

Aug. 22, 1961

F. B. DOYLE

2,997,046

APPARATUS FOR MOISTENING TOBACCO

Filed April 15, 1957

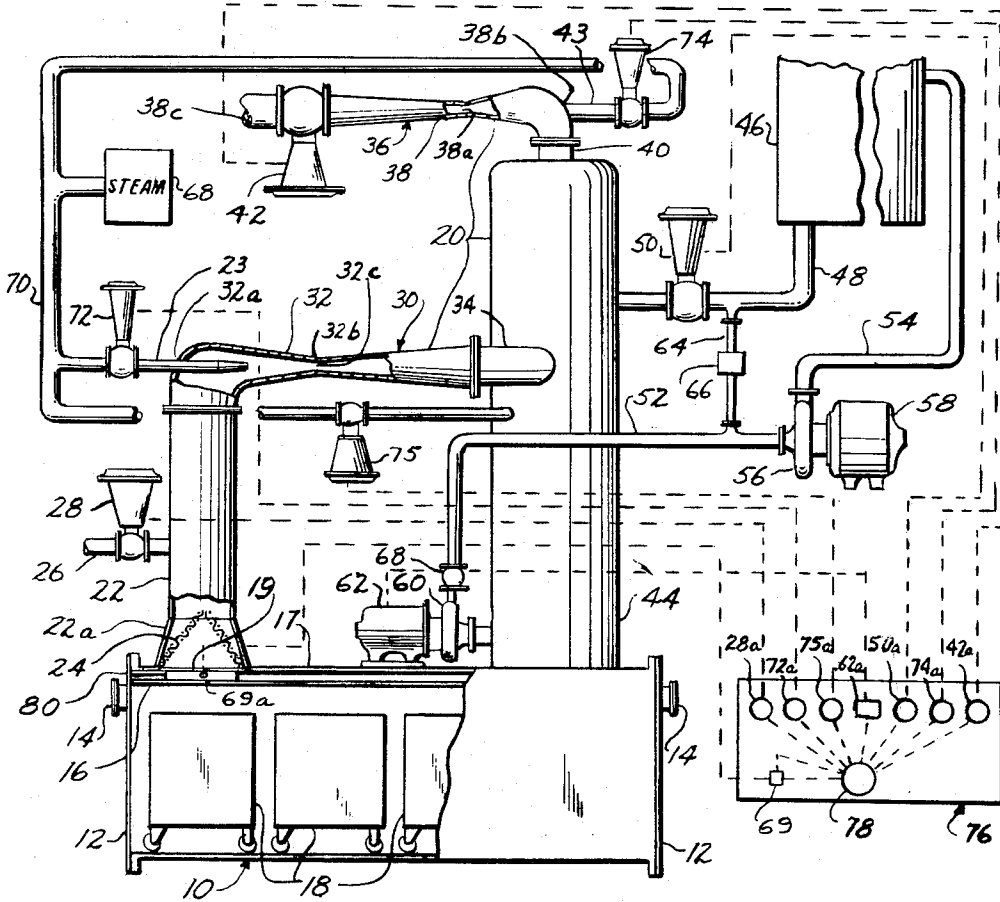


Fig 1

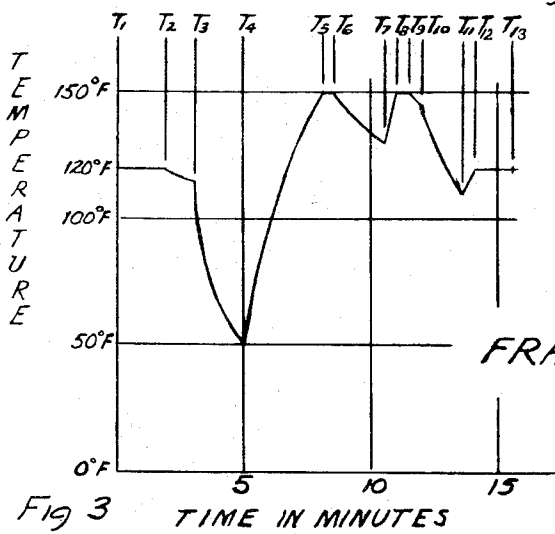


Fig 3

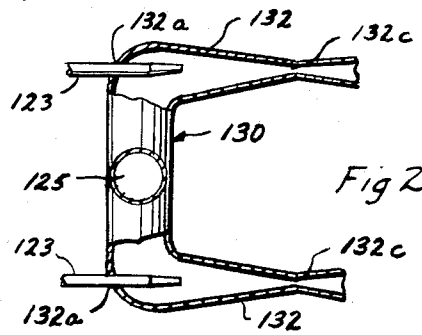


Fig 2

FRANK B. DOYLE INVENTOR
BY Frost and Verhoeven
ATTORNEYS

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2,997,046

APPARATUS FOR MOISTENING TOBACCO

Frank B. Doyle, Raymond, Ill.

Filed Apr. 15, 1957, Ser. No. 652,737

10 Claims. (Cl. 131-133)

My invention relates to an improved apparatus for moistening tobacco, the use of which produces a tobacco with increased filling power in a greatly reduced time.

In the production of cigarettes, the cost of the tobacco constitutes a major portion of the cost of the finished product. Thus the amount of tobacco, by weight, which is required to fill a cigarette to the standard desired fullness and firmness, constitutes an important factor in the cost of the cigarette. The capacity of a certain tobacco to fill a cigarette, known as the filling power of the tobacco, depends on its volume by weight and, for the reasons noted above, is a very important characteristic of smoking tobacco.

With the apparatus of the present invention tobacco with an increased filling power of between 2% and 3% can be consistently obtained. Furthermore, this important result can be achieved in approximately one-third the time required with equipment heretofore used.

After tobacco has been stored in bulk for a considerable period of time it may be necessary to add moisture before using the product. For example, after tobacco has been aged, it becomes so dry and brittle that moisture must be added to permit handling for additional processing of the product.

In moistening a bulk organic product such as tobacco the leaf is placed in a hermetically sealed chamber from which the air is drawn. Steam is then introduced into the chamber. The chamber is again evacuated and steam is fed to the chamber for a second time to assure an even distribution of moisture to the product. These steps may be repeated to achieve a more thorough moistening if required.

Evacuation of the chamber is achieved by means of ejectors, usually more than one connected in series relationship, with a first-stage ejector connected to the interior of the chamber. Heretofore the design of the ejector, and the period required for evacuation of the chambers, has been based on what was believed to be the most satisfactory engineering compromise in achieving inexpensive equipment, a moistening cycle of reasonable length, and a product of acceptable moisture content and condition. In tobacco moistening equipment the first-stage ejector has been designed with a restricted throat area of approximately .028 square inches for each cubic foot of volume of the interior of the chamber. Equipment of this design takes approximately one hour to complete the moistening cycle.

In the present invention the conventional considerations relating to the evacuation of the chamber were disregarded. Instead, a first-stage ejector with a substantially oversized throat was used and it has been found that a superior tobacco can be produced. Moreover, it was found that a moistening cycle of about one-third the duration of the conventional cycle could be achieved. Consequently, with the present invention, the same quantity of tobacco can be treated per hour with equipment having about one-third the chamber size, and requiring a fraction the space, of previous equipment.

The savings in equipment expense made possible by the present invention show that prior design considerations relating to the evacuating system have been erroneous.

While it might be expected that the use of equipment and a process which reduces the moistening time to about a third, at a considerable saving in equipment and space, might have a deleterious effect on the tobacco, the con-

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trary is true. As already noted, the filling power of the tobacco is appreciably increased and, in other respects, the tobacco has a moisture content and is in as good physical condition as tobacco processed on conventional equipment.

In the apparatus herein disclosed steam is not introduced directly into the chamber as in conventional equipment. Instead the steam is passed into the condenser, through the first stage ejector, and into the chamber. By this construction, steam of proper quality is supplied to the chamber without the need of supplementary moistening devices required on conventional apparatus. It has been found that the condenser and the ejector absorb a sufficient quantity of heat from the steam to render it suitable.

It is therefore an object of the present invention to provide a moistening apparatus for tobacco to produce a product of expanded volume.

It is another object of the present invention to provide apparatus for moistening tobacco in bulk with a substantially shortened cycle.

It is a further object of the present invention to provide a first-stage ejector for a moistening apparatus with a substantially increased throat area for rapid evacuation of the moistening chamber.

It is yet another object of the present invention to provide apparatus for moistening tobacco in bulk having a shortened evacuation period, a shortened moistening cycle, and producing a superior product.

It is another object of the present invention to provide an apparatus for moistening tobacco substantially smaller and less expensive than conventional equipment, capable of processing a like amount of tobacco, and producing a moistened tobacco superior in quality to tobacco moistened by other means.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, together with further objects and advantages thereof, will best be understood by reference to the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is an elevational view, with parts broken away, of the tobacco moistening equipment described herein;

FIGURE 2 is a bottom plan view of a modification of the first stage ejector, with parts broken away, which may be used in the moistening equipment of FIGURE 1; and

FIGURE 3 is a chart showing the steps of the moistening process as performed in the equipment of FIGURE 1 plotted against time.

As shown in FIGURE 1 the tobacco moistening apparatus has a hermetically sealed chamber, shown generally at 10, adapted to receive hogsheads 18 containing tobacco. The chamber 10 has, at each end, a removable door 12 which is capable of being secured to the chamber 10 by fastening means (not shown) in air-tight relationship. Each door has a porthole 14 to permit inspection of the product during the moistening process. The chamber 10 has a false ceiling 16 extending across the chamber adjacent the top 17 of the chamber. The top 17 of the chamber has an opening 19 through which the chamber can be evacuated and steam can be introduced.

A communicating passage between the chamber 10 and the evacuating system 20 is defined by the pipe 22. The pipe 22 has a flared portion 22a at its lower end which is connected in air-tight relationship to the top 17 of the chamber over the opening 19. Within the flared portion 22a of the pipe 22 is a conical shaped screen 24. The periphery of the conical screen 24 connects to the walls of the flared portion 22a of pipe 22 to span the

passage defined by the pipe. A pipe 26, communicating with the atmosphere, is connected to the pipe 22 between the chamber 10 and the steam evacuating system 20. The pipe 26 has a valve 28 which, when opened, serves to break the vacuum in the chamber 10.

As shown in FIGURE 1 the steam evacuating system 20 of the tobacco moistening apparatus consists essentially of a first-stage ejector shown generally at 30, a condenser shown at 44, and a final stage ejector shown generally at 36. The first stage ejector 30 consists of a pipe 32 and connecting pipe 34 which is connected to the condenser 44. Pipe 32 has an opening 32a adjacent the end which connects to pipe 22. The opening 32a is adapted to receive steam discharge pipe 23 which is oriented to discharge steam through pipe 32. Pipe 32 is tapered from each end so that the diameter at a point between the two ends is smaller than the diameter at either end to form a restriction 32b to the flow of steam through the pipe 32 and to define a throat 32c.

Heretofore throats for first stage ejectors for tobacco moistening equipment have been designed with areas of approximately .028 square inches per cubic foot of volume of the chamber. This size has conventionally been chosen in consideration of the cost of the ejector, the time of the moistening cycle, and the possible effect of the evacuating system on the condition of the tobacco within the chamber during evacuation.

In the moistening apparatus herein described, however, a first-stage ejector is used with a throat area substantially larger than was heretofore believed possible to use without damaging the tobacco during evacuation. It has been found that with this ejector a much shorter moistening process cycle can be achieved and that the desired moistening is attained without deleterious effect on the product. In fact, with the process and equipment herein described, the moistened tobacco produced is more suitable for certain uses because of its expanded volume by weight.

In order to achieve these results the throat area of the first stage evacuator should be at least .05 square inch per cubic foot of volume of the chamber which receives the product. When the product is tobacco, this will constitute a minimum throat area of .008 square inch per pound of tobacco. Preferably, the throat area of the first stage ejector should be approximately .085 square inch per cubic foot of volume of the chamber, or approximately .013 square inch per pound of tobacco received in these chambers. It is preferable that the throat area of this ejector not exceed .25 square inch per cubic foot of volume of the chamber.

It has been found that with a throat area of .0847 square inch per cubic foot of chamber volume for the first stage ejector tobacco within the chamber 10 will flutter during the evacuation. This, it has been found, does not have a deleterious effect on the tobacco but, on the contrary, the tobacco, after the moistening process, is superior to tobacco processed on conventional equipment for use in such products as cigarettes because of the increased volume per weight of the tobacco.

The final stage ejector is shown generally at 36 in FIGURE 1. The ejector consists of a pipe 38 connected at one end to the condenser 44 by pipe 40. At the opposite end the pipe 38 opens to the atmosphere through valve 42 and opening 38c. Pipe 38 tapers toward its center to define a throat 38a. The pipe 38 has an opening 38b to receive steam discharge pipe 43 which is oriented to discharge steam through pipe 38 and throat 38a toward the opening 38c to the atmosphere.

The condenser 44 receives water from the water cooling tower 46 through pipe 48 and valve 50. The water is pumped from the condenser back to the cooling tower 46 through valve 68, pipe 52 and pipe 54. The pumping action is achieved by the water pump 60 driven by the electric motor 62. The pumping action is aided by the water pump 56 driven by electric motor 58 which is

manually controlled and can be left operating during the entire cycle. When, during the cycle, motor 62 is not operating water circulates through pipe 48, pipe 64, flow controller 66, pump 56, and pipe 54 to reduce the temperature of the water in the cooling tower 46.

Steam is supplied to the ejectors 30 and 36 from a source 68. The steam is supplied to ejector 30 through pipe 70 and valve 72 into the steam discharge pipe 23 of ejector 30. Steam is supplied to ejector 36 through pipe 70 and valve 74 into the steam discharge pipe 43 of ejector 36. The pipe 70 is also connected to the condenser 44 through valve 75.

The control of the moistening process and equipment may be achieved by an automatic controller, shown generally at 76. The controller has a timer 78 which may, for example, be an electric motor having a geared shaft. The valves 28, 72, 75, 50, 74, and 42 may be diaphragm operated valves actuated by compressed air controlled by pilot valves. The pilot valves 28a, 72a, 75a, 50a, 74a, and 42a are installed in the automatic controller 76 and may be operated by cams carried on the shaft of the motor 78. The timer 78 also operates a cam-operated switch 62a which controls the energization of electric motor 62 which drives the water pump 60. The timer has a switch (not shown) which shuts off the timer in response to the flow of air to valve 75 to open that valve. The automatic controller 76 has a temperature controller 69 which has a bulb 69a. The bulb 69a is submerged in water in a pan 80 resting on the false ceiling 16 of the chamber 10 directly below the opening 19 in the top of the chamber. The temperature controller operates to turn on the timer 78 after a predetermined temperature has been reached. The timer has a cam which, after a predetermined time, resets the temperature controller 69 so that it will energize the timer 78 at a new predetermined temperature. Such a temperature controller is described in Taylor Instrument Companies' Bulletin 98,159 of April 1953.

The first stage ejector may consist of a plurality of pipes defining steam passages in parallel relationship as illustrated by the ejector 130 in FIGURE 2. In this modification two pipes 132, each have openings 132a to receive steam discharge pipe 123. Each pipe 132 has a throat 132c downstream from pipe 123 as steam is discharged from that pipe. The pipes 132 are connected and each is in communication with the chamber through opening 125. When an ejector having evacuating pipes in parallel relation is used the total cross-sectional area of all the throats 132c should be at least .05 square inch in total area per cubic foot of volume of the chamber.

In the operation of the moistening cycle with the apparatus herein described tobacco is placed in hogsheads 18 which are put in the chamber 10. The doors 12 are fastened in air-tight relationship with the chamber. The temperature of the water in pan 80 is, at this time, approximately 120 degrees Fahrenheit from the previous cycle. At this time the valves 28, 72, 75, 50, 74, and 42 are closed. The valve 68, which is manually operated, is open and the motor 58 is energized to circulate water through the cooling tower through the by-pass passage 64. The motor 62 is deenergized and pump 60 is not operating.

At time T_1 the timer is manually started and the valves 74 and 42 open, venting steam from source 68 through the final stage ejector 36 and out opening 38c to the atmosphere. At T_2 the absolute pressure in the chamber has been reduced to the point where the water in pan 80 begins to boil, lowering the temperature of the water. At T_3 valves 72 and 50 open and motor 62 is energized to commence operation of pump 60. This begins the circulation of water through condenser 44 and simultaneously begins operation of the first stage ejector 30.

After the first stage ejector begins operations the chamber 10 is quickly evacuated, removing vapor and non-condensibles. The vapor is condensed in the condenser

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44 while the non-condensibles are discharged to the atmosphere through ejector 36 and opening 38c.

At T_4 valves 42, 74, 50, and 72 close while valve 75 opens. This stops the flow of water to the condenser and stops the operation of ejectors 30 and 36. The opening 38c to the atmosphere is also closed. Simultaneously steam from source 68 is passed into condenser 44 where it expands with a consequent drop in pressure. This steam travels through pipe 34, first-stage ejector 30, and pipe 22 into the chamber 10. The screen 24 serves to scatter water which is entrained in the vapor. At time T_4 the timer 78 is shut off in response to the flow of air to valve 75 opening that valve.

When steam is introduced directly into a chamber from a source it is in the super-heated stage because of the expansion of the steam and the pressure reduction. In this condition moisture must be added from an external source of water to produce the necessary moistening of the product. However, in the apparatus herein described, the supplementary addition of moisture is not necessary. As the steam passes through the condenser 44 and the ejector 30 sufficient heat is absorbed by these structures before the steam is introduced into the chamber to bring the steam to a saturated state to moisten the product.

The temperature within the chamber 10 rises when the steam is introduced until it reaches a predetermined value as established by the temperature control 69 which may, for example, be 150 degrees Fahrenheit. When this temperature is reached, at T_5 , the timer 78 is turned on by the temperature controller 69 in response to the predetermined temperature.

At T_6 valve 75 closes and valves 74 and 42 open. This stops the flow of steam to the chamber 10 and resumes operation of the final stage evacuator to again evacuate the chamber. At T_7 valves 74 and 42 close and valve 75 opens, stopping the evacuation and repeating the steaming of the product. At this time the timer motor 78 again is shut off. As steam flows into the chamber the temperature rises to the predetermined value of 150 degrees Fahrenheit. After that temperature has been reached, at T_8 , the temperature controller 69 again starts the timer motor 78. At T_9 valve 75 closes and valves 42 and 74 open, thus stopping the steaming operation and resuming the evacuation by the final stage ejector 36. At T_{10} valve 50 opens to resume flow of water into the condenser 44. Before T_{11} the timer motor actuates the temperature controller 69 to lower the predetermined temperature at which the temperature controller energizes the timer 78. This new predetermined temperature may, for example, be 120 degrees Fahrenheit.

At T_{11} valves 42, 74, and 50 close while valve 75 opens. This shuts off evacuator 36, stops the flow of water to condenser 44, and begins the flow of steam from source 68 to the chamber 10. Simultaneously, the timer 78 shuts off. The temperature in the chamber rises to the new predetermined level of 120 degrees Fahrenheit and when this temperature is reached, at T_{12} , the timer 78 resumes. At T_{13} valve 75 closes, stopping the flow of steam to the chamber, and valve 28 opens to break the vacuum in the chamber 10.

It has been found preferable to lower the temperature of the final steaming operation so that the product will not suffer any deleterious effect from a sudden temperature drop when it is brought out into the atmosphere.

Using the apparatus and process herein described a moistening cycle of approximately 17 minutes has been consistently achieved. A chamber having a volume of 562 cubic feet, capable of receiving 4 hogsheads, of tobacco, was used. Each hogshead contained about 900 pounds of tobacco. The first-stage ejector had a throat area of 47.7 square inches. This equipment, by completing three cycles per hour, including loading and unloading time, was equal to conventional equipment

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having a chamber volume of over three times its size. The tobacco produced was not inferior in any respect and because of its greater volume per weight, was actually superior to tobacco processed on conventional equipment for many purposes.

While I have shown and described specific embodiments of the present invention it will, of course, be evident that various modifications and alternative constructions may be made without departing from the true spirit and scope thereof. I therefore intend by the appended claims to cover all such modifications and alternative constructions as come within their true spirit and scope.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Apparatus for treating tobacco to moisten the same and to produce an increased volume of moistened tobacco, said apparatus comprising: a hermetically sealed treating chamber of predetermined volume having means for the insertion of tobacco thereinto and removal of tobacco therefrom; a steam ejector means having a low pressure side, a discharge side and a throat therebetween, the low pressure side of said ejector means being connected to and communicating with the interior of said chamber, said throat having an area of between 0.05 and 0.25 square inch for each cubic foot of said volume; and means for introducing steam into said chamber.

2. Apparatus for treating tobacco to moisten the same and to produce an increased volume of moistened tobacco, said apparatus comprising: a hermetically sealed treating chamber of predetermined volume having means for the insertion of tobacco thereinto and removal of tobacco therefrom; a steam ejector means having a low pressure side, a discharge side and a throat therebetween, the low pressure side of said ejector means being connected to and communicating with the interior of said chamber, said throat having an area of between 0.05 and 0.25 square inch for each cubic foot of said volume; a vacuum producing means connected to the discharge side of said steam ejector means; and means for introducing steam into said chamber.

3. Apparatus for treating tobacco to moisten the same and to produce an increased volume of moistened tobacco, said apparatus comprising: a hermetically sealed treating chamber of predetermined volume having means for the insertion of tobacco thereinto and removal of tobacco therefrom; a steam ejector means having a low pressure side, a discharge side and a throat therebetween, the low pressure side of said ejector means being connected to and communicating with the interior of said chamber, said throat having an area of between 0.05 and 0.25 square inch for each cubic foot of said volume; a water cooled condenser connected to said discharge side of said ejector means; a second steam ejector having a low pressure side connected to said condenser; and means for introducing steam into said chamber.

4. Apparatus for treating tobacco to moisten the same and to produce an increased volume of moistened tobacco, said apparatus comprising: a hermetically sealed treating chamber of predetermined volume having means for the insertion of tobacco thereinto and removal of tobacco therefrom; a steam ejector means having a low pressure side, a discharge side and a throat therebetween, the low pressure side of said ejector means being connected to and communicating with the interior of said chamber, said throat having an area of between 0.05 and 0.25 square inch for each cubic foot of said volume; a first valve connected to said steam ejector means to control the flow of steam thereto; means including control valve means to supply saturated steam to said chamber; and sequence controller means connected to said valve and to said valve means sequentially to evacuate said chamber, to discontinue said evacuation, to supply saturated steam to said evacuated chamber and to re-evacuate said chamber.

5. Apparatus for treating tobacco to moisten the same and to produce an increased volume of moistened tobacco, said apparatus comprising: a hermetically sealed treating chamber of predetermined volume having means for the insertion of tobacco thereinto and removal of tobacco therefrom; a steam ejector means having a low pressure side, a discharge side and a throat therebetween, the low pressure side of said ejector means being connected to and communicating with the interior of said chamber, said throat having an area of between 0.05 and 0.25 square inch for each cubic foot of said volume; vacuum producing means connected to the discharge side of said steam ejector means; a first valve connected to said steam ejector means to control the flow of steam thereto; means including control valve means to supply saturated steam to said chamber; and sequence controller means connected to said vacuum means, to said valve and to said valve means to evacuate said chamber by said vacuum means, to continue said evacuation by means of said steam ejector means, to discontinue said evacuation, to supply saturated steam to said evacuated chamber and to reevacuate said chamber.

6. Apparatus for treating tobacco to moisten the same and to produce an increased volume of moistened tobacco, said apparatus comprising: a hermetically sealed treating chamber of predetermined volume having means for the insertion of tobacco thereinto and removal of tobacco therefrom; a steam ejector means having a low pressure side, a discharge side and a throat therebetween, the low pressure side of said ejector means being connected to and communicating with the interior of said chamber, said throat having an area of between 0.05 and 0.25 square inch for each cubic foot of said volume; a first valve connected to said steam ejector means to control the flow of steam thereto; means including control valve means to supply saturated steam to said chamber; and sequence controller means including a sensing element responsive to the temperature in said chamber, said controller means being connected to said valve and to said valve means sequentially to evacuate said chamber, to discontinue said evacuation, to supply saturated steam to said evacuated chamber until the temperature therein rises to a predetermined level, and to reevacuate said chamber.

7. Apparatus for treating tobacco to moisten the same and to produce an increased volume of moistened tobacco, said apparatus comprising: a hermetically sealed treating chamber of predetermined volume having means for the insertion of tobacco thereinto and removal of tobacco therefrom; a steam ejector means having a low pressure side, a discharge side and throat therebetween, the low pressure side of said ejector means being connected to and communicating with the interior of said chamber, said throat having an area of between 0.05 and 0.25 square inch for each cubic foot of said volume; and a vacuum producing means connected to the discharge side of said steam ejector means; a first valve connected to said steam ejector means to control the flow of steam thereto; means including control valve means to supply saturated steam to said chamber and sequence controller means including a sensing element responsive to the temperature in said chamber, said controller means being connected to said valve, to said vacuum means, and to said valve means sequentially to evacuate said chamber by said vacuum means, to continue said evacuation by means of said steam ejector means, to discontinue said evacuation, to supply saturated steam to said evacuated chamber until the temperature therein rises to a predetermined level, to reevacuate said chamber, to discontinue said reevacuation, to supply saturated steam until the temperature therein rises to said level, to secondly reevacuate said chamber, to discontinue said second reevacuation, and to supply saturated steam to said chamber until the temperature therein rises to a level less than said predetermined level.

8. Apparatus for treating tobacco to moisten the same and to produce an increased volume of moistened tobacco, said apparatus comprising: a hermetically sealed treating chamber of predetermined volume having means for the insertion of tobacco thereinto and removal of tobacco therefrom; a steam ejector means having a low pressure side, a discharge side and a throat therebetween, the low pressure side of said ejector means being connected to and communicating with the interior of said chamber, said throat having an area of between 0.05 and 0.25 square inch for each cubic foot of said volume; a water cooled condenser means connected to said discharge side of said ejector means, said condenser means including a first valve to control the supply of water to said condenser means; a vacuum producing means connected to said condenser means; said vacuum producing means including a second valve between said condenser means and atmosphere; a third valve connected to said steam ejector means to control the flow of steam thereto; dampening means including a fourth valve, said dampening means communicating with said condenser means to supply steam thereto; and a sequence controller means connected to said valves sequentially to actuate said vacuum producing means and said second valve to evacuate said chamber through said second valve to atmosphere, to open said first and third valves to further evacuate said chamber, to close said first, second and third valves and to open said fourth valve to supply steam to said chamber through said condenser and said steam ejector means.

9. Apparatus for treating tobacco to moisten the same, said apparatus comprising: a hermetically sealed treating chamber of predetermined volume having means for the insertion of tobacco thereinto and removal of tobacco therefrom; a steam ejector means having a low pressure side, a discharge side and a throat therebetween, the low pressure side of said ejector means being connected to and communicating with the interior of said chamber; a water cooled condenser means connected to said discharge side of said ejector means, said condenser means including a first valve to control the supply of water to said condenser means; a vacuum producing means connected to said condenser means; said vacuum producing means including a second valve between said condenser means and atmosphere; a third valve connected to said steam ejector means to control the flow of steam thereto; dampening means including a fourth valve, said dampening means communicating with said condenser means to supply steam thereto; and a sequence controller means connected to said valves sequentially to actuate said vacuum producing means and said second valve to evacuate said chamber through said second valve to atmosphere, to open said first and third valves to further evacuate said chamber, to close said first, second and third valves and to open said fourth valve to supply steam to said chamber through said condenser and said steam ejector means.

10. In an apparatus for treating tobacco comprising a hermetically sealed treating chamber of predetermined volume having means for the insertion of tobacco thereinto and removal of tobacco therefrom; a steam ejector means having a low pressure side, a discharge side, and a throat therebetween, the low pressure side of said ejector means being connected to and communicating with the interior of said chamber; a water cooled condenser means connected to said discharge side of said ejector means; wherein the steam ejector means is used to draw a vacuum in said chamber and, thereafter during a moistening period moisture is introduced into said chamber, the improvement comprising: steam injection means communicating with said condenser to introduce steam into the condenser during the moistening period so that the steam will be cooled in the condenser before it enters the chamber.

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