May 17, 1955 G. T. VIGLIONE 2,708,441

PROCESS OF CURING TOBACCO

Filed Nov. 19, 1951

Fig. 1.

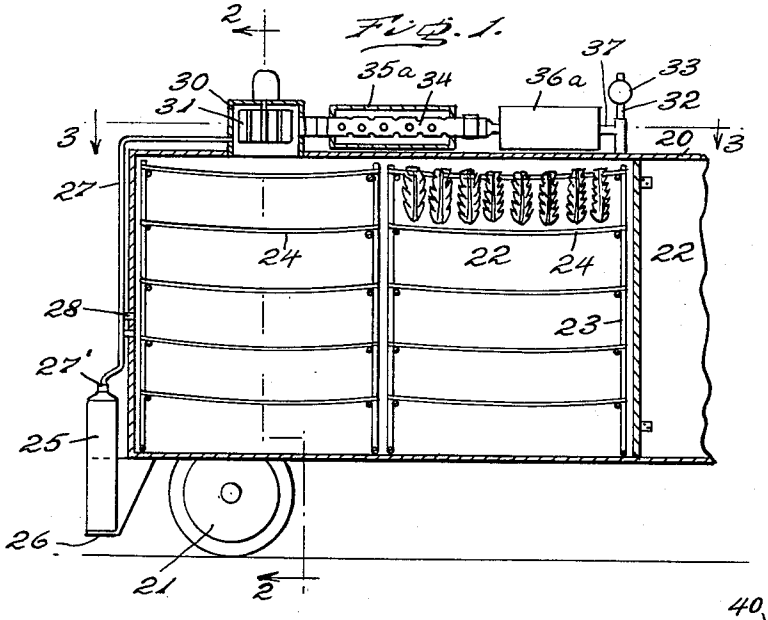


Fig. 2.

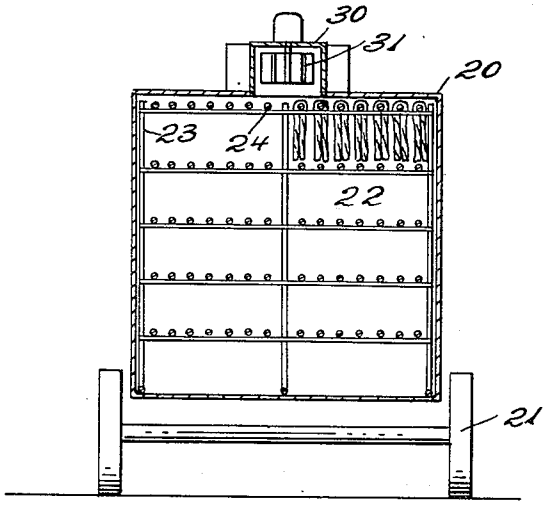
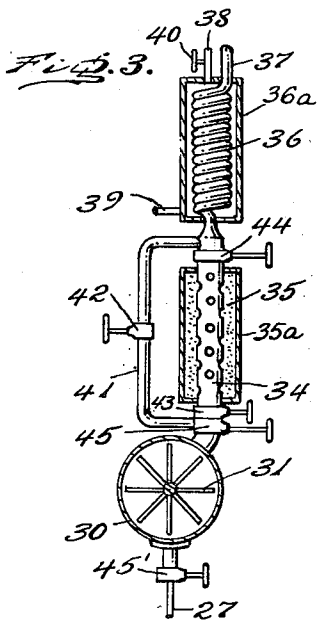


Fig. 3.



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PROCESS OF CURING TOBACCO

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2 Claims. (Cl. 131—140)

The present invention relates to the curing of tobacco and particularly to the curing of so-called flue cured types of tobacco, including United States Department of Agriculture types 11 to 14, inclusive, such as types 11–A and 11–B and also including very low grade flue cured types which previously have been regarded as uncurable and unsalable (such as "lugs").

This application has been divided and the apparatus subject matter is now contained in U. S. application Serial No. 322,600, filed November 26, 1952, for Tobacco Curing Apparatus.

A purpose of the invention is to speed the cure of flue cured tobaccos, and accomplish curing more economically.

A further purpose is to eliminate variables incident to weather conditions in tobacco curing.

A further purpose is to obtain more reliable color in tobacco curing, and assure proper conversion of starches to sugar by permitting favorable fermentation and enzymatic action.

A further purpose is to promote yellowing by the introduction of excess oxygen into the curing atmosphere during the yellowing step, desirably increasing the percentage of oxygen by volume in the air to in excess of 50 percent and preferably in excess of 85 percent, and desirably concurrently producing a relative humidity in excess of 85 percent and preferably as high as 98 percent, desirably maintaining a temperature of between 85° and 90° F.

A further purpose is to carry out the yellowing in an oxygen atmosphere at high relative humidity and promote yellowing by employing superatmospheric pressure, preferably in the range of 2 to 5 atmospheres absolute.

A further purpose is to follow the yellowing step by a color setting step during which the tobacco leaf is treated with circulating dry air at a relative humidity below 30 percent and preferably below 10 percent and suitably at a temperature of 170° to 210° F., desirably changing the air in the treating chamber at least three times per minute.

A further purpose is to accomplish killing out of the tobacco by continuing the treatment with dry air at elevated temperature, increasing the temperature at least 10° F., while at the same time keeping the temperature below an upper limit of 220° F.

A further purpose is to control the factors in the various steps such as gas composition, temperature, relative humidity, time, and pressure automatically so that the curing can be carried on with a minimum of necessary labor, and the labor required can be devoted most efficiently to loading and unloading the equipment.

In the drawings I have chosen to illustrate one only of the numerous embodiments in which my invention may appear, selecting the forms shown from the standpoints of convenience in illustration, satisfactory operation, and clear demonstration of the principles involved.

Figure 1 is a diagrammatic central vertical longitudinal section of one curing chamber in a vehicle designed for tobacco curing in accordance with the invention.

Figure 2 is a section of Figure 1 on the line 2—2.

Figure 3 is a fragmentary diagrammatic section of the circulating fan, desiccator and heating unit, the section being taken on the line 3—3 of Figure 1.

Describing in illustration but not in limitation and referring to the drawings:

In the prior practice tobacco has been generally cured in barns, and the effectiveness of the cure has been subject to a number of variables, such as the ambient temperature, the relative humidity, the oxygen content of the atmosphere (elevation), the character of the tobacco, the time at which it was picked, the heating means and the curing aids if any employed. This has resulted in unsatisfactory curing, particularly in respect to color and speed of curing.

The present invention is designed to accelerate the curing cycle, eliminate uncertainties, obtain more uniform quality, and particularly secure good color even on low grade tobacco, such as lugs, especially by promoting the fermentation and enzymatic activity during the yellowing step of the cycle.

In accordance with the invention, yellowing is promoted by increasing the oxygen content of the air and preferably using a gas which is substantially all oxygen (plus water vapor), while at the same time maintaining a high relative humidity, with elevated temperature, and preferably further promoting yellowing by increasing the atmospheric pressure.

The gas employed will suitably be air having an oxygen content in excess of 50 percent by volume, and preferably in excess of 85 percent by volume. The balance if any of the gas content will be harmless impurities, such as nitrogen, the rare inert gases, water vapor which is present incident to the high relative humidity, and small amounts of carbon dioxide. While it is considered best to obtain the gas of the invention by enriching air with oxygen, it will be understood that if desired the gas employed in the coloring step may be substantially pure oxygen or any of the commercial grades of oxygen which contain nitrogen as an impurity.

The effectiveness of the oxygen addition in the coloring step is greatly enhanced by maintaining a high relative humidity during the coloring. The relative humidity at this stage should be in excess of 85 percent, and preferably as high as 98 percent. It is usually not considered desirable to use a relative humidity higher than 98 percent because of the danger of precipitation which will needlessly complicate drying.

The temperature employed during the coloring step can be as low as room temperature (such as 70° F.) but for best results it should be in the range between 85° F. and 100° F. Temperatures in excess of 100° F. in the coloring step are not recommended.

The effectiveness of the increased oxygen content and high relative humidity in the coloring step is promoted by increasing the pressure of the gas. I find that pressures of from 2 to 5 atmospheres absolute are very desirable and greatly accelerate coloring.

It is not necessary to circulate the gas during the coloring step, although circulation is permissible if desired.

The presence of an increased oxygen content at elevated temperatures under increased pressure in the presence of high relative humidity greatly promotes the conversion of starches to sugars in the tobacco by assisting fermentation of leaf carbohydrate and promoting proper enzymatic action. The increased humidity is helpful as promoting wilting of the leaf. The enzyme which stimulates coloring of tobacco depends for its activity upon the presence of oxygen.

I find experimentally that the coloring step of the cycle

can be accomplished in from 2 to 8 minutes under the preferred conditions when operating on fine light body tobacco leaf, and that it requires no longer than 16 minutes when operating on heavy tobacco leaves. The time may vary from 2 to 40 minutes for yellowing. It will be evident, of course, that the user should control the time or any one of the other variables to secure the degree of yellowing desired in the particular case.

After yellowing is completed, the tobacco is next subjected to the color setting (drying step). The oxygen atmosphere is not desirable during the color setting step and should be removed either by wasting to atmosphere or by transferring to another charge undergoing the coloring step. During the setting step, dry air is employed, at a relative humidity below 30 percent and preferably below 10 percent. The air during drying should undergo circulation as by a circulating fan or blower, and I find that the minimum frequency of change of air for good results should be three changes of air in the treating chamber per minute.

The time required for the color setting step is ordinarily between 5 and 15 minutes.

I find that it is best to desiccate and heat the circulating air so that it can be reused during the color setting step. The desiccated air is very effective in removing moisture from the cells of the leaf without destroying or excessively dehydrating aromatic oils.

The temperature maintained during the color setting is from 170° to 210° F.

The color setting step has the effect of fixing the color, since fermentation and enzymatic action diminish or cease as soon as the leaf is dehydrated to a considerable extent.

The third step of the cycle is killing out. During this step the treatment with the circulating dry heated air is continued, and the temperature is raised at least 10° F., the temperature range during killing out being between 170° and 220° F.

The time of the killing out step may be a minimum of 5 to 20 minutes, and for good results the killing out step should not continue more than 40 minutes under the condition specified.

During the killing out step the circulation, heating and desiccation are continued as already described in connection with the color setting step.

The temperature at no time during the cure should exceed 220° F. This assures that no appreciable fire hazard will exist as the kindling point for tobacco is well in excess of this temperature.

The invention will be understood more completely by reference to the drawings.

As shown in the drawings, a curing machine **20** is conveniently mounted on wheels **21** so that it can be moved from one location to another after the manner familiar with threshing machines and other similar equipment. It will be understood, however, that a stationary installation may be employed if desired. The curing machine preferably is provided with a plurality of separate curing compartments **22**, each of which is substantially gas tight and provided with gas-tight access doors (not shown) of any well known character. Each compartment is suitably separately instrumented for automatic control of the cycle in that compartment, so that the various compartments can operate at different stages of the curing cycle.

In each of the compartments, racks **23** carry "sticks" **24** supporting tobacco leaves in spaced relation, as well known. A cylinder **25** of compressed oxygen is mounted on a holder **26** at a convenient position on the vehicle, and connected by a pipe **27** to the treating chamber **22**. A suitable valve **27'**, which will desirably be automatically operated by the control mechanism provided at panel **28**, controls the turning on and cutting off of the oxygen stream into the chamber.

The connection of the pipe **27** into the chamber is conveniently provided at one side of blower housing **30** having a blower rotor **31**. For removal of the oxygen atmosphere at the end of the coloring step, pipe **32** is provided control by valve **33** connected from the chamber to atmosphere. The valve **33** is suitably automatically actuated by the controls in any well known manner, not shown.

The blower discharges into a desiccator **34** suitably having a foraminated pipe surrounded by a desiccant **35** such as silica gel, activated alumina or the like in a casing **35*a***. From the desiccator **34** the circulating air passes through heater coil **36** and then through pipe **37** enters the treating chamber. The heater has a jacket **36*a*** through which a suitable heating medium such as steam is circulated through pipes **38** and **39**. The inlet is controlled by valve **40**.

If it is desired to by-pass the desiccator, this is done through by-pass **41**, opening valve **42** and closing desiccator inlet and outlet valves **43** and **44**. A master valve **45** cuts off flow to both the by-pass and the desiccator. On the inlet side of the blower, a valved connection **45'** is provided, normally kept closed.

In operation of the curing machine of Figures 1 to 3, when one charge has been cured in a particular chamber, the access doors are opened and the cured tobacco removed. Sticks of tobacco are then placed on the racks to fill the chamber with a new charge. The access doors are closed tight and the curing cycle is started. In the first step oxygen from tank **25** is introduced to pipe **27** and the pressure is built up suitably to about 4 atmospheres absolute. The by-pass is opened and the valves closed into the desiccator and the circulating fan started and the heater turned on, circulating the atmospheree continuously through the heater, back into the treating chamber and then again withdrawing it from the heating chamber and passing it through the blower. This builds up the temperature to the desired temperature for the coloring step, and the temperature can readily be regulated by varying the speed of the blower or the amount of steam at adequate pressure to the heater. At the same time the relative humidity builds up to the desired level by moisture removed from the tobacco. By a combination of control of the heater and control of the blower the correct temperature and relative humidity are secured, and by recirculating and admission of oxygen the desired oxygen content is obtained. The coloring step proceeds very quickly and at the end of a period of from 2 to 40 minutes the coloring is complete. Before the end of the coloring step, the oxygen flow will normally have been cut off. The coloring step results in generation of carbon dioxide and ethylene gas in minute quantities. At the end of the coloring step, valve **33** is opened and the oxygen atmosphere is removed either by wasting to atmosphere, by transferring to a storage or recovery system, or by supply of the oxygen to another chamber until an objectionable content of carbon dioxide is built up.

Exhaust valve **33** is maintained open and valve **45'** is opened to connect the blower to atmosphere so that outside air is brought in to sweep excess oxygen from the treating chamber. Then valves **45** and **33** are closed and the color setting step begins. During this step the by-pass to the desiccator is closed and the valving into and out of the desiccator is opened so that the air continuously circulates through the desiccator and through the heater. By controlling the blower at speed related to the capacity of the desiccator, and controlling the heater, the desired temperature, relative humidity and circulating velocity are obtained. At the end of 5 to 15 minutes at a temperature of 170° to 210° F. the color setting is complete. The killing out step then is begun, by slightly increasing the temperature and continuing to recirculate dry air for an additional time of at least 5 minutes and preferably at least 20 minutes. This completes the curing. At the end of the killing out step, the access doors are opened and the charge removed. The treating chamber is then ready to receive a new charge.

It will be evident that by the present invention, the time required for curing is markedly reduced, and the

uniformity of the results are greatly improved. I find that with proper control and design of the equipment, the complete curing cycle can be carried out in about 20 minutes, and the product in many cases is upgraded since the color and other evidence of quality is improved as compared with those resulting from conventional barn curing.

In view of my invention and disclosure variations and modifications will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the process shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. The process of curing tobacco, which comprises coloring the tobacco by exposure to a gas essentially consisting of over 50 percent by volume of oxygen, the balance harmless impurity, at a relative humidity of between 85 and 98 percent, at a temperature between 85° and 100° F., under a pressure of from 2 to 5 atmospheres absolute for a time of 2 to 40 minutes, setting the color by treatment in air for from 5 to 15 minutes at a relative humidity below 30 percent and a temperature of 170° to 210° F. while circulating the air, and killing out the tobacco by increasing the temperature at least 10° F. above the temperature of setting to a temperature not in excess of 220° F. and continuing the treatment with the dry air for a time of in excess of 5 minutes.

2. The process of curing tobacco which comprises coloring the tobacco by treating tobacco in leaf form for from 2 to 40 minutes with a gas essentially consisting of in excess of 85 percent of oxygen by volume, the balance harmless impurity, at a relative humidity of from 85 to 98 percent, at a temperature of 85° to 100° F. and at a pressure of 2 to 5 atmospheres absolute, setting the color by circulating dry air through the tobacco for from 5 to 15 minutes at a relative humidity below 10 percent, at a temperature of from 170° to 210° F. with change of air at least 3 times per minute in the treating space, and killing out the tobacco by continuing the dry air treatment for at least 5 minutes and raising the temperature at least 10° F., maintaining at all times a temperature not in excess of 220° F.

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