A pneumatic tobacco classifying apparatus wherein a tower contains adjustable walls and a partition defining upper and lower classifying chambers connected by two discrete channels. An adjustable chute admits a mixture of tobacco ribs and tobacco leaf laminae into the range of an accelerating device, such as a driven winnower roller or an air-discharging nozzle, which is mounted in the lower chamber and serves to propel the particles of the mixture across the lower chamber against one of the adjustable walls to thus break up agglomerations of ribs and laminae. An ascending air current entrains the laminae and some ribs into the upper chamber, mainly by way of the channels, whereby the entrained ribs descend mainly by way of the other channel and are again propelled by the accelerating device. The heavier ribs descend immediately into and are evacuated from the bottom zone of the lower chamber. The laminae are separated from the air current after leaving the upper chamber.
PNEUMATIC TOBACCO CLASSIFYING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to classifying apparatus for fibrous materials, and more particularly to improvements in pneumatic tobacco classifying apparatus. Still more particularly, the invention relates to improvements in classifying apparatus of the type wherein laminae and other lighter particles are segregated from a mixture of lighter and heavier tobacco particles by one or more ascending currents of air.

A pneumatic tobacco classifying apparatus normally comprises a chamber for an ascending air current and a feeding mechanism which delivers into the chamber a mixture of lighter and heavier tobacco particles, particularly a mixture of tobacco leaf laminae and tobacco ribs. The laminae are entrained by and leave the chamber with the air current whereas the ribs descend by gravity and can be evacuated from the bottom zone of the chamber.

A drawback of such apparatus is that heavier laminae are likely to remain admixed to the ribs as well as that smaller fragments of ribs rise with and remain admixed to the laminae. Also, those ribs which continue to adhere to relatively large laminae are likely to rise with the air current and to remain admixed to the lighter fraction. Such ribs are likely to float in the separating chamber to thereby reduce the efficiency of the apparatus. Unsatisfactory segregation of ribs from laminae affects the quality of cigarettes or other tobacco-containing products. For example, a piece of a rib can puncture the wrapper of a cigarette so that the latter cannot pass the customary test for the presence or absence of leaks and must be discarded.

Certain presently known classifying apparatus are capable of effectively separating lighter particles from heavier particles so that the thus segregated lighter particles contain a relatively small percentage of heavier particles. Certain other known apparatus are designed to prevent removal of lighter particles with heavier particles but are less satisfactory in other respects, particularly in that the removed lighter particles contain a relatively high percentage of ribs. For example, U.S. Pat. No. 1,945,771 to Dahlstrom et al. discloses an apparatus wherein the mixture of lighter and heavier tobacco particles is fed by a shaker table to enter an ascending air current which permits the heaviest particles to descend, which entrains the lighter particles, and which lifts the particles of medium weight to a certain level so that they can return onto the shaker table. A drawback of such apparatus is that they cannot break up agglomerations of lighter and heavier particles and that their efficiency is rather low, especially if the mixture contains a relatively high percentage of coherent particles. The agglomerations leave the apparatus with the heaviest particles so that the heavier particles must be subjected to at least one secondary separating action. Moreover, the particles of medium weight are caused to circulate in the apparatus again and again to thus affect the quality of the classifying action and the output.

U.S. Pat. No. 2,988,213 to Davis et al. discloses a classifying apparatus wherein the housing of the classifier contains an upright partition which divides the classifying chamber into two compartments. The mixture of lighter and heavier particles is to be loosened by a stream of air flowing across the particles which are admitted by a conventional conveyor belt. The air stream is drawn into the housing of the separator by suction. The lighter particles rise in one of the compartments and the heavier particles return onto the belt in the other compartment. The apparatus also comprises a dust extractor. It was found that such apparatus share the disadvantages of the Dahlstrom classifier, mainly because they are also incapable of breaking up agglomerations of coherent tobacco leaf laminae and ribs.

U.S. Pat. 3,164,548 to Rowell et al. discloses a further classifying apparatus wherein a paddle wheel admits a mixture of lighter and heavier tobacco particles into a chamber wherein the lighter particles are immediately entrained by a rising current of air and the heavier particles descend onto an inclined vibrating screen for removal from the housing. Such apparatus cannot discriminate between lightest, medium weight and heaviest particles so that their classifying action is not entirely satisfactory.

SUMMARY OF THE INVENTION

An object of the invention is to provide a pneumatic tobacco classifying apparatus which is capable of effectively breaking up accumulations of coherent lighter and heavier tobacco particles prior to and in the course of separation of lighter particles from heavier particles.

Another object of the invention is to provide a classifying apparatus whose efficiency is higher than that of presently known apparatus.

A further object of the invention is to provide an apparatus whose classifying action can be regulated in a number of ways to insure an optimum classification of each of many types of mixtures of lighter and heavier tobacco particles.

An additional object of the invention is to provide a novel and improved tower for use in a pneumatic tobacco classifying apparatus.

An ancillary object of the invention is to provide a novel device for breaking up accumulations of coherent lighter and heavier tobacco particles in a pneumatic tower type tobacco classifying apparatus.

The invention is embodied in an apparatus for segregating lighter particles from a mixture of lighter and heavier tobacco particles, such as a mixture of ribs and tobacco leaf laminae. The apparatus comprises an upright tower or other suitable housing provided with an upper and a lower classifying chamber and a pair of channels connecting the two chambers, feeding means for admitting into the lower chamber a mixture of lighter and heavier tobacco particles, air circulating means for conveying through the housing a current of air flowing up-wardly from the lower chamber, mainly through one of the channels, and into and from the upper chamber, and accelerating means provided in the lower chamber to propel the particles of the mixture admitted by the feeding means across the air current and preferably against an adjustable wall in the housing whereby the air current entrains lighter tobacco particles and some heavier particles but permits the remaining heavier particles to descend in the lower chamber by gravity.

The heavier particles which are entrained by the ascending air current are decelerated and deflected on entry into the upper chamber to descend, at least in part, by way of the other channel which delivers the descending heavier particles into the range of the accelerating means.

The accelerating means may include a mechanical accelerating device, e.g., a winnower roller which can be driven at several speeds, or a pneumatic accelerating device, for example, a single nozzle or several nozzles having one or more rows of air-discharging orifices. The accelerating action can be regulated by adjusting the feeding means, by adjusting the position of the accelerating device and/or by adjusting the force with which the accelerating device acts on the particles of the mixture. The accelerating device effectively breaks up accumulations of lighter and heavier particles and it also contributes to separation of such heavier particles which are still attached to tobacco leaf laminae.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved classifying 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 drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic partly elevational and partly sectional view of a classifying apparatus which employs a mechanical accelerating device; and
FIG. 2 is a fragmentary sectional view of a classifying apparatus with a pneumatic accelerating device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, there is shown a pneumatic classifying apparatus which segregates lighter tobacco particles from heavier tobacco particles, particularly tobacco leaf laminae from a mixture which contains such laminae and ribs, birds' eyes and like heavier parts. The apparatus comprises a classifier proper 1 which includes in a housing or chamber 7 having at its top a passageway 49 connected with a removing unit 3 for lighter particles and by way of the removing unit 3 to an air circulating or air moving device here shown as a blower 6. Air which is to be returned to the classifier 1 is relieved of a certain amount of dust by a dust extractor 4. A feeding unit 2 is provided to deliver a mixture of lighter and heavier tobacco particles into the interior of the housing 7. The latter contains an adjustable partition or divider 11 which is disposed between an upper classifying chamber 8 and a lower classifying chamber 9 of the housing 7. These chambers communicate with each other by way of two discrete channels, 12, 13 which flank the partition 11. The volume of the chamber 8, 9, and of the channels 12, 13 can be adjusted by moveable internal walls 14, 16, 17 which are installed in the housing 7 and can be adjusted from without to select an optimum cross-sectional area for the channels 12, 13 as well as an optimum capacity for the chambers 8, 9. The adjusting means for the moveable walls 14, 16, 17 are respectively shown at 21, 18, and 19. The partition 11 is pivotable with a horizontal adjusting shaft 22 which can be manipulated from the outer side of the housing 7 and serves as a means to adjust the cross-sectional areas of the channels 12, 13. In the illustrated embodiment, an angular adjustment of the partition 11 about the axis of the shaft 22 will result in an increase in the cross-sectional area of the channel 12 at the expense of the cross-sectional area of the channel 13; or vice versa. The mode of operation of the adjusting means 18, 19, and 21 will be self-evident by referring to FIG. 1. It suffices to say that each of the moveable walls 14, 16, 17 preferably comprises two or more articulately connected sections or panels which can be adjusted with as well as relative to each other. Certain adjusted positions of the moveable walls 14, 16, 17 are indicated in FIG. 1 by phantom lines but it is clear that each of these walls can be moved to a practically infinite number of positions other than those shown by solid and phantom lines.

The feeding unit 2 includes a belt conveyor 23 whose discharge end is trained around a roller 23a and which delivers a stream of intermixed lighter and heavier tobacco particles in the direction indicated by arrow 53. The particles of the mixture descend (arrow 54) into a metering device here shown as an air lock 24 including a paddling wheel which at least reduces the amounts of air entering the interior of the housing 7 and which feeds a practically continuous stream of tobacco particles (arrow 56) onto an adjustable chute 26 whose inclination can be regulated from without to change the direction of entry of the mixture and the manner in which the particles of the mixture are caused to move in and across the lower classifying chamber 9. It will be noted that the discharge end of the air lock 24 communicates with the housing 7 at a level below the partition 11 so that the mixture invariably enters the lower classifying chamber 9.

In accordance with a feature of the invention, the feeding unit 2 further includes a driven winnower roller 27 which constitutes a mechanical propelling or accelerating means and is disposed adjacent to the discharge end of the chute 26 close to the movable wall 16 to propel the particles of the mixture across the lower classifying chamber 9 in a direction toward the lowest cross section on panel 14a of the moveable wall 14. The air intake of the blower 6 draws current of air from the removing unit 3 by way of a return conduit 33 (arrow 64) provided with an air admitting gate or valve 34 which is adjustable to deliver into the return conduit 33 as much air as is necessary to compensate for leakage and losses due to extraction of dust in the unit 4. The outlet of the blower 6 discharges a current of air into a supply conduit 36 containing an adjustable air quantity regulating valve 37 and having a branch 41 containing a second adjustable regulating valve 42. The branch 41 is connected with the inlet of the dust extractor 4. The supply conduit 36 has two outlets 37, 38 which admit air to different zones in the interior of the housing 7. The outlet 36 discharges the major part of the air current into a compartment 43 which is bounded by the bottom wall and a portion of one side wall of the housing 7 as well as by the lowermost panel 14a of the movable wall 14. The panel 14a is provided with a large number of apertures or orifices which admit discrete currents of air (arrows 51) into the lower classifying chamber 9. The movable wall 16 forms with the panel 14a a funnel which diverges upwardly toward the partition 11 and flanks the lower chamber 9. The other outlet 38 of the supply conduit 36 discharges a relatively small amount of air into a second compartment 44 which is bounded by a portion of the bottom wall and a portion of another side wall of the housing 7 as well as by the sections or panels of the movable walls 16, 17. The wall 16 is also formed with apertures or orifices which admit discrete currents of air (arrows 52) into the adjacent portion of the lower classifying chamber 9 in the region below the winnower roller 27.

The bottom wall of the housing 7 has a substantially centrally located discharge opening above a cell wheel 48 which evacuates the heavier particles entering the cell wheel in the directions indicated by arrows 58. The cell wheel 48 discharges heavier particles into a collecting receptacle (not shown) or onto a takeoff conveyor. This cell wheel is flanked by the lowermost panels of the moveable walls 14 and 16. The lighter particles leave the upper classifying chamber 8 through the passageway 49 (arrow 62) and accumulate in the bottom portion of the separating unit 3 to leave the latter by way of a revolving cell wheel 46 (arrow 63) and to enter a discharging pipe 47 which delivers lighter particles to a second collecting receptacle (not shown) or to a second takeoff conveyor which advances such particles to a further processing station, for example, to a cutting machine which forms shreds for use in the manufacture of cigarettes.

The operation.

The motor 60 which drives the blower 6 is started and the valves 34, 39, 42 are adjusted to circulate a current of air at an optimum rate through the supply conduit 36, through the outlets 37, 38 and compartments 43, 44 (arrows 51 and 52), thereupon upwardly through the lower classifying chamber 9, mainly through the channel 12, upwardly through the classifying chamber 8, through the passageway 49, through the channel 13, downwardly through the return conduit 33 (arrow 64) back to the blower 6. The motor 60 can also drive the winnower roller 27 in a clockwise direction, to drive the air lock 24 and cell wheels 48, 46 and/or to operate the movable parts of the dust extractor 4. The operator also adjusts the moveable walls 14, 16, 17 (if necessary) by way of the adjusting means 21, 18, 19 so as to select a proper cross-sectional area for the classifying chambers 8, 9 and channels 12, 13. If necessary, the operator also adjusts the position of the partition 11 by changing the angular position of the shaft 22.

The conveyor belt 23 is thereupon started to deliver a substantially continuous stream of a mixture of lighter and heavier tobacco particles in the direction indicated by the arrow 53. Such mixture descends at the discharge end of the belt 23 (arrow 54) and enters the air lock 24 whose paddle wheel transmits metered quantities of the mixture onto the chute 26 whereby the resulting stream descends along an inclined path (arrow 56) and into the range of the revolving blades of the winnower roller 27. These blades accelerate the particles and propel them across the lower classifying chamber (arrows 57) in a direction toward the lowest cross section of panel 14a of the movable wall 14. The panel 14a permits passage of discrete currents of air (arrows 51) which entrain the lighter particles into and through the right-hand channel 12 (arrows 59). The blades of the winnower roller 27 perform the additional important func-
tion of breaking up agglomerations of lighter and heavier tobacco particles so that the lighter particles can be readily entrained by air to pass through the channel 12 and to rise in the upper classifying chamber 8 toward the passageway 49.

The ribs and other heavier particles of the mixture which is propelled by the blades of the winnower roller 27 are caused to impinge against the panel 14a and descend by gravity (arrows 51 and 52) without even reach the panel 14c; they can descend by gravity without any impact against the movable wall 14. The adjustability of the chute 26 is important because the operator is in a position to change the inclination of the path along which the mixture travels toward the blades of the winnower roller 27.

Thus, depending on the consistency of the mixture (the percentage of agglomerated or coherent lighter and heavier particles, the moisture content of the mixture, the percentage of ribs, and/or other factors), the paths along which the particles of the mixture are propelled across the lower classifying chamber 9 can be selected in such a way that the apparatus segregates a very high percentage of lighter particles.

The air currents which are the lower classifying chamber 9 by way of the panel 14c and movable wall 16 (arrows 51 and 52) immediately entrain the lighter tobacco particles so that such particles cannot enter the cell wheel 48. The ascending air is likely to entrain certain heavier particles, particularly those ribs which adhere to laminae. Such heavier particles enter the cell wheel 8 but are not of the passageway 49. Thus, they descend in the chamber 8 and return into the range of the blades on the winnower roller 27 which propel them toward the panel 14c to effect a secondary classification. The advantage feature of the apparatus that the heavier particles which have entered the upper chamber 8 descend by way of the channel 13 rather than by way of the channel 12 and are thereby returned into the range of the winnower roller 27 is due to the fact that the quantity of air admitted by the outlet 38 is less than the quantity of air entering the compartment 43 and chamber 9 by way of the outlet 37. The lesser quantity of air which is admitted by way of the outlet 37 forms a current which ascends mainly in the left-hand channel 13 and the larger quantity of air admitted by way of the outlet 37 rises mainly in the channel 12. Therefore, a pressure differential develops between the upper ends of the channels 12, 13 with the result that the heavier particles which happen to enter the upper chamber 8 seek the path of least resistance and move across this channel (arrows 61) to descend in the cell wheel 8. The heavier particles are preferably mounted close to the upper portion of the movable wall 16. It was found that repeated acceleration of heavier particles which descend by way of the channel 13 insures a practically complete breakup of agglomerations so that the percentage of segregated lighter particles is very high. The circulation of some heavier particles around the partition 11 can be repeated more than once, as long as such particles are too heavy to enter the passageway 49 but light enough to be entrained into the upper classifying chamber 8.

The lighter particles which enter the passageway 49 advance in the direction indicated by the arrow 62 and descend into the lower zone of the removing unit 3 to be evacuated by way of the arrow 63 which discharges pipe 47. The manner in which the lighter particles of tobacco leaves are separated from air is well known and, therefore, the exact construction of the removing unit 3 forms no part of the present invention. The air current flows in the direction indicated by the arrow 64 and enters the intake of the blower 6. It will be noted that the air circulating system of the apparatus defines a practically closed path for the flow of an air current upwardly through the housing 7 to insure economical utilization of moving air. The valve 34 admits some air to compensate for leakage in the air circulating system as well as for the amounts of air which are caused to pass through the dust extractor 4.

The drive for the winnower roller 27 preferably includes a variable-speed transmission or a variable-speed motor to enable the operator to vary the rotational speed of the blades.

The efficiency of pneumatic classifying apparatus depends to a high degree on the extent to which the accumulations of lighter and heavier particles are broken up not later than at the time when they enter the ascending air current. The winnower roller 27 has been found to constitute an effective accelerating device which breaks up all or nearly all accumulations as soon as they enter the lower classifying chamber. The elimination of air currents too low is classified in part 109. The particles against the rapidly revolving blades and/or teeth of the winnower roller and also to the fact that the particles impinge against the panel 14a. Moreover, the particles which are propelled by the blades of the winnower roller 27 travel along different paths, depending on the points of impact against the blades and on the weight of particles, to insure a highly satisfactory segregation of a substantial percentage of lighter particles in the lower classifying chamber 9. The lighter particles which reach the panel 14a are prevented from descending into the cell wheel 48 by currents of air (arrows 51) which enter the chamber 9 by way of perforations in the movable wall 14.

It was found that the major percentage of lighter particles is segregated from ribs before such lighter particles leave the lower classifying chamber 9. Also, a high percentage of ribs descends into the cell wheel 48 without even entering the channels 12 and 13. The remaining ribs are thereupon decelerated and deflected (arrows 61) to return into the range of the winnower roller 27 and to leave the apparatus by way of the panel 14a with the result that they leave the apparatus by way of the cell wheel 48. The particles entering the upper chamber 8 are subjected to an effective secondary classifying action with the result that only the laminae are permitted to leave the housing 7 by way of the passageway 49 and that the percentage of laminae in the stream of heavier particles leaving the chamber 9 by way of the cell wheel 48 is very low.

The air lock 24 of the feeding unit 2 can be replaced with another tobacco metering device without departing from the spirit of our invention. Metering of the mixture is desirable because the quality of the classifying action is affected if the mixture is admitted at a rate which fluctuates within a wide range.

FIG. 2 illustrates a portion of a second apparatus wherein the accelerating means for the mixture of lighter and heavier tobacco particles comprises an adjustable pneumatic accelerating device including at least one elongated nozzle 128 which is turnably mounted on a shaft 129 and discharges jets of compressed air 129. The latter jet is directed toward the winnowing nozzle 128 receives compressed air by way of a flexible hose 132 containing a regulating valve 131. All other parts of the apparatus shown in FIG. 2 are preferably identical or analogous to the parts of the apparatus shown in FIG. 1 and certain of such parts are denoted by similar reference characters plus 100. For example, the reference characters 113, 144 respectively denote the left-hand channel and the compartment behind the movable walls 116, 117. The hose 132 is connected to a source of compressed air, not shown, such as a pump or compressor.

The operation of the apparatus shown in FIG. 2 is also analogous to that of the first apparatus. In this embodiment of our invention, the force with which the particles of the mixture admitted by the adjustable chute 126 (along the inclined path indicated by the arrow 156) can be regulated by changing the inclination of the chute, by changing the angular position of the nozzle 128 and/or by adjusting the valve 131.

An important advantage of the classifying apparatus shown in FIGS. 1 and 2 is that they can break up agglomerations of lighter and heavier tobacco particles with greater efficiency and more rapidly than presently known apparatus. Such elimination of agglomerations insures that the apparatus can segregate a high percentage of lighter particles and that the material leaving the apparatus by way of the cell wheel for the heavier particles (see the cell wheel 48 of FIG. 1) contains little or no lighter particles. It was found that the percentage of lighter particles which leave the apparatus with the heavier particles is so small that such material need not be subjected...
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[Image 0x0 to 557x818]

3. Apparatus for segregating lighter particles from a mixture of lighter and heavier tobacco particles, comprising a housing provided with an upper and a lower classifying chamber and a pair of channels connecting said chambers, air circulating means for conveying through said housing a current of air flowing from said lower chamber mainly through one of said channels and into and from said upper chamber; feeding means for admitting into said lower chamber below the other of said channels a mixture of lighter and heavier tobacco particles; and accelerating means provided in said lower chamber underneath said feeding means to propel the particles of the admitted mixture across the air current whereby the air current entrains lighter particles and some heavier particles but permits the remaining heavier particles to descend in said lower chamber by gravity, the entrained heavier particles being decelerated on entry into said upper chamber to descend, at least in part, by way of said other channel.

4. Apparatus as defined in claim 1, wherein said accelerating means comprises a mechanical accelerating device.

5. Apparatus as defined in claim 1, wherein said feeding means comprises a chute defining an inclined path for directing the mixture of lighter and heavier tobacco particles into the range of said accelerating means, a conveyor for supplying a stream of such mixture, and a metering device for transferring the particles of said mixture at a substantially constant rate from said conveyor to said chute.

6. Apparatus as defined in claim 5, wherein said chute is adjustable so as to change the inclination of said path.

7. Apparatus as defined in claim 1, wherein said accelerating means comprises a pneumatic accelerating device.

8. Apparatus as defined in claim 7, wherein said pneumatic accelerating device comprises at least one adjustable air discharging nozzle.

9. Apparatus as defined in claim 1, wherein said housing includes partition means disposed at a level between said chambers and flanked by said channels.

10. Apparatus as defined in claim 9, further comprising means for adjusting the position of said partition means.

11. Apparatus as defined in claim 1, further comprising movable walls provided in said housing and means for adjusting the positions of said walls with reference to said housing to thereby change the cross-section of at least one of said chambers and at least one of said channels.

12. Apparatus as defined in claim 1, wherein said air circulating means comprises supply conduit means having two air-admitting outlets communicating with spaced portions of said housing to admit said air current into said lower chamber.

13. Apparatus as defined in claim 12, wherein one of said outlets admits air in quantities exceeding those admitted by the other of said outlets.

14. Apparatus as defined in claim 12, further comprising air permeable walls provided in said housing between said lower chamber and said outlets.

15. Apparatus as defined in claim 14, wherein said walls diverge toward said upper chamber and flank said lower chamber.

16. Apparatus as defined in claim 1, wherein said air circulating means comprises conduit means receiving said air current from said upper chamber and admitting said air current to said lower chamber and means for moving the air current through said conduit means.

17. Apparatus as defined in claim 16, further comprising means for removing lighter tobacco particles from the air current in said conduit means.

18. Apparatus as defined in claim 17, wherein the means for moving the air current comprises a blower and said removing means is disposed upstream of said blower.