

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Method and Apparatus for Determining Stem Content of Tobacco

5 We, THE AMERICAN TOBACCO COMPANY, a corporation organized and existing under the laws of the State of New Jersey, United States of America, of 150 East 42nd Street, New York, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to improved procedure and apparatus for quickly determining the stem content of strip tobacco so as to enable the stemming process to be effectively controlled.

15 Strip tobacco consists of leaves that have been "stemmed", that is, not only the stem proper but the midrib, or central vein, have been removed. The term "stem" as used in this specification includes both the stem and the central vein or midrib, while the term "leaf" includes the small or branch veins. It is important to control the stemming process so that the correct amount of stem will be removed because an over percentage of stem will tend to degrade the final product, whereas the removal of too large a percentage is uneconomical.

20 Heretofore two principal methods of determining the stem content of strip tobacco have been employed namely hand stemming, and the ball mill method. The former is inaccurate and requires considerable time to make a determination. The latter method also requires an excessive amount of time, although it is accurate. The disadvantage of these prior methods have been overcome by the improved method and apparatus of the present invention so that an accurate

determination of the stem content can be made within as short a time as five minutes. In this way the operator is enabled to effect changes in the stemming operation so as to properly control the stem content of the strip tobacco.

40 Although the invention has been developed to determine the stem content of tobacco, it can also be employed more generally, as for example, in examining any friable product having an associated contaminant, provided there is an appropriate difference in the bulk densities of the end product and the contaminant.

45 In accordance with the present invention, a sample of the friable product and associated contaminant, such as strip tobacco from which the stem has not been entirely removed, is first weighed and then placed in a closed threshing chamber, and a threshing operation is performed for a limited period of time (from 15 seconds to 3 minutes, preferably 1 minute and 30 seconds) so as to thrash the leaf portion from the stem portion and reduce the particle size of the leaf. A rotor having radially projecting blades is arranged to rotate within the threshing chamber and, advantageously, a stationary breaker bar is arranged to cooperate with these blades. Such bar assists in reducing the leaf particle size. The duration of the threshing operation is made sufficient to reduce the particle size of the leaf sufficiently to enable the threshed material to be carried or conveyed by means of an air current.

50 After the threshing operation has been terminated a current of air is sent for a limited time (from 15 seconds to 3 minutes, preferably 1 minute and 15 seconds) through

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both the threshing chamber and a separation chamber which is also a closed chamber and positioned at a level above the threshing chamber. The air enters the threshing chamber through a perforated door at the bottom, and carries the small particles of leaf and stem through a narrow passage or throat into the separation chamber where the relatively lighter portion is separated from the heavier portion (the stem portion). The leaf portion being lighter and having a larger surface area than the stem portion is carried out of the top of the separation chamber and through a suitable duct to an appropriate collection receptacle. The stem particles being heavier and having less surface area than the leaf, remain in the separation chamber until the air flow stops.

Advantageously the separation chamber is connected to the upper portion of the threshing chamber through a narrow throat, and also the walls of the separation chamber advantageously diverge upwardly from such throat portion. As the mixture of threshed material is drawn upwardly by the air current its velocity is caused to increase as it passes through the narrow throat, and immediately thereafter the velocity decreases as the mixture moves upwardly through the separation chamber. Such decreases in velocity enhance the separation of the lighter leaf portion, and the particles of such lighter portion are carried through the outlet at the top of the separation chamber and into the duct previously referred to. At the same time the heavier particles, that is, the stem portion, fall toward the lower section of the separation chamber, and when the air current is cut off, fall back into the threshing chamber. These relatively heavy stem particles are then removed through a suitable door at the bottom of the threshing chamber. In this way, the amount of the stem material can be accurately determined by weighing, and compared with the weight of the sample of the material which was introduced into the threshing chamber at the commencement of the process.

The purpose is to remove the lighter threshed material, that is, the leaf particles from the superposed separation chamber-threshing chamber combination, leaving only the relatively heavy stem particles of the threshed material therein, which are allowed to settle through the narrow throat to the bottom of the threshing chamber so that these may be removed and weighed. The weight of this material compared with the weight of the sample is a measure of the percentage of stem contained in the strip tobacco.

One form of apparatus according to the invention is shown in the single diagrammatic drawing which accompanies this application.

Referring to this drawing the threshing chamber is indicated at 1 and as shown is kidney shaped in end view, but in side view is elongated and its lengthwise dimension is sufficient to receive a sample of strip tobacco ranging from about 6 ounces in weight to about 18 ounces depending upon the type of tobacco. The volume of the tobacco sample should not be either too small or too large. If it is too large the sample will not be threshed adequately within the time allowed for the operation and there will be a tendency to block at the throat during the separation operation. The sample is introduced through an opening in the side of the chamber which is closed by means of a hinged door 2 equipped with a suitable latch.

In the lower portion of chamber 1 a rotary thresher 3 is arranged to rotate on a shaft 4 which is driven by an electric driving motor 5. Thresher 3 comprises a drum 6 fixed to shaft 4 and having a lengthwise series of projecting blades 7. These blades may be mounted in either a fixed or flexible position on the drum, and they cooperate with a stationary breaker bar 8 which is mounted at a suitable position on the interior wall of chamber 1 with a clearance of approximately 0.25 inches between the tips of the blades and bar 8.

Below thresher 3 there is a discharge gate 9 for the relatively heavy particles. This gate is hinged at one side and provided at its opposite side with a latch, neither of which is shown. Discharge gate 9 is perforated throughout its surface by holes having a diameter of about 2 mm for purposes which will appear later on.

The separation chamber is indicated at 10 and is disposed above and advantageously at one side of the threshing chamber 1. The walls 11 of the separation chamber are connected through a narrow throat 12 with the walls of the threshing chamber 1. The walls of the threshing chamber gradually approach one another below the throat 12, and the walls 11 of the separation chamber first abruptly and then gradually recede or diverge from one another above throat 12 to the top of the chamber.

At the top of separation chamber 10 there is a hood 13 which connects with a duct 14 leading to the intake of a fan 15, the outlet of which is connected with a bag 16 of porous material forming a collection chamber. Fan 15 is driven by an electric motor 17 through a variable speed gear mechanism 17a.

Electric power for operating motors 5 and 17 is received through supply conductors 18 by two control boxes 19 and 20. Box 19 is connected to motor 5 through conductors 21 and box 20 to motor 17 through conductors 22. Each of these control boxes includes suitable timing mechanism arranged to

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operate the respective motors for a predetermined period of time, such as for example 2-3/4 minutes for motor 5 and 1-1/4 minutes for motor 17, and the arrangement is such that the threshing motor 5 operates first and continues to operate throughout the test. After a predetermined period of time, say 1-1/2 minutes, the air current motor 17 commences its operation and continues for a period of 1-1/4 minutes, after which both motors stop and the sample separation is completed.

Like the threshing chamber 1, separation chamber 10 is elongated in the direction at right angles to the plane of the drawing and has the same width dimension as the threshing chamber.

In operating the apparatus to determine the stem content of the tobacco, a sample within the weight range indicated above is first weighed and then introduced through the door 2, and the control box 19 is activated to start motor 5. The operation of thresher 3 thrashes the leaf material from the stem material and reduces the particle size of both to a predetermined extent depending upon the time of operation and the character of the thresher. During this operation some of the fine particles of the lighter weight leaf material pass through the 2 mm perforations in the discharge gate 9, and a dust chute 23 attached to the discharge gate directs the dust into any suitable collection unit (not shown).

At the end of the threshing period, the grinder 3 continues to rotate for the purpose of circulating the threshed mixture and motor 17 is automatically energized, so that a current of air is drawn in through the perforations in gate 9 to carry the mixture of threshed material of both the leaf particles and the stem particles upwardly through the narrow venturi throat 12 and into the separation chamber 10. As the material approaches throat 12, the velocity of the air stream and the mixture suspended therein increases because of the gradually approaching sidewalls of the threshing chamber 1. As the current rises above throat 12 the velocity suddenly decreases because of the abrupt widening of the upper portion of throat 12 and lower portion of walls 11 of the suspension chamber. This reduction in velocity enables the separation of the relatively heavier particles of the stem material from the lighter particles of the leaf material to occur, and this latter material is carried upwardly to the top of the separation chamber and into the duct 14. Traversing this duct it passes through fan 15 and into the collection receptacle 16.

The velocity drop is dependent on the ratio of B to A, where B represents the widest area in the separation chamber 10 and A represents the minimum area in the throat 12.

The velocity of the air at A has to be above a minimum level in order to lift the threshed leaf and stems from the threshing chamber 1 into the separation chamber 10. At point B the air velocity has to be such that it will lift the leaf into the discharge duct 14 and leave the stems in chamber 10.

The ratio of B to A is also affected by C which represents the height of the separation chamber from A to B. C must be above a minimum height to prevent the stems being thrown into the discharge duct 14 due to the velocity that is imparted to them at point A. As C increases above the minimum, the ratio of B to A can decrease. However, the closer the ratio approaches 1 to 1, the more critical the air velocities become.

The relative values of C, B and A used in the apparatus are: C=10.6, B=4.8 and A=1.0. These can be varied within a reasonable range and still obtain an effective separation.

Upon the completion of the air current operation, the heavier stem particles fall by gravity downward through the throat 12 and through the threshing chamber 1 and collect on the perforated surface of discharge gate 9. This gate is then opened and such material removed and weighed.

The percentage of stem material is calculated in any known or convenient way. It will be understood that the moisture content of the sample is taken into account. Ordinarily the moisture content of the strip tobacco as prized into hogsheads at the stemmeries is from 10 to 12%, and the sample is weighed at this moisture content. However, if desired, the apparatus will process tobacco having from 8 to 14% moisture content without any change in the operating conditions. By making changes in the operating conditions, the apparatus will process tobacco from a bone-dry condition to the higher moisture content tobaccos customarily encountered in plant processing.

After the collection bag 16 has been emptied to remove the leaf material deposited during the test, the unit is ready for the next test.

Separation chamber 10 is offset from the center line of threshing chamber 1 to prevent any possibility of the rotor 3, which rotates in a clockwise direction, throwing stem material directly through the separation chamber and into the entrance to the duct 14. The bulge in the left-hand wall of threshing chamber 1 as shown in the drawing also assists in preventing such discharge of the stem material.

WHAT WE CLAIM IS:—

1. In the examination of a friable product and an associated contaminant having differing bulk densities, the steps which comprise subjecting a measured amount of the mixture to a threshing operation of limited

operate the respective motors for a predetermined period of time, such as for example 2-3/4 minutes for motor 5 and 1-1/4 minutes for motor 17, and the arrangement is such that the threshing motor 5 operates first and continues to operate throughout the test. After a predetermined period of time, say 1-1/2 minutes, the air current motor 17 commences its operation and continues for a period of 1-1/4 minutes, after which both motors stop and the sample separation is completed.

Like the threshing chamber 1, separation chamber 10 is elongated in the direction at right angles to the plane of the drawing and has the same width dimension as the threshing chamber.

In operating the apparatus to determine the stem content of the tobacco, a sample within the weight range indicated above is first weighed and then introduced through the door 2, and the control box 19 is activated to start motor 5. The operation of thresher 3 thrashes the leaf material from the stem material and reduces the particle size of both to a predetermined extent depending upon the time of operation and the character of the thresher. During this operation some of the fine particles of the lighter weight leaf material pass through the 2 mm perforations in the discharge gate 9, and a dust chute 23 attached to the discharge gate directs the dust into any suitable collection unit (not shown).

At the end of the threshing period, the grinder 3 continues to rotate for the purpose of circulating the threshed mixture and motor 17 is automatically energized, so that a current of air is drawn in through the perforations in gate 9 to carry the mixture of threshed material of both the leaf particles and the stem particles upwardly through the narrow venturi throat 12 and into the separation chamber 10. As the material approaches throat 12, the velocity of the air stream and the mixture suspended therein increases because of the gradually approaching sidewalls of the threshing chamber 1. As the current rises above throat 12 the velocity suddenly decreases because of the abrupt widening of the upper portion of throat 12 and lower portion of walls 11 of the suspension chamber. This reduction in velocity enables the separation of the relatively heavier particles of the stem material from the lighter particles of the leaf material to occur, and this latter material is carried upwardly to the top of the separation chamber and into the duct 14. Traversing this duct it passes through fan 15 and into the collection receptacle 16.

The velocity drop is dependent on the ratio of B to A, where B represents the widest area in the separation chamber 10 and A represents the minimum area in the throat 12.

The velocity of the air at A has to be above a minimum level in order to lift the threshed leaf and stems from the threshing chamber 1 into the separation chamber 10. At point B the air velocity has to be such that it will lift the leaf into the discharge duct 14 and leave the stems in chamber 10.

The ratio of B to A is also affected by C which represents the height of the separation chamber from A to B. C must be above a minimum height to prevent the stems being thrown into the discharge duct 14 due to the velocity that is imparted to them at point A. As C increases above the minimum, the ratio of B to A can decrease. However, the closer the ratio approaches 1 to 1, the more critical the air velocities become.

The relative values of C, B and A used in the apparatus are: C=10.6, B=4.8 and A=1.0. These can be varied within a reasonable range and still obtain an effective separation.

Upon the completion of the air current operation, the heavier stem particles fall by gravity downward through the throat 12 and through the threshing chamber 1 and collect on the perforated surface of discharge gate 9. This gate is then opened and such material removed and weighed.

The percentage of stem material is calculated in any known or convenient way. It will be understood that the moisture content of the sample is taken into account. Ordinarily the moisture content of the strip tobacco as prized into hogsheads at the stemmeries is from 10 to 12%; and the sample is weighed at this moisture content. However, if desired, the apparatus will process tobacco having from 8 to 14% moisture content without any change in the operating conditions. By making changes in the operating conditions, the apparatus will process tobacco from a bone-dry condition to the higher moisture content tobaccos customarily encountered in plant processing.

After the collection bag 16 has been emptied to remove the leaf material deposited during the test, the unit is ready for the next test.

Separation chamber 10 is offset from the center line of threshing chamber 1 to prevent any possibility of the rotor 3, which rotates in a clockwise direction, throwing stem material directly through the separation chamber and into the entrance to the duct 14. The bulge in the left-hand wall of threshing chamber 1 as shown in the drawing also assists in preventing such discharge of the stem material.

WHAT WE CLAIM IS:—

1. In the examination of a friable product and an associated contaminant having differing bulk densities, the steps which comprise subjecting a measured amount of the mixture to a threshing operation of limited



duration in a closed chamber to free the friable product from the contaminant, and thereafter subjecting the ground mixture to a current of air to transfer said measured amount of the mixture from the closed chamber to a separation chamber, separating the lighter portion of the threshed material within the separation chamber from the heavier portion thereof, and removing said lighter portion from said chamber, and comparing the amount of said heavier portion with said measured amount of the mixture.

2. In the process of determining the stem content of strip tobacco, the steps which comprise subjecting a measured sample of tobacco to a threshing operation of limited duration in a closed chamber to thrash the leaf portion from the stem portion; thereafter subjecting the threshed material to a current of air to transfer the threshed material from the closed chamber to a separation chamber, separating the lighter leaf portion of the threshed material within the separation chamber from the heavier stem portion thereof, removing and collecting the relatively high leaf portion of such material, and comparing the amount of said heavier portion with said measured amount of the mixture.

3. Apparatus for determining the stem content of strip tobacco which comprises a threshing chamber in which a measured sample of the strip tobacco is confined, means for threshing the sample to thrash the leaf from the stems, a separation chamber above the threshing chamber having an upwardly increasing cross-sectional area, means for forcing air through the threshed sample so as to lift the threshed sample into the separation chamber, and means for removing the particles of the relatively light leaf portion from the separation chamber to enable the amount of the relatively heavy stem portion to be determined.

4. Apparatus for determining the stem content of strip tobacco which comprises an

assembly including a threshing chamber in which a measured sample of the strip tobacco is confined, a separation chamber disposed thereabove and connected thereto by a narrow throat, means within the threshing chamber for threshing the sample to thrash the leaf from the stems, means for thereafter supplying a current of air upwardly through the assembly so as to carry the threshed sample through the narrow throat into the separation chamber, the separation chamber having an upwardly increasing cross-sectional area and the velocity of the air current after passing the throat decreasing so as to permit separation of the particles of the relatively light leaf portion from the particles of the relatively heavy stem portion, the current of air having sufficient velocity at the top of the separation chamber to carry the particles of the leaf portion out of said chamber; the relatively light leaf portion of the particles thereby being separated from the relatively heavy stem portion so as to enable the amount of such stem portion to be determined.

5. Apparatus for determining the stem content of strip tobacco as set forth in claim 3 in which the narrow throat and the separation chamber are offset from the threshing chamber so as to prevent threshed particles from being thrown by the threshing means into the separation chamber.

6. Apparatus for determining the stem content of strip tobacco as set forth in claim 3 in which a perforated discharge gate is disposed at the bottom of the threshing chamber to permit the entrance of the air current and to permit the collection and removal of the particles of the relatively heavy leaf portion of the threshed sample.

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