May 26, 1970 A. PIETRUCCI 3,513,858

PROCESS FOR STEMMING TOBACCO LEAVES

Filed Nov. 2, 1966 3 Sheets-Sheet 1

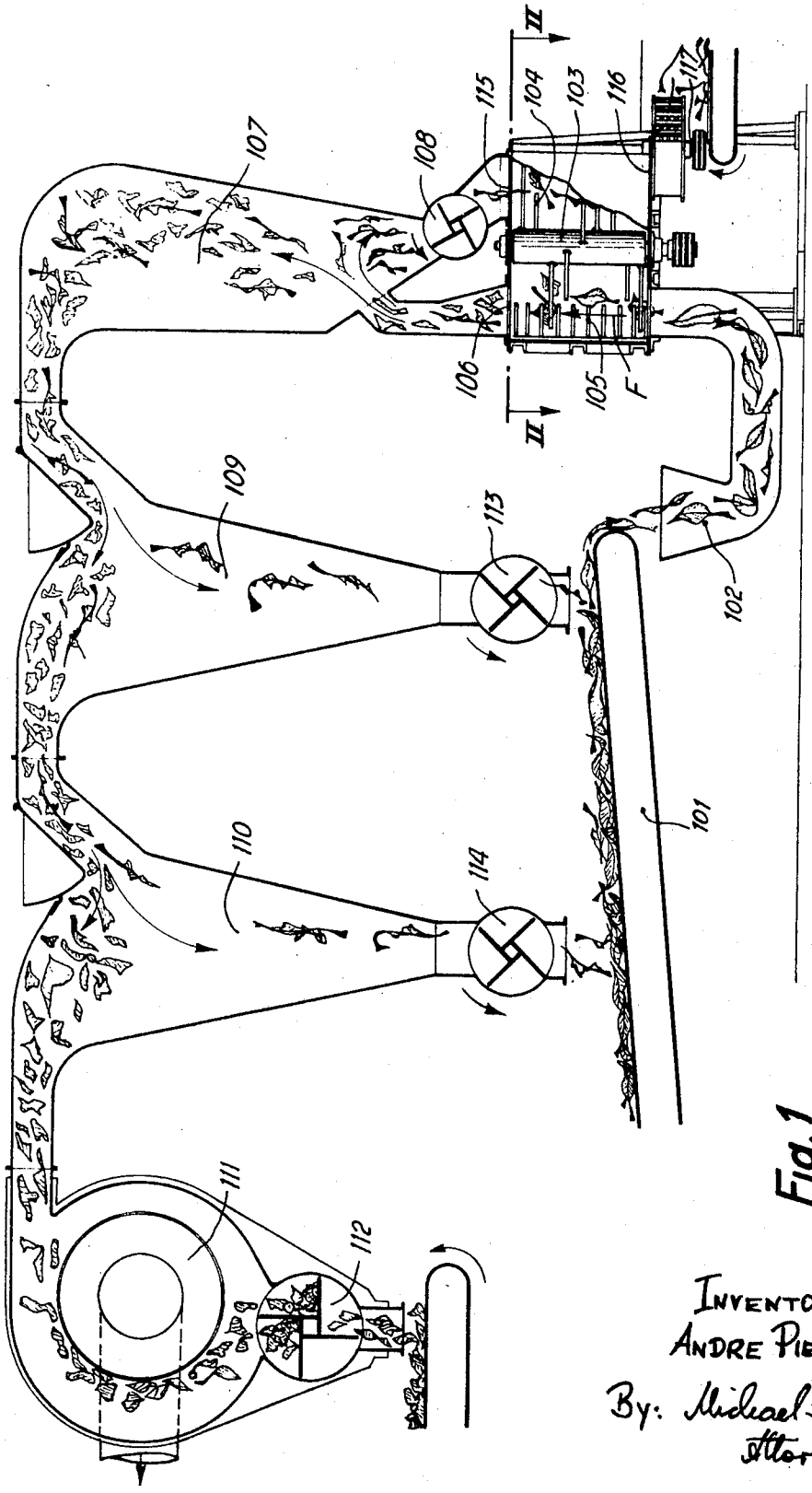

Fig. 1

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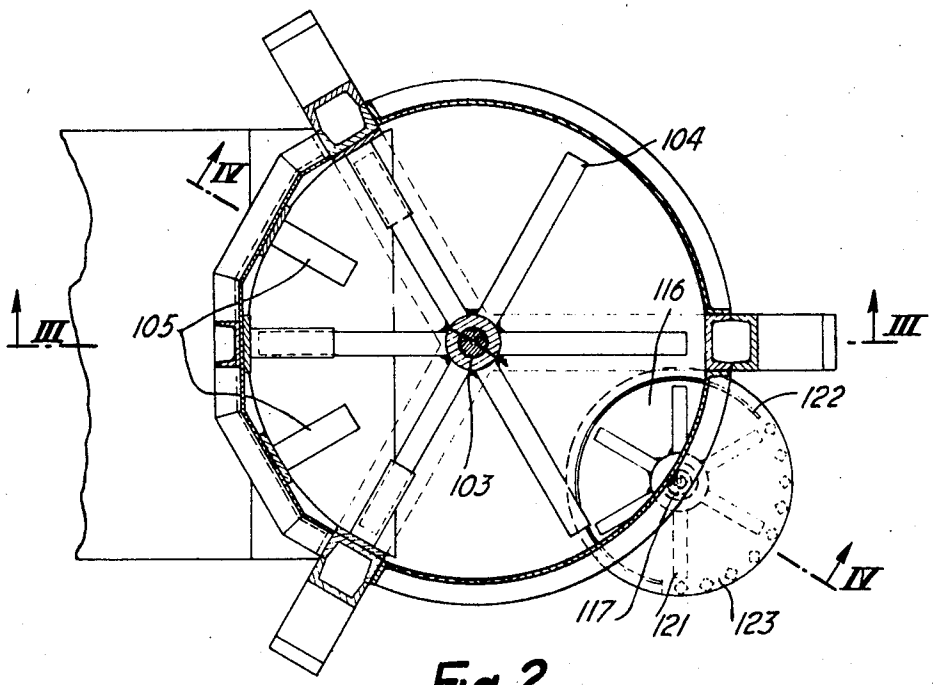

Fig. 2

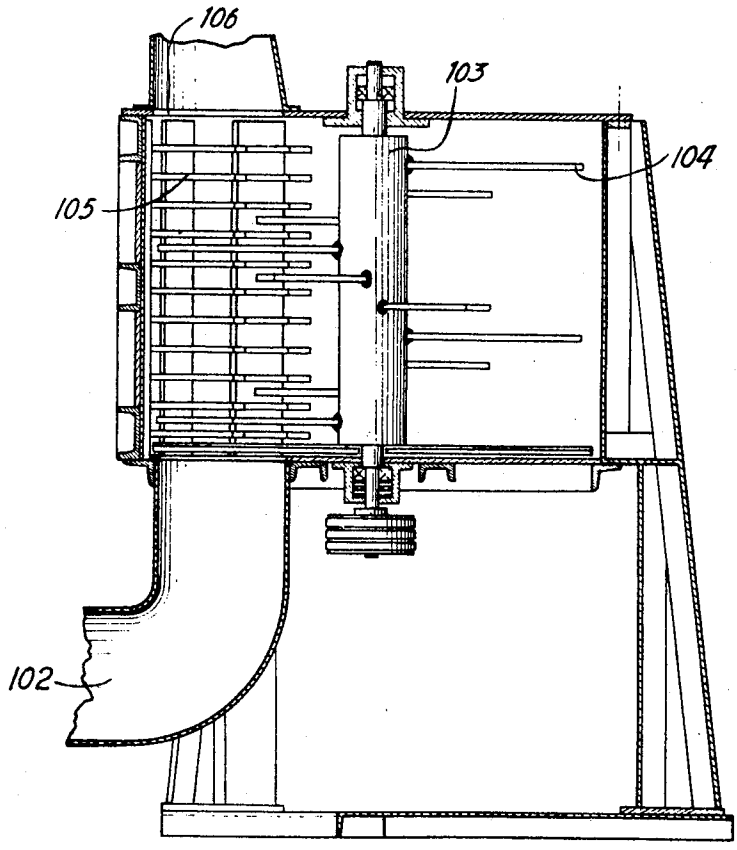

Fig. 3

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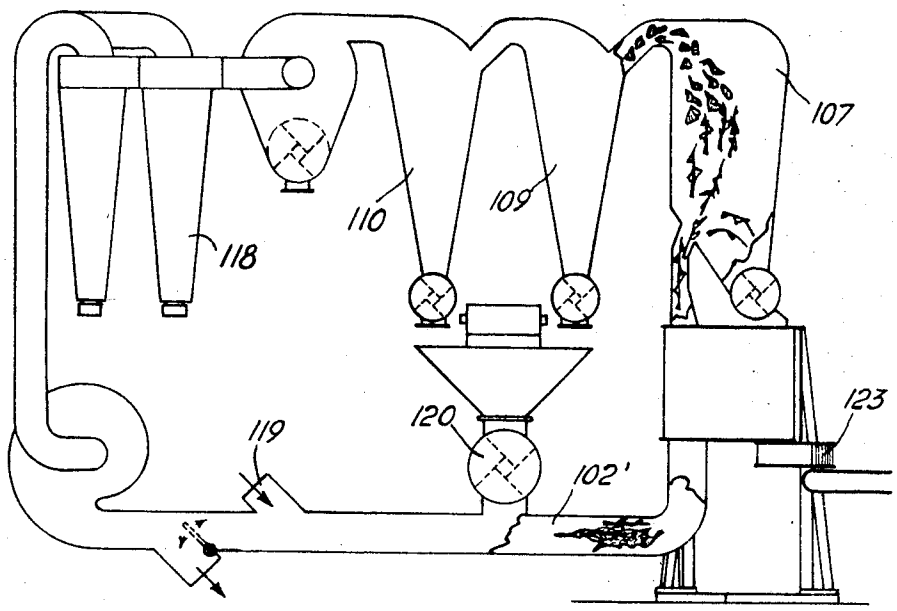

Fig. 5

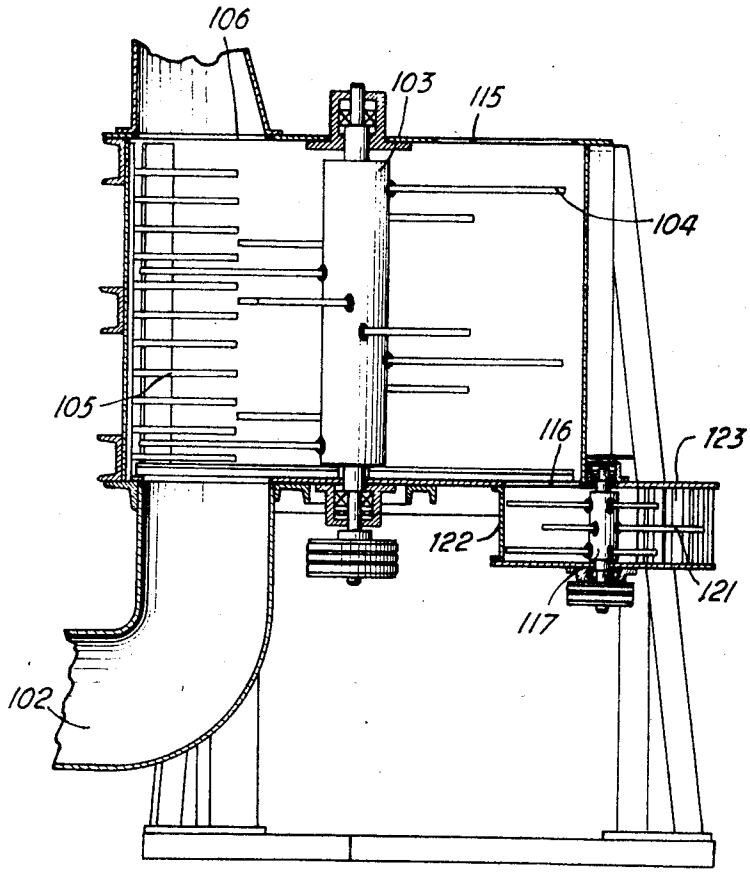

Fig. 4

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PROCESS FOR STEMMING TOBACCO LEAVES

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Int. Cl. A24b 5/10
U.S. Cl. 131—146 6 Claims

ABSTRACT OF THE DISCLOSURE

A process for stemming tobacco leaves and separating the products into lighter, intermediate-weight, and heavier parts. The leaves are introduced into an air stream exteriorly of the stemming chamber and circulated upwardly into and through the chamber. The air stream is evacuated from the chamber in a direction which is substantially opposite of the discharge direction of the heavier parts.

It is known that stemming of tobacco leaves can be obtained by feeding the leaves into a unit which is known as a beater. This unit is essentially made up of a toothed drum which is adapted to rotate within a stationary coaxial casing comprising open portions. As soon as they have been admitted into the annular space formed between the drum and the casing, the tobacco leaves are subjected to shocks during which the parenchyma is more or less completely stripped from the stems. The products which are released are continuously discharged through the open portions of the casing and then undergo a pneumatic sorting process in an air stream which is usually an upward flow and the velocity of which is regulated so as to carry away the fragments of parenchyma without stems and to allow the well-stripped stems to fall together with the fragments of parenchyma which still remain attached to stems.

In practice, the passing of tobacco through a single beater and a single separator is not sufficient to achieve complete separation of the tobacco into fragments of parenchyma without stems and perfectly stripped stems. In order to obtain such a result, it is necessary to employ a number of beaters and separators arranged in cascade, thereby resulting in bulky and costly installations.

It should also be noted that, in the case of certain types of tobacco and especially the Virginia type which is the most widely consumed throughout the world, the complete stripping of stems and midribs is a difficult operation by reason of the fact that the parenchyma adheres strongly to the midrib and cannot readily be detached. It has therefore been proved by experience that a single stripping stage is often insufficient and that sometimes two such operations are necessary in order to recover as a final result only a very small quantity of parenchyma corresponding to a percentage of a few units.

A further disadvantage of these installations is that the fragments of parenchyma which are obtained contain a not-negligible proportion of small elements; it is frequently observed that the end product contains 20 to 25% of fragments having a surface area of less than two or three square centimeters. A brief analysis of the processes involved in the operation of an ordinary beater will give a clearer conception of the causes of this disadvantage, thereby affording a better understanding of the advantages which are provided by the present invention.

In an ordinary beater, the discharge of stemming products is mainly effected under the action of impulses which are imparted to the fragments of tobacco leaves by the teeth of the rotary drum, the force of gravity being added to this action in horizontal beaters of the type most commonly met with. In the case of the heaviest products, that is to say the leaf stems and the fragments of parenchyma or laminae which still remain attached to the stems, the actions referred-to above are practically the only factors which influence the discharge process. So far as concerns lightweight products which have a large surface area, that is to say fragments of parenchyma which have been detached from stems, additional influences are exhibited, viz: aerodynamic forces such as air resistance, turbulence and eddies generated by the rotation of the teeth and the rapid displacements of the material, and also interactions between the released fragments, said interactions being correspondingly greater as the internal space of the beater is filled to a greater extent. These additional influences slow down and hinder the discharge of lightweight products which are therefore caused to remain within the beater and to undergo shocks therein to no useful purpose. This state of affairs also obliges the user to limit the rate at which the leaves are admitted into the beater so as to maintain the filling of this latter within suitable limits as otherwise, if filling is excessive, the released fragments are not readily discharged and degradation of the parenchyma increases to a considerable extent.

A third disadvantage of ordinary apparatuses lies in the fact that the leaf stems, the fragments of parenchyma which still remain attached to the stems and the fragments of parenchyma without stems are mixed together when delivered from the beater, thereby complicating their subsequent separation to a substantial extent. In fact, in order that this separation can take place, the products must follow very different paths, so that those which are of lightest weight follow the motion of the air stream whilst those which have a higher density progress in countercurrent flow. Taking the initial mixture into account, these paths intersect frequently and result in interengagement of the different products, which in turn has the effect of reducing the separation efficiency to a substantial degree.

It can additionally be stated that, in the case of the vertical beater, the separation air stream receives during its upflowing motion the entire quantity of products which are discharged from the beater chamber and which are of very different nature both in respect of density and surface area. In the case of a predetermined velocity of the air stream, some of these products such as fragments of stemless parenchyma move upwards rapidly, whereas other products such as stems which have been stripped to a more or less complete extent are permitted to fall without hindrance and, finally, other products such as intermediate elements composed of parenchyma which remains attached to the stems travel at a slower rate either in the direction of the air stream or in the opposite direction when they do not remain in suspension at a constant height. Inasmuch as products are circulated within the space formed between the beating chamber and the casing of the separating chamber at respective velocities which

are very different and even in opposite directions in certain cases, interengagement of elements must inevitably occur, thereby giving rise to a danger of agglomeration followed by clogging of the separator if the rate of delivery of products from the beating chamber is of a high order.

The movement of rotation of the beaters and of the material contained in the beating chamber is comparable to the action of a centrifugal fan in that it imparts to the separation air a rotational flow motion which combines with the main upward flow motion and serves to concentrate discharged material against the wall of the separating chamber after the fashion of a cyclone. The result thereby achieved is a further danger of agglomeration of material which may also be followed by clogging, especially if the annular separation space comprises stationary obstacles such a radial partitions, ridges, various projecting portions and so forth.

The object of the present invention is to eliminate the disadvantages mentioned above and accordingly to provide a process which can be practiced by resorting to a device of the type comprising a stemming unit or beater which is rotatably mounted within a beating chamber, said chamber being provided with at least one inlet for the supply of tobacco leaves to be beaten, at least one air inlet, at least one air outlet and at least one outlet for the discharge of dense elements. The various inlets and outlets aforesaid are so designed that the air passes through said chamber and that the chamber outlets are separate from the outlets through which said dense elements are discharged; as a rule, said outlets are so designed that the air stream which passes through the chamber follows a direction which is substantially opposite to the direction of discharge of the dense elements.

The air inlets can be arranged in the periphery of the beating chamber, for example in the lower portion of said chamber and the outlets for the discharge of dense elements can coincide with said air inlets.

The discharge of air and therefore the discharge of lightweight elements can be effected through a wide opening which is free of any obstacle such as, for example, an annular opening which can be coaxial with the supply inlet and formed at the upper portion of the chamber which can be one of the bases of said chamber.

Provision can usefully be made for at least one means whereby the velocity of the separation air stream can be regulated such as, for example, a means for regulating the air intake openings.

The stemming chamber can comprise several superposed stemming levels, one of said levels being adapted to communicate by way of its airstream outlet which is reduced to an annular surface with the inlets of the level which is located next in succession thereto in the direction of flow of the air stream.

In one particular embodiment, the air outlets and the leaf supply inlets form two separate and distinct zones which may even be adapted to form part of different walls of the beating chamber.

Preferably, the fragments which are lightest in weight can be propelled to the outlet as soon as they are separated from the stems by ensuring that the three separate openings are judiciously spaced around the beating chamber casing, whilst the whole leaves or insufficiently stripped leaves remain inside the beating chamber in order to undergo a further beating operation under the combined action of the rotating beating members and of the air stream which passes through the chamber and prevents such fragments as may still retain an appreciable quantity of parenchyma from being discharged through the airstream inlet.

In order that the air stream may be permitted to circulate countercurrentwise with full effectiveness for the purpose of preventing the discharge of the fragments aforesaid, provision can be made for an airtight opening through which tobacco leaves are supplied.

In order that fragments of parenchyma without stems may be separated from fragments with stems within the separating chamber, the invention further provides for the widening of the air stream as it passes out of the beating chamber into a volume of the separating chamber which has a larger cross-sectional area than the cross-sectional area of the outlet, said volume being provided with an air-tight unit for discharging insufficiently stripped elements from the device.

Provision is also made in accordance with the invention for processing dense fragments which are discharged from the beating chamber in countercurrent flow to the air stream and delivered into another beating chamber having a supply inlet which will be connected to the air inlet of the preceding chamber. The outlet of said second chamber can also be connected to the air inlet of the preceding chamber and the complete assembly can be so arranged that the air which flows through the separating chamber passes entirely or almost entirely through the successive chambers.

Provision is advantageously made for a rotating unit which collects the mixed elements near the lateral opening provided at the base of the separating chamber so as to evacuate said elements through an airtight collecting unit.

Moreover, the teeth which are rotatably mounted in the beating chamber can be angularly displaced in a manner and to an extent such that, taking into account the velocity of the air stream and the speed of rotation, the force of impact of the teeth on the stripped leaf fragments is thereby reduced.

The present invention removes practically all of the disadvantages which have been mentioned earlier. Thus, fragments of parenchyma which have been detached from the stems are immediately discharged from the beater. Any unnecessary degradation is therefore suppressed. Furthermore, at each moment of operation, the beater virtually contains only those products which are to be stemmed, with the result that the rate of introduction of leaves can be of a high order without any attendant disadvantage.

The invention also makes it possible to collect the fragments of parenchyma without stems in order to permit re-introduction in the beater of fragments of parenchyma which still have stems attached and in order to direct practically stripped stems towards a second finishing beater.

All of the above-mentioned advantages are available whether the tobacco leaves are supplied to the apparatus in continuous operation or in non-continuous operation.

However, when the supply to the apparatus is non-continuous or, more specifically, when the supply is effected in batches of tobacco leaves at uniformly spaced intervals, the means employed in accordance with the invention present a further advantage. In fact, there is delivered at the outlet of the beater a "train" of products corresponding to each feed batch, the head of said "train" being composed of fragments of parenchyma from which stems have been separated, the center being composed of fragments of parenchyma which still remain attached to the stems, and the tail end being made up of stems which are almost completely stripped. The products are thus subjected inside the beater itself to a pre-separation process which is conducive to considerably greater efficiency in the action of the separators which are placed downstream.

The invention additionally makes it possible to introduce the stream of tobacco in an air stream which is circulated at high velocity through the stemming chamber without any appreciable reduction in velocity. The stream of tobacco can in fact be made up of successive streams forming batches which are spaced in time in such a manner that one batch penetrates into the stemming unit only after discharge of the preceding batch. Preferably, the air stream and tobacco leaves or fragments to be stemmed pass through only one section of

the stemming unit and, within said section, the stream or successive streams are subjected to the action of different aerodynamic or mechanical forces which have the effect of detaching the parenchyma from the stems. The aerodynamic forces initiate the transfer motion through the stemming unit whilst the mechanical forces which may be composed of mutually opposing forces also act in opposition to said transfer motion. The mechanical forces are so adapted that they are no longer applied as soon as the fragments which are obtained have a sufficiently small surface area.

Thus, those fragments which have a sufficiently small surface area are driven out of the stemming unit by the aerodynamic forces which are generated by the high-velocity air stream.

Tobacco leaves and fragments of leaves of insufficiently reduced surface area which have escaped from the action of the aerodynamic forces in that section of the stemming unit in which said aerodynamic forces are exerted are reintroduced in said section as a result of the application of some mechanical forces in that portion of the stemming unit through which the high-velocity air stream does not pass. On the other hand, fragments of tobacco leaves of sufficiently reduced surface area and of sufficient density which have escaped from the action of the aerodynamic forces also escape from the action of the mechanical forces and fall under gravity into the lower portion of the stemming unit for subsequent discharge.

However, the fragments last mentioned can first be taken again by a second stemming unit and the light-weight fragments released therefrom are carried along unit through which the high-velocity air stream does not by an air stream at moderate velocity, said air stream being so directed as to come again into contact with the high-velocity air stream within the first unit.

So far as concerns the practical application of the process according to the invention, the stemming unit which receives the tobacco leaves can be constituted by a toothed drum rotatable about a stationary shaft which is oriented in any suitable manner, can be surrounded by a coaxial casing provided with counter-teeth and can be connected to at least two separating chambers disposed in cascade, the first chamber being adapted to collect and discharge stems which are almost completely stripped, the following chamber or chambers being adapted to collect and discharge fragments of parenchyma which still remain attached to stems, the last of said chambers being additionally adapted to transmit stemmed fragments of parenchyma to a unit for the recovery of parenchyma, a stream of transporting and separating air being circulated through all of said units.

In said device, the supply inlet and the air outlet can be located in oppositely-facing relation in the two bases of the cylinder which constitutes the casing of the stemming unit.

The counter-teeth which are fixed to the internal wall of the stemming unit casing may occupy only that section of the chamber through which the high-velocity air stream circulates from one opening to the other.

In another form of execution of the invention, practically the entire air stream penetrates through open portions formed in the wall of revolution of the beating chamber and practically the entire air stream passes out through open portions formed in the same wall.

Provision can be made for a series of separating chambers connected to each other, at least one of said chambers being adapted to communicate directly with the outlets of the beating chamber and at least one other chamber being adapted to communicate with the supply inlets of said chamber, said communication being preferably effected by means of an air-tight unit.

The aforesaid chamber which communicates with the outlets of the beating chamber is advantageously divided either wholly or in part by radial partition walls, the wall of revolution of the cylindrical bodies being provided before each partition wall with openings for the reintroduction of some fragments of tobacco which are discharged through the outlets formed in said wall of revolution.

Provision is advantageously made for deflectors which serve to join the internal wall of said separating chamber to the wall of revolution of the beating chamber and which are directed toward said reintroduction openings.

The internal face of the separating chamber comprises helicoidal ribs which serve to deflect downwards some of the products which are discharged from the beating chamber.

The entire air stream or nearly the entire air stream which passes out of the beating chamber is preferably sucked through nozzles disposed between two successive partition walls and connected to the separating chamber, said nozzles being oriented in such a manner as to suck the air in a direction which is substantially opposite to the direction of rotation of the teeth of the beating chamber, said air stream being intended to remain at right angles to the axis of rotation of the beating unit.

In the drawing:

FIG. 1 is a sectional view of a stemming and separating device which can be utilized for practicing the process of my invention;

FIG. 2 is an enlarged horizontal sectional view as seen in the direction of arrows from the line II—II of FIG. 1;

FIG. 3 is a vertical sectional view as seen in the direction of arrows from the line III—III of FIG. 2;

FIG. 4 is a vertical sectional view as seen in the direction of arrows from the line IV—IV of FIG. 2; and

FIG. 5 is a schematic sectional view of another device which entails partial recycling of the air after dedusting, and in which the products to be stemmed are introduced in batches at timely spaced intervals.

As shown in FIGS. 1 to 4 the tobacco leaves to be stripped are fed from the conveyor **101** into the duct **102** which performs the function of a pneumatic conveyor. An air stream is circulated through said duct **102** at a high velocity which can exceed 10 m./s.

The tobacco leaves are then admitted into the main beater which, in the example herein described, is essentially constituted by a shaft **103** which is rotatable about a vertical shaft fitted with radial teeth **104**, and by counter-teeth **105** secured to the casing which surrounds the beater.

The air stream which passes through the beater in the direction of the arrow F carries with it the leaves which are subjected to a first stemming operation in contact with successive obstacles which are both stationary and movable, as constituted by the counter-teeth and the teeth. The fragments of parenchyma which are liberated readily find a path between these obstructions and, by virtue of the high aerodynamic force to which they are subjected, leave the beater almost immediately. On the contrary, insufficiently stemmed leaves as well as partially stripped stems which have both higher density and greater length than the fragments of parenchyma engage for short moments either with the counter-teeth or with the teeth, move upwards less rapidly and are therefore subjected to the stemming process for a longer period of time.

The stream which passes out of the beater through the opening **106** is composed of fragments of parenchyma, of stems which still contain substantial quantities of parenchyma and stems which are almost completely stripped. This stream of material which is still conveyed by the air stream comes into the separation chamber **107** in which it slows down. The shape and section of said chamber are so determined that the stems which have almost completely stripped no longer move upward and then fall into a zone which is not swept by the air stream and in which said stems are discharged by a way of a rotary lock chamber **108**.

The remainder of the material then arrives in a second

separation chamber **109** in which the separation takes place between the fragments of parenchyma and the stems to which parenchyma still remains attached. Inasmuch as a single chamber may not prove sufficient to achieve the requisite degree of separation, provision can accordingly be made for two chambers **109, 110** as shown in FIG. 1, or even a greater number.

The stream of stemless parenchyma which is still transported by the air stream then reaches a centrifugal-action separator **111**, from which it is discharged by way of the rotary lock chamber **112**.

So far as concerns the stems to which a large amount of parenchyma still remains attached, said stems are discharged from the separation chambers **109** and **110** by means of the rotary lock chambers **113** and **114**, then return again to the stream of leaves to be stemmed on the conveyor **101**. Consequently, these products are again fed into the main beater in which they are subjected to a second stemming process.

In general outline, the beating process which is carried into effect in the apparatus herein described entails the introduction of leaves to be stemmed, the discharge of almost completely stripped stems, the discharge of fragments of parenchyma without stems, and is partly characterized in that the fragments of parenchyma which still remain attached to stems circulate within the main beater and the separation chambers in a closed loop and for as long a period of time as the stemming of said fragments is not sufficient, that is to say until they have been transformed into stems which have been almost completely stripped and into fragments of parenchyma without stems.

In order to complete the description of the present invention, the subsequent progress of the stems which are discharged through the rotary lock chamber **108** deserves some mention.

The stems referred-to can of course be simply directed towards a second separating beater of a standard type having characteristics which are adapted to the stripping operation to be performed.

In a form of construction to which preference is given on account of the fact that it is more compact and less costly, the aforesaid stems again penetrate into the main beater through an opening **115** which is placed substantially in such a manner as to be symmetrical with the opening **106**. This arrangement has a first advantage: should the stream which passes out of the rotary lock chamber **108** accidentally contain fragments of parenchyma which are attached to stems, these elements are taken again by the teeth of the main beater, brought back into the zone of the main beater, traversed by the air stream and are subjected therein to a further stemming process. So far as the stems proper are concerned, they pass downwards through the main beater under the action of gravity and are admitted to the finishing beater through the opening **116**.

Said finishing beater comprises a rotary shaft **117** fitted with teeth **121** and adapted to rotate within a casing **122** provided with open portions **123** over part of its periphery. The outer air is drawn in through said open portions at a velocity which is sufficiently low not to prevent the discharge of stems which have been completely stripped and which is sufficiently high to draw towards the main air stream the fragments of parenchyma which have been released by the stripping process.

As will be understood, in addition to the components described which constitute one example of the invention, the installation also comprises a fan of sufficient capacity to maintain the transporting and separating air stream, as well as driving motors and a dedusting system such as filters of cyclones.

FIG. 5 is a diagram of an alternative form of installation in which the transporting and separating air is partially recycled. To this end, part of the air is discharged to the exterior after dedusting in the bank of cyclones **118** whilst an equal quantity of pure air is admitted through the opening **119** and through the open portions **123** of the finishing beater. In this case, the leaves to be stemmed and the products to be stemmed a second time are fed into the duct **102'** by way of a rotary lock chamber **120**.

The utilization of said lock chamber is of interest even when no recycling of air is performed. In fact, the presence of said lock chamber divides the stream of tobacco which is introduced into successive batches. When one batch is admitted into the main beater and is transformed therein into fragments of parenchyma, into stems which are attached to the parenchyma and into stems which are almost completely stripped, the products of the stemming process undergo a first separation in space; the fragments of parenchyma pass out first from the beater at a speed which is distinctly higher than that of the products which still contain stems. As a result of this splitting-up process, the separation is carried out in a much more effective manner within the separation chambers **107, 109** and **110** inasmuch as the dangers of engagement between fragments of parenchyma without stems and stems to which parenchyma remains attached are considerably reduced. FIG. 5 shows the manner in which this process is achieved.

In the foregoing description, the present applicant has employed the expressions "beating chamber" and "separating chamber" for the purpose of designating respectively that portion of the apparatus in which the products to be stemmed are introduced and the container or chamber in which the separation of lightweight products from semi-lightweight products takes place. In fact, it should be clearly pointed out that the so-called "beating chamber" also performs a separating function as in the case of a number of devices which have been described by the present applicant. This separation process which concerns solely the dense products or stems which are almost completely stripped is carried out at the envelope surface which is lined with bars. In other words, this apparatus is also characterized in that it comprises a beating and separating device which is completed by a separating chamber of conventional type which is more especially adapted to carry out the separation of lightweight products from semi-lightweight products.

What I claim is:

1. Process for stemming tobacco leaves and separating the thus obtained products into lighter parts, intermediate-weight parts and heavier parts by feeding the leaves into a beater rotating within a stationary stemming chamber and separating the lighter and intermediate-weight parts from heavier parts by means of an air stream with discharge of heavier parts, comprising the steps of introducing the leaves into the air stream exteriorly of the stemming chamber, circulating the major part of the tobacco laden air stream at high velocity upwardly into and through the stemming chamber, and evacuating the air stream from the stemming chamber in a direction which is substantially opposite to the direction of discharge of heavier parts.

2. Process as defined in claim **1** wherein the air stream is passed through and beyond the stemming chamber at a velocity high enough to carry along only the lighter parts and intermediate-weight parts of the tobacco leaves but not high enough to carry along the heavier parts of the tobacco leaves, which heavier parts then descend into the stemming chamber by gravity in a direction opposite to the direction of flow of the air stream.

3. Process as defined in claim **1**, wherein the lighter parts comprise stripped tobacco leaf laminae and said intermediate-weight parts comprise laminae which adhere to stems of tobacco leaves and further comprising the steps of separating the laminae which adhere to stems from stripped laminae and reintroducing the laminae which adhere to stems into the air stream externally of the stemming chamber so that such laminae which adhere to stems are readmitted into the stemming chamber.

4. Process as defined in claim 1, further comprising the step of readmitting the intermediate-weight parts into the stemming chamber.

5. Process as defined in claim 1, further comprising the steps of subjecting the heavier parts to a further stemming action externally of the stemming chamber.

6. Process as defined in claim 1, further comprising the step of reintroducing portions of the separated lighter and heavier parts into the stemming chamber.

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241—19