

[54] METHOD AND APPARATUS FOR
CONDITIONING TOBACCO

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[56] References Cited

UNITED STATES PATENTS

2,768,629 10/1956 Maul..... 131/135
3,389,707 6/1968 Wochnowski..... 131/135

FOREIGN PATENTS OR APPLICATIONS

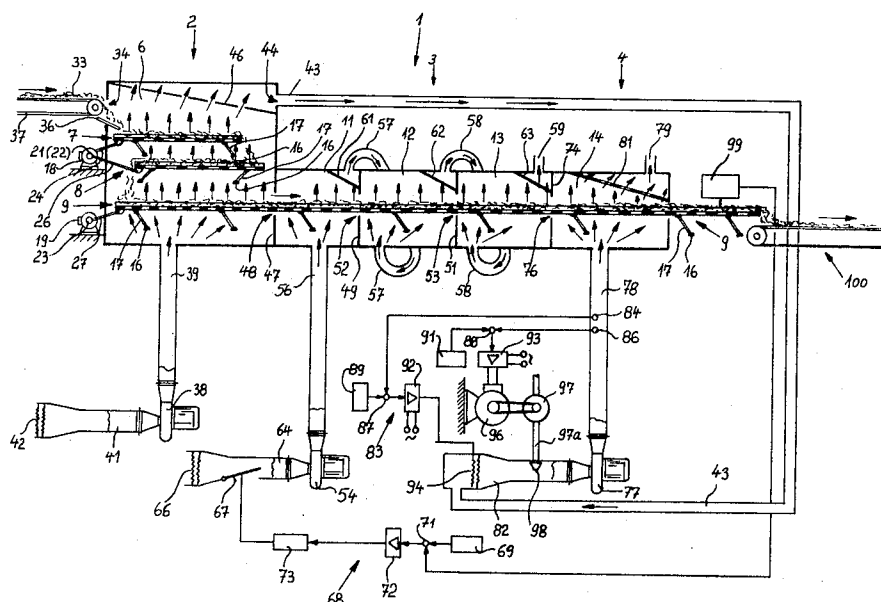
1,119,880 7/1968 Great Britain..... 131/143

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[57] ABSTRACT

The moisture content of tobacco, particularly green-leaf tobacco, is reduced to an accurately determined value by conveying a continuous tobacco stream through three successive sections of a transporting system wherein the tobacco is contacted by air currents. In the first section, a relatively hot current of air is conveyed countercurrent to the direction of tobacco transport; in the second section, the flow of hot air is concurrent with the direction of tobacco transport; in the third section, the tobacco is contacted by relatively cool air having a relatively high moisture content. The air which is conveyed through the third section is withdrawn from the first section, and the temperature of air in the second section is regulated as a function of deviations of moisture content of partially or completely conditioned tobacco from a desired moisture content. The temperature and moisture content of air in the third section are maintained at a constant value to bring about a hygroscopic equilibrium between air and tobacco particles in the third section.

23 Claims, 4 Drawing Figures



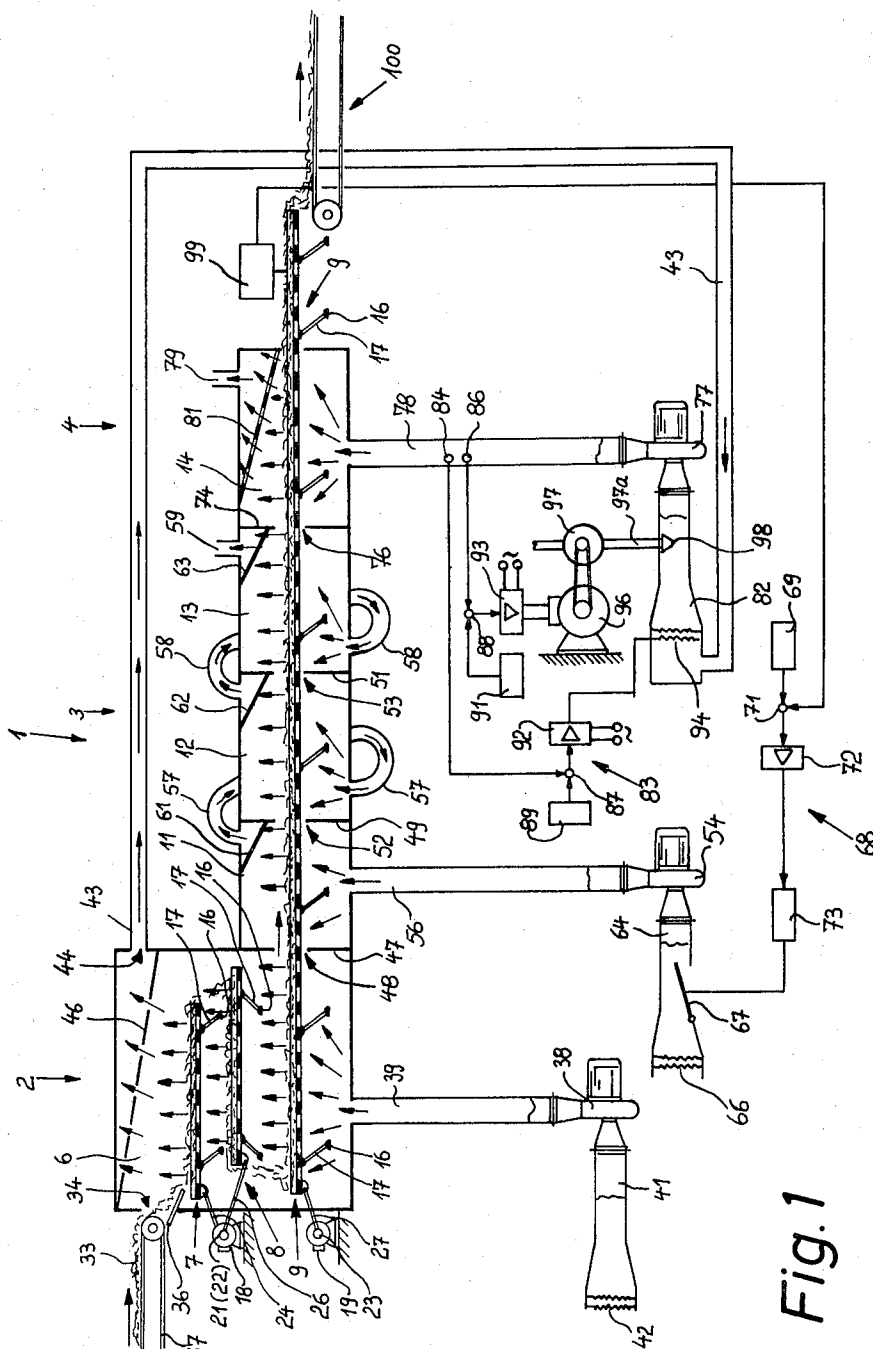
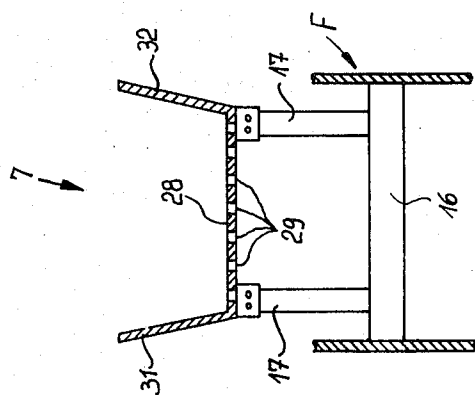
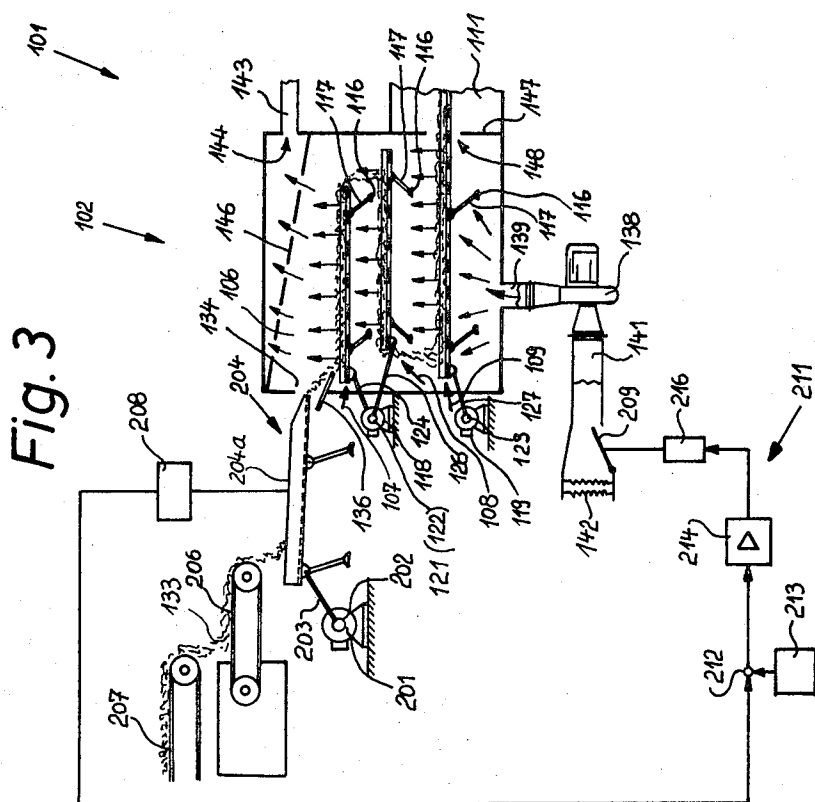


Fig. 1



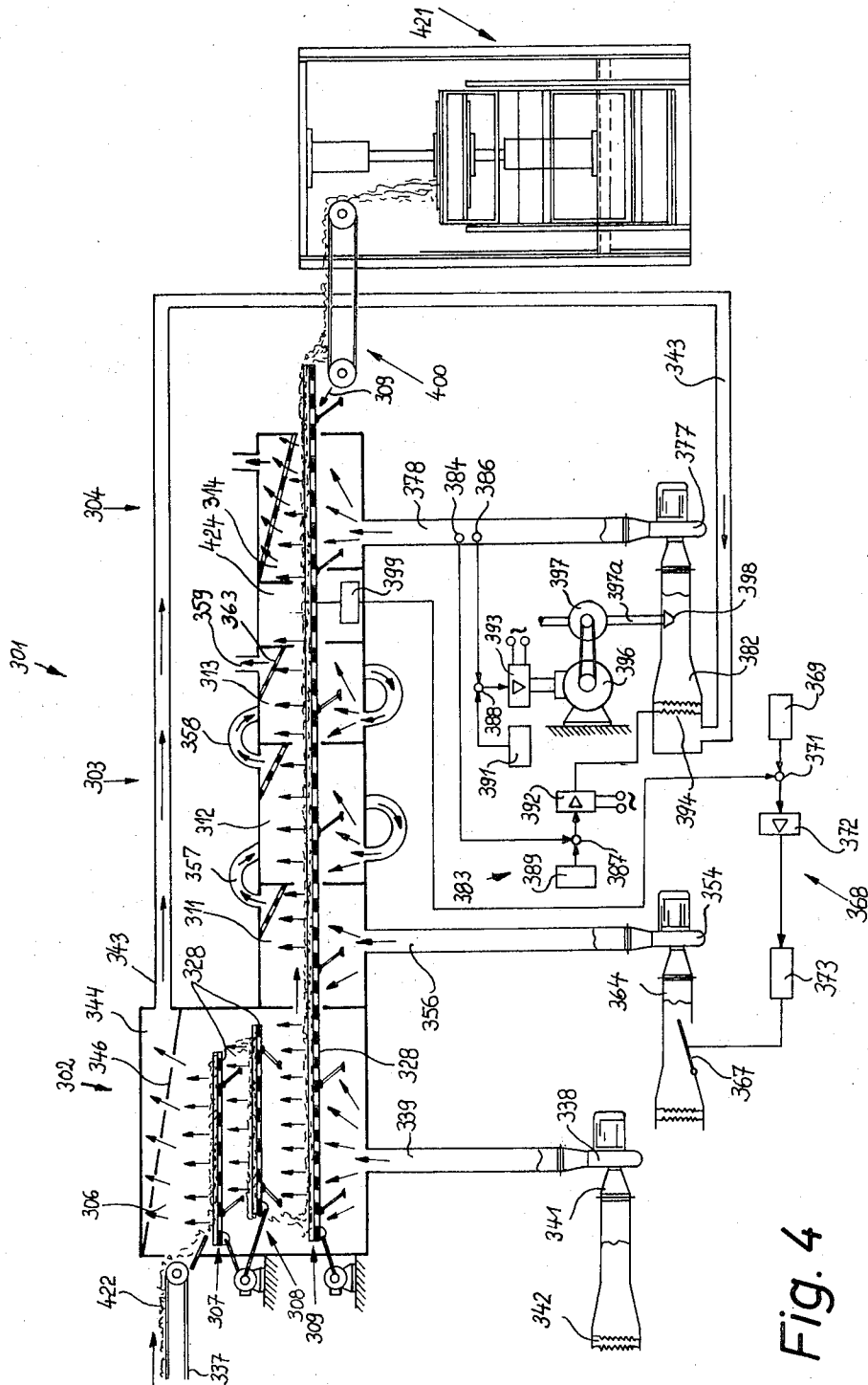


Fig. 4

METHOD AND APPARATUS FOR CONDITIONING TOBACCO

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for conditioning tobacco particles, and more particularly to a method and apparatus for conditioning tobacco particles in the form of whole leaves, laminae, ribs and stem and/or shreds which form a continuous stream and are transported through a series of conditioning zones. Still more particularly, the invention relates to improvements in a method and apparatus for conditioning tobacco particles by means of a gaseous fluid, preferably air.

It is well known that many treatments of tobacco must be preceded by increasing its moisture content so as to enhance the flexibility of tobacco particles (e.g., prior to shredding) and to reduce the likelihood of undesirable breakage or comminution and the formation of dust. It is also known to treat tobacco with a variety of substances (known as casing) in order to improve its aroma; such treatment also involves increasing the moisture content of tobacco. At least some moisture must be expelled from tobacco prior to final processing into cigarettes, cigarillos, cigars, pipe tobacco, chewing tobacco and/or other types of smokers' products. For example, prior to feeding tobacco shreds into a modern mass-producing cigarette making machine, it is necessary to insure that the moisture content of tobacco shreds is invariably within an extremely narrow range which cannot deviate from an optimum moisture content by more than a small fraction of one percent. The heretofore known procedures which are employed in connection with conditioning of tobacco particles normally involve contacting tobacco with a gaseous fluid which is conveyed countercurrent to or concurrently with the direction of tobacco transport through the conditioning apparatus, or a combined concurrent-countercurrent treatment.

The countercurrent treatment involves conveying a current of hot air counter to the direction of transport of tobacco particles and across the tobacco stream. Such treatment is desirable in many instances because the tobacco is treated gently. This is due to the fact that the tobacco particles are first contacted by a current of hot air at less than maximum temperature, i.e., the hottest portion of the air stream comes into contact with that portion of the tobacco stream which was already treated by cooler air. In other words, the moisture content of tobacco particles is inversely proportional to the temperature of air which contacts successive increments of the stream. As the temperature of air decreases in response to continued contact and energy exchange with tobacco, the moisture content of air rises so that each increment of the tobacco stream is first contacted by an air current having a relatively high moisture content and a relatively low temperature; the moisture content of air decreases and the temperature of air increases in the direction of tobacco transport. Thus, the very hot air contacts those particles of tobacco whose moisture content is already reduced and the relatively cool air contacts tobacco particles whose moisture content is high. Otherwise stated, the maximum exchange of energy takes place at the downstream end of the conditioning zone where the partially conditioned tobacco is contacted by freshly admitted air whose temperature is high. An advantage of such

countercurrent conditioning is that the final moisture content of tobacco can be selected and maintained with a high degree of accuracy because, if the moisture content in a region slightly ahead of the downstream end of the conditioning zone deviates from the desired optimum content, the temperature of freshly admitted hot air can be readily changed to compensate for such differences without any delay or with negligible delay. However, the just described countercurrent conditioning cannot insure that the moisture content of each portion of each tobacco particle is within the desired range, i.e., the overall moisture content of a batch of tobacco particles is satisfactory but the moisture content is likely to vary from portion to portion of a discrete tobacco particle.

The conditioning of tobacco with a current of hot air which is conveyed concurrently with the direction of tobacco transport involves conveying the tobacco in and often by the current of air. Such treatment renders it possible to achieve a hygroscopic equilibrium between tobacco and air at the downstream end of the conditioning zone, i.e., all portions of each tobacco particle will have a desired moisture content. However, the concurrent treatment exhibits a serious drawback, namely, that the tobacco particles are first contacted by very hot air which effects an abrupt drying of strata adjacent to the external surfaces of tobacco particles. As a result of such treatment, certain types of tobacco are likely to develop hard crusts. Moreover, the intervals between the measurement of moisture content and an effective adjustment in the event that the final moisture content of tobacco is unsatisfactory are very long. Thus, if the moisture content of tobacco is measured downstream of the conditioning zone and if such moisture content is unsatisfactory, it takes a relatively long interval of time to change the moisture content by changing the characteristics of the air current. This means that a substantial amount of tobacco is allowed to leave the conditioning zone with a final moisture content which is unsatisfactory for further processing. Also, the regulating system which is used to change the characteristics of an air current flowing concurrently with the direction of tobacco transport is likely to begin to oscillate. Since the main drying action takes place in the relatively short foremost portion of the conditioning zone, it is difficult to influence the moisture content of tobacco in the remaining portion of the conditioning zone if such moisture content is unsatisfactory.

The combined concurrent-countercurrent conditioning of tobacco exhibits the advantage that the adverse effects of the preceding (concurrent) treatment can be compensated for during the next-following (countercurrent) treatment. However, this takes place at the expense of uniformity of moisture content in all portions of tobacco particles which leave the conditioning zone. In other words, the countercurrent treatment which follows the concurrent treatment is likely to reduce the uniformity of moisture content in each portion of a tobacco particle which leaves the treating apparatus. Furthermore, even though the concurrent treatment allows for convenient elimination of substantial deviations of measured moisture content from a desired moisture content by proper regulation of the temperature of air currents which are transported concurrent with tobacco particles, such concurrent treatment is likely to bring about undesirable incrustation of tobacco particles in that portion of the conditioning zone where a

current of very hot air comes into contact with tobacco. Therefore, conditioning apparatus operating on the just discussed principle have failed to find widespread acceptance in the tobacco industry.

Freshly gathered tobacco leaves are normally dried at the farm. Prior to compacting of leaves in barrels, hogsheads or in the form of bales (this is the customary form of compacting tobacco for shipment to manufacturing plants), the moisture content of tobacco leaves must be reduced to an accurately determined relatively low value. Such accurate drying cannot be achieved by mere exposure of tobacco leaves to atmospheric air because various portions of tobacco leaves lose their moisture content at a different rate. Thus, the laminae will dry much faster than ribs and stem. Therefore, freshly gathered tobacco leaves are often stemmed or destalked to separate the laminae from stem so that the thus separated stem and laminae can be dried independently of each other. Tobacco which is subjected to a drying action after gathering is often called greenleaf tobacco. Accurate drying of greenleaf tobacco (so that the moisture content of each tobacco particle and of each portion of each tobacco particle remains within a narrow range) is desirable and necessary because, after the tobacco is compacted in barrels or in the form of bales, batches with a higher moisture content tend to mildew and the molding spreads very rapidly throughout an entire barrel or bale to cause substantial damage. A contemporary drying apparatus for greenleaf tobacco normally comprises a rotary open-ended vessel or barrel through which a stream of tobacco is conveyed with a current of air with attendant agitation of tobacco to insure more satisfactory exchange of energy between air and tobacco particles. It is also known to employ drying apparatus in the form of pneumatic conveyors wherein greenleaf tobacco is conveyed in a current of hot air passing through a pipe or the like.

Since a bale or barrel of dried greenleaf tobacco is likely to remain in storage for extended periods of time, the manufacturers require that the moisture content of such tobacco be maintained within an extremely narrow range because a very small nest of mildewy tobacco is likely to contaminate the contents of an entire barrel or an entire bale before the barrel or bale is removed from storage. As mentioned before, the moisture content must be reduced to a very low value, and the transport through a drying or conditioning apparatus wherein the moisture content is reduced to such low value is likely to result in undesirable breakage or comminution of tobacco and/or in the formation of excessive quantities of tobacco dust. The likelihood of breakage or dust formation is particularly pronounced in the aforementioned drying apparatus wherein a stream of tobacco is conveyed through a revolving open-ended vessel in the presence of hot air. This is due to the fact that the revolving vessel subjects the particles of tobacco to a very pronounced agitating action during which the particles are repeatedly lifted well above the bottom zone of the vessel by orbiting rakes or blades and are allowed to drop by gravity back into the bottom zone. Nevertheless, many tobacco growers still employ such types of drying apparatus because their conditioning action is more uniform than that of pneumatic drying apparatus.

SUMMARY OF THE INVENTION

An object of the invention is to provide a novel and

improved conditioning method for regulating the moisture content of tobacco particles which exhibits all advantages but avoids the drawbacks of presently known conditioning methods.

Another object of the invention is to provide a method which can be practiced in connection with the conditioning of a variety of tobacco particles including whole leaves, shreds, tobacco leaf laminae and/or ribs and stem.

A further object of the invention is to provide a method which insures gentle treatment of tobacco particles during expulsion of surplus moisture, which insures a uniform conditioning so that the moisture content of each portion of each tobacco particle is within a desired range when the conditioning treatment is completed, and which renders it possible to reduce the moisture content of greenleaf tobacco and/or other types of tobacco particles (e.g., tobacco shreds) to an accurately determined value which is best suited for further treatment or for placing the tobacco in storage.

An additional object of the invention is to provide a novel and improved apparatus which can be utilized for the practice of the above-outlined conditioning method and wherein the expulsion of surplus moisture from tobacco particles can be regulated and otherwise controlled by resorting to relatively simple, accurate, compact and reliable control means.

Still another object of the invention is to provide novel and improved means for transporting tobacco during expulsion of surplus moisture.

Another object of the invention is to provide novel and improved conditioning devices which can be utilized in the apparatus to effect a controlled reduction of moisture content in various types of tobacco particles including greenleaf tobacco.

One feature of the invention resides in the provision of a method of conditioning tobacco with a gaseous fluid, particularly of reducing the moisture content of moist tobacco by repeated intimate contact with currents of air. The method comprises the steps of transporting unconditioned tobacco particles along a predetermined elongated path, subjecting the particles to the action of a first current of a gaseous fluid which is conveyed countercurrent to the direction of travel of tobacco particles in a first section or portion of the path and whose characteristics (particularly its speed and temperature) are maintained within a predetermined range, and thereupon subjecting the particles to the action of a second current of a gaseous fluid which is conveyed concurrent with the direction of travel of particles in a second section or portion of the path located downstream of the first portion and whose characteristics (particularly its speed and temperature) are maintained within a predetermined range.

The method preferably further comprises the step of subjecting tobacco to the action of a third current of a gaseous fluid which acts on tobacco in a third section or portion of the path located downstream of the second portion and at least one characteristic of which (such as its temperature and/or moisture content) preferably closely approaches or matches the desired respective characteristic of conditioned tobacco particles. The third current can be obtained by reconveying one of the first and second currents (preferably the first current) into contact with tobacco particles in the third portion of the path. The characteristics of the third current are preferably regulated and selected in such a way

that a hygroscopic equilibrium is achieved between the third current and tobacco in the third portion of the path.

At least one characteristic of tobacco particles (particularly their moisture content) is preferably measured in a portion of the path which is located downstream of the second portion (and which may be located between the second and third portions or downstream of the third portion). The results of the measurement are compared with a predetermined value and at least one characteristic of the first and/or second current is regulated as a function of differences between the results of measurement and the predetermined value.

The aforementioned third current may be scanned by detector means to determine its temperature and/or moisture content prior to entry into the third portion of the path, and the characteristics of such third current are preferably changed when the measured value or values deviate from predetermined values. Thus, if the temperature and/or the moisture content of the third current deviates from the predetermined value (which may correspond to the desired temperature and/or moisture content of conditioned tobacco particles), the corresponding characteristic of the third current is changed in order to insure that each measured characteristic of the third air current corresponds to the respective predetermined value.

The transporting step preferably comprises vibrating or otherwise agitating the tobacco particles so that the tobacco stream is transported in the form of a layer of agitated particles. The tobacco stream may consist of greenleaf tobacco and the conditioned greenleaf tobacco is preferably compacted in a baling press or the like for convenient transport and/or storage.

Each of the gaseous currents is preferably subdivided into a plurality of smaller currents immediately prior to contact with tobacco particles in the respective sections or portions of the path, and such smaller currents are preferably conveyed substantially at right angles to the direction of transport of tobacco particles while the currents are in actual energy-exchanging contact with the particles. This can be achieved by breaking up larger currents during passage through the foraminous bottom wall of a vibratory conveyor. The conveyor is preferably designed in such a way that the speed of smaller currents decreases during contact with particles of tobacco to thus prevent the smaller currents from entraining lighter tobacco particles from the respective sections of the path.

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

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic partly elevational and partly sectional view of a conditioning apparatus which embodies one form of the invention;

FIG. 2 is an enlarged transverse vertical sectional view of a vibratory conveyor in the conditioning apparatus of FIG. 1;

FIG. 3 is a fragmentary schematic partly elevational and partly sectional view of a second conditioning apparatus; and

FIG. 4 is a schematic partly elevational and partly sectional view of a third conditioning apparatus which is particularly suited for conditioning and subsequent compacting of greenleaf tobacco.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The conditioning apparatus of FIG. 1 comprises a tobacco transporting system 1 including a first or foremost section 2, a second or intermediate section 3, and a third or rear section 4. The first transporting section 2 comprises a chamber 6 for three discrete vibratory conveyors 7, 8 and 9 which are disposed at different levels, with the conveyor 8 located above the conveyor 9 but below the conveyor 7. The arrangement is such that the right-hand or discharged end of the uppermost conveyor 7 discharges successive increments of a continuous stream of tobacco particles 33 onto the right hand end of the median conveyor 8 and that the left-hand end of the conveyor 8 discharges successive increments of the tobacco stream onto the left-hand end of the lowermost conveyor 9. The latter is substantially longer than the conveyors 7, 8 and also extends through and beyond successive chambers 11, 12, 13 of the intermediate transporting section 3 as well as through and beyond the single chamber 14 of the rear transporting section 4. The conveyors 7, 8 and 9 are mounted on sets of carriers 16 by means of pairs of leaf springs 17 (see also FIG. 2). The drive means for vibrating the conveyors 7, 8 comprises an electric motor 18 whose output shaft rotates two eccentrics 21, 22 which are respectively coupled with the conveyors 7, 8 by connecting rods 24, 26. The drive means for vibrating the conveyor 9 comprises a second electric motor 19 whose output shaft drives an eccentric 23 for a third connecting rod 27.

FIG. 2 shows that the carriers 16 are mounted in the frame F for the conditioning apparatus and that the conveyor 7 comprises a foraminous bottom wall or platform 28 having perforations or holes 29 and two side walls 31, 32 which flank the platform 28 and diverge upwardly and outwardly so that the width of the channel which is defined by the conveyor 7 increases in a direction upwardly and away from the bottom wall 28. The construction of the other two conveyors 8, 9 is identical with that of conveyor 7.

Referring again to FIG. 1, the upper end portion of the left-hand wall of the chamber 6 has an inlet opening 34 through which the stream of tobacco particles 33 is admitted onto the left-hand end of the uppermost vibratory conveyor 7. The particles 33 descend onto the conveyor 7 by sliding along an inclined chute 36 which receives tobacco from the upper stretch of a continuously driven conveyor belt 37.

The conditioning apparatus further comprises a first conditioning device having means 41, 38, 39 for circulating through the tobacco particles 33 in the chamber 6 a current of heated air countercurrent to the direction of tobacco travel. The circulating means comprises a blower 38 which is connected with the lower portion of the chamber 6 by a pipe 39 and receives heated air by way of a suction pipe 41 containing a preferably adjustable electric resistance heater 42 which constitutes a means for maintaining a characteristic (the tempera-

ture) of the first current within a predetermined range. The inflowing air is heated by the heater 42 and passes through the pipe 41, blower 38 and pipe 39 to enter the chamber 6 below the left-hand portion of the vibratory conveyor 9. The current of hot air passes upwardly through the perforations 29 in the bottom wall 28 of the conveyor 9, thereupon through the median conveyor 8 and finally through the uppermost conveyor 7 to be evacuated by way of an outlet opening 44 located behind a sieve or filter 46 which serves as a means for intercepting those tobacco particles 33 which might be entrained by the ascending air currents. The outlet opening 44 admits air into an elongated pipe or conduit 43. The current of air entering the chamber 6 by way of the pipe 39 is subdivided into a large number of smaller currents during travel through the bottom walls 28 of the conveyors 7, 8 and 9.

The chamber 6 of the first transporting section 2 is separated from the first chamber 11 of the second transporting section 3 by a partition or wall 47 having an opening 48 for the conveyor 9. Similar partitions or walls 49, 51, 74 respectively separate the chambers 11-12, 12-13 and 13-14; these partitions are respectively provided with openings 52, 53 and 76 for the conveyor 9. A further opening in the right-hand wall of the chamber 14 in the transporting section 4 serves to permit passage of the conveyor 9 and of the stream of conditioned tobacco particles thereon.

In the transporting section 3, the tobacco particles 33 are treated by a second current of hot air which flows concurrently with the tobacco stream, i.e., through the chambers 11, 12 and 13 in that order. Such second current is induced by a second blower 54 which is connected with the lower portion of the chamber 11 by a pipe 56 and is further connected with a suction pipe 64 serving to draw atmospheric air past a preferably adjustable electric resistance heater 66. The suction pipe 64 further contains an adjustable regulating valve 67 here shown as a flap which is pivotable by a servomotor 73 and serves to regulate the temperature of air which enters the pipe 56 and chamber 11 by determining the rate at which the air flowing across the heater 66 is mixed in the pipe 64 with unheated atmospheric air. The upper portion of the chamber 11 (above the conveyor 9) is connected with the lower portion of the chamber 12 (below the conveyor 9) by means of a suitably bent conduit or pipe 57, and a similar conduit or pipe 58 connects the upper portion of the chamber 12 with the lower portion of the chamber 13. Sieves or filters 61, 62 are respectively mounted in the chambers 11, 12 below the intake ends of the conduits 57, 58 to prevent escape of tobacco particles. The upper portion of the chamber 13 is provided with an outlet opening 59, located behind a sieve or filter 63, to permit escape of spent air into the surrounding atmosphere.

The aforementioned servomotor 73 forms part of a control unit 68 which determines the position of the regulating valve 67 in the suction pipe 64. This control unit 68 further comprises a potentiometer 69 or another suitable rated value setting device which is connected with a signal comparing junction 71. The output signal from the junction 71 is amplified at 72 and is transmitted to the servomotor 73 to be used as a means for determining the setting of the regulating valve 67. It will be seen that the second conditioning device which causes the second air current to flow through the section 3 comprises means 66, 64, 56, 57, 58 for circu-

lating the second current concurrently with the direction of tobacco transport and means 67, 68, 73 for maintaining the temperature of the second current within a predetermined range.

A third conditioning device of the apparatus comprises means 82, 77, 78 for circulating a current of moist heated air across the tobacco stream on the conveyor 9 in the chamber 14 of the third transporting section 4. Such circulating means comprises a blower 77 which is connected with the lower portion of the chamber 14 by a pipe 78. The suction pipe 82 of the blower 77 is connected with the outlet opening 44 of the chamber 6 by means of the aforementioned conduit 43, and the thus admitted air can be heated in the suction pipe 82 by an electric resistance heater 94 which is adjustable by a control unit 83. The latter insures that the characteristics of the air current which enters the pipe 78 and chamber 14 do not change at all or fluctuate within a very narrow range. The control unit 83 comprises two detectors 84, 86 which are mounted in the pipe 78 and respectively serve to measure the temperature and moisture content of the air current flowing into the lower portion of the chamber 14 below the conveyor 9. The detector 84 may be any suitable thermoelement or heat-sensitive conductor (NTC or PTC) which can produce signals indicating the temperature of surrounding air, and the detector 86 may be conventional hygrometer. The control unit 83 further comprises two signal comparing junctions 87, 88, two potentiometers or analogous rated value setting devices 89, 91, and two output amplifiers 92, 93. Still further, the control unit 83 comprises a variable-speed electric motor 96 which receives signals from the amplifier 93 and drives a variable-delivery pump 97 in a water line 97a having an atomizing nozzle 98 mounted in the suction pipe 82 downstream of the heater 94. The source from which the line 97a draws water at the rate determined by the speed of the motor 96 is not shown in FIG. 1.

The fully conditioned tobacco particles 33 on that portion of the conveyor 9 which extends beyond the chamber 14 of the last transporting section 4 travel past a detector 99 which serves to determine the moisture content of tobacco particles downstream of the chamber 14. The detector 99 may be of the type known as HWK produced by the Firm Hauni-Werke, Korber & Co., K.G., of Hmaburg-Bergedorf, Western Germany. The signal which is produced by the detector 99 is indicative of the moisture content of conditioned tobacco and is transmitted to the junction 71 of the control unit 68 to be compared with the signal furnished by the potentiometer 69. The detector 99, potentiometer 69, junction 71, amplifier 72 and servomotor 73 together form a circuit which determines the moisture content of conditioned tobacco in that the signal furnished by the detector 99 serves to cause the servomotor 73 to adjust the regulating valve 67 when the intensity of the signal from detector 99 is different from that of the signal furnished by the potentiometer 69, i.e., when the moisture content of tobacco downstream of the chamber 14 deviates from desired predetermined moisture content as represented by the signal from the potentiometer 69.

A take-off conveyor 100 (e.g., an endless belt) serves to transport conditioned tobacco to a further processing station, not shown.

The operation:

The conveyor belt 37 delivers a continuous stream of tobacco particles 33 onto the chute 36 which in turn delivers such particles into the channel between the walls 28, 31, 32 of the uppermost vibratory conveyor 7 in the chamber 6 of the first transporting section 2. The conveyor 7 transports the tobacco stream lengthwise in a direction to the right, and the stream thereupon reverses the direction of its movement during transport on the intermediate conveyor 8 to again move in a direction to the right while moving between the walls 28, 31, 32 of the conveyor 9. The latter transports the tobacco stream through the opening 48 in the partition 47 and into and through successive chambers 11, 12 and 13 of the median transporting section 3.

The blower 38 delivers a continuous current of hot air into the pipe 39 whereby such air flows upwardly through the perforations 29 in the bottom wall 28 of the conveyor 9, thereupon through the bottom wall 28 of the conveyor 8 and finally through the bottom wall 28 of the conveyor 7 to pass through the interstices of the sieve 46 and to leave the chamber 6 by way of the outlet opening 44 prior to entering the conduit 43 on its way into the inlet of the suction pipe 82. As the current of air passes through the bottom walls 28 of the three conveyors 7, 8 and 9, the resulting smaller currents of hot air agitate the tobacco particles 33 on the respective conveyors to bring about a thorough heating action. It will be noted that the flow of hot air in the chamber 6 is countercurrent to the direction of transport of tobacco particles 33 because the hot air first impinges on tobacco which is being transported by the lowermost conveyor 9, i.e., by the conveyor which is remotest from the inlet opening 34, thereupon on tobacco which is being transported on the median conveyor 8 and finally on tobacco which is being transported on the uppermost conveyor 7. Actually, the flow of hot air takes place at right angles to the direction of transport of tobacco particles 33, but only when considered in 2 relatively small portion of each of the three troughs formed by the walls 28, 31 and 32 of the respective vibratory conveyors.

The connecting rods 24, 26 and 27 transmit to the walls 26, 31, 32 of the respective conveyors 7, 8 and 9 recurrent movements which cause the particles of tobacco to "bounce" on the respective bottom walls 28. Such bouncing or rebounding of particles 33 is further assisted by the small currents of hot air which flow upwardly through the perforations 29 whereby the particles in the channels of the three vibratory conveyors 7-9 form three layers of highly agitated tobacco. Such mode of transport and treatment is highly desirable because the entire external surface of each tobacco particle is repeatedly brought into contact with surrounding hot air to thereby insure a highly effective exchange of energy between tobacco and hot air.

Since the side walls 31, 32 of the conveyors 7-9 diverge upwardly, i.e., in the direction of flow of currents of hot air across the tobacco stream, the speed of such air currents decreases in the same direction which is highly desirable because the decelerated air currents are less likely to entrain lighter tobacco particles toward the sieve 46. The countercurrent flow of hot air in the chamber 6 is desirable because the particles 33 which enter the chamber 6 by way of the inlet opening 34 are not immediately subjected to the action of very hot air. On the contrary, very hot air first comes into contact with particles 33 on the conveyor 9, i.e., with

particles which were preheated by hot air at less than maximum temperature on the conveyor 8 and with even less hot air on the conveyor 7. This reduces the likelihood of the formation of hard crusts along the external surfaces of tobacco particles in the transporting section 2.

The temperature of air currents passing through the interstices of the sieve 46 and into the conduit 43 is normally substantially less than the temperature of air in the pipe 39, and the air in the conduit 43 is enriched with moisture which is being withdrawn from tobacco particles 33 on the conveyors 7-9. The conveyor 9 transports the pretreated tobacco particles 33 from the chamber 6, through the opening 48 in the partition 47 and into the first chamber 11 of the second transporting section 3, thereupon into the second chamber 12, into the third chamber 13 and finally into and through the chamber 14 of the third transporting section 4. During travel across the chamber 11, the tobacco particles 33 are agitated by the bottom wall 28 of the conveyor 9 as well as by small currents of hot air which is supplied by the blower 54 by way of the pipe 56 and flows through the perforations 29 toward and through the interstices of the sieve 61 to enter the conduit 57 on its way into the lower portion of chamber 12. The small currents of air which pass through the perforations 29 of the bottom wall 28 in the chamber 12 whereupon pass through the sieve 62 and conduit 58 to enter the lower portion of the chamber 13, to pass again through the conveyor 9, thereupon through the sieve 63 and to be discharged into the atmosphere by way of the outlet opening 59. The flow of air currents across the tobacco stream in the chambers 11-13 takes place substantially at right angles to the direction of transport of tobacco particles; however, since the air current first enters the chamber 11 and thereupon passes across the chambers 12 and 13, the overall flow of such air is concurrent with the direction of tobacco travel through the transporting section 3.

The tobacco stream which passes across the chamber 14 of the transporting section 4 is treated by currents of moist hot air which is delivered by the blower 77 by way of the pipe 78. Such air currents pass through the perforations 29 of the bottom wall 28 in the chamber 14, thereupon through a sieve 81, and are discharged by way of an outlet opening 79. The moisture content of air which is admitted into the chamber 14 via pipe 78 is due to the fact that such air is delivered into the pipe 82 by way of the conduit 43 and also due to the provision of the atomizing nozzle 98 which delivers a spray of water into the pipe 82 downstream of the heater 94 at the rate determined by the speed of the electric motor 96. The condition of air which is supplied by the pipe 78 preferably corresponds exactly to the desired condition of tobacco which leaves the chamber 14 on its way toward the take-off conveyor 100, i.e., the moisture content and/or temperature of such air can be selected with a view to match or to closely approach the desired moisture content and/or temperature of conditioned tobacco particles 33. Such treatment of air which enters the chamber 14 insures the establishment of hygroscopic equilibrium between the air in the transporting section 4 and the tobacco particles 33; this is desirable in order to insure that the moisture content is uniform in each portion of each tobacco particle which leaves the chamber 14.

The detector 84 in the pipe 78 provides signals which are indicative of the temperature of air supplied by the blower 77, and such signals are transmitted to the junction 87 to be compared with the signal furnished by the potentiometer 89 which is adjusted so that its output signal represents the desired temperature of tobacco particles 33 on the conveyor 9 downstream of the chamber 14. When the temperature of air in the pipe 78 exceeds the desired temperature of conditioned tobacco, the junction 87 transmits a signal to the amplifier 92 which adjusts the heater 94 so that the air current which is supplied by the conduit 43 is subjected to a less intensive heating action. Inversely, when the temperature of air in the pipe 78 is too low, the signal which is furnished to the amplifier 92 is indicative of the difference between the intensities of signals from the detector 84 and potentiometer 89, and the heating action of the heater 94 upon air which is admitted into the pipe 82 by way of the conduit 43 is intensified accordingly.

The detector 86 produces signals which are indicative of the moisture content of air in the pipe 78; such signals are transmitted to the junction 88 which compares them with the signal furnished by the potentiometer 91. Depending on the positive or negative sign of the difference between the intensities of signals furnished by the detector 86 and potentiometer 91, the junction 88 transmits to the amplifier 93 signals which cause a deceleration or acceleration of the motor 96 with the result that the pump 97 delivers to the nozzle 98 larger or smaller quantities of water per unit of time. It will be noted that the control unit 83 automatically regulates the condition of air in the pipe 78 to match or to closely approach at least one desired characteristic of tobacco particles 33 on the conveyor 9 downstream of the chamber 14.

An advantage of the control unit 83 is that it can effect rapid changes in the temperature and/or moisture content of air in the pipe 78 because the suction pipe 82 receives a continuous current of preconditioned air, namely, a current of air which is preheated because it has already passed across the heater 42 and which contains moisture because it has been in contact with tobacco in the chamber 6. Consequently, the condition of air in the pipe 78 can be changed practically without any delay to insure that the temperature and/or moisture content of all portions of the tobacco stream which leaves the chamber 14 deviates little from or is identical with an optimum value. Moreover, the energy requirements of the control unit 83 are relatively low because such unit must insure an optimum temperature and moisture content of a preconditioned air current. Still further, the delivery of preheated and humid air from the chamber 6 into the suction pipe 82 reduces the overall air requirements of the apparatus with attendant savings in cost.

After the tobacco stream leaves the chamber 14, its particles 33 move past the detector 99 which produces signals indicating the moisture content of conditioned tobacco. Such signals are transmitted to the junction 71 and are compared with the signal from the potentiometer 69. If the two signals differ in intensity, the junction 71 transmits a signal to the amplifier 72 which causes the servomotor 73 to change the position of the regulating valve 67 and hence the temperature of air in the pipe 56. The detector 99 cooperates with the control unit 68 to effect very accurate changes in the mois-

ture content of tobacco particles 33 by regulating the heating action of air currents in the chambers 11-13 of the intermediate transporting section 3. It will be noted that the detector 99 influences the conditioning action in the intermediate, rather than the last, transporting section of the system 1.

The conveyor 9 delivers conditioned tobacco onto the upper stretch of the take-off conveyor 100 which transports such material to one or more additional treating stations, not shown.

By way of example, the conditioning apparatus of FIGS. 1 and 2 can be designed to process 2,500 kilograms of tobacco per hour. The initial moisture content of tobacco particles 33 (on the belt 37) may be about 19 percent, the overall length of the chamber 6 (as considered in the direction of tobacco transport on the conveyor 7, 8 or 9) may be about 150 centimeters, the overall length of the transporting section 3 may be about 150 centimeters and the length of the transporting section 4 may be about 250 centimeters. The width of the chambers 6 and 11-14 may be about 80 centimeters and the speed at which the currents of air are conveyed through these chambers may be about 110 centimeters per second. The temperature of air which enters the chambers 6 and 11 may be about 180° C. The temperature of air which enters the chamber 14 may be 25° C. and its moisture content may be about 60 percent. The final moisture content of tobacco at the downstream end of the conveyor 11 (below the detector 99) may be 12 percent. It is clear that the above values will vary with changes in the rate of tobacco delivery, with the nature of tobacco, with the desired final moisture content of tobacco and/or other factors. Moreover, the temperature of air currents in the transporting sections 2 and 3 can be reduced if the speed of tobacco transport is reduced or vice versa; the length of the section 2 may differ from the length of the section 3; the number of chambers in the section 3 may be reduced or increased; and the conditioning medium can be gaseous fluid other than air. Also, the conveyor 7, 8 and/or 9 can be replaced by two or more conveyors and the heater 42, 66 and/or 94 can be replaced by other types of heating devices. For example, at least the transporting sections 2 and 3 may employ tobacco conveyors in the form of open-ended revolving drums or endless foraminous belts. These are but a few examples of various modifications which can be carried out within the purview of the invention.

It will be seen that the method which can be performed by resorting to the apparatus of FIGS. 1 and 2 differs from conventional methods in that the particles 33 of tobacco are subjected to the action of a first current of gaseous fluid which is conveyed countercurrent to the direction of travel of particles in a first portion of the path defined by the transporting system 1 (namely, in the transporting section 2) and whose characteristics (particularly its rate of flow and its temperature) are maintained within a predetermined range (e.g., at or about 110 centimeters per second and 180° C), and that the particles 33 are thereupon subjected to the action of a second current of a gaseous fluid which is conveyed concurrently with the direction of travel of tobacco particles in a second portion of the path (namely, in the portion defined by the transporting section 3) located downstream of the first portion and whose characteristics (particularly its rate of flow and its temperature) are also maintained within a pre-

determined range (e.g., at or about 110 centimeters per second and 180° C). Furthermore, the particles 33 are subjected to the action of a third current of a gaseous fluid in a third portion of the path located downstream of the second portion (namely, in the portion defined by the transporting section 4) and the characteristics of the third current (particularly its temperature and moisture content) are maintained within a predetermined range (e.g., at or about 25° C. and at or about 60 percent).

The conditioning in the second transporting section 3, which follows the conditioning in the transporting section 2, exhibits the advantage that the tobacco leaving the chamber 13 can be brought into hygroscopic equilibrium with the gaseous fluid which contacts the particles 33 in the section 4. In certain instances, it suffices to condition the tobacco particles with only two currents of a gaseous fluid, namely in the sections 2 and 3 of the transporting system 1. However, such procedure cannot insure practically instantaneous corrections for eventual deviations of final moisture content from a desired or predetermined moisture content. In other words, were the chamber 14 omitted, it would require a longer interval of time to change the moisture content of tobacco particles 33 which leave the chamber 13 if the moisture content of such particles would be higher or less than the desired moisture content. The provision of the transporting section 4 and of the conditioning means for gaseous fluid which is supplied into the chamber 14 by way of the pipe 78 renders it possible to reduce the length of intervals which are needed to eliminate eventual deviations of final moisture content from a desired moisture content. This is achieved by selecting at least one characteristic of the gaseous fluid which enters the chamber 14 in such a way that it matches or closely approaches the desired corresponding characteristic of the particles 33 on the conveyor 100.

The provision of the conduit 43 reduces the energy requirements of the apparatus because this conduit conveys the once-used gaseous fluid from a preceding transporting section (2) into a next-following transporting section (4). It is clear that, if necessary, the chamber 14 can receive at least some air which leaves the chamber 6 and/or at least some air which leaves the chamber 13. The fluctuations in moisture content of tobacco which leaves the chamber 14 are reduced due to the provision of the detector 99 which influences the characteristics of at least one of the three currents of gaseous fluid; in the embodiment of FIGS. 1 and 2, the detector 99 influences the temperature of air which is being admitted into the chamber 11 of the transporting section 3. The vibratory conveyors 7-9 insure an optimum exchange of energy between tobacco particles 33 and the air currents by agitating the particles during transport through the chambers 6 and 11-14 to thus insure that each air current can intimately contact all sides of each particle.

FIG. 3 illustrates a portion of a second conditioning apparatus which differs from the apparatus of FIG. 1 mainly in that the belt conveyor 37 is replaced by a further vibratory conveyor 204 serving to deliver tobacco particles 133 in the form of a continuous stream through the inlet opening 134 and onto the uppermost conveyor 107 in the chamber 106. All such parts of the second apparatus which are identical with or clearly analogous to the corresponding parts of the first appa-

ratus are denoted by similar reference characters plus 100. Furthermore, the conditioning apparatus of FIG. 3 comprises detector means 208 which determines the moisture content of tobacco particles 133 prior to entry into the chamber 106. FIG. 3 merely shows the first section 102 of the transporting system 101, the other two sections being assumed to be identical with the sections 3 and 4 of the system 1 shown in FIG. 1.

The trough 204a of the conveyor 204 is vibrated by a connecting rod 203 which receives motion from an eccentric 202 on the output shaft of a variable-speed electric motor 201. The trough 204a is preceded by a metering device including a weighing conveyor belt 206 which receives a continuous stream of tobacco particles 133 from a further belt conveyor 207. The weighing conveyor 206 is of known design; it is operated in such a way that it delivers to the trough 204a unit quantities of tobacco particles per unit of time. Such weighing conveyors are used in many types of tobacco processing plants to insure constant delivery of tobacco to conveyors, hoppers or the like. Suitable weighing conveyors are produced by the Firm Kukla of Vocklabruck, Austria under the designation DWB.

The moisture detector 208 for tobacco in the trough 204a is preferably of the same type (HWK) as the moisture detector 99 of FIG. 1. The suction pipe 141 for the blower 138 which delivers hot air into the lower portion of the chamber 106 is provided with a regulating valve 209 similar to the valve 67 of FIG. 1 and having a flap which is pivotable by a servomotor 216. The latter forms part of a control unit 211 which receives signals from the moisture detector 208 and further includes a potentiometer 213 or an analogous rated value setting device, a signal comparing junction 212 and an amplifier 214. The regulating valve 209 can change the ratio of hot air which has been heated by the heater 142 at the intake end of the suction pipe 141 to unheated atmospheric air which is admitted by the valve 209 to thus change the temperature of air which is caused to flow into the chamber 106.

The operation of the conditioning apparatus which includes the structure of FIG. 3 is as follows:

The belt conveyor 207 delivers a continuous stream of tobacco particles 133 onto the metering conveyor belt 206 which weighs successive increments of tobacco and delivers it into the trough 204a at a constant rate. This insures that the rate of delivery of tobacco particles onto the uppermost vibratory conveyor 107 in the chamber 106 is constant. Such particles reach the foraminous bottom wall of the conveyor 107 by way of the chute 136 and thereupon descend onto the conveyors 108, 109 to be transported into, through and beyond the intermediate and rear sections of the transporting system 101 in the same way as described in connection with FIG. 1.

The detector 208 determines the moisture content of tobacco in the trough 204a and produces signals which are transmitted to the junction 212. The latter also receives a signal from the potentiometer 213; such signal indicates the desired or normal initial moisture content of tobacco particles 133. The junction 212 transmits to the amplifier 214 a signal when the signal from the detector 208 differs from the signal furnished by the potentiometer 213, and the amplifier 214 then causes the servomotor 216 to adjust the valve 209 to effect a more or less intensive heating action in the chamber 106. The purpose of the control unit 211 is to compensate

for fluctuations in moisture content of tobacco particles 133 which are being fed into the chamber 106 of the first transporting section 102 by altering the condition of hot air in the pipe 139 in dependency on the condition of incoming tobacco. This insures that the condition (particularly moisture content) of tobacco which enters the chamber 111 of the intermediate transporting section does not deviate appreciably from a predetermined condition which is best suited to insure that tobacco which leaves the transporting system 101 is maintained at a predetermined temperature and has a predetermined moisture content.

FIG. 4 illustrates a conditioning apparatus for so-called greenleaf tobacco 422. Such tobacco is supplied in the form of a stream on the upper stretch of a belt conveyor 337 to enter the uppermost vibratory conveyor 307 in a chamber 306 forming part of the first section 302 of a transporting system 301. The conveyor 307 delivers tobacco 422 onto a second vibratory conveyor 308 which in turn delivers tobacco onto a longer third vibratory conveyor 309 extending through and beyond the sections 302, 303, 304 of the transporting system 301. The section 303 has three chambers 311, 312, 313 and the section 304 has a single chamber 314.

The means for delivering a continuous current of hot air into the lower portion of the chamber 306 is similar to the corresponding means of FIG. 1; it also comprises a blower 338, a suction pipe 341, a heater 342 and a further pipe 339. The construction of all three vibratory conveyors 307, 308, 309 is preferably identical with that of the conveyor 7 shown in FIG. 2. As the bottom walls 328 of the conveyors 307-309 break up the ascending air current in the chamber 306 into smaller air currents which pass through the perforations of the respective bottom walls, such small air currents assist the bouncing action of the bottom walls 328 to insure that the tobacco particles 422 which advance in the vibratory conveyors form layers of agitated particles which are subjected to the action of hot air from all sides to insure a uniform drying and moisture-expelling action. This guarantees an optimum exchange of energy between greenleaf tobacco 422 and hot air as well as a gentle treatment of tobacco without excessive breakage or comminution and without any appreciable formation of dust. Since the side walls (not specifically shown) of the conveyors 307-309 diverge in the same way as the side walls 31, 32 shown in FIG. 2, the speed of air currents which pass through the perforations of the bottom walls 328 decreases to thus reduce the likelihood that the lighter tobacco leaves would tend to rise with the air currents toward the screen 346 which is located below the outlet opening 344 which is the intake end of the conduit 343. The latter receives air whose temperature is lower than that of air in the pipe 339 but which has a higher moisture content.

The thus treated tobacco 422 thereupon passes through the chambers 311, 312, 313 of the transporting section 303 and is treated by hot air delivered into the chamber 311 by a blower 354 through a pipe 356. The suction pipe 364 of the blower 354 contains a regulating valve 367 whose flap can be pivoted by a servomotor 373 forming part of a control unit 368 which is practically identical with the control unit 68 with the exception that the moisture detector 399 is mounted in an auxiliary chamber 424 located between the chambers 313 and 314. The manner in which the chambers 311-313 are connected with each other (by way of

conduits 357, 358) is preferably the same as described in connection with FIG. 1. Spent hot air passes through sieve 363 in the chamber 313 and is discharged into the atmosphere by way of an outlet opening 359.

The lower portion of the chamber 314 receives hot air which is supplied by a blower 377 through a pipe 378 containing a pair of detectors 384, 386 corresponding to the similarly referenced detectors 84, 86 of FIG. 1. The temperature and/or moisture content of air in the chamber 314 preferably corresponds to the desired temperature and/or moisture content of conditioned greenleaf tobacco 422 which is delivered to a take-off conveyor 400. The suction pipe 382 of the blower 377 contains a heater 394 which is adjustable in the same way as described in connection with the heater 94 of FIG. 1. Therefore, the parts of the control unit 383 are denoted by reference characters similar to those employed in FIG. 1 plus 300. The moisture content of air in the pipe 378 can be varied by the motor 396 which drives the pump 397 in a water line 397a the lower end portion of which extends into the suction pipe 382 and is provided with an atomizing nozzle 398.

The conveyor 400 delivers conditioned greenleaf tobacco 422 into a compacting device here shown as a baling press 421 of known design wherein the tobacco is compacted to form bales which are ready for storage. A baling press which can be used in the conditioning apparatus of FIG. 4 is produced by the Firm Heinen of Varel, Western Germany.

The provision of auxiliary chamber 424 and the placing of the moisture detector 399 into such auxiliary chamber insure that the condition of tobacco 422 entering the chamber 314 of the last transporting section 304 can be regulated with an extremely high degree of accuracy. This in turn insures that the condition of tobacco 422 leaving the chamber 414 will be maintained within a very narrow range. The signals furnished by the detector 399 (such signals indicate the moisture content of tobacco in the chamber 424) are transmitted to the junction 371 of the control unit 368 so that the position of the valve 367 can be changed in dependency on changes in moisture content of tobacco in chamber 424. Consequently, the conditioning of air which flows through the chambers 311-313 of the transporting section 303 can be selected with a view to insure that the moisture content of tobacco 422 in the auxiliary chamber 424 equals the moisture content represented by the signal from the potentiometer 369 or that, if the moisture content detected by the device 399 in the chamber 424 deviates from such desirable moisture content, the condition of tobacco particles 422 can be rapidly changed before the particles enter the final conditioning chamber 314. Therefore, the air which is supplied by the blower 377 must compensate only for minor deviations of the moisture content of tobacco from the desired final moisture content as selected by the potentiometer 391.

It is clear that the auxiliary chamber 424 can be used with equal advantage in the conditioning apparatus of FIG. 1 or 3, i.e., that the final measurement of moisture content of tobacco need not take place downstream of the transporting system but can be carried out during transport of tobacco between the last two sections of the transporting system. This holds true for the conditioning of greenleaf tobacco as well as for the conditioning of other types of tobacco. The actual drying of tobacco particles takes place in the first two sections,

and the actual or final conditioning takes place in the rear section of the transporting system.

An important advantage of the improved method and apparatus is that the tobacco particles are subjected to a gentle initial drying action (in the chamber 6, 106 or 306) because such treatment takes place with the help of a current of hot air which flows countercurrent to the direction of tobacco transport. The initial drying is followed by treatment with hot air which flows concurrently with the direction of tobacco transport (in the section 3, 103 or 303) and finally by establishment of a hygroscopic equilibrium between hot air and tobacco (in the section 4, 104 or 304). The last treatment (in the section 4, 104 or 304) insures that the moisture content is the same in each portion of each tobacco particle.

Another important advantage of the improved method and apparatus is that the tobacco transport and the conditioning of air which is admitted into the three sections of the transporting system can be regulated in a simple way and with a high degree of accuracy. This is important in connection with the treatment of certain types of tobacco since it is often necessary to maintain the moisture content of tobacco within a very narrow range of a small fraction of one percent. A further advantage of the improved method and apparatus is that the tobacco particles are treated gently (due to the provision of vibratory conveyors which insure the formation of a layer of agitated tobacco particles) and that the treatment results in uniform drying of all portions of each tobacco particle as well as in minimal breakage or comminution and negligible formation of tobacco dust.

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.

I claim:

1. A method of conditioning tobacco with a gaseous fluid to thereby change its temperature and/or moisture content, comprising the steps of transporting unconditioned tobacco particles along a predetermined path; subjecting the particles to the action of a first current of a gaseous fluid which is conveyed substantially transversely of the direction of travel of the particles in a first portion of said path and whose speed, moisture content and/or temperature is maintained within a predetermined range; subjecting the particles to the action of a second current of a gaseous fluid which is conveyed substantially transversely of the direction of travel of the particles in a second portion of said path located downstream of said first portion and whose speed, moisture content and/or temperature is maintained within a predetermined range; and subjecting the particles to the action of a third current of a gaseous fluid in a third portion of said path located downstream of said second portion and maintaining the temperature and/or moisture content of said third current at a value which closely approximates or equals the de-

sired temperature and/or moisture content of conditioned particles.

2. A method as defined in claim 1, further comprising the steps of collecting at least a portion of the gaseous fluid of at least one of said first and second currents after said one current has contacted the particles in the respective portion of said path, utilizing the thus collected gaseous fluid to form at least a portion of said third current, and maintaining said third current in contact with the particles for an interval of time which suffices to establish a hygroscopic equilibrium between the gaseous fluid of said third current and the particles.

3. A method as defined in claim 1, wherein said transporting step comprises vibrating said particles so that the particles are transported in the form of a layer of agitated particles.

4. A method as defined in claim 1, wherein said particles form a stream of greenleaf tobacco.

5. A method as defined in claim 4, further comprising the step of compacting the conditioned tobacco.

6. A method as defined in claim 1, wherein each of said currents is heated air.

7. A method as defined in claim 6, further comprising the steps of subdividing each of said currents into a plurality of smaller currents immediately prior to contact with tobacco particles in the respective portions of said path.

8. A method as defined in claim 1, further comprising the step of gradually reducing the speed of said first and second currents during contact with tobacco particles in the respective portions of said path.

9. A method as defined in claim 1, further comprising the step of continuously measuring the temperature and/or moisture content of tobacco particles downstream of said second portion, and changing the speed, temperature and/or moisture content of at least one of said first and second currents when the measured temperature and/or moisture content of the particles deviates from a desired value.

10. A method as defined in claim 1, further comprising the steps of measuring the temperature and/or moisture content of said third current prior to entry into said third portion of said path, comparing the thus measured temperature and/or moisture content of said third current with a predetermined value, and changing the temperature and/or moisture content of said third current when the measured value thereof deviates from said predetermined value, said predetermined value being selected in such a way that the tobacco particles reach a condition of hygroscopic equilibrium with said third current not later than on leaving said third portion of said path.

11. A method as defined in claim 1, further comprising the steps of measuring the moisture content of tobacco particles between said second and third portions of said path, and adjusting the speed, temperature and/or moisture content of at least one of said first and second currents as a function of deviations of the measured moisture content of tobacco particles from a predetermined value.

12. In an apparatus for conditioning tobacco with a gaseous fluid to thereby change its temperature and/or moisture content, a combination comprising transporting means arranged to transport a stream of unconditioned tobacco particles along an elongated path, said transporting means comprising a plurality of successive

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sections defining successive portions of said path; first conditioning means arranged to subject the particles of tobacco to the action of a first current of a gaseous fluid in a first section of said transporting means and including means for conveying said first current substantially transversely of the direction of transport of tobacco particles in said first section and means for maintaining the speed, temperature and/or moisture content of said first current within a predetermined range; second conditioning means arranged to subject the particles of tobacco to the action of a second current of a gaseous fluid in a second section of said transporting means located downstream of said first section, said second conditioning means comprising means for conveying said second current substantially transversely of the direction of tobacco transport in said second section and means for maintaining the speed, temperature and/or moisture content of said second current within a predetermined range; and third conditioning means arranged to subject the particles of tobacco to the action of a third current of a gaseous fluid in a third section of said transporting means located downstream of said second section, said third conditioning means comprising means for maintaining the speed, temperature and/or moisture content of said third current within a predetermined range.

13. A combination as defined in claim 12, wherein said transporting means comprises at least one vibratory conveyor having a foraminous tobacco supporting bottom wall and wherein said means for conveying said first and second currents are arranged to convey the respective currents through said bottom wall substantially at right angles to the direction of transport of tobacco particles.

14. A combination as defined in claim 13, wherein said vibratory conveyor further comprises a pair of side walls diverging upwardly and outwardly from said bottom wall, said means for conveying said first and second currents being arranged to convey said currents upwardly through and beyond said bottom wall so that the speed of ascending air currents decreases between said side walls.

15. A combination as defined in claim 12 wherein said stream consists of greenleaf tobacco.

16. A combination as defined in claim 15, further comprising means for compacting conditioned greenleaf tobacco downstream of said third section of said transporting means.

17. A combination as defined in claim 12, further comprising metering means for supplying said first section of said transporting means tobacco particles at a constant rate.

18. A combination as defined in claim 12, wherein

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said transporting means comprises a vibratory conveyor arranged to transport tobacco particles through all of said sections.

19. A combination as defined in claim 12, wherein said first section comprises a single tobacco conditioning chamber.

20. A combination as defined in claim 12, further comprising detector means located downstream of said third section for measuring the moisture content of tobacco particles, the means for maintaining the speed, temperature and/or moisture content of at least one of said first and second currents within a predetermined range comprising means for comparing the measured moisture content of the particles with a predetermined moisture content and means for changing the speed, temperature and/or moisture content of said one current as a function of deviations of the measured moisture content of the particles from said predetermined moisture content.

21. A combination as defined in claim 12, wherein said means for maintaining the speed, temperature and/or moisture content of said third current within a predetermined range comprises means for maintaining the temperature and moisture content of said third current at a predetermined constant value.

22. A combination as defined in claim 12, further comprising measuring means for determining the moisture content of tobacco particles in a fourth section of said transporting means located between said second and third sections, the means for maintaining the speed, temperature and/or moisture content of at least one of said first and second currents within a predetermined range comprising means for comparing the measured moisture content of tobacco particles with a predetermined moisture content and means for changing the speed, temperature and/or moisture content of said one current as a function of deviations of the measured moisture content of tobacco particles from said predetermined moisture content.

23. A combination as defined in claim 12, further comprising means for measuring the moisture content of tobacco upstream of said first section of said transporting means, the means for maintaining the speed, temperature and/or moisture content of at least one of said currents within a predetermined range comprising means for comparing the measured moisture content of tobacco particles with a predetermined moisture content and means for changing the speed, temperature and/or moisture content of said one current as a function of deviations of said measured moisture content of tobacco particles from said predetermined moisture content.

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