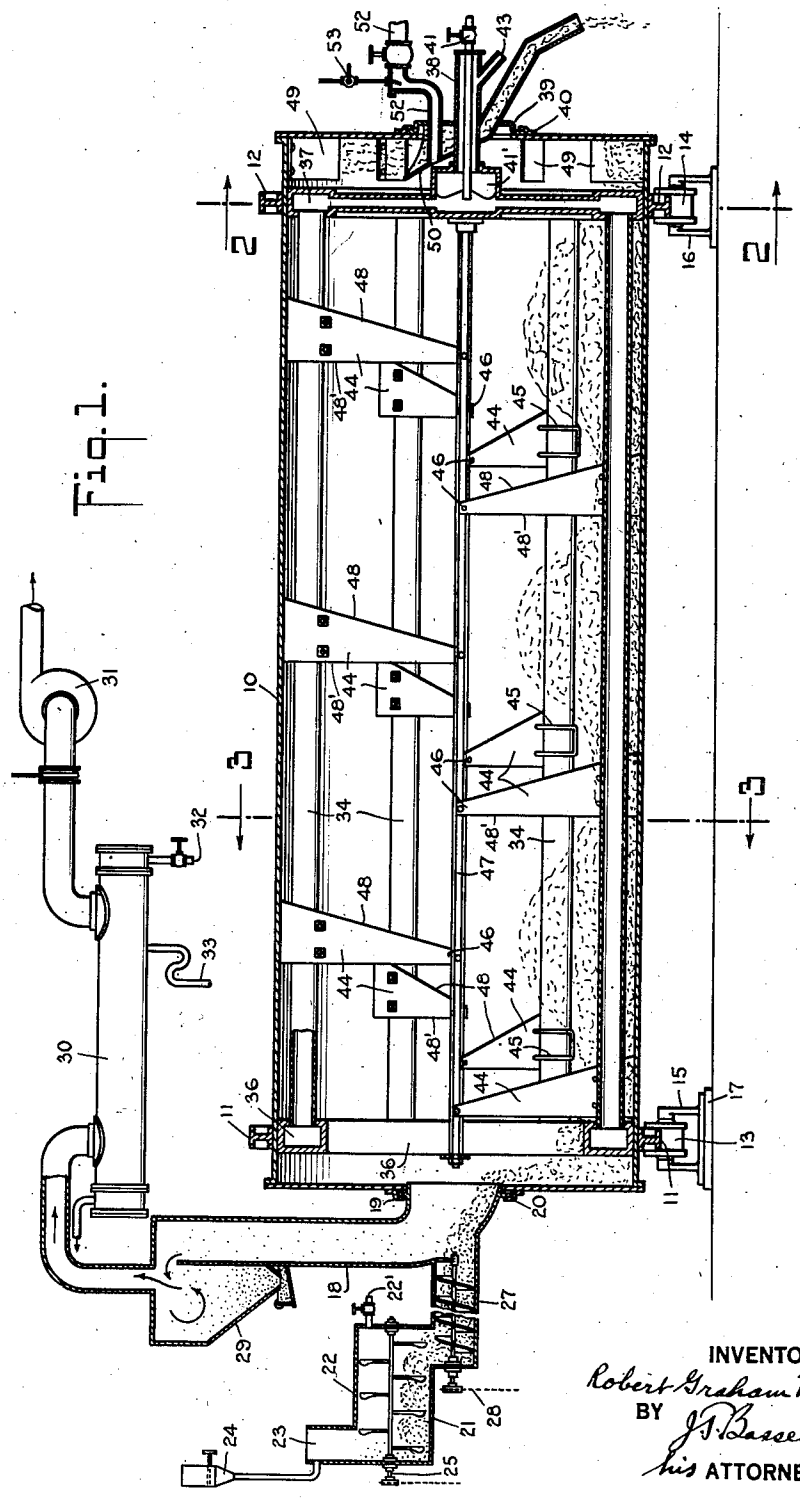
Sept. 15, 1931. R. G. MEWBORNE 1,823,554

PROCESS FOR TREATING TOBACCO MATERIAL AND APPARATUS THEREFOR

Filed Dec. 26, 1925 2 Sheets-Sheet 1

Fig. 1.



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Fig. 3.

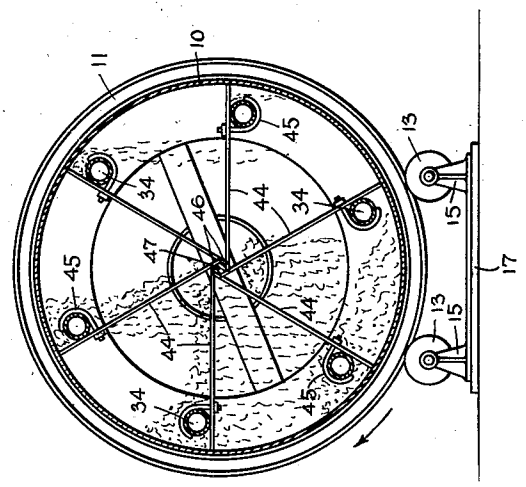
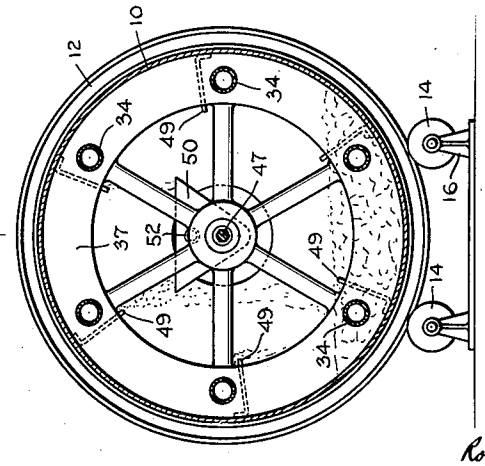


Fig. 2.



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UNITED STATES PATENT OFFICE

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PROCESS FOR TREATING TOBACCO MATERIAL AND APPARATUS THEREFOR

Application filed December 26, 1925. Serial No. 77,711.

This invention relates generally to a process for treating tobacco material to recover the nicotine content thereof and to new novel apparatus for carrying out the same. The invention is more particularly directed to the treatment of tobacco material in the various forms thereof or any or all parts of the plant in various forms, including the stalks, leaves or roots of the tobacco plant as grown, or various waste products of the plant of any tobacco industry. The invention is more particularly directed to the treatment of tobacco for recovering nicotine or similar alkaloidal, volatile constituents in an extractive agent, for the purpose of production of nicotine in its various forms, either as free nicotine, nicotine solutions or nicotine salts or compounds.

As the nicotine content thus far known is contained in the tobacco material in chemical, physical or mechanical combination with the acids or resinous, albuminous materials of the plant or the plant cells, in fairly stable condition, an ini ial treatment is first resorted to, to make the nicotine available for further processing by freeing the nicotine from its combination of plant constituents by treatment with alkaline materials, although, in some instances, where the nicotine is already free—due to fermentation or otherwise—this initial treatment with an alkali is unnecessary. The reaction of alkalies upon the tobacco material frees the nicotine as an alkaloid which remains in solution within the reaction products and the other constituents of the plant and is known as "free nicotine" and, in this connection, my invention is directed to that type of process which recovers the nico ine so freed from this heterogeneous mass by an extractive agent in the vapor form which, as it passes from the mass, serves to entrain, entrap, vaporize or mechanically carry off the nicotine for subsequent recovery by condensation or other sui able methods.

As hitherto practiced, nicotine has been separated from the plant containing the same by distillation, use being made of an extractive agent to volatilize the nicotine from the tobacco material which has been previously treated to free the same from the acid constituents, resinous gums, albuminous materials or the like in the plant cells, in original combination with nicotine. The nicotine, once liberated from chemical, physical or mechanical combination with the original plant constituents, is subjected to heat treatment to volatilize the nicotine and for economy of cost and efficiency of processing, particularly where water has been used as the solute for the initial alkaline treatment, steam has been used as the extractive agent.

With the tobacco material thus far used, the processes for the recovery of nicotine contended with a nicotine content of less than 4% and where steam or water and heat necessary to create the steam were used to carry off the nicotine products, a quantity of steam which when in the form of water equivalent to 3 to 4 pounds of water to each pound of tobacco was found to volatilize the nicotine content. The physical structure and constitution of tobacco material of this kind made it possible to use any degree of heat in order to volatilize a quantity of water to carry off the nicotine content in percentages mentioned without adversely interfering with the tobacco components to make the process a continuous one.

The methods thus far employed did not anticipate a greater nicotine content than 3 to 4% nor did they anticipate a higher resinous, albuminous, gummy or other component present in tobacco, as is found or may occur in tobacco material having a content upwards of 4%.

Where I have attempted to recover nicotine from tobacco material containing nicotine in excess of 4% by a water component equivalent to 4 pounds of water to 1 pound of tobacco, I have found that a total liberation of the nicotine cannot be effected, nor, where I have attempted to increase the temperatures for carrying out the process of recovering nicotine from tobacco carrying nicotine in excess of 4%, have I been able to effect the separation because of the high resinous, gummy, albuminous or other components found in the tobacco plant of this nicotine constitution so that, while ordinarily the nicotine will be volatilized to a degree in

which the temperatures are raised, the effect of heat on the components not desired in the plant are adversely affected to entrap the nicotine components beyond the condition where the nicotine content can be economically separated therefrom. While where I have attempted to supply an amount of water at one time to supply vapor sufficient to carry off the nicotine of percentages in excess of 4%, the resinous, gummy, albuminous and other constituents of the plant are dissolved to such an extent as to further interfere with the liberation of the nicotine and to make it impractical for a continuous process, particularly where heating elements are employed to liberate the steam by coating the heating elements or producing a froth, making it necessary to discontinue the process to cleanse the heating elements or remove the batch from the distilling chamber. Thus, any attempts to increase the quantity of extractive agent, such as water, have been found to adversely affect the physical characteristics of the batch, whereas where I have used high temperatures, the plant components are affected to further serve to entrap the desirable constituents beyond economical recovery.

My invention, therefore, has for an object thereof the provision of a process for recovering the nicotine from tobacco material by the use of an extractive agent in quantities sufficient to carry off the nicotine content without adversely affecting the physical characteristics of the material treated so that high economy of cost and efficiency of operation may be obtained to completely recover nicotine as present in tobacco material in any quantities, more particularly with a nicotine content tobacco ration above 4% and as high as 10%.

My invention further has for an object thereof, the provision of a process for recovering nicotine from tobacco material, including that having a nicotine content of as high as 10% in which water or its vapors are used as the extractive agent in quantities sufficient to charge the tobacco to its highest absorptive power, without interfering with conditions which are most conducive for liberating the nicotine and without imparting to the product treated physical conditions objectionable for treating the product continuously, due to the adhesive agents present in tobacco besides nicotine, such as resins, albuminous materials, gums or the like, the process involving the liberation of nicotine from a condition in which it will be more completely carried off when in contact with, or in the presence of water vapor such as steam, having combined therewith water and under conditions of temperature where it readily is converted from the liquid phase to the vapor phase.

My invention further has for an object thereof the provision of a process for extracting nicotine from tobacco material, using water vapor as the extractive agent and maintaining conditions wherein the tobacco material is always in contact with, and has present a quantity of water sufficient to dissolve the nicotine content so that the nicotine that is carried off by the vapors generated will be effectuated at conditions, so far as possible, when water changes from the liquid phase to the vapor phase.

My invention still further has for its object the provision of a process in which water vapor is used as an extractive agent and in which there is always present an amount of water in excess of that which will be sufficient to carry off the nicotine component but below that at which it adversely affects the adhesive components of the tobacco material to cause exudation of the adhesive material to wad the batch and interfere with separation in an apparatus in which the process is to be carried on continuously.

My invention further has for an object thereof the provision of a process controlled as to temperature and time of reaction so that use is made, to the maximum degree possible of heat transference when water changes from the liquid phase to the vapor phase, and from the vapor to the liquid phase, conditions being maintained such that there is alternately effected a heating of the tobacco material to liberate quantities of water vapor to carry off nicotine and then to a cooling in the presence of water vapor to condense an amount of water necessary for liberation of the nicotine in solution, and the absorption of heat units accompanying condensation to more efficiently raise the temperature of the nicotine so that upon again heating the mass, a maximum amount of steam will be generated under conditions carrying off the highest degree of nicotine.

The invention further has for an object thereof the provision of a process in which tobacco material is maintained in the presence of an extractive agent in the liquid phase in amounts sufficient to dissolve the nicotine content while maintaining conditions as to temperature so that the nicotine will more completely pass into the vapor form and this I accomplish by always maintaining the tobacco material treated with a quantity of water sufficient to dissolve the nicotine content and maintain the batch at a temperature at which steam is generated, and surrounding atmospheric conditions being maintained such as to carry off the nicotine liberated by charging the atmosphere with a quantity of water in the liquid phase and alternating the temperature conditions from an upper limit to liberate steam and carry off nicotine, and to a diminished temperature to rewet or condense a portion of the vapor upon the tobacco material undergoing treatment.

My invention still further has for an ob-

ject thereof the provision of a process for treating tobacco material and recovering the nicotine therefrom, the tobacco being maintained under temperatures such that it will never be heated so hot as to liberate the entire water content while there still remains a quantity of nicotine, nor is ever permitted to cool so that the vapors of the extractive agent with which it is kept in contact will transfer an unduly large amount of heat thereto, the cooling being effected, however, to just permit condensation to take place at, or close to the critical temperature for generating steam.

My invention may be considered as providing a process for obtaining nicotine beginning with tobacco which is so wet as to completely dissolve the nicotine content, but so dry as to be capable of processing without interfering mechanically in the apparatus used, the process including a series of drying and rewetting steps, the drying to carry off an amount of nicotine and the wetting to resupply water sufficient for solution of the nicotine content, further conditions being maintained during the process that the rewetting is carried on from the extractive agent used or under conditions that a rewetting is effected in proportion to the nicotine content and without interfering with the physical characteristics of the material treated necessary for a continuous operation. There is further provided atmospheric conditions surrounding the zone in which the nicotine is evolved and subjected to a movement in the direction to carry away the desirable component in a vapor phase, comprising an extractive agent including an amount thereof in a liquid phase so as to be able to carry a quantity of nicotine higher than that which a vapor would normally carry and maintaining a vapor pressure conducive to a more rapid generation of the nicotine from the tobacco material. In the more particular embodiment, my invention provides an extractive agent in the vapor form, such as stem, carrying with it a proportion of water in the liquid phase which, moving counter-currently to the tobacco material that is heated so as to generate nicotine vapor, will carry a higher amount of nicotine, the nicotine generated under these conditions serving to dissolve to some extent in the water in the liquid phase and producing a condition of vapor pressure, accelerating the generation of nicotine at the hotter portions of the apparatus.

Other objects of my invention reside in new and novel apparatus for serving efficiently to carry out my process and attain the objects above mentioned.

To attain these objects and such further objects as may appear herein or be hereinafter pointed out, I will now refer to a more detailed description of a preferred embodiment of my invention.

Tobacco material, preferably containing upwards of 4% of nicotine and as high as 10%, or even in excess thereof, including any or all parts of the tobacco plant, are used as the source for the nicotine. This tobacco material is preferably broken into small particles ranging from dust or particles of finer size to lumps from 1 to 2 inches in diameter. However, any form of the plant will serve the purpose in the process which will now be outlined.

The initial step is to treat the tobacco material to liberate, should it not already be free, the nicotine content from its combination with the resins, gums, albuminous materials or plant cells by a treatment with an alkali solution such as the hydroxides or carbonates of the alkali metals, as sodium, or the hydroxides of the alkali earths, such as calcium. Preferably a lime paste is added containing 10 to 20% of lime in proportions amounting to 2 to 4 parts of this mixture to 1 pound of tobacco. The variations in quantity of the lime mixture added will be made, depending upon the character of the tobacco, that is, where a high moisture content tobacco is used the amount will be diminished, whereas where a drier tobacco is used the amount may be increased towards the upper limit. However, the amount added should never be in excess of that where there will be any extraneous water and as a practical method of determining the desirable condition, after a time has elapsed to permit absorption of the lime paste added, and to cause the reaction to liberate the nicotine, a simple test employed after thorough commingling by suitable mixing apparatus has been effected is: The operator can determine approximately the proper condition by pressing a handful of the material. The amount of water should never be in excess of that which will cause the tobacco to wad or chunk but should have the property of again becoming fluffy, upon the release of the pressure.

The mixture thus prepared is introduced into a heating chamber provided with suitable heating and mixing elements to expose the material fed thereto to proper heating operation and serves to move the material fed thereto continuously. The heat is sufficient to generate steam within the mass and carry with it the nicotine contained therein. As the generation of the steam progresses, the vapors are removed counter-currently by some suitable suction device, at the same time drawing along with it a quantity of an extractive agent, such as steam, which preferably carries entrained therewith a suspension of water.

The heating arrangement is such that there is an alternate exposure of the tobacco material to a maximum temperature and then a

movement of the material so treated to a cooler zone, all being carried out within an atmosphere of the extractive agent in vapor charged with small particles of water in the form of a spray, fog or mist. As the tobacco material is exposed to the heat of the hottest portion of the chamber, steam is generated that will volatilize the nicotine, at the same time serving to dry the tobacco, to some extent. The tobacco material is then alternately directed to the cooler portion of the heating chamber where, coming in contact with the extractive agent, there is deposited thereon by absorption or condensation a small amount of water supplying an amount less than but almost as much as that lost at the previous heating but to an extent sufficient to further keep in solution the nicotine content. The tobacco material is then again exposed to the hotter portion of the heating chamber where again an amount of steam is generated within the wet mass to carry with it a fresh quantity of nicotine. The speed of operation is maintained such that when exposed to the hotter portion of the heating chamber, it will not become so hot that upon entering the cooler portion of the heating chamber it will cause undue transference of heat to the extractive agent, for example, steam containing dispersed water, but will so enter the cooler zone as to be able to condense and absorb an amount of the extractive agent, such as water, in proportion to the nicotine remaining in the tobacco material and retain it in solution.

The process continues so that the tobacco material becomes drier as the nicotine content is extracted and becomes less and, as previously stated, the speed of operation is such that as the nicotine content becomes smaller, there is a smaller amount of water absorbed, at each stage of the treatment of the material within the cooler zone.

In the more particular embodiment of my invention, as practiced, the hottest portion of the heating elements is maintained such that it will be just sufficient to generate steam within the wet mass while the cooler portion is maintained just short of that where, coming in contact with the vapor, it will transfer the heat thereto but just below that where it will cause condensation of a portion of the vapor thereon. Thus, it will be observed that the hottest zone of reaction is just about 212° F. so as to generate steam within the alkaline material while the cooler zone is just below 212° F., where it will absorb or condense an amount of the extractive agent with which it is in contact.

This process may be carried out in various ways but for my purpose the apparatus diagramatically shown in the accompanying drawing illustrates a preferred form thereof in which Fig. 1 is a vertical sectional elevation of my apparatus broken away in part to disclose certain details. Figure 2 is a section taken on a line 2—2 of Figure 1. Figure 3 is a section taken on a line 3—3 of Figure 1.

In the drawings, 10 is a drum or chamber of cylindrical form arranged for rotation by providing the annular tracks 11 and 12 near the ends thereof and resting upon rollers 13 and 14, supported in suitable bearings 15 and 16. Preferably, though not necessarily, the roller 13 and bearing 15 are supported upon a block 17 to elevate this end of the drum. There is provided at the front end of the drum 10 a stationary duct 18 leading into the drum at its axial line and arranged for permitting relative rotary movement thereof while being maintained sealed by the annular nib 19 within the flange 20.

The duct 18 has its lower end provided with the supply and feeding unit 21 for raw tobacco material. This unit comprises a mixing chamber 22 having a tobacco entrance port or hopper 23 and an alkali solution or lime paste measuring device 24 leading into the same. Suitable mixing paddles mounted on the shaft 25 are arranged for by the sprocket 26. Leading from the chamber 22 at one end thereof, is a cut flight screw conveyor 27 operated by the sprocket 28, and serves to feed the limed tobacco material to the duct, and allow a time for absorption of extraneous water, complete chemical reaction with the alkali, at the same time acting as a seal for the heating chamber. The upper end of the duct leads the vapors generated within the drum to suitable recovery and vapor cleansing apparatus, as the dust collector 29, and then to the surface condenser 30, movement of the vapors in the direction indicated being induced by the suction fan 31. The cooling water supply for the condenser is shown at 32, whereas the condensate may be collected from the outlet shown at 33.

Within the chamber 10 there is arranged heating elements or tubes 34 at the periphery of the drum, in suitable numbers, all connected at their ends by the front manifold 36 and the rear manifold 37. A stationary head 38 is sealed by the annular gasket 39 and flange 40 at the axial line, permitting rotary movement of the drain.

Preferably, high pressure steam is used to supply the heat, and this is accomplished at the axial line of the front manifold 37, through the pipe line 41 beyond the trap 41', within the housing 42 which serves as the means of discharging the condensed steam or water from the tubes or manifold through the end head 38 and then out through the spout 43.

Radially disposed within the chamber are a series of lifting shelves 44, of triangular conformation, supported upon the tubes at the periphery by suitable straps 45 and at their apex 46 upon the central shaft 47. The shelves are arranged progressively in screw-

pitch fashion, overlapping to some extent when considered in transverse section, with the right angular edges 48′ away from the direction of movement of the material and with the angular or hypothenuse edge 48 of the shelves in the direction of movement of the material, for purposes which will hereinafter be pointed out. Towards the exit end, and lying flush with the end of the chamber, are discharge lifting shelves 49 radially disposed towards the axial line directly over a central stationary hopper 50 mounted on the stationary end-head 38. A conduit 51 leads from the hopper 50 to discharge outside the chamber.

Also leading through the stationary end-head 38 into the chamber 10 is an extractive agent feed line 52, preferably for exhaust or low pressure wet steam, into which is led a needle valve 53 for adding additional water to the steam in the line 52, and is so positioned that the rush of steam will atomize or otherwise finely divide the water led thereinto. For certain purposes the exhaust steam from the spout 43 may be led into line 52 by suitable piping, as will be readily understood.

The operation of the process in connection with the apparatus above described is as follows:

The raw tobacco material, including any or all parts of the plant in any size whatsoever, preferably ranging from fine dust to lumps of 1 to 2 inches in diameter, is incorporated in the mixing chamber 22 to which is added, by means of the liquid measuring device 24, an amount of lime paste (10 to 20% free lime) until a quantity equivalent to 2 to 4 parts by weight have been added. This mixture of lime paste and tobacco material is thoroughly stirred by means of the paddles on the shaft 25 to thoroughly commingle the same, meanwhile adding a quantity of steam as an aid for chemical reaction, and also a "nice" control or adjustment of water content, by means of the steam line 22′ at one portion of the chamber. This mixture is carried on for a time sufficient to cause the reaction necessary for liberating the nicotine from its combination with the acid, resinous, albuminous or gummy constituents within the cells of the plant. It will be understood that this mixing may be done adjacent to the main drum or in a suitable apparatus forming a separate unit.

From the mixing chamber the mixture of limed tobacco material is fed to the main drum 10 by the cut flight or ribbon conveyor on the shaft 28, through the stationary head at the lower end of the duct 18. The main drum 10 is of a length sufficient to carry the process to completion as the tobacco material traverses from the entrance at 18 to the exit when timed with a speed of rotation of 1 to 2 revolutions per minute. The heating tubes 34 within the drum are brought to a proper temperature by the steam led thereinto from the main line 41, high pressure steam being used so that a temperature above 212° F. is maintained sufficient to volatilize water from the tobacco material alkalined as previously mentioned. As the tobacco material falls within the space between the end of the chamber and the manifold 36, it is picked up by the shelves 44, gradually and progressively moving it upwardly along the periphery of the drum, portions of the tobacco material being held in contact with the heating tubes through part of the rotation, until after a shelf reaches the horizontal position, whereupon some of the material will gravitate radially towards the axial line, other portions of the tobacco material sliding off the edge 48 to cascade the same towards the bottom of the tube.

The material thus gradually lifted and dropped will form ridges of tobacco material throughout the length of the heating chamber 10 and, by reason of the screw-pitch arrangement of the lifting shelves and the slight tilt which is given to the chamber, the tobacco material will, during the course of rotation, be traversed to the end of the chamber by the progressive lifting and falling from the shelves to the bottom of the tube. As the material reaches the end of the tube, the vertical lifting shelves 49, forming pockets with the end of the chamber, will drop some of the material into the hopper 50 and be discharged from the conduit 51 when the treatment is completed.

During the rotary movement of the main chamber 10, the suction fan 31 is put into operation to draw in vapors that may be evolved from the zone of reaction within the heating chamber 10, passing off through the duct 18 and the dust collector 29 and thence to the condenser 30 where the nicotine products are collected in connection with the condensed water of the vapor evolved. Non-condensable gases containing nicotine, ammonia and other valuable substances are passed onto a vapor scrubber for recovery thereof.

Simultaneous with this operation there is introduced into the heating chamber a quantity of wet steam through the conduit 52 which, during its flow, entraps therein additional water from the needle valve 53. The rush of steam thus introduced into the main chamber serves to transform the water injected at the needle valve into a fine spray, cloud or mist, thus carrying into the reaction chamber not only moisture in the form of vapor but moisture in the liquid phase, as a result of the atomization. There is thus created within the rotary drum a countercurrent of tobacco material and a vapor in which water exists to some extent in the liquid phase.

The material may be described as undergoing the following cycles in a series of repeats from its entrance into the heating chamber to its exit.

There is first the heating by direct contact with the heating tubes at the position at the bottom of the tube, at which point steam is generated, carrying off with it nicotine vapor. As the amount of material at this point is gradually lifted up by the rotation of the drum and shelf, heating continues, evolving at the same time an amount of water and nicotine vapor.

As the shelf approaches the horizontal position, some of the tobacco material will fall off. Other portions of it will be carried along until the shelf reaches a somewhat vertical position when other portions of the material will fall off or shower, so as to be cascaded transversely of the length of the heating chamber. Other quantities of the tobacco material remaining on the shelf will slide radially towards the axis of the chamber. As the material reaches the center of the heating chamber and as it necessarily moves away from the hottest portion or heating tubes, it will encounter that part at the center where there is an appreciable drop in temperature and, consequently will be cooled to some extent. On the axial line it will encounter some of the vapor introduced into the chamber and some of the water in the finely dispersed form, absorbing or condensing portions thereof and resupplying a portion of that lost by the previous heating portion. The temperature at the axial line is maintained such as it will be just critical to generate the steam and condensation of water.

Thus, the temperature at the central portion of the tube will be such that the tobacco material striking the cross flow of vapors, will not lose such quantity of heat units to generate any steam from the water that may be condensed or absorbed therein nor will it be so low as to be unduly wetted by the amount of steam condensed.

Further rotation of the chamber will finally deposit the material having this additional quantity of water absorbed therein or condensed thereon to the bottom of the tubes, upon the hottest portion or heating tubes 34, whereupon the cycle will begin again.

This progressive volatilization of steam, carrying with its nicotine vapor and subsequent absorption or condensation of water, progresses in such a manner that there is at first a larger quantity of moisture absorbed as the content of nicotine remains high and then gradually as nicotine is separated from the tobacco material, the product becomes hotter and absorbs less and less quantity of water in proportion to the nicotine remaining in the material treated. It will thus be noted that, at the exit end, as the material treated emerges with complete separation of nicotine, the water content will also almost completely be separated.

By undergoing a series of reheating and rewetting at the speed of operation described and within the temperature limits described, it has been found that a tobacco material having a content of nicotine as high as 10% or even in excess thereof, can be processed without detrimentally affecting the heating elements or without having the adhesive agents, resinous, albuminous materials and the like dissolved to an extent where they will gum or stick to the heating elements and, at the same time, having had added thereto an amount of water equivalent to 1000 pounds, or even more, if desired, of water to every 100 pounds of tobacco material.

It will be noted that the temperature at which the tobacco material is maintained is such as to permit interchange of heat units at the critical temperature while maintaining an atmosphere which further helps to accelerate the generation of the nicotine vapor. This is accomplished by reason of the extractive agent being present in both the liquid and vapor phase and the liquid carried within the extractive agent forming a solvent for any nicotine that may be generated, raising the possibility of further generating a quantity of nicotine vapor. This extractive agent in both the liquid and the vapor phase, can further carry more than the theoretical quantity of nicotine as compared with steam in the pure vapor phase. Thus, not only have I provided conditions for the more rapid generation of nicotine vapors but I have provided means for carrying a larger quantity of nicotine with the same amount of extractive agent.

In the claims where I have stated that I produce an atmosphere in which the extractive agent is in the liquid and vapor phase, I mean to include thereby any extractive agent, whether water or an organic solvent or nicotine, and where I have stated that the extractive agent is in the liquid phase in finely divided form, I mean to include thereby that condition of dispersion as may be characterized as a fog, cloud, vapor or spray.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent, is

1. In the process of treating tobacco material to remove its nicotine content which includes the steps of alternately exposing previously wetted tobacco material in the presence of a vapor extractive agent to heating and cooling, varying from an upper temperature limit sufficient to volatilize a portion of the water content and to a lower limit sufficient to condense and absorb portions of an extractive agent in contact there-

with when cooled and maintain it in liquid phase.

2. In the process of treating tobacco material to remove its nicotine content which includes the steps of alternately exposing previously wetted tobacco material in the presence of a vapor extractive agent to heating and cooling, varying respectively from an upper temperature, limit sufficient to volatilize a portion of the water content and to a lower limit sufficient to condense and absorb portions of an extractive agent being in contact therewith when cooled and maintain it in liquid phase, the extractive agent having a movement relative to the tobacco material to progressively remove the nicotine content thereof.

3. In the process of treating tobacco material to remove its nicotine content which includes the steps of intermittently exposing previously wetted tobacco material having its nicotine content liberated by treatment with an alkali, to heating while contacting the tobacco material with an extractive agent, the heating varying from an upper limit sufficient to volatilize a portion of the water content and to a lower limit sufficient to condense and absorb portions of the extractive agent and maintaining the extractive agent at a temperature within limits to retain the same in the mixed vapor and liquid phase while giving it a movement relative to the tobacco material to gradually remove the nicotine content.

4. In the process of treating tobacco material to remove the nicotine content thereof, the step which includes the treatment of the tobacco material by circulating in contact therewith an extractive agent comprising water in the mixed liquid and vapor phase, while maintaining temperatures to heat the tobacco to volatilize portions of the water.

5. In the process of treating tobacco material to remove the nicotine content thereof, the step which includes the treatment of the tobacco material with an extractive agent while maintaining a critical temperature for retaining the agent in the vapor phase, and intermittently subjecting the tobacco material to heating, varying from a temperature sufficient to volatilize the extractive agent to that which is just sufficient to condense portions thereof.

6. In the process of recovering nicotine from tobacco material the steps which comprise freeing the nicotine content thereof by treatment with a water solution of an alkaline agent in quantities just below that at which the tobacco material will be adhesive, subjecting the same to heating and cooling temperatures alternating from an upper limit sufficient to volatilize the water and carry off the nicotine, to a lower limit temperature at which water vapor condenses.

7. In the process of recovering nicotine from tobacco material the steps which comprise freeing the nicotine content thereof by treatment with an alkaline solution of water in quantities just below that at which the tobacco material will wad or chunk and subjecting the same to heat, alternating from a high temperature to a low temperature, the high temperature being sufficient to volatilize the water and carry a quantity of nicotine with it, the lower temperature being sufficient to permit condensation of the steam without appreciable transfer of heat.

8. In the process of recovering nicotine from tobacco material the steps which comprise converting the nicotine content thereof to free nicotine by treatment with an alkaline solution of water in quantities just below that at which the tobacco material will wad or chunk and subjecting the same to heat, alternating from a high temperature to a low temperature, in an atmosphere containing steam, the high temperature being sufficient to volatilize the water to carry off a quantity of nicotine with it, the lower temperature being sufficient to permit condensation of the steam without appreciable change of temperature and continuously removing the vapors containing nicotine from the zone in which they are generated.

9. In the process of recovering nicotine from tobacco material the steps which comprise initially converting the nicotine content into free nicotine by treating with an alkali, adding water in quantities upwards of 150% but below that percent at which the tobacco material will wad or chunk and subjecting the mixture to heat alternating from a high temperature to a low temperature in an atmosphere containing water in the liquid and vapor phase, the high temperature being sufficient to volatilize the water and carry off a quantity of nicotine with it, the low temperature being sufficient to permit condensation of the steam without appreciable change in temperature.

10. In the process of recovering nicotine from tobacco material the steps which comprise freeing the nicotine content thereof by treatment with an alkaline solution of water in quantities upwards of 150% but below that percent at which the tobacco material will wad or chunk and subjecting the same to heat, alternating from a high temperature to a low temperature, in a counter-current of an extractive agent containing steam, the high temperature being sufficient to volatilize the water to carry off a quantity of nicotine with it, the low temperature being sufficient to permit condensation of the steam without appreciable change in temperature and recovering the nicotine from the extractive agent.

11. The process of treating tobacco material to remove its nicotine content which

includes the steps of alternately exposing previously wetted tobacco material in the presence of an extractive agent in the mixed liquid and vapor phase to heating sufficient to volatilize a portion of the water content, to cooling sufficient to condense and absorb a portion of the extractive agent and repeating the heating and cooling for alternate treatment of the first and second order to progressively remove the nicotine content of the tobacco material.

12. In an apparatus for extracting nicotine from tobacco material, a heating chamber, of means for progressively feeding raw material to said heating chamber, and means for feeding an extractive agent counter-currently to said material feeding means in said chamber, the extractive agent feeding means including means for dispersing water in finely divided form, the chamber including shelves radially arranged in said chamber and of a size and form to cascade the tobacco material from the peripheral walls towards the axial line of the chamber transversely across said current of dispersed water.

13. In an extraction apparatus of the character described, a heating chamber, of means for progressively feeding raw material to said heating chamber, means for counter-currently feeding an extractive agent comprising water in finely dispersed form, radially disposed cascading means for said material formed to progressively feed the material transversely across the current of said extractive agent and from the peripheral walls across the axial section of the chamber.

14. In an apparatus for extracting nicotine from tobacco material, a heating chamber provided with heating means substantially peripherally disposed, means for feeding tobacco material progressively through said heating chamber, means for counter-currently feeding an extractive agent including finely dispersed water adjacent the axial portions of said heating chamber forming a cooler axial zone, and cascading means for said tobacco material radially disposed and formed to direct said tobacco material continuously and progressively from the peripherally heated portions of said chamber towards the axial zone across the path of the current of the said extractive agent.

15. In an apparatus for extracting nicotine from tobacco material, a rotary heating chamber provided with heating means substantially peripherally disposed in said chamber, means for feeding tobacco material progressively through said heating chamber, means for counter-currently feeding an extractive agent, including finely dispersed water adjacent the axial portion of said heating chamber, forming a cooler zone, and cascading means for gravitating the tobacco material radially and transversely to the movement of the extractive agent, said cascading means comprising radially disposed vanes.

16. In an apparatus for extracting nicotine from tobacco material, a rotary heating chamber provided with means for heating the same, said heating means being disposed substantially at the peripheral portions of said chamber, means for mounting said chamber for rotation, means for feeding the tobacco material progressively through said chamber, means for counter-currently feeding an extractive agent, adjacent the axial portions of said heating chamber, and cascading means for gravitationally forming a curtain of the tobacco material, transversely to the movement of the extractive agent through said chamber, said cascading means comprising radially disposed flat blades positioned to extend from the peripheral portions across the axial line of said chamber, and substantially free at said axial portions, whereby tobacco may be cascaded substantially diametrically across said chamber during its rotation.

17. In an apparatus for extracting nicotine from tobacco material, a rotary heating chamber provided with means for heating the same, said heating means being disposed substantially at the peripheral portions of said chamber, means for mounting said chamber for rotation, means for feeding the tobacco material progressively through said chamber, means for counter-currently feeding an extractive agent, adjacent the axial portions of said heating chamber, and cascading means for gravitationally forming a curtain of the tobacco material, transversely to the movement of the extractive agent through said chamber, said cascading means comprising radially disposed, triangularly formed, flat blades positioned to extend from the peripheral portions across the axial line of said chamber, and substantially free at said axial portions, and tapering in the direction of said axial portion of said chamber, whereby tobacco may be cascaded substantially diametrically across said chamber and moved towards the exit end during its rotation.

In witness whereof, I have signed and sealed this specification, this eleventh day of December, A. D. 1925.

ROBERT GRAHAM MEWBORNE.