Sept. 11, 1962 B. PERRIN ET AL 3,053,258

RECONSTITUTING TOBACCO

Filed May 3, 1961 3 Sheets-Sheet 1

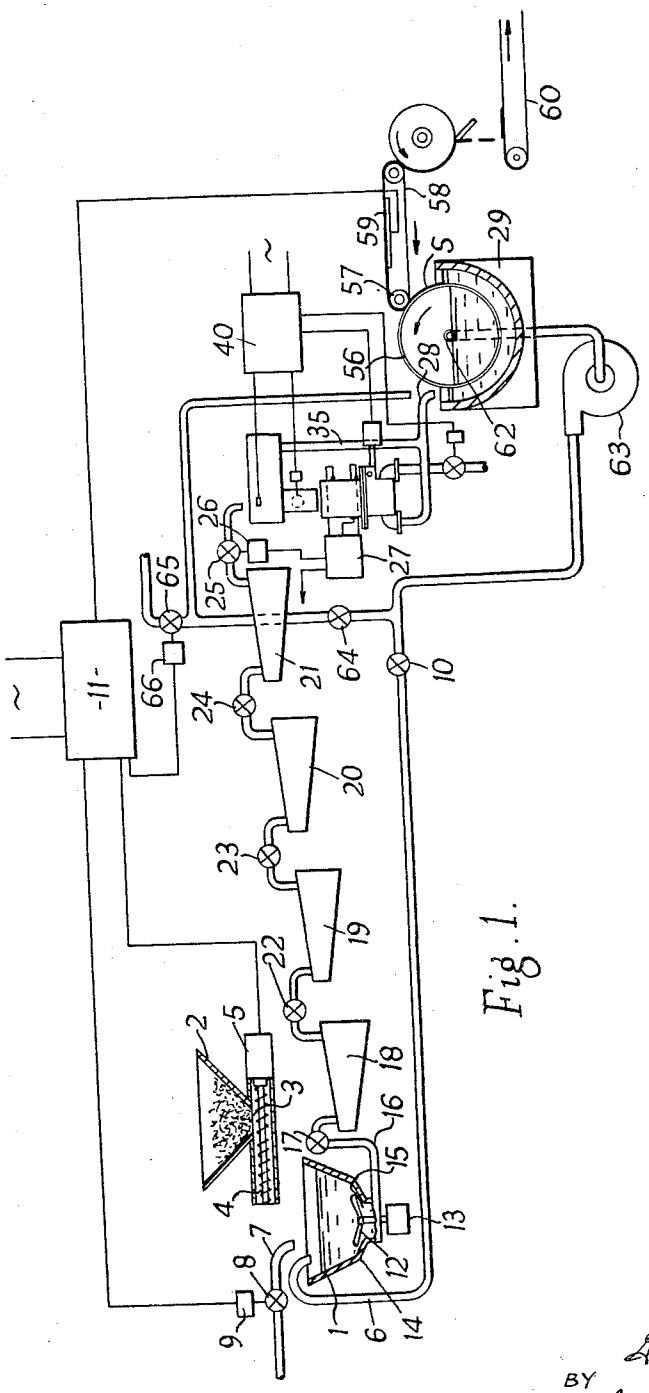
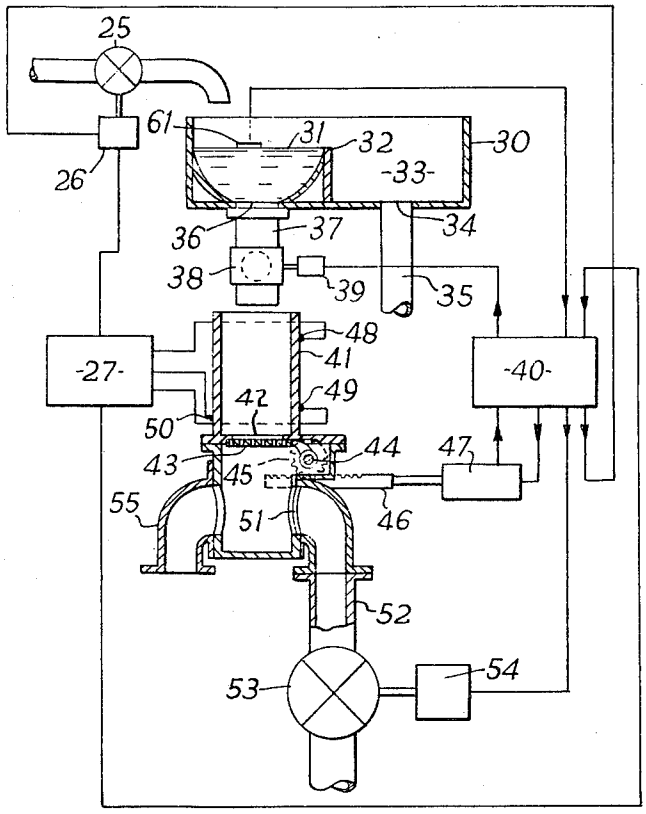


Fig. 1.

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Fig. 2.



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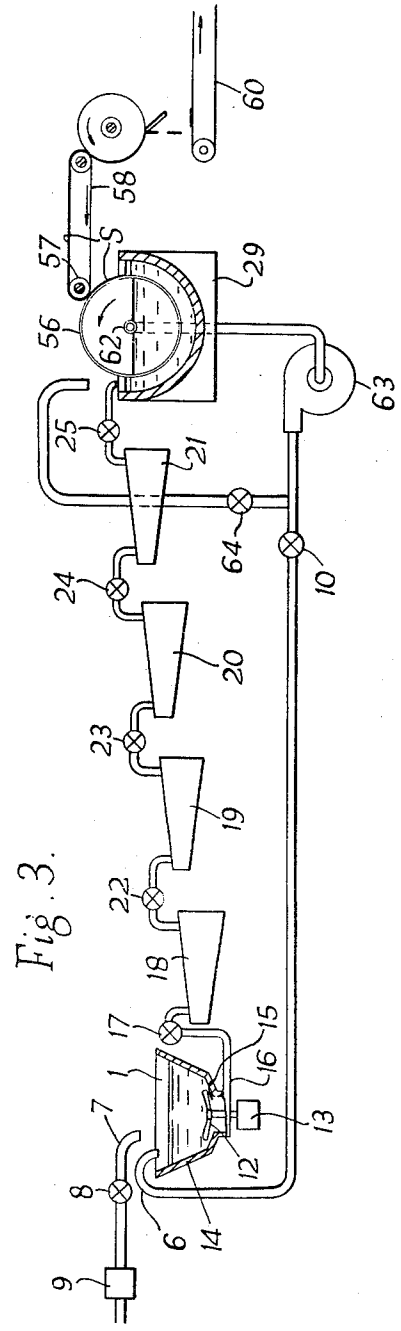


Fig. 3.

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RECONSTITUTING TOBACCO

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2 Claims. (Cl. 131—140)

This invention concerns improvements in or relating to a method of and apparatus for processing tobacco.

In the manufacture of tobacco products, such as cigarettes, it is customary to subject tobacco leaf to various primary processes which include stemming, conditioning and cutting of the leaf lamina in a tobacco cutting machine to obtain shredded tobacco which can then be used in a normal cigarette-making machine. With regard to the stem of tobacco leaf, this is subjected to different processes, which include rolling or crushing and then cutting, so that cut rolled stem is somewhat similar to the shredded leaf lamina and can be mixed with the leaf lamina for incorporation in the cigarettes produced on the cigarette-making machine.

In the manufacture of the cigarettes, some of the tobacco products become unusable for various reasons. For instance, dust is produced which contains minute tobacco particles, while some of the tobacco may be so broken up as to constitute what is sometimes referred to as "smalls" which are of little use for re-using in that condition in a cigarette machine, and slivers of stem, which possess undesirable characteristics, may also be removed in a cigarette machine by winnowing.

Heretofore no way has been found of re-using any of these waste products without special treatment. Some proposals have been made for what is called "reconstituting" these waste products by subjecting them to various processes some of which are similar to the paper-making process, in which they are formed into sheet with the object of using the sheet in the way the original leaf lamina was used by being shredded into fine shreds for incorporating into other shredded tobacco for use on the cigarette-making machine.

Many difficulties have been encountered in the making of this so-called reconstituted tobacco sheet, whether it is made from waste products, or whether it is made from the original tobacco before being subjected to any primary process as aforesaid. One difficulty is that, due to the large bulk of water used in reconstituting tobacco in the normal paper-making process, a great deal of the elements which are responsible for the characteristic flavour of the tobacco are lost by leaching.

The present invention is concerned with a process and apparatus for treating tobacco products, whether waste products or otherwise, all or any part of which shall be understood to come within the term "'tobacco product" when used herein and where the context permits.

According to the present invention there is provided a method of processing tobacco, comprising the steps of adding tobacco product to a liquid (such as water) to produce a solution of soluble constituents of tobacco product in the liquid, of pulping the fibrous portion of tobacco product so that it is capable of retaining a desired quantity of the solution, of concentrating the fibrous portion of tobacco product after it has been removed from the solution to form a concentrated pulpy product and of arranging that the ratio of soluble constituents of tobacco product to liquid, in the liquid retained by the concentrated pulpy product, is such that the concentrated pulpy product after being dried contains the constituents in substantially the same quantities as

were present in the tobacco product from which the concentrated pulpy product was formed.

The total quantity of the soluble constituents of the tobacco product retained by the said fibrous portion may be held at a substantially fixed ratio to the quantity of liquid present in the fibrous portion by maintaining the total quantity of the soluble constituents of the tobacco product in the solution present in the system at a substantially fixed ratio to the quantity of liquid present in the system.

Further according to the invention there is provided apparatus for the manufacture of reconstituted tobacco comprising mixing means for adding tobacco product to a liquid (e.g. water) to produce a solution of soluble constituents of tobacco product in the liquid, disintegrating means for pulping the insoluble portion of tobacco product so that it is capable of retaining a desired quantity of the solution, concentrating means for forming the insoluble portion of tobacco product within the solution into a pulpy product, and controlling means for holding the ratio of tobacco product in the liquid retained by the said insoluble portion of the puply product, to the quantity of liquid retained thereby, at a substantially fixed level, so that the pulpy product, after being dried, contains the constituents in substantially the same quantities as were present in the tobacco product from which the said pulpy product was formed.

Controlling means may be provided comprising a feedback control comprising a load cell or strain gauge or similar weighing device for measuring continuously the quantity of pulpy product prior to its being dried, a three-term controller to receive a series of signals from the load cell, strain gauge or similar weighing device and to transmit variations in operating voltage to regulating means such as hydraulic, pneumatic or electrically operated mechanisms for feeding desired quantities of the said tobacco product and of the said liquid into the system.

The disintegrating means for pulping the fibrous portion may comprise a feedback controller comprising means for feeding a specified volume of the mixture of the insoluble portion of the tobacco product and of the solution into a container which is so arranged that the time taken for the liquid portion of the said mixture (which time is a function of the degree of treatment of the fibrous portion), to pass through the fibrous portion, is used to provide input signal to an integrating controller, the output from which is used to regulate the treatment of the insoluble portion.

Past experience has shown that large quantities of liquid dissolve the soluble constituents from the tobacco product. If the excess liquid is then run to waste some of the soluble constituents are irretrievably lost and cannot be replaced in the pulpy product. By restricting the total quantity of liquid within the apparatus and by avoiding the wastage of any liquid except that retained by the concentrated pulpy product, which amount is automatically replaced in the apparatus, it has been found possible to maintain the system in a steady state in which the relationship between the total amount of solubles held in the liquid to the total quantity of liquid present within the system is held constant. The relationship can be expressed by:

$$E = SQ$$

where

E=Percentage of solubles in the liquid after the steady state has been reached.

S=Percentage of soluble constituents in the dry weight of the tobacco product.

Q=Proportion of the dry weight of fibrous portion of the tobacco product to the weight of liquid retained by that weight of fibrous portion.

Apparatus according to the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a diagrammatic arrangement.

FIGURE 2 is an enlarged view, partly side view, partly section and partly diagrammatic, of a portion of FIGURE 1.

FIGURE 3 is an alternative diagrammatic arrangement.

Referring to FIGURE 1, a mixing tank **1** is fed with tobacco product from a hopper **2**, at the base of which is an opening **3** communicating to an archimedean screw **4** driven by a variable speed unit **5**, and with solution from an open-ended pipe **6** and with liquid from a further open-ended pipe **7** controlled by a valve **8** operated by an electric motor **9**. The arrangement is such that the adding of solution into the mixing-tank **1** can be controlled by valve **10** which, when shut, recirculates the solution in a manner to be described later and, when open, allows the solution to be discharged through the open-ended pipe **6**. The quantity of tobacco product fed in the mixing-tank **1** is regulated by the variable speed unit **5** and the quantity of the liquid discharged through the open-ended pipe **7** is determined by the amount or the period of time of the opening of the valve **8**. Both the variable speed unit **5** and the motor **9** of the valve **8** are operated by a variable output voltage from a three-term controller **11**.

The mixing-tank **1** is provided with a propeller-shaped rotor **12** driven at constant speed by a motor **13**. Between the underside of the rotor **12** and a casing **14** of the mixing-tank **1** there is an annular space **15** leading to a discharged pipe **16** fitted with a valve **17** and connected to the inlet of a refiner **18**. Four refiners **18**, **19**, **20** and **21** are in series with outlets connected through valves **22**, **23** and **24** to the inlet of the following unit. The refiner **21** is provided with an outlet regulating-valve **25** fitted with a motor **26** operated by a voltage from an integrating controller **27**. The output from the refiner **21** is a pulpy product which is fed through a control system to be described and is discharged through an open-ended pipe **28** into a concentrator **29**.

FIGURE 2 represents the control system for the valve **25**. The pulpy product is discharged through the valve **25** into a flow-box **30** so arranged that the discharge is directed into a compartment **31** one wall of which is a weir **32**. Thus the compartment **31** is maintained full and all further discharge of the pulpy product flows over the weir **32** into a secondary compartment **33** provided with an opening **34** on its bottom-side through which the overflow passes to a pipe **35** connected to the open-ended pipe **28**. At the bottom of the compartment **31** is an opening **36** connected to a pipe **37** in which a butterfly-valve **38** is operated by a solenoid **39**. The solenoid is operated by a process-controller **40**. The compartment **31** is shaped so that it contains no corners or edges. When the butterfly-valve **38** is open the contents of the compartment **31** fall into compartment **41** which is made of an insulating material such as glass or a suitable plastic and is provided with an opening **42** on its bottom side. A flap-valve **43** constructed from a fine copper wire mesh is pivoted at **44** and is operated by a pinion **45** which engages with a rack **46** moved by a solenoid valve **47**. In its normal position the flap-valve **43** covers the opening **42**.

When the contents of the compartment **31** are dropped into the compartment **41** a sheet of solid matter is formed on the wire mesh of the flap-valve **43**. Three terminals **48**, **49** and **50** are disposed in the insulated material of the compartment **41** so that when liquid is present within the compartment **41** two electrical circuits are

completed. The first is between the terminals **48** and **50** so that when the liquid level is above **48** a circuit is completed. Conversely as the liquid level drops this circuit is broken immediately the level falls below the terminal **48**. The second circuit is between the terminals **49** and **50**. In the same way when the liquid level drops below **50** the circuit is broken. As each circuit is broken a signal is fed into the integrating controller **27** which can thereby measure the time taken for the liquid level to fall from the terminal **48** to the terminal **50**. The measured time can then be used to regulate the duration of an output voltage which will operate the motor **26** and thus control the amount of opening of the regulating-valve **25**.

When the liquid has drained through the wire mesh of the flap-valve **43** a sheet of the pulpy product will have formed on the wire mesh and must be washed off before the following contents of the compartment **31** can be dropped into the compartment **41**. Action of the rack **46** will rotate the pinion **45** and thus move the flap-valve **43** until it covers an opening **51**. In this position the sheet formed on the wire mesh can be washed off by means of a reflux of liquid through a pipe **52** when a valve **53** operated by a solenoid is opened for a short period. The liquid and solids from the sheet of intermediate pulpy product is washed through a pipe **55** which is connected to the open-ended pipe **28**.

Returning now to FIGURE 1 the concentrator **29** into which the mixture of the pulpy product and the solution is fed is provided with a cylinder **56** rotating in the direction shown by the arrow. A continuous sheet S of the pulpy mixture is formed on the outside of the cylinder **56** and is picked off by a couch roll **57**. A continuous felt band **58** running in the direction shown carries the continuous sheet S over a load cell **59** which transmits back to the three-term controller **11** a continuous record proportional to the weight of the sheet S and of the solution held in association with the sheet. The sheet is then transferred by known means to the first band of a dryer **60** where the final drying takes place. The solution extracted through the sheet S is emptied through trunnion-ends **62** and pumped through a pump **63** either to the mixing-tank **1** or back to the concentrator dependent on whichever of valves **10** and **64** is opened.

The operation of the apparatus will now be described. The tobacco product which is fed into the hopper **2** contains bundles of fibres in the form of pieces of stem or of stem sliver. The rotor **12** which is rotating at high speed, of the mixing tank **1** acts as a breaking force on the fibre bundles. Due to the shape of the casing **14** all fibre bundles coming into contact with the rotor are flung out by centrifugal force whereas individual fibres which are of lower weight can mix freely with the liquid and pass out of the mixing-tank through the annular space **15**. The rate at which the liquid and solid constituents of the tobacco product pass through the pipe **16** can be regulated by the valve **17** since the series of refiners acts as a pump and therefore exerts a suction head.

The action of the refiners **18**, **19**, **20** and **21** is in every way similar to their use in papermaking i.e. individual fibres are beaten and fibrillated until they are in a condition to be made into sheet form. In addition the degree to which the fibres are beaten and fibrillated determines the quantity of free solution they will retain under a given set of physical conditions. Consequently the control of the valve **25** which determines the rate at which the fibres are treated and thus the degree to which they will retain the solution, is of great importance. This control is exercised by measuring the time for a known quantity of a mixture of the solution and of the fibres and solids, as the mixture is delivered by the valve **25** to the flow-box **30**, taken to drain through a sheet formed by the same fibres and solids while the liquid level falls from the terminal **48** to the terminal **50**. The sequence of operations is as follows:

As soon as the liquid in the compartment **31** reaches

the level of the top of the weir 32 a signal is transmitted to the process controller 40 through a contact 61. A similar signal must also be received from the solenoid 47 to indicate to the process controller that the flap-valve 43 is in its correct position, at the bottom of the compartment 41. On receipt of these two signals two operating voltages are transmitted from the process controller, one to close the valve 25 and the other to open the butterfly-valve 38. As soon as a predetermined interval of sufficient duration to allow the contents of the compartment 31 to pass to the compartment 41 has elapsed, two reversing voltages are transmitted to open the valve 25 and to close the butterfly-valve 38. As soon as the circuit between the terminals 48 and 50 is broken an integrating timer in the controller 27 is started and is again stopped when the circuit between the terminals 50 and 49 is broken. An output signal dependent on the elapsed time is then transmitted to the motor 26 which accordingly controls the opening of the valve 25 to the required degree. At the same time a simple signal to indicate the completion of the timing cycle is passed by the controller 27 back to the process controller 40 which then transmits an operating voltage to the solenoid 47, thereby moving the flap-valve to its washing position over the opening 51. A further operating voltage is then passed to the solenoid 54 thereby opening the valve 53 and allowing the reflux washing of the wire mesh. After a predetermined interval the operating voltage is cut-off and the solenoid 54 closes the valve 53. Finally the voltage to the solenoid 47 is cut-off so that the flap-valve 43 returns to its position at the bottom of the compartmen 41. The system is now in a condition to start the next sequence of operations.

The sheet S, formed on the cylinder 56 of the concentrator 29 will contain fibres and solids treated so that they will retain a constant ratio of the solution to the dry weight of the fibres and the solids. Consequently the continuous weight signal produced by the load cell 59 as the sheet of the intermediate pulpy product passes over the load cell and transmitted to the three-term controller 11 can be split up in the three-term controller into two components, one corresponding to the weight of the solids and the other to the quantity of liquid held by the solids. The first component can then be used to regulate the operating voltage fed from the process-controller to the variable-speed unit 5. Similarly the second component of the continuous signal from the load-cell is used to regulate through a change-over switch the quantity of liquid added back into the apparatus either at the valve 8 or through a valve 65 operated by a motor 66. Both components are used to give three-term control i.e. proportional, derivative and integral, thereby achieving the desired effect of feeding back into the apparatus equal quantities of the tobacco product and of the liquid as are removed from the apparatus in the form of the pulpy product and the liquid which is subsequently evaporated in the drying stage.

For example, reconstituted tobacco can be made in the following manner. A solution is prepared by adding tobacco dust to water in the mixing tank 1 and stirring by means of the rotor 12 for five minutes until the soluble constituents of the dust have entered into the solution with the water. The slurry produced by the mixture of the insoluble dust constituents and the solution can then be pumped through the series of refiners 18 to 21 to the concentrator 29 which can then be used as a filter, with the solution being pumped back to the mixing-tank via the pump 63, the valve 10 and the open-ended pipe 6. The insoluble dust constituents will form on the outside of the cylinder 56 and special arrangements must be made for their removal since such dust constituents which may form a pulpy layer on the cylinder will not of themselves form a commercially satisfactory sheet and, therefore, cannot be picked off the cylinder 56 by the couch-roll 57. The insoluble dust constituents on their own are waste products and are not in this example put to any further useful purpose in the process being described once the dust has been used for the extraction of its soluble constituents.

The operation just described will then be repeated but, instead of using water, fresh tobacco dust is added to the solution already extracted in the concentrator 29 and returned to the mixing-tank 1. After each extraction of the soluble constituents from the dust the strength of the solution is checked. This can be done by taking a sample and using any suitable laboratory method.

The extraction process is repeated, until the solution obtained contains 8% of soluble constituents. It is also necessary that there should be sufficient of this solution to ensure that when the process of making reconstituted tobacco begins, the whole system will be filled by this solution and tobacco product added to it for the purpose of making a reconstituted product. It should be remembered that as soon as the tobacco product is added to the solution soluble constituents will be dissolved out of it and will pass into the solution so that in effect, on the addition of the tobacco product at the commencement of the process for making reconstituted tobacco, the solution will become stronger. However in this example that point is ignored.

In preparing the solution arrangements should be made for extracting and recovering liquid from the insoluble dust constituents (e.g. by pressing the slurry) after they are removed from the cylinder 56 of the concentrator 29, since considerable quantities of the solution would otherwise be lost.

Once the required quantity of the solution at a strength of 8% has been prepared it will be possible to feed tobacco product into the apparatus and produce reconstituted tobacco by the apparatus in the manner described hereinbefore. The tobacco product can be a mixture of shorts and winnowings with a total soluble content of 40% as determined by any suitable laboratory method and expressed on a dry weight basis. If the concentrator is then adjusted by a known method, either by regulating the difference of level between the liquid outside and the liquid inside the cylinder or by changing the effective length of a series of suction legs arranged inside the cylinder, and not shown in the drawing, the quantity of the liquid retained by the fibrous portion of the tobacco product after it has been suitably treated in the refiners 18 to 21, can be modified to be five times the weight of the fibrous portion itself.

It will be seen that the conditions quoted in this example comply with the steady state conditions hereinbefore stated in the formula:

$$E=SQ$$

In the example

S=percentage of soluble constituent in the dry weight of the tobacco product (in the example this was 40%)

Q=proportion of the dry weight of fibrous portion of the tobacco product to the weight of liquid retained by that weight of fibrous portion (in the example this was ⅕)

$E=40\%\times\frac{1}{5}=8\%$.

and this figures checks with the solution strength which was to be made up before the apparatus was started up for production.

If the controls already described are now put into operation, i.e. a control to maintain the ability of the fibrous portion to retain five times its own weight of liquid and a control to ensure that the weight of water and tobacco product fed into the apparatus is the same as the total weight of water and pulpy product leaving the concentrator, the final product after drying will contain substantially all those constituents, whether soluble or insoluble, that were present in the tobacco product.

In this example no steps were described to prevent fermentation of the sugar content of the soluble con-

stituents. It should be understood that such steps should be taken since, unless complete sterilization of air, water and tobacco product can be achieved, general ambient conditions must sooner or later be met when fermentation must take place. If the sugars present (up to approx. 20% of the dry weight of the tobacco product) are converted to carbon dioxide and alcohol then the smoking qualities of the resulting reconstituted tobacco will be irretrievably spoilt. Fermentation or other deleterious action originating from microorganisms can be prevented by many known methods such as the adding of inhibiting agents such as formaldehyde or benzoic acid to the solution, or by the destruction of all forms of microorganism as soon as they appear within the apparatus by such means as refrigeration, ultrasonic vibrations, radiation from a radioactive source and by other known means.

Fermentation as is well known can start in the course of a very short time, even in the course of one to two hours in suitable conditions and it is therefore important in a process such as the present to ensure that some steps are taken to inhibit fermentation of the ultimate product produced by the process. The apparatus according to the present invention will not be really satisfactory unless such suitable steps to prevent fermentation etc. are taken.

In addition to fermentation a precipitate forms in the solution after the elapse of a period of time, usually within the range of 24–72 hours. This precipitate is formed of very small particles which, if allowed to remain within the solution, cause clogging up of filter cloths and the like. It has, therefore, been found necessary to incorporate a centrifuge in the apparatus and to locate it at a position so that the solution enters the centrifuge before it enters the concentrator **29**. The particles of the precipitate collected by the centrifuge can then be returned to the final product by any known method, such as spraying onto the sheet S on the continuous felt band **58**. The centrifuge and spraying apparatus being of known design and not illustrated in FIGURE 1.

In FIGURE 3 in which like reference numbers refer to like parts there is shown an alternative apparatus in which the production of "reconstituted" tobacco is achieved by the use of a batch process. The method and apparatus described hitherto, and shown in FIGURES 1 and 2, refer to a continuous process for the production of this same product. In the batch process shown in FIGURE 3 a definite quantity of tobacco product is fed in the mixing-tank **1** and is converted into "reconstituted" tobacco before any further quantities of either tobacco product or of liquid are fed into the system. Once the processing of one batch has been completed and all the fibrous portion has been converted into sheet S and has entered the dryer **60**, a further batch of tobacco product can be fed into the mixing-tank.

Since the process is of the batch type the relationship between the total quantity of the soluble constituent of tobacco product and the quantity of liquid within the system will not remain constant during the time taken to process any one batch. This relationship will, however, remain at a steady level between any two different batches for identical periods of time within the time taken for the processing of the batches. Thus in each batch the steady state percentage E will be reached after the treatment of the fibrous portion has been completed and before the sheet S starts to form on the cylinder **56** of the concentrator **29**.

In FIGURE 3 the means for effecting control of the process are not shown. These controls might comprise the testing of the specific gravity of the solution within the system using a hydrometer and a drainage test for the fibrous portion using an instrument of a known type such as a Schopper-Reigler Tester. The figure obtained from such tests would then be compared with desired-value figures and any differences used to adjust the strength of the solution or to modify the time of treatment of the fibrous portion.

What we claim as our invention and desire to secure by Letters Patent is:

1. A method of producing reconstituted tobacco, comprising the steps of adding tobacco product to a liquid to produce a solution of soluble constituents of tobacco product in the liquid, pulping the fibrous portion of tobacco product in the said solution so that it is capable of retaining a desired quantity of the said solution, removing the insoluble portion of said tobacco product from said solution, concentrating the insoluble portion of tobacco product after it has been removed from the solution to form a pulpy product and so controlling the ratio of soluble constituents of tobacco product to liquid in the liquid retained by the said pulpy product that the said pulpy product after being dried contains substantially the same quantities of soluble constituents as were present in the tobacco product from which the said pulpy product was formed.

2. A method as claimed in claim 1, whereby the total quantity of the soluble constituents of the tobacco product retained by the said insoluble portion is held at a substantially fixed ratio to the quantity of liquid present in the insoluble portion by maintaining the total quantity of the soluble constituents of the tobacco product in the solution present in the system at a substantially fixed ratio to the quantity of liquid present in the system.

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