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[54] **APPARATUS FOR COMMINUTING TOBACCO**

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[51] **Int. Cl.** **B02c 23/02**

[58] **Field of Search** ..... 131/22 R, 22 A; 83/356.3; 241/34, 222

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[57] **ABSTRACT**

A tobacco shredding machine receives tobacco to be comminuted at such a rate that the weight of quantities delivered during successive identical unit periods of time is always the same. This enables the shredding machine to turn out shredded tobacco at a constant rate. The feeding unit which supplies tobacco to the shredding machine employs a weighing device which can weigh batches of tobacco or embodies a belt conveyor, a metering device which can operate intermittently or continuously and delivers tobacco to the weighing device, and a transporting device which transports tobacco from the weighing device to the shredding machine.

9 Claims, 4 Drawing Figures

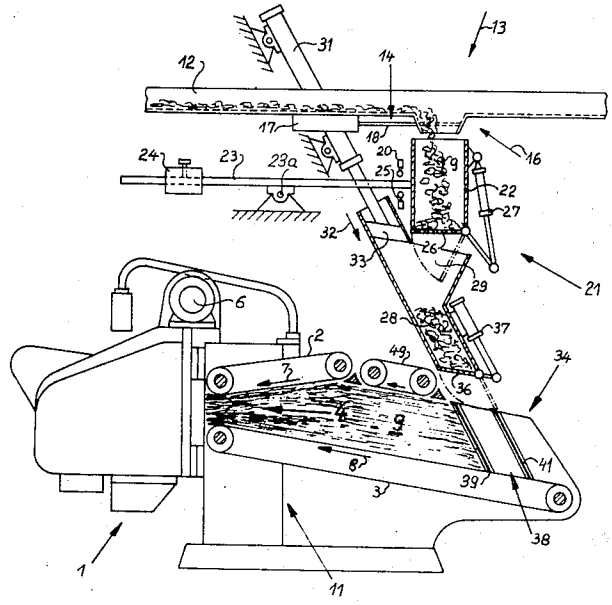
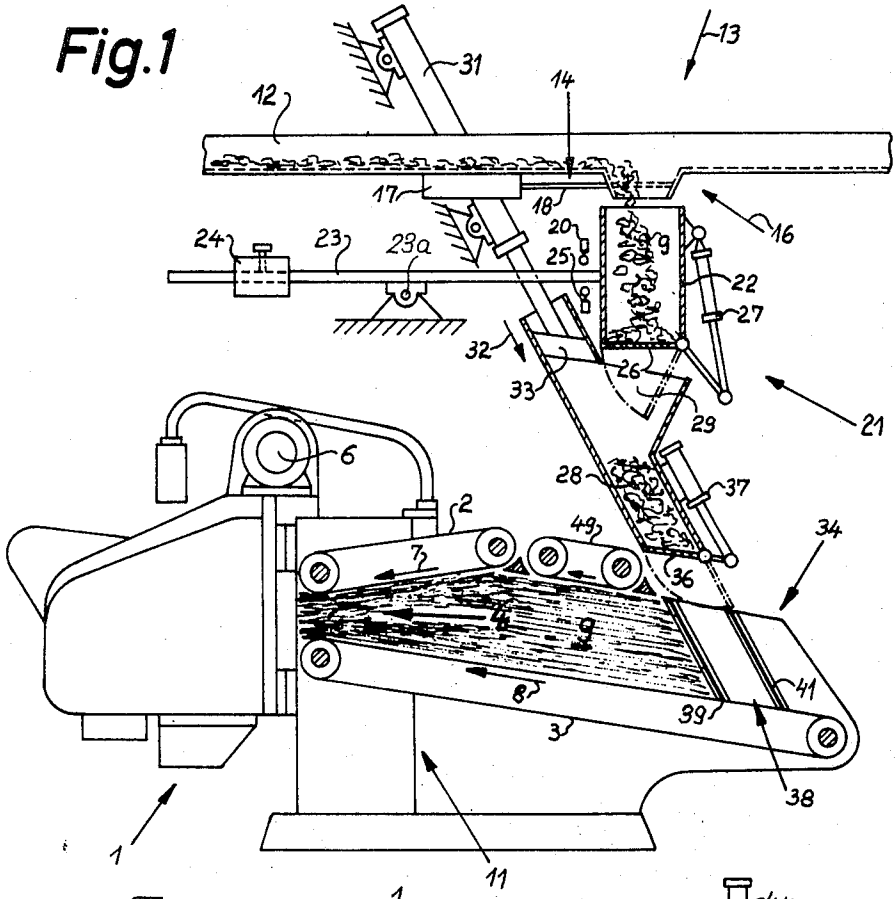


Fig.1



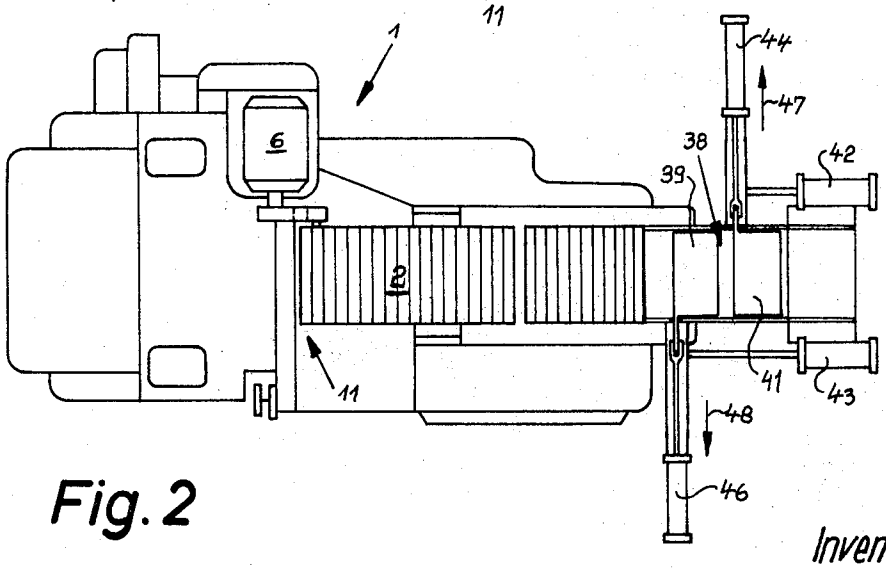


Fig.2

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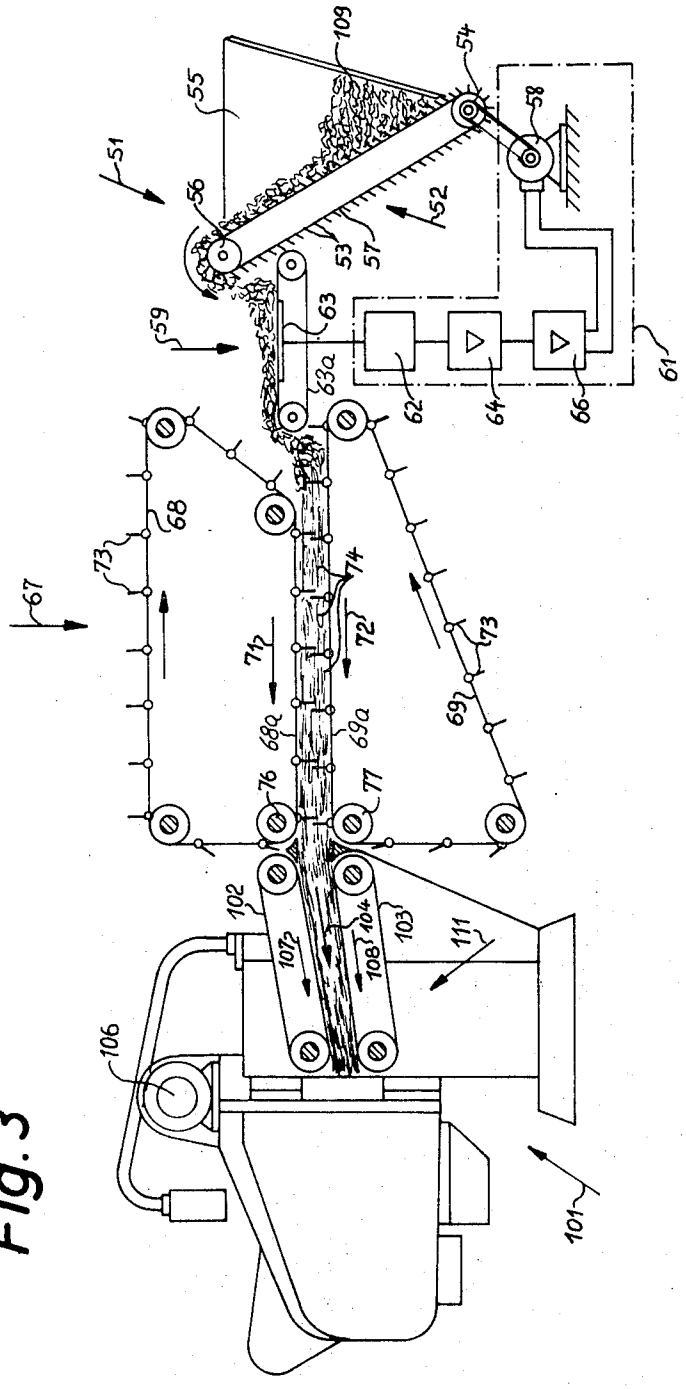


Fig. 3

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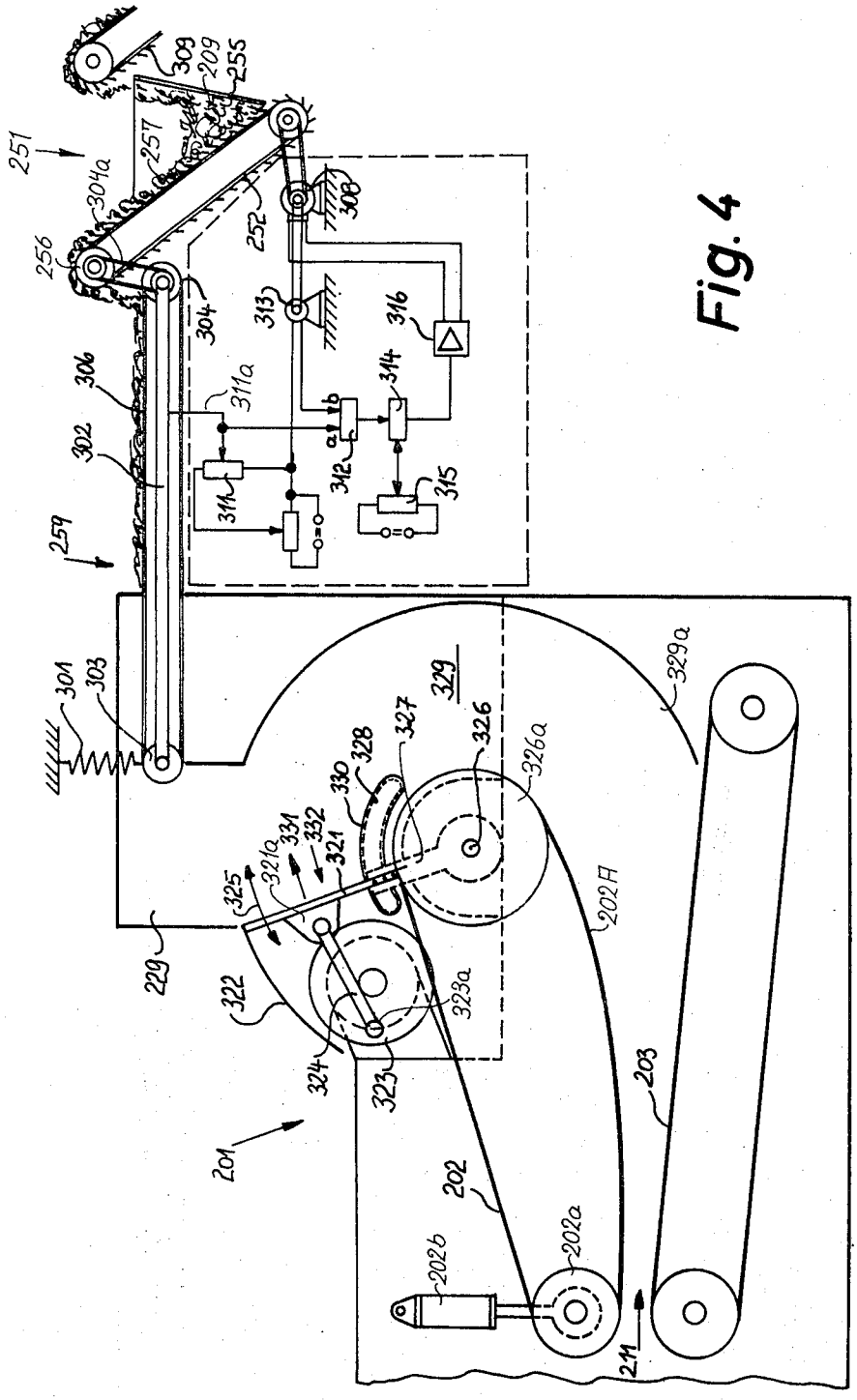


Fig. 4

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APPARATUS FOR COMMINUTING TOBACCO

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for comminuting tobacco, especially for shredding of tobacco leaf laminae.

It is well known that, in order to be properly shredded in a modern high-speed cutting or shredding machine, tobacco must be moistened so that its moisture content substantially exceeds the moisture content which is desirable in shreds that are being fed into a cigarette making machine. Consequently, the shreds which are formed in the cutting machine must be heated and dried to reduce their moisture content to a value which is best suited for the production of cigarettes or like smokers' products. As a rule, the moisture content of tobacco shreds which are introduced into a cigarette making machine must be very close to an optimum value, i.e., the deviation from such optimum value should not exceed a small fraction of 1 percent. The drying apparatus which are presently employed for reducing the moisture content of freshly shredded tobacco normally utilize one or more conveyors which transport shredded tobacco through one or more drying zones where the shreds are heated to reduce their moisture content to the optimum value. Such apparatus are designed with a view to reduce to a minimum the length of time which is required for expelling moisture because such treatment of tobacco shreds contributes significantly to the overall time which is spent for the conversion of tobacco into cigarettes or the like. The two factors which are mainly responsible for the complicatedness of drying apparatus for tobacco shreds are the fluctuations in moisture content and the fluctuations in weight of tobacco shreds which are fed into the drying apparatus per unit of time. Fluctuations in the weight of quantities of shreds which are supplied to the drying apparatus by one or more cutting or shredding machines are attributable to the fact that the output of such machines fluctuates, often within a rather wide range. Thus, it is highly desirable to insure that the shreds which are fed to drying appartus wherein the moisture content of such shreds is reduced to an optimum value should be furnished at a constant rate so that the drying apparatus invariably receives quantities of identical weight during each of a series of successive identical unit periods of time. Such rate of feed of tobacco shreds renders it possible to simplify the construction of drying apparatus, to reduce the length of intervals which are required for the drying of tobacco shreds, as well as to insure that the moisture content of shreds which leave the drying apparatus is very close to or matches the optimum moisture content.

SUMMARY OF THE INVENTION

An object of the invention is to provide a novel and improved apparatus for comminuting tobacco, particularly for shredding tobacco, in such a way that the output at the station where the tobacco is being comminuted remains constant to thus insure that the drying apparatus which receives comminuted tobacco from such station will receive identical quantities of comminuted material per unit of time.

Another object of the invention is to provide novel and improved means for feeding tobacco to a comminuting station where the thus delivered tobacco is converted into shreds or the like.

A further object of the invention is to provide a novel and improved apparatus for shredding or otherwise comminuting tobacco which is constructed and assembled in such a way that its output remains constant for any desired interval of time so that the expulsion of moisture from the comminuted material can be carried out with a high degree of accuracy and by resorting to relatively simple and inexpensive moisture expelling or drying apparatus.

An additional object of the invention is to provide novel and improved feeding means for supplying tobacco to shredding or like comminuting machines.

Still another object of the invention is to provide feeding means which can be used for delivery of tobacco to conventional shredding machines and insures that the output of such machines remains constant, i.e., that the weight of shreds which are produced during each of a series of successive identical units of time is always the same.

The apparatus of the present invention is employed for comminuting tobacco, particularly for shredding of tobacco which consists essentially of tobacco leaf laminae. The apparatus comprises means for feeding to a comminuting station (which can accommodate a suitable tobacco cutting or shredding machine) tobacco at such a rate that the comminuting station receives—during each of a series of successive identical periods of time—tobacco quantities of identical weight, and means for comminuting at the station one quantity of tobacco during each such period so that the output of comminuted tobacco per period of time remains constant, i.e., that the cutting machine furnishes during a series of successive identical periods of time a series of quantities of comminuted tobacco having identical weights. Such comminuted tobacco is preferably discharged in the form of a continuous stream.

The feeding means may comprise means for accumulating portions or batches each containing a mass of tobacco whose weight equals the weight of the mass of tobacco in the other portions, means for placing the portions end to end to form an at least substantially uninterrupted stream of tobacco portions, and means for conveying the stream to the comminuting station at a constant speed. The quantities of tobacco can be compressed or compacted prior to the comminuting step.

Alternatively, the feeding means may comprise means for introducing tobacco into and means for conveying the thus introduced tobacco in a predetermined path to form a continuous tobacco stream, means for weighing successive increments of the stream, and means for changing the rate of introduction of tobacco into the path when the weight of the increments deviates from a predetermined weight. The tobacco which forms the stream is preferably compacted before it reaches the comminuting station, and such compacting step is preferably carried out while the tobacco which forms the stream is in motion.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved comminuting 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 side elevational and partly longitudinal vertical sectional view of a comminuting apparatus which embodies one form of the invention;

FIG. 2 is a plan view of a portion of the structure shown in FIG. 1;

FIG. 3 is a schematic side elevational view of a second comminuting apparatus; and

FIG. 4 is a schematic side elevational view of a third apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIGS. 1 and 2, there is shown a tobacco comminuting apparatus which comprises a tobacco shredding or cutting machine 1 of the type known as "KT" and produced by Hauni-Werke, Körber & Co., K.G., of Hamburg-Bergedorf, Western Germany. The shredding machine 1 comprises two endless chains 2 and 3 respectively having mutually inclined tobacco-transporting lower and upper stretches which advance and simultaneously compact tobacco 9 so that the resulting cake moves in the direction indicated by the arrow 4. The chains 2 and 3 are driven by an electric motor 6 and their tobacco-transporting stretches respectively travel in directions indicated by the arrows 7 and 8. The reference character 11 denotes a severing or comminuting station where the cake of tobacco 9 is shredded by orbiting knives (not shown) which are mounted on a driven drum. The inclination of the aforementioned stretches is such that the tobacco (mainly tobacco leaf laminae) is compacted into the form of a homogeneous cake the leading end of which advances into the range of successive knives which orbit at the station 11.

The comminuting apparatus further comprises a novel and improved feeding unit which serves to supply tobacco 9 to the shredding machine 1 at such a rate that the machine receives a predetermined quantity of tobacco during each of a series of successive identical periods of time, namely, that the weight of that portion of the cake between the conveyor chains 2, 3 which is comminuted within a given period of time is the same as the weight of the portion or portions which were or will be comminuted during the preceding and the next-following periods of identical duration. The feeding unit comprises a metering device 13, a weighing device 21 and a transporting means or conveyor 34. The metering device 13 includes a vibrating trough 12 which advances a stream of loose tobacco 9 in a direction to the right, as viewed in FIG. 1, and toward and into an outlet 16 which delivers tobacco by gravity feed into a container 22 of the weighing device 21. The metering device 13 further comprises a mechanism 14 which can interrupt the delivery of tobacco 9 to the container 22 by sealing off the outlet 16. The mechanism 14 employs a hydraulically or pneumatically operated cylinder 17 which is mounted at the underside of the trough 12 and has a reciprocable piston rod 18 a portion of which constitutes a plate movable across the outlet 16 to temporarily interrupt the evacuation of tobacco from the trough 12.

The container 22 of the weighing device 21 is mounted on one arm of a weighbeam 23 which is fulcrumed at 23a and the other arm of which carries an adjustable and/or removable counterweight 24. The bottom wall 26 of the container 22 is pivotable and constitutes a gate which can be moved between an intercepting or closed position (shown by solid lines) and an open or discharging position (indicated by phantom lines). The means for pivoting the gate 26 between such positions comprises a hydraulically or pneumatically operated cylinder 27 which is articulately connected to the container 22. The right-hand arm of the weighbeam 23 is flanked by an upper limit switch 20 and a lower limit switch 25. When the weighbeam 23 actuates the limit switch 20, the container 22 is empty; the limit switch 25 is actuated when the container 22 accommodates a desired quantity of tobacco 9, namely, a quantity whose weight is determined by the position of the counterweight 24.

The feeding unit of the apparatus shown in FIGS. 1 and 2 further comprises a compacting device which is installed between the weighing device 21 and the conveyor 34. The purpose of this compacting device is to condense or compact the batches or portions of tobacco 9 which are discharged from the container 22 in response to movement of the gate 26 to its open position. The compacting device comprises a receptacle 28 which is provided with an inlet 29 located at a level below the container 22 so as to receive the portion or batch which is discharged by the weighing device 21 in response to opening of the gate 26. The bottom wall 36 of the receptacle 28 constitutes a second gate which is pivotable by a hydraulically or pneumatically operated cylinder 37 to move between a closed position (shown by solid lines) and an open position (indicated by phantom lines). The cylinder 37 is mounted on the receptacle 28 and is articulately connected with the gate 36 by means similar to that between the cylinder 27 and gate 26. The compacting device further comprises a ram 33 which is reciprocable in the receptacle 28 in and counter to the direction indicated by an arrow 32. The ram 33 is connected with the lower end of a piston rod forming part of a hydraulically or pneumatically operated cylinder 31 mounted in or on the frame of the comminuting apparatus. The ram 33 is caused to move downwardly (arrow 32) when the gate 36 dwells in the closed position so that the portion or batch of tobacco which has been transferred from the container 22 into the receptacle 28 is compressed between the parts 33 and 36 prior to being advanced (by the ram 33) into or onto the transporting means or conveyor 34.

The conveyor 34 is mounted at a level above the upper stretch of the lower chain 3; such upper stretch extends rearwardly and well beyond the upper chain 2. This conveyor 34 comprises a chamber 38 which is formed by two walls 39, 41. The wall 39 is movable forwardly and rearwardly (toward and away from the comminuting station 11) by a hydraulically or pneumatically operated cylinder 43. Furthermore, the wall 39 is movable transversely of the chain 3 (in and counter to the direction indicated by the arrow 48) by a hydraulically or pneumatically operated cylinder 46. The wall 41 is movable forwardly and rearwardly by a cylinder 42, and transversely of the chain 3 (in and counter to the direction indicated by an arrow 47) by a further fluid-operated cylinder 44. The conveyor 34

further includes an endless chain **49** which is installed between the chain **2** and the lower end of the receptacle **28** to promote and to control the transport of compacted tobacco into the range of the chain **2**.

The Operation

The machine which vibrates the trough **12** is started so that the trough delivers a continuous stream of tobacco **9** toward the outlet **16**. The trough **12** receives tobacco from a source of supply, preferably by way of a conveyor similar to the conveyor **52** of FIG. **3**. The particles of tobacco **9** descend through the outlet **16** and come to rest in the container **22** whose gate **26** then dwells in its closed position to intercept the descending tobacco. When the container **22** accumulates a predetermined quantity of tobacco **9** (namely a quantity which can be adjusted by moving the counterweight **24** with reference to the weighbeam **23**), the beam **23** is tilted clockwise to such an extent that its right-hand arm actuates the limit switch **25**. The latter causes an electric control circuit to actuate the cylinder **17** by opening a suitable valve which admits pressurized fluid into the left-hand chamber of the cylinder **17** while permitting evacuation of fluid from the right-hand chamber of the cylinder **17**. The piston rod **18** moves in a direction to the right and its plate-like portion seals the outlet **16** to prevent the admission of additional tobacco into the container **22**. When the piston in the cylinder **17** reaches its right-hand end position, such piston (or the piston rod **18**) actuates an electric switch (not shown) which controls the operation of the cylinder **27**. The latter is caused to move the gate **26** to the open position which is indicated by phantom lines so that the portion or batch of tobacco which was heretofore stored in the container **22** is free to descend and to enter the receptacle **28** by way of the inlet **29**.

When the gate **26** reaches its open position, the cylinder **27** (or the gate **26**) actuates a further switch which causes the cylinder **31** to move the ram **33** downwardly (arrow **32**) and to press the freshly transferred portion or batch against the gate **36** which is held in the closed position. When the ram **33** reaches that intermediate position in which the height of the compacted portion or batch of tobacco **9** in the receptacle **28** equals or approximates the height of the chamber **38** in the conveyor **34**, the ram **33** (or another portion of the cylinder **31**) actuates an electric switch which controls the cylinder **37**. The latter pivots the gate **36** to the open position and the ram **33** continues to move downwardly so as to transfer the compacted portion or batch of tobacco **9** into the chamber **38** of the conveyor **34**.

When the contents of the container **22** are evacuated into the receptacle **28** (i.e., upon actuation of the limit switch **25** by the weighbeam **23**), the weight of the parts which are suspended on the right-hand arm of the weighbeam is reduced so that the counterweight **24** causes the weighbeam to pivot in a counterclockwise direction and to actuate the limit switch **20**. The latter causes the cylinder **27** to return the gate **26** to the closed position and to thereupon actuate a further switch which causes the cylinder **17** to retract its piston rod **18** so that the outlet **16** is again free to discharge tobacco into the container **22**. The aforedescribed procedure is then repeated by accumulating in the container **22** a portion or batch whose weight is identical with the weight of the preceding portion or batch, by transferring the portion or batch into the receptacle **28**, by compacting the transferred portion or batch in the receptacle **28**, and by thereupon transferring the compacted portion or batch into the chamber **38**.

When the ram **33** completes the transfer of a freshly compacted portion or batch of tobacco **9** from the receptacle **28** into the chamber **38**, it dwells for a while in its lower end position so that it closes the upper end of the chamber **38**. A switch which is actuated by the cylinder **31** when the ram **33** reaches its lower end position causes the cylinder **46** to move the wall **39** of the chamber **38** in the direction indicated by the arrow **48** so that the front side of the chamber **38** (namely, that side which faces the comminuting station **11**) is open and the freshly transferred compacted portion or batch can be advanced forwardly (arrow **4**) into the range of the lower stretch of the chain **49**. When the wall **39** reaches its outer end position (i.e., the lower end position, as viewed in FIG. **2**), the cylinder **46** actuates a further switch which causes the cylinder **42** to move the wall **41** of the chamber **38** forwardly so that the compacted portion or batch which was transferred into the chamber **38** by the ram **33** is caused to move forwardly toward the comminuting station **11**. At the same time, the switch which was actuated by the cylinder **46** causes the cylinder **43** to move the wall **39** rearwardly (counter to the direction indicated by the arrow **4**) so that the wall **39** moves behind the wall **41** but is laterally offset from the chain **3**.

The cylinder **43** arrests the wall **39** when the latter reaches the plane of the wall **41** (as viewed in FIG. **2**). The cylinder **43** then actuates a further switch which causes the cylinder **46** to move the wall **39** in a direction counter to tha indicated by the arrow **48** so that the wall **39** moves into the space which was previously occupied by the wall **41**. The latter wall does not interfere with such movement of the wall **39** because it has been moved forwardly by the cylinder **42** to thereby push the freshly compacted portion or batch toward the comminuting station **11**.

The cylinder **31** retracts the ram **33** to the position shown in FIG. **1** shortly before the wall **41** reaches its foremost position (in which it occupies the space previously occupied by the wall **39**). Such return movement of the ram **33** to the position shown in FIG. **1** causes a switch to actuate the cylinder **37** which returns the gate **36** to its closed position. In the meantime, the container **22** has accumulated a fresh portion or batch of loose tobacco **9** so that the weighbeam **23** actuates the limit switch **25** which causes the cylinder **17** to close the outlet **16** and to terminate the admission of tobacco into the container **22** at the exact moment when the latter contains a predetermined quantity of tobacco, namely, a quantity whose weight equals the weight of each preceding portion or batch. The contents of the container **22** are thereupon transferred into the receptacle **28** where the tobacco undergoes a compacting action in response to downward movement of the ram **33** while the gate **36** dwells in the closed position.

When the wall **41** reaches the end of its forward movement toward the comminuting station **11**, the cylinder **37** opens the gate **36** and the ram **33** continues its movement in the direction indicated by the arrow **32** so as to transfer the freshly compacted portion or batch into the chamber **38**. This chamber is the same as shown in FIG. **2** with the exception that the positions of the walls **39** and **41** are changed, i.e., the wall **39** is located behind the wall **41**. The cylinder **31** actuates

the cylinder **44** when the ram **33** reaches the lower end of its stroke in which it closes the upper end of the chamber **38**, and the cylinder **44** then moves the wall **41** in the direction indicated by the arrow **47** so as to open the front side of the chamber **38**. When the wall **41** is moved out of the way, the cylinder **44** actuates a switch which causes the cylinder **43** to move the wall **39** forwardly whereby the wall **39** pushes the freshly transferred and freshly compacted portion or batch of tobacco **9** to advance it toward the comminuting station **11**. The supports for the cylinders **44** and **46** are respectively mounted on the piston rods of the cylinders **42, 43** or are movable in stationary guideways in response to movements of piston rods of the cylinders **42, 43**.

The aforedescribed operations are repeated again and again whereby the walls **39** and **41** alternately advance toward the chain **49** a continuous series of freshly compacted portions or batches which resemble bales and are entrained by the lower stretch of the chain **49** to be advanced into the range of the lower stretch of the chain **2**. The walls **39, 41** compel successively accumulated and compacted batches to move toward the comminuting station **11** and to be compacted into a continuous cake prior to moving into the range of orbiting knives at the station **11**. The forcible forward transport of bales or batches into the wedge-like compartment between the chains **2** and **3** is enhanced by the chain **49** which holds successive bales against movement with reference to each other. The orbiting knives remove from the front end of the cake narrow strips of shreds which are thereupon transported to the aforementioned drying or moisture controlling apparatus prior to introduction into a cigarette making machine. The shredding machine comminutes equal quantities of compacted tobacco per unit of time, i.e., the weight of shreds which are formed during each of a series of identical units of time is always the same. This insures that the shreds can be dried by a relatively simple and accurate apparatus which need not be designed with a view to compensate for eventual fluctuations in the weight of shreds which are fed thereto during successive periods of identical length.

The speed of forward movement of the walls **39, 41** (while such walls advance compacted portions or batches of tobacco into the range of the endless chain **49**) can be readily selected in such a way that it exceeds the speed of the upper stretch of the chain **3**. This compensates for the periods of idleness of the walls **39, 41** during transfer of a freshly compacted portion or batch from the receptacle **28** into the chamber **38**. The speed of forward movement of the walls **39, 41** is determined by the pump or pumps (not shown) which supply pressurized fluid (preferably a liquid) into the cylinders **42** and **43**.

The construction of the valves which regulate the flow of fluid into and from the cylinders **17, 27, 31, 37, 42, 43, 44** and **46** forms no part of the present invention. The same applies for the control circuit which includes the limit switches **20, 25** and other switches which control thecylinders to insure automatic formation and transport of batches of tobacco into the range of the chains **2** and **3**.

An advantage of the compacting means including the receptacle **28** and ram **33** is that the portions or batches which are introduced into the chamber **38** have an accurately determined shape and size. This renders it possible to place such batches end-to-end and to thus form a continuous series of batches which can be readily advanced into the range of the chain **2**. The feature that the batches assume a predetermined shape is due to the fact that the moisture content of tobacco **9** which enters the receptacle **28** is very high, such high moisture content being desirable to insure a satisfactory shredding action at the comminuting station **11**.

Forcible transport of compacted batches from the chamber **38** toward the station **11** (by means of cylinders **42, 43** and walls **39, 41**) insures that the quantities of tobacco which are being delivered to the machine **1** cannot change during transport on the conveyor **34**.

FIG. **3** illustrates a second comminuting apparatus including a shredding machine **101** and a modified feeding unit. All such parts of the shredding machine **101** which are clearly analogous to or identical with the corresponding parts of the machine **1** of FIGS. **1** and **2** are denoted by similar reference characters plus **100**. The main difference between the feeding unit of FIGS. **1** and **2** and the feeding unit of FIG. **3** is that the latter forms and transports a continuous uninterrupted stream of tobacco **109** all the way from a source or magazine **55** to the space between the chains **102, 103** of the shredding machine **101**.

The magazine **55** forms part of a metering device **51** which further includes the aforementioned conveyor **52**. The latter has an endless belt **57** which is provided with a carding **53** and whose right-hand (upwardly moving) stretch constitutes one wall of the magazine **55**. The belt **57** is trained over rollers **54, 56** and is driven by a variable-speed d-c motor **58** which rotates the lower roller **54**. The carding **53** of the belt **57** draws tobacco **109** from the magazine **55** and delivers such tobacco onto the upper stretch of an endless belt or band **63***a* forming part of a weighing device **59** which further comprises a movable detector **63** located below the upper stretch of the band **63***a*. The detector **63** moves up or down, depending on the variations in weight of successive increments of the tobacco stream which is formed on the upper stretch of the band **63***a*. The detector **63** transmits signals to a transducer **62** (e.g., a potentiometer) which forms part of a control circuit **61** for the variable-speed motor **58**. The transducer **62** produces electric signals in response to signals furnished by the detector **63**, and such signals are amplified first by a preamplifier **64** and thereupon by an output amplifier **66** which latter controls the speed of the motor **58**. The output amplifier **66** is preferably a thyristor amplifier with d-c output, for example, an amplifier of the type known as MINISEMI produced by the West German firm AEG.

The comminuting apparatus further comprises transporting means **67** which includes two endless chains **68, 69** serving to transport tobacco **109** from the discharge end of the band **63a** to the space between the chains **102, 103** of the shredding machine **101**. The drive means for moving the chains **68, 69** in directions respectively indicated by the arrows **71** and **72** is not shown in FIG. **3**. Each of the chains **68, 69** is provided with transversely extending walls **73** which are pivotably mounted thereon and are guided in such a way that, while moving along the stretches **68***a*, **69***a*, they are located in vertical planes to define a series of chambers **74** wherein the tobacco **109** is being transported toward the chains **102, 103**. The walls **73** are guided in suitable ways (not shown) and are permitted to pivot

with reference to the chains **68, 69** during travel about and beyond sprocket wheels **76, 77** which can be rotated by the aforementioned drive means for the chains **68, 69.** Such pivotability of the walls **73** at the sprocket wheels **76, 77** enables the chains **68, 69** to advance the contents of successive chambers **74** sufficiently close to the comminuting station **111** so that such contents can be engaged and transported (arrow **104**) by the chains **102, 103.**

The band **63***a* of the weighing device **59** can be driven by the roller **56** for the belt **57.**

The operation of the apparatus shown in FIG. **3** is as follows.

The motor **58** rotates the roller **54** so that the carding **53** of the belt **57** draws tobacco **109** from the magazine **55** of the metering device **51** at a constant rate. Such tobacco is discharged in the region of the roller **56** to form an uninterrupted stream successive increments of which are weighed during travel with the upper stretch of the band **63***a* which forms part of the weighing device **59.** If the weight of one or more increments of the tobacco stream deviates from a predetermined weight, the detector **63** changes its position and causes the transducer **62** of the control circuit **61** to produce an electric signal which is amplified at **64** and **66** and serves to change the speed of the motor **58** so that the rate at which the carding **53** draws tobacco **109** from the magazine **55** is changed to more closely approach or to equal the desired rate.

The band **63***a* delivers successive increments of the tobacco stream onto the rightmost portion of the upper stretch **69***a* of the chain **69** of the transporting means **67.** The tobacco is advanced in the direction indicated by the arrow **72** and is engaged from above by the lower stretch **68***a* of the chain **68** which lower stretch advances in the direction indicated by the arrow **71.** The walls **73** of the chains **68, 69** approach each other along the stretches **68***a*, **69***a* of these chains and form a succession of chambers **74** wherein the tobacco **109** is confined during travel toward the comminuting station **111.** The chains **68, 69** deliver the thus obtained coherent batches or portions of the tobacco stream into the range of the chains **102, 103.** Such transfer takes place in the region of the sprocket wheels **76, 77** where the walls **73** are caused to pivot with reference to the chains **68, 69** so as to allow orderly transfer of tobacco into the shredding machine **101.** The walls **73** which approach the sprocket wheels **76, 77** push the batches into the space between the chains **102, 103** so that the weight of tobacco which is fed into the range of orbiting knives at the station **111** per unit of time is constant and the machine **101** produces shreds at the same rate, i.e., in such a way that the weight of shreds produced during a preceding unit period of time equals the weight of shreds which are produced during the next-following unit period of time.

The comminuting apparatus of FIG. **4** is similar to the apparatus of FIG. **3.** All such parts of the apparatus of FIG. **4** which are clearly analogous to or identical with the corresponding parts of the apparatus of FIG. **3** are denoted by similar reference characters plus **100.** The main difference between these two apparatus is that the apparatus of FIG. **4** employs a modified weighing device **259** and modified transporting means **332** for delivering metered quantities of tobacco into the range of chains **202, 203** in the shredding machine **201.**

The metering device **251** of the feeding unit shown in FIG. **4** again comprises a magazine **255** which receives tobacco **209** from a constantly or intermittently driven carded supply conveyor **309** and one wall of which is formed by the right-hand stretch of the belt **257** forming part of the conveyor **252.** The belt **257** is driven by a variable-speed motor **308** which is controlled by the weighing device **259.** The latter comprises an elongated carrier **302** which is pivotable about the axis of a driven roller **304** and supports at its left-hand end a further roller **303.** The roller **304** is driven by a belt or chain **304***a* which receives motion from the upper roller **256** for the belt **257.** A helical spring **301** couples the left-hand end portion of the carrier **302** to a stationary part of the frame for the shredding machine **101.** An endless band **306** is trained over the rollers **303, 304** and is driven by the roller **304** so that its upper stretch advances in a direction to the left, as viewed in FIG. **4.** This upper stretch receives an uninterrupted stream of tobacco **209** from the carded belt **257** of the conveyor **252** and the weight of successive increments of the tobacco stream on the band **306** is measured during transport toward the roller **303.** For this purpose, the carrier **302** supports the movable contact arm **311***a* of a potentiometer **311** which is connected with the input *a* of a multiplying circuit **312.** The potentiometer **311** is a functional equivalent of the detector **63,** i.e., it converts mechanical signals produced by the carrier **302** and contact arm **311***a* into electrical signals whose intensity is indicative of the weight of tobacco on the band **306** of the weighing device **259.** The circuit **312** has another input *b* which is connected with a conventional tachometer generator **313** serving as a means for generating signals which are indicative of the momentary speed of the motor **308.** The output signal of the circuit **312** is indicative of the weight of tobacco **209** on the band **306** and of the momentary speed of the motor **308,** and such output signal is transmitted to a signal comparing circuit **314.** The latter further receives signals from an adjustable potentiometer **315** which is set to furnish a signal indicating the desired weight of tobacco **209** on the band **306.** If the signal from the circuit **312** deviates from the signal which is transmitted to the circuit **314** by the potentiometer **315,** the circuit **314** produces a signal which is transmitted to an amplifier **316** and the latter then changes the speed of the motor **308** to either increase or reduce the rate of feed of tobacco **209** from the magazine **255** onto the band **306** of the weighing device **259.**

It was found that the just described weighing device **259** with the pivotably mounted carrier **302** is particularly suited to insure the formation of a continuous tobacco stream wherein the weigh of successive increments is either identical with or deviates very little from a desirable optimum weight. The tobacco which advances beyond the left-hand end turn of the band **306** descends through the inlet **229** of an arcuate channel **329** which is defined by the frame of the shredding machine **201** and wherein the tobacco is compacted and advanced by the transporting means **332.** The preliminary compacting action in the channel **329** is followed by the more pronounced compacting action between the chains **202, 203** which form a cake whose leading end is moved into the range of knives at the comminuting station **211.** The lower stretch **202A** of the upper chain **202** is caused to travel along an arcuate path

which is configurated in such a way that the tobacco which enters the range of the chain **202** is compacted at a faster rate during the first stage and thereupon at a slower rate during the next stage of transport toward the comminuting station **211**. This has been found to be a highly satisfactory mode of condensing tobacco prior to shredding. The front sprocket wheel **202***a* for the chain **202** is movable up and down and is biased downwardly by a hydraulic or pneumatic cylinder **202***b*. As a rule, the tobacco which reaches the comminuting station **211** is subjected to very high compressive stresses and the gradual intensification of such stresses during transport of tobacco from the channel **329** to the station **211** is enhanced by the aforedescribed configuration of the lower stretch **202A** of the chain **202**. Furthermore, such configuration of the chain **202** allows for a reduction in the length of the path wherein the tobacco undergoes final compression on its way into the range of knives at the station **211**, and such reduction or shortening of the path is achieved without risking the generation of excessive stresses in the space immediately upstream of the knives.

The transporting means **332** comprises a plate-like pusher **321** which is pivotable about the axis of the shaft **326** for the sprocket wheel **326***a*. The pusher **321** carries an arcuate shield **322** which gradually seals the inlet **229** during pivotal movement of the pusher in a clockwise direction, as viewed in FIG. **4**. The means for pivoting the pusher **321** back and forth comprises a driven disk **323** having an eccentric pin **323**a for a rod **324** which is articulately connected to a bracket **321***a* of the member **321**. The arrow **325** indicates the directions in which the pusher **321** moves when the disk **323** rotates. In the illustrated retracted position, the pusher **321** is withdrawn from the channel **329** and the shield **322** is out of the way so that the inlet **229** can admit tobacco which descends at the left-hand end turn of the band **306**. The reference numeral **327** denotes a lever which is pivotable about the axis of the shaft **326** and supports the pusher **321**. The lever **327** has an intermediate portion which extends through an arcuate slot **328** provided in the rear side wall **329***a* of the frame for the shredding machine **201**. The lever **327** carries a plate **330** which overlaps the major part of the slot **328** to prevent escape of tobacco from the channel **329**. The pusher **321** is attached to that portion of the lever **327** which extends into the space between the side wall **329***a* and the other (front) side wall (not shown) of the frame. Such front side wall can be provided with a second arcuate slot for a portion of a second lever (not shown) which also pivots about the axis of the shaft **326** and is connected with the front marginal portion of the pusher **321**.

The operation of the comminuting apparatus of FIG. **4** is as follows.

The motor **308** is on and the band **306** receives from the conveyor **252** a continuous stream of tobacco **209**. If the weight of an increment of tobacco on the band **306** deviates from a desired weight (as selected by the setting of the potentiometer **315**), the control circuit of FIG. **4** automatically changes the speed of the motor **308** until the signal from the multiplying circuit **312** to the signal comparing circuit **314** matches the signal from the potentiometer **315**. The band **306** discharges tobacco **209** into the inlet **229** so that the tobacco enters the channel **329**. The pusher **321** is caused to pivot forwardly (arrow **331**) at regular intervals determined by the disk **323** and, during each forward movement, the pusher compresses the tobacco **209** and advances the resulting compacted portion or batch into the range of the chains **202, 203**. The tobacco which is discharged by the band **306** while the pusher **321** performs the second stage of its pivotal movement in the direction indicated by the arrow **331** is intercepted by the shield **322** and is held against entry into the channel **329** until the pusher **321** reaches the last stage of its return movement to the retracted position shown in FIG. **4**. A side wall of the inlet **229** strips the tobacco off the shield **322** to insure that all such tobacco enters the channel **329** and is ready to be compacted when the pusher **321** performs the next forward stroke.

An important advantage of the apparatus shown in FIG. **4** is that the weighing device **259** is capable of insuring the formation of a tobacco stream wherein the weight of each increment either equals or very closely approaches a desired optimum weight. Furthermore, the transporting means **332** occupies less room than the transporting means of FIG. **3** and is less complicated than the transporting means of the feeding unit shown in FIGS. **1** and **2**.

All of the illustrated comminuting apparatus share the advantage of insuring that the weight of tobacco shreds which are produced by the machine **1, 101** or **201** per unit of time is either constant or approximates very closely a selected weight. Furthermore, such constancy can be achieved by employing a relatively simple shredding machine whose operation need not be regulated at all, as long as it knives are capable of comminuting all such tobacco which enters the respective comminuting station per unit of time. All that is necessary is to provide a feeding unit which weighs the tobacco and thereupon forcibly advances to the comminuting station such quantities of tobacco per unit of time that the weight of each preceding quantity equals the weight of the next-following quantity. Moreover, since the operation of the shredding machine need not be regulated and the feeding unit can be readily adjusted to furnish to the shredding machine a desired quantity of tobacco per unit of time, the shredding machine can be set to operate at the speed which is best suited for the formation of satisfactory shreds. In other words, the operation of the shredding machine can be readily selected in such a way that it remains within an optimum range.

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 claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. Apparatus for comminuting tobacco, comprising a cutting machine; and a feeding unit for supplying to said cutting machine tobacco at such a rate that the cutting machine receives during each of a series of successive identical periods of time tobacco quantities of identical weight so that, by cutting such quantities of identical weight during each of said identical periods of time, the output of said cutting machine remains constant, said feeding unit comprising a weighing device

arranged to accumulate said quantities per period of time, metering means for supplying tobacco to said weighing device, compacting means for condensing said quantities into batches having predetermined volumes, and transporting means for conveying said batches to said cutting machine.

2. Apparatus as defined in claim 1, wherein said weighing device comprises means for accumulating successive portions each containing a mass of tobacco whose weight equals the weight of the mass of tobacco in the other portions.

3. Apparatus as defined in claim 1, wherein said metering means comprises means for interrupting the admission of tobacco to said weighing device.

4. Apparatus as defined in claim 1, wherein said weighing device comprises a conveyor and said metering means is arranged to furnish tobacco to said conveyor.

5. Apparatus as defined in claim 4, wherein said weighing device further comprises means for regulating the rate at which said metering means delivers tobacco to said conveyor.

6. Apparatus as defined in claim 1, wherein said weighing device comprises a continuously driven pivotable endless conveyor.

7. Apparatus as defined in claim 1, wherein said transporting means comprises at least one chamber having wall means movable in the direction of tobacco transport to said cutting machine.

8. Apparatus as defined in claim 1, wherein said compacting means forms part of said transporting means and comprises a pusher and means for moving said pusher forwardly and backwards at predetermined intervals.

9. Apparatus as defined in claim 1, wherein said compacting means forms part of said transporting means.

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