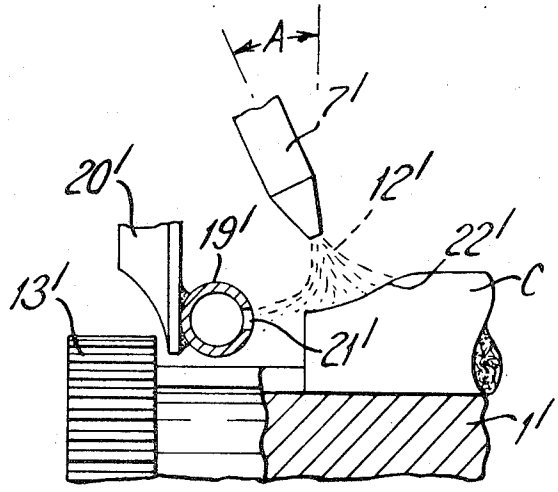
3,483,970	12/1969	McArthur	73/45.1 X
3,564,902	2/1971	Heitmann	73/37
3,595,067	7/1971	Von Der Lohe et al.	73/37.6
3,703,235	11/1972	McEnery	73/37.6 X
3,720,311	3/1973	Harrison, Jr.	73/37.6 X

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[57] **ABSTRACT**

A device for testing the ends of cigarettes comprises a carrier for the cigarettes, a nozzle for directing a stream of air against the wrapper of each cigarette adjacent to one end, with sufficient velocity to deform the wrapper of an inadequately filled cigarette, and means for sensing a characteristic of the air stream in a region to which the stream is deflected by the wrapper of an inadequately filled cigarette. Preferably a microphone is used to sense a change in the air pressure in that region. The nozzle preferably directs the stream of air towards the cigarette at an angle of approximately 65° to the longitudinal axis of the cigarette, and so that the air stream has a component of velocity towards the opposite end of the cigarette.

37 Claims, 3 Drawing Figures



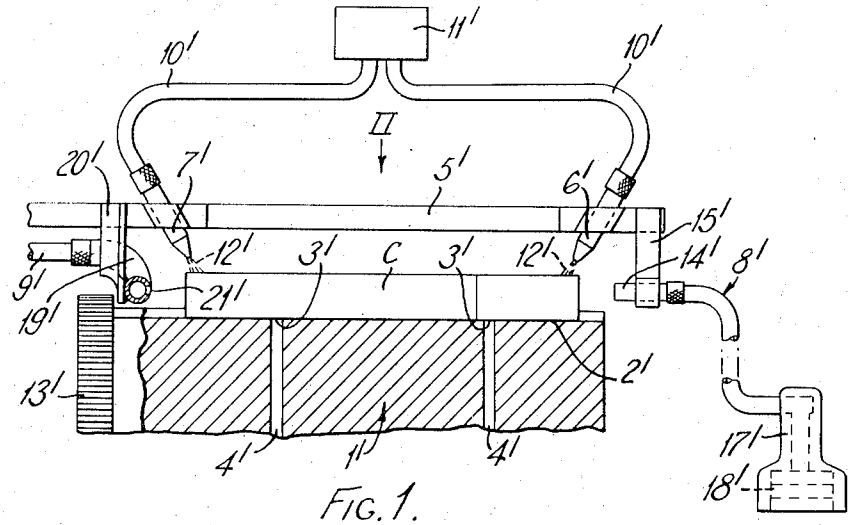


FIG. 1.

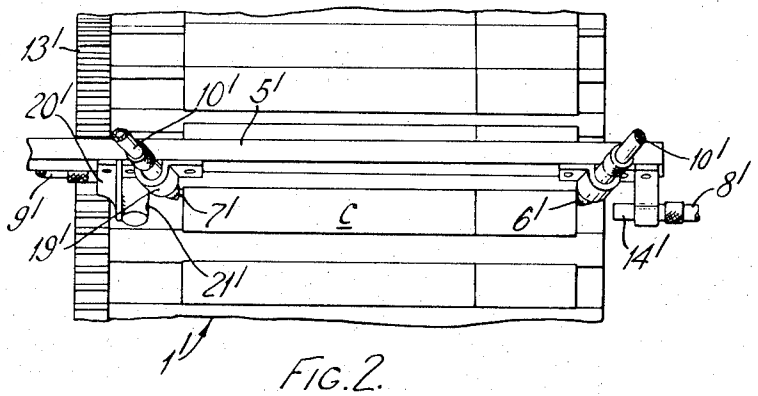


FIG. 2.

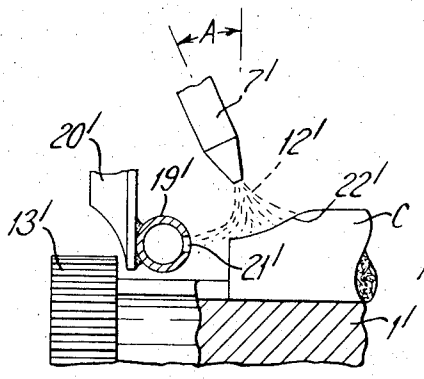


FIG. 3.

METHOD AND APPARATUS FOR TESTING CIGARETTES

This invention concerns testing cigarettes, and more particularly testing the ends of cigarettes to verify that such ends are sufficiently filled with tobacco (or with a filter plug, as the case may be). The proper filling of the ends of a cigarette is of some importance, as tobacco can drop out of a cigarette if its ends are not satisfactorily filled, and consumers tend to judge the quality of a cigarette as a whole by the nature of its ends.

It has been proposed for example in U.S. Pat. No. 3,720,311 in the name of Edmund Harrison, Jr. to inspect the filling of a cigarette end by directing a jet of air against the end face of the cigarette and sensing the effect produced, for example sensing air pressure in a region adjacent to the air jet and cigarette end. In U.S. Pat. No. 3,703,235 is has further been proposed to direct a jet of air towards the side of a cigarette end to compress it, and to detect when the cigarette end is unduly soft (that is to say, is insufficiently filled) for example by means of a beam of light so directed that it is normally interrupted by the side of the cigarette end against which the air jet is directed, but is allowed to pass when said end is sufficiently soft to be compressed by a predetermined amount by said air jet.

According to the invention, there is provided a method of testing an end of a cigarette, comprising directing a stream of air against the side of the cigarette adjacent to its end face, and sensing a characteristic of said air stream in a region which said stream may reach after encountering the side of the cigarette.

The air stream tends to compress the end of the cigarette and its paper wrapper will be deformed inwardly to an extent dependent upon the tobacco filling. If the end is well filled with tobacco (or with a filter plug) then the deformation of the paper will be slight, while if the end is only loosely packed with tobacco (or is empty due to the absence of a filter plug) then there will be a large deformation of the paper. The extent of the deformation of the paper influences the movement of the air stream after it has encountered the side of the cigarette, so that in any region which the air stream may subsequently reach, the characteristics of said air stream will be different when the paper deformation is large and when the deformation is small.

We prefer to sense air pressure in such a region, although it would be possible to sense some other characteristic, e.g. the speed or the direction of air flow.

The invention also extends to the provision of apparatus for carrying out the method of testing set forth above, comprising carrier means for supporting a cigarette to be tested with at least one of its ends adjacent to an air nozzle, said nozzle being arranged to direct a stream of air towards the side of the cigarette adjacent to said one end, and sensing means arranged so as to respond to a characteristic of said air stream in a region which said stream may reach after encountering the side of a cigarette supported by said carrier means.

In such apparatus, the carrier means may conveniently comprise a rotatable drum provided with flutes in its peripheral surface, each flute being of a size to accommodate one cigarette, and means to hold cigarettes in said flutes during testing. Preferably, the holding means comprises ports in the base of each flute and passages within the drum connecting said ports to a source of suction. Drums so fitted are well-known in the art.

The sensing means preferably is arranged to respond to air pressure and while other forms of pressure transducer may be used, a microphone has been found suitable. It is preferred to enclose the microphone in a housing and provide a tube linking the interior of the housing with the region in which pressure changes are to be sensed.

The inclination at which the air stream strikes the side of the cigarette has been found to be of importance; the optimum response (at least in terms of air pressure change) appears to be obtained when the air stream is directed at about 65° to the longitudinal axis of the cigarette. An appreciable loss of response has been found when this angle is outside a range of about 64°–68°. The sense of said inclination is such as to give the air a component of velocity towards the far end of the cigarette.

An example of a testing device in accordance with the invention will now be described with reference to the accompanying drawings, in which:

FIG. 1 is a partly-sectional view of the testing device;

FIG. 2 is a view of the device of FIG. 1, taken at an angle to the vertical in the direction indicated by the arrow II; and

FIG. 3 is a fragmentary view, on a larger scale, of part of the device of FIG. 1.

In the drawings, there is shown part of a rotatable drum 1′ have a plurality of flutes 2′ regularly placed around its circumference, each flute 2′ extending parallel to the rotational axis of the drum 1′ and being provided with suction ports 3′ in its base, said ports 3′ being connected by passages 4′ to a source (not shown) of suction. A cigarette C placed in any one of the flutes 2′ is accordingly held in place by the pressure difference created by the application of suction through the ports 3′.

A support bar 5′ is mounted by any convenient means (not shown) adjacent to the periphery of the drum 1′ and extends parallel to the axis of the drum 1′. On the bar 5′ are carried two air nozzles 6′, 7′ and two microphone tubes 8′, 9′. The nozzles 6′, 7′ are connected by pipes 10′ to a common source of compressed air diagrammatically indicated at 11′. The nozzle 6′ may be adjustably mounted and is so positioned as to direct a stream of air (indicated by dashed line 12′) on to the side of the cigarette C, immediately to its right-hand end (as seen in FIG. 1). The air stream is directed toward the axis of the drum 1′ and is inclined at about 65° to the longitudinal axis of the cigarette C, the inclination being in such a sense that the air has a component of velocity towards the far end of the cigarette. A smaller angle of inclination is in fact shown in FIG. 1, but FIG. 3 shows the preferred inclination, that is to say with the angle A equal to 25°. In general the angle A is preferably between 22° and 26°. The nozzle 7′ may be similarly mounted and symmetrically positioned to direct a similar air stream against the side of the cigarette adjacent to its left-hand end (FIG. 1) as also indicated by a further dashed line 12′. The nozzles 6′ and 7′ may be about 1.6 mm bore and spaced about 4 mm from the cigarette. The air pressure may be about 8 pounds per square inch.

The microphone tubes 8′, 9′ are of different forms by way of illustration but it is noted that there is no significant functional difference between the two tubes; ei-

ther form of tube may be used adjacent to either end of the cigarette, thus in general both tubes may be of the form of tube 8', both of the form of tube 9', or there may be one tube of each form, either as illustrated or interchanged. The main basis of choice between the two forms of microphone tube is the space available, and it will be seen that the tube 9' is mounted adjacent the left-hand end (as seen in FIG. 1) of the drum 1'; at this end, the drum shown carries a drive gear 13', and this makes it impracticable to mount a microphone tube similar to the tube 8' adjacent this end of the drum 1'.

The microphone tube 8' is simply an open-ended tube having a short straight and rigid portion 14' at its open end held, by a bracket 15' secured to the bar 5', parallel to the axis of the drum 1' in such a position as to be aligned with any cigarette brought (by rotation of the drum 1') to the position of cigarette C. The tube 8' may have a bore of about 3 mm. The remainder of the tube 8' is, preferably, of flexible material and its other end is connected to a housing 17' in which a microphone 18' is mounted. The internal arrangement of the housing 17' is indicated by dotted lines. The tube 8' may be positioned about 15 mm from the ends of the cigarettes.

The microphone tube 9' has a straight and rigid end portion 19' held, by a bracket 20' secured to the bar 5', in a position approximately tangential to, but just out of contact with, the end of drum 1'; apart from the end portion 19', tube 9' is of flexible material and is connected at its other end to a housing (not shown), similar to housing 17', containing a second microphone. The free end of the portion 19' is closed, but an aperture 21' is provided in the side of said portion 19' confronting the cigarette C. The aperture may be about 3mm diameter.

Comparison of the two microphone tubes 8', 9' as shown in FIGS. 1 and 2 will reveal that the open end of the end portion of tube 8' and the aperture 21' in the end portion 19' of tube 9' are in similar positions relative to the respective adjacent ends of cigarette C and the neighbouring air nozzles 6', 7'.

In operation, the drum 1' is rotated continuously, cigarettes being fed successively into the flutes 2' at a loading position and released therefrom at a discharge position in conventional manner. The loading and discharge positions need not be described and are not illustrated, but it will be understood that each cigarette is moved through the position of the cigarette C (FIG. 1) as it travels in a flute of the drum 1' from the loading to the discharge position. While each cigarette is in the illustrated position, its ends are subjected to the air jets from nozzles 6', 7' which blow against the curved side of the cigarette, immediately adjacent to such end face, so that each air jet exerts a pressure on the paper wrapper of the cigarette. The air jets are so regulated that this pressure has no material effect on the end of a cigarette which contains a satisfactory filling of tobacco or a filter plug. If however the end is soft, that is contains insufficient tobacco, or is empty because a filter plug is missing, then the pressure of the air jet deforms the wrapper inwardly. Such a deformation is shown in FIG. 3, where the inwardly deformed part is referenced 22'.

After encountering the end portion of a firm-ended cigarette, the air jet from each of the nozzles 6', 7' is dissipated in the ambient air around the region in which the jet meets the wrapper. The pattern of air flow around said region is, however, substantially altered when the wrapper is deformed by the jet, and as the open end of the microphone tube 8', or the aperture 21' of the microphone tube 9', as the case may be, is in the near vicinity of said region, the air pressure at said open end, or said aperture, is different when a cigarette in the position of cigarette C has an end which deforms in response to the neighbouring air jet.

With the nozzles 6', 7' inclined as shown, it will be apparent that the air jets from said nozzles are dissipated towards the centre part of the cigarette when the latter has no soft end or missing filter plug. Hence the air jets have no noticeable influence on the pressure at the ends of the microphone tubes. When a cigarette end is soft or lacks a filter plug, however, and the wrapper is deformed it will be apparent from FIG. 3 that the angle of impact of the air jet on the deformed wrapper is such that some of the jet will be deflected towards the neighbouring microphone tube and hence there will be a pressure change at the open end or aperture of said tube which will be communicated through the tube to the associated microphone which will therefore emit a corresponding electrical signal. The response obtained is not significantly dependent upon the precise spacing between the end of the microphone tube and the end of the cigarette.

When there is no cigarette in a flute 2', or when the drum 1' is so positioned that the nozzles 6', 7' are in register with a space between neighbouring cigarettes, the air from the jets again does not affect the pressure at the open end and aperture of the respective microphone tubes. Thus as the drum 1' revolves, the pressure in each microphone tube is unchanged, and no electric signal is emitted by either microphone so long as each flute of the drum passing the nozzles 6', 7' and tubes 8', 9' is either empty or contains a cigarette with satisfactory ends. When a cigarette with a soft end, or having an empty end due to lack of a filter plug, is brought to the position of cigarette C (FIG. 1) then at the unsatisfactory end the cigarette wrapper is deformed by the air jet which strikes it, and as a result an electric signal is emitted by the respective microphone. It will be appreciated that the air jets may be operative continuously; there is no need to provide valves to time the emission of air.

There is of course an electric circuit connected to both microphones; this circuit is not shown, but could, for example, by similar to that shown in FIG. 8 of the above-mentioned U.S. Pat. No. 3,720,311. Commonly, it is required to reject the faulty cigarette concerned, and this may readily be done by storing the signal from the microphone until the cigarette concerned reaches a position at which ejection mechanism is provided, said signal then being read out of storage to cause operation of said ejection mechanism. It may be found preferable to connect both microphone tubes to a single microphone, in which case the associated circuit may be somewhat simpler.

The test may be conveniently carried out on the main carrier drum 1' of testing apparatus such as is described in U.S. Pat. No. 3,608,380. Referring to the drawings of that patent, it will be seen that the carrier drum 24' and 25' has flanges 24 and 25 which cooperate with corresponding flanges on the closure drum 2. The radius of the flanges 24 and 25 is such that they mask half of the end of a cigarette in a flute on the drum. Consequently, when testing according to the present inven-

tion is carried out on cigarettes on such a drum, the microphone tubes 8' and 9' are positioned slightly further from the axis of the cigarette so that the open end portion of the tube 8' and the aperture 21' lies opposite that part of the cigarette which is not masked by the flange. This may require a slight change in the position or inclination of the nozzles 7'.

As an alternative to the fixed nozzles 7', there could be a series of nozzles on each end of the drum (i.e., one nozzle to each flute at each end of the drum) arranged to direct a stream of air radially outwards from the drum so as to deform the end of any soft ended cigarette, as in the examples shown. Suitably positioned microphone tubes like the tubes 8' and 9' can then be used to receive the air jet which is deflected towards it by each soft-ended cigarette. In this case the supply of air to the nozzles may be controlled so that air only issues from any given nozzle while it is passing the corresponding microphone tube.

Instead of using a microphone to detect the pressure change in the tube 8' or 9', it may be possible to use some other form of pressure-sensitive device.

We claim:

1. A method of testing a cigarette, comprising directing a stream of air against the side of the cigarette adajcent to one of its ends with a velocity sufficient to deform the end portion of an inadequately filled cigarette in which event said air stream is deflected towards a first region spaced from said end portion but insufficient to deform the end portion of an adequately filled cigarette in which event said air stream is deflected towards a second region spaced from said end portion and remote from said first region, and detecting the presence of the air stream in said first region to which said air stream is deflected by the deformed side of an inadequately filled cigarette.

2. A method according to claim 1 in which a change in the air pressure in said first region resulting from the pressure of said air stream is detected.

3. A method according to claim 2 in which the air pressure is detected in a conduit having in said first region an inlet into which at least part of the air stream is deflected by an inadequately filled cigarette.

4. A method according to claim 3 in which the air pressure is detected by a microphone.

5. A method according to claim 2 in which the stream of air is directed against the side of the cigarette in a direction such that the air stream has a component of velocity towards the opposite end of the cigarette.

6. A method according to claim 1 in which the presence of the air stream in said first region is detected by a microphone.

7. Apparatus for testing cigarettes, comprising a testing station, means for carrying a cigarette, a nozzle for directing a stream of air against the side of an end portion of the cigarette with a velocity sufficient to deform an inadequately filled cigarette in which event said air stream is deflected toward a first region spaced from said end portion but insufficient to deform an adequately filled cigarette in which event said air stream is deflected towards a second region spaced from said end portion and remote from said first region, and sensing means for sensing the presence of the air stream in said first region to which the air stream is deflected by the deformed side of an inadequately filled cigarette.

8. Apparatus according to claim 7 in which said sensing means comprises means for sensing the air pressure in said first region.

9. Apparatus according to claim 8 including a conduit having an inlet in said first region and into which at least part of the air stream is deflected by an inadequately filled cigarette, said sensing means being arranged to sense the air pressure in the conduit.

10. Apparatus according to claim 9 in which the air pressure sensing means is a microphone.

11. Apparatus according to claim 8 in which the nozzle is arranged to direct the stream of air against the side of the cigarette in a direction such that the air stream has a component of velocity in a direction towards the opposite end of the cigarette.

12. Apparatus according to claim 11 including a conduit having an inlet in said first region facing towards the end face of the cigarette for receiving at least part of the air stream deflected by an inadequately filled cigarette.

13. Apparatus according to claim 12 in which the nozzle is arranged to direct the stream of air towards the cigarette at an angle to the cigarette axis lying substantially within the range 64° to 68°.

14. Apparatus according to claim 12 including a microphone for detecting the occurrence of an air stream through the conduit indicative of an inadequately filled cigarette.

15. Apparatus according to claim 7 in which said sensing means comprises a microphone.

16. Apparatus for testing cigarettes comprising conveyor means for conveying a succession of cigarettes past a testing station; a nozzle mounted at the testing station for directing a stream of air against the wrapper of each cigarette adjacent to one of its ends, with a component of velocity towards the opposite end of the cigarette, and with a velocity sufficient to deform the wrapper of an inadequately filled cigarette but insufficient to deform the wrapper of an adequately filled cigarette; a pipe having an opening directed substantially axially towards the cigarette end being tested, for receiving at least part of the air stream deflected by the deformed wrapper of an inadequately filled cigarette; a housing connected to the pipe; and a microphone mounted in the housing to sense the occurrence of an air flow into the pipe indicative of an inadequately filled cigarette.

17. Apparatus according to claim 16 in which the nozzle is arranged to direct the stream of air against the wrapper of the cigarette in a direction which is inclined to the cigarette axis by approximately 65°.

18. A method of testing cigarettes comprising the steps of:

a. carrying a succession of cigarettes past a testing station;

b. directing a stream of air, at the testing station, against the wrapper of each cigarette in turn adjacent to one of its ends in a direction such that the air stream has a component of velocity towards the opposite end of the cigarette, the air stream being directed with a velocity sufficient to deform the wrapper of an inadequately filled cigarette but insufficient to deform the wrapper of an adequately filled cigarette; and

c. sensing by means of a microphone the air pressure in a region adjacent to the cigarette end being tested, and to which at least part of the air stream

is deflected by the deformed wrapper of an inadequately filled cigarette.

19. A method of testing a cigarette, comprising directing a stream of air against the side of the cigarette adjacent to one of its ends with a velocity sufficient to deform the end portion of an inadequately filled cigarette, but insufficient to deform the end portion of an adequately filled cigarette, and detecting the presence of the air stream in a region spaced from said end portion and to which said air stream is deflected by the deformed side of an inadequately filled cigarette, said stream of air being directed against the side of the cigarette in a direction such that the stream has a component of velocity towards the opposite end of the cigarette.

20. A method according to claim 19 in which the air pressure of said deflected air stream in said region is detected.

21. A method according to claim 20 wherein the stream of air is directed towards the cigarette at an angle to the cigarette axis lying substantially within the range 64 to 68 degrees.

22. Apparatus for testing cigarettes, comprising a testing station, means for carrying a cigarette, a nozzle for directing a stream of air against the side of an end portion of the cigarette with a velocity sufficient to deform an inadequately filled cigarette but insufficient to deform the end portion of an adequately filled cigarette, and sensing means for sensing the presence of the air stream in a region spaced from said end portion and to which the air stream is deflected by the deformed side of an inadequately filled cigarette, said nozzle being arranged to direct the stream of air against the side of the cigarette in a direction such that the stream has a component of velocity in a direction towards the opposite end of the cigarette.

23. Apparatus according to claim 22 in which said sensing means comprises means for sensing the air pressure in said region.

24. A method of testing a cigarette, comprising directing a stream of air against the side of the cigarette adjacent to one of its ends with a velocity sufficient to deform the end portion of an inadequately filled cigarette but insufficient to deform the end portion of an adequately filled cigarette, collecting air deflected from the side of an inadequately filled cigarette, and detecting the presence of the collected air.

25. A method according to claim 24 in which the air pressure of said collected air is detected.

26. A method according to claim 24 in which the presence of the collected air is detected by a microphone.

27. Apparatus for testing cigarettes, comprising a testing station, means for carrying a succession of cigarettes through the testing station, a nozzle at the testing station for directing a stream of air against the side of an end portion of a cigarette at the testing station with a velocity sufficient to deform an inadequately filled cigarette but insufficient to deform the end portion of an adequately filled cigarette, receiving means at the testing station arranged to receive at least a part of the air stream deflected by the deformed side of an inadequately filled cigarette, and sensing means associated with the receiving means for sensing the presence of the air stream received by the receiving means.

28. Apparatus according to claim 27 in which said sensing means comprises means for sensing the air pressure.

29. Apparatus according to claim 27 in which said sensing means comprises a microphone.

30. A method of testing a cigarette, comprising directing a stream of air against the side of the cigarette adjacent to one of its ends with a velocity which is sufficient to deform the end portion of an inadequately filled cigarette so that the air stream is deflected towards a predetermined region spaced from the end portion of the cigarette but which is insufficient to deform the end portion of an adequately filled cigarette to the degree necessary for a substantial part of the air stream to be deflected to said predetermined region, and detecting the presence of the air stream in said predetermined region.

31. A method according to claim 30 in which the presence of the air stream in said predetermined region is detected by a microphone.

32. A method according to claim 30 in which the stream of air is directed towards the side of the cigarette in a direction such that the air stream has a component of velocity towards the opposite end of the cigarette.

33. A method according to claim 32 wherein the stream of air is directed towards the cigarette at an angle to the cigarette axis lying substantially within the range of 64° to 68°.

34. Apparatus for testing cigarettes comprising a testing station, means for supporting a cigarette at said testing station, a nozzle for directing a stream of air against the side of an end portion of the cigarette with a velocity which is sufficient to deform an inadequately filled cigarette so that the air stream is deflected towards a predetermined region spaced from the end portion of the cigarette but which is insufficient to deform the end portion of an adequately filled cigarette to the degree necessary for a substantial part of the air stream to be deflected to said predetermined region, and sensing means for sensing the presence of the air stream in said predetermined region.

35. Apparatus according to claim 34 in which said sensing means comprises a microphone.

36. Apparatus according to claim 34 in which the nozzle is arranged to direct the stream of air towards the side of the cigarette in direction such that the air stream has a component of velocity in a direction towards the opposite end of the cigarette.

37. Apparatus according to claim 36 in which the nozzle is arranged to direct the stream of air towards the cigarette at an angle to the cigarette axis lying substantially within the range of 64° to 68°.

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