APPARATUS FOR COMMINUTING AND CLASSIFYING TOBACCO

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The present invention relates to an apparatus for comminuting and classifying tobacco. More particularly, the invention relates to an apparatus for destalking tobacco leaves and for separating from the resulting mixture at least the major part of tobacco leaf laminae. Still more particularly, the invention relates to improvements in an apparatus wherein tobacco leaves are subjected to a plurality of destalk ing actions.

It is already known to place two or more destalking units in series so that such destalking units alternate with pneumatic separators which serve to remove tobacco leaf laminae from stems, birds' eyes and other relatively heavy fractions. A serious drawback of such apparatus is that they must be provided with a large number of conveyors which transport the material to consecutive stations and that the apparatus must be provided with a large number of pneumatic separators each of which requires a substantial amount of air. Also, the classifying action of such apparatus is not entirely satisfactory.

Accordingly, it is an important object of the present invention to provide a very simple, compact and comparatively inexpensive apparatus for comminuting and classifying tobacco wherein the number of conveyors is reduced to a minimum, wherein the laminae of tobacco leaf can be separated in a very simple manner by resorting to a small number of pneumatic separators, and wherein separation of tobacco leaf laminae is carried out with relatively small amounts of conveying air.

Another object of the invention is to provide an apparatus for comminuting tobacco leaves in a plurality of stages wherein the segregation of tobacco leaf laminae from stems and other heavier fractions takes place simultaneously with the destalking operation.

A further object of the invention is to provide an apparatus of the above outlined characteristics wherein the destalking aggregates or units contribute to more rapid and more accurate classifying operation.

An additional object of the invention is to provide a novel pneumatic separator which can be used in an apparatus of the above outlined character.

Still another object of the invention is to provide an apparatus wherein the classifying operation is carried out in such a way that it contributes to superior destalking action and wherein the mixture of comminuted lighter and heavier particles is subjected to a plurality of classifying actions to make sure that all or nearly all useful particles are separated from the less valuable fraction or fractions of the mixture.

A concomitant object of the invention is to provide an apparatus wherein the material which must be subjected to two or more comminuting or destalking treatments can be transported without resorting to belts, chutes, chains and other bulky and costly conveyors.

Briefly stated, one feature of my invention resides in the provision of an apparatus for destalking tobacco leaves and for separating heavier and lighter particles of the resulting mixture. The apparatus comprises a housing which defines a separator chamber, a plurality of destalking units including an upper and a lower destalking unit each having a rotor rotatable about a substantially horizontal axis whereby the upper unit is disposed above the lower unit and is accommodated in the housing to divide the separator chamber into a pair of upwardly extending ducts having lower portions communicating with each other at a level above the lower unit, and means for directing into the separator chamber a current of air flowing transversely across the mixture which descends from the upper unit toward the lower unit so as to entrain lighter particles into and upwardly through the ducts. The upper unit discharges the mixture only toward the lower unit but the mixture is directed into the ducts wherein the lighter particles rise while the heavier particles descend into the lower unit.

This lower unit may be mounted in the separator chamber or it may be installed in the bottom part of the housing so that the mixture issuing therefrom leaves the separator chamber.

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

FIG. 1 is a vertical section through a combined comminuting or destalking and classifying apparatus which embodies one form of my invention and which comprises two destalking units; and

FIG. 2 is a similar section through a modified apparatus which comprises four destalking units.

Referring first to FIG. 1, there is shown an apparatus which comprises an upright separator housing 2 defining a chamber 2a. A medium portion of this chamber 2a accommodates a first or upper destalking unit 4 which is located at a level above a second or lower destalking unit 6. The lower unit 6 is mounted in an outlet provided in the box-shaped bottom portion 45 of the housing 2. The units 4 and 6 respectively comprise rotors 8, 10 whose shafts 13, 15 are rotatable about parallel horizontal axes and are provided with radially extending comminuting blades 9, 11. The rotors 8, 10 are respectively mounted in stationary cylindrical cages 12 and 14. In the illustrated embodiment, the rotors 8, 10 respectively rotate in directions indicated by the arrows 17 and 21, i.e., the blades 9 and 11 rotate in opposite directions. The blades 9 and 15 may be driven by a common prime mover, not shown.

The housing 2 accommodates a substantially vertically extending partition 87 which divides the chamber 2a into a pair of upwardly extending compartments having lower zones in communication with each other, as at 23, in the region between the destalking units 4 and 6. The left-hand compartment accommodates the upper destalking unit 4 and is thus divided into a pair of substantially vertical ducts 18, 29 whose lower portions communicate with each other through the space between the destalking units 4 and 6. The right-hand duct 20 is adjacent to the right-hand compartment 22.

The upper end of the duct 20 is in direct communication with a first outlet 24 which leads to a first air evacuating device 27. The upper end of the duct 18 communicates with a second outlet 28 which is connected with a second air evacuating device 31. A channel 25 connects the upper end of the right-hand compartment 22...
with the outlet 24. The air evacuating device 27 is located upstream of an air lock 26 which evacuates tobacco leaf laminae and deposits such laminae onto a first take-off conveyor belt 96. A second air lock 30 is located downstream of the air evacuating device 31 and serves to deposit tobacco leaf laminae onto a second take-off conveyor belt 98. A third take-off conveyor belt 46 is disposed below the lower destalking unit 6 and serves to remove the mixture of heavier and lighter tobacco particles which pass through the interstices of the cage 14. The belt 46 is trained around rollers 48, 50 and its upper stringer advances in the direction indicated by an arrow 52.

The accurate upper portion of the partition 87 is provided with an aperture 88 which is controlled by an adjustable flap valve 90. This valve can admit into the duct 20 some false air so as to regulate the pressure and velocity of the air current which flows upwardly through the duct 20 and into the outlet 24. A similar aperture 92, controlled by a flap valve 94, is provided in the top wall of the channel 25 to admit, if necessary, false air to the current which rises in the right-hand compartment 22 and flows into the outlet 24.

The feed for supplying tobacco leaves into the cage 12 of the upper destalking unit 6 is controlled by an air current which issues from the conduit 56 and flows through the apertures of the screen 60. Some particles of the mixture are expelled through the cage 12 and directly into the ducts 18 and 20 wherein the leaf laminae rise with the ascending portions of the air current to be entrained into the outlets 24 and 28. The heavier particles descend in the ducts 18, 20 and enter the main air current which issues from the conduit 56. Some air which issues from the conduit 56 flows through the passage 23 and rises in the compartment 22 to entrain lighter particles which are admixed to the heavier particles descending toward the opening at the upper end of the cage 14. Thus, the lighter particles ascend partly in the duct 18, partly in the duct 20, and partly in the compartment 22. Air entering the passage 23 can also entrain some heavier particles; however, such heavier particles descend prior to reaching the conveyor belt 46. The lighter particles which rise in the compartment 22 merge with lighter particles which rise in the duct 20 and enter the outlet 24 to be conveyed into the casing 81 of the air evacuating device 27. The revolving sieve 80 allows air to flow into the suction conduit 64 and to reenter the intake 18 of the blower 54. The lighter particles descend into the casing 70 of the air lock 26 and are transferred onto the upper stringer of the take-off belt 96. Lighter particles which ascend in the duct 18 pass through the outlet 28 and enter the casing of the evacuating device 31 where they are separated from air and enter the air lock 30 to be deposited onto the upper stringer of the take-off belt 98. Air which is withdrawn in the evacuating device 31 enters the suction conduit 64 and flows through the collecting conduit 68 to reenter the blower 54. The belts 96 and 98 transport lighter particles to the next processing station or stations, not shown.

The particles which descend through the air current 78 and into the cage 14 of the lower destalking unit 6 consist mainly of exclusively of stalks and stalks with portions of leaf laminae still adhering thereto. The cage 14 also receives such medium-weight particles which have ascended in the compartment 22 and which thereupon descend by gravity in a direct path of air through the compartment 22. The blades 11 of the lower destalking unit separate the remaining leaf laminae from the stalks and the resulting mixture is deposited on the belt 46 to be introduced into a second pneumatic or otherwise constructed separator, not shown.

By properly adjusting the various valves, as operator can control the pressure and velocity of the air current which issues from the conduit 56 and which flows in the chamber 2a in such a way that the outlets 24 and 28 re-
ceive pure leaf laminae or "lights" without any "heavies" therein. For example, by moving the valve 73 in the suction conduit 66 nearer to its fully closed position and by moving the valve 75 in the suction conduit 64 nearer to its fully open position, the operator can increase the speed of air in the duct 18 by simultaneously reducing the speed of air in the duct 20 and compartment 22. By adjusting the position of valves 58 and 61 in the conduit 56, and by adjusting the position of valves 90 and 94, the operator can further regulate the speed of air which flows in the duct 20 and compartment 22. If the valves 61, 90 and 94 are moved nearer to their fully open positions, the operators will insure that there develops in the lower part of the chamber 2 a region of "zero" pressure whereby the air column allows the air to escape upstream of such region and the apertures 88, 92 admit an equal area of air downstream of the same region. In this way, one can accurately control the velocity of air which rises in the duct 20 and compartment 22 to make sure that such air cannot entrain heavier tobacco particles or that the heavier particles are allowed to descend by gravity prior to reaching the outlet 24.

It is clear that the apparatus of FIG. 1 may be modified by omitting the conduits 64, 66 and 68. The blower 54 then simply supplies a current of compressed air which passes through the conduit 56 and is admitted into the lower part of the chamber 2 to classify the mixture which is formed by the upper destalking unit 4. Also, the apparatus may be provided with additional air flow regulating valves, or the valves shown in FIG. 1 may be replaced by valves which are installed in other parts of the housing 2 and conduit 56.

The apparatus of FIG. 2 differs from the apparatus of FIG. 1 mainly in that it comprises two additional or intermediate destalking units 116, 119 which are mounted in the chamber 102a of the housing 102 in the region between the upper destalking unit 104 and the lower destalking unit 106. All such components of the apparatus shown in FIG. 2 which are identical with or partially analogous to the corresponding parts of the apparatus shown in FIG. 1 are identified by similar reference numerals. Thus, the take-off belts 146, 196, 198 of FIG. 2 respectively correspond to the belts 46, 96, 98 of FIG. 1, the conduit 156 corresponds to the conduit 56, and so forth.

The right-hand side wall of the housing 102 is identified by the numeral 167, and the valve 90 of FIG. 1 is replaced by a valve 199 which is provided in the top wall of the outlet 128 at the upper end of the duct 118. FIG. 2 further comprises two additional air admitting conduits 163, 165 the former of which is connected with the side wall 157 at a level between the destalking units 104, 116. The conduit 165 is connected with the right-hand side wall 167 at a level between the destalking units 116, 119, and the conduit 156 is connected with the side wall 157 at a level between the destalking units 119, 106. In the illustrated embodiment, the conduits 156, 163, 165 are connected to the pressure sides of separate blowers 154, 153, 155; however, it is clear that each of these conduits can receive a current of compressed air from a common source, for example, from a plenum chamber or from a single blower. It will further be noted that the chamber 102a of the housing 102 is not divided into a pair of compartments, i.e., that the compartment 22 of FIG. 1 is not needed. The apparatus of FIG. 2 does not circulate air in an endless path because heavier particles in the air flow are deviated from the common path, for example, from the blower 54 and not into it. This will further be noted that the chamber 102a of the housing 102 is not divided into a pair of compartments, i.e., that the compartment 22 of FIG. 1 is not needed. The apparatus of FIG. 2 does not circulate air in an endless path because heavier particles in the air flow are deviated from the common path, for example, from the blower 54 and not into it.

The feed conveyor 138 receives tobacco leaves from the supply conveyor 140 and feeds such material to the chute 132 and air lock 149 which latter supplies tobacco leaves into the cage of the uppermost destalking unit 104. This unit discharges a mixture of still-air and tobacco leaf laminae into the ducts 118, 120 as well as by gravity towards a funnel at the upper end of the destalking unit 116. Lighter particles are immediately entrained by currents of air which ascend in the ducts 118, 120 and are advanced into the outlets 128, 124 to enter the air evacuating devices 127, 131 and to be expelled through the air locks 126, 130. The blower 155 sends a first current of air which passes through the conduit 163 and through the uppermost screen 160 to flow transversely across that part of the mixture which descends toward the cage of the destalking unit 116. Thus, the current of air produced by the blower 155 deflects from the descending mixture a large percentage or all of the lighter particles and directs such particles into the duct 120 so that the particles may travel upwardly and into the outlet 124.

The destalking unit 116 separates from the introduced mixture additional tobacco leaf laminae, and the resulting second mixture is expelled through the interstices of the cage in the unit 116 to enter in part the duct 118, in part the duct 120, and to also descend in part toward the cage of the destalking unit 119. The material which descends toward the cage of the unit 119 is traversed by the air current which issues from the conduit 165 whereby the current blows all or nearly all free lighter particles into the duct 118 whereas the lighter particles ascend to pass through the current issuing from the conduit 163 or to be deflected by this current and to enter the duct 120 at the right-hand side of the destalking unit 104.

The destalking unit 119 brings about further combination of the admitted mixture, and its cage discharges a third mixture into the ducts 118, 120 as well as toward the inlet of the lowermost destalking unit 106. The unit 106 is provided in an outlet in the bottom part of the housing 102 and discharges onto the take-off belt 146. The mixture which descends from the unit 119 is traversed by the air current issuing from the conduit 156 and passing through the lowermost grid 160 so that the lighter particles are blown into the duct 120 to enter the space in front of the conduit 165. At least that mixture which issues from the cages of the two intermediate or additional destalking units 119, 116 is classified in a plurality of ways, namely, first by being blown from the duct 120 into the duct 118 and/or vice versa, while ascending in the duct 118 and/or 120 and finally by being traversed by some of the air currents. It was found that lighter particles which issue from the upper two destalking units 104, 116 and happen to be admixed to or entrained by heavier particles will be segregated without fail prior to reaching the inlet to the cage of the lowermost unit 106. Such particles are classified alternatively in a transverse current and in an ascending current. The zig-zag line 151 indicates the path of lighter particles which ascend through the chamber 102a to ultimately enter the outlet 124. The duct 118 will convey lighter particles which issue mainly from the uppermost destalking unit 104. However, the duct 118 can also receive such lighter particles which are not deflected by the air current issuing from the conduit 163.

A very important advantage of my improved apparatus is that air which is utilized to segregate lighter particles from heavier particles can flow around the major part of each such destalking unit which is accommodated in the chamber 2a or 102a. Also, and since the units 104, 116, 119 divide the interior of the chamber 2a or 102a into the pair of upwardly extending ducts 18, 20 or 118, 120, and since such ducts are disposed at the opposite sides of the enclosed destalking units, the pressure and velocity of air which rises in the duct 18 or 118 may be adjusted independently of the pressure and velo-
ity of air which rises in the duct 20 or 120. Particles issuing from an enclosed destalking unit 4, 104, 116 or 119 are subjected to a third classifying action by the air current issuing from the conduit 56, 163, 165 or 156 so that one can say that the mixture issuing from the cage of an enclosed destalking unit is invariably subjected to three separating or classifying actions. By way of example, and referring to FIG. 2, the mixture issuing from the cage of the destalking unit 116 is classified in the duct 118, in the duct 120 and also by the current of air which is admitted by the conduit 165. It was found that such triplex classifying action results in collection of all or nearly all free lighter particles. The separating action of currents discharged by the conduits 56, 163, 165, 156 is particularly intensive because the material deflected by such currents is thereafter caused to enter the duct 18, 20, 118 or 120 and is subjected to a further classifying action of air which flows upwardly and toward the upper end of the respective duct.

Another important advantage of my improved apparatus is that parts may be accommodated in a very compact housing, and particularly that the material need not be mechanically transported from destalking unit to destalking unit. Thus, instead of resorting to conveyors as in conventional apparatus, I provide an apparatus wherein material issuing from an upper destalking unit and necessitating further comminution can descend by gravity so that the apparatus requires only a first conveyor or a first group of conveyors for feeding tobacco leaves into the uppermost destalking unit, and a set of take-off conveyors to collect and to transport such material which is being discharged from the separator housing. Furthermore, and since the destalking units are disposed one above the other, and also because the mixture which descends from an upper unit into the cage of a lower unit is traversed by a current of air, such mixture is loosened up before it actually undergoes the next comminuting action. This is of advantage because a loose mixture can be comminuted with greater efficiency than a mixture wherein the particles adhere to each other. While the lowermost destalking unit 6 or 106 discharges the mixture in the form of a continuous stream, the air locks 26, 30, 126 and 130 discharge lighter particles in the form of batches. However, it will be readily understood that the apparatus of FIG. 1 or 2 may be modified by installing the lowermost unit 6 or 106 entirely within the confines of the housing 2 or 102 and by providing an air lock through which the thus enclosed unit 6 or 106 discharges a mixture onto the belt 46 or 146. Still further, the lower unit 6 or 106 could be replaced by an air lock so that the apparatus of FIG. 1 would comprise a single destalking unit and that the apparatus of FIG. 2 would comprise a total of three destalking units. However, the apparatus preferably comprises at least two destalking units, particularly when it must comminute tobacco leaves or portions of tobacco leaves wherein the stalks or stems are hard to separate from tobacco leaf laminae. Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

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

1. An apparatus for destalking tobacco leaves and for separating heavier and lighter particles of such leaves, comprising a housing defining a separator chamber; a plurality of destalking units including an upper unit and a lower unit each having a rotor rotatable about a substantially horizontal axis, said upper unit being disposed at a level above said lower unit and being accommodated in said housing to divide said chamber into a pair of upwardly extending ducts having interconnected lower portions at a level below said upper unit; and means for admitting into said chamber a current of air which entrains lighter particles into and upwardly through said ducts.

2. An apparatus as set forth in claim 1, further comprising a feed for supplying tobacco leaves to upper destalking unit.

3. An apparatus as set forth in claim 1, wherein said air admitting means comprises conduit means discharging into said chamber in a zone between said units so that the current of air flows transversely across the mixture of lighter and heavier particles which descends from said upper unit toward said lower unit.

4. An apparatus as set forth in claim 3, further comprising at least one additional destalking unit disposed in said housing between said upper and lower units so that a portion of the mixture issuing from said upper unit descends toward said additional unit and a portion of the mixture issuing from said additional unit descends toward said lower unit, said conduit means being arranged to discharge a first current of air across the mixture which descends from said additional unit and one of said first named units and further comprising second conduit means for discharging into said chamber a second air current transversely across the mixture descending between said additional unit and the other of said first named units.

5. An apparatus as set forth in claim 4, wherein said housing comprises two side walls disposed at the opposite sides of said destalking units and wherein each of said conduit means is connected to one of said side walls so that said air currents enter said chamber at the opposite sides of said units.

6. An apparatus as set forth in claim 3, further comprising a screen provided between said conduit means and said chamber.

7. An apparatus as set forth in claim 6, wherein said housing comprises a side wall connected with the discharge end of said conduit means and said screen comprises planar portions which form an extension of said side wall at the discharge end of said conduit means.

8. An apparatus as set forth in claim 1, wherein said housing comprises a bottom portion having an outlet and said lower destalking unit is installed in the outlet of said bottom portion.

9. An apparatus as set forth in claim 1, further comprising upwardly extending partitioning means provided in said housing to divide said chamber into a pair of compartments one of which includes said ducts, said compartments being in communication with each other in a zone located between said destalking units and said air admitting means being arranged to direct said air current across said zone so that some air enters and entrains lighter particles upwardly through the other compartment.

10. An apparatus as set forth in claim 9, wherein said housing comprises a first outlet communicating with the upper end of one of said ducts and a second outlet communicating with the upper ends of the other duct and said other compartment.

11. An apparatus as set forth in claim 1, wherein said housing comprises two outlets each of which communicates with one of said ducts.

12. An apparatus as set forth in claim 11, further comprising an air evacuating device provided in each of said outlets to separate lighter particles from air.

13. An apparatus as set forth in claim 12, further comprising an air lock provided in each of said outlets downstream of the respective air evacuating device to remove lighter particles from said housing.

14. An apparatus as set forth in claim 12, wherein said air admitting means comprises blowers means having a suction side and a pressure side, first conduit means con-
necting said pressure side with said chamber, and second conduit mean connecting said suction side with said air evacuating devices.

15. An apparatus as set forth in claim 1, wherein said upper destalking unit comprises a cage for the respective rotor and said cage is provided with openings through which some of the mixture produced by said upper unit enters said ducts, the remainder of such mixture descending by gravity toward said lower unit.

16. An apparatus as set forth in claim 15, further comprising a plurality of additional destalking units provided in said housing between said upper unit and said lower unit, said additional units being disposed above each other, said upper unit and each of said additional units being arranged to discharge a mixture of lighter and lower particles toward the unit therebelow.

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