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APPARATUS FOR CONDITIONING TOBACCO

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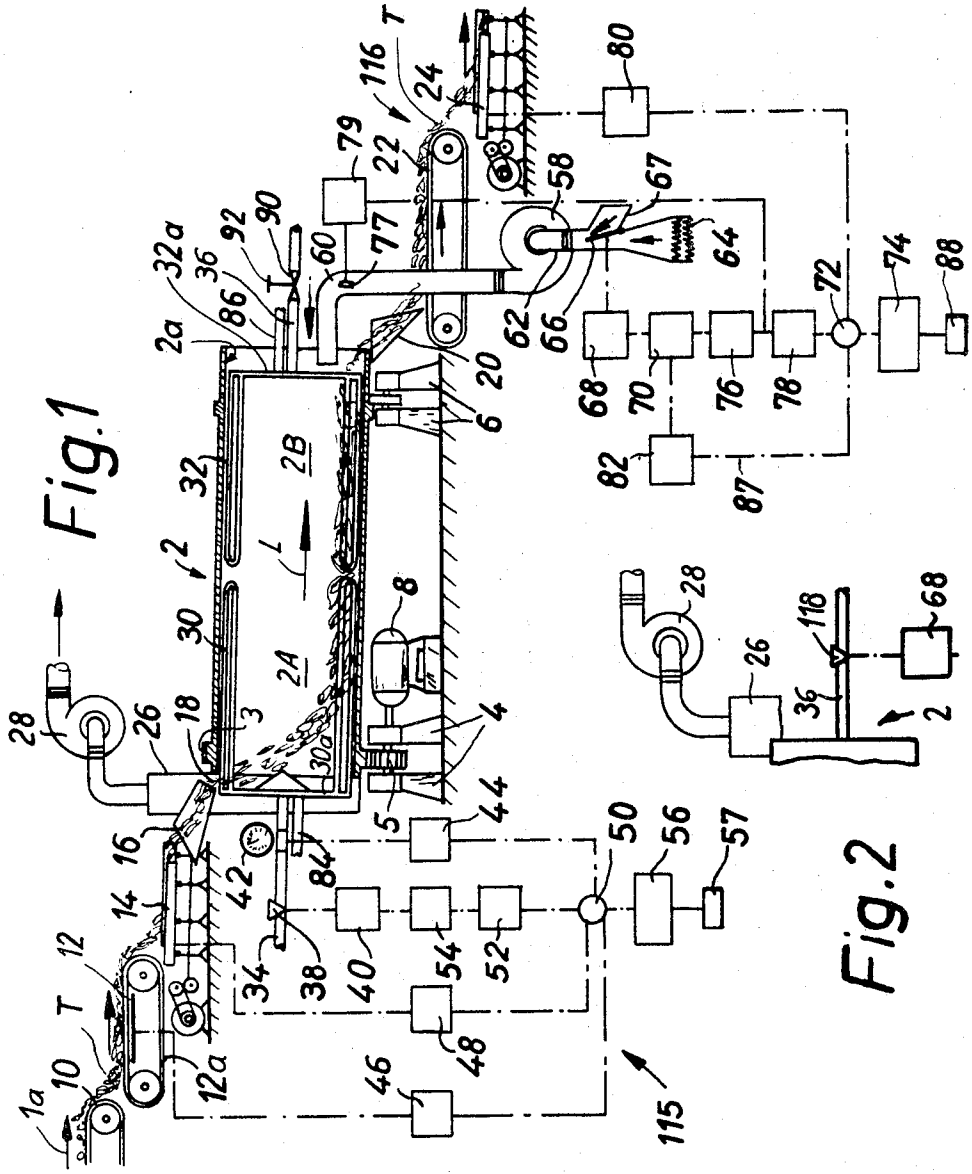


Fig.1

Fig.2

INVENTOR
WALDEMAR WOCHNOWSKI
BY Michael J. Strike
his ATTORNEY

United States Patent Office

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APPARATUS FOR CONDITIONING TOBACCO

Waldemar Wochnowski, Hamburg, Germany, assignor to Hauni-Werke, Koerber & Co. KG, Hamburg-Bergedorf, Germany

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The present invention relates to an apparatus for conditioning tobacco. More particularly, the invention relates to an apparatus for controlling the moisture content of whole or comminuted tobacco leaves. Still more particularly, the invention relates to improvements in tobacco conditioning apparatus of the type disclosed in the copending application Ser. No. 411,788 of Koch et al., filed Nov. 17, 1964, and assigned to the same assignee.

Said copending application Ser. No. 411,788 discloses a conditioning apparatus wherein a continuous tobacco stream is advanced through the chamber of a revolving drier and is heated by two heating units the first of which admits hot air at the upstream end of the chamber and the second of which comprises heating coils extending through the entire chamber. The heating action of the first unit can be regulated by a first control unit whose detectors determine the moisture content and certain other characteristics of the tobacco stream prior to admission into the drier. A second control unit which regulates the second heating unit comprises a detector which measures the moisture content of tobacco after the tobacco stream issues from the chamber of the drier. It was found that the conditioning action of hot air discharged by the first heating unit is often ineffective in the downstream part of the drier because the temperature of air changes considerably on contact with tobacco particles in the upstream portion of the drier. Thus, the heating action of the second heating unit is felt along the full length of the drier but the first heating unit is effective mainly in the region adjacent to the inlet of the aforementioned chamber. The just described conditioning apparatus operates very satisfactorily if the moisture content of successive increments of the tobacco stream varies gradually. However, if an increment having a first moisture content is followed by an increment having a substantially higher or substantially lower moisture content, the influence of the second heating unit upon the increments passing through the upstream portion of the drier will not reflect the actual moisture content of such increments. This will be readily understood by bearing in mind that the second heating unit is regulated by the second control unit whose moisture detector, is located downstream of the drier, i.e., at a greater distance from the upstream portion than from the downstream portion of the conditioning chamber in the drier. While the moisture detector can be placed close to the outlet of the drier, the conditioning chamber must have a certain length so that the elements of the second heating unit, which extends along the full length of the drier, might subject tobacco in the upstream section of the conditioning chamber to excessive or insufficient heating action, depending on the moisture content of that increment which has caused the downstream moisture detector to adjust the second heating unit.

Accordingly, it is an important object of the present

invention to provide an apparatus for controlling the moisture content of tobacco which is constructed and assembled in such a way that unsatisfactory heating or roasting of successive increments of a travelling tobacco stream is either eliminated or that the likelihood of unsatisfactory heating is reduced to a minimum regardless of whether the moisture content of successive increments of the tobacco stream varies gradually or abruptly.

Another object of the invevntion is to provide the conditioning apparatus with novel heating means and with relatively simple, compact and reliable control units for such heating means.

A further object of the invention is to provide a conditioning apparatus which can be used for controlling the moisture content of whole or comminuted tobacco leaves and which can change the moisture content by full consideration of two or more characteristics of the treated material.

An additional object of the invention is to provide a conditioning apparatus which can treat large quantities of tobacco per unit of time.

A concomitant object of the invention is to provide a novel method of conditioning a continuous travelling tobacco stream.

Briefly stated, one feature of my present invention resides in the provision of an apparatus for controlling the moisture content of tobacco. The apparatus comprises a drier defining a continuous conditioning chamber having a plurality of adjoining sections including an upstream section and a downstream section, a feed for advancing a stream of moist tobacco into, through and from the conditioning chamber so that the tobacco enters the upstream section prior to entering the downstream section, heating means including a first and a second adjustable heating unit for respectively heating tobacco in the upstream and downstream sections of the conditioning chamber, and first and second control means. The first control means comprises first detector means for measuring the moisture content of tobacco prior to admission of such tobacco into the conditioning chamber and first adjusting means for adjusting, if necessary, one of the adjustable heating units in accordance with the result of such measurement. The second control means comprises second detector means for measuring the moisture content of tobacco subsequent to evacuation of tobacco from the conditioning chamber and second adjusting means for adjusting, if necessary, the other adjustable heating unit in accordance with the result of measurement furnished by the second detector means.

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 drawings, in which:

FIG. 1 is a diagrammatic partly sectional view of an apparatus which embodies one form of the present invention; and

FIG. 2 illustrates a portion of a second apparatus.

FIG. 1 shows an apparatus which can be utilized for conditioning tobacco leaves in comminuted or uncomminuted condition. In the following description, the tobacco

stream T whose particles are conditioned in the apparatus of FIG. 1 will be referred to as a stream consisting of shredded tobacco. The apparatus comprises five basic assemblies, namely, a drier 2 defining a continuous conditioning chamber 2*a*, a feed including the parts 10, 12*a*, 16, 8, 20, 22 which serve to advance a continuous tobacco stream T lengthwise into, through and beyond the conditioning chamber 2*a*, heating means including two adjustable heating units 30 and 58, 60, 62, 64, and an auxiliary heating unit 32 for conditioning tobacco in the chamber 2*a*, a first control unit 115 which can adjust one of the adjustable heating units in response to determination of one or more characteristics of the tobacco stream T prior to entry of this stream into the chamber 2*a*, and a second control unit 116 which can adjust the other adjustable heating unit in response to determination of one or more characteristics of the tobacco stream T after the stream issues from the chamber 2*a*.

Referring now to FIG. 1 in greater detail, the drier 2 is a rotary cylinder or drum whose axis is inclined downwardly in a direction from the inlet 18 toward the outlet of the conditioning chamber 2*a* so that the tobacco stream T is compelled to advance in the direction indicated by an arrow 1 as soon as the drier 2 begins to rotate. Therefore, the motor 8 which is used to rotate the drier 2 can be said to constitute an element of the aforementioned feed which advances the tobacco stream lengthwise. The drier 2 is formed with a ring gear 3 and is supported by brackets 4 and 6. The gear 3 meshes with a pinion 5 which is driven by the output shaft of the motor 8. This motor is preferably of the variable speed type, or the motion transmitting connection between its output shaft and the pinion 5 may comprise a suitable variable speed transmission as disclosed in U.S. Patent No. 3,039,201 to Esenwein.

The aforementioned feed further comprises a conveyor belt 10 which can receive a continuous shower of shredded tobacco from a distributor, hopper or other suitable source, preferably in such a way that each successive increment or unit length of the tobacco stream T contains the same amount of shreds. The belt 10 showers the particles of the tobacco stream T onto a second conveyor belt 12*a* which cooperates with a detector in the form of a weighing device 12 serving as a means for determining the weight of successive increments of the tobacco stream and for producing impulses whose magnitude is indicative of the result of such measurement. Since the tobacco stream T is preferably conveyed at a constant speed and at a constant rate, the detector 12 will generate impulses at regular intervals or continuously, and such impulses are then utilized to adjust the heating action of the heating unit 30 whenever the rate of tobacco feed deviates from a preselected optimum value. The detector 12 forms part of the first control unit 115.

The control unit 115 also includes a vibrating trough 14 which receives the tobacco stream T from the belt 12*a* and delivers the shreds into an inclined chute 16 forming part of the feed and discharging into the inlet 18 of the conditioning chamber 2*a*, namely, into an upstream section 2A of the chamber which accommodates the adjustable heating unit 30 and whose volume equals about half the volume of the conditioning chamber.

The trough 14 constitutes one component of a dielectric moisture detector of the type disclosed, for example, in the copending application Ser. No. 192,834 of Esenwein which is assigned to the same assignee. This detector is capable of determining variations in moisture content of successive increments of the tobacco stream T and sends impulses which are utilized to adjust the action of the heating unit 30 when the moisture content deviates from a preselected optimum value.

The feed also comprises a second inclined chute 20 which receives conditioned tobacco shreds from the downstream section 2B of the chamber 2*a*. This downstream section 2B occupies the other half of the conditioning chamber and accommodates the auxiliary heating unit 32. The chute 20 discharges onto a conveyor belt 22 which latter, in turn, discharges into a vibrating trough 24 forming part of the second control unit 116 and constituting an element of a second dielectric moisture detector which serves to determine the moisture content of successive increments of the conditioned tobacco stream, i.e., of such increments which have been discharged from the downstream section 2B of the conditioning chamber 2*a*.

A suction head 26 is attached to the left-hand end of the drier 2 to evacuate from the section 2A spent heating medium which is supplied to the section 2B by the adjustable heating unit 58–64. The suction head 26 is connected with the suction side of a fan 28 or with another suitable suction generating device.

The heating unit 30 includes a set of heating coils which extend axially of the drier 2 and along the full length of the section 2A. The coils of the heating unit 30 can be said to constitute agitating vanes or blades which mix the particles of the tobacco stream T during passage through the section 2A so that each patricle or shred is subjected to a satisfactory heating action. The coils of the heating unit 30 are connected to a header 30*a* which is disposed in the interior of the suction head 26 and receives a heating medium, preferably saturated or unsaturated steam, through a supply pipe 34 which contains an adjustable valve 38 constituting the adjusting means of the first control unit 115. A discharge pipe 84 serves to evacuate spent steam after such steam has been circulated through one or more coils of the heating unit 30. It is clear that the heating unit 30 may be replaced by an adjustable electric heating unit without departing from the spirit of my invention. The valve 38 is then replaced by a potentiometer or another suitable adjusting means which can influence the heating action of the heating unit in the section 2A.

The auxiliary heating unit 32 comprises coils which extend along the full length of the section 2B and agitate the particles of the stream T of their way from the section 2A into the chute 20. A supply pipe 36 conveys steam to a header 32*a* of the heating unit 32, and a discharge pipe 86 evacuates spent steam. The supply pipe 36 contains a steam valve 90 which can be adjusted by a handle 92. The heating unit 32 can be replaced by an electric heating unit.

The valve 38 in the supply pipe 34 of the adjustable heating unit 30 can be adjusted by a servomotor 40. The control unit 115 for the heating unit 30 further comprises a third detector 42 constituted by a pressure gauge which is installed in the supply pipe 34 downstream of the valve 38. This pressure gauge sends impulses to a transducer 44 which conveys output signals to a junction 50 in the electric circuit of the control unit 115. A second transducer 46 receives impulses from the weighing device 12 and conveys output signals to the junction 50. The dielectric moisture detector including the trough 14 sends impulses to a third transducer 48 which converts such impulses into suitable electric signals and conveys the signals to the junction 50. The connection between the junction 50 and the servomotor 40 for the valve 38 includes two amplifiers 52, 54. The junction 50 is further connected with the output of a rated value selecting or setting device 56 which can be adjusted by a handle, push-button, lever or an analogous actuating device 57.

The second adjustable heating unit 58–64 comprises a blower 58 whose pressure side is connected with a supply pipe 60 discarging into the outlet of the drier 2, i.e., into the downstream end of the section 2B. The suction pipe 62 of the blower 58 has an open intake end which draws air from the atmosphere and contains an electric heater 64 including one or more resistance wires. The adjusting means for the heating unit including the just described parts 58–64 includes a valve 66 which can admit atmospheric air into the suction pipe 62 downstream of the

electric heater 64, so that such air (admitted through a nipple 67) influences the temperature of heated air entering the suction side of the blower 58. The valve 66 is adjustable by a servomotor 68.

The elements 66 and 68 form part of the second control unit 116 whose junction 72 is connected with a transducer 80 receiving impulses from the dielectric moisture detector including the trough 24. The junction 72 is further connected with a rated value setting device 74 controlled by an actuating device 88. Three amplifiers 78, 76, 70 connect the junction 72 with the servomotor 68 for the valve 66.

The numeral 77 denotes a further detector which measures the temperature of heated air flowing through the supply pipe 60. This detector 77 is connected with the input of the amplifier 76 through the intermediary of a transducer 79. The amplifier 70 has a second output connected with the input of a timer 82 which is connected with the junction 72 by a conductor 87.

The operation of the apparatus shown in FIG. 1 is as follows:

The conveyor belt 10 receives a continuous shower of shredded tobacco particles which form the stream T and advance in the direction of the arrow 1a. The distributor which feeds tobacco to the belt 10 is preferably adjusted to deliver such tobacco at a uniform rate so that each successive increment of the stream T preferably contains the same amount of shreds. While advancing with the upper stringer of the belt 12a, such successive increments of the tobacco stream T are weighed by the detector 12 and thereupon enter the trough 14 of the dielectric moisture detector. This detector determines the moisture content of successive increments and sends impulses to the transducer 48. The chute 16 then admits successive increments of the stream T into the inlet 18 of the conditioning chamber 2a so that the stream advances first through the upstream section 2A and thereupon through the downstream section 2B. The motor 8 rotates the drier 2 at a constant speed whereby the coils of the heating units 30, 32 agitate the tobacco shreds while such shreds travel toward the chute 20. The inclination of the drier 2 causes the tobacco stream T to travel from the inlet 18 toward the right-hand end of the section 2B.

The heating unit 30 is effective in the upstream section 2A of the conditioning chamber 2a. The heating action of this unit is determined by the control unit 115, i.e., by the setting of the adjusting means (valve 38) which admits steam to the header 30a at a rate determined by the servomotor 40. This servomotor will adjust the valve 38 in accordance with the results of measurements carried out by the dielectric moisture detector (trough 14) and detector 12. In other words, the rate at which fresh steam is admitted into the coils of the heating unit 30 (and hence the heating or roasting action of such coils) depends on the moisture content of tobacco upstream of the conditioning chamber 2a and on the weight of successive increments of the stream T. The coils of the heating unit 30 also heat the wall of the drier 2 so that the shreds of the tobacco stream T are conditioned by contact with the coils and by contact with the drier. Another factor determining the setting of the valve 38 is the pressure measured by the gauge 42 which sends impulses to the transducer 44. This transducer, in turn, sends signals that influence the operation of the servomotor 40. It will be seen that the momentary setting of the valve 38 is a function of several factors which are determined by the detectors 12, 14 and 42. The servomotor 40 will adjust the valve 38 only when the integrated signal transmitted by the transducers 44, 46, 48 differs from the signal transmitted by the rated value setting device 56. In other words, the control unit 115 actually compares the joint signal produced by the transducers 44, 46, 48 with the signal produced by the device 56 and the valve 38 will change the rate of steam admission into the distributor 30a only when the two signals do not cancel each other. A negative signal transmitted to the servomotor 40 will cause the latter to reduce the rate of steam flow through the supply pipe 34, and a positive signal will cause the valve 38 to open a greater cross-sectional area of the pipe 34 for admission of fresh steam. Each adjustment of the valve 38 results in a change in steam pressure immediately upstream of the distributor 30a, and such changes are detected by the pressure gauge 42.

The particles of shredded tobacco in the chamber 2a are further conditioned by hot air which is admitted by the heating unit 58–64. The heating action of such air depends on the setting of the adjusting means (valve 66) which regulates the admission of relatively cool atmospheric air through the nipple 67. The rated value setting device 74 of the second control unit 116 can be adjusted in such a way that the heating action of air admitted by the supply pipe 60 has little or no effect on tobacco shreds in the upstream section 2A of the conditioning chamber 2a. In other words, air admitted by the supply pipe 60 will actually condition tobacco shreds only in the downstream section 2B of the chamber 2a. The air flowing countercurrently through the section 2A then merely withdraws vapors which develop in response to drying of tobacco shreds by the heating unit 30. Of course, the setting of the device 74 can also be such that hot air admitted by the supply pipe 60 contributes considerably to the heating and drying action of the control unit 30, i.e., that the temperature of air admitted by the pipe 60 is sufficiently high on entry of such air into the upstream section 2A to influence the roasting of tobacco shreds immediately after such shreds enter the drier. When the control unit 116 causes its valve 66 to reduce considerably (or to terminate) the inflow of cool air through the nipple 67, the conditioning action of the heating unit 58–64 is superimposed upon the conditioning action of the heating unit 30 so that both heating units influence the drying action in the upstream section 2A of the chamber 2a. Regardless of the exact setting of the valve 66, the heating unit 58–64 invariably influences the drying action in the downstream section 2B so that the drying action in each section of the chamber 2a is controlled by an adjustable heating unit whereby one of these adjustable heating units can but need not be effective in the area which is heated by the other heating unit. When the heating action of air admitted by the supply pipe 60 is felt only in the section 2B, the unit 115 controls the heating action in the section 2A and the unit 116 controls the heating action only in the section 2B. This is of considerable advantage for reasons which were outlined hereinabove. All that the person in charge has to do is to adjust the device 74 by means of the handle 88 to select the preferred mode of operation in connection with a certain type of tobacco having a certain moisture content and being fed at a certain rate. The adjustment can be carried out while the apparatus is in actual use.

The adjusting action of the control unit 116 is such that the valve 66 is caused to reduce the admission of unheated air via nipple 67 when the detector including the trough 24 determines that the moisture content of tobacco leaving the conditioning chamber 2a is too high. In other words, air flowing in the supply pipe 60 then consists mainly of air which has been heated by the electric heater 64.

The amplifier 70 sends signals to the timer 82 which serves as a damper to prevent sudden variations in the temperature of air in the supply conduit 60. Signals transmitted from the amplifier 70 are delayed by the timer 82 and such signals prevent abrupt changes in the intensity of signals transmitted to the amplifier 78.

The timer 82 preferably comprises a capacitor and emits delayed signals whose amplitude is inversely proportional to the output potential of the amplifier 70. This interrupts the adjustment of the servomotor 68 by an interval which corresponds to the constant of the timer 82. Such constant is preferably proportional to the length of an interval

which elapses between an adjustment of the valve **66** and the moment when the detector including the trough **24** detects changes in moisture content in response to such adjustment.

Each adjustment of the valve **66** and the resultant change in the temperature of fluid in the supply conduit **60** is sensed by the detector **77** which sends impulses to the transducer **79** and the signals emitted by the transducer **79** also produce a damping action upon the adjustments of the servomotor **68** and valve **66**.

In the embodiment of FIG. 1, the auxiliary heating unit **32** is not adjustable by the control unit **115** and/or **116**. Its valve **90** is adjustable by hand (handle **92**) and the position of such valve then remains unchanged. The heating action of the unit **32** is superimposed upon the heating action of the adjustable heating unit **58–64**. The adjustment of the valve **90** can be made in dependency on the moisture content of tobacco upstream or downstream of the conditioning chamber **2***a*. It will be seen that successive increments of the tobacco stream T passing through the downstream section 2B are subjected to a constant heating action of the auxiliary unit **32** and also to a variable heating action of the unit **58–64**. The current of hot air admitted by the supply conduit **60** flows countercurrent to the tobacco stream T and is withdrawn by the fan **28** through the suction head **26**.

It is clear that the electric control units **115**, **116** may be replaced by other types of control units. For example, the servomotor **40** and/or **68** can be adjusted by mechanical, pneumatic or hydraulic means without departing from the spirit of the present invention.

It is equally clear that the conditioning chamber **2***a* of the drier **2** may be subdivided into three or more sections in each of which the tobacco stream is treated by one or more auxiliary and/or adjustable heating units. Each adjustable heating unit can be controlled by a separate control unit **115** and/or **116**. Regardless of the number of adjustable heating units, the action of the heating unit or units for conditioning tobacco in the upstream section or sections of the conditioning chamber is preferably regulated by a control unit whose detector or detectors determine the characteristics of tobacco prior to admission into the drier. At least one downstream heating unit is preferably regulated by a control unit whose detector or detectors determine the characteristics of tobacco in a zone located past, i.e., downstream of the drier.

A very important advantage of my conditioning apparatus is that the chamber **2***a* of the drier **2** is continuous, i.e., that the drier is a one-piece cylinder. In certain conventional apparatus, for example, in the apparatus disclosed in U.S. Patent No. 2,768,629 to Maul, the tobacco stream is conveyed through a plurality of separate driers each of which is equipped with its own heating unit. Such constructions are rather bulky and their heating units consume more energy. A subdivision of chambers in such separate driers into upstream or downstream sections is not disclosed.

Contrary to the teaching in the aforementioned copending application Ser. No. 411,788 of Koch et al., the heating unit **58–64** of my conditioning apparatus conveys a current of heated air to the downstream end of the conditioning chamber **2***a* and such air is thereupon withdrawn by the suction head **26** at the inlet **18** so that air flows counter to the direction of the tobacco stream T. This is of advantage in treatment of many types of tobacco because the quality of tobacco is improved if the substances which are expelled in response to roasting are compelled to remain in contact with the tobacco particles along the full length of the conditioning chamber. The curve indicating the drop in temperature of a current of air flowing countercurrent to the tobacco stream is a substantially straight line, i.e., the air is cooled gradually because the air current admitted by the supply pipe **60** and flowing toward the suction head **26** exchanges heat with successive increments of tobacco whose temperature increases in a direction toward the pipe **60**. As stated before, the temperature and quantity of heating medium admitted by the pipe **60** can be readily selected in such a way that the heating action of this medium is felt mainly or exclusively in the downstream section **2B** of the conditioning chamber **2***a*, namely, in the section nearer to the detector including the trough **24** which controls the temperature of the heating medium. In other words, and if the heating unit **58–64** is effective only in the section 2B, it will properly condition the tobacco stream as long as the moisture content of successive increments does not change without any transition, i.e., if the moisture content of the increment located in the range of the detector including the trough **24** is not substantially different from the moisture content of the increment passing through the section 2B.

The provision of the auxiliary heating unit **32** contributes to more economical operation of the conditioning apparatus. The auxiliary unit **32** takes care of such heating action which is always necessary in the section 2B so that the heating unit **58–64** takes care only of such heating which is necessary in addition to the heating action of the unit **32**. This enables the unit **58–64** to operate with lesser quantities of heated air and to respond more rapidly to eventual fluctuations in the moisture content.

The function of the detector **12** is to enhance the accuracy of the control unit **115** because this control unit adjusts its valve **38** by full consideration of the moisture content and also by full consideration of eventual fluctuations in the weight of successive increments of the tobacco stream T.

FIG. 2 illustrates a portion of a modified conditioning apparatus wherein the heating unit **32** (only the supply pipe **36** of this heating unit is actually shown) is adjustable by the servomotor **68** of the control unit **116**. The servomotor **68** controls a steam valve **118** which replaces the valve **90** of FIG. 1. The construction of the heating unit **30** and control unit **115** (not shown) is the same as in the apparatus of FIG. 1. In this embodiment of my invention, the heating unit **58–64** can be omitted or, if provided, constitutes an auxiliary heating unit whose valve **66** is adjusted once and then remains in selected position in the same way as described in connection with the valve **90** of FIG. 1.

In the apparatus of FIG. 2, the heating action of the unit including the supply pipe **36** is felt solely in the downstream section of the conditioning chamber and the heating unit **30** (not shown in FIG. 2) is effective in the upstream section. If the heating unit **58–64** is not used in the apparatus of FIG. 2, the suction fan **28** serves only as a means for withdrawing vapors and its suction head **26** can be connected to the downstream end of the drier **2**. It is equally possible to provide two suction heads **26** each of which is connected to one end of the drier.

My improved conditioning apparatus has been constructed by full consideration of the recognition that the moisture content of tobacco should not be changed too rapidly. Thus, the conditioning operation should not be too rapid because the quality of tobacco forming the stream T would suffer if the shreds would be subjected to excessive heating. For example, and if the heating action of the unit **30** in the upstream section 2A of the conditioning chamber **2***a* would be so strong that particles entering the section 2B would have the desired moisture content, the surfaces of the individual particles would be heated well beyond a permissible temperature. In fact, overheating does not result in sudden expulsion of moisture because the streamlets of moisture in the capillaries of tobacco leaves are interrupted and the remaining moisture remains entrapped in the material of the leaf. In order to avoid such rapid overheating of tobacco, my apparatus is provided with several serially arranged heating units which bring about gradual expulsion of moisture whereby the downstream heating unit (**58–64** of

FIG. 1 or 32 of FIG. 2) is preferably controlled by the downstream control unit **116** to make sure that the ultimate moisture content remains within a desirable range.

The method of the present invention comprises the steps of conveying a tobacco stream T lengthwise toward, through and beyond an elongated continuous conditioning zone (chamber *2a*) composed of a plurality of adjoining sections including an upstream section 2A and a downstream section 2B so that the tobacco stream T enters the downstream section 2B subsequent to passage through the upstream section 2A, subjecting successive increments of the tobacco stream T to independent heating actions during the passage of such increments through successive sections of the conditioning zone, measuring the moisture content of successive increments of the tobacco stream T upstream (trough **14**) and downstream (trough **24**) of the conditioning zone, comparing the results of such measurements with first and second rated values furnished by the devices **56** and **74**, adjusting the heating action (heating unit **30**) in the upstream section 2A when the result of measurement in the trough **14** upstream of the conditioning zone deviates from the rated value indicated by the device **56**, and adjusting the heating action (heating unit **58–64** or **32**) in the downstream section 2B when the result of measurement in the trough **24** downstream of the conditioning zone deviates from the rated value indicated by the device **74**.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

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

1. Apparatus for controlling the moisture content of tobacco, comprising a drier defining a continuous conditioning chamber having a plurality of adjoining sections including an upstream section and a downstream section; a feed for advancing a stream of moist tobacco into, through and from said chamber so that the tobacco enters said upstream section prior to entering said downstream section; heating means including a first and a second adjustable heating unit for respectively heating tobacco in the upstream and downstream sections of said chamber; first control means including first detector means for measuring the moisture content of tobacco in said stream prior to admission of such tobacco into said chamber, and first adjusting means for adjusting one of said heating units in accordance with the result of such measurement; and second control means including second detector means for measuring the moisture content of tobacco in such stream subsequent to evacuation of such tobacco from said chamber, and second adjusting means for adjusting the other heating unit in accordance with the result of measurement carried out by said second detector means.

2. Apparatus as set forth in claim **1**, wherein said first and second heating units are respectively adjusted by said first and second adjusting means.

3. Apparatus as set forth in claim **2**, wherein said upstream and downstream sections are immediately adjacent to each other.

4. Apparatus as set forth in claim **3**, wherein said upstream and downstream sections constitute the entire conditioning chamber and wherein each of said sections occupies substantially one-half of said chamber.

5. Apparatus as set forth in claim **2**, wherein one of said heating units comprises means for admitting a hot fluid into the respective section of said conditioning chamber so that such fluid flows counter to the direction in which the tobacco stream is conveyed through said chamber.

6. Apparatus as set forth in claim **2**, wherein said second heating unit comprises means for admitting a hot fluid into the downstream section of said conditioning chamber so that such fluid flows counter to the direction in which the tobacco stream is conveyed through said chamber.

7. Apparatus as set forth in claim **2**, further comprising an auxiliary heating unit for subjecting tobacco in said downstream section to a substantially constant heating action which is superimposed upon the heating action of said second adjustable heating unit.

8. Apparatus as set forth in claim **2**, wherein said drier comprises a rotary drum and wherein each of said heating units comprises means for agitating tobacco in the respective section of said chamber.

9. Apparatus as set forth in claim **2**, wherein said first control means further comprises third detector means for measuring the weight of successive increments of the tobacco stream prior to entry of such increments into said chamber, and an operative connection between said third detector means and said first adjusting means so that the operation of said one heating unit is influenced by variations in moisture content and also by variations in the weight of successive increments of the tobacco stream prior to entry of such increments into said conditioning chamber.

10. Apparatus as set forth in claim **2**, wherein at least one of said control means comprises rated value selecting means and means for actuating the respective adjusting means when the measurements supplied by the respective detector means differ from the rated value indicated by said selecting means.

11. Apparatus as set forth in claim **1**, wherein said second heating unit is arranged to heat tobacco at least in the downstream section of said chamber.

12. Apparatus as set forth in claim **1**, wherein said second control means comprises damping means for effecting gradual adjustments of said second heating unit by said second adjusting means.

13. Apparatus as set forth in claim **1**, wherein each of said detector means comprises means for continuously determining the moisture content of successive increments of the tobacco stream.

14. A method of conditioning tobacco, comprising the steps of conveying a tobacco stream lengthwise toward, through and beyond a continuous conditioning zone composed of a plurality of adjoining sections including an upstream section and a downstream section, said tobacco stream entering the downstream section of said conditioning zone subsequent to passage through said upstream section; subjecting successive increments of said tobacco stream to independent heating actions during the passage of such increments through successive sections of said zone; measuring the moisture content of successive increments of said tobacco stream upstream and downstream of said zone; comparing the results of said measurements with first and second rated values; adjusting the heating action in said upstream section when the result of measurement upstream of said zone deviates from the first rated value; and adjusting the heating action in said downstream section when the result of measurement downstream of said zone deviates from the second rated value.

15. A method as set forth in claim **14**, wherein each of said heating actions is confined solely to the respective section of said conditioning zone.

16. A method as set forth in claim **14**, wherein one of said heating actions includes conveying a heating fluid through the respective section countercurrent to the travel of said stream through the conditioning zone.

17. A method as set forth in claim **14**, further comprising the step of measuring the weight of successive increments of said stream upstream of said zone and adjusting the heating action in said upstream section when

the weight of such increments deviates from a predetermined weight.

18. A method as set forth in claim **14**, further comprising the step of withdrawing vapors, developing in response to heating of tobacco in said sections, at at least one end of said conditioning zone.

19. A method as set forth in claim **14**, wherein at least one of said heating actions comprises indirect heating of tobacco by means of steam.

20. A method as set forth in claim **14**, further comprising the step of agitating the ingredients of said tobacco stream while the stream advances through at least one section of said conditioning zone.

References Cited

UNITED STATES PATENTS

473,263	4/1892	Proctor	131—136 X
1,393,086	10/1921	Carrier	131—135
1,551,676	9/1925	McConnell	131—136 X
1,976,487	10/1934	Elberty	68—9
2,322,272	6/1943	Bailey et al.	34—46 X
2,679,115	5/1954	Bogaty et al.	131—136 X
2,768,629	10/1956	Maul	131—135
3,102,794	9/1963	Arnold	34—46 X

OTHER REFERENCES

1,416,676	9/1965	France.
1,499	4/1881	Great Britain.
953,893	4/1964	Great Britain.

ALDRICH F. MEDBERY, *Primary Examiner.*