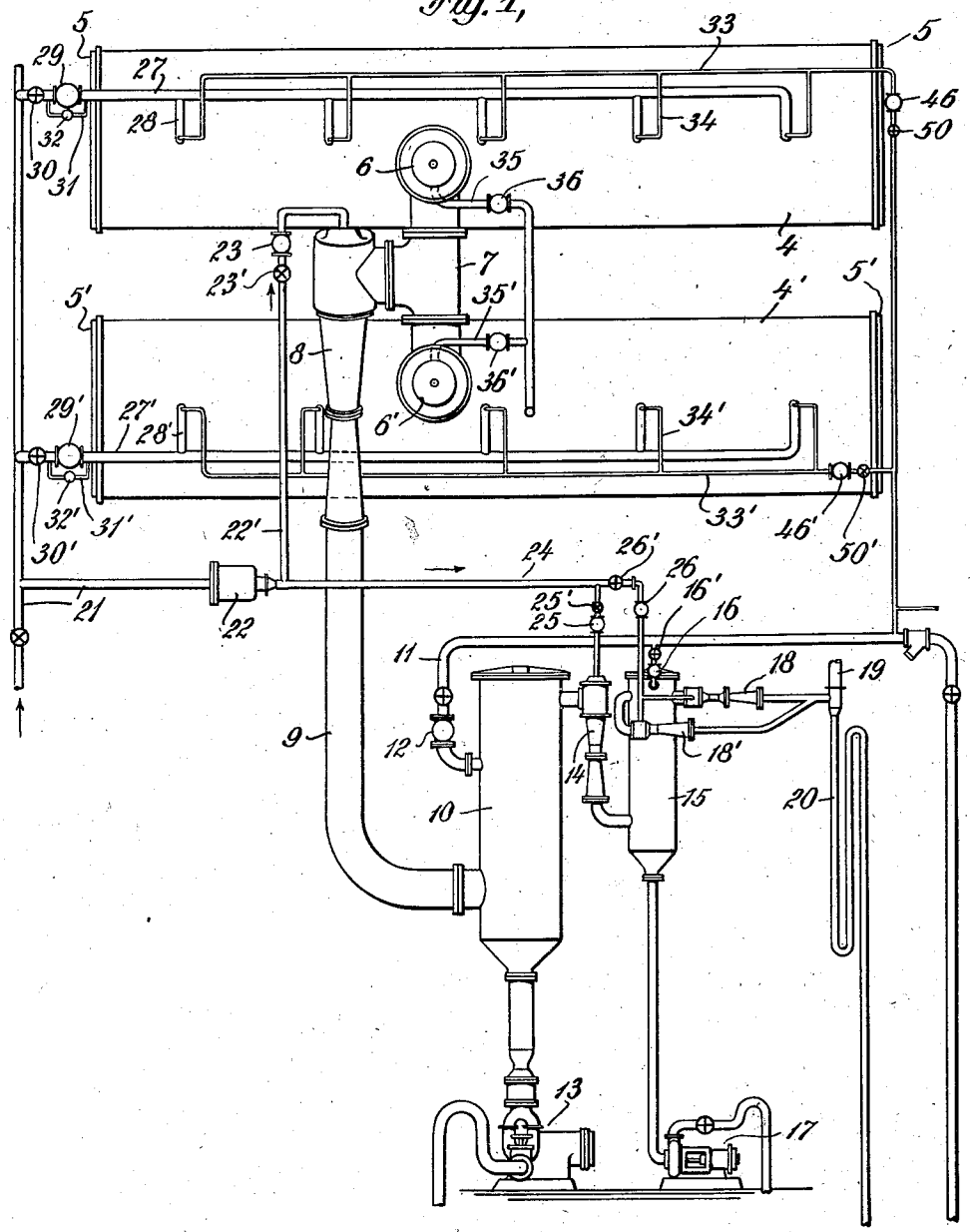
Oct. 15, 1940. H. L. SMITH, JR., ET AL 2,217,935

TOBACCO TREATMENT PROCESS

Filed Dec. 21, 1937 3 Sheets-Sheet 1

Fig. 1.



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TOBACCO TREATMENT PROCESS

Filed Dec. 21, 1937 3 Sheets-Sheet 2

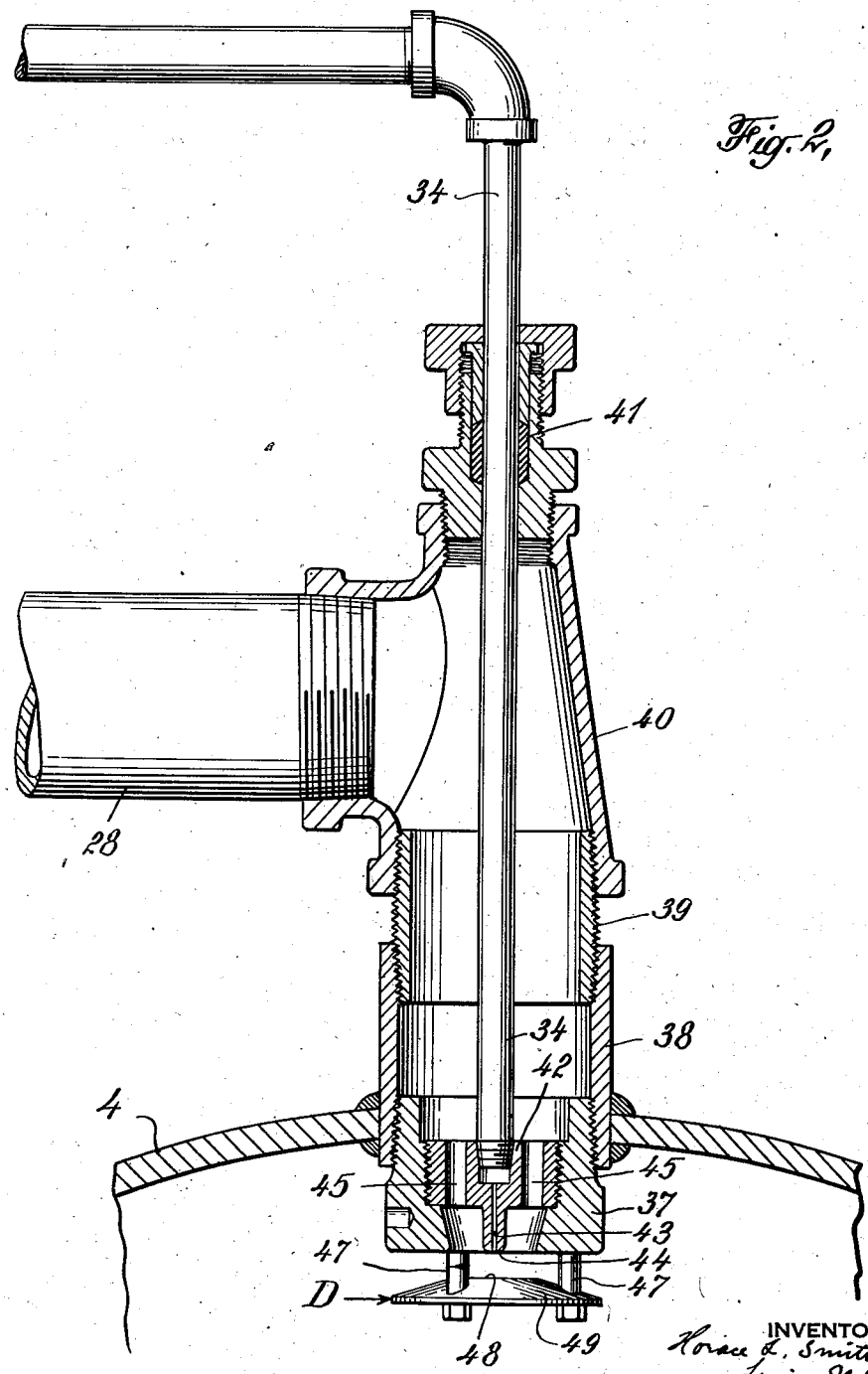


Fig. 2,

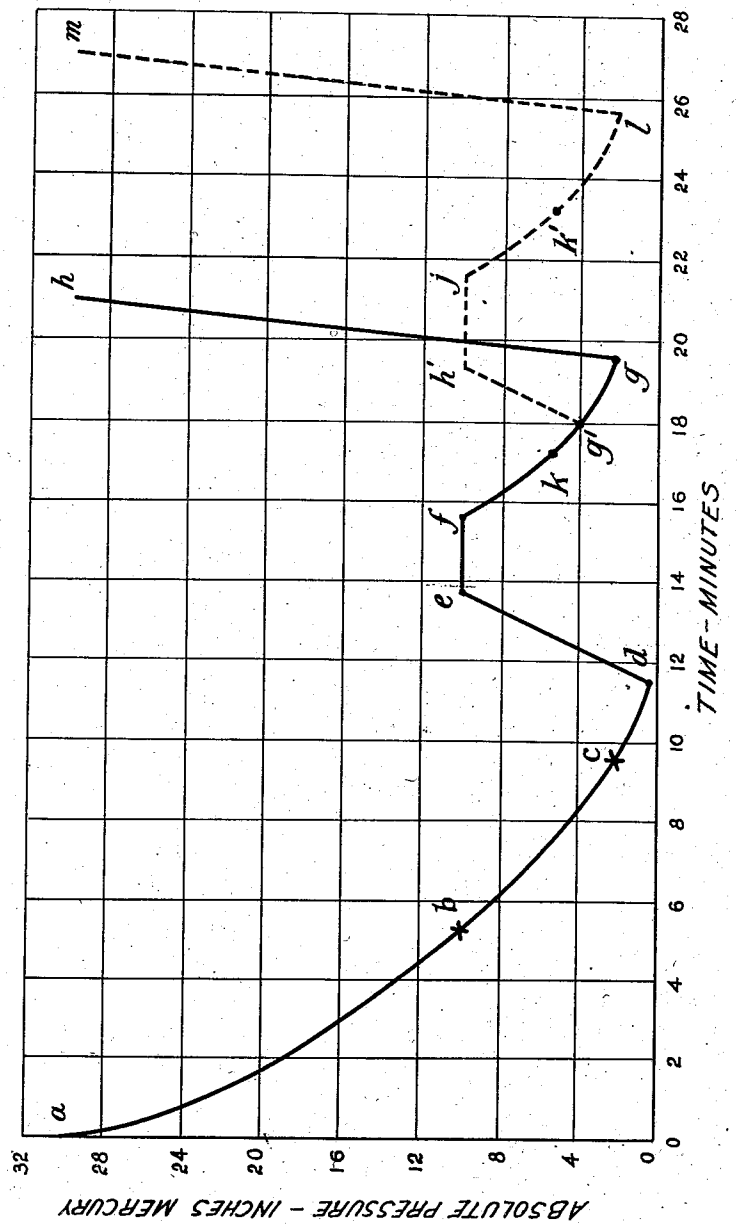
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TOBACCO TREATMENT PROCESS

Filed Dec. 21, 1937 3 Sheets-Sheet 3

Fig. 3.



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Patented Oct. 15, 1940 2,217,935

UNITED STATES PATENT OFFICE

2,217,935

TOBACCO TREATMENT PROCESS

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Application December 21, 1937, Serial No. 180,987

1 Claim. (Cl. 131—140)

This invention relates to tobacco treatment and more particularly concerns an improved process for altering the moisture content of and exterminating undesired organisms in tobacco. The invention also includes improved apparatus which may be used in carrying the process into effect.

We have heretofore devised a tobacco treatment process by means of which the moisture content of tobacco may be quickly and easily increased or otherwise adjusted, and by means of which, the expense, delay and losses involved in previously known moistening procedures are avoided. In that process, which is disclosed in detail in our Patent No. 2,086,446, and in our copending application, Serial No. 54,443, filed December 14, 1935, the tobacco is successively subjected to a high vacuum, supplied with steam with a reduction in degree of vacuum, and again subjected to a relatively high vacuum with the result that the moisture content of the tobacco is quickly increased without undesirable discoloration or other deterioration of the tobacco. The successive steaming and re-evacuating steps may obviously be repeated one or more times if desired. As disclosed in our patent above referred to, this process is also effective in exterminating organisms which infest tobacco.

It is the general object of the present invention to provide an improved process embodying the basic features of our aforesaid process, and to provide improved apparatus which may be used in carrying out these and related processes. We have found that moisture can be supplied to tobacco more effectively and in larger quantities by modifying our aforesaid process as hereinafter explained. The improved process is particularly useful in the treatment of tobacco which is tightly packed in hogsheads, bales or the like, and may also be used in the treatment of loose tobacco. Like the original process, the improved process is effective in exterminating pests which infest tobacco in all forms of their life cycle.

According to one feature of the present invention, steam is maintained in contact with the tobacco at a substantially constant pressure for a time interval after the absolute pressure on the tobacco has been increased from a relatively high vacuum value by the steam supplied thereto. This may be conveniently accomplished by continuously supplying steam, with or without water, as hereinafter explained, to the tobacco at a low rate sufficient to substantially replace the steam being condensed in the tobacco structure. This so-called "soaking" at substantially constant pressure preferably characterizes each steaming step regardless of whether one or more steaming steps are involved.

A still further feature of our present invention is supplying both water and steam to the tobacco, the water preferably taking the form of a fine mist or spray entrained in the steam and injected therewith into the evacuated space containing the tobacco. When steam under pressure is introduced to a previously evacuated area, the reduction in pressure, unaccompanied by the performance of work, liberates heat, which results in superheating of the steam. The water introduced with the steam is vaporized, the superheat of the steam supplying the necessary latent heat of vaporization. The steam is thus de-superheated with the result that unnecessary heating of the tobacco by the steam is avoided. We prefer to introduce with the steam an amount of water considerably in excess to that necessary to de-superheat the steam at the reduced pressure, whereby excess water, preferably in the form of a fine spray, suspension or mist, is entrained with the steam and carried into contact with the tobacco structure thereby. This is preferably accomplished by breaking up or atomizing a stream of water within or substantially within the previously evacuated treatment chamber at or adjacent the point where the steam is introduced thereto. Other ways of introducing steam and water may be employed, but we believe that the method generally described is preferable because the water de-superheats the steam as the superheat is developed, and the steam assists in breaking up the excess water into a fine mist or suspension of particles and immediately entrains this mist and carries it into intimate contact with the tobacco. Like the above described steam "soaking" feature, the introduction of water may accompany each steaming operation whether one or more steaming steps or stages are employed.

The improved apparatus of our invention comprises a novel means for simultaneously injecting steam and water into a previously evacuated treatment chamber in such a manner that the steam is de-superheated and excess water is formed into a fine suspension or mist and introduced with the steam and carried thereby into intimate contact with the tobacco or other material in the chamber. In a preferred embodiment, this means includes a nozzle structure having therein means for directing a stream of water under pressure into impinging contact with a surface whereby the water is broken into a mist in the presence of the steam. The structure pref-

erably directs the steam adjacent the point of impingement of the water stream, whereby the stream assists in atomizing the water and entrains the water mist (or the proportion thereof which has not immediately vaporized in de-superheating the steam), and sweeps it out of the nozzle opening into the treatment chamber. In one form of the invention, the nozzle structure is so constructed and mounted with relation to a tobacco treatment chamber that impingement of the stream of steam and entrained water against the chamber walls is minimized. This prevents considerable loss of entrained water in the introduced fluid prior to its contact with the tobacco of other material under treatment.

Other objects, advantages and characteristics of our invention will be apparent as the description thereof progresses.

In describing the invention in detail, reference will be made to the accompanying drawings, in which;

Figure 1 is a diagrammatic and simplified illustration of apparatus capable of carrying out our improved process;

Figure 2 is a sectional view of improved steam and water injecting apparatus embodying certain features of our invention; and

Figure 3 is a graph illustrating the various steps to which tobacco may be subjected in a typical treatment cycle embodying certain features of our invention.

Various forms of apparatus may be employed in carrying out our improved process. The illustrative apparatus diagram, shown in Figure 1, includes a pair of tobacco chambers 4 and 4' of substantially identical construction. The two chambers are employed to permit the loading of one at the same time that tobacco is being treated in the other. The process could obviously be carried out in a single chamber. The chambers shown are cylindrical and are provided with removable doors or closures 5 and 5' at each end thereof to permit the introduction and removal of the tobacco to be treated. Since our process involves subjecting the tobacco to a high vacuum, the treatment chambers 4 and 4' are air tight and the doors 5 and 5' are provided with suitable gaskets or other sealing means which prevent the admission of air while a process is being carried out. Each chamber 4 and 4' is preferably large enough to accommodate several hogsheads of tobacco and suitable means may be provided for introducing the hogsheads and removing them from the chambers. Suitable means are provided for selectively evacuating or drawing fluid from the chambers 4 and 4'. Although various means may be used for this purpose, we generally prefer to employ multi-stage steam jet evacuators which we have found to give excellent results. The illustrated apparatus includes a three-stage steam jet evacuating system but a greater or smaller number of stages may be used where warranted by the conditions encountered.

As shown, the chambers 4 and 4' are respectively connected through the suction line valves 6 and 6' with a common T fitting 7 opening into the inlet of a first stage steam jet ejector or booster 8. The first steam jet booster 8 discharges through a pipe 9 into an intercondenser 10. The intercondenser 10 may take any suitable form, and as shown, comprises a direct contact condenser of known construction. The intercondenser 10 is supplied with water through a pipe 11 under control of the valve 12. Water and condensate are withdrawn from the intercondenser 10 through a pump 13 constructed to prevent the ingress of air to the condenser. The fluid outlet of the intercondenser 10 is connected to the inlet of a second stage steam jet ejector 14 which discharges into a second intercondenser 15. The intercondenser 15 may be similar in construction to the first stage intercondenser 10, but is preferably of smaller capacity. Water is supplied to the intercondenser 15 from the pipe 11 under control of a valve 16, and condensate and water are withdrawn by a sealing pump 17. Two third-stage steam jet ejectors 18 and 18' are connected in parallel to withdraw fluid from the second intercondenser 15. The ejectors 18 and 18' may discharge steam and evacuated fluid to the atmosphere directly through an exhaust pipe 19, or a final condenser may be employed to condense the exhaust steam, if desired. A trapped drain 20 is preferably provided to carry off the liquid which condenses in the exhaust pipe 19, and the liquid from this drain may be either wasted or recirculated through a cooling system with the discharge from the condenser pumps 13 and 17.

The steam jet ejectors 8, 14, 18 and 18' are of known construction, each employing a jet of steam to propel and compress gaseous fluid by entrainment in a restricted throat. High pressure steam for operating the ejectors is supplied from any suitable source through a pipe 21 in which a separator 22 of known construction may be connected. The first stage steam booster 8 receives steam through a branch pipe 22' under the control of an automatic valve 23 and a hand valve 23'. The second and third stage ejectors receive steam from the pipe 24. The automatic valve 25 and manual valve 25' govern the admission of steam to the second stage ejector 14 and the automatic valve 26 and manual valve 26' control the admission of steam to the third stage ejector 18 and 18' in parallel.

Suitable means are provided for admitting steam to the treatment chambers 4 and 4'. In the disclosed embodiment, steam is introduced at a plurality of points spaced longitudinally by means of the manifold pipes 27 and 27' and the branch pipes 28 and 28' which terminate in openings in the chamber walls. The manifold pipes 27 and 27' are connected to the steam supply pipe 21 through automatic control valves 29 and 29', and manual valves 30 and 30' may also be used at this point, as shown. Restricted by-pass pipes 31 and 31' are preferably connected respectively around the automatic steam control valves 29 and 29' to admit steam at a restricted rate to the chambers 4 and 4' at certain times, as hereinafter explained. Water may be introduced with the restricted steam supply if desired. Automatic control valves 32 and 32' are provided in the by-pass pipes 31 and 31' respectively.

In accordance with one embodiment of our invention, water is introduced to the treatment chambers with steam, and for this purpose, water manifold pipes 33 and 33', each having branch pipes 34 and 34', are provided for the respective chambers 4 and 4'. The branch pipes 34 and 34' are connected to spaced openings in the walls of the chambers 4 and 4' respectively, and preferably enter these chambers at the same points as the branch steam pipes 28 and 28'. The admission of water is controlled by the automatic valves 46 and 46' in the manifold pipes 33 and 33' respectively and manually operable valves 50 and 50' may also be provided for this purpose.

Suitable means are provided for venting the chambers 4 and 4' to the atmosphere. As shown, the pipes 35 and 35', controlled respectively by the valves 36 and 36', are used for this purpose. The pipes 35 and 35' are shown as connected to the chambers 4 and 4' through the fittings which connect the suction line valves 6 and 6' to the chambers. The vent pipes could obviously be connected to the chambers at any other convenient point.

The supply of steam and water to the steam jet ejectors and the introduction of these fluids to the treatment chambers, as well as the venting and evacuation of the chambers, may be controlled manually by separate valves, manually from a central point or by suitable automatic control apparatus. The particular form of control valve actuation employed forms no part of the present invention but in many instances both manually operable and automatic valves have been disclosed to indicate the different types of actuation which may be resorted to. The suction line controlled valves 6 and 6' are preferably of large capacity and are usually operated by diaphragm or electric means of known construction. The remaining automatic valves may be similarly operated.

In accordance with one feature of our invention, water is introduced to the treatment chambers with the steam during the steaming steps or stages including the soaking stage if desired, and is converted into a fine mist or suspension and entrained with the steam as the two fluids enter the chamber. We have devised an improved apparatus for performing this function and it is illustrated in Figure 2. In this figure, the wall of a treatment chamber is illustrated at 4, a steam supply pipe at 28 and a water supply pipe at 34. These parts may comprise the correspondingly designated parts of the apparatus shown in Figure 1.

The water and steam injecting device or nozzle shown comprises a hollow inlet bushing 37 connected to the inner end of a collar 38 which is welded or otherwise sealed in an opening through the wall of the chamber 4. The collar 38 is connected through a nipple 39 and a T fitting 40 to the steam supply pipe 28, and the water supply pipe 34 passes axially through the parts 38 and 39 and is sealed in an opening of the T fitting 40 by a suitable packed gland 41. The end of the water pipe is fixed to a water nozzle fitting 42 in communication with a central water passage 43 of small bore which terminates in a nozzle opening 44. The fitting 42 is threadedly connected within the inlet bushing 37 and is provided with a plurality of steam openings 45 disposed about the central water passage 43. A deflecting disc D is fixed in spaced relation to the inner end of the fitting 37 by suitable means such as the bolts 47. The disc D extends across the outlet of the fitting 37 and preferably comprises a plane circular central portion 48 surrounded by a frusto conical or tapered rim portion 49. The disc D cooperates with the inner end of the fitting 37 to form a fluid outlet nozzle which directs the discharged fluid outwardly substantially parallel to the wall of the treatment chamber.

Water is supplied through the pipe 34 at a relatively high pressure and accordingly issues from the water nozzle 44 in a fine stream at high velocity and impinges upon the plane central portion 48 of the disc D where it is broken up into a fine mist or suspension. The steam from the pipe 28 flows through the openings 45 toward the disc D, and aids in breaking up the water into fine particles. The contact between the water and steam at the reduced pressure within the treatment chamber results in the vaporization of some of the water with a resultant de-superheating of the steam, and the excess water over that thus vaporized is entrained by the steam and carried out through the nozzle opening formed by the disc D and the fitting 37. Since the nozzle opening directs the injected fluid in an initial path substantially parallel to the treatment chamber wall, the loss of water from this fluid by impinging contact against the chamber wall at high velocity is minimized.

After curing, tobacco is customarily tightly packed in hogsheads, bales or the like and is aged in warehouses for periods which may run to several years. The tobacco loses moisture during aging and as a result becomes so dry and brittle that it cannot be unpacked, much less handled or stemmed, without excessive loss from shattering, tearing or powdering of the leaf structure. The process of the present invention may be employed to increase the moisture content at various stages during the preparation or shipment of tobacco, and also to exterminate organisms in tobacco with or without altering its moisture content. The process has proven particularly effective in the so-called "ordering" of aged and relatively dry packed tobacco, that is, increasing the moisture content of such tobacco to a point where it can be unpacked and stemmed without substantial breakage of the leaf structure. Our process will be here described by reference to a typical example thereof as employed in ordering tobacco.

The tobacco, which is usually packed in hogsheads or bales, is placed within one of the treatment chambers, for example, the chamber 4. The heads may be removed from the hogsheads before treatment if desired, but this operation is not essential since tobacco hogsheads are not fluid tight. The doors 5 of the treatment chamber 4 are closed and the tobacco is subjected to a series of operations which have been graphically illustrated in Figure 3, where the ordinates represent absolute pressure in the treatment chamber in inches of mercury, and the abscissa represent time in minutes.

The tobacco in the treatment chamber 4 is first subjected to a relatively high vacuum, as indicated by the portion *abcd* of the curve in Figure 3. The degree of vacuum should be such as to remove substantially all of the air initially contained in the treatment chamber and the interstices of the structure of the tobacco therein. We have found that the degree of vacuum required for this purpose varies somewhat with the temperature of the tobacco. Thus with tobacco having an initial minimum temperature of about 70° F. or higher, a vacuum from 29.5 to 29.6 inches of mercury (.5 to .4 inch Hg absolute pressure) is sufficient, whereas with lower initial minimum temperatures of the tobacco mass, vacuums as high as 29.85 to 29.95 or even higher may be required. In the example illustrated in Figure 3, the initial minimum temperature of the tobacco mass is assumed to be in the neighborhood of 70° F., and the initial vacuum is drawn to about 29.65 inches of mercury (.35 inch of Hg absolute pressure).

The steam jet evacuating equipment described may be operated in various ways to produce the

desired initially high vacuum and the following sequence of operations has been found effective and economical. The suction line valve 6 is opened and the valve 6' controlling the chamber 4' is closed, the valves 36, 23, 12, 25, 16, 29, 32 and 46 being closed. The steam supply valve 26 for the third stage ejectors 18 and 18' is opened and these ejectors, acting in parallel, reduce the absolute pressure by withdrawing fluid from the treatment chamber 4 as indicated by the portion *ab* of the curve *abce* in Figure 3. At about the point *b*, it is preferred to start the second stage ejector 14 and this is done by opening the steam valve 25. At the same time, cooling water is admitted to the second intercondenser 15 by opening the water valve 16, and in this manner, the steam issuing from the ejector 14 is condensed before it reaches the third stage ejectors 18 and 18'. When the absolute pressure of the chamber has been further reduced to a value such as that indicated by the point *c* on the curve, the first stage booster 8 and first intercondenser 10 are operated by opening the steam valve 23 and the water valve 12. With all of the ejectors in operation, the absolute pressure on the tobacco is rapidly reduced to the desired final value, as indicated by the point *d* in Figure 3. As shown in Figure 3, the entire evacuating operation can be completed in a relatively short interval, less than twelve minutes in the illustrative example shown. At the conclusion of the initial evacuating step, the suction line valve is closed and the ejectors and intercondensers are shut down by closing the valves 23, 12, 25, 16 and 26.

After the desired high vacuum has been attained, steam is supplied to the tobacco whereby the vacuum thereon is reduced. In accordance with one feature of our invention, water is supplied to the tobacco simultaneously with the steam, the amount of water so supplied being greater than that required to de-superheat the steam at the vacuum obtaining in the chamber. The simultaneous addition of water and steam is effected by opening the steam valve 29 and the water valve 46, and the pressure within the chamber increases as shown at *de* on Figure 3 to an intermediate but preferably sub-atmospheric value. We believe that the excess water introduced is carried into intimate contact with the tobacco by the steam which flows rapidly into the previously evacuated tobacco structure. In this manner, the moisture content of the tobacco is increased, both by the condensation of steam and by the water introduced with the steam.

During the steaming step, the absolute pressure should be increased to such a value that the steam, and entrained water where water is introduced therewith, will quickly penetrate the tobacco mass and moisten it substantially uniformly throughout. The steam introduced heats the tobacco and raises its temperature, and the amount of steam introduced, as determined by the absolute pressure attained at the conclusion of the steaming step, should not be so high as to cause discoloration or other heat deterioration of the tobacco within the time interval during which the elevated temperature is maintained. In accordance with our process, the absolute pressure attained in the steaming step produces a tobacco temperature high enough to cause discoloration of the tobacco after a time interval, but prior to the expiration of such interval, the absolute pressure is reduced sufficiently to appreciably lower the tobacco temperature, whereby discoloration or other heat deterioration is avoided. This reduction of absolute pressure takes place in the re-evacuating step or steps as hereinafter described. In the example disclosed in Figure 3, it is assumed that bright tobacco is under treatment, and the absolute pressure at the end of the steaming step is about ten inches of mercury (a vacuum of about 20 inches of mercury). When the process is applied to burley tobacco, which is more resistant to heat than bright tobacco, the absolute pressure at the end of the steaming step may reach a value in the neighborhood of 12 inches of mercury (a vacuum of 18 inches of mercury). With various varieties of tobacco and times of treatment, the final steaming pressure may vary between about 8 and 18 inches of mercury absolute. The steaming step is terminated by closing the steam and water valves 29 and 46.

The amount of water introduced during the steaming step is preferably in excess of that required to de-superheat the steam supplied to the tobacco whereby an excess of water, in the form of a fine mist or suspension, is carried into the tobacco structure by the steam. The amount of water so introduced is not critical, and amounts from twice to four or five times the amount necessary to de-superheat the steam may be used. In a typical example of our process, assuming that 25 lbs. per minute of dry saturated steam at an initial pressure of about 115 lbs. per square inch gauge is introduced through each branch pipe 28, about .7 gal. of water per minute may be introduced with the steam through each branch pipe 34. In the example given, assuming an initial vacuum of about 29.5 inches of mercury in the chamber, approximately .35 gal. per minute of water would be sufficient to saturate (de-superheat) the steam introduced at each branch pipe.

The water is preferably introduced to the tobacco chamber at the same point as the steam whereby the steam is de-superheated as the superheat develops and the water is broken up and entrained by the steam as it enters the chamber. The atomizing or breaking up of the water may be promoted by the use of known types of atomizing or spray nozzles, or the improved nozzle illustrated in Figure 2 and described above may be employed for this purpose. One or more combined water and steam inlets may be provided, and good results are obtained by using one such inlet for each hogshead, bale or other mass of tobacco in the treatment chamber 4. When our improved steam and water injecting nozzle is used, one such device may be provided at each inlet point and located adjacent each tobacco hogshead.

A so-called "soaking" step preferably follows the introduction of steam and water. During this portion of the process, the absolute pressure on the tobacco is maintained constant or nearly constant for a limited time interval as indicated by the portion *ef* of the curve of Figure 3. The previously introduced steam continues to condense after the introduction of steam has been discontinued, and accordingly, the pressure in the chamber 4 would normally fall during the "soaking" period. Accordingly, we prefer to introduce steam at a low rate substantially sufficient to continuously replace the steam being condensed, whereby the absolute pressure on the tobacco is maintained substantially constant. This may be accomplished by opening the steam valve 32 in

the restricted by-pass pipe 31, it being understood that the rate of steam flow through this pipe is reduced by the pipe size, a restricted orifice or otherwise to produce the desired continuous replacement of the steam being condensed in the chamber. The introduction of steam at a restricted rate during the "soaking" stage may, if necessary or desirable, be accompanied by the introduction of water in the form and amounts explained above. The "soaking" step is terminated by closing the valve 32.

At the conclusion of the "soaking" step, the tobacco is subjected to an increased vacuum, the pressure thereon being reduced as indicated by the portion *fg* of the curve in Figure 3. The degree of evacuation to which the tobacco is subjected in this step is preferably high enough to vaporize or evaporate some moisture from the tobacco whereby its temperature is reduced, heat being absorbed in the form of latent heat of vaporization. This re-evacuating step may comprise the final step of the process, and the evacuation preferably continues to an absolute pressure at which sufficient moisture has been evaporated or vaporized to reduce the tobacco temperature to a safe value. The heat discoloration and other heat deterioration of tobacco is a function of the temperature, the time for which the temperature is maintained and the type of tobacco under treatment. If certain types of bright tobacco are maintained at temperatures above about 125° F. for an extended time interval, discoloration and often other forms of heat deterioration take place, and the value of the tobacco is thereby substantially reduced. However, these tobaccos may be maintained at temperatures in the neighborhood of about 180° F. for intervals of about 10 or 15 minutes without discoloration or other detrimental change. In general, bright tobacco is more sensitive to heat than other varieties,—burley tobacco, for example, will withstand high temperatures for appreciably longer periods than will bright tobacco.

The re-evacuating step *fg* of our process is continued to a value of vacuum at which the temperature of the tobacco has been reduced by the evaporation or vaporization of moisture to a value at which heat deterioration will not take place. This temperature, and, accordingly, the final value of vacuum, varies as indicated above depending upon the type of tobacco under treatment. The treatment to which the tobacco is subjected after the conclusion of our process is also a factor in fixing the final tobacco temperature. In most cases, the tobacco is unpacked from the hogsheads or bales and the leaves are separated immediately after the "ordering" treatment. With this procedure, the tobacco is cooled by the atmosphere promptly after the treatment process is concluded and accordingly the temperature to which the tobacco is reduced in the re-evacuating step may be somewhat above the minimum temperature at which heat deterioration can take place after an extended interval. If the tobacco is not to be unpacked at the conclusion of the process, the re-evacuation is continued until the tobacco temperature is below the lowest temperature at which it can be adversely effected by heat in any time interval.

In the disclosed example, assuming bright tobacco is under treatment and is to be unpacked at the conclusion of the process, the re-evacuating step *fg* is continued to a vacuum of about 27.25 inches of mercury (2.25 inches of mercury absolute pressure). This final vacuum may vary from about 25 to about 29.8 inches of mercury (5 to .2 inch of mercury absolute pressure) and in the case of very dark heat resistant tobaccos, which are to be unpacked immediately after treatment, the final vacuum may be as low as 20 inches of mercury (10 inches of mercury absolute pressure).

The re-evacuating step *fg* may be performed by operating the third stage ejectors 18, 18' and the first stage intercondenser 10 until the absolute pressure has been reduced to some intermediate point, such as the point *k*. The second stage ejector 14 and second intercondenser 15 may then be operated by opening the valves 25 and 16 and the absolute pressure is further reduced to the point *g* by the second and third stage ejectors acting in series. If desirable or necessary, the first stage booster 8 may also be operated in drawing the desired vacuum. The re-evacuation step is concluded by closing the suction line valve 6 and cutting off the supply of steam and water to the ejectors and intercondensers.

At the conclusion of the re-evacuating step *fg*, the treatment chamber 4 is vented by opening the valve 36, and the pressure on the tobacco rises to atmospheric pressure as indicated by the curve section *gh*. The tobacco is now removed from the treatment chamber 4 and the process is complete.

It is obvious that the above described steaming and re-evacuating steps may be repeated one or more times if desired. One such repetition has been illustrated by the broken line curves starting at the point *g'* in Figure 3. Since a second steaming, "soaking" and re-evacuating cycle consumes only a short time interval, the temperature to which the tobacco is cooled in the first re-evacuating step may be somewhat higher than the temperature required at the conclusion of the treatment. Thus, as shown in Figure 3, the first re-evacuating step may continue until the absolute pressure is reduced to about 4 inches of mercury (a vacuum of 26 inches of mercury). In general, a practical working range of absolute pressures at the conclusion of an initial re-evacuating step may be from about 3 to about 5 inches of mercury absolute.

The first re-evacuating step in the case of recycling may be accomplished by manipulating the apparatus as described above. It is usually necessary to operate the third stage ejectors 18 and 18' and the first intercondenser 10 only, although operation of the second stage ejector 14 and second intercondenser 15 may be resorted to during a part of the re-evacuating step, if necessary or desirable.

The re-evacuating step just described is followed successively by a repetition of the steaming, "soaking" and re-evacuating steps. The second steaming step is indicated by the broken line *g'h'*, the second "soaking" step is indicated by the line *h'j'* and the second re-evacuating step is indicated by the broken curve section *jk'l*. These steps may be respectively performed by manipulating the apparatus as described above in connection with the steaming, "soaking" and re-evacuating steps represented by the curve sections *de*, *ef* and *fg*. The second steaming step *g'h'* is usually of shorter duration than the first steaming step *de*, the absolute pressure on the tobacco at *g'* being somewhat higher than that at *d*, and the final steaming or "soaking" pressures being substantially the same in each case. At the end of the final re-evacuating step *jk'l*, the treatment chamber is vented to the atmos-

phere, as indicated by the line *lm*, and the tobacco is removed from the chamber. The "soaking" step is believed to aid in the uniform distribution of moisture in the tobacco. By introducing water with the steam, the amount of moisture added to the tobacco is increased without undesirably increasing the maximum temperature to which the tobacco is heated.

Our improved process exterminates tobacco pests, such as the cigarette beetle, in all forms of its life cycle. This can be done simultaneously with the addition of moisture as described above, or without net change in the moisture content. In the latter case, the re-evacuating step is continued until all of the added moisture has been evaporated or vaporized and removed.

It should be understood that the described examples are merely illustrative and that our invention is not limited to the values of pressure and vacuum or the time intervals set forth above and indicated in Figure 3. The various features of our invention may be separately employed.

Although the process of the present invention has been described in connection with an example of its application to the moistening or "ordering" of packed and aged tobacco, it should be understood that the invention is not limited to this application and may be applied to other steps in the treatment of tobacco or other materials where it may be found applicable. For example, we have found that our above described process is effective in destroying mold and mold spores which sometimes appears in aged tobacco. We have also found that our process is effective in tempering and improving the quality of cased tobacco, that is, tobacco to which flavoring materials have been added. In either the destruction of mold or mold spores or the tempering of cased tobacco, our process may be so conducted as to increase the moisture content of the tobacco or without net change in the moisture content, and in the latter case, the re-evacuation is continued untill all or substantially all of the added moisture has been evaporated.

We claim:

In a tobacco treatment process the successive steps of subjecting tobacco in bulk to a high vacuum in a closed chamber, carrying steam and water in separate confined passageways to the chamber, spraying the steam under pressure and the water under pressure in separate adjacent streams from the confined passageways into the chamber, and impinging at high velocity both streams upon a solid surface in close proximity to the point of entrance of the streams, whereby the steam and water are impacted and thoroughly intermingled and water in a fine spray is produced, and supplying the reflected steam and water to the tobacco whereby the moisture content thereof is increased.

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