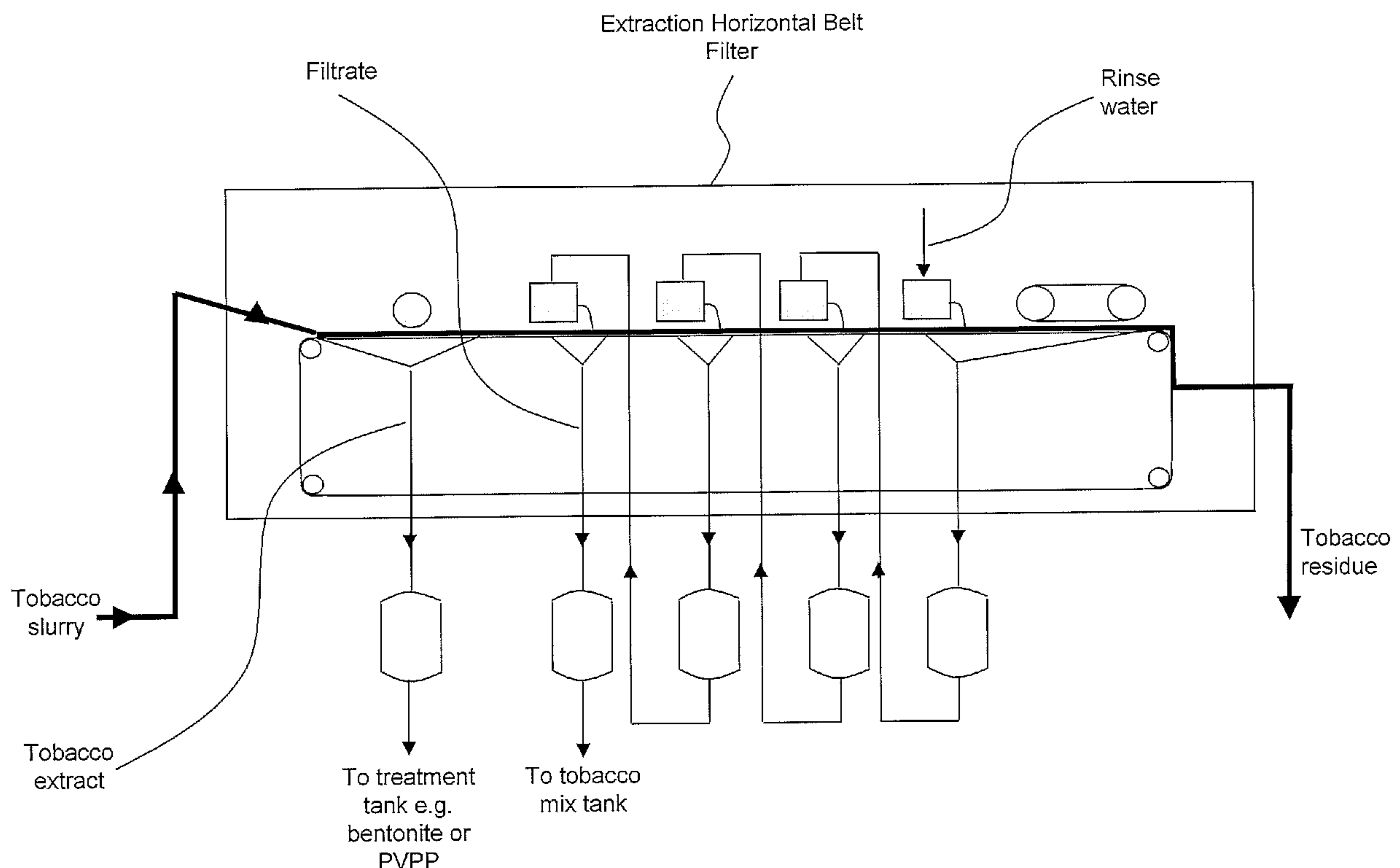




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(57) Abrégé/Abstract:

This invention provides a method for removing undesirable constituents from tobacco which includes extracting tobacco material in an aqueous or organic solvent and filtering the product of the extraction using a horizontal belt filter. The extract and insoluble tobacco residue may be further treated enzymically, chemically or otherwise to remove a complement of undesirable constituents. The extract and insoluble tobacco residue are recombined to form a regenerated tobacco material that is less harmful when combusted than the original material.

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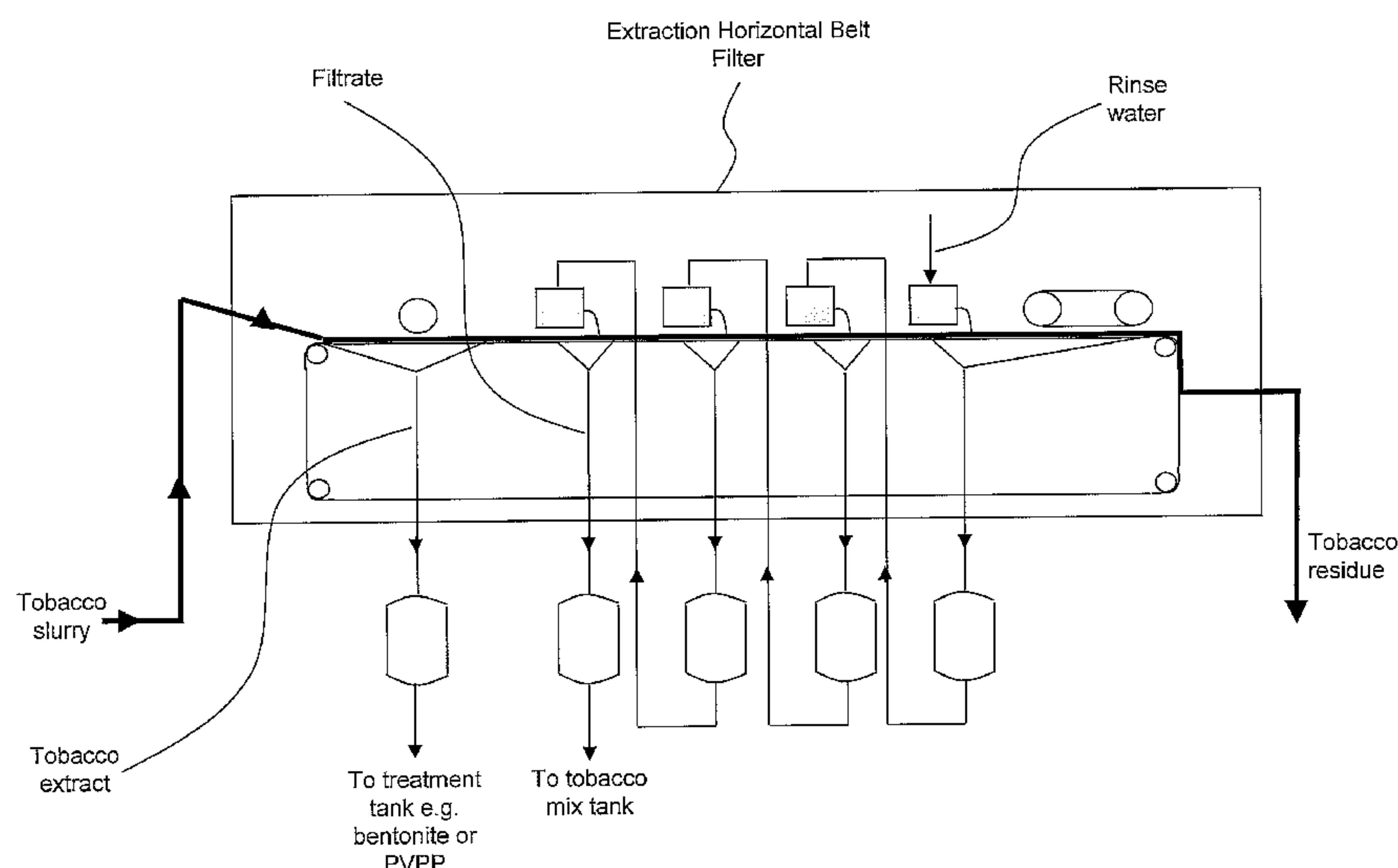
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(54) Title: TOBACCO TREATMENT



(57) Abstract: This invention provides a method for removing undesirable constituents from tobacco which includes extracting tobacco material in an aqueous or organic solvent and filtering the product of the extraction using a horizontal belt filter. The extract and insoluble tobacco residue may be further treated enzymically, chemically or otherwise to remove a complement of undesirable constituents. The extract and insoluble tobacco residue are recombined to form a regenerated tobacco material that is less harmful when combusted than the original material.

Tobacco Treatment

Description

The present invention relates to the treatment of tobacco and, in particular, to the
5 extraction of selected constituents from tobacco, for example, in order to reduce
certain smoke components.

Background of the Invention

Tobacco material may be treated and processed to produce a modified blend which,
when combusted, gives rise to smoke in which specific constituents of the smoke
10 are selectively reduced or removed compared to untreated tobacco. The sugar and
nicotine content of the tobacco, however, preferably remains substantially
unaffected by this process, so that the taste and smoking properties of the tobacco
are maintained.

Methods for removing or at least reducing selected constituents from tobacco are
15 known in the art. Such methods may comprise an extraction step in which tobacco
material is extracted with an aqueous or organic solvent, a separation step in which
the extracted solution is separated from the insoluble tobacco residue by filtration,
centrifugation or the like and a treatment step in which the extracted solution is
treated to remove specific constituents. The treated tobacco extract is then
20 recombined with the extracted tobacco to ensure that certain constituents of
tobacco are retained in the regenerated tobacco material.

US Patent Nos. 5,311,886 and 5,601,097 describe methods for removing proteins
from tobacco, which involve extracting tobacco material with an aqueous solvent
comprising a surfactant and, optionally, a proteolytic enzyme. The aqueous extract
25 (comprising solubilised tobacco components) is separated from the insoluble
tobacco residue and treated to remove any undesirable constituents, typically
including surfactant and polypeptides. The treated tobacco extract is concentrated
and recombined with the washed and dried tobacco residue, so ensuring retention
of certain constituents, such as water soluble flavour components and nicotine, in
30 the final product.

US Patent No. 5,601,097 further describes the sequential extraction of tobacco with a surfactant and a proteolytic enzyme, which may provide a greater reduction in tobacco protein than is observed following a single extraction only.

European Patent Publication No. 1 623 634 describes the fractionation of the tobacco extract and the differential treatment of the fractions according to the constituents contained. The fraction comprising desirable constituents is recombined with the extracted tobacco, while the fraction comprising undesirable constituents is either discarded or a portion of it is recombined with the extracted tobacco. The regenerated tobacco material thus obtained contains the full complement of desirable constituents (such as nicotine), but is substantially free from undesirable constituents (such as nitrates and amines).

In the methods described in European Patent Publication No. 0 517 407, tobacco extract is separated from the insoluble tobacco residue and contacted with a further tobacco extract that has been obtained by extracting tobacco with a basic solution. The combination of extracts is then applied to the extracted tobacco to form the regenerated product.

US Patent No. 5,243,999 describes a process in which tobacco extract is temperature treated to cause certain constituents to crystallise or precipitate out of solution. The extracted solution may alternatively or additionally be contacted with activated carbon particles, to remove further selected constituents therefrom. Following recombination of the treated extract with the extracted tobacco, a product with lowered amounts of potassium nitrate and aldehydes results.

European Patent Publication No. 0 535 834 describes a method in which tobacco extract is filtered or centrifuged to remove any essentially insoluble constituents. The extracted tobacco is treated with an agent capable of releasing pectins present in the tobacco material, processed into a predetermined shape and the treated tobacco extract is then applied thereto.

The prior art methods successfully result in regenerated tobacco having a lower amount of undesirable constituents than untreated tobacco. However, they are not without their disadvantages.

The methods known in the art involve extraction in a traditional batch reactor, followed by separation of the aqueous extract from the insoluble tobacco residue using conventional filtration, centrifugation or the use of one or more passes of the mixture through a screw press or the like. The throughput of such extraction and separation processes is clearly limited by the maximum capacity of the chosen apparatus. Furthermore, as the size of the mixing vessel used in the batch reactor increases, maintaining turbulent mixing at the edges of the vessel becomes difficult. The scale of the extraction and treatment steps is therefore limited by the size of the vessel that can effectively be used in practice.

10 The efficiency of the separation process is also dependent upon the particular filtration technique employed. This means that whilst these extraction processes are effective, they would not be suitable for running on a commercial scale.

Thus, the need remains for a high throughput process which can be used to efficiently separate the tobacco extract from the insoluble tobacco residue and efficiently extract undesirable constituents from tobacco.

The invention described herein overcomes the difficulties in the prior art by providing a process for the treatment of tobacco using a horizontal belt filter. The process may be a continuous process, the efficiency of which is significantly improved over that observed with the batch processing techniques known in the art.

20 The described process thus lends itself to commercial application, enabling the scaling up of tobacco treatment processes beyond the level currently achieved. The described process also does not require the use of surfactant, which clearly avoids the need to remove surfactant from the tobacco residue in the latter stages of the treatment process.

25 In the process described herein, both the extraction of tobacco and the separation of the tobacco extract from the tobacco residue can be performed using a horizontal belt filter.

Horizontal belt filters are known in industries unrelated to the tobacco industry including the mining, mineral and metallurgy industries. In fact, these filters have long been used in the dewatering of materials such as mineral sands, iron ore, coal

and lead zinc concentrates, due to their flexibility of operation, adaptation to corrosive slurries and suitability to handle large throughputs.

Horizontal belt filters comprise an endless, recirculating belt, constructed to allow drainage of the filtrate towards holes on the belt. The belt may be made of rubber
5 with traversing grooves for drainage or it may be made of polyaryletheretherketone (PEEKTM) woven into a mesh that is loose enough to allow drainage. Other materials and drainage arrangements are possible. A slurry of material to be separated is fed onto the belt. The filtrate drains through the holes in the belt while the slurry is carried along, possibly with vacuum assistance, but alternatively under
10 gravity alone, with the consequence that dewatered mat is discharged at the end.

Horizontal belt filters are efficient and reliable liquids/solids separation units for heavy duty applications. Improvements in technology over recent years have led to large belts of high mechanical strength being produced. This, coupled with advances in machine technology that were necessary to support the heavy belts
15 during operation, has enabled high throughput filters to be produced. Modern horizontal belt filters are capable of reaching belt speeds of over 50 m/min and yielding very short cycle times.

Since filtration using a horizontal belt filter may also be performed with vacuum assistance, the separation of fluid from the insoluble residue remaining on the belt
20 is a highly efficient process.

Furthermore, the operational sequence during filtration is such that aqueous solvent is applied to the retentate toward the end of the filter and the filtrate is collected and recycled by being applied to incoming material at an upstream point on the belt. This means that the eventual wash filtrate collected after the final counter-current
25 wash stage contains an increased concentration of soluble materials compared to filtrates collected following conventional filtration.

The suitability of horizontal belt filters to the tobacco industry was, however, by no means apparent. These filters were designed to separate fluid from heavy and dense materials and, as such, there was nothing to suggest that they could be used in the
30 treatment of tobacco.

However, the inventors have discovered that horizontal belt filters are in fact suitable for use in the extraction of tobacco and are surprisingly good at separating tobacco extract from the insoluble residue. Most notably, the proportion of soluble tobacco constituents ending up in the aqueous extract can be enhanced in
5 comparison to that observed via a simple batch extraction.

The use of horizontal belt filters thus improves the efficiency of the tobacco extraction and separation processes and enables a higher throughput to be achieved.

Summary of the Invention

Accordingly, in a first aspect of the invention there is provided a process for the
10 treatment of tobacco using a horizontal belt filter.

In an embodiment of the invention, the process comprises extracting tobacco with an aqueous or organic solvent and filtering the product of the extraction. Either or both of the extracting and filtering steps may be performed on a horizontal belt filter. Tobacco to be extracted may be continuously fed onto the horizontal belt
15 filter and the extracting and filtering steps may be performed continuously as tobacco is conveyed along the filter. The filtrate may be recycled and used as a solvent in the extraction of tobacco being fed onto the horizontal belt filter. In a preferred embodiment, the filtrate to be recycled is that from one or more downstream counter-current wash stages.

20 In another embodiment, the process of the invention further comprises treating the tobacco with an enzyme. In a preferred embodiment, the enzyme is a proteolytic enzyme.

The process may further comprise rinsing the enzyme-treated tobacco with a salt solution. This step is essentially an extraction step, as the residual enzyme is
25 extracted from the tobacco fibre. The salt rinsing step is preferably performed on a horizontal belt filter. The enzyme-treated tobacco may be rinsed twice with a salt solution, wherein the two salt rinsing steps are performed on separate horizontal belt filters. In a preferred embodiment, salt rinsing is performed continuously as tobacco is conveyed along the filter(s) and the filtrate from the second salt rinsing is

preferably recycled and used as a salt solution in a first salt rinsing of tobacco being fed onto the first salt rinsing horizontal belt filter.

In another embodiment, the process further comprises deactivating the enzyme in the tobacco. Deactivation may be carried out by steam treating, heat treating or
5 chemically treating the tobacco. Deactivation is preferably performed on tobacco on a horizontal belt filter.

Thus, in an embodiment, the process is performed using multiple horizontal belt filters and is a continuous process.

In another embodiment, the process comprises extracting tobacco with an aqueous
10 or organic solvent, treating the tobacco with an enzyme, rinsing the enzyme-treated tobacco with a salt solution and deactivating the enzyme in the tobacco, wherein one or more of these steps are performed on a horizontal belt filter. In a further embodiment, all of these steps are performed on a horizontal belt filter.

In a preferred embodiment, the tobacco extract emanating from the extraction step
15 is treated to remove protein therefrom, preferably by treating it with bentonite. The tobacco extract may alternatively or additionally be treated to remove polyphenols therefrom, preferably by treating it with polyvinylpolypyrrolidone (PVPP).

The process of the invention preferably further comprises the recombination of the extracted tobacco and treated tobacco extract.

20 In a second aspect of the invention, there is provided a tobacco product obtainable by a process of the invention.

In a third aspect of the invention, there is provided a smoking article comprising tobacco obtainable by a process of the invention.

Brief Description of the Drawings

25 Figure 1 illustrates the operational sequence for the extraction of tobacco and recycling of wash filtrate as the tobacco is conveyed on a horizontal belt filter.

Figure 2 illustrates the operational sequence for the salt rinsing of extracted tobacco using a horizontal belt filter.

Figure 3 illustrates the operational sequence for the second salt rinsing of extracted tobacco and recycling of wash filtrate as the tobacco is conveyed on a horizontal
5 belt filter.

Figure 4 illustrates the operational sequence for the fresh water rinsing of tobacco to remove salt and deactivation of enzyme using a horizontal belt filter.

Figure 5 illustrates a process for the treatment of tobacco in which the extraction and subsequent washing of tobacco is performed using a plurality of horizontal belt
10 filters in series. The tobacco extract and processed tobacco are then recombined.

Detailed Description of the Preferred Embodiments

In one embodiment of this invention, the tobacco material to be extracted is strip, cut, shredded or ground tobacco. In a preferred embodiment, the tobacco is shredded tobacco. Other forms of tobacco may, however, be extracted using the
15 methods described herein.

The tobacco material may be mixed with a solvent for extraction to form a slurry. The solvent may be added to the tobacco material in a ratio of between 10:1 and 50:1, preferably between 20:1 and 40:1 and most preferably between 25:1 and 30:1 by weight. In a particularly preferred embodiment, the solvent is added to the
20 tobacco material in a ratio of 27:1 by weight.

The solvent may be an organic solution, but preferably is an aqueous solution or is water. At the very start of the extraction process, the solvent is usually water, but it can also contain alcohols such as ethanol or methanol, or it can contain a surfactant. Other solvents could be used, depending on the particular constituents to be
25 extracted from the tobacco.

The slurry may first be formed in a tobacco mix tank before being pumped into a second tank, such as a plug flow reactor or a continuous stirred tank reactor, for extraction to be performed.

The extraction may be performed at 15-85 °C, and preferably is performed at 65 °C. It is preferable for the slurry to be continually stirred during extraction, such that the tobacco remains in suspension. Extraction should be performed for between 15 minutes and two hours. In a preferred embodiment, extraction is performed for
5 approximately 20 minutes.

During extraction, soluble tobacco components are removed from the tobacco material and enter solution. These include nicotine, sugars, some proteins, amino acids, pectins, polyphenols and flavours. Up to about 55% of the initial tobacco weight may become solubilised.

10 It is important that the pectins in the tobacco fibre remain cross-linked throughout the extraction and treatment process in order to maintain the fibrous structure of the tobacco. Accordingly, calcium may be added to the solvent used to extract the tobacco and to any solutions used in the downstream processing procedures.

Following extraction, the slurry may be fed from the extraction tank onto the belt
15 of a first horizontal belt filter. The filtrate drains through the holes in the belt as the slurry is conveyed. This filtrate (the “mother filtrate”) is collected.

Meanwhile, the insoluble tobacco residue remaining on the belt of the horizontal belt filter may be further extracted by counter-current washing as it is conveyed, so that as many soluble constituents as possible are removed from the tobacco.

20 The operational sequence for the extraction of the tobacco as it travels along the horizontal belt filter is such that fresh solvent may be applied to the tobacco toward the end of the filter and the filtrate (the “wash filtrate”) is collected.

The wash filtrate may be recycled by being applied to the incoming tobacco residue travelling on the belt at an upstream point. The collection and upstream
25 reapplication of wash filtrate to incoming tobacco residue may be repeated a number of times, preferably three, four or even five times. Thus, the final wash filtrate that is collected at the head of the belt may be concentrated in those soluble tobacco constituents that have been removed from the tobacco residue as it travels the length of the filter.

A scheme of the operational sequence for the extraction of the tobacco and recycling of wash filtrate as the tobacco travels along the horizontal belt filter is shown in Figure 1.

The final wash filtrate may be further recycled by being added to fresh tobacco to
5 form a tobacco slurry, ready for extraction. For example, the final wash filtrate may be added into the tobacco mix tank where a tobacco slurry is formed prior to extraction.

The extraction process may thus be a continual process in which fresh tobacco is extracted using recycled wash filtrate. Only at start-up of this extraction process is
10 tobacco extracted with fresh solvent. Once the extraction process has begun, no fresh solvent is used in the extraction, but the solvent is solely made up of recycled wash filtrate.

As the extraction process continues, the extract thus becomes more concentrated in soluble tobacco constituents. These constituents include those that entered
15 solution during primary extraction in the extraction tank (forming the mother filtrate), as well as those that entered solution during secondary extraction on the horizontal belt filter (forming the wash filtrate).

The final filtrate thus comprises both the mother and wash filtrates. In so doing, the tobacco residue that results after filtration is devoid of those constituents that
20 are soluble in the solvent used for extraction.

The extracted tobacco may be squeezed at the end of filtration, so as to remove any excess liquid from it. The extracted tobacco emanating from the horizontal belt filter is thus typically in the form of a dewatered mat.

The final filtrate, hereinafter referred to as the tobacco extract, may be subsequently
25 processed to remove those constituents not desired in the final tobacco product. Undesirable constituents include proteins, polypeptides, amino acids, polyphenols, nitrates, amines, nitrosamines and pigment compounds. The levels of desirable constituents such as sugar and nicotine should, however, remain unaffected so that

the flavour and smoking properties of the extracted tobacco are comparable to those of the original material.

In a preferred embodiment, the tobacco extract is treated to remove proteins, polypeptides and/or amino acids. Up to 60% of the proteins contained in the
5 original tobacco material may be removed using an insoluble adsorbent such as hydroxyapatite or a Fuller's Earth mineral such as attapulgite or bentonite.

The tobacco extract is preferably treated with bentonite, to remove polypeptides therefrom. Bentonite may be added to the extract in an amount of 2-4% of the weight of tobacco initially extracted. Alternatively, the tobacco extract may be fed
10 into a tank containing a slurry of bentonite in water. A suitable slurry contains approximately 7 kg of bentonite in approximately 64 kg water (quantities per hour), for example, 7.13 kg bentonite in 64.18 kg water (quantities per hour). In any case, the bentonite concentration should be high enough to substantially reduce the protein content of the tobacco extract, but not so high as to additionally adsorb
15 nicotine from it.

Bentonite treatment may also be effective in the removal of pigment compounds found in tobacco extract which, if not removed, tend to darken the extract after concentration. When sufficient bentonite is used to treat the extract, the reduced amount of pigment compounds may result in a product that is not overly darkened
20 in appearance.

Following bentonite treatment, the tobacco extract may be purified from the slurry by centrifugation and/or filtration.

The tobacco extract may also, or alternatively, be treated to remove polyphenols therefrom. Polyvinylpolypyrrolidone (PVPP) is an insoluble adsorbent for
25 polyphenols, traditionally used in the brewing industry to remove polyphenols from beer. PVPP in an amount of 5-10% of the weight of tobacco initially extracted may be added to the extract. This amount of PVPP is capable of removing between 50 and 90% of the polyphenols in solution.

The optimum pH for removal of polyphenols from the tobacco extract by PVPP is believed to be about 3. The efficiency of adsorption by PVPP may therefore be increased by reducing the pH of the extract via the addition of a suitable acid, such as hydrochloric acid.

- 5 As an alternative to using PVPP to adsorb the polyphenols, one or more enzymes may be added to the tobacco extract to degrade the polyphenols therein. A suitable enzyme is laccase (urishiol oxidase).

The invention is not, however, limited to methods for removing only proteins and/or polyphenols from tobacco. Alternative or additional enzymes, agents or
10 adsorbents may be used to remove other undesirable tobacco constituents from the tobacco extract. Examples of further undesirable tobacco constituents that could be removed from the extract include nitrates, amines and nitrosamines.

If a plurality of constituents are to be removed from the tobacco extract, a number of tanks may be set up in series, each one comprising a different enzyme, agent or
15 adsorbent, in order for a chosen complement of undesirable constituents to be removed. Alternatively, a single tank may contain a plurality of enzymes, agents or adsorbents so that the undesirable constituents may be removed in a single step. For example, a bentonite or PVPP holding tank could comprise one or more additional enzymes, agents or adsorbents so as to remove not only protein or
20 phenols from the tobacco, but one or more further undesirable constituents also.

Following treatment of the tobacco extract to remove the selected undesirable constituents, the extract is preferably concentrated to a solids concentration of between 20 and 50% by weight. Concentrations of up to 10% solids are most efficiently achieved using reverse osmosis. A further concentration to
25 approximately 40% solids may be achieved by means of a falling film evaporator. Other methods of concentration can be used and will be known to a person skilled in the art.

The concentrated tobacco extract may be subsequently recombined with the extracted tobacco.

The tobacco, having been extracted in an aqueous solution as discussed above, however, is preferably further extracted to remove one or more further undesirable constituents before being recombined with the concentrated tobacco extract.

Further extraction of the tobacco may be performed using an enzyme specifically
5 selected for removal of the constituent of choice.

In a preferred embodiment, the enzyme is a proteolytic enzyme for removal of protein from the tobacco. The enzyme is preferably a bacterial or fungal enzyme and, more preferably, is an enzyme used commercially in the food and detergent industries. The enzyme may be selected from the group consisting of SavinaseTM,
10 NeutraseTM, EnzobakeTM and AlcalaseTM, which are all available from Novo Inc.

The proteolytic enzyme is preferably added to the tobacco in an amount of between 0.1 and 5% by weight of the tobacco material. For example, SavinaseTM may be added to the tobacco in an amount of approximately 1% by weight.

The tobacco may be reslurried in a solution of the chosen enzyme. The ratio of
15 water to tobacco in the slurry should be between 10:1 and 50:1, preferably between 20:1 and 40:1 and most preferably between 25:1 and 30:1 by weight. In a particularly preferred embodiment, the ratio of water to tobacco is 27:1 by weight.

The pH of the tobacco/enzyme mixture should be that which promotes optimal enzyme activity. Accordingly, it may prove convenient to feed the dewatered mat of tobacco emanating from the first horizontal belt filter into a tank in which the pH is
20 adjusted, for example, by the addition of a base such as sodium hydroxide. The pH-adjusted tobacco may then be fed into an enzyme dosing tank for mixing with the enzyme of choice. The tobacco/enzyme mixture may subsequently be fed into a plug flow reactor, where the enzymic extraction is performed.

25 The enzymic extraction should be carried out at the temperature promoting optimal enzyme activity. Preferably, a narrow temperature range, such as 30-40 °C, should be used to avoid denaturing the enzyme.

The optimum working conditions when SavinaseTM is the chosen enzyme are 57 °C and pH 9-11.

The enzymic extraction should be carried out for at least 45 minutes; any shorter duration is believed to be insufficient for a proteolytic enzyme to degrade tobacco proteins.

Of course, multiple enzymic extractions could be carried out if there are multiple
5 constituents to be removed from the tobacco. These could be performed in series or multiple enzymes could be added to the tobacco in a single treatment step.

It also remains possible for the enzyme to be included in the very first extraction step in the treatment process, rather than forming a subsequent separate extraction step.

10 Following enzymic extraction, the tobacco/enzyme mixture may be fed onto a second horizontal belt filter and the mother filtrate may be collected and treated as waste. The insoluble tobacco residue may be washed with a salt solution, preferably a sodium chloride solution, to rinse it free of enzyme. Salt rinsing may be
15 performed in a sequential, counter-current fashion, similar to that employed in the extraction of tobacco on the first horizontal belt filter.

The salt solution may thus be applied to the tobacco toward the end of the filter. The wash filtrate may be recycled and used to wash the tobacco residue travelling on the belt at an upstream point. The collection and upstream reapplication of wash filtrate to incoming tobacco residue may be repeated a number of times,
20 preferably three, four or even five times. The final wash filtrate collected at the head of the belt is treated as waste. This is illustrated in Figure 2.

The salt rinsed tobacco may be squeezed at the end of the belt, so as to remove excess liquid from it.

The tobacco may then be fed into a salt rinse mix tank and plug flow reactor or
25 continuous stirred tank reactor for combination with a salt solution in a second salt rinse.

The mixture may be fed onto a third horizontal belt filter and the mother filtrate collected. This filtrate is treated as waste and is not recycled. A fresh salt solution, preferably a sodium chloride solution, may be applied to the tobacco toward the end

of the filter. As before, the wash filtrate may be recycled and used to wash the tobacco residue travelling on the belt at an upstream point. The collection and upstream reapplication of wash filtrate to incoming tobacco residue may be repeated a number of times, preferably three, four or even five times. The final wash filtrate
5 collected at the head of the belt may be recycled and used in the first salt rinse. This is illustrated in Figure 3.

The salt rinsed tobacco may be squeezed at the end of the belt to remove excess water from it. It is then preferably combined with a fresh batch of salt water to ensure as near complete removal of the enzyme from the tobacco as possible. A
10 mix tank and a plug flow reactor or continuous stirred tank reactor may be used for this purpose.

In order to remove the salt from the salt rinsed tobacco, a clean water rinse may be performed. The salt rinsed tobacco may be fed onto the belt of a fourth horizontal belt filter and the mother filtrate collected and recycled for use in the first or
15 second salt rinses. Fresh water may then be applied to the tobacco toward the end of the belt. The wash filtrate may be recycled and used to wash the tobacco residue travelling on the belt at an upstream point. The collection and upstream reapplication of wash filtrate to incoming tobacco residue may be repeated a number of times, preferably three, four or even five times. The final wash filtrate
20 collected at the head of the belt may be returned to a reservoir serving each of the salt water rinses. This is illustrated in Figure 4.

Salt and water rinsing, however, may not be sufficient to remove all the enzyme from the tobacco. It is important that the final tobacco product contains no enzyme activity at all, to avoid the risk to the operator of the process of any adverse
25 reactions associated with the enzyme in the finished product.

The washed tobacco may therefore be treated to deactivate any residual enzyme remaining in the tobacco following the salt and water rinses. This may be done by steam treating the tobacco sufficiently to deactivate the enzyme, but not so much that the tobacco loses its fibrous form. In an embodiment, steam treating is carried
30 out at 98 °C for four minutes, but the residence time may be increased to 10 minutes or so if desired. Alternatively, the tobacco may be heat treated to

deactivate the enzyme, for example by microwaving or baking the tobacco. In another embodiment, the enzyme may be deactivated by chemical denaturation; steps should however be taken to remove the chemical from the tobacco.

If the tobacco is steam treated, this may be performed as the tobacco nears the end
5 of the fourth horizontal belt filter, as shown in Figure 4. Excess liquid may be removed from the tobacco by squeezing it.

Thus, the process may comprise a series of separate steps, one or more of which may be performed using a horizontal belt filter. In an embodiment, all of the steps of the process are performed using a horizontal belt filter. The process may
10 therefore be a continuous process in which fresh tobacco is continually being fed onto a first horizontal belt filter and processed tobacco is continually being produced downstream. In an embodiment, the tobacco extraction, salt rinse and enzyme deactivation steps are each performed on a horizontal belt filter and the multiple filters may be arranged in series for this purpose. This is illustrated in
15 Figure 5.

The treated tobacco may then be further processed rendering it suitable for recombination with the tobacco extract. In a preferred embodiment, the tobacco is fed into a delumper which breaks the matted tobacco down into free flowing fibres.

The processed tobacco may then be recombined with the concentrated tobacco
20 extract. Adding the treated extract back to the extracted tobacco ensures retention of water soluble flavour components of tobacco and nicotine in the final product. Recombination therefore results in a tobacco product that has similar physical form and appearance, taste and smoking properties to the original material, but with substantially reduced levels of protein, polyphenols or other constituent(s) of
25 choice.

Recombination may be achieved by spraying the tobacco extract onto the tobacco. The amount of the original extract being recombined with the processed tobacco depends upon the amount that was lost during treatment of the extract to remove selected constituents, and will vary from one type of tobacco to the next.

A standard drying process may be used to dry the tobacco, either before, during or after recombination with the treated tobacco extract. The starting moisture content of the tobacco is typically approximately 70-80%. In a preferred embodiment, the moisture content after drying should be approximately 14%.

- 5 A heated dryer, such as an apron dryer, may be used to reduce the starting moisture content in the tobacco to approximately 30%. A second heated dryer, such as an air dryer, may then be used to further reduce the moisture content to approximately 14%.

The final dried product may subsequently be processed into a finished form, such as
10 a sheet, which, when shredded, can form all or part of a cigarette filler.

Owing to as much as 30% of the original constituents of tobacco being removed therefrom during the extraction and treatment process, however, the concentration of remaining constituents per unit weight of tobacco is increased in the finished product compared to the original material. These constituents include cellulose,
15 which, together with sugars and starches, may produce harmful volatile materials such as acetaldehyde and formaldehyde in smoke when combusted.

To compensate for this, a special type of filter may be included in a smoking article containing the treated tobacco. US Patent No. 4,033,361 describes a suitable filter, which contains a macroporous amine-type anion-exchange resin containing
20 substantially primary amino groups only, as an adsorbent for volatile tobacco-smoke constituents. Carbon may also be included in the filter.

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Claims

1. A process for the treatment of tobacco, comprising extracting tobacco with an aqueous or organic solvent and filtering the product of the extraction, wherein both the extracting and filtering steps are performed on a horizontal belt filter.
- 5 2. A process as claimed in claim 1, wherein tobacco to be extracted is continuously fed onto the horizontal belt filter and the extracting and filtering steps are performed continuously as tobacco is conveyed along the filter.
3. A process as claimed in claim 2, wherein the filtrate is recycled and used as a solvent in the extraction of tobacco being fed onto the horizontal belt filter.
- 10 4. A process as claimed in any of claims 1-3, further comprising treating the tobacco with an enzyme.
5. A process as claimed in claim 4, wherein the enzyme is a proteolytic enzyme.
6. A process as claimed in claim 4 or 5, further comprising rinsing the enzyme-treated tobacco with a salt solution.
- 15 7. A process as claimed in claim 6, wherein the salt rinsing step is performed on a horizontal belt filter.
8. A process as claimed in claim 6, wherein the enzyme-treated tobacco is rinsed twice with a salt solution.
9. A process as claimed in claim 8, wherein the two salt rinsing steps are
20 performed on separate horizontal belt filters.
10. A process as claimed in claim 7 or 9, wherein salt rinsing is performed continuously as tobacco is conveyed along the filter(s).
11. A process as claimed in claim 10, wherein the filtrate from the second salt rinsing is recycled and used as a salt solution in a first salt rinsing of tobacco being
25 fed onto the first salt rinsing horizontal belt filter.

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12. A process as claimed in any of claims 4-11, further comprising deactivating the enzyme in the tobacco.
13. A process as claimed in claim 12, wherein deactivation is carried out by steam treating, heat treating or chemically treating the tobacco.
- 5 14. A process as claimed in claim 13, wherein deactivation is performed on tobacco on a horizontal belt filter.
15. A process as claimed in any of claims 1-14, performed using multiple horizontal belt filters in series.
16. A process as claimed in claim 1, comprising:
- 10 (a) extracting tobacco with an aqueous or organic solvent;
(b) treating the tobacco with an enzyme;
(c) rinsing the enzyme-treated tobacco with a salt solution; and
(d) deactivating the enzyme in the tobacco;
wherein one or more of steps (a) to (d) are performed on a horizontal belt filter.
- 15 17. A process as claimed in any of claims 1-16, further comprising treating the tobacco extract obtained from the extraction of tobacco to remove protein therefrom.
18. A process as claimed in claim 17, wherein the tobacco extract is treated with bentonite.
- 20 19. A process as claimed in any of claims 1-18, further comprising treating the tobacco extract obtained from the extraction of tobacco to remove polyphenols therefrom.
20. A process as claimed in claim 19, wherein the tobacco extract is treated with polyvinylpyrrolidone (PVPP).
- 25 21. A process as claimed in any of claims 17-20, further comprising the recombination of the extracted tobacco and treated tobacco extract.
22. Tobacco obtainable by a process as claimed in any of claims 1-21.

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23. A smoking article comprising tobacco as claimed in claim 22.

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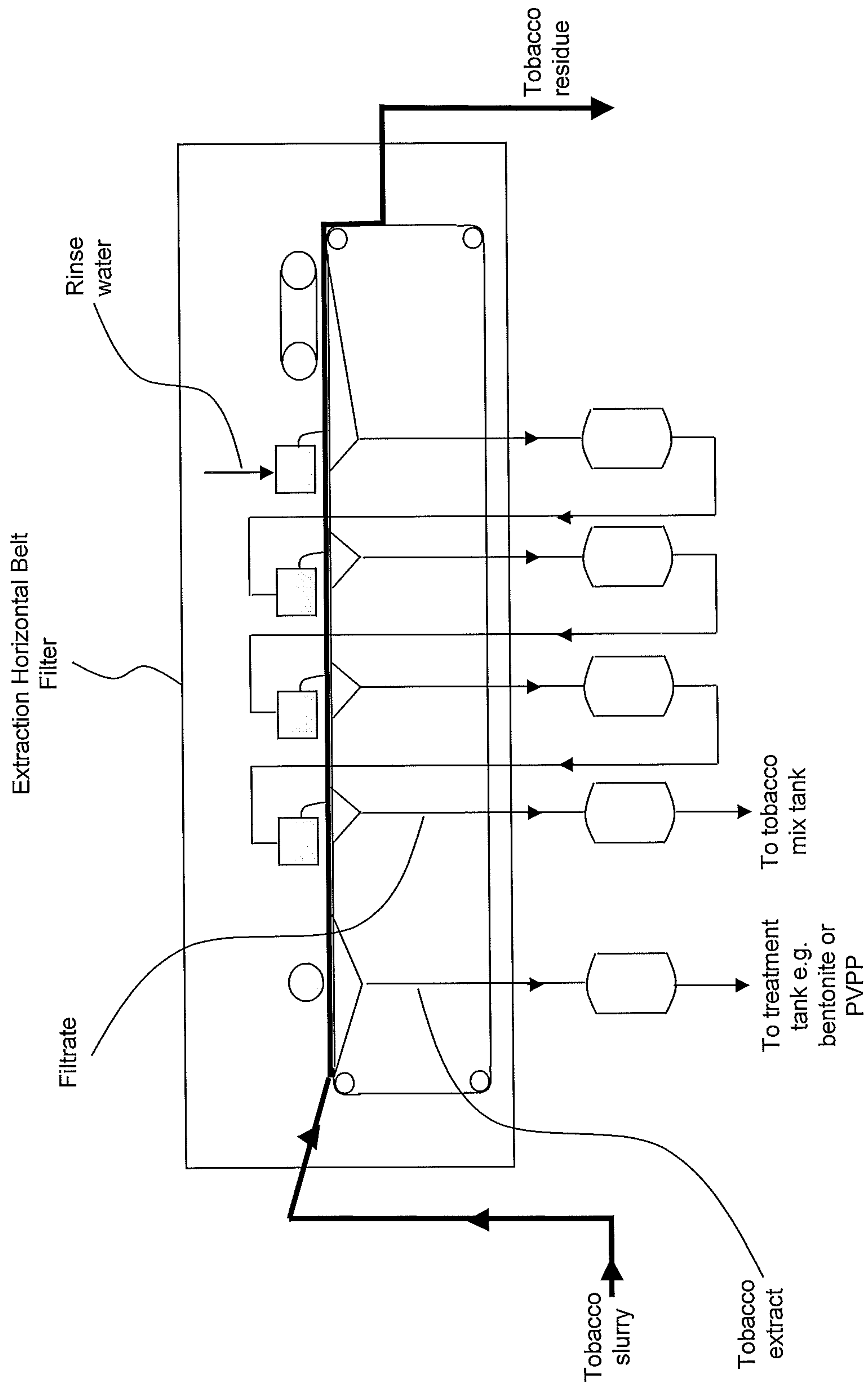


FIG. 1

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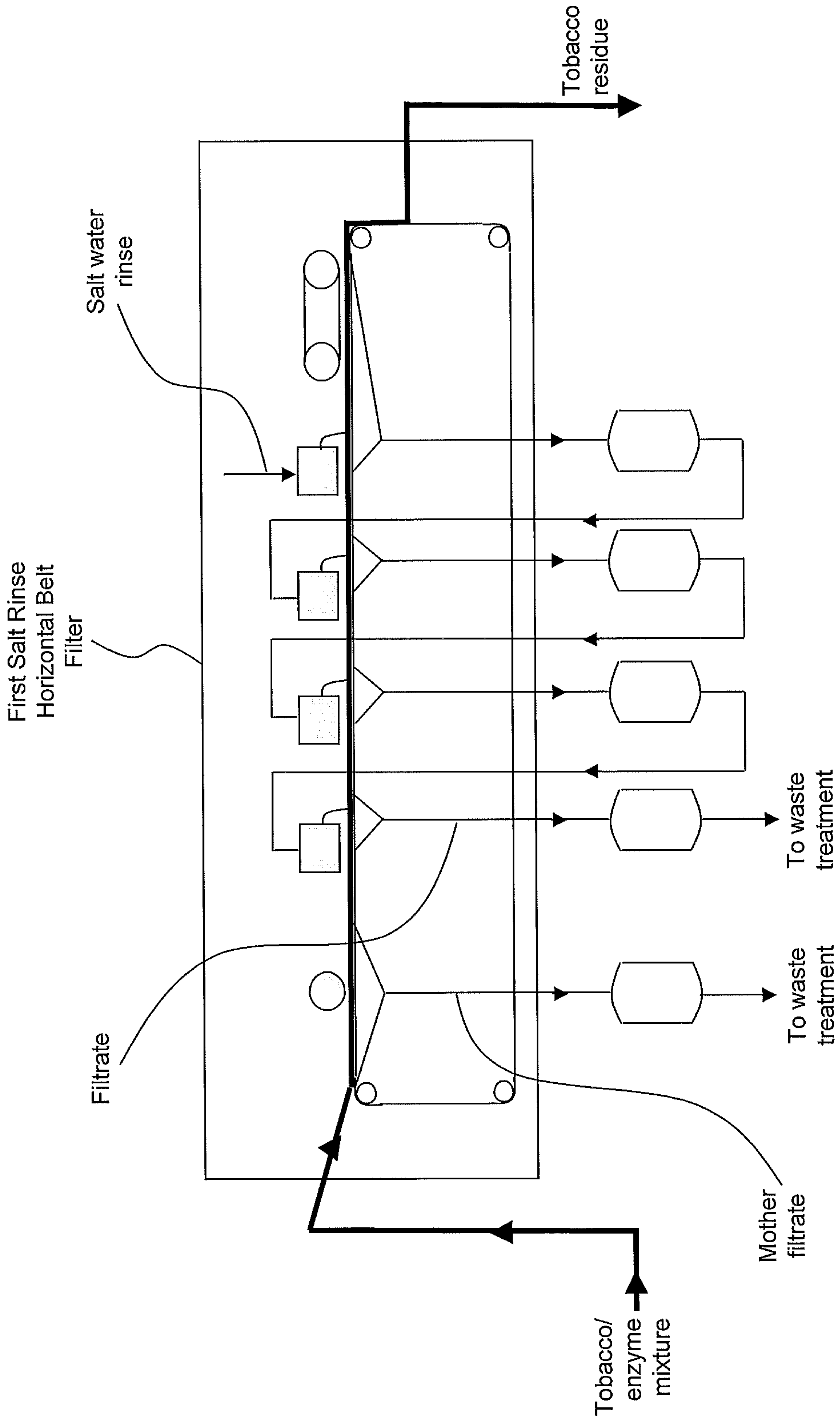


FIG. 2

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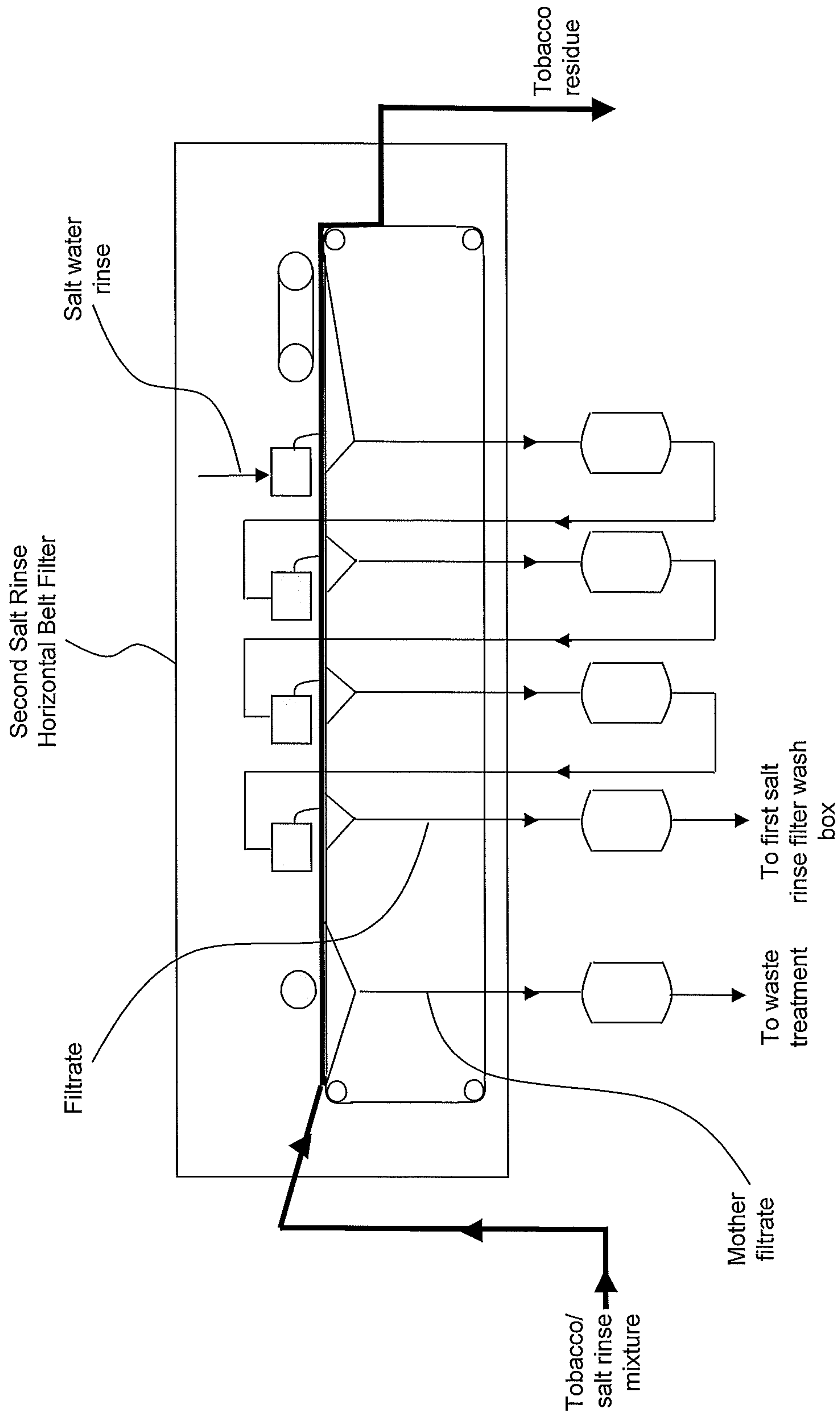


FIG. 3

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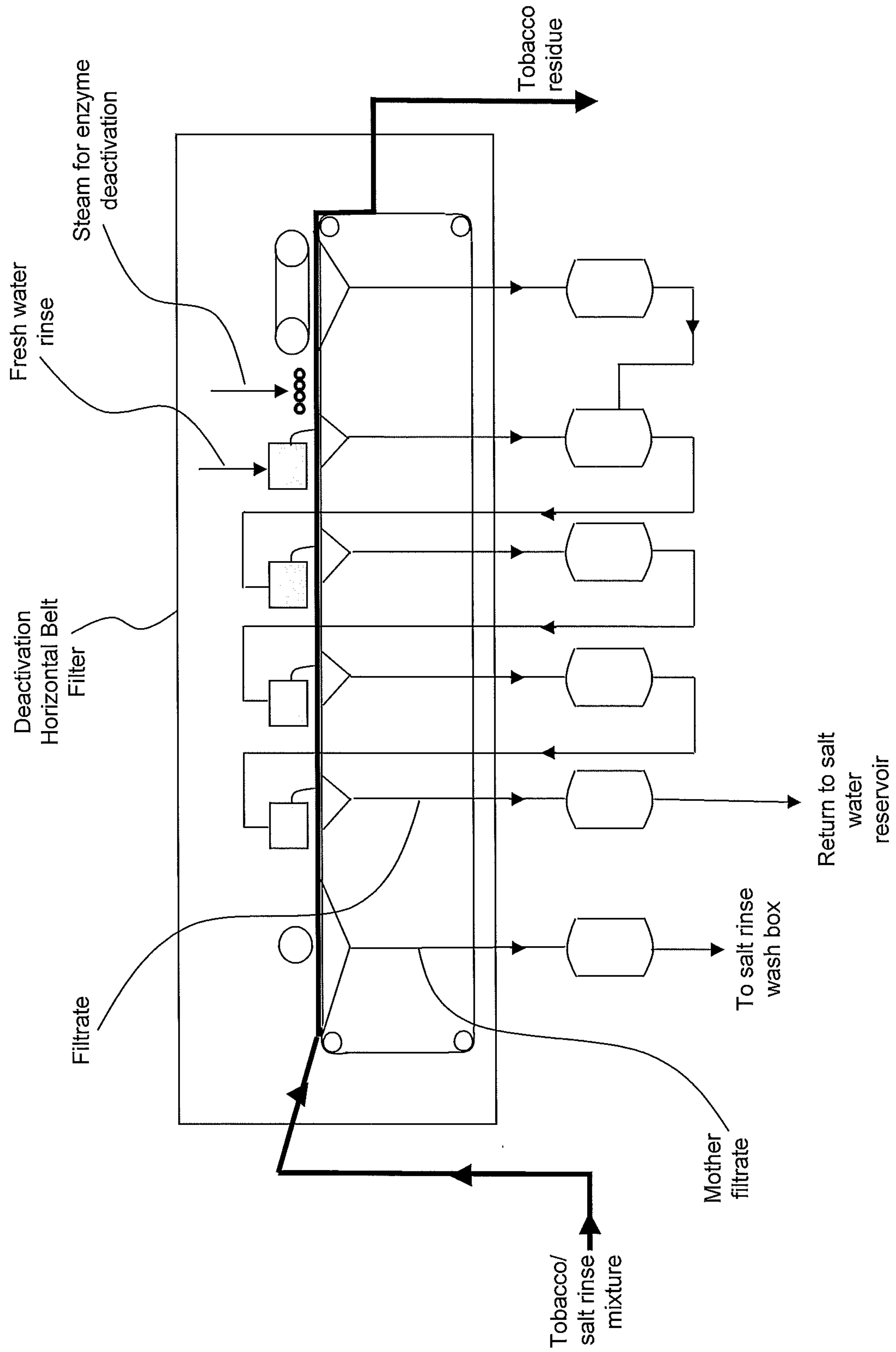
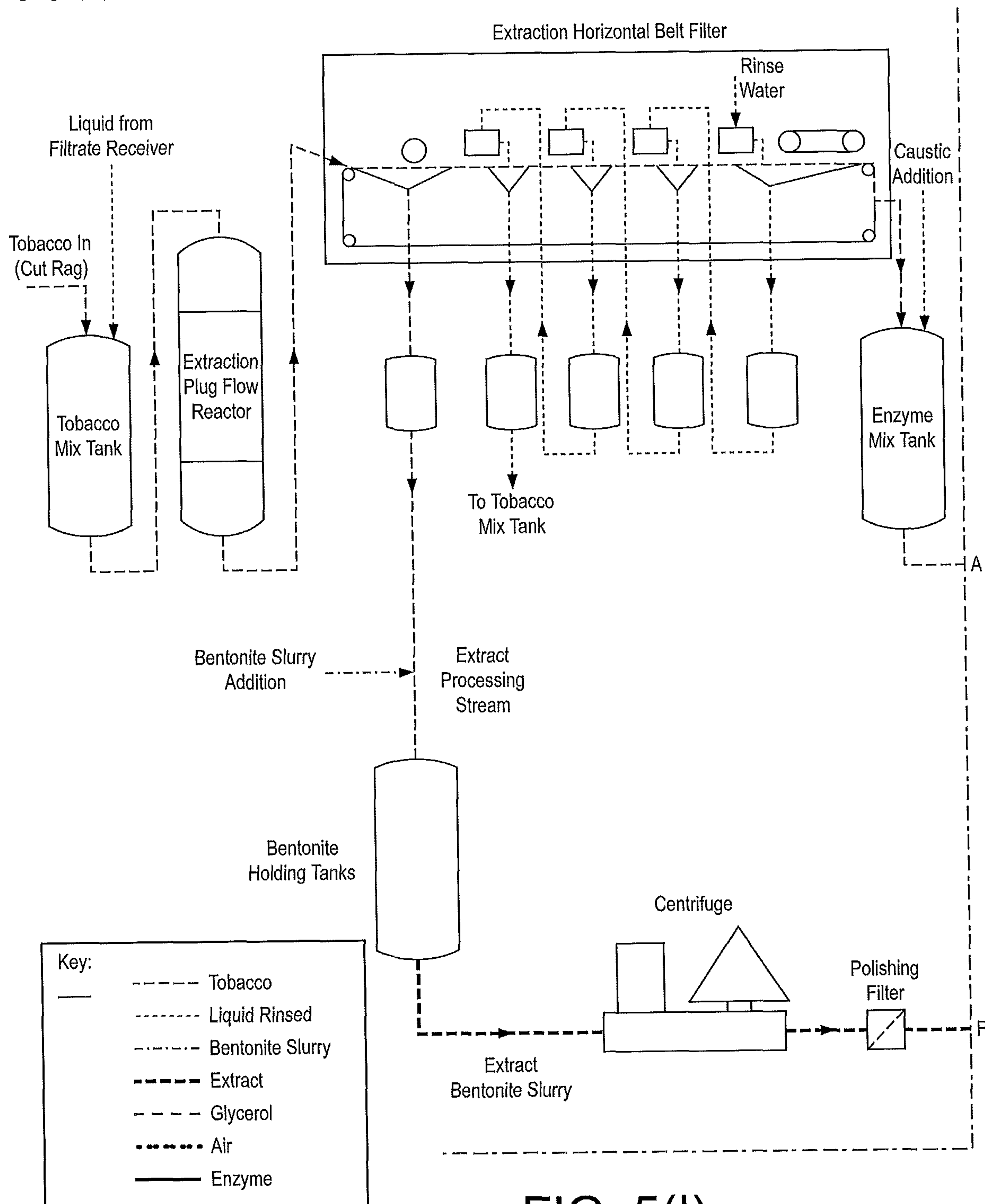
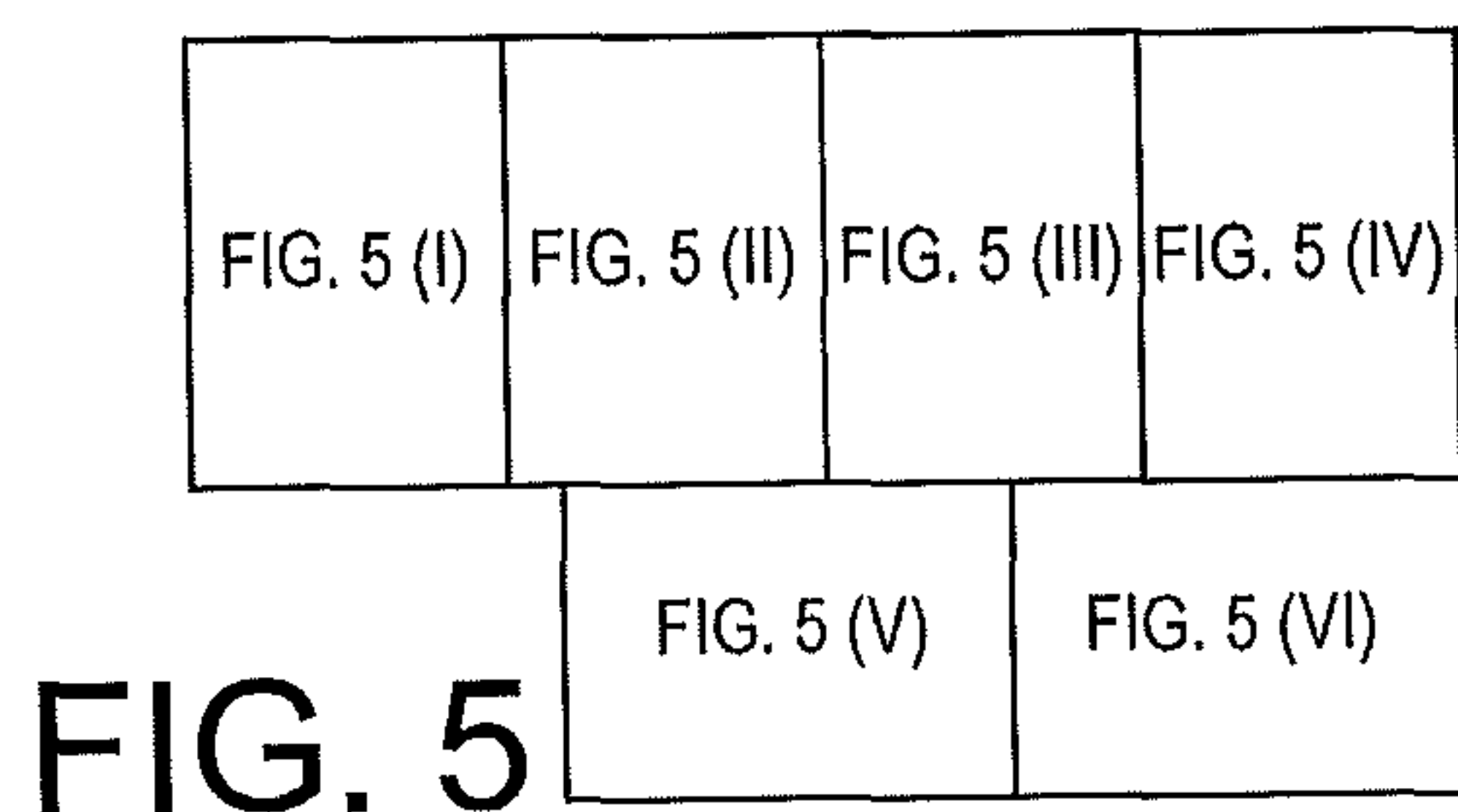


FIG. 4

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**FIG. 5(I)**

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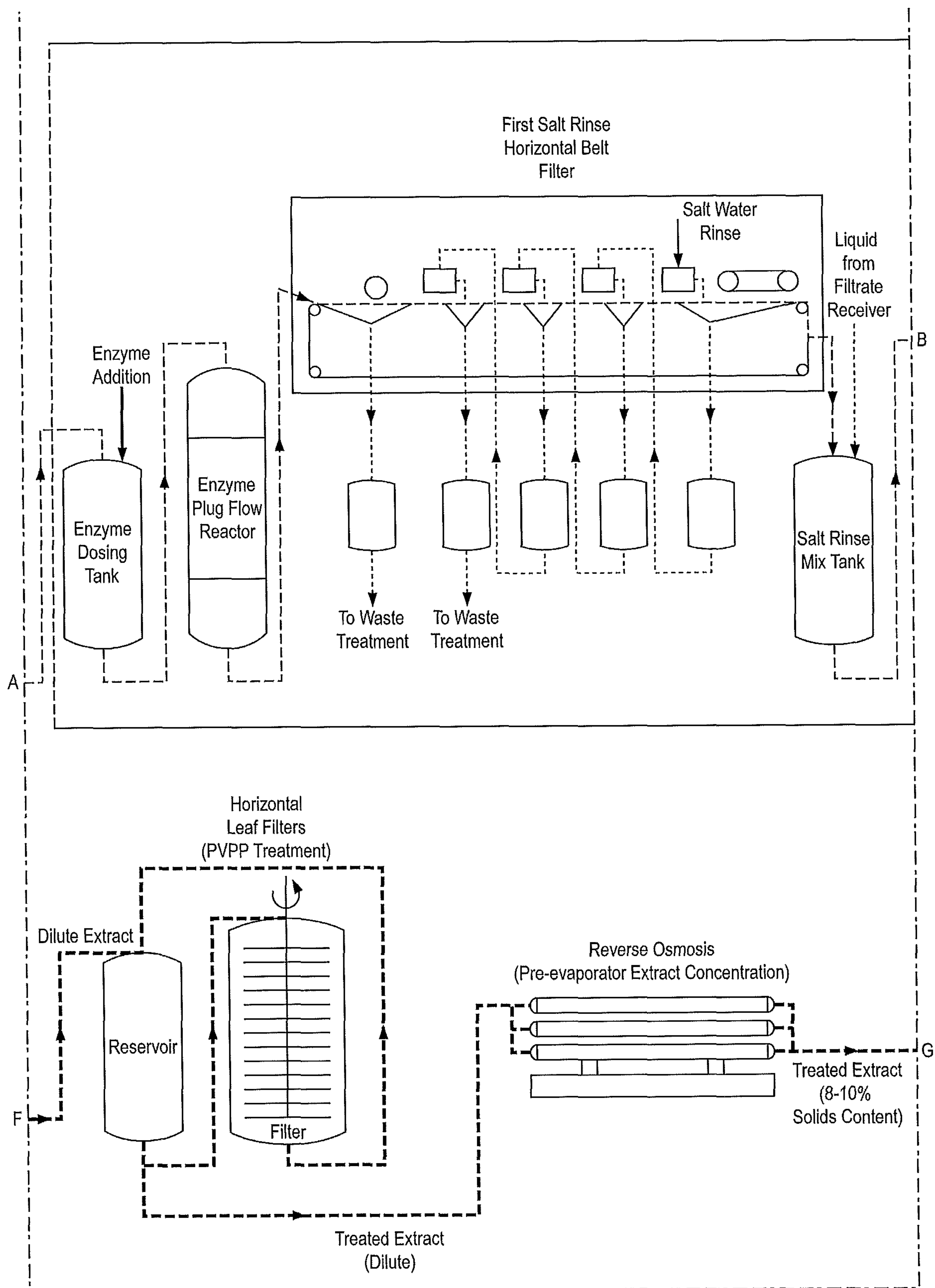


FIG. 5(II)

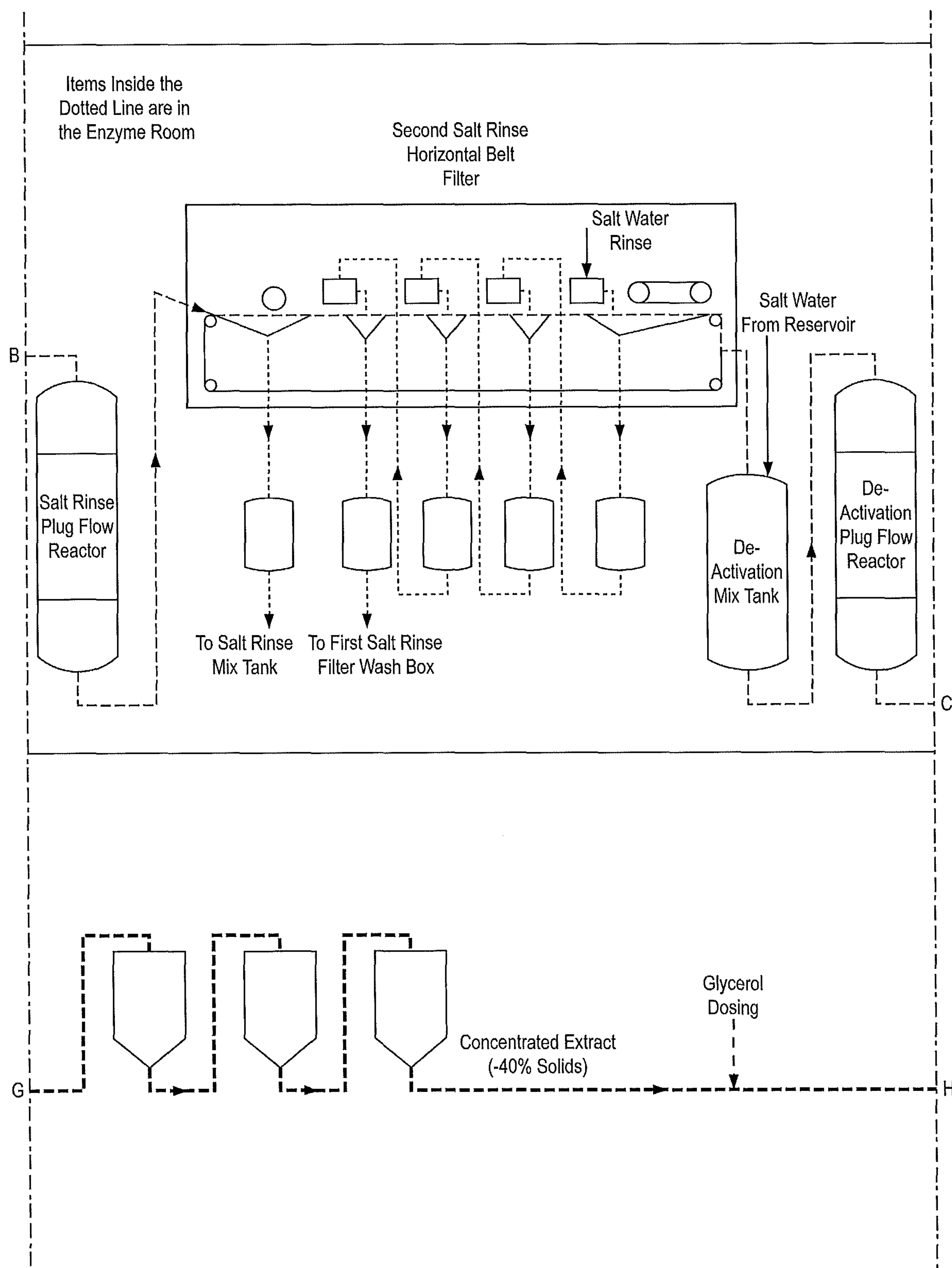


FIG. 5(III)

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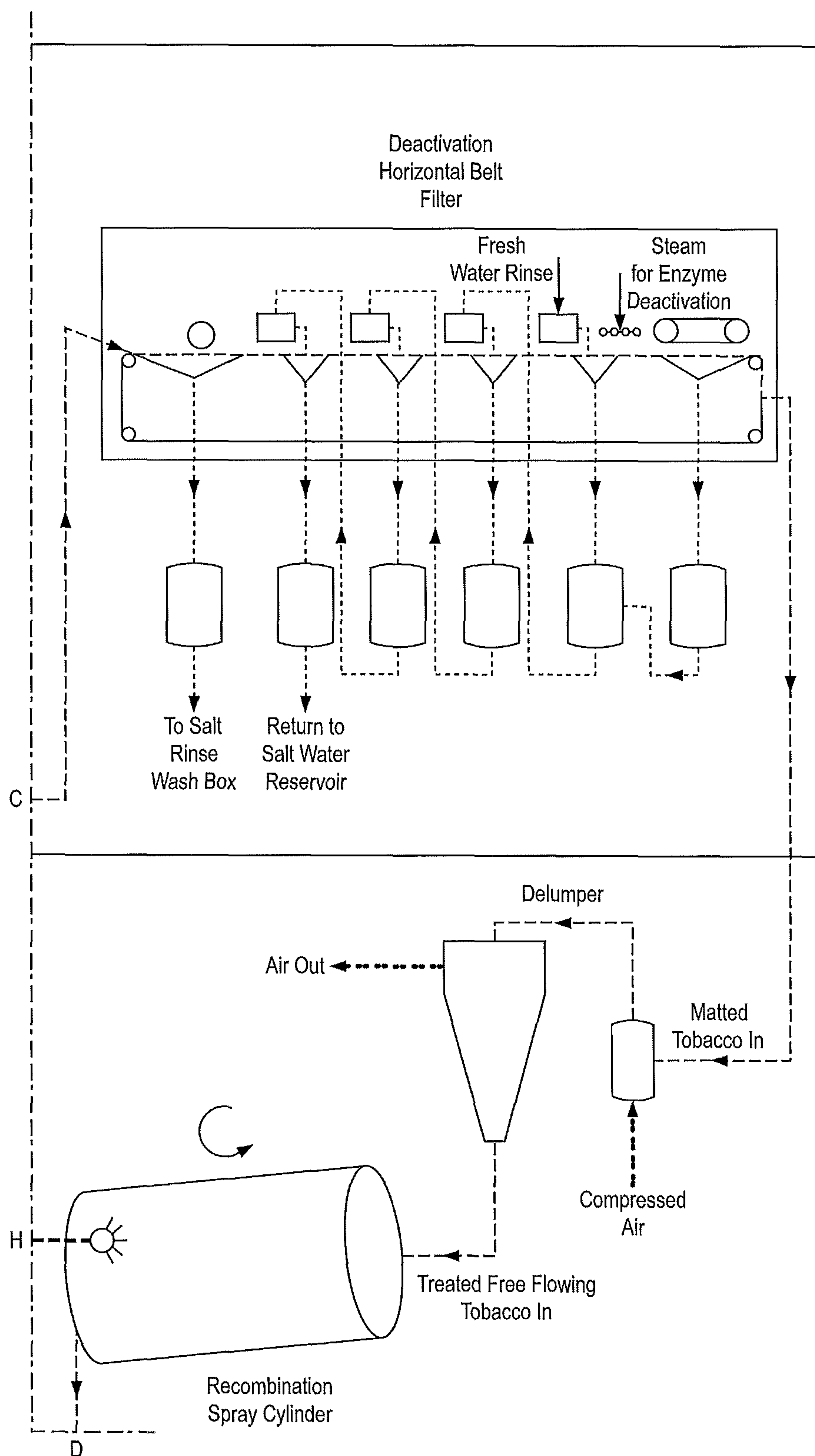


FIG. 5(IV)

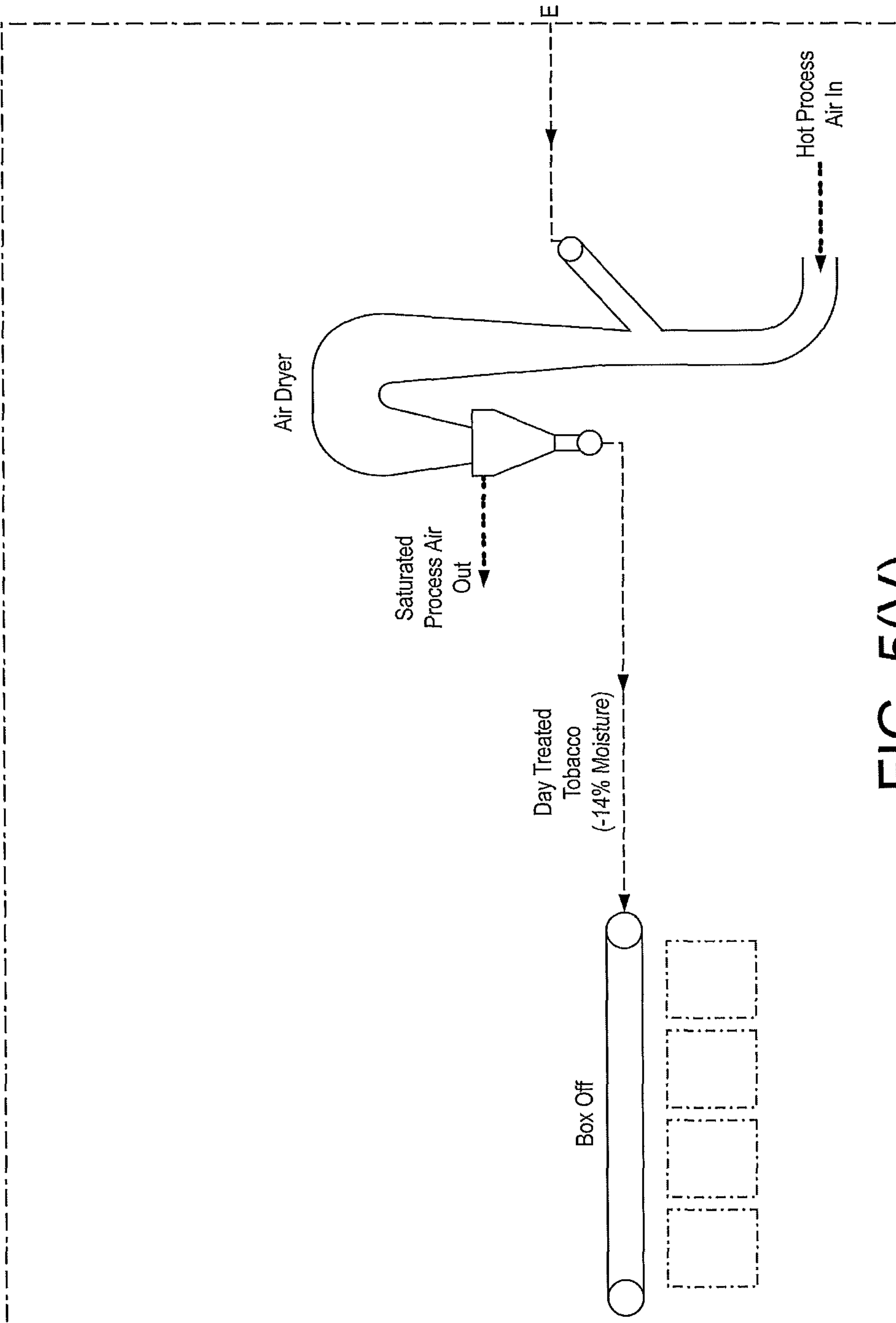


FIG. 5(V)

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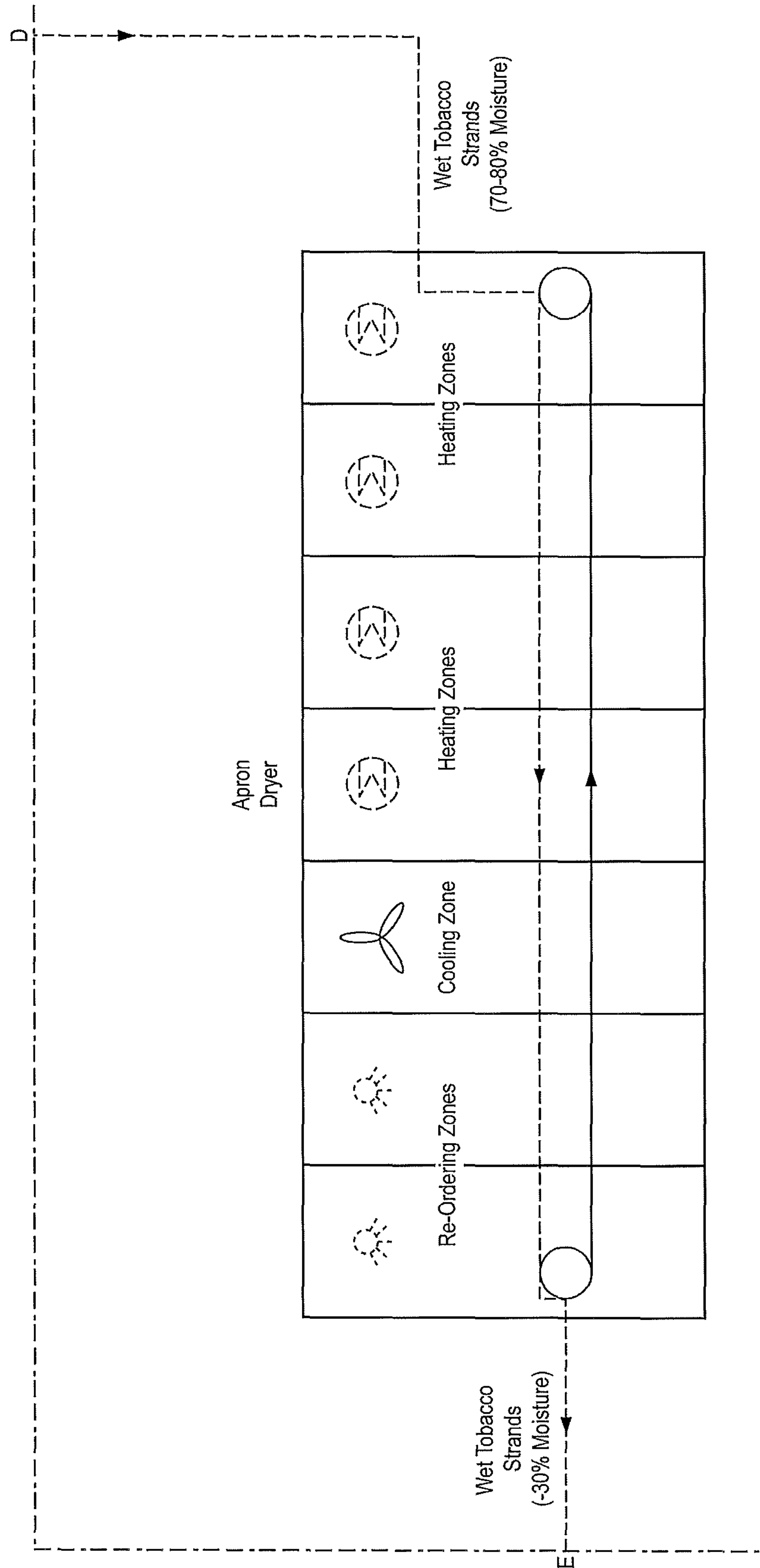


FIG. 5(VI)

