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 [33] **Germany**
 [31] **H61642**

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[54] **METHOD AND APPARATUS FOR CONDITIONING TOBACCO OR THE LIKE**
20 Claims, 8 Drawing Figs.

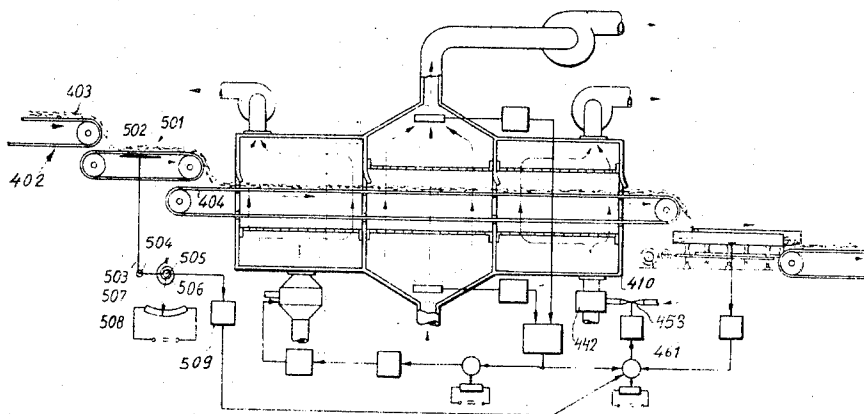
[52] U.S. Cl. **131/135,**
131/140
 [51] Int. Cl. **A24b 03/12,**
A24b 09/00
 [50] Field of Search. **131/135,**
140

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ABSTRACT: A stream of Burley tobacco is relieved of nitrogen by intensive heating so that its moisture content drops below an optimum moisture content for further processing. A valve which regulates the admission of moisture to successive increments of the thus heated stream is regulated in dependency on the results of measurements of the moisture content downstream of the point of moisture admission and in dependency on the extent of differences between the thus determined moisture content and the optimum moisture content. The valve can be further regulated in dependency on variations of parameters which influence the moisture content of tobacco upstream of the point of moisture admission, such as changes in the weight of successive increments of the stream and changes in the drop of temperature of air which is used to cool the stream after the intensive heating but prior to moistening. The temperature drop may also be used to simultaneously regulate the intensity of the heating.



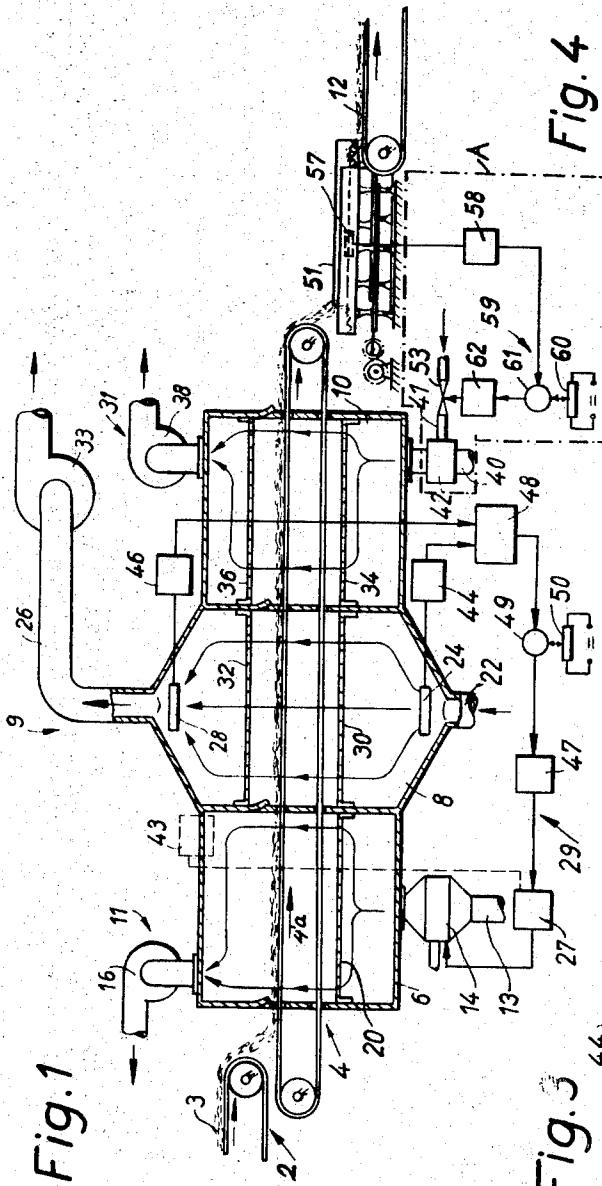


Fig. 1

Fig. 3

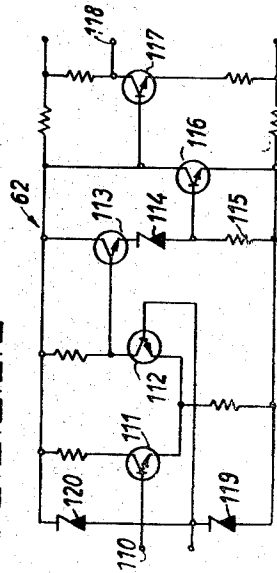


Fig. 4

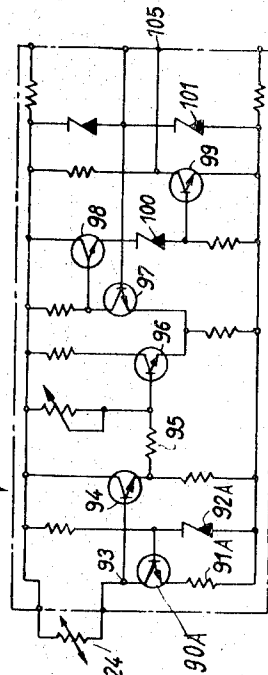
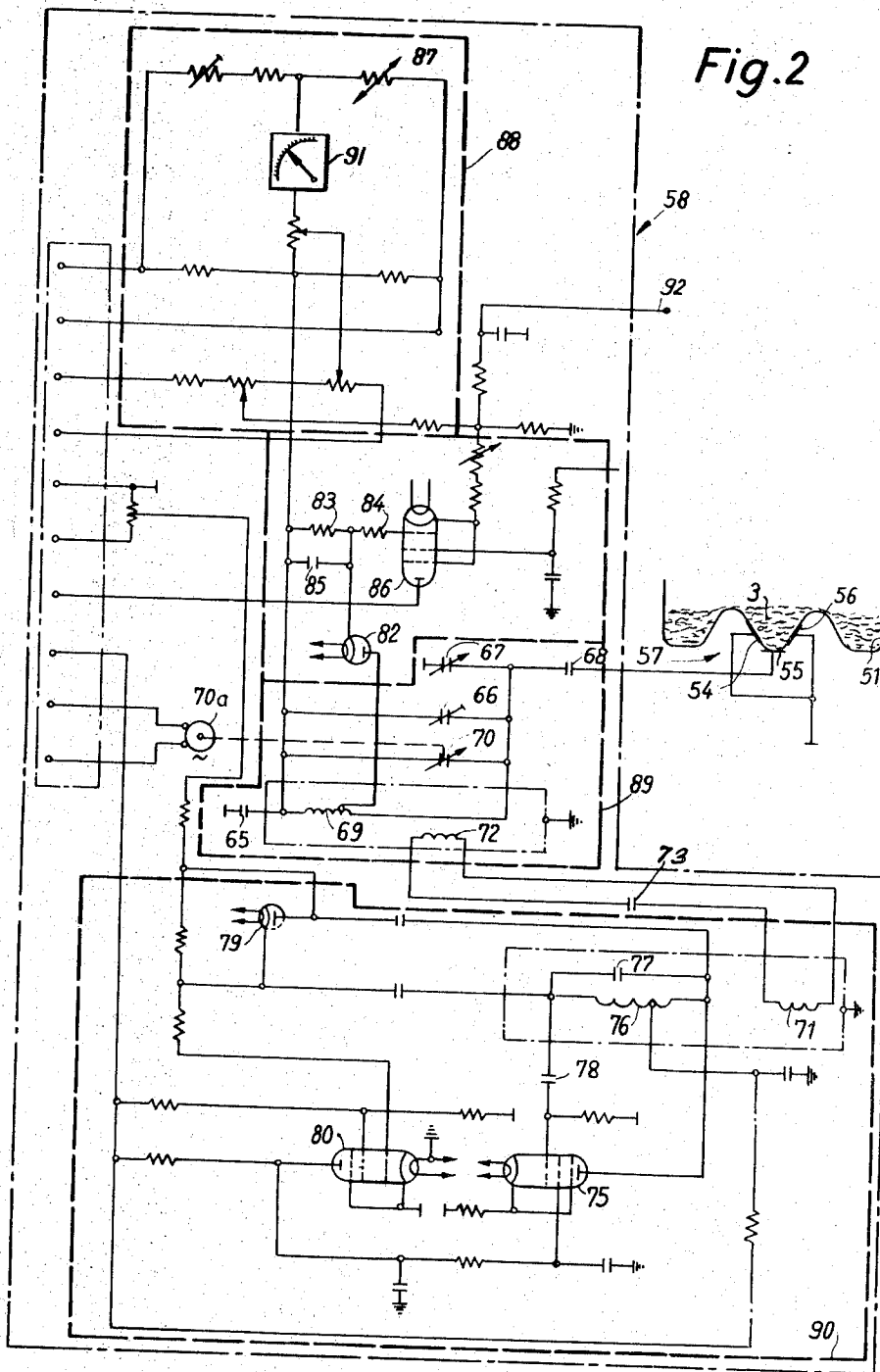


Fig. 3

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Fig. 5

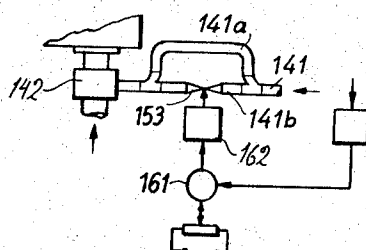
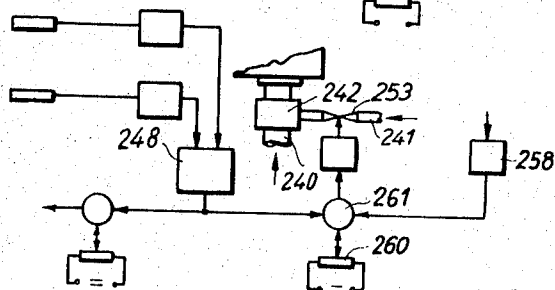


Fig. 6



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Fig. 7

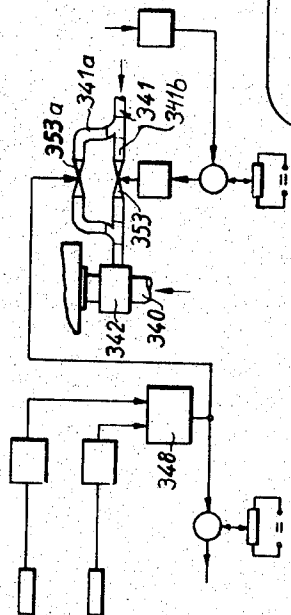
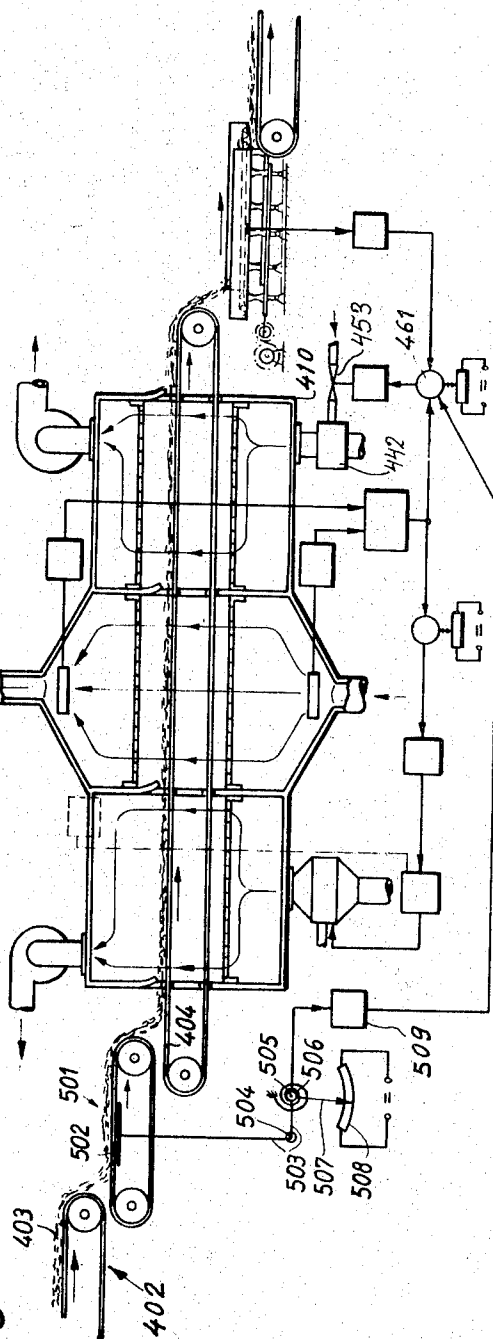


Fig. 8



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METHOD AND APPARATUS FOR CONDITIONING TOBACCO OR THE LIKE

CROSS-REFERENCE TO RELATED APPLICATIONS

The method and apparatus of my present invention constitute an improvement over the method and apparatus disclosed in my copending application Ser. No. 617,618, filed Feb. 21, 1967, now U.S. Pat. No. 3,502,085, and entitled "Method and Apparatus for Determining the Temperature of Tobacco."

Certain details of the circuitry in the apparatus of the present invention are disclosed in the copending application Ser. No. 411,788 filed by Hans Koch et al. on Nov. 17, 1964, now U.S. Pat. No. 3,372,488 and assigned to the same assignee.

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for conditioning tobacco or like fibrous materials, and more particularly to a method and apparatus which may be employed for conditioning of Burley tobacco.

It is well known that expulsion of nitrogen from Burley tobacco often necessitates heating to a temperature at which tobacco releases excessive moisture. Upon heating, the tobacco is subjected to a cooling action and its moisture content is raised to a value which is best suited for further processing. My aforementioned copending application Ser. No. 617,618, now U.S. Pat. No. 3,502,085 deals with a method and apparatus for controlled heating and cooling and for subsequent wetting or moistening of Burley.

SUMMARY OF THE INVENTION

It is an object of my invention to provide a novel and improved method and apparatus for automatically raising the moisture content of dried tobacco or like fibrous materials to an optimum value for further processing.

The method of my invention may be employed for conditioning of Burley tobacco, and particularly for wetting or moistening Burley tobacco which has undergone an intensive heating action and thereupon a cooling action. The method comprises conveying through a wetting or moistening zone a stream of tobacco whose moisture content is below a predetermined optimum moisture content, admitting to successive increments of tobacco moisture at a variable rate while such increments travel through the wetting zone, measuring the moisture content of the thus moistened increments, preferably in a zone downstream of the wetting zone, and regulating the admission of at least some of the total amount of moisture entering the wetting zone as a function of changes in the measured moisture content.

The procedure is preferably such that the measured moisture content is compared with the desired optimum moisture content and that the admission of at least some of the total amount of moisture entering the wetting zone is a function of the difference between the desired moisture content and the measured moisture content.

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 vertical sectional view of a conditioning apparatus which embodies one form of my invention;

FIG. 2 illustrates a portion of the electric circuit in the apparatus of FIG. 1;

FIG. 3 illustrates another portion of the electric circuit in the apparatus of FIG. 1;

FIG. 4 illustrates a further portion of the electric circuit in the apparatus of FIG. 1;

FIG. 5 illustrates a modification of a portion of the apparatus shown in FIG. 1, and more particularly a modification of that part of the apparatus located in the area surrounded by the phantom line A shown in FIG. 1;

FIG. 6 illustrates a portion, similar to that described in FIG. 5, of a third apparatus;

FIG. 7 shows a portion, similar to that described in FIG. 5, of a fourth apparatus; and

FIG. 8 illustrates, in a view similar to that of FIG. 1, a further apparatus wherein the moistening action is a function of the moisture content of conditioned tobacco and also a function of the rate of tobacco feed.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates an apparatus for conditioning Burley tobacco. The apparatus comprises a feed including an endless conveyor belt 2 which supplies a substantially continuous stream 3 of Burley tobacco onto the upper stringer of a driven endless transporting conveyor belt 4 consisting of foraminous material. The upper stringer of the transporting belt 4 travels in the direction indicated by arrow 4a and transports successive increments of the stream 3 along an elongated horizontal path. The right-hand end of the belt 4 discharges conditioned Burley tobacco into a trough 51 for a moisture measuring or detecting capacitor 57 and the trough 51 discharges tobacco onto the upper stringer of an endless takeoff belt 12. The transporting belt 4 extends through a drying chamber 6 which defines a tobacco heating zone, thereupon through a cooling chamber 8 which defines a cooling zone, and finally through a wetting or moistening chamber 10 which defines a wetting or moistening zone. Those increments of the stream 3 which advance through the drying chamber 6 exchange heat with air circulated by a heating unit 11. The increments passing through the chamber 8 are cooled by exchange of heat with air circulated by a pneumatic cooling unit 9, and the moisture content of increments passing through the wetting chamber 10 is raised by a wetting or moistening unit 31. The heating chamber 6 can be said to form part of the heating unit 11 which latter further comprises a blower or fan 16 having a suction inlet connected to the top wall of the chamber 6 and a pressure outlet which discharges heated air into the atmosphere. The bottom wall of the heating chamber 6 is connected with the outlet of an adjustable electric resistance heater 14 which receives atmospheric air or other suitable gaseous fluid from a supply pipe 13. The adjusting device for the heater 14 is shown at 27. The heating chamber 6 accommodates a platelike sieve or distributor 20 which is located below the lower stringer of the transporting belt 4. The purpose of the sieve 20 is to distribute heated air issuing from the heater 14 uniformly in all zones of the chamber 6 to insure uniform heating of Burley tobacco and controlled expulsion of nitrogen. The heating action which is necessary to expel nitrogen is so intensive that the tobacco mass leaving the chamber 6 must be enriched with moisture prior to further processing. Such mass contains only a few percent of moisture.

The bottom wall of the cooling chamber 8 is connected with a supply pipe 22 which admits cool atmospheric air, i.e., air whose temperature is lower than that of air issuing from the heater 14 of the unit 11. The top wall of the cooling chamber 8 is connected with a discharge pipe 26 serving to admit heated air to the suction inlet of a blower or fan 33 forming part of the pneumatic cooling unit 9. The apparatus further comprises a measuring means for determining the temperature of cooling air prior and subsequent to passage of such air through the tobacco stream 3 travelling with the upper stringer of the transporting belt 4. Such measuring means includes a first temperature measuring device or detector 24 located in the cooling chamber 8 below the belt 4 and a second temperature measuring device or detector 28 located in chamber 8 above the upper stringer of the belt 4. The detectors 24, 28 are in-

stalled in such a way that each thereof is sufficiently exposed to the stream of air flowing from the supply pipe 22 toward the discharge pipe 26. The cooling chamber 8 further accommodates two distributors or sieves 30, 32 which are respectively installed below and above the belt 4 and whose function is the same as that of the distributor 20 in the heating chamber 6. The upper sieve 32 is located between the path of the tobacco stream 3 and the upper detector 28. The detectors 24, 28 are respectively connected with control amplifiers 44, 46 which transmit electric signals to an evaluating device 48 forming part of a control circuit 29 which regulates the heater 14 through the intermediary of the adjusting device 27 as a function of the differential in temperatures measured by the detectors 24 and 28. The evaluating device 48 is a differential amplifier which transmits signals to a comparator circuit or synchronizing circuit 49. The latter is connected with an amplifier 47 which transmits signals to the adjusting device 27, and also with a rated value setting device 50, e.g., a suitable potentiometer. The device 50 can be adjusted by hand to influence the heating action of the unit 11. The magnitude of signals received by the amplifier 47 depends on the difference between the intensity of signals transmitted to the synchronizing circuit 49 by the device 50 on the one hand and by the evaluating device 48 on the other hand. Signals transmitted to the amplifier 47 and thence to the adjusting device 27 may be positive or negative signals, depending upon whether the heating action of the unit 11 is excessive or insufficient. The adjusting device 27 may comprise a conventional magnetic amplifier whose control windings receive current from the output of the amplifier 47 and whose load windings control the voltage for at least some of the resistances in the electric heater 14.

The wetting unit 31 which adds moisture to tobacco in the chamber 10 comprises a blower or fan 38 whose suction inlet is connected with the top wall of the chamber 10. This unit 31 further includes a supply pipe 40 for atmospheric air which is connected with the bottom wall of the chamber 10 and accommodates a conventional atomizer or disperser 42 serving to effect dispersion of liquid (preferably water) admitted thereto by a feed conduit 41. The conduit 41 contains an adjustable electromagnetically operated valve 53 which can regulate the rate of water flow to the atomizer 42 as a function of the intensity of electric signals transmitted thereto. Such types of valves are known in the art. For example, the valve 53 may include a valve member which is movable with reference to its seat and is connected with a coil located in a magnetic field. The strength of the current flowing through the coil can be varied as a function of the intensity of electric signals.

The wetting chamber 10 accommodates a lower sieve or distributor 34 located below the belt 4 and an upper sieve or distributor 36 located above the path for the tobacco stream 3.

The trough 51 accommodates three capacitor plates 54, 55, 56 (see FIG. 2) which form part of the measuring capacitor 57. The latter serves as a means for carrying out direct or immediate measurements of moisture content in successive increments of the stream 3 downstream of the wetting chamber 10. The trough 51 is similar to that disclosed in Pat. No. 3,320,528 to Esenwein and is designed to facilitate determination of the moisture content of successive increments of the stream 3 irrespective of eventual fluctuations in the rate of tobacco feed. The measuring capacitor 57 transmits signals to an adjusting device 59 which latter regulates the valve 53 of the wetting unit 31. The capacitor 57 transmits signals to a signal transmitting device 58 which in turn transmits signals to a comparator circuit or synchronizing circuit 61 of the adjusting device 59. A potentiometer 60 constitutes the rated value setting means of the device 59 and transmits signals to the synchronizing circuit 61. The output of the circuit 61 is connected with an amplifier 62 which is directly connected with the valve 53. Signals transmitted to the amplifier 62 are indicative of the difference between the intensity of signals transmitted to the synchronizing circuit 61 by the potentiometer

60 on the one hand and by the signal transmitting device 58 on the other hand.

The trough 51 is vibrated to effect continuous movement of the conditioned tobacco stream toward the takeoff belt 12. As shown in FIG. 2, the trough 51 comprises a central channel accommodating the plates 54—56 of the measuring capacitor 57 and two lateral channels into which tobacco overflows so that the central channel is invariably filled to capacity but not beyond capacity. This insures that the capacitor 57 can determine or detect the average moisture content of successive increments of the conditioned tobacco stream.

The capacitor 57 is connected into a high-frequency oscillating circuit 89 of the device 58. The circuit 89 includes capacitors 65—68, an inductance coil 69 and a variable rotary capacitor 70 which is driven at a constant speed by a motor 70a to change the reactance of the circuit. The oscillating circuit 89 is coupled in three-point connection with a high-frequency generator 90 through the intermediary of two coils 71, 72 and a capacitor 73. The generator 90 comprises essentially a pentode 75, a coil 76 and capacitors 77, 78, and is capacitatively coupled with a high-frequency rectifier 79 which actuates the control grid of a pentode 80. The plate voltage of the pentode 80 actuates the screen grid of the pentode 75. A high-frequency rectifier 82 forms part of a vacuum tube voltmeter 91 which further includes two resistors 83, 84, a capacitor 85 and a pentode 86. The output 92 (cathode circuit of the pentode 86) transmits signals generated by the device 58. A thermistor 87 is connected in a bridge circuit 88. When the motor 70a drives the capacitor 70 at a constant speed, the fundamental frequency of the oscillating circuit 89 varies periodically. Such frequency is determined by the coil 69, capacitor 68 and capacitor 57. The frequency of the generator 90 is amplitude stabilized due to feedback connection through the rectifier 82. This frequency is selected in such a way that it lies about in the middle of the periodically varying fundamental frequency of the oscillating circuit 89. The fundamental frequency range of the circuit 89 is determined by the capacitor 70 and is such as to be in resonance with the generator 90 once during each revolution of the capacitor 70 when the capacitor 57 is fully charged. There develops at the capacitor 57 a high-frequency field with the frequency of the generator 90 and an amplitude which is modulated with the frequency of the capacitor 70. Voltage peaks measured by the voltmeter 91 are in a linear relationship with the charge of the measuring capacitor 57 (moisture content and quantity).

The circuit of FIG. 2 is similar to that shown in FIG. 4 of the aforementioned copending application Ser. No. 411,788 of Hans Koch et al., now U.S. Pat. No. 3,372,488.

FIG. 3 illustrates the details of the temperature measuring device or detector 24 and of the associated control amplifier 44. The detector 24 comprises a temperature-sensitive semiconductive resistor and is connected in series with a transistor 90A, a resistor 91A and a Zener diode 92A. The flow of current in the circuit including the parts 90A—92A and 24 is held at a constant level due to the presence of detector 24. A junction 93 is connected with a push-pull stage (transistors 96, 97) through the intermediary of an auxiliary transistor 94 and a resistor 95. The push-pull stage 96, 97 is connected with a voltage amplifier stage including two transistors 98, 99. Zener diodes 100, 101 serve for voltage stabilization in the circuit. The output 105 of the control amplifier 44 furnishes a voltage which is in linear correspondence and relationship with the temperature detected by the detector 24.

The construction of the detector 28 and control amplifier 46 is similar. The evaluating device 48 is of conventional design.

The circuit of FIG. 3 is similar to that in FIG. 6 of the aforementioned copending application Ser. No. 411,788 of Koch et al., now U.S. Pat. No. 3,372,488.

Referring to FIG. 4, there is shown the circuit of the amplifier 62. The amplifier 47 is of similar design. The input 110 of the circuit shown in FIG. 4 is connected with a push-pull am-

plifier stage including two transistors 111, 112. This stage is connected with a voltage amplifier stage (including a transistor 116) through the intermediary of a coupling circuit including a transistor 113, a Zener diode 114 and a resistor 115. The transistor 117 forms part of a current amplifier stage and its collector is connected with the output 118 of the adjusting device 62. The Zener diodes 119, 120 serve for voltage stabilization. The input 110 receives impulses whose intensity is a function of the difference between the rated moisture content (potentiometer 60) and measured moisture content (signal transmitting device 58). Such impulses are power amplified by the push-pull stage (transistors 111, 112), thereupon voltage amplified (transistor 116) and current amplified transistor 117 so that the output 118 furnishes a satisfactory signal for regulation of the valve 53.

The circuit of FIG. 4 is similar to that shown in FIG. 7 of the aforementioned copending application Ser. No. 411,788 of Koch et al., now U.S. Pat. No. 3,372,488.

The operation of the apparatus shown in FIGS. 1 to 4 is as follows:

Successive increments of the stratified tobacco stream 3 enter the drying chamber 6 wherein a current of heated air flows upwardly from the heater 14 toward the fan 16. The current of heated air passes through the perforations of the distributor 20 and is thoroughly mixed to insure that each of its zones is equally hot prior to reaching the fibrous material on the belt 4. The sieve 20 also insures that the current of hot air is distributed uniformly in all zones of the heating chamber 6. The belt 4 is foraminous and permits passage of the air current which heats the tobacco sufficiently to expel nitrogen. Such expulsion requires heating to a temperature at which tobacco gives off excessive amounts of moisture so that its moisture content drops to a few percent and must be raised prior to further processing.

The strongly heated tobacco thereupon enters the median chamber 8 which receives cool atmospheric air from the supply pipe 22. Such air is distributed uniformly by the sieve 30 and thereupon penetrates through the belt 4 to exchange heat with tobacco and to pass through the sieve 32 prior to entering the discharge pipe 26 of the cooling unit 9. The sieves 30, 32 insure uniform distribution of air in all zones of the chamber 8. The lower detector 24 measures the average temperature of cool air which is admitted by the supply pipe 22 and the upper detector 28 measures the average temperature of heated air before such air enters the discharge conduit 26. The evaluating device 48 determines the difference between the two temperatures (in response to signals received from the control amplifiers 44, 46) and sends appropriate signals to the synchronizing circuit 49. The signals transmitted by evaluating device 48 are indicative of differences between the temperature of cooling air prior and subsequent to exchange of heat with tobacco in the chamber 8. The potentiometer 50 transmits to the synchronizing circuit 49 signals which are indicative of the desired or rated difference between the two temperatures, and the circuit 49 transmits to the amplifier 47 a signal whose intensity depends on the difference between the signals received from the potentiometer 50 and evaluating device 48. If the intensity of signals transmitted by the device 48 is different from the intensity of signals transmitted by the potentiometer 50, the amplifier 47 causes the adjusting device 27 to regulate the heater 14 in a sense to effect a more or less intensive heating action. If the difference detected by the evaluating device 48 is greater than warranted by the setting of the potentiometer 50, the adjusting device 27 reduces the heating action of the heater 14, and vice versa.

The thus cooled increments of the tobacco stream 3 enter the wetting chamber 10 which receives moist air from the atomizer 42. Such air is distributed evenly by the sieves 34, 36 and is withdrawn by the fan 38 after passing through the belt 4 and through the layer of tobacco thereon. Fully conditioned tobacco which issues from the chamber 10 is then showered into the trough 51 and is conveyed onto the upper run of the takeoff belt 12 which transports it to a further processing sta-

tion, not shown. The device 58 transmits signals which are indicative of the measured moisture content of successive increments of the conditioned tobacco stream, and such signals are received by the synchronizing circuit 61 which compares them with signals received from the potentiometer 60. The resulting signal is amplified by the amplifier 62 of the adjusting device 59 and is used to regulate the valve 53 which admits water to the atomizer 42. Signals transmitted by the amplifier 62 may be positive or negative signals.

Referring again to FIG. 1, the electric resistance heater 14 in the supply pipe 13 can be replaced by the infrared heater 43 (shown by broken lines). The adjusting device 27 of the circuit 29 then regulates the heating action of the heater 43. It is clear that the heater 14 can be used in combination with the heater 43.

In order to compensate for the time interval elapsing between measurement of moisture content by the capacitor 57 and adjustment of the valve by the device 59, the valve can be installed in such a way that it influences only a portion of the liquid which is supplied to the atomizer 42. This modification is illustrated in FIG. 5 wherein the parts corresponding to those shown in FIG. 1 are denoted by similar reference numerals each preceded by the digit "1." The structure shown in FIG. 5 corresponds to that shown in FIG. 1 in the area surrounded by the phantom line A. The feed conduit 141 of the wetting unit has two branches 141a, 141b the latter of which contains the valve 153. Thus, the valve 153 influences only that portion of the liquid stream which flows through the branch 141b whereas the branch 141a delivers to the atomizer 142 a substantially continuous stream of liquid. Adjustment of the valve 153 depends on the intensity of signals produced by the synchronizing circuit 161 transmitted by the amplifier 162.

FIG. 6 illustrates a modification of the structure shown in FIG. 5. In this embodiment of the present invention, the synchronizing circuit 261 of the device which adjusts the valve 253 receives signals from three sources, namely, from the signal transmitting device 258, from the potentiometer 260, and also from the evaluating device 248, i.e., the rate of liquid admission to the atomizer 242 is influenced in the same way as in FIG. 1 and additionally by the differential in temperatures measured by the detectors 24, 28 in the cooling chamber 8. The pipe 240 admits atmospheric air to the atomizer 242. The intensity of output signals produced by the evaluating device 248 depends on the relative moisture of Burley tobacco in the cooling chamber 8, i.e., signals transmitted by device 248 to the synchronizing circuit 261 indicate the initial moisture content of tobacco entering the wetting chamber 10. An advantage of the modification shown in FIG. 6 is that the valve 253 in feed conduit 241 is adjusted by device 248 prior to adjustment by the device 258. The circuit including the potentiometer 260 and signal transmitting device 258 completes or follows the adjustment of valve 253 by signals from the device 248 when a further adjustment is needed (i.e., depending upon whether, after adjustment of valve 253 in response to signals from device 248, the intensity of signals transmitted by the device 258 still deviates from the intensity of signals transmitted by the potentiometer 260). The manner in which the synchronizing circuit 261 can produce an output signal in response to three input signals is well known and the design of this circuit forms no part of the present invention.

A further modification of the structure which regulates the admission of liquid to the atomizer 342 in the pipe 340 is illustrated in FIG. 7. The feed conduit 341 has two branches 341a, 341b the latter of which contains a regulating valve 353 corresponding to the valve 153 of FIG. 5. The branch 341a contains a second regulating valve 353a which is adjustable in response to signals received from an evaluating device 348 corresponding to the device 48 or 248. This modification combines the features of the structures shown in FIGS. 1-4, 5 and 6 because the valve 353a can be adjusted with no delay by way of the evaluating device 348 and the valve 353 is adjusted in the same way as shown in FIG. 1 or 5. An important ad-

vantage of the solutions shown in FIGS. 5, 6 and 7 is that changes in the rate of liquid admission to the atomizer are less pronounced than in the apparatus of FIG. 4. This is due to the fact that a single valve 153 regulates the admission of a portion of the liquid, that a single valve 253 regulates the admission of liquid in response to detection of moisture content as well as in response to detection of excessive or insufficient temperature differences in the cooling chamber 8, or that two valves respectively regulate the admission of some liquid as a function of temperature differences in the cooling chamber and the admission of remaining liquid as a function of determination of the moisture content in conditioned tobacco.

Referring finally to FIG. 8, there is shown a further conditioning apparatus wherein all such parts which are similar to or identical with those described in connection with FIG. 1 are denoted by similar reference numerals each preceded by the digit "4." This apparatus is designed regulate the wetting action in chamber 410 in a manner as described in connection with FIGS. 1 to 4 and further as a function of changes in the rate of tobacco flow. The feed belt 402 showers successive increments of a tobacco stream 403 onto an intermediate conveyor 501 provided with or cooperating with a detector 502 which is a weighing device and whose displacement is a function of the changes in the mass of tobacco travelling toward the receiving end of the transporting belt 404. The detector 502 transmits motion to a linkage 503 provided with a pivot 504 and serving to turn a shaft 505 for the hub of a slider 507 forming part of a potentiometer 508. The shaft 505 is biased by a spring 506. The potentiometer 508 is connected in circuit with a control amplifier 509 which is connected to the synchronizing circuit 461. The intensity of signals produced by the amplifier 509 varies as a function of changes in the rate of tobacco flow over the intermediate conveyor 501. The synchronizing circuit 461 adjusts the valve 453 in such a way that the rate of liquid admission into the atomizer 442 is a function of several factors including fluctuations in the rate of tobacco delivery to the wetting chamber 410. The control amplifier 509 includes a delay unit which retards the transmission of signals to synchronizing circuit 461 so as to account for the interval required by successive increments of the stream 403 to advance from the detector or measuring device 502 into the wetting chamber 410. For example, the control amplifier 509 may include an endless magnetic tape whereon a recording head records signals in accordance with adjustments of the slider 507. A reproducing head transmits such signals to the synchronizing circuit 461 with requisite delay and an erasing head erases the signals downstream of the reproducing head. The speed of the tape is such that a signal encoded by the recording head reaches the reproducing head with the delay required by an increment of the stream 403 to travel from the belt 501 into the wetting chamber 410.

Of course, the apparatus of FIG. 8 can also embody the features shown in FIGS. 5, 6 or 7, i.e., the atomizer 442 can receive liquid from several valves or the setting of a single valve can be adjusted in accordance with the results of measurements of moisture content of conditioned tobacco as well as in accordance with the results of measurements of temperature differences in the cooling chamber.

It was found that the apparatus of this invention is capable of effecting requisite expulsion of nitrogen and of automatically increasing the moisture content of Burley tobacco to an optimum value which is best suited for further processing.

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.

I claim:

1. A method of treating fibrous materials, particularly of conditioning Burley tobacco subsequent to expulsion of nitrogen by intensive heating, comprising the steps of conveying successive increments of a stream of fibrous material

through a heating zone to reduce the moisture content of said fibrous material below a predetermined optimum content; conveying successive increments of said stream through a cooling zone; passing in said cooling zone a current of cooling gas through said stream so that the gas exchanges heat with said fibrous material; measuring the temperature of said gas prior and subsequent to passage through said stream; conveying said stream through a wetting zone; admitting to successive increments of said stream moisture at a variable rate while such increments travel through said wetting zone; measuring the moisture content of the thus moistened increments; and regulating the admission of at least some moisture entering said wetting zone as a function of changes in the measured moisture content and as a function of variations in difference between the temperatures of said gas prior and subsequent to passage through said fibrous material in said cooling zone.

2. A method of treating fibrous materials, particularly of conditioning Burley tobacco subsequent to expulsion of nitrogen by intensive heating, comprising the steps of conveying through a wetting zone a stream of fibrous material whose moisture content is below a predetermined optimum content; admitting to successive increments of said stream moisture at a variable rate while such increments travel through said wetting zone; measuring the moisture content of the thus moistened increments; measuring the rate of admission of fibrous material into said wetting zone; and regulating the admission of at least some moisture entering said wetting zone as a function of changes in the measured moisture content and as a function of changes in said rate.

3. A method of treating fibrous materials, particularly of conditioning Burley tobacco subsequent to expulsion of nitrogen by intensive heating, comprising the steps of subjecting a stream of fibrous material to an adjustable heating action during travel through a heating zone to reduce the moisture content of said fibrous material below a predetermined optimum content; conveying the thus heated fibrous material through a cooling zone; passing through said stream in said cooling zone a cooling gas so that the latter withdraws heat from said fibrous material; measuring the temperature of said gas prior and subsequent to passage through said stream; adjusting said heating action as a function of changes in the difference between the temperatures of said gas prior and subsequent to passage through said fibrous material in said cooling zone; conveying successive increments of the thus cooled stream through a wetting zone; admitting to successive increments of said stream moisture at a variable rate while such increments travel through said wetting zone; measuring the moisture content of the thus moistened increments; and regulating the admission of at least some moisture entering said wetting zone as a function of changes in the measured moisture content.

4. A method as defined in claim 3, further comprising the step of comparing the measured moisture content with said optimum moisture content, said regulating step comprising regulating the admission of at least some of the total amount of water entering said wetting zone as a function of changes in the difference between said optimum content and said measured content.

5. A method as defined in claim 3, wherein said regulating step comprises regulating the admission of some of the total amount of fluid entering said wetting zone.

6. A method as defined in claim 5, further comprising the steps of regulating the admission of the remainder of said total amount of fluid as a function of variations in the difference between the temperatures of said gas prior and subsequent to passage through the stream.

7. Apparatus for treating fibrous materials, particularly for conditioning Burley tobacco subsequent to expulsion of nitrogen by intensive heating, comprising transporting means for advancing a stream of fibrous material along a predetermined path; adjustable heating means adjacent to a first portion of said path for reducing the moisture content of fibrous material in said stream to below a predetermined optimum

content; cooling means adjacent to a second portion of said path and arranged to convey a current of cooling gas across said stream so that the gas is heated in said second portion of said path in response to exchange of heat with said fibrous material; detector means for measuring the differential in temperature of said gas prior and subsequent to exchange of heat with said fibrous material; adjustable wetting means operative to admit moisture to successive increments of said stream in a third portion of said path; moisture detecting means arranged to measure the moisture content of successive increments of said stream downstream of said third portion of said path; and adjusting means for adjusting said wetting means as a function of the results of measurements by said moisture detecting means and as a function of the results of measurements by said temperature detector means.

8. Apparatus as defined in claim 7, wherein said transporting means comprises channel means receiving successive increments of the moistened stream, said moisture detecting means comprising capacitor means having plate means in said channel means and said adjusting means comprising a source of high-frequency AC voltage connected with said plate means.

9. Apparatus as defined in claim 8, wherein said adjusting means further comprises high-frequency generator means, a high-frequency oscillating circuit coupled with said generator means and including said source and connected with said capacitor means, and vacuum tube voltmeter means receiving voltage impulses from said oscillating circuit and having an output for signals to said wetting means, said oscillating circuit further comprising means operative to effect periodic changes in the reactance of said circuit.

10. Apparatus as defined in claim 7, wherein said adjusting means comprises rated value setting means for producing signals indicating the optimum moisture content of said stream, and synchronizing means connected with said moisture detecting means and said rated value setting means and arranged to effect adjustments of said wetting means as a function of differences between the results of measurements by said moisture detecting means and said optimum moisture content.

11. Apparatus as defined in claim 7, further comprising an operative connection between said detector means and said heating means for adjusting the latter as a function of the results of measurements by said detector means.

12. Apparatus as defined in claim 7, wherein said adjusting means comprises rated value setting means for producing signals indicating said optimum moisture content and synchronizing means receiving signals from said detector means, said setting means and said moisture detecting means and being arranged to produce an output signal for adjustment of said wetting means as a function of the results of measurements by said detector means and as a function of differences between the signals from said setting and moisture detecting means.

13. Apparatus as defined in claim 7, wherein said wetting means comprises fluid admitting conduit means and valve means controlled by said adjusting means for regulating the rate of fluid admission through at least a portion of said conduit means.

14. Apparatus as defined in claim 13, wherein said wetting means comprises additional adjustable valve means in said conduit means and further comprising means for regulating said additional valve means as a function of a variable parameter measured upstream of said third portion of said path and influencing the moisture content of increments entering the range of said wetting means.

15. Apparatus for treating fibrous materials, particularly for conditioning Burley tobacco subsequent to expulsion of nitrogen by intensive heating, comprising transporting means for advancing a stream of fibrous material whose moisture content is below a predetermined optimum content along a predetermined path; adjustable wetting means operative to admit moisture to successive increments of said stream in a predetermined portion of said path; weight detecting means for measuring the rate at which said fibrous material enters said portion of said path; moisture detecting means arranged to measure the moisture content of successive increments of said stream downstream of said portion of said path; and adjusting means for adjusting said wetting means as a function of the results of measurements by said moisture detecting and said weight detecting means.

16. Apparatus as defined in claim 15, wherein said transporting means comprises channel means receiving successive increments of the moistened stream, said moisture detecting means comprising capacitor means having plate means in said channel means and said adjusting means comprising a source of high-frequency AC voltage connected with said plate means.

17. Apparatus as defined in claim 16, wherein said adjusting means further comprises high-frequency generator means, a high-frequency oscillating circuit coupled with said generator means and including said source and connected with said capacitor means, and vacuum tube voltmeter means receiving voltage impulses from said oscillating circuit and having an output for signals to said wetting means, said oscillating circuit further comprising means operative to effect periodic changes in the reactance of said circuit.

18. Apparatus as defined in claim 15, wherein said adjusting means comprises rated value setting means for producing signals indicating the optimum moisture content of said stream, and synchronizing means connected with said moisture detecting means and said rate value setting means and arranged to effect adjustments of said wetting means as a function of differences between the results of measurements by said moisture detecting means and said optimum moisture content.

19. Apparatus as defined in claim 15, wherein said wetting means comprises fluid admitting conduit means and valve means controlled by said adjusting means for regulating the rate of fluid admission through at least a portion of said conduit means.

20. Apparatus as defined in claim 19, wherein said wetting means comprises additional adjustable valve means in said conduit means and further comprising means for regulating said additional valve means as a function of a variable parameter measured upstream of said third portion of said path and influencing the moisture content of increments entering the range of said wetting means.